BACK RIVER PROJECT
Sewage Wastewater Treatment Plant Operation and Maintenance Manual

August 2024

Introduction

This document is the Sewage Wastewater Treatment Plant Operation and Maintenance Manual for B2Gold Nunavut Corporation's (B2Gold's) Back River Project (the Project) Goose Property.

The manual attached has been developed by the manufacturer of the wastewater treatment system for the Back River Project. The manual provides a system overview, facility drawings, electrical drawings, an overview of, and operation and maintenance instructions for, each component of the plant, including how sludge is handled and managed within the plant.

Sludge removed from the wastewater treatment plant will be transported directly from the Sewage Treatment Plant (STP) to the incinerator for incineration, used as a soil amendment in the landfarm, or will be placed in sealed containers and be disposed of in the landfill per the water licence 2AM-BRP1831 (the Licence) and the approved Incineration Management Plan and Landfill and Waste Management Plan. Sewage generated at the Project, or sewage sludge removed from the Goose STP may alternatively be added to the landfarm as nutrient amendment or be used for revegetation research and reclamation where appropriate. Treated effluent is discharged to the Tailings Facilities or onto land per the Licence. Monitoring of effluent quality is conducted as outlined in the Licence and the approved Water Management Plan. Any off-specification treated sewage during upset conditions will handled as outlined in the Water Management Plan. Any floating debris removed during plant operations will be landfilled in alignment with practices outlined in the Landfill and Waste Management Plan. Hazardous materials are managed as outlined in the Hazardous Materials Management Plan.

SABINA – GOLD & SILVER PROJECT
SEWAGE WASTEWATER TREATMENT SYSTEM
H2FLOW PROJECT # Q-231-19

OPERATING AND MAINTENANCE MANUAL
H2F-23119-IOM-009_R0

AUGUST 2022









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Section 1

System Overview

Section 1.1

Design Basis

DESIGN BASIS

The design basis of the proposed Sewage Wastewater Treatment Plant (WWTP) is defined in the Table 1 below:

Table 1: Design Basis Summary of WWTP Solution

Inlet Parameters	Unit	WWTP Influent Value	Target Effluent per BRP-17
Average Daily Design Flow	m^3/day	180	
Design Temperature	°C	15	
pH	-	6 – 9.5	
BOD_5, average	mg/L	300	< 30
TSS, average	mg/L	300	< 35
TKN	mg/L	40	
Ammonia	mg/L	40	4
Phosphorus	mg/L	12	4
Total oil & grease	mg/l	35	No visible sheen
Fecal Coliform	CFU/100 ml		1,000

Note:

- Design basis assumes that the wastewater does not contain any compounds that are inhibitory to the biological activity of the microorganisms required for the biological reduction of contaminants.
- The wastewater characteristics of Hardness is < 200 mg/L as $CaCO_3$, Alkalinity is 250 mg/L as $CaCO_3$, FOG < 35 mg/L.
- An external heating system will be required if the wastewater temperature is lower. Usually, a hydronic heater is used.

Section 1.2

Process Description

1. PROCESS DESCRIPTION

H2Flow has taken the utmost care and applied sound engineering practices and principles to design a treatment solution to the meet the defined treatment objectives. In the following description of the treatment process, please refer to the Process Flow Diagram (PFD) enclosed within our proposal package.

1.1. Treatment Process Scheme Description

The incoming domestic wastewater will be pumped from the existing septic tank and will be screened by a compact screw screen. The screened wastewater will then be sent to the horizontal integrated localized treatment (Horizontal Integrated Localized Treatment; HILT) equalization tank. The HILT tank is a prefabricated, standalone reactor equipped with aeration grids, ladder and platforms.

Following equalization, the flow is pumped to two (2) Moving bed bioreactor (MBBR) HILT tanks connected in series, where the organic materials are oxidized by the biological treatment process (further described below). The biofilm carrier (media), provide a large protected specific surface area for bacteria culture to grow and ultimately remove organic substances in the water. Air is applied to continuously mix and aerate the media. The air required will be provided by a blower, which will travel through piping to the bottom aeration grid.

Following the biological treatment stage, secondary clarification is provided by a Dissolved Air Flotation (DAF) system to remove suspended solids prior to by gravity through a UV disinfection system and then out of the container

The by-products of the wastewater treatment are screenings from the screen and the sludge produced. The screenings will be bagged automatically to prevent odours and mitigate health hazards. The sludge will be dewatered automatically in a bagged system to permit easy handling and disposal in the incinerator.

The offered containerized and modular package is constructed for outdoor operations with minimal installation cost. The process equipment containers are factory installed and FAT tested to assure the highest quality and performance on site. **Figure 1** provides a 3D rendering of a similar WWTS offering for your consideration.

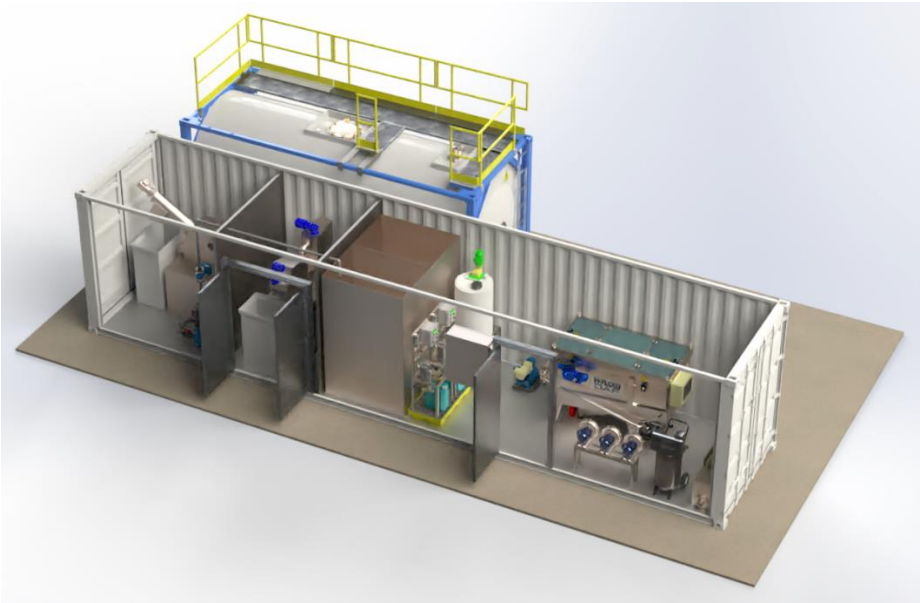


Figure 1: Schematic of H2Flow Containerized Wastewater Treatment System

1.2. Major Equipment Description

1.2.1. Moving Bed Bioreactor (MBBR) (Biological Treatment)

The Moving Bed Bioreactor (MBBR) is a flow-through, fixed-film biological process (**Figure 2**). It involves a reactor containing polyethylene carriers (media) where microorganisms attach and colonize, taking advantage of the biofilm principle. The media design provides a high surface area for biofilm to grow. The high concentration of microorganisms permits rapid oxidization/degradation of organic and inorganic substances in the wastewater within a small footprint.

The media, which are slightly less dense (0.95SG) than water, typically occupy a 50% fill ratio to reactor volume and are easily suspended by a forced-air system or other mixing methods. The reactor is considered 'complete mix' with no dead spots, giving the media sufficient contact time with all the containments in the wastewater, improving the reaction speeds and the overall system efficiency.

The MBBR process combines the advantages of activated sludge (high efficiency) and the trickling filter (low footprint) systems without the disadvantages of complex operations, high operation costs or poor mixing. It is also valuable to note that the MBBR is the most documented wastewater treatment fixed film process, with 50+ technical publications and presentations.

The MBBR process is a self-regulating system that requires minimal operator attention and has been utilized in over 500 installations worldwide. One of the most important considerations of the MBBR process is also footprint, which can be up to 4 times smaller when compared to other types of treatment processes due to the high surface area of the media.

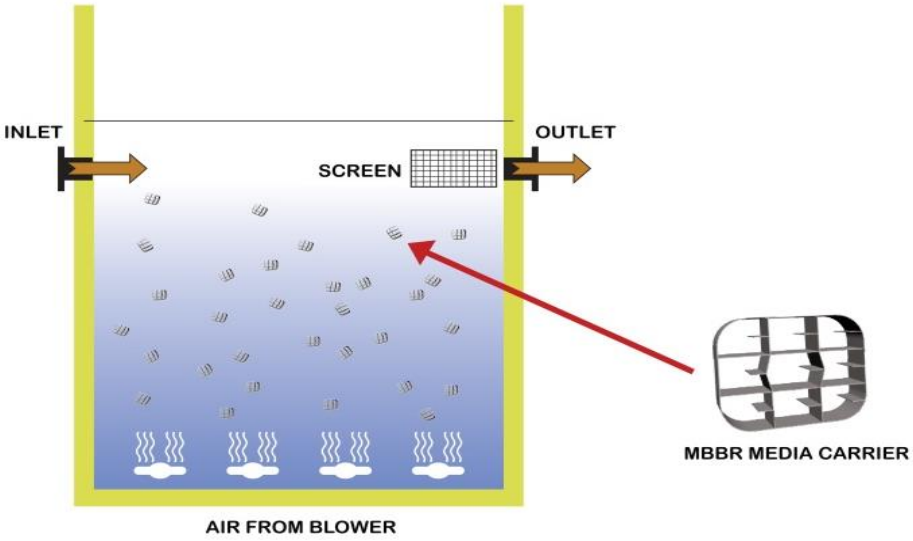


Figure 2: MBBR Illustration

1.2.2. Dissolved Air Flotation (DAF) Unit (Secondary Clarification)

The Dissolved Air Flotation (DAF) unit is a flotation system without plate packs (**Figure 3**). The separator consists of a vessel, sludge skimmer, an air saturation system comprising of a recycle pump, saturation tank, valves and hoses.

The effluent wastewater side stream is saturated with air and recycled back to the head of the unit and is then introduced with the DAF influent evenly via a distribution system of diffusers with the goal of removing oil, grease, solids and chemically flocculated contaminants, which would not have sufficient buoyancy to float or where a mixture of oil and solids influences the specific gravity in such a way that air flotation is necessary to enhance the separation. The air bubbles are usually in the 30-50 micron range and this size is essential for the efficiency of the flotation system since small bubbles easily adhere to equally sized or larger particles.

Any solids that are sufficiently heavy settle to the bottom of the unit and these solids will be collected in the sediment compartment of the system and removed via the sediment discharge valve. The H2Flow DAF unit is standard executed with an aeration/recirculation module and a pneumatic switch and control panel to control the air supply to the aeration module and sediment discharge valve.

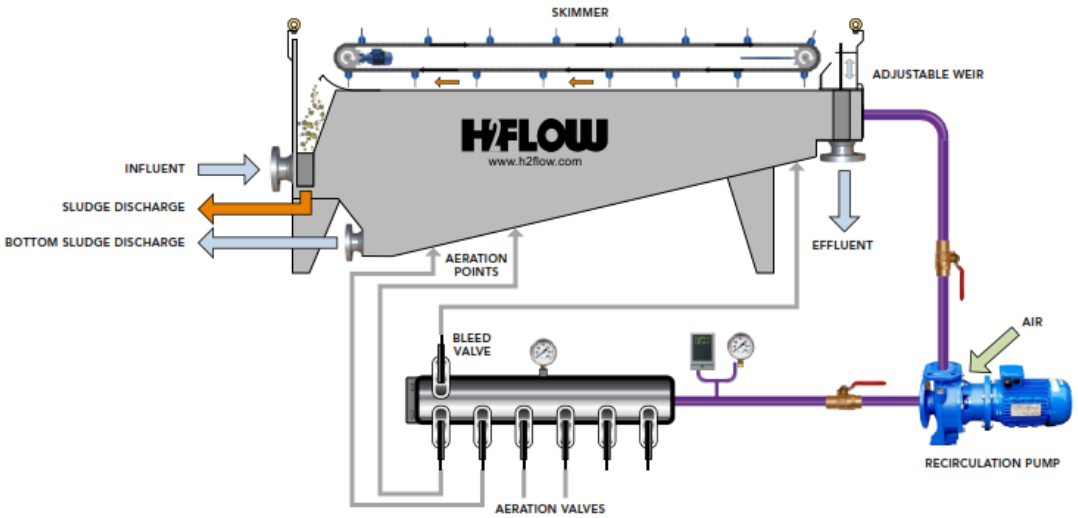


Figure 3: Representative Drawing of Major Components of H2Flow Dissolved Air Flotation (DAF) Unit

1.2.3. Sludge dewatering



The generated sludge form the DAF is pumped into a sludge storage tank. The Sludge holding tank is covered and passive vented to the exterior. The sludge holding capacity is One (1) day but are dewatered automatically into the sludge bag dewatering unit. An automatic polymer system using emulsion polymer will dosed the makedown polymer. The dewatered sludge are stored in a bag until it is full before being removed for disposal for stored for incineration.

Section 1.3

Scope of Supply

1. SCOPE OF SUPPLY

H2Flow assumes the availability of power 575VAC/3/60Hz and other required utilities to be provided by others. All civil, mechanical, and electrical works outside of the specific scope of supply to be provided by others.

Qty. One (1) Screw Screen, described as:

- Capacity: 15 m^3/h
- Power: 0.56 kW
- Perforation: 3 mm
- Mounting Angle: Variable (up to 60 degrees)

Qty. One (1) Screened Wastewater Transfer System, described as:

- Transfer tank Capacity: 1 m^3
- Transfer tank construction : SS 304
- Transfer pumps : Centrifugal with semi-open impeller – 1 HP 575V/3/60Hz
- No. of Transfer pumps: 2 (Duty/Standby)
- Level controls: 4 Float switches

Qty. One (1) HILT Vessel (Flow Equalization), described as:

Closed vessel constructed in 304SS, insulated and clad, epoxy-coated caged frame arrangement; approximate external dimensions of 20ft by 8ft by 8.5ft, providing 26 m^3 of volume per reactor complete with the following:

- 500mm manway access
- Heating coils for external heat source (heat source by others as required)
- 2” Insulation and FRP wrapping
- Ladder and access platform
- Installation brackets and anchoring kit
- A grid of coarse bubble aeration grid in SS 304
- Four (4) High-level float switch
- One (1) Regenerative blower (installed in the 40ft container) complete with air intake filter, pressure gauges and air pressure relief valve.

Qty. Two (2) Bioreactor Feed pumps, 8 m^3/h (1 duty + 1 standby) 1 HP and 20m TDH

Qty. One (1) Flowmeter (Type: Electromagnetic with local display)

Qty. Two (2) HILT MBBR Bioreactor Tanks, has approximate external dimensions of approximate external dimensions of 20ft by 8ft by 8.5ft, providing 26 m^3 of volume per reactor complete with the following:

- 500mm manway access
- Heating coils for external heat source (heat source by others as required)
- 2” Insulation and FRP wrapping
- Ladder and access platform
- Installation brackets and anchoring kit

- One (1) complete site specific, engineered diffused aeration systems in 304L stainless steel including headers and lateral piping, with all supports for the aeration grid systems, manifolds and drop pipes internal to each of the basins will be supplied, where the termination point for the aeration system drop pipe will be a flanged connection at the tank wall height, where materials of construction are schedule 5 and schedule 10 304L stainless steel piping, and where all flanges will be 150 lb. ANSI style
- One (1) set of biofilm carrier retention sieve assemblies, where sieve assemblies will be fitted with 150-lb ANSI flanges, and which will be of 304L stainless steel construction
- One (1) One lot of biofilm carriers, which can be described by the following:
    - Specific surface area of BWT-X media: 650 m^2/m^3 of biofilm carriers
    - Media Volume: 10.5 m^3
- One (1) High Level Float Switch.

Qty. Two (2) Foam detection and suppression system comprising of:

- One (1) Foam detector in each MBBR tank
- One (1) Anti-Foam dosing pump for each MBBR Tank
-

Qty. One (1) DO sensor and controller

Qty. Two (2) Regenerative Blowers (1 duty+ 1 standby) (1½ HP each)

Qty. One (1) Flocculation Tank, complete with:

- One (1) Mixer
- One (1) Polymer Mix/Feed Unit
- One (1) Lot of flanged nozzles

Qty. One (1) Alum Feed Pump

Qty. One (1) Dissolved Air Flotation Unit (Model ALPHA 10), complete with:

- DAF separator tank vessel made of 304 stainless steel
- Maximum hydraulic capacity: 10 m^3/hour
- Sludge float skimmer arrangement mounted on the DAF separator. Skimmer rakes are constructed of 304 stainless steel with FRP blades, plastic sprockets and drive chains, stainless steel shafts.
- Sediment valve complete with pneumatic actuator
- Skimmer drive reducer complete with motor 0.5 HP
- Two (2) Recirculation pump complete with 1 HP motor (Duty/Standby)
- Inlet flange (2”), Outlet (3”), float discharge (3”), bottom sludge (2”)
- Pneumatic panel in an FRP enclosure, factory-mounted on the DAF unit, and which is complete with:
    - Two (2) pressure switches; Two (2) solenoid valves;
    - Two (2) pressure regulators; One (1) moisture trap
    - One (1) airflow rotameter; Three (3) stainless steel pressure gauges
    - One (1) check valve (air outlet)

Qty. One (1) Sludge Transfer Pump, for sludge and sediment transfer from DAF Unit to Sludge Holding Tank

Qty. One (1) Air Compressor to provide compressed air to the DAF clarification.

Qty. One (1) Sludge Holding Tank, including:
- Two (2) Level Switch

Qty. One (1) Dewatering Sludge Feed Pump, to feed the dewatering unit.

Qty. One (1) Dewatering System (Bag-Type), includes:
- One (1) Closed Top Tank
- Two (2) Gasket Throats and Clamps
- One (1) DN 50 Overflow Pipe
- One (1) Bags Support Grid
- One (1) Filtrate Collection Tank
- One (1) Frontal Door Set
- One (1) Polymer Mix/Feed Unit
- One (1) Bag Trolley
- One (1) Wire Twister
- One (1) Lot of 100 dewatering bags

Qty. One (1) UV Disinfection Unit, described by the following:
- UV system supplied with Type 304 Stainless Steel Channel, Module Support Rack, Level Control Weir, Transition Boxes, Monitoring System, Spare Parts Package, Operators Kit and Maintenance Rack.

Qty. One (1) 40' Container, described as:
- One Compartment: (Class 1 Div. 1) and other Compartments: Non-hazardous

Container will comprise of the following:
- Two (2) Man door – 3'x 7' One for compartment 1 & 3
  - Panic Bar and hardware
  - Heavy duty hinges
  - Door Closer
  - Weather strip gasket
  - Tempered glass window.
- One (1) Double Man door – 6'x 7' One for compartment 2
  - Panic Bar and hardware
  - Heavy duty hinges
  - Door Closer
  - Weather strip gasket
  - Tempered glass window.
- One (1) Lot of opening with HSS framing
- Interior wall
  - Formed Studs
  - 2" Polyurethane closed cell 2 lbs density

  - R value: 14
  - Finishes – ½"Nu-Fiber panels with Stainless Steel screws and White Vinyl Trim
- Interior ceiling
  - Formed Studs
  - 2"Polyurethane closed cell 2 lbs density
  - R value: 14
  - Finishes – ½"Nu-Fiber panels with Stainless Steel screws and White Vinyl Trim
- Floor
  - 6 mm thick Alum Checker plate with seams fully welded and leak proof with a 4"return
  - One (1) floor drain
- Bottom insulation
  - 2" Polyurethane closed cell 2 lbs density; R value: 14
- Exterior Paint
  - Anti-corrosive Zinc primer
  - Epoxy primer Base Coat
  - Polyurethane Top Coat
- Electrical
  - LED Lighting suitable for location installed
  - Light switches
  - Emergency Lighting
  - Exterior lights with photosensor
- HVAC
  - 3 kW ceiling mounted with integrated thermostat – 575V/3/60Hz
  - Temperature sensor
  - Fresh air intake louvre
  - Exhaust fan.
- Step down transformer 600V-120V/208V, 3 phase transformer.
- Main breaker panel

Qty. One (1) 20' Container, similar to above

Qty. One (1) Lot of engineering technical data and drawings, which includes:
- General Arrangement (GA) drawings
- Process Flow Diagrams (PFDs)
- Process & Instrumentation Drawings (P&IDs)
- Equipment data sheets
- Control Panel drawings and electrical schematics as per CSA standards
- Submittal package

Qty. One (1) Electric Control Panel, designed to be suitable for indoor installation, including the required programming, NEMA 4 painted carbon steel enclosure with CSA approval, complete with:
- Allen Bradley PLC
- HMI for Operator Interface
- Required VFDs for motors with appropriate sized line reactor
- Required Modbus communication package and Ethernet switch
- All required fuse holders, fusing, interposing relays and power relays

- Required control transformer
- Thermal management package to include panel thermostat, filter fan and exhaust filter
- Stack light, push buttons and pilot lights
- All required safety controls
- All required terminal connections, wire markers, component labelling for automatic or manual operations with alarms

Project Name:	**Sabina Gold & Silver Corp.**
Subject:	**Equipment List**
Date:	**2022-06-21**
H2Flow Q No.:	**Q-231-19**

No.	P&ID Page No.	P&ID Tag No.	Equipment & Instrument Description	Make	Model	Equipment & Instrument Parameter
1	1	S-01-01	Screw screen Removing solids from incoming raw sewage	H2Flow	MCB-200	**Unit** SS Box Height: 815 mm SS Box Width: 300 mm SS Box Length: 1000 mm Discharge Height: 920 mm Screw Length: 1900 mm Screen Opening: 3 mm Inclination 45o Hydraulic Throughput: upto 15m3/hr Screen Rotation Speed: 10 RPM **WEG Motor** Motor: 0.25 kW Enclosure: Class 1 Division 1 (TEFC-XP) Voltage: 575 Volts, 3 Phase, 60 Hz **NORD Gear Reducer** Model: SK 1SI50.1FC71-71S/4
2	1	LE-01-05	Screen Level Switch Measuring low and high level in the screw screen tank	Ktech Industrial Product Inc.	FS401E-2	Maximum Switching Voltage: 120 V Maximum Switching Current: 1 A Maximum Switching Power: 100 V Class 1 Division 1, Groups B,C,D Electrical Connection 1/2" NPT Process Connection 1.5" NPT Switch A is 16" from the top Switch B is 23" from the top
3	1	T-01-13	Transfer Tank Collecting screen water before pumping in to EQ Tank	H2Flow	Custom Transfer Tank	Volume: 1.2m^3 Material of Construction: SS 304 Length: 60" Height: 35" Width: 40"
4	1	LS-01-09 LS-01-10 LS-01-11 LS-01-12	Transfer Tank Level Switch Monitoring High-High, High, Low, and Low-Low levels in the Transfer Tank	Ktech Industrial Product Inc.	FS401E-4	Maximum Switching Voltage: 120 V Maximum Switching Current: 1 A Maximum Switching Power: 100 V Class 1 Division 1, Groups B,C,D Electrical Connection 1/2" NPT Process Connection 1.5" NPT Switch A is 9" from the top (NC) Switch B is 14" from the top (NO) Switch C is 19" from the top (NO) Switch D is 25" from the top (NO)
5	1	P-01-16 P-01-17	Equivalization Tank Feed Pumps Transfering screen sewage from transfer tank to EQ tank	Vertiflo	Pump: 1312, size 2x1.5x6 Motor: W21X Explosion Proof NEMA Premium Motor	Close coupled end suctioncentrifugal pump in all cast iron construction with a single mechanical seal (silicon carbide/Viton). The pump will be suppliedwith 2" NPT suction connection and 1.5" NPT discharge connection. The pump will be close coupled to a 1 HP 1800 rpm (575V/3/60) Explosion proof motor Class 1 Div 1. TEMP CODE T3C CSA / UL: Class I, Div 1 - Groups C and D
6	3	T-03-21	HILT Equalization (EQ) Tank Equalizing the flow before pumping into MBBR Tanks.	H2Flow	H2Flow HILT	Tank Type: 20' ISO full frame tank Frame Dimensions: 20' x 8' x 8'6" Capacity: 26,000 Litres (6880 gallons) +/- 2% Full Weight: 30,000 kgs (66,000 lbs) Empty Weight: 3,800 kgs (8360 lbs) Vessel Material: 304 SS, hot rolled, ASTM 240 Shell & End Thickness: 5 mm Shell, 6mm End, Nominal Frame Material: GB/T 1591-Q345D epoxy coated carbon steel Frame to Shell: 304 stainless steel Vessel Design Code: ASME VIII Div 1 Vessel Approval: Lloyds Registry
7	2, 3, 5	LS-02-03 LS-02-04 LS-03-02 LS-03-03 LS-03-04 LS-03-05 LS-05-07 LS-05-08	Measuring Level in Following Tanks: Tetherless/Internally weighted switches for following tanks: **Sludge Holding Tank (T-02-02):** LS-02-03/04 **EQ Tank (T-03-01):** LS03-02/03/04/05 **MBBR#1 (T-05-01) & MBBR#2:** (T-05-02): LS-05-02 & LS-05-08	High-High Level Switch: MDI (3 wire, NC) Rest of Level Switch: SJE Signalmaster SPDT Weight: SJE Rhombus	H-H Level Switch: MDI SKF-5034-20 Rest Level Switch: 20SGMSPDTWE Weight: 720149/125170	<u>High-High Level Switch:</u> Switching Differential: 3½" Electrical Ratings: 0.25HP, 10A @ 120 VAC Float Material: ABS <u>Rest of Level Switch:</u> Switching Differential: 1½" Electrical Ratings: 5A @ 120 VAC Float Material: ABS <u>Level Weight:</u> 1 pound, 5 ounce (0.6 kgs) 2.8 inches diameter x 3.3 inches long
8	4	BL-04-16 BL-04-17	EQ & Sludge Tanks' Blowers Supply air to EQ & Sludge Tanks to mix the contents & prevent settle down	FPZ, Inc.	Blower: SCL R30-MD-2-3-575	2 hp-575-60-3 regenerative blower. Unit is capable of 65 cfm at open air flow. 1.25" npt inlet and outlet connections.
9	2	P-02-08 P-02-09	MBBR Feed Pumps Feeding screen sewage water from HILT EQ Tank to HILT MBBR#1	Rotech Pumps & System Inc.	SCP 150-C.I	Rotech close-coupled horizontal end suction self-priming pump model SCP-150, CI construction is driven by a TEFC Motor 1.5HP/3600rpm/3 phase/60Hz/575/56C FRAME Flow: 88 gpm Head: 20FT Material: CI Voltage: 575V/3ph/60Hz Casing - CI Impeller - CI Trimmed 4.10" Adaptor - CI Wear plate - CI Mechanical Seal: CARBON CERAMIC VITON PUMP END WITH MOTOR
10	3, 5	T-05-01 T-05-02	HILT MBBR Tank #1 & MBBR #2 Holding sewage in the tank for micro organism activity	H2Flow	H2Flow HILT	Tank Type: 20' ISO full frame tank Frame Dimensions: 20' x 8' x 8'6" Capacity: 26,000 Litres (6880 gallons) +/- 2% Full Weight: 30,000 kgs (66,000 lbs) Empty Weight: 3,800 kgs (8360 lbs) Vessel Material: 304 SS, hot rolled, ASTM 240 Shell & End Thickness: 5 mm Shell, 6mm End, Nominal Frame Material: GB/T 1591-Q345D epoxy coated carbon steel Frame to Shell: 304 stainless steel Vessel Design Code: ASME VIII Div 1 Vessel Approval: Lloyds Registry
11	3, 5	Media in T-05-01 T-05-03	Media Providing support for micro-organism growth	Biowater	BWT-X	Width/Height : 14.5 mm (±0.5 mm) Length : 8.2 mm (+0.2/-0.2mm) Outer Perimeter : 55 mm Inner Perimeter : 197 mm Wall Thickness : 0.35 (±0.1 mm) Material : Polyethylene, High-Density (HDPE). Colour : Natural Specific Weight : Raw Material 0.96 (± 0.02) kg/L Extruded Material 0.95 (± 0.02) kg/L
12	3, 5	FE-05-03 FE-05-05	Foam Indicator Indicating foam at the top of water column in the MBBR #1 and #2	ARJAY	Foam Control Transmitter: 2882-FCS-1-4 Probe: PCA-300mm-Z	2882-FCS-1-4 - probe mounted foam control switch - 110 vac power input - two alarm relays - Type 4 cast housing, no window PCA-300mm-Z - Teflon coated probe - 3/4" npt 316SS process connection

13	5	AE-05-04	DO Sensor Measuring dissloved oxygen level in the MBBR#2	YSI	Controller: YSI IQ SensorNet 282 & 284 Sensor: YSI IQ SensorNet FDO Wall Mounting Set: WMS/IQ IQ Sensor Net - Sensor Connection Cable Sensor Coupling	472110Y: DIQ/S 282-CR3, System 282, IQ SensorNet Controller, operate up to 2 sensors, 3 current output, 3 relays, 100-240 VAC, 1 IQ SensorNet connection. 480052Y:WMS/IQ, Wall Mount Kit for IQ Modules 201650Y:FDO 700 IQ, Optical DO probe for IQ System, 0-20 mg/l 480042Y:SACIQ-7.0, Sensor Connection cable, IQ, 7 m, 22.9 ft 559327-2Y: Threaded PVC sensor coupling. 559327-4Y: Slotted PVC end cap, 559327-7Y: PVC coupler
14	7	DP-07-06 MP-07-07 MP-07-10	Dosing chemistries to MBBR Tanks for foam reduction and removal of total phosphorous Anti foam pump (DP-07-06) for MBBR#1 Anti foam pump (DP-07-07) for MBBR#2 Alum pump (DP-07-10) for MBBR#2	Grundfos	DDA 7.5-16 for anti foam DDA 17-7 for alum	DDA 7.5-16 anti foam dosing pump Turn-down ratio (setting range): 1:3000 Max flow: 7.5 l/h Max pressure: 16 bar Min. dosing capacity: 0.0025 l/h DDA 17-7 anti foam dosing pump Turn-down ratio (setting range): 1:1000 Max flow: 17 l/h Max pressure: 7 bar Min. dosing capacity: 0.0170 l/h
15	4	BL-04-18 BL-04-20 BL-04-19	Providing air (oxygen) to Mircoorganism in the MBBR system BL-04-18 for MBBR #1 BL-04-20 for MBBR #1 and 2 (Standby) BL-04-19 for MBBR #2	Gardner Denver	2BH1810-0HQ23Z for MBBR#1 and Standby 2BH1600-7AH36Z for MBBR#2	2BH1810-0HQ23Z Flow at inlet conditions: 310 SCFM Inlet pressure: 14.69 PSIA Inlet Temp.: 68° F Discharge Pressure: 3.04 PSIG Discharge Temp.: 126° F Motor Rating: 13.3 HP 2BH1600-7AH36Z Flow at inlet conditions: 131 SCFM Inlet pressure: 14.69 PSIA Inlet Temp.: 68° F Discharge Pressure: 3.04 PSIG Discharge Temp.: 136° F Motor Rating: 7.1 HP
16	2	FIT-02-14	MBBR/DAF Flowmeter Measuring flowrate from HILT EQ Tank to HILT MBBR #1	IFM	SM2601	Number of Inputs: 2 Number of Outputs: 1 Measuring Range: 1.3 - 160 GPM Process Connection: 2" NPT DN50
17	6	T-06-02	Mixing Tank Polymer is mixed with water coming from HILT#2. Mixing is done by mixer.	H2Flow	Custom Mixing Tank	Material of Construction: SS 304 Length: 40" Height: 74" Width: 34"
18	6	M-06-01	Mixing Tank Mixer Mixing content (sewage and polymer) of mixing tank	Dynamix	DMX-3510K-1	Drive: Electric Motor 1.0 HP @ 1725 rpm 3/60/575V TEFC, Worm Gear Reducer Right Angle 20 to 1 Ratio @ 88 rpm Mount: Square Mounting Plate 11" x 11" / Mild Steel Shaft: 1" dia. 60" long (316SS) Custom: Custom Right angle gearbox, 88RPM Top Impeller: 14" diameter, Dynaflow Blade (316SS) - Spacing 25' Bottom Impeller: 14" diameter, Dynaflow Blade (316SS) - Off Bottom 14"
19	7	DP-07-08	Polymer Dosing Dosing polymer into mixing tank prior to DAF	Excell Feeder	6005PSA2-SX	Neat polymer flow range is 0.02 to 0.8 LPH (0.1 to 5 GPD) Dilution water flow range is 40 to 460 LPH (10 to 120 GPH) A solenoid operated valve turns the water flow on - off An H-O-A switch allows local or remote Start-Stop control
20	6	DAF-06-17	Dissolved Air Floatation System Mechanically separate the bigger particles from the incoming (treated with polymer) water. Heavy particles will settle down as sludge and lighter foam/froth will float on the top of the water.	H2Flow	Alpha 10	Hydraulic Capacity: 44 USGPM Overflow rate: 1.6 USGPM/FT2 Recirculation Flow: 8.8 USGPM @ 85 PSI Unit Length: 136.8" Unit Width: 52" Unit Height: 61.4" Inlet: 3" Float Discharge: 3" Outlet: 3" Bottom Sludge: 3"
21	6	M-06-18	Skimmer Drive Removing the foam/float/froth from top of the DAF water column	NORD Drive System	SK9023.1 - 71S/4	Power: 575V / 0.33HP / 3 Phase Output Speed: 3 RPM Output Torque: 6939 Service Factor: 1.1
22	6	P-06-22	Recirculation Pump @ DAF Recirculate the DAF effluent with air to create nano bubbles that help lighter particles float to top.	Pump: Nikuni Motor: Lafert	Pump: KTM25N-000 (SS304 Material) Motor: AMPH 90S-L B3	Normal capacity: 42 L/min Air flow rate: 3.3 NL/min Total head: 30 m Output: 2 HP Frequency: 60 Hz
23	6	LE-06-26	DAF Low Level Sensor / Switch Monitoring low level in the DAF to protect the recirculation pump from running dry	Endress + Hauser	FTL31	Output: 3-wire DC-PNP Power supply: 10 - 30 VDC M12 Connector
24	6	LS-06-19 LS-06-20	Sludge Hopper Level Switch Monitoring the low and high level sludge in the DAF sludge hopper.	Carlo Gavazzi	Controller: CLD4MA2DM24 Probe Head: CLH3 Electrodes: CLE1	Controller is DIN-rail mounting, relay SPDT + SPST, 24 VDC Probe head: 1.5" pipe thread, housing material PP Electrodes: 1000mm length, Material Stainless steel, AISI316
25	6	UV-06-28	UV System Disinfecting the DAF effluent before pumps to customer's ditch	TrojanUV	Trojan UV3050K PTP	Lamp: Single Peak flowrate: 11.7 m^3/hr Retention time: 4.9 S UV Transmittance range: 30% to 80% Bioassay Dose: 30,000 µWs/cm^2 (@ UVT of 65%)
26	6	P-06-27	Sludge Pump P-06-27 removing sludge from DAF to Sludge Holding Tank	Pump: Wastecorp Motor: Sew-Eurodrive	PN: 64722-00 Model#: 2FAC-EC	Pump up to 20 GPM 2" Connection Weight 80 lbs 1 hp, 1800 RPM/3/60/230/575V Maximum pump operating speed: 70 RPM (RPM Reduction: 25.7:1)
27	2	TK-02-02	Sludge Holding Tank Collection tank receives water from DAF	H2Flow	Custom Sludge Holding Tank	Tank Length: 40" Tand Width: 31.5" Tank Height: 55" Tank Volume: 1,110 L
28	2	P-02-16	Sludge Dewatering Pump Transferring sludge from holding tank to dewatering system	Continental Ultra Pump	CPML-44	Power: 0.75 HP Capacity @ 1750 RPM is 15 GPM @ 0 PSID, 12 GPM @ 25 PSID, 9.4 GPM @ 50 PSID
29	2	SDP-02-23	Dewatering System Remove the excess water from sludge (coming from DAF)	Teknofanghi	Teknofanghi 02BM	Height: 1,494mm Width: 520mm Length: 1,146mm Hydraulic flow: 1-2 m^3/h Dry solids: 0.5-4% Dry solids: 10-20 kg/day
30	2	MP-02-27	Polymer Dosing Dosing polymer into feed line of sludge dewatering system	Excell Feeder	6005PSA-NSX	Neat polymer flow range is 0.05 to 0.8 LPH (0.3 to 5 GPD) Dilution water flow range is 8 to 95 LPH (2 to 25 GPH) A solenoid operated valve turns the water flow on - off An H-O-A switch allows local or remote Start-Stop control
31	2	FIT-02-19	Sludge Dewatering Flowmeter Measuring flowrate from sludge holding tank to dewaering system	IFM	SM6601	Number of Inputs: 2 Number of Outputs: 1 Measuring Range: 0.03-6.6 GPM Process Connection: 0.5" NPT DN15
32	4	AC-04-40	Compressor Air compressor for DAF pneumatic panel	Craftsman	CMEC6150 6 Gallon Portable Air Compressor	Air Tank Capacity: 6 gal. Air Pressure: 150 psi max. Air Delivery: 2.6 SCFM @ 90 psig Tested per ANSI S12.6 (S3.19) Input: 120 V, AC only, 60 Hz, 15 Amps Duty Cycle: 5 minutes On/5 minutes Off

33	2	P-02-43	Dewatering System Transfer Pump Transfering dewatering system effluent water to septic tank	Liberty Pumps	Sink Pump Model 404	1/3 hp Residential 120V, 1 phase 25 GPM @ 10' head

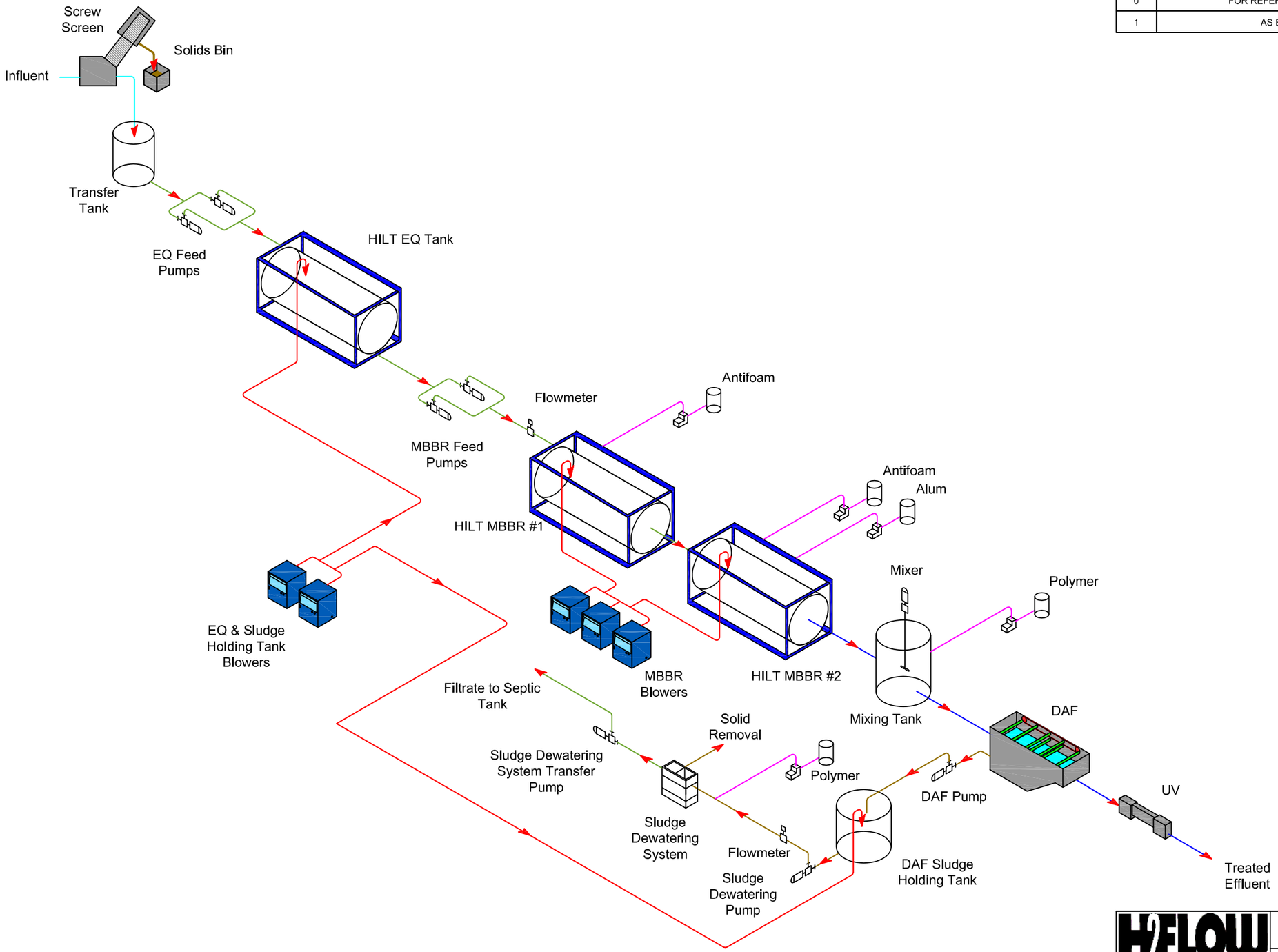
Section 2

Drawings

Section 2.1

Process Flow Diagram (PFD)

REV	DESCRIPTION	DATE	BY	APP'D
0	FOR REFERENCE ONLY	04/09/2018	DV	LB
1	AS BUILT	06/09/2022	SS	LB



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DRAWN BY: SS	DATE: 06/09/2022	PROJECT NAME: SABINA GOLD & SILVER STP	TITLE: PROCESS FLOW DIAGRAM PFD
APP'D BY: LB	DATE: 06/09/2022		DRAWING No.: Q-23119-000-001
SCALE: NTS			REV: 1
		ALL DIMENSION ARE IN INCHES UNLESS OTHERWISE SPECIFIED	SHEET 1 OF 1

Section 2.2

Piping and Instrumentation Diagram (P&ID)

T
TO SEPTIC TANK PUMPS

U
PI-03
EQ. TANK LEVEL HIGH

SYSTEM CONTROL PANEL (BY H2FLOW)

TIMER	OPEN	ON/OFF	FAULT	SPEED	RUNNING	MANUAL POSITION SELECTOR ACTIVATED	AUTO POSITION SELECTOR ACTIVATED	E-STOP ACTIVATED	SCREEN HIGH LEVEL	SCREEN LOW LEVEL	LEVEL SWITCH HIGH HIGH	LEVEL SWITCH HIGH	LEVEL SWITCH LOW	LEVEL SWITCH LOW LOW	FAULT	OVERLOAD	ON/OFF	RUNNING
KC	YC	YC	YA	SC	YI	YA	YA	YA	LH	LL	LSHH	LSH	LSL	LSLL	YA	YC	YC	YI
01-06	01-06	01-03	01-03	01-03	01-03	01-04	01-04	01-04	01-05	01-05	01-09	01-09	01-09	01-09	01-16	01-16	01-16	01-16
DO		MODBUS				DI	DI	DI	DI	DI	DI	DI	DI	DI	DI	DO		DI

CONTAINER #2
(40')
ELECTRICAL ROOM
NON-HAZARDOUS

CONTAINER #1
(20')
SCREEN ROOM
CL.1 DIV.1

FIELD WIRING BY OTHERS/
WIRING INSIDE THE CONTAINERS
BY H2FLOW

CONTAINER WALL

E-STOP
MAN-OFF-AUTO

SV-01-06
SOLENOID VALVE

M-01-03
¾" Ø

LE
01-05
LEVEL SWITCH

INSULATION/
HEAT TRACE
(BY OTHERS)

ET

A PI-01

FROM SEPTIC TANK SUBMERSIBLE PUMPS

3" Ø
6" Ø
2" Ø

VENT

S-01-01
SCREW SCREEN

SCRS-01-02
SCREENINGS BIN
(BY OTHERS)

LS-01-09
LS-01-10
LS-01-11
LS-01-12
LEVEL FLOATS

V-01-08 CHECK VALVE
V-01-07 BALL VALVE
½" Ø
SEPARATION WALL
GARDEN HOSE
V-01-24
1" Ø
PI-02 B
SERVICE WATER FROM SLUDGE DEWATERING ROOM

2" Ø
DRAIN
V-01-29

T-01-13
TRANSFER TANK
1.2 m³
SS304

FLOOR DRAIN

M-01-16
M-01-17
SAME AS P-01-16
V-01-14
V-01-15
V-01-18
V-01-19
V-01-20
V-01-21
V-01-24
P-01-16
P-01-17
EQ. FEED PUMPS

PRESSURE GAUGE
PG-01-22
PI
V-01-23

TSC
01-27
HTR-01-27
SCREEN ROOM HEATER
5kW

KC
01-26
POWER OUTLET
FAN-01-26
SCREEN ROOM EXHAUST FAN
LVR-01-28
SCREEN ROOM LOUVER

C PI-03
TO HILT EQ. TANK

Z
TO SEPTIC TANK

EXTERIOR PIPING
(BY OTHETRS)

	S-01-01	P-01-16	P-01-17	HTR-01-27
	SCREW SCREEN	EQ. FEED PUMPS	EQ. FEED PUMPS	HEATER
	15 m³/h, 3mm WEDGE WIRE	20 m³/h @ 6m TDH	20 m³/h @ 6m TDH	6.7HP, CLASS 1 DIV 1
	0.33HP, 1,800 RPM, CLASS 1 DIV. 1	1HP, 1800RPM, CLASS 1 DIV 1	1HP, 1800RPM, CLASS 1 DIV 1	575V/3/60Hz
	575V/3/60Hz	575V/3/60Hz	575V/3/60Hz	

REV.	DESCRIPTION	DATE	BY
2	AS-BUILT	06/09/22	SS
1	ISSUED FOR CONSTRUCTION	05/17/22	JC

DRAWN BY: SS — DATE: 12/22/21
CHECKED BY: LB — DATE: 12/22/21
SCALE: N.T.S

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REFERENCE INFORMATION

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TITLE: *Piping & Instrumentation Diagram*

REV. 2

DRAWING No.: *Q-23119-20-00*

PI-01

CONTAINER #2
(40')
ELECTRICAL ROOM
NON–HAZARDOUS

SYSTEM CONTROL PANEL (BY H2FLOW)

ON/OFF | FAULT | SPEED | RUNNING
YC 02-08 | YA 02-08 | SC 02-08 | YI 02-08
MODBUS

LEVEL SWITCH HIGH | LEVEL SWITCH LOW
LSH 02-03 | LSL 02-04
DI | DI

FLOW | TOTALIZED
FI 02-14 | FQT 02-14
AI | DI

ON/OFF | FAULT | SPEED | RUNNING
YC 02-16 | YA 02-16 | SC 02-16 | YI 02-16
MODBUS

ON/OFF | SPEED | LOW WATER FLOW ALARM
YC 02-27 | SC 02-27 | YC 02-27
DO | AO | DO

FLOW | TOTALIZED
FI 02-19 | FQT 02-19
AI | DI

FROM EQ. TANK LOW LEVEL → AA PI–03
FROM MBBR #1 TANK LEVEL HIGH → AB PI–05
FROM MBBR #2 TANK LEVEL HIGH → AC PI–05
TO DAF POLYMER FEED PUMP → V PI–07

CONTAINER #1
(20')
SLUDGE DEWATERING ROOM
NON–HAZARDOUS

FIELD WIRING BY OTHERS/ WIRING INSIDE THE CONTAINERS BY H2FLOW

CONTAINER WALL

FROM M–02–08

1" Ø INSULATION

2" Ø VENT PIPE

V–02–41

D PI–04 FROM EQ. & SLUDGE TANK BLOWERS

VENT

INSULATION/ HEAT TRACE (BY OTHERS) ET

E PI–06 FROM SLUDGE TRANSFER PUMP

2" Ø 2" Ø

F PI–03 FROM HILT EQ. TANK

3" Ø

TO HILT MBBR #1

PI–05 G

EXTERIOR PIPING (BY OTHETRS)

PRV–02–19
PRV
SET @ 1.5 Bar

2" Ø 1" Ø

LS–02–03 LS–02–04 LEVEL FLOATS

T–02–02
SLUDGE HOLDING TANK
1.11 m³, SS304

2" Ø 1" Ø DRAIN V–02–05

2" Ø

V–02–40 DRAIN

V–02–15

PG–02–18 PI

TO PLC

M–02–08 P–02–08

V–02–06 V–02–07

V–02–10 V–02–12 V–02–11 V–02–13

SAME AS P–02–08

M–02–09 P–02–09

MBBR FEED PUMPS

FIT 02–14 MBBR / DAF FLOWMETER

M–02–16 P–02–16

V–02–42

SLUDGE DEWATERING PUMP

P–02–16
SLUDGE DEWATERING PUMP
1.35 m³/h @ 10 TDH
0.75 HP, 1800RPM
575V/3/60Hz

MP–02–27
LIQUID POLYMER MAKEDOWN SYSTEM

POLYMER MAKE DOWN SYSTEM CONTROL

POLYMER MAKEDOWN TANK

1/2" Ø

DP–02–28 METERING PUMP

T–02–26 POLYMER BARREL (BY OTHERS)

RM–02–29 ROTOMETER

SV–02–30 SOLENOID VALVE

1/2" Ø

TSC 02–34

HTR–02–34
SLUDGE DEWATERING ROOM HEATER
3kW

KC 02–32

POWER OUTLET

CONTAINER WALL

FAN–02–32
SLUDGE DEWATERING ROOM EXHAUST FAN

LVR–02–33
SLUDGE DEWATERING ROOM LOUVER

V–02–18

FIT 02–19

1/2" Ø 1" Ø

MX–02–22
STATIC MIXER

FLOOR DRAIN

DEWATERING SYSTEM FLOWMETER

V–02–20 V–02–21

SEPARATION WALL

GARDEN HOSE V–02–39

PI–02 B SERVICE WATER TO SCREEN ROOM

V–02–24A V–02–24B

SDP–02–23
DEWATERING SYSTEM

P–02–43
DEWATERING SYSTEM TRANSFER PUMP
¾ HP, 25 GPM @ 10'
120V/1Ph/60HZ
2 WIRES + GND

INSULATION/ HEAT TRACE (BY OTHERS) TO SEPTIC TANK

TO SEPTIC TANK

INSULATION/ HEAT TRACE (BY OTHERS)

V–02–38 V–02–36 BACKFLOW PREVENTER V–02–37

SERVICE WATER (BY OTHERS)

	P–02–08	P–02–09	P–02–16	HTR–02–34
	MBBR FEED PUMPS	MBBR FEED PUMPS	SLUDGE DEWATERING PUMP	SLUDGE DEWATERING ROOM HEATER
	20 m³/h @ 20' TDH	20 m³/h @ 20' TDH	1.35 m³/h @ 10 TDH	4 HP, 575V/3/60Hz
	1.5HP, 1800RPM, 575V/3/60Hz	1.5HP, 1800RPM, 575V/3/60Hz	0.75 HP, 1800RPM, 575V/3/60Hz	

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2	AS-BUILT	06/09/22	SS
1	ISSUED FOR CONSTRUCTION	05/17/22	JC

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TITLE: *Piping & Instrumentation Diagram*

REV. 2

DRAWING No.: *Q-23119-20-00*

PI-02

U
PI–01
TO EQ. FEED PUMPS

SYSTEM CONTROL PANEL (BY H2FLOW)

FIELD WIRING BY OTHERS/ WIRING INSIDE THE CONTAINERS BY H2FLOW

LEVEL SWITCH HIGH HIGH — LSHH 03–02 — DI
LEVEL SWITCH HIGH — LSH 03–03 — DI
LEVEL SWITCH LOW — LSL 03–04 — DI
LEVEL SWITCH LOW LOW — LSLL 03–05 — DI

AA
PI–02
TO MBBR FEED PUMP

CONTAINER #2
(40')
ELECTRICAL ROOM
NON–HAZARDOUS

OUTDOOR

C | PI–01
FROM EQ. FEED PUMPS

ET
HEAT TRACE (BY OTHERS)

3" Ø

3" Ø
VENT PIPE

2" Ø

ET
HEAT TRACE (BY OTHERS)

PI–04 | H
FROM EQ. & SLUDGE BLOWERS

3" Ø

LS–03–02
LS–03–03
LS–03–04
LS–03–05

OVERFLOW

AERATION GRID

3" Ø

V–03–06
BY OTHERS

V–03–07
BY OTHERS

ET
HEAT TRACE (BY OTHERS)

3" Ø

F | PI–02
TO MBBR FEED PUMPS

T–03–01
HILT EQUALIZATION TANK

V–03–08
BY OTHERS
DRAIN

REV.	DESCRIPTION	DATE	BY
2	AS-BUILT	06/09/22	SS
1	ISSUED FOR CONSTRUCTION	05/17/22	JC

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TITLE: *Piping & Instrumentation Diagram*

REV. 2

DRAWING No.: *Q-23119-20-00*

PI-03

CONTAINER #2 (40') ELECTRICAL ROOM NON-HAZARDOUS

FROM DO TRANSMITTER
AD PI-05

RUNNING | ON/OFF | OVERLOAD | FAULT
YI 04-17 | YC 04-17 | YA 04-17
DI | DO | DI

RUNNING | ON/OFF | OVERLOAD | FAULT
YI 04-16 | YC 04-16 | YA 04-16
DI | DO | DI

RUNNING | SPEED | FAULT | ON/OFF
YI 04-18 | SC 04-18 | YA 04-18 | YC 04-18
MODBUS

RUNNING | SPEED | FAULT | ON/OFF
YI 04-20 | SC 04-20 | YA 04-20 | YC 04-20
MODBUS

RUNNING | SPEED | FAULT | ON/OFF
YI 04-19 | SC 04-19 | YA 04-19 | YC 04-19
MODBUS

SYSTEM CONTROL PANEL (BY H2FLOW)

CONTAINER WALL

BLOWER AIR INTAKE SCREEN

3" Ø

2" Ø

PI-03 H
TO HILT EQ. TANK

INSULATION

2" Ø 1½" Ø V-04-03

INSULATION V-04-06

PG-04-14 PI V-04-13 ¼" Ø 1½" Ø
PRV-04-15 PRV 2" Ø V-04-08 1½" Ø
M-04-16 V-04-45 1½" Ø
BL-04-16 EQ. & SLUDGE BLOWER

FAN-04-01 BLOWER ROOM EXHAUST FAN
KC 04-01
POWER OUTLET
LVR-04-02 BLOWER ROOM LOUVER

SAME AS BL-04-16
PG-04-10 PI V-04-11 ¼" Ø
PRV-04-12 PRV 2" Ø V-04-09 1½" Ø
M-04-17 V-04-44 1½" Ø
BL-04-17 EQ. & SLUDGE BLOWER

1" Ø V-04-05

INSULATION V-04-07

PI-02 D
TO SLUDGE TANK

INSULATION

3" Ø

2" Ø

FLOOR DRAIN
2" Ø
Z
TO SEPTIC TANK

EXTERIOR PIPING (BY OTHETRS)

PRV-04-21 PRV 1¼" Ø 2½" Ø
PG-04-24 PI V-04-25 ¼" Ø
V-04-26 3" Ø
V-04-27 4" Ø
V-04-28 4" Ø
BL-04-18 MBBR BLOWER #1

PRV-04-22 PRV 1¼" Ø 2½" Ø
PG-04-29 PI V-04-30 ¼" Ø
V-04-31 3" Ø
V-04-32 4" Ø
BL-04-20 MBBR BLOWER #1 & #2 (COMMON STAND-BY)

PRV-04-23 PRV 1½" Ø 2" Ø
PG-04-33 PI V-04-34 ¼" Ø
V-04-35 2" Ø
V-04-36 2" Ø
V-04-37 2" Ø
2" Ø
BL-04-19 MBBR BLOWER #2

TSC 04-25
HTR-04-39 BLOWER ROOM HEATER 3 kW

FIELD WIRING BY OTHERS / WIRING INSIDE THE CONTAINERS BY H2FLOW

CONTAINER WALL

INSULATION
I PI-05
TO MBBR TANK #1

INSULATION
J PI-05
TO MBBR TANK #2

POWER OUTLET
AC-04-40 AIR COMPRESSOR
V-04-41 1/4" Ø
PCV-04-42 PRESSURE REGULATOR
V-04-43 ¼" Ø

INSULATION
K PI-06
TO DAF PNEUMATIC PANEL

EXTERIOR PIPING (BY OTHETRS)

AC-04-40	AIR COMPRESSOR 3 Nl/min @ 6 bar 120V/1/60Hz
BL-04-16/17	EQ. & SLUDGE BLOWERS 26 Nm3/h @ 0.3 bar 2 HP, 575V/3/60Hz
BL-04-18/20	MBBR #1 & #2 BLOWERS 498 Nm3/h @ 0.21 bar 13.3 HP, 575V/3/60Hz
BL-04-19	MBBR #2 BLOWER 210 Nm3/h @ 0.21 bar 7.1 HP, 575V/3/60Hz
HTR-04-25	BLOWER ROOM HEATER 4 HP, 575V/3/60Hz

REV.	DESCRIPTION	DATE	BY
2	AS-BUILT	06/09/22	SS
1	ISSUED FOR CONSTRUCTION	05/17/22	JC

DRAWN BY: SS | DATE: 12/22/21
CHECKED BY: LB | DATE: 12/22/21
SCALE: N.T.S

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TITLE: *Piping & Instrumentation Diagram*

REV. 2

DRAWING No.: *Q-23119-20-00*

SHEET 4 OF 7

PI-04

AC PI–02 TO MBBR FEED PUMPS

AB PI–02 TO MBBR FEED PUMPS

SYSTEM CONTROL PANEL (BY H2FLOW)

HIGH LEVEL LSAH 05–07 DI

FOAM INDICATOR FLI 05–03 DI

DO LEVEL OLI 05–04 AI

FAULT YA 05–04

FOAM INDICATOR FLI 05–05 DI

HIGH LEVEL LSAH 05–08 DI

AE PI–07 TO MBBR #1 ANTI FOAM DOSING PUMP

AD PI–04 TO MBBR BLOWERS SPEED CONTROL

AF PI–07 TO MBBR #2 ANTI FOAM DOSING PUMP

FIELD WIRING BY OTHERS/ WIRING INSIDE THE CONTAINERS BY H2FLOW

OUTDOOR

OUTDOOR

G PI–02 FT 3" MBBR FEED

I PI–04 BLOWER AIR FROM BLOWER ROOM CONTAINER #2

P PI–07 FROM DAF/CHEMICAL ROOM CONTAINER #2

ET HEAT TRACE (BY OTHERS)

ANTI FOAM

4" 6" 3" 1" 1" 1" 3"

FE 05–03 FOAM INDICATOR

VENT 3"

LS–05–07

INSULATION

AERATION GRID

V–05–10 DRAIN

T–05–01 HILT MBBR TANK MBBR #1

DO SENSOR AE 05–04

FE 05–05 FOAM INDICATOR

VENT 3"

1"ø 1"ø 1" 1" 1"ø 6" 2"ø

LS–05–08

INSULATION

AERATION GRID

V–05–09 DRAIN

T–05–02 HILT MBBR TANK MBBR #2

ALUM ET HEAT TRACE (BY OTHERS) PI–07 R FROM DAF/CHEMICAL ROOM CONTAINER #2

ANTI FOAM ET HEAT TRACE (BY OTHERS) PI–07 Q FROM DAF/CHEMICAL ROOM CONTAINER #2

COMPRESSED AIR PI–04 J FROM BLOWER ROOM CONTAINER #2

6"ø 4"ø O PI–06 TO FLOCCULATION TANK

REV.	DESCRIPTION	DATE	BY
2	AS-BUILT	06/09/22	SS
1	ISSUED FOR CONSTRUCTION	05/17/22	JC

DRAWN BY: SS DATE: 12/22/21

CHECKED BY: LB DATE: 12/22/21

SCALE: N.T.S

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REFERENCE INFORMATION

PROJECT NAME: SABINA GOLD & SILVER CORP. SEWAGE WASTEWATER TREATMENT PLANT

TITLE: Piping & Instrumentation Diagram

REV. 2

DRAWING No.: Q-23119-20-00

SHEET 5 OF 7

PI-05

SYSTEM CONTROL PANEL (BY H2FLOW)

CONTAINER #2
(40')
ELECTRICAL ROOM
NON–HAZARDOUS

FAULT | YA 06-01
RUNNING | YI 06-01
RUN | YC 06-01
STOP | SC 06-01
SPEED | HS 06-01
HAND/AUTO | HS 06-01
RECIRCULATION LOW PRESSURE ALARM | PAL 06-12 DI
COMPRESSED AIR LOW PRESSURE ALARM | PAL 06-07 DI
OPEN | YC 06-08 DO
CLOSE | YC 06-09 DO
HIGH LEVEL | LH 06-19 DI
LOW LEVEL | LL 06-20 DI
FAULT | YA 06-18
RUNNING | YI 06-18
RUN | YC 06-18
STOP | SC 06-18
SPEED | HS 06-18
HAND/AUTO | HS 06-18
ON | YC 06-24 DO
OFF / FAULT | YA 06-24 DI
DAF LOW LEVEL | LAL 06-26 DI
FAULT | YA 06-27 DI
RUN | YC 06-27 DO
STOP
UV INTENSITY | AI 06-28 AI
UV FAULT | YA 06-28 DI
ON / OFF | YC 06-28 DO

CONTAINER WALL

FIELD WIRING BY OTHERS/
WIRING INSIDE THE CONTAINERS
BY H2FLOW

PANEL MOUNTED
CARLO GAVAZI
CLG–CLD4MA2DM24
CONTROLLER
24 VAC

S PI–07
FROM POLYMER FEED

O PI–05
FROM HILT
MBBR #2

ET
HEAT TRACE
(BY OTHERS)

INSULATION

4"

M-06-01

M-06-18
SKIMMER DRIVE

LS-06-19
LS-06-20

SLUDGE LINE

DAF-06-17
DAF TANK
ALPHA 10

LE 06-29
LEVEL SWITCH
24 VDC

V-06-15

T-06-02
MIXING TANK

V-06-03
DRAIN

V-06-16
PNEUMATIC
ACTUATED
VALVE

SATURATION
TANK

PI-06-23
PRESSURE
GAUGE

M-06-24

V-06-21

P-06-22
RECIRCULATION
PUMP

V-06-25

UV CONTROL
PANEL

UVT 06-28

UV-06-28
UV DISINFECTION

V-06-29
SAMPLE PORT

CONTAINER WALL

ET
Y
TO DITCH
HEAT TRACE
(BY OTHERS)

K PI–04
FROM AIR
COMPRESSOR

ET
HEAT TRACE
(BY OTHERS)

$\frac{1}{4}$" Ø

PI-06-06
PRESSURE GAUGE

V-06-04

V-06-05
PRESSURE
REGULATOR
W/FILTER

DRAIN

PS 06-07
PRESSURE SWITCH
24 VDC

SV-06-08
3-WAY SOLENOID
VALVE, 24 VDC

SV-06-09
SOLENOID VALVE
24 VDC

V-06-30
PRESSURE
REGULATOR

RM-06-10
ROTAMETER

V-06-11

PS 06-12
PRESSURE SWITCH
24 VDC

PI-06-13
PRESSURE GAUGE

PANEL-06-14
PNEUMATIC PANEL

V-06-30

P-06-27
SLUDGE PUMP

V-06-31

ET
E PI–02
TO SLUDGE
HOLDING TANK
HEAT TRACE
(BY OTHERS)

EXTERIOR PIPING
(BY OTHETRS)

EXTERIOR PIPING
(BY OTHETRS)

CONTAINER #2
(40')
DAF/CHEMICAL ROOM
NON–HAZARDOUS

P-06-22
RECIRCULATION PUMP
2HP, 575/3/60

P-06-27
SLUDGE PUMP
1 HP, 575/3/60

UV-06-28
UV DISINFECTION
180W, 120/1/60

REV.	DESCRIPTION	DATE	BY
2	AS-BUILT		SS
1	ISSUED FOR CONSTRUCTION	05/17/22	JC

DRAWN BY: LC — DATE: 12/22/21
CHECKED BY: LB — DATE: 12/22/21
SCALE: N.T.S

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REFERENCE INFORMATION

PROJECT NAME: SABINA GOLD & SILVER CORP. SEWAGE WASTEWATER TREATMENT PLANT

TITLE: Piping & Instrumentation Diagram

REV. 2

DRAWING No.: Q-23119-20-00

SHEET 6 OF 7

PI-06

AF PI–05 FROM MBBR #2 FOAM INDICATOR

AE PI–05 FROM MBBR #1 FOAM INDICATOR

V PI–02 FROM MBBR / DAF FLOWMETER

SC 07–08 SPEED CONTROL AO

YC 07–08 START/STOP REMOTE DO

YA 07–08 LOW WATER FLOW ALARM DI

YC 07–06 ON/OFF REMOTE SPEED CONTROL DO AO

YC 07–07 ON/OFF REMOTE SPEED CONTROL DO AO

YC 07–10 ON/OFF REMOTE SPEED CONTROL DO AO

CONTAINER #2
(40')
ELECTRICAL ROOM
NON–HAZARDOUS

CONTAINER WALL

FAN–07–01
DAF/CHEMICAL ROOM
EXHAUST FAN

KC 07–01

LVR–07–02
DAF/CHEMICAL ROOM
Llouver

POWER OUTLET

TSC 07–03

HTR–07–03
DAF ROOM
HEATER
5kW

DP-07-06
ANTI FOAM PUMP

ANTIFOAM

ET

P PI–05 TO HILT MBBR (MBBR #1)

DP-07-07
ANTI FOAM PUMP

ANTIFOAM

ET

Q PI–05 TO HILT MBBR (MBBR #2)

S PI–06 TO MIXING TANK

DP-07-10
ALUM PUMP

ALUM

ET

R PI–05 TO HILT MBBR (MBBR #2)

FLOOR DRAIN

Z TO SEPTIC TANK

B SERVICE WATER BY OTHERS

ET

¾" Ø

BACKFLOW PREVENTER

PI-07-05
PRESSURE GAUGE

½" Ø

GARDEN HOSE

½" Ø

CONTAINER #2
(40')
DAF/CHEMICAL ROOM
NON–HAZARDOUS

T-07-15/16
ANTIFOAM PUMPS
24W, 120/1/60

T-07-20
ALUM PUMP
24W, 120/1/60

EXTERIOR PIPING (BY OTHERS)

EXTERIOR PIPING (BY OTHETRS)

REV.	DESCRIPTION	DATE	BY
2	AS-BUILT	06/09/22	SS
1	ISSUED FOR CONSTRUCTION	05/17/22	JC

DRAWN BY: SS — DATE: 12/22/21
CHECKED BY: LB — DATE: 12/22/21
SCALE: N.T.S

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REFERENCE INFORMATION

PROJECT NAME: *SABINA GOLD & SILVER CORP. SEWAGE WASTEWATER TREATMENT PLANT*

TITLE: *Piping & Instrumentation Diagram*

REV. 2

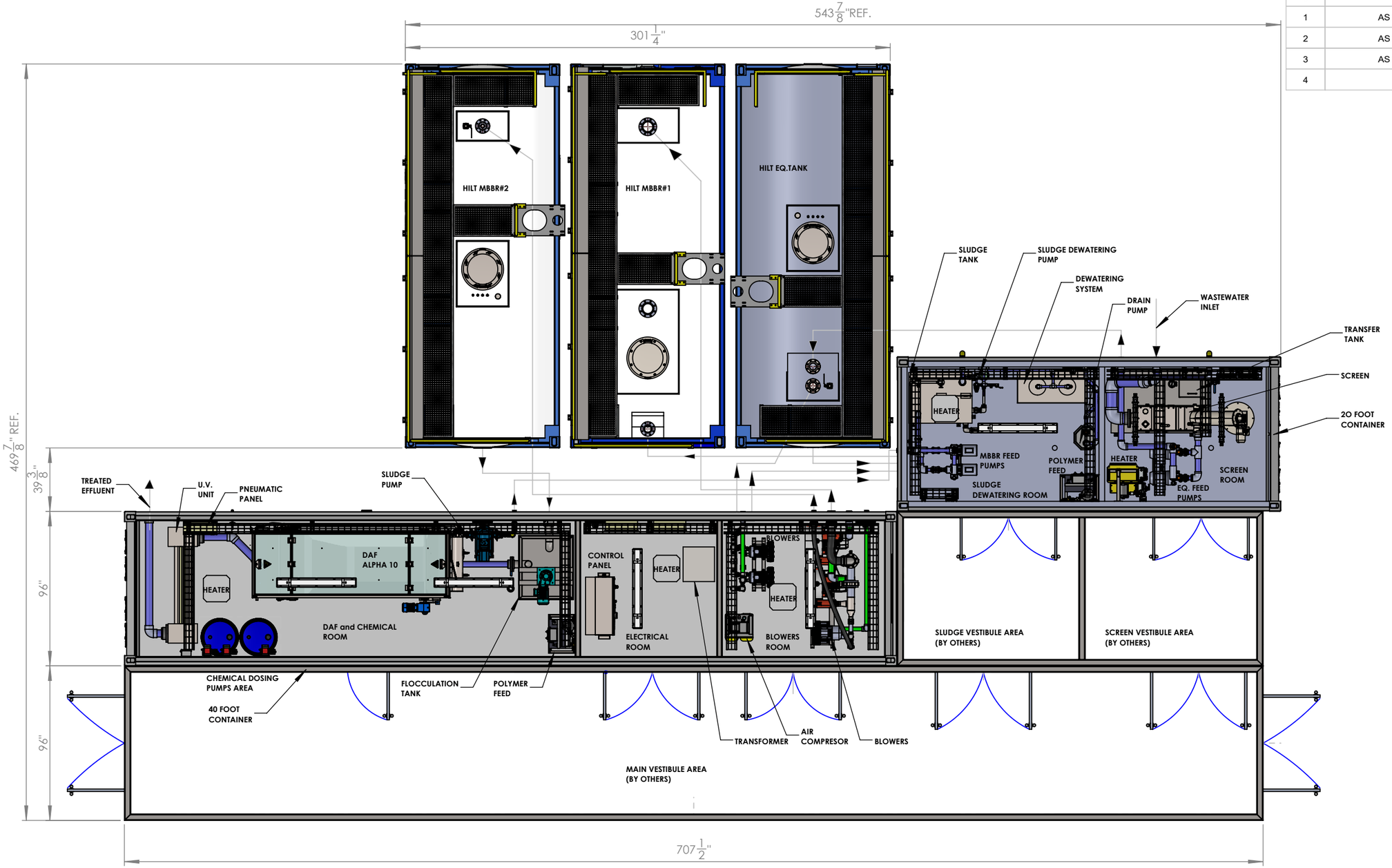
DRAWING No.: *Q-23119-20-00* SHEET 7 OF 7

PI-07

Section 2.3

General Assembly Diagram (GAD)

REV	DESCRIPTION	DATE	BY	APP'D
0	FOR REFERENCE ONLY	01/17/2022	DM	JC
1	AS PER CUSTOMER REQUEST	01/24/2022	DM	JC
2	AS PER CUSTOMER REQUEST	02/01/2022	DM	JC
3	AS PER CUSTOMER REQUEST	02/03/2022	DM	JC
4	AS BUILT	07/28/2022	DM	JC



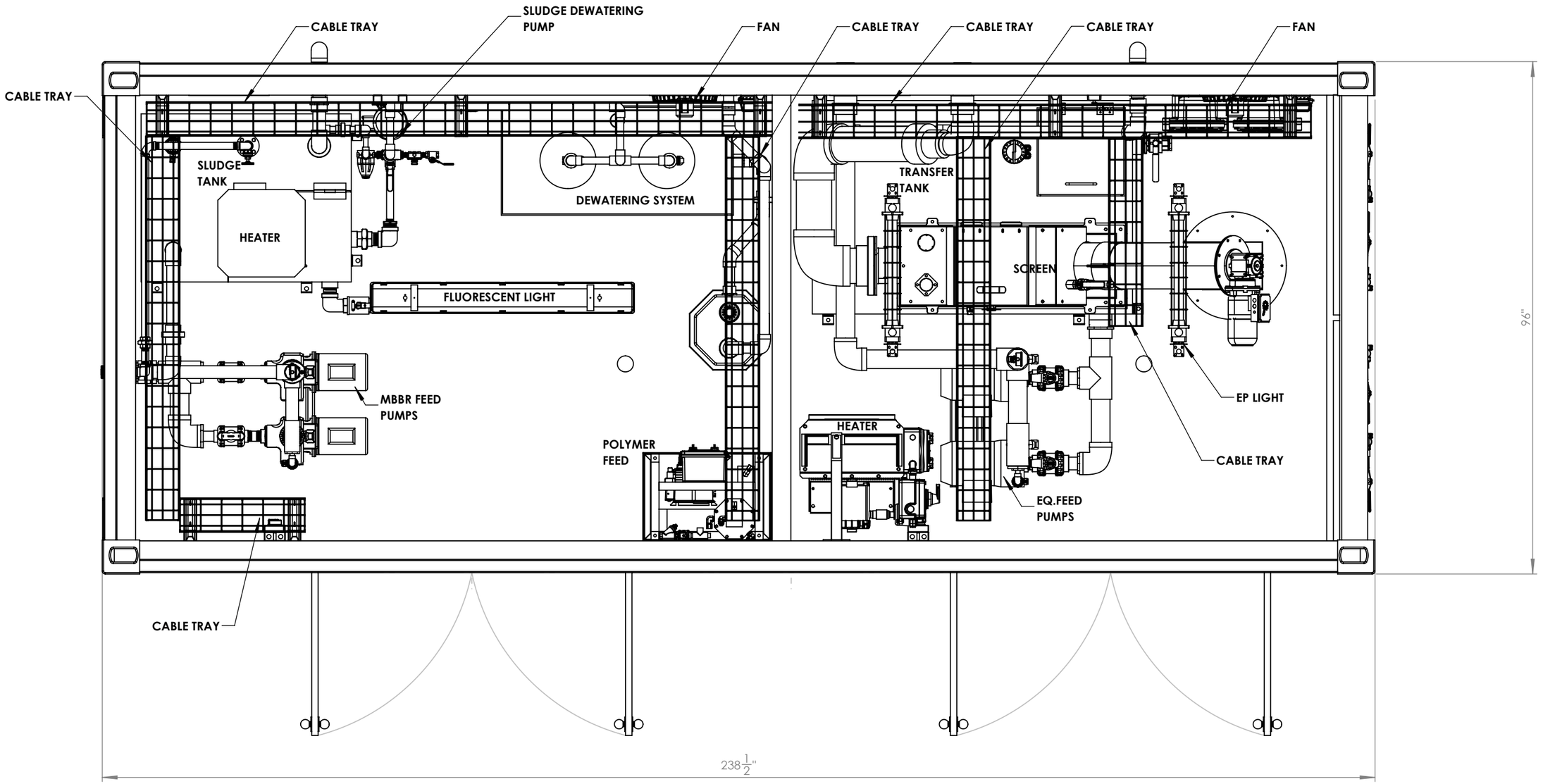
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APP'D BY: JC	DATE: 02/02/2022		DRAWING No.: Q-23119-10-01
SCALE: NTS			REV: 4
		ALL DIMENSION ARE IN INCHES UNLESS OTHERWISE SPECIFIED	SHEET 1 OF 3

REV	DESCRIPTION	DATE	BY	APP'D
0	FOR REFERENCE ONLY	01/06/2022	DM	JC
1	AS BUILT	08/02/2022	DM	JC



TOP VIEW

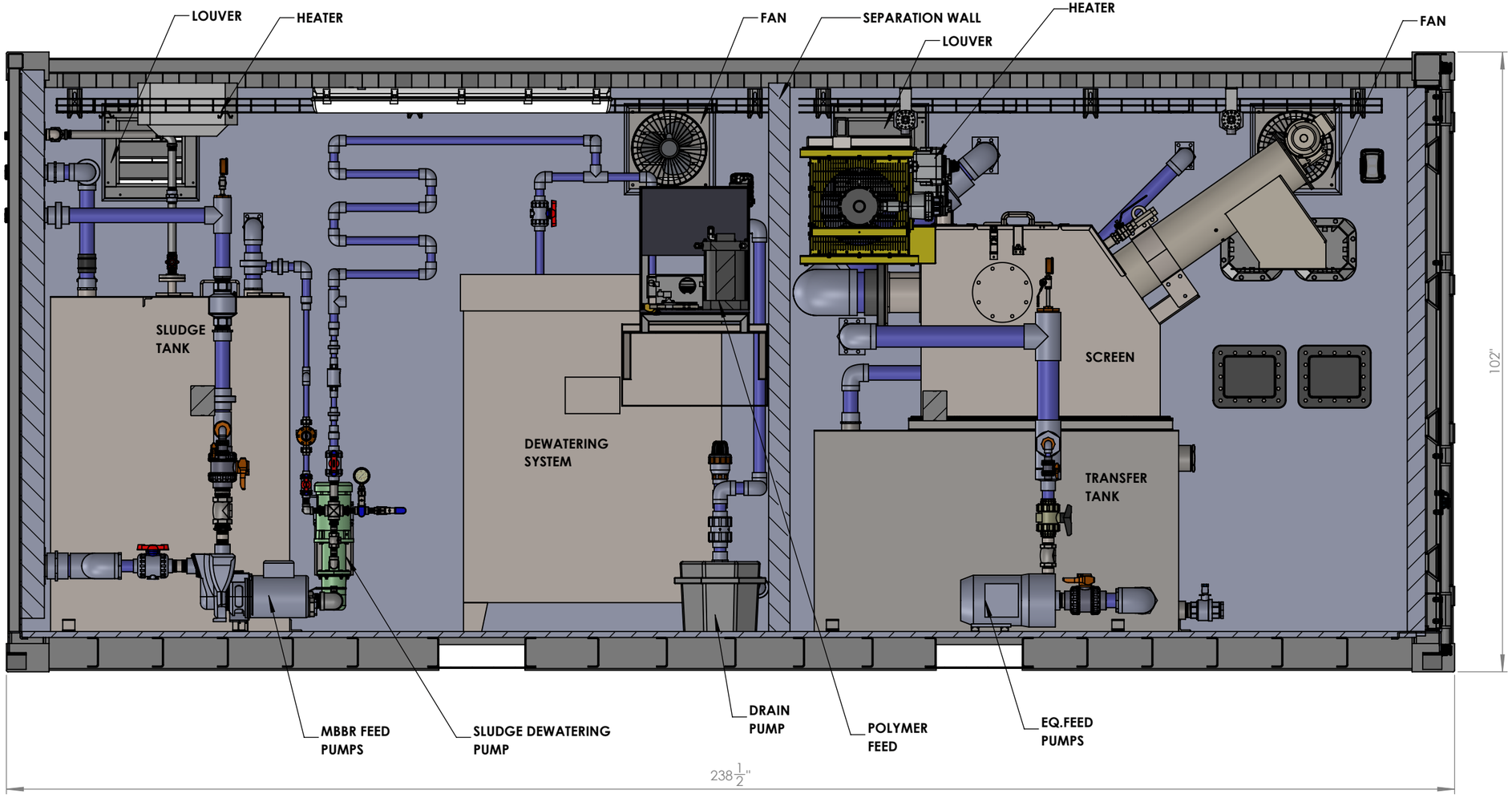
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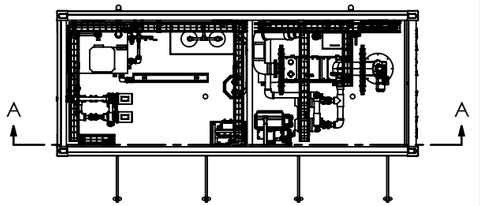
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APP'D BY: JC	DATE: 01/06/2022		DRAWING No.: Q-23119-30-04
SCALE: NTS			REV: 1
		ALL DIMENSION ARE IN INCHES UNLESS OTHERWISE SPECIFIED	SHEET 1 OF 8

REV	DESCRIPTION	DATE	BY	APP'D
0	FOR REFERENCE ONLY	01/06/2022	DM	JC
1	AS BUILT	08/02/2022	DM	JC





SECTION A-A
SCALE 1 : 20

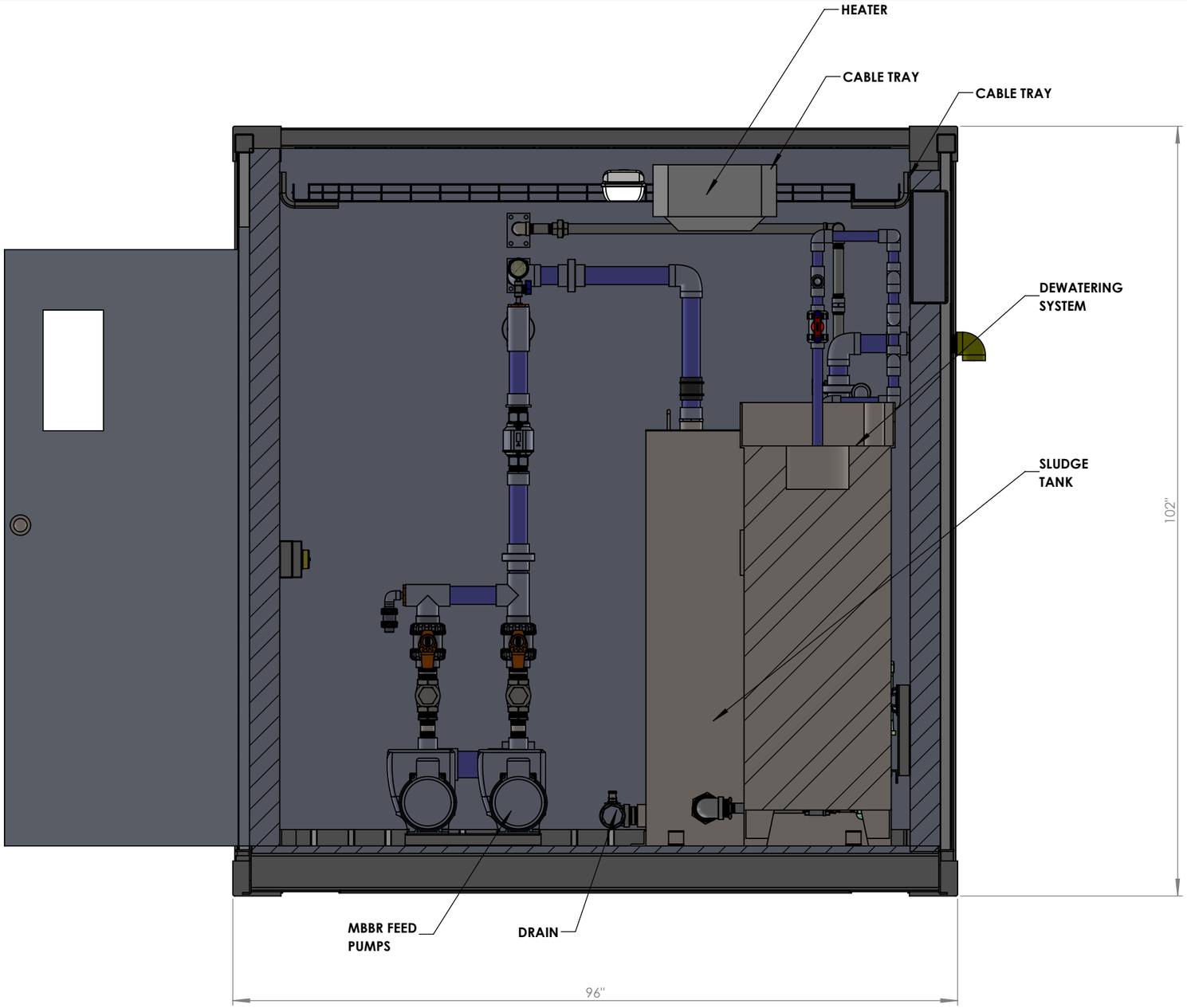
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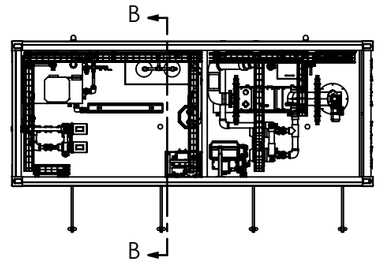
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APP'D BY: JC	DATE: 01/06/2022		DRAWING No.: Q-23119-30-04
SCALE: NTS		ALL DIMENSION ARE IN INCHES UNLESS OTHERWISE SPECIFIED	REV: 1
			SHEET 2 OF 8

REV	DESCRIPTION	DATE	BY	APP'D
0	FOR REFERENCE ONLY	01/06/2022	DM	JC
1	AS BUILT	08/02/2022	DM	JC





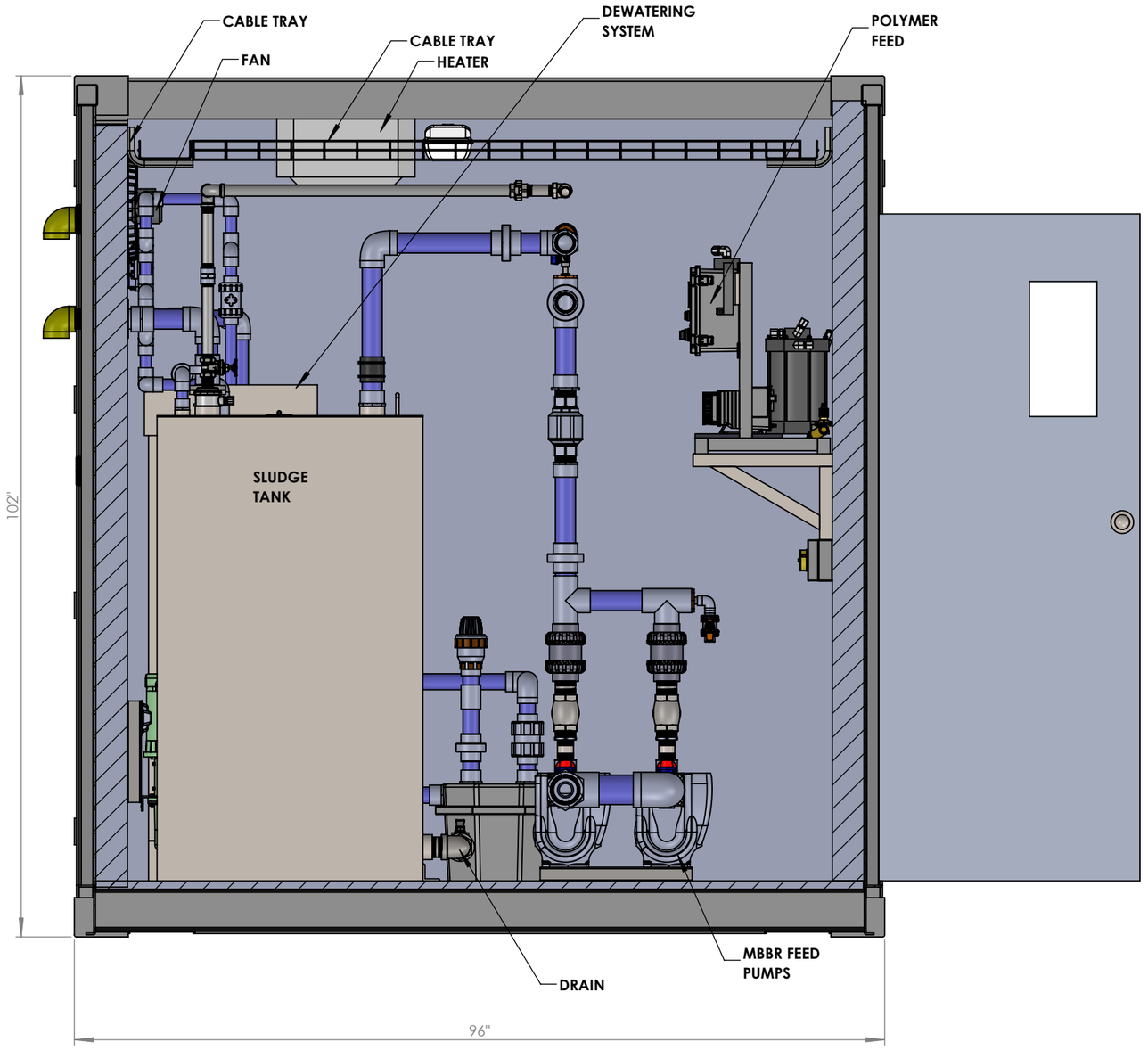
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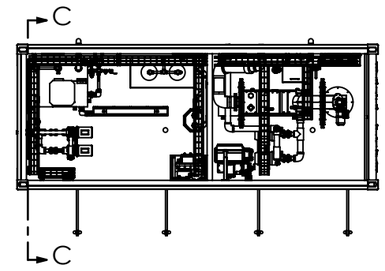
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APP'D BY: JC	DATE: 01/06/2022		DRAWING No.: Q-23119-30-04
SCALE: NTS			REV: 1
		ALL DIMENSION ARE IN INCHES UNLESS OTHERWISE SPECIFIED	SHEET 3 OF 8

REV	DESCRIPTION	DATE	BY	APP'D
0	FOR REFERENCE ONLY	01/06/2022	DM	JC
1	AS BUILT	08/02/2022	DM	JC



SECTION C-C
SCALE 1 : 16

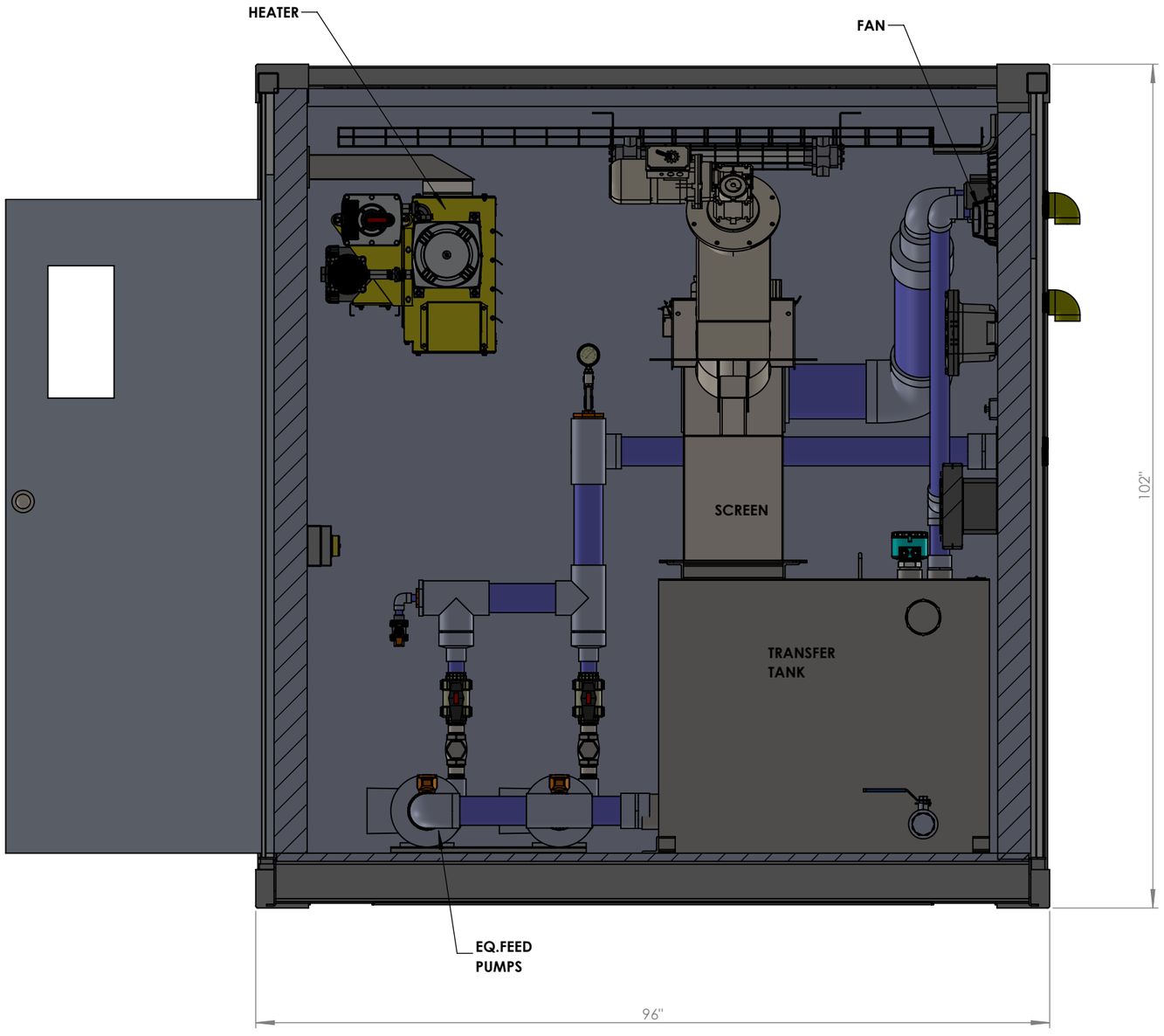


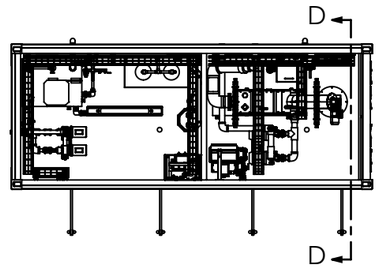
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APP'D BY: JC	DATE: 01/06/2022		DRAWING No.: Q-23119-30-04
SCALE: NTS		ALL DIMENSION ARE IN INCHES UNLESS OTHERWISE SPECIFIED	REV: 1
			SHEET 4 OF 8

REV	DESCRIPTION	DATE	BY	APP'D
0	FOR REFERENCE ONLY	01/06/2022	DM	JC
1	AS BUILT	08/02/2022	DM	JC





SECTION D-D

SCALE 1 : 16

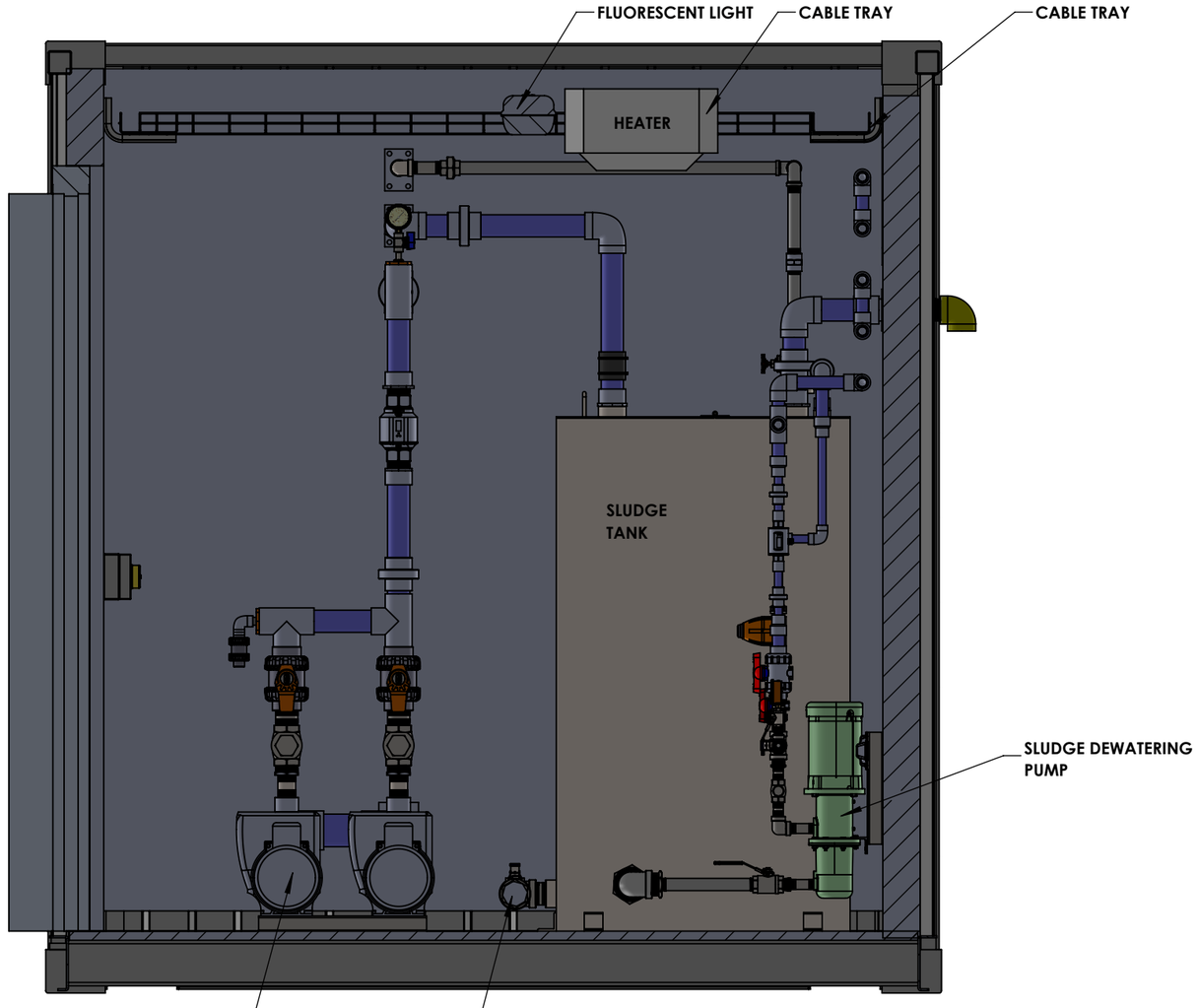
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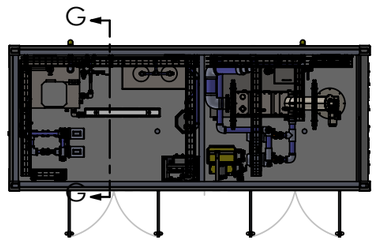
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APP'D BY: JC	DATE: 01/06/2022		DRAWING No.: Q-23119-30-03
SCALE: NTS		ALL DIMENSION ARE IN INCHES UNLESS OTHERWISE SPECIFIED	REV: 1
			SHEET 5 OF 8

REV	DESCRIPTION	DATE	BY	APP'D
0	FOR REFERENCE ONLY	01/06/2022	DM	JC
1	AS BUILT	08/02/2022	DM	JC





SECTION G-G
SCALE 1 : 16

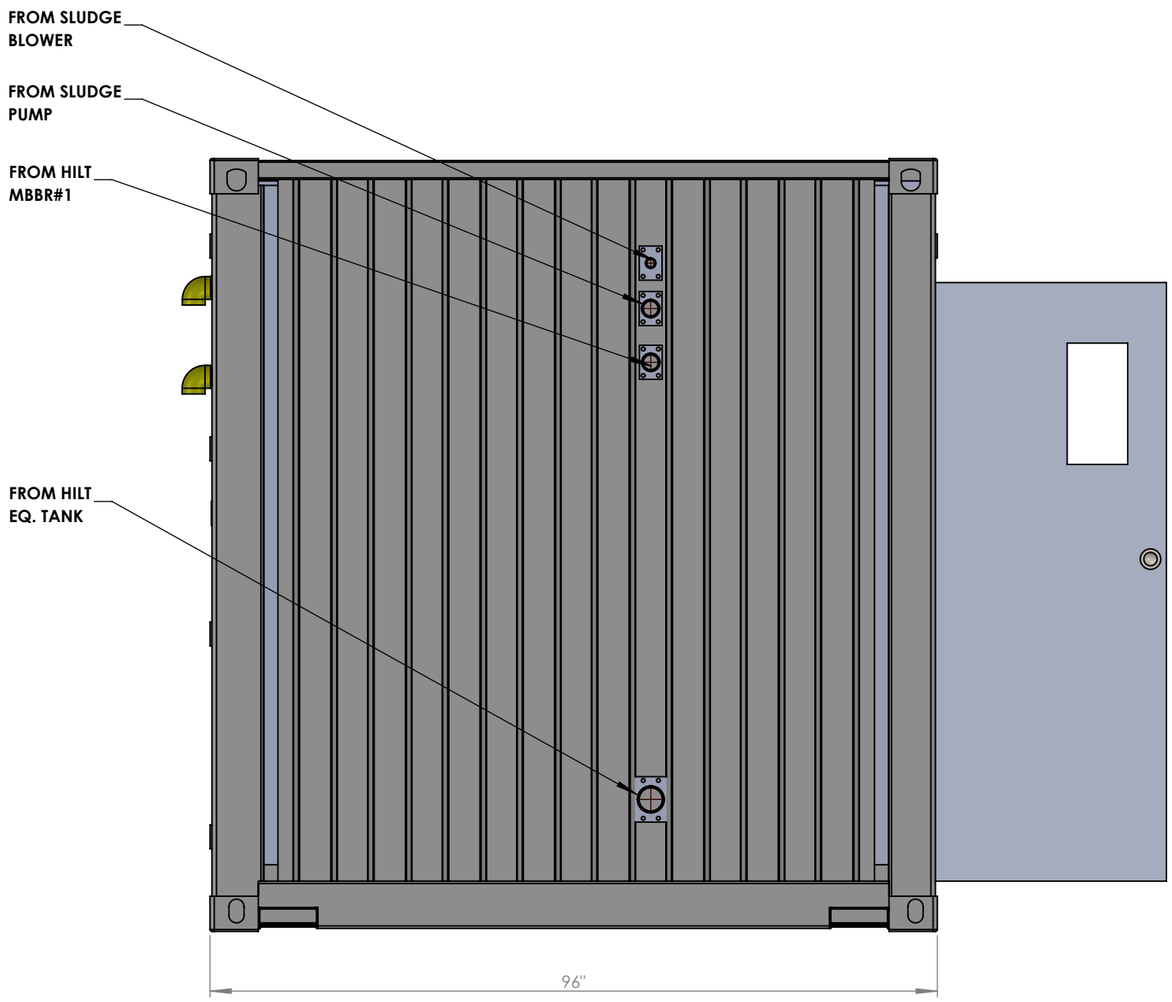
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APP'D BY: JC	DATE: 01/06/2022		DRAWING No.: Q-23119-30-04
SCALE: NTS		ALL DIMENSION ARE IN INCHES UNLESS OTHERWISE SPECIFIED	REV: 1
			SHEET 6 OF 8

REV	DESCRIPTION	DATE	BY	APP'D
0	FOR REFERENCE ONLY	01/06/2022	DM	JC
1	AS BUILT	08/02/2022	DM	JC



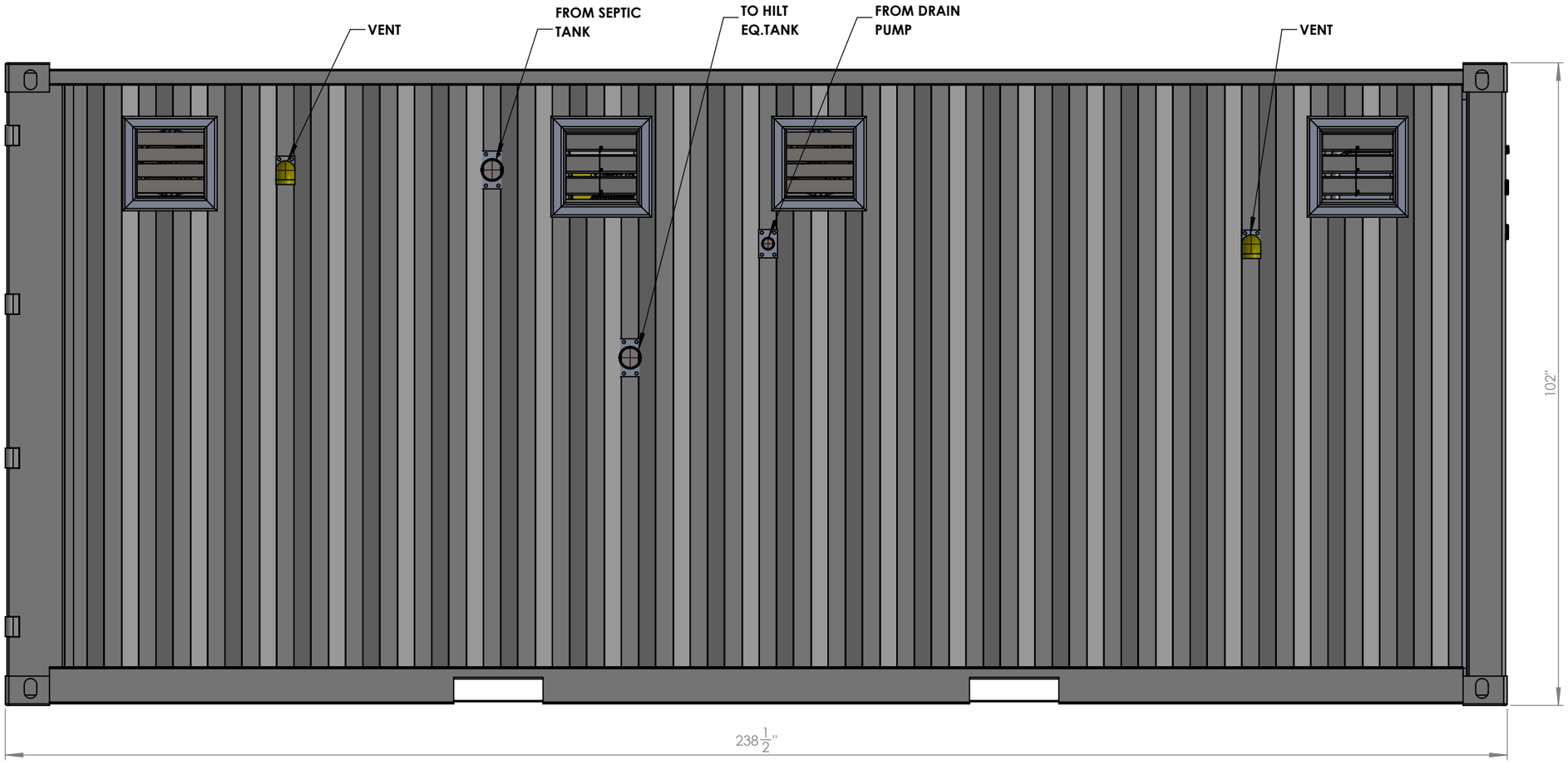
LEFT VIEW

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DRAWN BY: DM	DATE: 01/06/2022	PROJECT NAME: SABINA GOLD STP NUNAVUT	TITLE: 20 FOOT CONTAINER WITH EQUIPMENT
APP'D BY: JC	DATE: 01/06/2022		DRAWING No.: Q-23119-30-04
SCALE: NTS			REV: 1
		ALL DIMENSION ARE IN INCHES UNLESS OTHERWISE SPECIFIED	SHEET 7 OF 8

REV	DESCRIPTION	DATE	BY	APP'D
0	FOR REFERENCE ONLY	01/06/2022	DM	JC
1	AS BUILT	08/02/2022	DM	JC



REAR VIEW

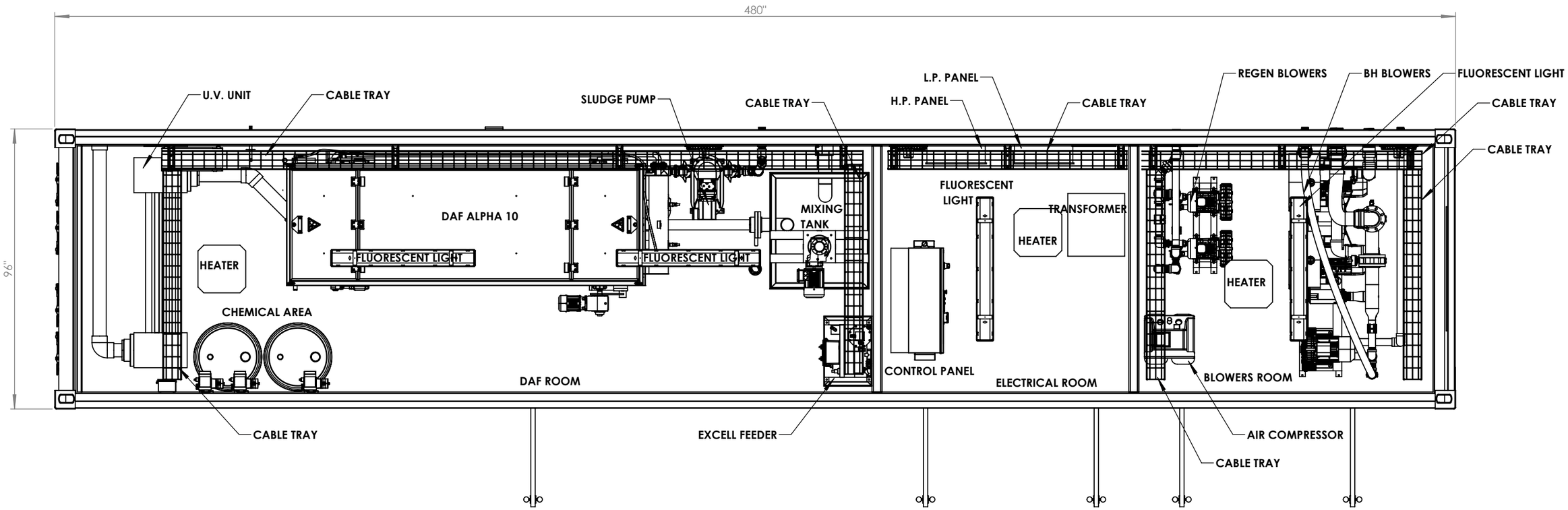
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APP'D BY: JC	DATE: 01/06/2022		DRAWING No.: Q-23119-30-04
SCALE: NTS			REV: 1
		ALL DIMENSION ARE IN INCHES UNLESS OTHERWISE SPECIFIED	SHEET 8 OF 8

REV	DESCRIPTION	DATE	BY	APP'D
0	FOR REFERENCE ONLY	01/27/2022	DM	JC
1	AS BUILT	08/06/2022	DM	JC



TOP VIEW

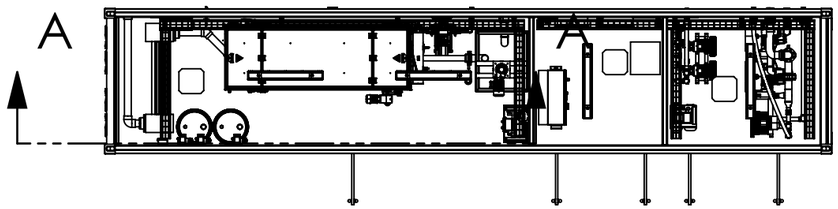
H2FLOW EQUIPMENT INC.

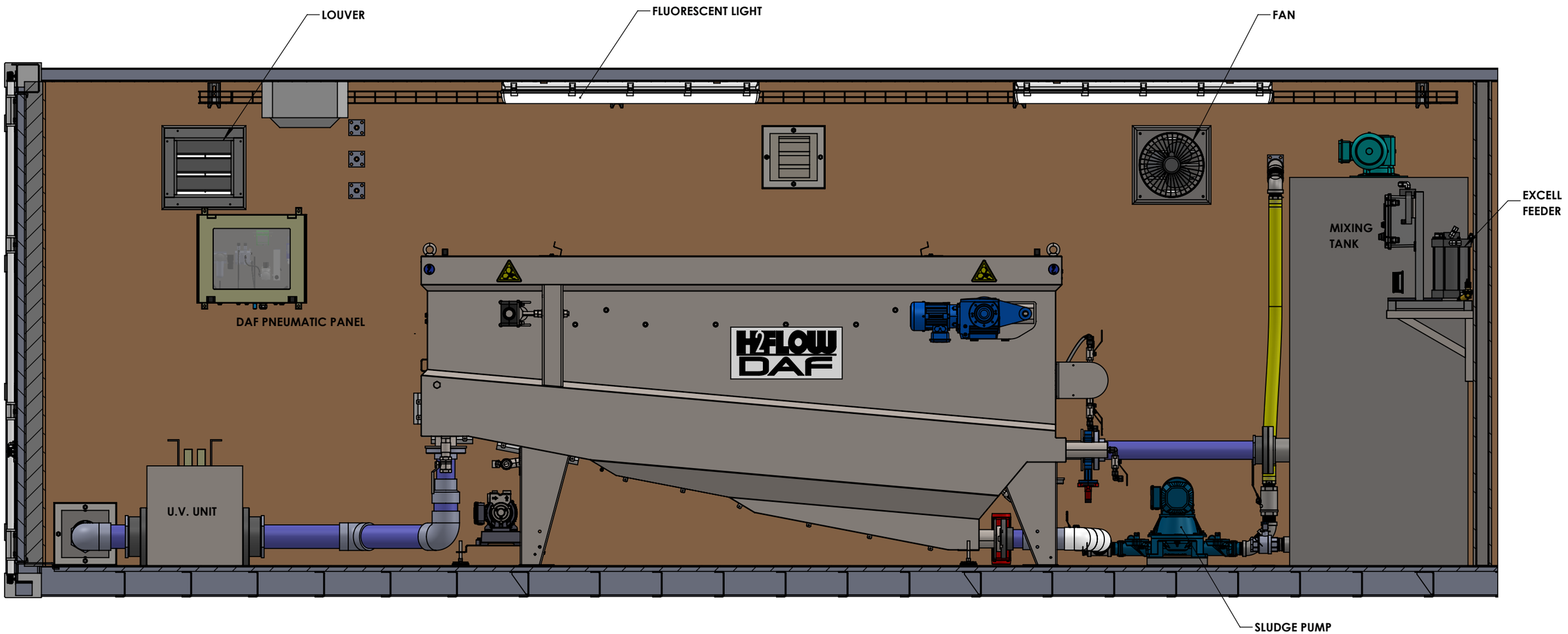
WATER AND WASTEWATER TREATMENT EQUIPMENT
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TEL: (905) 660-9775 FAX: (905) 660-9744
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DRAWN BY: DM	DATE: 02/02/2022	PROJECT NAME: SABINA GOLD STP NUNAVUT	TITLE: 40 FOOT CONTAINER WITH EQUIPMENT
APP'D BY: JC	DATE: 02/02/2022		DRAWING No.: Q-23119-30-04
SCALE: NTS			REV: 1
		ALL DIMENSION ARE IN INCHES UNLESS OTHERWISE SPECIFIED	SHEET 1 OF 5

REV	DESCRIPTION	DATE	BY	APP'D
0	FOR REFERENCE ONLY	01/27/2022	DM	JC
1	AS BUILT	08/06/2022	DM	JC





SECTION A-A
SCALE 1 : 20
DAF ROOM

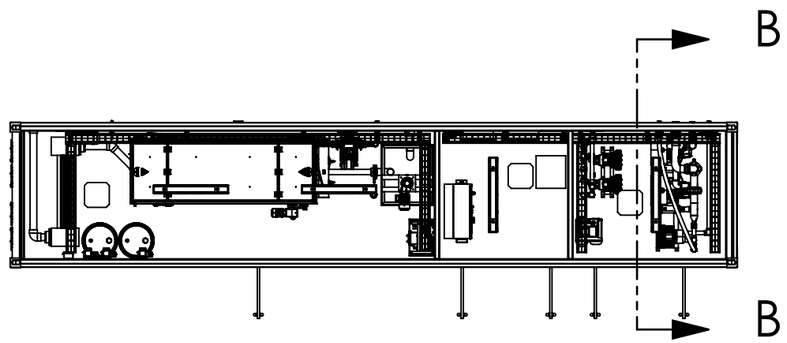
H2FLOW EQUIPMENT INC.

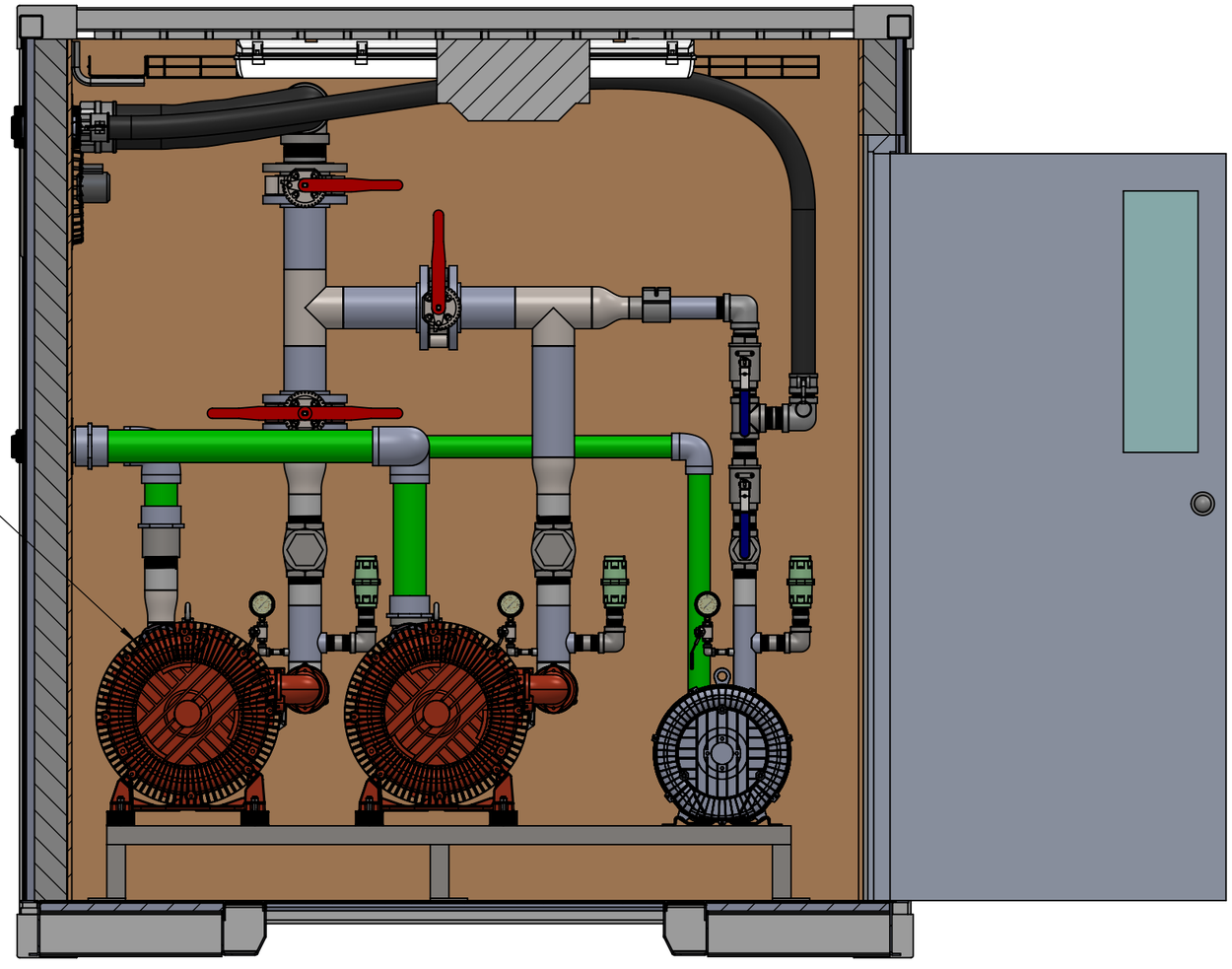
WATER AND WASTEWATER TREATMENT EQUIPMENT
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DRAWN BY: DM	DATE: 02/02/2022	PROJECT NAME: SABINA GOLD STP NUNAVUT	TITLE: 40 FOOT CONTAINER WITH EQUIPMENT
APP'D BY: JC	DATE: 02/02/2022		DRAWING No.: Q-23119-30-04
SCALE: NTS			REV: 1
		ALL DIMENSION ARE IN INCHES UNLESS OTHERWISE SPECIFIED	SHEET 2 OF 5

REV	DESCRIPTION	DATE	BY	APP'D
0	FOR REFERENCE ONLY	01/27/2022	DM	JC
1	AS BUILT	08/06/2022	DM	JC





SECTION B-B
SCALE 1 : 16
BLOWERS ROOM

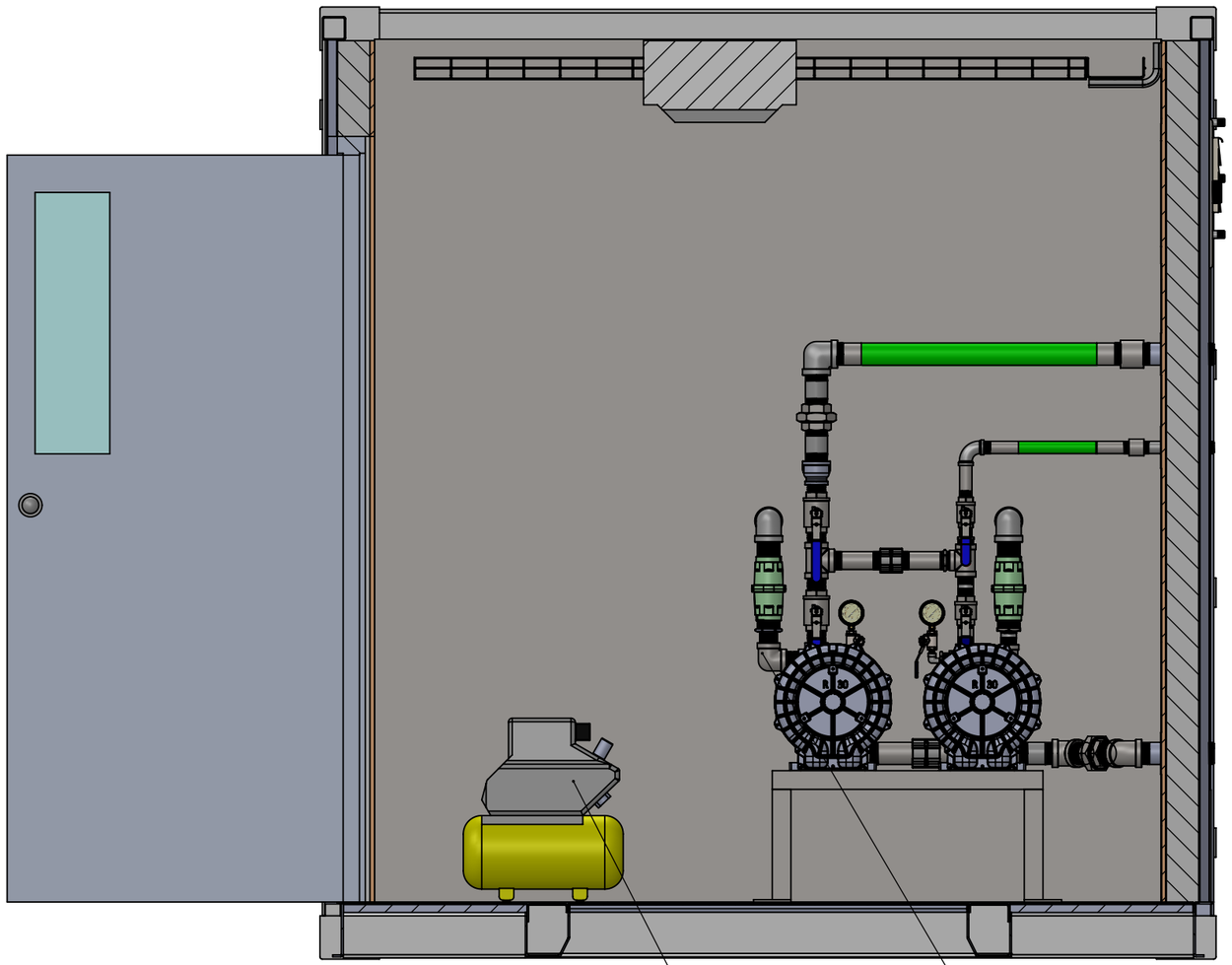
H2FLOW EQUIPMENT INC.

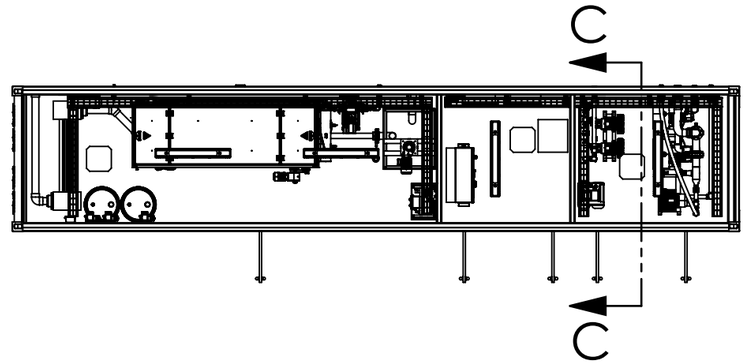
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DRAWN BY: DM	DATE: 02/02/2022	PROJECT NAME: SABINA GOLD STP NUNAVUT	TITLE: 40 FOOT CONTAINER WITH EQUIPMENT
APP'D BY: JC	DATE: 02/02/2022		DRAWING No.: Q-23119-30-04
SCALE: NTS			REV: 1
		ALL DIMENSION ARE IN INCHES UNLESS OTHERWISE SPECIFIED	SHEET 3 OF 5

REV	DESCRIPTION	DATE	BY	APP'D
0	FOR REFERENCE ONLY	01/27/2022	DM	JC
1	AS BUILT	08/06/2022	DM	JC





SECTION C-C
SCALE 1 : 16
BLOWERS ROOM

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DRAWN BY	DM
DATE	02/02/2022
APP'D BY	JC
DATE	02/02/2022
SCALE	NTS

PROJECT NAME: SABINA GOLD STP NUNAVUT

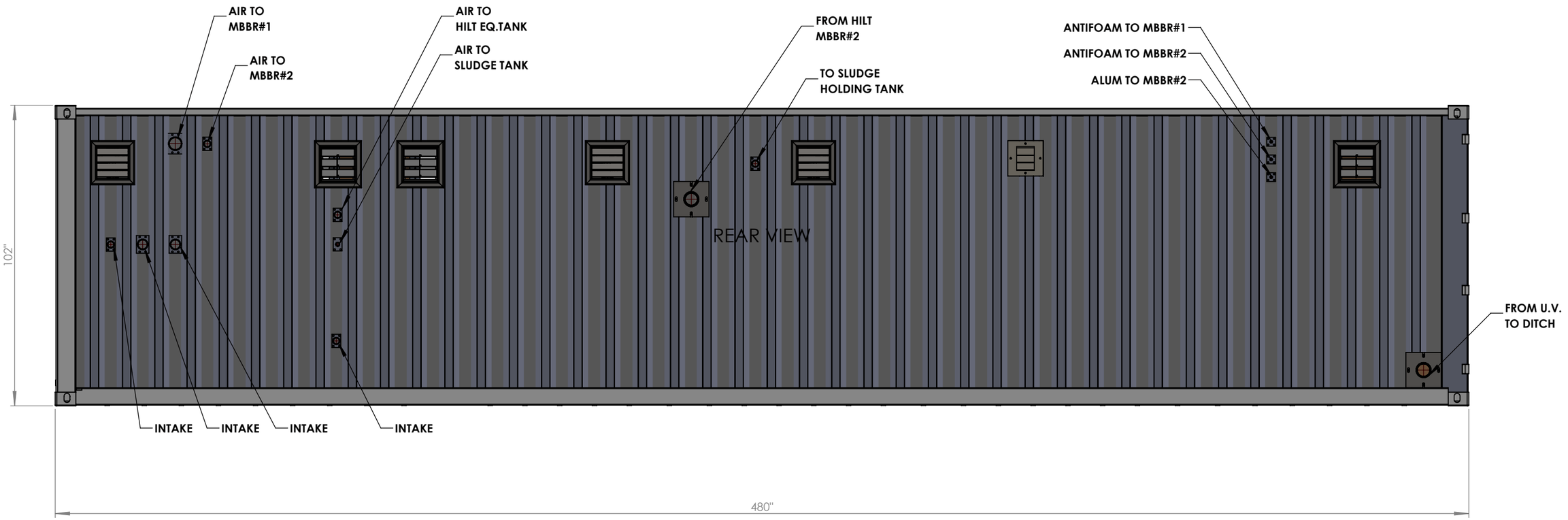
ALL DIMENSION ARE IN INCHES UNLESS OTHERWISE SPECIFIED

TITLE: 40 FOOT CONTAINER WITH EQUIPMENT

DRAWING No.: Q-23119-30-04

REV: 1

REV	DESCRIPTION	DATE	BY	APP'D
0	FOR REFERENCE ONLY	01/27/2022	DM	JC
1	AS BUILT	08/06/2022	DM	JC



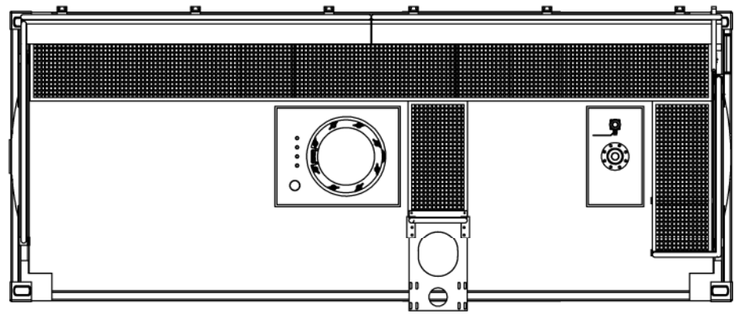
H2FLOW EQUIPMENT INC.

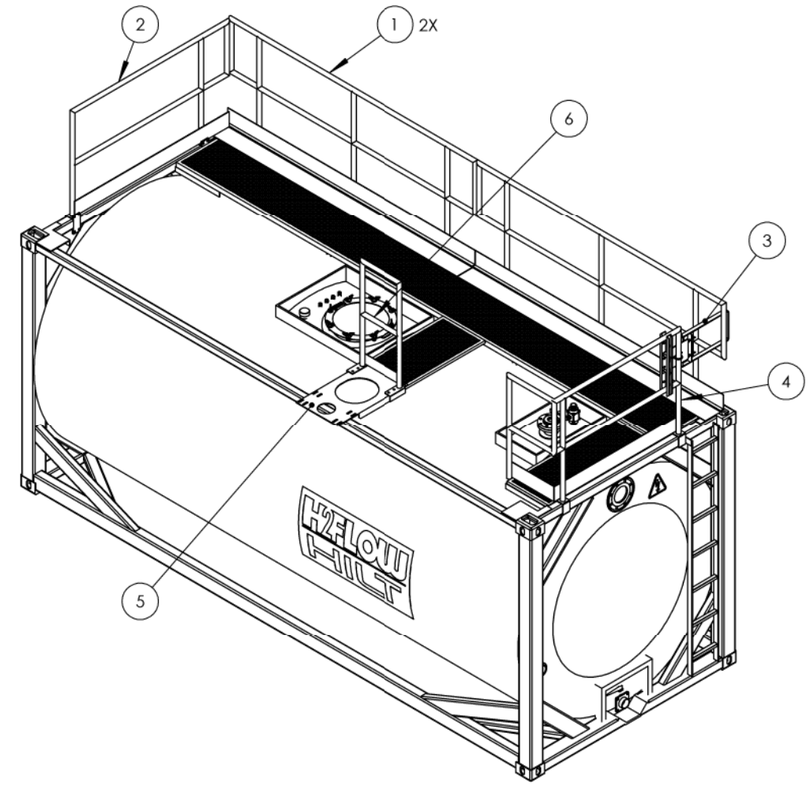
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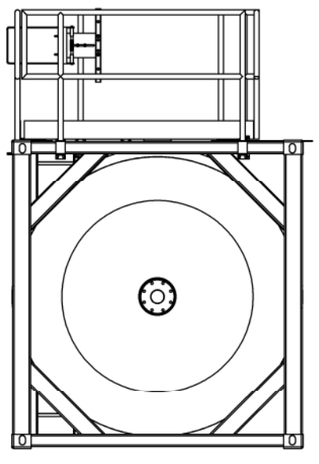
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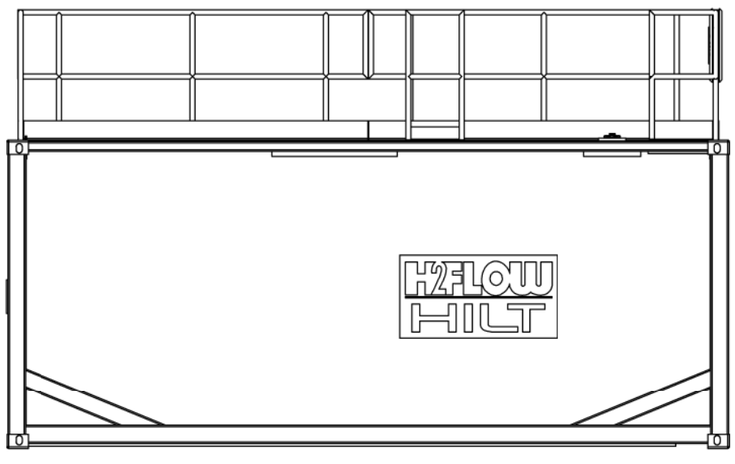
DRAWN BY: DM	DATE: 02/02/2022	PROJECT NAME: SABINA GOLD STP NUNAVUT	TITLE: 40 FOOT CONTAINER WITH EQUIPMENT
APP'D BY: JC	DATE: 02/02/2022		DRAWING No.: Q-23119-30-04
SCALE: NTS			REV: 1
ALL DIMENSION ARE IN INCHES UNLESS OTHERWISE SPECIFIED			SHEET 5 OF 5

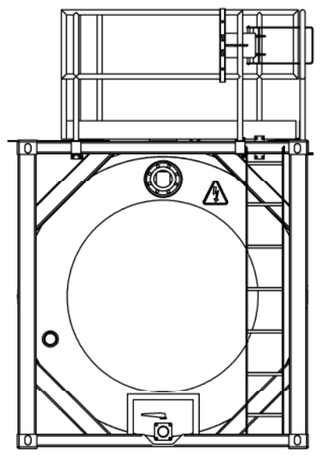
REV	DESCRIPTION	DATE	BY	APP'D
0	FOR REFERENCE ONLY	04/12/22	JC	LB











ITEM NO.	DESCRIPTION	QTY
1	HANDRAIL TYPE 1	2
2	HANDRAIL TYPE 2	1
3	SAFETY GATE	1
4	HANDRAIL TYPE 3	1
5	HANDRAIL SUPPORT	1
6	HANDRAIL TYPE 4	1

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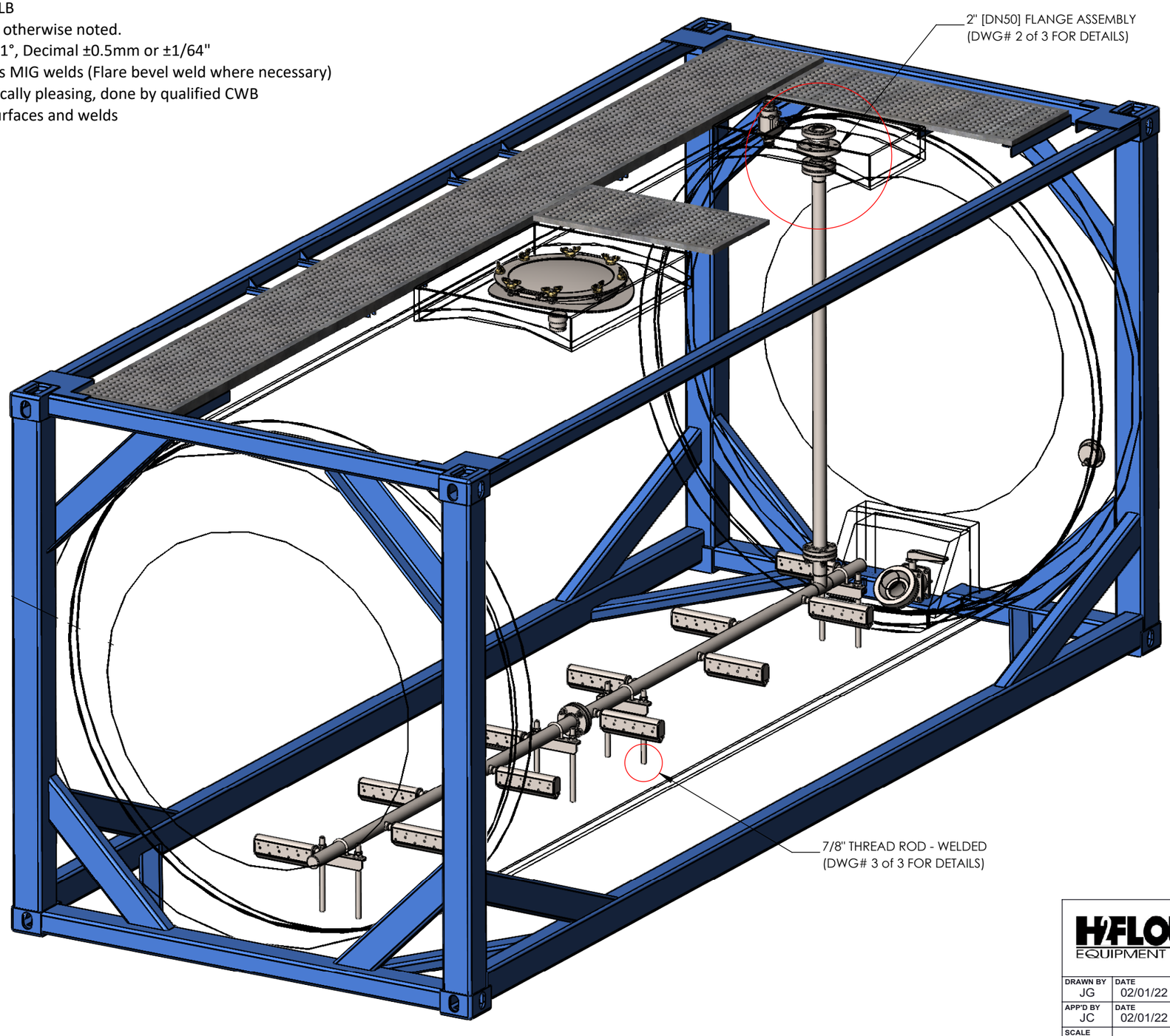
DRAWN BY: JC	DATE: 04/12/22	PROJECT NAME: CONSULTEC-ASCOT ASCOT-PREMIER SEWAGE WWTP	TITLE: HAND RAIL INSTALLATION DETAIL
APP'D BY: LB	DATE: 04/12/22		DRAWING No.: Q-20519-50-30
SCALE: NTS		ALL DIMENSION ARE IN "mm" UNLESS OTHERWISE SPECIFIED	REV: 0
			SHEET 1 OF 1

H2FLOW HILT AERATION GRID & FITTINGS SETUP LAYOUT

Manufacturing Notes:

1. Qty: 1 Unit
2. Material: SS 304, Sch. 10/40. ANSI 150 LB
3. All Dimensions are edge to edge unless otherwise noted.
4. Tolerances: Angular Mach. ±1°, Bend ± 1°, Decimal ±0.5mm or ±1/64"
5. All welds must be min.3/16" continuous MIG welds (Flare bevel weld where necessary)
6. All welds must be uniform and aesthetically pleasing, done by qualified CWB
7. Remove all sharp edges and clean all surfaces and welds

REV	DESCRIPTION	DATE	BY	APP'D
1	FOR MFG ONLY	03/01/22	JG	JC



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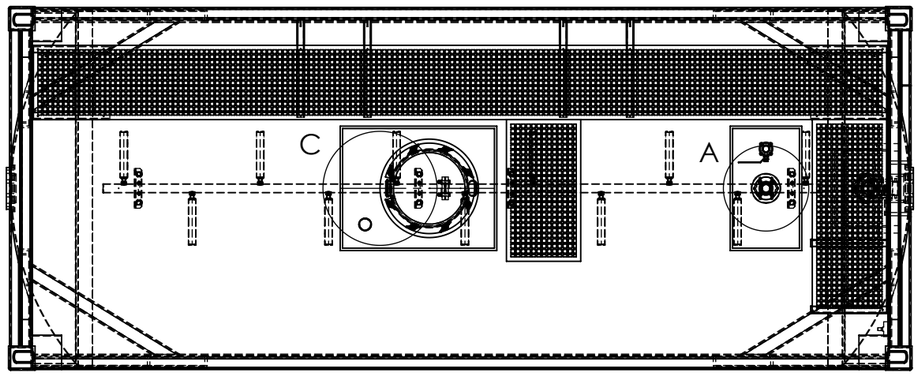
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DRAWN BY: JG	DATE: 02/01/22	PROJECT NAME: H2FLOW HILT AERATION SYSTEM	TITLE: H2FLOW HILT - 26KL - EQ AERATION LAYOUT
APP'D BY: JC	DATE: 02/01/22		DRAWING No.: Q-23119-32-20
SCALE: NTS			REV: 1
		ALL DIMENSION ARE IN "mm" UNLESS OTHERWISE SPECIFIED	SHEET 1 OF 3

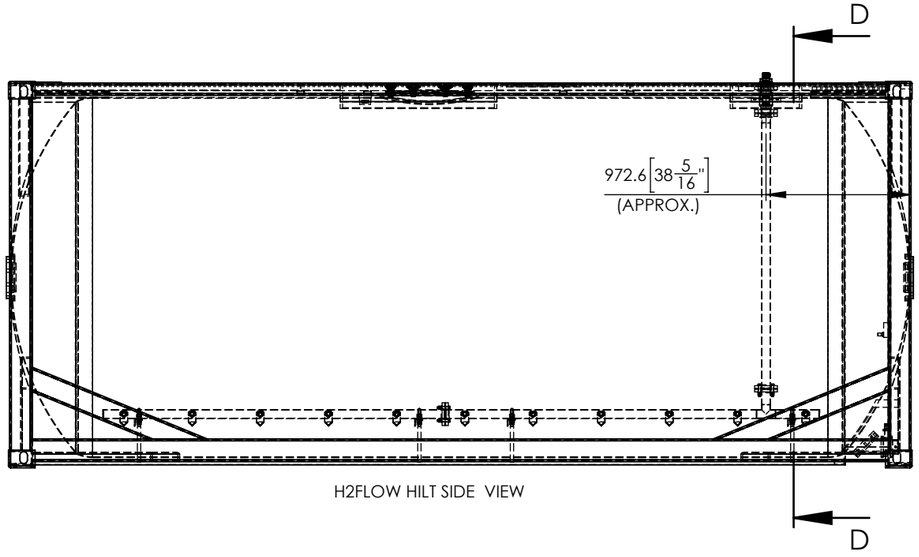
REV	DESCRIPTION	DATE	BY	APP'D
1	FOR MFG ONLY	03/01/22	JG	JC

2" [DN50] FLANGE ADAPTER AND 1"[DN25] COUPLING(x4) INSTALL/WELDED

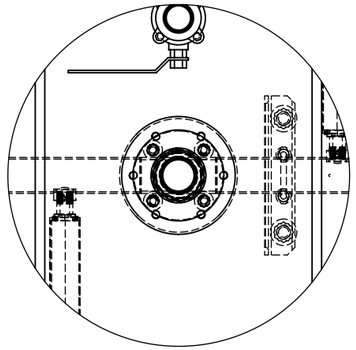
Manufacturing Notes:
1. Qty: 1 Unit
2. Material: SS 304, Sch. 10, ANSI 150 LB
3. Remove the existing blank flange plate.
4. Install & weled the new (2 Sets) - 2" [DN50] ANSI Flange & 3"x 2"[DN75 x 50] Reducing coupling
5. All welds must be min. 3/16" continuous MIG welds (Flare bevel weld where necessary)
6. All welds must be uniform and aesthetically pleasing, done by qualified CWB
7. Remove all sharp edges and clean all surfaces and welds



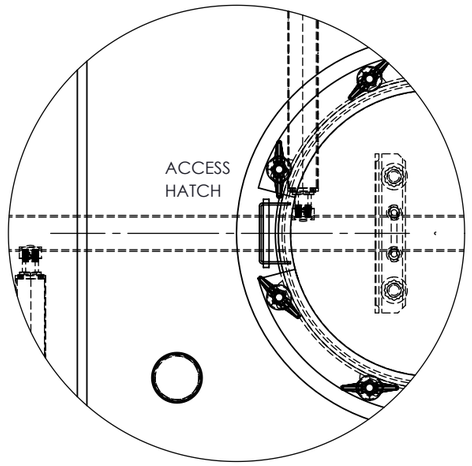
H2FLOW HILT TOP VIEW



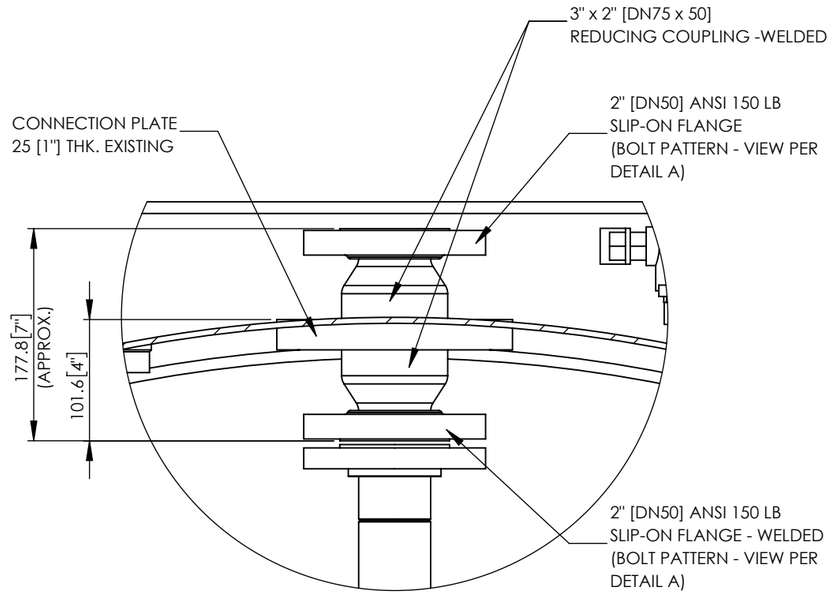
H2FLOW HILT SIDE VIEW



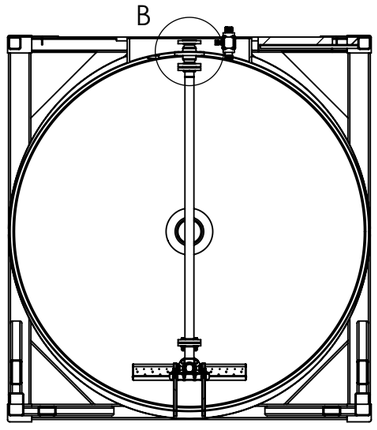
DETAIL A
SCALE 1 : 10



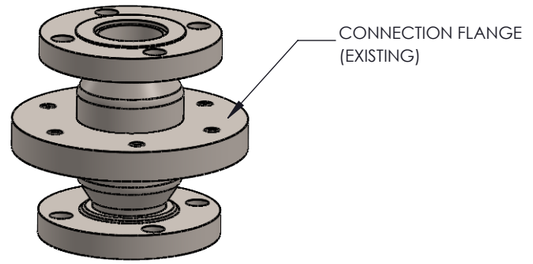
DETAIL C
SCALE 1 : 10



DETAIL B
SCALE 1 : 5



SECTION D-D
SCALE 1 : 40



2" [DN50] FLANGE CONNECTION ISOMETRIC VIEW

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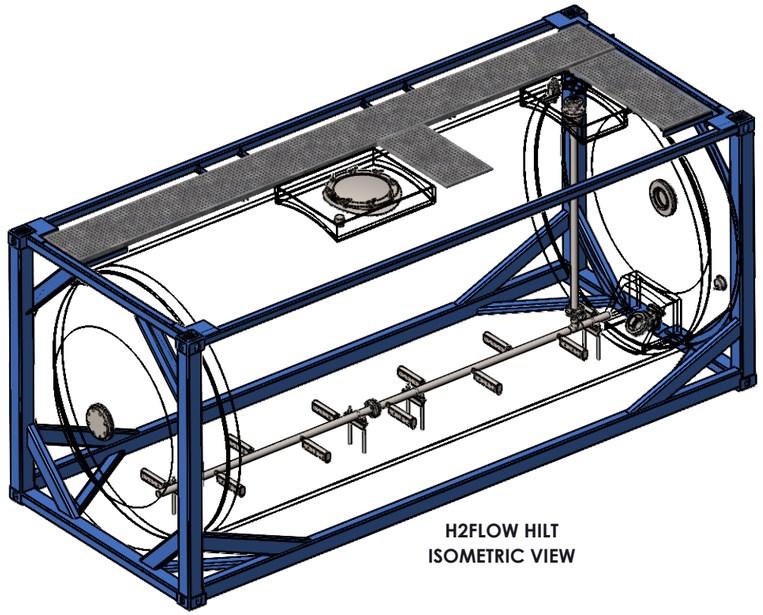
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DRAWN BY: JG	DATE: 02/01/22	PROJECT NAME: H2FLOW HILT AERATION SYSTEM	TITLE: H2FLOW HILT - 26KL - EQ AERATION LAYOUT
APP'D BY: JC	DATE: 02/01/22		DRAWING No.: Q-23119-32-20
SCALE: NTS			REV: 1
		ALL DIMENSION ARE IN "mm" UNLESS OTHERWISE SPECIFIED	SHEET 2 OF 3

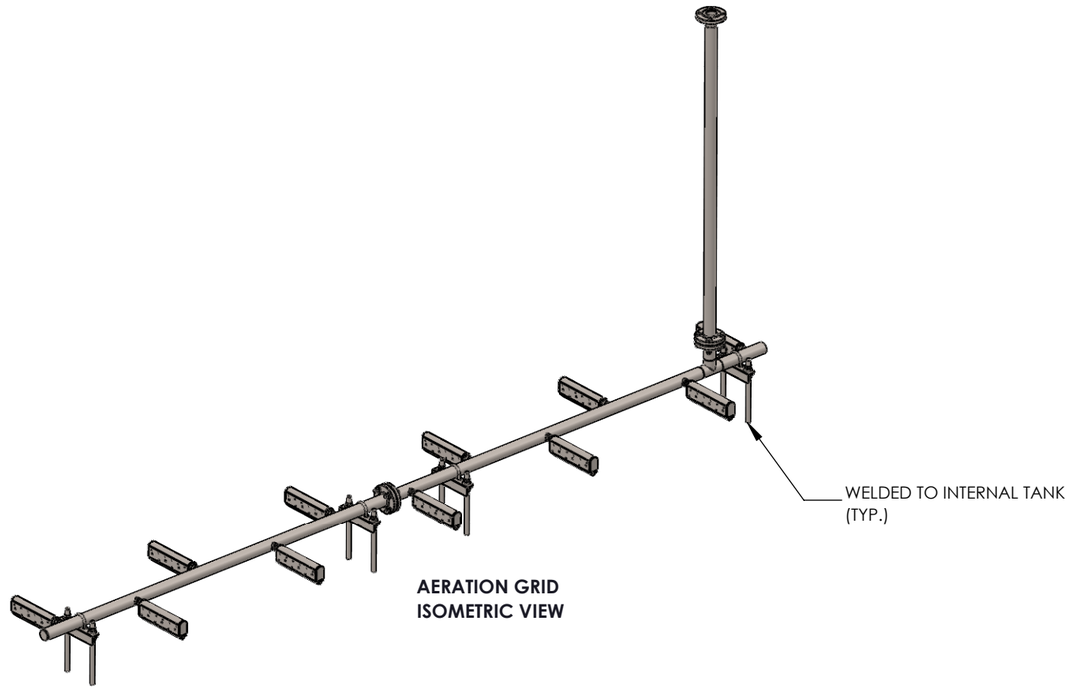
REV	DESCRIPTION	DATE	BY	APP'D
1	FOR MFG ONLY	03/01/22	JG	JC

7/8" THREADED ROD WELDED

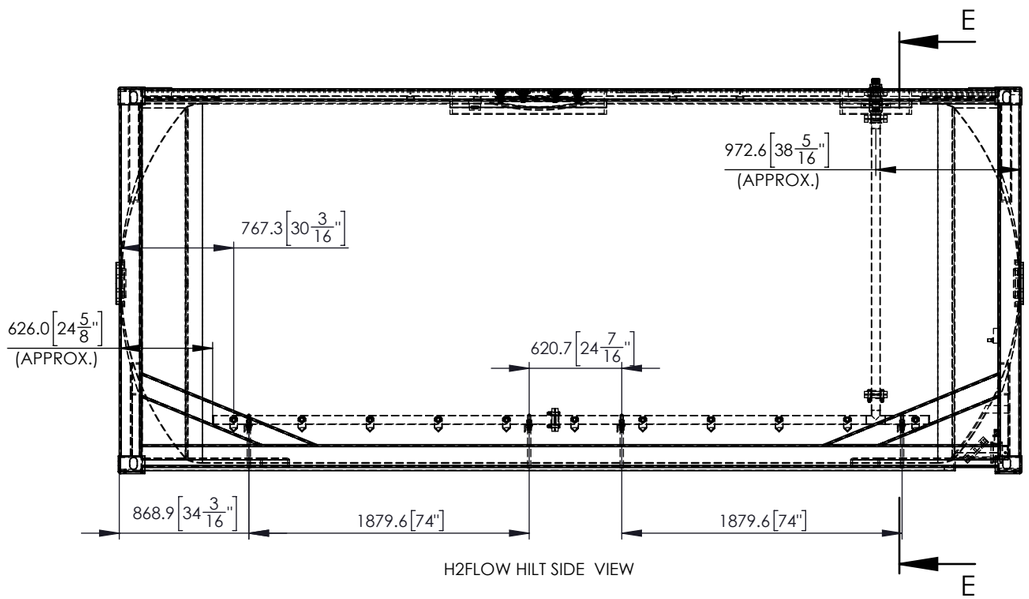
Manufacturing Notes:
1. Qty: 8 PCS for each tank
2. Welded threaded rod vertically inside of tank
3. Remove all sharp edges and clean all surfaces and welds



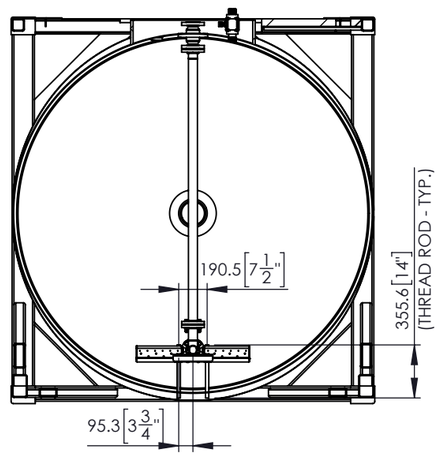
H2FLOW HILT
ISOMETRIC VIEW



AERATION GRID
ISOMETRIC VIEW



H2FLOW HILT SIDE VIEW



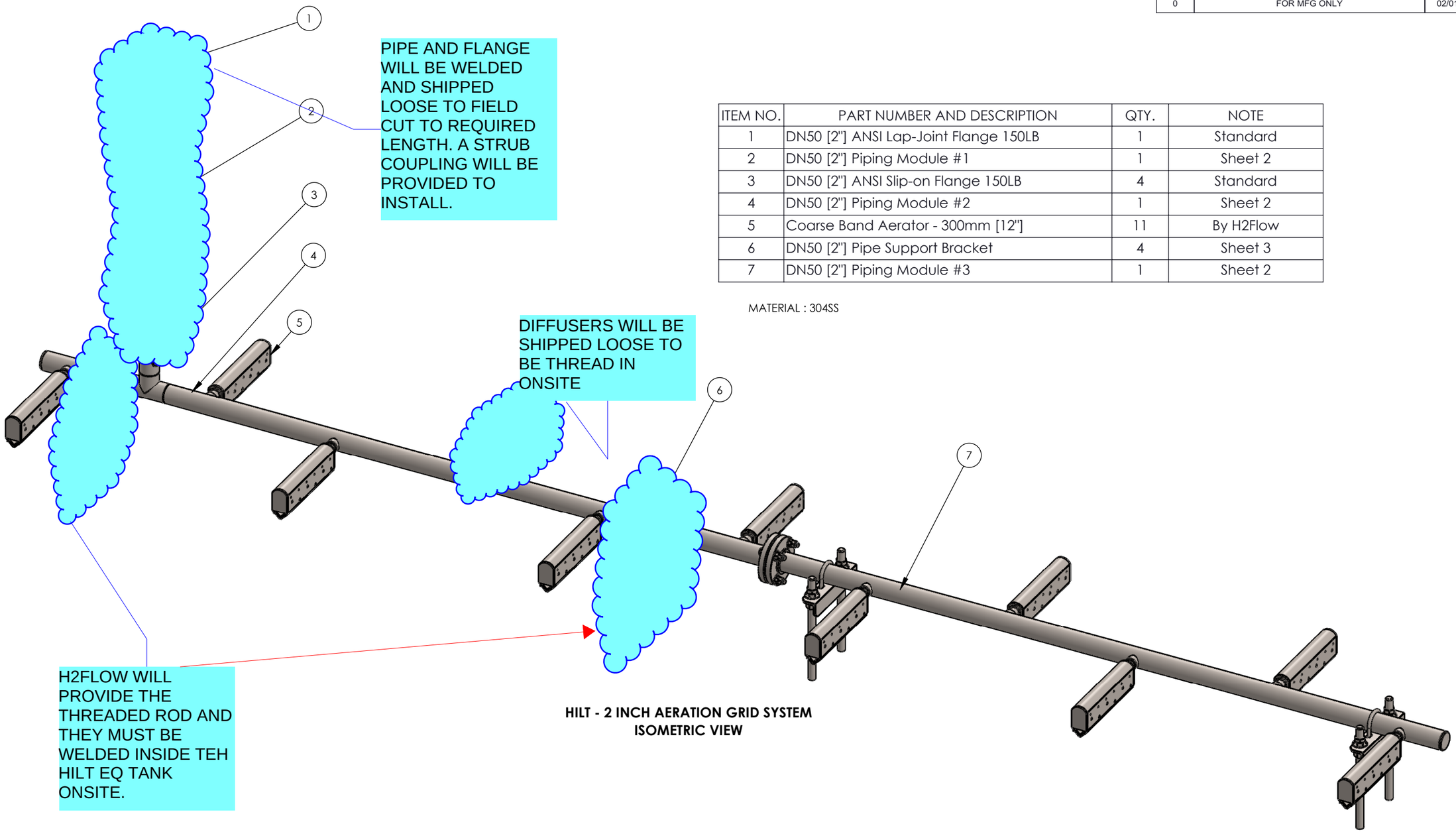
SECTION E-E
SCALE 1 : 40

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DRAWN BY: JG	DATE: 02/01/22	PROJECT NAME: H2FLOW HILT AERATION SYSTEM	TITLE: H2FLOW HILT - 26KL -MBBR AERATION LAYOUT
APP'D BY: JC	DATE: 02/01/22		DRAWING No.: Q-23119-32-20
SCALE: NTS			REV: 1
		ALL DIMENSION ARE IN "mm" UNLESS OTHERWISE SPECIFIED	SHEET 3 OF 3

REV	DESCRIPTION	DATE	BY	APP'D
0	FOR MFG ONLY	02/01/22	JG	JC



ITEM NO.	PART NUMBER AND DESCRIPTION	QTY.	NOTE
1	DN50 [2"] ANSI Lap-Joint Flange 150LB	1	Standard
2	DN50 [2"] Piping Module #1	1	Sheet 2
3	DN50 [2"] ANSI Slip-on Flange 150LB	4	Standard
4	DN50 [2"] Piping Module #2	1	Sheet 2
5	Coarse Band Aerator - 300mm [12"]	11	By H2Flow
6	DN50 [2"] Pipe Support Bracket	4	Sheet 3
7	DN50 [2"] Piping Module #3	1	Sheet 2

MATERIAL : 304SS

HILT - 2 INCH AERATION GRID SYSTEM
ISOMETRIC VIEW

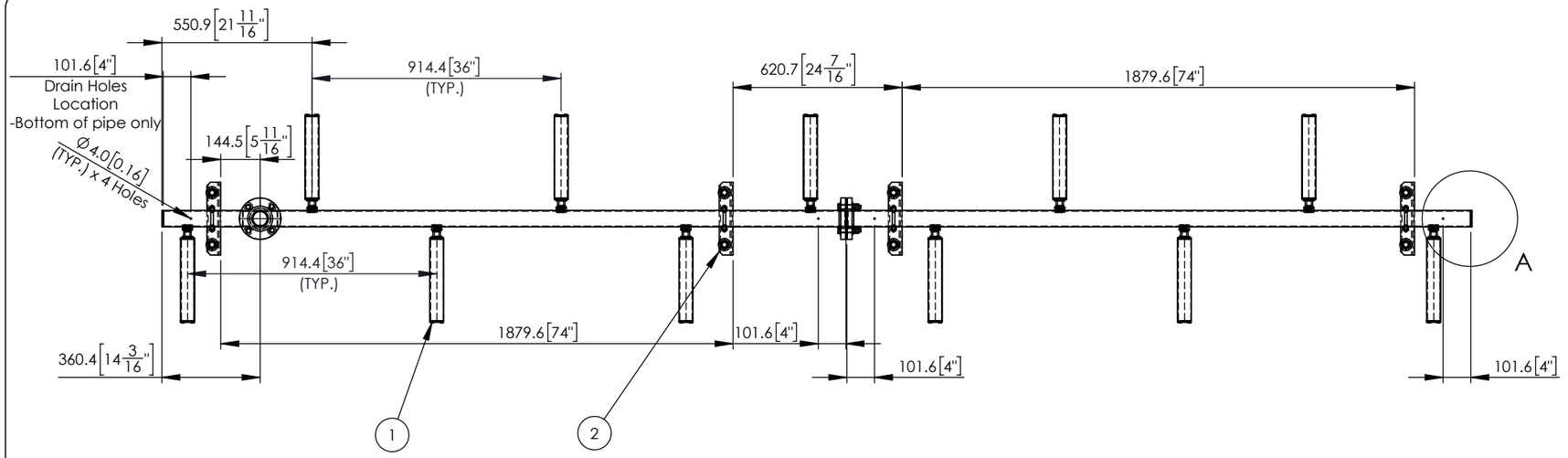
H2FLOW EQUIPMENT INC.

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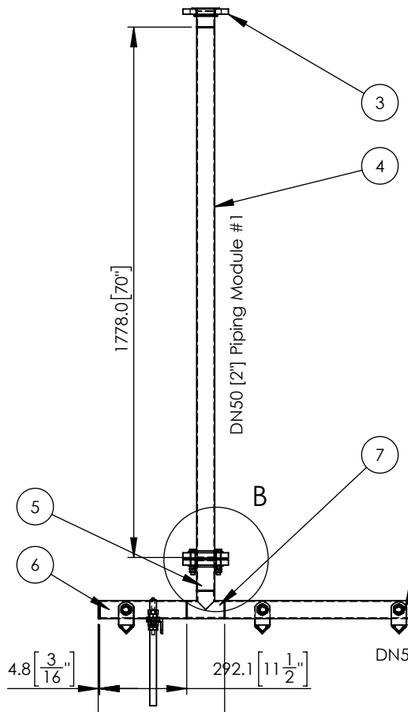
DRAWN BY: JG	DATE: 02/01/22	PROJECT NAME: H2FLOW HILT AERATION SYSTEM	TITLE: H2FLOW EQ HILT - 2" AERATION SYSTEM
APP'D BY: JC	DATE: 02/01/22		DRAWING No.: Q-23119-32-10
SCALE: NTS		ALL DIMENSION ARE IN "mm" UNLESS OTHERWISE SPECIFIED	REV: 0
			SHEET 1 OF 3

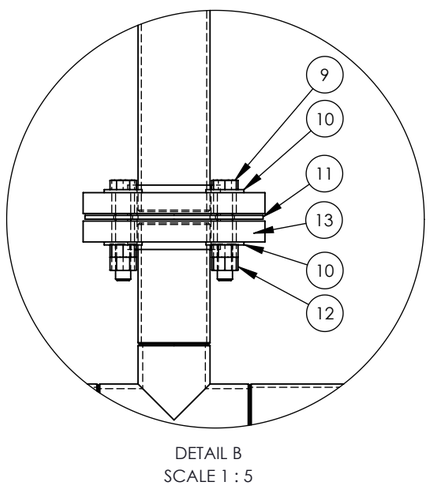
REV	DESCRIPTION	DATE	BY	APP'D
0	FOR MFG ONLY	02/01/22	JG	JC



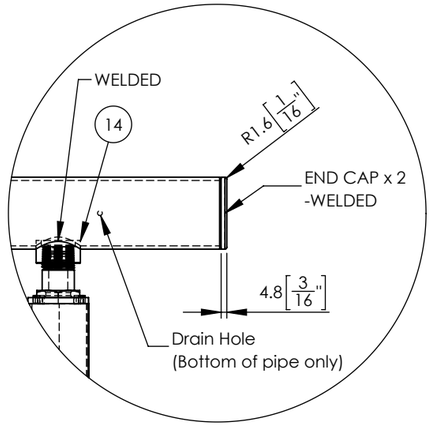
ITEM NO.	PART NUMBER AND DESCRIPTION	QTY.
1	Coarse Band Aerator	10
2	DN50 [2"] Pipe Support Bracket	4
3	DN50 [2"] Lap-Joint ANSI Flange 150LB	1
4	DN50 [2"] Sch. 10 Pipe [70"L]	1
5	DN50 [2"] Sch. 10 Pipe [4"L]	1
6	DN50 [2"] Sch. 10 Pipe [11-1/2"L]	1
7	DN50 [2"] Sch. 10 Tees - Butt Weld	1
8	DN50 [2"] Sch. 10 Pipe [82"L]	1
9	5/8" x 3"L Bolt	8
10	5/8" Flat Washer	16
11	DN50 [2"] EPDM Rubber Gasket	2
12	5/8" Hex Nut	16
13	DN50 [2"] Slip-on ANSI Flange 150LB	4
14	DN20 [3/4"] Half Coupling	11
15	DN50 [2"] Sch. 10 Pipe [90"L]	1

MATERAL: 304SS

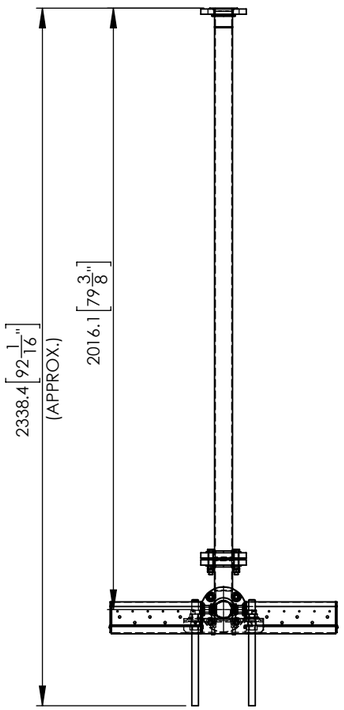




DETAIL B
SCALE 1 : 5



DETAIL A
SCALE 1 : 5



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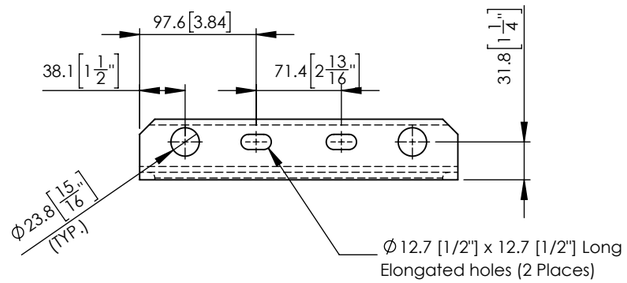
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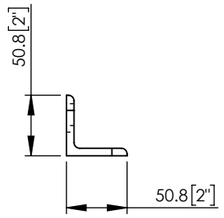
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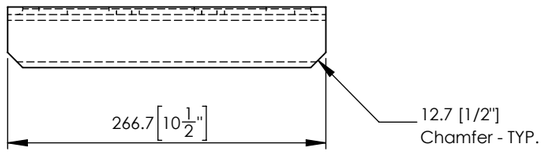
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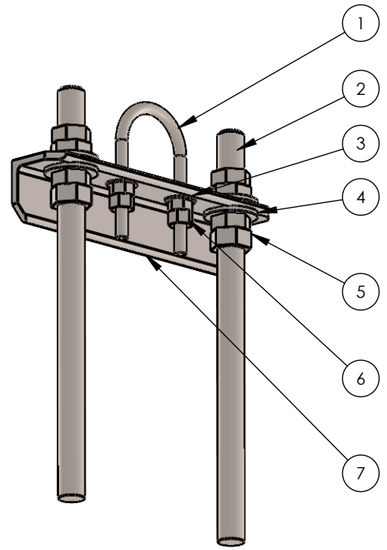
REV	DESCRIPTION	DATE	BY	APP'D
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DN50 [2"] PIPE SUPPORT BRACKET ASSEMBLY
QTY: 4 PCS









ISOMETRIC VIEW

ITEM NO.	PART No. AND DESCRIPTION	QTY.
1	DN50 [2"] U-Bolt 3/8" Dia.	1
2	7/8" x 14"L Thread Road	2
3	3/8" Flat Washer	2
4	7/8" Flat Washer	4
5	7/8" Hex Nut	8
6	3/8" Hex Nut	4
7	2" x 2" x 1/4" Structure Angle [10-1/2"L]	1

MATERIAL: 304SS

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SCALE: NTS			REV: 0
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Section 3

Equipment

Section 3.1

Wastewater Screening

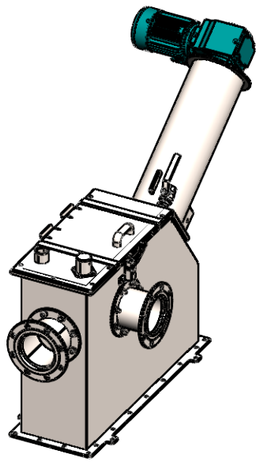
Section 3.1.1

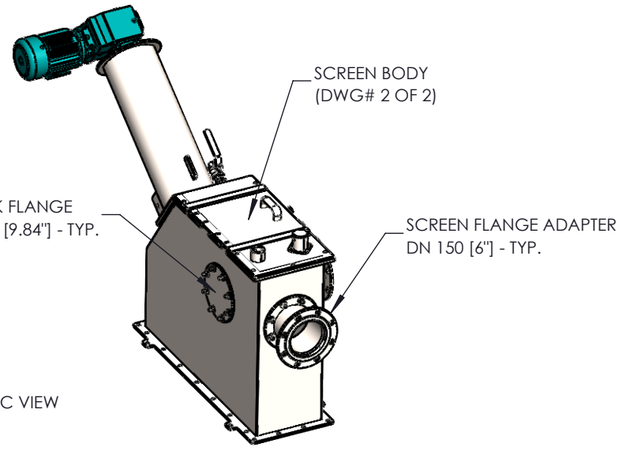
Screw Screen

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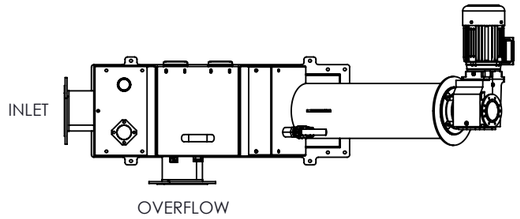
MCB 200NB SCREEN SETUP

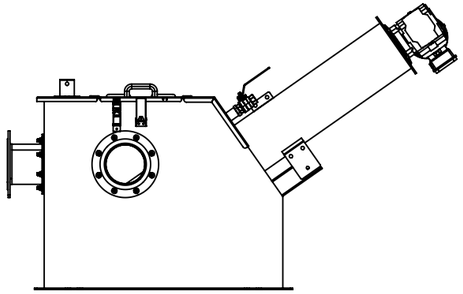
CONFIGURATION #1: RIGHT HANDED SETUP

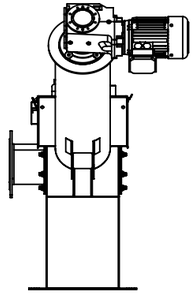




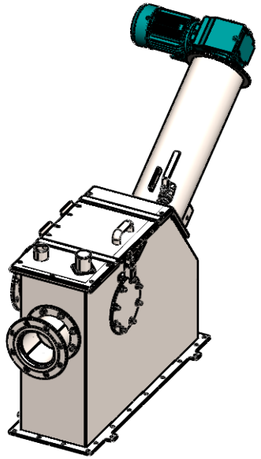
ISOMETRIC VIEW

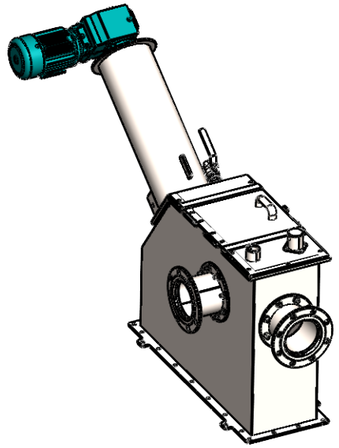




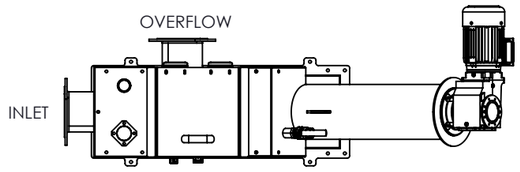


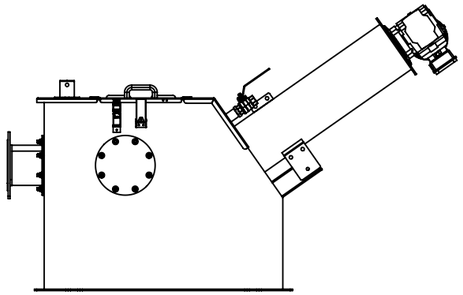
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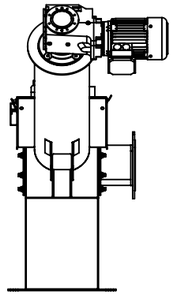




ISOMETRIC VIEW







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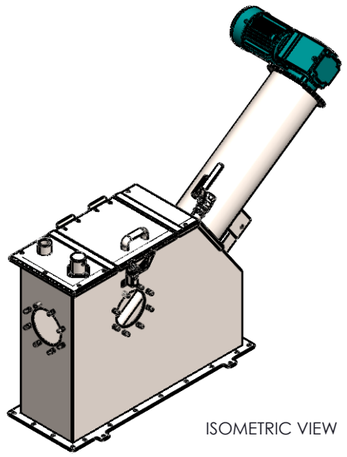
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APP'D BY: JC	DATE: 02/08/22		DRAWING No.: MCB200-NB-00
SCALE: NTS		ALL DIMENSION ARE IN "mm" UNLESS OTHERWISE SPECIFIED	REV: 0
			SHEET 1 OF 2

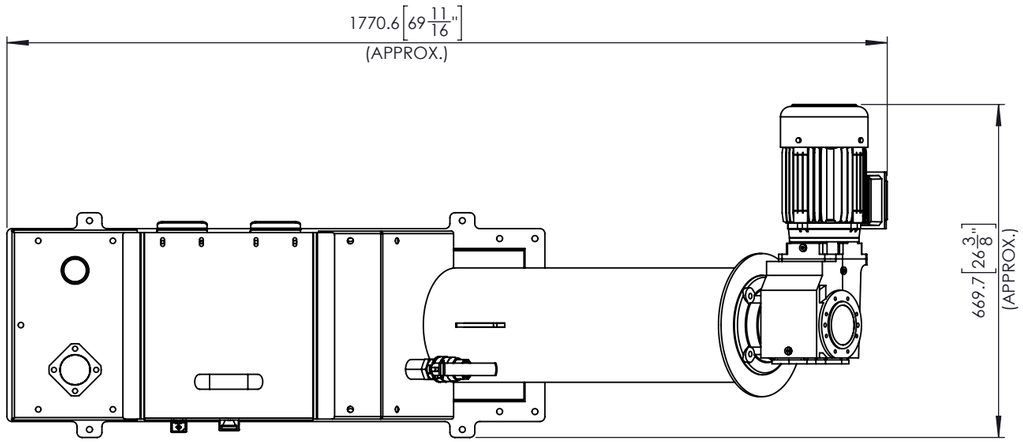
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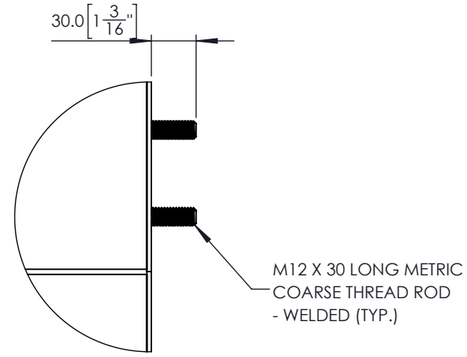
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MCB 200 BODY

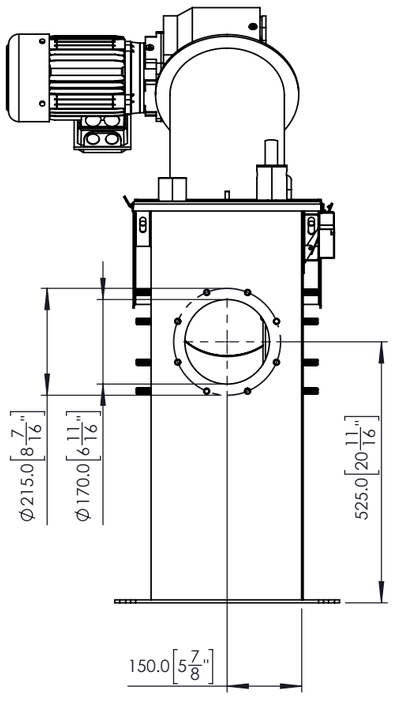


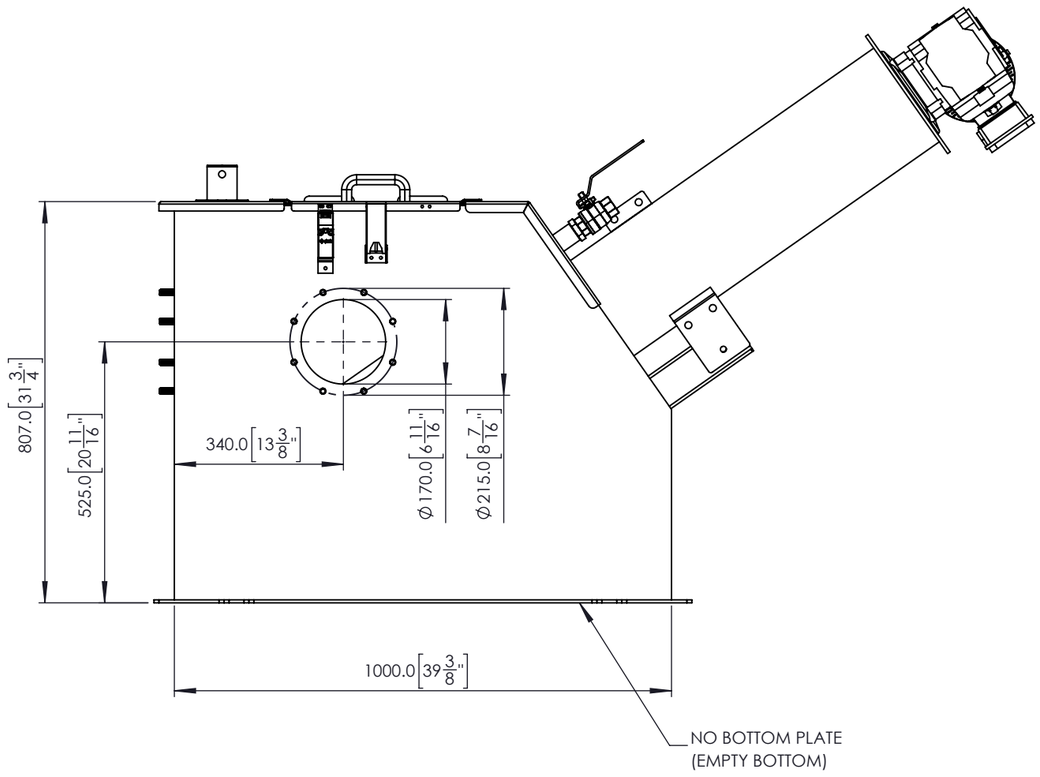
ISOMETRIC VIEW

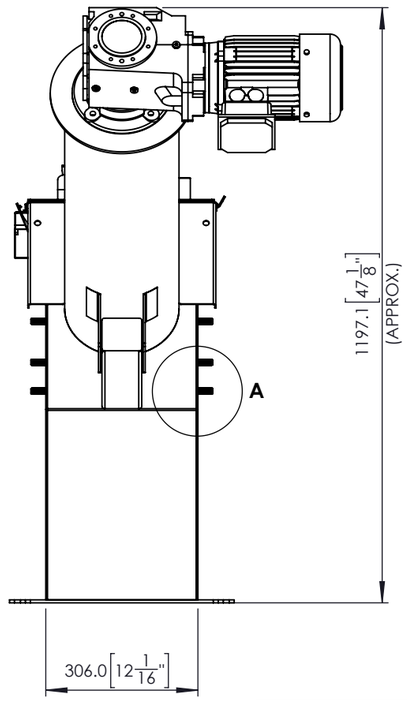




DETAIL A
SCALE 1 : 4







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APP'D BY: JC	DATE: 02/08/22		DRAWING No.: MCB200-NB-00
SCALE: NTS		ALL DIMENSION ARE IN "mm" UNLESS OTHERWISE SPECIFIED	REV: 0
			SHEET 2 OF 2

R10 VERSION 1 APRIL 07, 2021

OPERATION AND MAINTENANCE MANUAL

MCB-200 SCREW SCREEN

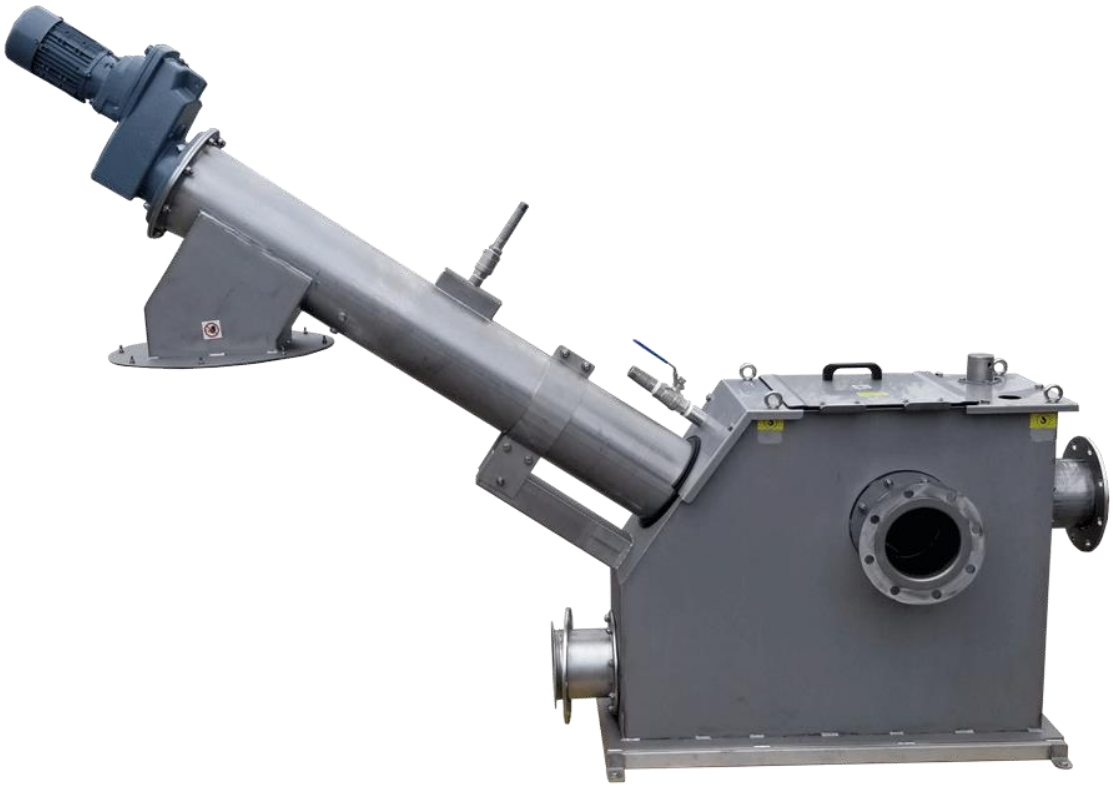


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1.0 SCREEN DATA

1.1 Screw Screen Specifications

Standard Unit Data

SS Box Height:	815 mm
SS Box Width:	300 mm
SS Box Length:	1000 mm
Discharge Height:	920 mm
Screw Length:	1900 mm
Opening:	3 mm
Inclination:	45^{o}
Cover Type:	Removable
Hydraulic Throughput:	Up to 15 m^3/hr
Screen Rotation Speed:	10 rpm

Drive Unit (Electrical Motor, Gear Box and Drive)

WEG Motor

Motor:	0.25 kW
Enclosure:	Class 1 Division 1 (TEFC-XP)
Voltage:	575 Volts, 3 Phase, 60 Hz

NORD Gear Reducer

Model	SK1SI50-IEC71-71S/4

1.2 Description

The Screw Screen is designed to provide separation of solids from liquids, typically as pre-treatment for wastewater. The screen will remove solids larger than the specified screen opening. The screen is placed in a stainless steel tank where water is flowing. The unit is designed to have a 45º inclination. The influent water flow passes through the fixed screen present in the lower section of the machine. The screened effluent continues after the screen in the same channel. Within the screen, a rotating screw with brushes clean the screen and convey the captured solids upwards to the screenings discharge outlet. This is a continuous process throughout the operation of the Screw Screen as shown in Figure 1.

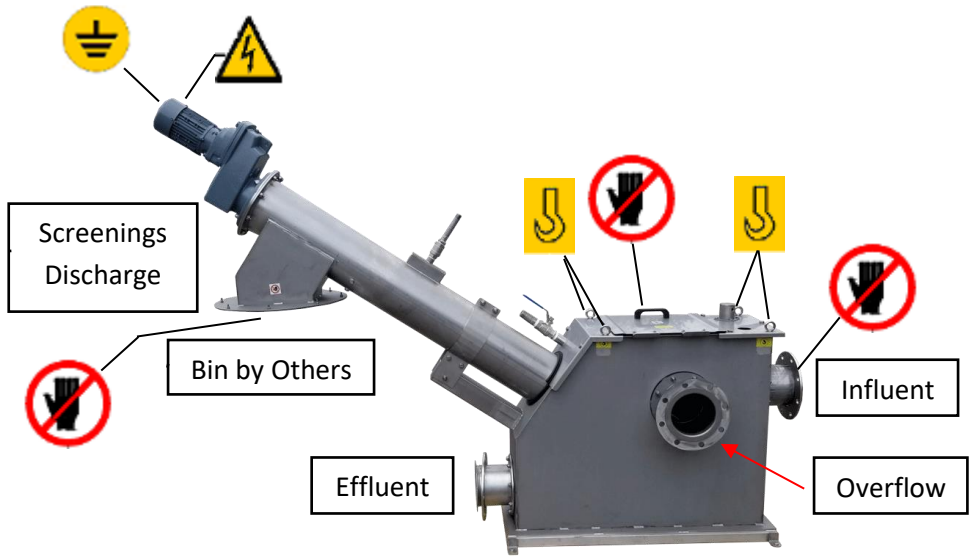


Figure 1: Screw Screen description

1.3 Screw Screen Operation

WARNING:

Before operating the machine, please check that all potential blocking conditions are removed. Check that all safety devices are present and operational.

CHECKS AND STARTUP

Before starting the Screw Screen, please complete the following:

1. Check the positioning and grounding of the machine. Check that all bolts are fastened.
2. Check all connections.
3. Check electric devices and the electric motor box to ensure that they are totally sealed.
4. Check that all covers are closed.
5. Check rotation of the screw. It must be as per the sticker indicator (see Figure 2).



Figure 2: Rotation of the screw

Warning:

During the initial startup, it is necessary to check for any working defects i.e. vibration, high noise level, wrong rotation direction, etc.

The startup procedure must be executed each time the machine has remained stopped for a long period of time (one week or more).

It is necessary to read all safety rules before operation.

1.4 System Components

The Screw Screen is made almost entirely of stainless steel construction. The water enters the unit at the front of the screw. Water flows through a perforated screen basket. The filtered water then exits through the outlet. The rotating screw scrapes the screen with brushes and collect the solids. The solids are transported up the length of the unit. The moving screw is powered by the gearmotor. The solids are deposited at the screenings discharge.

2.0 TROUBLESHOOTING

PROBLEM					
MACHINE DOES NOT START AND / OR ELECTRIC MOTOR DOES NOT WORK					
	THE MACHINE WORKS, BUT AFTER A FEW SECONDS THE MOTOR STARTER RELAY GIVES THE SIGNAL TO SWITCH OFF THE MOTOR				
		GEARMOTOR ROTATES, BUT THE SCREW CANNOT MOVE			
			SCREENINGS ARE NOT DISCHARGED FROM THE OUTLET		
				Cause	**Solution**
●				Lack of electric power	Switch on electric power
●				Wrong electric connections	Correct the electric connections
●	●			Bad regulation of electric motor limit switch	Regulate it
●				Very low tension, very high frequency	Check wire conditions
●		●		Screw is blocked	Remove the material causing blockage
	●			Screen is clogged	Clean it
●		●		Gearmotor damaged	Check that the electric motor is connected Voltage and phases must be as per electric motor manufacturer label
			●	Solids outlet clogged	Remove the material causing the blockage

3.0 SAFETY

3.1 Hazards

The Screw Screen is supplied with covers as safety equipment. Extra precautions should be taken to ensure that all personnel understand the safe use of the unit.

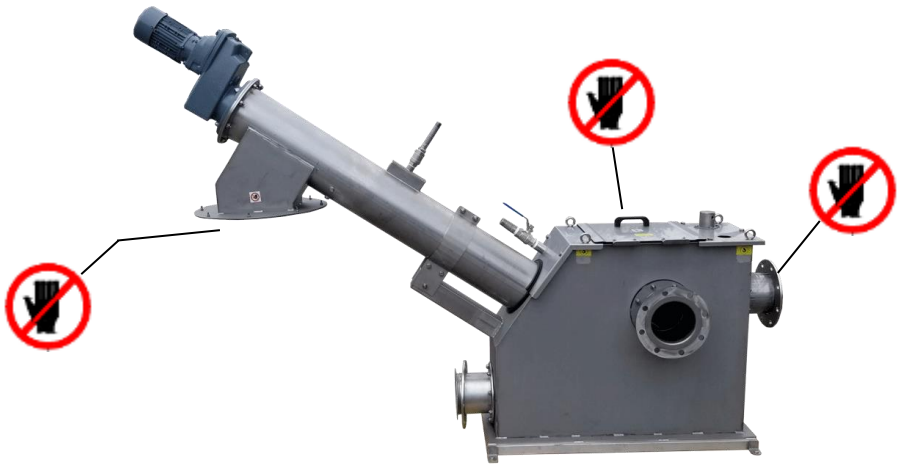


Figure 3: Dangerous zones

WARNING:

Never put hands or objects inside the solids outlet.

Areas shown in Figure 3 are all dangerous access points. Avoid contact.

Safety measures include:

- **Upper covers**
- **Safety notices**

3.2 Safe Use

To avoid accidents, read the following information:

1. The Screw Screen can be used only by qualified and trained personnel.
2. Connections and safety checks must be done by qualified and trained personnel.
3. All components must be grounded and the entirety of the machine must be secured to the floor. The external metallic part of the machine must be secured to the floor.
4. During use, all personnel must remain at a safe distance.
5. Before starting the machine, it is necessary that all safety devices are connected and working. The machine must be in working condition.
6. Before each use of the unit, the safety devices must be checked and be in proper working conditions.
7. In the case of defects, especially on safety devices, the operator must inform a supervisor immediately.
8. If the defect poses a safety risk, the machine must be stopped immediately. In the case of an anomaly, stop the unit immediately.
9. During use, all working personnel must be informed before beginning operation or if any changes occur.
10. The machine can be used only for its intended purpose.
11. Every modification regarding the use or the safety conditions can only be done by personnel from H2Flow. H2Flow refuses every responsibility for unauthorized modifications or damages caused from these modifications.
12. It is forbidden to remove safety devices from the machine.
13. Personnel in charge must wear proper safety equipment i.e. gloves, safety shoes, goggles, etc.
14. Disconnect electric power before maintenance of the machine.
15. To avoid accidental startup of the machine during inspection/ cleaning/ maintenance of the machine, it is necessary to turn the general switch OFF and to push the emergency button to stop the machine.
16. It is necessary to inspect the machine at a minimum of one time per day, or one time each working shift, to check for damages or defects.
17. Ensure that safety devices, safety notices and the nameplate are always readable.
18. It is forbidden to remove safety and warning notices.
19. It is forbidden to start the machine with open safety devices or to open them during operation.
20. Touching rotating parts of the machine can cause injuries.
21. Never put hands inside the outlet of the machine.
22. It is forbidden to use the machine without the upper covers completely bolted.

3.3 Emergency Safety Devices

If not provided, the unit should be provided with an emergency button (red colour) to stop the machine. Push this button when the machine must stop immediately. The emergency button must be present near the machine and must be easily approachable.

4.0 MAINTENANCE

4.1 General

The procedures for inspection and maintenance are explained in this section.

Refer to the control panel manual for instructions related to the electrical control of the equipment.

Before any maintenance, ensure the electrical power is switched OFF.

Tag out and lock out.

Use only spare parts supplied by H2Flow to replace any original parts.

4.2 Periodic Maintenance

The following maintenance should be done on a regular basis:

- After first ten hours of work:
  - Check for unusual noises from the screw
  - Check noise levels of motor and gearbox
- Daily maintenance:
  - Check for brush wear and ensure brushes are able to clean the screen
  - Check temperature of gearbox and drive motor
  - Ensure no debris/objects are obstructing moving parts
  - Ensure screen is running smoothly, no excess noise, etc.
  - Visually inspect screw, thus ensuring no damage has occurred
  - Visually inspect for missing bolts, etc., thus ensuring no moving parts are loose
  - Should any obstruction occur, stop screen and isolate prior to opening the maintenance covers. Further inspect to ensure no large objects are affecting operation

- Monthly maintenance:
  - Inspect screen grid for wear/damages
  - Ensure that the two top bearings are greased on a monthly basis
  - Gearbox oil level - monthly check
  - The checks have to be documented in the enclosed table.

- Every six months:
  - Check for wear on screw
  - Check bolts for tightening
  - Greasing of the gearmotor

The checks must be documented in the Maintenance Checklist table found in section 6.0.

4.3 Technical Instructions and Repair

This part of the manual gives detailed technical instructions how to adjust and maintain the unit.

4.3.1 How to replace the Gearmotor

1. Unscrew bolt securing the shaft motor
2. Pull gear motor off shaft – make sure you do not lose the keyway

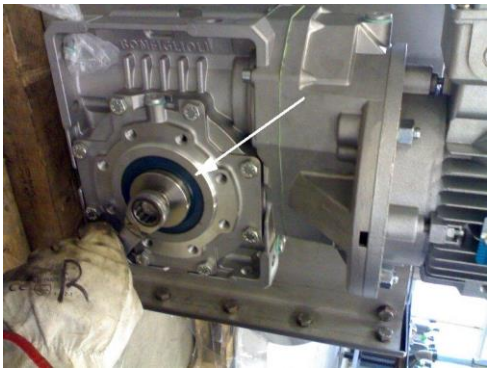


Figure 4: Gearmotor

4.3.2 Screw Screen Removal Procedure

To remove screw screen from tank:

1. Open all the covers and clean with plenty of water.
2. Unscrew the bolts supporting the screw.
3. Hang the screw screen from the lifting straps with suitable lifting equipment (A) arranged so that it allows the screen to be lifted with an angle of about 45° (angle of 35° for CFT model) with the ground and (B) place the screw screen horizontally on the ground.
4. **Please note, MCB models do not have lifting eyes on the screw screen, lifting straps are required for removal procedure.**

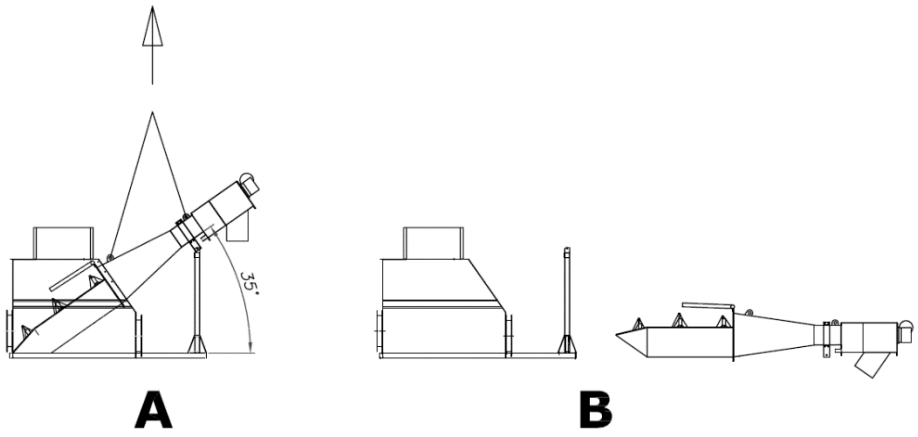


Figure 5: Screen Removal Procedure*

Note: CFT model is shown.

4.4.5 Brush Replacement

Follow screw screen removal sequence

1. Unscrew the bolts (A in photo below) of the brushes as shown.
2. Mount the new brushes and tight the bolts.
3. Follow the instruction in the reverse order to mount the screw back into the machine again.



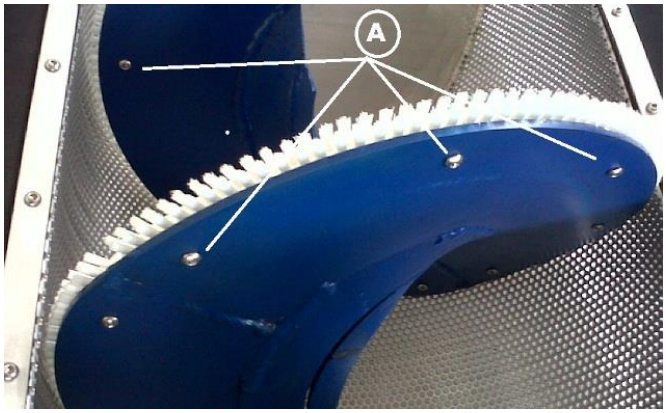


Figure 6: Brush Replacement

4.4.6 Screen Basket Replacement

Follow screw screen removal sequence

1. Remove the screen basket bolts (see photo below).
2. Slide screen basket off
3. Install new screen basket

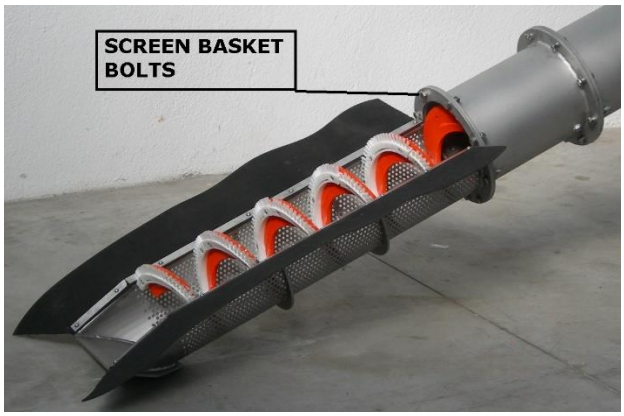


Figure 7: Screen Basket Replacement

4.5 Lubrication

The operating temperature is from 0° to 35°C;

Gear reduction unit is supplied with a first oil filling and are equipped with oil level, outlet and breather plugs.

Synthetic oil is used. The trade mark is SHELL TIVELA OIL 320. If a different oil is to be used as replacement, it must have the same propriety of the original oil, as listed in the table below.

Shell Tivela Oil 320	
Viscosity Class ISO (iso 3448)	320
Kinematic Viscosity 40°C cSt 100°C cSt (ASTM D445)	 320 56.4
Viscosity Index (ASTM D2270)	245
Volumic mass @ 15° (Kg/dm3) (ASTM D 1298)	1.076
Flash point (ASTM D92)	240 °C
Pour point (ASTM D97)	-33°C

Avoid any mixing between oil of different brands

Oil-change interval [hours]:

Oil temperature	Mineral oil	Synthetic Oil
< 65°C	8000	25000
65° - 80°C	4000	15000
80° - 95°C	2000	12500

5.0 SPARE PARTS

The following describes the recommended spares parts:

Part	Quantity
Brushes	1 set
Screen Basket	1
Reducer	1
Motor	1

6.0 TRANSPORT, STORAGE AND INSTALLATION

6.1 Lifting and transport

The unloading and positioning of the machine must be carried out with a lifting device that is appropriate for the weight and size of the machine (for the weight and dimensions, refer to attached drawing).

The lifting of the machinery must be done via the eyebolts attached to the machine.

MODELS WITH MACHINE SUPPLIED IN ONE ASSEMBLED PART

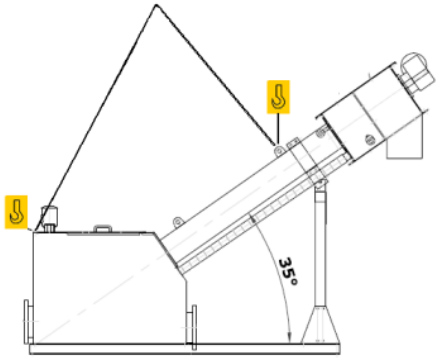


Figure 8: Lifting Procedure – One Piece

MODELS WITH MACHINE SUPPLIED IN TWO PARTS

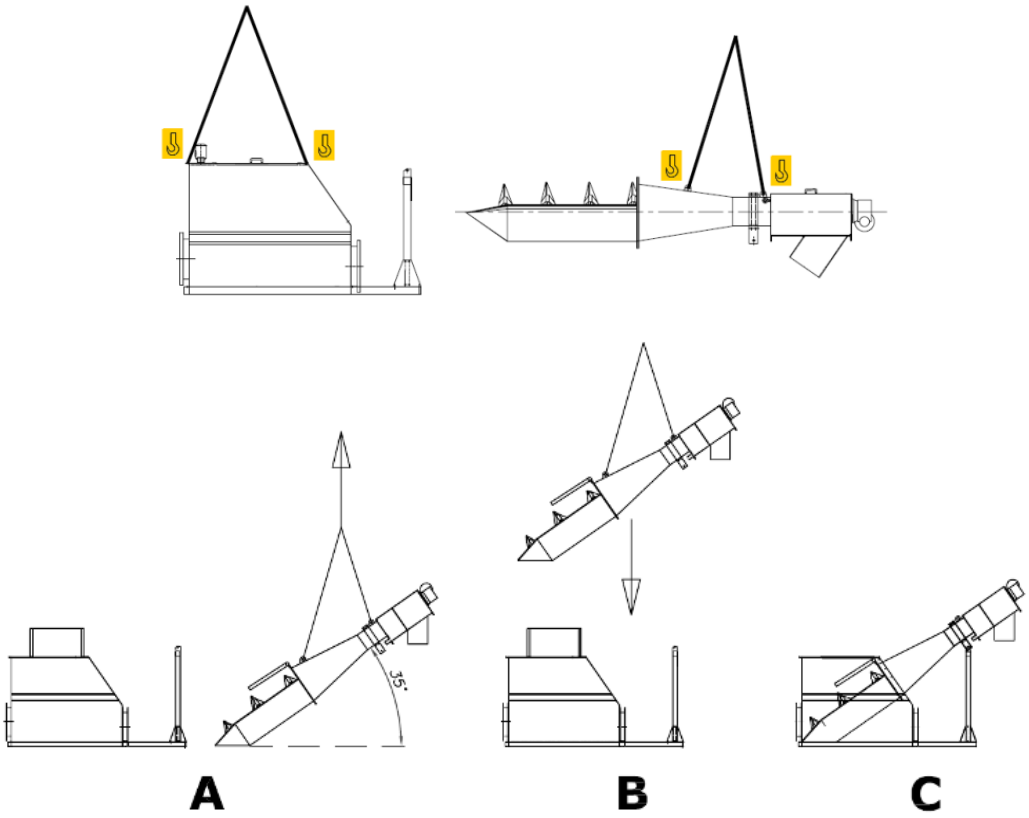


Figure 10: Lifting Procedure – Two Pieces

Note: CFT model is shown. MCB models do not have lifting eyes on the screw screen, lifting straps are required for lifting procedure.

1) PLACE THE TANK IN THE FINAL POSITION (PICTURE **A**)
2) REMOVE ALL THE COVERS
3) PLACE THE SCREEN INSIDE THE TANK: for this purpose use a pre set lifting belts or chains, in order to lift the screen with an inclination of about 45° - pictures **B** and **C**)
4) RE ASSEMBLE THE COVERS

Lifting and rigging must be done by competent persons.

WARNING:

Person in charge of lifting and rigging of the machine must pay attention to prevent damage to goods.

Check the operation of the lifting system prior to moving the machine to avoid damage to the machine or operator.

Do not use a lifting chain that will damage the surface of the machine. If damage does occur, repairs must be made before use. Transport packing should not be removed until the machine is close to the installation area.

6.2 Installation Area

The area destined for the placement of the machine must be provided by the user with all appropriate connections (electrical, etc.) for the proper operation of the machine. It is the responsibility of the user that the machine destination follows all regulations and laws.

6.3 Installation

Preferably, install the unit in a dry, clean and frost-free area with a flat concrete surface.

Incorrect grounding could cause damage to the device and to people therefore it is necessary to follow the installation directions carefully.



Figure 12: Suggested Anchor Bolt Placement

The machine, lifted through suitable equipment by means of eyebolts / lifting strap and placed on the suitable area.

The fixing of the machine is done through suitable anchor bolts / expansion wedges for each hole, on each side. Check the drawing before choosing the anchor bolts:

6.3.1 Electrical Installation

The Screw Screen is supplied with standard electrical components:

1. Electric motor
2. Motor starter relay (optional)
3. Electrical panel (optional)

WARNING:

Electric work must be executed by a trained professional. The Screw Screen must be disconnected from power sources while any changes or repairs are being done.

Check that the electrical voltage is the same as per the nameplate present on the electric motor. Electric cables must have the correct dimensions to be compatible to the electric motor.

Electric cables must be properly secured and protected.

6.4 Long Term Storage

In the case of long term storage:

1. Clean all parts of the machine thoroughly including the screen zones, compactor, inlet and outlets
2. Place the machine in a wooden storage box and store in a cool, dry location
3. To store the gearmotor, follow the instructions in the manufacturer manual
4. Before restarting the machine, proceed as per first start up.

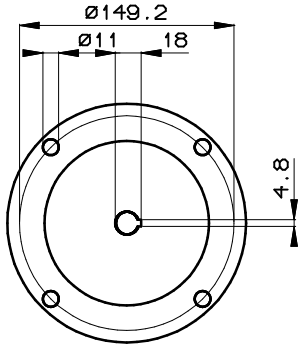
7.0 MAINTENANCE CHECKLIST

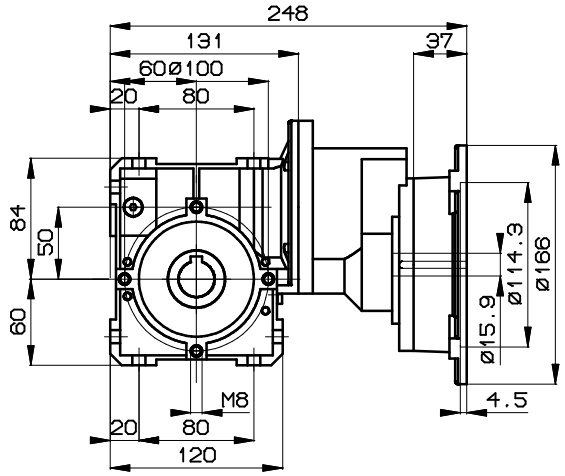
All equipment should be checked on a regular basis for leaks and/or breaks. Frequency of maintenance items listed below should be conducted as needed for proper operation.

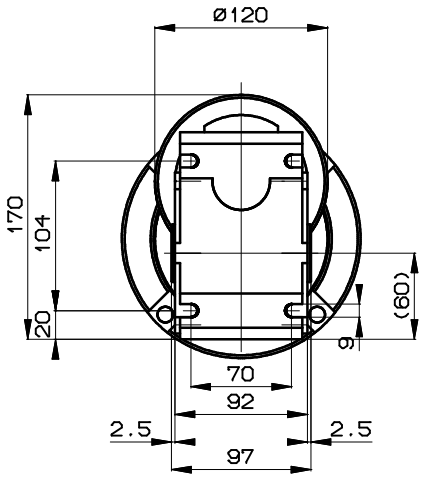
SCREW SCREEN	
Check for unusual noises from screw machine and gearbox	Daily
Check for brush wear and ensure brushes are able to clean the screen	Daily
Check temperature of gearbox and drive motor	Daily
Ensure no debris/objects are obstructing moving parts	Daily
Check for missing bolts	Daily
Check screen for wear/damage	Monthly
Check screw connections between rakes and chain links	Monthly
Grease two top bearings	Monthly
Check gearbox oil level	Monthly
Check for wear on screw	Every six months
Grease the gearmotor	Every six months

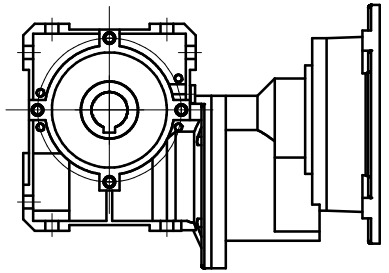
8.0 WARRANTY

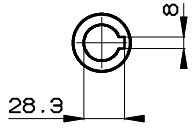
H2flow will provide warranty against any defects in design, material or workmanship. The warranty shall extend for a period of 12 months from date of start-up but not exceeding 18 months from delivery date. Any warranty service shall be provided by our service department in Concord, ON.

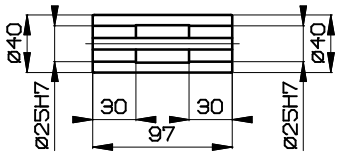












SK1S150/H10 - N56C

NORD

Nord Internet: http://www.nord.com

DRIVESYSTEMS

	Date	Name
Drawn	11/29/2021	Gavez

NC211123075813JU_D

Technical changes reserved!
This drawing is created with NORDCAD 9.2.4 s

Intelligent Drivesystems



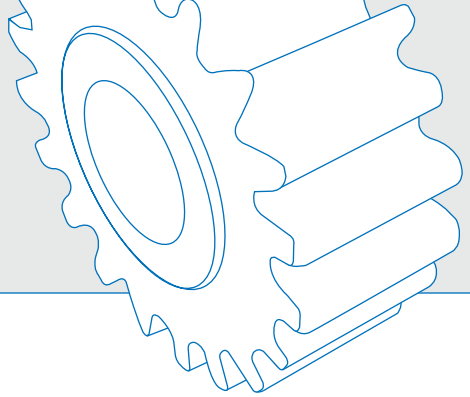
FLEXBLOC™ & MINICASE® WORM DRIVES

Speed Reducer / Gear Motors

F1033

NORD DRIVESYSTEMS

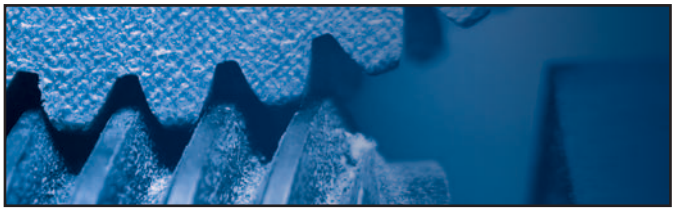
FLEXBLOC™ & MINICASE® Speed Reducers



FLEXBLOC™ and MINICASE® Worm Gears

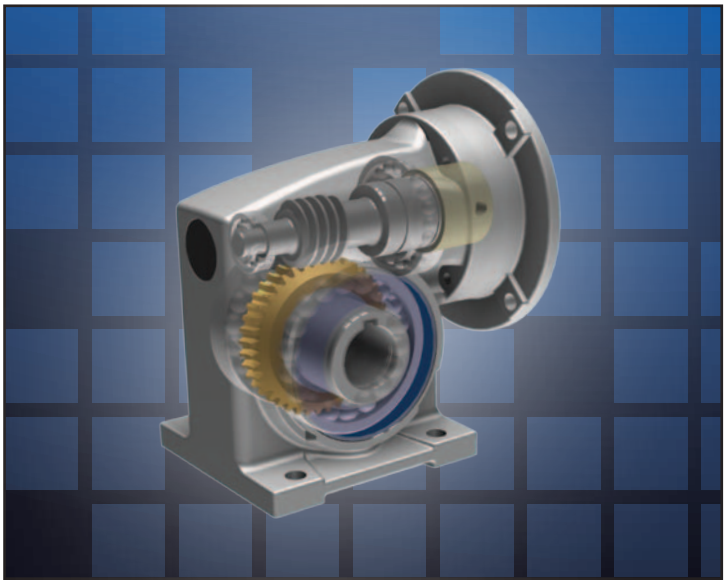
NORD modular worm gear products cover 5 industry standard center distances from 31 mm-75 mm (1.2 in-3.0 in) and range in torque capacity up to 3,779 lb-in. This product offering comes in a variety of standard, single worm, and compound worm ratios ranging from 5:1 to 10,000:1. The product family consists of the FLEXBLOC™ (SI Series) worm with universal gear housing and the MINICASE® (SMI Series) worm characterized by its smooth outer surface design and its separate footed and flanged gear housing. Exceptional modularity is guaranteed by offering a unified set of factory-stocked and easy-to-assemble accessory kits. This flexibility allows for a variety of input and output mounting options along with a large variety of output shaft options. The FLEXBLOC™ and MINICASE® worm gear products share many innovative design features.

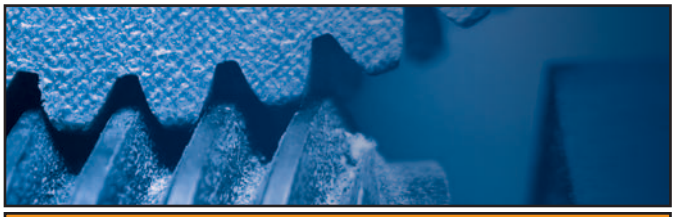




FLEXBLOC™ Key Features:

- Factory-stocked worm-modules & accessory kits
- Universal foot and flange-mount housings
- Keyed hollow-bore units with solid shaft kits
- Adaptable to any mounting position (universal oil fill)
- Easy to assemble accessories
- NEMA, IEC, or solid shaft input as standard
- Accommodates stocked C-Face motors or brakemotors

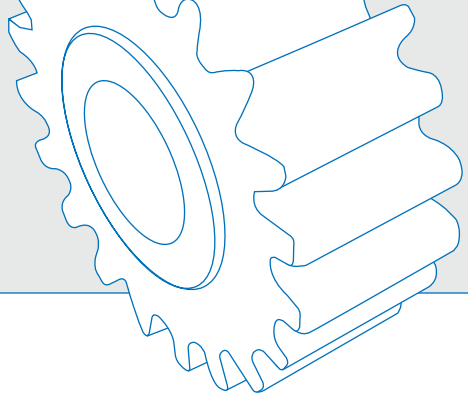




MINICASE® Key Features:

- Factory-assembled from stocked parts
- Separate smooth-bodied foot & flange-mount housings
- Keyed hollow-bore or one-piece solid shaft as standard
- Specific bores accommodate plug-in shafts
- Easy to assemble accessories
- NEMA, IEC, or solid shaft input
- Supplied as an integral motor or brakemotor (C-Face motorized options possible)

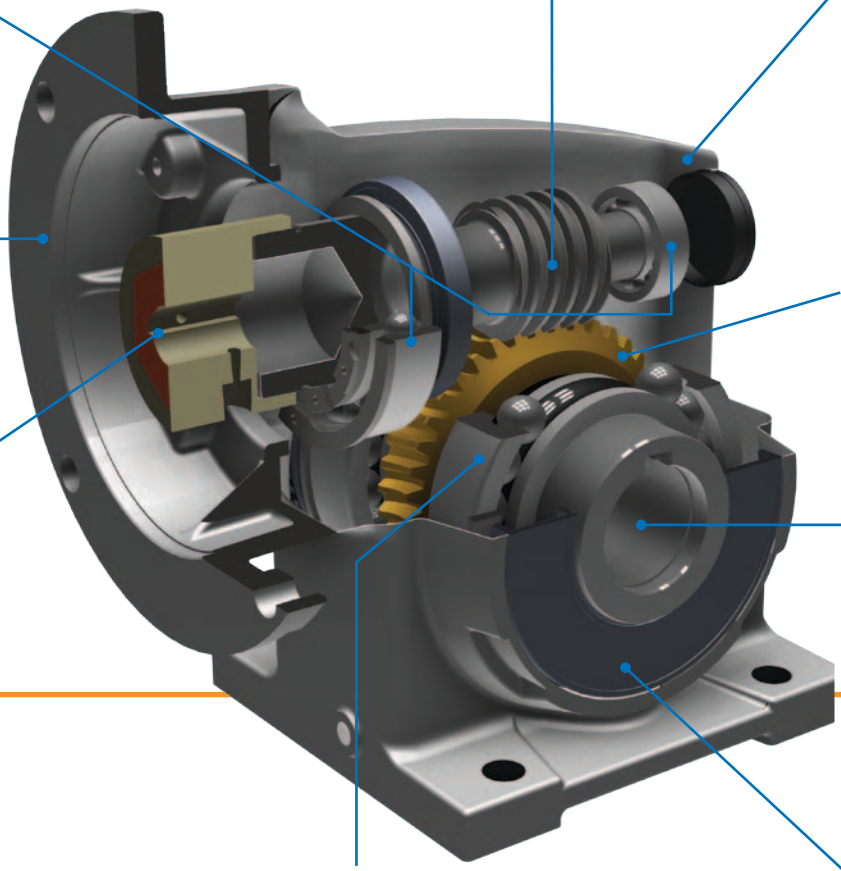
Product Features



Dual Pinion Shaft Bearings
Two bearing supports maintain accurate gear and shaft alignment, isolate and protect motor bearings, and provide smooth/quite operation.

Worm Pinion Gear
Surfaced hardened alloy steel gears with an optimized tooth form maximize gear contact and provide long service life.

Alluminum Alloy Housing
Light weight, high strength, optimal heat dissipation and natural corrosion resistance. Flange or torque-arm mount options available.

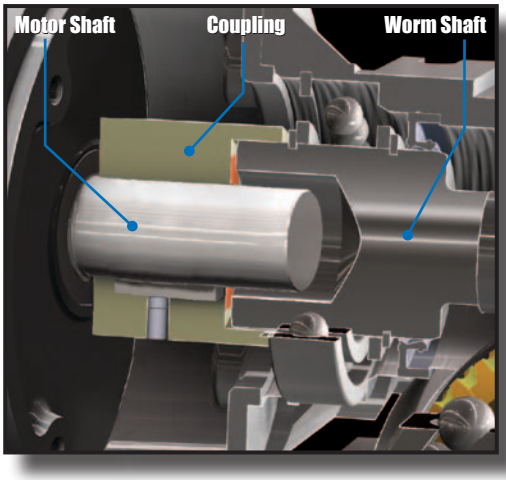


Input Configuration
NEMA, IEC and free input shaft designs are readily available. Integral motor mounting is optional. Adaptation to servo motors is possible.

Worm Gear
Fine-grained bronze alloy minimizes wear providing maximum strength and durability.

Motor Coupling
Guarantees accurate motor shaft alignment, minimizes fretting and provides a low backlash / high strength connection.

Output Shaft
Hollow bore and single-sided or double-sided shafted models are also available.



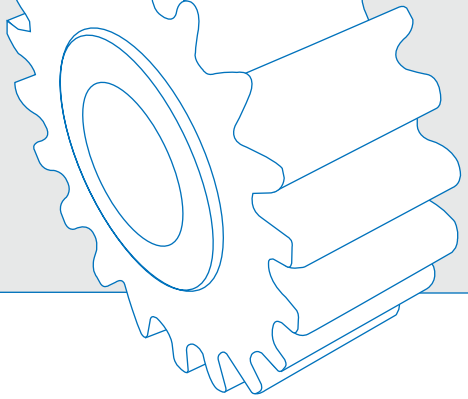
Output Bearings
Oversized bearings provide high radial and axial load capacities and long service life.

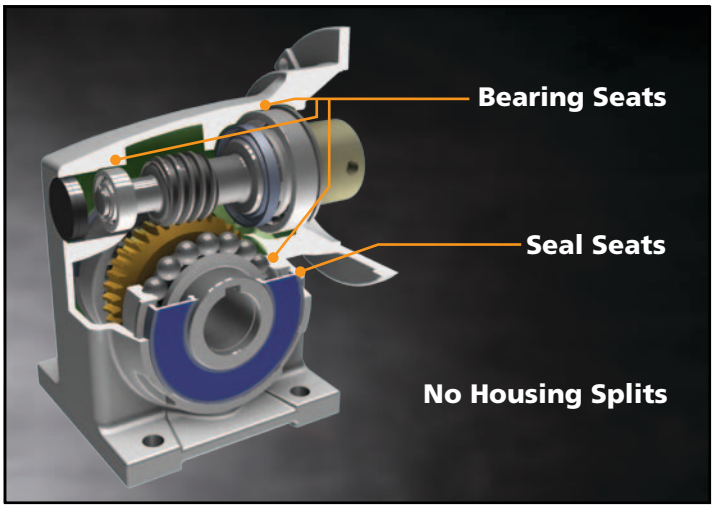
Oil Seals
Double-lip oil seals provide extra sealing and protection against the elements.

Advantages of the NORD Compact Coupled Unit

- Easy to assemble and disassemble.
- Eliminates fretting corrosion common to quill-mount inputs.
- Maintains shaft alignment and provides vibration-free torque transfer.
- Protects and isolates motor shaft and reducer shaft bearings.
- Provides a stiff, high-strength, near-zero backlash connection.
- Reduces the chance of bearing, shaft and key failures.

Innovative Design Features





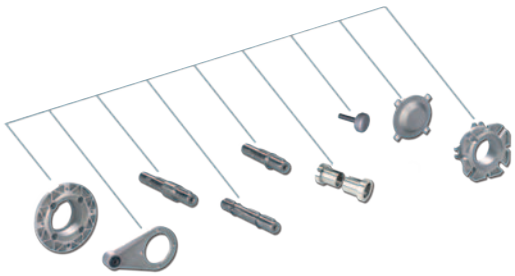
UNICASE® One Piece Housing

NORD heavy-duty, one-piece housings are precisely machined to exacting standards. Internal reinforcements further increase strength and rigidity. All bearings and seal seats are contained within the casting, eliminating splits or bolt-on carriers that can weaken the housing and allow oil leakage. Bores and mounting faces are machined in one step, producing extremely precise tolerances — thus ensuring accurate positioning of gear teeth, bearings and seals, and longer life for all components.

- Increased torsional strength and rigidity.
- Eliminates housing splits and bolt-on carriers.
- Leak-free housing design.
- Versatile mounting options and accessory kits.

Modular Construction

- Easy-to-configure input and output accessories.
- Integral motor or motorized c-face units.
- NEMA, IEC or solid shaft input options.
- Footed, flanged or shaft-mount.
- 10:1 helical pre-stage & compound assemblies.
- Keyed hollow bore, solid shaft, and bushing-kit options.





Factory Oil Filled

NORD factory-filled gear units allow for easy commissioning of the gear unit and prevent damage caused by dry start-ups. Each unit is filled with a quality gear lubricant that is recognized by the industry.

- Maintence free / lubricated-for-life.
- High-quality long-life synthetic lubricant.
- USDA H1 lubrication readily available.
- Optional venting capabilities.

nsd tupH Sealed Surface Conversion

The NEW NSD^{tuph} Sealed Surface Conversion System offers a cost effective weight saving alternative to stainless steel reducers. Through a revolutionary process the reducer housing and its components are electrically catalyzed resulting in a surface conversion at the molecular level. NSD^{tuph} provides exceptional chemical, corrosion and abrasion resistance. The converted surface also becomes extremely scratch resistant as it becomes 6-7 times harder than the original aluminum alloy.



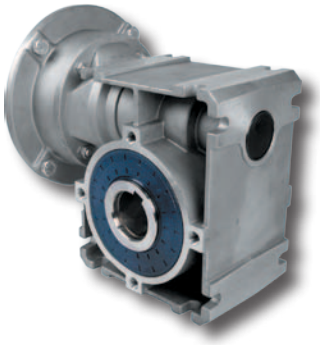
The NSD^{tuph} package includes stainless steel reducer hardware and c-face gasket for the motor. Options include stainless steel reducer shafting, smooth-bodied stainless steel c-face motors, and food grade lubricants. NSD^{tuph} is the ideal package for many harsh environments involving chemicals or wash-downs and areas where sanitation and cleanliness are the highest priority.

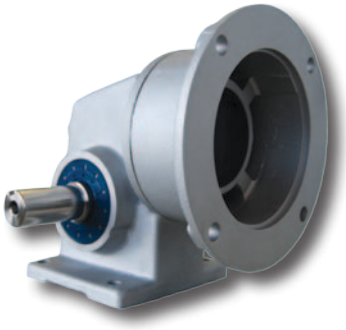
Available FLEXBLOC™ / MINICASE® worm Units with NSD^{tupH} Conversion

	SK1SI31 / SK1SMI31	SK1SI40 / SK1SMI40	SK1SI50 / SK1SMI50	SK1SI63 / SK1SMI63
N48C Input	X			
N56C Input		X	X	X
N140TC Input		X	X	X

nsd tupH System Package

- Standard electrically catalized reducer housing and accessories
- Standard stainless steel hardware
- Standard C-Face gasket included
- Housings surfaces are self draining
- Food grade H1 synthetic lubrication (optional)
- Stainless steel output shafting (optional)
- Stainless steel C-Face inverter duty motor up to 10HP (optional)
- 3 Year warranty when supplied with synthetic lube





nsd tupH is Useful in Many Harsh Environments

(not limited to but including)

- Chemical wash down
- Damp and wet environments
- Marine / Coastal
- Food & Beverage industry
- Car Wash
- Dairy
- Pharmaceutical
- Water and waste treatment

Some of the Many Benefits of nsd tupH

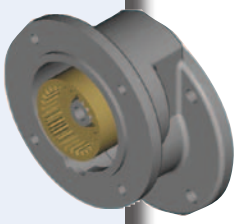
- Cost effective alternate to stainless steel
- Corrosion resistance
- Chip resistance
- Non propagating from scratches or other blemishes
- Highly Cleanable low friction surface
- Non-porous
- Lighter than stainless
- Chemical resistant
- Elimination of galvanic corrosion
- Surface conversion is 1000X harder than paint

FLEXBLOC™ & MINICASE®
Flexible Solutions & Bolt-On Modules



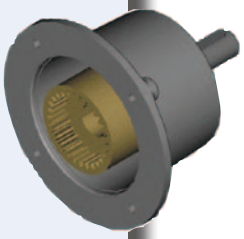
NEMA C-FACE COUPLING ADAPTER
For attaching standard motors

Kit contains:
- Adapter flange
- Coupling
- Nuts and bolts



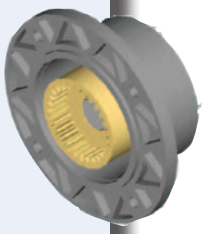
2ND REDUCTION
Helical 10:1 gear set
Fits all size gearboxes
Lifetime synthetic lubricant
Sealed unit

Kit contains:
- Pre-assembled unit
- Bolts



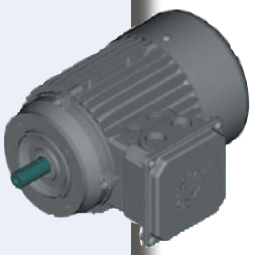
SOLID INPUT SHAFT
Fits all size gearboxes
Lifetime lubricant
Sealed unit

Kit contains:
- Pre-assembled unit
- Bolts



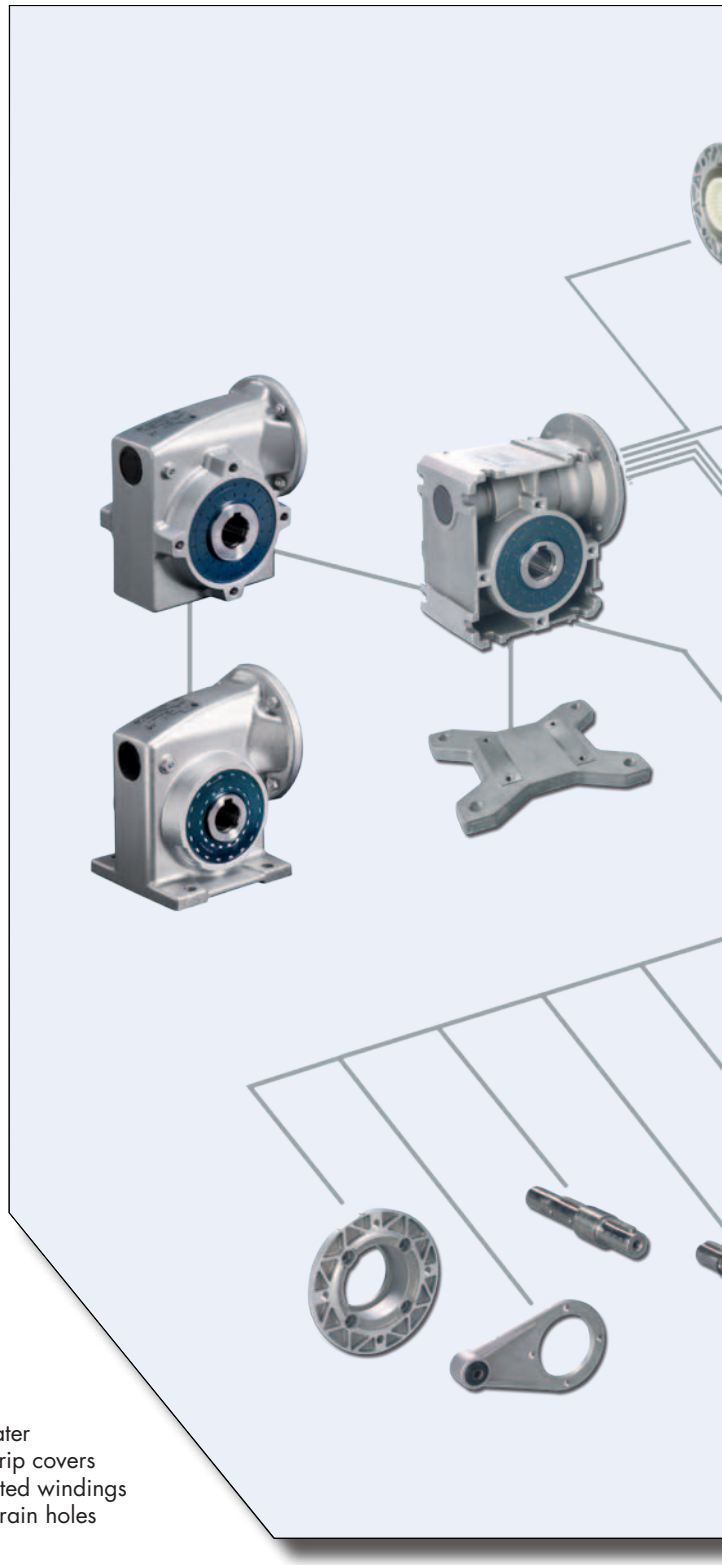
DOUBLE WORM ADAPTER
Mounts the SK1SI/SMI31 to the input of the larger SK1SI/SMI40 - SK1SI/SMI75 to produce a high reduction double worm gear unit

Kit contains:
- Adapter flange
- Coupling
- Shaft
- Keys
- Bolts

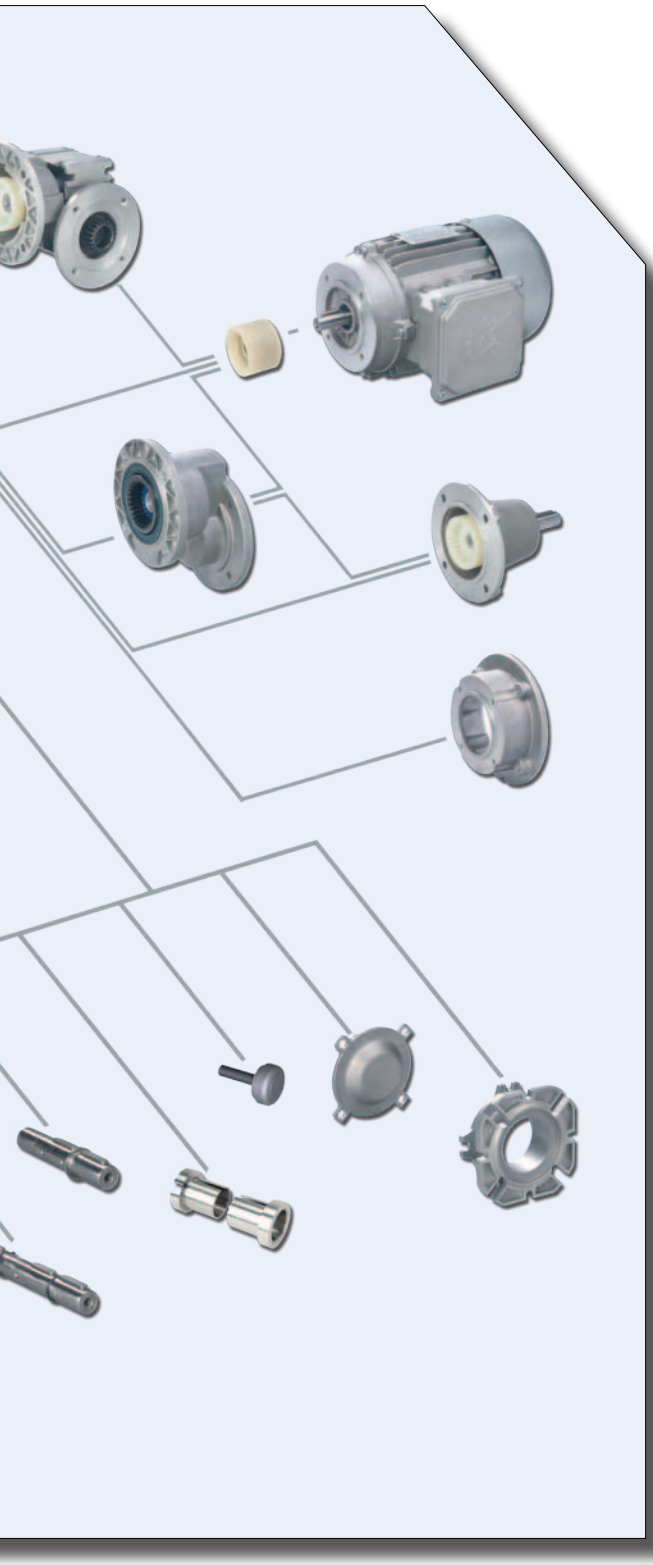


NORD C-FACE MOTORS & BRAKEMOTORS
3 phase, 230/460, 60 Hertz
3 phase, 575V, 60 Hertz

Options:
- Power off brake
- Numerous brake options
- Thermistor temperature sensors
- Thermostat temperature sensors
- Blower fan
- Encoders
- Space heater
- Canopy drip covers
- Encapsulated windings
- End bell drain holes



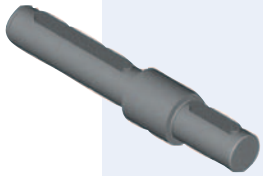
DRIVESYSTEMS



SOLID OUTPUT SHAFT
Inch dimensions with standard keys
Plug into standard hollow shaft
Install on either side

Kit contains:
- Shaft
- Keys
- External snap ring

Options:
- Double solid shaft



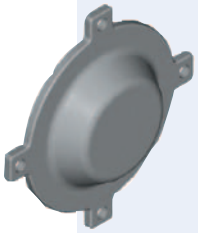
B5 OUTPUT FLANGE
Multiple flanges available for each size gearbox. Flange pilots are centered in seal bore.

Kit contains:
- Die cast flange
- Bolts



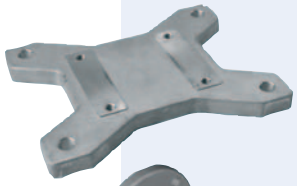
SHAFT PROTECTION COVER
Seals shaft end Safety protection from rotating shafts.

Kit contains:
- Cover
- Bolts



FOOT PLATE
Mounts to the bottom of the FLEXBLOC™ to provide drop-in compatibility with many worm gear reducers.

Kit contains:
- Foot plate
- Bolts



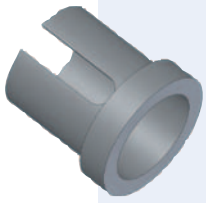
TORQUE REACTION ARM
For shaft mounting
Rubber shock absorber installed in attachment end.

Kit contains:
- Torque arm
- Bolts



SHAFT BUSHING
Hollow shaft bushing for increased bore flexibility.

Kit contains:
- Bushings with set screw
- Key

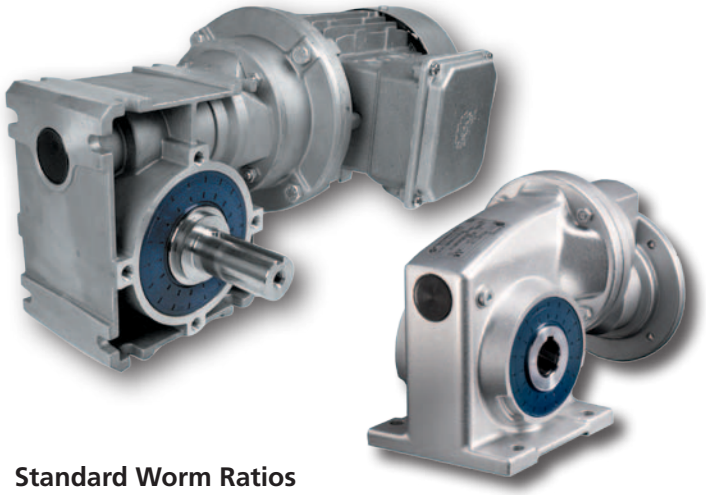


FIXING KIT
Optional mounting device that engages the customer solid shaft tap and draws the end of the shaft into contact with the hollow bore snap ring.

Kit contains:
- Carbon Steel retaining washer and bolt
- Spring loaded steel snap ring
- Plastic cover



Gearbox Ratings



Standard Worm Ratios

- 5:1 - 100:1 single worm ratios.
- Up to 1000:1 with a 10:1 helical pre-stage option.
- Compound Unit ratios up to 10,000:1

Type	Ratio	Output RPM	Torque [lb-in]	Max Input HP
SK 1SI 31 SK 1SMI 31	5	350	204	1.30
	7.5	233	239	1.06
	10	175	230	0.80
	12.5	140	212	0.61
	15	117	257	0.66
	20	88	239	0.49
	25	70	221	0.38
	30	58	266	0.44
	40	43	248	0.34
	50	35	230	0.27
	60	29	212	0.23
	80	22	195	0.18
	100	18	186	0.17

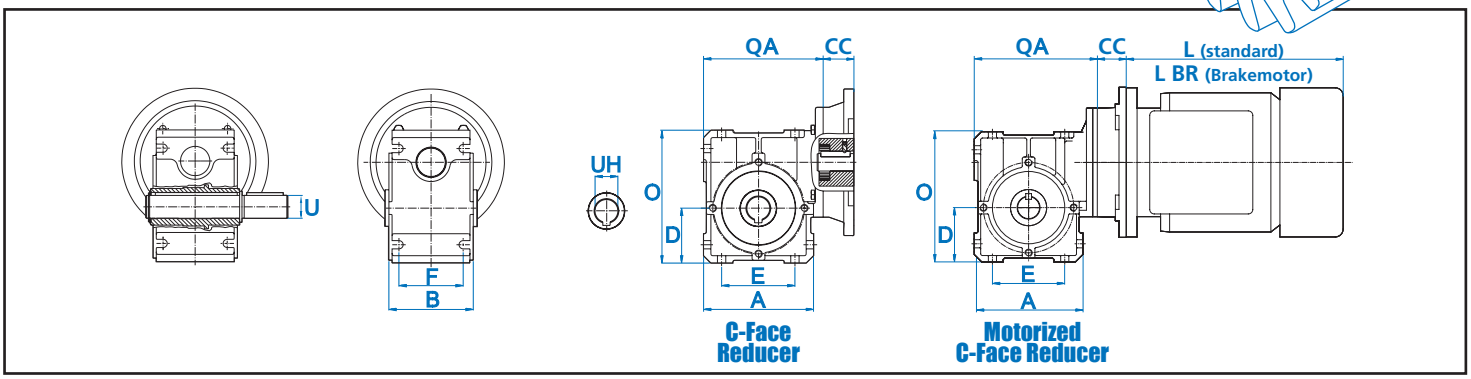
Type	Ratio	Output RPM	Torque [lb-in]	Max Input HP
SK 1SI 40 SK 1SMI 40	5	350	336	2.10
	7.5	233	389	1.69
	10	175	372	1.24
	12.5	140	363	1.00
	15	117	434	1.06
	20	88	398	0.77
	25	70	372	0.60
	30	58	442	0.67
	40	43	407	0.51
	50	35	381	0.41
	60	29	354	0.34
	80	22	327	0.27
	100	18	301	0.23
SK 1SI 40/H10 SK 1SMI 40/H10	50	35	549	0.38
	thru			
	1000	1.8	487	0.06
SK 1SI 40/31 SK 1SMI 40/31	150	12	655	0.30
	thru			
	3000	0.6	876	0.06

Type	Ratio	Output RPM	Torque [lb-in]	Max Input HP
SK 1SI 50 SK 1SMI 50	5	350	584	3.56
	7.5	233	690	2.90
	10	175	664	2.14
	12.5	140	637	1.69
	15	117	770	1.79
	20	88	717	1.30
	25	70	673	1.01
	30	58	796	1.11
	40	43	735	0.83
	50	35	681	0.65
	60	29	646	0.55
	80	22	593	0.43
	100	18	549	0.36
SK 1SI 50/H10 SK 1SMI 50/H10	50	35	742	0.50
	thru			
	1000	1.8	894	0.09
SK 1SI 50/31 SK 1SMI 50/31	150	12	1177	0.49
	thru			
	3000	0.6	1575	0.11

Type	Ratio	Output RPM	Torque [lb-in]	Max Input HP
SK 1SI 63 SK 1SMI 63	5	350	1044	6.30
	7.5	233	1230	5.05
	10	175	1186	3.74
	12.5	140	1142	2.91
	15	117	1372	3.07
	20	88	1274	2.22
	25	70	1195	1.72
	30	58	1416	1.86
	40	43	1301	1.38
	50	35	1212	1.09
	60	29	1150	0.90
	80	22	1044	0.69
	100	18	974	0.57
SK 1SI 63/H10 SK 1SMI 63/H10	50	35	751	0.50
	thru			
	1000	1.8	1584	0.16
SK 1SI 63/31 SK 1SMI 63/31	150	12	2097	0.83
	thru			
	3000	0.6	2797	0.20

Type	Ratio	Output RPM	Torque [lb-in]	Max Input HP
SK 1SI 75 SK 1SMI 75	5	350	1735	10.36
	7.5	233	2071	8.41
	10	175	2009	6.2
	12.5	140	1912	4.77
	15	117	2336	5.1
	20	88	2168	3.65
	25	70	2036	2.79
	30	58	1929	2.25
	40	43	2212	2.21
	50	35	2062	1.71
	60	29	1956	1.41
	80	22	1779	1.05
	100	18	1655	0.88
SK 1SI 75/40	150	12	2832	0.96
	thru			
	3000	0.60	3779	0.19

FLEXBLOC™ Worm Dimensions



DIMENSIONS

	A	B	D	E	F	O	QA	U	UH
SK 1SI 31	3.15	2.48	1.57	2.13	1.73	3.82	3.82	0.625	0.625
SK 1SI 40	3.94	3.07	1.97	2.76	2.36	4.78	4.69	0.750	1.000
SK 1SI 50	4.72	3.62	2.36	3.15	2.76	5.67	5.16	1.000	1.125
SK 1SI 63	5.67	4.41	2.83	3.94	3.35	6.85	6.22	1.125	1.4375
SK 1SI 75	6.77	5.12	3.39	4.72	3.54	8.08	7.87	1.375	1.9375

Metric Shaft available

NEMA C-FACE DIMENSIONS

	48C		56C		140TC		180TC	
	Available	CC	Available	CC	Available	CC	Available	CC
SK 1SI 31	X	1.50	X	1.89	-	-	-	-
SK 1SI 40	-	-	X	1.46	X	1.93	-	-
SK 1SI 50	-	-	X	1.46	X	1.93	-	-
SK 1SI 63	-	-	X	1.46	X	1.93	X	3.06
SK 1SI 75	-	-	X	1.61	X	1.61	X	2.16

NEMA C-FACE GEARMOTOR DIMENSIONS

	56C-63S/L		56C-71S/L		56C-80S/L-LH-LP		140TC-80L-LH-LP		140TC-90LH-LP		180TC-100LH-LP		180TC-112MH-MP	
	L	L BR	L	L BR	L	L BR	L	L BR	L	L BR	L	L BR	L	L BR
SK 1SI 31	7.57	9.78	8.44	10.72	9.46	11.98	9.46	11.98	-	-	-	-	-	-
SK 1SI 40	7.57	9.78	8.44	10.72	9.46	11.98	9.46	11.98	11.00	13.95	-	-	-	-
SK 1SI 50	7.57	9.78	8.44	10.72	9.46	11.98	9.46	11.98	11.00	13.95	-	-	-	-
SK 1SI 63	7.57	9.78	8.44	10.72	9.46	11.98	9.46	11.98	11.00	13.95	11.97	15.57	-	-
SK 1SI 75	-	-	8.44	10.72	9.46	11.98	9.46	11.98	11.00	13.95	11.97	15.57	13.56	17.26

NORD GEAR LIMITED
Member of the NORD DRIVESYSTEMS Group

Item	Description	Material	Qty	Total
100	**SK1SI50/H10-N56C**			

Product Name	Worm Gearbox with NEMA Adapter
Nominal Motor Speed	1,750
Ratio	150.00
Assumed Output Speed	12.000 1/min
Service Factor	1.10
Nominal Output Torque (lb-in)	1,196.00
Max. Torque Capacity (lb-in)	1,257.00
Maximum Motor Power (kW)	0.250
Maximum Motor Power (HP)	0.335
Gearbox Mounting Position	M1
Helical Input Stage Mounting P	Input Stage T1
Housing Type	Foot
Input Adapter	N56C
Output Shaft Dimensions	25H7
Breather	Autovent
Lubricant Type	VG680-SYN-PG
Lubricant Supplier	Klüber
Lubricant	KLUBERSYNTH GH 6-680
Quantity Lubricant(l)	0.095
Paint Option Old	Without paint
Paint Option	Without painting
Separate part	Coupling half + sprocket
Weight	approx. 7 KG /PC

Intelligent Drivesystems, Worldwide Services



B1000

Operating & Instruction Manuals
For Gear Units

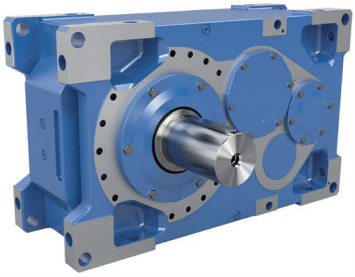
NORD®
DRIVESYSTEMS

NORD DRIVESYSTEMS Group



NORD Delivers

NORD offers full-featured drive solutions that can tackle the toughest requirements. All components are carefully selected and precisely configured to meet your exact specifications. In the rare case that standard components won't meet your needs, our in-house engineering team will work with you to design custom components or a complete customized system.





Reduce Lead Times and Decrease Inventory

- 25% of orders ship same day or next day with NO expedite fees
- 47% of orders ship within 5 working days
- 81% of orders ship in 2-3 weeks





Global Product Designs, Standards, and Support

- Innovative product range (one-stop shop)
- Global connected presence
- Mechanical and electrical application engineers ready to assist you
- Online resources





Increase Efficiency and Reduce Operation Costs

- First-class customer service and support, plus myNORD online tools
- Product flexibility through standard components and customizations
- Program personalization, such as weekly shipment schedules and custom nameplates
- Partner with a company that is easy to do business with and wants to see you succeed!





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Terms & Conditions of Sale	Terms

1. Importance of the operating instructions

These operating instructions are intended to provide general information and safety guidelines. It is the responsibility of the buyer, machine builder, installer and user of the NORD product to make sure that all the proper safetynotes and operating instructions have been reviewed and understood. If the contents of this instruction or any applicable operating instructions are not understood, please consult NORD.

> ⚠ ***WARNING***
>
> Electric motors, gearmotors, electrical brakes, variable frequency drives, and gear reducers contain potentially dangerous high-voltage, rotating-components and surfaces that may become hot during operation. All work involved in the transport, connection, commissioning and maintenance of any NORD product must be carried out by qualified and responsible technicians.

2. Inspect incoming freight

Before accepting shipment from the freight company, thoroughly inspect the NORD equipment for any shipping and handling damage. If any goods called for in the bill of lading or express receipt are damaged, or if the quantity is short, do not accept until the freight express agent makes an appropriate notation on your freight bill or express receipt. If any concealed loss or damage is discovered later, notify your freight carrier or express agent at once, and request a formal review of your claim.

Claims for loss or damage in shipment must not be deducted from the NORD invoice, nor should payment of the NORD invoice be withheld awaiting adjustment of such claims, as the carrier guarantees safe delivery. NORD will try to assist in collecting claims for loss or damage during shipment; however, this willingness on our part does not remove the transportation company's responsibility in reimbursing you for collection of claims or replacement of material.

3. Obtaining order specific user manuals and spare parts lists

One can receive the detailed installation and maintenance instructions by entering a serial number (or NORD order number) at the appropriate location on the NORD web site.

i. Record the serial number from your gearmotor, gear reducer, or motor nameplate, or record the serial number found on your order confirmation.

ii. Go to **https://shop.nord.com/US-en/mynord/documentcenter** to download the appropriate operating instructions.

iii. Obtain order-specific parts lists and place orders online via the Parts shop at https://shop.nord.com/US-en/home

EXAMPLE: https://shop.nord.com/US-en/mynord/documentcenter

4. Intended use

NORD is a supplier of electric motors, gearmotors, reducers, electromechanical brakes, mechanical variators, and electrical variable frequency drives that are intended for commercial installations on larger systems and machines.

> ⚠ ***WARNING***
>
> NORD does not accept any liability for damage or injury caused by:
>
> - Inappropriate use, operation or adaptation of the drive system.
> - Unauthorized removal of housing covers, safety and inspection covers, guarding, etc.
> - Unauthorized modifications to the drive system.
> - Improper servicing or repair work on the drive system.
> - Damage caused during shipment or transportation.
> - Disregard of the important Safety Notes or Operating Instructions.

5. Notes concerning warranty and liability

All units are supplied according to the terms described in our standard "Conditions of Sale." The unit limited warranty is also defined in our "Conditions of Sale" and is located in the back of our product catalogs as well as the back of your order invoice.

All NORD Safety Notes and all related NORD Operating instructions shall be considered up-to-date at the time in which they were compiled by the buyer, machine builder, installer or user. NORD reserves the right to incorporate technical modifications and information updates to any safety/operating instructions that are within the scope of providing additional knowledge or clarification, communicating design changes, or product enhancements. Information updates may include any NORD product, or subsequent products purchased and supplied by NORD; No specific claims can be derived from the information or illustrations and descriptions contained in the safety notes or related operating instructions.

⚠ *WARNING*

NORD assumes no liability for personal injury, equipment damage or malfunctions resulting from failure to comply with any installation safety notes. The applicable national, regional, and local work regulations and safety requirements must also be complied with. Failure to comply with any safety notes or regulations may result in serious injury, damage to property, or even death.

6. Checklist for installation and operation

- ☑ Verify that the purchased NORD product has been supplied with the expected accessories & options. Check the received goods and packing slip to make sure items are properly received.
- ☑ Make sure that you have all of the required Operating Instructions for your NORD electric motor, gearmotor, reducer, electromechanical brake, mechanical variable speed drives, or electrical variable frequency drives.
- ☑ Consult NORD if you feel you are missing any documentation or if you have questions.

1. Safety & information symbols

All work including transportation, storage, installation, electrical connection, commissioning, servicing, maintenance and repair must be performed **only by qualified specialists or personnel**. It is recommended that repairs to NORD Products are carried out by the NORD Service Department. Instructions related to operational safety will be emphasized as shown.

Symbol	Meaning
⚠	**Danger, Caution or Warning -** Severe risk or danger of personal injury or death by working around dangerously high electrical voltage or moving machinery. Proper safety precautions must be taken.
NOTICE	**Notice -** Care must be taken to avoid the possibility of damaging the drive unit, driven machine, or the environment.
ℹ	**Important Note -** Useful note or tip to help assure trouble-free operation.
♻	**Material Disposal Note -** Important note concerning suggested material disposal.

2. Safety warnings

⚠ DANGER

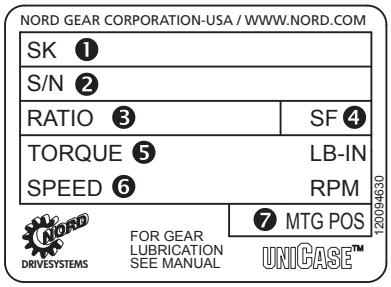
- All work involved in the transport, connection, commissioning and maintenance of any NORD product must be carried out by qualified and responsible technicians. All applicable national, regional, and local work regulations and safety requirements must also be complied with. **NORD assumes no liability for personal injury, accidental death, or equipment damage and malfunctions resulting from failure to comply with installation or operating instructions, safety notes, or any work regulations and laws!**
- Gear unit installation and maintenance work may only be performed when no power is available to the prime mover or motor. Electric motors, electrical brakes, and variable frequency drives, contain potentially dangerous high-voltage. Prior to installation or maintenance, shut down the power at the circuit breaker or power switch. **While working on the drive, make sure the power from the prime mover is isolated or secured on "lock-out" to prevent accidental start-up and to safeguard against injury!**
- Surfaces of motors and gear units may become hot during operation or shortly after start-up. In some instances additional protection against accidental contact may be necessary. **Use caution to avoid burns or serious injury!**

3. Observe published performance range & nameplate data

NOTICE

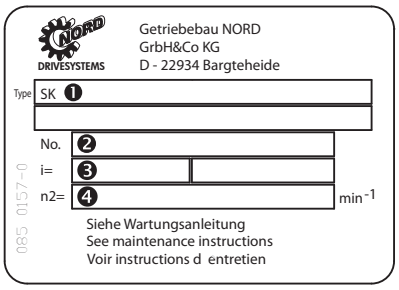
Observe the data on all reducer nameplates and verify published ratings for the NORD item/s in question. Do not operate any NORD equipment outside the published performance range. Failure to comply may result in damage to the drive unit, driven machine, or the environment.

U.S. Nameplate



❶ Model/Type
❷ Serial Number
❸ Gear Ratio
❹ Service Factor
❺ Torque Rating
❻ Output Speed RPM
❼ Mounting Position

European Nameplate



❶ Model/Type
❷ Serial Number
❸ Gear Ratio
❹ Speed

4. Transportation and handling

Make sure that all eyebolts and lifting lugs are tight and lift only at designed points. Protect the mounting surface from possible damage during transportation.

⚠ WARNING

Do not attach other machinery or loads to the NORD assembly, the supplied lifting bolts are not designed for this purpose and may result in drive damage or personal injury.

If the gearmotor or assembly is equipped with two suspension eye bolts, then both locations should be used for transportation and placement of the unit; in this case the tension force of the slings must not exceed a 45° angle.

In some instances it may be appropriate to use additional lifting straps or slings in order to assure safe transportation of the assembly. Always use sufficiently rated handling equipment and ensure that adequate safety measures are taken to protect personnel from injury during transportation. Once the NORD assembly is properly installed, remove the transportation fixtures.

5. DISPOSAL

MATERIAL DISPOSAL

Properly dispose of all used gear units and internal parts in accordance with all local regulations. In particular, all lubricants must be properly collected and disposed.

For confirmation of specific materials used in a specific reducer or gearmotor assembly, please consult NORD with the appropriate unit identification or serial number.

Components	Material
Gear wheels, shafts, rolling bearings, parallel keys, snap rings, spacers, shims, etc.	Steel
Gear housing and housing components	Cast iron or Aluminum (depending on type and size)
Worm gears	Bronze alloy
Radial seals, sealing caps, and rubber components	Elastomers with some steel
Coupling components	Plastic or Elastomer with Steel
Housing gaskets and flat oil seals	Asbestos-free sealing or gasket material (various types used)
Gear Oil	Mineral, SHC-Synthetic or PG-Synthetic (can vary)

1. Storage

IMPORTANT NOTE

For storage periods longer than 9 months, or for storage in less than desirable conditions, please consult NORD for recommendations.

Storage for up to 9 months is possible, so long as the following conditions are observed:

- Store the gear unit in its actual mounting position in accordance with the specified oil fill-level, in a clean and dry temperature controlled area. Avoid temperature fluctuations within the range of 0°C and 40°C (32°F to 104°F) and avoid relative humidity conditions in excess of 60%.
- Protect all exposed or unpainted shaft and flange surfaces with an anti-corrosion agent or grease.
- Store in a location free from shock and vibration, to avoid false brinelling of bearing elements and raceways.
- Whenever possible, rotate the shafts periodically, by hand if necessary, to help prevent brinelling (bearing damage) and to help keep the shaft seals pliable.
- Avoid direct exposure to the sun or UV light and aggressive or corrosive materials in the environment (ozone, gases, solvents, acids, caustic solutions, salts, radioactivity, etc.

2. Commissioning

Prior to gear unit start-up, complete the following:

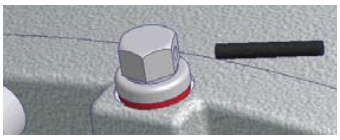
- Please check your gear unit for a vent and if applicable to your product, remove the sealing plug to activate.

NOTICE

To prevent build-up of excessive pressure, sealed vents must be activated as shown prior to gear unit start up. Excessive pressure may cause damage to internal gearbox components and leakage.



Sealed vent



Activated vent

- Check the lubricant and be sure the gear unit is filled with the proper oil type, to the proper level, as determined by the mounting position.

IMPORTANT NOTE

Some smaller gear units are supplied as maintenance free/ lubricated for life gear units. Oil level may not be checked on some of these units.

- Check the condition of all shaft seals and all assembled flange gasket areas. If any change is detected in the shape, color, hardness or permeability, or if any leaks are detected, the corresponding shaft seals and/or gaskets must be replaced.
- Remove all anti-corrosive metal protectant from otherwise bare metal surfaces. Follow product manufacturers directions and warnings during surface protection removal.
- Check the resistance of all motor and brake windings to verify the integrity of the winding insulation and inspect all terminal box openings and wire connection areas to verify that all components are dry and free of corrosion.

3. Long-Term Storage

By taking special precautions, problems such as seal leakage and reducer failure due to the lack of lubrication, improper lubrication quantity, or contamination can be avoided. The following precautions will protect gear reducers during periods of extended storage:

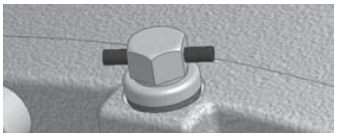
- Store the gear unit in its actual mounting position in accordance with the specified oil fill-level, in a clean and dry temperature controlled area. Avoid temperature fluctuations within the range of 0°C and 40°C (32°F to 104°F) and avoid relative humidity conditions in excess of 60%.
- Fill the reducer full with oil that is compatible with the product normally used or recommended during service.
- Apply grease to all unpainted or unprotected shafts, bores, keyways, flange surfaces, tapped holes, and to the exterior of all oil seals.
- Store in a location free from shock and vibration, to avoid false brinelling of bearing elements and raceways.
- Once every few months rotate the input shaft approximately 10-20 revolutions to redistribute the weight of gears and shafts and to prevent brinnelling of the bearings and drying of the seal track.
- Avoid direct exposure to the sun or UV light and aggressive or corrosive materials in the environment (ozone, gases, solvents, acids, caustic solutions, salts, radioactivity, etc.)

4. Commissioning After Long-Term Storage

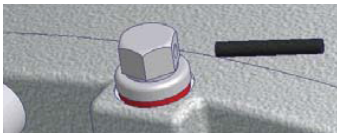
• Please check your gear unit for a vent and if applicable to your product, remove the sealing plug to activate.

NOTICE

To prevent build-up of excessive pressure, sealed vents must be activated as shown prior to gear unit start up. Excessive pressure may cause damage to internal gearbox components and leakage.



Sealed vent



Activated vent

- Remove all anti-corrosive metal protectant from otherwise bare metal surfaces. Follow product manufacturers directions and warnings during surface protection removal.
- Drain the reducer and refill it with the proper type and amount of lubricant.
- Observe start-up and initial operation to make sure there are no seal or gasket leaks, or unusual sounds, vibration or heat rise during operation.
- Check the resistance of all motor and brake windings to verify the integrity of the winding insulation and inspect all terminal box openings and wire connection areas to verify that all components are dry and free of corrosion.

1. Installation site

Drives must be properly installed if they are to produce the rated torque. Improper installation may lead to oil leaks, reduced life, or even catastrophic failure. NORD gear drives and motors are intended to be installed at a suitable mounting site under the following conditions:

- Unimpeded airflow to and around the units.
- Accessibility to oil drain, level and breather plugs.
- On brakemotors, allow adequate space for removing the fan guard and replacing and adjusting the brake.
- Mounting surfaces must be flat, torsionally rigid, and dampened against vibration.
- Unless special measures are taken, the immediate vicinity around the gear drive or motor should not be exposed to any aggressive or corrosive substances, contaminated air, ozone, gases, solvents, acids, alkalis, salts, radioactivity, etc.

2. Mounting position

Reducer mounting position charts illustrate the standard mounting positions for horizontal and vertical mounting. All gear units are assembled with the oil fill-level, oil-drain and vent plugs installed in their proper locations, **according to the customer-specified mounting position**. For mounting orientations other than shown consult NORD Gear.

NOTICE

Improper oil levels may lead to premature component wear and diminished service life. The gear reducer may not receive proper lubrication if the unit is not mounted in the position for which it is designed. Observe the mounting position designated on the reducer nameplate, or specified in the order acknowledgement. Consult NORD prior to changing mounting position in the field. While it is often possible to simply relocate the oil fill-level and vent locations, and adjust the oil fill amount, in some cases, different mounting positions may lend themselves to different internal construction features.

3. Reducer mounting

- The support foundation must be straight, level and flat. Whether the gear unit is foot-mounted or flange-mounted, NORD recommends that the straightness and flatness of the customer-supplied support foundation follow **Table 1**.
- The gear unit must be properly aligned with the driven shaft of the machine in order to prevent additional stress or load forces from being imposed upon the gear unit.
- To facilitate oil drainage it may be desirable to elevate the gear box foundation above the surrounding support structure.
- All bolting surfaces must be clean and free from contamination and corrosion.

Table 1: Recommended Straightness and Flatness of Customer-Supplied Support Foundation

Above (in)	To & Including (in)	General Tolerance on Straigtness & Flatness ISO 2768-2, Tolerance Class K
0.00	0.39	+/- 0.002 in
0.39	1.18	+/- 0.004 in
1.18	3.9	+/- 0.008 in
3.9	11.8	+/- 0.016 in
11.8	39	+/- 0.024 in
39	118	+/- 0.031 in

Above (mm)	To & Including (mm)	General Tolerance on Straigtness & Flatness ISO 2768-2, Tolerance Class K
0	10	+/- 0.05 mm
10	30	+/- 0.1 mm
30	100	+/- 0.2 mm
100	300	+/- 0.4 mm
300	1000	+/- 0.6 mm
1000	3000	+/- 0.8 mm

Straightness: Based upon the length of the corresponding line.

Flatness: Based upon the longer lateral surface or the diameter of the circular surface.

IMPORTANT NOTE

The responsibility for the design and construction of the support foundation is with the user. The foundation must be adequate to withstand normal operating loads and possible overloads while maintaining alignment to attached system components under such loads. ***Motors and drive components mounted on prefabricated base plates can become misaligned during shipment. Always check alignment after installation.***

4. Steel foundation

An engineered structural steel foundation should be designed to provide adequate rigidity and prevent loads from distorting the housing or causing misalignment of internal gears and shafts. When foot-mounting the gear reducer, a base plate or sole plate with suitable thickness (generally equal or greater than the thickness of the drive feet) should be securely bolted to steel supports and extend under the entire gear drive assembly. When flange-mounting the gear unit, the bulk head plate must be engineered to minimize buckling distortions and support the cantilevered weight of the gear unit or gear motor.

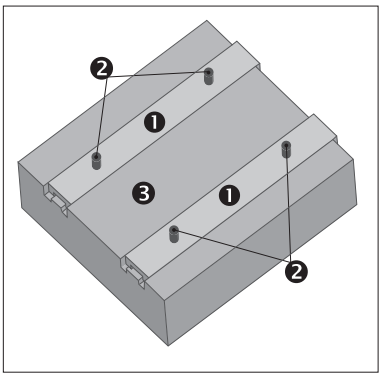
NOTICE

Do not weld on the gear unit or use the gear unit as an earth or ground connection for any welding procedure as this may cause permanent damage to the bearings and gears.

5. Concrete foundation

If a concrete foundation is used, allow the concrete to set firmly before bolting down the gear drive. Grout structural steel mounting pads and bolts of sufficient size into the concrete, to adequately distribute the load stress onto the concrete foundation.

Figure 1: Concrete Foundation



❶ Grouted Structural Steel Mounting Pads
❷ Mounting Bolts
❸ Concrete Foundation

6. Bolt connections for footed & flange mounted units

NORD footed reducers and flange-mount reducers (with B5 flange) have clearance designed into the mounting holes to allow for some minor adjustments in alignment. Bolt size, strength and quantity should be verified to insure proper torque reaction capacity whatever the mounting arrangement. Tightening torque for gear reducer mounting bolts, and recommended fastener grades, are provided in Table 2.

Table 2A: Tightening Torque for Inch Reducer Mounting Bolts

Thread Size	Grade SAE 5 / ASTM A449		Grade SAE 8	
(in)	(lb-ft)	(Nm)	(lb-ft)	(Nm)
1/4-20	7.1	9.6	10.0	13.6
5/16-18	16	21	22	30
3/8-16	28	37	39	53
1/2-13	69	93	98	132
5/8-11	138	188	195	264
3/4-10	247	334	348	472
7/8-9	396	537	558	757
1-8	592	802	833	1,130
1 1/8-7	-	-	1,233	1,672
1 1/4-7	-	-	1,717	2,327
1 3/8-6	-	-	2,267	3,073
1 1/2-6	-	-	2,983	4,045
1 3/4-5	-	-	4,458	6,045

- Calculated tightening torques are based a conventional 60°, clean and dry (un-lubricated) thread, with thread-friction and head-friction equal to 0.15.
- When using inch-fasteners, NORD recommends a minimum Grade SAE 5 (ASTM A-449) for sizes up to 1-8 UNC, and Grade SAE 8 for all larger sizes.

Table 2B: Tightening Torque for Metric Reducer Mounting Bolts

Above	ISO Grade 8.8		ISO Grade 10.9		ISO Grade 12.9	
(mm)	(lb-ft)	(Nm)	(lb-ft)	(Nm)	(lb-ft)	(Nm)
M4	2.4	3.2	3.5	4.7	4.1	5.5
M5	4.7	6.4	6.9	9.3	8.1	11
M6	8	11	12	16	14	19
M8	20	27	29	39	34	46
M10	39	53	58	78	67	91
M12	68	92	100	135	110	155
M14	107	145	159	215	180	250
M16	170	230	247	335	290	390
M18	240	325	343	465	400	540
M20	339	460	487	660	570	770
M22	465	630	664	900	770	1,050
M24	583	790	848	1,150	960	1,300
M27	848	1,150	1,217	1,650	1,440	1,950
M30	1,180	1,600	1,660	2,250	1,950	2,650
M36	2,050	2,780	2,884	3,910	3,470	4,710
M42	3,297	4,470	4,639	6,290	5,560	7,540
M48	4,940	6,700	7,010	9,500	8,260	11,200

- Calculated tightening torques are based on a conventional 60°, clean and dry (un-lubricated) thread, with thread-friction and head-friction equal to 0.15.
- When using metric-fasteners, NORD recommends a minimum ISO Grade 8.8 bolt.

7. Mounting the prime mover

When the motor is not flange mounted or integrally mounted to the gearbox, it is important to properly secure and align the gear drive with respect to the driven machine before attempting to align the prime mover or motor.

A. After the main gear drive is properly aligned and bolted in place, align the prime mover with respect to the reducer input shaft.

B. Use shims under the feet of the prime mover as needed, and secure in place with the proper mounting bolts. Dowel pins may be field-installed to help prevent misalignment and ensure proper realignment if removed for service.

IMPORTANT NOTE

When using a high speed coupling connection between the prime mover and the reducer, check alignment per the coupling manufacturers recommendations. If the coupling is misaligned, the reducer alignment or shimming is incorrect. Re-align the gear reducer and re-check the high-speed coupling alignment before re-aligning the motor.

SOLID SHAFT CONNECTIONS

1. Solid shaft diameter tolerance

Reducer input and output shaft extensions have a diameter tolerance as specified in **Table 1**.

Table 1: Solid Shaft Diameter Tolerance

Above ø (in)	To & Including ø (in)	Tolerance (in)
0.375	1.750	+0.0000 / -0.0005
1.750	7.500	+0.0000 / -0.0010

Above ø (mm)	To & Including ø (mm)	Tolerance (mm)	ISO 286-2 Fit Class
10	18	+0.012 / +0.001	k6
18	30	+0.015 / +0.002	k6
30	50	+0.018 / +0.002	k6
50	80	+0.030 / +0.011	m6
80	120	+0.035 / +0.013	m6
120	180	+0.040 / +0.015	m6
180	190	+0.046 / +0.017	m6

2. Fitting drive elements onto the reducer solid shaft

Solid input and output shaft extensions are provided with a drill and tap feature as indicated in Table 2. When installing drive elements such as coupling hubs, pulleys, sprockets, or gears, NORD recommends using the threaded hole in the end of the shaft, along with a suitable assembly device fitted into the threaded hole.

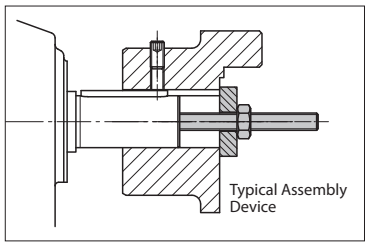


Table 2: Solid Shaft End - Threaded Holes

Above ø (in)	To & Including ø (in)	Tap Size & Depth (in)
0.375	0.500	10-24 x 0.43 in
0.500	0.875	1/4-20 x 0.59 in
0.875	0.938	5/16-18 x 0.71 in
0.938	1.100	3/8-16 x 0.87 in
1.100	1.300	1/2-13 x 1.10 in
1.300	1.875	5/8-11 x 1.42 in
1.875	3.500	3/4-10 x 1.73 in
3.500	7.500	1-8 x 2.63 in
5.125	8.875	1 1/4 - 7 x 3.15*
6.000	8.875	1 3/8 - 6 x 3.46**

Above ø (mm)	To & Including ø (mm)	Tap Size & Depth (mm)
10	13	M4 x 10 mm
13	16	M5 x 12.5 mm
16	21	M6 x 16 mm
21	24	M8 x 19 mm
24	30	M10 x 22 mm
30	38	M12 x 28 mm
38	50	M16 x 36 mm
50	85	M20 x 42 mm
85	130	M24 x 50 mm
130	225	M30 x 60 mm*
130	225	M36 x 74 mm**

* Only used on the SK9096.1 Helical-Bevel Gear Unit.

** Only used on the SK10382.1 & SK11382.1 CLINCHER™ gear units.

NOTICE

DO NOT DRIVE or **HAMMER** the coupling hub, pulley, sprocket, or gear into place. An endwise blow to the reducer shaft can generate damaging axial forces and cause damage to the reducer housing, bearings or internal components.

⚠ WARNING

To avoid serious injury the user must provide suitable safety guards for all rotating shafts and shaft components such as couplings, chain drives, belt drives, etc. All guarding must adhere to local regulations and safety standards.

3. Installing interference-fit hubs to the reducer shaft

Prior to installing any interference-fit hubs to the reducer shaft, consult with the manufacturer to determine proper assembly and fit. Interference-fits usually require heating the coupling, sprocket or gear hub, per the manufacturer's recommendations. Coupling hub installation typically follows ANSI/AGMA 9002-A86. Always make sure the reducer shaft seals are protected from the heat source. Apply uniform heat to the drive element hub to prevent distortion. NORD does not recommend heating the drive element hub beyond 212°F to 275°F (100°C to 135° C).

⚠ WARNING

When using heat to mount a drive element hub, do not use open flame in a combustible atmosphere or near flammable materials. Use suitable protection to avoid burns or serious injury.

IMPORTANT NOTE

When using external chain or belt drives, make sure the reducer is sized so that the shaft and bearings have adequate capacity. To avoid unnecessary bearing loads and additional shaft deflection, mount all power take-off devices (sprockets, pulleys, etc.) so that the applied load center is as close to the gear housing as possible and check component alignment and tension of any belts or chains per the manufacturer's recommendation. Do not over tighten the belts or chains.

4. Coupling installation

The performance and life of any coupling depends upon how well it is installed. Coupling hubs are typically mounted flush with the shaft ends, unless specifically ordered for overhung mounting. Shaft couplings should be installed according to the coupling manufacturer's recommendations for gap, angular and parallel alignment. To help obtain critical shaft alignment coupling hubs may be installed to the machine shafts prior to final shimming or tightening of the foundation bolts. Proper coupling alignment allows for thermal and mechanical shaft movement during operation and ensures that only torque (no radial load) is transmitted between the mating shafts.

Coupling gap and angular alignment

The shaft gap must be sufficient to accommodate any anticipated thermal or mechanical axial movement. When setting the coupling gap, insert a spacer or shim stock equal to the required spacing or gap between the coupling hub faces. Measure the clearance using feeler gauges at 90-degree intervals, to verify the angular alignment.

Parallel (or offset) alignment

Mount a dial indicator to one coupling hub, and rotate this hub, sweeping the outside diameter of the other hub. The parallel or offset misalignment is equal to one-half of the total indicator reading. Another method is to rest a straight edge squarely on the outside diameter of the hubs at 90° intervals and measure any gaps with feeler gauges. The maximum gap measurement is the parallel or offset misalignment.

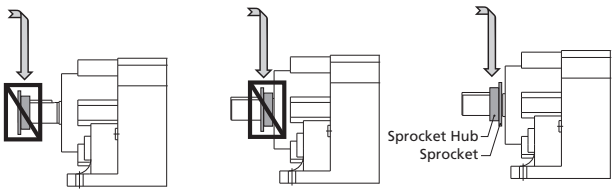
Check alignment

After both angular and parallel alignments are within specified limits, tighten all foundation bolts securely and re-check critical alignment. If any of the specified limits for alignment are exceeded, realign the coupling.

5. Installing sheaves (pulleys), sprockets and gears

To avoid unnecessary bearing loads and additional shaft deflection, mount all power take-off devices (sprockets, pulleys, gears, etc.) so that the applied load center is as close to the gear housing as possible, as shown in **Figure 2**.

Figure 2: Sprocket or Gear Mounting



Preferred Mounting of Sprocket or Gear

Align the driver sheave or sprocket with the driven sheave or sprocket by placing a straight-edge length-wise across the face of the sheaves or sprockets. Alignment of bushed sheaves and sprockets should be checked only after bushings have been tightened. Check horizontal shaft alignment by placing one leg of a square or a level vertically against the face of the sheave or sprocket.

Always check component alignment and tension any belts or chains per the manufacturer's recommendation. The ideal belt or chain tension allows proper wrap of the driver and driven wheels, while maintaining the lowest possible tension of the belts or chain, so that no slipping occurs under load conditions. Check belt or chain tension frequently over the first 24 to 48 hours of operation.

IMPORTANT NOTE

When using external chain or belt drives, make sure the reducer is sized so that the shaft and bearings have adequate capacity. To avoid unnecessary bearing loads and additional shaft deflection, mount all power take-off devices (sprockets, pulleys, etc.) so that the applied load center is as close the gear housing as possible and check component alignment and tension of any belts or chains per the manufacturer's recommendation. Do not over tension the belts or chains.

6. Outboard pinion gear alignment

Align outboard pinion gears and adjust the gear tooth clearance according to the manufacturer's recommendations, checking for acceptable outboard pinion tooth contact. The foundation bolts may have to be loosened and the gear unit moved slightly to obtain proper gear tooth contact. After the unit is moved to correct tooth contact, the prime mover may need to be realigned.

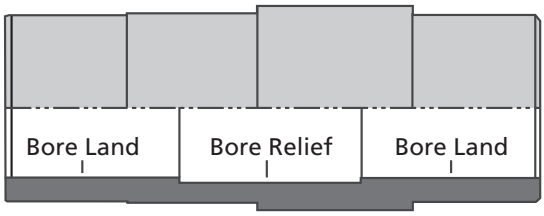
KEYED HOLLOW SHAFT

1. Keyed hollow shaft design

NORD uses high quality carbon steel to manufacture hollow-shafts. Upon request, NORD can provide alternate materials, such as stainless steel. NORD hollow shafts are designed with a bore relief (reduced contact area) between the mating shafts.

The bore relief provides a cavity to hold an anti-seize assembly paste. It also acts as a design feature intended to help prevent corrosion and to facilitate gearbox removal from the solid shaft.

NORD furnishes dual keys designed to be used in each of the bore land areas, as opposed to supplying a single long key. The dual keys are intended to simplify assembly onto the machine's solid shaft.



IMPORTANT NOTE

If a single shaft key or dual shaft keys are supplied by others, the key/s must engage the full bore-land length at each end of the hollow shaft.

2. Key and keyway dimensions

Unless otherwise indicated, inch keys and keyways follow the ANSI B17.1 standard and metric keys and keyways follow the DIN6885-1 standard. Inch bores will typically utilize square keys but in some instances the larger hollow shaft bore sizes utilize the alternate rectangular key shown in the ANSI B17.1 standard.

Key slots for the solid machine shaft should be made with a Class 2, transitional-fit class (slightly loose to slightly tight). Key slots in the female shaft are designed to be a low clearance fit. These suggested practices should allow for easier assembly with the mating solid shaft, without allowing excessive clearance which could cause keys to work loose during reducer operation.

IMPORTANT NOTE

If the key fit is too tight, light filing of the key sides and hand-fitting of the keys may be required.

3. Keyed hollow-shaft bore tolerances

Standard keyed hollow-shaft bore tolerances are shown in the following table.

Table 1 - Keyed hollow bore tolerances

Above ø [in]	To and Including ø [in]	Bore Diameter Tolerance ø [in]
0.4375	1.6250	+0.0010 / -0.0000
1.6250	3.2500	+0.0012 / -0.0000
3.2500	7.0000	+0.0014 / -0.0000

Above ø [mm]	To and Including ø [mm]	Bore Diameter Tolerance ø [mm]
10	18	+0.018 / -0.000
18	30	+0.021 / -0.000
30	50	+0.025 / -0.000
50	80	+0.030 / -0.000
80	120	+0.035 / -0.000
120	180	+0.040 / -0.000
180	190	+0.035 / -0.000

Metric hollow bore tolerances per ISO286-2, Class H7

4. Suggested solid shaft (machine shaft) tolerances

NORD recommends a close fit of the customer-supplied solid shaft or machine-shaft, for the following reasons:

- To help minimize the potential for fretting and corrosion.
- To help prevent excessive free play in the shaft connection that could lead to excessive load stress on the driven system, the gear drive, or both.

Table 2 - Suggested solid shaft tolerances

Above ø [in]	To and Including ø [in]	Shaft Diameter Tolerance Uniform Load ø [in]	Shaft Diameter Tolerance Shock Load ø [in]
0.4375	0.8750	+0.0000 / -0.0005	+0.0000 / +0.0005
0.8750	4.5000	+0.0000 / -0.0010	+0.0000 / +0.0010
4.5000	7.0000	+0.0000 / -0.0012	+0.0000 / +0.0015

Above ø [mm]	To and Including ø [mm]	Shaft Diameter Tolerance Uniform Load ❶ ø [mm]	Shaft Diameter Tolerance Shock Load ❷ ø [mm]
10	18	+0.000 / -0.011	+0.012 / +0.001
18	30	+0.000 / -0.013	+0.015 / +0.002
30	50	+0.000 / -0.016	+0.018 / +0.002
50	80	+0.000 / -0.019	+0.021 / +0.002
80	120	+0.000 / -0.022	+0.025 / +0.003
120	180	+0.000 / -0.025	+0.028 / +0.003
180	190	+0.000 / -0.029	+0.033 / +0.004

❶ **Uniform load: Mating shaft diameter tolerance per ISO286-2, class h6**

❷ **Shock load: Mating shaft diameter tolerance per ISO286-2, class k6**

As indicated in Table 2, different solid shaft tolerances are suggested depending upon the load type.

- If the machine load conditions are considered "Uniform" a clearance fit is allowed.
- If the machine load conditions are considered to have "Shock Load" a light clearance to interference fit condition is suggested.

Typically the machine builder will have good knowledge as to the load type. As an alternate method to classify load type, one could follow the "Mass Acceleration Factor Selection Method" that is discussed in NORD's product catalog/s.

Straightness, roundness, and diameter tolerance variations of both shafts should be controlled as accurately as possible. When mating, solid shaft design features are not controlled, reducer installation may be very difficult without ordering special hollow-bore design features to accomodate.

NOTICE

The supporting solid shaft or driven machine shaft must be of adequate size and strength to withstand normal operating loads and peak loads without damage to itself or any of the system components.

5. Suggested solid-shaft mating shaft surface finish

Controlling the mating shaft surface finish helps to assure proper fit and assembly while minimizing the possibility of corrosion and fretting. NORD recommends that the mating solid shaft surface should be at least 125 micro-inches (3.2 microns) or smoother.

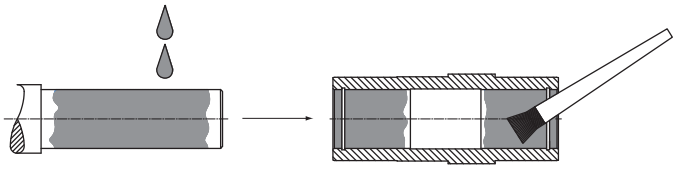
6. Assembly to the machine shaft

A. Clean and remove any dirt, grease, or rust-preventative coatings from both the reducer hollow shaft and the machine shaft.

B. Make sure the edges of both the reducer hollow shaft and machine shaft are free from any nicks or burrs. If nicks or burrs are present remove them using an abrasive material such as an emery cloth.

C. Before installing the gear reducer onto the machine shaft, apply an anti-seize compound or anti-corrosive lubricant to the mating shafts as shown in Figure 1. Assembly and subsequent dismantling will be aided by the anti-seize agent.

Figure 1 – Application of anti-seize to the mating shafts



Apply to solid shaft Apply to bore land area

D. Fit the shaft key/s into place on the machine shaft. Depending upon the key slot design on the machine shaft, it may be necessary to stake or Loctite® the key/s into place so they do not slide axially while fitting the reducer to the shaft.

E. Lift the gear unit assembly into place and align it carefully with respect to the machine shaft.

F. Fit the gear unit assembly onto the machine shaft using a suitable pulling device.

G. Secure the reducer onto the machine shaft in an axial direction, to prevent the reducer from shifting or walking out of place during operation.

NOTICE

Do not use excessive force or try to hammer the gear unit into place. The housing, shafting, bearings or gear wheels may become damaged.

7. Securing the reducer onto the machine shaft

There are slight shaft oscillations during operation in any rotating shaft equipment or any shaft-mounted reducer assembly. Therefore it is important to secure the reducer in an axial direction onto the machine shaft, to prevent the reducer from shifting or walking out of place during operation.

Possible methods to secure the reducer axially to the machine shaft include:

- Using commercial set collars, retaining rings, or snap rings.
- Using the optional "NORD Fixing Element Kit" (see U10280).

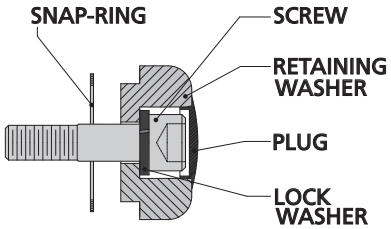
The NORD Fixing Element Kit includes all of the necessary parts to secure the shaft by using a tapped hole in the end of the mating male shaft.

Loctite® is a registered trademark of Loctite Corporation U.S.A. and Henkel.

1. Shaft fixing kit - basic design

The NORD Fixing Kit provides a method for securing the reducer in an axial direction, after the keyed-hollow shaft reducer is mounted onto the machine shaft. The fixing kit prevents the reducer from shifting or walking out of place during operation. NORD offers a variety of standard fixing kits, based upon bore size, as shown on Page 2 of this manual.

Figure 1 – Fixing kit components



IMPORTANT NOTE

For installation of the keyed-hollow bore reducer to the machine-shaft, see user manual U10270.

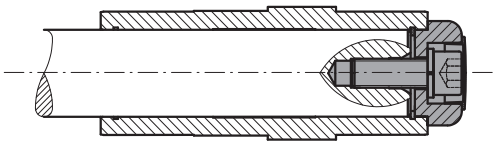
2. Assembly types

There are two types of assembly methods commonly used for securing the fixing kit.

Figure 2 – Fixing kit assembly methods

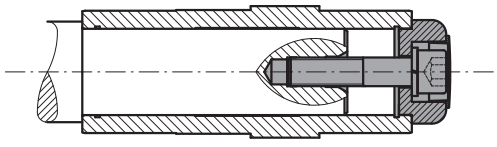
Type 1

The machine-shaft is located against a fixed snap-ring located inside the bore of the reducer.



Type 2

The machine shaft is shouldered and is pulled tight against the hollow-shaft; the snap-ring is no longer required.



NOTICE

The maximum edge break on the solid machine shaft must not exceed the values shown on Page 2 of this manual. Otherwise the load-bearing capacity of the snap-ring will be reduced and may result in failure.

3. Assembly

A. If using a Type 1 assembly, secure the appropriate snap-ring into the bore of the reducer. With Type 2 assembly, no snap-ring is required.

B. Draw the hollow bore gear reducer onto the machine shaft as instructed in U10270. Remember to apply a suitable assembly paste or anti-seize compound to the mating shafts.

C. Install the retaining washer over the end of the hollow bore.

D. Secure the appropriate cap-screw into the machine shaft and tighten the screw based upon the assembly type, as noted below. Then install the protective plug over the screw hole.

Type 1 - Screw tightening

Tighten until lightly snug and secure the screw with a thread-locking compound to prevent the screw from backing out.

NOTICE

Over tightening the retaining screw may cause the snap ring to be pulled out of its seating groove, causing damage to the hollow-bore or snap ring.

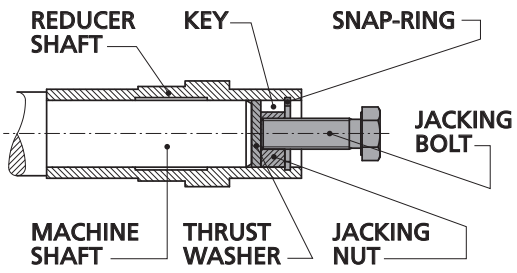
Type 2 - Screw tightening

Follow the cap screw manufactures guidelines and tighten the screw to the proper torque, based upon the bolt grade and material. For reference tightening torque values, also see manual U10060, Table 2.

4. Disassembly

When using Type 2 assembly, it is possible to design a simple disassembly tool to allow easier removal of the hollow-bore reducer. The solid shaft is shouldered to rest against the hollow-bore of the reducer. The machine shaft is supported in both of the hollow bore land areas, but the overall length is reduced compared to Type 1 assembly.

Figure 3 – Disassembly Tool



IMPORTANT NOTE

For suggestions on how to construct a disassembly tool for a particular reducer and bore size, please consult NORD's application engineering department.

5. Standard fixing kit size offerings

NORD offers a variety of standard fixing kit sizes as shown by the following tables.

Table 1 - Standard fixing kit size offerings

Shaft Bore [in]	Bolt Size	Allowable Thrust Groove ❷ lb [N]	Allowable Thrust Ring ❸ lb [N]	Max. Edge Break ❹ in [mm]
0.500	10-32	730 [3255]	520 [2300]	0.02 [0.5]
0.750	1/4-20	1800 [7905]	560 [2500]	0.04 [1]
1.000	3/8-16	2900 [13020]	1000 [4600]	0.04 [1]
1.188	7/16-14	5100 [22630]	1000 [4700]	0.04 [1]
1.250	7/16-14	5100 [22630]	1000 [4700]	0.04 [1]
1.375	5/8-11	6500 [29140]	1400 [6400]	0.06 [1.5]
1.438	5/8-11	6900 [30690]	1500 [6500]	0.06 [1.5]
1.500	5/8-11	7800 [34875]	1500 [6700]	0.06 [1.5]
1.625	5/8-11	9900 [44020]	1900 [8400]	0.08 [2]
1.688	5/8-11	10500 [46810]	1800 [8200]	0.08 [2]
1.938	5/8-11	11100 [49600]	1900 [8400]	0.08 [2]
2.000	5/8-11	14100 [62775]	2700 [12100]	0.08 [2]
2.063	5/8-11	14100 [62775]	2700 [12100]	0.08 [2]
2.188	5/8-11	16800 [74865]	2900 [13000]	0.08 [2]
2.375	3/4-10	17400 [77190]	2900 [13000]	0.08 [2]
2.438	3/4-10	17400 [77190]	2900 [13000]	0.08 [2]
2.750	3/4-10	19600 [87110]	4700 [21000]	0.10 [2.5]
2.938	3/4-10	20900 [93000]	4700 [21000]	0.10 [2.5]
3.188	3/4-10	27700 [123225]	7000 [31200]	0.12 [3]
3.438	3/4-10	29300 [130200]	7000 [31400]	0.12 [3]
3.625	3/4-10	30900 [137330]	7000 [31400]	0.12 [3]
3.938	7/8-9	32400 [144305]	6900 [30800]	0.12 [3]
4.000	7/8-9	39000 [173600]	16400 [73000]	0.12 [3]
4.063	7/8-9	39000 [173600]	16400 [73000]	0.12 [3]
4.375	7/8-9	41500 [184450]	16200 [72000]	0.12 [3]
4.438	7/8-9	41500 [184450]	16200 [72000]	0.12 [3]
4.750	7/8-9	44200 [196850]	15700 [70000]	0.12 [3]
4.938	7/8-9	48000 [213900]	15500 [69000]	0.12 [3]

Upon request, additional hollow-bore sizes & fixing kit sizes may be offered.

Shaft Bore [mm]	Bolt Size	Allowable Thrust Groove ❷ N [lb]	Allowable Thrust Ring ❸ N [lb]	Max. Edge Break ❹ mm [in]
16	M5	Not applicable ❶		
20	M6	8370 [1900]	5600 [1300]	1.0 [0.04]
25	M10	12400 [2800]	7300 [1600]	1.0 [0.04]
30	M10	17515 [3900]	7200 [1600]	1.0 [0.04]
35	M12	29140 [6500]	8700 [1900]	1.5 [0.06]
40	M16	41850 [9400]	10900 [2400]	2.0 [0.08]
45	M16	46810 [10500]	10700 [2400]	2.0 [0.08]
50	M16	62775 [14100]	19000 [4300]	2.0 [0.08]
60	M20	74865 [16800]	29200 [6600]	2.0 [0.08]
70	M20	87110 [19600]	30300 [6800]	2.5 [0.10]
80	M20	115630 [26000]	56000 [12600]	2.5 [0.10]
90	M24	130200 [29300]	56000 [12600]	3.0 [0.12]
100	M24	144305 [32400]	55000 [12400]	3.0 [0.12]
110	M24	181350 [40800]	71000 [16000]	3.0 [0.12]
120	M24	196850 [44300]	70000 [15700]	3.0 [0.12]

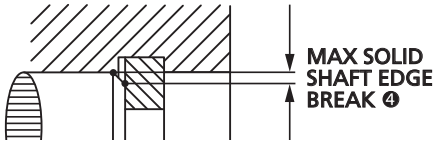
Upon request, additional hollow-bore sizes and fixing kit sizes may be offered.

❶ This fixing kit is not supplied with a snap-ring. A Type 2 machine shaft is required.

❷ Thrust load-bearing capacity of the groove is based upon using a hollow-shaft material with a yield-strength of at least 45,000 psi (310 N/mm^2).

❸ Thrust load-bearing capacity of the snap-ring is based upon a typical snap-ring material with a yield-strength of at least 30,500 psi (210 N/mm^2).

❹ On the solid machine shaft, observe the maximum edge break (radius or chamfer) shown. A larger edge break will result in reduced load-bearing capacity of the snap-ring.

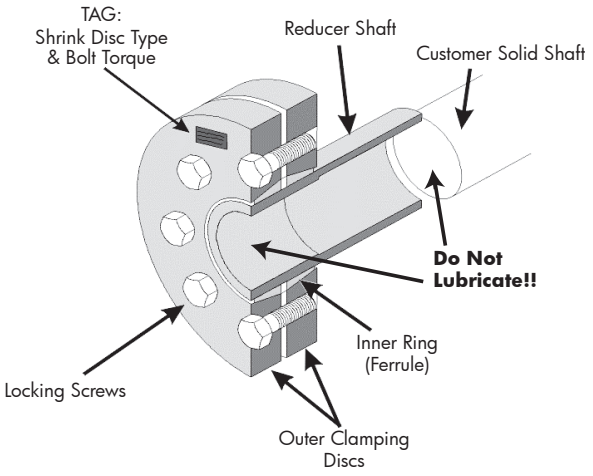


HOLLOW SHAFT WITH SHRINK DISC

1. Shrink disc design concept

A shrink disc option is adaptable to many NORD hollow-bore reducers. The shrink disc applies a high-capacity, zero backlash, interference fit to the driven machine shaft. The double tapered inner ring converts most all of the screw clamping load into radial contact pressure, as the outer clamping discs are pulled together by proper tightening of the locking screws. As the inner ring is contracted, the clearance between the customer solid shaft and reducer shaft is absorbed.

- In their relaxed state, shrink discs provide a generous assembly clearance, thus eliminating the typical assembly and disassembly challenges of using interference fits.
- Shrink discs also reduce solid machine shaft stresses by eliminating the need for shaft keys and keyways.
- When properly applied, high shrink fits help eliminate shaft fretting corrosion and allow for easier shaft mounting and dismounting.



2. Solid (machine) shaft design guidelines

Always use a solid shaft material of adequate strength and apply proper shaft fits in order to establish adequate clamping force during assembly and assure proper shaft release during disassembly.

- Use solid shaft material with yield strength of at least 52,260 psi (360 N/mm²).
- The solid machine shaft should be machined according to ISO 286-2, Class h6 fit tolerances, with a shaft finish of 125 micro inches (3.2 µm) or smoother, per Table 1.
- The solid machine shaft must extend the full length of the reducer hollow shaft.

IMPORTANT NOTE

Contact NORD when using a shrink disc in an application where the shrink disc connection must simultaneously transmit torque and thrust.

3. Safety

NOTICE

- The supporting solid shaft or driven machine shaft must be of adequate size and strength to withstand normal operating loads and peak loads without damage to itself or any of the system components.
- The transmissible torque and the gripping capacity of the shrink disc may be reduced if shaft tolerances or clearances are larger than specified.
- Excessive tightening torque can result in permanent deformation of the inner ring and the reducer hollow bore, making disassembly very difficult. Do not over tighten the shrink disc to compensate for excessive clearance between the machine shaft and reducer bore.
- Observe the published ratings and safety factors for both the reducer and shrink disc. Overload conditions or excessively high torque can cause the shrink disc connection to slip. In extreme cases localized galling or welding of components may occur.

4. Shrink disc shaft tolerances

Recommended solid shaft tolerances and reducer bore tolerances are shown in the table below.

Table 1: Shrink disc shaft tolerances

Above & Including ø [in]	To & Including ø [in]	Solid Shaft Tolerance ø [in]	Reducer Bore Tolerance ø [in]	Max. Assembly Clearance [in]
0.7500	1.1250	+0.0000 / -0.0005	+0.0008 / -0.0000	0.0013
1.1250	1.9375	+0.0000 / -0.0006	+0.0009 / -0.0000	0.0015
2.0000	3.1250	+0.0000 / -0.0007	+0.0011 / -0.0000	0.0018
3.1875	4.6875	+0.0000 / -0.0008	+0.0013 / -0.0000	0.0021
4.7500	7.0625	+0.0000 / -0.0009	+0.0015 / -0.0000	0.0024
7.1250	7.5000	+0.0000 / -0.0011	+0.0018 / -0.0000	0.0029

Above ø [mm]	To & Including ø [mm]	Solid Shaft Tolerance ø [mm]	Reducer Bore Tolerance ø [mm]	Max. Assembly Clearance [mm]
18	30	+0.000 / -0.013	+0.021 / -0.000	0.034
30	50	+0.000 / -0.016	+0.025 / -0.000	0.041
50	80	+0.000 / -0.019	+0.030 / -0.000	0.049
80	120	+0.000 / -0.022	+0.035 / -0.000	0.057
120	180	+0.000 / -0.025	+0.040 / -0.000	0.065
180	190	+0.000 / -0.029	+0.046 / -0.000	0.075

Shaft/bore tolerances per ISO 282-6, Class h6/H7.

Solid shaft finish should be 125 micro inches (3.2 micro meters) or smoother.

5. Installation

⚠ WARNING

Disconnect all power sources from the equipment before beginning this installation procedure. Gearmotors, variable frequency drives and gear reducers contain potentially dangerous high voltage, rotating components and surfaces that may become hot during operation. Handle the components with care and avoid all sharp machined edges to prevent personal injury.

NOTICE

Do not tighten any of the shrink disc locking screws prior to installing the reducer with shrink disc onto the machine shaft. The inner ring of the shrink disc can become permanently contracted or damaged at relatively low tightening torque.

A. Inspect the gear unit received. Make sure the shrink disc and extended hollow shaft projection is on the side of the reducer where it was specified or ordered.

B. Loosen the shrink disc locking screws but do not take the shrink disc completely apart. Remove and discard any packaging material or transportation spacers that come with the shrink disc.

C. Remove all burrs, rust, corrosion, lubricants, and foreign matter from the surfaces of the solid shaft and hollow-bore.

D. Make sure the shrink disk is positioned onto the hollow shaft until the outer clamping ring is flush with the edge of the hollow shaft.

E. To aid in assembly, it is acceptable to lightly grease the solid shaft, only in the area that will come in contact with the bronze-bushing side of the reducer hollow-shaft. ***The reducer hollow shaft must be completely de-greased and free of lubricant, especially in the area of the shrink disc.***

F. Position the gear reducer onto the solid machine shaft and make certain the area under the shrink disc is completely supported by the solid shaft.

G. After confirming the proper positioning of gear reducer and the shrink disc, hand tighten (3) or (4) equally spaced locking screws to make sure the outer collars of the shrink disc are drawn together in a parallel fashion. Then hand-tighten the remaining screws.

H. Refer to Table 2 for the specified tightening torques for the shrink disc locking screws. Using a properly set torque wrench using approximately ¼ (90°) turns; tighten the locking screws, by working in a circular clockwise or counterclockwise sequence around the shrink disc.

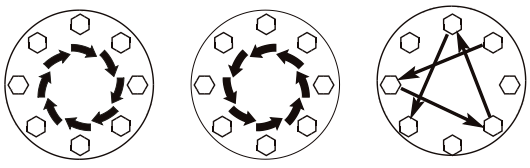
I. Continue the tightening sequence (Step H.) even if some locking screws initially require very low tightening torque to achieve ¼ turns; do this for several passes until ¼ turns can no longer be achieved.

J. Reset the torque wrench to approximately 3-5% over-torque and tighten the locking screws for 1 or 2 more passes. This procedure will compensate for relaxation of the locking screws, since tightening of a given screw will always tend to relax the adjacent screw. Without a slight overtorquing of the screws, an infinite number of passes would be required to reach the desired tightening torque.

Table 2 - Shrink Disc Locking Screw Torque

Screw Size	Wrench Size [mm]	Tightening Torque [Nm]	[lb-in]	[lb-ft]
M5	8	7	62	5.2
M6	10	12	106	8.9
M8	13	30	266	22
M10	17	59	522	44
M12	19	100	885	74
M16	24	250	2213	184
M20	30	490	4337	361
M24	36	840	7435	620
M30	46	1700	15050	1254

BOLT TIGHTENING PATTERN



CLOCKWISE CIRCULAR PATTERN **RIGHT**

COUNTER CLOCKWISE CIRCULAR PATTERN **RIGHT**

STAR PATTERN **WRONG**

K. Reset the torque wrench to the correct tightening torque as indicated in Table 2. Make sure each locking screw has been properly tightened until the screws are no longer turning at the specified torque wrench setting. If necessary repeat Steps G. & H.

6. Removal

A. Loosen the shrink disc locking screws in a circular pattern by using ½ (180°) turns, until the shrink disc hub can be moved or until the shrink disc hub and reducer shaft will return to their original fits.

⚠ WARNING

Do not completely remove the locking screws before the outer clamping disks of the shrink disc are disengaged from the inner ring. A sudden release of the outer collars will create high separating forces and could result in injury or even death.

B. Loosen the outer collars of the shrink disc from the tapered inner ring. This may require tapping the bolts with a **soft faced** hammer or prying lightly between the outer collars.

C. Remove the gear reducer from the machine shaft.

7. Re-installation

A. It may be possible to re-use the shrink disc. However the shrink disk should not be re-used if it becomes damaged during removal, or excessively rusty or corroded. Shrink discs must always be disassembled and thoroughly cleaned before re-using.

B. After cleaning the shrink disc, lubricate between the taper of the outer clamping disks and the outside of the inner ring using MOLYKOTE® G-Rapid Plus Paste (product of Dow Corning) or equivalent. In addition, grease screw threads and head contact area with multi-purpose grease.

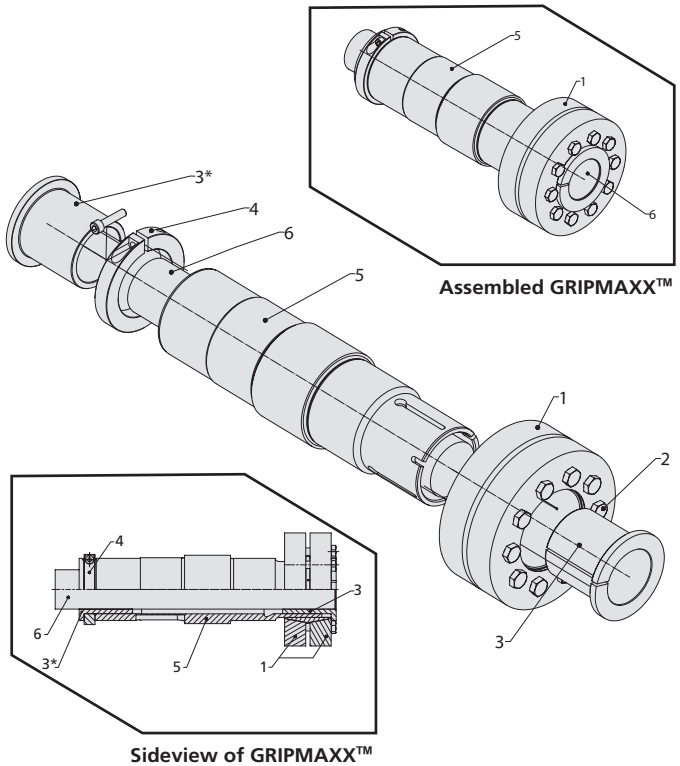
1. General information

The NORD GRIPMAXX™ keyless bushing system is adaptable to most all NORD shaft-mounted reducers. The bushing system offers interchangeable bushings to accommodate a large range of driven machine-shaft sizes.

The unique design of the NORD GRIPMAXX™ bushing system offers a number of distinct advantages as follows:

- The NORD GRIPMAXX™ allows the machine builder to utilize standard cold finished shaft stock, without the need for additional shaft machining or shaft keys.
- It uses a NORD shrink disc to apply a high-capacity, zero backlash, interference fit to the driven machine shaft, while eliminating the typical assembly and disassembly challenges of using interference fits.
- The built in clearance between the customer shaft and the bushing system helps to ensure easy installation and removal of the gearbox. To help ensure easy removal, the NORD GRIPMAXX™ bushings are prepared with a special low-wear, corrosion-resistant hardened surface treatment, that minimizes the formation of shaft corrosion and fretting.
- The NORD GRIPMAXX™ is ideal for start-stop operation and bi-directional loading because it does not depend on keys or keyways that transmit torque, which can also can become loose or deform when subjected to these loading conditions.
- Unlike the typical conical or tapered bushing kits, the NORD GRIPMAXX™ design allows a tight fit against a shouldered machine shaft.
- The torque bushing and support bushing are the same part and are fully interchangeable with one another.

2. GRIPMAXX™ assembly detail



Assembled GRIPMAXX™

Sideview of GRIPMAXX™

[1] NORD Shrink Disc
[2] Locking Screw
[3] Bushing (Torque Side)
[3*] Bushing (Support Side)
[4] Clamp Ring
[5] Gear Reducer Hollow Shaft
[6] Machine Shaft

IMPORTANT NOTE

NORD recommends that the machine shaft have a yield strength of at least 52,260psi (360N/mm^2)

IMPORTANT NOTE

Observe the recommended machine shaft tolerances in table 1, page 2.

NOTICE

The supporting solid shaft or driven machine shaft must be of adequate size and strength to withstand normal operating loads and peak loads without damage to itself or any of the system components.

3. Installation

⚠ WARNING

Disconnect all power sources from the equipment before beginning this installation procedure. Gearmotors, variable frequency drives and gear reducers contain potentially dangerous high voltage, rotating components and surfaces that may become hot during operation. Handle the components with care and avoid all sharp or machined edges to prevent personal injury.

NOTICE

Do not tighten any of the shrink disc locking screws prior to installing the reducer with shrink disc onto the machine shaft. The inner ring of the shrink disc can become permanently contracted or damaged at a relatively low tightening torque.

Table 1 - Required Machined Shaft Tolerance

Inch Machine Shaft			Metric Machine Shaft		
From	To	ISO 286-2 Tolerance h11(-)	Over	Including	ISO 286-2 Tolerance h11(-)
ø [in]	ø [in]	[in]	ø [mm]	ø [mm]	[mm]
0.4375	0.6875	- 0.004	10	18	- 0.11
0.7500	1.0625	- 0.005	18	30	- 0.13
1.1250	1.9375	- 0.006	30	50	- 0.16
2.0000	3.1250	- 0.007	50	80	- 0.19
3.1875	4.6875	-0.008	80	120	-0.22
4.7500	7.0625	-0.009	120	180	-0.25

A. Carefully inspect the machine shaft [6] and remove all burrs, rust, corrosion, lubricants, and foreign matter from the shaft surface. Verify that the diameter is within the dimensional tolerances shown in Table 1.

B. Inspect the gear unit received to confirm the correct position of the shrink disc [1]. Make sure the hollow shaft [5] projection is on the side of the reducer where it was specified or ordered.

C. In addition to cleaning the machine shaft [6], remove all dirt, grease or oils from the reducer hollow shaft [5], bushings [3], clamp ring [4], and shrink disk [1]. ***Do not apply lubricants, corrosion preventatives, anti-sieze compounds or coatings to the mating surfaces of the shaft, bushings, clamp collars or shrink disc.***

D. Position the clamp ring [4] and support bushing [3*] over the machine shaft [6], making sure the support bushing is in its desired location. Then secure the support bushing [3*] with the clamp ring [4] and tighten the clamp ring screw.

E. Slide the gear reducer onto the machine shaft [6] until the gear reducer stops against the secured support bushing [3*].

F. Without taking the shrink disc [1] apart, loosen the shrink disc locking screws [2]. Slide the shrink disk over the reducer shaft [5] and slide the torque bushing [3] onto the machine shaft, making sure it is seated completely.

G. Confirm the positioning of the shrink disc [1] and torque bushing [3]. ***Do not tighten the shrink disc until the machine shaft and torque bushing are in proper position, or the reducer shaft will be damaged.*** Hand-tighten 3 or 4 or locking screws [2] and make sure the outer collars of the shrink disc are drawn together in a parallel fashion and then hand-tighten the remaining screws.

H. Refer to Table 2 for the specified tightening torques for the shrink disc locking screws. Using a properly set torque wrench using approximately ¼ (90°) turns; tighten the locking screws, by working in a circular clockwise or counterclockwise sequence around the shrink disc.

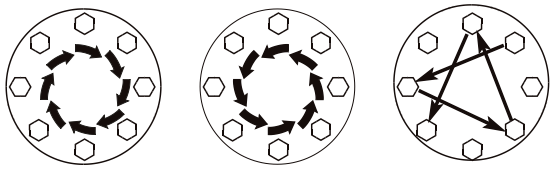
I. Continue the tightening sequence (Step H.) even if some locking screws initially require very low tightening torque to achieve ¼ turns; do this for several passes until ¼ turns can no longer be achieved.

J. Reset the torque wrench to approximately 3-5% overtorque and tighten the locking screws for 1 or 2 more passes. This procedure will compensate for relaxation of the locking screws, since tightening of a given screw will always tend to relax the adjacent screw. Without a slight overtorquing of the screws, an infinite number of passes would be required to reach the desired tightening torque.

Table 2 - Shrink Disc Locking Screw Torque

Screw Size	Wrench Size [mm]	Tightening Torque [Nm]	[lb-in]	[ft-lb]
M5	8	7	62	5.2
M6	10	12	106	8.9
M8	13	30	266	22
M10	17	59	522	44
M12	19	100	885	74
M16	24	250	2213	184
M20	30	490	4337	361

BOLT TIGHTENING PATTERN



CLOCKWISE CIRCULAR PATTERN **RIGHT**

COUNTER CLOCKWISE CIRCULAR PATTERN **RIGHT**

STAR PATTERN **WRONG**

K. Reset the torque wrench to the correct tightening torque as indicated in Table 2. Make sure each locking screw has been properly tightened until the screws are no longer turning at the specified torque wrench setting. If necessary repeat Steps G. & H.

5. Bushing kit removal

A. Loosen the shrink disc locking screws [2] in circular pattern by using ½ (180°) turns, until the shrink disc hub can be moved or until the shrink disc hub and reducer shaft will return to their original fits.

> ⚠ ***WARNING***
>
> Do not completely remove the locking screws before the outer clamping disks of the shrink disc are disengaged from the inner ring. A sudden release of the outer collars will create high separating forces and may result in injury or even death.

B. Loosen the outer collars of the shrink disc from the tapered inner ring. This may require tapping the bolts with a **soft faced** hammer or prying lightly between the outer collars.

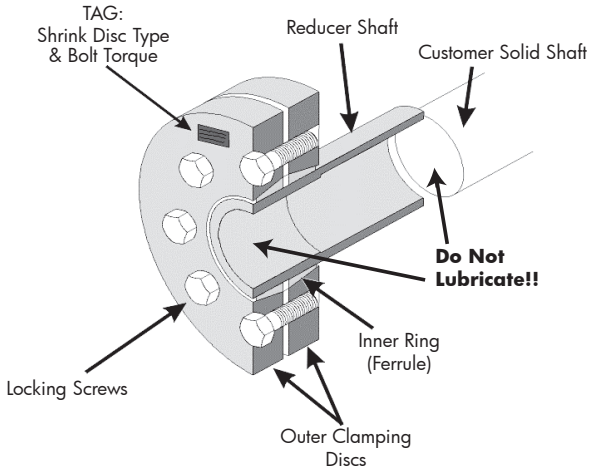
C. Remove the gear reducer from the machine shaft.

6. Re-installation

A. It may be possible to re-use the bushings and shrink disc that are part of the NORD bushing system. However these components should not be re-used if they are damaged during removal, or excessively rusty or corroded.

B. Never re-use any of the bushing kit components without prior cleaning. Shrink discs must always be disassembled and thoroughly cleaned before re-using.

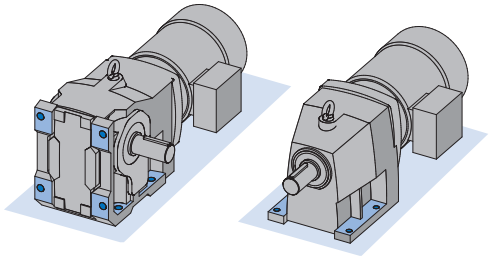
C. After cleaning the shrink disc, lubricate between the taper of the outer clamping disks and the outside of the inner ring using MOLYKOTE® G-Rapid Plus Paste (product of Dow Corning) or equivalent. In addition, grease screw threads and head contact area with multipurpose grease.



REDUCER MOUNTING
FOOTED & FLANGE MOUNT GEAR UNITS

1. Foot-mounted reducers

When installing the foot-mounted gear unit, observe the flatness specifications and bolt tightening torque guidelines provided in U10060 and make sure the mating mounting surface and reducer feet are clean and free of debris. Use of shims under the feet of the gear unit may be required in order to align the output shaft to the driven equipment. Make sure that all feet are supported so that the housing will not distort when it is bolted down. Improper shimming will cause mis-alignment and may reduce the life of the gear unit or cause component failure. Dowel pins may be field-installed to help prevent misalignment and ensure proper realignment if removed for service.



IMPORTANT NOTE

Gear units may be subjected to radial loads or side pull, caused by external chain drives or belt drives. In these instances it is recommended that the mounting base be designed with a slide-plate adjustment to accommodate extra slack in the chain or the belt after the feet are loosened. When using an external chain or belt drive, make sure the reducer is sized so that the shaft and bearings have adequate capacity.

2. Flange-mounted reducers (with B5 flange)

When using the B5 flange to mount the gear unit, the bulk head plate must be engineered to minimize buckling distortions and support the cantilevered weight of the gear reducer or gearmotor. When the mating hole is designed with the proper fit, the flange pilot tenon provides a means of accurately positioning the reducer while the hold-down bolts are properly secured; once the reducer is secured, the tenon helps prevent movement of the reducer and it helps locate the center of the reducer output shaft. The flange centering shoulder tolerance for standard units is listed in table 1. For units with NSD Tuph please see table 2 on the following page.

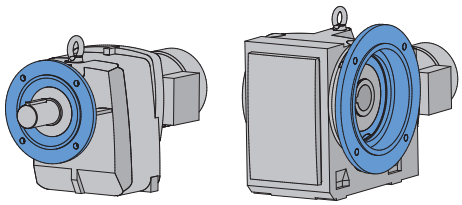


Table 1 : Flange Centering Shoulder Tolerance

Above ø (in)	To & Including ø (in)	Tolerance (in)	ISO 286-2 Fit Class
1.969	3.150	+0.0005 / -0.0003	j6
3.150	4.724	+0.0005 / -0.0004	j6
4.724	7.087	+0.0006 / -0.0004	j6
7.087	9.055	+0.0006 / -0.0005	j6
9.055	9.843	+0.0000 / -0.0011	h6
9.843	12.402	+0.0000 / -0.0013	h6
12.402	15.748	+0.0000 / -0.0014	h6
15.748	19.685	+0.0000 / -0.0016	h6
19.685	21.654	+0.0000 / -0.0017	h6

Above ø (mm)	To & Including ø (mm)	Tolerance (mm)	ISO 286-2 Fit Class
50	80	+0.012 / -0.007	j6
80	120	+0.013 / -0.009	j6
120	180	+0.014 / -0.011	j6
180	230	+0.016 / -0.013	j6
230	250	+0.000 / -0.029	h6
250	315	+0.000 / -0.032	h6
315	400	+0.000 / -0.036	h6
400	500	+0.000 / -0.040	h6
500	550	+0.000 / -0.044	h6

When installing the flange mounted gear unit, observe the flatness specifications and bolt tightening torque guidelines provided in U10060. Make sure the mating mounting surface and reducer flange are clean and free of debris. Use a straight edge or parallel bar to check for high spots on the mating mounting surface and remove any raised material around the mounting holes.

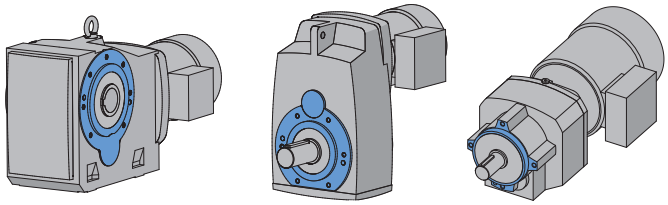
Set the gear unit into place and tighten the bolts until they are snug. Before final bolt-tightening check for any material gaps between the mating surfaces and if shimming is required, use "U" shaped shims at least 2 times the width of the bolt. Avoid over shimming a very irregular surface as this will make it very difficult to achieve proper alignment.

IMPORTANT NOTE

For heavy shock applications, it is advisable to field-install dowel pins through the mounting flange connection (in addition to the mounting bolts). This will help control flange movement or flange rotation and relieve the mounting bolts from this additional stress.

3. Flange-mounted reducers (with B14 flange)

When using the B14 flange to mount the gear unit, the bulk head plate must be engineered to minimize buckling distortions and support the cantilevered weight of the gear reducer or gearmotor. When properly installed, the output flange of the reducer housing is designed to enable the permissible torques and radial forces to be reliably transmitted by the bolt connections. The flange centering shoulder tolerance for standard units is listed in table 1 on the previous page. For units with NSD Tuph please see table 2 below.



IMPORTANT NOTE

When using the B14 flange-face for mounting, if dowel pin holes are provided in addition to the threaded holes, then it is advisable to also use the proper dowel pins, to help control flange movement or flange rotation and relieve the mounting bolts from this additional stress This is especially important for heavy shock applications.

Table 2 : Flange Centering Shoulder Tolerance on NSD Tuph Units

Above ø (in)	To & Including ø (in)	Tolerance (in)
1.969	3.150	+0.0020 / +0.0013
3.150	4.724	+0.0021 / +0.0012
4.724	7.087	+0.0021 / +0.0011
7.087	9.055	+0.0022 / +0.0011

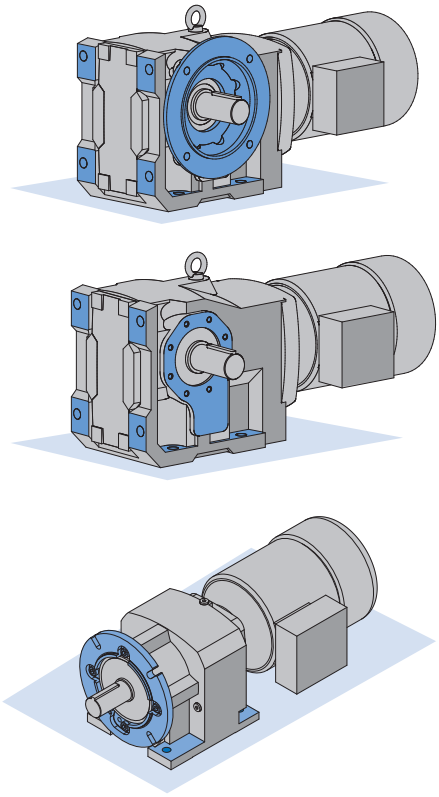
Above ø (mm)	To & Including ø (mm)	Tolerance (mm)
50	80	+0.052 / +0.033
80	120	+0.053 / +0.031
120	180	+0.054 / +0.029
180	230	+0.056 / +0.027

4. Foot & flange reducer housings

Some gear reducer housings are available with a foot and an output flange. Units with a foot and a B5 Flange are designated with the suffix XF after the primary model number and units with a B14 face-flange are designated with the suffix XZ after the primary model number. When a gear unit is provided with both a foot and a flange, the foot is consider the primary mounting surface. The flange is generally considered to be the secondary mounting option and it is intended that this surface be used for auxiliary add on elements that place minimal load stress on the reducer housing.

NOTICE

To prevent overstress on the main gear unit housing, never tighten the reducer mounting feet and the mounting flange against one-another. Auxiliary add-on elements that are mounted to the reducer flange, must not transmit excessive force, torque or vibration to the main gear housing.

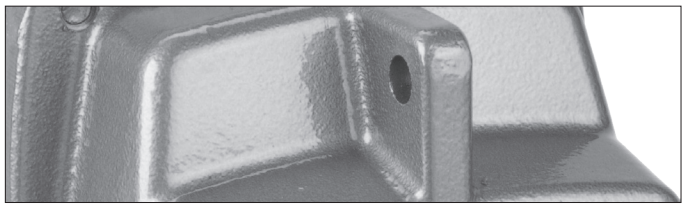


CLINCHER™ SHAFT-MOUNT WITH RUBBER BUFFERS

1. Purpose of the built-in torque arm lug

The preferred method of installing a shaft-mounted Clincher™ reducer is to support the weight of the gear unit or gearmotor assembly from the driven solid machine shaft. In order to restrain the gearbox, react the torque, and keep the gear unit from spinning around the shaft, the Clincher™ gear units have a built-in torque arm lug or tab cast into the reducer housing. This torque tab is intended to be used in conjunction with the NORD Rubber Buffers.

Figure 1: Built-in torque lug



2. Rubber buffers

When specified, NORD provides two rubber buffers that are installed on either side of the gear unit's integral torque lug.

When properly used in tandem, on either side of the torque-arm lug, the rubber buffers help isolate and absorb the load forces present in the system and increase the reducer's service life by reducing cumulative torsional shock loads.

- The primary load force acts in the direction of driven shaft rotation, reacts the torque of the reducer, keeping the gearbox from spinning on the shaft.
- Additional forces present themselves in the direction opposite of the shaft rotation, due to the typical slight out-of-round condition present in the machine shaft. This condition is the reason most shaft mounted-reducers have a slight shaft-wobble, which is normal.

For further dampening it is possible to combine several rubber buffers in a row, on either side of the torque lug.

IMPORTANT NOTE

Please reference Table 1 on page 2 of this manual for dimensional information.

NOTICE

Always mount at least one rubber buffer on either side of the reducer's torque-arm lug. When using rubber buffers in tandem, make sure equal numbers are used on both sides of the torque tab. Failure to do so will not properly cushion the reducer and can result in excessive binding, bearing stress, and damage to the reducer.

3. Machine support

WARNING

It is the responsibility of the machine builder to design a support bracket of adequate strength and rigidity, and supply an appropriate tightening bolt assembly. Failure to do so may result in injury caused from a damaged or broken torque-reaction assembly.

A single customer-supplied machine support bracket, of adequate strength and rigidity, can provide adequate restraint for both directions. This is because when the rubber buffer system is used, the applied load forces are always parallel to the retaining bolt and there are no twisting forces induced onto the bolt in either the clockwise or counter-clockwise direction. In some cases the customer may desire to supply a rigid support on either side of the rubber buffers. In these instances, longer assembly hardware is required.

4. Installation of the rubber buffers

A. Install the Clincher™ hollow bore reducer onto the machine shaft. Line up the hole in the reducer's torque-arm lug with the hole in the machine's support bracket and temporarily hold the reducer in place.

B. Properly secure the gear unit assembly to the driven shaft in an axial direction. If using the NORD Shaft Fixing Kit, follow the instructions in User Manual U10280.

C. Install the rubber buffers on either side of the gear unit's torque-arm lug. Apply a thread locking compound to the end of the fixing bolt. Then place the fixing bolt through the rubber buffers, torque-arm lug and rigid machine support bracket and loosely secure the nut onto the end of the bolt.

D. Tighten the fixing bolt and nut until lightly snug until all of the free play is eliminated from the rubber buffer assembly. Then snug the fixing bolt assembly by tightening an additional 1/4 to 1/2 turn.

NOTICE

To help prevent damage to the rubber buffers, avoid over-tightening.

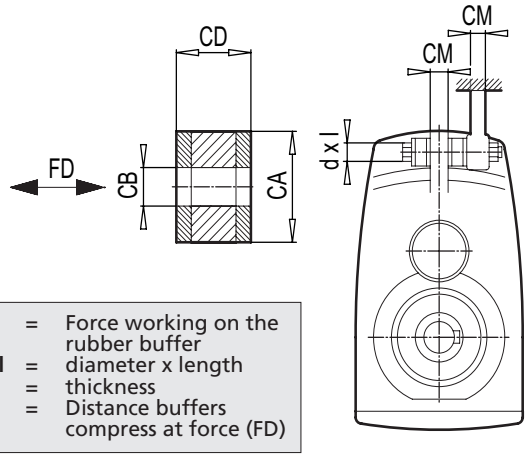
IMPORTANT NOTE

- A min. of (2) rubber buffers are required for each unit.
- For larger size CLINCHER'S™, NORD offers the heavy-duty rubber buffer (Option VG).
- A metric fixing bolt is preferred for rubber buffer assembly. NORD recommends a minimum ISO Grade 8.8 fixing bolt.

CLINCHER™ SHAFT-MOUNT WITH RUBBER BUFFERS

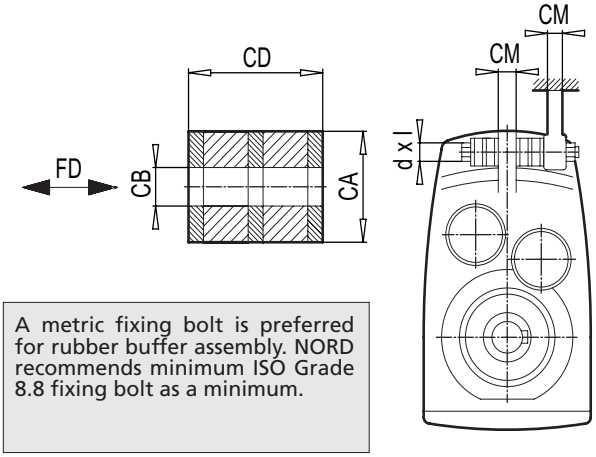
Table 1: Rubber buffer assembly/typical dimensions

Standard Rubber Buffer Assembly Option **(G)**



FD = Force working on the rubber buffer
d x l = diameter x length
c = thickness
S_{FD} = Distance buffers compress at force (FD)

Heavy Duty Rubber Buffer Assembly Option **(VG)**



A metric fixing bolt is preferred for rubber buffer assembly. NORD recommends minimum ISO Grade 8.8 fixing bolt as a minimum.

Type	Rubber Buffer P/N	CB inch [mm]	CA inch [mm]	CD inch [mm]	CM inch [mm]	Bolt d x l [metric]	FD lb [kN]	SFD inch [mm]
SK0182NB G	29603000	0.43 [11]	1.18 [30]	0.59 [15]	0.39 [10]	M10 x 70	217 [0.967]	0.06 [1.5]
SK0282NB G	29603000	0.43 [11]	1.18 [30]	0.59 [15]	0.47 [12]	M10 x 70	234 [1.04]	0.07 [1.7]
SK1282 G	29603000	0.43 [11]	1.18 [30]	0.59 [15]	0.55 [14]	M10 x 80	504 [2.24]	0.14 [3.6]
SK1382NB G	29603000	0.43 [11]	1.18 [30]	0.59 [15]	0.55 [14]	M10 x 80	402 [1.79]	0.11 [2.8]
SK2282 G SK2382 G	29604000	0.49 [12.5]	1.57 [40]	0.59 [15]	0.63 [16]	M12 x 90	600 [2.67]	0.07 [1.8]
SK3282 G SK3382 G	29604000	0.49 [12.5]	1.57 [40]	0.59 [15]	0.71 [18]	M12 x 90	935 [4.16]	0.11 [2.9]
SK4282 G SK4382 G	29606000	0.83 [21]	2.36 [60]	1.18 [30]	0.87 [22]	M20 x 150	1661 [7.39]	0.29 [7.3]
SK5282 G SK5382 G	29606000	0.83 [21]	2.36 [60]	1.18 [30]	1.1 [28]	M20 x 150	2133 [9.49]	0.37 [9.4]
SK6282 G SK6382 G	29608000	0.98 [25]	3.15 [80]	1.57 [40]	1.38 [35]	M24 x 190	3779 [16.81]	0.36 [9.2]
SK7282 G SK7382 G	29608000	0.98 [25]	3.15 [80]	1.57 [40]	1.57 [40]	M24 x 200	4676 [20.8]	0.45 [11.4]
SK8282 G SK8382 G	29610000	1.22 [31]	3.94 [100]	1.97 [50]	1.97 [50]	M30 x 260	6382 [28.39]	0.64 [16.3]
SK9282 G SK9382 G	29610000	1.22 [31]	3.94 [100]	1.97 [50]	2.17 [55]	M30 x 260	9777 [43.49]	0.98 [24.9]

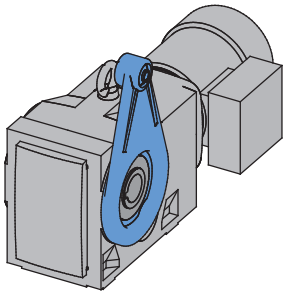
Type	Rubber Buffer P/N	CB inch [mm]	CA inch [mm]	CD inch [mm]	CM inch [mm]	Bolt d x l [metric]	FD lb [kN]	SFD inch [mm]
SK7282 VG SK7382 VG	29620850	0.98 [25]	3.35 [85]	2.36 [60]	1.57 [40]	M24 x 240	4676 [20.8]	0.48 [12.2]
SK8282 VG SK8382 VG	29621100	1.22 [31]	4.33 [110]	3.54 [90]	1.97 [50]	M30 x 340	6382 [28.39]	0.76 [19.3]
SK9282 VG SK9382 VG	29621400	1.22 [31]	5.51 [140]	4.33 [110]	2.17 [55]	M30 x 380	9777 [43.49]	0.83 [21.2]
SK10282 VG SK10382 VG SK10382.1 VG	29621800	1.22 [31]	5.51 [140]	4.33 [110]	3.15 [80]	M30 x 430	12670 [56.36]	1.08 [27.4]
SK11282 VG SK11382 VG SK11382.1 VG	29621800	1.93 [49]	7.09 [180]	5.91 [150]	3.54 [90]	M48 x 550	18185 [80.89]	1.52 [38.5]
SK12382 VG	29621800	1.93 [49]	7.09 [180]	5.91 [150]	3.54 [90]	M48 x 550	23720 [105.51]	1.98 [50.2]

RIGHT-ANGLE SHAFT-MOUNT WITH TORQUE ARM (D)

1. Torque arm (D)

The preferred method of installing a shaft-mounted reducer is to support the weight of the gear unit or gearmotor assembly from the driven solid machine shaft. A torque arm is required in order to restrain the gearbox, react the load torque, and keep the gear unit from spinning around the shaft.

The Torque-Arm (D) bracket is mounted to either side of the right-angle gear unit using mounting screws that thread into the B14 flange-face of the reducer. The anchor hole of the torque-arm bracket is supplied with a resilient rubber bushing.



IMPORTANT NOTE

The side of the reducer that the torque arm is mounted on, and the angular position can be specified at time of order. Consult the appropriate NORD catalog for specific Torque Arm (D) mounting options and ordering guidelines.

2. Purpose of the built-in resilient rubber bushing

The resilient rubber bushing installed into the anchor hole end of the torque-arm helps isolate and absorb all the load forces present in the system and increase the reducer's service life by reducing cumulative torsional shock loads.

- The primary load force acts in the direction of driven shaft rotation, reacts the load torque of the reducer, and prevents the gearbox from spinning on the shaft.
- Additional forces present themselves in the direction opposite of the shaft rotation, due to the typical slight out-of-round condition present in the machine shaft. This condition is the reason most shaft mounted-reducers have a slight shaft-wobble, which is normal.

NOTICE

Always make sure that the Torque Arm (D) has the resilient rubber bushing installed into the anchor hole end of the torque arm. Failure to do so will not properly cushion the reducer and can result in excessive binding, bearing stress, and damage to the reducer.

3. Machine support

The user must supply a suitably strong and rigid mating machine support that provides load bearing capacity on both sides of the torque-arm bracket.

WARNING

It is the responsibility of the machine builder to design a support bracket of adequate strength and rigidity, and supply an appropriate tightening bolt assembly. Failure to do so may result in injury caused from a damaged or broken torque-reaction assembly.

4. Installation of a right-angle reducer with torque arm

A. Make sure the Torque-Arm (D) is mounted in the correct position on the reducer. Assembled screw heads should always sit flush with the torque arm.
   - To reposition the torque-arm, remove the mounting screws, relocate the torque-arm, and reassemble the mounting screws as noted above.
   - If the torque-arm was shipped loose, position the torque-arm in the correct location on the gear unit, and secure the torque-arm as noted above.

IMPORTANT NOTES

- Torque arm mounting screws should be secured with a thread locking product (ex. Loctite® 242 or Loxeal® 54-03) and tightened per the table on page 2.
- Assembled screw heads should always sit flush with the torque arm.
- The support bracket should provide support on both sides of the torque arm or be in the form of a U-shape.
- Do not force the torque-arm. The torque arm must remain at a right angle to the gear unit.
- If mounting holes do not align properly the machine support may need to be moved.

B. Install the right-angle hollow bore reducer onto the machine shaft. Then line up the hole in the reducer's torque-arm with the hole in the machine's support bracket, and temporarily hold the reducer in place.

C. Apply a thread locking compound such as Loctite® 242 or Loxeal® 54-03 to the end of the anchor bolt that is used to secure the torque arm in place.

D. Place the anchor bolt through the support bracket and the reducer torque-arm. Attach the mating nut to the bolt and tighten the assembly until snug. At least one bolt diameter should protrude from the nut after assembly.

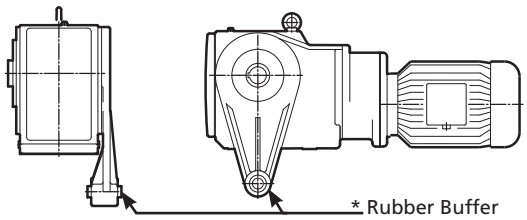
NOTICE

Do not force misalignment of the torque-arm. The torque arm must remain at a right angle to the gear unit or excessive load may be placed on the reducer shaft and bearings.

E. Properly secure the gear unit assembly to the driven shaft in an axial direction.

RIGHT-ANGLE SHAFT-MOUNT WITH TORQUE ARM (D)

Table 1 - Torque Arm (D) with rubber buffer



- For all 90.1 Series Helical-Bevel gear units, NORD also offers a bottom mount Torque Arm (K). See User Manual U10620.
- For the large 90.1 Series Helical-Bevel gear units sizes: SK9082.1, SK9086.1, SK9092.1, and SK9096.1, please use the Torque Arm (K).
- A metric fixing bolt is preferred for fastening the Torque-Arm(D) to the machine support bracket.

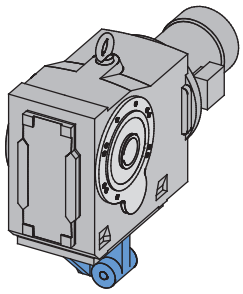
Gear Unit Series	Torque Arm				Torque Arm Mounting Screw				
	Type	Rubber Buffer P/N	Anchor Hole Size	Anchor Bolt Size	Qty	Size	Grade	Torque (Nm)	Torque (lb-ft)
92.1/93.1 Series Helical-Bevel	SK92072.1AD/SK93072.1AD	29602505	10.5 mm [0.41 in]	M10	4	M8 x 25	8.8	27	20
	SK92172.1AD/SK93172.1AD	29602505	10.5 mm [0.41 in]	M10	4	M8 x 25	8.8	27	20
	SK92372.1AD/SK93372.1AD	29602505	10.5 mm [0.41 in]	M10	4	M10 x 30	8.8	53	39
	SK92672.1AD/SK93672.1AD	29602505	10.5 mm [0.41 in]	M10	4	M10 x 30	8.8	53	39
	SK92772.1AD/SK93772.1AD	29603605	16.5 mm [0.65 in]	M16	4	M12 x 30	8.8	92	68
92 Series Helical-Bevel	SK92172AZD	29602505	10.5 mm [0.41 in]	M10	8	M6 x 16	8.8	11	8
	SK92372AZD	29602505	10.5 mm [0.41 in]	M10	8	M8 x 25	8.8	27	20
	SK92672AZD	29602505	10.5 mm [0.41 in]	M10	8	M8 x 25	8.8	27	20
	SK92772AZD	29603605	16.5 mm [0.65 in]	M16	8	M8 x 25	8.8	27	20
90.1 Series Helical-Bevel	SK9012.1AZD/SK9013.1AZD	29602505	10.5 mm [0.41 in]	M10	7	M8 x 20	8.8	27	20
	SK9016.1AZD/SK9017.1AZD	29602505	10.5 mm [0.41 in]	M10	7	M8 x 20	8.8	27	20
	SK9022.1AZD/SK9023.1AZD	29603605	16.5 mm [0.65 in]	M16	7	M8 x 25	8.8	27	20
	SK9032.1AZD/SK9033.1AZD	29603605	16.5 mm [0.65 in]	M16	7	M10 x 30	8.8	53	39
	SK9042.1AZD/SK9043.1AZD	29605205	25 mm [0.98 in]	M24	7	M12 x 35	8.8	92	68
	SK9052.1AZD/SK9053.1AZD	29605205	25 mm [0.98 in]	M24	7	M12 x 35	8.8	92	68
	SK9072.1AZD	29605205	25 mm [0.98 in]	M24	7	M16 x 45	8.8	230	170
Helical-Worm	SK02040AZD	29602505	10.5 mm [0.41 in]	M10	4	M6 x 20	8.8	11	8
	SK02050AZD/SK13050AZD	29602505	10.5 mm [0.41 in]	M10	4	M8 x 20	8.8	27	20
	SK12063AZD/SK13063AZD	29602505	10.5 mm [0.41 in]	M10	7	M8 x 22	8.8	27	20
	SK12080AZD/SK13080AZD	29602505	10.5 mm [0.41 in]	M10	7	M10 x 25	8.8	53	39
	SK32100AZD/SK33100AZD	29603605	16.5 mm [0.65 in]	M16	7	M12 x 30	8.8	92	68
	SK42125AZD/SK43125AZD	29603605	16.5 mm [0.65 in]	M16	7	M12 x 30	8.8	92	68
MINICASE® SMI Series Worm	SK1SMI31AZD	29602505	10.5 mm [0.41 in]	M10	4	M6 x 16	8.8	11	8
	SK1SMI40AZD/SK2SMI40AZD	29602505	10.5 mm [0.41 in]	M10	4	M8 x 22	8.8	27	20
	SK1SMI50AZD/SK2SMI50AZD	29602505	10.5 mm [0.41 in]	M10	4	M8 x 22	8.8	27	20
	SK1SMI50AZD/SK2SMI50AZD	29602505	10.5 mm [0.41 in]	M10	4	M8 x 22	8.8	27	20
	SK1SMI63AZD/SK2SMI63AZD	29602505	10.5 mm [0.41 in]	M10	4	M10 x 25	8.8	53	39
	SK1SMI75AZD	29602505	10.5 mm [0.41 in]	M10	4	M12 x 30	8.8	92	68
MINICASE® SM Series Worm	SK1SM31AZD	29602505	10.5 mm [0.41 in]	M10	4	M6 x 20	8.8	11	8
	SK1SM40AZD/SK2SM40AZD	29602505	10.5 mm [0.41 in]	M10	4	M8 x 20	8.8	27	20
	SK1SM50AZD/SK2SM50AZD	29602505	10.5 mm [0.41 in]	M10	4	M8 x 20	8.8	27	20
	SK1SM63AZD/SK2SM63AZD	29602505	10.5 mm [0.41 in]	M10	4	M8 x 20	8.8	27	20
"FLECBLOC™ SI Series Worm"	SK1SI31D	29602505	10.5 mm [0.41 in]	M10	4	M6 x 16	8.8	11	8
	SK1SI40D	29602505	10.5 mm [0.41 in]	M10	4	M8 x 22	8.8	27	20
	SK1SI50D	29602505	10.5 mm [0.41 in]	M10	4	M8 x 22	8.8	27	20
	SK1SI63D	29602505	10.5 mm [0.41 in]	M10	4	M10 x 25	8.8	53	39
	SK1SMI75D	29602505	10.5 mm [0.41 in]	M10	4	M12 x 30	8.8	92	68

90.1 HELICAL-BEVEL SHAFT-MOUNT WITH BOTTOM MOUNT TORQUE ARM (K)

1. Torque arm (K)

The preferred method of installing a shaft-mounted reducer is to support the weight of the gear unit or gearmotor assembly from the driven solid machine shaft. A torque arm is required in order to restrain the gearbox, react to the load torque, and keep the gear unit from spinning around the shaft.

Table 1 (Page 2) provides a list of Torque-Arm (K) part numbers available for the 90.1 Series Helical-Bevel gear units. The Torque Arm (K) is secured to the base of the reducer. On most sizes there is an integral resilient rubber bushing located at the fastening hole-end of the torque arm. On the larger sizes, rubber buffers are used in conjunction with the torque arm and when properly used they are applied in tandem, on either side of the torque arm lug.



IMPORTANT NOTE

When ordering the Torque Arm (K) one can specify which side of the reducer to mount the fastening hole that bolts to the machine support bracket. Consult the appropriate NORD catalog for specific Torque Arm (K) mounting options and ordering guidelines.

2. Purpose of the rubber bushing or rubber buffers

Regardless if the Torque Arm (K) is supplied with the integral rubber bushing or whether separate rubber buffers are required, the bushing/buffers help isolate and absorb all the load forces present in the system and increase the reducer's service life by reducing cumulative torsional shock loads.

- The primary load force acts in the direction of driven shaft rotation, reacts the load torque of the reducer, and prevents the gearbox from spinning on the shaft.
- Additional forces present themselves in the direction opposite of the shaft rotation, due to the typical slight out-of-round condition present in the machine shaft. This condition is the reason most shaft mounted-reducers have a slight shaft-wobble, which is normal.

NOTICE

Always make sure that the Torque Arm (K) is used in conjunction with the required rubber bushing/s. Failure to do so will not properly cushion the reducer and can result in excessive binding, bearing stress, and damage to the reducer.

3. Machine support

The user must supply a suitably strong and rigid mating machine support that provides load bearing capacity on both sides of the machine support bracket.

⚠ WARNING

It is the responsibility of the machine builder to design a support bracket of adequate strength and rigidity, and supply an appropriate tightening bolt assembly. Failure to do so may result in injury caused from a damaged or broken torque-reaction assembly.

4. Installation of the right-angle reducer with torque arm (K)

A. Make sure the Torque-Arm (K) is mounted so that the machine fastening hole is on the correct side of the reducer.
   - The torque-arm can be repositioned on the as-received unit by removing the fixing screws, re-position the torque-arm in the correct location, and re-securing the fixing screws to the proper tightening torque, as indicated in Table 2 (Page 2).
   - If the torque-arm was shipped loose, position the torque-arm in the correct location on the gear unit, and secure the torque-arm with the proper fixing screws & tightening torque, as indicated in Table 2 (Page 2).

B. Install the right-angle hollow bore reducer onto the machine shaft. Line up the hole in the reducer's torque-arm with the hole in the machine's support bracket ,and temporarily hold the reducer in place

C. Properly secure the gear unit assembly to the driven shaft in an axial direction.

D. Apply thread locking compound to the end of the fixing bolt, then place the fastening bolt through the rigid machine support bracket and reducer torque-arm and loosely secure the nut onto the end of the bolt.

E. If the torque arm has an integral rubber bushing follow step F and skip steps G-H. If the torque arm uses rubber buffers skip forward to steps G-H.

F. Tighten the fixing bolt to the proper tightening torque as indicated in Table 2 (Page 2).

G. Install the rubber buffers on either side of the gear unit's torque-arm lug and place the fixing bolt through the rubber buffers and torque-arm lug and into the rigid machine support bracket.

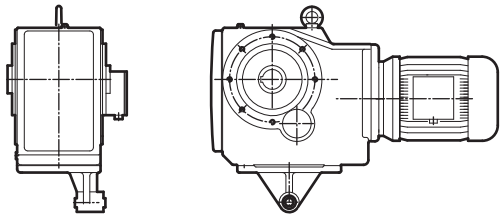
H. Tighten the fixing bolt and nut lightly snug, until all the free-play is eliminated from the rubber buffer assembly. Then snug the fixing bolt assembly by tightening an additional ¼ to ½ turn.

NOTICE

To prevent damage to the rubber buffers, avoid over-tightening.

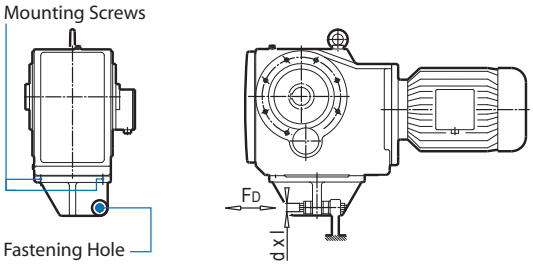
90.1 HELICAL-BEVEL SHAFT-MOUNT WITH BOTTOM MOUNT TORQUE ARM (K)

Torque Arm (K) with integrated bushing



Available for Sizes SK9012.1 - SK9072.1

Torque Arm (K) with rubber buffer



Available for Sizes SK9082.1 - SK90906.1

- For most all 90.1 series Helical-Bevel gear units, an optional tear-drop shaped side -mounted torque arm (D) is available. See user manual U10600.
- A metric fixing bolt is preferred for fastening the torque arm (K) to the machine support bracket.

Type	Torque Arm P/N	Reducer Hardware Hex Head Cap Screws + Lock Washer	Mounting Screw P/N	Lock Washer P/N	Rubber Buffer P/N	Fastening Hole In [mm]	Fastening Bolt Size	Bolt d x l [metric]	FD lb [N]	SFD inch [mm]
SK9012.1...K SK9013.1...K	68190600	M10 X 30 + A10 (Qty 3 Ea.)	22010300	28560106	N/A	0.41 [10.5]	M10	N/A	N/A	N/A
SK9016.1...K SK9017.1...K	68190600	M10 X 30 + A10 (Qty 3 Ea.)	22010300	28560106	N/A	0.41 [10.5]	M10	N/A	N/A	N/A
SK9022.1...K SK9023.1...K	68290610	M12 X 35 + A12 (Qty 3 Ea.)	22012350	28560126	N/A	0.65 [16.5]	M16	N/A	N/A	N/A
SK9032.1...K SK9033.1...K	68390610	M12 X 35 + A12 (Qty 3 Ea.)	22012350	28560126	N/A	0.65 [16.5]	M16	N/A	N/A	N/A
SK9042.1...K SK9043.1...K	68490610	M16 X 40 + A16 (Qty 3 Ea.)	22016400	28560166	N/A	0.98 [25]	M24	N/A	N/A	N/A
SK9052.1...K SK9053.1...K	68590620	M16 X 40 + A16 (Qty 3 Ea.)	22016450	28560166	N/A	0.98 [25]	M24	N/A	N/A	N/A
SK9072.1...K	68690620	M24 X 60 + A24 (Qty 4 Ea.)	22024060	28560246	N/A	0.98 [25]	M24	N/A	N/A	N/A
SK9082.1...K SK9082.1...SHK	68819010	M24 x 65 + A24 (Qty 4 Ea.)	22024650	22024650	29610000	1.22 [31]	M30	M30 x 260	5300 [23.64]	0.53 [13.5]
SK9086.1...K SK9086.1...SHK	68819010	M24 x 65 + A24 (Qty 4 Ea.)	22024650	22024650	29610000	1.22 [31]	M30	M30 x 260	6900 [30.77]	0.69 [17.6]
SK9092.1...SHK	68919010	M36 x 90 + A36 (Qty 4 Ea.)	22036900	28560366	29610000	1.22 [31]	M30	M30 x 260	10300 [45.71]	1.03 [26.2]
SK9096.1...SHK	69019000	M42 x 120 + A42 (Qty 4 Ea.)	22042120	28560426	29621800	1.93 [49]	M48	M48 x 550	12,500 [55.56]	1.06 [27.0]

HELICAL & BEVEL REDUCER LUBRICATION

1. Importance of proper lubrication

Proper gearbox lubrication is essential in order to reduce friction, heat, and component wear. Lubricants reduce heat and wear by inserting a protective "fluid boundary" between mating parts and preventing direct metal to metal contact. Lubricants also help prevent corrosion and oxidation, minimize foam, improve heat transfer, optimize reducer efficiency, absorb shock loads and reduce noise.

Most NORD reducers are shipped from the factory with a pre-determined oil fill level in accordance to the specified reducer size and mounting position.

2. Standard oil type

The following tables indicate the standard oil fill type used. Please see user manual U11000 for more specific information and for optional helical and bevel gear lubricants:

Serviceable Gear Units	
Helical In-line	Standard Oil Fill: ISO VG 220, Mineral Oil
Clincher Parallel-Shaft	
Right-Angle Bevel	
NORDBLOC® Series In-line	
NORDBLOC®.1 Series In-line	
Standard Series In-line	

IMPORTANT NOTE

For shipping purposes, the following large Clincher™ gear units are supplied without oil:
- Clincher™ Sizes SK11282, SK11382, SK11382.1 and SK12382

Maintenance-free / Lubricated For Life Gear Units	
Clincher™ sizes SK0182NB, SK0282NB & SK1382NB	Standard Oil Fill: ISO VG220 SHC/PAO Synthetic Oil
NORDBLOC® Sizes SK172, SK272, SK371F, SK372, SK373, SK320	

IMPORTANT NOTE

Maintenance-free units are supplied as sealed units with no vent-plug. Consult NORD prior to ordering if interested in ordering any of the above sizes as serviceable gear units.

IMPORTANT NOTE

Consult the sticker adjacent to the fill plug to determine the type of lubricant installed at the factory. Some units have special lubricants designed to operate in certain environments or intended to extend the service life or service temperature range of the lubricant. If in doubt about which lubricant is needed for a certain application, please contact NORD Gear.

3. Lubrication replacement

If the gear unit is filled with mineral oil, the lubricant should be replaced at least after every 10,000 operating hours or after every two years. If the gear unit is filled with synthetic oil, the lubricant should be replaced at least after every 20,000 operating hours or after every four years. Often gear reducers are exposed to extreme ambient conditions, hostile environments, wet conditions, or dirty and dusty operating areas. Especially in these situations, it is important to establish a condition-based oil service interval.

4. Oil viscosity

Viscosity, or the oil's resistance to shear under load, is often considered the single most important property of any gear oil.

- Often one will consider making a viscosity correction to the oil to improve the performance when operating the gear unit at low temperature or high temperature.
- In cases of extreme load conditions, gear pairs and antifriction bearings may be more susceptible to sliding or scuffing wear. In these operating conditions, it may also be beneficial to consider an increased lubrication viscosity and/or a lubrication with improved antiwear additive packages.

IMPORTANT NOTE

The user should consult with their primary lubrication supplier before considering changes in oil type or viscosity.

5. Maximum oil sump temperature limit

To prevent reducer overheating, the reducer's maximum oil sump temperature limit must not be exceeded for prolonged periods of operation (up to 3 hours continuous operation depending upon reducer size).

Oil Type	Maximum Oil Temperature Limit	
	NORD	AGMA 9005-D94
Mineral	80-85°C (176-185°F)	95°C (203°F)
Synthetic	105°C (220°F)	107°C (225°F)

IMPORTANT NOTE

Use caution when specifying gear reducers for high temperature service. If there is concern about exceeding the allowable safe operating temperatures, please consult NORD to discuss alternatives.

6. The importance of routine oil analysis

Routine oil analysis, sound lubrication practices, and good tracking of oil performance trends will help establish proper lubrication maintenance and change-out intervals. To maximize equipment reliability, NORD Gear generally recommends a condition-based lubrication maintenance program. One may take exceptions to this general recommendation on sealed-for-life or maintenance-free gear units or smaller and less costly gear units. In these instances, the replacement cost of the gear unit is often small compared to the costs associated with this type of oil analysis program.

NOTICE

NORD suggests replacing the gear oil if oil analysis indicates any of the following. Failure to replace the oil may cause internal damage to gearbox and diminished performance:

- Viscosity has changed by approximately 10% or more.
- Debris particles (silicon, dust, dirt or sand) exceed 25 ppm.
- Iron content exceeds 150-200 ppm.
- Water content is greater than 0.05% (500 ppm).
- The total acid number (TAN) tests indicate a significant level of oxidative break-down of the oil, and a critical reduction in performance; If the TAN number measured changes by more than 5% over the new oil, then an oil change would be recommended.

7. Mounting position and oil fill quantity

All NORD Gear reducers are shipped from the factory with a pre-determined oil fill level in accordance to the specified reducer size and mounting position. ***For additional information, please see the seperate mounting position diagrams and the corresponding oil fill quantity tables for the specified gear unit.***

The gearbox nametag will indicate the mounting position that was provided. ***For mounting orientations other than shown in the mounting position charts, please consult NORD Gear.***

IMPORTANT NOTE

Actual oil volume can vary slightly depending upon the gear case size, mounting and ratio. Prior to commissioning the reducer, check the oil-fill level using the reducer's oil-level plug and drain or add additional oil as needed. The minimum acceptable oil level is 0.15 in (4mm) below the oil level hole.

8. Oil plug locations

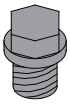
All gear units are assembled with the oil fill-level, oil-drain and vent plugs installed in their proper locations, according to the specified mounting position. All standard plugs are metric and utilize sealing gaskets between the head of the plug and the reducer housing.

9. Drain and fill-level plugs

All reducer drain plugs are metric socket head cap screws. For easier identification, it is NORD's standard practice to provide a hex-head screw for the fill-level plug. For ease of draining the used oil from the gear reducer, use the socket head screw located at the lowest part of the gearbox.



Drain Plug



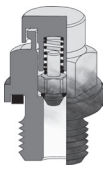
Fill Level Plug

10. Vent plug locations

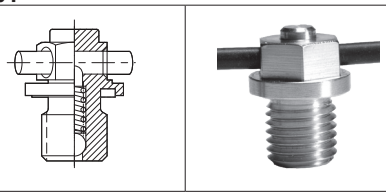
Reducer venting allows for air pressure differences that occur during operation, between the inner space of the reducer and the atmosphere, while ensuring leak-free operation. The AUTOVENT™ is standard for all vented gear units, unless otherwise noted.

AUTOVENT™ - The AUTOVENT™ helps prevent bearing and gear damage by behaving like a check valve to block the entry of foreign material and prevent lubrication contamination from dust particles, moisture and air-borne process chemicals. The breather opens at approximately 0.3-0.9 psi during operation and closes tightly as the gearbox cools. This option is perfect for humid conditions and wash-down environments, helping to maintain proper oil cleanliness, while reducing foaming and oxidation.

Figure 1 AUTOVENT™ Types



Type 1

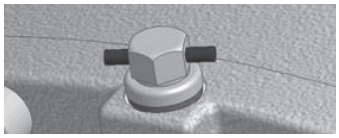


Type 2 with transportation plug

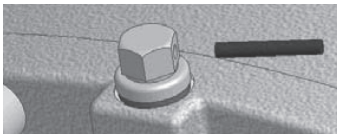
Open Vent - An optional open vent can be supplied by NORD. The open vent comes closed upon delivery with a transportation sealing plug (see Warning).

NOTICE

To prevent build-up of excessive pressure, sealed vents must be activated as shown prior to gear unit start up. Excessive pressure may cause damage to internal components and cause leakage.



Sealed vent



Activated vent

Filtered Vent - NORD may offer an optional filtered vent, which allows gases to permeate, but does not allow dust and debris to pass through the vent.

CONVEYOR DRIVE REDUCER LUBRICATION

1. Importance of proper lubrication

Proper gearbox lubrication is essential in order to reduce friction, heat, and component wear. Lubricants reduce heat and wear by inserting a protective "fluid boundary" between mating parts and preventing direct metal to metal contact. Lubricants also help prevent corrosion and oxidation, minimize foam, improve heat transfer, optimize reducer efficiency, absorb shock loads and reduce noise.

2. Factory oil type

All SK 9055 and SK9155 Conveyor Drive reducers shipped from the factory with a pre-determined oil fill level in accordance to the specified mounting position. Oil filling before shipment prevents damage from dry start-ups and helps assure that the proper lubrication is used.

Standard Oil Fill

The standard oil fill for the SK 9055 and SK 9155 Conveyor Drive is ISO VG 220, Mineral Oil.

Optional Oil Fill

Both synthetic and food grade oil options are also available upon request.

IMPORTANT NOTE

Consult the sticker adjacent to the fill plug to determine the type of lubricant installed at the factory. Some units have special lubricants designed to operate in certain environments or intended to extend the service life or service temperature range of the lubricant. If in doubt about which lubricant is needed for a certain application, please contact NORD Gear.

3. Lubrication replacement

If the gear unit is filled with mineral oil, the lubricant should be replaced at least after every 10,000 operating hours or after every two years. If the gear unit is filled with synthetic oil, the lubricant should be replaced at least after every 20,000 operating hours or after every four years. Often gear reducers are exposed to extreme ambient conditions, hostile environments, wet conditions, or dirty and dusty operating areas. Especially in these situations, it is important to establish a condition-based oil service interval.

4. Oil viscosity

Viscosity, or the oil's resistance to shear under load, is often considered the single most important property of any gear oil.

- Often one will consider making a viscosity correction to the oil to improve the performance when operating the gear unit at low temperature or high temperature.
- In cases of extreme load conditions, gear pairs and antifriction bearings may be more susceptible to sliding or scuffing wear. In these operating conditions, it may also be beneficial to consider an increased lubrication viscosity and/or a lubrication with improved antiwear additive packages.

IMPORTANT NOTE

The user should consult with their primary lubrication supplier before considering changes in oil type or viscosity.

5. Maximum oil sump temperature limit

To prevent reducer overheating, the reducer's maximum oil sump temperature limit must not be exceeded for prolonged periods of operation (up to 3 hours continuous operation depending upon reducer size).

Oil Type	Maximum Oil Temperature Limit	
	NORD	AGMA 9005-D94
Mineral	85°C (185°F)	95°C (203°F)
Synthetic	105°C (220°F)	107°C (225°F)

IMPORTANT NOTE

Use caution when specifying gear reducers for high temperature service. If there is concern about exceeding the allowable safe operating temperatures, please consult NORD to discuss alternatives.

6. The importance of routine oil analysis

Routine oil analysis, sound lubrication practices, and good tracking of oil performance trends will help establish proper lubrication maintenance and change-out intervals. To maximize equipment reliability, NORD Gear generally recommends a condition-based lubrication maintenance program. One may take exceptions to this general recommendation on sealed-for-life or maintenance-free gear units or smaller and less costly gear units. In these instances, the replacement cost of the gear unit is often small compared to the costs associated with this type of oil analysis program.

NOTICE

NORD suggests replacing the gear oil if oil analysis indicates any of the following. Failure to replace the oil may cause internal damage to gearbox and diminished performance:

- Viscosity has changed by approximately 10% or more.
- Debris particles (silicon, dust, dirt or sand) exceed 25 ppm.
- Iron content exceeds 150-200 ppm.
- Water content is greater than 0.05% (500 ppm).
- The total acid number (TAN) tests indicate a significant level of oxidative break-down of the oil, and a critical reduction in performance; If the TAN number measured changes by more than 5% over the new oil, then an oil change would be recommended.

7. Mounting position and oil fill quantity

Please see the seperate mounting position diagrams and the corresponding oil fill quantity tables for the specified gear unit.

The gearbox nametag will indicate the mounting position that was provided. ***For mounting orientations other than shown in the mounting position charts, please consult NORD Gear.***

IMPORTANT NOTE

Actual oil volume can vary slightly depending upon the gear case size, mounting and ratio. Prior to commissioning the reducer, check the oil-fill level using the reducer's oil-level plug and drain or add additional oil as needed. The minimum acceptable oil level is 0.15 in (4mm) below the oil level hole.

8. Oil plug locations

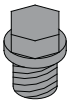
All gear units are assembled with the oil fill-level, oil-drain and vent plugs installed in their proper locations, according to the specified mounting position. All standard plugs are metric and utilize sealing gaskets between the head of the plug and the reducer housing.

9. Drain and fill-level plugs

All reducer drain plugs are metric socket head cap screws. For easier identification, it is NORD's standard practice to provide a hex-head screw for the fill-level plug. For ease of draining the used oil from the gear reducer, use the socket head screw located at the lowest part of the gearbox.



Drain Plug



Fill Level Plug

10. Vent plug locations

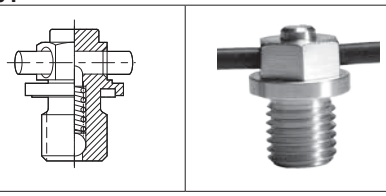
Reducer venting allows for air pressure differences that occur during operation, between the inner space of the reducer and the atmosphere, while ensuring leak-free operation. The AUTOVENT™ is standard for all vented gear units, unless otherwise noted.

AUTOVENT™ - The AUTOVENT™ helps prevent bearing and gear damage by behaving like a check valve to block the entry of foreign material and prevent lubrication contamination from dust particles, moisture and air-borne process chemicals. The breather opens at approximately 0.3-0.9 psi during operation and closes tightly as the gearbox cools. This option is perfect for humid conditions and wash-down environments, helping to maintain proper oil cleanliness, while reducing foaming and oxidation.

Figure 1 AUTOVENT™ Types



Type 1



Type 2 with transportation plug

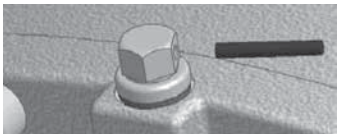
Open Vent - An optional open vent can be supplied by NORD. The open vent comes closed upon delivery with a transportation sealing plug (see Warning).

NOTICE

To prevent build-up of excessive pressure, sealed vents must be activated as shown prior to gear unit start up. Excessive pressure may cause damage to internal components and cause leakage.



Sealed vent



Activated vent

Filtered Vent - NORD may offer an optional filtered vent, which allows gases to permeate, but does not allow dust and debris to pass through the vent.

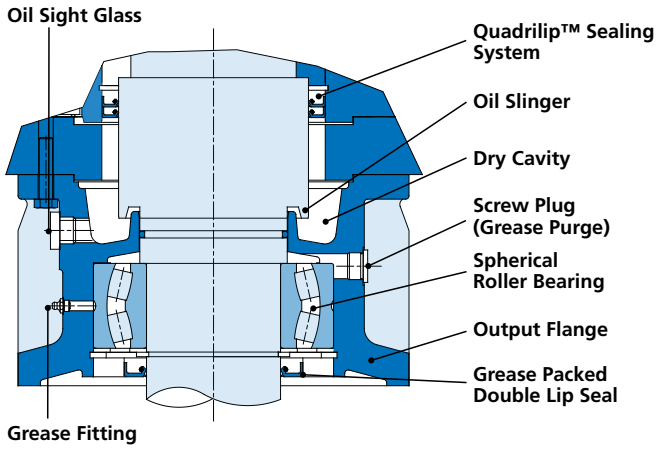
CONVEYOR DRIVE EXTENDED BEARING LUBRICATION

1. SK 9055 and SK 9155 Conveyor Drive Units

The NORD SK 9055 and SK 9155 Conveyor Drive reducers are designed to be a 'mounting flange and output shaft drop-in' for existing 'industry-standard' overhead conveyor drives.

2. Spread Bearing Design with Dry Cavity

The SK 9055 and SK 9155 Overhead Conveyor Drive gear units have two main features: a spread bearing design or large output bearing span and an oil leakage protection system. The spread bearing design enables the NORD box to handle high, overhung loads. The top bearing is a cylindrical roller bearing and the bottom bearing is a spherical roller bearing, selected for its high radial load capacity.



3. Service Guidelines for the Extended Bearing Flange

The spherical roller bearing on the extended bearing housing should be re-greased with 0.75 to 1.0 ounces (20-25 grams) of grease after every 2,500 hours of service or at least every 6 months. Prior to re-greasing the screw plug located opposite to the grease nipple should be unscrewed. After re-greasing the screw plug must be reinstalled and tightened. The extended bearing is factory assembled with the proper amount and type of grease. The type of grease supplied depends upon the type of oil specified at time of order.

Bearing Grease Options

Reducer Oil Type	NLGI Grade	Grease Thickener	Grease Base Oil	Ambient Temperature Range	Manufacturer Brand/Type
MIN-EP	NLGI 2	Li-Complex	MIN	-30 to 60°C (-22 to 140°F)	Mobil Grease XHP222
PAO	NLGI 2	Li-Complex	PAO	-40 to 80°C (-40 to 176°F)	Mobil / Mobilith SHC 220
FG or FG-PAO	NLGI 2	Polyurea	FG-PAO	-30 to 80°C (-22 to 176°F)	Mobil SHC Polyrex 222

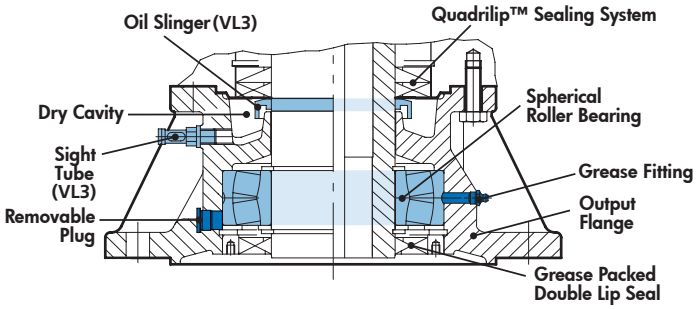
NOTICE

Grease compatibility depends upon the type of thickener or soap complex used, the base oil type suspended within the thickener, and the type of additives used. The user should check with the lubrication supplier before making substitutions in brand and type in order to assure compatibility and to avoid causing possible damage to the extended bearing.

VL2 & VL3
EXTENDED BEARING LUBRICATION

1. VL2 – Spread Bearing Design

NORD offers reinforced output shaft bearings with increased bearing distance. The lower bearing is a oversized, double row spherical bearing, which absorbs high overhung and thrust loads while providing a longer bearing service life. The spherical roller bearing is especially useful in compensating for alignment errors in long agitator shafts. The VL2 spread bearing design is commonly used for shredders, mixers, overhead conveyors or applications requiring increased bearing load carrying capacities. Included with the VL2 design is a grease fitting for the lower bearing and a removable plug to allow excess grease to purge from the bearing cavity.



2. VL3 – Spread Bearing Design with Oil Safe Dry Cavity

The VL3 dry cavity design adds additional oil leak protective measures to the VL2 spread bearing design. NORD's Quadralip™ sealing system prevents oil from leaking from the gearbox into the VL2 flange. If in any case oil does leak past the Quadralip™ seals, it would flow down to the oil slinger mounted onto the shaft. As the shaft rotates, the oil will sling off into the dry cavity. A sight tube is provided for dry cavity inspection. At the bottom of the spread bearing flange is greased packed, double lip seal.

3. Service Guidelines for the Extended Bearing Flange

The spherical roller bearing on the extended bearing housing should be re-greased with 0.75 to 1.0 ounces (20-25 grams) of grease after every 2,500 hours of service or at least every 6 months. Prior to re-greasing the screw plug located opposite to the grease nipple should be unscrewed. After re-greasing the screw plug must be reinstalled and tightened. The extended bearing is factory assembled with the proper amount and type of grease. The type of grease supplied depends upon the type of oil specified at time of order.

Bearing Grease Options

Reducer Oil Type	NLGI Grade	Grease Thickener	Grease Base Oil	Ambient Temperature Range	Manufacturer Brand/Type
MIN-EP	NLGI 2	Li-Complex	MIN	-30 to 60°C (-22 to 140°F)	Mobil Grease XHP222
PAO	NLGI 2	Li-Complex	PAO	-40 to 80°C (-40 to 176°F)	Mobil / Mobilith SHC 220
FG or FG-PAO	NLGI 2	Polyurea	FG-PAO	-30 to 80°C (-22 to 176°F)	Mobil SHC Polyrex 222

NOTICE

Grease compatibility depends upon the type of thickener or soap complex used, the base oil type suspended within the thickener, and the type of additives used. The user should check with the lubrication supplier before making substitutions in brand and type in order to assure compatibility and to avoid causing possible damage to the extended bearing.

HELICAL-WORM REDUCER LUBRICATION

1. Importance of proper lubrication

Proper gearbox lubrication is essential in order to reduce friction, heat, and component wear. Lubricants reduce heat and wear by inserting a protective "fluid boundary" between mating parts and preventing direct metal to metal contact. Lubricants also help prevent corrosion and oxidation, minimize foam, improve heat transfer, optimize reducer efficiency, absorb shock loads and reduce noise.

NORD helical-worm reducers are shipped from the factory with a pre-determined oil fill level in accordance to the specified reducer size and mounting position.

2. Standard oil type

NORD helical worm gear reducers are filled with ISO VG 680 synthetic-hydrocarbon/polyalphaolefin (SHC/PAO) worm gear oil.

- SHC/PAO worm gear oils have good high and low temperature stability, are compatible with most paint and seal types, and are miscible with mineral oils.
- SHC/PAO worm gear oils also contain a small amount of organic ester and other antiwear (AW) packages to offer improved lubrication conditions, especially in the worm mesh, where a sideways sliding motion prevails.

Please see user manual U11020 for more specific information and for optional helical worm lubricants.

NOTICE

In worm gears avoid using extreme pressure (EP) gear oils containing sulfur-phosphorous chemistries; these additives can react adversely with bronze worm gears, and accelerate wear.

IMPORTANT NOTE

Consult the sticker adjacent to the fill plug to determine the type of lubricant installed at the factory. Some units have special lubricants designed to operate in certain environments or intended to extend the service life or service temperature range of the lubricant. If in doubt about which lubricant is needed for a certain application, please contact NORD Gear.

3. Lubrication replacement

The helical-worm gear oil should be replaced at least after every 20,000 operating hours or after every four years. Often gear reducers are exposed to extreme ambient conditions, hostile environments, wet conditions, or dirty and dusty operating areas. Especially in these situations, it is important to establish a condition-based oil service interval.

4. Efficiency

Helical worm gears reach efficiencies up to 92% and are generally much more efficient than worm-only gear units. However, it is important to consider the following, when using worm gears.

- Worm gears reach their peak rated efficiency, after they undergo a natural run-in process (up to 25 hours operating time at maximum rated load). Catalog published power and torque figures are based upon the rated efficiency after the run-in is complete.
- Worm gears have naturally lower startup efficiencies compared to operating efficiencies. As input speed increases the enhanced hydrodynamic effects of the oil result in less tooth friction and increased worm gear efficiency.

IMPORTANT NOTE

Worm gear reducers applied in cold temperature service, may require increased motor power for the following reasons:

- Lower operating temperatures, cause lubrication viscosity to increase in both the gearbox and in the moving areas of the driven machine.
- Worm-gears have naturally lower start-up efficiencies compared to operating efficiencies.
- In extreme cases, one might need to consider increasing the motor power and lowering the oil viscosity

5. Oil Viscosity

Viscosity, or the oil's resistance to shear under load, is often considered the single most important property of any gear oil.

- Often one will consider making a viscosity correction to the oil to improve the performance when operating the gear unit at low temperature or high temperature.
- In cases of extreme load conditions, gear pairs and antifriction bearings may be more susceptible to sliding or scuffing wear. In these operating conditions, it may also be beneficial to consider an increased lubrication viscosity and/or a lubrication with improved antiwear additive packages.

IMPORTANT NOTE

The user should consult with their primary lubrication supplier before considering changes in oil type or viscosity.

6. Maximum oil sump temperature limit

To prevent reducer overheating, the reducer's maximum oil sump temperature limit must not be exceeded for prolonged periods of operation (up to 3 hours continuous operation depending upon reducer size).

Oil Type	Maximum Oil Temperature Limit	
	NORD	AGMA 9005-D94
Synthetic	105°C (220°F)	107°C (225°F)

IMPORTANT NOTE

Use caution when specifying gear reducers for high temperature service. If there is concern about exceeding the allowable safe operating temperatures, please consult NORD to discuss alternatives.

7. The importance of routine oil analysis

Routine oil analysis, sound lubrication practices, and good tracking of oil performance trends will help establish proper lubrication maintenance and change-out intervals. To maximize equipment reliability, NORD Gear generally recommends a condition-based lubrication maintenance program. One may take exceptions to this general recommendation on sealed-for-life or maintenance-free gear units or smaller and less costly gear units. In these instances, the replacement cost of the gear unit is often small compared to the costs associated with this type of oil analysis program.

NOTICE

NORD suggests replacing the gear oil if oil analysis indicates any of the following. Failure to replace the oil may cause internal damage to gearbox and diminished performance:

- Viscosity has changed by approximately 10% or more.
- Debris particles (silicon, dust, dirt or sand) exceed 25 ppm.
- Iron content exceeds 150-200 ppm.
- Water content is greater than 0.05% (500 ppm).
- The total acid number (TAN) tests indicate a significant level of oxidative break-down of the oil, and a critical reduction in performance; If the TAN number measured changes by more than 5% over the new oil, then an oil change would be recommended.

8. Mounting position and oil fill quantity

All NORD Gear reducers are shipped from the factory with a pre-determined oil fill level in accordance to the specified reducer size and mounting position. ***For additional information, please see the seperate mounting position diagrams and the corresponding oil fill quantity tables for the specified gear unit.***

The gearbox nametag will indicate the mounting position that was provided. ***For mounting orientations other than shown in the mounting position charts, please consult NORD Gear.***

IMPORTANT NOTE

Actual oil volume can vary slightly depending upon the gear case size, mounting and ratio. Prior to commissioning the reducer, check the oil-fill level using the reducer's oil-level plug and drain or add additional oil as needed. The minimum acceptable oil level is 0.15 in (4mm) below the oil level hole.

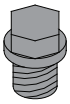
9. Oil plug locations

All gear units are assembled with the oil fill-level, oil-drain and vent plugs installed in their proper locations, according to the specified mounting position. All standard plugs are metric and utilize sealing gaskets between the head of the plug and the reducer housing.

10. Drain and fill-level plugs

All reducer drain plugs are metric socket head cap screws. For easier identification, it is NORD's standard practice to provide a hex-head screw for the fill-level plug. For ease of draining the used oil from the gear reducer, use the socket head screw located at the lowest part of the gearbox.


Drain Plug

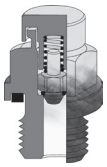

Fill Level Plug

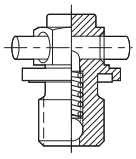
11. Vent plug locations

Reducer venting allows for air pressure differences that occur during operation, between the inner space of the reducer and the atmosphere, while ensuring leak-free operation. The AUTOVENT™ is standard for all vented gear units, unless otherwise noted.

AUTOVENT™ - The AUTOVENT™ helps prevent bearing and gear damage by behaving like a check valve to block the entry of foreign material and prevent lubrication contamination from dust particles, moisture and air-borne process chemicals. The breather opens at approximately 0.3-0.9 psi during operation and closes tightly as the gearbox cools. This option is perfect for humid conditions and wash-down environments, helping to maintain proper oil cleanliness, while reducing foaming and oxidation.

Figure 1 AUTOVENT™ Types


Type 1

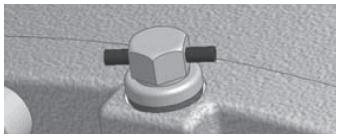


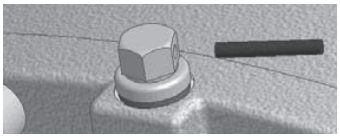
Type 2 with transportation plug

Open Vent - An optional open vent can be supplied by NORD. The open vent comes closed upon delivery with a transportation sealing plug (see Warning).

NOTICE

To prevent build-up of excessive pressure, sealed vents must be activated as shown prior to gear unit start up. Excessive pressure may cause damage to internal components and cause leakage.


Sealed vent


Activated vent

Filtered Vent - NORD may offer an optional filtered vent, which allows gases to permeate, but does not allow dust and debris to pass through the vent.

MINICASE® (SM SERIES) WORM GEAR LUBRICATION GUIDELINES

1. Importance of proper gearbox lubrication

Proper gearbox lubrication is essential in order to reduce friction, heat, and component wear. Lubricants reduce heat and wear by inserting a protective "fluid boundary" between mating parts and preventing direct metal to metal contact. Lubricants also help prevent corrosion and oxidation, minimize foam, improve heat transfer, optimize reducer efficiency, absorb shock loads and reduce noise.

2. Maintenance free design

MINICASE® (SM series) worm gear reducers are designed to be maintenance-free and are supplied completely sealed. They are factory oil-filled with a pre-determined oil fill amount in accordance to the specified reducer size and mounting position. The synthetic lubrication used is suitable for the life of the product so the MINICASE™ is inherently maintenance free.

3. Standard oil type

The standard factory oil fill for MINICASE® (SM) worm gear reducers is ISO viscosity VG synthetic hydrocarbon/polyalphaolefin (SHC/PAO oil) food grade oil suitable for NSF-H1 incidental contact and is a factory stocked lubricant. Food grade oil suitable for NSF-H1 incidental contact is a factory stocked option.

See user manual U11040 for specific information and for optional MINICASE® (SM) worm lubrication types and options.

NOTICE

In worm gears avoid using extreme pressure (EP) gear oils containing sulfur-phosphorous chemistries; these additives can react adversely with bronze worm gears, and accelerate wear.

4. Efficiency

It is important to consider the following, when using worm gears.

- Worm gears reach their peak rated efficiency, after they undergo a natural run-in process (up to 25 hours operating time at maximum rated load). Catalog published power and torque figures are based upon the rated efficiency after the run-in is complete.
- Worm gears have naturally lower startup efficiencies compared to operating efficiencies. As input speed increases the enhanced hydrodynamic effects of the oil result in less tooth friction and increased worm gear efficiency.

IMPORTANT NOTE

Worm gear reducers applied in cold temperature service, may require increased motor power for the following reasons:

- Lower operating temperatures, cause lubrication viscosity to increase in both the gearbox and in the moving areas of the driven machine.
- Worm-gears have naturally lower start-up efficiencies compared to operating efficiencies.
- In extreme cases, one might need to consider increasing the motor power and/or lowering the oil viscosity.

5. Maximum oil sump temperature limit

To prevent reducer overheating, the reducer's maximum oil sump temperature limit must not be exceeded for prolonged periods of operation (up to 3 hours continuous operation depending upon reducer size).

Oil Type	Maximum Oil Temperature Limit	
	NORD	AGMA 9005-D94
Synthetic	105°C (220°F)	107°C (225°F)

IMPORTANT NOTE

Use caution when specifying gear reducers for high temperature service. If there is concern about exceeding the allowable safe operating temperatures, please consult NORD to discuss alternatives.

6. Oil Viscosity

The viscosity rating determines the operating oil's resistance to shear under load conditions. Some important viscosity considerations include the following:

- Lightly loaded gears require lower viscosity oils than highly loaded gears.
- Lower viscosity will provide thin oil film, lower friction, higher mechanical efficiency, and better heat removal conditions.
- Higher viscosity will provide thicker oil film, and better resistance to sliding wear, scuffing wear, and galling at high pressure.
- Higher operating temperatures will cause a reduction in viscosity and lower operating temperatures, cause an increase in viscosity or a thickening of the oil.

The standard oil-fill is considered acceptable for most applications. In certain situations an oil viscosity change may be beneficial.

- If the gear unit is exposed to frequent high load conditions. A higher viscosity oil will have a higher film thickness offering better overall resistance to oil shear, sliding wear and scuffing wear in gears and roller element bearings.
- An oil viscosity correction or lubrication change may improve the overall performance when operating the gear unit at very low or high ambient temperature conditions.

IMPORTANT NOTE

The user should consult with their primary lubrication supplier before considering changes in oil type or viscosity.

7. Viscosity Index

Viscosity index helps quantify the rate of oil viscosity change with respect to temperature changes. Oils with a reasonably high viscosity index tend to be more stable in a changing temperature environment. The ability of an oil to maintain a small viscosity differential over the operating range of the gearbox provides a more consistent lubricating film and better wear performance.

Synthetic oils typically have a higher viscosity index than mineral oils and polyglycol oils tend to have an exceptionally high viscosity index compared to other synthetic oils like polyalphaolefin or ester based products.

MINICASE® (SMI/SMID) WORM GEAR LUBRICATION GUIDELINES

1. Importance of proper gearbox lubrication

Proper gearbox lubrication is essential in order to reduce friction, heat, and component wear. Lubricants reduce heat and wear by inserting a protective "fluid boundary" between mating parts and preventing direct metal to metal contact. Lubricants also help prevent corrosion and oxidation, minimize foam, improve heat transfer, optimize reducer efficiency, absorb shock loads and reduce noise.

2. Factory Oil-Filled / Maintence-Free

NORD modular worm gear units are inherently maintence-free, factory oil filled, and supplied with a high-quality, long-life, synthetic oil which is intend to be suitable for the life of the gear unit.

MINICASE® (SMI/SMID) worm gear units are assembled at the factory from stocked component parts. They are filled at time of assembly in accordance to the specified reducer mounting position. See user manuals U13150 and U13250 for more info.

3. Standard Oil Types

MINICASE® (SMI/SMID) worm gear units are factory filled with synthetic poly glycol oil. Food-grade polyglycol oil is optional. The specific oil type and viscosity grade are displayed on the reducer nameplate. See user manual 11050 for specific MINICASE® (SMI/SMID) worm lubrication types and options.

NOTICE

In worm gears avoid using extreme pressure (EP) gear oils containing sulfur-phosphorous chemistries; these additives can react adversely with bronze worm gears, and accelerate wear.

4. Efficiency

It is important to consider the following, when ordering worm gears.

- Worm gears reach their peak rated efficiency, after they undergo a natural run-in process (up to 25 hours operating time at maximum rated load). Catalog published power and torque figures are based upon the rated efficiency after the run-in is complete.
- Worm gears have naturally lower startup efficiencies compared to operating efficiencies. As input speed increases the enhanced hydrodynamic effects of the oil result in less tooth friction and increased worm gear efficiency.

IMPORTANT NOTE

Worm gear reducers applied in cold temperature service, may require increased motor power for the following reasons:

- Lower operating temperatures, cause lubrication viscosity to increase in both the gearbox and in the moving areas of the driven machine.
- Worm-gears have naturally lower start-up efficiencies compared to operating efficiencies.
- In extreme cases, one might need to consider increasing the motor power and lowering the oil viscosity

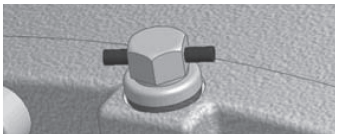
5. Optional Vent Kits

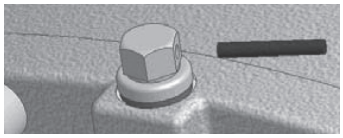
MINICASE® (SMI/SMID) worm gear units are designed to operate sealed or vented. As a standard the modular worm gear units are factory oil filled and supplied with oil plugs in the housing, making vent plugs optional. See user manual U14750.

NORD can supply an AUTOVENT™ or an open vent with each gear unit size. If a vent is desired the type must be specified at the time of order. Reducer vents are sealed with a transportation plug that must be removed prior to gear unit start-up.

Type	Transportation Seal	Installation	Part Number
AUTOVENT™	Included	Factory or Field site	66093510
Open Vent	None	Field Only	60693500
Open Vent	Included	Factory or Field site	22008004 (vent) 25308120 (gasket)

Unless noted by a seperate part number, vent kits include the housing gasket





NOTICE

To prevent build-up of excessive pressure, sealed vents must be activated as shown prior to gear unit start-up. Excessive pressure may cause damage to internal components and cause leakage.

6. AUTOVENT™

The AUTOVENT™ helps prevent bearing and gear damage by behaving like a check valve to block the entry of foreign material and prevent lubrication contamination from dust particles, moisture and air-borne process chemicals. The breather opens at approximately 0.3-0.9 psi during operation and closes tightly as the gearbox cools. This option is perfect for humid conditions and wash-down environments, helping to maintain proper oil cleanliness, while reducing foaming and oxidation.

7. Open Vent

A typical gearbox industry open vent option can also be supplied by NORD. This option allows free exchange of air and does not build-up any back pressure inside the gear unit. This option is ideal for many operating conditions where the geared product is used in relatively clean and moisture-free environment.

8. When to Use a Sealed or a Vented Unit

There are many conditions that should be considered when deciding whether to use a sealed or vented unit.

1. If the duty cycle is intermittent, the run times are short, and any build-up of internal pressure or temperature is relatively low, the sealed unit option may be used.
2. If running continuous and under moderate to high load conditions, worm gears can generate higher operating temperatures and a build-up of internal pressure. In these instances a vent is strongly recommended. Consult NORD if operation at high load conditions is required.
3. If running continuous at 4-pole electric motor speeds (1800 rpm at 60 Hz) or higher, then a vent option is usually recommended. Consult NORD if operation at higher speeds is required.
4. Radial shaft seals produce a hydrodynamic pumping action to help push lubricant back into the gear unit, causing a small amount of ingested air and a small pressure increase (1-2 psi) that does not normally require a reducer vent; however when combined with continuous operation under high load (Condition 2), additional operating pressures will result and a vent should be used.
5. When the environment is contaminated with water, dirt, or other objects that may be ingested into the breather, increased wear of bearings, gearing, and lubrication breakdown can result. In these instances the sealed option or an AUTOVENT™ should be considered.

9. Maximum Oil Sump Temperature Limit

To prevent reducer overheating, the reducer's maximum oil-sump temperature limit must not be exceeded for prolonged periods of operation.

Oil Type	Maximum Oil Temperature Limit	
	NORD	AGMA 9005-D94
Synthetic	105°C (220°F)	107°C (225°F)

IMPORTANT NOTE

Use caution when specifying gear reducers for high temperature service. If there is concern about exceeding the safe operating temperature limit, please consult NORD to discuss alternatives.

10. Oil Viscosity

The viscosity rating determines the operating oil's resistance to shear under load conditions. Some important viscosity considerations include the following:

- Lightly loaded gears require lower viscosity oils than highly loaded gears.
- Lower viscosity will provide thin oil film, lower friction, higher mechanical efficiency, and better heat removal conditions.
- Higher viscosity will provide thicker oil film, and a better resistance to sliding wear, scuffing wear, and galling at high pressure.
- Higher operating temperatures will cause a reduc-tion in viscosity and lower operating temperatures, cause an increase in viscosity or a thickening of the oil.

The standard oil-fill is considered acceptable for most applications. In certain situations an oil viscosity change may be beneficial.

- If the gear unit is exposed to frequent high load conditions. A higher viscosity oil will have a higher film thickness offering better overall resistance to oil shear, sliding wear and scuffing wear in gears and roller element bearings.
- An oil viscosity correction or lubrication change may improve the overall performance when operating the gear unit at very low or high ambient temperature conditions.

IMPORTANT NOTE

The user should consult with their primary lubrication supplier before considering changes in oil type or viscosity.

11. Viscosity Index

Viscosity index helps quantify the rate of oil viscosity change with respect to temperature changes. Oils with a reasonably high viscosity index tend to be more stable in a changing temperature environment. The ability of an oil to maintain a small viscosity differential over the operating range of the gearbox provides a more consistent lubricating film and better wear performance.

Synthetic oils typically have a higher viscosity index than mineral oils and polyglycol oils tend to have an exceptionally high viscosity index compared to other synthetic oils like polyalphaolefin or ester based products.

FLEXBLOC™ (SI/SID SERIES) WORM GEAR LUBRICATION GUIDELINES

1. Importance of Proper Lubrication

Proper gearbox lubrication is essential in order to reduce friction, heat, and component wear. Lubricants reduce heat and wear by inserting a protective "fluid boundary" between mating parts and preventing direct metal to metal contact. Lubricants also help prevent corrosion and oxidation, minimize foam, improve heat transfer, optimize reducer efficiency, absorb shock loads and reduce noise.

2. Factory Oil-Filled / Maintence-Free

NORD modular worm gear units are inherently maintence-free, factory oil filled, and supplied with a high-quality, long-life, synthetic oil which is intend to be suitable for the life of the gear unit.

FLEXBLOC™ SI worm gear units are filled at time of assembly to a universal oil fill, allowing for many mounting position possibilities. See user manual U13300.

3. Standard oil type

FLEXBLOC™ (SI/SID) worm gear units are factory filled with synthetic poly glycol oil. Food-grade polyglycol oil is optional. The specific oil type and viscosity grade are displayed on the reducer nameplate. See user manual 11060 for specific FLEXBLOC™ (SI/SID) worm lubrication types and options.

NOTICE

In worm gears avoid using extreme pressure (EP) gear oils containing sulfur-phosphorous chemistries; these additives can react adversely with bronze worm gears, and accelerate wear.

4. Efficiency

It is important to consider the following, when ordering worm gears.

- Worm gears reach their peak rated efficiency, after they undergo a natural run-in process (up to 25 hours operating time at maximum rated load). Catalog published power and torque figures are based upon the rated efficiency after the run-in is complete.
- Worm gears have naturally lower startup efficiencies compared to operating efficiencies. As input speed increases the enhanced hydrodynamic effects of the oil result in less tooth friction and increased worm gear efficiency.

IMPORTANT NOTE

Worm gear reducers applied in cold temperature service, may require increased motor power for the following reasons:

- Lower operating temperatures, cause lubrication viscosity to increase in both the gearbox and in the moving areas of the driven machine.
- Worm-gears have naturally lower start-up efficiencies compared to operating efficiencies.
- In extreme cases, one might need to consider increasing the motor power and lowering the oil viscosity

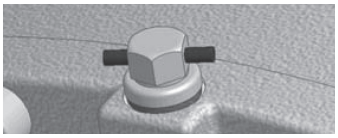
5. Optional Vent Kits

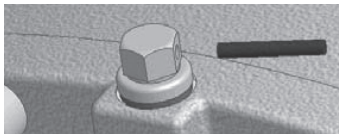
FLEXBLOC™ (SI) worm gear units are designed to operate sealed or vented. As a standard the modular worm gear units are factory oil filled and supplied with oil plugs in the housing, making vent plugs optional. See user manual U14800 for vent locations.

NORD can supply an AUTOVENT™ or an open vent with each gear unit size. If a vent is desired the type must be specified at the time of order. Reducer vents are sealed with a transportation plug that must be removed prior to gear unit start-up.

Type	Transportation Seal	Installation	Part Number
AUTOVENT™	Included	Factory or Field site	66093510
Open Vent	None	Field Only	60693500
Open Vent	Included	Factory or Field site	22008004 (vent) 25308120 (gasket)

Unless noted by a seperate part number, vent kits include the housing gasket





NOTICE

To prevent build-up of excessive pressure, sealed vents must be activated as shown prior to gear unit start-up. Excessive pressure may cause damage to internal components and cause leakage.

6. AUTOVENT™

The AUTOVENT™ helps prevent bearing and gear damage by behaving like a check valve to block the entry of foreign material and prevent lubrication contamination from dust particles, moisture and air-borne process chemicals. The breather opens at approximately 0.3-0.9 psi during operation and closes tightly as the gearbox cools. This option is perfect for humid conditions and wash-down environments, helping to maintain proper oil cleanliness, while reducing foaming and oxidation.

7. Open Vent

A typical gearbox industry open vent option can also be supplied by NORD. This option allows free exchange of air and does not build-up any back pressure inside the gear unit. This option is ideal for many operating conditions where the geared product is used in relatively clean and moisture-free environment.

8. When to Use a Sealed or a Vented Unit

There are many conditions that should be considered when deciding whether to use a sealed or vented unit.

1. If the duty cycle is intermittent, the run times are short, and any build-up of internal pressure or temperature is relatively low, the sealed unit option may be used.
2. If running continuous and under moderate to high load conditions, worm gears can generate higher operating temperatures and a build-up of internal pressure. In these instances a vent is strongly recommended. Consult NORD if operation at high load conditions is required.
3. If running continuous at 4-pole electric motor speeds (1800 rpm at 60 Hz) or higher, then a vent option is usually recommended. Consult NORD if operation at higher speeds is required.
4. Radial shaft seals produce a hydrodynamic pumping action to help push lubricant back into the gear unit, causing a small amount of ingested air and a small pressure increase (1-2 psi) that does not normally require a reducer vent; however when combined with continuous operation under high load (Condition 2), additional operating pressures will result and a vent should be used.
5. When the environment is contaminated with water, dirt, or other objects that may be ingested into the breather, increased wear of bearings, gearing, and lubrication breakdown can result. In these instances the sealed option or an AUTOVENT™ should be considered.

9. Maximum Oil Sump Temperature Limit

To prevent reducer overheating, the reducer's maximum oil-sump temperature limit must not be exceeded for prolonged periods of operation.

Oil Type	Maximum Oil Temperature Limit	
	NORD	AGMA 9005-D94
Synthetic	105°C (220°F)	107°C (225°F)

IMPORTANT NOTE

Use caution when specifying gear reducers for high temperature service. If there is concern about exceeding the allowable safe operating temperatures, please consult NORD to discuss alternatives.

10. Oil Viscosity

The viscosity rating determines the operating oil's resistance to shear under load conditions. Some important viscosity considerations include the following:

- Lightly loaded gears require lower viscosity oils than highly loaded gears.
- Lower viscosity will provide thin oil film, lower friction, higher mechanical efficiency, and better heat removal conditions.
- Higher viscosity will provide thicker oil film, and better resistance to sliding wear, scuffing wear, and galling at high pressure.
- Higher operating temperatures will cause a reduction in viscosity and lower operating temperatures, cause an increase in viscosity or a thickening of the oil.

The standard oil-fill is considered acceptable for most applications. In certain situations an oil viscosity change may be beneficial.

- If the gear unit is exposed to frequent high load conditions. A higher viscosity oil will have a higher film thickness offering better overall resistance to oil shear, sliding wear and scuffing wear in gears and roller element bearings.
- An oil viscosity correction or lubrication change may improve the overall performance when operating the gear unit at very low or high ambient temperature conditions.

IMPORTANT NOTE

The user should consult with their primary lubrication supplier before considering changes in oil type or viscosity.

11. Viscosity Index

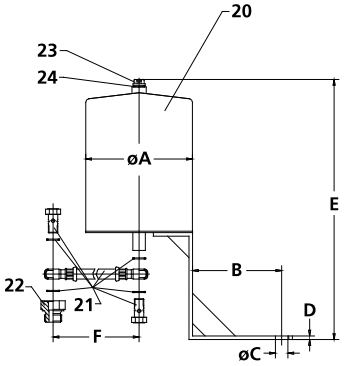
Viscosity index helps quantify the rate of oil viscosity change with respect to temperature changes. Oils with a reasonably high viscosity index tend to be more stable in a changing temperature environment. The ability of an oil to maintain a small viscosity differential over the operating range of the gearbox provides a more consistent lubricating film and better wear performance.

Synthetic oils typically have a higher viscosity index than mineral oils and polyglycol oils tend to have an exceptionally high viscosity index compared to other synthetic oils like polyalphaolefin or ester based products.

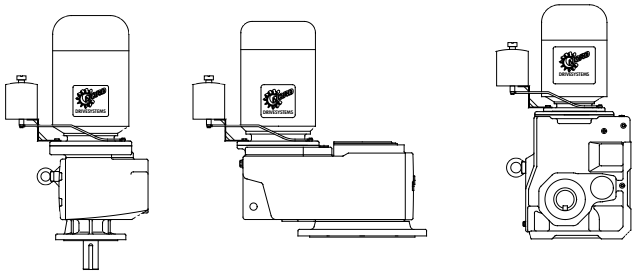
EXPANSION CHAMBERS INSTALLATION & MAINTENANCE MANUAL

Installation Instructions

Sometimes NORD requires the use of an oil expansion chamber when the motor or reducer input is mounted vertically. Consult your NORD catalog for additional information and application considerations.



1. Secure the gear reducer in the proper mounting position for the application and remove the vent plug from the gear reducer. The hose assembly kit (21) will be fitted to the reducer using the housing port provided.
2. When using the larger 2.7 and 5.4 liter chambers, screw the adapter fitting (22) into the reducer housing port. Use all sealing gaskets provided.
3. Mount the overflow tank (20) at the highest location from the reducer, as permitted by the hose assembly kit (21). Typical mounting configurations are represented below. Use one of the input cover's mounting bolts, to mount the chamber support leg to the reducer.



4. Be sure to use the proper fittings. Assemble one end of the vent-hose assembly (21) to bottom of the chamber and one-end to the reducer.
5. Secure the vent-plug (23) and gasket (24) that is supplied with the kit to the top of the expansion chamber.

NOTICE

Remove the protective "rubber element" from the supplied vent prior to use so that an open-vent is formed on top of the overflow tank. Avoid using a pressurized AUTOVENT™ breather on the overflow tank since this may create an undesired pressure-vacuum in the overflow tank.

Expansion Chamber Kit Dimensions & Parts List

Kit Part Number: 28390390 - 0.7 Liter Oil Expansion Chamber

Kit P/N	Ø A	B	Ø C	D	E	F	Units
28390390	3.94	1.97	0.53	0.20	8.50	19.69	inch
(0.7 Liter)	100	50	13.5	5	216	500	mm

Item	Part Number	Description
20	28300390	Overflow Tank - 0.7 Liter
21	28310020	Flexible Vent Hose Assembly - Includes: Hose, metal gaskets & 2 Hollow Bolts (1 Bolt. - M12 X 1.5 and 1 Pc. - G1/4)
22	None	Adapter Fitting
23	22012004	Normal Style Vent Plug (M12 X 1.5, DIN 910)
24	25312150	Vent Plug Gasket (12 X 15.5 X 1.5)

Kit Part Number: 28390400 - 2.7 Liter Oil Expansion Chamber

Kit P/N	Ø A	B	Ø C	D	E	F	Units
28390400	5.91	4.92	0.69	0.20	15.22	27.56	inch
(2.7 Liter)	150	125	17.5	5	386.5	700	mm

Item	Part Number	Description
20	28300400	Overflow Tank - 2.7 Liter
21	28310030	Flexible Vent Hose Assy - Includes: Hose, metal gaskets & 2 Hollow Bolts (2 Pcs. - G1/4)
22	22024030	Adapter Fitting (M24 X 1.5 to G1/4)
23	22012004	Normal Style Vent Plug (M12 X 1.5, DIN 910)
24	25312150	Vent Plug Gasket (12 X 15.5 X 1.5)

Kit Part Number: 28390410 - 5.4 Liter Oil Expansion Chamber

Kit P/N	Ø A	B	Ø C	D	E	F	Units
28390410	7.09	3.54	0.69	0.20	15.18	31.50	inch
(5.4 Liter)	180	90	17.5	5	385.5	800	mm

Item	Part Number	Description
20	28300410	Overflow Tank - 5.4 Liter
21	28310040	Flexible Vent Hose Assy - Includes: Hose, metal gaskets & 2 Hollow Bolts (2 Pcs. - G1/4)
22	22030030	Adapter Fitting (M30 X 1.5 to G1/4)
23	22012004	Normal Style Vent Plug (M12 X 1.5, DIN 910)
24	25312150	Vent Plug Gasket (12 X 15.5 X 1.5)

Please see page 2 for gearbox compatability

Expansion Chamber Compatability Chart

Helical In-line	NORDBLOC™	NORDBLOC.1™	Clincher™	Helical-Bevel	Part Number	[lb]
SK 42/43 SK 52/53 SK 63	SK472/473 SK572/573 SK672/673 SK772/773 SK872/873 SK972/973	SK572.1/573.1* SK672.1/673.1* SK772.1/773.1 SK872.1/873.1 SK972.1/973.1	SK 4282/4382 SK 5282/5382 SK 6382	SK 9042.1/9043.1 SK 9052.1/9053.1	28390390	11.0
SK 62 SK 72/73			SK 6282 SK 7282/7382	SK 9072.1 SK 9082.1	28390400	13.2
SK 82/83 SK 92/93 SK 102/103			SK 8282/8382	SK 9086.1 SK 9092.1 SK 9096.1	28390410	15.4

* Need to additionally order part #28390380 which is sub-assembly shown below.

Expansion Chamber Compatability Chart

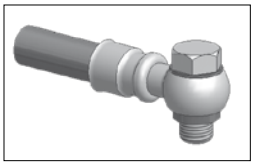
Helical Worm	Two-Stage Helical Bevel	NORDBLOC.1™	Clincher™	Part Number
SK 02040.1	SK 920072.1 SK 92072.1	SK 072.1 / 071.1 SK 172.1	N/A	28390840**
N/A	SK 92172.1	SK 171.1 SK 372.1	SK 0182.1 SK 0282.1 SK 1382.1	28390850**

* See page 3 for assembly information

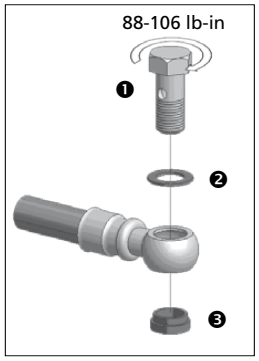
Sub-Assembly P/N 28390380 for NORDBLOC®.1 gear units with M10x1 air vent.

❶	❷	❸	❹
			
1x DIN 7643 M10x1 283 00380	1x DIN 7603A Cu 10x16x1 253 10166	1x Ring 10x14x5 283 00370	1xDIN 9021 ø8,4 227 10840

Assembly of the expansion unit at the gear unit. Types SK 572.1/573.1, SK 672.1/673.1

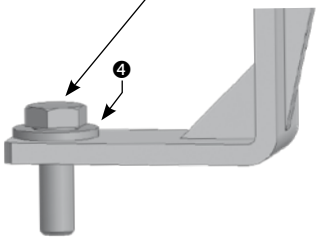


Vent Hose Sub-Assembly

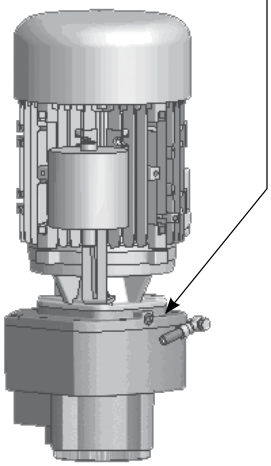


❹ For motor sizes 63, 71, 80, 90, 100 & 112

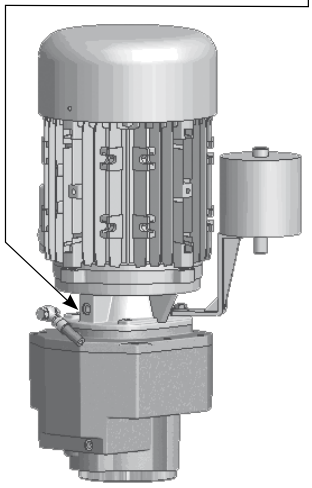
• Motor attachment bolt



Motor Sizes 63, 71 & 80:
Assembly vent-hose to port as shown.



Motor Sizes 90,100 & 112:
Assembly vent-hose to port as shown.



Assembly instruction for 0.25-liter oil expansion chamber (OA)

1. After fitting the drive in the find operating position remove vent-plug of the drive.
2. Assemble the expansion unit (suggestions for position listed below).

Attention: Terminal box position for the construction M4 in position 2 is not possible.
The expansion tank should be screwed straight, parallel to the motor axis.
Attention: On ATEX gearboxes, screw the pressure vent plug M10x1.0, into the expansion unit.

Designation	0 A	0 B
Vent plug M10x1.0 with oil seal	X	X
Expansion tank (l)	0.25	0.25
Pipe 6 mm	PR 06	PR 06
Gear connection	M8x1	M10x1
Part number	28390840	28390850

HELICAL & BEVEL REDUCER LUBRICATION TYPES

Lubrication Tables – Helical and Bevel Gear Units

Standard Oil Lubricants

ISO Viscosity	Oil Type	Ambient Temperature Range	Manufacturer Brand/Type	Notes
VG220	MIN-EP	0 to 40°C (32 to 104°)	Mobilgear 600XP220	♦❶
	PAO-EP	-35 to 60°C (-31 to 140°F)	Mobil SHC Gear 220	♦❷
	FG	-5 to 40°C (23 to 104°F)	Fuchs FM220	♦

Optional Oil Lubricants

ISO Viscosity	Oil Type	Ambient Temperature Range	Manufacturer Brand/Type	Notes
VG460	PAO-EP	-35 to 80°C (-31 to 176°F)	Mobil SHC Gear 460	-
	FG-PAO	-35 to 80°C (-31 to 176°F)	Mobil SHC Cibus 460	-
VG220	FG-PAO	-35 to 60°C (-31 to 140°F)	Mobil SHC Cibus 220	S
VG150	PAO-EP	-35 to 25°C (-31 to 77°F)	Mobil SHC Gear 150	-

Grease Options (applied to greased bearings and seal cavities)

NLGI Grade	Grease Thickener	Grease Base Oil	Ambient Temperature Range	Manufacturer Brand/Type	Notes
NLGI 2	Li-Complex	MIN	-30 to 60°C (-22 to 140°F)	Mobil Grease XHP222	♦❶
	Li-Complex	PAO	-40 to 80°C (-40 to 176°F)	Mobil / Mobilith SHC 220	♦❷
	Polyurea	FG-PAO	-30 to 80°C (-22 to 176°F)	Mobil SHC Polyrex 222	♦

♦ Stocked Lubricants

❶ Standard product on serviceable gear units

❷ Standard product on maintenance free gear units

IMPORTANT NOTE

- The "Ambient Temperature" is intended to be an operation guideline based upon the typical properties of all the lubricant. The viscosity and other properties of the lubricant change based upon load, speed, ambient conditions, and reducer operating temperatures. The user should consult with their lubrication supplier & NORD gear before considering changes in oil type or viscosity.
- To prevent reducer overheating, observe the maximum operating oil temperature limits:
  Mineral Oil: 85 °C (185 °F).
  Synthetic Oil: 105 °C (225 °F).
- In the following instances, please consult NORD for specific recommendations:
  - √ Gear units will operate in high ambient temperature conditions exceeding 40 °C (104 °F).
  - √ Gear units will operate in cold ambient temperature conditions approaching 0 °C (32 °F) or lower.
  - √ Lower than an ISO VG100 viscosity oil is being considered for a cold-temperature service.
  - √ Fluid grease is required for lubricating the gear unit.
- Observe the general lubrication guidelines outlined in user manual U10750.

Oil Formulation Codes

MIN-EP - Mineral Oil with EP Additive
PAO-EP - Synthetic Polyalphaolefin Oil with EP Additive
PAO - Synthetic Polyalphaolefin Oil
PG - Synthetic Polyglycol Oil
FG - Food-Grade Oil
FG-PAO - Food-Grade, Synthetic Poyalphaolefin Oil
FG-PG - Food-Grade, Synthetic Polyglycol Oil

Lubrication Notes

- Avoid using (EP) gear oils in worm gears that contain sulfur-phosphorous chemistries, as these additives can react adversely with bronze worm gears and accelerate wear.
- Food grade lubricants must be in compliance with FDA 212 CFR 178.3570 and qualify as a NSF-H1 lubricant. Please consult with lubrication manufacturer for more information.
- When making a lubrication change, check with the lubrication supplier to assure compatibility and to obtain recommended cleaning or flushing procedures.
- Do not to mix different oils with different additive packages or different base oil formulation types. Polyglycol (PG) oils are not miscible with other oil types and should never be mixed with mineral oil or polyalphaolefin (PAO) synthetic oil.

HELICAL & BEVEL REDUCER LUBRICATION TYPES

Oil Cross-reference Chart

ISO Viscosity	Oil Type	Ambient Temperature Range	Mobil	Shell	Castrol	FUCHS	KLÜBER LUBRICATION
VG150	MIN-EP	0 to 25°C (32 to 77°F)	Mobilgear 600XP150	Omala S2 G 150	Alpha SP150	Renolin EP150	Klüberoil GEM 1-150N
	PAO-EP	-30 to 25 °C (-22 to 77 °F)	Mobil SHC Gear 150	Omala S4 GX 150	Alphasyn EP150	Gearmaster SYN150/NA	Klübersynth EG 4-150
	PAO	-30 to 25°C (-22 to 77°F)	Mobil SHC629	Morlina S4 B 150	Alphasyn T150	N/A	Klübersynth GEM 4-150N
	PG	-25 to 25°C (-13 to 77°F)	Mobil Glygoyle 150	Omala S4 WE 150	Alphasyn PG150	Renolin PG150	Klübersynth GH 6-150
	FG	0 to 25°C (32 to 77°F)	Mobil DTE FM 150	N/A	N/A	N/A	N/A
	FG-PAO	-15 to 25°C (5 to 77°F)	Mobil SHC Cibus 150	N/A	N/A	Cassida GL150	Klüberoil 4 UH 1-150N
	FG-PG	-25 to 25°C (-13 to 77°F)	Mobil Glygoyle 150	N/A	N/A	N/A	Klübersynth UH1 6-150
VG220	MIN-EP	0 to 40°C (32 to 104°)	Mobilgear 600XP220	Omala S2 G 220	Alpha SP220	Renolin EP220	Klüberoil GEM 1-220N
	PAO-EP	-30 to 60 °C (-22 to 140 °F)	Mobil SHC Gear 220	Omala S4 GX 220	Alphasyn EP220	Gearmaster SYN220/NA	Klübersynth EG 4-220
	PAO	-30 to 60°C (-22 to 140°F)	Mobil SHC630	Morlina S4 B 220	Alphasyn T220	N/A	Klübersynth GEM 4-220N
	PG	-25 to 60°C (-13 to 140°F)	Mobil Glygoyle 220	Omala S4 WE 220	Alphasyn PG220	Renolin PG220	Klübersynth GH 6-220
	FG	0 to 40°C (32 to 104°F)	Mobil DTE FM 220	N/A	N/A	Fuchs FM220	N/A
	FG-PAO	-25 to 60°C (-13 to 140°F)	Mobil SHC Cibus 220	N/A	N/A	Cassida GL220	Klüberoil 4 UH 1-220N
	FG-PG	-25 to 60°C (-13 to 140°F)	Mobil Glygoyle 220	N/A	N/A	Cassida WG220	Klübersynth UH1 6-220
VG460	MIN-EP	0 to 40°C (32 to 104°F)	Mobilgear 600XP460	Omala S2 G 460	Alpha SP460	Renolin EP460	Klüberoil GEM 1-460N
	PAO-EP	-20 to 80°C (-4 to 176°F)	Mobil SHC Gear 460	Omala S4 GX 460	Alphasyn EP460	Gearmaster SYN460/NA	Klübersynth EG 4-460
	PAO	-20 to 80°C (-4 to 176°F)	Mobil SHC 634	Morlina S4 B 460	Alphasyn T460	N/A	Klübersynth GEM 4-460N
	PG	-20 to 80°C (-4 to 176°F)	Mobil Glygoyle 460	Omala S4 WE 60	Alphasyn PG460	N/A	Klübersynth GH 6-460
	FG	0 to 40°C (32 to 104°F)	Mobil DTE FM460	N/A	N/A	Fuchs FM460	N/A
	FG-PAO	-20 to 80°C (-4 to 176°F)	Mobil SHC Cibus 460	N/A	N/A	Cassida GL460	Klüberoil 4 UH 1-460N
	FG-PG	-20 to 80°C (-4 to 176°F)	Mobil Glygoyle 460	N/A	N/A	Cassida WG460	Klübersynth UH1 6-460

Low-end service temperature limit may vary for a specific lubricant; Please also see the important notes on Page 1.

CONVEYOR DRIVE LUBRICATION TYPES

Lubrication Tables – SK 9055 and SK 9155 Gear Units

Standard Oil Lubricants

ISO Viscosity	Oil Type	Ambient Temperature Range	Manufacturer Brand/Type	Notes
VG220	MIN-EP	0 to 40°C (32 to 104°)	Mobilgear 600XP220	♦❶
	PAO-EP	-35 to 60°C (-31 to 140°F)	Mobil SHC Gear 220	♦❷
	FG	-5 to 40°C (23 to 104°F)	Fuchs FM220	♦

Optional Oil Lubricants

ISO Viscosity	Oil Type	Ambient Temperature Range	Manufacturer Brand/Type	Notes
VG460	PAO-EP	-35 to 80°C (-31 to 176°F)	Mobil SHC Gear 460	-
	FG-PAO	-35 to 80°C (-31 to 176°F)	Mobil SHC Cibus 460	-
VG220	FG-PAO	-35 to 60°C (-31 to 140°F)	Mobil SHC Cibus 220	-
VG150	PAO-EP	-35 to 25°C (-31 to 77°F)	Mobil SHC Gear 150	-

Grease Options (applied to greased bearings and seal cavities)

NLGI Grade	Grease Thickener	Grease Base Oil	Ambient Temperature Range	Manufacturer Brand/Type	Notes
NLGI 2	Li-Complex	MIN	-30 to 60°C (-22 to 140°F)	Mobil Grease XHP222	♦❶
	Li-Complex	PAO	-40 to 80°C (-40 to 176°F)	Mobil / Mobilith SHC 220	♦❷
	Polyurea	FG-PAO	-30 to 80°C (-22 to 176°F)	Mobil SHC Polyrex 222	♦

♦ Stocked Lubricants

❶ Standard product on serviceable gear units

❷ Standard product on maintenance free gear units

IMPORTANT NOTE

- The "Ambient Temperature" is intended to be an operation guideline based upon the typical properties of all the lubricant. The viscosity and other properties of the lubricant change based upon load, speed, ambient conditions, and reducer operating temperatures. The user should consult with their lubrication supplier & NORD gear before considering changes in oil type or viscosity.
- To prevent reducer overheating, observe the maximum operating oil temperature limits:
  Mineral Oil: 85 °C (185 °F).
  Synthetic Oil: 105 °C (225 °F).
- In the following instances, please consult NORD for specific recommendations:
  - √ Gear units will operate in high ambient temperature conditions exceeding 40 °C (104 °F).
  - √ Gear units will operate in cold ambient temperature conditions approaching 0 °C (32 °F) or lower.
  - √ Lower than an ISO VG100 viscosity oil is being considered for a cold-temperature service.
  - √ Fluid grease is required for lubricating the gear unit.
- Observe the general lubrication guidelines outlined in user manual U10750.

Oil Formulation Codes

MIN-EP - Mineral Oil with EP Additive
PAO-EP - Synthetic Polyalphaolefin Oil with EP Additive
PAO - Synthetic Polyalphaolefin Oil
PG - Synthetic Polyglycol Oil
FG - Food-Grade Oil
FG-PAO - Food-Grade, Synthetic Poyalphaolefin Oil
FG-PG - Food-Grade, Synthetic Polyglycol Oil

Lubrication Notes

- Avoid using (EP) gear oils in worm gears that contain sulfur-phosphorous chemistries, as these additives can react adversely with bronze worm gears and accelerate wear.
- Food grade lubricants must be in compliance with FDA 212 CFR 178.3570 and qualify as a NSF-H1 lubricant. Please consult with lubrication manufacturer for more information.
- When making a lubrication change, check with the lubrication supplier to assure compatibility and to obtain recommended cleaning or flushing procedures.
- Do not to mix different oils with different additive packages or different base oil formulation types. Polyglycol (PG) oils are not miscible with other oil types and should never be mixed with mineral oil or polyalphaolefin (PAO) synthetic oil.

Oil Cross-reference Chart

ISO Viscosity	Oil Type	Ambient Temperature Range	Mobil	Shell	Castrol	FUCHS	KLÜBER LUBRICATION
VG150	MIN-EP	0 to 25°C (32 to 77°F)	Mobilgear 600XP150	Omala S2 G 150	Alpha SP150	Renolin EP150	Klüberoil GEM 1-150N
	PAO-EP	-30 to 25 °C (-22 to 77 °F)	Mobil SHC Gear150	Omala S4 GX 150	Alphasyn EP150	Gearmaster SYN150/NA	Klübersynth EG 4-150
	PAO	-30 to 25°C (-22 to 77°F)	Mobil SHC629	Morlina S4 B 150	Alphasyn T150	N/A	Klübersynth GEM 4-150N
	PG	-25 to 25°C (-13 to 77°F)	Mobil Glygoyle 150	Omala S4 WE 150	Alphasyn PG150	Renolin PG150	Klübersynth GH 6-150
	FG	0 to 25°C (32 to 77°F)	Mobil DTE FM 150	N/A	N/A	N/A	N/A
	FG-PAO	-15 to 25°C (5 to 77°F)	Mobil SHC Cibus 150	N/A	N/A	Cassida GL150	Klüberoil 4 UH 1-150N
	FG-PG	-25 to 25°C (-13 to 77°F)	Mobil Glygoyle 150	N/A	N/A	N/A	Klübersynth UH1 6-150
VG220	MIN-EP	0 to 40°C (32 to 104°)	Mobilgear 600XP220	Omala S2 G 220	Alpha SP220	Renolin EP220	Klüberoil GEM 1-220N
	PAO-EP	-30 to 60 °C (-22 to 140 °F)	Mobil SHC Gear 220	Omala S4 GX 220	Alphasyn EP220	Gearmaster SYN220/NA	Klübersynth EG 4-220
	PAO	-30 to 60°C (-22 to 140°F)	Mobil SHC630	Morlina S4 B 220	Alphasyn T220	N/A	Klübersynth GEM 4-220N
	PG	-25 to 60°C (-13 to 140°F)	Mobil Glygoyle 220	Omala S4 WE 220	Alphasyn PG220	Renolin PG220	Klübersynth GH 6-220
	FG	0 to 40°C (32 to 104°F)	Mobil DTE FM 220	N/A	N/A	Fuchs FM220	N/A
	FG-PAO	-25 to 60°C (-13 to 140°F)	Mobil SHC Cibus 220	N/A	N/A	Cassida GL220	Klüberoil 4 UH 1-220N
	FG-PG	-25 to 60°C (-13 to 140°F)	Mobil Glygoyle 220	N/A	N/A	Cassida WG220	Klübersynth UH1 6-220
VG460	MIN-EP	0 to 40°C (32 to 104°F)	Mobilgear 600XP460	Omala S2 G 460	Alpha SP460	Renolin EP460	Klüberoil GEM 1-460N
	PAO-EP	-20 to 80°C (-4 to 176°F)	Mobil SHC Gear 460	Omala S4 GX 460	Alphasyn EP460	Gearmaster SYN460/NA	Klübersynth EG 4-460
	PAO	-20 to 80°C (-4 to 176°F)	Mobil SHC 634	Morlina S4 B 460	Alphasyn T460	N/A	Klübersynth GEM 4-460N
	PG	-20 to 80°C (-4 to 176°F)	Mobil Glygoyle 460	Omala S4 WE 60	Alphasyn PG460	N/A	Klübersynth GH 6-460
	FG	0 to 40°C (32 to 104°F)	Mobil DTE FM460	N/A	N/A	Fuchs FM460	N/A
	FG-PAO	-20 to 80°C (-4 to 176°F)	Mobil SHC Cibus 460	N/A	N/A	Cassida GL460	Klüberoil 4 UH 1-460N
	FG-PG	-20 to 80°C (-4 to 176°F)	Mobil Glygoyle 460	N/A	N/A	Cassida WG460	Klübersynth UH1 6-460

Low-end service temperature limit may vary for a specific lubricant; Please also see the important notes on Page 1.

HELICAL-WORM REDUCER LUBRICATION TYPES

Lubrication Tables – Helical Worm Gear Units

Standard Oil Lubricants

ISO Viscosity	Oil Type	Ambient Temperature Range	Manufacturer Brand/Type	Notes
VG680	PAO	0 to 60°C (32 to 140°F)	Mobil SHC636	♦

Optional Oil Lubricants

ISO Viscosity	Oil Type	Ambient Temperature Range	Manufacturer Brand/Type	Notes
VG460	PAO	0 to50°C (32 to 122°F)	Mobil SHC 634	-
	FG-PAO	0 to50°C (32 to 122°F)	Mobil SHC Cibus 460	-

Grease Options (applied to greased bearings and seal cavities)

NLGI Grade	Grease Thickener	Grease Base Oil	Ambient Temperature Range	Manufacturer Brand/Type	Notes
NLGI 2	Li-Complex	PAO	-40 to 80°C (-40 to 176°F)	Mobil / Mobilith SHC 220	♦
	Polyurea	FG-PAO	-30 to 80°C (-22 to 176°F)	Mobil SHC Polyrex 222	♦

♦ **Stocked Lubricants**

IMPORTANT NOTE

- The "Ambient Temperature" is intended to be an operation guideline based upon the typical properties of all the lubricant. The viscosity and other properties of the lubricant change based upon load, speed, ambient conditions, and reducer operating temperatures. The user should consult with their lubrication supplier & NORD Gear before considering changes in oil type or viscosity.
- To prevent reducer overheating, observe the maximum operating oil temperature limits:

  Synthetic Oil: 105 °C (225 °F).
- In the following instances, please consult NORD for specific recommendations:

√ Gear units will operate in high ambient temperature conditions exceeding 40 °C (104 °F).
√ Gear units will operate in cold ambient temperature conditions approaching 0 °C (32 °F) or lower.
√ Lower than an ISO VG100 viscosity oil is being considered for a cold-temperature service.
√ Fluid grease is required for lubricating the gear unit.

- Observe the general lubrication guidelines outlined in user manual U10770.

Oil Formulation Codes

PAO - Synthetic Polyalphaolefin Oil
PG - Synthetic Polyglycol Oil
FG-PAO - Food-Grade, Synthetic Poyalphaolefin Oil
FG-PG - Food-Grade, Synthetic Polyglycol Oil

Lubrication Notes

- Avoid using (EP) gear oils in worm gears that contain sulfur-phosphorous chemistries, as these additives can react adversely with bronze worm gears and accelerate wear.
- Food grade lubricants must be in compliance with FDA 212 CFR 178.3570 and qualify as a NSF-H1 lubricant. Please consult with lubrication manufacturer for more information.
- When making a lubrication change, check with the lubrication supplier to assure compatibility and to obtain recommended cleaning or flushing procedures.
- Do not to mix different oils with different additive packages or different base oil formulation types. Polyglycol (PG) oils are not miscible with other oil types and should never be mixed with mineral oil or polyalphaolefin (PAO) synthetic oil.

HELICAL-WORM REDUCER LUBRICATION TYPES

Oil Cross-reference Chart

ISO Viscosity	Oil Type	Ambient Temperature Range	Mobil	Shell	Castrol	FUCHS	KLÜBER LUBRICATION
VG 100	PAO	-35 to 25°C (-31 to 77°F)	Mobil SHC627	Morlina S4 B 100	N/A	N/A	Klübersynth GEM 4-100N
	PG	-25 to 25°C (-13 to 77°F)	Mobil Glygoyle 100	N/A	N/A	N/A	Klübersynth GH 6-100
	FG-PAO	-35 to 25°C (-31 to 77°F)	Mobil SHC Cibus 100	N/A	N/A	N/A	Klüberoil 4 UH 1-100N
	FG-PG	-25 to 25°C (-13 to 77°F)	Mobil Glygoyle 100	N/A	N/A	N/A	Klübersynth UH1 6-100
VG150	PAO	-35 to 25°C (-31 to 77°F)	Mobil SHC629	Morlina S4 B 150	Alphasyn T150	N/A	Klübersynth GEM 4-150N
	PG	-25 to 25°C (-13 to 77°F)	Mobil Glygoyle 150	Omala S4 WE 150	Alphasyn PG150	Renolin PG150	Klübersynth GH 6-150
	FG-PAO	-15 to 25°C (5 to 77°F)	Mobil SHC Cibus 150	N/A	N/A	Cassida GL150	Klüberoil 4 UH 1-150N
	FG-PG	-25 to 25°C (-13 to 77°F)	Mobil Glygoyle 150	N/A	N/A	N/A	Klübersynth UH1 6-150
VG220	PAO	-15 to 40°C (5 to 104°F)	Mobil SHC630	Morlina S4 B 220	Alphasyn T220	N/A	Klübersynth GEM 4-220N
	PG	-25 to 40°C (-13 to 104°F)	Mobil Glygoyle 220	Omala S4 WE 220	Alphasyn PG220	Renolin PG220	Klübersynth GH 6-220
	FG-PAO	-25 to 40°C (-13 to 104°F)	Mobil SHC Cibus 220	N/A	N/A	Cassida GL220	Klüberoil 4 UH 1-220N
	FG-PG	-25 to 40°C (-13 to 104°F)	Mobil Glygoyle 220	N/A	N/A	Cassida WG220	Klübersynth UH1 6-220
VG460	PAO	0 to50°C (32 to 122°F)	Mobil SHC 634	Morlina S4 B 460	Alphasyn T460	N/A	Klübersynth GEM 4-460N
	PG	0 to50°C (32 to 122°F)	Mobil Glygoyle 460	Omala S4 WE 60	Alphasyn PG460	N/A	Klübersynth GH 6-460
	FG-PAO	0 to50°C (32 to 122°F)	Mobil SHC Cibus 460	N/A	N/A	Cassida GL460	Klüberoil 4 UH 1-460N
	FG-PG	0 to50°C (32 to 122°F)	Mobil Glygoyle 460	N/A	N/A	Cassida WG460	Klübersynth UH1 6-460
VG680	PAO	0 to 60°C (32 to 140°F)	Mobil SHC636	Morlina S4 B 680	N/A	N/A	Klübersynth GEM 4-680N
	PG	0 to 60°C (32 to 140°F)	Mobil Glygoyle 680	Omala S4 WE 680	N/A	N/A	Klübersynth GH 6-680
	FG-PAO	0 to 60°C (32 to 140°F)	N/A	N/A	N/A	Cassida GL680	Klüberoil 4 UH1-680N
	FG-PG	0 to 60°C (32 to 140°F)	Mobil Glygoyle 680	N/A	N/A	Cassida WG680	*Klübersynth UH1 6-680*

Low-end service temperature limit may vary for a specific lubricant; Please also see the important notes on Page 1.

MINICASE® (SM SERIES) WORM GEAR LUBRICATION TYPES

Lubrication Tables – MINICASE® (SM series) Worm Gear Units

Standard Oil Lubricants

ISO Viscosity	Oil Type	Ambient Temperature Range	Manufacturer Brand/Type	Notes
VG680	PG	-20 to 40°C (-4 to 104°F)	Klübersynth GH 6-680	♦

Optional Oil Lubricants

ISO Viscosity	Oil Type	Ambient Temperature Range	Manufacturer Brand/Type	Notes
VG680	FG-PG	-25 to 80°C (-13 to 176°F)	Klübersynth UH1 6-680	♦

Grease Options (applied to greased bearings and seal cavities)

NLGI Grade	Grease Thickener	Grease Base Oil	Ambient Temperature Range	Manufacturer Brand/Type	Notes
NLGI 2	Li-Complex	PAO	-25 to 80°C (-13 to 176°F)	Kluber / Petamo GHY133N	♦
	Aluminum	FG	-25 to 40°C (-13 to 104°F)	Kluber / Klubersynth UH1 14-151	♦

♦ **Stocked Lubricants**

IMPORTANT NOTE

- Observe the general lubrication guidelines in User Manual U17900.
- Ambient temperature range is a guideline only. The allowed operating temperature range for the gear unit is dependent upon assembly components used, their individual temperature limits, and the actual operating conditions.
- The selected oil type and viscosity is considered appropriate for most applications utilizing the specified NORD gear unit type. Different oil types or viscosity grades may be recommended if the gear unit is exposed to frequent high load conditions or operating under extreme low or high ambient temperature conditions.
- To prevent reducer overheating, observe the maximum operating oil temperature limits:
  Synthetic oil: 105 °C (225 °F).
- Consult NORD for recommendations in the following instances:
  √ The gear unit is exposed to frequent high load conditions.
  √ Ambient temperature conditions exceed 40 °C (104 °F) or approach 0 °C (32 °F) or lower.
  √ Fluid grease is being considered or specified for lubricating the gear unit.
  √ Lower than an ISO VG100 viscosity oil is being considered for a cold-temperature service.

Oil Formulation Codes

PAO - Synthetic Polyalphaolefin Oil
PG - Synthetic Polyglycol Oil
FG-PAO - Food-Grade, Synthetic Poyalphaolefin Oil
FG-PG - Food-Grade, Synthetic Polyglycol Oil

NOTICE

- Avoid using (EP) gear oils in worm gears that contain sulfur-phosphorous chemistries, as these additives can react adversely with bronze worm gears and accelerate wear.
- Food grade lubricants must be in compliance with FDA 212 CFR 178.3570 and qualify as a NSF-H1 lubricant. Please consult with lubrication manufacturer for more information.
- When making a lubrication change, check with the lubrication supplier to assure compatibility and to obtain recommended cleaning or flushing procedures.
- Do not to mix different oils with different additive packages or different base oil formulation types. Polyglycol (PG) oils are not miscible with other oil types and should never be mixed with mineral or polyaolpha-olefin (PAO) oils.

MINICASE® (SM SERIES) WORM GEAR LUBRICATION TYPES

Oil Cross-reference Chart

ISO Viscosity	Oil Type	Ambient Temperature Range	Mobil	Shell	Castrol	FUCHS	KLÜBER LUBRICATION
VG 100	PAO	-35 to 25°C (-31 to 77°F)	Mobil SHC627	Morlina S4 B 100	N/A	N/A	Klübersynth GEM 4-100N
	PG	-25 to 25°C (-13 to 77°F)	Mobil Glygoyle 100	N/A	N/A	N/A	Klübersynth GH 6-100
	FG-PAO	-30 to 25°C (-22 to 77°F)	Mobil SHC Cibus 100	N/A	N/A	N/A	Klüberoil 4 UH 1-100N
	FG-PG	-25 to 25°C (-13 to 77°F)	Mobil Glygoyle 100	N/A	N/A	N/A	Klübersynth UH1 6-100
VG150	PAO	-35 to 25°C (-31 to 77°F)	Mobil SHC629	Morlina S4 B 150	Alphasyn T150	N/A	Klübersynth GEM 4-150N
	PG	-25 to 25°C (-13 to 77°F)	Mobil Glygoyle 150	Omala S4 WE 150	Alphasyn PG150	Renolin PG150	Klübersynth GH 6-150
	FG-PAO	-15 to 25°C (5 to 77°F)	Mobil SHC Cibus 150	N/A	N/A	Cassida GL150	Klüberoil 4 UH 1-150N
	FG-PG	-25 to 25°C (-13 to 77°F)	Mobil Glygoyle 150	N/A	N/A	N/A	Klübersynth UH1 6-150
VG220	PAO	-35 to 40°C (-31 to 104°F)	Mobil SHC630	Morlina S4 B 220	Alphasyn T220	N/A	Klübersynth GEM 4-220N
	PG	-25 to 40°C (-13 to 104°F)	Mobil Glygoyle 220	Omala S4 WE 220	Alphasyn PG220	Renolin PG220	Klübersynth GH 6-220
	FG-PAO	-25 to 40°C (-13 to 104°F)	Mobil SHC Cibus 220	N/A	N/A	Cassida GL220	Klüberoil 4 UH 1-220N
	FG-PG	-25 to 40°C (-13 to 104°F)	Mobil Glygoyle 220	N/A	N/A	Cassida WG220	Klübersynth UH1 6-220
VG460	PAO	-20 to 40°C (-4 to 104°F)	Mobil SHC 634	Morlina S4 B 460	Alphasyn T460	N/A	Klübersynth GEM 4-460N
	PG	-20 to 40°C (-4 to 104°F)	Mobil Glygoyle 460	Omala S4 WE 60	Alphasyn PG460	N/A	Klübersynth GH 6-460
	FG-PAO	-5 to 40°C (23 to 104°F)	Mobil SHC Cibus 460	N/A	N/A	Cassida GL460	Klüberoil 4 UH 1-460N
	FG-PG	-5 to 40°C (23 to 104°F)	Mobil Glygoyle 460	N/A	N/A	Cassida WG460	Klübersynth UH1 6-460
VG680	PAO	-20 to 40°C (-4 to 104°F)	Mobil SHC636	Morlina S4 B 680	N/A	N/A	Klübersynth GEM 4-680N
	PG	-20 to 40°C (-4 to 104°F)	Mobil Glygoyle 680	Omala S4 WE 680	N/A	N/A	Klübersynth GH 6-680
	FG-PAO	-5 to 40°C (23 to 104°F)	N/A	N/A	N/A	Cassida GL680	Klüberoil 4 UH1-680N
	FG-PG	-25 to 80°C (-13 to 176°F)	Mobil Glygoyle 680	N/A	N/A	Cassida WG680	*Klübersynth UH1 6-680*

Low-end service temperature limit may vary for a specific lubricant; Please also see the important notes on Page 1.

MINICASE® (SMI/SMID) WORM GEAR LUBRICATION TYPES

Lubrication Tables – MINICASE® (SMI/SMID series) Worm Gear Units

Standard Oil Lubricants

ISO Viscosity	Oil Type	Ambient Temperature Range	Manufacturer Brand/Type	Notes
VG680	PG	-20 to 40°C (-4 to 104°F)	Klübersynth GH 6-680	♦

Optional Oil Lubricants

ISO Viscosity	Oil Type	Ambient Temperature Range	Manufacturer Brand/Type	Notes
VG680	FG-PG	-25 to 80°C (-13 to 176°F)	Klübersynth UH1 6-680	♦

Grease Options (applied to greased bearings and seal cavities)

NLGI Grade	Grease Thickener	Grease Base Oil	Ambient Temperature Range	Manufacturer Brand/Type	Notes
NLGI 2	Li-Complex	PAO	-25 to 80°C (-13 to 176°F)	Kluber / Petamo GHY133N	♦
	Aluminum	FG	-25 to 40°C (-13 to 104°F)	Kluber / Klubersynth UH1 14-151	♦

♦ **Stocked Lubricants**

IMPORTANT NOTE

- Observe the general lubrication guidelines in User Manual U10800.
- Ambient temperature range is a guideline only. The allowed operating temperature range for the gear unit is dependent upon assembly components used, their individual temperature limits, and the actual operating conditions.
- The selected oil type and viscosity is considered appropriate for most applications utilizing the specified NORD gear unit type. Different oil types or viscosity grades may be recommended if the gear unit is exposed to frequent high load conditions or operating under extreme low or high ambient temperature conditions.
- To prevent reducer overheating, observe the maximum operating oil temperature limits:
  Synthetic oil: 105 °C (225 °F).
- Consult NORD for recommendations in the following instances:
  √ The gear unit is exposed to frequent high load conditions.
  √ Ambient temperature conditions exceed 40 °C (104 °F) or approach 0 °C (32 °F) or lower.
  √ Fluid grease is being considered or specified for lubricating the gear unit.
  √ Lower than an ISO VG100 viscosity oil is being considered for a cold-temperature service.

Oil Formulation Codes

PAO - Synthetic Polyalphaolefin Oil
PG - Synthetic Polyglycol Oil
FG-PAO - Food-Grade, Synthetic Poyalphaolefin Oil
FG-PG - Food-Grade, Synthetic Polyglycol Oil

NOTICE

- Avoid using (EP) gear oils in worm gears that contain sulfur-phosphorous chemistries, as these additives can react adversely with bronze worm gears and accelerate wear.
- Food grade lubricants must be in compliance with FDA 212 CFR 178.3570 and qualify as a NSF-H1 lubricant. Please consult with lubrication manufacturer for more information.
- When making a lubrication change, check with the lubrication supplier to assure compatibility and to obtain recommended cleaning or flushing procedures.
- Do not to mix different oils with different additive packages or different base oil formulation types. Polyglycol (PG) oils are not miscible with other oil types and should never be mixed with mineral or polyaolphaolefin (PAO) oils.

MINICASE® (SMI/SMID) WORM GEAR LUBRICATION TYPES

Oil Cross-reference Chart

ISO Viscosity	Oil Type	Ambient Temperature Range	Mobil	Shell	Castrol	FUCHS	KLÜBER LUBRICATION
VG 100	PAO	-35 to 25°C (-31 to 77°F)	Mobil SHC627	Morlina S4 B 100	N/A	N/A	Klübersynth GEM 4-100N
	PG	-25 to 25°C (-13 to 77°F)	Mobil Glygoyle 100	N/A	N/A	N/A	Klübersynth GH 6-100
	FG-PAO	-30 to 25°C (-22 to 77°F)	Mobil SHC Cibus 100	N/A	N/A	N/A	Klüberoil 4 UH 1-100N
	FG-PG	-25 to 25°C (-13 to 77°F)	Mobil Glygoyle 100	N/A	N/A	N/A	Klübersynth UH1 6-100
VG150	PAO	-35 to 25°C (-31 to 77°F)	Mobil SHC629	Morlina S4 B 150	Alphasyn T150	N/A	Klübersynth GEM 4-150N
	PG	-25 to 25°C (-13 to 77°F)	Mobil Glygoyle 150	Omala S4 WE 150	Alphasyn PG150	Renolin PG150	Klübersynth GH 6-150
	FG-PAO	-15 to 25°C (5 to 77°F)	Mobil SHC Cibus 150	N/A	N/A	Cassida GL150	Klüberoil 4 UH 1-150N
	FG-PG	-25 to 25°C (-13 to 77°F)	Mobil Glygoyle 150	N/A	N/A	N/A	Klübersynth UH1 6-150
VG220	PAO	-35 to 40°C (-31 to 104°F)	Mobil SHC630	Morlina S4 B 220	Alphasyn T220	N/A	Klübersynth GEM 4-220N
	PG	-25 to 40°C (-13 to 104°F)	Mobil Glygoyle 220	Omala S4 WE 220	Alphasyn PG220	Renolin PG220	Klübersynth GH 6-220
	FG-PAO	-25 to 40°C (-13 to 104°F)	Mobil SHC Cibus 220	N/A	N/A	Cassida GL220	Klüberoil 4 UH 1-220N
	FG-PG	-25 to 40°C (-13 to 104°F)	Mobil Glygoyle 220	N/A	N/A	Cassida WG220	Klübersynth UH1 6-220
VG460	PAO	-20 to 40°C (-4 to 104°F)	Mobil SHC 634	Morlina S4 B 460	Alphasyn T460	N/A	Klübersynth GEM 4-460N
	PG	-20 to 40°C (-4 to 104°F)	Mobil Glygoyle 460	Omala S4 WE 60	Alphasyn PG460	N/A	Klübersynth GH 6-460
	FG-PAO	-5 to 40°C (23 to 104°F)	Mobil SHC Cibus 460	N/A	N/A	Cassida GL460	Klüberoil 4 UH 1-460N
	FG-PG	-5 to 40°C (23 to 104°F)	Mobil Glygoyle 460	N/A	N/A	Cassida WG460	Klübersynth UH1 6-460
VG680	PAO	-20 to 40°C (-4 to 104°F)	Mobil SHC636	Morlina S4 B 680	N/A	N/A	Klübersynth GEM 4-680N
	PG	-20 to 40°C (-4 to 104°F)	Mobil Glygoyle 680	Omala S4 WE 680	N/A	N/A	Klübersynth GH 6-680
	FG-PAO	-5 to 40°C (23 to 104°F)	N/A	N/A	N/A	Cassida GL680	Klüberoil 4 UH1-680N
	FG-PG	-25 to 80°C (-13 to 176°F)	Mobil Glygoyle 680	N/A	N/A	Cassida WG680	Klübersynth UH1 6-680

Low-end service temperature limit may vary for a specific lubricant; Please also see the important notes on Page 1.

FLEXBLOC™ (SI/SID SERIES) WORM GEAR LUBRICATION TYPES

Lubrication Tables – FLEXBLOC™ (SI/SID Series) Worm Gear Units

Standard Oil Lubricants

NORD uses a semi automated assembly process to produce the FLEXBLOC™ gear unit assemblies. During this process the gear units are factory filled in accordance with the following table.

Standard Oil Lubricants

ISO Viscosity	Oil Type	Ambient Temperature Range	Manufacturer Brand/Type	Notes
VG680	FG-PG	-25 to 80°C (-13 to 176°F)	Klübersynth UH1 6-680	Inch
	PG	-20 to 40°C (-4 to 104°F)	Klübersynth GH 6-680	Metric
VG220	FG-PG	-25 to 40°C (-13 to 104°F)	Klübersynth UH1 6-220	Inch
	PG	-25 to 40°C (-13 to 104°F)	Klübersynth GH 6-220	Metric

Grease Options (applied to greased bearings and seal cavities)

NLGI Grade	Grease Thickener	Grease Base Oil	Ambient Temperature Range	Manufacturer Brand/Type	Notes
NLGI 2 0	Li-Complex	PAO	-25 to 80°C (-13 to 176°F)	Kluber / Petamo GHY133N	♦
	Aluminum	FG	-25 to 40°C (-13 to 104°F)	Kluber / Klubersynth UH1 14-151	♦

♦ **Stocked Lubricants**

IMPORTANT NOTE

- Observe the general lubrication guidelines in User Manual U10800.
- Ambient temperature range is a guideline only. The allowed operating temperature range for the gear unit is dependent upon assembly components used, their individual temperature limits, and the actual operating conditions.
- The selected oil type and viscosity is considered appropriate for most applications utilizing the specified NORD gear unit type. Different oil types or viscosity grades may be recommended if the gear unit is exposed to frequent high load conditions or operating under extreme low or high ambient temperature conditions.
- To prevent reducer overheating, observe the maximum operating oil temperature limits:
  Synthetic oil: 105 °C (225 °F).
- Consult NORD for recommendations in the following instances:
  √ The gear unit is exposed to frequent high load conditions.
  √ Ambient temperature conditions exceed 40 °C (104 °F) or approach 0 °C (32 °F) or lower.
  √ Fluid grease is being considered or specified for lubricating the gear unit.
  √ Lower than an ISO VG100 viscosity oil is being considered for a cold-temperature service.

Oil Formulation Codes

PAO - Synthetic Polyalphaolefin Oil
PG - Synthetic Polyglycol Oil
FG-PAO - Food-Grade, Synthetic Poyalphaolefin Oil
FG-PG - Food-Grade, Synthetic Polyglycol Oil

NOTICE

- Avoid using (EP) gear oils in worm gears that contain sulfur-phosphorous chemistries, as these additives can react adversely with bronze worm gears and accelerate wear.
- Food grade lubricants must be in compliance with FDA 212 CFR 178.3570 and qualify as a NSF-H1 lubricant. Please consult with lubrication manufacturer for more information.
- When making a lubrication change, check with the lubrication supplier to assure compatibility and to obtain recommended cleaning or flushing procedures.
- Do not to mix different oils with different additive packages or different base oil formulation types. Polyglycol (PG) oils are not miscible with other oil types and should never be mixed with mineral or polyaolpha-olefin (PAO) oils.

FLEXBLOC™ (SI/SID SERIES) WORM GEAR LUBRICATION TYPES

Oil Cross-reference Chart

ISO Viscosity	Oil Type	Ambient Temperature Range	Mobil	Shell	Castrol	FUCHS	KLÜBER LUBRICATION
VG 100	PAO	-35 to 25°C (-31 to 77°F)	Mobil SHC627	Morlina S4 B 100	N/A	N/A	Klübersynth GEM 4-100N
	PG	-25 to 25°C (-13 to 77°F)	Mobil Glygoyle 100	N/A	N/A	N/A	Klübersynth GH 6-100
	FG-PAO	-30 to 25°C (-22 to 77°F)	Mobil SHC Cibus 100	N/A	N/A	N/A	Klüberoil 4 UH 1-100N
	FG-PG	-25 to 25°C (-13 to 77°F)	Mobil Glygoyle 100	N/A	N/A	N/A	Klübersynth UH1 6-100
VG150	PAO	-35 to 25°C (-31 to 77°F)	Mobil SHC629	Morlina S4 B 150	Alphasyn T150	N/A	Klübersynth GEM 4-150N
	PG	-25 to 25°C (-13 to 77°F)	Mobil Glygoyle 150	Omala S4 WE 150	Alphasyn PG150	Renolin PG150	Klübersynth GH 6-150
	FG-PAO	-15 to 25°C (5 to 77°F)	Mobil SHC Cibus 150	N/A	N/A	Cassida GL150	Klüberoil 4 UH 1-150N
	FG-PG	-25 to 25°C (-13 to 77°F)	Mobil Glygoyle 150	N/A	N/A	N/A	Klübersynth UH1 6-150
VG220	PAO	-35 to 40°C (-31 to 104°F)	Mobil SHC630	Morlina S4 B 220	Alphasyn T220	N/A	Klübersynth GEM 4-220N
	PG	-25 to 40°C (-13 to 104°F)	Mobil Glygoyle 220	Omala S4 WE 220	Alphasyn PG220	Renolin PG220	Klübersynth GH 6-220
	FG-PAO	-25 to 40°C (-13 to 104°F)	Mobil SHC Cibus 220	N/A	N/A	Cassida GL220	Klüberoil 4 UH 1-220N
	FG-PG	-25 to 40°C (-13 to 104°F)	Mobil Glygoyle 220	N/A	N/A	Cassida WG220	Klübersynth UH1 6-220
VG460	PAO	-20 to 40°C (-4 to 104°F)	Mobil SHC 634	Morlina S4 B 460	Alphasyn T460	N/A	Klübersynth GEM 4-460N
	PG	-20 to 40°C (-4 to 104°F)	Mobil Glygoyle 460	Omala S4 WE 60	Alphasyn PG460	N/A	Klübersynth GH 6-460
	FG-PAO	-5 to 40°C (23 to 104°F)	Mobil SHC Cibus 460	N/A	N/A	Cassida GL460	Klüberoil 4 UH 1-460N
	FG-PG	-5 to 40°C (23 to 104°F)	Mobil Glygoyle 460	N/A	N/A	Cassida WG460	Klübersynth UH1 6-460
VG680	PAO	-20 to 40°C (-4 to 104°F)	Mobil SHC636	Morlina S4 B 680	N/A	N/A	Klübersynth GEM 4-680N
	PG	-20 to 40°C (-4 to 104°F)	Mobil Glygoyle 680	Omala S4 WE 680	N/A	N/A	Klübersynth GH 6-680
	FG-PAO	-5 to 40°C (23 to 104°F)	N/A	N/A	N/A	Cassida GL680	Klüberoil 4 UH1-680N
	FG-PG	-25 to 80°C (-13 to 176°F)	Mobil Glygoyle 680	N/A	N/A	Cassida WG680	Klübersynth UH1 6-680

Low-end service temperature limit may vary for a specific lubricant; Please also see the important notes on Page 1.

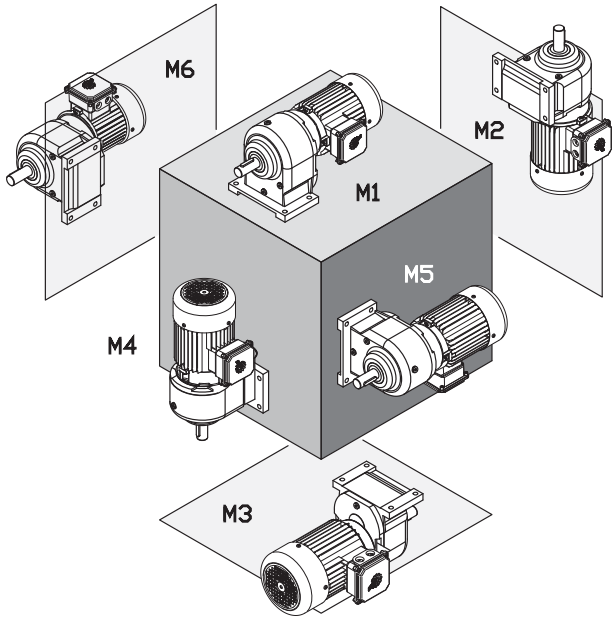
STANDARD IN-LINE FOOTED OIL FILL QUANTITIES

Standard In-line footed lubrication

All Standard In-line reducers are shipped from NORD with a pre-determined oil fill level in accordance to the specified reducer size and mounting position. When filling these gear units the oil must be measured and added until one establishes the proper fill quantity. For additional information please refer to the "Oil & vent plug locations" documentation for your specified gear unit

IMPORTANT NOTE

For mounting orientations other than shown please consult NORD Gear. Reducer modifications may be required.



Type	M1		M2		M3		M4		M5		M6	
	Quarts	Liters	Quarts	Liters	Quarts	Liters	Quarts	Liters	Quarts	Liters	Quarts	Liters
SK0 / SK05	0.14	0.13	0.23	0.22	0.14	0.13	0.23	0.22	0.14	0.13	0.14	0.13
SK000	0.25	0.24	0.42	0.40	0.25	0.24	0.42	0.40	0.25	0.24	0.25	0.24
SK01 / SK015	0.23	0.22	0.40	0.38	0.23	0.22	0.40	0.38	0.23	0.22	0.23	0.22
SK010 / SK0105	0.40	0.38	0.63	0.60	0.40	0.38	0.63	0.60	0.40	0.38	0.40	0.38
SK20 / SK205	0.58	0.55	1.06	1.00	0.58	0.55	1.06	1.00	0.58	0.55	0.58	0.55
SK200 / SK2005	0.85	0.80	1.37	1.30	0.85	0.80	1.37	1.30	0.85	0.80	0.85	0.80
SK25 / SK255	0.53	0.50	1.06	1.00	0.53	0.50	1.06	1.00	0.53	0.50	0.53	0.50
SK250 / SK2505	1.27	1.20	1.59	1.50	1.27	1.20	1.59	1.50	1.27	1.20	1.27	1.20
SK30 / SK305	0.95	0.90	1.37	1.30	0.95	0.90	1.37	1.30	0.95	0.90	0.95	0.90
SK300 / SK3005	1.27	1.20	2.11	2.00	1.27	1.20	2.11	2.00	1.27	1.20	1.27	1.20
SK33 / SK335	1.06	1.00	1.69	1.60	1.06	1.00	1.69	1.60	1.06	1.00	1.06	1.00
SK330 / SK3305	1.90	1.80	2.96	2.80	1.90	1.80	2.96	2.80	1.90	1.80	1.90	1.80

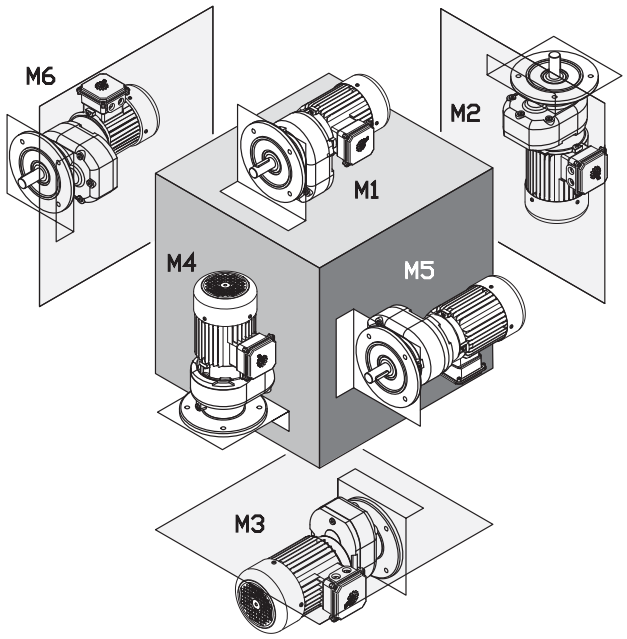
STANDARD IN-LINE FLANGED OIL FILL QUANTITIES

Standard In-line flanged lubrication

All Standard In-line reducers are shipped from NORD with a pre-determined oil fill level in accordance to the specified reducer size and mounting position. When filling these gear units the oil must be measured and added until one establishes the proper fill quantity. For additional information please refer to the "Oil & vent plug locations" documentation for your specified gear unit

IMPORTANT NOTE

For mounting orientations other than shown please consult NORD Gear. Reducer modifications may be required.

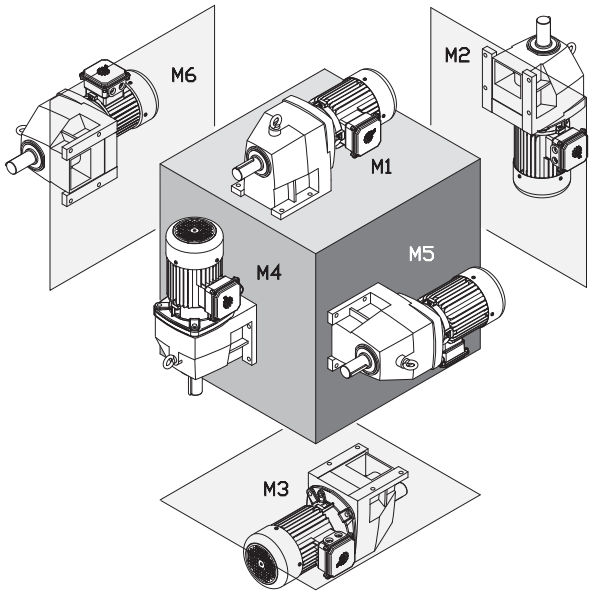


Type	M1		M2		M3		M4		M5		M6	
	Quarts	Liters	Quarts	Liters	Quarts	Liters	Quarts	Liters	Quarts	Liters	Quarts	Liters
SK0 F / SK05 F	0.14	0.13	0.23	0.22	0.14	0.13	0.23	0.22	0.14	0.13	0.14	0.13
SK000 F	0.25	0.24	0.43	0.41	0.25	0.24	0.43	0.41	0.25	0.24	0.25	0.24
SK01 F	0.23	0.22	0.40	0.38	0.23	0.22	0.40	0.38	0.23	0.22	0.23	0.22
SK010 F / SK0105 F	0.37	0.35	0.69	0.65	0.37	0.35	0.78	0.74	0.37	0.35	0.37	0.35
SK20 F	0.37	0.35	0.63	0.60	0.37	0.35	0.63	0.60	0.37	0.35	0.37	0.35
SK200 F / SK2005 F	0.69	0.65	1.00	0.95	0.69	0.65	1.16	1.10	0.69	0.65	0.69	0.65
SK25 F	0.53	0.50	1.06	1.00	0.53	0.50	1.06	1.00	0.53	0.50	0.53	0.50
SK250 F / SK2505 F	0.95	0.90	1.48	1.40	0.95	0.90	1.69	1.60	0.95	0.90	0.95	0.90
SK30 F	0.74	0.70	1.16	1.10	0.74	0.70	1.16	1.10	0.74	0.70	0.74	0.70
SK300 F / SK3005 F	1.32	1.25	1.59	1.50	1.32	1.25	1.90	1.80	1.32	1.25	1.32	1.25
SK33 F / SK335F	1.06	1.00	1.59	1.50	1.06	1.00	1.59	1.50	1.06	1.00	1.06	1.00
SK330 F / SK3305 F	1.69	1.60	2.64	2.50	1.69	1.60	3.06	2.90	1.69	1.60	1.69	1.60

HELICAL IN-LINE FOOTED OIL FILL QUANTITIES

Helical In-line footed lubrication

The following NORD Gear reducers are shipped from the factory with a pre-determined oil fill level in accordance to the specified reducer size and mounting position. For additional information, please refer to the "Oil Plug & Vent Locations" documentation for your gear unit.



IMPORTANT NOTE

Actual oil volume can vary slightly depending upon the gear case size, mounting and ratio. Prior to commissioning the reducer, check the oil-fill level using the reducer's oil level plug and drain or add addition oil as needed. The minimum acceptable oil level is 0.15 in (4mm) below the oil level hole.

For mounting orientations other than shown please consult NORD Gear. Reducer modifications may be required.

Type	M1		M2		M3		M4		M5		M6	
	Quarts	Liters	Quarts	Liters	Quarts	Liters	Quarts	Liters	Quarts	Liters	Quarts	Liters
SK02	0.21	0.20	0.79	0.75	0.79	0.75	0.69	0.65	0.63	0.60	0.63	0.60
SK 03	0.37	0.35	1.27	1.20	0.85	0.80	1.06	1.00	0.74	0.70	0.74	0.70
SK11E	0.26	0.25	0.53	0.50	0.69	0.65	0.53	0.50	0.42	0.40	0.42	0.40
SK12	0.26	0.25	0.85	0.80	0.90	0.85	0.79	0.75	0.58	0.55	0.58	0.55
SK 13	0.79	0.75	1.37	1.30	1.37	1.30	1.27	1.20	0.79	0.75	0.79	0.75
SK21E	0.63	0.60	1.27	1.20	1.37	1.30	1.06	1.00	1.06	1.00	1.06	1.00
SK22	0.53	0.50	2.01	1.90	2.22	2.10	1.90	1.80	1.48	1.40	1.48	1.40
SK 23	1.27	1.20	2.11	2.00	2.01	1.90	2.54	2.40	1.69	1.60	1.69	1.60
SK31E	1.16	1.10	2.11	2.00	2.32	2.20	1.80	1.70	1.59	1.50	1.59	1.50
SK32	0.95	0.90	2.64	2.50	3.28	3.10	3.28	3.10	2.11	2.00	2.11	2.00
SK 33N	1.85	1.75	3.17	3.00	3.59	3.40	4.23	4.00	2.43	2.30	2.43	2.30
SK41E	1.69	1.60	2.75	2.60	3.49	3.30	2.96	2.80	2.43	2.30	2.43	2.30
SK42	1.48	1.40	4.76	4.50	4.76	4.50	4.54	4.30	3.38	3.20	3.38	3.20
SK 43	3.17	3.00	5.92	5.60	5.49	5.20	6.97	6.60	3.80	3.60	3.80	3.60
SK51E	1.90	1.80	3.70	3.50	4.33	4.10	4.23	4.00	4.02	3.80	4.02	3.80
SK52	2.64	2.50	7.40	7.00	7.19	6.80	7.19	6.80	5.39	5.10	5.39	5.10
SK 53	4.76	4.50	9.19	8.70	8.14	7.70	9.19	8.70	6.34	6.00	6.34	6.00
SK62	6.87	6.50	15.9	15.0	13.7	13.0	16.9	16.0	15.9	15.0	15.9	15.0
SK 63	13.7	13.0	15.3	14.5	15.3	14.5	16.9	16.0	13.7	13.0	13.7	13.0
SK72	10.6	10.0	24.3	23.0	19.0	18.0	27.5	26.0	24.3	23.0	24.3	23.0
SK 73	21.7	20.5	21.1	20.0	23.8	22.5	28.5	27.0	21.1	20.0	21.1	20.0
SK82	14.8	14.0	37.0	35.0	28.5	27.0	46.5	44.0	33.8	32.0	33.8	32.0
SK 83	31.7	30.0	32.8	31.0	35.9	34.0	39.1	37.0	34.9	33.0	34.9	33.0
SK92	26.4	25.0	77.0	73.0	49.7	47.0	80.0	76.0	55.0	52.0	55.0	52.0
SK 93	56.0	53.0	74.0	70.0	62.0	59.0	76.0	72.0	52.0	49.0	52.0	49.0
SK102	38.0	36.0	84.0	79.0	70.0	66.0	108	102	75.0	71.0	75.0	71.0
SK 103	78.0	74.0	75.0	71.0	78.0	74.0	102	97.0	71.0	67.0	71.0	67.0

HELICAL IN-LINE FLANGED OIL FILL QUANTITIES

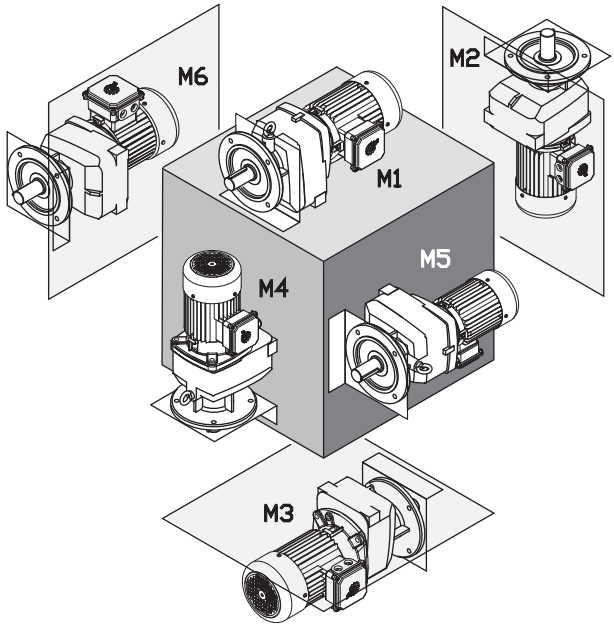
Helical In-line flanged lubrication

The following NORD Gear reducers are shipped from the factory with a pre-determined oil fill level in accordance to the specified reducer size and mounting position. For additional information, please refer to the "Oil Plug & Vent Locations" documentation for your gear unit.

IMPORTANT NOTE

Actual oil volume can vary slightly depending upon the gear case size, mounting and ratio. Prior to commissioning the reducer, check the oil-fill level using the reducer's oil level plug and drain or add addition oil as needed. The minimum acceptable oil level is 0.15 in (4mm) below the oil level hole.

For mounting orientations other than shown please consult NORD Gear. Reducer modifications may be required.

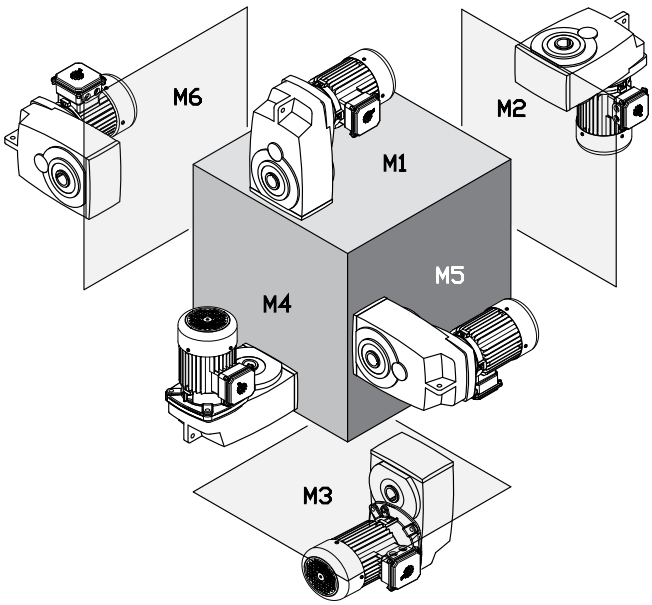


Type	M1		M2		M3		M4		M5		M6	
	Quarts	Liters	Quarts	Liters	Quarts	Liters	Quarts	Liters	Quarts	Liters	Quarts	Liters
SK02F	0.26	0.25	0.74	0.70	0.74	0.70	0.74	0.70	0.53	0.50	0.53	0.50
SK 03 F	0.58	0.55	1.00	0.95	0.95	0.90	1.27	1.20	0.95	0.90	0.95	0.90
SK11E F	0.32	0.30	0.53	0.50	0.53	0.50	0.48	0.45	0.42	0.40	0.42	0.40
SK12F	0.37	0.35	0.90	0.85	0.95	0.90	0.95	0.90	0.74	0.70	0.74	0.70
SK 13 F	1.06	1.00	1.37	1.30	1.37	1.30	1.27	1.20	1.06	1.00	1.06	1.00
SK21E F	0.53	0.50	1.27	1.20	1.37	1.30	0.63	0.60	0.95	0.90	0.95	0.90
SK22F	0.74	0.70	1.90	1.80	1.90	1.80	1.90	1.80	1.48	1.40	1.48	1.40
SK 23 F	1.48	1.40	2.75	2.60	2.43	2.30	2.96	2.80	2.96	2.80	2.96	2.80
SK31E F	0.95	0.90	1.90	1.80	1.74	1.65	1.37	1.30	1.32	1.25	1.32	1.25
SK32F	1.27	1.20	2.96	2.80	3.28	3.10	3.28	3.10	2.32	2.20	2.32	2.20
SK 33N F	2.32	2.20	3.17	3.00	3.59	3.40	4.44	4.20	2.43	2.30	2.43	2.30
SK41E F	1.27	1.20	2.43	2.30	2.85	2.70	2.11	2.00	2.01	1.90	2.01	1.90
SK42F	1.90	1.80	4.65	4.40	4.76	4.50	4.23	4.00	3.91	3.70	3.91	3.70
SK 43 F	3.70	3.50	6.02	5.70	5.28	5.00	6.45	6.10	4.33	4.10	4.33	4.10
SK51E F	1.90	1.80	3.70	3.50	4.33	4.10	3.17	3.00	4.02	3.80	4.02	3.80
SK52F	3.17	3.00	7.19	6.80	6.55	6.20	7.82	7.40	5.92	5.60	5.92	5.60
SK 53 F	5.49	5.20	8.88	8.40	7.40	7.00	9.40	8.90	7.08	6.70	7.08	6.70
SK 62 F	7.40	7.00	15.9	15.0	14.8	14.0	19.5	18.5	16.9	16.0	16.9	16.0
SK 63 F	14.3	13.5	14.8	14.0	16.4	15.5	19.0	18.0	14.8	14.0	14.8	14.0
SK 72 F	10.6	10.0	24.3	23.0	19.5	18.5	29.6	28.0	24.3	23.0	24.3	23.0
SK 73 F	23.2	22.0	23.8	22.5	24.3	23.0	29.1	27.5	21.1	20.0	21.1	20.0
SK 82 F	15.9	15.0	39.1	37.0	30.6	29.0	47.6	45.0	36.5	34.5	36.5	34.5
SK 83 F	32.8	31.0	35.9	34.0	37.0	35.0	42.3	40.0	35.9	34.0	35.9	34.0
SK 92 F	27.5	26.0	77.0	73.0	49.7	47.0	82.0	78.0	55.0	52.0	55.0	52.0
SK 93 F	56.0	53.0	74.0	70.0	62.0	59.0	78.0	74.0	52.0	49.0	52.0	49.0
SK 102 F	42.3	40.0	86.0	81.0	70.0	66.0	110	104	76.0	72.0	76.0	72.0
SK 103 F	73.0	69.0	82.0	78.0	82.0	78.0	105	99.0	71.0	67.0	71.0	67.0

CLINCHER™ OIL FILL QUANTITIES

CLINCHER™ lubrication

Unless otherwise noted below, the following NORD Gear reducers are shipped from the factory with a pre-determined oil fill level in accordance to the specified reducer size and mounting position. For additional information, please refer to the "Oil Plug & Vent Locations" documentation for your gear unit.



IMPORTANT NOTE

Actual oil volume can vary slightly depending upon the gear case size, mounting and ratio. Prior to commissioning the reducer, check the oil-fill level using the reducer's oil level plug and drain or add addition oil as needed. The minimum acceptable oil level is 0.15 in (4mm) below the oil level hole.

For mounting orientations other than shown please consult NORD Gear. Reducer modifications may be required.

Type	M1		M2		M3		M4		M5		M6	
	Quarts	Liters	Quarts	Liters	Quarts	Liters	Quarts	Liters	Quarts	Liters	Quarts	Liters
SK 0182NB	0.42	0.40	0.58	0.55	0.58	0.55	0.42	0.40	0.42	0.40	0.42	0.40
SK 0182.1	0.74	0.7	1.14	1.08	0.66	0.62	0.93	0.88	0.63	0.6	0.68	0.64
SK 0282NB	0.74	0.70	1.16	1.10	0.85	0.80	1.16	1.10	0.95	0.90	0.95	0.90
SK 0282.1	1.08	1.02	1.48	1.4	0.85	0.8	1.41	1.33	0.85	0.8	0.92	0.87
SK 1282	1.00	0.95	1.37	1.30	0.95	0.90	1.37	1.30	1.06	1.00	1.06	1.00
SK 1282.1	1.77	1.67	2.28	2.16	1.11	1.05	2.06	1.95	1.35	1.28	1.42	1.34
SK 1382NB	1.48	1.40	2.43	2.30	2.32	2.20	2.32	2.20	2.11	2.00	2.11	2.00
SK 1382	1.53	1.45	1.69	1.6	1.22	1.15	1.8	1.7	1.16	1.1	1.16	1.1
SK 1382.1	1.77	1.67	2.11	2	1.11	1.05	2.06	1.95	1.35	1.28	1.42	1.34
SK 2282	1.80	1.70	2.43	2.30	1.80	1.70	2.32	2.20	2.01	1.90	2.01	1.90
SK 2382	2.43	2.30	2.85	2.70	2.22	2.10	3.38	3.20	2.11	2.00	2.11	2.00
SK 3282	2.96	2.80	4.23	4.00	3.49	3.30	4.02	3.80	3.17	3.00	3.17	3.00
SK 3382	4.02	3.80	4.54	4.30	3.17	3.00	5.81	5.50	3.17	3.00	3.17	3.00
SK 4282	4.44	4.20	5.71	5.40	4.65	4.40	5.28	5.00	4.44	4.20	4.44	4.20
SK 4382	6.45	6.10	7.29	6.90	5.18	4.90	8.88	8.40	5.28	5.00	5.28	5.00
SK 5282	7.93	7.50	9.30	8.80	7.93	7.50	9.30	8.80	7.61	7.20	7.61	7.20
SK 5382	13.2	12.5	12.7	12.0	7.08	6.70	14.8	14.0	8.77	8.30	8.77	8.30
SK 6282	18.0	17.0	16.4	15.5	13.2	12.5	18.5	17.5	11.6	11.0	14.8	14.0
SK 6382	16.9	16.0	13.7	13.0	10.6	10.0	19.0	18.0	14.8	14.0	13.2	12.5
SK 7282	26.9	25.5	22.2	21.0	21.7	20.5	28.5	27.0	16.9	16.0	22.2	21.0
SK 7382	23.2	22.0	22.2	21.0	16.9	16.0	26.4	25.0	24.3	23.0	23.2	22.0
SK 8282	39.6	37.5	34.9	33.0	32.2	30.5	46.5	44.0	32.8	31.0	32.8	31.0
SK 8382	36.5	34.5	34.3	32.5	26.4	25.0	40.2	38.0	37.0	35.0	31.7	30.0
SK 9282	79.2	75.0	74.0	70.0	58.1	55.0	76.1 †	72.0 †	63.4	60.0	62.4	59.0
SK 9382	78.2	74.0	74.0	70.0	47.6	45.0	79.2 †	75.0 †	68.7	65.0	63.4	60.0
SK 10282	95.0	90.0	95.0	90.0	42.3	40.0	95.0 †	90.0 †	63.0	60.0	87.0	82.0
SK 10382	90.0	85.0	95.0	90.0	77.0	73.0	106 †	100 †	85	80.0	85.0	80.0
SK10382.1	80.3	76.0	84.5	80.0	75.0	71.0	98.2	93.0	76.1	72.0	70.8	67.0
SK 11282*	174	165	169	160	153	145	206 †	195 †	106	100	148	140
SK 11382*	169	160	164	155	148	140	222 †	210 †	164	155	143	135
SK11382.1*	134.2	127	140.5	133	124.7	118	205	194	131	124	118.4	112
SK 12382*	169	160	164	155	148	140	**222 †**	**210 †**	164	155	143	135

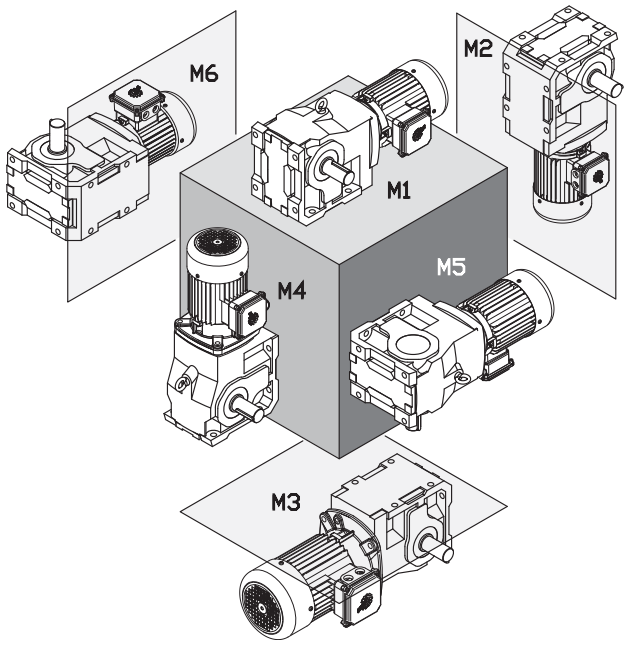
*** For shipping purposes the larger Clincher™ gear units are supplied without oil.**

† Oil quantities shown are for the gearbox only. When the OT (oil tank) option is used, the oil must be filled to the level shown on the dipstick which is located inside of the oil tank. Even when the gear unit is filled by NORD, the user MUST add more oil untill the oil is filled to the proper level.

90.1 HELICAL-BEVEL FOOTED OIL FILL QUANTITIES

90.1 Helical-bevel footed lubrication

Unless otherwise noted below, the following NORD Gear reducers are shipped from the factory with a pre-determined oil fill level in accordance to the specified reducer size and mounting position. For additional information, please refer to the "Oil Plug & Vent Locations" documentation for your gear unit.



IMPORTANT NOTE

Actual oil volume can vary slightly depending upon the gear case size, mounting and ratio. Prior to commissioning the reducer, check the oil-fill level using the reducer's oil level plug and drain or add addition oil as needed. The minimum acceptable oil level is 0.15 in (4mm) below the oil level hole.

For mounting orientations other than shown please consult NORD Gear. Reducer modifications may be required.

Type	M1		M2		M3		M4		M5		M6	
	Quarts	Liters	Quarts	Liters	Quarts	Liters	Quarts	Liters	Quarts	Liters	Quarts	Liters
SK 9012.1	0.74	0.70	1.80	1.70	2.01	1.90	2.22	2.10	1.16	1.10	1.59	1.50
SK 9013.1	1.43	1.35	2.22	2.10	2.27	2.15	2.91	2.75	1.06	1.00	1.90	1.80
SK 9016.1	0.74	0.70	1.80	1.70	2.01	1.90	2.22	2.10	1.16	1.10	1.59	1.50
SK 9017.1	1.37	1.30	2.11	2.00	2.22	2.10	2.85	2.70	1.06	1.00	1.80	1.70
SK 9022.1	1.37	1.30	3.06	2.90	3.49	3.30	4.02	3.80	1.80	1.70	2.96	2.80
SK 9023.1	2.32	2.20	3.38	3.20	3.80	3.60	4.97	4.70	2.32	2.20	3.06	2.90
SK 9032.1	1.90	1.80	5.71	5.40	6.45	6.10	7.19	6.80	3.17	3.00	4.86	4.60
SK 9033.1	3.28	3.10	6.02	5.70	6.66	6.30	8.45	8.00	3.59	3.40	5.07	4.80
SK 9042.1	2.85	2.70	9.51	9.00	10.6	10.0	11.3	10.7	5.49	5.20	8.14	7.70
SK 9043.1	5.28	5.00	10.7	10.1	11.6	11.0	14.1	13.3	6.02	5.70	8.56	8.10
SK 9052.1	6.87	6.50	16.9	16.0	20.1	19.0	22.7	21.5	11.6	11.0	16.4	15.5
SK 9053.1	10.6	10.0	18.0	17.0	21.1	20.0	25.9	24.5	12.2	11.5	17.4	16.5
SK 9062.1	10.6	10.0	29.1	27.5	33.8	32.0	38.0	36.0	19.0	18.0	25.4	24.0
SK 9072.1	10.6	10.0	29.1	27.5	33.8	32.0	38.0	36.0	19.0	18.0	25.4	24.0
SK 9082.1	18.0	17.0	54.0	52.0	66.0	63.0	76.0	72.0	34.9	33.0	49.1	46.5
SK 9086.1	30.6	29.0	77.0	73.0	90.0	85.0	108	102	51.0	48.0	66.0	62.0
SK 9092.1	43.3	41.0	166	157	180	170	182	172	85.0	80.0	95.0	90.0
SK 9096.1	74.0	70.0	198	187	205	194	268	254	115	109	161	152

Oil Levels shown apply to base models and gear units ending in LX, AX, & VX.

90.1 HELICAL-BEVEL FLANGED OIL FILL QUANTITIES

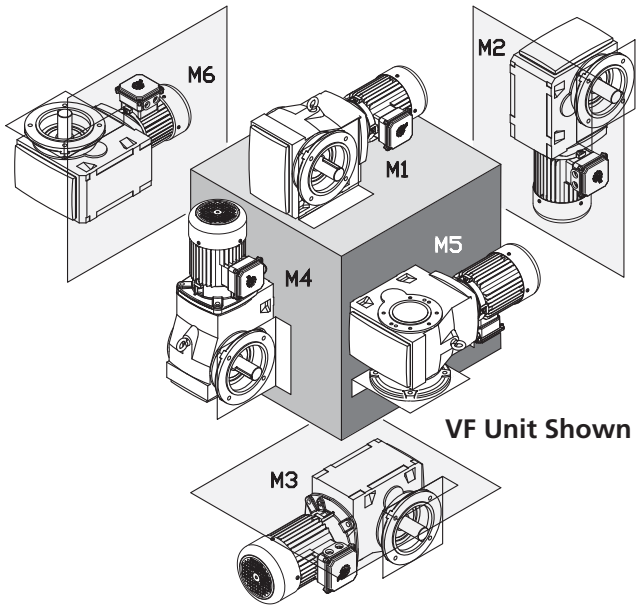
90.1 Helical-bevel flanged lubrication

Unless otherwise noted below, the following NORD Gear reducers are shipped from the factory with a pre-determined oil fill level in accordance to the specified reducer size and mounting position. For additional information, please refer to the "Oil Plug & Vent Locations" documentation for your gear unit.

IMPORTANT NOTE

Actual oil volume can vary slightly depending upon the gear case size, mounting and ratio. Prior to commissioning the reducer, check the oil-fill level using the reducer's oil level plug and drain or add addition oil as needed. The minimum acceptable oil level is 0.15 in (4mm) below the oil level hole.

For mounting orientations other than shown please consult NORD Gear. Reducer modifications may be required.



VF Unit Shown

Type	M1		M2		M3		M4		M5		M6	
	Quarts	Liters	Quarts	Liters	Quarts	Liters	Quarts	Liters	Quarts	Liters	Quarts	Liters
SK 9012.1	1.06	1.00	2.01	1.90	2.01	1.90	2.32	2.20	1.27	1.20	1.80	1.70
SK 9013.1	1.53	1.45	2.43	2.30	2.22	2.10	2.96	2.80	1.11	1.05	1.90	1.80
SK 9016.1	1.06	1.00	2.01	1.90	2.01	1.90	2.32	2.20	1.27	1.20	1.80	1.70
SK 9017.1	1.53	1.45	2.43	2.30	2.22	2.10	2.96	2.80	1.11	1.05	1.90	1.80
SK 9022.1	1.69	1.60	3.70	3.50	3.70	3.50	4.44	4.20	2.43	2.30	2.96	2.80
SK 9023.1	2.43	2.30	3.70	3.50	4.02	3.80	5.60	5.30	2.32	2.20	3.59	3.40
SK 9032.1	2.22	2.10	5.07	4.80	6.76	6.40	7.50	7.10	3.49	3.30	5.39	5.10
SK 9033.1	3.91	3.70	6.02	5.70	7.08	6.70	9.09	8.60	3.80	3.60	5.60	5.30
SK 9042.1	4.76	4.50	10.6	10.0	10.6	10.0	12.2	11.5	6.87	6.50	8.66	8.20
SK 9043.1	6.87	6.50	11.1	10.5	12.6	11.9	15.5	14.7	7.08	6.70	9.83	9.30
SK 9052.1	7.93	7.50	17.4	16.5	21.1	20.0	24.8	23.5	12.2	11.5	19.0	18.0
SK 9053.1	13.7	13.0	19.0	18.0	22.7	21.5	28.0	26.5	13.7	13.0	18.0	17.0
SK 9062.1	12.7	12.0	29.1	27.5	34.9	33.0	40.7	38.5	20.1	19.0	27.5	26.0
SK 9072.1	12.7	12.0	29.1	27.5	34.9	33.0	40.7	38.5	20.1	19.0	27.5	26.0
SK 9082.1	22.2	21.0	57.0	54.0	70.0	66.0	85.0	80.0	40.2	38.0	55.0	52.0
SK 9086.1	38.0	36.0	82.0	78.0	96.0	91.0	113	107	56.0	53.0	80.0	76.0
SK 9092.1	42.3	40.0	137	130	163	154	185	175	87.0	82.0	96.0	91.0
SK 9096.1	85.0	80.0	198	187	204	193	272	257	119	113	165	156

Oil Levels shown apply to base models and gear units ending in AZ, AF, VZ, & VF.

92 SERIES HELICAL-BEVEL FOOTED OIL FILL QUANTITIES

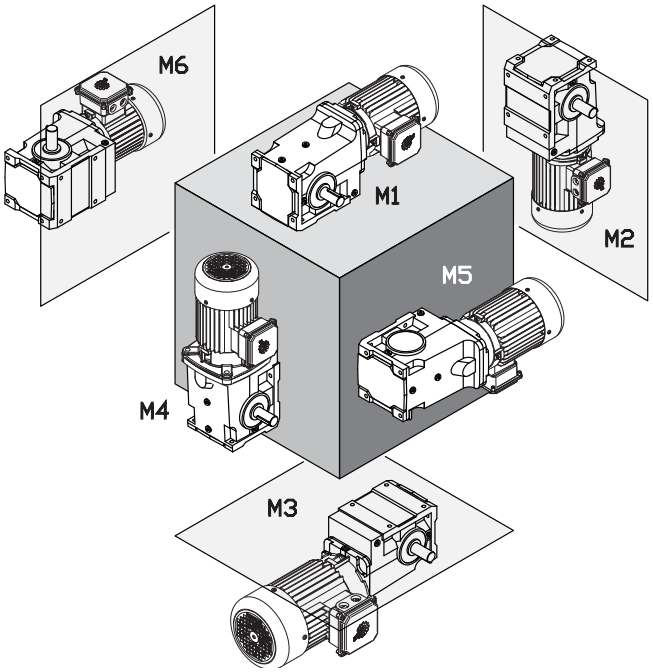
92 Helical-bevel footed lubrication

The following NORD Gear reducers are shipped from the factory with a pre-determined oil fill level in accordance to the specified reducer size and mounting position. For additional information, please refer to the "Oil Plug & Vent Locations" documentation for your gear unit.

IMPORTANT NOTE

Actual oil volume can vary slightly depending upon the gear case size, mounting and ratio. Prior to commissioning the reducer, check the oil-fill level using the reducer's oil level plug and drain or add addition oil as needed. The minimum acceptable oil level is 0.15 in (4mm) below the oil level hole.

For mounting orientations other than shown please consult NORD Gear. Reducer modifications may be required.



Type	M1		M2		M3		M4		M5		M6	
	Quarts	Liters	Quarts	Liters	Quarts	Liters	Quarts	Liters	Quarts	Liters	Quarts	Liters
SK 92072	0.42	0.40	0.63	0.60	0.53	0.50	0.58	0.55	0.42	0.40	0.42	0.40
SK 92172	0.63	0.60	0.95	0.90	1.06	1.00	1.16	1.10	1.16	1.10	0.85	0.80
SK 92372	0.95	0.90	1.69	1.60	1.59	1.50	2.01	1.90	1.59	1.50	0.95	0.90
SK 92672	1.90	1.80	3.70	3.50	3.80	3.60	3.59	3.40	2.75	2.60	2.75	2.60
SK 92772	2.43	2.30	4.76	4.50	4.86	4.60	5.60	5.30	4.33	4.10	4.33	4.10

Oil Levels shown apply to base models and gear units ending in LX, AX, & VX.

92.1/93.1 SERIES HELICAL-BEVEL OIL FILL QUANTITIES

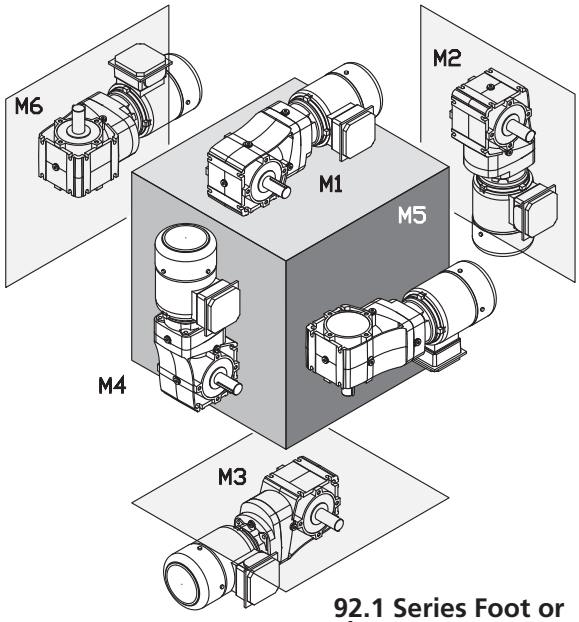
92.1/93.1 Helical-bevel mount lubrication

All NORD Gear reducers are shipped from the factory with a pre-determined oil fill level in accordance to the specified reducer size & mounting position. For additional information, please refer to the "Oil Plug & Vent Locations" documentation for your gear unit.

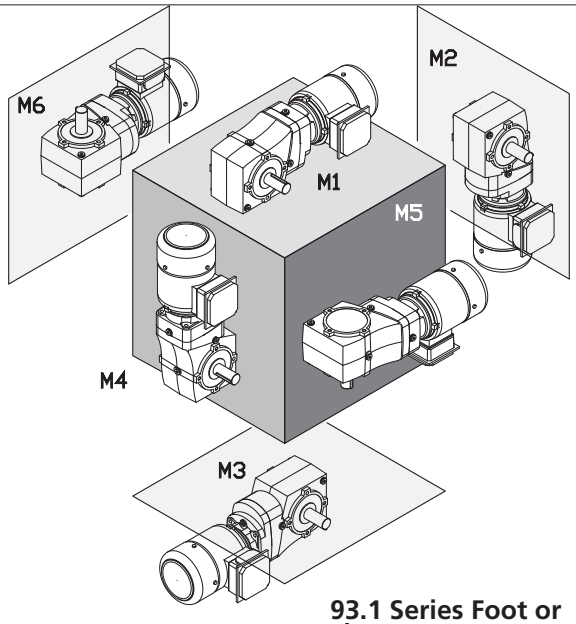
IMPORTANT NOTE

Actual oil volume can vary slightly depending upon the gear case size, mounting and ratio. Prior to commissioning the reducer, check the oil-fill level using the reducer's oil level plug and drain or add addition oil as needed.

For mounting orientations other than shown please consult NORD Gear. Reducer modifications may be required.



92.1 Series Foot or Flange Mount



93.1 Series Foot or Flange Mount

92.1 Series Oil Fill

Type	M1		M2		M3		M4		M5		M6	
	Quarts	Liters	Quarts	Liters	Quarts	Liters	Quarts	Liters	Quarts	Liters	Quarts	Liters
SK 920072.1	0.22	0.21	0.50	0.47	0.22	0.36	0.22	0.34	0.22	0.28	0.22	0.28
SK 92072.1	0.28	0.26	0.52	0.49	0.44	0.42	0.57	0.54	0.31	0.29	0.33	0.31
SK 92172.1	0.36	0.34	0.65	0.61	0.55	0.52	0.71	0.67	0.44	0.42	0.51	0.48
SK 92372.1	0.45	0.43	0.97	0.92	0.77	0.73	0.88	0.83	0.58	0.55	0.65	0.61
SK 92672.1	0.90	0.85	1.69	1.60	1.27	1.20	1.59	1.50	1.08	1.02	1.08	1.02
SK 92772.1	1.37	1.30	2.80	2.65	1.97	1.86	2.85	2.70	1.69	1.60	1.69	1.60

Oil levels shown apply to all foot & flange mounted units.

93.1 Series Oil Fill

Type	M1		M2		M3		M4		M5		M6	
	Quarts	Liters	Quarts	Liters	Quarts	Liters	Quarts	Liters	Quarts	Liters	Quarts	Liters
SK 930072.1	0.30	0.28	0.69	0.65	0.22	0.56	0.22	0.54	0.22	0.39	0.22	0.39
SK 93072.1	0.41	0.39	0.98	0.93	0.83	0.79	1.08	1.02	0.52	0.49	0.66	0.62
SK 93172.1	0.63	0.60	1.24	1.17	0.99	0.94	1.29	1.22	0.69	0.65	0.90	0.85
SK 93372.1	1.06	1.00	2.08	1.97	1.74	1.65	2.26	2.14	1.18	1.12	1.42	1.34
SK 93672.1	1.90	1.80	3.41	3.23	2.86	2.71	4.02	3.80	2.13	2.02	2.59	2.45
SK 93772.1	2.87	2.72	4.89	4.63	3.91	3.70	6.13	5.80	3.10	2.93	3.43	3.25

Oil levels shown apply to all foot & flange mounted units.

NORD Gear Limited
Toll Free in Canada: 800.668.4378

NORD Gear Corporation
Toll Free in the United States: 888.314.6673

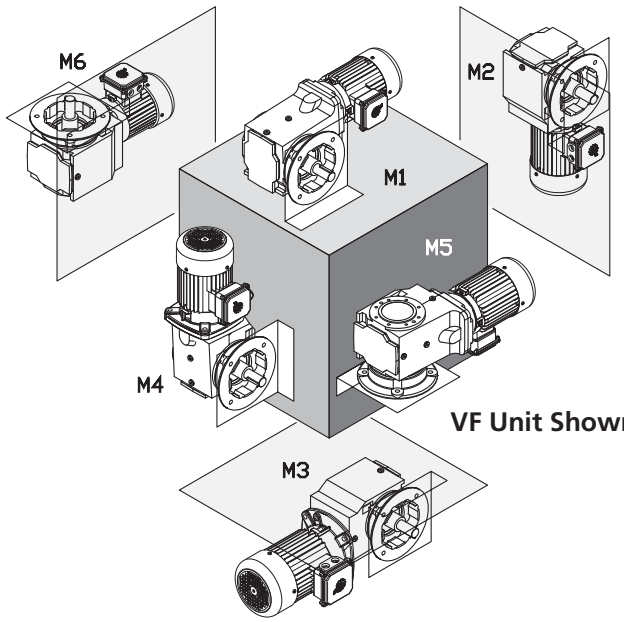
92 Helical-bevel flanged lubrication

The following NORD Gear reducers are shipped from the factory with a pre-determined oil fill level in accordance to the specified reducer size and mounting position. For additional information, please refer to the "Oil Plug & Vent Locations" documentation for your gear unit.

IMPORTANT NOTE

Actual oil volume can vary slightly depending upon the gear case size, mounting and ratio. Prior to commissioning the reducer, check the oil-fill level using the reducer's oil level plug and drain or add addition oil as needed. The minimum acceptable oil level is 0.15 in (4mm) below the oil level hole.

For mounting orientations other than shown please consult NORD Gear. Reducer modifications may be required.



VF Unit Shown

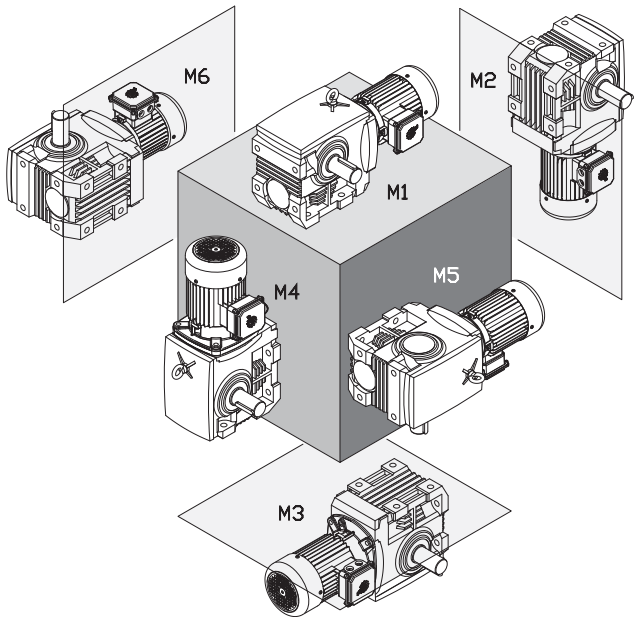
Type	M1		M2		M3		M4		M5		M6	
	Quarts	Liters	Quarts	Liters	Quarts	Liters	Quarts	Liters	Quarts	Liters	Quarts	Liters
SK 92072	0.42	0.40	0.63	0.60	0.58	0.55	0.58	0.55	0.42	0.40	0.42	0.40
SK 92172	0.53	0.50	1.06	1.00	0.95	0.90	1.11	1.05	0.95	0.90	0.63	0.60
SK 92372	1.27	1.20	1.69	1.60	1.59	1.50	2.01	1.90	1.37	1.30	1.37	1.30
SK 92672	1.69	1.60	2.96	2.80	2.64	2.50	3.49	3.30	2.54	2.40	2.54	2.40
SK 92772	2.96	2.80	4.65	4.40	4.76	4.50	5.81	5.50	3.70	3.50	3.70	3.50

Oil Levels shown apply to gear units ending in AZ, AF, VZ, & VF.

HELICAL-WORM FOOTED OIL FILL QUANTITIES

Helical-worm footed lubrication

The following NORD Gear reducers are shipped from the factory with a pre-determined oil fill level in accordance to the specified reducer size and mounting position. For additional information, please refer to the "Oil Plug & Vent Locations" documentation for your gear unit.



IMPORTANT NOTE

Actual oil volume can vary slightly depending upon the gear case size, mounting and ratio. Prior to commissioning the reducer, check the oil-fill level using the reducer's oil level plug and drain or add addition oil as needed. The minimum acceptable oil level is 0.15 in (4mm) below the oil level hole.

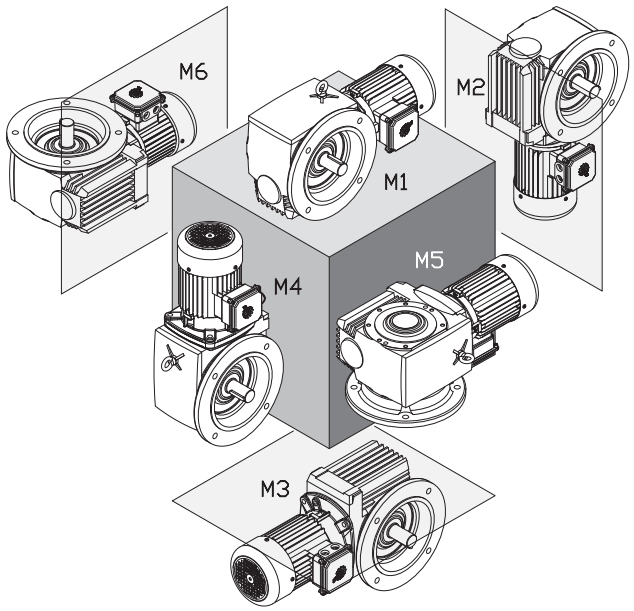
For mounting orientations other than shown please consult NORD Gear. Reducer modifications may be required.

Type	M1		M2		M3		M4		M5		M6	
	Quarts	Liters	Quarts	Liters	Quarts	Liters	Quarts	Liters	Quarts	Liters	Quarts	Liters
SK 02040	0.42	0.40	0.85	0.80	0.79	0.75	0.69	0.65	0.53	0.50	0.53	0.50
SK 02040.1	0.13	0.12	0.48	0.45	0.31	0.29	0.41	0.39	0.30	0.28	0.30	0.28
SK 02050	0.42	0.40	1.48	1.40	1.16	1.10	1.37	1.30	0.74	0.70	0.74	0.70
SK 13050	0.79	0.75	1.85	1.75	1.37	1.30	1.85	1.75	0.79	0.75	0.79	0.75
SK 12063	0.63	0.60	1.90	1.80	1.27	1.20	1.69	1.60	1.06	1.00	1.06	1.00
SK 13063	1.06	1.00	2.43	2.30	1.59	1.50	2.32	2.20	1.16	1.10	1.16	1.10
SK 12080	0.95	0.90	3.28	3.10	2.54	2.40	3.17	3.00	1.90	1.80	1.90	1.80
SK 13080	1.80	1.70	3.70	3.50	3.70	3.50	3.70	3.50	2.11	2.00	2.11	2.00
SK 32100	1.59	1.50	6.66	6.30	5.92	5.60	5.81	5.50	3.80	3.60	3.80	3.60
SK 33100	2.54	2.40	6.76	6.40	5.71	5.40	6.87	6.50	3.59	3.40	3.59	3.40
SK 42125	2.96	2.80	12.5	11.8	10.8	10.2	10.6	10.0	6.55	6.20	6.55	6.20
SK 43125	4.49	4.25	13.7	13.0	11.1	10.5	14.3	13.5	7.61	7.20	7.61	7.20

HELICAL-WORM SOLID SHAFT/FLANGED OIL FILL QUANTITIES

Helical-worm solid shaft/flanged lubrication

The following NORD Gear reducers are shipped from the factory with a pre-determined oil fill level in accordance to the specified reducer size and mounting position. For additional information, please refer to the "Oil Plug & Vent Locations" documentation for your gear unit.



IMPORTANT NOTE

Actual oil volume can vary slightly depending upon the gear case size, mounting and ratio. Prior to commissioning the reducer, check the oil-fill level using the reducer's oil level plug and drain or add addition oil as needed. The minimum acceptable oil level is 0.15 in (4mm) below the oil level hole.

For mounting orientations other than shown please consult NORD Gear. Reducer modifications may be required.

Type	M1		M2		M3		M4		M5		M6	
	Quarts	Liters	Quarts	Liters	Quarts	Liters	Quarts	Liters	Quarts	Liters	Quarts	Liters
SK 02040 VF	0.53	0.50	0.85	0.80	0.79	0.75	0.63	0.60	0.53	0.50	0.53	0.50
SK 02040.1	0.13	0.12	0.48	0.45	0.31	0.29	0.41	0.39	0.30	0.28	0.30	0.28
SK 02050 VF	0.42	0.40	1.59	1.50	1.32	1.25	1.27	1.20	0.95	0.90	0.79	0.75
SK 13050 VF	0.79	0.75	1.90	1.80	1.59	1.50	1.80	1.70	1.11	1.05	0.95	0.90
SK 12063 VF	0.53	0.50	2.06	1.95	1.80	1.70	1.85	1.75	1.27	1.20	1.00	0.95
SK 13063 VF	1.06	1.00	2.43	2.30	2.01	1.90	2.32	2.20	1.43	1.35	1.16	1.10
SK 12080 VF	0.95	0.90	3.91	3.70	3.38	3.20	3.59	3.40	2.64	2.50	2.43	2.30
SK 13080 VF	1.69	1.60	4.02	3.80	3.70	3.50	4.12	3.90	2.85	2.70	2.64	2.50
SK 32100 VF	1.48	1.40	6.66	6.30	6.45	6.10	6.45	6.10	4.23	4.00	3.80	3.60
SK 33100 VF	2.80	2.65	7.61	7.20	6.76	6.40	8.03	7.60	4.54	4.30	4.02	3.80
SK 42125 VF	3.17	3.00	12.2	11.5	12.2	11.5	11.6	11.0	8.88	8.40	7.71	7.30
SK 43125 VF	4.97	4.70	15.9	15.0	13.7	13.0	16.9	16.0	9.51	9.00	8.14	7.70

HELICAL-WORM HOLLOW SHAFT OIL FILL QUANTITIES

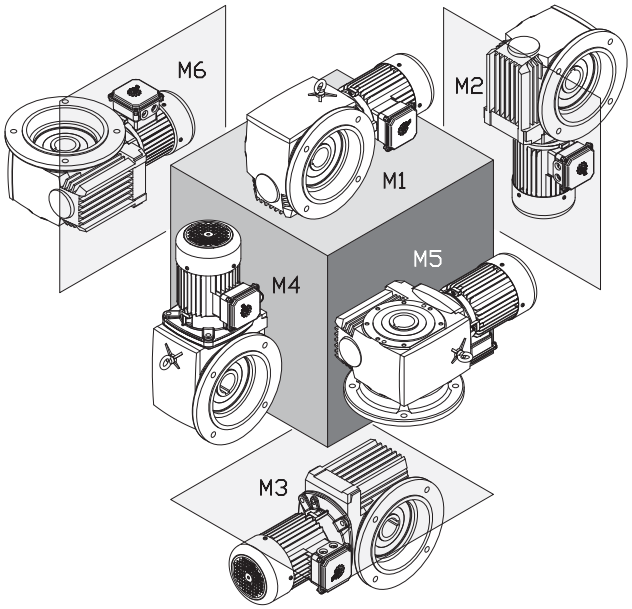
Helical-worm hollow shaft lubrication

The following NORD Gear reducers are shipped from the factory with a pre-determined oil fi ll level in accordance to the specifi ed reducer size and mounting position. For additional information, please refer to the "Oil Plug & Vent Locations" documentation for your gear unit.

IMPORTANT NOTE

Actual oil volume can vary slightly depending upon the gear case size, mounting and ratio. Prior to commissioning the reducer, check the oil-fi ll level using the reducer's oil level plug and drain or add addition oil as needed. The minimum acceptable oil level is 0.15 in (4mm) below the oil level hole.

For mounting orientations other than shown please consult NORD Gear. Reducer modifications may be required.



AF Unit Shown

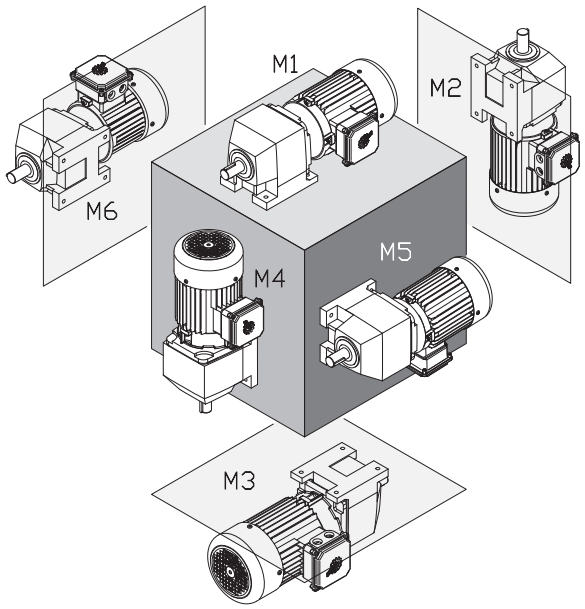
Type	M1		M2		M3		M4		M5		M6	
	Quarts	Liters	Quarts	Liters	Quarts	Liters	Quarts	Liters	Quarts	Liters	Quarts	Liters
SK 02040	0.42	0.40	0.74	0.70	0.69	0.65	0.69	0.65	0.58	0.55	0.58	0.55
SK 02040.1	0.13	0.12	0.48	0.45	0.31	0.29	0.41	0.39	0.30	0.28	0.30	0.28
SK 02050	0.48	0.45	1.32	1.25	1.22	1.15	1.16	1.10	0.79	0.75	0.79	0.75
SK 13050	0.95	0.90	1.90	1.80	1.37	1.30	1.74	1.65	1.37	1.30	1.37	1.30
SK 12063	0.58	0.55	1.53	1.45	1.69	1.60	1.69	1.60	1.16	1.10	1.16	1.10
SK 13063	1.11	1.05	2.22	2.10	1.90	1.80	2.22	2.10	1.48	1.40	1.48	1.40
SK 12080	0.85	0.80	3.28	3.10	3.38	3.20	2.96	2.80	1.90	1.80	1.90	1.80
SK 13080	1.69	1.60	3.80	3.60	3.06	2.90	3.80	3.59	2.11	2.00	2.11	2.00
SK 32100	1.59	1.50	5.92	5.60	5.92	5.60	5.60	5.30	3.38	3.20	3.38	3.20
SK 33100	2.75	2.60	6.34	6.00	6.13	5.80	6.66	6.30	3.70	3.50	3.70	3.50
SK 42125	3.17	3.00	13.2	12.5	11.4	10.8	11.4	10.8	6.87	6.50	6.87	6.50
SK 43125	4.86	4.60	14.4	13.6	12.0	11.4	15.1	14.3	8.03	7.60	8.03	7.60

Oil Levels shown apply to gear units ending in AZ, AF.

NORDBLOC® FOOTED OIL FILL QUANTITIES

NORDBLOC® footed lubrication

The following NORD Gear reducers are shipped from the factory with a pre-determined oil fill level in accordance to the specified reducer size and mounting position. For additional information, please refer to the "Oil Plug & Vent Locations" documentation for your gear unit.



IMPORTANT NOTE

Actual oil volume can vary slightly depending upon the gear case size, mounting and ratio. Prior to commissioning the reducer, check the oil-fill level using the reducer's oil level plug and drain or add addition oil as needed. The minimum acceptable oil level is 0.15 in (4mm) below the oil level hole.

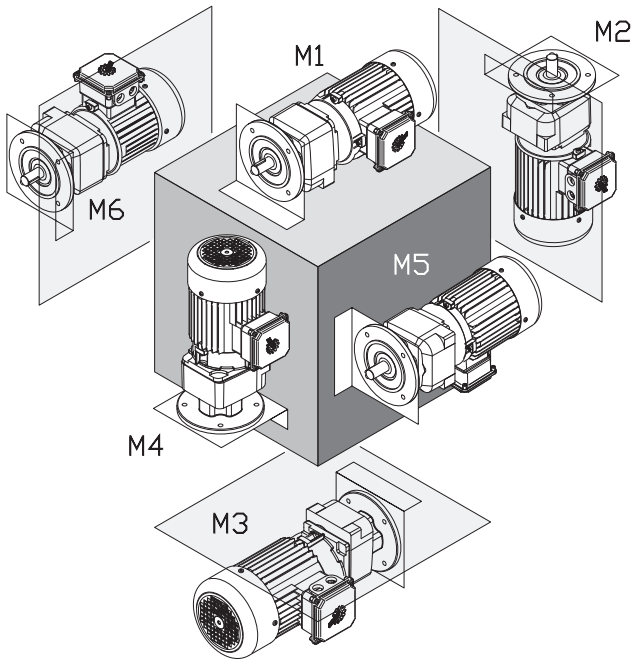
For mounting orientations other than shown please consult NORD Gear. Reducer modifications may be required.

Type	M1		M2		M3		M4		M5		M6	
	Quarts	Liters	Quarts	Liters	Quarts	Liters	Quarts	Liters	Quarts	Liters	Quarts	Liters
SK 172	0.37	0.35	0.53	0.50	0.53	0.50	0.53	0.50	0.53	0.50	0.53	0.50
SK 272	0.63	0.60	1.06	1.00	1.06	1.00	1.06	1.00	1.06	1.00	1.06	1.00
SK 273	0.66	0.62	1.16	1.10	1.16	1.10	1.16	1.10	1.16	1.10	1.16	1.10
SK 372	0.63	0.60	1.06	1.00	1.06	1.00	1.06	1.00	1.06	1.00	1.06	1.00
SK 373	0.58	0.55	1.16	1.10	1.16	1.10	1.16	1.10	1.16	1.10	1.16	1.10
SK 472	1.06	1.00	2.01	1.90	2.01	1.90	2.11	2.00	1.90	1.80	1.90	1.80
SK 473	1.37	1.30	2.64	2.50	2.22	2.10	2.54	2.40	2.22	2.10	2.22	2.10
SK 572	1.06	1.00	2.01	1.90	2.01	1.90	2.11	2.00	1.90	1.80	1.90	1.80
SK 573	1.37	1.30	2.64	2.50	2.22	2.10	2.54	2.40	2.22	2.10	2.22	2.10
SK 672	1.48	1.40	3.59	3.40	3.28	3.10	3.33	3.15	1.53	1.45	3.33	3.15
SK 673	1.90	1.80	4.02	3.80	3.38	3.20	3.59	3.40	3.06	2.90	3.17	3.00
SK 772	2.11	2.00	3.49	3.30	3.70	3.50	4.44	4.20	2.85	2.70	3.49	3.30
SK 773	2.64	2.50	4.76	4.50	3.91	3.70	4.86	4.60	3.49	3.30	3.49	3.30
SK 872	3.91	3.70	10.1	9.60	9.62	9.10	7.71	7.30	4.97	4.70	8.45	8.00
SK 873	6.55	6.20	8.88	8.40	7.93	7.50	9.62	9.10	7.93	7.50	7.93	7.50
SK 972	6.87	6.50	16.9	16.0	16.6	15.7	15.5	14.7	8.98	8.50	14.8	14.0
SK 973	11.6	11.0	16.7	15.8	13.7	13.0	16.9	16.0	14.1	13.3	13.7	13.0

NORDBLOC® FLANGED OIL FILL QUANTITIES

NORDBLOC® flanged lubrication

The following NORD Gear reducers are shipped from the factory with a pre-determined oil fill level in accordance to the specified reducer size and mounting position. For additional information, please refer to the "Oil Plug & Vent Locations" documentation for your gear unit.



IMPORTANT NOTE

Actual oil volume can vary slightly depending upon the gear case size, mounting and ratio. Prior to commissioning the reducer, check the oil-fill level using the reducer's oil level plug and drain or add addition oil as needed. The minimum acceptable oil level is 0.15 in (4mm) below the oil level hole.

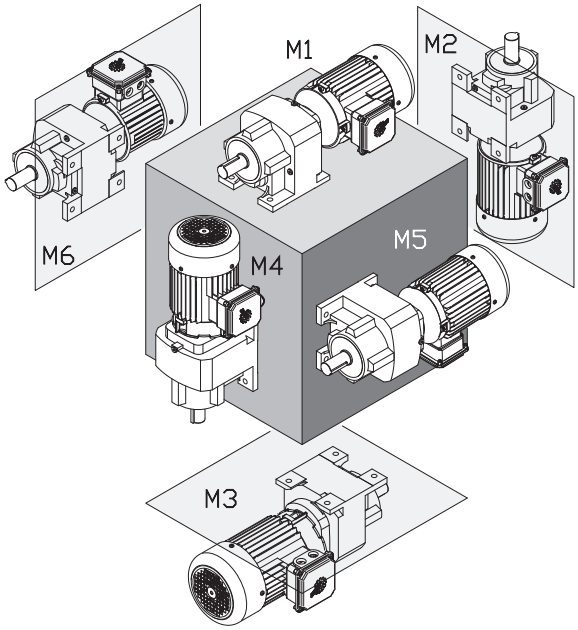
For mounting orientations other than shown please consult NORD Gear. Reducer modifications may be required.

Mounting Position	M1		M2		M3		M4		M5		M6	
	Quarts	Liters	Quarts	Liters	Quarts	Liters	Quarts	Liters	Quarts	Liters	Quarts	Liters
SK 172 F	0.37	0.35	0.53	0.50	0.53	0.50	0.53	0.50	0.53	0.50	0.53	0.50
SK 272 F	0.63	0.60	1.06	1.00	1.06	1.00	1.06	1.00	1.06	1.00	1.06	1.00
SK 273 F	0.66	0.62	1.16	1.10	1.16	1.10	1.16	1.10	1.16	1.10	1.16	1.10
SK 372 F	0.63	0.60	1.06	1.00	1.06	1.00	1.06	1.00	1.06	1.00	1.06	1.00
SK 373 F	0.58	0.55	1.16	1.10	1.16	1.10	1.16	1.10	1.16	1.10	1.16	1.10
SK 472 F	1.06	1.00	2.01	1.90	2.01	1.90	2.01	1.90	2.01	1.90	1.59	1.50
SK 473 F	1.32	1.25	2.54	2.40	2.22	2.10	2.64	2.50	2.22	2.10	2.22	2.10
SK 572 F	1.06	1.00	2.01	1.90	2.01	1.90	2.01	1.90	2.01	1.90	1.59	1.50
SK 573 F	1.32	1.25	2.54	2.40	2.22	2.10	2.64	2.50	2.22	2.10	2.22	2.10
SK 672 F	1.22	1.15	3.59	3.40	2.85	2.70	2.96	2.80	1.32	1.25	2.85	2.70
SK 673 F	1.80	1.70	4.02	3.80	3.17	3.00	3.38	3.20	3.17	3.00	3.17	3.00
SK 772 F	1.69	1.60	3.49	3.30	3.70	3.50	3.49	3.30	3.28	3.10	3.28	3.10
SK 773 F	2.43	2.30	5.28	5.00	3.80	3.60	4.76	4.50	4.12	3.90	4.12	3.90
SK 872 F	3.70	3.50	9.51	9.00	8.35	7.90	8.14	7.70	4.12	3.90	7.61	7.20
SK 873 F	5.28	5.00	9.30	8.80	8.03	7.60	8.45	8.00	8.45	8.00	8.45	8.00
SK 972 F	6.87	6.50	15.9	15.0	13.7	13.0	14.3	13.5	6.87	6.50	12.7	12.0
SK 973 F	10.9	10.3	17.4	16.5	13.7	13.0	16.9	16.0	14.8	14.0	14.8	14.0

NORDBLOC®.1 FOOTED OIL FILL QUANTITIES

NORDBLOC®.1 Fill Quantities (Footed)

The following NORD Gear reducers are shipped from the factory with a pre-determined oil fill level in accordance to the specified reducer size and mounting position. For oil plug & vent locations please see U14700.



IMPORTANT NOTE

Actual oil volume can vary slightly depending upon the gear case size, mounting and ratio. Prior to commissioning the reducer, check the oil-fill level using the reducer's oil level plug and drain or add addition oil as needed. The correct oil level should be located at the lower edge of the oil level hole.

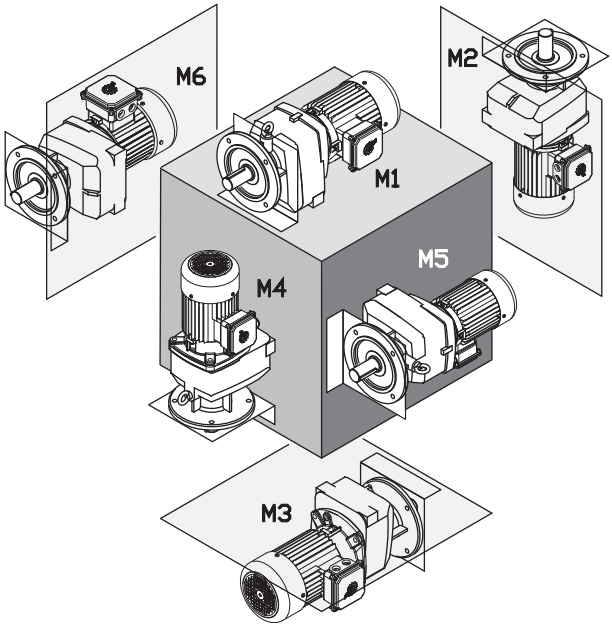
For mounting orientations other than shown please consult NORD Gear. Reducer modifications may be required.

Type	M1		M2		M3		M4		M5		M6	
	Quarts	Liters	Quarts	Liters	Quarts	Liters	Quarts	Liters	Quarts	Liters	Quarts	Liters
SK 071.1	0.19	0.18	0.42	0.40	0.40	0.38	0.42	0.40	0.32	0.30	0.32	0.30
SK 072.1	0.17	0.16	0.34	0.32	0.22	0.21	0.24	0.23	0.19	0.18	0.21	0.20
SK 171.1	0.23	0.22	0.42	0.40	0.38	0.36	0.42	0.40	0.35	0.33	0.35	0.33
SK 172.1	0.29	0.27	0.62	0.59	0.44	0.42	0.48	0.45	0.34	0.32	0.41	0.39
SK 371.1	0.37	0.35	0.61	0.58	0.58	0.55	0.61	0.58	0.52	0.49	0.52	0.49
SK 372.1	0.48	0.45	1.10	1.05	0.79	0.75	1.10	1.00	0.63	0.60	0.69	0.65
SK 373.1	0.48	0.45	1.10	1.05	0.79	0.75	1.10	1.00	0.63	0.60	0.69	0.65
SK 571.1	0.51	0.48	0.91	0.86	0.85	0.80	0.97	0.92	0.72	0.68	0.72	0.68
SK 572.1	0.79	0.75	2.00	1.90	1.60	1.50	2.10	2.00	1.20	1.10	1.20	1.15
SK 573.1	0.79	0.75	2.00	1.90	1.60	1.50	2.10	2.00	1.20	1.10	1.20	1.15
SK 672.1	1.20	1.10	2.70	2.60	2.30	2.15	2.90	2.70	1.60	1.55	1.70	1.65
SK 673.1	1.20	1.10	2.70	2.60	2.30	2.15	2.90	2.70	1.60	1.55	1.70	1.65
SK 771.1	0.95	0.90	1.60	1.50	1.30	1.20	1.80	1.70	1.20	1.16	1.20	1.16
SK 772.1	1.40	1.30	4.00	3.80	2.50	2.40	3.40	3.20	1.70	1.60	2.60	2.50
SK 772.1 VL	2.10	2.00	4.00	3.80	2.50	2.40	3.40	3.20	1.70	1.60	2.60	2.50
SK 773.1	2.40	2.30	4.00	3.80	3.50	3.30	3.40	3.20	2.50	2.40	3.30	3.10
SK 773.1 VL	2.40	2.30	4.00	3.80	3.50	3.30	3.40	3.20	2.50	2.40	3.30	3.10
SK 871.1	1.59	1.5	3.38	3.2	3.38	3.2	2.75	2.6	2.43	2.3	2.43	2.3
SK 872.1	3.10	2.90	8.20	7.80	4.90	4.60	6.80	6.40	2.60	2.50	4.20	4.00
SK 872.1 VL	5.30	5.00	8.20	7.80	4.90	4.60	6.80	6.40	2.60	2.50	4.20	4.00
SK 873.1	4.40	4.20	8.20	7.80	6.20	5.90	6.80	6.40	4.30	4.10	6.20	5.90
SK 873.1 VL	4.40	4.20	8.20	7.80	6.20	5.90	6.80	6.40	4.30	4.10	6.20	5.90
SK 971.1	2.01	1.9	4.12	3.9	4.12	3.9	3.59	3.4	3.28	3.1	3.28	3.1
SK 972.1	4.80	4.50	13.00	12.00	7.90	7.50	12.00	11.50	4.40	4.20	7.90	7.50
SK 972.1 VL	9.00	8.50	13.00	12.00	7.90	7.50	12.00	11.50	4.40	4.20	7.90	7.50
SK 973.1	7.90	7.50	13.00	12.00	11.00	10.50	12.00	11.50	7.90	7.50	11.00	10.50
SK 973.1 VL	7.90	7.50	13.00	12.00	11.00	10.50	12.00	11.50	7.90	7.50	11.00	10.50
SK 1071.1	3.49	3.3	7.82	7.4	7.82	7.4	7.08	6.7	5.6	5.3	5.6	5.3

NORDBLOC®.1 FLANGED OIL FILL QUANTITIES

NORDBLOC®.1 Fill Quantities (Flanged)

The following NORD Gear reducers are shipped from the factory with a pre-determined oil fill level in accordance to the specified reducer size and mounting position. For additional information, please refer to the "Oil Plug & Vent Locations" documentation for your gear unit.



IMPORTANT NOTE

Actual oil volume can vary slightly depending upon the gear case size, mounting and ratio. Prior to commissioning the reducer, check the oil-fill level using the reducer's oil level plug and drain or add addition oil as needed. The correct oil level should be located at the lower edge of the oil level hole.

For mounting orientations other than shown please consult NORD Gear. Reducer modifications may be required.

Type	M1		M2		M3		M4		M5		M6	
	Quarts	Liters	Quarts	Liters	Quarts	Liters	Quarts	Liters	Quarts	Liters	Quarts	Liters
SK 071.1 F	0.19	0.18	0.42	0.40	0.40	0.38	0.42	0.40	0.32	0.30	0.32	0.30
SK 072.1 F	0.17	0.16	0.34	0.32	0.22	0.21	0.24	0.23	0.19	0.18	0.21	0.20
SK 171.1 F	0.23	0.22	0.42	0.40	0.38	0.36	0.42	0.40	0.35	0.33	0.35	0.33
SK 172.1 F	0.29	0.27	0.62	0.59	0.44	0.42	0.48	0.45	0.34	0.32	0.41	0.39
SK 371.1 F	0.37	0.35	0.61	0.58	0.58	0.55	0.61	0.58	0.52	0.49	0.52	0.49
SK 372.1 F	0.48	0.45	1.10	1.05	0.79	0.75	1.10	1.00	0.63	0.60	0.69	0.65
SK 373.1 F	0.48	0.45	1.10	1.05	0.79	0.75	1.10	1.00	0.63	0.60	0.69	0.65
SK 571.1 F	0.51	0.48	0.91	0.86	0.85	0.80	0.97	0.92	0.72	0.68	0.72	0.68
SK 572.1 F	0.79	0.75	2.00	1.90	1.60	1.50	2.10	2.00	1.20	1.10	1.20	1.15
SK 573.1 F	0.79	0.75	2.00	1.90	1.60	1.50	2.10	2.00	1.20	1.10	1.20	1.15
SK 672.1 F	1.20	1.10	2.70	2.60	2.30	2.15	2.90	2.70	1.60	1.55	1.70	1.65
SK 673.1 F	1.20	1.10	2.70	2.60	2.30	2.15	2.90	2.70	1.60	1.55	1.70	1.65
SK 771.1 F	0.95	0.90	1.60	1.50	1.30	1.20	1.80	1.70	1.20	1.16	1.20	1.16
SK 772.1 F	1.40	1.30	4.00	3.80	2.50	2.40	3.50	3.30	1.80	1.70	2.50	2.40
SK 772.1 VL F	2.10	2.00	4.00	3.80	2.50	2.40	3.50	3.30	1.80	1.70	2.50	2.40
SK 773.1 F	2.10	2.00	3.70	3.50	3.40	3.20	3.10	2.90	2.40	2.30	3.20	3.00
SK 773.1 VL F	2.10	2.00	3.70	3.50	3.40	3.20	3.10	2.90	2.40	2.30	3.20	3.00
SK 871.1 F	1.59	1.5	3.38	3.2	3.38	3.2	2.75	2.6	2.43	2.3	2.43	2.3
SK 872.1 F	3.40	3.20	7.90	7.50	5.40	5.10	7.10	6.70	2.70	2.60	4.50	4.30
SK 872.1 VL F	5.30	5.00	7.90	7.50	5.40	5.10	7.10	6.70	2.70	2.60	4.50	4.30
SK 873.1 F	4.30	4.10	8.00	7.60	7.30	6.90	7.00	6.60	5.30	5.00	7.00	6.60
SK 873.1 VL F	4.30	4.10	8.00	7.60	7.30	6.90	7.00	6.60	5.30	5.00	7.00	6.60
SK 971.1 F	2.01	1.9	4.12	3.9	4.12	3.9	3.59	3.4	3.28	3.1	3.28	3.1
SK 972.1 F	4.80	4.50	13.00	12.50	8.50	8.00	13.00	12.50	4.80	4.50	8.10	7.70
SK 972.1 VL F	9.00	8.50	13.00	12.50	8.50	8.00	13.00	12.50	4.80	4.50	8.10	7.70
SK 973.1 F	7.80	7.40	13.00	12.20	12.00	11.10	12.00	11.60	8.50	8.00	12.00	10.90
SK 973.1 VL F	7.80	7.40	13.00	12.20	12.00	11.10	12.00	11.60	8.50	8.00	12.00	10.90
SK 1071.1 F	3.49	3.3	7.82	7.4	7.82	7,4	7.08	6.7	5.6	5.3	5.6	5.3

MINICASE® (SM SERIES) WORM GEAR OIL FILL QUANTITIES - FOOT HOUSING

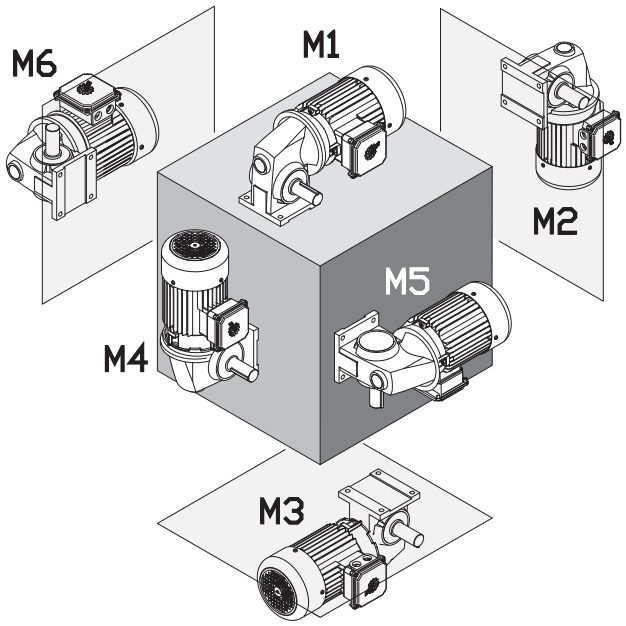
MINICASE® (SM Series) Lubrication

NORD MINICASE® (SM Series) worm gear reducers and worm gearmotors are inherently maintence free, factory oil filled, and supplied with a high quality, long life synthetic gear oil intended to be suitable for the life of the product. These gear units are also supplied without oil service plugs or vents.

Related User Manuals

U10790 MINICASE® (SM Series) Worm – Lubrication Guidelines.
U11040 MINICASE® (SM Series) Worm – Lubrication Types.

> ***IMPORTANT NOTE***
>
> For mounting orientations other than shown please consult NORD Gear. Reducer modifications may be required.



Type	M1		M2		M3		M4		M5		M6	
	oz	ml	oz	ml	oz	ml	oz	ml	oz	ml	oz	ml
SK 1SM31	4.1	120	4.1	120	4.1	120	4.1	120	4.1	120	4.1	120
SK 1SM40	7.4	220	7.4	220	7.4	220	7.4	220	7.4	220	7.4	220
SK 2SM40	11.2	330	11.2	330	11.2	330	12.2	360	11.2	330	11.2	330
SK 1SM50	8.5	250	8.5	250	8.5	250	8.5	250	8.5	250	8.5	250
SK 2SM50	11.8	350	11.8	350	11.8	350	14.2	420	11.8	350	11.8	350
SK 1SM63	14.2	420	14.2	420	14.2	420	14.2	420	14.2	420	14.2	420
SK 2SM63	17.9	530	17.9	530	17.9	530	21.3	630	17.9	530	17.9	530

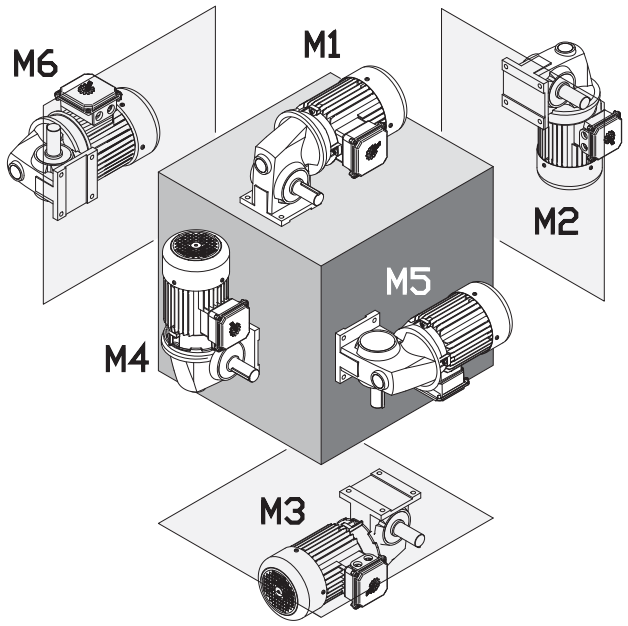
Oil levels shown apply to any foot-mount gear housings including those ending with no suffix or ending with LX or AX.

MINICASE® (SMI/SMID) WORM GEAR OIL FILL QUANTITIES - FOOT HOUSING

MINICASE® (SMI/SMID Series) Lubrication

NORD MINICASE® (SMI/SMID Series) worm gear reducers and worm gearmotors are inherently maintence free, factory oil filled, and supplied with a high quality, long life synthetic gear oil intended to be suitable for the life of the product. For lubrication types see user manual U11050.

NORD MINICASE® (SMI/SMID Series) worm gear reducers and worm gearmotors are equipped with oil plugs. Venting the gear unit is optional as discussed in user manual U14750.



Related User Manuals

U10800 - MINICASE® (SMI/SMID Series) Worm – Lubrication Guidelines.
U11050 - MINICASE® (SMI/SMID Series) Worm – Lubrication Types
U14750 - MINICASE® (SMI/SMID Series) Worm – Oil Plug Locations

IMPORTANT NOTE

For mounting orientations other than shown please consult NORD Gear. Reducer modifications may be required.

MINICASE® (SMI Series) Gear Reducer Oil Fill - Foot Housing

Type	M1		M2		M3		M4		M5		M6	
	oz	ml	oz	ml	oz	ml	oz	ml	oz	ml	oz	ml
SK 1SMI31	1.5	45	1.5	45	1.5	45	1.5	45	1.5	45	1.5	45
SK 1SMI40	2.7	80	2.7	80	2.7	80	2.7	80	2.7	80	2.7	80
SK 1SMI50	4.4	130	4.4	130	4.4	130	4.4	130	4.4	130	4.4	130
SK 1SMI63	9.1	270	9.1	270	9.1	270	9.1	270	9.1	270	9.1	270
SK 1SMI75	14.2	420	14.2	420	14.2	420	14.2	420	14.2	420	14.2	420

Oil fill level is universal and independent of mounting position
Oil levels shown apply to any foot-mount gear housings including those ending with no-suffix or LX or AX.

MINICASE® (SMID Series) Integral Gearmotor Oil Fill - Foot Housing

Type	M1		M2		M3		M4		M5		M6	
	oz	ml	oz	ml	oz	ml	oz	ml	oz	ml	oz	ml
SK 1SMID31	2.0	60	3.6	105	2.4	70	1.7	50	2.4	70	2.4	70
SK 1SMID40	3.4	100	5.6	165	4.1	120	3.0	90	4.1	120	4.1	120
SK 1SMID50	5.9	175	8.8	260	6.6	195	5.4	160	6.6	195	6.6	195
SK 1SMID63	9.6	285	14.4	425	11.0	325	9.1	270	11.0	325	11.0	325

Oil levels shown apply to any foot-mount gear housings including those ending with no-suffix or LX or AX.

MINICASE® (SM SERIES) WORM GEAR OIL FILL QUANTITIES - FLANGE HOUSING

MINICASE® (SM Series) Lubrication

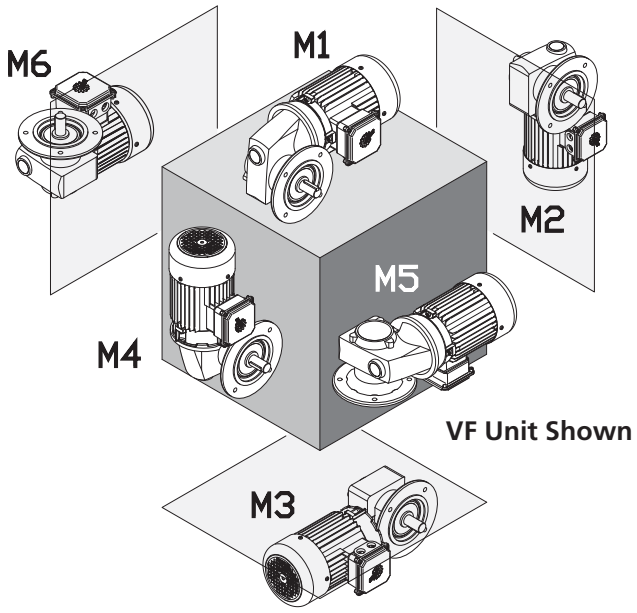
NORD MINICASE® (SM Series) worm gear reducers and worm gearmotors are inherently maintence free, factory oil filled, and supplied with a high quality, long life synthetic gear oil intended to be suitable for the life of the product. These gear units are also supplied without oil service plugs or vents.

Related User Manuals

U10790 MINICASE® (SM Series) Worm – Lubrication Guidelines.
U11040 MINICASE® (SM Series) Worm – Lubrication Types.

IMPORTANT NOTE

For mounting orientations other than shown please consult NORD Gear. Reducer modifications may be required.



VF Unit Shown

Type	M1		M2		M3		M4		M5		M6	
	oz	ml	oz	ml	oz	ml	oz	ml	oz	ml	oz	ml
SK 1SM31	4.4	130	4.4	130	4.4	130	4.4	130	4.4	130	4.4	130
SK 1SM40	8.1	240	8.1	240	8.1	240	8.1	240	8.1	240	8.1	240
SK 2SM40	11.5	340	11.5	340	11.5	340	12.8	380	11.5	340	11.5	340
SK 1SM50	9.1	270	9.1	270	9.1	270	9.1	270	9.1	270	9.1	270
SK 2SM50	12.5	370	12.5	370	12.5	370	15.2	450	12.5	370	12.5	370
SK 1SM63	15.2	450	15.2	450	15.2	450	15.2	450	15.2	450	15.2	450
SK 2SM63	20.3	600	20.3	600	20.3	600	24.7	730	20.3	600	20.3	600

Oil Levels shown apply to flange-mount gear housings with model type ending in AZ, AF, VZ or VF.

MINICASE® (SMI/SMID) WORM GEAR OIL FILL QUANTITIES - FLANGE HOUSING

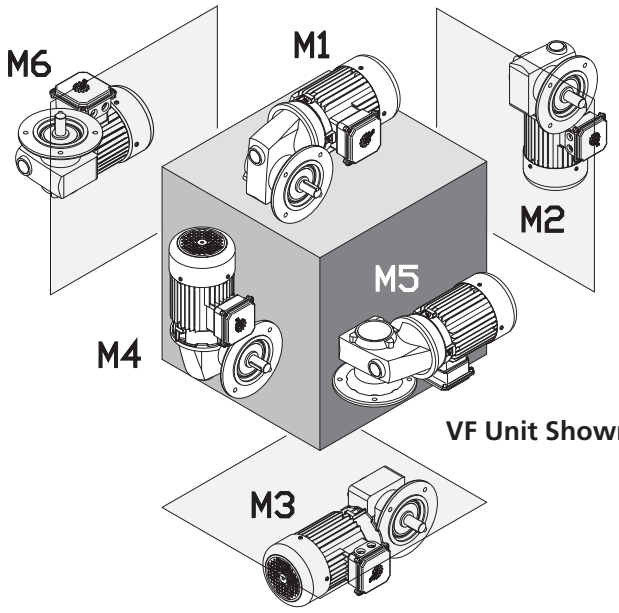
MINICASE® (SMI/SMID Series) Lubrication

NORD MINICASE® (SMI/SMID Series) worm gear reducers and worm gearmotors are inherently maintence free, factory oil filled, and supplied with a high quality, long life synthetic gear oil intended to be suitable for the life of the product. For lubrication types see user manual U11050.

NORD MINICASE® (SMI/SMID Series) worm gear reducers and worm gearmotors are equipped with oil plugs. Venting the gear unit is optional as discussed in user manual U14750.

Related User Manuals

U10800 - MINICASE® (SMI/SMID Series) Worm – Lubrication Guidelines.
U11050 - MINICASE® (SMI/SMID Series) Worm – Lubrication Types
U14750 - MINICASE® (SMI/SMID Series) Worm – Oil Plug Locations



VF Unit Shown

IMPORTANT NOTE

For mounting orientations other than shown please consult NORD Gear. Reducer modifications may be required.

MINICASE® (SMI Series) Gear Reducer Oil Fill - Flange Housing

Type	M1		M2		M3		M4		M5		M6	
	oz	ml	oz	ml	oz	ml	oz	ml	oz	ml	oz	ml
SK 1SMI31	1.5	45	1.5	45	1.5	45	1.5	45	1.5	45	1.5	45
SK 1SMI40	2.7	80	2.7	80	2.7	80	2.7	80	2.7	80	2.7	80
SK 1SMI50	4.4	130	4.4	130	4.4	130	4.4	130	4.4	130	4.4	130
SK 1SMI63	9.1	270	9.1	270	9.1	270	9.1	270	9.1	270	9.1	270
SK 1SMI75	14.2	420	14.2	420	14.2	420	14.2	420	14.2	420	14.2	420

Oil Fill is universal and independent of mounting position.
Oil Levels shown apply to flange-mount gear housings with model type ending in AZ, AF, VZ or VF.

MINICASE® (SMID Series) Integral Gearmotor Oil Fill - Flange Housing

Type	M1		M2		M3		M4		M5		M6	
	oz	ml	oz	ml	oz	ml	oz	ml	oz	ml	oz	ml
SK 1SMID31	2.0	60	3.6	105	2.4	70	1.7	50	2.4	70	2.4	70
SK 1SMID40	3.4	100	5.6	165	4.1	120	3.0	90	4.1	120	4.1	120
SK 1SMID50	5.9	175	8.8	260	6.6	195	5.4	160	6.6	195	6.6	195
SK 1SMID63	9.6	285	14.4	425	11.0	325	9.1	270	11.0	325	11.0	325

Oil Levels shown apply to flange-mount gear housings with model type ending in AZ, AF, VZ or VF.

FLEXBLOC™ (SI/SID SERIES) WORM GEAR OIL FILL QUANTITIES

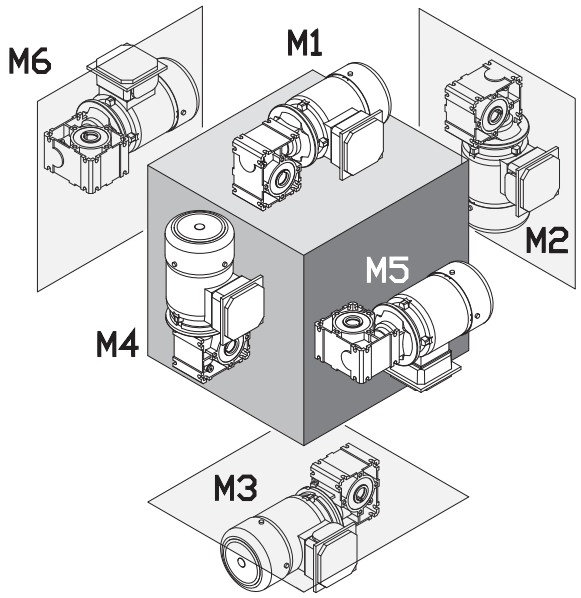
FLEXBLOC™ (SI/SID Series) Lubrication

NORD FLEXBLOC™ worm gear reducers are inherently maintence free, factory oil filled, and supplied with a high quality, long life synthetic gear oil intended to be suitable for the life of the product. For lubrication types see User Manual U11060.

NORD FLEXBLOC™ worm gear reducers are equipped with oil plugs. Venting the gear unit is optional as discussed in User Manual U14800.

Related User Manuals

U10810 FLEXBLOC™ (SI/SID Series) Worm – Lubrication Guidelines
U11060 FLEXBLOC™ Worm (SI/SID Series) – Lubrication Types
U14800 FLEXBLOC™ Worm (SI/SID Series) – Oil Plug Locations



FLEXBLOC™ (SI Series) Gear Reducer Oil Fill

Type	M1		M2		M3		M4		M5		M6	
	oz	ml	oz	ml	oz	ml	oz	ml	oz	ml	oz	ml
SK 1SI31	1.0	30	1.0	30	1.0	30	1.0	30	1.0	30	1.0	30
SK 1SI40	1.9	55	1.9	55	1.9	55	1.9	55	1.9	55	1.9	55
SK 1SI50	3.2	95	3.2	95	3.2	95	3.2	95	3.2	95	3.2	95
SK 1SI63	6.1	180	6.1	180	6.1	180	6.1	180	6.1	180	6.1	180
SK 1SI75	12.2	360	12.2	360	12.2	360	12.2	360	12.2	360	12.2	360

Oil Fill is universal and independent of mounting position.

FLEXBLOC™ (SID Series) Gear Reducer Oil Fill

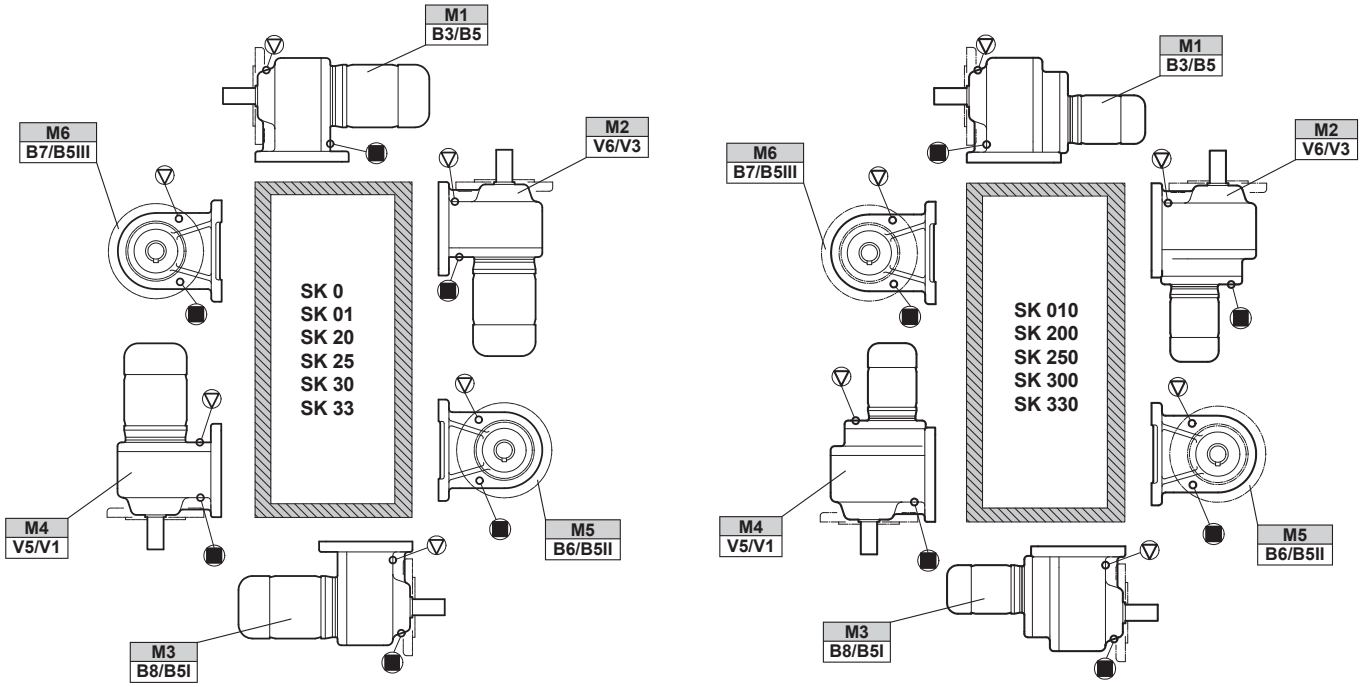
Type	M1		M2		M3		M4		M5		M6	
	oz	ml	oz	ml	oz	ml	oz	ml	oz	ml	oz	ml
SK 1SID31	1.7	50	3.0	90	2.4	70	1.7	50	2.4	70	2.4	70
SK 1SID40	3.0	90	5.1	150	3.7	110	2.7	80	4.1	120	4.1	120
SK 1SID50	5.7	170	6.8	200	5.7	170	5.1	150	6.1	180	6.1	180
SK 1SID63	9.8	280	12.2	360	9.8	290	8.1	240	10.5	310	10.5	310

Integral gear motors only available upon special request.

STANDARD IN-LINE OIL PLUG & VENT LOCATIONS

Oil plug connections

All reducers are shipped from the factory with a pre-determined oil fill level in accordance to the specified reducer size and mounting position. ***For mounting orientations other than shown please consult NORD Gear. New plug locations may be required.***



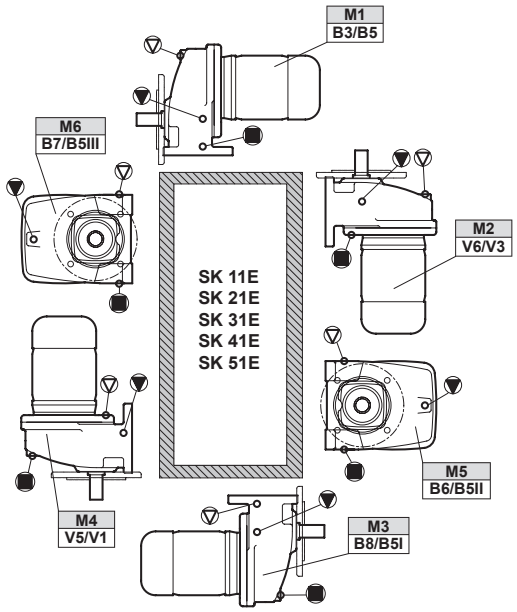
▽ = Vent

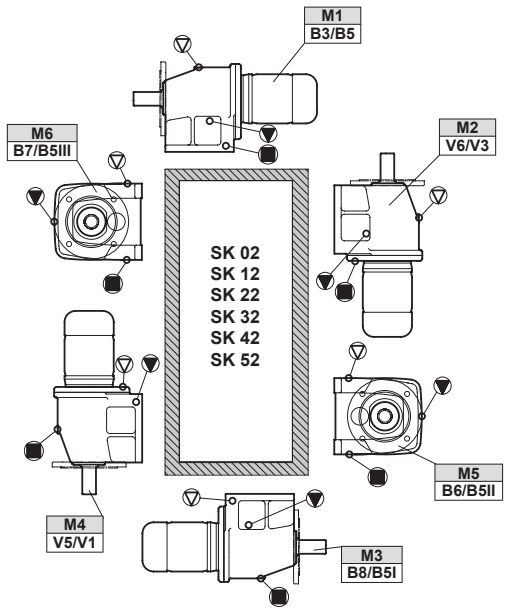
■ = Oil Plug

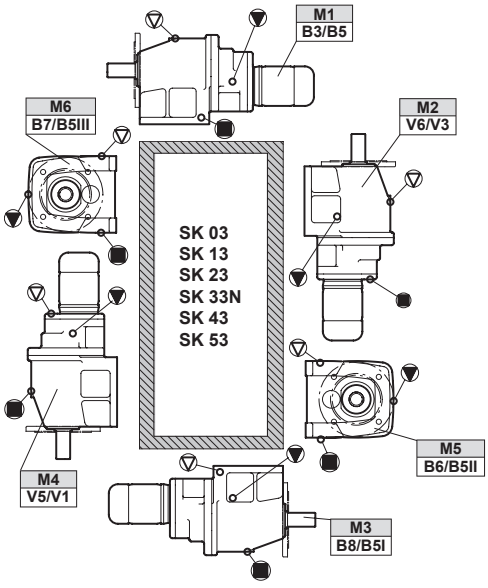
HELICAL IN-LINE OIL PLUG & VENT LOCATIONS

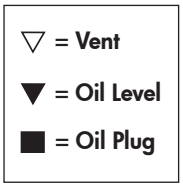
Oil plug connections

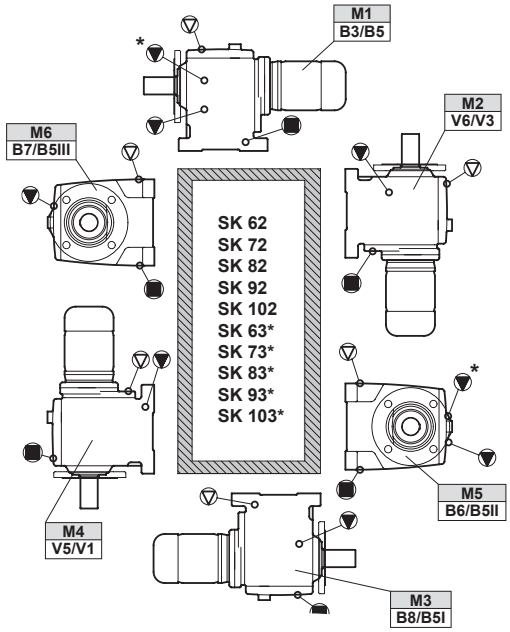
Prior to commissioning the reducer, check the oil-fill level using the reducer's oil-level plug and drain or add additional oil as needed. The minimum acceptable oil level is 0.15 in (4mm) below the oil level hole. ***For mounting orientations other than shown please consult NORD Gear. New plug locations may be required.***











*** Oil level for 3 stage gear units.**

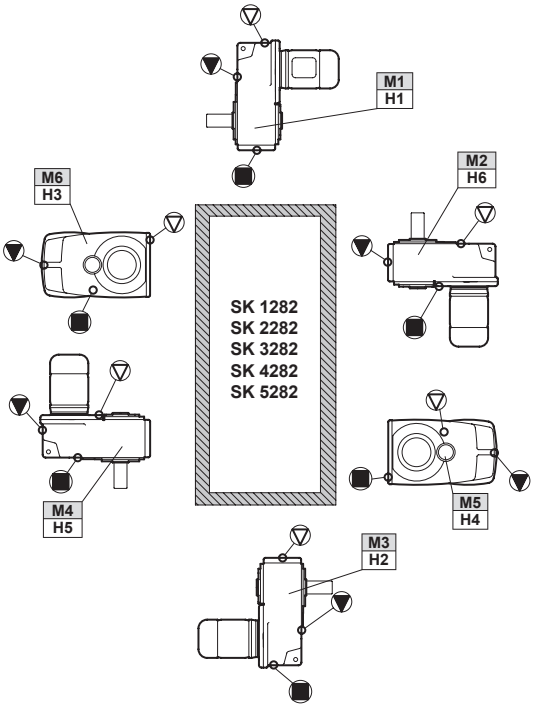
NORD Gear Limited
Toll Free in Canada: 800.668.4378

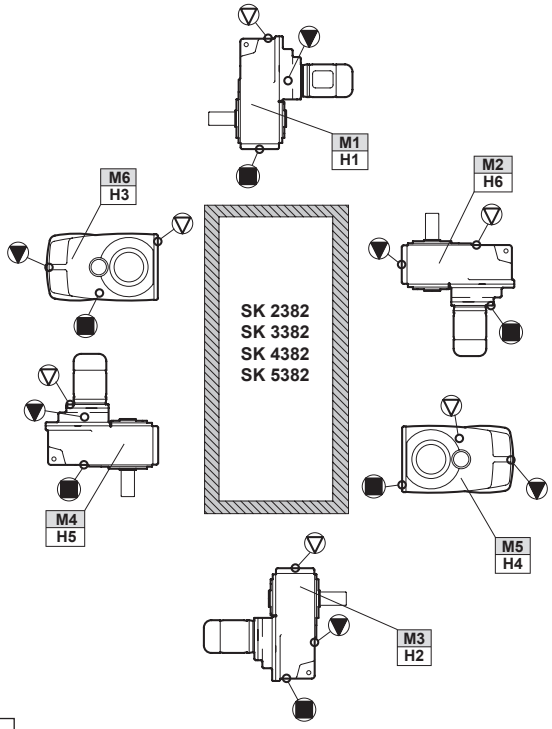
NORD Gear Corporation
Toll Free in the United States: 888.314.6673

CLINCHER™
OIL PLUG & VENT LOCATIONS

Oil plug connections

Prior to commissioning the reducer, check the oil-fill level using the reducer's oil-level plug and drain or add additional oil as needed. The minimum acceptable oil level is 0.15 in (4mm) below the oil level hole. ***For mounting orientations other than shown please consult NORD Gear. New plug locations may be required.***

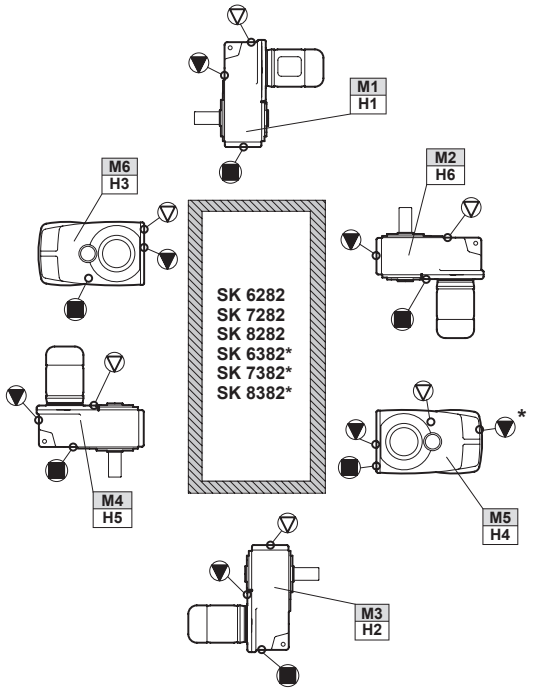




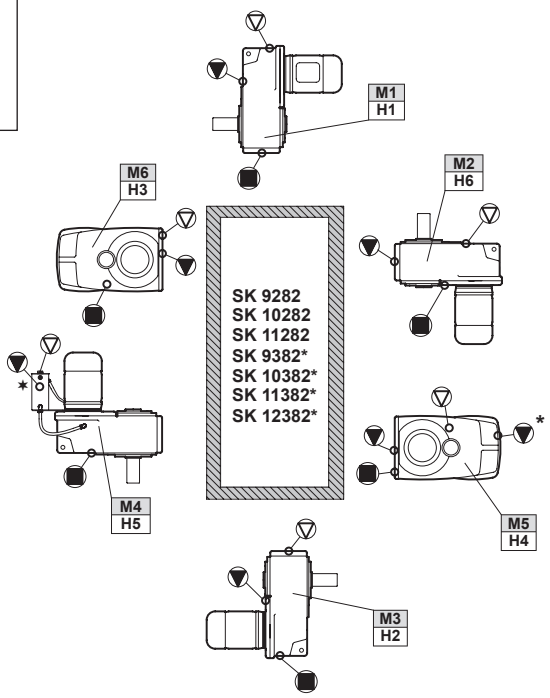
▽ = Vent

▼ = Oil Level

■ = Oil Plug



* Oil level for 3 stage gear units



* Oil level for 3 stage gear units

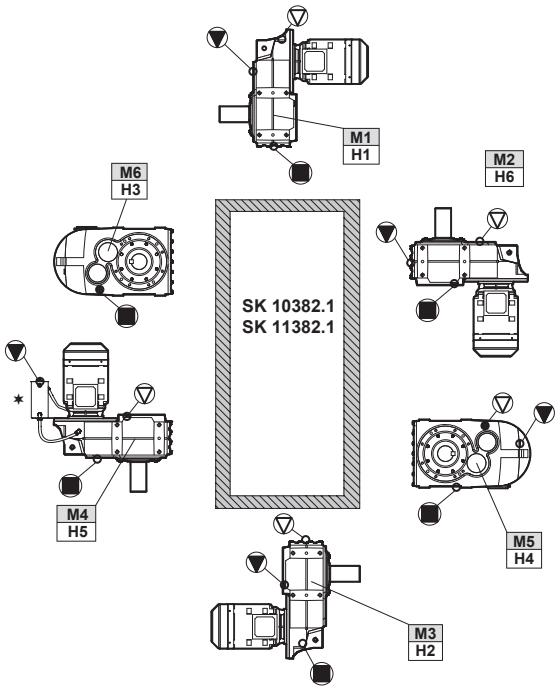
∗ Oil fill level should be verified using the dip stick located in the oil tank for the M4/H5 position.

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Oil plug connections

Prior to commissioning the reducer, check the oil-fill level using the reducer's oil-level plug and drain or add additional oil as needed. The minimum acceptable oil level is 0.15 in (4mm) below the oil level hole. ***For mounting orientations other than shown please consult NORD Gear. New plug locations may be required.***



∗ Oil fill level should be verified using the dip stick located in the oil tank for the M4/H5 position.

▽ = Vent

▼ = Oil Level

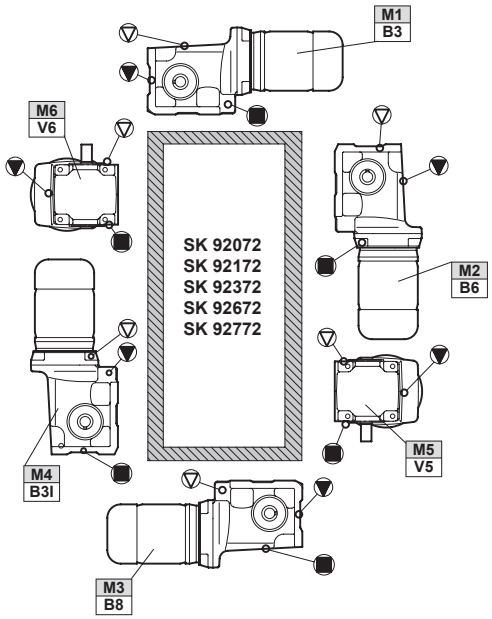
■ = Oil Plug

92 SERIES HELICAL-BEVEL OIL PLUG & VENT LOCATIONS

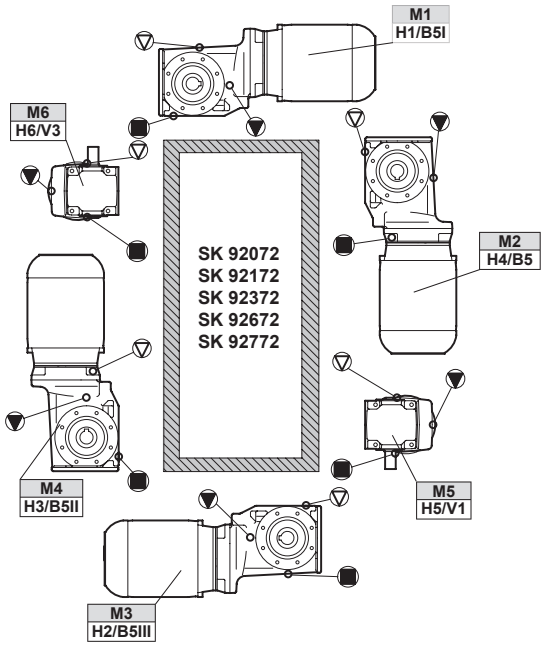
Oil plug connections

Prior to commissioning the reducer, check the oil-fill level using the reducer's oil-level plug and drain or add additional oil as needed. The minimum acceptable oil level is 0.15 in (4mm) below the oil level hole. ***For mounting orientations other than shown please consult NORD Gear. New plug locations may be required.***

Foot Mount



Shaft/Flange Mount



▽ = Vent

▼ = Oil Level

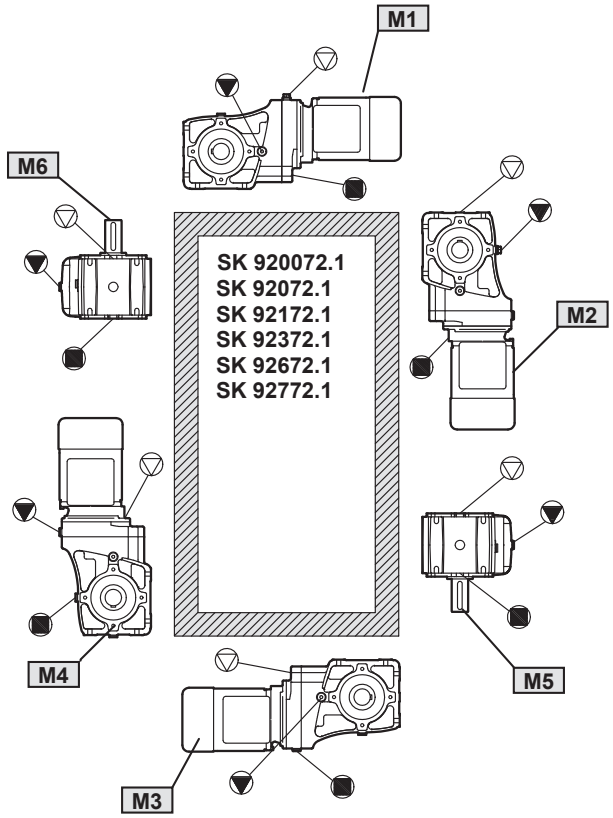
■ = Oil Plug

92.1/93.1 SERIES HELICAL-BEVEL OIL PLUG & VENT LOCATIONS

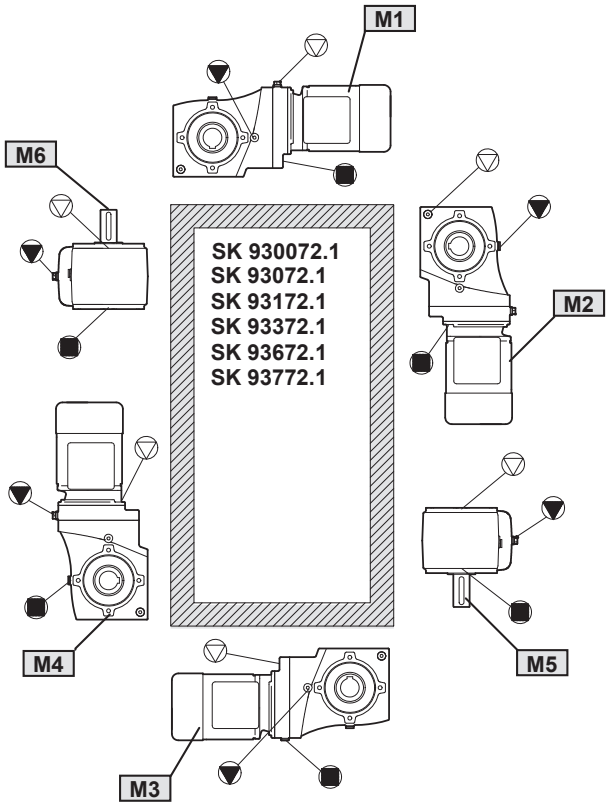
Oil plug locations

Prior to commissioning the reducer, check the oil-fill level using the reducer's oil-level plug and drain or add additional oil as needed. ***For mounting orientations other than shown please consult NORD Gear. New plug locations may be required.***

92.1 Series



93.1 Series



▽ = Vent

▼ = Oil Level

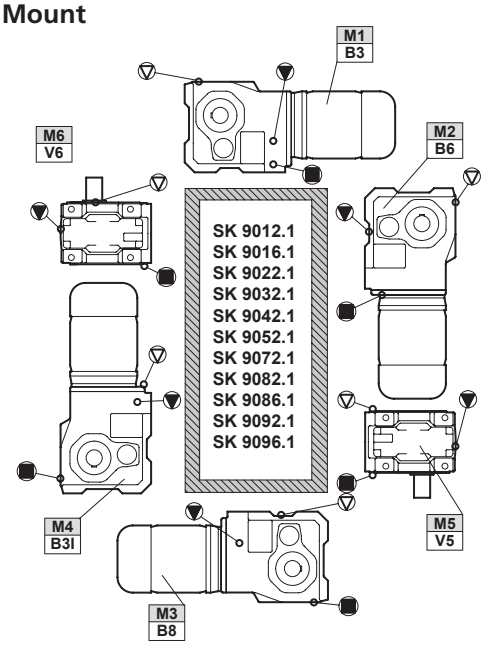
■ = Oil Plug

90.1 HELICAL-BEVEL OIL PLUG & VENT LOCATIONS

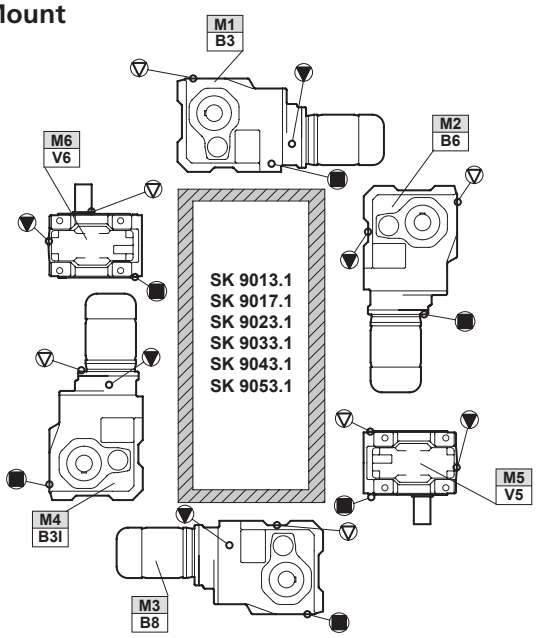
Oil plug connections

Prior to commissioning the reducer, check the oil-fill level using the reducer's oil-level plug and drain or add additional oil as needed. The minimum acceptable oil level is 0.15 in (4mm) below the oil level hole. ***For mounting orientations other than shown please consult NORD Gear. New plug locations may be required.***

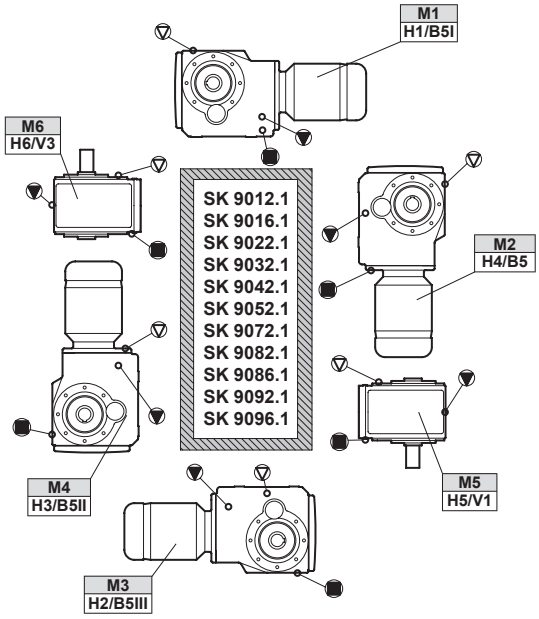
Foot Mount



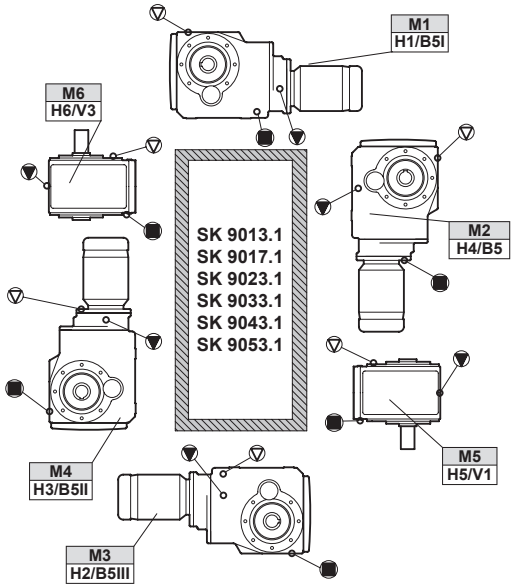
Foot Mount



Shaft/Flange Mount



Shaft/Flange Mount



▽ = Vent

▼ = Oil Level

■ = Oil Plug

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CONVEYOR DRIVE
OIL PLUG & VENT LOCATIONS

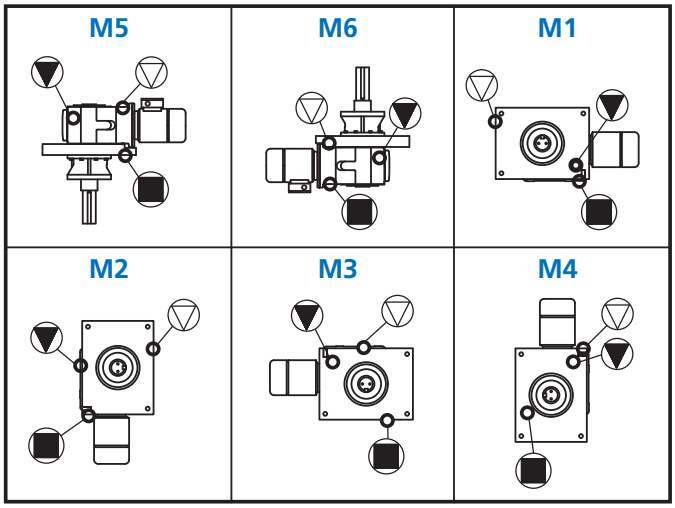
Oil Plug Locations

The NORD SK 9055 and SK 9155 Conveyor Drive reducers are designed to be output flange mounted. The following charts detail the six basic mounting positions for the SK 9055 and SK 9155 gear units. The standard or most typical mounting position is M5.

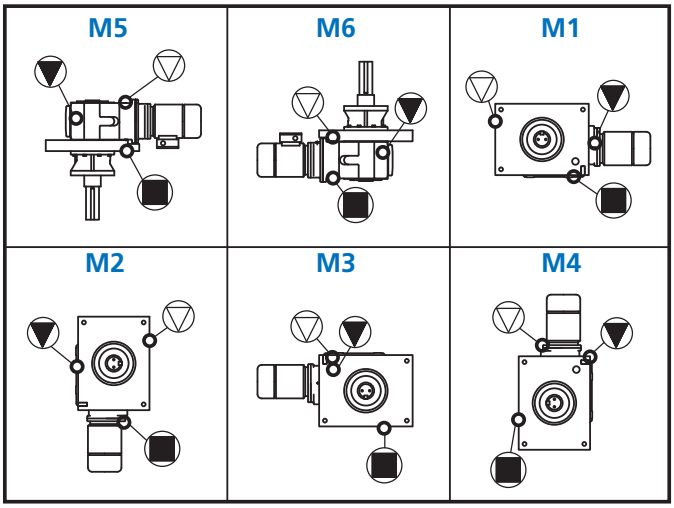
All SK 9055 and SK 9155 NORD gear reducers are shipped from the factory with a pre-determined oil fill level in accordance to the specified reducer size and mounting position. The mounting position also determines the position of the oil drain, oil fill and oil vent locations on the gear unit. SK 9155/42 and SK 9155/32 compound gear unit assemblies have separate oil sump areas.

Prior to commissioning the reducer, check the oil-fill level using the reducer's oil-level plug and drain or add additional oil as needed. The minimum acceptable oil level is 0.15 in (4mm) below the oil level hole. ***For mounting orientations other than shown please consult NORD Gear. New plug locations may be required.***

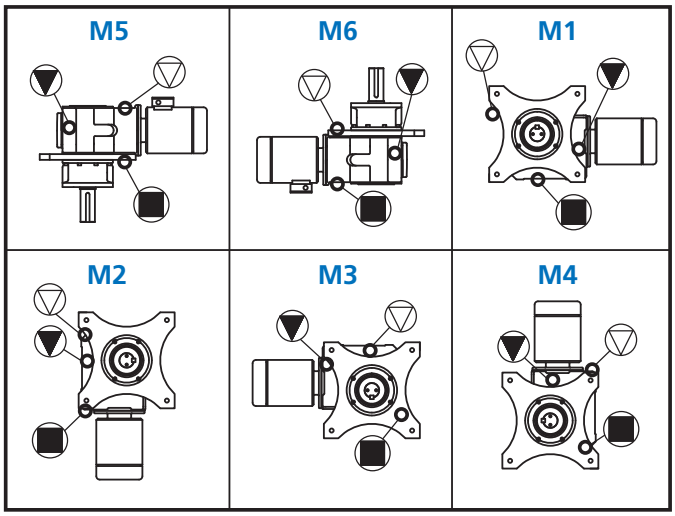
SK 9055 (3 Stage)



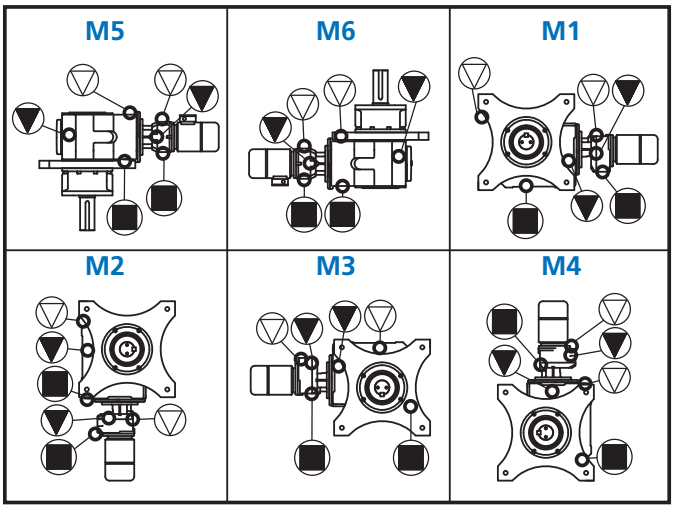
SK 9055 (4 Stage)



SK 9155



SK 9155/42



For mounting positions other than shown, please consult NORD Gear.

▽ = Vent

▼ = Oil Level

■ = Oil Plug

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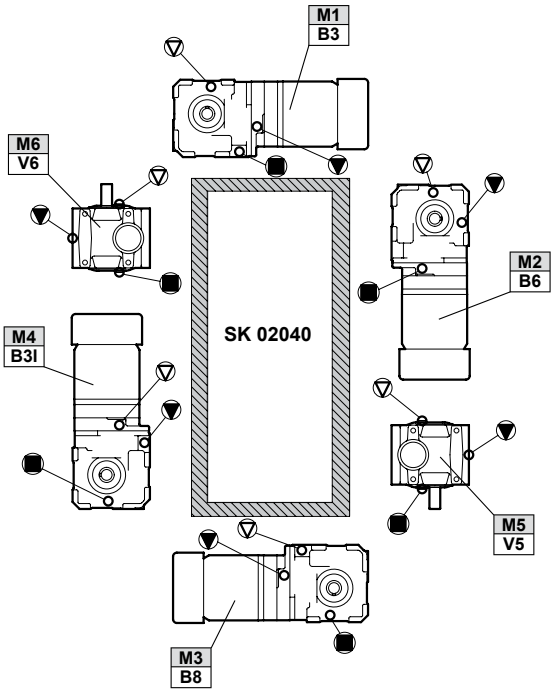
NORD Gear Corporation
Toll Free in the United States: 888.314.6673

HELICAL-WORM
OIL PLUG & VENT LOCATIONS

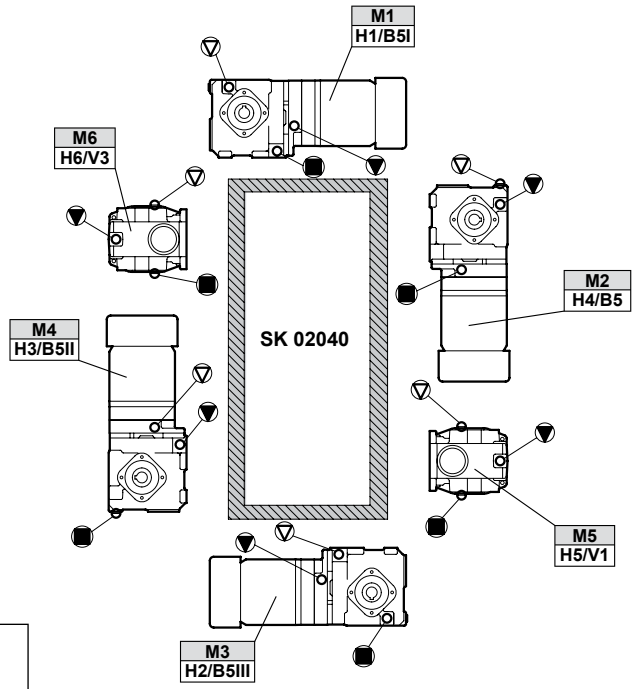
Oil plug connections

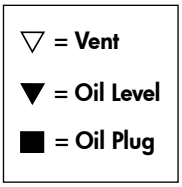
Prior to commissioning the reducer, check the oil-fill level using the reducer's oil-level plug and drain or add additional oil as needed. The minimum acceptable oil level is 0.15 in (4mm) below the oil level hole. **For mounting orientations other than shown please consult NORD Gear. New plug locations may be required.**

Foot Mount



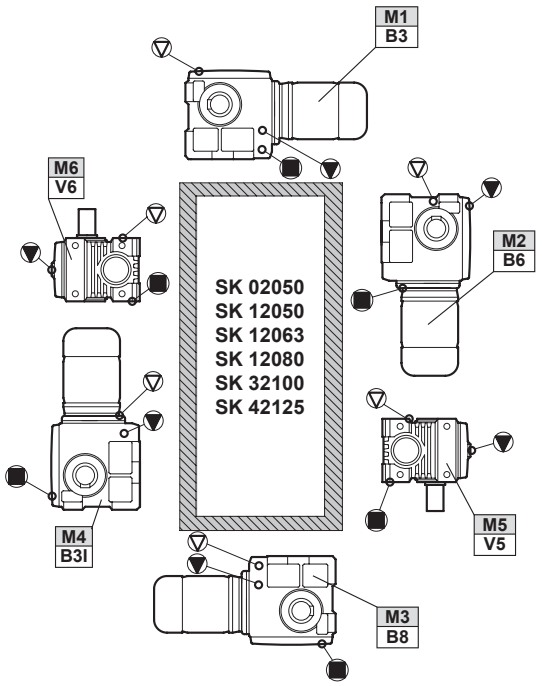
Shaft/Flange Mount



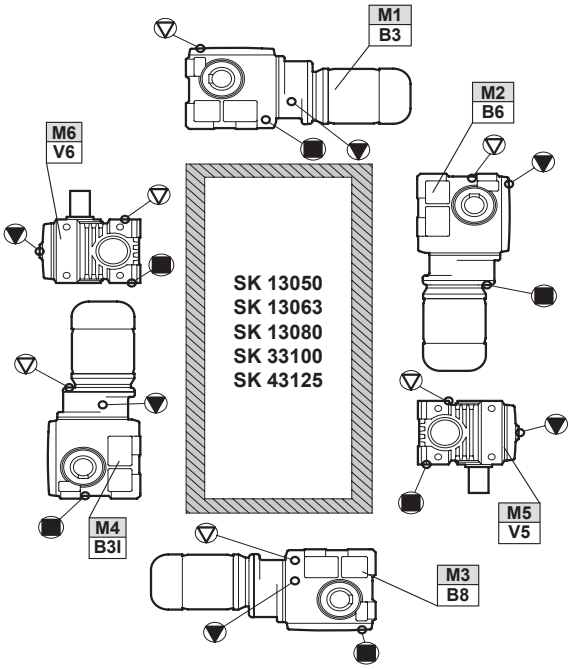


HELICAL-WORM
OIL PLUG & VENT LOCATIONS

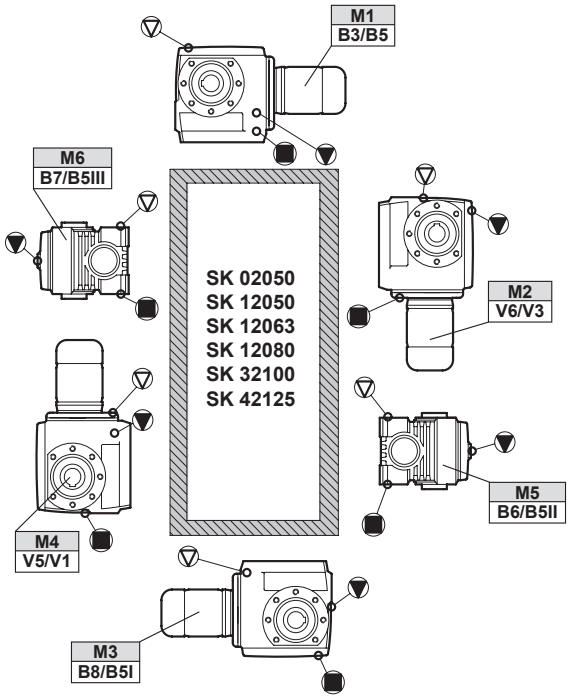
Foot Mount



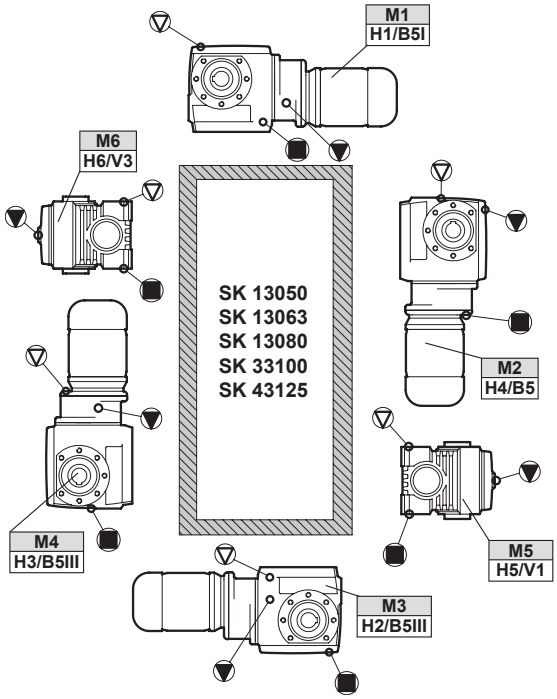
Foot Mount



Shaft/Flange Mount



Shaft/Flange Mount



▽ = Vent

▼ = Oil Level

■ = Oil Plug

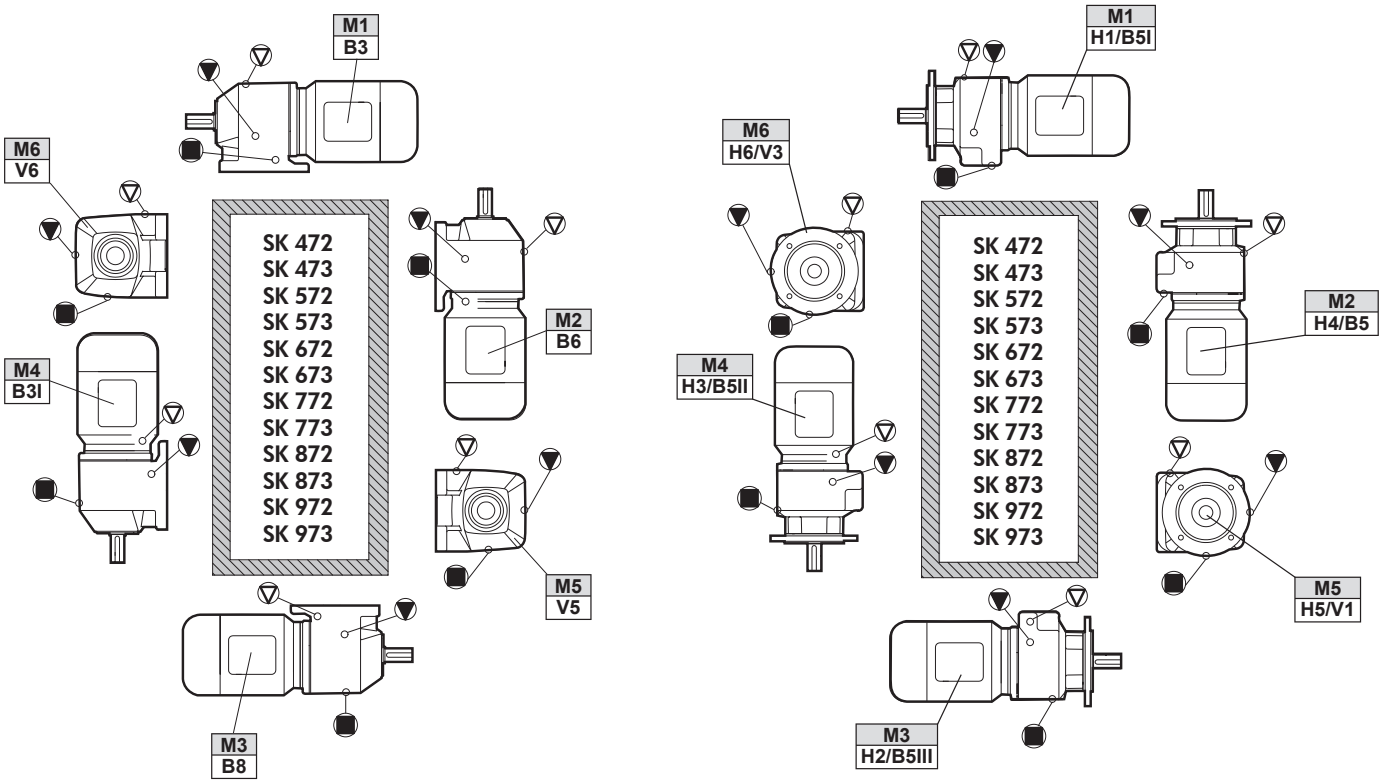
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NORDBLOC®
OIL PLUG & VENT LOCATIONS

Oil plug connections

Prior to commissioning the reducer, check the oil-fill level using the reducer's oil-level plug and drain or add additional oil as needed. The minimum acceptable oil level is 0.15 in (4mm) below the oil level hole. ***For mounting orientations other than shown please consult NORD Gear. New plug locations may be required.***



▽ = Vent

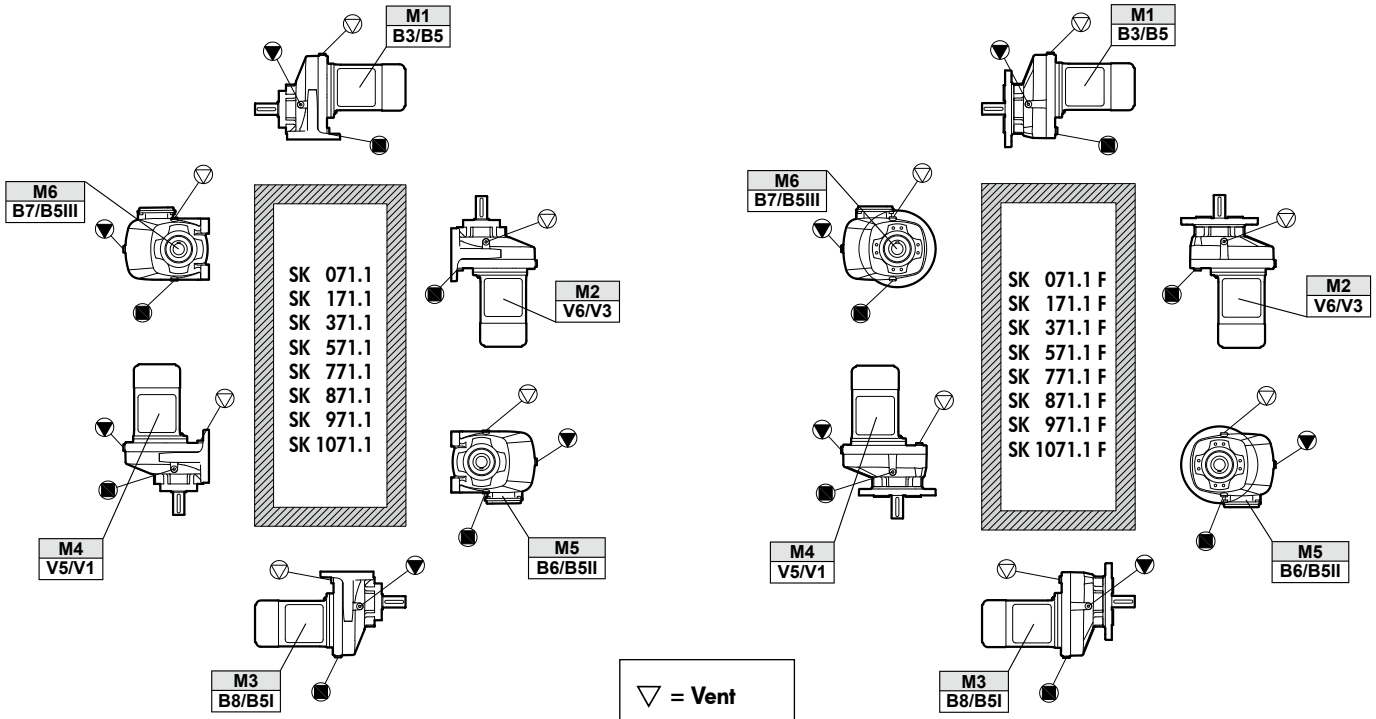
▼ = Oil Level

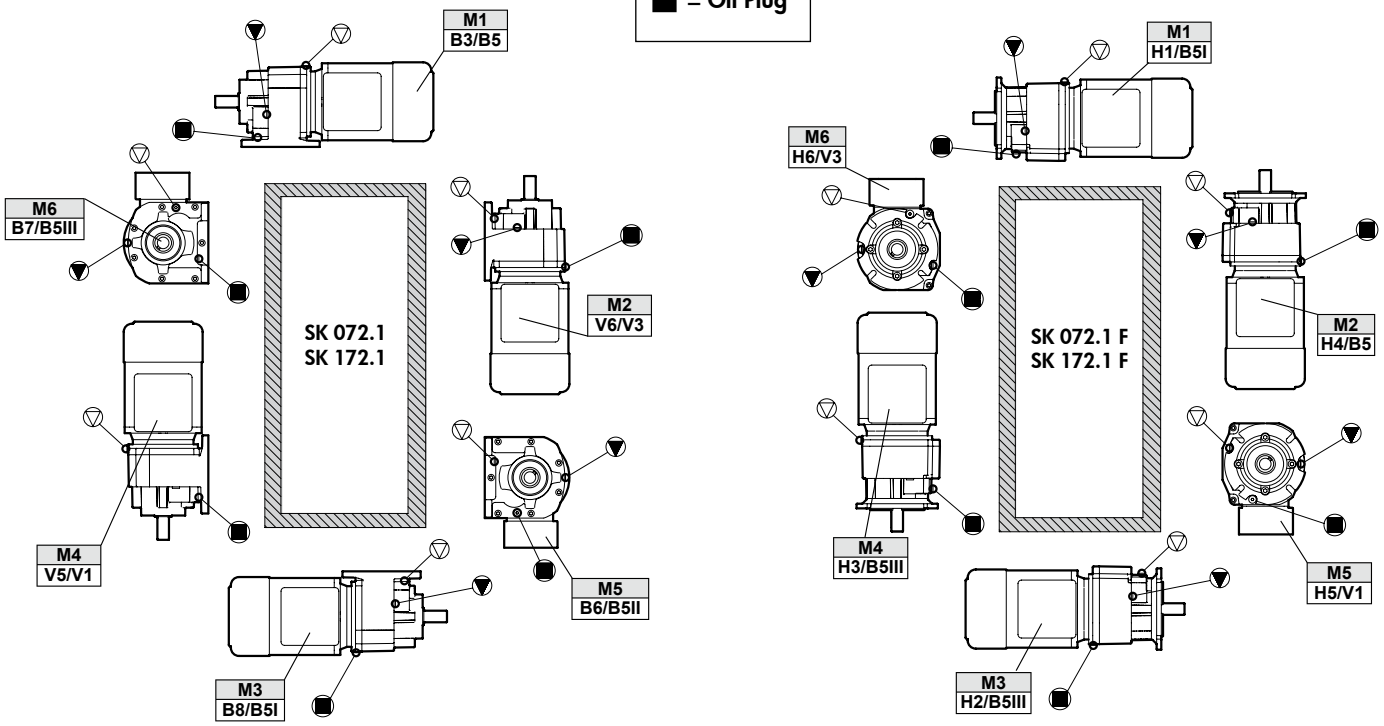
■ = Oil Plug

NORDBLOC®.1
OIL PLUG & VENT LOCATIONS

Oil plug connections

Prior to commissioning the reducer, check the oil-fill level using the reducer's oil-level plug and drain or add additional oil as needed. The correct oil level should be located at the lower edge of the oil level hole. ***For mounting orientations other than shown please consult NORD Gear. New plug locations may be required.***





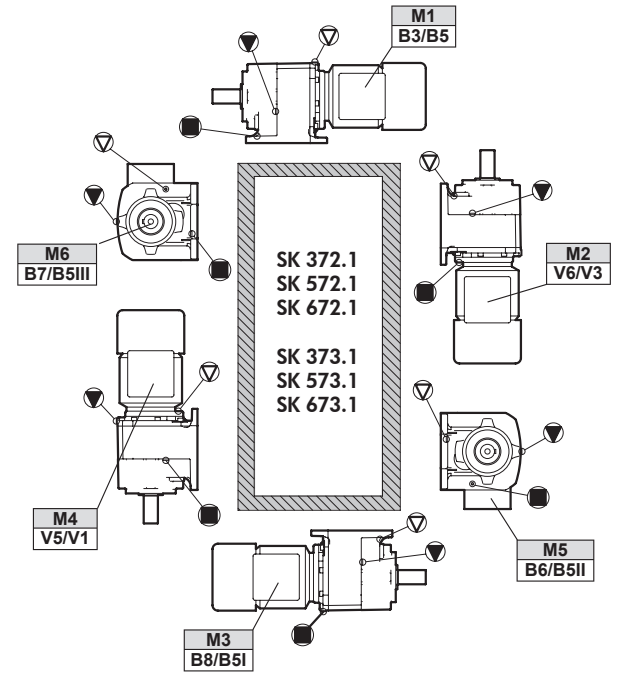
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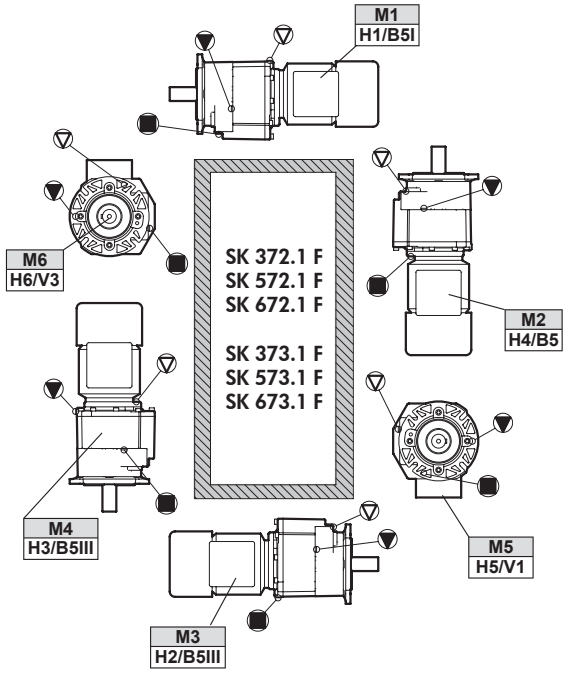
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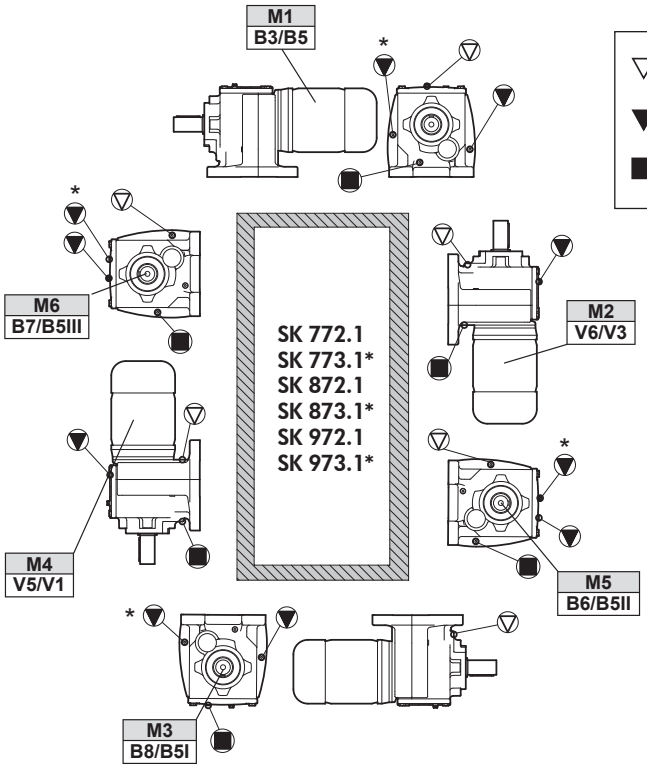
NORDBLOC®.1
OIL PLUG & VENT LOCATIONS

Oil plug connections

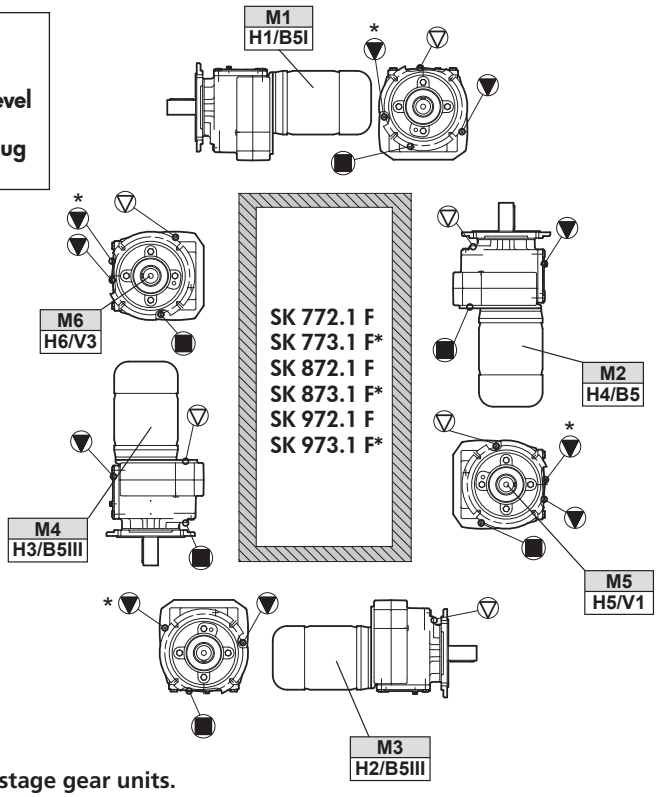
Prior to commissioning the reducer, check the oil-fill level using the reducer's oil-level plug and drain or add additional oil as needed. The correct oil level should be located at the lower edge of the oil level hole. ***For mounting orientations other than shown please consult NORD Gear. New plug locations may be required.***







▽ = Vent
▼ = Oil Level
■ = Oil Plug



*** Oil fill level for three stage gear units.**

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MINICASE® (SMI/SMID) WORM GEAR OIL PLUG & VENT LOCATIONS

DRIVESYSTEMS — RETAIN FOR FUTURE USE — U14750 - 1 of 1

Oil Plug and Vent Locations

MINICASE® (SMI/SMID) reducers and gear motors are fitted with oil plugs to allow for optional venting of the gear unit. NORD can supply either an AUTOVENT™ (valve-type) vent or an open vent. Vent options are available for most gear unit sizes and positions as indicated by the table below. For more complete details on vent options and when to consider reducer venting, see user manual U10800.

Vent Compatability by Unit Size & Mounting Position

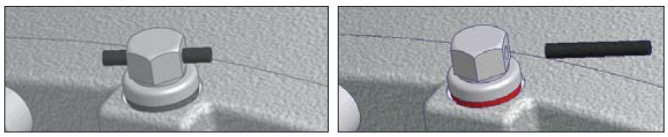
	M1	M2	M3	M4	M5	M6
SMI/SMID 31		✓	✓	✓		✓
SMI/SMID 40		✓	✓	✓		✓
SMI/SMID 50	✓	✓	✓	✓		✓
SMI/SMID 63	✓	✓	✓	✓	✓	✓
SMI/SMID 75	✓	✓	✓	✓		✓

Continuous Input speed ≤ 1800 rpm

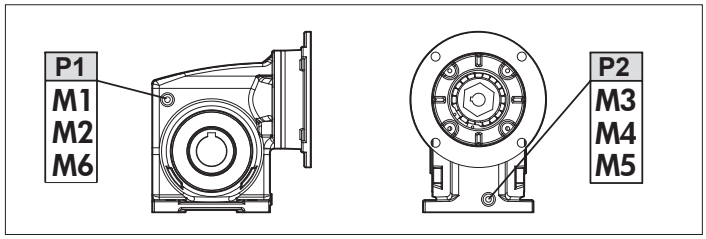
Vent Kit Part Numbers

Type	Transportation Seal	Installation	Part Number
AUTOVENT™	Included	Factory or Field site	60693510
Open Vent	None	Field Only	60693500
Open Vent	Included	Factory or Field site	22008004 (vent) 25308120 (gasket)

Unless noted by a seperate part number, vent kits include the housing gasket



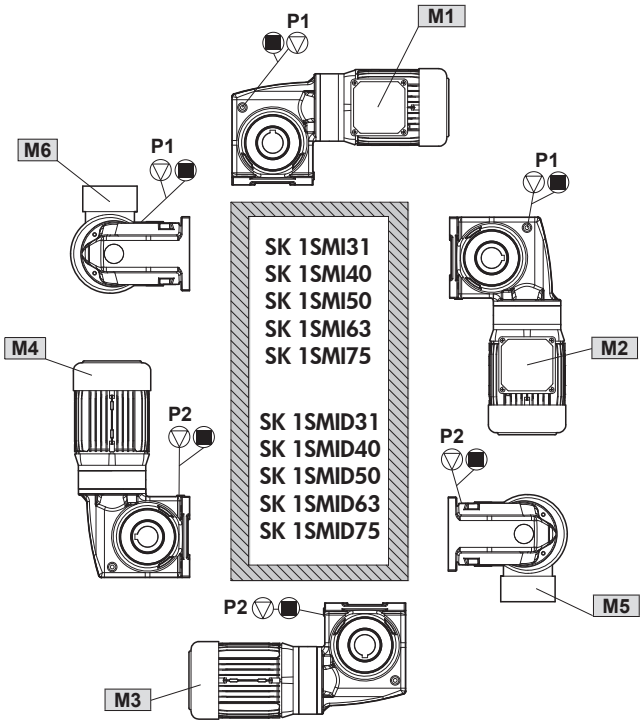
Optional Vent Locations



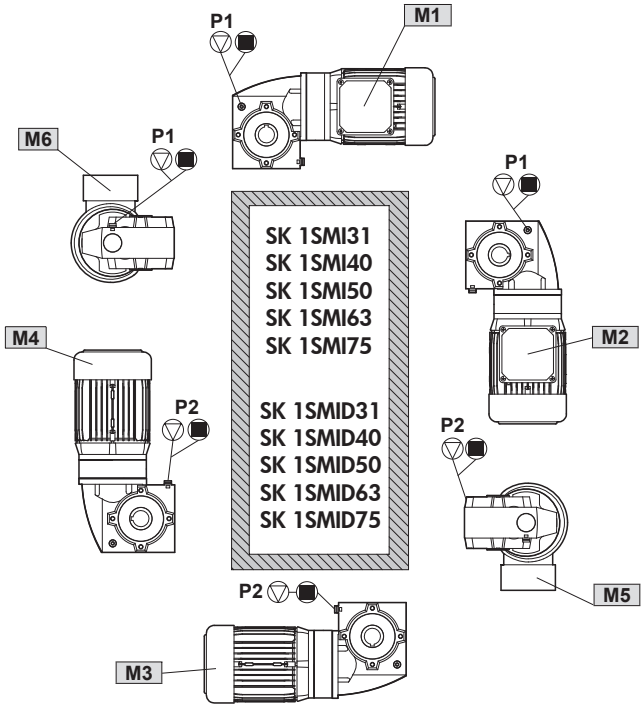
NOTICE

To prevent build-up of excessive pressure, sealed vents must be activated as shown prior to gear unit start-up. Excessive pressure may cause damage to internal components and cause leakage.

MINICASE® (SMI/SMID) Foot Housing



MINICASE® (SMI/SMID) Flange Housing



▽ = Vent
■ = Oil Plug

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FLEXBLOC™ (SI/SID SERIES) WORM GEAR OIL PLUG & VENT LOCATIONS

Vent locations

FLEXBLOC™ (SI?SID SERIES) reducers are fitted with oil plugs to allow for optional venting of the gear unit. NORD can supply either an AUTOVENT™ (valve-type) vent or an open vent. Vent options are available for most gear unit sizes and positions as indicated by the table below. For more complete details on vent options and when to consider reducer venting, see user manual U10810.

Vent Compatability by Unit Size & Mounting Position

	M1	M2	M3	M4	M5	M6
SI/SID 31		✓	✓	✓		✓
SI/SID 40		✓	✓	✓		✓
SI/SID 50	✓	✓	✓	✓		✓
SI/SID 63	✓	✓	✓	✓	✓	✓
SI/SID 75	✓	✓	✓	✓		✓

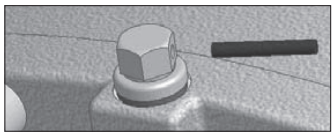
Continuous Input speed ≤ 1800 rpm

Vent Kit Part Numbers

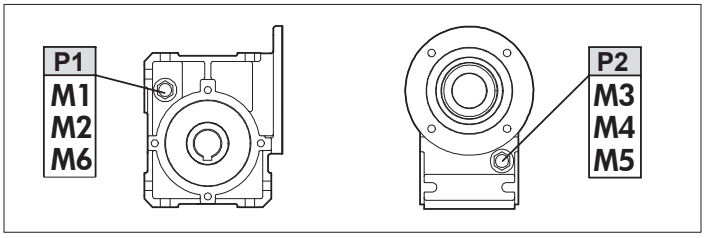
Type	Transportation Seal	Installation	Part Number
AUTOVENT™	Included	Factory or Field site	66093510
Open Vent	None	Field Only	60693500
Open Vent	Included	Factory or Field site	22008004 (vent) 25308120 (gasket)

Unless noted by a seperate part number, vent kits include the housing gasket





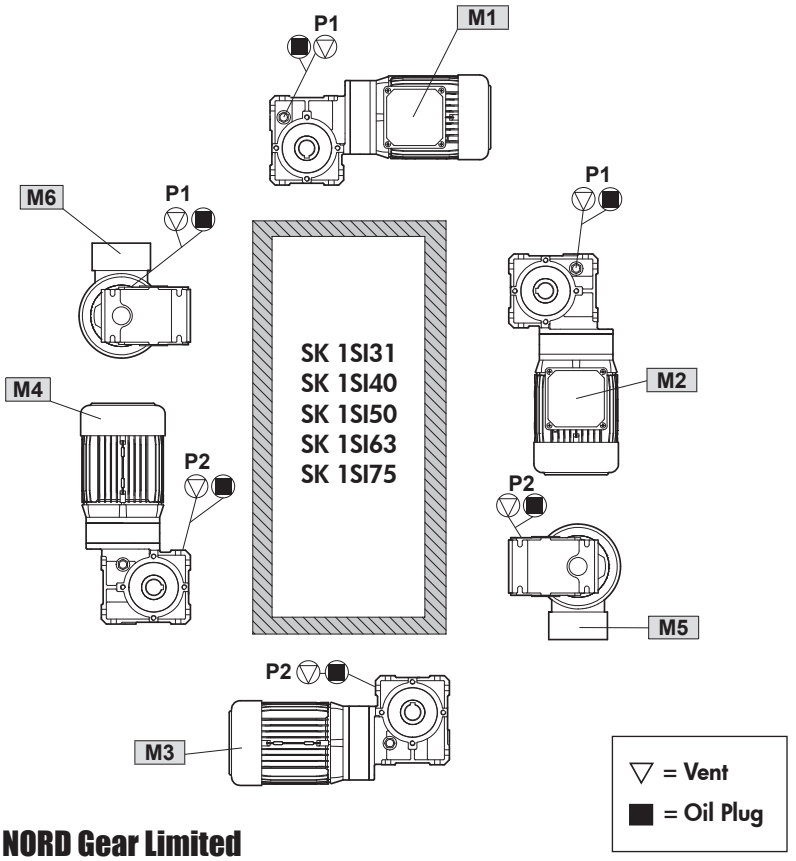
Optional Vent Locations



NOTICE

To prevent build-up of excessive pressure, sealed vents must be activated as shown prior to gear unit start-up. Excessive pressure may cause damage to internal components and cause leakage.

FLEXBLOC™ (SI Series) Universal Housing



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Troubleshooting

This section identifies some of the most common issues involved with NORD Gear speed reducers , and provides recommendations to assist you in defining and answering your questions as you work with our products. You may also contact our Engineering/Application departments if your questions are not answered in the table below.

Problem With the Reducer		Possible Causes	Suggested Remedy
Runs Hot	Overloading	Load exceeds the capacity of the reducer	Check rated capacity of reducer, replace with unit of sufficient capacity or reduce the load.
	Improper lubrication	Insufficient lubrication	Check lubricant level and adjust up to recommended levels
		Excessive lubrication	Check lubricant level and adjust down to recommended levels.
		Wrong lubrication	Flush out and refill with correct lubricant as recommended
Runs Noisy	Loose foundation bolts	Weak mounting structure	Inspect mounting of reducer. Tighten loose bolts and/or reinforce mounting and structure.
		Loose hold down bolts	Tighten bolts
	Failure of bearings	May be due to lack of lubricant	Replace bearing. Clean and flush reducer and fill with recommended lubricant.
		Overload	Check rated capacity of reducer.
	Insufficient lubricant	Level of lubricant in reducer not properly maintained.	Check lubricant level and adjust to factory recommended level.
Output shaft does not turn	Internal parts are broken or missing	Overloading of reducer can cause damage	Replace broken parts. Check rated capacity of reducer.
		Key missing or sheared off on input shaft.	Replace key.
		Coupling loose or disconnected	Properly allign reducer and coupling. Tighten coupling.
Oil Leakage	Worn seals	Caused by dirt or grit entering seal.	Replace seals. Autovent may be clogged. Replace or clean.
	Unit runs hot or leaks	Overfilled reducer	Check lubricant level and adjust to recommended level.
		Vent clogged.	Clean or replace, being sure to prevent any dirt from falling into the reducer.
	Incorrect fill level	Improper mounting position, such as wall or ceiling mount of horizontal reducer.	Check mounting position on the name tag & verify with mounting chart in manual.

1. Basic operation and speed adjustment

⚠ WARNING ⚠

Lock-out power before any maintenance is performed. Make absolutely sure that no voltage is applied while work is being done on the drive unit.

Titan™ Adjustable-Speed Drives are ideal for use when operating conditions dictate infinitely variable output speeds over a fixed range. The Titan™ Drive consists of a motor, belt casing, and main gear drive.

The beltbox contains an Adjusting Pulley (Driver) that is attached to the motor output shaft. A handwheel or optional Electric Remote Control Motor (EMFST) is used to vary the operating pitch diameters of the driver pulley in-turn making a corresponding adjustment to the Spring Pulley (Driven). Belt center distance remains fixed. Speed is typically adjusted by loosening the lock nut handle on the handwheel.

Pulleys are manufactured from the corrosive resistant and extremely durable alloy "Durfondal" to provide superior wear resistance and assure grooving and wear will be minimized under rated operating conditions. All sliding components are coated to resist fretting and corrosion. Pulleys are permanently grease lubricated and require no service during the normal life of the Titan™ drive.

⚠ WARNING ⚠

NORD does not support the use of the Titan™ belt drive in explosion proof or hazardous environments. While the belt is non-sparking, the Titan™ belt drive assembly does not have a safety to disengage the belt. In the event of an overload the belt can slip and generate excessive heat.

STOP HARMFUL SITUATION STOP

Operational speed adjustments must be performed when the motor is operational. Failure to comply may damage the belt and pulleys.

IMPORTANT NOTE

- In order to renew the grease coating over the full tracking distance of the pulleys and to avoid damage to the pulley surfaces and/or belt, the Titan™ belt drive should occasionally be operated over the entire speed range.
- Speeds stops located on the adjustment spindle are factory adjusted; further adjustments can cause damage to the belt box and/or main drive.
- When operating in areas of higher ambient temps, or when installed where ventilation is poor, additional cooling may need to be applied to the belt housing.
- The adjustment wheel and speed adjustment shaft should also be cleaned periodically and coated with molybdenum based anti-seize compound.

2. Motor

⚠ WARNING ⚠

To prevent possible injury and/or damage to the electric motor, the variable speed drive, or the driven equipment, it is important to follow the motor manufacturer's instructions pertaining to safe handling, installation, and maintenance of the electric motor.

Connect the motor in accordance with the wiring information supplied by the motor manufacturer and make sure the motor nameplage voltage and frequency agree with the available power supply. Use the proper protective motor switches to help protect the motor windings from overload and/or phase failure.

To insure the same performance the replacement motor must be of the same design and style as the original. The end of the motor shaft must also have a tapped hole in it as shown below.

NEMA Frame Size	Thread Size	Minimum Thread Depth
56C	1/4-20	1.00 inch
143TC/145TC	1/4-20	1.00 inch
182TC/184TC	3/8-16	1.25 inch
213TC/215TC	5/8-11	1.25 inch
254TC/256TC	5/8-11	1.50 inch
284TC	5/8-11	1.50 inch

3. Installation

Titan™ drive packages may be supplied with a variety of gear units including foot-mounted, flange-mounted or shaft-mounted options.

When selecting the drive installation site, one should remember that air-cooled motors are ideally designed for ambient temperatures between -4°F and +104°F (-20°C and +40°C) and for installation at altitudes of 3,300ft (1,000m) above mean sea level.

The installation site should also ensure the following:

- Unrestricted airflow over the motor and variable speed drive.
- Accessibility to the oil fill-hole, level-hole and vent-hole locations on the main gear drive.
- A foundation (mounting base) of adequate size that is flat, torsionally rigid, and vibration-proof.
- Adequate shaft alignment between the drive and the driven equipment.
- Adequate space to allow motor removal and/or maintenance.
- In cases where brake motors are used, fan guard removal may be necessary to allow for brake adjustment and maintenance.

4.V-Belt replacement

Please reference the general parts lists starting on Page 6 of this manual.

A. Run the Titan™ drive to its maximum speed and switch off. Be certain the power can not be inadvertently switched on again.

B. Unscrew the socket head screws (521) and remove the belt casing cover, together with the entire speed control unit.

C. Remove the old V-belt by first drawing it over the cones of the spring-loaded pulley (507) and then sliding over the open adjustable pulley (506). Installing a tapered wedge made of soft pine between the spring pulley halves will help keep the adjustable pulley open, and may aid in the removal of the old V-belt.

D. Wrap the new V-belt around the cones of the open adjustable pulley (506) and then draw it over the spring-loaded pulley (507). Installing a tapered wedge made of soft pine between the spring pulley halves will help keep the adjustable pulley open, and may aid in the installation of the new V-belt.

E. Reassemble the belt casing cover.

⚠ *WARNING* ⚠

NORD does not support the use of the Titan™ belt drive in explosion proof or hazardous environments. While the belt is non-sparking, the Titan™ belt drive assembly does not have a safety to disengage the belt. In the event of an overload the belt can slip and generate excessive heat.

TITAN™ V-Belt part numbers and sizes

TYPE	Belt P/N	Belt Size
R100	71092000	22 x 7 x 567 x 28°
R150	71592000	28 x 8 x 754 x 28°
R196	71992000	33 x 9 x 906 x 28°
R210	72192000	37 x 10 x 954 x 28°
R250	72592000	47 x 12 x 1135 x 28°
R280	72892100	55 x 15 x 1255 x 28°
R300	73092100	51 x 16 x 1444 x 28°
R350	73592100	70 x 18 x 1515 x 30°
R375	73792100	83 x 23 x 1767 x 32°
R400	74092100	83 x 23 x 1842 x 32°
R500	75092100	83 x 26 x 2877 x 32°

5. Pulley replacement

HARMFUL SITUATION

- Install new pulleys in the same exact orientation as the old pulleys to prevent damage to the machinery.
- Special care must be taken when reassembling the Z-Flow pattern, as the moving parts of the pulleys must always be situated on opposite (diagonal) sides.
- Do not attempt to disassemble spring pulley. Failure to remove the spring without the proper fixtures/tools can result in serious injury.

Please reference the instructions and diagrams shown below, as well as the general parts lists that start on Page 6 of this manual.

A. The spring loaded pulley (507) and the adjustable pulley (506) are held securely to the shaft using a holding screw (519/516), a thrust washer (518/515), and a snap ring (520/517). Remove the screw (519/516), thrust washer (518/515) and snap ring (520/517) that are used to hold the pulley on the shaft.

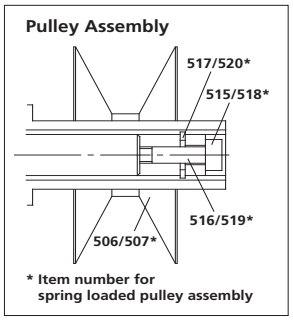
B. In order to protect the tapped hole in the shaft, place a steel disc (I), slightly smaller than the shaft diameter, against the end of the shaft.

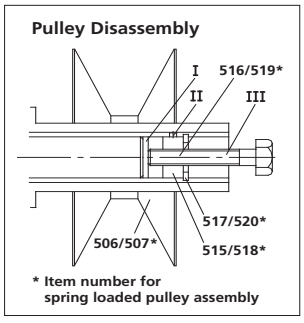
C. The thrust washer has an internal thread diameter that is slightly larger that the thread on the holding screw (516/519). Refit the snap ring (520/517) and replace the thrust washer (518/515). In order to aid in the removal of the pulley, a disassembly screw, slightly larger than the holding screw (516/519) can be inserted into the thrust washer (518/515) and tightened against the steel disc (I). Remove the spring loaded pulley (507) or the adjustable pulley (506) by using the thrust washer and disassembly screw (III) as a "jacking bolt".

D. If the thrust washer (518/515) rotates when trying to remove the pulley, secure the thrust washer with a pin inserted into the keyway (II).

E. After the old pulley is removed, disassemble or remove the disassembly screw (III), thrust washer (518/515), snap ring (520/517), and protective steel disc (I) that was placed over the shaft.

F. Before installing the new pulley, apply an anti-seize compound to the shaft. Reassemble the snap ring (520/517) and thrust washer (518/515) into the pulley bore. Use the holding screw (519/516), pull the pulley onto the shaft. Do not drive the pulley onto the shaft with a hammer.



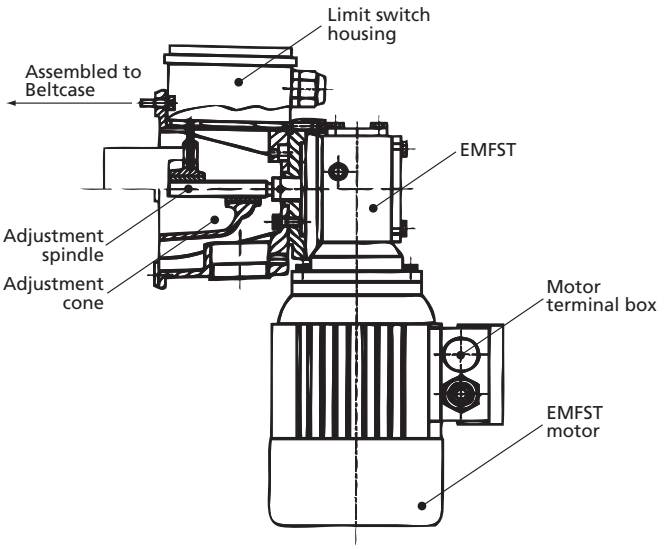


6. Electromechanical remote control speed adjustment

The Electromechanical Remote Control (EMFST) replaces the hand wheel when remote speed adjustment is desired. With the EMFST the speed range is set by adjusting the limit switches that are supplied with the motor. The limit switches are factory preset to operate within the specified speed range of the TitanTM variator.

HARMFUL SITUATION

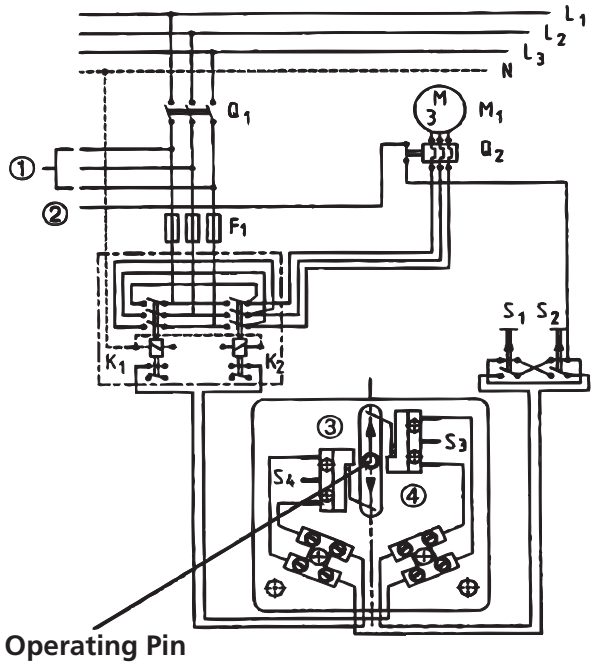
The EMFST is assembled to the control-side of the Titan™ belt case; prior to assembly, the adjustment cone of the EMFST control must be driven towards the "full-back" or "minimum speed" position. This must be done by powering the EMFST motor. To prevent damage to the adjustment spindle, nut, or EMFST gear unit, one must be very careful to stop the motor prior to reaching the final "full-back" position.



Dual Rated – Electronic Remote Control Motor Option (EMFST)

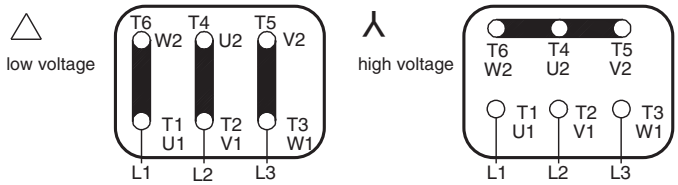
Type	FY63 A-4
Phase	3 ~
Nominal Frequency	50 / 60 Hz
Nominal Power	0.12/0.14 kW
Nominal Speed	1360 / 1660
Voltage	265Δ - 460Y/230Δ - 400Y
Current at High Voltage	0.43/0.50 Amp
Starting Current Ratio	3.5
Starting Torque Ratio	1.8
Breakdown Torque Ratio	1.9
Efficiency	45.2%
Power Factor	0.68/0.70
Enclosure	IP55
Insulation Class/Rise	F/B
Weight	4.0 kg or 8.82 lb

7. Wiring diagram



Symbol legend - wiring diagram

L_1, L_2, L_3	Incoming Power
K_1, K_2	Combined relay for phase reversal of the EMFST motor (CW or CCW shaft rotation)
M_1	EMFST motor
Q_1	Main switch
Q_2	Motor protection switch
S_1	Push Button "speed increase"
S_2	Push Button "speed decrease"
S_3	Limit switch "upper limit"
S_4	Limit switch "lower limit"
①	Main drive motor
②	Control for servo motor and motor protection switch
③	Direction of "speed increase"
④	Direction of "speed decrease"



8. Limit switch adjustment

HARMFUL SITUATION

The main motor and TitanTM variator must be operating while trying to adjust the limit switches of the EMFST motor.

A. Wire the EMFST motor according to the motor wiring diagram (Page 4).

B. Open the cover plate of the limit switch housing and check the direction of rotation while in operation as follows:
- Pressing Push Button S1 should move the operating pin forward or towards the belt case.
- Pressing Push Button S2 should move the operating pin in the opposite direction or away from the belt case.
- If the direction of rotation is incorrect, reverse the polarity of the electric remote control motor (EMFST).

C. Check the function of the limit switches as follows:
- Actuate Limit Switch S3 (upper speed limit) and press Push Button S1 (speed increase).
- Actuate Limit Switch S4 (lower speed limit) and press Push Button S2 (speed decrease).
- In both cases there should be no movement of the operating pin.

D. Operate the EMFST motor towards minimum speed. Use a tachometer to check the final output speed of the drive unit. As minimum speed is approached, make only small incremental adjustments in speed. Re-check the output speed of the drive unit.

E. Upon reaching the required minimum speed, stop the EMFST unit.

IMPORTANT NOTE

There should be no "wheezing" noise emitted from the belt drive at this stage. If there is such a noise the belt may be "bottoming" on the "adjustable control pulley". You should then increase the speed of the drive slightly.

8. Limit switch adjustment (ctd)

F. Unscrew the two fixing screws of the minimum speed limit switch. Adjust the limit switch by putting it against the operating pin and re-tightening the screws.

G. Operate the EMFST motor towards maximum speed. Use a tachometer to check the final output speed of the drive unit. As maximum speed is approached, make only small incremental adjustments in speed. Re-check the output speed of the drive unit.

H. Upon reaching the required maximum speed, stop the EMFST unit.

IMPORTANT NOTE

There should be no "wheezing" noise emitted from the belt drive at this stage. If there is such a noise the belt may be bottoming on the "spring pulley". You should then decrease the speed of the drive slightly.

I. Unscrew the two fixing screws of the maximum speed limit switch. Adjust the limit switch by putting it against the operating pin and re-tightening the screws.

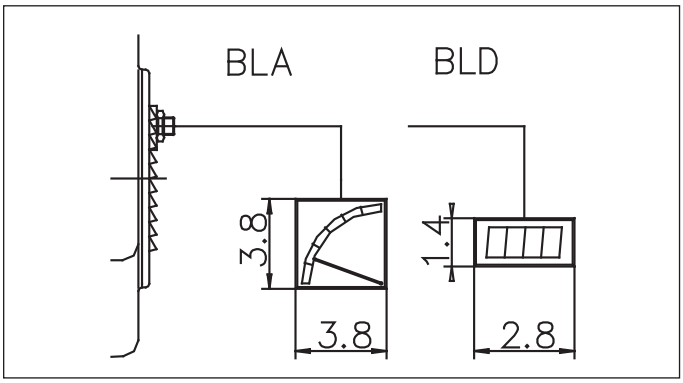
J. Re-check both minimum and maximum speed positions by operating the EMFST and moving towards the limit switch settings. Use a tachometer to check the speed range at the output of the final drive. Readjust limit switches if necessary.

9. Non-contacting speed indicator

IMPORTANT NOTE

The speed indicator options are not available when using the EMFST.

The speed indicator contains a built in sensor which converts the signals coming from the pulse generator into a direct current signal for the speed indicator. Adjustment of the analog style meter is possible by means of set screws on the back of the meter.



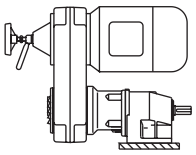
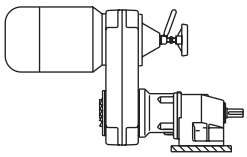
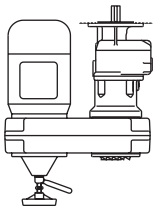
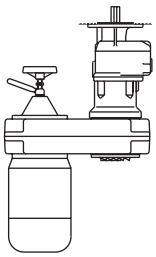
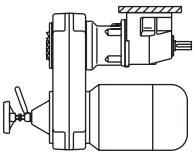
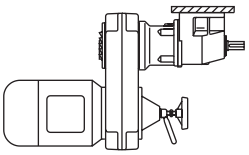
Type BLA: analog speed indicator

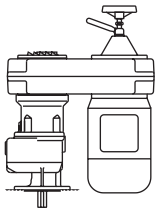
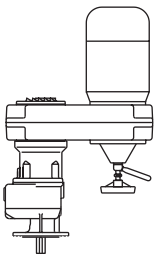
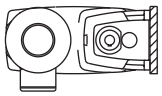
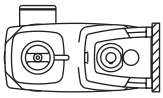
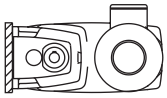
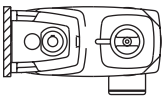
Scale Marking: 0-100% - Scale deflection: 90°
Type of enclosure: IP 53 – Terminals IP 00

Type BLD: digital speed indicator

Digital indicator: 4 digits – 7 segment red LED display.
Type of enclosure: IP 50 – Terminals IP 00.

Variable Speed Helical In-Line Gear Units Mounting Positions

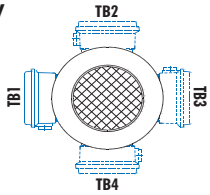
M1 U	M1 Z	M2 U	M2 Z	M3 U	M3 Z
					

M4 U	M4 Z	M5 U	M5 Z	M6 U	M6 Z
					

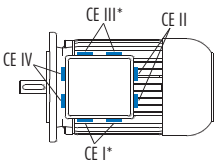
Variable Speed Helical-in-Line Position of terminal box and cable entry

Please specify position of terminal box and cable entry.

Normal Design: Cable entry at 3 and terminal box at I or III only.
If other positions are required, please specify while ordering.

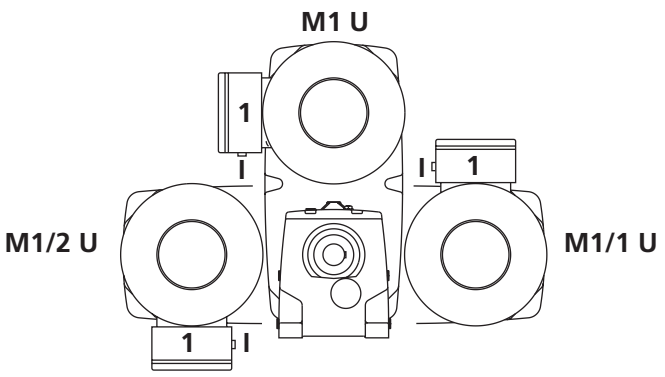


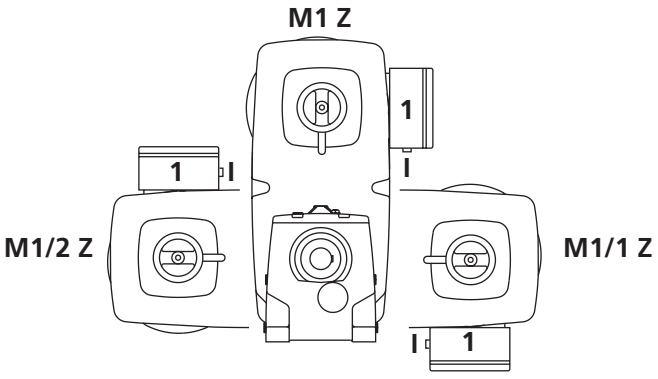
Terminal Box Positions (Position M1 shown)



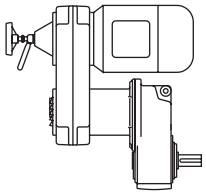
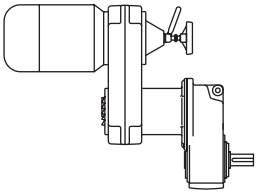
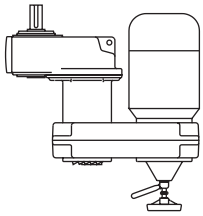
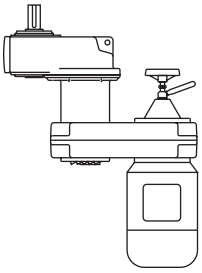
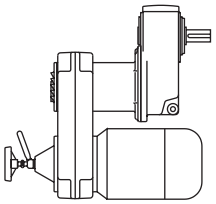
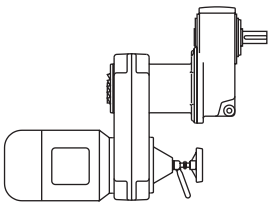
Conduit Entry Positions (Position M1 shown)

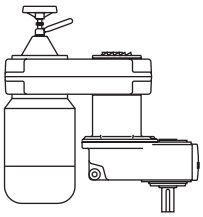
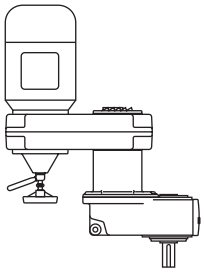
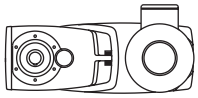
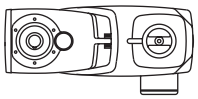
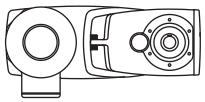
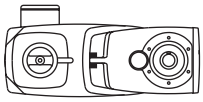
In all mounting positions the variable speed drive may be mounted at an angle interval of 90°.





Variable Speed Clincher™ Gear Units Mounting Positions

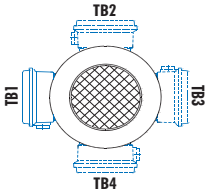
M1 U	M1 Z	M2 U	M2 Z	M3 U	M3 Z
					

M4 U	M4 Z	M5 U	M5 Z	M6 U	M6 Z
					

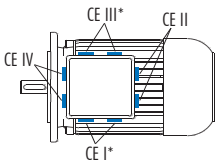
Variable Speed Clincher™ Position of terminal box and cable entry

Please specify position of terminal box and cable entry.

Normal Design: Cable entry at 3 and terminal box at I or III only.
If other positions are required, please specify while ordering.



Terminal Box Positions (Position M1 shown)

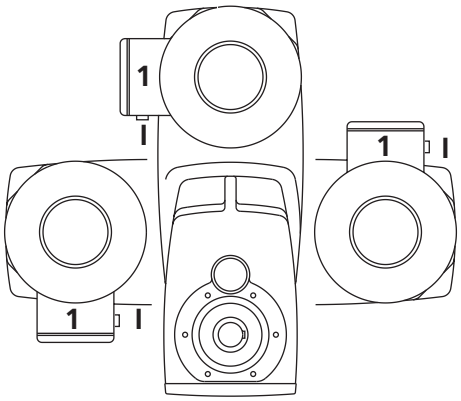


Conduit Entry Positions (Position M1 shown)

In all mounting positions the variable speed drive may be mounted at an angle interval of 90°.

M1 U

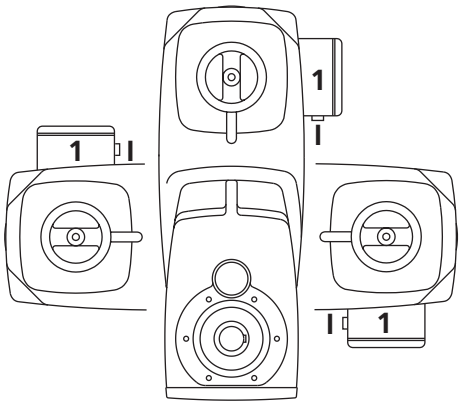
M1/2 U



M1/1 U

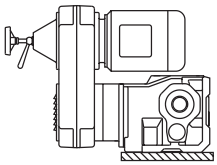
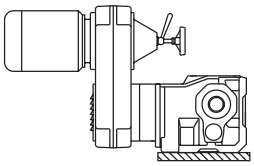
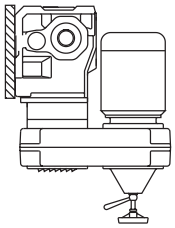
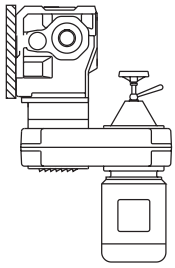
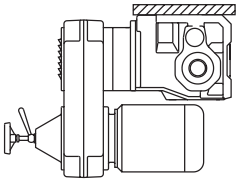
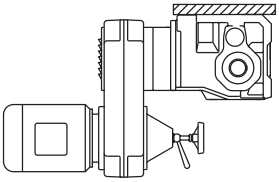
M1 Z

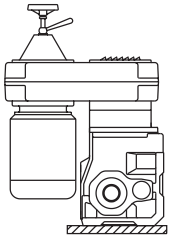
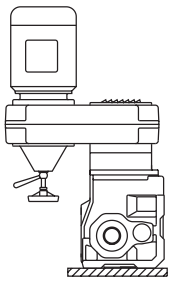
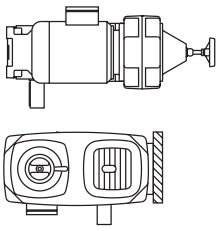
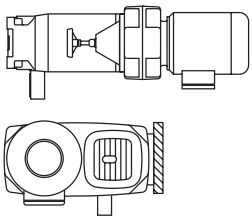
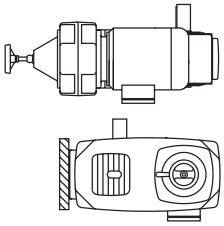
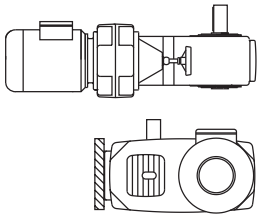
M1/2 Z



M1/1 Z

Variable Speed Helical Bevel Gear Units Mounting Positions

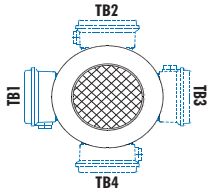
M1 U	M1 Z	M2 U	M2 Z	M3 U	M3 Z
					

M4 U	M4 Z	M5 U	M5 Z	M6 U	M6 Z
					

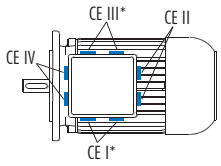
Variable Speed Helical-bevel Position of terminal box and cable entry

Please specify position of terminal box and cable entry.

Normal Design: Cable entry at 3 and terminal box at I or III only.
If other positions are required, please specify while ordering.



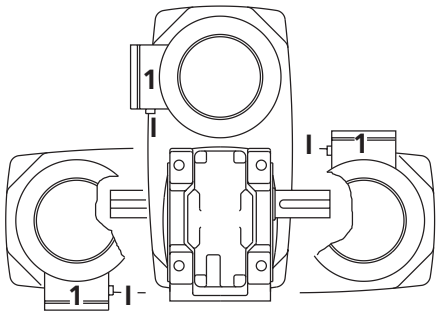
Terminal Box Positions (Position M1 shown)



Conduit Entry Positions (Position M1 shown)

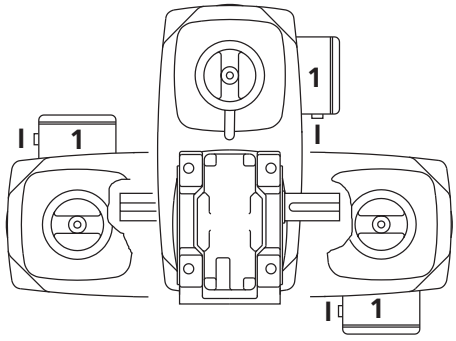
In all mounting positions the variable speed drive may be mounted at an angle interval of 90°.

M1 U



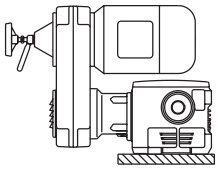
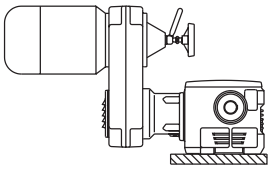
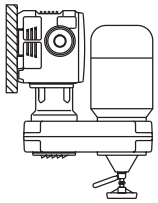
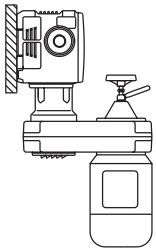
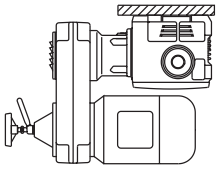
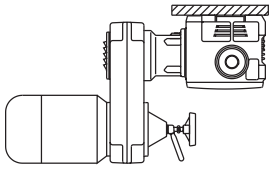
M1/2 U — M1/1 U

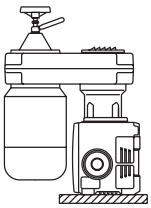
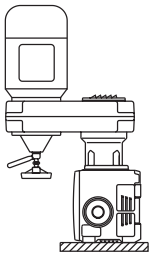
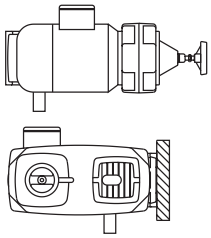
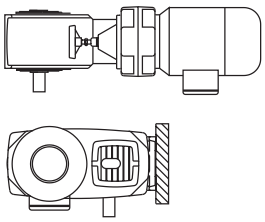
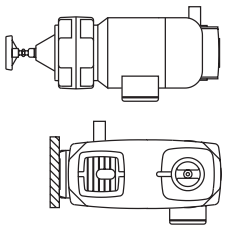
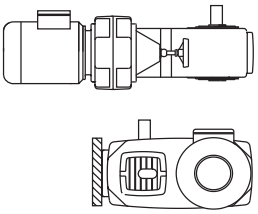
M1 Z



M1/2 Z — M1/1 Z

Variable Speed Helical Worm Gear Units Mounting Positions

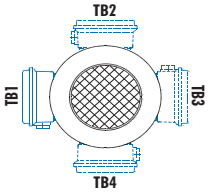
M1 U	M1 Z	M2 U	M2 Z	M3 U	M3 Z
					

M4 U	M4 Z	M5 U	M5 Z	M6 U	M6 Z
					

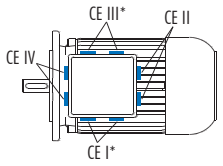
Variable Speed Helical-worm Position of terminal box and cable entry

Please specify position of terminal box and cable entry.

Normal Design: Cable entry at 3 and terminal box at I or III only.
If other positions are required, please specify while ordering.

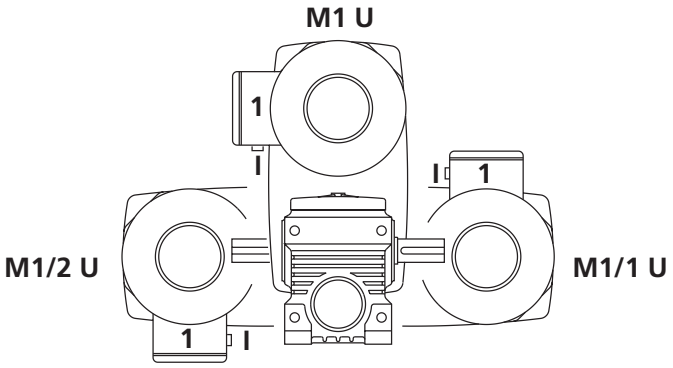


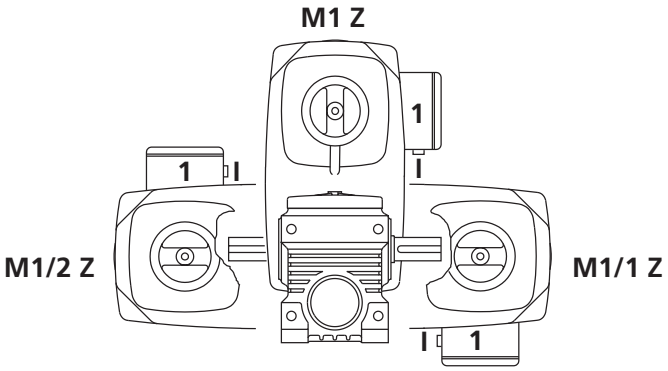
Terminal Box Positions (Position M1 shown)

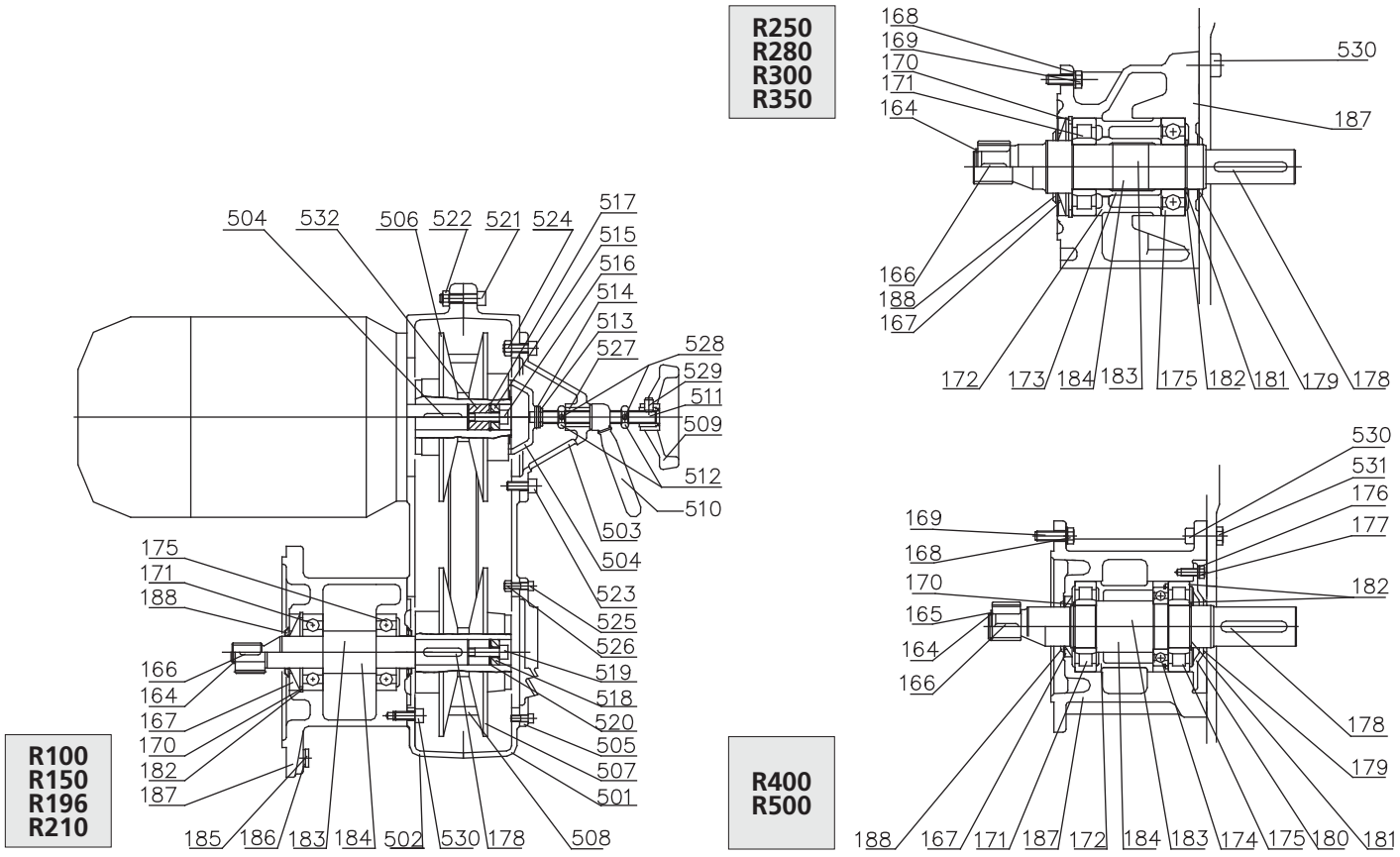


Conduit Entry Positions (Position M1 shown)

In all mounting positions the variable speed drive may be mounted at an angle interval of 90°.



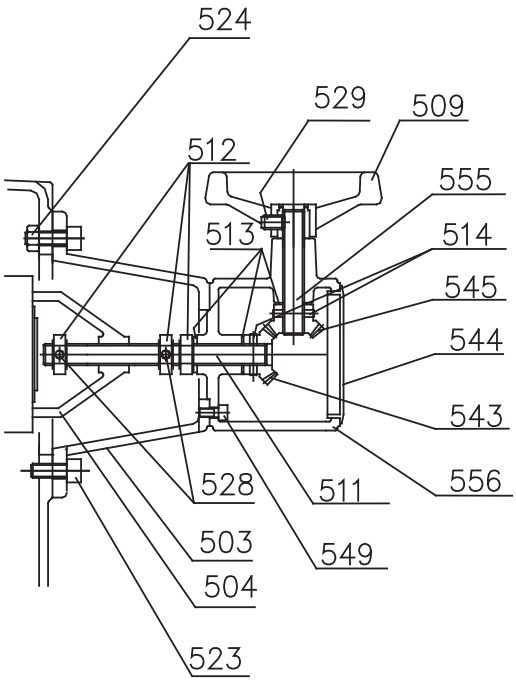




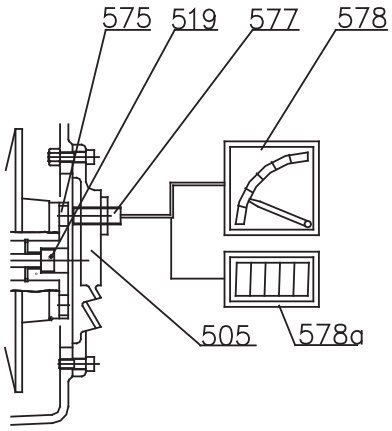
TITAN™ General Parts List

164	Circlip / Snap ring	184	Input shaft, cut gear	515	Thrust Washer
165	Shim	185	Locking screw	516	Socket head bolt
166	Key	186	Seal washer	517	Circlip / Snap ring
167	Shaft Seal	187	Reducer input housing	518	Thrust washer
168	Washer	188	Oil slinger	519	Socket head bolt
169	Hex head bolt	501	Beltcase cover	520	Circlip / Snap ring
170	Circlip / Snap ring	502	Beltcase connecting cover	521	Socket head bolt
171	Input shaft bearing	503	Hand wheel adjustment cover	522	Hex nut
172	Spacer	504	Adjustment cone	523	Socket head bolt
173	Spacer	505	Ventilation cover	524	Hex nut
174	Ball bearing	506	Adjustable pulley	525	Socket head bolt
175	Input shaft bearing	507	Spring loaded pulley	526	Hex nut
177	Hex head bolt	508	V-belt	527	Screw bushing
178	Key	509	Handwheel	528	Set screw
179	Oil slinger	510	Locking Handle	529	Set screw
180	Bearing cover	511	Adjustment Spindle	530	Socket head bolt
181	Circlip / Snap ring	512	Locknut (speed stop)	531	Hex nut
182	Shim	513	Washer	532	Spacer
183	Input shaft, plain	514	Spiral Pin / Spring Cotter		

Angular Handwheel Assembly for R100-R400



Non-Contacting Speed Indicator for R100-R500 *



Angular Handwheel Assembly & Non-contacting Speed Indicator

503	Adjustment Cover	519*	Socket head bolt	549	Socket head bolt
504	Adjusting Cone	523	Socket head bolt	555	Handwheel shaft
505*	Ventilation Cover	524	Hex nut	556	Bevel gear case
509	Handwheel	528	Set screw	575*	Pulse generator
511	Adjustment Spindle	529	Set screw	577*	Pulse Sensor
512	Locknut	543	Bevel Gear	578*	Speed Indicator (Type BLA)
513	Washer	544	Seal plug	578a*	Speed Indicator (Type BLD)
514	Spiral Pin / Spring Cotter	545	Bevel gear		

11. TITAN™ Belt replacement part numbers

Ttan™ Type	Belt P/N	Belt Size
R100	71092000	22 x 7 x 567 x 28°
R150	71592000	28 x 8 x 754 x 28°
R196	71992000	33 x 9 x 906 x 28°
R210	72192000	37 x 10 x 954 x 28°
R250	72592000	47 x 12 x 1135 x 28°
R280	72892100	55 x 15 x 1255 x 28°
R300	73092100	51 x 16 x 1444 x 28°
R350	73592100	70 x 18 x 1515 x 30°
R375	73792100	83 x 23 x 1767 x 32°
R400	74092100	83 x 23 x 1842 x 32°
R500	75092100	83 x 26 x 2877 x 32°

12. TROUBLESHOOTING

Problem with Variable Speed Unit	Possible Causes	Suggested Remedy
Drive Slips	V-Belt is worn	Replace V-Belt.
	V-Belt or face of adjustment pulley is dirty or contaminated.	Clean Contaminated part: • V-Belt – use dry cloth or paper. • Adjustment Pulley – okay to use mild solvent provide excess is cleaned with a dry cloth.
	Load is too high.	Check measured power and reduce operating load to catalog values.
Drive heats up excessively	Load is too high.	Check measured power and reduce operating load to catalog values.
Drive appears noisy or too loud.	V-Belt is damaged: • May be caused after a brief stalling of the drive. • May be caused by intermittent loading of the drive.	Determine cause of damage, and replace V-Belt.

Problem with Electromechanical Remote Control (EMFST)	Possible Causes	Suggested Remedy
Speed cannot be adjusted.	Unit is not wired properly.	Wire unit in accordance with circuit diagram.
Speed range cannot be reached.	Motor limit switches turn off too early.	Adjust limit switches.

NORDISC™ ADJUSTABLE SPEED DRIVES

1. Basic operation and speed adjustment

The NORDISC™ Friction Drive will supply infinite variable speed adjustments over a fixed speed range. The NORDISC™ Drive consists of a motor, dry traction drive, and main gear drive. The motor is typically furnished as an integral mount to the traction drive, however a NEMA C-face Input Adapter (Flex-C-Input Adapter) is also available.

Attached to the output shaft of a constant speed motor, is the driving disc portion of the traction drive. The driven disc is angled approximately 2°, localizing the friction contact on the disc pair. As the adjustment spindle is rotated, the input side of the housing moves either up or down, changing the effective pitch diameter of the driving disc. Speed is typically adjusted by the handwheel.

STOP *HARMFUL SITUATION* **STOP**

Speed adjustments must be performed when the motor is running to prevent possible damage to the traction drive parts.

STOP *HARMFUL SITUATION* **STOP**

Initial adjustments of the speed stops located internal to the traction drive are completed at the factory. Further adjustments of the speed stops can cause damage to the traction drive and/or main drive.

2. NORDISC™ Friction Drive

The variable speed drive requires only minimal maintenance. However, the friction ring is a wear item.

STOP *HARMFUL SITUATION* **STOP**

The traction drive should be periodically operated through its entire speed range, in order to prevent localized wear patterns on the driving disc and/or possible damage to the driving disc.

The friction drive does not require lubrication unless it is disassembled for an overhaul. Units should be checked periodically for:

- Increased noise level.
- Increased operating temperatures.
- Increased vibration.
- Increased motor amperage draw.
- Increased or excessive shaft movement.

Every 10,000 hours of operation, it is suggested that the bearings be cleaned and re-greased with a lithium-based NLGI #2 Grease.

The adjustment wheel and speed adjustment shaft should also be cleaned periodically and coated with molybdenum-based anti-seize compound.

3. Motor

⚠ *WARNING* ⚠

To prevent possible injury and/or damage to the electric motor, the variable speed drive, or the driven equipment, it is important to follow the motor manufacturer's instructions pertaining to safe handling, installation, and maintenance of the electric motor.

Connect the motor in accordance with the wiring information supplied by the motor manufacturer and make sure the motor nameplage voltage and frequency agree with the available power supply. Use the proper protective motor switches to help protect the motor windings from overload and/or phase failure.

⚠ *WARNING* ⚠

Explosion proof motors should not be used on the friction drive. The friction drive is not recommended for use in explosion proof atmospheres.

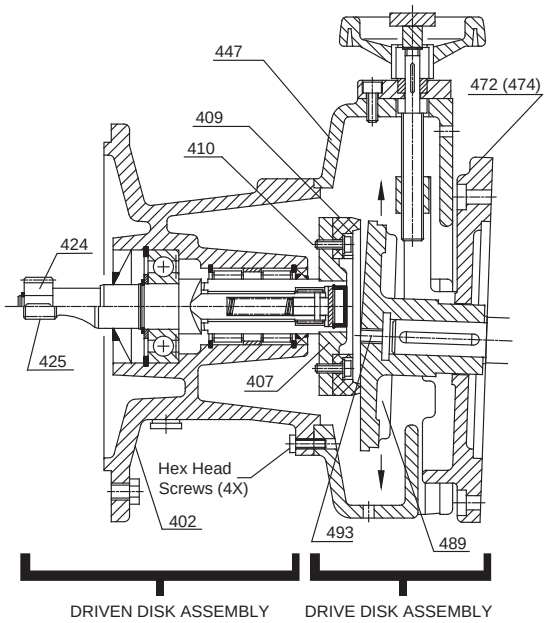
4. Seperating the driven disc assembly from the driving disc assembly

A. Lockout the electric power to the motor and make sure the wires are disconnected.

B. Support the intermediate housing (Item 447) and the attached motor assembly.

C. Remove the four hex head screws that connect the driving disc assembly (intermediate housing / Item 447) to the driven disc assembly (output housing / Item 402).

D. Slide the intermediate housing (Item 447) away from the output housing (Item 402).



5. Friction disc replacement

A. Separate the driven disc assembly from the driving disc assembly (See Separate Instructions).

B. Once the friction disc (Item 409), is exposed remove the socket head cap screws (Item 410) that hold the friction disc or friction ring (Item 409) to the friction disc carrier (Item 407).

C. Clean the contact surface between the friction disc and friction disc carrier.

D. Vacuum or brush out the NORDISC™ drive housing to remove accumulated friction material dust. Be careful not to ingest dust while cleaning.

E. Inspect main housing for damaged parts while disassembled.

F. Attach the new friction disc to the carrier using the socket head cap screws. Permissible tightening torques are per the table below:

Type	Screw Size	Material Grade	Tightening Torque
RV10	M5 X 12	8.8	6 N-m / 53 lb-in
RV20	M5 X 16	8.8	6 N-m / 53 lb-in
RV30	M6 x 16	8.8	10 N-m / 88 lb-in
RV40	M6 x 20	8.8	10 N-m / 88 lb-in

G. Re-assemble intermediate housing or "RV" housing (Item 447) to output bearing housing (Item 402). To re-assemble, apply Steps 1-4 in reverse order. Use a thread-locking compound to secure the hex head screws.

6. Bearing and seal replacement - NORDISC™ output

A. Separate the driven disc assembly from the driving disc assembly (See Separate Instructions).

B. Slide the intermediate housing (Item 447) away from the output housing (Item 402) and remove the shaft oil seal (Item 439).

C. Remove circlips/snap-rings (Item 437 and 438).

D. Remove shims and supporting disc (Items 434 & 436).

E. Slide the hollow shaft/friction disc carrier assembly (Item 404) away from output housing (Item 402).

F. Press output gear-shaft (Item 424 or 425) and bearing (Item 435) out of output housing. Shaft and bearing come out on the output or gear-shaft side.

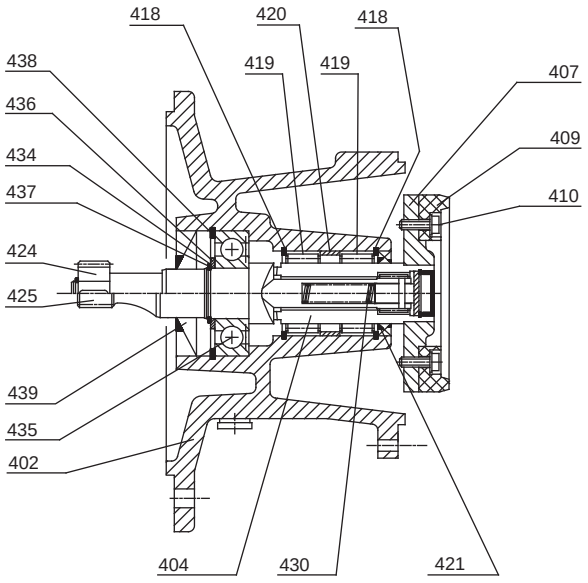
G. Remove oil seal (Item 421) from output housing.

H. Remove two circlips/snap-rings (Items 418) from output housing and remove needle bearings and spacer (Items 419 and 420).

I. Re-assemble in the reverse order, replacing ball bearing, needle bearings, and oil seals (Items 435, 419, 421 and 439). If required, also replace any shims, spacers, or circlips (Items 434, 436, 420, 437, 438, and 418). During assembly, repack bearings with a lithium-based NLGI #2 grease. Needle bearing cavity should be approximately 1/3 full after re-greasing.

⚠ *WARNING* ⚠

- The output shaft compression spring (Item 430) does not require maintenance. If the spring fractures the complete shaft should be replaced as a complete assembly or returned to NORD Gear for repair.
- Special fixtures are required to remove and install the spring. Personal injury can result if this repair is attempted in the field.



7. Driving disc dissassembly and reassembly

The driving disc (Item 489) is attached directly to either the motor shaft or the shaft of the C-Face Input (Flex-C-Input) Adapter. One must first remove the driving disc from the input-side of the NORDISC™ in order to:

- Replace the motor.
- Replace the bearings in the C-Face Adapter.

Driving Disc Removal

A. Separate the driven disc assembly from the driving disc assembly (See Separate Instructions).

B. Slide the intermediate housing (Item 447) away from the output housing (Item 402).

C. After removing the input side from the output side, position the driving disc (Item 489) in the middle of the housing by turning the speed adjusting hand wheel (Item 462).

D. Remove the setscrew in the middle of the driving disc (Item 493). Insert a hardened bolt in the hole that is in the center of the driving disc (Item 489), and tighten the bolt against the shaft to separate or remove the driving disc from the shaft (see table).

Type	Setscrew Size	Bolt Size
RV10	1/4-20	1/4-20 x 2-1/4 in
RV20	5/16-18	5/16-8 x 2-3/4 in
RV30	1/2-13	1/2-13 x 3 in
RV40	5/8-11	5/8-11 x 4 in

Driving Disc Re-Assembly

A. Installation of the driving disc (Item 489) may require heating the disc in an oven or on a hot plate, to allow the disc to be positioned all the way on to the motor shaft or C-Face Input shaft.

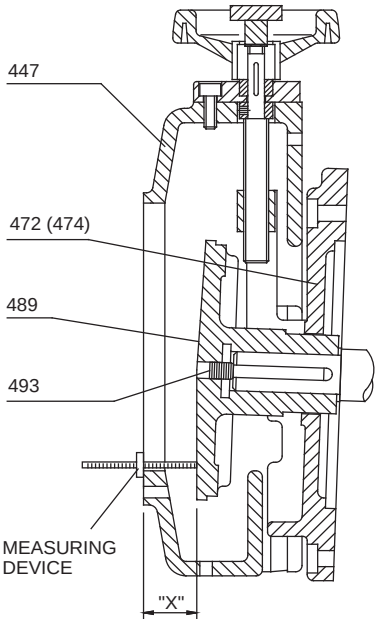
> ⚠ *WARNING* ⚠
>
> Exercise extreme caution when handling the hot driving disc. Protective gloves are recommended.

B. After heating the disc, position it all the way onto the shaft until it bottoms.

C. Using the table below, measure the "X" dimension from the bottom edge of the friction drive housing (Item 447) to the face of the driving disc (Item 489).

Type	Setscrew Size	"X" Dimension
RV10	1/4-20	0.837/0.867 in
RV20	5/16-18	0.975/1.005 in
RV30	1/2-13	1.133/1.163 in
RV40	5/8-11	1.311/1.341 in

D. Insert the setscrew (Item 493) into the hole in the center of the driving disc, and tighten the setscrew snug to the shaft of the motor or C-Face input assembly. Use a thread-locking compound to help secure the setscrew.

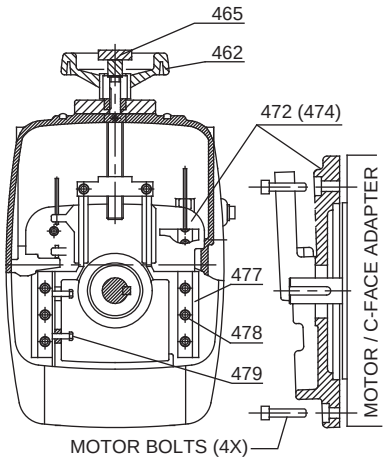


Removal and re-assembloy of motor or C-face input adapter (Flex-C-Input)

A. Separate the driven disc assembly from the driving disc assembly and remove the driving disc (See Separate Instructions).

B. After removing the driving disc (Item 489), the mounting bolts for the motor or C-Face adapter can be accessed. To gain access to all four bolts requires the removal of the two cam grooves (Item 477). The cam grooves can be removed by first removing the socket head screws (Item 478). Then, the motor or adapter bolts ((Item 453) can be removed.

C. Assembly is the reverse of disassembly.



IMPORTANT NOTE

The cam grooves or tapered gibs (Item 477) need to be adjusted during assembly.

Cam groove or tapered gib adjustment

The cam groove or tapered gib on the right side (Item 477) is not adjustable. The cam groove on the left-hand side is to be adjusted by the screws (Item 479) located next to the slide bar (Item 477). The cam grooves are properly adjusted when the slide plate (Item 472 or 474) is allowed to move freely through its complete range.

A. Remove the handwheel assembly nut (Item 465) and handwheel (Item 462) before making adjustment.

B. Clean sliding surfaces of the slide plate and cam grooves, and then re-apply a molybdenum-based anti-seize com pound to these surfaces.

C. Assemble the motor and/or c-face adapter to the slide-plate (Item 472/474) by re-installing the motor bolts. Apply a thread-locking agent to the screw threads during assembly.

D. Place the non-adjustable (right-side) cam groove onto the slide plate and tighten the socket head setscrews (Item 478). Apply a thread-locking agent to the screw threads during assembly

E. Place the intermediate housing (Item 447) onto the slide plate (Item 472 or 474) and then install the adjustable (Left-side) cam groove (Item 477).

F. Install the socket head screws (Item 478) and the adjustment setscrews (Item 479). Apply a thread-locking agent to the screw threads during assembly. Do not completely tighten either set of screws – follow Steps 7 & 8!

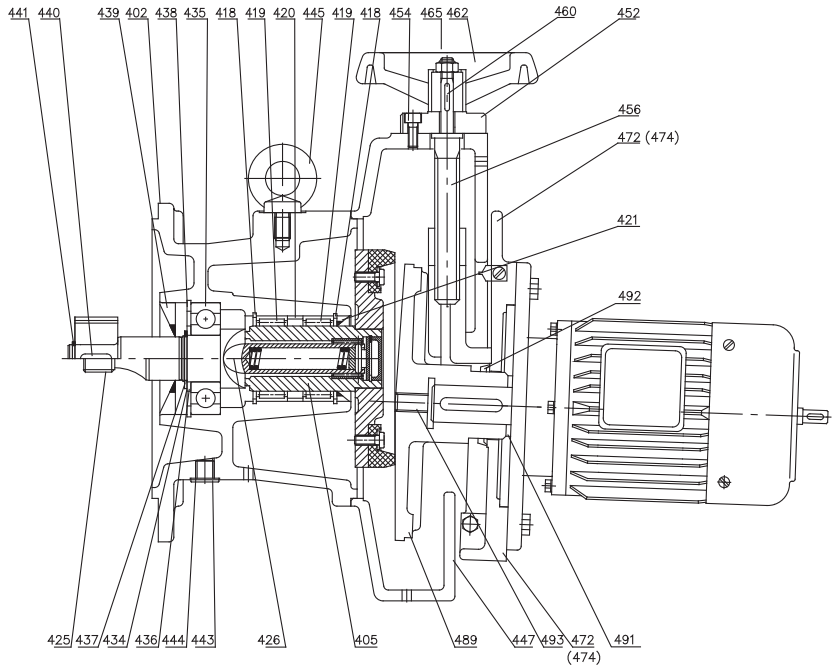
G. Adjust the cam groove set screws (Item 479) so that there is minimal side-play or side-movement and be certain that the friction drive housing (Item 447) can move freely.

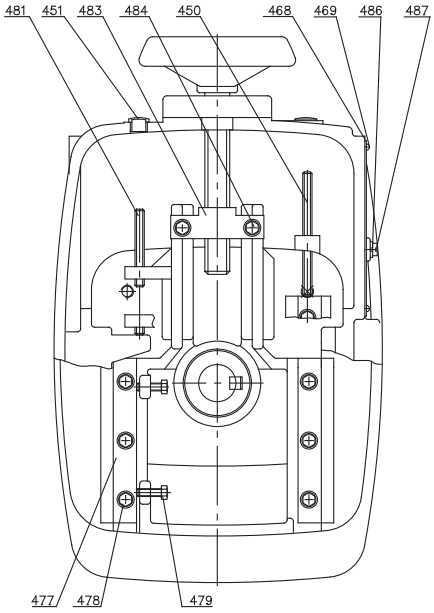
H. Then, tighten the socket head setscrews (Item 478).

I. After completing the adjustment of the cam grooves (Item 477) the handwheel (Item 462) and handwheel assembly nut (Item 465) can be re-installed.

J. Re-assemble the driving disc and re-connect the driving disc assembly and the driven disc assembly.

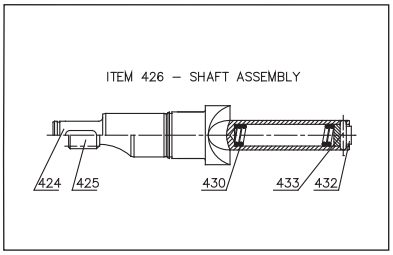
NORDISC™ ADJUSTABLE SPEED DRIVES

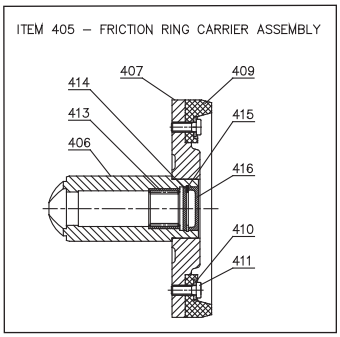




Item 426 (Shaft assembly) and Item 405 (Friction ring carrier assembly) are stocked as complete assemblies.

Item 409 (Friction disc) can be ordered separately per the Table on page 6.





NORDISC™ Parts List

402	Housing	456	Adjusting spindle	426	**Complete shaft assembly**
418	Snap Ring	460	Key	424	Shaft, plain cut *
419	Needle roller bearing	462	Hand wheel	425	Shaft, gear cut *
420	Spacer	464	Washer	430	Compression spring *
421	Seal	465	Hex nut	433	Dowel pin *
434	Shim	468	Scale	432	Spiral pin *
435	Ball Bearing	469	Rivet / self-tapping screw		
436	Supporting disc	472	Slide-plate (NEMA)	*	**Included with Item 426**
437	Snap ring	474	Slide-plate (IEC)		
438	Snap ring	477	Cam groove / taper gib	405	**Friction ring carrier assy**
439	Seal	478	Socket head screw	406	Hollow shaft **
440	Key	479	Screw	407	Friction ring carrier **
441	Snap ring	481	Set screw	409	Friction disc **
443	Oil plug	483	Spindle nut	410	Socket head screw **
444	Gasket	484	Socket head screw	411	Washer **
445	Flanged eye bolt	486	Indicator	413	Needle roller bearing **
447	Intermediate housing	487	Indicator screw	414	Washer **
450	Set screw	489	Driving disc	415	Snap ring **
451	Bore plug	491	Supporting disc	416	Bore plug **
452	Spindle cover	492	V-ring seal		
454	Socket head screw	493	Set screw	**	**Included with Item 405**
455	Snap ring				

NORD Gear Limited
Toll Free in Canada: 800.668.4378

NORD Gear Corporation
Toll Free in the United States: 888.314.6673

8. NORDISC™ FRICTION DISC REPLACEMENT PART NUMBERS

NORDISC™ Type	RV10	RV20	RV30	RV40
Item 409 - Friction Disc Part Number	79119000	79219000	79319000	79419000

9. TROUBLESHOOTING

Problem With Variable Speed Unit	Possible Causes	Suggested Remedy
Drive Slips.	Friction Disc is worn. Friction Disc or Drive Disc face is dirty or contaminated. Load is too high.	Replace Friction Disc (Page 3). Clean Contaminated part: • Friction Disc – use dry cloth or paper. • Drive Disc – okay to use mild solvent provided excess is removed or cleaned with a dry cloth. Check measured power and reduce operating load to catalog values.
Drive heats up excessively.	Load is too high.	Check measured power and reduce operating load to catalog values.
Drive appears noisy or too loud.	Friction Disc is damaged: • May be caused after a brief stalling of the drive. • May be caused by intermittent loading of the drive.	Determine cause of damage, and replace friction disc (Page 3).
Adjust rate is too low.	Sluggish adjustment rate may be due to corrosion between the slide plate and the cam grooves that are internal to the intermediate housing.	Re-establish low-friction conduction. • Separate driven disc assembly from driving disc assembly. • Clean and re-lubricate slide plate and cam grooves by applying a molybdenum-based anti-seize compound to these surfaces. • In extreme instances it may be necessary to remove the motor and cam grooves in order to thoroughly clean the cam grooves and slide plate. Reference instructions on Page 4, “Cam Groove or Tapered Gib Adjustment”.

1. Overview

This user manual applies to NORD Motor products and it provides general information for motor operation, installation, maintenance, inspection, repair, and trouble shooting, which is relevant to most of the motor products shipped by NORD. Information and instructions provided in this manual, safety and commissioning information and all other manuals applicable to any items supplied by NORD must be observed.

This instruction manual is not intended to include comprehensive details and information related to all possible design variations or accessories options available with NORD motors. If there is any uncertainty about specific procedures, instructions or motor details, then please refer these questions to NORD for additional information or clarification.

Before installing, operating, or performing maintenance on any electrical motor become familiar with the following:

- The detailed operating instructions and wiring diagrams.
- All applicable national, local and system-specific regulations, codes and practices.
- The national / regional regulations governing safety and accident prevention.
- The proper use of any tools, transportation or hoisting equipment, and safety equipment needed to complete the installation.
- To avoid serious injury or possible damage to the equipment or machine, compliance with all safety and information notes is mandatory!

⚠ *WARNING*

All work involved in the transport, connection, commissioning and maintenance of any NORD product must be carried out by qualified and responsible technicians. All applicable national, regional, and local work regulations and safety requirements must also be complied with. NORD assumes no liability for personal injury, accidental death, or equipment damage and malfunctions resulting from failure to comply with installation or operating instructions, safety notes, or any work regulations and laws!

⚠ *DANGER*

To avoid electrocution, injury or death, make certain the motor is properly grounded, completely de-energized and brought to a no-voltage condition prior to working on any electrical connections.

IMPORTANT NOTE

See B1091 user manual for Class I, Division 2 (ID2) and Class II, Division 2 (IID2) Motors.
https://www.nord.com/us/documentation/manuals/details/b1091.jsp

2. Motor Types

NORD AC electric induction motors described in this manual generally include the following types:

- Single speed or two-speed design.
- Three phase alternating current or single phase design.
- Enclosure types: TEFC, TENV, and TEBC.
- See B1091 manual for Class I, Division 2 (ID2) and Class II, Division 2 (IID2) Motors.

https://www.nord.com/us/documentation/manuals/details/b1091.jsp

3. Enclosure Types

Totally enclosed fan cooled (TEFC).

TEFC motor designs rely on fan that is mounted on the mo tor's rotor shaft so the cooling capacity can vary based upon the motor's operating speed.

Totally enclosed, non-ventilated (TENV)

The TENV motor designs rely purely on convection cooling and they have no fan. Often TENV designs are labeled for intermittent or periodic duty or at a lower power rating than is typical for the given motor frame size.

Totally enclosed, blower cooled (TEBC)

The TEBC design uses separate blower or ventilator fan, with its own low wattage motor and a separate power supply, to provide continuous airflow and cooling. The blower can be used to extend the speed range of the motor and allow extreme slow speed operation without causing a concern for overheating. Blower data is provided in Table 6, page 11.

4. Voltage and Frequency Variation

Voltage and frequency variations are based upon the assumption that the nameplate horsepower will not be exceeded and that the motor temperature may increase. Standard allow able deviations are based upon the type of motor labeling.

NEMA and CSA Labeled Motors

Variations are based upon the nominal utilization voltage, and not the service (supply) voltage as per ANSI C84.1.

Service Voltages	Utilization Voltages
120V, 208V, 240V, 480V, 600V	115V, 200V, 230V, 460V, 575V

- Voltage variation at rated frequency = ±10%.
- Frequency variations at rated voltage = ±5%.
- Combined voltage/frequency variation = ±5%.

CE Labeled Motors

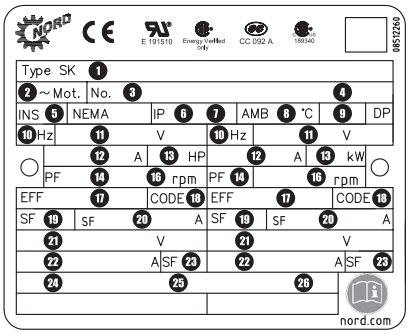
Per IEC 60038, allowable service voltage variations on in the current system, compared to the previous system, are as in dicated.

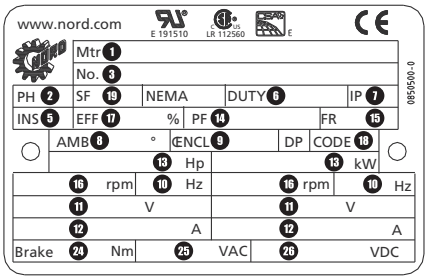
Previous Service Voltages	Current Service Voltages
220V, 380V, 660V	230V, 400V, 690V +6/-10%
240V, 415V	230V, 400V +10/-6%

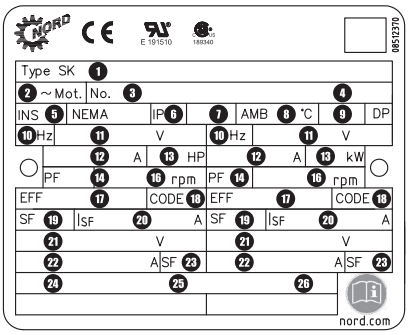
- Per EN 60034-1 a ±5% voltage variation and a ±2% frequency variation can be tolerated.
- The allowed variations are based upon the voltage (or voltage range) indicated on the motor nameplate.

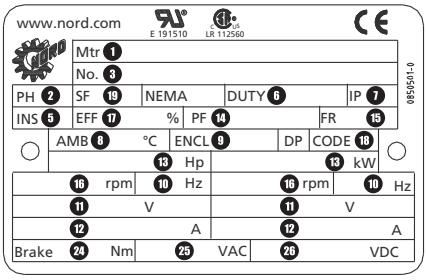
5. Motor Nameplate Information

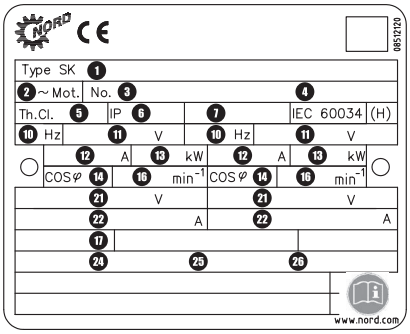
The motor nameplate and the display of technical information may vary slightly depending upon the global standard/s that the motor conforms to and the efficiency level. Please reference the examples below.











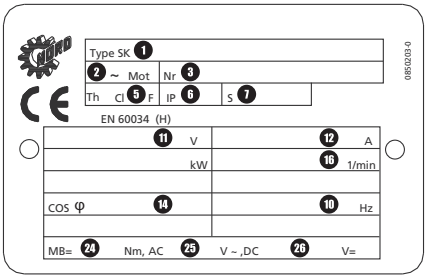


Table 1. Nameplate Data

Field	Definition
1	Model / Type
2	Number of Phases
3	Order Number
4	Serial Number
5	Insulation Class
6	IP (Ingress Protection) Enclosure Rating
7	Duty Cycle
8	Ambient Temperature Rating (°C)
9	Enclosure Type
10	Motor Frequency (Hz)
11	Voltage Rating (V)
12	Current Rating (A)
13	Rated Power (HP or kW)

Field	Definition
14	Power Factor
15	Motor Frame Size
16	Full Load Speed (rpm or 1/min^2)
17	Efficiency
18	NEMA Code Letter
19	Service Factor
20	Current Rating (If Service Factor ≥ 1.15)
21	Operating Voltage Rage (A)
22	Current Rating at Operating Voltage Range (A)
23	Service Factor at Operating Voltage Range (A)
24	Brake Rating (Nm)
25	Brake Supply Voltage (VAC)
26	Brake Coil Voltage (VDC)

6. Motor Options And Nomenclature

NORD offers many options for its motors. The option code will be shown in the motor nomenclature. Below are commonly used options.

Code	Description
AICM	Additional Internal Insulation Coating Applied
BRE	With Brake
EAR	Single Phase, Start Cap/Run Cap
ECR	Single Phase, Start Cap/Run Cap Increased SF
EHB	Single Phase, Run Capacitor Only
EP	Epoxy Dipped Windings
F	Blower Cooling Fan - 3ph & 1ph
FC	Blower Cooling Fan - 1ph
FHL	Brake – Lockable Manual Release
H	Energy Efficient
HL	Brake – Manual Hand Release
IG	Incremental Encoder
IP66	IP66 Environmental Protection
IR	Brake – Current Sensing Relay
KB	Condensation Holes - Removable Plugs
KD	Condensation Holes - Open
MIK	Brake – Microswitch
MS	Power Plug Connector

Code	Description
OL	TENV Motor – Without Fan / With Cover
OL/H	TENV Motor - Without Fan & Cover
P	Premium Efficient Motors
RD	Canopy Cover
RDD	Double Canopy Cover
RG	Brake – Corrosion Protected
RLS	Backstop
SH	Motor Space Heater
SR	Brake – Dust Protected
TF	Thermistor
TW	Thermostat
VN	10:1 Constant Torque Rated Motor
VR	5:1 Constant Torque Rated Motor
VW	20:1 Constant Torque Rated Motor
VZ-F	1000+:1 Constant Torque Rated Motor
WE	2nd Motor Shaft End
WU	High Slip Rotor
Z	High Inertia Motor Fan

Motor Nomenclature

100LP / 4 BRE 40 ...

- **...** — Other Options
- **40** — Brake Size Nm
- **BRE** — Brake
- **4** — Number of Poles
- **100LP** — Frame Size

Ordering Examples

100LP / 4 BRE 100 HL RG

- **RG** — Corrosion Protection
- **HL** — Hand Release Lever
- **100** — 100 Nm Brake Torque
- **BRE** — Brake
- **4** — 4 Poles
- **100LP** — Motor Frame Size

100 Frame Motor with 4 poles, Brake, 100 Nm with a hand release lever, corrosion protected brake, and a current sensing relay.

63L / 4 BRE 40 FHL SR

- **SR** — Dust & Corrosion Prot.
- **FHL** — Locking Hand Release Lever
- **40** — 40 Nm Brake Torque
- **BRE** — Brake
- **4** — 4 Poles
- **63L** — Motor Frame Size

63 Frame motor with 4 poles, a 40 Nm Brake with a locking hand release lever and dust & corrosion protection.

7. Application Conditions

Standard NORD motors are designed to operate in dusty or moist environments and have anti-fungal, thermal class F insulation.

- Enclosure Protection Rating = IP55 (minimum).
- Maximum Installation Height = 3300 ft (1000 m).
- Ambient Temperature = -4 to 104°F (-20 to 40 °C).
- Tropical-proof, Thermal Class F insulation.

The protection level and maximum ambient temperature are stated on the motor nameplate.

IMPORTANT NOTE

NORD can provide motors for an expanded range of applications and service conditions including higher protection levels, extreme ambient conditions and, higher altitudes.

IMPORTANT NOTE

Consult NORD for recommendations if motors are operated under extreme loading conditions, exposed to high inertia loads, or need to operate under unusually high cycling conditions with high starting and stopping frequency.

DANGER

Special design and assembly considerations are needed if NORD motors are subject to any of the following conditions. Environmental conditions may lead to premature damage and/or failure without the proper protective features. Consult NORD for design considerations:

- Outdoor installation with motor in a vertical position.
- Direct contact with aggressive or corrosive materials (acids, bases, salts, certain gases, etc.).
- Exposure to extreme high or low temperatures, high relative humidity, condensation moisture or very wet environments.
- Subject to extreme material build-up on the unit (dirt, dust, sand, etc.).
- Hazardous Locations (risk of fire or explosion).

8. Transportation

During transportation observe the following:

- Make sure that all eyebolts and lifting lugs are tight and firmly against their supporting surface.
- Use all the lifting eyes that are intentionally supplied with the motor.
- Lift only at designed points.
- Protect the mounting surface from possible damage during transportation.
- Always use sufficiently rated handling equipment, lift mechanisms and lifting straps.
- With heavier objects or unbalanced loads, it may be appropriate to use more than one lifting point or an additional strap or sling to assure safe transportation of the assembly. This is especially true of assembled gearmotors and motorized reducers.
- Once the NORD motor or assembly is properly installed, remove the transportation fixtures completely or make certain they are properly re-secured and tightened.

WARNING

Transportation – Use of Lifting Devices

To avoid death, serious injury or equipment damage…

- Hoisting lugs or lifting eyes attached to the motor are designed for the weight of the motor only! Do not attach any additional loads!
- The motor must only be transported and lifted using the lifting eyes, in a position that is appropriate for its type of construction. Otherwise, it could fall over or slip in the lifting tackle.
- During suspended transport, two straps must be able to carry the entire load weight safely.
- When required use additional, suitable means of support for transportation, installation or removal.
- Always secure the support equipment to prevent it from slipping.

9. Storage

If the motor is not in service, store it according to the following conditions:

- Store the motor in a clean, dry, dirt-free, vibration free area.
- Storage temperatures of 10°C (50°F) to 50°C (120°F) must be maintained.
- Relative humidity must not exceed 60%.
- If vibration in the area exceeds 0.002 inch (0.05 mm) at 60 hertz, then vibration isolation pads are suggested to prevent brinelling of the bearings.
- Treat the unprotected shaft end and mating flange surfaces with a corrosion inhibitor that can be cleaned off prior to commissioning.
- Before placing the motor into service, visually inspect the motor exterior for evidence of deterioration during storage. Turn the motor shaft by hand to make sure the shaft turns freely.
- Motor space heaters, when provided, are to be connected and energized whenever there is a possibility that the storage ambient conditions will reach the dew point. Space heaters are optional. Remove motor from the storage container when the heater is energized.
- If the motor needs to be stored for extended periods, or if it is stored in less than favorable conditions, it is recommend that the winding insulation resistance be checked prior to commissioning (page 7).
- Even if stored in favorable conditions, the antifriction motor bearings and motor shaft seals may need to be replaced if the storage period is more than 4 years.

10. Safety Considerations

When installing, servicing or replacing electric motors it is important to be working in a “voltage-free” state. Observe the following safety rules.

Safety Rules

1. Disconnect the system. Disconnect the auxiliary circuits (brakes, space heaters, etc.).
2. Prevent reconnection (follow safe lock-out/tag-out practices).
3. Make sure that the equipment is at zero voltage.
4. Make certain the equipment is properly grounded and short-circuited.
5. Cover or isolate nearby components that are still electrically live.

To energize the system, apply the measures in reverse order.

Qualified Personnel

All work involved in the transport, connection, commissioning and maintenance of any NORD product must be carried out by qualified and responsible technicians.

For the purpose of this documentation, a qualified personnel is taken to mean a person or people who fulfill the following requirements:

- Through appropriate training and experience, they are able to recognize and avoid risks and potential dangers in their particular field of activity.
- They have been instructed to carry out work on the machine by the appropriate person responsible.
- They are responsible for knowing and complying with all applicable national, regional, and local work regulations and safety requirements.

10. Safety Considerations Ctd.

General Warnings and Cautions

⚠ DANGER

To avoid electrocution, injury or death, make certain all electrical devices (motors, brakes, variable frequency drives, etc.) are properly grounded, completely de-energized, and brought to a no-voltage condition prior to working on any electrical connections. Remember that most of these devices carry potentially dangerous energy levels for a period of time after power is removed. Always follow proper lock-out/tag-out procedures.

⚠ DANGER

Electrical machines contain dangerous voltage levels, electrically live parts, rotating surfaces and hot surfaces. To prevent injury, death or possible equipment damage always observe the following:

- Keep all safety covers and guards in place during operation. Remove and replace covers in compliance with the applicable safety regulations.
- Allow the machine to cool down before starting any work on it.
- Operate the machines properly.
- Perform regular maintenance on the machine.
- Secure and guard free-standing shaft extensions.

⚠ DANGER

Electrically Live Parts

Electrical machines contain electrically live parts. Fatal or severe injuries and substantial material damage can occur if the required covers are removed or if the machines are not handled, operated, or maintained properly.

⚠ WARNING

Rotating Parts

Electrical machines contain dangerous rotating parts. Fatal or severe injuries and substantial material damage can occur if the required covers are removed or if the machines are not handled, operated, or maintained properly.

⚠ WARNING

Hot Surfaces

Electrical machines have hot surfaces. Fatal or severe injuries and substantial material damage can occur if the required covers are removed or if the machines are not handled, operated, or maintained properly. Allow the machine to cool down before starting any work on it.

⚠ WARNING

Maintain Proper Cooling

Operating the motor without the intended cooling fan may cause overheating and result in very hot surfaces, personal injury and material damage. Never commission a motor intended to be fan cooled when it is missing the shaft-driven fan or external blower assembly.

⚠ DANGER

Condensation Drain Holes (Optional)

Inserting objects into the condensation drain holes can damage the winding and can result in death, serious injury and damage to property!

- Before opening sealed drain holes, make sure the motor is in a no-voltage condition. Close the condensation drain holes before re-commissioning.
- Exercise caution around drain holes that are intended to be left open, especially when the motor is energized.

IMPORTANT NOTE

Before start-up check the following:

- All electrical connections are secure, well grounded and properly made.
- The motor is rotating in the correct direction (when de-coupled from the driven load).
- There are no temperature-sensitive parts (cables etc.), in contact with motor enclosure.
- Condensation drain holes are always located at the lowest point of the motor.

11. Checking the Insulation

Before putting the motor into operation for the first time, after a lengthy period of storage or standstill (approx. 6 months), the insulation resistance of the winding should be checked.

⚠ WARNING

During or directly after measurement the motor connection terminals carry hazardous voltages. Fatal or severe injuries and substantial material damage can occur if the required covers are removed or if the machines are not handled, operated, or maintained properly.

A. Control

The insulation resistance of new, cleaned, or repaired motor windings against the grounded housing and against one another should be > 200 Mega-Ohms.

B. Measurement

Using a Mega-Ohm meter apply a DC voltage of 500 VDC to the motor winding for a period of 60 seconds and record the winding insulation resistance compared to ground.

- The 500 VDC test voltage is applicable to low voltage motors up to 1000 VAC.
- When performing this test the temperature of the windings should be 25°C ± 15°C (77°F ± 27°F).

C. Verification

- If the insulation resistance of the winding is less than 50 Mega-Ohms, the cause may be moisture. The windings should be dried and the test should be repeated.
- After any lengthy period of operation the insulation resistance may drop. So long as the measured value does not fall below the critical value of 50 Mega-Ohm, the motor may continue to be operated.
- If the measured value falls below the critical 50 Mega-Ohm level, the cause must be established and the windings or winding sections must be cleaned, dried, repaired, or replaced as needed.

12. Bearing Lubrication

NORD motor frame sizes 63 up to and including 225 are normally supplied with internally grease lubricated bearings and require no lubrication during normal operation.

NORD motor frame sizes 250 and larger are supplied with grease fittings for re-greasing the motor bearings.

IMPORTANT NOTE

Motors with grease fittings are normally supplied with a label indicating the grease type used, the suggested re-lubrication interval, and the amount of new grease to be applied. General bearing maintence guidelines are listed in Table 3.

Typical motor bearing grease is an NLGI No. 2 consistency, high grade product with a polyurea base thickener, synthetic or blended mineral/synthetic oil, and stabilizing agents to protect against heat and oxidation.

Table 3 – Motor Bearing Maintence Guidelines

Frame Size	Power	Poles	Re-greasing Interval
63-225	0.16-60 HP (0.12-45 kW)	All	Maintence Free
250 to 280	75-125 HP (55-75 kW)	2	4000 h
		4 to 8	8000 h
315	150-250 HP (132-200 kW)	2	3000 h
		4 to 8	6000 h

NOTICE

When re-greasing motor bearings do not to mix different greases without verifying the compatibility with a reputable grease lubrication supplier. Mixing incompatible products can lead to bearing failure.

13. Mechanical Installation

Integral motors, NEMA C-face motors, and IEC flange mounted motors must be rigidly secured to their mating connection surface using all fastening screws tightened to the proper bolt torque. It is good practice to apply a medium strength thread- locking agent (Loctite® 242) to the mounting screws.

Foot mounted motors must be securely installed to a rigid and level foundation or mounting surface to minimize vibration and maintain alignment between the motor and shaft load. All mounting hole locations must be utilized. Tighten all hold down screws or bolts to the proper bolt torque.

NOTICE

Failure to provide a proper mounting surface may cause vibration, misalignment and bearing damage.

Accurate alignment and proper balancing of output devices (couplings, belts, pulleys, etc.) is required to assure quite, low vibration, trouble free operation. When the motor is directly coupled to a gear drive or a driven machine make sure that the motor shaft and driven machine shaft are aligned with one another axially.

NOTICE

Inaccurate alignment may lead to bearing damage, excessive vibrations and shaft breakage.

IMPORTANT NOTE

For motor replacement guidelines see section 20 on page 15 and section 21 on page 16.

14. Electrical Connections

⚠ DANGER

To avoid electrocution, injury or death, make certain all electrical devices (motors, brakes, variable frequency drives, etc.) are properly grounded, completely de-energized, and brought to a no-voltage condition prior to working on any electrical connections. Remember that most of these devices potentially dangerous energy levels for a period of time after power is removed. Always follow proper lock-out/tag-out procedures.

IMPORTANT NOTE

External motor brakes have their own connection requirements as indicated in the appropriate brake instruction manuals.

⚠ WARNING

If the motor has an integral brake, make certain there is no load connected to the driven equipment before releasing the brake. Otherwise serious injury, death, or damage to the equipment may result.

- The supply voltage and frequency must agree with the motor nameplate data.
- Always feed the connecting leads into the terminal box using appropriate mating cable glands. The mating connection cables and cable glands should be suitable for temperatures ≥ 194°F (90°C).
- Provide the ends of the connecting leads and ground lead with cable lugs or curved ring eyelets before connecting them to the terminal board.
- Make certain that the wiring connections and arrangement of the terminal board jumpers conform to the appropriate wiring diagram as provided in the motor terminal box and/or page 9 of this manual.
- Tighten the terminal board screw connections on the on the main terminal board per the table below.

Table 4 – Tightening Torque: Terminal Board and Grounding Screws

Thread Size	Nut Size [mm]	Tightening Torque [lb-ft]	Tightening Torque [Nm]
M4	7	0.6-0.9	0.8-1.2
M5	8	1.3-1.8	1.8-2.5
M6	10	2.0-3.0	2.7-4
M8	13	4.0-5.9	5.5-8
M10	17	6.6-9.6	9-13
M12	19	11.8-14.8	16-20

- Upon final assembly, the terminal box cover must be sealed so that it is dust-tight and water-tight.

Table 5 – Tightening Torque: Terminal Box Cover Screws

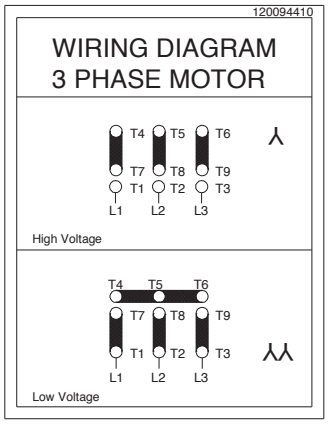
Thread Size	Tightening Torque [lb-ft]	Tightening Torque [Nm]
M4	0.6-0.9	0.8-1.2
M5	0.9-1.3	1.2-1.8
M6	1.1-1.8	1.5-2.5
M8	2.2-3.7	3.0-5.0

15. Direction of Rotation

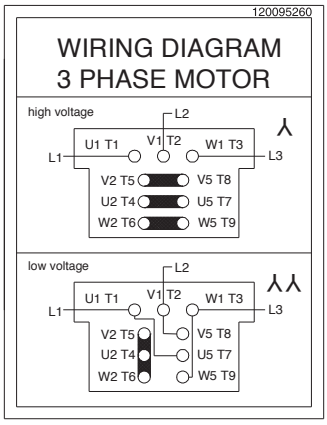
The motor shaft rotation is defined per IEC 600034, Part 8. The motor shaft rotation can be controlled by the way the incoming line power is connected. When connecting the incoming line power in phase order to the terminal block posts, T1 (U1), T2 (V1), and T3 (W1) respectively, the motor shaft rotation will be clockwise when viewing the motor shaft at the drive-end.

15. Wiring Diagrams - Motor & Motor Option Connection Diagrams

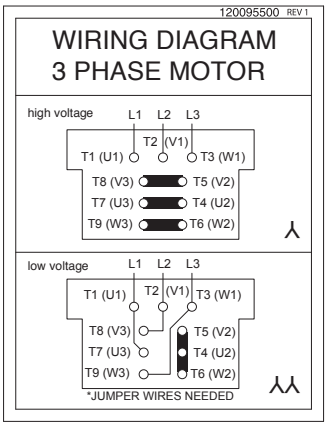
NORD Frames 63-225
230 / 460V, 60Hz, 3Ø | 200 / 400V, 50Hz, 3Ø



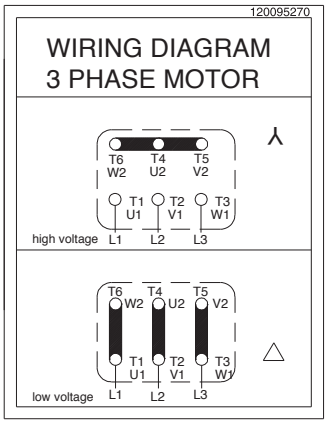
NORD Mfg by Siemens - Frames 200+
230 / 460V, 60Hz, 3Ø | 200 / 400V, 50Hz, 3Ø
190 / 380V, 60Hz, 3Ø



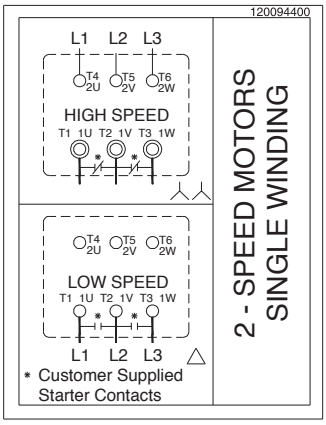
NORD Mfg by Siemens - Frames 200+
230 / 460V, 60Hz, 3Ø | 200 / 400V, 50Hz, 3Ø
190 / 380V, 60Hz, 3Ø



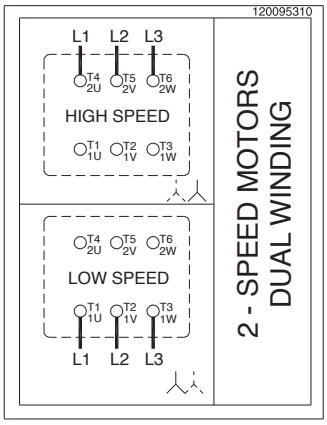
NORD Frames 63-225
460 / 800V, 60Hz, 3Ø | 230 / 400V, 50Hz, 3Ø
208 / 360V, 60Hz, 3Ø | 400 / 690V, 50Hz, 3Ø
332 / 575V, 60Hz, 3Ø

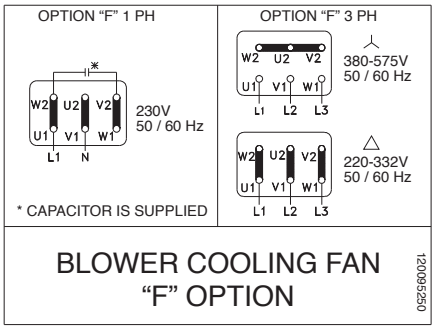


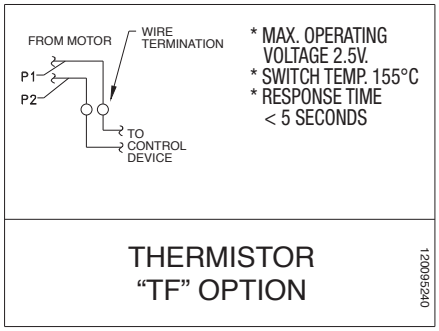
NORD 2 - SPEED MOTORS
SINGLE WINDING (4-2 & 8-4 POLE)

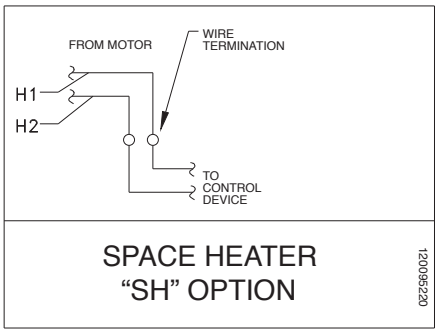


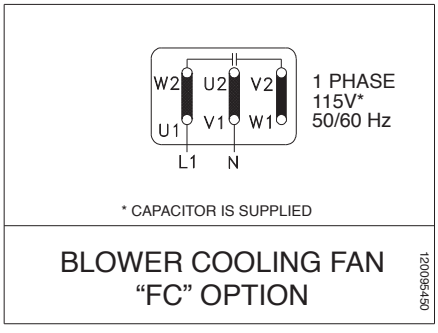
NORD 2 - SPEED MOTORS
DUAL WINDING (8-2 POLE)

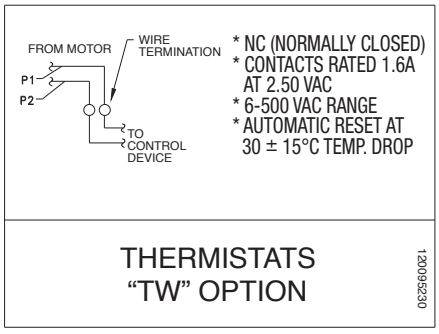








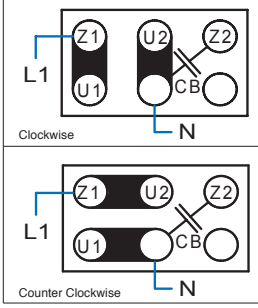




15. Wiring Diagrams Ctd. - Single Phase Motor Connection Diagrams

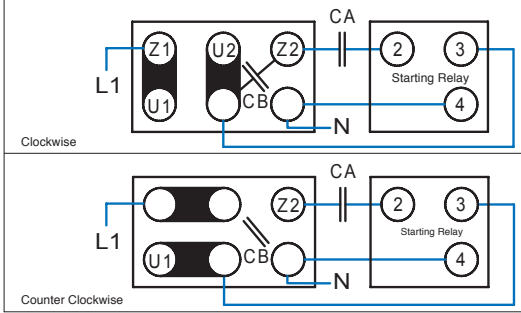
Motor Frame Sizes 63-90
230V, 50Hz, 1Ø

SINGLE PHASE MOTOR EHB1



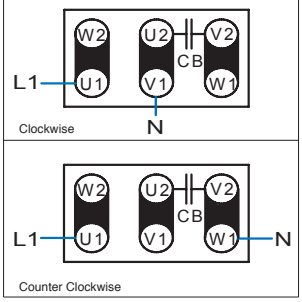
Motor Frame Sizes 63-90
230V, 50Hz, 1Ø

SINGLE PHASE MOTOR EAR1



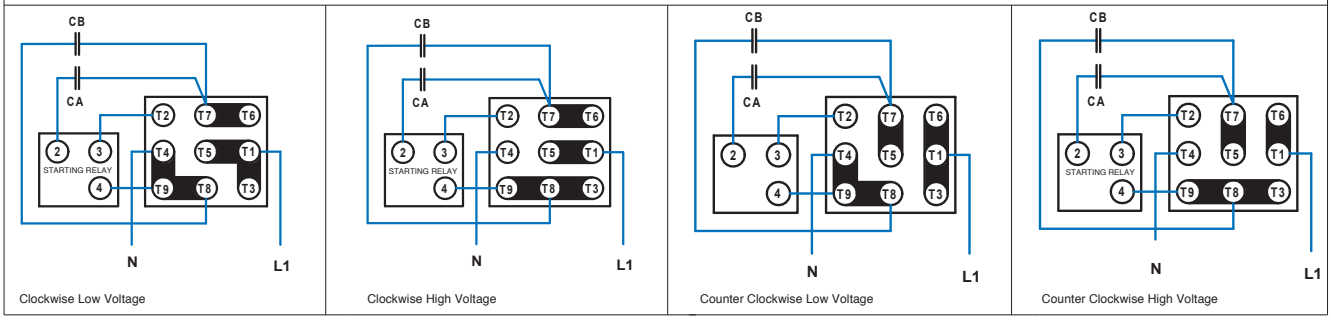
Motor Frame Sizes 63-90
230V, 50Hz, 1Ø

SINGLE PHASE MOTOR - EST



Motor Frame Sizes 63-90
115 / 230, 60Hz, 1Ø

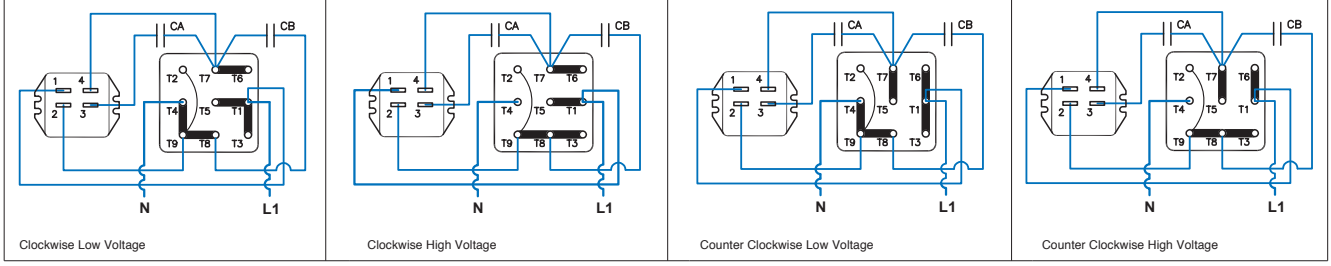
SINGLE PHASE MOTOR WITH STANDARD RELAY
ECR - NEMA 115/230V



Motor Frame Sizes 63-90
115 / 230, 60Hz, 1Ø

08506980

SINGLE PHASE MOTOR WITH SINPAC RELAY
ECR - NEMA 115/230V



16. Motor Accessories

Blower Cooling Fan (Option F & FC)

- Connection Diagram Shown on page 10
- Option FC is 1-phase, 115V
- Option F has capability of 1 phase by connecting a supplied capacitor

Table 6 – Option F & FC

Option F – 3ph & 1ph 220-575V 50/60Hz

Motor Frame	60Hz Ratings			50Hz Ratings		
	Voltage [V]	Current [A]	Power [W]	Voltage [V]	Current [A]	Power [W]
Single phase connection - ⊥ (Δ Delta)						
63	230 – 277	0.11	38	230 – 277	0.10	27
71	230 – 277	0.12	41	230 – 277	0.10	28
80	230 – 277	0.13	44	230 – 277	0.11	29
90	230 – 277	0.25	88	230 – 277	0.26	72
100	230 – 277	0.28	88	230 – 277	0.26	70
112	230 – 277	0.31	107	230 – 277	0.26	73
132	230 – 277	0.27	89	230 – 277	0.29	82
160 - 225	230 – 277	0.41	140	230 – 277	0.45	128
Three phase low-voltage connection - (Δ Delta)						
63	220 – 332	0.08	23	220 – 290	0.10	27
71	220 – 332	0.08	24	220 – 290	0.10	30
80	220 – 332	0.08	25	220 – 290	0.01	29
90	220 – 332	0.21	64	220 – 290	0.28	86
100	220 – 332	0.21	66	220 – 290	0.27	86
112	220 – 332	0.23	70	220 – 290	0.27	85
132	220 – 332	0.25	74	220 – 290	0.32	96
160 - 225	220 – 322	0.49	165	220 – 290	0.52	155
Three phase high-voltage connection - (Y)						
63	380 – 575	0.04	23	380 – 500	0.05	29
71	380 – 575	0.04	25	380 – 500	0.05	30
80	380 – 575	0.04	26	380 – 500	0.05	29
90	380 – 575	0.12	62	380 – 500	0.16	82
100	380 – 575	0.12	66	380 – 500	0.16	83
112	380 – 575	0.13	70	380 – 500	0.16	82
132	380 – 575	0.14	75	380 – 500	0.18	96
160 - 225	380 – 575	0.28	165	380 – 500	0.29	155

Option FC – 115V 50/60Hz 1ph

Motor Frame	60Hz Ratings			50Hz Ratings		
	Voltage [V]	Current [A]	Power [W]	Voltage [V]	Current [A]	Power [W]
Single Phase Connection - ⊥ (Δ Delta)						
63	100 – 135	0.23	42	100 – 135	0.30	42
71	100 – 135	0.23	47	100 – 135	0.30	44
80	100 – 135	0.27	57	100 – 135	0.30	43
90	100 – 135	0.46	102	100 – 135	0.57	78
100	100 – 135	0.53	105	100 – 135	0.54	78
112	100 – 135	0.60	115	100 – 135	0.55	80

16. Motor Acc. Ctd. - Motors with Thermal Protection

Effective July 15th, 2016 many newly manufactured NORD motors that require a thermal protection device will use WAGO® Series 221 Series Compact Splicing Connectors. These connectors will be used for splicing the leads of the thermal protection option supplied by NORD to the customer supplied control device.

- The WAGO® connector will facilitate assembly of NORD 63-132 frame, 60Hz, CUS approved motors
- An oversized brake terminal box and secondary 2-post wire termination strip will no longer be required.
- NORD will supply (2) Wago® Series 221, 2 conductor splicing connectors for each motor requiring thermal protection (NORD P/N 18251607)

Table 7 – Motors Receiving the WAGO® Connector

Motor Supplier	NORD
Frame Size	63 to 132
Type	CUS
Thermal Protection Option	TW, TF, PT100, KTY
Motor Connection	Wye-Wye/Wye (YY/Y)
Voltage – Hz	230/460V – 60 Hz
Brake Motors Affected	No
EKK Small Terminal Box	Not possible (space limited

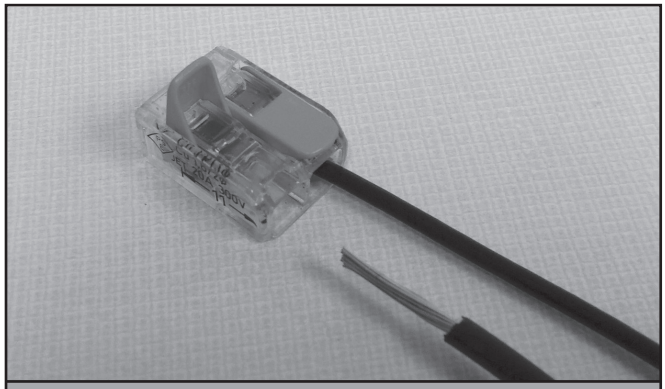
Table 8 – WAGO® Series 221 Connector Ratings

Wire Size	12-24 AWG (solid stranded or fine stranded) 0.14 - 4mm² (fine stranded) 0.2 - 2mm² (solid stranded)
Rated Voltage	600V
Rated Current	20A
Operating Temp.	105°C (221°F)
Global Approvals	cULus, ENC 05, EAC, PSE

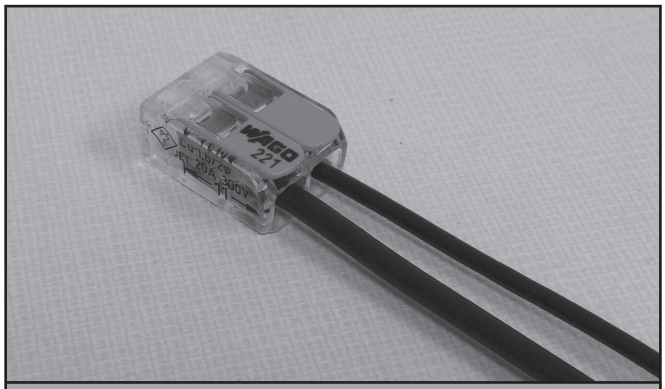
UL Certificate E69654

Operation of WAGO® Series 221 Connector

1. Strip the wire/s to be connected to 11 mm (0.43 in).
2. Open up the lever of the lever-nut, place the wire in the receptical and close the clamp.
3. Repeat for the additional wires being joined.



WAGO® receptical in the open position



WAGO® receptical in the closed position

The WAGO Connector remains optional for the following NORD motors:

Brake Motors - An oversized conduit box is utilized with a secondary 2-post wire termination block for the thermal protection option

Delta/Wye (Δ/Y) Connected Motors - These utilize an 8 post terminal box (6 primary posts for the supply power and 2 auxillary posts for thermal protection)

Motors 160 Frame and Larger - The terminal box is large enough to allow the use of a secondary 2-post wire termination block for your thermal protection device.

Thermostats (TW & 2TW)

Table 9. TW & 2TW options, Thermostats

Standard connection	Series connected, one per phase
Contact	NC (Normally Closed)/ Auto Re-setting
Response Temperature (Option TW)	311 °F (155 °C) Shut-Off Device
Response Temperature (Option 2TW)	311 °F (155 °C) Shut-Off Device + 266°F (130 °C) Alarm Device
Nominal Current	1.6 Amp at 250 V
Resistance	< 50 mΩ
Switch Rebound	< 1ms
Insulation Rating	2000 VAC
Cycles	10,000 max
Lead Identification (inside terminal box)	P1 and P2 or TB1 and TB2 / 2TB1 and 2TB2

Motor thermostats or bi-metallic switches can be wired directly into the control circuit without a separate control module or tripping device. Thermostats operate on a relatively high control voltage so they are less sensitive to voltage interference from the main power supply. Often one can run thermostat leads and motor power leads next to each other when using the appropriate shielded cable. The installer is responsible to wire the thermostats into the motor control circuit. The leads may be labeled as indicated below.

Thermistors (TF)

Table 10. TF option, Thermistors

Standard Connection	Three devices, series connected, one per phase
Type	Positive temperature coefficient (PTC)
Transition Temperature	150°C±5 °C
Resistance	20… 500Ω (below transition) > 4 kΩ (above transition)
Reed Current	< 1mA
Max Voltage	30V
Lead Identification (inside terminal box)	P1 and P2 or TP1 and TP2

With a separate control module or tripping device (ex. Kirwan INT69) thermistors are used to sense motor overload/ over temperature conditions by converting the critical operating temperature limit into large internal resistance change. Due to their small size, heat sink construction, and high change in resistance value, minor resistance variations caused by relatively long lead runs can be tolerated. This feature also allows for one controller to be used for several temperature sensing locations. Many variable frequency drives come with on-board thermistor inputs. NORD does not supply the thermistor control module.

IMPORTANT NOTE

- Thermostats and Thermistors will automatically reset.
- All wiring must be completed by qualified personal and adhere to all local codes.

16. Motor Acc. Ctd. - Space Heaters (Option SH)

- Connection Diagram shown on Page 9
- Space Heaters are mounted directly on the motor winding
- The leads are brought into the terminal box and labeled H1 and H2
- They require a separate voltage supply and must not be energized when the motor is energized
- The heaters will keep the winding of the motor approximately 5°C above the surrounding ambient

Table 11. Space Heater Data

Frame Size	Wattage	Voltages	Heater Strips/MTR
63 & 71	18W	110V	1
		230V	
		460V	
80	25W	110V	1
		230V	
		460V	
90 – 112	50W	110V	2
		230V	
		460V	
132-180	100W	110V	2
		230V	
		460V	
200 & 225	120W	110V	2
		230V	
		460V	

Encoder (Option IG)

- Most standard encoders will be enclosed inside the fan cover
- Incremental, Quadrature, Differential, Marker Channel
- IP66 Protection
- IG1 = 1024PPR, IG2 = 2048PPR, IG4 = 4096PPR
- TTL/RS422, HTL/Push-Pull, Line Driver.
- 5V or 10-30V available.
- Absolute encoders also available.
- Seperate encoder wiring instructions are provided by NORD.

17. Inspection

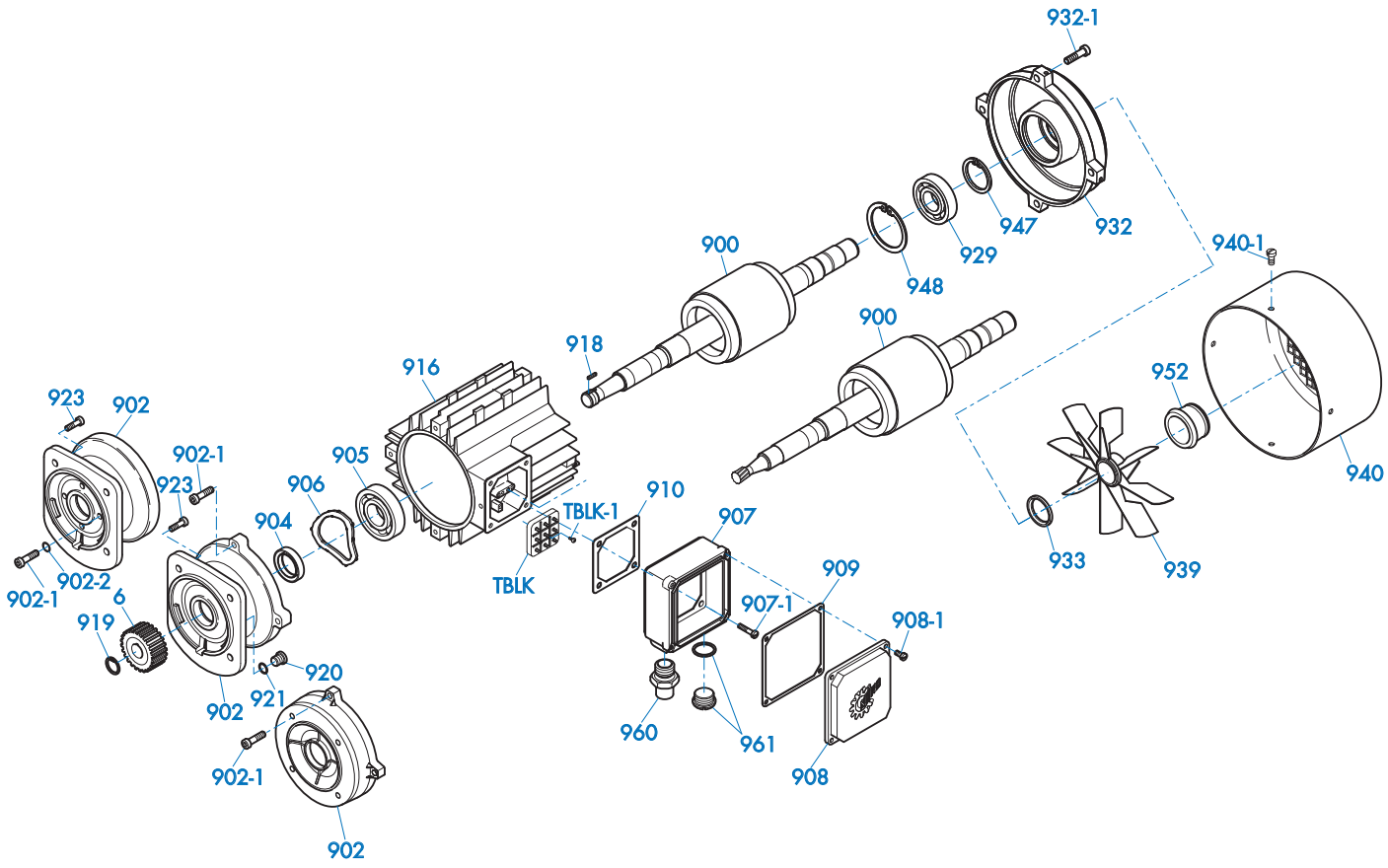
Inspect the motor after every 500 operating hours. Please use table 12 below for inspection guidelines.

⚠ CAUTION

If it is necessary to clean the motor exterior, do not use shop air. Shop air can force contaminents into the motor and may cause parts damage or result in blowing debris causing injury.

Table12. - Motor Inspection Guidelines

Inspect	Check	Action
Motor Exterior	Check the external surfaces for contamination. Accumulation of dirt and fibrous deposits must be removed.	Clean the motor external surfaces using clean, lint-free cloths.
		Clean deposits from between cooling fins using a vacuum cleaner and a stiff-bristled nylon brush.
	Check the external surfaces for oil film and greasy deposits.	Clean the oil film and greasy deposits from the motor surface using clean, lint-free cloths.
		If necessary, moisten the cloth with an approved non-flammable, residue-free solvent. Do not pour solvent on the motor.
	Check for evidence of damage or overheating.	If the motor has physical damage, replace the motor.
Motor Mountings	Make sure the mounting hardware is secure.	If the mounting hardware is not secure, check the motor/gearbox alignment, and tighten the mounting hardware.
Motor Electrical Connections	Check that all electrical connections are secure.	If the electrical connections are not secure, tighten them.
	Check the electrical connections for evidence of arcing.	Loose electrical connections can cause arcing, which is evident by discoloration and charring. If you find evidence of arcing, replace the damaged connections.
Insulation Resistance	Using an ohmmeter, check and record the resistance of motor winding insulation.	Compare the current resistance reading to previous readings. If the resistance drops significantly, perform an internal inspection for insulation damage or deterioration.
Motor Brake	On motors that have a brake, use a feeler gauge to check the air gap in between the brake pad and the rotor according to the appropriate user manual.	If the air gap exceeds the maximum allowed for that brake configuration provided in the manual, adjust the air gap or replace the brake pad according to user manual U35000.



Part Number	Part Description	Qty per Assembly
6	Input Pinion	1
900	Rotor Assembly	1
902	A-Endbell	1
902-1	Screw	4
902-2	Dubo Seal	4
904	Oil Seal	1
905	Bearing	1
906	Preload Spring	1
907	Terminal Box Frame	1
907-1	Screw	4
908	Terminal Box Cover	1
908-1	Screw	4
909	Gasket - Terminal Box Frame	1
910	Gasket - Terminal Box Cover	1
916	Stator	1
918	Key	1
919	Retaining Ring	1
920	Oil Plug	1

Part Number	Part Description	Qty per Assembly
921	Gasket	1
923	Screw	4
929	Bearing	1
932	B-Endbell	1
932-1	Screw	4
933	Oil Seal	1
939	Fan	1
940	Fan Cover	1
940-1	Screw	4
947	Retaining Ring	1
948	Retaining Ring	1
952	Fan Clip	1
960	NPT Thread Adapter	1
961	Plug (includes O-ring)	1
TBLK	Terminal Block	1
TBLK-1	Screw, Terminal Block Mounting	2
	Jumper Bar (not illustrated)	AR

19. Repair

Reference the parts list drawing on page 14 for clarification.

A. Disassemble the motor according to the general exploded view in PARTS INFORMATION. Disassemble only as far as necessary to replace the failed parts.

B. Whenever the motor is disassembled, clean all dust and contamination from the motor interior using a vacuum cleaner and a soft-bristled nylon brush.

C. The following parts must be replaced if they are removed:

- Oil seal (904), Oil seal (933)
- Gasket (909), Gasket (910), Gasket (921)
- Gasket on plug (961)
- Self-locking screws (907-1, 908-1, 923, 932-1, 940-1)
- Dubo Seals (902-2)

D. If the following parts are removed, inspect them, and replace them if they are deformed or damaged:

- Retaining ring (919), Retaining ring (947), Retaining ring (948)
- Fan clip (952)

20. Removing and Replacing Integral Motors

Reference the parts list on Page 14 for clarification.

A. Disconnect the power to the electric motor. Make certain the motor is properly grounded, de-energized and secured with a lock-out/tag-out device.

B. Drain the oil from the mating gearbox, or rotate the motor/gearbox assembly so that the motor is up, to prevent oil from spilling from the gearbox when the motor is removed.

C. Support the motor and prepare it for removal. Steady the motor and support it. For larger motors, use of mechanical lifting or support devices to may be appropriate.

D. Remove the fastening screws that hold the motor to the reducer input.

IMPORTANT NOTE

Most integral motor installations have mounting bolts accessible from the motor exterior. If the bolts are not clearly visible, unbolt the input flange from the gearbox. Remove the bolts securing the motor to the reducer input flange, and discard the old DUBO sealing rings that were under the screw heads.

E. Maintain motor shaft alignment and move the motor directly away from its mounting surface until the motor shaft and mating input gear clear both the internal gear mesh and reducer input.

F. Remove and discard the old flange gasket.

G. Clean the gasket faces on the motor and gearbox, making sure no cleaning debris enters the gearbox.

H. Check the replacement motor to make sure the motor flange, motor shaft, and motor pinion are identical to the motor that was removed.

I. Place a new gasket between the gearbox and new motor.

J. Position the motor on the gearbox, making sure the input pinion meshes with the input gear. Rotate the motor as necessary to align the bolt holes and seat the motor flange. Make sure the gasket remains properly aligned and seated

K. Apply a medium strength thread locking compound to the bolt threads. Install the bolts and tighten them to the appropriate torque.

IMPORTANT NOTE

If the motor/gearbox installation uses an input flange, first mount the input flange to the motor using the four mounting bolts and NEW DUBO sealing rings under the head of each fastening screw. Make sure the fastening screws are clean and apply new thread sealant if necessary.

L. Check the gearbox oil level in accordance with the appropriate User Manual/s. If necessary fill or add oil to the gearbox.

NOTICE

Do not mix oil types. Mixing oil types may lead to component damage and diminished performance. Consult NORD for assistance or reference oil type listed on gearbox tag.

M. Re-establish the electrical connection to the motor.

N. Observe the subsequent start-up closely to make certain the equipment is operating properly and there are no seal or gasket leaks.

21. Removing and Replacing NEMA C-Face or IEC Fange-Mounted Motors

For further clarification of these instructions, reference the parts list on Page 14 of this manual.

A. Disconnect the power to the electric motor. Make certain the motor is properly grounded, de-energized and secured with a lock-out/tag-out device.

B. Support the motor and prepare it for removal. Steady the motor and support it. For larger motors, use of mechanical lifting or support devices to may be appropriate.

C. Remove the fastening screws that hold the motor to the C-face or IEC mounting flange.

D. Maintain motor shaft alignment, and move the motor directly away from its mounting surface until the motor shaft and mating coupling clear the mounting flange surface of the driven equipment.

E. Measure and record the proper placement of the motor shaft coupling prior to removing it from the old motor.

F. Make sure the new motor shaft, key and key slot are free of all nicks, burrs, and lubrication or grease.

G. Install the new shaft key on the new motor. If the shaft key is not captured or if an open-ended key slot is utilized it is good practice to secure the key into the key slot with a medium strength thread locking agent or alternatively one may stake the key in place.

H. Re-install the coupling on the new motor shaft, making sure the placement of the coupling is in the same location as it was on the old motor (See Step E).

I. Clean all old gasket material, sealants, contamination, and corrosion from the flange surface on the driven equipment.

J. If the motor is utilized in a wet or wash down environment apply a sealing gasket or gasket eliminating compound to the mating flange surface, as would seem most appropriate for the application.

K. Support the new motor and mount it flush against the mating flange surface of the driven equipment.

L. Apply a medium strength thread locking agent to the bolt threads.

M. Install the bolts and tighten them to the appropriate torque.

N. Re-establish the electrical connection to the motor.

O. Observe the subsequent start-up closely to make certain the equipment is operating properly.

22. Testing

IMPORTANT NOTE

NORD electric motors do not require periodic testing. However, if a motor is removed from its installation, NORD recommends that the motor be checked according to the following static and dynamic testing procedures before it is reinstalled. Finding a condition that will require future repair before the motor is reinstalled decreases the overall maintenance time.

This section provides general test information and functional checks for the types of motors covered by this manual. Read and understand the tests and checks before performing them on your motor.

Record and date all measurements taken.

If the motor fails any of the test procedures provided below, use the troubleshooting guide to determine the motor problem.

Static Testing

A. The motor can only be static tested if it is disconnected from the component it drives and securely mounted on a fixture or mounting plate. These tests are usually conducted when a motor has been removed for any reason other than failure

B. Turn the motor shaft slowly by hand. Feel and listen for evidence of a failed bearing, which is indicated by a rough feel as the shaft rotates, and by noise.

C. Check for smooth rotation, with no evidence of binding or catching. If the shaft does not rotate smoothly, or binds or catches, the bearings are worn or failing, lack lubrication, or are contaminated.

D. Check the motor shaft for side play by applying pressure at right angles to the shaft in several places around the circumference. If the shaft moves perceptibly, the front bearing may be worn.

Dynamic Testing

A. Find the motor voltage and rated load current values as listed on the motor nameplate.

B. Using a volt-ohmmeter, verify that the motor power supply is in the correct range.

C. Run the motor with no load. As the motor is operating, listen for unusual motor noise and check for excessive vibration. Vibration and motor noise are indications of bearing contamination, lack of lubrication, damage, or failure.

D. Use an ammeter to measure the no-load current. Record the no-load current for comparison with previous readings, and for reference during future testing.

E. If the motor passes the no-load test, operate the motor at rated load and check and record the current.

F. Check the motor operating temperature at rated load. If the motor operates at a higher than normal temperature, the motor may be damaged, overloaded or failing.

23. Troubleshooting

Fault	Likely Cause	Corrective Action
Motor fails to start.	• Motor is mis-wired • Brake is may not be releasing. • Fan guard damaged and contacting fan. • Motor protection device has tripped or does not switch • 1-Ph Capacitor or start switch has failed.	• Verify and correct motor wiring. • Troubleshoot brake per User Manual U35000. • Replace damaged fan guard. • Check motor protection device for correct setting and correct error. • Discharge capacitor and use a volt-ohm meter to check the capacitor for an open circuit - replace if needed. Inspect switch and connections. Replace if contacts look burned or pitted.
Fuses blow or motor protection faults immediately.	• Short circuit in line. • Lines connected incorrectly. • Fuse or circuit breaker tripped. • Motor is overloaded or equipment jammed. • Stator is shorted or went to ground.	• Rectify short circuit. • Check circuit diagram and make corrections. • Replace fuse or circuit breaker. • Make sure load is free. Verify motor amp draw compared to nameplate rating. • A damaged or blown stator will show a burn mark. Stator must be repaired or replaced.
Motor hums and has high current consumption	• Brake may not be releasing. • Rotor may be rubbing stator. • Defective or incorrect stator winding.	• Troubleshoot brake per User Manual U35000. • Send motor to a repair specialist.
Severe speed loss under load or excessive acceleration time.	• Overload. • Excessive voltage drop. • Damaged or failing motor bearings. • Damaged or worn gear unit. • 1-Ph Capacitor or start switch has failed.	• Check load conditions and make certain system is unobstructed. Reduce load or consider a larger motor. • Verify service voltage is within specification. Check if nearby equipment is affecting incoming power. Make sure connection harness and wiring is adequate. • Replace motor bearings. • Replace or repair damaged gear unit. • See instructions under "Motor fails to start".
Motor runs the incorrect direction.	• Incorrect wiring.	• Rewire motor according to system schematic and/or switch two incoming motor phases.
Motor heats up excessively or thermal overload protection trips	• Overload. • Ambient temperature is too high. • Inadequate cooling. • Operation is outside the allowed duty cycle. • Motor protection device may be defective. • Excessive supply voltage. • System short or damaged stator.	• Make sure load is free. Verify motor amp draw compared to nameplate rating. Reduce load or consider a larger motor. • Do not operate above the rated conditions. • Correct cooling air supply. Open and clear cooling air passages. Retrofit with forced ventilator fan if needed. • Adjust operating duty cycle or contact a specialist to select a suitable motor or drive. • Replace motor protection device. • Adapt motor supply voltage. • Check for loose, cut or damaged wires. Check stator winding for defects or burn damage.
Excessive Noise or Vibration	• Motor bearings contaminated or damaged. • Excessive motor shaft end play. • Misaligned or imbalanced load.	• Test motor by itself. If bearings are bad noise may be heard or roughness detected. Replace bearings. Add lubrication if bearings have grease fittings. • Check shaft endplay with motor and system power disconnected. If shaft movement is excessive replace motor shaft bearings. • Check all mating shaft connections for proper alignment and correct all imbalanced load conditions.
1 Ph Start Capacitor Failures	• Motor is not coming up to speed quickly enough. • Motor is being cycled frequently • Start switch is defective or damaged.	• Verify motor size to load conditions. Motor should come up to speed in no more than 2-3 seconds. • Verify duty cycle and consult specialist for recommendations. • Replace start switch.
1 Ph Run Capacitor Failures	• Possible power surge to motor caused by transient voltage or lightening. • Excessive ambient temperature.	• Install proper surge protection. • Verify ambient conditions do not exceed nameplate value.

General Instructions

This manual provides information on brake rectifiers along with typical connection diagrams for NORD motors with brakes. It is not intended to include a comprehensive listing of all details or procedures required for installation, operation, maintenance or troubleshooting.
NORD utilizes brakes manufactured by Precima and Mayr. NORD recommends referencing the supplier documentation for information regarding operation and maintenance.

- BRE5 - BRE150 and BRE1200 sizes utilize Precima brakes as standard
- BRE250 - BRE 800 sizes utilize Precima or Mayr

Obtaining Brake Supplier Documentation

The myNORD Serial Number Lookup tool provides unit documentation specific to your product. Simply enter the sales order number from the product nameplate to access all relevant operation & maintenance manuals including supplier-specific documentation.

https://shop.nord.com/US-en/mynord/documentcenter#?order=&language=EN-US

PDF copies of all NORD or supplier-specific manuals are also available on our website. Filters are available to drill down to the specific required documentation.

Brake Control Rectifiers

NORD brake control rectifiers convert AC voltage to DC voltage. Rectifiers are used because most applications require AC voltage to power the motor, but DC power is required to power the brake and DC power is not typically available. NORD brake motors typically include the rectifier located inside the terminal box.

Rectifier Advantages

- Individual power source for each brake.
- Compact size, mounted inside the terminal box.
- Multiple types, voltage options and release/engagement modes available.
- Mountable in a separate control cabinet.
- Integral protection against voltage spikes.

Model	Type	Part No.	Color	Input Voltage V_{AC} ± 10%	Rated Current A_{DC} (40°C)	Rated Current A_{DC} (75°C)
GVE20L	Full-wave	19141000	Black	110-275	1.5	1.0
GVE20V	Full-wave	19141030	Black	110-275	1.5	1.0
GHE40L	Half-wave	19141010	Yellow	200-480	2.0	1.0
GHE40V	Half-wave	19141040	Yellow	200-480	2.0	1.0
GHE50L	Half-wave	19141020	Gray	200-575	2.0	1.0
GHE50V	Half-wave	19141050	Gray	200-575	2.0	1.0
GUE40V	Dual-wave	19140300	Black	190-460	0.7	0.5
PMG500	Push-Hybrid	19140200	Black	200-500	4.0	2.8

Rectifier electronics are sealed for moisture-protection; electronics on models ending with the suffix "V" are resin-encapsulated to provide added protection if water should get into the motor terminal box.

Rectifier Types

Full-wave rectifier [GVE]:

A rectifier in which both the positive and negative half-cycles of the AC input signal are rectified to produce a uni-directional DC current supply to the load or the brake. The output voltage is 90% of the input voltage ($V_{DC} = 0.90 \times V_{AC}$).

Half-wave rectifier [GHE]:

A rectifier in which only alternate half-cycles of the AC input signal are rectified to produce a uni-directional DC current supply to the load or the brake. The output voltage is 45% of the input voltage ($V_{DC} = 0.45 \times V_{AC}$).

Dual Wave Rectifier [GUE]

A rectifier that can be wired as either a full-wave rectifier or a half-wave rectifier depending upon how it is connected to the AC input signal.

IMPORTANT NOTE

If the motor is connected to a frequency inverter, soft start, or is a two-speed motor, then seperate AC power must be supplied to the brake rectifier.

Rectifier Types [Ctd.]

PMG 500 Push-Hybrid rectifier [PMG]:

A fast-acting or push-hybrid brake rectifier provides an initial "push" in the form of a timed full-wave brake-release function, which is then followed by a continuous half-wave brake-holding function. There are two ways to apply these rectifiers as follows:

- "Overexcitation" of the brake coil provides faster brake release or improved cycling capacity. The DC voltage of the brake coil is determined based upon using a half-wave rectifier. The output voltage is 45% of the input voltage ($V_{DC} = 0.45 \times V_{AC}$).
- "Reducer-Power Holding" of the brake coil maintains the brake in a released state by using only 25% of the power needed for the initial brake release. This results in very fast brake stopping. The DC voltage of the brake coil is determined based upon using a full-wave rectifier. The output voltage is 90% of the input voltage. ($V_{DC} = 0.90 \times V_{AC}$).

NORD offers additional fast-acting rectifiers besides the PMG 500. For additional details please reference User Manual U35100 – Fast Acting Brake Rectifiers.

NOTICE

In order to prevent rapid wear, the PMG 500 rectifier is required when utilizing the larger 800 Nm (590 lb-ft) and 1200 Nm (885 lb-ft) twin-rotor brakes. The PMG 500 rectifier is wired to "overexcite" the brake during its initial release.

Brake Switching Options

The rectifiers discussed in this manual can be wired to allow brake switching at either the AC power source (input) or the DC power source (output).

- AC switching allows the brake rectifier to be powered directly from the motor's terminal block with no additional wiring. However, this provides a slower brake stopping time due to the additional time needed to de-energize or collapse the motor's magnetic field.
- DC switching directly interrupts the current flow in the DC circuit of the brake rectifier. This method of brake switching guarantees faster brake stopping or brake engagement times.

⚠ *WARNING*

When the moving system undergoes a change in height (such as in a lift or incline conveyor application) or if the system tends to speed up or overhaul during normal operation, then DC-switching of the brake is required in order to prevent excessive load movement, drift or falling loads during stopping.

Figure 2.1: GVE/GHE Dimensions

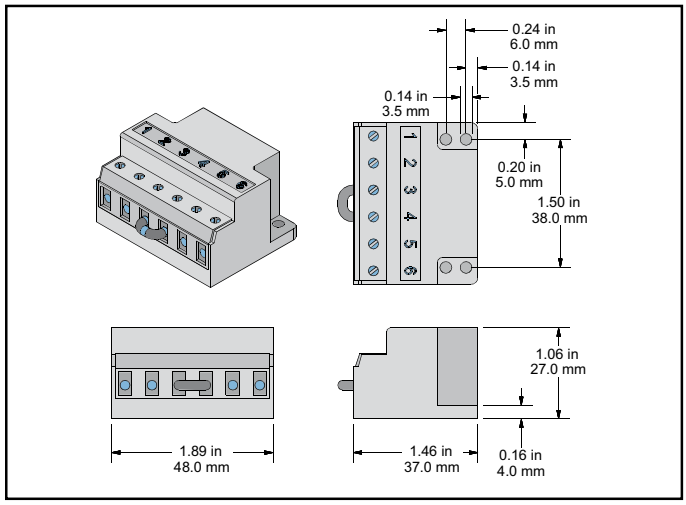


Figure 3.1: GUE Dimensions

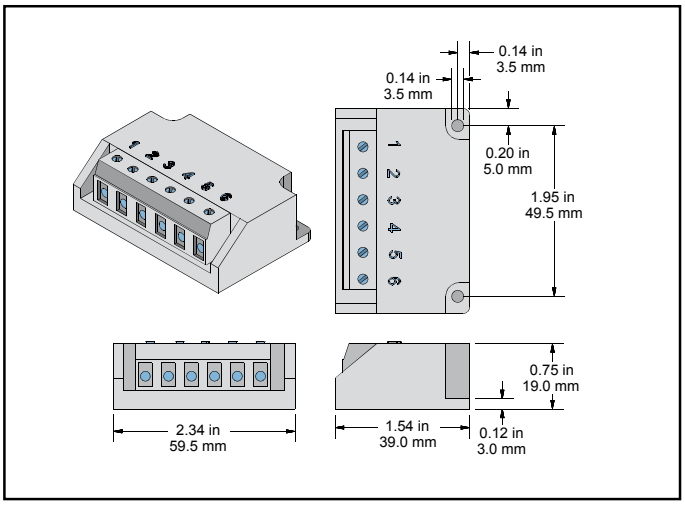
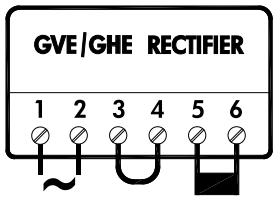


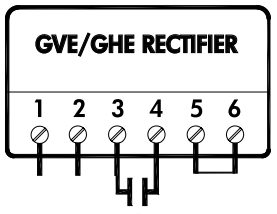
Figure 2.2: GVE/GHE Braking Methods

STANDARD STOPPING AC-SWITCHING



1 & 2	3 & 4	5 & 6
AC BRAKE VOLTAGE	JUMPER	DC BRAKE

FAST STOPPING DC-SWITCHING



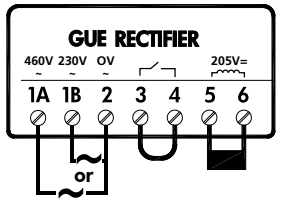
1 & 2	3 & 4	5 & 6
AC BRAKE VOLTAGE	NORMALLY OPEN CONTACT	DC BRAKE

* The normally open contact/s (NO) is not supplied by NORD it must close at the same time power is supplied to the brake. The contact must be capable of switching inductive loads and/or be rated at IEC AC3.

Braking Method	Break Release (Start)	Brake Engage (Stop)	Power Source
10	Standard	Standard (AC-Switching)	Motor terminals
15	Standard	Fast (DC-switching)	Motor terminals
20	Standard	Standard (AC-Switching)	Separate power
25	Standard	Fast (DC-switching)	Separate power

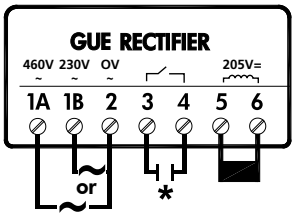
Figure 3.2: GVE/GHE Braking Methods

STANDARD STOPPING AC-SWITCHING



1B & 2	3 & 4	5 & 6
AC BRAKE VOLTAGE	JUMPER	DC BRAKE

FAST STOPPING DC-SWITCHING

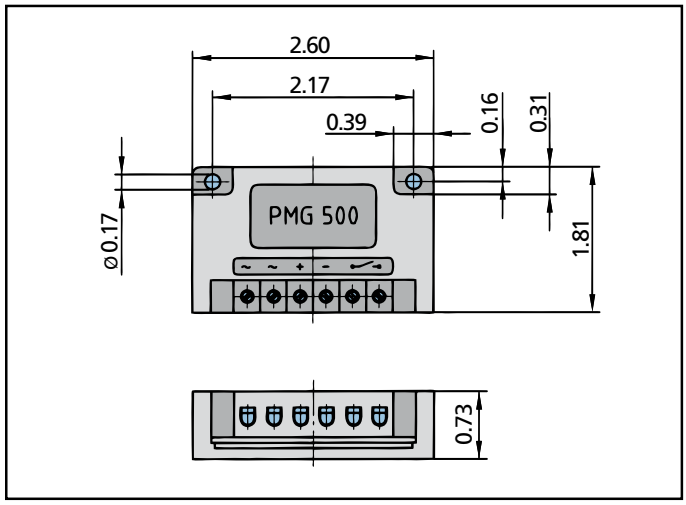


1 & 2	3 & 4	5 & 6
AC BRAKE VOLTAGE	NORMALLY OPEN CONTACT	DC BRAKE

* The normally open contact/s (NO) is not supplied by NORD it must close at the same time power is supplied to the brake. The contact must be capable of switching inductive loads and/or be rated at IEC AC3.

Braking Method	Break Release (Start)	Brake Engage (Stop)	Power Source
10	Standard	Standard (AC-Switching)	Motor terminals
15	Standard	Fast (DC-switching)	Motor terminals
20	Standard	Standard (AC-Switching)	Separate power
25	Standard	Fast (DC-switching)	Separate power

Figure 4.1: PMG 500 Dimensions



PMG 500 Push-Hybrid Rectifier

The PMG 500 rectifier provides an initial "push" the form of a timed full-wave brake-release function, which is then followed by a continuous half-wave brake-holding function.

- In order to prevent rapid wear, the PMG 500 rectifier is required when utilizing the larger 800 Nm (590 lb-ft) - and 1200 Nm (885 lb-ft) twin-rotor brakes.
- The PMG 500 rectifier is wired to "overexcite" the brake during its initial release. The DC voltage of the brake coil is determined based upon using a half-wave rectifier.

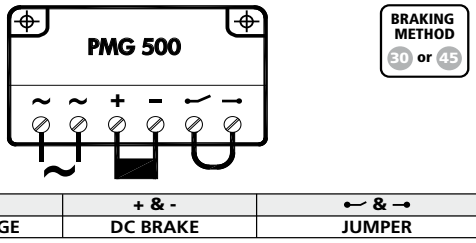
In some applications the PMG rectifier may be used for "Reduced Power Holding" or very fast brake engagement (See user manual U35100 for details).

IMPORTANT NOTE

If the motor is connected to an AC drive, soft start, or is a two-speed motor, the AC power must be supplied to the brake rectifier seperately from the motor power.

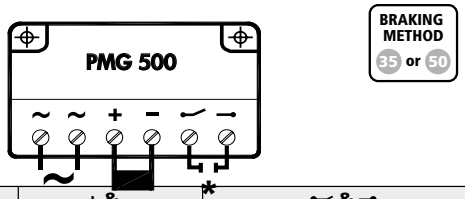
Figure 4.2: PMG 500 Braking Methods

STANDARD STOPPING (AC-SWITCHING)



~ & ~	+ & -	⊷ & ⊸
AC BRAKE VOLTAGE	DC BRAKE	JUMPER

FAST & VERY FAST STOPPING (DC-SWITCHING)



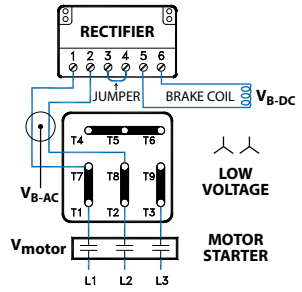
~ & ~	+ & -	⊷ & ⊸
AC BRAKE VOLTAGE	DC BRAKE	NORMALLY OPEN CONTACT

* The normally open contact/s (NO) is not supplied by NORD it must close at the same time power is supplied to the brake. The contact must be capable of switching inductive loads and/or be rated at IEC AC3.

Braking Method	Break Release (Start)	Brake Engage (Stop)	Power Source
30	Fast (Overecitation)	Standard (AC Switching)	Motor terminals
35	Fast (Overecitation)	Fast (DC Switching)	Motor terminals
45	Fast (Overecitation)	Standard (AC Switching)	Seperate power
50	Fast (Overecitation)	Fast (DC Switching)	Seperate power

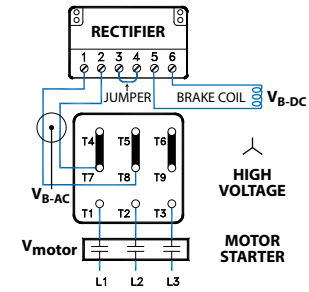
Typical Connection Diagrams

BR101A — POWERED FROM MOTOR TERMINAL BLOCK — STANDARD RELEASE — NORMAL STOPPING (AC-SWITCHING) — 10



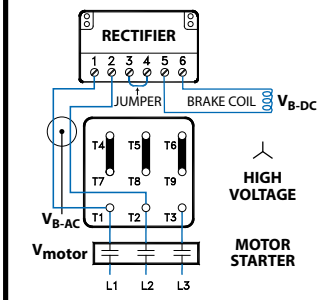
MOTOR	RECTIFIER	V_{motor}	V_{B-AC}	V_{B-DC}
208-230YY/460Y	GVE20	208 VAC	230 VAC	205 VDC
230YY/460Y	GVE20	230 VAC	230 VAC	205 VDC
230YY/460Y	GHE40	230 VAC	230 VAC	105 VDC

BR101B — POWERED FROM MOTOR TERMINAL BLOCK — STANDARD RELEASE — NORMAL STOPPING (AC-SWITCHING) — 10



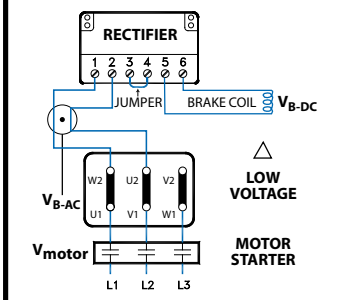
MOTOR	RECTIFIER	V_{motor}	V_{B-AC}	V_{B-DC}
230YY/460Y	GVE20	460 VAC	230 VAC	205 VDC
230YY/460Y	GHE40	460 VAC	230 VAC	105 VDC

BR101C — POWERED FROM MOTOR TERMINAL BLOCK — STANDARD RELEASE — NORMAL STOPPING (AC-SWITCHING) — 10



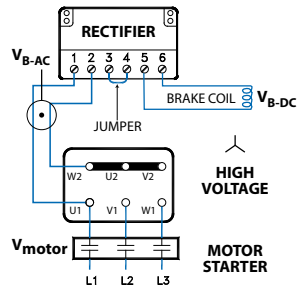
MOTOR	RECTIFIER	V_{motor}	V_{B-AC}	V_{B-DC}
230YY/460Y	GHE40	460 VAC	460 VAC	205 VDC

BR601A — POWERED FROM MOTOR TERMINAL BLOCK — STANDARD RELEASE — NORMAL STOPPING (AC-SWITCHING) — 10



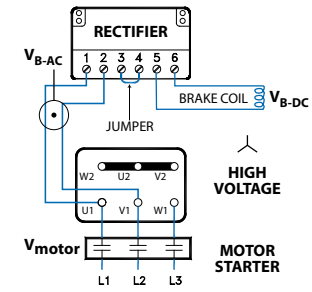
MOTOR	RECTIFIER	V_{motor}	V_{B-AC}	V_{B-DC}
208Δ/360Y	GVE20	208 VAC	208 VAC	180 VDC
230Δ/400Y	GVE20	230 VAC	230 VAC	205 VDC
400Δ/690Y	GHE40	400 VAC	400 VAC	180 VDC
460Δ/Y	GHE40	460 VAC	460 VAC	205 VDC

BR601B — POWERED FROM MOTOR TERMINAL BLOCK — STANDARD RELEASE — NORMAL STOPPING (AC-SWITCHING) — 10



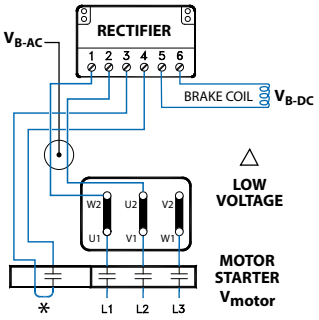
MOTOR	RECTIFIER	V_{motor}	V_{B-AC}	V_{B-DC}
230Δ/400Y	GVE20	400 VAC	230 VAC	205 VDC

BR601C — POWERED FROM MOTOR TERMINAL BLOCK — STANDARD RELEASE — NORMAL STOPPING (AC-SWITCHING) — 10



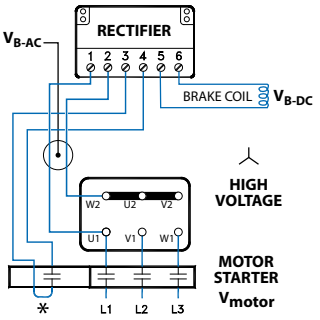
MOTOR	RECTIFIER	V_{motor}	V_{B-AC}	V_{B-DC}
230Δ/400Y	GHE40	400 VAC	400 VAC	180 VDC
332Δ/575Y	GHE50	575 VAC	575 VAC	250 VDC

BR603A — POWERED FROM MOTOR TERMINAL BLOCK — STANDARD RELEASE — FAST STOPPING (DC-SWITCHING) — 15



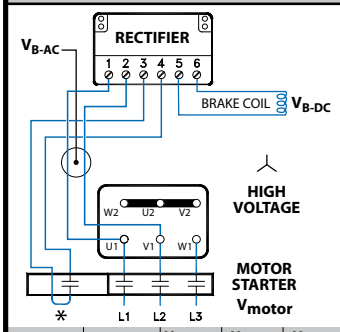
MOTOR	RECTIFIER	V_{motor}	V_{B-AC}	V_{B-DC}
208Δ/360Y	GVE20	208 VAC	208 VAC	180 VDC
230Δ/400Y	GVE20	230 VAC	230 VAC	205 VDC
400Δ/690Y	GHE40	400 VAC	400 VAC	180 VDC
460Δ/Y	GHE40	460 VAC	460 VAC	205 VDC

BR603B — POWERED FROM MOTOR TERMINAL BLOCK — STANDARD RELEASE — FAST STOPPING (DC-SWITCHING) — 15



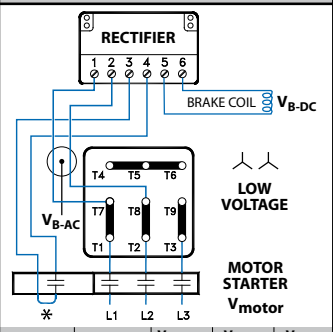
MOTOR	RECTIFIER	V_{motor}	V_{B-AC}	V_{B-DC}
230Δ/400Y	GVE20	400 VAC	230 VAC	205 VDC

BR603C — POWERED FROM MOTOR TERMINAL BLOCK — STANDARD RELEASE — FAST STOPPING (DC-SWITCHING) — 15



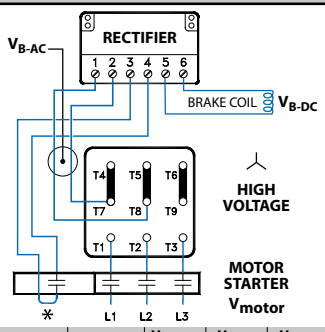
MOTOR	RECTIFIER	V_{motor}	V_{B-AC}	V_{B-DC}
230Δ/400Y	GHE40	400 VAC	400 VAC	180 VDC
332Δ/575Y	GHE50	575 VAC	575 VAC	250 VDC

BR103A — POWERED FROM MOTOR TERMINAL BLOCK — STANDARD RELEASE — FAST STOPPING (DC-SWITCHING) — 15



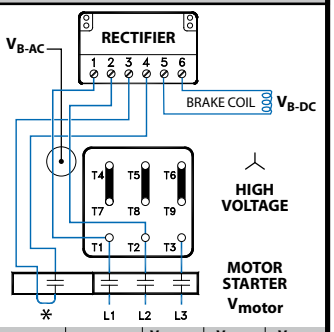
MOTOR	RECTIFIER	V_{motor}	V_{B-AC}	V_{B-DC}
208-230YY/460Y	GVE20	208 VAC	230 VAC	205 VDC
230YY/460Y	GVE20	230 VAC	230 VAC	205 VDC
230YY/460Y	GHE40	230 VAC	230 VAC	105 VDC

BR103B — POWERED FROM MOTOR TERMINAL BLOCK — STANDARD RELEASE — FAST STOPPING (DC-SWITCHING) — 15



MOTOR	RECTIFIER	V_{motor}	V_{B-AC}	V_{B-DC}
230YY/460Y	GVE20	460 VAC	230 VAC	205 VDC

BR103C — POWERED FROM MOTOR TERMINAL BLOCK — STANDARD RELEASE — FAST STOPPING (DC-SWITCHING) — 15



MOTOR	RECTIFIER	V_{motor}	V_{B-AC}	V_{B-DC}
230YY/460Y	GHE40	460 VAC	460 VAC	205 VDC

✻ The normally open contact/s (NO) is not supplied by NORD. It must close at the same time power is supplied to the brake. The contact must be capable of switching inductive loads and/or be rated IEC AC3.

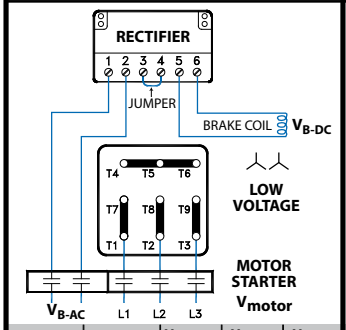
= Braking Method

MOTOR BRAKES INSTALLATION & MAINTENANCE

Typical Connection Diagrams

BR102A — 20

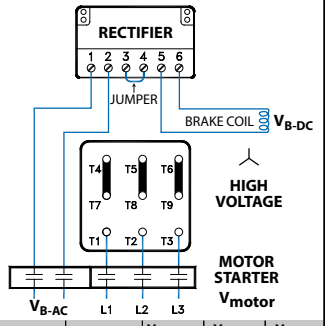
SEPERATE POWER SOURCE
STANDARD RELEASE
NORMAL STOPPING (AC-SWITCHING)



MOTOR	RECTIFIER	V_{motor}	V_{B-AC}	V_{B-DC}
208-230YY/460Y	GVE20	208 VAC	230 VAC	205 VDC
230YY/460Y	GVE20	230 VAC	115 VAC	105 VDC
230YY/460Y	GVE20	230 VAC	230 VAC	205 VDC
230YY/460Y	GHE40	230 VAC	230 VAC	105 VDC

BR102B — 20

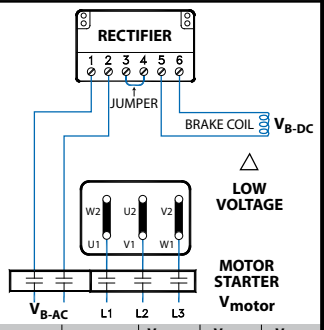
SEPERATE POWER SOURCE
STANDARD RELEASE
NORMAL STOPPING (AC-SWITCHING)



MOTOR	RECTIFIER	V_{motor}	V_{B-AC}	V_{B-DC}
230YY/460Y	GVE20	460 VAC	115 VAC	105 VDC
230YY/460Y	GVE20	460 VAC	230 VAC	205 VDC
230YY/460Y	GHE40	460 VAC	460 VAC	205 VDC

BR602A — 20

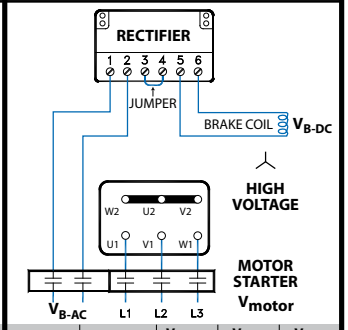
SEPERATE POWER SOURCE
STANDARD RELEASE
NORMAL STOPPING (AC-SWITCHING)



MOTOR	RECTIFIER	V_{motor}	V_{B-AC}	V_{B-DC}
208Δ/360Y	GVE20	208 VAC	208 VAC	180 VDC
230Δ/400Y	GVE20	230 VAC	230 VAC	205 VDC
400Δ/690Y	GHE40	400 VAC	400 VAC	180 VDC
460Δ/Y	GHE40	460 VAC	460 VAC	205 VDC

BR602B — 20

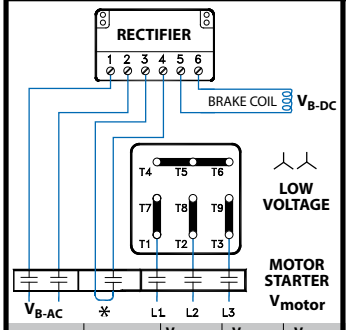
SEPERATE POWER SOURCE
STANDARD RELEASE
NORMAL STOPPING (AC-SWITCHING)



MOTOR	RECTIFIER	V_{motor}	V_{B-AC}	V_{B-DC}
230Δ/400Y	GHE40	400VAC	230 VAC	105 VDC
230Δ/400Y	GHE20	400VAC	230 VAC	205VDC
230Δ/400Y	GHE40	400 VAC	400 VAC	180 VDC
332Δ/575Y	GHE50	575 VAC	575 VAC	250 VDC

BR104A — 25

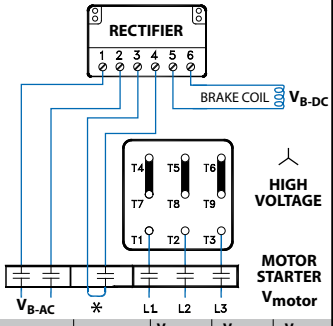
SEPERATE POWER SOURCE
STANDARD RELEASE
FAST STOPPING (DC-SWITCHING)



MOTOR	RECTIFIER	V_{motor}	V_{B-AC}	V_{B-DC}
208-230YY/460Y	GVE20	208 VAC	230 VAC	205 VDC
230YY/460Y	GVE20	230 VAC	115 VAC	105 VDC
230YY/460Y	GVE20	230 VAC	230 VAC	205 VDC
230YY/460Y	GHE40	230 VAC	230 VAC	105 VDC

BR104B — 25

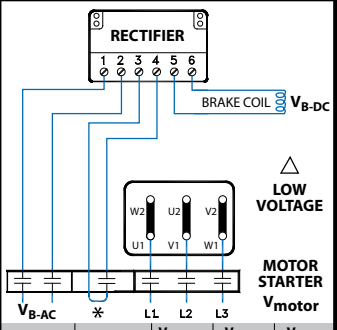
SEPERATE POWER SOURCE
STANDARD RELEASE
FAST STOPPING (DC-SWITCHING)



MOTOR	RECTIFIER	V_{motor}	V_{B-AC}	V_{B-DC}
230YY/460Y	GVE20	460 VAC	115 VAC	105 VDC
230YY/460Y	GVE20	460 VAC	230 VAC	205 VDC
230YY/460Y	GHE40	460 VAC	460 VAC	205 VDC

BR604A — 25

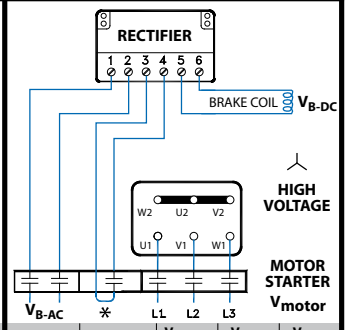
SEPERATE POWER SOURCE
STANDARD RELEASE
FAST STOPPING (DC-SWITCHING)



MOTOR	RECTIFIER	V_{motor}	V_{B-AC}	V_{B-DC}
208Δ/360Y	GHE20	208 VAC	208 VAC	105 VDC
230Δ/400Y	GHE20	230 VAC	230 VAC	105 VDC
400Δ/690Y	GHE40	400 VAC	400 VAC	180 VDC
460Δ/Y	GHE40	460 VAC	460 VAC	205 VDC

BR604B — 25

SEPERATE POWER SOURCE
STANDARD RELEASE
FAST STOPPING (DC-SWITCHING)



MOTOR	RECTIFIER	V_{motor}	V_{B-AC}	V_{B-DC}
230Δ/400Y	GHE40	400VAC	230 VAC	105 VDC
230Δ/400Y	GHE20	400VAC	230 VAC	205VDC
230Δ/400Y	GHE40	400 VAC	400 VAC	180 VDC
332Δ/575Y	GHE50	575 VAC	575 VAC	250 VDC

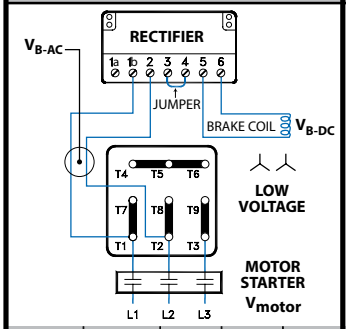
✻ The normally open contact/s (NO) is not supplied by NORD. It must close at the same time power is supplied to the brake. The contact must be capable of switching inductive loads and/or be rated IEC AC3.

= Braking Method

MOTOR BRAKES INSTALLATION & MAINTENANCE

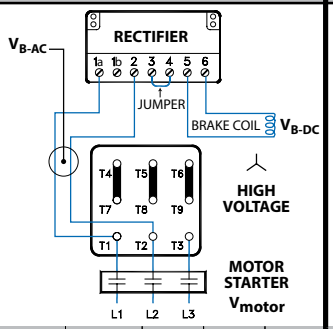
Typical Connection Diagrams

GU101A — POWERED FROM MOTOR TERMINAL BLOCK — STANDARD RELEASE — STANDARD STOPPING (AC-SWITCHING) — 10



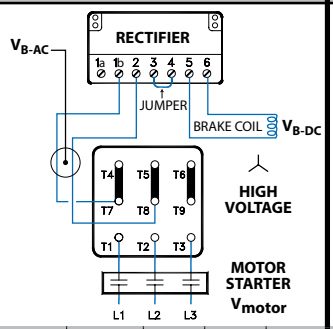
MOTOR	RECTIFIER	V_{motor}	V_{B-AC}	V_{B-DC}
208-230YY/460Y	GUE40V	208 VAC	208-230 VAC	205 VDC
230YY/460Y	GUE40V	230 VAC	230 VAC	205 VDC

GU101B — POWERED FROM MOTOR TERMINAL BLOCK — STANDARD RELEASE — STANDARD STOPPING (AC-SWITCHING) — 10



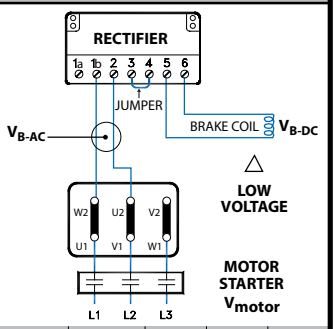
MOTOR	RECTIFIER	V_{motor}	V_{B-AC}	V_{B-DC}
208-230YY/460Y	GUE40V	460 VAC	460 VAC	205 VDC
230YY/460Y	GUE40V	460 VAC	460 VAC	205 VDC

GU101D — POWERED FROM MOTOR TERMINAL BLOCK — STANDARD RELEASE — STANDARD STOPPING (AC-SWITCHING) — 10



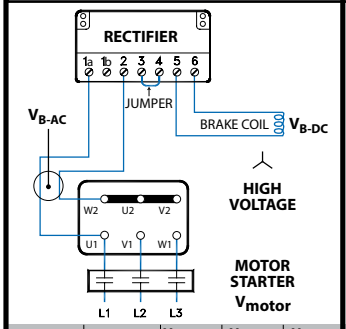
MOTOR	RECTIFIER	V_{motor}	V_{B-AC}	V_{B-DC}
230YY/460Y	GUE40V	460 VAC	230 VAC	205 VDC

GU101E — POWERED FROM MOTOR TERMINAL BLOCK — STANDARD RELEASE — NORMAL STOPPING (AC-SWITCHING) — 10



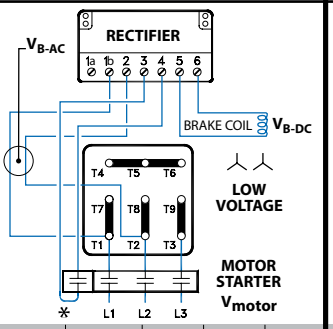
MOTOR	RECTIFIER	V_{motor}	V_{B-AC}	V_{B-DC}
230Δ/400Y	GUE40V	230 VAC	230 VAC	205 VDC

GU101F — POWERED FROM MOTOR TERMINAL BLOCK — STANDARD RELEASE — NORMAL STOPPING (AC-SWITCHING) — 10



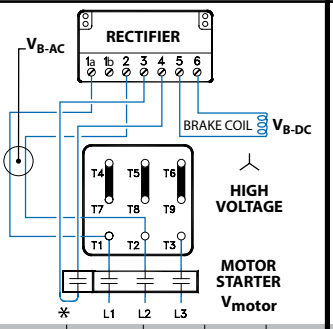
MOTOR	RECTIFIER	V_{motor}	V_{B-AC}	V_{B-DC}
230Δ/400Y	GUE40V	400 VAC	400 VAC	180 VDC

GU103A — POWERED FROM MOTOR TERMINAL BLOCK — STANDARD RELEASE — FAST STOPPING (DC-SWITCHING) — 15



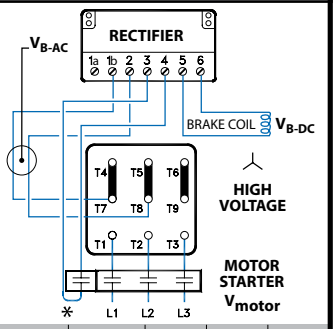
MOTOR	RECTIFIER	V_{motor}	V_{B-AC}	V_{B-DC}
208-230YY/460Y	GUE40V	208 VAC	208-230 VAC	205 VDC
230YY/460Y	GUE40V	230 VAC	230 VAC	205 VDC

GU103B — POWERED FROM MOTOR TERMINAL BLOCK — STANDARD RELEASE — FAST STOPPING (DC-SWITCHING) — 15



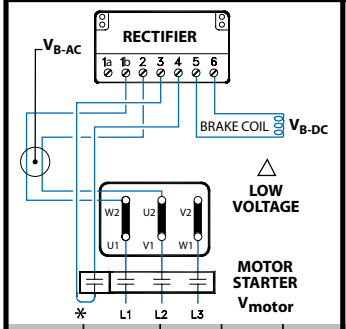
MOTOR	RECTIFIER	V_{motor}	V_{B-AC}	V_{B-DC}
208-230YY/460Y	GUE40V	460 VAC	460 VAC	205 VDC
230YY/460Y	GUE40V	460 VAC	460 VAC	205 VDC

GU103D — POWERED FROM MOTOR TERMINAL BLOCK — STANDARD RELEASE — FAST STOPPING (DC-SWITCHING) — 15



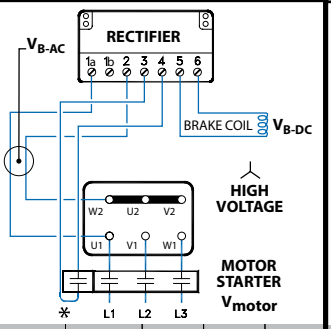
MOTOR	RECTIFIER	V_{motor}	V_{B-AC}	V_{B-DC}
230YY/460Y	GUE40V	460 VAC	230 VAC	205 VDC

GU103E — POWERED FROM MOTOR TERMINAL BLOCK — STANDARD RELEASE — FAST STOPPING (DC-SWITCHING) — 15



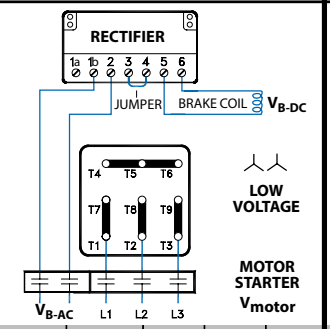
MOTOR	RECTIFIER	V_{motor}	V_{B-AC}	V_{B-DC}
230Δ/400Y	GUE40V	230 VAC	230 VAC	205 VDC

GU103F — POWERED FROM MOTOR TERMINAL BLOCK — STANDARD RELEASE — FAST STOPPING (DC-SWITCHING) — 15



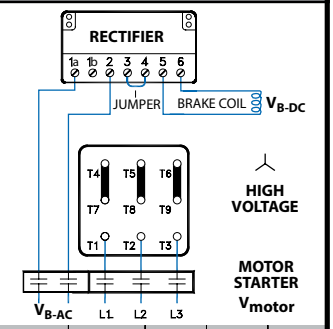
MOTOR	RECTIFIER	V_{motor}	V_{B-AC}	V_{B-DC}
230Δ/400Y	GUE40V	400 VAC	400 VAC	180 VDC

GU102A — SEPERATE POWER SOURCE — STANDARD RELEASE — STANDARD STOPPING (AC-SWITCHING) — 20



MOTOR	RECTIFIER	V_{motor}	V_{B-AC}	V_{B-DC}
208-230YY/460Y	GUE40V	208 VAC	208-230 VAC	205 VDC
230YY/460Y	GUE40V	230 VAC	230 VAC	205 VDC
208-230YY/460Y	GUE40V	208 VAC	115 VAC	105 VDC
230YY/460Y	GUE40V	230 VAC	115 VAC	105 VDC

GU102B — SEPERATE POWER SOURCE — STANDARD RELEASE — STANDARD STOPPING (AC-SWITCHING) — 20



MOTOR	RECTIFIER	V_{motor}	V_{B-AC}	V_{B-DC}
208-230YY/460Y	GUE40V	460 VAC	460 VAC	205 VDC
230YY/460Y	GUE40V	460 VAC	460 VAC	205 VDC

✱ The normally open contact/s (NO) is not supplied by NORD. It must close at the same time power is supplied to the brake. The contact must be capable of switching inductive loads and/or be rated IEC AC3.

= Braking Method

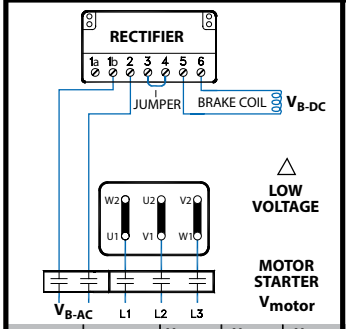
NORD Gear Limited
Toll Free in Canada: 800.668.4378

NORD Gear Corporation
Toll Free in the United States: 888.314.6673

Typical Connection Diagrams

GU102E — 20

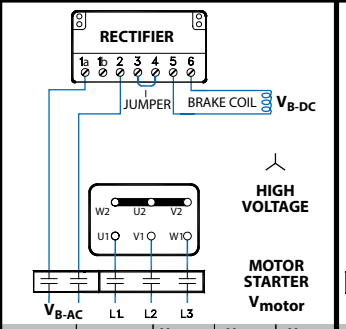
SEPERATE POWER SOURCE
STANDARD RELEASE
STANDARD STOPPING (AC-SWITCHING)



MOTOR	RECTIFIER	V_{motor}	V_{B-AC}	V_{B-DC}
230Δ/400Y	GUE40V	230 VAC	230 VAC	205 VDC

GU102F — 20

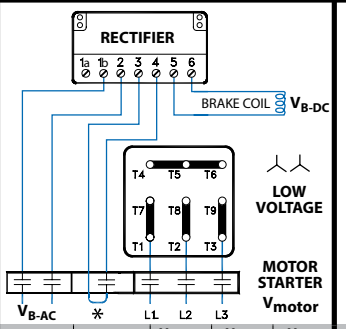
SEPERATE POWER SOURCE
STANDARD RELEASE
STANDARD STOPPING (AC-SWITCHING)



MOTOR	RECTIFIER	V_{motor}	V_{B-AC}	V_{B-DC}
230Δ/400Y	GUE40V	400 VAC	400 VAC	180 VDC

GU104A — 25

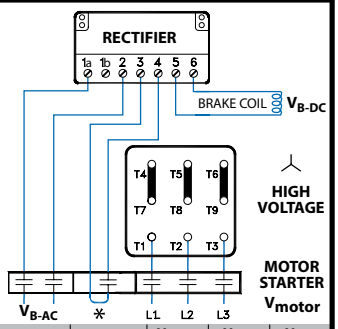
SEPERATE POWER SOURCE
STANDARD RELEASE
FAST STOPPING (DC-SWITCHING)



MOTOR	RECTIFIER	V_{motor}	V_{B-AC}	V_{B-DC}
208-230Y/460Y	GUE40V	208 VAC	208-230 VAC	205 VDC
230YY/460Y	GUE40V	230 VAC	230 VAC	205 VDC
208-230Y/460Y	GUE40V	208 VAC	115 VAC	105 VDC
230YY/460Y	GUE40V	230 VAC	115 VAC	105 VDC

GU104B — 25

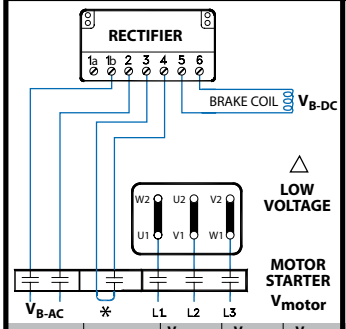
SEPERATE POWER SOURCE
STANDARD RELEASE
FAST STOPPING (DC-SWITCHING)



MOTOR	RECTIFIER	V_{motor}	V_{B-AC}	V_{B-DC}
208-230Y/460Y	GUE40V	460 VAC	460 VAC	205 VDC
230YY/460Y	GUE40V	460 VAC	460 VAC	205 VDC

GU104E — 25

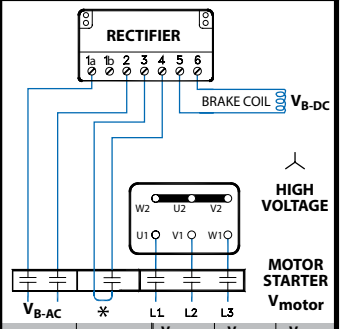
SEPERATE POWER SOURCE
STANDARD RELEASE
FAST STOPPING (DC-SWITCHING)



MOTOR	RECTIFIER	V_{motor}	V_{B-AC}	V_{B-DC}
230Δ/400Y	GUE40V	230 VAC	230 VAC	205 VDC

GU104F — 25

SEPERATE POWER SOURCE
STANDARD RELEASE
FAST STOPPING (DC-SWITCHING)



MOTOR	RECTIFIER	V_{motor}	V_{B-AC}	V_{B-DC}
230Δ/400Y	GUE40V	400 VAC	400 VAC	180 VDC

✻ The normally open contact/s (NO) is not supplied by NORD. It must close at the same time power is supplied to the brake. The contact must be capable of switching inductive loads and/or be rated IEC AC3.

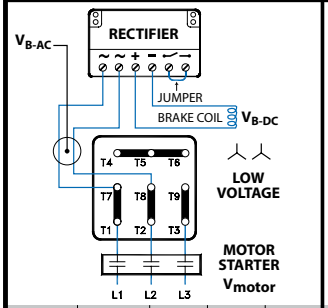
= Braking Method

MOTOR BRAKES INSTALLATION & MAINTENANCE

Typical Connection Diagrams

PMG101A

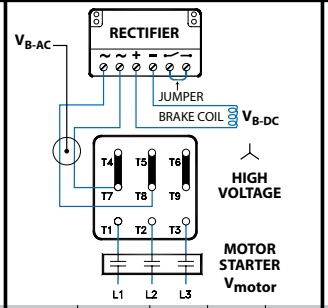
POWERED FROM MOTOR TERMINAL BLOCK — FAST-RELEASE (OVER EXCITATION) — NORMAL STOPPING (AC-SWITCHING) — 30



MOTOR	RECTIFIER	V_{motor}	V_{B-AC}	V_{B-DC}
230YY/460Y	PMG500	230 VAC	230 VAC	105 VDC

PMG101B

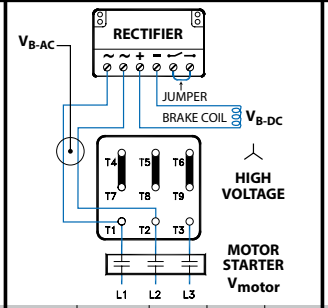
POWERED FROM MOTOR TERMINAL BLOCK — FAST-RELEASE (OVER EXCITATION) — NORMAL STOPPING (AC-SWITCHING) — 30



MOTOR	RECTIFIER	V_{motor}	V_{B-AC}	V_{B-DC}
230YY/460Y	PMG500	460 VAC	230 VAC	105 VDC

PMG101C

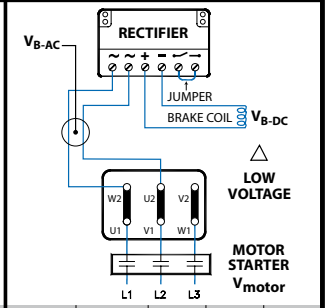
POWERED FROM MOTOR TERMINAL BLOCK — FAST-RELEASE (OVER EXCITATION) — NORMAL STOPPING (AC-SWITCHING) — 30



MOTOR	RECTIFIER	V_{motor}	V_{B-AC}	V_{B-DC}
230YY/460Y	PMG500	460 VAC	460 VAC	205 VDC

PMG101D

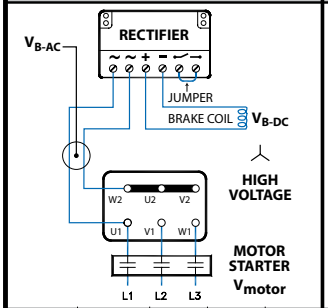
POWERED FROM MOTOR TERMINAL BLOCK — FAST-RELEASE (OVER EXCITATION) — NORMAL STOPPING (AC-SWITCHING) — 30



MOTOR	RECTIFIER	V_{motor}	V_{B-AC}	V_{B-DC}
208Δ/360Y	PMG500	208 VAC	208 VAC	105 VDC
230Δ/400Y	PMG500	230 VAC	230 VAC	105 VDC
400Δ/690Y	PMG500	400 VAC	400 VAC	180 VDC
460Δ/Y	PMG500	460 VAC	460 VAC	205 VDC

PMG101E

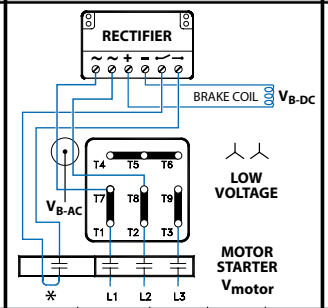
POWERED FROM MOTOR TERMINAL BLOCK — FAST-RELEASE (OVER EXCITATION) — NORMAL STOPPING (AC-SWITCHING) — 30



MOTOR	RECTIFIER	V_{motor}	V_{B-AC}	V_{B-DC}
230Δ/400Y	PMG500	400 VAC	230 VAC	105 VDC

PMG102A

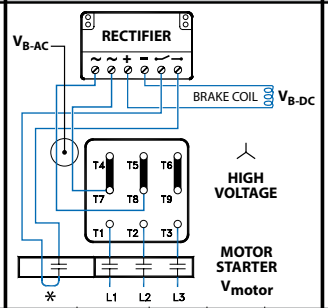
POWERED FROM MOTOR TERMINAL BLOCK — FAST-RELEASE (OVER EXCITATION) — FAST STOPPING (DC-SWITCHING) — 35



MOTOR	RECTIFIER	V_{motor}	V_{B-AC}	V_{B-DC}
230YY/460Y	PMG500	230 VAC	230 VAC	105 VDC

PMG102B

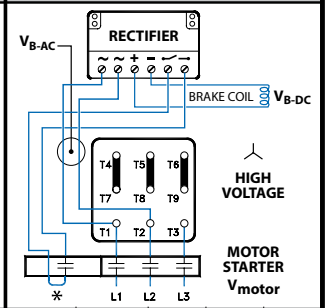
POWERED FROM MOTOR TERMINAL BLOCK — FAST-RELEASE (OVER EXCITATION) — FAST STOPPING (DC-SWITCHING) — 35



MOTOR	RECTIFIER	V_{motor}	V_{B-AC}	V_{B-DC}
230YY/460Y	PMG500	460 VAC	230 VAC	105 VDC

PMG102C

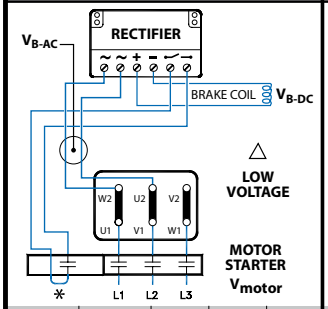
POWERED FROM MOTOR TERMINAL BLOCK — FAST-RELEASE (OVER EXCITATION) — FAST STOPPING (DC-SWITCHING) — 35



MOTOR	RECTIFIER	V_{motor}	V_{B-AC}	V_{B-DC}
230YY/460Y	PMG500	460 VAC	460 VAC	205 VDC

PMG102D

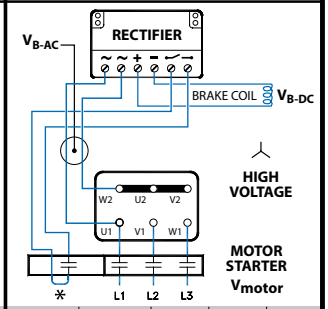
POWERED FROM MOTOR TERMINAL BLOCK — FAST-RELEASE (OVER EXCITATION) — FAST STOPPING (DC-SWITCHING) — 35



MOTOR	RECTIFIER	V_{motor}	V_{B-AC}	V_{B-DC}
208Δ/360Y	PMG500	208 VAC	208 VAC	105 VDC
230Δ/400Y	PMG500	230 VAC	230 VAC	105 VDC
400Δ/690Y	PMG500	400 VAC	400 VAC	180 VDC
460Δ/Y	PMG500	460 VAC	460 VAC	205 VDC

PMG102E

POWERED FROM MOTOR TERMINAL BLOCK — FAST-RELEASE (OVER EXCITATION) — FAST STOPPING (DC-SWITCHING) — 35



MOTOR	RECTIFIER	V_{motor}	V_{B-AC}	V_{B-DC}
230Δ/400Y	PMG500	400 VAC	230 VAC	105 VDC

✱ The normally open contact/s (NO) is not supplied by NORD. It must close at the same time power is supplied to the brake. The contact must be capable of switching inductive loads and/or be rated IEC AC3.

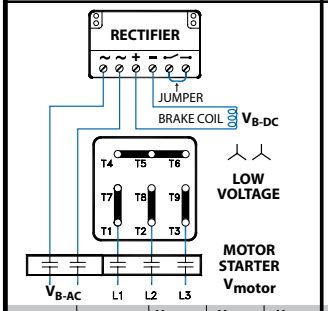
= Braking Method

Typical Connection Diagrams

PMG104A

45

SEPERATE POWER SOURCE
FAST-RELEASE (OVER EXCITATION)
NORMAL STOPPING (AC-SWITCHING)

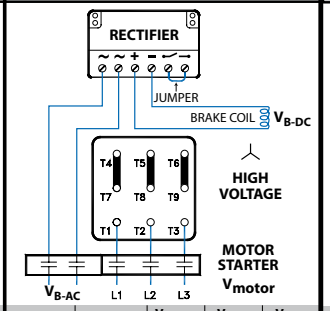


MOTOR	RECTIFIER	V_{motor}	V_{B-AC}	V_{B-DC}
230YY/460Y	PMG500	230 VAC	230 VAC	105 VDC

PMG104B

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SEPERATE POWER SOURCE
FAST-RELEASE (OVER EXCITATION)
NORMAL STOPPING (AC-SWITCHING)

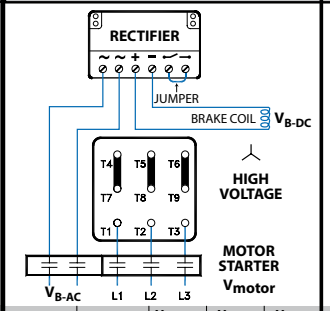


MOTOR	RECTIFIER	V_{motor}	V_{B-AC}	V_{B-DC}
230YY/460Y	PMG500	460 VAC	230 VAC	105 VDC

PMG104C

45

SEPERATE POWER SOURCE
FAST-RELEASE (OVER EXCITATION)
NORMAL STOPPING (AC-SWITCHING)

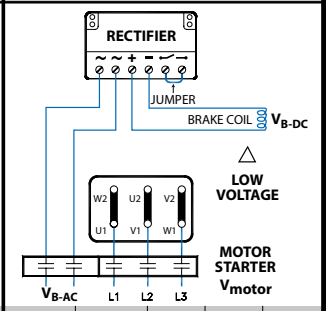


MOTOR	RECTIFIER	V_{motor}	V_{B-AC}	V_{B-DC}
230YY/460Y	PMG500	460 VAC	460 VAC	205 VDC

PMG104D

45

SEPERATE POWER SOURCE
FAST-RELEASE (OVER EXCITATION)
NORMAL STOPPING (AC-SWITCHING)

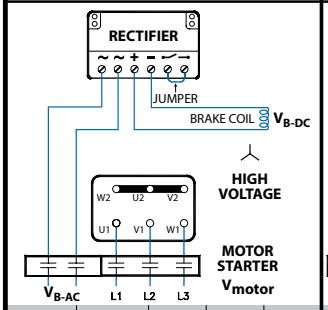


MOTOR	RECTIFIER	V_{motor}	V_{B-AC}	V_{B-DC}
208Δ/360Y	PMG500	208 VAC	208 VAC	105 VDC
230Δ/400Y	PMG500	230 VAC	230 VAC	105 VDC
400Δ/690Y	PMG500	400 VAC	400 VAC	180 VDC
460Δ/Y	PMG500	460 VAC	460 VAC	205 VDC

PMG104E

45

SEPERATE POWER SOURCE
FAST-RELEASE (OVER EXCITATION)
NORMAL STOPPING (AC-SWITCHING)

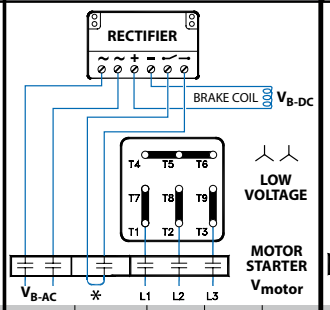


MOTOR	RECTIFIER	V_{motor}	V_{B-AC}	V_{B-DC}
230Δ/400Y	PMG500	400 VAC	230 VAC	105 VDC

PMG105A

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SEPERATE POWER SOURCE
FAST-RELEASE (OVER EXCITATION)
FAST STOPPING (DC-SWITCHING)

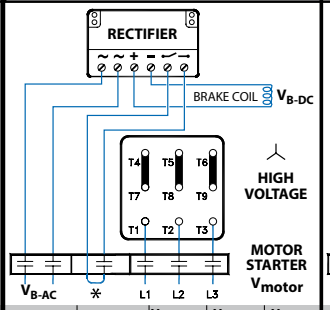


MOTOR	RECTIFIER	V_{motor}	V_{B-AC}	V_{B-DC}
230YY/460Y	PMG500	230 VAC	230 VAC	105 VDC

PMG105B

50

SEPERATE POWER SOURCE
FAST-RELEASE (OVER EXCITATION)
FAST STOPPING (DC-SWITCHING)

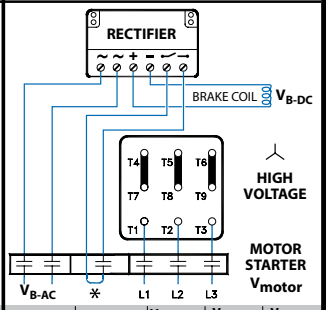


MOTOR	RECTIFIER	V_{motor}	V_{B-AC}	V_{B-DC}
230YY/460Y	PMG500	460 VAC	230 VAC	105 VDC

PMG105C

50

SEPERATE POWER SOURCE
FAST-RELEASE (OVER EXCITATION)
FAST STOPPING (DC-SWITCHING)

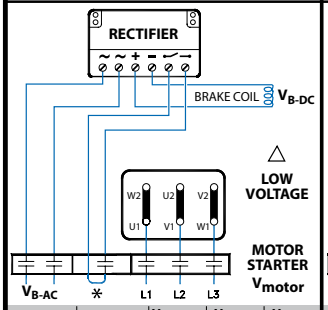


MOTOR	RECTIFIER	V_{motor}	V_{B-AC}	V_{B-DC}
230YY/460Y	PMG500	460 VAC	460 VAC	205 VDC

PMG105D

50

SEPERATE POWER SOURCE
FAST-RELEASE (OVER EXCITATION)
FAST STOPPING (DC-SWITCHING)

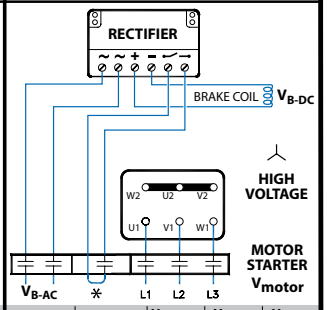


MOTOR	RECTIFIER	V_{motor}	V_{B-AC}	V_{B-DC}
208Δ/360Y	PMG500	208 VAC	208 VAC	105 VDC
230Δ/400Y	PMG500	230 VAC	230 VAC	105 VDC
400Δ/690Y	PMG500	400 VAC	400 VAC	180 VDC
460Δ/Y	PMG500	460 VAC	460 VAC	205 VDC

PMG105E

50

SEPERATE POWER SOURCE
FAST-RELEASE (OVER EXCITATION)
FAST STOPPING (DC-SWITCHING)

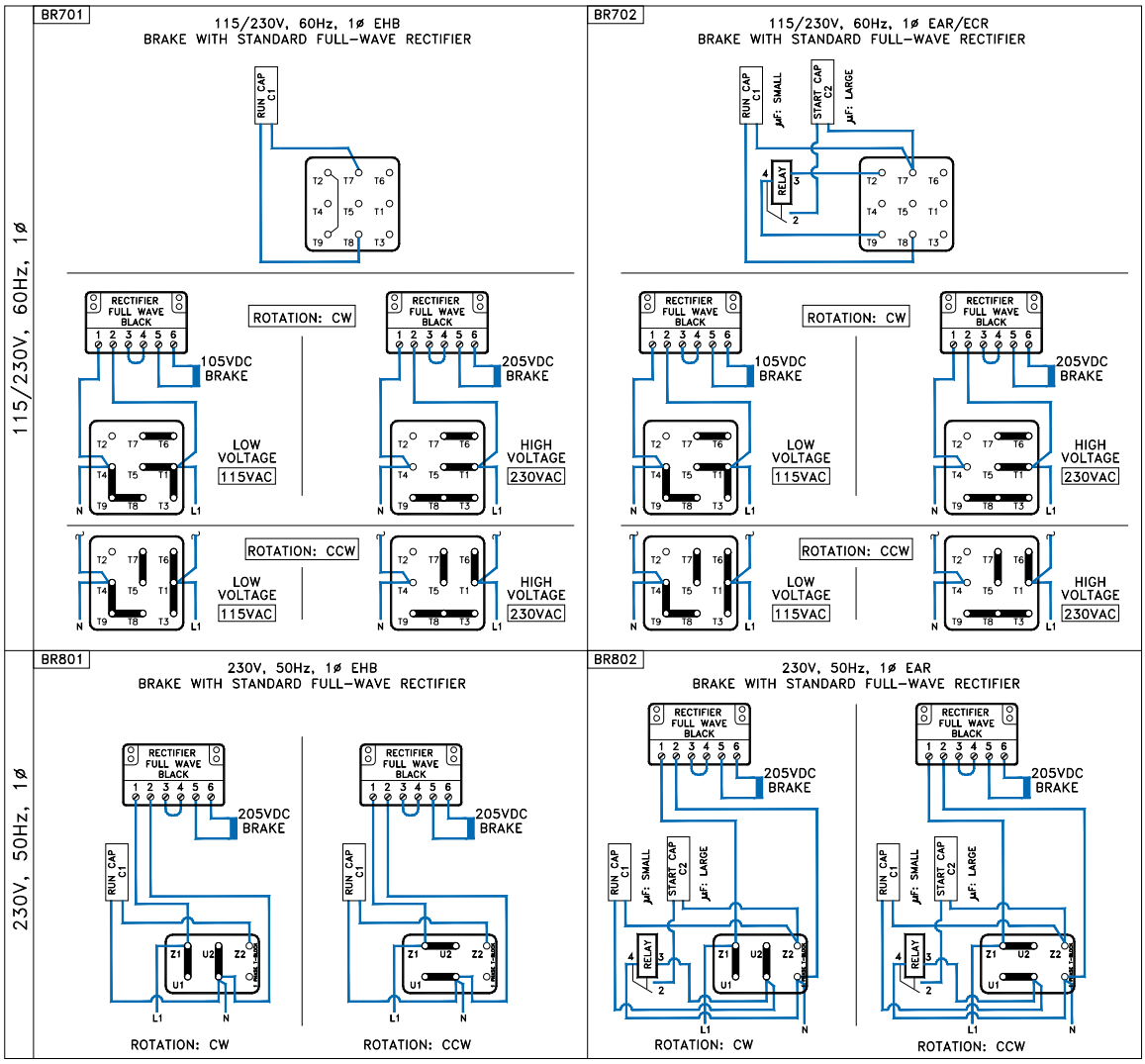


MOTOR	RECTIFIER	V_{motor}	V_{B-AC}	V_{B-DC}
230Δ/400Y	PMG500	400 VAC	230 VAC	105 VDC

* The normally open contact/s (NO) is not supplied by NORD. It must close at the same time power is supplied to the brake. The contact must be capable of switching inductive loads and/or be rated IEC AC3.

= Braking Method

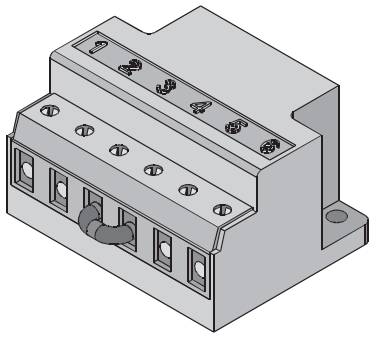
Typical Connection Diagrams - Single Phase Motors



Troubleshooting Information

Troubleshooting	Cause	Remedy
Brake doesn't release	Air gap too large	Check air gap and adjust
	Brake not recieving electrical power	Check electrical connection
	Failed rectifier	Replace rectifier
	Brake is getting too warm	Use fast response (FR) rectifier
	Voltage to brake coil too small	Check connection voltageof brake coil
	Rectifier supply voltage from inverter	Rectifier voltage must be from seperate source. (Inverter output voltage varies)
Brake release is delayed	Air gap too large	Check air gap and adjust
	Voltage to brake coil too small	Check connection voltage of brake coil
Brake does not engage	Voltage to coil too large	Check connection voltages of brake windings
	Hand release is adjusted incorrectly	Adjust to correct air gap
	Anchor plate mechanically blocked	Remove mechanical blockage
Brake engagement is delayed	Voltage to coil too large	Check connection voltage of brake windings
	Brake is switched to AC side	Use DC switching

FAST ACTING BRAKE RECTIFIERS (GPE, GPU & PMG)



General Instructions

This manual provides general operating instructions for the "Fast Acting Brake Rectifiers type "GPE, GPU, and PMG" that are commonly offered by NORD in addition to the standard brake control rectifiers. Please feel free to contact NORD with any questions concerning the supplied brake rectifiers and brake components.

Safety Notice

Only qualified personnel should attempt installation, operation and maintenance of NORD brakes and brake rectifiers. If you have a question about a procedure or are uncertain about any detail, seek clarification and DO NOT PROCEED.

⚠ DANGER

- This equipment contains high electrical voltage. Remove and lockout all power from the electric motor and brake before any work is completed on the brake.
- The user is responsible for conforming to all national and local electrical and safety codes. Wiring practices, proper grounding, disconnects, and over current protection, are of particular importance.
- Make certain the load is supported when servicing the brake. Removing power from the brake or removing the brake from the motor will release the load, which may cause severe injury or death.
- Failure to follow proper procedures and precautions may result in severe bodily injury or death.

Brake Control Rectifiers

NORD brake control rectifiers convert AC voltage to DC voltage. Rectifiers are used because most applications require AC voltage to power the motor, but DC power is required to power the brake and DC power is not typically available. NORD brakemotors typically include the rectifier located inside the terminal box.

Rectifier Advantages

- Individual power source for each brake.
- Compact size, mounted inside the terminal box.
- Multiple types, voltage options and release/engagement modes available.
- Mountable in a separate control cabinet.
- Integral protection against voltage spikes.

Standard Rectifier Types

Full-Wave Rectifier

A rectifier in which both the positive and negative half-cycles of the AC input signal are rectified to produce a uni-directional DC current supply to the load or the brake. The output voltage is 90% of the input voltage ($V_{DC} = 0.90 \times V_{AC}$).

Half-Wave Rectifier

A rectifier in which only alternate half-cycles of the AC input signal are rectified to produce a uni-directional DC current supply to the load or the brake. The output voltage is 45% of the input voltage ($V_{DC} = 0.45 \times V_{AC}$).

Dual-Wave Rectifier

A rectifier that can be wired as either a full-wave rectifier or a half-wave rectifier depending upon how it is connected to the AC input signal.

IMPORTANT NOTE

This manual provides general operating instructions for NORD brakes with Fast-Acting brake Rectifiers. For additional brake and brake rectifier information please reference User Manual U35000.

Fast-Acting or Push-Hybrid Rectifiers [GPE, GPU & PMG]

A push-hybrid rectifier or fast-acting brake rectifier provides an initial "push" in the form of a timed full-wave brake-release function, which is then followed by a continuous half-wave brake-holding function. There are two ways to apply these rectifiers as follows:

- "Overexcitation" of the brake coil provides faster brake release or improved cycling capacity. The DC voltage of the brake coil is determined based upon using a half-wave rectifier. The output voltage is 45% of the input voltage ($V_{DC} = 0.45 \times V_{AC}$).
- "Reducer-Power Holding" of the brake coil maintains the brake in a released state by using only 25% of the power needed for the initial brake release. This results in very fast brake stopping. The DC voltage of the brake coil is determined based upon using a full-wave rectifier. The output voltage is 90% of the input voltage. ($V_{DC} = 0.90 \times V_{AC}$).

NOTICE

In order to prevent rapid wear, the PMG 500 rectifier is required when utilizing the larger 800 Nm (590 lb-ft) and 1200 Nm (885 lb-ft) twin-rotor brakes. The PMG500 rectifier is wired to "overexcite" the brake during its initial release.

FAST ACTING BRAKE RECTIFIERS (GPE, GPU & PMG)

Push-Hybrid Rectifiers External DC Switching (GPE)

Like the standard NORD brake control rectifiers, NORD's fast acting brake control rectifiers convert AC voltage to DC voltage. The "Fast Acting Brake Rectifiers"are utilized to improve brake performance and are often recommended in order to provide shorter brake release times or to provide faster stopping times.

The fast acting rectifiers are a two-stage "push" design. When power is first applied these rectifiers operate like a full-wave rectifier and then after a relatively short period of time they act like a half-wave rectifier. The GPE type rectifiers start out in full-wave mode when power is first applied and then after approximately 250 ms they switch to half-wave mode.

GPE rectifiers were designed for external control of the brake's DC-switching. GPE rectifiers are primarily used in across-the-line applications where the brake power is supplied by the motor terminals but they may also be used in situations where the brake power is supplied separately to the brake rectifier.

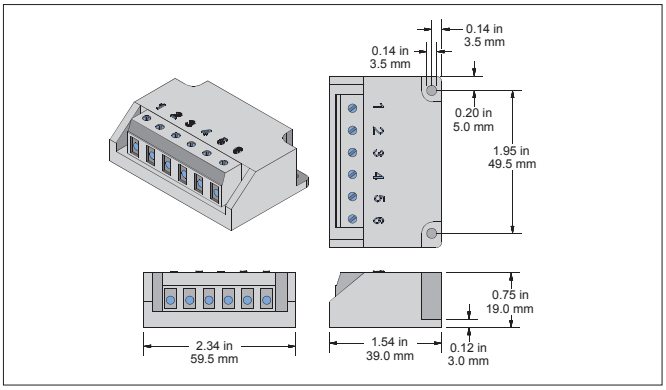
There are two ways to apply the fast acting rectifiers:

- The first method, known as "Overexcitation," provides fast brake release. The brake coil is selected like a half-wave system (45% of the AC supply voltage).
- The second method, known as "Reduced Power Holding," provides very fast brake stopping. The brake coil is selected like a full-wave system (90% of the AC supply voltage).

IMPORTANT NOTE

If the motor is connected to a frequency inverter, soft start, or is a two-speed motor, then seperate AC power must be supplied to the brake rectifier.

GPE Rectifier Dimensions



Ratings & Part Numbers

Model Type	GPE20L	GPE40L
Part Number	19140230	19140240
Protection (electronics)	Coated	Coated
Color	Black	
Input Voltage (V_{AC})	200V-275V	380V-480V
Output Voltage (V_{DC})	(V_{DC}=0.45 x V_{AC}) - As Half-Wave (V_{DC}=0.90 x V_{AC}) - As Full-Wave	
Rated Current @ 40°C	0.7 A	0.7A
Rated Current @ 75°C	0.5 A	0.5A
Temperature Range	-20°C to 75°C	
DC-Switching via	External Contact or IR Relay	

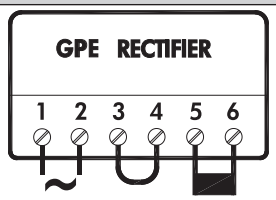
Braking Method

Braking Method	Break Release (Start)	Brake Engage (Stop)	Power Source
40	Standard	Very Fast (Reduced Power Holding)	Motor terminals
30	Fast (Overecitation)	Standard (AC Switching)	Motor terminals
35	Fast (Overecitation)	Fast (DC Switching)	Motor terminals

Basic Connection (AC & DC Switching)

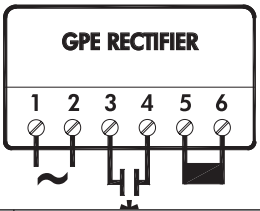
The GPE brake system can be connected for standard stopping (AC-Switching), fast stopping (DC-Switching) and very fast stopping (Reduced power holding & DC-Switching). Fast brake release can also be achieved by selecting a different brake coil combination.

STANDARD STOPPING (AC-SWITCHING)



1 & 2	3 & 4	5 & 6
AC BRAKE VOLTAGE	JUMPER	DC BRAKE

FAST & VERY FAST STOPPING (DC-SWITCHING)



1 & 2	3 & 4	5 & 6
AC BRAKE VOLTAGE	NORMALLY OPEN CONTACT	DC BRAKE

* The normally open contact/s (NO) is not supplied by NORD it must close at the same time power is supplied to the brake. The contact must be capable of switching inductive loads and/or be rated at IEC AC3.

FAST ACTING BRAKE RECTIFIERS (GPE, GPU & PMG)

Push-Hybrid Rectifiers Integrated DC Switching (GPU)

Like the standard NORD brake control rectifiers, NORD's fast acting brake control rectifiers convert AC voltage to DC voltage. The "Fast Acting Brake Rectifiers"are utilized to improve brake performance and are often recommended in order to provide shorter brake release times or to provide faster stopping times.

The fast acting rectifiers are a two-stage "push" design. When power is first applied these rectifiers operate like a full-wave rectifier and then after a relatively short period of time they act like a half-wave rectifier. The GPU rectifiers start out in full-wave mode when power is first applied and then after approximately 250 ms they switch to half-wave mode.

GPU rectifiers were designed for integrated control of the brake's DC-switching and are voltage sensing. GPU rectifiers are primarily used in applications where there is a frequency inverter, soft start, or two-speed motor. Seperate AC power must be supplied to the brake rectifier.

There are two ways to apply the fast acting rectifiers:

- The first method, known as "Overexcitation," provides fast brake release. The brake coil is selected like a half-wave system (45% of the AC supply voltage).
- The second method, known as "Reduced Power Holding," provides very fast brake stopping. The brake coil is selected like a full-wave system (90% of the AC supply voltage).

IMPORTANT NOTE

The GPU rectifier may also be utilized for across-the-line applications; however it must always be powered separate from the motor and have its own pair of contactors or starters. It is unadvisable to use the motor terminal block to supply the GPU rectifier's AC power due to the motor's slow energy dissipation when switched off.

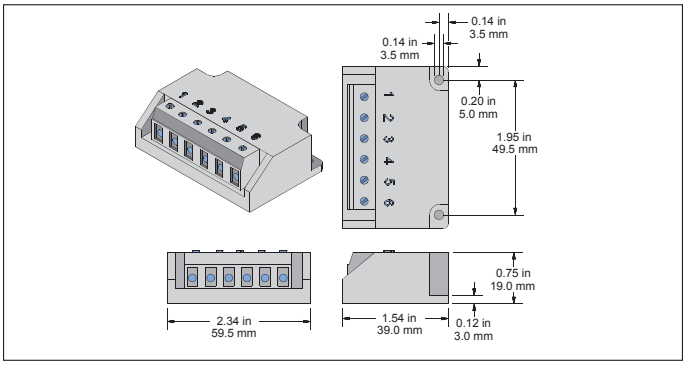
IMPORTANT NOTE

If the motor is connected to a frequency inverter, soft start, or is a two-speed motor, then seperate AC power must be supplied to the brake rectifier.

Braking Method

Braking Method	Break Release (Start)	Brake Engage (Stop)	Power Source
55	Standard	Very Fast (Reduced Power Holding)	Seperate power
45	Fast (Overecitation)	Standard (AC Switching)	Seperate power
50	Fast (Overecitation)	Fast (DC Switching)	Seperate power

GPU Rectifier Dimensions



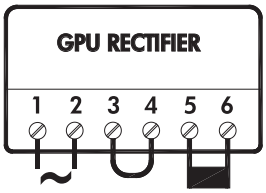
Ratings & Part Numbers

Model Type	GPU20L	GPU40L
Part Number	19140090	19140170
Protection (electronics)	Coated	Coated
Color	Black	
Input Voltage (V_{AC})	200V-275V	380V-480V
Output Voltage (V_{DC})	(V_{DC}=0.45 x V_{AC}) - As Half-Wave (V_{DC}=0.90 x V_{AC}) - As Full-Wave	
Rated Current @ 40°C	0.7A	0.7A
Rated Current @ 75°C	0.5A	0.5A
Temperature Range	-20°C to 75°C	
DC-Switching via	Internal Activation	

Basic Connection (AC & DC Switching)

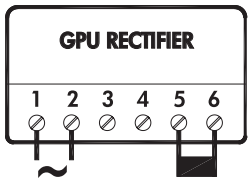
The GPU brake system can be connected for standard stopping (AC-Switching), fast stopping (DC-Switching) and very fast stopping (Reduced power holding & DC-Switching). Fast brake release can also be achieved by selecting a different brake coil combination.

STANDARD STOPPING AC-SWITCHING



1 & 2	3 & 4	5 & 6
AC BRAKE VOLTAGE	JUMPER	DC BRAKE

FAST & VERY FAST STOPPING DC-SWITCHING



1 & 2	3 & 4	5 & 6
AC BRAKE VOLTAGE	-	DC BRAKE

FAST ACTING BRAKE RECTIFIERS (GPE, GPU & PMG)

Push-Hybrid Rectifiers External DC Switching (PMG)

Like the standard NORD brake control rectifiers, NORD's fast acting brake control rectifiers convert AC voltage to DC voltage. The "Fast Acting Brake Rectifiers"are utilized to improve brake performance and are often recommended in order to provide shorter brake release times or to provide faster stopping times.

The fast acting rectifiers are a two-stage "push" design. When power is first applied these rectifiers operate like a full-wave rectifier and then after a relatively short period of time they act like a half-wave rectifier. The PMG type rectifiers start out in full-wave mode when power is first applied and then after approximately 250 ms they switch to half-wave mode.

PMG rectifiers were designed for external control of the brake's DC-switching. PMG rectifiers are primarily used in across-the-line applications where the brake power is supplied by the motor terminals, but they may also be used in situations where the brake power is supplied separately from the brake rectifier.

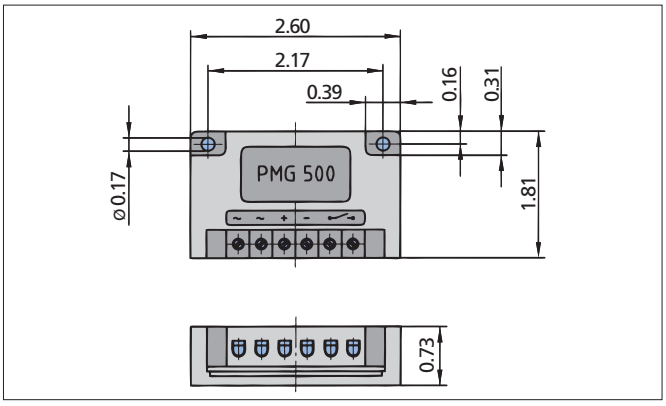
There are two ways to apply the fast acting rectifiers:

- The first method, known as "Overexcitation," provides fast brake release. The brake coil is selected like a half-wave system (45% of the AC supply voltage).
- The second method, known as "Reduced Power Holding," provides very fast brake stopping. The brake coil is selected like a full-wave system (90% of the AC supply voltage).

IMPORTANT NOTE

If the motor is connected to a frequency inverter, soft start, or is a two-speed motor, then seperate AC power must be supplied to the brake rectifier.

PMG Rectifier Dimensions



Ratings & Part Numbers

Model Type	PMG 500
Part Number	19140200
Protection (electronics)	Coated
Color	Black
Input Voltage (V_{AC})	200-500V_{AC} +/- 10%
Output Voltage (V_{DC})	(V_{DC}=0.45 x V_{AC}) - As Half-Wave (V_{DC}=0.90 x V_{AC}) - As Full-Wave
Rated Current @ 40°C	4.0 A
Rated Current @ 75°C	2.8 A
Temperature Range	-15°C to 80°C
DC-Switching via	External Contact

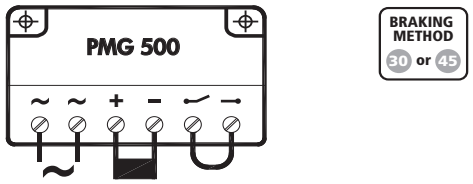
Braking Method

Braking Method	Break Release (Start)	Brake Engage (Stop)	Power Source
40	Standard	Very Fast (Reduced Power Holding)	Motor terminals
30	Fast (Overecitation)	Standard (AC Switching)	Motor terminals
35	Fast (Overecitation)	Fast (DC Switching)	Motor terminals
55	Standard	Very Fast (Reduced Power Holding)	Seperate power
45	Fast (Overecitation)	Standard (AC Switching)	Seperate power
50	Fast (Overecitation)	Fast (DC Switching)	Seperate power

Basic Connection (AC & DC Switching)

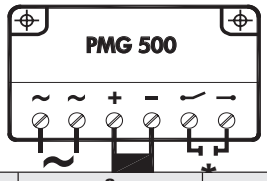
The PMG brake system can be connected for standard stopping (AC-Switching), fast stopping (DC-Switching) and very fast stopping (Reduced power holding & DC-Switching). Fast brake release can also be achieved by selecting a different brake coil combination.

STANDARD STOPPING (AC-SWITCHING)



~ & ~	+ & -	⏦ & ⊸
AC BRAKE VOLTAGE	DC BRAKE	JUMPER

FAST & VERY FAST STOPPING (DC-SWITCHING)



~ & ~	+ & -	⏦ & ⊸
AC BRAKE VOLTAGE	DC BRAKE	NORMALLY OPEN CONTACT

* The normally open contact/s (NO) is not supplied by NORD it must close at the same time power is supplied to the brake. The contact must be capable of switching inductive loads and/or be rated at IEC AC3.

Brake Times & Electrical Selection

Brake timing performance is critical in selecting the optimal brake system. NORD brakes can provide exceptional performance in terms of the release (start) times and engagement (stop) times. Use the following guidelines in order to select the correct brake control components and connections.

1) Determine if the brake needs to be wired directly from the motor terminal block or powered by a separate source.

- If you are using a frequency inverter, soft-start or a two speed motor you will need to supply the rectifier from a separate power source.

- If the motor is powered direct across-the-line the rectifier power can be supplied from the motor's terminal block.

2) What type of performance do I need?

- Is the standard brake performance OK?

- Is a higher performance required for fast brake release or very fast brake stopping?

3) Determine the brake supply voltage and check the rectifier compatability using the table on the page 6.

Selection Suggestions

When Fast or Very Fast Stopping is Recommended

Any applications that require quick stops and positive action at stand-still

Recommended Applications

- conveyors and inclined conveyors
- hoists and lifts
- bulk material handling equipment (bucket elevators, idler conveyor's).

> ⚠ ***WARNING***
>
> **Hoisting (lifting/lowering) applications** - must have the brake wired for fast response (DC-switching) Hoisting (lifting/lowering) applications must have the brake wired for fast response to protect against injury or damage to the equipment.

When Fast-Release is Recommended (Overexcitation)

Any application that is very high-cycling with frequent starts and stops. These applications require the brake to release very-quickly in order to avoid excessive heat build-up in the AC motor and brake coil.

Recommended Applications

- Index conveyors
- Diverters

Power Source	Brake Release (start)	Brake engagement (stop)	Braking Method *	Rectifier
Motor Terminal Block	Standard	Very Fast (Reduced power holding)	40	GPE or PMG 500
	Fast (Overexcitation)	Standard (AC switching)	30	GPE or PMG 500
	Fast (Overexcitation)	Fast (DC switching)	35	GPE or PMG 500
Seperate Power Source	Standard	Very Fast (Reduced power holding)	55	GPU or PMG 500
	Fast (Overexcitation)	Standard (AC switching)	45	GPU or PMG 500
	Fast (Overexcitation)	Fast (DC switching)	50	GPU or PMG 500

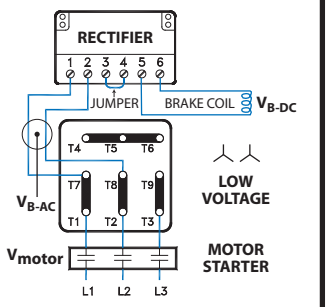
*** Braking methods referenced in connection diagrams on pages 7-11.**

FAST ACTING BRAKE RECTIFIERS (GPE, GPU & PMG)

Rectifier Supply Voltage (VAC)	Brake Coil Voltage (VDC)	Braking Method	Rectifier Type	Rectifier P/N	BRE 5	BRE 10	BRE 20	BRE 40	BRE 60	BRE 100	BRE 150	BRE 250	BRE 400	BRE 800	BRE 1200
208 (200-208)	105	30	GPE20L	19140230	X	X	X	X							
	105	30	PMG500	19140200					X	X	X	X	X	X	X
	105	35	GPE20L	19140230	X	X	X	X							
	105	35	PMG500	19140200					X	X	X	X	X	X	X
	180	40	GPE20L	19140230	X	X	X	X	X	X	X				
	180	40	PMG500	19140200								X	X	X	X
	105	45	GPU20L	19140090	X	X	X	X							
	105	45	PMG500	19140200					X	X	X	X	X	X	X
	105	50	GPU20L	19140090	X	X	X	X							
	105	50	PMG500	19140200					X	X	X	X	X	X	X
	180	55	GPU20L	19140090	X	X	X	X	X	X	X				
	180	55	PMG500	19140200								X	X	X	X
230 (220-240)	105	30	GPE20L	19140230	X	X	X	X							
	105	30	PMG500	19140200					X	X	X	X	X	X	X
	105	35	GPE20L	19140230	X	X	X	X	X	X	X				
	105	35	PMG500	19140200								X	X	X	X
	205	40	GPE20L	19140230	X	X	X	X	X	X	X				
	205	40	PMG500	19140200								X	X	X	X
	105	45	GPU20L	19140090	X	X	X	X							
	105	45	PMG500	19140200					X	X	X	X	X	X	X
	105	50	GPU20L	19140090	X	X	X	X							
	105	50	PMG500	19140200					X	X	X	X	X	X	X
	205	55	GPU20L	19140090	X	X	X	X	X	X	X				
	205	55	PMG500	19140200								X	X	X	X
332	180	30	GPE40L	19140240	X	X	X	X	X	X	X				
	180	30	PMG500	19140200								X	X	X	X
	180	35	GPE40L	19140240	X	X	X	X	X	X	X				
	180	35	PMG500	19140200								X	X	X	X
	180	45	GPU40L	19140170	X	X	X	X	X	X	X				
	180	50	GPU40L	19140170	X	X	X	X	X	X	X				
400 (380-415)	180	30	GPE40L	19140240	X	X	X	X	X	X	X				
	180	30	PMG500	19140200								X	X	X	X
	180	35	GPE40L	19140240	X	X	X	X	X	X	X				
	180	35	PMG500	19140200								X	X	X	X
	180	45	GPU20L	19140090	X	X	X	X	X	X	X				
	180	45	PMG500	19140200								X	X	X	X
	180	50	GPU20L	19140090	X	X	X	X	X	X	X				
	180	50	PMG500	19140200								X	X	X	X
460 (440-480)	205	30	GPE40L	19140240	X	X	X	X	X	X	X				
	205	30	PMG500	19140200								X	X	X	X
	205	35	GPE40L	19140240	X	X	X	X	X	X	X				
	205	35	PMG500	19140200								X	X	X	X
	205	45	GPU40L	19140170	X	X	X	X	X	X	X				
	205	45	PMG500	19140200								X	X	X	X
	205	50	GPU40L	19140170	X	X	X	X	X	X	X				
	205	50	PMG500	19140200								X	X	X	X

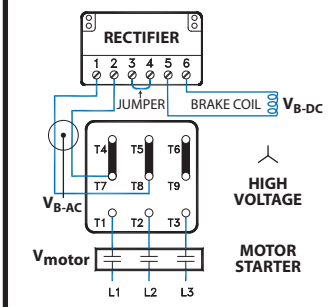
FAST ACTING BRAKE RECTIFIERS (GPE, GPU & PMG)

GP101A — POWERED FROM MOTOR TERMINAL BLOCK — FAST-RELEASE (OVER EXCITATION) — NORMAL STOPPING (AC-SWITCHING) — 30



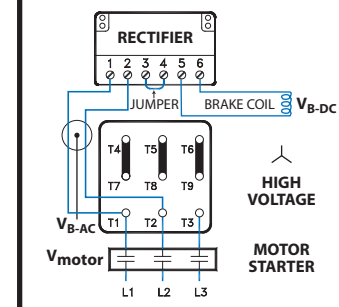
MOTOR	RECTIFIER	Vmotor	VB-AC	VB-DC
230YY/460Y	GPE20L	230 VAC	230 VAC	105 VDC

GP101B — POWERED FROM MOTOR TERMINAL BLOCK — FAST-RELEASE (OVER EXCITATION) — NORMAL STOPPING (AC-SWITCHING) — 30



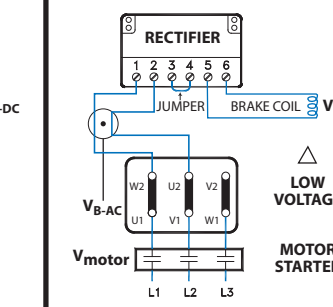
MOTOR	RECTIFIER	Vmotor	VB-AC	VB-DC
230YY/460Y	GPE20L	460 VAC	230 VAC	105 VDC

GP101C — POWERED FROM MOTOR TERMINAL BLOCK — FAST-RELEASE (OVER EXCITATION) — NORMAL STOPPING (AC-SWITCHING) — 30



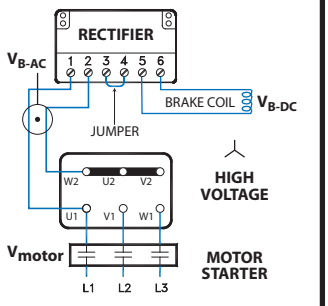
MOTOR	RECTIFIER	Vmotor	VB-AC	VB-DC
230YY/460Y	GPE40L	460 VAC	460 VAC	205 VDC

GP101D — POWERED FROM MOTOR TERMINAL BLOCK — FAST-RELEASE (OVER EXCITATION) — NORMAL STOPPING (AC-SWITCHING) — 30



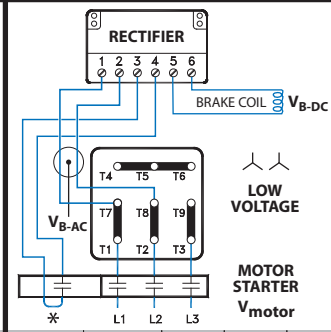
MOTOR	RECTIFIER	Vmotor	VB-AC	VB-DC
208Δ/360Y	GPE20L	208 VAC	208 VAC	105 VDC
230Δ/400Y	GPE20L	230 VAC	230 VAC	105 VDC
400Δ/690Y	GPE40L	400 VAC	400 VAC	180 VDC
460Δ/Y	GPE40L	460 VAC	460 VAC	205 VDC

GP101E — POWERED FROM MOTOR TERMINAL BLOCK — FAST-RELEASE (OVER EXCITATION) — NORMAL STOPPING (AC-SWITCHING) — 30



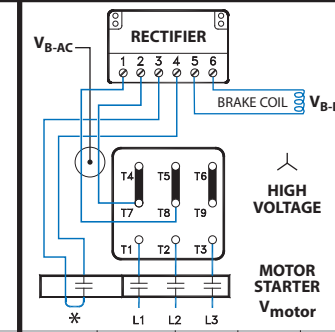
MOTOR	RECTIFIER	Vmotor	VB-AC	VB-DC
230Δ/400Y	GPE20L	400 VAC	230 VAC	105 VDC
332Δ/575Y	GPE40L	575 VAC	332 VAC	180 VDC

GP102A — POWERED FROM MOTOR TERMINAL BLOCK — FAST-RELEASE (OVER EXCITATION) — FAST STOPPING (DC-SWITCHING) — 35



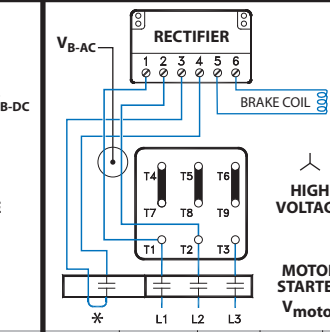
MOTOR	RECTIFIER	Vmotor	VB-AC	VB-DC
230YY/460Y	GPE20L	230 VAC	230 VAC	105 VDC

GP102B — POWERED FROM MOTOR TERMINAL BLOCK — FAST-RELEASE (OVER EXCITATION) — FAST STOPPING (DC-SWITCHING) — 35



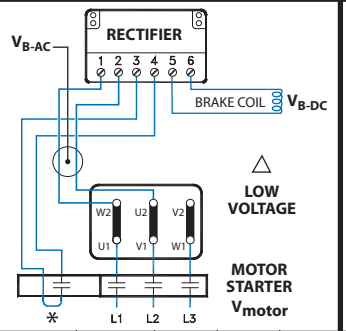
MOTOR	RECTIFIER	Vmotor	VB-AC	VB-DC
230YY/460Y	GPE20L	460 VAC	230 VAC	105 VDC

GP102C — POWERED FROM MOTOR TERMINAL BLOCK — FAST-RELEASE (OVER EXCITATION) — FAST STOPPING (DC-SWITCHING) — 35



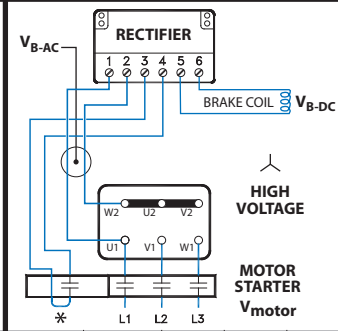
MOTOR	RECTIFIER	Vmotor	VB-AC	VB-DC
230YY/460Y	GPE40L	460 VAC	460 VAC	205 VDC

GP102D — POWERED FROM MOTOR TERMINAL BLOCK — FAST-RELEASE (OVER EXCITATION) — FAST STOPPING (DC-SWITCHING) — 35



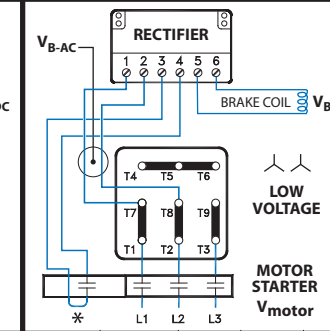
MOTOR	RECTIFIER	Vmotor	VB-AC	VB-DC
208Δ/360Y	GPE20L	208 VAC	208 VAC	105 VDC
230Δ/400Y	GPE20L	230 VAC	230 VAC	105 VDC
400Δ/690Y	GPE40L	400 VAC	400 VAC	180 VDC
460Δ/Y	GPE40L	460 VAC	460 VAC	205 VDC

GP102E — POWERED FROM MOTOR TERMINAL BLOCK — FAST-RELEASE (OVER EXCITATION) — FAST STOPPING (DC-SWITCHING) — 35



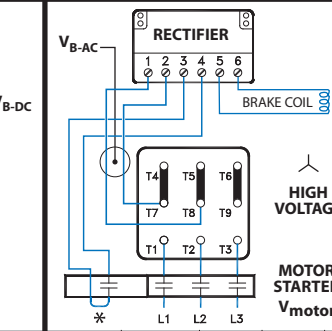
MOTOR	RECTIFIER	Vmotor	VB-AC	VB-DC
230Δ/400Y	GPE20L	400 VAC	230 VAC	105 VDC
332Δ/575Y	GPE40L	575 VAC	332 VAC	180 VDC

GP103A — POWERED FROM MOTOR TERMINAL BLOCK — STANDARD RELEASE — VERY FAST STOPPING (DC-SWITCHING + REDUCED POWER HOLDING) — 40



MOTOR	RECTIFIER	Vmotor	VB-AC	VB-DC
230YY/460Y	GPE20L	230 VAC	230 VAC	205 VDC

GP103B — POWERED FROM MOTOR TERMINAL BLOCK — STANDARD RELEASE — VERY FAST STOPPING (DC-SWITCHING + REDUCED POWER HOLDING) — 40



MOTOR	RECTIFIER	Vmotor	VB-AC	VB-DC
230YY/460Y	GPE20L	460 VAC	230 VAC	205 VDC

* The normally open contact/s (NO) is not supplied by NORD. It must close at the same time power is supplied to the brake. The contact must be capable of switching inductive loads and/or be rated IEC AC3.

= Braking Method

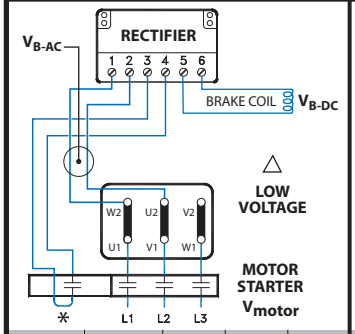
NORD Gear Limited
Toll Free in Canada: 800.668.4378

NORD Gear Corporation
Toll Free in the United States: 888.314.6673

FAST ACTING BRAKE RECTIFIERS (GPE, GPU & PMG)

GP103C — 40

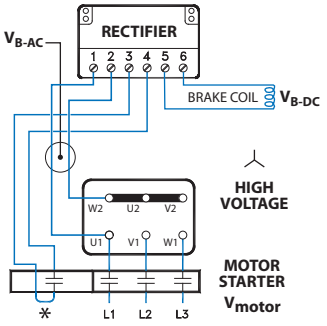
POWERED FROM MOTOR TERMINAL BLOCK
STANDARD RELEASE
VERY FAST STOPPING
(DC-SWITCHING + REDUCED POWER HOLDING)



MOTOR	RECTIFIER	V_{motor}	V_{B-AC}	V_{B-DC}
208Δ/360Y	GPE20L	208 VAC	208 VAC	180 VDC
230Δ/400Y	GPE20L	230 VAC	230 VAC	205 VDC

GP103D — 40

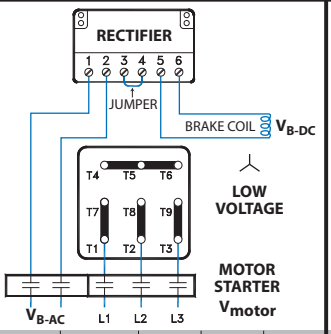
POWERED FROM MOTOR TERMINAL BLOCK
STANDARD RELEASE
VERY FAST STOPPING
(DC-SWITCHING + REDUCED POWER HOLDING)



MOTOR	RECTIFIER	V_{motor}	V_{B-AC}	V_{B-DC}
230Δ/400Y	GPE20L	400 VAC	230 VAC	205 VDC

GP104A — 45

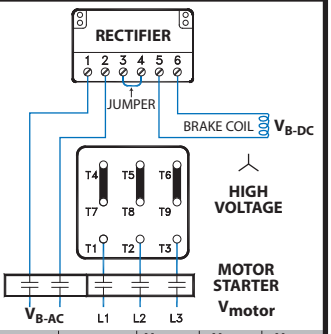
SEPERATE POWER SOURCE
FAST-RELEASE (OVER EXCITATION)
NORMAL STOPPING (AC-SWITCHING)



MOTOR	RECTIFIER	V_{motor}	V_{B-AC}	V_{B-DC}
230YY/460Y	GPU20L	230 VAC	230 VAC	105 VDC

GP104B — 45

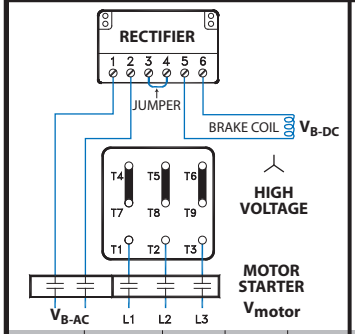
SEPERATE POWER SOURCE
FAST-RELEASE (OVER EXCITATION)
NORMAL STOPPING (AC-SWITCHING)



MOTOR	RECTIFIER	V_{motor}	V_{B-AC}	V_{B-DC}
230YY/460Y	GPU20L	460 VAC	230 VAC	105 VDC

GP104C — 45

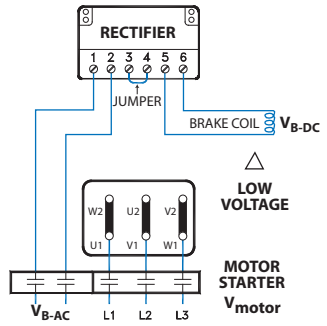
SEPERATE POWER SOURCE
FAST-RELEASE (OVER EXCITATION)
NORMAL STOPPING (AC-SWITCHING)



MOTOR	RECTIFIER	V_{motor}	V_{B-AC}	V_{B-DC}
230YY/460Y	GPU40L	460 VAC	460 VAC	205 VDC

GP104D — 45

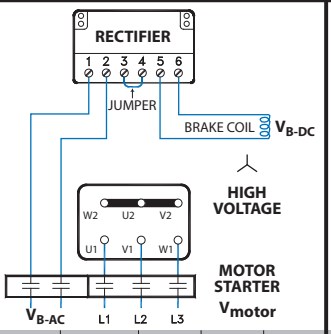
SEPERATE POWER SOURCE
FAST-RELEASE (OVER EXCITATION)
NORMAL STOPPING (AC-SWITCHING)



MOTOR	RECTIFIER	V_{motor}	V_{B-AC}	V_{B-DC}
208Δ/360Y	GPU20L	208 VAC	208 VAC	105 VDC
230Δ/400Y	GPU20L	230 VAC	230 VAC	105 VDC
400Δ/690Y	GPU40L	400 VAC	400 VAC	180 VDC
460Δ/Y	GPU40L	460 VAC	460 VAC	205 VDC

GP104E — 45

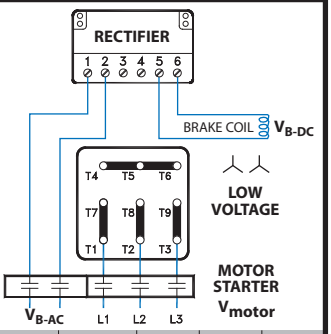
SEPERATE POWER SOURCE
FAST-RELEASE (OVER EXCITATION)
NORMAL STOPPING (AC-SWITCHING)



MOTOR	RECTIFIER	V_{motor}	V_{B-AC}	V_{B-DC}
230Δ/400Y	GPU20L	400 VAC	230 VAC	105 VDC
332Δ/575Y	GPU40L	575 VAC	332 VAC	180 VDC

GP105A — 50

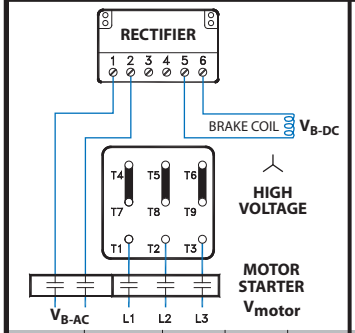
SEPERATE POWER SOURCE
FAST-RELEASE (OVER EXCITATION)
FAST STOPPING (DC-SWITCHING)



MOTOR	RECTIFIER	V_{motor}	V_{B-AC}	V_{B-DC}
230YY/460Y	GPU20L	230 VAC	230 VAC	105 VDC

GP105B — 50

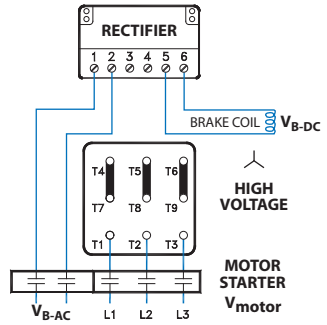
SEPERATE POWER SOURCE
FAST-RELEASE (OVER EXCITATION)
FAST STOPPING (DC-SWITCHING)



MOTOR	RECTIFIER	V_{motor}	V_{B-AC}	V_{B-DC}
230YY/460Y	GPU20L	460 VAC	230 VAC	105 VDC

GP105C — 50

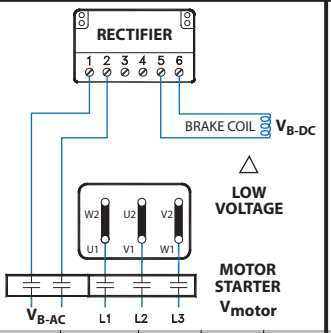
SEPERATE POWER SOURCE
FAST-RELEASE (OVER EXCITATION)
FAST STOPPING (DC-SWITCHING)



MOTOR	RECTIFIER	V_{motor}	V_{B-AC}	V_{B-DC}
230YY/460Y	GPU40L	460 VAC	460 VAC	205 VDC

GP105D — 50

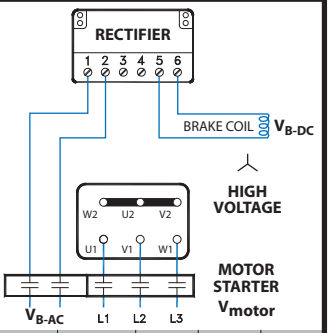
SEPERATE POWER SOURCE
FAST-RELEASE (OVER EXCITATION)
FAST STOPPING (DC-SWITCHING)



MOTOR	RECTIFIER	V_{motor}	V_{B-AC}	V_{B-DC}
208Δ/360Y	GPU20L	208 VAC	208 VAC	105 VDC
230Δ/400Y	GPU20L	230 VAC	230 VAC	105 VDC
400Δ/690Y	GPU40L	400 VAC	400 VAC	180 VDC
460Δ/Y	GPU40L	460 VAC	460 VAC	205 VDC

GP105E — 50

SEPERATE POWER SOURCE
FAST-RELEASE (OVER EXCITATION)
FAST STOPPING (DC-SWITCHING)



MOTOR	RECTIFIER	V_{motor}	V_{B-AC}	V_{B-DC}
230Δ/400Y	GPU20L	400 VAC	230 VAC	105 VDC
332Δ/575Y	GPU40L	575 VAC	332 VAC	180 VDC

✻ The normally open contact/s (NO) is not supplied by NORD. It must close at the same time power is supplied to the brake. The contact must be capable of switching inductive loads and/or be rated IEC AC3.

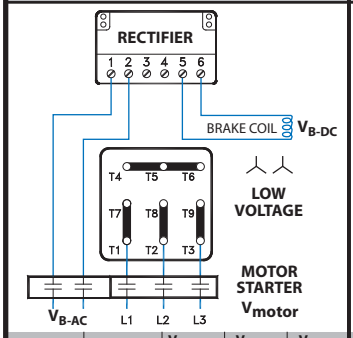
= Braking Method

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NORD Gear Corporation
Toll Free in the United States: 888.314.6673

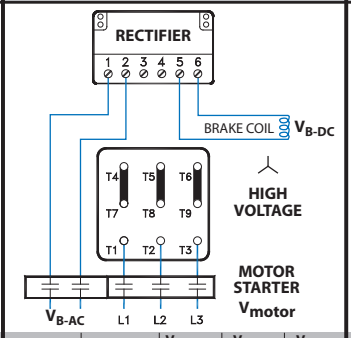
FAST ACTING BRAKE RECTIFIERS (GPE, GPU & PMG)

GP106A — SEPERATE POWER SOURCE — STANDARD RELEASE — VERY FAST STOPPING (DC-SWITCHING + REDUCED POWER HOLDING) — 55



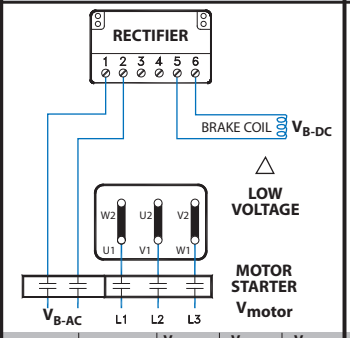
MOTOR	RECTIFIER	V_{motor}	V_{B-AC}	V_{B-DC}
230YY/460Y	GPU20L	230 VAC	230 VAC	205 VDC

GP106B — SEPERATE POWER SOURCE — STANDARD RELEASE — VERY FAST STOPPING (DC-SWITCHING + REDUCED POWER HOLDING) — 55



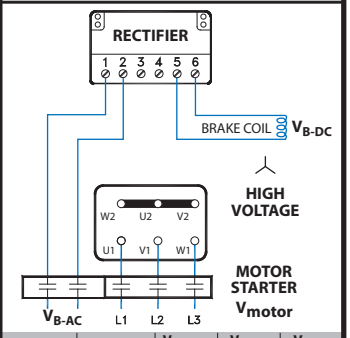
MOTOR	RECTIFIER	V_{motor}	V_{B-AC}	V_{B-DC}
230YY/460Y	GPU20L	460 VAC	230 VAC	205 VDC

GP106C — SEPERATE POWER SOURCE — STANDARD RELEASE — VERY FAST STOPPING (DC-SWITCHING + REDUCED POWER HOLDING) — 55



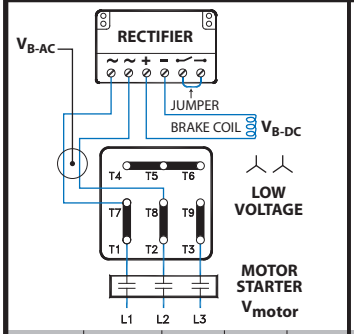
MOTOR	RECTIFIER	V_{motor}	V_{B-AC}	V_{B-DC}
208Δ/360Y	GPU20L	208 VAC	208 VAC	180 VDC
230Δ/400Y	GPU20L	230 VAC	230 VAC	205 VDC

GP106D — SEPERATE POWER SOURCE — STANDARD RELEASE — VERY FAST STOPPING (DC-SWITCHING + REDUCED POWER HOLDING) — 55



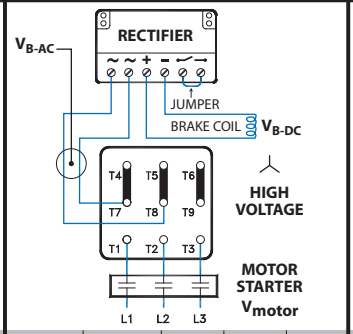
MOTOR	RECTIFIER	V_{motor}	V_{B-AC}	V_{B-DC}
230Δ/400Y	GPU20L	400 VAC	230 VAC	205 VDC

PMG101A — POWERED FROM MOTOR TERMINAL BLOCK — FAST-RELEASE (OVER EXCITATION) — NORMAL STOPPING (AC-SWITCHING) — 30



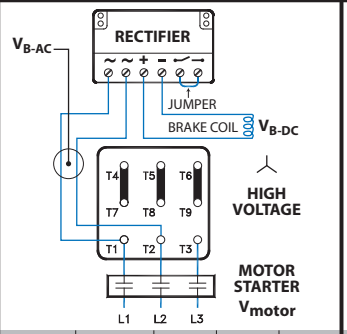
MOTOR	RECTIFIER	V_{motor}	V_{B-AC}	V_{B-DC}
230YY/460Y	PMG500	230 VAC	230 VAC	105 VDC

PMG101B — POWERED FROM MOTOR TERMINAL BLOCK — FAST-RELEASE (OVER EXCITATION) — NORMAL STOPPING (AC-SWITCHING) — 30



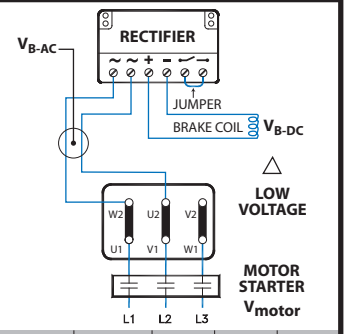
MOTOR	RECTIFIER	V_{motor}	V_{B-AC}	V_{B-DC}
230YY/460Y	PMG500	460 VAC	230 VAC	105 VDC

PMG101C — POWERED FROM MOTOR TERMINAL BLOCK — FAST-RELEASE (OVER EXCITATION) — NORMAL STOPPING (AC-SWITCHING) — 30



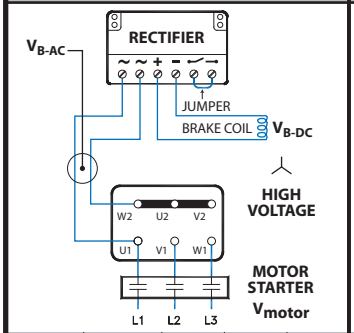
MOTOR	RECTIFIER	V_{motor}	V_{B-AC}	V_{B-DC}
230YY/460Y	PMG500	460 VAC	460 VAC	205 VDC

PMG101D — POWERED FROM MOTOR TERMINAL BLOCK — FAST-RELEASE (OVER EXCITATION) — NORMAL STOPPING (AC-SWITCHING) — 30



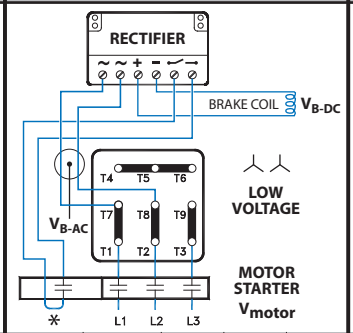
MOTOR	RECTIFIER	V_{motor}	V_{B-AC}	V_{B-DC}
208Δ/360Y	PMG500	208 VAC	208 VAC	105 VDC
230Δ/400Y	PMG500	230 VAC	230 VAC	105 VDC
400Δ/690Y	PMG500	400 VAC	400 VAC	180 VDC
460Δ/Y	PMG500	460 VAC	460 VAC	205 VDC

PMG101E — POWERED FROM MOTOR TERMINAL BLOCK — FAST-RELEASE (OVER EXCITATION) — NORMAL STOPPING (AC-SWITCHING) — 30



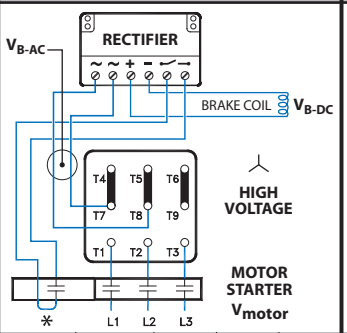
MOTOR	RECTIFIER	V_{motor}	V_{B-AC}	V_{B-DC}
230Δ/400Y	PMG500	400 VAC	230 VAC	105 VDC

PMG102A — POWERED FROM MOTOR TERMINAL BLOCK — FAST-RELEASE (OVER EXCITATION) — FAST STOPPING (DC-SWITCHING) — 35



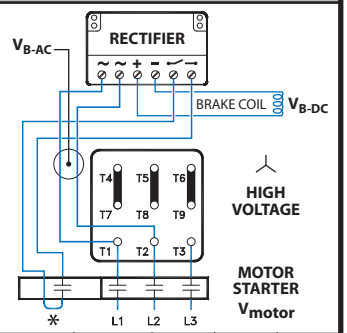
MOTOR	RECTIFIER	V_{motor}	V_{B-AC}	V_{B-DC}
230YY/460Y	PMG500	230 VAC	230 VAC	105 VDC

PMG102B — POWERED FROM MOTOR TERMINAL BLOCK — FAST-RELEASE (OVER EXCITATION) — FAST STOPPING (DC-SWITCHING) — 35



MOTOR	RECTIFIER	V_{motor}	V_{B-AC}	V_{B-DC}
230YY/460Y	PMG500	460 VAC	230 VAC	105 VDC

PMG102C — POWERED FROM MOTOR TERMINAL BLOCK — FAST-RELEASE (OVER EXCITATION) — FAST STOPPING (DC-SWITCHING) — 35



MOTOR	RECTIFIER	V_{motor}	V_{B-AC}	V_{B-DC}
230YY/460Y	PMG500	460 VAC	460 VAC	205 VDC

✻ The normally open contact/s (NO) is not supplied by NORD. It must close at the same time power is supplied to the brake. The contact must be capable of switching inductive loads and/or be rated IEC AC3.

= Braking Method

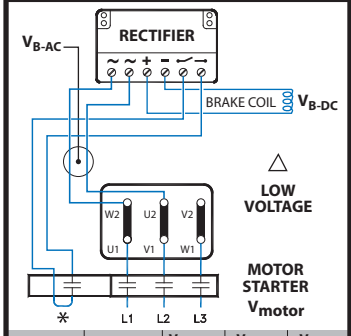
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NORD Gear Corporation
Toll Free in the United States: 888.314.6673

FAST ACTING BRAKE RECTIFIERS (GPE, GPU & PMG)

PMG102D

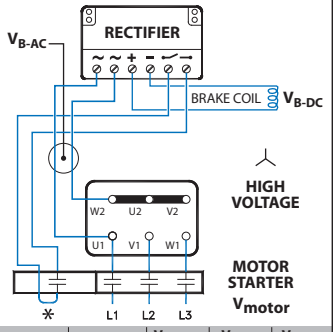
POWERED FROM MOTOR TERMINAL BLOCK
FAST-RELEASE (OVER EXCITATION)
FAST STOPPING (DC-SWITCHING)
35



MOTOR	RECTIFIER	V_{motor}	V_{B-AC}	V_{B-DC}
208Δ/360Y	PMG500	208 VAC	208 VAC	105 VDC
230Δ/400Y	PMG500	230 VAC	230 VAC	105 VDC
400Δ/690Y	PMG500	400 VAC	400 VAC	180 VDC
460Δ/Y	PMG500	460 VAC	460 VAC	205 VDC

PMG102E

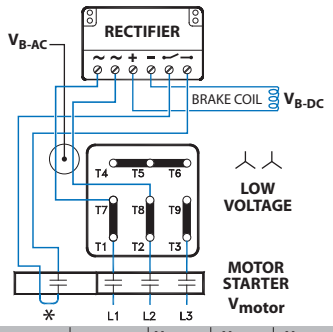
POWERED FROM MOTOR TERMINAL BLOCK
FAST-RELEASE (OVER EXCITATION)
FAST STOPPING (DC-SWITCHING)
35



MOTOR	RECTIFIER	V_{motor}	V_{B-AC}	V_{B-DC}
230Δ/400Y	PMG500	400 VAC	230 VAC	105 VDC

PMG103A

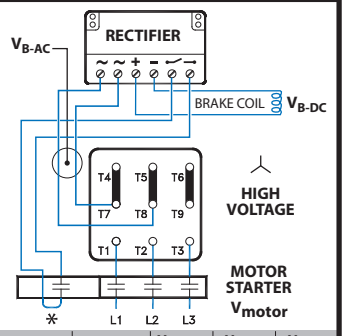
POWERED FROM MOTOR TERMINAL BLOCK
STANDARD RELEASE
VERY FAST STOPPING
(DC-SWITCHING + REDUCED POWER HOLDING)
40



MOTOR	RECTIFIER	V_{motor}	V_{B-AC}	V_{B-DC}
230YY/460Y	PMG500	230 VAC	230 VAC	205 VDC

PMG103B

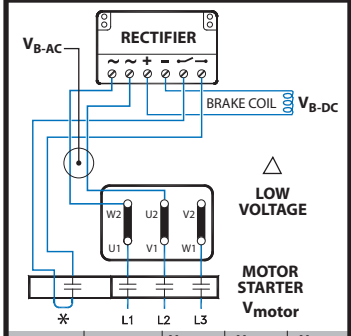
POWERED FROM MOTOR TERMINAL BLOCK
STANDARD RELEASE
VERY FAST STOPPING
(DC-SWITCHING + REDUCED POWER HOLDING)
40



MOTOR	RECTIFIER	V_{motor}	V_{B-AC}	V_{B-DC}
230YY/460Y	PMG500	460 VAC	230 VAC	205 VDC

PMG103C

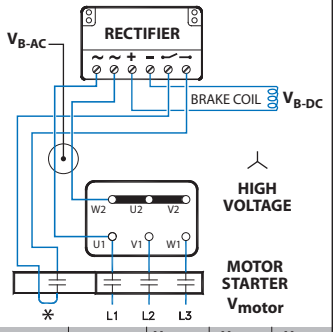
POWERED FROM MOTOR TERMINAL BLOCK
STANDARD RELEASE
VERY FAST STOPPING
(DC-SWITCHING + REDUCED POWER HOLDING)
40



MOTOR	RECTIFIER	V_{motor}	V_{B-AC}	V_{B-DC}
208Δ/360Y	PMG500	208 VAC	208 VAC	180 VDC
230Δ/400Y	PMG500	230 VAC	230 VAC	205 VDC

PMG103D

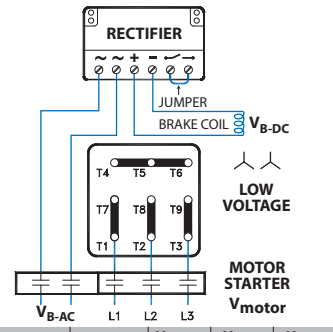
POWERED FROM MOTOR TERMINAL BLOCK
STANDARD RELEASE
VERY FAST STOPPING
(DC-SWITCHING + REDUCED POWER HOLDING)
40



MOTOR	RECTIFIER	V_{motor}	V_{B-AC}	V_{B-DC}
230Δ/400Y	PMG500	400 VAC	230 VAC	205 VDC

PMG104A

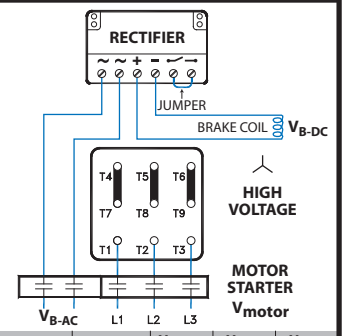
SEPERATE POWER SOURCE
FAST-RELEASE (OVER EXCITATION)
NORMAL STOPPING (AC-SWITCHING)
45



MOTOR	RECTIFIER	V_{motor}	V_{B-AC}	V_{B-DC}
230YY/460Y	PMG500	230 VAC	230 VAC	105 VDC

PMG104B

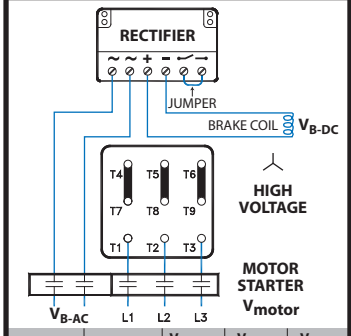
SEPERATE POWER SOURCE
FAST-RELEASE (OVER EXCITATION)
NORMAL STOPPING (AC-SWITCHING)
45



MOTOR	RECTIFIER	V_{motor}	V_{B-AC}	V_{B-DC}
230YY/460Y	PMG500	460 VAC	230 VAC	105 VDC

PMG104C

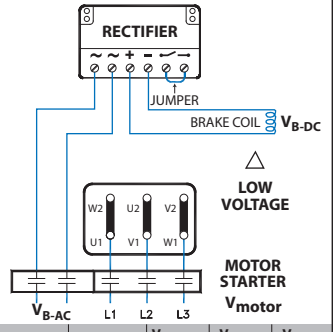
SEPERATE POWER SOURCE
FAST-RELEASE (OVER EXCITATION)
NORMAL STOPPING (AC-SWITCHING)
45



MOTOR	RECTIFIER	V_{motor}	V_{B-AC}	V_{B-DC}
230YY/460Y	PMG500	460 VAC	460 VAC	205 VDC

PMG104D

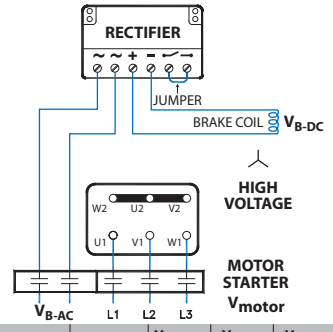
SEPERATE POWER SOURCE
FAST-RELEASE (OVER EXCITATION)
NORMAL STOPPING (AC-SWITCHING)
45



MOTOR	RECTIFIER	V_{motor}	V_{B-AC}	V_{B-DC}
208Δ/360Y	PMG500	208 VAC	208 VAC	105 VDC
230Δ/400Y	PMG500	230 VAC	230 VAC	105 VDC
400Δ/690Y	PMG500	400 VAC	400 VAC	180 VDC
460Δ/Y	PMG500	460 VAC	460 VAC	205 VDC

PMG104E

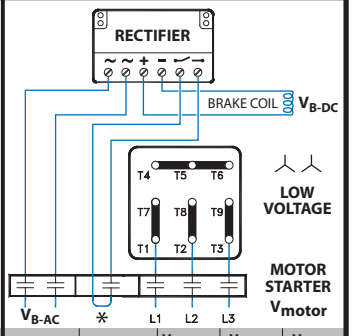
SEPERATE POWER SOURCE
FAST-RELEASE (OVER EXCITATION)
NORMAL STOPPING (AC-SWITCHING)
45



MOTOR	RECTIFIER	V_{motor}	V_{B-AC}	V_{B-DC}
230Δ/400Y	PMG500	400 VAC	230 VAC	105 VDC

PMG105A

SEPERATE POWER SOURCE
FAST-RELEASE (OVER EXCITATION)
FAST STOPPING (DC-SWITCHING)
50



MOTOR	RECTIFIER	V_{motor}	V_{B-AC}	V_{B-DC}
230YY/460Y	PMG500	230 VAC	230 VAC	105 VDC

✱ The normally open contact/s (NO) is not supplied by NORD. It must close at the same time power is supplied to the brake. The contact must be capable of switching inductive loads and/or be rated IEC AC3.

= Braking Method

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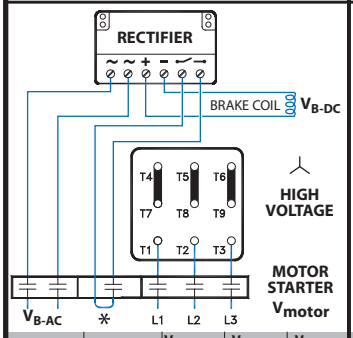
NORD Gear Corporation
Toll Free in the United States: 888.314.6673

FAST ACTING BRAKE RECTIFIERS (GPE, GPU & PMG)

PMG105B

50

SEPERATE POWER SOURCE
FAST-RELEASE (OVER EXCITATION)
FAST STOPPING (DC-SWITCHING)

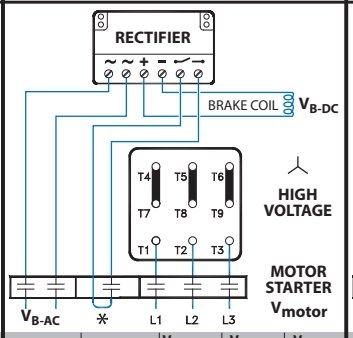


MOTOR	RECTIFIER	V_{motor}	V_{B-AC}	V_{B-DC}
230YY/460Y	PMG500	460 VAC	230 VAC	105 VDC

PMG105C

50

SEPERATE POWER SOURCE
FAST-RELEASE (OVER EXCITATION)
FAST STOPPING (DC-SWITCHING)

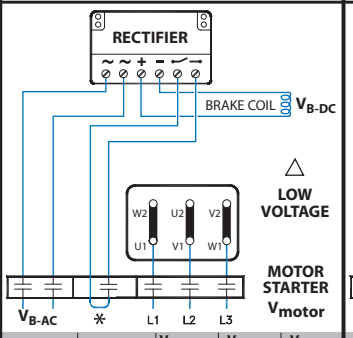


MOTOR	RECTIFIER	V_{motor}	V_{B-AC}	V_{B-DC}
230YY/460Y	PMG500	460 VAC	460 VAC	205 VDC

PMG105D

50

SEPERATE POWER SOURCE
FAST-RELEASE (OVER EXCITATION)
FAST STOPPING (DC-SWITCHING)

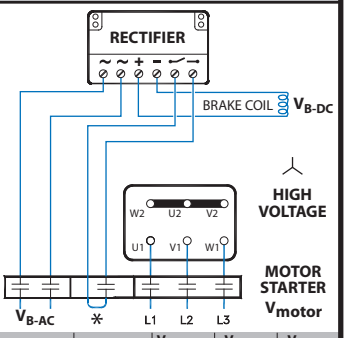


MOTOR	RECTIFIER	V_{motor}	V_{B-AC}	V_{B-DC}
208Δ/360Y	PMG500	208 VAC	208 VAC	105 VDC
230Δ/400Y	PMG500	230 VAC	230 VAC	105 VDC
400Δ/690Y	PMG500	400 VAC	400 VAC	180 VDC
460Δ/Y	PMG500	460 VAC	460 VAC	205 VDC

PMG105E

50

SEPERATE POWER SOURCE
FAST-RELEASE (OVER EXCITATION)
FAST STOPPING (DC-SWITCHING)

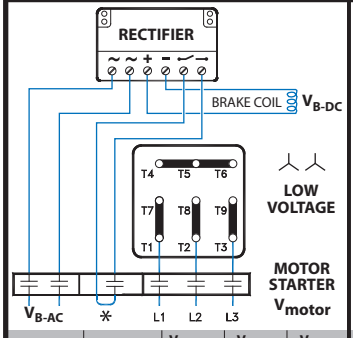


MOTOR	RECTIFIER	V_{motor}	V_{B-AC}	V_{B-DC}
230Δ/400Y	PMG500	400 VAC	230 VAC	105 VDC

PMG106A

55

SEPERATE POWER SOURCE
STANDARD RELEASE
VERY FAST STOPPING
(DC-SWITCHING + REDUCED POWER HOLDING)

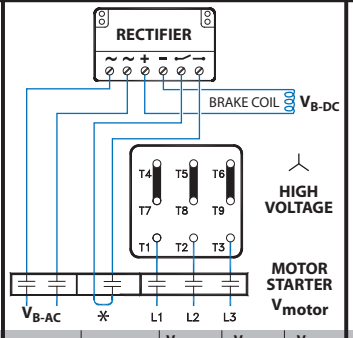


MOTOR	RECTIFIER	V_{motor}	V_{B-AC}	V_{B-DC}
230YY/460Y	PMG500	230 VAC	230 VAC	205 VDC

PMG106B

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SEPERATE POWER SOURCE
STANDARD RELEASE
VERY FAST STOPPING
(DC-SWITCHING + REDUCED POWER HOLDING)

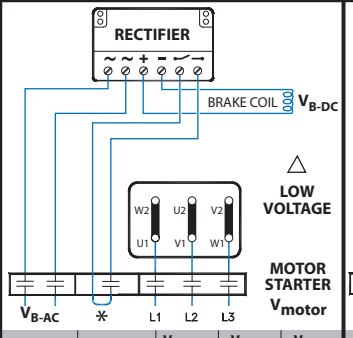


MOTOR	RECTIFIER	V_{motor}	V_{B-AC}	V_{B-DC}
230YY/460Y	PMG500	460 VAC	230 VAC	205 VDC

PMG106C

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SEPERATE POWER SOURCE
STANDARD RELEASE
VERY FAST STOPPING
(DC-SWITCHING + REDUCED POWER HOLDING)

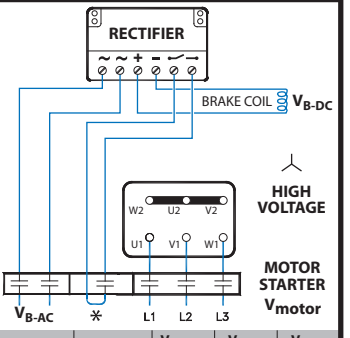


MOTOR	RECTIFIER	V_{motor}	V_{B-AC}	V_{B-DC}
208Δ/360Y	PMG500	208 VAC	208 VAC	180 VDC
230Δ/400Y	PMG500	230 VAC	230 VAC	205 VDC

PMG106D

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SEPERATE POWER SOURCE
STANDARD RELEASE
VERY FAST STOPPING
(DC-SWITCHING + REDUCED POWER HOLDING)



MOTOR	RECTIFIER	V_{motor}	V_{B-AC}	V_{B-DC}
230Δ/400Y	PMG500	400 VAC	230 VAC	205 VDC

✻ The normally open contact/s (NO) is not supplied by NORD. It must close at the same time power is supplied to the brake. The contact must be capable of switching inductive loads and/or be rated IEC AC3.

= Braking Method

NORD Gear Limited
Toll Free in Canada: 800.668.4378

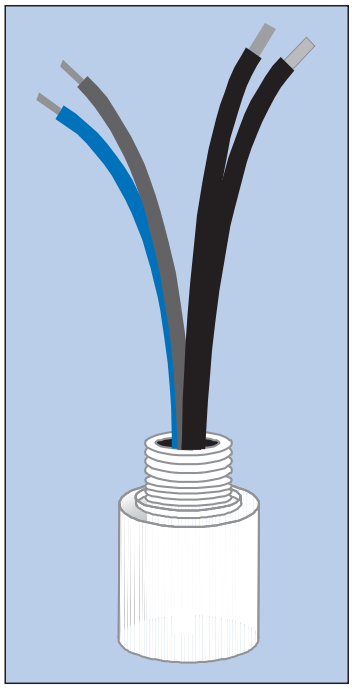
NORD Gear Corporation
Toll Free in the United States: 888.314.6673

CURRENT SENSING BRAKE RELAY (IR) INSTALLATION & MAINTENANCE

Current Sensing Relay (IR)

Modify

The current sensing relay, is used to achieve a fast brake engagement (stopping) without the use of external control equipment or additional wiring. The relay is mounted directly on the conduit box, and is powered from the motor's terminal block. The power leads for the relay replace one of the brass jumper bars on the terminal block of any single speed motor. The switch leads are connected to terminals 3 and 4 of the rectifier. When the power to the motor is shut off, the IR relay opens the brake circuit on the DC side which allows the brake to de-magnetize quickly.



IMPORTANT NOTE

Current Sensing Relay Requirements

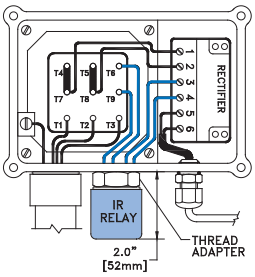
- Brake must be powered from the motor's terminal block (not seperately powered)
- Motor must be single speed and should not be powered by a frequency inverter or soft starter.

Part number	18556010	18556020
Reissmann Part Number	RSR 25-46	RSR 50-46
Primary Current Rating (black/white wires)	25A_{AC}	50 A_{AC}
Maximum Primary Current (black/white wires)	75A_{AC}	150 A_{AC}
Maximum Time at Maximum Primary Current	0.2 s	0.2 s
Maximum Cycles per hour	500	500
Switching Voltage	42 - 550V_{DC}	42 - 550V_{DC}
Switching Current (red/blue wires)	1.0 A_{DC}	1.0 A_{DC}
Holding Current ❶	< 0.7 A_{AC}	< 0.7 A_{AC}
Delay Time ❷	18 ms	18 ms
Enclosure Rating	IP65	IP65
Ambient Temp.	- 25 to 90 °C (- 40 to 167 °F)	- 25 to 90 °C (- 40 to 167 °F)

❶ Relative to the distortion created by the magnetising current of the motor.

❷ Additional setting time delay added to the DC-setting time of the brake circuit.

IR Relay Wiring Diagram



Rectifier			IR-Relay Wires to Rectifier	
Model Type	Part Number	Design	Red	Blue
GVE20L	1914000	Full-wave	4	3
GHE40L	19141010	Half-wave	4	3
GHE50L	19141020	Half-wave	4	3
GPE20L	19140230	Push-hybrid	4	3
GPE40L	19140240	Push-hybrid	4	3
GUE40V	19140300	Dual Wave	4	3

Conduit Box Thread Adapter

Thread	Motor Frame	Part Number	O-Ring
M20	63-71	18542006*	25501615
M25	80-90	18522253	25501615
M32	100-132	18522320	25501615
M40	160-180	18522400 + 18522253	25501615

* Spacer

IR Relay Selection Table for 4-Pole Motors

Type	Efficiency	230/460 V 60 Hz	460V D 60 Hz	332/575V 60 Hz	208/360 V 60 Hz	230/400V 50 Hz	400/690V 50 Hz
63S/4	SE (IE1)	25A	-	25A	25A	25A	-
63SP/4	PE (IE3)	25A	-	25A	-	25A	-
63L/4	SE (IE1)	25A	-	25A	25A	25A	-
63LP/4	PE (IE3)	25A	-	25A	-	25A	-
71S/4	SE (IE1)	25A	-	25A	25A	25A	-
71SP/4	PE (IE3)	25A	-	25A	-	25A	-
71L/4	SE (IE1)	25A	-	25A	25A	25A	-
71LP/4	PE (IE3)	25A	-	25A	-	25A	-
80S/4	SE (IE1)	25A	-	25A	25A	25A	-
80SH/4	EE (IE2)	-	-	-	-	25A	-
80SP/4	PE (IE3)	25A	-	25A	-	25A	-
80L/4	SE (IE1)	25A	-	25A	25A	25A	-
80LH/4	EE (IE2)	25A	-	25A	-	25A	-
80LP/4	PE (IE3)	25A	-	25A	-	25A	-
90S/4	SE (IE1)	25A	-	25A	25A	25A	-
90SH/4	EE (IE2)	25A	-	25A	-	25A	-
90SP/4	PE (IE3)	25A	-	25A	-	25A	-
90L/4	SE (IE1)	25A	-	25A	25A	25A	-
90LH/4	EE (IE2)	25A	-	25A	-	25A	-
90LP/4	PE (IE3)	25A	-	25A	-	25A	-
100L/4	SE (IE1)	25A	-	25A	25A	-	25A
100LH/4	EE (IE2)	25A	-	25A	-	-	25A
100LP/4	PE (IE3)	25A	-	25A	-	-	25A
100LA/4	SE (IE1)	25A	-	25A	25A	-	25A
100AH/4	EE (IE2)	-	-	-	-	-	25A
100AP/4	PE (IE3)	-	-	-	-	-	25A
112M/4	SE (IE1)	-	-	-	-	-	25A
112MH/4	EE (IE2)	25A	-	25A	-	-	25A
112MP/4	PE (IE3)	25A	-	25A	-	-	25A
132S/4	SE (IE1)	25A	-	25A	25A	-	25A
132SH/4	EE (IE2)	25A	-	25A	-	-	25A
132SP/4	PE (IE3)	25A	-	25A	-	-	25A
132M/4	SE (IE1)	25A	-	25A	25A	-	25A
132MH/4	EE (IE2)	25A	-	25A	-	-	25A
132LH/4	EE (IE2)	-	-	-	-	-	25A
132MA/4	SE (IE1)	-	-	-	-	-	25A
132MP/4	PE (IE3)	25A	-	25A	-	-	25A

25 A (P/N 18556010) – IR Relay is rated for 25 Amp motor phase current.

50 A (P/N 18556020) – IR Relay is rated for 50 Amp motor phase current.

N/A – IR Relay option is not available.

Observe the efficiency law requirements for the country that the motor will be utilized in.

IR Relay Selection Table for 4-Pole Motors Ctd.

Type	Efficiency	230/460 V 60 Hz	460V D 60 Hz	332/575V 60 Hz	208/360 V 60 Hz	230/400V 50 Hz	400/690V 50 Hz
160SH/4	EE (IE2)	-	-	-	-	-	25A
160SP/4	PE (IE3)	-	-	-	-	-	25A
160M/4	SE (IE1)	25A	-	25A	-	-	25A
160MH/4	EE (IE2)	25A	-	25A	-	-	25A
160MP/4	PE (IE3)	25A	-	25A	-	-	25A
160L/4	SE (IE1)	25A	-	25A	-	-	25A
160LH/4	EE (IE2)	25A	-	25A	-	-	50 A
160LP/4	PE (IE3)	25A	-	25A	-	-	50 A
180MX/4	SE (IE1)	50 A	-	25A	-	-	25A
180MH/4	EE (IE2)	50 A	-	25A	-	-	50 A
180MP/4	PE (IE3)	50 A	-	25A	-	-	50 A
180LX/4	SE (IE1)	50 A	-	50 A	-	-	25A
180LH/4	EE (IE2)	50 A	-	50 A	-	-	50 A
180LP/4	PE (IE3)	50 A	-	50 A	-	-	50 A
200LX/4	SE (IE1)	50 A	-	50 A	-	-	50 A
200XH/4	EE (IE2)	N/A	-	50 A	-	-	N/A
225RP/4	PE (IE3)	-	50 A	50 A	-	-	N/A
225SH/4	EE (IE2)	-	50 A	50 A	-	-	N/A
225SP/4	PE (IE3)	-	50 A	50 A	-	-	N/A
225MH/4	EE (IE2)	-	50 A	N/A	-	-	N/A
225MP/4	PE (IE3)	-	50 A	N/A	-	-	N/A
250WH/4	EE (IE2)	-	N/A	N/A	-	-	N/A
250WP/4	PE (IE3)	-	50 A	N/A	-	-	N/A
280SH/4	EE (IE2)	-	N/A	N/A	-	-	N/A
280SP/4	PE (IE3)	-	N/A	N/A	-	-	N/A
280MH/4	EE (IE2)	-	N/A	N/A	-	-	N/A
280MP/4	PE (IE3)	-	N/A	N/A	-	-	N/A
315SH/4	EE (IE2)	-	N/A	N/A	-	-	N/A
315SP/4	PE (IE3)	-	N/A	N/A	-	-	N/A
315MH/4	EE (IE2)	-	N/A	N/A	-	-	N/A
315MP/4	PE (IE3)	-	N/A	N/A	-	-	N/A
315RH/4	EE (IE2)	-	N/A	N/A	-	-	N/A
315RP/4	PE (IE3)	-	N/A	N/A	-	-	N/A
315LH/4	EE (IE2)	-	N/A	N/A	-	-	N/A
315LP/4	PE (IE3)	-	N/A	N/A	-	-	N/A

25 A (P/N 18556010) – IR Relay is rated for 25 Amp motor phase current.

50 A (P/N 18556020) – IR Relay is rated for 50 Amp motor phase current.

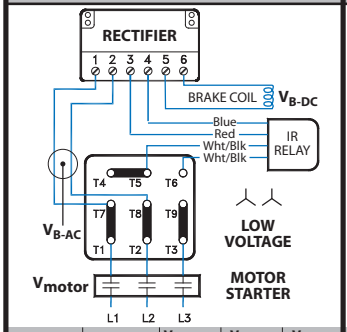
N/A – IR Relay option is not available.

Observe the efficiency law requirements for the country that the motor will be utilized in.

CURRENT SENSING BRAKE RELAY (IR) INSTALLATION & MAINTENANCE

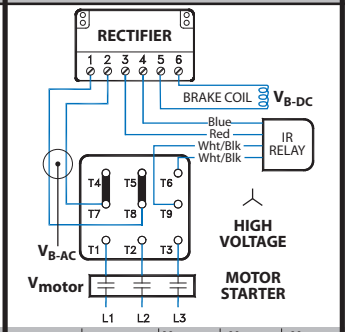
IR Relay Typical Connection Diagrams

IR101A — POWERED FROM MOTOR TERMINAL BLOCK — STANDARD-RELEASE — FAST STOPPING (DC-SWITCHING) — 15



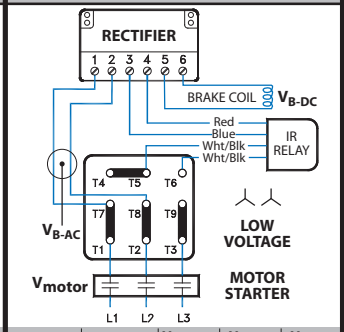
MOTOR	RECTIFIER	V_{motor}	V_{B-AC}	V_{B-DC}
208-230YY/460Y	GVE20	208VAC	230 VAC	205 VDC
230YY/460Y	GVE20	230 VAC	230 VAC	205 VDC

IR101B — POWERED FROM MOTOR TERMINAL BLOCK — STANDARD-RELEASE — FAST STOPPING (DC-SWITCHING) — 15



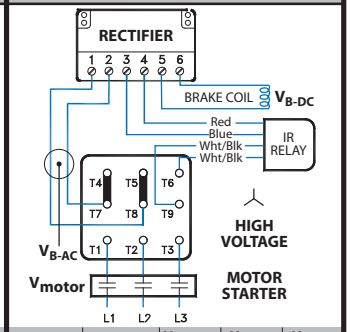
MOTOR	RECTIFIER	V_{motor}	V_{B-AC}	V_{B-DC}
230YY/460Y	GVE20	460 VAC	230 VAC	205 VDC

IR102A — POWERED FROM MOTOR TERMINAL BLOCK — STANDARD-RELEASE — FAST STOPPING (DC-SWITCHING) — 15



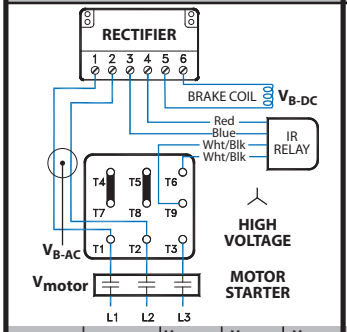
MOTOR	RECTIFIER	V_{motor}	V_{B-AC}	V_{B-DC}
208-230YY/460Y	GHE40	208VAC	230 VAC	105 VDC
230YY/460Y	GHE40	230 VAC	230 VAC	105 VDC

IR102B — POWERED FROM MOTOR TERMINAL BLOCK — STANDARD-RELEASE — FAST STOPPING (DC-SWITCHING) — 15



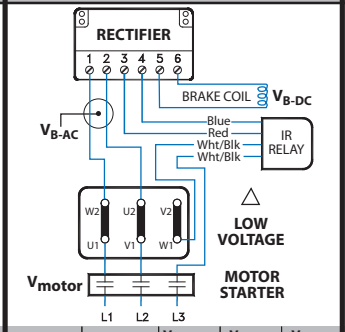
MOTOR	RECTIFIER	V_{motor}	V_{B-AC}	V_{B-DC}
230YY/460Y	GHE40	460 VAC	230 VAC	105 VDC

IR103 — POWERED FROM MOTOR TERMINAL BLOCK — STANDARD-RELEASE — FAST STOPPING (DC-SWITCHING) — 15



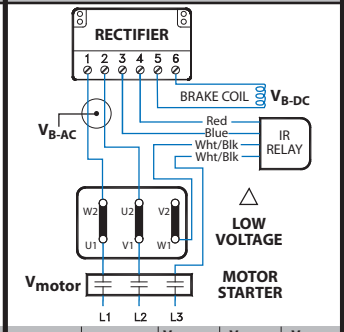
MOTOR	RECTIFIER	V_{motor}	V_{B-AC}	V_{B-DC}
230YY/460Y	GHE40	460 VAC	460VAC	205 VDC

IR301 — POWERED FROM MOTOR TERMINAL BLOCK — STANDARD-RELEASE — FAST STOPPING (DC-SWITCHING) — 15



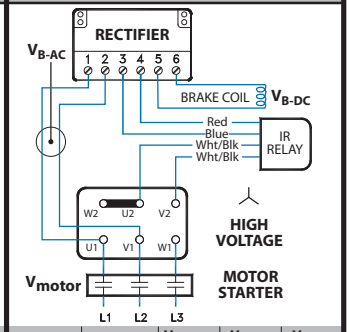
MOTOR	RECTIFIER	V_{motor}	V_{B-AC}	V_{B-DC}
208Δ/360Y	GVE20	208 VAC	208 VAC	180 VDC
230Δ/400Y	GVE20	230 VAC	230 VAC	205 VDC

IR401 — POWERED FROM MOTOR TERMINAL BLOCK — STANDARD-RELEASE — FAST STOPPING (DC-SWITCHING) — 15



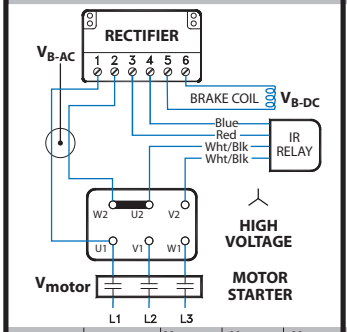
MOTOR	RECTIFIER	V_{motor}	V_{B-AC}	V_{B-DC}
460Δ/800Y	GHE40	460 VAC	460 VAC	205 VDC

IR501 — POWERED FROM MOTOR TERMINAL BLOCK — STANDARD-RELEASE — FAST STOPPING (DC-SWITCHING) — 15



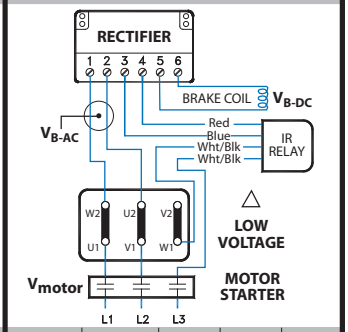
MOTOR	RECTIFIER	V_{motor}	V_{B-AC}	V_{B-DC}
332Δ/575Y	GHE50	575 VAC	575 VAC	250 VDC

IR601 — POWERED FROM MOTOR TERMINAL BLOCK — STANDARD-RELEASE — FAST STOPPING (DC-SWITCHING) — 15



MOTOR	RECTIFIER	V_{motor}	V_{B-AC}	V_{B-DC}
230Δ/400Y	GVE20	400 VAC	230 VAC	205 VDC
230Δ/400Y	GHE40	400 VAC	230 VAC	105 VDC

IR602 — POWERED FROM MOTOR TERMINAL BLOCK — STANDARD-RELEASE — FAST STOPPING (DC-SWITCHING) — 15



MOTOR	RECTIFIER	V_{motor}	V_{B-AC}	V_{B-DC}
400Δ/690Y	GHE40	400 VAC	400 VAC	180 VDC

IMPORTANT NOTE

Requirements

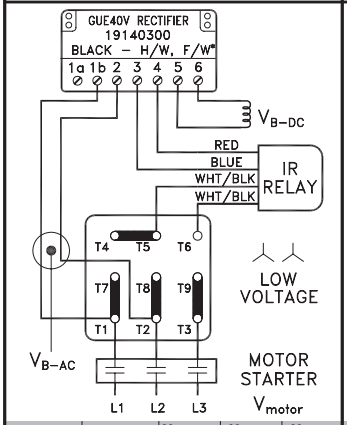
- Brake must be powered from the motor's terminal block (not seperately powered)
- Motor must be a single speed and should not be powered by a frequency inverter or soft starter.

= Braking Method

CURRENT SENSING BRAKE RELAY (IR) INSTALLATION & MAINTENANCE

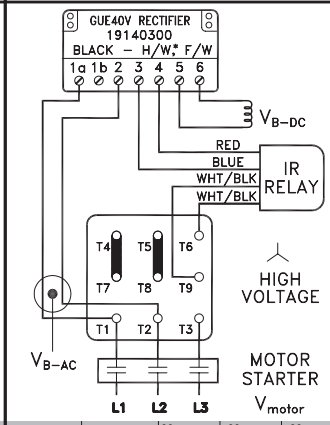
IR Relay with GUE40V Dual Wave Rectifier

IR701A — POWERED FROM MOTOR TERMINAL BLOCK — STANDARD-RELEASE — FAST STOPPING (DC-SWITCHING) — 15



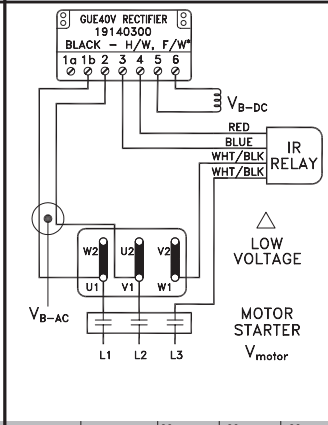
MOTOR	RECTIFIER	V_{motor}	V_{B-AC}	V_{B-DC}
208-230YY/460Y	GUE40V	208 VAC	230 VAC	205 VDC
230YY/460Y	GUE40V	230 VAC	230 VAC	205 VDC

IR701B — POWERED FROM MOTOR TERMINAL BLOCK — STANDARD-RELEASE — FAST STOPPING (DC-SWITCHING) — 15



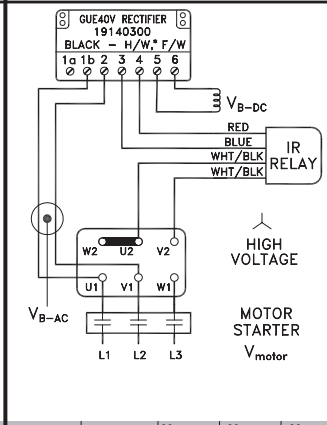
MOTOR	RECTIFIER	V_{motor}	V_{B-AC}	V_{B-DC}
208-230YY/460Y	GUE40V	460 VAC	460 VAC	205 VDC
230YY/460Y	GUE40V	460 VAC	460 VAC	205 VDC

IR702A — POWERED FROM MOTOR TERMINAL BLOCK — STANDARD-RELEASE — FAST STOPPING (DC-SWITCHING) — 15



MOTOR	RECTIFIER	V_{motor}	V_{B-AC}	V_{B-DC}
208Δ/360Y	GUE40V	208 VAC	208 VAC	180 VDC
230Δ/400Y	GUE40V	230 VAC	230 VAC	205 VDC

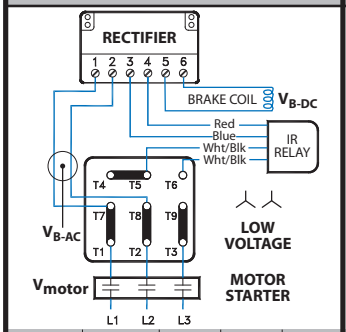
IR702B — POWERED FROM MOTOR TERMINAL BLOCK — STANDARD-RELEASE — FAST STOPPING (DC-SWITCHING) — 15



MOTOR	RECTIFIER	V_{motor}	V_{B-AC}	V_{B-DC}
230Δ/400Y	GUE40V	400 VAC	400 VAC	180 VDC

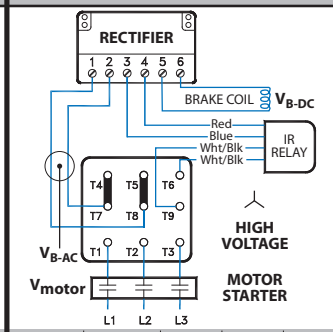
GPE Rectifier for External DC-Switching with IR Relay

IR151A — POWERED FROM MOTOR TERMINAL BLOCK — FAST RELEASE (OVER EXCITATION) — FAST STOPPING (DC-SWITCHING) — 35



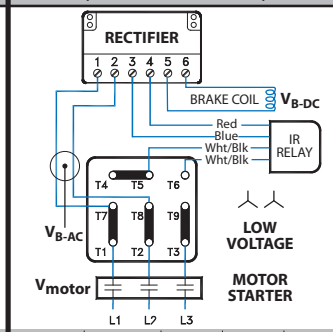
MOTOR	RECTIFIER	V_{motor}	V_{B-AC}	V_{B-DC}
230YY/460Y	GPE20L	230 VAC	230 VAC	105 VDC

IR151B — POWERED FROM MOTOR TERMINAL BLOCK — STANDARD-RELEASE — FAST STOPPING (DC-SWITCHING) — 35



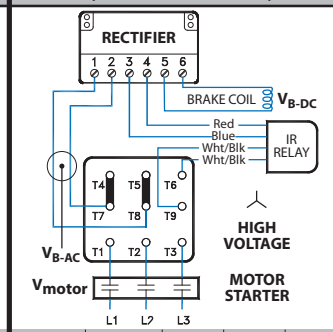
MOTOR	RECTIFIER	V_{motor}	V_{B-AC}	V_{B-DC}
230YY/460Y	GPE20L	460 VAC	230 VAC	105 VDC

IR152A — POWERED FROM MOTOR TERMINAL BLOCK — STANDARD-RELEASE — VERY FAST STOPPING (REDUCED POWER HOLD) — 40



MOTOR	RECTIFIER	V_{motor}	V_{B-AC}	V_{B-DC}
230YY/460Y	GPE20L	230 VAC	230 VAC	205 VDC

IR152B — POWERED FROM MOTOR TERMINAL BLOCK — STANDARD-RELEASE — VERY FAST STOPPING (REDUCED POWER HOLD) — 40



MOTOR	RECTIFIER	V_{motor}	V_{B-AC}	V_{B-DC}
230YY/460Y	GPE20L	460 VAC	230 VAC	205 VDC

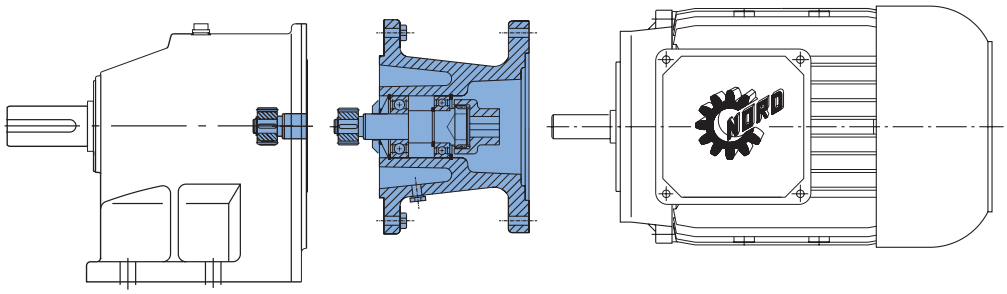
IMPORTANT NOTE

Requirements

- Brake must be powered from the motor's terminal block (not seperately powered)
- Motor must be a single speed and should not be powered by a frequency inverter or soft starter.

= Braking Method

NEMA/IEC/SERVO INPUT ADAPTERS & THEIR COUPLINGS



⚠ WARNING

While working on the gear drive system, make sure the power from the prime mover is isolated or secured on "lock-out" to prevent accidental start-up and to safeguard against injury!

NEMA/ IEC Motor Adapters

Motor adapters allow for easy installation and removal of industry standard motors. Motor adapters consist of a coupling and an adapter housing that connects the motor to the gear reducer.

NORD Gear supplies a coupling that is to be mounted on the motor shaft. It is important that the coupling is properly positioned.

- For NEMA Input Adapters, follow the Motor Installation Instructions on pages 3-5.
- For IEC Input Adapters, the supplied coupling will mount directly against the motor shaft shoulder. No locating measurements need to be taken.

IMPORTANT NOTE

Some of the larger IEC inputs will have a coupling spacer included to help locate the coupling. Slide the spacer against the motor shaft shoulder, slide the coupling against the spacer and tighten set screw(s).

IMPORTANT NOTE

For the larger motor adapters (IEC160 / N250TC and larger), an Automatic Lubricator may be supplied. This will need to be activated at the time of startup. For operation andactivation instructions, refer to user manual U45200. Motor adapter option AI and AN do not utilize an Automatic Lubricator and are lubricated for life.

NEMA/IEC Motor Weight Limits

When mounting a motor to a NORD NEMA C-face motor adapter it is important to consider the motor's weight. Following is a table that includes the maximum motor weight the NEMA adapter can support. If the motor exceeds the listed weight is must be externally supported. When a C-face mounted motor is externally supported care must be taken to ensure that the support system does not impose additional pre-loads on the NEMA motor adapter.

NEMA Motor Weight Limit

Motor FRAME	56C	140TC	180TC	210TC	250TC	280TC
Max Weight [lb]	66	110	176	221	441	551
Motor FRAME	**320TC**	**360TC**	**400TC**			
Max Weight [lb]	772	1544[4)]	1544			

IEC Motor Weight Limit

Motor FRAME	63	71	80	90	100	112	132
Max Weight [kg]	25	30	50[1)]	50	80[2)]	80	100
Motor FRAME	**160**	**180**	**200**	**225**	**250**	**280**	**315**
Max Weight [kg]	250[3)]	250	350	500	1000	1000	1500

1) ≤ 40 kg SK 920072.1, SK 92072.1, SK 071.1, SK 0182.1
2) ≤ 60 kg SK 1382.1, SK 92372.1, SK 12063, SK 372.1, SK 371.1
3) ≤ 200 kg SK 42, SK 4282, SK 9042.1, SK 42125
4) ≤ 1103 lb SK 62, SK 72, SK 73, SK 83, SK 93, SK 9072.1, SK 6282, SK 7282, SK 7382, SK 8382, SK 9392

Couplings

Couplings are made with tough abrasion resistant materials, which resist most chemicals and petroleum products. They are electrically isolated (prevent metal to metal contact) and require no lubrication or maintenance. Depending upon the size of the input, NORD provides either a gear or a jawtype coupling.

NORD supplies three different types of couplings depending on the size of input: "J" style, "M" style and "Jaw" style coupling. Following are instructions on how to properly mount each type of coupling onto the motor.

NEMA/IEC/SERVO INPUT ADAPTERS & THEIR COUPLINGS

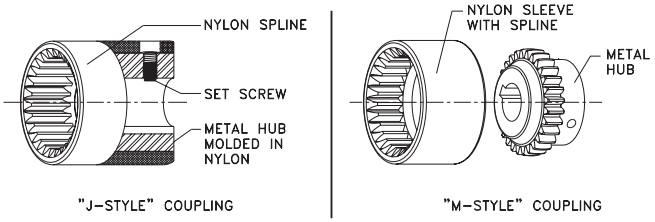
Couplings for the NEMA and IEC Adapters

Depending on the size of the input adapter to the gearbox, NORD Gear supplies two styles of couplings - BoWex® (gear tooth) and Rotex® (jaw) couplings.

BoWex® Couplings

NORD motor adapter input shafts have a machined spline on the end. NORD incorporates two styles of BoWex® couplings, the "J" and "M" styles. The "J" style is a one-piece coupling with a metal hub and nylon spline. The "M" style is a two-piece coupling – the metal hub and a nylon sleeve. Nylon and steel components allow them to operate in high ambient temperatures without lubrication or maintenance.

- Nylon sleeves resist dirt, moisture, most chemicals and petroleum products
- No lubrication required
- Operating Conditions: -22°F - 212°F (-30°C - 100°C)
- Higher temperature coupling sleeve available up to 250°F (120°C)
- Special bore available



BoWex® Couplings Mechanical Ratings "J" Style (NEMA & IEC)

Coupling Type	Rated Torque Cont.	Rated Torque Peak	Input Adapter Sizes	Bore Size
BoWex® J14	44.3 lb-in 5 N-m	88.5 lb-in 10 N-m	N56C IEC63, IEC71	5/8" 11mm, 14mm
BoWex® J24	106 lb-in 12 N-m	212 lb-in 24 N-m	N56C, N140TC IEC80, IEC90	5/8", 7/8" 19mm, 24mm
BoWex® J28	398 lb-in 45 N-m	1,195 lb-in 135 N-m	N180TC IEC100, IEC112	1-1/8" 28mm

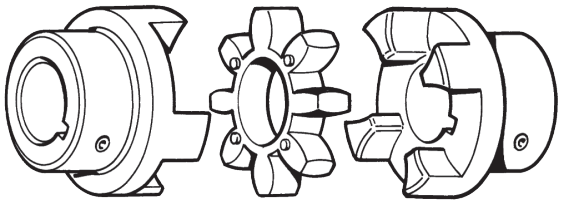
BoWex® Couplings Mechanical Ratings "M" Style (NEMA & IEC)

Coupling Type	Rated Torque Cont.	Rated Torque Peak	Input Adapter Sizes	Bore Size
BoWex® M38	708 lb-in 80 N-m	2,124 lb-in 240 N-m	N180TC, N210TC IEC132	1-1/8", 1-3/8" 38 mm
BoWex® M42	885 lb-in 100 N-m	2,655 lb-in 300 N-m	N250TC IEC160	1-5/8" 42 mm
BoWex® M48	1,239 lb-in 140 N-m	3,717 lb-in 420 N-m	N280TC IEC180	1-7/8" 48 mm

Rotex® Couplings

The cast iron jaw type couplings have an integral urethane "spider" that provides smooth transmission of the motor torque. A set screw on the coupling prohibits axial movement along the motor shaft.

- Excellent shock and vibration dampening
- Excellent resistance to oils and most chemicals
- No metal-to-metal contact
- Operating Conditions: -22°F - 195°F (-30°C - 90°C)
- Higher temperature material (Hytrel) spider available up to 230°F (110°C)
- Low temperature materials available upon request
- Special bores available



Rotex® Couplings Mechanical Ratings "R" Style (NEMA & IEC)

Coupling Type	Rated Torque Cont.	Rated Torque Peak	Input Adapter Sizes	Bore Size
Rotex® R42	3,983 lb-in 450 N-m	7,966 lb-in 900 N-m	AN250TC	1-5/8"
Rotex® R48	4,647 lb-in 525 N-m	9,294 lb-in 1,050 N-m	AN280TC AI160, AI180	1-7/8" 42, 42 mm
Rotex® R55	6,063 lb-in 685 N-m	12,126 lb-in 1,370 N-m	AN320TC AI200	2-1/8" 55 mm
Rotex® R65	8,319 lb-in 940 N-m	12,125 lb-in 1,880 N-m	N320TC, AN360TC[1] IEC200, AI200, IEC225	2-1/8", 2-3/8" 55, 55, 60mm
Rotex® R75	16,992 lb-in 1,920 N-m	33,954 lb-in 3,840 N-m	AN360TC[2], AN400TC AI250, AI280	2-3/8", 2-7/8" 70, 80 mm
Rotex® R90	31,860 lb-in 3,600 N-m	63,720 lb-in 7,200 N-m	N360TC IEC250, IEC280, IEC315, AI315	2-3/8" 70, 80, 85, 85 mm

1) AN360TC with R350 flange
2) AN360TC with R450 flange

Couplings for Servo Adapters

NORD Gear supplies Rotex® (jaw) couplings for SERVO adapter connections.

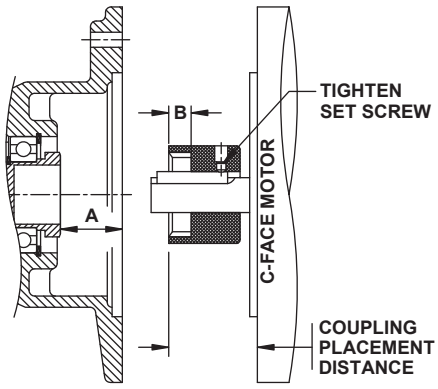
Rotex® Couplings Mechanical Ratings (Servo Adapter)

Coupling Type	Rated Torque Cont.	Rated Torque Peak	Input Adapter Sizes	Reducer Input Flange	Bore Size
Rotex® R19 GS	150 lb-in 17 Nm	301 lb-in 34 Nm	-SEP100, -SEK100	160S	19 mm
Rotex® R24 GS	531 lb-in 60 Nm	1062 lb-in 120 Nm	-SEP130, -SEK130	160S, 250S	24 mm
Rotex® R28 GS	1416 lb-in 160 Nm	2832 lb-in 320 Nm	-SEP165, -SEK165, -SEP215, -SEK215	160S, 250S 250S	32 mm 38 mm
Rotex® R48 GS	4647 lb-in 525 Nm	9293 lb-in 1050 Nm	-SEP215, -SEK215 -SEP300, -SEK300 -SEP300, -SEK300	300S 300S 350	38 mm 48 mm

SEP adapter couplings are for keyed motor shafts.
SEK adapter couplings are clamping style for shafts without key.
Alternate bores upon request.

"J" Style Coupling NEMA C-face Motor Installation

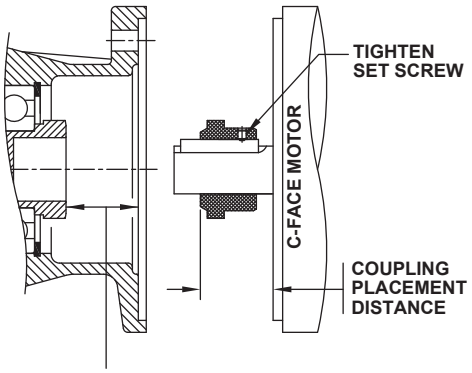
1. Measure the distance from the face of the input adapter to the face of the splined shaft and record that measurement as A in the equation below.
2. Measure depth of coupling engagement zone and record the measurement as "B" in the equation below.
3. Add "A" + "B" and subtract 0.08" (~2mm) from the distance. This needs to be done so that the coupling will not be preloaded after installation!
4. Use that measurement to locate the coupling from the face of the motor onto the shaft.
5. Once in place, tighten the set screw to lock the coupling in place. It is recommended that the key is staked or bonded (Loctite) in place to prohibit the key from vibrating out.
6. Mount the motor onto the input adapter with customer supplied bolts. Make sure that the coupling from the adapter and the motor engage securely. Use lock washers or Loctite to prohibit bolts from becoming loose from vibration.



MEASURED DISTANCES A + B		SUBTRACT DISTANCE	COUPLING PLACEMENT DISTANCE
____ +	____	- 0.080" (2mm) =	____

"M" Style Coupling NEMA C-face Motor Installation

1 Measure the distance from the face of the input adapter to the face of the splined shaft & record that measurement.
2. Subtract 0.31" (~8mm) from the distance. This needs to be done so that the coupling will not be preloaded after installation!
3. Use that measurement to locate the coupling from the face of the motor onto the shaft.
4. Once in place, tighten the set screw to lock the coupling in place. It is recommended that the key is staked or bonded (Loctite) in place to prohibit the key from vibrating out.
5. Mount the motor onto the input adapter with customer supplied bolts. Make sure that the coupling from the adapter and the motor engage securely. Use lock washers or Loctite to prohibit bolts from becoming loose from vibration.



MEASURED DISTANCE	SUBTRACT DISTANCE	COUPLING PLACEMENT DISTANCE
____	- 0.310" (8mm) =	____

"Jaw" Style Coupling NEMA C-face Installation for Type N Adapters and Servo Adapters

1. Measure the distance from the face of the input adapter to the face of the coupling as shown and record that measurement.

2. Subtract the "X" dimension from the measured distance. This needs to be done so that the coupling will not be preloaded after installation!

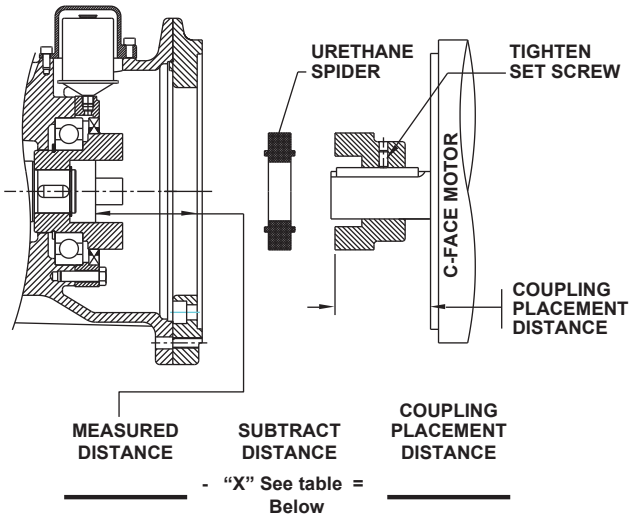
3. Use that measurement to locate the coupling from the face of the motor onto the shaft.

4. The metal portion of the coupling should be heated up prior to assembly, generally 250°F to 300°F (120°C to 150°C).

> ***IMPORTANT NOTE***
>
> DO NOT HEAT THE URETHANE SPIDER.

5. Once in place, tighten the setscrew to lock coupling in place. Let the coupling cool down before placing the spider into the jaws. It is recommended that the key is staked or bonded (Loctite) in place to prohibit the key from vibrating out.

6. Mount the motor onto the input adapter with customer supplied bolts. Make sure that the coupling from the adapter and the motor engage securely. Use lock washers or Loctite to prohibit bolts from becoming loose from vibration.



Coupling Size	"X" (Subtract this value from measured distance)
R14	0.06" (1.5 mm)
R19 & R24	0.08" (2.0 mm)
R28	0.10" (2.5 mm)
R38 & 42	0.12" (3.0 mm)
R48	0.14" (3.5 mm)
R55	0.16" (4.0 mm)
R65	0.18" (4.5 mm)
R75	0.20" (5.0 mm)
R90	0.22" (5.5 mm)

NEMA/IEC/SERVO INPUT ADAPTERS & THEIR COUPLINGS

"Jaw" Style Coupling NEMA C-face Installation for Type AN Adapters

1. Remove the motor shaft's key and replace with the key supplied with the adapter. Reference Motor Parallel Keys table below.

IMPORTANT NOTE

NORD SUPPLIES A SPECIAL MOTOR SHAFT KEY
DO NOT USE THE KEY SUPPLIED WITH THE MOTOR!

2. For the attachment of the coupling half, heat up the coupling half to approx. 212°F (100°C). Position the coupling half as follows:
   - Push AI160, AI180 and AI225 on to the spacer bushing.
   - Push AI200, AI250, AI280 and AI315 on to the motor shaft collar.
   - AN250TC–AN400TC until dimension A has been reached (reference Position of the Coupling Half on the NEMA Motor Shaft table below)

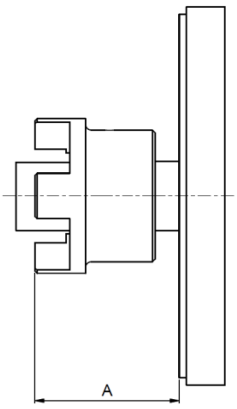
IMPORTANT NOTE

DO NOT HEAT THE URETHANE SPIDER.

2. Once in place, apply Loctite to the setscrew and tighten the setscrew to lock coupling in place. Let the coupling cool down before placing the spider into the jaws. It is recommended that the key is staked or bonded (Loctite) in place to prohibit the key from vibrating out.

3. Attach the motor to the adapter. For the AN360TC and AN400TC adapters, attach the adapter flange to the motor first, then attach to the adapter.

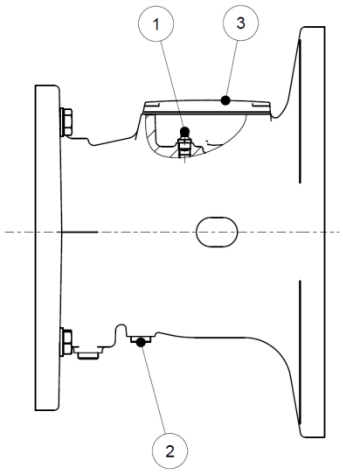
Motor Parallel Keys			
IEC/NEMA Type	**Coupling**	**Shaft ø**	**Motor Shaft's Key**
AI 160	R42	42 mm	12x8x45 mm
AI 180	R48	48 mm	14x9x45 mm
AN 250	R42	1.625 in	3/8x3/8x1 1/2 in
AN 280	R48	1.875 in	1/2x1/2x1 1/2 in
AI 200	R55	55 mm	16x10x50 mm
AN 320	R55	2.125 in	1/2x1/2x1 1/2 in
AI 225	R65	60 mm	18x11x70 mm
AN 360 R350	R65	2.375 in	5/8x5/8x2 1/4 in
AI 250	R75	65 mm	18x11x70 mm
AI 280	R75	75 mm	20x12x70 mm
AN 360 R450	R75	2.375 in	5/8x5/8x3 1/8 in
AN 400	R75	2.875 in	3/4x3/4x3 1/4 in



Coupling Half on the NEMA Motor Shaft		
NEMA type	**Coupling size**	**A [in]**
N250TC R350	R42	3.26
N250TC 300S	R42	3.38
N280TC R350	R48	3.44
N280TC 300S	R48	4.03
N320TC	R55	3.58
N360TC/350	R65	4.98
N360TC/450	R75	5.92
N400TC	R75	6.47

Re-greasing Option for AI...BRG1 and AN...BRG1

For the IEC/NEMA adapters AI and AN with option BRG1, grease the outer roller bearing with approx. 20–25 g of grease at the grease nipple. The grease nipple is located under a bolt-on inspection cover. Before re-greasing, unscrew the grease drain screw so that the excess grease can drain off. Remove the excess grease on the motor adapter.



1 Conical grease nipple
2 Grease drain screw
3 Inspection cover

Automatic Lubricator

Some NORD gear units with NEMA (or IEC) adapters ranging in size from N250TC-N400TC (or IEC160-IEC315) are supplied with a factory-installed, field-activated, PERMA® Classic Automatic Lubrication Cartridge. The automatic lubricator is used to dispense lubricant to the outer most roller bearing of the input NEMA (or IEC) input assembly. The lubrication cartridge must be activated prior to commissioning the gear unit. (Figures 1 & 2)

Some newer versions of the NEMA (or IEC) adapters also include a grease purge. The grease purge area is sealed for transportation; however, it is recommended that the G1/4 sealing screw be removed and that the grease collection container provided by NORD be installed just prior to activating the automatic lubricant dispenser. (Figure 3)

Principle of Operation

First the activation screw is threaded into the lubrication canister. Then the ring-eyelet on top of the activation screw is tightened until its breaking point. This causes a zinc-molybdenum gas generator to drop into a citric acid liquid electrolyte, which is contained within an elastic bladder. An electrochemical reaction slowly releases small amounts of hydrogen gas and gradually pressurizes the bladder, pushing the piston towards the lubrication chamber.

Grease is continuously injected into the lubrication point until the bearing cavity is full. Any back pressure from the bearing will cause the system to neutralize. The bladder inside the canister will continue to slowly build pressure so that once the equipment resumes normal operation; the lubricator will also resume its normal function.

The lubricator contains approximately 120 cm^3 or 120 ml (4.8 oz) of grease. For reference, a single stroke of a typical grease gun delivers approximately 1.0-1.2 cm^3 (0.03–0.04 oz) of grease. This means the canister contains approximately 100 strokes of grease. See Figure 1 for a detailed view of the PERMA® Lubricator.

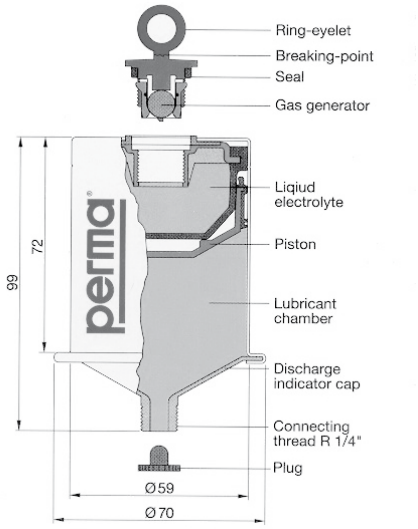


Figure 1 - PERMA® Automatic Lubrication Canister

NOTICE

- To prevent premature bearing failure, the lubrication dispenser must be activated prior to commissioning the gear reducer.
- The lubricator must only be used once and should never be opened or taken apart or permanent damage will result.
- Never unscrew the PERMA® canister from the lubrication point after activation or during the discharge period. This would cause a permanent pressure loss in the lubricator and would justify replacing the lubricator.

⚠ WARNING

- Avoid swallowing the gas generator, the liquid electrolyte, and the lubricant.
- Avoid contact of, the liquid electrolyte, and the lubricant with the eyes, skin or clothing.
- Observe all applicable MSDS sheets.
- Follow applicable local laws and regulations concerning waste disposal.

PERMA® Automatic Lubricator Options Supplied by NORD

NORD Part Number	28301000	28301010
Lubrication Option	Synthetic (standard)	Food Grade (optional)
PERMA® Classic Temperature Range ♦	0 to 40 °C (32 to 104 °F)	0 to 40 °C (32 to 104 °F)
Lubrication Volume	120 cm^3 or 120 ml (4.8 oz)	120 cm^3 or 120 ml (4.8 oz)
Grease Lubrication Mfg. / Type	Klüber / Petamo GHY 133	Lubriplate / FGL1
Lubrication Temperature Range ♦	-30 to 120 °C (-22 to 248 °F)	-18 to 120 °C (0 to 248 °F)

♦ The temperature range values shown do not apply to other components and/or lubricants within the gear reducer.

Lubricator Service Interval

The Automatic lubricator should be inspected approximately every 6 months. At the end of the lubrication period the piston becomes clearly visible through the clear nylon discharge indicator cap located at the bottom of the PERMA® canister (Figure 1); this helps indicate that the lubricant has been fully discharged at which time the lubricator should be replaced. When operating the gear unit 8 hours/day or less a replacement interval of 12 months or 1 year is possible. Ambient temperature will influence the discharge rate and may extend or shorten the replacement interval.

Ambient Considerations

The grease discharge rate is affected by the ambient temperature. PERMA® indicates that the lubricator contents will dispense for a 12 month period when the average temperature is 20 °C (68 °F). Grease dispensing rates depend primarily on average ambient conditions and not extreme highs and lows. Lower ambient temperatures will lead to slower dispensing rates and higher ambient temperatures will lead to faster dispensing rates.

Average Ambient Temperature	Discharge Period Months ♦
0 °C (32 °F)	>18
10 °C (50 °F)	18
20 °C (68 °F)	12
30 °C (86 °F)	6
40 °C (104 °F)	3

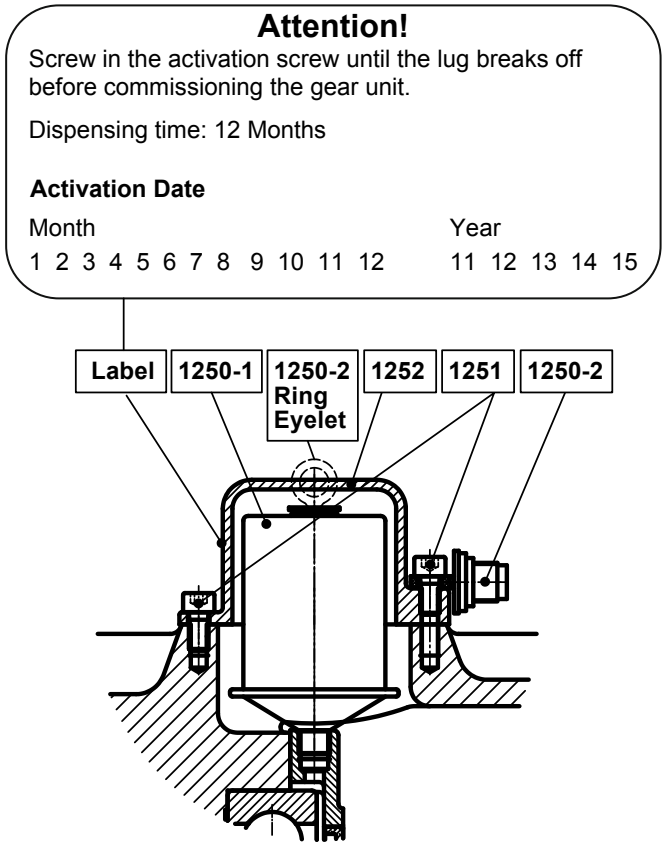
♦ Values are approximate.

Discharge can also be influenced by type of lubricant, vibration, and by the mating connecting parts in the lubrication system.

Activating the Automatic Lubricator

1. Loosen and remove the M8x16 assembly socket head cap screws (1251).
2. Carefully remove the protective cover (1252) installed over the automatic lubricator (1250-1).
3. Screw the activation screw (1250-2) into the automatic lubricator (1250-1) and twist the ring-eyelet until it reaches its breaking point.
4. Re-fit the cartridge cover (1252) and re-install and tighten the assembly screws (1251).
5. Mark the activation date on the adhesive label that is provided.

Figure 2 - Activating the Automatic Lubricator



1250-1 Automatic Lubricator
1250-2 Activation Screw
1251 Socket Head Cap Screws
1252 Protective Cover

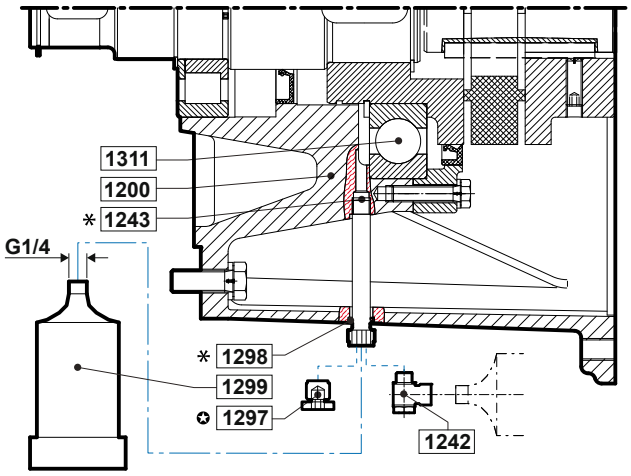
Grease Purge and Grease Drain Cup

Some versions of the NEMA (or IEC) adapters also include a grease purge and a grease drain cup (1299) for collecting old grease. The grease purge area is sealed for transportation.

It is recommended that the G1/4 sealing screw (1297) be removed and that the grease drain cup be installed after the automatic lubricant dispenser is activated.

The swivel fitting (1242) that NORD supplies allows the grease cup to be positioned at a 90° angle from its typical mounting. The swivel fitting allows the grease cup to be rotated so that it remains clear of any gear unit mounting obstructions.

Figure 3 – Grease Purge and Grease Cup Assembly



1200 NEMA or IEC Input Cylinder
1242 Swivel Fitting (P/N) 22006359)
1243 Extension*
1297 Screw Plug ✪
1298 Seal Ring*
1299 Grease Drain Cup (P/N 28301210)
1311 Bearing

* Supplied on certain input assembly sizes as needed.

✪ Remove the screw plug to install either the grease drain cup or the swivel fitting with the grease drain cup.

Grease Cup Servicing

NORD suggests that with every second replacement of the automatic lubricator, the grease collection cup (NORD Part No. 28301210) should be emptied or replaced with a new one. Follow the steps below to service the grease cup.

1. Unscrew the grease drain cup (1299) from either the outlet port of the NEMA or IEC input cylinder or from the extension (1243) that is secured to the NEMA or IEC input cylinder.
2. To empty the grease drain cup (1299) insert a stiff rod through the hole in the grey cap-end of the drain cup and push the internal plunger towards the thread-end of the drain cup. Please note that the dark gray end cap is bonded into place and cannot be removed.
3. Collect and properly dispose of the grease being pushed out of the drain cup. Due to the design of the container a residual amount of grease may remain in the container.
4. After emptying and cleaning the grease cup it can be fitted back onto the grease outlet port of the NEMA or IEC adaptor.
5. In the event the grease cup becomes damaged it should be replaced with a new container. Consider replacing the grease cup (P/N 28301210) with every second replacement of the automatic lubricator.

Replacing the Automatic Lubricator

A new automatic lubricator can be ordered from NORD by specifying the appropriate Part Number from the table at the bottom of Page 1 of this manual. Reference Figure 2 and follow the steps below to replace the automatic lubricator.

1. Loosen and remove the M8x16 socket head cap screws (1251) holding the protective cover (1252) in place.
2. Unscrew the automatic lubricator (1250-1) from the bearing cover area of the NEMA or IEC input cylinder.
3. Install the new automatic lubricator and activate per the instructions on page 2.
4. Re-install the protective cover (1252) and the assembly screws (1251).
5. Note the activation date of the newly installed automatic lubricator

NEMA OR IEC INPUT ADAPTER WITH GREASE FITTING

Application

NORD gear units listed in the table below that are supplied with a NEMA 250TC or IEC 160 and larger input adapter, may be supplied with an external grease fitting. The grease fitting allows the user to service the outboard bearing of the reducer's input assembly

Helical Inline	SK62, SK72, SK73, SK82, SK83, SK92, SK93, SK102 and SK103
Parallel-Shaft CLINCHER™	SK6282, SK7282, SK7382, SK8282, SK8382, SK9282, SK9382, SK10282, SK10382, SK11282, SK11382 & SK12382
90.1 Series Helical-Bevel	SK9072.1, SK9082.1, SK9086.1, SK9092.1 & SK9096.1

The grease fitting is an option which must be specified upon ordering, otherwise NORD will normally supply a PERMA Automatic Lubricator (See User Manual U45250).

Factory Supplied Grease

The bearing grease applied at the factory is as follows:

Brand	Mobil, Mobilith SHC220
Thickener	LI-Complex
NLGI Grade	2
Temperature Range	40°C to 120°C (-40°F to 250°F)

IMPORTANT NOTE

It is the user's responsibility to ensure that if replacement grease is used, that it is fully compatible with the factory supplied grease.

Service Instructions

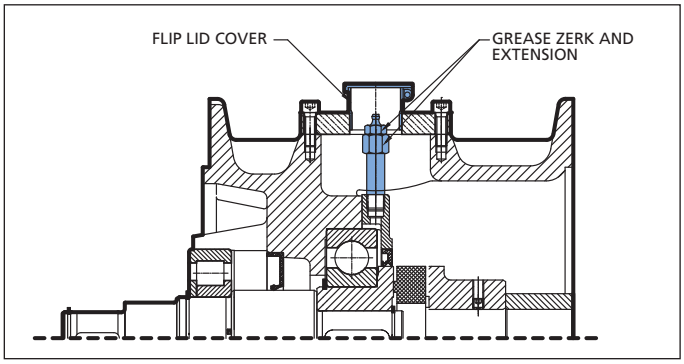
WARNING

- While working on the gear drive system, make sure the power from the prime mover is isolated or secured on "lock-out" to prevent accidental start-up and to safeguard against injury!
- Surfaces of motors and gear units may become hot during operation or shortly after start-up. In some instances additional protection against accidental contact may be necessary. Use caution to avoid burns or serious injury!

1. It is best to re-grease the bearing within a short period after the gear unit was operational because the old grease will be more viscous and will flow easier.
2. Ensure that the grease gun contains the right lubricant for the bearing to be re-greased.
3. Open the protective flip cover and clean the areas around the grease fitting to ensure that contaminants are not introduced into the bearing cavity.
4. Using a grease gun, apply 0.75 ounces (20-25 grams) of compatible bearing grease every 2,500 service hours.

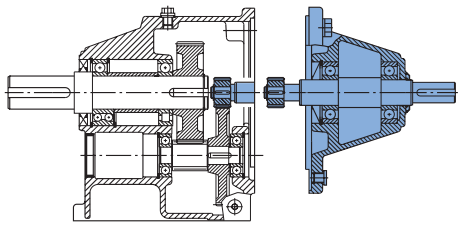
IMPORTANT NOTE

Re-greasing should be carried out while the bearing is still warm from operation and/or while rotating (if it is safe).



1. Solid Input Shaft (W)

The shaft will be inch or metric, depending on how the unit was ordered. Measure and verify the shaft before mounting anything on the shaft. Below are the tolerances used for the solid shafts.



2. Solid shaft diameter tolerance

Reducer input shaft extensions have a diameter tolerance as specified in **Table 1**.

Table 1: Solid Shaft Diameter Tolerance

Above ø (in)	To & Including ø (in)	Tolerance (in)
0.375	1.750	+0.0000 / -0.0005
1.750	2.750	+0.0000 / -0.0010

Above ø (mm)	To & Including ø (mm)	Tolerance (mm)	ISO 286-2 Fit Class
10	18	+0.012 / +0.001	k6
18	30	+0.015 / +0.002	k6
30	50	+0.018 / +0.002	k6
50	70	+0.030 / +0.011	m6

3. Fitting drive elements onto the reducer solid shaft

Solid input shaft extensions are provided with a drill and tap feature as indicated in Table 2. When installing drive elements such as coupling hubs, pulleys, sprockets, or gears, NORD recommends using the threaded hole in the end of the shaft, along with a suitable assembly device fitted into the threaded hole.

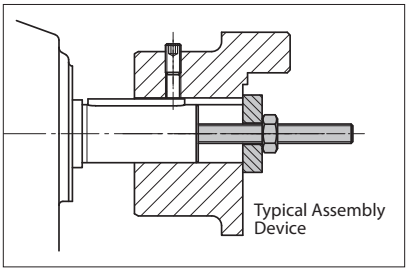


Table 2: Solid Input Shaft End - Threaded Holes

Above ø (in)	To & Including ø (in)	Tap size & Depth (in)
0.375	0.500	10-24 x 0.43 in
0.500	0.875	1/4-20 x 0.59 in
0.875	0.938	5/16-18 x 0.71 in
0.938	1.100	3/8-16 x 0.87 in
1.100	1.300	1/2-13 x 1.10 in
1.300	1.875	5/8-11 x 1.42 in
1.875	2.750	3/4-10 x 1.73 in

Above ø (mm)	To & Including ø (mm)	Tap Size & Depth (mm)
10	13	M4 x 10 mm
13	16	M5 x 12.5 mm
16	21	M6 x 16 mm
21	24	M8 x 19 mm
24	30	M10 x 22 mm
30	38	M12 x 28 mm
38	50	M16 x 36 mm
50	70	M20 x 42 mm

NOTICE

DO NOT DRIVE or **HAMMER** the coupling hub, pulley, sprocket, or gear into place. An endwise blow to the reducer shaft can generate damaging axial forces and cause damage to the reducer housing, bearings or internal components.

⚠ *WARNING*

To avoid serious injury the user must provide suitable safety guards for all rotating shafts and shaft components such as couplings, chain drives, belt drives, etc. All guarding must adhere to local regulations and safety standards.

4. Installing interference-fit hubs to the reducer shaft

Prior to installing any interference-fit hubs to the reducer shaft, consult with the manufacturer to determine proper assembly and fit. Interference-fits usually require heating the coupling, sprocket or gear hub, per the manufacturer's recommendations. Coupling hub installation typically follows ANSI/AGMA 9002-A86. Always make sure the reducer shaft seals are protected from the heat source. Apply uniform heat to the drive element hub to prevent distortion. NORD does not recommend heating the drive element hub beyond 212°F to 275°F (100°C to 135° C).

⚠ *WARNING*

When using heat to mount a drive element hub, do not use open flame in a combustible atmosphere or near flammable materials. Use suitable protection to avoid burns or serious injury.

i *IMPORTANT NOTE*

When using external chain or belt drives, make sure the reducer is sized so that the shaft and bearings have adequate capacity. To avoid unnecessary bearing loads and additional shaft deflection, mount all power take-off devices (sprockets, pulleys, etc.) so that the applied load center is as close to the gear housing as possible and check component alignment and tension of any belts or chains per the manufacturer's recommendation. Do not over tighten the belts or chains.

5. Coupling installation

The performance and life of any coupling depends upon how well it is installed. Coupling hubs are typically mounted flush with the shaft ends, unless specifically ordered for overhung mounting. Shaft couplings should be installed according to the coupling manufacturer's recommendations for gap, angular and parallel alignment. To help obtain critical shaft alignment coupling hubs may be installed to the machine shafts prior to final shimming or tightening of the foundation bolts. Proper coupling alignment allows for thermal and mechanical shaft movement during operation and ensures that only torque (no radial load) is transmitted between the mating shafts.

Coupling gap and angular alignment

The shaft gap must be sufficient to accommodate any anticipated thermal or mechanical axial movement. When setting the coupling gap, insert a spacer or shim stock equal to the required spacing or gap between the coupling hub faces. Measure the clearance using feeler gauges at 90-degree intervals, to verify the angular alignment.

Parallel (or offset) alignment

Mount a dial indicator to one coupling hub, and rotate this hub, sweeping the outside diameter of the other hub. The parallel or offset misalignment is equal to one-half of the total indicator reading. Another method is to rest a straight edge squarely on the outside diameter of the hubs at 90° intervals and measure any gaps with feeler gauges. The maximum gap measurement is the parallel or offset misalignment.

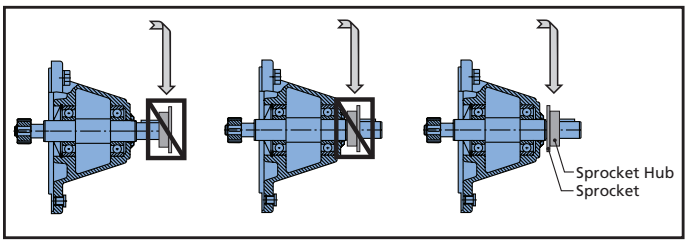
Check alignment

After both angular and parallel alignments are within specified limits, tighten all foundation bolts securely and re-check critical alignment. If any of the specified limits for alignment are exceeded, realign the coupling.

6. Installing sheaves (pulleys), sprockets and gears

To avoid unnecessary bearing loads and additional shaft deflection, mount all power take-off devices (sprockets, pulleys, gears, etc.) so that the applied load center is as close to the gear housing as possible, as shown in **Figure 2**.

Figure 2: Pully or Sprocket Mounting



Align the driver sheave or sprocket with the driven sheave or sprocket by placing a straight-edge length-wise across the face of the sheaves or sprockets. Alignment of bushed sheaves and sprockets should be checked only after bushings have been tightened. Check horizontal shaft alignment by placing one leg of a square or a level vertically against the face of the sheave or sprocket.

Always check component alignment and tension any belts or chains per the manufacturer's recommendation. The ideal belt or chain tension allows proper wrap of the driver and driven wheels, while maintaining the lowest possible tension of the belts or chain, so that no slipping occurs under load conditions. Check belt or chain tension frequently over the first 24 to 48 hours of operation.

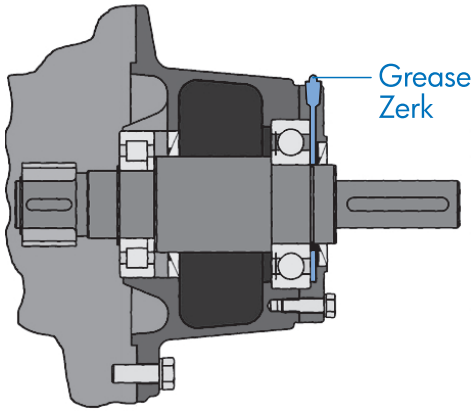
i *IMPORTANT NOTE*

When using external chain or belt drives, make sure the reducer is sized so that the shaft and bearings have adequate capacity. To avoid unnecessary bearing loads and additional shaft deflection, mount all power take-off devices (sprockets, pulleys, etc.) so that the applied load center is as close the gear housing as possible and check component alignment and tension of any belts or chains per the manufacturer's recommendation. Do not over tension the belts or chains.

7. Service Guidelines for W-Shaft Input with Grease Fitting

On some solid shaft input (Type W) gear units, the outer roller bearing needs to be re-greased at regular service intervals. This is necessary for double-stage gearboxes sizes SK62 or SK6282 and larger, and triple-stage gearboxes from size SK73, SK7382 or SK9072.1 and larger.

To lubricate the bearing of the input shaft, approximately 0.75 to 1.0 ounces (20-25 grams) grease should be added by the grease fitting approximately after every 2,500 hours of service or at least every 6 months. The W-shaft input is factory assembled with the proper amount and type of grease. The type of grease supplied depends upon the type of oil specified at time of order.



Bearing Grease Options

Reducer Oil Type	NLGI Grade	Grease Thickener	Grease Base Oil	Ambient Temperature Range	Manufacturer Brand/Type
MIN-EP	NLGI 2	Li-Complex	MIN	-30 to 60°C (-22 to 140°F)	Mobil Grease XHP222
PAO	NLGI 2	Li-Complex	PAO	-40 to 80°C (-40 to 176°F)	Mobil / Mobilith SHC 220
FG or FG-PAO	NLGI 2	Polyurea	FG-PAO	-30 to 80°C (-22 to 176°F)	Mobil SHC Polyrex 222

NOTICE

Grease compatibility depends upon the type of thickener or soap complex used, the base oil type suspended within the thickener, and the type of additives used. The user should check with the lubrication supplier before making substitutions in brand and type in order to assure compatibility and to avoid causing damage to the extended bearing.

Motor Mount Platform (MK)

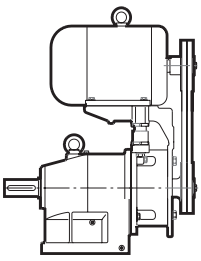
For proper installation of the belt drive, consult the manufacturer. NORD MK motor mounts are adjustable in two ways. Slotted holes are provided at the input cylinder for the initial height adjustment. There are two fine adjustments at the yoke to increase/decrease tension. Two spanner head wrenches will be needed to tighten/loosen the fine adjustments. The four bolts holding the motor platform to the input cylinder must be loosened in order to use the fine adjustments.

The motor mounting platform has tapped holes to accept the foot pattern of the standard footed NEMA or IEC motor. All MK mounting input shaft diameters are metric.

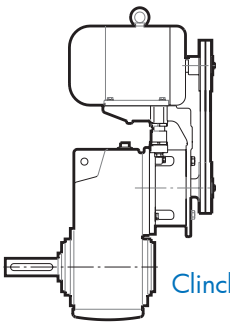
Align the sheaves or sprockets square and parallel by placing a straight edge across their faces. Alignment of bushed sheaves and sprockets should be checked after bushings have been tightened. Check horizontal shaft alignment by placing a level vertically against the face of the sheave or sprocket. Adjust belt or chain tension per the manufacturer's specified procedure. After a period of operation, recheck alignment and adjust as required.

IMPORTANT NOTE

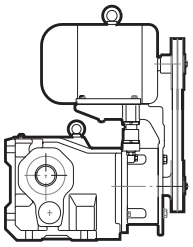
When using external chain or belt drives, make sure the reducer is sized so that the shaft and bearings have adequate capacity. To avoid unnecessary bearing loads and additional shaft deflection, mount all power take-off devices (sprockets, pulleys, etc.) so that the applied load center is as close to the gear housing as possible and check component alignment and tension of any belts or chains per the manufacturer's recommendation. Do not over tighten the belts or chains.



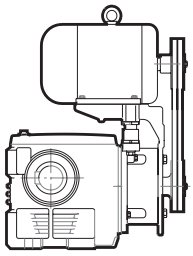
In-Line Unit



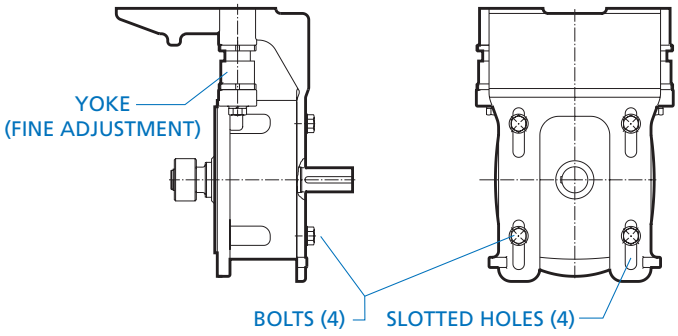
Clincher™ Unit



Bevel Unit



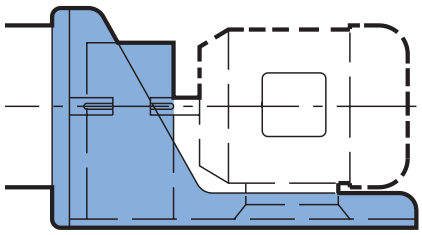
Worm Unit



CAUTION

NORD Gear does not furnish the safety guards for the belt drive. It is the responsibility of the customer to install a safety guard to conform to OSHA standards.

Sugar Scoop



Each scoop bracket includes the coupling for the motor and the coupling guard.

- NORD's standard supplied coupling is the jaw-type coupling with elastomeric spider element.
- The reducer-side (driven) coupling hub is mounted by NORD.
- The motor-side (driver) coupling hub must be mounted by the party responsible for supplying or mounting the motor.
- The supplied coupling guard must be mounted after coupling installation.

Coupling Mounting Instructions

1. Make sure that the motor shaft is clean and free of burrs or defects.

2. Check the motor shaft, coupling hub bores, key and key seat dimensions to make sure they are the proper dimensions.

3. Mount the coupling onto the motor by placing the coupling so that the inside face is flush with the end of the motor shaft and tightening the set screws to hold it in place (Figure 1).

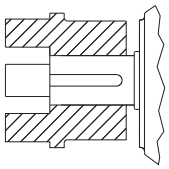


Figure 1. Place coupling flush with end of motor shaft and tighten setscrew.

IMPORTANT NOTE

Heating the coupling hub slightly, up to 176°F (80°C) will help facilitate installation onto the motor shaft.

WARNING

Wear appropriate safety gloves to handle the heated coupling hubs to avoid serious burns or injury.

NOTICE

DO NOT DRIVE or HAMMER coupling hubs into place. An endwise blow to the reducer or motor shaft can generate damaging axial forces and cause damage to the reducer or motor housing, bearings, or internal components.

4. Let the coupling cool down before mounting the spider into the jaws. The spider should not be under axial compression when installed.

5. Place the motor onto the scoop and engage the couplings together. The scoop has slotted holes to help accommodate axial alignment. Secure the motor to the scoop bracket but do not completely tighten the fasteners.

IMPORTANT NOTE

Before tightening the motor to the scoop bracket, the alignment of the coupling must be checked. Shimming of the motor feet may be needed to properly align the couplings. Careful coupling alignment extends the life of not only the coupling but all the components of the drive train.

6. Check the parallel alignment by placing a straight edge or level across the two coupling hubs, and measure the maximum offset at various points around the circumference of the coupling, without rotating the coupling. The maximum parallel alignment should not exceed 0.015 inches (4 mm).

7. Check the angular alignment of the coupling without rotating the hubs. The maximum angular displacement should not exceed 1.0°.

8. After both angular and parallel alignment is within specified limits, tighten all motor mounting hardware to the appropriate torque specification.

9. Re-check the critical alignment and repeat steps 6 and 7 if needed.

10. Mount the coupling guard to the scoop.

CAUTION

It is the customer responsibility to properly guard the rotating shaft and coupling connection and make sure the system meets all local safety regulations.

IMPORTANT NOTE

After a period of operation, it is suggested that the system be checked to make sure coupling alignment is being maintained.

Items included in the touch-up kit

I. No Rinse Alodine® Touch-N-Prep pen.

II. Color matched sealer pen

IMPORTANT NOTE

- Always wear Personal Protective Equipment (PPE), including gloves and safety glasses with side shields.
- When opening individual pens, pull safety caps straight out from pen. Do not twist or torque the cap to avoid damaging the applicator assembly.
- Do not use fingers to prime the applicator tip. Priming takes 15-30 seconds.
- Make sure the surface is clean and dry.

IMPORTANT NOTE

I. Metal temperature must be above 50° F

II. Do not excessively use abrasive pad while removing surface oxidation. Oxidation only needs to be removed from areas with exposed aluminum.

III. Use enough product to wet surface but avoid pooling.

IV. Do not rinse or wipe Alodine coating before the product is allowed to dry.

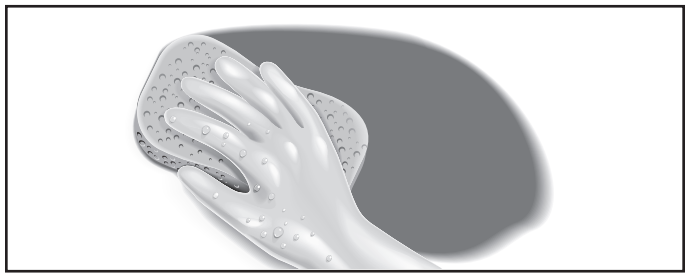
V. Allow to air dry or use a blow dryer. Do not use a heat gun. Maximum drying temperature is 140°F.

VI. Dry color will appear opaque.

Part I: Allodine® 871 Touch-N-Prep® Pen Instructions

Touch-N-Prep® pens are designed for easy and safe repair of clean, bare, or previously painted aluminum surfaces. It is a non-rinse, dry-in-place application that can be applied using the following steps:

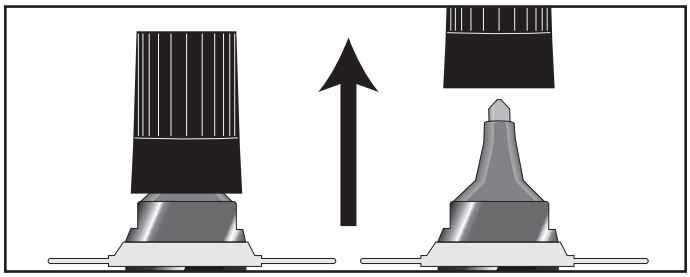
1. Surface Preperation



Before applying the coating, the treated surface must be cleaned using the following process:

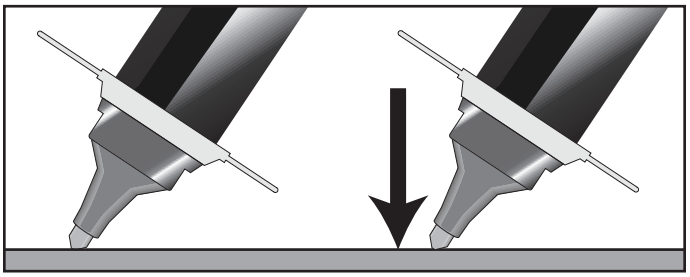
- If the scratch is more than 24 hours old use a moistened abrasive pad to remove oxides from the surface of the metal.
- Wipe substrate with a damp lint-free cloth to ensure complete removal of soils and dislodged oxides generated from the previous step.
- Allow Surface to dry before Touch-N-Prep® application.

2. Prime Applicator Tip

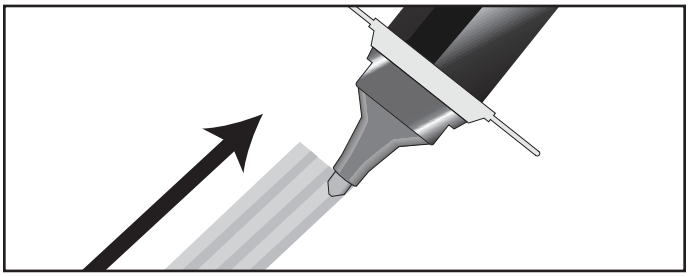


To activate, hold the Touch-N-Prep® pen upright and pop off the cap. Do not twist or turn to remove the cap, since this may result in the pen leaking. Hold the pen tip down onto a clean surface to begin the flow of solution to the tip.

3. Application

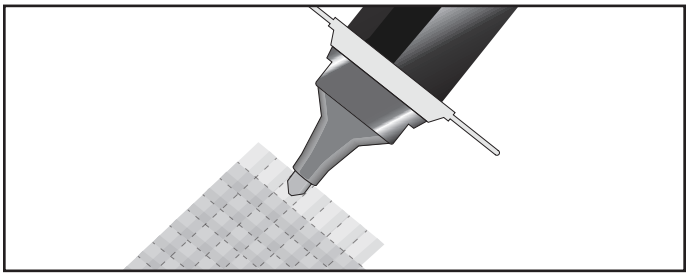


Press the pen tip down on the surface until solution fills the pen tip. Apply the Alodine® 871™ solution to the metal surface with firm, smooth, even strokes, covering all of the edges. Overlap each stroke and allow to dry.



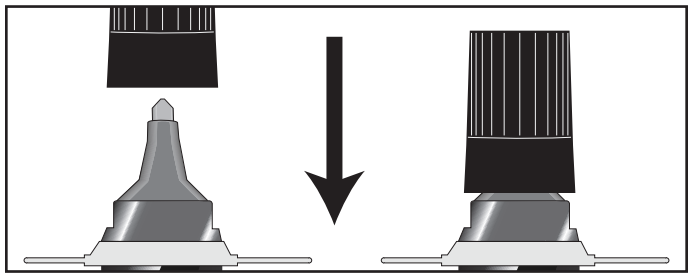
Frequent short jabs to re wet the application rip are preferred to maintain constant coating weights and avoid over-wetting the felt tip.

4. Re-Application



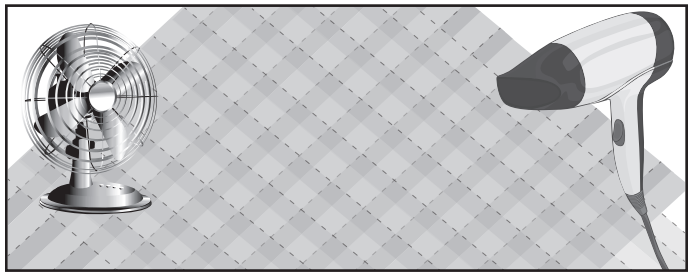
Within 5 minutes of the first coat, apply a second coat at a 90° angle to the first coat with the same smooth, firm stroke.

5. Prepare the Pen for Storage



Always immediately replace the cap when not in use to avoid evaporation and contamination.

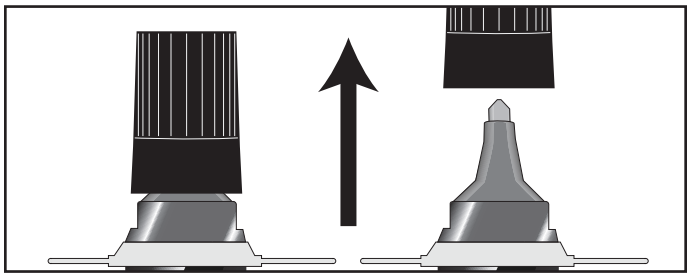
6. Drying



Allow the Alodine Touch-N-Prep® coating to air dry thoroughly.

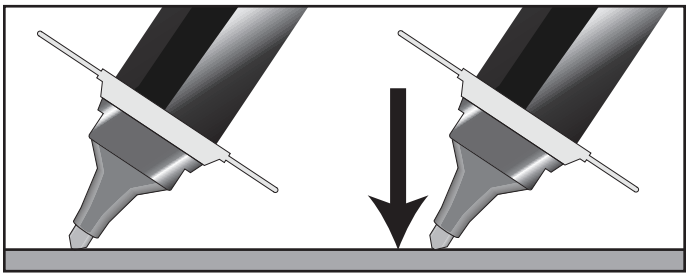
Part II: Sealer Application

1. Prime Applicator Tip



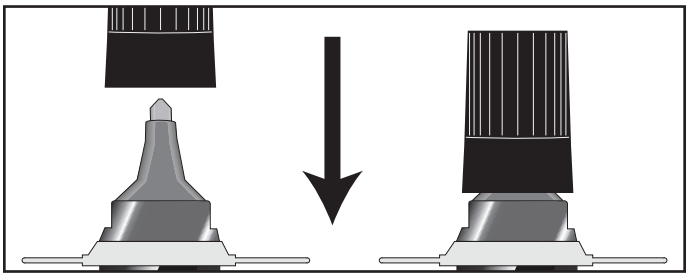
To activate, hold the pen upright and pop off the cap. Do not twist or turn to remove the cap, since this may result in the pen leaking. Hold the pen tip down onto a clean surface to begin the flow of solution to the tip.

2. Application



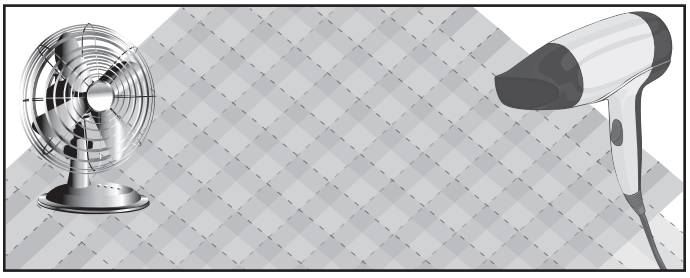
Press the pen tip down on the surface until solution fills the pen tip. Apply the sealer pen solution to the metal surface with firm, smooth, even strokes, covering all of the edges. Overlap each stroke and allow to dry.

3. Prepare the Pen for Storage



Always immediately replace the cap when not in use to avoid evaporation and contamination.

4. Drying



Allow the sealer pen coating to air dry thoroughly.

NORD GEAR CORPORATION

DRIVESYSTEMS — CONDITIONS OF SALE — WWW.NORD.COM

1. CONTRACT

Any contract between Nord Gear Corporation, hereinafter designated as Seller, and the Buyer is subject to the terms and conditions of sale hereinafter set forth. Any deviation from such terms and conditions must be specifically set forth in writing and consented to by Seller. Accordingly, the Buyer and Seller acknowledge and agree that the terms and conditions set forth below and on the face hereof shall govern Buyer's purchase of the goods described on the face hereof and shall take precedence over and represents the final agreement between Buyer and Seller, notwithstanding any inconsistent, contradictory or other prior or further conditions contained in any oral or written request or purchase order issued by Buyer or any other document furnished by Buyer in connection with its purchase of the Goods, regardless of whether such document or documents are exchanged simultaneously with this Invoice or prior or subsequent thereto. Any additional or different terms or conditions which may appear in any communicaiton, oral or written, from Seller, its officers, employees, agents or representatives, are hereby expressly rejected and shall not be effective or binding upon the Seller, unless specifically hereafter agreed to in writing by Seller and no such additional or different terms or conditions in any document submitted to Seller by Buyer shall become part of the contract between Buyer and Seller, unless such written acceptance by Seller specifically recognizes and assents to their inclusion. Any objection by Buyer to the terms and conditions hereof shall be ineffective unless Seller is advised in writing thereof within two (2) days of the date of this Invoice.

2. CONFIRMATION

An order shall be deemed accepted only when duly confirmed by Seller, at Nord Gear Corporation's home office in Waunakee, Wisconsin, and upon such confirmation the order shall become a contract binding upon the parties hereto, their successors and assigns.

3. PRICES

Prices shown are list prices and may be subject to applicable discounts. Unless otherwise agreed upon in writing, prices are FOB factory Waunakee, Wisconsin. Prices and discounts are subject to change without notice until order is accepted. Seller's prices do not include cost of any inspection permits required.

4. LIMITED WARRANTY

Seller hereby warrants that the goods sold hereunder shall be free from material defects in material and workmanship, if properly installed and used under normal operating conditions, for a period of twelve (12) months from the date of installation or eighteen (18) months from date of shipment, whichever comes first (the "Warranty Period"). With respect to gears and housings only, the Warranty Period is extended to thirty-six (36) months from the date of invoice or twenty-four (24) months from the date of installation, whichever comes first. The limited warranty shall not apply to any components or parts which are subject to normal operational wear and tear, including, but not limited to, belts and traction discs. Should any goods fail to comply with the foregoing limited warranty, Buyer shall provide written notice to Seller of the claimed defect and all relevant details within thirty (30) days of Buyer's discovery of the claimed defect. Buyer shall return the allegedly defective goods to Seller at its facilities in Waunakee, Wisconsin or to such other location within the USA as may be designated by Seller in its sole discretion, with all shipping and transportation charges prepaid by Buyer. Seller shall then examine the returned goods to determine if the claimed defect is covered by the limited warranty. If the claimed defect is covered by the limited warranty, Buyer's sole and exclusive remedy shall be to have Seller repair or replace, at Seller's option, the defective goods or components in accordance with the terms of this limited warranty. Seller shall have a commercially reasonable time to make such repairs or replacements and may use new or reconditioned components. Any repair or replacement shall not extend the Warranty Period unless otherwise agreed by Seller. Buyer shall pay all shipping costs and any costs of removal and re-installation of goods or components.

The foregoing limited warranty shall not apply with respect to any goods or components (i) which are not installed, used, operated, serviced or maintained in accordance with manufacturer's instructions or which are otherwise not properly installed, used, operated, serviced or maintained, or (ii) which are misused, neglected, damaged, altered, repaired, reconfigured or incorrectly wired. Seller makes no representations as to the specifications, capacity or performance of the goods sold hereunder, except as may be specifically set forth in the invoice's written specifications, and any such representations are expressly conditioned upon the accuracy and completeness of the data and information furnished by the buyer and upon the goods being properly installed, used, serviced and maintained by Buyer. Any description or model of the goods is for identification or illustrative purposes only and shall not be deemed to create any warranty, express or implied.

THE FOREGOING LIMITED WARRANTY SHALL EXTEND SOLELY TO BUYER AND NOT TO ANY OTHER PARTY. THE FOREGOING LIMITED WARRANTY IS IN LIEU OF ANY AND ALL OTHER WARRANTIES, WHETHER EXPRESS OR IMPLIED. SELLER HEREBY EXCLUDES AND DISCLAIMS ANY AND ALL OTHER WARRANTIES, WHETHER EXPRESS OR IMPLIED, INCLUDING, WITHOUT LIMITATION, ANY IMPLIED WARRANTIES OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE. IF BUYER SHALL FAIL TO PAY WHEN DUE ANY PORTION OF THE PURCHASE PRICE OR ANY OTHER PAYMENT REQUIRED FROM BUYER TO SELLER UNDER THIS CONTRACT, ALL WARRANTIES AND REMEDIES SET FORTH HEREIN SHALL BE DEEMED NULL AND VOID, AB INITIO. THE PARTIES ACKNOWLEDGE AND AGREE THAT THE EXCLUSIVE REMEDY UNDER THE FOREGOING LIMITED WARRANTY SHALL NOT HAVE FAILED OF ITS ESSENTIAL PURPOSE (AS THAT TERM IS USED IN THE UNIFORM COMMERCIAL CODE) PROVIDED THAT SELLER REMAINS WILLING TO REPAIR OR REPLACE DEFECTIVE GOODS WITHIN A COMMERCIALLY REASONABLE TIME. BUYER SPECIFICALLY ACKNOWLEDGES AND AGREES THAT THE PRICE CHARGED BY SELLER FOR THE GOODS IS BASED UPON THE LIMITATIONS OF SELLER'S WARRANTY OBLIGATIONS AND OTHER LIABILITIES AS SET FORTH HEREIN.

LIMITATION OF LIABILITY. NOTWITHSTANDING ANY OTHER PROVISION HEREOF, IN NO EVENT SHALL SELLER BE LIABLE TO BUYER OR TO ANY OTHER PARTY FOR ANY INCIDENTAL, SPECIAL, INDIRECT OR CONSEQUENTIAL DAMAGES, LOST PROFITS, OR FOR ANY LOSSES, CLAIMS OR DAMAGES RELATING TO OR ARISING FROM THE USE OR OPERATION OF THE GOODS, AND IN NO EVENT SHALL ANY CLAIM OR RECOVERY OF ANY KIND EXCEED THE PURCHASE PRICE OF THE GOODS IDENTIFIED IN THE RELATED INVOICE.

5. SHORTAGE AND NONCONFORMITY

Any claim of shortage or that the goods do not conform with the specifications of the order or model must be made in writing within ten (10) days after delivery of the goods (as to which such claim is made) to Buyer or its nominees, but in no event shall the claim be later than within the time limit provided by the carrier or insurance company, otherwise such claim shall be deemed waived. Buyer may not return any goods claimed to be in non-conformity without Seller's prior written authorization. Goods returned without permission will not be accepted, including for credit, and will be returned to Buyer, F.O.B. Sellter's plant. Any claim based on the receipt of damaged Goods must be filed with the carrier which delivered the goods. The samples, measurements, dimensions and weights contained in the Seller's catalogs, sales manuals, photographs and drawings constitute only an approximate guide. The Seller reserves the right to make any change which the Seller, in its absolute discretion, considers necessary. While the goods will be delivered principally according to specifications or standards or quantities agreed upon, insignificant deviations or insignificant changes in construction are permissible. The same applies to partial deliveries, In the event that Buyer has a verified claim of shortage or nonconformity of the goods to the specifications of the order or the model, and if such claim has been submitted within the required time limit as set forth above, the Seller shall, at its own expense, make up for the shortage of the goods, or replace or repair the goods, as the case may be, but in no event shall Seller be or become liable to Buyer or to any other person or persons for any loss in damage, direct or indirect, arising out of or caused by such incidents or for the loss of profits, business or good will. The liability of the Seller to Buyer, if any hereunder, for breach of warranty, contract, negligence or otherwise, shall in no event exceed the amount of the purchase price of the goods sold with respect to which any damages are claimed. Shipping dates are estimates unless parties expressly agree on time of the essence.

6. FORCE MAJEURE

The obligation of the Seller shall be modified or excused, as the case may be, for reasons of Acts of God, war, governmental law regulations, strikes or lock-outs, fire, breakdown of machinery, whether in its own business enterprise, or if for any other cause beyond Seller's control, the goods cannot be delivered or their delivery becomes delayed in whole or in part. In the above instances time for delivery shall be extended for the period of the delay caused, with the proviso, however, that either party may cancel in writing the undelivered portion of the order or contract if the delay exceeds six (6) months from the delivery date originally confirmed by Seller. In no event shall Seller become liable in the aforesaid instances to Buyer or any third party for consequential damages or business loss.

7. SHIPMENT AS UNIT

Each shipment by Seller shall be treated as a separate and distinct unit with respect, but only with respect to forwarding, terms of payment, and the making of claims by the Buyer: provided, however, that if the Buyer defaults in the payment of any obligation to Seller or any installments thereof, under any agreement between Buyer and Seller, or if Buyer refuses to accept any goods when tendered for delivery, the Seller may, on fifteen (15) days written notice to the Buyer, without prejudice to Seller's other lawful remedies, either defer further performance until the defaulted payments are made in full, or make future deliveries for cash in advance only, or treat the entire contract or contracts with Buyer as breached by the Buyer and pursue its remedies for breach.

8. BUYER'S REFUSAL OF DELIVERY

If Buyer refuses to accept delivery of any goods tendered for delivery, then Seller, without prejudice to Seller's other lawful remedies, may either store or cause such goods to be stored in a warehouse, for buyer's account and at Buyer's cost, risk and expense, or sell such goods (without notice) to any purchases at public or private sale, and hold the Buyer liable for any difference between (a) the contract price of the goods, and (b) the price at which goods are resold less the costs and expense of such resale including brokerage commissions, or restocking charges.

9. GOODS IN TRANSIT

If prior to delivery or while the goods are in transit, Buyer or Seller becomes bankrupt or insolvent, or any petition in bankruptcy or for the reorganization or for a state court receivership is filed against Buyer or Seller, as the case may be, then the other party hereto may forthwith terminate this contract by giving written notice of such termination. Such termination shall not affect any claim for damages available to the Buyer, provided that if Buyer is then indebted to Seller, the amount of any such damage claim shall be abated to the extent that the indebtedness of Buyer to Seller, as actually paid in money, is abated by any order of judgement entered or any plan adopted in any bankruptcy, reorganization, receivership, or similar proceeding. Such termination shall not prejudice the Seller's rights to any amounts then due under the contract. If Buyer becomes bankrupt or insolvent or any petition in bankruptcy or for reorganizing or if a state court receivership is filed against Buyer, then, at its option Seller may take possession of any goods theretofore sold to Buyer, in connection with which the full purchase price has not been paid, analogous to the terms and provisions set forth in Paragraphs 11 and 12 hereinafter.

10. DELIVERY

(a) Any indicated dates of delivery are approximate only, but NORD Gear will attempt to meet them whenever possible. (b) NORD Gear will not be liable for any penalty clausess contained in any specifications or order submitted unless agreed to in writing by an authorized officer of NORD Gear Corporation. (c) Unless otherwise agreed, delivery of the goods to any carrier shall constitute delivery to the Buyer, and thereafter the risk of loss or damage to the goods shall be upon the Buyer. (d) If the Buyer does not give delivery instructions to the Seller at least (10) days prior to the delivery date ex factory confirmed by the Seller, the Seller may deliver the goods to a carrier of its own choosing, at Buyer's cost and risk, or, at Seller's option, may store the goods on the pier or any warehouse, at Buyer's cost and risk. Any purchase price in such event becomes due and payable within ten (10) days of such storage.

11. PAYMENT OF PURCHASE PRICE

Time of payment is of the essence under the contract. Unless otherwise provided, terms of payment are 30 days net from the date of invoice with a 1% discount if paid within 10 days of date of invoice. Upon default in any of the terms of the contract, or failure to comply with any of the conditions thereof, or upon seizure of the property under execution or other legal process, or if the Buyer becomes bankrupt or insolvent, or any petition for reorganization or for a state court receivership is filed against Buyer, or if the Buyer makes any assignment for the benefit of it's creditors or otherwise sells, encumbers or disposes of the goods, or if for any other reason the Seller should deem itself insecure, the full amount of the purchase price then remaining unpaid shall at once become due and payable at the option of the Seller.

12. BUYER'S DEFAULT

Upon the Buyer's default, the Seller may dispose of the merchandise in any manner that it deems fit and, if it desires to resell same, may do so at private or public sale, with or without notice, and with or without the property being at the place of sale, subject, however, to applicable laws. The Seller or its assigns shall have the right to bid at such sale and may become the purchaser of the property. The proceeds of the sale shall first be applied to the expenses incurred in retaking, repairing, storing and selling the goods, reasonable attorney's fees included, and then shall be applied to the payment of the balance due under the contract. Any surplus amount shall be paid to the Buyer. If a deficiency results after the resale, the Buyer agrees to pay such forthwith, together with reasonable attorney's fees, for the recovery of the goods incurred by the Seller. If upon the Buyer's default, the Seller elects not to resell any goods which it may repossess, then the cost of repossession, including reasonable attorney's fees, shall forthwith be due and payable from Buyer to Seller. Buyer agrees to pay all reasonable costs and reasonable attorneys' fees incurred by Seller in enforcing Seller's rights against Buyer, including Seller's right to payment of the purchase price of the goods and Buyer's payment of all other amounts owing to Seller required under this Invoice and Conditions of Sale.

13. SECURITY INTEREST AND TITLE

In states and localities which are governed by the Uniform Commercial Code, this contract shall serve as security agreement, reserving in Seller a security interest until full payment of purchase price. The provisions of the Uniform Commercial Code regarding security interest shall have preference and apply if inconsistent with other terms of the conditions of sale. In states and localities where the Uniform Commercial Code does not apply, title to the goods shall remain in the Seller or its assigns until full payment of the purchase price. Buyer agrees to execute forthwith any and all documents in such a way and form as Seller may need for filing or recording the security interest under the Uniform Commercial Code with the proper registers or offices, or for filing or recording the conditional sales contract.

14. SALES AND USE TAX

Buyer agrees to bear and pay any sales or use tax in connection with the purchase herein, and to hold the Seller harmless from payment. At the option the Seller, Buyer shall give evidence of payment or of exemption certificate.

15. INSURANCE

The Buyer shall keep the goods insured against damage by fire, water or other casualty as required by Seller, with a company acceptable to Seller, with loss payable to Seller for the total purchase price until the Seller is fully paid. Seller, if it so elects, may place said insurance at Buyer's expense; Seller may cancel such insurance at any time and without notice and may receive the return premium, if any.

16. MODIFICATION BY SELLER

Any contract may be assigned or transferred by the Seller, or the time for the making of any payment due by Buyer may be extended by Seller without derogation of any of the rights of the Seller or its assigns. Waiver by any party of any default shall not be deemed a waiver of any subsequent default.

17. RETURNED GOODS

No goods will be accepted for return unless authorized in writing by Seller. In all cases, transportation and restocking charges will be borne by Buyer.

18. PACKING

The Buyer will be charged for export packaging or other special packing desired. Cost for cartage to ship or transfer express will be added to the invoice. No credit will be allowed if no packing is required.

19. CHANGES/CANCELLATION

NORD Gear will not accept changes in specifications to a confirmed order unless such changes are requested in writing and confirmed back in writing. In addition, the purchaser must to agree to any additional charges that may arise from the change. Placing orders on hold or cancellation of orders require Seller's written approval, and are subject to cancellation and/or restocking charges.

20. BUYER'S RESPONSIBILITY AS TO MAINTENANCE

Buyer shall use and shall require its employees and agents to use all safety devices and guards and shall maintain the same in proper working order. Buyer shall use and require its employees and agents to use safe operation procedures in operating the equipment and shall further obey and have its employees and agents obey safety instructions given by Seller. If Buyer fails to meet the obligations herein, Buyer agrees to defend, indemnify and save Seller harmless from any liability or obligation with regard to any personal injuries or property damages directly or indirectly connected with the operation of the equipment. Buyer further agrees to notify Seller promptly and in any event not later than ten (10) days after notice or knowledge of any accident or malfunction involving Seller's equipment which has caused personal injury or property damages and to cooperate fully with Seller in investigating and determining the causes of such accident and malfunction. In the event that Buyer fails to give such notice to Seller or to cooperate with Seller, Buyer shall be obligated to defend, indemnify and save Seller harmless from any such claims arising from such accident.

21. MISCELLANEOUS PROVISIONS

(a) If for any reason a provision of a contract is legally invalid, then in such event the rest of the contract shall remain in full force and affect, except that the parties shall try to replace such invalid provision closest to their original mutual intentions. (b) This Invoice and these Conditions of Sale constitute the entire agreement between the parties regarding the subject matter hereof and supercedes all prior agreements, understandings and statements, whether oral or written, regarding such subject matter. No modification to, change in or departure from, the provisions of this Invoice and Conditions of Sale shall be valid or binding on Seller, unless approved in writing by Seller. No course of dealing or usage of trade shall be applicable unless expressly incorporated into this Invoice and Conditions of Sale. Any amendments to any contract or contracts between the parties shall be valid only upon the written consent of both parties.

22. NON ASSIGNMENT BY BUYER

Contract or contracts may not be assigned by the Buyer without prior written consent of the Seller.

23. APPLICABLE LAW AND VENUE

All contracts and their interpretation are governed by the applicable, substantive laws of the State of Wisconsin. Any litigation brought by the Buyer regarding this Invoice or goods purchased hereunder may only be brought in the Circuit Court for Dane County, Wisconsin.

NORD GEAR LIMITED

DRIVESYSTEMS — TERMS & CONDITIONS OF SALE — WWW.NORD.COM

1. CONTRACT
Any contract between Nord Gear Limited, hereinafter designated as "Seller", and the party or parties accepting these terms and conditions of sale and any agent, officer, servant, employee or subcontractor of such party or parties, hereinafter designated as "Buyer", is subject to the terms and conditions of sale hereinafter set forth. Any deviation from such terms and conditions must be specifically set forth in writing and consented to by Seller.

2. CONFIRMATION
An order shall be deemed accepted only when duly confirmed by Seller, at Nord Gear Limited's home office in Brampton, Ontario, and upon such confirmation the orders shall become a contract binding upon the parties hereto, their successors and assigns.

3. PRICES
Prices shown are list prices and may be subject to applicable discounts. Unless otherwise agreed upon in writing, prices are FOB factory Brampton, Ontario. Prices and discounts are subject to change without notice until the order is accepted. Seller's prices do not include cost of any inspection permits required.

4. LIMITED WARRANTY
Seller warrants the goods sold hereunder to be free from defects in material and workmanship under normal use and service not arising from misuse, negligence, or accident, including but not limited to the use, installation, and transportation of the goods by Buyer, its agents, servants, employees, or by carriers. This warranty shall pertain to any part or parts of any goods to which Buyer or its assigns has within one year from date of delivery given written notice of claimed defects to Seller. Buyer shall be required to furnish Seller with details of such defects and this warranty shall be effective as to such goods which Seller's examination shall disclose to its satisfaction to have been defective and which at Seller's option shall promptly thereafter be returned to Seller or its nominees. EXCEPT FOR THE EXPRESS WARRANTIES SET FORTH ABOVE, SELLER HAS MADE NO WARRANTIES, EXPRESS, IMPLIED OR STATUTORY, AS TO THE GOODS SOLD HEREUNDER, INCLUDING, BUT NOT LIMITED TO THEIR MERCHANTABILITY OR FITNESS FOR ANY PARTICULAR PURPOSE. ANY DESCRIPTION OR MODEL OF THE GOODS IS FOR IDENTIFICATION OR ILLUSTRATIVE PURPOSES ONLY AND SHALL NOT BE DEEMED TO CREATE AN EXPRESS WARRANTY. The Buyer's exclusive remedy for claims arising from defective or nonconforming goods shall be limited to the repair or replacement thereof at the Seller's sole option. THE SELLER SHALL NOT BE RESPONSIBLE OR LIABLE FOR CONSEQUENTIAL DAMAGES ARISING OUT OF OR IN CONNECTION WITH THE SALE, DELIVERY, USE, PERFORMANCE, OR SERVICE OF THE GOODS SOLD UNDER THIS AGREEMENT. SELLER SHALL NOT BE LIABLE FOR ANY LOST PROFITS OR FOR ANY CLAIM OR DEMAND AGAINST SELLER BY ANY PARTY. IN NO EVENT WILL SELLER BE LIABLE FOR SPECIAL, INDIRECT OR CONSEQUENTIAL DAMAGES, EVEN IF SELLER HAS BEEN ADVISED OF THE POSSIBILITY OF SUCH DAMAGES. SELLER'S AGGREGATE LIABILITY FOR DAMAGES UNDER THIS AGREEMENT, WHETHER ARISING FROM OR BASED UPON BREACH OF WARRANTY, BREACH OF CONTRACT, TORT OR OTHER CAUSE OF ACTION, SHALL IN NO CASE EXCEED THE PURCHASE PRICE THAT BUYER PAYS FOR THE PARTICULAR GOODS INVOLVED. Seller shall in no event be liable to any person or firm (including any assignee or Buyer) except Buyer and its successors. Unless specifically authorized by Seller in writing, Seller shall not become responsible for any repair work done by Buyer or any other party on any goods sold. Any costs of the return of such goods to Seller shall be borne by Buyer. Goods sold but not manufactured by Seller are being warranted as to defects in material and workmanship consistent with the limited warranty policy of the original manufacturer of the goods and if there is not such a limited warranty policy, the warranty shall be limited to the provisions of Article 4 herein. Standards for the operating characteristics of the gearboxes and the gear motors are in conformity with Seller's tests. THIS WARRANTY IS IN LIEU OF ALL OTHER EXPRESS OR IMPLIED WARRANTIES, INCLUDING ANY IMPLIED WARRANTY OF MERCHANTABILITY OR FITNESS FOR ANY PARTICULAR PURPOSE SELLER DOES NOT ASSUME, NOR DOES IT AUTHORIZE ANY PERSON TO ASSUME, ON ITS BEHALF, ANY OTHER OBLIGATION OR LIABILITY.

5. SHORTAGE AND NONCONFORMITY
Any claim of shortage or that the goods do not conform with the specifications of the order or model must be made in writing within ten (10) days after delivery of the goods (as to which such claim is made) to Buyer or its nominees, but in no event shall the claim be later than within the time limit provided by the carrier or insurance company, otherwise such claim shall be deemed waived. The samples, measurements, dimensions and weights contained in Seller's catalogs, sales manuals, photographs and drawings constitute only an approximate guide. Seller reserves the right to make any changes which Seller, in its absolute discretion, considers necessary. While the goods will be delivered principally according to specifications of standards or quantities agreed upon, insignificant deviations or insignificant changes in construction are permissible. The same applies to partial deliveries. In the event that Buyer has a verified claim of shortage or nonconformity of the goods to the specifications of the order or the model, and if such claim has been submitted within the required time limit as set forth above, Seller shall, at its own expense, make up for the shortage of the goods, or replace or repair the goods, as the cause may be, but in no event shall Seller be or become liable to Buyer or to any other person or persons for any loss in damage, direct or indirect, arising out of or caused by such incidents or for the loss of profits, business of good will. Shipping dates are estimates unless parties expressly agree on time of the essence.

6. FORCE MAJEURE
The obligation of Seller shall be modified or excused, as the case may be, for reasons of Acts of God, war, governmental law regulations, strikes or lock-outs, fire, breakdown of machinery, whether in its own business enterprise, or if for any other cause beyond Seller's control, the goods cannot be delivered or their delivery becomes delayed in whole or in part. In the above instances time for delivery shall be extended for the period of the delay caused, with the proviso, however, that either party may cancel in writing the undelivered portion of the order of contract if the delay exceeds six (6) months from the delivery date originally confirmed by Seller. In no event shall Seller become liable in the aforesaid instances to Buyer or any third party for consequential damages or business loss.

7. SHIPMENT AS UNIT
Each shipment by Seller shall be treated as a separate and distinct unit with respect, but only with respect to forwarding, terms of payment, and the making of claims by Buyer; provided, however, that if Buyer defaults in the payment of any obligation to Seller or any installments thereof, under any agreement between Buyer and Seller, or if Buyer refuses to accept any goods when tendered for delivery, Seller may, on fifteen (15) days written notice to Buyer, without prejudice to Seller's other lawful remedies, either defer further performance until the defaulted payments are made in full, or make future deliveries for cash in advance only, or to treat the entire contract or contracts with Buyer as breached by Buyer and pursue its remedies for breach.

8. BUYER'S REFUSAL OF D ELIVERY
If Buyer refuses to accept delivery of any goods tendered for delivery, then Seller, without prejudice to Seller's other lawful remedies, may either store or cause such goods to be stored in a warehouse, for Buyer's account and at Buyer's cost, risk and expense, or sell such goods (without notice) to any purchaser at public or private sale, and hold Buyer liable for any difference between (A) the contract price of the goods, and (B) the price at which goods are resold less the costs and expense of such resale including brokerage commissions, or restocking charges.

9. GOODS IN TRANSIT
If prior to delivery or while the goods are in transit, Buyer or Seller becomes bankrupt or insolvent, or any petition in bankruptcy or for the reorganization or for appointment of a receiver is filed against Buyer or Seller, as the case may be, then the other party hereto may forthwith terminate this contract by giving written notice of such termination. Such termination shall not affect any claim for damages available to Buyer, to Seller, as actually paid in money, is abated by any order of judgment entered or any plan adopted in any bankruptcy, reorganization, receivership, or similar proceeding. Such termination shall not prejudice Seller's rights to any amounts then due under the contract. If Buyer becomes bankrupt or insolvent or any petition in bankruptcy or for reorganization or if a state court receivership is filed against Buyer, then, at its option, Seller may take possession of any goods theretofore sold to Buyer, in connection with which the full purchase price has not been paid, analogous to the terms and provisions set forth in Paragraphs 11 and 12 hereinafter.

10.DELIVERY
(A)Unless otherwise agreed, delivery of the goods to any carrier shall constitute delivery to Buyer, and thereafter the risk of loss or damage to the goods shall be upon Buyer. (B) If Buyer does not give delivery instructions to Seller at least ten (10) days prior to the delivery date ex factory confirmed by Seller, Seller may deliver the goods to a carrier of its own choosing, at Buyer's cost and risk, or, at Seller's option may store the goods on the pier or on any warehouse at Buyer's cost and risk. Any purchase price in such event becomes due and payable within ten (10) days of such storage.

11. PAYMENT OF PURCHASE PRICE
Time of payment is of the essence under the contract. Upon default in any of the terms of the contract, or failure to comply with any of the conditions thereof, or upon seizure of the property under execution or other legal process, or if Buyer becomes bankrupt or insolvent, or any petitions for reorganization or for appointment of a receiver is filed against Buyer, or if Buyer makes any assignment for the benefit of its creditors or otherwise sells, encumbers or disposes of the goods, or if for any other reason Seller should deem itself insecure, the full amount of the purchase price then remaining unpaid shall at once become due and payable at the option of Seller. Interest on the delinquent payment from the due date thereof until paid shall be at a rate of two (2%) percent per month.

12. BUYER'S DEFAULT
Upon Buyer's default, Seller may dispose of the merchandise in any manner that it deems fit and, if it desires to resell same, may do so at private or public sale, with or without notice, and with or without the property being at the place of sale, subject, however, to applicable laws. Seller or its assigns shall have the right to bid at such sale and may become the purchaser of the property. The proceeds of the sale shall first be applied to the expenses incurred in retaking, repairing, storing and selling the goods; reasonable solicitor's fees included, and then shall be applied to the payment of the balance due under the contract. Any surplus amount shall be paid to Buyer. If a deficiency results after the sale, Buyer agrees to pay such forthwith, together with reasonable solicitor's fees, for the recovery of the goods incurred by Seller. If upon Buyer's default, Seller elects not to resell any goods which it may repossess, then the cost of repossession, including reasonable solicitor's fees, shall forthwith be due and payable from Buyer to Seller.

13. SECURITY INTEREST AND TITLE
In provinces which are governed by a Personal Property Security Act, this contract shall serve as a security agreement, reserving in Seller a security interest until full payment of the purchase price. The provisions of the Personal Property Security Act regarding security interest shall have preference and apply if inconsistent with other terms of the conditions of sale herein. In provinces where a Personal Property Security Act does not apply, title to the goods shall remain in the Seller or its assigns until full payment of the purchase price. Buyer agrees to execute forthwith any and all documents in such a way and form as Seller may need for filing or recording the security interest under a Personal Property Security Act with the proper registers or offices, or for filing or recording the Conditional Sales Contract herein.

14. SALES AND USE TAX
Seller's prices do not include sales, use, excise or other taxes payable to any governmental authority in respect of the sale of Seller's goods. Buyer shall pay, in addition to Seller's price, the amount of any such taxes or shall reimburse Seller for the amount thereof that Seller may be required to pay. At the option of Seller, Buyer shall give evidence of payment or of exemption certificate.

15. INSURANCE
Buyer shall keep the goods insured against damage by fire, water or other casualty as required by Seller, with a company acceptable to Seller, with loss payable to Seller for the total purchase price until Seller is fully paid. Seller, if it so elects, may place said insurance at Buyer's expense; Seller may cancel such insurance at any time and without notice and may receive the return premium, if any.

16. MODIFICATION BY SELLER
Any contract may be assigned or transferred by Seller, or the time for the making of any payment due by Buyer may be extended by Seller without derogation of any of the rights of Seller or its assigns. Waiver by any party of any default shall not be deemed a waiver of any subsequent default.

17. RETURNED GOODS
No goods will be accepted for return unless authorized in writing by Seller. In all cases, transportation and restocking charges will be borne by Buyer.

18. PACKING
Seller does not charge for standard packaging for domestic shipment. Buyer will be charged, however, for export packaging or other special packing desired. Cost for cartage to ship or transfer express will be added to the invoice. No credit will be allowed if no packing is required.

19. EXPORT ORDER
Export orders are to be accompanied by a confirmed irrevocable Letter of Credit in Seller's favor, in Canadian currency, with an accredited Canadian bank, subject to Seller's draft, with shipping documents attached.

20. CANCELLATION
Placing orders on hold or cancellation of orders require Seller's written approval, and are subject to cancellation and/or restocking charges.

21. BUYER'S RESPONSIBILITY AS TO MAINTENANCE
Buyer shall use and shall require its employees and agents to use all safety devices and guards and shall maintain the same in proper working order. Buyer shall use and require its employees and agents to use safe operating procedures in operating the equipment and shall further obey and have its employees and agents obey safety instructions given by Seller. If Buyer fails to meet the obligations herein, Buyer agrees to indemnify and save Seller harmless from any liability or obligation with regard to any personal injuries or property damages directly or indirectly connected with the operation of the equipment. Buyer further agrees to notify Seller promptly and in any event not later than ten (10) days after notice or knowledge of any accident or malfunction involving Seller's equipment which has caused personal injury or property damages and to cooperate fully with Seller in investigating and determining the causes of such accident and malfunction. In the event that Buyer fails to give such notice to Seller or to cooperate with Seller, Buyer shall be obligated to indemnify and save Seller harmless from any such claims arising from such accident.

22. MISCELLANOUS PROVISIONS
(A)If for any reason a provision of a contract is legally invalid, then in such event the rest of the contract shall remain in full force and affect, except that the parties shall try to replace such invalid provision with a provision closest to their original mutual intentions. (B) Any amendments to any contract or contracts require the consent in writing by both parties. Headings in this document are for ease of reference only.

23. NON ASSIGNMENT BY BUYER
Contract or contracts may not be assigned by Buyer without prior written consent of Seller.

24. APPLICABLE LAW
This agreement shall be governed by the laws of the Province of Ontario and the applicable laws of Canada. Buyer and Seller agree that any judicial proceeding with respect to this agreement must be brought and maintained in the City of Toronto, In the Province of Ontario.

25.
This instrument sets forth the entire understanding and agreement of the parties hereto in respect of the subject matter hereof, and all prior undertaking between the parties hereto, together with all representations and obligations of such parties in respect of such subject matter, shall be superseded by and merged into this instrument.

26.
The provisions of this agreement shall bind and ensure to the benefit of the parties hereto and their respective heirs, executors, administrators, successors and (subject to any restrictions or assignment herein above set forth) assigns, as the case may be.

27.
The parties acknowledge that they have requested this document and all notices or other documents relating thereto be drafted in the English language.

Les parties reconnaissent qu'ils ont requis que ce contrat et tous les avis ou autres documents qui s'y rapportent soient rédiges en langue anglaise.

"Terms and Conditions in French available upon request."

NORD DRIVESYSTEMS

Product Literature

Gear Units



DuoDrive Integrated Gear Motor
Catalog: G5010
Flyer: S5010



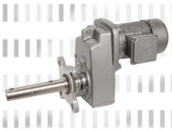
Helical Inline
Catalog: G1000



NORDBLOC.1® Helical Inline
Catalog: G1013



CLINCHER™ Parallel Shaft
Catalog: G1020



Screw Conveyor Package (SCP)
Catalog: G1129



Overhead Conveyor Drives
Catalog: G1043



2-Stage Right Angle Helical Bevel
Catalog: G1014



Right Angle Helical Bevel
Catalog: G1000

Worm Gear Units



FLEXBLOC® Worm - SI
Catalog: G1035
Flyer: F1033



MINICASE™ Worm - SMI
Catalog: G1035
Flyer: F1033



Right Angle Helical Worm
Catalog: G1000

Industrial Gear Units



MAXXDRIVE® Industrial Gear Units (Parallel, Right Angle)
Catalog: G1050
Flyer: F1050



MAXXDRIVE® XT Industrial Gear Units (Parallel)
Catalog: TI60-0011
Flyer: S1055

Motors & Brakemotors



VFD/AC Vector Duty Motors
Catalog: M7000



IE4/IE5+ Premium Efficiency Motors
Catalog: M5000
Flyer: S9012



Smooth Body Motors
Catalog: M7010

Variable Frequency Drives



NORDAC® *START* Motor Starter - SK 135E
Catalog: E3000
Flyer: F3015



NORDAC® *BASE* VFD - SK 180E
Catalog: E3000
Flyer: F3018



NORDAC® *FLEX* VFD - SK 200E
Catalog: E3000
Flyer: F3020



NORDAC® *LINK* VFD & Motor Starters
Catalog: E3000
Flyer: F3025



NORDAC® *PRO* Cabinet VFD - SK 500E
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NORDAC® *PRO* Decentralized VFD - SK 500P
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Flyer: F3060



NORDAC® *ON/ON+* Decentralized VFD
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NORD DRIVESYSTEMS

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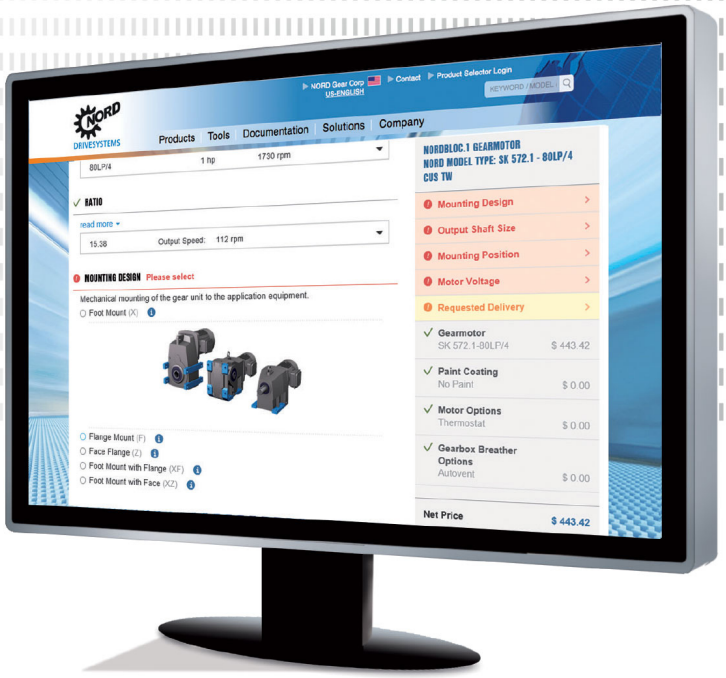
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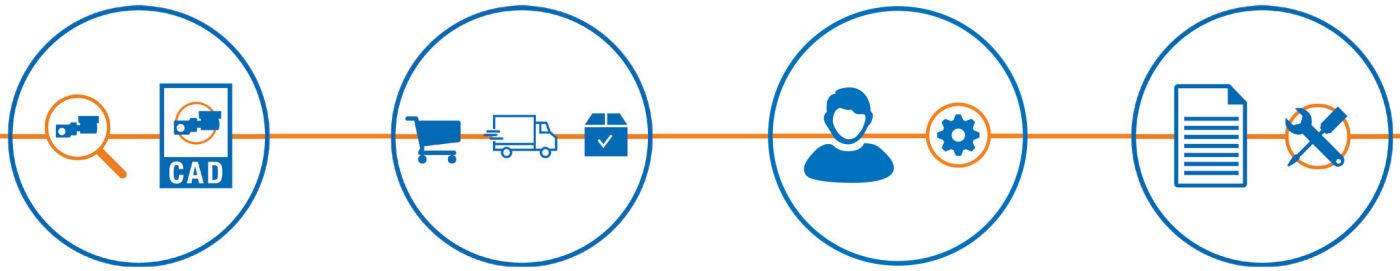
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INSTALLATION, OPERATION AND MAINTENANCE MANUAL OF ELECTRIC MOTORS

This manual provides information about WEG induction motors fitted with squirrel cage, permanent magnet or hybrid rotors, low, medium and high voltage, in frame sizes IEC 56 to 630 and NEMA 42 to 9606/10.
The motor lines indicated below have additional information that can be checked in their respective manuals:

- Smoke Extraction Motors;
- Electromagnetic Brake Motors;
- Hazardous Area Motors.

These motors meet the following standards, if applicable:

- NBR 17094-1: Máquinas Elétricas Girantes - Motores de Indução - Parte 1: trifásicos.
- NBR 17094-2: Máquinas Elétricas Girantes - Motores de Indução - Parte 2: monofásicos.
- IEC 60034-1: Rotating Electrical Machines - Part 1: Rating and Performance.
- NEMA MG 1: Motors and Generators.
- CSA C 22.2 N°100: Motors and Generators.
- UL 1004-1: Rotating Electrical Machines - General Requirements.

If you have any questions regarding this manual please contact your local WEG branch, contact details can be found at www.weg.net.

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1. TERMINOLOGY

Balancing: the procedure by which the mass distribution of a rotor is checked and, if necessary, adjusted to ensure that the residual unbalance or the vibration of the journals and/or forces on the bearings at a frequency corresponding to service speed are within specified limits in International Standards.
[ISO 1925:2001, definition 4.1]

Balance quality grade: indicates the peak velocity amplitude of vibration, given in mm/s, of a rotor running free-in-space and it is the product of a specific unbalance and the angular velocity of the rotor at maximum operating speed.

Grounded Part: metallic part connected to the grounding system.

Live Part: conductor or conductive part intended to be energized in normal operation, including a neutral conductor.

Authorized personnel: employee who has formal approval of the company.

Qualified personnel: employee who meets the following conditions simultaneously:
- Receives training under the guidance and responsibility of a qualified and authorized professional;
- Works under the responsibility of a qualified and approved professional.

Note*: The qualification is only valid for the company that trained the employee in the conditions set out by the authorized and qualified professional responsible for training.*

2. INITIAL RECOMMENDATIONS

Electric motors have energized circuits, exposed rotating parts and hot surfaces that may cause serious injury to people during normal operation. Therefore, it is recommended that transportation, storage, installation, operation and maintenance services are always performed by qualified personnel.
Also the applicable procedures and relevant standards of the country where the machine will be installed must be considered.
Noncompliance with the recommended procedures in this manual and other references on the WEG website may cause severe personal injuries and/or substantial property damage and may void the product warranty.

For practical reasons, it is not possible to include in this Manual detailed information that covers all construction variables nor covering all possible assembly, operation or maintenance alternatives.
This Manual contains only the required information that allows qualified and trained personnel to carry out their services. The product images are shown for illustrative purpose only.

For *Smoke Extraction Motors*, please refer to the additional instruction manual 50026367 available on the website www.weg.net.

For brake motors, please refer to the information contained in WEG 50021973 brake motor manual available on the website www.weg.net.

For information about permissible radial and axial shaft loads, please check the product technical catalogue.

The user is responsible for the correct definition of the installation environment and application characteristics.

During the warranty period, all repair, overhaul and reclamation services must be carried out by WEG authorized Service Centers to maintain validity of the warranty.

2.1. WARNING SYMBOL

Warning about safety and warranty.

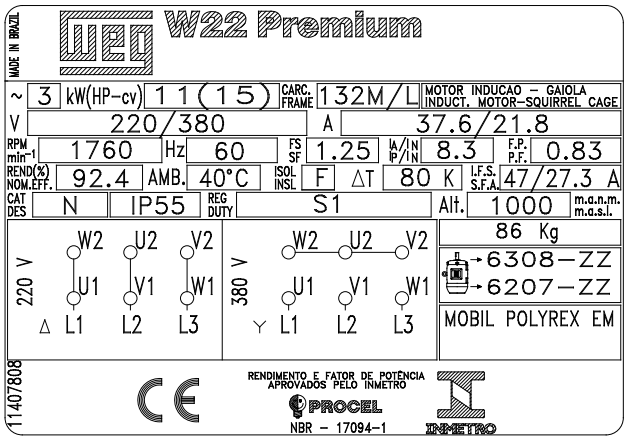
2.2. RECEIVING INSPECTION

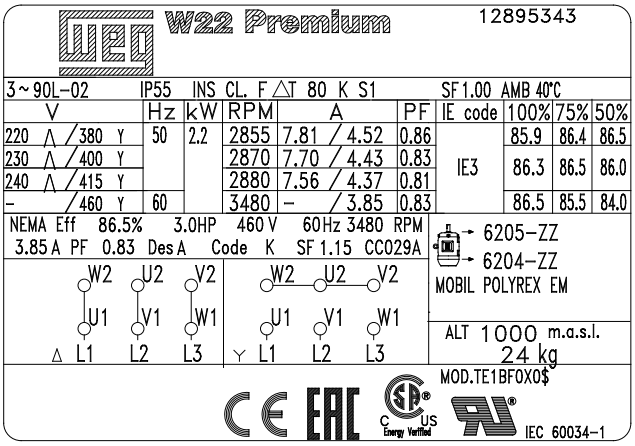
All motors are tested during the manufacturing process.
The motor must be checked when received for any damage that may have occurred during the transportation. All damages must be reported in writing to the transportation company, to the insurance company and to WEG. Failure to comply with such procedures will void the product warranty.
You must inspect the product:
- Check if nameplate data complies with the purchase order;
- Remove the shaft locking device (if any) and rotate the shaft by hand to ensure that it rotates freely;
- Check that the motor has not been exposed to excessive dust and moisture during the transportation.

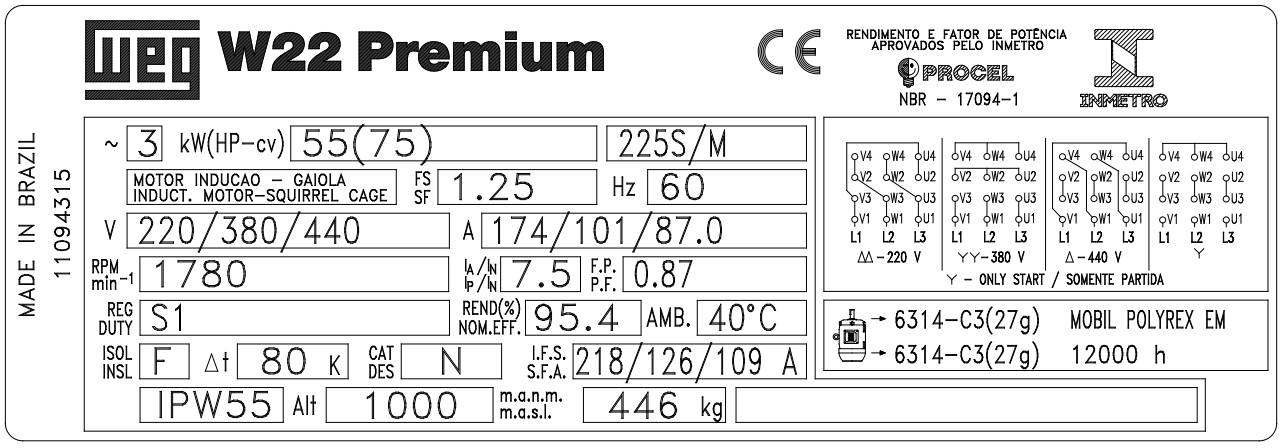
Do not remove the protective grease from the shaft, or the plugs from the cable entries. These protections must remain in place until the installation has been completed.

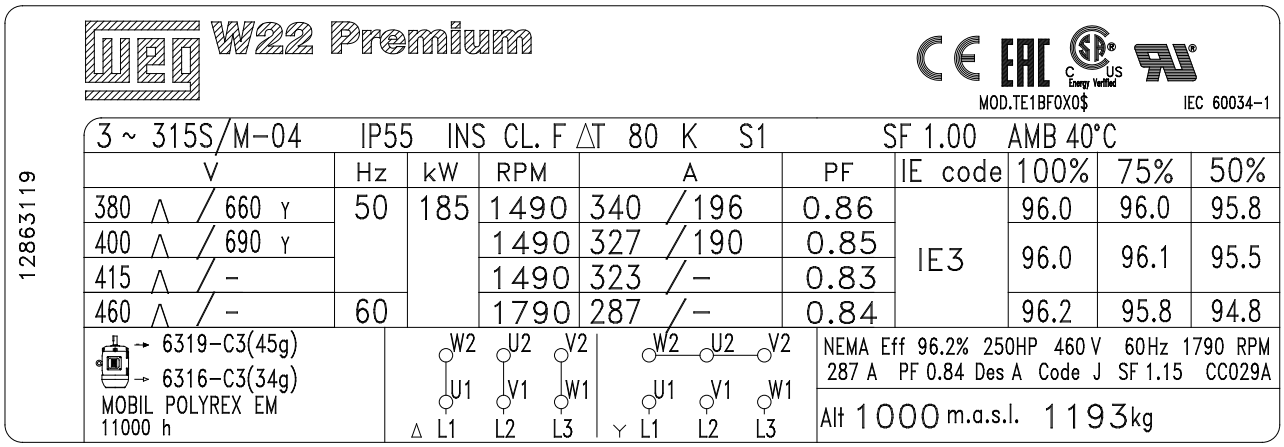
2.3. NAMEPLATES

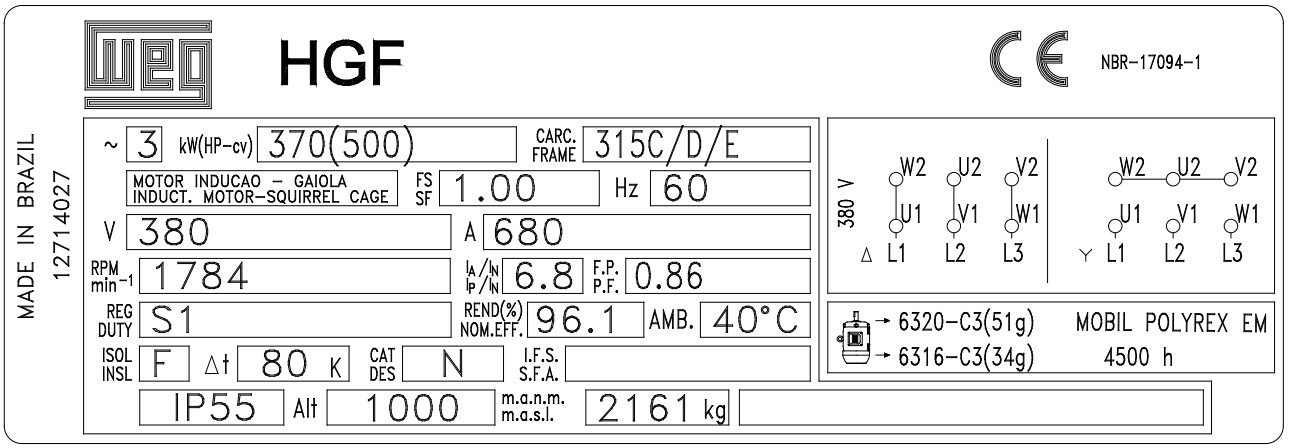
The nameplate contains information that describes the construction characteristics and the performance of the motor. Figure 2.1 and Figure 2.2 show nameplate layout examples.

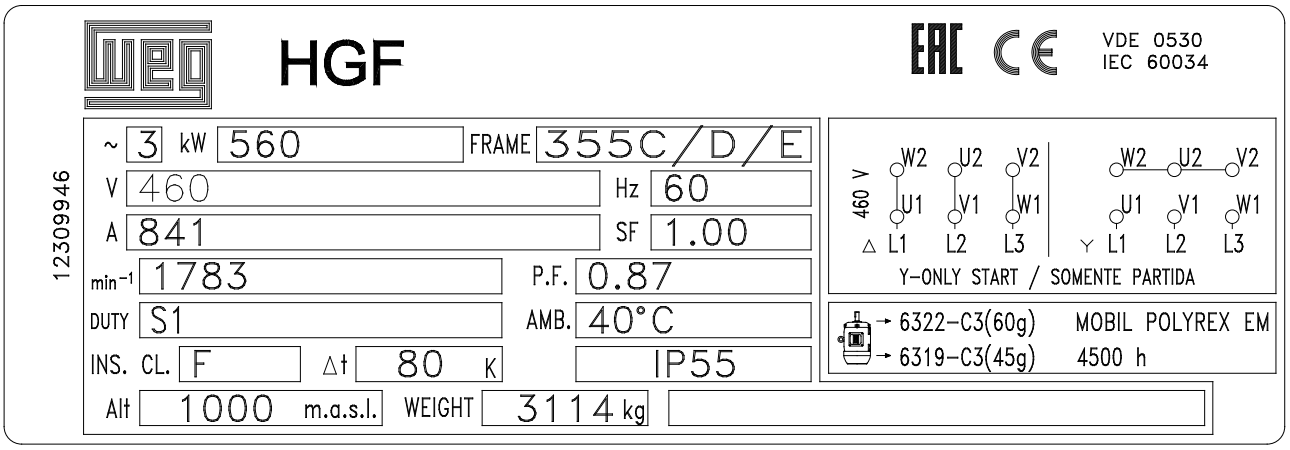












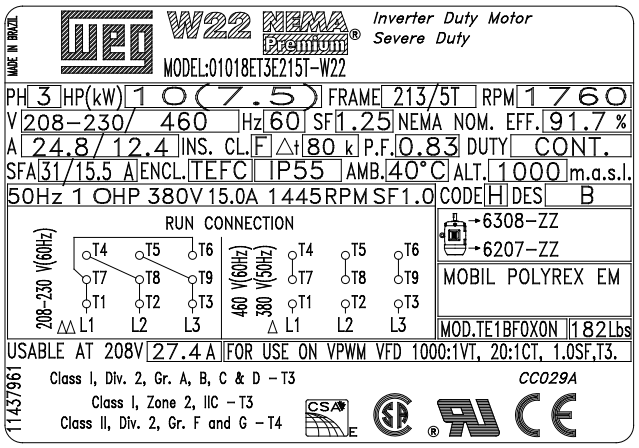


Figure 2.1 - *IEC motor nameplate*

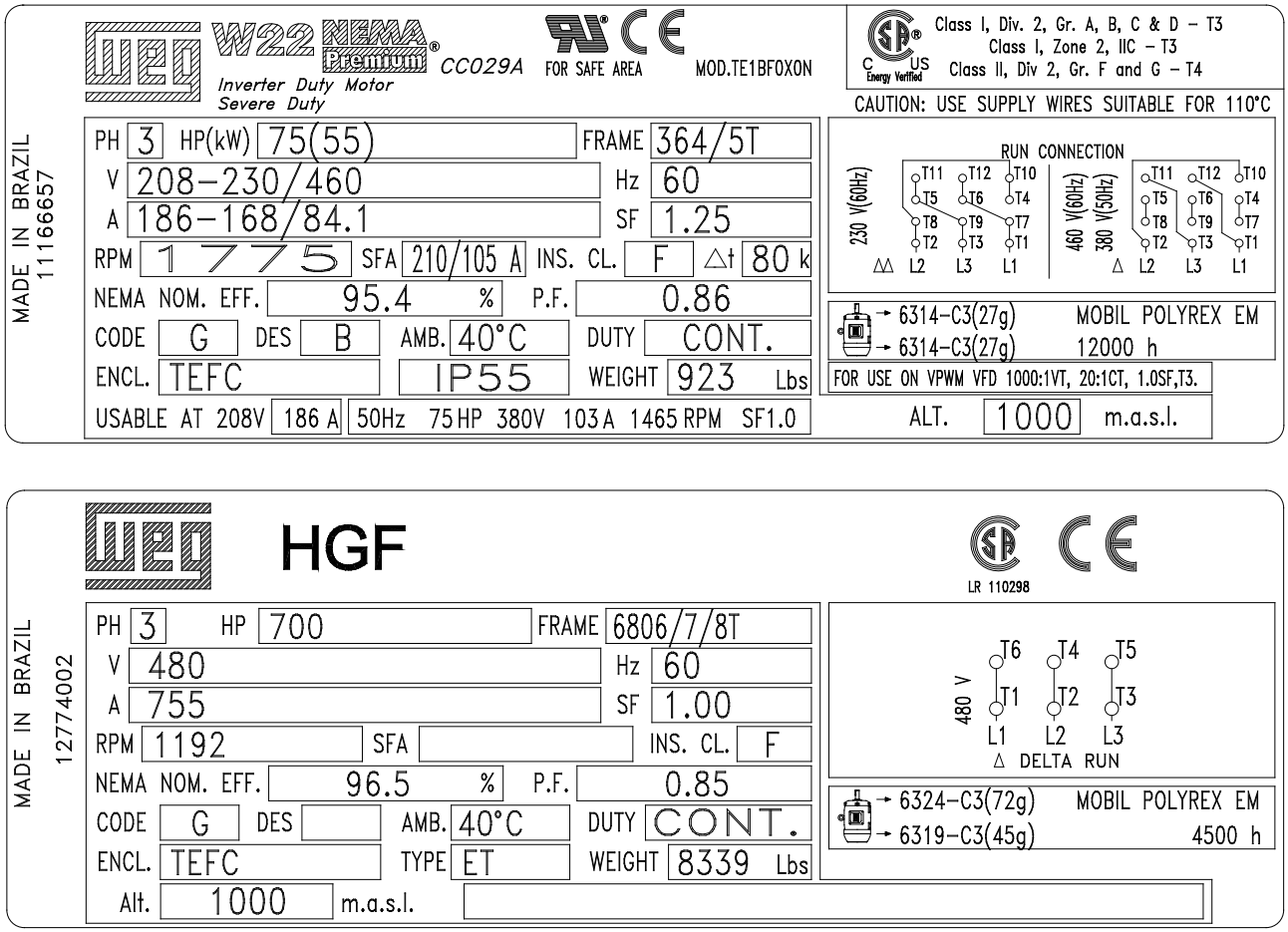


Figure 2.2 - *NEMA motor nameplate*

3. SAFETY INSTRUCTIONS



The motor must be disconnected from the power supply and be completely stopped before conducting any installation or maintenance procedures. Additional measures should be taken to avoid accidental motor starting.



Professionals working with electrical installations, either in the assembly, operation or maintenance, should use proper tools and be instructed on the application of standards and safety requirements, including the use of Personal Protective Equipment (PPE) that must be carefully observed in order to reduce risk of personal injury during these services.



Electric motors have energized circuits, exposed rotating parts and hot surfaces that may cause serious injury to people during normal operation. It is recommended that transportation, storage, installation, operation and maintenance services are always performed by qualified personnel.

Always follow the safety, installation, maintenance and inspection instructions in accordance with the applicable standards in each country.

4. HANDLING AND TRANSPORT

Individually packaged motors should never be lifted by the shaft or by the packaging. They must be lifted only by means of the eyebolts, when supplied. Use always suitable lifting devices to lift the motor. Eyebolts on the frame are designed for lifting the machine weight only as indicated on the motor nameplate. Motors supplied on pallets must be lifted by the pallet base with lifting devices fully supporting the motor weight.

The package should never be dropped. Handle it carefully to avoid bearing damage.

Eyebolts provided on the frame are designed for lifting the machine only. Do not use these eyebolts for lifting the motor with coupled equipment such as bases, pulleys, pumps, reducers, etc..

Never use damaged, bent or cracked eyebolts. Always check the eyebolt condition before lifting the motor.

Eyebolts mounted on components, such as on end shields, forced ventilation kits, etc. must be used for lifting these components only. Do not use them for lifting the complete machine set.

Handle the motor carefully without sudden impacts to avoid bearing damage and prevent excessive mechanical stresses on the eyebolts resulting in its rupture.

To move or transport motors with cylindrical roller bearings or angular contact ball bearings, use always the shaft locking device provided with the motor.
All HGF motors, regardless of bearing type, must be transported with shaft locking device fitted.
Vertical mounted motors with oil-lubricated bearings must be transported in the vertical position. If necessary to move or transport the motor in the horizontal position, install the shaft locking device on both sides (drive end and non-drive end) of the motor.

4.1. LIFTING

Before lifting the motor ensure that all eyebolts are tightened properly and the eyebolt shoulders are in contact with the base to be lifted, as shown in Figure 4.1. Figure 4.2 shows an incorrect tightening of the eyebolt.
Ensure that lifting machine has the required lifting capacity for the weight indicated on the motor nameplate.



Figure 4.1 *- Correct tightening of the eyebolt*

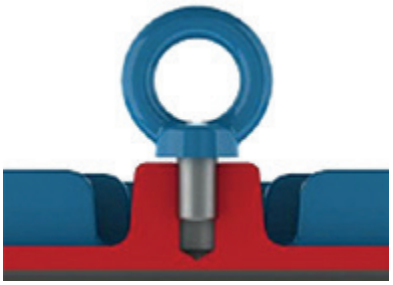


Figure 4.2 *- Incorrect tightening of the eyebolt*

The center-of-gravity may change depending on motor design and accessories. During the lifting procedures the maximum allowed angle of inclination should never be exceeded as specified below.

4.1.1. Horizontal motors with one eyebolt

For horizontal motors fitted with only one eyebolt, the maximum allowed angle-of-inclination during the lifting process should not exceed 30º in relation to the vertical axis, as shown in Figure 4.3.

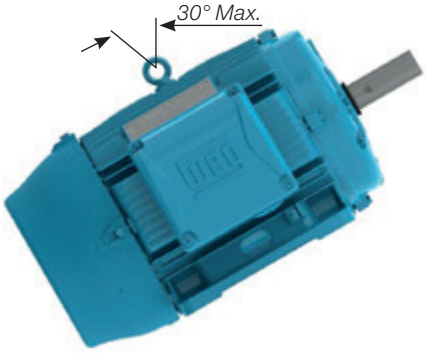


Figure 4.3 *- Maximum allowed angle-of-inclination for motor with one eyebolt*

4.1.2. Horizontal motor with two eyebolts

When motors are fitted with two or more eyebolts, all supplied eyebolts must be used simultaneously for the lifting procedure.

There are two possible eyebolt arrangements (vertical and inclined), as shown below:

- For motors with vertical lifting eyebolts, as shown in Figure 4.4, the maximum allowed lifting angle should not exceed 45° in relation to the vertical axis. We recommend to use a spreader beam for maintaining the lifting elements (chain or rope) in vertical position and thus preventing damage to the motor surface;



Figure 4.4 *- Maximum resulting angle for motors with two or more lifting eyebolts*

- For HGF, W40 and W50 motors, as shown in Figure 4.5, the maximum resulting angle should not exceed 30° in relation to the vertical axis;

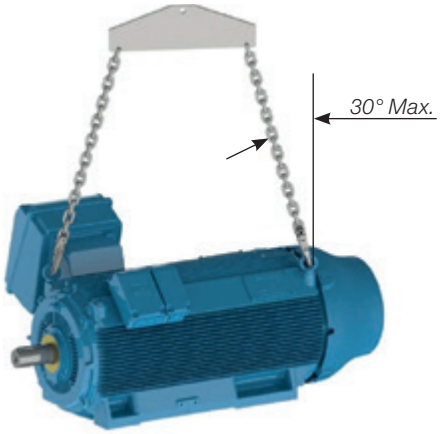


Figure 4.5 *- Maximum resulting angle for horizontal HGF, W40 and W50 motors*

- For motors fitted with inclined eyebolts, as shown in Figure 4.6, the use of a spreader beam is required for maintaining the lifting elements (chain or rope) in vertical position and thus preventing damage to the motor surface.



Figure 4.6 *- Use of a spreader beam for lifting*

4.1.3. Vertical motors

For vertical mounted motors, as shown in Figure 4.7, the use of a spreader beam is required for maintaining the lifting element (chain or rope) in vertical position and thus preventing damage to the motor surface.



Figure 4.7 *- Lifting of vertical mounted motors*

Always use the eyebolts mounted on the top side of the motor, diametrically opposite, considering the mounting position. See Figure 4.8.



Figure 4.8 *- Lifting of HGF and W50 motors.*

4.1.3.1. Procedures to place W22 motors in the vertical position

For safety reasons during the transport, vertical mounted Motors are usually packed and supplied in horizontal position.
To place W22 motors fitted with eyebolts (see Figure 4.6), to the vertical position, proceed as follows:

1. Ensure that the eyebolts are tightened properly, as shown in Figure 4.1;
2. Remove the motor from the packaging, using the top mounted eyebolts, as shown in Figure 4.9;



Figure 4.9 *- Removing the motor from the packaging*

3. Install a second pair of eyebolts, as shown in Figure 4.10;



Figure 4.10 *- Installation of the second pair of eyebolts*

4. Reduce the load on the first pair of eyebolts to start the motor rotation, as shown in Figure 4.11. This procedure must be carried out slowly and carefully.



Figure 4.11 *- End result: motor placed in vertical position*

These procedures will help you to move motors designed for vertical mounting. These procedures are also used to place the motor from the horizontal position into the vertical position and vertical to horizontal.

4.1.3.2. Procedures to place HGF and W50 motors in the vertical position

HGF motors are fitted with eight lifting points: four at drive end and four at non-drive end. W50 motors are fitted with nine lifting points: four at drive end, one in the central part and four at non-drive end. The motors are usually transported in horizontal position, however for the installation they must be placed in the vertical position.
To place an these motors in the vertical position, proceed as follows:

1. Lift the motor by using the four lateral eyebolts and two hoists, see Figure 4.12;



Figure 4.12 *- Lifting of HGF and W50 motors with two hoists*

2. Lower the hoist fixed to motor drive end while lifting the hoist fixed to motor non-drive end until the motor reaches its equilibrium, see Figure 4.13;



Figure 4.13 *- Placing HGF and W50 motors in vertical position*

3. Remove the hoist hooks from the drive end eyebolts and rotate the motor 180° to fix the removed hooks into the two eyebolts at the motor non-drive end, see Figure 4.14;



Figure 4.14 *- Lifting HGF and W50 motors by the eyebolts at the non-drive end*

4. Fix the removed hoist hooks in the other two eyebolts at the non-drive end and lift the motor until the vertical position is reached, see Figure 4.15.



Figure 4.15 *- HGF and W50 motors in the vertical position*

These procedures will help you to move motors designed for vertical mounting. These procedures are also used to place the motor from the horizontal position into the vertical position and vertical to horizontal.

4.2 Procedures to place W22 vertical mount motors in horizontal position

To place W22 vertical mount motor in horizontal position, proceed as follows:

1. Ensure that all eyebolts are tightened properly, as shown in Figure 4.1;

2. Install the first pair of eyebolts and lift the motor as shown in Figure 4.16;



Figure 4.16 - *Install the first pair of eyebolts*

3. Install the second pair of eyebolts, as shown in Figure 4.17;



Figure 4.17 - *Install the second pair of eyebolts*

4. Reduce the load on the first pair of eyebolts for rotating the motor, as shown in Figure 4.18. This procedure must be carried out slowly and carefully;



Figure 4.18 - *Motor is being rotated to horizontal position*

5. Remove the first pair of eyebolts, as shown in Figure 4.19.



Figure 4.19 - *Final result: motor placed in horizontal position*

5. STORAGE

If the motor is not installed immediately, it must be stored in a dry and clean environment, with relative humidity not exceeding 60%, with an ambient temperature between 5 ºC and 40 ºC, without sudden temperature changes, free of dust, vibrations, gases or corrosive agents. The motor must be stored in horizontal position, unless specifically designed for vertical operation, without placing objects on it. Do not remove the protection grease from shaft end to prevent rust.

If the motor are fitted with space heaters, they must always be turned on during the storage period or when the installed motor is out of operation. Space heaters will prevent water condensation inside the motor and keep the winding insulation resistance within acceptable levels. Store the motor in such position that the condensed water can be easily drained. If fitted, remove pulleys or couplings from the shaft end (more information are given on item 6).

The space heaters should never be energized when the motor is in operation.

5.1. EXPOSED MACHINED SURFACES

All exposed machined surfaces (like shaft end and flange) are factory-protected with temporary rust inhibitor. A protective film must be reapplied periodically (at least every six months), or when it has been removed and/or damaged.

5.2. STORAGE

The stacking height of the motor packaging during the storage period should not exceed 5 m, always considering the criteria indicated in Table 5.1:

Table 5.1 *- Max. recommended stacking height*

Packaging type	Frame sizes	Maximum stacking quantity
Cardboard box	IEC 63 to 132 NEMA 143 to 215	Indicated on the top side of the cardboard box
Wood crate	IEC 63 to 315 NEMA 48 to 504/5	06
	IEC 355 NEMA 586/7 and 588/9	03
	W40 / W50 / HGF IEC 315 to 630 W40 / W50 / HGF NEMA 5000 to 9600	Indicated on the packaging

Notes:
1) Never stack larger packaging onto smaller packaging;
2) Align the packaging correctly (see Figure 5.1 and Figure 5.2);



Figure 5.1 *- Correct stacking*

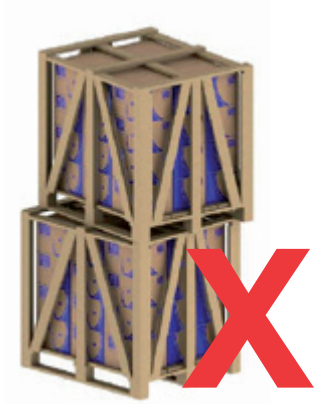


Figure 5.2 *- Incorrect stacking*

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3) The feet of the crates above should always be supported by suitable wood battens (Figure 5.3) and never stand on the steel tape or without support (Figure 5.4);



Figure 5.3 - Correct stacking



Figure 5.4 - Incorrect stacking

4) When stacking smaller crates onto longer crates, always ensure that suitable wooden supports are provided to withstand the weight (see Figure 5.5). This condition usually occurs with motor packaging above IEC 225S/M (NEMA 364/5T) frame sizes.

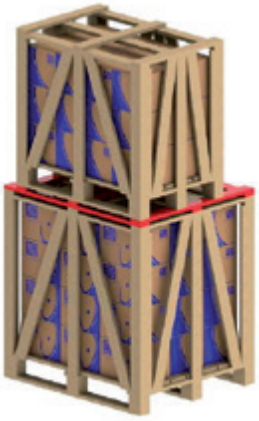


***Figure 5.5** - Use of additional battens for stacking*

5.3 BEARINGS

5.3.1 Grease lubricated bearings

We recommend rotating the motor shaft at least once a month (by hand, at least five revolutions, stopping the shaft at a different position from the original one). If the motor is fitted with shaft locking device, remove it before rotating the shaft and install it again before performing any handling procedure. Vertical motors may be stored in the vertical or in horizontal position. If motors with open bearings are stored longer than six months, the bearings must be relubricated according to item 8.2 before commissioning of the motor.
If the motor is stored for longer than 2 years, the bearings must be replaced or removed, washed, inspected and relubricated according to item 8.2.

5.3.2 Oil lubricated bearings

The motor must be stored in its original operating position and with oil in the bearings. Correct oil level must be ensured. It should be in the center of the sight glass.
During the storage period, remove the shaft locking device and rotate the shaft by hand every month, at least five revolutions, thus achieving an even oil distribution inside the bearing and maintaining the bearing in good operating conditions. Reinstall the shaft locking device every time the motor has to be moved.
If the motor is stored for a period equal or longer than the oil change interval, the oil must be replaced according to Item 8.2, before starting the operation. If the motor is stored for a period of over two years, the bearings must be replaced or removed, washed according to manufacturer instructions, checked and relubricated according to Item 8.2. The oil of vertical mounted motors is removed to prevent oils leaks during the transport. After receiving the motor the bearings must be lubricated.

5.3.3 Oil Mist lubricated bearings

The motor must be stored in horizontal position. Lubricate the bearings with ISO VG 68 mineral oil in the amount indicated in the Table 5.2 (this is also valid for bearings with equivalent dimensions). After filling with oil, rotate the shaft by hand, at least five revolutions)
During the storage period, remove the shaft locking device (if any) and rotate the shaft by hand every week, at least five revolutions, stopping it at a different position from the original one. Reinstall the shaft locking device every time the motor has to be moved. If the motor is stored for a period of over two years, the bearings must be replaced or removed, washed according to manufacturer instructions, checked and relubricated according to item 8.2.

Table 5.2 - *Amount of oil per bearing*

Bearing size	Amount of oil (ml)	Bearing size	Amount of oil (ml)
6201	15	6309	65
6202	15	6311	90
6203	15	6312	105
6204	25	6314	150
6205	25	6315	200
6206	35	6316	250
6207	35	6317	300
6208	40	6319	350
6209	40	6320	400
6211	45	6322	550
6212	50	6324	600
6307	45	6326	650
6308	55	6328	700

The oil must always be removed when the motor has to be handled. If the oil mist system is not operating after installation, fill the bearings with oil to prevent bearing rusting. During the storage period, rotate the shaft by hand, at least five revolutions, stopping it at a different position from the original one. Before starting the motor, all bearing protection oil must be drained from the bearing and the oil mist system must be switched ON.

5.3.4 Sleeve bearing

The motor must be stored in its original operating position and with oil in the bearings. Correct oil level must be ensured. It should be in the middle of the sight glass. During the storage period, remove the shaft locking device and rotate the shaft by hand every month, at least five revolutions, and at 30 rpm, thus achieving an even oil distribution inside the bearing and maintaining the bearing in good operating conditions. Reinstall the shaft locking device every time the motor has to be moved.
If the motor is stored for a period equal or longer than the oil change interval, the oil must be replaced, according to Item 8.2, before starting the operation.

If the motor is stored for a period longer than the oil change interval, or if it is not possible to rotate the motor shaft by hand, the oil must be drained and a corrosion protection and dehumidifiers must be applied.

5.4. INSULATION RESISTANCE

We recommend measuring the winding insulation resistance at regular intervals to follow-up and evaluate its electrical operating conditions. If any reduction in the insulation resistance values are recorded, the storage conditions should be evaluated and corrected, where necessary.

5.4.1. Insulation resistance measurement

We recommend measuring the winding insulation resistance at regular intervals to follow-up and evaluate its electrical operating conditions. If any reduction in the insulation resistance values are recorded, the storage conditions should be evaluated and corrected, where necessary.



The insulation resistance must be measured in a safe environment.

The insulation resistance must be measured with a megohmmeter. The machine must be in cold state and disconnected from the power supply.

To prevent the risk of an electrical shock, ground the terminals before and after each measurement. Ground the capacitor (if any) to ensure that it is fully discharged before the measurement is taken.

It is recommended to insulate and test each phase separately. This procedure allows the comparison of the insulation resistance between each phase. During the test of one phase, the other phases must be grounded. The test of all phases simultaneously evaluates the insulation resistance to ground only but does not evaluate the insulation resistance between the phases.
The power supply cables, switches, capacitors and other external devices connected to the motor may considerably influence the insulation resistance measurement. Thus all external devices must be disconnected and grounded during the insulation resistance measurement.
Measure the insulation resistance one minute after the voltage has been applied to the winding. The applied voltage should be as shown in Table 5.3.

Table 5.3 *- Voltage for the insulation resistance*

Winding rated voltage (V)	Testing voltage for measuring the insulation resistance (V)
< 1000	500
1000 - 2500	500 - 1000
2501 - 5000	1000 - 2500
5001 - 12000	2500 - 5000
> 12000	5000 - 10000

The reading of the insulation resistance must be corrected to 40 °C as shown in the Table 5.4.

Table 5.4 *- Correction factor for the insulation resistance corrected to 40 °C*

Measuring temperature of the insulation resistance (°C)	Correction factor of the insulation resistance corrected to 40 °C	Measuring temperature of the insulation resistance (°C)	Correction factor of the insulation resistance corrected to 40 °C
10	0.125	30	0.500
11	0.134	31	0.536
12	0.144	32	0.574
13	0.154	33	0.616
14	0.165	34	0.660
15	0.177	35	0.707
16	0.189	36	0.758
17	0.203	37	0.812
18	0.218	38	0.871
19	0.233	39	0.933
20	0.250	40	1.000
21	0.268	41	1.072
22	0.287	42	1.149
23	0.308	43	1.231
24	0.330	44	1.320
25	0.354	45	1.414
26	0.379	46	1.516
27	0.406	47	1.625
28	0.435	48	1.741
29	0.467	49	1.866
30	0.500	50	2.000

The motor insulation condition must be evaluated by comparing the measured value with the values indicated in Table 5.5 (corrected to 40 °C):

Table 5.5 *- Evaluation of the insulation system*

Limit value for rated voltage up to 1.1 kV (MΩ)	Limit value for rated voltage above 1.1 kV (MΩ)	Situation
Up to 5	Up to 100	Dangerous. The motor can not be operated in this condition
5 to 100	100 to 500	Regular
100 to 500	Higher than 500	Good
Higher than 500	Higher than 1000	Excellent

The values indicated in the table should be considered only as reference values. It is advisable to log all measured values to provide a quick and easy overview on the machine insulation resistance.
If the insulation resistance is low, moisture may be present in the stator windings. In this case the motor should be removed and transported to a WEG authorized Service Center for proper evaluation and repair (This service is not covered by the warranty). To improve the insulation resistance through the drying process, see section 8.4.

6. INSTALLATION

The insulation resistance must be measured in a safe environment.

Check some aspects before proceeding with the installation:

1. Insulation resistance: must be within the acceptable limits. See item 5.4.
2. Bearings:
   If the motor is installed without running immediately, proceed as described in item 5.3.
3. Operating conditions of the start capacitors: If single-phase motors are stored for a period of over two years, it is recommended to change the start capacitors before motor starting since they lose their operating characteristics.
4. Terminal box:
   a. the inside of the terminal box must be clean and dry;
   b. the contacts must be correctly connected and corrosion free. See 6.9 and 6.10;
   c. the cable entries must be correctly sealed and the terminal box cover properly mounted in order to ensure the degree of protection indicated on the motor nameplate.
5. Cooling: the cooling fins, air inlet and outlet openings must be clean and unobstructed. The distance between the air inlet openings and the wall should not be shorter than ¼ (one quarter) of the diameter of the air inlet. Ensure sufficient space to perform the cleaning services. See item 7.
6. Coupling: remove the shaft locking device (where fitted) and the corrosion protection grease from the shaft end and flange just before installing the motor. See item 6.4.
7. Drain hole: the motor must always be positioned so the drain hole is at the lowest position (If there is any indication arrow on the drain, the drain must be so installed that the arrow points downwards).
   Motors supplied with rubber drain plugs leave the factory in the closed position and must be opened periodically to allow the exit of condensed water. For environments with high water condensation levels and motor with degree of protection IP55, the drain plugs can be mounted in open position (see Figure 6.1).
   For motors with degree of protection IP56, IP65 or IP66, the drain plugs must remain at closed position (see Figure 6.1), being opened only during the motor maintenance procedures.
   The drain system of motors with Oil Mist lubrication system must be connected to a specific collection system (see Figure 6.12).

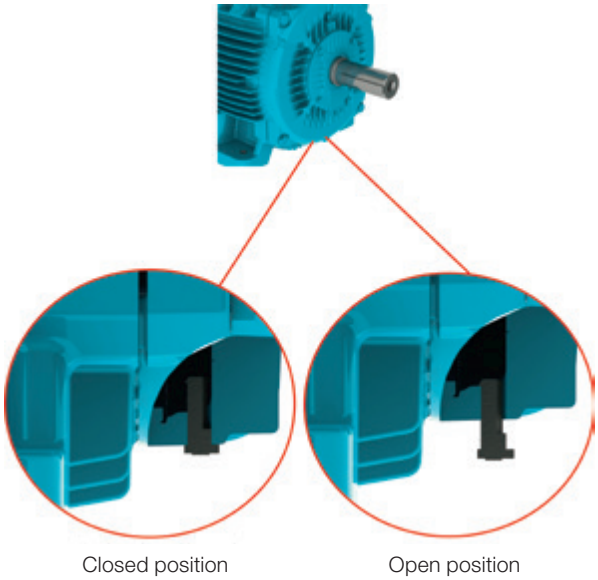


Figure 6.1 *- Detail of the rubber drain plug mounted in closed and open position*

8.Additional recommendations:
a. Check the direction of motor rotation, starting the motor at no-load before coupling it to the load;
b. Vertical mounted motors with shaft end down must be fitted with drip cover to protect them from liquids or solids that may drop onto the motors;
c. Vertical mounted motors with shaft end up should be fitted with water slinger ring to prevent water ingress inside the motor.
d. The fixing elements mounted in the threaded through holes in the motor enclosure (for example, the flange) must be properly sealed.

Remove or fix the shaft key before starting the motor.

Changes on the motor construction (features), such as installation of extended grease fittings or modification of the lubrication system, installation of accessories at alternative locations, etc., can be carried out only after prior written consent from WEG.

6.1. FOUNDATIONS

The foundation is the structure, structural element, natural or prepared base, designed to withstand the stresses produced by the installed equipment, ensuring safe and stable performance during operation. The foundation design should consider the adjacent structures to avoid the influences of other installed equipment and no vibration is transferred through the structure

The foundation must be flat and its selection and design must consider the following characteristics:

a) The features of the machine to be installed on the foundation, the driven loads, application, maximum allowed deformations and vibration levels (for instance, motors with reduced vibration levels, foot flatness, flange concentricity, axial and radial loads, etc. lower than the values specified for standard motors).

b) Adjacent buildings, conservation status, maximum applied load estimation, type of foundation and fixation and vibrations transmitted by theses constructions.

If the motor is supplied with leveling/alignment bolts, this must be considered in the base design.

Please consider for the foundation dimensioning all stresses that are generated during the operation of the driven load.
The user is responsible for the foundation designing and construction.

The foundation stresses can be calculated by using the following equations (see Figure 6.2):

$$F_1 = 0,5 * g * m - (4 * T_b / A)$$
$$F_2 = 0,5 * g * m + (4 * T_b / A)$$

Where:

F_1 and F_2 = lateral stresses (N);
g = gravitational acceleration (9,8 m/s^2);
m = motor weight (kg);
T_b = breakdown torque (Nm);
A = distance between centerlines of mounting holes in feet or base of the machine (end view) (m).

The motors may be mounted on:
- Concrete bases: are most used for large-size motors (see Figure 6.2);
- Metallic bases: are generally used for small-size motors (see Figure 6.3).

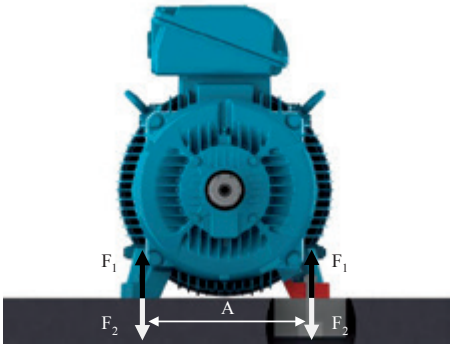


Figure 6.2 *- Motor installed on concrete base*



Figure 6.3 *- Motor installed on metallic base*

The metallic and concrete bases may be fitted with sliding system. These types of foundations are generally used where the power transmission is achieved by belts and pulleys. This power transmission system is easier to assemble/disassemble and allows the belt tension adjustment. Other important aspect of this foundation type is the location of the base locking screws that must be diagonally opposite. The rail nearest the drive pulley is placed in such a way that the positioning bolt is between the motor and the driven machine. The other rail must be placed with the bolt on the opposite side (diagonally opposite), as shown in Figure 6.4 .

To facilitate assembly, the bases may have the following features:
- Shoulders and/or recesses;
- Anchor bolts with loose plates;
- Bolts cast in the concrete;
- Leveling screws;
- Positioning screws;
- Steel & cast iron blocks, plates with flat surfaces.

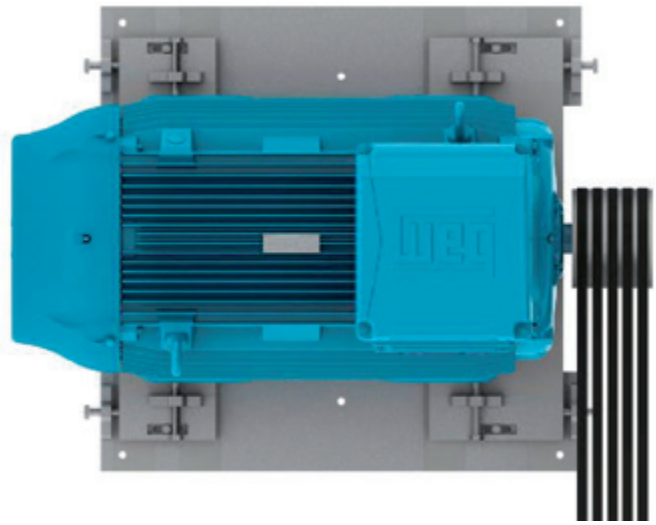


Figure 6.4 *- Motor installed on sliding base*

After completing the installation, it is recommended that all exposed machined surfaces are coated with suitable rust inhibitor.

6.2. MOTOR MOUNTING

Footless motors supplied with transportation devices, according to Figure 6.5, must have their devices removed before starting the motor installation.

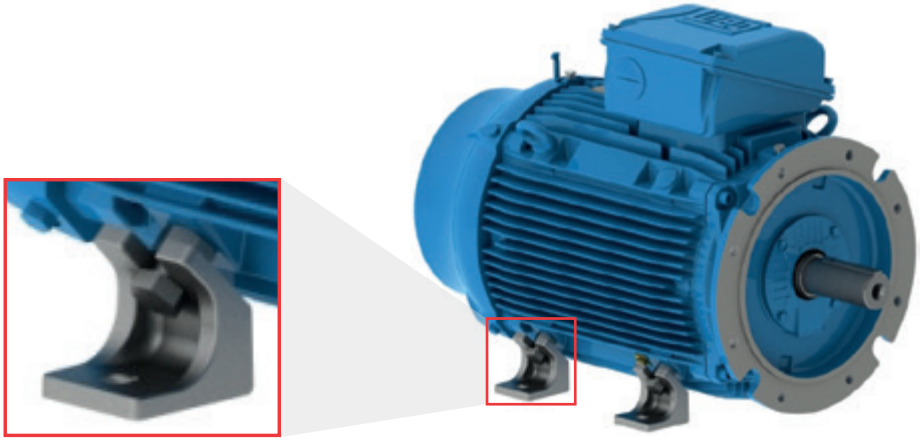


Figure 6.5 *- Detail of the transportation devices for footless motors*

6.2.1. Foot mounted motors

The drawings of the mounting hole dimensions for NEMA or IEC motors can be checked in the respective technical catalogue.
The motor must be correctly aligned and leveled with the driven machine. Incorrect alignment and leveling may result in bearing damage, generate excessive vibration and even shaft distortion/breakage.
For more details, see section 6.3 and 6.6. The thread engagement length of the mounting bolt should be at least 1.5 times the bolt diameter. This thread engagement length should be evaluated in more severe applications and increased accordingly.
Figure 6.6 shows the mounting system of a foot mounted motor indicating the minimum required thread engagement length.

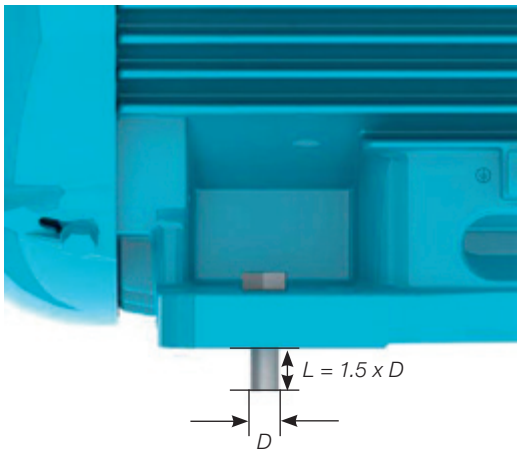


Figure 6.6 *- Mounting system of a foot mounted motor*

6.2.2. Flange mounted motors

The drawings of the flange mounting dimensions, IEC and NEMA flanges, can be checked in the technical catalogue.
The coupling of the driven equipment to the motor flange must be properly dimensioned to ensure the required concentricity of the assembly.
Depending on the flange type, the mounting can be performed from the motor to the driven equipment flange (flange FF (IEC) or D (NEMA)) or from the driven equipment flange to the motor (flange C (DIN or NEMA)).
For the mounting process from the driven equipment flange to the motor, you must consider the bolt length, flange thickness and the thread depth of the motor flange.

If the motor flange has tapped through-holes, the length of the mounting bolts must not exceed the tapped through-hole length of the motor flange, thus preventing damage to the winding head.

For flange mounting the thread engagement length of the mounting bolt should be at least 1.5 times the bolt diameter. In severe applications, longer thread engagement length may be required.
In severe applications or if large motors are flange mounted, a foot or pad mounting may be required in addition to the flange mounting (Figure 6.7). The motor must never be supported on its cooling fins.

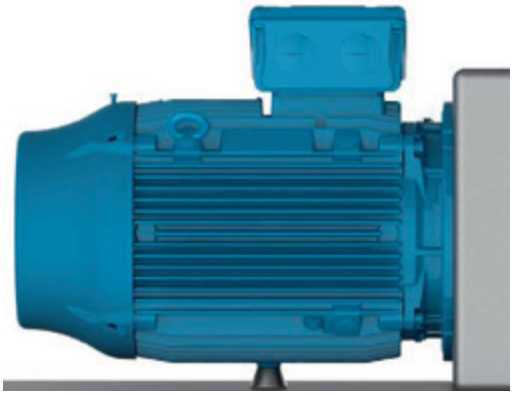


Figure 6.7 *- Mounting method of flange mounted motors with frame base support*

Note*:*
When liquid (for example oil) is likely to come into contact with the shaft seal, please contact your local WEG representative.

6.2.3. Pad mounted motors

Typically, this method of mounting is used in axial fans. The motor is fixed by tapped holes in the frame. The dimensions of these tapped holes can be checked in the respective product catalogue. The selection of the motor mounting rods/bolts must consider the dimensions of the fan case, the installation base and the thread depth in the motor frame.
The mounting rods and the fan case wall must be sufficiently stiff to prevent the transmission of excessive vibration to the machine set (motor & fan). Figure 6.8 shows the pad mounting system.

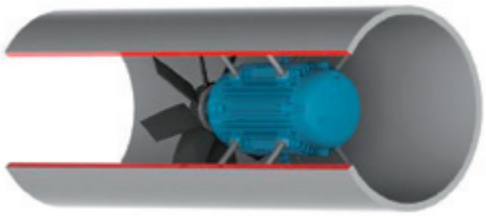


Figure 6.8 *- Mounting of the motor inside the cooling duct*

6.3. BALANCING

Unbalanced machines generate vibration which can result in damage to the motor. WEG motors are dynamically balanced with “half key” and without load (uncoupled). Special balancing quality level must be stated in the Purchase Order.

The transmission elements, such as pulleys, couplings, etc., must balanced with “half key” before they are mounted on the motor shaft.

The balance quality grade meets the applicable standards for each product line.

The maximum balancing deviation must be recorded in the installation report.

6.4. COUPLINGS

Couplings are used to transmit the torque from the motor shaft to the shaft of the driven machine. The following aspects must be considered when couplings are installed:

- Use proper tools for coupling assembly & disassembly to avoid damages to the motor and bearings;
- Whenever possible, use flexible couplings, since they can absorb eventual residual misalignments during the machine operation;
- The maximum loads and speed limits informed in the coupling and motor manufacturer catalogues cannot be exceeded;
- Level and align the motor as specified in sections 6.5 and 6.6, respectively.

Remove or fix the shaft key firmly when the motor is operated without coupling in order to prevent accidents.

6.4.1. Direct coupling

Direct coupling is characterized when the Motor shaft is directly coupled to the shaft of the driven machine without transmission elements. Whenever possible, use direct coupling due to lower cost, less space required for installation and more safety against accidents.

Do not use roller bearings for direct coupling, unless sufficient radial load is expected.

6.4.2. Gearbox coupling

Gearbox coupling is typically used where speed reduction is required.
Make sure that shafts are perfectly aligned and strictly parallel (in case of straight spur gears) and in the right meshing angle (in case of bevel and helical gears).

6.4.3. Pulley and belt coupling

Pulleys and belts are used when speed increase or reduction between motor shaft and driven load is required.

Excessive belt tension will damage the bearings and cause unexpected accidents such as breakage of the motor shaft.

6.4.4. Coupling of sleeve bearing motors

Motors designed with sleeve bearings must be operated with direct coupling to the driven machine or a gearbox. Pulley and belts can not be applied for sleeve bearing motors.

Motors designed with sleeve bearings have 3 (three) marks on the shaft end. The center mark is the indication of the magnetic center and the 2 (two) outside marks indicate the allowed limits of the rotor axial movement, as shown in Figure 6.9.
The motor must be so coupled that during operation the arrow on the frame is placed over the central mark indicating the rotor magnetic center. During start-up, or even during operation, the rotor may freely move between the two outside marks when the driven machine exerts an axial load on the motor shaft. However, under no circumstance, the motor can operate continuously with axial forces on the bearing.

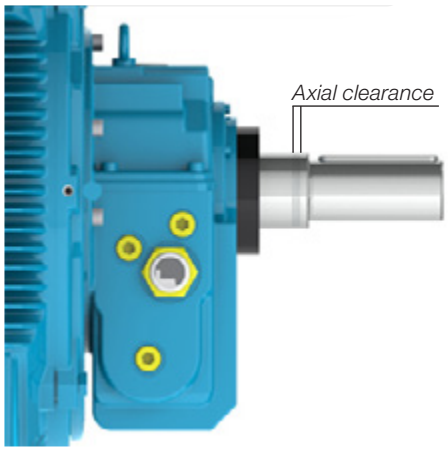


Figure 6.9 *- Axial clearance of motor designed with sleeve bearing*

For coupling evaluation consider the maximum axial bearing clearance as shown in Table 6.1.
The axial clearance of the driven machine and coupling influence the maximum bearing clearance.

Table 6.1 *- Clearance used for sleeve bearings*

Bearing size	Total axial clearance (mm)
9*	3 + 3 = 6
11*	4 + 4 = 8
14*	5 + 5 =10
18	7,5 + 7,5 = 15

** For Motors in accordance with API 541, the total axial clearance is 12.7 mm*

The sleeve bearings used by WEG were not designed to support axial load continuously.
Under no circumstance must the motor be operated continuously at its axial clearance limits.

6.5. LEVELING

The motor must be leveled to correct any deviations in flatness arising from the manufacturing process and the material structure rearrangement. The leveling can be carried out by a leveling screw fixed on the motor foot or on the flange or by means of thin compensation shims. After the leveling process, the leveling height between the motor mounting base and the motor cannot exceed 0.1 mm.
If a metallic base is used to level the height of the motor shaft end and the shaft end of the driven machine, level only the metallic base relating to the concrete base.

Record the maximum leveling deviations in the installation report.

6.6. ALIGNMENT

The correct alignment between the motor and the driven machine is one of the most important variables that extends the useful service life of the motor. Incorrect coupling alignment generates high loads and vibrations reducing the useful life of the bearings and even resulting in shaft breakages. Figure 6.10 illustrates the misalignment between the motor and the driven machine.

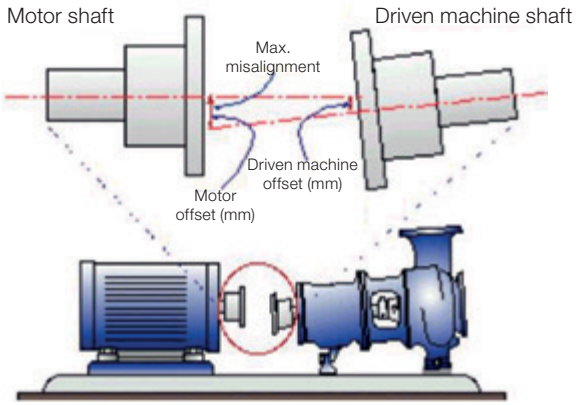
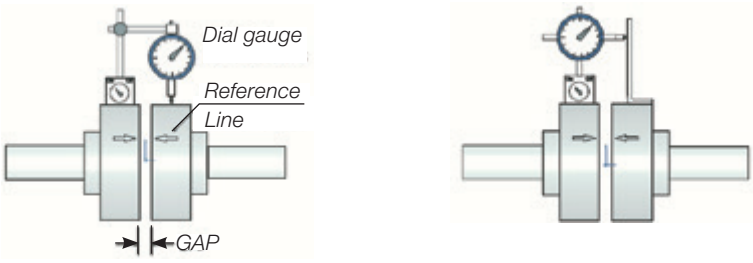


Figure 6.10 *- Typical misalignment condition*

Alignment procedures must be carried out using suitable tools and devices, such as dial gauge, laser alignment instruments, etc.. The motor shaft must be aligned axially and radially with the driven machine shaft.

The maximum allowed eccentricity for a complete shaft turn should not exceed 0.03 mm, when alignment is made with dial gauges, as shown in Figure 6.11. Ensure a gap between couplings to compensate the thermal expansion between the shafts as specified by the coupling manufacturer.



Parallel alignment *Angular alignment*

Figure 6.11 *- Alignment with dial gauge*

If alignment is made by a laser instrument, please consider the instructions and recommendations provided by the laser instrument manufacturer.
The alignment should be checked at ambient temperature with machine at operating temperature.

The coupling alignment must be checked periodically.

Pulley and belt couplings must be so aligned that the driver pulley center lies in the same plane of the driven pulley center and the motor shaft and the shaft of the driven machine are perfectly parallel.
After completing the alignment procedures, ensure that mounting devices do not change the motor and machine alignment and leveling resulting into machine damage during operation.

It is recommended to record the maximum alignment deviation in the Installation Report.

6.7. CONNECTION OF OIL LUBRICATED OR OIL MIST LUBRICATED MOTORS

When oil lubricated or oil mist lubricated motors are installed, connect the existing lubricant tubes (oil inlet and oil outlet tubes and motor drain tube), as shown in Figure 6.12. The lubrication system must ensure continuous oil flow through the bearings as specified by the manufacturer of the installed lubrication system.

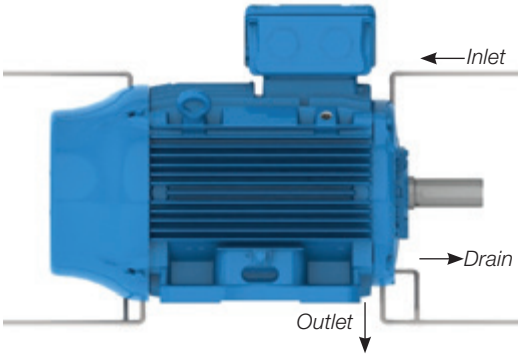


Figure 6.12 *- Oil supply and drain system of oil lubricated or oil mist lubricated motors*

6.8. CONNECTION OF THE COOLING WATER SYSTEM

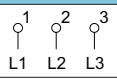
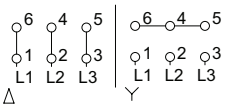
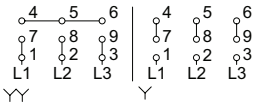
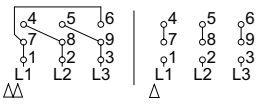
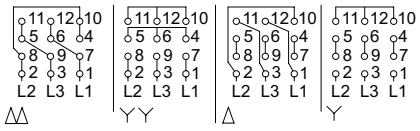
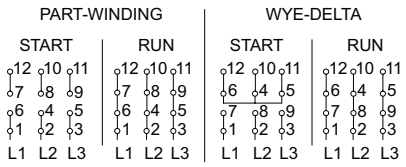
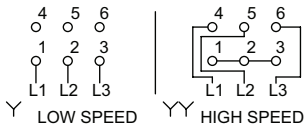
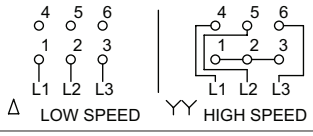
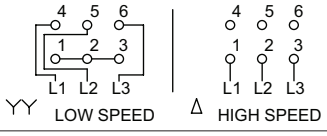
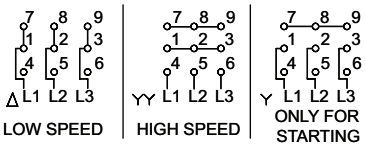
When water cooled motors are installed, connect the water inlet and outlet tubes to ensure proper motor cooling. According to item 7.2, ensure correct cooling water flow rate and water temperature in the motor cooling system.

6.9. ELECTRICAL CONNECTION

Consider the rated motor current, service factor, starting current, environmental and installation conditions, maximum voltage drop, etc. to select appropriate power supply cables and switching and protection devices. All motors must be installed with overload protection systems. Three-phase motors should be fitted with phase fault protection systems.

Before connecting the motor, check if the power supply voltage and the frequency comply with the motor nameplate data. All wiring must be made according to the connection diagram on the motor nameplate. Please consider the connection diagrams in the Table 6.2 as reference value.
To prevent accidents, check if motor has been solidly grounded in accordance with the applicable standards.

Table 6.2 - *Typical connection diagram for three-phase motors.*

Configuration	Quantity of leads	Type of connection	Connection diagram
Single speed	3	-	
	6	Δ - Y	
	9	YY - Y	
		ΔΔ - Δ	
	12	ΔΔ - YY - Δ - Y	
		Δ - PWS Part-winding start	
Double speed Dahlander	6	YY - Y Variable Torque	
		Δ - YY Constant Torque	
		YY - Δ Constant Output	
	9	Δ - Y - YY	
Double speed Double winding	6	-	

Equivalent table for lead identification													
Lead identification on the wiring diagram		**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
Single speed	NEMA MG 1 Part 2	T1	T2	T3	T4	T5	T6	T7	T8	T9	T10	T11	T12
	IEC 60034-8	U1	V1	W1	U2	V2	W2	U3	V3	W3	U4	V4	W4
	JIS (JEC 2137) - up to 6 terminals	U	V	W	X	Y	Z						
	JIS (JEC 2137) - above 6 terminals	U1	V1	W1	U2	V2	W2	U5	V5	W5	U6	V6	W6
Double speed (Dahlander / Double winding)	NEMA MG 1 Part 2[1)]	1U	1V	1W	2U	2V	2W	3U	3V	3W	4U	4V	4W
	IEC 60034-8	1U	1V	1W	2U	2V	2W	3U	3V	3W	4U	4V	4W
	JIS (JEC 2137)	1U	1V	1W	2U	2V	2W	3U	3V	3W	4U	4V	4W

1) NEMA MG 1 Part 2 defines T1 to T12 for two or more winding, however WEG adopts 1U to 4W.

WARNING - Local Standards have priority on the definition of the connection standards.

The connections presented below are a reference for the connection of the customer's power cables on low voltage motors with terminal block. The terminal blocks presented below are the standard for each product line, however variations may occur.
It is recommended the use of terminals made of electrolytic copper or brass, similar to the terminals used on the motors cables.

W21 and W22

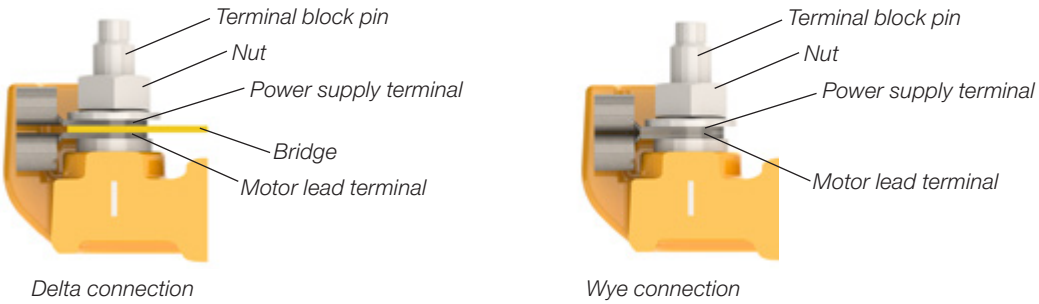


Figure 6.13 *- Connetion for W21 and W22 motors with terminal block*

W50 and HGF

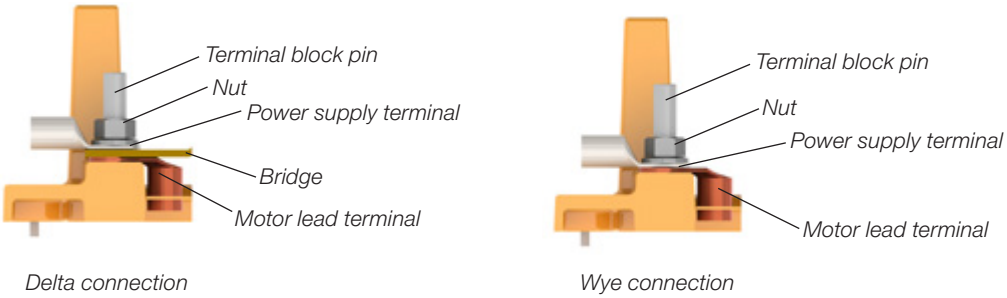


Figure 6.14 *- Connetion for W50 and HGF motors with terminal block*

If motors are supplied without terminal blocks, insulate the cable terminals with suitable insulation material that meets the power supply voltage and the insulation class indicated on the motor nameplate.

Ensure correct tightening torque for the power cable and grounding connections as specified in Table 8.11

The clearance distance (see Figure 6.15) between non-insulated live parts with each other and between grounded parts must be as indicated in Table 6.3.

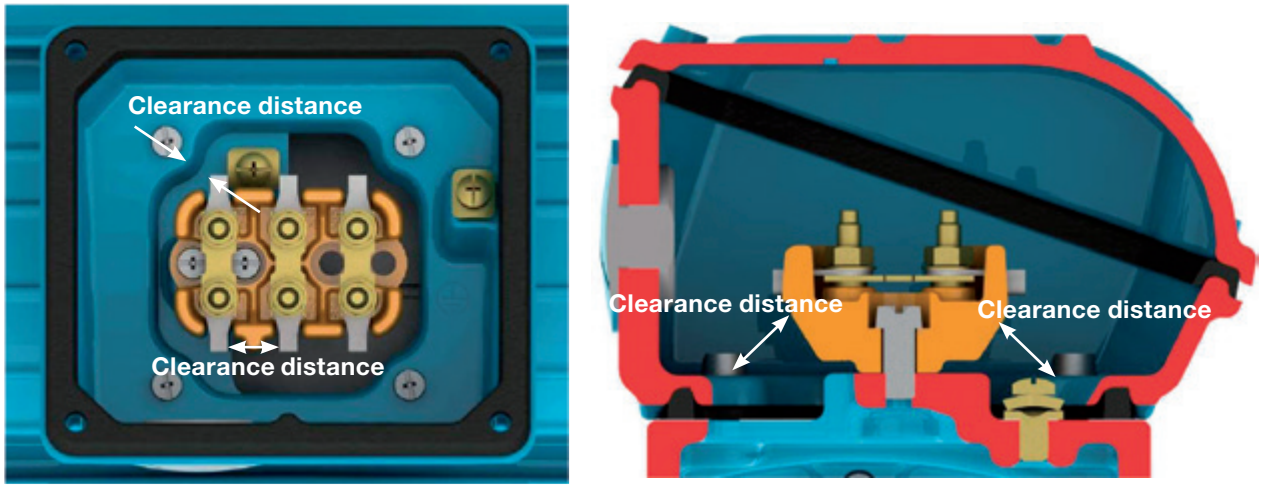


Figure 6.15 - *Clearance distance representation*

Table 6.3 - *Minimum clearance distance (mm) x supply voltage*

Voltage	Minimum clearance distance (mm)
U ≤ 440 V	4
440 < U ≤ 690 V	5.5
690 < U ≤ 1000 V	8
1000 < U ≤ 6900 V	45
6900 < U ≤ 11000 V	70
11000 < U ≤ 16500 V	105

Even when the motor is off, dangerous voltages may be present inside the terminal box used for the space heater supply or winding energization when the winding is used as heating element.
Motor capacitors will hold a charge even after the power has been cut off. Do not touch the capacitors and/or motor terminals, before discharging the capacitors completely.

After the motor connection has been completed, ensure that no tool or foreign body has been left inside the terminal box.

Take the required measures in order to ensure the degree of protection indicated on the motor nameplate:
- unused cable inlet holes in the terminal boxes must be properly closed with blanking plugs;
- components supplied loose (for example, terminal boxes mounted separately) must be properly closed and sealed.
The cable inlets used for power supply and control must be fitted with components (for example, cable-glands and conduits) that meet the applicable standards and regulations in each country.

If the motor is fitted with accessories, such as brakes and forced cooling systems, these devices must be connected to the power supply according to the information provided on their nameplates and with special care as indicated above.

All protection devices, including overcurrent protection, must be set according to the rated machine conditions. These protection devices must protect the machine against short circuit, phase fault or locked rotor condition. The motor protection devices must be set according to the applicable standards.

Check the direction of rotation of the motor shaft. If there is no limitation for the use of unidirectional fans, the shaft rotation direction can be changed by reversing any two of the phase connections. For single-phase motor, check the connection diagram indicated on the motor nameplate.

6.10. CONNECTION OF THE THERMAL PROTECTION DEVICES

If the motor is supplied with temperature monitoring devices, such as, thermostat, thermistors, automatic thermal protectors, Pt-100 (RTD), etc., they must be connected to the corresponding control devices as specified on the accessory nameplates. The non-compliance with this procedure may void the product warranty and cause serious material damages.

Do not apply test voltage above 2.5 V on thermistors and current above 1 mA on RTDs (Pt-100) according to IEC 60751 standard.

Figure 6.16 and Figure 6.17 show the connection diagram of the bimetal thermal protector (thermostats) and thermistors, respectively.

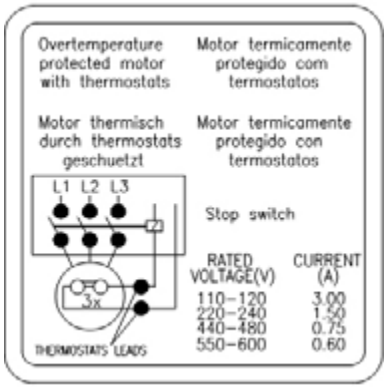


Figure 6.16 *- Connection of the bimetal thermal protectors (thermostats)*

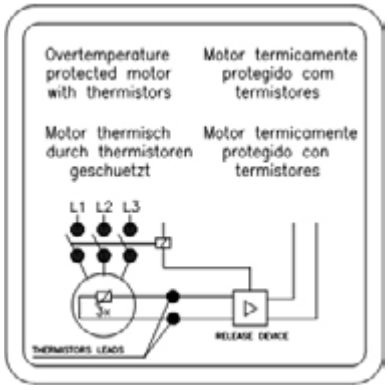


Figure 6.17 *- Thermistor connection*

The alarm temperature limits and thermal protection shutdowns can be defined according to the application; however these temperature limits can not exceed the values in Table 6.4.

Table 6.4 *- Maximum activation temperature of the thermal protections*

Component	Insulation class	Maximum temperature of the protection setting (°C)	
		Alarm	Tripping
Winding	B	-	130
	F	130	155
	H	155	180
Bearing	All	110	120

Notes:
1) The number and type of the installed protection devices are stated on the accessory nameplate of the motor.
2) If the motor is supplied with calibrated resistance, (for example, Pt-100), the motor protection system must be set according to the operating temperatures indicated in Table 6.4.

6.11. RESISTANCE TEMPERATURE DETECTORS (PT-100)

The thermocouples Pt-100 are made of materials, whose resistance depends on the temperature variation, intrinsic property of some materials (usually platinum, nickel or copper), calibrated resistance. Its operation is based on the principle that the electric resistance of a metallic conductor varies linearly with the temperature, thus allowing a continuous monitoring of the motor warm-up through the controller display ensuring a high level of precision and answer stability. These devices are widely used for measuring temperatures in various industry sectors.
In general these devices are used in installations where precise temperature control is required, for example, in installation for irregular or intermittent duty.
The same detector may be used for alarm and tripping purposes.

Table 6.5 and Figure 6.18 show the equivalence between the Pt-100 resistance and the temperature.

Table 6.5 *- Equivalence between the Pt-100 resistance and the temperature*

°C	Ω	°C	Ω	°C	Ω	°C	Ω	°C	Ω
-29	88.617	17	106.627	63	124.390	109	141.908	155	159.180
-28	89.011	18	107.016	64	124.774	110	142.286	156	159.553
-27	89.405	19	107.404	65	125.157	111	142.664	157	159.926
-26	89.799	20	107.793	66	125.540	112	143.042	158	160.298
-25	90.193	21	108.181	67	125.923	113	143.420	159	160.671
-24	90.587	22	108.570	68	126.306	114	143.797	160	161.043
-23	90.980	23	108.958	69	126.689	115	144.175	161	161.415
-22	91.374	24	109.346	70	127.072	116	144.552	162	161.787
-21	91.767	25	109.734	71	127.454	117	144.930	163	162.159
-20	92.160	26	110.122	72	127.837	118	145.307	164	162.531
-19	92.553	27	110.509	73	128.219	119	145.684	165	162.903
-18	92.946	28	110.897	74	128.602	120	146.061	166	163.274
-17	93.339	29	111.284	75	128.984	121	146.438	167	163.646
-16	93.732	30	111.672	76	129.366	122	146.814	168	164.017
-15	94.125	31	112.059	77	129.748	123	147.191	169	164.388
-14	94.517	32	112.446	78	130.130	124	147.567	170	164.760
-13	94.910	33	112.833	79	130.511	125	147.944	171	165.131
-12	95.302	34	113.220	80	130.893	126	148.320	172	165.501
-11	95.694	35	113.607	81	131.274	127	148.696	173	165.872
-10	96.086	36	113.994	82	131.656	128	149.072	174	166.243
-9	96.478	37	114.380	83	132.037	129	149.448	175	166.613
-8	96.870	38	114.767	84	132.418	130	149.824	176	166.984
-7	97.262	39	115.153	85	132.799	131	150.199	177	167.354
-6	97.653	40	115.539	86	133.180	132	150.575	178	167.724
-5	98.045	41	115.925	87	133.561	133	150.950	179	168.095
-4	98.436	42	116.311	88	133.941	134	151.326	180	168.465
-3	98.827	43	116.697	89	134.322	135	151.701	181	168.834
-2	99.218	44	117.083	90	134.702	136	152.076	182	169.204
-1	99.609	45	117.469	91	135.083	137	152.451	183	169.574
0	100.000	46	117.854	92	135.463	138	152.826	184	169.943
1	100.391	47	118.240	93	135.843	139	153.200	185	170.313
2	100.781	48	118.625	94	136.223	140	153.575	186	170.682
3	101.172	49	119.010	95	136.603	141	153.950	187	171.051
4	101.562	50	119.395	96	136.982	142	154.324	188	171.420
5	101.953	51	119.780	97	137.362	143	154.698	189	171.789
6	102.343	52	120.165	98	137.741	144	155.072	190	172.158
7	102.733	53	120.550	99	138.121	145	155.446	191	172.527
8	103.123	54	120.934	100	138.500	146	155.820	192	172.895
9	103.513	55	121.319	101	138.879	147	156.194	193	173.264
10	103.902	56	121.703	102	139.258	148	156.568	194	173.632
11	104.292	57	122.087	103	139.637	149	156.941	195	174.000
12	104.681	58	122.471	104	140.016	150	157.315	196	174.368
13	105.071	59	122.855	105	140.395	151	157.688	197	174.736
14	105.460	60	123.239	106	140.773	152	158.061	198	175.104
15	105.849	61	123.623	107	141.152	153	158.435	199	175.472
16	106.238	62	124.007	108	141.530	154	158.808	200	175.840

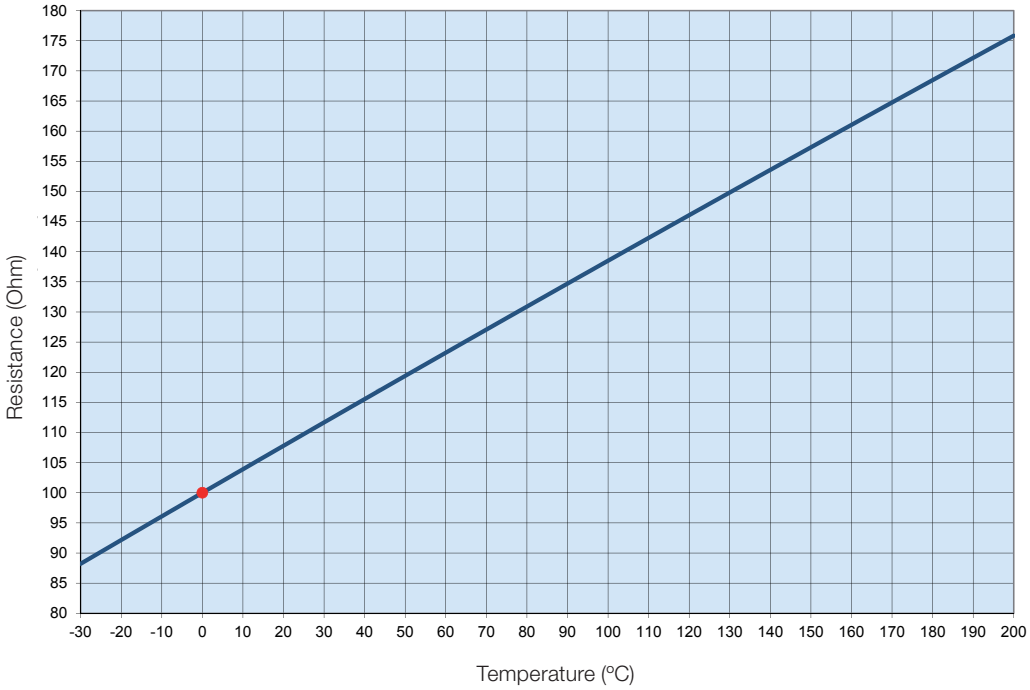


Figure 6.18 *- Ohmic resistance of the Pt-100 x temperature*

6.12. CONNECTION OF THE SPACE HEATERS

Before switching ON the space heaters, check if the space heaters connection have been made according to the connection diagram shown on the space heater nameplate. For motors supplied with dual voltage space heaters (110-127/220-240 V), see Figure 6.19.

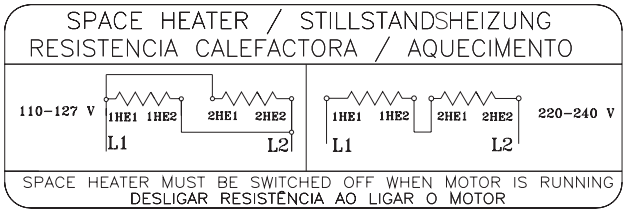


Figure 6.19 *- Dual voltage space heater connection*

The space heaters should never be energized when the motor is in operation.

ENGLISH

6.13. STARTING METHODS

Whenever possible, the motor starting must be Direct On Line (DOL) at rated voltage. This is the most simple and feasible starting method. However, it must only be applied when the starting current does not affect the power supply. Please consider the local electric utility regulations when installing a motor.
High inrush current may result in:
a) high voltage drop in the power supply line creating unacceptable line disturbance on the distribution system;
b) requiring oversized protection system (cables and contactor) increasing the installation costs.

If DOL starting is not allowed due to the reasons mentioned above, an indirect starting method compatible with the load and motor voltage to reduce the starting current may be used.
If reduced voltage starters are used for starting, the motor starting torque will also be reduced.

Table 6.6 shows the possible indirect starting methods that can be used depending on the number of the motor leads.

Table 6.6 *- Starting method x number of motor leads*

Number of leads	Possible starting methods
3 leads	Autotransformer Soft-starter
6 leads	Star-Delta Autotransformer Soft-starter
9 leads	Series/Parallel Part winding Autotransformer Soft-starter
12 leads	Star-Delta Series/Parallel Part winding Autotransformer Soft-starter

Table 6.7 shows examples of possible indirect starting methods to be used according to the voltage indicated on the motor nameplate and the power supply voltage.

Table 6.7 *- Starting methods x voltage*

Nameplate voltage	Operating voltage	Star-delta	Autotransformer starting	Starting by series/ parallel switch	Part-winding starting	Starting by Soft-starter
220/380 V	220 V 380 V	YES NO	YES YES	NO NO	NO NO	YES YES
220/440 V	220 V 440 V	NO NO	YES YES	YES NO	YES NO	YES YES
230/460 V	230 V 460 V	NO NO	YES YES	YES NO	YES NO	YES YES
380/660 V	380 V	YES	YES	NO	NO	YES
220/380/440 V	220 V 380 V 440 V	YES NO YES	YES YES YES	YES YES NO	YES YES NO	YES YES YES

The WQuattro line motors must be started direct on-line (DOL) or driven by a frequency inverter in scalar mode.

6.14. MOTORS DRIVEN BY FREQUENCY INVERTER

The operation with frequency inverter must be stated in the Purchase Order since this drive type may require some changes of the motor design.

Wmagnet Motors must only be driven by WEG frequency inverter.

The frequency inverter used to drive motors up to 690 V must be fitted with Pulse With Modulation (PWM) with vector control.

When a motor is driven by a frequency inverter at lower frequencies than the rated frequency, you must reduce the motor torque to prevent motor overheating. The torque reduction (derating torque) can be found in the item 6.4 of the "Technical Guidelines for Induction Motors driven by PWM Frequency inverters" available on the site www.weg.net.

If the motor is operated above the rated frequency, please note:
- That the motor must be operated at constant output;
- That the motor can supply max. 95% of its rated output;
- Do not exceed the maximum speed and please consider:
  - max. operating frequency stated on the additional nameplate;
  - mechanical speed limitation of the motor.

Information on the selection of the power cables between the frequency inverter and the motor can be found in the item 6.4 of the "Technical Guidelines for Induction Motors driven by PWM Frequency inverters" available at www.weg.net.

6.14.1. Use of dV/dt filter

6.14.1.1. Motor with enameled round wire

Motors designed for rated voltages up to 690 V, when driven by frequency inverter, do not require the use of dV/dT filters, provided that following criteria are considered.

Criteria for the selection of motors with round enameled wire when driven by frequency inverter				
Motor rated votage [1]	**Peak voltage at the motor terminals (max)**	**dV/dt inverter output (max)**	**Inverter Rise Time [2] (min.)**	**MTBP [2] Time between pulses (min)**
Vnom < 460 V	≤ 1600 V	≤ 5200 V/µs	≥ 0,1 µs	≥ 6 µs
460 ≤ Vnom < 575 V	≤ 2000 V	≤ 6500 V/µs		
575 ≤ Vnom ≤ 1000 V	≤ 2400 V	≤ 7800 V/µs		

***Notes**:*
1. For the application of dual voltage motors, example 380/660 V, consider the lower voltage (380 V).
2. Information supplied by the inverter manufacturer.

6.14.1.2. Motor with prewound coils

Motors with prewound coils (medium and high voltage motors regardless of frame sizes, and low voltage motors from IEC 500 / NEMA 800 frame on), designed for the use with frequency inverters, do not require the use of filters, provided they comply with the criteria in Table 6.8.

***Table 6.8** - Criteria to be considered when using motor with prewound coils to be drive by frequency inverters*

Motor rated voltage	**Type of modulation**	**Turn to turn insulation (phase-phase)**		**Phase-ground insulation**	
		Peak voltage at the motor terminals	**dV/dt at the motor terminals**	**Peak voltage at the motor terminals**	**dV/dt at the motor terminals**
690 < Vnom ≤ 4160 V	Sinusoidal	≤ 5900 V	≤ 500 V/µs	≤ 3400 V	≤ 500 V/µs
	PWM	≤ 9300 V	≤ 2700 V/µs	≤ 5400 V	≤ 2700 V/µs
4160 < Vnom ≤ 6600 V	Sinusoidal	≤ 9300 V	≤ 500 V/µs	≤ 5400 V	≤ 500 V/µs
	PWM	≤ 14000 V	≤ 1500 V/µs	≤ 8000 V	≤ 1500 V/µs

6.14.2. Bearing insulation

Only the motors in IEC frame size 400 (NEMA 680) and larger are supplied, as standard, with insulated bearing. If motor must be driven by frequency inverter, insulate the bearing according to Table 6.9.

Table 6.9 *- Recommendation on the bearing insulation for inverter driven motors*

Frame size	Recommendation
IEC 315 and 355 NEMA 445/7 to L5810/11	■ Insulated bearing/end shield ■ Grounding between shaft and frame by grounding brush
IEC 400 and larger NEMA 680 and larger	■ Insulated NDE bearing ■ Grounding between shaft and frame by grounding brush

When motors are supplied with shaft grounding system, monitor the grounding brush constantly during its operation and, when it reaches the end of its useful life, it must be replaced by another brush with the same specification.

6.14.3. Switching frequency

The minimum inverter switching frequency must not be lower than 2.5 kHz and should not exceed 5 kHz.

The non-compliance with the criteria and recommendations indicated in this manual may void the product warranty.

6.14.4. Mechanical speed limitation

Table 6.10 shows the maximum speeds allowed for motors driven by frequency inverter.

Table 6.10 *- Maximum motor speed (in rpm)*

Frame size		DE-bearing	Maximum speed for standard motors
IEC	NEMA		
63-90	143/5	6201 6202 6203 6204 6205	10400
100	-	6206	8800
112	182/4	6207	7600
		6307	6800
132	213/5	6308	6000
160	254/6	6309	5300
180	284/6	6311	4400
200	324/6	6312	4200
225-630	364/5-9610	6314	3600
		6315	3600
		6316	3200
		6319	3000
		6218	3600
		6220	3600
		6320	2200
		6322	1900
		6324	1800
		6328	1800
		6330	1800
		6224	1800
		6228	1800

Note:
To select the maximum allowed motor speed, consider the motor torque derating curve.

For more information on the application of frequency inverters, contact WEG or check the “Technical Guidelines for Induction Motors driven by PWM Frequency inverters” available at www.weg.net.

7. COMMISSIONING

7.1. INITIAL START-UP

After finishing the installation procedures and before starting the motor for the first time or after a long period without operation, the following items must be checked:

- If the nameplate data (voltage, current, connection diagram, degree of protection, cooling system, service factor, etc.) meet the application requirements;
- If the machine set (motor + driven machine) has been mounted and aligned correctly;
- If the motor driving system ensures that the motor speed does not exceed the max. allowed speed indicated in Table 6.10;
- Measure the winding insulation resistance, making sure it complies with the specified values in item 5.4;
- Check the motor rotation direction;
- Inspect the motor terminal box for damage and ensure that it is clean and dry and all contacts are rust-free, the seals are in perfect operating conditions and all unused threaded holes are properly closed thus ensuring the degree of protection indicated on the motor nameplate;
- Check if the motor wiring connections, including grounding and auxiliary equipment connection, have been carried out properly and are in accordance with the recommendations in item 6.9;
- Check the operating conditions of the installed auxiliary devices (brake, encoder, thermal protection device, forced cooling system, etc.);
- Check bearing operating conditions. If the motors are stored and/or installed for more than two years without running, it is recommended to change the bearings, or to remove, wash, inspect and relubricate them before the motor is started. If the motor is stored and/or installed according to the recommendations described in item 5.3, lubricate the bearings as described in item 8.2. For the bearing condition evaluation, it is recommended to use of the vibration analysis techniques: Envelope Analysis or Demodulation Analysis.
- For roller bearing motors with oil lubrication, ensure:
  - The oil level should be in the center of the sight glass (see Figure 8.1 and 8.2);
  - That if the motor is stored for a period equal or longer than the oil change interval, the oil must be changed before starting the motor.
- When motors are fitted with sleeve bearings, ensure:
  - Correct oil level for the sleeve bearing. The oil level should be in the center of the sight glass (see Figure 8.3);
  - That the motor is not started or operated with axial or radial loads;
  - That if the motor is stored for a period equal or longer than the oil change interval, the oil must be changed before starting the motor.
- Inspect the capacitor operating condition, if any. If motors are installed for more than two years, but were never commissioned, it is recommended to change the start capacitors since they lose their operating characteristics;
- Ensure that the air inlet and outlet opening are not blocked. The minimum clearance to the nearest wall (L) should be at least ¼ of the fan cover diameter (D), see Figure 7.1. The intake air temperature must be at ambient temperature.

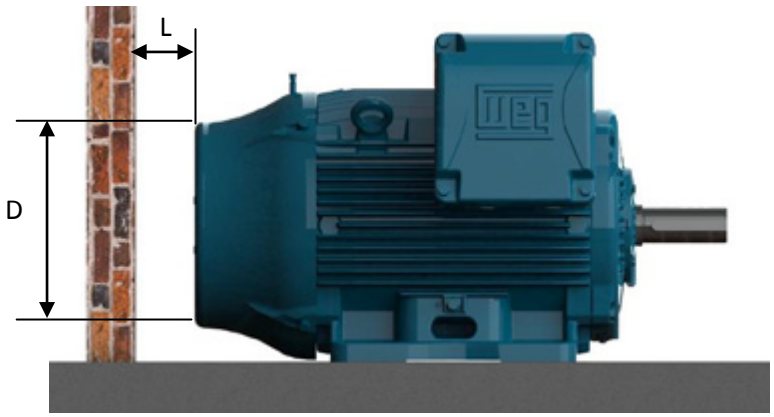


***Figure 7.1**- Minimum clearance to the wall*

Please consider the minimum distances shown in the Table 7.1 as reference value;

Table 7.1 *- Minimum distance between the fan cover and wall*

Frame size		Distance between the fan cover and the wall (L)	
IEC	**NEMA**	**mm**	**inches**
63	-	25	0.96
71	-	26	1.02
80	-	30	1.18
90	143/5	33	1.30
100	-	36	1.43
112	182/4	41	1.61
132	213/5	50	1.98
160	254/6	65	2.56
180	284/6	68	2.66
200	324/6	78	3.08
225 250	364/5 404/5	85	3.35
280	444/5 445/7 447/9	108	4.23
315	L447/9 504/5 5006/7/8 5009/10/11	122	4.80
355	586/7 588/9 5807/8/9 5810/11/12	136	5.35
400	6806/7/8 6809/10/11	147	5.79
450	7006/10	159	6.26
500	8006/10	171	6.73
560	8806/10	185	7.28
630	9606/10	200	7.87

- Ensure correct water flow rate and water temperature when water cooled motors are used. See item 7.2;
- Ensure that all rotating parts, such as pulleys, couplings, external fans, shaft, etc. are protected against accidental contact.

Other tests and inspections not included in the manual may be required, depending on the specific installation, application and/or motor characteristics.

After all previous inspections have been carried out, proceed as follows to start the motor:

- Start the motor on no-load (if possible) and check the motor direction of rotation. Check for the presence of any abnormal noise, vibration or other abnormal operating conditions;
- Ensure the motor starts smoothly. If any abnormal operating condition is noticed, switch off the motor, check the assembly system and connections before the motor is started again;
- If excessive vibrations are noticed, check if the motor mounting bolts are well tightened or if the vibrations are not generated and transmitted from adjacent installed equipment. Check the motor vibration periodically and ensure that the vibration limits are as specified in item 7.2.1;
- Start the motor at rated load during a short time and compare the operating current with the rated current indicated on the nameplate;
- Continue to measure the following motor variables until thermal equilibrium is reached: current, voltage, bearing and motor frame temperature, vibration and noise levels;
- Record the measured current and voltage values on the Installation Report for future comparisons.

As induction motors have high inrush currents during start-up, the acceleration of high inertia load requires an extended starting time to reach full speed resulting in fast motor temperature rise. Successive starts within short intervals will result in winding temperature increases and can lead to physical insulation damage reducing the useful life of the insulation system. If the duty cycle S1 / CONT. is specified on the motor nameplate, this means that the motor has been designed for:

- Two successive starts: first start from cold condition, i. e., the motor windings are at room temperature and the second start immediately after the motor stops;
- One start from hot condition, i. e., the motor windings are at rated temperature.

The Troubleshooting Chart in section 10 provides a basic list of unusual cases that may occur during motor operation with the respective corrective actions.

7.2. OPERATING CONDITIONS

Unless otherwise stated in the Purchase Order, electric motors are designed and built to be operated at altitudes up to 1000 meters above sea level and in a temperature range from -20 °C to +40 °C. Any deviation from the normal condition of motor operation must be stated on the motor nameplate. Some components must be changed if the ambient temperature is different from the specified one. Please contact WEG to check the required special features.

For operating temperatures and altitudes differing from those above, the factors indicated in Table 7.2 must be applied to the nominal motor power rating in order to determine the derated available output (Pmax = Pnom x correction factor).

Table 7.2 - *Correction factors for altitude and ambient temperature*

T (°C)	Altitude (m)								
	1000	1500	2000	2500	3000	3500	4000	4500	5000
10							0.97	0.92	0.88
15						0.98	0.94	0.90	0.86
20					1.00	0.95	0.91	0.87	0.83
25				1.00	0.95	0.93	0.89	0.85	0.81
30			1.00	0.96	0.92	0.90	0.86	0.82	0.78
35		1.00	0.95	0.93	0.90	0.88	0.84	0.80	0.75
40	1.00	0.97	0.94	0.90	0.86	0.82	0.80	0.76	0.71
45	0.95	0.92	0.90	0.88	0.85	0.81	0.78	0.74	0.69
50	0.92	0.90	0.87	0.85	0.82	0.80	0.77	0.72	0.67
55	0.88	0.85	0.83	0.81	0.78	0.76	0.73	0.70	0.65
60	0.83	0.82	0.80	0.77	0.75	0.73	0.70	0.67	0.62
65	0.79	0.76	0.74	0.72	0.70	0.68	0.66	0.62	0.58
70	0.74	0.71	0.69	0.67	0.66	0.64	0.62	0.58	0.53
75	0.70	0.68	0.66	0.64	0.62	0.60	0.58	0.53	0.49
80	0.65	0.64	0.62	0.60	0.58	0.56	0.55	0.48	0.44

Motors installed inside enclosures (cubicles) must be ensured an air renewal rate in the order of one cubic meter per second for each 100 kW installed power or fraction of installed power. Totally Enclosed Air Over motors - TEAO (fan and exhaust / smoke extraction) are supplied without cooling fan and the manufacturer of the driven machine is responsible for sufficient motor cooling. If no minimum required air speed between motor fins is indicated on the motor nameplate, ensure the air speed indicated in the table 7.3 is provided. The values shown in Table 7.3 are valid for 60 Hz motors. To obtain the minimum air speed for 50 Hz motors, multiply the values in the table by 0.83.

Table 7.3 *- Minimum required air speed between motor fins (metres/second)*

Frame		Poles			
IEC	NEMA	2	4	6	8
63 to 90	143/5	13	7	5	4
100 to 132	182/4 to 213/5	18	12	8	6
160 to 200	254/6 to 324/6	20	15	10	7
225 to 280	364/5 to 444/5	22	20	15	12
315 to 450	445/7 to 7008/9	25	25	20	15

The voltage and frequency variations may affect the performance characteristics and the electromagnetic compatibility of the motor. The power supply variations should not exceed the values specified in the applicable standards. Examples:

- ABNT NBR 17094 - Parts 1 and 2. The motor has been designed to supply the rated torque for a combined variation in voltage and frequency:
  - Zone A: ±5% of the rated voltage and ±2% of the rated frequency;
  - Zone B: ±10% of the rated voltage and +3% -5% of the rated frequency.

When operated continuously in Zone A or B, the motor may show performance variations and the operating temperature may increase considerably. These performance variations will be higher in Zone B. Thus it is not recommended to operate the motor in Zone B during extended periods.

- IEC 60034-1. The motor has been designed to supply the rated torque for combined variation in voltage and frequency:
  - Zone A: ±5% of the rated voltage and ±2% of the rated frequency;
  - Zone B: ±10% of the rated voltage and +3% -5% of the rated frequency.

When operated continuously in Zone A or B, the motor may show performance variations and the operating temperature may increase considerably. These performance variations will be higher in Zone B. Thus it is not recommended to operate the motor in Zone B during extended periods. For multivoltage motors (example 380-415/660 V), a ±5% voltage variation from the rated voltage is allowed.

- NEMA MG 1 Part 12. The motor has been designed to be operated in one of the following variations:
  - ±10% of the rated voltage, with rated frequency;
  - ±5% of the rated frequency, with rated voltage;
  - A combined variation in voltage and frequency of ±10%, provided the frequency variation does not exceed ±5%.

If the motor is cooled by ambient air, clean the air inlet and outlet openings and cooling fins at regular intervals to ensure a free airflow over the frame surface. The hot air should never be returned to the motor. The cooling air must be at room temperature limited to the temperature range indicated on the motor nameplate (if no room temperature is specified, please consider a temperature range between -20 °C and +40 °C).

Table 7.4 shows the minimum required water flow for water cooled motors considering the different frame sizes and the maximum allowed temperature rise of the cooling water after circulating through the motor. The inlet water temperature should not exceed 40 °C.

Table 7.4 *- Minimum required water flow and the maximum allowed temperature rise of the cooling water after circulating through the motor*

Frame size		Flow rate (litres/minute)	Maximum allowed water temperature rise (°C)
IEC	NEMA		
180	284/6	12	5
200	324/6	12	5
225	364/5	12	5
250	404/5	12	5
280	444/5 445/7 447/9	15	6
315	504/5	16	6
355	586/7 588/9	25	6

Motors fitted with oil mist lubrication systems can be operated continuously for a maximum of one hour after the failure of the oil pumping system.

Considering the sun's heat increases the operating temperature, externally mounted motors should always be protected from direct sunlight exposure.

Each and every deviation from the normal operating condition (tripping of the thermal protection, noise and vibration level increase, temperature and current rise) should be investigated and corrected by WEG Authorized Service Centers.

Motors fitted with cylindrical roller bearings require a minimum radial load to ensure a normal operation. For information regarding the radial preload, please contact WEG.

7.2.1.Limits of vibration

The vibration severity is the maximum vibration value measured at all positions and in all directions as recommended in the standard IEC 60034-14. Table 7.5 specifies the limits of the maximum vibrations magnitudes according to standard IEC 60034-14 for shaft heights IEC 56 to 400, for vibrations grades A and B. The vibration severity limits in Table 7.5 are given as RMS values (Root Mean Square values or effective values) of the vibration speed in mm/s measured in free suspension condition.

Table 7.5 *- Recommended limits for the vibration severity according to standard IEC 60034-14*

Shaft height [mm]	56 ≤ H ≤ 132	132 ≤ H ≤ 280	H > 280
Vibration grade	Vibration severity on elastic base [mm/s RMS]		
A	1.6	2.2	2.8
B	0.7	1.1	1.8

Notes:

1 - The values in Table 7.5 are valid for measurements carried out with decoupled machines (without load) operated at rated voltage and frequency.

2 - The values in Table 7.5 are valid regardless of the direction of rotation of the machine.

3 - The values in Table 7.5 are not applicable to single-phase motors, three-phase motors powered by a single-phase system or to machines mounted in situ or coupled with inertia flywheels or to loads.

According to NEMA MG 1, the allowed vibration limit for standard motors is 0.15 in/s (peak vibration in in/s).

Note:

For the load operation condition, the use of the standard ISO 10816-3 is recommended for evaluating the motor vibration limits. In the load condition the motor vibration will be influenced by several factors, such as, type of the coupled load, condition of the motor fixation, alignment condition under load, structure or base vibration due to other equipments, etc..

8. MAINTENANCE

The purpose of the maintenance is to extend the useful life of the equipment. The non-compliance with one of these previous items can cause unexpected machine failures.

If motors with cylindrical roller or angular contact bearings are to be transported during the maintenance procedures, the shaft locking device must always be fitted. All HGF motors, regardless of the bearing type, must always be transported with the shaft locking device fitted.

All repairs, disassembly and assembly related services must be carried out only by qualified and well-trained personnel by using proper tools and techniques. Make sure that the machine has stopped and it is disconnected from the power supply, including the accessory devices (space heater, brake, etc.), before any servicing is undertaken.
The company does not assume any responsibility or liability for repair services or maintenance operations executed by non-authorized Service Centers or by non qualified service personnel. The company shall have no obligation or liability whatsoever to the buyer for any indirect, special, consequential or incidental loss or damage caused or arising from the company's proven negligence

8.1. GENERAL INSPECTION

The inspection intervals depend on the motor type, application and installation conditions. Proceed as follows during inspection:

- Visually inspect the motor and coupling. Check if abnormal noises, vibrations, excessive heating, wear signs, misalignment or damaged parts are noticed. Replace the damaged parts as required;
- Measure the insulation resistance according to the item 5.4;
- Clean the motor enclosure. Remove oil spills and dust accumulation from the motor frame surface to ensure a better heat transfer to the surrounding ambient;
- Check cooling fan condition and clean the air inlet & outlet openings to ensure a free air flow over the motor;
- Investigate the actual condition of the seals and replace them, if required;
- Drain the condensed water from inside the motor. After draining, reinstall the drain plugs to ensure the degree of protection as indicated on the motor nameplate. The motor must always be positioned so the drain hole is at the lowest position (see item 6);
- Check the connections of the power supply cables, ensuring the correct clearance distance between live and grounded parts, as specified in Table 6.3;
- Check if the tightening torque of the bolted connections and mounting bolts meets the tightening torque specified in Table 8.11;
- Check the status of the cable passages, the cable gland seals and the seals inside the terminal box and replace them, if required;
- Check the bearing operating conditions. Check for the presence of any abnormal noise, vibration or other abnormal operating conditions, like motor temperature rise. Check the oil level, the lube oil condition and compare the workings hours with the informed life time;
- Record and file all changes performed on the motor.



Do not reuse damaged or worn parts. Damaged or worn parts must be replaced by parts supplied by the manufacturer and must be installed as if they were the original parts.

8.2. LUBRICATION

Proper lubrication plays a vital role in the motor performance. Only use the grease or oil types, amounts and lubrication intervals recommended for the bearings. This information is available on the motor nameplate and the lubrication procedures must be carried out according to the type of lubricant (oil or grease).
When the motor is fitted with thermal protection devices for bearing temperature control, consider the operating temperature limits shown in Table 6.4.
The maximum operating temperature of motors used in special applications may differ from those shown in Table 6.4. The grease and oil disposal should be made in compliance with applicable laws in each country.



Please contact WEG when motors are to be installed in special environments or used for special applications.

8.2.1. Grease lubricated rolling bearings

Excess grease causes bearing overheating, resulting in bearing failure.

The lubrication intervals specified in Table 8.1, Table 8.2, Table 8.3, Table 8.4, Table 8.5, Table 8.6, Table 8.7 and Table 8.8 consider an absolute temperature on the bearing of 70 °C (up to frame size IEC 200 / NEMA 324/6) and 85 °C (for frame size IEC 225 / NEMA 364/5 and above), the motor running at rated speed, a motor mounted in horizontal position and greased with Mobil Polyrex EM grease. Any variation of the parameters listed above must be evaluated.

Table 8.1 *- Lubrication intervals for ball bearings*

Frame		Poles	Bearing designation	Amount of grease (g)	Lubrication intervals (hours)					
					ODP (Open Drip Proof)		W21 TEFC (Totally Enclosed Fan Cooled)		W22 TEFC (Totally Enclosed Fan Cooled)	
IEC	NEMA				50 Hz	60 Hz	50 Hz	60 Hz	50 Hz	60 Hz
90	143/5	2	6205	4	-	-	20000	20000	25000	25000
		4								
		6								
		8								
100	-	2	6206	5	-	-	20000	20000	25000	25000
		4								
		6								
		8								
112	182/4	2	6207/ 6307	9	-	-	20000	20000	25000	25000
		4								
		6								
		8								
132	213/5	2	6308	11	-	-	20000	18400	25000	23200
		4					20000	20000	25000	25000
		6								
		8								
160	254/6	2	6309	13	20000	20000	18100	15700	22000	20000
		4					20000	20000	25000	25000
		6								
		8								
180	284/6	2	6311	18	20000	20000	13700	11500	17000	14000
		4					20000	20000	25000	25000
		6								
		8								
200	324/6	2	6312	21	20000	20000	11900	9800	15000	12000
		4					20000	20000	25000	25000
		6								
		8								
225 250 280 315 355	364/5 404/5 444/5 445/7 447/9 L447/9 504/5 5008 5010/11 586/7 588/9	2	6314	27	18000	14400	4500	3600	5000	4000
		4			20000	20000	11600	9700	14000	12000
		6					16400	14200	20000	17000
		8					19700	17300	24000	20000
		2	6316	34	14000	*Upon request	3500	*Upon request	4000	*Upon request
		4			20000	20000	10400	8500	13000	10000
		6					14900	12800	18000	16000
		8					18700	15900	20000	20000
		2	6319	45	*Upon request					
		4			20000	20000	9000	7000	11000	8000
		6					13000	11000	16000	13000
		8					17400	14000	20000	17000
		4	6322	60	20000	20000	7200	5100	9000	6000
		6					10800	9200	13000	11000
		8					15100	11800	19000	14000

Table 8.2 - *Lubrication intervals for cylindrical roller bearings*

Frame		Poles	Bearing designation	Amount of grease (g)	LUBRICATION INTERVALS (hours)					
					ODP (Open Drip Proof)		W21 TEFC (Totally Enclosed Fan Cooled)		W22 TEFC (Totally Enclosed Fan Cooled)	
IEC	NEMA				50 Hz	60 Hz	50 Hz	60 Hz	50 Hz	60 Hz
160	254/6	2	NU309	13	20000	19600	13300	9800	16000	12000
		4				20000	20000	20000	25000	25000
		6								
		8								
180	284/6	2	NU311	18	18400	12800	9200	6400	11000	8000
		4			20000	20000	20000	19100	25000	25000
		6						20000		
		8								
200	324/6	2	NU312	21	15200	10200	7600	5100	9000	6000
		4			20000	20000	20000	17200	25000	21000
		6						20000		25000
		8								
225 250 280 315 355	364/5 404/5 444/5 445/7 447/9 L447/9 504/5 5008 5010/11 586/7 588/9	4	NU314	27	17800	14200	8900	7100	11000	9000
		6			20000	20000	13100	11000	16000	13000
		8					16900	15100	20000	19000
		4	NU316	34	15200	12000	7600	6000	9000	7000
		6			20000	19000	11600	9500	14000	12000
		8				20000	15500	13800	19000	17000
		4	NU319	45	12000	9400	6000	4700	7000	5000
		6			19600	15200	9800	7600	12000	9000
		8			20000	20000	13700	12200	17000	15000
		4	NU322	60	8800	6600	4400	3300	5000	4000
		6			15600	11800	7800	5900	9000	7000
		8			20000	20000	11500	10700	14000	13000

Table 8.3 - *Lubrication intervals for ball bearings - HGF line*

Frame		Poles	Bearing designation	Amount of grease (g)	Lubrication intervals (hours)	
IEC	NEMA				50 Hz	60 Hz
315L/A/B and 315C/D/E	5006/7/8T and 5009/10/11T	2	6314	27	3100	2100
		4 - 8	6320	50	4500	4500
			6316	34	4500	4500
355L/A/B and 355C/D/E	5807/8/9T and 5810/11/12T	2	6314	27	3100	2100
		4 - 8	6322	60	4500	4500
			6319	45	4500	4500
400L/A/B and 400 C/D/E	6806/7/8T and 6809/10/11T	2	6315	30	2700	1800
		4 - 8	6324	72	4500	4500
			6319	45	4500	4500
450	7006/10	2	6220	31	2500	1400
		4	6328	93	4500	3300
			6322	60	4500	4500
		6 - 8	6328	93	4500	4500
			6322	60	4500	4500
500	8006/10	4	6330	104	4200	2800
			6324	72	4500	4500
		6 - 8	6330	104	4500	4500
			6324	72	4500	4500
500	8006/10	4	6330	104	4200	2800
			6324	72	4500	4500
		6 - 8	6330	104	4500	4500
			6324	72	4500	4500
560	8806/10	4 - 8	*Upon request			
630	9606/10	4 - 8				

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Table 8.4 - *Lubrication intervals for cylindrical roller bearings - HGF line*

Frame		Poles	Bearing designation	Amount of grease (g)	Lubrication intervals (hours)	
IEC	NEMA				50 Hz	60 Hz
315L/A/B and 315C/D/E	5006/7/8 and 5009/10/11	4	NU320	50	4300	2900
		6 - 8			4500	4500
355L/A/B and 355C/D/E	5807/8/9 and 5810/11/12	4	NU322	60	3500	2200
		6 - 8			4500	4500
400L/A/B and 400C/D/E	6806/7/8 and 6809/10/11	4	NU324	72	2900	1800
		6 - 8			4500	4500
450	7006/10	4	NU328	93	2000	1400
		6			4500	3200
		8			4500	4500
500	8006/10	4	NU330	104	1700	1000
		6			4100	2900
		8			4500	4500
560	8806/10	4	NU228 + 6228	75	2600	1600
		6 - 8		106	4500	4500
630	9606/10	4	NU232 + 6232	92	1800	1000
		6		120	4300	3100
		8		140	4500	4500

Tabela 8.5 - *Lubrication intervals for ball bearings - W50 line*

	Frame		Poles	D.E. Bearing	Amount of grease (g)	50 Hz (h)	60 Hz (h)	N.D.E. Bearing	Amount of grease (g)	50 Hz (h)	60 Hz (h)
	IEC	NEMA									
Horizontal mounting Ball bearings	315 H/G	5009/10	2	6314	27	4500	3500	6314	27	4500	3500
			4 - 8	6320	50		4500	6316	34		4500
	355 J/H	5809/10	2	6314	27		3500	6314	27		3500
			4 - 8	6322	60		4500	6319	45		4500
	400 L/K and 400 J/H	6806/07 and 6808/09	2	6218	24	3800	2500	6218	24	3800	1800
			4 - 8	6324	72	4500	4500	6319	45	4500	4500
	450 L/K and 450 J/H	7006/07 and 7008/09	2	6220	31	3000	2000	6220	31	3000	2000
			4	6328	93	4500	3300	6322	60	4500	4500
			6 - 8				4500				
Vertical mounting Ball bearings	315 H/G	5009/10	2	7314	27	2500	1700	6314	27	2500	1700
			4	6320	50	4200	3200	6316	34	4500	4500
			6 - 8			4500	4500				
	355 J/H	5809/10	2	7314	27	2500	1700	6314	27	2500	1700
			4	6322	60	3600	2700	6319	45	4500	3600
			6 - 8			4500	4500				4500
	400 L/K and 400 J/H	6806/07 and 6808/09	2	7218	24	2000	1300	6218	24	2000	1300
			4	7324	72	3200	2300	6319	45	4500	3600
			6			4500	4300				4500
			8				4500				
	450 L/K and 450 J/H	7006/07 and 7008/09	2	7220	31	1500	1000	6220	31	1500	1000
			4	7328	93	2400	1700	6322	60	3500	2700
			6			4100	3500			4500	4500
			8			4500	4500				

Tabela 8.6 - *Lubrication intervals for cylindrical roller bearings - W50 line*

	Frame		Poles	D.E. Bearing	Amount of grease (g)	50 Hz (h)	60 Hz (h)	N.D.E. Bearing	Amount of grease (g)	50 Hz (h)	60 Hz (h)
	IEC	NEMA									
Horizontal mounting Roller bearings	315 H/G	5009/10	4	NU320	50	4300	2900	6316	34	4500	4500
			6 -8			4500	4500				
	355 J/H	5809/10	4	NU322	60	3500	2200	6319	45		
			6 - 8			4500	4500				
	400 L/K and 400 J/H	6806/07 and 6808/09	4	NU324	72	2900	1800				
			6 - 8			4500	4500				
	450 L/K and 450 J/H	7006/07 and 7008/09	4	NU328	93	2000	1400	6322	60		
			6			4500	3200				
			8				4500				

Tabela 8.7 - Lubrication intervals for ball bearings - W40 line

	Frame		Poles	D.E. Bearing	Amount of grease (g)	50 Hz (h)	60 Hz (h)	N.D.E. Bearing	Amount of grease (g)	50 Hz (h)	60 Hz (h)
	IEC	NEMA									
Horizontal mounting Ball bearings	315G/F	5010/11	2	6314	27	4500	4500	6314	27	4500	4500
			4 - 8	6319	45	4500	4500	6314	27	4500	4500
	355 J/H	L5010/11	2	6218	24	4500	4500	6218	24	4500	4500
			4 – 8	6224	43	4500	4500	6218	24	4500	4500
	400 J/H	L5810/11	2	6220	31	4500	3800	6220	31	4500	3800
			4 – 8	6228	52	4500	4500	6220	31	4500	4500
	450 K/J	L6808/09	2	6220	31	4500	3800	6220	31	4500	3800
			4 – 8	6228	52	4500	4500	6220	31	4500	4500

Tabela 8.8 - Lubrication intervals for cylindrical roller bearings - W40 line

	Frame		Poles	D.E. Bearing	Amount of grease (g)	50 Hz (h)	60 Hz (h)	N.D.E. Bearing	Amount of grease (g)	50 Hz (h)	60 Hz (h)
	IEC	NEMA									
Horizontal mounting Roller bearings	315G/F	5010/11	4 - 8	NU319	45	4500	4500	6314	27	4500	4500
	355 J/H	L5010/11	4 – 8	NU224	43	4500	4500	6218	24	4500	4500
	400 J/H	L5810/11	4 – 8	NU228	52	4500	3300	6220	31	4500	4500
	450 K/J	L6808/09	4 – 8	NU228	52	4500	3300	6220	31	4500	4500

For each increment of 15 °C above the bearing temperature, the relubrication intervals given in the Table must be halved. The relubrication interval of motors designed by the manufacturer for mounting in horizontal position, but installed in vertical position (with WEG authorization), must be halved.
For special applications, such as: high and low temperatures, aggressive environments, driven by frequency inverter (VFD - frequency inverter), etc., please contact WEG about the required amount of grease and the relubrication intervals.

8.2.1.1. Motor without grease fitting

Motors without grease fittings must be lubricated in accordance with the existing Maintenance Plan. Motor disassembly must be carried out as specified in Item 8.3. If motors are fitted with shielded bearings (for example, ZZ, DDU, 2RS, VV), these bearings must be replaced at the end of the grease service life.

8.2.1.2. Motor with grease fitting

To lubricate the bearings with the motor stopped, proceed as follows:
- Before lubricating, clean the grease nipple and immediate vicinity thoroughly;
- Lift grease inlet protection;
- Remove the grease outlet plug;
- Pump in approximately half of the total grease indicated on the motor nameplate and run the motor for about 1 (one) minute at rated speed;
- Switch-off the motor and pump in the remaining grease;
- Lower again the grease inlet protection and reinstall the grease outlet protection.

To grease the motor while running, proceed as follows:
- Before lubricating, clean the grease nipple and immediate vicinity thoroughly;
- Pump the total grease indicated on the motor nameplate;
- Lower again the grease inlet protection.



For lubrication, use only manual grease gun.

If Motors are provided with a spring device for grease removal, the grease excess must be removed by pulling the rod and cleaning the spring until the spring does not remove more grease.

8.2.1.3. Compatibility of the Mobil Polyrex EM grease with other greases

The Mobil Polyrex EM grease has a polyurea thickener and a mineral oil and it is not compatible with other greases.
If you need another type of grease, contact WEG.
It is not recommended to mix different types of greases. In such a case, clean the bearings and lubrication channels before applying new grease.
The used grease must have in its formulation corrosion and oxidation inhibitors.

8.2.2. Oil lubricated bearings

To change the oil of oil lubricated motor proceed as follows:
- Switch-off the motor;
- Remove threaded oil drain plug;
- Open the valve and drain the oil;
- Close the drain valve again;
- Reinstall the threaded oil drain plug;
- Fill-up with the type and amount of oil as specified on the nameplate;
- Check oil level. The oil level is OK when the lubricant can be viewed approximately in the center of the sight glass;
- Reinstall oil inlet plug;
- Check for oil leaks and ensure that all not used threaded plugs are closed with plugs.

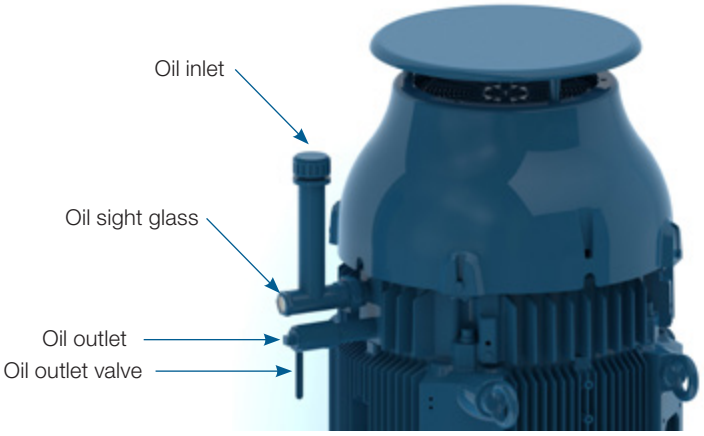


Figure 8.1 *- Oil lubricated bearing - vertical mounting*

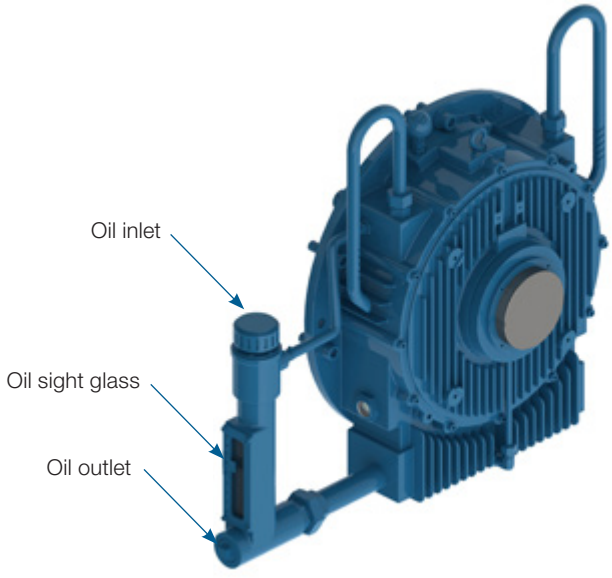


Figure 8.2 *- Oil lubricated bearing - horizontal mounting*

The bearing lubricating oil must be replaced as specified on the nameplate or whenever changes in the oil properties are noticed. The oil viscosity and pH must be checked periodically. The oil level must be checked every day and must be kept in the center of the sight glass.
Please contact WEG, when oils with different viscosities should be used.

***Note**:*
The HGF vertical mounted motors with high axial thrust are supplied with grease lubricated DE-bearings and with oil lubricated NDE-bearings. The DE-bearings must be lubricated according to recommendations in item 8.2.1. Table 8.9 specifies the oil type and the amount of oil required for this motor lubrication.

***Table 8.9** - Oil properties for HGF vertical mounted motors with high axial thrust*

Mounting - high axial thrust	Frame		Poles	Bearing designation	Oil (liters)	Interval (h)	Lubricant	Lubricant specification
	IEC	NEMA						
	315L/A/B e 315C/D/E	5006/7/8T e 5009/10/11T	4 - 8	29320	20	8000	FUCHS Renolin DTA 40 / Mobil SHC 629	ISO VG150 mineral oil with antifoam and antioxidant additives
	355L/A/B e 355C/D/E	5807/8/9T e 5810/11/12T	4 - 8	29320	26			
	400L/A/B e 400C/D/E	6806/7/8T e 6809/10/11T	4 - 8	29320	37			
	450	7006/10	4 - 8	29320	45			

8.2.3. Oil mist lubricated bearings

Check the service conditions of the seals and if replacement is required use only original components. Clean the seal components before assembly (bearing caps, end shields, etc.).
Apply joint sealant between the bearing caps and end shields. The joint sealant must be compatible with the used lubricating oil. Connect the oil lubricant tubes (oil inlet and oil outlet tubes and motor drain tube), as shown in Figure 6.12.

8.2.4. Sleeve bearings

The lubricating oil of sleeve bearings must be changed at the intervals specified in Table 8.10. To replace the oil, proceed as follows:

- NDE-bearing: remove the protection plate from the fan cover;
- Drain the oil through the drain hole located at the bottom of the bearing (see Figure 8.3);
- Close the oil drain hole;
- Remove the oil inlet plug;
- Fill the sleeve bearing with the specified oil and with the amount of oil specified in;
- Check the oil level and ensure it is kept close to the center of the sight glass;
- Install the oil inlet plug;
- Check for oil leaks.

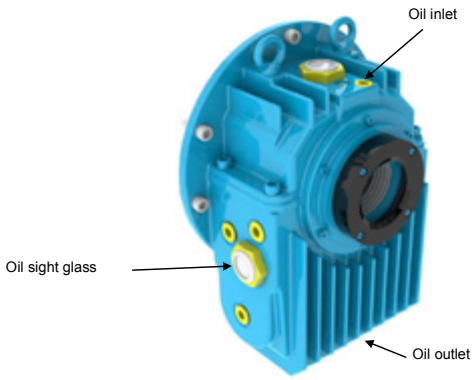


***Figure 8.3** - Sleeve bearing*

Table 8.10 - Oil properties for sleeve bearings

Frame		Poles	Bearing designation	Oil (liters)	Interval (h)	Lubricant	Lubricant specification
IEC	NEMA						
315	5000	2	9-80	2.8	8000	FUCHS Renolin DTA 10	ISO VG32 mineral oil with antifoam and antioxidant additives
355	5800						
400	6800						
450	7000						
315	5000	4 - 8	9-90	2.8	8000	FUCHS Renolin DTA 15	ISO VG46 mineral oil with antifoam and antioxidant additives
355	5800		9-100				
400	6800		11-110	4.7			
450	7000		11-125				
500	8000						

The lubricating oil must be replaced as specified on the nameplate or whenever changes on the oil properties are noticed. The oil viscosity and pH must be checked periodically. The oil level must be checked every day and kept in the center of the sight glass.
Please contact WEG, when oils with different viscosities are to be used.

8.3. MOTOR ASSEMBLY AND DISASSEMBLY

All repair services on motors should be always performed by qualified personnel and in accordance with the applicable laws and regulations in each country. Always use proper tools and devices for motor disassembly and assembly.

Disassembly and assembly services can be carried out only after the motor has been disconnected from the power supply and is completely stopped.

Dangerous voltages may be present at the motor terminals inside the terminal box since capacitors can retain electrical charge for long periods of time even when they are not connected directly to a power source or when space heaters are connected to the motor or when the motor windings are used as space heaters. Dangerous voltages may be present at the motor terminals when they are driven by frequency inverter even when they are completely stopped.

Record the installation conditions such as terminal connection diagram, alignment / leveling conditions before starting the disassembly procedures. These records should be considered for later assembly.

Disassemble the motor carefully without causing scratches on machined surfaces or damaging the threads.

Assemble the motor on a flat surface ensuring a good support base. Footless motors must be fixed/locked on the base to prevent accidents.

Handle the motor carefully to not damage the insulated components such as windings, insulated rolling bearings, power cables etc..

Seal elements, such as joint seals and bearing seals should always be replaced when wear or damage is noticed.
Motors with degree of protection higher than IP55 are supplied with joint and screw seal Loctite 5923 (Henkel) Clean the components and apply a new coat of Loctite 5923 on the surfaces before assembly.

For the W50 and HGF motor lines provided with axial fans, the motor and the axial fan have different markings for indicating the direction of rotation for prevent incorrect assembly.
The axial fan must be assembled so that the indicative arrow for direction of rotation is always visible, viewing the non-drive end side. The marking indicated on the axial fan blade, CW for clockwise direction of rotation or CCW for counterclockwise direction of rotation, indicates the direction of rotation of the motor viewing the drive end side.

8.3.1. Terminal box

Proceed as follows to remove the terminal box cover and to disconnect/connect the power supply cables and the cables of the accessory devices:

- Ensure that during the screw removal the terminal box cover does not damage the components installed inside the terminal box;
- If the terminal box cover is fitted with lifting eyebolt, lift the terminal box cover always by its lift eyebolt;
- If motors are supplied with terminal blocks, ensure the correct tightening torque on the motor terminals as specified in Table 8.11;
- Ensure that the cables do not contact sharp edges;
- Ensure that the original IP degree of protection is not changed and is maintained as indicate on the motor nameplate. The power supply cables and the control cables must always be fitted with components (cable glands, conduits) that meet the applicable standards and regulations of each country;
- Ensure that the pressure relief device is in perfect operating condition, if provided. The seals in the terminal box must be in perfect condition for reuse and must be reinstalled correctly to ensure the specified degree of protection;
- Ensure the correct tightening torque for the securing bolts of the terminal box cover as specified in Table 8.11.

Table 8.11 *- Tightening torque for the securing bolts [Nm]*

Screw type and seal	M4	M5	M6	M8	M10	M12	M14	M16	M20
Hex bolt/hex socket bolt (rigid joint)	-	3,5 to 5	6 to 9	14 to 20	28 to 40	45 to 70	75 to 110	115 to 170	230 to 330
Combined slotted screw (rigid joint)	1,5 to 3	3 to 5	5 to 10	10 to 18	-	-	-	-	-
Hex bolt/hex socket bolt (flexible joint)	-	3 to 5	4 to 8	8 to 15	18 to 30	25 to 40	30 to 45	35 to 50	-
Combined slotted screw (flexible joint)	-	3 to 5	4 to 8	8 to 15	-	-	-	-	-
Terminal blocks	1 to 1,5	2 to 4 1)	4 to 6,5	6,5 to 9	10 to 18	15,5 to 30	-	30 to 50	-
Grounding terminals	1,5 to 3	3 to 5	5 to 10	10 to 18	28 to 40	45 to 70	-	115 to 170	

Note: 1) For 12-pin terminal block, apply the minimum torque of 1.5 Nm and maximum torque of 2.5 Nm.

8.4. DRYING THE STATOR WINDING INSULATION

Dismantle the motor completely. Remove the end shields, the rotor with the shaft, the fan cover, the fan and the terminal box before the wound stator with the frame is transferred to the oven for the drying process. Place the wound stator in the oven heated to max. 120 °C for two hours. For larger motors a longer drying time may be required. After the drying process has been concluded, allow the stator to cool to room temperature. Measure the insulation resistance again as described in item 5.4. Repeat the stator drying process if the required insulation resistance does not meet the values specified in Table 5.3. If the insulation resistance does not improve despite several drying processes, evaluate the causes of the insulation resistance drop carefully and an eventual replacement of the motor winding may be required. If in doubt contact WEG.



To prevent electrical shock, discharge the motor terminals immediately before, and after each measurement. If the motor is equipped with capacitors, these must be discharged before beginning any repair.

8.5. SPARE PARTS

When ordering spare parts, always provide complete motor designation, indicating the motor type, the code number and the serial number, which are stated on the motor nameplate.

Spare parts must always be purchased from WEG authorized Service Centers. The use of non-original spare parts can cause motor failure, performance drop and void the product warranty.

The spare parts must be stored in a clean, dry and properly ventilated room, with relative air humidity not exceeding 60%, with ambient temperature between 5 °C and 40 °C, free of dust, vibrations, gases, corrosive smokes and at constant temperature. The spare parts must be stored in their normal mounting position without placing other components onto them.

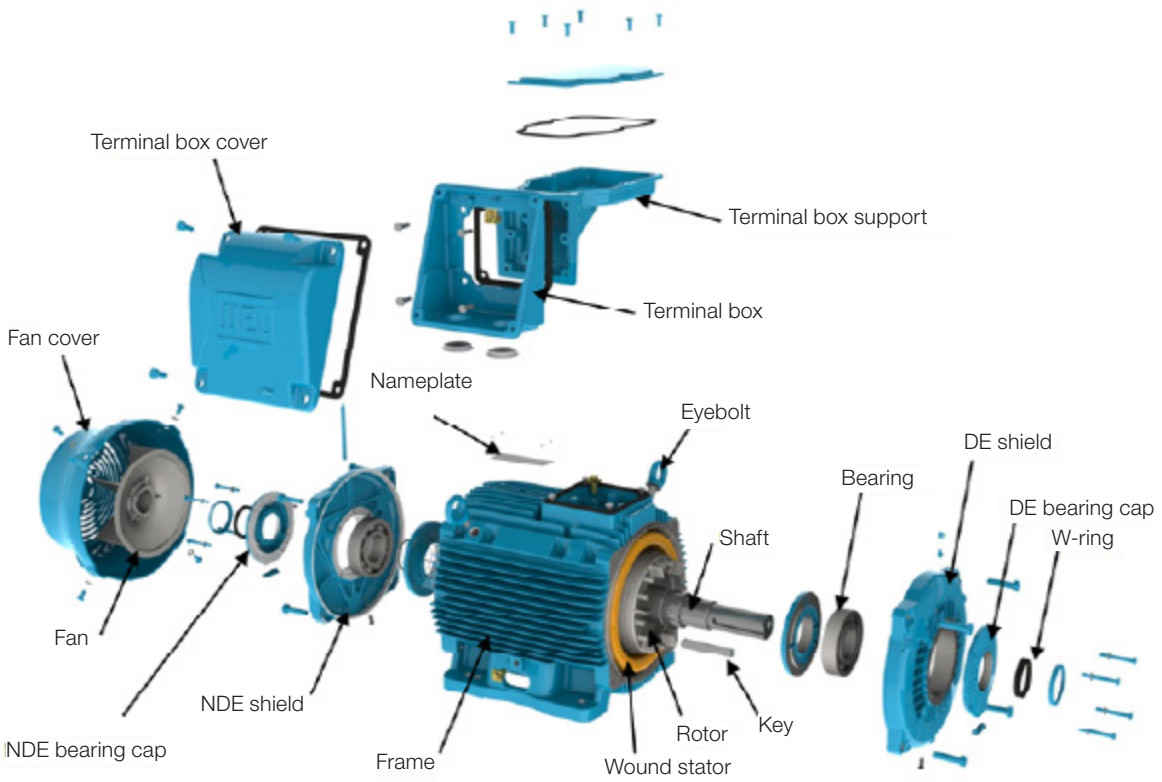


Figure 8.4 *- Exploded view of the components of a W22 motor*

9. ENVIRONMENTAL INFORMATION

9.1. PACKAGING

WEG electric motors are supplied in cardboard, plastic or wooden packaging. These materials can be recycled and must be disposed according to the applicable laws and regulations in each country. All wood used in the packaging of WEG motors come from the company reforestation program and is not submitted to any chemical conservation treatment.

9.2. PRODUCT

Electric motors consist mainly of ferrous metals (steel plates and cast iron), non ferrous metals (copper and aluminum) and plastic materials.

In general, electric motors have relatively long service live. However when they must be discarded, WEG recommends to dismantle the motor, sort the different materials and send them for recycling.

No-recyclable materials should be disposed of at industrial landfills according to the applicable environmental laws and regulations in each country, or co-processed in cement kilns or incinerated.

The recycling service providers, the disposal in industrial landfills, the waste co-processing or the incineration process must be properly authorized by the state environment agency to carry out these activities.

10. TROUBLESHOOTING CHART X SOLUTIONS

This troubleshooting chart provides a basic list of problems that may occur during motor operation, possible causes and recommended corrective actions. In case of doubts, please contact WEG Service Center.

Problem	Possible cause	Corrective action
Motor does not start, neither coupled nor decoupled	Power cables are interrupted	Check the control panel and the motor power supply cables
	Blown fuses	Replace blown fuses
	Wrong motor connection	Correct the motor connection according to connection diagram
	Locked rotor	Check motor shaft to ensure that it rotates freely
The motor starts at no-load, but fails when load is applied. It starts very slowly and does not reach the rated speed	Load toque is too high during start-up	Do not start the motor on load
	Too high voltage drop in the power cables	Check the installation dimensioning (transformer, cable cross section, relays, circuit breakers, etc.)
Abnormal/excessive noise	Defective transmission component or defective driven machine	Check the transmission force, the coupling and the alignment
	Misaligned / unleveled base	Align / level the motor with the driven machine
	Unbalanced components or unbalanced driven machine	Balance the machine set again
	Different balancing methods used for motor and coupling balancing (halve key, full key)	Balance the motor again
	Wrong motor direction of rotation	Reverse the direction of rotation
	Loose bolts	Retighten the bolts
	Foundation resonance	Check the foundation design
	Damaged bearings	Replace the bearings
Motor overheating	Insufficient cooling	Clean air inlet and outlet and cooling fins
		Check the minimum required distance between the fan cover and nearest walls. See item 7
		Check air temperature at inlet
	Overload	Measure motor current, evaluate motor application and if required, reduce the load
	Number of starts per hour is too high or the load inertia moment is too high	Reduce the number of starts per hour
	Power supply voltage too high	Check the motor power supply voltage. Power supply voltage must not exceed the tolerance specified in item 7.2
	Power supply voltage too low	Check the motor power supply voltage and the voltage drop. Power supply voltage must not exceed the tolerance specified in item 7.2
	Interrupted power supply	Check the connection of the power cables
	Voltage unbalance at the motor terminals	Check for blown fuses, wrong commands, voltage unbalance in the power line, phase fault or interrupted power cables
	Direction of rotation is not compatible with the unidirectional fan	Check if the direction of rotation matches the rotation arrow indicated on end shield
Bearing overheating	Excessive grease/oil	Clean the bearing and lubricate it according to the provided recommendations
	Grease/oil aging	
	The used grease/oil does not matches the specified one	
	Lack of grease/oil	Lubricate the bearing according to the provided recommendations
	Excessive axial or radial forces due to the belt tension	Reduce the belt tension
		Reduce the load applied to the motor

NEMA 56 Frame Explosion Proof Motors
TEFC

Standard Features

- Single and Three Phase, 4 pole, 60 Hz
- Voltage:
  - Single Phase 115/208-230V
  - Three Phase 208-230/460 or 575V
- Totally Enclosed Fan Cooled (IP44)
- Die cast aluminum squirrel cage rotor
- Ball bearings
- Overload protection:
  - Single Phase: Automatic Thermostats
  - Three Phase: Thermostats
- 575V rated motors have Spike Resistant WISE wire.
  - Protects against IGBT voltage spikes up to 2200V.
  - Exceeds NEMA MG1 Part 31.4.4.2
- Continuous Duty
- 40°C ambient
- High starting torque
- Service Factor: 1.15
- Insulation class 'B' (Δt 80°C)
- Paint: RAL 7022 (Grey)
- WEG Paint Plan: 207N
- Terminal box included



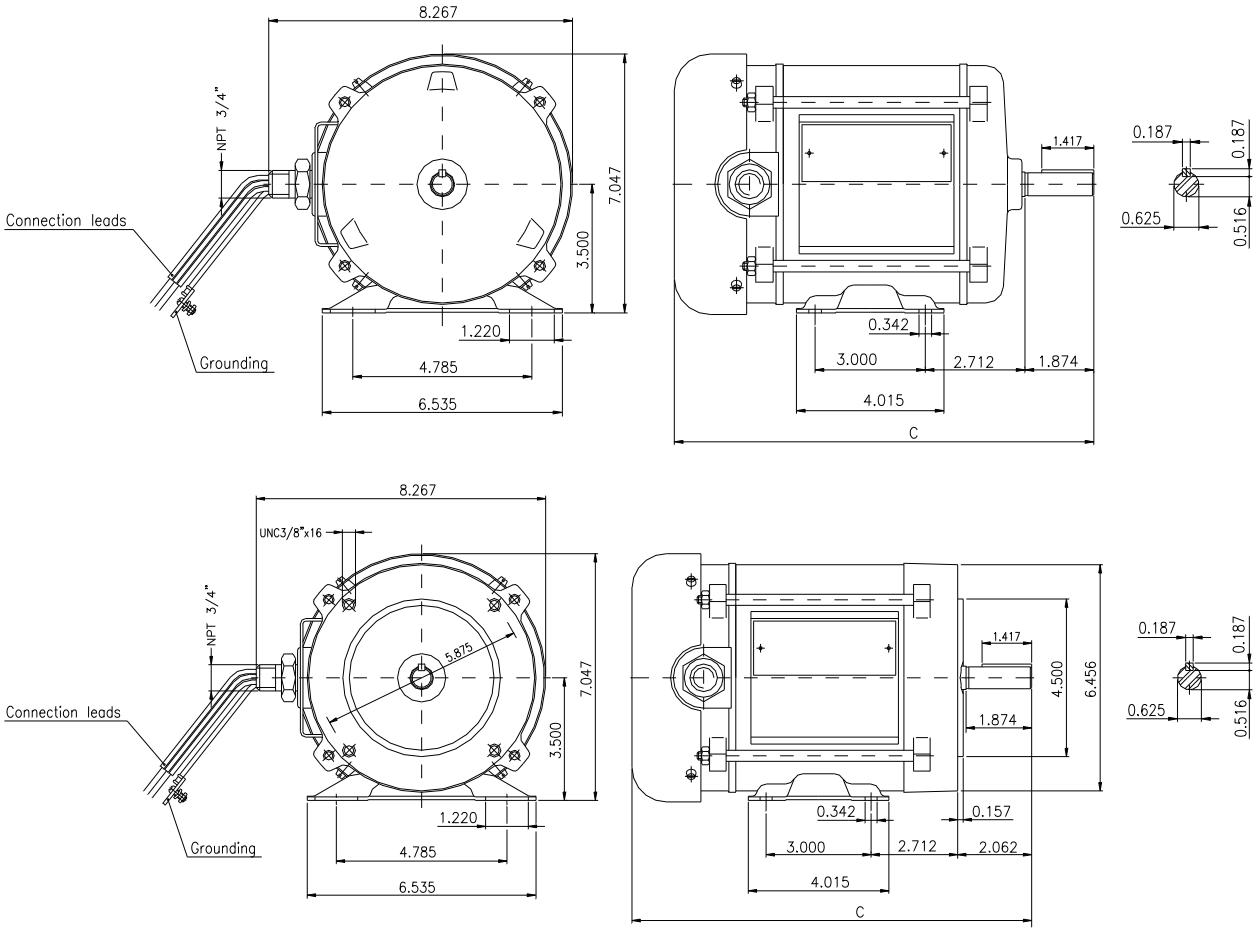
TEMP CODE T3C
Class I, Div 1, Groups C & D
Class II, Div 1, Groups F & G

Optional Features

- C Flange
- Special voltages
- Specially dimensioned shaft
- Second shaft end
- Stainless steel shaft
- Footless
- Other mounting configurations

NEMA 56 Frame Explosion Proof Motors

TEFC - Mechanical Data



NEMA FRAMES	C	BEARINGS	
		D.E	N.D.E.
A56	11.410	6203-ZZ	
B56	12.204		
D56	13.385		

Section 3.1.2

Screen Level Switch

Ktech INDUSTRIAL PRODUCTS INC.

Model FS401 Overfill Protection Device Installation Instructions
Part No.: FS401E-2

CAUTION: REFER TO INSTRUCTIONS BEFORE OPERATING OR SERVICING SWITCH.
Construction: ½" O.D. ss stem, 2" dia. 316 ss float, 2" NPT bushing, explosion proof J-box. Switch set-point distances are measured from the underside of the 2" NPT bushing to the center of the float at the level where the switch is activated. Switch set-point distances are not field adjustable. They are factory-set as specified on the purchase order. The contact arrangement may be changed from normally open (NO) to normally closed (NC) and vice versa. Turn over the float and return the stop collars to their original positions. If the contact arrangement is altered, use an ohmmeter to test that the switch operates correctly. Screw the float switch into the 2" NPT opening on top of the tank. The conductors are colour coded to identify each switch. The switch must be connected in series with a load.

DO NOT CONNECT THE SWITCH DIRECTLY ACROSS THE POWER SUPPLY.
The voltage / current product must not exceed the power rating.

Electrical Specifications

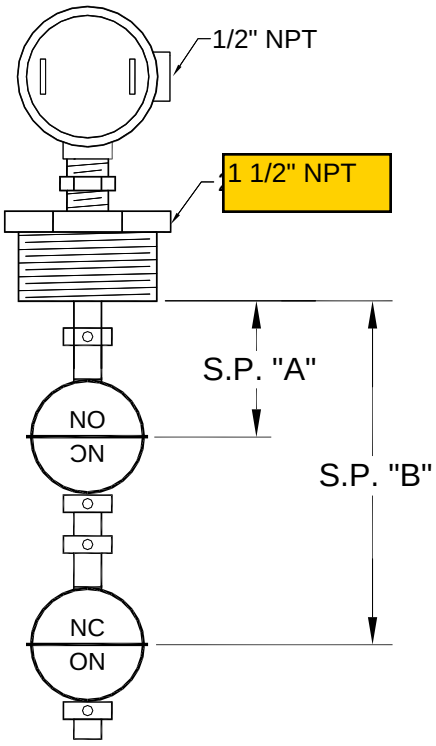
Maximum Switching Voltage Volts DC/AC	120
Maximum Switching Current Amps DC/AC	1.0
Maximum Switching Power Volt/Amps DC/AC	100
Operating Temperature Range	-25˚C to 90˚C -13˚F to 194˚F

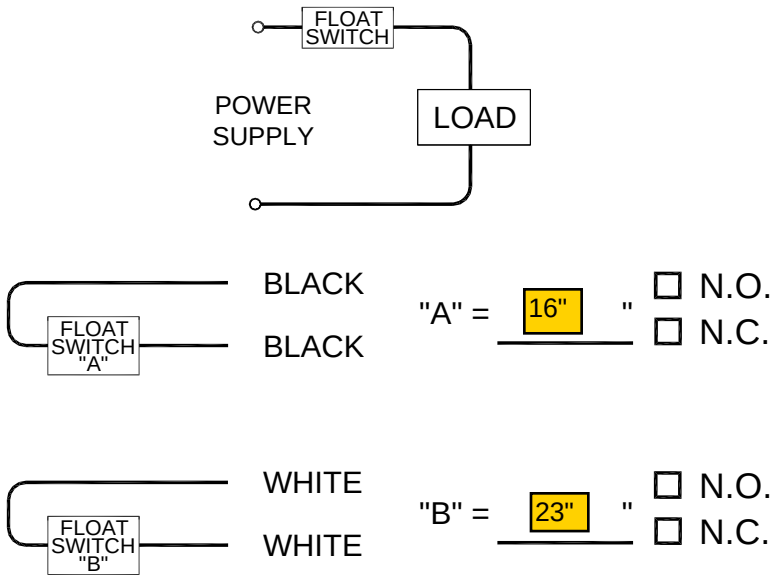
LISTED
OVERFILL
PROTECTION
DEVICES
4YC9

Intertek
9700099

Meets Standards:
Class 1 Division 1, Groups B,C,D
CSA C22.2 No. 1010-1 and ANSI/I SA S82-03
CSA C22.2 No. 30 and UL1203
Factory Sealed

MINIMUM SETPOINT DISTANCE FROM TOP IS 2"
MINIMUM SETPOINT DISTANCE BETWEEN CONTACTS IS 3"
MINIMUM SETPOINT DISTANCE FROM BOTTOM IS 2 1/2"





Ktech INDUSTRIAL PRODUCTS INC.

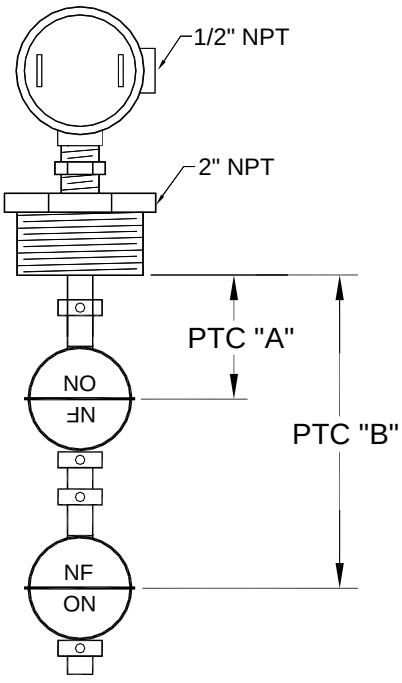
Guide d'installation pour dispositif anti-débordement **Modèle FS401**
No. d'article : FS401E-2

MISE EN GARDE : VEUILLEZ CONSULTER LE MODE D'EMPLOI AVANT D'UTILISER OU D'ENTRETENIR L'INTERRUPTEUR.
CONFIGURATION : Tige de 1/2" (diamètre extérieur) en acier inoxydable, Flotteur de 2" (diamètre) en acier inoxydable 316, Douille 2" NPT, Cuve en J antidéflagrante.
Les distances des points de consigne de l'interrupteur sont mesurées à partir de la face inférieure de la douille 2" NPT jusqu'au centre du flotteur au niveau où l'interrupteur est activé. Les distances des points de consigne de l'interrupteur ne sont pas réglables sur place. Elles sont réglées en usine tel que précisé sur le bon de commande. L'arrangement des contacts peut être modifié de normalement ouvert (NO) à normalement fermé (NF) et vice versa. Retournez le flotteur et remettez les colliers de butée à leurs positions initiales. Si l'arrangement des contacts est modifié, utilisez un ohmmètre pour assurer le bon fonctionnement de l'interrupteur. Vissez l'interrupteur à flotteur dans l'ouverture 2" NPT au sommet du réservoir. Les conducteurs sont chromocodés pour pouvoir identifier chaque interrupteur. Il faut que l'interrupteur soit branché en série avec une charge.

NE BRANCHEZ PAS L'INTERRUPTEUR DIRECTEMENT À TRAVERS L'ALIMENTATION ÉLECTRIQUE.
Le produit de la tension et du courant ne doit pas dépasser la puissance nominale.

Spécifications électriques

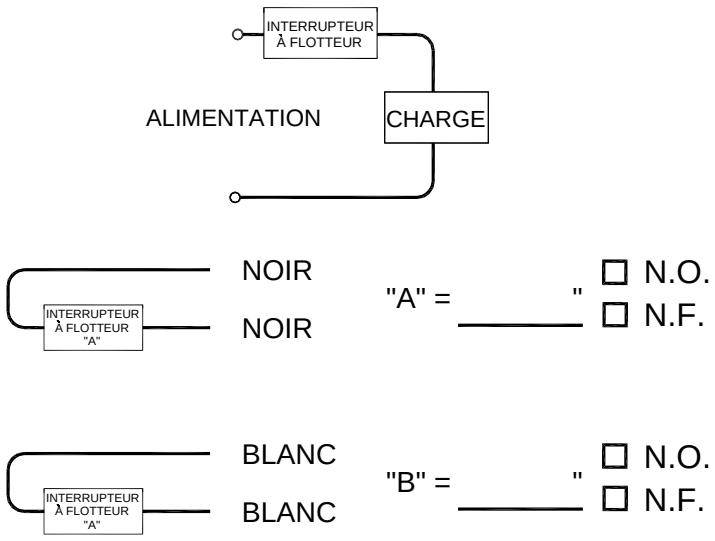
Tension de commutation maximum V CC/CA	120
Courant de commutation maximum A CC/CA	1.0
Puissance de commutation maximum V/A CC/CA	100
Gamme des temperature de fonctionnement	-25°C a 90°C -13°F a 194°F



Dispositifs anti-débordement enregistrés 4YC9

Conforme aux normes:
Classe 1, Division 1, Groupes B, C et D
CSA C22.2 No. 1010-1 et ANSI/I SA S82-03
CSA C22.2 No. 30 et UL1203
Scellé en usine

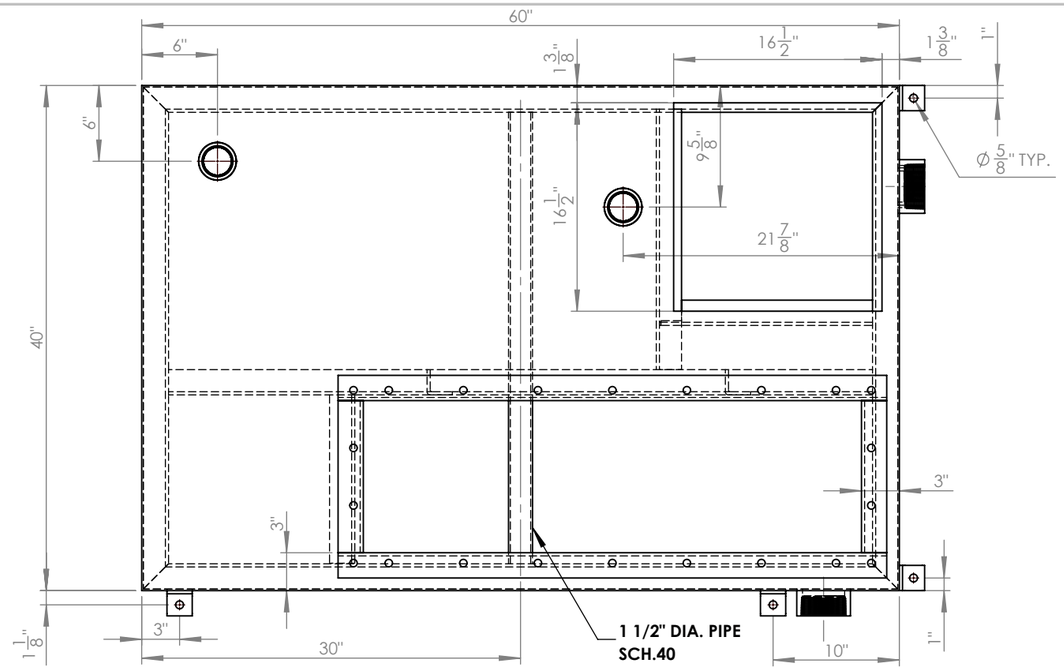
La distance min. du point de consigne mesurée à partir du sommet est de 2"
La distance min. du point de consigne entre les contacts est de 3"
La distance min. du point de consigne mesurée à partir du la face inférieure est de 2 1/2"



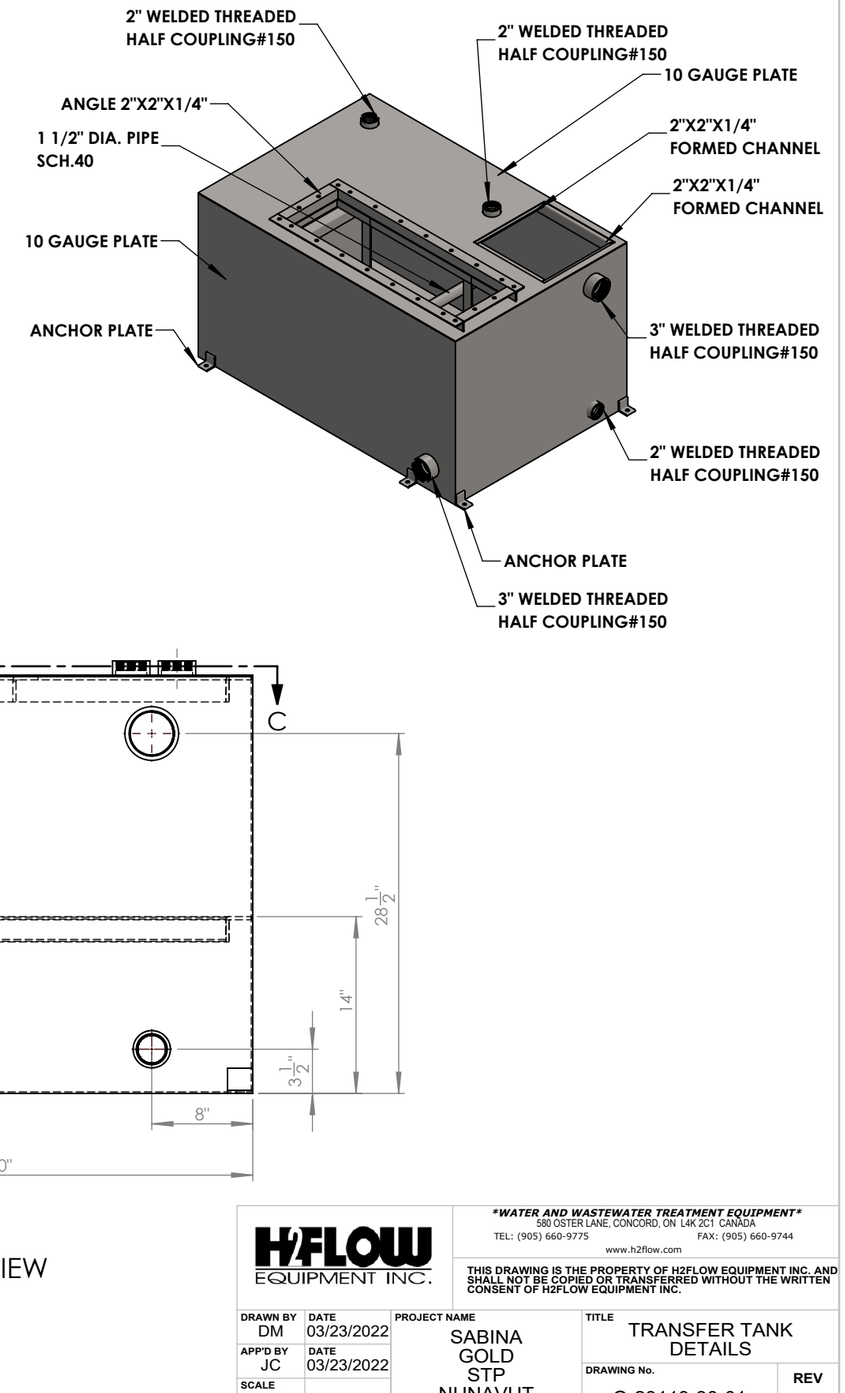
Section 3.1.3

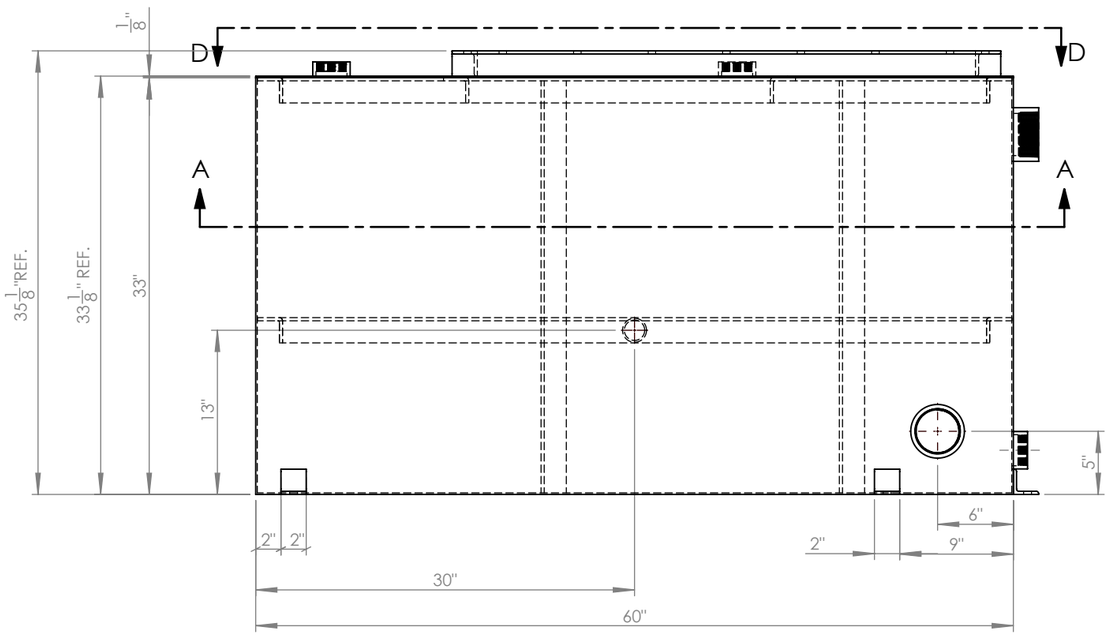
Transfer Tank

REV	DESCRIPTION	DATE	BY	APP'D
0	FOR FABRICATION	03/23/2022	DM	JC

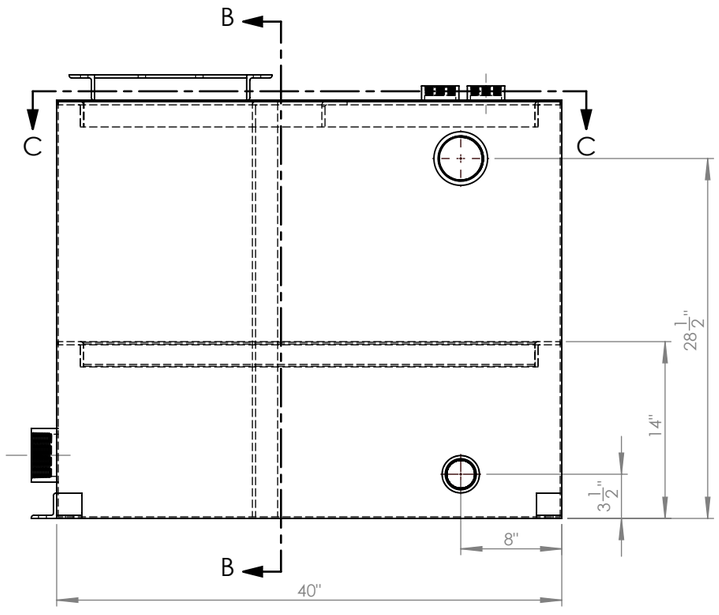


TOP VIEW





FRONT VIEW



RIGHT VIEW

NOTES:

1. **QTY: 1 UNIT**
2. **MATERIAL: SS 304, GAUGE 10-TANK WALL,**
3. **ALL DIMENSIONS ARE EDGE TO EDGE UNLESS OTHERWISE NOTED**
4. **TOLERANCES: ANGULAR MACH. ±1°, BEND ± 1°, DECIMAL ±0.5mm OR ±1/64"**

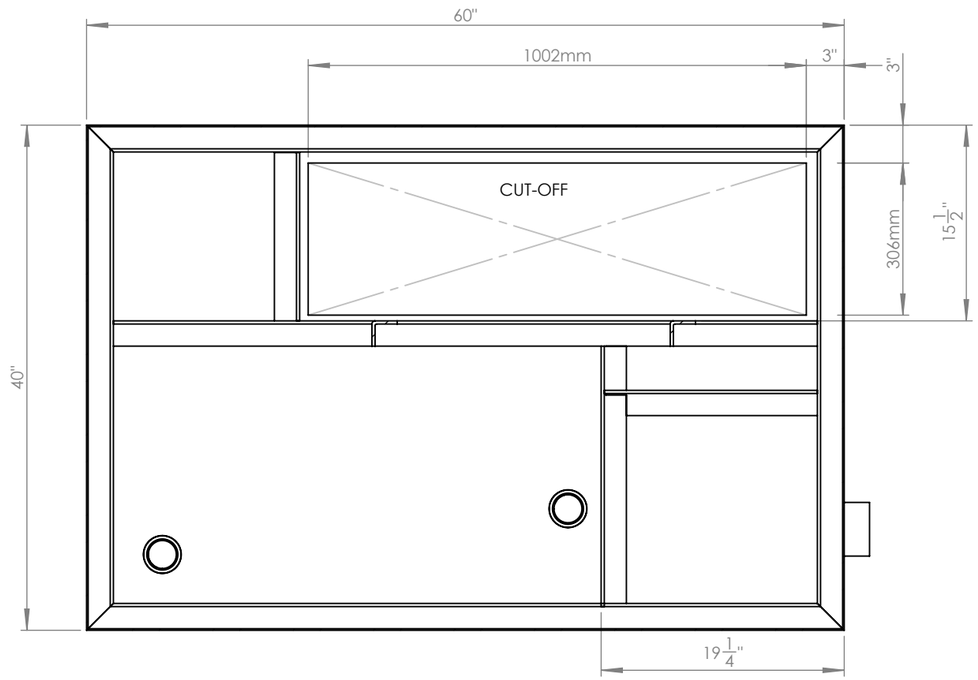
H2FLOW EQUIPMENT INC.

WATER AND WASTEWATER TREATMENT EQUIPMENT
580 OSTER LANE, CONCORD, ON L4K 2C1 CANADA
TEL: (905) 660-9775 FAX: (905) 660-9744
www.h2flow.com

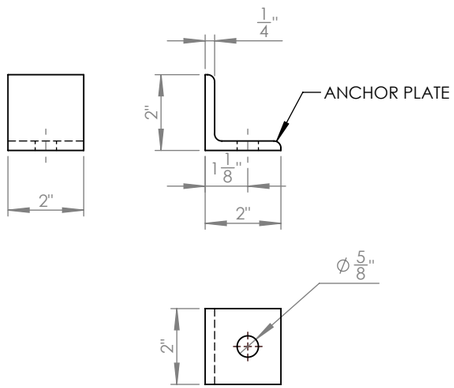
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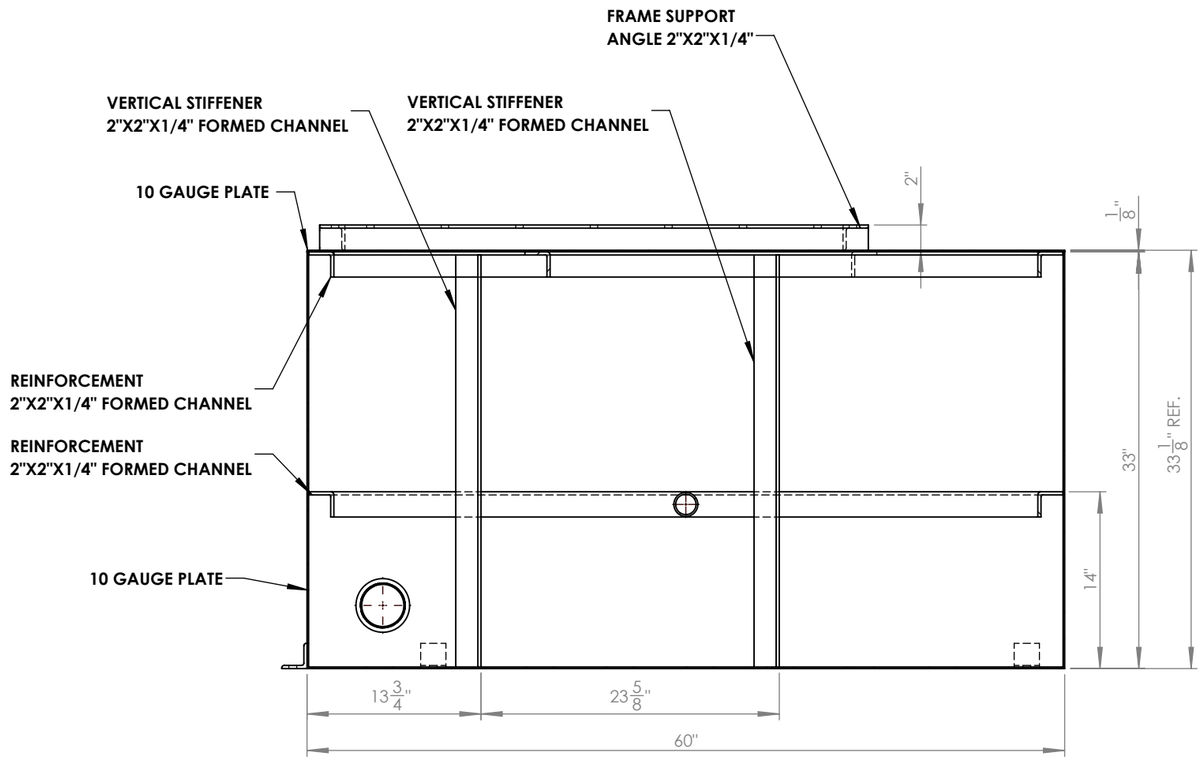
DRAWN BY: DM	DATE: 03/23/2022	PROJECT NAME: SABINA GOLD STP NUNAVUT	TITLE: TRANSFER TANK DETAILS
APP'D BY: JC	DATE: 03/23/2022		DRAWING No.: Q-23119-30-01
SCALE: NTS			REV: 0
		ALL DIMENSION ARE IN INCHES UNLESS OTHERWISE SPECIFIED	SHEET 1 OF 5

REV	DESCRIPTION	DATE	BY	APP'D
0	FOR FABRICATION	03/23/2022	DM	JC



SECTION A-A
SCALE 1 : 12





SECTION B-B
SCALE 1 : 12

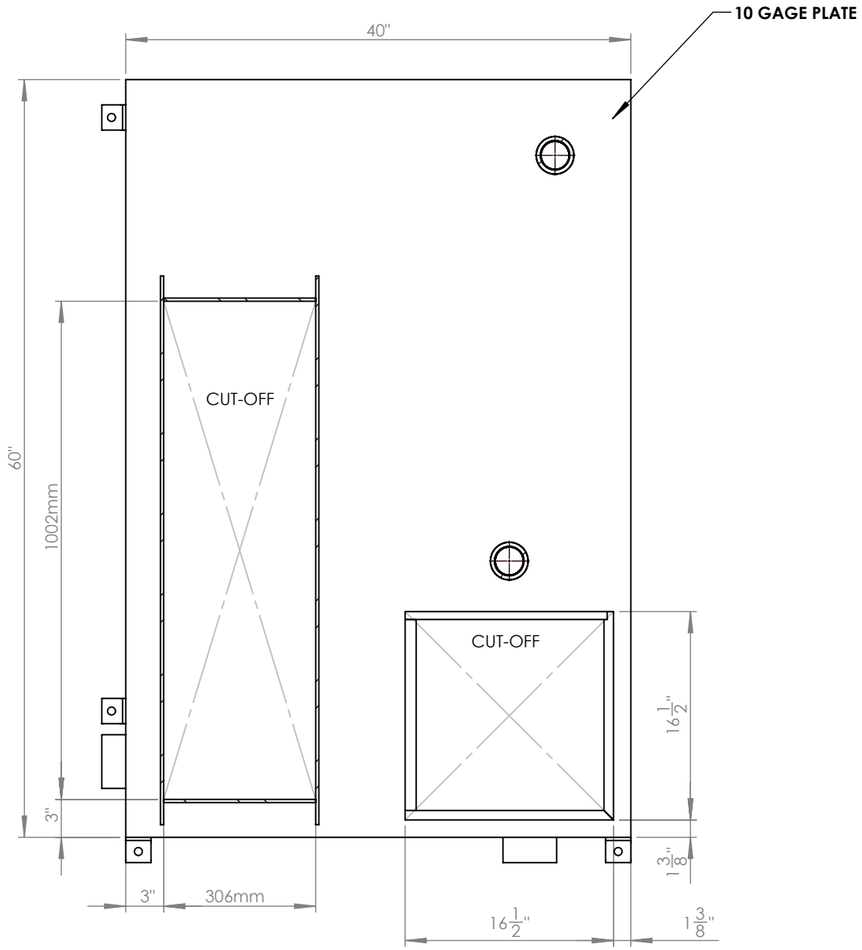
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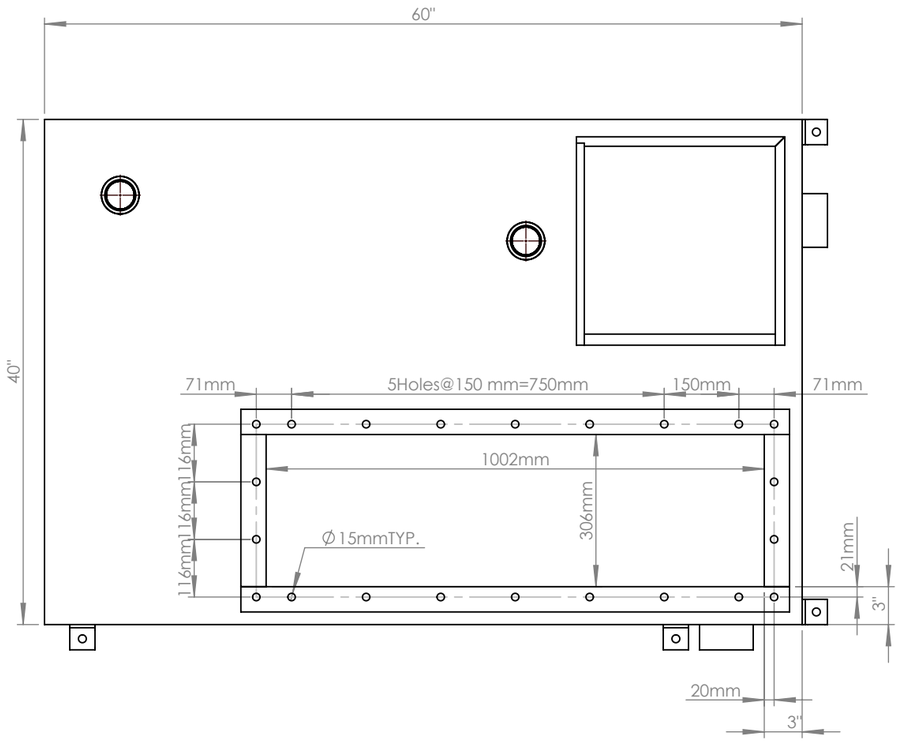
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DRAWN BY: DM	DATE: 03/23/2022	PROJECT NAME: SABINA GOLD STP NUNAVUT	TITLE: TRANSFER TANK DETAILS
APP'D BY: JC	DATE: 03/23/2022		DRAWING No.: Q-23119-30-01
SCALE: NTS		ALL DIMENSION ARE IN INCHES UNLESS OTHERWISE SPECIFIED	REV: 0
			SHEET 2 OF 5

REV	DESCRIPTION	DATE	BY	APP'D
0	FOR FABRICATION	03/23/2022	DM	JC



SECTION C-C
SCALE 1 : 12



SECTION D-D
SCALE 1 : 12
NOTE;IN SECTION D-D FOR PRECISION DIMENSIONS BETWEEN HOLES ARE IN ,,mm"

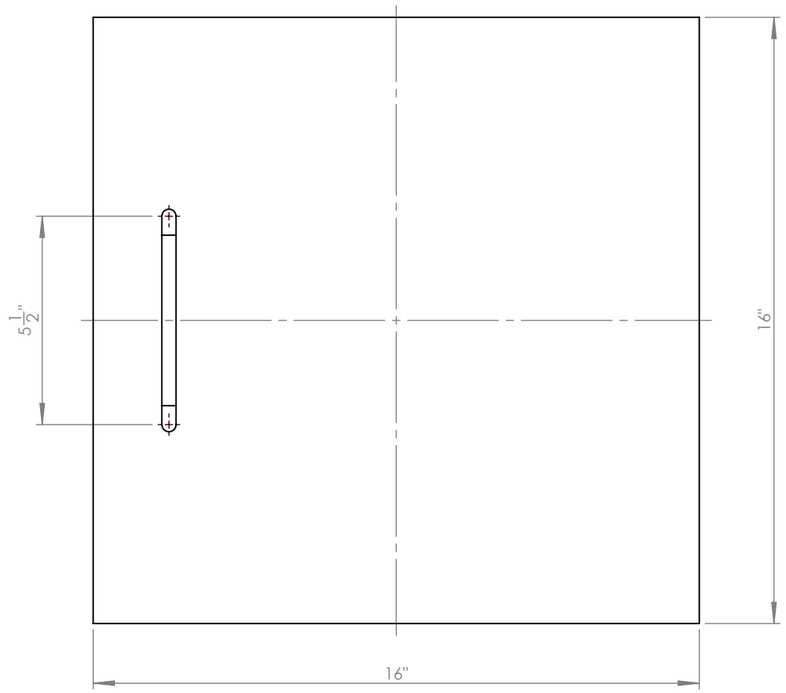
H2FLOW EQUIPMENT INC.

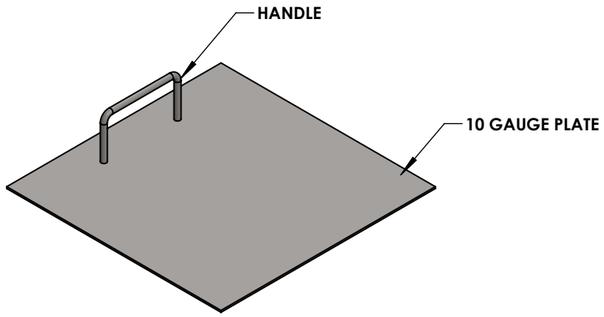
WATER AND WASTEWATER TREATMENT EQUIPMENT
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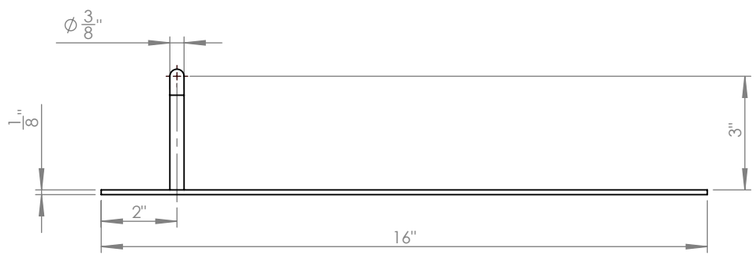
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DRAWN BY: DM	DATE: 03/23/2022	PROJECT NAME: SABINA GOLD STP NUNAVUT	TITLE: TRANSFER TANK DETAILS
APP'D BY: JC	DATE: 03/23/2022		DRAWING No.: Q-23119-30-01
SCALE: NTS		ALL DIMENSION ARE IN INCHES UNLESS OTHERWISE SPECIFIED	REV: 0
			SHEET 3 OF 5

REV	DESCRIPTION	DATE	BY	APP'D
0	FOR FABRICATION	03/23/2022	DM	JC







NOTES:

1. **QTY: 1 UNIT**
2. **MATERIAL: SS 304, GAUGE 10-TANK WALL,**
3. **ALL DIMENSIONS ARE EDGE TO EDGE UNLESS OTHERWISE NOTED**
4. **TOLERANCES: ANGULAR MACH. ±1°, BEND ± 1°, DECIMAL ±0.5mm OR ±1/64"**

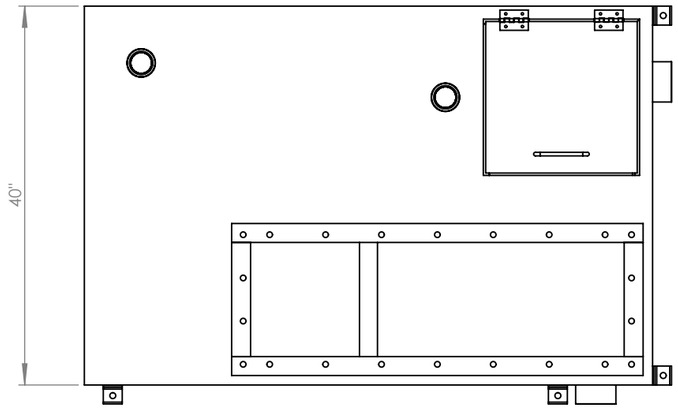
H2FLOW EQUIPMENT INC.

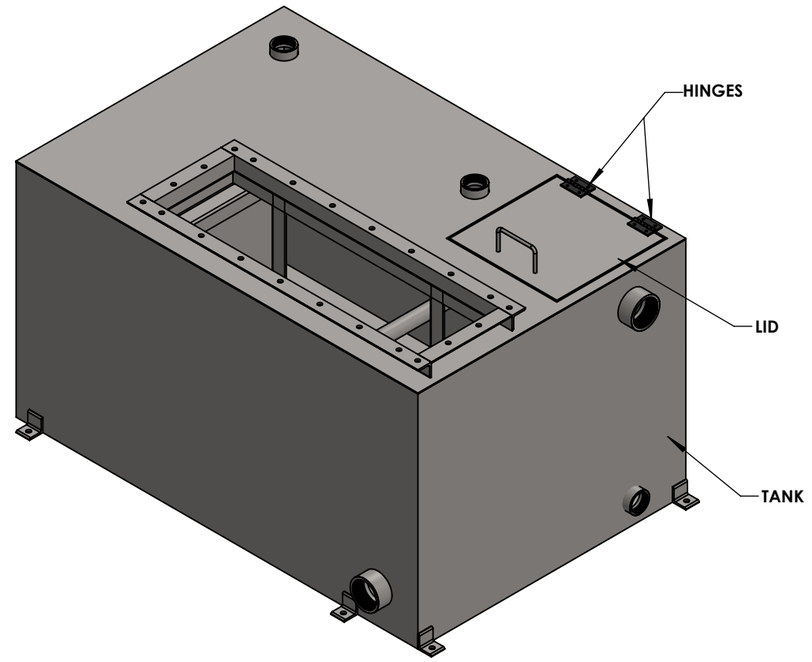
WATER AND WASTEWATER TREATMENT EQUIPMENT
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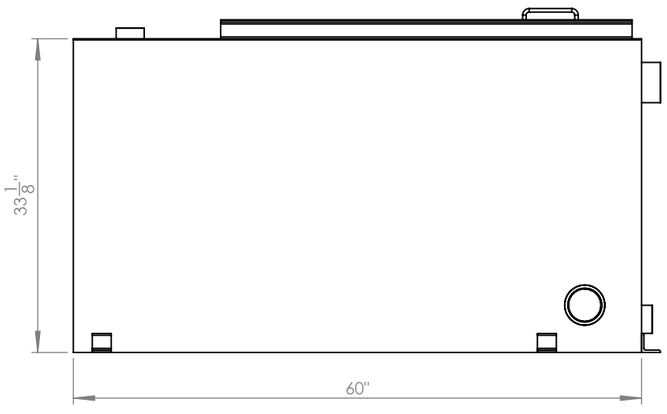
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DRAWN BY: DM	DATE: 03/23/2022	PROJECT NAME: SABINA GOLD STP NUNAVUT	TITLE: HATCH LID DETAILS
APP'D BY: JC	DATE: 03/23/2022		DRAWING No.: Q-23119-30-01
SCALE: NTS			REV: 0
		ALL DIMENSION ARE IN INCHES UNLESS OTHERWISE SPECIFIED	SHEET 4 OF 5

REV	DESCRIPTION	DATE	BY	APP'D
0	FOR FABRICATION	03/23/2022	DM	JC







H2FLOW EQUIPMENT INC.

WATER AND WASTEWATER TREATMENT EQUIPMENT
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DRAWN BY: DM	DATE: 03/23/2022	PROJECT NAME: SABINA GOLD STP NUNAVUT	TITLE: TRANSFER TANK ASSEMBLY
APP'D BY: JC	DATE: 03/23/2022		DRAWING No.: Q-23119-30-01
SCALE: NTS			REV: 0
		ALL DIMENSION ARE IN INCHES UNLESS OTHERWISE SPECIFIED	SHEET 5 OF 5

Section 3.1.4

Transfer Tank Level Float

Ktech INDUSTRIAL PRODUCTS INC.

Model FS401 Overfill Protection Device Installation Instructions
Part No.: FS401E-4

CAUTION: REFER TO INSTRUCTIONS BEFORE OPERATING OR SERVICING SWITCH.
Construction: ½" O.D. ss stem, 2" dia. 316 ss float, 2" NPT bushing, explosion proof J-box. Switch set-point distances are measured from the underside of the 2" NPT bushing to the center of the float at the level where the switch is activated. Switch set-point distances are not field adjustable. They are factory-set as specified on the purchase order. The contact arrangement may be changed from normally open (NO) to normally closed (NC) and vice versa. Turn over the float and return the stop collars to their original positions. If the contact arrangement is altered, use an ohmmeter to test that the switch operates correctly. Screw the float switch into the 2" NPT opening on top of the tank. The conductors are colour coded to identify each switch. The switch must be connected in series with a load.

DO NOT CONNECT THE SWITCH DIRECTLY ACROSS THE POWER SUPPLY.
The voltage / current product must not exceed the power rating.

Electrical Specifications

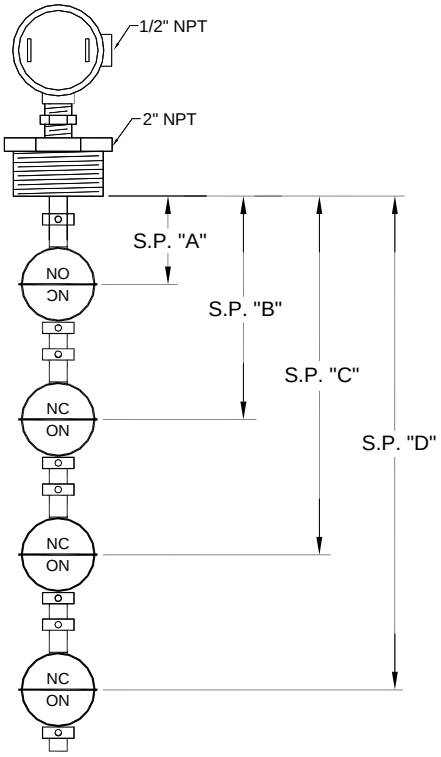
Maximum Switching Voltage Volts DC/AC	120
Maximum Switching Current Amps DC/AC	1.0
Maximum Switching Power Volt/Amps DC/AC	100
Operating Temperature Range	-25˚C to 90˚C -13˚F to 194˚F

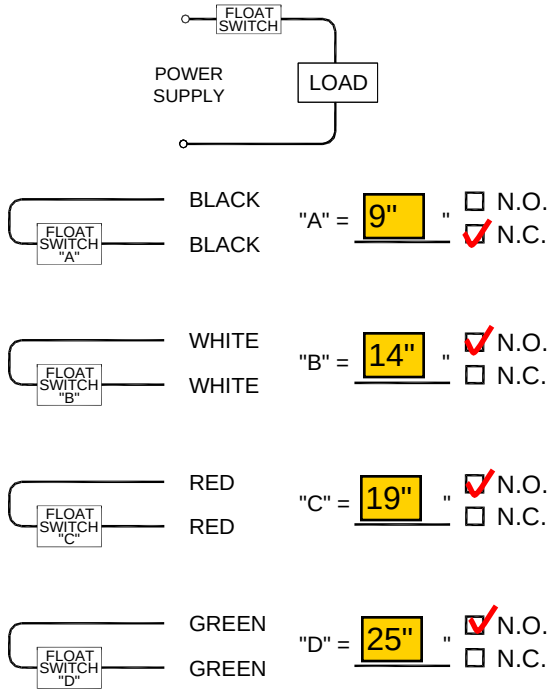
LISTED
OVERFILL
PROTECTION
DEVICES
4YC9

Intertek
9700099

Meets Standards:
Class 1 Division 1, Groups B,C,D
CSA C22.2 No. 1010-1 and ANSI/I SA S82-03
CSA C22.2 No. 30 and UL1203
Factory Sealed

MINIMUM SETPOINT DISTANCE FROM TOP IS 2"
MINIMUM SETPOINT DISTANCE BETWEEN CONTACTS IS 3"
MINIMUM SETPOINT DISTANCE FROM BOTTOM IS 2 1/2"





Ktech INDUSTRIAL PRODUCTS INC.

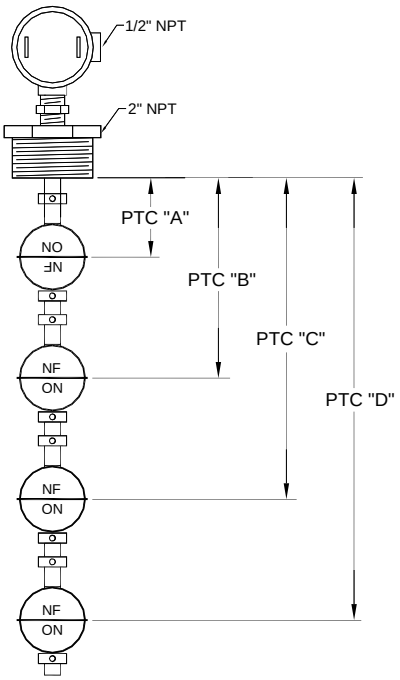
Guide d'installation pour dispositif anti-débordement **Modèle FS401**
No. d'article : FS401E-4

MISE EN GARDE : VEUILLEZ CONSULTER LE MODE D'EMPLOI AVANT D'UTILISER OU D'ENTRETENIR L'INTERRUPTEUR.
CONFIGURATION : Tige de 1/2" (diamètre extérieur) en acier inoxydable, Flotteur de 2" (diamètre) en acier inoxydable 316, Douille 2" NPT, Cuve en J antidéflagrante.
Les distances des points de consigne de l'interrupteur sont mesurées à partir de la face inférieure de la douille 2" NPT jusqu'au centre du flotteur au niveau où l'interrupteur est activé. Les distances des points de consigne de l'interrupteur ne sont pas réglables sur place. Elles sont réglées en usine tel que précisé sur le bon de commande. L'arrangement des contacts peut être modifié de normalement ouvert (NO) à normalement fermé (NF) et vice versa. Retournez le flotteur et remettez les colliers de butée à leurs positions initiales. Si l'arrangement des contacts est modifié, utilisez un ohmmètre pour assurer le bon fonctionnement de l'interrupteur. Vissez l'interrupteur à flotteur dans l'ouverture 2" NPT au sommet du réservoir. Les conducteurs sont chromocodés pour pouvoir identifier chaque interrupteur. Il faut que l'interrupteur soit branché en série avec une charge.

NE BRANCHEZ PAS L'INTERRUPTEUR DIRECTEMENT À TRAVERS L'ALIMENTATION ÉLECTRIQUE.
Le produit de la tension et du courant ne doit pas dépasser la puissance nominale.

Spécifications électriques

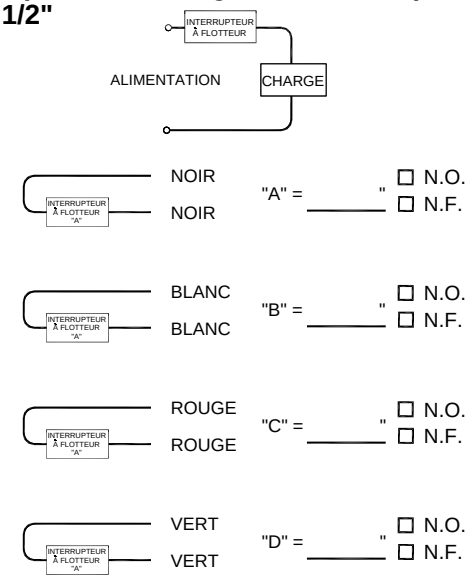
Tension de commutation maximum V CC/CA	120
Courant de commutation maximum A CC/CA	1.0
Puissance de commutation maximum V/A CC/CA	100
Gamme des temperature de fonctionnement	-25°C a 90°C -13°F a 194°F



Dispositifs anti-débordement enregistrés 4YC9

Conforme aux normes:
Classe 1, Division 1, Groupes B, C et D
CSA C22.2 No. 1010-1 et ANSI/I SA S82-03
CSA C22.2 No. 30 et UL1203
Scellé en usine

La distance min. du point de consigne mesurée à partir du sommet est de 2"
La distance min. du point de consigne entre les contacts est de 3"
La distance min. du point de consigne mesurée à partir du la face inférieure est de 2 1/2"



Section 3.2

Wastewater Equalization

Section 3.2.1

EQ Feed Pumps

Pump Data Sheet - Vertiflo

Company: ProSpec Technologies
Name: Dipen Parmar
Date: 04/07/2022

Pump:

Size:	2x1.5x6	Dimensions:	
Type:	1312	Suction:	2 in
Synch Speed:	1800 rpm	Discharge:	1.5 in
Dia:	5.5625 in		
Curve:	1312		

Fluid:

Name:	Water		
SG:	1	Vapor Pressure:	0.256 psi a
Density:	62.4 lb/ft³	Atm Pressure:	14.7 psi a
Viscosity:	1.1 cP		
Temperature:	60 °F	Margin Ratio:	1

Search Criteria:

Flow:	88 US gpm	Near Miss:	---
Head:	20 ft	Static Head:	0 ft

Pump Limits:

Temperature:	---	Sphere Size:	---
Wkg Pressure:	---		

Motor:

Standard:	NEMA	Size:	1 hp
Enclosure:	TEFC	Speed:	1800 rpm
Frame:	143T		
Sizing Criteria:	Max Power on Design Curve		

Pump Selection Warnings:

None

--- Duty Point ---

Flow:	88.7 US gpm
Head:	20.3 ft
Eff:	59.9%
Power:	0.76 hp
NPSHr:	---
Speed:	1750 rpm

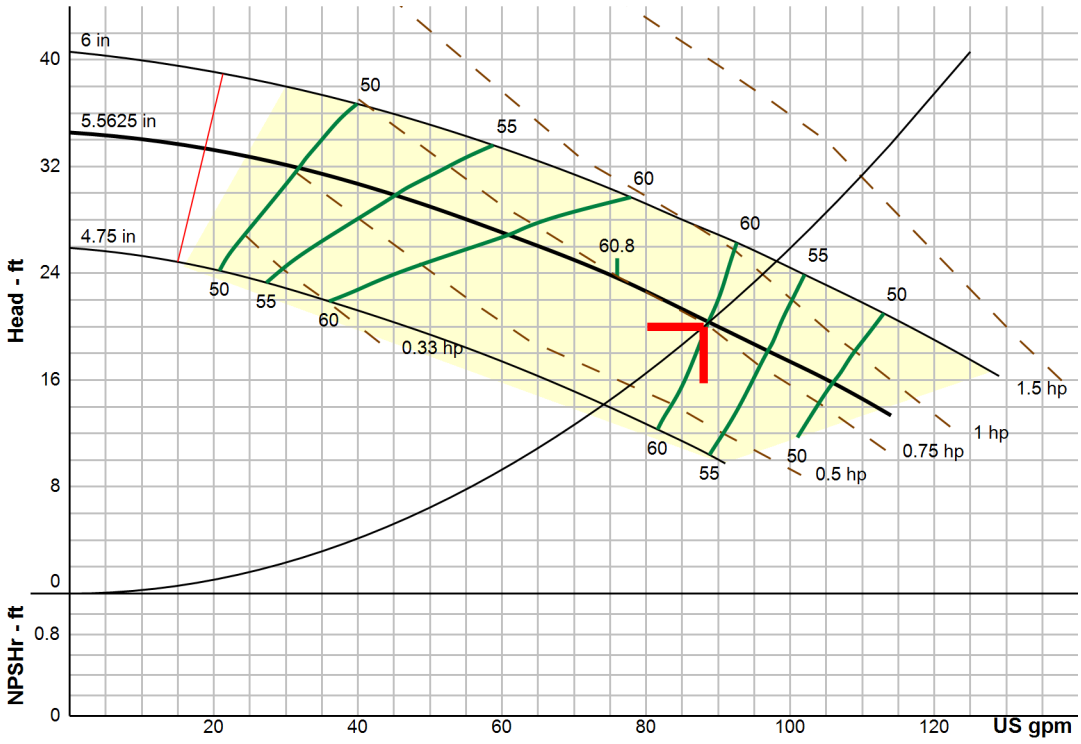
--- Design Curve ---

Shutoff Head:	34.6 ft
Shutoff dP:	15 psi
Min Flow:	19 US gpm

BEP: 60.8% @ 76 US gpm
NOL Power:
0.884 hp @ 114 US gpm

--- Max Curve ---

Max Power:
1.33 hp @ 129 US gpm

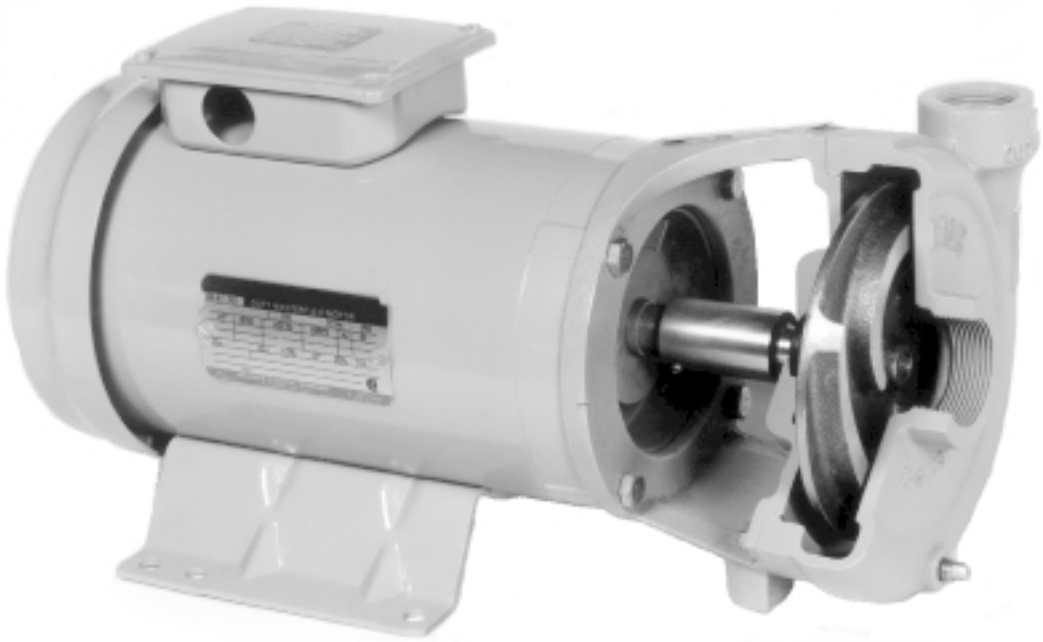


Keep max GPM in printed range of pump GPM/TDH & not to extreme right. Consider NPSHR & temp. Min flow = > 25% of flow at best eff.

Performance Evaluation:

Flow	Speed	Head	Efficiency	Power	NPSHr
US gpm	rpm	ft	%	hp	ft
106	1750	15.8	50	0.845	---
88	1750	20.5	60	0.759	---
70.4	1750	24.8	61	0.725	---
52.8	1750	28.4	57	0.653	---
35.2	1750	31.4	51	0.54	---

VERTIFLO SERIES 1300, MODEL 1312
Quality Design Features Assure Long, Trouble-Free Service



WIDE RANGE OF APPLICATIONS:

- General Pumping
- Process
- Chemicals
- Deionized Water
- Wash Systems
- OEM

CAPABILITIES:

- Capacities to 240 GPM
- Heads To 160 Feet TDH
- 1750 and 3500 RPM

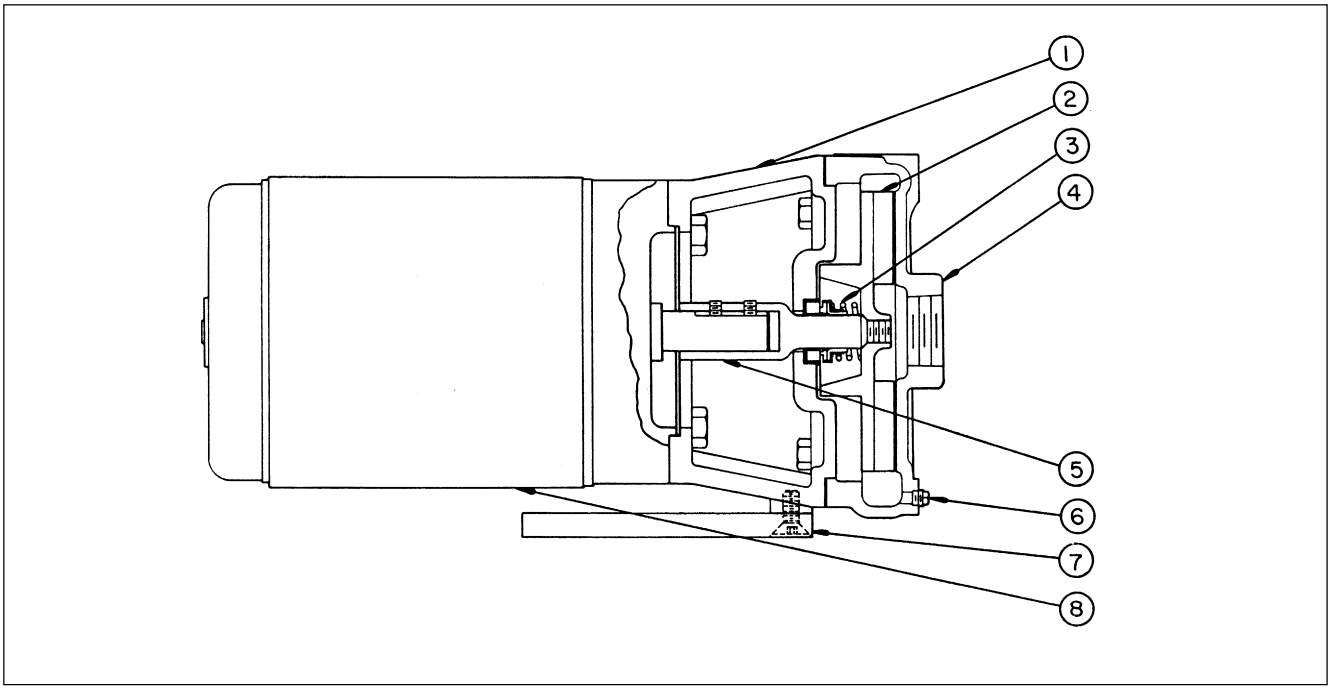
CONSTRUCTION:

- All Iron
- Bronze Fitted
- 316 Stainless Steel Fitted
- All 316 Stainless Steel

FEATURES:

- Close-Coupled Design Saves Installation Space
- Back Pull-Out Design
- Standard NEMA C-Face Motor
- Standard Size Mechanical Seal
- Pump Volute, Impeller and Mounting Bracket are Heavy Cast Metal
- Semi-Open Impeller
- Threaded NPT Suction and Discharge Connections

Model 1312 horizontal motor-mounted end suction pumps are designed for use with NEMA standard C-face electric motors. This rugged and dependable pump will provide many years of dependable service.



CUSTOMER Benefits

1. Motor Support and Seal Housing
one-piece casting

•Assures positive alignment of motor and pump with registered fits

2. Impeller
semi-open design with balance hub. Secured to shaft by taper and threads.

• High quality - smooth performance
• Easily removed

3. Mechanical Seal
Self-aligning design

• No adjustment required

4. Casing
Back pull-out design. Discharge orientation options.

• Rotating element easily removed - casing remains in piping
• Casing may be rotated in 90° increments to accommodate various piping requirements

5. Shaft
316 stainless steel material. Standard with taper and threads.

• Long lasting and replacable

6. Support Foot Adaptor (optional)

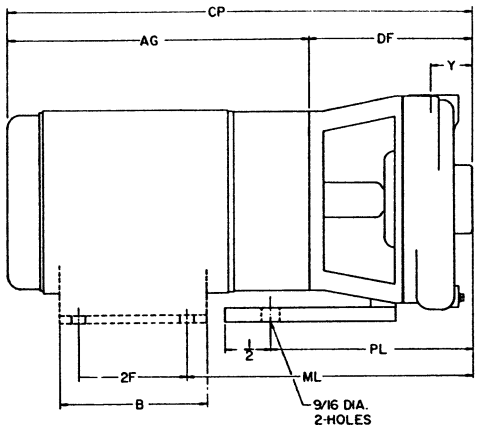
• Bolt-on type design for versatility

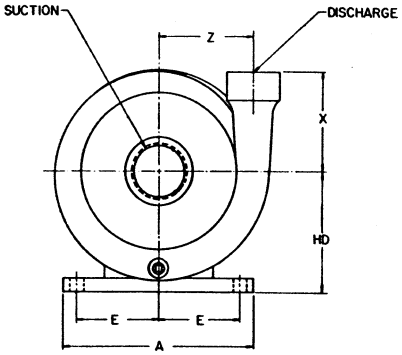
7. C-Face Motor
Standard

• Readily available

VERTIFLO PUMP COMPANY Dimensions

1300 Series / Model 1312





Size 1½ x 1 x 6

RPM	HP	PUMP FOOT	SUC	DIS	A	AG	B	CP	E	2F	DF	H*	HD	ML	PL	X	Y	Z
1750	⅓	NOT REQ'D	1½" NPT	1" NPT	6.50	9.29	4.25	15.17	2.44	3.00	5.88	NA	4.38	8.75	5.50	3.75	1.25	3.50
	½																	
	¾																	
	1					9.94		15.82										
3500	1					9.29		15.19										
	1½					10.29		16.17										
	2					11.06	5.94	16.94	2.75	5.00		.44	4.50					
	3					12.07		17.82										
	5					13.68	6.50	19.56	3.75	5.50								

Dimensions are for TEFC motors only
**Optional pump foot shown for motors less feet*

Size 2 x 1½ x 6

RPM	HP	PUMP FOOT	SUC	DIS	A	AG	B	CP	E	2F	DF	H*	HD	ML	PL	X	Y	Z
1750	½	NOT REQ'D	2" NPT	1½" NPT	6.50	9.29	4.25	15.67	2.44	3.00	6.38	NA	4.38	9.25	6.00	3.88	1.63	3.63
	¾																	
	1					9.94		16.32										
	1½					10.19		16.57										
3500	1½					10.29		16.67										
	2					11.06	5.94	17.44	2.75	5.00		.44	4.50					
	3					12.07		18.32										
	5				8.63	13.68	6.50	20.06	3.75	5.50								
	7½					15.18		21.56										

Dimensions are for TEFC motors only. NA= not applicable
**Optional pump foot shown for motors less feet*

Not for construction unless certified, some dimensions may vary ± 1/2". Pump Construction:_____

CUSTOMER_____CUSTOMER NO._____
PROJECT_____SERIAL NO._____
ENGINEER_____LOCATION_____
CONTRACTOR_____

PUMP DATA	Model	Size	Curve No.	GPM	Head	SP. GR.@Temp.
	_____	_____	_____	_____	_____	_____

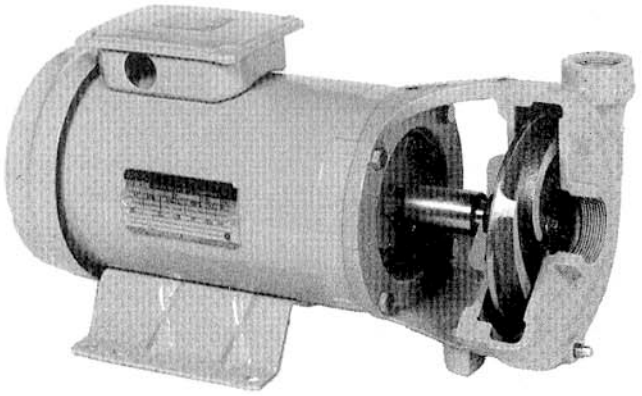
MOTOR DATA	Mfgr.	HP	RPM	Volt-Phase-Cycle	Frame	ENC.	Furnished by	Mounted by
	_____	_____	_____	_____	_____	_____	_____	_____

Shop Order_____Certified by_____Date_____

VERTIFLO

Installation, Operation & Service Instructions

MODEL 1312 - Horizontal Motor Pumps



I. Installation Instructions

Vertiflo Model 1312 Horizontal Motor-Mounted Pumps are completely assembled and carefully adjusted before shipment.

A. Carefully set pump at the required location. Check for full contact of the motor base to the foundation.

B. Secure pump to the foundation by bolting, etc.; whatever is convenient or required for the installer.

C. Connect the system piping to the pump casing (1). A check valve and gate valve should be installed in the discharge piping and a gate valve in the suction piping. An elbow in the suction piping should not be closer to the pump than the equivalent of 5 times the suction pipe diameter.

NOTE: ALL PIPING IS TO BE SUPPORTED INDEPENDENT OF THE PUMP. NO PIPING STRAIN IS TO BE IMPOSED ON THE PUMP.

D. Connect power lines to motor leads as shown on the wiring diagram of the motor for specific line voltage used.

FOLLOW ALL STATE AND LOCAL WIRING CODES.

Check and be sure starter and overload protection is proper for specific voltage and amperage rating.

Check for free rotation by turning shaft (3) by hand. Binding in the pump can be caused by either piping strain or the impeller (2) is out of adjustment. Make necessary piping correction or impeller adjustment. (See paragraph V.)

G. Jog motor quickly to check for proper rotation. Shaft rotation should be clockwise when looking from the motor end. A rotation arrow is also on the pump case. If rotation is incorrect, contact a qualified electrician to make necessary corrections.

H. Open suction gate valve. Close discharge gate valve and start pump. Open discharge line gate valve slowly until desired capacity is obtained. Pump should now operate smoothly. If vibration occurs, check for pipe stress or incorrect impeller adjustment.

II. Disassembly and Inspection

NOTE: BEFORE DISASSEMBLY, MATCH MARK PARTS FOR EASE IN REASSEMBLY.

A. Turn off electrical supply to the MOTOR and all CONTROLS. Close suction and discharge valves. Remove drain plug(1 C) for pump casing and drain pump.

B. Remove the hold-down bolts in motor or adaptor foot.

C. Remove the four capscrews (1B) holding the motor I adaptor (4) to casing (1).

D. Pull motor and rotating assembly backwards leaving the casing connected to the piping.

E. Remove case gasket(1 A).

F. To remove impeller (2), hold stub shaft (3) tightly and unscrew impeller. (Standard right-hand thread)

BE CAREFUL AS SEAL SPRING WILL HAVE A TENDENCY TO PUSH IMPELLER QUICKLY OFF WHEN IMPELLER BECOMES FREE FROM THE SHAFT.

G. Carefully remove the spring, retainer and rotating seal head from the stub shaft (3). I nspect the stub shaft at the seal area and thread area for any unusual wean-Replace if necessary.

III. Unit Assembly

A. Thread dog point set screw (3B) into center hole of stub shaft (3) allowing about 1/8 ' protrusion inside I.D. bore.

B. Slide stub shaft (3) with protruding dog point set screw, over the motor shaft, aligning the set screw (3B) with the I motor shaft keyway. The stub shaft should SLIDE EASILY ON THE MOTOR SHAFT.

C. Thread two cup point set screws (3A) into the stub shaft (3), but do not tighten.

D. When using the large motor adaptor (6) (frame 182TC and larger) fasted adaptor (4) by bolting with the socket head capscrews (6C) hex nuts (6E), and lockwashers (6D).

E. When using Foot Kit (7), attach to small motor adaptor (4) with flat head socket head capscrews (7A).

IV. Mechanical Seal Installation

A. Lubricate the stationary seal cup (5) with a suitable lubricant and press into motor adaptor (4) until contact is made with the back of the seal bore

BE CAREFUL NOT TO GET ANY LUBRICANT ON THE SEAL FACE

B. Slide motor adaptor (4) over stub shaft (3).

BE CAREFUL NOT TO DAMAGE SEAL STATIONARY

Fasten to motor with capscrews (4A) or (6A).

C. Lubricate seal head elastomer (5) where it contacts the shaft.

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BE CAREFUL NOT TO GET ANY LUBRICANT ON THE SEAL FACE

Slide seal head over stub shaft (3) until contact is made with the stationary seal face.

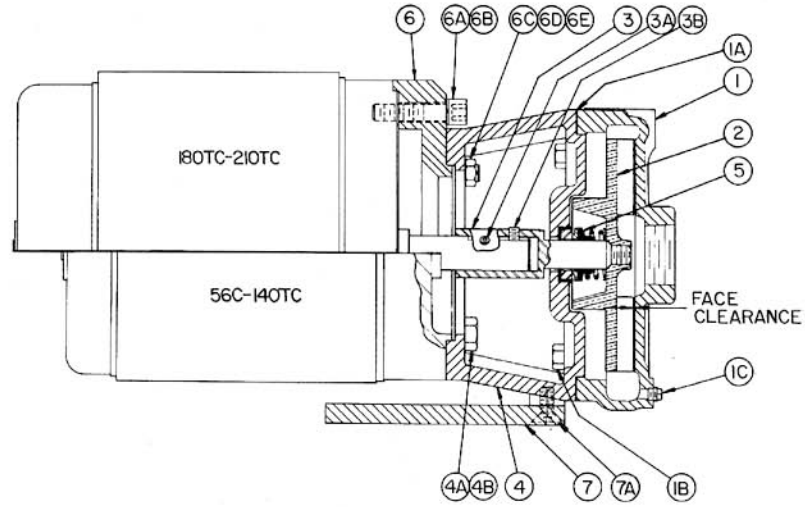
D. Slide seal spring and retainer over the shaft(3).

E. Put a drop of Loctite on the inside impeller (2) threads. Hold stub shaft(3) securely and thread impeller (2) tightly onto stub shaft(3).

F. Slide case gasket (IA) into position on motor adaptor (4).

G. Bolt case(1) to motor adaptor (4) and fasten tightly with four 5/16" capscrews (1 B).

H. Set impeller face clearance.



V. Setting Impeller Face Clearance

Since the 1312 utilizes a semi-open impeller, the face clearance must be set properly for optimum performance. The FACE CLEARANCE IS THE DISTANCE BETWEEN THE IMPELLER FACE AND THE CASING SURFACE. SEE DRAWING

FACE CLEARANCE SETTINGS:

Cast Iron Units .010"-.015"

316ss Units .015"-.020"

BENCH ADJUSTMENT

Insert feeler gauge into the suction port between the impeller face and case.

Slide stub shaft toward the pump casing, thus setting recommended impeller face clearance. Tighten the middle (dog point) set screw (3B) with an Allen wrench. Remove the feeler gauge and check for free rotation. Then tighten the other two set screws (cup point) (3A) and again check for free rotation.

RECHECK ALL SET SCREWS FOR TIGHTNESS FIELD ADJUSTMENT

Loosen all three set screws on the stub shaft. Put a screw driver between the stub shaft shoulder and the motor adaptor, moving the stub shaft toward the motor slightly (estimating recommended impeller face clearance). Retighten the middle (dog point) set screw (3B). Check for free rotation. Retighten the two set screws (cup point) (3A).

Check for free rotation.

RECHECK ALL SETSCREWS FOR TIGHTNESS

If performance is lower than anticipated, the clearance is too great and must be reset.

Model 1312 Parts Information

Item	Description	Pump Size	56C	140TC	180TC	210TC
1	Case[1]	1½x1x6	11-2403-01-10			
		2x1½x6	11-2404-01-10			
1A	Gasket, Case	All	50-2825-01-10			
1B	Capscrew (4)	All	CS-0503H-01-30			
1C	Pipe Plug[1]	All	PP-0200-01-30			
2	Impeller[1]	1½x1xx6	10-2403-11-10			
		2x1½x6	10-2404-11-10			
3	Stub Shaft[1]	All	20-1312-56-23	20-1312-45-23	20-1312-84-23	20-1312-15-23
3A	Set Screw, Cup Point(2)	All	SC-0401-01-30			
3B	Set Screw, Dog Point	All	SD-0401H-01-10			
4	Small Motor Adaptor[1]	All	35-1312-01-10			
4A	Capscrew (4)	All	CS-0604-01-30		Not Required	
4B	Lockwasher (4)	All	WL-0600-01-30		Not Required	
5	Seal	All	SJ-2112-C1-00			
6	Large Motor Adaptor	All	Not Required		35-1312-50-10	
6A	Capscrew, Socket Head(4)	All	Not Required		CA-0807-01-30	
6B	Lockwasher (4)	All	Not Required		WL-0800-01-30	
6C	Capscrew, Socket Head(4)	All	Not Required		CA-0606-01-30	
6D	Lockwasher (4)	All	Not Required		WL-0600-01-30	
6E	Hex Nut (4)	All	Not Required		NH-0600-01-30	
7	Pump Foot	All	42-1312-01-30		Not Required	
7A	Capscrew (2)	All	CC-0604-01-30		Not Required	

[1]For 316SS change last two numbers to -20 ( ) indicates quantity required

VERTIFLO PUMP CO., INC.
7807 Redsky Drive
Cincinnati, Ohio 45249

VERTIFLO

W21X Explosion Proof NEMA Premium Motors

TEFC

Standard Features

- Motors are compliant with DOE and NRCAN
- Three-phase, 2, 4, 6 and 8 pole, 60Hz
- Voltage: 230/460V, 575V
- Totally Enclosed Fan Cooled - TEFC (IP55) waterproof as per NEMA MG1 1.26.6 “Waterproof Machine”
- Die cast aluminum squirrel cage rotor
- Internal Oil/Lip Seal
- Ball bearings
- 1045 heat treated and stress relieved carbon steel shaft up to frame 364/5T and all 2 pole motors
- 4140 for 404/5T shaft upwards in 4, 6 and 8 pole motors
- Class “F” insulation for all frames. Temperature rise limited to Class “B” (80K)
- 575V rated motors have Spike Resistant WISE wire.
  - Protects against IGBT voltage spikes up to 2400V.
  - Exceeds NEMA MG1 Part 31.4.4.2
- Insulation System:
  - Dip and Bake Insulation system with class “H” resin up to frame 324/6T
  - CFRI Continuous Flow Resin Impregnation Insulation system with class “H” resin for frame 364/5T and up.
- NEMA design “B”
- Service Factor: 1.15
- Continuous duty (S1)
- Thermostats (N/C 1 per phase/3 in series)
- 104ºF (40ºC) ambient temperature
- Altitude: 3300 ft (1000m)
- Stainless steel nameplate with laser etching
- Paint: Synthetic enamel alkyd resin base
- Paint Plan:
  - 202P
- Color: RAL 5009 - Blue
- Brass drain/breather plug from frame 254T and up
- Regreasable bearings, positive pressure lubrication system (frames 254T and up)
- 2RS bearings from frame 143T to 215T



TEMP CODE T3C
CSA / UL: Class I, Div 1 - Groups C and D
CSA: Class II, Div 1 - Groups F and G
CSA: Class I, Zone 1, IIB
TEMP CODE T4 with a maximum SF 1.15, not as Inverter Duty, maximum ambient temperature of 40°C.

Inverter Ratings				
Frames	Poles	Constant Torque	Variable Torque	VFD
143T - 504/5T	All	20:1	1000:1	Any
143T - 504/5T	All	1000:1*		WEG
586/7T	All	2:1		Any

* Can only be achieved by a WEG VFD running in Sensorless Vector
See page 7.6 for details

Optional Features

- Metric Frames available (Division I - non-ATEX)
- Special voltages
- Special shafts
- Space heaters
- Labyrinth taconite seal available for all ratings
- Thermistors
- Drip cover (canopy) for shaft down applications
- NEMA C & D flanges and Metric flanges for all ratings
- Roller bearings
- Insulated bearings

Explosion Proof NEMA Premium Motors

TEFC - Purchasing Data

Rated Output		NEMA Frame	List Price	List Price with 'C' Flange	List Price with 'D' Flange	Part Number	Full Load Current		Full Load Efficiency	Shipping Weight (lbs.)	Overall Length "C" Dim. (in.)	Shaft Diameter "U" Dim. (in.)
HP	RPM						460V	575V				
1	3600	143/5T	$813	$1,054	$1,065	HX000X02NPW21X	1.41	1.13	81.5	61.7	13.752	0.875
	1800	143/5T	$815	$1,056	$1,067	HX000X04NPW21X	1.43	1.14	85.5	61.7	13.752	0.875
	1200	143/5T	$964	$1,206	$1,218	HX000X06NPW21X	1.54	1.23	82.5	52.9	13.752	0.875
	900	182/4T	$1,522	$1,851	$1,870	HX000X08NPW21X	2.30	1.84	78.5	112	15.862	1.125
1.5	3600	143/5T	$898	$1,140	$1,151	HX001X02NPW21X	2.05	1.64	84.0	61.7	13.752	0.875
	1800	143/5T	$865	$1,107	$1,118	HX001X04NPW21X	2.05	1.64	86.5	70.5	13.752	0.875
	1200	182/4T	$1,190	$1,520	$1,535	HX001X06NPW21X	2.33	1.86	87.5	1175	15.862	1.125
	900	182/4T	$1,674	$2,003	$2,023	HX001X08NPW21X	2.70	2.16	82.5	128	15.862	1.125
2	3600	143/5T	$947	$1,188	$1,200	HX002X02NPW21X	2.69	2.15	85.5	66.1	13.752	0.875
	1800	143/5T	$887	$1,129	$1,140	HX002X04NPW21X	2.73	2.18	86.5	72.8	13.752	0.875
	1200	182/4T	$1,254	$1,583	$1,599	HX002X06NPW21X	3.13	2.50	88.5	1287	15.862	1.125
	900	213/5T	$2,115	$2,510	$2,535	HX002X08NPW21X	3.45	2.76	84.0	165	19.450	1.375
3	3600	182/4T	$1,078	$1,408	$1,422	HX003X02NPW21X	3.80	3.04	86.5	90.4	15.862	1.125
	1800	182/4T	$1,067	$1,397	$1,411	HX003X04NPW21X	3.91	3.13	89.5	115	15.862	1.125
	1200	213/5T	$1,565	$1,972	$1,992	HX003X06NPW21X	4.41	3.53	89.5	165	19.450	1.375
	900	213/5T	$2,269	$2,664	$2,691	HX003X08NPW21X	4.44	3.55	87.0	201	19.450	1.375
5	3600	182/4T	$1,232	$1,562	$1,577	HX005X02NPW21X	6.10	4.88	88.5	106	15.862	1.125
	1800	182/4T	$1,171	$1,500	$1,515	HX005X04NPW21X	6.58	5.26	89.5	130	15.862	1.125
	1200	213/5T	$1,829	$2,225	$2,247	HX005X06NPW21X	6.83	5.46	89.5	218	19.450	1.375
	900	254T	$2,640	$3,211	$3,243	HX005X08NPW21X	7.93	6.34	87.5	313	23.175	1.625
7.5	3600	213/5T	$1,588	$1,983	$2,003	HX007X02NPW21X	8.98	7.18	89.5	190	19.450	1.375
	1800	213/5T	$1,717	$2,113	$2,134	HX007X04NPW21X	9.41	7.53	91.7	152	19.450	1.375
	1200	254T	$2,203	$2,774	$2,802	HX007X06NPW21X	9.73	7.78	91.0	309	23.175	1.625
	900	256T	$3,213	$3,784	$3,822	HX007X08NPW21X	11.6	9.28	87.5	353	24.923	1.625
10	3600	213/5T	$1,871	$2,267	$2,289	HX010X02NPW21X	12.0	9.60	90.2	201	19.450	1.375
	1800	L215T	$1,990	$2,385	$2,409	HX010X04NPW21X	12.8	10.2	91.7	207	20.631	1.375
	1200	256T	$2,706	$3,277	$3,310	HX010X06NPW21X	13.3	10.6	91.0	364	24.923	1.625
	900	284T	$4,269	$4,906	$4,955	HX010X08NPW21X	13.3	10.6	91.0	467	26.407	1.875
15	3600	254T	$2,245	$2,816	$2,844	HX015X02NPW21X	16.9	13.5	91.7	317	23.175	1.625
	1800	254T	$2,341	$2,912	$2,941	HX015X04NPW21X	18.4	14.7	92.4	328	23.175	1.625
	1200	284T	$3,481	$4,118	$4,159	HX015X06NPW21X	17.5	14.0	91.7	463	26.407	1.875
	900	286T	$5,060	$5,697	$5,754	HX015X08NPW21X	19.0	15.2	91.0	507	27.905	1.875
20	3600	256T	$2,805	$3,394	$3,428	HX020X02NPW21X	23.1	18.5	91.7	357	24.923	1.625
	1800	256T	$2,803	$3,392	$3,426	HX020X04NPW21X	25.0	20.0	93.0	364	24.923	1.625
	1200	286T	$4,138	$4,775	$4,822	HX020X06NPW21X	24.3	19.4	91.7	500	27.905	1.875
	900	324T	$6,171	$6,924	$6,993	HX020X08NPW21X	27.5	22.0	92.4	606	29.602	2.125
25	3600	284TS	$3,625	$4,282	$4,324	HX025X02NPW21X	28.6	22.9	92.4	452	25.033	1.625
	1800	284T	$3,553	$4,190	$4,232	HX025X04NPW21X	29.9	23.9	93.6	472	26.407	1.875
	1200	324T	$4,889	$5,642	$5,698	HX025X06NPW21X	30.4	24.3	93.0	639	29.602	2.125
	900	326T	$6,980	$7,733	$7,810	HX025X08NPW21X	35.4	28.3	92.4	672	31.106	2.125
30	3600	286TS	$4,076	$4,713	$4,760	HX030X02NPW21X	33.8	27.0	93.0	529	26.531	1.625
	1800	286T	$3,988	$4,625	$4,672	HX030X04NPW21X	36.0	28.8	93.6	511	27.905	1.875
	1200	326T	$5,911	$6,664	$6,730	HX030X06NPW21X	36.8	29.4	93.0	694	31.106	2.125
	900	364/5T	$12,116	$13,321	$13,454	HX030X08NP	38.5	30.8	93.0	910	33.701	2.375
40	3600	324TS	$5,354	$6,107	$6,168	HX040X02NPW21X	45.8	36.6	93.6	639	28.102	1.875
	1800	324T	$5,175	$5,928	$5,987	HX040X04NPW21X	48.3	38.6	94.1	650	29.602	2.125
	1200	364/5T	$9,129	$10,333	$10,436	HX040X06NP	47.1	37.7	94.1	1010	33.701	2.375
	900	364/5T	$12,245	$13,450	$13,584	HX040X08NP	52.3	41.8	93.6	1058	33.701	2.375
50	3600	326TS	$6,575	$7,328	$7,402	HX050X02NPW21X	55.5	44.4	94.1	728	29.606	1.875
	1800	326T	$6,122	$6,874	$6,943	HX050X04NPW21X	60.6	48.5	94.5	705	31.106	2.125
	1200	364/5T	$10,071	$11,275	$11,388	HX050X06NP	58.1	46.5	94.1	1036	33.701	2.375
	900	404/5T	$15,609	$16,814	$16,982	HX050X08NP	68.0	54.4	93.6	1257	38.074	2.875
60	3600	364/5TS	$9,636	$10,841	$10,949	HX060X02NP	68.3	54.6	94.1	1016	31.575	1.875
	1800	364/5T	$9,772	$10,976	$11,086	HX060X04NP	68.3	54.6	95.0	1014	33.701	2.375
	1200	404/5T	$13,007	$14,211	$14,353	HX060X06NP	70.4	56.3	94.5	1213	38.074	2.875
	900	404/5T	$15,926	$17,130	$17,301	HX060X08NP	75.9	60.7	93.0	1279	38.074	2.875
75	3600	364/5TS	$12,562	$13,766	$13,904	HX075X02NP	82.4	65.9	94.1	1025	31.575	1.875
	1800	364/5T	$11,415	$12,620	$12,746	HX075X04NP	83.3	66.6	95.4	937	33.701	2.375
	1200	404/5T	$14,515	$15,719	$15,876	HX075X06NP	87.0	69.6	94.5	1257	38.074	2.875
	900	444/5T	$23,376	$25,312	$25,565	HX075X08NP	92.3	73.8	93.6	1911	43.797	3.375
100	3600	404/5TS	$16,360	$17,565	$17,740	HX100X02NP	110	88.1	95.0	1206	35.074	2.125
	1800	404/5T	$14,517	$15,721	$15,878	HX100X04NP	113	90.4	95.4	1221	38.074	2.875
	1200	444/5T	$19,079	$21,015	$21,225	HX100X06NP	121	96.7	95.0	1896	43.797	3.375
	900	444/5T	$24,824	$26,760	$27,027	HX100X08NP	125	100	94.1	2052	43.797	3.375

Flange: Replace 'H' with 'C' for C Flange
Replace 'H' with 'D' for D Flange

Voltage: Replace 'X' with '4' for 208-230/460V
Replace 'X' with '5' for 575V

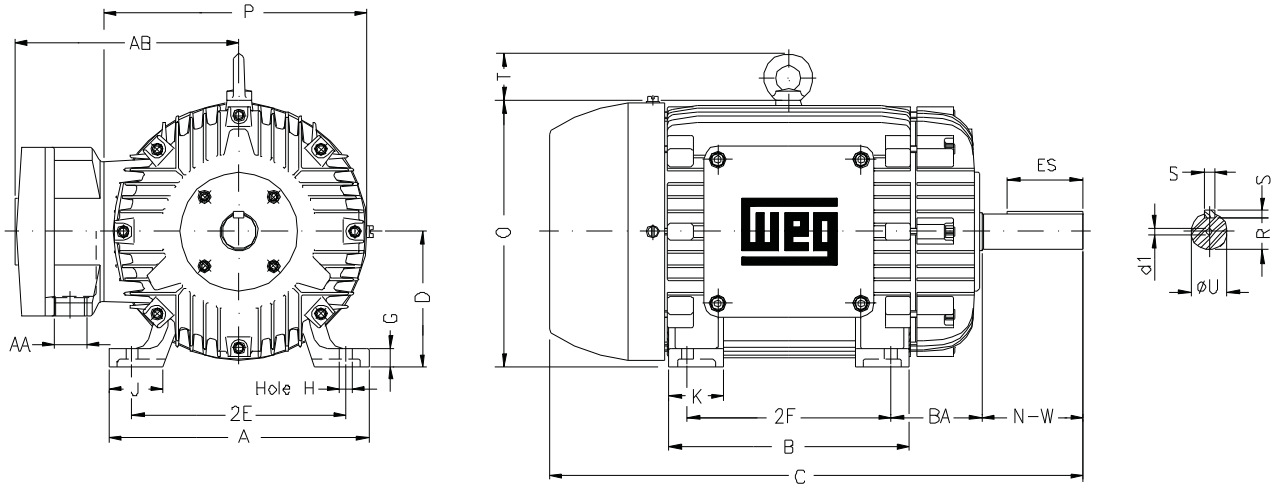
Explosion Proof NEMA Premium Motors

TEFC - Electrical Data

Rated Output		Full Load Speed (RPM)	NEMA Frame	Full Load Current (A)			Locked rotor current (Il/In)	Locked rotor torque	Breakdown torque	Locked rotor time (s)	Weight (lb)	Noise level	Service Factor	Efficiency (%)			Power factor		
HP	kW			230V	460V	575V								50%	75%	100%	50%	75%	100%
1	0.75	3495	143/5T	2.98	1.49	1.19	9.0	300%	400%	40	61.7	68	1.15	75.5	77.0	77.0	0.65	0.76	0.82
		1760	143/5T	2.86	1.43	1.14	8.6	290%	370%	18	61.7	51	1.15	80.0	82.5	85.5	0.57	0.70	0.77
		1150	143/5T	3.26	1.63	1.30	6.2	260%	280%	28	52.9	50	1.15	77.0	82.0	82.5	0.61	0.63	0.70
		875	182/4T	4.80	2.40	1.92	6.0	300%	350%	22	112	50	1.15	74.0	75.5	75.5	0.32	0.42	0.52
1.5	1.1	3500	143/5T	4.10	2.05	1.64	9.2	300%	400%	20	61.7	68	1.15	78.5	82.5	84.0	0.62	0.73	0.80
		1760	143/5T	4.10	2.05	1.64	8.9	270%	350%	14	70.5	51	1.15	81.5	85.5	86.5	0.58	0.70	0.78
		1165	182/4T	4.65	2.32	1.86	6.6	230%	330%	35	1175	52	1.15	84.5	86.5	87.5	0.47	0.59	0.68
		860	182/4T	5.68	2.84	2.27	6.2	240%	260%	17	128	50	1.15	77.0	78.5	78.5	0.42	0.54	0.62
2	1.5	3495	143/5T	5.38	2.69	2.15	9.4	350%	400%	15	66.1	68	1.15	80.0	84.0	85.5	0.64	0.76	0.82
		1750	143/5T	5.44	2.72	2.18	8.9	250%	320%	11	72.8	51	1.15	84.0	85.5	86.5	0.60	0.73	0.80
		1165	182/4T	6.26	3.13	2.50	7.0	260%	330%	35	129	52	1.15	84.5	86.5	88.5	0.47	0.58	0.68
		875	213/5T	6.90	3.45	2.76	7.0	230%	280%	35	198	52	1.15	80.0	82.5	84.0	0.45	0.57	0.65
3	2.2	3510	182/4T	7.52	3.76	3.01	8.4	250%	400%	30	90.4	69	1.15	82.5	85.5	86.5	0.73	0.81	0.85
		1760	182/4T	7.82	3.91	3.13	8.0	250%	320%	28	115	56	1.15	87.5	88.5	89.5	0.59	0.71	0.79
		1175	213/5T	8.82	4.41	3.53	7.0	220%	250%	58	203	55	1.15	86.5	88.5	89.5	0.50	0.62	0.70
		865	213/5T	8.72	4.36	3.49	7.1	210%	240%	32	201	52	1.15	84.0	85.5	85.5	0.54	0.66	0.74
5	3.7	3490	182/4T	12.2	6.10	4.88	7.5	250%	380%	26	106	69	1.15	85.5	87.5	88.5	0.70	0.81	0.86
		1750	182/4T	13.1	6.57	5.26	7.1	210%	330%	17	130	56	1.15	86.5	88.5	89.5	0.59	0.71	0.79
		1170	213/5T	13.7	6.83	5.46	6.8	170%	260%	57	205	55	1.15	88.5	89.5	89.5	0.58	0.70	0.76
		880	254T	15.9	7.93	6.34	5.3	210%	270%	21	313	54	1.15	84.0	86.5	87.5	0.46	0.58	0.67
7.5	5.5	3525	213/5T	17.1	8.57	6.86	7.0	220%	300%	23	190	72	1.15	85.5	88.5	89.5	0.78	0.87	0.90
		1765	213/5T	18.8	9.41	7.53	6.7	240%	280%	12	207	58	1.15	90.2	91.0	91.7	0.60	0.73	0.80
		1175	254T	19.5	9.73	7.78	7.0	270%	320%	25	309	59	1.15	88.5	90.2	91.0	0.58	0.71	0.78
		880	256T	23.2	11.6	9.28	5.3	210%	280%	23	353	54	1.15	86.5	87.5	87.5	0.48	0.60	0.68
10	7.5	3515	213/5T	23.2	11.6	9.28	6.9	210%	280%	15	201	72	1.15	89.5	90.2	90.2	0.81	0.88	0.90
		1765	L215T	25.4	12.7	10.2	6.5	210%	300%	15	229	58	1.15	90.2	91.0	91.7	0.62	0.75	0.81
		1175	256T	26.6	13.3	10.6	7.2	270%	310%	26	364	59	1.15	89.5	90.2	91.0	0.60	0.70	0.78
		884	284T	26.8	13.4	10.7	6.0	250%	240%	30	467	54	1.15	91.0	91.7	91.0	0.62	0.72	0.77
15	11	3540	254T	34.8	17.4	13.9	6.8	200%	270%	31	317	75	1.15	90.0	90.5	91.0	0.84	0.83	0.87
		1770	254T	36.8	18.4	14.7	7.3	300%	300%	26	328	69	1.15	90.2	91.7	92.4	0.65	0.75	0.81
		1180	284T	35.0	17.5	14.0	7.2	250%	260%	25	463	59	1.15	91.0	91.7	91.7	0.74	0.83	0.86
		880	286T	38.0	19.0	15.2	6.1	240%	230%	37	507	54	1.15	91.0	91.7	91.0	0.66	0.76	0.80
20	15	3530	256T	46.4	23.2	18.6	6.2	200%	250%	26	357	75	1.15	90.2	91.0	91.7	0.79	0.86	0.89
		1770	256T	50.0	25.0	20.0	7.5	300%	300%	20	364	69	1.15	91.7	92.4	93.0	0.63	0.75	0.81
		1180	286T	48.4	24.2	19.4	7.2	250%	270%	22	500	59	1.15	91.7	91.7	91.7	0.70	0.80	0.85
		880	324T	55.0	27.5	22.0	5.3	230%	230%	25	606	56	1.15	91.7	92.4	92.4	0.56	0.67	0.74
25	18.5	3555	284TS	57.2	28.6	22.9	9.0	280%	330%	58	452	75	1.15	91.7	92.4	92.4	0.78	0.85	0.88
		1775	284T	59.8	29.9	23.9	8.2	320%	320%	20	472	68	1.15	92.4	93.6	93.6	0.67	0.78	0.83
		1180	324T	60.8	30.4	24.3	6.4	230%	260%	25	639	62	1.15	92.4	93.0	93.0	0.65	0.76	0.82
		880	326T	70.8	35.4	28.3	5.1	240%	240%	20	672	56	1.15	91.0	92.4	92.4	0.51	0.63	0.71
30	22	3545	286TS	67.4	33.7	27.0	7.7	260%	300%	14	529	75	1.15	92.4	93.0	93.0	0.78	0.86	0.88
		1775	286T	72.0	36.0	28.8	7.9	350%	350%	17	511	68	1.15	93.0	93.6	93.6	0.66	0.77	0.82
		1180	326T	73.4	36.7	29.4	7.1	240%	270%	25	694	62	1.15	92.4	93.0	93.0	0.63	0.75	0.81
		885	364/5T	77.0	38.5	30.8	5.7	220%	220%	14	910	62	1.15	92.4	93.0	93.0	0.64	0.73	0.77
40	30	3555	324TS	91.5	45.8	36.6	6.6	270%	270%	43	516	81	1.15	92.4	93.6	93.6	0.80	0.86	0.88
		1780	324T	96.4	48.2	38.6	7.7	270%	300%	19	650	71	1.15	93.0	94.1	94.1	0.66	0.77	0.83
		1185	364/5T	94.2	47.1	37.7	7.0	230%	230%	24	1010	65	1.15	93.6	94.1	94.1	0.72	0.80	0.85
		885	364/5T	104	52.2	41.8	5.2	220%	220%	25	1058	62	1.15	93.0	93.6	93.6	0.64	0.73	0.77
50	37	3560	326TS	111	55.5	44.4	7.2	260%	260%	33	728	81	1.15	92.4	93.6	94.1	0.82	0.88	0.89
		1775	326T	121	60.6	48.5	7.3	260%	280%	20	705	71	1.15	93.6	94.5	94.5	0.65	0.76	0.81
		1185	364/5T	116	58.1	46.5	7.4	260%	280%	20	1036	65	1.15	93.6	94.1	94.1	0.71	0.81	0.85
		885	404/5T	136	68.0	54.4	7.3	220%	210%	12	1257	62	1.15	92.4	93.0	93.6	0.67	0.73	0.73
60	45	3550	364/5TS	137	68.6	54.9	6.4	200%	250%	60	1016	85	1.15	92.4	93.0	93.6	0.79	0.86	0.88
		1780	364/5T	137	68.3	54.6	7.0	250%	250%	20	1014	75	1.15	94.1	94.5	95.0	0.72	0.82	0.87
		1185	404/5T	141	70.3	56.2	6.9	250%	270%	29	1213	65	1.15	93.6	94.5	94.5	0.73	0.82	0.85
		885	404/5T	152	75.9	60.7	6.2	180%	220%	25	1279	62	1.15	92.4	93.0	93.0	0.65	0.75	0.80
75	55	3560	364/5TS	165	82.4	65.9	7.0	230%	260%	18	1025	85	1.15	93.0	94.1	94.1	0.81	0.87	0.89
		1780	364/5T	166	83.2	66.6	7.0	240%	290%	16	937	75	1.15	94.5	95.0	95.4	0.74	0.83	0.87
		1180	404/5T	174	87.0	69.6	7.7	250%	260%	15	1257	65	1.15	94.1	95.0	94.5	0.72	0.81	0.84
		890	444/5T	184	92.2	73.8	6.1	170%	210%	18	1911	64	1.15	93.6	94.1	93.6	0.66	0.76	0.80
100	75	3550	404/5TS	220	110	88.0	6.5	250%	280%	21	1206	85	1.15	93.6	95.0	95.0	0.85	0.89	0.90
		1780	404/5T	226	113	90.4	7.2	270%	300%	13	1221	75	1.15	94.5	95.0	95.4	0.72	0.82	0.87
		1190	444/5T	242	121	96.7	6.8	230%	260%	49	1896	70	1.15	94.1	95.0	95.0	0.66	0.76	0.82
		890	444/5T	250	125	100	6.1	170%	200%	16	2052	64	1.15	94.1	94.5	94.1	0.68	0.77	0.80
125	90	3570	444/5TS	264	132	106	6.6	200%	250%	22	1940	86	1.15	93.0	94.5	95.0	0.83	0.89	0.90
		1785	444/5T	284	142	114	6.4	200%	220%	18	2026	76	1.15	95.0	95.4	95.4	0.76	0.83	0.86
		1185	444/5T	300	150	120	7.4	230%	240%	41	2293	70	1.15	94.5	95.0	95.0	0.67	0.76	0.82
		890	447T	308	154	123	6.1	170%	200%	18	2337	66	1.15	94.5	95.0	94.5	0.66	0.76	0.80
		890	504/5T	308	154	123	6.1	170%	200%	18	2337	66	1.15	94.5	95.0	94.5	0.66	0.76	0.80

Explosion Proof NEMA Premium Motors

TEFC - Mechanical Data

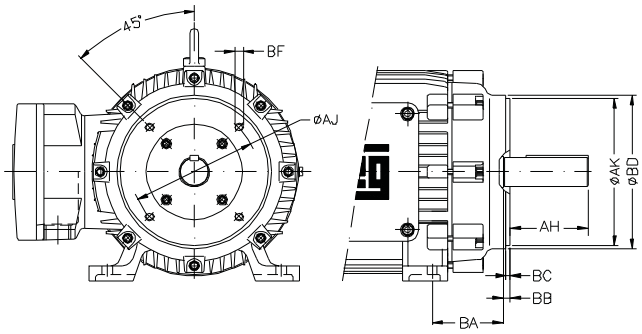


NEMA Frames	Mounting				A	B	C	D	G	J	K	O	P	T	Keyway			Shaft Extension		AB	AA	d1	Bearings	
	2E	2F	H	BA											S	R	ES	N-W	U				D.E.	N.D.E.
143/5T	5.500	4.000/5.000	0.344	2.250	6.457	5.157	13.752	3.500	0.429	1.496	1.654	7.000	7.000	1.677	0.187	0.771	1.575	2.250	0.875	6.811	NPT 0.75"	A4	6205-2RS	6204-2RS
145T		5.000				6.142																	6205-2RS	6204-2RS
182/4T	7.500	4.500/5.500	0.406	2.750	8.661	5.945	15.862	4.500	0.787	1.890	1.969	9.421	8.909	1.772	0.250	0.984	1.969	2.750	1.125	8.240			6307-2RS	6206-2RS
184T		5.500				6.969																	6307-2RS	6206-2RS
213/5T	8.500	5.500/7.000	0.409	3.500	9.764	8.898	19.450	5.250	0.877	2.037	3.058	11.156	10.709		0.313	1.203	2.480	3.375	1.375	9.252	NPT 1"		6308-2RS	6207-2RS
215T		7.000																			NPT 1"		6308-2RS	6207-2RS
L215T		7.000/8.171				10.088	20.631														NPT 1"		6308-2RS	6207-2RS
254T	10.000	8.252	0.531	4.250	12.126	10.000	23.175	6.250	0.817	2.520	2.559	12.352	12.224	2.087	0.375	1.416	2.756	4.000	1.625	11.063	NPT 1.5"		6309-C3	6309-C3
256T		10.000				11.732	24.923									1.406							6309-C3	6309-C3
284T	11.000	9.500		4.750	13.780	11.575	26.407	7.000	1.024	3.150	2.953	14.362	14.094	2.441	0.500	1.594	3.149	4.622	1.875	11.850			6311-C3	6311-C3
284TS							25.033								0.375	1.406	2.480	3.250	1.625				6311-C3	6311-C3
286T		11.000				13.071	27.905								0.500	1.594	3.149	4.622	1.875				6311-C3	6311-C3
286TS							26.531								0.375	1.406	2.480	3.250	1.625				6311-C3	6311-C3
324T	12.500	10.500	0.657	5.250	15.157		29.602	8.000	1.307	3.228	3.346	15.992	15.697	2.795	0.500	1.844	3.937	5.250	2.125	12.961	NPT 2"		6312-C3	6312-C3
324TS							28.102									1.594	2.756	3.750	1.875				6312-C3	6312-C3
326T		12.000				14.567	31.106									1.844	3.937	5.250	2.125				6312-C3	6312-C3
326TS							29.606									1.594	2.756	3.750	1.875				6312-C3	6312-C3
364/5T	14.000	11.250/12.250		5.875	17.165	15.394	33.701	9.000	1.480	3.150	4.134	18.898	18.583		0.625	2.019	4.330	5.874	2.375	16.654	NPT 3"		6314-C3	6314-C3
364/5TS							31.575								0.500	1.591	1.968	3.748	1.875				6314-C3	6314-C3
404/5T	16.000	12.250/13.752		6.625	19.921	17.520	38.074	10.000	1.812		5.433	19.843			0.750	2.449	5.512	7.250	2.875				6217-C3	6314-C3
404/5TS							35.074								0.500	1.842	2.756	4.250	2.125				6314-C3	6314-C3
444/5T	18.000	14.500/16.500	0.807	7.500	21.929	20.079	43.797	11.000	1.630	3.937	5.591	23.622	24.016	3.543	0.875	2.880	7.087	8.500	3.375	21.732	2xNPT 3"	UNC 0.75"	6219-C3	6316-C3
444/5TS							40.047								0.625	2.021	3.000	4.750	2.375				6314-C3	6314-C3
447T		20.000				23.640	47.339								0.875	2.880	7.087	8.500	3.375	20.984			6319-C3	6316-C3
447TS							43.589								0.625	2.021	3.000	4.750	2.375				6314-C3	6314-C3
449T		25.000				32.126	54.996				7.104				0.875	2.880	7.087	8.500	3.375				6322-C3	6319-C3
449TS							51.246								0.625	2.021	3.000	4.750	2.375				6314-C3	6314-C3
504/5T	20.000	16.000/18.000	1,250	8.500	24.724	21.969	49.445	12.500	2.146	4.724	5.984	25.197	24.212		0.875	3.134	8.661	10.630	3.625	21.850			6319-C3	6316-C3
504/5TS							46.875								0.625	2.021	3.000	4.750	2.375				6316-C3	6316-C3
586/7T	23.000	22.000/25.000	1,181	10.000	29.528	29.921	61.389	14.500	2.492	5.236	7.874	30.428	30.709	4.291	1.000	3.312	8.661	11.625	3.875	25.787		UNC 7/8"	6322-C3	6319-C3
586/7TS							54.514								0.625	2.021	3.000	4.750	2.375			UNC 0.75"	6314-C3	6314-C3

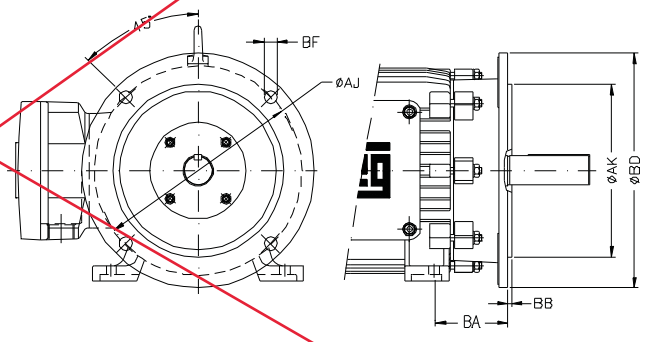
Explosion Proof NEMA Premium Motors

TEFC - Mechanical Data

"C" FLANGE DIMENSIONS									
NEMA FRAMES	BA	AJ	AK	BD	BF		BB	BC	AH
					NUMBER	TAP SIZE			
143/5TC	2.250	5.875	4.500	6.500	4	UNC 3/8"x16	0.156	0.125	2,125
145TC									
182/4TC	2.750	7.250	8.500	8.875		UNC 0.5"x13	0.250		2,625
184TC									
213/5TC	3.500							0.250	3,125
215TC									
L215TC									
254TC	4.250								3,750
256TC									
284TC	4.750	9.000	10.500	11.031					4,375
284TSC									3,000
286TC									4,375
286TSC									3,000
324TC	5.250	11.000	12.500	13.583		UNC 5/8"x11			5,000
324TSC									3,500
326TC									5,000
326TSC									3,500
364/5TC	5.875			15.562	8				5,625
364/5TSC									3,500
404/5TC	6.625								7,000
404/5TSC									4,000
444/5TC	7.500	14.000	16.000	17.913					8,250
444/5TSC									4,500
447TC									8,250
447TSC									4,500
449TC									8,250
449TSC									4,500
504/5TC	8.500	14.500	16.500						10,375
504/5TSC									4,500
586/7TC	10.000								
586/7TSC	10.000								4,500



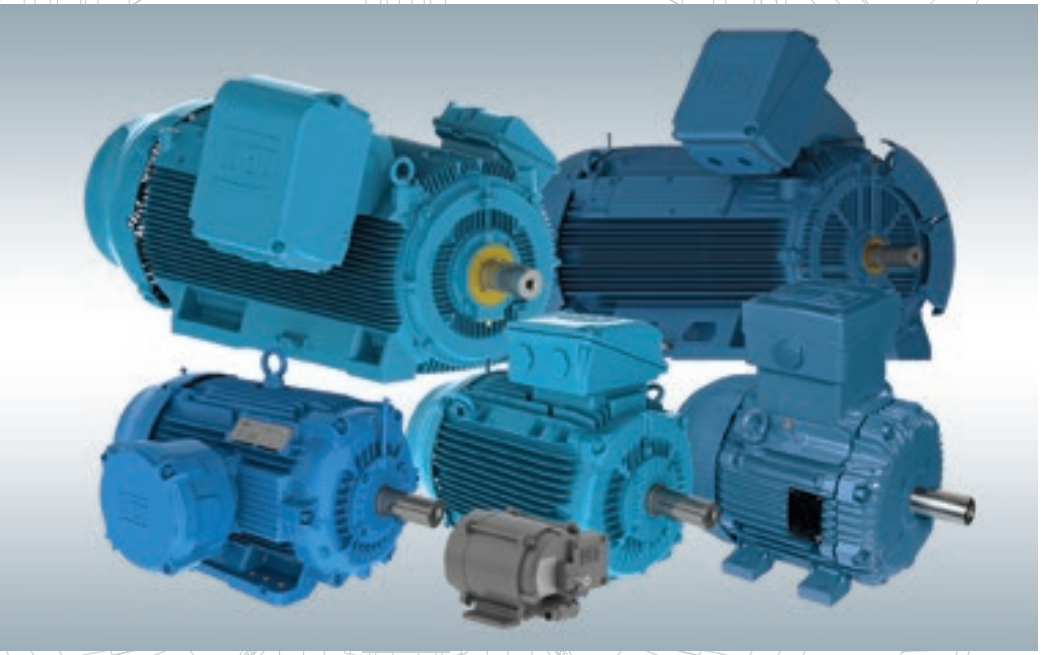
"D" FLANGE DIMENSIONS								
NEMA FRAMES	BA	AJ	AK	BD	BF		BB	AH
					NUMBER	TAP SIZE		
143/5TD	2.250	10.000	9.000	11.000	4	0.551	0.203	2.125
145TD								
182/4TD	2.750							2.625
184TD								
213/5TD	3.500							3.125
215TD								
L215TD								
254TD	4.250	12.500	11.000	14.000		0.828		3.750
256TD								
284TD	4.750							4.375
284TSD								3.000
286TD								4.375
286TSD								3.000
324TD	5.250	16.000	14.000	18.000				5.000
324TSD								3.500
326TD								5.000
326TSD								3.500
364/5TD	5.875							5.625
364/5TSD								3.500
404/5TD	6.625	20.000	18.000	21.656	8			7.000
404/5TSD								4.000
444/5TD	7.500							8.250
444/5TSD								4.500
447TD								8.250
447TSD								4.500
449TD								8.250
449TSD								4.500
504/5TD	8.500			24.803				10.375
504/5TSD								4.500
586/7TD	10.000	30.000	28.000	32.000				11.375
586/7TSD								4.500



Manual Geral de Instalação, Operação e Manutenção de Motores Elétricos para Atmosferas Explosivas

Installation, Operation and Maintenance Manual of Electric Motors for Use in Explosive Atmospheres

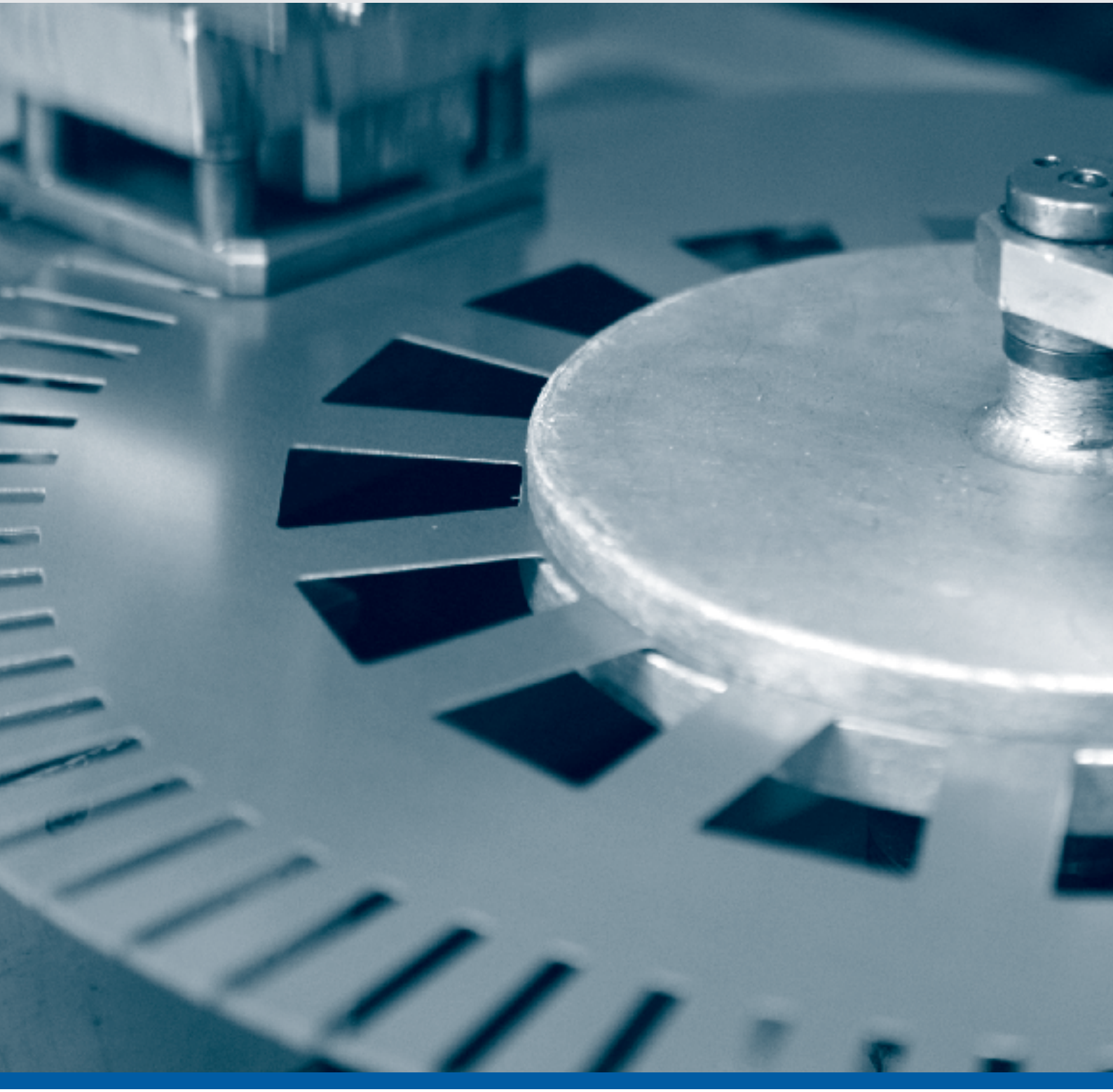
Manual General de Instalación, Operación y Mantenimiento de Motores Eléctricos para Atmosferas Explosivas



Português 2

English 58

Español 115



Installation, Operation and Maintenance Manual of Electric Motors for Use in Explosive Atmospheres

This manual provides information about WEG induction motors fitted with squirrel cage, permanent magnet or hybrid rotors, low, medium and high voltage, in frame size IEC 56 to 630 and NEMA 42 to 9606/10 for use in explosive atmospheres with the following types of protection:

- Equipment protection by increased safety – “Ex e”
- Equipment protection by type of protection “n” – “Ex n”
- Equipment protection by flameproof enclosures – “Ex d” and “Ex de”
- Equipment dust ignition protection by enclosure – “Ex t” and “Ex tD”
- Equipment protection for use in Class I, Division 1
- Equipment protection for use in Class I, Division 2

These motors meet the following standards, if applicable:

- NBR 17094-1 (2008): Máquinas Elétricas Girantes - Motores de Indução - Parte 1: Trifásicos
- NBR 17094-2 (2008): Máquinas Elétricas Girantes - Motores de Indução - Parte 2: Monofásicos
- IEC 60034-1 (2010): Rotating Electrical Machines - Part 1: Rating and Performance
- NEMA MG 1 (2009): Motors and Generators
- EN / IEC 60079-0 (2007): Explosive Atmospheres – Part 0: Equipment - General Requirements
- NBR IEC 60079-0 (2008): Atmosferas Explosivas - Equipamentos - Requisitos Gerais
- EN / IEC 60079-1 (2007): Explosive Atmospheres – Part 1: Equipment protection by flameproof enclosures “d”
- NBR IEC 60079-1 (2009): Proteção de Equipamento por Invólucro à Prova de Explosão “d”
- EN / IEC 60079-7 (2006): Explosive Atmospheres – Part 7: Equipment protection by increased safety “e”
- NBR IEC 60079-7 (2008): Proteção de Equipamentos por Segurança Aumentada “e”
- EN / IEC 60079-15 (2010):): Explosive Atmospheres – Part 15: Equipment protection by type of protection “n”
- NBR IEC 60079-15 (2007): Construção, Ensaio e Marcação de Equipamentos Elétricos com Tipo de Proteção “n”
- EN / IEC 60079-31 (2008): Explosive Atmospheres – Part 31: Equipment dust ignition protection by enclosure “t”
- IEC 61241-0 (2004): Electrical apparatus for use in the presence of combustible dust - Part 0: General requirements
- NBR IEC 61241-0 (2006): Equipamentos Elétricos para Utilização em Presença de Poeira Combustível - Parte 0: Requisitos Gerais
- NBR IEC 61241-1 (2007): Equipamentos Elétricos para Utilização em Presença de Poeira Combustível - Parte 1: Proteção por Invólucros “tD”
- UL 674 (2010) – Electric Motors and Generators for Use in Division 1 Hazardous (Classified) Locations
- CSA C22.2 N°145 (1986) – Motors and Generators for Use in Hazardous Locations
- CSA C22.2 N°30 (1986) - Explosion-Proof Enclosures for Use in Class I Hazardous Locations
- CSA C22.2 N°213 (1987) - Non-Incendive Electrical Equipment for Use in Class I, Division 2 Hazardous Locations

Information about classification of areas and safety requirements to be considered during equipment repair, overhaul and reclamation, when applicable, can be found in the following standards:

- EN / IEC 60079-10-1 (2008): Classification of areas - Explosive gas atmospheres
- ABNT NBR IEC 60079-10-1 (2009): Classificação de áreas - Atmosferas explosivas de gás
- EN/ IEC 60079-10-2 (2009): Classification of areas - Combustible dust atmospheres
- EN / IEC 60079-14 (2007): Electrical installations design, selection and erection
- NBR IEC 60079-14 (2009): Projeto, Seleção e Montagem de Instalações Elétricas
- EN / IEC 60079-17 (2007): Electrical installations inspection and maintenance
- NBR IEC 60079-17 (2009): Inspeção e Manutenção de Instalações Elétricas
- EN / IEC 60079-19 (2006): Equipment repair, overhaul and reclamation
- NBR IEC 60079-19 (2008): Reparo, Revisão e Recuperação de Equipamentos

If you have any questions regarding this manual, please contact WEG branch.

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1. TERMINOLOGY

Balancing: the procedure by which the mass distribution of a rotor is checked and, if necessary, adjusted to ensure that the residual unbalance or the vibration of the journals and/or forces on the bearings at a frequency corresponding to service speed are within specified limits in International Standards.

[ISO 1925:2001, definition 4.1]

Balance quality grade: indicates the peak velocity amplitude of vibration, given in mm/s, of a rotor running free-in-space and it is the product of a specific unbalance and the angular velocity of the rotor at maximum operating speed.

Hazardous area: area in which an explosive atmosphere is present, or may be expected to be present, in quantities such as to require special precautions for the construction, installation and use of electrical apparatus.

[IEC 60050 IEV number 426-03-01]

Non-hazardous area: area in which an explosive atmosphere is not expected to be present in quantities such as to require special precautions for the construction, installation and use of electrical apparatus.

[IEC 60050 IEV number 426-03-02]

Explosive atmosphere: mixture with air, under atmospheric conditions, of flammable substances in the form of gas, vapour, dust, fibres, or flyings which, after ignition, permits self-sustaining propagation.

[IEC 60050 IEV number 426-01-06]

Temperature class: maximum surface temperature of the equipment. Following temperature classes are defined:

Temperature Class		Maximum surface temperature (°C)
IEC	NEC	
T1	T1	450
T2	T2	300
-	T2A	280
-	T2B	260
-	T2C	230
-	T2D	215
T3	T3	200
-	T3A	180
-	T3B	165
-	T3C	160
T4	T4	135
-	T4A	120
-	T5	100
-	T6	85

[IEC 60050 IEV number 426-01-05]

Simple apparatus: electrical component or combination of components of simple construction with well-defined electrical parameters which is compatible with the intrinsic safety of the circuit in which it is used.

[IEC 60050 IEV number 426-11-09]

Flameproof enclosure "d" (Ex d): type of protection in which the parts capable of igniting an explosive gas atmosphere are provided with an enclosure which can withstand the pressure developed during an internal explosion of an explosive mixture, and which prevents the transmission of the explosion to the explosive gas atmosphere surrounding the enclosure

[IEC 60050 IEV number 426-06-01]

Increased safety "e" (Ex e): type of protection applied to electrical apparatus in which additional measures are applied so as to give increased security against the possibility of excessive temperatures and of the occurrence of arcs and sparks in normal service or under specified abnormal conditions.

[IEC 60050 IEV number 426-08-01]

Type of protection "n" (Ex n): type of protection applied to electrical apparatus such that, in normal operation and in certain specified abnormal conditions, it is not capable of igniting a surrounding explosive gas atmosphere.

[IEC 60050 IEV number 426-13-01]

Dust ignition protection by enclosure “t” (Ex t): type of protection for explosive dust atmosphere where electrical equipment is provided with an enclosure providing dust ingress protection and a means to limit surface temperatures.

[IEC 60079-31 item 3.1]

Gas groups: are subdivided according to the nature of the explosive atmosphere for which they are intended:
- Group I: coal mines susceptible to firedamp (methane).
- Group II: areas not susceptible to firedamp. This group is subdivided into:
  - Group IIA (IEC) / D (NEC): propane, acetone, butane, combustible gas, gasoline, ethyl alcohol, methyl alcohol, benzene, etc.
  - Group IIB (IEC) / C (NEC): ethylene, cyclopropane, butadiene 1-3, etc.
  - Group IIC (IEC): hydrogen, acetylene, etc.
  - Group B (NEC): hydrogen.
  - Group A (NEC): acetylene.

Dust groups: are subdivided into (excepting mines susceptible to firedamp (methane)):
- Group IIIA (IEC): combustible fibers / combustible flyings – solid particles, including fibers larger than 500 µm
- Group IIIB (IEC): electrically nonconductive dusts – solid particles smaller than 500 µm, with electrical resistivity ≤ 10^3 Ω.m
- Group IIIC (IEC): electrically conductive dusts - solid particles smaller than 500 µm, with electrical resistivity > 10^3 Ω.m
- Group E (NEC): combustible metallic powders, for example: aluminum, magnesium and their commercial alloys.
- Group F (NEC): combustible carbonaceous dusts that have more than 8% total entrapped volatiles.
- Group G (NEC):atmospheres containing dusts not included in Group E and F, including flour, grain wood , plastic, chemicals, etc.

Flameproof joint: place where the corresponding surfaces of two parts of an enclosure, or the conjunction of enclosures, come together, and which prevents the transmission of an internal explosion to the explosive gas atmosphere surrounding the enclosure.

[IEC 60050 IEV number 426-06-02]

Symbol “X”: symbol used to denote special conditions for safe use.

[IEC 60050 IEV number 426-04-32]

Equipment Protection Level - EPL: level of protection assigned to equipment based on its likelihood of becoming a source of ignition and distinguishing the differences between explosive gas atmospheres, explosive dust atmospheres, and the explosive atmospheres in mines susceptible to firedamp. These EPLs are classified into:
- EPL Ga: equipment for explosive gas atmospheres, having a “very high” level of protection, which is not a source of ignition in normal operation, during expected malfunctions ou during rare malfunctions.

- EPL Gb: equipment for explosive gas atmospheres, having a “high” level of protection, which is not a source of ignition in normal operation, during expected malfunctions.

- EPL Gc: equipment for explosive gas atmosphere, having a “enhanced” level of protection, which is not a source of ignition in normal operation and which may have some additional protection to ensure that it remains inactive as an ignition source in case of regular expected occurrences (for example failure of a lamp).

- EPL Da: equipment for explosive dust atmospheres, having a “very high” level of protection, which is not a source of ignition in normal operation, during expected malfunctions, or during rare malfunctions.

- EPL Db: equipment for explosive dust atmospheres, having a “high” level of protection, which is not a source of ignition in normal operation or during expected malfunctions

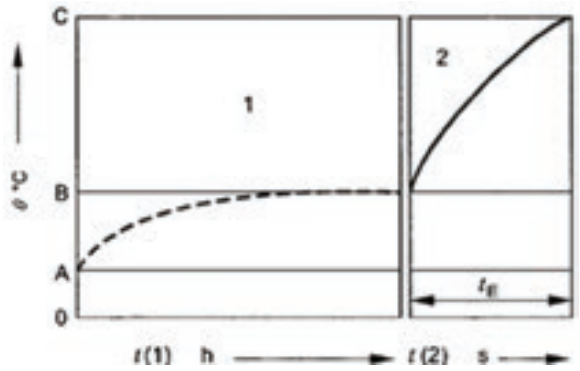
- EPL Dc: equipment for explosive dust atmospheres, having a “enhanced” level of protection, which is not a source of ignition in normal operation and which may have some additional protection to ensure that it remains inactive as an ignition source in the case of regular expected occurrences (for example failure of a lamp).

- EPL Ma: equipment for installation in a mine susceptible to firedamp, having a “very high” level of protection, which has sufficient security that it is unlikely to become an ignition source in normal operation, during expected malfunctions or during rare malfunctions, even when left energized in the presence of an outbreak of gas.

- EPL Mb: equipment for installation in a mine susceptible to firedamp, having a “high” level of protection, which has sufficient security that it is unlikely to become an source of ignition in normal operation or during expected malfunctions in the time span between there being an outbreak of gas and the equipment being de-energized.

[IEC 60079-0 item 3.18]

Time “t_E”: time taken for an a.c. rotor or stator winding, when carrying the initial starting current I_A, to be heated up to the limiting temperature from the temperature reached in rated service at the maximum ambient temperature. See Figure 1-1.



Symbols
θ - temperature
A – maximum allowed ambient temperature
B – service temperature
C – limiting temperature
t - time
1 – temperature rise in rated service
2 – Temperature rise during locked rotor test

Figure 1.1: *Time “t_E”*

[IEC 60050 IEV number 426-08-03]

Type of protection: set of specific measures applied to electrical apparatus to avoid ignition of a surrounding explosive atmosphere by such apparatus.

[IEC 60050 IEV number 426-01-02]

Zones: hazardous areas are classified in terms of zones on the basis of the frequency and duration of the occurrence of an explosive atmosphere.

Zone 0 (IEC) / Class I Div 1 (NEC): area in which an explosive gas atmosphere is present continuously, or for long periods or frequently.

[IEC 60050 IEV number 426-03-03]

Zone 1 (IEC) / Class, I Div 1 (NEC): area in which an explosive gas atmosphere is likely to occur in normal operation occasionally.

[IEC 60050 IEV number 426-03-04]

Zone 2 (IEC) / Class I, Div 2 (NEC): area in which an explosive gas atmosphere is not likely to occur in normal operation, but if it does occur, will persist for a short period only.

[IEC 60050 IEV number 426-03-05]

Zone 20 (IEC) / Class II, Div 1 (NEC): area in which an explosive atmosphere in the form of a cloud of combustible dust in air is present continuously, or for long periods or frequently.

[IEC 60050 IEV number 426-03-23]

Zone 21 (IEC) / Class II, Div 1 (NEC): area in which an explosive atmosphere in the form of a cloud of combustible dust in air is likely to occur, occasionally, in normal operation.

[IEC 60050 IEV number 426-03-24]

Zone 22 (IEC) / Class II, Div 2 (NEC): area in which an explosive atmosphere in the form of a cloud of combustible dust in air is not likely to occur in normal operation but, if it does occur, will persist for a short period only.

[IEC 60050 IEV number 426-03-25]

Grounded Part: metallic part connected to the grounding system.

Live Part: Conductor or conductive part intended to be energized in normal operation, including a neutral conductor.

Authorized personnel: employee who has formal approval of the company.

Qualified personnel: employee who meets the following conditions simultaneously:
- receives training under the guidance and responsibility of a qualified and authorized professional;
- works under the responsibility of a qualified and approved professional.

Note: *The qualification is only valid for the company that trained the employee in the conditions set out by the authorized and qualified professional responsible for training.*

2. INITIAL RECOMMENDATIONS

Motors for hazardous areas are specially designed to meet the government regulations regarding the environment in which they are installed. Misapplication, incorrect connection or other changes although small, may jeopardize product reliability.
Electric motors have energized circuits, exposed rotating parts and hot surfaces that may cause serious injury to people during normal operation. Therefore, it is recommended that transportation, storage, installation, operation and maintenance services are always performed by qualified personnel.
Also the applicable procedures and relevant standards of the country where the machine will be installed must be considered.
Noncompliance with the recommended procedures in this manual may cause severe personal injuries and/or substantial property damage and may void the product warranty.

For practical reasons, it is not possible to include in this Manual detailed information that covers all construction variables nor covering all possible assembly, operation or maintenance alternatives.
This Manual contains only the required information that allows qualified and trained personnel to carry out their services. The product images are shown for illustrative purpose only and the type of protection is not represented.

The type of protection and the Equipment Protection Level (EPL) indicated on the motor nameplate must be respected considering the explosive atmosphere where the motor will be installed.

Components added to the motor by the user, such as cable-glands, threaded plugs, encoder, etc. must meet the type of protection, the Equipment Protection Level (EPL) in accordance with the standards indicated on the product certificate.

The symbol “X” added to the certificate number, informed on the motor nameplate, denotes that motor requires special conditions for installation, use and/or maintenance, as described in the certificate.

Failure to follow these requirements may affect the product and installation safety.

For *Smoke Extraction Motors*, please refer to the additional instruction manual 50026367 available on the website www.weg.net.

For brake motors, please refer to the information contained in WEG 50006742 / 50021973 brake motor manual available on the website www.weg.net.

For information about permissible radial and axial shaft loads, please check the product technical catalogue.

The user is responsible for the correct classification of the area for the motor installation, for the definition of environment conditions and application characteristics.

During the warranty period, all repair, overhaul and reclamation services must be carried out by WEG authorized Service Centers for explosive atmospheres to maintain validity of the warranty.

2.1. WARNING SYMBOL

Warning about safety and warranty.

2.2. RECEIVING INSPECTION

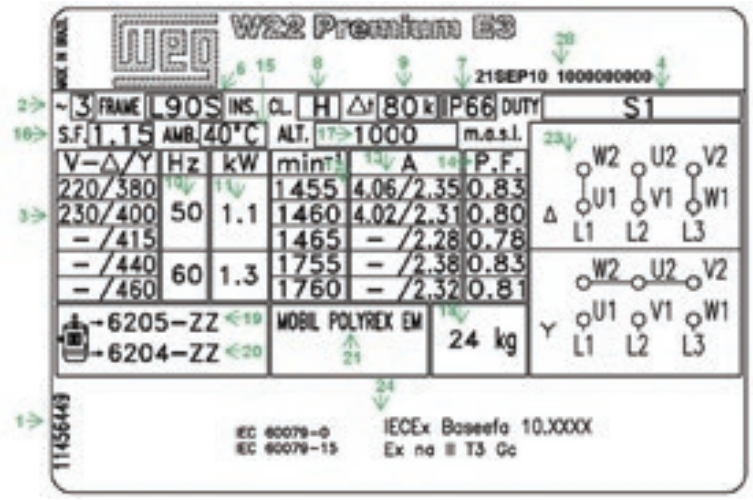
All motors are tested during the manufacturing process.
The motor must be checked when received for any damage that may have occurred during the transportation. All damages must be reported in writing to the transportation company, to the insurance company and to WEG. Failure to comply with such procedures will void the product warranty.
You must inspect the product:

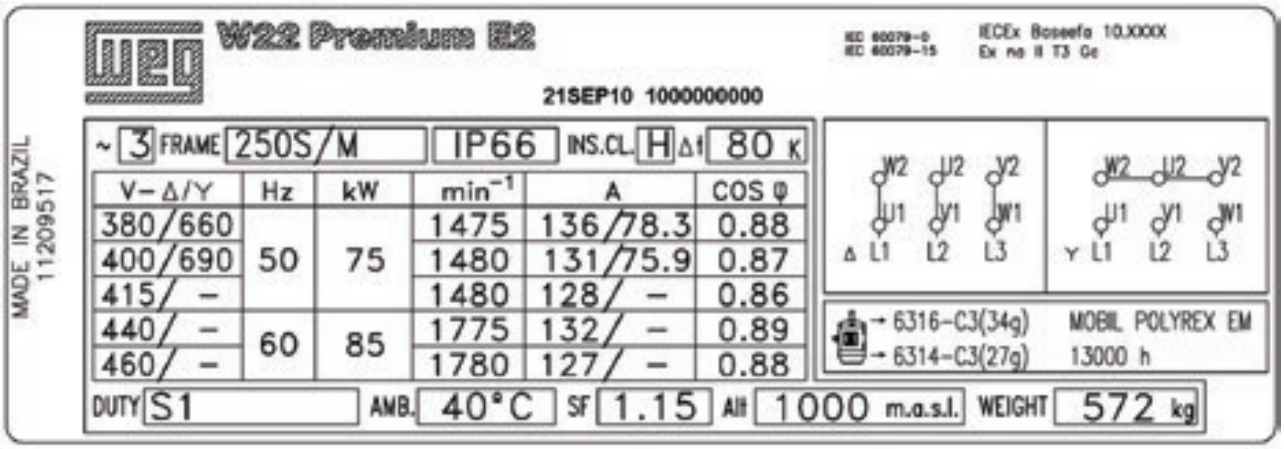
- Check if nameplate data complies with the purchase order.
  Special attention should be given to the type of protection and/or to the Equipment Protection Level.
- Remove the shaft locking device (if any) and rotate the shaft by hand to ensure that it rotates freely.
- Check that the motor has not been exposed to excessive dust and moisture during the transportation.

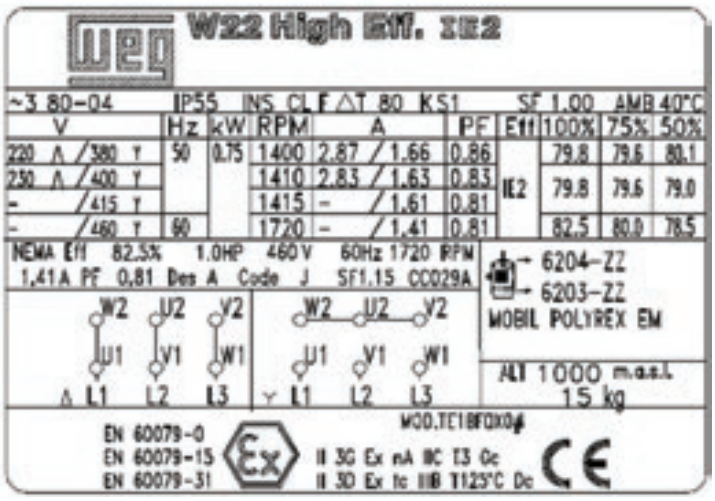
Do not remove the protective grease from the shaft, or the plugs from the cable entries. These protections must remain in place until the installation has been completed.

2.3. NAMEPLATES

The nameplate contains information that describes the construction characteristics and the performance of the motor. Figure 2-1, Figure 2-2, Figure 2-3 and Figure 2-4 show nameplate layout examples.







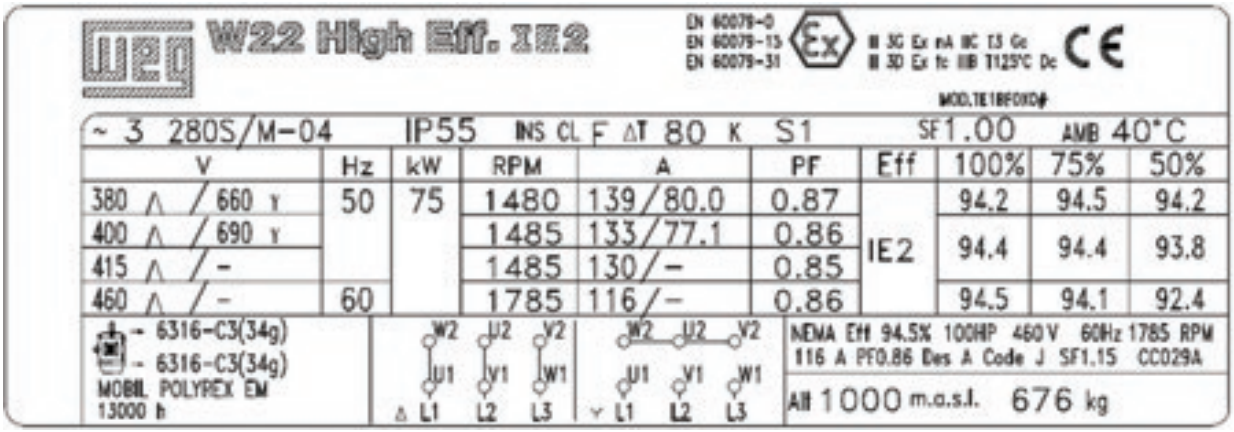
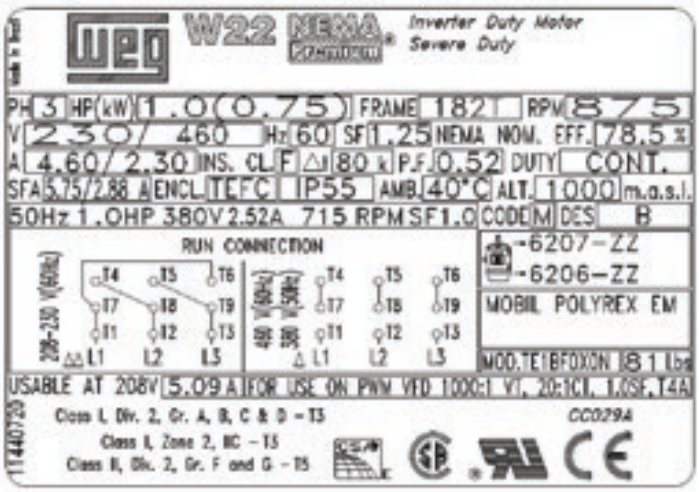


Figure 2.1 - *IEC motor nameplate.*



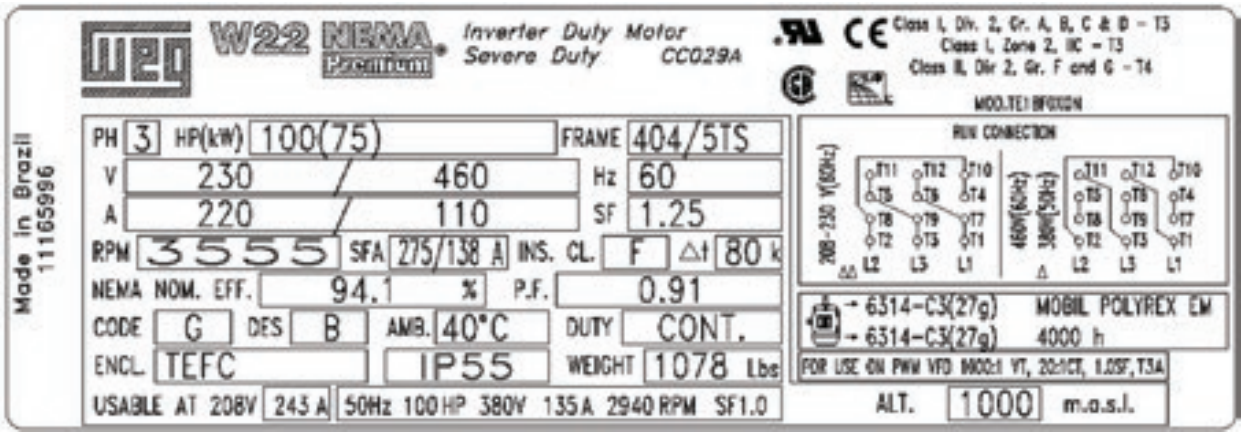


Figure 2.2 – *NEMA motor nameplate.*

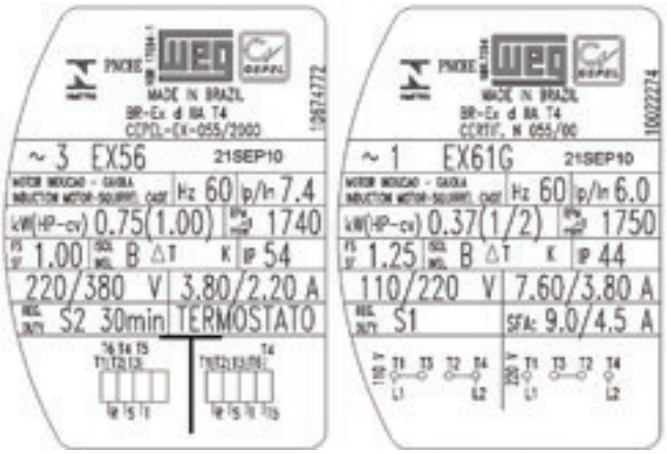


Figure 2.3 - *Nameplate of fuel pump motor.*

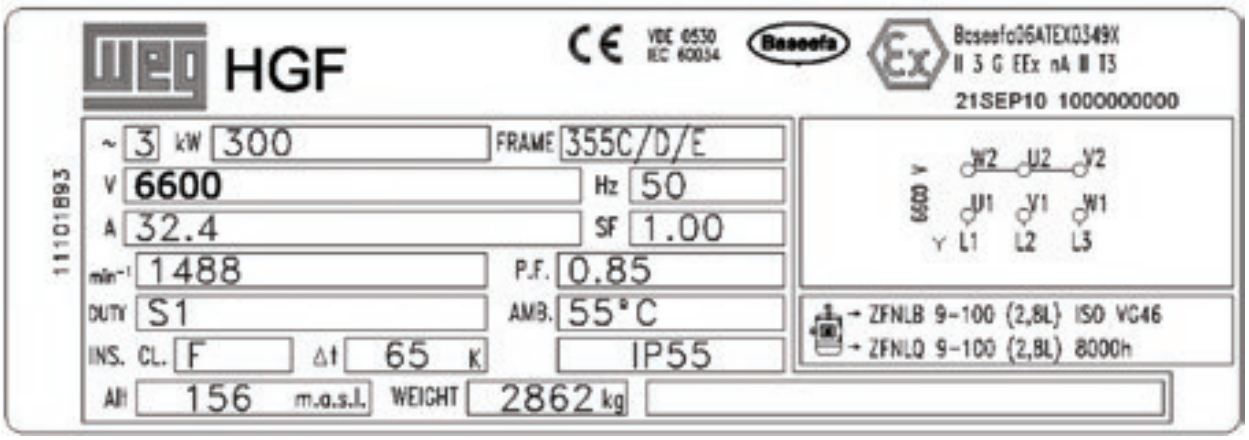


Figure 2.4 - HGF motor nameplate.

Number	Symbol	Features
1		Motor code (SAP material)
2	~	Number of phases
3	V	Rated voltage (V)
4	REG. / DUTY	Duty
5	REND. / NOM. EFF. / EFF.	Efficiency (%)
6	CARC. / FRAME	Frame
7	IP	Degree of protection
8	ISOL. / INSL. / INS.CL.	Insulation class
9	ΔT	Temperature rise (K)
10	Hz	Frequency (Hz)
11	kW (HP-cv) / kW / HP	Output (kW / HP / cv)
12	RPM / min^{-1}	Revolution per minute (RPM)
13	A	Rated current (A)
14	F.P / P.F	Power factor
15	AMB.	Ambient Temperature (°C)
16	F.S. / S.F.	Service factor
17	ALT.	Altitude (m.a.s.l.)
18	kg / lb / WEIGHT	Weight (kg / lb)
19		DE bearing specification and amount of grease
20		NDE bearing specification and amount of grease
21		Grease type used for bearing lubrication
22		Lubrication interval (h)
23		Connection diagram
24		Hazardous areas / Type of protection / Certificate[1)]
25	$I_A / I_N / I_P / I_N$	Starting current / rated current relationship
26	CAT. / DES.	Design
27	I.F.S. / S.F.A.	Service factor amps (A)
28		Serial number

The product certificates can be obtained from WEG. Please contact WEG nearest Office.

Motor marking intended for use in hazardous areas: the marking system is indicated according to the standards applicable for each type of protection:

Marking according to IEC				
Ex equipment	**Type of protection**	**Apparatus grouping for gas or dust**	**Temperature Class**	**Equipment Protection Level EPL**
Ex	nA	II	T3	Gc
	e	II	T3	Gb
	d	IIB	T4	
		IIC		
	de	IIB		
		IIC		
	tc	IIIB	T125 °C	Dc
	tb	IIIC		Db
	d	I	T4	Mb

Marking according to NEC			
Class	**Division or Zone**	**Apparatus grouping for gas or dust**	**Temperature class**
Class I	Div. 1	Gr. C and D	T4
Class II	Div. 1	Gr. E, F and G	T4
Class I	Zona 1	IIB	T4
Class II	Zona 21	IIIC	T125 °C
Class II	Zona 22	IIIB	T125 °C
Class I	Div. 2	Gr. A, B, C and D	T3

** Other temperature classes are available upon request.*

Marking according to ATEX							
Apparatus grouping	**Equipment category**	**Gas, dust or mine**	**Ex equipment**	**Type of protection**	**Apparatus grouping for gas or dust**	**Temperature class**	**Equipment Protection Level (EPL)**
II	3	G	Ex	nA	II	T3	Gc
	2			e	II	T3	Gb
				d	IIB	T4	
					IIC		
				de	IIB		
					IIC		
	3	D		tc	IIIB	T125 °C	Dc
	2			tb	IIIC		Db
I	2	M		d	I	T4	Mb

** Other temperature classes are available upon request.*

ENGLISH

3. SAFETY INSTRUCTIONS



The motor must be disconnected from the power supply and be completely stopped before conducting any installation or maintenance procedures. Additional measures should be taken to avoid accidental motor starting.



Professionals working with electrical installations, either in the assembly, operation or maintenance, should use proper tools and be instructed on the application of standards and safety requirements, including the use of Personal Protective Equipment (PPE) that must be carefully observed in order to reduce risk of personal injury during these services.



Electric motors have energized circuits, exposed rotating parts and hot surfaces that may cause serious injury to people during normal operation. It is recommended that transportation, storage, installation, operation and maintenance services are always performed by qualified personnel.

Always follow the safety, installation, maintenance and inspection instructions in accordance with the applicable standards in each country.

4. HANDLING AND TRANSPORT

Individually packaged motors should never be lifted by the shaft or by the packaging. They must be lifted only by means of the eyebolts, when supplied. Use always suitable lifting devices to lift the motor. Eyebolts on the frame are designed for lifting the machine weight only as indicated on the motor nameplate. Motors supplied on pallets must be lifted by the pallet base with lifting devices fully supporting the motor weight.

The package should never be dropped. Handle it carefully to avoid bearing damage.

Eyebolts provided on the frame are designed for lifting the machine only. Do not use these eyebolts for lifting the motor with coupled equipment such as bases, pulleys, pumps, reducers, etc.

Never use damaged, bent or cracked eyebolts. Always check the eyebolt condition before lifting the motor.

Eyebolts mounted on components, such as on end shields, forced ventilation kits, etc. must be used for lifting these components only. Do not use them for lifting the complete machine set.

Handle the motor carefully without sudden impacts to avoid bearing damage and prevent excessive mechanical stresses on the eyebolts resulting in its rupture.

To move or transport motors with cylindrical roller bearings or angular contact ball bearings, use always the shaft locking device provided with the motor.
All HGF motors, regardless of bearing type, must be transported with shaft locking device fitted.

4.1. LIFTING

Before lifting the motor ensure that all eyebolts are tightened properly and the eyebolt shoulders are in contact with the base to be lifted, as shown in Figure 4.1. Figure 4.2 shows an incorrect tightening of the eyebolt.
Ensure that lifting machine has the required lifting capacity for the weight indicated on the motor nameplate.

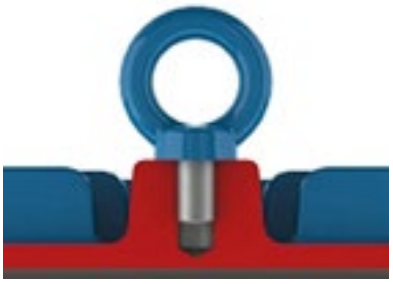


Figure 4.1 *– Correct tightening of the eyebolt*



Figure 4.2 *– Incorrect tightening of the eyebolt.*

The center-of-gravity may change depending on motor design and accessories. During the lifting procedures the maximum allowed angle of inclination should never be exceeded as specified below.

4.1.1. Horizontal motors with one eyebolt

For horizontal motors fitted with only one eyebolt, the maximum allowed angle-of-inclination during the lifting process should not exceed 30º in relation to the vertical axis, as shown in Figure 4.3.

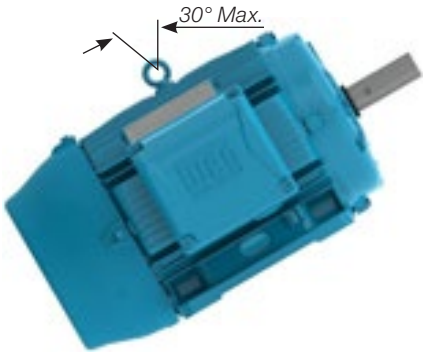


Figure 4.3 *– Maximum allowed angle-of-inclination for motor with one eyebolt.*

4.1.2. Horizontal motor with two eyebolts

When motors are fitted with two or more eyebolts, all supplied eyebolts must be used simultaneously for the lifting procedure.

There are two possible eyebolt arrangements (vertical and inclined), as shown below:

- For motors with vertical lifting eyebolts, as shown in Figure 4.4, the maximum allowed lifting angle should not exceed 45° in relation to the vertical axis. We recommend to use a spreader beam for maintaining the lifting elements (chain or rope) in vertical position and thus preventing damage to the motor surface.



Figure 4.4 *– Maximum resulting angle for motors with two or more lifting eyebolts.*

- For HGF motors, as shown in Figure 4.5, the maximum resulting angle should not exceed 30° in relation to the vertical axis.

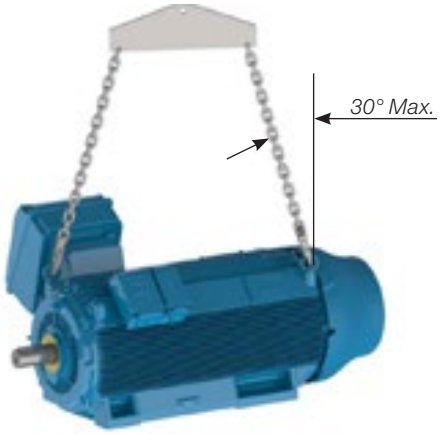


Figure 4.5 *– Maximum resulting angle for horizontal HGF motors*

- For motors fitted with inclined eyebolts, as shown in Figure 4.6, the use of a spreader beam is required for maintaining the lifting elements (chain or rope) in vertical position and thus preventing damage to the motor surface.



Figure 4.6 *– Use of a spreader beam for lifting.*

4.1.3. Vertical Motors

For vertical mounted motors, as shown in Figure 4.7, the use of a spreader beam is required for maintaining the lifting element (chain or rope) in vertical position and thus preventing damage to the motor surface.



Figure 4.7 *– Lifting of vertical mounted motors.*

Always use the eyebolts mounted on the top side of the motor, diametrically opposite, considering the mounting position. See Figure 4.8.



Figure 4.8 *– Lifting of HGF motors.*

4.1.3.1. Procedures to place W22 motors in the vertical position

For safety reasons during the transport, vertical mounted Motors are usually packed and supplied in horizontal position.
To place W22 motors fitted with eyebolts (see Figure 4.6), to the vertical position, proceed as follows:

1. Ensure that the eyebolts are tightened properly, as shown in Figure 4.1;
2. Remove the motor from the packaging, using the top mounted eyebolts, as shown in Figure 4.9;



Figure 4.9 *– Removing the motor from the packaging.*

3. Install a second pair of eyebolts, as shown in Figure 4.10;



Figure 4.10 *– Installation of the second pair of eyebolts.*

4. Reduce the load on the first pair of eyebolts to start the motor rotation, as shown in Figure 4.11. This procedure must be carried out slowly and carefully.



Figure 4.11 *– End result: motor placed in vertical position.*

These procedures will help you to move motors designed for vertical mounting. These procedures are also used to place the motor from the horizontal position into the vertical position and vertical to horizontal.

4.1.3.2. Procedures to place HGF motors in the vertical position

HGF motors are fitted with eight lifting points: four at drive end and four at non-drive end. The HGF motors are usually transported in horizontal position, however for the installation they must be placed in the vertical position.
To place an HGF motor in the vertical position, proceed as follows:

1. Lift the motor by using the four lateral eyebolts and two hoists, see Figure 4.12;



Figure 4.12 *– Lifting HGF motor with two hoists.*

2. Lower the hoist fixed to motor drive end while lifting the hoist fixed to motor non-drive end until the motor reaches its equilibrium, see Figure 4.13.



Figure 4.13 *– Placing HGF motor in vertical position*

3. Remove the hoist hooks from the drive end eyebolts and rotate the motor 180° to fix the removed hooks into the two eyebolts at the motor non-drive end, see Figure 4.14.



Figure 4.14 *– Lifting HGF motors by the eyebolts at the non-drive end.*

4. Fix the removed hoist hooks in the other two eyebolts at the non-drive end and lift the motor until the vertical position is reached, see Figure 4.15.



Figure 4.15 *– HGF motor in the vertical position*

These procedures will help you to move motors designed for vertical mounting. These procedures are also used to place the motor from the horizontal position into the vertical position and vertical to horizontal.

4.2 Procedures to place W22 vertical mount motors in horizontal position

To place W22 vertical mount motor in horizontal position, proceed as follows:

1. Ensure that all eyebolts are tightened properly, as shown in Figure 4.1;

2. Install the first pair of eyebolts and lift the motor as shown in Figure 4.16;



Figure 4.16 – *Install the first pair of eyebolts*

3. Install the second pair of eyebolts, as shown in Figure 4.17;



Figure 4.17 – *Install the second pair of eyebolts*

4. Reduce the load on the first pair of eyebolts for rotating the motor, as shown in Figure 4.18. This procedure must be carried out slowly and carefully.



Figure 4.18 – *Motor is being rotated to horizontal position*

5. Remove the first pair of eyebolts, as shown in Figure 4.19.



Figure 4.19 – *Final result: motor placed in horizontal position*

5. STORAGE

If the motor is not installed immediately, it must be stored in a dry and clean environment, with relative humidity not exceeding 60%, with an ambient temperature between 5 °C and 40 °C, without sudden temperature changes, free of dust, vibrations, gases or corrosive agents. The motor must be stored in horizontal position, unless specifically designed for vertical operation, without placing objects on it. Do not remove the protection grease from shaft end to prevent rust.

If the motor are fitted with space heaters, they must always be turned on during the storage period or when the installed motor is out of operation. Space heaters will prevent water condensation inside the motor and keep the winding insulation resistance within acceptable levels. Store the motor in such position that the condensed water can be easily drained. If fitted, remove pulleys or couplings from the shaft end (more information are given on item 6).

The space heaters should never be energized when the motor is in operation.
For the use of space heaters in motors that are stored in hazardous area, adopt the same cable inlet and connection requirements described in item 6.

5.1. EXPOSED MACHINED SURFACES

All exposed machined surfaces (like shaft end and flange) are factory-protected with temporary rust inhibitor. A protective film must be reapplied periodically (at least every six months), or when it has been removed and/or damaged.

5.2. STORAGE

The stacking height of the motor packaging during the storage period should not exceed 5 m, always considering the criteria indicated in Table 5.1:

Table 5.1 *– Max. recommended stacking height*

Packaging Type	Frame sizes	Maximum stacking quantity
Cardboard box	IEC 63 to 132 NEMA 143 to 215	Indicated on the top side of the cardboard box
Wood crate	IEC 63 to 315 NEMA 48 to 504/5	06
	IEC 355 NEMA 586/7 and 588/9	03
	HGF IEC 315 to 630 HGF NEMA 5000 to 9600	Indicated on the packaging

Notes*:*
1) Never stack larger packaging onto smaller packaging.
2) Align the packaging correctly (see Figure 5.1 and Figure 5.2).

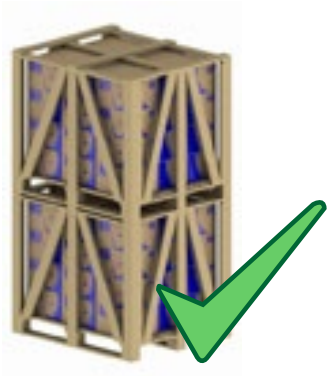


Figure 5.1 *– Correct stacking*

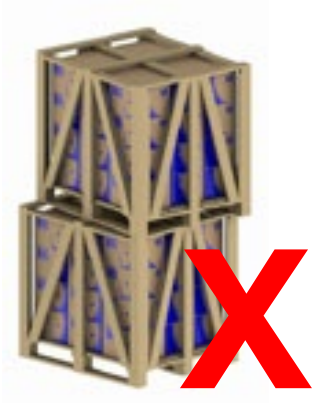


Figure 5.2 *– Incorrect stacking*

3) The feet of the crates above should always be supported by suitable wood battens (Figure 5.3) and never stand on the steel tape or without support (Figure 5.4).

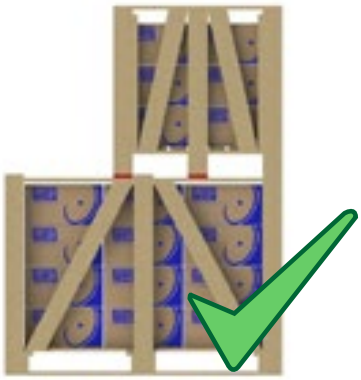


Figure 5.3 – Correct stacking

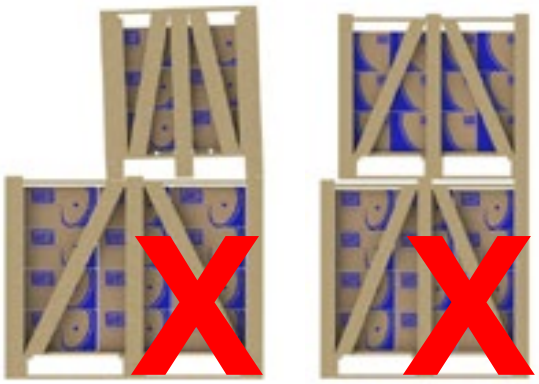


Figure 5.4 – Incorrect stacking

4) When stacking smaller crates onto longer crates, always ensure that suitable wooden supports are provided to withstand the weight (see Figure 5.5). This condition usually occurs with motor packaging above IEC 225S/M (NEMA 364/5T) frame sizes.

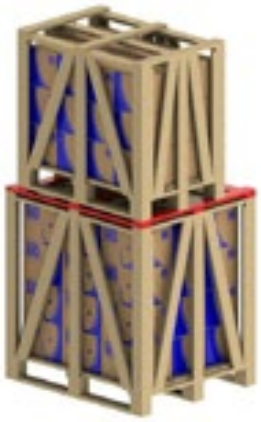


***Figure 5.5** – Use of additional battens for stacking*

5.3 BEARINGS

5.3.1 Grease lubricated bearings

We recommend rotating the motor shaft at least once a month (by hand, at least five revolutions, stopping the shaft at a different position from the original one). If the motor is fitted with shaft locking device, remove it before rotating the shaft and install it again before performing any handling procedure. Vertical motors may be stored in the vertical or in horizontal position. If motors with open bearings are stored longer than six months, the bearings must be relubricated according to Item 8.2 before commissioning of the motor.
If the motor is stored for longer than 2 years, the bearings must be replaced or removed, washed, inspected and relubricated according to Item 8.2.

5.3.2 Oil Lubricated bearings

The motor must be stored in its original operating position and with oil in the bearings. Correct oil level must be ensured. It should be in the center of the sight glass.
During the storage period, remove the shaft locking device and rotate the shaft by hand every month, at least five revolutions, thus achieving an even oil distribution inside the bearing and maintaining the bearing in good operating conditions. Reinstall the shaft locking device every time the motor has to be moved.
If the motor is stored for a period of over six months, the bearings must be relubricated according to Item 8.2 before starting the operation. If the motor is stored for a period of over two years, the bearings must be replaced or removed, washed according to manufacturer instructions, checked and relubricated according to Item 8.2. The oil of vertical mounted motors that are transported in horizontal position is removed to prevent oils leaks during the transport. These motors must be stored in vertical position after receiving and the bearing must be lubricated.

5.3.3 Oil Mist lubricated bearings

The motor must be stored in horizontal position. Lubricate the bearings with ISO VG 68 mineral oil in the amount indicated in the Table 5.2 (this is also valid for bearings with equivalent dimensions). After filling with oil, rotate the shaft by hand, at least five revolutions)
During the storage period, remove the shaft locking device (if any) and rotate the shaft by hand every week, at least five revolutions, stopping it at a different position from the original one. Reinstall the shaft locking device every time the motor has to be moved. If the motor is stored for a period of over two years, the bearings must be replaced or removed, washed according to manufacturer instructions, checked and relubricated according to item 8.2.

Table 5.2 – *Amount of oil per bearing*

Bearing Size	Amount of Oil (ml)	Bearing Size	Amount of Oil (ml)
6201	15	6309	65
6202	15	6311	90
6203	15	6312	105
6204	25	6314	150
6205	25	6315	200
6206	35	6316	250
6207	35	6317	300
6208	40	6319	350
6209	40	6320	400
6211	45	6322	550
6212	50	6324	600
6307	45	6326	650
6308	55	6328	700

The oil must always be removed when the motor has to be handled. If the oil mist system is not operating after installation, fill the bearings with oil to prevent bearing rusting. During the storage period, rotate the shaft by hand, at least five revolutions, stopping it at a different position from the original one. Before starting the motor, all bearing protection oil must be drained from the bearing and the oil mist system must be switched ON.

5.3.4 Sleeve Bearing

The motor must be stored in its original operating position and with oil in the bearings. Correct oil level must be ensured. It should be in the middle of the sight glass. During the storage period, remove the shaft locking device and rotate the shaft by hand every month, at least five revolutions (and at 30 rpm), thus achieving an even oil distribution inside the bearing and maintaining the bearing in good operating conditions. Reinstall the shaft locking device every time the motor has to be moved.
If the motor is stored for a period of over six months, the bearings must be relubricated according to the Item 8.2 before starting the operation.

If the motor is stored for a period longer than the oil change interval, or if it is not possible to rotate the motor shaft by hand, the oil must be drained and a corrosion protection and dehumidifiers must be applied.

5.4. INSULATION RESISTANCE

We recommend measuring the winding insulation resistance at regular intervals to follow-up and evaluate its electrical operating conditions. If any reduction in the insulation resistance values are recorded, the storage conditions should be evaluated and corrected, where necessary.

5.4.1. Insulation resistance measurement

We recommend measuring the winding insulation resistance at regular intervals to follow-up and evaluate its electrical operating conditions. If any reduction in the insulation resistance values are recorded, the storage conditions should be evaluated and corrected, where necessary.



The insulation resistance must be measured in a safe environment.

The insulation resistance must be measured with a megohmmeter. The machine must be in cold state and disconnected from the power supply.

To prevent the risk of an electrical shock, ground the terminals before and after each measurement. Ground the capacitor (if any) to ensure that it is fully discharged before the measurement is taken.

It is recommended to insulate and test each phase separately. This procedure allows the comparison of the insulation resistance between each phase. During the test of one phase, the other phases must be grounded. The test of all phases simultaneously evaluates the insulation resistance to ground only but does not evaluate the insulation resistance between the phases.
The power supply cables, switches, capacitors and other external devices connected to the motor may considerably influence the insulation resistance measurement. Thus all external devices must be disconnected and grounded during the insulation resistance measurement.
Measure the insulation resistance one minute after the voltage has been applied to the winding. The applied voltage should be as shown in Table 5.3.

Table 5.3 *– Voltage for the insulation resistance*

Winding rated voltage (V)	Testing voltage for measuring the insulation resistance (V)
< 1000V	500
1000 - 2500	500 - 1000
2501 - 5000	1000 - 2500
5001 - 12000	2500 - 5000
> 12000	5000 - 10000

The reading of the insulation resistance must be corrected to 40 °C as shown in the Table 5.4.

Table 5.4 *– Correction Factor for the Insulation Resistance corrected to 40 °C*

Measuring temperature of the insulation resistance (°C)	Correction factor of the insulation resistance corrected to 40 °C	Measuring temperature of the insulation resistance (°C)	Correction factor of the insulation resistance corrected to 40 °C
10	0.125	30	0.500
11	0.134	31	0.536
12	0.144	32	0.574
13	0.154	33	0.616
14	0.165	34	0.660
15	0.177	35	0.707
16	0.189	36	0.758
17	0.203	37	0.812
18	0.218	38	0.871
19	0.233	39	0.933
20	0.250	40	1.000
21	0.268	41	1.072
22	0.287	42	1.149
23	0.308	43	1.231
24	0.330	44	1.320
25	0.354	45	1.414
26	0.379	46	1.516
27	0.406	47	1.625
28	0.435	48	1.741
29	0.467	49	1.866
30	0.500	50	2.000

The motor insulation condition must be evaluated by comparing the measured value with the values indicated in Table 5.5 (corrected to 40 °C):

Table 5.5 *– Evaluation of the insulation system*

Limit value for rated voltage up to 1.1 kV (MΩ)	Limit value for rated voltage above 1.1 kV (MΩ)	Situation
Up to 5	Up to 100	Dangerous. The motor can not be operated in this condition
5 to 100	100 to 500	Regular
100 to 500	Higher than 500	Good
Higher than 500	Higher than 1000	Excellent

The values indicated in the table should be considered only as reference values. It is advisable to log all measured values to provide a quick and easy overview on the machine insulation resistance.
If the insulation resistance is low, moisture may be present in the stator windings. In this case the motor should be removed and transported to a WEG authorized Service Center for proper evaluation and repair (This service is not covered by the warranty). To improve the insulation resistance through the drying process, see section 8.4.

6. INSTALLATION

The installation of electric motors in hazardous areas must be always performed by qualified personnel with knowledge on relevant standards and safety rules.

Check some aspects before proceeding with the installation:

1. Insulation resistance: must be within the acceptable limits. See item 5.4.
2. Bearings:
   If the electric motor is installed without running immediately, proceed as described in item 5.3.
3. Operating conditions of the start capacitors: If single-phase motors are stored for a period of over two years, it is recommended to change the start capacitors before motor starting since they lose their operating characteristics.
4. Terminal box:
   a. the inside of the terminal box must be clean and dry.
   b. the contacts must be correctly connected and corrosion free. See 6.9 and 6.10.
   c. the cable entries must be correctly sealed and the terminal box cover properly mounted in order to ensure the degree of protection indicated on the motor nameplate.
5. Cooling: the cooling fins, air inlet and outlet openings must be clean and unobstructed. The distance between the air inlet openings and the wall should not be shorter than ¼ (one quarter) of the diameter of the air inlet. Ensure sufficient space to perform the cleaning services. See item 7.
6. Coupling: remove the shaft locking device (where fitted) and the corrosion protection grease from the shaft end and flange just before installing the motor. See item 6.4.
7. Drain hole: the motor must always be positioned so the drain hole is at the lowest position (If there is any indication arrow on the drain, the drain must be so installed that the arrow points downwards).
   Motors supplied with rubber drain plugs leave the factory in the closed position and must be opened periodically to allow the exit of condensed water. For environments with high water condensation levels and motor with degree of protection IP55, the drain plugs can be mounted in open position (see Figure 6.1).
   For motors with degree of protection IP56, IP65 or IP66, the drain plugs must remain at closed position (see Figure 6.1), being opened only during the motor maintenance procedures.
   The drain system of motors with Oil Mist lubrication system must be connected to a specific collection system (see Figure 6.12).

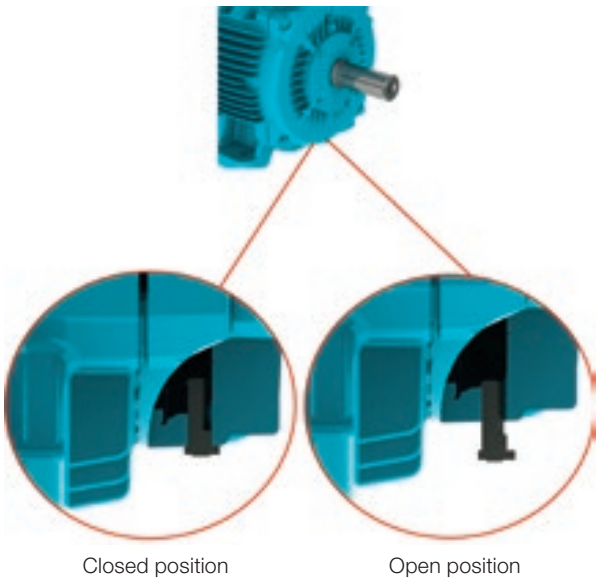


Figure 6.1 *– Detail of the rubber drain plug mounted in closed and open position.*

8.Additional recommendations:
a. Check the direction of motor rotation, starting the motor at no-load before coupling it to the load.
b. Vertical mounted motors with shaft end down must be fitted with drip cover to protect them from liquids or solids that may drop onto the motors.
c. Vertical mounted motors with shaft end up should be fitted with water slinger ring to prevent water ingress inside the motor.
d. The fixing elements mounted in the threaded through holes in the motor enclosure (for example, the flange) must be properly sealed.

Remove or fix the shaft key before starting the motor.

6.1. FOUNDATIONS

The foundation is the structure, structural element, natural or prepared base, designed to withstand the stresses produced by the installed equipment, ensuring safe and stable performance during operation. The foundation design should consider the adjacent structures to avoid the influences of other installed equipment and no vibration is transferred through the structure.

The foundation must be flat and its selection and design must consider the following characteristics:

a) The features of the machine to be installed on the foundation, the driven loads, application, maximum allowed deformations and vibration levels (for instance, motors with reduced vibration levels, foot flatness, flange concentricity, axial and radial loads, etc. lower than the values specified for standard motors).

b) Adjacent buildings, conservation status, maximum applied load estimation, type of foundation and fixation and vibrations transmitted by theses constructions.

If the motor is supplied with leveling/alignment bolts, this must be considered in the base design.

Please consider for the foundation dimensioning all stresses that are generated during the operation of the driven load.
The user is responsible for the foundation designing and construction.

The foundation stresses can be calculated by using the following equations (see Figure 6.2):

$$F_1 = 0,5 * g * m - (4 * T_b / A)$$
$$F_2 = 0,5 * g * m + (4 * T_b / A)$$

Where:

F_1 and F_2 = lateral stresses (N);
g = gravitational acceleration (9,8 m/s^2);
m = motor weight (kg);
T_b = breakdown torque (Nm);
A = distance between centerlines of mounting holes in feet or base of the machine (end view) (m).

The motors may be mounted on:
- Concrete bases: are most used for large-size motors (see Figure 6.2);
- Metallic bases: are generally used for small-size motors (see Figure 6.3).

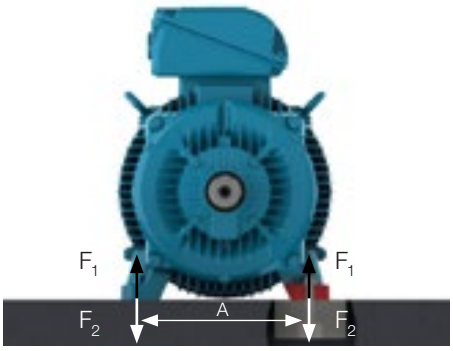


Figure 6.2 *– Motor installed on concrete base*



Figure 6.3 *– Motor installed on metallic base*

The metallic and concrete bases may be fitted with sliding system. These types of foundations are generally used where the power transmission is achieved by belts and pulleys. This power transmission system is easier to assemble/disassemble and allows the belt tension adjustment. Other important aspect of this foundation type is the location of the base locking screws that must be diagonally opposite. The rail nearest the drive pulley is placed in such a way that the positioning bolt is between the motor and the driven machine. The other rail must be placed with the bolt on the opposite side (diagonally opposite), as shown in Figure 6.4 .

To facilitate assembly, the bases may have the following features:

- shoulders and/or recesses;
- anchor bolts with loose plates;
- bolts cast in the concrete;
- leveling screws;
- positioning screws;
- steel & cast iron blocks, plates with flat surfaces.

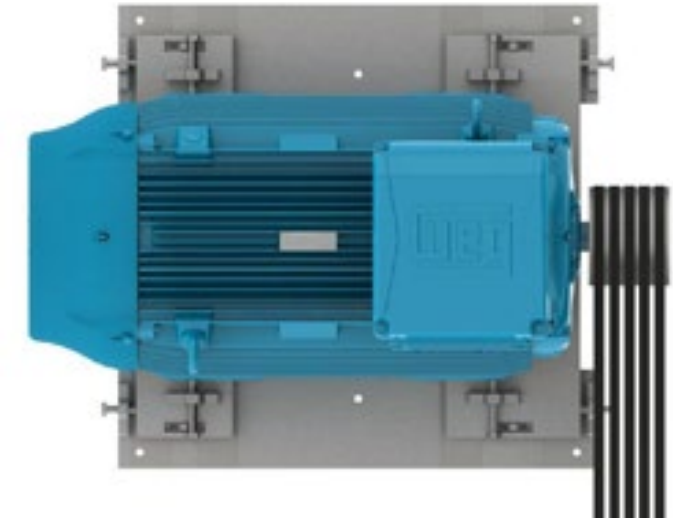


Figure 6.4 *– Motor installed on sliding base*

After completing the installation, it is recommended that all exposed machined surfaces are coated with suitable rust inhibitor.

6.2. MOTOR MOUNTING

Footless motors supplied with transportation devices, according to Figure 6.5, must have their devices removed before starting the motor installation.

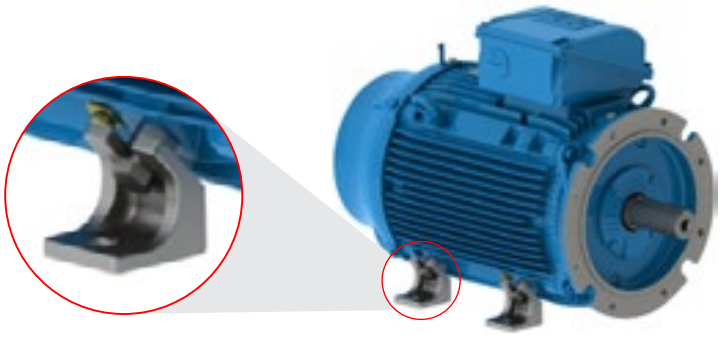


Figure 6.5 *- Detail of the transportation devices for footless motors.*

6.2.1. Foot mounted motors

The drawings of the mounting hole dimensions for NEMA or IEC motors can be checked in the respective technical catalogue.
The motor must be correctly aligned and leveled with the driven machine. Incorrect alignment and leveling may result in bearing damage, generate excessive vibration and even shaft distortion/breakage.
For more details, see section 6.5 and 6.6. The thread engagement length of the mounting bolt should be at least 1.5 times the bolt diameter. This thread engagement length should be evaluated in more severe applications and increased accordingly.
Figure 6.6 shows the mounting system of a foot mounted motor indicating the minimum required thread engagement length.

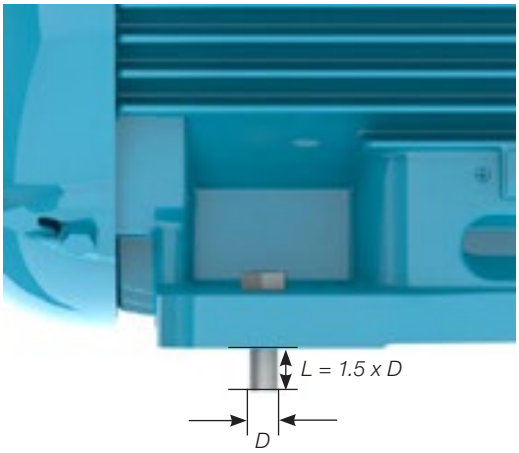


Figure 6.6 *– Mounting system of a foot mounted motor*

6.2.2. Flange mounted motors

The drawings of the flange mounting dimensions, IEC and NEMA flanges, can be checked in the technical catalogue.
The coupling of the driven equipment to the motor flange must be properly dimensioned to ensure the required concentricity of the assembly.
Depending on the flange type, the mounting can be performed from the motor to the driven equipment flange (flange FF (IEC) or D (NEMA)) or from the driven equipment flange to the motor (flange C (DIN or NEMA)).
For the mounting process from the driven equipment flange to the motor, you must consider the bolt length, flange thickness and the thread depth of the motor flange.

If the motor flange has tapped through-holes, the length of the mounting bolts must not exceed the tapped through-hole length of the motor flange, thus preventing damage to the winding head.

For flange mounting the thread engagement length of the mounting bolt should be at least 1.5 times the bolt diameter. In severe applications, longer thread engagement length may be required.
In severe applications or if large motors are flange mounted, a foot or pad mounting may be required in addition to the flange mounting (Figure 6.7). The motor must never be supported on its cooling fins.



Figure 6.7 *- Mounting method of flange mounted motors with frame base support*

Note*:*
When liquid (for example oil) is likely to come into contact with the shaft seal, please contact your local WEG representative.

6.2.3. Pad mounted motors

Typically, this method of mounting is used in axial fans. The motor is fixed by tapped holes in the frame. The dimensions of these tapped holes can be checked in the respective product catalogue. The selection of the motor mounting rods/bolts must consider the dimensions of the fan case, the installation base and the thread depth in the motor frame.
The mounting rods and the fan case wall must be sufficiently stiff to prevent the transmission of excessive vibration to the machine set (motor & fan). Figure 6.8 shows the pad mounting system.

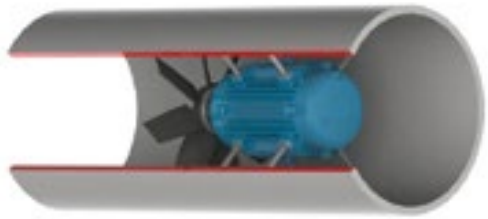


Figure 6.8 *– Mounting of the motor inside the cooling duct*

6.3. BALANCING

Unbalanced machines generate vibration which can result in damage to the motor. WEG motors are dynamically balanced with “half key” and without load (uncoupled). Special balancing quality level must be stated in the Purchase Order.

The transmission elements, such as pulleys, couplings, etc., must balanced with “half key” before they are mounted on the motor shaft.

The balance quality grade meets the applicable standards for each product line.

The maximum balancing deviation must be recorded in the installation report

6.4. COUPLINGS

Couplings are used to transmit the torque from the motor shaft to the shaft of the driven machine. The following aspects must be considered when couplings are installed:

- Use proper tools for coupling assembly & disassembly to avoid damages to the motor and bearings.
- Whenever possible, use flexible couplings, since they can absorb eventual residual misalignments during the machine operation.
- The maximum loads and speed limits informed in the coupling and motor manufacturer catalogues cannot be exceeded.
- Level and align the motor as specified in sections 6.5 and 6.6, respectively.

Remove or fix the shaft key firmly when the motor is operated without coupling in order to prevent accidents.

6.4.1. Direct coupling

Direct coupling is characterized when the Motor shaft is directly coupled to the shaft of the driven machine without transmission elements. Whenever possible, use direct coupling due to lower cost, less space required for installation and more safety against accidents.

Do not use roller bearings for direct coupling unless sufficient radial load is expected.

6.4.2. Gearbox coupling

Gearbox coupling is typically used where speed reduction is required.
Make sure that shafts are perfectly aligned and strictly parallel (in case of straight spur gears) and in the right meshing angle (in case of bevel and helical gears).

6.4.3. Pulley and belt coupling

Pulleys and belts are used when speed increase or reduction between motor shaft and driven load is required.

Excessive belt tension will damage the bearings and cause unexpected accidents such as breakage of the motor shaft.

To prevent the buildup of static electricity in the belt drive system, use only properly grounded belts in conductive construction.

6.4.4. Coupling of sleeve bearing motors

Motors designed with sleeve bearings must be operated with direct coupling to the driven machine or a gearbox. Pulley and belts can not be applied for sleeve bearing motors.

Motors designed with sleeve bearings have 3 (three) marks on the shaft end. The center mark is the indication of the magnetic center and the 2 (two) outside marks indicate the allowed limits of the rotor axial movement, as shown in Figure 6.9.
The motor must be so coupled that during operation the arrow on the frame is placed over the central mark indicating the rotor magnetic center. During start-up, or even during operation, the rotor may freely move between the two outside marks when the driven machine exerts an axial load on the motor shaft. However, under no circumstance, the motor can operate continuously with axial forces on the bearing.

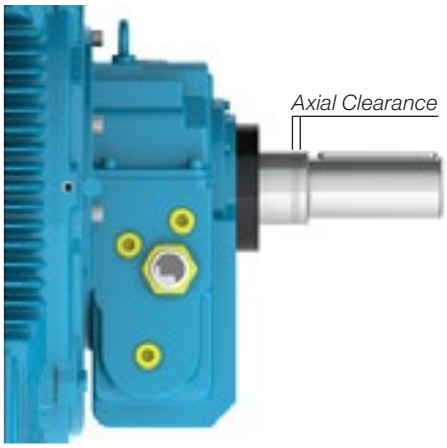


Figure 6.9 *- Axial clearance of motor designed with sleeve bearing*

For coupling evaluation consider the maximum axial bearing clearance as shown in Table 6.1.
The axial clearance of the driven machine and coupling influence the maximum bearing clearance.

Table 6.1 *– Clearance used for sleeve bearings*

Bearing size	Total axial clearance (mm)
9*	3 + 3 = 6
11*	4 + 4 = 8
14*	5 + 5 =10
18	7,5 + 7,5 = 15

** For Motors in accordance with API 541, the total axial clearance is 12.7 mm*

The sleeve bearings used by WEG were not designed to support axial load continuously.
Under no circumstance must the motor be operated continuously at its axial clearance limits.

6.5. LEVELING

The motor must be leveled to correct any deviations in flatness arising from the manufacturing process and the material structure rearrangement. The leveling can be carried out by a leveling screw fixed on the motor foot or on the flange or by means of thin compensation shims. After the leveling process, the leveling height between the motor mounting base and the motor cannot exceed 0.1 mm.
If a metallic base is used to level the height of the motor shaft end and the shaft end of the driven machine, level only the metallic base relating to the concrete base.

Record the maximum leveling deviations in the installation report.

6.6. ALIGNMENT

The correct alignment between the motor and the driven machine is one of the most important variables that extends the useful service life of the motor. Incorrect coupling alignment generates high loads and vibrations reducing the useful life of the bearings and even resulting in shaft breakages. Figure 6.10 illustrates the misalignment between the motor and the driven machine.

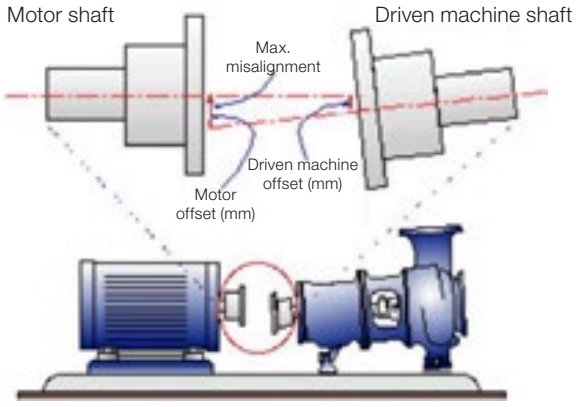
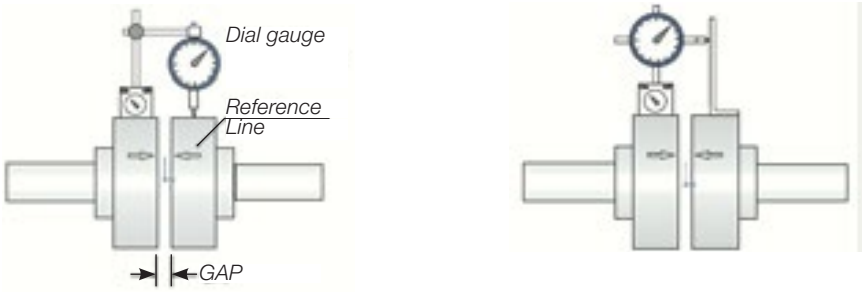


Figure 6.10 *– Typical misalignment condition*

Alignment procedures must be carried out using suitable tools and devices, such as dial gauge, laser alignment instruments, etc. The motor shaft must be aligned axially and radially with the driven machine shaft.

The maximum allowed eccentricity for a complete shaft turn should not exceed 0.03 mm, when alignment is made with dial gauges, as shown in Figure 6.11. Ensure a gap between couplings to compensate the thermal expansion between the shafts as specified by the coupling manufacturer.



Parallel alignment *Angular alignment*

Figure 6.11 *– Alignment with dial gauge.*

If alignment is made by a laser instrument, please consider the instructions and recommendations provided by the laser instrument manufacturer.
The alignment should be checked at ambient temperature with machine at operating temperature.

The coupling alignment must be checked periodically

Pulley and belt couplings must be so aligned that the driver pulley center lies in the same plane of the driven pulley center and the motor shaft and the shaft of the driven machine are perfectly parallel.
After completing the alignment procedures, ensure that mounting devices do not change the motor and machine alignment and leveling resulting into machine damage during operation.

It is recommended to record the maximum alignment deviation in the Installation Report.

6.7. CONNECTION OF OIL LUBRICATED OR OIL MIST LUBRICATED MOTORS

When oil lubricated or oil mist lubricated motors are installed, connect the existing lubricant tubes (oil inlet and oil outlet tubes and motor drain tube), as shown in Figure 6.12. The lubrication system must ensure continuous oil flow through the bearings as specified by the manufacturer of the installed lubrication system.

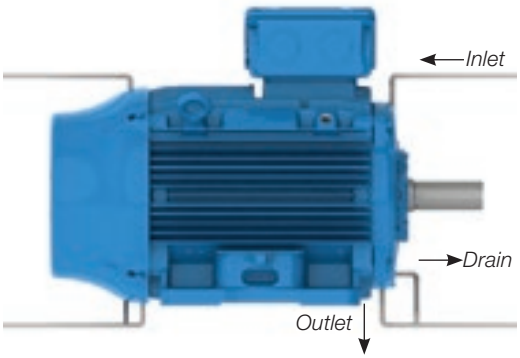


Figure 6.12 *– Oil supply and drain system of oil lubricated or oil mist lubricated motors*

6.8. CONNECTION OF THE COOLING WATER SYSTEM

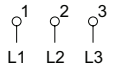
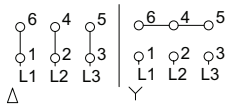
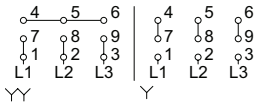
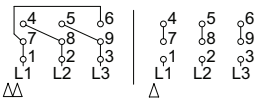
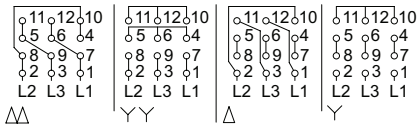
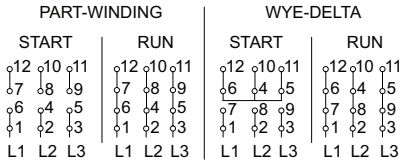
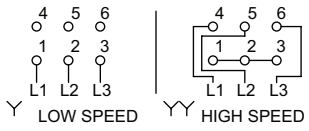
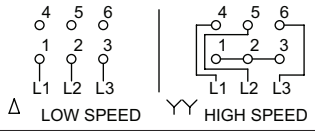
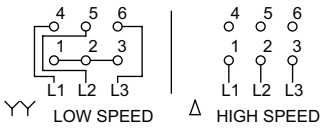
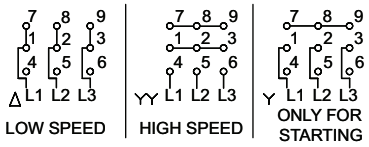
When water cooled motors are installed, connect the water inlet and outlet tubes to ensure proper motor cooling. According to item 7.2, ensure correct cooling water flow rate and water temperature in the motor cooling system.

6.9. ELECTRICAL CONNECTION

Consider the rated motor current, service factor, starting current, environmental and installation conditions, maximum voltage drop, etc. to select appropriate power supply cables and switching and protection devices. All motors must be installed with overload protection systems. Three-phase motors should be fitted with phase fault protection systems.

Before connecting the motor, check if the power supply voltage and the frequency comply with the motor nameplate data. All wiring must be made according to the connection diagram on the motor nameplate. Please consider the connection diagrams in the Table 6.2 as reference value.
To prevent accidents, check if motor has been solidly grounded in accordance with the applicable standards.

Table 6.2 - Typical connection diagram for three-phase motors.

Configuration	Quantity of Leads	Type of connection	Connection diagram
Single Speed	3	-	
	6	Δ - Y	
	9	YY - Y	
		ΔΔ - Δ	
	12	ΔΔ - YY - Δ - Y	
		Δ - PWS Part-winding start	
Double Speed Dahlander	6	YY - Y Variable Torque	
		Δ - YY Constant Torque	
		YY - Δ Constant Output	
	9	Δ - Y - YY	
Double Speed Double Winding	6	-	

Equivalent table for lead identification													
Lead identification on the wiring diagram		1	2	3	4	5	6	7	8	9	10	11	12
Single Speed	NEMA MG 1 Part 2	T1	T2	T3	T4	T5	T6	T7	T8	T9	T10	T11	T12
	IEC 60034-8	U1	V1	W1	U2	V2	W2	U3	V3	W3	U4	V4	W4
	JIS (JEC 2137) - up to 6 terminals	U	V	W	X	Y	Z						
	JIS (JEC 2137) - above 6 terminals	U1	V1	W1	U2	V2	W2	U5	V5	W5	U6	V6	W6
Double Speed (Dahlander / Double Winding)	NEMA MG 1 Part 2[1)]	1U	1V	1W	2U	2V	2W	3U	3V	3W	4U	4V	4W
	IEC 60034-8	1U	1V	1W	2U	2V	2W	3U	3V	3W	4U	4V	4W
	JIS (JEC 2137)	1U	1V	1W	2U	2V	2W	3U	3V	3W	4U	4V	4W

1) NEMA MG 1 Part 2 defines T1 to T12 for two or more winding, however WEG adopts 1U to 4W.

Connect the motor properly to the power supply by means of safe and permanent contacts.

The grounding connectors are provided inside the terminal box and on the motor frame. Upon request, grounding terminals may be also provided on the motor feet. According to IEC 60079-0, the grounding cable must have a cross-section area of at least 4 mm².

When connectors are used, all wires of the stranded cable must be properly inserted and fixed inside the connector.

If motors are supplied without terminal blocks, insulate the cable terminals with suitable insulation material that meets the power supply voltage and the insulation class indicated on the motor nameplate. The connection must be made outside the hazardous area or protected by a standardized type of protection.

Ensure correct tightening torque for the power cable and grounding connections as specified in Table 8-8.

The clearance distance (see Figure 6.13) between non-insulated live parts with each other and between grounded parts must be as indicated in Table 6.3.

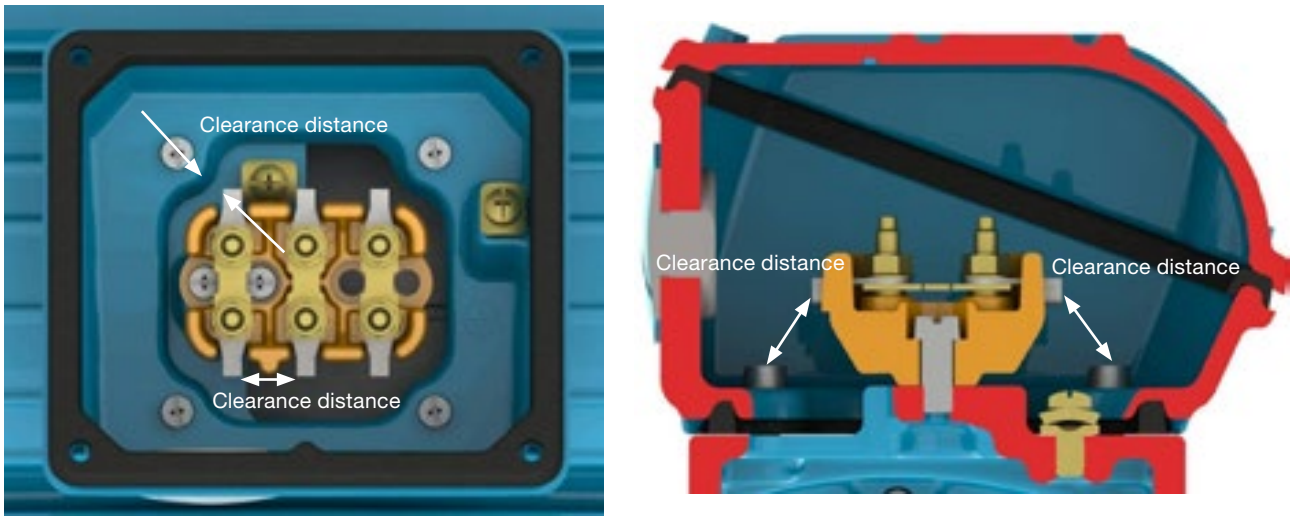


Figure 6.13 *- Clearance distance representation*

Table 6.3 *- Minimum clearance distance (mm) x supply voltage.*

Voltage	Minimum clearance distance (mm) x type of protection	
	Ex e Ex de	**Ex n Ex d Ex t**
U ≤ 440 V	6	4
440 < U ≤ 690 V	10	5.5
690 < U ≤ 1000 V	14	8
1000 < U ≤ 6900 V	60	45
6900 < U ≤ 11000 V	100	70
11000<U ≤ 16500 V	-	105

Even when the motor is off, dangerous voltages may be present inside the terminal box used for the space heater supply or winding energization when the winding is used as heating element.
Motor capacitors will hold a charge even after the power has been cut off. Do not touch the capacitors and/or motor terminals, before discharging the capacitors completely.

After the motor connection has been completed, ensure that no tool or foreign body has been left inside the terminal box.

The thread types and sizes for cable inlet are specified in Table 6.4 and Table 6.5.

Tabela 6.4 *- Thread dimensions for inlet power cables.*

Frame		Threads for power cables		
IEC	**NEMA**	**Pg**	**NPT/Rp/Gk**	**Metric**
-	EX61G	-	1/2"	-
63 71 80 90 100	143/5	Pg11 Pg13.5 Pg16	1/4" 1/2" 3/4"	M20 M25
112 132	182/4 213/5	Pg11 Pg13.5 Pg16 Pg21	1/2" 3/4" 1"	M20 M25 M32
160 180 200	254/6 284/6 324/6	Pg11 Pg13.5 Pg16 Pg21 Pg29 Pg36	1/2" 3/4" 1" 1 1/2"	M20 M25 M32 M40 M50
225 250 280 315 355 400 450 500 560 630	364/5 404/5 444/5 445/7 447/9 L447/9 504/5 5008 586/7 588/9 5800 6800 7000 8000 8800 9600	Pg29 Pg36 Pg42 Pg48	1" 1 1/2" 2" 2 1/2" 3" 4"	M32 M40 M50 M63 M72 M75 M80

Note: *explosion-proof motors are supplied with Metric or NPT threads only.*

Tabela 6.5 *- Thread dimensions for accessory cable inlet.*

Frame		Threads for accessory cables		
IEC	**NEMA**	**Pg**	**NPT/Rp/Gk**	**Metric**
All	All	Pg11 Pg13.5 Pg16 Pg21	1/4" 1/2" 3/4" 1"	M20 M25 M32 M40

Note: *explosion-proof motors are supplied with Metric or NPT threads only.*



Take the required measures in order to ensure the type of protection of enclosure (Ex), the equipment protection level (EPL) and the degree of protection (IP) indicated on the motor nameplate:
- Not-used cable inlet holes in the terminal boxes must be properly closed with certified plugs;
- components supplied loose (for example, terminal boxes mounted separately) must be properly closed and sealed.
The cable entries used must be fitted with components (such as, cable glands and conduits) that meet the applicable standards and regulations for each country. For “Ex d” motors, the conduit entries are permitted only for electrical equipment of group II.



If the motor is fitted with accessories, such as brakes and forced cooling systems, these devices must be connected to the power supply according to the information provided on their nameplates and with special care as indicated above.

All protection devices, including overcurrent protection, must be set according to the rated machine conditions. These protection devices must protect the machine against short circuit, phase fault or locked rotor condition.

The motor protection devices intended for use in hazardous areas must be set according to the applicable standards.

Delta connected motors must be protected against phase fault. To do that, connect the overload relay in series to the winding phases and set it to 0.58 times the rated current.

Check the direction of rotation of the motor shaft. If there is no limitation for the use of unidirectional fans, the shaft rotation direction can be changed by reversing any two of the phase connections. For single-phase motor, check the connection diagram indicated on the motor nameplate.

6.10. CONNECTION OF THE THERMAL PROTECTION DEVICES

If the motor is supplied with temperature monitoring devices, such as, thermostat, thermistors, automatic thermal protectors, Pt-100 (RTD), etc., their connection must be done to the corresponding control devices as specified on the accessory nameplates. The non-compliance with this procedure may void the product warranty and cause serious material damages.

All thermal protections (RTDs, bimetal thermal protectors and thermistors for stator protection) used in the motor protection circuit must be connected as a simple equipment in and intrinsically safe circuit.

Motors driven by frequency inverters must have their winding thermal protections connected. For other starting methods, the use of the thermal protections is optional.

Do not apply test voltage above 2.5 V on thermistors and current above 1 mA on RTDs (Pt-100) according to IEC 60751 standard.

Figure 6.14 and Figure 6.15 show the connection diagram of the bimetal thermal protector (thermostats) and thermistors, respectively.

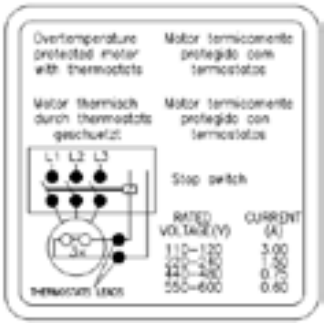


Figure 6.14 *- Connection of the bimetal thermal protectors (thermostats)*

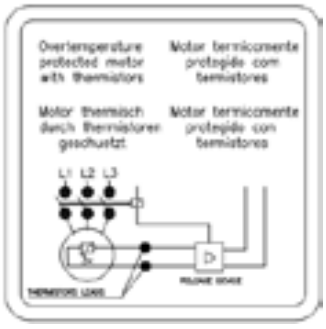


Figure 6.15 *– Thermistor connection*

In applications with protection by increased safety “Ex e”, the protection device, in case of overload or locked rotor, must trip with time delay based on the current along with monitoring the three external leads. The time-“t_E” indicated on the motor nameplate should not be exceeded.

If motors with protection by increased safety “Ex e” are submitted to acceleration time > 1.7x time-“t_E”, they must be protected by protection devices against overcurrent.

Table 6.6 - Maximum activation temperature of the thermal protections.

Component	Marking for hazardous area on the motor nameplate	Hazardous area where the equipment will be installed	Max. operating temperature (°C)	
			Alarm	Tripping
Winding	Ex d	Ex d	130	150
	Ex n	Ex n	130	155
	Ex t	Ex t	120	140
	Ex e	Ex e	-	110
	Ex n + Ex t	Ex n	140	155
		Ex t	-	140
	Ex d + Ex t	Ex d	140	150
		Ex t	-	140
	Class I Div. 1	Class I Div. 1	130	150
	Class I Div. 2	Class I Div. 2	130	155
	Class II Div. 1	Class II Div. 1	120	140
Bearing	All	All	110	120

Notes:
1) The number and type of the installed protection devices are stated on the accessory nameplate of the motor.
2) If the motor is supplied with calibrated resistance, (for example, Pt-100), the motor monitoring system must be set according to the operating temperatures indicated in Table 6.6

The non-isolated part of the accessory cables should not exceed 1 mm up to the connector as shown in Figure 6.16.

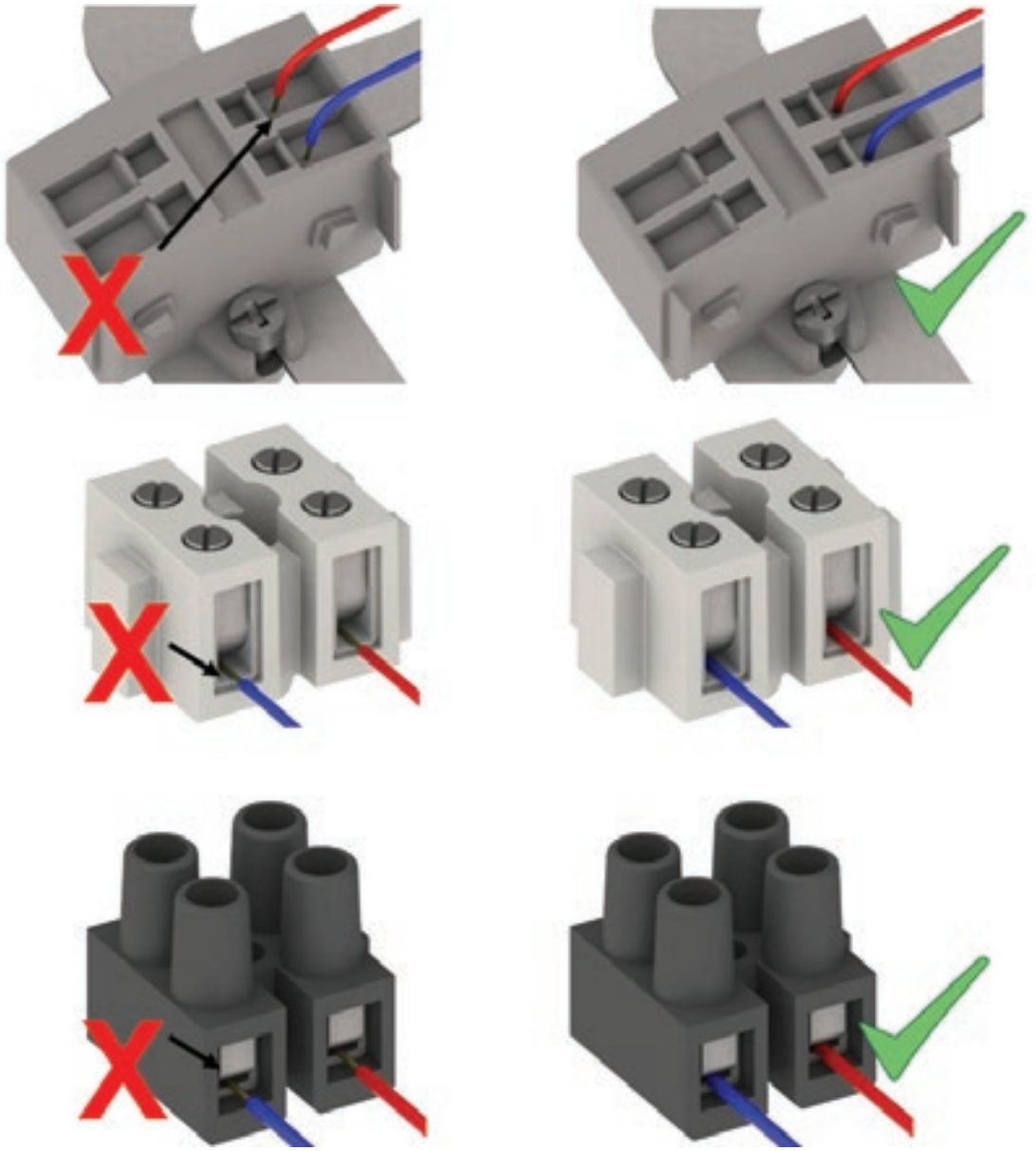


***Figure 6.16** - Connection of the accessory cables to the connector.*

6.11. RESISTANCE TEMPERATURE DETECTORS (Pt-100)

The RTDs (Pt-100) are made of materials, whose resistance depends on the temperature variation, intrinsic property of some materials (usually platinum, nickel or copper), calibrated resistance. Its operation is based on the principle that the electric resistance of a metallic conductor varies linearly with the temperature, thus allowing a continuous monitoring of the motor warm-up through the controller display ensuring a high level of precision and answer stability. These devices are widely used for measuring temperatures in various industry sectors.
In general these devices are used in installations where precise temperature control is required, for example, in installation for irregular or intermittent duty.
The same detector may be used for alarm and tripping purposes.

Table 6.7 and Figure 6.17 show the equivalence between the Pt-100 resistance and the temperature.

Table 6.7 *– Equivalence between the Pt-100 resistance and the temperature.*

°C	Ω	°C	Ω	°C	Ω	°C	Ω	°C	Ω
-29	88.617	17	106.627	63	124.390	109	141.908	155	159.180
-28	89.011	18	107.016	64	124.774	110	142.286	156	159.553
-27	89.405	19	107.404	65	125.157	111	142.664	157	159.926
-26	89.799	20	107.793	66	125.540	112	143.042	158	160.298
-25	90.193	21	108.181	67	125.923	113	143.420	159	160.671
-24	90.587	22	108.570	68	126.306	114	143.797	160	161.043
-23	90.980	23	108.958	69	126.689	115	144.175	161	161.415
-22	91.374	24	109.346	70	127.072	116	144.552	162	161.787
-21	91.767	25	109.734	71	127.454	117	144.930	163	162.159
-20	92.160	26	110.122	72	127.837	118	145.307	164	162.531
-19	92.553	27	110.509	73	128.219	119	145.684	165	162.903
-18	92.946	28	110.897	74	128.602	120	146.061	166	163.274
-17	93.339	29	111.284	75	128.984	121	146.438	167	163.646
-16	93.732	30	111.672	76	129.366	122	146.814	168	164.017
-15	94.125	31	112.059	77	129.748	123	147.191	169	164.388
-14	94.517	32	112.446	78	130.130	124	147.567	170	164.760
-13	94.910	33	112.833	79	130.511	125	147.944	171	165.131
-12	95.302	34	113.220	80	130.893	126	148.320	172	165.501
-11	95.694	35	113.607	81	131.274	127	148.696	173	165.872
-10	96.086	36	113.994	82	131.656	128	149.072	174	166.243
-9	96.478	37	114.380	83	132.037	129	149.448	175	166.613
-8	96.870	38	114.767	84	132.418	130	149.824	176	166.984
-7	97.262	39	115.153	85	132.799	131	150.199	177	167.354
-6	97.653	40	115.539	86	133.180	132	150.575	178	167.724
-5	98.045	41	115.925	87	133.561	133	150.950	179	168.095
-4	98.436	42	116.311	88	133.941	134	151.326	180	168.465
-3	98.827	43	116.697	89	134.322	135	151.701	181	168.834
-2	99.218	44	117.083	90	134.702	136	152.076	182	169.204
-1	99.609	45	117.469	91	135.083	137	152.451	183	169.574
0	100.000	46	117.854	92	135.463	138	152.826	184	169.943
1	100.391	47	118.240	93	135.843	139	153.200	185	170.313
2	100.781	48	118.625	94	136.223	140	153.575	186	170.682
3	101.172	49	119.010	95	136.603	141	153.950	187	171.051
4	101.562	50	119.395	96	136.982	142	154.324	188	171.420
5	101.953	51	119.780	97	137.362	143	154.698	189	171.789
6	102.343	52	120.165	98	137.741	144	155.072	190	172.158
7	102.733	53	120.550	99	138.121	145	155.446	191	172.527
8	103.123	54	120.934	100	138.500	146	155.820	192	172.895
9	103.513	55	121.319	101	138.879	147	156.194	193	173.264
10	103.902	56	121.703	102	139.258	148	156.568	194	173.632
11	104.292	57	122.087	103	139.637	149	156.941	195	174.000
12	104.681	58	122.471	104	140.016	150	157.315	196	174.368
13	105.071	59	122.855	105	140.395	151	157.688	197	174.736
14	105.460	60	123.239	106	140.773	152	158.061	198	175.104
15	105.849	61	123.623	107	141.152	153	158.435	199	175.472
16	106.238	62	124.007	108	141.530	154	158.808	200	175.840

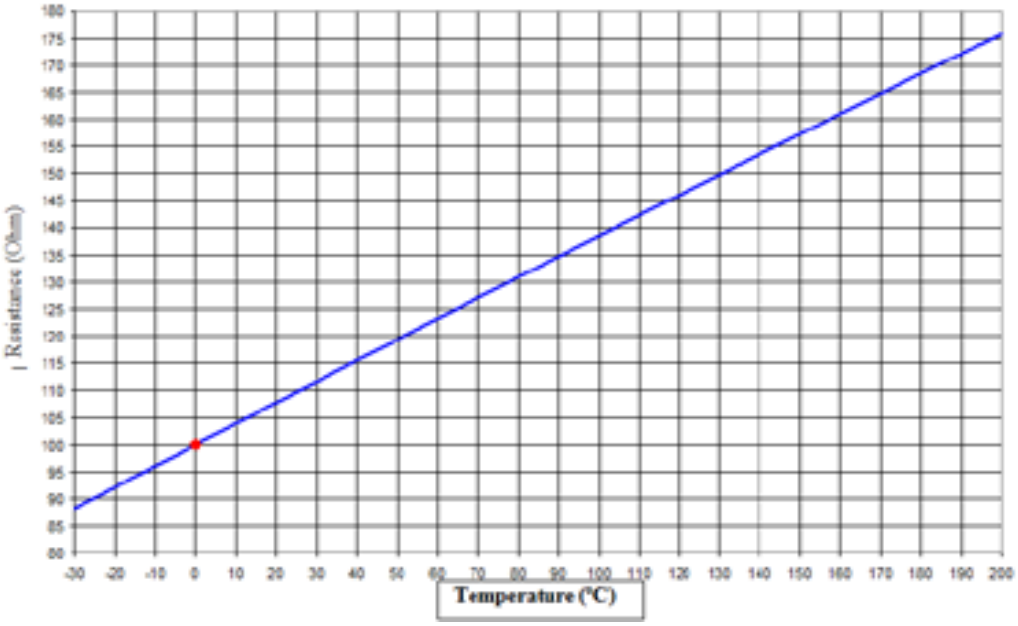


Figure 6.17 *- Ohmic resistance of the Pt-100 x temperature*

6.12. CONNECTION OF THE SPACE HEATERS

Before switching ON the space heaters, check if the space heaters connection have been made according to the connection diagram shown on the space heater nameplate. For motors supplied with dual voltage space heaters (110-127/220-240 V), see Figure 6.18.

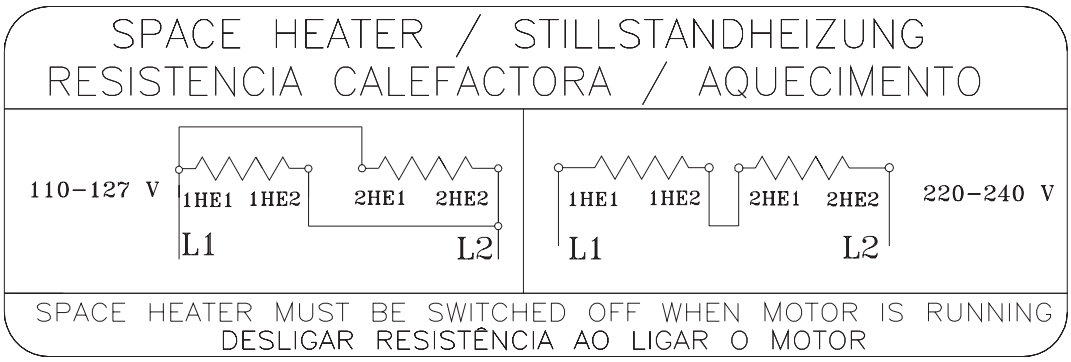


Figura 6.18 *- Dual voltage space heater connection.*

The space heaters should never be energized when the motor is in operation.

6.13. STARTING METHODS

Whenever possible, the motor starting must be Direct On Line (DOL) at rated voltage. This is the most simple and feasible starting method. However, it must only be applied when the starting current does not affect the power supply. Please consider the local electric utility regulations when installing a motor.
High inrush current may result in:
a) high voltage drop in the power supply line creating unacceptable line disturbance on the distribution system;
b) requiring oversized protection system (cables and contactor) increasing the installation costs.
If DOL starting is not allowed due to the reasons mentioned above, an indirect starting method compatible with the load and motor voltage to reduce the starting current may be used.
If reduced voltage starters are used for starting, the motor starting torque will also be reduced.

Table 6.8 shows the possible indirect starting methods that can be used depending on the number of the motor leads.

Table 6.8 - *Starting method x number of motor leads.*

Number of leads	Possible starting methods
3 leads	Autotransformer Soft-starter
6 leads	Star-Delta Autotransformer Soft-Starter
9 leads	Star-Delta Series/Parallel Part Winding Autotransformer Soft-Starter
12 leads	Star-Delta Series/Parallel Part Winding Autotransformer Soft-Starter

Table 6.9 shows examples of possible indirect starting methods to be used according to the voltage indicated on the motor nameplate and the power supply voltage.

Table 6.9 – *Starting methods x voltage*

Nameplate voltage	Operating voltage	Star-delta	Autotransformer Starting	Part Winding Starting	Starting by series/parallel switch	Starting by soft-starter
220/380 V	220 V 380 V	YES NO	YES YES	NO NO	NO NO	YES YES
220/440 V	220 V 440 V	NO NO	YES YES	YES NO	YES NO	YES YES
230/460 V	230 V 460 V	NO NO	YES YES	YES NO	YES NO	YES YES
380/660 V	380 V	YES	YES	NO	NO	YES
220/380/440 V	220 V 380 V 440 V	YES NO YES	YES YES YES	YES YES NO	YES YES NO	YES YES YES

The W22 Quattro line motors must be started direct on-line (DOL) or driven by a frequency inverter in scalar mode.

The starting by frequency inverter may be another starting method to avoid overloading the power supply line. For more information about the motor control by frequency inverter, see item 6.14.

6.14. MOTORS DRIVEN BY FREQUENCY INVERTER

The operation with frequency inverter must be stated in the Purchase Order since this drive type may require some changes of the motor design.

Motors driven by frequency inverters must have their winding thermal protections connected.

W22 Magnet Motors must only be driven by WEG frequency inverter.

The frequency inverter used to drive motors up to 690 V must be fitted with Pulse With Modulation (PWM) with vector control.

Motors driven by frequency inverters have an additional nameplate fixed on the motor frame indicating the Service Factor, inverter type, frame size, and/or load type (constant or variable torque) as function of the speed range and motor torque.

When a motor is driven by a frequency inverter at lower frequencies than the rated frequency, you must reduce the motor torque to prevent motor overheating. The torque reduction (derating torque) can be found in the item 6.4 of the “Technical Guidelines for Induction Motors driven by PWM Frequency inverters” available on the site www.weg.net.

If the motor is operated above the rated frequency, please note:
- That the motor must be operated at constant output;
- That the motor can supply max. 95% of its rated output;
- Do not exceed the maximum speed and please consider:
  - max. operating frequency informed on the additional nameplate;
  - mechanical speed limitation of the motor.

The “Ex n” motor line driven by frequency inverter (used in Zone 2 – presence of gas) can be operated up to the limit of the Temperature Class T3 (200 °C).
The “Ex t” motor line driven by frequency inverter (used in Zone 22 and Zone 21 - in the presence of combustible dust) can be operated up to the temperature limit of 125 °C.

Information on the selection of the power cables between the frequency inverter and the motor can be found in the item 6.8 of the “Technical Guidelines for Induction Motors driven by PWM Frequency inverters” available at www.weg.net.

6.14.1. Use of dV/dt filter

6.14.1.1. Motor with enameled round wire

Motors designed for rated voltages up to 690 V, when driven by frequency inverter, do not require the use of dV/dT filters, provided that following criteria are considered.

Criteria for the selection of motors with round enameled wire when driven by frequency inverter				
Motor rated votage 1[2]	**Peak voltage at the motor terminals (max)**	**dV/dt inverter output (max)**	**Inverter Rise Time [2] (min.)**	**MTBP [2] Time between pulses (min)**
Vnom < 460 V	≤ 1600 V	≤ 5200 V/µs	≥ 0,1 µs	≥ 6 µs
460 ≤ Vnom < 575 V	≤ 2000 V	≤ 6500 V/µs		
575 ≤ Vnom ≤ 1000 V	≤ 2400 V	≤ 7800 V/µs		

***Notes**:*
1. For the application of dual voltage motors, example 380/660 V, consider the lower voltage (380 V).
2. Information supplied by the inverter manufacturer.

6.14.1.2. Motor with prewound coils

Motors with prewound coils (medium and high voltage motors regardless of frame sizes, and low voltage motors from IEC 500 / NEMA 800 frame on), designed for the use with frequency inverters, do not require the use of filters, provided they comply with the criteria in Table 6.10.

***Table 6.10** - Criteria to be considered when using motor with prewound coils to be drive by frequency inverters*

Motor rated voltage	**Type of modulation**	**Turn to turn insulation (phase-phase)**		**Phase-ground insulation**	
		Peak voltage at the motor terminals	**dV/dt at the motor terminals**	**Peak voltage at the motor terminals**	**dV/dt at the motor terminals**
690 < Vnom ≤ 4160 V	Sinusoidal	≤ 5900 V	≤ 500 V/µs	≤ 3400 V	≤ 500 V/µs
	PWM	≤ 9300 V	≤ 2700 V/µs	≤ 5400 V	≤ 2700 V/µs
4160 < Vnom ≤ 6600 V	Sinusoidal	≤ 9300 V	≤ 500 V/µs	≤ 5400 V	≤ 500 V/µs
	PWM	≤ 14000 V	≤ 1500 V/µs	≤ 8000 V	≤ 1500 V/µs

6.14.2. Bearing insulation

Only the motors in IEC frame size 400 (NEMA 680) and larger are supplied, as standard, with insulated bearing. If motor must be driven by frequency inverter, insulate the bearing according to Table 6.11.

Table 6.11 – Recommendation on the bearing insulation for inverter driven motors

Frame size	Recommendation
IEC 315 and 355 NEMA L447/9, 504/5, 5006/7/8, 5009/10/11, 586/7, 5807/8/9, 5810/11/12 and 588/9	One bearing is isolated
IEC 400 and higher NEMA 680 and higher	NDE-bearing is isolated

The shaft grounding system for explosion-proof motors can be used only inside the enclosure. For other types of protection the shaft grounding system is not allowed.

6.14.3. Switching Frequency

The minimum inverter switching frequency must not be lower than 2.5 kHz and should not exceed 5 kHz.

The non-compliance with the criteria and recommendations indicated in this manual may void the product warranty.

The use of sparking components, such as grounding brushes, is not allowed in explosive atmospheres.

6.14.4. Mechanical speed limitation

Table 6.12 shows the maximum speeds allowed for motors driven by frequency inverter.

Table 6.12 – Maximum motor speed (in rpm).

Frame size		DE-bearing	Maximum speed for standard motors
IEC	NEMA		
63-90	143/5	6201 6202 6203 6204 6205	10400
100	-	6206	8800
112	182/4	6207	7600
		6307	6800
132	213/5	6308	6000
160	254/6	6309	5300
180	284/6	6311	4400
200	324/6	6312	4200
225-630	364/5-9610	6314	3600
		6315	3600
		6316	3200
		6319	3000
		6220	3600
		6320	2200
		6322	1900
		6324	1800
		6328	1800
		6330	1800

***Note**:*
To select the maximum allowed motor speed, consider the motor torque derating curve.

For more information on the application of frequency inverters, contact WEG or check the “Technical Guidelines for Induction Motors driven by PWM Frequency inverters” available at www.weg.net.

7. COMMISSIONING

7.1. INITIAL START-UP

After finishing the installation procedures and before starting the motor for the first time or after a long period without operation, the following items must be checked:

- If the nameplate data (voltage, current, connection diagram, degree of protection, type of protection, cooling system, service factor, etc.) meet the application requirements.
- If the machine set (motor + driven machine) has been mounted and aligned correctly.
- If the motor driving system ensures that the motor speed does not exceed the max. allowed speed indicated in Table 6.12.
- Measure the winding insulation resistance, making sure it complies with the specified values in item 5.4.
- Check the motor rotation direction.
- Inspect the motor terminal box for damage and ensure that it is clean and dry and all contacts are rust-free, the seals are in perfect operating conditions and all unused threaded holes are properly closed thus ensuring the degree of protection and the type of protection of the motor indicated on the motor nameplate.
- Check if the motor wiring connections, including grounding and auxiliary equipment connection, have been carried out properly and are in accordance with the recommendations in item 6.9.
- Check the operating conditions of the installed auxiliary devices (brake, encoder, thermal protection device, forced cooling system, etc.).
- Check bearing operating conditions. If the motors are stored and/or installed for more than two years without running, it is recommended to change the bearings, or to remove, wash, inspect and relubricate them before the motor is started. If the motor is stored and/or installed according to the recommendations described in item 5.3, lubricate the bearings as described in item 8.2. For the bearing condition evaluation, it is recommended to use of the vibration analysis techniques: Envelope Analysis or Demodulation Analysis.
- When motors are fitted with sleeve bearings, ensure:
  - correct oil level for the sleeve bearing. The oil level should be in the center of the sight glass (see Figure 6.8);
  - that the motor is not started or operated with axial or radial loads;
  - that if the motor is stored for a period equal or longer than the oil change interval, the oil must be changed before starting the motor.
- Inspect the capacitor operating condition, if any. If motors are installed for more than two years, but were never commissioned, it is recommended to change the start capacitors since they lose their operating characteristics.
- Ensure that the air inlet and outlet opening are not blocked. The minimum clearance to the nearest wall (L) should be at least ¼ of the fan cover diameter (D), see Figure 7.1. The intake air temperature must be at ambient temperature.

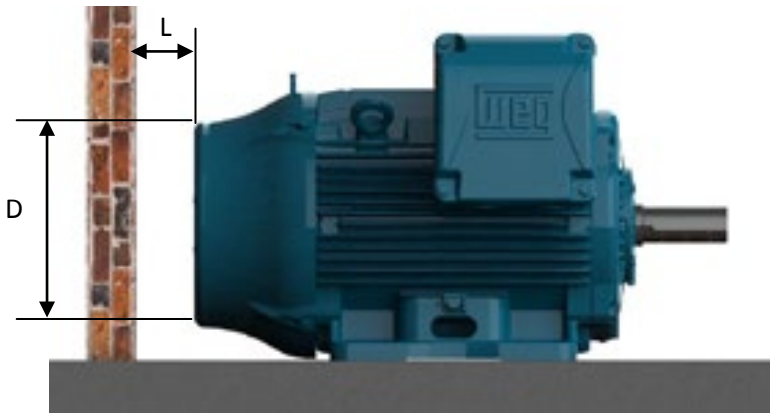


***Figure 7.1**- Minimum clearance to the wall*

Please consider the minimum distances shown in the Table 7.1 as reference value

Table 7.1 *– Minimum distance between the fan cover and wall*

Frame size		Distance between the fan cover and the wall (L)	
IEC	**NEMA**	**mm**	**inches**
63	-	25	0.96
71	-	26	1.02
80	-	30	1.18
90	143/5	33	1.30
100	-	36	1.43
112	182/4	41	1.61
132	213/5	50	1.98
160	254/6	65	2.56
180	284/6	68	2.66
200	324/6	78	3.08
225 250	364/5 404/5	85	3.35
280	444/5 445/7 447/9	108	4.23
315	L447/9 504/5 5006/7/8 5009/10/11	122	4.80
355	586/7 588/9 5807/8/9 5810/11/12	136	5.35
400	6806/7/8 6809/10/11	147	5.79
450	7006/10	159	6.26
500	8006/10	171	6.73
560	8806/10	185	7.28
630	9606/10	200	7.87

- ensure correct water flow rate and water temperature when water cooled motors are used. See item 7.2.
- ensure that all rotating parts, such as pulleys, couplings, external fans, shaft, etc. are protected against accidental contact.

Other tests and inspections not included in the manual may be required, depending on the specific installation, application and/or motor characteristics.
After all previous inspections have been carried out, proceed as follows to start the motor:

- Start the motor on no-load (if possible) and check the motor direction of rotation. Check for the presence of any abnormal noise, vibration or other abnormal operating conditions.
- Ensure the motor starts smoothly. If any abnormal operating condition is noticed, switch off the motor, check the assembly system and connections before the motor is started again.
- If excessive vibrations are noticed, check if the motor mounting bolts are well tightened or if the vibrations are not generated and transmitted from adjacent installed equipment. Check the motor vibration periodically and ensure that the vibration limits are as specified in item 7.2.1.
- Start the motor at rated load during a short time and compare the operating current with the rated current indicated on the nameplate.
- Continue to measure the following motor variables until thermal equilibrium is reached: current, voltage, bearing and motor frame temperature, vibration and noise levels.
- Record the measured current and voltage values on the Installation Report for future comparisons.

As induction motors have high inrush currents during start-up, the acceleration of high inertia load requires an extended starting time to reach full speed resulting in fast motor temperature rise. Successive starts within short intervals will result in winding temperature increases and can lead to physical insulation damage reducing the useful life of the insulation system. If the duty S1 is specified on the motor nameplate, this means that the motor has been designed for:

- two successive starts: first start from cold condition, i. e., the motor windings are at room temperature and the second start immediately after the motor stops.
- one start from hot condition, i. e., the motor windings are at rated temperature.

The Troubleshooting Chart in section 10 provides a basic list of unusual cases that may occur during motor operation with the respective corrective actions

7.2. OPERATING CONDITIONS

Unless otherwise stated in the Purchase Order, electric motors are designed and built to be operated at altitudes up to 1000 meters above sea level and in a temperature range from -20 °C to +40 °C. Any deviation from the normal condition of motor operation must be stated on the motor nameplate. Some components must be changed if the ambient temperature is different from the specified one. Please contact WEG to check the required special features.

For operating temperatures and altitudes differing from those above, the factors indicated in Table 7.2 must be applied to the nominal motor power rating in order to determine the derated available output (Pmax = Pnom x correction factor).

Table 7.2 - *Correction factors for altitude and ambient temperature.*

T (°C)	Altitude (m)								
	1000	1500	2000	2500	3000	3500	4000	4500	5000
10							0.97	0.92	0.88
15						0.98	0.94	0.90	0.86
20					1.00	0.95	0.91	0.87	0.83
25				1.00	0.95	0.93	0.89	0.85	0.81
30			1.00	0.96	0.92	0.90	0.86	0.82	0.78
35		1.00	0.95	0.93	0.90	0.88	0.84	0.80	0.75
40	1.00	0.97	0.94	0.90	0.86	0.82	0.80	0.76	0.71
45	0.95	0.92	0.90	0.88	0.85	0.81	0.78	0.74	0.69
50	0.92	0.90	0.87	0.85	0.82	0.80	0.77	0.72	0.67
55	0.88	0.85	0.83	0.81	0.78	0.76	0.73	0.70	0.65
60	0.83	0.82	0.80	0.77	0.75	0.73	0.70	0.67	0.62
65	0.79	0.76	0.74	0.72	0.70	0.68	0.66	0.62	0.58
70	0.74	0.71	0.69	0.67	0.66	0.64	0.62	0.58	0.53
75	0.70	0.68	0.66	0.64	0.62	0.60	0.58	0.53	0.49
80	0.65	0.64	0.62	0.60	0.58	0.56	0.55	0.48	0.44

Motors installed inside enclosures (cubicles) must be ensured an air renewal rate in the order of one cubic meter per second for each 100 kW installed power or fraction of installed power. Totally Enclosed Air Over motors - TEAO (fan and exhaust / smoke extraction) are supplied without cooling fan and the manufacturer of the driven machine is responsible for sufficient motor cooling. If no minimum required air speed between motor fins is indicated on the motor nameplate, ensure the air speed indicated in the table 7.3 is provided. The values shown in Table 7.3 are valid for 60 Hz motors. To obtain the minimum air speed for 50 Hz motors, multiply the values in the table by 0.83.

Table 7.3 *– Minimum required air speed between motor fins (metres/second).*

Frame		Poles			
IEC	**NEMA**	**2**	**4**	**6**	**8**
63 to 90	143/5	13	7	5	4
100 to 132	182/4 to 213/5	18	12	8	6
160 to 200	254/6 to 324/6	20	15	10	7
225 to 280	364/5 to 444/5	22	20	15	12
315 to 450	445/7 to 7008/9	25	25	20	15

The voltage and frequency variations may affect the performance characteristics and the electromagnetic compatibility of the motor. The power supply variations should not exceed the values specified in the applicable standards. Examples:

- ABNT NBR 17094 - Parts 1 and 2. The motor has been designed to supply the rated torque for a combined variation in voltage and frequency:
  - Zone A: ±5% of the rated voltage and ±2% of the rated frequency.
  - Zone B: ±10% of the rated voltage and +3% -5% of the rated frequency.

When operated continuously in Zone A or B, the motor may show performance variations and the operating temperature may increase considerably. These performance variations will be higher in Zone B. Thus it is not recommended to operate the motor in Zone B during extended periods.

- IEC 60034-1. The motor has been designed to supply the rated torque for combined variation in voltage and frequency:
  - Zone A: ±5% of the rated voltage and ±2% of the rated frequency.
  - Zone B: ±10% of the rated voltage and +3% -5% of the rated frequency.

When operated continuously in Zone A or B, the motor may show performance variations and the operating temperature may increase considerably. These performance variations will be higher in Zone B. Thus it is not recommended to operate the motor in Zone B during extended periods. For multivoltage motors (example 380-415/660 V), a ±5% voltage variation from the rated voltage is allowed.

- NEMA MG 1 Part 12. The motor has been designed to be operated in one of the following variations:
  - ±10% of the rated voltage, with rated frequency;
  - ±5% of the rated frequency, with rated voltage;
  - A combined variation in voltage and frequency of ±10%, provided the frequency variation does not exceed ±5%.

"Ex e" motors are designed to be operated only in Zone A – voltage and frequency variation.

If the motor is cooled by ambient air, clean the air inlet and outlet openings and cooling fins at regular intervals to ensure a free airflow over the frame surface. The hot air should never be returned to the motor. The cooling air must be at room temperature limited to the temperature range indicated on the motor nameplate (if no room temperature is specified, please consider a temperature range between -20 °C and +40 °C).

Table 7.4 shows the minimum required water flow for water cooled motors considering the different frame sizes and the maximum allowed temperature rise of the cooling water after circulating through the motor. The inlet water temperature should not exceed 40 °C.

***Table 7.4** – Minimum required water flow and the maximum allowed temperature rise of the cooling water after circulating through the motor*

Frame size		Flow rate (litres/minute)	Maximum allowed water temperature rise (°C)
IEC	NEMA		
180	284/6	12	5
200	324/6	12	5
225	364/5	12	5
250	404/5	12	5
280	444/5 445/7 447/9	15	6
315	504/5	16	6
355	586/7 588/9	25	6

Motors fitted with oil mist lubrication systems can be operated continuously for a maximum of one hour after the failure of the oil pumping system.

Considering the sun's heat increases the operating temperature, externally mounted motors should always be protected from direct sunlight exposure.

Each and every deviation from the normal operating condition (tripping of the thermal protection, noise and vibration level increase, temperature and current rise) should be investigated and corrected by WEG Authorized Service Centers for explosive atmospheres.

Motors fitted with cylindrical roller bearings require a minimum radial load to ensure a normal operation. For information regarding the radial preload, please contact WEG.

7.2.1.Limits of vibration

The vibration severity is the maximum vibration value measured at all positions and in all directions as recommended in the standard IEC 60034-14. Table 7.5 specifies the limits of the maximum vibrations magnitudes according to standard IEC 60034-14 for shaft heights IEC 56 to 400, for vibrations grades A and B. The vibration severity limits in Table 7.5 are given as RMS values (Root Mean Square values or effective values) of the vibration speed in mm/s measured in free suspension condition.

***Table 7.5** - Limits of maximum vibration magnitude according to standard IEC 60034-14*

Shaft height [mm]	56 ≤ H ≤ 132	132 ≤ H ≤ 280	H > 280
Vibration Grade	Vibration severity on elastic base [mm/s RMS]		
A	1.6	2.2	2.8
B	0.7	1.1	1.8

***Notes**:*
1 – The values in Table 7.5 are valid for measurements carried out with decoupled machines (without load) operated at rated voltage and frequency.
2 - The values in Table 7.5 are valid regardless of the direction of rotation of the machine.
3 – The values in Table 7.5 are not applicable to single-phase motors, three-phase motors powered by a single-phase system or to machines mounted in situ or coupled with inertia flywheels or to loads.

According to NEMA MG 1, the allowed vibration limit for standard motors is 0.15 in/s (peak vibration in in/s).

***Note**:*
For the load operation condition, the use of the standard ISO 10816-3 is recommended for evaluating the motor vibration limits. In the load condition the motor vibration will be influenced by several factors, such as, type of the coupled load, condition of the motor fixation, alignment condition under load, structure or base vibration due to other equipments, etc.

8. MAINTENANCE

The purpose of the maintenance is to extend the useful life of the equipment. The non-compliance with one of these previous items can cause unexpected machine failures.

If motors with cylindrical roller or angular contact bearings are to be transported during the maintenance procedures, the shaft locking device must always be fitted. All HGF motors, regardless of the bearing type, must always be transported with the shaft locking device fitted.

All repairs, disassembly and assembly related services must be carried out only by qualified and well-trained personnel by using proper tools and techniques. Make sure that the machine has stopped and it is disconnected from the power supply, including the accessory devices (space heater, brake, etc.), before any servicing is undertaken.
The company does not assume any responsibility or liability for repair services or maintenance operations to motor for use in hazardous areas executed by non-authorized Service Centers or by non qualified service personnel. The company shall have no obligation or liability whatsoever to the buyer for any indirect, special, consequential or incidental loss or damage caused or arising from the company's proven negligence.

Repairs to motor for use in hazardous areas must be executed in accordance with the applicable standards.

8.1. GENERAL INSPECTION

The inspection intervals depend on the motor type, application and installation conditions. Proceed as follows during inspection:

- Visually inspect the motor and coupling. Check if abnormal noises, vibrations, excessive heating, wear signs, misalignment or damaged parts are noticed. Replace the damaged parts as required.
- Measure the insulation resistance according to the item 5.4.
  Clean the motor enclosure. Remove oil spills and dust accumulation from the motor frame surface to ensure a better heat transfer to the surrounding ambient. Motors with potential risk for electrostatic charge accumulation, duly identified, must be cleaned carefully by using a damp cloth to prevent electrostatic discharge during maintenance interventions.
- Check cooling fan condition and clean the air inlet & outlet openings to ensure a free air flow over the motor.
- Investigate the actual condition of the seals and replace them, if required.
- Drain the condensed water from inside the motor. After draining, reinstall the drain plugs to ensure the degree of protection as indicated on the motor nameplate. The motor must always be positioned so the drain hole is at the lowest position (see item 6).
- Check the connections of the power supply cables, ensuring the correct clearance distance between live and grounded parts, as specified in Table 6-2.
- Check if the tightening torque of the bolted connections and mounting bolts meets the tightening torque specified in Table 8 8.
- Check the status of the cable passages, the cable gland seals and the seals inside the terminal box and replace them, if required.
- Check the bearing operating conditions. Check for the presence of any abnormal noise, vibration or other abnormal operating conditions, like motor temperature rise. Check the oil level, the lube oil condition and compare the workings hours with the informed life time.
- For explosion-proof motors check if the gap between the components is according to the Table 8-7. The tolerance class of the metric threads for the cable inlet must be 6H or better.
- Record and file all changes performed on the motor.



Do not reuse damaged or worn parts. Damaged or worn parts must be replaced by parts supplied by the manufacturer and must be installed as if they were the original parts.

8.2. LUBRICATION

Proper lubrication plays a vital role in the motor performance. Only use the grease or oil types, amounts and lubrication intervals recommended for the bearings. This information is available on the motor nameplate and the lubrication procedures must be carried out according to the type of lubricant (oil or grease).
When the motor is fitted with thermal protection devices for bearing temperature control, consider the operating temperature limits shown in Table 6.3.
The maximum operating temperature of motors used in special applications may differ from those shown in Table 6.3. The grease and oil disposal should be made in compliance with applicable laws in each country

Please contact WEG when motors are to be installed in special environments or used for special applications.

8.2.1. Grease lubricated rolling bearings

Excess grease causes bearing overheating, resulting in bearing failure.

The lubrication intervals specified in Table 8.1, Table 8.2, Table 8.3 and Table 8.4 consider an absolute temperature on the bearing of 70 °C (up to frame size IEC 200 / NEMA 324/6) and 85 °C (for frame size IEC 225 / NEMA 364/5 and above) the motor running at rated speed, a motor mounted in horizontal position, greased with Mobil Polyrex EM grease. Any variation of the parameters listed above must be evaluated.

Table 8.1 *- Lubrication intervals for deep groove ball bearings.*

Frame		Poles	Bearing designation	Amount of grease (g)	Lubrication intervals (hours)			
					W21 TEFC (Totally Enclosed Fan Cooled)		W22 TEFC (Totally Enclosed Fan Cooled)	
IEC	NEMA				50 Hz	60 Hz	50 Hz	60 Hz
90	143/5	2	6205	4	20000	20000	25000	25000
		4						
		6						
		8						
100	-	2	6206	5	20000	20000	25000	25000
		4						
		6						
		8						
112	182/4	2	6207/ 6307	9	20000	20000	25000	25000
		4						
		6						
		8						
132	213/5	2	6308	11	20000	18400	25000	23200
		4			20000	20000	25000	25000
		6						
		8						
160	254/6	2	6309	13	18100	15700	22000	20000
		4			20000	20000	25000	25000
		6						
		8						
180	284/6	2	6311	18	13700	11500	17000	14000
		4			20000	20000	25000	25000
		6						
		8						
200	324/6	2	6312	21	11900	9800	15000	12000
		4			20000	20000	25000	25000
		6						
		8						
225 250 280 315 355	364/5 404/5 444/5 445/7 447/9 L447/9 504/5 5008 5010/11 586/7 588/9	2	6314	27	4500	3600	5000	4000
		4			11600	9700	14000	12000
		6			16400	14200	20000	17000
		8			19700	17300	24000	20000
		2	6316	34	3500	*Upon request	4000	*Upon request
		4			10400	8500	13000	10000
		6			14900	12800	18000	16000
		8			18700	15900	20000	20000
		2	6319	45	2400	*Upon request	3000	*Upon request
		4			9000	7000	11000	8000
		6			13000	11000	16000	13000
		8			17400	14000	20000	17000
		4	6322	60	7200	5100	9000	6000
		6			10800	9200	13000	11000
		8			15100	11800	19000	14000

Table 8.2 - Lubrication intervals for cylindrical roller bearings

Frame		Poles	Bearing designation	Amount of grease (g)	Lubrication intervals (hours)			
					W21 TEFC (Totally Enclosed Fan Cooled)		W22 TEFC (Totally Enclosed Fan Cooled)	
IEC	NEMA				50 Hz	60 Hz	50 Hz	60 Hz
160	254/6	2	NU309	13	13300	9800	16000	12000
		4			20000	20000	25000	25000
		6						
		8						
180	284/6	2	NU311	18	9200	6400	11000	8000
		4			20000	19100	25000	25000
		6				20000		
		8						
200	324/6	2	NU312	21	7600	5100	9000	6000
		4			20000	17200	25000	21000
		6				20000		25000
		8						
225 250 280 315 355	364/5 404/5 444/5 445/7 447/9 L447/9 504/5 5008 5010/11 586/7 588/9	4	NU314	27	8900	7100	11000	9000
		6			13100	11000	16000	13000
		8			16900	15100	20000	19000
		4	NU316	34	7600	6000	9000	7000
		6			11600	9500	14000	12000
		8			15500	13800	19000	17000
		4	NU319	45	6000	4700	7000	5000
		6			9800	7600	12000	9000
		8			13700	12200	17000	15000
		4	NU322	60	4400	3300	5000	4000
		6			7800	5900	9000	7000
		8			11500	10700	14000	13000

Table 8.3 – Lubrication intervals for deep groove ball bearings – HGF line.

Frame		Poles	Bearing designation	Amount of grease (g)	Lubrication intervals (hours)	
IEC	NEMA				50 Hz	60 Hz
315L/A/B and 315C/D/E	5006/7/8T and 5009/10/11T	2	6314	27	3100	2100
		4 – 8	6320	50	4500	4500
			6316	34	4500	4500
355L/A/B and 355C/D/E	5807/8/9T and 5810/11/12T	2	6314	27	3100	2100
		4 – 8	6322	60	4500	4500
			6319	45	4500	4500
400L/A/B and 400 C/D/E	6806/7/8T and 6809/10/11T	2	6315	30	2700	1800
		4 – 8	6324	72	4500	4500
			6319	45	4500	4500
450	7006/10	2	6220	31	2500	1400
		4	6328	93	4500	3300
			6322	60	4500	4500
		6 – 8	6328	93	4500	4500
			6322	60	4500	4500
500	8006/10	4	6330	104	4200	2800
			6324	72	4500	4500
		6 – 8	6330	104	4500	4500
			6324	72	4500	4500
500	8006/10	4	6330	104	4200	2800
			6324	72	4500	4500
		6 – 8	6330	104	4500	4500
			6324	72	4500	4500
560	8806/10	4 - 8	*Upon request			
630	9606/10	4 - 8				

ENGLISH

Table 8.4 - Lubrication intervals for cylindrical roller bearings – HGF line

Frame		Poles	Bearing designation	Amount of grease (g)	Lubrication intervals (hours)	
IEC	NEMA				50 Hz	60 Hz
315L/A/B and 315C/D/E	5006/7/8 and 5009/10/11	4	NU320	50	4300	2900
		6 - 8			4500	4500
355L/A/B and 355C/D/E	5807/8/9 and 5810/11/12	4	NU322	60	3500	2200
		6 - 8			4500	4500
400L/A/B and 400C/D/E	6806/7/8 and 6809/10/11	4	NU324	72	2900	1800
		6 - 8			4500	4500
450	7006/10	4	NU328	93	2000	1400
		6			4500	3200
		8			4500	4500
500	8006/10	4	NU330	104	1700	1000
		6			4100	2900
		8			4500	4500
560	8806/10	4	NU228 + 6228	75	2600	1600
		6 - 8		106	4500	4500
630	9606/10	4	NU232 + 6232	92	1800	1000
		6		120	4300	3100
		8		140	4500	4500

For each increment of 15 ºC above the room temperature, the relubrication intervals given in the Table must be halved. The relubrication interval of motors designed by the manufacturer for mounting in horizontal position, but installed in vertical position (with WEG authorization), must be halved.
For special applications, such as: high and low temperatures, aggressive environments, driven by frequency inverter (VFD – frequency inverter), etc., please contact WEG about the required amount of grease and the relubrication intervals.

8.2.1.1. Motor without grease fitting

Motors without grease fittings must be lubricated in accordance with the existing Maintenance Plan. Motor disassembly must be carried out as specified in Item 8.3. If motors are fitted with shielded bearings (for example, ZZ, DDU, 2RS, VV), these bearings must be replaced at the end of the grease service life.

8.2.1.2. Motor with grease fitting

To lubricate the bearings with the motor stopped, proceed as follows:
Motors with grease fittings must be stopped to be lubricated. Proceed as follows:
- Before lubricating, clean the grease nipple and immediate vicinity thoroughly;
- Lift grease inlet protection;
- Remove the grease outlet plug;
- Pump in approximately half of the total grease indicated on the motor nameplate and run the motor for about 1 (one) minute at rated speed;
- Switch-off the motor and pump in the remaining grease;
- Lower again the grease inlet protection and reinstall the grease outlet protection.

To grease the motor while running, proceed as follows:
- Before lubricating, clean the grease nipple and immediate vicinity thoroughly;
- Pump the total grease indicated on the motor nameplate;
- Lower again the grease inlet protection.



For lubrication, use only manual grease gun.

If Motors are provided with a spring device for grease removal, the grease excess must be removed by pulling the rod and cleaning the spring until the spring does not remove more grease.

8.2.1.3. Compatibility of the Mobil Polyrex EM grease with other greases

The Mobil Polyrex EM grease has a polyurea thickener and a mineral oil and it is not compatible with other greases.
If you need another type of grease, contact WEG.
It is not recommended to mix different types of greases. In such a case, clean the bearings and lubrication channels before applying new grease.
The used grease must have in its formulation corrosion and oxidation inhibitors.

8.2.2. Oil lubricated bearings

To change the oil of oil lubricated motor proceed as follows:
- switch-off the motor;
- remove threaded oil drain plug;
- open the valve and drain the oil;
- close the drain vale again;
- reinstall the threaded oil drain plug;
- fill-up with the type and amount of oil as specified on the nameplate;
- check oil level. The oil level is OK when the lubricant can be viewed approximately in the center of the sight glass;
- reinstall oil inlet plug;
- check for oil leaks and ensure that all not used threaded plugs are closed with plugs.

The bearing lubricating oil must be replaced as specified on the nameplate or whenever changes in the oil properties are noticed. The oil viscosity and pH must be checked periodically. The oil level must be checked every day and must be kept in the center of the sight glass.
Please contact WEG, when oils with different viscosities should be used.

***Note**:*
The HGF vertical mounted motors with high axial thrust are supplied with grease lubricated DE-bearings and with oil lubricated NDE-bearings. The DE-bearings must be lubricated according to recommendations in item 8.2.1. Table 8.5 specifies the oil type and the amount of oil required for this motor lubrication.

***Table 8.5** – Oil properties for HGF vertical mounted motors with high axial thrust*

Mounting - High axial thrust	Frame		Poles	Bearing designation	Oil (liters)	Interval (h)	Lubricant	Lubricant specification
	IEC	NEMA						
	315L/A/B e 315C/D/E	5006/7/8T e 5009/10/11T	4 - 8	29320	20	8000	Renolin DTA 40 / SHC 629	ISO VG150 mineral oil with antifoam and antioxidant additives
	355L/A/B e 355C/D/E	5807/8/9T e 5810/11/12T	4 - 8	29320	26			
	400L/A/B e 400C/D/E	6806/7/8T e 6809/10/11T	4 - 8	29320	37			
	450	7006/10	4 - 8	29320	45			

8.2.3. Oil mist lubricated bearings

Check the service conditions of the seals and if replacement is required use only original components. Clean the seal components before assembly (bearing caps, end shields, etc.).
Apply joint sealant between the bearing caps and end shields. The joint sealant must be compatible with the used lubricating oil. Connect the oil lubricant tubes (oil inlet and oil outlet tubes and motor drain tube), as shown in Figure 6.12.

8.2.4. Sleeve bearings

The lubricating oil of sleeve bearings must be changed at the intervals specified in Table 8.6. To replace the oil, proceed as follows:
- NDE-bearing: remove the protection plate from the fan cover;
- Drain the oil through the drain hole located at the bottom of the bearing (see Figure 8.1);
- Close the oil drain hole;
- Remove the oil inlet plug;
- Fill the sleeve bearing with the specified oil and with the amount of oil specified in;
- Check the oil level and ensure it is kept close to the center of the sight glass;
- Install the oil inlet plug;
- Check for oil leaks.



***Figure 8.1** – Sleeve bearing*

Table 8.6 – Oil properties for sleeve bearings.

Frame		Poles	Bearing designation	Oil (liters)	Interval (h)	Lubricant	Lubricant Specification
IEC	NEMA						
315L/A/B and 315C/D/E	5006/7/8T and 5009/10/11T	2	9-80	2.8	8000	Renolin DTA 10	ISO VG32 mineral oil with antifoam and antioxidant additives
355L/A/B and 355C/D/E	5807/8/9T and 5810/11/12T						
400L/A/B and 400C/D/E	6806/7/8 and 6809/10/11T						
450	7006/10						
315L/A/B and 315C/D/E	5006/7/8T and 5009/10/11T	4 - 8	9-90	2.8	8000	Renolin DTA 15	ISO VG46 mineral oil with antifoam and antioxidant additives
355L/A/B and 355C/D/E	5807/8/9T and 5810/11/12T		9-100				
400L/A/B and 400C/D/E	6806/7/8 and 6809/10/11T		11-110	4.7			
450	7006/10		11-125				
500	8006/10						

The lubricating oil must be replaced as specified on the nameplate or whenever changes on the oil properties are noticed. The oil viscosity and pH must be checked periodically. The oil level must be checked every day and kept in the center of the sight glass.
Please contact WEG, when oils with different viscosities are to be used.

8.3. MOTOR ASSEMBLY AND DISASSEMBLY

All repair services on motors for use in hazardous areas should be always performed by qualified personnel and in accordance with the applicable laws and regulations in each country. Always use proper tools and devices for motor disassembly and assembly.

Disassembly and assembly services can be carried out only after the motor has been disconnected from the power supply and is completely stopped.

Dangerous voltages may be present at the motor terminals inside the terminal box since capacitors can retain electrical charge for long periods of time even when they are not connected directly to a power source or when space heaters are connected to the motor or when the motor windings are used as space heaters. Dangerous voltages may be present at the motor terminals when they are driven by frequency inverter even when they are completely stopped.

For explosion-proof motors and protection by enclosure motors, open the terminal box and/or disassemble the motor only after the enclosure surface temperature has cooled down up to ambient temperature.

Record the installation conditions such as terminal connection diagram, alignment / leveling conditions before starting the disassembly procedures. These records should be considered for later assembly.

Disassemble the motor carefully without causing scratches on machined surfaces or damaging the threads.

Assemble the motor on a flat surface ensuring a good support base. Footless motors must be fixed/locked on the base to prevent accidents.

Handle the motor carefully to not damage the insulated components such as windings, insulated rolling bearings, power cables etc.

Seal elements, such as joint seals and bearing seals should always be replaced when wear or damage is noticed.

Motors with degree of protection higher than IP55, the machined joints are protected at factory by a suitable rust inhibitor. Thus all machined surfaces (for example, covers of the terminal boxes of explosion-proof motors) must be carefully cleaned before assembly and provided again by a thin coat of rust inhibitor as shown in Figure 8.2.

For explosion-proof motors, the joints can be coated only with the following products:
- Lumomoly PT/4 (Lumobras);
- Molykote DC 33 (Dow Corning).

For other types of protection, apply Loctite 5923 (Henkel) on the joints.



Figure 8.2 - Machined surface of the terminal box of explosion-proof Motors.

For explosion-proof motors special care should be taken with the machined surfaces of the flame path. These surfaces must be free of burrs, scratches, etc. that reduce the flame path length and increase the gap.
The gaps between terminal boxes and the respective terminal box covers should not exceed the values specified in Table 8.7.

Table 8.7 - Maximum gap between terminal box and terminal box cover for explosion-proof enclosures.

Frame size	Flat joint Cylindrical joint		
	W21	W22X	W22X
IEC 71 to 355 NEMA 143 to 586/7	0.05 mm	0.076 mm	0.158 mm

For the W50 and HGF motor lines provided with axial fans, the motor and the axial fan have different markings for indicating the direction of rotation for prevent incorrect assembly.
The axial fan must be assembled so that the indicative arrow for direction of rotation is always visible, viewing the non-drive end side. The marking indicated on the axial fan blade, CW for clockwise direction of rotation or CCW for counterclockwise direction of rotation, indicates the direction of rotation of the motor viewing the drive end side.

8.3.1. Terminal box

Proceed as follows to remove the terminal box cover and to disconnect/connect the power supply cables and the cables of the accessory devices:
- Ensure that during the screw removal the terminal box cover does not damage the components installed inside the terminal box.
- If the terminal box cover is fitted with lifting eyebolt, lift the terminal box cover always by its lift eyebolt.
- If motors are supplied with terminal blocks, ensure the correct tightening torque on the motor terminals as specified in Table 8.7.
- Ensure that the cables do not contact sharp edges.
- Ensure that the original IP degree of protection is not changed and is maintained as indicate on the motor nameplate. The power supply cables and the control cables must always be fitted with components (cable glands, conduits) that meet the applicable standards and regulations of each country.
- Ensure that the pressure relief device is in perfect operating condition, if provided. The seals in the terminal box must be in perfect condition for reuse and must be reinstalled correctly to ensure the specified degree of protection.
- Ensure the correct tightening torque for the securing bolts of the terminal box cover as specified in Table 8.8.

Table 8.8 – *Tightening torque for the securing bolts [Nm]*

Screw type and seal		M4	M5	M6	M8	M10	M12	M14	M16	M20
Hex bolt/hex socket bolt (rigid seal)		-	3,5 to 5	6 to 9	14 to 20	28 to 40	45 to 70	75 to 110	115 to 170	230 to 330
Combined slotted screw (rigid seal)		1,5 to 3	3 to 5	5 to 10	10 to 18	-	-	-	-	-
Hex bolt/hex socket bolt (Flexible seal)		-	3 to 5	4 to 8	8 to 15	18 to 30	25 to 40	30 to 45	35 to 50	-
Combined slotted screw (Flexible seal)		-	3 to 5	4 to 8	8 to 15	-	-	-	-	-
Terminal blocks		1 to 1,5	2 to 4 [1)]	4 to 6,5	6,5 to 9	10 to 18	15,5 to 30	-	30 to 50	-
Grounding terminals		1,5 to 3	3 to 5	5 to 10	10 to 18	28 to 40	45 to 70	-	115 to 170	
Terminal box cover	Explosion-proof motors	-	-	-	35 to 41	69 to 83	120 to 145	-	295 to 355	580 to 690
	Other types of protection	-	3 to 5	4 to 8	8 to 15	25 to 37	40 to 55	-	50 to 65	-

Note: 1) For 12-pin terminal block, apply the minimum torque of 1.5 Nm and maximum torque of 2.5 Nm.

8.4. DRYING THE STATOR WINDING INSULATION

Dismantle the motor completely. Remove the end shields, the rotor with the shaft, the fan cover, the fan and the terminal box before the wound stator with the frame is transferred to the oven for the drying process. Place the wound stator in the oven heated to max. 120 °C for two hours. For larger motors a longer drying time may be required. After the drying process has been concluded, allow the stator to cool to room temperature. Measure the insulation resistance again as described in item 5.4. Repeat the stator drying process if the required insulation resistance does not meet the values specified in Table 5.3. If the insulation resistance does not improve despite several drying processes, evaluate the causes of the insulation resistance drop carefully and an eventual replacement of the motor winding may be required. If in doubt contact WEG.

To prevent electrical shock, discharge the motor terminals immediately before, and after each measurement. If the motor is equipped with capacitors, these must be discharged before beginning any repair.

8.5. SPARE PARTS

When ordering spare parts, always provide complete motor designation, indicating the motor type, the code number and the serial number, which are stated on the motor nameplate.

Spare parts must always be purchased from WEG authorized Service Centers. The use of non-original spare parts can cause motor failure, performance drop and void the product warranty.

The spare parts must be stored in a clean, dry and properly ventilated room, with relative air humidity not exceeding 60%, with ambient temperature between 5 °C and 40 °C, free of dust, vibrations, gases, corrosive smokes and at constant temperature. The spare parts must be stored in their normal mounting position without placing other components onto them.

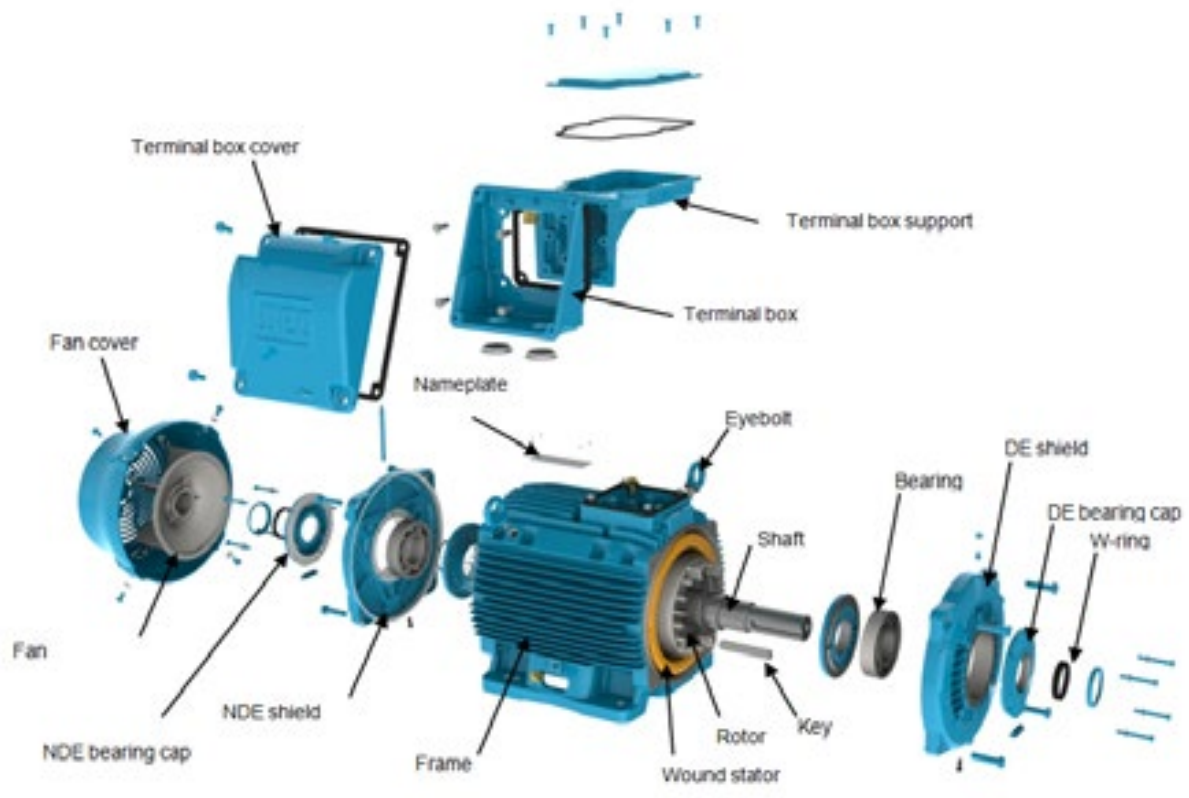


Figure 8.3 *- Exploded view of the components of a motor with type of protection "n".*

9. ENVIRONMENTAL INFORMATION

9.1. PACKAGING

WEG electric motors are supplied in cardboard, plastic or wooden packaging. These materials can be recycled and must be disposed according to the applicable laws and regulations in each country. All wood used in the packaging of WEG motors come from the company reforestation program and is not submitted to any chemical conservation treatment.

9.2. PRODUCT

Electric motors consist mainly of ferrous metals (steel plates and cast iron), non ferrous metals (copper and aluminum) and plastic materials.

In general, electric motors have relatively long service live. However when they must be discarded, WEG recommends to dismantle the motor, sort the different materials and send them for recycling.

No-recyclable materials should be disposed of at industrial landfills according to the applicable environmental laws and regulations in each country, or co-processed in cement kilns or incinerated.

The recycling service providers, the disposal in industrial landfills, the waste co-processing or the incineration process must be properly authorized by the state environment agency to carry out these activities.

10. TROUBLESHOOTING CHART X SOLUTIONS

This troubleshooting chart provides a basic list of problems that may occur during motor operation, possible causes and recommended corrective actions. In case of doubts, please contact WEG Service Center.

Problem	Possible cause	Corrective action
Motor does not start, neither coupled nor decoupled	Power cables are interrupted.	Check the control panel and the motor power supply cables.
	Blown fuses.	Replace blown fuses.
	Wrong motor connection.	Correct the motor connection according to connection diagram.
	Locked rotor.	Check motor shaft to ensure that it rotates freely.
The motor starts at no-load, but fails when load is applied. It starts very slowly and does not reach the rated speed.	Load toque is too high during start-up.	Do not start the motor on load.
	Too high voltage drop in the power cables	Check the installation dimensioning (transformer, cable cross section, relays, circuit breakers, etc.)
Abnormal / excessive noise	Defective transmission component or defective driven machine.	Check the transmission force, the coupling and the alignment.
	Misaligned / unleveled base.	Align / level the motor with the driven machine
	Unbalanced components or unbalanced driven machine	Balance the machine set again
	Different balancing methods used for motor and coupling balancing (halve key, full key)	Balance the motor again
	Wrong motor direction of rotation	Reverse the direction of rotation
	Loose bolts	Retighten the bolts
	Foundation resonance	Check the foundation design
	Damaged bearings	Replace the bearings
Motor overheating	Insufficient cooling	Clean air inlet and outlet and cooling fins
		Check the minimum required distance between the fan cover and nearest walls. See item 7
		Check air temperature at inlet
	Overload	Measure motor current, evaluate motor application and if required, reduce the load
	Number of starts per hour is too high or the load inertia moment is too high	Reduce the number of starts per hour
	Power supply voltage too high	Check the motor power supply voltage. Power supply voltage must not exceed the tolerance specified in item 7.2
	Power supply voltage too low	Check the motor power supply voltage and the voltage drop. Power supply voltage must not exceed the tolerance specified in item 7.2
	Interrupted power supply	Check the connection of the power cables
	Voltage unbalance at the motor terminals	Check for blown fuses, wrong commands, voltage unbalance in the power line, phase fault or interrupted power cables
	Direction of rotation is not compatible with the unidirectional fan	Check if the direction of rotation matches the rotation arrow indicated on end shield
Bearing overheating	Excessive grease / oil	Clean the bearing and lubricate it according to the provided recommendations
	Grease / oil aging	
	The used grease / oil does not matches the specified one	
	Lack of grease / oil	Lubricate the bearing according to the provided recommendations
	Excessive axial or radial forces due to the belt tension	Reduce the belt tension
		Reduce the load applied to the motor

Section 3.2.2

HILT EQ Tank

HILT Tank Specification Sheet

Customer:
Project:
Proposal:
Date:





Description

Tank Type:	20’ ISO full frame tank
Frame Dimensions:	20’ x 8’ x 8’6”
Capacity:	26,000 Litres (6880 gallons) +/- 2%
Full Weight:	30,000 kgs (66,000 lbs)
Empty Weight:	3,800 kgs (8360 lbs)
Vessel Material:	304 SS, hot rolled, ASTM 240
Shell & End Thickness:	5 mm Shell, 6mm End, Nominal
Frame Material:	GB/T 1591-Q345D epoxy coated carbon steel
Frame to Shell:	304 stainless steel
Vessel Design Code:	ASME VIII Div 1
Vessel Approval:	Lloyds Registry

Fittings and Accessories:

Manway Assembly	500mm - 8-point fastening manlid, low profile Gasket: PTFE encapsulated EPDM inner
Standard Fittings	1.5” BSP airline with ball valve 2.5” BSP Pressure Relief Valve - pressure set at 4.4 bar 80mm Blank flange weld in pad w 6x12M taps - shipped with blanking flange 3” 45° foot valve and 3” clamped butterfly valve terminating with 3” BSP **Additional fittings available upon request**

Walkway

'F' Type walkway, 475 wide aluminium 'Q' grating fitted as follows:-
1 full length walkways fitted with two transverse sections, one adjacent to the centre spill box, one across rear of tank

Ladder

Aluminium; anti-slip rungs, right-hand rear of tank

Grounding Plate

Welded to bottom frame rear end of tank

Internal Finish

Longitudinal welds: as-welded
Circumferential welds: as-welded but with 400 mm ground flush and polished to a maximum of 1.2 micron CLA on bottom centre line.
Entire internal surface chemically cleaned and passivated after completion of all welding and dressing.
Tank internal surface shall be free of scratches; However, if polishing is necessary, it shall not exceed 1% of the internal surface.

External Finish

Tank Shell: External surface of tank cleaned after completion of all welding and testing.

Framework: All carbon steel frame parts will be shot blasted to Swedish standard SA2½ followed by the application of:-

First coat:	Hempadur Zinc (15360)	30 micron min DFT
Intermediate:	Hempatex Primer (1530C)	40 micron min DFT
Final coat:	Hempatex Hibuild (5643C)	50 micron min DFT
	TOTAL	120 micron min DFT
	Colour Blue	RAL 5013

Insulation

Tank insulated with (2") 50 mm mineral wool with a density of 60kg/m^3 where possible. Aluminium foil will be fitted between insulation and tank shell External cladding: white GRP

Heating

6 longitudinal runs of heating coils, giving a total effective heating area of 8.00 m^2 will be fitted
The working pressure is 4 bar and the testing pressure is 6bar
Inlet and outlet connections are ¾" BSP
Dust caps and chain will be fitted.

OPTIONAL HEATING:

Use steam, glycol generator or hot water source by others

REV	DESCRIPTION	DATE	BY	APP'D
0	FOR SUBMITTAL ONLY	09/22/21	JG	JC

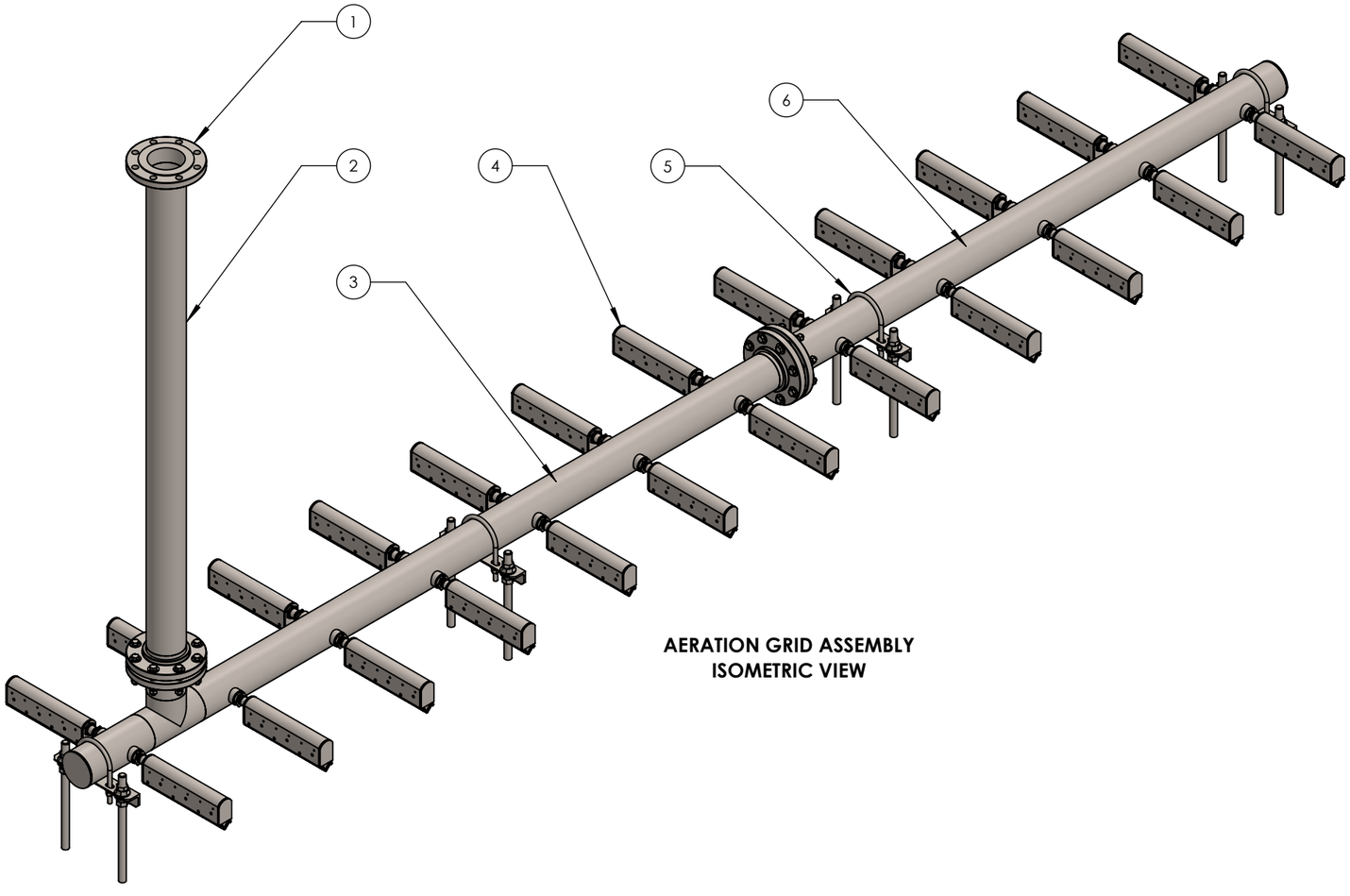
H2FLOW HILT AERATION GRID

MANUFACTURING NOTES:

1. QTY: 1 UNIT
2. MATERIAL: SS 304, ANSI 150LB FLANGE, SCH. 10
3. ALL DIMENSIONS ARE EDGE TO EDGE UNLESS OTHERWISE NOTED.
4. TOLERANCES: ANGULAR MACH. ±1°, BEND ± 1°, DECIMAL ±0.5mm OR ±1/64"
5. ALL WELDS MUST BE MIN.3/16" CONTINUOUS MIG WELDS (FLARE BEVEL WELD WHERE NECESSARY)
6. ALL WELDS MUST BE UNIFORM AND AESTHETICALLY PLEASING, DONE BY QUALIFIED CWB
7. REMOVE ALL SHARP EDGES AND CLEAN ALL SURFACES AND WELDS

BILL OF MATERIAL			
ITEM#	QTY.	DESCRIPTION	NOTE
1	5	DN100 [4"] LAP-JOINT FLANGE	
2	1	DN100 [4"] PIPE	
3	1	DN100 [4"] PIPING MODULE #1	
4	24	DN20 [3/4"] AERATION MODULE	
5	4	PIPE BRACKET ASSEMBLY	
6	1	DN100 [4"] PIPING MODULE #2	

*** ALL FASTENERS ARE DOUBLED NUTS WITH FLAT WASKET ***



AERATION GRID ASSEMBLY
ISOMETRIC VIEW

H2FLOW EQUIPMENT INC.
WATER AND WASTEWATER TREATMENT EQUIPMENT
580 OSTER LANE, CONCORD, ON L4K 2C1 CANADA
TEL: (905) 660-9775 FAX: (905) 660-9744
www.h2flow.com

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DRAWN BY: JG	DATE: 09/22/21	PROJECT NAME: CONSULTEC ASCOT-PREMIER SEWAGE WWTP	TITLE: GENERAL ARRANGEMENT - H2FLOW HILT AERATION
APP'D BY: JC	DATE: 09/22/21		DRAWING No.: Q-20519-30-32
SCALE: NTS		ALL DIMENSION ARE IN "mm" UNLESS OTHERWISE SPECIFIED	REV: 0
			SHEET 1 OF 1

R10 VERSION 1 APRIL 07, 2021

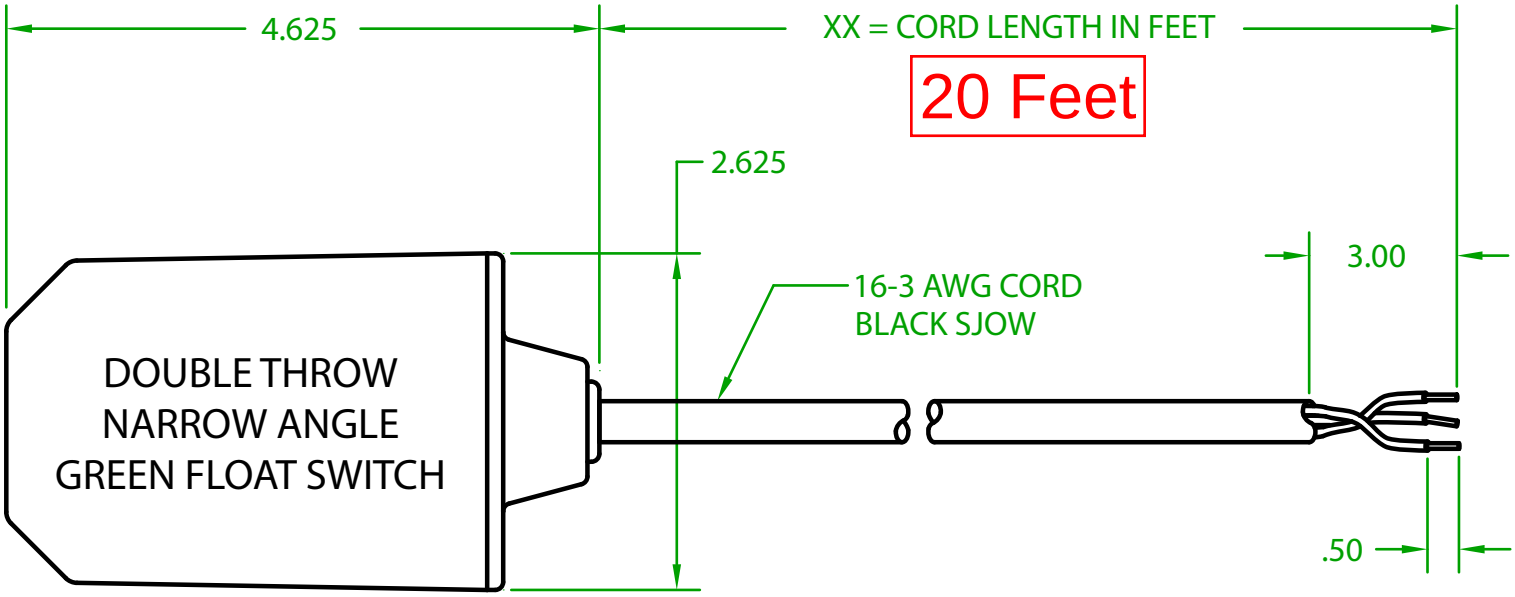
Section 3.2.3

Level Floats

MERCURY DISPLACEMENT INDUSTRIES, INC.
Post Office Box 710 - U.S. 12 East - Edwardsburg, Michigan 49112-0710
Phone (269) 663-8574 - Fax (269) 663-2924
(800) 634-4077

SKF-5034-*XX*

Mercury Free



OPERATING ANGLE: TETHERLESS/INTERNALLY WEIGHTED
SWITCHES @ 25° ABOVE AND 10° BELOW HORIZONTAL.
@ 25° ABOVE HORIZONTAL:
(RED IS CLOSED / WHITE IS OPEN)
@ 10° BELOW HORIZONTAL: (NORMAL POSITION)
(RED IS OPEN / WHITE IS CLOSED)

SWITCHING DIFFERENTIAL: 3 1/2"

ELECTRICAL RATINGS: 1/4 H.P. 10 AMPS @ 120/240 VAC. 34.8 LRA

FLOAT MATERIAL: A.B.S.

High High Alarm - Normally Closed
White - NC & Black - Common

J.J.S. OCTOBER 03, 2012

Revised 01-16-2014

Contactors - Relays - Switches

http://www.mdius.com

SJE SIGNALMASTER® SPDT Control Switch

Mechanically-activated, narrow-angle float switch designed to activate pump control panels and alarms.



This narrow-angle sensing device is used to accurately monitor liquid levels in:

- water
- sewage applications

The SJE SignalMaster® SPDT control switch can be wired to work in either normally open or normally closed applications. It is not sensitive to rotation.

When wired as Normally Open (high level)
The control switch turns on (closes) when the switch tips slightly **above** horizontal signaling a high level, and turns off (opens) when the switch drops slightly below horizontal.

When wired as Normally Closed (low level)
The control switch turns on (closes) when the switch tips slightly **below** horizontal signaling a low level, and turns off (opens) when the switch tips slightly above horizontal.

FEATURES

- Can be wired to work in either normally open or normally closed applications (Single Pole, Double Throw).
- Mechanically-activated, snap action contacts.
- High impact, corrosion resistant, polypropylene float housing.
- Not sensitive to rotation.
- Control differential of 1.5 inches (4 cm) above or below horizontal.
- Green colored cap for easy identification of SPDT control switch.
- UL Listed for use in water and sewage.
- CSA Certified.
- Five-year limited warranty.

SSPMA MEMBER
LR54245
LISTED 83N2
Member of Hydraulic Institute

SPECIFICATIONS

CABLE: flexible 18 gauge, 3 conductor (UL) SJOW, water-resistant (CPE)

FLOAT: 2.74 inch diameter x 4.83 inch long (7.0 x 12.3 cm) high impact, corrosion resistant, polypropylene housing for use in sewage and water up to 140°F (60°C)

MAXIMUM WATER DEPTH: 30 feet (9 meters), 13 PSI (90 kPa)

ELECTRICAL: 5 amp, 125/250 VAC, 50/60 Hz

NOTE: This switch is not recommended for controlling:

- electric loads less than 100 milliamps, 12 VAC
- non-arcing electric loads

OPTIONS

This switch is available:

- CE certified switch available upon request
- in standard cable lengths of 10, 15, 20, or 30 feet and 3, 5, 6, or 10 meters (longer lengths available)
- with two mounting options that allow for flexibility in installation:

  Mounting Clamp: for applications where the switch can be attached to a discharge pipe or similar mounting device.

  Externally Weighted: for applications where the switch can be suspended from above.

California Prop 65 requires the following: ⚠ WARNING Cancer and Reproductive Harm - www.P65Warnings.ca.gov

SEE REVERSE SIDE FOR ORDERING INFORMATION.
SEE PRICE BOOK FOR LIST PRICE.

SJE RHOMBUS
1-888-DIAL-SJE • 1-218-847-1317
1-218-847-4617 Fax
email: customer.service@sjeinc.com
www.sjerhombus.com

SJE SIGNALMASTER® SPDT Control Switch

Mechanically-activated, narrow-angle float switch designed to activate pump control panels and alarms.

ORDERING INFORMATION

Normally Open or Normally Closed		Shipping Weight
Part Number	**Description**	
1006094	10SGMSPDTPC	1.20 lbs.
1006098	10SGMSPDTWE	2.29 lbs.
1006095	15SGMSPDTPC	1.61 lbs.
1006099	15SGMSPDTWE	2.69 lbs.
1006096	20SGMSPDTPC	2.01 lbs.
1006100	20SGMSPDTWE	3.10 lbs.
1006097	30SGMSPDTPC	2.82 lbs.
1006101	30SGMSPDTWE	3.91 lbs.

PC = **P**ipe **C**lamp **WE** = **W**eighted **E**xternally

Can be wired to work in either pump down (normally open) or pump up (normally closed) applications.

NOTE: Descriptions are grouped by cable length measured in feet (10, 15, 20, 30).

SEE PRICE BOOK FOR LIST PRICE.

OPTIONS

PACKAGING
Bagged - standard
Boxed - optional
Bulk - optional

ADDITIONAL CABLE
Longer cable lengths available. Please call for details.

UL Listed for Water & Sewage

LISTED 83N2 LR54245

SSPMA MEMBER

SPECIFICATIONS

CABLE: flexible 18 gauge, 3 conductor (UL) SJOW, water-resistant (CPE)

FLOAT: 2.74 inch diameter x 4.83 inch long (7 cm x 12.3 cm), high impact, corrosion resistant polypropylene for use in sewage and water up to 140°F (60°C)

MAXIMUM WATER DEPTH: 30 feet (9 meters), 13 psi

ELECTRICAL: 5 amp, 125/250 VAC, 50/60 Hz

This switch is not recommended for controlling:

- electric loads less than 100 milliamps, 12 VAC
- non-arcing electric loads

OTHER INFORMATION

NORMALLY OPEN (high level) OPERATION
The control switch closes (turns on) when the float tips slightly **above** horizontal signaling a high level, and opens (turns off) when the float drops slightly **below** horizontal in water or sewage applications.

NORMALLY CLOSED (low level) OPERATION
The control switch closes (turns on) when the float tips slightly **below** horizontal signaling a low level, and opens (turns off) when the float tips slightly **above** horizontal in water or sewage applications.

Call or fax your order!
1-888-DIAL-SJE (1-888-342-5753) • Fax 218-847-4617

Product offering and pricing are subject to change without notice.
*Please visit **www.sjerhombus.com** for the most current information.*

SJE RHOMBUS®
www.sjerhombus.com
customer.service@sjeinc.com

9500116E 10/18
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SJE-Rhombus®

Accessories Installation Instructions

Cord Seal, Cable Weight, Cable Clamp Assembly, and Float Bracket.

CORD SEALS



Provides strain relief and a liquid-tight seal.

- Seals 1-4 cables in 2" terminal adapters
- Seals 1-6 cables in 2½" terminal adapters
- PVC plugs included (for unused cable positions)
- Ground wire

CABLE WEIGHT



U.S. Patent 5,306,885

Provides an accurate pivot point for suspended float switches.

- Gripper teeth on clip and weight channel securely lock float cable into place
- Cable Weight can be adjusted without the use of tools

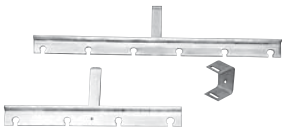
CABLE CLAMP ASSEMBLY



Provides cable anchor point and strain relief. Secures cable in vertical direction.

- For use with 18/16 gauge, 14 gauge, & 12 gauge cable
- Mounting clamp: ABS Nylon blend
- Hose clamp: highly corrosion resistant stainless steel

FLOAT BRACKET



Provides convenient installation of float switches.

- Six Float Bracket supports 1-6 floats
- Four Float Bracket supports 1-4 floats
- Can be directly mounted to wall or used with wall mounting device
- Provides convenient location to stow excess float cord
- Supplied with cord strain relief connectors

PREVENTATIVE MAINTENANCE

- Periodically inspect the product. Check that the cable has not become worn or that the housing has not been damaged so as to impair the protection of the product. Replace the product immediately if any damage is found or suspected.
- Periodically check to see that the float is free to move and operate the pump or alarm.
- Use only SJE-Rhombus® replacement parts.

SJE-RHOMBUS® THREE-YEAR LIMITED WARRANTY

SJE-RHOMBUS® warrants to the original consumer that this product shall be free of manufacturing defects for three years after the date of consumer purchase. During that time period and subject to the conditions set forth below, **SJE-RHOMBUS®** will repair or replace, for the original consumer, any component which proves to be defective due to defective materials or workmanship of **SJE-RHOMBUS®**.

ELECTRICAL WIRING AND SERVICING OF THIS PRODUCT MUST BE PERFORMED BY A LICENSED ELECTRICIAN.

THIS WARRANTY DOES NOT APPLY: (A) to damage due to lightning or conditions beyond the control of **SJE-RHOMBUS®**; **(B)** to defects or malfunctions resulting from failure to properly install, operate or maintain the unit in accordance with printed instructions provided; **(C)** to failures resulting from abuse, misuse, accident, or negligence; **(D)** to units which are not installed in accordance with applicable local codes, ordinances, or accepted trade practices, and **(E)** to units repaired and/or modified without prior authorization from **SJE-RHOMBUS®**.

Some states do not allow limitations on how long an implied warranty lasts, so the above limitation may not apply to you. Some states do not allow the exclusion or limitation of incidental or consequential damages, so the above limitation or exclusion may not apply to you. This warranty gives you specific legal rights, and you may also have other rights which vary from state to state.

TO OBTAIN WARRANTY SERVICE: The consumer shall assume all responsibility and expense for removal, reinstallation, and freight. Any item to be repaired or replaced under this warranty must be returned to **SJE-RHOMBUS®**, or such place as designated by **SJE-RHOMBUS®**.

ANY IMPLIED WARRANTIES OF MERCHANTABILITY OR FITNESS ARE LIMITED TO THE DURATION OF THIS WRITTEN WARRANTY. SJE-RHOMBUS® SHALL NOT, IN ANY MANNER, BE LIABLE FOR ANY INCIDENTAL OR CONSEQUENTIAL DAMAGES AS A RESULT OF A BREACH OF THIS WRITTEN WARRANTY OR ANY IMPLIED WARRANTY.

SJE-Rhombus®

22650 County Highway 6 ■ P.O. Box 1708 ■ Detroit Lakes, Minnesota 56502 USA
1-888-DIAL-SJE (1-888-342-5753) ■ Phone: 218-847-1317 ■ Fax: 218-847-4617 ■ E-mail: customer.service@sjerhombus.com

⚠ WARNING — **ELECTRICAL SHOCK HAZARD**
Disconnect power before installing or servicing this product. A qualified service person must install and service this product according to applicable electrical and plumbing codes.

⚠ WARNING — **EXPLOSION OR FIRE HAZARD**
Do not use this product with flammable liquids. Do not install in hazardous locations as defined by National Electrical Code, ANSI/NFPA 70.

Failure to follow these precautions could result in serious injury or death. Replace product immediately if switch cable becomes damaged or severed. Keep these instructions with warranty after installation. This product must be installed in accordance with National Electric Code, ANSI/NFPA 70 so as to prevent moisture from entering or accumulating within boxes, conduit bodies, fittings, float housing, or cable.

For detailed specifications on this product, or for the complete line of SJE-Rhombus® panel, alarm, and switch products, visit our web-site at www.sjerhombus.com.

CORD SEAL INSTALL

1. Pass the cables through the 2" or 2½" terminal adaptor.
2. Route cables through the seal, leaving adequate cable to work with. See **Figure A**.
   NOTE: If all hole positions are not used, plug open position(s) in the cord seal with the PVC plug(s) provided.
3. Insert the cord seal into the terminal adaptor and tighten hex nut until adequate strain relief is achieved.
4. Gather all ground wires, including ground conductor on the cord seal and secure to ground terminal.

CABLE WEIGHT INSTALL

1. Lay cable in weight as shown in Figure B.
2. Align clip with weight groove and slide clip towards cable as shown in Figure B. Snap clip snugly up to cable and manually force clip to tightest possible position.
3. See Figure C for proper tether length.

CABLE CLAMP INSTALL

1. Determine the required cord tether length according to product specifications.
2. Place the cord into the clamp as shown as shown in Figure D.
3. Locate clamp at desired activation level and secure the clamp to the discharge pipe as shown in Figure D.
   Note: Do not install cord under hose clamp.
4. Tighten the hose clamp using screwdriver. Over tightening may result in damage to the plastic clamp. Make sure the float cable is not allowed to touch the excess hose clamp band during operation.
5. Wire switch as shown in the Wiring Diagrams.
6. Check installation. Allow system to cycle to insure proper operation.

Note: All hose clamp components are made of 18-8 stainless steel material. See your SJE-Rhombus® supplier for replacements.

FLOAT BRACKET INSTALL

1. Drill holes in mounting surface 1-5/16 inches apart vertically.
2. Install the mounting bracket to the mounting surface using two fasteners shown in Figure E.
   NOTE: Use stainless steel fasteners appropriate for the mounting surface.
3. Snap the cord lock onto the cable shown in Figure E.
4. Drop the cord lock and cord into the top side of a desired hole in the float bracket as shown in Figure F.
5. Adjust the cord to the proper length, so that activation occurs at the desired level.
6. To lock the cord in place, turn the cord lock clockwise as shown in Figure F.
7. Slide the float bracket into the mounting bracket slots as shown in Figure F.
8. Confirm the float cords are set at a proper height to insure correct activation/deactivation levels.

Figure A

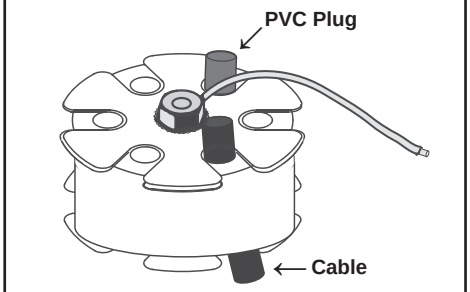


Figure B

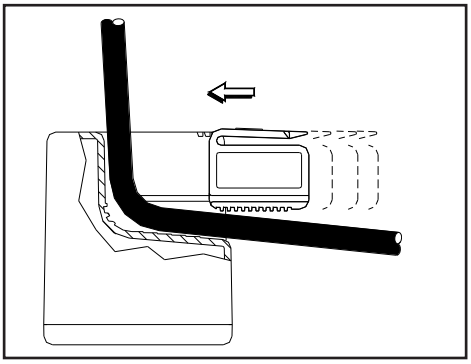
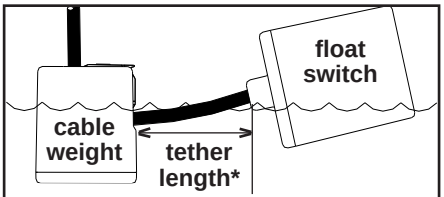


Figure C



***Control Switches:**
Recommended tether length is 4 inches (10 cm)

***Pump Switches:**
Minimum recommended tether length is 3.5 inches (9 cm)

Figure D

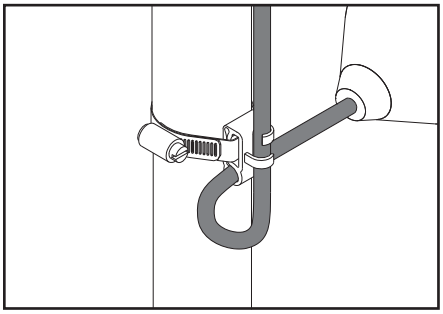


Figure E

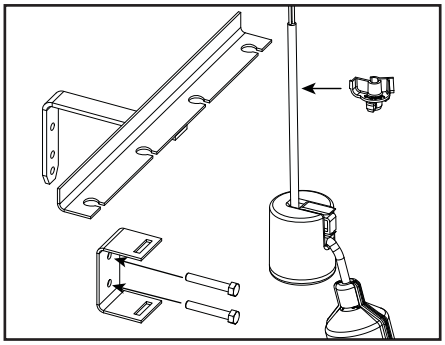
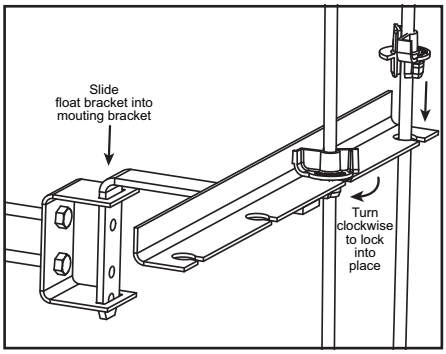


Figure F



Instl. Instr. PN 1041933A
©SJE-Rhombus Printed in USA 09/14

Section 3.2.4

EQ Tank Blowers

SCL R20 / R30 / R40

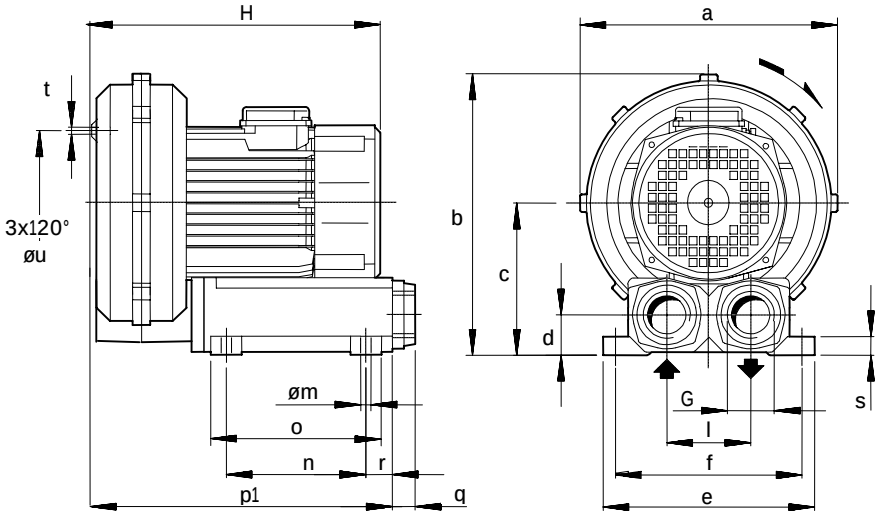
MD SERIES

SN 2464-7 1/2

STANDARD FEATURES
- Low weight cast aluminum construction.
- Quiet operation with integral inlet and outlet muffling.
- Recognized TEFC - cURus motor.
- High efficiency / low noise impeller design.
- No lubrication / maintenance required.
- Allowed ambient: +5 °F to +104 °F.
- Mountable in any plane.

OPTIONS
- Remote drive models (belt or coupling).
- Special voltages.
- Surface treatment or plating.
- Gas tight sealing.
- Special designs available.

ACCESSORIES
- Inlet and/or inline filters.
- Additional inlet/outlet silencers.
- Relief valves.
- Flow converting devices.
- Optionals connectors



Dimensions in inches.
Dimension for reference only.

Model	a	b	c	d	e	f	G	l	m	n	o	p1	q	r	s	t	u
R20-MD	11.14	12.17	6.57	1.85	9.25	8.27	1" ¼ NPT	3.54	0.39	5.91	7.87	13.58	0.71	1.77	0.87	M6	5.91
R30-MD	12.56	13.62	7.36	1.85	9.25	8.27	1" ¼ NPT	3.54	0.39	5.91	7.87	13.94	0.71	1.77	0.87	M6	7.09
R40-MD	13.78	14.65	7.76	1.85	9.25	8.27	1" ¼ NPT	3.54	0.39	5.91	7.87	14.33	0.71	1.77	0.87	M8	8.86

Model	Maximum flow Scfm		Installed power Hp		Maximum differential pressure Δp (In WG)		Noise level Lp dB (A) (1)		Overall dimensions H	Weight
	60 Hz 3500 rpm	50 Hz 2900 rpm	60 Hz 3500 rpm	50 Hz 2900 rpm	60 Hz 3500 rpm	50 Hz 2900 rpm	60 Hz 3500 rpm	50 Hz 2900 rpm	Inches	Lbs
R20-MD	41	35	1 ½	1 ½	161	161	68.5	66.5	13.39	48.5
R30-MD	65	54	2	2	140	170	72.2	69.2	15.58	57.3
			3	-	191	-	72.8	69.7	15.55	66.1
R40-MD	78	69	3	3	141	170	72.8	70.8	16.22	77.2
			4	4	201	201	73.3	71.3	17.09	88.2

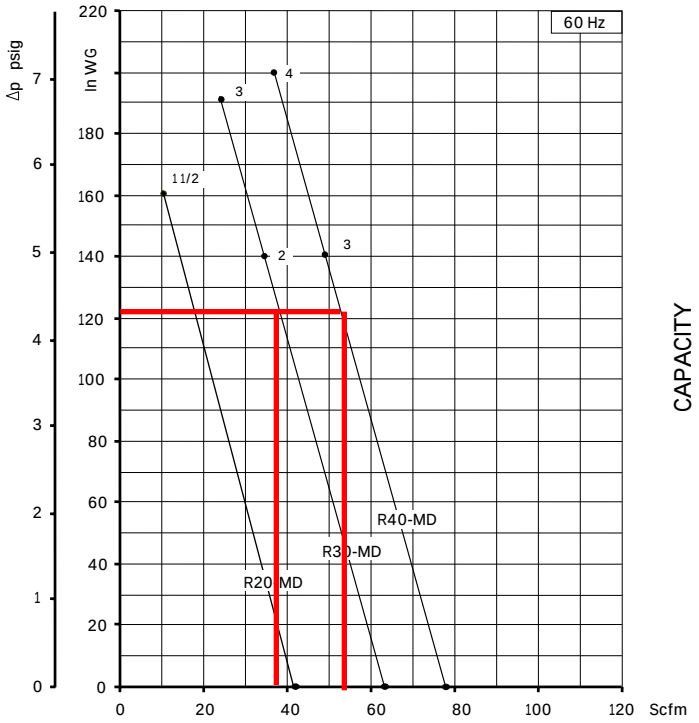
(1) Noise measured at 1 m distance with inlet and outlet ports piped, in accordance to ISO 3744.

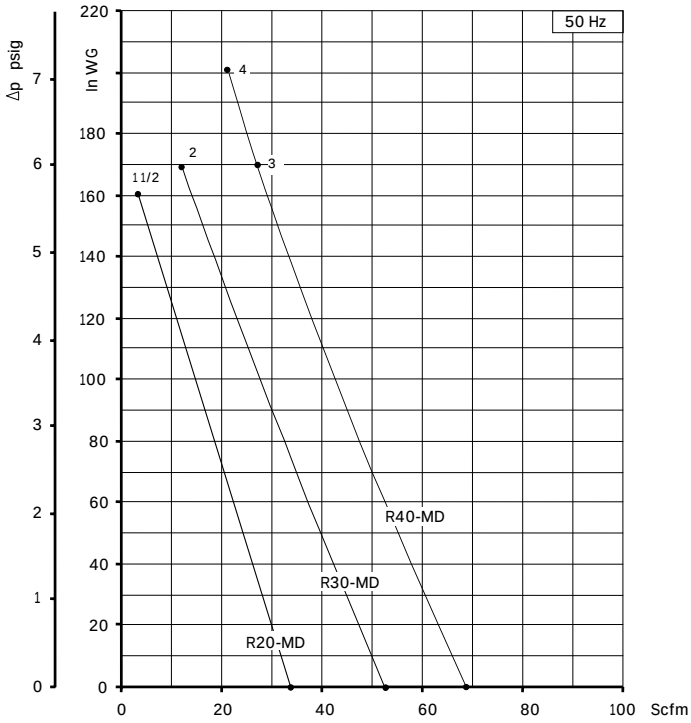
- For proper use, the blower should be equipped with inlet filter and relief valve; other accessories available on request.
- Ambient temperaturefrom +5° to +104°F.
- Specifications subject to change without notice.

SCL R20 / R30 / R40 MD SERIES

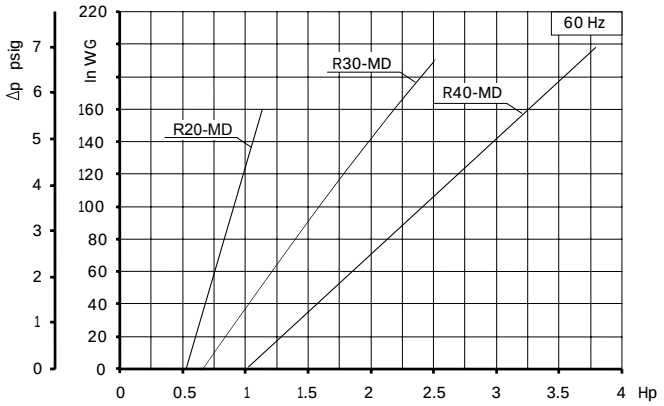
SN 2464-7 2/2

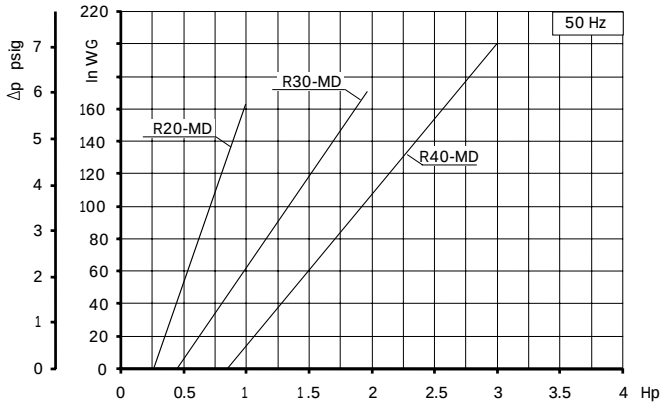
CAPACITY



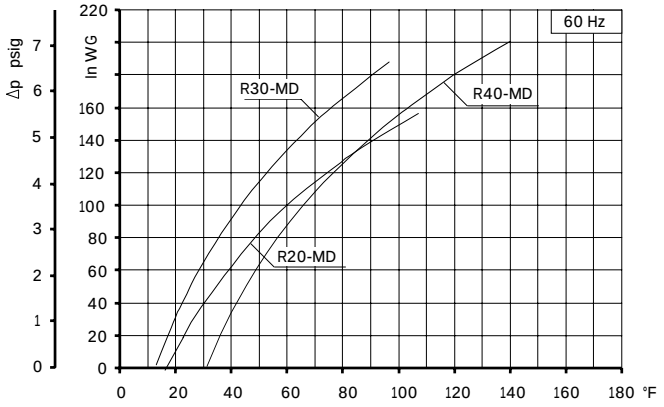


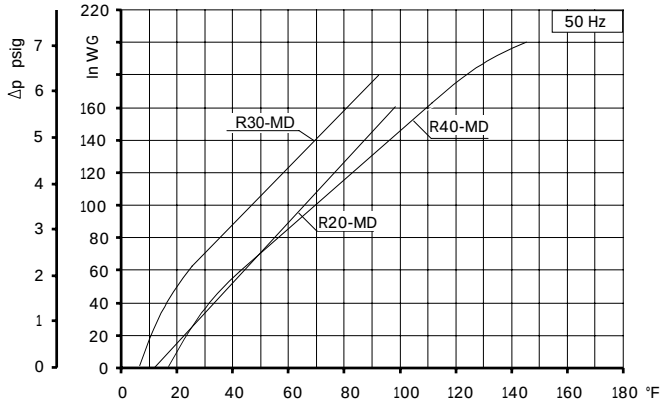
ABSORBED POWER





TEMPERATURE INCREASE





Curves refer to air at 68°F temperature and 29.92 In Hg atmospheric pressure (abs) measured at inlet port.
Values for flow, power consumption and temperature rise: +/-10% tolerance.
Data subject to change without notice.

Safety Valves

SN 1733 -7 1/1

The VRL valves are designed to protect blowers and / or motors from over pressurization or excess vacuum. When there is over pressurization, the valve opens and discharges to the outside. When there is excess in vacuum, the valve opens and takes flow from outside.

The valves have been designed for low pressure / low vacuum, with minimal difference between the initial value at which the valve begins to open and its fully opened position. The valves are supplied with 2 different springs to maximize their efficiency. These compact valves, made of aluminum alloy, are both easy to install and calibrate, and operate in a wide range of capacities. The VRL can be plumbed to divert excess primary flow through a secondary external outlet when working in pressure conditions, or to pipe in a secondary flow when working in vacuum.

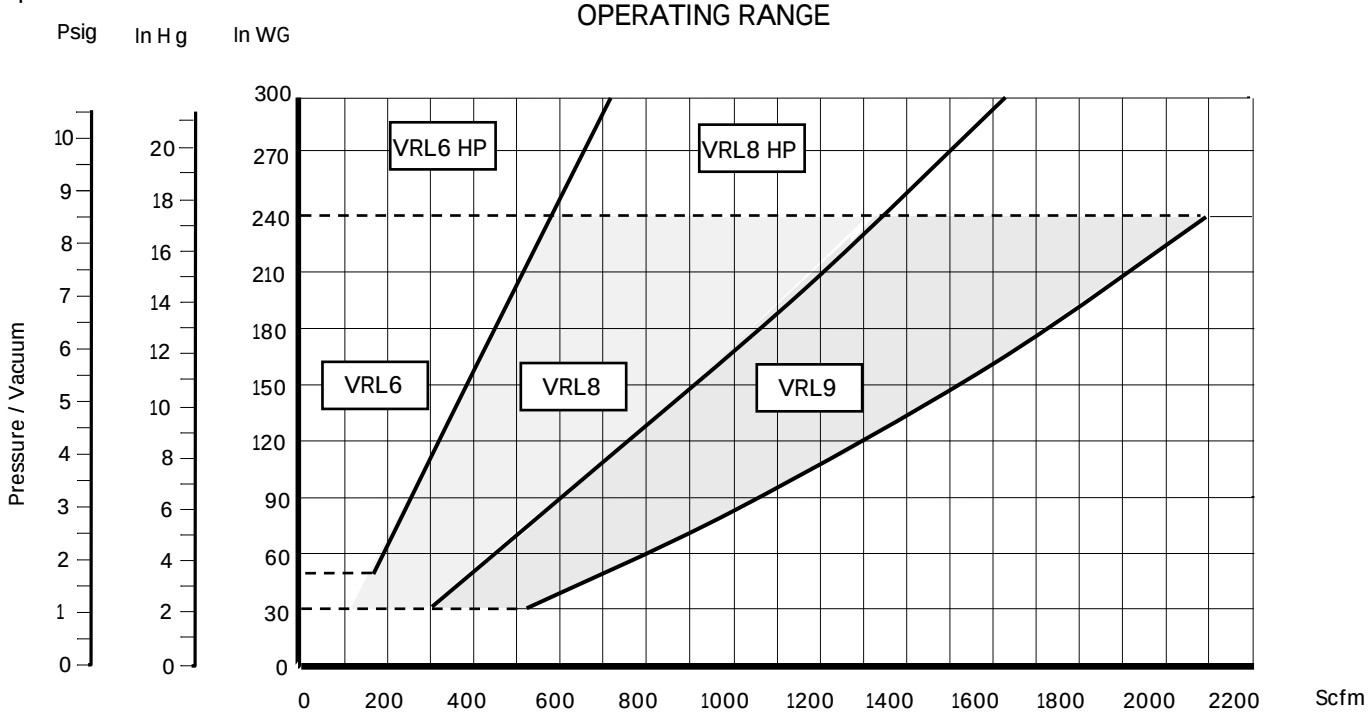
"HP" valves are used for pressures >240" H2O.

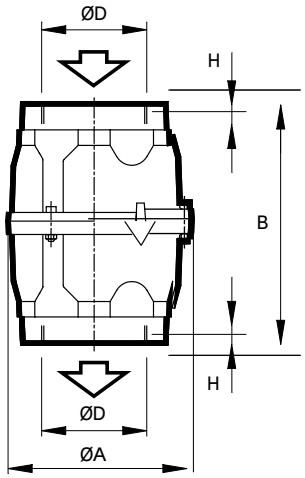
Maximum efficiency is achieved by keeping operating values (flow versus pressure or vacuum) within the operating range (shaded area on graph). Capacity refers to air having a density equal to 0.075 lbs./cu.ft .



VRL6 VRL6 HP | VRL8 VRL8 HP | VRL9

OPERATING RANGE





OVERALL DIMENSIONS

TYPE	ND	D	A	B	H	WEIGHT (Lbs)
VR6 & VRL6 HP	2”	2” NPT	4.02	6.90	0.47	1.9
VRL8 & VRL8HP	3”	3” NPT	5.31	7.48	0.59	4.2
VRL9	4”	4” NPT	6.30	8.11	0.71	5.7

- Dimensions in inches.
- Specifications subject to change without prior notice.

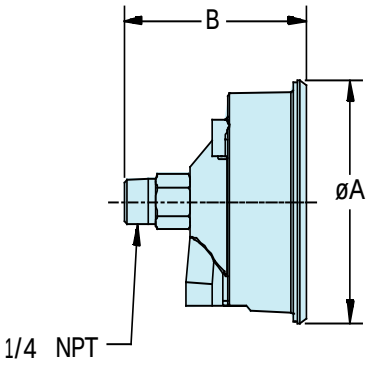
VRL valves are supplied uncalibrated - contact FPZ for calibration options.

FPZ, Inc. 150 N. Progress Drive Saukville, WI 53080 USA Tel. (262) 268-0180 usa@fpz.com www.fpzusa.com

Gauges, Check Valves, Silencers, Enclosures

SS1708

Gauges



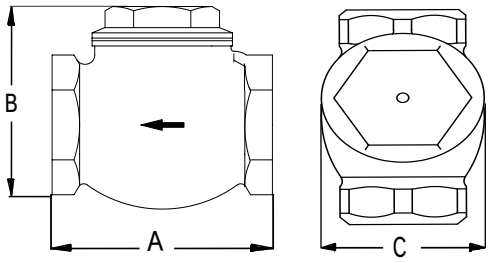
Gauges are important for monitoring the operating pressure or vacuum of the blower. Gauges should be positioned as close to the blower as possible.

Part number	Duty	Scale	A	B
VG25-60	Vacuum	0-60" H_2O	2.88	2.59
VG25-200	Vacuum	0-200"H_2O		
VG25-300	Vacuum	0-300" H_2O		
PG25-60	Pressure	0-60" H_2O		
PG25-200	Pressure	0-200" H_2O		
PG25-300	Pressure	0-300" H_2O		
PG25-15*	Pressure	0-15 psi	2.7	2.25

Dimensions in inches. Tolerance on given values ± 10% - unbinding and can be changed without prior notice.

*PG25-15 is suitable for outdoor use

Check Valves

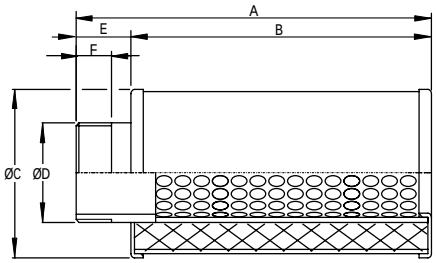


Swing check valves allow air to flow in one direction. These valves prevent backflow into the blower and are supplied in bronze or brass.

Part Number	NPT	A	B	C
CV075	0.75"	2.4		
CV10	1"	2.8	2.7	1.9
CV125	1.25"	3.2	3.2	2.2
CV15	1.5"	3.6	3.5	2.5
CV20	2"	4.3	4.2	3.1
CV30	3"	5.8	6.1	4.2
CV40	4"	6.9	7.1	5.5

Dimensions in inches. Tolerance on given values ± 10% - unbinding and can be changed without prior notice.

Silencers



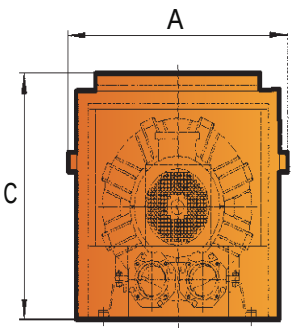
Silencers provide additional sound attenuation.

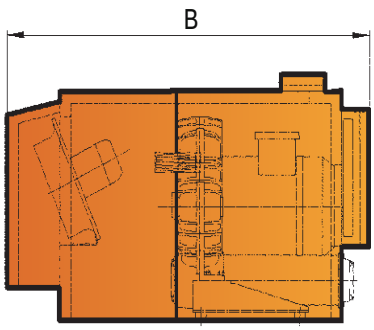
TYPE	D	A	B	C	E	F	lbs
SS 4	1" 1/4	7.5	5.5	2.8	2	0.6	0.8
SS 5	1" 1/2	7.9	6.7	3.1	1.2	0.8	1.1
SS 6	2"	9.1	7.9	3.5	1.2	0.8	1.3
SS 8	3"	19.1	15.7	6.0	3.3	0.8	4.8
SS 9	4"	18.3	16.9	6.7	1.1	0.8	9.9

Steel manufactured (apart from SI 9 / SS 9 - entirely in aluminium) with sound absorbing polyurethane element.

Dimensions in inches. Tolerance on given values ± 10% - unbinding and can be changed without prior notice.

Sound Enclosures





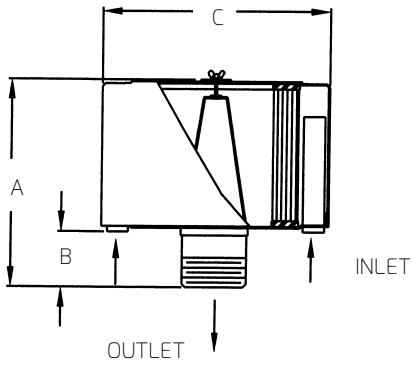
Part #	Used on models	A	B	C
IH1	SCL K03-MS	13.4	18.2	15.8
IH3	SCL K04-MS	14.3	19.7	16.5
IH5	SCL K05-6 MS + 30-40DH	16.9	26.8	21.3
IH7	SCL K07-8 MS / MD	31.7	64.4	26
IH8	SCL K07-8 TD	31.7	64.4	26
IH9	SCL K07-8 TS	31.7	64.4	26
IH10	SCL K09-12 MS/MD	31.7	67.2	30
IH11	SCL K09-10 TD	31.7	67.2	30
IH12	SCL K11-TD	31.7	67.2	30
IH13	SCL K09-11 TS	31.7	67.2	31.5

Dimensions in inches - unbinding and can be changed without prior notice.

Inlet Filters

SS1905

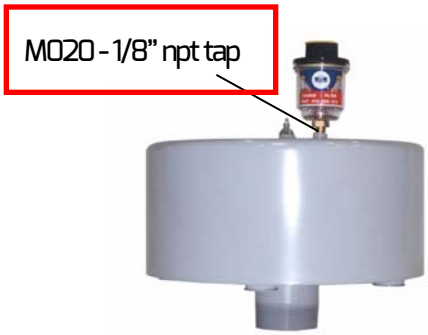
FPZ inlet filters are used for pressure applications. The inlet filters combine filtration and sound attenuation into a compact package. Inlet filters consist of a filter cartridge enclosed by a carbon steel weather hood. Elements are easily serviceable by simply removing the weather hood.



Dimension tolerance ± 1/8"



VG-020-013



FEATURES & SPECIFICATIONS

- Polyester: 99%+ removal efficiency standard to 5 micron. (Other media available upon request.)
- Fully drawn weather hood - no welds to rust or vibrate apart
- Tubular silencing design - tube is positioned to maximize sound attenuation and air flow while minimizing pressure drop
- Durable carbon steel construction with baked enamel finish
- Filter change out differential: 10"-15" H_2O Over Initial Delta P.

OPTIONAL DIRTY FILTER INDICATOR

The **VG-020-013** dirty filter indicator is used to maximize filter life for pressure applications only. The yellow indicator in the site window drops as dirt accumulates on the filter element. The element is ready for change out or servicing when the yellow indicator reaches the red zone. The filter condition can be determined without removing the weather hood even after the blower has been shut down.

The indicator can be mounted in the inlet piping between the blower and filter or directly to the filter housing by having a 1/8" npt tap installed in the hood. If a tap is required, FPZ part number **M020*** should be ordered.

Polyester Element	NPT	Dimensions (Inches) A	B	C	Used on Models	Approx Wt. Lbs
FS-15-050	½"	4	1 ½	6	10DL	2
FS-15-075	¾"	4	1 ½	6	15DH	2
FS-15-100	1"	4	1 ½	6	06	2
FS-19P-125	1 ¼"	6 5/8"	1 5/8"	6	K03-MS, R20-MD, R30-MD, R40-MD	3
FS-19P-150	1 ½"	6 5/8"	1 5/8"	6	K04-MS	4
FS-31P-200	2"	7 ¼"	2 ¼"	10	K05-MS, K05-TD	8
FS-231P-200	2"	12 ¼"	2 ¼"	10	K06-MS, K06-TD, K07R-MD, K08R-MD	14
FS-231P-300	3"	13"	3"	10"	K07-MS, K05-TS, K07-TD	15
FS-235P-300	3"	13"	3"	16"	K08-MS, K06-TS, K08-TD	29
FS-235P-400	4"	14"	4"	16"	K09-MS, K10-MS, K09-MD, K10-MD, K11-MD, K12-MD, K09-TD, K10-TD	30
FS-245P-400	4"	14"	4"	16"	K07-TS, K08-TS, K11-MS, K12-MS, K11-TD, K12TD	31
FL10**	NA	14 3/8"	1 3/8"	16 3/16"	K09-TS, K10-TS, K11-TS, K12-TS,	18

*M020 1/8" npt filter tap will be added to filter part number suffix if ordered.

**FL10 utilizes 15 micron paper element and does not include tubular silencers. FL10 filters are normally ordered with CA10

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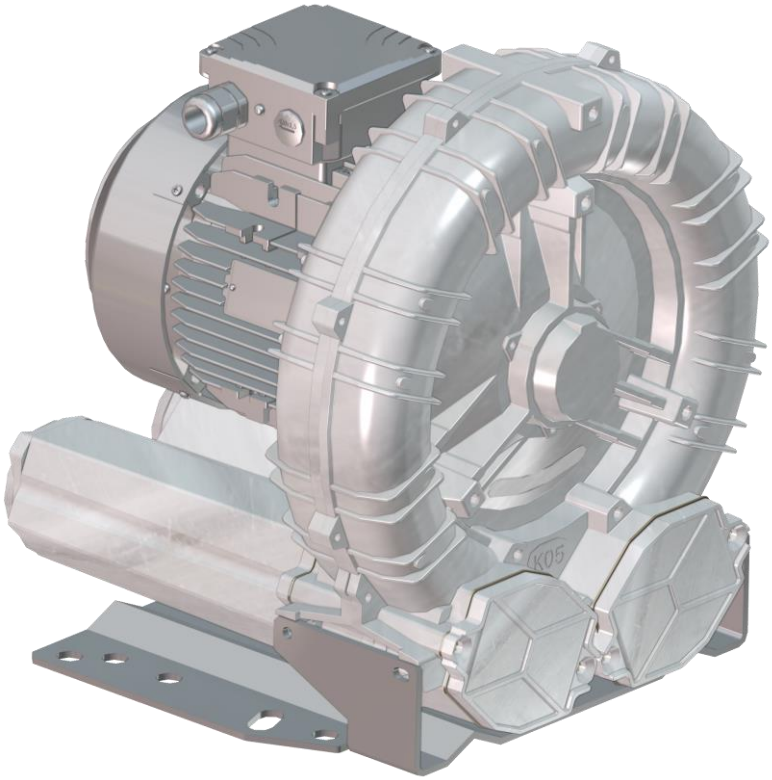
COMPRESSORI-ASPIRATORI A CANALE LATERALE — ISTRUZIONI — I
LATERAL CHANNEL BLOWERS-EXHAUSTERS — INSTRUCTIONS — GB



WARNING

Leggere e seguire le istruzioni prima dell'uso e conservare il manuale come riferimento per il futuro. Il mancato rispetto di tutte le istruzioni del produttore, inclusa l'installazione impropria o l'uso improprio del prodotto, le alterazioni del prodotto e/o il mancato utilizzo del prodotto in conformità al presente manuale, possono causare danni, lesioni gravi o morte. — I

Read and follow all instructions before use and keep manual for future reference. Failure to comply with all manufacturer's instructions, including improper installation or use of the product, alterations to the product, and/or failure to use the product in accordance with this manual can result in property damage, serious injury or death. — *GB*



Per ulteriori informazioni o assistenza all'installazione, prego contattare:
For further information or assistance with installation, please contact:

@ service@fpz.com +39 039 690981

COMPANY WITH QUALITY SYSTEM CERTIFIED BY DNV GL = ISO 9001 =

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1 GENERAL INFORMATION

Read the manual for safety information on correct installation, operation and maintenance.

1.1 PURPOSE OF MANUAL

- The purpose of the manual is to complete the information contained in the *operative instructions* (Figure 1*)* supplied with the blower in order to give "instructions for use" to the skilled operator to prevent and minimize risks during the interaction between man and machine.
- For safe installation, carefully read this manual before installing the product and follow all instructions exactly as shown.
- The information was prepared by the manufacturer in the original language (ITALIAN) considering the content communication effectiveness for the interested parties also depending on the operator's qualifications and perspicacity.
- Keep the *operative instructions* (Figure 1*)* for the entire service life of the unit in a known and easy to access place to make it always at hand for reference.
- Any observations made by recipients can be an important contribution to improve the after-sales services provided by the manufacturer.
- The information contained in this manual is intended for use by specialized operators whose definition is contained in the document MAN_PIC (Figure 2).
- For electric components and motors that may be installed to the blower, please refer to the manuals of their own manufacturers.

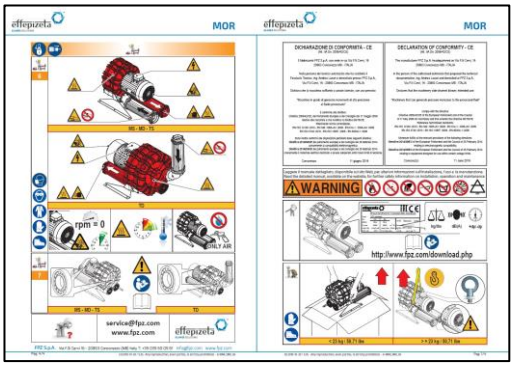


Figure 1 – *Operating Instruction*

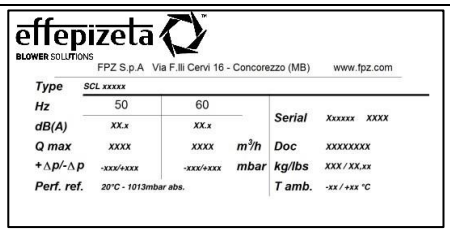


Figure 2 - Document MAN_PIC

1.2 TECHNICAL DATA – NAMEPLATE

On the product nameplate are stated:

• Unit description
• Performance (Noise [dB], Flow [m^3/h] and Pressure [mbar]) at 50 Hz and 60 Hz frequency referring to 20°C and 1013 mbar abs.
• Serial number and year of manufacture
• Reference Doc. (*Operating Instruction)*
• Weight [kg/lbs]
• Reference temperature for the working blower (T. amb.)





It is strictly forbidden to remove or tamper with the product label.

1.3 TESTING, WARRANTY AND LIABILITY

Testing and inspection

- The entire unit is sent to the customer ready for installation, after passing the tests and inspections required by the manufacturer, in conformity with the applicable laws and the mandatory technical standards.

Warranty

- Warranties are defined in the general terms and conditions of sale.

Liability

- See document MAN_PIC.

2 SAFETY RULES

2.1 IMPORTANT SAFETY INFORMATION

WARNING	**The instructions listed below must be read carefully and become a fundamental part of daily procedures in the normal use and maintenance of all the equipment, in order to prevent any kind of personal or domestic animals (even serious) injury (or death) or damage to equipment.**

- Do not start the unit until its operation is clearly understood.
- All installation, commissioning and maintenance operations must be carried out by specialized operators only (see doc MAN_PIC).
- Keep the area around the unit constantly free of obstructions.
- Use appropriate PPE (Personal Protective Equipment) such as boots, gloves, goggles and work clothes.
- Pay attention to all danger and caution signs placed on the unit.
- Do not wear clothes, jewellery or accessories that can get caught in the cooling fan of the electric motor or that can be sucked into the blower.
- Do not modify the electrical connections on the unit.
- Observe all local, state and national electrical codes.
- Before starting the unit and/or with weekly frequency, the operator must check the efficiency of the devices that ensure the operation of the unit and any other unit defects. In case of any defects, immediately notify FPZ S.p.A.
- Devices that ensure the operation of the unit must never be removed or rendered useless.
- During maintenance or repair work, it may be necessary to exclude some mentioned devices from the service. This operation must be carried out by specialized operators only (see doc MAN_PIC).
- Always apply and enforce the safety rules; in case of any doubts, always consult this manual before acting.

WARNING	**Non-compliant installation with the unit's intended use can cause personal (even serious) injury (or death) or damage to equipment.**

The unit must only be started:

- in conformity with the purposes of use, transport and handling specified in "FORESEEN USE";
- respecting the values given in the nameplate data.

2.2 PROHIBITIONS

WARNING	**Failure to comply the following PROHIBITIONS can cause personal (even serious) injury (or death) or damage to equipment.**

- NEVER suck up and convey aggressive, corrosive, and/or harmful fluids.
- NEVER use the unit under conditions that differ from those indicated on the nameplate.
- NEVER use the unit without having installed a suction filter.
- NEVER operate with the suction and/or delivery openings closed.
- NEVER make conversions or changes to the unit, maintenance or repair work on one's own initiative or not envisaged in the manual. Maintenance work can be carried out only in compliance with what is described in this user manual, exclusively by specialized operators (see document MAN_PIC).
- NEVER use the unit in places where ATEX classification does not comply with Annex II of Directive 1999/92/EC.
- NEVER use the unit without having first installed and connected the sensors and/or regulators required to the plant and correctly installed and checked the seal system of the machine.
- NEVER use the unit with ambient temperatures below -15°C (+5°F) and above +40°C (+104°F).
- NEVER use the unit before ensuring correspondence between grid voltage and motor label voltage.

3 PROPER AND IMPROPER USE

3.1 OPERATING CONDITIONS

WARNING **Failure to observe the temperature, altitude, differential pressure and filtering modes for design and operation specifications there can be an impeller break which can cause personal (even serious) injury (or death) or damage to equipment .**

- The maximum permissible differential pressure indicated on the product nameplate must never be exceeded.
- It is important to install the unit at a maximum altitude of 1000 m (3300 ft.) above sea level, for higher altitudes contact FPZ.
- The unit is designed to operate at ambient temperature between -15°C (+5°F) and +40°C (+104°F).
- In case of suction in the environment or on the plant, protect the suction pipe using a suitable filter with a maximum degree of filtration of 25µm. Contact FPZ for filters with a different filtration degree. Check the compliance with the data of maximum pressure/vacuum listed on the nameplate. For ATEX blower we recommend an ATEX filter with a filtration degree of 20 µm / 25 µm.
- Installation, operation and maintenance of the blower must be carried out by specialized operators (see document MAN_PIC). Due to incorrect maintenance or an unauthorized modification, a non-compliant condition of use is determined, so the responsibility lies with the customer or end user.

NOTICE If installed outdoors, protect the unit against exposure to sunlight and to atmospheric agents.
If the flow rate has to be reduced, use a draw-off valve rather than throttling back the suction or delivery lines.

3.2 STANDARD SIDE CHANNEL BLOWER

FPZ side channel blowers / exhausters are designed to generate vacuum and overpressure for conveying non-explosive, non-flammable, non-dangerous gases and air in continuous use in a non-explosive environment. Side channel blowers are not designed to transport dusts of any grain size.

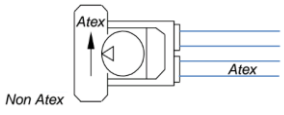
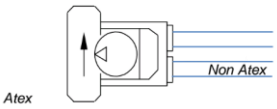
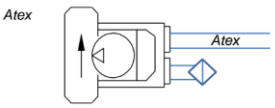
FPZ side channel blowers / exhausters are designed and built for use in industrial plants and are equipped with three-phase or single-phase asynchronous bipolar electric motors in compliance with IEC 60034-1.

3.3 ATEX BLOWERS (Category 3GD – Category 2G)

Atex blowers are designed and built in accordance with 2014/34/UE Directive and European standards EN 1127-1, EN 80079-36, EN 80079-37, EN 14986, considering the compatibility of unit components with treated fluids (contact FPZ for components compatibility details). Accessories and monitoring systems linked to the unit have to be compliant with 2014/34/UE Directive.
It is recommended that the connections and suction and delivery pipes are in metal or antistatic material.

Units are group II devices for use in environments classified as explosive for the presence of Gas (G) zone 1/2 and/or Dust (D) zone 22.

- For motors that may be installed to the blower refer to the Atex complementary instructions of the motor manufacturer.
- In case the blower is disposed vertically, thus standing on the cover, foreign objects shall be prevented from falling into the ventilation openings. If necessary the motor can be provided of a fan cover with protecting canopy.
- If not specifically indicated, the ATEX label refers to the equipment “indoor” and “outdoor” area.
- In the case of a double indication separated by the “/” symbol, the first number indicates the “indoor” category (internal surface of the blower), the second number the “outdoor” category (outside of the blower, including the electric motor).
- The blower protection mode is constructive (“EX **c**”).
- Electric motors have different protection modes depending on the category and the environment they are designed for.
- All “2G” e “3/2G” configurations have explosion-proof motors (EX d protection).
- Classification of work zones:

1	Use of blower for conveying flammable gas	**Equipment with internal potentially explosive atmospheres, intended for use in areas that are not classified**	
2	Use of blower for conveying non-hazardous fluids in ATEX classified environment	**Equipment with internal non-explosive atmospheres and intended for use in areas that are classified**	
3	Use of blower with suction of ambient air and operating in a classified zone	**Equipment with internal explosive atmospheres, interfaced with process atmospheres and intended for use in areas that are classified**	

3.4 IMPROPER USE AND ASSOCIATED RISKS

⚠WARNING	**Non-compliance with the unit's intended use or with prohibitions/obligations can cause personal (also serious) injury (or death) or equipment damage.**

- Listed below are some improper uses, identified through risk assessment and experiences. Improper uses are subdivided according to the conditions that they may generate.
- The list is a non-exhaustive and representative example of improper use and associated risks.

IMPROPER USE	POSSIBLE CONSEQUENCES	RISKS
IMPROPER USE LINKED TO NORMAL OPERATION		
Absence of cyclic monitoring and control.	Anomalous operation not detected / hidden.	Risk of damage to the unit, with possible injury (or death) for the operator if present nearby.
Different installation with respect to manufacturer's suggestion.	Yielding / break of fastening points.	Risk of damage to the unit, with possible injury (or death) for the operator if present nearby. The unit may fall or be subject to damage due to incorrect load at support.
Operation outside the performance indicated on the blower and electric nameplate.	Seizure of the impeller.	Risk of damage to the unit, with possible injury (or death) for the operator if present nearby. The unit may break.
Proceeding at all stages without consulting the *operating instructions* and this manual.	Using the unit for unforeseen purposes and without considering the associated risk factors.	Risk of damage to the unit, with possible injury (or death) for the operator if present nearby.
IMPROPER USE LINKED TO METHODS OF USE		
Use of a fluid different from that indicated / forbidden.	Incorrect workload.	Risk of damage to the unit, with possible injury (or death) for the operator if present nearby. The unit may break.
Physical load applied to the machine (no element excluded).	Breakage and/or presence of leakage of fluid collected.	Risk of damage to the unit, with possible injury (or death) for the operator if present nearby due to inhalation of harmful substances.
IMPROPER USE LINKED TO THE STOPPAGE OF A BLOWER		
Manipulation of the machine still rotating / moving.	Direct contact of the operator with moving parts and with the surface unit still hot.	Risk of possible injury for the operator such as burns and entanglement.
Disconnecting the unit from the electricity with the voltage inserted.	Direct contact of the operator with the live parts.	Risk of possible injuries for the operator through electrocution.
IMPROPER USE LINKED TO MAINTENANCE WORK		
Handling the machine differently from instructions for use.	Falling or sudden movement of the unit.	Risk of damage to the unit, with possible injury for the operator if present nearby.
Use of liquid during unit cleaning operations.	In case of stagnation, characteristics of the material may be compromised.	Risk of damage to the unit, with possible injury for the operator if present nearby.
Use of types of spare parts different to those supplied by FPZ.	Different performance from design (pressure, noise, vibration, sealing).	Risk of damage to the unit, with possible injury for the operator if present nearby.
BREAKDOWN AND EMERGENCY CONDITIONS		
Not stopping the machine when it is making an unusual noise.	Seizure of the impeller and overheating of the unit and of the electric motor.	Risk of damage for the unit, with possible injury (or death) for the operator if present nearby. The unit may break down.

4 STORAGE AND TRANSPORT

4.1 RECEIPT AND CHECK OF THE PACKAGE

- When receiving the unit, it is necessary to check that the packaging is intact and free from signs of damage due to transport or storage conditions.
- In the case of damage to the packaging, immediately inform the shipping agent and the manufacturer.

4.2 HANDLING AND TRANSPORT



Danger of crushing and / or impacting various parts of the body

During the transport and handling phases due to the sudden drop or displacement of the packaging, there may be a risk of crushing and / or impacting various parts of the body. During the activities around the unit, the operator may fall due to stumbling or slipping.
Use equipment compliant with the laws and follow the handling and manual handling procedures described in the operating manual, based on the weight indications on the packaging and in accordance with applicable regulations in the state in which this activity takes place. Use safety shoes during this phase.

4.3 STORAGE

- Store in a dry place, possibly keeping the machine in the packaging.
- Do not remove the protective covers of the openings.
- In the event of long-term storage, remove dust deposits on external surfaces and, before commissioning, check the unit's functional status with a start-up test.

5 INSTALLATION

5.1 INSTALLATION CONDITIONS



Commissioning and operation must only take place under the following installation conditions:

- The unit must be completely assembled and intact (not damaged or tampered).
- Silencers must be connected to the pipe system (see *operating instructions*); if silencers are not present, make sure that the connection is made by flexible sleeve.
- The machine must be securely fastened to the predetermined site and in the recommended modes (see *operating instructions*).
- The motor must be connected to a suitable control panel.
- Ensure the visibility of the unit installed from the position of the control elements.



Danger of ejection of objects

The entry of foreign bodies into the unit, even if very small, can cause personal serious injury (or death) and/or equipment damage with probable breakage of the impeller blades, including the danger of debris can be thrown out of the machine violently.
Remove the closure caps from the silencers and connect the pipes of the system, making sure to carry out the operation in a non-dusty area to prevent the entry of foreign bodies.



Danger of crushing and / or impacting various parts of the body

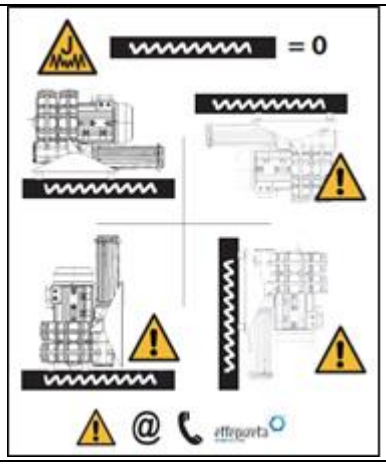
During the installation phase due to the sudden drop or displacement of the packaging, there may be a risk of crushing and / or impacting various parts of the body. During work around the unit, the operator may fall due to stumbling or slipping. Use the appropriate device (e.g. toe) to hook and lift the unit properly.



Danger of injury to upper limbs

The risk of injury to upper limbs may arise due to a combination of hazards during the mechanical assembly phase and the connection of the machine to the piping. Observe the operating manual to install the unit safely.

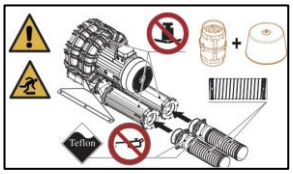
- The support surface of the unit must be flat, robust, stable and absolutely levelled.
- It is important that the unit is installed on supports that do not transmit vibration for example structures or antivibration

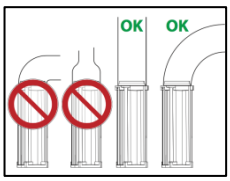


- Connect the pipes with flexible sleeves and avoid the unit bears pipes weight; except for the filter in the case of suction in the environment.

Size the pipes and choose accessories that minimize the load losses, therefore:

- do not fit pipes with diameters smaller than those of the machine's outlets and inlets;
- install multiple machines in parallel, sizing the manifold and main line proportionally;
- do not use angle-pipe, but bends with a large radius of curvature;
- do not install valves with passages smaller than the nominal value and check valves with a stopper pushed by a spring (the check valve with the lowest load loss is the type with a light disc);
- in the case of use for oxygenation, choose low-resistance diffusers (low load loss).





⚠WARNING	To avoid overloads caused by pressure variations, it's recommended that you install a relief valve on aspiration in the case of operation as suction, and on discharge in the case of operation as a compressor.



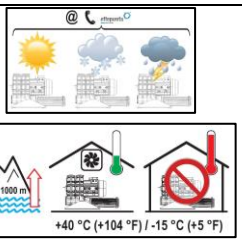
⚠WARNING	If you need to reduce the flow rate, use a branch valve instead of throttling the suction or discharge.



⚠WARNING	Protect the intake duct with a suitable filter with a filtration degree of 25 µm. Foreign bodies are: dust, sand, calcite, impurities in the pipes, cutting blades and shavings, drops and waste from welding, metal burrs, and residues of sealants produced during connection of pipes. Replace the filters regularly.



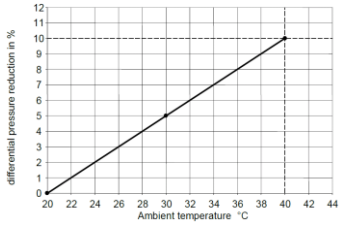
- When installing outdoors, protect the unit against direct exposure to the sun and atmospheric agents. For outdoor installations without the use of protections contact FPZ S.p.A..
- Ventilation of the motor must not be hampered by obstacles placed in the immediate vicinity. For this purpose, the electric motor air intake must remain free and a minimum distance between the electric motor fan cover and any other structure as defined by the manufacturer of electric motor.
- The unit must be installed at a maximum height of 1000 m a.s.l., for different conditions contact FPZ S.p.A..



The ambient temperature, and the conveyed gas intake temperature, is permissible inside the range -15°C (+5°F) ÷ +40°C (+104°F) with the following provisions:

- For ambient temperature +30°C (+86°F) **reduce** the maximum pressure differential given in the Data Sheet by 5%;
- For ambient temperature +40°C (+104°F) **reduce** the maximum pressure differential given in the Data Sheet 10%.

The graph on the right has to be used to reduce the maximum pressure differential in case of ambient temperature between +21°C and +40°C (+70°F and +104°F)



- Check dimensions to allow adequate space for installing the unit with its accessories and ensure sufficient ventilation of the electric motor.

⚠WARNING	In the case of ATEX side channel blower intended for classified areas, the unit must be installed outdoors or in an air conditioned environment.

5.2 BLOWER WITHOUT ELECTRIC MOTOR (GOR – GVR EXECUTION)

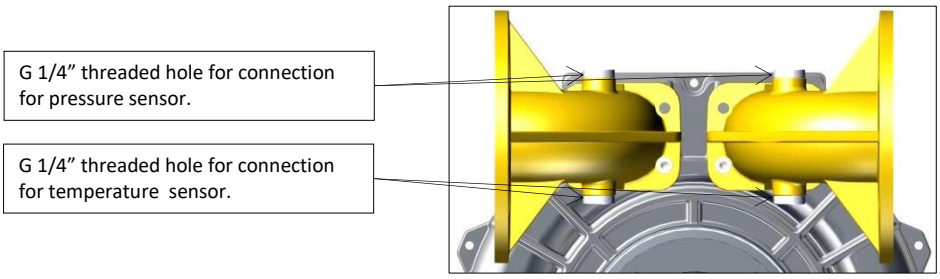
NOTICE	Units supplied without an electric motor, GOR execution (with horizontal coupling) or GVR (with vertical coupling) are considered as partly completed machinery, so the designer has to check the compatibility of the electric motor chosen with the data in the data sheets downloadable from the website. During installation and maintenance, to install or dismantle the elastomeric coupling; it is recommended not to use a hammer, but pushers or extractors, to fit or remove the coupling flanges from the shaft. . Percussion can damage the slope of the bearings by reducing their durability. Coupling requires axial and angular alignment accuracy. Also refer to the coupling instruction manual.

5.3 ATEX 2G BLOWER (EXCLUDED TMD VERSION)

The blower is arranged for the installation of measurement/control systems in order to prevent machine faults that can produce potential sources of triggering:

- pressure sensor
- temperature sensor.

	**Danger of explosion. The unit is designed to convey flammable gas and is sealed. Do not start the machine before connecting and activating the unit and surveillance system**



Pressure sensor

	**ALWAYS use a pressure sensor**

Given the likelihood of an explosive atmosphere, the use of pressure measuring instruments is compulsory in order to check that the difference between the delivery and suction pressures respects the levels given in the "specifications" and on the machine's rating plate.

NOTICE	The use of an alarm and stop device (non-automatic reset) that automatically shuts off the power to the machine is advisable.

Temperature sensor

A possible temperature sensor is deemed functional for the customer's measurement needs, but can in any way replace the pressure sensor for monitoring any dangerous machine conditions.

⚠WARNING	**All the sensors must be protected against possible impacts, damage and atmospheric agents.**

5.4 GOR TMD ATEX 2G BLOWER

The blower is designed for the installation of control systems which must be set up by the installer for the purpose of monitoring machine breakdowns which could produce possible sources of combustion:

- vibration sensor;
- pressure switch / vacuum switch;
- thermostat.

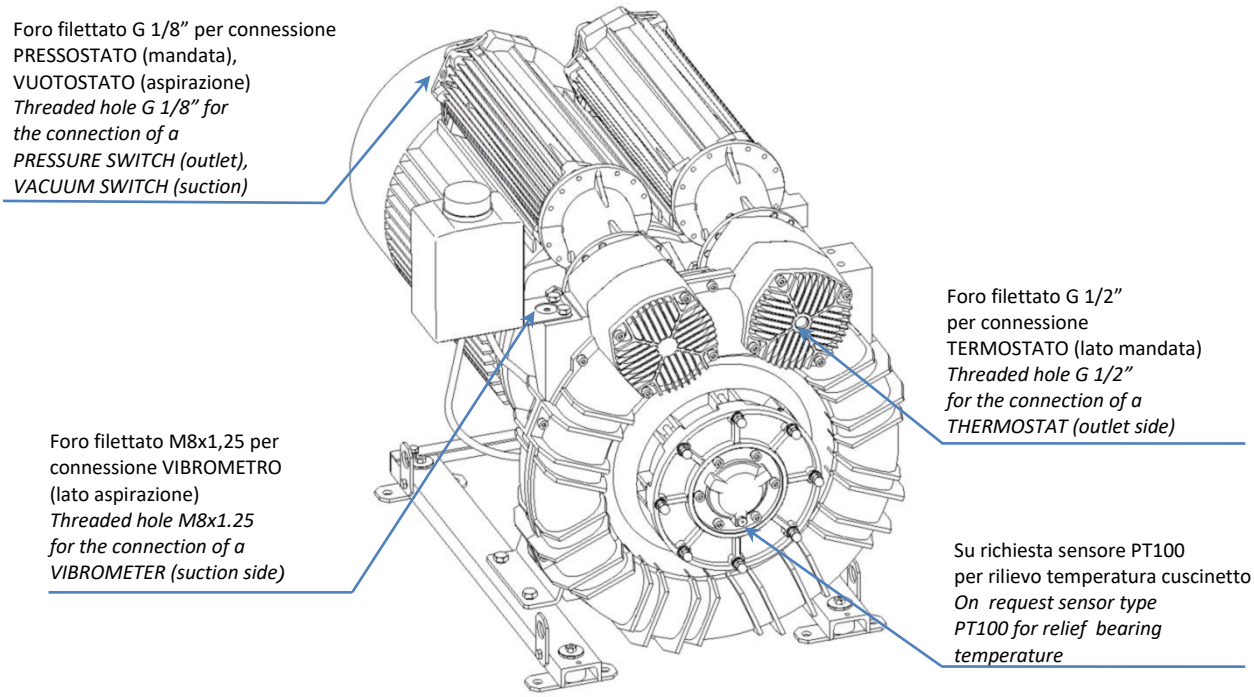
The mechanical seal installed also requires the following operations:

- refilling of the oil tray, as indicated below;
- connection of the oil level sensor.

If necessary, in order to avoid overloads caused by pressure variations, provide a vent device in conformity with EN 1127-1 branching off from the suction pipe, in the case of operation as a suction pump, and on the delivery pipe, in the case of operation as a compressor.

5.4.1 INSTALLATION OF SENSOR GOR TMD ATEX 2G BLOWERS

Install the machine on the plant. Fit the sensors (suitable for the purpose and especially for the Atex environment in question) in their places and connect them to the control system as specified in the instructions provided with the sensors and as required in the plant diagram:



- Vibration sensor

The signal from the sensor must monitor the vibrations of the machine constantly. This signal must be connected to an alarm and block device with manual reset, which automatically interrupts the power supply to the compressor/suction pump at the moment the level of the vibration signal exceeds the predetermined limits.

Effective vibration velocity value [mm/s]	***Class I*** (≤ 15kW)
a<**2.2**	***A***

Effective vibration velocity value [mm/s]	***Class II*** (> 15kW)
a<**3.5**	***A***

- Pressure switch and vacuum switch

The pressure or vacuum switch installed must be calibrated to the maximum pressure or vacuum level specified on the plate of the machine or in accordance with the operating limits of the plant.
The signal must be connected to an alarm and block device, with manual reset, that automatically interrupts the power supply to the machine.

- Thermostat

The thermostat must be set to come on at a temperature not exceeding 125°C to interrupt the power supply to the machine automatically.
The signal must be connected to an alarm and block device, with manual reset, that automatically interrupts the power supply to the machine.

⚠WARNING | **All sensors installed must be protected against impact, damage and weathering**. FPZ can supply a protective casing, on request and after receiving the dimensions of the sensors installed.

5.4.2 CONNECTION OF THE MECHANICAL SEAL FOR GOR TMD ATEX 2G BLOWER

	**Danger of slipping**

Oil spills can make the floor slippery. Clean the floor with absorbent and /or degreasing products.

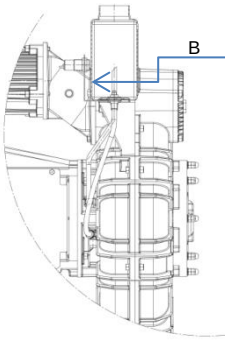
	**Danger of electrostatic charges**

Do not clean or rub the oil reservoir with dry clothes.

- Refilling the cooling oil tray

Refill the cooling circuit of the mechanical seal. For good circulation of the cooling liquid, it is important not to have air bubbles inside the circuit. To achieve this, refill by pouring the liquid into the vessel repeatedly in small amounts without exceeding level (B) of the return line. Top up completely only when the level at the return line has covered the bottom of the vessel.

The cooling liquid must be kept at least 10 mm above the level of the return line (B); top up as necessary.

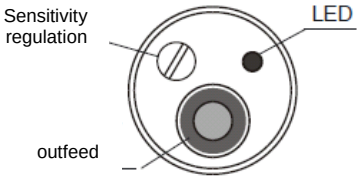


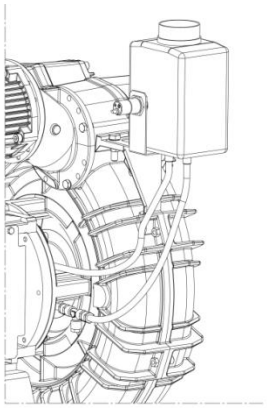
Recommended cooling liquid:	SAE 10W-40 oil Or SAE 5W-40 oil
First filling quantity:	Approx. 1,5 kg

A small leak of fluxing liquid is normal, especially when the seals are settling down.

- Connection of the cooling oil level sensor

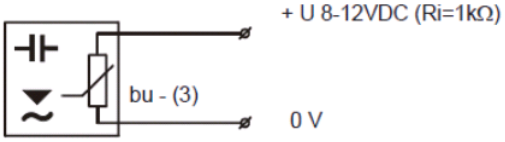
The capacitive oil level sensor consists of a stainless steel cylindrical body and is suitable for use in explosion risk zones. It is fitted with a potentiometer to regulate sensitivity and a LED display on the back end, which is normally on.





This sensor must be connected to an alarm and block system with manual reset which automatically interrupts the power supply to the machine. Connect the sensor to the control system following the specific instructions enclosed with this manual.

CPS-24Xi □-R□



Note: the connection cable must not be cut or tampered with.

5.5 ELECTRIC MOTOR

WARNING	**Comply with safety measures and instructions indicated in the instruction manual for the electric motor.**

Before starting working on the unit or system, the following precautions must be taken:

- make sure that the unit is NOT connected to electrical power mains;
- take precautions to prevent electricity from being reconnected;
- open the terminal box only after making sure that there is absolutely no live current.

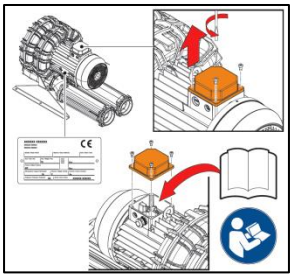
	Danger due to electricity

- If connecting operations are carried out without removing the voltage from the electrical system or without setting up a system to avoid reinsertion, direct contact between the operator and the live parts can occur. This can also cause personal serious injury (or death).
- Work on electrical equipment (installation and maintenance) has to be done only by specialized operators (see document MAN_PIC), wearing PPE.
- In the event of contact with a defective unit there is a risk of electrocution. Always have seals and electrics checked regularly by a specialized operator (see document MAN_PIC).
  - The terminal box must not contain foreign bodies, impurities or humidity. Close the terminal box with the cover, and seal the cable gland openings to prevent dust, water and humidity from getting inside.

NOTICE	In the case of several motor starts during an hour, there is a limitation of 6 start-ups per hour, evenly distributed; failure to respect this can severely damage the unit.

5.5.1 ELECTRIC CONNECTION

Incorrect motor connection may seriously damage the unit.



- Check that the details on the data plate are compatible with the line voltage and frequency.
- Always connect the motor's earth cable to the relevant terminal marked with this symbol  before connecting to the mains supply and check the dispersion capacity. The earth cable can be recognized by its color (yellow/green).
- Connect the machine to the earth system too, using the specific hole (marked with the relative symbol) located on the base of the unit. Connection to the power grid must be carried out in compliance with what is shown in the diagram inside the terminal box.
- Use the cable gland openings to allow power supply cables to pass into the terminal box.
- Proceed to tighten the power supply cables, taking the section of the electrical cables into account each time.
- The terminal boards for the electrical connections must be tightened properly to avoid high contact resistances and resulting overheating.
- Check that the insulation gaps between the various conductors are kept in the air and between surfaces, as indicated in the standards.
- All the screws used to close the terminal board must be tightened properly. Damaged screws must be replaced immediately, using screws of the same or better quality.

The connection must guarantee:

- long-lasting safety;
- that no wire ends are sticking out;
- protection with a (thermal or amperometric) trip switch is essential for dealing with risks of overloading, a loss of one phase in the mains supply, excessive voltage fluctuations, or the rotor getting stuck;
- that the motor trip switch has been set to a value that does not exceed the maximum current level shown on the nameplate. Warning: the trip switch does not always protect the blower in case the maximum pressure differential is exceeded. Verify the maximum pressure or vacuum as per chapter 6.2.
- motors may be equipped with thermal protectors PTO or PTC. To avoid that the motor is damaged by temperature rise over the admissible limit: PTO or PTC have to be connected to a suitable cut off device that opens the line that feed the motor itself.
- if the application requires protection against accidental start-up, this must be carried out on the electrical control circuit of the motor.

5.5.2 ELECTRIC MOTOR POWERED BY FREQUENCY CONVERTER

The unit's nominal pressure or vacuum characteristics for service at mains frequency cannot be maintained if the unit is powered via a frequency converter. Contact FPZ S.p.A. for information about the performance of a unit powered by a frequency converter. Download from the website www.fpz.com the "RPM Table" of your blower and do not exceed the maximum pressure differentials shown for every rotation speed.

When power is supplied with a frequency converter, the installer is responsible for:

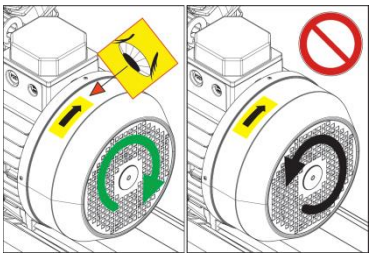
- respecting the laws;
- checking with FPZ assistance if the motor can be powered by a frequency converter, if it doesn't appear on data sheet;
- checking and making any measures necessary to comply with the immunity and emission limits set by the standards;
- checking the suitability of the plant and the frequency converter for operation with standard motors (class F), or the need to use specific motors for these types of operation.

5.5.3 ROTATION DIRECTION

The machines must be used respecting the rotation direction indicated by the arrow on the electric motor fan cover.

- To check the rotation direction, switch the motor on briefly and observe the fan.
- To change the rotation direction, invert the power cable connections, leaving the earth connection unchanged.

Refer to the connection diagram located inside the terminal box and to this section.



6 START UP AND NORMAL OPERATION

6.1 PRELIMINARY CHECKS

WARNING! Before starting the machine for use, carry out the following preliminary checks:

- if the unit has not been started up for some time, check its condition and, if necessary, remove any dust from the external surfaces, to avoid compromising the heat dissipation during the unit work;
- deactivate/open any pipe closing devices (shut-off valves, solenoid valves, etc.) before starting the unit;
- never start and operate the unit with the inlet and/or outlet ports closed;
- make sure the ambient and conveyed gas suction temperatures come within the levels: -15°C (+5 °F)÷ +40°C (+104 °F);
- check the operation of any flow control/limiting devices (not supplied).

6.2 OPERATION

- If the side channel blower is put into operation without being fixed to a surface, a sudden displacement of the starting torque on ignition of the electric motor may occur.
- The information on the product nameplate must always be considered when commissioning and operating.

The unit can be started for use after carrying out the preliminary checks

- Start the unit by switching on the power to the electric motor.
- Respect the maximum pressure differential stated in the blower's nameplate.
  To evaluate the pressure differential Δp across the blower take into account:
  - For compression operating: add up to the outlet pressure the inlet vacuum if applied.
  - For vacuum operation: add up to the inlet vacuum the outlet pressure if applied.
- Pressure losses in the pipes are often underestimated but are decisive factors for the operating differential pressure.
- Measure the motor absorption and check compliance with the rated nameplate value. An amperage below nameplate does not always guarantee that the blower is not exceeding the maximum permitted pressure differential.

WARNING	**Non-compliance with the unit's use or with prohibitions/obligations can cause personal (also serious) injury (or death) or equipment damage**

	Danger of burns

Danger of burns caused by contact with hot surfaces of the unit, which at start-up and operation may reach high surface temperatures, as specified on the product nameplate.
Apply adequate PPE against the risk of burns.



Danger of suction

Danger of injury due to depression, which can cause a sudden suction of objects, hair and clothes.
Start the machine only if it is properly connected to the system.



Danger of vibration

Regularly check that the unit is firmly fixed to the support frame.
Excessive vibration of the unit can cause serious damage to the machine, such as the seizure of the impeller.



Danger due to noise

Some machines can produce loud noise, even over 80 dB (A).
Reference levels are shown on the table of characteristic data that does not consider environmental reverb.
Warning to be taken:
Measure the acoustic pressure of the machine in the installation environment.
In the case of levels above the threshold defined by local standards:

- report the noise hazard
- prepare the use of PPE
- isolate the environment



Danger of ejection of objects

- Danger due to exceeding performance levels that may cause seizure of the impeller.
  Check that operating conditions are in accordance with values declared on the nameplate.
  Avoid operating with the inlet and/or outlet ports closed even temporarily.
  Install a limit valve or equivalent circuit that can avoid excessive vacuum and / or overpressure and allow the compliance with levels shown on the product plate
- Danger of injury due to objects and fluids aspirated and thrown at high speed (injury to the skin or eyes).
  Only start the unit (first start) if it is properly connected and check it accurately.
  In the case of unusual noise from the impeller, switch off the unit immediately and check it accurately.



Danger of injury to upper limbs

During the start-up (first start) phase due to a combination of hazards, the risk of injury to upper limbs may arise.



Danger of sudden leakage and/or aspiration of fluids (even harmful ones)

They could cause damage to the respiratory system due to the leakage of gas while the unit is in use and/or the slowing down of connection to the gas flow circuit.



Danger due to a limited view of the place in which the unit is installed.

Make sure you always have the unit installed in your sight while carrying out any activities close to it.

6.3 STOPPING

- The unit must be stopped by switching off the power supply to the motor.
- On shutdown, make sure to operate the unit with open outlet (suction / delivery) for about 20 minutes. This operation allows the removal of any condensation inside.

7 MAINTENANCE

In order to prevent faults and damage it is important to check periodically the units in operation; therefore it is advisable to adopt a maintenance plan in line with this manual, providing for:

- periodical checks;
- periodical maintenance.

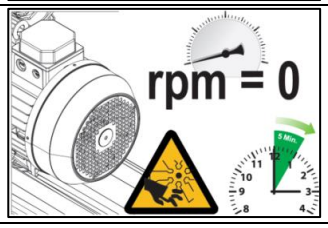
7.1 MAINTENANCE AND FAILURE CONDITIONS

WARNING **Before starting any maintenance, either periodical or due to malfunction, take the following safety measures in order to prevent personal (also serious) injury (or death) or equipment damage:**

- unplug the unit from the power supply by unplugging the main switch;
- apply a sign to the system and to the control unit **"DANGER! Maintenance work in progress";**
- cool the unit for at least 15 minutes;



- wait until the unit has completely stopped, checking through the motor fan that the impeller is not rotating;



- make sure that there is no depression or overpressure in the unit through a pressure gauge and make sure that no fluid can escape from the unit (through its stopping) and / or the system (through its insulation).

Danger due to electricity

- If connecting operations are carried out without removing the voltage from the electrical system or without setting up a system to avoid reinsertion, a direct contact of the operator with live parts can occur. This can also cause personal serious injury (or death).
- Work on electrical equipment (installation and maintenance) must be done only by specialized operators (see document MAN_PIC), wearing PPE.
- In the event of contact with a defective unit there is a risk of electrocution.

Danger of moving parts

High risk of cuts caused by rotating impellers. By removing the manifolds or blind flanges, it is possible to access the rotating impeller through the openings of the body and the cover of the side channel blower.
Never put your hands or objects through the openings.

Danger of burns

Danger of burns caused by contact with hot surfaces of the unit, which at startup and in operation may reach high surface temperatures, as specified on the product nameplate.
Apply adequate PPE against the risk of burns.

Danger of injury to upper limbs

During the maintenance phase due to use of improper tools, lack of PPE, bad illumination of the workplace or unauthorized start-up, the operator fails to perform the required procedures, the machine can be put into unmanaged operation, and the risk of injury to upper limbs may arise.

Danger due to noise

Some machines can produce loud noise, even over 80 dB (A) therefore the operator may be subject to acoustic pressure which may cause buzzing in the headset and reduced attention.

WARNING **Danger of sudden spillage of gas (also harmful) suction**

Respiratory damage could occur due to gas leakage during operation and / or loosening of the connections to the gas flow circuits.

7.2 PERIODICAL CHECKS

In order to avoid any defects that may directly or indirectly cause damage, it is important that the unit is inspected by specialized operators (see document MAN_PIC).

A) When the unit is running, routinely carry out the following checks:

- delivery temperature;
- operating pressure and/or vacuum;
- electric motor current absorption;
- vibrations;
- state of the filter and related load loss.

⚠WARNING	**Danger of seizure of the impeller due to excess vibration. Vibrations above the threshold (see table below) are considered NOT eligible and can cause damage to the machine and consequently personal injury even serious (or death) and / or damage to things.** **In the event of unusual noise and / or vibration over parameters, that may indicate the possibility the impeller is seizing up, turn off the unit immediately.**

Class I (Blower with electric motor of power ≤15kW)	Class II (Blower with electric motor of power >15kW)
a > 2,2	a > 3,5
a = effective vibration speed level [mm/s]	

Changes to normal working conditions (power ups, abnormal noise, vibrations, excessive overheating of the service fluid) are indications that the units is not working properly.

B) With the unit stopped and cooled, periodically carry out the following checks:

- dust: check and remove deposits from the external surfaces of the unit;
- suction filter (if fitted): every 10-15 days, check and clean or replace the filter cartridge. The dirty cartridge creates strong suction resistance and consequently a higher pressure differential, power absorption and operating temperature;
- for unit supplied with elastic joint, check the condition of the elastic joint as indicated in its operating manual;
- condensation discharge (if present): every 8-10 days, turn the yellow valve counterclockwise 90° to allow draining of the condensation that has built up inside the blower;
- check for oil leaks (TMD version) near the joint; if leaks are found, maintenance work must be scheduled to replace the seals.

7.3 ROUTINE MAINTENANCE REPAIR OF BREAKDOWNS

See the following chapter “TROUBLESHOOTING” for identifying possible critical situations and types of breakdowns.
Always disconnect the unit and remove it from the plant to do routine maintenance, cleaning and replacing components and in the event of a breakdown.

⚠WARNING	**Danger due to residual overpressure or drop in pressure:**

- with residual overpressure, process fluids can leak, with the risk of injury to the skin and eyes;
- with a drop in pressure there is the risk that hair and clothes can be trapped;
- disconnect the unit only after closing and bleeding the system connected to it.

7.4 LIFESPAN OF BEARINGS

Under normal operating conditions, the bearings of the unit must be replaced by a specialized operator (see document MAN_PIC), after a time fixed by the manufacturer (see details in the table below).

NOT ATEX BLOWERS

Every model, except the models at the following line	25000 hours or 3 years
e07 / e08 / e09 / e10 / e11 MS – TS – TD	40000 hours or 5 years

SOFFIANTI ATEX

Every Atex model	18000 hours or 3 years

NOTICE Replace the bearings of the unit only if you have all the instructions, the parts list and the section/explosion of the unit

7.5 DISMANTLING AND DEMOLITION



Danger of crushing and / or impacting various parts of the body

During the dismantling and demolition phases due to the sudden drop or displacement of the packaging, there may be a risk of crushing and / or impacting various parts of the body. During work around the unit, the operator may fall due to stumbling or slipping.

8 RESIDUAL RISKS

During the design of the machines or system on which the blower will be installed, the following residual risks should be considered.



Danger during the transport phase

Danger of crushing or slipping during the unit transport steps. The *operating instructions* (attached to the unit) and this manual describe how to carry out safe transport operations according to tested procedures.



Danger during the installation phase

Danger of crushing or slipping during the installation phases of the unit. The *operating instructions* (attached to the unit) and this manual describes how to carry out safe installation operations and according to tested procedures.



Danger during the start-up and operating phase

Danger of electrocution, burns, noise, unauthorized start-up of the unit, and ejection of objects or fluids during the start-up and operation phases of the unit. The *operating instructions* (attached to the unit) and this manual describe how to perform the operations mentioned safely and according to tested procedures.



Danger during maintenance and dismantling phases

Danger of electrocution, burns, noise, unauthorized start-up of the unit, and ejection of objects or fluids during the maintenance and dismantling phases of the unit. The *operating instructions* (attached to the unit) and this manual describe how to perform the operations mentioned safely and according to tested procedures.

9 TROUBLESHOOTING

Problem	Serious page	Cause	Solution	Precaution
The unit does not start	F	Electrical wiring incorrect	The electrical connection has to be checked by a technician referring to the wiring diagram contained in the terminal board box	Turn off the power to the electrical system or set up a system that avoids reinsertion
	F	Power supply voltage unsuitable	Check that the power supply voltage, measured at the motor terminals, is within +/- 10% of the rated voltage	Use PPE against the electrical hazards
	G	The impeller is stuck	Call FPZ assistance to repair the unit	
No or insufficient air flow	G	The suction filter is clogged	A specialized operator (see MAN_PIC) has to clean or replace the cartridge	Avoid entering foreign bodies into the unit
	G	Wrong frequency (for units powered through an inverter)	Correct the frequency	Check the rating plate
	G	Profile of the impeller blades modified (due to deposits on the profile)	Call FPZ assistance personnel to check the impeller	
No or insufficient pressure differential	F	Incorrect direction of rotation	The direction of rotation has to be inverted by a specialized operator (see MAN_PIC) switching two of the electrical power supply wires.	Turn off the power to the electrical system or set up a system that avoids reinsertion
	G	Leaks in the plant	Locate the leak and seal	Use proper sealants
Current absorption exceeding the admissible level	F	Electrical wiring incorrect	The electrical connection has to be checked by a technician referring to the wiring diagram contained in the terminal board box	Take off the power to the electrical system or set up a system that avoids reinsertion
	F	Drop in mains supply voltage	The power supply voltage has to be restored by a specialized operator (see MAN_PIC) at the terminals and at the established values.	
	G	The suction filter is clogged	The cartridge has to be cleaned or replaced by a specialized operator (see MAN_PIC)	Avoid entering foreign bodies into the unit.
	G	The unit has accumulated deposits inside	Call FPZ assistance personnel to clean the inside of the unit	Avoid entering foreign bodies into the unit.
	G	The unit is operating at a pressure and/or vacuum that exceeds the admissible level	Adjust the system and/or the regulating valve to lower pressure differentials.	Use appropriate PPE to operate near the unit
High delivery air temperature	G	The suction filter is clogged	Adjust the system and/or the regulating valve to lower pressure differentials.	Use appropriate PPE (surge protectors, gloves) to operate near the unit
	G	The suction filter is clogged	The cartridge has to be cleaned or replaced by a specialized operator (see MAN_PIC)	Avoid entering foreign bodies into the unit.
	G	The unit has accumulated deposits inside	The unit has to be cleaned inside by a specialized operator (see MAN_PIC).	Avoid entering foreign bodies into the unit.
	G	Suction and/or delivery piping obstructed.	Obstructions have to be removed by a specialized operator (see MAN_PIC).	Avoid entering foreign bodies into the unit.
	G	Suction air temperature exceeds 40°C (+104°F)	Use heat exchangers to reduce the suction air temperature	
Abnormal noise	F	The soundproofing material is damaged	Soundproofing cloth has to be replaced by a technician.	Avoid entering foreign bodies into the unit.
	G	The impeller scrapes against the casing. - The unit is operating at a pressure and/or vacuum that exceeds the admissible level	Reduce the pressure differentials in the plant	Use appropriate PPE (surge protectors, gloves) to operate near the unit
	G	- Reduction of assembly tolerances due to internal deposits (dust, impurities in the pipes, process residues, etc.)	The unit has to be cleaned inside by a specialized operator (see MAN_PIC).	Avoid entering foreign bodies into the unit.
	G	Worn bearing	Bearings have to be replaced by a specialized operator (see MAN_PIC).	
	F	Unit's installation position unsuitable	The unit has to be installed by a technician on structures that cannot transmit or amplify noise (tanks, steel plating, etc.)	Use proper anti-vibration and move the units according to local regulations

Abnormal vibrations	G	The impeller is damaged	The impeller has to be replaced by a specialized operator (see MAN_PIC).	
	G	The impeller has accumulated deposits	The unit has to be cleaned inside by a specialized operator (see MAN_PIC).	Avoid entering foreign bodies into the unit
	G	Unit anchored without anti-vibration insulators	The unit has to be anchored with anti-vibration insulators by specialized operator (see MAN_PIC).	Use proper anti-vibration and move the units according to local regulations
	F	Rigid connection to the plant	Flexible hoses between the unit and the piping have to be fitted by a specialized operator (see MAN_PIC).	Carry out the activity only if the unit is disconnected to the power supply.
	G	Bearing on the blower or motor side defective	Bearings have to be replaced by a specialized operator (see MAN_PIC).	

Leaks	G	Defective silencer gaskets	Gaskets have to be checked by a specialized operator (see MAN_PIC), and if necessary have to be replaced.	Avoid entering foreign bodies into the unit.
	G	Defective casing gaskets	Gaskets have to be cleaned by a specialized operator (see MAN_PIC), and if necessary have to be replaced.	Avoid entering foreign bodies into the unit.

Seriousness: F for functional fault and G for serious fault.

10 REFERENCES

Documents quoted:

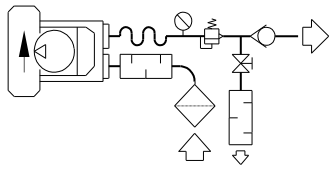
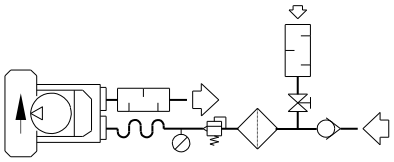
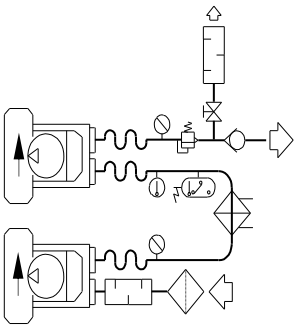
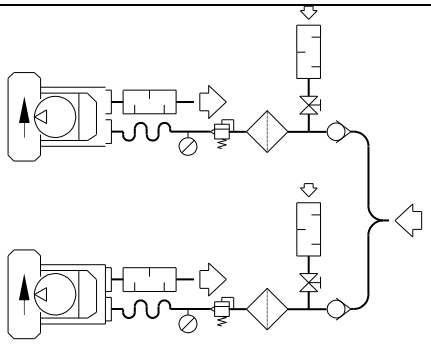
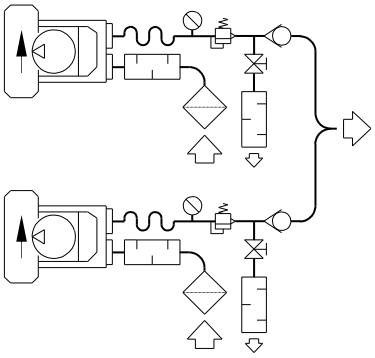
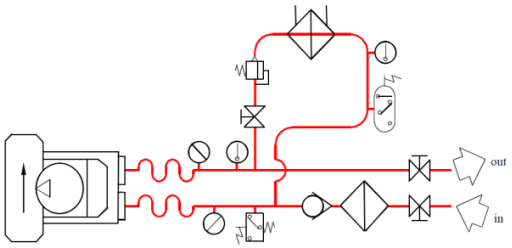
- Operating Instruction: supplied with the blower
- MAN_PIC: document with pictogram definitions
- Instruction manual of elastic joint
- Instruction manual of electric motor

Norme e direttive:

- Machinery directive 2006/42/EC
- Atex directive 2014/34/EU (Applies to Atex blowers only)
- EN ISO 12100: 2010
- EN 349:1993+A1: 2008
- EN 614-1: 2006+A1: 2009
- EN ISO 3746: 2010
- EN ISO 13857: 2008
- EN 60204-1: 2006
- EN 1127-1: 2011 (Applies to Atex blowers only)
- EN ISO 80079-36: 2016 (Applies to Atex blowers only)
- EN ISO 80079-37: 2016 (Applies to Atex blowers only)
- EN 14986: 2017 (Applies to Atex blowers only)

11 INSTALLATION DIAGRAMS

SCHEMI DI INSALLAZIONE I
INSTALLATION DIAGRAM GB

COMPRESSORE PRESSURE SERVICE	ASPIRATORE VACUUM SERVICE
	
COMPRESSORE IN SERIE SERIAL PRESSURE SERVICE	ASPIRATORE IN PARALLELO PARALLEL VACUUM SERVICE
	
COMPRESSORE IN PARALLELO PARALLEL PRESSURE SERVICE	ATEX BLOWERS SCHEMA D'INSTALLAZIONE INSTALLATION DIAGRAM
	

LEGENDA, KEY – ACCESSORIES

Item Item		Denominazione Name	Item Item		Denominazione Name
1		Filtro - Filtro in linea Filter - Inline filter	7		Valvola di ritegno Check valve
(2)		Silenziatore Silencer	8		Valvola Valve
3		Manicotto flessibile Flexible sleeve	(9)		Scambiatore Cooler
4		Manometro – Vuotometro Pressure gauge - Vacuum gauge	(10)		Termometro Thermometer
5		Pressostato – Vuotostato Pressure switch – Vacuum switch	(11)		Termostato Thermostat
6		Valvola limitatrice Pressure relief valve	(x) (x)	SE NECESSARIO IF NECESSARY	

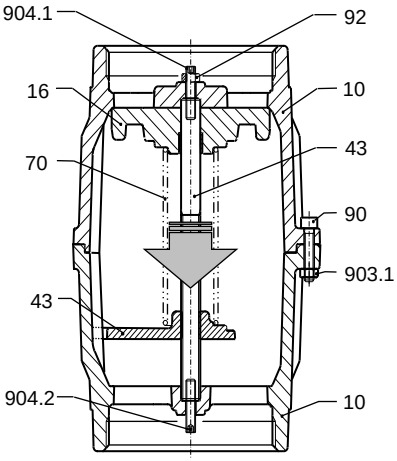
SN 1701-9

SAFETY VALVE VRL USE INSTRUCTIONS

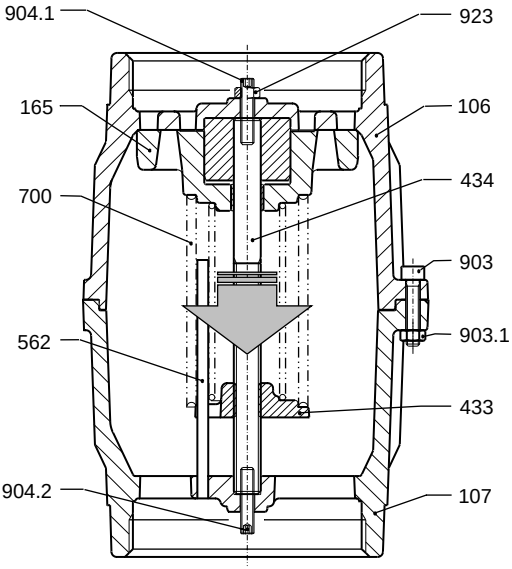
CAUTION! THE VALVE IS SUPPLIED NOT CALIBRATED



PLEASE READ CAREFULLY ALL INSTRUCTIONS AND KEEP THEM FOR FUTURE REFERENCE



VRL6
Fig. 1a



VRL8 - VRL9
Fig. 1b

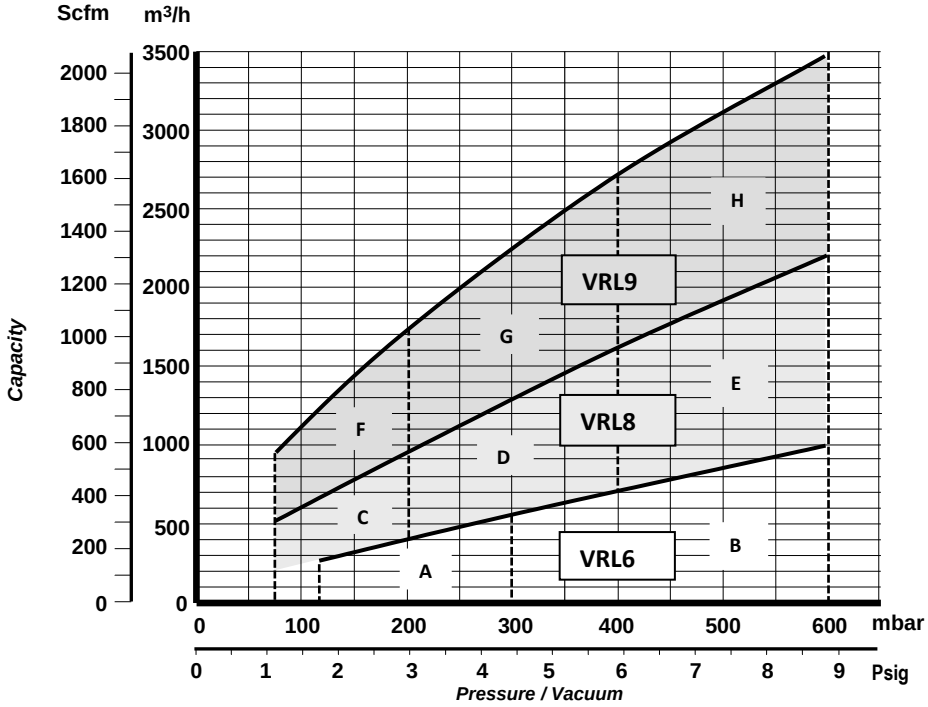
Description

106	*Housing*	700	*Spring*
107	*Cover*	903	*Screw*
165	*Shutter*	903.1	*Nut*
433	*Spring guide disc*	904.1	*Upper grub screw*
434	*Shutter guide*	904.2	*Lower grub screw*
562	Dowel pin	923	*Nut*

GB **CONDITIONS OF USE**

- ***THE VRL VALVES ARE DESIGNED FOR THE HANDLING OF AIR OR NON-EXPLOSIVE, NON-HAZARDOUS AND NON-FLAMMABLE GASES IN NON-EXPLOSIVE ENVIRONMENTS. THE GAS INLET TEMPERATURE MUST BE IN THE RANGE OF -15 TO +160 °C.***
- ***RELIEF VALVES ARE DESIGNED AND MANUFACTURED TO LIMIT THE OPERATING PRESSURE IN LOW PRESSURE/VACUUM APPLICATIONS. THEY ARE FOR USE SPECIFICALLY ON LOW PRESSURE BLOWERS AND VACUUM PUMPS ONLY;***
- ***THE VALVE CANNOT WITHSTAND HIGH INTERNAL PRESSURE, DESIGN MAXIMUM OF 2.8 bar A;***
- ***THERE IS SMALL LOSS OF THE AIR/GAS BEING HA***
- ***SOLID PARTICULES, HOWEVER SMALL, INCLUDING DIRT CAN CAUSE SERIOUS DAMAGE; THEREFORE IT IS ESSENTIAL THAT SUCH SUBSTANCES SHOULD BE REMOVED FROM THE GAS BY SUITABLE FILTERS UPSTREAM OF THE INLET.***

SELECTION DIAGRAM



SPRING SELECTION CHART

RANGE	*SPRING* N	*Pressure / Vacuum* MIN [mbar]	[psig]	*Pressure / Vacuum* MAX [mbar]	[psig]	*Colour of identification*
VRL6						
A	I	120	1.763	300	4.408	*SILVER*
B	II	300	4.408	600	8,820	*GREEN*
VRL8						
C	I	75	1.102	200	2.940	*SILVER*
D	II	200	2.940	400	5.880	GREEN
E	I + II	400	5.880	600	8,820	*SILVER & GREEN*
VRL9						
F	I	75	1.102	200	2.940	VERDE - GREEN - VERT - GRÜN - VERDE
G	II	200	2.940	400	5.880	*SILVER*
H	I + II	400	5.880	600	8,820	*SILVER & GREEN*

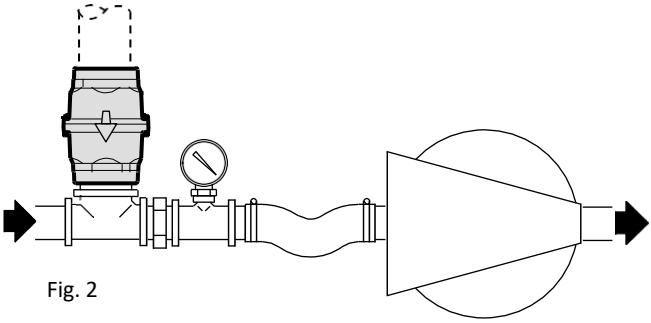


Fig. 2

INSTALLATION SKETCH – VACUUM RELIEF VALVE

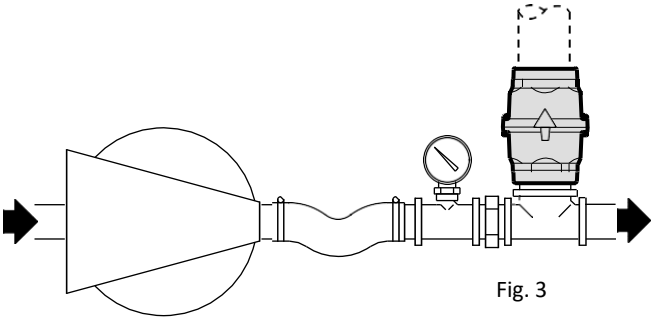


Fig. 3

INSTALLATION SKETCH – PRESSURE RELIEF VALVE

1. CHOICE OF SPRING

The valve is supplied with 2 different springs; each spring is to be used within a specific pressure-vacuum operating range. For the VRL8 and VRL9 there is the possibility to use both springs working in parallel. Referring to the SELECTION DIAGRAM, check that the valve is correctly sized and depending where the operating point (area A, B,…H) is located, choose one or two springs according to SPRING SELECTION CHART.
The valve is supplied with spring # I installed. If spring needs to be replaced or a supplementary spring is needed to be added (for VRL8 / VRL9), proceed to point # 2 otherwise, adjust valve as per point #3.

2. INSTRUCTIONS FOR SPRING REPLACEMENT (OR MOUNTING ADITIONAL SPRING FOR VRL8 / VRL9)

- Remove the two plastic caps on valve.
- **Ensure stop-nut 923 is locked on the upper housing 106.**
- Unscrew screw 903 from nut 903.1.
- Remove cover 107 from housing 106.
- Unscrew spring guide disc 433 taking it out from shutter guide 434.
- Remove spring 700 (only in case of replacement).
- Install the appropriate spring into shutter 165.
- Compress spring and screw spring guide disc 433 on shutter guide 434 for at least 20 full thread terms
- Check that both ends of the spring are properly positioned within their seats.
- Install the cover 107 on the housing 106 inserting:
  - for VRL6: the sliding guide on the slot in spring guide disc 433
  - for VRL8 and VRL9: dowel pin 562 on the slot in spring guide disc 433.
- Tighten screw 903 on nut 903.1

3. VALVE SETTING

A) Setting-up at allowed vacuum level

- Remove the two plastic caps on valve, if any.
- Position valve on the suction by-pass and connect a vacuum gage as close as possible to the exhauster inlet (Fig. 2).
- Unscrew nut 923.
- Relieve spring tension by backing off upper grub screw 904.1 with the fit key.
- Turn on exhauster. Induce highest attainable vacuum by throttling air intake upstream relief valve (normally reducing throttle to fully-closed).
- Adjust upper grub screw 904.1 until maximum allowable vacuum level is reached.
- Tighten nut 923 keeping blocked upper grub screw 904.1.
- Open suction line.

Double-check vacuum gauge to ensure no additional losses are induced by pipes or filters installed upstream relief valve

B) Setting-up at allowed pressure level

- Remove the two plastic caps on valve, if any.
- Remove nut 923 from upper grub screw 904.1 and place it on to the lower grub screw 904.2. Do not tighten.
- Position valve on the discharge by-pass and connect a pressure gage as close as possible to the blower outlet (Fig. 3).
- Relieve spring tension by backing on lower grub screw 904.2 with the fit key.
- Turn on blower. Induce highest attainable pressure by throttling air discharge downstream of the valve (normally reducing throttle to fully-closed).
- Unscrew lower grub screw 904.2 until maximum allowable pressure level is reached.
- Tighten nut 923 keeping blocked lower grub screw 904.2.
- Open discharge line.

Double-check pressure gauge to ensure no additional losses are induced by pipes or filters installed downstream the valve

Section 3.3

MBBR Package

Section 3.3.1

MBBR Feed Pumps

ROTECH
Pumps & Systems Inc

"A Trusted Partner in Pump Solutions"





SCP/SFP SELF PRIMING PUMPS

CONTENT

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INTRODUCTION OF PUMP

Rotech SCP series Pumps close coupled self-priming centrifugal pumps can be mounted with NEMA C face electric motor frames (56TC, 143TC, 145TC etc.) , IEC electric motors and Hydraulic Motors while Rotech RFP series Pumps are self-priming centrifugal frame mounted or Base mounted Pumps directly couple with coupling or V belt pulley drive wither with motor or engine.

SCP/SFP series are capable to lift liquid up to 25 ft form the liquid level below ground. However, for the best performance of pump , the pump should be installed less than 15 above the liquid level. The flapper valve will maintain a full column liquid in suction pipe line.

Standard features include stainless steel drive sleeve, stainless steel fasteners, renewable wear plate, and a semi-open dynamically balanced impeller. Option Include double grease-lubricated seals, stainless steel impeller and seals for all types of abrasive and / or corrosive services.

The ROTECH series of pumps are commonly used in water , waste water, Industrial, transfer pump application , wash down, OEM, Agricultural, Fertilizer and Pesticide Pumps, Applicators & Sprayers, , Bulk Transfer Pumps and much more.





SPECIFICATIONS:

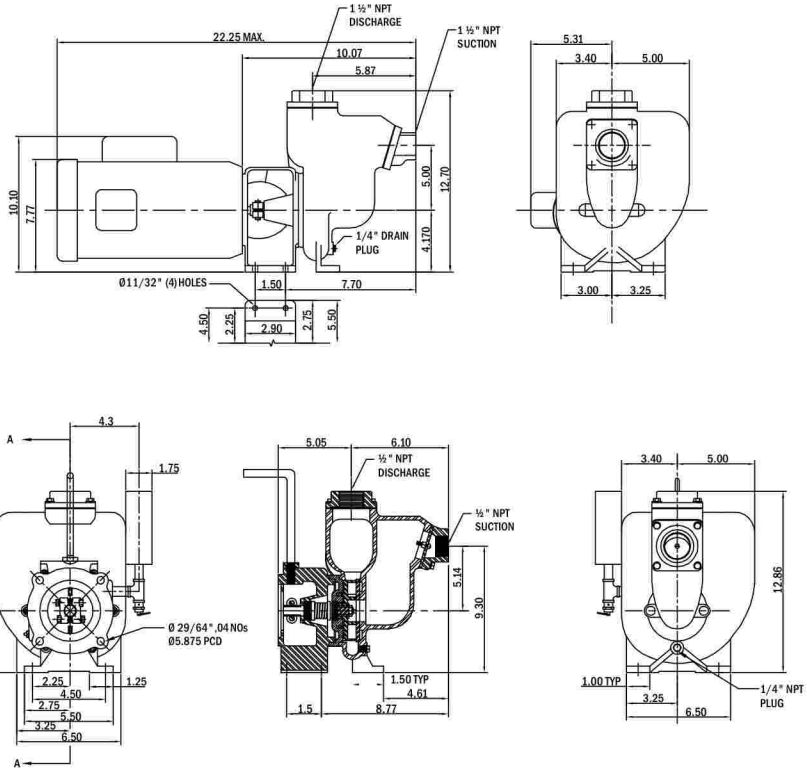
MODEL	SCP150/SFP150	SCP200/SFP200	SCP300/SFP300
Suction and Discharge	1-1/2" x 1-1/2" NPT	2" x 2" NPT	3" x 3" NPT
Materials of Construction	Cast Iron Bronze Aluminum Stainless Steel	Cast Iron Bronze Aluminum Stainless Steel	Cast Iron Bronze Aluminum Stainless Steel
Flow	Up to 145 GPM	Up to 150 GPM	Up to 320 GPM
Head Feet (TDH)	Up to 100'	Up to 100'	Up to 145'
Impeller	5.0" max diameter, semi-open	5.0" max diameter, semi open	6.0" max diameter, semi-open
Max Solid Size	1/2"	1/2 "	0.6"
Motor	Up to 3 HP	Up to 3 HP	Up to 7.5 HP
Drive Options	Close Coupled 145TC Close Coupled 56C Engine Mount 5.5 HP Engine Mount 6.5 HP Pedestal	Close Coupled 145TC Close Coupled 56C Engine Mount 5.5 HP Engine Mount 6.5 HP Pedestal	Close Coupled 184TC Close Coupled 215C Engine Mount 5.5 HP, 6.5 HP, 11 HP & 13 HP Pedestal
Seal	Standard Carbon / Ceramic / Viton Special Seal material combinations available (consult factory)	Standard Carbon / Ceramic / Viton Special Seal material combinations available (consult factory)	Standard Carbon / Ceramic / Viton Special Seal material combinations available (consult factory)

	SCP/SFP 150	SCP/SFP 200	SCP/SFP 300
APPLICATION	Water and Water Waste Industrial OEM Industrial Transfer	Water and Water Waste Industrial OEM Industrial Transfer	Water and Water Waste Industrial OEM Industrial Transfer
SPECIAL FEATURES	Stainless Renewable Wear Plate Stainless Steel Drive Sleeve Stainless Steel Fasteners Up to 25' suction lift Various Drive Options	Stainless Renewable Wear Plate Stainless Steel Drive Sleeve Stainless Steel Fasteners Up to 25' suction lift Various Drive Options	Stainless Renewable Wear Plate Stainless Steel Drive Sleeve Stainless Steel Fasteners Up to 25' suction lift Various Drive Options
OPTIONS	Various drive options available in various MOC Base Plate Option Hydraulic Motor available Stainless Steel Impeller, Bronze, Duplex Stainless Steel	Various drive options available in various MOC Base Plate Option Hydraulic Motor available Stainless Steel Impeller, Bronze, Duplex Stainless Steel	5 Blade Impeller available for higher flows Base Plate Option Double Seal available for dry run applications Hydraulic Motor available

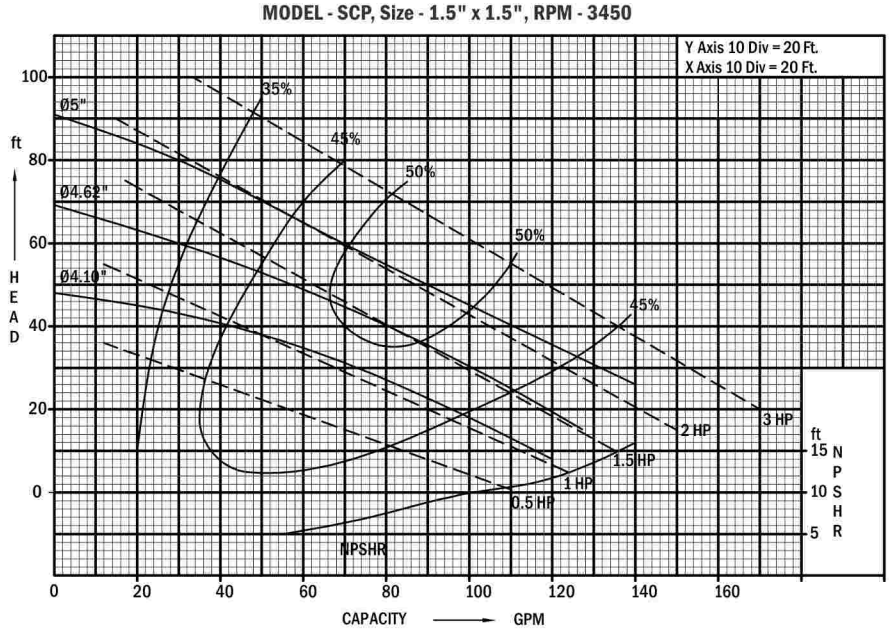
SCP 150/SFP 150

1.5" x 1.5" Self Priming Centrifugal Pump

DIMENSIONAL DRAWINGS



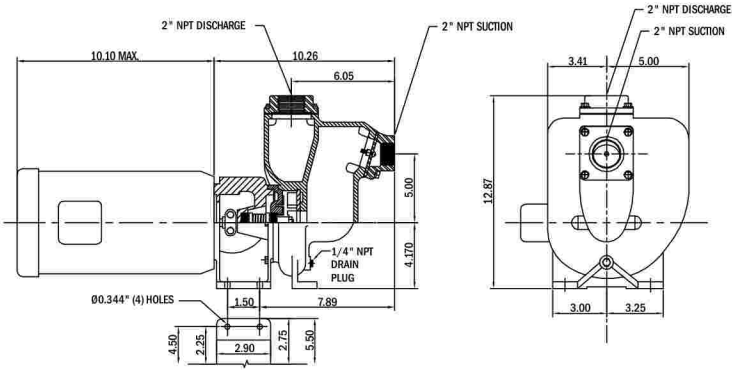
PERFORMANCE CURVES

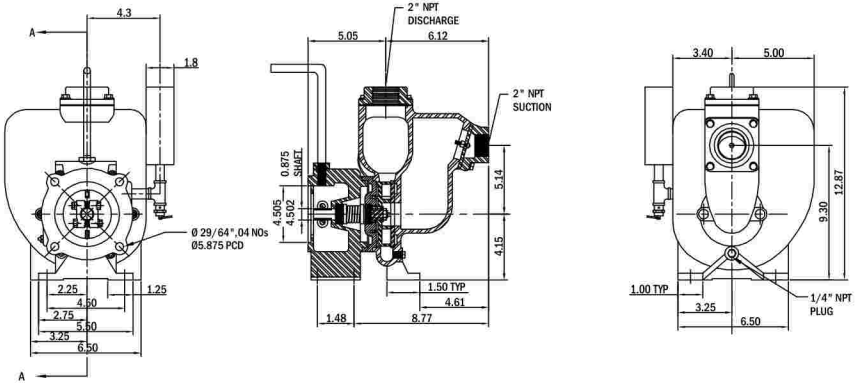


SCP 200

2" x 2" Self Priming Centrifugal Pump

DIMENSIONAL DRAWINGS

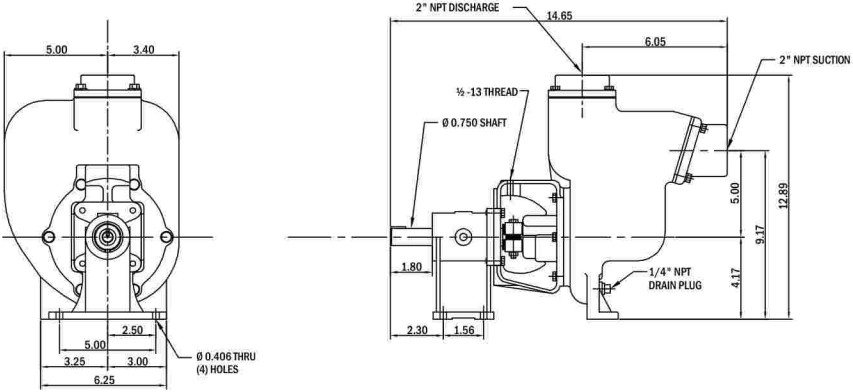




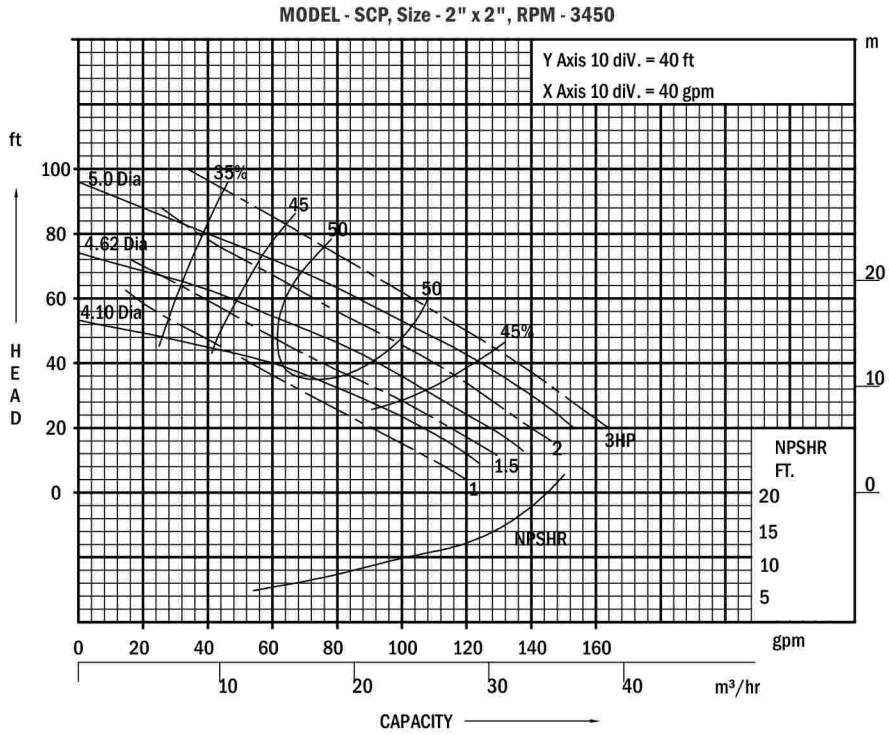
SFP 200

2" x 2" Self Priming Centrifugal Pump

DIMENSIONAL DRAWINGS



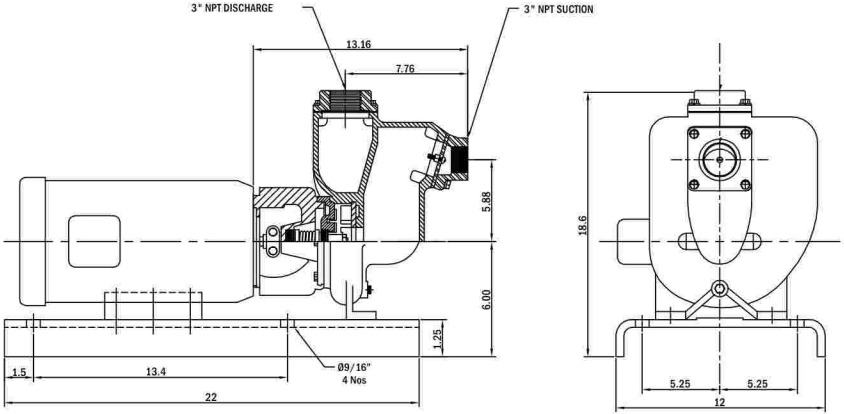
PERFORMANCE CURVES

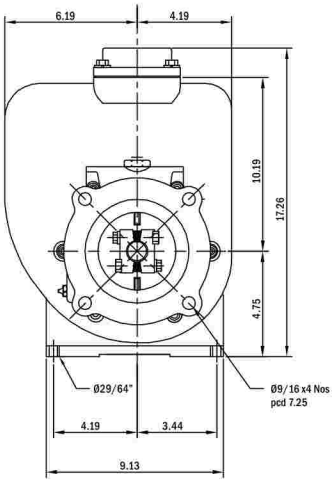


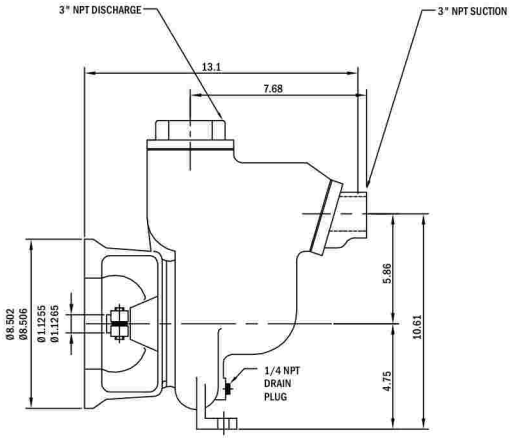
SCP 300

3" x 3" Self Priming Centrifugal Pump

DIMENSIONAL DRAWINGS



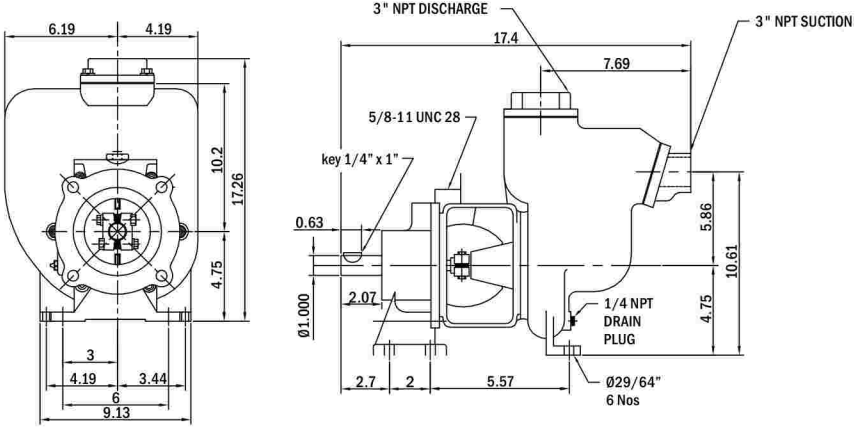


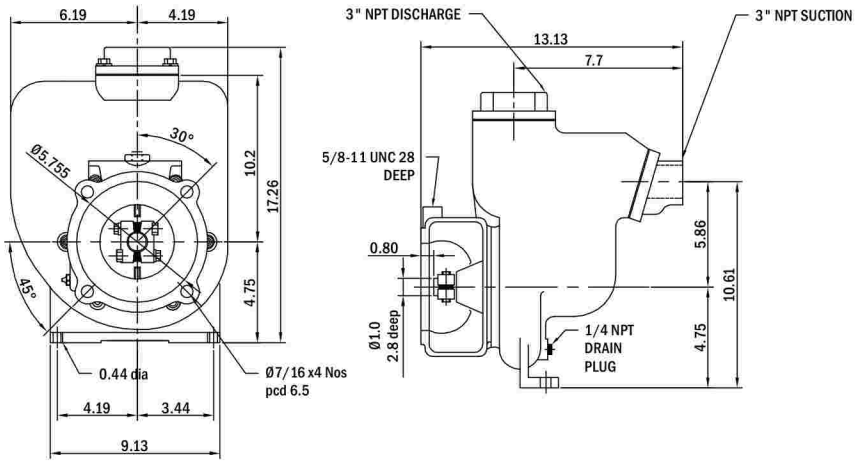


SFP 300

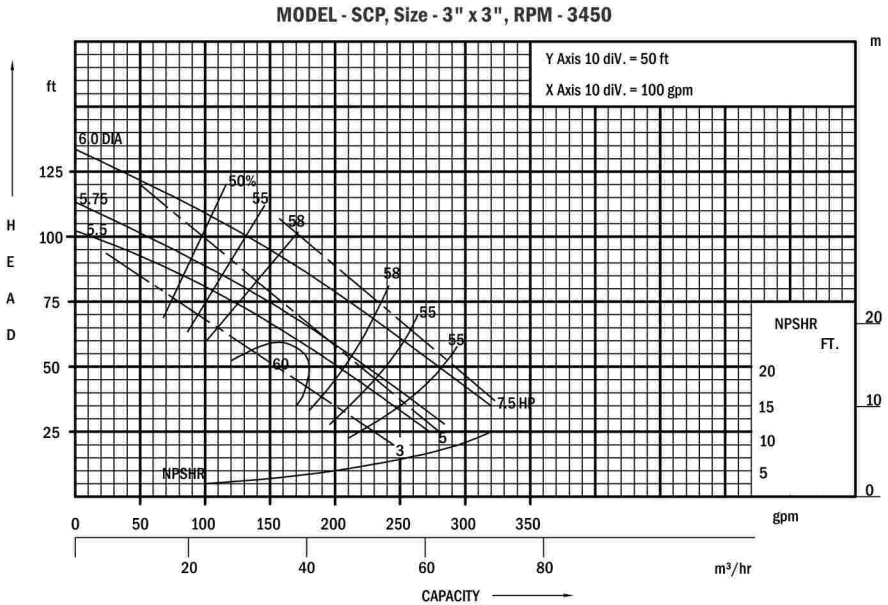
3" x 3" Self Priming Centrifugal Pump

DIMENSIONAL DRAWINGS

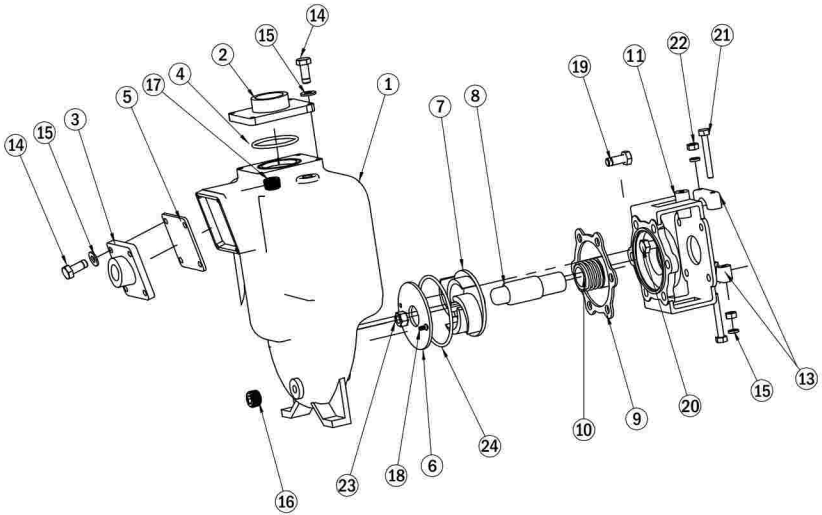




PERFORMANCE CURVES



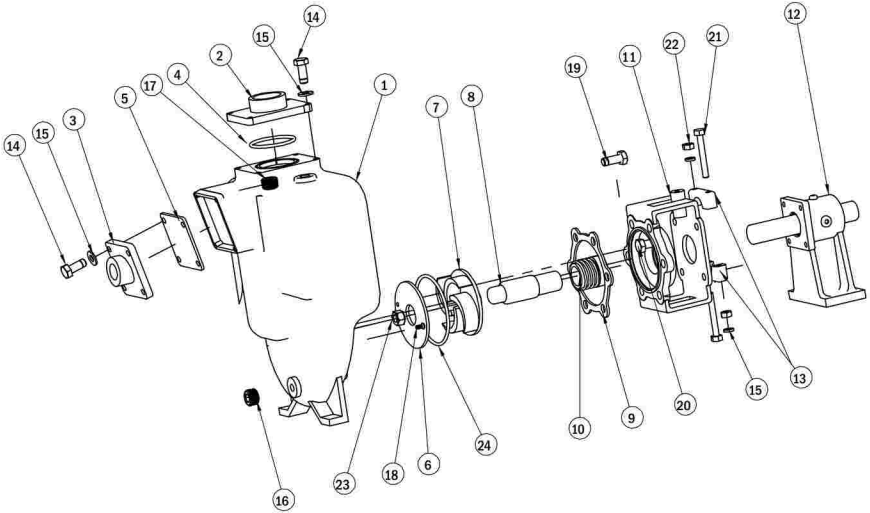
EXPLODED VIEW - SCP PUMP



ITEM NO.	DESCRIPTION	QTY
1	CASING	1
2	DISCHARGE FLANGE	1
3	SUCTION FLANGE	1
4	O-RING VITON	1
5	FLAPPER ASSY.	1
6	WEAR PLATE	1
7	IMPELLER	1
8	SLEEVE	1
9	GASKET	1
10	SEAL ASSY.	1
11	ADAPTOR	1
12	NOT APPLICABLE	-

ITEM NO.	DESCRIPTION	QTY
13	CLAMP	2
14	CAP SCREW - 5/16" - 18 x 7/8"	8
15	LOCKWASHER 5/16	14
16	PIPE PLUG	1
17	FILL PLUG	1
18	FLAT HEAD SCREW	2
19	CAPSCREW - 5/16" - 18 x 3/4"	6
20	CAPSCREW - 5/16" - 24 x 0.88	4
21	CAPSCREW - 5/16" - 18 x 1 3/4"	2
22	HEX NUT - 5/16" - 18 x 1 3/4"	2
23	JAM NUT	1
24	O-RING VITON	1

EXPLODED VIEW - SFP PUMP



ITEM NO.	DESCRIPTION	QTY
1	CASING	1
2	DISCHARGE FLANGE	1
3	SUCTION FLANGE	1
4	O-RING VITON	1
5	FLAPPER ASSY.	1
6	WEAR PLATE	1
7	IMPELLER	1
8	SLEEVE	1
9	GASKET	1
10	SEAL ASSY.	1
11	ADAPTOR	1
12	PEDESTAL ASSY.	1

ITEM NO.	DESCRIPTION	QTY
13	CLAMP	2
14	CAP SCREW - 5/16" - 18 x 7/8"	8
15	LOCKWASHER 5/16	14
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Pumps & Systems Inc

"A Trusted Partner in Pump Solutions"

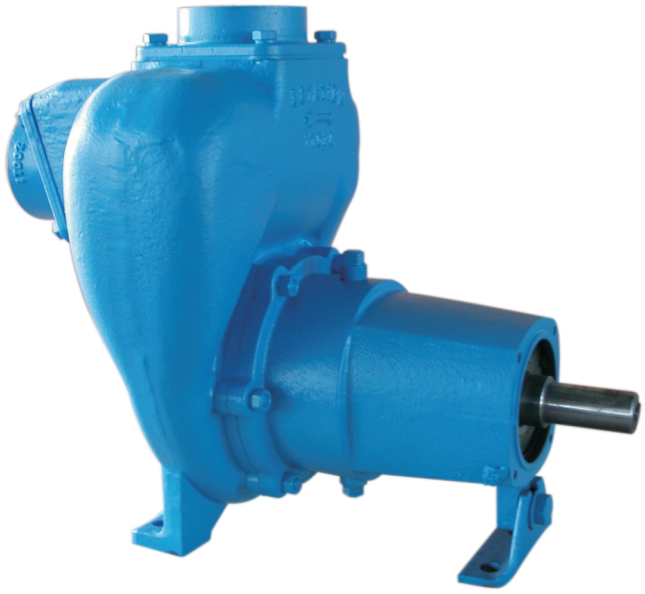
1320 Britannia Road East, Mississauga, Ontario, Canada. L4W 1C8
Phone: (905) 461-9617 | Fax: (905) 461-9618 | Toll Free: 1-866-217-PUMP (7867)
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Pumps & Systems Inc

"A Trusted Partner in Pump Solutions"





Installation, Operation and Maintenance Manual

SCP/SFP SELF PRIMING PUMPS

IMPORTANT - WARRANTY CLAUSE

ROTECH PUMPS:

Pumps manufactured & assembled by Rotech , are covered by warranty for free of manufacturing defects for a period not exceeding twelve months from the date of shipment from our Plant/warehouse.

This warranty will be limited and subject to Rotech authorisation /approval.

1. Rotech will make good by repair or its option as replacement of faulty parts under warranty, providing always that:
   (a) The equipment was correctly installed and properly used in accordance with Rotech Installation & Operating instruction manual and accepted codes of good engineering practice.
   (b) The claims for goods under warranty arise solely from faulty design, material or workmanship. Rotech products don't offer warranty or guarantee for any pump application. The customer can't blame Rotech for selection of Material of constructions and other specifications. The customer can consult consulting engineers before purchase of pumps.
   (c) The repair is carried out by Rotech service department or by an authorized agent or distributor Appointed by Rotech. Authorized repair agent must obtain written approval (WRA#) from Rotech before Completing repair under warranty.
   (d) Authorized repair agents will be refunded with the amount of equivalent to a similar repair work in the Rotech service department.
   (e) All freight costs to and from the service department or repair agents to be paid by the purchaser.
2. In case of equipment or components which are not manufactured by Rotech, but supplied by Rotech,(for example Electric motors, engines, trade accessories etc.), the warranty is limited of such equipment and subject to respective manufacturers.
3. Rotech Pumps warranty doesn't cover any of the following:
   (a) Claims for third party liability, labor cost, transportation cost or damage caused by failure of any of the company's products.
   (b) Damage caused by abnormal operating conditions, war, violence, storm, cataclysm or any other force.
   (c) Damage caused by the equipment being used for an application for which it is not recommended.
   (d) Damage caused by sand or abrasive materials, corrosion due to acid waters, electrolytic action, liquid temperature beyond the recommended range, cavitation, improper supply voltage or insufficient liquid to enable the pump to specification.
4. The decision of Rotech in relation to any claims or disputes over warranty is final.
5. This warranty is in lieu of all other warranties and conditions expressed or limited written or oral, statutory to the extent allowable by law or otherwise, which are hereby negated and excluded.

LIMITED LIABILITY:

Rotech shall not be liable for any damage, delays or personal injury caused by following improper or proper procedure of installation and maintenance of equipment being supplied by Rotech.

The pump and other equipment supplied by Rotech based on customer specification. Rotech can't be liable the installation of pump and equipment in any hazardous environment. Customer has to consult engineers before purchasing for proper pump application.

CONTENT

1. INTRODUCTION 1
2. RECEIPT AND STORAGE 2
3. INSTALLATION 3
   - LOCATION 3
   - FOUNDATION 3
   - PIPING 3
4. OPERATION 3
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   - REMOVING PUMP HOUSING / VOLUTE
   - REMOVING INPELLER
   - INSPECTION & REPLACEMENT OF MECHANICAL SEAL
   - ASSEMBLY OF PUMP WITH DRIVE
   - IMPELLER ASSEMBLY
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INTRODUCTION

Rotech SCP series Pumps close coupled self-priming centrifugal pumps can be mounted with NEMA C face electric motor frames (56TC, 143TC, 145TC etc.) , IEC electric motors and Hydraulic Motors while Rotech RFP series Pumps are self-priming centrifugal frame mounted or Base mounted Pumps directly couple with coupling or V belt pulley drive wither with motor or engine.

SCP/SFP series are capable to lift liquid up to 25 ft form the liquid level below ground. However, for the best performance of pump , the pump should be installed less than 15 above the liquid level. The flapper valve will maintain a full column liquid in suction pipe line.

Standard features include stainless steel drive sleeve, stainless steel fasteners, renewable wear plate, and a semi-open dynamically balanced impeller. Options include double grease-lubricated seals, stainless steel impeller and seals for all types of abrasive and / or corrosive services.

The ROTECH series of pumps are commonly used in water , waste water, Industrial, transfer pump application , wash down, OEM, Agricultural, Fertilizer and Pesticide Pumps, Applicators & Sprayers, , Bulk Transfer Pumps and much more.

RECEIPT AND STORAGE

RECEIVING AND HANDLING OF PUMP

Immediately after receipt of pump, please check following:

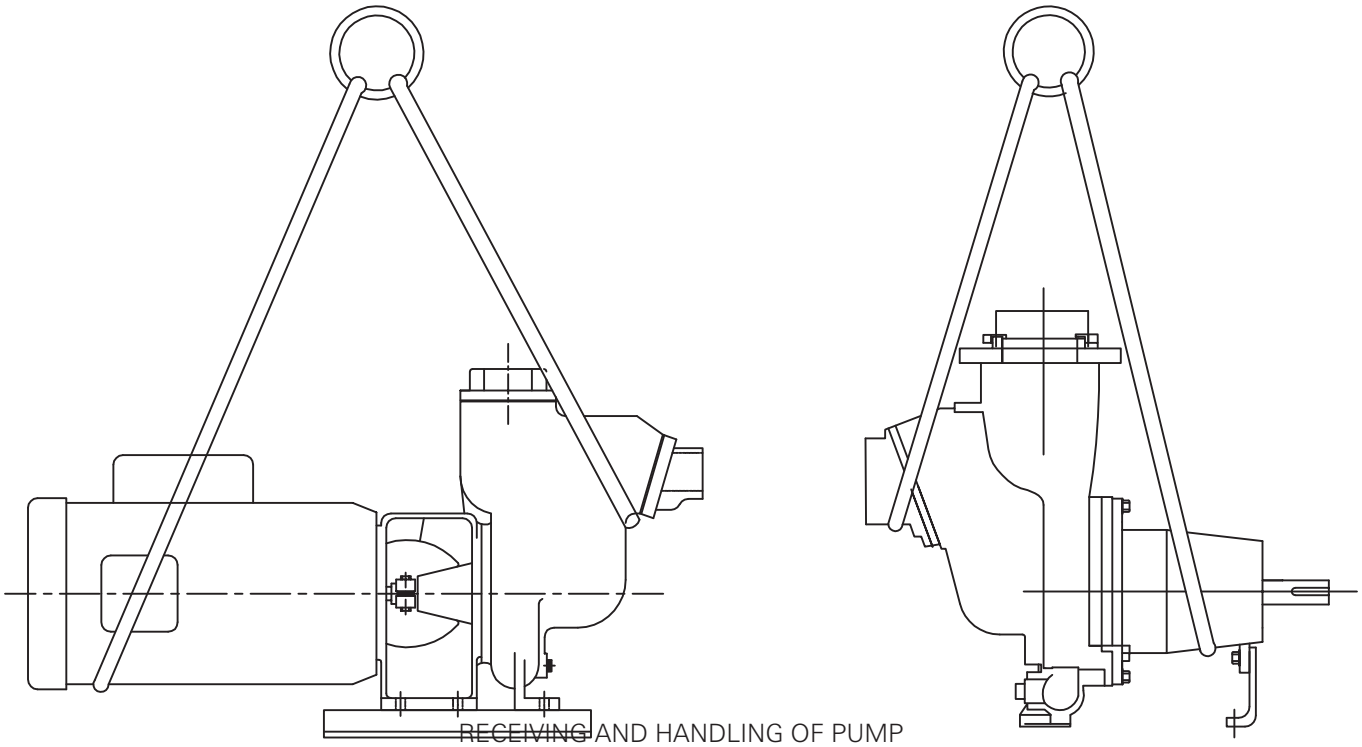
Check Name plate details on pump.

Please check name plate details on which Pump Model number, Size of pump, Flow, Head, Serial number, HP of Motor, RPM and compared with Purchase order just to make sure you have received right pump against order to avoid any issue.

Check pump crate and pump & other equipment is in good condition and did not damage in transportation. If there is any damage, immediately report to shipper Rotech Distributor or your supplier.

Use proper procedure unloading pump and equipment from truck

Please follow proper handling procedure of the pump as shown in figure below:



RECEIVING AND HANDLING OF PUMP

STORING OF THE PUMP

Store pump in a cool and dry area free from heat, dirt. Do not remove packing if not necessary. Rotate pump shaft at least once a week to maintain protective film of oil or grease on bearings.

If you intend to store for long term, use proper storage treatment for safegaurd of pumps.

ROTECH SELF-PRIMING CENTRIFUGAL PUMPS

INSTALLATION

LOCATION:

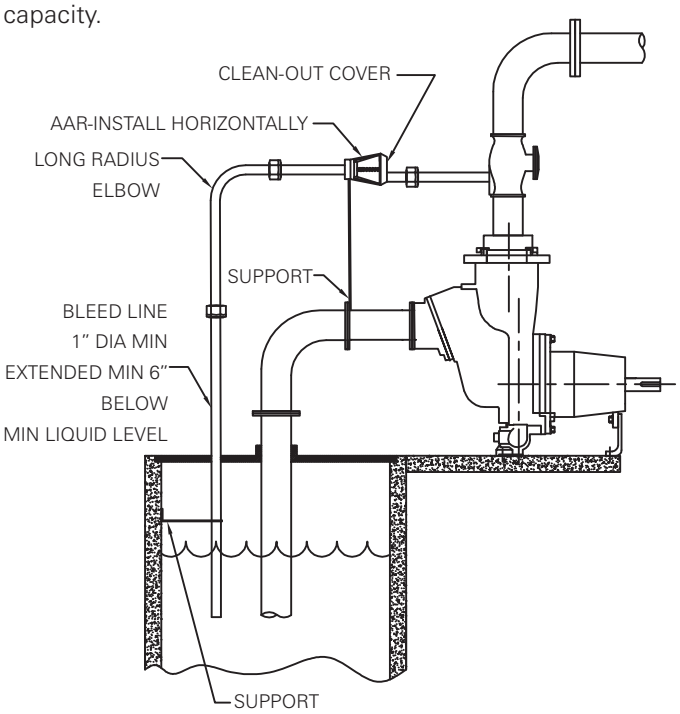
For optimum performance, place pump as close to liquid source as possible to reduce suction lift to a minimum. For best results, pump should be installed not more than 15 feet above the liquid supply. Set the unit on solid footing and as nearly level as possible.

FOUNDATION:

It is recommended that the foundation should be rigid strong and five times the total mass of pump set.

PIPING:

Pipe or hose of the same size as flanges provided should be used. Reinforced rubber suction hose is recommended because it provides greater flexibility and prevents collapsing due to vacuum in the suction line when pump is in operation. Suction line should be as short as possible and have as few elbows or bends as possible to keep friction loss at a minimum. Use pipe dope on all connections and make certain that all fittings are tight, particularly on the suction line where an air leak can prevent priming or reduce pump capacity.



OPERATION

The ROTECH pump is a self-priming centrifugal pump and only requires priming prior to its initial start. The pump will retain sufficient liquid for self-priming thereafter.

Provision for a priming plug can be made by using a close nipple and tee on the discharge opening. A pipe plug installed in the top opening of the tee is easily removed when necessary to prime pump. Prime pump by filling pump housing with liquid.

If pump fails to prime or stops pumping, check for the following possible causes:

1. No liquid in the pump housing.
2. Air leak in the suction line due to loose connections or pin holes in the hose.
3. Collapsed suction line or clogged strainer.
4. Seal worn and leaking air.
5. Worn impeller - too much clearance between impeller and wear plate
6. Pump not running fast enough.
7. Suction lift is too high.
8. Trying to prime against too high a discharge head.

MAINTENANCE

The ROTECH pump is of simple construction with only one moving part. The impeller on the ROTECH 150 & 200 is threaded to a stainless steel drive sleeve. The impeller on the ROTECH 300 has a stainless steel cover pressed on. The sleeve slips over the drive shaft and is locked to use a standard drive shaft - no special tapers or threads. It's easy to adjust or remove the impeller.

ROTECH pumps are available with a self-lubricated shaft seal.

The self-lubricated seal is lubricated by the liquid in the pump. Operating the pump dry will seriously damage the seal.

If the pump is being operated at very low freezing temperature the pump should be made empty by drawing liquid in pump housing. Draining is provided for by a drain plug located at the base of the pump housing.

SCP CLOSE COUPLED PUMP

DISASSEMBLY OF PUMP FROM DRIVE (MOTOR OR ENGINE)

Disconnect power supply to prevent accident.

Disconnect lines and drain pump housing.

REMOVING PUMP HOUSING / VOLUTE

Remove bolts and nuts holding pump housing to mounting base if it is fastened.

Remove nuts and washers holding pump housing to the adaptor.

Loosen the housing and remove carefully to prevent tearing gaskets.

REMOVING IMPELLER

Remove impeller clamp nuts and clamp to unlock impeller drive sleeve from drive shaft.

Use two large screwdrivers diagonally across from each other between adaptor and end of drive sleeve. Try the sleeve off the drive shaft.

INSPECTION & REPLACEMENT OF MECHANICAL SEAL

Before removing the mechanical seal from the impeller, inspect the matting faces of Rotary Seal. If matting faces are damaged or worn replace it with a new one. Inspect the stationary seal seat in seal housing. If there are no scratches or crack on surface, it is recommended to use new stationary seat. To replace stationary seat, remove adaptor by removing four nuts and washers. Place adaptor on flat surface, with impeller side down. Press out stationary seal seat by using a screw driver or similar tool.

ASSEMBLY OF PUMP WITH DRIVE

The care should be taken into consideration while assembly of impeller and seal to the drive shaft. The assembly should take place as soon as the rotary seal installed on impeller sleeve to avoid disruption of working height of mechanical seal.

IMPELLER ASSEMBLY

The Motor key will not be used to mount impeller on shaft but in built clamp key will be used to hold impeller on shaft with bolts and nuts. Before tightening clamp adjust clearance between back face of impeller and adaptor allowing from 0.015" to 0.020" clearance. Tighten impeller clamp to lock impeller onto drive shaft. This automatically sets face clearance of impeller when housing is mounted.

RE ASSEMBLY OF PUMP HOUSING

Inspect gasket of pump housing and if it is damaged replace new on the adaptor. Replace two lockwashers and nuts on studs diagonally across from each other and tighten. Turn drive shaft over slowly by hand and listen at outlet opening on housing for any rubbing of impeller on the housing or wear plate.

The clearance between the impeller and wear plate can be checked with a feeler gauge. Normal clearance is 0.015" to 0.025". If clearance exceeds readjust impeller. If the impeller rubs use an additional gasket to spacer impeller.

After clearance has been established, replace lockwashers and nuts on remaining studs and tighten. If capscrews and nuts are used to hold housing to mounting base, replace these and tighten.

TO REMOVE WEAR PLATE

After pump housing has been removed from the adaptor, inspect the wear plate. If wear plate is badly worn, it should be replaced. To remove wear plate, loosen and remove acorn nuts and gaskets on the outside of the pump housing.

SFP FRAME MOUNTED PUMP:

DISASSEMBLY OF SFP SERIES PUMP:

Check exploded view drawing and disassembly pattern on parts. Keep all necessary parts for reassembly of pump carefully.

- Disconnect power supply from drive & remove the pump end from the driver.
- Remove and replace the flapper assembly and discharge gasket. Tighten the inlet and discharge flange fasteners to 24 ft-lbs.

- Remove bolts & nuts from the adaptor and disassemble the rotating assembly form the housing.
- Inspect the wear plate for abrasive wear and replace if necessary using new screws, gaskets and acorn nuts.
- Inspect Rotary seal mounted on impeller sleeve. Remove the stationary seal seats from the adaptors and discard.
- Impellers are threaded onto a drive sleeve & fastened with a jam nut.
- Inspect the impeller for abrasive wear at the edges of the machined surfaces. If they are not well defined the impeller should be replaced.

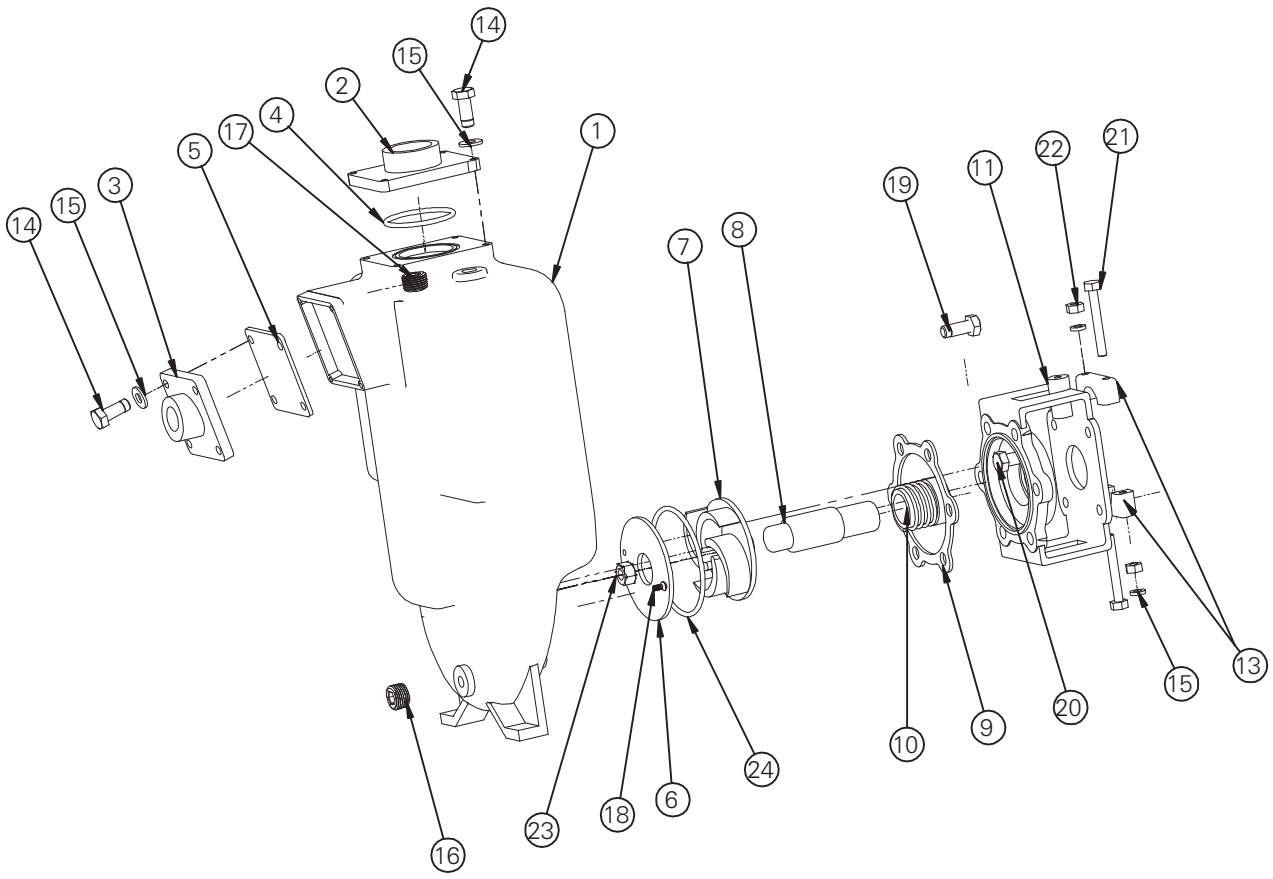
REASSEMBLLY OF PUMP:

- Lubricate the stationary seal seat cup seat or o-rings & seal housing bore. Install new stationary seats into the seal housing / adaptors with lapped face stays up. Use proper tool to secure stationary seat into housing. Do not touch surface of lapped faces , it may get damaged. If there is dirt or oil traces on lapped faces , clean with rubbing alcohol to make it dry.
- Place the impeller inside the pump housing.
- Install the housing gasket over the housing studs/ bolts & position it on the housing gasket face.
- Using lubricant, lubricate the impeller sleeve and the seal rotary bellows inner diameters.
- Install rotary seal over the sleeve to make contact with the spring.

Place housing gasket over the studs and install the driver adaptor onto the pump assembly to compress the seal spring. Tighten all 6 nuts with lockwashers to 28 ft-lbs. with equal pattern. Slide the drive sleeve clamp assembly on the sleeve. Pull the clamp assembly and sleeve back out of the pump and slide a shim inside the pump discharge between the wear plate and impeller vanes. Use proper thickness of Shim.

The pump can now be installed to the driver .

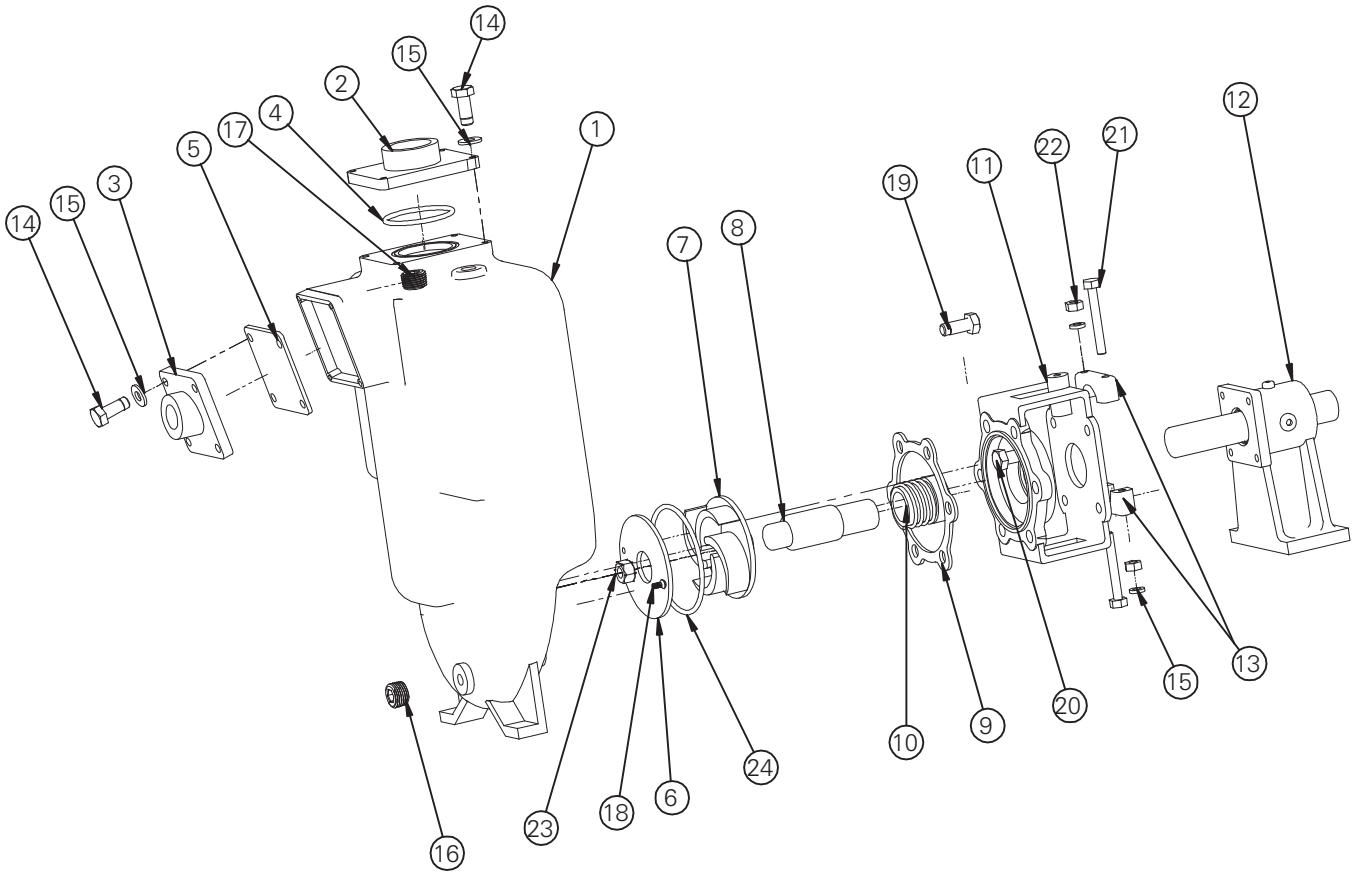
EXPLODED VIEW - SCP SELF PRIMING PUMPS



ITEM NO.	DESCRIPTION	QTY
1	CASING	1
2	DISCHARGE FLANGE	1
3	SUCTION FLANGE	1
4	O-RING VITON	1
5	FLAPPER ASSY.	1
6	WEAR PLATE	1
7	IMPELLER	1
8	SLEEVE	1
9	GASKET	1
10	SEAL ASSY.	1
11	ADAPTOR	1
12	NOT APPLICABLE	-

ITEM NO.	DESCRIPTION	QTY
13	CLAMP	2
14	CAP SCREW - 5/16" - 18 x 7/8"	8
15	LOCKWASHER 5/16	14
16	PIPE PLUG	1
17	FILL PLUG	1
18	FLAT HEAD SCREW	2
19	CAPSCREW - 5/16" - 18 x 3/4"	6
20	CAPSCREW - 5/16" - 24 x 0.88	4
21	CAPSCREW - 5/16" - 18 x 1 3/4"	2
22	HEX NUT - 5/16" - 18 x 1 3/4"	2
23	JAM NUT	1
24	O-RING VITON	1

EXPLODED VIEW - SFP SELF PRIMING PUMPS



ITEM NO.	DESCRIPTION	QTY
1	CASING	1
2	DISCHARGE FLANGE	1
3	SUCTION FLANGE	1
4	O-RING VITON	1
5	FLAPPER ASSY.	1
6	WEAR PLATE	1
7	IMPELLER	1
8	SLEEVE	1
9	GASKET	1
10	SEAL ASSY.	1
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ITEM NO.	DESCRIPTION	QTY
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Email: sales@rotechpumps.com | www.rotechpumps.com

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Section 3.3.2

HILT MBBR Tank

HILT Tank Specification Sheet

Customer:
Project:
Proposal:
Date:





Description

Tank Type:	20’ ISO full frame tank
Frame Dimensions:	20’ x 8’ x 8’6”
Capacity:	26,000 Litres (6880 gallons) +/- 2%
Full Weight:	30,000 kgs (66,000 lbs)
Empty Weight:	3,800 kgs (8360 lbs)
Vessel Material:	304 SS, hot rolled, ASTM 240
Shell & End Thickness:	5 mm Shell, 6mm End, Nominal
Frame Material:	GB/T 1591-Q345D epoxy coated carbon steel
Frame to Shell:	304 stainless steel
Vessel Design Code:	ASME VIII Div 1
Vessel Approval:	Lloyds Registry

Fittings and Accessories:

Manway Assembly	500mm - 8-point fastening manlid, low profile Gasket: PTFE encapsulated EPDM inner
Standard Fittings	1.5” BSP airline with ball valve 2.5” BSP Pressure Relief Valve - pressure set at 4.4 bar 80mm Blank flange weld in pad w 6x12M taps - shipped with blanking flange 3” 45° foot valve and 3” clamped butterfly valve terminating with 3” BSP **Additional fittings available upon request**

Walkway

'F' Type walkway, 475 wide aluminium 'Q' grating fitted as follows:-
1 full length walkways fitted with two transverse sections, one adjacent to the centre spill box, one across rear of tank

Ladder

Aluminium; anti-slip rungs, right-hand rear of tank

Grounding Plate

Welded to bottom frame rear end of tank

Internal Finish

Longitudinal welds: as-welded
Circumferential welds: as-welded but with 400 mm ground flush and polished to a maximum of 1.2 micron CLA on bottom centre line.
Entire internal surface chemically cleaned and passivated after completion of all welding and dressing.
Tank internal surface shall be free of scratches; However, if polishing is necessary, it shall not exceed 1% of the internal surface.

External Finish

Tank Shell: External surface of tank cleaned after completion of all welding and testing.

Framework: All carbon steel frame parts will be shot blasted to Swedish standard SA2½ followed by the application of:-

First coat:	Hempadur Zinc (15360)	30 micron min DFT
Intermediate:	Hempatex Primer (1530C)	40 micron min DFT
Final coat:	Hempatex Hibuild (5643C)	50 micron min DFT
	TOTAL	120 micron min DFT
	Colour Blue	RAL 5013

Insulation

Tank insulated with (2") 50 mm mineral wool with a density of 60kg/m^3 where possible. Aluminium foil will be fitted between insulation and tank shell External cladding: white GRP

Heating

6 longitudinal runs of heating coils, giving a total effective heating area of 8.00 m^2 will be fitted
The working pressure is 4 bar and the testing pressure is 6bar
Inlet and outlet connections are ¾" BSP
Dust caps and chain will be fitted.

OPTIONAL HEATING:

Use steam, glycol generator or hot water source by others

REV	DESCRIPTION	DATE	BY	APP'D
0	FOR SUBMITTAL ONLY	09/22/21	JG	JC

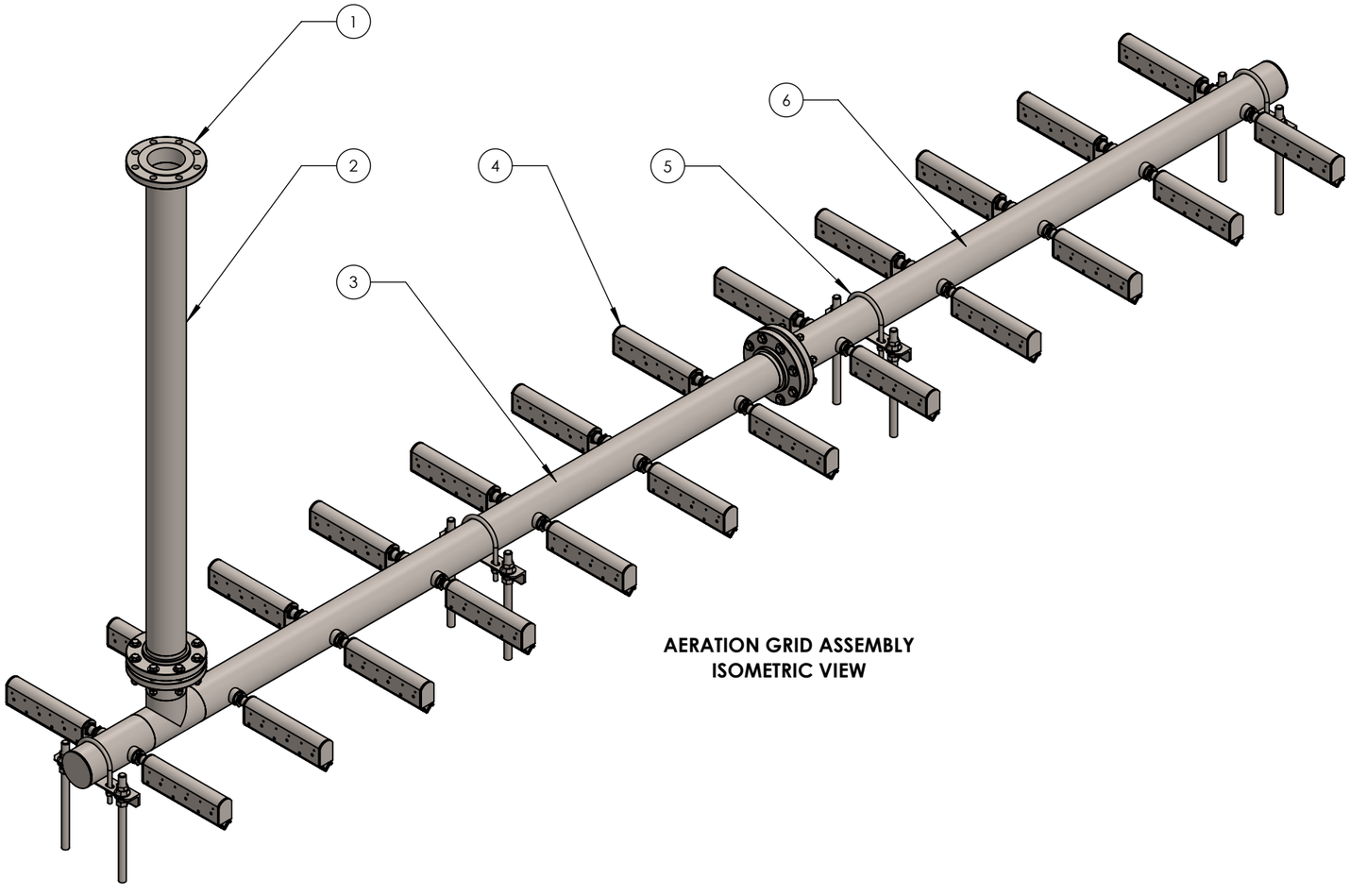
H2FLOW HILT AERATION GRID

MANUFACTURING NOTES:

1. QTY: 1 UNIT
2. MATERIAL: SS 304, ANSI 150LB FLANGE, SCH. 10
3. ALL DIMENSIONS ARE EDGE TO EDGE UNLESS OTHERWISE NOTED.
4. TOLERANCES: ANGULAR MACH. ±1°, BEND ± 1°, DECIMAL ±0.5mm OR ±1/64"
5. ALL WELDS MUST BE MIN.3/16" CONTINUOUS MIG WELDS (FLARE BEVEL WELD WHERE NECESSARY)
6. ALL WELDS MUST BE UNIFORM AND AESTHETICALLY PLEASING, DONE BY QUALIFIED CWB
7. REMOVE ALL SHARP EDGES AND CLEAN ALL SURFACES AND WELDS

BILL OF MATERIAL			
ITEM#	QTY.	DESCRIPTION	NOTE
1	5	DN100 [4"] LAP-JOINT FLANGE	
2	1	DN100 [4"] PIPE	
3	1	DN100 [4"] PIPING MODULE #1	
4	24	DN20 [3/4"] AERATION MODULE	
5	4	PIPE BRACKET ASSEMBLY	
6	1	DN100 [4"] PIPING MODULE #2	

*** ALL FASTENERS ARE DOUBLED NUTS WITH FLAT WASKET ***



AERATION GRID ASSEMBLY
ISOMETRIC VIEW

H2FLOW EQUIPMENT INC.
WATER AND WASTEWATER TREATMENT EQUIPMENT
580 OSTER LANE, CONCORD, ON L4K 2C1 CANADA
TEL: (905) 660-9775 FAX: (905) 660-9744
www.h2flow.com

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DRAWN BY: JG	DATE: 09/22/21	PROJECT NAME: CONSULTEC ASCOT-PREMIER SEWAGE WWTP	TITLE: GENERAL ARRANGEMENT - H2FLOW HILT AERATION
APP'D BY: JC	DATE: 09/22/21		DRAWING No.: Q-20519-30-32
SCALE: NTS		ALL DIMENSION ARE IN "mm" UNLESS OTHERWISE SPECIFIED	REV: 0
			SHEET 1 OF 1

R10 VERSION 1 APRIL 07, 2021

Section 3.3.3

MBBR Media

TORONTO – MONTREAL – VANCOUVER
Tel: 905-660-9775 1-888-575-8642
info@h2flow.com www.h2flow.com

Biofilm Carrier

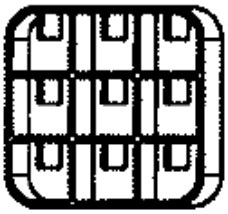
Product Name – BWTX™

Application

The BWT X™ Biofilm Carrier element is used in biological treatment processes for both water and wastewater treatment.

Design

The BWT X™ elements consist of nine (9) cells, with following dimensions:



Width/Height :	14.5 mm (±0.5 mm)
Length :	8.2 mm (+0.2/-0.2mm)
Outer Perimeter :	55 mm
Inner Perimeter :	197 mm
Wall Thickness :	0.35 (±0.1 mm)

Note: Tolerances according to DIN 16941/3.

Material

Material :	Polyethylene, High-Density (HDPE).
Colour :	Natural
Specific Weight :	
Raw Material	0.96 (± 0.02) kg/L
Extruded Material	0.95 (± 0.02) kg/L

Note: Add-Max® 104 added to material to improve stabilization for extruding process.

The biofilm carrier elements are produced from a material and with a procedure that ensures that material will have a prolonged aging time; guaranteeing proper operation for its service life, provided that the carrier elements are:

- stored and packaged, as from the producer, and;
- applied in the biological reactors, according to standard practice.

The shape of the biofilm carrier elements may in some cases be irregular, which has no negative effect on the total guaranteed specific surface area.

Specifications

Carrier Element :	
Specific Surface Area (Protected)	650 m^2 per m^3
Weight	131 kg/m^3 (in bulk, at production)

Quality Assurance

The producer is instructed to visually inspect/test to control form, dimensions and density (kg/m^3 in bulk), to ensure conformity to specification.

Section 3.3.4

Foam Indicator

MODELS:

2882-FCS / 2882W-FCS

PROBE MOUNTED
FOAM CONTROL SWITCH



USER MANUAL (REV: 1.0)

ARJAY ENGINEERINGLTD.		
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1.0 SPECIFICATION

Specifications are subject to change without notice

Specification	*Details*
Power Input: *(Specify voltage at time of Order)*	12VDC +15% /-10% or 24VDC +15% /-10%, 250mA maximum 100VAC – 240VAC +/- 10%, 50/60 Hz, 150mA maximum ***Note:*** DC input models must be supplied by Limited Energy power source. Limited Energy means compliance with one of the following requirements: - Class 2 circuit according to Canadian Electrical Code, Part, I, C22.1; - Class 2 circuit according to National Electrical Code, NFPA-70; - Limited Power Supply (LPS) according to IEC 60950-1; - Limited-energy circuit according to IEC 61010-1.
Connections to mains supply	Permanent (for AC/DC model)
User Interface:	
Display & Keypad	Two line LCD display, Alarm status LEDs and Keypad for select menu or enter values
Communication Interface:	Modbus (RS485)
Relays / Analog Outputs:	
Relay Outputs	2 SPDT relays, Dry Contacts are 3A @ 250 VAC (Resistive), selectable failsafe or non-failsafe, selectable high or low acting alarm, programmable time delay: 0 – 600 seconds
mA Signal Output	4mA during Normal and 20 mA during an alarm condition, 900 Ohms max (24VDC Power) OR 450 Ohms max (12VDC Power). *Set for Relay 1 only
Instrument Performance:	
Measuring Range	0 - 5000 pF (most applications are 100pF to 1000pF)
Accuracy	0.2%
Resolution	0.05% of setpoint via network display 0.002% of Full Scale capacitance via network display
Calibration	Single point per relay: Auto calibration
Environmental:	
Operating conditions	Continuous
Ambient Temperature	-20 °C to +55 °C controller
Process Temperature	-60 °C to +200 °C Standard or Heavy Duty Probe -60 °C to +100 °C Flexible Tefzel Probe
Maximum Process Pressure	1500 PSI / 10342 kPa
Relative humidity	0 to 95% (non-condensing)
Altitude	≤2000 m

Specification	***Details***
Installation Category	II
Pollution Degree	2
Equipment mobility	Fixed
Mechanical Specification:	Refer to Dimensional Drawing
Enclosure Protection Degree	IP65, Die-Cast Aluminum Junction, Painted (Blue) NEMA 4X, Die-Cast Aluminum Junction, Painted (Grey)
2880 Series Controller With Level Probe Certification	
Ordinary Locations:	• UL file number: E343390 • UL / IEC 61010-1, 2nd Edition, 2008/10/28 (Electrical Equipment for Measurement, Control, and Laboratory Use; Part 1: General Requirements) • CAN/CSA-22.2 No. 61010-1, 2nd Edition, 2008/10/01, (Electrical Equipment for Measurement, Control, and Laboratory Use; Part 1: General Requirements) • CE: UL / IEC 61010-1; IEC / EN 61000-4; ISO 9001:2008
Hazardous Locations:	•
North America	• CSA file number: 56812 • Class – 2258-02 – Process control equipment for Hazardous Locations • Class – 2258-82 – Process control equipment for Hazardous Locations – Certified to US Standards • Ex db IIC T5 Gb • Class I, Zone 1, AEx db IIC T5 Gb
International IECEx / ATEX *****	• II 2G Ex db IIC T5 Gb • Sira 17ATEX1303X • IECEx CSA 17.0034X

**** For ATEX / IECEx / CSA / UL and EU Declaration of Conformity certificates refer to www.arjayeng.com***

SPECIFIC CONDITIONS OF USE FOR HAZARDOUS LOCATION
(denoted by X after the certificate number)

1. Process temperature for the standard and heavy duty probes are -60°C to +200°C and for flexible probe is -60°C to +100°C. It is end-user's responsibility to ensure that the ambient around the Capacitance Controller and ARJAY Probe does not exceed the permitted ambient of +55°C.

2. The maximum process pressure is 1500psi/ 10342KPa.

3. Only approved certified entry devices shall be used.

4. Flameproof joints are not permitted to be repaired in the field. If the flamepath is damaged, the enclosure is to be removed from service and replaced with a new enclosure.

Model: **28aaa-bbb-c -d**
Model: **28aaaW-bbb-c -d**

Where:

aaa	bbb	c	d
80*	LT*	1 = 100-240VAC, 50/60Hz	4 = Ordinary Location Without Window, ***North America***
81*	LS	2 = N/A	5 = Ordinary Location With Window, ***North America***
82	OWS	3 = 12 VDC	6 = Explosion Proof Without Window, ***North America***
80W*	OWI*	4 = 24 VDC	7 = Explosion Proof Without Window, ***ATEX, IECEx, North America***
81W*	CAP*		8 = Explosion Proof With Window, ***ATEX, IECEx, North America***
82W	FCM*		
	FCS		
	IFA		

Where: W = Window Option

* *2880, 2881, 2880W & 2881W available for these models only.*

2.0 USE HAZARD INFORMATION

CAUTION	Indicates a potentially hazardous situation that may result in minor or moderate injury.
WARNING	Indicates a potentially or imminently hazardous situation which, if not avoided, could result in death or serious injury.
DANGER	Indicates a potentially or imminently hazardous situation which, if not avoided, will result in death or serious injury.
NOTICE	Indicates a situation which, if not avoided, may cause damage to the instrument. Information that requires special emphasis.

3.0 INSTRUMENT OVERVIEW

The Arjay Model 2882-FCS Foam Control Switch provides two independent alarm relays for monitoring and control of foam in tanks, sumps and vessels.

The Arjay system has an active capacitance probe that is inserted into the vessel. As the foam level approaches or changes around the probe, the capacitance reading of the probe increases or decreases. The controller relays are calibrated to alarm at user determined levels of foam on the probe.

The probe mounted controller monitors the capacitance change of the probe and activates the relay contacts for use with alarms, pumps, valves, defoamer sprayers.

The complete 2882-FCS system consists of the probe and the 2882 controller.
The standard probe is constructed of a Teflon coated probe.

Probes can be inserted vertically, horizontally, or angled into the tank. The sensor does not differentiate between liquid and foam. This system is designed to alarm for foam presence in a normal air condition.

On vertical and angled probes, the two relays can be set at the same or different levels. Each relay also has a differential setpoint to allow the relay to activate at one level and de-activate at a different level. This is similar to a latching format which can cycle a valve or control action between two points through the use of only one relay. For example, the defoamer spray can be activated at a high point and held on until the foam reaches a desired lower point.
On a horizontal insertion, both relays are calibrated to the same setpoint.
For single point high foam level applications, it is typical for both relays to be calibrated without bringing the foam level up to a specific alarm point. For example, in a high alarm application, the controller can be calibrated to air. An alarm will occur when the foam approaches and begins to cover the probe.

Models are available for use in General Purpose non-hazardous (Ordinary Location) areas as well as Hazardous Location use.

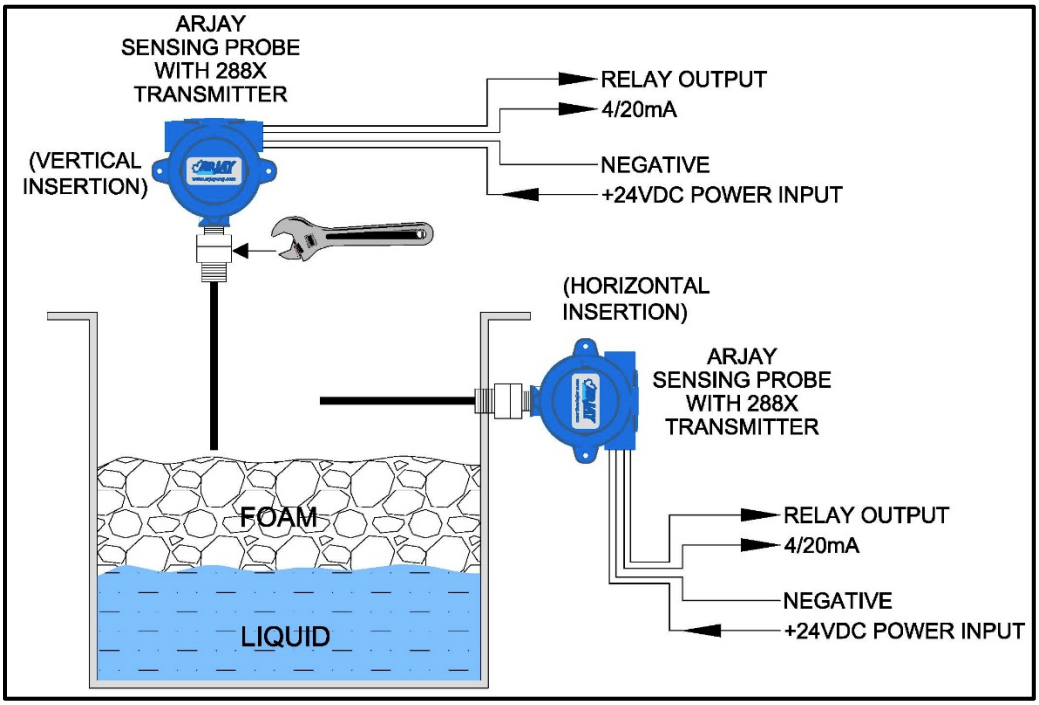


Figure 1 – Typical 2882-FCS Foam Control Application

3.1 Features

- Microprocessor based RF capacitance Foam Control Switch
- Two Differential Alarm relays (SPDT, 3A @ 250VAC)
- 4mA = Normal and 20mA = alarm output
- Modbus protocol via RS-485 for access by Arjay handheld, Central Access Panel or compatible system
- Local single point Auto calibration or remote calibration via network
- User specified custom features may be added by contacting Arjay Engineering Ltd.

3.2 Model Number Table

MODEL	DESCRIPTION
2882-FCS	PROBE MOUNTED 4/20mA (NON-ISOLATED) C/W RELAYS
2882W-FCS	PROBE MOUNTED 4/20mA (NON-ISOLATED) C/W RELAYS – WINDOW MOUNT

4.0 INSTALLATION

NOTICE	**If any damage to the instrument is found, please notify an Arjay Engineering representative as soon as possible prior to installation.**
NOTICE	**Qualified Personnel must undertake all installations.**

⚠ WARNING	**EXPLOSION HAZARD – DO NOT OPEN WHEN ENERGIZED.**
⚠ WARNING	**DO NOT OPEN WHEN EXPLOSIVE ATMOSPHERE IS PRESENT**

⚠ WARNING	**If the equipment is used in a manner not specified by the manufacturer, the protection provided by the equipment may be impaired.**

4.1 Probe Mounted Controller Installation

Choose the mounting location in accordance with good instrument practice. Extremes of ambient temperature and vibration should be avoided (see specifications and installation drawing).

Due to static buildup during shipment the probe is left disconnected from the electronics. Make sure probe connector is installed into TB6 as per figure 3.

NOTICE	**The controller operates in a Failsafe Mode (factory default)** *This means that the relays are in an energized state during normal operation. The N.O. relay contact will be held closed and the N.C. relay contact will be held open during a normal condition. This will allow the relay to return to its non-energized (shelf) state during an alarm, fault or power failure condition. Wire accordingly.*

NOTICE	**Maximum Conduit size for installation size is ¾" FNPT.**

⚠ CAUTION	**The *Internal* ground screw provided in this enclosure must be used for equipment grounding connection.** **The *External* ground screw is provided for use only as a supplemental connection where required (or, permitted) by local codes or authorities.**

4.2 Probe Installation

NOTICE	**Read the following information *before* installation.**

Standard probe entry into a tank is via a 3/4" NPT opening (standard probes) or 1" NPT opening (heavy duty probes). Flanges and concentric shields are available as options. The entrance configuration may vary depending on the application requirements.

TO SCREW IN THE PROBE (THREADED ENTRY) USE A WRENCH ON THE LOWER FITTING ONLY. The probe fittings are compression type with Teflon ferrules assembled by applying torque between the two sections. The fittings are sealed at the factory to provide a compression seal capable of withstanding pressure up to 1500 psi / 10342kPa. Once opened they cannot be reassembled without new ferrules.

NOTICE	**Install the probe with care. Teflon sheath is used to electrically isolate the metal probe from the liquid. Damage causing leaks may cause reading errors.**

NOTICE	**The controller junction box should be mounted above the water surge level and in protected area.**

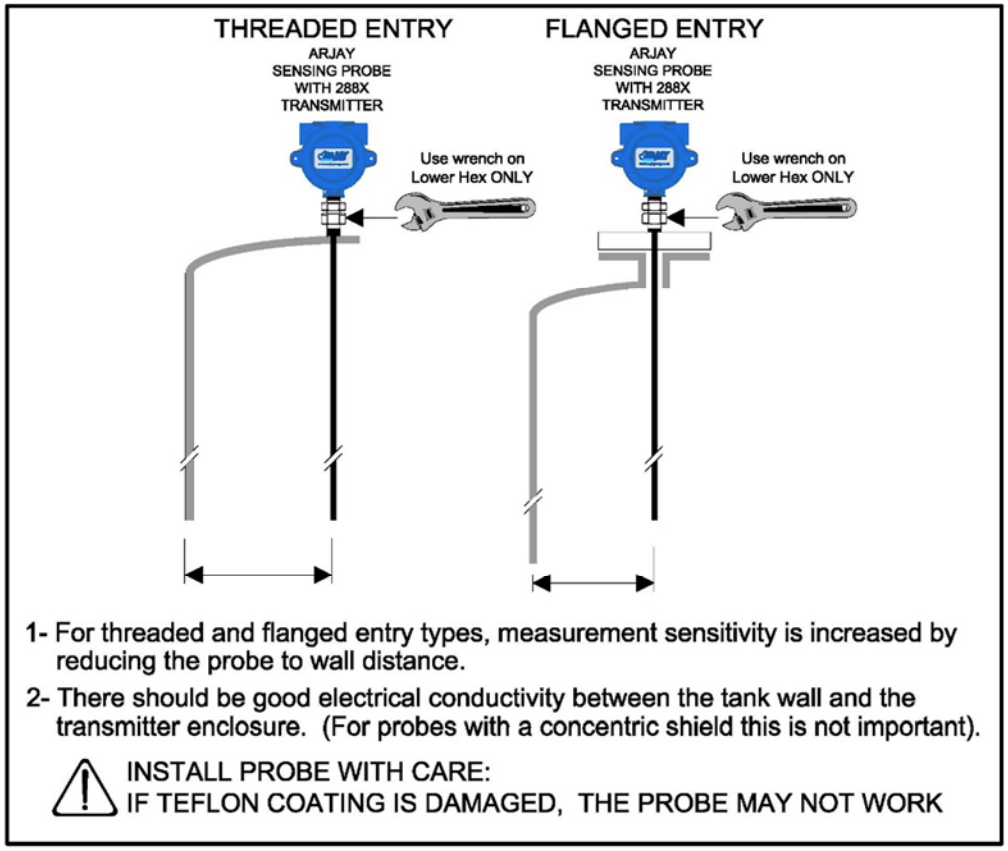


Figure 2 – Probe Installation

5.0 CONTROLLER OVERVIEW

See specific drawing(s) attached to this manual for more detail

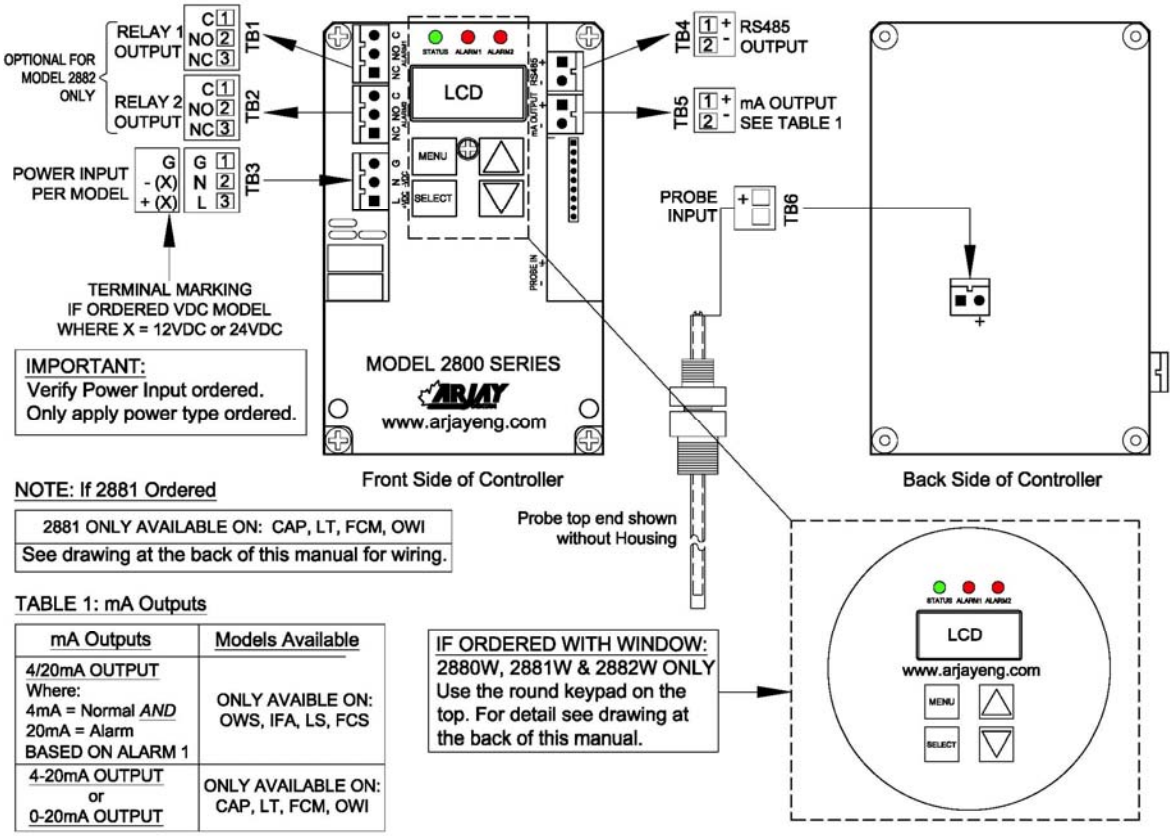


Figure 3 – Controller Overview

TB1/TB2 - Relay Output
2 SPDT relay, Dry Contacts are 3A @ 250 VAC (Resistive), selectable failsafe or non-failsafe, selectable high or low acting alarm, programmable time delay: 0 – 600 seconds

NOTICE	**The controller relays are factory set in a Failsafe mode.**

TB3 - Power Input
Power input as per Model. Check if ordered AC or DC. Earth ground is connected to Primary ground screw inside of enclosure.

TB4 - Network Output
Connect RS485 + and – to the network D+ and D-.

TB5 - mA Output

For OWS, IFA, FCS & LS models only:

The 4/20 mA is a sourced output referenced to Ground. It is not loop powered.
4mA = Normal 20mA = Alarm

For CAP, LT, FCM & OWI models only:

The 4-20mA is a sourced output referenced to Ground. It is not loop powered.

TB6 - Probe Input
Probe input is wired by the factory. The terminal block is disconnected during shipment for static reasons and has to be re-connected during installation. Probe wire is connected to "+" terminal of TB6.

5.1 Input / Output Terminal Specification

Input Terminals – Power Source					
Terminal ID	**Overvoltage category**	**Rated Voltage (V)**	**Rated Current/power (A/W/VA)**	**___ HZ or DC**	**Specified Mains fluctuation**
TB3	*II*	*100-240V*	*150mA*	*50/60Hz*	*± 10%*
TB3	*II*	*12 OR 24V*	*250mA*	*DC*	*+15% –10%*

Input Terminals – Measuring Circuits					
Terminal ID	**Function**	**Measurement Category**	**Nominal a.c. or d.c line to neutral voltage / if CAT I, Max. transient overvoltage Ut**	**Nominal a.c. or d.c current**	**Rating of insulation required for external circuit**
TB6	*Frequency*	*I*	*N/A*	*--*	*DI * or RI***
TB4	*RS485 Communication*	*I*	*5V, 5mA / 0*	*--*	*DI * or RI***

***** *Double Insulation*
****Reinforced Insulation*

Output Terminals					
Terminal ID	**Function**	**Isolation or protection**	**Rated V, A**	**Max. V, A**	**Load type and nominal**
TB1	*Load*	*Relay*	*3A Contact @250VAC*	*--*	*--*
TB2	*Load*	*Relay*	*3A Contact @250VAC*	*--*	*--*
TB5	*Current*	*Isolator(optional)*	*- 18V,20mA, 900Ω - 9V, 20mA, 450Ω*	*50mA@18V*	*--*

5.2 Permanent Power Connection (AC Powered Models Only)

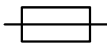
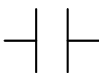
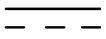
1) Connection to the building wiring system shall be in accordance with the Canadian Electrical Code (CEC), Part 1 in Canada, the National Electrical Code, ANSI/NFPA 70 in the USA, or the local electrical codes of the country where the equipment is being installed.
2) A disconnecting device is required. The disconnecting means shall disconnect all current-carrying conductors.
3) 15A circuit breaker or equivalent fuse is required.
4) An external switch or breaker shall be in close proximity to the equipment and within easy reach of the operator. The switch shall be marked as the disconnecting device for the equipment and include the symbols to its “ON” and “OFF” positions using the following symbols:


Power Off


Power On

5) The wiring for AC power should be minimum 18 AWG / 300V or as required by local / country codes.
6) After field wiring, the primary wires must be secured to the enclosure by tie-wraps to maintain the separation from the signal wires.
7) Wiring diagram for permanent connection: See drawings at the back of this manual.
8) Use copper conductors only.

5.3 Glossary Of Symbols

	Attention, consult accompanying documents *Attention, veuillez consulter les documents ci-joints.*		
	Primary Protective Earth Ground *Primaire de terre de protection*		Fuse *Coupe-circuit; fusible*
	Secondary Earth Ground *Mise à la terre de secondaire*		Normally open relay contacts *Contacts travail*
	Direct Current (DC) *Courant continu*		Power off *ArróÕ (mise hors tension)*
	Normally closed relay contacts *Contacts Repos*	**L**	Live *Sous tension*
	Power on *Marche (mise sous tension)*	**G**	Ground *Terre*
		N	Neutral *Neutre*

6.0 STARTUP AND CALIBRATION

6.1 Startup

WARNING	**EXPLOSION HAZARD – DO NOT OPEN WHEN ENERGIZED.**
WARNING	**DO NOT OPEN WHEN EXPLOSIVE ATMOSPHERE IS PRESENT**

Check that the power wiring and probe are wired in accordance with the electrical installation drawing. Connect the probe terminal block TB6 as per figure 3.

Power On the unit. Allow a 1 hour warm-up period before calibrating.

The Status LED on the controller circuit board should be green. A red Status LED indicates a fault condition. If red, check the Troubleshooting section.

The LCD will scroll to the normal operating display. See section 10.0 Menu Flow Chart.

NOTICE	**An instrument setup and field calibration is required on initial power up. See section 6.3 for controller setup and section 6.4 to calibrate the transmitter.**

6.2 Menu Flow Chart Background Information

The control setup, diagnostics, and calibration are accessed using the display and keypad on the controller. The Flow Chart in Section 10.0 provides an overview to the various menus and features. Keep a copy of the flow chart at hand when accessing the internal controller features.

Below is a description of the menu functions.

6.2.1 Menu Short Form

Since the 288X controller has a small LCD, some menu description may be in short form. The following are the menu descriptions:

Short Form	***Description***
Diags:	*Diagnostics*
Cal Pts:	*Calibration points*
Auto Cal:	*Auto calibrate*
Man Cal:	*Manual calibrate*
Cal Ok:	*Calibrate ok*
Cal Err:	*Calibrate err*
mA out:	*mA output*
mA Span:	*mA output span*
Sec:	*Seconds*
ALRM CAL:	*Alarm Calibration*
Cal:	*Calibration point*
Net ID	*Network Identification*

Short Form	***Description***
SENSTVTY:	*Sensitivity*
A1:	*Alarm relay 1*
A2:	*Alarm relay 2*
Alrm:	*Alarm*
Alrm Lvl:	*Alarm level*
Diff Hi:	*Differential Hi alarm set value*
Diff Lo:	*Differential Lo alarm set value*
Alrm Del:	*Alarm Delay*
^SP:	*Relay Setpoint Hi action*
vSP:	*Relay Setpoint Low action*

6.2.2 Menu Description

The 2882-FCS controller will display the **Normal** in its normal condition and **Alarm** during an foam condition.

The 2882 controller has a password protect feature. The default password is 2000. See section 6.3.1 “Password” if wish to have personal password.

From the main menu, you can select **Cal Only, View, and Change**.

Cal Only allows a one point calibration based on a factory or custom pre-configuration. In most applications, this is the only menu item required after the initial power-up. The calibration is required at site after power up or anytime a component or sensor is changed out. A password is required to enter this and is described in the calibration section.

View allows an operator to view the **Calibration** setpoints in pF, the **Alarms** settings such as low or high action, failsafe or non-failsafe and the 0-600 second delay, the **Diagnostics** of raw readings and the **Setup** values such as mA output and ID address. This can be viewed without a password and without risk of changing any values. This information may be requested during technical assistance inquiries.

Change is password protected and allows an operator to change the configuration set-up values indicated in the View. Changes will be required for the initial setup of relay setpoints, delays, span etc. or to re-set the values to the factory default.

6.2.3 Data Entry

Data Entry

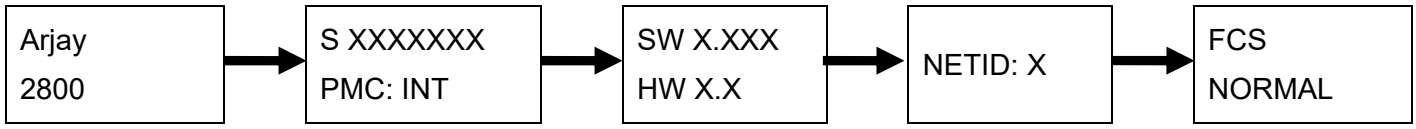
Press <▲> / <▼> key to increase / decrease the digital value.

Press <SELECT> key to move the cursor.

Press <MENU> key to abort certain screens.

6.3 288X Controller Setup

Power up the 288X Controller. The status LED should be green. The LCD will scroll to the normal operating screen after a series of the following screens (each displays for 2 sec.). * It may read **Normal** or **Alarm** until a calibration is performed.



***Operating Screen**

6.3.1 Setup And Network

Press and Hold the menu key to enter the main menu. Follow the Flow Chart procedure to access the **Change** menu. Toggle to access the Setup menu.

The 2882 Foam Control Switch Controller has the following setup parameters. These must be set up to the requirements of the application and can be accessed in the CHANGE menu. Follow through the flowchart in section 10.0 and input the settings as required.

1. Sensitivity

The sensitivity determines the amount of pF change required to cause an alarm. The factory default setting is 1.0 pF. The most sensitive setting is 0.1 pF. Increasing the pF value will increase the amount of foam required to cause an alarm. Since different foam may have different dielectrics

pF to mm of liquid level relationship cannot be factory determined. If this is changed in the field, it should be tested to confirm an alarm.

2. Alarm Calibration above or below setpoint
This setting advises the Level Switch if the calibration setpoint is above or below the alarm condition. For high alarm applications, the alarm condition is above calibration setpoint. This indicates that the pF value must increase above the setpoint to activate the alarm. For low alarm applications, the alarm condition is below the calibration setpoint. This indicates that the pF value must decrease below the setpoint to activate the alarm. The factory default is High Alarm = ^SP.

3. Defaults
Factory settings are pre-configured into the unit based on the most typical set-up required for this application. This provides for a quick and easy calibration at site but can be changed to suit specific applications. If the setup has been field changed, selecting this will change back to the factory defaults.

4. NET ID
The ID number is used only for network applications. To communicate on a network, each controller must have a unique ID number. The factory default ID number is 1.

NOTICE	**If multiple units on a network have the same address, network errors will result.**

5. Filter
Data filtering is used to smooth data from a sudden change and minimize fluctuating readings. For example, a 5 second setting means the calculated value of the capacitance and resulting values of pF will start to respond immediately but will take 5 seconds to reach their final values. The factory default is 0 to provide an immediate and active response. This can be user selected from 0 - 99.9 seconds.

6. Password
The unit is shipped with password “2000”. The user can continue to use this password or may change to a personal password after installation. To change password go to “Change” menu and toggle down to “Setup” menu then to “Password”. Press Select. Enter new password. The password “2000” is no longer available. Consult factory if new password has been forgotten.

6.3.2 Relay Setup Menu

Press and Hold the menu key to enter the main menu. Follow the Flow Chart procedure to access the **Change** menu. Toggle to access the Setup menu.

The 2882 FCS Controller has 2 relays (A1 and A2) that operate independently. The following parameters are available to set up each of the relays:

1. RELAY DELAY. Minimum time in seconds for an alarm to exist before the relays change to an alarm state. The relay alarm state depends on the Relay Action and Failsafe settings. The factory setting is 20 seconds to suppress false alarms due to sudden of intermittent flows or disturbances in front of the sensor.

2. RELAY ACTION. This determines if the Alarms LEDs should activate when the pF reading rises above or below the setpoint. The factory default is above the setpoint because the application of air to foam is an increase in capacitance.

3. FAILSAFE. Failsafe typically means that the relay is normally (when not in an alarm condition) held in an energized state. In an alarm condition, the relay is de-energized i.e. identical to when the instrument power is shut off. The rationale is that the alarm condition should match the Power Fail condition. Factory default is Yes.

Example Of Single Point Alarms (No Differential) Applications

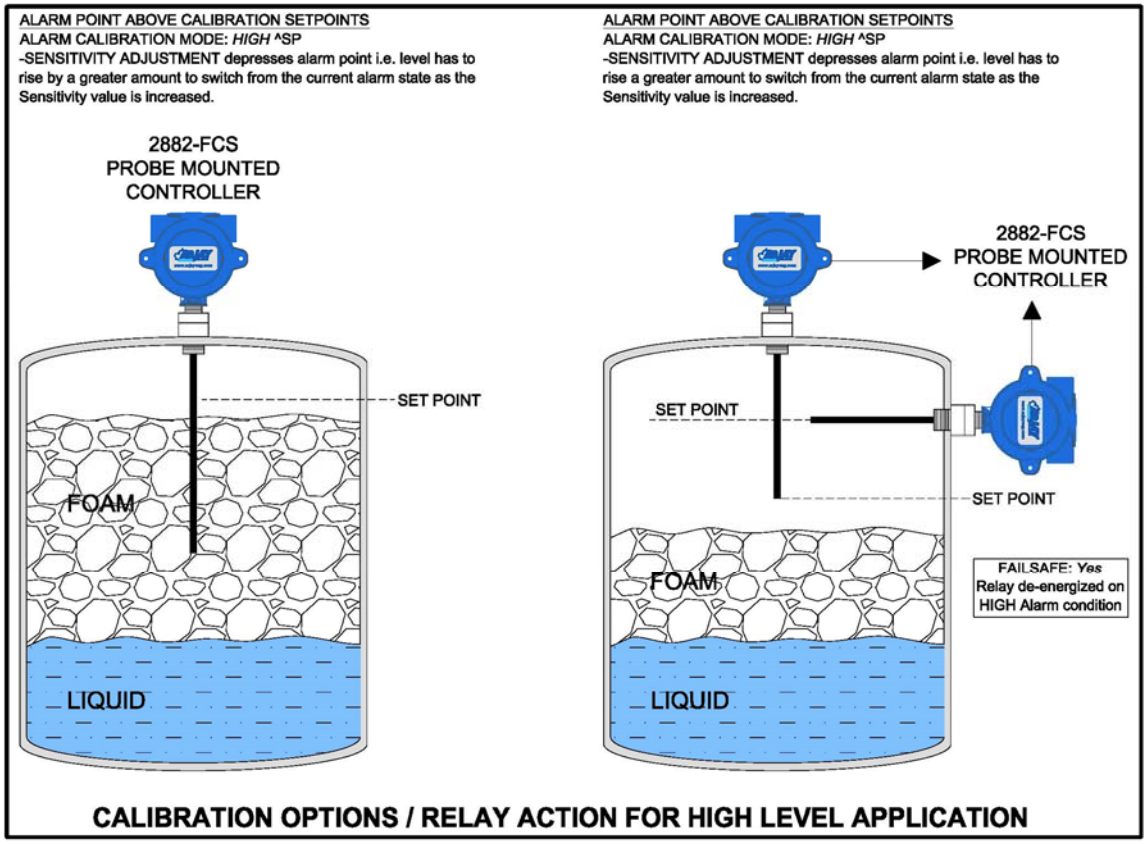


Figure 4 – No Differential Application – High Level

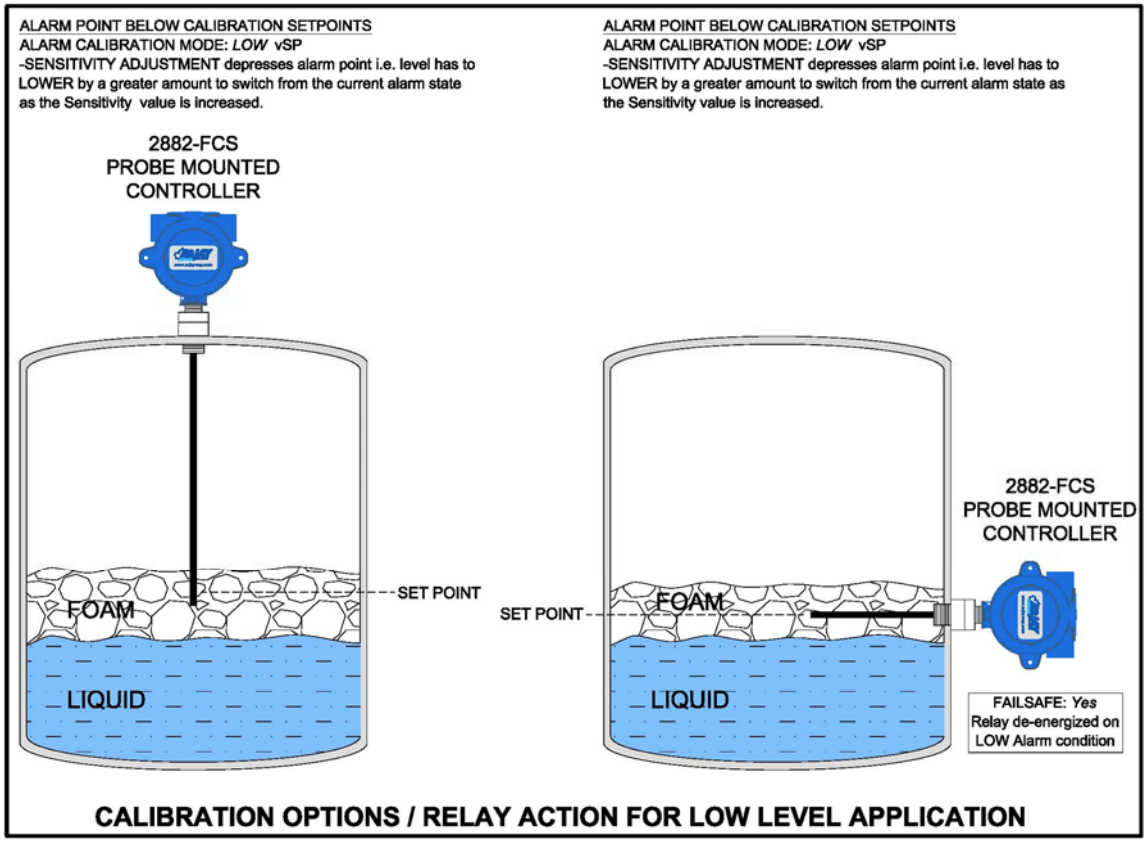


Figure 5 – No Differential Application – Low Level

6.4 288X Controller Calibration

6.4.1 Site Calibration

For a single point high foam alarm, the foam level may not need to be changed.

For a high alarm application, a *vertical* OR *horizontal* probe can be in air and well above the liquid or foam. The probe is calibrated to air and as the foam reaches the probe, it will alarm.

For a low alarm application, a *horizontal* probe can be fully submerged in foam during calibration. The probe is calibrated to the foam and as the foam interface drops below the probe, it will alarm.

However, on vertical probes, if the alarm setpoint is desired at a specific point along the length the probe, or if the differential control is being used, a product level change during calibration will be required.

The following are the basic steps for setting up two alarm points each with a HI/LO differential. Refer to the Flow Chart for a detailed set-up and calibration.

Check that the foam or liquid is at the desired level for calibration (ie. that the probe is in air for a typical high level alarm application).

Press and hold Menu key for 5 seconds to enter the main menu. The display will read the first menu item **Cal only**. Press select key, enter password ¨2000¨.

The display will read **Select Cal A1**. Press Select to calibrate the first setpoint of Relay 1. This can be either the HI or LOW point of the differential.

This display will read **A1 PT 1** with a pF reading of the probe displayed. Press select to acknowledge and then press select to confirm the new calibration.

The display will read **A1 PT 2** with a pF reading. This is the second point for Relay 1. For a single point alarm without differential this will be the same point. Press select to accept this second point. If differential control on the relay is required, change the product level to the new setpoint level and press Select.

The menu will now guide you through setting up the second relay (A2) setpoints.

When complete, Select **EXIT**.

This will get you back to the main menu of “CAL ONLY”. Press arrow down until you get to “EXIT” in order to get back to main screen OR go to “Change” if different relay configurations are required.

THIS COMPLETES THE SETUP & CALIBRATION PROCEDURE FOR THE 2882-FCS PROBE MOUNTED FOAM CONTROL SWITCH

7.0 CONTROLLER NETWORK

The *28XX series Transmitter may be monitored and calibrated via RS-485 protocol compatible digital communications.

Typical features are:

1. Ease of wiring in multiple level point monitoring:

Up to 255 of Arjay *28XX Series transmitter or monitor may be connected together in a daisy chain (2 wire communication plus power wiring) connection to an Arjay Remote Access monitor or customer control system which allows viewing data and setup of any of the transmitters on the network. The 4-20mA output may still be used if necessary.

2. Setup for the *28XX for network operation:

Each *28XX controller must have a unique number to connect in a network system. See section 10.0 Menu Flow Chart, CHANGE menu for details to change the ID number.

Where "XX" = 80, 81 or 82

7.1 MODBUS Configuration

Parameter settings: 9600 Baud Rate; Even Parity, 8 Data Bits and 1 Stop Bit.
Wiring connection: RS485 (+) connect to D+; RS485 (-) connect to D-.

7.2 2800 Series MODBUS Register Mapping

REG	Zero Based	DESCRIPTION	TYPE	No. of Reg
40001	0	Serial Number	float	2
40003	2	Hardware Rev / Software Rev	byte	1
40004	3	Spare / Mode	byte	1
40005	4	Sensitivity A2 / Sensitivity A1	byte	1
40006	5	Instrument Status 1 / Instrument Status 0	byte	1
40007	6	Model type / Modbus ID address	byte	1
40008	7	Relay2 Setup / Relay 1 Setup	byte	1
40009	8	Password	int	1
40010	9	XA "A" cal parameter	float	2
40012	11	XK "K" cal parameter	float	2
40014	13	XC "C" cal parameter	float	2
40016	15	Filter	float	2
40018	17	Slope - pF per% level	float	2
40020	19	Offset - pF for empty vessel	float	2
40022	21	mA output span value	float	2
40024	23	mA output zero value	float	2
40026	25	mA output Trim Slope value	float	2
40028	27	mA output Trim Offset value	float	2
40030	29	Cal1 PV: Level calibration: 1st level point in %	float	2
40032	31	Cal2 PV: Level calibration: 2nd level point in %	float	2
40034	33	Cal1 pF: Level calibration: 1st capacitance value in pF	float	2
40036	35	Cal2 pF: Level calibration: 2nd capacitance value in pF	float	2
40038	37	Relay 1 : Differential High Alarm.	float	2
40040	39	Relay 2: Differential High Alarm.	float	2
40042	41	Relay 1: Differential Low Alarm.	float	2
40044	43	Relay 2: Differential Low Alarm.	float	2
40046	45	Relay 1 On delay [seconds]	int	1
40047	46	Relay 2 On delay [seconds]	int	1
40048	47	mA Analog Output	float	2
40050	49	Osc. Frequency	float	2
40052	51	Frequency	float	2
40054	53	Capacitance	float	2
40056	55	Filtered Capacitance	float	2
40058	57	Level	float	2
40060	59	Compensated pF for point level if enable Temperature compensation	float	2
40062	61	Temperature in mV	float	2
40064	63	Temperature in degree C	float	2
40066	65	Compensation factor: percent per degree	float	2
40068	67	Temperature at Calibration	float	2
40070	69	Temperature offset [mV at 0 dC]	float	2
40072	71	Temperature slope [mV per dC]	float	2
40074	73	Alarm 1 differential Off value	float	2
40076	75	Alarm 2 differential Off value	float	2

8.0 MAINTENANCE

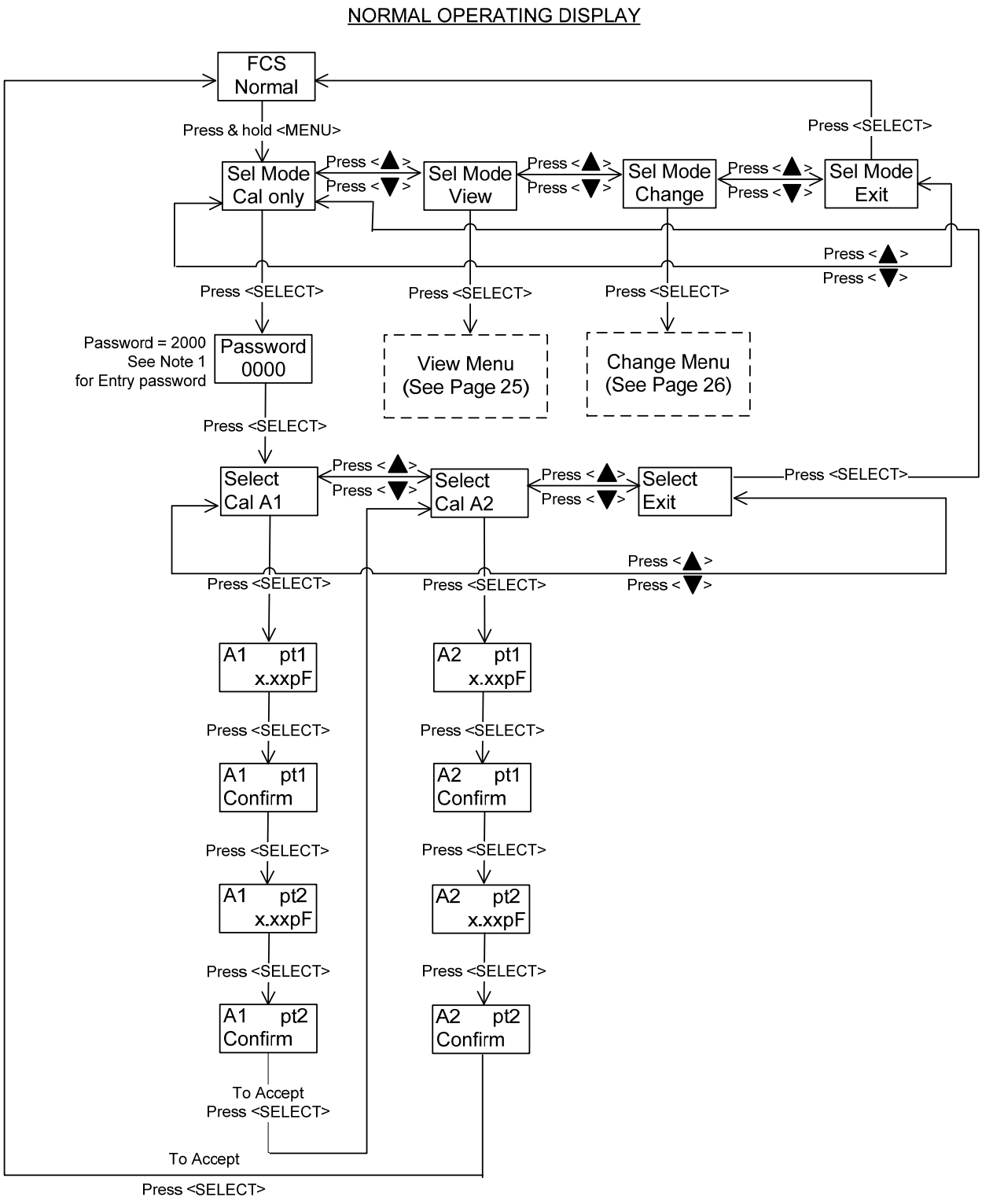
There is no routine cleaning required for this controller.

9.0 TROUBLESHOOTING

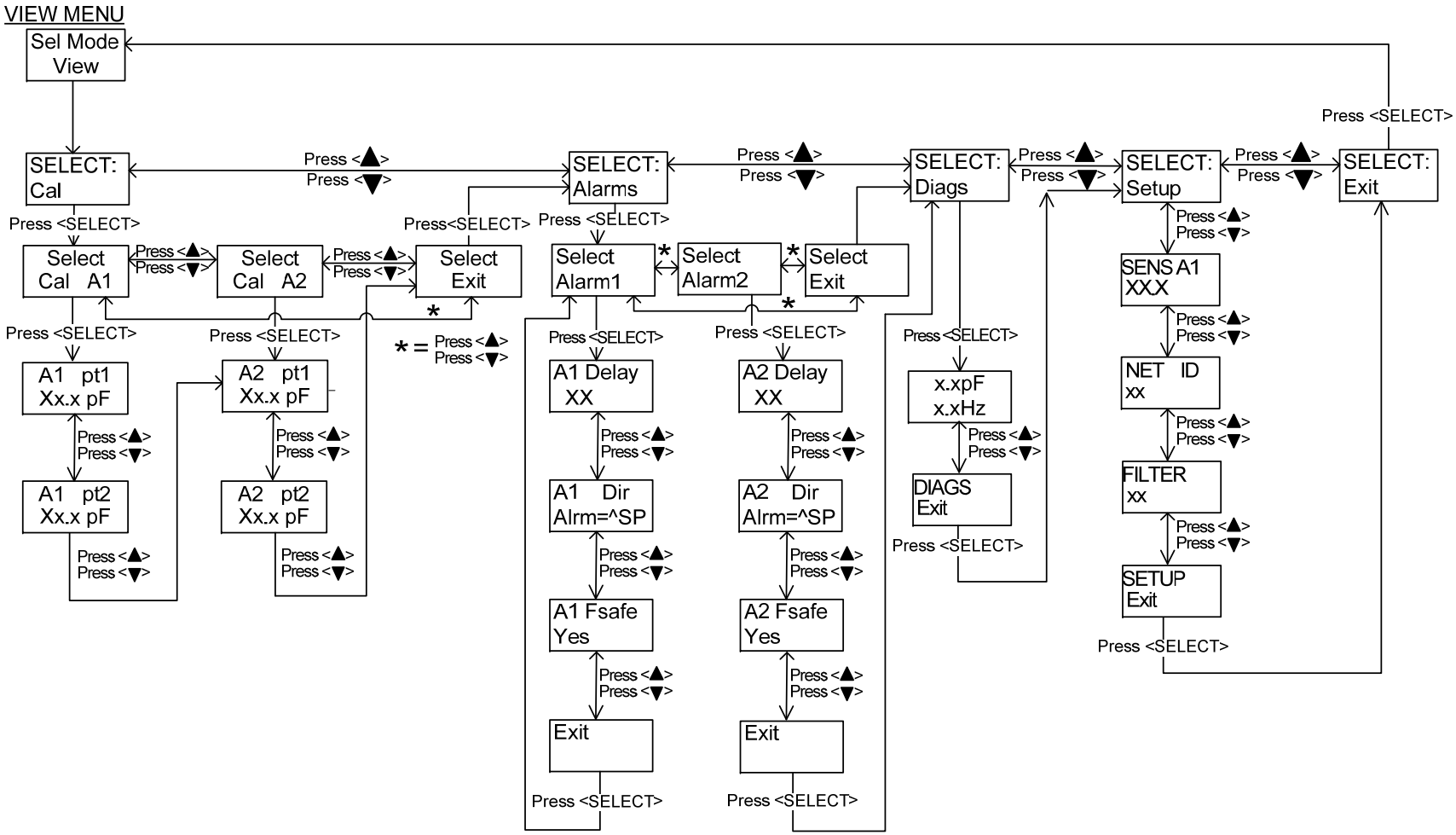
CONDITION	DO THIS
1. Status LED is OFF and the LCD display if off	Check the power to the unit. If the unit is a 12VDC or 24VDC model, check the external source and polarity is correct. If the unit is a 100-240VAC model, then check the Line, Neutral and Ground wiring is correct.
2. If the status LED is RED	This indicates a major error such as memory failure, no probe signal etc. Check the following: • Make sure the probe wiring is correct and plugged into controller. • Microprocessor may have lost its parameters due to a power surge in the line. Go to Diagnostic in view Menu (see section 10.0 Flow Chart) to check the Calibration values, frequency and capacitance values then, call Arjay Technical Support.
3. No mA output OR incorrect mA output.	IMPORTANT: THE UNIT **SOURCES** mA OUT FROM THE mA OUTPUT TERMINAL. **THIS TERMINAL SHOULD NOT BE CONNECTED TO +24V.** IT IS NOT A 2 WIRE mA TRANSMITTER. See Figure 3 for Electrical hookup details. • Disconnect external wires from mA output and measure with mA Meter. • Check the mA output Action (direct or inverse) and mA output Span are set as desired. See section 10.0 Flow chart / Change menu. • If the mA output still does not match the level, then call Arjay Technical Support.
4. Level reading is not correct	• Make sure probe is properly grounded to Tank. • Ensure that there is a parallel ground reference with probe via Tank wall or concentric shield. • Go to View Menu, then select CAL. Write down the %level and pF reading of each CAL point. Go to DIAG menu and verify existing pF reading. If pF reading is within range of CAL point then unit can be trimmed by Entering a new CAL point in manual CAL under change menu. If pF way out of range then check what changes may have occurred since initial CAL. E.G. different material, new location for probe, Temperature.
5. CAL Error No Change	• Make sure blue wire from probe end is connected to TB6 terminal plug and connected to the 288X electronics. • Make sure level is changing in tank when performing 2nd Cal point.

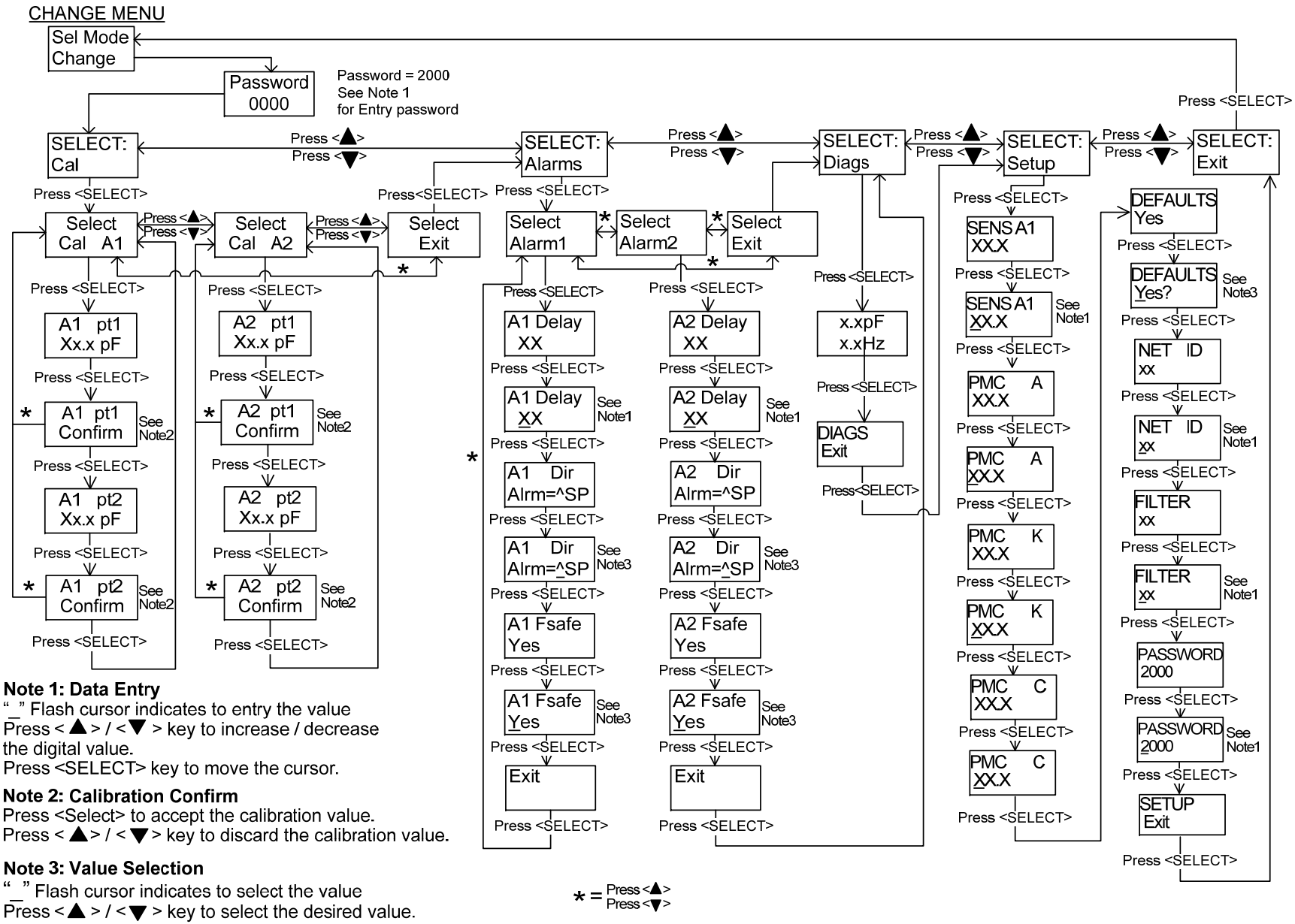
ARJAY ENGINEERING TECHNICAL SUPPORT
(800) 387-9487
+1 (905) 829-2418
www.arjayeng.com

10.0 FLOW CHARTS



Note 1: Data Entry
Press < ▲ > / < ▼ > key to increase / decrease the digital value.
Press <SELECT> key to move the cursor.
See section 6.3.1 step 7 if password has changed.


VIEW MENU
Sel Mode View
SELECT: Cal
SELECT: Alarms
SELECT: Diags
SELECT: Setup
SELECT: Exit
Press <▲>
Press <▼>
Press <SELECT>
Select Cal A1
Select Cal A2
Select Exit
Select Alarm1
Select Alarm2
Select Exit
* = Press <▲> Press <▼>
A1 pt1 Xx.x pF
A1 pt2 Xx.x pF
A2 pt1 Xx.x pF
A2 pt2 Xx.x pF
A1 Delay XX
A1 Dir Alrm=^SP
A1 Fsafe Yes
Exit
A2 Delay XX
A2 Dir Alrm=^SP
A2 Fsafe Yes
Exit
x.xpF x.xHz
DIAGS Exit
SENS A1 XXX
NET ID xx
FILTER xx
SETUP Exit



Note 1: Data Entry
"_" Flash cursor indicates to entry the value
Press < ▲ > / < ▼ > key to increase / decrease the digital value.
Press <SELECT> key to move the cursor.

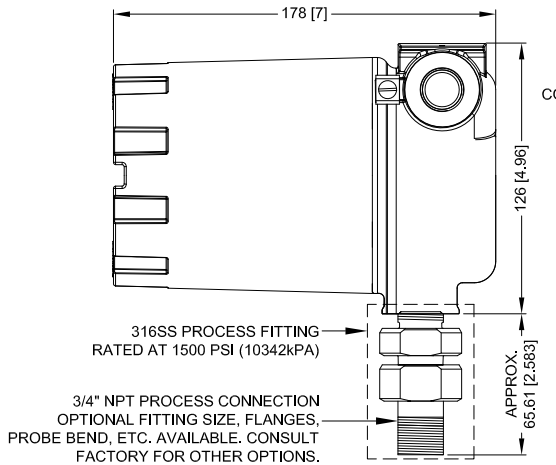
Note 2: Calibration Confirm
Press <Select> to accept the calibration value.
Press < ▲ > / < ▼ > key to discard the calibration value.

Note 3: Value Selection
"_" Flash cursor indicates to select the value
Press < ▲ > / < ▼ > key to select the desired value.

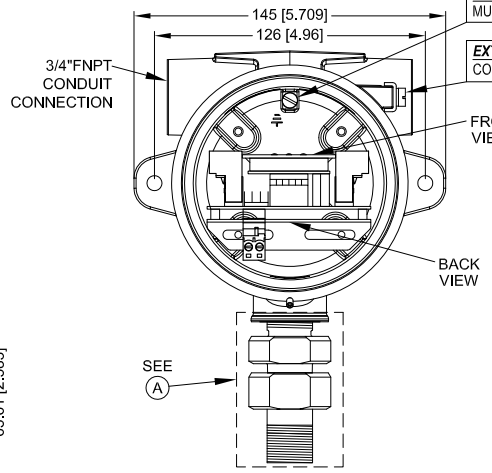
Note 4: Password
See section 6.3.1 step 7 if password has changed.

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PROBE HOUSING WITH LID

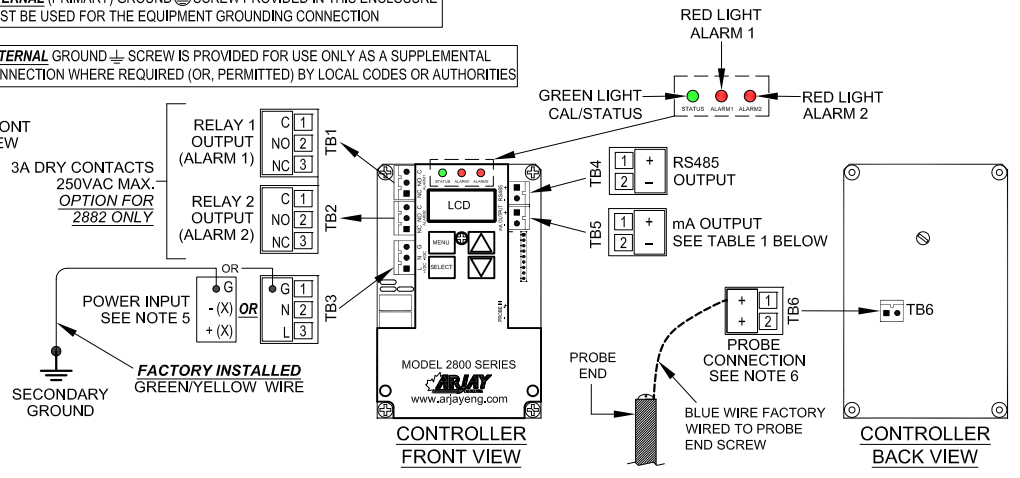


PROBE HOUSING WITHOUT LID

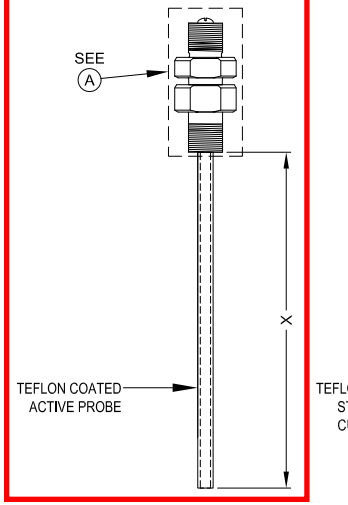


INTERNAL (PRIMARY) GROUND ⏚ SCREW PROVIDED IN THIS ENCLOSURE MUST BE USED FOR THE EQUIPMENT GROUNDING CONNECTION

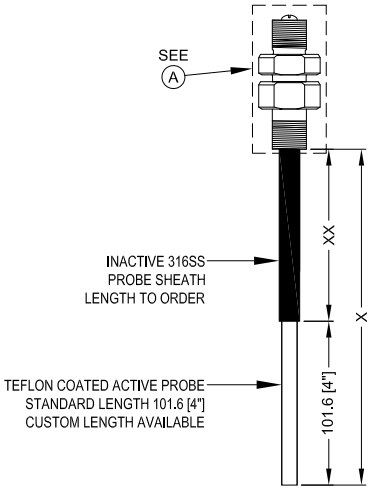
EXTERNAL GROUND ⏚ SCREW IS PROVIDED FOR USE ONLY AS A SUPPLEMENTAL CONNECTION WHERE REQUIRED (OR, PERMITTED) BY LOCAL CODES OR AUTHORITIES



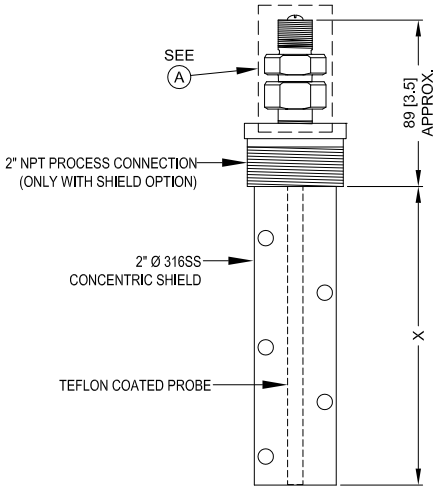
TYPICAL PART NUMBER:
PCA-Xmm-Z
Where:
X = Overall probe length



TYPICAL PART NUMBER:
PCA-Xmm-D(XXmm)-Z
Where:
X = Overall probe length
XX = Inactive probe sheath length



TYPICAL PART NUMBER:
PKA-Xmm-Z
Where:
X = Overall probe length



TYPICAL PART NUMBER:
PMD-Xmm-J-Z
Where:
X = Overall probe length
J = 316SS Weight (2.5lb)

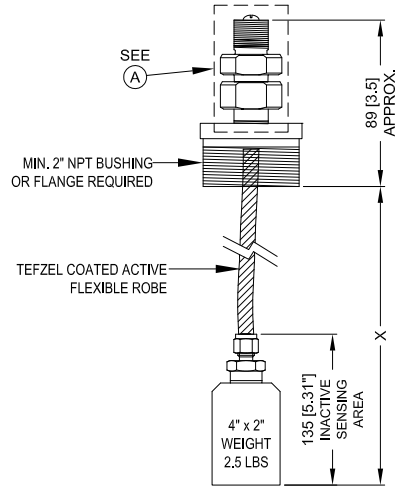


TABLE 1: mA Outputs

mA Outputs	Models Available
4/20mA OUTPUT Where: 4mA = Normal *AND* 20mA = Alarm BASED ON ALARM 1	2882-OWS, 2882-LS, 2882-FCS, 2882-IFA
4-20mA OUTPUT *or* 0-20mA OUTPUT	2880-OWI, 2882-OWI, 2880-LT,2882-LT, 2880-FCM, 2882-FCM 2880-CAP, 2882-CAP

**2880 Available for these models only.*

2880 & 2882 SERIES WORK SHEET

CODE	Base Unit
28	Arjay 2880 Series Capacitance Level Transmitter

CODE	Probe Input and Controller Mounting Type
*80	Non-isolated 4-20mA, Probe Mount
82	Non-isolated 4-20mA With Relays, Probe Mount

CODE	Type of Application (Model)
* LT	Level Transmitter with proportional mA Output
LS	Level Switch with Latched mA Output
OWS	Oil Water Separator (Sump) Alarm
* OWI	Oil/Water Interface
* CAP	Capacitance Monitor
* FCM	Form Control Monitor
FCS	Form Control Switch
IFA	Interface Alarm

CODE	Power Input
1	100-240VAC, 50/60Hz
2	N/A
3	12VDC
4	24VDC

CODE	Unit Enclosure
4	Ordinary Location **without** window, North America Certificate
6	Explosion Proof **without** window, North America Certificate
7	Explosion Proof **without** window, ATEX, IECEx

28 aaa bbb c d

GENERAL NOTES:

1. DIMENSIONS ARE IN mm [inches].
2. TOLERANCE +1mm (0.04 inches).
3. PROBE HOUSING (STANDARD) AS SHOWN ABOVE:
   - MATERIAL: TYPE 4X DIE-CAST ALUMINIUM JUNCTION, PAINTED RAL 5015 SKY BLUE.
   - MODEL: LIMATHERM "XD-IH".
   - OVERALL OUTSIDE DIMENSIONS: 145 X 126 X 178 (H) (5.71 X 4.96 X 7.01(H)).
4. PROBE HOUSING FOR NORTH AMERICA ONLY (EXPLOSION PROOF):
   - MATERIAL: TYPE 4X DIE-CAST ALUMINIUM JUNCTION, SILVER POWDER EPOXY PAINT.
   - MODEL: HUBBELL/KILLARK "HK" SERIES.
   - OVERALL OUTSIDE DIMENSIONS: 156 X 133 X 151(H) (6.125 X 5.234 X 5.938(H)).
5. POWER INPUT:
   - VOLTAGE AS PER ORDER
   - 12VDC or 24VDC or 100-240VAC, 50/60Hz.
   - TERMINALS MARKED (-) (+) ARE FOR DC POWERED UNITS.
6. TB6 IS DISCONNECTED DURING SHIPMENT FOR STATIC REASONS. MUST RE-CONNECT DURING INSTALLATION. TB6 HAS TWO "+" CONNECTIONS. EITHER IS ACCEPTABLE.

CERTIFICATION:

PROCESS TEMPERATURE FOR THE STANDARD & HEAVY DUTY PROBES ARE -60°C to +200°C AND FOR FLEXIBLE PROBE IS -60°C to +100°C. IT IS END-USER'S RESPONSIBILITY TO ENSURE THAT AMBIENT TEMPERATURE AROUND THE CAPACITANCE CONTROLLER AND ARJAY PROBE HEAD DOES NOT EXCEED THE PERMITTED AMBIENT OF 55°C.

ORDINARY LOCATION RATING:
- UL FILE NUMBER: E343390
- UL / IEC 61010-1, 2ND EDITION, 2008/10/28
- CAN/CSA-22.2 NO. 61010-1, 2ND EDITION, 2008/10/01
- CE: UL / IEC 61010-1; IEC / EN 61000-4; ISO 9001:2008

HAZARDOUS LOCATION RATING FOR NORTH AMERICA:
- Ex db IIC T5 Gb
- Class I, Zone 1, AEx db IIC T5 Gb

HAZARDOUS LOCATION RATING FOR INTERNATIONAL:
- II 2G Exd T5 Gb
- Sira 17ATEX2261X
- IECEx CSA 17.0019X

REV	DATE	DESCRIPTION	CHK'D	APP'D

REVISIONS

ARJAY ENGINEERING LIMITED

PROJECT

DWG. STATUS	BY	DATE D	M	Y
DRAWN	F.H.	02	01	17
CHECKED				
APPROVED				

TITLE: ***2880/2882*** SERIES TRANSMITTER
DIMENSIONAL AND ELECTRICAL DRAWING

SCALE	REF. DWGS.	DWG. NO.	SHT.	REV.
N.T.S.		20170820	1	0

Section 3.3.5

DO Sensor

SPECIFICATIONS

DOCUMENT #W123-03



YSI IQ SensorNet 282 & 284 Terminals

Continuous Water Quality Monitoring for Process Control

The YSI IQ SensorNet 282 and 284 are modular water quality terminals for complete process control designed for wastewater.

The network can accept additional sensors easily at any time and grow as your facility grows. Benefits include better network visibility and management, early detection of network failures, improved compliance with regulatory targets, and cost savings (energy, pump/blower maintenance, labor).

- 3-year instrument warranty
- User-replaceable cables and sensors
- Centralized power supply along entire network; 2-wire cable provides power and communications
- Lightning protection along network
- Tactile buttons; easily use while wearing gloves
- Modular expansion from 1 to 4 sensors and up to 20 parameters
- Many sensors provide ultrasonic cleaning
- Digital outputs available
- Programmable access permission
- USB interface and data logger

Building a system is easy...choose the IQ SensorNet terminal, determine which modules are needed (control, communications, etc.), determine distances for cabling and select parameters.

Parameters:

Dissolved Oxygen (optical or electrochemical)
pH
ORP/Redox
Conductivity/Salinity
Temperature
Turbidity*
TSS (total suspended solids)*
Ammonium
Nitrate
Nitrite
Orthophosphate
Potassium
Sludge Level
COD (chemical oxygen demand)*
TOC (total organic carbon)*
DOC (dissolved organic carbon share of TOC)*
SAC (spectral absorption coefficient)*
BOD (biochemical oxygen demand)*

* ultrasonic cleaning for sensors



282 Terminal



YSI.com/IQSN282

IQ SensorNet 282/284 Specifications

Certifications	ETL, cETL (conforms with relevant UL and Canadian standards), CE
Electromagnetic Compatibility	EN 61326, Class B; FCC Class A, EMC for indispensable operation
Integrated Lightning Protection	According to EN 61326 enhanced over-voltage protection for *entire system*, implemented in each component
Cable	2-wire with shield for power supply and communications; resistant to polarity reversal; comprehensive EMC shield control; cable topology within network can be in the form of a line, tree, star or multiple star
	Total cable length max. = 250 m (820 ft)
Data Logger	Data memory up to 520,000 data sets
Radio	Radio transmission Class 1 with a range of 100 m (328 ft); max 300 m (984 ft)
Display	Graphic color display; resolution 320 x 240 pixels; visible area 77 x 64 mm (3.03 x 2.52 in); backlit
Control Keys/Buttons	5 operation keys: 3 master keys for Measurement (M), Calibration (C), Set/System settings (S)
	2 function keys for confirmation/switching menu OK (OK) and Escape (ESC)
	4 directional buttons for quick selection of software functions
Electrical	100 to 240 VAC (50/60 Hz), 24 V AC/DC
Temperature Conditions	Operating Temperature: -4 to 131 °F (-20 to 55 °C)
	Storage Temperature: -13 to 149 °F (-25 to 65 °C)
Enclosure	Material: PC-20% (Polycarbonate with 20% fiberglass)
	Rating: IP-66 (not suitable for conduit connection)
	Dimensions for 282/284: 144 W x 144 H x 120.2 D mm (5.67 W x 5.67 H x 4.73 D in)
	Weight for 282/284: 1.2 kg (2.6 lbs)
	Weight for DIQ/S 284-CR6: 1.7 kg (3.7 lbs)
Warranty	3 years
Module Coupling at Rear	Combined mechanical and electrical connection for docking additional modules; a total of 3 modules as a stacked mounted unit
Cable Feeds	4 screw cable glands M 16 x 105
Terminal Connections	Screw terminal strips; terminal area for solid connectors 0.2 to 4.0 mm for flexible connectors 0.2 to 2.5 mm; accessible through cover Used for connecting sensors or as an input/output or for looping through/branching of the IQ SensorNet cable

IQ SensorNet 282/284 Ordering Information (order modules, cables, sensors separately)*

Model #	Item #	Description
Controller for up to 2 sensors:		
DIQ/S 282-CR3	472 110Y	Controller for up to 2 sensors, with 3 analog outputs and 3 relays
DIQ/S 282-PR	472 111Y	Controller for up to 2 sensors, with PROFIBUS connection, 3 relays
DIQ/S 282-MOD	472 112Y	Controller for up to 2 sensors, with MODBUS connection, 3 relays
DIQ/S 282-CR3-E	472 113Y	Controller for up to 2 sensors, with 3 analog outputs, 3 relays, with RJ45 interface for internet access and remote control
DIQ/S 282-EF	472 114Y	Controller for up to 2 sensors, 3 relays, Ethernet fieldbuses, internet access and remote control
Controller for up to 4 sensors:		
DIQ/S 284-CR6	472 130Y	Controller for up to 4 sensors, with 6 analog outputs, 6 relays
DIQ/S 284-PR	472 131Y	Controller for up to 4 sensors, with PROFIBUS connection, 3 relays
DIQ/S 284-MOD	472 132Y	Controller for up to 4 sensors, with MODBUS connection, 3 relays
DIQ/S 284-CR6-E	472 133Y	Controller for up to 4 sensors, with 6 analog outputs, 6 relays, with RJ45 interface for internet access and remote control
DIQ/S 284-EF	472 134Y	Controller for up to 4 sensors, 3 relays, Ethernet fieldbuses, internet access and remote control

* For 24V AC/DC power, please contact YSI

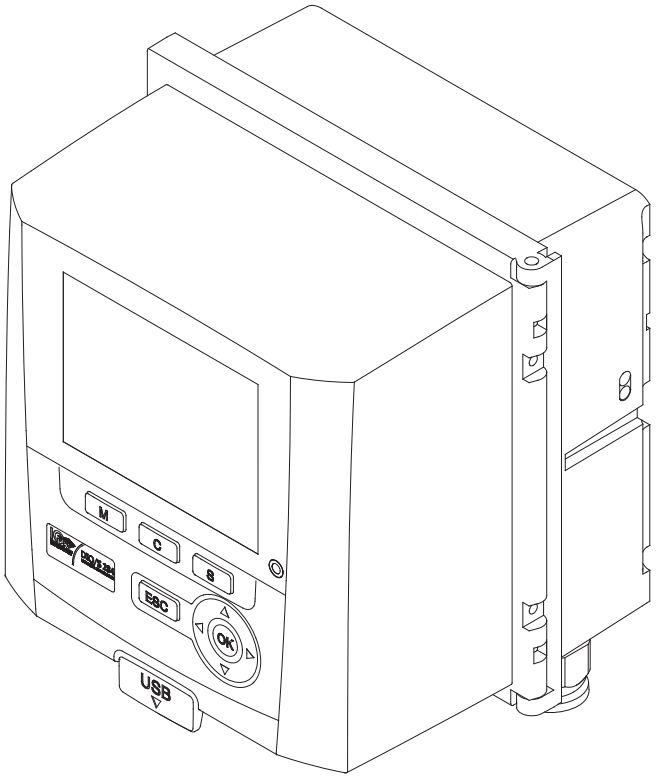
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Tel +1 937.767.7241 800.897.4151 (US)
info@ysi.com
YSI.com

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a xylem brand

OPERATING MANUAL

ba76183e03 02/2017



DIQ/S 282
DIQ/S 284

IQ SENSORNET SYSTEM 28X FOR 2 OR 4 DIGITAL IQ SENSORS

YSI®

a xylem brand

Contact YSI
1725 Brannum Lane
Yellow Springs, OH 45387 USA
Tel: +1 937-767-7241
800-765-4974
Email: environmental@ysi.com
Internet: www.ysi.com

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1 Overview

1.1 Structure and function

The IQ SENSORNET System 28X is a modular measuring system for online analysis.

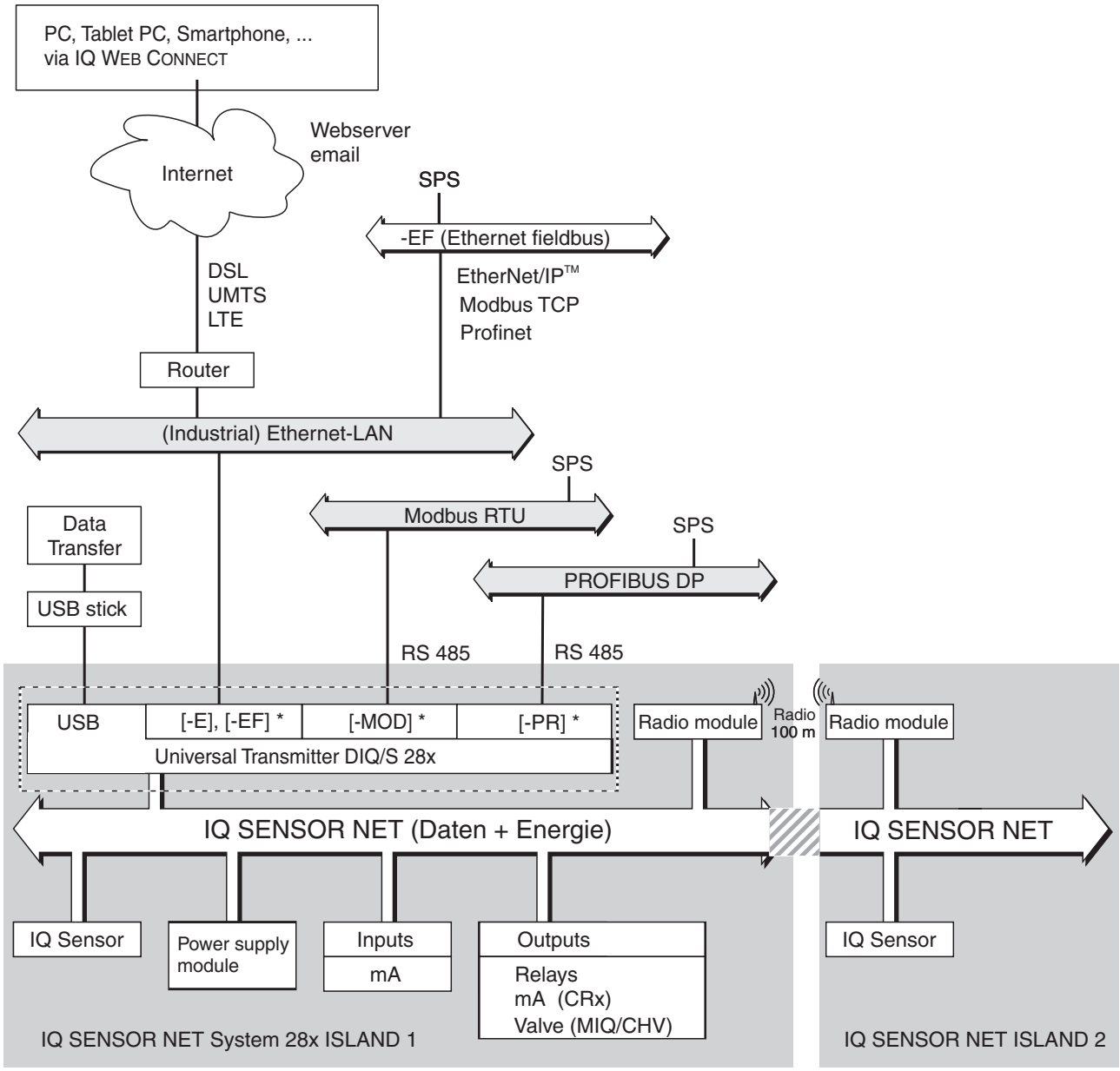


Fig. 1-1 Functional units of the IQ SENSORNET System 28X
** depending on the variant, one of these interfaces is available at the system*

The functional units are connected with one another via a common line. The line consists of two wires and a shield. It transports digital information between the

Universal Transmitter and the other modules. At the same time it is used for the power supply of all components.

Sensors

All main and secondary measured parameters of the sensors connected can be displayed and administrated. Each sensor is automatically recognized after being connected and immediately starts measuring.

Universal Transmitter

The Universal Transmitter DIQ/S 28X[-XX] provides the core functions of the IQ SENSORNET system (power supply, controller, terminal, relays).

The variants of the Universal Transmitters DIQ/S 28X enhance the IQ SENSORNET System 28X by additional functions and interfaces.

Overview IQ SENSORNET System 28X

	Function	DIQ/S 28X Variant(s)
Line power variants	Supply voltage 100 ... 240 V	[-XX]
	24 V	[-XX]/24V
Basic functions	Terminal	[-XX]
	Controller	[-XX]
	Power supply module	[-XX]
	Relay	[-XX]
	USB interface	[-XX]
	SENSORNET interface	[-XX]
Extended functions	Current outputs	-CR3[-XX], -CR6[-XX]
More interfaces	Ethernet interface	[-CRx]-E, -EF
	Fieldbus interface for connection to existing process control systems:	
	● Modbus	-MOD
	● Profibus	PR
	● Ethernet fieldbuses	-EF
Sensors	Max. 2 sensors	DIQ/S 282 [-XX]
	Max. 4 sensors	DIQ/S 284 [-XX]

Components to extend the system?

	Function	Component
Passive components	Power supply module	MIQ/PS
	Radio link (with power supply unit)	MIQ/WL PS
	Branching (interfaces for sensors)	DIQ/JB, MIQ/JB
Active components	Relay	DIQ/CR3, MIQ/CR3, MIQ/R6
	Current outputs	DIQ/CR3, MIQ/CR3, MIQ/C6
More components	Valve output	DIQ/CHV, MIQ/CHV Plus

Maximum extensibility of the system:

- Passive components: no limitation
- Valve outputs: maximum 1 output per sensor
- Active components: 2
  Example:
  The variant DIQ/S 284-CR6[-XX] already contains one active component (DIQ/CR3). The system can still be extended by one active component.

Branches

To be able to connect more sensors than there are SENSORNET connections available at a Universal Transmitter DIQ/S 28X, use the branching module DIQ/JB (accessory). The DIQ/JB branching module is a simple passive module for the branching of IQ SENSOR NET lines.

Relay and current outputs

The relay and current outputs can be linked with sensors. Linked outputs can be used to monitor sensors and for the output of measured values.

A relay output can be programmed as:

- Monitoring relay
- Limit monitor
- Proportional output of measured values (pulse width or frequency output)
- Control unit of a sensor cleaning system driven by compressed air.

A current output (system variant or extra component -CR3 or -CR6) is programmable as:

- Analog output
- PID controller

For quick orientation, the states of all relay and current outputs are clearly indicated on the display.

Compressed air-driven cleaning system

The DIQ/S 28X Universal Transmitter is prepared for the compressed air-driven, time-controlled sensor cleaning function. For this, a DIQ/CHV valve module and if necessary a CH cleaning head is required per sensor (both available as accessories). The cleaning procedure is controlled by the Universal Transmitter. The Universal Transmitter provides the supply voltage and control relay for the compressed air valve in the DIQ/CHV valve module. This enables a simple setup and uncomplicated wiring.

Alternatively, the MIQ/CHV PLUS valve module can be installed in the system. It combines the relay, valve and valve power supply in one MIQ enclosure. Thus, no additional wiring is required, which makes installation easier especially if the distance between the Universal Transmitter and sensor is great.

If necessary, an additional power pack can be added to supply sensors with high power consumption (e.g. UV/VIS sensor).

Example of a simple system

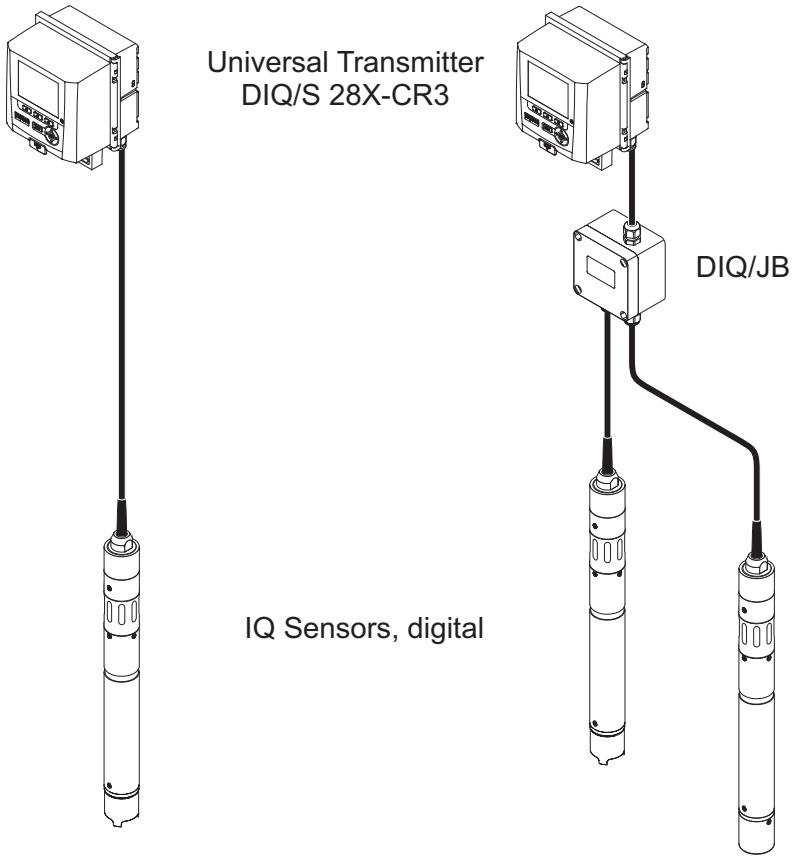


Fig. 1-2 Simple systems with one and two sensors

1.2 Functions in the IQ SENSORNET

The functions of the IQ SENSORNET are provided by the system (DIQ/S 28X) and the retrofitting components. Details on the functions listed can be found in the relevant system or components operating manuals.

Function	Operating manual
Alarm messages	System
Analog output	System
Data logging	System
Data logging	IQ WEB CONNECT
Data transmission	IQ WEB CONNECT
Data communication (Profibus DP, Modbus RTU, Profinet, Modbus TCP, EtherNet/IP)	Fieldbus linking
Data communication Ethernet	System, fieldbus linking
Data logger	System
Webserver, Email server	System
Frequency output	System, relay output module
Limit monitor	System, relay output module
Calibration history	System
List of outputs, list of sensors	System
Log book	System
Log book (messages from components)	IQ Sensor, output module
Measured value representation (4 types)	System
Password	System
PID controller	System, current output module
Pulse-width output	System, relay output module
Sensor cleaning	System, relay output module Valve module, Cleaning Air Box
Local settings	System
Daily load diagram, weekly load diagram, monthly load diagram	System
Monitoring functions (sensors, system)	System, current or relay output module, fieldbus linking

1.3 Interfaces

1.3.1 USB interface

The USB interface of the DIQ/S 28X provides the following functions:

- Connection of a USB memory for the transfer of data (see section 4.9)
  - Measured data
  - Calibration data
  - Configuration data
  - Log book
  - IQ LabLink data
- Connection of a USB memory device to be used as an electronic key for simple access to the system when access control is switched on (see section 5.3.3)
- Connection of a USB hub for the reproduction of the USB interface.

NOTE:
The USB interface is designed for USB memory devices with a maximum power consumption of 1 watt. USB memory devices with a higher power consumption have to be supplied with power by an extra power supply. If these instructions are not complied with, the availability of the system can be adversely affected.



The USB interface is equipped with a protective cover.
Only remove the protective cover when you want to connect a USB device. Immediately close the USB connection again when you have removed the USB device.
When the USB connection is open, there is a danger of corrosion.

1.3.2 Ethernet interface (DIQ/S 28X-E[F])

The Ethernet interface of the DIQ/S 28X -E[F] provides the following functions:

- Integration into an Ethernet network (see section 6)
- Monitoring and remote control via the Internet (IQ WEB CONNECT)
- E-mail feature

1.3.3 Fieldbus interface (DIQ/S 28X -MOD, -PR, -EF)

The following variants of the DIQ/S 28X have a fieldbus interface:

DIQ/S 28X variant	Fieldbus connection
DIQ/S 28XPR	PROFIBUS DP
DIQ/S 28X-MOD	Modbus RTU/RS 485
DIQ/S 28X[-CRx]-EF	Ethernet fieldbuses (EtherNet/IP™, Profinet, Modbus TCP)

1.4 Behaviour of the system to a power failure

- The system configuration is permanently retained. It consists of the following settings:
  - Sensor settings
  - Settings and links of the relay outputs
  - Settings and links of the current outputs
  - System settings (display language, air pressure/altitude, passwords etc.)
- Linked relay outputs switch to the non active condition (open).
- Linked current outputs switch to the non active condition (0 mA).
- A restart is carried out automatically when the power returns. The continues working with the settings of the time prior to the power failure.
  If the power failure lasted several hours the system clock has to be reset.

2 Safety

2.1 Safety information

2.1.1 Safety information in the operating manual

This operating manual provides important information on the safe operation of the product. Read this operating manual thoroughly and make yourself familiar with the product before putting it into operation or working with it. The operating manual must be kept in the vicinity of the product so you can always find the information you need.

Important safety instructions are highlighted in this operating manual. They are indicated by the warning symbol (triangle) in the left column. The signal word (e.g. "CAUTION") indicates the level of danger:



WARNING

indicates a possibly dangerous situation that can lead to serious (irreversible) injury or death if the safety instruction is not followed.



CAUTION

indicates a possibly dangerous situation that can lead to slight (reversible) injury if the safety instruction is not followed.

NOTE

indicates a situation where goods might be damaged if the actions mentioned are not taken.

2.1.2 Safety signs on the product

Note all labels, information signs and safety symbols on the product. A warning symbol (triangle) without text refers to safety information in this operating manual.

2.1.3 Further documents providing safety information

The following documents provide additional information, which you should observe for your safety when working with the measuring system:

- Operating manuals of other components of the IQ SENSORNET system (power supply modules, accessories)
- Safety datasheets of calibration and maintenance equipment (e.g. cleaning solutions).

2.2 Safe operation

2.2.1 Authorized use

The authorized use of the DIQ/S 28X Universal Transmitter consists of its use in online analysis. Only the operation and running of the sensor according to the instructions and technical specifications given in this operating manual is authorized (see chapter 10 TECHNICAL DATA). Any other use is considered unauthorized.

2.2.2 Requirements for safe operation

Note the following points for safe operation:

- The product may only be operated according to the authorized use specified above.
- The product may only be operated under the environmental conditions mentioned in this operating manual.
- The product may only be supplied with power by the energy sources mentioned in this operating manual.
- The product may only be opened if this is explicitly described in this operating manual (example: connecting electrical lines to the terminal strip).

2.2.3 Unauthorized use

The product must not be put into operation if:

- it is visibly damaged (e.g. after being transported)
- it was stored under adverse conditions for a lengthy period of time (storing conditions, see chapter 10 TECHNICAL DATA).

2.3 User qualification

Target group

The IQ SENSORNET System 28X was developed for online analysis. Some maintenance activities, e.g. changing the membrane caps in D.O. sensors, require the safe handling of chemicals. Thus, we assume that the maintenance personnel is familiar with the necessary precautions to take when dealing with chemicals as a result of their professional training and experience.

Special user qualifications

The following installation activities may only be performed by a qualified electrician:

- Connection of the DIQ/S 28X to the power supply.
- Connection of external, line voltage-carrying circuits to relay contacts (see module manual of the relay output module).

3 Installation

3.1 Scopes of delivery

The following parts are included in the scope of delivery:

- DIQ/S 28X Universal Transmitter
- Accessory kit with:
  - Contact carrier with screws
  - ISO cap nuts with screws and ring washers
  - Cable glands with sealing gaskets
- Operating manual.

3.2 Basic principles of installation

3.2.1 Requirements of the measurement location

The measurement location must meet the environmental conditions specified in section 10.1 DIQ/S 282, DIQ/S 284.

Controlled environmental conditions

Work on the open instrument (e.g. during mounting, installation, maintenance) may only be carried out under controlled environmental conditions:

Temperature	+ 5 °C ... + 40 °C (+ 41 ... +104 °F)
Relative humidity	≤ 80 %

3.3 Safety requirements of the electrical installation

Electrical equipment (such as motors, contactors, cables, lines, relays, switches, instruments) must meet the following requirements:

- Compliance with national regulations (e.g. NEC, VDE and IEC)
- Suitability for the electrical conditions at the place of installation
  - Maximum operational voltage
  - Maximum operational current
- Suitability for the ambient conditions at the place of installation
  - Temperature resistance (minimum and maximum temperature)
  - Stability against UV light in the case of outdoor usage
  - Protection against water and dust (IP type of protection).
- Suitable fuse protection of the electrical circuit
  - Overcurrent protection devices

(according to the technical data of the instrument input or output)

– Overvoltage limitations of overvoltage category II

- Suitable external separator (e.g. switch or circuit-breaker) for the power supply of permanently installed instruments with separate power connection
  – compliant with the following regulations
    - IEC 60947-1
    - IEC 60947-3
  – in the vicinity of the instruments (recommendation)
- Flame resistant (cable and lines),
  compliant with the following regulations
  – UL 2556 VW-1 (for USA, Canada)
  – IEC 60332-1-2 (outside the USA, Canada)

3.4 Installation guidelines for lightning protection

During the use of the DIQ/S 28X universal transmitter, particularly in outdoor areas, adequate protection against (electrical) surges must be provided. A surge is a summation phenomenon of surge voltage and surge current. It is generated through the indirect effect of a lightning event or switching operation in the mains, in the grounding system and in information technology lines.

To be adequately protected against the damaging effects of surges, an integrated concept of the following protective measures is required:

- internal device-related protective measures and
- external protective measures of the installation environment.

The internal device-related protective measures are already integrated in the YSI online instrumentation as so-called 'lightning protection' (see chapter 10 TECHNICAL DATA).

The external protective measures of the installation environment can be carried out with respect to the following guidelines:

1 All lines of systems must be
  a) installed inside (or else close to) the grounded metallic mounting constructions, e.g. handrails, pipes and posts if possible
  b) or, particularly in the case of longer lines, laid in the ground.

  Background: The formation of highly lightning hazardous inductive loops between the cables and ground is avoided through the low clearance of the grounded metal construction or by installation in the ground.

2 Only IQ cable material may be used. This cable material is an important prerequisite for the hazard-free discharging of the surge without inadmissibly high overvoltages developing along the line at the same time that could have a damaging effect on the individual components.

3 All metallic mounting constructions (handrails, pipes, posts etc.) on which

DIQ modules are installed must be connected to the local potential equalization system and the grounding system or must be individually sufficiently grounded locally according to the codes of practice.
For the individual grounding of the measuring point the mounting construction must be solidly connected by means of a large-area auxiliary electrode with the measuring medium.
Metallic control shafts/pipes and other large-area metallic bodies that reach into the measuring medium are, for example, ideal for use in the grounding of the mounting construction.
This creates a set path for the main surge. As a result it is possible to avoid the surge being discharged via the cable and via the valuable sensor in the measuring medium.

4 It is recommended to attach a metallic or nonmetallic sun shield to each outside location of the DIQ modules. Sun shields protect the electric field lines in the area of the DIQ module due to an advantageous development of the electrical field lines in the area of the MIQ module and promote the dissipation of the surge via the mounting construction.

5 The line voltage for the supply of the IQ SENSORNET must comply with overvoltage category II. Generally this is ensured through the public operator of the power supply networks. In company-owned networks, e.g. in all power supply systems owned by wastewater treatment plants, this must be kept separate by a potential equalization and a surge protection system for the plant.

6 One part of the safety and lightning protection concept is based on high-grade protective insulation of the IQ SENSORNET. It does not have or require any protective ground conductor or earth terminal. Avoid any direct contact of any SENSOR connections or the metallic sensor enclosures with the local grounding or potential equalization system and with metallic construction elements (see point 8).

7 Additional external lightning protection measures, e.g. the use of overvoltage surge arresters, are not necessary for protection against the indirect effects of lightning and could possibly result in malfunctions.

8 For the realization of the internal lightning protection of the system (e.g. wastewater treatment plant control stands) and for the protection of external resources, cable entry points into buildings or distributions coming from the DIQ/S 28X must be carried out as follows:

– The shield of SNCIQ or SNCIQ-UG cables can be connected to the local potential equalization with a gas overvoltage arrester. Use shield clamps for the contacting of the shield. The shield of the cable must not be opened under any circumstances.

– 0/4-20 mA interfaces must be realized with shielded cables. The cable shield must be connected directly to the potential equalization(s) provided. If plant potential equalization systems are provided on both sides, the shield must also be connected on both sides. The inner conductors must have no contact with the potential equalization.

– Relay lines should be connected to the local potential equalization in order

to provide general and consistent protection via gas overvoltage surge arresters.

3.5 Drawing up the power rating

General information

The IQ SENSORNET supplies all components with low voltage as well as digital communication via a shielded 2-wire line.

Because of this characteristic the energy consumption of all components must be taken into account (power rating) when planning an IQ SENSORNET system. The energy consumption determines whether an additional power module is necessary.



Only IQ SENSORNET products may be used in the IQ SENSORNET.

Power rating - why?

All components in the system require a specific level of electrical power for operation. Thus, it is necessary to draw up a power rating after selecting the desired components. At the same time, this can determine whether the entire power requirement of all components (consumers) is covered by the internal power supply module of the Universal Transmitter. If this is not the case, the power available in the system must be increased by further MIQ power supply modules.

To operate the DIQ/S 28X safely, the power rating must meet the following condition for continuous operation and for power peaks:

Sum of the power requirement (continuous)	≤	Sum of the power delivery (continuous)
Sum of the power requirement (peak)	≤	Sum of the power delivery (peak)



The power rating provides an initial guide value. In specific limiting cases, the power supply may be insufficient despite the positive power rating.

Example: Temperatures above 47 °C (117 ° F) reduce the available power output of the DIQ/S 28X (see TEMPERATURE DEPENDENCY (DEGRADATION) OF THE MAXIMUM ALLOWED P(CONTINUOUS), page 25). The reduced power output may possibly have to be compensated for with further MIQ power supply modules.

Maximum allowed power delivery of IQ SENSORNET components

The maximum allowed power delivery of the power supply components of the IQ SENSORNET is given in the following table:

Component	Power delivery [W]	
	Continuous	Peak
IQ sensors		
DIQ/S 28X	6.5	12
MIQ/PS	18	18
MIQ/WL PS	7	7

The power requirement of the individual components is listed in the following table:

Power requirement of IQ SENSORNET components

Component	Power requirement [W]	
	Continuous	Peak
IQ sensors		
SensoLyt® 700 IQ (SW)	0.2	0.2
TriOxmatic® 70x IQ (SW)	0.2	0.2
FDO® 70x IQ (SW)(H)	0.7	0.7
TetraCon® 700 IQ (SW)	0.2	0.2
VisoTurb® 700 IQ (SW)	1.5	1.5
ViSolid® 700 IQ (SW)(H)	1.5	1.5
AmmoLyt® *Plus* 700 IQ	0.2	0.2
NitraLyt® *Plus* 700 IQ	0.2	0.2
VARiON® *Plus* 700 IQ	0.2	0.2
Spectral sensors XXXVis® 7YY IQ (e.g. NiCaVis® 705 IQ)	3.5	8
UV 70x IQ NOx	3.5	8
UV 70x IQ SAC	3.5	8
IFL 700 IQ	3.0	5.5
IFL 701 IQ	3.0	3.0
P 700 IQ (MIQ/WCA 232)	0.5	0.5
MIQ modules		
MIQ/JB	0.1	0.1
MIQ/CR3	2.3	3.0
DIQ/CR3	2.3	2.3
MIQ/C6	2.0	3.0
MIQ/R6	1.2	1.5

Component	Power requirement [W]	
	Continuous	Peak
MIQ/IC2	0.2 + 2.2 W per connected WG 21 A7 power supply/isolator	0.2 + 2.2 W per connected WG 21 A7 power supply/isolator
DIQ/CHV	2.2 x rel. turn-on duration *	2.2 x rel. turn-on duration *
MIQ/CHV PLUS	0.2 + 2.3 x TD (rel. turn-on duration) *	2.5
MIQ/WL PS	0.6	0.6

* The following text informs about allowing for the relative turn-on duration (TD)

Allowing for the relative on-time in valves

Valves usually switch on periodically for a limited time and then require the nominal power. Crucial for the load on the power unit of the DIQ/S 28X is the time averaged (effective) power requirement that depends on the relative on-time, OT:

Relative on-time OT = t_{On} / (t_{On} + t_{Off})

The effective power requirement is the product of the nominal power of the valve component and the relative on-time:

P = $P_{nominal}$ * OT

Since OT is always < 1, the effective power requirement is always smaller than the nominal power of the valve component.

For the control of sensor cleaning systems operated by compressed air, a relative on-time of max. 0.1 has been adopted in practice.

Determining the number of additional MIQ power supply modules

From the value determined for the power requirement, determine the number of the MIQ power supply modules as follows:

Total power requirement P		Number of additionally required MIQ/PS power supply modules
P (continuous)	P (peak)	
P(c) ≤ 6.5 W	P(p) ≤ 12 W	-
P(c) ≤ 6.5 W	P(p) > 12 W	1
P(c) > 6.5 W		1

Calculation example:

Example configuration 1	**Power requirement [W] (component)**	
	Continuous	**Peak**
+ 1 FDO® 700 IQ	0.7	0.7
NitraVis® 705 IQ	3.5	8
MIQ/CHV PLUS (TD = 0.9)	2.27 (= 0.2 + 2.3 x 0.9)	2.45 (= 0.2 + 2.5 x 0.9)
Total power requirement P [W] (sum of the components)	**P (continuous): 6.47**	**P (peak): 11.15**

Result:
Total power requirement P (continuous) < 6.5 W
Total power requirement P (peak) < 12 W

No additional power supply module is required.

Example configuration 2	**Power requirement [W] (component)**	
	Continuous	**Peak**
+ DIQ/CR3 also as element of the DIQ/S 284-CR6[-XX]	2.3	2.3
+ 1 FDO® 700 IQ	0.7	0.7
NitraVis® 705 IQ	3,5	8
MIQ/CHV PLUS (OT = 0.9)	2.27 (= 0.2 + 2.3 x 0.9)	2,45 (= 0.2 + 2.5 x 0.9)
Total power requirement P [W] (sum of the components)	**P (continuous): 8.77**	**P (peak): 15**

Result:
Total power requirement P (continuous) > 6.5 W
Total power requirement P (peak) > 12 W

An additional power supply module is required.

Temperature dependency (degradation) of the maximum allowed P(continuous)

If the DIQ/S 28X is operated at an ambient temperature below 47 °C (117 °F), the operator has to make sure that the total power requirement P (continuous) is not more than 6.5 W.

If the DIQ/S 28X is operated at an ambient temperature above 47 °C (117 °F), the allowed total power requirement P (continuous) is linearly reduced to 0.7 W at 55 °C (131 °F).

For the short-term total power requirement P (peak), no temperature dependency has to be taken into account.

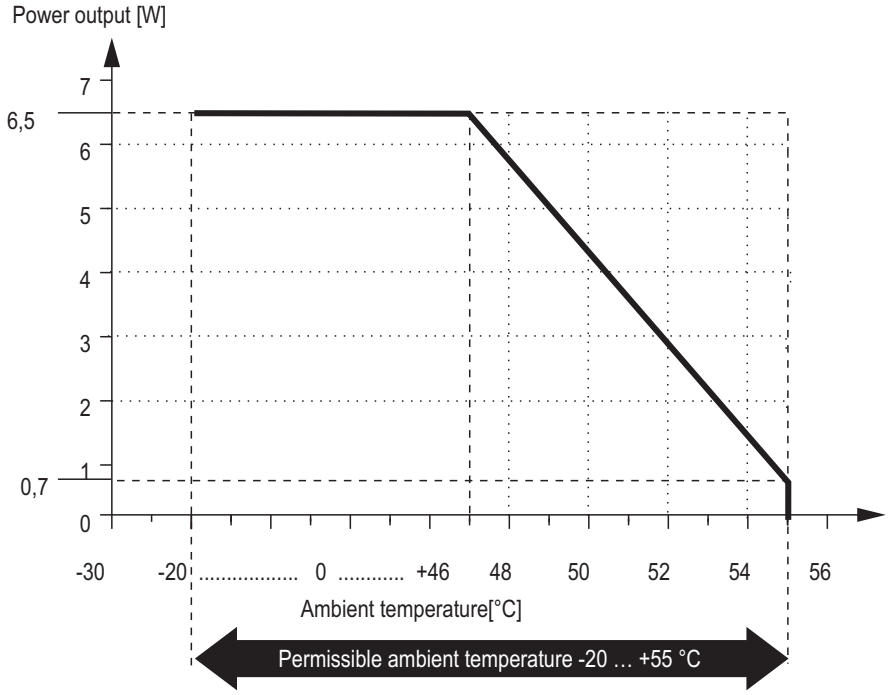


Fig. 3-1 Degradation line of the line power variant DIQ/S 28X[-XX]

If the DIQ/S 28X [-XX]/24V is operated at an ambient temperature below 47 °C (117 °F), the operator has to make sure that the total power requirement P (continuous) is not more than 6.5 W.

If the DIQ/S 28X[-XX]/24V is operated at an ambient temperature above 47 °C (117 °F), the allowed total power requirement P (continuous) is linearly reduced to 4 W at 55 °C (131 °F).

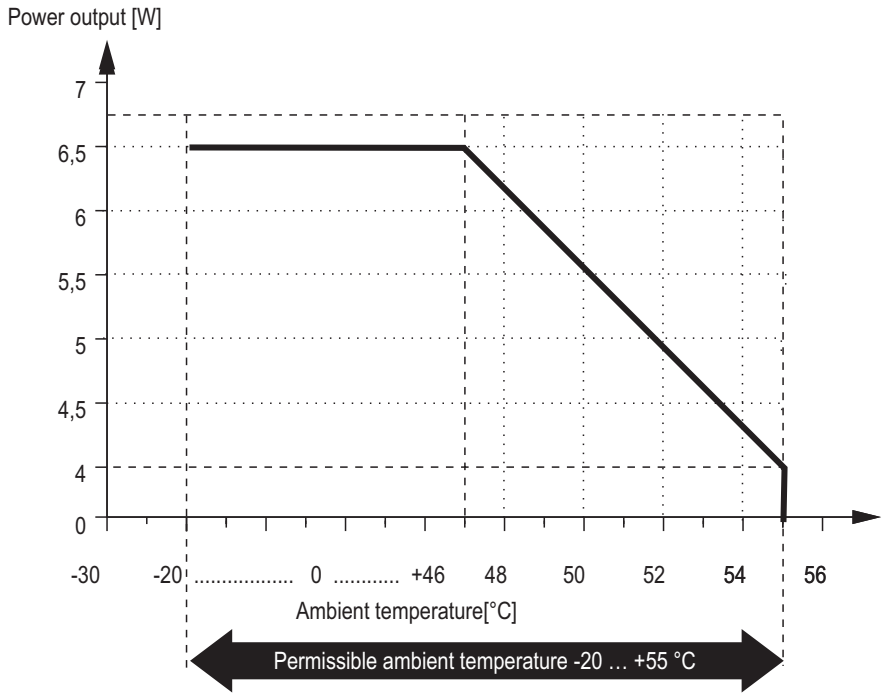


Fig. 3-2 Degradation line of the 24V variant DIQ/S 28X[-XX]/24V

3.6 Connecting the sensor

The sensors are connected to a SENSORNET connector of the DIQ/S 28X.

General installation instructions

Lines must always be installed separately at a minimum distance of 20 cm from other lines that carry a voltage greater than 60 V.

The free end of the sensor cable was stripped in the factory and all the wires are fitted with wire end sleeves.

Tools

- Phillips screwdriver
- Small screwdriver.

NOTE
The sensor cable may only be connected to the SENSORNET connections. No wire of the cable may be connected with an external electrical potential. Otherwise, malfunctions could occur.

1 On the left-hand side of the DIQ/S 28X, remove the two countersunk screws and open the enclosure.

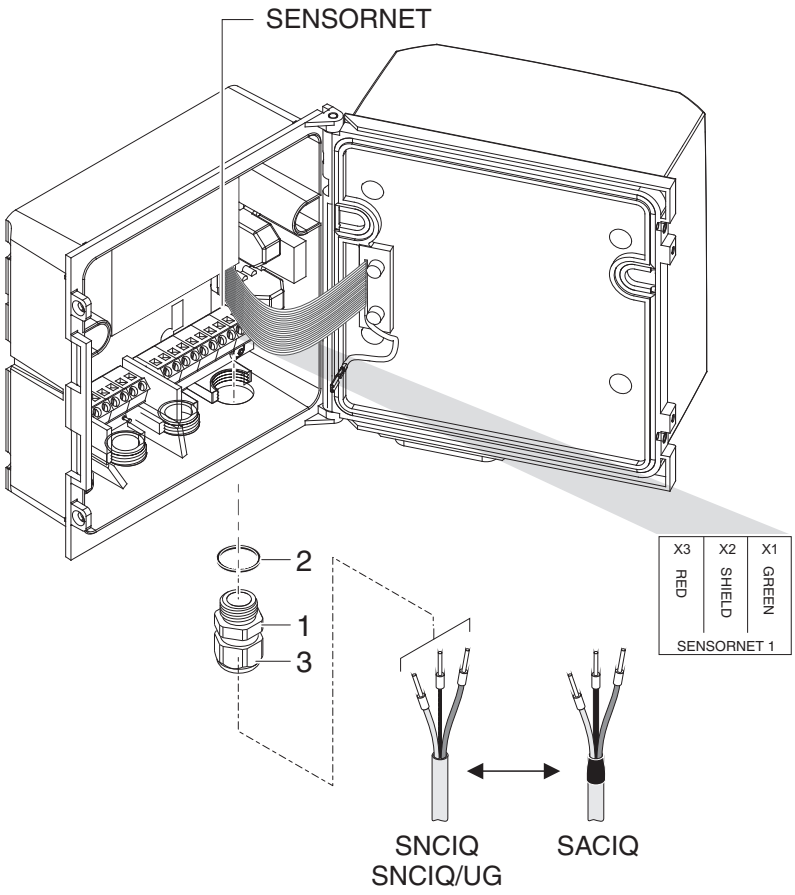


Fig. 3-3 Connecting the cable (example DIQ/S 28XCR3)

2 Screw the cable gland (no. 029 212, pos. 1 in Fig. 3-3) with the sealing (pos. 2) into the housing at the mounting position for the SENSORNET connection (see label on the bottom of the housing)

3 Loosen the cap nut (pos. 3 in Fig. 3-3).

4 Feed the sensor cable through the cable gland into the enclosure.

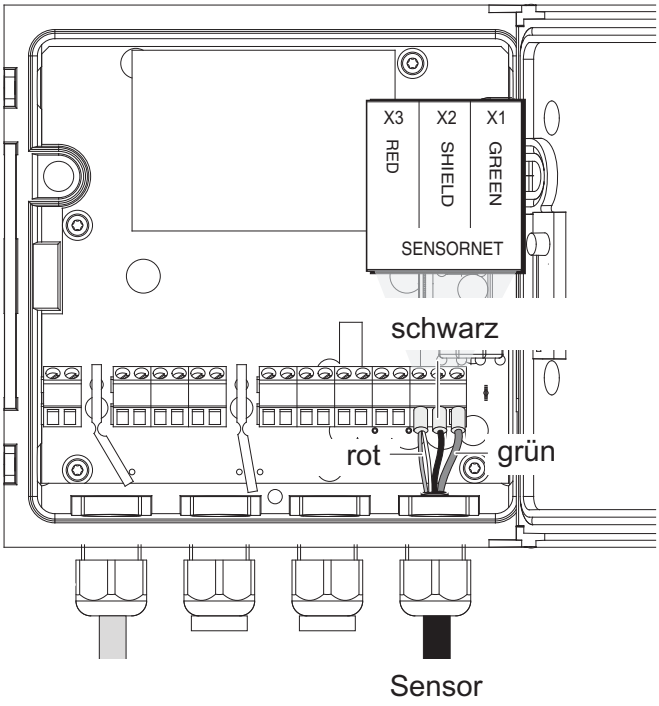


Fig. 3-4 SENSORNET connector (example DIQ/S 28X CR3)

5 Connect the cable ends to the terminal strip. At the same time, look out for the designations of the terminals (red / shield / green).

6 Tighten the cap nut (pos. 3 in Fig. 3-3).

7 Close the enclosure.

The complete assignment of the terminal strip is shown in section 3.13.

For further instructions on the mounting of the sensor at the application location, please refer to the relevant manual (immersion depth, etc.).

3.7 On-site mounting of the DIQ/S 28X

3.7.1 General information

The universal transmitter DIQ/S 28X is designed for stationary installation. With the aid of mounting accessories, the setup can be adjusted to meet various requirements.

NOTE
Components installed outside must always be protected by a sun shield against the effects of the weather (snow, ice and direct solar radiation). Otherwise, malfunctions can result. Always mount the universal transmitter in an upright position. Do not under any circumstances install the universal transmitter without rain protection with the lid facing upwards (danger of retained humidity and penetration of moisture).

NOTE
No contact base may be mounted on the back of the module (danger of short-circuit!) if the module is mounted on a wall, a sun shield, or a top hat rail.

Installation options

The most important types of installation for the universal transmitter are described in the following chapters:

- **Mounting with sun shield SSH/IQ:**
  (see section 3.7.2).
- **Mounting to the sun shield SD/K 170**
  The sun shield SD/K 170 provides room for the universal transmitter. The sun shield can be mounted to round or square section pipes (e.g. rails) with the aid of the MR/SD 170 mounting kit (section 3.7.3).
- **Wall mounting:**
  The universal transmitter is permanently fixed to a wall. For wall mounting, use the WMS/IQ mounting set (see chapter 11 ACCESSORIES AND OPTIONS).
- **Panel mounting:**
  The universal transmitter is mounted in the aperture of a switch panel. The dimensions of the aperture are 138 mm x 138 mm. The panel may not be thicker than 10 mm (section 3.7.5).
  To install the interface (MOD, PR, E, EF) of the DIQ/S 28X [-MOD], [-PR], [-E(F)] behind the panel, use the PMS/IQ-X accessory (see section 11).
- **Top hat rail mounting:**
  The universal transmitter is mounted on a 35 mm top hat rail with the aid of a bracket, e.g. in a control cabinet. The connection can be released again with one simple movement (section 3.7.4).

The following chapters describe the mounting of the universal transmitter.

3.7.2 Mounting on a mounting stand with the SSH/IQ sun shield

Materials and tools required

- SSH/IQ sun shield (see chapter 11 ACCESSORIES AND OPTIONS).
- 4 mm set screw wrench
- Phillips screwdriver.

Mounting the sun shield on a mounting stand

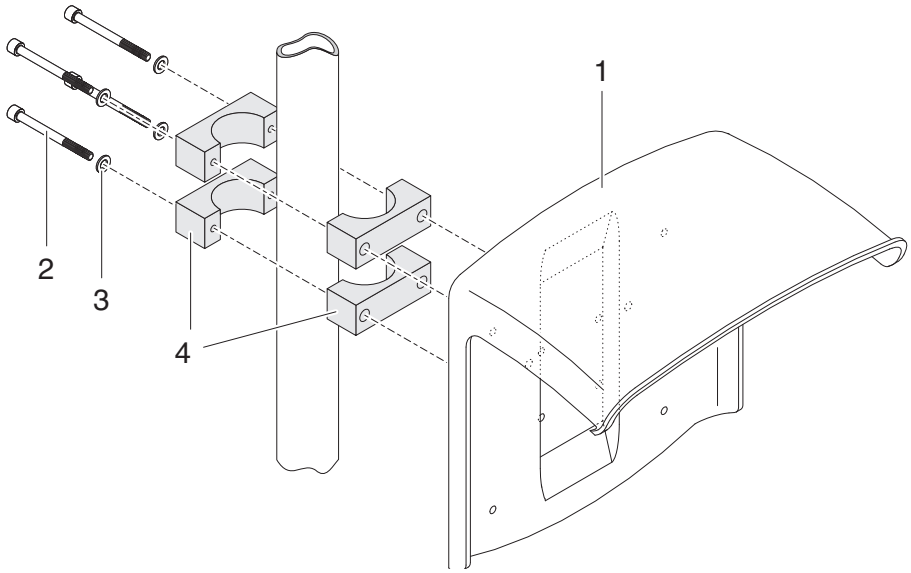


Fig. 3-5 Mounting the SSH/IQ sun shield on a mounting stand

1 Screw the sun shield (pos. 1 in Fig. 3-5) with the four hexsocket head screws (pos. 2), the washers (pos. 3) and the clamps (pos. 4) at the required height on the mounting stand from the back.

Premounting the ISO blind nuts

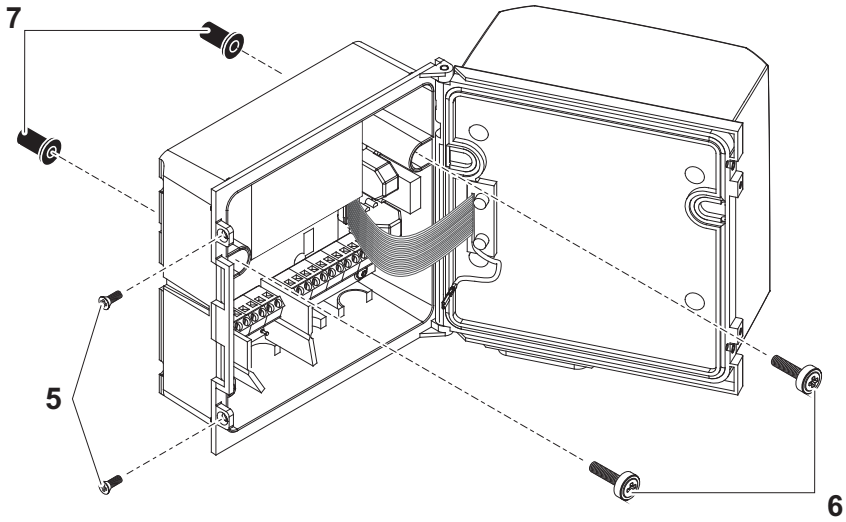


Fig. 3-6 Mounting the sun shield: Premounting the ISO blind nuts

2 Remove the two countersunk screws (pos. 5 in Fig. 3-6) and swing open the lid.

3 Insert the cheese-head screws (pos. 6 in Fig. 3-6) with the plastic washers in the drilled mounting holes and loosely screw in the ISO blind nuts (pos. 7).

Mounting the DIQ/S 28X on the sun shield

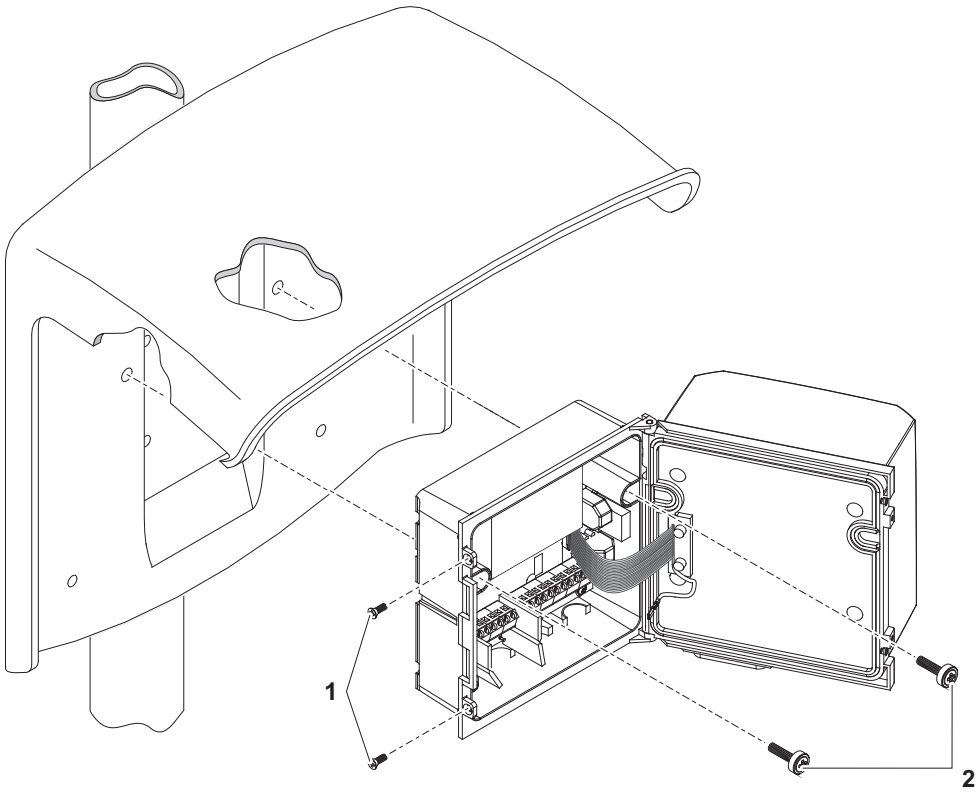


Fig. 3-7 Mounting the *DIQ/S 28X* on the sun shield SSH/IQ

4 Position the universal transmitter on the sun shield and fix it into place with the two screws (pos. 6 in Fig. 3-6).

5 Close the lid and fix it with the two countersunk screws (pos. 5 in Fig. 3-6).

3.7.3 Mounting under the SD/K 170 sun shield

The SD/K 170 sun shield can be mounted directly on a wall, on a mounting stand or on a railing. The MR/SD 170 mounting kit is also required for mounting on a mounting stand or railing.

How to mount the sun shield at the installation location is described in the instructions for the sun shield or mounting kit.

Materials required

- SD/K 170 sun shield (see chapter 11 ACCESSORIES AND OPTIONS)
- The MR/SD 170 mounting kit is also required for mounting the sun shield on a mounting stand or railing (see chapter 11 ACCESSORIES AND OPTIONS).

Tools

- Phillips screwdriver.

Mounting the DIQ/S 28X with sun shield

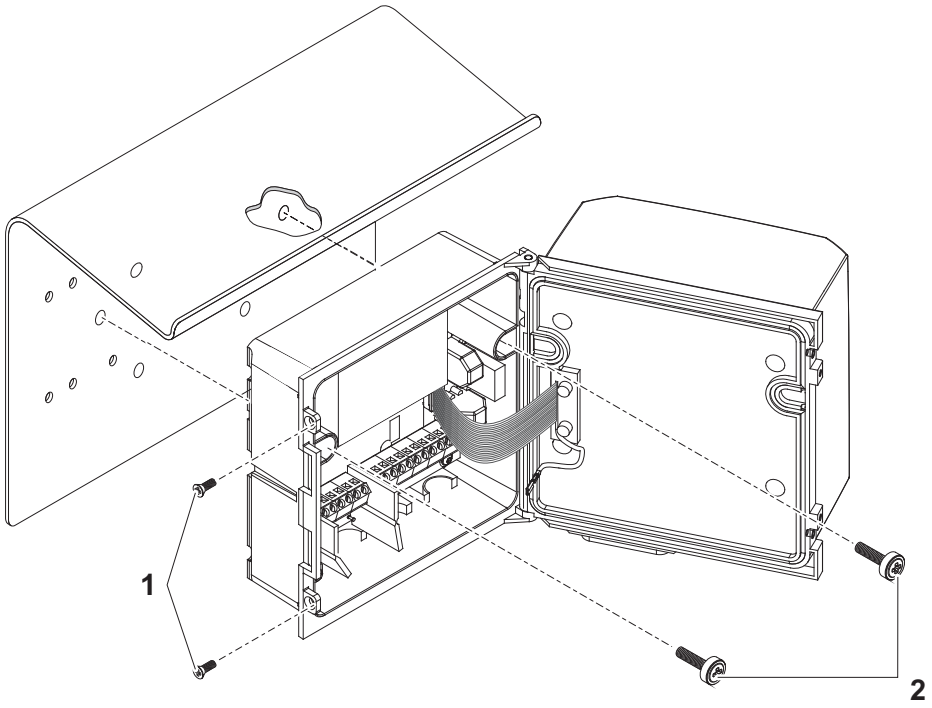


Fig. 3-8 Mounting the DIQ/S 28X with sun shield SD/K 170

1 Remove the two countersunk screws (pos. 1 in Fig. 3-8) and swing open the module lid.

2 Position the universal transmitter on the sun shield and fix it into place with the two screws (pos. 2 in Fig. 3-8).

3 Close the lid and fix it with the two countersunk screws (pos. 1 in Fig. 3-8).

3.7.4 Top hat rail mounting

Materials required

- THS/IQ kit for top hat rail mounting (see chapter 11 ACCESSORIES AND OPTIONS).

Tools

- Phillips screwdriver.

Mounting the DIQ/S 28X on a top hat rail

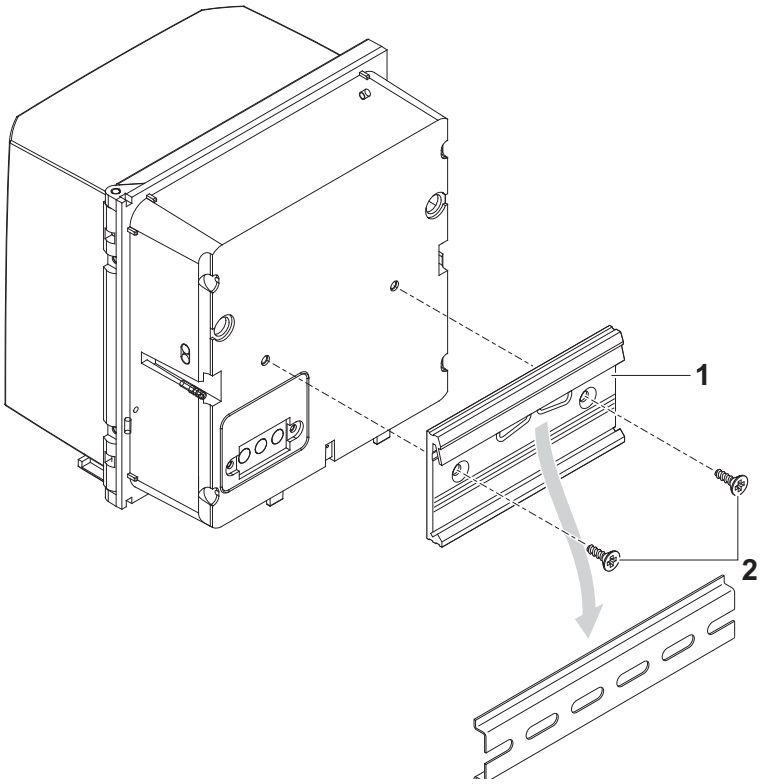


Fig. 3-9 Mounting the DIQ/S 28X on a top hat rail

1 Screw the clamping assembly (pos. 1 in Fig. 3-9) on the back of the universal transmitter with the two plastic tapping screws (pos. 2).

2 Attach the universal transmitter to the top hat rail from above using the clamping assembly and press against the rail until the clamping assembly clicks into place. The universal transmitter can be moved sideways afterwards.

3 To unhook the universal transmitter, press it downward and pull it forward at the bottom.

3.7.5 Panel mounting

Variants of the DIQ/S 28X without fieldbus or Ethernet interface can be mounted to a switch panel with the PMS/IQ mounting set.

For variants of the DIQ/S 28X with fieldbus or Ethernet interface, we recommend using the PMS/IQ-X mounting set. It enables to mount the DIQ/S 28X in the switch panel so that the fieldbus or Ethernet interface is accessible behind the switch panel.

Switch panel mounting sets

Variant DIQ/S 28X	Switch panel mounting set	Switch panel aperture	Max. thickness of the switch panel
DIQ/S 28X[CRx]	PMS/IQ	138 x 138 mm	10 mm
DIQ/S 28X-PR, -MOD	PMS/IQ-X	186 x 186 mm	8 mm
DIQ/S 28X[-CRx]-E(F)	PMS/IQ-X	186 x 186 mm	5 mm

Switch panel mounting with PMS/IQ-X

Details on panel mounting with the PMS/IQ-X mounting set are given in the operating manual of the PMS/IQ-X.

Switch panel mounting with PMS/IQ

Panel mounting with the PMS/IQ mounting set is described below:

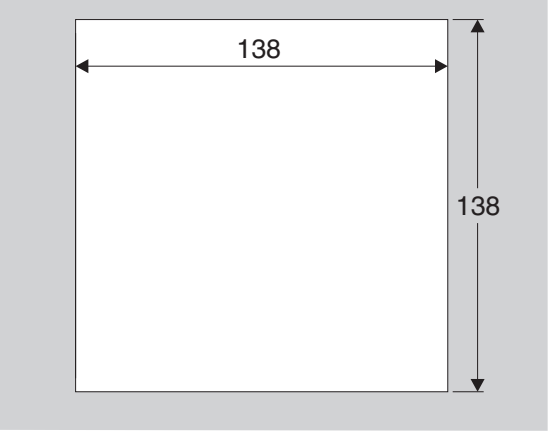
Materials required

- PMS/IQ kit for panel mounting (see chapter 11 ACCESSORIES AND OPTIONS).

Tools

- 3 mm set screw wrench (contained in the panel installation kit).

Switch panel aperture



Maximum thickness
10 mm

Fig. 3-10 Mounting aperture in the switch panel (dimensions in mm)

Mounting the DIQ/S 28X in a switch panel

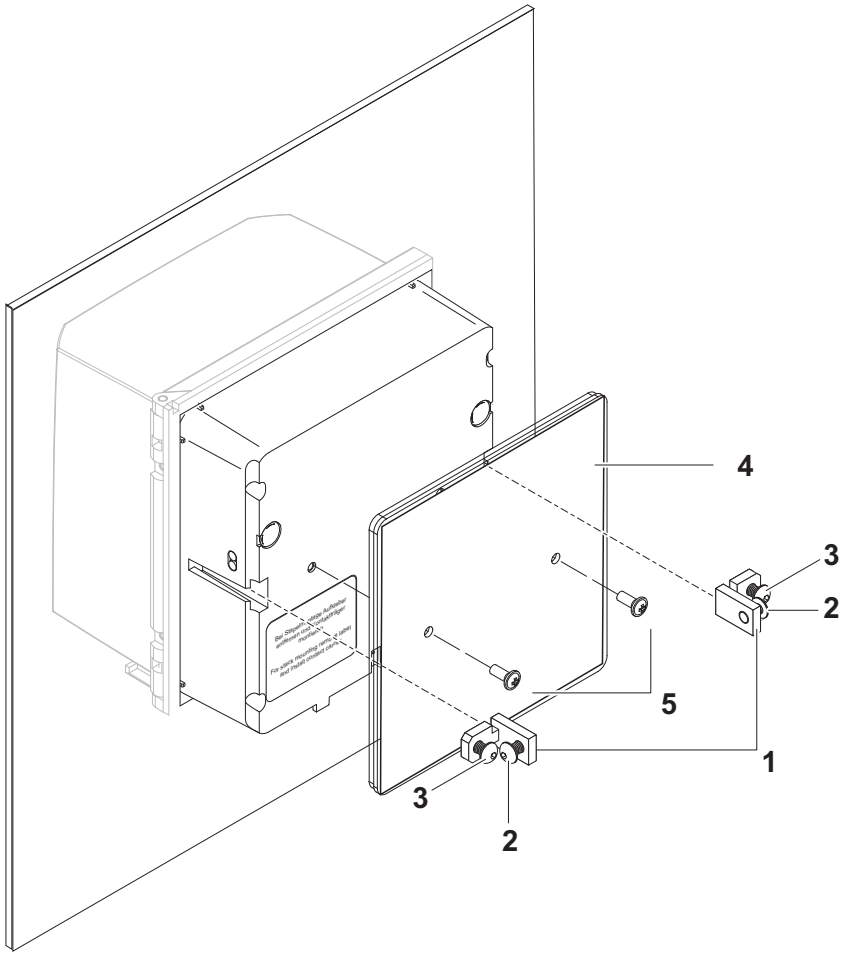


Fig. 3-11 Mounting the DIQ/S 28X in Fig. 3-11

1 Angle bracket
2 Bolts
3 Bolts
4 Impact protection plate
5 Bolts to fix the impact protection plate

1 Insert the universal transmitter in the panel aperture from the front.

2 Slightly unscrew the bolts (pos. 2 and 3) of the two angle brackets (pos. 1 in Fig. 3-11), but do not remove them.

3 Push in the two angle brackets - as shown in Fig. 3-11 - into the lateral guides of the universal transmitter up to the stop.

4 Tighten the bolts (pos. 2).

5 Screw in the bolts (pos. 3) until the bolts rest snugly against the panel.

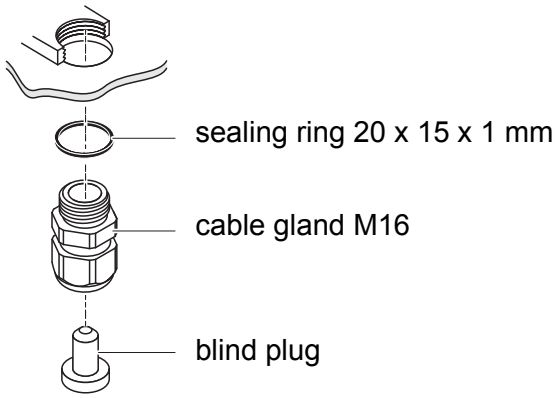
6 Fix the impact protection plate (Pos. 4) to the back of the DIQ/S 28X with the bolts (Pos. 5).

3.8 Electrical connections: General instructions

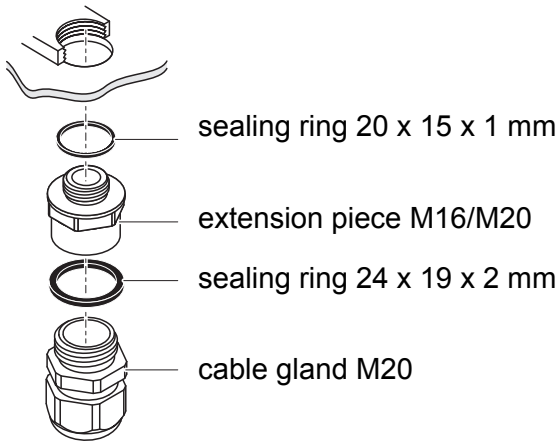
Cable glands

All electric cables are fed from below through openings prepared in the enclosure of the DIQ/S 28X and the DIQ modules. Cable glands with different clamping ranges are included with the DIQ/S 28X to provide sealing between the cable and enclosure as well as for strain relief. Select the suitable cable gland for the relevant cable type and cable diameter:

- **Small**, clamping range 4.5 to 10 mm.
  This cable gland is suitable for all cables (earth cable after stripping the outer insulation, see section 3.7) and sensor connection cables.



- **Large**, clamping range 7 to 13 mm.
  This cable gland is required for cable sheaths with an outside diameter of more than 10 mm and is screwed into the enclosure via an extension piece.



If necessary, you can order more big cable glands (see chapter 11 ACCESSORIES AND OPTIONS).

General installation instructions

Observe the following points when attaching connecting wires to the terminal strip

- Shorten all wires to be used to the length required for the installation
- Always fit all the ends of the wires with wire end sleeves before connecting them to the terminal strip
- Any wires that are not used and project into the enclosure must be cut off as closely as possible to the cable gland.
- Screw a small cable gland with sealing ring into each remaining free opening and close it with a blind plug.



WARNING

No free wires are allowed to project into the housing. Otherwise, there is a danger that areas safe to contact could come into contact with dangerous voltages. Always cut off any wires that are not in use as closely as possible to the cable gland.

3.9 Connecting the voltage supply

The two following paragraphs describe how to connect both models of the DIQ/S 28X universal transmitter to the voltage supply.

3.9.1 DIQ/S 28X (line power version)



WARNING

If the power supply is connected incorrectly, it may represent a danger to life from electric shock. Pay attention to the following points during installation:

- **The DIQ/S 28X universal transmitter may only be connected by a trained electrician.**
- **The connection of the DIQ/S 28X universal transmitter to the power supply may only be carried out when it is not carrying any voltage.**
- **The power supply must fulfill the specifications given on the nameplate and in chapter 10 TECHNICAL DATA.**
- **When installed in a building, a switch or power switch must be provided as an interrupt facility for the DIQ/S 28X.**
  The interrupt facility must
  - **be installed in the vicinity of the DIQ/S 28X universal transmitter, easily accessible by the user, and**
  - **be labeled as the interrupt facility for the DIQ/S 28X universal transmitter.**
- **After the DIQ/S 28X universal transmitter has been installed, it may only be opened if the line voltage has been switched off beforehand.**

Materials required

- Wire end sleeves, suitable for the power line, with suitable crimping tool
- 1 x cable gland with sealing ring (included in scope of delivery of the DIQ/S 28X).

Tools

- Cable stripping knife
- Wire stripper
- Phillips screwdriver
- Small screwdriver.

Preparing the power cable

1 Cut off the cable to the required length.

2 Strip the cable insulation for approx. 45 mm.

3 Bare the wires of phases L and N and fit them with wire end sleeves.

4 If present, cut off the ground wire at the end of the cable sheath.

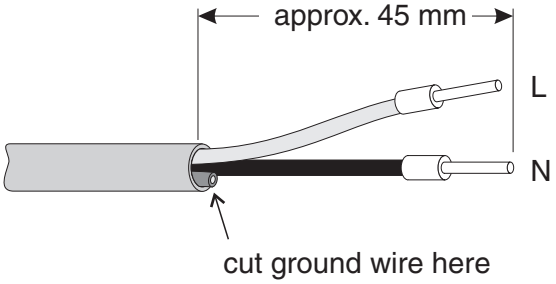


Fig. 3-12 Prepared power cable.

NOTE
The ground wire must not project into the enclosure. Otherwise, malfunctions could occur.

Connecting the power line

5 On the left-hand side of the DIQ/S 28X, remove the two countersunk screws and open the enclosure.

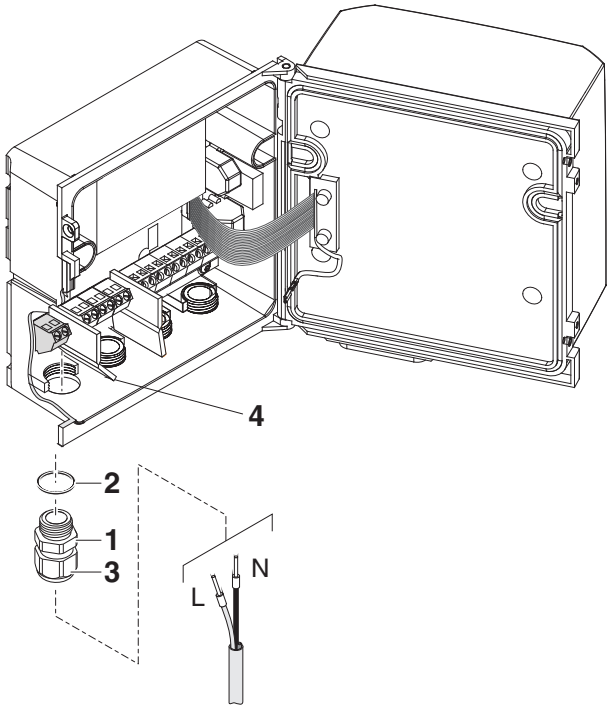


Fig. 3-13 Inserting the supply line.

6 Screw a cable gland (pos. 1 in Fig. 3-13) with sealing ring (pos. 2) into the enclosure below the power supply connection.

7 Loosen the coupling ring (pos. 3).

8 Feed the power line through the cable gland into the enclosure. When doing so bend the flexible divider (pos. 4) to the right.

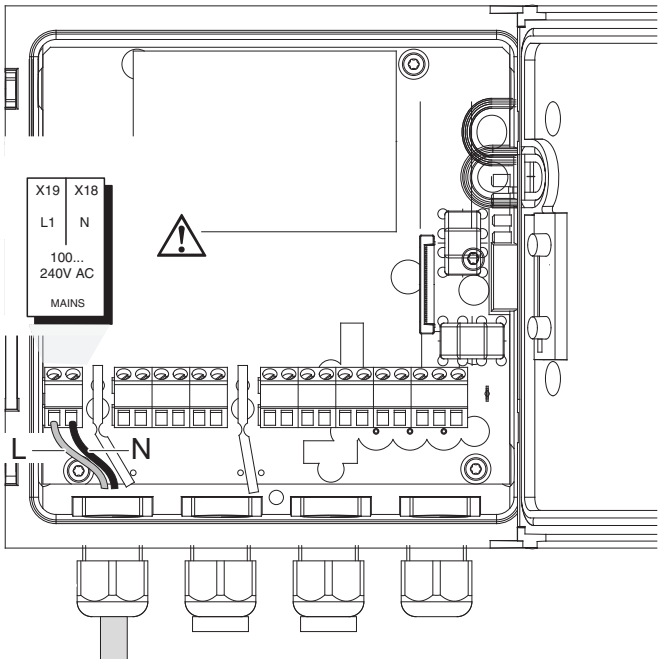


Fig. 3-14 Line power connection.

The complete assignment of the terminal strip is shown in section 3.13.

9 Connect phases L and N to the terminal strip. Make sure that the cable assignment agrees with the specification on the terminal label under the terminal strip.

10 Tighten the cap nut (pos. 3 in Fig. 3-13).

WARNING
No free wires are allowed to project into the housing. Otherwise, there is a danger that areas safe to contact could come into contact with dangerous voltages. Always cut off any wires that are not in use as closely as possible to the cable gland.

11 Close the enclosure of the DIQ/S 28X.

3.9.2 DIQ/S 28X[-XX]/24V (24 V version)



WARNING

If the 24 V AC/DC supply is connected incorrectly, it may represent a danger to life from electric shock. Pay attention to the following points during installation:

- **The DIQ/S 28X universal transmitter may only be connected by a trained electrician.**
- **The 24 V AC/DC supply must meet the specifications quoted on the name plate and in chapter 10 TECHNICAL DATA** (protective low voltage SELV).
- **The connection of the DIQ/S 28X universal transmitter to the power supply may only be carried out when it is not carrying any voltage.**
- **When installed in a building, a switch or power switch must be provided as an interrupt facility for the universal transmitter DIQ/S 28X.**
  The interrupt facility must
  - be installed in the vicinity of the DIQ/S 28X universal transmitter, easily accessible by the user, and
  - be labeled as the interrupt facility for the DIQ/S 28X universal transmitter.



Rechargeable battery systems should have a deep discharge protection. The DIQ/S 28X[-XX]/24V does not have any built-in deep discharge protection.

Materials required

- Wire end sleeves, suitable for the 24 V AC/DC feed line, with suitable crimping tool
- 1 x cable gland with sealing ring (included in scope of delivery of the DIQ/S 28X).

Tools

- Cable stripping knife
- Wire stripper
- Phillips screwdriver
- Small screwdriver.

Preparing the 24 V AC/DC line

1 Cut off the cable to the required length.

2 Strip the cable insulation for approx. 45 mm.

3 Bare the wires 1 and 2 and fit them with wire end sleeves.

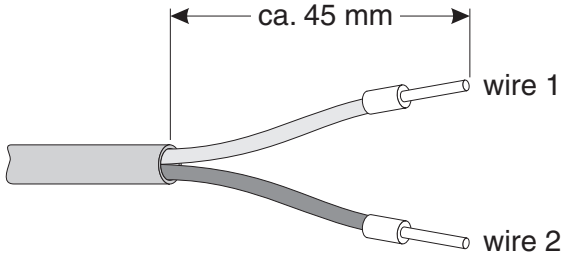


Fig. 3-15 Prepared 24 V AC/DC line.

Connecting the 24 V AC/DC line

4 On the left-hand side of the DIQ/S 28X, remove the two countersunk screws and open the enclosure.

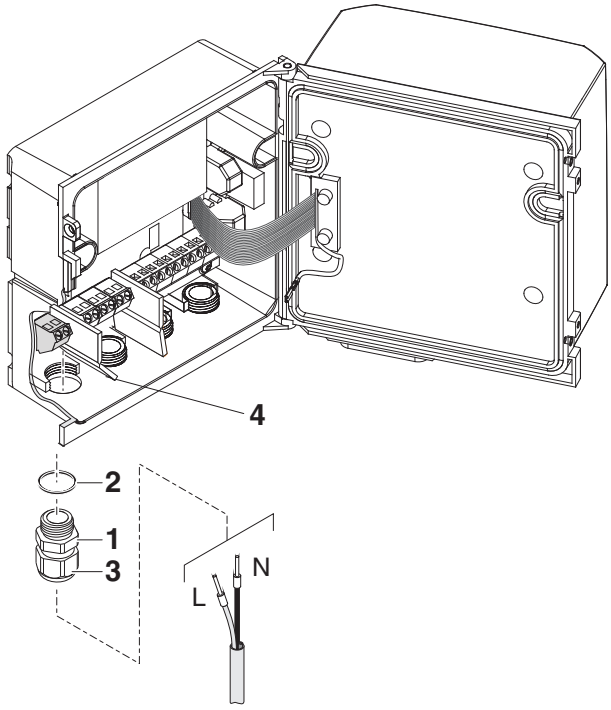


Fig. 3-16 Inserting the 24V AC/DC line

5 Screw a cable gland (pos. 1 in Fig. 3-16) with sealing ring (pos. 2) into the enclosure below the 24 V AC/DC connection.

6 Loosen the coupling ring (pos. 3).

7 Feed the 24 V AC/DC line through the cable gland into the enclosure. When doing so bend the flexible divider (pos. 4) to the right.

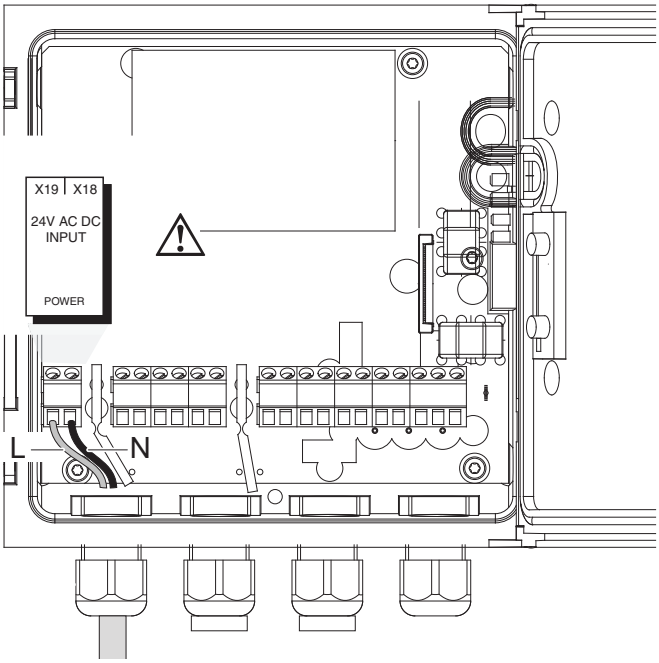


Fig. 3-17 24 V AC/DC connection.

The complete assignment of the terminal strip is shown in section 3.13.

8 Connect wires 1 and 2 to the terminal strip. Make sure that the cable assignment agrees with the specification on the terminal label under the terminal strip.

9 Tighten the cap nut (pos. 3 in Fig. 3-16).

NOTE
No free wires are allowed to project into the housing. Otherwise there is the danger of short circuits that can cause a fire. Always cut off any wires that are not in use as closely as possible to the cable gland.

10 Close the enclosure of the DIQ/S 28X.

3.10 Connections to the relay and current outputs

3.10.1 General installation instructions



WARNING

If external electrical circuits that are subject to the danger of physical contact are incorrectly connected to the relay contacts, there may be a danger of life threatening electric shock. Electrical circuits are regarded to be subject to the danger of physical contact when there are voltages higher than the Safety Extra Low Voltage (SELV).

Pay attention to the following points during installation:

- **Electrical circuits subject to the danger of physical contact may only be connected by a qualified electrician.**
- **Electrical circuits subject to the danger of physical contact may only be connected when they are voltage-free.**
- **If electrical circuits subject to the danger of physical contact are switched with a relay, no circuit that is not subject to this danger (e. g. the DIQ/CHV module) may be operated on the further relays.**
- **Switching voltages and switching currents on the relay contacts must not exceed the values specified in chapter 10 TECHNICAL DATA. Protect electrical circuits against currents that are too high with an electrical fuse.**
- **Only single-phase consumers can be switched with the relays. Under no circumstances may multiphase consumers be switched with the aid of several relays (example: three-phase current driven pumps). Always switch multiphase consumers via a protective relay.**
- **After the Universal Transmitter DIQ/S 28X has been installed, it may only be opened if all external voltages have been switched off beforehand.**

Materials required

- Wire end sleeves, suitable for the connecting wires, with suitable crimping tool
- 4 x cable gland with sealing ring (scope of delivery of the DIQ/S 28X)

Tools

- Cable stripping knife
- Wire stripper
- Phillips screwdriver
- Small screwdriver

Connecting lines to the terminal strip

1 On the left-hand side of the DIQ/S 28X, remove the two countersunk screws and open the enclosure.

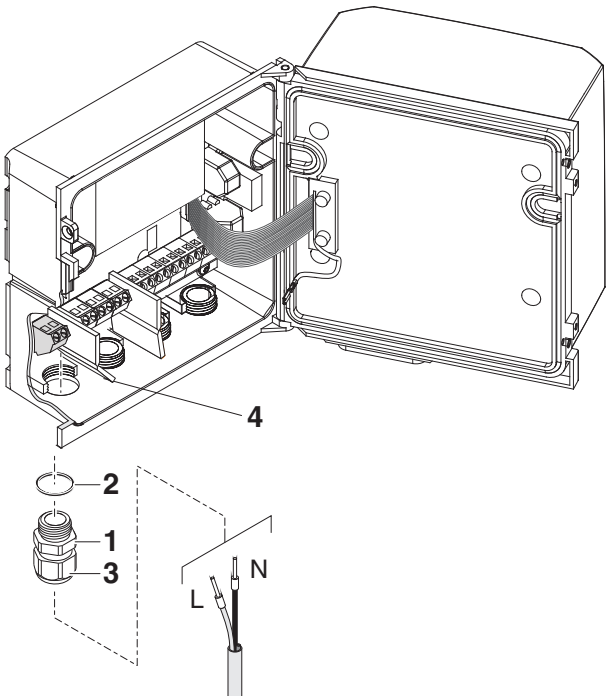


Fig. 3-18 Inserting lines

The complete assignment of the terminal strip is shown in section 3.13.

2 Screw a cable gland (pos. 1 in Fig. 3-18) with the sealing ring (pos. 2) into the enclosure below the respective connections.

3 Loosen the coupling ring (pos. 3).

4 Feed the line through the cable gland in the enclosure.

5 Connect the wires to the terminal strip. While doing so, pay attention to the specifications on the label located under the terminal strip.

6 Tighten the coupling ring (pos. 3).

WARNING
No free wires are allowed to project into the housing. Otherwise, there is a danger that areas safe to contact could come into contact with dangerous voltages. This could result in life threatening electric shock when working with the universal transmitter DIQ/S 28X. Always cut off any wires that are not in use as closely as possible to the cable gland.

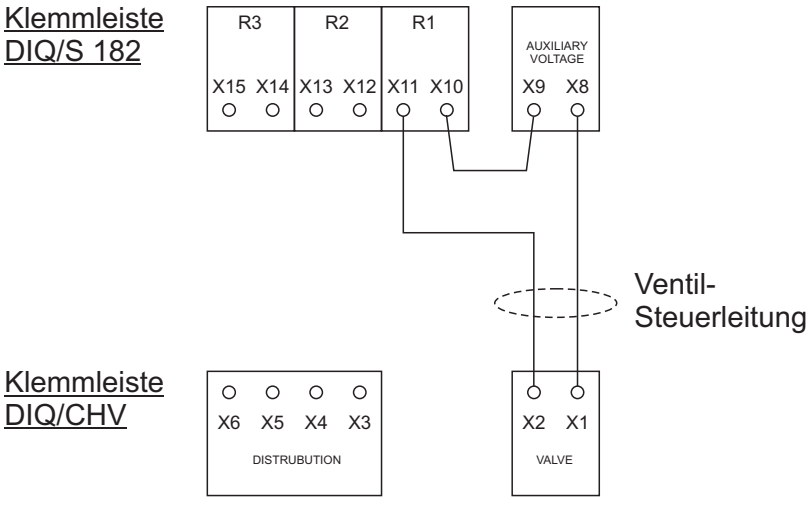
7 Close the enclosure of the DIQ/S 28X.

3.10.2 Usage of the auxiliary voltage

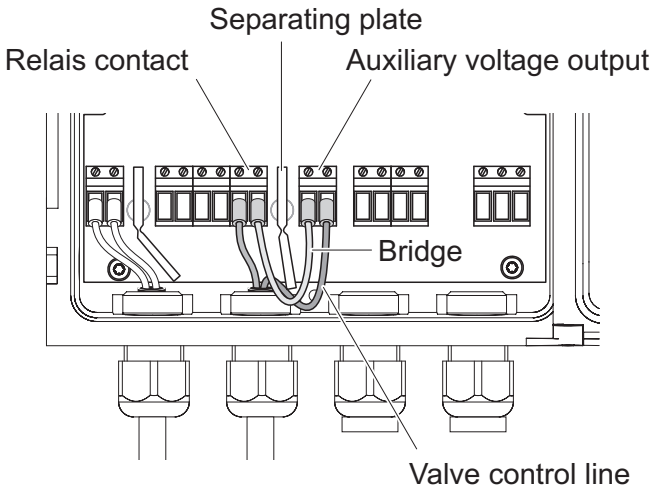
The universal transmitter DIQ/S 28X has a 24 V output (designation HILFSSPANNUNG or AUXILIARY VOLTAGE on the terminal strip). You can use this auxiliary voltage for the relay-controlled opening of the valve in a DIQ/CHV valve module for the compressed air-driven sensor cleaning function. To do so, you have to connect the auxiliary voltage output, a free relay contact and the valve connection in the DIQ/CHV in series. Bridge a terminal of the auxiliary voltage output with a terminal of a relay output and run a control line from the remaining terminals to the valve module.

NOTE
The auxiliary voltage must not be used for other purposes.

Connection scheme for one sensor with compressed air cleaning



NOTE
Run the bridge below the divider so the bridge does not bump against the circuit board in the lid when the enclosure is closed.



3.11 Commissioning

Start checklist and system start

Before starting the system, carry out the system check using the following checklist. Always carry out the check:

- before the initial commissioning
- before any further commissioning if the system has been previously extended or modified.

Start checklist:

1 Are all components correctly connected with each other (see section 3.6, if necessary, section 3.7)?

2 Is the universal transmitter correctly connected to the power supply (see section 3.9)?

3 Do the line voltage and line frequency agree with the data on the name plate of the universal transmitter?

4 Is the sensor ready for measuring, e.g. a D.O. sensor filled with electrolyte solution?

Starting the system

Switch on the power supply of the DIQ/S 28X. As soon as the system is successfully initialized, the measured value display appears. With a sensor not yet providing any measurement values, "Init" appears temporarily:

Select your system language during the first system start. The selected system language can be changed in the *Einstellungen/ Settings* menu at any time.

Initial start phase

The Universal Transmitter is initialized during the first start phase. All IQ SENSORNET components are automatically registered with the Universal Transmitter DIQ/S 28X. The system then performs a self test. This process can take several seconds. During this period, the following display appears:

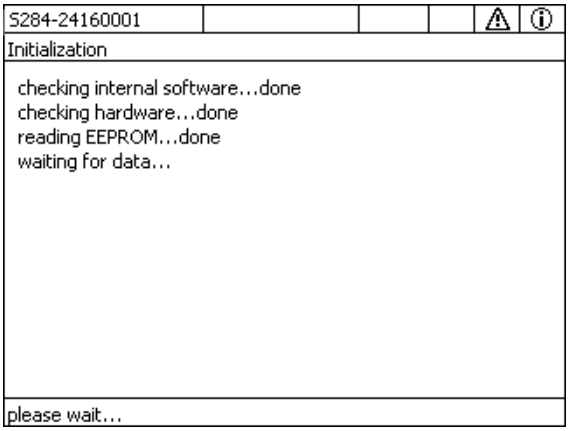


Fig. 3-19 Display during the initialization process

Second start phase

As soon as the Universal Transmitter is successfully initialized, the measured value display appears (fourfold display). In the case of IQ sensors that are not yet providing measured values, "Init" appears temporarily

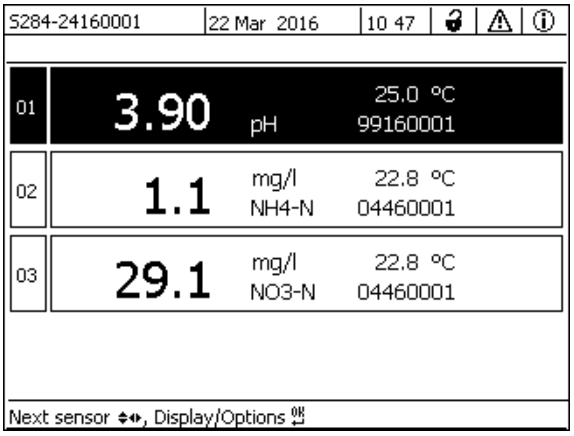


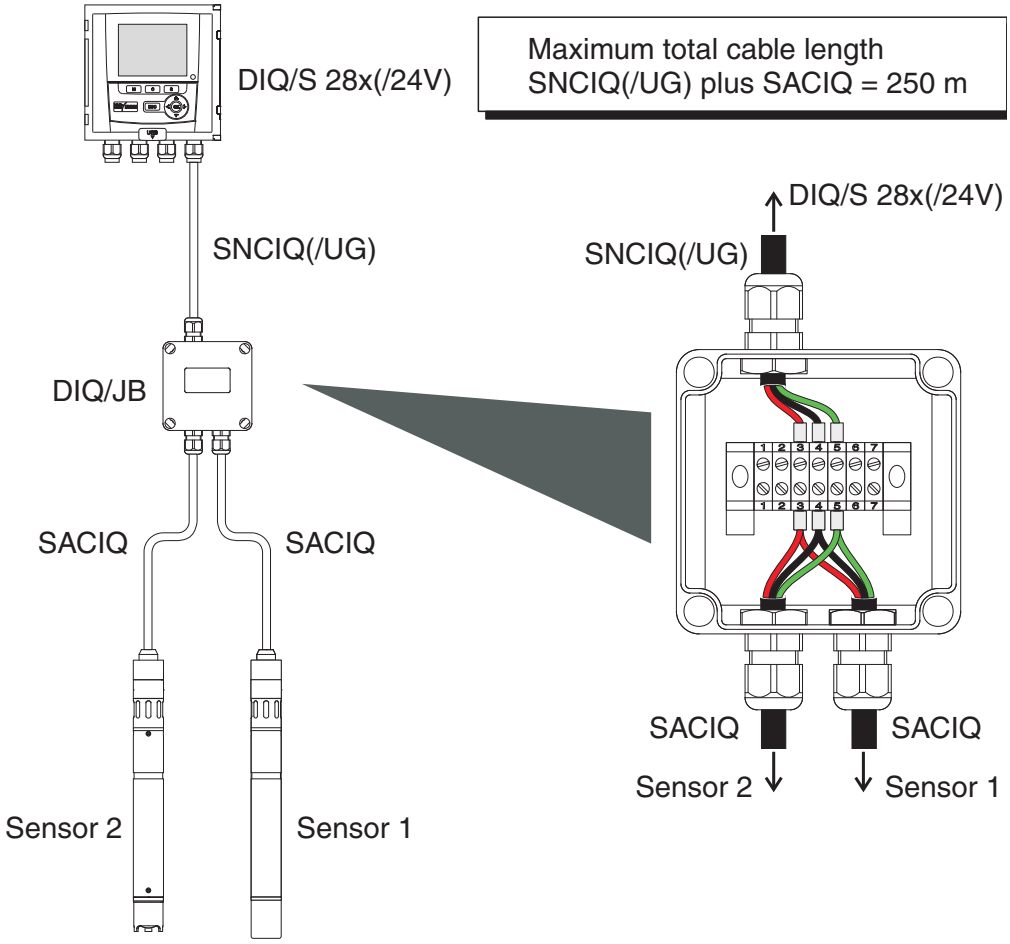
Fig. 3-20 Display after initialization of the terminal

Assign a name to each IQ sensor after putting it into operation for the first time so you can identify it more easily. How to assign a sensor name is described in section 5.4.1 on page 5-87.

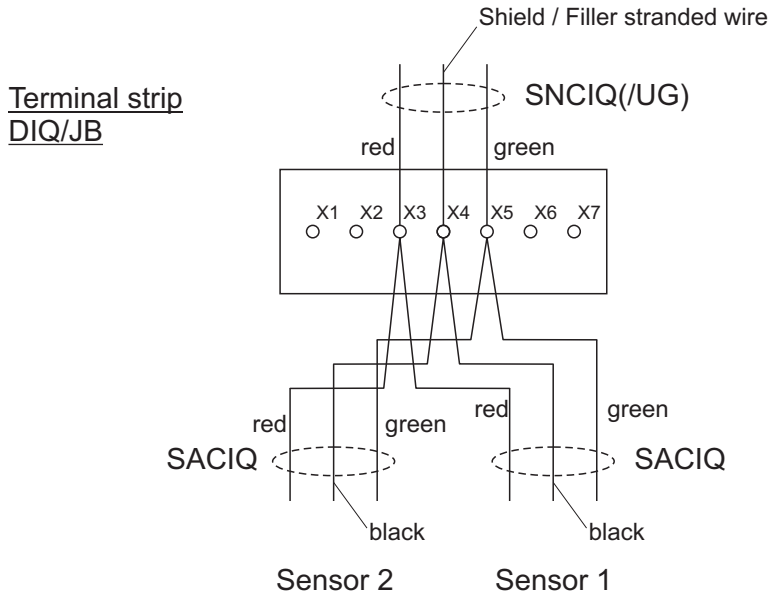
If the system start failed, see chapter 9 WHAT TO DO IF ....

3.12 Installation examples

3.12.1 Connecting two sensors without compressed air cleaning

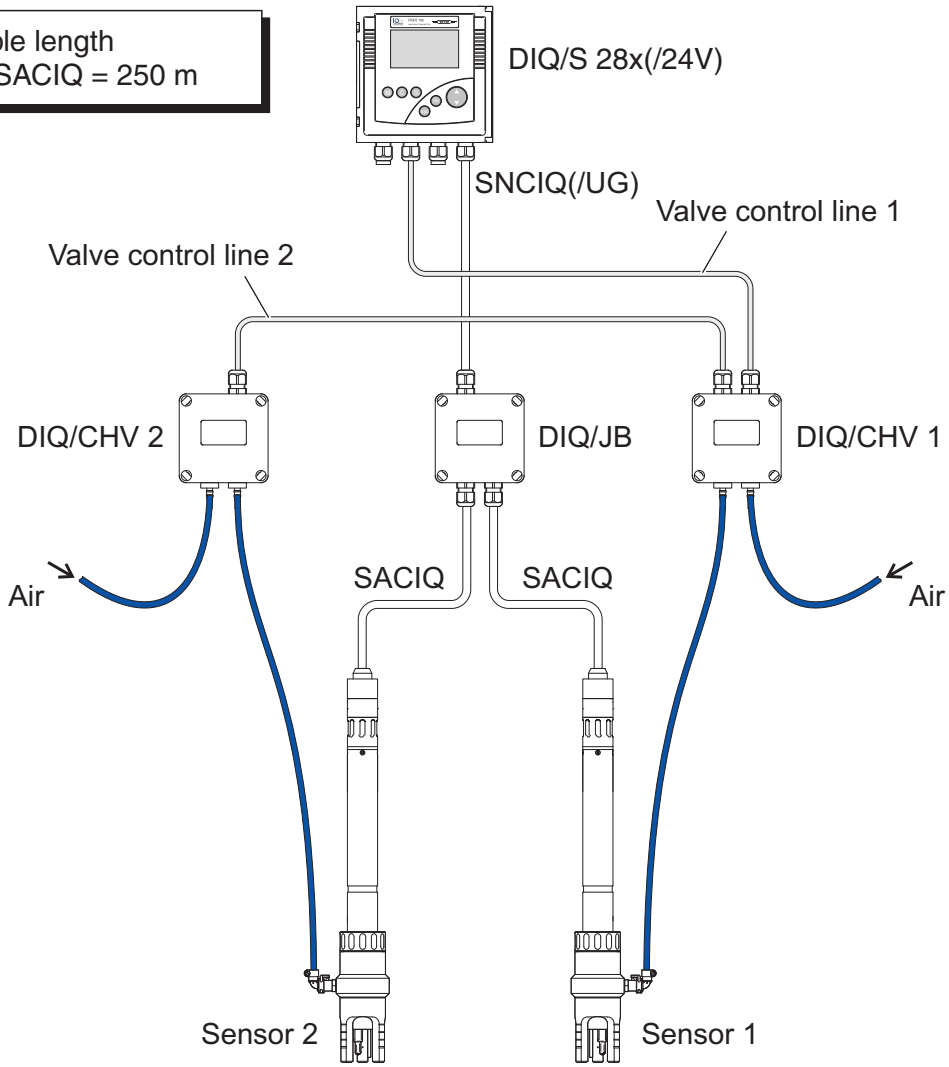


Connection scheme of the DIQ/JB



3.12.2 Connecting two sensors with compressed air cleaning

Maximum total cable length
SNCIQ(/UG) plus SACIQ = 250 m



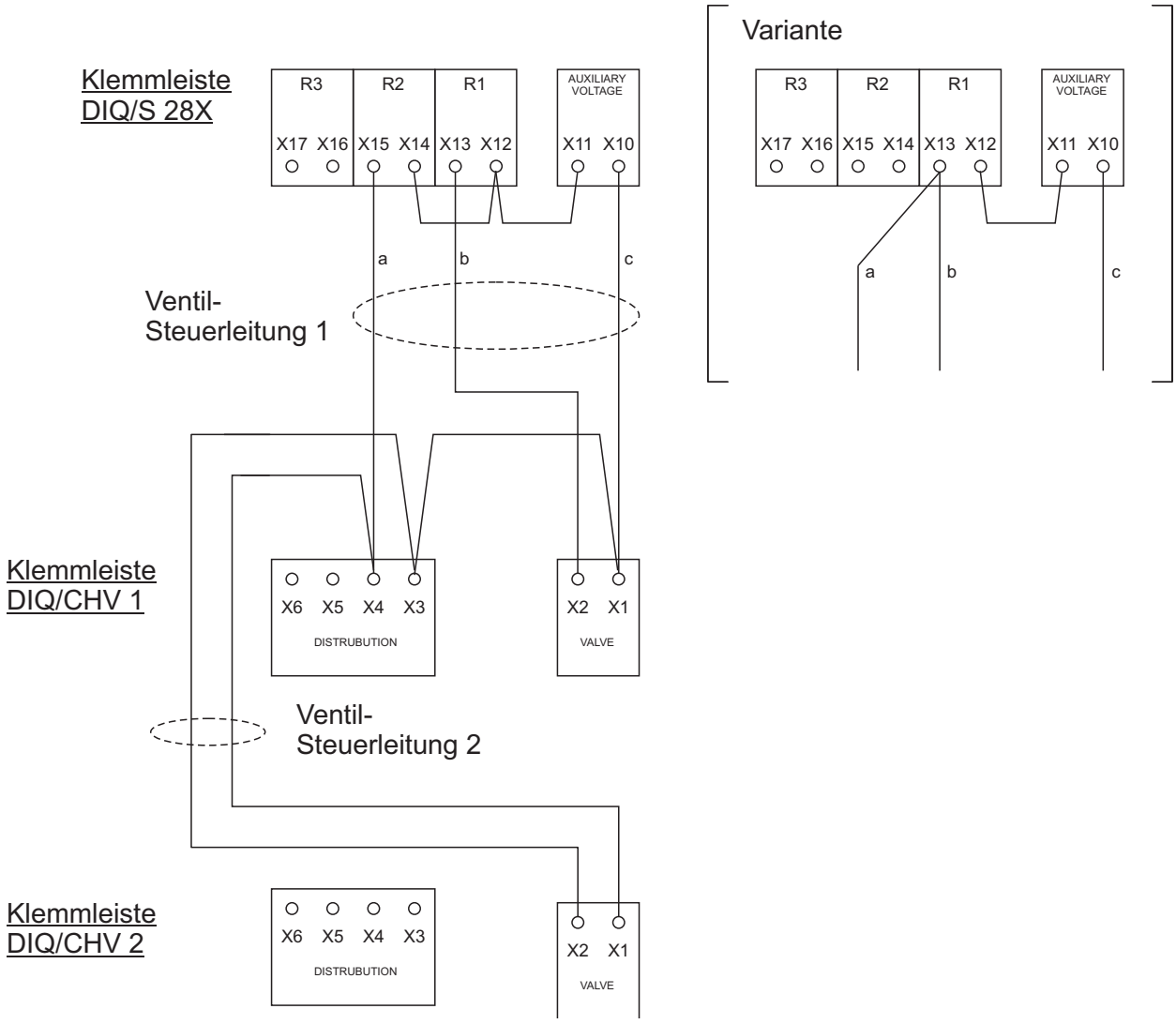
Connection scheme of valve control

Example:
Relay 1 controls the cleaning of sensor 1.
Relay 2 controls the cleaning of sensor 2.

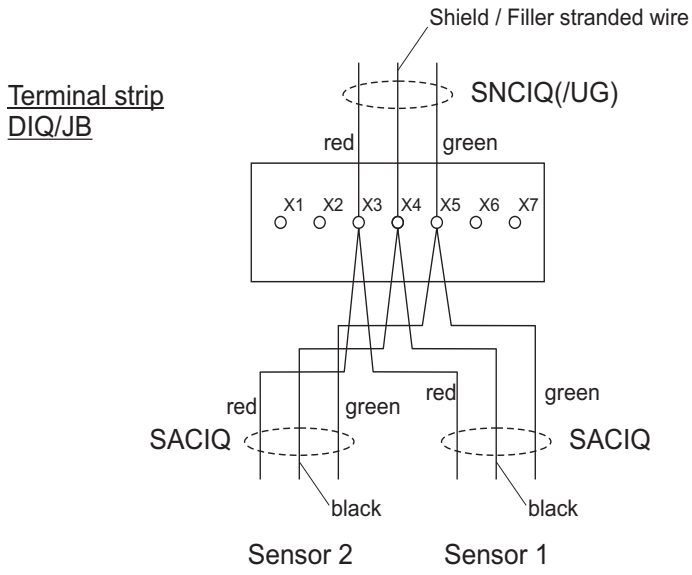
Variant: Relay 1 controls the cleaning of both sensors. Cleaning of both sensors is carried out with the same settings.

NOTE
In this configuration, the free switching contact (here: R3) may be used to switch SELV voltages only.

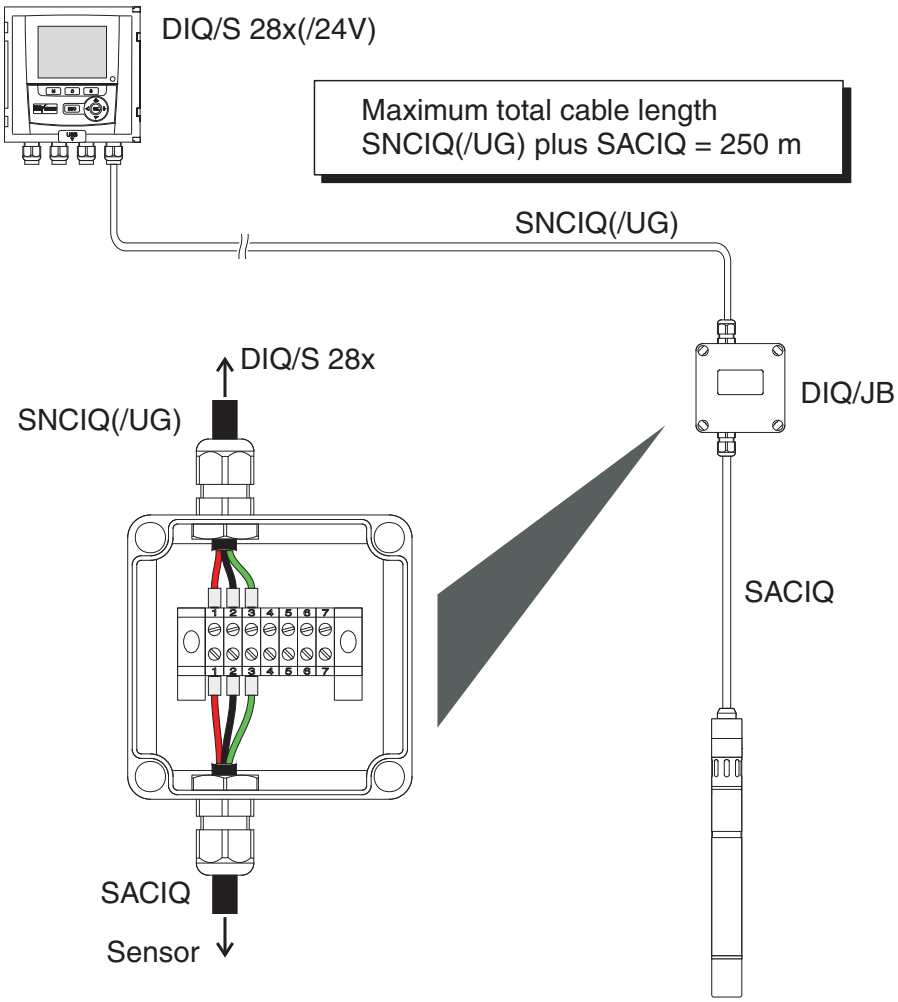
No free wires are allowed to project into the housing. Otherwise, there is a danger that areas safe to contact could come into contact with dangerous voltages. Always cut off any wires that are not in use as closely as possible to the cable gland.



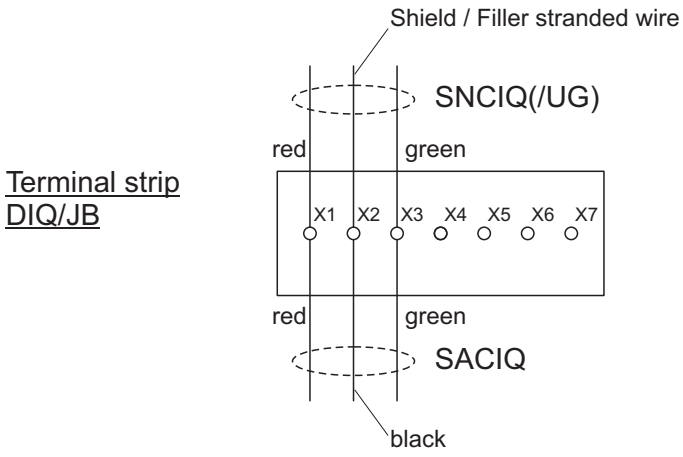
Connection scheme of the DIQ/ JB



3.12.3 Connection of a sensor that is located at a distance (without compressed air cleaning)



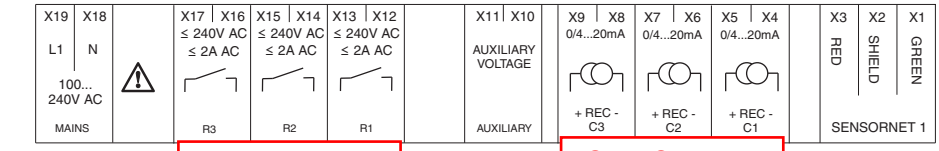
Connection scheme of the DIQ/ JB



Wiring details 2

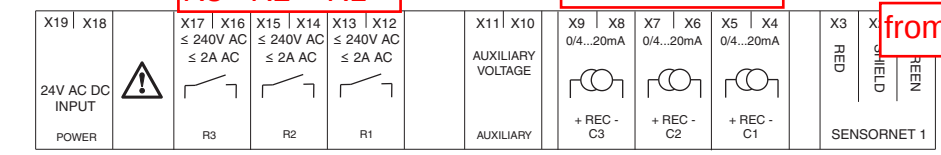
3.13 Figures of the terminal strips

DIQ/S 28X -CRx[-E]



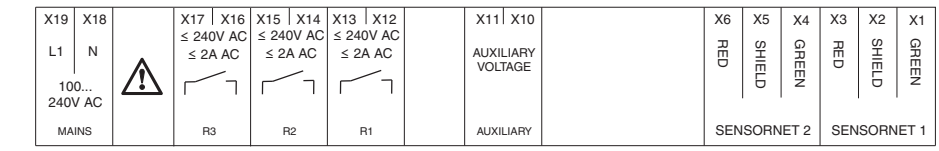
R3 R2 R1 A3 A2 A1

DIQ/S 28X -CRx[-E] /24V

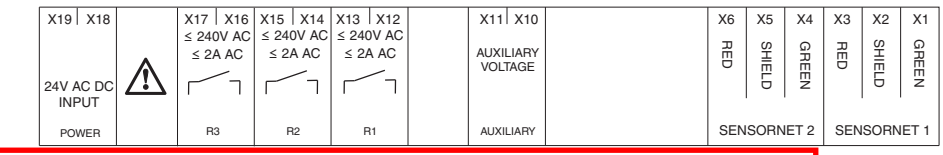


from JB4

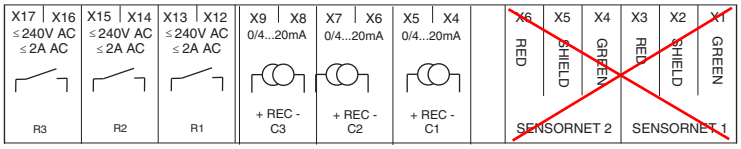
DIQ/S 28X -MOD, -PR, -EF



DIQ/S 28X -MOD, -PR, -EF /24V

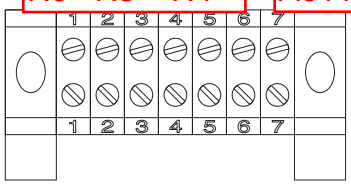


DIQ/CR3 (component of the DIQ/S 284-CR6 [-XX])



R6 R5 R4 A6 A5 A4

DIQ/JB



(7 passive, potential-free terminals for line extension)

DIQ/CHV



4 Operation

4.1 Operating elements

4.1.1 Overview of the operating elements

The Universal Transmitter is equipped with a large display for the clear presentation of current measured values, the graph of measured values, status displays and message texts.

The 5 keys **<M>**, **<C>**, **<S>**, **<ESC>**, **<OK>** and the arrow keys **<▲▼◀▶>** are used to operate the IQ SENSORNET system.

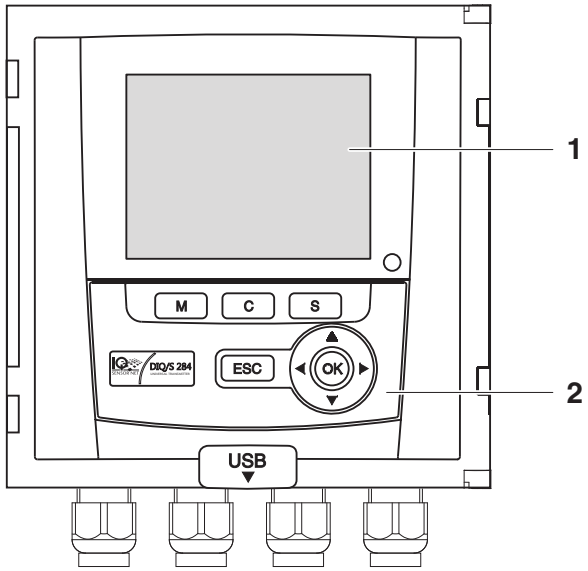


Fig. 4-1 Operating elements of the DIQ/S 28X

1 Display (see section 4.1.2 DISPLAY)

2 Keypad
Arrow keys and 5 keys **<M>**, **<C>**, **<S>**, **<ESC>**, **<OK>** (see section 4.1.3 KEYS)

4.1.2 Display

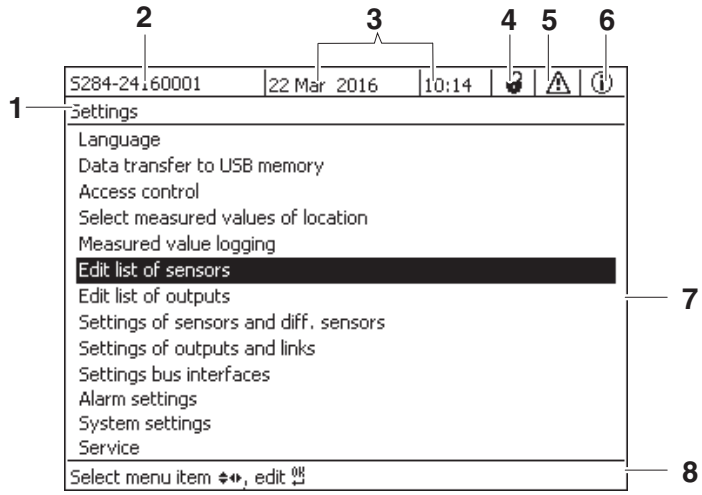


Fig. 4-2 Display

1 Name of the display indication (is skipped in the measured value display)

2 Name and series number (e.g. S284-16160001) of the instrument Under this name the DIQ/S 28X[-xx]-E(F) can be addressed in an Ethernet network (see section 6)

3 Date, time

4 User right (details see below)

5 Error symbol ⚠:
If the error symbol flashes, a new or unacknowledged error message is present in the log book that requires immediate action (see section 4.5.3).

6 Info symbol ⓘ:
If the info symbol flashes, new or unacknowledged information is present in the log book (see section 4.5.3).

7 Display range for measured values, menus, lists, etc.

8 Help line with operating instructions

Detail on the user right (4)

	Lock open: No access control, settings released System settings can be changed
	Crown: Administrator authorization Configuration and running operation of the system
	Tool: Maintenance authorization Running operation of the system and maintenance activities
	Eye: Monitoring permission Only read permission, no operation of the system

Measured value display

The measured value display contains the following information for each IQ sensor:

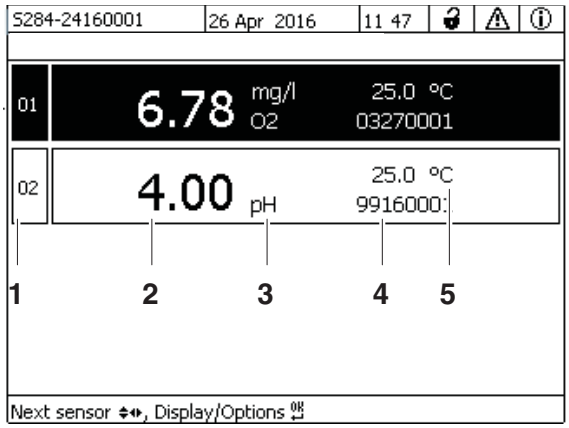


Fig. 4-3 Display - measured value display

1 Consecutive numbering of the measured values
2 Main measured value
3 Unit and parameter of the main measured value
4 Name of the sensor (to enter name: see section 5.4.1
5 User right (details see below)
6 Adjoining measured value with unit

Special displays

Init	Sensor is being initialized ● during commissioning or ● if a new IQ sensor is recognized that is not yet giving measured values
----	Invalid measured value
Cal	Sensor is being calibrated
Clean	Cleaning system active, sensor is offline
Error	Sensor is inactive or defective
OFL	Measuring range undercut or exceeded (overflow)
Display flashes	Sensor in maintenance condition

4.1.3 Keys

Key	Function
<M>	Display measured values
<C>	Start calibration of the IQ sensor selected in the measured value display
<S>	Open the *Einstellungen/Settings* menu
<ESC>	Change to the higher menu levels or abort entries without storing them
<OK>	Confirm selection
<▲▼◀▶> (arrow keys)	Highlight and select: ● Menu items ● Entries ● Columns or fields ● Letters or numerals



The selection highlighted with the arrow keys is displayed as white text on a black background (reverse video).

4.2 General operating principles

The operation of the IQ SENSORNET is standardized and user-friendly.

- Select an item with the arrow keys **<▲▼◀▶>**
  - Highlight individual elements in menus, lists and tables, e.g. menu entries, list elements, columns or fields
  - Select a setting in selection fields
  - Select a character in text entry fields
- Confirm a selection with the **<OK>** key.
- Break off an action and change to the next higher level with the **<ESC>** key.
- Start a calibration procedure with the **<C>** key.
- Switch to the settings with the **<S>** key.
- Change to the measured value display and break off current actions with the **<M>** key.

Short operating instructions are given in the help lines on the display.

Examples of the operating principles are given below:

- Navigation in menus, lists and tables (see chapter 4.2.1)
- Entering text and numerical values (see chapter 4.2.2)

If two or more terminals are used in an IQ SENSORNET, access to the functions **<C>** and **<S>** is blocked when the functions are already being used on another terminal.

4.2.1 Navigating in menus, lists and tables

1 Open the *Einstellungen/Settings* menu with **<S>**.
Menus appear in the form of a list on the display, e.g. the *Einstellungen/Settings* menu shown here.

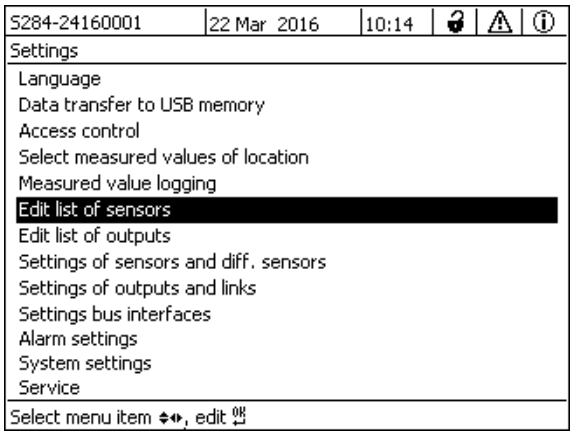


Fig. 4-4 Einstellungen/Settings

2 Select a menu item (e.g. *System settings*) with **<▲▼◀▶>**.
Move the highlighting (reverse video display, black background) in the list of menu items with the arrow keys **<▲▼◀▶>**.

3 Confirm the menu item (e.g. *System settings*) with **<OK>**.
The display (e.g. *System settings*) opens.
Confirm the selection and move to a new display by pressing the **<OK>** key.

4 Return to a higher level with **<ESC>**.
or:
Switch to the measured value display with **<M>**.

4.2.2 Entering texts or numerals

You can assign names to IQ sensors and MIQ output modules. Example: Entering a sensor name:

1 Open the *Einstellungen/Settings* menu with **<S>**.

2 Select the *Edit list of sensors* menu item with **<▲▼◀▶>**.

3 Confirm the *Edit list of sensors* menu item with **<OK>**.
The *Edit list of sensors* display opens. A column is highlighted.

4 Select the *Sensor name* column with **<▲▼◀▶>**.

5 Confirm the *Sensor name* column with **<OK>**.
A sensor name is highlighted.

6 Select a sensor name with **<▲▼◀▶>**.

S284-24160001	22 Mar 2016	10:14			
Edit list of sensors					
No.	Model	Ser. no.	Sensor name		
S01	SensoLyt700IQ	99160001	99160001		
S05	TetraCon700IQ	99190001	99886699		
S02	TriOxmatic700IQ	01341000	08410001		
S03	VARiON A	04460001	08410001		
S04	VARiON N	04460001	03270001		
Select ⇕⇔, display position/erase sensor					

Fig. 4-5 Edit list of sensors

7 Confirm the selection with **<OK>**.
The name of the selected sensor is edited.

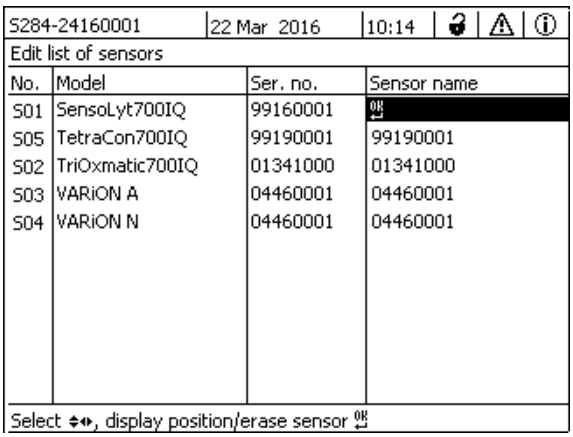


Fig. 4-6 Edit list of sensors

The following letters, numerals and special characters can be entered: **AaBb..Zz0..9µ%&/()+-=><!?_ °**.

8 Select a letter or numeral with **<▲▼◀▶>**.

9 Confirm the letter with **<OK>**.
The character OK appears behind the last letter.

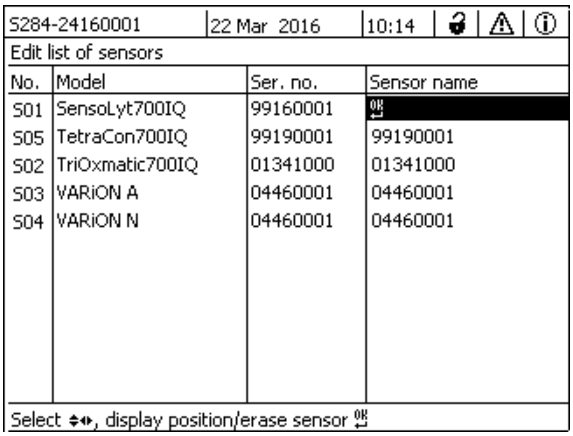


Fig. 4-7 Edit list of sensors

10 ● Add a new character
Select the character to be added with **<▲▼◀▶>** and confirm with **<OK>**.

or

● Delete the last character
Select the character with **<▲▼◀▶>** and confirm with **<OK>**.

or

● Adopt the name
Select the character with **<▲▼◀▶>** and confirm with **<OK>**.

11 Repeat steps 8 to 10 until the whole name has been entered.



You can break off entering the name with **<ESC>**. The old name is retained.

4.3 Access to the IQ SENSORNET with active access control



Access control is switched off in the delivery condition. No login to the IQ SENSORNET is required.

As soon as an access control of any type is enabled, access to the IQ SENSORNET is protected completely or partly.

Access to the system is enabled as follows:

- Connecting the electronic key to the USB interface (Universal Transmitter), if the administrator has enabled this function
- Entering a password

Extended access control:



In the *Display/Options* / *Change user rights* menu, enter the password with the arrow keys and confirm with OK.

Extended access control with instrument block:

Press the any button.
In the password query, enter the password with the arrow keys and confirm with OK.

Further details on access control (see section 5.3)

4.4 Display of current measured values

Several options can be selected for displaying the measured values:

- *Measured values (1 sensor)*
  The measured value is shown numerically and as a bar graph on the *Measured values (1 sensor)* display (see section 4.4.1)
- *Measured values (4 sensors)*
  The *Measured values (4 sensors)* display provides an overview of a maximum of four IQ sensors (see section 4.4.2)
- *Measured values (8 sensors)*
  The *Measured values (8 sensors)* display provides an overview of a maximum of eight IQ sensors (see section 4.4.3)

Switch between the different types of display as follows:

1 Call up the measured value display with **<M>**.

2 Open the *Display/Options* menu with **<OK>**.

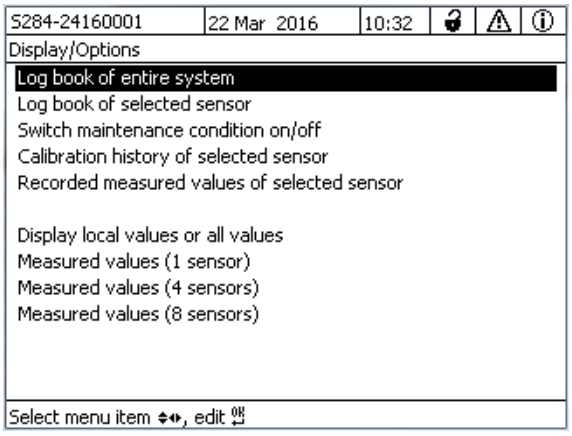


Fig. 4-8 Display/Options

3 Select and confirm a display type with **<▲▼◀▶>** and **<OK>**.The selected display is activated.

4.4.1 Displaying a single measured value

The measured value is shown numerically and as a bar graph on the *Measured values (1 sensor)* display.

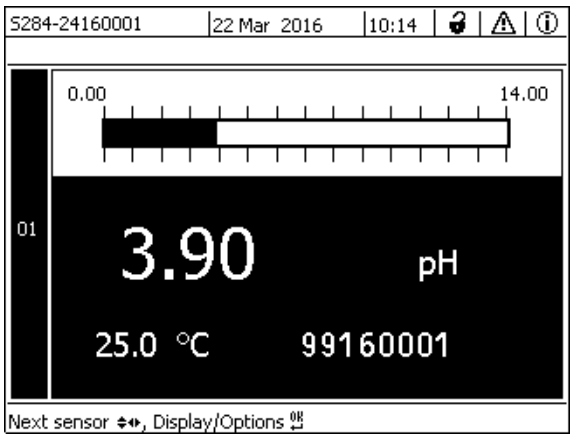


Fig. 4-9 Values: location -> Measured values (1 sensor)

4.4.2 Displaying four measured values

Up to four measured values of IQ sensors are shown on the display at the same time.

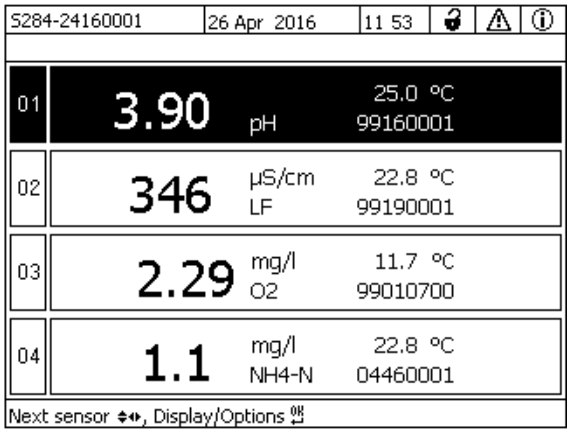


Fig. 4-10 Values: location -> Measured values (4 sensors)

4.4.3 Displaying eight measured values

Up to eight measured values of IQ sensors are shown on the display at the same time.

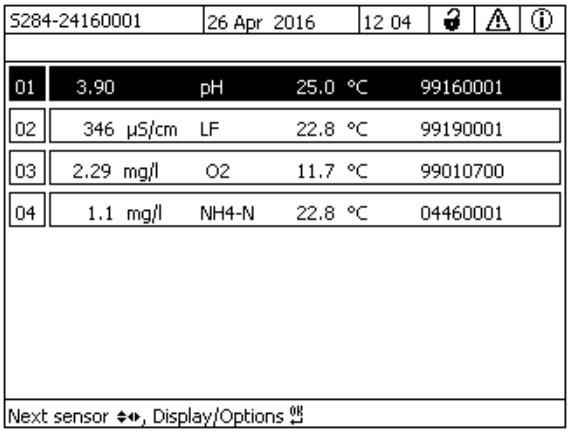


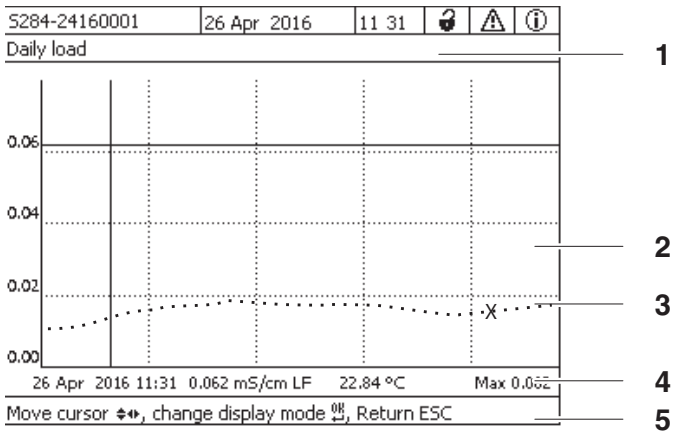
Fig. 4-11 Values: location -> Measured values (8 sensors)

4.4.4 Displaying recorded measured values

If the measured value recording has been activated for an IQ sensor (see section 5.10), the temporal course of the recorded measured values can be displayed numerically and graphically.

The following display options are possible:

- *Monthly load of selected sensor* (graphic display)
- *Weekly load of selected sensor* (graphic display)
- *Daily load of selected sensor* (graphic display)
- *Measured value list of selected sensor* (numerical display)



1 Display

2 Range of the graphical display
The time range (x-axis) corresponds to the selected type of display (1 day, 1 week, 1 month).
The value range of the y-axis is automatically adjusted to min and max values

3 Position of the cursor (X)

4 Data on the position of the cursor (X)
(date, time, main and secondary measured value)

5 Navigation instructions

Fig. 4-12 Daily load of selected sensor (example)

Displaying recorded measured values

1 Switch to the measured value display with **<M>**.

2 Select an IQ sensor with **<▲▼◀▶>**.

3 Open the *Display/Options* menu with **<OK>**.

4 Select one of the display types with **<▲▼◀▶>**
- *Monthly load of selected sensor*
- *Weekly load of selected sensor*
- *Daily load of selected sensor*
- *Measured value list of selected sensor*

and confirm with **<OK>**.
The selected option is displayed.

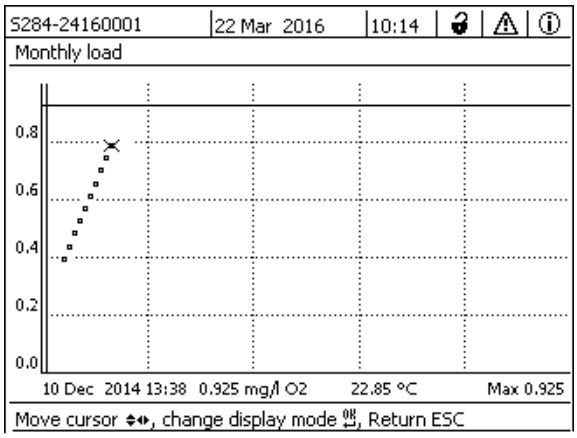


Fig. 4-13 Monthly load of selected sensor (example)

5 Move the cursor (X) along the measured value curve with **<▲▼◀▶>**. The cursor (X) marks the selected measured value.

6 Switch to the next display option with a shorter display period with **<OK>**.
or
Switch to the next display option with a longer display period with **<ESC>**.

4.4.5 Transmitting recorded measurement data to a PC

Recorded measured values can be transmitted to a PC via the Ethernet interface. For details on data transmission, see section 6.

4.5 Messages and log book

The IQ SENSORNET continuously monitors the status of the entire system. If the IQ SENSORNET identifies system changes, a message appears. New messages can be recognized by the flashing information symbol or error symbol on the display.

All messages are recorded in the log book.

4.5.1 Message types

The system differentiates two types of messages:

- **Error ⚠**
  Indicates a critical status in the system or an individual system component that requires immediate action.

In the case of new error messages, the error symbol flashes on the display.

- **Information** ⓘ
  Information that does not require immediate action.
  In the case of new information, the info symbol flashes on the display.



In the case of errors, immediately open the detailed message text in the log book and perform the recommended actions. If the actions have been performed, mark the message as read (see section 4.5.3).

4.5.2 Log book

The log book is a list with all the messages from all modules. The log book contains up to 1000 entries. If there are more than 1000 messages, the oldest entries are deleted.

New messages can be recognized by the flashing information symbol or error symbol. The log book always contains the latest message in the first position. They do not yet have a checkmark in the status field.

The flashing of the info or error symbol only stops after all detailed message texts in the log book have been opened and marked with a checkmark (✔) (see section 4.5.3).

Structure of the log book

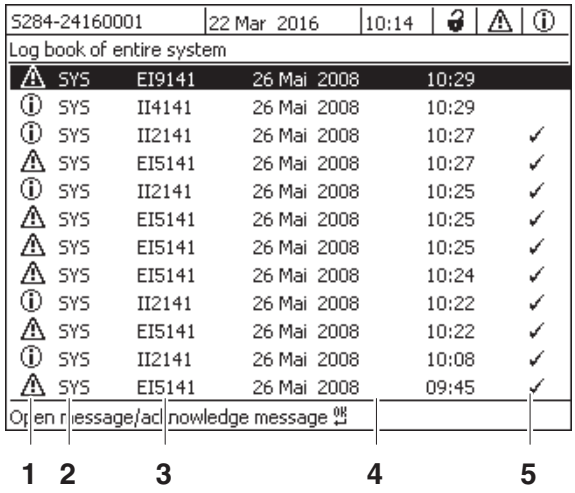


Fig. 4-14 Log book of entire system

1 Message category (error or info symbol)

2 Module that triggered the message.
SYS System (Universal Transmitter, controller)
S01 IQ sensor (number 01)
S?? IQ sensor (inactive, dataset erased)
D01 DIQ output module (number 01)
D?? DIQ output module (inactive, dataset erased)

3 Message code

4 Date and time of the message

5 Status field of the message
✔ Message was acknowledged
No checkmark Message was not acknowledged

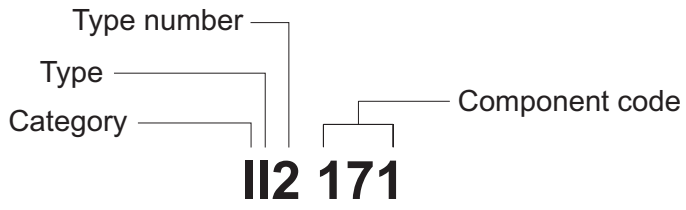
The system provides the following log books:

- *Log book of entire system*:
  List of all messages from all modules
- *Log book of selected sensor*:
  List of all messages from a single IQ sensor.

There is a detailed message text for each message of a module that is ready for operation. The detailed message text on each message is given in the log book (see section 4.5.3) and in the operating manual of the registering module.

Structure of the message code

The message code consists of 6 characters and can contain numerals and letters, e.g.: II21171.



Position	Information	Explanation
1 - 3	Short message form	The short form of the message contains the following information of the message: Category, type and type number
	1: possible categories	● Info message (I) ● Error message (E)
	2: possible types	● Calibration data (C) ● Installation and commissioning (I) ● Instructions for service and repair (S) ● Application instructions (A)
	3: Type number	Each type contains subtypes (0..9A..Z)
4 - 6	Module code	The three-digit module code designates the module that generated the message. The module code can be found in the chapter LISTS of the respective component operating manual.

Example: Message code II2171

The "171" module (Universal Transmitter DIQ/S 284) sends a message with the short message form "II2".
This is an info message (I) of the type Installation (I) with the type number (2).
The detailed message text of the short form message (II2) can be found in the log book and in the operating manual of the component that sent it.

The detailed message text in the log book contains a precise description of the message code and, if required, any further actions.

The detailed message texts can also be found in the component operating manuals of the individual components.

The log book shows the current status at the point of time it was opened. If new messages arrive while a log book is open, these do not appear in the log book. As usual, you are informed of new messages by flashing info or error symbols. The current log book with the new messages can be viewed by closing and reopening the log book.

4.5.3 Viewing detailed message texts

1 Switch to the measured value display with **<M>**.

2 Open the *Display/Options* menu with **<OK>**.

3 Using **<▲▼◀▶>** and **<OK>**, select and open the *310 - Log book of entire system*.
A list of log book entries appears.

4 Using **<▲▼◀▶>** and **<OK>** select and confirm a new log book entry (unchecked).
The message text with further information on the selected log book entry appears.

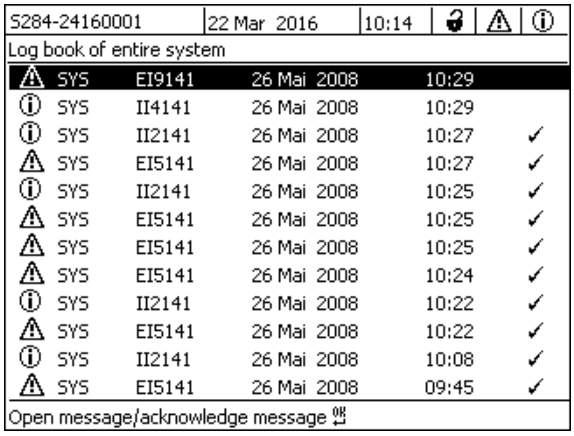


Fig. 4-15 Log book of entire system

5 Acknowledge the message with **<OK>**. A checkmark appears in the log book entry.

6 Exit the message text with **<ESC>**.

Acknowledgment of a new message text in the log book marks the message as read. When all errors or information messages are acknowledged, the symbols no longer flash.

With the *Acknowledge all messages* function you can acknowledge all messages at the same time (see section 4.5.4).

Message texts are stored in the modules that caused them. Therefore, further information on a log book entry for an IQ sensor such as, e.g. calibration messages, instructions and help texts are only accessible in the case of connected components that are ready for operation.

If a message text is not available because, e.g. a module is not connected with the system, you can look up the detailed text of the message as follows:

- Messages of the system are given in this operating manual (see section 12.1).
- Messages of a module are given in the respective component operating manual of the module.

4.5.4 *Acknowledge all messages*

1 Switch to the measured value display with **<M>**.

2 Open the *Einstellungen/Settings* menu with **<S>**.

3 Using **<▲▼◀▶>**, select the menu item, *Service* and confirm with **<OK>**.

4 Using **<▲▼◀▶>**, select the menu item, *Acknowledge all messages* and confirm with **<OK>**. A security prompt opens.

5 Using **<▲▼◀▶>**, select *Acknowledge* and confirm with **<OK>**. All messages are acknowledged. Error symbol and info symbol do no longer flash.

4.6 Calibration data

Details on calibration are given in the operating manual for the IQ sensor.

Each calibration of IQ sensors that are able to be calibrated causes an entry to be made in the log book. Log book entries contain the following information:

- Calibration date
- Calibration successful or not successful.

The detailed calibration data of the last calibrations are integrated in the *Calibration history of selected sensor* overview.

All calibration data are stored in the IQ sensor. In order to view the calibration data of an IQ sensor, the IQ sensor must be connected to the IQ SENSORNET and must be ready for operation.

4.6.1 Calibration entries in the log book

The date and time of a calibration are entered in the log book. The respective message text contains an indication as to whether a calibration was successful or not. The values determined with calibration can be viewed in the calibration history (see section 4.6.2).

1 Call up the measured value display with **<M>**.

2 Using **<▲▼◀▶>**, highlight a sensor and confirm with **<OK>**.
The *Display/Options* menu opens.

3 Using **<▲▼◀▶>**, highlight the menu item, *Log book of selected sensor*, and confirm with **<OK>**. Calibration entries in the log book are held in message code (ICxxxx and ECxxxx).

4 Select and open a calibration entry (ECxxxx or ICxxxx) with **<▲▼◀▶>** and **<OK>**.

5 Exit the *Calibration history of selected sensor* with **<▲▼◀▶>**.

4.6.2 Calibration history

The calibration history contains the detailed calibration data of the last calibrations.

1 Call up the measured value display with **<M>**.

2 Using **<▲▼◀▶>**, highlight a sensor and confirm with **<OK>**.
The *Display/Options* menu opens.

3 Using **<▲▼◀▶>**, highlight the menu item, *Calibration history of selected sensor*, and confirm with **<OK>**.
The calibration history with the results of the last calibration procedures opens.

4 Exit the *Calibration history of selected sensor* overview with **<M>**.

4.7 Status info of sensors and outputs

The display of the instrument status provides a simple overview of the current modes of sensors (sensor info) and outputs in the IQ SENSORNET.

The status display can be reached in the *Einstellungen/Settings*/*Service*/*List of all components* menu (see section 4.10).

1 Call up the *List of all components* (see section 4.10).

2 Highlight the required component with **<▲▼◀▶>** and confirm with **<OK>**.
- Output module: The *Status of output channels* window opens up (for details, refer to the operating manual of the output module).
- Sensor: The sensor info opens up (for details, refer to the operating manual of the selected sensor).

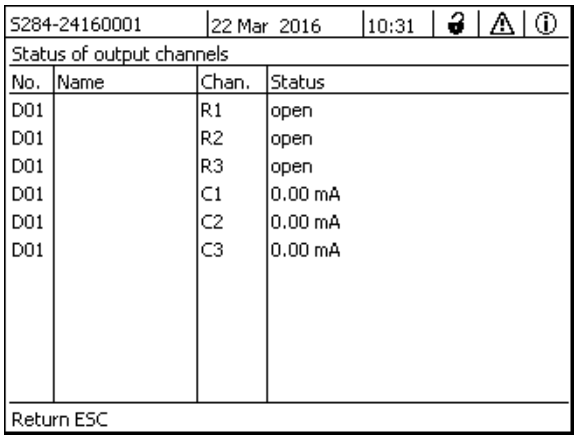


Fig. 4-16 List of all components with sensor info

3 Exit the *Status of output channels* window with **<M>** or **<ESC>**.

4.8 General course when calibrating, cleaning, servicing or repairing an IQ sensor

When an IQ sensor is calibrated, cleaned, serviced or repaired, the maintenance condition for the relevant IQ sensor should always be switched on.

In the maintenance condition

- the system does not react to the current measured value or the condition of the selected IQ sensor
- linked outputs are frozen
- IQ sensor errors do not prompt changes in the conditions of linked outputs.

The maintenance condition for IQ sensors is automatically activated

- during calibration. After calibration the IQ sensor remains in the maintenance condition until the maintenance condition is switched off manually (see section 4.8.3)
- during a compressed air cleaning cycle.

Therefore, keep to the following course when you calibrate, clean, service or repair an IQ sensor.

Outlet

1 Switch on the maintenance condition for the IQ sensor (see section 4.8.2).
The display of the sensor in the measured value display flashes.

2 Pull the sensor out of the sample.

3 Perform the calibration in the laboratory, cleaning, maintenance or repair (removing and replacing) of the sensor (about these topics, see the component operating manual of the corresponding sensor).

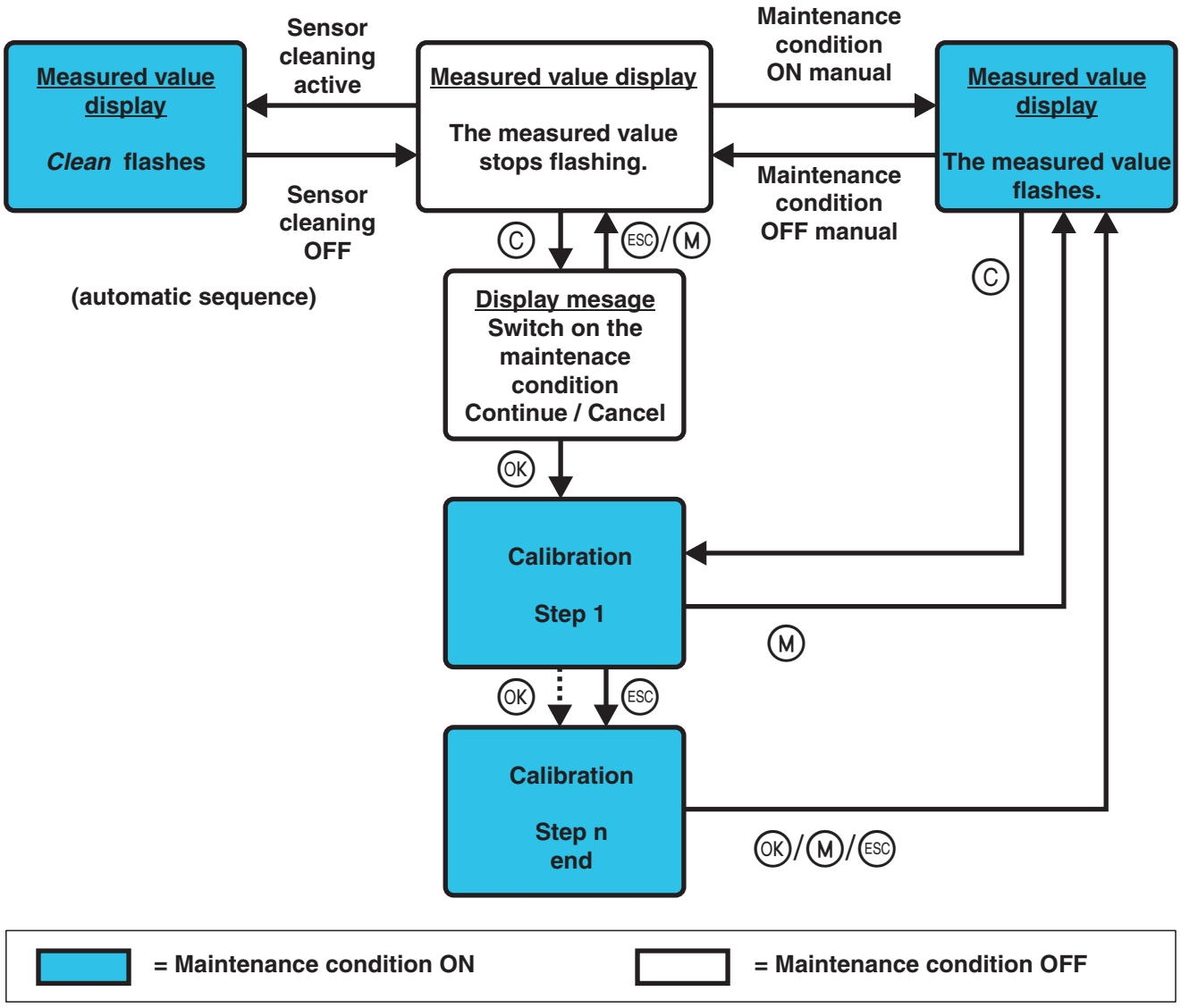
4 Submerse the sensor in the sample again.

5 Wait until the measured value no longer changes.

6 Switch off the maintenance condition for the sensor (see section 4.8.3).
The display of the sensor in the measured value display no longer flashes.

4.8.1 Maintenance condition of IQ sensors

The following diagram gives you an overview of when an IQ sensor is in the maintenance condition.



4.8.2 Switching on the maintenance condition

Switch on the maintenance condition manually when you want to clean, service or repair (remove and replace) an IQ sensor.

1 Press **<M>** to call up the measured value display.

2 Select the sensor you want to switch on the maintenance condition for with **<▲▼◀▶>**.
The display of the sensor in the measured value display does not flash.

3 Open the *Display/Options* menu with **<OK>**.

4 Using **<▲▼◀▶>**, highlight the menu item, *Switch maintenance condition on/off*, and confirm with **<OK>**.
A window that informs you about the maintenance condition opens up.

5 Use **<OK>** to confirm *Continue*.
The selected sensor is in the maintenance condition. Linked outputs are frozen.

6 Call up the measured value display with **<M>**.
The display of the sensor in the measured value display flashes.

Subsequently, perform the cleaning, maintenance or repair work (removal and replacement).

When you have finished calibrating, cleaning, servicing or repairing the sensor, switch off the maintenance condition manually (see section 4.8.3).

4.8.3 Switching off the maintenance condition

1 Call up the measured value display with **<M>**.

2 Select the sensor you want to switch off the maintenance condition for with **<▲▼◀▶>**.
The display of the sensor in the measured value display flashes.

3 Open the *Display/Options* menu with **<OK>**.

4 Using **<▲▼◀▶>**, highlight the menu item, *Switch maintenance condition on/off*, and confirm with **<OK>**.
A window that informs you about the maintenance condition opens up.

5 Use **<OK>** to confirm *Continue*.
The maintenance condition of the selected sensor is switched off. Linked outputs are released.

6 Call up the measured value display with **<M>**.
The display of the sensor in the measured value display does not flash.



If a power failure occurs, the outputs automatically are in the non-operative condition (relays: open, current output: 0 A; see component operating manual of the output module). After the end of the power failure the outputs work as defined by the user again.

If a power failure occurs while an IQ sensor that is linked with an output is in the maintenance condition, the current and relay outputs work as defined by the user after the maintenance condition has been switched off only (see section 4.8.3).

4.9 USB interface

The USB interface on the DIQ/S 28X can be used for the following actions:

- Saving data of the IQ SENSORNET to a USB memory device (see section 4.9.1)
- Transmitting configuration data to the Universal Transmitter (see section 4.9.2)
- Carrying out a software update (see section 4.11)
- Accessing the system with the Electronic Key (see section 4.3)

4.9.1 Saving IQ SENSORNET data to a USB memory device

You can save the following data types:

- Configuration data (see section 4.9.2)
- Measurement data (see section 4.9.2)
- Log book
- Calibration history

The configuration data can be transferred from the USB memory device back to the IQ SENSORNET. Thus, you can very easily create systems that are configured identically.

Data backup

1 Switch to the measured value display with **<M>**.

2 Open the *Einstellungen/Settings* menu with **<S>**.

3 Use **<▲▼◀▶>** and **<OK>** to open the *Data transfer to USB memory* menu.

4 Select the data to be saved with **<▲▼◀▶>**.
- *Save configuration*
- *Measured data storage*
- *Log book*
- *Calibration history*

and confirm with **<OK>**.

5 The data are prepared for the transfer.



You can cancel the data saving process by highlighting and confirming the Cancel menu item with **<▲▼◀▶>** and **<OK>**. In this case the data will not be stored to the USB memory device.

6 Press **<▲▼◀▶>** to highlight the *Save* menu item and confirm with **<OK>**.
The selected data will be stored to the USB memory device.

4.9.2 Restore system configuration

The restoration of a configuration back to the universal transmitter is carried out manually from the USB memory. For this it is useful to save the configuration to a USB memory device manually and regularly.

Manual restoration

To transfer configuration data to the Universal Transmitter, proceed as follows:

1 Open the *Settings* menu with **<S>**.

2 Press **<▲▼◀▶>** to select the menu item *Data transfer to USB memory* and press **<OK>**.

3 Press **<▲▼◀▶>** to select the menu item *Retransfer configuration* and press **<OK>**. The process is started.

4 Wait until the restore is terminated.

5 Confirm the concluding message with **<OK>**.

4.10 Info on software versions

The system informs you of the current versions of the software of the individual IQ SENSORNET components.

1 Call up the measured value display with **<M>**.

2 Open the *Einstellungen/Settings* menu with **<S>**.

3 Using **<▲▼◀▶>**, highlight the menu item, *Service*, and confirm with **<OK>**. The *Service* dialog window opens.

4 Using **<▲▼◀▶>**, highlight the menu item, *List of all components*, and confirm with **<OK>**.
The *List of all components* dialog box opens.

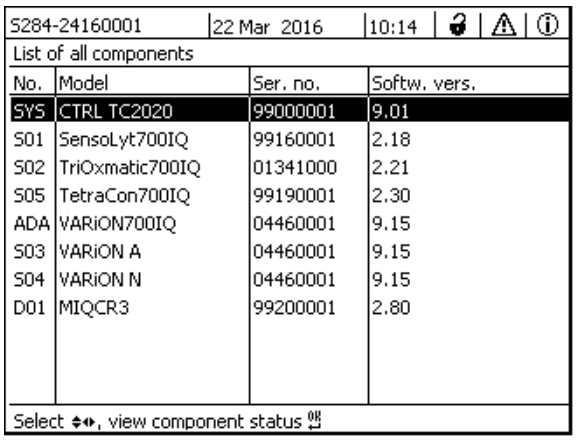


Fig. 4-17 List of all components

5 Exit the *List of all components* dialog box with **<M>** or **<ESC>**.

If the software version of a component is not up-to-date, you can carry out a software update via the USB interface (see section 4.11).

4.11 Software-Update for DIQ/S 28X

With a Software-Update, you maintain the latest state of the instrument software for the Universal Transmitter DIQ/S 28X and all active components.

The update packet with the current instrument software for active IQ SENSORNET components and detailed instructions on how to proceed are available on the Internet under www.YSI.com.

The instrument software is transferred to the System 28X via the USB port and with the aid of a USB memory device.

A Software-Update does not change the measurement settings, measurement data and calibration data.

You can view the software versions of all components in the dialog box, *List of all components* (see section 4.11).

5 Settings/setup

5.1 Selecting the language

A list shows all the available system languages.

1 Open the *Einstellungen/Settings* menu with **<S>**.

2 Using **<▲▼◀▶>** and **<OK>**, select and confirm the menu item, *Language*.
The *Language* display opens.

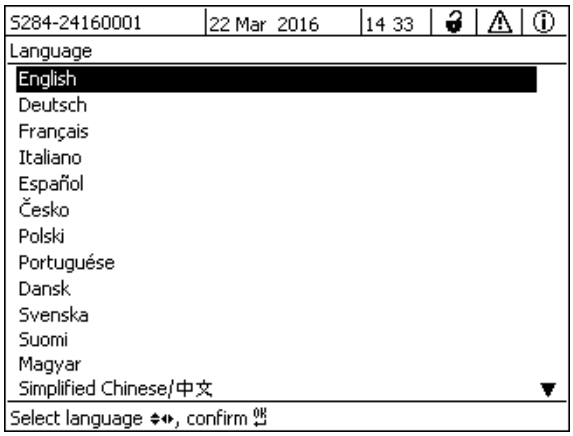


Fig. 5-1 Language

3 Select a language from the list with **<▲▼◀▶>** and confirm with **<OK>**.
The active language is marked with a checkmark.

4 Switch to the higher menu level with **<ESC>**.
or:
Switch to the measured value display with **<M>**.

If the selected system language is not available in a component, all indications of this component (e.g. sensor, Universal Transmitter, output module) appear in the standard language, *English*. To activate the selected system language for this component, a software update of the component is required (see section 4.11).

5.2 Terminal settings of the DIQ/S 28X

The terminal settings include:

- *Terminal name*

- *Illumination brightness*
- *Illumination brightness (standby)*

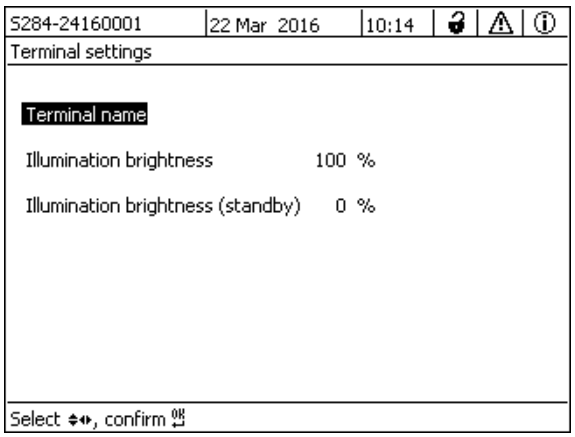


Fig. 5-2 Terminal settings

Setting	Selection/Values	Explanation
Terminal name	AaBb..Zz 0..9µ%&/() +-=><!?_ °	User-defined character string with max. 15 characters
Illumination brightness	AUTO 0 ... 100 %	Brightness of the display during operation of the terminal
Illumination brightness (standby)	AUTO 0 ... 50 %	Brightness of the display during operation if no key is pressed for a longer period of time

5.3 Access control

Use the *Access control* function to define the safety settings for the IQ SENSORNET.

The DIQ/S 28X provides the following levels of system security:

- Access control
  (4 authorization levels, see section 5.3.1):
  - No access control
  - Administrator authorization
  - Maintenance authorization
  - Read permission
- Access control with instrument block (see section 5.3.2):

Access to the system with active access control (see section 4.3).

Default settings

Access control is switched off in the delivery condition.
Any user can carry out all functions.

Saving the password

If access control for the IQ SENSORNET is active and the administrator password is lost, rapid administrator access to the IQ SENSORNET is no longer possible.

To avoid losing the administrator password, we recommend saving it. This also applies to the use of the electronic key.

To save the administrator password, you can save it on an electronic key, for example, and/or note it down on paper or on a PC. Keep the passwords in a safe place.

If the IQ SENSORNET is locked and the administrator password lost, you can unlock the system with a master password. Please contact the service department.

The master password is valid for 7 days.

If you have unlocked the IQ SENSORNET with the master password, we recommend to note down the normal administrator password and keep it in a safe place.

5.3.1 Activating the access control

Access control provides three preconfigured user rights in the system. Each user type can be protected with its own password.

User right

The current user right is shown on the display with the following symbols.

Validity	User right	Symbol	User rights
System-wide	Settings are unlocked (access control swiched off)		All functions in the system are accessible to all users

Validity	User right	Symbol	User rights
	Administration		● Access only with password ● Change system settings ● Assign user rights ● Calibration ● Data backup ● Restore configuration ● View measured values ● Carry out software updates
	Maintenance		● Access only with password ● Calibration ● Data backup ● View measured values
	Viewer		● Without instrument block: Access without password ● With instrument block: Access only with password ● Data backup ● View measured values
For the instrument on which the function was activated	Instrument block		● Instrument block switched off: User rights as for *Viewer*. ● Instrument block active: The System 28X is blocked. Only the IQ SENSORNET logo is displayed. Access only with password.

Switching on the access control

1 Open the *Settings* menu with **<S>**.

2 Using **<▲▼◀▶>** and **<OK>**, select and confirm the menu item, *Access control*.
The *Simple access control* dialog window opens.

3 Using **<▲▼◀▶>**, select the function, *Activate extended access control* and confirm with **<OK>**.
User right and instrument block can be selected.

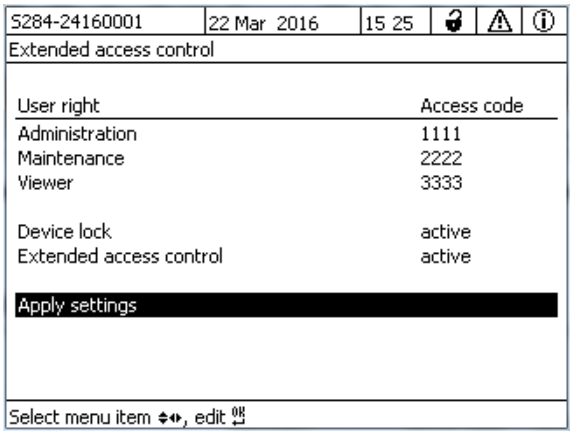


Fig. 5-3 Settings -> Access control -> Extended access control

The instrument automatically generates a password for each user right. This password can be accepted or changed.

4 Press **<▲▼◀▶>** to select an user right and confirm with **<OK>**.
If necessary, change the password in the selection dialog and/or save the password to a connected USB memory.

5 Note passwords.
For reasons of safety the administrator password at least should be saved in such a way that it can be accessed in an emergency.

6 Press **<▲▼◀▶>** to select the *Apply settings* function and confirm with **<OK>**.
A security prompt opens.

7 Using **<▲▼◀▶>**, select *OK* and confirm with **<OK>**.
The settings are adopted.
The *Extended access control* window is still open.
The current passwords are visible.
The *Viewer* user right is active.

Switching off the access control

1 Press **<OK>** to open the *Display/Options* / *Change user rights* menu.
The password query is displayed.

2 Enter and confirm the administrator password with **<▲▼◀▶>** and **<OK>**.

3 Open the *Settings* menu with **<S>**.
Deactivate the access control.
Take over the setting.

5.3.2 Activating the instrument block

With the function *Device lock* you can protect the Universal Transmitter no only against unauthorized operating bus also against unauthorized reading of the current measured values. By activating the instrument block the password for viewing the measured values is activated.

After a selected interval without user entries, the system is automatically blocked. The display shows only the IQ SENSORNET logo.

Switching on the instrument block

1 Call up the access control (see section 5.3.1).

2 Press **<▲▼◀▶>** to select the *Device lock* function and confirm with **<OK>**.
A checkmark appears next to the function.

3 Press **<▲▼◀▶>** to select the *Apply settings* function and confirm with **<OK>**.
A security prompt opens.

4 Using **<▲▼◀▶>**, select *OK* and confirm with **<OK>**.
The settings are adopted.
The *Access control* dialog window is still open.
The current passwords are visible.

Switching off the instrument block

1 Press **<OK>** to open the *Display/Options* / *Change user rights* menu.
The password query is displayed.

2 Enter and confirm the administrator password with **<▲▼◀▶>** and **<OK>**.

3 Open the *Settings* menu with **<S>**.
Deactivate the access control.
Take over the setting.

5.3.3 Electronic key

The administrator can simplify access to the IQ SENSORNET by saving the password to USB memory. The USB memory thereby becomes an electronic key.

When the electronic key is connected to the System 28X, the user right stored there with the relevant password is automatically read out. The user of the electronic key is logged on to the system with his user right without any further password prompt.

When the electronic key is disconnected, the IQ SENSORNET automatically switches to the lowest user right.

Passwords for different IQ SENSORNET systems can be saved to every electronic key.
For each IQ SENSORNET system only one password can be saved to each electronic key.

Saving a password to an electronic key

1 Connect the USB memory to the USB-A interface.

2 Open the *Settings* menu with **<S>**.

3 Using **<▲▼◀▶>** and **<OK>**, select and confirm the menu item, *Access control*.
The *Access control* dialog window opens.

4 Press **<▲▼◀▶>** to select an authorization level and confirm with **<OK>**.

5 Using **<▲▼◀▶>**, select the menu item, *Save access code on USB memory* and confirm with **<OK>**.
The password for the system settings is saved to the USB memory.

5.3.4 Access to the IQ SENSOR NET with active access control

Simple access control

- Administrator access after entering the password in order to take over a changed setting:
  The protection is automatically reactivated after the one setting was changed.
- Administrator access through connecting the electronic key: The protection is restored by disconnecting the electronic key

Access control (with instrument block):

- Administrator access through entering the password:
  - After 10 minutes without key-pressing, the highest protection level is automatically activated.
  - Select the menu *Display/Options* / *Viewing only*.
    The highest level of protection is activated.
- Administrator access through connecting the electronic key: The protection is restored by disconnecting the electronic key

5.4 Editing the list of sensors

The *Edit list of sensors* display provides an overview of all IQ sensors and inactive datasets (see section 9.3.2).

In the *Edit list of sensors* display, you can:

- assign sensor names (see section 5.4.1)
- delete inactive datasets (see section 5.4.1)
- change the order of the display of measured values on the measured value display (see section 5.4.2).

5.4.1 Entering / editing a name for an IQ sensor

For the easier identification of the IQ sensors you can assign an individual name to each IQ sensor.

1 Open the *Einstellungen/Settings* menu with **<S>**.

2 Using **<▲▼◀▶>** and **<OK>**, select and confirm the menu item, *System settings -> Edit list of sensors*.
The *Edit list of sensors* display opens.

3 Using **<▲▼◀▶>**, highlight the *Sensor name* column. Confirm with **<OK>**.

4 Using, **<▲▼◀▶>** highlight the name of a sensor and confirm with **<OK>**.

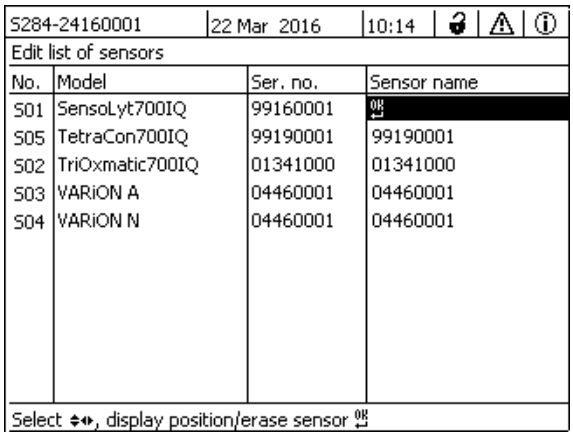


Fig. 5-4 Edit list of sensors

5 Enter the name with **<▲▼◀▶>** and **<OK>** and confirm with **<OK>** (see section 5.4.1).

5.4.2 Changing the display position

The numbering of the sensors is generated by the system. The order of the sensors in the measured value display and in the *Edit list of sensors* overview can be individually determined.

1 Open the *Einstellungen/Settings* menu with **<S>**.

2 Using **<▲▼◀▶>** and **<OK>**, select and confirm the menu item, *System settings -> Edit list of sensors*.
The *Edit list of sensors* display opens.

3 Using **<▲▼◀▶>**, highlight the *Model* column. Confirm with **<OK>**.

4 Press **<▲▼◀▶>** to highlight a *Model* and confirm with **<OK>**.
A dialog window opens.

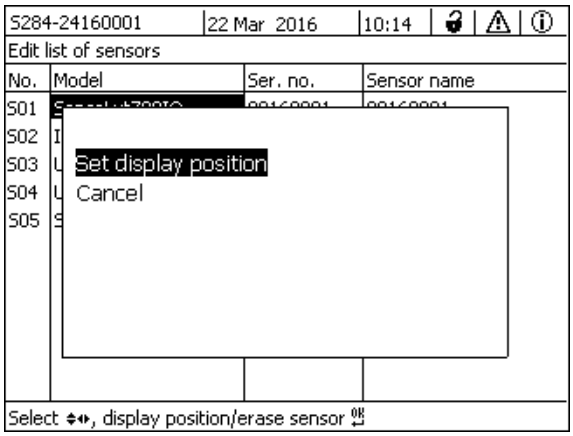


Fig. 5-5 Edit list of sensors -> Set display position

5 Using **<▲▼◀▶>**, select the menu item, *Set display position* and confirm with **<OK>**. A dialog window opens.

6 Press **<▲▼◀▶>** to select the required number for the display position and confirm with **<OK>**.
The sensor is displayed at the new position in the list of sensors. The other sensors are moved accordingly.

5.4.3 Erasing inactive sensor datasets

An inactive dataset for an IQ sensor arises if the Universal Transmitter receives no signals from an already registered IQ sensor. The *Error* display appears on the measured value display instead of a measured value. Inactive datasets can be recognized by a question mark, e.g. "?01" in the *Edit list of sensors* overview.

An inactive dataset can be reactivated by assigning it, e.g. to an IQ sensor of the same type (see section 9.3.2). All settings are retained. If these data are no longer required, they can be erased. All the data and settings and the link with an output belonging to this IQ sensor are erased by this action.

1 Open the *Einstellungen/Settings* menu with **<S>**.

2 Using **<▲▼◀▶>** and **<OK>**, select and confirm the menu item, *System settings -> Edit list of sensors*.
The *Edit list of sensors* display opens.

3 Using **<▲▼◀▶>**, highlight the *Model* column. Confirm with **<OK>**.

4 Press **<▲▼◀▶>** to highlight a *Model* and confirm with **<OK>**.

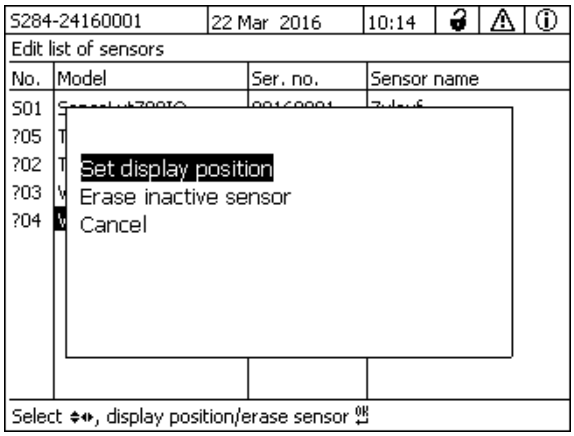


Fig. 5-6 Edit list of sensors -> Erase inactive sensor

5 Using **<▲▼◀▶>**, select *Erase inactive sensor* and confirm with **<OK>**.
The dialog window for the security prompt appears.

6 Using **<▲▼◀▶>**, select *Erase inactive sensor* and confirm with **<OK>**.
The inactive sensor is erased.

5.5 Settings for sensors

Sensor settings include the measured parameter, measuring range and, if necessary, compensations.

Enhanced sensor functions

For certain sensors, special representation types and settings are available in the menu, *Extended sensor functions*. An example for an enhanced sensor function is the editing of measured values as a graphic representation with cursor and zoom function (e.g. echo profile for the sludge level sensor IFL 700 IQ).

Sensor settings The following diagram shows the operating steps to call up the sensor setting menu and enhanced sensor functions:

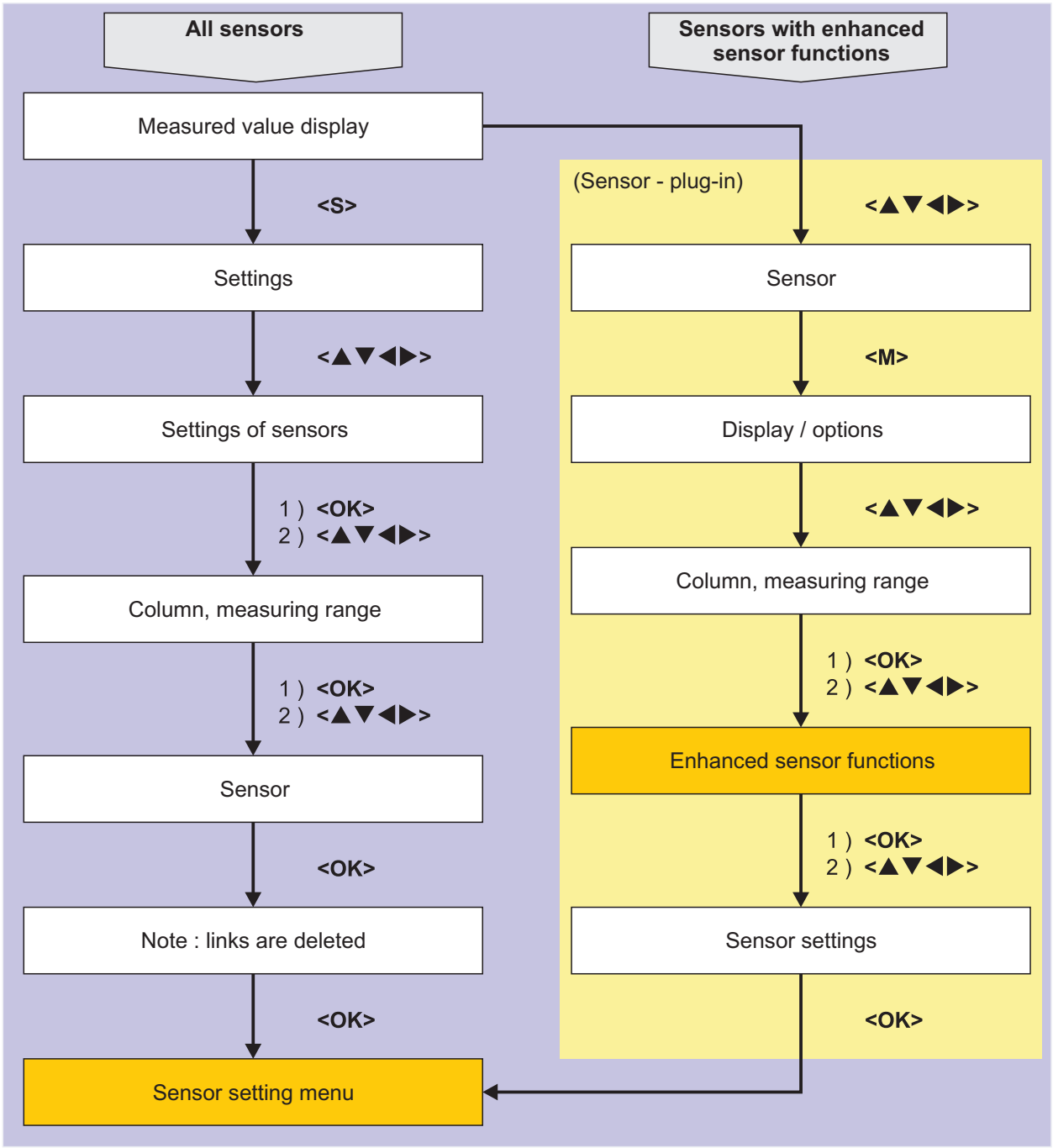


Fig. 5-7 Calling up the sensor settings

If the measuring mode or measured parameter are changed, a link of the sensor with a relay is erased!

Details on sensor settings are given in the operating manual for the IQ sensor.

5.6 *Sensor-sensor link* (automatic offset of an influencing quantity)

The *Sensor-sensor link* function automatically makes available the measured value of a sensor to another sensor in the IQ SENSORNET system.

Example: Measuring the D.O. concentration

D.O. sensors measure the D.O. partial pressure and use the solubility function of oxygen in the test sample to calculate the D.O. concentration (mg/l).
The solubility of oxygen in water is influenced by the salt content (the salinity) of the solution and other factors such as the temperature or air pressure.

Static salinity correction

To take into account the influence of the salinity on the D.O. concentration, many D.O. measuring systems provide a function where you can manually enter the salinity value. The sensor includes the salinity and provides a corrected measured value.

This type of static salinity correction is especially suitable for test samples with almost unchanging salinity.
To obtain optimum measurement results even with changing salinity values, the actual salinity has to be newly determined and entered for each measurement of the D.O. concentration.

Dynamic salinity correction

A dynamic salinity correction is provided by the *Sensor-sensor link* function. This function supplies the D.O. sensor continuously with the current salinity value and is thus especially suitable for the continuous measurement of the D.O. concentration with changing salinity values.

5.6.1 Establishing the sensor-sensor link

Requirements for a sensor-sensor link

The following requirements have to be met for a sensor-sensor link:

- Hardware
  - A sensor for which an influence quantity can be corrected (e. g. FDO® 700 IQ, TriOxmatic® 700 IQ) is in the IQ SENSORNET system.
  - A sensor that measures the influence quantity (e.g. TetraCon® 700 IQ) is in the IQ SENSORNET system.
- Software
  - The software of the sensor with correction function (e.g. FDO® 700 IQ) supports the *Sensor-sensor link* function.
  - The software of the sensor measuring the influence quantity (e.g.Tetra-Con® 700 IQ) supports the *Sensor-sensor link* function.
- Sensor settings
  - The correction function is enabled in the setting menu for the sensor with

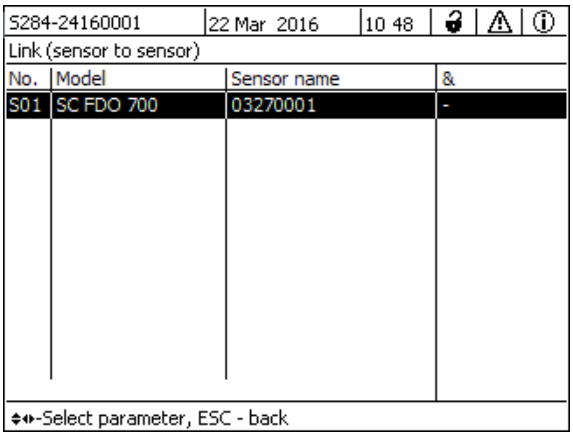
correction function (e.g. FDO® 700 IQ).

– The automatic (dynamic) correction is enabled in the setting menu for the sensor with correction function (e.g. FDO® 700 IQ).
– A sensor measures the influence quantity and displays it with the unit which is used for manual input in the menu of the sensor with correction function (e.g. TetraCon® 700 IQ measures the salinity - salinity is quoted dimensionless).
– The manually entered value for the static correction is set to the mean value of the influence quantity (e.g. salinity value) of the test sample. If no measured value for the influence quantity is available, the correction is made with the value that was manually entered (static correction).

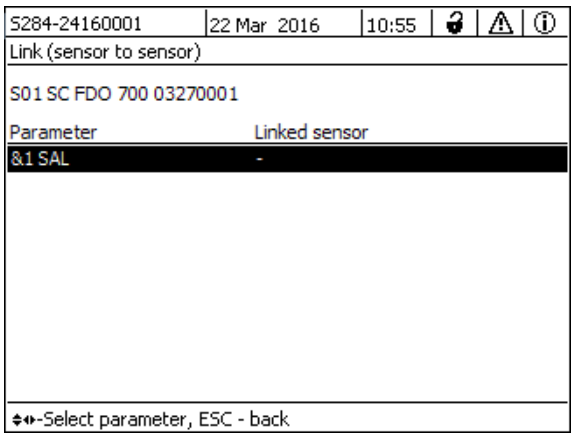
Establishing the link

1 Using **<S>**, open the *Settings* menu.

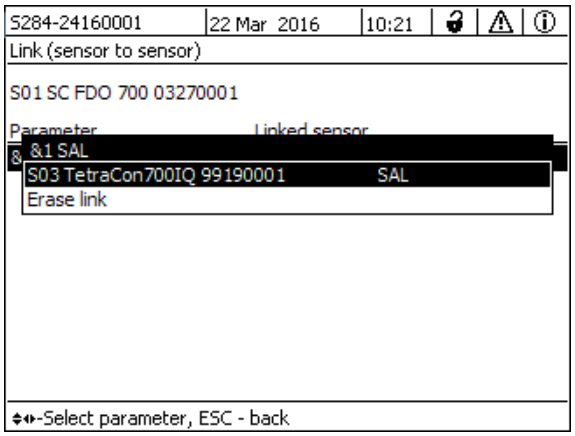
2 Using **<▲><▼>** and **<OK>**, select and confirm the menu item, *System settings -> Sensor-sensor link*.
The *Sensor-sensor link* overview opens.
The displayed list includes all sensors with which the correction of an influence quantity is possible (e.g. FDO® 700 IQ).



3 Using **<▲><▼>**, highlight a sensor and confirm with **<OK>**.
The influence quantity to be linked and the current state of the link are displayed.



4 Using **<▲><▼>**, highlight a parameter to be linked, and confirm with **<OK>**.
The displayed list includes all sensors that measure an influence quantity with the correct unit (e.g. TetraCon® 700 IQ, which measures the salinity in mg/l).



5 Using **<▲><▼>**, highlight a sensor that can be linked, and confirm with **<OK>**.
The sensors are linked.
The influence quantity to be linked and the linked sensor are displayed.

6 Leave the system settings with **<M>**.
In the measured value display, the corrected measured value is marked by an asterisk (*).

Behavior if there is no measured value for the influence quantity

Cause	Behavior
– Sensor failure	– The manually entered value for the influence quantity is automatically used for correction. An exclamation mark (!) indicates the interrupted link. – The sensor-sensor link is reactivated as soon as the measured value for the influence quantity is available again.
– Maintenance condition active	– The value last measured for the influence quantity is automatically used for correction. – The current measured value is used for correction as soon as the measured value for the influence quantity is available again.

5.6.2 Erasing a *Sensor-sensor link*

1 Open the *Settings* menu with **<S>**.

2 Using **<▲><▼>** and **<OK>**, select and confirm the menu item, *System settings -> Sensor-sensor link*.
The *Sensor-sensor link* overview opens.
The displayed list includes all sensors with which the correction of an influence quantity is possible (e.g. FDO® 700 IQ).

3 Using **<▲><▼>**, highlight a sensor and confirm with **<OK>**.
The displayed list includes all linked sensors.

4 Using **<▲><▼>**, highlight a sensor and confirm with **<OK>**.
The displayed list includes all sensors that measure an influence quantity with the correct unit (e.g. TetraCon® 700 IQ, which measures the salinity in mg/l) and the menu item *Erase link*.

5 Using **<▲><▼>**, highlight the menu item, *Erase link*, and confirm with **<OK>**.
The sensor-sensor link is erased.

6 Leave the system settings with **<M>**.
In the measured value display, the measured value is corrected by the manually entered value.

The *Sensor-sensor link* function is automatically deactivated if the measured parameter of the linked sensor is changed (e.g. by switching the display of the TetraCon® 700 IQ conductivity sensor from salinity to conductivity).

5.7 Editing the list of outputs

The *Edit list of outputs* display provides an overview of all outputs, links and inactive datasets (see section 9.3.3).

In the *Edit list of outputs* display, you can:

- assign output names (see section 5.4.1) and
- erase inactive datasets (see section 5.4.2).

5.7.1 Entering / editing the name of an output

For the easier identification of the outputs, you can assign an individual name to each output in the *Edit list of outputs* display.

1 Open the *Einstellungen/Settings* menu with **<S>**.

2 Using **<▲▼◀▶>** and **<OK>**, select and confirm the menu item, *System settings -> Edit list of outputs*.
The *Edit list of outputs* overview opens.

3 Press **<▲▼◀▶>** to highlight a name in the *Name* column and confirm with **<OK>**.

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Edit list of outputs

No.	Model/Channel	Ser. no.	Name
D01	MIQCR3/R1	99200004	
D01	MIQCR3/R2	99200004	
D01	MIQCR3/R3	99200004	
D01	MIQCR3/C1	99200004	
D01	MIQCR3/C2	99200004	
D01	MIQCR3/C3	99200004	

Select ⇕⇔, edit output names OK

Fig. 5-8 Edit list of outputs -> enter a name

4 Enter the name with **<▲▼◀▶>** and **<OK>** and confirm with **<OK>** (see also section 4.2.2).

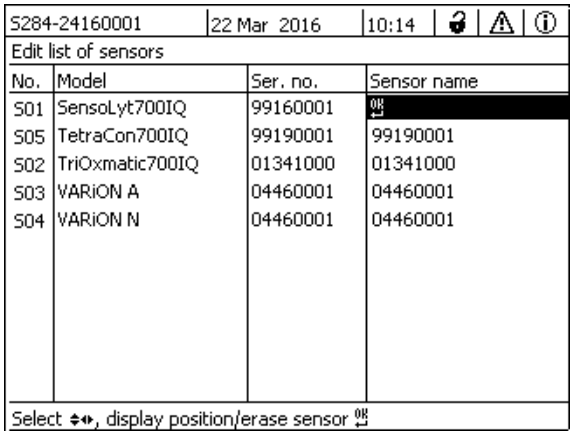


Fig. 5-9 Edit list of sensors

5.7.2 Erasing an inactive dataset for an MIQ output module

An inactive dataset for an MIQ output module arises if the system receives no signals from a registered MIQ output module. Inactive datasets can be recognized by a question mark, e.g. "?01" in the *Edit list of outputs* overview.

An inactive dataset can be reactivated by assigning it, e.g. to an MIQ output module of the same type (see section 9.3.3). All settings are retained. If you no longer require the stored data, you can erase them.

1 Open the *Einstellungen/Settings* menu with **<S>**.

2 Using **<▲▼◀▶>** and **<OK>**, select and confirm the menu item, *System settings -> Edit list of outputs*.
The *Edit list of outputs* display opens.

3 Using **<▲▼◀▶>**and **<OK>**, highlight and confirm the *Model/Channel* column. This column can only be highlighted if an inactive dataset (?xx) is present.

4 Press **<▲▼◀▶>** to highlight a *Model/Channel* and confirm with **<OK>**.

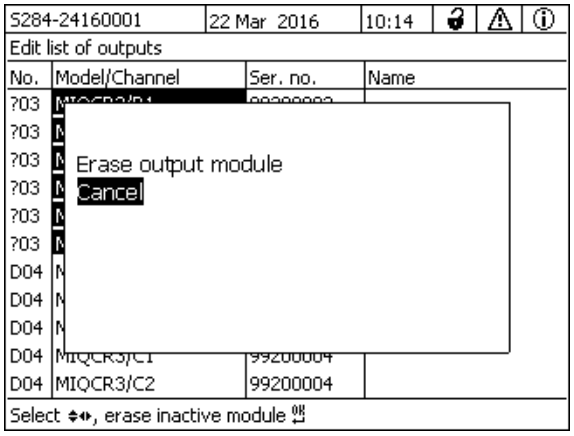


Fig. 5-10 Edit list of outputs -> Erase output module

5 Using **<▲▼◀▶>**, select *Erase output module* and confirm with **<OK>**. The dialog window for the security prompt appears.

6 Using **<▲▼◀▶>**, select *Erase output module* and confirm with **<OK>**. The output is erased.

5.7.3 Output links/settings

The procedure and possible settings for linking outputs with sensors are given in the operating manual of the respective output module.

5.8 Alarm settings

5.8.1 General information

Under this menu item you can specify reactions on certain alarm events.

An alarm event is when a certain measured value (limiting value) of a sensor is exceeded or undercut.

Alarm events can be relayed as follows:

- As a message on the display
- As a relay action
- As an Email (see section 5.9.5)

An alarm message via display or relay cannot be acknowledged or switched off. An alarm only disappears if the cause for the alarm was eliminated or the *Alarm settings* were changed or erased.

5.8.2 Setting up / editing alarms

1 Open the *Einstellungen/Settings* menu with **<S>**.

2 Using **<▲▼◀▶>** and **<OK>**, select and confirm the menu item, *Alarm settings*.
The *Alarm link overview* dialog window opens.
Alarms that have already been set up have entries in the *Sensor* column.

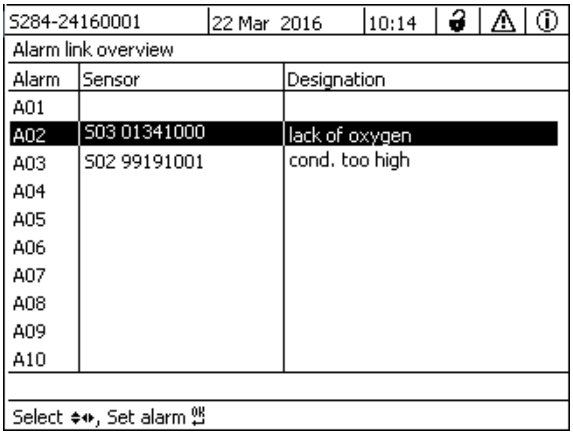


Fig. 5-11 Alarm settings -> Alarm link overview

In the *Sensor* column, the sensor number (corresponding to the list of sensors) and series number is named.

3 Select an alarm *A01* to *AXX* to be edited with **<▲▼◀▶>**. To set up a new alarm without entry select in the *Sensor* column. Then confirm with **<OK>**. When a new alarm is set up a list with all sensors appears first. Alarm links that are already available can be erased or edited (for editing continue with step 5).

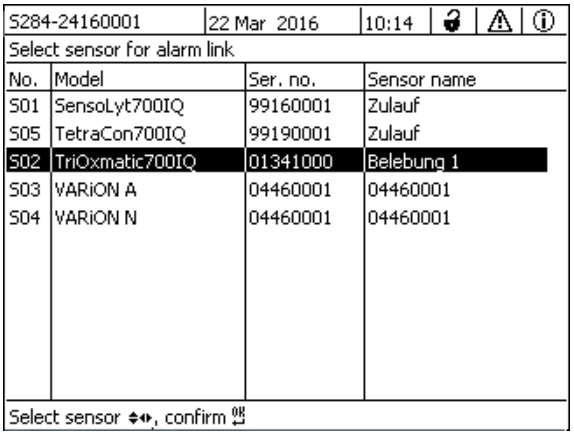


Fig. 5-12 Select sensor for alarm link

4 To set up a new alarm, select a sensor from the list with **<▲▼◀▶>** and confirm with **<OK>**. The *Set alarm link* display opens.

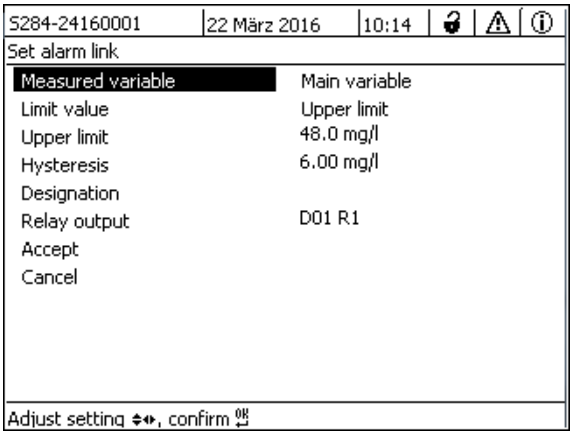


Fig. 5-13 Set alarm link

5 Edit the setting table. The required operating steps are described in detail in section 4.2 GENERAL OPERATING PRINCIPLES.

Alarm links setting table

Menu item	Selection/Values	Explanations
Measured variable	● *Main variable* ● *Adjoining variable*	*Main variable* designates the actual measured parameter of the sensor (e.g. pH, oxygen, etc.). *Adjoining variable* designates an additional measured parameter (e.g. temperature).

Menu item	Selection/Values	Explanations
Limit value	● *Lower limit* ● *Upper limit*	Type of the alarm event. *Lower limit*: An alarm is triggered if the defined limit value is undercut. *Upper limit*: An alarm is triggered if the defined limit value is exceeded.
Lower limit / *Upper limit*	within the measuring range (sensor-dependent)	Limit value for the alarm event
Hysteresis	0 - 10 % of the measuring range	Hysteresis for the limit value
Designation	(max. 20 characters)	User-defined designation for easier identification in the alarm message.
Relay output	Dxx / .../Ry ... ... *No relay output*	Opens a list with all relay outputs where the *Alarm contact* is set. Dxx: number of the output module .../Ry: relay output channel Here you can select a relay output. When the alarm event occurs, it carries out the specified action (Open or Close). For details, see section 5.8.3 ALARM OUTPUT TO DISPLAY.
Accept		The settings are taken over in the setting table by pressing **<OK>**. The display switches to the next higher level.
Cancel		The display switches to the next higher level without storing the new settings.

5.8.3 Alarm output to display

When an alarm event occurs, a window with a text message appears.

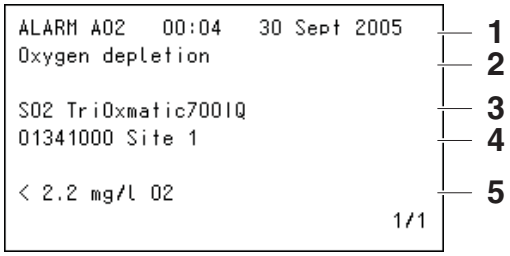


Fig. 5-14 Example of an alarm message on the display

1 Alarm no. Axx and date and time of the alarm event

2 User-defined designation

3 Sensor number and model name of the sensor that triggered the alarm event

4 Series number and name of the sensor that triggered the alarm event

5 Description of the event with specification of the limiting value:
"<" = Undercut
">" = Exceeded

Operating instructions

If there are several alarm messages indicated on the display, you can scroll through the messages with **<▲▼◀▶>**. This can be recognized from the page number in the right lower corner. The latest message is always on the first position.

Pressing **<M>** hides the alarm messages and switches to the measured value display. After one minute the alarm messages appear again if what caused them is still present.

5.8.4 Alarm output as relay action

The relay outputs of the IQ SENSORNET can be configured so a relay action is triggered when an alarm event occurs (Open or Close). For this the *Alarm contact* function must be set for the relay output in the *Settings of outputs and links*.

The *Alarm contact* function is only available for relays that are not linked with a sensor. If necessary, an existing link must be erased. For details please refer to the operating manual of the output module.

5.8.5 Alarm message as Email (variant -E, EF)

All alarm messages can be sent to an Email address. In this case, the same information that is output on the display is transmitted. For details, see section 5.9.5.



For critical alarm events take into account that Email messages may possibly be received delayed.

5.9 System settings

System settings include:

- *Change password* (see section 5.9.1).
- *Language* (see section 5.1)
- *Date/Time* (see section 5.9.2)
- *Location altitude/Air pressure* (see section 5.9.3)
- *TCP/IP settings* (variant -E, EF)
- *email* (variant -E, EF)
- *Settings bus interfaces* (variant -MOD, -PR, -EF)
- *Function code*

5.9.1 Changing the password

A password protects the system settings against inadvertent changes. The password must always be entered in order to change the release of the settings.

The password is set to 1000 in the delivery state.

1 Open the *Einstellungen/Settings* menu with **<S>**.

2 Using **<▲▼◀▶>** and **<OK>**, select and confirm the menu item, *System settings -> Change password*.
The *Change password* dialog window opens.

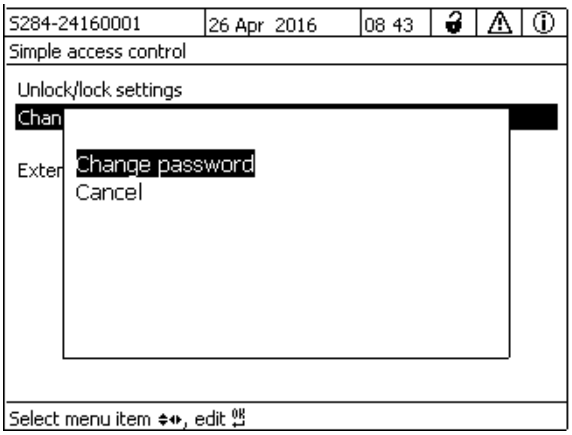


Fig. 5-15 System settings -> Change password

3 Using **<▲▼◀▶>** and **<OK>**, select and confirm the menu item, *Change password*. The dialog window for entering the password opens.

4 Press **<▲▼◀▶>** and **<OK>** to enter the new password and press **<OK>** to confirm. The setting is changed.

5.9.2 Setting the date and time

The real time clock is used for the display of date and time in the measured value display and in log book entries.

1 Open the *Einstellungen/Settings* menu with **<S>**.

2 Using **<▲▼◀▶>** and **<OK>**, select and confirm the menu item, *System settings -> Date/Time*.
The *Date/Time* display opens.

3 Press **<▲▼◀▶>** to select *Set date* or *Set time*.

4 Confirm the selection with **<OK>**.
A field is highlighted, e.g. *Year*.

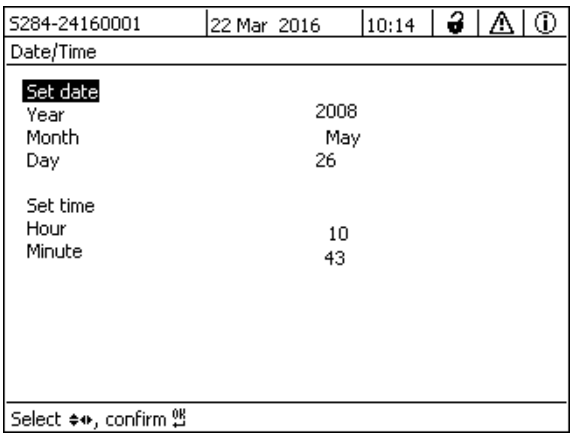


Fig. 5-16 Date/Time

5 Press **<▲▼◀▶>** and **<OK>** to select and confirm a number.
The next field is highlighted, e.g. *Month*.

6 Complete the entries on the display *Date/Time*.

The clock in the DIQ/S 28X bridges periods of power failure of up to several hours. After a longer power failure, the clock starts precisely at the time of the failure. A message and an entry in the log book provide information on the power failure and the necessity for resetting the clock.

5.9.3 Location altitude / average air pressure

Air pressure values can be set within a range of 500 to 1100 mbar.

1 Open the *Settings* menu with **<S>**.

2 Using **<▲▼◀▶>** and **<OK>**, select and confirm the menu item, *System settings -> Location altitude/Air pressure*.
The *Location altitude/Air pressure* display opens.

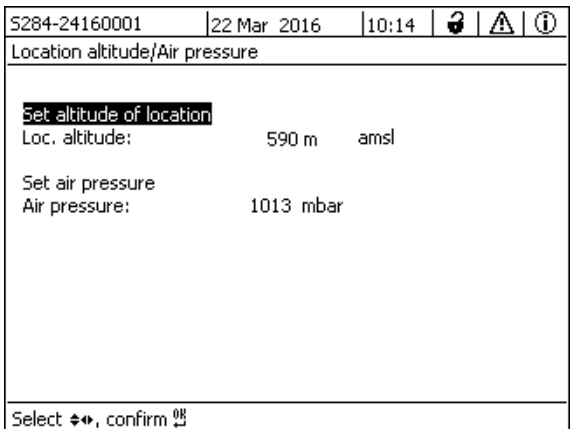


Fig. 5-17 Location altitude/Air pressure

3 Press **<▲▼◀▶>** to select *Set altitude of location* or *Set air pressure* and confirm with **<OK>**.

4 Press **<▲▼◀▶>** to change the values for *Loc. altitude* or *Air pressure* and confirm with **<OK>**.

5.9.4 *TCP/IP settings* (variant -E, EF)

The *TCP/IP settings* menu includes functions and settings for the operation of the DIQ/S 28X in an Ethernet network.

1 Open the *Einstellungen/Settings* menu with **<S>**.

2 Using **<▲▼◀▶>** and **<OK>**, select and confirm the menu item, *System settings -> TCP/IP settings*.
The *TCP/IP settings* display opens.

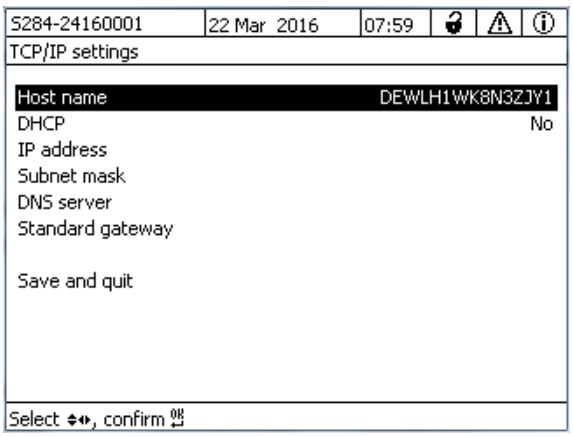


Fig. 5-18 TCP/IP settings

3 Press **<▲▼◀▶>** and **<OK>** to select and confirm a menu item.
An entry field or selection list opens up.

Setting	Selection/Values	Explanation
DHCP	Yes	The IQ SENSOR NET is configured as a DHCP client. If a DHCP server is in the network, the IQ SENSOR NET receives all further network settings from the DHCP server.
	No	The IQ SENSOR NET is not configured as a DHCP client. All other settings have to be made as necessary.
IP address	Address	Permanent IP address for the IQ SENSOR NET in the LAN (if *DHCP No*).
Subnet mask	Address	Subnet mask (if *DHCP No*). The subnet mask depends on the network size (for small networks: e.g. 255.255.255.0).
DNS server	Address	Entry for fieldbuses not required. For a connection with the Internet (if *DHCP No*), e.g.: ● IP address of the DNS server in the network ● Entry of *IP address* or e.g. 127.0.0.1
Standard gateway	Address	Entry for fieldbuses not required. For a connection with the Internet (if *DHCP No*), e.g.: ● IP address of the instrument providing access to the Internet ● Entry of *IP address* or e.g. 127.0.0.1

4 Enter texts with **<▲▼◀▶>** and **<OK>**, or select and confirm an option from the list.

5 Complete the entries on the display *TCP/IP settings*.

5.9.5 *email* (variant -E, EF)

The *email* menu contains functions and settings for the sending of alarm messages via Email.

1 Open the *Einstellungen/Settings* menu with **<S>**.

2 Using **<▲▼◀▶>** and **<OK>**, select and confirm the menu item, *System settings -> email*.
The *email* display opens.

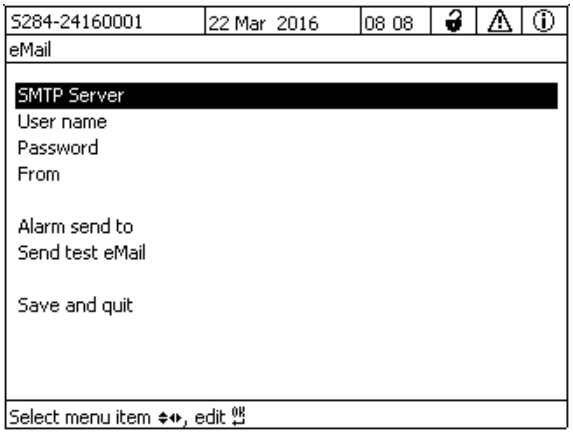


Fig. 5-19 email settings

3 Press **<▲▼◀▶>** and **<OK>** to select and confirm a menu item.
An entry field or selection list opens up.

Setting	Selection/Values	Explanation
SMTP Server	Address	Address of the SMTP server of the Email provider through which the Email will be sent.
User name	Name	User name of the Email account
Password	Character string	Password to log on to the Email account
From	Name	Email sender address
Alarm send to	Name	Email target address
Send test email		A test Email with the specified settings is sent.

4 Enter texts with **<▲▼◀▶>** and **<OK>**, or select and confirm an option from the list.

5 Complete the entries on the display *email*.

6 Using **<▲▼◀▶>** and **<OK>**, select and confirm the menu item, *Save and quit*.
The settings are stored. The menu ist closed.

5.9.6 *Settings bus interfaces* (variant -E, EF)

The *Settings bus interfaces* menu contains functions and settings for the communication of the IQ SENSORNET with a fieldbus. Prerequisite: An interface to a fieldbus is available (hardware, optional).

For details, see operating manual ba77010 "IQ SENSORNET Fieldbus linking", for download at www.YSI.com.

5.9.7 *Function code*

Function for the service staff.

5.10 *Measured value logging*

With the *Measured value logging* setting you can record and store measured values of IQ sensors.

You can display the stored measured values

- as a list or
- display the temporal course of the stored measured values graphically (see section 4.4.4).
- display the stored measured values to a PC.

The system allocates memory blocks to an IQ sensor for the *Measured value logging*. With a recording interval of 1 measurement dataset per minute, a recording duration of 1 day per memory block is possible. 360 memory blocks are available and can be distributed to the sensors.

The recording duration directly depends on the recording interval. If a recording duration of 0 d is set for a sensor, there is no memory block allocated to the IQ sensor. The *Dur.* setting also contains the number of the allocated memory blocks (see table).

Recording interval	**Possible recording durations with the given recording interval**					
1 min	0 d	1 d	2 d	3 d	...	360 d
5 min	0 d	5 d	10 d	15 d	...	1800 d
10 min	0 d	10 d	20 d	30 d	...	3600 d

Recording interval	Possible recording durations with the given recording interval					
15 min	0 d	15 d	30 d	45 d	...	5400 d
30 min	0 d	30 d	60 d	90 d	...	10800 d
60 min	0 d	60 d	120 d	180 d	...	21600 d

5.10.1 Setting the recording interval (*dt*) and recording duration (*Dur.*)

1 Open the *Einstellungen/Settings* menu with **<S>**.

2 Using **<▲▼◀▶>** and **<OK>**, select and confirm the menu item, *Measured value logging*.
The *Measured value logging* display opens.
It contains a list of all sensors and inactive sensors.

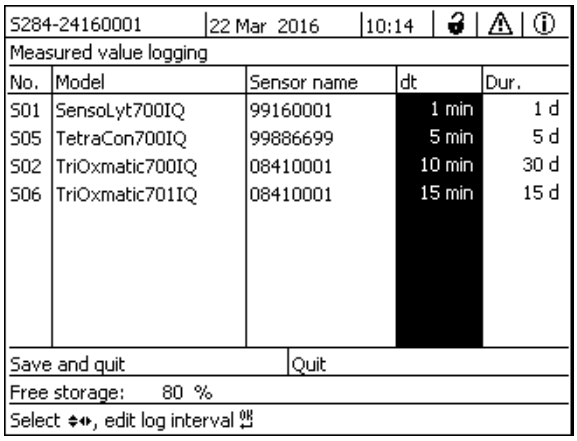


Fig. 5-20 Measured value logging

3 Press **<▲▼◀▶>** and **<OK>** to select and confirm the *dt* column.

4 Press **<▲▼◀▶>** and **<OK>** to select and confirm a sensor.

5 Determine the recording interval with **<▲▼◀▶>** and **<OK>**.
When the recording interval is changed, the recording duration changes at the same time (*Dur.*), because the recording duration results from the recording interval due to a fixed number of memory blocks.

6 Switch to the selection of columns with **<ESC>**.

7 Press **<▲▼◀▶>** and **<OK>** to select and confirm the *Dur.* column.

8 Press **<▲▼◀▶>** and **<OK>** to select and confirm a sensor.

9 Select the recording duration with **<▲▼◀▶>** and **<OK>**.
The recording duration is always increased or decreased in the same steps.

The percentage of the memory blocks not yet allocated is shown on the display. If all memory block are occupied (*Free storage:* 0%), the number of memory blocks allocated to another IQ sensor may have to be reduced.

When the number of memory blocks for a sensor is reduced, the memory block with the oldest data is erased. All other data is retained.

For inactive IQ sensors, the *Dur.* setting can only be reduced.

10 Switch to the selection of columns with **<ESC>**.

11 Press **<▲▼◀▶>** and **<OK>** to select and confirm the *Save and quit* column.
The changes are stored.
The *Einstellungen/Settings* display opens.

If the changes made for recording duration or recording interval should not be stored, press **<▲▼◀▶>** and **<OK>** to select and confirm the *Quit* field.

6 Ethernet connection (variant -E, -EF)

If the Universal Transmitter DIQ/S 28X-E is connected to an Ethernet network, communication with the IQ SENSORNET System 28X is enhanced and facilitated.

- The Ethernet interface allows the DIQ/S 28XE[F] to be integrated into a local network and to be connected to other networks (e.g. Internet) using commercially available network technology.
- The web server des DIQ/S 28X-E[F] makes available the measurement data of the IQ SENSORNET as a web page.
- Communication with the DIQ/S 28X-E[F] is possible via a large number of network-capable terminals.
  - Internet-capable devices with web browser (e.g. PC, smartphone, tablet PC) can display the measurement data of the IQ SENSORNET.
  - The programs of the IQ WEB CONNECT can be used to operate and manage the IQ SENSORNET on a PC.
- Extraction of the data provided by the web server is possible using commercially available or self-created programs (DataLogger).
- With the Ethernet interface of the variant DIQ/S 28X-EF, the instrument can additionally be integrated into an EtherNet/IP™, Profinet and Modbus TCP environment. Details on this subject are given in the operating manual ("IQ SENSORNET fieldbus linking"). The current version can be found on the Internet at www.YSI.com.

6.1 Configuring the Ethernet network

The following overview helps in the general planning, project planning and installation of a network connection of the DIQ/S 28X-E[F].

A basic understanding of network technology is useful for setting up a local network and especially the connection to the Internet.

Various settings are to be made on the individual network subscribers according to the configuration of the network.

Insofar as the settings affect network subscribers of third-party vendors (e.g. the router), only a general reference is made here to the setting. For details, of the menus in which the settings are made, please refer to the respective operating manual for your device.
If you have no knowledge of networks, please contact your network administrator.

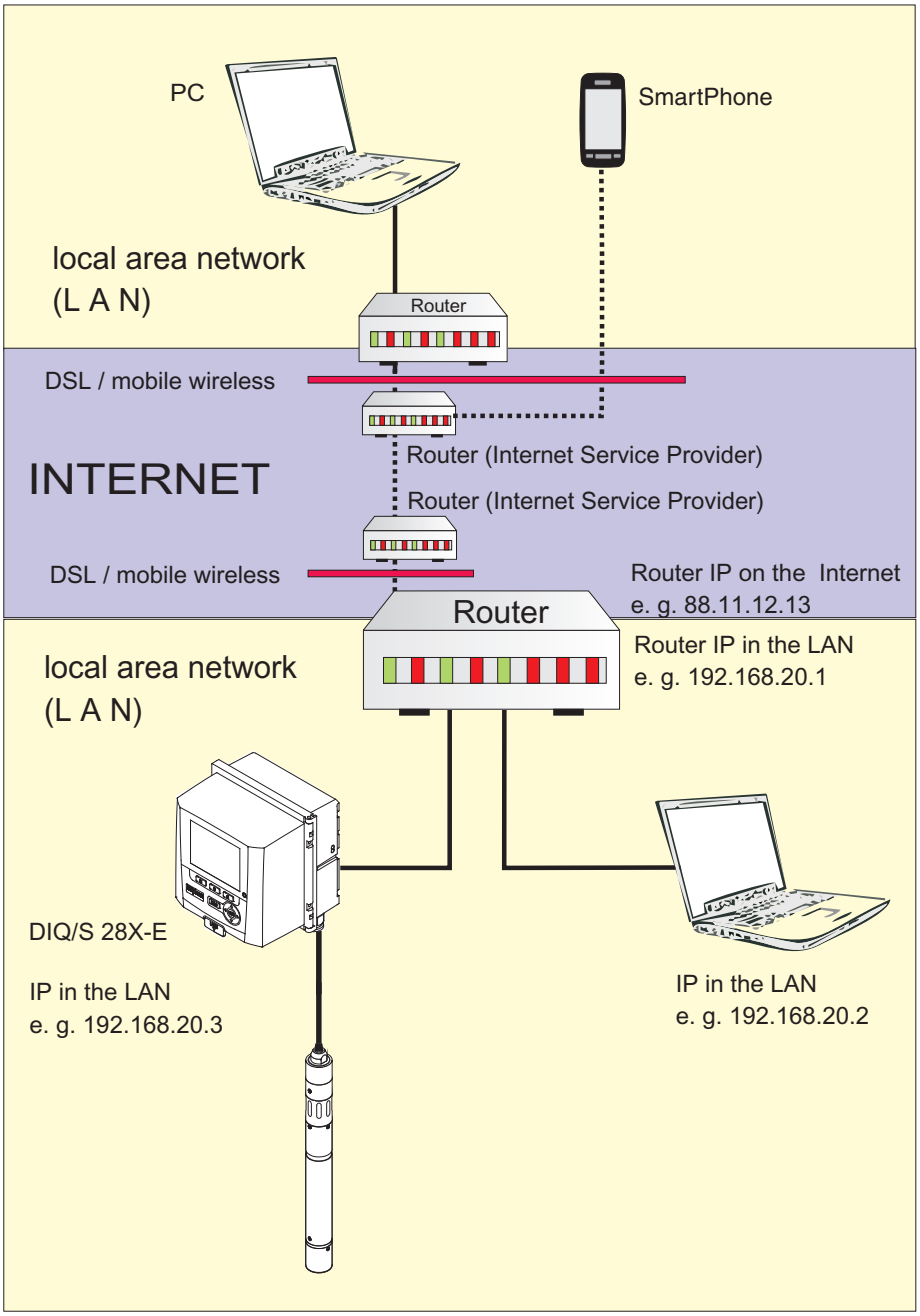


Fig. 6-1 DIQ/S 28X-E[F] in a local network and on the Internet (example)

6.1.1 Communication in a local network (LAN)

	Prerequisites	Details / Examples / Designations
Hardware	IQ SENSOR NET System 28X	Universal Transmitter DIQ/S 28X-E[F]
	Ethernet cable	RJ45 cable to connect the IQ SENSOR NET and router. Note: If the DIQ/S 28X-E[F] is located at an open air test site, please note section 6.2.
	Terminal equipment (a network subscriber that sets up the communication), e.g.:	● PC ● Tablet PC ● Smartphone
Software	Communication software on the terminal equipment, e.g.:	● web browser ● programs of the IQ WEB CONNECT (for PC only)
	Network services (e.g. on the terminal device or router)	● WINS server ● with DHCP and DNS servers (for network access in the LAN via the name of the DIQ/S 28X-E[F])

Network address of the Universal Transmitter in the LAN

- Instrument name (is specified in the terminal settings of the Universal Transmitters (siehe section 5.2).
  When delivered, the combination of instrument name + serial number is entered as the name (e.g. S284-16160001).

or

- Fixed local IP address of the Universal Transmitter (defined in the settings of the Universal Transmitter (see section 6.1.2).

6.1.2 Communication on the Internet

	Prerequisite	Details / Examples / Designations
Hardware	IQ SENSOR NET System 28X	Universal Transmitter DIQ/S 28X-E[F]
	Router, e.g.	● DSL router ● Mobile wireless router
	Ethernet cable	RJ45 cable to connect the DIQ/S 28X-E[F] and router. Note: If the DIQ/S 28X is located at an open air test site, please note section 6.2.
	Terminal equipment (network subscriber that sets up the communication), e.g.:	● PC ● Tablet PC ● Smartphone
Software	Communication software on the terminal equipment, e.g.:	● web browser
Network address of the DIQ/S 28X-E[F] on the Internet	The network address of the router on the Internet is configured via an Internet service (see below).	
Internet services	Internet access with data flat rate, e.g.:	● DSL connection ● Mobile wireless connection (SIM card)
	Internet service which makes the router publicly addressable on the Internet, e.g.:	● A public IP address (e.g. available at an Internet service provider) ● A service (e.g. DynDNS), which assigns a fixed name to a changing IP address of an Internet subscriber so that the subscriber is always accessible under the same name

	Prerequisite	Details / Examples / Designations
Special settings of the network subscriber	IQ SENSOR NET Universal Transmitter DIQ/S 28X-E[F]	Menu: *System settings* / *TCP/IP settings*: ● *DHCP*: *No* ● *IP address*: Enter a fixed IP address (the IP address must lie outside the address range of the DHCP server (the DHCP server is often a network service of the router) ● *Subnet mask*: The IP address depends on the local network (in home networks, e.g. 255.255.255.0) ● *DNS server*: Local IP address of the router (e.g. 192.168.179.1) ● *Standard gateway*: Local IP address of the router (e.g. 192.168.179.1)
	Router (see operating manual for your router)	● Data for Internet access (from Internet service provider) ● Port forwarding of port 8080 to port 80 of the fixed IP address of the DIQ/S 28X

6.2 Ethernet connection if mounted at an open air test site (DIQ/S 28X-E[F])

The RJ45 socket does not protect sufficiently against moisture. At an open test site, the moisture protection device (ADA/E) available as an accessory has to be mounted for safe Ethernet communication (see section 11.

6.3 Establishing the connection with the DIQ/S 28X via a network

6.3.1 Opening the IQ WEB CONNECT

The web server of the DIQ/S 28X provides functions for the (remote) operation of the DIQ/S 28X and for the data exchange (e.g. with a PC) via a network address.

Prerequisites

- All network components (Universal Transmitter, router, network-capable devices with browser) are connected
- The network services are active
- Web browser (HTML 5)



The IP address and the other network settings for the Universal Transmitter DIQ/S 28X are configured in the *System settings -> TCP/IP settings* menu.

Procedure

Enter the network address of the DIQ/S 28X in the address line in the web browser

1 Enter the network address of the *Web browser* DIQ/S 28X-E[F] in the address line of the web browser.
   - in the LAN
     e.g. name or IP address of the DIQ/S 28X-E[F]
   - on the Internet,
     e.g. fixed IP address of the router or DynDNS name

   The network connection to the DIQ/S 28X-E[F] is established.
   The start page of the IQ SENSOR NET is displayed.



Fig. 6-2 IQ WEB CONNECT start page

The IQ WEB CONNECT start page of the DIQ/S 28X-E[F] provides links to the following functions:

- "IQ WEB CONNECT Terminal"
  (operating the DIQ/S 28X-E[F])
- "IQ WEB CONNECT DatalogTransfer"
  (transmitting measurement data)
- "IQ WEB CONNECT ConfigSaveLoad"
  (saving and loading the system configuration of the DIQ/S 28X-E[F])

2 Open a link on the IQ WEB CONNECT start page.

3 Enter the user name and password
(user name and password are defined in the settings of the access control of the DIQ/S 28X-E[F].
Default setting: User name "ADMIN", password "1111")
The selected website is displayed.

6.3.2 IQ WEB CONNECT Terminal

With the "IQ WEB CONNECT Terminal", you can operate your DIQ/S 28X-E[F] just like you are used to on the instrument.

You can save data to a USB memory device connected to the instrument (similar to operation of the instrument). To save data to a PC, select the function "IQ WEB CONNECT DatalogTransfer" (see section 6.3.3).

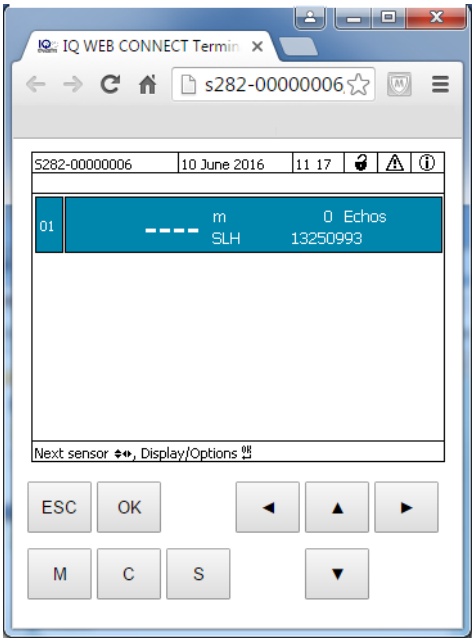


Fig. 6-3 IQ WEB CONNECT Terminal

6.3.3 IQ WEB CONNECT DatalogTransfer

"IQ WEB CONNECT DatalogTransfer" exchanges data with the terminal device with which you are carrying out IQ WEB CONNECT functions. The data exchange is optimized for the following operating systems:

- Microsoft® Windows®
- Linux

Via the website "IQ WEB CONNECT DatalogTransfer", you can save measurement data of the DIQ/S 28X-E[F] directly to a PC.

The transmitted measurement data are stored in a separate file in CSV data format for each sensor. The file name (e. g. S03_*TriOxmatic700IQ_1.csv)* is automatically assigned and includes:

- sensor number (e. g. S03)
- sensor model (e. g. TriOxmatic700IQ)
- consecutive number.

For processing you can open the csv file, e.g. with Microsoft Excel.

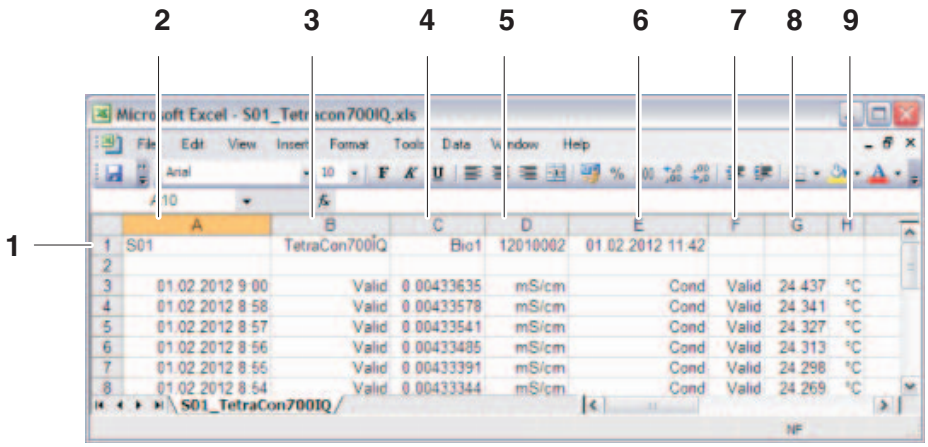


Fig. 6-4 Example of a CSV file after being imported into Microsoft Excel

1 Identification of the measurement data (from left to right, line 1)
- Sensor number (Sxx)
- Sensor model
- Sensor name
- Serial number (sensor)
- Date and time of the file save

2 Date and time of the measured value save
3 Measured value status
4 Measured value
5 Unit of the measured value
6 Measured parameter
7 Measured value status of the secondary measured value
8 Secondary measured value
9 Unit of the secondary measured value

The measured values are transmitted unprocessed. Therefore, the measured values may have a number of decimal places that exceeds the display accuracy of the respective sensor.

When you want to display and process the transmitted measured values, it may be required to limit the number of digits (e. g. by rounding).

6.3.4 IQ WEB CONNECT ConfigSaveLoad

"IQ WEB CONNECT DatalogTransfer" exchanges data with the terminal device with which you are carrying out IQ WEB CONNECT functions. The data exchange is optimized for the following operating systems:

- Microsoft® Windows®
- Linux

Via the website IQ WEB CONNECT ConfigSaveLoad, you can display or save the system configuration of the DIQ/S 28X-E[F] or load it to a DIQ/S 28X-E[F].

The system configuration comprises the following data:

- *Settings of sensors and diff. sensors*
- *Settings of outputs and links*
- *Edit list of sensors*
- *Edit list of outputs*
- *Measured value recording* (data logger settings)
- *Language*
- *Access control*
- *Alarm settings*
- *System settings*

6.4 Communication with fieldbuses (DIQ/S 28X[-XX]-EF)

Details on communication with fieldbuses are given in the operating manual ba77010e ("IQ SENSORNET fieldbus linking"). The current version can be found on the Internet at www.YSI.com.

6.5 Troubleshooting

The Universal Transmitter DIQ/S 28X provides an Ethernet interface for the connection of the IQ SENSORNET to private networks, company networks and public networks.

To establish accessibilty of the IQ SENSORNET in a public network (e.g. Internet), external services (e.g. Internet access, fixed public IP address etc.) are required.

A detailed error analysis for connection errors is not possible within the scope of this operating manual because of the multitude of service providers, network architectures and connection options involved.

Here is a selection of possible causes for network/connection problems. If there are other connection problems, contact your network administrator or a network specialist.

No network connection

Cause	Remedy
– Ethernet hardware defective, e.g. – Ethernet cable defective – Ethernet connection on the DIQ/S 28X or router defective	– Exchange the Ethernet hardware
– Incorrect network address entered in the LAN (name)	– Enter the correct name: "Instrument name-serial number", replace special characters (/, spaces, etc.) with "-", e.g. DIQ-S284-16160001 – Ascertain or define the correct IP address of the DIQ/S 28X in the local network (e.g. IQ SENSORNET setting + router setting) and enter it.
– Incorrect network address on the Internet (IP address of the router)	– Ascertain or define the correct Internet IP address of the router (e.g. FixedPublicIP) and enter
– A network connection from a terminal device to the DIQ/S 28X (IQ WEB CONNECT) already exists	– 2nd IQ WEB CONNECT
– Incorrect setting in the router (e.g. Internet access data, port forwarding)	– Correct the settings
– Incorrect setting in the DIQ/S 28X (System menu/*TCP/IP settings*)	– Correct the settings
– Ports which are used by the DIQ/S 28X are already assigned to other devices in the network (e.g. another IQ SENSORNET system)	– Have your network administrator assign you free ports – Specify the port (1-65535) manually in the address line of the browser/ IQ WEB CONNECT (example: http://10.11.12.13:65535) – Forward this port (65535) in the router to the IP address of the DIQ/S 28X.
– Blocking by firewall	– Contact your network administrator or a network specialist

6.6 Technical network terms

DHCP (Dynamic Host Configuration Protocol)

DHCP is a network service which automatically assigns an IP address to a network subscriber.
In local networks, this function is mostly carried out by the router.

DNS (Domain Name System)

DNS is a network service which manages the name of a subscriber on the Internet (e.g. www.google.com) and the associated IP address e.g. "http://74.125.224.72/".
In local networks, this function is mostly carried out by the router.

DynDNS (Dynamic DNS)

DynDNS is an Internet service which makes a subscriber with changing (dynamically issued) IP address accessible under a fixed name on the Internet.
Prerequisite: The router in the local network must support DynDNS and must always send its current dynamic public IP address to the Internet service.

Firewall

A firewall protects a device or a local network against attacks from the Internet.
A firewall blocks the communication interfaces (ports) that are not used for standard communication (web browser, E-mail etc.).

IP address

A network address identifies a subscriber in a network.

Private IP addresses are IP addresses specially reserved for home networks (range 192.168.0.0 to 192.168.255.255). In most cases, they are automatically assigned by the router which manages the local network. They are used to uniquely identify the individual subscribers within a local network.
Routers provide the possibility to manually assign a fixed local IP address for individual devices.

Public IP addresses are automatically assigned to the router in the local network (LAN) by the Internet Service Provider (ISP). They are used to uniquely identify an Internet subscriber (a home network or even an individual device) to the Internet. They are mostly only valid for the duration of an Internet session (dynamic IP address) and are released again upon ending the Internet connection.
An Internet user can also be assigned a fixed public IP address via (chargeable) Internet services.

ISP (Internet Service Provider)

An ISP is an Internet service provider which provides Internet access.

Port

A port is the communication interface of an application (possible port numbers: 0-65535).
Some ports (port numbers) are reserved for special applications, e.g.:

- 21: FTP (File Transfer Protocol)
- 25: SMTP (Simple Mail Transfer Protocol)
- 80: HTTP (Hypertext Transfer Protocol)
  (used by the web browser for communication with web servers)

Port forwarding

If a router receives a communication request on a port for which forwarding is configured, communication is forwarded to the port of a network subscriber which is defined in the forwarding rule.
In local networks, this function is mostly carried out by the router.

Router

A router fulfills the following tasks as an interface between two networks:

- It connects the local network to the Internet.
- It controls the communication of network devices within a local network and manages the local IP addresses of the subscriber. In the local network, it is also possible to manage names for individual IP addresses (DHCP) in most cases.

Routers often assume other services in a network, e. g.:

- DNS (assigning of names to IP addresses)
- Firewall (protects the network subscriber against attacks from the Internet)
- Port forwarding

TCP/IP (Transmission Control Protocol / Internet Protocol)

The Internet Protocol is the common language (protocol) of the network subscriber.

7 Outputs

7.1 Outputs of the System 28X

Functioning of the outputs

- Relay outputs work as openers or closers.
- Current outputs provide a current depending on the measured value. Current outputs are available in the variants DIQ/S 28X-CRX and when an extension module with current outputs is used).

On the DIQ/S 28X you can do the following:

- Assign names for the outputs (see section 7.3).
- Link outputs with sensors (see section 7.4)
- Erase links between outputs and sensors (seesection 7.5)
- Set up outputs (see section 7.6 and section 7.7)
- Check the conditions of the outputs (see section 7.8)

Basis information on the use of relay outputs is given in section 7.2.

Functions for current and relay outputs

Relay output (see section 7.6)

- *System monitoring*
- *Sensor monitoring*
- *Limit indicator*
- *Frequency controller*
- *Pulse-width output*
- *Cleaning*
- *Sensor-controlled*
- *Manual control*
- *Alarm contact*

Current output (see section 7.7)

- *Recorder*
- *PID controller*
- *Fixed current value*

7.2 Basic information on relay functions

This chapter describes general basic information concerning the following relay functions:

- Monitoring (see section 7.2.1)
- Limit indicator (see section 7.2.2)
- Proportional output (see section 7.2.3)

7.2.1 Monitoring

When using a relay for monitoring, a relay action (*Open*, *Close*) occurs when certain states occur. This function is suitable, for example, for the monitoring of errors in the system.



For monitoring functions, use the relay preferably as normally closed (see section 7.6.1). In the case of an error, the relay opens. As a result, the monitoring function operates even if, for instance, the supply voltage fails.

7.2.2 Limit indicator

With a limit indicator, a relay switches when a specified limiting value is exceeded or undercut.

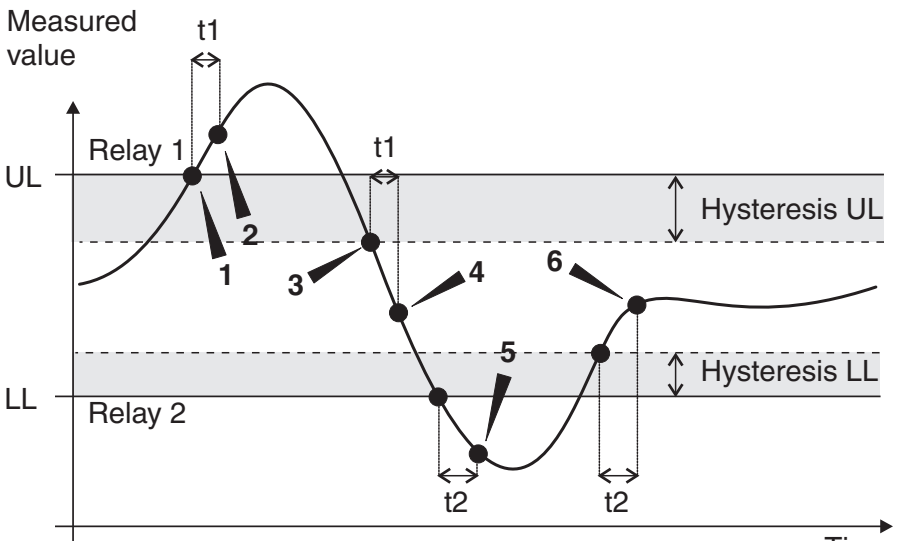
Limit indicators can be used in the following way:

- Monitoring a limiting value using a relay:
  when a limiting value (upper or lower limiting value) is exceeded or undercut, a relay switches. The *Open* or *Close* relay actions are possible in each case (see page 126).
- Monitoring two limiting values using two relays:
  If the upper limiting value is exceeded or undercut, a relay switches, and if the lower limiting value is exceeded or undercut, another relay switches. The *Open* or *Close* relay actions are possible in each case (see page 126).



If the simple monitoring function (*Open*, *Close*) with one or two relays is not sufficient, use proportional output (see section 7.2.3).

Monitoring limiting values using one or two relays



1 Upper limit value (relay 1) exceeded

2 Selected switching delay t1 for relay 1 1 expired
Relay 1 switches

3 Hysteresis for upper limiting value (relay 1) undercut

4 Selected switching delay t1 for relay 1 1 expired
Relay 1 switches back

5 Lower limit value (relay 2) undercut
Selected switching delay t2 for relay 1 1 expired
Relay 2 switches

Fig. 7-1 Switching points for relays with the function of a limit indicator

A switching delay (t) can be set up for each relay for switching processes. This is the time period for which a limiting value must be exceeded before the relay switches. This prevents frequent switching if the measured values are close to the limiting value.

7.2.3 Proportional output

In the case of proportional output, a relay switches cyclically on and off in a defined measured value range (proportional range). At the same time, the relay switches with a:

- duration of operation that corresponds to the measured value (pulse-width output, see page 128) or
- switching frequency (frequency output, see page 128).

Proportional outputs can be used in the following way:

- Output with one relay:
  An output range is defined with a *Start value* and an *End value*. No output takes place above and below the output range (see page 127).
- Output with two relays:
  An output range is defined for each relay with a *Start value* and an *End value*. One relay outputs in the upper output range and a further relay in the lower output range (see page 127).

Output with one relay

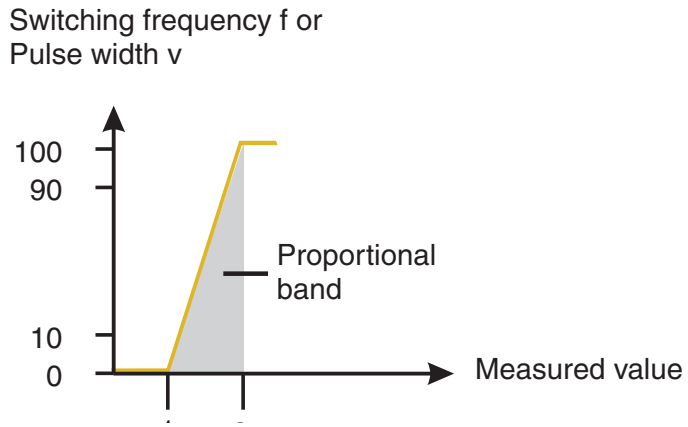
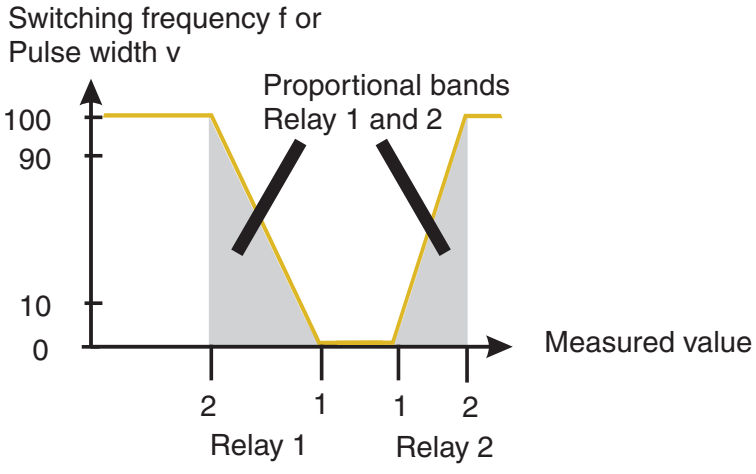


Fig. 7-2 Output with one relay

Output with two relays



1 *Start value*
Measured value with a minimum pulse width or switching frequency

2 *End value*
Measured value with a maximum pulse width or switching frequency

Fig. 7-3 Output with two relays

Pulse width output

The output of the pulse width is used, e.g. for controlling valves.

Pulse-width regulation changes the duration of operation (t_{on}) of the output signal. Depending on the position of the measured value in the proportional range, the relay is operated for a longer or shorter period.

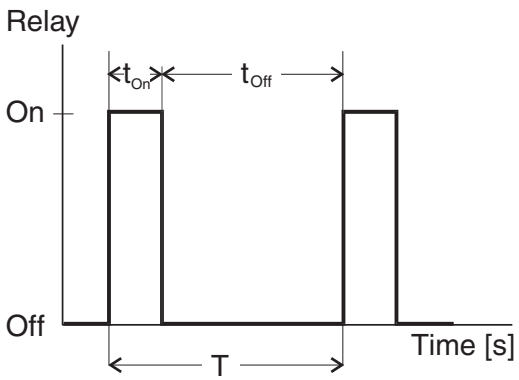


Fig. 7-4 Relay output of the pulse-width output

The cycle duration (T) is made up of the turn-on and turn-off switching duration (t_{on}, t_{off}) of the relay together. While the selected cycle duration (T) remains constant, the turn-on duration (t_{on}) changes depending on the measured value and, with it, the pulse width (v). The pulse width can be set from 0 % to 100 %.

$v = (t_{on} / T) * 100\ \%$

v = pulse width, T = cycle duration, t_{on} = turn-on duration

- If the measured value is at the end of the proportional range (*End value*), the turn-on duration (t_{on}) is long, the turn-off duration is short. This means the relay operates for a longer period.
- If the measured value is at the beginning of the proportional range (*Start value*), the turn-on duration (t_{on}) is short, and the relay operates for a correspondingly shorter period.

If the duration of the closing or opening pulse is shorter than 0.1 s, the relay remains open or closed for the complete cycle duration.

Frequency output

Switching frequency output is used, e.g. for controlling dosing pumps.

In contrast to the pulse-width output, the pulse width is not modulated with the frequency output but the switching frequency of the output signal. Depending on the position of the measured value in the proportional range, the relay is switched more often or less often.

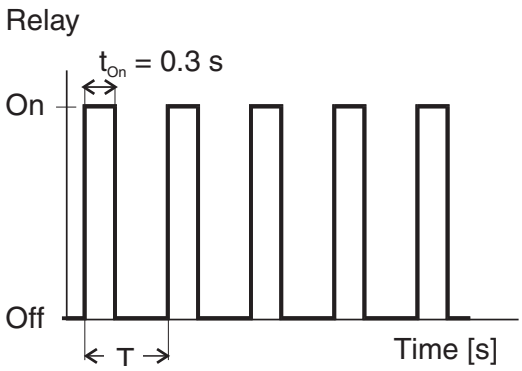


Fig. 7-5 Relay output of frequency output

While the selected switching duration (t_{on} = 0.3 s) always remains constant, the switching frequency at which the relay switches changes depending on the measured value.

- If the measured value is at the end of the proportional range (*End value*), the switching frequency is higher.
- If the measured value is at the beginning of the proportional range (*Start value*), the switching frequency is low.

Characteristic curves

Through the selection of the *Start value* and *End value*, the proportional output can be operated with a positive or negative characteristic curve.

- Positive characteristic curve:
  Select the *End value* to be greater than the *Start value*.
  The turn-on duration or frequency increases with an increasing measured value (see page 131).
- Negative characteristic curve:
  Select the *End value* to be smaller than the *Start value*.
  The turn-on duration or frequency decreases with an increasing measured value (see page 132).

The maximum values for the pulse width or switching frequency are assigned to the *End value* value and the minimum values for turn-on duration or frequency are assigned to the *Start value* value.

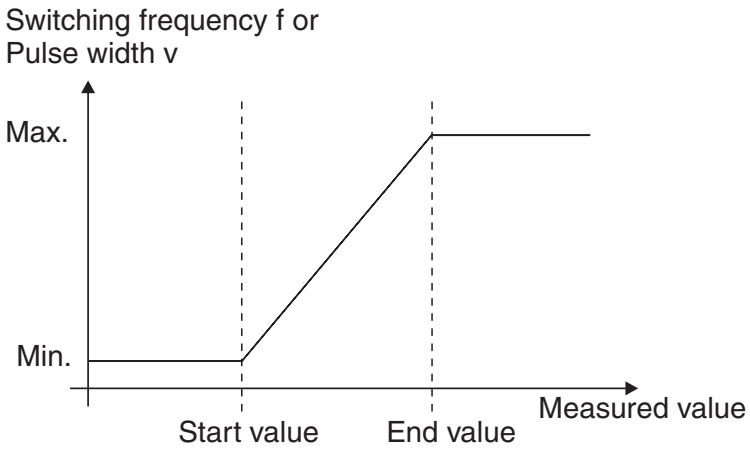


Fig. 7-6 Positive characteristic curve

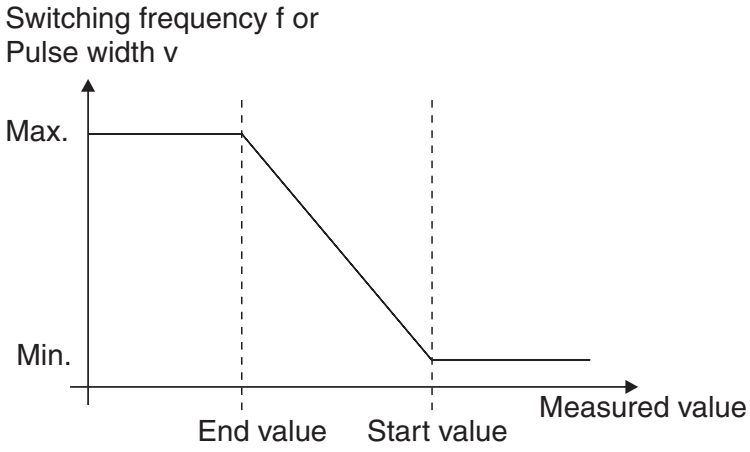


Fig. 7-7 Negative characteristic curve

Positive characteristic curve

The proportional output range begins above the initial value. If the proportional range is undercut or exceeded, the selected behavior comes into force.

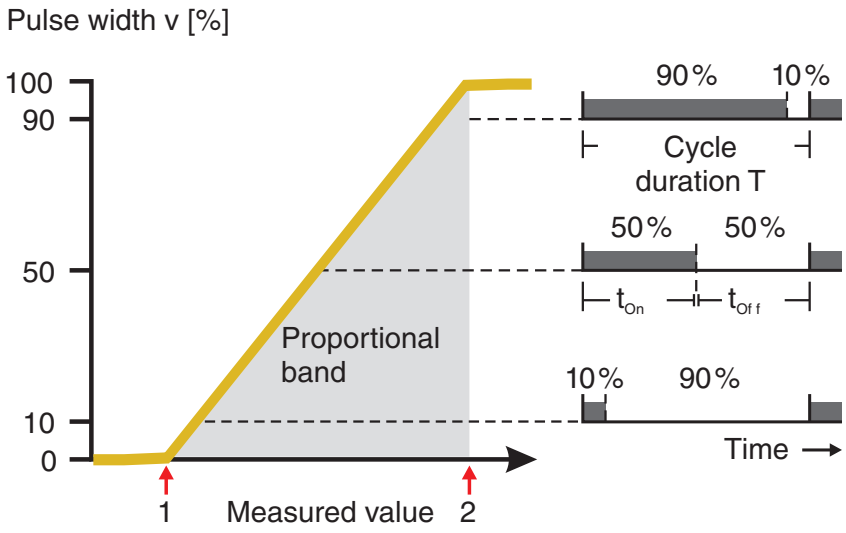


Fig. 7-8 Pulse width output

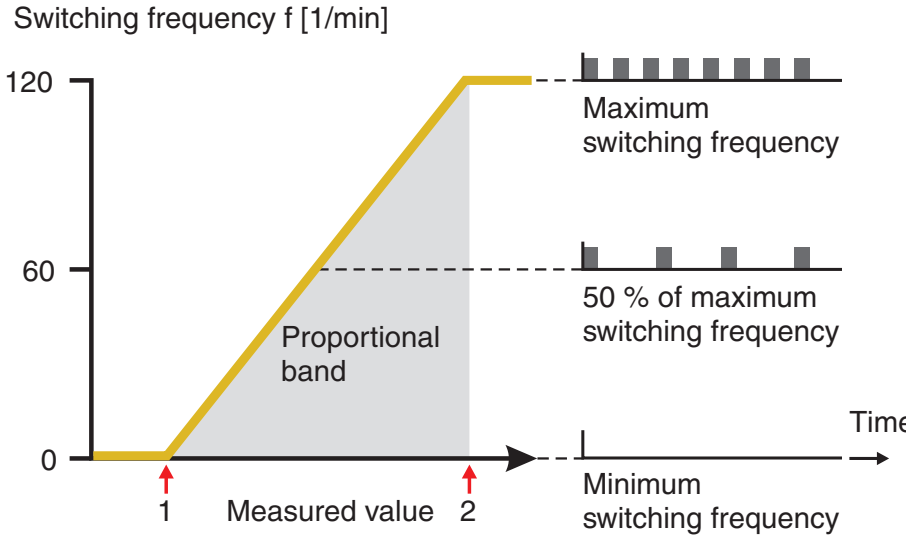


Fig. 7-9 Frequency output

1 *Start value*
Measured value with a minimum pulse width or switching frequency

2 *End value*
Measured value with a maximum pulse width or switching frequency

Negative characteristic curve

The proportional output range begins below the initial value. If the proportional range is undercut or exceeded, the selected behavior comes into force.

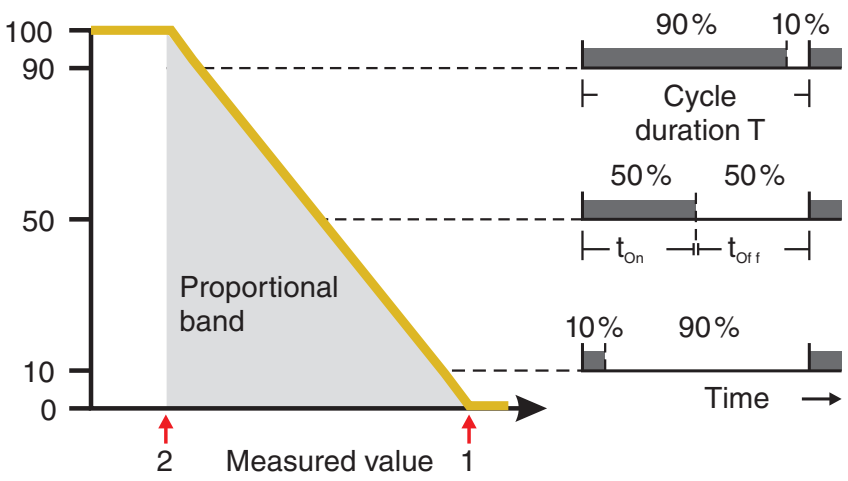


Fig. 7-10 Pulse width output

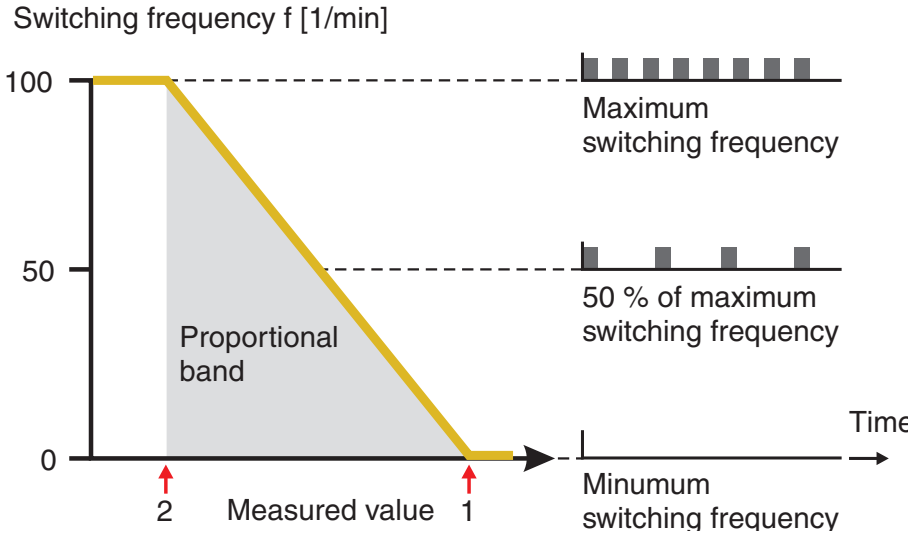


Fig. 7-11 Frequency output

1 *Start value*
Measured value with a minimum pulse width or switching frequency

2 *End value*
Measured value with a maximum pulse width or switching frequency

7.3 Entering / editing the name of an output

For easier identification of the outputs, an individual name can be given to each output in the *Edit list of outputs* overview.

1 Open the *Settings* menu with **<S>**.

2 Using **<▲▼◀▶>** and **<OK>**, select and confirm the menu item, *System settings -> Edit list of outputs*.
The *Edit list of outputs* display opens.

3 Press **<▲▼◀▶>** to highlight a name in the *Name* column and confirm with **<OK>**.

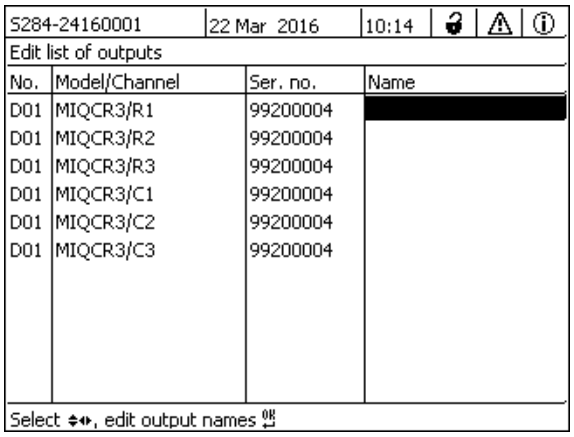


Fig. 7-12 Edit list of outputs

4 Select a letter, number or special character with **<▲▼◀▶>** and confirm with **<OK>**.

5 Complete the name of the output and confirm with **<OK>**.

7.4 Linking the output with a sensor

1 Open the *Settings* menu with **<S>**.

2 Using **<▲▼◀▶>** and **<OK>**, select and confirm the menu item, *System settings -> Settings of outputs and links*.
The *Settings of outputs and links* display opens.

3 Press **<▲▼◀▶>** to highlight the *&* column and confirm with **<OK>**.

4 Select an output with **<▲▼◀▶>** and confirm with **<OK>**. The *Link with...* display opens.
The display shows a list of sensors that can be linked.

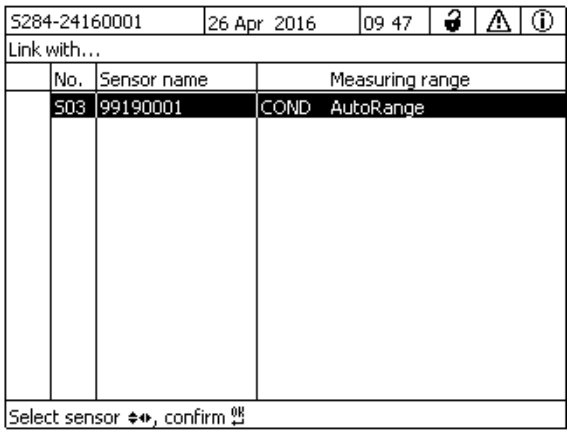


Fig. 7-13 Settings of outputs and links: Link with...

5 Using **<▲▼◀▶>**, select a sensor and confirm with **<OK>**.
The output is linked with the sensor.

In the overview *Settings of outputs and links*, field *Ser. no.*, outputs that are linked with sensors have the name of the linked sensor.

7.5 Deleting a link with an output

If a link between a current or relay output and a sensor is no longer required, you can erase the link.

1 Open the *Settings* menu with **<S>**.

2 Using **<▲▼◀▶>** and **<OK>**, select and confirm the menu item, *System settings -> Settings of outputs and links*.
The *Settings of outputs and links* display opens.

3 Press **<▲▼◀▶>** to highlight the *&* column and confirm with **<OK>**.

4 Select a linked output with **<▲▼◀▶>** and confirm with **<OK>**.

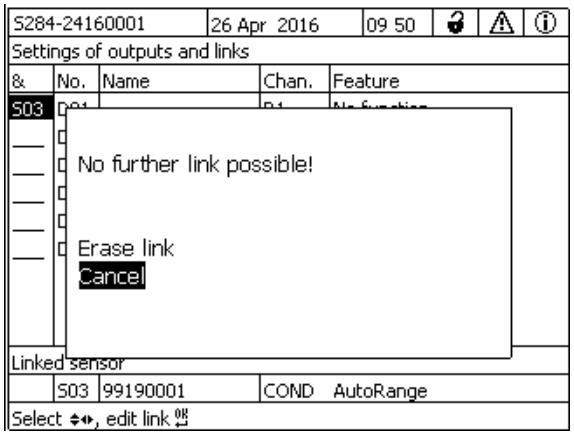


Fig. 7-14 Settings of outputs and links: Erase link

5 Select and confirm *Erase link* with **<▲▼◀▶>** and **<OK>**.
A safety query appears.

6 Select and confirm *Erase link* with **<▲▼◀▶>** and **<OK>**.
The link is deleted.

7.6 Setting the relay outputs

1 Call up the measured value display with **<M>**.

2 Open the *Settings* menu with **<S>**.

3 Using **<▲▼◀▶>**, highlight the menu item, *Settings of outputs and links*, and confirm with **<OK>**. The *Settings of outputs and links* display appears.

4 Using **<▲▼◀▶>**, highlight the *Feature* column. Confirm with **<OK>**.

5 Using **<▲▼◀▶>**, highlight a line for a relay output (Rx) in the column *Feature*. Confirm with **<OK>**.
The *Settings of outputs and links* display opens.

6 Using **<▲▼◀▶>**, highlight the menu item, *Relay function*, and confirm with **<OK>**.

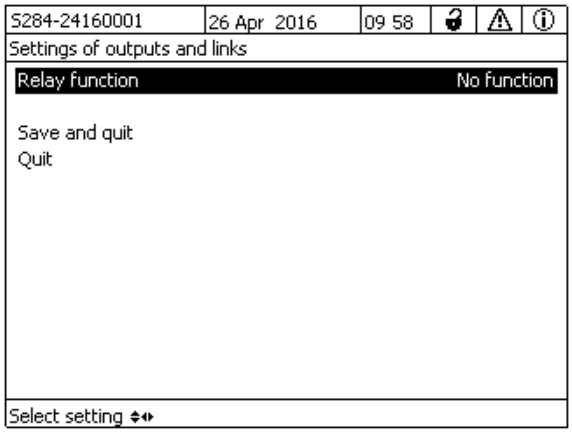


Fig. 7-15 Settings of outputs and links

7 Using **<▲▼◀▶>**, select one of the functions listed below. Confirm with **<OK>**.

Function	Description
No function	The relay output is not used.
System monitoring	see section 7.6.2
Sensor monitoring	see section 7.6.3
Limit indicator	see section 7.6.4
Frequency controller	see section 7.6.5
Pulse-width output	see section 7.6.6
Cleaning	see section 7.6.7
Sensor-controlled	see section 7.6.8
Manual control	see section 7.6.9
Alarm contact	see section 7.6.10

8 Make the settings for the relay outputs with **<▲▼◀▶>** and **<OK>**. The settings comprise the relay action (see section 7.6.1) and sensor dependent settings.

9 Using **<▲▼◀▶>** and **<OK>**, highlight and confirm *Save and quit*. The new settings are stored.

As soon as a function was selected for a relay output, you can select a relay action (see section 7.6.1).

7.6.1 Relay action

The following actions of the relay can be defined in the *Action* setting:

Settings	Explanations
Open	The relay should open on every event.
Close	The relay should close on every event.



Preferably set up the relay output as normally closed for monitoring functions (*ActionOpen*).

7.6.2 *System monitoring*

Function

The *System monitoring* function enables the monitoring of system errors.

In order to set up the *System monitoring* function for a relay output, the relay output must not be linked with a sensor (see section 7.4).

It can be used to monitor the following system errors.

Settings

Settings	Selection	Explanations
Power failure	*On* *Off*	The *Power failure On* function monitors the supply voltage in the IQ SENSORNET at the DIQ/S 28X or the combination output module. If the voltage falls below the critical value, the relay switches.
Communication	*On* *Off*	The *Communication On* function monitors the functioning of the DIQ/S 28X and the communication with the combination output module.
Collective error message	*On* *Off*	*Collective error message On* function simultaneously monitors the proper functioning of all sensors and the functioning of the combination output module to be monitored. (for details, see below this table)
Action	*Open*	For all functions of the *System monitoring*, the relay action is set to *Open*.

Collective error message

In the case of a *Collective error* message, the relay opens if one of the following malfunctions occurs:

- One of the sensors properly registered to the DIQ/S 28X does not provide a valid main measured value
- One of the sensors properly registered to the DIQ/S 28X does not provide a valid secondary measured value
- The monitoring output module has not received any new data DIQ/S 28X for 2 minutes.

In any case, the relay remains open for 10 seconds and only closes when the malfunction is no longer present.

In the following cases, the relay does not open despite an invalid measured value:

- The sensor is being calibrated
- The sensor is in the maintenance condition
- The sensor is being cleaned with the aid of a valve module in the system (compressed air operated cleaning system).

7.6.3 *Sensor monitoring*

Function

The *Sensor monitoring* function enables the monitoring of sensor errors and the maintenance condition.

In order to set up the *Sensor monitoring* function for a relay output, the relay output must be linked with a sensor (see section 7.4).

Settings

Setting	Selection	Explanation
Errors	*Special*	Special sensor errors are monitored and can prompt a relay action.
	All	All sensor errors (special ones and general ones) are monitored and can prompt a relay action.
	Off	Sensor errors are not monitored.
Mainten. Condition	*On* *Off*	Switching on and off the maintenance condition (see section 7.10) is monitored and can prompt a relay action.
Action	*Open* *Close*	Relay action (see section 7.6.1)



Preferably set up the relay output for monitoring functions as an opener (*Action Open*, see section 7.6.1).

Sensor messages include errors and information that are registered by the sensor.

Special sensor errors

The special sensor errors are sensor-dependent. Details of this are given in the component operating manual of the respective sensor.

General Sensor errors

Init	This can prompt a relay action for a short time, depending on the starting behavior of the system
----	Invalid measured value, or defective sensor
Error	Communication with sensor interrupted
OFL	Measuring range undercut or exceeded (overflow)

7.6.4 *Limit indicator*

Function The characteristic of the limit indicator is laid down in the *Limit value UL*, *Limit value LL*, *Hysteresis UL* and *Hysteresis LL* settings. The fundamentals of the function are described in the introductory chapter (see section 7.2.2).

In order to set up the *Limit indicator* function for a relay output, the relay output must be linked with a sensor (see section 7.4).

Settings

Setting	Selection/Values	Explanation
Limit values	*UL main variable* *LL main variable* *UL adjoining var.* *LL adjoining var.*	*Main variable* designates the actual measured parameter of the sensor (e.g. pH, oxygen, etc.). *Adjoining variable* designates an additional measured parameter (e.g. temperature).
Limit value UL	Upper or lower limiting value Any value within the measuring range (sensor-dependent)	Minimum difference between the upper and lower limit value: 5 % of the measuring range
Limit value LL		
Hysteresis UL	0 - 5% of the measuring range	Hysteresis for *Limit value UL* and *Limit value LL*.
Hysteresis LL		
Behavior at error	*Open* *Close* *Unchanged*	The relay opens, closes or remains unchanged in the case of system errors or sensor errors (see page 156).
Action	*Open* *Close*	Relay action (see section 7.6.1)
Switching delay	0 ... 3600 s	The time period for which a limiting value must be exceeded before the relay operates. Prevents frequent switching for measured values that are close to the limiting value.

7.6.5 *Frequency controller*

Function The characteristic of the frequency output is laid down in the *Start value*, *End value*, *Frequency (f) min.* and *Frequency (f) max.* settings. The fundamentals of the function are described in the introductory chapter (see section 7.2.3).

In order to set up the *Frequency controller* function for a relay output, the relay output must be linked with a sensor (see section 7.4).

Settings

Setting	Selection/Values	Explanation
Measured variable	*Main variable* *Adjoining variable*	*Main variable* designates the actual measured parameter of the sensor (e.g. pH, oxygen, etc.). *Adjoining variable* designates an additional measured parameter (e.g. temperature).
Start value	within the measuring range (sensor-dependent)	Minimum spacing: 5 % of the measuring range
End value		
Frequency (f) min.	0 to 120 1/min	Minimum spacing: 10 1/min
Frequency (f) max.		
Frequency with error	0 to 120 1/min	In case of system errors or sensor errors (see page 156), the relay switches with the frequency specified.
Action	*Open* *Close*	Relay action (see section 7.6.1)

Characteristic curve

If a value for *End value* that is greater than the *Start value* is entered, the output has a positive characteristic curve.

In order to obtain a negative characteristic curve, a value for *End value* must be entered that is smaller than the value for *Start value*.

7.6.6 *Pulse-width output*

Function

The characteristic of the pulse width output is laid down in the *Start value*, *End value*, *Pulse width (v) min.* and *Pulse width (v) max.* settings. The fundamentals of the function are described in the introductory chapter (see section 7.2.3).

In order to set up the *Pulse-width output* function for a relay output, the relay output must be linked with a sensor (see section 7.4).

Settings

Setting	Selection/Values	Explanation
Measured variable	*Main variable* *Adjoining variable*	*Main variable* designates the actual measured parameter of the sensor (e.g. pH, oxygen, etc.). *Adjoining variable* designates an additional measured parameter (e.g. temperature).
Start value	within the measuring range (sensor-dependent)	Minimum spacing: 5 % of the measuring range
End value		
Pulse width (v) min.	0 ... 100 %	Minimum spacing: 10 % of the *Cycle duration (T)*
Pulse width (v) max.		
Cycle duration (T)	5 ... 100 s	Length of the switching period T $T = (t_{on} + t_{off})$
Error pulse width	0 ... 100 %	In case of system errors or sensor errors (see page 156), the relay switches with the pulse-width specified.
Action	*Open* *Close*	Relay action (see section 7.6.1)

Characteristic curve

You can specify the minimum and maximum pulse width (v). This determines the steepness of the characteristic curve of the output.

7.6.7 *Cleaning*

If the valve module MIQ/CHV PLUS is used, it is best to set the *Cleaning* function directly at the valve output (V) of the MIQ/CHV PLUS (see operating manual MIQ/CHV PLUS). The relay can be used for other purposes.

Function

The *Cleaning* function enables the time controlled automatic start of the sensor cleaning function with the aid of a relay of the combination output module. The relay controls the MIQ/CHV valve module and switches the compressed air for the CH sensor cleaning head on or off.

In order to set up the *Cleaning* function for a relay output, the relay output must be linked with a sensor (see section 7.4).

The relay of the combination output module assigned always works as a closer.

The cleaning cycle consists of *Cleaning duration* and *Adjustment time*.

During the cleaning cycle the *Clean* display flashes. The outputs linked with this sensor are frozen. The maintenance condition (see section 7.10) is active.

After the *Cleaning duration*, the relay is opened. During the following *Adjustment time* the outputs remain blocked.
The outputs linked with this sensor are only released when the cleaning cycle is complete. The *Clean* display disappears. The maintenance condition is finished.

Testing the operativeness

You can test the operativeness of the cleaning system as follows: Manually open or close the relay with the *Manual control* function (see section 7.6.9) and, while doing so, check the behavior of the cleaning system.

Alternatively, you can test the operativeness of the cleaning system by checking the performance of the function at the start time set up (reference time ± interval). To perform a test immediately, the reference time can be set so that the next cleaning cycle will start in a few minutes (settings: see following table).

Settings

Setting	Selection/Values	Explanation
Reference time (h)	0 ... 23 h	Time at which a cleaning cycle is started. Further cleaning cycles will be performed at the times specified by the cleaning interval.
Reference time (min)	0 ... 60 min	
Interval unit	1 .. 7 d 1 .. 24 h 5 .. 60 min	Selection of range and unit for the *Reinigungsintervall*.

Setting	Selection/Values	Explanation
Cleaning interval	1/2/3/4/5/6/7 d or: 1/2/3/4/6/8/12/24 h or: 5/10/15/20/30/60 min	Repeat interval for the cleaning function: Time between the start time of a cleaning cycle and the start time of the next cleaning cycle*.
Cleaning duration	0 ... 300 s	Duration of the cleaning
Adjustment time	0 ... 900 s	Time extension to allow the sensor to adjust to the test sample after cleaning.

* With short *cleaning intervals*, the adjustable values for the *Cleaning duration* and *Adjustment time* are limited. The following values apply:

Cleaning interval	***Cleaning duration***	***Adjustment time***
≤ 10 min	max. 60 s	max. 120 s
≤ 20 min	max. 180 s	max. 300 s

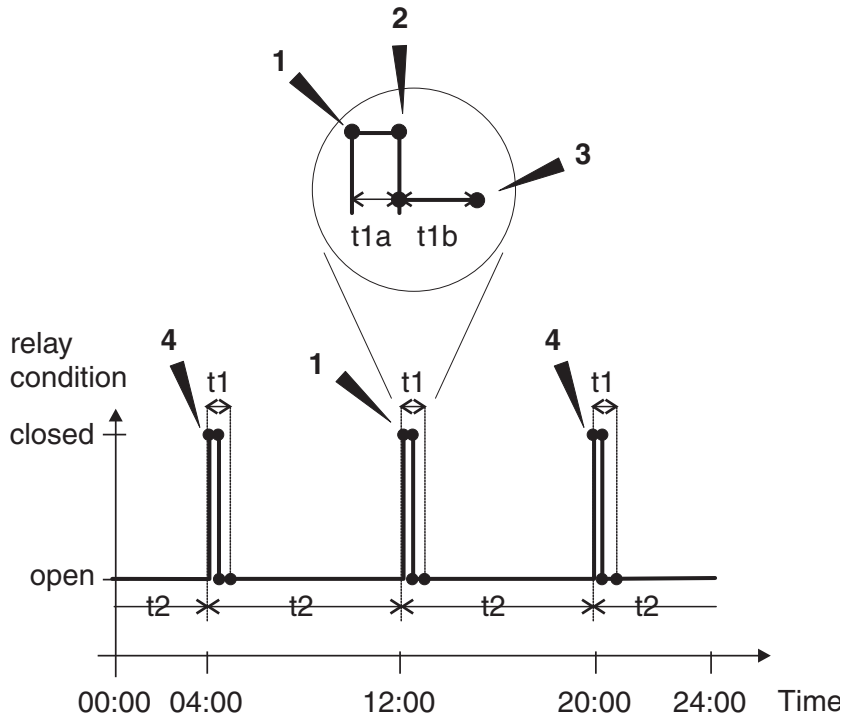


With this, the cleaning times are fixed. They only change when the *reference time* is changed.

The reference time and all further cleaning times relate to the date and time of the system clock. How to set the system clock is described in the system operating manual.

Example

Setting		Result
Reference time (h): *Reference time (min)*: *Interval unit*: *Cleaning interval*:	12 0 *Hours (h)* 8 h	Reference time: 12:00 hours This specifies the following start times: 04:00, 12:00 and 20:00 hours



1 Reference time
Begin of a cleaning cycle (**t1**)
Begin of the specified *Cleaning duration* (**t1a**)

2 End of the specified *Cleaning duration* (**t1a**)
Begin of the specified *Adjustment time* (**t1b**)

3 End of the specified *Adjustment time* (**t1b**)
End of the cleaning cycle (**t1**)

4 Reference time ± *Cleaning interval* (**t2**)
Begin of a cleaning cycle

Canceling the cleaning

A running cleaning cycle is canceled:

- Automatic
  - if the sensor switches to the inactive condition during the cleaning cycle
- Manual
  - By pressing the **<C>** key
  - By switching on the maintenance condition

Each time the cleaning cycle is canceled, the relay opens immediately.

If the cleaning cycle is canceled automatically, the outputs linked to the sensor are released immediately.
If the cleaning cycle is canceled manually, the sensor is in the maintenance

condition. The linked outputs are only released after the maintenance condition was terminated manually.

The next cleaning cycle will be performed at the time set up.



In case of a power failure, all relays open. The cleaning cycle is canceled. The outputs linked with the sensor change to the non-active condition (see section 7.9.2). As soon as the power is available, the outputs are released again. The next cleaning cycle will be performed at the time set up.

7.6.8 *Sensor-controlled*

With the *Sensor-controlled* function, the relay is controlled by a linked sensor.

Prerequisites

- Sensor that sends signals to trigger a cleaning cycle, e.g. UV/VIS sensor

Settings

Setting	Selection/Values	Explanation
Pulse length	*Automatic*	The duration of the cleaning procedure with air is programmed in the sensor. The relay automatically takes over from the sensor the cleaning duration.
	0,5 s 1 s 2 s 3 s	The relay finishes the cleaning procedure after the interval selected here.



Set up the cleaning process in the menu *Settings of sensors and diff. sensors* of the relevant sensor.

7.6.9 *Manual control*

Function The *Manual control* function can be used to test the operativeness of an instrument that is connected to the relay. To do so, close or open the relay manually and, while doing so, check the behavior of the connected instrument.

Setting	Selection/Values	Explanation
Relay function	*Manual control*	The selected relay action is carried out with *Save and quit*.
Action	*Open* *Close*	Relay action (see section 7.6.1)



The settings for other functions in the *Relay function* menu as, for example, *Frequency controller* and *Pulse-width output* are retained while the *Manual control* is carried out.

7.6.10 *Alarm contact*

Function The *Alarm contact* function triggers a relay action (opening or closing) if a defined alarm event takes place. The *Alarm contact* function is only available for relays that are not linked with a sensor. If necessary, an existing link must be erased.

Setting	Selection/Values	Explanation
Relay function	*Alarm contact*	The selected relay action is carried out with *Save and quit*.
Action	*Open* *Close*	Relay action (see section 7.6.1)

7.7 Setting the current outputs (variant -CR3, CR6)

1 Call up the measured value display with **<M>**.

2 Open the *Settings* menu with **<S>**.

3 Using **<▲▼◀▶>**, highlight the menu item, *Settings of outputs and links*, and confirm with **<OK>**. The *Settings of outputs and links* display appears.

4 Using **<▲▼◀▶>**, highlight the *Feature* column. Confirm with **<OK>**.

5 Using **<▲▼◀▶>**, highlight a line for a current output (Cx) in the column *Feature*. Confirm with **<OK>**.
The *Settings of outputs and links* display opens.

6 Using **<▲▼◀▶>**, highlight the menu item, *Current output*, and confirm with **<OK>**.

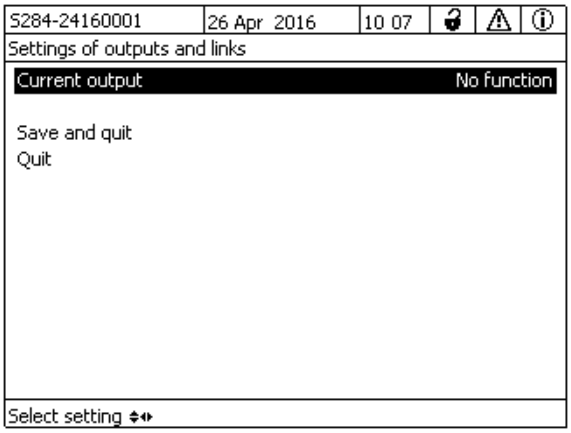


Fig. 7-16 Settings of outputs and links

7 Select and confirm a function with **<▲▼◀▶>** and **<OK>**.

Function	Settings
No function	The current output is not used.
Recorder	see section 7.7.1
PID controller	see section 7.7.2
Fixed current value	see section 7.7.3

8 Make the settings for the current output with **<▲▼◀▶>** and **<OK>**.

9 Using **<▲▼◀▶>** and **<OK>**, highlight and confirm *Save and quit*.
The new settings are stored.

7.7.1 *Recorder*

Function The measured values of the linked sensor at the current output are set up as current intensity in the *Recorder* application. The output of measured values is laid down in the *Recorder type*, *Start value* and *End value* settings.

Settings

Setting	Selection/Values	Explanation
Recorder type	0 to 20 mA or 4 to 20 mA	
Start value	(sensor dependent)	Minimum spacing: ≤ 5 % of the measuring range (sensor-dependent)
End value		
Measured variable	*Main variable* *Adjoining variable*	*Main variable* designates the actual measured parameter of the sensor (e.g. pH, oxygen, etc.). *Adjoining variable* designates an additional measured parameter (e.g. temperature).
Attenuation	0 ... 40 mA/s	Speed of change of the output current (mA/s) in the case of erratic changes of the input signal.
I -> UFL/OFL	*Error*	Current values outside the range between *Start value* and *End value* are regarded as an error. The current output reacts as specified under *Behavior at error* (see below).
	Limitation	The current at the output is limited to the *Start value* or *End value*.
Behavior at error	*Fixed current value*	In the case of system errors and sensor errors, the current output delivers the fixed current value that was specified. Possible values: 0 ... 21 mA.
	Unchanged	The current at the output remains unchanged.

7.7.2 *PID controller*

Function

The *PID controller* function can use an output as a controller output. The regulator can be configured as a **P**roportional regulator with switchable **I**ntegral and **D**ifferential regulator parts (**PID** Controller).

The control response of the PID controller is described by the following formula:

$$I_{Controller} = I_0 + K\left(x_e + \frac{1}{T_i}\int x_e dt + T_d \frac{dx_e}{dt}\right)$$

with:

$$K = \frac{I_{max} - I_{min}}{X_p}$$

$$x_e = x_{nom} - x_{actual}$$

$$I_{min} \le I_{Controller} \le I_{max}$$

$I_{Controller}$	Current on the controller output at time t
I_0	*Current on the output if $x_{actual} = x_{set}$*
K	Amplification
X_p	Proportional range
x_e	Control difference
x_{actual}	Actual value (current measured value)
x_{set}	Set value
ti	Integral algorithm
td	Differential control part
t	Time
I_{min}	Lower current limitation
I_{max}	Upper current limitation

The adjustable control parameters are x_{set}, I_0, X_p, I_{min}, I_{max}, *ti* and *td* (see setting table on page 153).
By activating or deactivating the **I**ntegral (*ti*) and **D**ifferential (*td)* controller part, the following controller types can be configured:

Regulator type	***td* [s]**	***ti* [s]**
P controller	0	0
PI controller	0	1 to 9999

Regulator type	*td* [s]	*ti* [s]
PD controller	1 to 9999	0
PID controller	1 to 9999	1 to 9999

Characteristic curve of the proportional controller

For a pure P controller the correlation between the measured value and current I on the controller output results in the following characteristic curve:

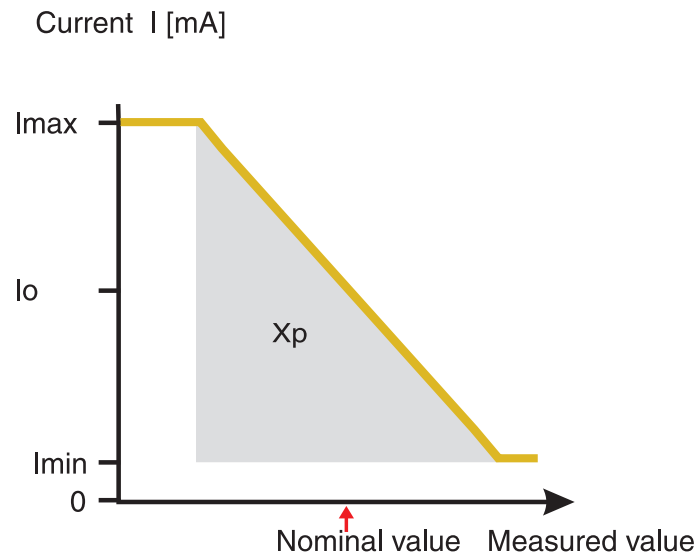


Fig. 7-17 Proportional controller (negative characteristic curve)

The proportional range *Xp* is limited by the measurement range of the linked sensor. If a value is entered for the parameter *Xp* that is greater than zero, the controller has a positive characteristic curve (example Fig. 7-17). To obtain a positive characteristic curve, a negative value must be entered for *Xp*.

Application example

- Regulation of the oxygen concentration
- Sensor: TriOxmatic 700 IQ (measuring range: 0 to 60 mg/l)

Control parameter	Value
Nominal value	4 mg/l
Xp	10 % of the measuring range or 6 mg/l
Imin	8 mA
Imax	14 mA
Io	12 mA
ti	0 s (no I algorithm)
td	0 s (no D algorithm)

The control parameters result in the following (negative) characteristic curve:

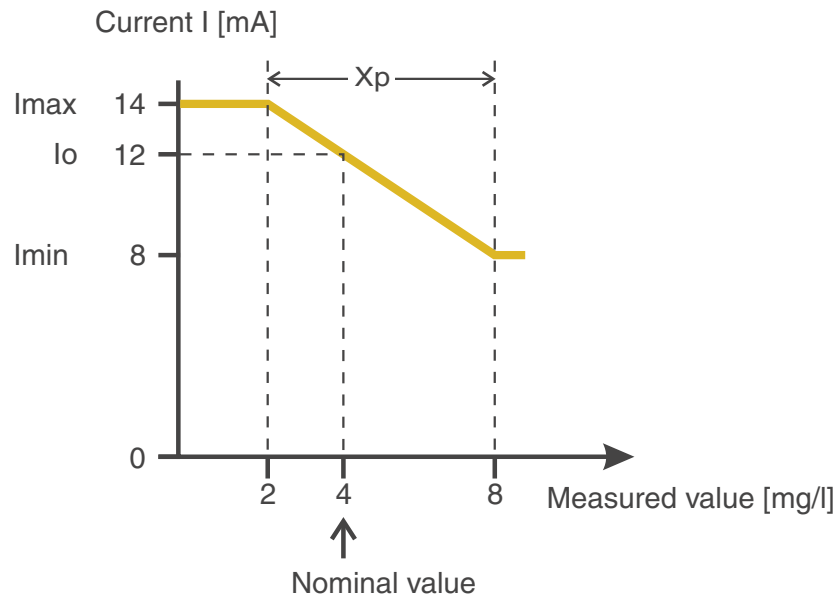


Fig. 7-18 Characteristic curve for application example

The controller works with the following amplification:

$$K = \frac{6\ mA}{6\ mg/l} = 1\frac{mA}{mg/l}$$

Within the proportional range an increase of the concentration by 1 mg/l causes a reduction of the output current by 1 mA. If the measured concentration is 5 mg/l, for example, 11 mA is output:

$$I_{Controller} = 12\ mA + 1\frac{mA}{mg/l} \cdot (4\ mg/l - 5\ mg/l)$$

$$I_{Regler} = 12\ mA + 1\frac{mA}{mg/l} \cdot (-1\ mg/l) = 11\ mA$$

The highest concentration at which the controller still works in the proportional range is 8 mg/l (corresponding to *Imin* = 8 mA) and the lowest is 2 mg/l (corresponding to *Imax* = 14 mA).

Settings

Setting	Selection/Values	Explanation
Measured variable	*Main variable* *Adjoining variable*	*Main variable* designates the actual measured parameter of the sensor (e.g. pH, oxygen, etc.). *Adjoining variable* designates an additional measured parameter (e.g. temperature).
Nominal value	within the measuring range (sensor-dependent)	Nominal value the measured value is regulated to
Xp	5 ... 100 % -5 ... -100 % % of the measuring range	Proportional range of the controller. Negative values result in a positive characteristic curve.
Imin	0 ... 20 mA	Lower current limitation *
Imax	0 ... 20 mA	Upper current limitation * * Note: Spacing between *Imin* and *Imax*: at least 5 mA

Setting	Selection/Values	Explanation
Io	0 ... 20 mA	Current value on the output if the measured value equals the *Nominal value*
ti	0 ... 9999 s	Hold-back time: Integral part of the controller (*0* = not effective)
td	0 ... 9999 s	Reset time: Differential part of the controller (*0* = not effective)
Behavior at error	*Fixed current value*	In the case of an error, the current output supplies the current value defined in the *Current with error* field (any in the range *0 ... 21 mA).*
	Unchanged	In the case of an error, the current on the output remains unchanged.

7.7.3 *Fixed current value*

Function The *Fixed current value* function can be used to test the operativeness of the instruments connected to the outputs: output different current values to the output and, while doing so, check the behavior of the connected instrument.

Setting	Selection/Values	Explanation
Current output	*Fixed current value*	Using *Save and quit*, the nominal amperage that was input as *Inom* is output.
Inom	0 ... 20 mA	The nominal amperage that is output.



The settings for other functions in the *Current output* menu as, for example, *PID controller* and *Recorder* are retained while the *Fixed current value* is carried out.

7.8 Checking the condition of the outputs

This function provides a simple overview of the conditions of all outputs of the combination output module.

For the relays, the displayed condition is *open* or *closed*.

For the current outputs, the current value present at the outputs is displayed.

1 Call up the measured value display with **<M>**.

2 Open the *Settings* menu with **<S>**.

3 Using **<▲▼◀▶>**, highlight the menu item, *Service*, and confirm with **<OK>**. The *Service* dialog window opens.

4 Using **<▲▼◀▶>**, highlight the menu item, *List of all components*, and confirm with **<OK>**.
The *List of all components* dialog window opens.

5 Highlight the required component with **<▲▼◀▶>** (column *Model*, entry *MIQCR3*) and confirm with **<OK>**.
The *Status of output channels* window opens.

S284-24160001	26 Apr 2016	10 43			
Status of output channels					
No.	Name	Chan.	Status		
D01	GW Lft 1	R1	open		
D01	GW Lft 2	R2	open		
D01	GW Lft 3	R3	open		
D01	O2 Bel 1	C1	6.78 mA		
D01	O2 Bel 2	C2	0.00 mA		
D01	O2 Bel 3	C3	10.13 mA		
Return ESC					

Fig. 7-19 Status of output channels

6 Using **<M>** or (ESC), exit the window *Status of output channels*.

7.9 Behavior of linked outputs

7.9.1 Behavior in case of error

For linked relay outputs or current outputs, you can determine the behavior of the outputs in case of errors.

Depending on the use of the output, the behavior in case of errors is set in the following menus:

Output	Menu
Frequency controller	*Frequency with error* (see section 7.6.5)
Pulse-width output	*Error pulse width* (see section 7.6.6)
Recorder	*Current with error* (see section 7.7.1)

Error events

The specified behavior occurs with the following events or conditions:

- The linked sensor does not provide any valid measured value (display of *Init*, *Error*, *"-----"*, or *OFL)*
- Communication with the DIQ/S 28X is interrupted for more than 2 minutes.
- The supply voltage for the DIQ/S 28X is too low.
- In the function *Recorder*, the measured value of the linked sensor is outside the range between *Start value* and *End value*.

Freezing the conditions of the outputs

Irrespective of the behavior in case of error that was defined, the following situations cause the conditions of the outputs to be frozen:

- The linked sensor is in the maintenance condition (display of *Cal*, *Clean*, or flashing measured value).
- Communication with the DIQ/S 28X is temporarily interrupted. After an interruption of 2 minutes the output changes to the behavior defined for error.

Restoring the normal functioning

The relay or current output automatically returns to its normal condition as soon as all errors have been eliminated and all conditions that caused the freezing of the outputs were eliminated.

7.9.2 Behavior in non-operative condition

An output is non-operative when no function is activated for the output.

An output becomes non-operative in case of

- Power failure
  (As soon as the supply voltage is sufficient again, the non-operative condition of the outputs ends. The outputs function as specified by the user again.)
- Erasing a link to a sensor
- Changing the *Measuring mode* sensor setting for a linked sensor
- Changing the *Measuring range* sensor setting for a linked sensor



Before editing sensor settings a note appears on the display to inform you that links will be erased when you change the *Measuring mode* or *Measuring range* sensor setting.

Settings in the non-active condition

Current output	Relay output
Current: 0 A	Relay: Open

7.10 Maintenance condition of the sensors

The maintenance condition of the sensors is used for calibrating, cleaning, servicing and repairing (removing and exchanging) the sensors.

In the maintenance condition

- the system does not react to the current measured value or the condition of the selected sensor
- linked outputs are frozen
- sensor errors do not prompt changes in the conditions of linked outputs.

The maintenance condition is automatically activated

- during calibration. After calibration the sensor remains in the maintenance condition until the maintenance condition is switched off manually (see section 7.10.2)
- during the cleaning cycle (see section 7.6.7)

If you want to clean, service or repair (remove and exchange) a sensor, switch on the maintenance condition manually (see section 7.10.1).

When you have finished cleaning, servicing or repairing the sensor, switch off the maintenance condition manually (see section 7.10.2).

If the maintenance condition is activated for a sensor, the measured values or status indicators of this sensor flash in the measured value display.

7.10.1 Switching on the maintenance condition

1 Call up the measured value display with **<M>**.

2 Select the sensor you want to switch on the maintenance condition for with **<▲▼◀▶>**. The measured values of the sensor do not flash.

3 Open the *Display/Options* menu with **<OK>**.

4 Using **<▲▼◀▶>**, highlight the menu item *Switch maintenance condition on/off* or *Maintenance Sensor S0x* and confirm with **<OK>**. A window that informs you about the maintenance condition opens up.

5 Confirm *Continue* with **<OK>**.
The selected sensor is in the maintenance condition. Linked outputs are frozen.

6 Call up the measured value display with **<M>**.
The measured values of the sensor flash.

7.10.2 Switching off the maintenance condition

1 Call up the measured value display with **<M>**.

2 Select the sensor you want to switch off the maintenance condition for with **<▲▼◀▶>**. The measured values of the sensor flash.

3 Open the *Display/Options* menu with **<OK>**.

4 Using **<▲▼◀▶>**, highlight the menu item *Switch maintenance condition on/off* or *Maintenance Sensor S0x* and confirm with **<OK>**. A window that informs you about the maintenance condition opens up.

5 Confirm *Continue* with **<OK>**.
The maintenance condition of the selected sensor is switched off. Linked outputs are released.

6 Call up the measured value display with **<M>**.
The measured values of the sensor do not flash.

8 Maintenance and cleaning

8.1 Maintenance

Maintenance activities

Component	Maintenance
IQ sensors	Depending on the type of sensor (see the component operating manual of the sensor)
IQ SENSORNET, DIQ modules, MIQ modules	No maintenance required

8.2 Cleaning

IQ SENSORNET, DIQ modules, MIQ modules

Clean components mounted in the open of gross contamination as necessary. We recommend cleaning the worst of the dirt on the enclosure and the area directly around it each time before opening in order to prevent contamination from entering the open enclosure.

To clean the module, wipe the enclosure surfaces with a damp, lint-free cloth. If compressed air is available on site, blow off the worst of the dirt beforehand. Keep the enclosure closed while doing so.

NOTE
Do not use high-pressure water blasters for cleaning (danger of water penetration!). Also do not use aggressive cleaning agents such as alcohol, organic solvents or chemical detergents. These types of cleaning agent can attack the surface of the enclosure.



The enclosure and the window of the display are made of plastic. Thus, avoid contact with acetone and similar detergents. Remove any splashes immediately.

IQ sensors

The cleaning of the IQ sensors depends greatly on the respective application. Instructions for this are given in the respective component operating manual.

A valve module for the compressed air-operated cleaning of sensors is available as an accessory.

9 What to do if ...

9.1 Information on errors

Log book

The IQ SENSORNET system performs a comprehensive cyclical self test during operation. While doing so, the system identifies all states that deviate from normal operation and enters corresponding messages in the log book (information or error message).

With the aid of the log book, you can call up instructions on how to clear the error directly on the Universal Transmitter. The log book is described in detail in section 4.5 MESSAGES AND LOG BOOK.



Information on possible errors in IQ sensors and MIQ output modules is given in the chapter WHAT TO DO IF ... of the respective component operating manual.

9.2 Errors: causes and elimination

The system no longer reacts to entries

Cause	Remedy
– System error	Reset the system: – Switch off the power supply and switch it on again after 10 s

"Error" in the measured value display

Cause	Remedy
– Communication with the IQ Sensor interrupted	– Check the cable connection
– Error in the IQ sensor	– Disconnect the IQ sensor and reconnect it after 10 s

The selected system language was not activated for all components

Cause	Remedy
– A system language was selected that is not available in at least one component (sensor, Universal Transmitter, output module). The standard language, *English*, was activated instead of the selected system language.	– Contact the service department, as a software update is required for the relevant components.

9.3 Replacing system components



It is always possible to replace components and assign a substitute if the software state of the substitute component is as high as or higher than the software version of the original component.

9.3.1 Replacing passive components

Passive components include all components that the Universal Transmitter cannot recognize.
These include:

- MIQ/PS (power supply module)
- DIQ/JB (branching module)
- DIQ/CHV (module for automatic compressed air cleaning)
- Cables (SNCIQ, SACIQ).



WARNING
If the MIQ/PS power supply module is opened during operation, there is a danger to life due to possible hazard of electric shock. The MIQ/PS may only be opened when the line voltage is switched off. Secure the line voltage against being switched on again.
Only ever replace components when the IQ SENSORNET system is switched off. Defective components are removed in the reverse order to the installation (see chapter 3 INSTALLATION).

9.3.2 Adding and replacing IQ sensors

Inactive datasets of IQ sensors

If an IQ sensor is removed from the system, its settings remain stored in the Universal Transmitter. A "?" appears in the left column of the *Edit list of sensors* menu. This indicates an "inactive dataset". A dataset contains the following information:

- Serial number of the IQ sensor (and, with it, the type of sensor)
- Display position
- All sensor settings
- All characteristics of the link with an output.

If no suitable inactive dataset is available, a newly connected IQ sensor is automatically recognized as a new module and added to the list of sensors.

The maximum number of datasets (active and inactive datasets) for IQ sensors is limited to 2 in the IQ SENSORNET system DIQ/S 284, to 4 in the IQ SENSORNET system DIQ/S 282.

When this number is reached, no further IQ sensor can be installed. If necessary, an inactive dataset has to be erased to make an extension possible.

The current calibration data of the IQ sensor is always stored in the sensor. If an IQ sensor is connected that is ready for operation and calibrated, this can be used immediately without the need for recalibration.

To erase inactive datasets, see section 5.4.3.

If an IQ sensor is connected to the system when an inactive dataset is present, the following cases are possible:

Case 1:

The serial number of the IQ sensor is identical with the serial number of an inactive dataset.	The connected IQ sensor is automatically assigned to the inactive dataset and starts to operate again. Example: Maintenance or repair. This mechanism ensures that all IQ sensors retain their settings and links if an IQ sensor was removed for maintenance, or if the system was temporarily switched off.

Case 2:

The type of sensor is identical with the type of sensor in an inactive dataset (or several inactive datasets), but the serial numbers differ.	Operator intervention is required here. The connected IQ sensor can: – be assigned to the inactive dataset (or one of the inactive datasets). Example: Replacing an IQ sensor. Make sure that the substitute sensor has at least the software status of the active IQ sensor. – be included as a new module in the list of the sensors. The operating sequence to do this is described below.

Operating sequence in case 2

1 Connect a new IQ sensor.

2 Switch to the measured value display with **<M>**. The component database is updated. The following display appears (example):

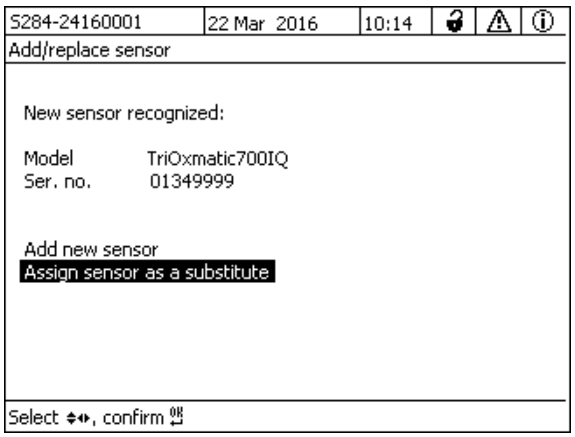


Fig. 9-1 510 - Add/replace sensor

3 Select the required option with **<▲▼◀▶>** and confirm with **<OK>**.
- If *Add new sensor* was selected, the system changes directly to the measured value display. As soon as the IQ sensor is ready for operation, it delivers a measured value.
- If *Assign sensor as a substitute* was selected, a list of matching inactive datasets appears:

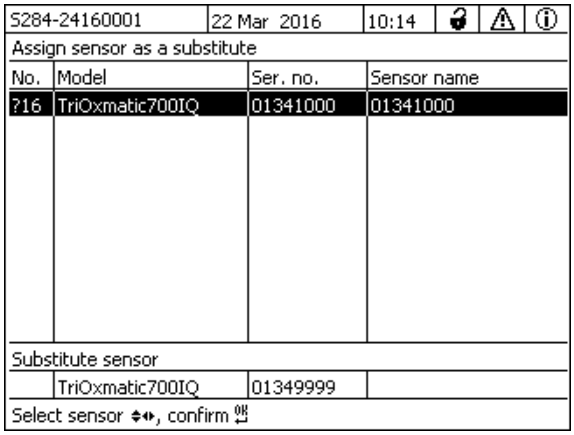


Fig. 9-2 520 - Assign sensor as a substitute

4 Select the required inactive dataset with **<▲▼◀▶>** and confirm with **<OK>**. The system changes to the measured value display. The IQ sensor takes over all settings of the inactive dataset. As soon as the IQ sensor is ready for operation, it delivers a measured value.

9.3.3 Adding and replacing DIQ or MIQ output modules

WARNING
There is also a danger to life from voltages that may present a hazard of electric shock on the relay contacts of open DIQ or MIQ output modules (e.g. DIQ/CR3 or MIQ/CR3). Output modules with relays may only be opened if all external voltages have previously been switched off. Secure all external voltages against being switched on again for the duration of the work.

When replacing DIQ or MIQ modules make sure that the substitute module has at least the software status of the active module.

Only replace any DIQ or MIQ output modules (all DIQ or MIQ modules with relay contacts and/or electrical signal outputs) while the DIQ/S 28X system is switched off. Defective DIQ or MIQ output modules are removed in the reverse order to that of the installation. The installation is described in the INSTALLATION chapter of the respective component operating manual.

Inactive datasets in MIQ output modules

If an DIQ or MIQ output module is removed from the system, its settings remain stored in the Universal Transmitter. A "?" appears in the left column (= inactive dataset) of the *Edit list of outputs* menu. The dataset contains the following information:

- All settings of the relays
- All settings of the current outputs.

If no inactive dataset is available, a newly connected MIQ output module is automatically recognized as a new module and added to the list of outputs.



The maximum number of data sets (active and inactive datasets) for DIQ or MIQ output modules is limited to 2 in the IQ SENSORNET system DIQ/S 28X. When this number is reached, no further DIQ or MIQ output module can be installed. If necessary, an inactive dataset has to be erased to make an extension possible.



To erase inactive datasets, see section 5.7.2.

If a DIQ or MIQ output module is connected to the system when an inactive dataset is present, the following cases are possible:

Case 1:

The serial number of the DIQ or MIQ output module is identical with the serial number in an inactive dataset.	The connected DIQ or MIQ output module is automatically assigned to the inactive dataset and start operating again. Example: In the case of repair.

Case 2:

The type of the DIQ or MIQ output module is identical with the type of an inactive dataset (or several inactive datasets), but the serial numbers differ.	Operator intervention is required here. The connected DIQ or MIQ output module can: – be assigned to the inactive dataset (or one of the inactive datasets). Example: Replacing a DIQ or MIQ output module. – be included as a new module in the list of outputs. The operating sequence to do this is described below.

Operating sequence in case 2

1 Remove the (defective) DIQ or MIQ output module. The output module is removed in the reverse order to the installation. The installation is described in the INSTALLATION chapter of the respective component operating manual.

2 Install the new DIQ or MIQ output module (INSTALLATION chapter of the respective component operating manual).

3 Switch to the measured value display with **<M>**. The component database is updated. The following display appears (example):

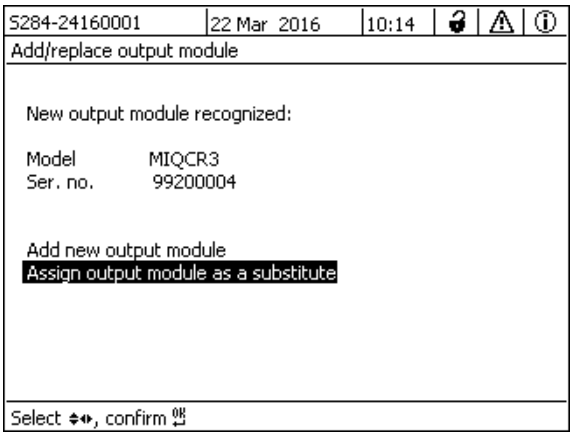


Fig. 9-3 410 - Add/replace output module

4 Select the required option with **<▲▼◀▶>** and confirm with **<OK>**.
- If *Add new output module* was selected, the system changes directly to the measured value display.
- If *Assign output module as a substitute* was selected, a list of the matching inactive datasets appears:

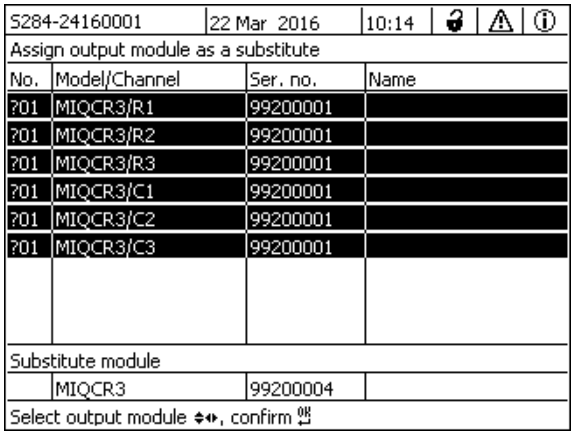


Fig. 9-4 420 - Assign output module as a substitute

5 Select the required inactive dataset with **<▲▼◀▶>** and confirm with **<OK>**. The system changes to the measured value display. The MIQ output module takes over all settings of the inactive dataset.

10 Technical data

10.1 DIQ/S 282, DIQ/S 284

Dimensions DIQ/S 28X-CRx

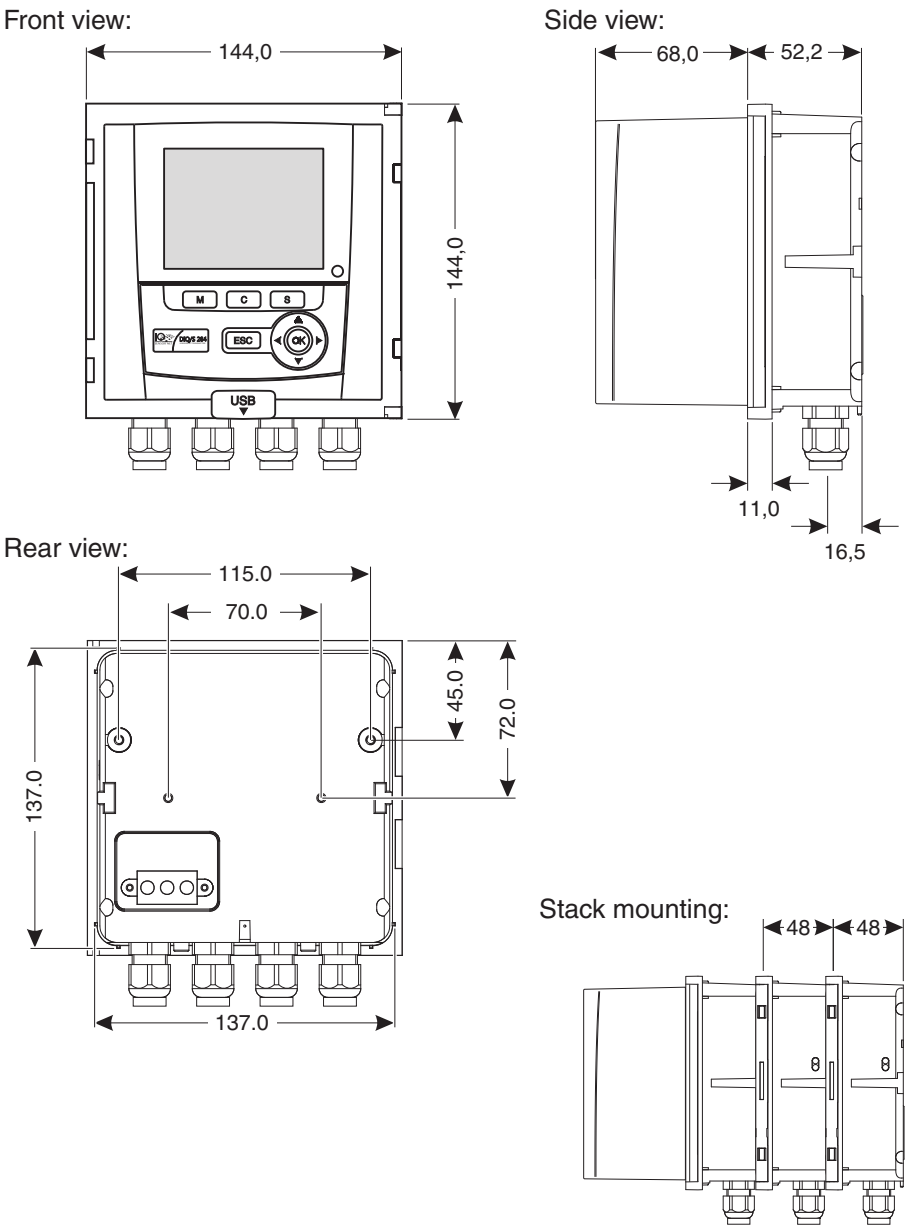


Fig. 10-1 Dimension drawing of the DIQ/S 28X (dimensions in mm)

Dimensions
DIQ/S 28X-MOD
DIQ/S 28X-PR

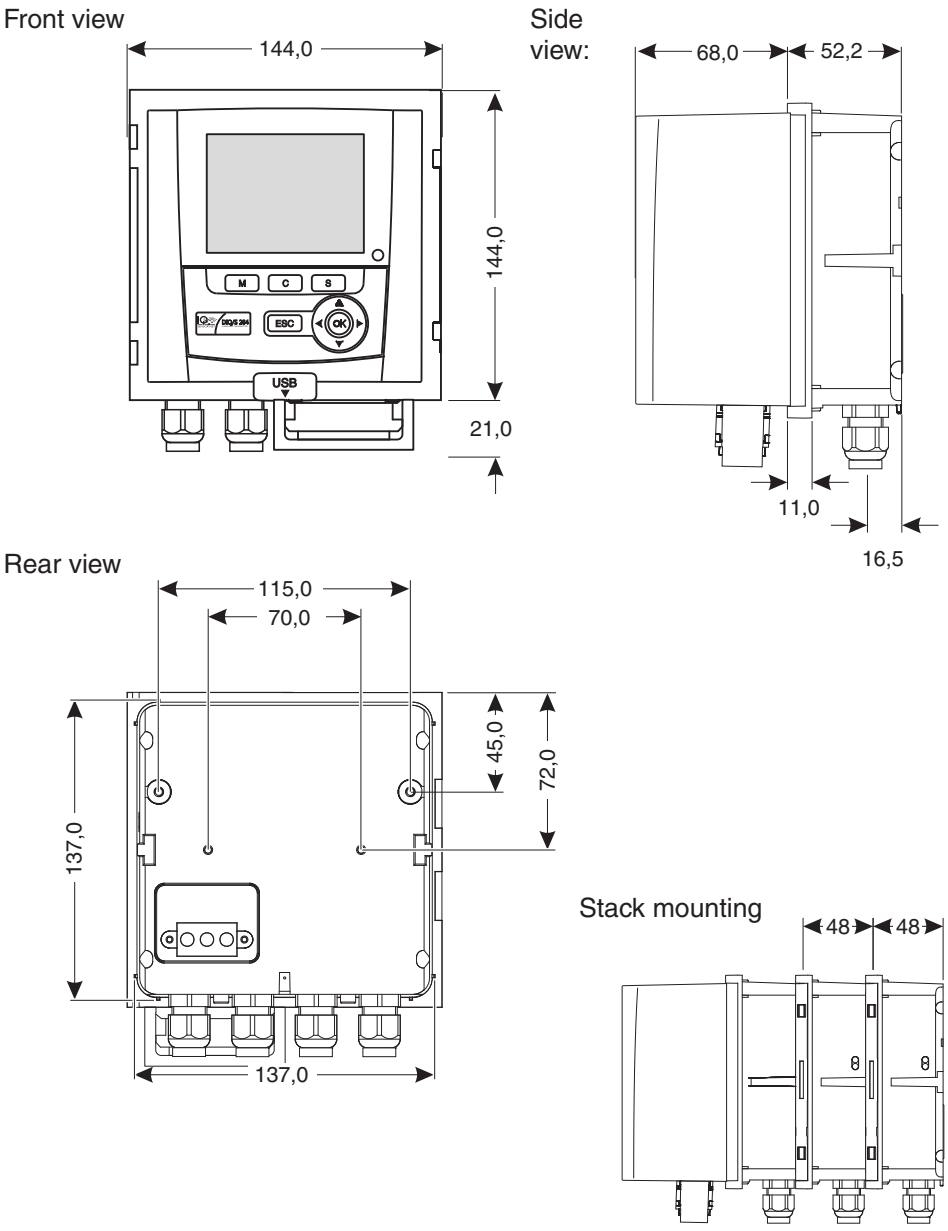


Fig. 10-2 Dimension drawing DIQ/S 28X-MOD, DIQ/S 28X-PR (dimensions in mm)

Dimensions DIQ/S 28X [-CRx]-E[F]

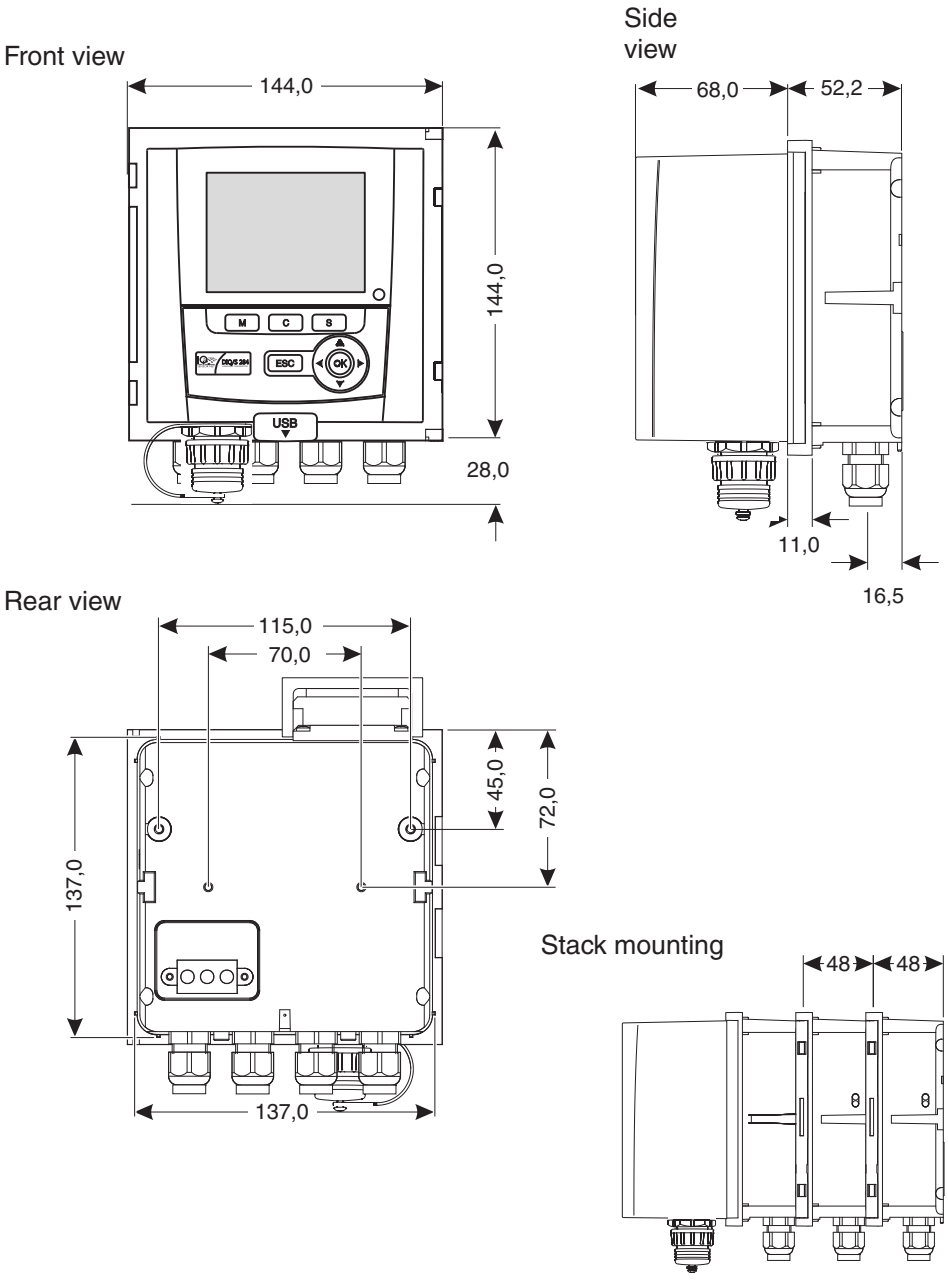


Fig. 10-3 Dimension drawing of the DIQ/S 284E[F] (dimensions in mm)

Mechanical structure

Maximum number of MIQ modules in a module stack	3
Enclosure material	Polycarbonate with 20 % glass fiber
Weight	Approx. 1.2 kg Approx. 1.7 kg (Variant DIQ/S 284-CR6[-E])

Type of protection	IP 67 (not suitable for direct conduit connection). Conduits have to be connected with CC-Box flexible adapters, or with CC-PM adapters (see chapter 11 ACCESSORIES AND OPTIONS)

Test certificates

CE

Ambient conditions

Temperature	
Mounting/installation/ maintenance	+ 5 °C ... + 40 °C (+ 41 ... +104 °F)
Operation	- 20 °C ... + 55 °C (- 4 ... + 131 °F)
Storage	- 25 °C ... + 65 °C (- 13 ... + 149 °F)
Relative humidity	
Mounting/installation/ maintenance	≤ 80 %
Yearly average	≤ 90 %
Dew formation	Possible

Site altitude	Max. 2000 m above sea level

Electrical data DIQ/S 28X (240 V AC/DC line power version)

Power supply	Nominal voltage: 100 ... 240 VAC ± 10 % Frequency: 50/60 Hz according to DIN IEC 60038 Line power connection: 2 pin, N and L Line cross-section of mains connection: Europe: 1.5 ... 4.0 mm^2 USA: AWG 14 ... 12 Fuse rating on the operator side: max. 16 A
Protective class	II

	Overvoltage category	II
	Power consumption	max. approx. 20 W

Electrical data DIQ/S 28X[-XX]/ 24V (24 V AC/DC version)

Supply	Nominal voltage: 24 V AC/DC ± 10 % protective low voltage SELV (Safety Extra Low Voltage) AC frequency:50/60 Hz according to DIN IEC 60038 Connection:2 pin Line cross-section of connections: Europe: 1.5 ... 4.0 mm^2 USA: AWG 14 ... 12 Fuse rating on the operator side: max. 16 A Switch-on current: 1.5 A AC/DC (100 ms)
Power consumption	max. approx. 20 W

Electrical connections DIQ/S 28X[-...]

The electrical connections are inside the housing.

Assignment of the terminal strips: See section 3.13.

Relay (3 x)

Output	Galvanically separated
Max. switching voltage	240 VAC or 24 VDC
Max. switching current	2 A (AC and DC)
Installation requirements	Fuse rating on the operator side: max. 2 A
Relay functions	Programmable as: – Opener or closer – Limit monitor – Monitoring of the warning and error signals of the IQ SENSORNET – Proportional frequency output – Proportional pulse width output

Current outputs (DIQ/S 28X-CRx)	Output	Galvanically separated from the sensors
	Output current	Can be switched between 0 - 20 mA and 4 - 20 mA In the case of errors, can be set to: 0 ... 21 mA
	Max. initial output voltage	13 V, in the case of missing or incorrect burden
	Accuracy	0.3 % of current value ± 50 µA, load max. 500 Ω
	Functions	Programmable: – Recorder attenuation, adjustable 0 - 40 mA/s – Error behavior can be set as required 0 ... 21 mA – Error behavior according to Namur NE43 can be selected – Positive and negative characteristic curve – PID controller

Connecting terminals	Terminal type	Screw-type terminal strip, accessible by raising the lid	
	Terminal ranges	Solid wires: Flexible wires:	0.2 ... 4.0 mm^2 AWG 24 ... 12 0.2 ... 2.5 mm^2

Cable glands	Suitable for cable diameter	4.5 ... 10 mm or 7 ... 13 mm

EMC product and system characteristics	EN 61326	EMC requirements for electrical resources for control technology and laboratory use – Resources for industrial areas, intended for indispensable operation – Interference emission limits for resources of class A
	System lightning protection	Extended protective characteristics as opposed to EN 61326
	FCC, class A	

Any combination of the IQ SENSORNET with IQ SENSOR NET products in a user-specific system achieves the listed EMC characteristics.

Meter safety

Applicable norms	– EN 61010-1 – UL 61010-1 – CAN/CSA C22.2#61010-1

USB-A interface

Version	USB 2.0
Usage	Download of measurement data, software updates, electronic key

Immediately close the USB connection with the protective cover when you have removed the USB device.
When the USB connection is open, there is a danger of corrosion.

Ethernet connection (DIQ/S 28X-E[F])

RJ45 socket (can be retrofitted as a climate resistant RJ45 socket for operation at an open-air test site section 11).

Fieldbus connection

DIQ/S 28X variant	Fieldbus connection
DIQ/S 28X[-CRx][-E]	no connection to fieldbus
DIQ/S 28XPR	PROFIBUS DP (RS 485)*
DIQ/S 28X-MOD	Modbus RTU (RS 485)*
DIQ/S 28X[-CRx]-EF	Ethernet fieldbuses (EtherNet/IP™, Profinet, Modbus TCP)

* Connection via 9-pin D-SUB socket on the underside of the housing, compatible with Phoenix connector (IP67).

10.2 General data of MIQ modules

Technical data on special MIQ modules are given in the respective operating manuals.

Dimensions

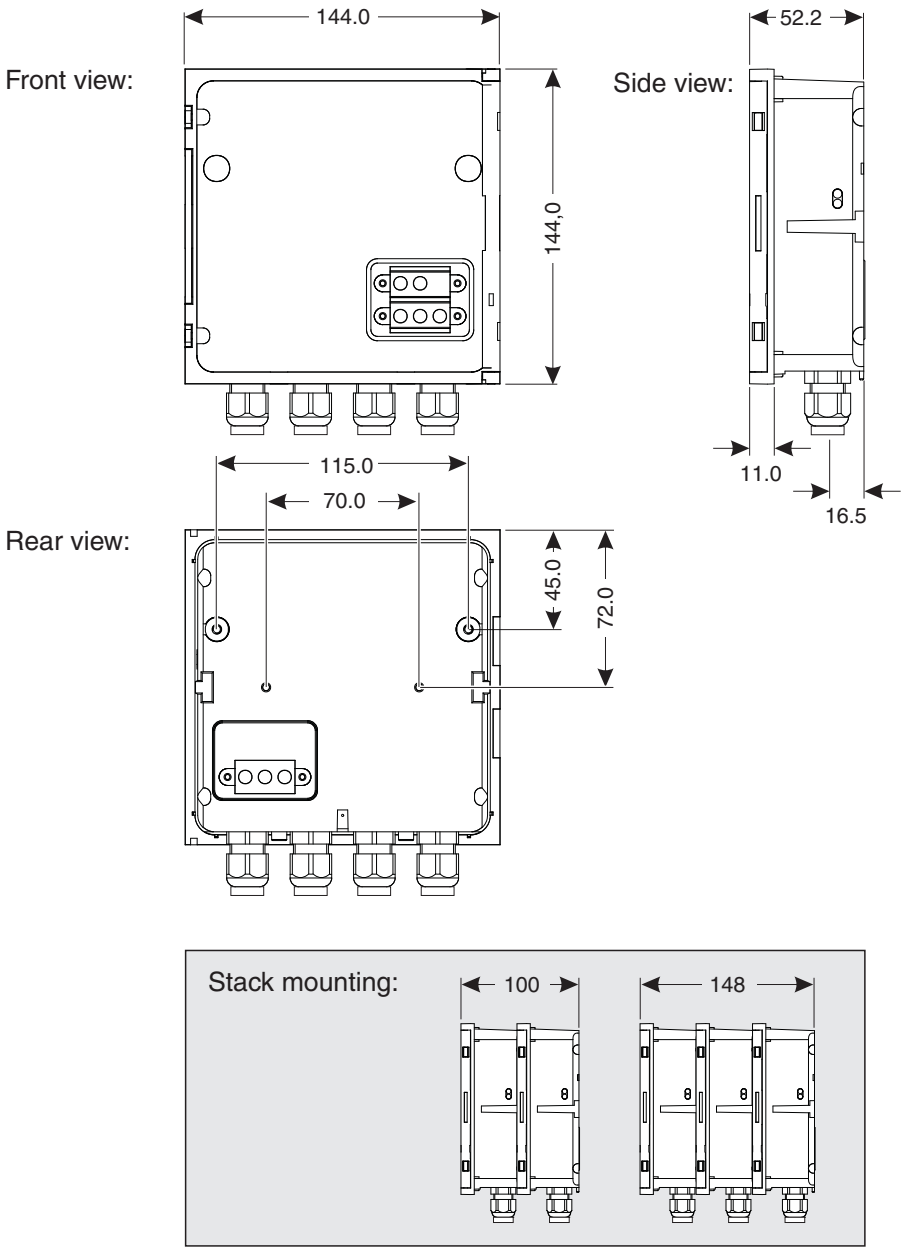


Fig. 10-4 Dimension drawing of MIQ module (dimensions in mm)

Mechanical structure	Maximum number of MIQ modules in a module stack	3
	Enclosure material	Polycarbonate with 20 % glass fiber
	Weight	Approx. 0.5 kg
	Type of protection	IP 66 (not suitable for direct conduit connection). Conduits have to be connected with CC-Box flexible adapters, or with CC-PM adapters (see chapter 11 ACCESSORIES AND OPTIONS)
Terminal connections	SENSORNET connections	At least two in each DIQ or MIQ module. Additional connectable SENSORNET terminator (terminating resistor)
	Further connections	Module-dependent
	Terminal type	Screw-type terminal strip, accessible by raising the lid
	Terminal ranges	Solid wires: 0.2 ... 4.0 mm^2 AWG 24 ... 12 Flexible wires: 0.2 ... 2.5 mm^2
	Cable feeds	4 cable glands M16 x 1.5 on the underside of the module
Cable glands	Suitable for cable sheath diameter	4.5 - 10 mm or 9.0 - 13 mm

10.3 DIQ/JB

Dimensions

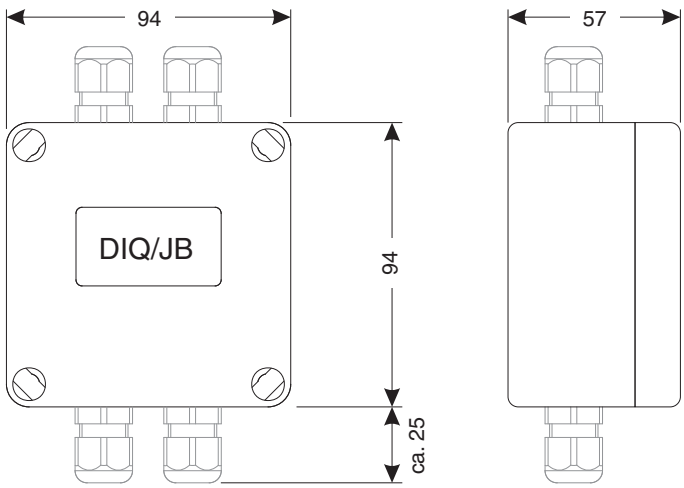
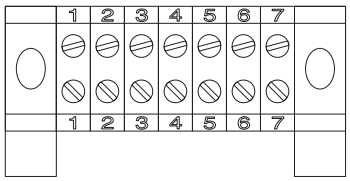


Fig. 10-5 Dimension drawing of DIQ/JB (dimensions in mm)

Mechanical structure

Enclosure material	Polystyrene
Weight	Approx. 0.2 kg
Type of protection	IP 66 (not suitable for direct conduit connection). Conduits have to be connected with CC-Box flexible adapters, or with CC-PM adapters (see chapter 11 ACCESSORIES AND OPTIONS)
Type of protection	IP 66 (not suitable for direct conduit connection). Conduits have to be connected with CC-Box flexible adapters, or with CC-PM adapters (see chapter 11 ACCESSORIES AND OPTIONS)

Electrical connections



(7 passive, potential free terminals for line extension or branching)

Connecting terminals

Terminal type	Screw-type terminal strip

Terminal ranges	Solid wires:	0.2 ... 4.0 mm^2 AWG 24 ... 12
	Flexible wires:	0.2 ... 2.5 mm^2
Cable feeds	Prepared openings for installing two screwed cable glands M16 x 1.5 both on the upper and underside	

10.4 DIQ/CHV

Dimensions

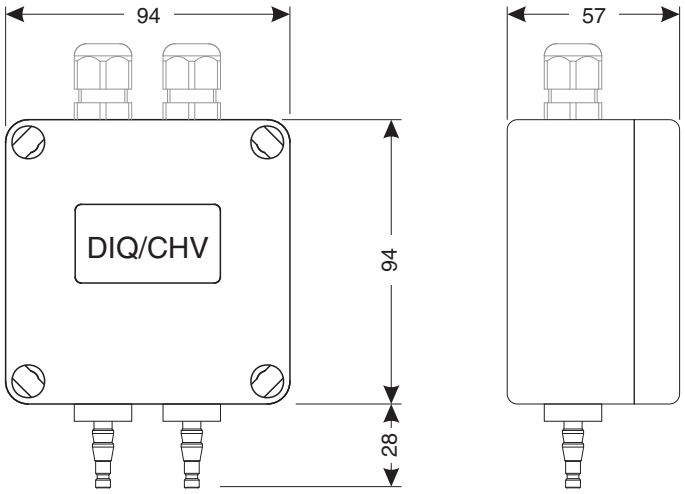


Fig. 10-6 Dimension drawing of DIQ/CHV (dimensions in mm)

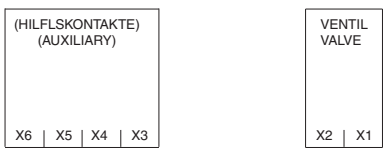
Mechanical structure

Enclosure material	Polystyrene
Weight	Approx. 0.3 kg
Type of protection	IP 66 (not suitable for direct conduit connection). Conduits have to be connected with CC-Box flexible adapters, or with CC-PM adapters (see chapter 11 ACCESSORIES AND OPTIONS)

Electrical connections

- 1 x valve switching contact
- 4 x potential-free terminals to connect interface lines

Terminal strip inside the enclosure:



Connecting terminals

Terminal type	Screw-type terminal strip	
Terminal ranges	Solid wires:	0.2 ... 4.0 mm^2 AWG 24 ... 12
	Flexible wires:	0.2 ... 2.5 mm^2
Cable feeds	Prepared openings for installing two screwed cable glands M16 x 1.5 on the upper side	

Valve circuits

Switching voltage	Approx. 22 V
Max. switching current	Approx. 40 mA

NOTE
The valve may only be operated with the auxiliary voltage of the DIQ/S 28X Universal Transmitter.

Compressed air

Required air quality	Dry, free of dust and oil
Operating pressure	Max. $7x10^5$ Pa (7 bar) absolute
Connections on the DIQ/CHV	6 mm hose nozzles

10.5 Space required by mounted components

Wall mounting and top hat rail mounting

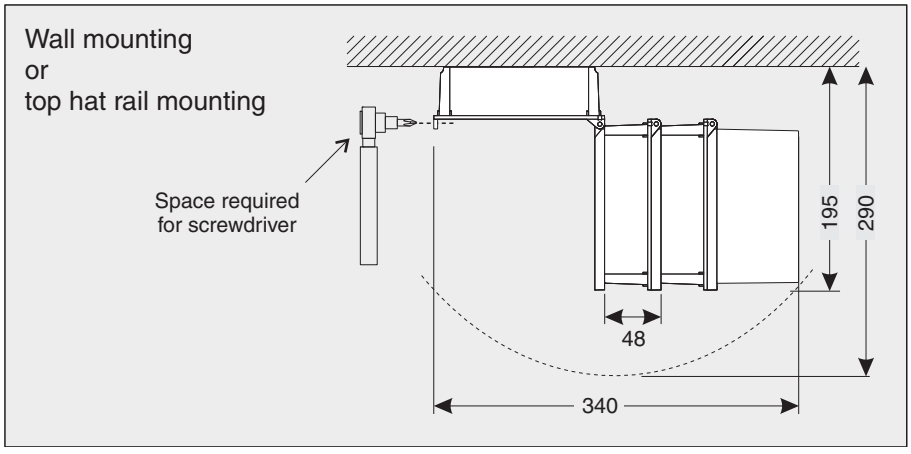


Fig. 10-7 Space required for wall and top hat rail mounting: (dimensions in mm)

Panel mounting (PMS/IQ)

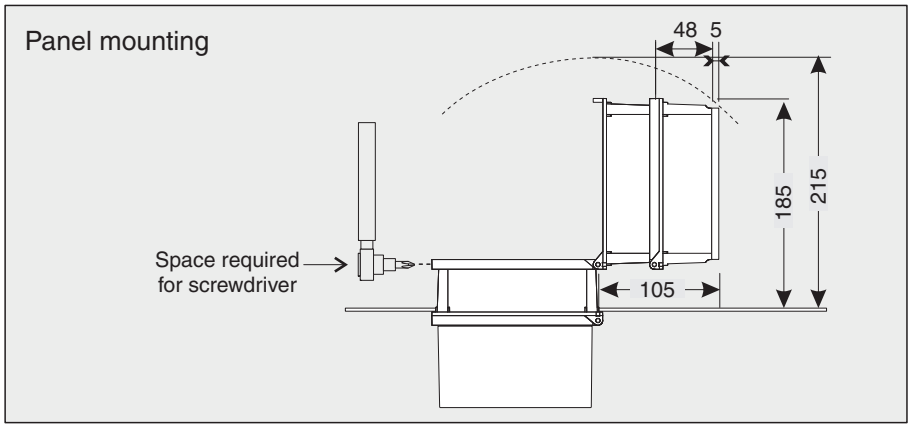


Fig. 10-8 Space required for panel mounting (PMS/IQ) (dimensions in mm)

Information on the space required with the PMS/IQ-X mounting set: see PMS/IQ-X operating manual.

11 Accessories and options

Description	Model	Order no.
IQ SENSORNET cable - please specify required length in m when ordering	SNCIQ SNCIQ/UG	480046Y 480047Y
IQ sensor connection cable 1.5 m 7.0 m 15.0 m Special length up to max. 100 m 20 m (seawater version) 25 m (seawater version) 50 m (seawater version) Special length (seawater version)	 SACIQ-1.5 SACIQ-7.0 SACIQ-15.0 SACIQ-SO SACIQ-20.0 SW SACIQ-25.0 SW SACIQ-50.0 SW SACIQ-SO SW	 480040Y 480042Y 480044Y 480041VY 480045Y 480066Y 480060Y 480064VY
Set of 4 cable glands M20 for cable sheaths with an outer diameter greater than 10 mm	EW/1	480051Y
Branching module	DIQ/JB	472005Y
Valve module	DIQ/CHV	472007Y
Sun shield for a unit of up to two stacked MIQ modules plus docked Universal Transmitter	SSH/IQ	109295Y
Sun shield for a single MIQ module plus docked Universal Transmitter	SD/K 170	109284Y
Mounting kit for fixing the SD/K 170 sun shield on horizontal or vertical pipes	MR/SD 170	109286Y
Kit for wall mounting of a MIQ module	WMS/IQ	480052Y
Set for panel mounting of MIQ modules	PMS/IQ	480048Y
Set for panel mounting of the DIQ/S 28X [-MOD], [-PR], [-E(F)]. The interface (MOD, PR, E, EF) is mounted behind the panel.	PMS/IQ-X	480049Y
Kit for mounting of MIQ modules on a 35 mm top hat rail in accordance with EN 50022	THS/IQ	480050Y
Adapter to protect the RJ45 interface against moisture	ADA/E	902890Y
Flexible conduit adapter for IQ SENSORNET components	CC-Box	900120Y
Flexible conduit adapter for fieldbus plugs	CC-PM	900125Y

12 Messages

12.1 Explanation of the message codes

The log book contains a list with all the messages from all modules. Each message consists of message code, date and time. You can obtain more detailed information by opening the full message text (see section 4.5).

The full message text comes from the component that has triggered the message. Therefore, these texts are only available from components which are connected to the system and ready for operation.

If a message text is not available, because the component is not connected to the system, you can look up the texts of the messages in the operating manual of the respective component.

The following lists contain the message codes and the related message texts that are shown on the display. Error messages and info messages are listed separately.

General explanations on the subjects of messages, message codes and log book are given in section 4.5 of this system operating manual.

Module code	Component
171	DIQ/S 282
172	DIQ/S 284

12.1.1 Error messages

Message code	Message text
EI4171 EI4172	*Max. components of this component type exceeded* *Danger of system overload* ** Check and adapt the components for this type*
EI5171 EI5172	*Component cannot be reached or not present* ** Component has been removed from the system, insert component again* ** Connex. to component cut.,* *Check sys. installation acc. to op. manual*
EI6171 EI6172	*Incompatible terminal software* ** Contact service*
EI7171 EI7172	*Incompatible controller software* ** Contact service*

Message code	Message text
EI8171 EI8172	*Connection to the component instable* ** Check installation and cable lengths, Follow installation instructions* ** Set SN terminator switch acc. to operating manual* ** Check environmental effects* ** Component defective, contact service*
EI9171 EI9172	*Power failure occurred* ** Check date and time and, if necessary, adjust them*
EA8171 EA8172	*Error at automatic air pressure measurement* *An air pressure value of 1013 mbar is used for air pressure compensation* ** Contact service*

12.1.2 Informative messages

Message code	Message text
II1171 II1172	*Language not available, Default language German* ** Contact service*
II2171 II2172	*New IQ Sensor Net component identified*
II3171 II3172	*New IQ Sensor Net component recorded* ** See component lists*
II4171 II4172	*IQ Sensor Net component recorded as replacement component* ** See component lists*
II5171 II5172	*Link sensor - output has been erased* ** if necessary, link sensor again*
II9171 II9172	*Date and time have been set*

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14 Contact Information

14.1 Ordering & Technical Support

Telephone: (800) 897-4151
(937) 767-7241
Monday through Friday, 8:00 AM to 5:00 PM ET

Fax: (937) 767-1058

Email: environmental@ysi.com

Mail: YSI Incorporated
1725 Brannum Lane
Yellow Springs, OH 45387
USA

Internet: www.ysi.com

When placing an order please have the following information available:

YSI account number (if available)	Name and Phone Number
Model number or brief description	Billing and shipping address
Quantity	Purchase Order or Credit Card

14.2 Service Information

YSI has authorized service centers throughout the United States and Internationally. For the nearest service center information, please visit www.ysi.com and click ‘Support’ or contact YSI Technical Support directly at 800-897-4151.

When returning a product for service, include the Product Return form with cleaning certification. The form must be completely filled out for an YSI Service Center to accept the instrument for service. The Product Return form may be downloaded at www.ysi.com and clicking on the ‘Support‘ tab.

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1) The tissue in plants that brings water upward from the roots;
2) a leading global water technology company.

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SPECIFICATIONS

DOCUMENT #W102

YSI IQ SensorNet FDO®

Optical Dissolved Oxygen Sensor

The FDO is an optical, luminescent based DO sensor for the IQ SensorNet system. During the biological nutrient removal process at wastewater treatment plants, continuous and precise measurement of dissolved oxygen concentration is of vital importance for optimal performance and trouble-free operation. Efficiency and energy demand is mainly determined by the performance of the aeration control system. The FDO is a reliable, proven, long-term solution for continuous DO data that can help optimize your process and lower energy costs.



Parameters:

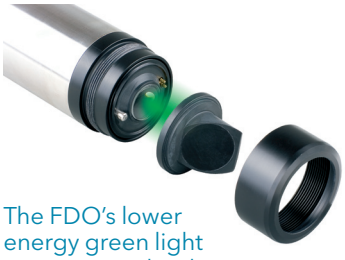
Dissolved Oxygen (optical)

Temperature

- **Intelligent Sensor Cap**
  The sensor cap is individually factory calibrated. Calibration data is stored on a chip that is embedded in the sensor cap. No need to enter calibration coefficients. When a new cap is installed, the coefficients are recognized and sent directly to the controller terminal eliminating the need to manually enter information.

- **Equal Path Reference System**
  The optical measurement and reference paths are identically designed. This allows for identical aging of the components which enables accurate compensation and eliminates calibrations. That's correct, there is no calibration required.

- **Green Light Technology**
  Softer, low-intensity excitation light increases the lifetime of the cap. This translates into a two year warranty on the standard cap.



The FDO's lower energy green light excitation technology extends the sensor cap lifetime.





Learn More:

Scan with a smart phone or tablet, to see the FDO angled sensor tip allow bubbles to pass by.

YSI.com/FDO

IQ SensorNet FDO Optical Dissolved Oxygen General Specifications

Sensor Cap Replacement	Yes; the cap, can be replaced. Automatic recognition by the sensor of the cap including the factory calibration.	
Calibration Capability	Yes; not required, factory calibrated	
Interferences	None	
Minimum Flow Rate	None; no flow requirement	
Response Time at 25 °C	700 IQ and 700 IQ SW - T90 = <150 seconds; T95 = <200 seconds	
	701 IQ and 701 IQ SW - T90 = <80 seconds	
Signal Output	Digital	
Lightning Protection	Yes	
Power Consumption	0.7 watts	
Maximum Pressure	10 bars (145 psi); with sensor connection cable	
Electrical Connections	2-wire shield cable with quick sensor connection	
Conformance/Certifications	EN 61326, Class B, FCC Class A; Intended for indispensable operation, CE, cETLus	
Temperature Conditions	Operating Temperature:	23 to 122 °F (-5 to 50 °C)
	Storage Temperature:	-13 to 122 °F (-25 to 50 °C)
Sensor	Material:	Housing - VA steel 1.4571; Sensor Cap and Locking Cap - POM (Polyoxmethylene), PVS, silicone, PMMA
	Rating:	IP-68; waterproof
	Dimensions:	400 L x 40 D mm (15.75 L x 1.57 D in)
	(length x diameter)	400 L x 59.5 D mm (15.75 L x 2.34 D in) Salt Water version
	Weight:	900 g (1.98 lbs)
		1,500 g (3.31 lbs) Salt Water version
	Warranty:	2 years

IQ SensorNet FDO Optical Dissolved Oxygen Technical Specifications

Dissolved Oxygen Range		
	Concentration	0 to 20.00 mg/L
	Saturation	0 to 200.0%
Dissolved Oxygen Resolution		
	Concentration	0.01 mg/L
	Saturation	0.1%
Temperature		
	Measurement	23 to 140 °F (-5 to 60 °C)
	Compensation	32 to 140 °F (0 to 60 °C)

IQ SensorNet FDO Ordering Information (order 2020 XT terminal, modules, cables, sensors separately)

FDO 700 IQ (#201 650Y)	Optical DO sensor for monitoring and control; includes 1 factory calibrated sensor cap.
FDO 700 IQ SW (#201 652Y)	Salt Water Design Optical DO sensor for monitoring and control; includes 1 factory calibrated sensor cap.
FDO 701 IQ (#201 660Y)	Optical DO sensor for monitoring and control; faster response time; includes 1 fast response factory calibrated cap.
FDO 701 IQ SW (#201 653Y)	Salt Water Design Optical DO sensor for monitoring and control; faster response time; includes 1 fast response factory calibrated cap.
SC-FDO 700 (#201 654Y)	Replacement; universal factory calibrated sensor cap for FDO 700 IQ and FDO 700 IQ SW
SC-FDO 701 (#201 655Y)	Replacement; fast response factory calibrated sensor cap for FDO 701 IQ and FDO 701 IQ SW

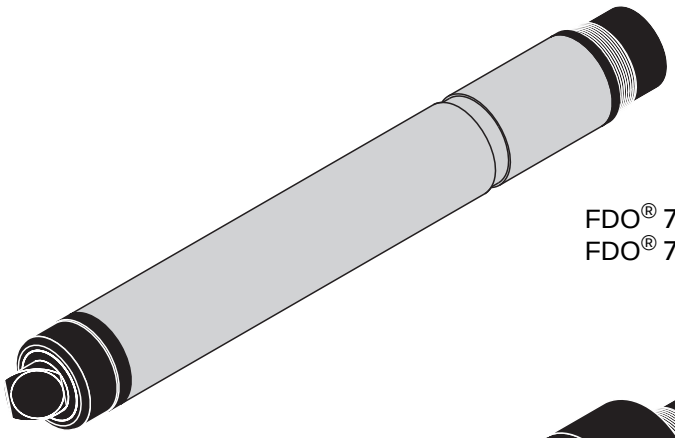
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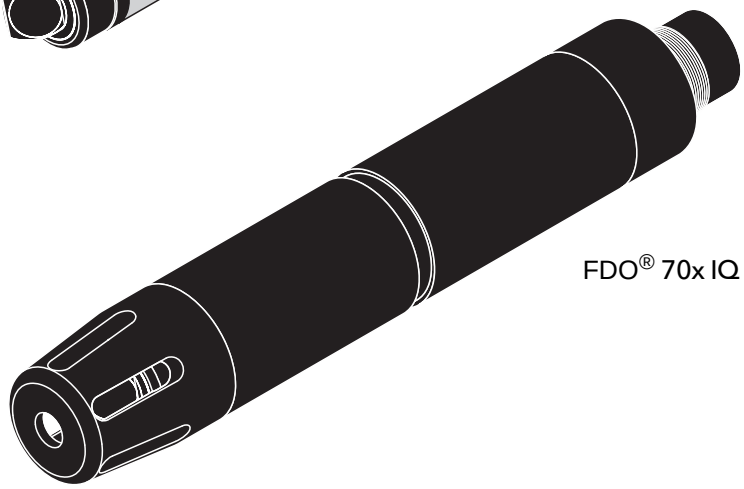
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OPERATING MANUAL

ba76014d03 05/2014



FDO® 70x IQ
FDO® 70x IQ H



FDO® 70x IQ SW

FDO® 70x IQ
FDO® 70x IQ SW
FDO® 70x IQ H

OPTICAL SENSOR FOR DISSOLVED OXYGEN

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For the most recent version of the manual, please visit www.ysi.com.

Contact

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Tel: +1 937-767-7241
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1 Overview

1.1 How to use this component operating manual

Structure of the IQ SENSORNET operating manual

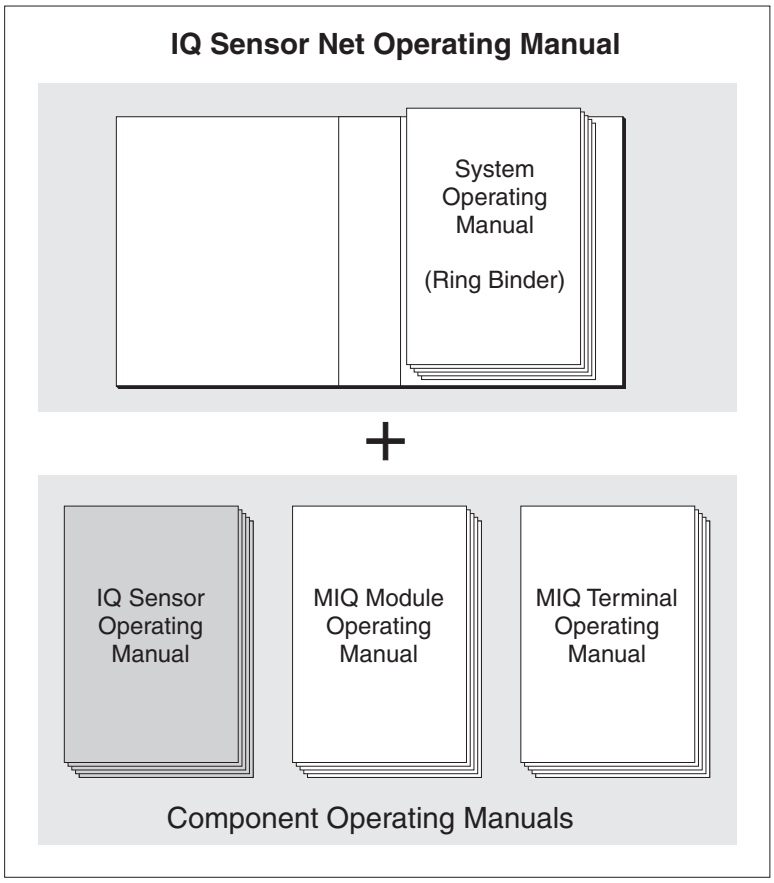


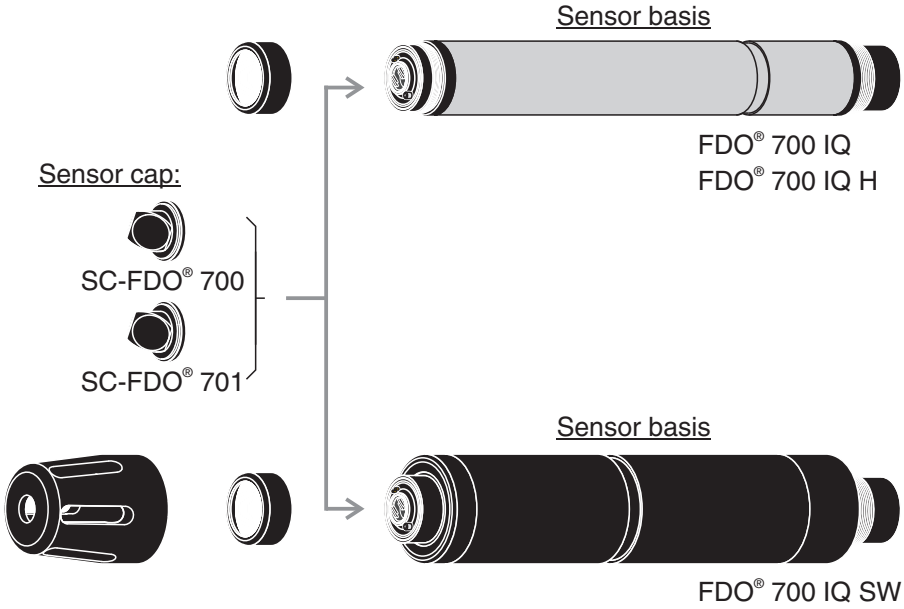
Fig. 1-1 Structure of the IQ SENSORNET operating manual

The IQ SENSOR NET operating manual has a modular structure like the IQ SENSORNET system itself. It consists of a system operating manual and the operating manuals of all the components used.

Please file this component operating manual into the ring binder of the system operating manual.

1.2 Sensor models

The FDO® 70x IQ ... consists of a sensor basis equipped with different sensor cap types, depending on the model:



Sensor models

Sensor model	Sensor basis	Sensor cap
FDO® 700 IQ	FDO® 700 IQ *	SC-FDO® 700
FDO® 700 IQ SW	FDO® 700 IQ SW *	SC-FDO® 700
FDO® 701 IQ	FDO® 700 IQ *	SC-FDO® 701
FDO® 701 IQ SW	FDO® 700 IQ SW *	SC-FDO® 701
FDO® 700 IQ H	FDO® 700 IQ H **	SC-FDO® 700
FDO® 701 IQ H	FDO® 701 IQ H **	SC-FDO® 701

* Type designation on the name plate in the plug head connector

** Type designation on the name plate on the shaft

The sensor cap primarily determines the measuring characteristics of the sensor as a whole. Thus the sensor can be adapted to the measuring job by exchanging the type of sensor cap. The specifications of the individual sensor cap types are given in chapter 7 TECHNICAL DATA.

H models

The sensor models FDO® 700 IQ H and FDO® 701 IQ H are rated for use in Class I Division 2 hazardous locations (see chapter 2.3 for details).

SW models

Compared to the standard models, the sea water models of the sensors (SW models) are optimized concerning their resistance to corrosion in sea water and brackish water.

1.3 Recommended fields of application

Sensor model	Recommended field of application.
FDO® 700 IQ FDO® 701 IQ	Stationary measurements in water/wastewater applications in non-hazardous locations only.
FDO® 700 IQ H FDO® 701 IQ H	Stationary measurements in water/wastewater applications in Class I Division 2 hazardous locations.
FDO® 700 IQ SW FDO® 701 IQ SW	Stationary measurements in seawater, aquaculture. The FDO® 70x IQ SW is equipped with a protective hood that is prepared for the connection of the MSK FDO® CS cleaning set for compressed air-driven sensor cleaning (order information, see section 5.5 REPLACEMENT PARTS AND ACCESSORIES).

1.4 Structure

Structure

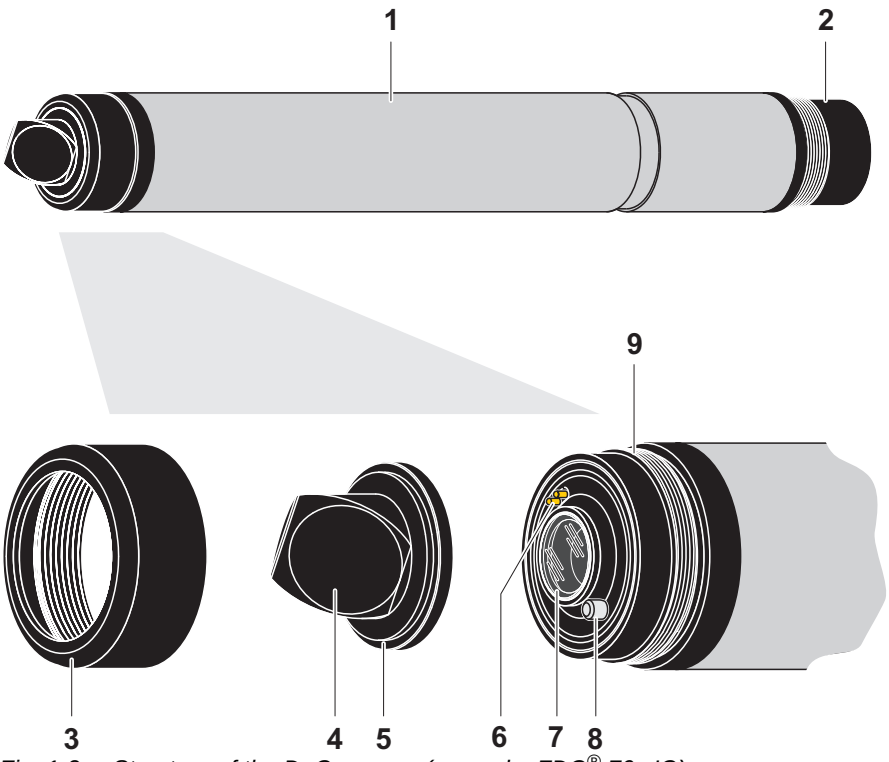


Fig. 1-2 Structure of the D. O. sensor (example: FDO® 70x IQ)

1	Shaft
2	Plug head connector
3	Fixing ring
4	Sensor membrane
5	Sensor cap with memory chip
6	Gold-plated contact pins for memory chip
7	Measurement window
8	Temperature sensor and locking device
9	Sensor head

Sensor cap with memory chip

A memory chip is integrated in the sensor cap. The following data is stored on the memory chip:

- Type designation of the sensor cap
- Series number
- Data of the factory calibration

Intelligent membrane (IQMC technology)

For each membrane the individual calibration values are determined by a factory calibration and stored on the memory chip of the sensor cap, ensuring maximum accuracy over the whole lifetime of the sensor.

2 Safety

2.1 Safety information

2.1.1 Hazard warnings in this operating manual

The hazard warnings are defined for the following levels of danger:



⚠DANGER

DANGER indicates an imminently hazardous situation which, if not avoided, will result in death or serious injury.



⚠WARNING

WARNING indicates a potentially hazardous situation which, if not avoided, could result in death or serious injury.



⚠CAUTION

CAUTION indicates a potentially hazardous situation which, if not avoided, may result in minor or moderate injury.



NOTICE

NOTICE is used to address practices not related to personal injury.

2.1.2 Safety information on the product

Note all labels, information signs and safety symbols on the product.

2.2 Safe operation

2.2.1 Authorized use

The authorized use of the FDO® 70x IQ ... comprises its use as a D.O. sensor in the IQ SENSORNET.
The technical specifications according to chapter 7 TECHNICAL DATA must be observed. Only operation according to the instructions in this operating manual is authorized.

Any other use is considered to be **unauthorized**. Unauthorized use invalidates any claims with regard to the guarantee.

2.2.2 Requirements for safe operation

Note the following points for safe operation:

- The product may only be operated according to the authorized use specified above.
- The product may only be supplied with power by the energy sources specified in this operating manual.
- The product may only be operated under the environmental conditions specified in this operating manual.
- The product or its components may only be opened if this is required for installation and maintenance work and described in the operating manual.

2.2.3 Unauthorized use

The product must not be put into operation if:

- it is visibly damaged (e.g. after being transported)
- it was stored under adverse conditions for a lengthy period of time (storing conditions, see chapter 7 TECHNICAL DATA)

2.3 Hazardous location use (FDO® 70x IQ H models)

⚠DANGER

Explosion hazard.
Only hazardous location rated sensor models ("Hazloc Sensor") must be used in hazardous locations. Read the name plate on the sensor shaft and verify that the sensor is rated for your specific application.

Rated sensor models

The following sensor models are rated for hazardous location use:

- FDO® 700 IQ H (YSI-Order No. 207065Y)
- FDO® 701 IQ H (YSI-Order No. 207066Y)

Hazardous location rated sensors are identified by the name plate with the rating details engraved on the sensor shaft:

Name plate of a Hazloc sensor (example)



⚠DANGER

Explosion hazard.
The associated apparatus MIQ/BB1 (YSI part no. 207001Y) has to be used for connection. Refer to the following documents for proper installation:

- **Control drawing, YSI document no. 28123 (see MIQ/BB1 operating manual)**
- **MIQ/BB1 operating manual**
- **All applicable electrical code regulations.**

⚠DANGER

Explosion hazard.
This product does not meet the requirements of the directive 94/9/EC (ATEX).

3 Commissioning

3.1 Scope of delivery

- Sensor, consisting of sensor basis and sensor cap
- Operating manual.

3.2 Installation

Safety guidelines for installation in a hazardous location (H-models only)



⚠DANGER

Explosion hazard.
Only hazardous location rated sensor models ("Hazloc Sensor") must be used in hazardous locations. Verify the rating on the product name plate on the sensor shaft.
The associated apparatus MIQ/BB1 (YSI part no. 207001Y) has to be used for connection. Refer to the following documents for proper installation:

- **Control drawing, YSI document no. 28123 (see MIQ/BB1 operating manual)**
- **MIQ/BB1 operating manual**
- **All applicable electrical code regulations.**

Connection cable

A sensor connection cable of the SACIQ or SACIQ SW type is required to connect the sensor. The cable is available in different lengths. Compared to the standard model SACIQ, the SACIQ SW sensor connection cable is optimized regarding its corrosion resistance in seawater and brackish water and adapted for use in conjunction with the FDO 70x IQ SW. Information on this and other IQ SENSORNET accessories is given in the YSI catalog and on the Internet.



⚠DANGER

Explosion hazard.
For hazardous location use only the cable types listed in the control drawing must be used.

How to connect the SACIQ (SW) sensor connection cable to the terminal strip of a MIQ module is described in chapter 3 INSTALLATION of the IQ SENSORNET system operating manual.

Are the plug connections dry?

Before connecting the sensor and sensor connection cable, please make sure the plug connections are dry. If moisture gets into the plug connections, first dry the plug connections (dab them dry or blow them dry using compressed air).

Do not suspend the sensor on the sensor connection cable. Use a sensor holder or armature. Information on this and other IQ SENSORNET accessories is given in the YSI catalog and on the Internet.

Connecting the sensor to the sensor connection cable

1	Take the protective caps off the plug connections of the sensor and the SACIQ (SW) sensor connection cable and keep them safe.
2	Plug the jack of the SACIQ (SW) sensor connection cable onto the plug head connector of the sensor. At the same time, rotate the socket so that the pin in the plug head connector (1) clicks into one of the two holes in the socket.
3	Then screw the coupling ring (2) of the sensor connection cable onto the sensor up to the stop.

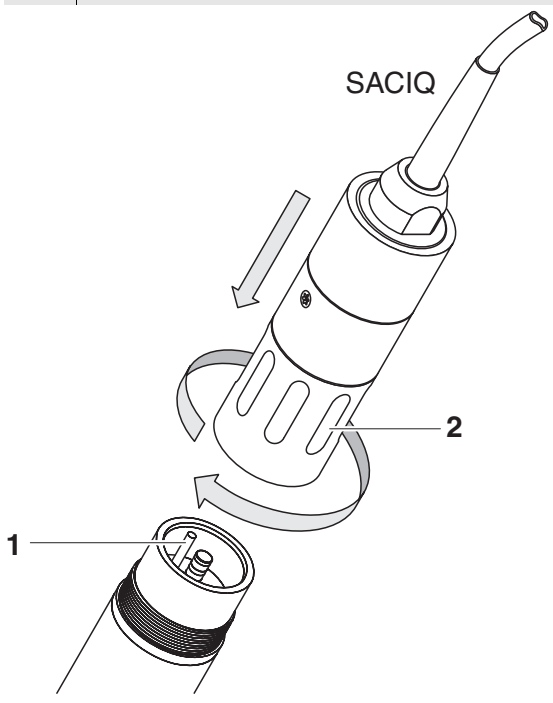


Fig. 3-1 Connecting the sensor

3.3 Commissioning / Getting the instrument ready for measuring

Identification in the IQ SENSORNET

Both the sensor cap and sensor basis (sensor without cap) have a series number of their own. The sensor has to be equipped with a sensor cap for a successful login to the IQ SENSORNET. The operable sensor is displayed as follows in the list of sensors:

- *Model*: Model designation of the sensor cap (="SC FDO 70x")
- *Ser. no.*: Series number of the sensor cap
- *Sensor name*: The series number of the sensor basis is preset here. You can change this entry as necessary by entering a user-defined name.

Commissioning steps

1	Pull the protective cap off the sensor.
2	If required, assign a user-defined name to the sensor (see relevant IQ SENSORNET system operating manual).
3	When using IQ SENSORNET without automatic air pressure compensation the mean air pressure value or the location altitude has to be entered (for more detailed information see the relevant IQ SENSORNET system operating manual).
4	Set the sensor (see section 3.4).

3.4 FDO® 70x IQ ... setting table

Setting	Selection/values	Explanation
Measuring mode	● *Concentration* ● *Saturation*	Unit of the measured value on the measured value display.
Measuring range Concentration	● *0 ... 20.00 mg/l* ● *0 ... 20.00 ppm*	These measuring ranges are available for selection.
Measuring range Saturation	● *0 ... 200.0 %*	The measuring range is set permanently.
Response time t90	● 150 .. 300 s (with SC-FDO® 700) or ● 60 ... 300 s (with SC-FDO® 701)	Response time of the signal filter. Depending on the sample matrix, the measured values may fluctuate more or less. A signal filter in the sensor reduces the fluctuation range of the measured value. The signal filter is characterized by the *Response time t90*. This is the time after which 90 % of a signal change is displayed. The setting range depends on the sensor cap type.
Calibration	● *Factory calibration* ● *User calibration* ● *active* ● *abort*	Determines which calibration data the measured value calculation will be based on. The active calibration is displayed in the calibration history. The selection, *User calibration* is only displayed if valid data of a *User calibration* is stored in the sensor. *active* indicates that the sensor is being calibrated. If *abort* is selected, the active calibration is canceled the next time the setting table is quit with *Save and quit*.
Test	● *active* ● *abort*	*active* indicates that the sensor is being checked. If *abort* is selected, the active check is canceled the next time the setting table is quit with *Save and quit*.
Temperature mode	● *°C* ● *°F*	Unit of the measured temperature value (Celsius, Fahrenheit).

Setting	Selection/values	Explanation
Temp. adjustment	-1.5 K ... +1.5 K	The temperature compensation enables the temperature display to be balanced (shifting of the zero point by ±1.5K). Notes: ● Due to the thermal capacity of the sensor, it is necessary to place it in a container with at least 2 liters of water. ● Leave the sensor in this container for at least 15 minutes while stirring occasionally until the balancing can be performed. With temperature differences between the water and sensor > 10 °C, leave the sensor for at least 1 hour in this container while stirring occasionally until the balancing can be performed.
Salinity	● *On* ● *Off*	Determines whether the entered salinity should be taken into account.
Salinity input	2.0 ... 70.0	The entry of the salinity enables a salt content correction that compensates for the effect of salt contents > 0.1 % on the oxygen measurement. The salt content correction is recommended for measurements in salt-contaminated wastewater (salinity ≥ 2.0 corresponding to a conductivity of ≥ 3.4 mS/cm at a reference temperature T_{REF} = 20 °C).
Sensor cap data	● *Do not download* ● *Transmit to log book*	Generates a log book message with all data stored in the sensor cap when the settings are quit with *Save and quit* (see section 1.2). When opening the menu again the setting is reset to *Do not download*.
Save and quit		The system confirms the saving of the settings and the display switches to the next higher level.
Quit		The display switches to the next higher level without saving the new settings.

Carrying out settings

Using **<S>**, switch from the measured value display to the main menu of the settings. Then navigate to the setting menu (setting table) of the sensor. The exact procedure is given in the relevant IQ SENSORNET system operating manual.

4 Measuring / Operation

4.1 Measuring



⚠WARNING

Chemical or biological hazard.
Contact with the sample can be harmful to the user. Depending on the type of sample, suitable protective measures must be taken (protective clothing, goggles, etc.).

Note the data given in section 7.2 APPLICATION CONDITIONS, especially the minimum immersion depth of the sensor (> 50 mm). The measured value is available immediately on submersing.



If keeping the sensor clean is a problem, we recommend using the compressed air-driven cleaning system with the CH cleaning head (see section 5.5 REPLACEMENT PARTS AND ACCESSORIES).

4.2 Function check and user calibration

4.2.1 General information

Factory calibration

The FDO® 70x IQ ... is factory calibrated. In the recommended application (see section 1.3 RECOMMENDED FIELDS OF APPLICATION), the measuring characteristics of the sensor cap remain stable for the specified service life. Thus, a user calibration is not usually required.

When does a function check or user calibration make sense?

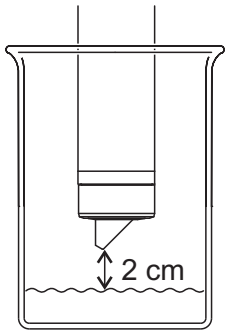
A function check or user calibration can be useful in the following special cases:

- If the measured values appear to be implausible and it is assumed that the service life of the sensor cap is over
- Routinely within the framework of the company quality assurance.

Check or calibration medium

Select one of the following two variants depending on the air temperature at the calibration site:

- With air temperatures over 5 °C, the function check and user calibration ideally take place in water vapor-saturated air. To do so, position the sensor approx. 2 cm above a water surface, for example in a narrow bucket or similar container with water. The membrane must be clean and dry for this.



- With air temperatures under 5 °C we recommend performing the function check and user calibration not in air but in air-saturated water that has a higher temperature. You obtain air-saturated water by pouring water several times in and out of two vessels so that it sparkles.

4.2.2 Function check

A function check is the simplest way to determine whether the sensor needs to be cleaned or user-calibrated.

Principle The function check can either be done in water vapor-saturated air or in air-saturated water (see CHECK OR CALIBRATION MEDIUM on page 4-1).

Steps Generally, a check on the IQ SENSORNET is carried out as follows. System specific details are given in the respective IQ SENSORNET system operating manual.

1	Switch to the measured value display with **<M>** and select the FDO® 70x IQ ... sensor.
2	Press **<C>**. The next step switches on the maintenance condition for the sensor. A corresponding message appears on the display.
3	Confirm the note with **<OK>**. The maintenance condition is active.
4	Select the *TEST* procedure and press **<OK>**.
5	Put the sensor into the calibration position (water vapor-saturated air or air-saturated water - see section 4.2.1).
6	Press **<OK>**. The sensor starts the check. The display switches to the measured value display. The *CAL* indicator flashes instead of the main measured value. At the same time, the momentary relative slope flashes as the secondary measured value with the addition of *TEST*. The process ends automatically as soon as the measured values meet the criterion for the stability control. With a great temperature difference between the sensor and the environment this may take a while. Subsequently, the main measured value and temperature are displayed.

7	Put the sensor in the measuring position again.
8	Wait for the measured value to be largely stable (temperature adjustment).
9	Switch off the maintenance condition.

Canceling the check

As long as the determination of the relative slope has not yet been started (step 6), you can quit the check with **<M>** or **<ESC>**.

The running determination of the relative slope (after pressing **<OK>** in step 6) can be aborted as follows:

1	Open the setting table (see section 3.4).
2	In the *Test* menu item, select the *abort* setting and then quit the setting table with *Save and quit*.

Evaluation

The result of the check is entered in the log book of the sensor. If the relative slope is outside the tolerance range (0.90 ... 1.10), the check is assessed as erroneous.



The information recorded in the log book entry is partly identical with that of the calibration history. The calibration history is described in detail in section 4.2.4 CALIBRATION HISTORY.

4.2.3 User calibration

Principle

The user calibration can either be done in water vapor-saturated air or in air-saturated water (see CHECK OR CALIBRATION MEDIUM on page 4-1). With the calibration procedure, the relative slope of the sensor is determined. The calibration is evaluated based on the relative slope and the intensity (successful <-> unsuccessful).

The result of the user calibration is stored in the calibration record and calibration history respectively and can be viewed afterwards (see respective IQ SENSORNET system operating manual).



We want to point out that the factory calibration of the membrane is highly precise due to the IQMC technology. If you still want to carry out a user calibration, influences due to environmental conditions have to be taken into account.

Steps

Generally, a user calibration on the IQ SENSORNET is carried out as follows. System specific details are given in the respective IQ SENSORNET system operating manual.

1	Switch to the measured value display with **<M>** and select the FDO® 70x IQ ... sensor.
2	Press **<C>**. The next step switches on the maintenance condition for the sensor. A corresponding message appears on the display.
3	Confirm the note with **<OK>**. The maintenance condition is active.
4	Select the *CALIBRATION* procedure and press **<OK>**.
5	Put the sensor into the calibration position (water vapor-saturated air or air-saturated water - see section 4.2.1).
6	Press **<OK>**. The sensor determines the calibration data. The display switches to the measured value display. The *CAL* indicator flashes instead of the main measured value. At the same time, the momentary relative slope flashes as the secondary measured value. The process ends automatically as soon as the measured values meet the criterion for the stability control. With a great temperature difference between the sensor and the environment this may take a while. Subsequently, the main measured value and temperature are displayed.
7	If the user calibration was successful, bring the sensor into the measuring position again.
8	Wait for the measured value to be largely stable (temperature adjustment).
9	Switch off the maintenance condition.

Canceling the user calibration

As long as the determination of the calibration data has not yet been started (step 6), you can quit the calibration routine with **<M>** or **<ESC>**.

The running determination of calibration data (after pressing **<OK>** in step 6) can be aborted as follows:

1	Open the setting table (see section 3.4).
2	In the *Calibration* menu item, select the *abort* setting and then quit the setting table with *Save and quit*.

After the user calibration was canceled the sensor again works with the calibration data that was used before the canceled user calibration.

Possible results of the user calibration

The calibration data is evaluated by the system. A calibration can have the following results:

Display	Explanation
Measured value display	Sensor was successfully calibrated. The calibration data can be viewed in the calibration history (section 4.2.4).
"----"	The sensor could not be calibrated. The sensor is blocked for further measurement. Notes on possible causes are given in the log book of the sensor.

4.2.4 Calibration history

Calibration history (available in the IQ SENSORNET systems 184 XT and 2020 XT only)

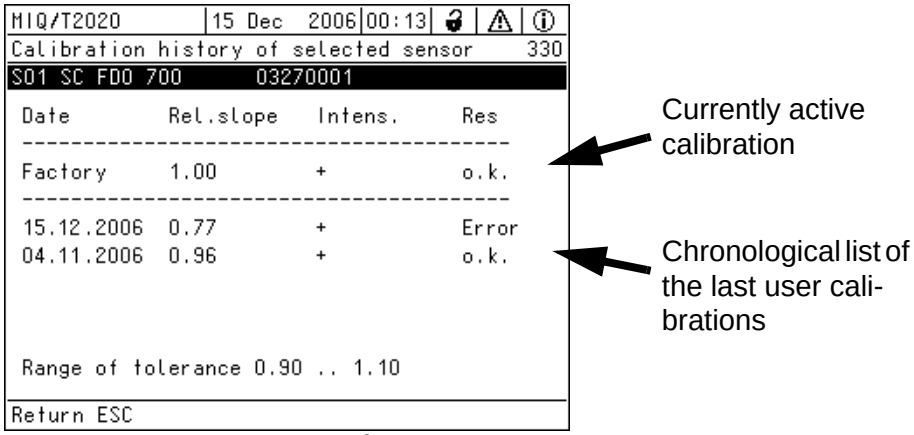


Fig. 4-1 Calibration historyFDO® 70x IQ ...

The calibration history contains the following information:

Date	Calibration date (*Factory* = factory calibration)
Rel.slope	Relative slope (non-dimensional)
Intens.	Intensity: **+** : sufficient - : too low
Res	Evaluation of the calibration *o.k.* : Calibration successful. The new calibration data was taken over for measurement. *Error* : Calibration unsuccessful. Invalid calibration data were discarded. Measurement was continued with the last valid values.

The calibration history is stored in the sensor basis. If another sensor cap (with different series number) is mounted, the calibration history is deleted and cannot be restored afterwards.

4.2.5 Reactivating previous calibration data

The FDO® 70x IQ ... enables you to reactivate the last valid user calibration or the factory calibration. Thus you can immediately go on measuring if a calibration procedure failed or you suspect that the calibration conditions were not optimally met.

Reactivating old calibration data is only a temporary solution. Please take into account that the sensor might thus possibly provide incorrect measured values. Please make sure the sensor works correctly by carrying out a function check and/or recalibration.

Reactivating calibration data

1	Open the setting table (see section 3.4).
2	In the *Calibration* menu item, select the *User calibration* or *Factory calibration* setting and then quit the setting table with *Save and quit*.

5 Maintenance, cleaning, replacement parts

5.1 General maintenance instructions



⚠WARNING

Chemical or biological hazard.
Contact with the sample can be harmful to the user. Depending on the type of sample, suitable protective measures must be taken (protective clothing, goggles, etc.).

Maintenance condition

We recommend to switch on the maintenance condition each time the sensor is taken out of the measuring position. This avoids unwanted reactions of linked outputs. For more detailed information on the maintenance condition please refer to the respective IQ SENSORNET system operating manual.



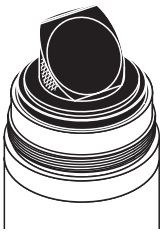
We do not recommend unscrewing the sensor from the sensor connection cable in order to do maintenance work. Otherwise, moisture and/or dirt can get into the plug connection where it can cause contact problems.

If you would like to disconnect the sensor from the sensor connection cable, please note the following points:

- Before disconnecting the sensor from the SACIQ (SW) sensor connection cable, the sensor has to be cleaned on the outside (see section 5.4.1).
- Unscrew the sensor from the SACIQ (SW) sensor connection cable.
- Place a protective cap on the sensor plug head connector and on the SACIQ (SW) sensor connection cable each time so that no moisture or dirt can get on the contacting surfaces.
- In corrosive environments, close the socket of the sensor connection cable with the screwable SACIQ-Plug when it is dry in order to protect the electrical contacts from corrosion. The protective plug is available as an accessory (see section 5.5 REPLACEMENT PARTS AND ACCESSORIES). It is included in the standard scope of delivery of the SACIQ SW sensor connection cable.

5.2 Handling of the sensor cap

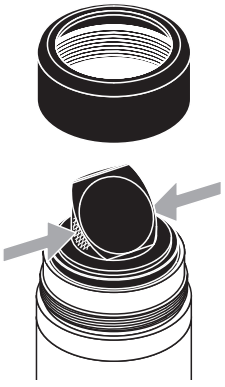
Despite its exterior robustness, the sensor is an optical high precision instrument. Therefore, special care should be taken when doing any maintenance or cleaning work:



- Dirt and moisture under the sensor cap can affect the functioning and shorten the service life of the sensor cap. Therefore, make sure the working environment is clean and dry prior to removing the sensor cap.
- Please do not touch the outer sensor membrane with your fingers. Touch the sensor cap at the sides only (shaded area in figure on the left).
- Avoid any great mechanical stress of the sensor membrane (pressure, scratches).
- Exposure to light, particularly daylight of the interior of the sensor cap will, by-and-by, affect the measurement characteristics and shorten the service life of the sensor cap. Therefore, the interior of the sensor cap should not be exposed to direct sunlight. Avoid any exposure to light that exceeds the extent required for necessary maintenance and cleaning activities. Store dismantled sensor caps in a light-protected environment only.

5.3 Exchanging the sensor cap

Removing the sensor cap

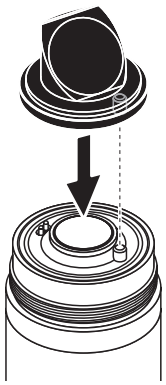


1	Pull the sensor out of the sample.
2	Clean the outside of the sensor (see section 5.4.1).
3	Unscrew the fixing ring from the sensor by hand.
4	Thoroughly clean and dry the sensor head once again.
5	Grasp the sensor cap on the sides (arrows in figure on the left) and remove it by pulling it away from the sensor in a straight upward direction.

NOTICE

Do not push any tools or other sharp objects between the sealing surfaces. This might damage the sealing surfaces.

Mounting the sensor cap



6	Check the front surface of the sensor for absolute cleanness and clean it if necessary (see section 5.4.1).
7	Thoroughly clean the thread of the fixing ring.
8	Place the new sensor cap on the sensor so that the temperature sensor fits into the hole inside the sensor cap (see figure opposite).
9	Put the fixing ring on the sensor head and screw it tight by hand.

5.4 Cleaning the sensor

5.4.1 Exterior cleaning

Dirt on the sensor can affect the measuring characteristics. Biological deposits for example, consume oxygen and can, when occurring on the sensor cap membrane, impair the responding behavior and cause values that are too low. Therefore, we recommend regular visual inspections and exterior cleaning as necessary.

Pay attention to the following points for cleaning:

- First, thoroughly rinse the sensor with tapwater to remove loosely adhering dirt.
- Rough dirt on the sensor shaft can be brushed off with a soft brush. Attention: Do not use the brush in the area of the sensor membrane. Risk of damage!
- The sensor cap including the sensor membrane should be wiped with a soft and moist microfiber cloth.
- In the case of persisting dirt you can add some household washing-up liquid to the tapwater. Attention: Never use any alcohol for cleaning!
- If the are any salt or lime deposits, the sensor can be cleaned with aqueous citric acid solution (10 % weight percent).

5.4.2 Interior cleaning of sensor cap and sensor head

If moisture or dirt have penetrated under the sensor cap, e.g. because the sensor cap is damaged, you can make the sensor ready for operation again as follows:

NOTICE

Only use nonabrasive, alcohol-free detergents, as otherwise the optical surfaces could be damaged.

1	Remove the sensor cap (see section 5.3).
2	Clean the sensor head and sensor cap: – Rinse all inner surfaces with tapwater – Remove contamination containing fat and oil with warm water and household washing-up liquid
3	Dry all surfaces with a clean, lint free cloth. A lint-free cloth such as a microfiber cloth used to clean eyeglasses is suitable.
4	Allow the sensor and sensor cap to dry completely at a dry location so moisture can evaporate even from corners difficult to access. When doing, so protect the inside of the sensor cap from light.

If the sensor cap is visibly damaged it has to be replaced.

5.5 Replacement parts and accessories

Description	Model	Order no.
Sensor cap	SC-FDO® 700	201 654Y
Sensor cap	SC-FDO® 701	201 655Y
Protective screw cap for sensor connection cable	SACIQ-Plug	480 065Y
Protective hood against damage caused by fish, with connection for the MSK FDO® CS cleaning set	MSK FDO®	205 253Y
Cleaning set for connection of the protective hood MSK FDO® to a valve module or Cleaning Air Box	MSK FDO® CS	205 254Y

Components for compressed air cleaning system

Description	Model	Order no.
Cleaning head	CH	900 107Y
Active valve module (does not require a free relay output in the IQ SENSORNET system)	MIQ/CHV PLUS	480 018Y
Valve module for the IQ SENSORNET system 182 (external relay and compressed air supply)	DIQ/CHV	472 007Y
Air compressor to be triggered by relay, power supply 115 V AC	Cleaning Air Box - 115 VAC	480 017Y
Air compressor to be triggered by relay, power supply 230 V AC	Cleaning Air Box - 230 VAC	480 019Y



Information on further IQ SENSORNET accessories is given in the YSI catalog and on the Internet.

6 What to do if...

Sensor does not appear in the measured value display and list of sensors

Cause	Remedy
– Sensor cap not mounted or defective	– Sensor cap (see section 5.3) – Replace a defective sensor cap as necessary

Measured value implausible

Cause	Remedy
– Coating on sensor cap	– Clean the outside of the sensor (see section 5.4.1)
– Service life of the sensor cap over	– Check the sensor (see section 4.2.2) – Replace the sensor cap as necessary (see section 5.3)
– Dirt inside the sensor cap and sensor head. – Fixing ring not properly tightened. – Sensor cap untight or defective.	– Dismantle sensor cap – Clean the insides of the sensor cap and sensor head (see section 5.4.2) – Mount the sensor cap correctly and tighten the fixing ring as far as it will go (see section 5.3) – Replace a defective sensor cap as necessary

Measured value fluctuating heavily

Cause	Remedy
– Coating on sensor cap	– Clean the outside of the sensor (see section 5.4.1)
– Service life of the sensor cap over	– See point "Measured value implausible"
– Dirt inside the sensor cap and sensor head. – Fixing ring not properly tightened. – Sensor cap untight or defective.	– See point "Measured value implausible"

Measured value invalid ("----" displayed)

Cause	Remedy
– User calibration unsuccessful. The sensor is blocked for measurement.	– As a temporary measure to quickly restore the readiness for service: Activate the factory calibration (see section 4.2.5) – For exact measurements, carry out a function check and repeat the user calibration if necessary.

Incorrect temperature display

Cause	Remedy
– Temperature sensor defective	– Return the sensor

7 Technical data

7.1 General measurement characteristics

The measurement characteristics are primarily determined by the sensor cap type. The relevant data are given in the sections 7.6 and 7.7.

Measuring principle

Optical measurement based on photoluminescence.

Measurement in water

According to solubility function according to ISO 5814

Measurement in salt-contaminated wastewater

Salinity input from 2.0 ... 70.0;
corresponds to 3.4 mS/cm ... 86.2 mS/cm at T_{REF} 20 °C
(salinity measurement according to IOT = International Oceanographic Tables)

Temperature measurement

Temperature sensor	Integrated NTC
Measuring range	- 5 °C ... + 50 °C (23 ... 122 °F)
Accuracy	± 0.5 K
Resolution	0.1 K

Temperature compensation

In the range -5 °C ... + 50 °C (23 ... 122 °F)

7.2 Application conditions

Pressure resistance

Sensor with connected SACIQ (SW) sensor connection cable:

Max. allowed overpressure	10^6 Pa (10 bar)

The sensor meets all requirements according to article 3(3) of 97/23/EC ("pressure equipment directive").

Type of protection

Sensor with connected SACIQ (SW) sensor connection cable:

IP 68, 10 bar (10^6 Pa)

Immersion depth

Min. 10 cm; max. 100 m depth

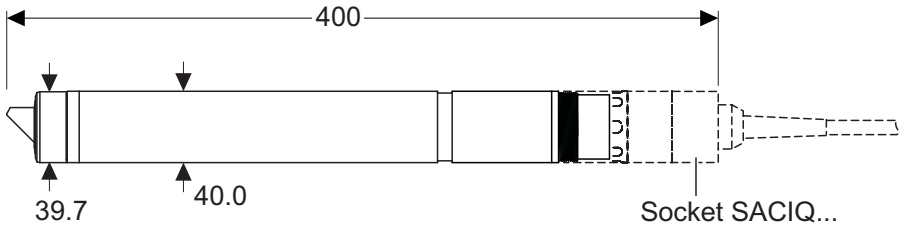
Operating position

Any

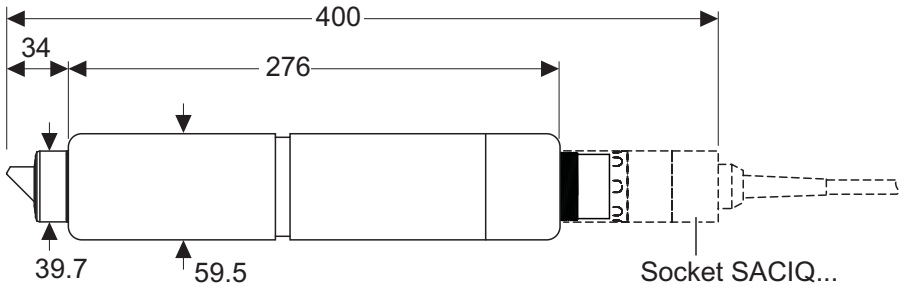
7.3 General data

Dimensions

FDO 70x IQ (H):



FDO 70x IQ SW:



Weight (without sensor connection cable)

FDO® 70x IQ (H)	Approx. 900 g
FDO® 70x IQ SW	Approx. 1500 g

Connection technique

Connection via SACIQ (SW) sensor connection cable

Material

Shaft: – FDO® 70x IQ – FDO® 70x IQ SW	V4A stainless steel 1.4571 * POM
Plug head connector housing	POM
Sensor head	POM and PVC
Sensor cap	See section 7.6 or section 7.7
Plug, 3-pole	ETFE (blue) Tefzel®
Fixing ring	POM
Protective hood (FDO® 70x IQ SW)	POM

* Stainless steel can be corrodible if there are chloride concentrations of 500 mg/L or more. For applications in such media we recommend to use the SW sensors.

Automatic sensor monitoring (SensCheck function)

Monitoring of the membrane function

7.4 Instrument safety

7.4.1 General instrument safety

Applicable norms	– UL 61010-1 – CAN/CSA C22.2 # 61010.1

7.4.2 Hazardous location ratings (H models)

Applicable directives and standards

In addition to the standards listed in chapter 7.4.1, the FDO® 70x IQ H conforms to the following directives and standards:

- ANSI/ISA-12.12.01
- CAN/CSA C22.2 # 213

The FDO® 70x IQ H is a non-incendive electrical equipment for use in Class I Division 2 hazardous locations.

Hazardous location rating

FDO® 700 IQ H FDO® 701 IQ H	Class I Division 2 Groups A, B, C, D T6 Class I Zone 2 Group IIC T6
Associated apparatus	MIQ/BB1, YSI part no. 207001Y
Control Drawing	YSI document no. 28123

7.5 Electrical data

Rated voltage (non-H models)	24 V DC via the IQ SENSORNET (for more details, see chapter TECHNICAL DATA of the IQ SENSORNET system operating manual)
Voltage range (H models)	14 V DC ... 24 V DC via the MIQ/BB1 barrier box (=associated apparatus)
Power consumption	0.7 W
Protective class	III

7.6 Technical data of the SC-FDO® 700

Measuring ranges and resolutions

D. O. partial pressure 0 ... 400 hPa

Measuring mode	Adjustable measuring range	Resolution
D. O. concentration	0 ... 20.00 mg/L 0 ... 20.00 ppm	0.01 mg/L 0.01 ppm
D. O. saturation	0 ... 200.0 %	0.1 %

Measurement accuracy

In the range	Accuracy
< 1 mg/L (ppm)	± 0.05 mg/L (ppm)
> 1 mg/L (ppm)	± 0.1 mg/L (ppm)

Repeatability

± 0.05 mg/L (ppm) according to EN ISO 15839

Response time

t_{90} (90 % of the final display value after) < 150 s according to EN ISO 15839
t_{95} (95 % of the final display value after) < 200 s according to EN ISO 15839

Minimum approach flow

No incident flow required

Interferences

Non-sensitive to against hydrogen sulfide, chlorine, and ionogenic substances

Allowed temperature range

Measuring medium	- 5 °C ... + 50 °C (23 ... 122 °F)
Storage/transport	- 10 °C ... + 50 °C (14 ... 122 °F)

Allowed pH range of the test sample

4 ... 12

Calibration procedure

Factory calibration by means of IQMC (Intelligent Membrane Calibration) procedure. User calibration possible in water vapor-saturated air or air-saturated water.

Material

PMMA, PVC and silicone

Working life

2 years guaranteed with authorized use

7.7 Technical data of the SC-FDO® 701

Measuring ranges and resolutions

D. O. partial pressure 0 ... 400 hPa

Measuring mode	Adjustable measuring range	Resolution
D. O. concentration	0 ... 20.00 mg/L 0 ... 20.00 ppm	0.01 mg/L 0.01 ppm
D. O. saturation	0 ... 200.0 %	0.1 %

Measurement accuracy

In the range	Accuracy
< 1 mg/L (ppm)	± 0.05 mg/L (ppm)
> 1 mg/L (ppm)	± 0.1 mg/L (ppm)

Repeatability

± 0.05 mg/L (ppm) according to EN ISO 15839

Response time

t_{90} (90 % of the final display value after) < 60 s according to EN ISO 15839
t_{95} (95 % of the final display value after) < 80 s according to EN ISO 15839

Minimum approach flow

No incident flow required

Interferences

Non-sensitive to against hydrogen sulfide, chlorine, and ionogenic substances

Allowed temperature range

Measuring medium	-5 °C ... + 40 °C (23 ... 104 °F)
Storage/transport	- 10 °C ... + 40 °C (-33 ... 104 °F)

Allowed pH range of the test sample

4 ... 12

Calibration procedure

Factory calibration by means of IQMC (Intelligent Membrane Calibration) procedure. User calibration possible in water vapor-saturated air or air-saturated water.

Material

PMMA, PVC and silicone

Working life

6 months guaranteed for authorized use under the specified environmental conditions

8 Contact Information

8.1 Ordering & Technical Support

Telephone: (800) 897-4151
(937) 767-7241
Monday through Friday, 8:00 AM to 5:00 PM ET

Fax: (937) 767-1058

Email: environmental@ysi.com

Mail: YSI Incorporated
1725 Brannum Lane
Yellow Springs, OH 45387
USA

Internet: www.ysi.com

When placing an order please have the following information available:

YSI account number (if available)	Name and Phone Number
Model number or brief description	Billing and shipping address
Quantity	Purchase Order or Credit Card

8.2 Service Information

YSI has authorized service centers throughout the United States and Internationally. For the nearest service center information, please visit www.ysi.com and click ‘Support’ or contact YSI Technical Support directly at 800-897-4151.

When returning a product for service, include the Product Return form with cleaning certification. The form must be completely filled out for an YSI Service Center to accept the instrument for service. The Product Return form may be downloaded at www.ysi.com and clicking on the ‘Support‘ tab.

9 Indexes

9.1 Explanation of the messages

This chapter contains a list of all the message codes and related message texts that can occur in the log book of the IQ SENSORNET system for the FDO® 70x IQ ... sensor.

Information on the contents and structure of the log book, and how to call it up, is given in the LOG BOOK chapter of the IQ SENSORNET system operating manual.

The last three digits of the message code identify the source of the message:

- 334 = SC FDO 700 (sensor cap SC-FDO® 700)
- 335 = SC FDO 701 (sensor cap SC-FDO® 701)
- 531 = FDO700IQ (sensor basis / component class, adapter ADA)

9.1.1 Error messages

Message code	Message text
EA133x	*Meas. range exceeded or undercut* ** Check process* ** Select other meas. range*
EA233x	*Sensor temperature too high!* ** Check process and application*
EA333x	*Sensor temperature too low!* ** Check process and application*
EAP33x	*Measurement interfered* ** SensCheck: Sensor cap is missing, leaky, depleted, or defective* ** Clean sensor and space between cap and sensor according to op.instructions* ** Screw on sensor cap securely* ** Replace sensor cap*
EAP531	*Measurement interfered* ** SensCheck: Sensor cap is missing, leaky, depleted, or defective* ** Clean sensor and space between cap and sensor according to op.instructions* ** Screw on sensor cap securely* ** Replace sensor cap*

Message code	Message text
EC833x	*Sensor could not be calibrated, sensor blocked for measurement Cause: instable signal * Check temperature adjustment * Check calibration conditions (see operating manual) * Repeat calibration*
EC933x	*Calibration error, measurement disabled Cause: Sensor cap is missing, leaky, depleted, or defective * Clean sensor and space between cap and sensor according to op.instructions * Screw on sensor cap securely * Repeat calibration * Replace sensor cap*
EI133x	*Operational voltage too low * Check installation and cable lengths, Follow installation instructions * Power supply module(s) overloaded, add power supply module(s) * Check terminal and module connections * Defective components, replace components*
EI233x	*Operational voltage too low, no operation possible * Check installation and cable lengths, Follow installation instructions * Power supply module(s) overloaded, add power supply module(s) * Check terminal and module connections * Defective components, replace components*
ES133x	*Component hardware defective * Contact service*

9.1.2 Info messages

Message code	Message text
IC133x	*Sensor has been successfully calibrated* ** For calibration data, see calibration history*
IC333x	*Factory calibration has been activated. Make sure the sensor operates correctly.*
IC433x	*Last valid calibration has been activated. Make sure the sensor operates correctly.*
IC533x	*Invalid user calibration has been replaced by last valid user calibration. Caution! Wrong measured values possible. Carry out a new successful calibration to make sure the sensor operates correctly.*es correctly.
IC633x	*The invalid user calibration was replaced by the factory calibration. Caution! Wrong measured values possible. Check whether the sensor operates correctly or carry out a new successful calibration.user calibration.*
IC733x	This message displays the result of the last check (see section 4.2.2)
IS133x	This message displays the information stored in the sensor cap (see section 1.2)

9.2 Status info

The status info is a coded piece of information on the current status of a sensor. Each sensor sends this status info to the controller. The status info of sensors consists of 32 bits, each of which can have the value 0 or 1.

Status info, general structure

0 1 2 3 4 5 6 7	8 9 10 11 12 13 14 15	
1 0 0 0 0 0 0 0	0 0 0 0 0 0 0 0	(general)
0 0 0 0 0 0 0 0	0 0 0 0 0 0 0 0	(internal)
16 17 18 19 20 21 22 23	24 25 26 27 28 29 30 31	

The bits 0 - 15 are reserved for general information.
The bits 16 - 21 are reserved for internal service information.

You obtain the status info:

- via a manual query in the *Einstellungen/Settings/Service/List of all components* menu (see system operating manual)
- by an automated query
  - from a superordinate process control (e. g. when connected to the Profibus)
  - from the IQ Data Server (see IQ SENSORNET Software Pack operating manual)

The evaluation of the status info, e.g. in the case of an automated query, has to be made individually for each bit.

Status info

Status bit	Explanation
Bit 0	*Component hardware defective*
Bit 1	Sensor cap missing, untight, depleted or defective
Bit 2-31	-

Xylem |'zīləm|

1) The tissue in plants that brings water upward from the roots;
2) a leading global water technology company.

We're 12,500 people unified in a common purpose: creating innovative solutions to meet our world's water needs. Developing new technologies that will improve the way water is used, conserved, and re-used in the future is central to our work. We move, treat, analyze, and return water to the environment, and we help people use water efficiently, in their homes, buildings, factories and farms. In more than 150 countries, we have strong, long-standing relationships with customers who know us for our powerful combination of leading product brands and applications expertise, backed by a legacy of innovation.

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Email: environmental@ysi.com
Web: www.ysi.com

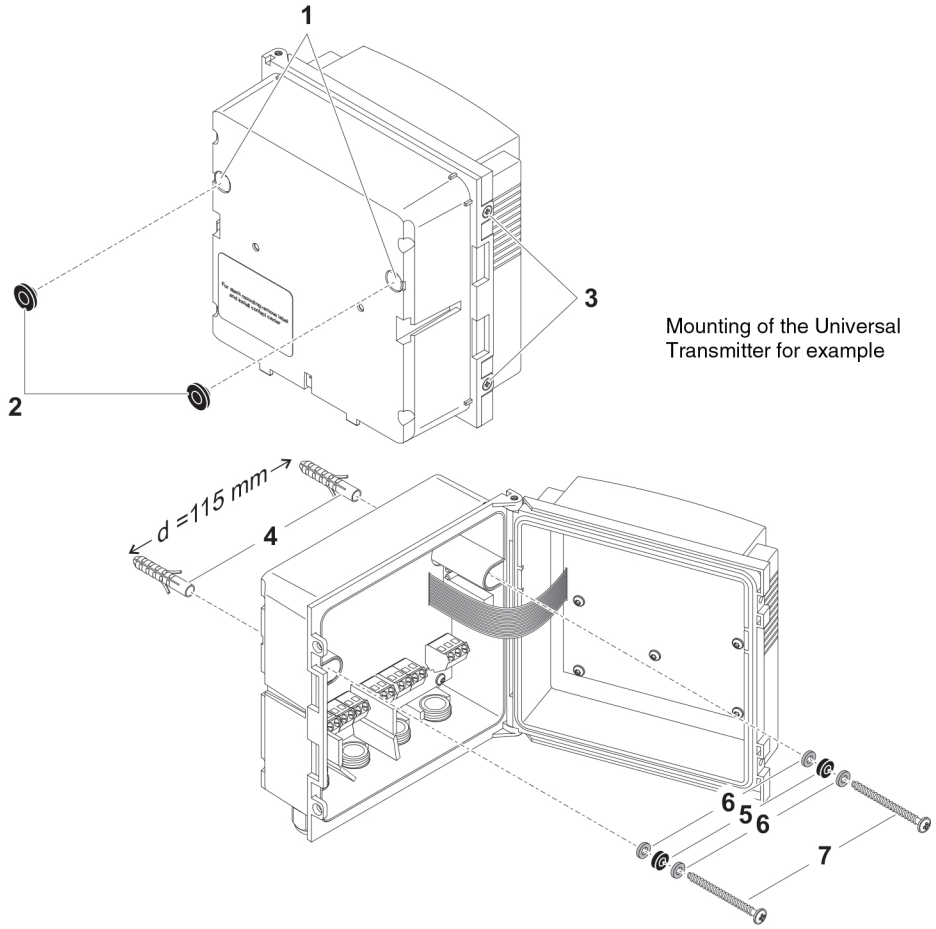
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Installation instructions

WMS/IQ

Wall mounting set



Mounting of the Universal Transmitter for example

Mounting

With the WMS/IQ kit you can mount a DIQ/S 182 Universal Transmitter or an MIQ module to a wall. To do so, proceed as follows:

Note
Depending on the condition of the wall, dowels other than those contained in the kit may be required.

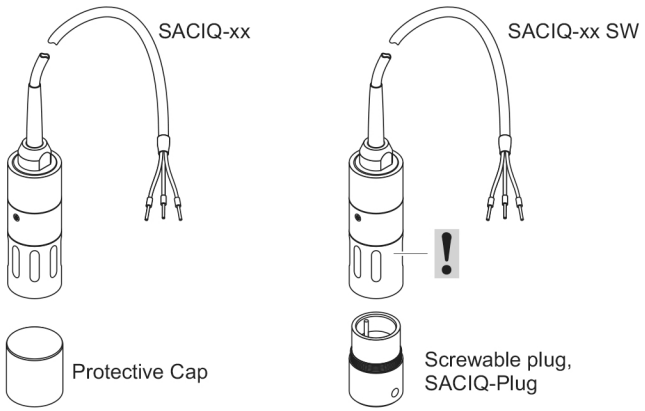
1	Remove the covers from the drilled mounting holes (1).
2	Insert the distance washers (2) in the drilled mounting holes.
3	Remove the countersunk screws (3) and swing open the lid.
4	Screw the Universal Transmitter to the previously drilled wall with the aid of the dowels (4), the washers (5), the sealing washers (6) and the screws (7).
5	Close the lid and fix it with the two countersunk screws (3).

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Operating manual

SACIQ-xx (SW)

IQ SENSOR NET
Sensor connection cable



Cable assortment

	Standard models		Seawater models	
Cable length	**Model**	**Order no.**	**Model**	**Order no.**
1.5 m	SACIQ-1,5	480 040Y		
7.0 m	SACIQ-7,0	480 042Y		
15.0 m	SACIQ-15,0	480 044Y		
20 m			SACIQ-20,0 SW	480 045Y
25 m			SACIQ-25,0 SW	480 066Y
50 m			SACIQ-50,0 SW	480 060Y
75 m			SACIQ-75,0 SW	480 067Y
100 m			SACIQ-100,0 SW	480 062Y
Special length	SACIQ-SO	480 041VY	SACIQ-SO SW	480 064VY

Standard and seawater models

Compared to the standard model, the seawater model is optimized concerning corrosion resistance in sea water and brackish water. All parts that are susceptible to corrosion are made of high quality titanium. The seawater model can be recognized by the missing recessed grip on the coupling ring (see above figure).

Instructions on handling

Installation

How to connect the cable with the sensor and the IQ SENSOR NET is described in detail in the IQ SENSOR NET system operating manual. Please exactly follow the instructions given there.

Caution
Before assembling, thoroughly dry all moist plug connectors on the sensor and connection cable (dab dry or blow out with dry compressed air), especially the area of the electrical contacts and the thread.

Sensor maintenance

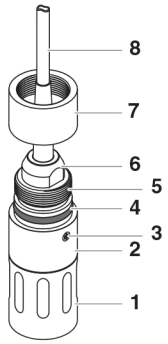
If you disconnect the sensor from the connection cable, close the socket of the sensor connection cable with the protective cap in order to largely avoid moisture and dirt. For safe sealing, use the screwable plug, SACIQ-Plug (it is included in the scope of delivery of the seawater models).

Accessories

For the standard models, the SACIQ-Plug is available as an accessory (order no. 480 065Y).

Technical data

Material



Pos.	Description	Material	
		Standard model	**Seawater model**
1	Coupling ring	Stainless steel 1.4571	Titanium, grade 2
2	Ring	POM	
3	Screw	Stainless steel V4A	Polyamide 6.6
4	O-ring	NBR	
5	Enclosure	POM	
6	Nut	Stainless steel 1.4571	Titanium, grade 2
7	Protection ring	POM	
8	Cable sheath	PUR	
-	Protection device	Soft PVC (protective cap)	POM (SACIQ-Plug screwable plug)

Cable

Diameter	8 mm
Smallest allowed bend radius	Permanent bend: 80 mm One-time bend: 50 mm

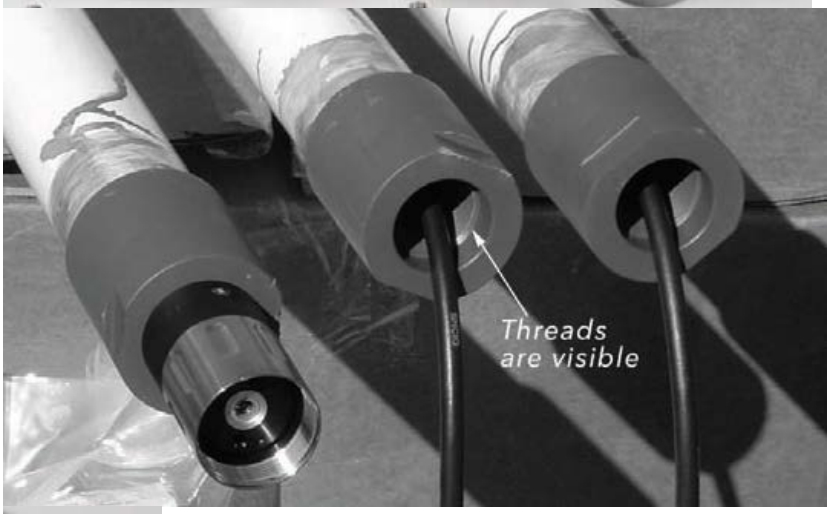
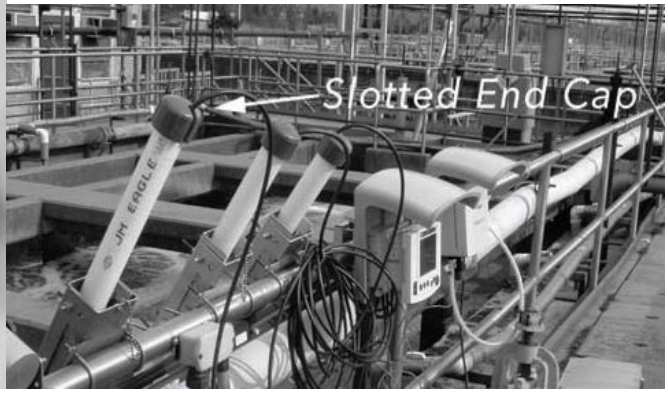
Temperature range

- 35 °C ... + 80 °C (-31 °F ... 176 °F)

Pressure resistance of the plug connection

Max. admissible overpressure	10^6 Pa (10 bar) (cable connected to sensor)

The sensor meets all requirements according to article 3(3) of 97/23/EC ("pressure equipment directive").

Item Article	Qty. Qté	Description		
		    **559327-2Y**: Threaded PVC sensor coupling. **559327-4Y**: Slotted PVC end cap, **559327-7Y**: PVC coupler		

Section 3.3.6

MBBR Chemical Feed (Alum & Anti Foam)

SMART Digital - DDA

up to 30 l/h

Installation and operating instructions



Further languages

http://net.grundfos.com/qr/i/95724708

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English (GB) Installation and operating instructions

Original installation and operating instructions

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Warning



Prior to installation, read these installation and operating instructions. Installation and operation must comply with local regulations and accepted codes of good practice.

1. Safety instructions

These installation and operating instructions contain general instructions that must be observed during installation, operation and maintenance of the pump. It must therefore be read by the installation engineer and the relevant qualified operator prior to installation and start-up, and must be available at the installation location at all times.

1.1 Symbols used in this document



Warning
If these safety instructions are not observed, it may result in personal injury.

Caution — If these safety instructions are not observed, it may result in malfunction or damage to the equipment.

Note — Notes or instructions that make the job easier and ensure safe operation.

1.2 Qualification and training of personnel

The personnel responsible for the installation, operation and service must be appropriately qualified for these tasks. Areas of responsibility, levels of authority and the supervision of the personnel must be precisely defined by the operator. If necessary, the personnel must be trained appropriately.

Risks of not observing the safety instructions

Non-observance of the safety instructions may have dangerous consequences for the personnel, the environment and the pump and may result in the loss of any claims for damages.

It may lead to the following hazards:

- Personal injury from exposure to electrical, mechanical and chemical influences.
- Damage to the environment and personal injury from leakage of harmful substances.

1.3 Safety instructions for the operator/user

The safety instructions described in these instructions, existing national regulations on health protection, environmental protection and for accident prevention and any internal working, operating and safety regulations of the operator must be observed.

Information attached to the pump must be observed.

Leakages of dangerous substances must be disposed of in a way that is not harmful to the personnel or the environment.

Damage caused by electrical energy must be prevented, see the regulations of the local electricity supply company.

Caution — Before any work to the pump, the pump must be in the "Stop" operating state or be disconnected from the power supply. The system must be pressureless!

Note — The mains plug is the separator separating the pump from the mains.

Only original accessories and original spare parts should be used. Using other parts can result in exemption from liability for any resulting consequences.

1.4 Safety of the system in the event of a failure in the dosing pump

The dosing pump was designed according to the latest technologies and is carefully manufactured and tested.

If it fails regardless of this, the safety of the overall system must be ensured. Use the relevant monitoring and control functions for this.

Caution — Make sure that any chemicals that are released from the pump or any damaged lines do not cause damage to system parts and buildings.

The installation of leak monitoring solutions and drip trays is recommended.

1.5 Dosing chemicals

Warning

Before switching the supply voltage back on, the dosing lines must be connected in such a way that any chemicals in the dosing head cannot spray out and put people at risk.

The dosing medium is pressurised and can be harmful to health and the environment.

Warning

When working with chemicals, the accident prevention regulations applicable at the installation site should be applied (e.g. wearing protective clothing).

Observe the chemical manufacturer's safety data sheets and safety instructions when handling chemicals!

Caution

A deaeration hose, which is routed into a container, e.g. a drip tray, must be connected to the deaeration valve.

Caution

The dosing medium must be in liquid aggregate state!

Observe the freezing and boiling points of the dosing medium!

The resistance of the parts that come into contact with the dosing medium, such as the dosing head, valve ball, gaskets and lines, depends on the medium, media temperature and operating pressure.

Caution

Ensure that parts in contact with the dosing media are resistant to the dosing medium under operating conditions, see data booklet!

Should you have any questions regarding the material resistance and suitability of the pump for specific dosing media, please contact Grundfos.

1.6 Diaphragm breakage

If the diaphragm leaks or is broken, dosing liquid escapes from the drain opening (fig. 41, pos. 11) on the dosing head. Observe section *7.6 Diaphragm breakage*.

Warning

Danger of explosion, if dosing liquid has entered the pump housing!

Operation with damaged diaphragm can lead to dosing liquid entering the pump housing.

In case of diaphragm breakage, immediately separate the pump from the power supply!

Make sure the pump cannot be put back into operation by accident!

Dismantle the dosing head without connecting the pump to the power supply and make sure no dosing liquid has entered the pump housing. Proceed as described in section *7.6.1 Dismantling in case of diaphragm breakage*.

To avoid any danger resulting from diaphragm breakage, observe the following:

- Perform regular maintenance. See section *7.1 Regular maintenance*.
- Never operate the pump with blocked or soiled drain opening.
  - If the drain opening is blocked or soiled, proceed as described in section *7.6.1 Dismantling in case of diaphragm breakage*.
- Never attach a hose to the drain opening. If a hose is attached to the drain opening, it is impossible to recognise escaping dosing liquid.
- Take suitable precautions to prevent harm to health and damage to property from escaping dosing liquid.
- Never operate the pump with damaged or loose dosing head screws.

2. General information



The DDA dosing pump is a self-priming diaphragm pump. It consists of a housing with stepper motor and electronics, a dosing head with diaphragm and valves and the control cube.

Excellent dosing features of the pump:

- Optimal intake even with degassing media, as the pump always works at full suction stroke volume.
- Continuous dosing, as the medium is sucked up with a short suction stroke, regardless of the current dosing flow, and dosed with the longest possible dosing stroke.

2.1 Applications

The pump is suitable for liquid, non-abrasive, non-flammable and non-combustible media strictly in accordance with the instructions in these installation and operating instructions.

Areas of application

- Drinking water treatment
- Wastewater treatment
- Swimming pool water treatment
- Boiler water treatment
- CIP (Clean-In-Place)
- Cooling water treatment
- Process water treatment
- Wash plants
- Chemical industry
- Ultrafiltration processes and reverse osmosis
- Irrigation
- Paper and pulp industry
- Food and beverage industries

2.2 Improper operating methods

The operational safety of the pump is only guaranteed if it is used in accordance with section *2.1 Applications*.



Warning

Other applications or the operation of pumps in ambient and operating conditions, which are not approved, are considered improper and are not permitted. Grundfos cannot be held liable for any damage resulting from incorrect use.



Warning

The pump is NOT approved for operation in potentially explosive areas!



Warning

A sunscreen is required for outdoor installation!

Caution

Frequent disengagement from the mains voltage, e.g. via a relay, can result in damage to the pump electronics and in the breakdown of the pump. The dosing accuracy is also reduced as a result of internal start procedures.

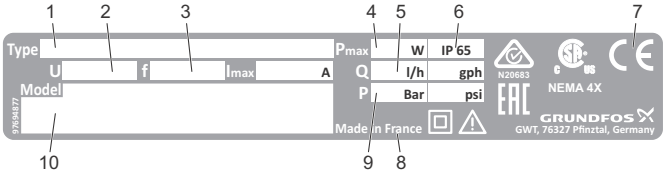
Do not control the pump via the mains voltage for dosing purposes!

Only use the "External stop" function to start and stop the pump!

2.3 Symbols on the pump

Symbol	Description
	Indication of universally dangerous spot.
	In case of emergency and prior to all maintenance work and repairs, take the mains plug out of the mains supply!
	The device complies with electrical safety class II.
	Connection for deaeration hose at dosing head. If the deaeration hose is not correctly connected, danger will arise due to possible leakage of dosing liquid!

2.4 Nameplate



TM04 8144 1716

Fig. 1 Nameplate

Pos.	Description	Pos.	Description
1	Type designation	6	Enclosure class
2	Voltage	7	Mark of approval, CE mark, etc.
3	Frequency	8	Country of origin
4	Power consumption	9	Max. operating pressure
5	Max. dosing flow	10	Model

2.5 Type key

The type key is used to identify the precise pump and is not used for configuration purposes.

Code	Example	DDA	7.5-	16	AR-	PP/	V/	C-	F-	3	1	U2U2	F	G
	Pump type													
	Max. flow [l/h]													
	Max. pressure [bar]													
	Control variant													
AR	Standard													
FC	AR with FlowControl													
FCM	FC with integrated flow measurement													
	Dosing head material													
PP	Polypropylene													
PVC	PVC (polyvinyl chloride, only up to 10 bar)													
PV	PVDF (polyvinylidene fluoride)													
SS	Stainless steel DIN 1.4401													
	Gasket material													
E	EPDM													
V	FKM													
T	PTFE													
	Valve ball material													
C	Ceramic													
SS	Stainless steel DIN 1.4401													
	Control cube position													
F	Front-mounted (can be changed to the right or left)													
	Voltage													
3	1 x 100-240 V, 50/60 Hz													
	Valve type													
1	Standard													
2	Spring-loaded (HV version)													
	Suction/discharge side connection													
U2U2	Hose, 4/6 mm, 6/9 mm, 6/12 mm, 9/12 mm													
U7U7	Hose 0.17" x 1/4"; 1/4" x 3/8"; 3/8" x 1/2"													
AA	Threaded Rp 1/4", female (stainless steel)													
VV	Threaded 1/4" NPT, female (stainless steel)													
XX	No connection													
	Installation set*													
I001	Hose, 4/6 mm (up to 7.5 l/h, 13 bar)													
I002	Hose, 9/12 mm (up to 60 l/h, 9 bar)													
I003	Hose, 0.17" x 1/4" (up to 7.5 l/h, 13 bar)													
I004	Hose, 3/8" x 1/2" (up to 60 l/h, 10 bar)													
	Mains plug													
F	EU													
B	USA, Canada													
G	UK													
I	Australia, New Zealand, Taiwan													
E	Switzerland													
J	Japan													
L	Argentina													
	Design													
G	Grundfos													

* including: 2 pump connections, foot valve, injection unit, 6 m PE discharge hose, 2 m PVC suction hose, 2 m PVC deaeration hose (4/6 mm)

2.6 Product overview

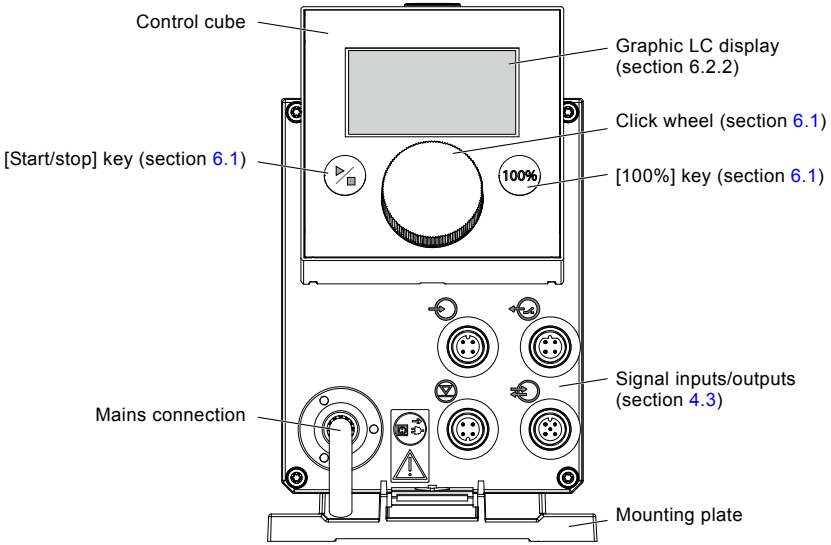


Fig. 2 Front view of the pump

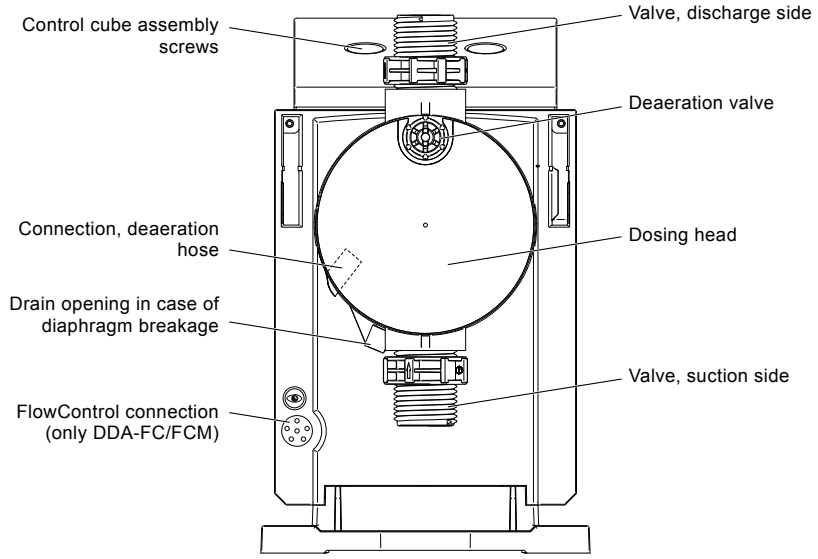


Fig. 3 Rear view of the pump

3. Technical data / Dimensions



3.1 Technical data

Data			7.5-16	12-10	17-7	30-4
Mechanical data	Turn-down ratio (setting range)	[1:X]	3000	1000	1000	1000
	Max. dosing capacity	[l/h]	7.5	12.0	17.0	30.0
		[gph]	2.0	3.1	4.5	8.0
	Max. dosing capacity with SlowMode 50 %	[l/h]	3.75	6.00	8.50	15.00
		[gph]	1.00	1.55	2.25	4.00
	Max. dosing capacity with SlowMode 25 %	[l/h]	1.88	3.00	4.25	7.50
		[gph]	0.50	0.78	1.13	2.00
	Min. dosing capacity	[l/h]	0.0025	0.0120	0.0170	0.0300
		[gph]	0.0007	0.0031	0.0045	0.0080
	Max. operating pressure[6)]	[bar]	16	10	7	4
		[psi]	230	150	100	60
	Max. stroke frequency[1)]	[strokes/ min]	190	155	205	180
	Stroke volume	[ml]	0.74	1.45	1.55	3.10
	Accuracy of repeatability	[%]	± 1			
	Max. suction lift during operation[2)]	[m]	6			
	Max. suction lift when priming with wet valves[2)]	[m]	2	3	3	2
	Min. pressure difference between suction and discharge side	[bar]	1 (FC and FCM: 2)			
	Max. inlet pressure, suction side	[bar]	2			
	Max. viscosity in SlowMode 25 % with spring-loaded valves[3)]	[mPas] (= cP)	2500	2500	2000	1500
	Max. viscosity in SlowMode 50 % with spring-loaded valves[3)]	[mPas] (= cP)	1800	1300	1300	600
	Max. viscosity without SlowMode with spring-loaded valves[3)]	[mPas] (= cP)	600	500	500	200
	Max. viscosity without spring-loaded valves[3)]	[mPas] (= cP)	50	300	300	150
	Min. internal hose/pipe diameter suction/discharge side[2), 4)]	[mm]	4	6	6	9
	Min. internal hose/pipe diameter suction/discharge side (high viscosity)[4)]	[mm]	9			
	Min./Max. liquid temperature	[°C]	-10/45			
	Min./Max. ambient temperature	[°C]	0/45			
	Min./Max. storage temperature	[°C]	-20/70			
	Max. relative humidity (non-condensing)	[%]	96			
	Max. altitude above sea level	[m]	2000			

Data			7.5-16	12-10	17-7	30-4
Electrical data	Voltage	[V]	100-240 V, - 10 %/+ 10 %, 50/60 Hz			
	Length of mains cable	[m]	1.5			
	Max. inrush current for 2 ms (100 V)	[A]	8			
	Max. inrush current for 2 ms (230 V)	[A]	25			
	Max. power consumption P_1	[W]	24[5)]			
	Enclosure class		IP65, Nema 4X			
	Electrical safety class		II			
	Pollution degree		2			
Signal input	Max. load for level input		12 V, 5 mA			
	Max. load for pulse input		12 V, 5 mA			
	Max. load for External stop input		12 V, 5 mA			
	Min. pulse length	[ms]	5			
	Max. pulse frequency	[Hz]	100			
	Impedance at 0/4-20 mA analog input	[Ω]	15			
	Accuracy of analog input (full-scale value)	[%]	± 1.5			
	Min. resolution of analog input	[mA]	0.05			
	Max. resistance in level/pulse circuit	[Ω]	1000			
Signal output	Max. ohmic load on relay output	[A]	0.5			
	Max. voltage on relay/analog output	[V]	30 VDC/30 VAC			
	Impedance at 0/4-20 mA analog output	[Ω]	500			
	Accuracy of analog output (full-scale value)	[%]	± 1.5			
	Min. resolution of analog output	[mA]	0.02			
Weight/size	Weight (PVC, PP, PVDF)	[kg]	2.4	2.4		2.6
	Weight (stainless steel)	[kg]	3.2	3.2		4.0
	Diaphragm diameter	[mm]	44	50		74
Sound pressure	Max. sound pressure level	[dB(A)]	60			
Approvals			CE, CB, CSA-US, NSF61, EAC, ACS, C-Tick			

1) The maximum stroke frequency varies depending on calibration

2) Data is based on measurements with water

3) Maximum suction lift: 1 m, dosing capacity reduced (approx. 30 %)

4) Length of suction line: 1.5 m, length of discharge line: 10 m (at max. viscosity)

5) With E-Box

6) PVC (polyvinyl chloride), only up to 10 bar

3.2 Dimensions

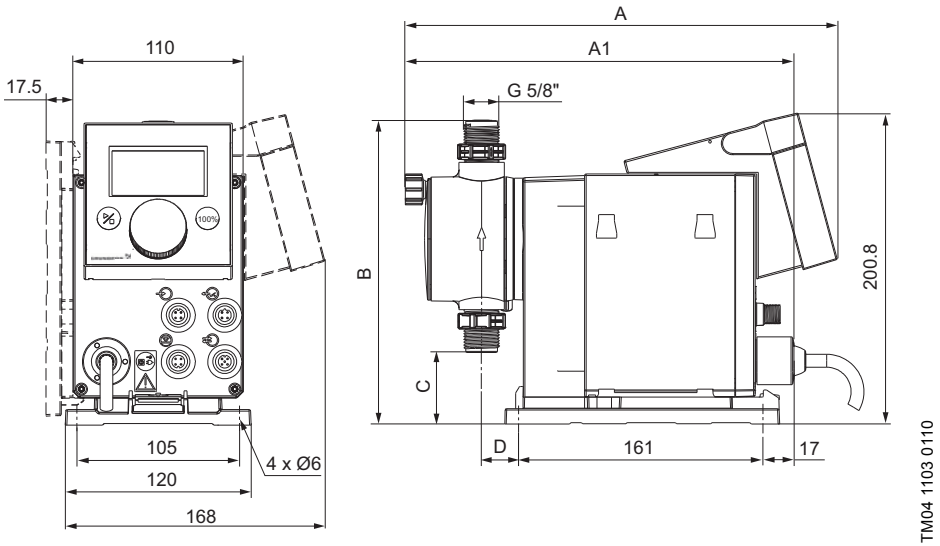


Fig. 4 Dimensional sketch

Pump type	A [mm]	A1 [mm]	B [mm]	C [mm]	D [mm]
DDA 7.5-16	280	251	196	46.5	24
DDA 12-10/17-7	280	251	200.5	39.5	24
DDA 30-4	295	267	204.5	35.5	38.5

4. Assembly and installation

For use in Australia:

Note

Installation of this product must comply with AS/NZS3500!

Certificate of suitability number: CS9431

C-tick number: N20683

4.1 Pump assembly

Warning

Install the pump in such a way that the plug can easily be reached by the operator during operation! This will enable the operator to separate the pump from the mains quickly in case of emergency!

The pump is delivered with a mounting plate.
The mounting plate can be mounted vertically e.g. on a wall or horizontally e.g. on a tank. It takes just a few quick steps to firmly secure the pump to the mounting plate by means of a slot mechanism.

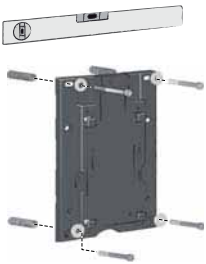
The pump can easily be released from the mounting plate for maintenance.

4.1.1 Requirements

- The mounting surface must be stable and must not vibrate.
- Dosing must flow upwards vertically.

4.1.2 Align and install mounting plate

- **Vertical installation**: Mounting plate slot mechanism must be above.
- **Horizontal installation**: Mounting plate slot mechanism must be opposite the dosing head.
- The mounting plate can be used as a drill template, please see fig. 4 for drill hole distances.



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Fig. 5 Locate mounting plate

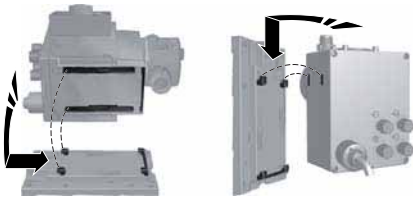
Warning

Make sure that you do not damage any cables and lines during installation!

1. Indicate drill holes.
2. Drill holes.
3. Secure mounting plate using four screws, diameter 5 mm, to the wall, on the bracket or the tank.

4.1.3 Engage pump in mounting plate

1. Attach the pump to the mounting plate support clamps and slide under slight pressure until it engages.



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Fig. 6 Engaging the pump

4.1.4 Adjusting control cube position

The control cube is fitted to the front of the pump on delivery. It can be turned by 90 ° so that the user can select to operate the pump from the right or left side.

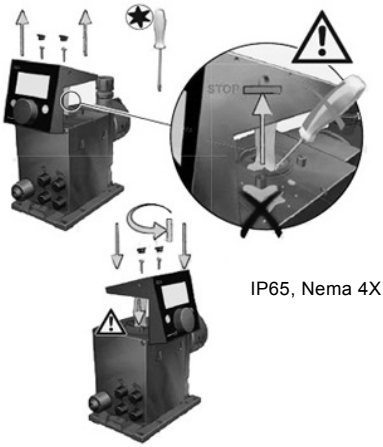
Caution

The enclosure class (IP65/Nema 4X) and shock protection are only guaranteed if the control cube is installed correctly!

Caution

Pump must be disconnected from the power supply!

1. Carefully remove both protective caps on the control cube using a thin screwdriver.
2. Loosen screws.
3. Carefully lift off control cube only so far from the pump housing that no tensile stress is produced on the flat band cable.
4. Turn control cube by 90 ° and re-attach.
   – Make sure the O-ring is secure.
5. Tighten screws slightly and attach protective caps.



IP65, Nema 4X

TM04 1182 0110

Fig. 7 Adjusting control cube

4.2 Hydraulic connection

Warning

Risk of chemical burns!

Wear protective clothing (gloves and goggles) when working on the dosing head, connections or lines!

The dosing head may contain water from the factory check!

Caution When dosing media which should not come into contact with water, another medium must be dosed beforehand!

Caution Faultless function can only be guaranteed in conjunction with lines supplied by Grundfos!

Caution The lines used must comply with the pressure limits as per section *3.1 Technical data*!

Important information on installation

- Observe suction lift and line diameter, see section *3.1 Technical data*.
- Shorten hoses at right angles.
- Ensure that there are no loops or kinks in the hoses.
- Keep suction line as short as possible.
- Route suction line up towards the suction valve.
- Installing a filter in the suction line protects the entire installation against dirt and reduces the risk of leakage.
- Only control variant FC/FCM: For discharge quantities < 1 l/h we recommend the use of an additional spring-loaded valve (approx. 3 bar) on the discharge side for the safe generation of the necessary differential pressure.

Hose connection procedure

1. Push union nut and tensioning ring across hose.
2. Push cone part fully into hose, see fig. 8.
3. Attach cone part with hose to corresponding pump valve.
4. Tighten union nut manually.
   – Do not use tools!
5. Tighten up union nuts after 2-5 operating hours if using PTFE gaskets!
6. Attach deaeration hose to the corresponding connection (see fig. 3) and run into a container or a collecting tray.

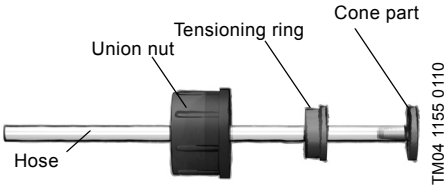


Fig. 8 Hydraulic connection

Note Pressure differential between suction and discharge side must be at least 1 bar/14.5 psi!

Caution Tighten the dosing head screws with a torque wrench once before commissioning and again after 2-5 operating hours at 4 Nm.

Installation example

The pump offers various installation options. In the picture below, the pump is installed in conjunction with a suction line, level switch and multifunction valve on a Grundfos tank.

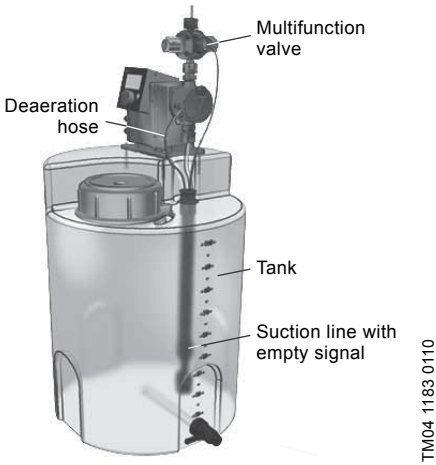


Fig. 9 Installation example

4.3 Electrical connection

Warning

The enclosure class (IP65/Nema 4X) is only guaranteed if plugs or protective caps are correctly installed!

Warning

The pump can start automatically when the mains voltage is switched on!

Do not manipulate mains plug or cable!

The mains plug is the separator separating the pump from the mains.

Note The rated voltage of the pump, see section *2.4 Nameplate*, must conform to local conditions.

Signal connections

Warning

Electric circuits of external devices connected to the pump inputs must be separated from dangerous voltage by means of double or reinforced insulation!

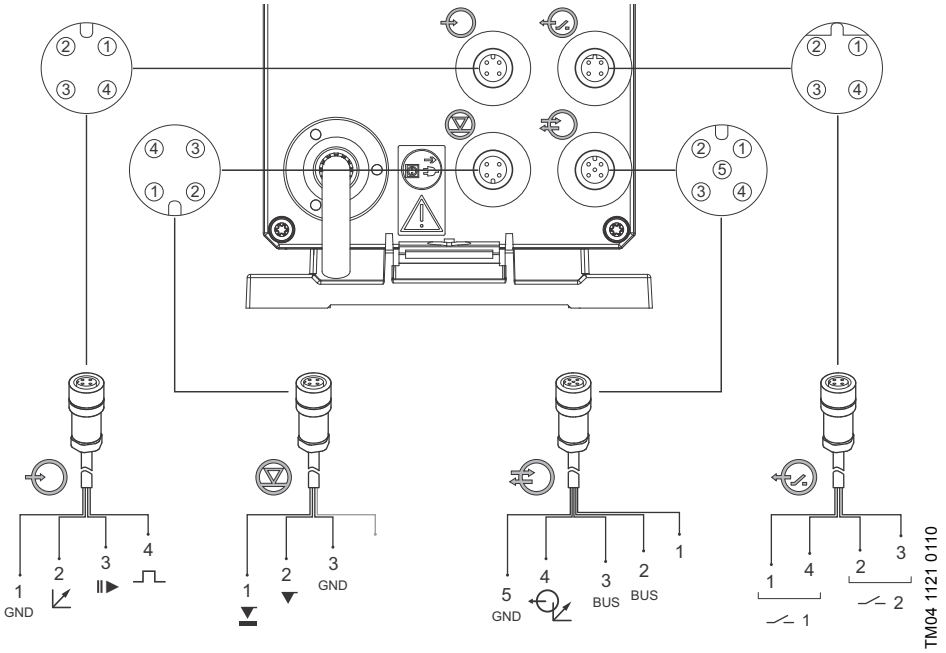


Fig. 10 Wiring diagram of the electrical connections

Analog, External stop and pulse input

Function	Pins				Plug type
	1/brown	2/white	3/blue	4/black	
Analog	GND/(-) mA	(+) mA			mA signal
External stop	GND		X		Pulse
Pulse	GND			X	Pulse

Level signals: Empty signal and Low-level signal

Function	Pins				Plug type
	1	2	3	4	
Low-level signal	X		GND		Pulse
Empty signal		X	GND		Pulse

GENIbus, Analog output

Caution

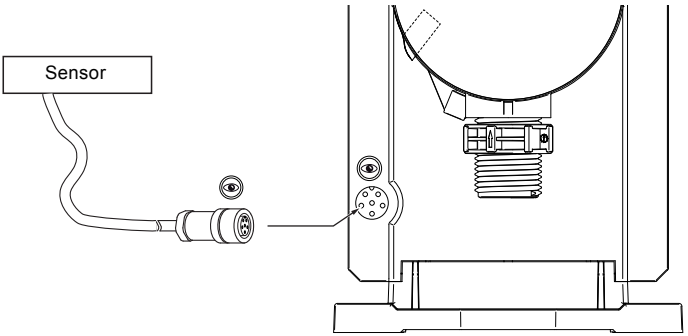
Danger of damage to the product due to short circuit! Pin 1 supplies 30 VDC.
Never short-circuit pin 1 with any of the other pins!

Function	Pins					Plug type
	1/brown	2/white	3/blue	4/black	5/yellow/ green	
GENIbus	+30 V	GENI bus TXD	GENI bus RXD		GND	Bus
Analog output				(+) mA	GND/(-) mA	mA signal

Relay outputs

Function	Pins				Plug type
	1/brown	2/white	3/blue	4/black	
Relay 1	X			X	Pulse
Relay 2		X	X		Pulse

FlowControl signal connection



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Fig. 11 FlowControl signal connection

5. Startup

5.1 Setting the menu language

For description of control elements, see section 6.

1. Turn click wheel to highlight the cog symbol.

2. Press the click wheel to open the "Setup" menu.

3. Turn the click wheel to highlight the "Language" menu.

4. Press the click wheel to open the "Language" menu.

5. Turn the click wheel to highlight the desired language.

6. Press the click wheel to select the highlighted language.

7. Press the click wheel again to confirm the "Confirm settings?" prompt and apply the setting.

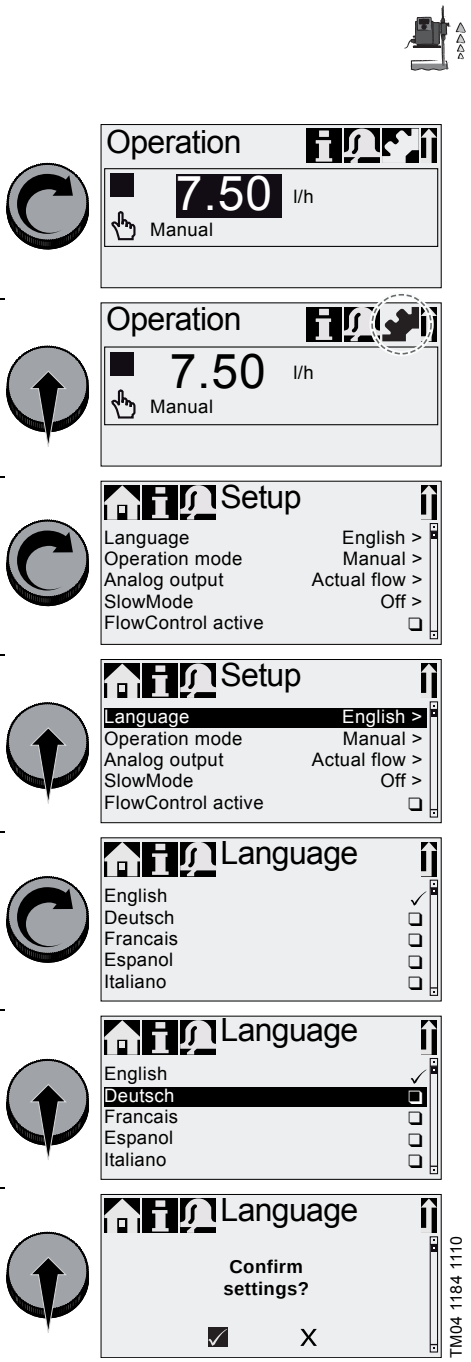


Fig. 12 Set menu language

5.2 Deaerating the pump



Warning
The deaeration hose must be connected correctly and inserted into a suitable tank!

1. Open deaeration valve by approximately half a turn.
2. Press and hold down the [100%] key (deaeration key) until liquid flows continuously without any bubbles from the deaeration hose.
3. Close deaeration valve.

Note

Press the [100%] key and simultaneously turn the click wheel clockwise to increase the duration of the process to up to 300 seconds. After setting the seconds, do not press the key any longer.

5.3 Calibrating the pump

The pump is calibrated in the factory for media with a viscosity similar to water at maximum pump backpressure (see section *3.1 Technical data*).

If the pump is operated with a backpressure that deviates or if dosing a medium whose viscosity deviates, the pump must be calibrated.

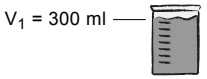
For pumps with FCM control variant, it is not necessary to calibrate the pump if there is deviating or fluctuating backpressure as long as the "AutoFlowAdapt" function has been enabled (see section *6.10 AutoFlowAdapt*).

Requirements

- The hydraulics and electrics of the pump are connected (see section *4. Assembly and installation*).
- The pump is integrated into the dosing process under operating conditions.
- The dosing head and suction hose are filled with dosing medium.
- The pump has been deaerated.

Calibration process - example for DDA 7.5-16

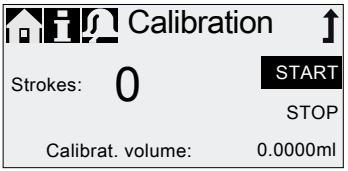
1. Fill a measuring beaker with dosing medium. Recommended filling volumes V_1:
   – DDA 7.5-16: 0.3 l
   – DDA 12-10: 0.5 l
   – DDA 17-7: 1.0 l
   – DDA 30-4: 1.5 l



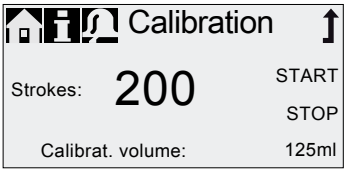
2. Read off and note down the fill volume V_1 (e.g. 300 ml).
3. Place the suction hose in the measuring beaker.



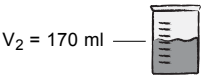
4. Start the calibration process in the "Setup > Calibration" menu.



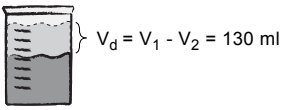
5. The pump executes 200 dosing strokes and displays the factory calibration value (e.g. 125 ml).



6. Remove the suction hose from the measuring beaker and check the remaining volume V_2 (e.g. 170 ml).

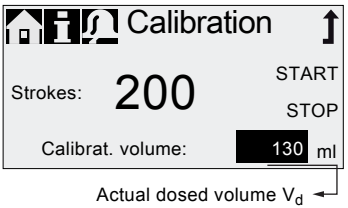


7. From V_1 and V_2, calculate the actual dosed volume $V_d = V_1 - V_2$ (e.g. 300 ml - 170 ml = 130 ml).



8. Set and apply V_d in the calibration menu.

• The pump is calibrated.



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6. Operation

6.1 Control elements

The pump control panel includes a display and the following control elements.

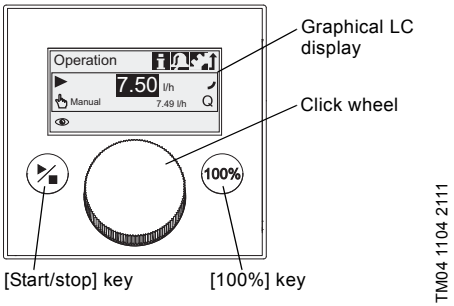


Fig. 13 Control panel

Keys

Key	Function
[Start/stop] key	Starting and stopping the pump.
[100%] key	The pump doses at maximum flow regardless of the operation mode.

Click wheel

The click wheel is used to navigate through the menus, select settings and confirm them.

Turning the click wheel clockwise moves the cursor clockwise in increments in the display. Turning the click wheel counter-clockwise moves the cursor counter-clockwise.

6.2 Display and symbols

6.2.1 Navigation

In the "Info", "Alarm" and "Setup" main menus, the options and submenus are displayed in the rows below. Use the "Back" symbol to return to the higher menu level. The scroll bar at the right edge of the display indicates that there are further menu items which are not shown.

The active symbol (current cursor position) flashes. Press the click wheel to confirm your selection and open the next menu level. The active main menu is displayed as text, the other main menus are displayed as symbols. The position of the cursor is highlighted in black in the sub-menus.

When you position the cursor on a value and press the click wheel, a value is selected. Turning the click wheel clockwise increases the value, turning the click wheel counter-clockwise reduces the value. When you now press the click wheel, the cursor will be released again.

6.2.2 Operating states

The operating state of the pump is indicated by a symbol and display colour.

Display	Fault	Operating state		
White	-	Stop ■	Standby ❚❚	
Green	-			Running ▶
Yellow	Warning	Stop ■	Standby ❚❚	Running ▶
Red	Alarm	Stop ■	Standby ❚❚	

6.2.3 Sleep mode (energy-saving mode)

If in the "Operation" main menu the pump is not operated for 30 seconds, the header disappears. After two minutes, the display brightness is reduced.

If in any other menu the pump is not operated for two minutes, the display switches back to the "Operation" main menu and the display brightness is reduced. This state will be cancelled when the pump is operated or a fault occurs.

6.2.4 Overview of display symbols

The following display symbols may appear in the menus.

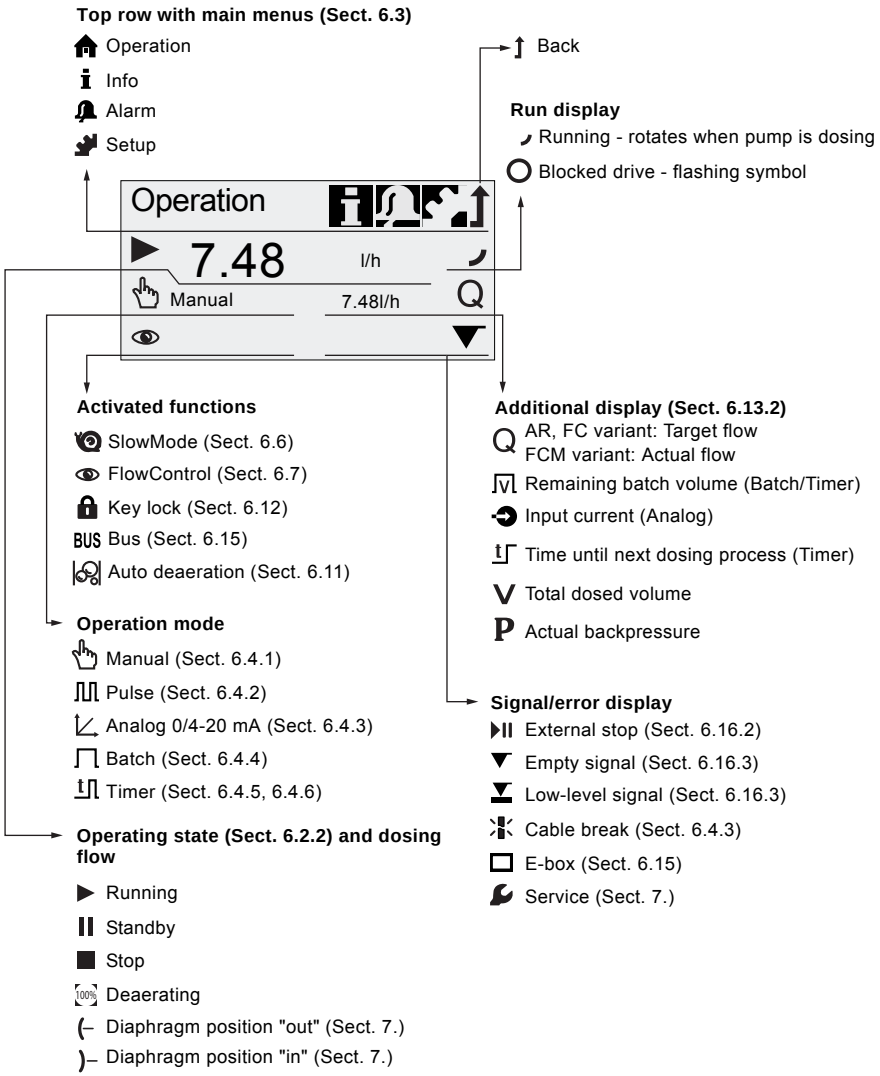


Fig. 14 Overview of display symbols

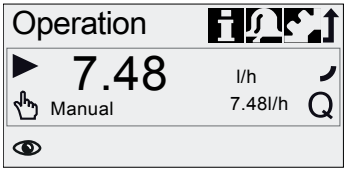
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6.3 Main menus

The main menus are displayed as symbols at the top of the display. The currently active main menu is displayed as text.

6.3.1 Operation

Status information such as the dosing flow, selected operation mode and operating state is displayed in the "Operation" main menu.

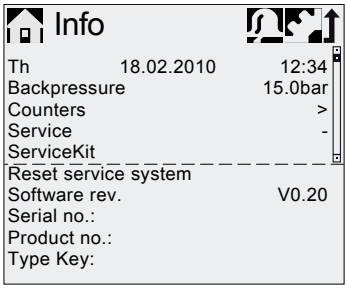


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6.3.2 Info

You can find the date, time and information about the active dosing process, various counters, product data and the service system status in the "Info" main menu. The information can be accessed during operation.

The service system can also be reset from here.



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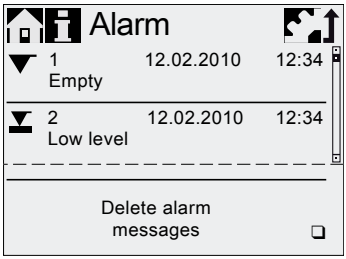
Counters

The "Info > Counters" menu contains the following counters:

Counters	Resettable
Volume Total dosed volume [l] or US gallons	Yes
Operating hours Accumulated operating hours (pump switched on) [h]	No
Motor runtime Accumulated motor runtime [h]	No
Strokes Accumulated number of dosing strokes	No
Power on/off Accumulated frequency of switching mains voltage on	No

6.3.3 Alarm

You can view errors in the "Alarm" main menu.



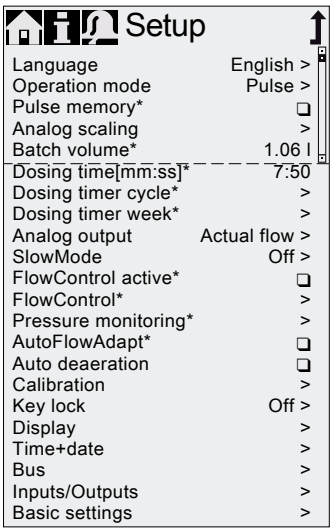
TM04 1109 1010

Up to 10 warnings and alarms, together with their date, time and cause, are listed in chronological order. If the list is full, the oldest entry will be overwritten, see section *8. Faults*.

6.3.4 Setup

The "Setup" main menu contains menus for pump configuration. These menus are described in the following sections.

Note Check all pump settings after any change in the "Setup" menu.



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* These submenus are only displayed for specific default settings and control variants.
The contents of the "Setup" menu also vary depending on the operation mode.

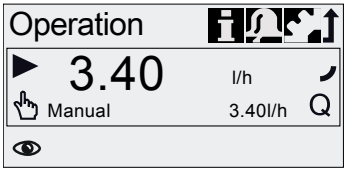
6.4 Operation modes

Six different operation modes can be set in the "Setup > Operation mode" menu.

- Manual, see section 6.4.1
- Pulse, see section 6.4.2
- Analog 0-20 mA, see section 6.4.3
  Analog 4-20 mA, see section 6.4.3
- Batch (pulse-based), see section 6.4.4
- Dosing timer cycle, see section 6.4.5
- Dosing timer week, see section 6.4.6

6.4.1 Manual

In this operation mode, the pump constantly doses the dosing flow set with the click wheel. The dosing flow is set in l/h or ml/h in the "Operation" menu. The pump automatically switches between the units. Alternatively, the display can be reset to US units (gph). See section *6.13 Display Setup*.



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Fig. 15 Manual mode

The setting range depends on the pump type:

Type	Setting range*	
	[l/h]	[gph]
DDA 7.5-16	0.0025 - 7.5	0.0007 - 2.0
DDA 12-10	0.012 - 12	0.0031 - 3.1
DDA 17-7	0.017 - 17	0.0045 - 4.5
DDA 30-4	0.03 - 30	0.0080 - 8.0

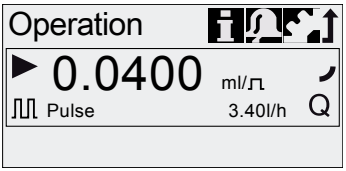
* When the "SlowMode" function is active, the maximum dosing flow is reduced, see section *3.1 Technical data*.

6.4.2 Pulse

In this operation mode, the pump doses the set dosing volume for each incoming (potential-free) pulse, e.g. from a water meter. The pump automatically calculates the optimum stroke frequency for dosing the set volume per pulse.

The calculation is based on:

- the frequency of external pulses
- the set dosing volume/pulse.



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Fig. 16 Pulse mode

The dosing volume per pulse is set in ml/pulse in the "Operation" menu using the click wheel. The setting range for the dosing volume depends on the pump type:

Type	Setting range [ml/pulse]
DDA 7.5-16	0.0015 - 14.9
DDA 12-10	0.0029 - 29.0
DDA 17-7	0.0031 - 31.0
DDA 30-4	0.0062 - 62.0

The frequency of incoming pulses is multiplied by the set dosing volume. If the pump receives more pulses than it can process at the maximum dosing flow, it runs at the maximum stroke frequency in continuous operation. Excess pulses will be ignored if the memory function is not enabled.

Memory function

When the "Setup > Pulse memory" function is enabled, up to 65,000 unprocessed pulses can be saved for subsequent processing.

Warning
Subsequent processing of saved pulses can cause local increase in concentration!

The contents of the memory will be deleted by:

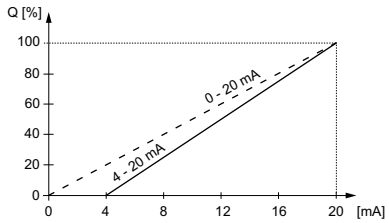
- Switching off the power supply
- Changing the operation mode
- Interruption (e.g. alarm, External stop).

6.4.3 Analog 0/4-20 mA

In this operation mode, the pump doses according to the external analog signal.
The dosing volume is proportional to the signal input value in mA.

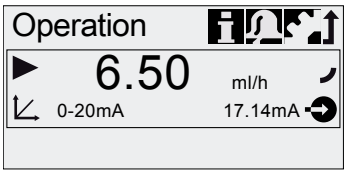
Operation mode	Input value [mA]	Dosing flow [%]
4-20 mA	≤ 4.1	0
	≥ 19.8	100
0-20 mA	≤ 0.1	0
	≥ 19.8	100

If the input value in operation mode 4-20 mA falls below 2 mA, an alarm is displayed and the pump stops. A cable break or signal transmitter error has occurred. The "Cable break" symbol is displayed in the "Signal and error display" area of the display.



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Fig. 17 Analog scaling



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Fig. 18 Analog operation mode

Set analog scaling

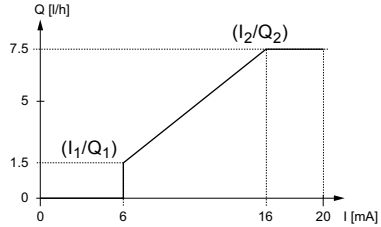
Analog scaling refers to the assignment of the current input value to the dosing flow.

Changes of analog scaling affect also the analog output signal. See section *6.5 Analog output*.

Analog scaling passes through the two reference points (I_1/Q_1) and (I_2/Q_2), which are set in the "Setup > Analog scaling" menu. The dosing flow is controlled according to this setting.

Example 1 (DDA 7.5-16)

Analog scaling with positive gradient:



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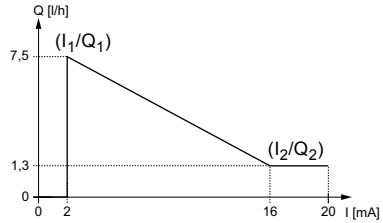
Fig. 19 Analog scaling with pos. gradient

In example 1, the reference points I_1 = 6 mA, Q_1 = 1.5 l/h and I_2 = 16 mA, Q_2 = 7.5 l/h have been set.

From 0 to 6 mA analog scaling is described by a line that passes through Q = 0 l/h, between 6 mA and 16 mA it rises proportionally from 1.5 l/h to 7.5 l/h and from 16 mA onwards it passes through Q = 7.5 l/h.

Example 2 (DDA 7.5-16)

Analog scaling with negative gradient (Operation mode 0-20 mA):



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Fig. 20 Analog scaling with neg. gradient

In example 2, the reference points I_1 = 2 mA, Q_1 = 7.5 l/h and I_2 = 16 mA, Q_2 = 1.3 l/h have been set.

From 0 to 2 mA analog scaling is described by a line that passes through Q = 0 l/h, between 2 mA and 16 mA it drops proportionally from 7.5 l/h to 1.3 l/h and from 16 mA onwards it passes through Q_2 = 1.3 l/h.

Set analog scaling in the "Operation" menu

Analog scaling can also be modified after a security prompt directly in the "Operation" menu. This is how the dosing flow is directly modified for the current flow input value.

Caution Please observe that changes also have a direct effect on point I_2/Q_2 (see fig. 21)!

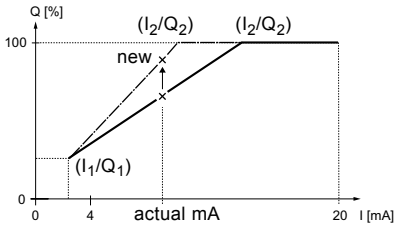


Fig. 21 Set analog scaling ("Operation" menu)

6.4.4 Batch (pulse-based)

In this operation mode, the pump doses the set batch volume in the set dosing time (t_1). A batch is dosed with each incoming pulse.

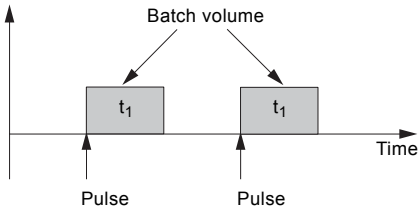


Fig. 22 Batch (pulse-based)

The setting range depends on the pump type:

Type	Setting range per batch		
	from [ml]	to [l]	Resolution* [ml]
DDA 7.5-16	0.74	999	0.0925
DDA 12-10	1.45	999	0.1813
DDA 17-7	1.55	999	0.1938
DDA 30-4	3.10	999	0.3875

* Thanks to the digital motor control, dosing quantities with a resolution of up to 1/8 of the dosing stroke volume can be dosed.

The batch volume (e.g. 75 ml) is set in the "Setup > Batch volume" menu. The minimum dosing time required for this (e.g. 36 seconds) is displayed and can be increased.

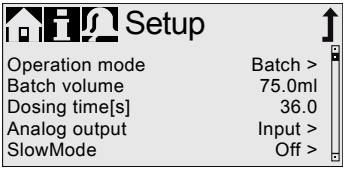


Fig. 23 Batch mode

Signals received during a batch process or an interruption (e.g. alarm, External stop) will be ignored. If the pump is restarted following an interruption, the next batch volume is dosed on the next incoming pulse.

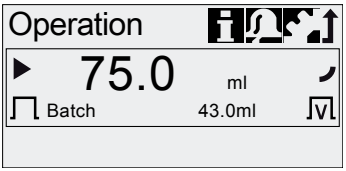


Fig. 24 Batch mode

In the "Operation" menu, the total batch volume (e.g. 75 ml) and the remaining batch volume still to be dosed (e.g. 43 ml) are shown in the display.

6.4.5 Dosing timer cycle

In this operation mode, the pump doses the set batch volume in regular cycles.
Dosing starts when the pump is started after a singular start delay. The setting range for the batch volume corresponds to the values in section *6.4.4 Batch (pulse-based)*.

Warning

When time or date is changed in "Time+date" menu, timer dosing and timer relay output functions (Relay 2) are stopped!

Timer dosing and timer relay output functions must be restarted manually!

Changing time or date can cause increase or decrease in concentration!

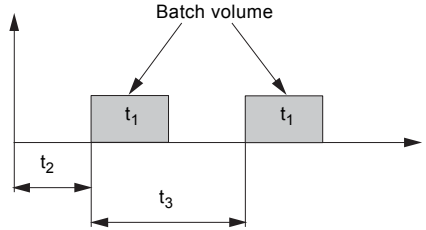


Fig. 25 Dosing timer cycle diagram

t_1	Dosing time
t_2	Start delay
t_3	Cycle time

In the event of an interruption (e.g. interruption of the mains voltage, External stop), the dosing will be stopped while the time continues running.
After suspending the interruption, the pump will continue to dose according to the actual timeline position.

The following settings are required in the "Setup > Dosing timer cycle" menu:

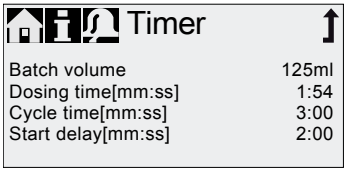


Fig. 26 Dosing timer cycle

The batch volume to be dosed (e.g. 125 ml) is set in the "Setup > Dosing timer cycle" menu. The dosing time required for this (e.g. 1:54) is displayed and can be changed.

The total batch volume (e.g. 125 ml) and the remaining batch volume still to be dosed are displayed in the "Operation" menu. During breaks in dosing, the time until the next dosing process (e.g. 1:21) is displayed.

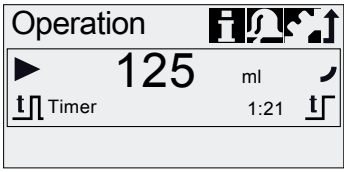


Fig. 27 Dosing timer cycle

6.4.6 Dosing timer week

In this operation mode, up to 16 dosing procedures are defined for a week.
These dosing procedures may take place regularly on one or several week days. The setting range for the batch volume corresponds to the values in section *6.4.4 Batch (pulse-based)*.

Warning

When time or date is changed in "Time+date" menu, timer dosing and timer relay output functions (Relay 2) are stopped!

Timer dosing and timer relay output functions must be restarted manually!

Changing time or date can cause increase or decrease in concentration!

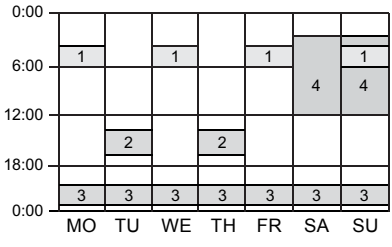


Fig. 28 Example for Dosing timer week function

Note If several procedures overlap, the process with the higher dosing flow has priority!

In the event of an interruption (e.g. disconnection of the mains voltage, External stop), the dosing is stopped while the time continues running.
After suspending the interruption, the pump continues to dose according to the actual timeline position.

The following settings are required in the "Setup > Dosing timer week" menu for each dosing procedure:

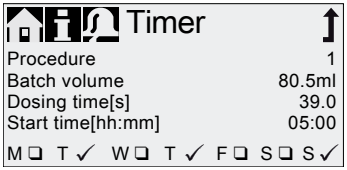


Fig. 29 Setting the timer

The batch volume (e.g. 80.5 ml) is set in the "Setup > Dosing timer week" menu. The dosing time required for this (e.g. 39.0) is displayed and can be changed.

In the "Operation" menu, the total batch volume (e.g. 80.5 ml) and the remaining batch volume to be dosed is displayed. During breaks in dosing, the time (e.g. 43:32) until the next dosing is displayed.

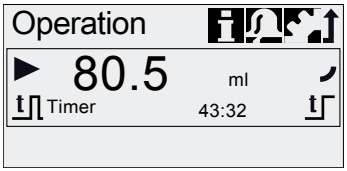


Fig. 30 Weekly timer dosing (break in dosing)

6.5 Analog output

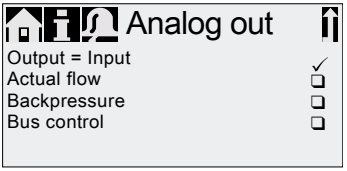


Fig. 31 Configure analog output

The analog output of the pump is parametrised in the "Setup > Analog output" menu. The following settings are possible:

Setting	Description of output signal	Variant FCM	Variant FC	Variant AR
Output = Input	Analog feedback signal (not for master-slave application). The analog input signal is mapped 1:1 to the analog output.	X	X	X
Actual flow**	Current actual flow • 0/4 mA = 0 % • 20 mA = 100 % see section *6.9 Flow measurement*	X	X*	X*
Backpressure	Backpressure, measured in the dosing head • 0/4 mA = 0 bar • 20 mA = Max. operating pressure see section *6.8 Pressure monitoring*	X	X	
Bus control	Enabled by command in Bus control, see section *6.15 Bus communication*	X	X	X

* Output signal is based on motor speed and pump status (target flow).

** Signal has same analog scaling as the current analog input signal. See *6.4.3 Analog 0/4-20 mA*.

Wiring diagram see section *4.3 Electrical connection*.

Note In all operation modes, the analog output has a range of 4-20 mA. Exception: Operation mode 0-20 mA. Here, the analog output range is 0-20 mA.

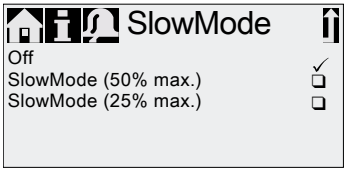
6.6 SlowMode

When the "SlowMode" function is enabled, the pump slows down the suction stroke. The function is enabled in the "Setup > SlowMode" menu and is used to prevent cavitation in the following cases:

- for dosing media with a high viscosity
- for degassing dosing media
- for long suction lines
- for large suction lift.

In the "Setup > SlowMode" menu, the speed of the suction stroke can be reduced to 50 % or 25 %.

Caution Enabling the 'SlowMode' function reduces the maximum dosing flow of the pump to the set percentage value!



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Fig. 32 SlowMode menu

6.7 FlowControl

Applies to DDA-FC/FCM control variant.

This function is used to monitor the dosing process. Although the pump is running, various influences e.g. air bubbles, can cause a reduced flow or even stop the dosing process. In order to guarantee optimum process safety, the enabled "FlowControl" function directly detects and indicates the following errors and deviations:

- Overpressure
- Damaged discharge line
- Air in the dosing chamber
- Cavitation
- Suction valve leakage > 70 %
- Discharge valve leakage > 70 %.

The occurrence of a fault is indicated by the "eye" symbol flashing. The faults are displayed in the "Alarm" menu (see section *8. Faults*).

FlowControl works with a maintenance-free sensor in the dosing head. During the dosing process, the sensor measures the current pressure and continuously sends the measured value to the microprocessor in the pump. An internal indicator diagram is created from the current measured values and the current diaphragm position (stroke length). Causes for deviations can be identified immediately by aligning the current indicator diagram with a calculated optimum indicator diagram. Air bubbles in the dosing head reduce e.g. the discharge phase and consequently the stroke volume (see fig. 33).

Requirements for a correct indicator diagram are:

- FlowControl function is active
- pressure difference between suction and discharge side is > 2 bar
- No interruption/pause in discharge stroke
- Pressure sensor and cable are functioning properly
- No leakage > 50 % in suction or discharge valve

If one of these requirements is not met, the indicator diagram cannot be evaluated.

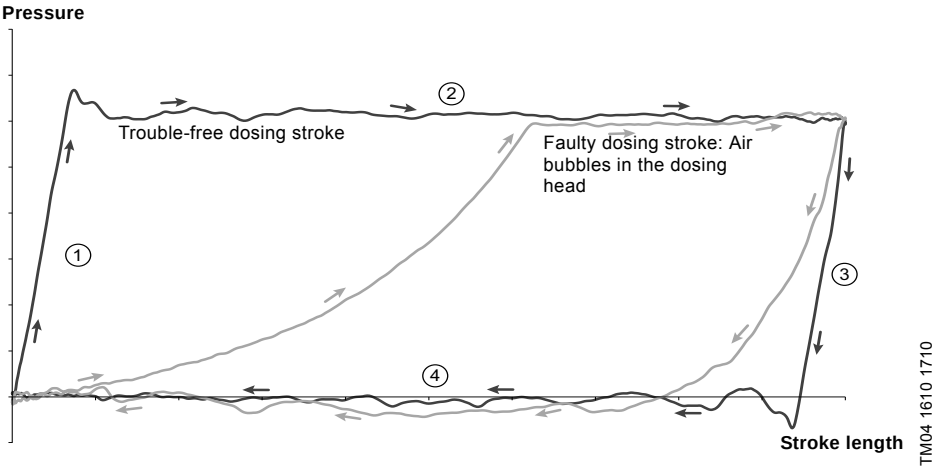


Fig. 33 Indicator diagram

1	Compression phase
2	Discharge phase
3	Expansion phase
4	Suction phase

Setting FlowControl

The "FlowControl" function is set using the two parameters "Sensitivity" and "Delay" in the "Setup > FlowControl" menu.

Sensitivity

In "Sensitivity" the deviation in stroke volume, which will result in an error message, is set in percent.

Sensitivity	Deviation
low	approx. 70 %
medium	approx. 50 %
high	approx. 30 %

Delay

The "Delay" parameter is used to define the time period until an error message is generated: "short", "medium" or "long". The delay depends on the set dosing flow and therefore cannot be measured in strokes or time.

Air bubbles

The "FlowControl" function identifies air bubbles > 60 % of the stroke volume. After switching to "Air bubble" warning status, the pump adapts the stroke frequency to approximately 30-40 % of max. stroke frequency, and starts a special motor drive strategy. The adaptation of the stroke frequency allows the air bubbles to rise from suction to discharge valve. Due to the special motor drive strategy the air bubbles are displaced from the dosing head into the discharge line.

If the air bubbles have not been eliminated after a maximum of 60 strokes, the pump returns to the normal motor drive strategy.

6.8 Pressure monitoring

Applies to DDA-FC/FCM control variant.

A pressure sensor monitors the pressure in the dosing head. If the pressure during the discharge phase falls below 2 bar, a warning is generated (pump continues running). If in the "Setup > Pressure monitoring" menu the function "Min. pressure alarm" is activated, an alarm is generated and the pump is stopped.

If the pressure exceeds the "Max. pressure" set in the "Setup > Pressure monitoring" menu, the pump is shut down, enters the standby state and indicates an alarm.

Caution

The pump restarts automatically once the backpressure falls below the set "Max. pressure"!

6.8.1 Pressure setting ranges

Type	Fixed min. pressure [bar]	Adjustable max. pressure [bar]
DDA 7.5-16	< 2	3-17
DDA 12-10	< 2	3-11
DDA 17-7	< 2	3-8
DDA 30-4	< 2	3-5

Warning

Install a pressure-relief valve in the pressure line to provide protection against impermissibly high pressure!

Caution

The pressure measured in the dosing head is slightly higher than the actual system pressure.

Therefore the "Max. pressure " should be set at least 0.5 bar higher than the system pressure.

6.8.2 Calibration of pressure sensor

The pressure sensor is calibrated in the factory. As a rule, it does not need to be re-calibrated. If specific circumstances (e.g. pressure sensor exchange, extreme air pressure values at the location of the pump) necessitate a calibration, the sensor can be calibrated as follows:

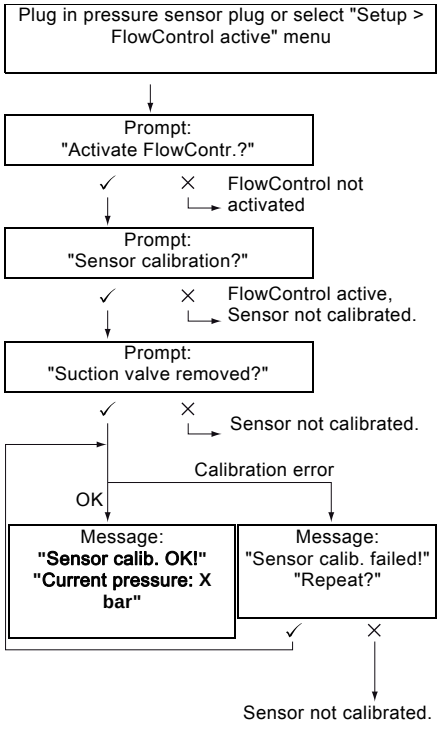
1. Set pump to "Stop" operating state.
2. Make system pressureless and flush.
3. Dismantle suction line and suction valve.

Warning

Calibrating when the suction valve is installed produces incorrect calibration and can cause personal injuries and damage to property!

Only carry out a calibration if this is technically required!

4. Proceed as described below to calibrate:



If a calibration is not successfully possible, check plug connections, cable and sensor and replace defective parts where necessary.

6.9 Flow measurement

Applies to DDA-FCM control variant.

The pump accurately measures the actual flow and displays it. Via the 0/4-20 mA analog output, the actual flow signal can easily be integrated into an external process control without additional measuring equipment (see section *6.5 Analog output*).

The flow measurement is based on the indicator diagram as described in section *6.7 FlowControl*. The accumulated length of the discharge phase multiplied by the stroke frequency produces the displayed actual flow. Faults e.g. air bubbles or backpressure that is too low result in a smaller or larger actual flow. When the "AutoFlowAdapt" function is activated (see section *6.10 AutoFlowAdapt*), the pump compensates for these influences by correction of the stroke frequency.

Note

Strokes which cannot be analysed (partial strokes, pressure differential which is too low) are provisionally calculated based on the setpoint value and displayed.

6.10 AutoFlowAdapt

Applies to DDA-FCM control variant.

The "AutoFlowAdapt" function is activated in the "Setup" menu. It detects changes in various parameters and responds accordingly in order to keep the set target flow constant.

Note

Dosing accuracy is increased when "AutoFlowAdapt" is activated.

This function processes information from the pressure sensor in the dosing head. Errors detected by the sensor are processed by the software. The pump responds immediately regardless of the operation mode by adjusting the stroke frequency or where necessary compensating for the deviations with a corresponding indicator diagram.

If the target flow cannot be achieved by the adjustments, a warning is issued.

"AutoFlowAdapt" operates on the basis of the following functions:

- FlowControl: malfunctions are identified (see section *6.7 FlowControl*).
- Pressure monitoring: pressure fluctuations are identified (see section *6.8 Pressure monitoring*).
- Flow measurement: deviations from the target flow are identified (see section *6.9 Flow measurement*).

Example of "AutoFlowAdapt"

Pressure fluctuations

The dosing volume decreases as backpressure increases and conversely the dosing volume increases as the backpressure decreases.

The "AutoFlowAdapt" function identifies pressure fluctuations and responds by adjusting the stroke frequency. The actual flow is thus maintained at a constant level.

6.11 Auto deaeration

Dosing degassing media can result in air pockets in the dosing head during breaks in dosing. This can result in no medium being dosed when restarting the pump. The "Setup > Auto deaeration" function performs pump deaeration automatically at regular intervals. Software-controlled diaphragm movements encourage any bubbles to rise and gather at the discharge valve so that they can be removed on the next dosing stroke.

The function works:

- when the pump is not in the "Stop" operating state
- during breaks in dosing (e.g. External stop, no incoming pulses, etc.).

Note

The diaphragm movements can displace small volumes into the discharge line. When dosing strongly degassing media, this is however virtually impossible.

6.12 Key lock

The key lock is set in the "Setup > Key lock" menu by entering a four-digit code. It protects the pump by preventing changes to settings. Two levels of key lock can be selected:

Level	Description
Settings	All settings can only be changed by entering the lock code. The [Start/stop] key and the [100%] key are not locked.
Settings + keys	The [Start/stop] key and the [100%] key and all settings are locked.

It is still possible to navigate in the "Alarm" and "Info" main menu and reset alarms.

6.12.1 Temporary deactivation

If the "Key lock" function is activated but settings need to be modified, the keys can be unlocked temporarily by entering the deactivation code. If the code is not entered within 10 seconds, the display automatically switches to the "Operation" main menu. The key lock remains active.

6.12.2 Deactivation

The key lock can be deactivated in the "Setup > Key lock" menu via the "Off" menu point. The key lock is deactivated after the general code "2583" or a pre-defined custom code has been entered.

6.13 Display Setup

Use the following settings in the "Setup > Display" menu to adjust the display properties:

- Units (metric/US)
- Display contrast
- Additional display.

6.13.1 Units

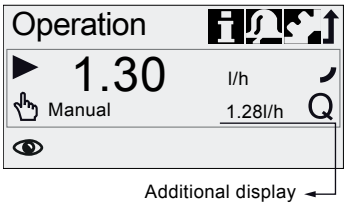
Metric units (litres/millilitres/bar) or US units (US gallons/PSI) can be selected. According to the operation mode and menu, the following units of measurement are displayed:

Operation mode / function	Metric units	US units
Manual control	ml/h or l/h	gph
Pulse control	ml/⊓	ml/⊓
0/4-20 mA Analog control	ml/h or l/h	gph
Batch (pulse- or timer-controlled)	ml or l	gal
Calibration	ml	ml
Volume counter	l	gal
Pressure monitoring	bar	psi

6.13.2 Additional display

The additional display provides additional information about the current pump status. The value is shown in the display with the corresponding symbol.

In "Manual" mode the "Actual flow" information can be displayed with Q = 1.28 l/h (see fig. 34).



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Fig. 34 Display with additional display

The additional display can be set as follows:

Setting	Description
Default display	Depending on the operation mode:
	Q Actual flow (Manual/Pulse)[1), 2)]
	Q Target flow (Pulse)
	Input current (analog)
	Remaining batch volume (Batch, Timer)
	t⊓ Period until next dosing (Timer)
Dosed volume	V Dosed vol. since last reset (see *Counters* on page 21)
Actual flow	Q Current actual flow[1)]
Backpressure	P Current backpressure in the dosing head[3)]

1) only DDA-FCM control variant

2) only if indicator diagram can be evaluated (see *6.7 FlowControl*)

3) only DDA-FCM/FC control variant

6.14 Time+date

The time and date can be set in the "Setup > Time+date" menu.

Warning

When time or date is changed in "Time+date" menu, timer dosing and timer relay output functions (Relay 2) are stopped!

Timer dosing and timer relay output functions must be restarted manually!

Changing time or date can cause increase or decrease in concentration!

Caution

The conversion between summer and winter time does not take place automatically!

6.15 Bus communication

BUS

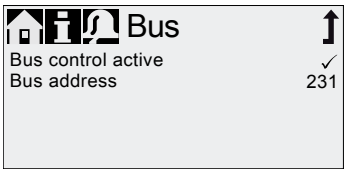
The bus communication enables remote monitoring and setting of the pump via a fieldbus system.

Further manuals, functional profiles and support files (e.g. GSD-files) are available on the CD delivered with the interface hardware and on www.grundfos.com.

6.15.1 GENIbus communication

The pump is supplied with an integrated module for GENIbus communication. The pump identifies the bus control after connecting to the corresponding signal input. The "Activate communication?" prompt is displayed. After confirmation, the corresponding symbol appears in the "Activated functions" area in the "Operation" menu.

In the "Setup > Bus" menu the GENIbus address can be set from 32 to 231 and bus control can be deactivated.



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Fig. 35 Bus menu

Caution The maximum cable length for GENIbus connection is 3 m and must not be exceeded!

6.15.2 Possible industrial bus types

The pump can be integrated into several networks using the additional E-box (Extension-Box).

Bus type	Interface hardware	Retrofitting possible for pump software
Profibus® DP	E-Box 150	V2.0 and higher
Modbus RTU	E-Box 200	V2.5 and higher

The pump can also be connected to a Grundfos CIU unit (CIU = Communication Interface Unit) equipped with one of the following CIM modules (CIM = Communication Interface Module):

- CIM150 Profibus
- CIM200 Modbus
- CIM270 GRM
- CIM500 Ethernet

For internal communication between the E-Box/CIU and the dosing pump, GENIbus is used.

Caution The maximum cable length for GENIbus connection is 3 m and must not be exceeded!

Caution Prior to installation and start-up, read the documentation delivered with the E-Box or CIU unit!

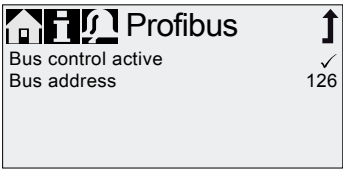
6.15.3 Activate communication

1. Set the pump to operating state "Stop" with the [Start/stop] key.
2. Switch off the power supply of the pump.
3. Install and connect the E-Box/CIU as described in the respective separate installation and operating instructions.
4. Switch on the power supply of the pump.

The "Activate communication?" prompt is displayed.

After confirmation, the "Bus" symbol appears in the "Activated functions" area of the "Operation" menu, no matter if the prompt was accepted or refused.

If the prompt has been accepted, the bus control function is activated. If the prompt has been refused, bus control function can be activated in "Setup > Bus" menu.



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Fig. 36 Example of submenu for Profibus®

6.15.4 Setting the bus address

1. Enter "Setup > Bus" menu and set desired bus address:

Bus type	Address range
Profibus® DP	~~0 - 126~~0-126
Modbus RTU	~~1 - 247~~1-247

2. The pump needs to be restarted to initialise the new bus address. Switch off the power supply of the pump and wait for approximately 20 seconds.
3. Switch on the power supply of the pump.

The pump is initialised with the new bus address.

6.15.5 Characteristics of bus communication

To start and stop the pump via bus, it needs to be in operating state "Running". When the pump is remotely stopped from bus, the "External stop" symbol is displayed and the pump switches to operating state "Standby".

While bus control function is activated, the "Setup" menu only shows the "Bus" and "Key lock" submenus. The other main menus, the "External stop" function and the keys are still available.

All operation modes (see section *6.4 Operation modes*) can still be used when bus control is activated. This allows to use the bus control only for monitoring and setting the pump. In this case the respective "BusWatchDog" (see funtional profile on E-Box/CIU product CD) should be deactivated in bus control, because otherwise faults in communication can stop the pump.

Note

To change any settings manually, the bus control function must be deactivated temporarily.

The analog output can not be used while the pump is bus-controlled as both functions use the same electrical connection. See section *4.3 Electrical connection*.

6.15.6 Deactivate communication



Warning

After deactivating the bus control function, the pump can start automatically!

Before deactivating the bus control function, set the pump to operating state "Stop"!

Bus control function can be deactivated in the "Setup > Bus" menu. After deactivation all submenus in "Setup" menu are available.

The "Bus" symbol in the display disappears at next restart of the pump, after the E-Box/CIU plug was disconnected.

Caution

After disconnecting any plug, always refit protective cap!

6.15.7 Communication faults

Faults are only detected, if the respective "BusWatchDog" (see functional profile on E-Box/CIU product CD) is activated.



Warning

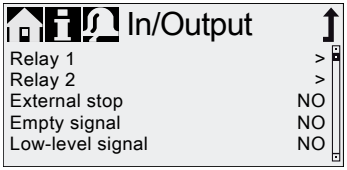
After a communication fault is repaired, the pump can start automatically, depending on current bus control and pump settings!

Before repairing any fault, set the pump to operating state "Stop"!

In case of bus communication faults (e.g. communication cable break), the pump stops dosing and switches to operating state "Standby" approximately 10 seconds after the fault was detected. An alarm is triggered, detailing the cause of the fault. See section *8. Faults*.

6.16 Inputs/Outputs

In the "Setup > Inputs/Outputs" menu, you can configure the two outputs "Relay 1+Relay 2" and the signal inputs "External stop", "Empty signal" and "Low-level signal".



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Fig. 37 Inputs/Outputs menu

Warning

When time or date is changed in "Time+date" menu, timer dosing and timer relay output functions (Relay 2) are stopped!

Timer dosing and timer relay output functions must be restarted manually!

Changing time or date can cause increase or decrease in concentration!

6.16.1 Relay outputs

The pump can switch two external signals using installed relays. The relays are switched by potential-free pulses. The connection diagram of the relays is shown in section *4.3 Electrical connection*. Both relays can be allocated with the following signals:

Relay 1 signal	**Relay 2 signal**	**Description**
Alarm*	Alarm	Display red, pump stopped (e.g. empty signal, etc.)
Warning*	Warning	Display yellow, pump is running (e.g. low-level signal, etc.)
Stroke signal	Stroke signal	Each full stroke
Pump dosing	Pump dosing*	Pump running and dosing
Pulse input**	Pulse input**	Each incoming pulse from pulse input
Bus control	Bus control	Activated by a command in the bus communication
	Timer Cycle	See following sections
	Timer Week	See following sections
Contact type		
NO*	NO*	Normally open contact
NC	NC	Normally closed contact

* Factory setting

** The correct transmission of incoming pulses can only be guaranteed up to a pulse frequency of 5 Hz.

Timer Cycle (Relay 2)

For the "Relay 2 > Timer Cycle" function, set the following parameters:

- On (t_1)
- Start delay (t_2)
- Cycle time (t_3)

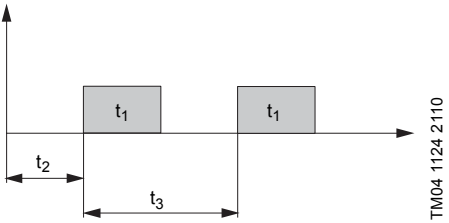


Fig. 38 Diagram

Timer Week (Relay 2)

This function saves up to 16 relay on-times for a week. The following settings can be made for each relay switching operation in the "Relay 2 > Timer Week" menu:

- Procedure (No.)
- On time (duration)
- Start time
- Weekdays.

6.16.2 External stop

The pump can be stopped via an external pulse, e.g. from a control room. When activating the external stop pulse, the pump switches from the operating state "Running" into the operating state "Standby". The corresponding symbol appears in the "Signal/error display" area of the display.

Caution Frequent disengagement from the mains voltage, e.g. via a relay, can result in damage to the pump electronics and in the breakdown of the pump. The dosing accuracy is also reduced as a result of internal start procedures.

Do not control the pump via the mains voltage for dosing purposes!

Only use the "External stop" function to start and stop the pump!

The contact type is factory-set to normally open contact (NO). In the "Setup > Inputs/Outputs > External stop" menu, the setting can be changed to normally closed contact (NC).

6.16.3 Empty and Low level signals

In order to monitor the filling level in the tank, a dual-level sensor can be connected to the pump. The pump responds to the signals as follows:

Sensor signal	Pump status
Low level	• Display is yellow • ▼ Flashes • Pump continues running
Empty	• Display is red • ▼ Flashes • Pump stops

Caution When the tank is filled up again, the pump restarts automatically!

Both signal inputs are allocated to the normally open contact (NO) in the factory. They can be re-allocated in the "Setup > Inputs/Outputs" menu to normally closed contact (NC).

6.17 Basic settings

All settings can be reset to the settings default upon delivery in the "Setup > Basic settings" menu.

Selecting "Save customer settings" saves the current configuration to the memory. This can then be activated using "Load customer settings".

The memory always contains the previously saved configuration. Older memory data is overwritten.

7. Service

In order to ensure a long service life and dosing accuracy, wearing parts such as diaphragms and valves must be regularly checked for signs of wear. Where necessary, replace worn parts with original spare parts made from suitable materials.

Should you have any questions, please contact your service partner.

Warning
Maintenance work must only be carried out by qualified staff.

7.1 Regular maintenance

Interval	Task
Daily	Check, if liquid leaks from the drain opening (fig. 41, pos. 11) and if the drain opening is blocked or soiled. If so, follow the instructions given in section *7.6 Diaphragm breakage*.
	Check, if liquid leaks from the dosing head or valves. If necessary, tighten dosing head screws with a torque wrench at 4 Nm. If necessary, tighten valves and cap nuts, or perform service (see *7.4 Perform service*).
	Check, if a service requirement is present at the pump display. If so, follow the instructions given in section *7.3 Service system*.
Weekly	Clean all pump surfaces with a dry and clean cloth.
Every 3 months	Check dosing head screws. If necessary, tighten dosing head screws with a torque wrench at 4 Nm. Replace damaged screws immediately.

7.2 Cleaning

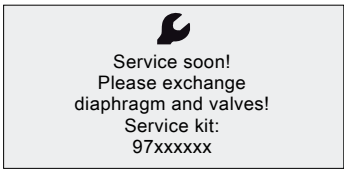
If necessary, clean all pump surfaces with a dry and clean cloth.

7.3 Service system

According to the motor runtime or after a defined period of operation, service requirements will appear. Service requirements appear regardless of the current operating state of the pump and do not affect the dosing process.

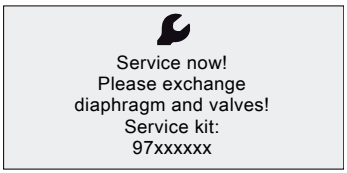
Service requirement	Motor runtime [h]*	Time interval [months]*
Service soon!	7500	23
Service now!	8000	24

* Since the last service system reset



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Fig. 39 Service soon!



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Fig. 40 Service now!

Caution For media which result in increased wear, the service interval must be shortened.

The service requirement signals when the replacement of wearing parts is due and displays the number of the service kit. Press the click wheel to temporarily hide the service prompt.

When the "Service now!" message appears (displayed daily), the pump must be serviced immediately. The symbol appears in the "Operation" menu.

The number of the service kit required is also displayed in the "Info" menu.

7.4 Perform service

Only spare parts and accessories from Grundfos should be used for maintenance. The usage of non-original spare parts and accessories renders any liability for resulting damages null and void.

Further information about carrying out maintenance can be found in the service kit catalogue on our homepage. See www.grundfos.com.

Warning

Risk of chemical burns!

When dosing dangerous media, observe the corresponding precautions in the safety data sheets!

Wear protective clothing (gloves and goggles) when working on the dosing head, connections or lines!

Do not allow any chemicals to leak from the pump. Collect and dispose of all chemicals correctly!

Caution

Before any work to the pump, the pump must be in the "Stop" operating state or be disconnected from the power supply. The system must be pressureless!

7.4.1 Dosing head overview

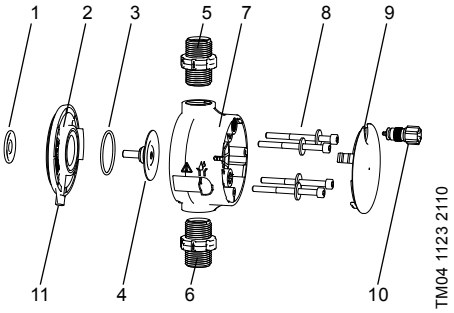


Fig. 41 Changing the diaphragm and valves

1	Safety diaphragm
2	Flange
3	O-ring
4	Diaphragm
5	Valve on discharge side
6	Valve on suction side
7	Dosing head
8	Screws with discs
9	Cover
10	Deaeration valve
11	Drain opening

7.4.2 Dismantling the diaphragm and valves

Warning

Danger of explosion, if dosing liquid has entered the pump housing!

If the diaphragm is possibly damaged, don't connect the pump to the power supply! Proceed as described in section *7.6 Diaphragm breakage*!

This section refers to fig. 41.

1. Make system pressureless.
2. Empty dosing head before maintenance and flush it if necessary.
3. Set pump to "Stop" ■ operating state using the [Start/stop] key.
4. Press the [Start/stop] and [100%] keys at the same time to put the diaphragm into "out" position.
   – Symbol (– must be displayed (see fig. 14).
5. Take suitable steps to ensure that the returning liquid is safely collected.
6. Dismantle suction, pressure and deaeration hose.
7. Dismantle valves on suction and discharge side (5, 6).
8. Remove the cover (9).
9. Loosen screws (8) on the dosing head (7) and remove with discs.
10. Remove the dosing head (7).
11. Unscrew diaphragm (4) counter-clockwise and remove with flange (2).
12. Make sure the drain opening (11) is not blocked or soiled. Clean if necessary.
13. Check the safety diaphragm (1) for wear and damage. Replace if necessary.

If nothing indicates that dosing liquid has entered the pump housing, go on as described in section *7.4.3 Reassembling the diaphragm and valves*. Otherwise proceed as described in section *7.6.2 Dosing liquid in the pump housing*.

7.4.3 Reassembling the diaphragm and valves

The pump must only be reassembled, if nothing indicates that dosing liquid has entered the pump housing. Otherwise proceed as described in section *7.6.2 Dosing liquid in the pump housing*.

This section refers to fig. 41.

1. Attach flange (2) correctly and screw on new diaphragm (4) clockwise.
   – Make sure that the O-ring (3) is seated correctly!
2. Press the [Start/stop] and [100%] keys at the same time to put the diaphragm into "in" position.
   – Symbol ⟩– must be displayed (see fig. 14).
3. Attach the dosing head (7).
4. Install screws with discs (8) and cross-tighten with a torque wrench.
   – Torque: 4 Nm.
5. Attach the cover (9).
6. Install new valves (5, 6).
   – Do not interchange valves and pay attention to direction of arrow.
7. Connect suction, pressure and deaeration hose (see section *4.2 Hydraulic connection*)
8. Press the [Start/stop] key to leave the service mode.

Caution

Tighten the dosing head screws with a torque wrench once before commissioning and again after 2-5 operating hours at 4 Nm.

9. Deaerate dosing pump (see section *5.2 Deaerating the pump*).
10. Please observe the notes on commissioning in section *5. Startup*!

7.5 Resetting the service system

After performing the service, the service system must be reset using the "Info > Reset service system" function.

7.6 Diaphragm breakage

If the diaphragm leaks or is broken, dosing liquid escapes from the drain opening (fig. 41, pos. 11) on the dosing head.

In case of diaphragm breakage, the safety diaphragm (fig. 41, pos. 1) protects the pump housing against ingress of dosing liquid.

When dosing crystallising liquids the drain opening can be blocked by crystallisation. If the pump is not taken out of operation immediately, a pressure can build up between the diaphragm (fig. 41, pos. 4) and the safety diaphragm in the flange (fig. 41, pos. 2). The pressure can press dosing liquid through the safety diaphragm into the pump housing.

Most dosing liquids don't cause any danger when entering the pump housing. However a view liquids can cause a chemical reaction with inner parts of the pump. In the worst case, this reaction can produce explosive gases in the pump housing.



Warning

Danger of explosion, if dosing liquid has entered the pump housing!

Operation with damaged diaphragm can lead to dosing liquid entering the pump housing.

In case of diaphragm breakage, immediately separate the pump from the power supply!

Make sure the pump cannot be put back into operation by accident!

Dismantle the dosing head without connecting the pump to the power supply and make sure no dosing liquid has entered the pump housing. Proceed as described in section *7.6.1 Dismantling in case of diaphragm breakage*.

To avoid any danger resulting from diaphragm breakage, observe the following:

- Perform regular maintenance. See section *7.1 Regular maintenance*.
- Never operate the pump with blocked or soiled drain opening.
  – If the drain opening is blocked or soiled, proceed as described in section *7.6.1 Dismantling in case of diaphragm breakage*.
- Never attach a hose to the drain opening. If a hose is attached to the drain opening, it is impossible to recognise escaping dosing liquid.
- Take suitable precautions to prevent harm to health and damage to property from escaping dosing liquid.
- Never operate the pump with damaged or loose dosing head screws.

7.6.1 Dismantling in case of diaphragm breakage

Warning

Danger of explosion, if dosing liquid has entered the pump housing!

Do not connect the pump to the power supply!

This section refers to fig. 41.

1. Make system pressureless.
2. Empty dosing head before maintenance and flush it if necessary.
3. Take suitable steps to ensure that the returning liquid is safely collected.
4. Dismantle suction, pressure and deaeration hose.
5. Remove the cover (9).
6. Loosen screws (8) on the dosing head (7) and remove with discs.
7. Remove the dosing head (7).
8. Unscrew diaphragm (4) counter-clockwise and remove with flange (2).
9. Make sure the drain opening (11) is not blocked or soiled. Clean if necessary.
10. Check the safety diaphragm (1) for wear and damage. Replace if necessary.

If nothing indicates that dosing liquid has entered the pump housing, go on as described in section *7.4.3 Reassembling the diaphragm and valves*. Otherwise proceed as described in section *7.6.2 Dosing liquid in the pump housing*.

7.6.2 Dosing liquid in the pump housing

Warning

Danger of explosion!

Immediately separate the pump from the power supply!

Make sure the pump cannot be put back into operation by accident!

If dosing liquid has entered the pump housing:

- Send the pump to Grundfos for repair, following the instructions given in section *7.7 Repairs*.
- If a repair isn't economically reasonable, dispose of the pump observing the information in section *9. Disposal*.

7.7 Repairs

Warning

The pump housing must only be opened by personnel authorised by Grundfos!

Repairs must only be carried out by authorised and qualified personnel!

Switch off the pump and disconnect it from the voltage supply before carrying out maintenance work and repairs!

After consulting Grundfos, please send the pump, together with the safety declaration completed by a specialist, to Grundfos. The safety declaration can be found at the end of these instructions. It must be copied, completed and attached to the pump.

The pump must be cleaned prior to dispatch!

Caution If dosing liquid has possibly entered the pump housing, state that explicitly in the safety declaration! Observe section *7.6 Diaphragm breakage*.

If the above requirements are not met, Grundfos may refuse to accept delivery of the pump. The shipping costs will be charged to the sender.

8. Faults



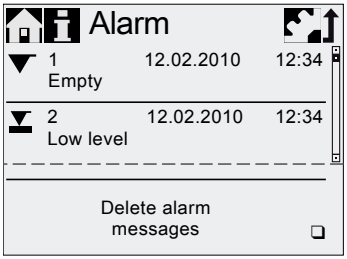
In the event of faults in the dosing pump, a warning or an alarm is triggered.
The corresponding fault symbol flashes in the "Operation" menu, see section *8.1 List of faults*.
The cursor jumps to the "Alarm" main menu symbol.
Press the click wheel to open the "Alarm" menu and, where necessary, faults to be acknowledged will be acknowledged.

A yellow display indicates a warning and the pump continues running.

A red display indicates an alarm and the pump is stopped.

The last 10 faults are stored in the "Alarm" main menu. When a new fault occurs, the oldest fault is deleted.

The two most recent faults are shown in the display, you can scroll through all the other faults. The time and cause of the fault are displayed.



TM04 1109 1010

The list of faults can be deleted at the end of the list.

If there is a service requirement, this appears when the "Alarm" menu is opened. Press the click wheel to temporarily close the service prompt (see section *7.3 Service system*).

8.1 List of faults

8.1.1 Faults with error message

Display in the "Alarm" menu	Possible cause	Possible remedy
▼ Empty (Alarm)	• Dosing medium tank empty	• Fill tank. • Check contact setting (NO/NC).
▼ Low level (Warning)	• Dosing medium tank almost empty	
Overpressure (Alarm)	• Discharge valve blocked • Isolating valve in discharge line closed • Pressure peaks due to high viscosity • Max. pressure set too low (see section *6.8 Pressure monitoring*)	• Replace valve if necessary (see section *7.4 Perform service*). • Check flow direction of valves (arrow) and correct if necessary. • Open the isolating valve (on the discharge side). • Enlarge diameter of discharge line. • Change pressure setting (see section *6.8 Pressure monitoring*).
Low backpressure (Warning/alarm*)	• Faulty diaphragm • Broken discharge line • Pressure differential between suction and discharge side too low • Leakage in the pressure loading valve at Q < 1 l/h • Deaeration valve open	• Change the diaphragm (see section *7.4 Perform service*). • Check discharge line and repair if necessary. • Install additional spring-loaded valve (approx. 3 bar) on the discharge side. • Close the deaeration valve.
Air bubble (Warning)	• Broken/leaky suction line • Strongly degassing medium • Tank dosing medium empty	• Check suction line and repair if necessary. • Provide positive inlet pressure (place dosing medium tank above the pump). • Enable "SlowMode" (see section *6.6 SlowMode*). • Fill tank.
Cavitation (Warning)	• Blocked/constricted/squeezed suction line • Blocked/constricted suction valve • Suction lift too high • Viscosity too high	• Enable "SlowMode" (see section *6.6 SlowMode*). • Reduce suction lift. • Increase suction hose diameter. • Check suction line and open isolating valve if necessary.
Suct. valve leak (Warning)	• Leaky/dirty suction valve • Deaeration valve open	• Check valve and tighten it up. • Flush system. • Replace valve if necessary (see section *7.4 Perform service*). • Check O-ring position. • Install filter in suction line. • Close the deaeration valve.
Disch. valve leak (Warning)	• Leaky/dirty discharge valve • Leakage in the pressure loading valve • Deaeration valve open	• Check valve and tighten it up. • Flush system. • Replace valve if necessary (see section *7.4 Perform service*). • Check O-ring position. • Install screen in suction line. • Close the deaeration valve. • Install spring-loaded valve on the discharge side.
Flow deviation (Warning)	• Considerable deviation between target and actual flow • Pump not or incorrectly calibrated	• Check installation. • Calibrate the pump (see section *5.3 Calibrating the pump*).

Display in the "Alarm" menu	Possible cause	Possible remedy
Pressure sensor (Warning)	• Broken "FlowControl" cable (see fig. 11) • Sensor defect • Pressure sensor not correctly calibrated.	• Check plug connection. • Change sensor if necessary. • Calibrate pressure sensor correctly (see section *6.8.2 Calibration of pressure sensor*).
Motor blocked (Alarm)	• Backpressure greater than nominal pressure • Damage to gears	• Reduce backpressure. • Arrange for repair of gears, if necessary.
BUS Bus error (Alarm)	• Fieldbus communication error	• Check cables for correct specification and damage; replace if necessary. • Check cable routing and shielding; correct if necessary.
E-Box (Alarm)	• E-Box connection error • Faulty E-Box	• Check plug connection. • Replace E-Box if necessary.
Cable break (Alarm)	• Defect in analog cable 4-20 mA (input current < 2 mA)	• Check cable/plug connections and replace, if necessary. • Check signal transmitter.
Service now (Warning)	• Time interval for service expired	• Perform service (see section *7.4 Perform service*).

* Depending on setting

8.1.2 General faults

Fault	Possible cause	Possible remedy
Dosing flow too high	Inlet pressure greater than backpressure	Install additional spring-loaded valve (approx. 3 bar) on the discharge side.
		Increase pressure differential.
	Incorrect calibration	Calibrate the pump (see section *5.3 Calibrating the pump*).
No dosing flow or dosing flow too low	Air in dosing head	Deaerate the pump.
	Faulty diaphragm	Change the diaphragm (see section *7.4 Perform service*).
	Leakage/fracture in lines	Check and repair lines.
	Valves leaking or blocked	Check and clean valves.
	Valves installed incorrectly	Check that the arrow on the valve housing is pointing in the direction of flow. Check whether all O-rings are installed correctly.
	Blocked suction line	Clean suction line/install filter.
	Suction lift too high	Reduce suction lift.
		Install priming aid.
		Enable "SlowMode" (see section *6.6 SlowMode*).
	Viscosity too high	Enable "SlowMode" (see section *6.6 SlowMode*).
		Use hose with larger diameter.
		Install spring-loaded valve on the discharge side.
	Faulty calibration	Calibrate the pump (see section *5.3 Calibrating the pump*).
	Deaeration valve open	Close the deaeration valve.
Irregular dosing	Valves leaking or blocked	Tighten up valves, replace valves if necessary (see section *7.4 Perform service*).
	Backpressure fluctuations	Keep backpressure constant.
		Activate "AutoFlowAdapt" (only DDA-FCM).
Liquid escaping from the drain opening on the flange	Faulty diaphragm	Immediately separate the pump from the power supply! Observe section *7. Service* and especially section *7.6 Diaphragm breakage*.
Liquid escaping	Dosing head screws not tightened	Tighten up screws (see section *4.2 Hydraulic connection*).
	Valves not tightened	Tighten up valves/union nuts (see section *4.2 Hydraulic connection*).
Pump not sucking in	Suction lift too high	Reduce suction lift; if necessary, provide positive inlet pressure.
	Backpressure too high	Open the deaeration valve.
	Soiled valves	Flush system, replace valves if necessary (see section *7.4 Perform service*).

9. Disposal



This product or parts of it must be disposed of in an environmentally sound way.
Use appropriate waste collection services.
If this is not possible, contact the nearest Grundfos company or service workshop.

Subject to alterations.

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Section 3.3.7

MBBR Blowers

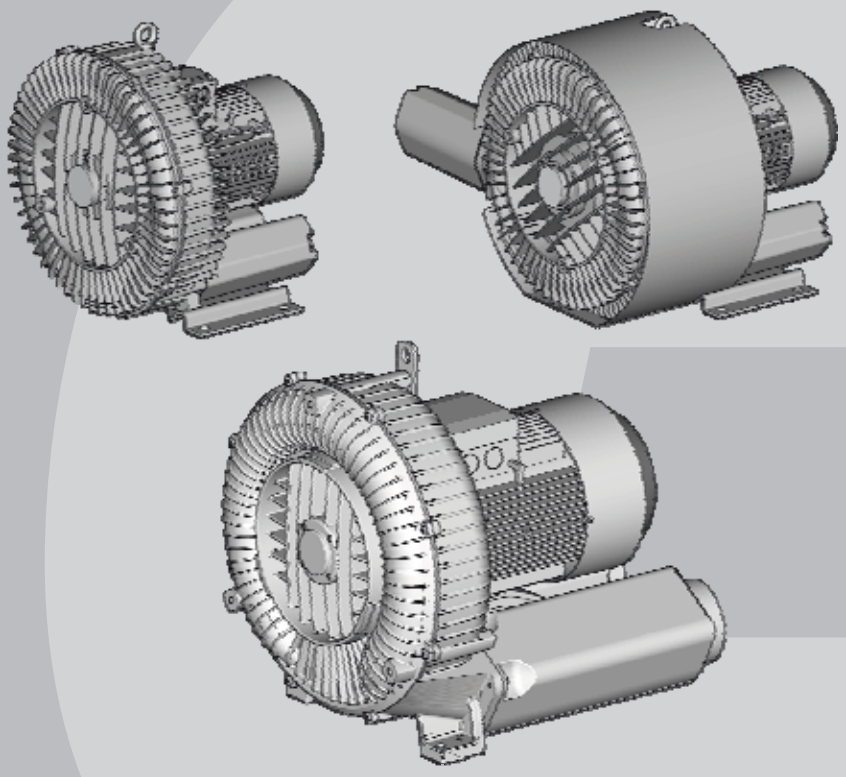
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Original operating instructions · English

Operating instructions G-BH1, G-BH9

Elmo Rietschle
A Gardner Denver Product

CE



2BH1 1
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2BH1 8
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G-Serie
G-Series
Seitenkanal
Side Channel

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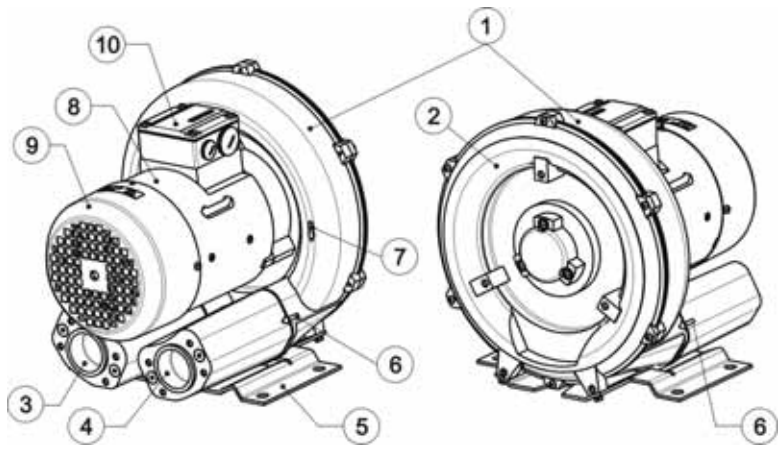


Fig. 1: Design of gas-ring vacuum pump/compressor

1 Vacuum pump/compressor housing
2 Vacuum pump/compressor cover
3 Inlet connection with muffler
4 Discharge connection with muffler
5 Base
6 Arrow indicating delivery direction
7 Arrow indicating direction of rotation
8 Drive motor
9 Fan guard (over external fan)
10 Terminal box

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1 Safety

1.1 Definitions

To point out dangers and important information, the following signal words and symbols are used in these operating instructions:

1.1.1 Safety alert symbol

The **safety alert symbol** ⚠ is located in the safety precautions in the highlighted heading field on the left next to the signal word (DANGER, WARNING, CAUTION).

Safety precautions **with** a safety alert symbol indicate a danger of **injuries**.

Be sure to follow these safety precautions to protect against **injuries or death**!

Safety precautions **without** a safety alert symbol indicate a danger of **damage**.

1.1.2 Signal words

DANGER **WARNING** **CAUTION** **NOTICE** **NOTE**	The **signal words** are located in the safety precautions in the highlighted heading field. They follow a certain hierarchy and indicate (in conjunction with the safety alert symbol, see Chapter 1.1.1) the **seriousness of the danger** and the **type of warning.** See the following explanations:

⚠ DANGER

Danger of injuries.
Indicates an imminently hazardous situation, that **will** result in **death or serious injury** if the corresponding measures are not taken.

⚠ WARNING

Danger of injuries.
Indicates a potentially hazardous situation, that **could** result in **death or serious injury** if the corresponding measures are not taken.

⚠ CAUTION

Danger of injuries.
Indicates a potentially hazardous situation, that may result in **minor or moderate injury** if the corresponding measures are not taken.

CAUTION

Danger of damage.
Indicates a potentially hazardous situation that may result in **property damage** if the corresponding measures are not taken.

NOTICE

Indicates a possible **disadvantage**, i.e. undesirable conditions or consequences can occur if the corresponding measures are not taken.

NOTE

Indicates a possible **advantage** if the corresponding measures are taken; tip.

1.2 General safety precautions

⚠ WARNING

Improper use of the unit can result in serious or even fatal injuries!
These operating instructions

- must have been read completely and understood before beginning any work with or at the pump-motor unit,
- must be strictly observed,
- must be available at the operating location of the pump-motor unit.

⚠ WARNING

Improper use of the unit can result in serious or even fatal injuries!
Only operate the pump-motor unit

- for the purposes indicated under "Intended Use"!
- with the fluids indicated under 'Intended Use'!
- with the values indicated under 'Technical Data'!

⚠ WARNING

Improper use of the unit can result in serious or even fatal injuries!
All work on and with the pump-motor unit (transport, installation, operation, shut-down, maintenance, disposal) may only be carried out by **trained, reliable expert personnel**!

⚠ WARNING

When working on the unit, there is a danger of injury, e.g. in the form of cuts/cutting off, crushing and burns!
During all work on and with the pump-motor unit (transport, installation, operation, shut-down, maintenance, disposal) wear **personal safety equipment (safety helmet, protective gloves, safety shoes)**!

⚠ WARNING

Hair and clothing can be pulled into the unit or caught and wound up moving parts!
Do not wear long, loose hair or wide, loose clothes! Use a hair net!

⚠ DANGER

Electrical danger!
Work on electrical installations may be carried out by trained and authorized electricians only!

⚠ DANGER

Electrical danger!
Before beginning work on the unit or system, the following measures must be carried out:

- Deenergize.
- Secure against being switched on again.
- Determine whether deenergized.
- Ground and short-circuit.
- Cover or block off adjacent energized parts.

⚠ DANGER

Electrical danger!
Do not open the motor terminal box until absence of electricity has been ensured!

⚠ WARNING

Danger due to vacuum and gauge pressure: sudden escape of fluids (skin and eye injuries),
sudden drawing in of hair and clothing!

Danger due to escaping fluid: Burns!
Use mounting elements, connections, lines, fittings and containers with sufficient freedom from leaks and strength for the pressures which occur.

Check the mounting elements, connections, lines, fittings and containers for strength, leaks and firm seating at regular intervals!

⚠ WARNING

Danger from rotating parts (external fan, impeller, shaft):
Cutting/cutting off of extremities, Grasping/winding up of hair and clothing!

Danger due to vacuum and gauge pressure: sudden escape of fluids (skin and eye injuries), sudden drawing in of hair and clothing!

Danger due to escaping fluid: Burns!
Start-up and operation only under the following conditions:

- The pump-motor unit must be completely assembled. When doing so, pay particular attention to the following components:
  - the vacuum pump/compressor cover,
  - the muffler on inlet and discharge connections,
  - the fan guard.
- The pipes/hoses must be connected to inlet and discharge connections.
- Inlet and discharge connections and the connected pipes/hoses may not be closed, clogged or soiled.
- Check the mounting elements, connections of the pipe/hose connections, lines, fittings and containers for strength, leaks and firm seating at regular intervals.

⚠ WARNING

Danger from rotating parts (external fan, impeller, shaft):
Cutting/cutting off of extremities, Grasping/winding up of hair and clothing!

Danger due to vacuum and gauge pressure: sudden escape of fluids (skin and eye injuries), sudden drawing in of hair and clothing!

Danger due to escaping fluid: Burns!
Before beginning work on the pump-motor unit, take the following measures:

- Shut down pump-motor unit and secure against being switched on again.
- Attach a sign on the system controller and on the control elements for the pump-motor unit: "DANGER! Maintenance work on vacuum pump/compressor! Do not switch on!"
- Wait for pump-motor unit to come to a complete stop. Observe run-on time!
- Allow pump-motor unit to cool!
- Shut-off lines. Release pressure.
- Make sure that no vacuum or gauge pressure is present in the lines/tanks to be opened.
- Make sure that no fluids can escape.

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⚠ WARNING

Danger from rotating impeller:
Cutting/cutting of off extremities!
The rotating impeller is accessible with the inlet and discharge connections open!

Do not reach into the unit through open connections!

Do not insert objects into the unit through the openings!

⚠ WARNING

Danger from rotating impeller:
Cutting/cutting of off extremities!
The rotating impeller is accessible with the inlet and discharge connections open!

With free entry and exit of gases, i.e. with direct intake out of or direct feeding into the atmosphere without piping, the following therefore applies:

Provide the inlet and discharge connections of the pump-motor unit either with additional mufflers or with additional piping of a sufficient length to prevent access to the impeller!

⚠ WARNING

Danger of burns from hot surfaces of the pump-motor unit and from hot fluids!
High temperatures of up to approx. 160°C [320°F] can occur on the surface of the pump-motor unit.

Cover the pump-motor unit with a suitable touch protection (e.g. perforated plate cover or wire cover). Do not touch during operation!
Allow to cool after shut-down!

1.3 Residual risks

⚠ WARNING

Danger zone:
Hot surface up to approx. 160°C [320°F].

Hazard:
Possible burns.

Protective measures:
Cover the pump-motor unit with a suitable touch protection (e.g. perforated plate cover or wire cover).

⚠ WARNING

Danger zone:
Fan guard

Hazard:
Long, loose hair can be drawn into external fan through fan guard grate, even with fan guard mounted!

Protective measures:
Wear hair net!

⚠ WARNING

Danger zone:
Missing or defective muffler inlet or discharge connection.

Hazard:
Possible serious hearing damage due to emitted noise.

Protective measures:
Have missing or defective mufflers replaced. Conduct a noise measurement in the system after installing the pump-motor unit. The following measures can be taken from 85 dB(A) and must be taken from 90 dB(A):

- Mark noise area with a warning sign.
- Wear hearing protection.

⚠ WARNING

Danger zone:
Environment of pump-motor unit.

Hazard:
Possible serious hearing damage due to emitted noise.

Protective measures:
Conduct a noise measurement in the system during operation after installing the pump-motor unit.

The following measures can be taken from 85 dB(A) and must be taken from 90 dB(A):

- Mark noise area with a warning sign.
- Wear hearing protection.
- With free entry and exit of gases, i.e. with direct intake out of or direct feeding into the atmosphere without piping, attach an additional muffler.

2 Intended Use

This operating manual

- is intended for side channel compressors of the
  G-BH1 and G-BH9 series, types 2BH1 1 2BH1 2 2BH1 3 2BH1 4 2BH1 5 2BH1 6 2BH1 8 2BH1 9 2BH9 23,
- contains instructions bearing on transport and handling, installation, commissioning, operation, shut-down, storage, servicing and disposal of the G-BH1,G-BH9,
- must be completely read and understood by all operating and servicing personnel before beginning to work with or on the G-BH1, G-BH9,
- must be strictly observed,
- must be available at the site of operation of the G-BH1, G-BH9.

About the operating and servicing personnel of the G-BH1, G-BH9

- These persons must be trained and authorized for the work to be carried out.
- Work on electrical installations may be carried out by trained and authorized electricians only.

The G-BH1,G-BH9

- are pump-motor units for generating vacuum or gauge pressure;
- are used to **extract**, **pump** and **compress the following gases**:
  - Air,
  - Non-flammable, non-aggressive, non-toxic and non-explosive gases or gas-air mixtures.
  - With differing gases/gas-air mixtures, inquire with the Service Department.
- are equipped with one of the following kind of drive motors:
  - 3-phase AC drive motor with a standard or explosion-protected design
  - Single-phase AC drive motor

  These operating instructions apply **only to** pump-motor units with a **standard design**. For an explosion-protected design (EEx e II), see the separate operating instructions.
- are intended for industrial applications,
- are designed for continuous operation. With increased switch-on frequency (6x per hour with equal pauses and operating times) or with increased gas inflow and ambient temperature, the excess temperature limit of the coil and the bearing can be exceeded. Consult the manufacturer when using under such conditions.

When operating the G-BH1, G-BH9 the limits listed in Chapter 3, "Technical Data", Pg. 7 ff. must always be complied with.

Foreseeable Misuse

It is prohibited

- to use the G-BH1, G-BH9 in applications other than industrial applications unless the necessary protection is provided on the system, e.g. guards suitable for children's fingers;
- to use the device in rooms in which explosive gases can occur if the G-BH1, G-BH9 is not expressly intended for this purpose;
- to extract, to deliver and to compress explosive, flammable, corrosive or toxic fluids, unless the G-BH1, G-BH9 is specifically designed for this purpose;
- to operate the G-BH1 with values other than those specified in Chapter 3, "Technical Data", Pg. 7 ff.

Any unauthorized modifications of the G-BH1, G-BH9 are prohibited for safety reasons.

The operator is only permitted to perform the maintenance and service work described in these operating instructions.

Maintenance and servicing work which goes beyond this may only be carried out by companies which have been authorised by the manufacturer (ask the service department for details).

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3 Technical Data

3.1 Mechanical data

Weight

Single-impeller design		
	Weight	
Type	[kg] approx.	[lbs] approx.
2BH1100-7..0.	9	20
2BH1200-7..0.	9	20
2BH1300-7..0.	9	20
2BH1300-7..1.	10	22
2BH1300-7..2.	11	24
2BH1330-7..0.	10	22
2BH1330-7..1.	11	24
2BH1330-7..2.	12	26
2BH1400-7..0.	13	29
2BH1400-7..1.	16	35
2BH1400-7..2.	17	37
2BH1430-7..0.	14	31
2BH1430-7..1.	17	37
2BH1430-7..2.	18	40
2BH1500-7..0.	20	44
2BH1500-7..1.	22	49
2BH1500-7..2.	23	51
2BH1500-7..3.	25	55
2BH1530-7..0.	21	46
2BH1530-7..1.	23	51
2BH1530-7..2.	24	53
2BH1530-7..3.	26	57
2BH1600-7..0.	27	60
2BH1600-7..1.	30	66
2BH1600-7..2.	36	79
2BH1600-7..3.	40	88
2BH1600-7..6.	32	71
2BH1600-7..7.	39	86
2BH1630-7..0.	29	64
2BH1630-7..1.	32	71
2BH1630-7..2.	37	82
2BH1630-7..3.	43	95
2BH1630-7..6.	34	75
2BH1630-7..7.	40	88

Single-impeller design		
	Weight	
Type	[kg] approx.	[lbs] approx.
2BH180.-7..0.	117	258
2BH180.-7..1.	126	278
2BH180.-7..2.	132	291
2BH183.-7..0.	120	265
2BH183.-7..1.	129	284
2BH183.-7..2.	135	298
2BH190.-7..0.	179	395
2BH190.-7..1.	198	437
2BH190.-7..3.	210	463
2BH193.-7..0.	179	395
2BH193.-7..1.	198	437
2BH193.-7..3.	209	463
2BH923..-…P	167	368
2BH923..-…Q	145	320
2BH923..-…H	151	333

Two-impeller design		
	Weight	
Type	[kg] approx.	[lbs] approx.
2BH1310-7..2.	15	33
2BH1410-7..3.	25	55
2BH1410-7..4.	27	60
2BH1510-7..4.	40	88
2BH1510-7..5.	44	97
2BH1610-7..1.	43	95
2BH1610-7..2.	48	106
2BH1610-7..3.	54	119
2BH1610-7..4.	66	146
2BH1610-7..5.	73	161
2BH1610-7..7.	50	110
2BH1610-7..8.	62	137
2BH1640-7..3.	54	119
2BH1640-7..4.	69	152
2BH1640-7..5.	75	165
2BH1640-7..8.	62	137
2BH181.-7..1.	171	377
2BH181.-7..2.	177	390

Two-impeller design		
	Weight	
Type	[kg] approx.	[lbs] approx.
2BH181.-7..3.	203	448
2BH181.-7..4.	215	474
2BH184.-7..2.	177	390
2BH184.-7..3.	203	448
2BH191.-7..1.	274	604
2BH191.-7..2.	288	635
2BH191.-7..3.	299	659
2BH191.-7..4.	309	681
2BH1940-7B.2.	275	606
2BH1940-7B.3.	314	692
2BH1940-7B.4.	324	714
2BH1943-7..2.	330	728
2BH1943-7..3.	339	747
2BH1943-7..4.	349	769

Minimum distances

Minimum distance to fan guard (for sucking in cooling air):

Type	[mm]	[inches]
2BH1 1.. - 2BH1 4	34	1.34
2BH1 5.. - 2BH1 9	53	2.09
2BH923…	52	2.05

Minimum distance to face of vacuum pump/compressor cover:

Type	[mm]	[inches]
2BH1 1.. - 2BH1 5	20	0.79
2BH1 6..	30	1.18
2BH1 8.. - 2BH1 9	40	1.57
2BH923..	52	2.05

Noise level

Measuring-surface sound-pressure level as per EN ISO 3744, measured at a distance of 1 m [3.28 ft] at an operating point of approximately 2/3 of the permissible total pressure difference with the lines connected without a vacuum or pressure relief valve, tolerance ±3 dB (A).

Single-impeller design		
Type	1-m measuring-surface sound pressure level L [dB (A)]	
	50 Hz approx.	60 Hz approx.
2BH1100-7..0.	52	55
2BH1200-7..0.	57	61
2BH1300-7..0.	53	56
2BH1300-7..1.	53	56
2BH1300-7..2.	53	56
2BH1330-7..0.	53	56
2BH1330-7..1.	53	56
2BH1330-7..2.	53	56
2BH1400-7..0.	63	64
2BH1400-7..1.	63	64
2BH1400-7..2.	63	64
2BH1430-7..0.	63	64
2BH1430-7..1.	63	64
2BH1430-7..2.	63	64
2BH1500-7..0.	64	70
2BH1500-7..1.	64	70
2BH1500-7..2.	64	70
2BH1500-7..3.	64	70
2BH1530-7..0.	64	70
2BH1530-7..1.	64	70
2BH1530-7..2.	64	70
2BH1530-7..3.	64	70
2BH1600-7..0.	69	72
2BH1600-7..1.	69	72
2BH1600-7..2.	69	72
2BH1600-7..3.	69	72
2BH1600-7..6.	69	72
2BH1600-7..7.	69	72
2BH1630-7..0.	69	72

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Single-impeller design		
Type	**1-m measuring-surface sound pressure level L [dB (A)]**	
	50 Hz approx.	**60 Hz approx.**
2BH1630-7..1.	69	72
2BH1630-7..2.	69	72
2BH1630-7..3.	69	72
2BH1630-7..6.	69	72
2BH1630-7..7.	69	72
2BH180.-7..0.	70	74
2BH180.-7..1.	70	74
2BH180.-7..2.	70	74
2BH183.-7..0.	70	74
2BH183.-7..1.	70	74
2BH183.-7..2.	70	74
2BH190.-7..0.	74	79
2BH190.-7..1.	74	79
2BH190.-7..3.	74	79
2BH193.-7..0.	75	80
2BH193.-7..1.	75	80
2BH193.-7..3.	75	80
2BH923..	79	81

Two-impeller design		
Type	**1-m measuring-surface sound pressure level L [dB (A)]**	
	50 Hz approx.	**60 Hz approx.**
2BH1310-7..2.	55	61
2BH1410-7..3.	66	69
2BH1410-7..4.	66	69
2BH1510-7..4.	72	74
2BH1510-7..5.	72	74
2BH1610-7..1.	73	76
2BH1610-7..2.	73	76
2BH1610-7..3.	73	76
2BH1610-7..4.	73	76
2BH1610-7..5.	73	76
2BH1610-7..7.	73	76
2BH1610-7..8.	73	76
2BH1640-7..3.	74	78
2BH1640-7..4.	74	78
2BH1640-7..5.	74	78
2BH1640-7..8.	74	---
2BH181.-7..1.	74	---
2BH181.-7..2.	74	78
2BH181.-7..3.	74	78
2BH181.-7..4.	74	78
2BH184.-7..2.	74	78
2BH184.-7..3.	74	78
2BH191.-7..1.	74	84
2BH191.-7..2.	74	84
2BH191.-7..3.	74	84
2BH1940-7B.2.	75	84
2BH1940-7B.3.	75	84
2BH1940-7B.4.	75	84
2BH1943-7..2.	75	84
2BH1943-7..3.	75	84
2BH1943-7..4.	75	84

Sound power level

Sound power level L_W as per EN ISO 3744, tolerance ±3 dB (A).

Two-impeller design		
	Sound power level L_W [dB (A)]	
Type	50 Hz	60 Hz
2BH191.	-	98
2BH1940	-	98
2BH1943	-	99
2BH923..	-	93

Tightening torques for screw connections

The following values apply if no other information is available.

With non-electrical connections, property classes of 8.8 and 8 or higher as per ISO 898-1 are assumed.

	Tightening torques for non-electrical connections	
Thread	[Nm]	[ft lbs]
M4	2.7 - 3.3	1.99 - 4.44
M5	3.6 - 4.4	2.65 - 3.25
M6	7.2 - 8.8	5.31 - 6.5
M8	21.6 - 26.4	15.9 - 19.5
M10	37.8 - 46.2	27.9 - 34.1
M12	63.0 - 77.0	46.5 - 56.8

The following information for electrical connection applies to all terminal board connections with the exception of terminal strips.

	Tightening torques for electrical connections	
Thread	[Nm]	[ft lbs]
M4	0.8 - 1.2	0.59 - 0.89
M5	1.8 - 2.5	1.33 - 1.84

Especially for metal and plastic threaded cable glands and pipe unions, the following values apply:

	Tightening torques for metal threaded glands/unions	
Thread	[Nm]	[ft lbs]
M12x1,5	4 - 6	2.95 - 4.43
M16x1,5	5 - 7.5	3.69 - 5.53
M25x1,5	6 - 9	4.43 - 6.64
M32x1,5	8 - 12	5.9 - 8.85
M40x1,5		

	Tightening torques for plastic threaded glands/unions	
Thread	[Nm]	[ft lbs]
M12x1,5	2 - 3.5	1.48 - 2.58
M16x1,5	3 - 4	2.21 - 2.95
M25x1,5	4 - 5	2.95 - 3.69
M32x1,5	5 - 7	3.69 - 5.16
M40x1,5		

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3.2 Electrical data

See rating plate.

3.3 Operating conditions

Temperatures

Temperature of pumped gases:	max. permissible temperature: +40°C [+104°F] Nominal value: +15°C [+59°F] Pump-motor units for higher fluid temperatures on request.
Ambient temperature:	max. permissible temperature: +40°C [+104°F] min. permissible temperature: -15°C [+5°F] Nominal value: +25°C [+77°F] Ambient temperatures between 25°C [+77°F] and 40°C [+104°F] affect the permissible total pressure difference. At higher temperatures the winding may be damaged and the grease change interval may be shortened.

Pressures

Min. suction pressure:	See rating plate
Max. discharge pressure in compressor mode:	See rating plate

* The total pressure difference, shown on the rating plate, applies only for the following conditions:

- Ambient temperature: 25°C
- Pressure for vacuum operation: 1013 mbar at pressure connection;
- Pressure for compressor operation: 1013 mbar at suction connection;
- Intake temperature (temperature of conveyed gases at suction connection): 15°C
  For ambient temperatures between 25°C and 40°C, the total pressure difference specified on the rating plate must be reduced (at 40°C by 10%).

Consultation with the manufacturer is essential for such operational conditions.

Installation altitude

Max. of 1,000 m [3,280 ft] above sea level.

When installing the pump-motor unit at an altitude of more than 1,000 m [3,280 ft] above sea level, first inquire with the Service department.

4 Transport and Handling

⚠ WARNING

Tipping or falling can lead to crushing, broken bones etc.! Sharp edges can cause cuts!
Wear personal safety equipment (gloves, safety shoes and protective helmet) during transport!

⚠ WARNING

Danger from tipping or falling loads!
Prior to transport and handling make sure that all components are securely assembled and secure or remove all components the fasteners of which have been loosened!

Manual handling:

⚠ WARNING

Danger from lifting heavy loads!
Manual handling of the unit is only permitted within the following limits:

- max. 30 kg [max. 66 lbs] for men
- max. 10 kg [max. 22 lbs] for women
- max. 5 kg [max. 11 lbs] for pregnant women

For the weight of the pump-motor unit, see Chapter 3.1, "Mechanical data", Section "Weight", Pg. 7. For weights above the given values use suitable lifting appliances and handling equipment!

Handling by means of lifting equipment:

⚠ WARNING

Danger from tipping or falling loads!
When transporting with lifting equipment, observe the following basic rules:

- Before each transport, check the tight fit of the eye bolt/lifting attachment, see "Tightening torques for screw connections", p. 10.
- The lifting capacity of lifting equipment and lifting gear must be at least equal to the unit's weight. For the weight of the pump-motor unit, see Chapter 3.1, "Mechanical data", Section "Weight", Pg. 7.
- The pump-motor unit must be secured so that it cannot tip or fall.
- Do not stand or walk under suspended loads!

The transport must be carried out in different ways depending on the type:

- 2BH11., 2BH12., 2BH13., 2BH14., 2BH15. (single-impeller): Manual handling
- 2BH15. (two-impeller), 2BH16., 2BH18., 2BH19., 2BH923…
  Transport with crane, hooked onto eye bolt/lifting attachment (1 attachment point)
- 2BH1943:
  Transport with crane, hooked with lifting belts onto eye bolt and onto the holes in the two feet of the vacuum pump/compressor housing (3 attachment points).

For **transport with a crane**, the pump-motor unit can be hooked into the crane hook as follows:

- directly on the eye bolt/lifting attachment (With 2BH194 the eye bolt and the two foot holes should be used)

or possibly

- with lifting belts.

Eye bolt/lifting attachment:

Types with a weight of up to 30 kg [66 lbs] are **not** equipped with an eye bolt/lifting attachment (2BH11., 2BH12., 2BH13., 2BH14., 2BH15 [single-impeller]).

Types with a weight of more than 30 kg [66 lbs] are equipped with an eye bolt/lifting attachment as **standard** (2BH15. [two-impeller], 2BH16., 2BH18., 2BH19., 2BH9…).

The eye bolt/lifting attachment is mounted on the vacuum pump/compressor housing.

In case of possible removal and remounting of the eye bolt, it must be ensured that the eye level is positioned exactly in the axis direction of the pump-motor unit. Lay shims under the eye bolt if necessary.

The eye bolt/lifting attachment must be firmly tightened.

Loads laterally to the ring level are not permissible. Heavy impact loads during transport must be avoided.

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5 Installation

⚠ WARNING

Improper use of the unit can result in serious or even fatal injuries!

Have you read the safety precautions in Chapter 1, "Safety", Pg. 3 f.?

Otherwise you many not carry out any work with or on the pump-motor unit!

⚠ DANGER

Danger from missing view into area of pump-motor unit!

When operating the control elements without a view into the area of the pump-motor unit, there is a danger that the pump-motor unit will be switched on while other persons are still performing work on it. Extreme injuries are possible!

Provide control elements at a location with a view of the pump-motor unit.

⚠ DANGER

Electrical danger!

The pump-motor unit must be installed so that the electrical device cannot be damaged by external influences!

In particular, the feed pipes must be securely routed, e.g. in cable ducts, in the floor etc.

⚠ WARNING

Danger from balance damage caused by vibration!

Vibrating environments can cause balance damage!

Install the pump-motor unit on a solid foundation or on a solid mounting surface.

Check screw glands/unions for mounting the pump-motor unit on the mounting surface regularly for strength and firm seating.

⚠ WARNING

Danger from crushing due to pump-motor unit tipping over!

Wear personal safety equipment (protective gloves and safety shoes). Handle the unit with the appropriate care. Install the pump-motor unit on a solid foundation or on a solid mounting surface! Check screw glands/unions for mounting the pump-motor unit on the mounting surface regularly for strength.

⚠ WARNING

Danger of fire from flammable substances!

The pump-motor unit must never come into contact with flammable substances.

⚠ WARNING

Danger of burns from hot surfaces of the pump-motor unit and from hot fluids!

High temperatures of up to approx. 160°C [320°F] can occur on the surface of the pump-motor unit.

The pump-motor unit must be installed so that accidental touch of its surface is not possible. Cover the pump-motor unit with a suitable touch protection (e.g. perforated plate cover or wire cover).

⚠ WARNING

Danger of injuries from flying parts!

Select installation so that parts that are thrown out through the grate if the external fan breaks cannot hit persons!

⚠ CAUTION

Danger of tripping and falling!

Make sure the unit does not present a danger of tripping. Lay cables and pipes so that they cannot be reached during operation(recessed in floor, in ducts on the wall etc.).

CAUTION

Danger of overheating due to hot surface of pump-motor unit!

High temperatures can occur on the surface of the pump-motor unit.

Temperature sensitive parts, such as lines or electronic components, may not come into contact with the surface of the pump-motor unit.

The pump-motor unit is ready to connect on delivery. However, if the time from delivery to commissioning of the pump-motor unit exceeds a certain period, the lubrication of the rolling bearings must be renewed.
See Chapter 8.2, "Storage conditions", Section "Lubrication of rolling bearings after longer storage", Pg. 24 for information on this topic.

Carry out the following work to install the pump-motor unit:

- Installation and securing,
- Attachment of the included loose muffler if necessary,
- Attachment of threaded flange or hose flange (available as accessories)
  for the connection of inlet or discharge pipe to the muffler,
- Electrical connection,
- Connection of inlet and discharge connection to the system.

5.1 Installation

⚠ WARNING

For an installation that differs from the following specifications, it is necessary to inquire with the Service Department!

Ambient conditions:

The pump-motor unit is suitable for installation in the following environments:

- In a dusty or damp environment,
- in buildings,
- in the open.
  When properly installed in the open, the pump-motor unit must be protected from exposure to intensive sunlight, e.g. by attaching a protective roof. Otherwise, no special protective devices against the effects of weathering are required.

The drive motors of the pump-motor units have the following design:

- with degree of protection IP55 (see rating plate),
- with tropicalized insulation.

Installation conditions:

The pump-motor unit must be installed as follows:

- on level surfaces,
- at a maximum height of 1000 m [3280 ft] above sea level.
  When installing at an altitude of more than 1,000 m [3,280 ft] above sea level, first inquire with the Service Department.

Minimum distances:

To ensure sufficient cooling of the pump-motor unit, it is absolutely necessary that the required minimum distances to the **fan guard** and to the **face of the vacuum pump/compressor cover** be maintained. see Chapter 3.1, "Mechanical data", Section "Minimum distances", Pg. 8.

The minimum distances to the face of the vacuum pump/compressor cover are especially important when installing on the vacuum pump/compressor cover or near a wall.

CAUTION

To ensure sufficient cooling of the pump-motor unit, also observe the following:

- Ventilation screens and openings must remain clear.
- Discharge air of other units may not be directly sucked in again!

Noise radiation:

To reduce the noise radiation, the following must be observed:

- Do not mount pump-motor unit on noise-conducting or noise-radiating parts (e.g. thin walls or sheet-metal plates).
- Provide pump-motor unit with sound-insulating intermediate layers (e.g. rubber buffers under the base of the pump-motor unit) if necessary.
- Install the pump-motor unit on a stable foundation or on a rigid mounting surface. This provides for smooth, low-vibration running of the pump-motor unit.

Components for reducing noise on the pump-motor unit:

- **Mufflers** (included as standard equipment):
  On delivery the pump-motor units are equipped with attached mufflers as standard. The noise radiation is considerably reduced by the mufflers. See Fig. 2 to Fig. 9, Pg. 18 ff.
- **Additional silencer** (available as an accessory for the 2BH1):
  The additional mufflers enable a further noise reduction. They may only be used with free entry and exit of gases, i.e. with direct intake out of or direct feeding into the atmosphere **without piping**.

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- **Sound protection hood** (available as an accessory for the 2BH1):
  Noise protection hoods are suitable for installation in rooms and in the open. They reduce both the total sound pressure level and tonal components that are perceived as particularly annoying.

Installation variants/axis position:

Basically, when installing the pump-motor unit, the following variants are possible with a different axis position (horizontal or vertical):

- Horizontal installation
- Vertical installation on the vacuum pump/compressor cover ("cover installation")
- Vertical mounting on the wall

Basically, all variants are possible with all type.

Exceptions

- For the 2BH1943, vertical axis mounting on the compressor cover ("cover position") is necessary.
- For the 2BH923, only horizontal axis mounting and vertical axis mounting on the compressor cover are possible.
- For units with condensate water opening, horizontal axis mounting with a foot below is necessary.

Horizontal axis mounting

The foot of the unit has fastening holes.

- Screw the foot of the unit to the base using suitable screws.
  All fastening holes must have screws!

Vertical axis mounting on the compressor cover ("cover position")

For vertical axis mounting on the compressor cover, use spring elements.

Spring elements are available as accessories and come in a set of 3. The upper part has a threaded stud and the lower part a threaded hole.

- fFastening spring elements to the unit:
  Screw threaded studs of the spring elements into the holes on the front side of the compressor cover and tighten.
- Fastening the unit with spring elements to the foundation:
  Select suitable fastening elements for the threaded hole.
  Screw spring elements over the threaded hole into the base or foundation.

Vertical axis mounting on the wall with the compressor cover pointing downward

For vertical axis mounting of the unit on the wall, the unit is fastened using the holes in the foot. The foot of the unit has fastening holes.

- Place the unit with the foot to the wall on a base plate with sufficient load-bearing capability in the mounting position.
- Screw the foot of the unit to the wall using suitable screws.
  All fastening holes must have screws!
- Remove the base plate.

Eye bolt/lifting attachment:

After set-up, the eye bolt/lifting attachment can be removed.

5.2 Electrical connection (motor)

⚠ DANGER

Electrical danger!
Malpractice can result in severe injuries and material damage!

⚠ DANGER

Electrical danger!
The electrical connection may be carried out by trained and authorized electricians only!

⚠ DANGER

Electrical danger!
Before beginning work on the unit or system, the following measures must be carried out:

- Deenergize.
- Secure against being switched on again.
- Determine whether deenergized.
- Ground and short-circuit.
- Cover or block off adjacent energized parts.

CAUTION

Incorrect connection of the motor can lead to serious damage to the unit!

Regulations:

The electrical connection must be carried out as follows:

- according to the applicable national and local laws and regulations,
- according to the applicable system-dependent prescriptions and requirements,
- according to the applicable regulations of the utility company.

Electrical power supply:

Observe the **rating plate**.
It is imperative that the operating conditions correspond to the data given on the rating plate!

Deviations permissible without reduction in performance:

- ±5 % voltage deviation
- ±2 % frequency deviation

Connection to drive-motor terminal box:

Open the required cable entry openings on the terminal box. Here the following two cases are differentiated:

- The cable entry opening is prefabricated and provided with a sealing plug.
- Screw out sealing plug.

OR

- The cable entry opening is closed off with a casting skin (only on pump-motor units with drive-motor axis heights of 100 to 160 in standard design).
- Break out casting skin using a suitable tool. For example, use a metal pin with a corresponding diameter or a chisel and hammer.

CAUTION

When pounding out the casting skin on the cable entry openings in the terminal box, the terminal box or its parts can be damaged (e.g. terminal board, cable connections).

Proceed with suitable caution and precision when doing so! Prevent flash formation!

Mount cable glands on the terminal box. Proceed as follows:

- Select one cable gland in each case which is suitable for the cable diameter.
- Insert this cable gland in the opening of the terminal box.
  Use a reducer if necessary.
- Screw on the cable gland so that no moisture, dirt etc. can penetrate into the terminal box.

Carry out the connection and the arrangement of the jumpers in accordance with the **circuit diagram in the terminal box**.

Connect the protective conductor to the terminal with the following symbol:



.

The electrical connection must be carried out as follows:

- The electrical connection must be permanently safe.
- There may be no protruding wire ends.
- Clearance between bare live parts and between bare live parts and ground: ≥ 5.5 mm [0.217"] (at a nominal voltage of U_N ≤ 690V).
- For the tightening torques for terminal board connections (except terminal strips), see Chapter 3.1, "Mechanical data", Section "Tightening torques for screw connections", Pg. 10.
- For terminals with clamping straps (e.g. as per DIN 46282), the conductors must be inserted so that approximately the same clamping height results on both sides of the bar. Individual conductors must therefore be bent into a U-shape or connected with a cable lug (DIN 46234).

This also applies to:

- the protective conductor,
- the outer ground conductor.

Both conductors can be recognized from their color (green/yellow).

⚠ DANGER

Electrical danger!
The terminal box must be free from

- foreign bodies,
- dirt,
- humidity.

Terminal box cover and cable entries must be tightly closed so as to make them dustproof and waterproof. Check for tightness at regular intervals.

⚠ DANGER

Electrical danger!
Clearance between bare live parts and between bare live parts and ground:

at least **5.5 mm [0.217"]** (at a nominal voltage of U_N ≤ 690V).

There may be no protruding wire ends!

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For **motor overload protection**:

- Use motor circuit breakers.
- This must be adjusted to the specified nominal current (see rating plate).

⚠ DANGER

Electrical danger!
There is danger of an electrical shock when a defective pump-motor unit is touched!

Mount motor circuit breaker.
Have electrical equipment checked regularly by an electrician.

Interference immunity of drive motor:

For drive motors with integrated sensors, the operator must provide for a sufficient interference immunity itself. Select a suitable sensor signal cable (e.g. with screening, connection as for a motor power-supply cable) and analyzing unit.

Operation with frequency converter:

⚠ WARNING

Pump-motor units with a UL approbation may not be operated on frequency converters in the US without testing by a suitable test agency!

With a power supply by a frequency converter, the following must be observed:

- High-frequency current and voltage harmonics in the motor supply cables can lead to emitted electromagnetic interference. This is dependent on the converter design (type, manufacturer, interference suppression measures).
- Be sure to observe the EMC notes of the converter manufacturer!
- Use screened power supply cables if necessary. For optimal screening, the screen must be conductively connected over a large area to the metal terminal box of the drive motor with a screwed metal gland.
- In the case of drive motors with integrated sensors (e.g. PTC thermistors) interference voltage can occur on the sensor cable depending on the converter type.
- Limit speed:
  see specifications on the rating plate.

5.3 Connecting pipes/hoses (vacuum pump/compressor)

Mufflers:

The pump-motor units are delivered with mufflers (indicated with arrows in the following illustrations) for the inlet and discharge connections as standard equipment.

On delivery the mufflers are already mounted on the following pump-motor units.

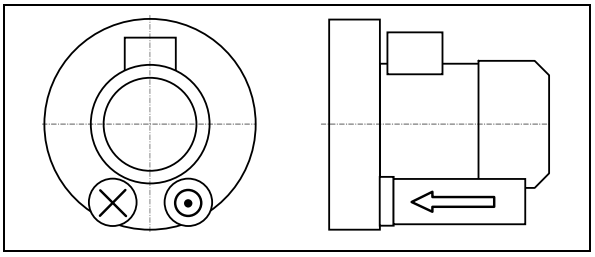


Fig. 2: 2BH1… (single-impeller pump-motor units), 2BH9 23

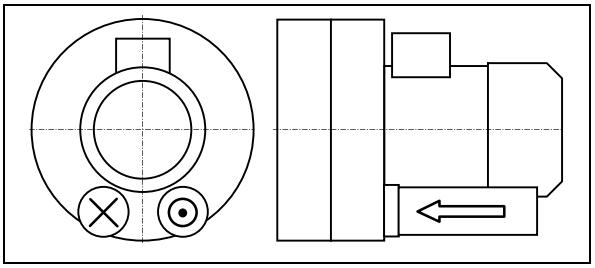


Fig. 3: 2BH1640 (two-impeller pump-motor unit with double-flow design)

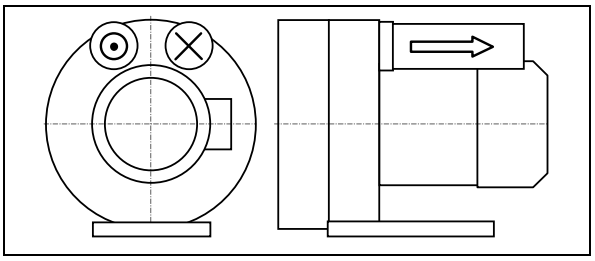


Fig. 4: 2BH1840-7G... (two-impeller pump-motor unit with double-flow design)

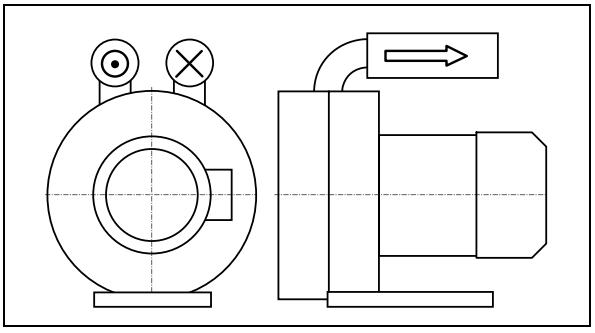


Fig. 5: 2BH1840-7J... (two-impeller pump-motor unit with double-flow design)

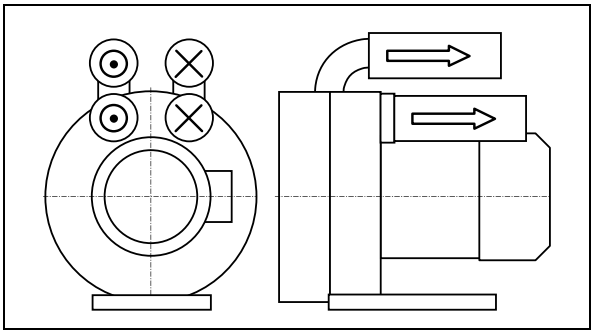


Fig. 6: 2BH1840-7L... (two-impeller pump-motor unit with double-flow design)

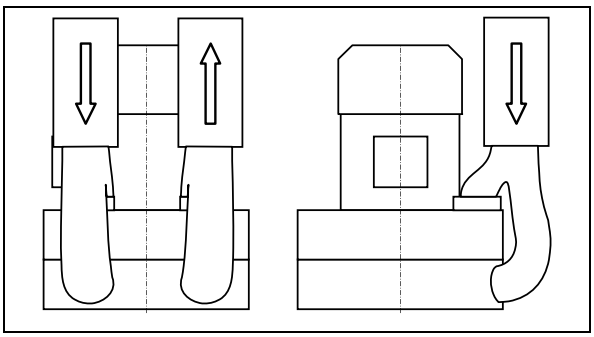


Fig. 7: 2BH1943 (two-impeller pump-motor unit with double-flow design)

On **two-impeller pump-motor units with a two-stage design of the types 2BH1310 to 2BH1910** the discharge-side muffler is included loose for packing-related reasons and must be mounted by the customer.

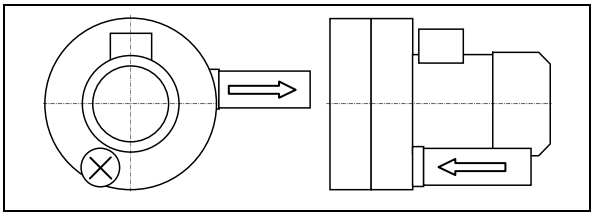


Fig. 8: 2BH1310 ... 2BH1610, 2BH1910 (two-impeller pump-motor units with a two-stage design)

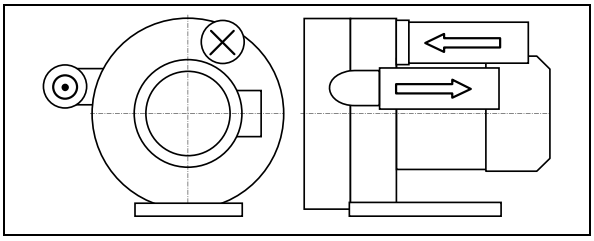


Fig. 9: 2BH1810 (two-impeller pump-motor unit with a two-stage design)

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⚠ WARNING

Danger from rotating impeller:
Cutting/cutting of off extremities!
The rotating impeller is accessible with the inlet and discharge connections open!

With free entry and exit of gases, i.e. with direct intake out of or direct feeding into the atmosphere without piping, the following therefore applies:

Provide the inlet and discharge connections of the pump-motor unit either with additional mufflers or with additional piping of a sufficient length to prevent access to the impeller!

Connections:

To prevent foreign bodies from entering the unit, all connections are sealed off when delivered. Do not remove the sealing plugs until immediately before connecting the pipes/hoses.

The following applies for the arrangement of the pipe/hose connections:

The **pumped gases** are sucked in via the inlet connection (see Chapter 5.3.1, Pg. 19) and discharged via the discharge connection (see Chapter 5.3.2, Pg. 19).

The **shaft rotating direction** is marked with an arrow on the back of the vacuum pump/compressor housing (Fig. 1, Pg. 2, Item 7).

The **delivery direction of the gases** is marked with arrows on both connections (Fig. 1, Pg. 2, Item 6).

⚠ WARNING

Danger from interchanging inlet and pressure line!
Interchanged inlet and pressure lines can lead to damage to the pump-motor unit and the system, and as a result of this to serious injuries!

Make sure that the inlet and pressure line cannot be confused when connecting.

Look for the clear marking with the arrow indicating the delivery direction on the inlet and discharge connections.

⚠ WARNING

Danger due to vacuum and gauge pressure!

Danger due to escaping fluid!

During operation, connected pipes and vessels are vacuumized or pressurized!

Use only mounting elements, connections, lines, fittings and containers with sufficient freedom from leaks and strength for the pressures which occur.

Make sure that the mounting elements and connections are mounted sufficiently firmly and leak-free!

CAUTION

If the pumped gases are passed on on the discharge side in a closed pipe system, then it must be ensured that the pipe system is adapted to the maximum discharge pressure. See Chapter 3.3: "Operating conditions", Section "Pressures", Pg. 11. Connect a pressure relief valve upstream if necessary.

NOTICE

Attach pipes/hoses free of mechanical tensions. Support the weight of the pipes/hoses.

5.3.1 Inlet connection

The inlet connection with the related muffler (Fig. 1, Pg. 2, Item 3) is marked with an arrow pointing into the vacuum pump/compressor. Connect the inlet pipe here. The pumped gases are sucked in via this.
Procedure: see Chapter 5.3.3.

⚠ WARNING

Danger from solid bodies and impurities in the pump-motor unit!
If solid bodies penetrate into the pump-motor unit, blades of the impellers can break and broken pieces can be thrown out.

Install a filter in the inlet pipe.
Replace filter regularly!

5.3.2 Discharge connection

The discharge connection with the related muffler (Fig. 1, Pg. 2, Item 4) is marked with an arrow pointing out of the vacuum pump/compressor. Connect the discharge pipe here. The pumped gases are discharged via this. Procedure: see Chapter 5.3.3.

5.3.3 Procedure when connecting pipes/hoses

Attach the pipes/hoses to the unit as described in the following. The pipes/hoses are connected differently to inlet and discharge connections depending on the muffler design and the type of line (pipe or hose):

- Muffler with inside threads:
  The pipe is screwed directly into the muffler.
- Muffler without inside thread:
  - Screw threaded flange (available as an accessory) onto the muffler.
  - Screw the pipe into the threaded flange.
- Hose connection:
  - for 2BH1 Screw the hose flange (available as an accessory) onto the silencer.
  - Push the hose onto the hose flange and secure it with a hose clamp. See Chapter 3.1, "Mechanical data", Section "Tightening torques for screw connections", Pg. 10 for information on this topic.

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6 Commissioning

⚠ WARNING

Improper use of the unit can result in serious or even fatal injuries!

Have you read the safety precautions in Chapter 1, "Safety", Pg. 3 f.? Otherwise you many not carry out any work with or on the pump-motor unit!

⚠ WARNING

Danger from rotating parts (external fan, impeller, shaft): Cutting/cutting off of extremities, Grasping/winding up of hair and clothing!

Danger due to vacuum and gauge pressure: sudden escape of fluids (skin and eye injuries), sudden drawing in of hair and clothing!

Danger due to escaping fluid: Burns!

Start-up and operation only under the following conditions:

- The pump-motor unit must be completely assembled. When doing so, pay particular attention to the following components:
  - the vacuum pump/compressor cover,
  - the muffler on inlet and discharge connections,
  - the fan guard.
- The pipes/hoses must be connected to inlet and discharge connections.
- Inlet and discharge connections and the connected pipes/hoses may not be closed, clogged or soiled.
- Check the mounting elements, connections of the pipe/hose connections, lines, fittings and containers for strength, leaks and firm seating at regular intervals.

6.1 Preparation

⚠ WARNING

Danger from closed connections!

With closed/soiled intake or discharge connections vacuum or gauge pressure results in the pump-motor unit.

This can overheat and damage the drive motor winding.

Before start-up, make sure that the inlet and discharge connections are not closed, clogged or soiled!

CAUTION

Before starting up again after a longer standstill: Measure the insulation resistance of the motor. With values ≤ 1 kΩ per volt of nominal voltage, the winding is too dry.

Measures before start-up:

- If a shut-off device is installed in the discharge pipe:
  Make sure that the unit is NOT operated with the shut-off device closed.
- Before starting up the pump-motor unit, observe the values specified on the rating plate. Specifications on the drive-motor nominal current apply at a gas entry and ambient temperature of +40° C [104°F].
- Adjust the motor circuit breaker to the drive-motor nominal current.

Check direction of rotation:

- The intended rotating direction of the shaft is marked with arrows on the vacuum pump/compressor housing (Fig. 1, Pg. 2, Item. 7).
- The gas delivery direction is marked with arrows on the inlet and discharge connections (Fig. 1, Pg. 2, Item 6).
- Make sure the pipes/hoses on the inlet and discharge connections are properly connected.
- Switch the pump-motor unit on briefly and then off again.
- Compare the actual rotating direction of the external fan with the intended shaft rotating direction indicated with the arrows shortly before the pump-motor unit comes to a standstill.
- If necessary, reverse the direction of rotation of the motor.

⚠ WARNING

Danger due to rotating parts! Danger due to vacuum and gauge pressure! Danger due to escaping fluid!
Test runs may also only be conducted with the pump-motor unit completely mounted.

⚠ DANGER

Electrical danger!
The electrical connection may be carried out by trained and authorized electricians only!

⚠ DANGER

Electrical danger!
Before beginning work on the unit or system, the following measures must be carried out:

- Deenergize.
- Secure against being switched on again.
- Determine whether deenergized.
- Ground and short-circuit.
- Cover or block off adjacent energized parts.

Check operating speeds:

Observe the operating speed specified on the rating plate. This may not be exceeded, as otherwise the noise radiation, vibration behavior, grease consumption duration and bearing change interval worsen. To prevent damage as a result of higher speeds, it may be necessary to inquire with the Service Department as to the maximum speed.

⚠ WARNING

Danger of hearing damage due to noise radiation!
For the noise emission of the pump-motor unit measured by the manufacturer, see Chapter 3.1, "Mechanical data", Section "Noise level", Pg. 8. However, the actual noise emission during operation is highly dependent on the installation and system conditions. Conduct a noise measurement in the system during operation after installing the pump-motor unit. The following measures can be taken from 85 dB(A) and must be taken from 90 dB(A):

- Mark noise area with a warning sign.
- Wear hearing protection.
- With free entry and exit of gases, i.e. with direct intake out of or direct feeding into the atmosphere without piping, attach an additional muffler.

6.2 Start-up and shut-down

Start-up

- Open shut-off device in intake/discharge pipe.
- Switch on power supply for drive motor.

Shut-down:

- Switch off power supply for drive motor.
- Close shut-off device in intake/discharge pipe.

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7 Operation

⚠ WARNING

Improper use of the unit can result in serious or even fatal injuries!

Have you read the safety precautions in Chapter 1, "Safety", Pg. 3 f.?
Otherwise you many not carry out any work with or on the pump-motor unit!

Also **be sure** to read the safety precautions in Chapter 6, "Commissioning", Pg. 21!

Starting up and shutting down

See Chapter 6, "Commissioning", Sub-Chapter 6.2, "Start-up and shut-down", Pg. 22.

Also be sure to observe the following important notes especially for operation:

⚠ WARNING

Danger of burns from hot surfaces of the pump-motor unit and from hot fluids!

High temperatures of up to approx. 160°C [320°F] can occur on the surface of the pump-motor unit.

Do not touch during operation!
Allow to cool after shut-down!

CAUTION

Danger of overheating due to hot surface of pump-motor unit!

High temperatures of up to approx. 160°C [320°F] can occur on the surface of the pump-motor unit.

Temperature sensitive parts, such as lines or electronic components, may not come into contact with the surface of the pump-motor unit.

CAUTION

Danger of overheating!

During operation the standstill heating may, if installed, **not** be switched on!

CAUTION

Danger of rusting due to collection of condensed water in drive motor area!

On drive motors with closed condensed water openings:
Remove closures occasionally to allow any water which has collected to drain off.

CAUTION

Danger of bearing damage!

Heavy mechanical impacts must be avoided during operating and while at a standstill.

8 Shut-Down and Longer Standstills

8.1 Preparing for shut-down or longer standstill

⚠ WARNING

Improper use of the unit can result in serious or even fatal injuries!
Have you read the safety precautions in Chapter 1, "Safety", Pg. 3 f.?
Otherwise you many not carry out any work with or on the pump-motor unit!

CAUTION

Danger of rusting due to collection of condensed water in drive motor area!
On drive motors with closed condensed water openings:
Remove closures occasionally to allow any water which has collected to drain off.

CAUTION

Danger of bearing damage!
Avoid mechanical shocks during operation and shut-down.

Prior to shut-down or longer standstill, proceed as follows:

- Switch off the pump-motor unit.
- Close shut-off device in inlet and pressure line if installed.
- Disconnect pump-motor unit from power supply.
- Release pressure.
  When doing so, open pipes/hoses slowly and carefully so that the vacuum or gauge pressure in the pump-motor unit can be released.
- Remove pipes/hoses.
- Provide mufflers on inlet and discharge side with sealing plugs.

8.2 Storage conditions

To prevent standstill damage during storage, the environment must provide the following conditions:

- dry,
- dust-free,
- low-vibration (V_{eff} ≤ 2.8 mm/s [0.11"/sec]).
- Ambient temperature:
  min. -30°C [-22°F]
  max. 40°C [+104°F].

CAUTION

Danger of overheating due to high temperature!
When storing in an environment with a temperature of over 40°C [104°F], the winding may be damaged and the grease change interval may be shortened.

Lubrication of rolling bearings after longer storage:

The new pump-motor unit may at first be stored following delivery. If the time from deliver to commissioning exceeds the following periods, the lubrication of the rolling bearings must be renewed:

- Under advantageous storage conditions (as specified above): 4 years.
- Under disadvantageous storage conditions (e.g. high humidity, salty air, sandy or dusty air): 2 years.

In these cases open rolling bearings must be relubricated and closed rolling bearings must be completely replaced. In this case be sure to inquire with the Service Department. In particular, exact information with regard to the procedure and grease type are required.

⚠ WARNING

Improper use of the unit can result in serious or even fatal injuries!
All maintenance work on the pump-motor unit must always be performed by the Service Department!

Maintenance work on the pump-motor unit may only be conducted by the operator itself when the related **maintenance manual** on hand!

Inquire with the Service Department!

Commissioning after longer standstill:

Before recommissioning after a longer standstill, measure the insulation resistance of the drive motor. With values ≤ 1 kΩ per volt of nominal voltage, the winding is too dry.

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9 Servicing

⚠ WARNING

Improper use of the unit can result in serious or even fatal injuries!

Have you read the safety precautions in Chapter 1, "Safety", Pg. 3 f.?

Otherwise you many not carry out any work with or on the pump-motor unit!

⚠ WARNING

Improper use of the unit can result in serious or even fatal injuries!

All maintenance work on the pump-motor unit must always be performed by the Service Department!

Maintenance work on the pump-motor unit may only be conducted by the operator itself when the related **maintenance manual** on hand!

Inquire with the Service Department!

9.1 Emptying/Rinsing/Cleaning

Before any maintenance/servicing work, empty, rinse and clean the outside of the unit.

- Empty unit with air and rinse until all residues have been removed.
- Clean the outside of the unit with compressed air.
  - Wear gloves and protective safety glasses.
  - Secure the surrounding area.
  - Clean the entire surface of the unit and exterior fan with compressed air.

9.2 Repairs/troubleshooting

Fault	Cause	Remedy	Carried out by
Motor does not start; no motor noise.	At least two power supply leads interrupted.	Eliminate interruption by fuses, terminals or power supply cables.	Electrician
Motor does not start; humming noise..	One power supply lead interrupted.	Eliminate interruption by fuses, terminals or power supply cables.	Electrician
	Impeller is jammed.	Open vacuum pump/compressor cover, remove foreign body, clean.	Service*)
		Check or correct impeller gap setting if necessary.	Service
	Impeller defective.	Replace impeller.	Service*)
	Rolling bearing on drive motor side or vacuum pump/compressor side defective.	Replace motor bearing or vacuum pump/compressor bearing.	Service*)
Protective motor switch trips when motor is switched on. Power consumption too high.	Winding short-circuit.	Have winding checked.	Electrician
	Motor overloaded. Throttling does not match specification on rating plate.	Reduce throttling.	Service*)
		Clean filters, mufflers and connection pipes if necessary.	Service*)
	Compressor is jammed.	See fault: "Motor does not start; humming noise." with cause: "Impeller is jammed.".	Service*)

Fault	Cause	Remedy	Carried out by
Pump-motor unit does not generate any or generates insufficient pressure difference.	Leak in system.	Seal leak in the system.	Operator
	Wrong direction of rotation.	Reverse direction of rotation by interchanging two connecting leads.	Electrician
	Incorrect frequency (on pump-motor units with frequency converter).	Correct frequency.	Electrician
	Shaft seal defective.	Replace shaft seal.	Service*)
	Different density of pumped gas.	Take conversion of pressure values into account. Inquire with Service Department.	Service
	Change in blade profile due to soiling.	Clean impeller, check for wear and replace if necessary.	Service*)
Abnormal flow noises.	Flow speed too high.	Clean pipes. Use pipe with larger cross-section if necessary.	Operator
	Muffler soiled.	Clean muffler inserts, check condition and replace if necessary.	Service*)
Abnormal running noise.	Ball bearing lacking grease or defective.	Regrease or replace ball bearing.	Service*)
Compressor leaky.	Seals on muffler defective.	Check muffler seals and replace if necessary.	Service*)
	Seals in motor area defective.	Check motor seals and replace if necessary.	Service

*) Only when the maintenance manual is at hand: rectification by the operator.

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9.3 Service/After-sales service

Our Service is available for work (in particular the installation of spare parts, as well as maintenance and repair work), not described in these operating instruction.

A list of spare parts with an exploded drawing is available on the Internet at www.gd-elmorietschle.com.

Observe the following when **returning** pump-motor unit:

- The pump-motor unit must be delivered complete, i.e. not dismantled.
- The pump-motor unit may not present a danger to the workshop personnel.
  Each pump motor unit on delivery to the workshop must be accompanied with a fully completed "Statement on health safety and on the protection of the environment", Pg. 29.
- The original rating plate of the pump-motor unit must be properly mounted, intact and legible.
  All warranty claims are voided for pump-motor units delivered for a damage expertise without the original rating plate or with a destroyed original rating plate.
- In case of warranty claims, the manufacturer must be informed of the operating conditions, operating duration etc. and additional detailed information provided on request if necessary.

10 Disposal

Have the entire pump-motor unit scrapped by a suitable disposal company. No special measures are required when doing so.
For additional information on disposing of the unit, ask the Service Department.

11 Explosion-Protected Design

An additional set of operating instructions with supplementary or specific information is provided with these pump-motor units.

EU declaration of conformity

Manufacturer:	Gardner Denver Deutschland GmbH Industriestraße 26 97616 Bad Neustadt Germany
Responsible for documentation:	Holger Krause Industriestraße 26 97616 Bad Neustadt Germany
Designation:	G series Side channel blower G-BH1, G-BH9 Types 2BH1 1 2BH1 2 2BH1 3 2BH1 4 2BH1 5 2BH1 6 2BH1 8 2BH1 9 2BH9 23

The side channel blower described above meets the following applicable Community harmonisation legislation:

2004/108/EC*)	Directive 2004/108/EC of the European Parliament and of the Council of 15 December 2004 on the approximation of the laws of the Member States relating to electromagnetic compatibility and repealing Directive 89/336/EEC
2006/42/EC	Directive 2006/42/EC of the European Parliament and of the Council of 17 May 2006 on machinery, and amending Directive 95/16/EC The protection targets of the directive 2006/95/EC have been met

Harmonised standards applied:

EN 1012-1:2010	Compressors and vacuum pumps - Safety requirements - Part 1: Air compressors
EN 1012-2:1996 +A1:2009	Compressors and vacuum pumps - Safety requirements - Part 2: Vacuum pumps
EN ISO 12100:2010	Safety of machinery - General principles for design - Risk assessment and risk reduction
EN 60204-1:2006	Safety of machinery - Electrical equipment of machines Part 1: General requirements

Bad Neustadt, 26.09.2011
(Place and date of issue)
Thomas Kurth, Managing Director
(Name and function)



(Signature)

*) Only applicable for version with frequency converter 2FC

664.44434.40.000

 © Gardner Denver Deutschland GmbH

Gardner Denver

Statement on health safety and on the protection of the environment

- For the safety of our employees and to comply with statutory requirements on handling substances harmful to the health and the environment, this statement must be enclosed, fully completed, with **each** unit/system sent.
- **Without the fully completed statement, repair/disposal is not possible and delays are unavoidable!**
- The statement is to be completed and signed by suitably qualified, authorised personnel at the operating organisation.
- In the case of shipment to Germany, the statement is to be completed in German or English.
- The statement is to be attached to the outside of the packing on shipment.
- If necessary, the carrier is to be informed.

1. **Product designation (type):** .....
2. **Serial number (no. BN):** .....
3. **Reason for sending:** .....
4. **The unit/system**
   - ☐ has **not** come into contact with hazardous substances. There will be **no** hazards for personnel or the environment during repair/disposal. Continue with "6. Legally binding statement"
   - ☐ has come into contact with hazardous substances. Continue with "5. Information on the contamination"
5. **Information on the contamination** (if necessary provide more information on an additional sheet)

   The unit/system was used in the following application:

   .....

   and has come into contact with the following classifiable substances or substances presenting a hazard to health/environment:

Trade name:	Chemical designation:	Hazardous substance class:	Properties (e.g. toxic, inflammable, caustic, radioactive):

   - ☐ The unit/system has been emptied in accordance with the operating instructions, flushed and cleaned externally.
   - ☐ Safety data sheets in accordance with the applicable regulations are enclosed (..... sheet).
   - ☐ The following safety precautions are necessary for handling (e.g. personal protective equipment):

     .....

     .....

6. **Legally binding statement**

   I herewith guarantee that the details specified are true and complete and that I, as signatory, am in a position to judge that this is so.
   We are aware that we are liable to the contractor for any damages arising from incomplete or incorrect specifications. We are obliged to indemnify the contractor against claims for damages by third parties arising from incomplete or incorrect specifications. We are aware that, irrespective of this statement, we are directly liable to third parties - in particular including the contractor's employees tasked with repair/disposal.

Company/institute:	.....		
Name, position:	.....	Phone:	.....
Street:	.....	Fax:	.....
Post code, city:	.....		
Country:	.....	Stamp:	
Date, signature:	.....		

© Gardner Denver Deutschland GmbH

P.O. box 1510
97605 Bad Neustadt
Phone: +49 7622 392 0
Fax: +49 7622 392 300
E-mail: er.de@gardnerdenver.com
Internet: www.gd-elmorietschle.com

610.00250.40.905
10.2009
English

 © Gardner Denver Deutschland GmbH

Elmo Rietschle
A Gardner Denver Product

www.gd-elmorietschle.de
er.de@gardnerdenver.com

Gardner Denver
Schopfheim GmbH
Roggenbachstraße 58
79650 Schopfheim · Deutschland
Tel. +49 7622 392-0
Fax +49 7622 392-300

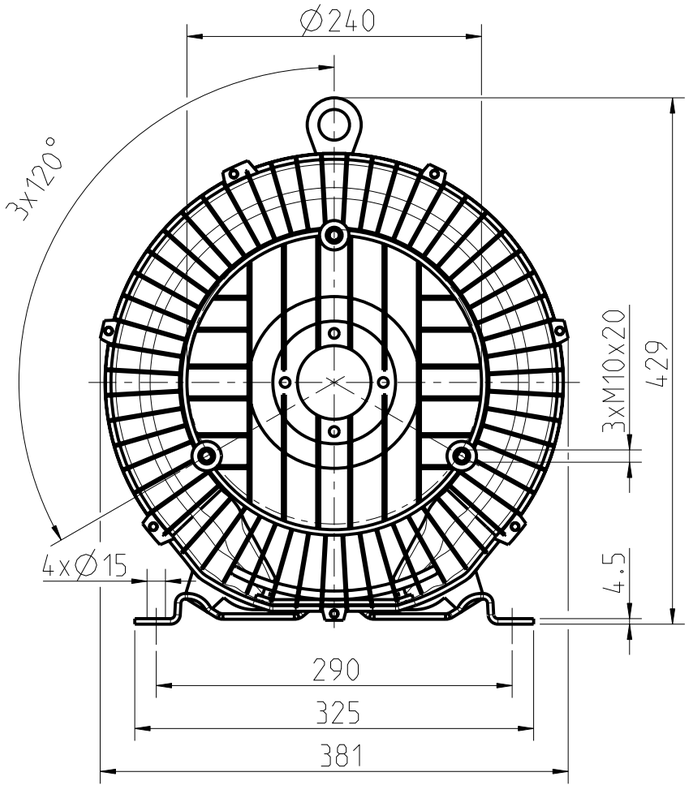
Gardner Denver
Deutschland GmbH
Industriestraße 26
97616 Bad Neustadt · Deutschland
Tel. +49 9771 6888-0
Fax +49 9771 6888-4000

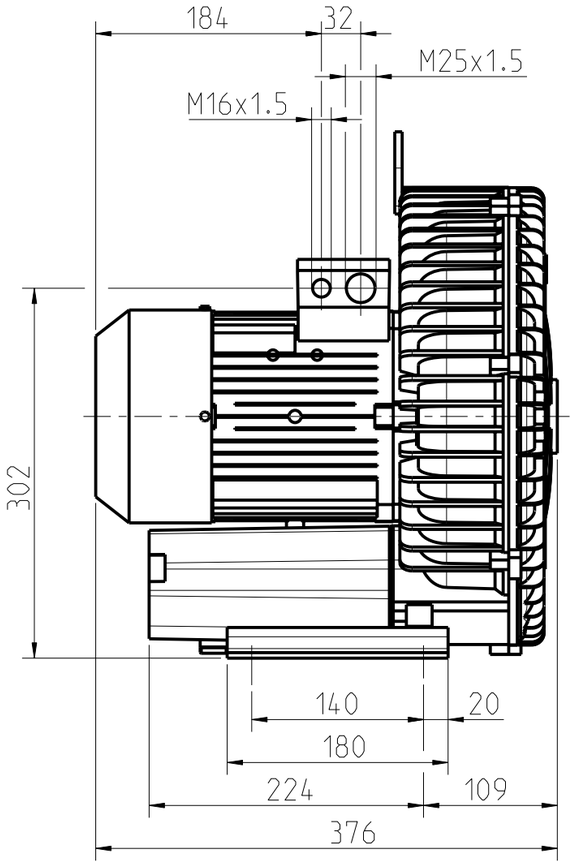
Gardner Denver

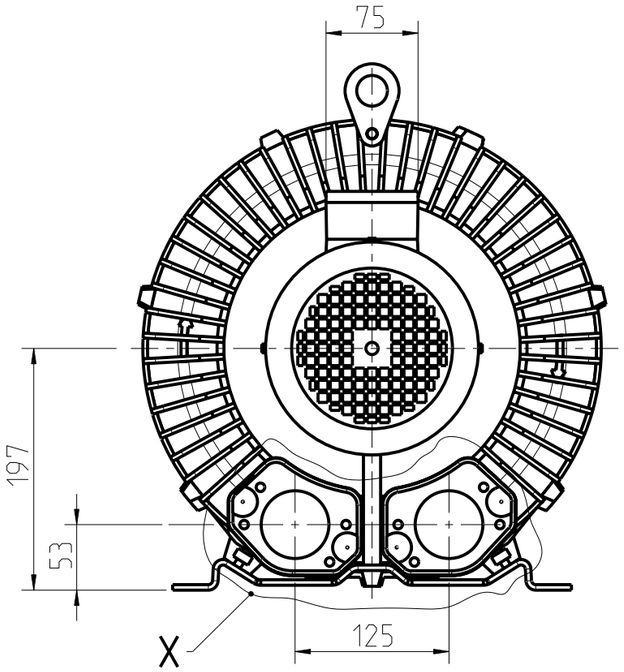
Elmo Rietschle is a brand of Gardner Denver's Industrial Products Group and part of Blower Operations.

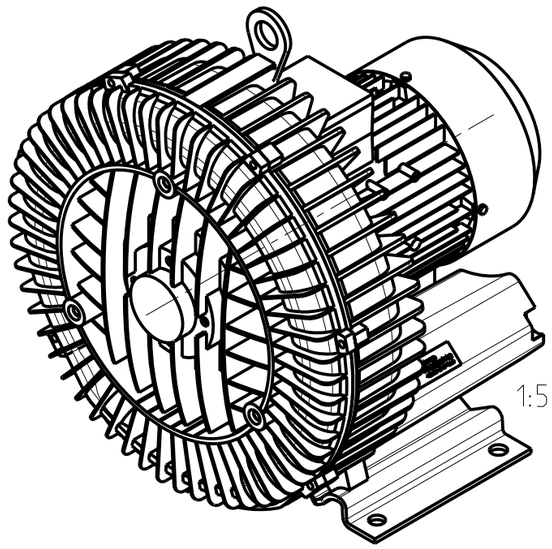
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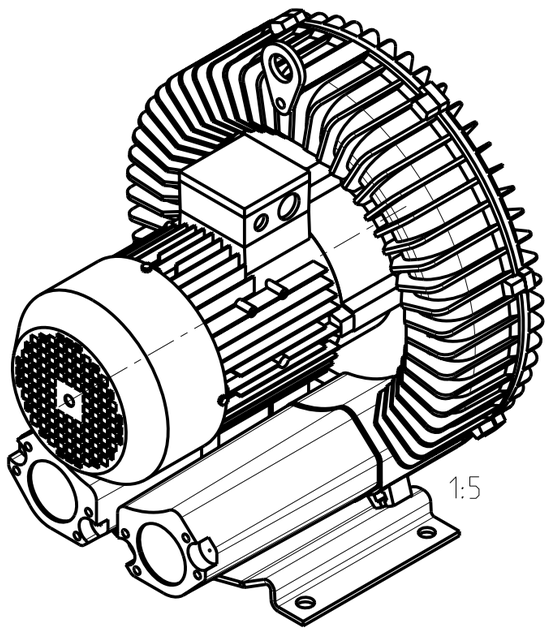
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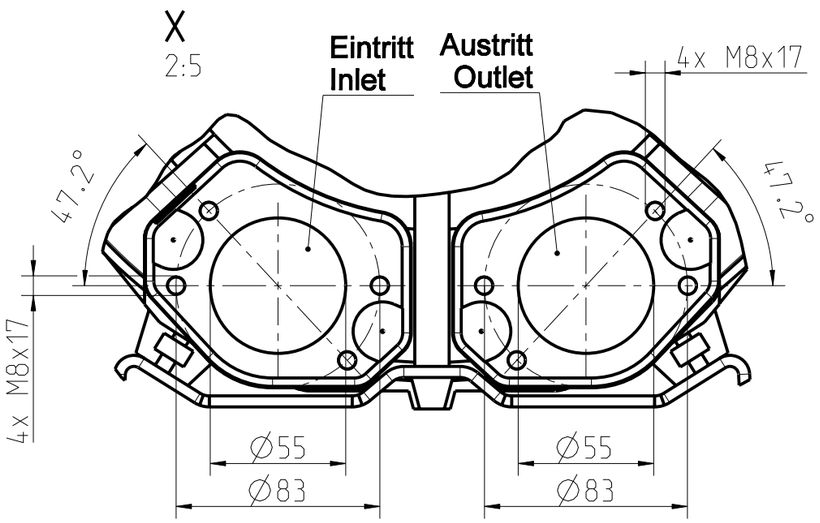












Das Verwenden von gesetzlich verbotenen und bei Gardner Denver gelisteten Stoffen ist nicht erlaubt./The use of hazardous substances banned by law and listed by Gardner Denver is not allowed.

Pro/ENGINEER Wildfire

Werkstoff / material:	.
Halbzeug / semi-finished part:	.
Beschichtung coating:	.

Änderung / Change management		
Mitteilung / information:		
o ÄM: 3D-Daten berichtigt		
.		
.		
Datum / date:	Name / name:	Geprüft / checked:
26.10.2009	Scheeder	/Fis
Ersatz für replacement for: .		Version: 1

Datum / date:	26.11.1999
Name / name:	Fenn
Geprüft / checked:	Fischer
Abt. / dept.:	R&D D

Gardner Denver
Industriestraße 26
97616 Bad Neustadt a. d. Saale

Maßblatt
Drehstrom mit Standardklemmenkasten

dimension sheet
three-phase with standard terminal box

2BH1600-7A.0.

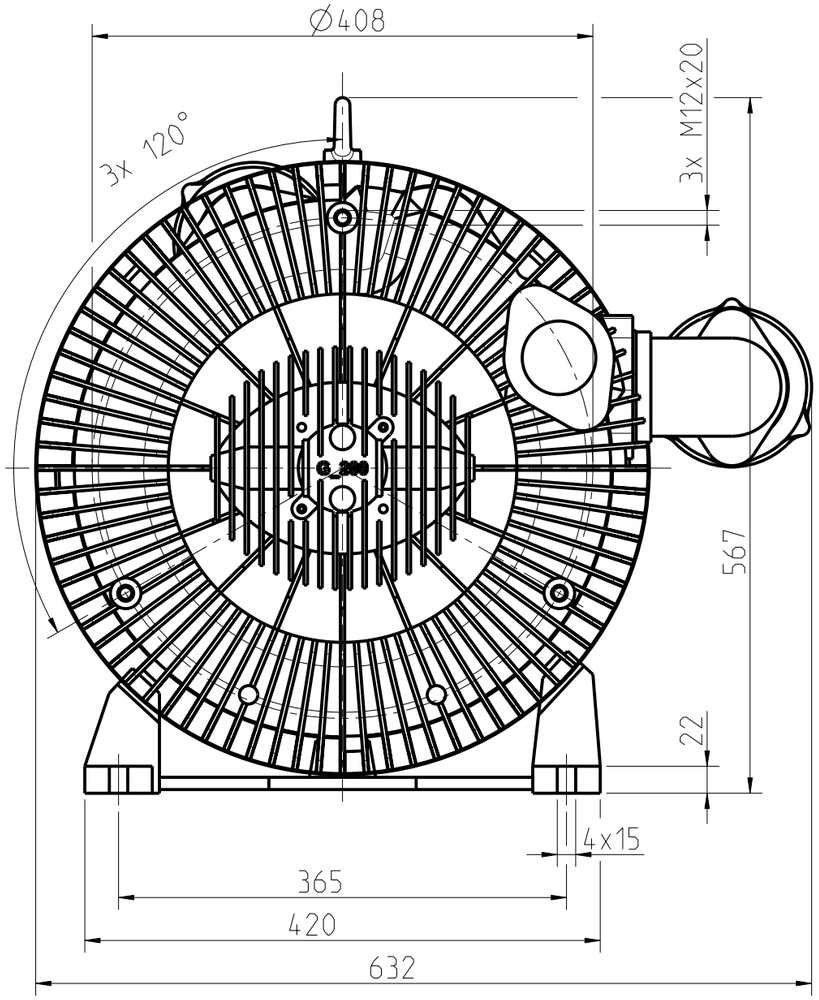
510_31111_01

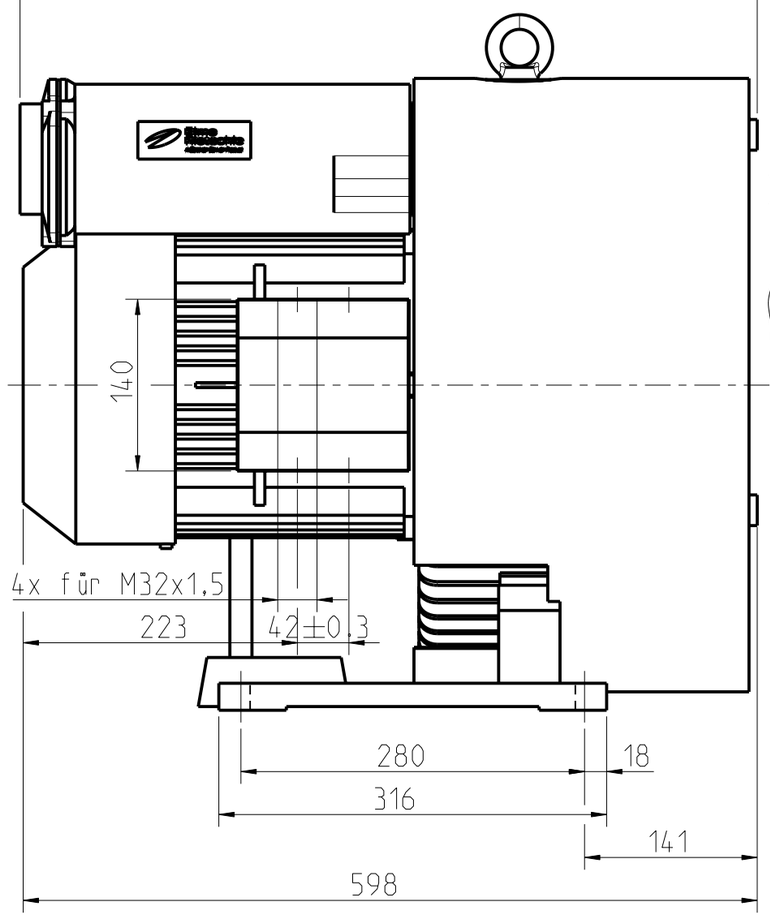
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Einheit / unit:	mm
Maßstab / scale:	1:5
Format:	A3
Blatt / sheet Nr.	1 von / of 1

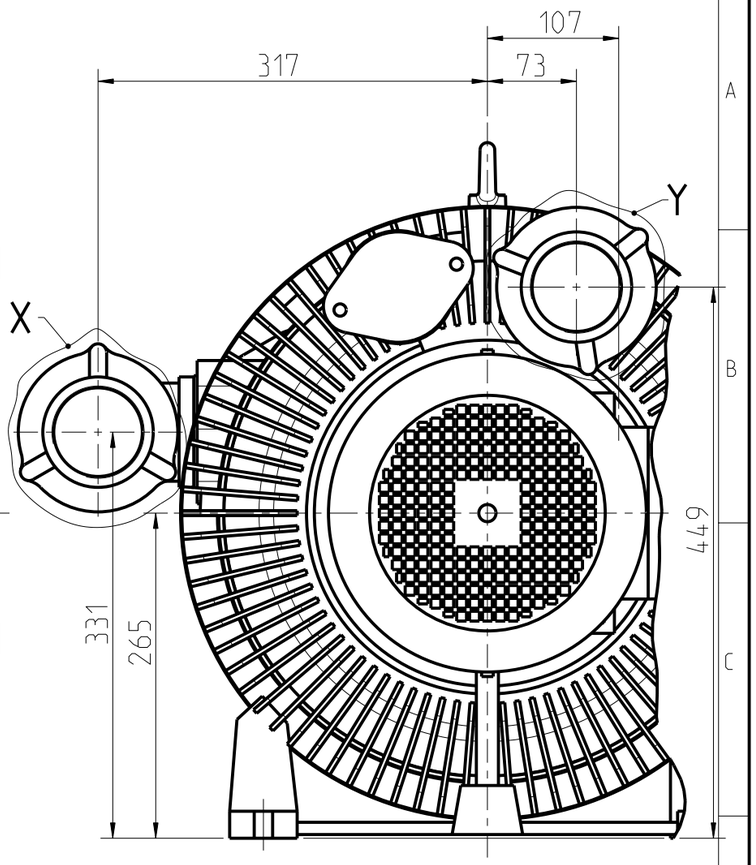
Gardner Denver A3-12-2006, DIN EN ISO 9200-2004

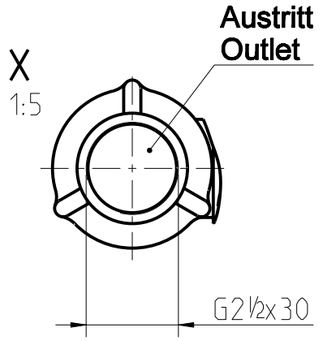
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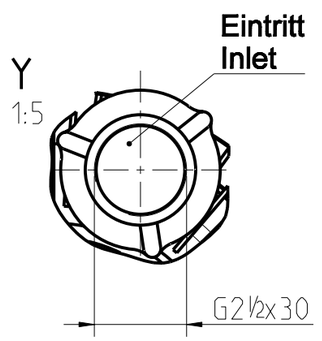
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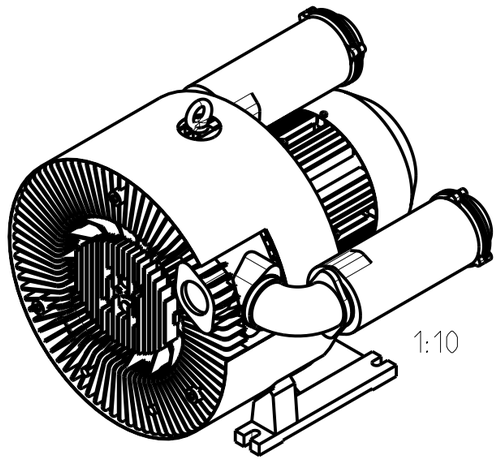


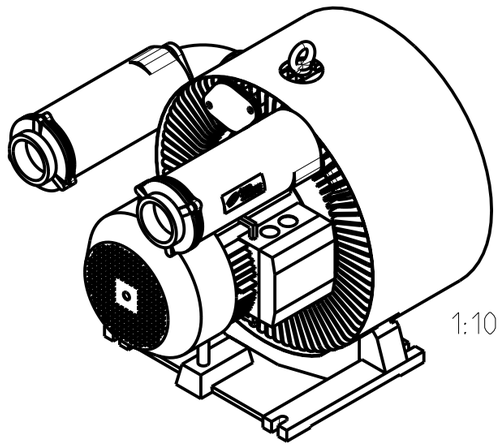












Das Verwenden von gesetzlich verbotenen und bei Gardner Denver gelisteten Stoffen ist nicht erlaubt./The use of hazardous substances banned by law and listed by Gardner Denver is not allowed.

Pro/ENGINEER Wildfire

Werkstoff / material:	.
Halbzeug / semi-finished part:	.
Beschichtung/ coating:	.

Änderung / Change management	Datum / date:	03.05.2000
Mitteilung / information:	Name / name:	Fenn
Luftleitblech entfernt	Geprüft / checked:	Fischer
.	Abt. / dept.:	R&D D
.		

Datum / date:	Name / name:	Geprüft / checked:
19.03.2008	Kirchner	/Fis

Ersatz für/ replacement for: .

Version: 0.

Gardner Denver
Industriestraße 26
97616 Bad Neustadt a. d. Saale

Maßblatt
Drehstrom mit Standardklemmenkasten

dimension sheet
three-phase with standard terminal box

2BH1810-7H.2.

510_31116_26

Masse / mass:	ca. 177 kg
Einheit / unit:	mm
Maßstab / scale:	1:5
Format:	A3
Blatt / sheet Nr.	1 von / of 1

d

Gardner Denver A3-12.2006, DIN EN ISO 7200-2004

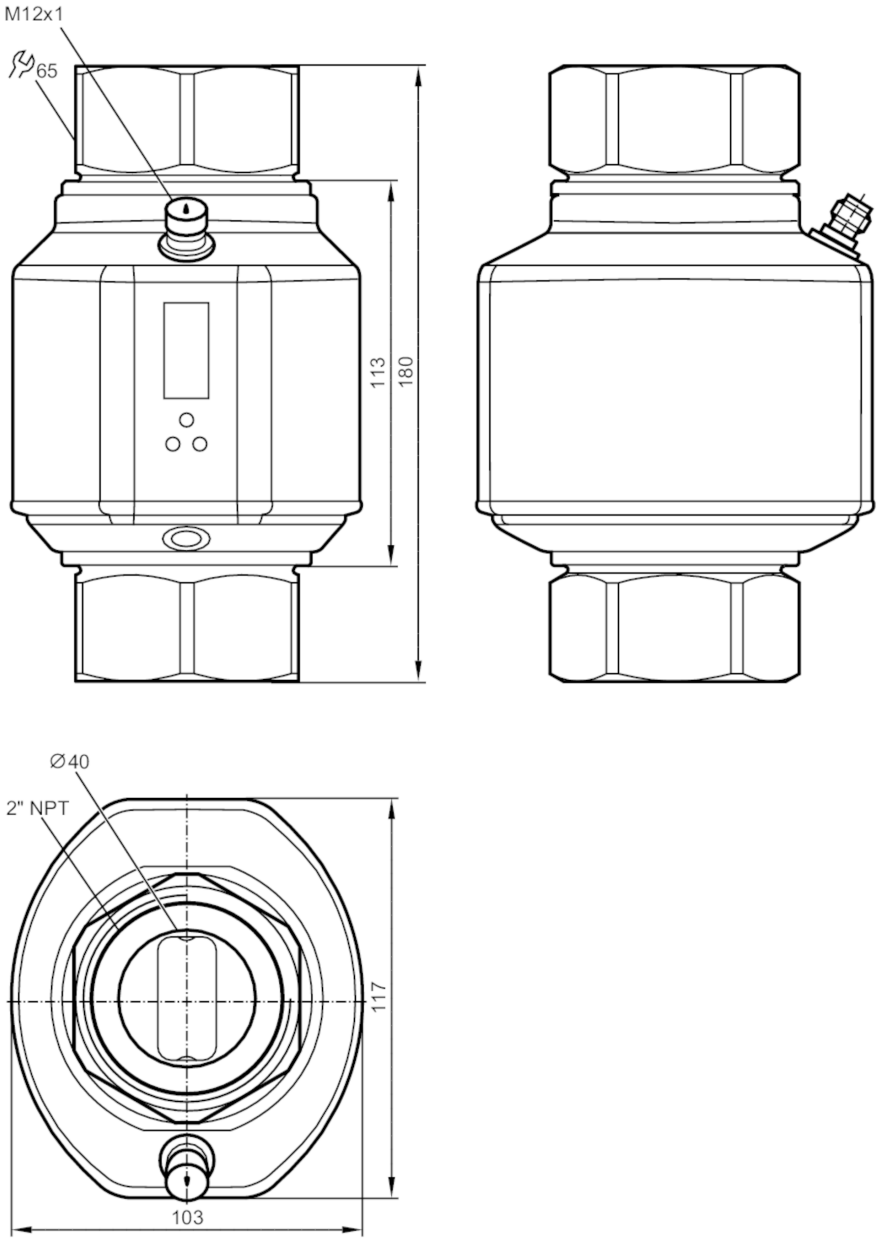
Section 3.3.8

MBBR Flowmeter

SM2601

Magnetic-inductive flow meter

SMN21XGXFRKG/US-100



Product characteristics		
Number of inputs and outputs	Number of digital outputs: 2; Number of analog outputs: 1	
Measuring range	80...9600 gph	1.3...160 gpm
Process connection	threaded connection 2" NPT DN50	

SM2601

Magnetic-inductive flow meter

SMN21XGXFRKG/US-100

Application		
System		gold-plated contacts
Application		Totalizer function; empty pipe detection; for industrial applications
Media		Conductive liquids; water; water-based media
Note on media		conductivity: ≥ 20 µS/cm
		viscosity: < 70 mm²/s (40 °C)
Medium temperature	[°F]	14...158
Pressure rating	[bar]	16
Pressure rating	[psi]	232
MAWP (for applications according to CRN)	[bar]	16
Electrical data		
Operating voltage	[V]	18...32 DC; (according to EN 50178 SELV/PELV)
Current consumption	[mA]	< 150
Protection class		III
Reverse polarity protection		yes
Power-on delay time	[s]	5
Inputs / outputs		
Number of inputs and outputs		Number of digital outputs: 2; Number of analog outputs: 1
Inputs		
Inputs		counter reset
Outputs		
Total number of outputs		2
Output signal		switching signal; analog signal; pulse signal; frequency signal; IO-Link; (configurable)
Electrical design		PNP/NPN
Number of digital outputs		2
Output function		normally open / closed; (configurable)
Max. voltage drop switching output DC	[V]	2
Permanent current rating of switching output DC	[mA]	250; (per output)
Number of analog outputs		1
Analog current output	[mA]	4...20; (scalable)
Max. load	[Ω]	500
Analog voltage output	[V]	0...10; (scalable)
Min. load resistance	[Ω]	2000
Pulse output		flow rate meter
Short-circuit protection		yes
Type of short-circuit protection		yes (non-latching)
Overload protection		yes
Frequency of the output	[Hz]	0.1...10000

SM2601

Magnetic-inductive flow meter

SMN21XGXFRKG/US-100

Measuring/setting range			
Measuring range		80...9600 gph	1.3...160 gpm
Display range		-11520...11520 gph	-190...190 gpm
Resolution		5 gph	0.1 gpm
Set point SP		130...9600 gph	2.1...160 gpm
Reset point rP		80...9550 gph	1.3...159.2 gpm
Analog start point ASP		0...7680 gph	0...128 gpm
Analog end point AEP		1920...9600 gph	32...160 gpm
Low flow cut-off LFC		< 240 gph	< 4 gpm
In steps of		5 gph	0.1 gpm
Measuring dynamics		1:120	
Volumetric flow quantity monitoring			
Pulse value		0.02...160 E06 gal	
In steps of		0.02 gal	
Pulse length	[s]	0,008...2	
Temperature monitoring			
Measuring range	[°F]	-4...176	
Display range	[°F]	-40...212	
Resolution	[°F]	0.5	
Set point SP	[°F]	-2...176	
Reset point rP	[°F]	-3...175	
Analog start point	[°F]	-4...140	
Analog end point	[°F]	32...176	
In steps of	[°F]	0.5	
Accuracy / deviations			
Flow monitoring			
Accuracy (in the measuring range)		± (0,8 % MW + 0,5 % MEW)	
Repeatability		± 0,2% MEW	
Temperature monitoring			
Temperature drift		± 0,0185 °F / K	
Accuracy	[K]	± 1 (77 °F; Q > 4 gpm)	
Reaction times			
Flow monitoring			
Response time	[s]	0.35; (dAP = 0)	
Delay time programmable dS, dr	[s]	0...50	
Damping for the switching output dAP	[s]	0...5	
Temperature monitoring			
Dynamic response T05 / T09	[s]	T09 = 3 (Q > 4 gpm)	
Software / programming			
Parameter setting options		Flow monitoring; quantity meter; Preset counter; Temperature monitoring; hysteresis / window; normally open / closed; switching logic; current/voltage/frequency/pulse output; Start-up delay; display can be deactivated; Display unit; empty pipe detection	

SM2601

Magnetic-inductive flow meter

SMN21XGXFRKG/US-100

Interfaces			
Communication interface		IO-Link	
Transmission type		COM2 (38,4 kBaud)	
IO-Link revision		1.1	
SDCI standard		IEC 61131-9 CDV	
Profiles		Smart Sensor: Process Data Variable; Device Identification	
SIO mode		yes	
Required master port class		A	
Process data analog		3	
Process data binary		2	
Min. process cycle time	[ms]	5	
Supported DeviceIDs		Type of operation	DeviceID
		default	390
Operating conditions			
Ambient temperature	[°F]	14...140	
Storage temperature	[°F]	-13...176	
Protection		IP 65; IP 67	
Tests / approvals			
EMC		DIN EN 60947-5-9	
Shock resistance		DIN EN 60068-2-27	20 g (11 ms)
Vibration resistance		DIN EN 60068-2-6	5 g (10...2000 Hz)
MTTF	[years]	78	
UL approval		UL approval number	I008
		File number UL	E174189
Pressure equipment directive		sound engineering practice; can be used for group 2 fluids; group 1 fluids on request	
Mechanical data			
Weight	[g]	2643	
Material		stainless steel (1.4404 / 316L); stainless steel (1.4571/316Ti); PEI; FKM; PBT-GF20; TPE-U	
Materials (wetted parts)		stainless steel (1.4404 / 316L); stainless steel (1.4571/316Ti); PEEK; FKM	
Process connection		threaded connection 2" NPT DN50	
Displays / operating elements			
Display		Display unit	6 x LED, green (gpm, gph, gal, °F, 10^3, 1000 x 10^3)
		Switching status	2 x LED, yellow
		Measured values	alphanumeric display, 4-digit
		Programming	alphanumeric display, 4-digit
Accessories			
Items supplied		Label	
Remarks			
Remarks		MW = Measured value	
		MEW = Final value of the measuring range	
Pack quantity		1 pcs.	

Electrical connection

Connector: 1 x M12; Contacts: gold-plated

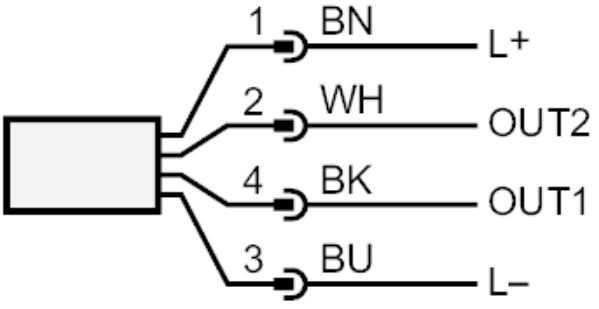
SM2601

Magnetic-inductive flow meter

SMN21XGXFRKG/US-100



Connection



	Colors to DIN EN 60947-5-2
OUT1:	Switching output empty pipe detection
	Switching output Volumetric flow quantity monitoring
	Frequency output Volumetric flow quantity monitoring
	Pulse output quantity meter
	signal output Preset counter
	IO-Link
OUT2:	Switching output empty pipe detection
	Switching output Volumetric flow quantity monitoring
	Switching output Temperature monitoring
	analog output Volumetric flow quantity monitoring
	analog output Temperature monitoring
	Input counter reset
	Core colors :
BK =	black
BN =	brown
BU =	blue
WH =	white

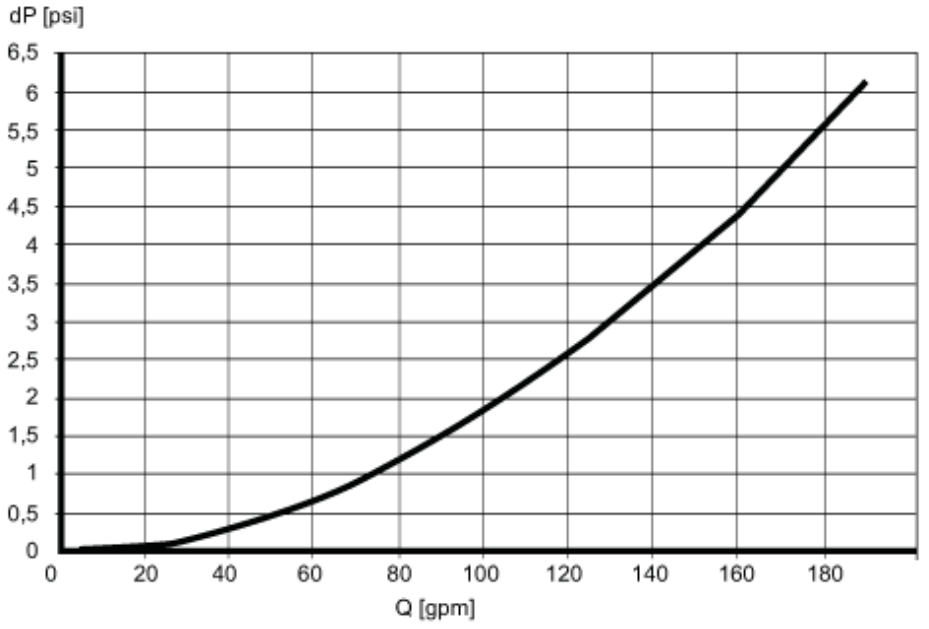
SM2601

Magnetic-inductive flow meter

SMN21XGXFRKG/US-100

Diagrams and graphs

Pressure loss



dP Pressure loss

Q volumetric flow quantity

345 Carlingview Drive
Toronto, Ontario
CANADA M9W 6N9
Tel.: 416.734.3300
Fax.: 416.231.1626
Toll Free: 1.877.682.8772
www.tssa.org

April 18, 2018

KARL KLINGER
IFM EFECTOR INC
1100 ATWATER DR
MALVERN PA 19355
US

Service Request Type: BPV-Fitting Registration
Service Request No.: 2079952
Your Reference No.:
Registered to: IFM PROVER GMBH

Dear KARL KLINGER,

Technical Standards and Safety Authority (TSSA) is pleased to inform you that your submission has been reviewed and registered as follows:

CRN No.: 0F20267.5

Main Design No.: SCOPE OF REGISTRATION - IFM SENSORS
Expiry Date: 18-Apr-2028

Please be advised that a valid quality control system must be maintained for the fitting registration to remain valid until the expiry date.

The stamped copy of the approved registration and the invoice are mailed separately. Should you have any questions or require further assistance, please contact a Customer Service Advisor at 1.877.682.TSSA (8772) or e-mail customerservices@tssa.org. We will be happy to assist you. When contacting TSSA regarding this file, please refer to the Service Request number provided above

Yours truly,

Liliana Constantinescu
Tel. : 416-734-3425

NOTE: You cannot save the DATA you entered on this form, you must print a copy and FAX it or MAIL it!

Technical Standards and Safety Authority
345 Carlingview Drive
Toronto, Ontario M9W 6N9
www.tssa.org

Show facsimile of manufacturer's logo or trademark, as it will appear on the fitting, in the space below

STATUTORY DECLARATION
Registration of Fittings

I, Karl Klinger, Director of Marketing
(Name and Position, e.g. President, Plant Manager, Chief Engineer)

of ifm efector, inc.
(Name of Manufacturer)

Located at 1100 Atwater Drive, Malvern, PA 19355 610-524-2000 610-524-2800
(Plant Address) *(Telephone No.)* *(Fax No.)*

☐ do solemnly declare that the fittings listed hereunder, which are subject to the ***Technical Standards and Safety Act***, Boilers and Pressure Vessels Regulation, comply with all of the requirements of

(Title of recognized North American Standard)

which specifies the dimensions, materials of construction, pressure/temperature ratings, identification marking the fittings and service;

☑ or are not covered by the provisions of a recognized North American standard and are therefore manufactured to comply with ASME B31.3 2012 ED. as supported by the attached data which identifies the dimensions, material of construction, pressure/temperature ratings and the basis for such ratings, the marking of the fitting for identification and service.

I further declare that the manufacture of these fittings is controlled by a quality system meeting the requirements of ISO 9001:2008 which has been verified by the following authority, DQS GmbH.

The items covered by this declaration, for which I seek registration, are category F type fittings. In support of this application, the following information and/or test data are attached as follows:

Test reports and drawings for sensor families LM (level), PG, PI & PM (pressure) and SA, SB, SI, SM & SV (flow)
(drawings, calculations, test reports, etc.)

Declared before me at 1100 Atwater Dr **in the** State **of** PA

the 4th **day of** May **AD 20** 17.

COMMONWEALTH OF PENNSYLVANIA
NOTARIAL SEAL
Maureen G. Marabella, Notary Public
West Whiteland Twp., Chester County
My Commission Expires July 27, 2018
MEMBER, PENNSYLVANIA ASSOCIATION OF NOTARIES

Commissioner for Oaths:

Maureen Marabella
(Printed name)

Maureen G Marabella
(Signature)

K. Klinger
(Signature of Declarer)

FOR OFFICE USE ONLY

To the best of my knowledge and belief, the application meets the requirements of the ***Technical Standards and Safety Act***, Boilers and Pressure Vessels Regulation, and CSA Standard B51 and is accepted for registration in Category F.

CRN: OF20267.5

Registered by:

Dated: April 18, 2018

NOTE: This registration expires on: April 18, 2028

Technical Standards and Safety Authority — Boilers and Pressure Vessels Safety Program
REGISTERED
C.R.N.: OF20267.5
Signed:
Date: April 18, 2018

**Information provided in this application is releasable under the Freedom of Information and Privacy Protection Act and may be disclosed upon request.*

PV 09553 (04/17)

See attached stamped Scope of registration

IFM Flow Sensors - CRN Scope of Registration

Design Code: ASME B31.3 2014 Edition
Design Pressure and Temperature: See Chart Below
Hydrotest Pressure: See Chart Below
Corrosion Allowance: None
Impact Testing: Exempt per paragraph 323.2.2
Radiography: None

Nearest equivalent ASME or ASTM material specification:		
1.4404	ASTM A276 Type 316L	UNS S31603
1.4404	ASTM A312 Type TP316L	UNS S31603

Cat. No.	Description	Pressure / bar				Temp. Range	1: Process Connection						2: gasket					3: Tube					4: Sensor tip				
		Tested Bursting Pressure B	Factor of safety	Rated MAWP	MAWP in Data Sheet		Dimension	Material Number	Material Name	ref. to Standard	Art. No.	Refer to Assembly Drawing	Material Number	Material Name	ref. to Standard	Art. No.	Refer to Assembly Drawing	Material Number	Material Name	ref. to Standard	Art. No.	Refer to Assembly Drawing	Material Number	Material Name	ref. to Standard	Art. No.	Refer to Assembly Drawing
SA2000	tested sensor				85	-20...90 °C -4...194 °F	G1/2"	1.4404	X2CrNiMo17-12-2	DIN EN 10088-3: 2014	80230120	11121114	FKM	na	na	700426	11121114	No tube					1.4404	X2CrNiMo17-12-2	DIN EN 10088-3: 2014	80235277	11121114
SA2004	ref to SA2000				85	-20...90 °C -4...194 °F	G1/2"	1.4404	X2CrNiMo17-12-2	DIN EN 10088-3: 2014	80230120	11121114	FKM	na	na	700426	11121114	No tube					1.4404	X2CrNiMo17-12-2	DIN EN 10088-3: 2014	80235277	11121114
SA6010	tested sensor				100	-20...90 °C -4...194 °F	1/2-14 NPT male	1.4404	X2CrNiMo17-12-2	DIN EN 10088-3: 2014	80230119	11136109	No gasket					No tube					1.4404	X2CrNiMo17-12-2	DIN EN 10088-3: 2014	80235277	11136109
SA6014	ref to SA6010				100	-20...90 °C -4...194 °F	1/2-14 NPT male	1.4404	X2CrNiMo17-12-2	DIN EN 10088-3: 2014	80230119	11136109	No gasket					No tube					1.4404	X2CrNiMo17-12-2	DIN EN 10088-3: 2014	80235277	11136109
SA4100	tested sensor				50	-20...100 °C -4...212 °F	Dia 8mm	1.4404	X2CrNiMo17-12-2	DIN EN 10088-3: 2014	80230118	11120039	No gasket					1.4404	X2CrNiMo17-12-2	DIN EN 10088-3: 2014	80221732	11120039	1.4404	X2CrNiMo17-12-2	DIN EN 10088-3: 2014	80235277	11120039
SA4104	ref to SA4100				50	-20...100 °C -4...212 °F	Dia 8mm	1.4404	X2CrNiMo17-12-2	DIN EN 10088-3: 2014	80230118	11120039	No gasket					1.4404	X2CrNiMo17-12-2	DIN EN 10088-3: 2014	80221732	11120039	1.4404	X2CrNiMo17-12-2	DIN EN 10088-3: 2014	80235277	11120039
SA4110	ref to SA4100				50	-20...100 °C -4...212 °F	Dia 8mm	1.4404	X2CrNiMo17-12-2	DIN EN 10088-3: 2014	80230118	11120039	No gasket					1.4404	X2CrNiMo17-12-2	DIN EN 10088-3: 2014	80221732	11120039	1.4404	X2CrNiMo17-12-2	DIN EN 10088-3: 2014	80235277	11120039
SA4300	ref to SA4100				50	-20...100 °C -4...212 °F	Dia 8mm	1.4404	X2CrNiMo17-12-2	DIN EN 10088-3: 2014	80230118	11120039	No gasket					1.4404	X2CrNiMo17-12-2	DIN EN 10088-3: 2014	80221238	11120039	1.4404	X2CrNiMo17-12-2	DIN EN 10088-3: 2014	80235277	11120039
SA4304	ref to SA4100				50	-20...100 °C -4...212 °F	Dia 8mm	1.4404	X2CrNiMo17-12-2	DIN EN 10088-3: 2014	80230118	11120039	No gasket					1.4404	X2CrNiMo17-12-2	DIN EN 10088-3: 2014	80221238	11120039	1.4404	X2CrNiMo17-12-2	DIN EN 10088-3: 2014	80235277	11120039
SA4310	ref to SA4100				50	-20...100 °C -4...212 °F	Dia 8mm	1.4404	X2CrNiMo17-12-2	DIN EN 10088-3: 2014	80230118	11120039	No gasket					1.4404	X2CrNiMo17-12-2	DIN EN 10088-3: 2014	80221238	11120039	1.4404	X2CrNiMo17-12-2	DIN EN 10088-3: 2014	80235277	11120039
SA5000	tested sensor				100	-20...90 °C -4...194 °F	Conic 24° / Dia: 9,8mm	1.4404	X2CrNiMo17-12-2	DIN EN 10088-3: 2014	80230117	11119714	FKM	na	na	580801	11119714	1.4404	X2CrNiMo17-12-2	DIN EN 10088-3: 2014	80011927	11119714	1.4404	X2CrNiMo17-12-2	DIN EN 10088-3: 2014	80235277	11119714
SA5004	ref to SA5000				100	-20...90 °C -4...194 °F	Conic 24° / Dia: 9,8mm	1.4404	X2CrNiMo17-12-2	DIN EN 10088-3: 2014	80230117	11119714	FKM	na	na	580801	11119714	1.4404	X2CrNiMo17-12-2	DIN EN 10088-3: 2014	80011927	11119714	1.4404	X2CrNiMo17-12-2	DIN EN 10088-3: 2014	80235277	11119714
SA5030	ref to SA5000				100	-20...90 °C -4...194 °F	Conic 24° / Dia: 9,8mm	1.4404	X2CrNiMo17-12-2	DIN EN 10088-3: 2014	80230117	11119714	FKM	na	na	580801	11119714	1.4404	X2CrNiMo17-12-2	DIN EN 10088-3: 2014	80011927	11119714	1.4404	X2CrNiMo17-12-2	DIN EN 10088-3: 2014	80235277	11119714

THIS IS PART OF
CRN 0F20267.5
Technical Standards & Safety Authority
Boilers & Pressure Vessels
Safety Program

IFM Level Sensors - CRN Scope of Registration

Design Code: ASME B31.3 2014 Edition
Design Pressure and Temperature: See Chart Below
Hydrotest Pressure: See Chart Below
Corrosion Allowance: None
Impact Testing: Exempt per paragraph 323.2.2
Radiography: None

Nearest equivalent ASME or ASTM material specification:		
1.4404	ASTM A276 Type 316L	UNS S31603
CW614N	ASTM B455	UNS C38500

Cat. No.	Description	Pressure / bar				Temp. Range	1: PCB				2: Process Connection					3: Potting Compound				4: Gasket				5: O-Ring				6: Filler				7: Electrode				7: Sensor Tip				Assembly Group / Dimension Drawing
		Tested Bursting Pressure B	Factor of safety	Max. MAWP	MAWP in Data Sheet		Material No.	Material Name	ref. to Standard	Art. No.	Dimension	Material No.	Material Name	ref. to Standard	Art. No.	Material No.	Material Name	ref. to Standard	Art. No.	Material No.	Material Name	ref. to Standard	Art. No.	Material No.	Material Name	ref. to Standard	Art. No.	Material No.	Material Name	ref. to Standard	Art. No.	Material No.	Material Name	ref. to Standard	Art. No.	Material No.	Material Name	ref. to Standard	Art. No.	Drawing No.
LMC100	Level Sensor	[redacted]			40	-40 .... 100 °C -40 .... 212 °F	-	FR4	-	80261079	G 1/2	1.4404	X2CrNiMo17-12-2	DIN EN 10088	80254822	-	Epoxy Resin	-	5740203 / 703246	-	U-Ring NBR	-	80236282	-	FKM	-	80254403	-	PP GF30	-	80254196	CW614N	CuZn39Pb3	DIN EN 12164	80254946	-	PEEK	-	80236617	11120069
LMC110	Level Sensor				40	-40 .... 100 °C -40 .... 212 °F	-	FR4	-	80261079	G 1/2	1.4404	X2CrNiMo17-12-2	DIN EN 10088	80254822	-	Epoxy Resin	-	5740203 / 703246	-	U-Ring NBR	-	80236282	-	FKM	-	80254403	-	PP GF30	-	80254196	CW614N	CuZn39Pb3	DIN EN 12164	80254946	-	PEEK	-	80236617	11120069
LMC400	Level Sensor				40	-40 .... 100 °C -40 .... 212 °F	-	FR4	-	80261079	G 1/2	1.4404	X2CrNiMo17-12-2	DIN EN 10088	80254824	-	Epoxy Resin	-	5740203 / 703246	-	U-Ring NBR	-	80236282	-	FKM	-	80254403	-	PP GF30	-	80254196	CW614N	CuZn39Pb3	DIN EN 12164	80254946	-	PEEK	-	80236617	11120069
LMC410	Level Sensor				40	-40 .... 100 °C -40 .... 212 °F	-	FR4	-	80261079	G 1/2	1.4404	X2CrNiMo17-12-2	DIN EN 10088	80254824	-	Epoxy Resin	-	5740203 / 703246	-	U-Ring NBR	-	80236282	-	FKM	-	80254403	-	PP GF30	-	80254196	CW614N	CuZn39Pb3	DIN EN 12164	80254946	-	PEEK	-	80236617	11120069
LMC500	Level Sensor				40	-40 .... 100 °C -40 .... 212 °F	-	FR4	-	80261079	1/2 NPT	1.4404	X2CrNiMo17-12-2	DIN EN 10088	80254823	-	Epoxy Resin	-	5740203 / 703246	-	-	-	-	-	FKM	-	80254403	-	PP GF30	-	80254196	CW614N	CuZn39Pb3	DIN EN 12164	80254946	-	PEEK	-	80236617	11120069
LMC510	Level Sensor				40	-40 .... 100 °C -40 .... 212 °F	-	FR4	-	80261079	1/2 NPT	1.4404	X2CrNiMo17-12-2	DIN EN 10088	80254823	-	Epoxy Resin	-	5740203 / 703246	-	-	-	-	-	FKM	-	80254403	-	PP GF30	-	80254196	CW614N	CuZn39Pb3	DIN EN 12164	80254946	-	PEEK	-	80236617	11120069

THIS IS PART OF
CRN OF20267.5
Technical Standards & Safety Authority
Boilers & Pressure Vessels
Safety Program

IFM Flow Sensors - CRN Scope of Registration

Design Code: ASME B31.3 2014 Edition
Design Pressure and Temperature: See Chart Below
Hydrotest Pressure: See Chart Below
Corrosion Allowance: None
Impact Testing: Exempt per paragraph 323.2.2
Radiography: None

Nearest equivalent ASME or ASTM material specification:		
1.4404	ASTM A276 Type 316L	UNS S31603
CW617N	ASTM B124	UNS C37700

Cat. No.	Description	Pressure Data				Temp. Range	1: Process Connection						2: Mandrel					3: Plug						4: Connecting Piece				
		Tested Bursting Pressure B	Factor of safety	Max. MAWP	MAWP in Data Sheet		Dimension	Material Number	Material Name	ref. to Standard	Art. No.	Refer to Assembly Drawing	Material Number	Material Name	ref. to Standard	Art. No.	Refer to Assembly Drawing	Dimension	Material Number	Material Name	ref. to Standard	Art. No.	Refer to Assembly Drawing	Material Number	Material Name	ref. to Standard	Art. No.	Refer to Assembly Drawing
SBY232	Flow Sensor	[redacted]			40	-10...100 °C 14...212 °F	Rp 3/4	[redacted]					PPS GF40	[redacted]				G3/4	1.4404	X2CrNiMo17-12-2	DIN EN 10088-3	80225910	11128406	n/a	n/a	n/a	n/a	11128406
SBY233	Flow Sensor				40	-10...100 °C 14...212 °F	Rp 3/4						PPS GF40					G3/4	1.4404	X2CrNiMo17-12-2	DIN EN 10088-3	80225910	11128406	n/a	n/a	n/a	n/a	11128406
SBY234	Flow Sensor				40	-10...100 °C 14...212 °F	Rp 3/4						PPS GF40					G3/4	1.4404	X2CrNiMo17-12-2	DIN EN 10088-3	80225910	11128406	n/a	n/a	n/a	n/a	11128406
SBG232	Flow Sensor				40	-10...100 °C 14...212 °F	G 1/2						PPS GF40					G3/4	1.4404	X2CrNiMo17-12-2	DIN EN 10088-3	80225910	11128406	n/a	n/a	n/a	n/a	11128406
SBG233	Flow Sensor				40	-10...100 °C 14...212 °F	G 1/2						PPS GF40					G3/4	1.4404	X2CrNiMo17-12-2	DIN EN 10088-3	80225910	11128406	n/a	n/a	n/a	n/a	11128406
SBG234	Flow Sensor				40	-10...100 °C 14...212 °F	G 1/2						PPS GF40					G3/4	1.4404	X2CrNiMo17-12-2	DIN EN 10088-3	80225910	11128406	n/a	n/a	n/a	n/a	11128406
SBN232	Flow Sensor				40	-10...100 °C 14...212 °F	NPT 3/4						PPS GF40					G3/4	1.4404	X2CrNiMo17-12-2	DIN EN 10088-3	80225910	11128406	n/a	n/a	n/a	n/a	11128406
SBN233	Flow Sensor				40	-10...100 °C 14...212 °F	NPT 3/4						PPS GF40					G3/4	1.4404	X2CrNiMo17-12-2	DIN EN 10088-3	80225910	11128406	n/a	n/a	n/a	n/a	11128406
SBN234	Flow Sensor				40	-10...100 °C 14...212 °F	NPT 3/4						PPS GF40					G3/4	1.4404	X2CrNiMo17-12-2	DIN EN 10088-3	80225910	11128406	n/a	n/a	n/a	n/a	11128406
SBY246	Flow Sensor				25	-10...100 °C 14...212 °F	Rp 1						PPS GF40					G1	1.4404	X2CrNiMo17-12-2	DIN EN 10088-3	80225936	11128449	n/a	n/a	n/a	n/a	11128449
SBG246	Flow Sensor				25	-10...100 °C 14...212 °F	G 3/4						PPS GF40					G1	1.4404	X2CrNiMo17-12-2	DIN EN 10088-3	80225936	11128449	n/a	n/a	n/a	n/a	11128449
SBN246	Flow Sensor				25	-10...100 °C 14...212 °F	NPT 1						PPS GF40					G1	1.4404	X2CrNiMo17-12-2	DIN EN 10088-3	80225936	11128449	n/a	n/a	n/a	n/a	11128449
SBY257	Flow Sensor				25	-10...100 °C 14...212 °F	Rp 1 1/2						PPS GF40					G 1 1/2	1.4404	X2CrNiMo17-12-2	DIN EN 10088-3	80225937	11128449	1.4404	X2CrNiMo17-12-2	DIN EN 10088-3	80225938	11128449
SBG257	Flow Sensor				25	-10...100 °C 14...212 °F	G 1 1/2						PPS GF40					G 1 1/2	1.4404	X2CrNiMo17-12-2	DIN EN 10088-3	80225937	11128449	1.4404	X2CrNiMo17-12-2	DIN EN 10088-3	80225938	11128449
SBN257	Flow Sensor				25	-10...100 °C 14...212 °F	NPT 1 1/2						PPS GF40					G 1 1/2	1.4404	X2CrNiMo17-12-2	DIN EN 10088-3	80225937	11128449	1.4404	X2CrNiMo17-12-2	DIN EN 10088-3	80225938	11128449

THIS IS PART OF CRN OF20267.5
Technical Standards & Safety Authority
Boilers & Pressure Vessels
Safety Program

IFM Pressure Sensors - CRN Scope of Registration

Design Code: ASME B31.3 2014 Edition
Design Pressure and Temperature: See Chart Below
Hydrotest Pressure: See Chart Below
Corrosion Allowance: None
Impact Testing: Exempt per paragraph 323.2.2
Radiography: None

Nearest equivalent ASME or ASTM material specification:		
1.4435	ASTM A276 Type 316L	UNS S31603
CW614N	ASTM B455	UNS C38500

THIS IS FAR
CRN 0F20267.5
Technical Standards & Safety Authority
Boilers & Pressure Vessels
Safety Program

Cat. No.	Description	Pressure / bar				Temp. Range	1: Process Connection						2: Pressure Cell					3: Cell Fixing					4: Gasket Support					5: Gasket					Assembly Group / Dimension Drawing	Grouping Reason
		Tested Bursting Pressure B	Factor of safety	Max. MAWP	MAWP in Data Sheet		Dimension	Material Number	Material Name	ref. to Standard	Art. No.	Refer to Assembly Drawing	Nominal Pressure	Material Number	Material Name	ref. to Standard	Art. No.	Refer to Assembly Drawing	Material Number	Material Name	ref. to Standard	Art. No.	Refer to Assembly Drawing	Material Number	Material Name	ref. to Standard	Art. No.	Refer to Assembly Drawing	Material Number	Material Name	ref. to Standard	Art. No.	Refer to Assembly Drawing	Drawing No.	Drawing No.
PG2734	Pressure Sensor				50	-25...150 °C -13...302 °F	G1 EXTERNAL ASEPTOFLEX VARIO	1.4435	X2CrNiMo18-14-3	DIN EN 10088-3	50015939	11128653	1000 kPa (10 bar)	AL2O3 99.9%	n/a	n/a	585584	11128653												PTFE	n/a	n/a	583739	11128653	11128653	11128653
PG2789	Pressure Sensor				4	-25...150 °C -13...302 °F	G1 EXTERNAL ASEPTOFLEX VARIO	1.4435	X2CrNiMo18-14-3	DIN EN 10088-3	80234172	11128662	0,1 bar	AL2O3 99.9%	n/a	n/a	585589	11128662												PTFE	n/a	n/a	583738	11128662	11128662	11128662
PG2793	Pressure Sensor				60	-25...150 °C -13...302 °F	G1 EXTERNAL ASEPTOFLEX VARIO	1.4435	X2CrNiMo18-14-3	DIN EN 10088-3	50015939	11128653	25 bar	AL2O3 99.9%	n/a	n/a	585583	11128653												PTFE	n/a	n/a	583739	11128653	11128653	11128653
PG2794	Pressure Sensor				50	-25...150 °C -13...302 °F	G1 EXTERNAL ASEPTOFLEX VARIO	1.4435	X2CrNiMo18-14-3	DIN EN 10088-3	50015939	11128653	10 bar	AL2O3 99.9%	n/a	n/a	585584	11128653												PTFE	n/a	n/a	583739	11128653	11128653	11128653
PG2795	Pressure Sensor				30	-25...150 °C -13...302 °F	G1 EXTERNAL ASEPTOFLEX VARIO	1.4435	X2CrNiMo18-14-3	DIN EN 10088-3	50015939	11128653	4 bar	AL2O3 99.9%	n/a	n/a	585585	11128653												PTFE	n/a	n/a	583739	11128653	11128653	11128653
PG2796	Pressure Sensor				20	-25...150 °C -13...302 °F	G1 EXTERNAL ASEPTOFLEX VARIO	1.4435	X2CrNiMo18-14-3	DIN EN 10088-3	50015939	11128653	2,5 bar	AL2O3 99.9%	n/a	n/a	585586	11128653												PTFE	n/a	n/a	583739	11128653	11128653	11128653
PG2797	Pressure Sensor				10	-25...150 °C -13...302 °F	G1 EXTERNAL ASEPTOFLEX VARIO	1.4435	X2CrNiMo18-14-3	DIN EN 10088-3	50015939	11128653	1 bar	AL2O3 99.9%	n/a	n/a	585587	11128653												PTFE	n/a	n/a	583739	11128653	11128653	11128653
PG2798	Pressure Sensor				10	-25...150 °C -13...302 °F	G1 EXTERNAL ASEPTOFLEX VARIO	1.4435	X2CrNiMo18-14-3	DIN EN 10088-3	80234172	11128662	0,25 bar	AL2O3 99.9%	n/a	n/a	585588	11128662												PTFE	n/a	n/a	583738	11128662	11128662	11128662
PG2799	Pressure Sensor				10	-25...150 °C -13...302 °F	G1 EXTERNAL ASEPTOFLEX VARIO	1.4435	X2CrNiMo18-14-3	DIN EN 10088-3	50015939	11128653	±1 bar	AL2O3 99.9%	n/a	n/a	585587	11128653												PTFE	n/a	n/a	583739	11128653	11128653	11128653
PG2889	Pressure Sensor				4	-25...150 °C -13...302 °F	G1 EXTERNAL SEALING CONE WITH UNION NUT	1.4435	X2CrNiMo18-14-3	DIN EN 10088-3	50019345	11130069	0,1 bar	AL2O3 99.9%	n/a	n/a	585589	11130069												PTFE	n/a	n/a	583738	11130069	11130069	11130069
PG2893	Pressure Sensor				60	-25...150 °C -13...302 °F	G1 EXTERNAL SEALING CONE WITH UNION NUT	1.4435	X2CrNiMo18-14-3	DIN EN 10088-3	50018943	11130072	25 bar	AL2O3 99.9%	n/a	n/a	585583	11130072												PTFE	n/a	n/a	583739	11130072	11130072	11130072
PG2894	Pressure Sensor				50	-25...150 °C -13...302 °F	G1 EXTERNAL SEALING CONE WITH UNION NUT	1.4435	X2CrNiMo18-14-3	DIN EN 10088-3	50018943	11130072	10 bar	AL2O3 99.9%	n/a	n/a	585584	11130072												PTFE	n/a	n/a	583739	11130072	11130072	11130072
PG2895	Pressure Sensor				30	-25...150 °C -13...302 °F	G1 EXTERNAL SEALING CONE WITH UNION NUT	1.4435	X2CrNiMo18-14-3	DIN EN 10088-3	50018943	11130072	4 bar	AL2O3 99.9%	n/a	n/a	585585	11130072												PTFE	n/a	n/a	583739	11130072	11130072	11130072
PG2896	Pressure Sensor				20	-25...150 °C -13...302 °F	G1 EXTERNAL SEALING CONE WITH UNION NUT	1.4435	X2CrNiMo18-14-3	DIN EN 10088-3	50018943	11130072	2,5 bar	AL2O3 99.9%	n/a	n/a	585586	11130072												PTFE	n/a	n/a	583739	11130072	11130072	11130072
PG2897	Pressure Sensor				10	-25...150 °C -13...302 °F	G1 EXTERNAL SEALING CONE WITH UNION NUT	1.4435	X2CrNiMo18-14-3	DIN EN 10088-3	50018943	11130072	1 bar	AL2O3 99.9%	n/a	n/a	585587	11130072												PTFE	n/a	n/a	583739	11130072	11130072	11130072
PG2898	Pressure Sensor				10	-25...150 °C -13...302 °F	G1 EXTERNAL SEALING CONE WITH UNION NUT	1.4435	X2CrNiMo18-14-3	DIN EN 10088-3	50019345	11130069	0,25 bar	AL2O3 99.9%	n/a	n/a	585588	11130069												PTFE	n/a	n/a	583738	11130069	11130069	11130069
PG2899	Pressure Sensor				10	-25...150 °C -13...302 °F	G1 EXTERNAL SEALING CONE WITH UNION NUT	1.4435	X2CrNiMo18-14-3	DIN EN 10088-3	50018943	11130072	±1 bar	AL2O3 99.9%	n/a	n/a	585587	11130072												PTFE	n/a	n/a	583739	11130072	11130072	11130072
PI2714	Pressure Sensor				60	-25...150 °C -13...302 °F	G1 EXTERNAL ASEPTOFLEX VARIO	1.4435	X2CrNiMo18-14-3	DIN EN 10088-3	80255321	11128653	16 bar	AL2O3 99.9%	n/a	n/a	80236654	11128653												PTFE	n/a	n/a	583739	11128653	11128653	11128653
PI2715	Pressure Sensor				30	-25...150 °C -13...302 °F	G1 EXTERNAL ASEPTOFLEX VARIO	1.4435	X2CrNiMo18-14-3	DIN EN 10088-3	80255321	11128653	6 bar	AL2O3 99.9%	n/a	n/a	585585	11128653												PTFE	n/a	n/a	583739	11128653	11128653	11128653
PI2717	Pressure Sensor				15	-25...150 °C -13...302 °F	G1 EXTERNAL ASEPTOFLEX VARIO	1.4435	X2CrNiMo18-14-3	DIN EN 10088-3	80255321	11128653	1,6 bar	AL2O3 99.9%	n/a	n/a	80236653	11128653												PTFE	n/a	n/a	583739	11128653	11128653	11128653
PI2789	Pressure Sensor				4	-25...150 °C -13...302 °F	G1 EXTERNAL ASEPTOFLEX VARIO	1.4435	X2CrNiMo18-14-3	DIN EN 10088-3	80237713	11128662	0,1 bar	AL2O3 99.9%	n/a	n/a	585589	11128662												PTFE	n/a	n/a	583738	11128662	11128662	11128662
PI2793	Pressure Sensor				60	-25...150 °C -13...302 °F	G1 EXTERNAL ASEPTOFLEX VARIO	1.4435	X2CrNiMo18-14-3	DIN EN 10088-3	50020668	11128653	25 bar	AL2O3 99.9%	n/a	n/a	583883	11128653												PTFE	n/a	n/a	583739	11128653	11128653	11128653
PI2794	Pressure Sensor				50	-25...150 °C -13...302 °F	G1 EXTERNAL ASEPTOFLEX VARIO	1.4435	X2CrNiMo18-14-3	DIN EN 10088-3	50020668	11128653	10 bar	AL2O3 99.9%	n/a	n/a	583884	11128653												PTFE	n/a	n/a	583739	11128653	11128653	11128653
PI2795	Pressure Sensor				30	-25...150 °C -13...302 °F	G1 EXTERNAL ASEPTOFLEX VARIO	1.4435	X2CrNiMo18-14-3	DIN EN 10088-3	50020668	11128653	4 bar	AL2O3 99.9%	n/a	n/a	583885	11128653												PTFE	n/a	n/a	583739	11128653	11128653	11128653
PI2796	Pressure Sensor				20	-25...150 °C -13...302 °F	G1 EXTERNAL ASEPTOFLEX VARIO	1.4435	X2CrNiMo18-14-3	DIN EN 10088-3	50020668	11128653	2,5 bar	AL2O3 99.9%	n/a	n/a	583886	11128653												PTFE	n/a	n/a	583739	11128653	11128653	11128653
PI2797	Pressure Sensor				10	-25...150 °C -13...302 °F	G1 EXTERNAL ASEPTOFLEX VARIO	1.4435	X2CrNiMo18-14-3	DIN EN 10088-3	50020668	11128653	1 bar	AL2O3 99.9%	n/a	n/a	583887	11128653												PTFE	n/a	n/a	583739	11128653	11128653	11128653
PI2798	Pressure Sensor				10	-25...150 °C -13...302 °F	G1 EXTERNAL ASEPTOFLEX VARIO	1.4435	X2CrNiMo18-14-3	DIN EN 10088-3	80237713	11128662	0,25 bar	AL2O3 99.9%	n/a	n/a	583888	11128662												PTFE	n/a	n/a	583738	11128662	11128662	11128662
PI2799	Pressure Sensor				10	-25...150 °C -13...302 °F	G1 EXTERNAL ASEPTOFLEX VARIO	1.4435	X2CrNiMo18-14-3	DIN EN 10088-3	50020668	11128653	±1 bar	AL2O3 99.9%	n/a	n/a	583889	11128653												PTFE	n/a	n/a	583739	11128653	11128653	11128653
PI2814	Pressure Sensor				50	-25...150 °C -13...302 °F	G1 EXTERNAL SEALING CONE WITH UNION NUT	1.4435	X2CrNiMo18-14-3	DIN EN 10088-3	80256382	11130072	16 bar	AL2O3 99.9%	n/a	n/a	80236654	11130072												PTFE	n/a	n/a	583739	11130072	11130072	11130072
PI2815	Pressure Sensor				30	-25...150 °C -13...302 °F	G1 EXTERNAL SEALING CONE WITH UNION NUT	1.4435	X2CrNiMo18-14-3	DIN EN 10088-3	80256382	11130072	6 bar	AL2O3 99.9%	n/a	n/a	585585	11130072												PTFE	n/a	n/a	583739	11130072	11130072	11130072
PI2817	Pressure Sensor				15	-25...150 °C -13...302 °F	G1 EXTERNAL SEALING CONE WITH UNION NUT	1.4435	X2CrNiMo18-14-3	DIN EN 10088-3	80256382	11130072	1,6 bar	AL2O3 99.9%	n/a	n/a	80236653	11130072												PTFE	n/a	n/a	583739	11130072	11130072	11130072
PI2889	Pressure Sensor				4	-25...150 °C -13...302 °F	G1 EXTERNAL SEALING CONE WITH UNION NUT	1.4435	X2CrNiMo18-14-3	DIN EN 10088-3	50019345	11130069	0,1 bar	AL2O3 99.9%	n/a	n/a	585589	11130069												PTFE	n/a	n/a	583738	11130069	11130069	11130069
PI2893	Pressure Sensor				60	-25...150 °C -13...302 °F	G1 EXTERNAL SEALING CONE WITH UNION NUT	1.4435	X2CrNiMo18-14-3	DIN EN 10088-3	50018943	11130072	25 bar	AL2O3 99.9%	n/a	n/a	585583	11130072												PTFE	n/a	n/a	583739	11130072	11130072	11130072
PI2894	Pressure Sensor				50	-25...150 °C -13...302 °F	G1 EXTERNAL SEALING CONE WITH UNION NUT	1.4435	X2CrNiMo18-14-3	DIN EN 10088-3	50018943	11130072	10 bar	AL2O3 99.9%	n/a	n/a	585584	11130072												PTFE	n/a	n/a	583739	11130072	11130072	11130072
PI2895	Pressure Sensor				30	-25...150 °C -13...302 °F	G1 EXTERNAL SEALING CONE WITH UNION NUT	1.4435	X2CrNiMo18-14-3	DIN EN 10088-3	50018943	11130072	4 bar	AL2O3 99.9%	n/a	n/a	585585	11130072												PTFE	n/a	n/a	583739	11130072	11130072	11130072
PI2896	Pressure Sensor				20	-25...150 °C -13...302 °F	G1 EXTERNAL SEALING CONE WITH UNION NUT	1.4435	X2CrNiMo18-14-3	DIN EN 10088-3	50018943	11130072	2,5 bar	AL2O3 99.9%	n/a	n/a	585586	11130072												PTFE	n/a	n/a	583739	11130072	11130072	11130072
PI2897	Pressure Sensor				10	-25...150 °C -13...302 °F	G1 EXTERNAL SEALING CONE WITH UNION NUT	1.4435	X2CrNiMo18-14-3	DIN EN 10088-3	50018943	11130072	1 bar	AL2O3 99.9%	n/a	n/a	585587	11130072												PTFE	n/a	n/a	583739	11130072	11130072	11130072
PI2898	Pressure Sensor				10	-25...150 °C -13...302 °F	G1 EXTERNAL SEALING CONE WITH UNION NUT	1.4435	X2CrNiMo18-14-3	DIN EN 10088-3	50019345	11130069	0,25 bar	AL2O3 99.9%	n/a	n/a	583888	11130069												PTFE	n/a	n/a	583738	11130069	11130069	11130069
PI2899	Pressure Sensor				10	-25...150 °C -13...302 °F	G1 EXTERNAL SEALING CONE WITH UNION NUT	1.4435	X2CrNiMo18-14-3	DIN EN 10088-3	50018943	11130072	±1 bar	AL2O3 99.9%	n/a	n/a	585587	11130072												PTFE	n/a	n/a	583739	11130072	11130072	11130072
PM1603	Pressure Sensor				45	-25...150 °C -13...302 °F	G1 EXTERNAL SEALING CONE	1.4435	X2CrNiMo18-14-3	DIN EN 10088-3	80255344	11128633	25 bar	AL2O3 99.9%	n/a	n/a	583883	11128633												PTFE	n/a	n/a	583739	11128633	11128633	11128633
PM1604	Pressure Sensor				50	-25...150 °C -13...302 °F	G1 EXTERNAL SEALING CONE	1.4435	X2CrNiMo18-14-3	DIN EN 10088-3	80255344	11128633	10 bar	AL2O3 99.9%	n/a	n/a	583884	11128633												PTFE	n/a	n/a	583739	11128633	11128633	11128633
PM1605	Pressure Sensor				30	-25...150 °C -13...302 °F	G1 EXTERNAL SEALING CONE	1.4435	X2CrNiMo18-14-3	DIN EN 10088-3	80255344	11128633	4 bar	AL2O3 99.9%	n/a	n/a	583885	11128633												PTFE	n/a	n/a	583739	11128633	11128633	11128633
PM1606	Pressure Sensor				20	-25...150 °C -13...302 °F	G1 EXTERNAL SEALING CONE	1.4435	X2CrNiMo18-14-3	DIN EN 10088-3	80255344	11128633	2,5 bar	AL2O3 99.9%	n/a	n/a	583886	11128633												PTFE	n/a	n/a	583739	11128633	11128633	11128633
PM1607	Pressure Sensor				10	-25...150 °C -13...302 °F	G1 EXTERNAL SEALING CONE	1.4435	X2CrNiMo18-14-3	DIN EN 10088-3	80255344	11128644	1 bar	AL2O3 99.9%	n/a	n/a	583887	11128644												PTFE	n/a	n/a	583739	11128644	11128644	11128644
PM1608	Pressure Sensor				10	-25...150 °C -13...302 °F	G1 EXTERNAL SEALING CONE	1.4435	X2CrNiMo18-14-3	DIN EN 10088-3	80233143	11128645	0,25 bar	AL2O3 99.9%	n/a	n/a	583888	11128645												PTFE	n/a	n/a	583738	11128645	11128645	11128645
PM1609	Pressure Sensor				10	-25...150 °C -13...302 °F	G1 EXTERNAL SEALING CONE	1.4435	X2CrNiMo18-14-3	DIN EN 10088-3	80255344	11128644	1 bar	AL2O3 99.9%	n/a	n/a	583887	11128644												PTFE	n/a	n/a	583739	11128644	11128644	11128644

IFM Pressure Sensors - CRN Scope of Registration

Design Code: ASME B31.3 2014 Edition
Design Pressure and Temperature: See Chart Below
Hydrotest Pressure: See Chart Below
Corrosion Allowance: None
Impact Testing: Exempt per paragraph 323.2.2
Radiography: None

Nearest equivalent ASME or ASTM material specification:		
1.4435	ASTM A276 Type 316L	UNS S31603
CW614N	ASTM B455	UNS C38500

Cat. No.	Description	Pressure / bar				Temp. Range	1: Process Connection						2: Pressure Cell						3: Cell Fixing					4: Gasket Support					5: Gasket					Assembly Group / Dimension Drawing	Grouping Reason
		Tested Bursting Pressure B	Factor of safety	Max. MAWP	MAWP in Data Sheet		Dimension	Material Number	Material Name	ref. to Standard	Art. No.	Refer to Assembly Drawing	Nominal Pressure	Material Number	Material Name	ref. to Standard	Art. No.	Refer to Assembly Drawing	Material Number	Material Name	ref. to Standard	Art. No.	Refer to Assembly Drawing	Material Number	Material Name	ref. to Standard	Art. No.	Refer to Assembly Drawing	Material Number	Material Name	ref. to Standard	Art. No.	Refer to Assembly Drawing	Drawing No.	Drawing No.
PM1614	Pressure Sensor	[redacted]			55	-25...150 °C -13...302 °F	G1 EXTERNAL SEALING CONE	1.4435	X2CrNiMo18-14-3	DIN EN 10088-3	80255344	11128633	16 bar	AL2O3 99.9%	n/a	n/a	80236654	11128633	[redacted]										PTFE	n/a	n/a	583739	11128633	11128633	11128633
PM1615	Pressure Sensor				30	-25...150 °C -13...302 °F	G1 EXTERNAL SEALING CONE	1.4435	X2CrNiMo18-14-3	DIN EN 10088-3	80255344	11128633	6 bar	AL2O3 99.9%	n/a	n/a	585585	11128633											PTFE	n/a	n/a	583739	11128633	11128633	11128633
PM1617	Pressure Sensor				15	-25...150 °C -13...302 °F	G1 EXTERNAL SEALING CONE	1.4435	X2CrNiMo18-14-3	DIN EN 10088-3	80255344	11128633	1,6 bar	AL2O3 99.9%	n/a	n/a	80236653	11128633											PTFE	n/a	n/a	583739	11128633	11128633	11128633
PM1689	Pressure Sensor				4	-25...150 °C -13...302 °F	G1 EXTERNAL SEALING CONE	1.4435	X2CrNiMo18-14-3	DIN EN 10088-3	80233143	11128645	0,1 bar	AL2O3 99.9%	n/a	n/a	585489	11128645											PTFE	n/a	n/a	583738	11128645	11128645	11128645
PM1703	Pressure Sensor				60	-25...150 °C -13...302 °F	G1 EXTERNAL ASEPTOFLEX VARIO	1.4435	X2CrNiMo18-14-3	DIN EN 10088-3	80255341	11128653	25 bar	AL2O3 99.9%	n/a	n/a	583883	11128653											PTFE	n/a	n/a	583739	11128653	11128653	11128653
PM1704	Pressure Sensor				59	-25...150 °C -13...302 °F	G1 EXTERNAL ASEPTOFLEX VARIO	1.4435	X2CrNiMo18-14-3	DIN EN 10088-3	80255341	11128653	10 bar	AL2O3 99.9%	n/a	n/a	583884	11128653											PTFE	n/a	n/a	583739	11128653	11128653	11128653
PM1705	Pressure Sensor				30	-25...150 °C -13...302 °F	G1 EXTERNAL ASEPTOFLEX VARIO	1.4435	X2CrNiMo18-14-3	DIN EN 10088-3	80255341	11128653	4 bar	AL2O3 99.9%	n/a	n/a	583885	11128653											PTFE	n/a	n/a	583739	11128653	11128653	11128653
PM1706	Pressure Sensor				20	-25...150 °C -13...302 °F	G1 EXTERNAL ASEPTOFLEX VARIO	1.4435	X2CrNiMo18-14-3	DIN EN 10088-3	80255341	11128653	2,5 bar	AL2O3 99.9%	n/a	n/a	583886	11128653											PTFE	n/a	n/a	583739	11128653	11128653	11128653
PM1707	Pressure Sensor				10	-25...150 °C -13...302 °F	G1 EXTERNAL ASEPTOFLEX VARIO	1.4435	X2CrNiMo18-14-3	DIN EN 10088-3	80233008	11128659	1 bar	AL2O3 99.9%	n/a	n/a	583887	11128659											PTFE	n/a	n/a	583739	11128659	11128659	11128659
PM1708	Pressure Sensor				10	-25...150 °C -13...302 °F	G1 EXTERNAL ASEPTOFLEX VARIO	1.4435	X2CrNiMo18-14-3	DIN EN 10088-3	80234172	11128662	0,25 bar	AL2O3 99.9%	n/a	n/a	583888	11128662											PTFE	n/a	n/a	583738	11128662	11128662	11128662
PM1709	Pressure Sensor				10	-25...150 °C -13...302 °F	G1 EXTERNAL ASEPTOFLEX VARIO	1.4435	X2CrNiMo18-14-3	DIN EN 10088-3	80255341	11128659	1 bar	AL2O3 99.9%	n/a	n/a	583887	11128659											PTFE	n/a	n/a	583739	11128659	11128659	11128659
PM1714	Pressure Sensor				60	-25...150 °C -13...302 °F	G1 EXTERNAL ASEPTOFLEX VARIO	1.4435	X2CrNiMo18-14-3	DIN EN 10088-3	80255341	11128653	16 bar	AL2O3 99.9%	n/a	n/a	80236654	11128653											PTFE	n/a	n/a	583739	11128653	11128653	11128653
PM1715	Pressure Sensor				30	-25...150 °C -13...302 °F	G1 EXTERNAL ASEPTOFLEX VARIO	1.4435	X2CrNiMo18-14-3	DIN EN 10088-3	80255341	11128653	6 bar	AL2O3 99.9%	n/a	n/a	585585	11128653											PTFE	n/a	n/a	583739	11128653	11128653	11128653
PM1717	Pressure Sensor				15	-25...150 °C -13...302 °F	G1 EXTERNAL ASEPTOFLEX VARIO	1.4435	X2CrNiMo18-14-3	DIN EN 10088-3	80255341	11128653	1,6 bar	AL2O3 99.9%	n/a	n/a	80236653	11128653											PTFE	n/a	n/a	583739	11128653	11128653	11128653
PM1789	Pressure Sensor				4	-25...150 °C -13...302 °F	G1 EXTERNAL ASEPTOFLEX VARIO	1.4435	X2CrNiMo18-14-3	DIN EN 10088-3	80234172	11128662	0,1 bar	AL2O3 99.9%	n/a	n/a	585489	11128662											PTFE	n/a	n/a	583738	11128662	11128662	11128662

PM1789

IFM Flow Sensors - CRN Scope of Registration

Design Code: ASME B31.3 2014 Edition
Design Temperature: See Chart Below
Burst Pressure: See Chart Below
Corrosion Allowance: None
Impact Testing: Exempt per paragraph 323.2.2
Radiography: None

Nearest equivalent ASME or ASTM material specification:		
1.4404	ASTM A276 Type 316L	UNS S31603
1.4310	ASTM A240 Type 301	UNS S30100
1.4301	ASTM A193 Type 304	UNS S30400

Cat. No.	Description	Pressure / bar				Temp. Range	1: Process Connection						2: gasket process connetction					3: Sensor tube					4: Sensor with gasket					5: adapter nut					
		Tested Bursting Pressure B	Factor of safety	Rated MAWP	MAWP in Data Sheet		Dimension	Material Number	Material Name	ref. to Standard	Art. No.	Refer to Assembly Drawing	Material Number	Material Name	ref. to Standard	Art. No.	Refer to Assembly Drawing	Material Number	Material Name	ref. to Standard	Art. No.	Refer to Assembly Drawing	Material Number	Material Name	ref. to Standard	Art. No.	Refer to Assembly Drawing	Material Number	Material Name	ref. to Standard	Art. No.	Refer to Assembly Drawing	M N
SV4200	tested sensor				3.9	-10...90 °C -14...194 °F	G1/2" female	1.4404	X2CrNiMo17-12-2	DIN EN 10088-3: 2014	80227509	11120324	na	FKM	na	80223885	11120324											1.4404	X2CrNiMo17-12-2	DIN EN 10088-3: 2014	80227508	11120324	
SV4204	ref to SV4200				3.9	-10...90 °C -14...194 °F	G1/2" female	1.4404	X2CrNiMo17-12-2	DIN EN 10088-3: 2014	80227509	11120324	na	FKM	na	80223885	11120324											1.4404	X2CrNiMo17-12-2	DIN EN 10088-3: 2014	80227508	11120324	
SV4610	ref to SV4200				3.9	-10...90 °C -14...194 °F	1/2-14NPT female	1.4404	X2CrNiMo17-12-2	DIN EN 10088-3: 2014	80227504	11120324	na	FKM	na	80223885	11120324											1.4404	X2CrNiMo17-12-2	DIN EN 10088-3: 2014	80227508	11120324	
SV4614	ref to SV4200				3.9	-10...90 °C -14...194 °F	1/2-14NPT female	1.4404	X2CrNiMo17-12-2	DIN EN 10088-3: 2014	80227504	11120324	na	FKM	na	80223885	11120324											1.4404	X2CrNiMo17-12-2	DIN EN 10088-3: 2014	80227508	11120324	
SV5200	tested sensor				4.8	-10...90 °C -14...194 °F	G1/2" female	1.4404	X2CrNiMo17-12-2	DIN EN 10088-3: 2014	80227509	11120324	na	FKM	na	80223885	11120324											1.4404	X2CrNiMo17-12-2	DIN EN 10088-3: 2014	80227508	11120324	
SV5204	ref to SV5200				4.8	-10...90 °C -14...194 °F	G1/2" female	1.4404	X2CrNiMo17-12-2	DIN EN 10088-3: 2014	80227509	11120324	na	FKM	na	80223885	11120324											1.4404	X2CrNiMo17-12-2	DIN EN 10088-3: 2014	80227508	11120324	
SV5610	ref to SV5200				4.8	-10...90 °C -14...194 °F	1/2-14NPT female	1.4404	X2CrNiMo17-12-2	DIN EN 10088-3: 2014	80227504	11120324	na	FKM	na	80223885	11120324											1.4404	X2CrNiMo17-12-2	DIN EN 10088-3: 2014	80227508	11120324	
SV5614	ref to SV5200				4.8	-10...90 °C -14...194 °F	1/2-14NPT female	1.4404	X2CrNiMo17-12-2	DIN EN 10088-3: 2014	80227504	11120324	na	FKM	na	80223885	11120324											1.4404	X2CrNiMo17-12-2	DIN EN 10088-3: 2014	80227508	11120324	
SV7200	tested sensor				4.3	-10...90 °C -14...194 °F	G3/4" female	1.4404	X2CrNiMo17-12-2	DIN EN 10088-3: 2014	80228487	11120564	na	FKM	na	80223884	11120564											1.4404	X2CrNiMo17-12-2	DIN EN 10088-3: 2014	80228486	11120564	
SV7204	ref to SV7200				4.3	-10...90 °C -14...194 °F	G3/4" female	1.4404	X2CrNiMo17-12-2	DIN EN 10088-3: 2014	80228487	11120564	na	FKM	na	80223884	11120564											1.4404	X2CrNiMo17-12-2	DIN EN 10088-3: 2014	80228486	11120564	
SV7610	ref to SV7200				4.3	-10...90 °C -14...194 °F	3/4-14 NPT female	1.4404	X2CrNiMo17-12-2	DIN EN 10088-3: 2014	80229060	11120564	na	FKM	na	80223884	11120564											1.4404	X2CrNiMo17-12-2	DIN EN 10088-3: 2014	80228486	11120564	
SV7614	ref to SV7200				4.3	-10...90 °C -14...194 °F	3/4-14 NPT female	1.4404	X2CrNiMo17-12-2	DIN EN 10088-3: 2014	80229060	11120564	na	FKM	na	80223884	11120564											1.4404	X2CrNiMo17-12-2	DIN EN 10088-3: 2014	80228486	11120564	

THIS IS PART OF
CRN OF20267.5
Technical Standards & Safety Authority
Boilers & Pressure Vessels
Safety Program

IFM Flow Sensors - CRN Scope of Registration

Design Code: ASME B31.3 2014 Edition
Design Temperature: See Chart Below
Burst Pressure: See Chart Below
Corrosion Allowance: None
Impact Testing: Exempt per paragraph 323.2.2
Radiography: None

THIS IS PART OF CRN OF20267.5
Technical Standards & Safety Authority
Boilers & Pressure Vessels
Safety Program

Nearest equivalent ASME or ASTM material specification:		
1.4404	ASTM A276 Type 316L	UNS S31603
1.4571	ASTM A276 Type 316Ti	UNS S31635
1.4301	ASTM A276 Type 304	UNS S30400
EN AW-6082	6082 ASTM B221	UNS A96082
EN AW-6060	6060 ASTM B221	UNS A96060
2.4610	ASTM B574	UNS N06455

Cat. No.	Description	Pressure / bar				Temp. Range	1: Process Connection						2: gasket process connetction					3: Sensor tube					4: Sensor electrode					5: temperature electrode					
		Tested Bursting Pressure B	Factor of safety	Rated MAWP	MAWP in Data Sheet		Dimension	Material Number	Material Name	ref. to Standard	Art. No.	Refer to Assembly Drawing	Material Number	Material Name	ref. to Standard	Art. No.	Refer to Assembly Drawing	Material Number	Material Name	ref. to Standard	Art. No.	Refer to Assembly Drawing	Material Number	Material Name	ref. to Standard	Art. No.	Refer to Assembly Drawing	Material Number	Material Name	ref. to Standard	Art. No.	Refer to Assembly Drawing	Mat Num
SM2000	tested sensor				16.5	-10...70 °C -14...158 °F	G2" male	1.4571	X6CrNiMoTi17-12-2	DIN EN 10088: 2014	50025336	11119889	na	FKM	na	50024186	11119889																n
SM2001	ref to SM2000				16.5	-10...70 °C -14...158 °F	G2" male	1.4571	X6CrNiMoTi17-12-2	DIN EN 10088: 2014	50025336	11119889	na	FKM	na	50024186	11119889																n
SM2004	ref to SM2000				16.5	-10...70 °C -14...158 °F	G2" male	1.4571	X6CrNiMoTi17-12-2	DIN EN 10088: 2014	50025336	11119889	na	FKM	na	50024186	11119889																n
SM2100	ref to SM2000				16.5	-10...70 °C -14...158 °F	G2" male	1.4571	X6CrNiMoTi17-12-2	DIN EN 10088: 2014	50025336	11119889	na	EPDM	na	80229726	11119889																n
SM2601	ref to SM2000				16.5	-10...70 °C -14...158 °F	2-11,5NPT female	1.4571	X6CrNiMoTi17-12-2	DIN EN 10088: 2014	80012058	11119889	na	FKM	na	50024186	11119889																n
SM2604	ref to SM2000				16.5	-10...70 °C -14...158 °F	2-11,5NPT female	1.4571	X6CrNiMoTi17-12-2	DIN EN 10088: 2014	80012058	11119889	na	FKM	na	50024186	11119889																n
SM9000	ref to SM2000				16.5	-10...70 °C -14...158 °F	G11/2" male	1.4571	X6CrNiMoTi17-12-2	DIN EN 10088: 2014	50025336	11119889	na	FKM	na	50024186	11119889																n
SM9001	ref to SM2000				16.5	-10...70 °C -14...158 °F	G11/2" male	1.4571	X6CrNiMoTi17-12-2	DIN EN 10088: 2014	50025336	11119889	na	FKM	na	50024186	11119889																n
SM9004	ref to SM2000				16.5	-10...70 °C -14...158 °F	G11/2" male	1.4571	X6CrNiMoTi17-12-2	DIN EN 10088: 2014	50025336	11119889	na	FKM	na	50024186	11119889																n
SM9100	ref to SM2000				16.5	-10...70 °C -14...158 °F	G11/2" male	1.4571	X6CrNiMoTi17-12-2	DIN EN 10088: 2014	50025336	11119889	na	EPDM	na	80229726	11119889																n
SM9601	ref to SM2000				16.5	-10...70 °C -14...158 °F	11/2-11,5NPT female	1.4571	X6CrNiMoTi17-12-2	DIN EN 10088: 2014	80012057	11119889	na	FKM	na	50024186	11119889																n
SM9604	ref to SM2000				16.5	-10...70 °C -14...158 °F	11/2-11,5NPT female	1.4571	X6CrNiMoTi17-12-2	DIN EN 10088: 2014	80012057	11119889	na	FKM	na	50024186	11119889																n
SM6000	tested sensor				17.7	-10...70 °C -14...158 °F	G 1/2" male	1.4404	X2CrNiMo17-12-2	DIN EN 10088: 2014	50014379 50014387	11119987	na	FKM	na	50017755	11119987																n
SM6001	ref to SM6000				17.7	-10...70 °C -14...158 °F	G 1/2" male	1.4404	X2CrNiMo17-12-2	DIN EN 10088: 2014	50014379 50014387	11119987	na	FKM	na	50017755	11119987																n
SM6004	ref to SM6000				17.7	-10...70 °C -14...158 °F	G 1/2" male	1.4404	X2CrNiMo17-12-2	DIN EN 10088: 2014	50014379 50014387	11119987	na	FKM	na	50017755	11119987																n
SM6050	ref to SM6000				17.7	-10...70 °C -14...158 °F	G 1/2" male	1.4404	X2CrNiMo17-12-2	DIN EN 10088: 2014	50014379 50014387	11119987	na	FKM	na	50017755	11119987																n
SM6100	ref to SM6000				17.7	-10...70 °C -14...158 °F	G 1/2" male	1.4404	X2CrNiMo17-12-2	DIN EN 10088: 2014	50014379 50014387	11119987	na	EPDM	na	80229663	11119987																n
SM6601	ref to SM6000				17.7	-10...70 °C -14...158 °F	1/2-14 NPT female	1.4404	X2CrNiMo17-12-2	DIN EN 10088: 2014	80012032 80010316	11119987	na	FKM	na	50017755	11119987																n
SM6604	ref to SM6000				17.7	-10...70 °C -14...158 °F	1/2-14 NPT female	1.4404	X2CrNiMo17-12-2	DIN EN 10088: 2014	80012032 80010316	11119987	na	FKM	na	50017755	11119987																n
SM7000	tested sensor				11.2	-10...70 °C -14...158 °F	G 3/4" male	1.4404	X2CrNiMo17-12-2	DIN EN 10088: 2014	50014420 50014421	11120033	na	FKM	na	50014580	11120033																n
SM7001	ref to SM7000				11.2	-10...70 °C -14...158 °F	G 3/4" male	1.4404	X2CrNiMo17-12-2	DIN EN 10088: 2014	50014420 50014421	11120033	na	FKM	na	50014580	11120033																n
SM7004	ref to SM7000				11.2	-10...70 °C -14...158 °F	G 3/4" male	1.4404	X2CrNiMo17-12-2	DIN EN 10088: 2014	50014420 50014421	11120033	na	FKM	na	50014580	11120033																n
						-10...70 °C																										

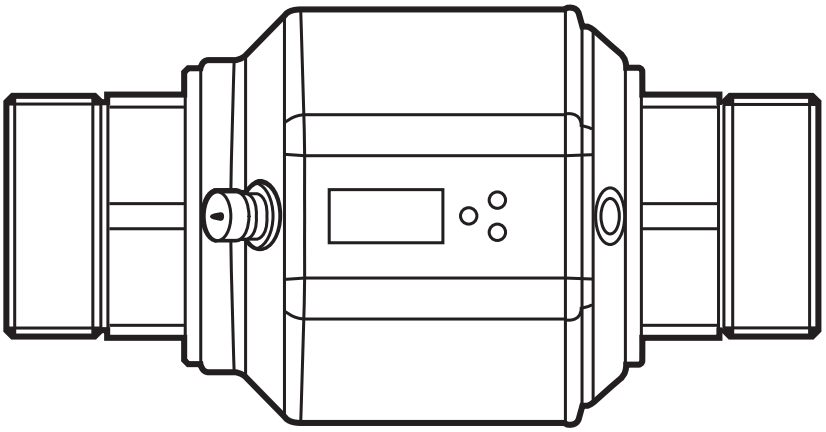
SM7050	ref to SM7000	11.2	-10...70 °C -14...158 °F	G 3/4" male	1.4404	XZCrNiMo17-12-2	DIN EN 10088: 2014	500144Z0 500142Z1	1112003Z	na	FKM	na	5001458Ø	1112003Z					
SM7100	ref to SM7000	11.2	-10...70 °C -14...158 °F	G 3/4" male	1.4404	XZCrNiMo17-12-2	DIN EN 10088: 2014	500144Z0 500142Z1	1112003Z	na	EPDM	na	8022966S	1112003Z					
SM7601	ref to SM7000	11.2	-10...70 °C -14...158 °F	3/4-14 NPT female	1.4404	XZCrNiMo17-12-2	DIN EN 10088: 2014	8001Z03Z 8001Z034	1112003Z	na	FKM	na	5001458Ø	1112003Z					
SM7604	ref to SM7000	11.2	-10...70 °C -14...158 °F	3/4-14 NPT female	1.4404	XZCrNiMo17-12-2	DIN EN 10088: 2014	8001Z03Z 8001Z034	1112003Z	na	FKM	na	5001458Ø	1112003Z					
SM0505	ref to SM7000	11.2	-10...70 °C -14...158 °F	G 3/4" male	1.4404	XZCrNiMo17-12-2	DIN EN 10088: 2014	500144Z0 500144Z1	1112003Z	na	FKM	na	5001458Ø	1112003Z					
SM8000	ref to SM7000	11.2	-10...70 °C -14...158 °F	G 1" male	1.4404	XZCrNiMo17-12-2	DIN EN 10088: 2014	500144Z2 500144Z5	1112003Z	na	FKM	na	5001458Ø	1112003Z					
SM8001	ref to SM7000	11.2	-10...70 °C -14...158 °F	G 1" male	1.4404	XZCrNiMo17-12-2	DIN EN 10088: 2014	500144Z2 500144Z5	1112003Z	na	FKM	na	5001458Ø	1112003Z					
SM8004	ref to SM7000	11.2	-10...70 °C -14...158 °F	G 1" male	1.4404	XZCrNiMo17-12-2	DIN EN 10088: 2014	500144Z2 500144Z5	1112003Z	na	FKM	na	5001458Ø	1112003Z					
SM8050	ref to SM7000	11.2	-10...70 °C -14...158 °F	G 1" male	1.4404	XZCrNiMo17-12-2	DIN EN 10088: 2014	500144Z2 500144Z5	1112003Z	na	FKM	na	5001458Ø	1112003Z					
SM8100	ref to SM7000	11.2	-10...70 °C -14...158 °F	G 1" male	1.4404	XZCrNiMo17-12-2	DIN EN 10088: 2014	500144Z2 500144Z5	1112003Z	na	EPDM	na	8022966S	1112003Z					
SM8601	ref to SM7000	11.2	-10...70 °C -14...158 °F	1-11,5 NPT female	1.4404	XZCrNiMo17-12-2	DIN EN 10088: 2014	8001Z03S 8001Z056	1112003Z	na	FKM	na	5001458Ø	1112003Z					
SM8604	ref to SM7000	11.2	-10...70 °C -14...158 °F	1-11,5 NPT female	1.4404	XZCrNiMo17-12-2	DIN EN 10088: 2014	8001Z03S 8001Z056	1112003Z	na	FKM	na	5001458Ø	1112003Z					

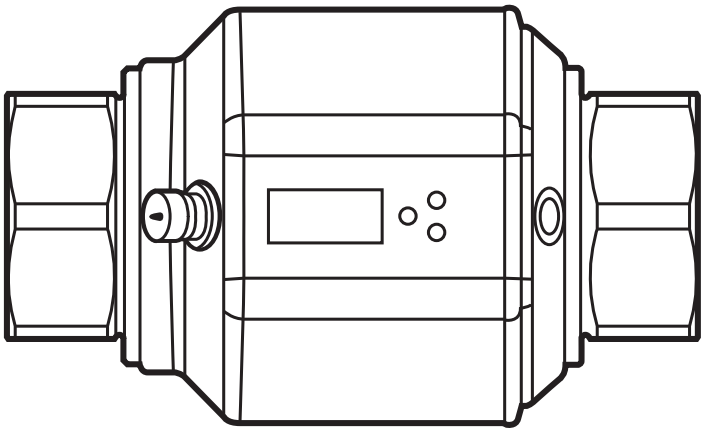
CE

Operating instructions
Magnetic-inductive flow meter

UK

SM0510
SM2x00
SM2130
SM9x00
SM2x01
SM9x01





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1 Preliminary note

1.1 Symbols used

▶ Instructions

> Reaction, result

[…] Designation of keys, buttons or indications

→ Cross-reference



Important note
Non-compliance may result in malfunction or interference.



Information
Supplementary note.

1.2 Warnings used



CAUTION

Warning of personal injury.
Slight reversible injuries may result.

2 Safety instructions

- The device described is a subcomponent for integration into a system.
  - The manufacturer of the system is responsible for the safety of the system.
  - The system manufacturer undertakes to perform a risk assessment and to create a documentation in accordance with legal and normative requirements to be provided to the operator and user of the system. This documentation must contain all necessary information and safety instructions for the operator, the user and, if applicable, for any service personnel authorised by the manufacturer of the system.
- Read this document before setting up the product and keep it during the entire service life.
- The product must be suitable for the corresponding applications and environmental conditions without any restrictions.
- Only use the product for its intended purpose (→ Functions and features).
- Only use the product for permissible media (→ Technical data).
- If the operating instructions or the technical data are not adhered to, personal injury and/or damage to property may occur.
- The manufacturer assumes no liability or warranty for any consequences caused by tampering with the product or incorrect use by the operator.
- Installation, electrical connection, set-up, operation and maintenance of the unit must be carried out by qualified personnel authorised by the machine operator.
- Protect units and cables against damage.

3 Functions and features

The unit monitors liquid media. It detects the 3 process variables volumetric flow quantity, consumed quantity, medium temperature.

3.1 Pressure Equipment Directive (PED)

The units comply with the Pressure Equipment Directive and are designed and manufactured for group 2 fluids in accordance with the sound engineering practice. Use of group 1 fluids on request.

3.2 Applications

Conductive liquids with the following properties:

- Conductivity: ≥ 20 µS/cm
- Viscosity: < 70 mm2/s at 40 °C; < 70 cSt at 104°F

This is a class A product.
The unit may cause radio interference in domestic areas.

▶ If required, take appropriate EMC screening measures.

3.3 Note regarding SM0510 and SM2130

Operation in overload conditions can cause cavitation. Operation with cavitation can damage the pressure-carrying parts.

▶ Consider the cavitation limits (→ Technical data).

4 Function

- The unit detects the flow based on the magnetic-inductive volumetric flow measuring principle.
- The unit also detects the medium temperature.
- It features an IO-Link interface.
- The unit displays the current process value.

4.1 Process measured signals

The unit generates 2 output signals according to the parameter settings:

OUT1/IO-Link: 5 selection options	Parameter setting
- Switching signal for volumetric flow limit value	→ 10.2.1
- Frequency signal for volumetric flow quantity	→ 10.2.4

- Pulse signal for quantity meter → 10.3.1
- Switching signal for preset counter → 10.3.2
- Switching signal for empty pipe detection → 10.5.8

OUT2: 6 selection options Parameter setting

- Switching signal for volumetric flow limit value → 10.2.2
- Switching signal for temperature limit value → 10.4.1
- Analogue signal for volumetric flow quantity → 10.2.3
- Analogue signal for temperature → 10.4.2
- Switching signal for empty pipe detection → 10.5.8
- Input for external reset signal (InD) → 10.3.7

4.2 Direction of flow

In addition to the flow velocity and the volumetric flow quantity, the unit also detects the direction of flow.

4.2.1 Determining the direction of flow (Fdir)

An arrow with the text "flow direction" on the unit indicates the positive flow direction. The flow direction can be inversed (→ 10.5.3).

▶ Use the supplied label to mark the changed flow direction (new positive direction of flow).

Flow...	Process value display
corresponds to the marked flow direction	+ (positive)
against the marked flow direction	- (negative)

4.3 Consumed quantity monitoring (ImP)

The unit has an internal mass flow meter (totaliser). It continuously totals the consumed quantity after the last reset. Pulse signals or a switching signal can be used to monitor the consumed quantity.
→ 10.3.1 Quantity monitoring by pulse output (OUT1)
→ 10.3.2 Quantity monitoring by preset counter (OUT1)

4.3.1 Display and counting method of the quantity meter

Meter reading:

- The current quantity meter reading can be indicated (→ 11.2).
- In addition, the value before the last reset is saved. This value can also be displayed (→ 11.2).

The meter saves the totalled volumetric flow quantity every 10 minutes. After a power failure this value is available as the current meter reading. If a time-controlled reset is set, the elapsed time of the set reset interval is also saved. So the possible data loss can be at most 10 minutes.

Counter reset:

- There are different ways to reset the quantity meter.
  → 10.3.4 Manual counter reset
  → 10.3.5 Time-controlled counter-reset
  → 10.3.7 Counter reset using an external signal
- If the quantity meter is not reset by applying one of the above-mentioned methods, an automatic reset takes place when the maximum volumetric flow quantity that can be displayed is exceeded (overflow).

Consideration of the direction of flow:

- The quantity meter takes account of the flow direction when totalising the consumed quantity. The following counting methods can be defined via the parameter [FPro] (→ 10.5.12):

[FPro]	Counting method
0+	Negative flow values (against the marked direction of flow) are not taken into consideration for totalling.
– +	Negative flow values are subtracted from the consumed quantity.

Depending on the setting of the counting method [FPro] totalling of the volumetric flow quantity takes into account the flow in negative direction of flow (– +) or does not take it into account (0+).

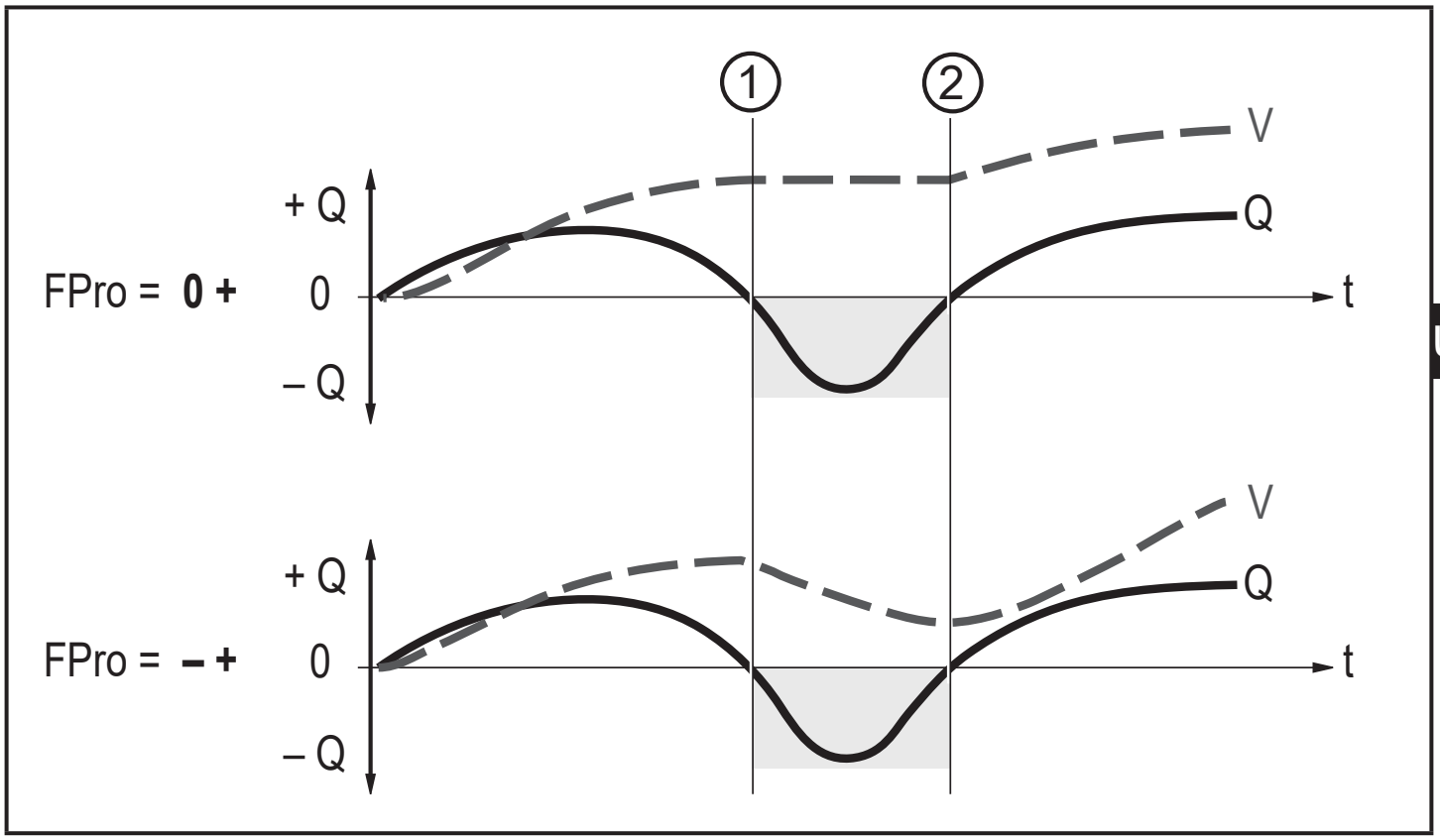


Fig. 1: Taking account of the volumetric flow direction when totalling the consumed quantity

+ Q = volumetric flow quantity in positive direction
- Q = volumetric flow quantity in negative direction
V = volumetric flow quantity absolute (= sum of negative and positive volumetric flow)
① Volumetric flow changes to negative direction
② Volumetric flow changes to positive direction

When the volumetric flow direction is changed a minimum volumetric flow quantity is taken into account: - LFC in negative direction; + LFC in positive direction.

4.3.2 Consumed quantity monitoring via pulse output

OUT 1 issues a pulse signal each time the set volumetric flow quantity has been reached (→ 10.3.3 Pulse value).

4.3.3 Consumed quantity monitoring via preset counter

2 kinds of monitoring are possible which can be set via the parameter [rTo].

[rTo]	Output	Meter reset
OFF (→ 10.3.6)	OUT1 switches when the volumetric flow quantity set with [ImPS] has been reached.	The preset counter is only reset - when a manual reset is made (→ 10.3.4) or - when the maximum display range has been exceeded.
1, 2,... h 1, 2,... d 1, 2,... w (→ 10.3.5)	OUT1 switches when the volumetric flow quantity set with [ImPS] is reached within the set time.	The preset counter is reset automatically when the time has elapsed and counting starts again.

4.4 Empty pipe detection

The unit detects when the two electrodes are not wetted by the medium.

The empty pipe detection can be activated or deactivated (→ 10.5.8). If it is active and the pipe is empty, the unit reacts as follows:

> [SEnS] is indicated in the display.

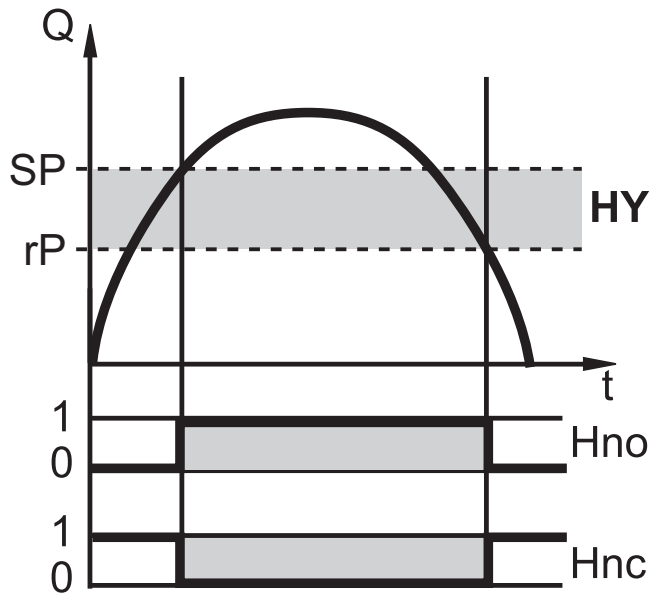
> The flow is set to zero.

The empty pipe detection can be set as time-depending or not time depending) (→ 10.5.10).

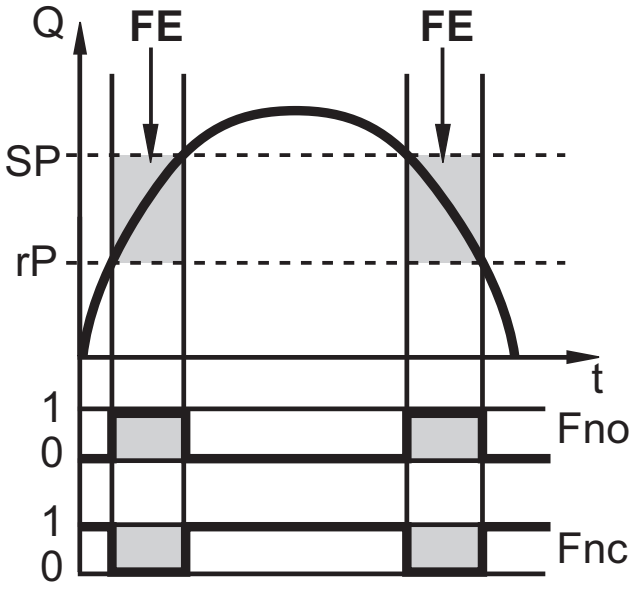
4.5 Switching function

OUTx changes its switching status if it is above or below the set switching limits (flow or temperature). Hysteresis or window function can be selected. Example of volumetric flow monitoring:

Hysteresis function



Window function



SP = set point
rP = reset point
HY = hysteresis
Hno = hysteresis NO (normally open)
Hnc = hysteresis NC (normally closed)

SP = upper limit
rP = lower limit
FE = window
Fno = window NO (normally open)
Fnc = window NC (normally closed)

When the hysteresis function is set, the set point [SP] is defined first and then the reset point [rP] which must have a lower value. If only the set point is changed, the reset point is changed automatically; the difference remains constant.

When set to the window function, the upper limit [SP] and the lower limit [rP] have a fixed hysteresis of 0.25 % of the final value of the measuring range. This keeps the switching status of the output stable if the flow rate varies slightly.

4.6 Analogue function

- The unit provides an analogue signal that is proportional to the flow quantity and the medium temperature.
- The analogue signal can be provided as current or voltage signal.
- Within the measuring range, the analogue signal is 4...20 mA (current output) or 0...10 V (voltage output).
- If the measured value is outside the measuring range or in the event of an internal error, the current or voltage signals indicated in Figure 1 are provided.
- The measuring range is scalable:
  Analogue start point [ASP2] determines at which measured value the output signal is 4 mA or 0 V.
  Analogue end point [AEP2] determines at which measured value the output signal is 20 mA or 10 V.

  Minimum distance between [ASP2] and [AEP2] = 20 % of the final value of the measuring range.

MAW	Initial value of the measuring range	For non-scaled measuring range (= factory setting)
VMR	Final value of the measuring range	
ASP2	Analogue start point	For scaled measuring range
AEP2	Analogue end point	

Table 1: Definitions

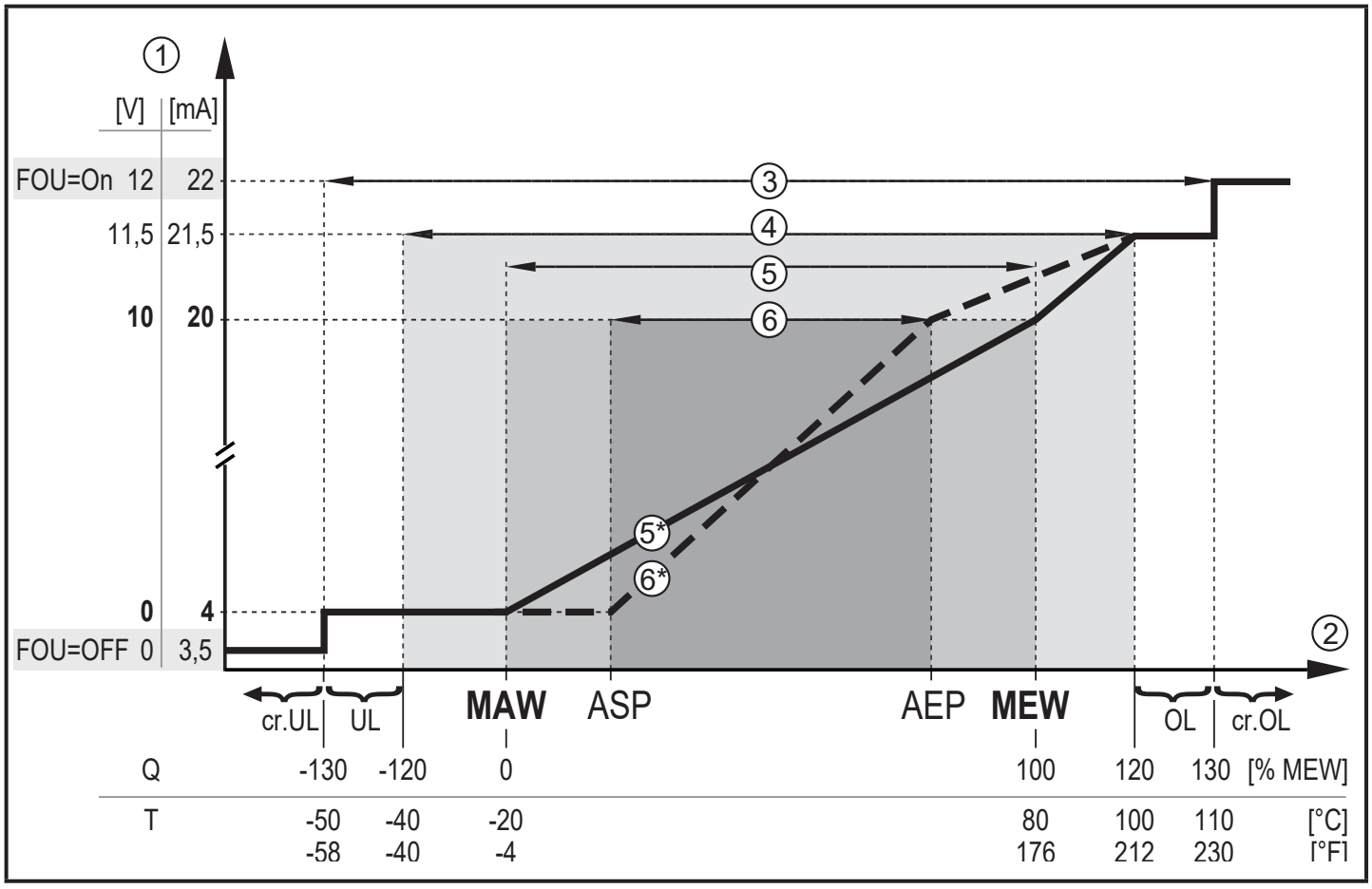


Figure 1: Characteristics of the analogue output according to the standard IEC 60947-5-7.

Q: Flow (a negative flow value means flow against the marked flow direction).
T: Temperature
UL: Below the display range
OL: Above the display range
cr.UL: Below the detection zone (error)
cr.OL: Above the detection zone (error)
FOU=On: Default setting at which the analogue signal goes to the upper final value in case of an error.*
FOU=OFF: Default setting at which the analogue signal goes to the lower final value in case of an error.

* The type of error is displayed: cr.UL, cr.OL, Err (→ 12).

① Analogue signal (voltage or current)
② Measured value (flow or temperature)
③ Detection zone
④ Display range
⑤ Measuring range
⑤* Analogue signal in the measuring range with factory setting
⑥ Scaled measuring range
⑥* Analogue signal with scaled measuring range

4.7 Frequency output

The unit provides a frequency signal that is proportional to the volumetric flow.

Within the measuring range the frequency signal is between 0 and 1 kHz for the factory setting.

The frequency signal is scalable:

FrEP = Frequency signal in Hz which is provided at OUT1 when the upper measured value FEP is reached.

Factory setting: FrEP = 1 kHz = 100 %.

The measuring range is scalable:

FEP = Upper measured value at which OUT1 provides the frequency signal FrEP.

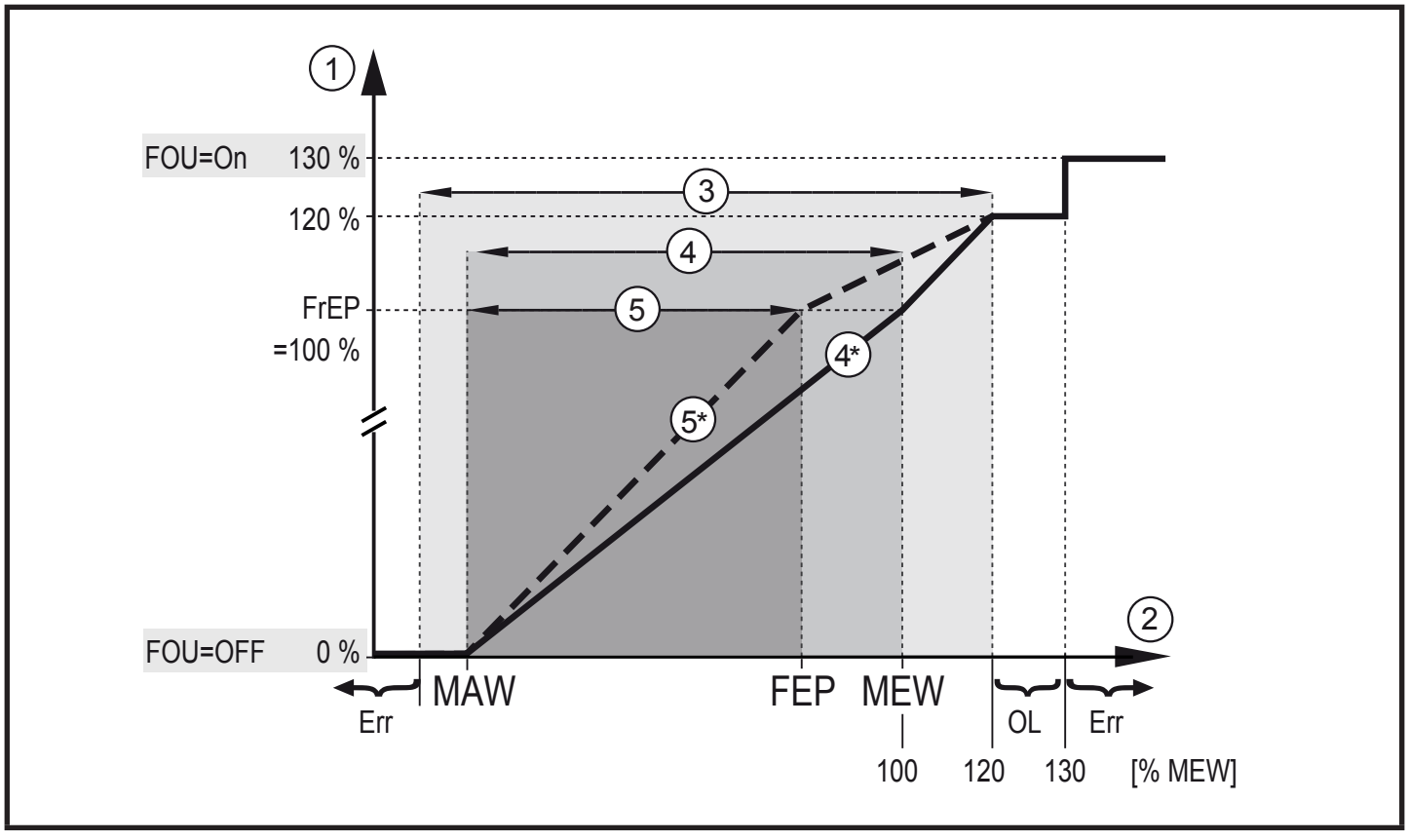


Figure 1: Output curve frequency output
MAW = initial value of the measuring range; MEW = final value of the measuring range

① Frequency signal
② Volumetric flow quantity
③ Display range
④ Measuring range
④* Frequency signal in the measuring range with factory setting
⑤ Scaled measuring range
⑤* Frequency signal with scaled measuring range

4.8 Measured value damping (dAP)

The damping time enables to set after how many seconds the output signal has reached 63 % of the final value if the flow value changes suddenly. The set damping time stabilises the outputs, the display and the process value transfer via the IO-Link interface. The signals [UL] and [OL] (→ 12) are defined under consideration of the damping time.

4.9 Start-up delay (dSt)

The start-up delay dST influences the switching outputs of the volumetric flow monitoring.

If the start-up delay is active (dST > 0), note: As soon as the volumetric flow quantity exceeds the LFC (LFC = Low flow cut-off → 4.10), the following processes are carried out:

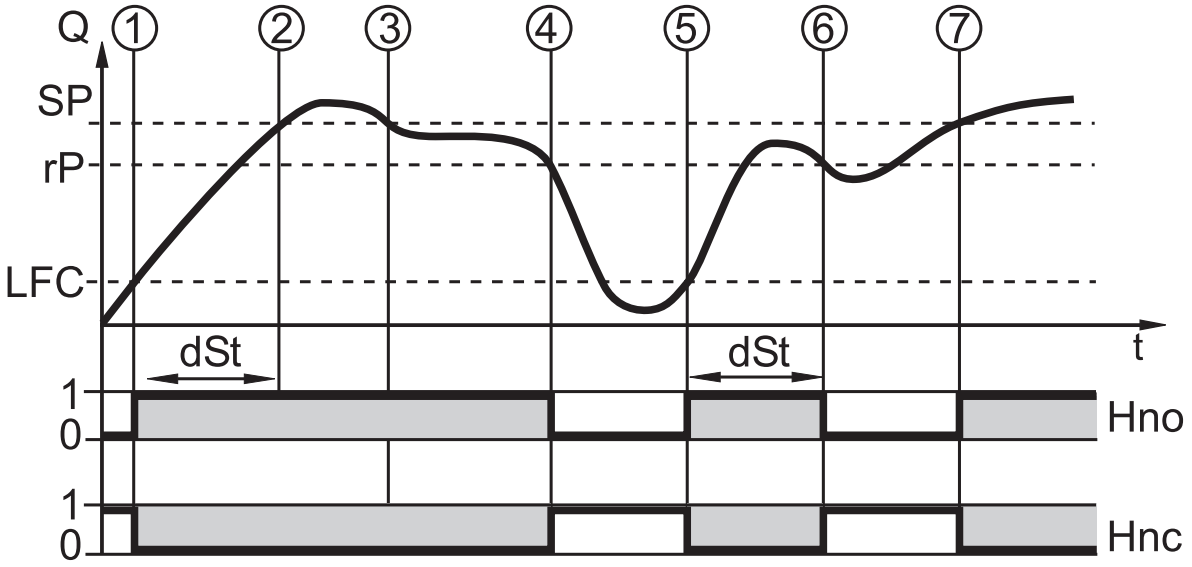
> The start-up delay is activated.

> The outputs switch as programmed:ON for NO function, OFF for NC function.

After the start of the start-up delay there are 3 options:

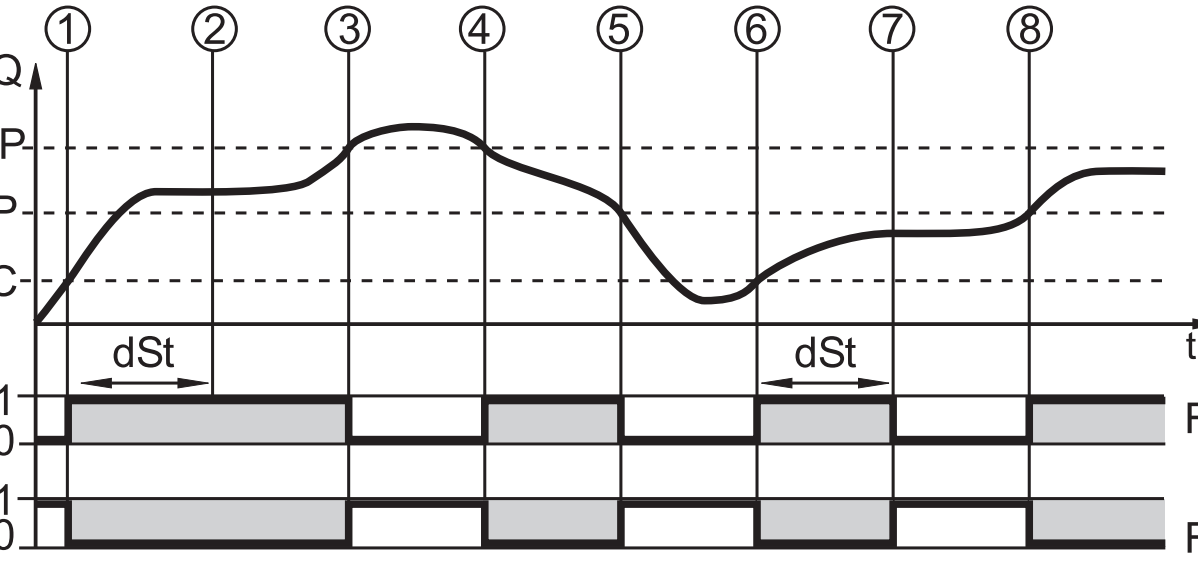
1. The volumetric flow increases quickly and reaches the set point / good range within dST.
   > Outputs remain active.
2. The volumetric flow increases slowly and does not reach the set point /good range within dST.
   > Outputs are reset.
3. Volumetric flow quantity falls below LFC within dST.
   > Outputs are reset at once; dST is stopped.

Example: dST for hysteresis function



	Condition	Reaction
1	Volumetric flow quantity Q reaches LFC	dST starts, output becomes active
2	dST elapsed, Q reached SP	Output remains active
3	Q below SP but above rP	Output remains active
4	Q below rP	Output is reset
5	Q reaches again LFC	dST starts, output becomes active
6	dST elapsed, Q has not reached SP	Output is reset
7	Q reaches SP	Output becomes active

Example: dST for window function



	Condition	Reaction
1	Volumetric flow quantity Q reaches LFC	dST starts, output becomes active
2	dST elapsed, Q reached good range	Output remains active
3	Q above SP (leaves good range)	Output is reset
4	Q again below SP	Output becomes active again
5	Q below rP (leaves good range)	Output is reset again
6	Q reaches again LFC	dST starts, output becomes active
7	dST elapsed, Q has not reached good range	Output is reset
8	Q reaches good range	Output becomes active

4.10 Low flow cut-off (LFC)

With this function small volumetric flow quantities can be suppressed (→ 10.5.13). Flows below the LFC value are evaluated by the sensor as standstill (Q = 0).

4.11 Simulation

With this function flow and temperature values can be simulated (→ 10.6.2).
The simulation does not have any effect on the totaliser or the current flow. The outputs operate as previously set.
When the simulation starts, the value of the totaliser is saved and then the simulated totaliser is set to 0. The simulated flow value then has an effect on the simulated totaliser. When the simulation is finished, the original totaliser value is restored.



During the simulation the original totaliser value remains saved without any changes even if there is a real flow.

4.12 IO-Link

This unit has an IO-Link communication interface which enables direct access to process and diagnostic data. In addition it is possible to set the parameters of the unit during operation. Operation of the unit via IO-Link interface requires an IO-Link capable module (IO-Link master).

With a PC, suitable IO-Link software and an IO-Link adapter cable communication is possible when the system is not in operation.

The IODDs necessary for the configuration of the unit, detailed information about process data structure, diagnostic information, parameter addresses and the

necessary information about the required IO-Link hardware and software can be found at www.ifm.com.

5 Installation

CAUTION

If the medium temperature is above 50 °C (122 °F) parts of the housing can increase in temperature to over 65 °C (149 °F).

> Risk of burns.

▶ Protect the housing against contact with flammable substances and unintentional contact.

▶ Apply the supplied warning label to the sensor cable.

▶ Ensure that the system is free of pressure during installation.
▶ Ensure that no media can leak at the mounting location during installation.
▶ Avoid deposits, accumulated gas and air in the pipe system.

The unit can be installed independently of the orientation if the following is ensured:

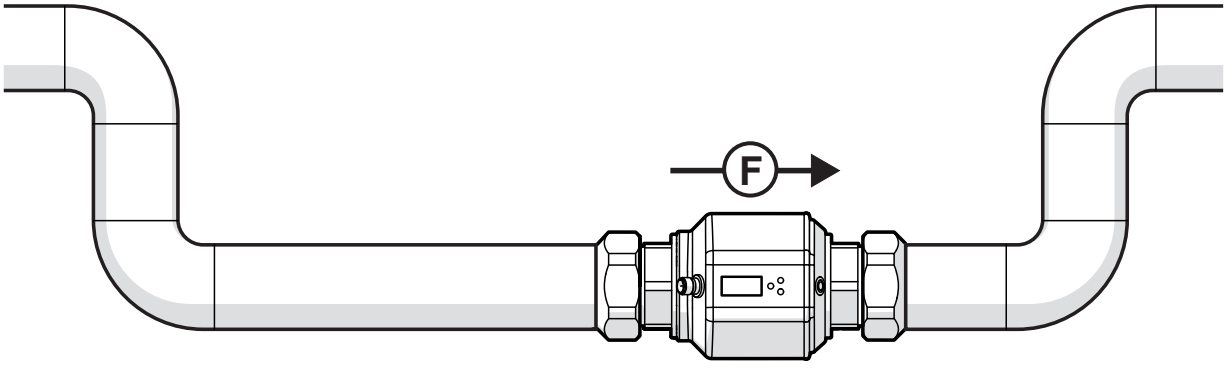
- No air bubbles can form in the pipe system.
- The pipes are always completely filled.

5.1 Recommended mounting position

▶ To ensure best possible empty pipe detection, install the unit according to Figure 1.

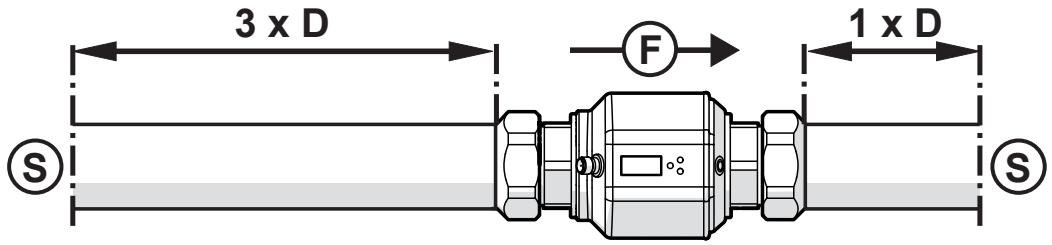
Example of an optimised installation:

1



- ▶ Install the unit so that the measuring pipe is always completely filled.
- ▶ Allow for laminar flow for inlet and outlet pipe lengths. Disturbances caused by bends, valves or pipe reductions, etc. are then eliminated This applies in particular to: Shut-off valves and control devices are not allowed directly in front of the unit.

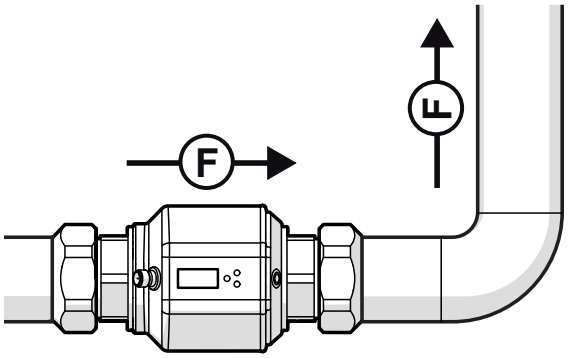
2



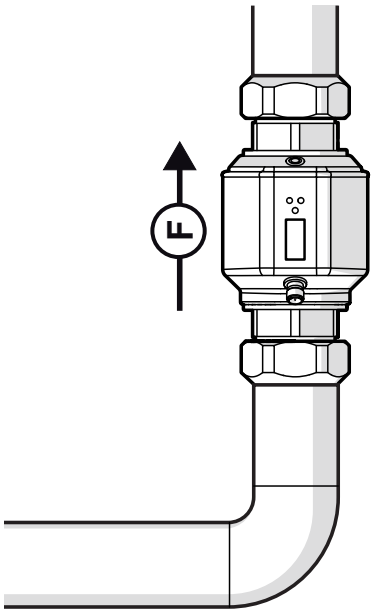
S = disturbance; D = pipe diameter; F = flow direction

- ▶ Install in front of or in a rising pipe:

3



4

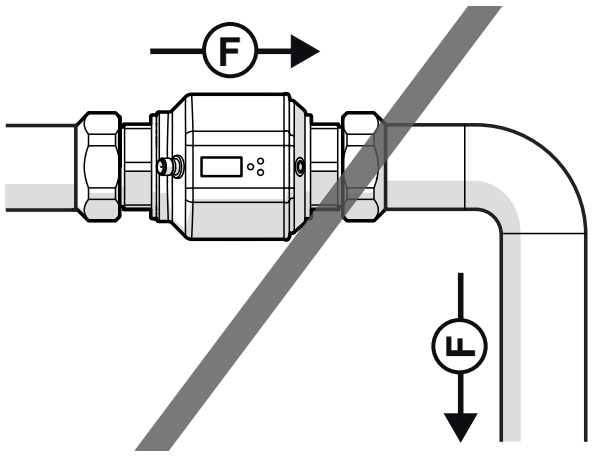


F = flow direction

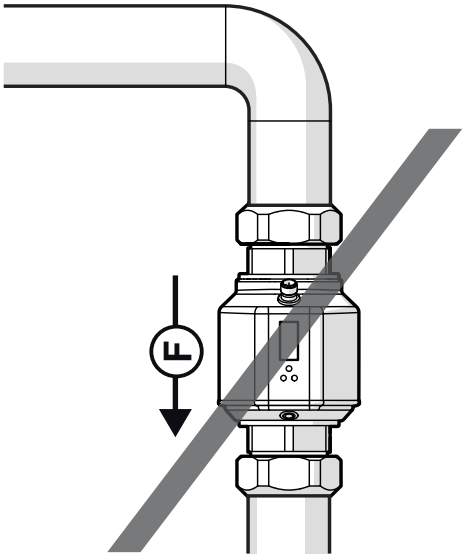
UK

5.2 Non recommended installation position

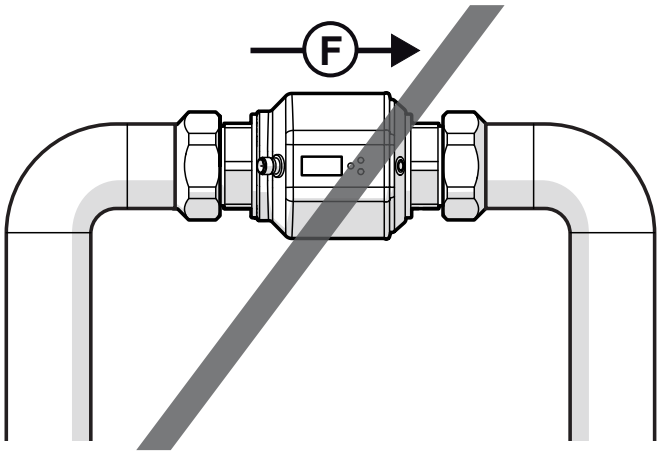
▶ Avoid the following installation positions:



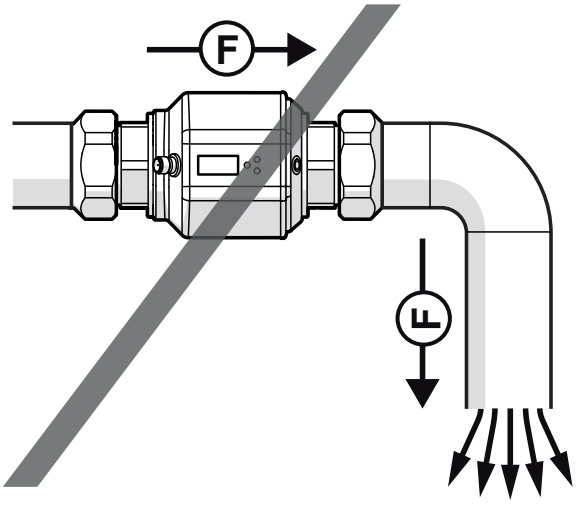
Directly in front of a falling pipe.



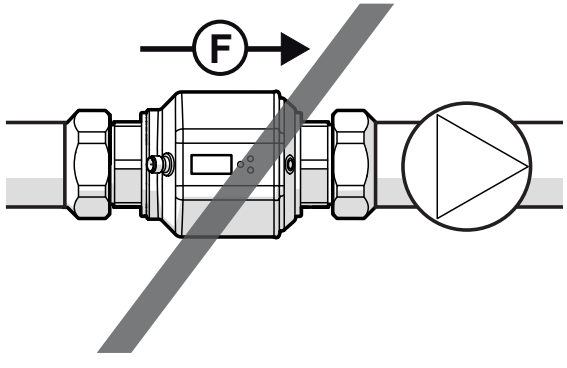
In a falling pipe.



At the highest point of the pipe system.



Directly in front of the spout of the pipe.



On the suction side of a pump.

F = flow direction

5.3 Grounding

If installed in an ungrounded pipe system (e.g. plastic pipes), the unit must be grounded (functional earth).

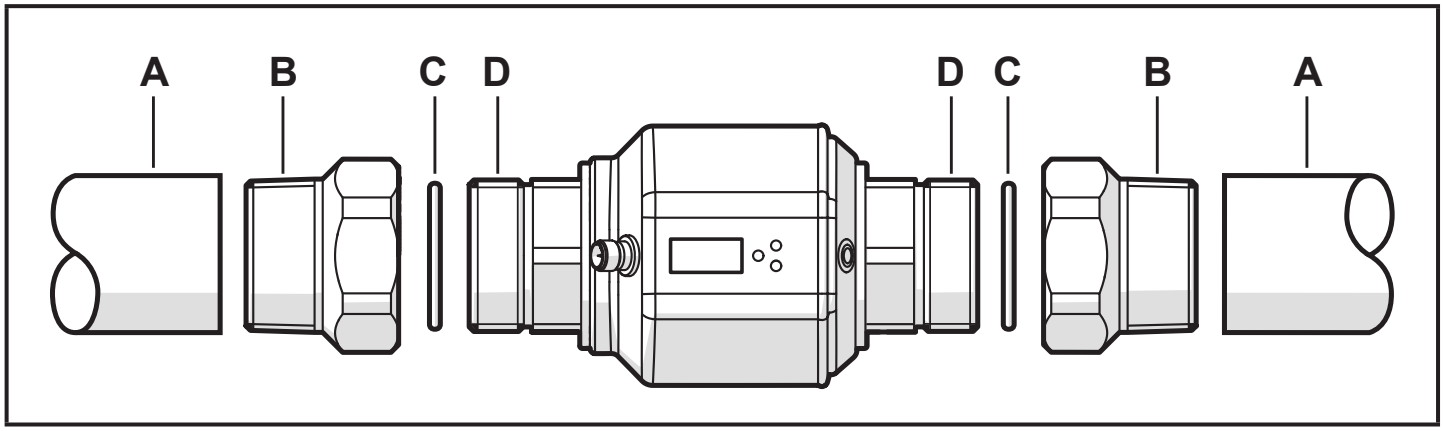
Ground brackets for the M12 connector are available as accessories (→ www.ifm.com).

5.4 Installation in pipes

The units with a G thread can be installed in the pipes using adapters.

Information about the available mounting accessories at

A correct fit of the unit and ingress resistance of the connection are only ensured using ifm adapters.



1. Screw the adapter (B) into the pipe (A).
2. Place the seals (C) and install the unit according to the marked flow direction.
   ▶ To mount the adapters on the process connection of the sensor use suitable lubricants.
3. Screw the adapter (B) with the threads (D) until it is hand-tight.
4. Tighten the two adapters in opposite direction (tightening torque: 30 Nm).

After installation, air bubbles in the system can affect the measurement.
Corrective measures:

▶ Rinse the system after installation for ventilation (rinsing quantity > 15 l/min, 4 gpm).

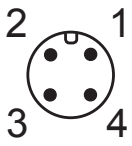
In case of horizontal installation:
As a result of horizontal mounting a small quantity of the medium always remains in the measuring channel, even after switching off the pump.

6 Electrical connection

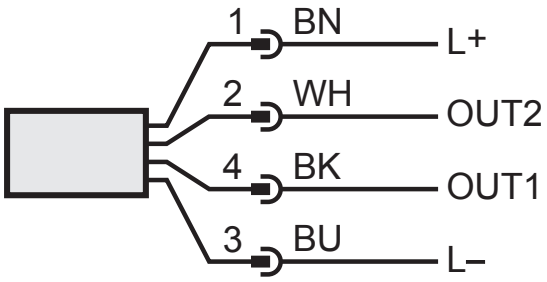
The unit must be connected by a qualified electrician.
The national and international regulations for the installation of electrical equipment must be adhered to.
Voltage supply according to EN 50178, SELV, PELV.

▶ Disconnect power.

▶ Connect the unit as follows:



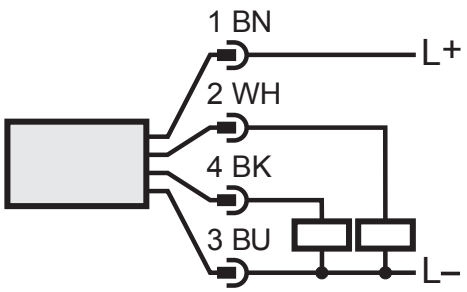
BK: black
BN: brown
BU: blue
WH: white



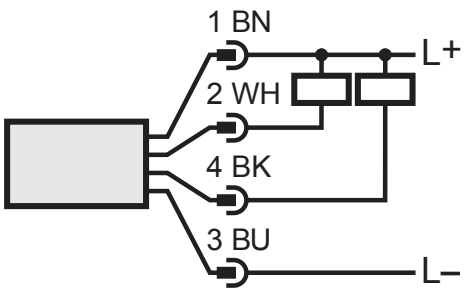
Colours to DIN EN 60947-5-2

Sample circuits:

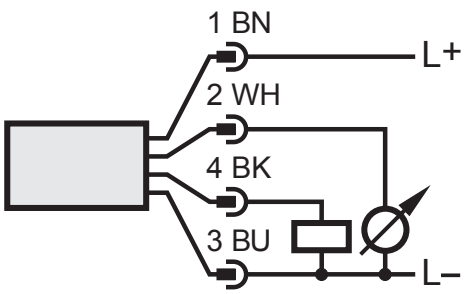
2 x positive switching



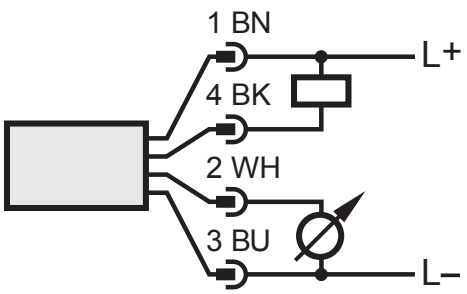
2 x negative switching



1 x positive switching / 1 x analogue



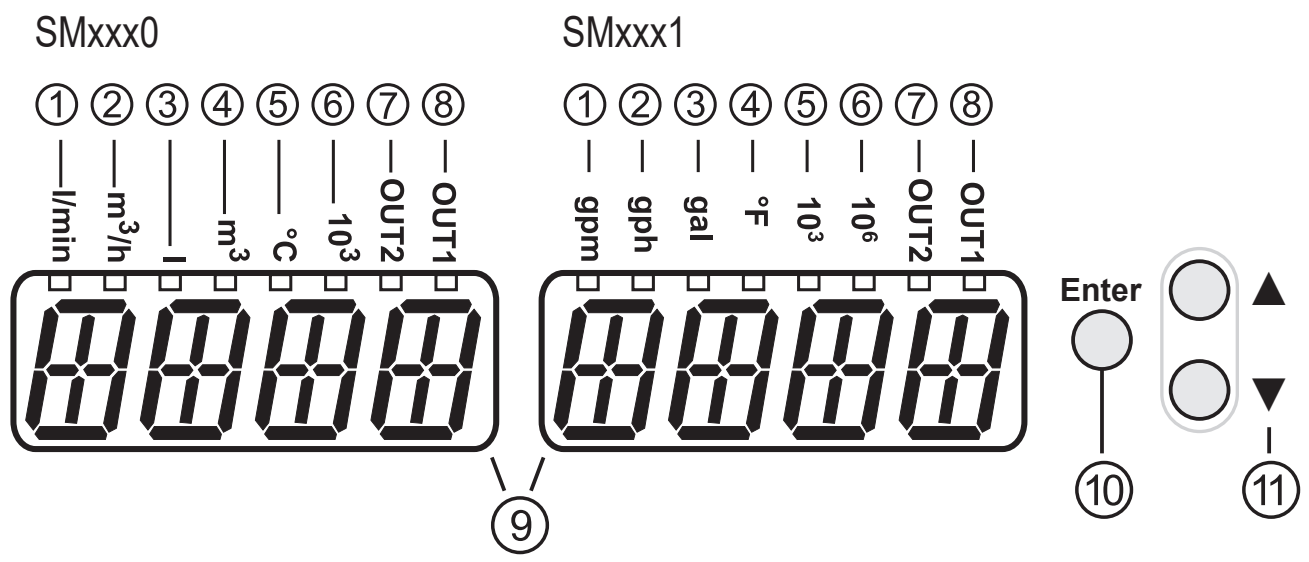
1 x negative switching / 1 x analogue



Pin 1	L+
Pin 3	L-

Pin 4 (OUT1)	• Switching signal: limit values for volumetric flow quantity • Pulse signal: 1 pulse every time the defined volumetric flow quantity is reached • Switching signal: quantity meter has reached preset value • Frequency signal for volumetric flow quantity • Switching signal: empty pipe detection • IO-Link
Pin 2 (OUT2/InD)	• Switching signal: limit values for volumetric flow quantity • Switching signal: limit values for temperature • Analogue signal for volumetric flow quantity • Analogue signal for temperature • Switching signal: empty pipe detection • Input for external reset signal (InD)

7 Operating and display elements



1-6: Indicator LEDs

SMxxx0:

LED		Process value display		Unit
1	□	Current flow volume per minute		l/min
2	□	Current flow volume per hour		m^3/h
3	□	Current consumed quantity (= meter reading) since the last reset	Totaliser *	l
4	□			m^3
4 + 6	□			$m^3 \times 10^3$
3	⌘	Consumed quantity (= meter reading) before the last reset		l
4	⌘			m^3
4 + 6	⌘			$m^3 \times 10^3$
5	□	Current medium temperature		°C

SMxxx1:

LED		Process value display		Unit
1	□	Current flow volume per minute		gpm
2	□	Current flow volume per hour		gph
3	□	Current consumed quantity (= meter reading) since the last reset	Totaliser *	gal
3 + 5	□			gal x 10^3
3 + 6	□			gal x 10^6
3	⌘	Consumed quantity (= meter reading) before the last reset		gal
3 + 5	⌘			gal x 10^3
3 + 6	⌘			gal x 10^6
4	□	Current medium temperature		°F

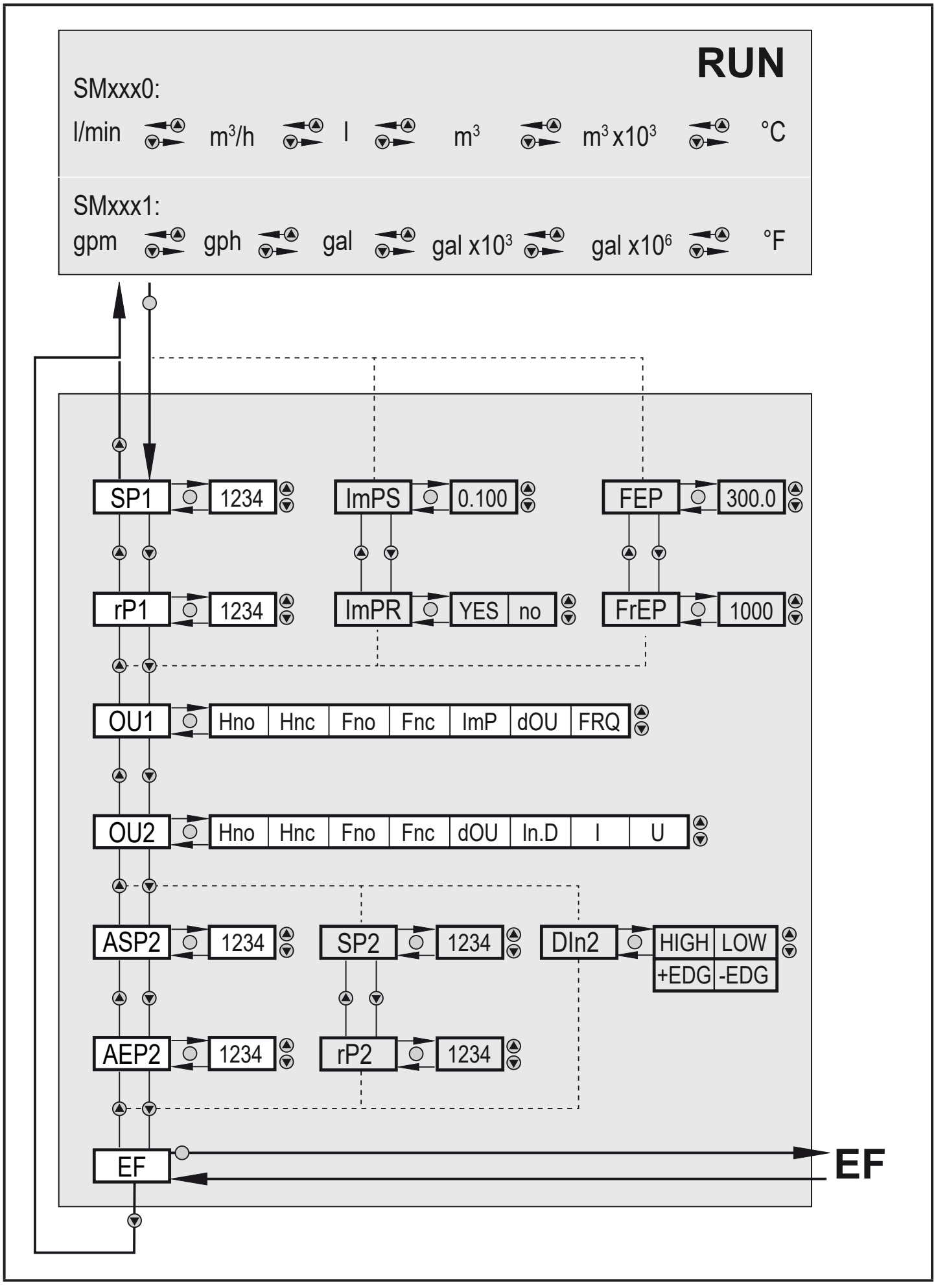
▭ LED is lit; ⌸ LED flashes * The consumed quantity is automatically displayed in the unit of measurement providing the highest accuracy.
7-8: Indicator LEDs for switching output
LED 7: Switching status OUT2 (lights when output 2 is switched) LED 8: Switching status OUT1 (lights when output 1 is switched)
9: Alphanumeric display, 4 digits
• Current volumetric flow quantity with [SELd] setting = FLOW • Meter reading of the totaliser with [SELd] setting = TOTL • Current medium temperature with [SELd] setting = TEMP • Parameters and parameter values
10: [Enter] button
• Selection of the parameters • Reading the set values • Confirmation of the parameter values Symbol used in → 8 Menu: ○
11: Buttons up [▲] and down **[▼]**
• Selection of the parameters • Activation of the setting functions • Changing the parameter values • Change of the display unit in the normal operating mode (RUN mode) • Locking / unlocking Symbol used in → 8 Menu: ▲ and ▼

8 Menu

Parameters with white background are indicated in case of factory setting (→ 14).

Parameters with grey background are available if OU1 or OU2 have been selected as Pulse or Frequency.

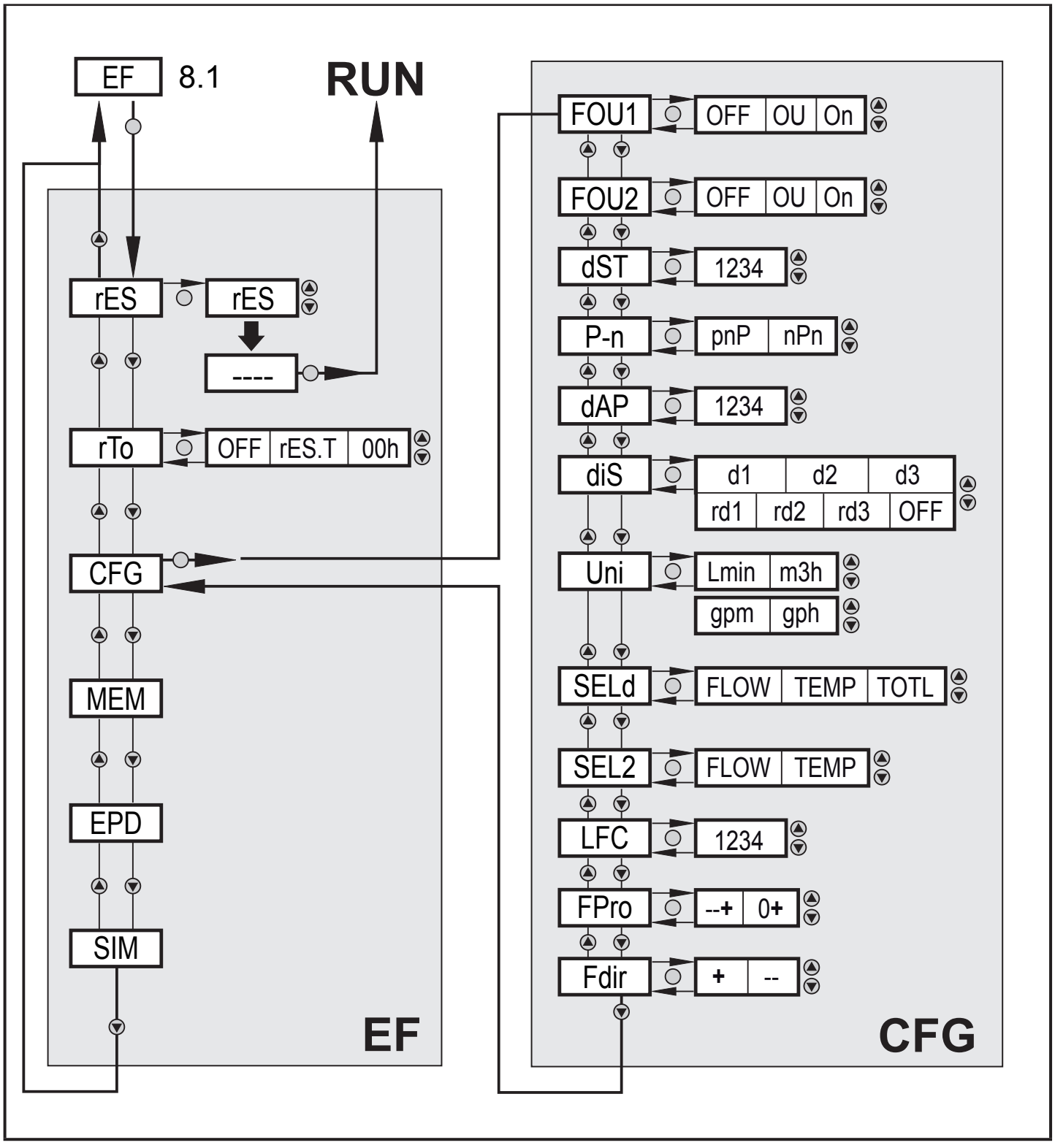
8.1 Main menu


RUN
SMxxx0:
l/min
m³/h
l
m³
m³ x10³
°C
SMxxx1:
gpm
gph
gal
gal x10³
gal x10⁶
°F
SP1
1234
ImPS
0.100
FEP
300.0
rP1
1234
ImPR
YES
no
FrEP
1000
OU1
Hno
Hnc
Fno
Fnc
ImP
dOU
FRQ
OU2
Hno
Hnc
Fno
Fnc
dOU
In.D
I
U
ASP2
1234
SP2
1234
DIn2
HIGH
LOW
+EDG
-EDG
AEP2
1234
rP2
1234
EF
EF

8.1.1 Explanation of the main menu

Parameters	Explanation and setting options
SP1	Switch Point value for volumetric flow on OUT1.
rP1	Reset Switch Point value for volumetric flow on OUT1.
ImPS	Pulse value = volumetric flow quantity at which 1 pulse is provided.
ImPR	Configuration of the output for consumed quantity monitoring:YES (pulse signal), no (switching signal).
FEP	Upper flow value at which OUT1 provides the frequency signal FrEP.
FrEP	Frequency signal that is provided at OUT1 when FEP is reached.
OU1	Output function for OUT1 (volumetric flow): - Hno, Hnc, Fno, Fnc: Switching signal for the limit values - ImP: Consumed quantity monitoring (totaliser function) - dOU: Switching signal for empty pipe detection - FRQ: Frequency output
OU2	Output function for OUT2 (volumetric flow or temperature): - Hno, Hnc, Fno, Fnc: Switching signal for the limit values - dOU: Switching signal for empty pipe detection - I (current signal 4...20 mA), U (voltage signal 0...10 V) Input function for OUT2: - In.D: input for external meter reset signal
ASP2	Analogue start point for volumetric flow or temperature on OUT2.
AEP2	Analogue end point for volumetric flow or temperature on OUT2.
SP2	Switch Point value for volumetric flow or temperature on OUT2.
rP2	Reset Switch Point value for volumetric flow or temperature on OUT2.
DIn2	Configuration of the input for external meter reset signal.
EF	Extended functions: Opening of the lower menu level.

8.2 Extended functions – Basic settings



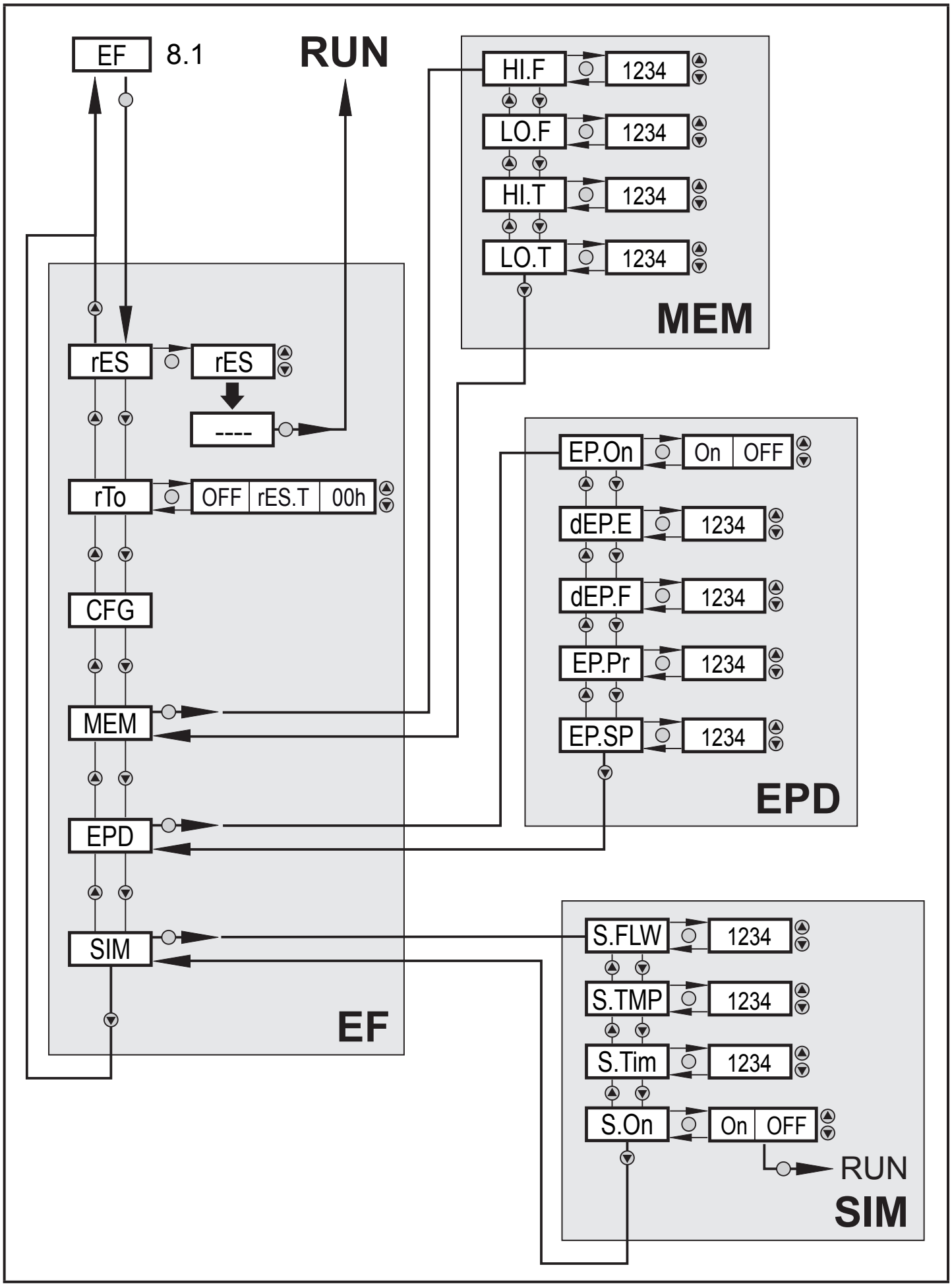
8.2.1 Explanation extended functions (EF)

rES	Restore factory settings
rTo	Reset the consumed quantity meter (totaliser)
CFG	Submenu basic settings
MEM	Submenu min/max memory
EPD	Submenu empty pipe
SIM	Submenu simulation

8.2.2 Submenu basic settings (CFG)

FOU1	Behaviour of OUT 1 in case of a fault
FOU2	Behaviour of OUT 2 in case of a fault
dST	Start-up delay for volumetric flow monitoring
P-n	Output logic: pnp / npn
dAP	Measured value damping: damping constant in seconds
diS	Update rate and orientation of the display
Uni	Standard unit of measurement for volumetric flow
SELd	Standard measuring unit of the display: FLOW (volumetric flow value), TEMP (medium temperature), TOTL (meter reading)
SEL2	Standard measured variable for evaluation by OUT2: FLOW (volumetric flow) or TEMP (temperature)
LFC	Low flow cut-off
FPro	Counting method of the totaliser
Fdir	Direction of flow

8.3 Extended functions – Min/max memory – Empty pipe – Simulation



8.3.1 Explanation extended functions (EF)

rES	Restoring the factory settings
rTo	Reset the consumed quantity meter (totaliser)
CFG	Submenu basic settings
MEM	Submenu min/max memory
EPD	Submenu empty pipe
SIM	Submenu simulation

8.3.2 Submenu min/max memory (MEM)

HI.F	Max. value of the flow measured in the process
LO.F	Min. value of the flow measured in the process
HI.T	Max. value of the temperature measured in the process
LO.T	Min. value of the temperature measured in the process

8.3.3 Submenu empty pipe (EPD)

EP.On	Empty pipe detection on / off
dEP.E.	Empty signal delay time
dEP.F	Full signal delay time
EP.Pr	Current measured value of empty pipe detection
EP.SP	Switch point of empty pipe detection

8.3.4 Submenu simulation (SIM)

S.FLW	Simulation flow value
S.TMP	Simulation temperature value
S.Tim	Simulation time
S.On	Simulation start

9 Set-up

After power up and expiry of the start up delay time (approx. 5 s) the unit is in the RUN mode (= normal operating mode). It carries out its measurement and evaluation functions and generates output signals according to the set parameters.

- During the start up delay time the outputs are switched as programmed:
  - ON with normally open function (Hno / Fno)
  - OFF with normally closed function (Hnc / Fnc).
- If output 2 is configured as analogue output, the output signal is at 20 mA (current output) or 10 V (voltage output) during the start up delay time.

10 Parameter setting

Parameters can be set before installation and set-up of the unit or during operation.

If you change parameters during operation, this will influence the function of the plant.

▶ Ensure that there will be no malfunctions in your plant.

During parameter setting the unit remains in the operating mode. It continues to monitor with the existing parameter until the parameter setting has been completed.

The parameters can also be set via the IO-Link interface (→ 4.12).

CAUTION

If the medium temperature is above 50 °C (122 °F) parts of the housing can increase in temperature to over 65 °C (149 °F).

> Risk of burns.

▶ Do not touch the device with your hands.

▶ Use another object (e.g. a ballpoint pen) to carry out settings on the unit.

10.1 Parameter setting in general

1. Change from the RUN mode to the main menu	[Enter]
2. Select the requested parameter	[▲] or [▼]
3. Display of the set parameter value	[Enter]
4. Change to the setting mode	[▲] or [▼] > 1 s (Display flashes, then permanent)
5. Modification of the parameter value - incremental by pressing once - continuous by keeping the button pressed	[▲] or [▼]
6. Acknowledge the set parameter value	[Enter]
7. Return to the RUN mode	> 30 seconds (timeout) or navigate through the menu levels using [▲] or [▼] until the RUN mode is reached.

10.1.1 Parameter setting in submenus

1. Change from the RUN mode to the main menu	[Enter]
2. Change to the sumenus	[▼] till EF [Enter]
3. Select the requested submenu	[▼] till CFG, MEM, EPD or SIM [Enter]
4. Select the requested parameter	[▲] or [▼]
5. Display of the set parameter value	[Enter]
6. Changing the parameter value	→ 10.1 Parameter setting in general, steps 4-7

10.1.2 Locking / unlocking

The unit can be locked electronically to prevent unintentional settings. On delivery: not locked.

Locking is also possible via an IO-Link capable parameter setting tool.

Locking	▶ Make sure that the unit is in the normal operating mode. ▶ Press [▲] and [▼] simultaneously for 10 s until [Loc] is displayed.
Unlocking	▶ Make sure that the unit is in the normal operating mode. ▶ Press [▲] and [▼] simultaneously for 10 s until [uLoc] is displayed.

10.1.3 Timeout

If no button is pressed for 30 s during parameter setting, the unit returns to the operating mode with unchanged parameter.

10.2 Settings for volumetric flow monitoring

10.2.1 Switch Point monitoring of volumetric flow (OUT1)

▶ Select [OU1] and set the switching function: Hno, Hnc, Fno or Fnc. ▶ Select [SP1] and set the Switch Point limit value of the volumetric flow. ▶ Select [rP1] and set the Reset Switch Point limit value of the volumetric flow.	Main menu: [OU1] [SP1] [rP1]

10.2.2 Switch Point monitoring of volumetric flow (OUT2)

▶ Select [SEL2] and set FLOW. ▶ Select [OU2] and set the switching function: Hno, Hnc, Fno or Fnc. ▶ Select [SP2] and set the Switch Point limit value of the volumetric flow. ▶ Select [rP2] and Reset Switch Point lower limit of the volumetric flow.	Menu CFG: [SEL2] Main menu: [OU2] [SP2] [rP2]

10.2.3 Analogue output flow rate (OUT2)

▶ Select [SEL2] and set FLOW. ▶ Select [OU2] and set the analogue function: I (4...20 mA) or U (0...10 V). ▶ Select [ASP2] and set the volumetric flow value at which the minimum current or voltage value is provided. ▶ Select [AEP2] and set the volumetric flow value at which the maximum current or voltage value is provided	Menu CFG: [SEL2] Main menu: [OU2] [ASP2] [AEP2]

10.2.4 Frequency signal for flow (OUT1)

▶ Select [OU1] and set FRQ. ▶ Select [FEP] and set the flow value at which the frequency set in FrEP is provided. ▶ Select [FrEP] and set the frequency.	Main menu: [OU1] [FEP] [FrEP]

10.3 Settings for consumed quantity monitoring

10.3.1 Quantity monitoring by pulse output (OUT1)

▶ Select [OU1] and set ImP. ▶ Select [ImPS] and set the volumetric flow quantity at which 1 pulse is provided (→ 10.3.3). ▶ Select [ImPR] and set [YES]. > Pulse repetition is active. Output 1 provides a counting pulse each time the value set in [ImPS] is reached.	Main menu: [OU1] [ImPS] [ImPR]

10.3.2 Quantity monitoring by preset counter (OUT1)

▶ Select [OU1] and set ImP. ▶ Select [ImPS] and set the volumetric flow quantity at which output 1 switches (→ 10.3.3). ▶ Select [ImPR] and set no. > Pulse repetition is not active. The output switches ON if the value set in [ImPS] is reached. It remains switched until the counter is reset.	Main menu: [OU1] [ImPS] [ImPR]

10.3.3 Pulse value

▶ Select [OU1] and set the consumed quantity to be monitored: → 10.3.1 or → 10.3.2. ▶ Select [ImPS]. ▶ Briefly press [Enter]. > The currently set value is displayed. ▶ keep [▲] or [▼] pressed until "⊏⊏⊏⊏ ▶ Press [▲] or [▼] > With each press of the pushbutton the display changes to the next setting range (decimal point shifts and / or LED* changes). ▶ Press [Enter] to confirm the setting range. ▶ Press [▲] or [▼] until the requested numerical value is displayed. ▶ Briefly press [Enter]. * → 7 Operating and display elements	Main menu: [OU1] [ImPS]

10.3.4 Manual counter reset

▶ Select [rTo] and set rES.T. > The counter is reset to zero.	Menu EF: [rTo]

10.3.5 Time-controlled counter-reset

▶ Select [rTo] and set the requested value:intervals of hours (h), days (d) or weeks (w). > The counter is reset automatically with the value now set.	Menu EF: [rTo]

10.3.6 Deactivation of the counter reset

▶ Select [rTo] and set OFF. > The meter is only reset after overflow (= factory setting).	Menu EF: [rTo]

10.3.7 Counter reset using an external signal

▶ Select [OU2] and set InD. ▶ Select [DIn2] and set the reset signal: - HIGH = reset for high signal - LOW = reset for low signal - +EDG = reset for rising edge - -EDG = reset for falling edge	Main menu: [OU2] [DIn2]

10.4 Settings for temperature monitoring

10.4.1 Switch Point monitoring for temperature (OUT2)

▶ Select [SEL2] and set TEMP. ▶ Select [OU2] and set the switching function: Hno, Hnc, Fno or Fnc. ▶ Select [SP2] and set the Switch Point temperature limit ▶ Select [rP2] and Reset the Switch Point temperature limit.	Menu CFG: [SEL2] Main menu: [OU2] [SP2] [rP2]

10.4.2 Analogue output temperature (OUT2)

▶ Select [SEL2] and set TEMP. ▶ Select [OU2] and set the analogue function: I (4...20 mA) or U (0...10 V). ▶ Select [ASP2] and set the temperature value at which the minimum current or voltage value is provided. ▶ Select [AEP2] and set the temperature value at which the maximum current or voltage value is provided.	Menu CFG: [SEL2] Main menu: [OU2] [ASP2] [AEP2]

10.5 User settings (optional)

10.5.1 Standard unit of measurement for volumetric flow

▶ Select [Uni] and set the unit of measurement. The setting only has an effect on the volumetric flow value. The consumed quantity (meter reading) is automatically displayed in the unit of measurement providing the highest accuracy.	Menu CFG: [Uni]

10.5.2 Standard display

▶ Select [SELd] and define the standard unit of measurement FLOW = display shows the current volumetric flow value in the standard unit of measurement.TOTL = display shows the current meter reading in the unit providing the highest accuracy. TEMP = the display shows the current medium temperature in °C / F°. ▶ Select [diS] and set the update rate and orientation of the display: d1 = update of the measured values every 50 ms. d2 = update of the measured values every 200 ms. d3 = update of the measured values every 600 ms. rd1, rd2, rd3 = display like d1, d2, d3; rotated by 180°. OFF = the display is switched off in the operating mode. The LEDs remain active even if the display is deactivated. Error messages are displayed even if the display is deactivated.	Menu CFG: [SELd] [diS]

10.5.3 Direction of flow

▶ Select [Fdir] and set the direction of flow: + = flow in the direction of the flow arrow (= factory setting) – = flow against the flow arrow ▶ label over the arrow	Menu CFG: [Fdir]

10.5.4 Output logic

▶ Select [P-n] and set PnP or nPn.	Menu CFG: [P-n]

10.5.5 Start-up delay

▶ Select [dST] and set the numerical value in seconds.	Menu CFG: [dST]

10.5.6 Measured value damping

▶ Select [dAP] and set the damping constant in seconds (τ value 63 %).	Menu CFG: [dAP]

10.5.7 Error behaviour of the outputs

▶ Select [FOU1] and set the value: 1. Switching output: - On = Output 1 switches ON in case of a fault. - OFF = Output 1 switches OFF in case of an error. - OU = Output 1 switches irrespective of the fault as defined with the parameters. 2. Frequency output: - On = 130% of FrEP. - OFF = 0 Hz - OU = continues running ▶ Select [FOU2] and set the value: 1. Switching output: - On = Output 2 switches ON in case of a fault. - OFF = Output 2 switches OFF in case of a fault. - OU = Output 2 switches irrespective of the fault as defined with the parameters. 2. Analogue output: - On = The analogue signal goes to the upper fault value (→ 4.6). - OFF = The analogue value goes to the lower fault value (→ 4.6). - OU = The analogue signal corresponds to the measured value.	Menu CFG: [FOU1] [FOU2]

10.5.8 Activating / deactivating empty pipe detection

▶ Select [OU1] or [OU2] and set dOU. ▶ Select [EP.On] and set the function: - OFF = empty pipe detection deactivated. - On = empty pipe detection activated.	Main menu: [OU1] [OU2] Menu EPD: [EP.On]

10.5.9 Empty pipe detection switching logic

▶ Select [P-n] and set PnP or nPn.	Menu CFG: [P-n]

10.5.10 Time-delay empty pipe detection

▶ Select [dEP.E] and set the delay time from 0…30 s, at which the signal should be provided when the pipe is empty. ▶ Select [dEP.F] and set the delay time from 0…30 s, at which the signal should be provided when the pipe is full.	Menu EPD: [dEP.E] [dEP.F]

10.5.11 Empty pipe detection limit value

▶ Select [EP.Pr] to display the current value of the empty pipe detection in percent. ▶ Select [EP.SP] and set the switch point of empty pipe detection.	Menu EPD: [EP.Pr] [EP.SP]

10.5.12 Counting method of the totaliser

▶ Select [FPro] and set the value: –+ = totalling the volumetric flow values with the correct sign. 0+ = totalling only positive volumetric flow values.	Menu CFG: [FPro]

10.5.13 Low flow cut-off

▶ Select [LFC] and set the limit value.	Menu CFG: [LFC]

10.6 Service functions

10.6.1 Read min/max values

▶ Select [HI.x] or [LO.x] and read the value. HI.F = maximum volumetric flow, LO.F = minimum volumetric flow HI.T = maximum temperature, LO.T = minimum temperature Delete memory: ▶ Select [HI.x] or [LO.x]. ▶ Briefly press [Enter]. ▶ keep [▲] or [▼] pressed until [----] is displayed. ▶ Briefly press [Enter]. It makes sense to delete the memories as soon as the unit operates under normal operating conditions for the first time.	Menu MEM: [HI.F] [LO.F] [HI.T] [LO.T]

10.6.2 Simulation menu

▶ Select [S.FLW] and set the flow value to be simulated. ▶ Select [S.TMP] and set the temperature value to be simulated. ▶ Select [S.Tim] and set the time of the simulation in minutes. ▶ Select [S.On] and set the function: - On: The simulation starts. The values are simulated for the time set at [S.Tim]. [SIM] is displayed simultaneously with the process values. Cancel with [Enter]. - OFF: The simulation is not active.	Menu SIM: [S.FLW] [S.TMP] [S.Tim] [S.On]

10.6.3 Reset all parameters to factory setting

▶ Select [rES]. ▶ Briefly press [Enter]. ▶ keep [▲] or [▼] pressed. > [----] is displayed. ▶ Briefly press [Enter].  → 14 Factory setting. We recommend taking down your own settings in that table before carrying out a reset.	Menu EF: [rES]

11 Operation

11.1 Reading the process value

The LEDs 1-6 signal which process value is currently displayed in which unit.

The process value to be displayed as standard (temperature, flow velocity or meter reading of the totaliser) can be preset → 10.5.2.

A standard unit of measurement can be defined for the flow velocity → 10.5.1.

11.2 Changing the process value display in the RUN mode

▶ Briefly press [▼] or [▲] in the RUN mode.

> The unit displays the current measured value in the selected display unit for approx. 30 s, the corresponding indicator LED lights (→ 7)

11.3 Read the set parameters

▶ Press [Enter].

▶ Press [▲] or [▼] until the requested parameter is displayed.
Change to the sub-menu if needed→ 10.1.1.

▶ Press [Enter].

> The unit displays the corresponding parameter value. After approx. 30 s it returns to the RUN mode.

12 Troubleshooting

The unit has many self-diagnostic options. It monitors itself automatically during operation.

Warnings and error states are displayed, even when the display is switched off. Error indications are also available via IO-Link.

Display	Type	Description	Troubleshooting
IOE.n	Error	• Unit faulty / malfunction	▶ Replace the unit.
SEnS	Warning	Sensor signal invalid. • Measuring pipe not sufficiently filled. • Medium with too low a conductivity.	▶ Verifying the installation position → 5 ▶ Verify the conductivity of the medium (≥ 20 µS/cm).
No display	Error	• Supply voltage too low. • Setting [diS] = OFF	▶ Check the supply voltage. ▶ Change the setting [diS] → 10.5.2
Loc	Warning	Setting buttons on the unit locked, parameter change rejected.	▶ Unlock the unit → 10.1.2
C.Loc	Warning	Setting buttons on the unit temporarily locked, parameter setting via IO-Link communication active.	▶ Finish parameter setting via IO-Link communication.
S.Loc	Warning	Setting buttons locked via parameter software, parameter change rejected.	▶ Unlock the unit via IO-Link interface using the parameter setting software.

Display	Type	Description	Troubleshooting
UL	Warning	Below the display range. • Current value between -130 % ... -120 % VMR • Temperature value between -50...-40 °C or -58...40 °F	▶ Check flow range / temperature range.
cr.UL	Error	Below the measuring range. • Flow value < -130 % VMR • Temperature value < - 50 °C or -58 °F	▶ Check flow range / temperature range.
OL	Warning	Display range exceeded. • Current value between 120 % ... 130 % VMR • Temperature value between 100...110 °C or 212...230 °F	▶ Check flow range / temperature range.
cr.OL	Error	Above the measuring range. • Flow value > 130 % VMR • Temperature value > 110 °C or 230 °F	▶ Check flow range / temperature range.
PArA	Error	Parameter setting outside the valid range.	▶ Repeat parameter setting.
SC1	Warning	Switching status LED for OUT1 flashing: OUT1 short circuit.	▶ Check switching output OUT1 for short-circuit or excessive current.
SC2	Warning	Switching status LED for OUT2 flashing: short circuit OUT2.	▶ Check switching output OUT2 for short-circuit or excessive current.
SC	Warning	Switching status LEDs for OUT1 and OUT2 flashing: Short circuit in both outputs.	▶ Check switching outputs OUT1 and OUT2 for short-circuit or excessive current.

MEW = final value of the measuring range

13 Technical data

Further technical data and scale drawing at www.ifm.com

14 Factory setting

Parameter	Factory setting		User setting
	SMxxx0	SMxxx1	
SP1	20 % *	20 % *	
rP1	19.5 % *	19.5 % *	
ImPS	0.1	0.02	
ImPR	YES	YES	
OU1	Hno	Hno	
OU2	I	I	
SP2 (FLOW)	40 % *	40 % *	
rP2 (FLOW)	39.5 % *	39.5 % *	
SP2 (TEMP)	20 °C	68 °F	
rP2 (TEMP)	19,6 °C	67,3 °F	
ASP2 (FLOW)	0 % *	0 % *	
AEP2 (FLOW)	100 % *	100 % *	
ASP2 (TEMP)	-20 °C	-4 °F	
AEP2 (TEMP)	80 °C	176 °F	
FEP	100 % *	100 % *	
FrEP	1 kHz	1 kHz	
FDir	+	+	
FPro	- +	- +	
LFC	5 l/min	1.1 gpm	
DIn2	+EDG	+EDG	
FOU1	OFF	OFF	
FOU2	OFF	OFF	
dSt	0	0	
P-n	PnP	PnP	
dAP	0.6 s	0.6 s	
rTo	OFF	OFF	

Parameter	Factory setting		User setting
	SMxxx0	SMxxx1	
diS	d2	d2	
Uni	Lmin	gpm	
SELd	FLOW	FLOW	
SEL2	FLOW	FLOW	
EP.On	OFF	OFF	
dEP.E	0 s	0 s	
dEP.F	2 s	2 s	
EP.SP	75 %	75 %	
S.FLW	20 %	20 %	
S.TMP	20 °C	68 °F	
S.Tim	3 min	3 min	

* of the final value of the measuring range

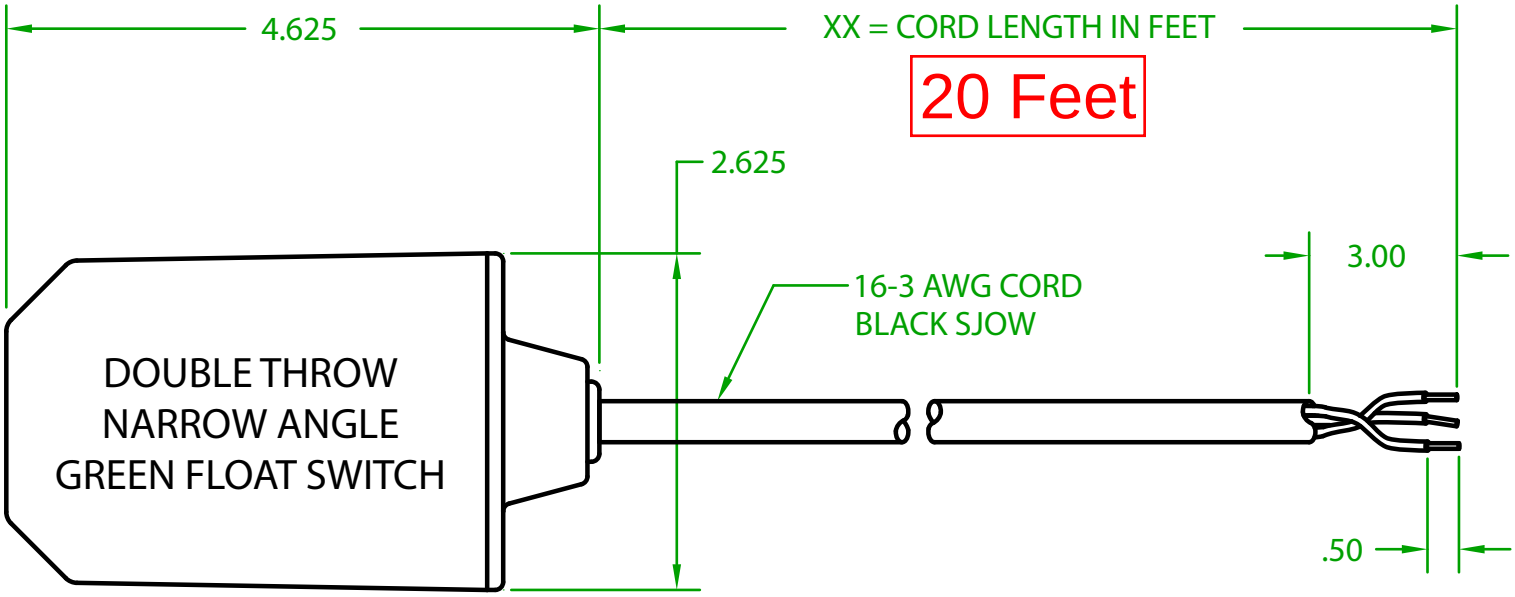
Section 3.3.9

High Level Float

MERCURY DISPLACEMENT INDUSTRIES, INC.
Post Office Box 710 - U.S. 12 East - Edwardsburg, Michigan 49112-0710
Phone (269) 663-8574 - Fax (269) 663-2924
(800) 634-4077

SKF-5034-*XX*

Mercury Free



OPERATING ANGLE: TETHERLESS/INTERNALLY WEIGHTED
SWITCHES @ 25° ABOVE AND 10° BELOW HORIZONTAL.
@ 25° ABOVE HORIZONTAL:
(RED IS CLOSED / WHITE IS OPEN)
@ 10° BELOW HORIZONTAL: (NORMAL POSITION)
(RED IS OPEN / WHITE IS CLOSED)

SWITCHING DIFFERENTIAL: 3 1/2"

ELECTRICAL RATINGS: 1/4 H.P. 10 AMPS @ 120/240 VAC. 34.8 LRA

FLOAT MATERIAL: A.B.S.

High High Alarm - Normally Closed
White - NC & Black - Common

J.J.S. OCTOBER 03, 2012

Revised 01-16-2014

Contactors - Relays - Switches

http://www.mdius.com

SJE-Rhombus®

Accessories Installation Instructions

Cord Seal, Cable Weight, Cable Clamp Assembly, and Float Bracket.

CORD SEALS



Provides strain relief and a liquid-tight seal.

- Seals 1-4 cables in 2" terminal adapters
- Seals 1-6 cables in 2½" terminal adapters
- PVC plugs included (for unused cable positions)
- Ground wire

CABLE WEIGHT



U.S. Patent 5,306,885

Provides an accurate pivot point for suspended float switches.

- Gripper teeth on clip and weight channel securely lock float cable into place
- Cable Weight can be adjusted without the use of tools

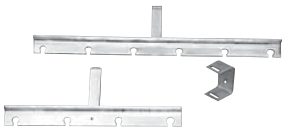
CABLE CLAMP ASSEMBLY



Provides cable anchor point and strain relief. Secures cable in vertical direction.

- For use with 18/16 gauge, 14 gauge, & 12 gauge cable
- Mounting clamp: ABS Nylon blend
- Hose clamp: highly corrosion resistant stainless steel

FLOAT BRACKET



Provides convenient installation of float switches.

- Six Float Bracket supports 1-6 floats
- Four Float Bracket supports 1-4 floats
- Can be directly mounted to wall or used with wall mounting device
- Provides convenient location to stow excess float cord
- Supplied with cord strain relief connectors

PREVENTATIVE MAINTENANCE

- Periodically inspect the product. Check that the cable has not become worn or that the housing has not been damaged so as to impair the protection of the product. Replace the product immediately if any damage is found or suspected.
- Periodically check to see that the float is free to move and operate the pump or alarm.
- Use only SJE-Rhombus® replacement parts.

SJE-RHOMBUS® THREE-YEAR LIMITED WARRANTY

SJE-RHOMBUS® warrants to the original consumer that this product shall be free of manufacturing defects for three years after the date of consumer purchase. During that time period and subject to the conditions set forth below, **SJE-RHOMBUS®** will repair or replace, for the original consumer, any component which proves to be defective due to defective materials or workmanship of **SJE-RHOMBUS®**.

ELECTRICAL WIRING AND SERVICING OF THIS PRODUCT MUST BE PERFORMED BY A LICENSED ELECTRICIAN.

THIS WARRANTY DOES NOT APPLY: (A) to damage due to lightning or conditions beyond the control of **SJE-RHOMBUS®**; **(B)** to defects or malfunctions resulting from failure to properly install, operate or maintain the unit in accordance with printed instructions provided; **(C)** to failures resulting from abuse, misuse, accident, or negligence; **(D)** to units which are not installed in accordance with applicable local codes, ordinances, or accepted trade practices, and **(E)** to units repaired and/or modified without prior authorization from **SJE-RHOMBUS®**.

Some states do not allow limitations on how long an implied warranty lasts, so the above limitation may not apply to you. Some states do not allow the exclusion or limitation of incidental or consequential damages, so the above limitation or exclusion may not apply to you. This warranty gives you specific legal rights, and you may also have other rights which vary from state to state.

TO OBTAIN WARRANTY SERVICE: The consumer shall assume all responsibility and expense for removal, reinstallation, and freight. Any item to be repaired or replaced under this warranty must be returned to **SJE-RHOMBUS®**, or such place as designated by **SJE-RHOMBUS®**.

ANY IMPLIED WARRANTIES OF MERCHANTABILITY OR FITNESS ARE LIMITED TO THE DURATION OF THIS WRITTEN WARRANTY. SJE-RHOMBUS® SHALL NOT, IN ANY MANNER, BE LIABLE FOR ANY INCIDENTAL OR CONSEQUENTIAL DAMAGES AS A RESULT OF A BREACH OF THIS WRITTEN WARRANTY OR ANY IMPLIED WARRANTY.

SJE-Rhombus®

22650 County Highway 6 ■ P.O. Box 1708 ■ Detroit Lakes, Minnesota 56502 USA
1-888-DIAL-SJE (1-888-342-5753) ■ Phone: 218-847-1317 ■ Fax: 218-847-4617 ■ E-mail: customer.service@sjerhombus.com

⚠ WARNING — **ELECTRICAL SHOCK HAZARD**
Disconnect power before installing or servicing this product. A qualified service person must install and service this product according to applicable electrical and plumbing codes.

⚠ WARNING — **EXPLOSION OR FIRE HAZARD**
Do not use this product with flammable liquids. Do not install in hazardous locations as defined by National Electrical Code, ANSI/NFPA 70.

Failure to follow these precautions could result in serious injury or death. Replace product immediately if switch cable becomes damaged or severed. Keep these instructions with warranty after installation. This product must be installed in accordance with National Electric Code, ANSI/NFPA 70 so as to prevent moisture from entering or accumulating within boxes, conduit bodies, fittings, float housing, or cable.

For detailed specifications on this product, or for the complete line of SJE-Rhombus® panel, alarm, and switch products, visit our web-site at www.sjerhombus.com.

CORD SEAL INSTALL

1. Pass the cables through the 2" or 2½" terminal adaptor.
2. Route cables through the seal, leaving adequate cable to work with. See **Figure A**.
   NOTE: If all hole positions are not used, plug open position(s) in the cord seal with the PVC plug(s) provided.
3. Insert the cord seal into the terminal adaptor and tighten hex nut until adequate strain relief is achieved.
4. Gather all ground wires, including ground conductor on the cord seal and secure to ground terminal.

CABLE WEIGHT INSTALL

1. Lay cable in weight as shown in Figure B.
2. Align clip with weight groove and slide clip towards cable as shown in Figure B. Snap clip snugly up to cable and manually force clip to tightest possible position.
3. See Figure C for proper tether length.

CABLE CLAMP INSTALL

1. Determine the required cord tether length according to product specifications.
2. Place the cord into the clamp as shown as shown in Figure D.
3. Locate clamp at desired activation level and secure the clamp to the discharge pipe as shown in Figure D.
   Note: Do not install cord under hose clamp.
4. Tighten the hose clamp using screwdriver. Over tightening may result in damage to the plastic clamp. Make sure the float cable is not allowed to touch the excess hose clamp band during operation.
5. Wire switch as shown in the Wiring Diagrams.
6. Check installation. Allow system to cycle to insure proper operation.

Note: All hose clamp components are made of 18-8 stainless steel material. See your SJE-Rhombus® supplier for replacements.

FLOAT BRACKET INSTALL

1. Drill holes in mounting surface 1-5/16 inches apart vertically.
2. Install the mounting bracket to the mounting surface using two fasteners shown in Figure E.
   NOTE: Use stainless steel fasteners appropriate for the mounting surface.
3. Snap the cord lock onto the cable shown in Figure E.
4. Drop the cord lock and cord into the top side of a desired hole in the float bracket as shown in Figure F.
5. Adjust the cord to the proper length, so that activation occurs at the desired level.
6. To lock the cord in place, turn the cord lock clockwise as shown in Figure F.
7. Slide the float bracket into the mounting bracket slots as shown in Figure F.
8. Confirm the float cords are set at a proper height to insure correct activation/deactivation levels.

Figure A

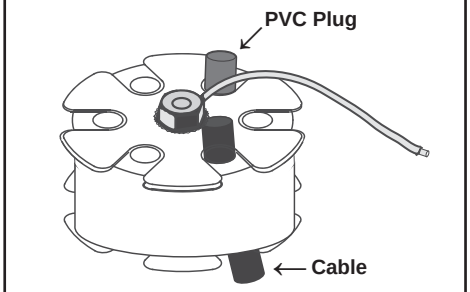


Figure B

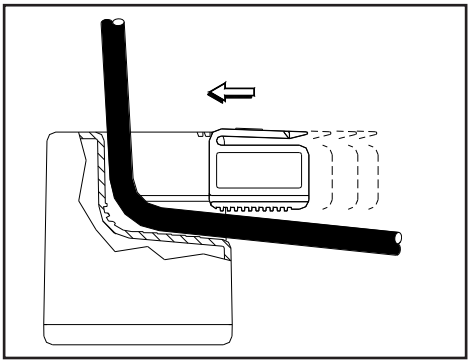
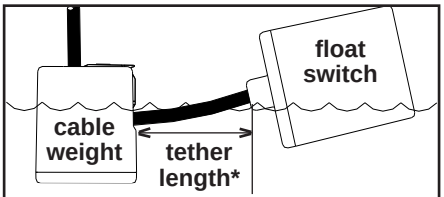


Figure C



***Control Switches:**
Recommended tether length is 4 inches (10 cm)

***Pump Switches:**
Minimum recommended tether length is 3.5 inches (9 cm)

Figure D

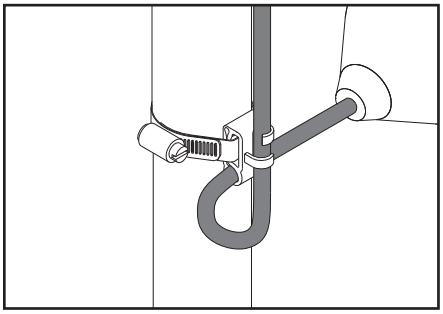


Figure E

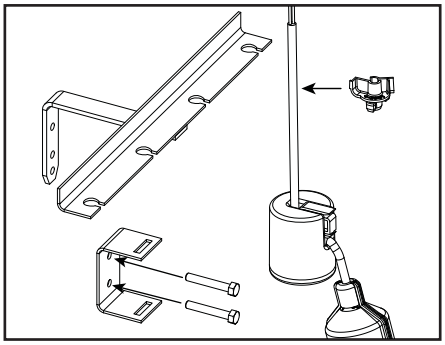
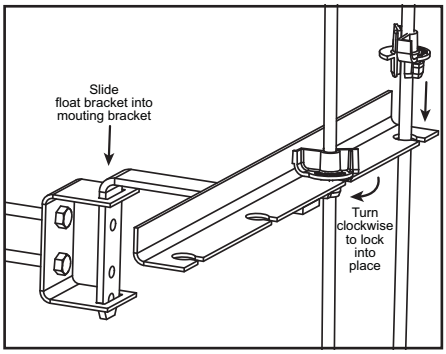


Figure F



Instl. Instr. PN 1041933A
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Section 3.4

DAF Package

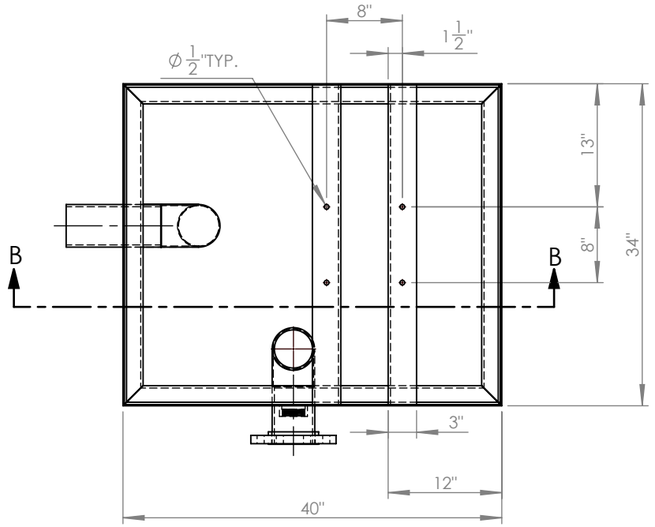
Section 3.4.1

Mixing Tank Package

Section 3.4.1.1

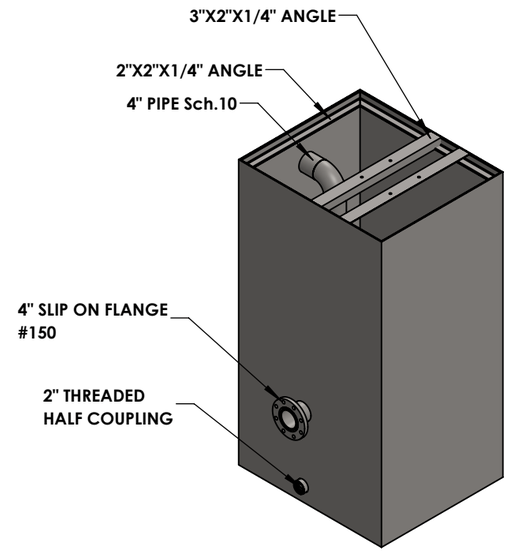
Mixing Tank

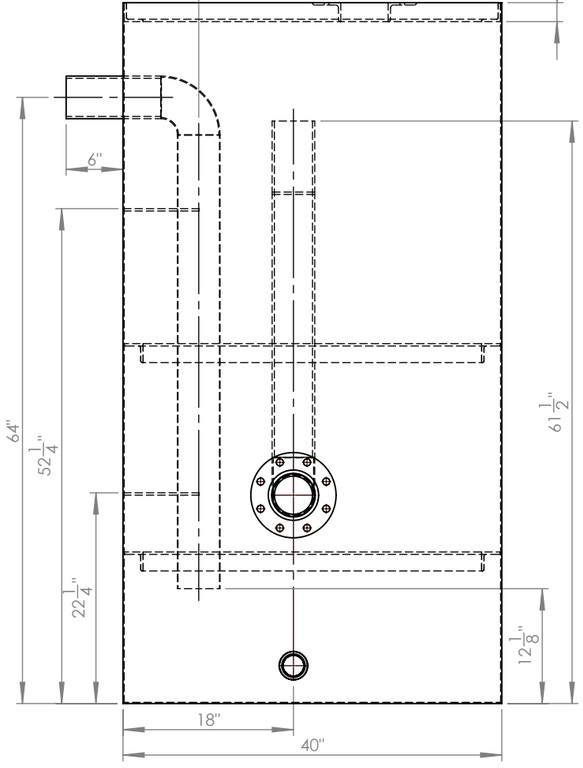
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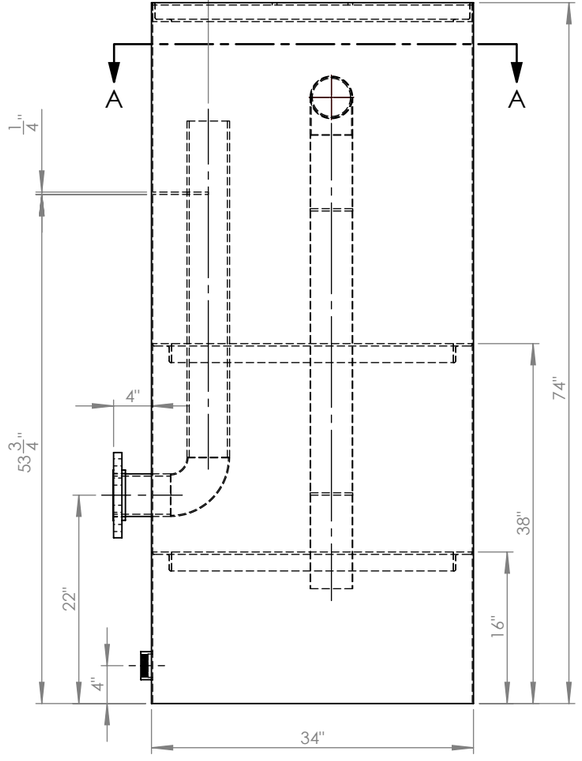


NOTES:

1. QTY: 1 UNIT
2. MATERIAL: SS 304, GAUGE 10-TANK WALL,
3. ALL DIMENSIONS ARE EDGE TO EDGE UNLESS OTHERWISE NOTED
4. TOLERANCES: ANGULAR MACH. ±1°, BEND ± 1°, DECIMAL ±0.5mm OR ±1/64"







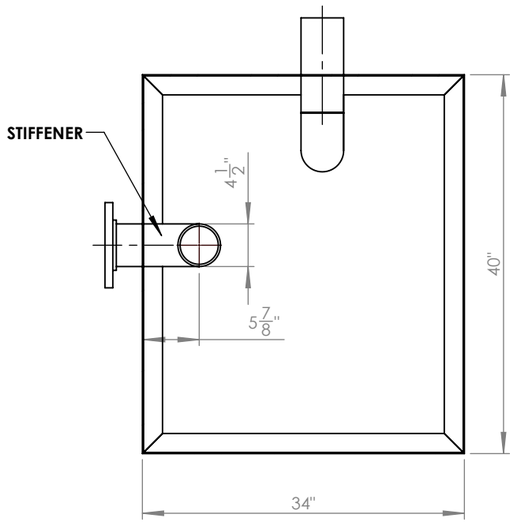
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WATER AND WASTEWATER TREATMENT EQUIPMENT
580 OSTER LANE, CONCORD, ON L4K 2C1 CANADA
TEL: (905) 660-9775 FAX: (905) 660-9744
www.h2flow.com

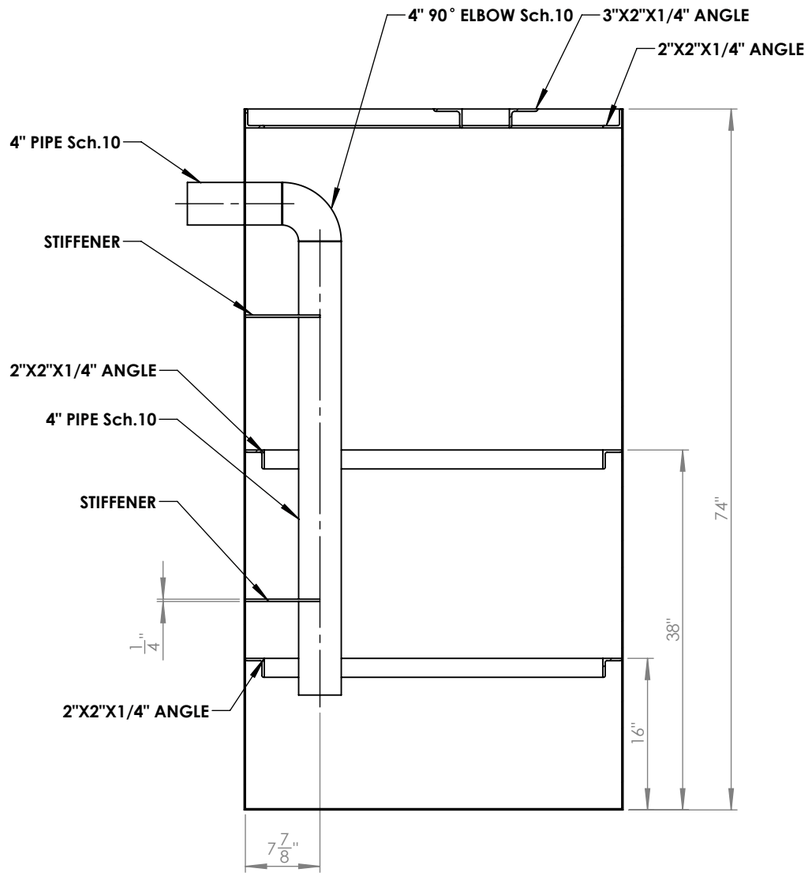
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DRAWN BY: DM	DATE: 04/06/2022	PROJECT NAME: SABINA GOLD STP NUNAVUT	TITLE: MIXING TANK DETAILS
APP'D BY: JC	DATE: 04/06/2022		DRAWING No.: Q-23119-30-03
SCALE: NTS		ALL DIMENSION ARE IN INCHES UNLESS OTHERWISE SPECIFIED	REV: 0
			SHEET 1 OF 2

REV	DESCRIPTION	DATE	BY	APP'D
0	FOR FABRICATION	04/06/2022	DM	JC



SECTION A-A
SCALE 1 : 16



SECTION B-B
SCALE 1 : 16

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SCALE: NTS			REV: 0
		ALL DIMENSION ARE IN INCHES UNLESS OTHERWISE SPECIFIED	SHEET 2 OF 2

Section 3.4.1.2

Mixer

CONSTRUCTION				
Drive	Electric Motor 1.0 HP @ 1725 rpm 3/60/575V TEFC, Worm Gear Reducer Right Angle 20 to 1 Ratio @ 88 rpm			
Mount	Square Mounting Plate 11" x 11" / Mild Steel	**Top Impeller**	14" diameter, Dynaflow Blade (316SS)	Spacing 25"
Shaft	1" dia. 60" long (316SS)	**Bottom Impeller**	14" diameter, Dynaflow Blade (316SS)	Off Bottom 14"
Custom	Custom Right angle gearbox, 88RPM			

CUSTOMER DATA			
Tank Size	Rect. 31.5" W x 39.37" L x 74" Ht (64" fluid Ht.)	**Mixing Class**	Blending
Volume	344 Gallons	**Mixing Level**	Mild
Temperature	Ambient	**Pressure**	Atm.
Baffles	None	**Torque**	17 [lb.inch]

Material	Specific Gravity	Viscosity (cps)	% WT	Particle Size	Settling Rate
Wastewater (Flocculation)	**1.00**	**1.57**	**100%**	**0.00**	
	1.00	**1.57**	**100%**	**0.00**	

DYNAMIX AGITATORS

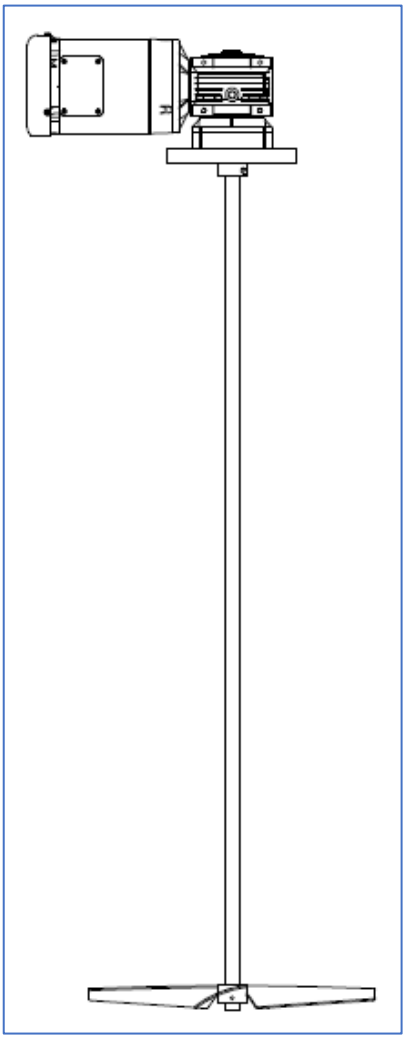
Installation, Operation & Maintenance Manual

DMX3000 Series
UTILITY MIXER

Important Safety Instructions

This Installation and Operation Manual Includes **Important Warnings and Safety Information**.

Be sure to keep this manual with equipment and ensure all operators read the enclosed information.



DMX3000
Utility Mixer
**all drawings in this manual are Typical Drawings*

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Important Safety Warnings

Please Read These Warnings Carefully Before Unpacking the Mixer



The following safety instructions must be COMPLETELY REVIEWED AND FOLLOWED before operating any Dynamix Mixer. FAILURE TO FOLLOW THESE INSTRUCTIONS COULD RESULT IN SERIOUS INJURY

In the installation, operation and maintenance of the Mixer, SAFETY comes first.

ALL safety precautions listed in this manual MUST be followed by all personnel working on or with the equipment if serious injury is to be avoided.

1. This mixer is intended for professional use only.
2. The installation of this equipment does not normally require the services of factory personnel. If required, these services can be agreed upon before or after purchase. These services are available from Dynamix Agitators by contacting the Sales Department.
3. Adequate installation, maintenance, and safety instructions must be given by the operator to personnel directly responsible for the operation of the drive and accessory equipment. In addition, the procedures set forth in the operating instructions must be carefully followed.
4. All service personnel MUST be knowledgeable relative to the equipment before performing any maintenance or repair work. Use proper clothing, tools, and methods of handling to prevent serious accidents.
5. The operator is responsible for furnishing and installing any guards or other safety equipment needed to protect operating personnel as required by Occupational Safety and Health Administration standards (OSHA) or other applicable safety regulations. This equipment normally is not furnished by Dynamix Agitators except when specified as part of the order. In all cases, however, the operator has the responsibility of complying with all local, state / province and national fire, electrical, and safety regulations when installing the equipment.
6. Each mixer is selected for a specific application. **Do not use this mixer in applications other than that for which was designed and quoted. Applying a mixer in applications outside of intended use may result in overload conditions, which will damage the mixer.** If you are unsure of the appropriate application, please contact Dynamix Agitators with the relevant mixer serial number.
7. Do not connect the power source until this Manual is followed and the mixer is properly assembled and installed as per design.
8. Your mixer has been tested and checked for shaft straightness before shipping. Care must be taken while handling the shaft to ensure proper operation.
9. Do not alter or modify this mixer. Any alteration or modification will void the mixer's Warranty.
10. Ensure all equipment and personnel are clear off the rotating parts.
11. Do not touch rotating mixer parts.
12. If your mixer requires lifting by eyebolt or by another method, ensure that eyebolts or other means are securely fastened before lifting the mixer.
13. Some electric motors will run excessively hot under continuous load. Before touching the drive unit, make sure the motor and gearbox are not hot.
14. Check equipment daily. Repair and replace damaged parts immediately.

15. Do not uninstall or service this mixer until you have followed your “Control of Hazardous Energy Sources” procedure as per OSHA Guidelines and/or the Canadian Occupational Health and Safety Regulations.



FIRE AND EXPLOSION HAZARD

Improper grounding, poor ventilation, open flames, or sparks can cause a hazardous condition and result in a fire or explosion and serious injury.

Receiving, Inspection & Storage

Please Read These Warnings Carefully Before Unpacking the Mixer



The following safety instructions must be COMPLETELY REVIEWED AND FOLLOWED before operating any Dynamix Mixer. FAILURE TO FOLLOW THESE INSTRUCTIONS COULD RESULT IN SERIOUS INJURY

Goods must be inspected within 30 days of receive date. It is assumed that goods are satisfactory if Dynamix is not notified within this period.

Please follow the following steps to prevent injury or damage to equipment:

1. Immediately upon delivery, check all crating and boxes for damage which may have occurred during transit, and report any damage to the carrier and Dynamix Agitators Inc.
2. Carefully inventory all furnished equipment against packing list to determine if any shortages exist in delivered material. Any such shortages must immediately be reported to Dynamix Agitators and the Carrier if a timely claim is to be made.
3. Your mixer has been tested and checked for shaft straightness before shipping. Care must be taken while handling the shaft to ensure proper operation and longevity.
4. Store the mixer in a clean, dry environment, with a relatively constant temperature. Electric motors may easily damage by moisture. Circulating air will help prevent moisture buildup in the mixer drive.
5. Store the mixer assembly off the floor, covered by plastic.
6. Do not seal the plastic covering as this will increase the risk of condensation. Use desiccants if possible.



MOVING PARTS HAZARD

Always shut off the mixer power source (unplug electric power and disconnect air power source) before performing any maintenance, repair, or adjustments. Not doing so can result in serious injury.

Operation Instructions

Please Read These Warnings Carefully Before Operating the Mixer

WARNING!

The following safety instructions must be COMPLETELY REVIEWED AND FOLLOWED before operating any Dynamix Mixer. FAILURE TO FOLLOW THESE INSTRUCTIONS COULD RESULT IN SERIOUS INJURY

Important: This instruction manual is not intended to include a comprehensive listing of all details for all procedures required for installation, operation, and maintenance. If you have a question about a procedure or are uncertain about any detail, **Do Not Proceed**. Please contact Dynamix Agitators for more information or clarification.

1. Do not uninstall or service this mixer until you have followed your “Control of Hazardous Energy Sources” procedure as per OSHA Guidelines and/or the Canadian Occupational Health and Safety Regulations.
2. Read and fully understand the manual before installation and start-up.
3. Ensure the mixer is designed for the application. Operating outside of the mixer's intended use will result in damage. Refer to original quotation.
4. Do not handle the mixer by the shaft. Lifting and handling the mixer by the shaft will cause damage.
5. Check the straightness of the shaft by slowly rotating by hand before operation in fluid.
6. On start-up ensure the mixer shaft and impeller is not obstructed from rotation.
7. Minimum fluid level **must** be at least one impeller diameter above the (top) impeller for proper mixing. Vertexing may occur if the fluid level is too close to the impeller. Aeration of the product and excess vibration may occur. **Avoid operating the mixer in air.**
8. Avoid extended operation when fluid level is at or near the (bottom) impeller.
9. Fluidize settled solids before starting mixer. Impeller cannot be buried in solids at start-up. For best performance axial flow impellers (Dynaflow™ and Pitch) should be positioned at least ½ of their diameter above the tank floor or settled solids. If the impeller is buried, disperse any settled solids before starting the mixer.
10. When viewed from above (looking into the mixing tank), mixer rotation is counter clockwise. Reversed rotation may cause overloading and inefficient mixing. Confirm rotation with sticker on side of mixer.
11. When mixing materials of different viscosities or specific gravities, the lighter or less viscous material should be introduced first. Add heavier materials gradually in the center of the tank while the mixer is running. **Do not dump large quantities of solids or powders into the tank.** This will cause impacting on the impeller and may cause equipment damage.
12. Check the quotation data sheet for operating speed requirements if a variable speed drive is used.
13. Some shaft vibration is normal. A bent shaft may cause excess vibration.
14. Keep motors clean and dry. The electric motors supplied are designed for outdoor use but may be damaged due to harsh weather. Severe duty motors are also available.

Start-up Checklist

Please Review This Checklist Carefully Before Operating the Mixer

Prior to, and during start-up, please check that the following things have been done:

Manual has been read and followed ☐

Sufficient protection for motor (*if outdoors*) ☐

Wiring correctly installed, grounded, and insulated ☐

Impeller(s) installed correctly. See Installation section of Manual. ☐

Impellers spaced correctly (*if two or more*) for maximum and minimum liquid levels ☐

Impeller immersed in liquid and no equipment or obstructions can impact the impeller ☐

Proper shaft rotation is counter clockwise looking down, unless otherwise noted. Refer to Directional Sticker on Impellers to show proper impeller assembly and rotation. ☐



Correct voltage / amperage upon starting. ☐

Check against motor nameplate data: Record: _____ Volts _____Amps

Excessive noise after start-up? Record: _____ db. @ 3ft distance ☐

Excessive vibration of tank or support ☐

_____ _____

Inspector Date

Assembly & Installation

Mounting the Drive

Mounting structure must be stable and strong enough to handle torque, bending moment, and weight specified on assembly drawing. If mounted on an unstable support, mixer loads may cause damage to the equipment and tank.

Mixer drives with mounting plates (figure 1) may need to be shimmed to be vertical and then bolted securely to the mounting structure. Flange mounts must have gaskets between flanges before bolting securely for proper sealing. When a remote seal is used, the seal must be concentric and perpendicular to the mixer shaft. Using lock washers or double nutting the mounting bolts are recommended to prevent bolts from loosening by equipment vibration. When installing the mounting plate, tighten the bolts to torque listed in Appendix 1.

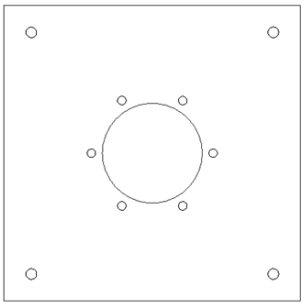


Figure 1: mounting plate

CAUTION!

DO NOT lift the mixer by the shaft.
DO NOT hammer parts in place.
DO NOT lift the mixer using the lifting lug of the motor.
Use slings tightened around the mixer drive, NOT the mixer shaft.

Installing the Mixer Shaft

Mixer installation procedures may vary according to the environment or custom design. *Refer to the Technical Drawing at the beginning of the Parts, Maintenance & Service section of this manual. If there are any concerns, contact your Representative.*

NOTE: Ensure the Mixer Drive Assembly is firmly secured or in a fixed position before shaft installation:

Plate Mount Mixers:

1. Clean the top section of the Mixer Shaft and apply anti seize compound. Be sure to apply anti-seize fluid on both shaft and coupling.
2. Raise Mixer Shaft from below and insert into the coupling (The upper section of the coupling is attached to drive unit during mixer assembly).
3. Tighten up the coupling screws to torque listed in appendix 1.
4. Remove motor fan guard and turn fan by hand to check that the mixer shaft turns freely, and alignment is true. Repeat once impellers are installed. (*Figure 2.1*)



Figure 2.1

Clamp Mount Mixers:

1. Remove the clamp mount from mixer drive assembly.
2. Clean the top section of the Mixer Shaft and apply anti seize compound. Be sure to apply anti-seize fluid on both shaft and coupling.
3. Raise Mixer Shaft from below and insert into the coupling (The upper section of the coupling is attached to drive unit during mixer assembly).
4. Tighten up the coupling screws to torque listed in appendix 1.
5. Mount the clamp back on the drive unit flange.
6. Remove motor fan guard and turn fan by hand to check that the mixer shaft turns freely, and alignment is true. Repeat once impellers are installed. (*Figure 2.2*)



Figure 2.2

Flange Mount Mixers:

1. Remove the mounting flange from mixer drive assembly.
2. Clean the top section of the Mixer Shaft and apply anti seize compound. Be sure to apply anti-seize fluid on both shaft and coupling.
3. Raise Mixer Shaft from below and insert into the coupling (The upper section of the coupling is attached to drive unit during mixer assembly).
4. Tighten up the coupling screws to torque listed in appendix 1.
5. Attach the mounting flange to the drive unit.
6. Remove motor fan guard and turn fan by hand to check that the mixer shaft turns freely, and alignment is true. Repeat once impellers are installed. (*Figure 2.3*)



Figure 2.3

Installing the Mixer Impeller

Refer to mixer assembly and Impeller detail drawings for proper Impeller rotation, positioning and placement.

1. Slide the Impeller on the shaft facing the correct way (according to the assembly drawings). (*Figure 3*)
2. Adjust the impeller screws with shaft dimples. (*Figure 4*)
3. Tighten up the screws securely to torque listed in appendix 1.



Figure 3

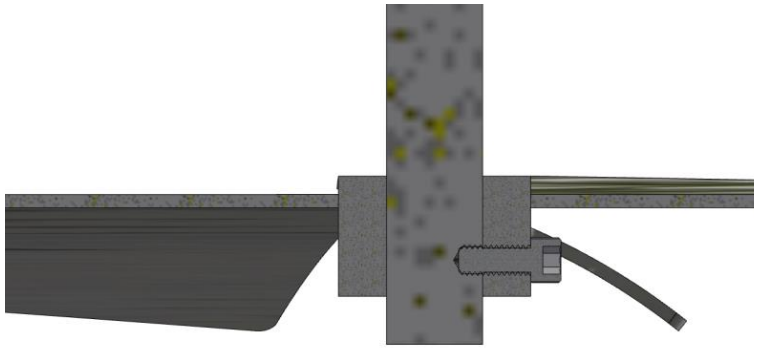
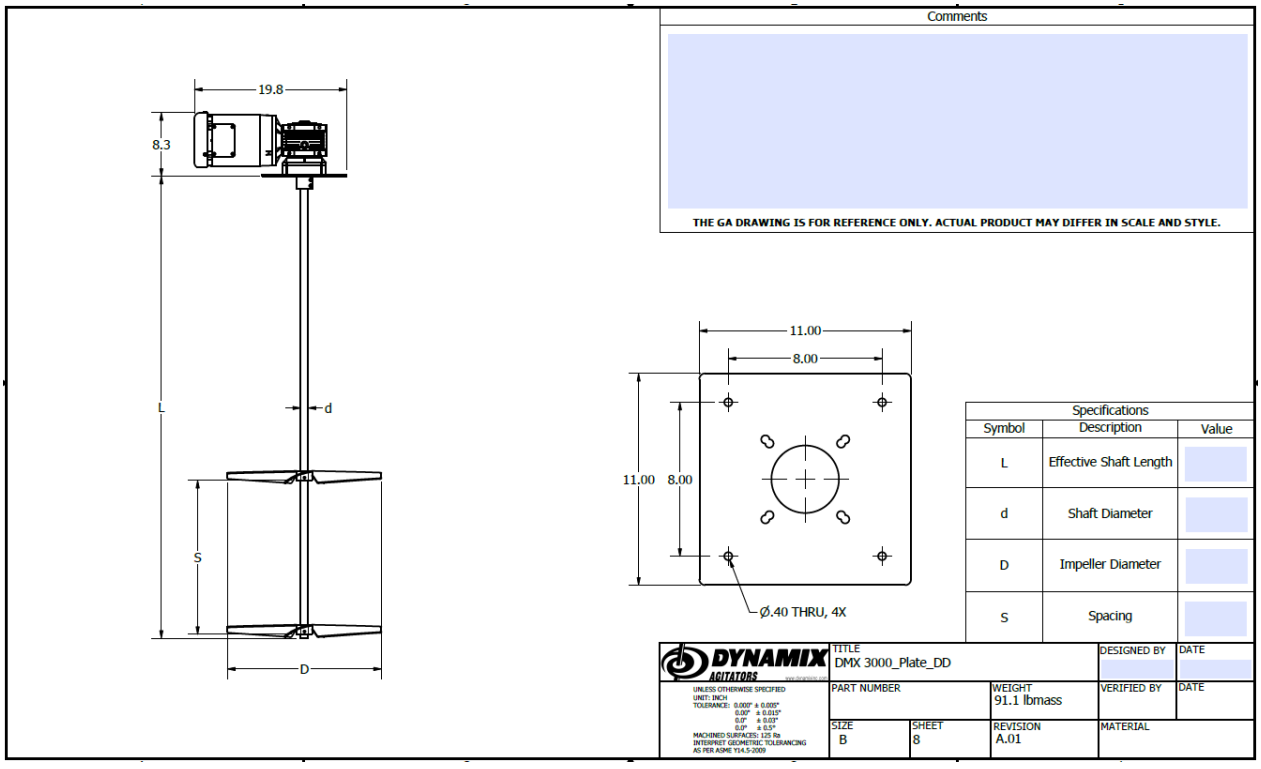


Figure 4

Parts, Maintenance & Service

Technical Drawing & General Parts List

This is a Typical Drawing. It is only a representation of the DMX3000 Series models. For more information, please contact your Dynamix representative with your mixer serial number.



All equipment design and application data shown herin and related info is confidential and the property of Dynamix Agitators Inc. ***No use or disclosure therof may be made without written permission from Dynamix Agitators Inc.***

Lubrication

Note: Our DMX3000 gearboxes are shipped with oil/grease. Before start-up, check that the oil/grease is not leaked out during shipping/installation. If there is any, consult Dynamix.Our worm gearboxes are meant to be maintenance free and sealed for life. There is no oil change interval recommendation.

General Information Regarding Electric Motors

Safety Notice

This equipment contains **High Voltage! Electrical shock can cause serious or fatal injury.** Only qualified personnel should attempt installation, operation, and maintenance of electrical equipment. Be sure that you are completely familiar with NEMA safety standards for construction and guide for selection, installation and use of electric motors and the National Electrical Code and local codes and practices. Unsafe installation or use can cause conditions that lead to serious or fatal injury.

Only qualified personnel should attempt the installation, operation, and maintenance of this equipment.



WARNING!

- Do not touch electrical connections before you first ensure that power has been disconnected. Electrical shock can cause serious or fatal injury. Only qualified personnel should attempt the installation, operation, and maintenance of this equipment.
- Be sure the system is properly grounded before applying power. Do not apply AC power before you ensure that all grounding instructions have been followed. Electrical shock can cause serious or fatal injury. National Electrical Code and Local codes must be carefully followed.
- Use proper care and procedures that are safe during handling, lifting, installing, operating, and maintaining operations. Improper methods may cause muscle strain or other harm.
- Disconnect all electrical power from the motor windings and accessory devices before disassembly of the motor. Electrical shock can cause serious or fatal injury.
- Do not use these motors in the presence of flammable or combustible vapors or dust. Our standard motors are not designed for atmospheric conditions that require explosion proof operation. Motors that are to be used in flammable and/or explosive atmospheres must display on the nameplate the UL label showing the correct classification for the area it is operated in. Specific service conditions for these motors are defined.
- To prevent equipment damage, be sure that the electrical service is not capable of delivering more than the maximum motor rated amps listed on the rating plate.

Motor Connections

1. All electrical connections must conform to National Electrical Code and all local regulations. Match line voltage and wire capacity to motor rating found on the motor nameplate.
2. Single-phase electric motors may be pre-wired with a six (6) foot electrical cord. If not provided, follow the wiring diagram on the motor for proper connections.
3. Three phase electric motors must be wired according to the diagram on the motor.
4. If there is a switch, ensure it is in the OFF position before connecting the mixer to power supply. Before applying power, read the instructions carefully, and make the required adjustments.
5. Mixer standard direction of rotation is Counter Clockwise facing lead end. For three phase motors, switch the connections to achieve proper direction of rotation.

Troubleshooting Guide

Use This Chart to Diagnose Operation Issues

Problem	Possible Cause	Possible Solution
Mixer Does Not Start	• Loose connections	• Check and tighten connection
	• Incorrect wiring	• Check wiring diagram and wire correctly
	• Blown fuse	• Replace fuse
	• Mechanical jamming	• Free all debris for rotation
	• Water damage to motor	• Service or replace motor
Motor Runs Hot	• Restricted ventilation	• Prepare adequate ventilation
	• Amperage overload	• Consult factory
	• Low or high voltage	• Wire for correct voltage
	• Unbalanced voltage between phases	• Consult electrician
	• Frequent starting and stopping	• Check with factory – a special motor may be required
	• Product too viscous	• Check viscosity and specific gravity of product with the Quote
	• Impeller(s) upside down	• Reinstall in correct position
	• Incorrect rotation	• Change motor leads per nameplate instructions
Mixer Does Not Reach Correct Speed	• Overload of motor	• Check amperage against nameplate data
	• Loose drive coupling bolts	• Check coupling bolt tension (coupling and shaft may damage if mixer has been run with slipping coupling)
Shaft Does Not Fit Into Drive	• Shaft over size	• Measure and consult factory
	• Wrong end of shaft (only one end fits)	• Install the stub shaft end (or marked motor end)
	• Coupling bolts are too tight (if there is any)	• Loosen bolts
	• Wrong size shaft or coupling	• Consult factory
	• Damaged shaft or coupling	• Consult factory
Shaft Vibration	• Unstable mounting platform	• Reinforce platform
	• Bent mixer shaft	• Consult factory
	• Bent or uneven impeller blades	• Consult factory
	• Impeller not immersed in liquid	• Fill tank
	• Impeller too close to surface	• Fill tank. Impeller must be at least 1 dia. submerged
Noisy Operation	• Contaminated lubricant	• Change lubricant
	• Insufficient lubricant	• Fill proper amount of lubricant
	• Incorrect lubricant	• Change to correct lubricant
	• Loose drive coupling bolts (if there is any)	• Check and tighten coupling bolts
	• Worn or faulty bearings/gears	• Consult factory
Oil Leakage	• Damaged broken gasket	• Consult factory
	• Excessive lubricant	• Check manual for proper amount of lubricant and drain excess
	• Seals worn or damaged	• Consult factory
	• Loose bolts around side plates	• Check and tighten bolts
Bearing Failure	• Water damage	• Consult factory
	• High temperature product	• Provide heat shield

Terms & Conditions

These Delivered Terms and Conditions (the "Delivered Terms") apply to the purchase of Dynamix Agitators Inc. ("**Dynamix**", "**We**" or "**Our**") products ("**Products**") by a customer (the "**Customer**"). Unless otherwise indicated, these terms and conditions will apply to all purchases of Products from Dynamix.

PURCHASE TERMS

The Customer's purchase of Products is governed by: (1) the quotation sent to the Customer for the Products, which sets out the Customer's name and address, the Products covered, price and payment terms (the "**Quotation**"); (2) the terms and conditions attached to the Quotation; (3) these Delivered Terms; and (4) any additional terms referenced in the Quotation (collectively, the "**Agreement**").

CONFIDENTIAL INFORMATION

The Product pricing, terms and conditions of sale, the Quotation, and other information contained in or disclosed by Dynamix pursuant to the Agreement is confidential. Customer may not disclose such pricing, terms and conditions, Quotation and other information to any other party without Dynamix's prior written approval, except for any legally required disclosures. Dynamix reserves the right to enforce these confidentiality restrictions against any party who wrongfully discloses, receives or further disseminates Dynamix's confidential information.

LIMITATION OF REMEDIES

Customer's remedy for breach of any of the foregoing warranties shall be limited to those set forth in the **Warranty Section** provided below, however, that We will not be responsible for removal, loading, installation, freight or similar related expenses in connection with any modification, replacement or repair. The determination of which remedy shall be applicable, shall be determined by Dynamix, in its sole discretion.

DYNAMIX AND ITS AFFILIATES AND REPRESENTATIVES HAVE NO LIABILITY TO CUSTOMER FOR ANY DIRECT, INDIRECT, SPECIAL, PUNITIVE, INCIDENTAL OR CONSEQUENTIAL DAMAGES OR DELAY WHATSOEVER, INCLUDING, BUT NOT LIMITED TO, DAMAGES FOR LOST OR INTERRUPTED BUSINESS, LOSS OF USE, LOST PROFITS OR LOST REVENUES, HOWEVER CAUSED AND UNDER ANY THEORY OF LIABILITY (INCLUDING, BUT NOT LIMITED TO, CONTRACT, TORT, WARRANTY OR NEGLIGENCE), EVEN IF WE HAVE BEEN ADVISED OF THE POSSIBILITY OF SUCH DAMAGES. THE TOTAL LIABILITY OF DYNAMIX AND ITS AFFILIATES AND REPRESENTATIVES TO CUSTOMER AND CUSTOMER'S EXCLUSIVE REMEDY FOR ANY AND ALL CLAIMS ARISING OUT OF OR RELATING TO THIS CONTRACT, INCLUDING, BUT NOT LIMITED TO, THE PRODUCTS PROVIDED HEREUNDER, IS LIMITED TO THE PURCHASE PRICE OF THE PRODUCT THAT IS THE BASIS FOR THE CLAIM.

Customer will be barred from any remedy unless Customer gives Dynamix prompt written notice of the problem. Further, any returns of Products for modification, repair or replacement must be authorized by Dynamix in writing prior to return of the Products by the Customer.

Dynamix will not be responsible for any repairs performed by third parties unless the extent, or terms and costs of such repairs, are authorized by Dynamix, in writing in advance.

PATENTS

Dynamix represents and warrants that, to its knowledge, the Products do not infringe upon any patents granted to others. We do not assume any responsibility or liability for any claim of infringement brought against the Customer, its successors, assigns, customers or users of the Products.

UNAUTHORIZED MODIFICATIONS

Modifications to the Products ordered by Customer, or any of their components, could significantly affect their performance or conformance to Dynamix's features. Any modification of the Products, or any of their components, other than as performed or authorized in writing by Dynamix, is prohibited and will invalidate and terminate Dynamix's warranty for the Products, effective on the date of any such modification.

LEGAL FEES

If a suit or action is brought by any party under this Contract to enforce or interpret any of its terms or in any appeal therefrom, it is agreed that the prevailing party shall be entitled to reasonable legal fees to be fixed by the trial court and/or appellate court. Customer shall be responsible for any and all costs of collection incurred by Dynamix in connection herewith, including legal fees and costs.

JURISDICTION / VENUE

These Delivered Terms will be governed by and construed in accordance with the laws in force in the Province of British Columbia and the federal laws of Canada, as applicable therein, without regard to its conflict of laws principles. The Parties agree to attorn to the exclusive jurisdiction of the courts of British Columbia.

GENERAL MATTERS

Any assignment of these Delivered Terms will be void without the other party's prior written consent, which will not be unreasonably withheld. Dynamix may hire subcontractors or use its affiliates to perform the obligations under this Agreement. If any part of these Delivered Terms are found invalid, the remaining part will be effective. No waiver, alteration or modification of any of the provisions of these Delivered Terms will be binding on Dynamix, unless made in writing and signed by a duly authorized officer of Dynamix. These Delivered Terms, the Quotation and its attached terms and conditions, and any other terms referenced in the Quotation contain the entire agreement of the parties.

Warranty

Dynamix warrants to the Customer that the Product will perform substantially in accordance with the features and Solution Assurance as set out in the Quotation and be free from defects in materials and workmanship under normal use.

We warrant that we will modify, repair or replace the Product provided to the Customer, at Our sole discretion and at no charge, Ex Works (Incoterms 2000) Dynamix plant, if the Product is defective in materials or workmanship under normal use.

WE DO NOT GUARANTEE THE PRODUCTS AGAINST CHEMICAL OR ABRASIVE ATTACK OR OTHER DETERIORATION DUE TO EXPOSURE.

THE FOREGOING WARRANTIES EXTEND ONLY FOR 12 MONTHS AFTER FIRST INSTALLATION OF THE PRODUCT AT CUSTOMER'S FACILITY OR FOR 18 MONTHS AFTER ITS SHIPMENT FROM DYNAMIX'S PLANT, WHICHEVER PERIOD IS SHORTER, OR AS OTHERWISE STATED IN WRITING BY DYNAMIX.

EXCEPT AS EXPRESSLY PROVIDED IN THE AGREEMENT, WE EXPRESSLY DISCLAIM AND MAKE NO EXPRESS OR IMPLIED REPRESENTATIONS, CONDITIONS, GUARANTEES OR WARRANTIES OF ANY KIND, ORAL OR WRITTEN, INCLUDING, BUT NOT LIMITED TO, IMPLIED WARRANTIES OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE, NON-INFRINGEMENT, INTER-OPERABILITY OF PRODUCTS, USAGE, CUSTOM OR TRADE, AND OF ALL OTHER OBLIGATIONS OR LIABILITIES ON THE PART OF DYNAMIX. THE ABOVE WARRANTIES SHALL NOT APPLY TO FAILURES RESULTING FROM (A) NORMAL WEAR AND TEAR, (B) ACCIDENT, NEGLIGENCE, ALTERATION, ABUSE, MISUSE OR USE INCONSISTENT WITH ANY INSTRUCTIONS PROVIDED AS TO STORAGE, HANDLING, MAINTENANCE, LUBRICATION, INSTALLATION, STARTUP, OPERATION AND SAFETY, (C) IMPROPER INSTALLATION AND/OR (D) INACCURATE AND/OR INCOMPLETE SPECIFICATIONS, DESIGN CONDITIONS OR OTHER DATA FURNISHED BY OR ON BEHALF OF CUSTOMER. WE MAKE NO WARRANTY WHATSOEVER WITH RESPECT TO ACCESSORIES OR PARTS NOT SUPPLIED BY DYNAMIX.

Warranty & Claims Policy

The following statement of our Warranty and Claims Policy is intended to assist our customers in understanding the terms of our warranty, the circumstances under which we will honor claims, and the procedure for making claims.

Our Warranty and Claims Policy should be read in conjunction with and is subject in as respect to the Terms and Conditions of Sale which appear on our quotation and acknowledgment forms and the specific terms of any distributorship or other such agreement between us and the individual customer.

1. **Warranty Manufactured Products**

   We warrant Products manufactured by us to be free from defects in material and workmanship for a period of twelve (12) months after first installation of mixer or for eighteen (18) months after shipment from our factory, whichever occurs first.

   Our liability under this warranty or in connection with any other claim relating to our Products is limited to the repair, or at our option, the replacement or refund of the purchase price, of any Products or parts or components which are returned to us freight prepaid and which are defective in material or workmanship. Products or parts or components thereof, which are repaired or replaced by us will be returned to our customer freight collect.

2. **Limitation of Liability**

   The only warranty that we offer our customers is that warranty which is set forth on our quotation and acknowledgment forms and which is summarized above.

   WE DO NOT MAKE ANY OTHER EXPRESS WARRANTIES OR ANY IMPLIED WARRANTIES, INCLUDING ANY IMPLIED WARRANTY OF MERCHANTABILITY OR OF FITNESS FOR A PARTICULAR PURPOSE OR USE.

   In addition, we do not assume, and we expressly disclaim any liability for

   a. any SPECIAL, INDIRECT, INCIDENTAL, OR CONSEQUENTIAL DAMAGES which anyone may suffer as the result of the sale, delivery, servicing, use or loss of use, of any Product, or

   b. any charges or expenses of any nature which are incurred without our express written consent.

   Our total liability under our warranty or in connection with any claim involving any Product is expressly limited to the purchase price of the Product in respect of which damages are unclaimed.

3. **What Is Not Covered by Warranty:** Damages and Claims for Which Dynamix Is Not Responsible

   The Seller's Warranty applies insofar as the unit is operated within the rating and service conditions for which it was specifically sold. The Purchaser must prevent the existence of any destructive external conditions that might typically include vibratory loads, severe shock loading, mechanical or thermal overloads or other conditions that may adversely affect the operation. The gear drive must be installed and maintained in accordance with instructions and provided in this manual.

   The following are examples of the kinds of defect which are not covered by Our warranty; defects which are caused by improper installation, improper or abnormal use or operation, or improper storage or handling; defects caused by our customer's failure to perform normal preventive maintenance; defects caused by repairs by persons not authorized by us; defects caused by modification alterations made by our customer; and any damage to our Product occurring while is in our customer’s possession.

   Since these are examples and not a complete list, we suggest that our customers contact our Customer Service Department if they have any question concerning the scope of our warranty.

   Additional costs incurred by our customers because of delays in delivery are consequential damages for which we are not responsible.

   Risk of loss or damage to our Products passes to our customer when we tender our Products to the carrier. Although we cannot process transit damage claims with any carrier on a customer's behalf, we will provide reasonable assistance to our customers when such claims arise.

4. Consultations with Customers

When so requested, our engineers and other personnel may consult with our customers concerning our Products. While our employees will offer their best judgment on any question, the ultimate responsibility for selecting that Product which will perform the functions and applications desired by the customer rests with the customer. As noted above, we make no warranty, express or implied, as to the fitness of any Product for any Product for any particular purpose or use.

5. How to Make a Claim

Within the limits of the terms and conditions set forth on our quotation and acknowledgment forms and in the Warranty and Claims Policy, we will honor reasonable and justified claims when adequate evidence is provided to show that our Product was defective.

Whenever a customer has a claim concerning a Product, the customer should contact the Customer Service Department.

CUSTOMERS SHOULD NOT RETURN ANY PRODUCTS OR PARTS OR COMPONENTS TO US WITHOUT FIRST CONTACTING US.

When contacting us, customers should have the following information available:

a) Customer name, location, purchase order number and date of purchase

b) Factory/Branch order number (serial number)

c) Product/Model number

d) Equipment installation date

e) Equipment failure date

f) Application or service of unit

g) Details of claim

Dynamix will notify the customer whether it will be necessary to return the Product or part or component to us. If so, we will send the customer an "AUTHORIZED RETURN NUMBER" that must be attached to the product or part or component before returning it. All items returned to us must be returned freight prepaid.

If we determine that the Product or part or component is defective and that the defect is covered by our warranty, we will, as explained above, correct the defect or refund the purchase price.

Customers should promptly inspect all Products upon delivery. The Customer must make claims for shortages within 20 days after the date of shipment from our factory or warehouse. We suggest that shortages be noted on the bill of lading or packing list, which should then be sent to our Customer Service Department for verification.

All other claims must be submitted within 60 days after the date of shipment from our factory or warehouse, or in the case of an alleged breach of warranty, within 60 days after the date within the warranty period on which the defect is or should have been discovered. Claims may not be deducted from payments made to us unless we have so agreed in writing in advance.

In the event of malfunction within the warranty period, Dynamix Agitators must be notified promptly, within thirty (30) days, if it is intended that the warranty is to cover the incident.

Appendix 1: Bolt Tightening - Torque

316 Stainless Steel Bolts

316 SS	TORQUE (ft lb)	
Bolt Size	Dry	Lubricated
1/4"-20	6.6	5.6
5/16"-18	11.5	9.8
3/8"-16	20.6	17.5
7/16"-14	32.8	27.8
1/2"-13	45.0	38.0
9/16"-12	59.0	50.0
5/8"-11	96.0	82.0
3/4"-10	131.0	111.0
7/8"-9	202.0	172.0
1"-8	299.0	254.0

Mild Steel Bolts

Mild Steel	TORQUE (ft lb)					
	Grade 2		Grade 5		Grade 8	
Bolt Size	Dry	Lubricated	Dry	Lubricated	Dry	Lubricated
1/4"-20	5.2	4.0	8.4	6.3	11.9	8.9
5/16"-18	10.4	8.0	17.4	13.1	24.6	18.4
3/8"-16	19.5	15.0	31.0	23.0	44.0	33.0
7/16"-14	31.2	24.0	49.0	37.0	70.0	52.0
1/2"-13	48.1	37.0	75.0	57.0	106.0	80.0
9/16"-12	68.9	53.0	109.0	82.0	154.0	115.0
5/8"-11	94.9	73.0	150.0	113.0	212.0	159.0
3/4"-10	149.5	115.0	267.0	200.0	376.0	282.0
7/8"-9	167.7	129.0	429.0	322.0	606.0	455.0
1"-8	244.4	188.0	644.0	483.0	909.0	681.0

Warranty Data Sheet

To validate your warranty, please complete this form and return to:

Dynamix Agitators Inc.
#150-14480 River Road
Richmond, BC, Canada
V6V 1L4

Mixer Model Number _____ Serial Number _____

Purchase Order Number _____ Date Received _____

Tank Number or Location _____

Agitator Start Up Data

Date of Installation _____ Voltage at Start Up _____ V

DD/MM/YYYY

Full Load amperage measured with ammeter _____ Agitator shaft speed _____

RPM

Observed Level of Agitation:

- Gentle ☐
- Medium ☐
- Vigorous ☐
- Violent ☐

Inspector: _____ Date: _____

Please print name clearly DD/MM/YYYY

Description of Process:

_____

_____

_____

Comments:

_____

_____

_____

Notes:

_____

_____

_____

DATA SHEET

Three Phase Induction Motor - Squirrel Cage

Customer	: H2Flow Equipment Inc.
Customer reference	: PO-0506-22

Product line	: Rolled Steel Premium Efficiency Three-Phase	Product code :	13484339
		Catalog # :	FC000504W01DOE

Frame	: 56C	Locked rotor time	: 34s (cold) 19s (hot)
Output	: 1 HP (0.75 kW)	Temperature rise	: 80 K
Poles	: 4	Duty cycle	: Cont.(S1)
Frequency	: 60 Hz	Ambient temperature	: -20°C to +40°C
Rated voltage	: 575 V	Altitude	: 1000 m.a.s.l.
Rated current	: 1.18 A	Protection degree	: IP55
L. R. Amperes	: 10.1 A	Cooling method	: IC411 - TEFC
LRC	: 8.6x(Code M)	Mounting	: F-1
No load current	: 0.712 A	Rotation[1]	: Both (CW and CCW)
Rated speed	: 1765 rpm	Noise level[2]	: 52.0 dB(A)
Slip	: 1.94 %	Starting method	: Direct On Line
Rated torque	: 2.98 ft.lb	Approx. weight[3]	: 36.9 lb
Locked rotor torque	: 280 %		
Breakdown torque	: 300 %		
Insulation class	: F		
Service factor	: 1.15		
Moment of inertia (J)	: 0.1232 sq.ft.lb		
Design	: B		

Output	25%	50%	75%	100%
Efficiency (%)	81.0	82.5	84.0	85.5
Power Factor	0.30	0.52	0.66	0.75

Foundation loads

Max. traction	: 69 lb
Max. compression	: 106 lb

		Drive end	Non drive end
Bearing type	:	6204 ZZ	6202 ZZ
Sealing	:	V'Ring	Without Bearing Seal
Lubrication interval	:	-	-
Lubricant amount	:	-	-
Lubricant type	:	Mobil Polyrex EM	

Notes
Dynamix quote#Q58177

This revision replaces and cancel the previous one, which must be eliminated.
(1) Looking the motor from the shaft end.
(2) Measured at 1m and with tolerance of +3dB(A).
(3) Approximate weight subject to changes after manufacturing process.
(4) At 100% of full load.

These are average values based on tests with sinusoidal power supply, subject to the tolerances stipulated in NEMA MG-1.

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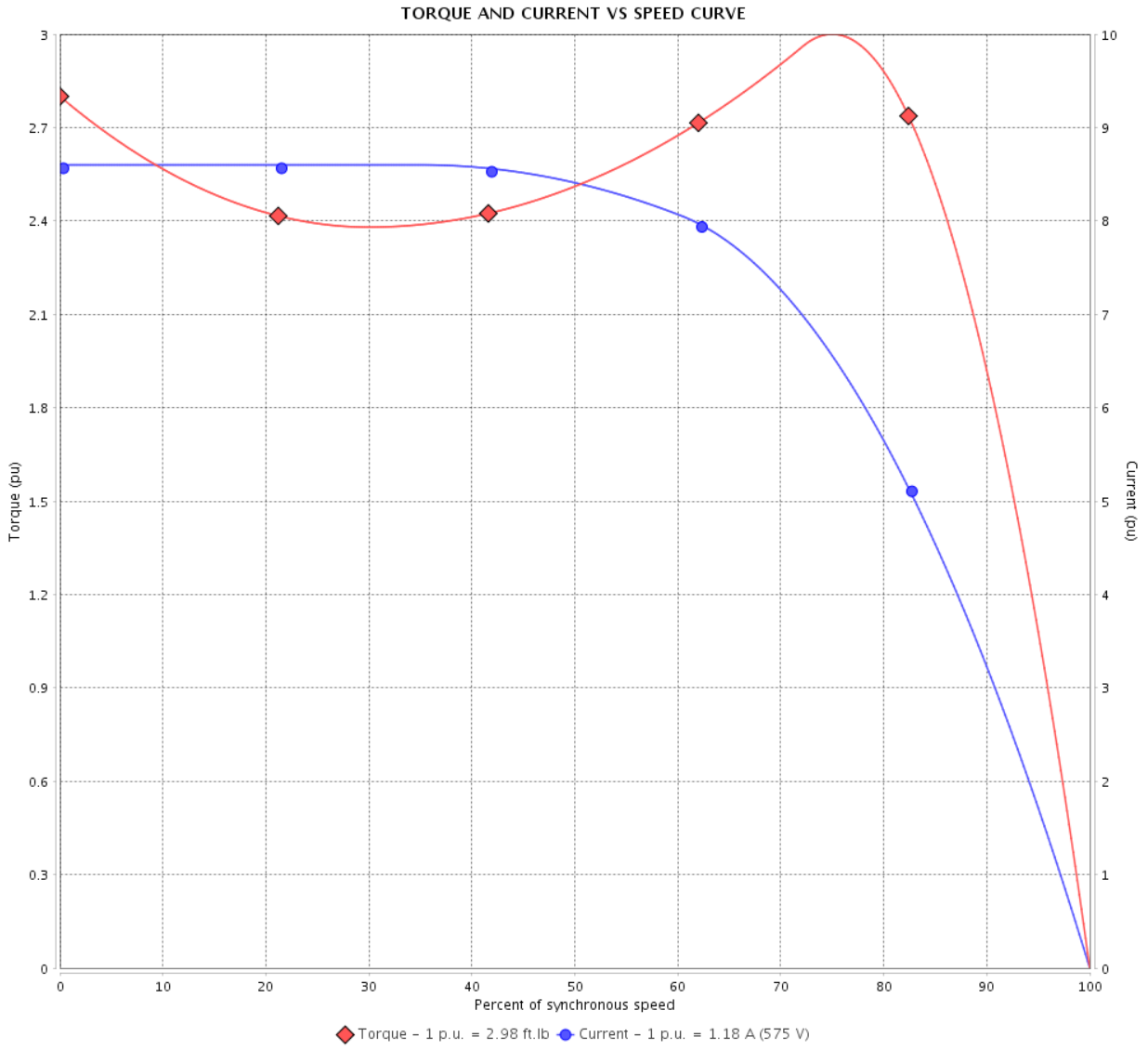
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TORQUE AND CURRENT VS SPEED CURVE

Three Phase Induction Motor - Squirrel Cage

Customer	: ProMinent Fluid Controls Ltd. - CA
Customer reference	: PFC Job No. 3122800042

Product line	: Rolled Steel Premium Efficiency Three-Phase	Product code :	13484339
		Catalog # :	FC000504W01DOE



Performance	: 575 V 60 Hz 4P

Rated current	: 1.18 A	Moment of inertia (J)	: 0.1232 sq.ft.lb
LRC	: 8.6	Duty cycle	: Cont.(S1)
Rated torque	: 2.98 ft.lb	Insulation class	: F
Locked rotor torque	: 280 %	Service factor	: 1.15
Breakdown torque	: 300 %	Temperature rise	: 80 K
Rated speed	: 1765 rpm	Design	: B

Locked rotor time	: 34s (cold) 19s (hot)

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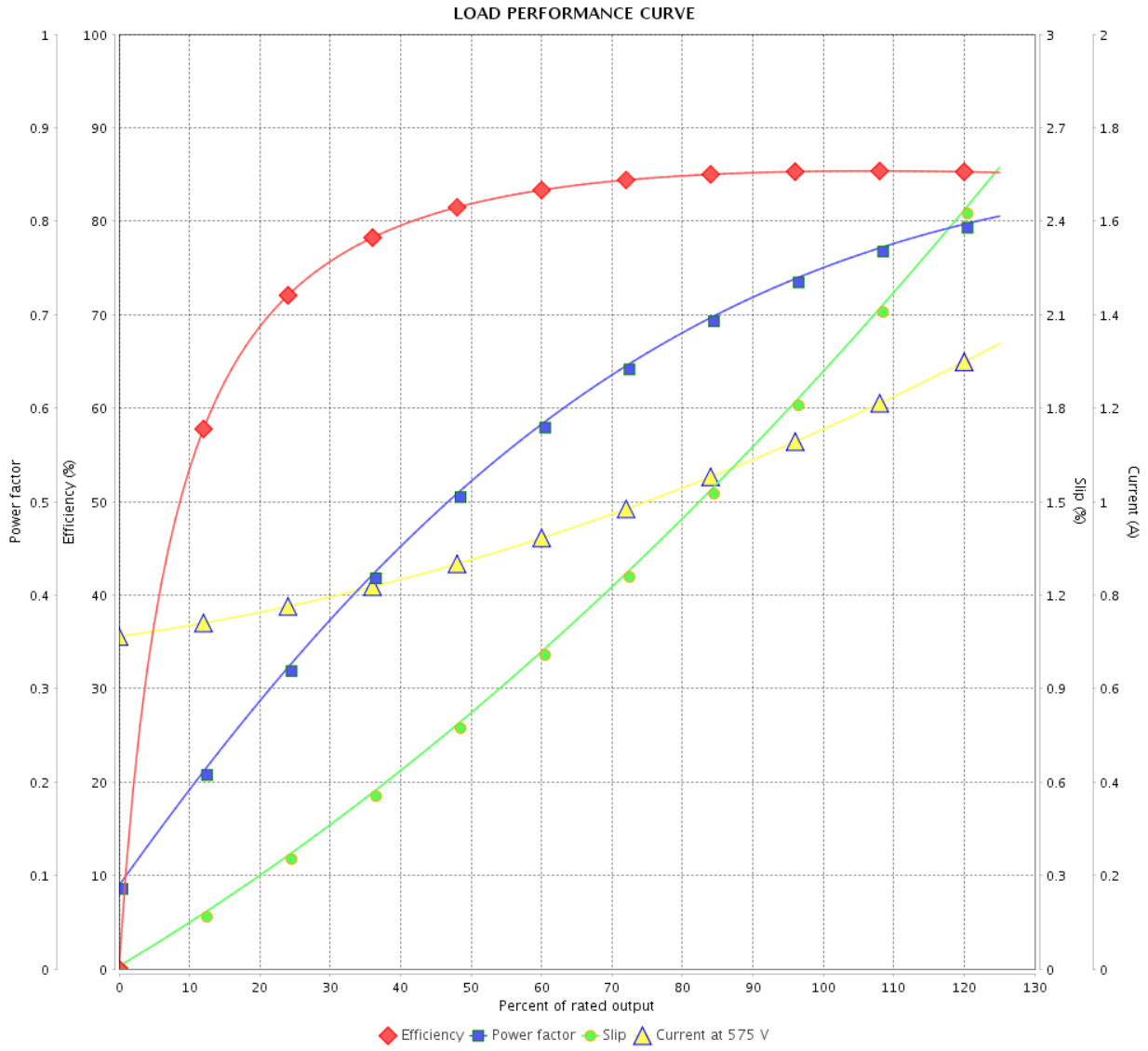
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LOAD PERFORMANCE CURVE

Three Phase Induction Motor - Squirrel Cage

Customer	: ProMinent Fluid Controls Ltd. - CA
Customer reference	: PFC Job No. 3122800042

Product line	: Rolled Steel Premium Efficiency Three-Phase	Product code :	13484339
		Catalog # :	FC000504W01DOE



Performance	: 575 V 60 Hz 4P		
Rated current	: 1.18 A	Moment of inertia (J)	: 0.1232 sq.ft.lb
LRC	: 8.6	Duty cycle	: Cont.(S1)
Rated torque	: 2.98 ft.lb	Insulation class	: F
Locked rotor torque	: 280 %	Service factor	: 1.15
Breakdown torque	: 300 %	Temperature rise	: 80 K
Rated speed	: 1765 rpm	Design	: B

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THERMAL LIMIT CURVE

Three Phase Induction Motor - Squirrel Cage

Customer	: ProMinent Fluid Controls Ltd. - CA
Customer reference	: PFC Job No. 3122800042

Product line	: Rolled Steel Premium Efficiency Three-Phase	Product code :	13484339
		Catalog # :	FC000504W01DOE

Performance	: 575 V 60 Hz 4P

Rated current	: 1.18 A	Moment of inertia (J)	: 0.1232 sq.ft.lb
LRC	: 8.6	Duty cycle	: Cont.(S1)
Rated torque	: 2.98 ft.lb	Insulation class	: F
Locked rotor torque	: 280 %	Service factor	: 1.15
Breakdown torque	: 300 %	Temperature rise	: 80 K
Rated speed	: 1765 rpm	Design	: B

Heating constant	
Cooling constant	

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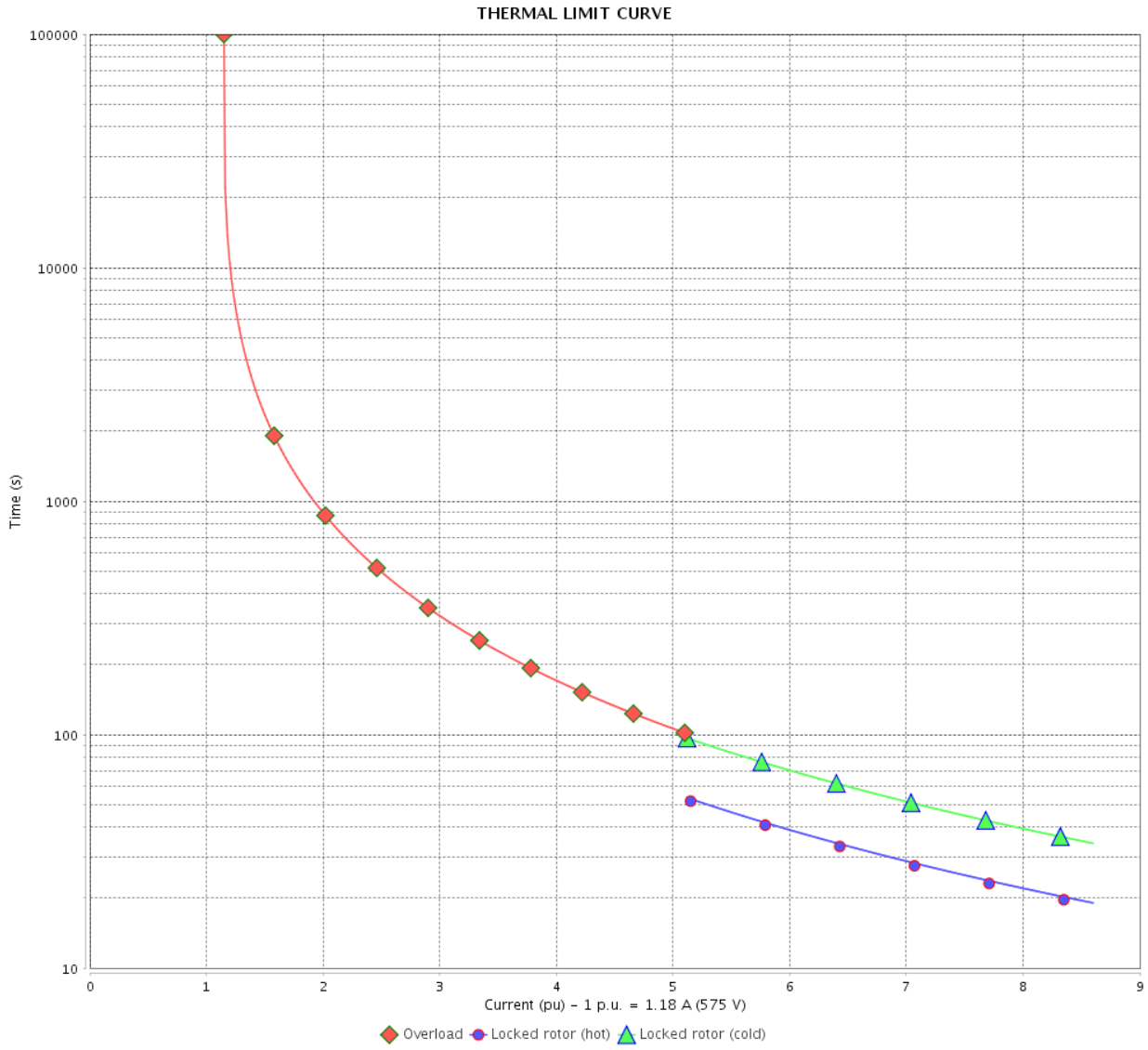
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THERMAL LIMIT CURVE

Three Phase Induction Motor - Squirrel Cage

Customer : ProMinent Fluid Controls Ltd. - CA
Customer reference : PFC Job No. 3122800042



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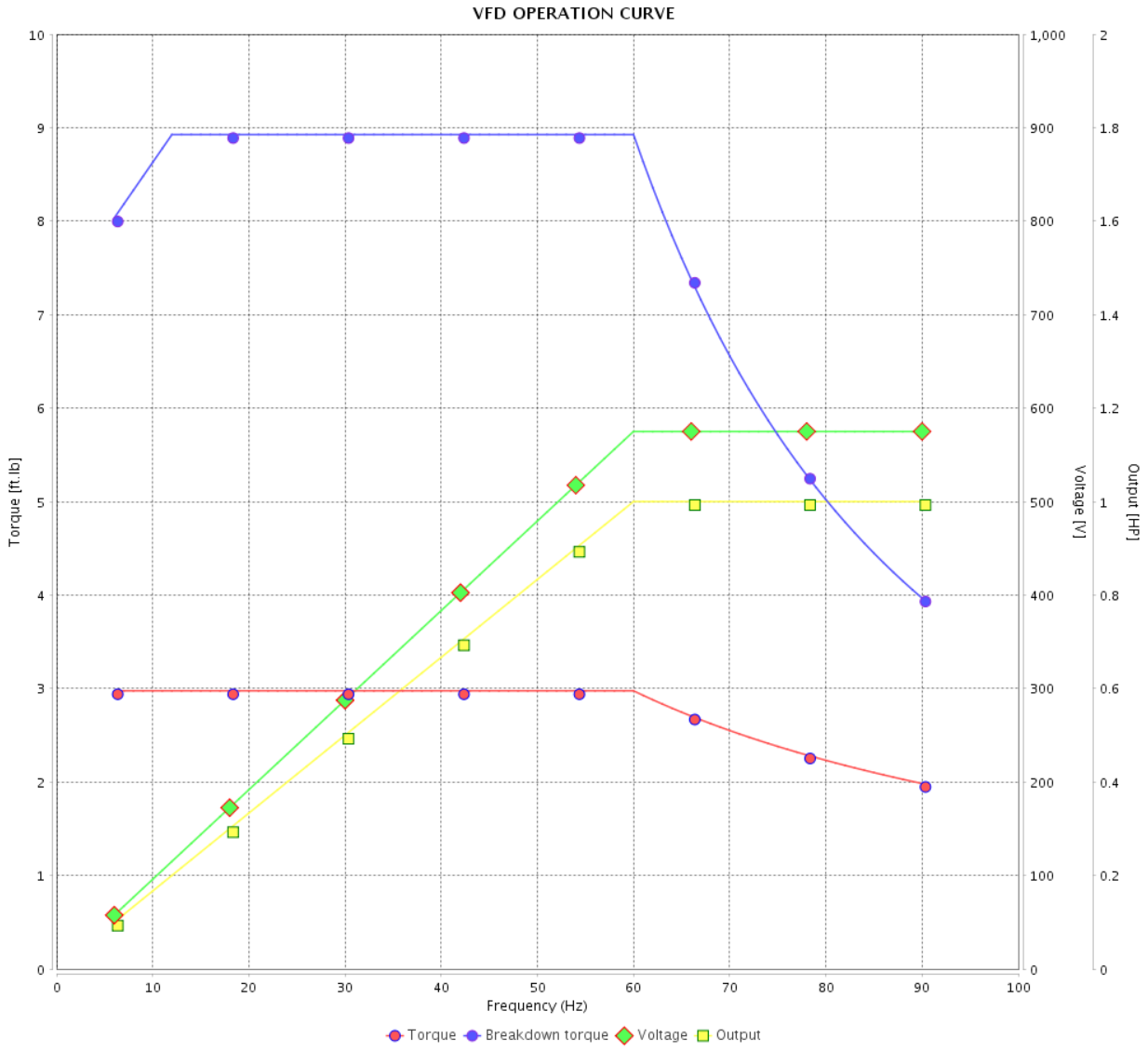
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VFD OPERATION CURVE

Three Phase Induction Motor - Squirrel Cage

Customer	: ProMinent Fluid Controls Ltd. - CA
Customer reference	: PFC Job No. 3122800042

Product line	: Rolled Steel Premium Efficiency Three-Phase	Product code :	13484339
		Catalog # :	FC000504W01DOE



Performance	: 575 V 60 Hz 4P

Rated current	: 1.18 A	Moment of inertia (J)	: 0.1232 sq.ft.lb
LRC	: 8.6	Duty cycle	: Cont.(S1)
Rated torque	: 2.98 ft.lb	Insulation class	: F
Locked rotor torque	: 280 %	Service factor	: 1.15
Breakdown torque	: 300 %	Temperature rise	: 80 K
Rated speed	: 1765 rpm	Design	: B

Rev.	Changes Summary	Performed	Checked	Date

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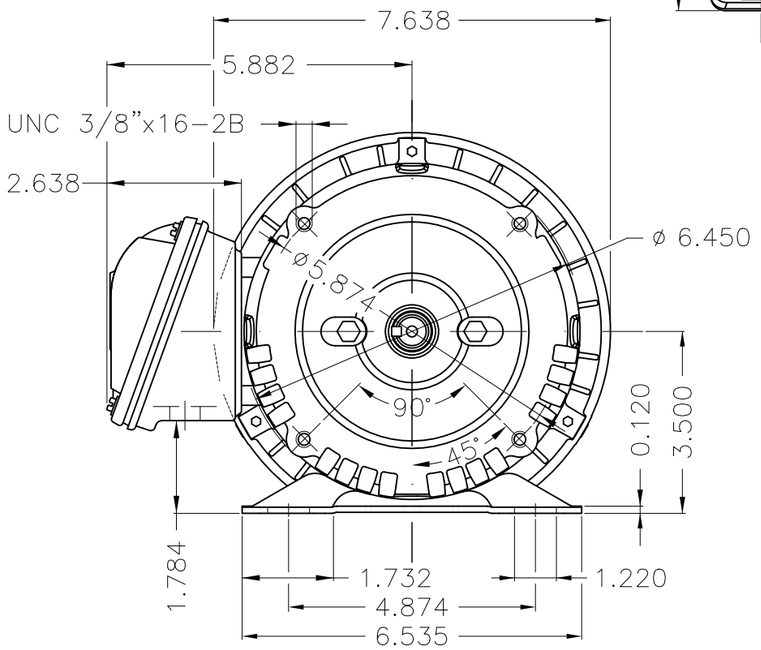
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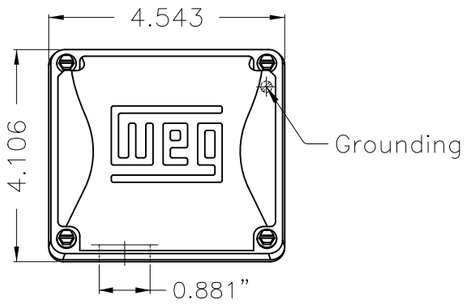
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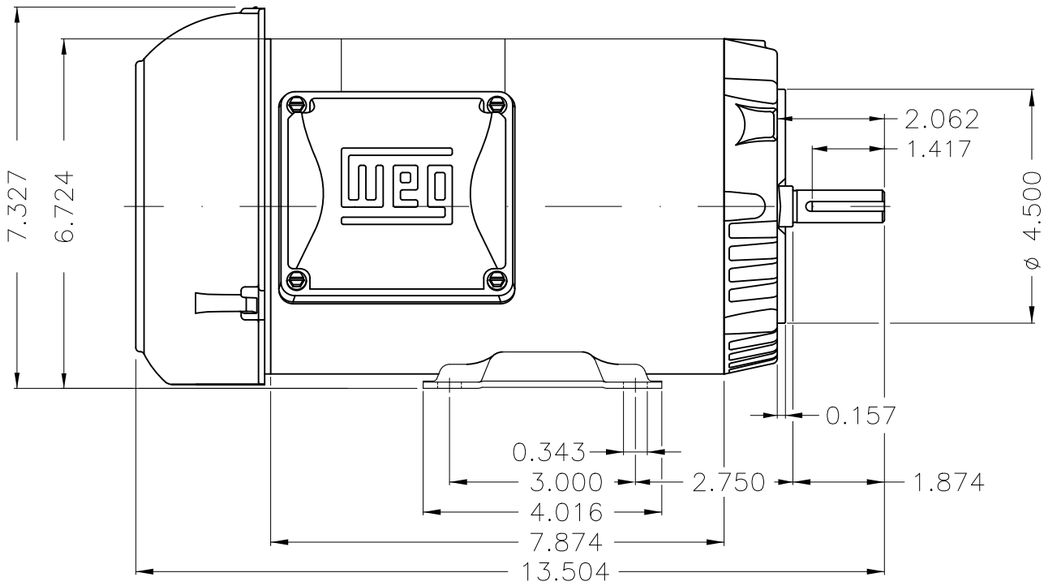
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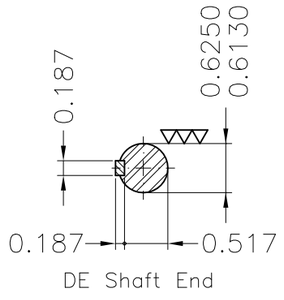
Dimensões em polegada
Dimensions in inches

THIS IS AN UPDATED REVISION, THE PREVIOUS ONE MUST BE DISREGARDED.









Color Munsell N 1 matte black
Painting plan 207N
Mounting F-1/B34R(D)

ECM	LOC	SUMMARY OF MODIFICATIONS	EXECUTED	CHECKED	RELEASED	DATE	VER

EXECUTED	USERADMIN	THREE PHASE MOTOR CLOSED ROLLED STEEL			
CHECKED		FRAME 56C IP55 TEFC			
RELEASED		WEG code: 13484339			
REL DT	01.03.2022	WMO	Jaragua do Sul	Product Engineering	SHEET 1 / 1

1 HP 04 Poles 60Hz

A

ZME A3

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INSTALLATION, OPERATION AND MAINTENANCE MANUAL OF ELECTRIC MOTORS

This manual provides information about WEG induction motors fitted with squirrel cage, permanent magnet or hybrid rotors, low, medium and high voltage, in frame sizes IEC 56 to 630 and NEMA 42 to 9606/10.
The motor lines indicated below have additional information that can be checked in their respective manuals:

- Smoke Extraction Motors;
- Electromagnetic Brake Motors;
- Hazardous Area Motors.

These motors meet the following standards, if applicable:

- NBR 17094-1: Máquinas Elétricas Girantes - Motores de Indução - Parte 1: trifásicos.
- NBR 17094-2: Máquinas Elétricas Girantes - Motores de Indução - Parte 2: monofásicos.
- IEC 60034-1: Rotating Electrical Machines - Part 1: Rating and Performance.
- NEMA MG 1: Motors and Generators.
- CSA C 22.2 N°100: Motors and Generators.
- UL 1004-1: Rotating Electrical Machines - General Requirements.

If you have any questions regarding this manual please contact your local WEG branch, contact details can be found at www.weg.net.

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1. TERMINOLOGY

Balancing: the procedure by which the mass distribution of a rotor is checked and, if necessary, adjusted to ensure that the residual unbalance or the vibration of the journals and/or forces on the bearings at a frequency corresponding to service speed are within specified limits in International Standards.
[ISO 1925:2001, definition 4.1]

Balance quality grade: indicates the peak velocity amplitude of vibration, given in mm/s, of a rotor running free-in-space and it is the product of a specific unbalance and the angular velocity of the rotor at maximum operating speed.

Grounded Part: metallic part connected to the grounding system.

Live Part: conductor or conductive part intended to be energized in normal operation, including a neutral conductor.

Authorized personnel: employee who has formal approval of the company.

Qualified personnel: employee who meets the following conditions simultaneously:
- Receives training under the guidance and responsibility of a qualified and authorized professional;
- Works under the responsibility of a qualified and approved professional.

Note*: The qualification is only valid for the company that trained the employee in the conditions set out by the authorized and qualified professional responsible for training.*

2. INITIAL RECOMMENDATIONS

Electric motors have energized circuits, exposed rotating parts and hot surfaces that may cause serious injury to people during normal operation. Therefore, it is recommended that transportation, storage, installation, operation and maintenance services are always performed by qualified personnel.
Also the applicable procedures and relevant standards of the country where the machine will be installed must be considered.
Noncompliance with the recommended procedures in this manual and other references on the WEG website may cause severe personal injuries and/or substantial property damage and may void the product warranty.

For practical reasons, it is not possible to include in this Manual detailed information that covers all construction variables nor covering all possible assembly, operation or maintenance alternatives.
This Manual contains only the required information that allows qualified and trained personnel to carry out their services. The product images are shown for illustrative purpose only.

For *Smoke Extraction Motors*, please refer to the additional instruction manual 50026367 available on the website www.weg.net.

For brake motors, please refer to the information contained in WEG 50021973 brake motor manual available on the website www.weg.net.

For information about permissible radial and axial shaft loads, please check the product technical catalogue.

The user is responsible for the correct definition of the installation environment and application characteristics.

During the warranty period, all repair, overhaul and reclamation services must be carried out by WEG authorized Service Centers to maintain validity of the warranty.

2.1. WARNING SYMBOL

Warning about safety and warranty.

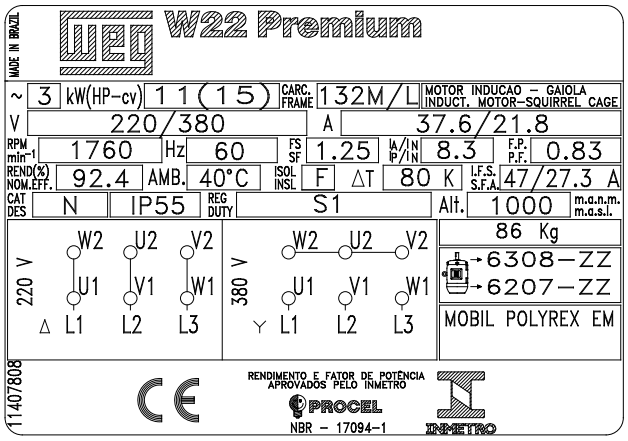
2.2. RECEIVING INSPECTION

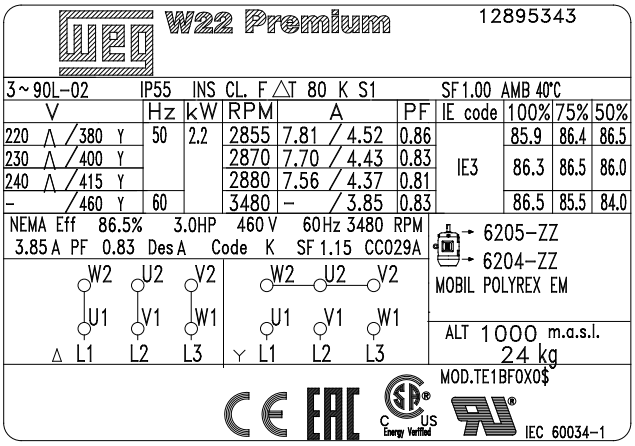
All motors are tested during the manufacturing process.
The motor must be checked when received for any damage that may have occurred during the transportation. All damages must be reported in writing to the transportation company, to the insurance company and to WEG. Failure to comply with such procedures will void the product warranty.
You must inspect the product:
- Check if nameplate data complies with the purchase order;
- Remove the shaft locking device (if any) and rotate the shaft by hand to ensure that it rotates freely;
- Check that the motor has not been exposed to excessive dust and moisture during the transportation.

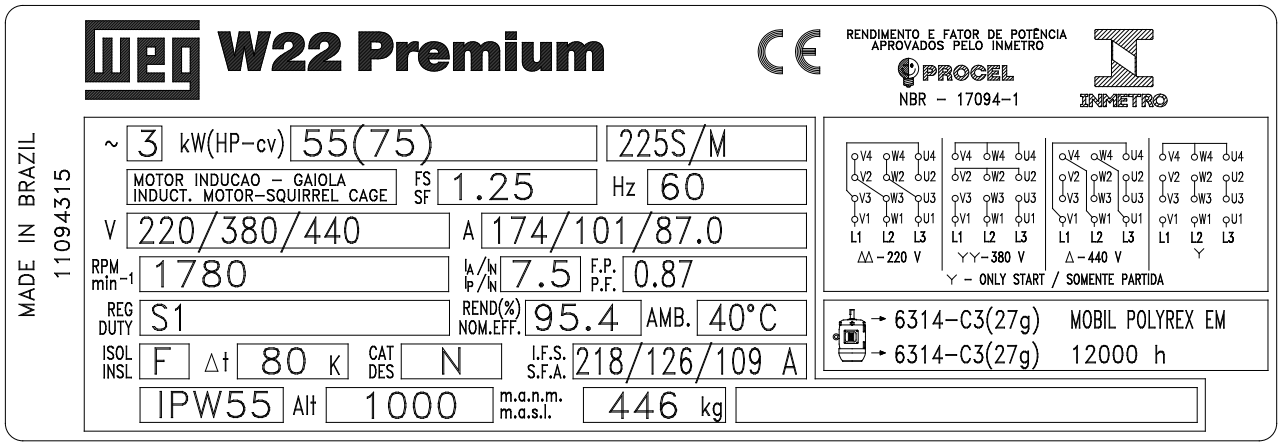
Do not remove the protective grease from the shaft, or the plugs from the cable entries. These protections must remain in place until the installation has been completed.

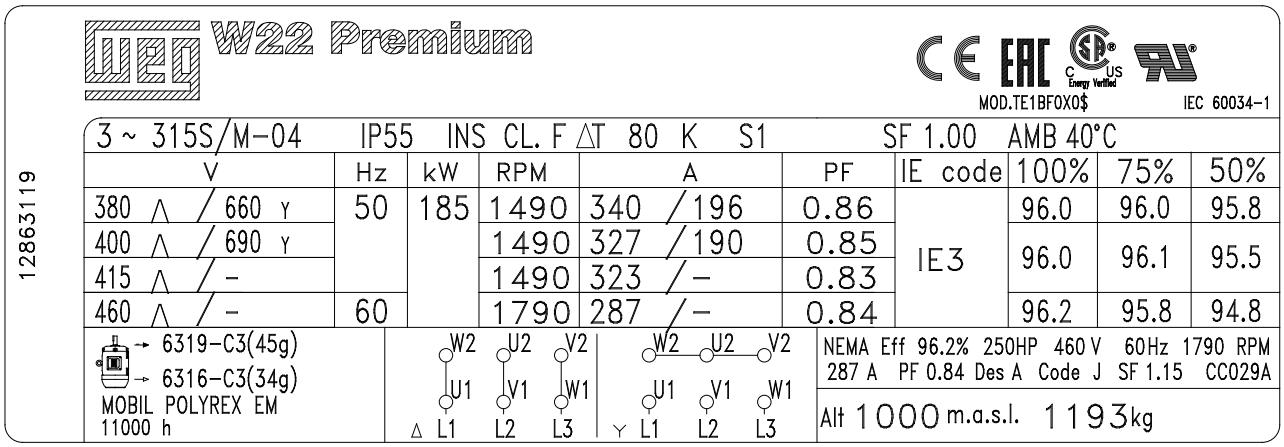
2.3. NAMEPLATES

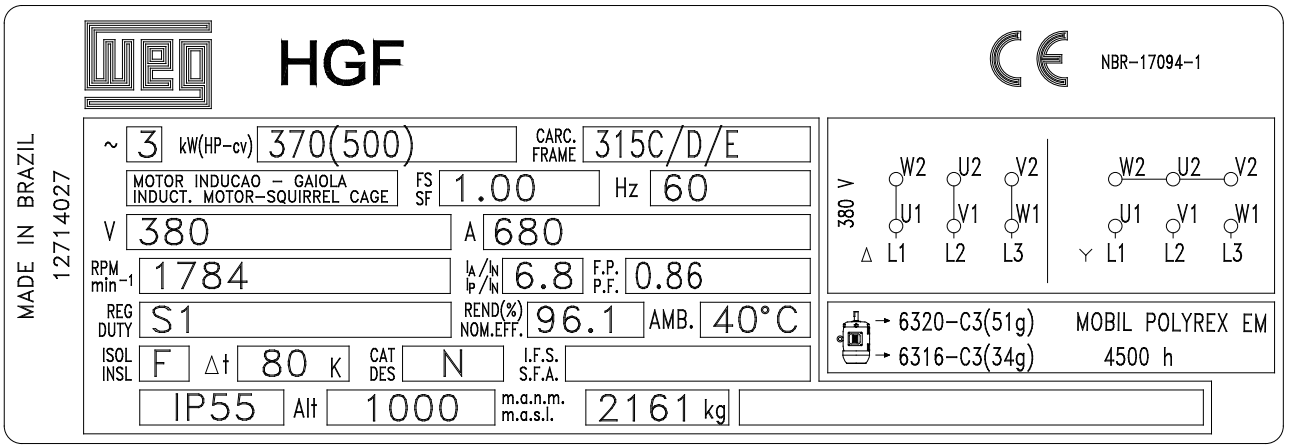
The nameplate contains information that describes the construction characteristics and the performance of the motor. Figure 2.1 and Figure 2.2 show nameplate layout examples.

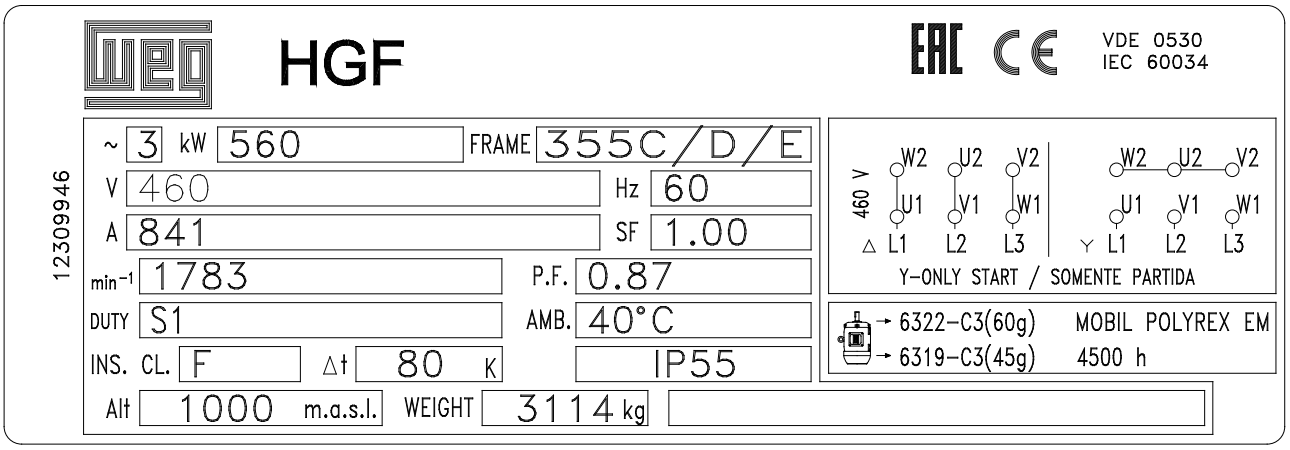












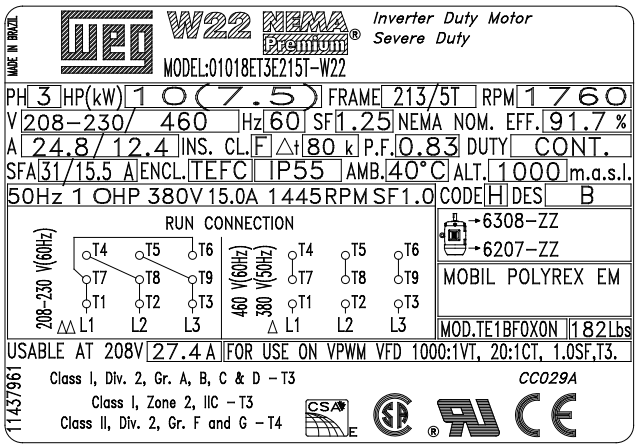


Figure 2.1 - *IEC motor nameplate*

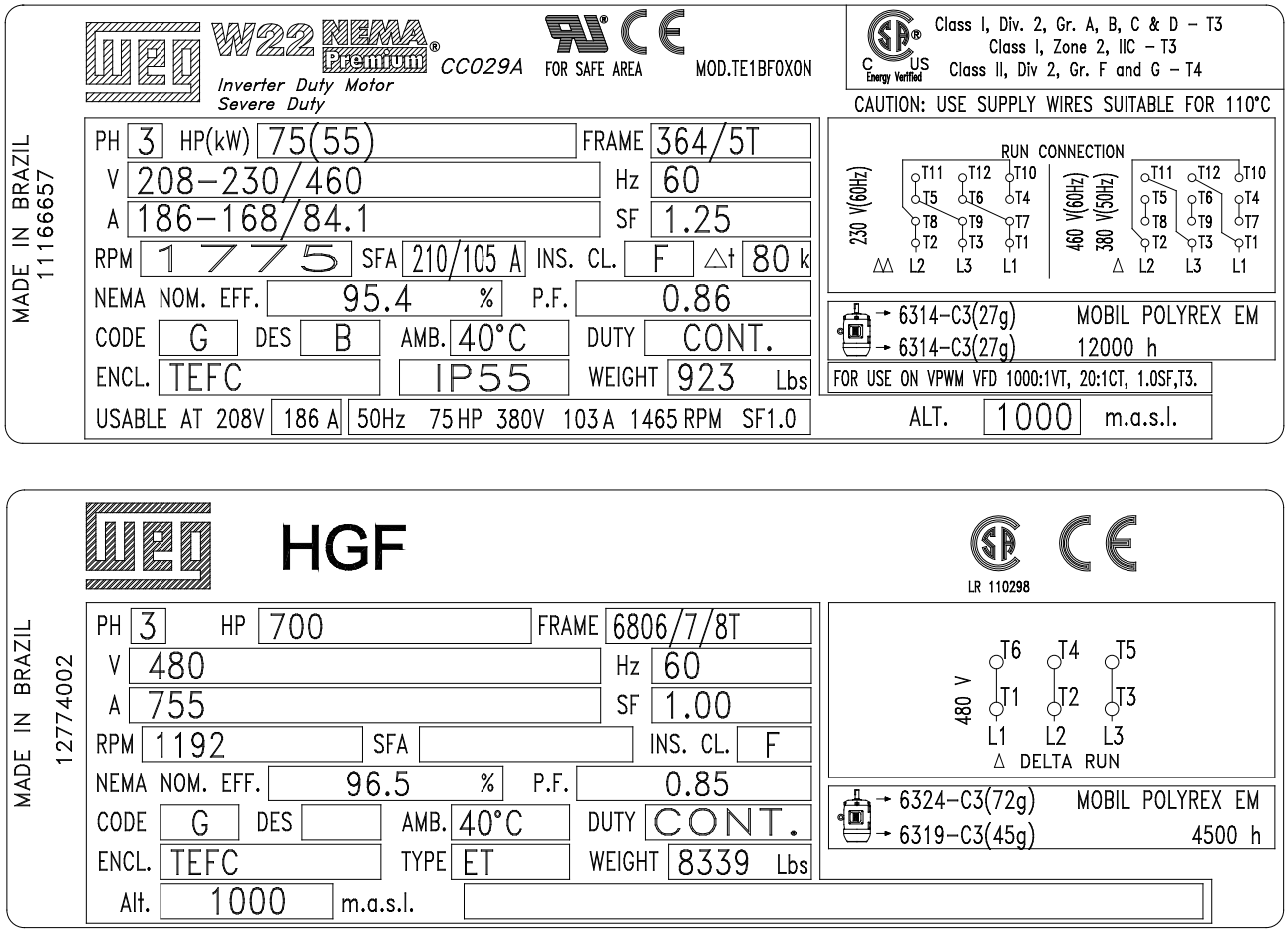


Figure 2.2 - *NEMA motor nameplate*

3. SAFETY INSTRUCTIONS



The motor must be disconnected from the power supply and be completely stopped before conducting any installation or maintenance procedures. Additional measures should be taken to avoid accidental motor starting.



Professionals working with electrical installations, either in the assembly, operation or maintenance, should use proper tools and be instructed on the application of standards and safety requirements, including the use of Personal Protective Equipment (PPE) that must be carefully observed in order to reduce risk of personal injury during these services.



Electric motors have energized circuits, exposed rotating parts and hot surfaces that may cause serious injury to people during normal operation. It is recommended that transportation, storage, installation, operation and maintenance services are always performed by qualified personnel.

Always follow the safety, installation, maintenance and inspection instructions in accordance with the applicable standards in each country.

4. HANDLING AND TRANSPORT

Individually packaged motors should never be lifted by the shaft or by the packaging. They must be lifted only by means of the eyebolts, when supplied. Use always suitable lifting devices to lift the motor. Eyebolts on the frame are designed for lifting the machine weight only as indicated on the motor nameplate. Motors supplied on pallets must be lifted by the pallet base with lifting devices fully supporting the motor weight.

The package should never be dropped. Handle it carefully to avoid bearing damage.

Eyebolts provided on the frame are designed for lifting the machine only. Do not use these eyebolts for lifting the motor with coupled equipment such as bases, pulleys, pumps, reducers, etc..

Never use damaged, bent or cracked eyebolts. Always check the eyebolt condition before lifting the motor.

Eyebolts mounted on components, such as on end shields, forced ventilation kits, etc. must be used for lifting these components only. Do not use them for lifting the complete machine set.

Handle the motor carefully without sudden impacts to avoid bearing damage and prevent excessive mechanical stresses on the eyebolts resulting in its rupture.

To move or transport motors with cylindrical roller bearings or angular contact ball bearings, use always the shaft locking device provided with the motor.
All HGF motors, regardless of bearing type, must be transported with shaft locking device fitted.
Vertical mounted motors with oil-lubricated bearings must be transported in the vertical position. If necessary to move or transport the motor in the horizontal position, install the shaft locking device on both sides (drive end and non-drive end) of the motor.

4.1. LIFTING

Before lifting the motor ensure that all eyebolts are tightened properly and the eyebolt shoulders are in contact with the base to be lifted, as shown in Figure 4.1. Figure 4.2 shows an incorrect tightening of the eyebolt.
Ensure that lifting machine has the required lifting capacity for the weight indicated on the motor nameplate.



Figure 4.1 *- Correct tightening of the eyebolt*

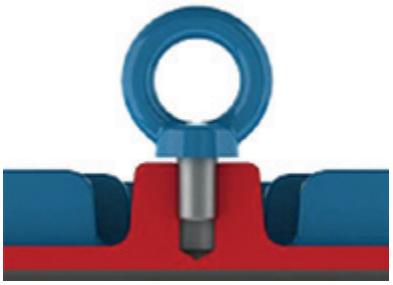


Figure 4.2 *- Incorrect tightening of the eyebolt*

The center-of-gravity may change depending on motor design and accessories. During the lifting procedures the maximum allowed angle of inclination should never be exceeded as specified below.

4.1.1. Horizontal motors with one eyebolt

For horizontal motors fitted with only one eyebolt, the maximum allowed angle-of-inclination during the lifting process should not exceed 30º in relation to the vertical axis, as shown in Figure 4.3.

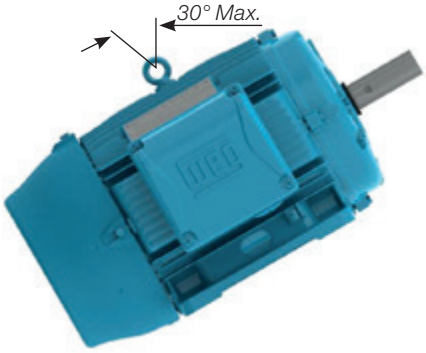


Figure 4.3 *- Maximum allowed angle-of-inclination for motor with one eyebolt*

4.1.2. Horizontal motor with two eyebolts

When motors are fitted with two or more eyebolts, all supplied eyebolts must be used simultaneously for the lifting procedure.

There are two possible eyebolt arrangements (vertical and inclined), as shown below:

- For motors with vertical lifting eyebolts, as shown in Figure 4.4, the maximum allowed lifting angle should not exceed 45° in relation to the vertical axis. We recommend to use a spreader beam for maintaining the lifting elements (chain or rope) in vertical position and thus preventing damage to the motor surface;



Figure 4.4 *- Maximum resulting angle for motors with two or more lifting eyebolts*

- For HGF, W40 and W50 motors, as shown in Figure 4.5, the maximum resulting angle should not exceed 30° in relation to the vertical axis;

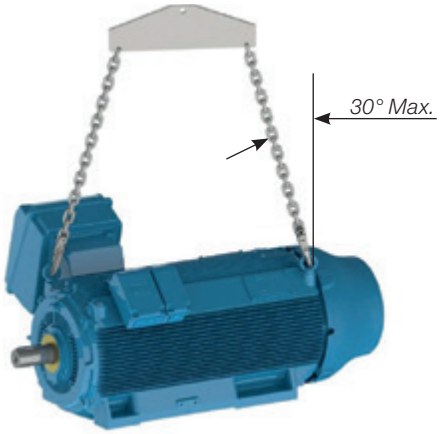


Figure 4.5 *- Maximum resulting angle for horizontal HGF, W40 and W50 motors*

- For motors fitted with inclined eyebolts, as shown in Figure 4.6, the use of a spreader beam is required for maintaining the lifting elements (chain or rope) in vertical position and thus preventing damage to the motor surface.



Figure 4.6 *- Use of a spreader beam for lifting*

4.1.3. Vertical motors

For vertical mounted motors, as shown in Figure 4.7, the use of a spreader beam is required for maintaining the lifting element (chain or rope) in vertical position and thus preventing damage to the motor surface.



Figure 4.7 *- Lifting of vertical mounted motors*

Always use the eyebolts mounted on the top side of the motor, diametrically opposite, considering the mounting position. See Figure 4.8.



Figure 4.8 *- Lifting of HGF and W50 motors.*

4.1.3.1. Procedures to place W22 motors in the vertical position

For safety reasons during the transport, vertical mounted Motors are usually packed and supplied in horizontal position.
To place W22 motors fitted with eyebolts (see Figure 4.6), to the vertical position, proceed as follows:

1. Ensure that the eyebolts are tightened properly, as shown in Figure 4.1;
2. Remove the motor from the packaging, using the top mounted eyebolts, as shown in Figure 4.9;



Figure 4.9 *- Removing the motor from the packaging*

3. Install a second pair of eyebolts, as shown in Figure 4.10;



Figure 4.10 *- Installation of the second pair of eyebolts*

4. Reduce the load on the first pair of eyebolts to start the motor rotation, as shown in Figure 4.11. This procedure must be carried out slowly and carefully.



Figure 4.11 *- End result: motor placed in vertical position*

These procedures will help you to move motors designed for vertical mounting. These procedures are also used to place the motor from the horizontal position into the vertical position and vertical to horizontal.

4.1.3.2. Procedures to place HGF and W50 motors in the vertical position

HGF motors are fitted with eight lifting points: four at drive end and four at non-drive end. W50 motors are fitted with nine lifting points: four at drive end, one in the central part and four at non-drive end. The motors are usually transported in horizontal position, however for the installation they must be placed in the vertical position.
To place an these motors in the vertical position, proceed as follows:

1. Lift the motor by using the four lateral eyebolts and two hoists, see Figure 4.12;



Figure 4.12 *- Lifting of HGF and W50 motors with two hoists*

2. Lower the hoist fixed to motor drive end while lifting the hoist fixed to motor non-drive end until the motor reaches its equilibrium, see Figure 4.13;



Figure 4.13 *- Placing HGF and W50 motors in vertical position*

3. Remove the hoist hooks from the drive end eyebolts and rotate the motor 180° to fix the removed hooks into the two eyebolts at the motor non-drive end, see Figure 4.14;



Figure 4.14 *- Lifting HGF and W50 motors by the eyebolts at the non-drive end*

4. Fix the removed hoist hooks in the other two eyebolts at the non-drive end and lift the motor until the vertical position is reached, see Figure 4.15.



Figure 4.15 *- HGF and W50 motors in the vertical position*

These procedures will help you to move motors designed for vertical mounting. These procedures are also used to place the motor from the horizontal position into the vertical position and vertical to horizontal.

4.2 Procedures to place W22 vertical mount motors in horizontal position

To place W22 vertical mount motor in horizontal position, proceed as follows:

1. Ensure that all eyebolts are tightened properly, as shown in Figure 4.1;

2. Install the first pair of eyebolts and lift the motor as shown in Figure 4.16;



Figure 4.16 - *Install the first pair of eyebolts*

3. Install the second pair of eyebolts, as shown in Figure 4.17;



Figure 4.17 - *Install the second pair of eyebolts*

4. Reduce the load on the first pair of eyebolts for rotating the motor, as shown in Figure 4.18. This procedure must be carried out slowly and carefully;



Figure 4.18 - *Motor is being rotated to horizontal position*

5. Remove the first pair of eyebolts, as shown in Figure 4.19.



Figure 4.19 - *Final result: motor placed in horizontal position*

5. STORAGE

If the motor is not installed immediately, it must be stored in a dry and clean environment, with relative humidity not exceeding 60%, with an ambient temperature between 5 ºC and 40 ºC, without sudden temperature changes, free of dust, vibrations, gases or corrosive agents. The motor must be stored in horizontal position, unless specifically designed for vertical operation, without placing objects on it. Do not remove the protection grease from shaft end to prevent rust.

If the motor are fitted with space heaters, they must always be turned on during the storage period or when the installed motor is out of operation. Space heaters will prevent water condensation inside the motor and keep the winding insulation resistance within acceptable levels. Store the motor in such position that the condensed water can be easily drained. If fitted, remove pulleys or couplings from the shaft end (more information are given on item 6).

The space heaters should never be energized when the motor is in operation.

5.1. EXPOSED MACHINED SURFACES

All exposed machined surfaces (like shaft end and flange) are factory-protected with temporary rust inhibitor. A protective film must be reapplied periodically (at least every six months), or when it has been removed and/or damaged.

5.2. STORAGE

The stacking height of the motor packaging during the storage period should not exceed 5 m, always considering the criteria indicated in Table 5.1:

Table 5.1 *- Max. recommended stacking height*

Packaging type	Frame sizes	Maximum stacking quantity
Cardboard box	IEC 63 to 132 NEMA 143 to 215	Indicated on the top side of the cardboard box
Wood crate	IEC 63 to 315 NEMA 48 to 504/5	06
	IEC 355 NEMA 586/7 and 588/9	03
	W40 / W50 / HGF IEC 315 to 630 W40 / W50 / HGF NEMA 5000 to 9600	Indicated on the packaging

Notes:
1) Never stack larger packaging onto smaller packaging;
2) Align the packaging correctly (see Figure 5.1 and Figure 5.2);



Figure 5.1 *- Correct stacking*

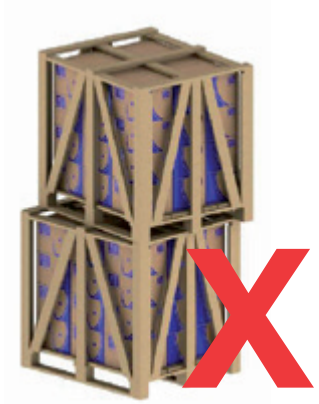


Figure 5.2 *- Incorrect stacking*

ENGLISH

3) The feet of the crates above should always be supported by suitable wood battens (Figure 5.3) and never stand on the steel tape or without support (Figure 5.4);



Figure 5.3 - Correct stacking



Figure 5.4 - Incorrect stacking

4) When stacking smaller crates onto longer crates, always ensure that suitable wooden supports are provided to withstand the weight (see Figure 5.5). This condition usually occurs with motor packaging above IEC 225S/M (NEMA 364/5T) frame sizes.

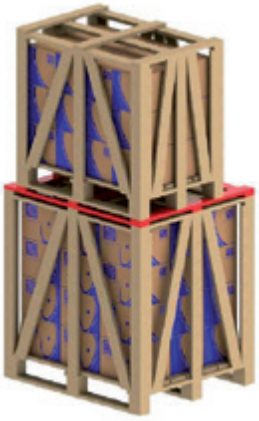


***Figure 5.5** - Use of additional battens for stacking*

5.3 BEARINGS

5.3.1 Grease lubricated bearings

We recommend rotating the motor shaft at least once a month (by hand, at least five revolutions, stopping the shaft at a different position from the original one). If the motor is fitted with shaft locking device, remove it before rotating the shaft and install it again before performing any handling procedure. Vertical motors may be stored in the vertical or in horizontal position. If motors with open bearings are stored longer than six months, the bearings must be relubricated according to item 8.2 before commissioning of the motor.
If the motor is stored for longer than 2 years, the bearings must be replaced or removed, washed, inspected and relubricated according to item 8.2.

5.3.2 Oil lubricated bearings

The motor must be stored in its original operating position and with oil in the bearings. Correct oil level must be ensured. It should be in the center of the sight glass.
During the storage period, remove the shaft locking device and rotate the shaft by hand every month, at least five revolutions, thus achieving an even oil distribution inside the bearing and maintaining the bearing in good operating conditions. Reinstall the shaft locking device every time the motor has to be moved.
If the motor is stored for a period equal or longer than the oil change interval, the oil must be replaced according to Item 8.2, before starting the operation. If the motor is stored for a period of over two years, the bearings must be replaced or removed, washed according to manufacturer instructions, checked and relubricated according to Item 8.2. The oil of vertical mounted motors is removed to prevent oils leaks during the transport. After receiving the motor the bearings must be lubricated.

5.3.3 Oil Mist lubricated bearings

The motor must be stored in horizontal position. Lubricate the bearings with ISO VG 68 mineral oil in the amount indicated in the Table 5.2 (this is also valid for bearings with equivalent dimensions). After filling with oil, rotate the shaft by hand, at least five revolutions)
During the storage period, remove the shaft locking device (if any) and rotate the shaft by hand every week, at least five revolutions, stopping it at a different position from the original one. Reinstall the shaft locking device every time the motor has to be moved. If the motor is stored for a period of over two years, the bearings must be replaced or removed, washed according to manufacturer instructions, checked and relubricated according to item 8.2.

Table 5.2 - *Amount of oil per bearing*

Bearing size	Amount of oil (ml)	Bearing size	Amount of oil (ml)
6201	15	6309	65
6202	15	6311	90
6203	15	6312	105
6204	25	6314	150
6205	25	6315	200
6206	35	6316	250
6207	35	6317	300
6208	40	6319	350
6209	40	6320	400
6211	45	6322	550
6212	50	6324	600
6307	45	6326	650
6308	55	6328	700

The oil must always be removed when the motor has to be handled. If the oil mist system is not operating after installation, fill the bearings with oil to prevent bearing rusting. During the storage period, rotate the shaft by hand, at least five revolutions, stopping it at a different position from the original one. Before starting the motor, all bearing protection oil must be drained from the bearing and the oil mist system must be switched ON.

5.3.4 Sleeve bearing

The motor must be stored in its original operating position and with oil in the bearings. Correct oil level must be ensured. It should be in the middle of the sight glass. During the storage period, remove the shaft locking device and rotate the shaft by hand every month, at least five revolutions, and at 30 rpm, thus achieving an even oil distribution inside the bearing and maintaining the bearing in good operating conditions. Reinstall the shaft locking device every time the motor has to be moved.
If the motor is stored for a period equal or longer than the oil change interval, the oil must be replaced, according to Item 8.2, before starting the operation.

If the motor is stored for a period longer than the oil change interval, or if it is not possible to rotate the motor shaft by hand, the oil must be drained and a corrosion protection and dehumidifiers must be applied.

5.4. INSULATION RESISTANCE

We recommend measuring the winding insulation resistance at regular intervals to follow-up and evaluate its electrical operating conditions. If any reduction in the insulation resistance values are recorded, the storage conditions should be evaluated and corrected, where necessary.

5.4.1. Insulation resistance measurement

We recommend measuring the winding insulation resistance at regular intervals to follow-up and evaluate its electrical operating conditions. If any reduction in the insulation resistance values are recorded, the storage conditions should be evaluated and corrected, where necessary.



The insulation resistance must be measured in a safe environment.

The insulation resistance must be measured with a megohmmeter. The machine must be in cold state and disconnected from the power supply.

To prevent the risk of an electrical shock, ground the terminals before and after each measurement. Ground the capacitor (if any) to ensure that it is fully discharged before the measurement is taken.

It is recommended to insulate and test each phase separately. This procedure allows the comparison of the insulation resistance between each phase. During the test of one phase, the other phases must be grounded. The test of all phases simultaneously evaluates the insulation resistance to ground only but does not evaluate the insulation resistance between the phases.
The power supply cables, switches, capacitors and other external devices connected to the motor may considerably influence the insulation resistance measurement. Thus all external devices must be disconnected and grounded during the insulation resistance measurement.
Measure the insulation resistance one minute after the voltage has been applied to the winding. The applied voltage should be as shown in Table 5.3.

Table 5.3 *- Voltage for the insulation resistance*

Winding rated voltage (V)	Testing voltage for measuring the insulation resistance (V)
< 1000	500
1000 - 2500	500 - 1000
2501 - 5000	1000 - 2500
5001 - 12000	2500 - 5000
> 12000	5000 - 10000

The reading of the insulation resistance must be corrected to 40 °C as shown in the Table 5.4.

Table 5.4 *- Correction factor for the insulation resistance corrected to 40 °C*

Measuring temperature of the insulation resistance (°C)	Correction factor of the insulation resistance corrected to 40 °C	Measuring temperature of the insulation resistance (°C)	Correction factor of the insulation resistance corrected to 40 °C
10	0.125	30	0.500
11	0.134	31	0.536
12	0.144	32	0.574
13	0.154	33	0.616
14	0.165	34	0.660
15	0.177	35	0.707
16	0.189	36	0.758
17	0.203	37	0.812
18	0.218	38	0.871
19	0.233	39	0.933
20	0.250	40	1.000
21	0.268	41	1.072
22	0.287	42	1.149
23	0.308	43	1.231
24	0.330	44	1.320
25	0.354	45	1.414
26	0.379	46	1.516
27	0.406	47	1.625
28	0.435	48	1.741
29	0.467	49	1.866
30	0.500	50	2.000

The motor insulation condition must be evaluated by comparing the measured value with the values indicated in Table 5.5 (corrected to 40 °C):

Table 5.5 *- Evaluation of the insulation system*

Limit value for rated voltage up to 1.1 kV (MΩ)	Limit value for rated voltage above 1.1 kV (MΩ)	Situation
Up to 5	Up to 100	Dangerous. The motor can not be operated in this condition
5 to 100	100 to 500	Regular
100 to 500	Higher than 500	Good
Higher than 500	Higher than 1000	Excellent

The values indicated in the table should be considered only as reference values. It is advisable to log all measured values to provide a quick and easy overview on the machine insulation resistance.
If the insulation resistance is low, moisture may be present in the stator windings. In this case the motor should be removed and transported to a WEG authorized Service Center for proper evaluation and repair (This service is not covered by the warranty). To improve the insulation resistance through the drying process, see section 8.4.

6. INSTALLATION

The insulation resistance must be measured in a safe environment.

Check some aspects before proceeding with the installation:

1. Insulation resistance: must be within the acceptable limits. See item 5.4.
2. Bearings:
   If the motor is installed without running immediately, proceed as described in item 5.3.
3. Operating conditions of the start capacitors: If single-phase motors are stored for a period of over two years, it is recommended to change the start capacitors before motor starting since they lose their operating characteristics.
4. Terminal box:
   a. the inside of the terminal box must be clean and dry;
   b. the contacts must be correctly connected and corrosion free. See 6.9 and 6.10;
   c. the cable entries must be correctly sealed and the terminal box cover properly mounted in order to ensure the degree of protection indicated on the motor nameplate.
5. Cooling: the cooling fins, air inlet and outlet openings must be clean and unobstructed. The distance between the air inlet openings and the wall should not be shorter than ¼ (one quarter) of the diameter of the air inlet. Ensure sufficient space to perform the cleaning services. See item 7.
6. Coupling: remove the shaft locking device (where fitted) and the corrosion protection grease from the shaft end and flange just before installing the motor. See item 6.4.
7. Drain hole: the motor must always be positioned so the drain hole is at the lowest position (If there is any indication arrow on the drain, the drain must be so installed that the arrow points downwards).
   Motors supplied with rubber drain plugs leave the factory in the closed position and must be opened periodically to allow the exit of condensed water. For environments with high water condensation levels and motor with degree of protection IP55, the drain plugs can be mounted in open position (see Figure 6.1).
   For motors with degree of protection IP56, IP65 or IP66, the drain plugs must remain at closed position (see Figure 6.1), being opened only during the motor maintenance procedures.
   The drain system of motors with Oil Mist lubrication system must be connected to a specific collection system (see Figure 6.12).

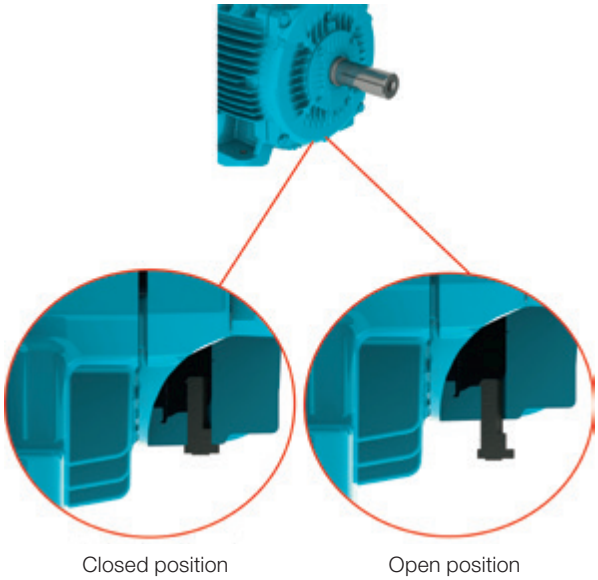


Figure 6.1 *- Detail of the rubber drain plug mounted in closed and open position*

8.Additional recommendations:
a. Check the direction of motor rotation, starting the motor at no-load before coupling it to the load;
b. Vertical mounted motors with shaft end down must be fitted with drip cover to protect them from liquids or solids that may drop onto the motors;
c. Vertical mounted motors with shaft end up should be fitted with water slinger ring to prevent water ingress inside the motor.
d. The fixing elements mounted in the threaded through holes in the motor enclosure (for example, the flange) must be properly sealed.

Remove or fix the shaft key before starting the motor.

Changes on the motor construction (features), such as installation of extended grease fittings or modification of the lubrication system, installation of accessories at alternative locations, etc., can be carried out only after prior written consent from WEG.

6.1. FOUNDATIONS

The foundation is the structure, structural element, natural or prepared base, designed to withstand the stresses produced by the installed equipment, ensuring safe and stable performance during operation. The foundation design should consider the adjacent structures to avoid the influences of other installed equipment and no vibration is transferred through the structure

The foundation must be flat and its selection and design must consider the following characteristics:

a) The features of the machine to be installed on the foundation, the driven loads, application, maximum allowed deformations and vibration levels (for instance, motors with reduced vibration levels, foot flatness, flange concentricity, axial and radial loads, etc. lower than the values specified for standard motors).

b) Adjacent buildings, conservation status, maximum applied load estimation, type of foundation and fixation and vibrations transmitted by theses constructions.

If the motor is supplied with leveling/alignment bolts, this must be considered in the base design.

Please consider for the foundation dimensioning all stresses that are generated during the operation of the driven load.
The user is responsible for the foundation designing and construction.

The foundation stresses can be calculated by using the following equations (see Figure 6.2):

$$F_1 = 0,5 * g * m - (4 * T_b / A)$$
$$F_2 = 0,5 * g * m + (4 * T_b / A)$$

Where:

F_1 and F_2 = lateral stresses (N);
g = gravitational acceleration (9,8 m/s^2);
m = motor weight (kg);
T_b = breakdown torque (Nm);
A = distance between centerlines of mounting holes in feet or base of the machine (end view) (m).

The motors may be mounted on:
- Concrete bases: are most used for large-size motors (see Figure 6.2);
- Metallic bases: are generally used for small-size motors (see Figure 6.3).

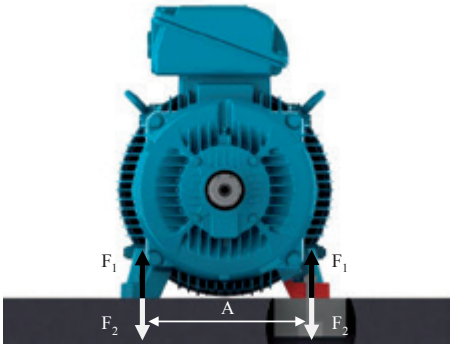


Figure 6.2 *- Motor installed on concrete base*



Figure 6.3 *- Motor installed on metallic base*

The metallic and concrete bases may be fitted with sliding system. These types of foundations are generally used where the power transmission is achieved by belts and pulleys. This power transmission system is easier to assemble/disassemble and allows the belt tension adjustment. Other important aspect of this foundation type is the location of the base locking screws that must be diagonally opposite. The rail nearest the drive pulley is placed in such a way that the positioning bolt is between the motor and the driven machine. The other rail must be placed with the bolt on the opposite side (diagonally opposite), as shown in Figure 6.4 .

To facilitate assembly, the bases may have the following features:
- Shoulders and/or recesses;
- Anchor bolts with loose plates;
- Bolts cast in the concrete;
- Leveling screws;
- Positioning screws;
- Steel & cast iron blocks, plates with flat surfaces.

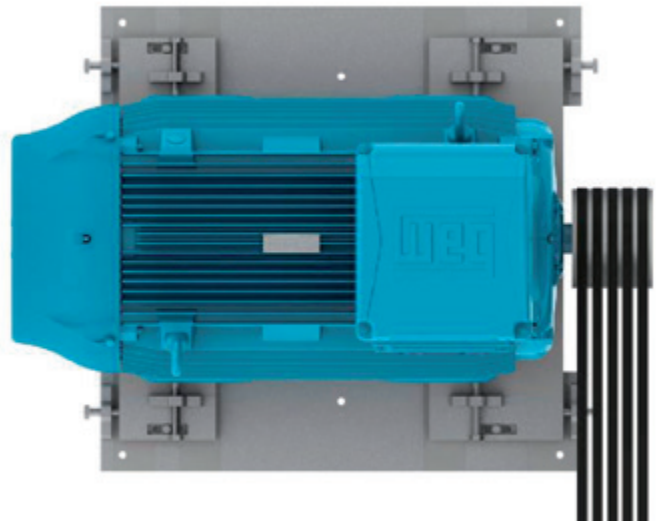


Figure 6.4 *- Motor installed on sliding base*

After completing the installation, it is recommended that all exposed machined surfaces are coated with suitable rust inhibitor.

6.2. MOTOR MOUNTING

Footless motors supplied with transportation devices, according to Figure 6.5, must have their devices removed before starting the motor installation.

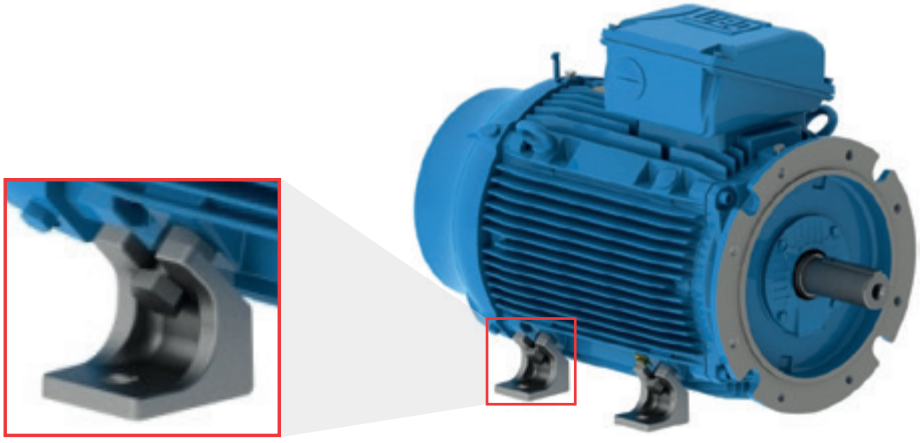


Figure 6.5 *- Detail of the transportation devices for footless motors*

6.2.1. Foot mounted motors

The drawings of the mounting hole dimensions for NEMA or IEC motors can be checked in the respective technical catalogue.
The motor must be correctly aligned and leveled with the driven machine. Incorrect alignment and leveling may result in bearing damage, generate excessive vibration and even shaft distortion/breakage.
For more details, see section 6.3 and 6.6. The thread engagement length of the mounting bolt should be at least 1.5 times the bolt diameter. This thread engagement length should be evaluated in more severe applications and increased accordingly.
Figure 6.6 shows the mounting system of a foot mounted motor indicating the minimum required thread engagement length.

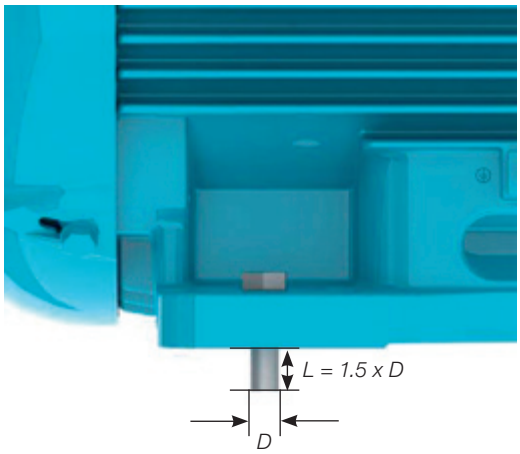


Figure 6.6 *- Mounting system of a foot mounted motor*

6.2.2. Flange mounted motors

The drawings of the flange mounting dimensions, IEC and NEMA flanges, can be checked in the technical catalogue.
The coupling of the driven equipment to the motor flange must be properly dimensioned to ensure the required concentricity of the assembly.
Depending on the flange type, the mounting can be performed from the motor to the driven equipment flange (flange FF (IEC) or D (NEMA)) or from the driven equipment flange to the motor (flange C (DIN or NEMA)).
For the mounting process from the driven equipment flange to the motor, you must consider the bolt length, flange thickness and the thread depth of the motor flange.

If the motor flange has tapped through-holes, the length of the mounting bolts must not exceed the tapped through-hole length of the motor flange, thus preventing damage to the winding head.

For flange mounting the thread engagement length of the mounting bolt should be at least 1.5 times the bolt diameter. In severe applications, longer thread engagement length may be required.
In severe applications or if large motors are flange mounted, a foot or pad mounting may be required in addition to the flange mounting (Figure 6.7). The motor must never be supported on its cooling fins.

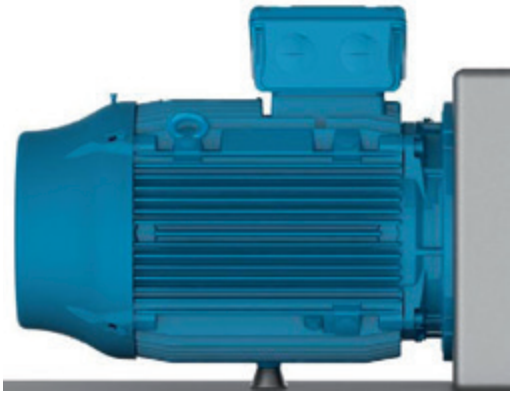


Figure 6.7 *- Mounting method of flange mounted motors with frame base support*

Note*:*
When liquid (for example oil) is likely to come into contact with the shaft seal, please contact your local WEG representative.

6.2.3. Pad mounted motors

Typically, this method of mounting is used in axial fans. The motor is fixed by tapped holes in the frame. The dimensions of these tapped holes can be checked in the respective product catalogue. The selection of the motor mounting rods/bolts must consider the dimensions of the fan case, the installation base and the thread depth in the motor frame.
The mounting rods and the fan case wall must be sufficiently stiff to prevent the transmission of excessive vibration to the machine set (motor & fan). Figure 6.8 shows the pad mounting system.

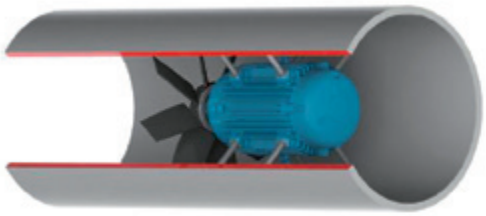


Figure 6.8 *- Mounting of the motor inside the cooling duct*

6.3. BALANCING

Unbalanced machines generate vibration which can result in damage to the motor. WEG motors are dynamically balanced with “half key” and without load (uncoupled). Special balancing quality level must be stated in the Purchase Order.

The transmission elements, such as pulleys, couplings, etc., must balanced with “half key” before they are mounted on the motor shaft.

The balance quality grade meets the applicable standards for each product line.

The maximum balancing deviation must be recorded in the installation report.

6.4. COUPLINGS

Couplings are used to transmit the torque from the motor shaft to the shaft of the driven machine. The following aspects must be considered when couplings are installed:

- Use proper tools for coupling assembly & disassembly to avoid damages to the motor and bearings;
- Whenever possible, use flexible couplings, since they can absorb eventual residual misalignments during the machine operation;
- The maximum loads and speed limits informed in the coupling and motor manufacturer catalogues cannot be exceeded;
- Level and align the motor as specified in sections 6.5 and 6.6, respectively.

Remove or fix the shaft key firmly when the motor is operated without coupling in order to prevent accidents.

6.4.1. Direct coupling

Direct coupling is characterized when the Motor shaft is directly coupled to the shaft of the driven machine without transmission elements. Whenever possible, use direct coupling due to lower cost, less space required for installation and more safety against accidents.

Do not use roller bearings for direct coupling, unless sufficient radial load is expected.

6.4.2. Gearbox coupling

Gearbox coupling is typically used where speed reduction is required.
Make sure that shafts are perfectly aligned and strictly parallel (in case of straight spur gears) and in the right meshing angle (in case of bevel and helical gears).

6.4.3. Pulley and belt coupling

Pulleys and belts are used when speed increase or reduction between motor shaft and driven load is required.

Excessive belt tension will damage the bearings and cause unexpected accidents such as breakage of the motor shaft.

6.4.4. Coupling of sleeve bearing motors

Motors designed with sleeve bearings must be operated with direct coupling to the driven machine or a gearbox. Pulley and belts can not be applied for sleeve bearing motors.

Motors designed with sleeve bearings have 3 (three) marks on the shaft end. The center mark is the indication of the magnetic center and the 2 (two) outside marks indicate the allowed limits of the rotor axial movement, as shown in Figure 6.9.
The motor must be so coupled that during operation the arrow on the frame is placed over the central mark indicating the rotor magnetic center. During start-up, or even during operation, the rotor may freely move between the two outside marks when the driven machine exerts an axial load on the motor shaft. However, under no circumstance, the motor can operate continuously with axial forces on the bearing.

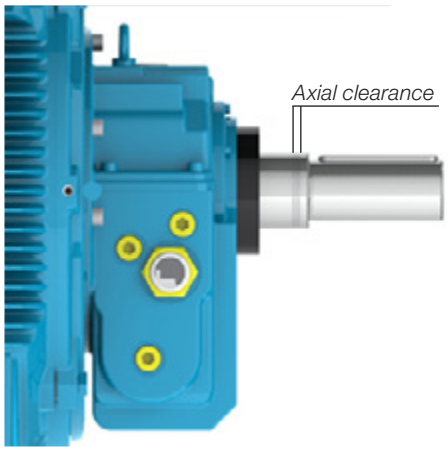


Figure 6.9 *- Axial clearance of motor designed with sleeve bearing*

For coupling evaluation consider the maximum axial bearing clearance as shown in Table 6.1.
The axial clearance of the driven machine and coupling influence the maximum bearing clearance.

Table 6.1 *- Clearance used for sleeve bearings*

Bearing size	Total axial clearance (mm)
9*	3 + 3 = 6
11*	4 + 4 = 8
14*	5 + 5 =10
18	7,5 + 7,5 = 15

** For Motors in accordance with API 541, the total axial clearance is 12.7 mm*

The sleeve bearings used by WEG were not designed to support axial load continuously.
Under no circumstance must the motor be operated continuously at its axial clearance limits.

6.5. LEVELING

The motor must be leveled to correct any deviations in flatness arising from the manufacturing process and the material structure rearrangement. The leveling can be carried out by a leveling screw fixed on the motor foot or on the flange or by means of thin compensation shims. After the leveling process, the leveling height between the motor mounting base and the motor cannot exceed 0.1 mm.
If a metallic base is used to level the height of the motor shaft end and the shaft end of the driven machine, level only the metallic base relating to the concrete base.

Record the maximum leveling deviations in the installation report.

6.6. ALIGNMENT

The correct alignment between the motor and the driven machine is one of the most important variables that extends the useful service life of the motor. Incorrect coupling alignment generates high loads and vibrations reducing the useful life of the bearings and even resulting in shaft breakages. Figure 6.10 illustrates the misalignment between the motor and the driven machine.

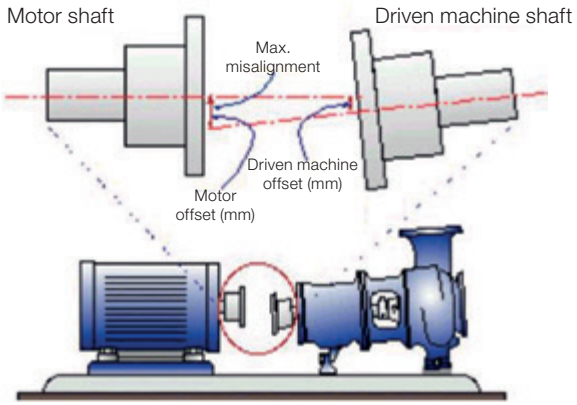
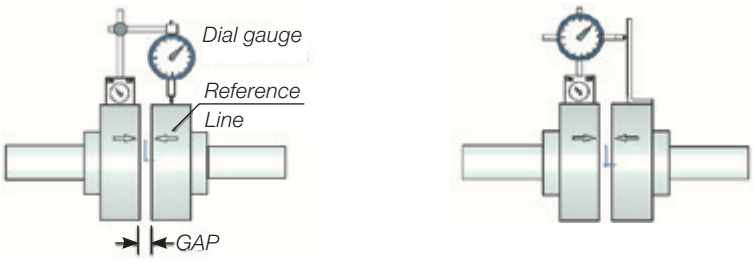


Figure 6.10 *- Typical misalignment condition*

Alignment procedures must be carried out using suitable tools and devices, such as dial gauge, laser alignment instruments, etc.. The motor shaft must be aligned axially and radially with the driven machine shaft.

The maximum allowed eccentricity for a complete shaft turn should not exceed 0.03 mm, when alignment is made with dial gauges, as shown in Figure 6.11. Ensure a gap between couplings to compensate the thermal expansion between the shafts as specified by the coupling manufacturer.



Parallel alignment *Angular alignment*

Figure 6.11 *- Alignment with dial gauge*

If alignment is made by a laser instrument, please consider the instructions and recommendations provided by the laser instrument manufacturer.
The alignment should be checked at ambient temperature with machine at operating temperature.

The coupling alignment must be checked periodically.

Pulley and belt couplings must be so aligned that the driver pulley center lies in the same plane of the driven pulley center and the motor shaft and the shaft of the driven machine are perfectly parallel.
After completing the alignment procedures, ensure that mounting devices do not change the motor and machine alignment and leveling resulting into machine damage during operation.

It is recommended to record the maximum alignment deviation in the Installation Report.

6.7. CONNECTION OF OIL LUBRICATED OR OIL MIST LUBRICATED MOTORS

When oil lubricated or oil mist lubricated motors are installed, connect the existing lubricant tubes (oil inlet and oil outlet tubes and motor drain tube), as shown in Figure 6.12. The lubrication system must ensure continuous oil flow through the bearings as specified by the manufacturer of the installed lubrication system.

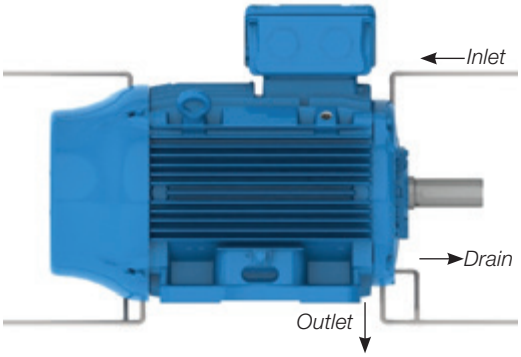


Figure 6.12 *- Oil supply and drain system of oil lubricated or oil mist lubricated motors*

6.8. CONNECTION OF THE COOLING WATER SYSTEM

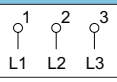
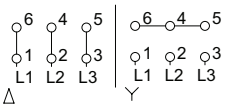
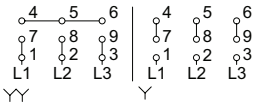
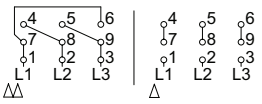
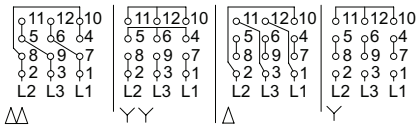
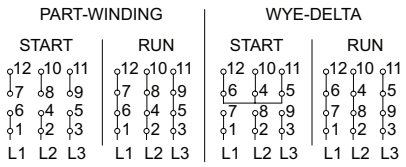
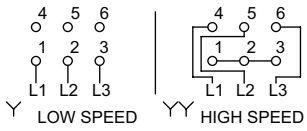
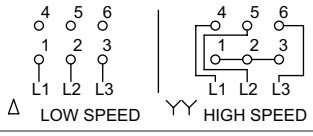
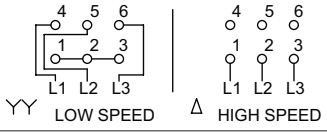
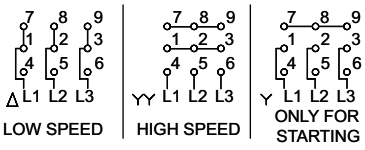
When water cooled motors are installed, connect the water inlet and outlet tubes to ensure proper motor cooling. According to item 7.2, ensure correct cooling water flow rate and water temperature in the motor cooling system.

6.9. ELECTRICAL CONNECTION

Consider the rated motor current, service factor, starting current, environmental and installation conditions, maximum voltage drop, etc. to select appropriate power supply cables and switching and protection devices. All motors must be installed with overload protection systems. Three-phase motors should be fitted with phase fault protection systems.

Before connecting the motor, check if the power supply voltage and the frequency comply with the motor nameplate data. All wiring must be made according to the connection diagram on the motor nameplate. Please consider the connection diagrams in the Table 6.2 as reference value.
To prevent accidents, check if motor has been solidly grounded in accordance with the applicable standards.

Table 6.2 - *Typical connection diagram for three-phase motors.*

Configuration	Quantity of leads	Type of connection	Connection diagram
Single speed	3	-	
	6	Δ - Y	
	9	YY - Y	
		ΔΔ - Δ	
	12	ΔΔ - YY - Δ - Y	
		Δ - PWS Part-winding start	
Double speed Dahlander	6	YY - Y Variable Torque	
		Δ - YY Constant Torque	
		YY - Δ Constant Output	
	9	Δ - Y - YY	
Double speed Double winding	6	-	

Equivalent table for lead identification													
Lead identification on the wiring diagram		**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
Single speed	NEMA MG 1 Part 2	T1	T2	T3	T4	T5	T6	T7	T8	T9	T10	T11	T12
	IEC 60034-8	U1	V1	W1	U2	V2	W2	U3	V3	W3	U4	V4	W4
	JIS (JEC 2137) - up to 6 terminals	U	V	W	X	Y	Z						
	JIS (JEC 2137) - above 6 terminals	U1	V1	W1	U2	V2	W2	U5	V5	W5	U6	V6	W6
Double speed (Dahlander / Double winding)	NEMA MG 1 Part 2[1)]	1U	1V	1W	2U	2V	2W	3U	3V	3W	4U	4V	4W
	IEC 60034-8	1U	1V	1W	2U	2V	2W	3U	3V	3W	4U	4V	4W
	JIS (JEC 2137)	1U	1V	1W	2U	2V	2W	3U	3V	3W	4U	4V	4W

1) NEMA MG 1 Part 2 defines T1 to T12 for two or more winding, however WEG adopts 1U to 4W.

WARNING - Local Standards have priority on the definition of the connection standards.

The connections presented below are a reference for the connection of the customer's power cables on low voltage motors with terminal block. The terminal blocks presented below are the standard for each product line, however variations may occur.
It is recommended the use of terminals made of electrolytic copper or brass, similar to the terminals used on the motors cables.

W21 and W22

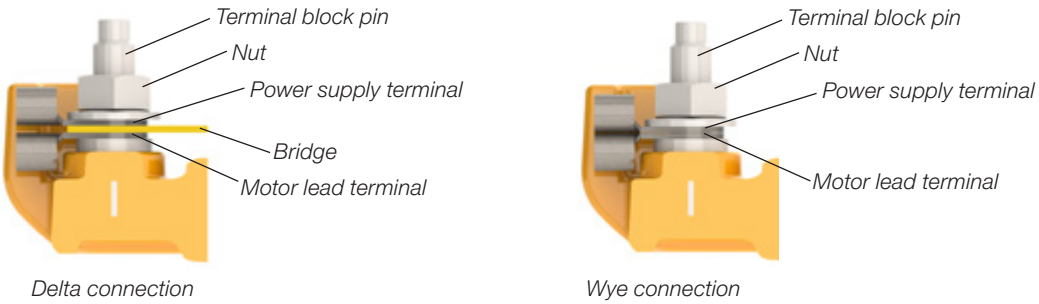


Figure 6.13 *- Connetion for W21 and W22 motors with terminal block*

W50 and HGF

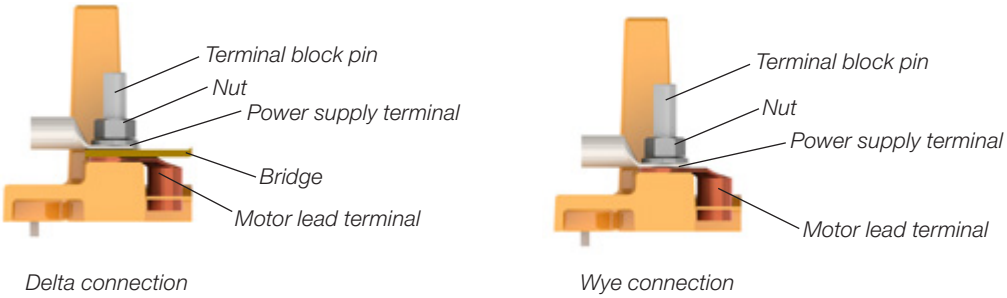


Figure 6.14 *- Connetion for W50 and HGF motors with terminal block*

If motors are supplied without terminal blocks, insulate the cable terminals with suitable insulation material that meets the power supply voltage and the insulation class indicated on the motor nameplate.

Ensure correct tightening torque for the power cable and grounding connections as specified in Table 8.11

The clearance distance (see Figure 6.15) between non-insulated live parts with each other and between grounded parts must be as indicated in Table 6.3.

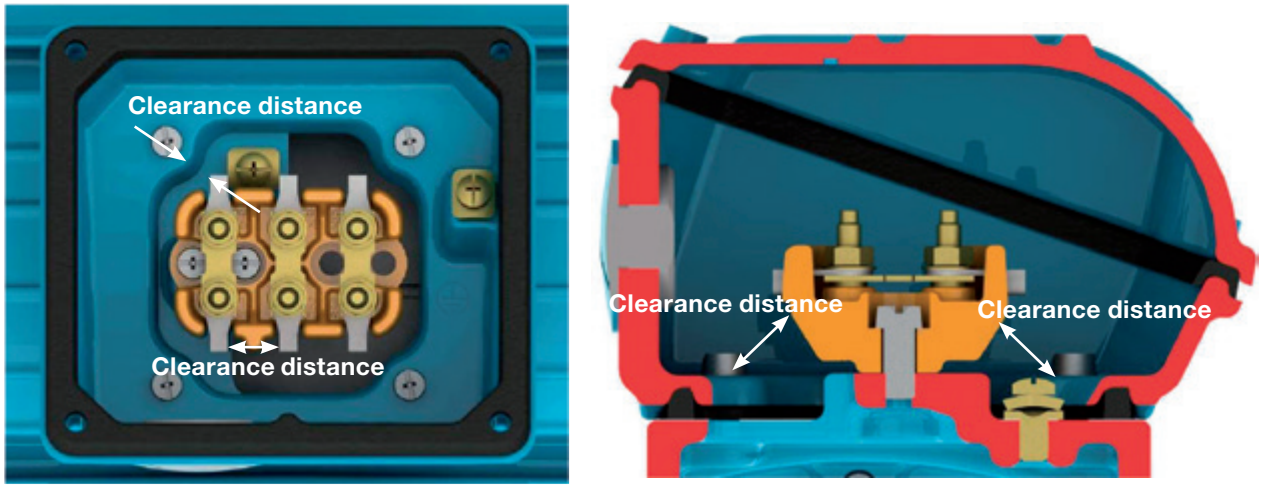


Figure 6.15 - *Clearance distance representation*

Table 6.3 - *Minimum clearance distance (mm) x supply voltage*

Voltage	Minimum clearance distance (mm)
U ≤ 440 V	4
440 < U ≤ 690 V	5.5
690 < U ≤ 1000 V	8
1000 < U ≤ 6900 V	45
6900 < U ≤ 11000 V	70
11000 < U ≤ 16500 V	105

Even when the motor is off, dangerous voltages may be present inside the terminal box used for the space heater supply or winding energization when the winding is used as heating element.
Motor capacitors will hold a charge even after the power has been cut off. Do not touch the capacitors and/or motor terminals, before discharging the capacitors completely.

After the motor connection has been completed, ensure that no tool or foreign body has been left inside the terminal box.

Take the required measures in order to ensure the degree of protection indicated on the motor nameplate:
- unused cable inlet holes in the terminal boxes must be properly closed with blanking plugs;
- components supplied loose (for example, terminal boxes mounted separately) must be properly closed and sealed.
The cable inlets used for power supply and control must be fitted with components (for example, cable-glands and conduits) that meet the applicable standards and regulations in each country.

If the motor is fitted with accessories, such as brakes and forced cooling systems, these devices must be connected to the power supply according to the information provided on their nameplates and with special care as indicated above.

All protection devices, including overcurrent protection, must be set according to the rated machine conditions. These protection devices must protect the machine against short circuit, phase fault or locked rotor condition. The motor protection devices must be set according to the applicable standards.

Check the direction of rotation of the motor shaft. If there is no limitation for the use of unidirectional fans, the shaft rotation direction can be changed by reversing any two of the phase connections. For single-phase motor, check the connection diagram indicated on the motor nameplate.

6.10. CONNECTION OF THE THERMAL PROTECTION DEVICES

If the motor is supplied with temperature monitoring devices, such as, thermostat, thermistors, automatic thermal protectors, Pt-100 (RTD), etc., they must be connected to the corresponding control devices as specified on the accessory nameplates. The non-compliance with this procedure may void the product warranty and cause serious material damages.

Do not apply test voltage above 2.5 V on thermistors and current above 1 mA on RTDs (Pt-100) according to IEC 60751 standard.

Figure 6.16 and Figure 6.17 show the connection diagram of the bimetal thermal protector (thermostats) and thermistors, respectively.

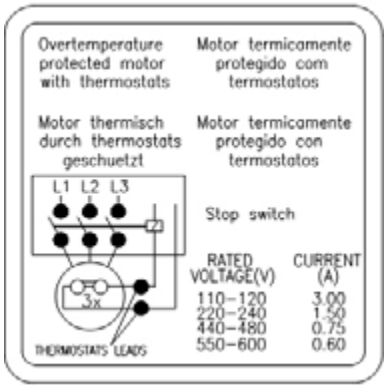


Figure 6.16 *- Connection of the bimetal thermal protectors (thermostats)*

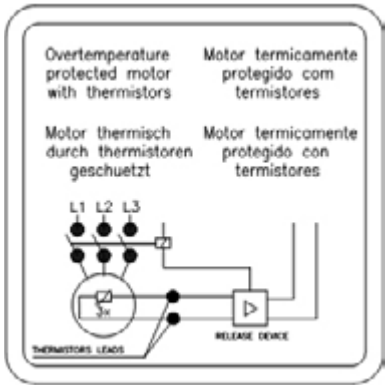


Figure 6.17 *- Thermistor connection*

The alarm temperature limits and thermal protection shutdowns can be defined according to the application; however these temperature limits can not exceed the values in Table 6.4.

Table 6.4 *- Maximum activation temperature of the thermal protections*

Component	Insulation class	Maximum temperature of the protection setting (°C)	
		Alarm	Tripping
Winding	B	-	130
	F	130	155
	H	155	180
Bearing	All	110	120

Notes:
1) The number and type of the installed protection devices are stated on the accessory nameplate of the motor.
2) If the motor is supplied with calibrated resistance, (for example, Pt-100), the motor protection system must be set according to the operating temperatures indicated in Table 6.4.

6.11. RESISTANCE TEMPERATURE DETECTORS (PT-100)

The thermocouples Pt-100 are made of materials, whose resistance depends on the temperature variation, intrinsic property of some materials (usually platinum, nickel or copper), calibrated resistance. Its operation is based on the principle that the electric resistance of a metallic conductor varies linearly with the temperature, thus allowing a continuous monitoring of the motor warm-up through the controller display ensuring a high level of precision and answer stability. These devices are widely used for measuring temperatures in various industry sectors.
In general these devices are used in installations where precise temperature control is required, for example, in installation for irregular or intermittent duty.
The same detector may be used for alarm and tripping purposes.

Table 6.5 and Figure 6.18 show the equivalence between the Pt-100 resistance and the temperature.

Table 6.5 *- Equivalence between the Pt-100 resistance and the temperature*

°C	Ω	°C	Ω	°C	Ω	°C	Ω	°C	Ω
-29	88.617	17	106.627	63	124.390	109	141.908	155	159.180
-28	89.011	18	107.016	64	124.774	110	142.286	156	159.553
-27	89.405	19	107.404	65	125.157	111	142.664	157	159.926
-26	89.799	20	107.793	66	125.540	112	143.042	158	160.298
-25	90.193	21	108.181	67	125.923	113	143.420	159	160.671
-24	90.587	22	108.570	68	126.306	114	143.797	160	161.043
-23	90.980	23	108.958	69	126.689	115	144.175	161	161.415
-22	91.374	24	109.346	70	127.072	116	144.552	162	161.787
-21	91.767	25	109.734	71	127.454	117	144.930	163	162.159
-20	92.160	26	110.122	72	127.837	118	145.307	164	162.531
-19	92.553	27	110.509	73	128.219	119	145.684	165	162.903
-18	92.946	28	110.897	74	128.602	120	146.061	166	163.274
-17	93.339	29	111.284	75	128.984	121	146.438	167	163.646
-16	93.732	30	111.672	76	129.366	122	146.814	168	164.017
-15	94.125	31	112.059	77	129.748	123	147.191	169	164.388
-14	94.517	32	112.446	78	130.130	124	147.567	170	164.760
-13	94.910	33	112.833	79	130.511	125	147.944	171	165.131
-12	95.302	34	113.220	80	130.893	126	148.320	172	165.501
-11	95.694	35	113.607	81	131.274	127	148.696	173	165.872
-10	96.086	36	113.994	82	131.656	128	149.072	174	166.243
-9	96.478	37	114.380	83	132.037	129	149.448	175	166.613
-8	96.870	38	114.767	84	132.418	130	149.824	176	166.984
-7	97.262	39	115.153	85	132.799	131	150.199	177	167.354
-6	97.653	40	115.539	86	133.180	132	150.575	178	167.724
-5	98.045	41	115.925	87	133.561	133	150.950	179	168.095
-4	98.436	42	116.311	88	133.941	134	151.326	180	168.465
-3	98.827	43	116.697	89	134.322	135	151.701	181	168.834
-2	99.218	44	117.083	90	134.702	136	152.076	182	169.204
-1	99.609	45	117.469	91	135.083	137	152.451	183	169.574
0	100.000	46	117.854	92	135.463	138	152.826	184	169.943
1	100.391	47	118.240	93	135.843	139	153.200	185	170.313
2	100.781	48	118.625	94	136.223	140	153.575	186	170.682
3	101.172	49	119.010	95	136.603	141	153.950	187	171.051
4	101.562	50	119.395	96	136.982	142	154.324	188	171.420
5	101.953	51	119.780	97	137.362	143	154.698	189	171.789
6	102.343	52	120.165	98	137.741	144	155.072	190	172.158
7	102.733	53	120.550	99	138.121	145	155.446	191	172.527
8	103.123	54	120.934	100	138.500	146	155.820	192	172.895
9	103.513	55	121.319	101	138.879	147	156.194	193	173.264
10	103.902	56	121.703	102	139.258	148	156.568	194	173.632
11	104.292	57	122.087	103	139.637	149	156.941	195	174.000
12	104.681	58	122.471	104	140.016	150	157.315	196	174.368
13	105.071	59	122.855	105	140.395	151	157.688	197	174.736
14	105.460	60	123.239	106	140.773	152	158.061	198	175.104
15	105.849	61	123.623	107	141.152	153	158.435	199	175.472
16	106.238	62	124.007	108	141.530	154	158.808	200	175.840

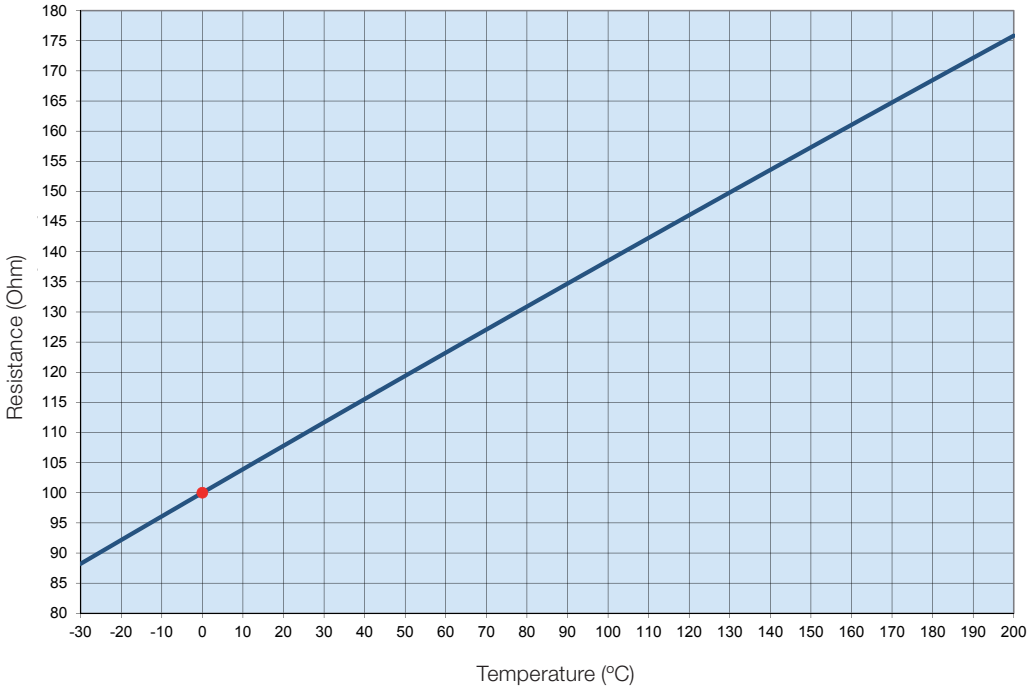


Figure 6.18 *- Ohmic resistance of the Pt-100 x temperature*

6.12. CONNECTION OF THE SPACE HEATERS

Before switching ON the space heaters, check if the space heaters connection have been made according to the connection diagram shown on the space heater nameplate. For motors supplied with dual voltage space heaters (110-127/220-240 V), see Figure 6.19.

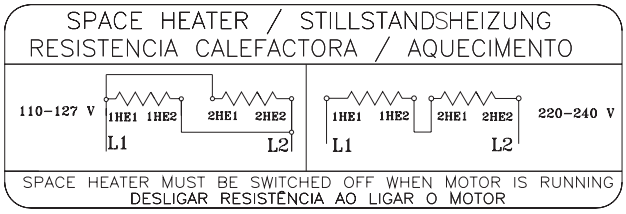


Figure 6.19 *- Dual voltage space heater connection*

The space heaters should never be energized when the motor is in operation.

ENGLISH

6.13. STARTING METHODS

Whenever possible, the motor starting must be Direct On Line (DOL) at rated voltage. This is the most simple and feasible starting method. However, it must only be applied when the starting current does not affect the power supply. Please consider the local electric utility regulations when installing a motor.
High inrush current may result in:
a) high voltage drop in the power supply line creating unacceptable line disturbance on the distribution system;
b) requiring oversized protection system (cables and contactor) increasing the installation costs.

If DOL starting is not allowed due to the reasons mentioned above, an indirect starting method compatible with the load and motor voltage to reduce the starting current may be used.
If reduced voltage starters are used for starting, the motor starting torque will also be reduced.

Table 6.6 shows the possible indirect starting methods that can be used depending on the number of the motor leads.

Table 6.6 *- Starting method x number of motor leads*

Number of leads	Possible starting methods
3 leads	Autotransformer Soft-starter
6 leads	Star-Delta Autotransformer Soft-starter
9 leads	Series/Parallel Part winding Autotransformer Soft-starter
12 leads	Star-Delta Series/Parallel Part winding Autotransformer Soft-starter

Table 6.7 shows examples of possible indirect starting methods to be used according to the voltage indicated on the motor nameplate and the power supply voltage.

Table 6.7 *- Starting methods x voltage*

Nameplate voltage	Operating voltage	Star-delta	Autotransformer starting	Starting by series/ parallel switch	Part-winding starting	Starting by Soft-starter
220/380 V	220 V 380 V	YES NO	YES YES	NO NO	NO NO	YES YES
220/440 V	220 V 440 V	NO NO	YES YES	YES NO	YES NO	YES YES
230/460 V	230 V 460 V	NO NO	YES YES	YES NO	YES NO	YES YES
380/660 V	380 V	YES	YES	NO	NO	YES
220/380/440 V	220 V 380 V 440 V	YES NO YES	YES YES YES	YES YES NO	YES YES NO	YES YES YES

The WQuattro line motors must be started direct on-line (DOL) or driven by a frequency inverter in scalar mode.

6.14. MOTORS DRIVEN BY FREQUENCY INVERTER

The operation with frequency inverter must be stated in the Purchase Order since this drive type may require some changes of the motor design.

Wmagnet Motors must only be driven by WEG frequency inverter.

The frequency inverter used to drive motors up to 690 V must be fitted with Pulse With Modulation (PWM) with vector control.

When a motor is driven by a frequency inverter at lower frequencies than the rated frequency, you must reduce the motor torque to prevent motor overheating. The torque reduction (derating torque) can be found in the item 6.4 of the "Technical Guidelines for Induction Motors driven by PWM Frequency inverters" available on the site www.weg.net.

If the motor is operated above the rated frequency, please note:
- That the motor must be operated at constant output;
- That the motor can supply max. 95% of its rated output;
- Do not exceed the maximum speed and please consider:
  - max. operating frequency stated on the additional nameplate;
  - mechanical speed limitation of the motor.

Information on the selection of the power cables between the frequency inverter and the motor can be found in the item 6.4 of the "Technical Guidelines for Induction Motors driven by PWM Frequency inverters" available at www.weg.net.

6.14.1. Use of dV/dt filter

6.14.1.1. Motor with enameled round wire

Motors designed for rated voltages up to 690 V, when driven by frequency inverter, do not require the use of dV/dT filters, provided that following criteria are considered.

Criteria for the selection of motors with round enameled wire when driven by frequency inverter				
Motor rated votage [1]	**Peak voltage at the motor terminals (max)**	**dV/dt inverter output (max)**	**Inverter Rise Time [2] (min.)**	**MTBP [2] Time between pulses (min)**
Vnom < 460 V	≤ 1600 V	≤ 5200 V/µs	≥ 0,1 µs	≥ 6 µs
460 ≤ Vnom < 575 V	≤ 2000 V	≤ 6500 V/µs		
575 ≤ Vnom ≤ 1000 V	≤ 2400 V	≤ 7800 V/µs		

***Notes**:*
1. For the application of dual voltage motors, example 380/660 V, consider the lower voltage (380 V).
2. Information supplied by the inverter manufacturer.

6.14.1.2. Motor with prewound coils

Motors with prewound coils (medium and high voltage motors regardless of frame sizes, and low voltage motors from IEC 500 / NEMA 800 frame on), designed for the use with frequency inverters, do not require the use of filters, provided they comply with the criteria in Table 6.8.

***Table 6.8** - Criteria to be considered when using motor with prewound coils to be drive by frequency inverters*

Motor rated voltage	**Type of modulation**	**Turn to turn insulation (phase-phase)**		**Phase-ground insulation**	
		Peak voltage at the motor terminals	**dV/dt at the motor terminals**	**Peak voltage at the motor terminals**	**dV/dt at the motor terminals**
690 < Vnom ≤ 4160 V	Sinusoidal	≤ 5900 V	≤ 500 V/µs	≤ 3400 V	≤ 500 V/µs
	PWM	≤ 9300 V	≤ 2700 V/µs	≤ 5400 V	≤ 2700 V/µs
4160 < Vnom ≤ 6600 V	Sinusoidal	≤ 9300 V	≤ 500 V/µs	≤ 5400 V	≤ 500 V/µs
	PWM	≤ 14000 V	≤ 1500 V/µs	≤ 8000 V	≤ 1500 V/µs

6.14.2. Bearing insulation

Only the motors in IEC frame size 400 (NEMA 680) and larger are supplied, as standard, with insulated bearing. If motor must be driven by frequency inverter, insulate the bearing according to Table 6.9.

Table 6.9 *- Recommendation on the bearing insulation for inverter driven motors*

Frame size	Recommendation
IEC 315 and 355 NEMA 445/7 to L5810/11	■ Insulated bearing/end shield ■ Grounding between shaft and frame by grounding brush
IEC 400 and larger NEMA 680 and larger	■ Insulated NDE bearing ■ Grounding between shaft and frame by grounding brush

When motors are supplied with shaft grounding system, monitor the grounding brush constantly during its operation and, when it reaches the end of its useful life, it must be replaced by another brush with the same specification.

6.14.3. Switching frequency

The minimum inverter switching frequency must not be lower than 2.5 kHz and should not exceed 5 kHz.

The non-compliance with the criteria and recommendations indicated in this manual may void the product warranty.

6.14.4. Mechanical speed limitation

Table 6.10 shows the maximum speeds allowed for motors driven by frequency inverter.

Table 6.10 *- Maximum motor speed (in rpm)*

Frame size		DE-bearing	Maximum speed for standard motors
IEC	NEMA		
63-90	143/5	6201 6202 6203 6204 6205	10400
100	-	6206	8800
112	182/4	6207	7600
		6307	6800
132	213/5	6308	6000
160	254/6	6309	5300
180	284/6	6311	4400
200	324/6	6312	4200
225-630	364/5-9610	6314	3600
		6315	3600
		6316	3200
		6319	3000
		6218	3600
		6220	3600
		6320	2200
		6322	1900
		6324	1800
		6328	1800
		6330	1800
		6224	1800
		6228	1800

Note:
To select the maximum allowed motor speed, consider the motor torque derating curve.

For more information on the application of frequency inverters, contact WEG or check the “Technical Guidelines for Induction Motors driven by PWM Frequency inverters” available at www.weg.net.

7. COMMISSIONING

7.1. INITIAL START-UP

After finishing the installation procedures and before starting the motor for the first time or after a long period without operation, the following items must be checked:

- If the nameplate data (voltage, current, connection diagram, degree of protection, cooling system, service factor, etc.) meet the application requirements;
- If the machine set (motor + driven machine) has been mounted and aligned correctly;
- If the motor driving system ensures that the motor speed does not exceed the max. allowed speed indicated in Table 6.10;
- Measure the winding insulation resistance, making sure it complies with the specified values in item 5.4;
- Check the motor rotation direction;
- Inspect the motor terminal box for damage and ensure that it is clean and dry and all contacts are rust-free, the seals are in perfect operating conditions and all unused threaded holes are properly closed thus ensuring the degree of protection indicated on the motor nameplate;
- Check if the motor wiring connections, including grounding and auxiliary equipment connection, have been carried out properly and are in accordance with the recommendations in item 6.9;
- Check the operating conditions of the installed auxiliary devices (brake, encoder, thermal protection device, forced cooling system, etc.);
- Check bearing operating conditions. If the motors are stored and/or installed for more than two years without running, it is recommended to change the bearings, or to remove, wash, inspect and relubricate them before the motor is started. If the motor is stored and/or installed according to the recommendations described in item 5.3, lubricate the bearings as described in item 8.2. For the bearing condition evaluation, it is recommended to use of the vibration analysis techniques: Envelope Analysis or Demodulation Analysis.
- For roller bearing motors with oil lubrication, ensure:
  - The oil level should be in the center of the sight glass (see Figure 8.1 and 8.2);
  - That if the motor is stored for a period equal or longer than the oil change interval, the oil must be changed before starting the motor.
- When motors are fitted with sleeve bearings, ensure:
  - Correct oil level for the sleeve bearing. The oil level should be in the center of the sight glass (see Figure 8.3);
  - That the motor is not started or operated with axial or radial loads;
  - That if the motor is stored for a period equal or longer than the oil change interval, the oil must be changed before starting the motor.
- Inspect the capacitor operating condition, if any. If motors are installed for more than two years, but were never commissioned, it is recommended to change the start capacitors since they lose their operating characteristics;
- Ensure that the air inlet and outlet opening are not blocked. The minimum clearance to the nearest wall (L) should be at least ¼ of the fan cover diameter (D), see Figure 7.1. The intake air temperature must be at ambient temperature.

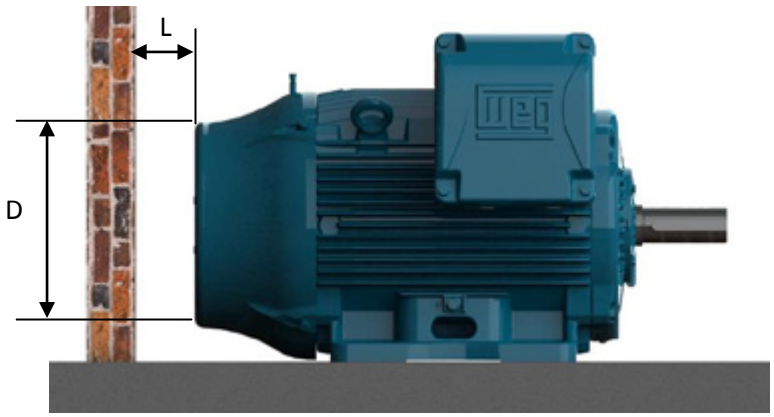


***Figure 7.1**- Minimum clearance to the wall*

Please consider the minimum distances shown in the Table 7.1 as reference value;

Table 7.1 *- Minimum distance between the fan cover and wall*

Frame size		Distance between the fan cover and the wall (L)	
IEC	**NEMA**	**mm**	**inches**
63	-	25	0.96
71	-	26	1.02
80	-	30	1.18
90	143/5	33	1.30
100	-	36	1.43
112	182/4	41	1.61
132	213/5	50	1.98
160	254/6	65	2.56
180	284/6	68	2.66
200	324/6	78	3.08
225 250	364/5 404/5	85	3.35
280	444/5 445/7 447/9	108	4.23
315	L447/9 504/5 5006/7/8 5009/10/11	122	4.80
355	586/7 588/9 5807/8/9 5810/11/12	136	5.35
400	6806/7/8 6809/10/11	147	5.79
450	7006/10	159	6.26
500	8006/10	171	6.73
560	8806/10	185	7.28
630	9606/10	200	7.87

- Ensure correct water flow rate and water temperature when water cooled motors are used. See item 7.2;
- Ensure that all rotating parts, such as pulleys, couplings, external fans, shaft, etc. are protected against accidental contact.

Other tests and inspections not included in the manual may be required, depending on the specific installation, application and/or motor characteristics.

After all previous inspections have been carried out, proceed as follows to start the motor:

- Start the motor on no-load (if possible) and check the motor direction of rotation. Check for the presence of any abnormal noise, vibration or other abnormal operating conditions;
- Ensure the motor starts smoothly. If any abnormal operating condition is noticed, switch off the motor, check the assembly system and connections before the motor is started again;
- If excessive vibrations are noticed, check if the motor mounting bolts are well tightened or if the vibrations are not generated and transmitted from adjacent installed equipment. Check the motor vibration periodically and ensure that the vibration limits are as specified in item 7.2.1;
- Start the motor at rated load during a short time and compare the operating current with the rated current indicated on the nameplate;
- Continue to measure the following motor variables until thermal equilibrium is reached: current, voltage, bearing and motor frame temperature, vibration and noise levels;
- Record the measured current and voltage values on the Installation Report for future comparisons.

As induction motors have high inrush currents during start-up, the acceleration of high inertia load requires an extended starting time to reach full speed resulting in fast motor temperature rise. Successive starts within short intervals will result in winding temperature increases and can lead to physical insulation damage reducing the useful life of the insulation system. If the duty cycle S1 / CONT. is specified on the motor nameplate, this means that the motor has been designed for:

- Two successive starts: first start from cold condition, i. e., the motor windings are at room temperature and the second start immediately after the motor stops;
- One start from hot condition, i. e., the motor windings are at rated temperature.

The Troubleshooting Chart in section 10 provides a basic list of unusual cases that may occur during motor operation with the respective corrective actions.

7.2. OPERATING CONDITIONS

Unless otherwise stated in the Purchase Order, electric motors are designed and built to be operated at altitudes up to 1000 meters above sea level and in a temperature range from -20 °C to +40 °C. Any deviation from the normal condition of motor operation must be stated on the motor nameplate. Some components must be changed if the ambient temperature is different from the specified one. Please contact WEG to check the required special features.

For operating temperatures and altitudes differing from those above, the factors indicated in Table 7.2 must be applied to the nominal motor power rating in order to determine the derated available output (Pmax = Pnom x correction factor).

Table 7.2 - *Correction factors for altitude and ambient temperature*

T (°C)	Altitude (m)								
	1000	1500	2000	2500	3000	3500	4000	4500	5000
10							0.97	0.92	0.88
15						0.98	0.94	0.90	0.86
20					1.00	0.95	0.91	0.87	0.83
25				1.00	0.95	0.93	0.89	0.85	0.81
30			1.00	0.96	0.92	0.90	0.86	0.82	0.78
35		1.00	0.95	0.93	0.90	0.88	0.84	0.80	0.75
40	1.00	0.97	0.94	0.90	0.86	0.82	0.80	0.76	0.71
45	0.95	0.92	0.90	0.88	0.85	0.81	0.78	0.74	0.69
50	0.92	0.90	0.87	0.85	0.82	0.80	0.77	0.72	0.67
55	0.88	0.85	0.83	0.81	0.78	0.76	0.73	0.70	0.65
60	0.83	0.82	0.80	0.77	0.75	0.73	0.70	0.67	0.62
65	0.79	0.76	0.74	0.72	0.70	0.68	0.66	0.62	0.58
70	0.74	0.71	0.69	0.67	0.66	0.64	0.62	0.58	0.53
75	0.70	0.68	0.66	0.64	0.62	0.60	0.58	0.53	0.49
80	0.65	0.64	0.62	0.60	0.58	0.56	0.55	0.48	0.44

Motors installed inside enclosures (cubicles) must be ensured an air renewal rate in the order of one cubic meter per second for each 100 kW installed power or fraction of installed power. Totally Enclosed Air Over motors - TEAO (fan and exhaust / smoke extraction) are supplied without cooling fan and the manufacturer of the driven machine is responsible for sufficient motor cooling. If no minimum required air speed between motor fins is indicated on the motor nameplate, ensure the air speed indicated in the table 7.3 is provided. The values shown in Table 7.3 are valid for 60 Hz motors. To obtain the minimum air speed for 50 Hz motors, multiply the values in the table by 0.83.

Table 7.3 *- Minimum required air speed between motor fins (metres/second)*

Frame		Poles			
IEC	NEMA	2	4	6	8
63 to 90	143/5	13	7	5	4
100 to 132	182/4 to 213/5	18	12	8	6
160 to 200	254/6 to 324/6	20	15	10	7
225 to 280	364/5 to 444/5	22	20	15	12
315 to 450	445/7 to 7008/9	25	25	20	15

The voltage and frequency variations may affect the performance characteristics and the electromagnetic compatibility of the motor. The power supply variations should not exceed the values specified in the applicable standards. Examples:

- ABNT NBR 17094 - Parts 1 and 2. The motor has been designed to supply the rated torque for a combined variation in voltage and frequency:
  - Zone A: ±5% of the rated voltage and ±2% of the rated frequency;
  - Zone B: ±10% of the rated voltage and +3% -5% of the rated frequency.

When operated continuously in Zone A or B, the motor may show performance variations and the operating temperature may increase considerably. These performance variations will be higher in Zone B. Thus it is not recommended to operate the motor in Zone B during extended periods.

- IEC 60034-1. The motor has been designed to supply the rated torque for combined variation in voltage and frequency:
  - Zone A: ±5% of the rated voltage and ±2% of the rated frequency;
  - Zone B: ±10% of the rated voltage and +3% -5% of the rated frequency.

When operated continuously in Zone A or B, the motor may show performance variations and the operating temperature may increase considerably. These performance variations will be higher in Zone B. Thus it is not recommended to operate the motor in Zone B during extended periods. For multivoltage motors (example 380-415/660 V), a ±5% voltage variation from the rated voltage is allowed.

- NEMA MG 1 Part 12. The motor has been designed to be operated in one of the following variations:
  - ±10% of the rated voltage, with rated frequency;
  - ±5% of the rated frequency, with rated voltage;
  - A combined variation in voltage and frequency of ±10%, provided the frequency variation does not exceed ±5%.

If the motor is cooled by ambient air, clean the air inlet and outlet openings and cooling fins at regular intervals to ensure a free airflow over the frame surface. The hot air should never be returned to the motor. The cooling air must be at room temperature limited to the temperature range indicated on the motor nameplate (if no room temperature is specified, please consider a temperature range between -20 °C and +40 °C).

Table 7.4 shows the minimum required water flow for water cooled motors considering the different frame sizes and the maximum allowed temperature rise of the cooling water after circulating through the motor. The inlet water temperature should not exceed 40 °C.

Table 7.4 *- Minimum required water flow and the maximum allowed temperature rise of the cooling water after circulating through the motor*

Frame size		Flow rate (litres/minute)	Maximum allowed water temperature rise (°C)
IEC	NEMA		
180	284/6	12	5
200	324/6	12	5
225	364/5	12	5
250	404/5	12	5
280	444/5 445/7 447/9	15	6
315	504/5	16	6
355	586/7 588/9	25	6

Motors fitted with oil mist lubrication systems can be operated continuously for a maximum of one hour after the failure of the oil pumping system.

Considering the sun's heat increases the operating temperature, externally mounted motors should always be protected from direct sunlight exposure.

Each and every deviation from the normal operating condition (tripping of the thermal protection, noise and vibration level increase, temperature and current rise) should be investigated and corrected by WEG Authorized Service Centers.

Motors fitted with cylindrical roller bearings require a minimum radial load to ensure a normal operation. For information regarding the radial preload, please contact WEG.

7.2.1.Limits of vibration

The vibration severity is the maximum vibration value measured at all positions and in all directions as recommended in the standard IEC 60034-14. Table 7.5 specifies the limits of the maximum vibrations magnitudes according to standard IEC 60034-14 for shaft heights IEC 56 to 400, for vibrations grades A and B. The vibration severity limits in Table 7.5 are given as RMS values (Root Mean Square values or effective values) of the vibration speed in mm/s measured in free suspension condition.

Table 7.5 *- Recommended limits for the vibration severity according to standard IEC 60034-14*

Shaft height [mm]	56 ≤ H ≤ 132	132 ≤ H ≤ 280	H > 280
Vibration grade	Vibration severity on elastic base [mm/s RMS]		
A	1.6	2.2	2.8
B	0.7	1.1	1.8

Notes:

1 - The values in Table 7.5 are valid for measurements carried out with decoupled machines (without load) operated at rated voltage and frequency.

2 - The values in Table 7.5 are valid regardless of the direction of rotation of the machine.

3 - The values in Table 7.5 are not applicable to single-phase motors, three-phase motors powered by a single-phase system or to machines mounted in situ or coupled with inertia flywheels or to loads.

According to NEMA MG 1, the allowed vibration limit for standard motors is 0.15 in/s (peak vibration in in/s).

Note:

For the load operation condition, the use of the standard ISO 10816-3 is recommended for evaluating the motor vibration limits. In the load condition the motor vibration will be influenced by several factors, such as, type of the coupled load, condition of the motor fixation, alignment condition under load, structure or base vibration due to other equipments, etc..

8. MAINTENANCE

The purpose of the maintenance is to extend the useful life of the equipment. The non-compliance with one of these previous items can cause unexpected machine failures.

If motors with cylindrical roller or angular contact bearings are to be transported during the maintenance procedures, the shaft locking device must always be fitted. All HGF motors, regardless of the bearing type, must always be transported with the shaft locking device fitted.

All repairs, disassembly and assembly related services must be carried out only by qualified and well-trained personnel by using proper tools and techniques. Make sure that the machine has stopped and it is disconnected from the power supply, including the accessory devices (space heater, brake, etc.), before any servicing is undertaken.
The company does not assume any responsibility or liability for repair services or maintenance operations executed by non-authorized Service Centers or by non qualified service personnel. The company shall have no obligation or liability whatsoever to the buyer for any indirect, special, consequential or incidental loss or damage caused or arising from the company's proven negligence

8.1. GENERAL INSPECTION

The inspection intervals depend on the motor type, application and installation conditions. Proceed as follows during inspection:

- Visually inspect the motor and coupling. Check if abnormal noises, vibrations, excessive heating, wear signs, misalignment or damaged parts are noticed. Replace the damaged parts as required;
- Measure the insulation resistance according to the item 5.4;
- Clean the motor enclosure. Remove oil spills and dust accumulation from the motor frame surface to ensure a better heat transfer to the surrounding ambient;
- Check cooling fan condition and clean the air inlet & outlet openings to ensure a free air flow over the motor;
- Investigate the actual condition of the seals and replace them, if required;
- Drain the condensed water from inside the motor. After draining, reinstall the drain plugs to ensure the degree of protection as indicated on the motor nameplate. The motor must always be positioned so the drain hole is at the lowest position (see item 6);
- Check the connections of the power supply cables, ensuring the correct clearance distance between live and grounded parts, as specified in Table 6.3;
- Check if the tightening torque of the bolted connections and mounting bolts meets the tightening torque specified in Table 8.11;
- Check the status of the cable passages, the cable gland seals and the seals inside the terminal box and replace them, if required;
- Check the bearing operating conditions. Check for the presence of any abnormal noise, vibration or other abnormal operating conditions, like motor temperature rise. Check the oil level, the lube oil condition and compare the workings hours with the informed life time;
- Record and file all changes performed on the motor.



Do not reuse damaged or worn parts. Damaged or worn parts must be replaced by parts supplied by the manufacturer and must be installed as if they were the original parts.

8.2. LUBRICATION

Proper lubrication plays a vital role in the motor performance. Only use the grease or oil types, amounts and lubrication intervals recommended for the bearings. This information is available on the motor nameplate and the lubrication procedures must be carried out according to the type of lubricant (oil or grease).
When the motor is fitted with thermal protection devices for bearing temperature control, consider the operating temperature limits shown in Table 6.4.
The maximum operating temperature of motors used in special applications may differ from those shown in Table 6.4. The grease and oil disposal should be made in compliance with applicable laws in each country.



Please contact WEG when motors are to be installed in special environments or used for special applications.

8.2.1. Grease lubricated rolling bearings

Excess grease causes bearing overheating, resulting in bearing failure.

The lubrication intervals specified in Table 8.1, Table 8.2, Table 8.3, Table 8.4, Table 8.5, Table 8.6, Table 8.7 and Table 8.8 consider an absolute temperature on the bearing of 70 °C (up to frame size IEC 200 / NEMA 324/6) and 85 °C (for frame size IEC 225 / NEMA 364/5 and above), the motor running at rated speed, a motor mounted in horizontal position and greased with Mobil Polyrex EM grease. Any variation of the parameters listed above must be evaluated.

Table 8.1 *- Lubrication intervals for ball bearings*

Frame		Poles	Bearing designation	Amount of grease (g)	Lubrication intervals (hours)					
					ODP (Open Drip Proof)		W21 TEFC (Totally Enclosed Fan Cooled)		W22 TEFC (Totally Enclosed Fan Cooled)	
IEC	NEMA				50 Hz	60 Hz	50 Hz	60 Hz	50 Hz	60 Hz
90	143/5	2	6205	4	-	-	20000	20000	25000	25000
		4								
		6								
		8								
100	-	2	6206	5	-	-	20000	20000	25000	25000
		4								
		6								
		8								
112	182/4	2	6207/ 6307	9	-	-	20000	20000	25000	25000
		4								
		6								
		8								
132	213/5	2	6308	11	-	-	20000	18400	25000	23200
		4					20000	20000	25000	25000
		6								
		8								
160	254/6	2	6309	13	20000	20000	18100	15700	22000	20000
		4					20000	20000	25000	25000
		6								
		8								
180	284/6	2	6311	18	20000	20000	13700	11500	17000	14000
		4					20000	20000	25000	25000
		6								
		8								
200	324/6	2	6312	21	20000	20000	11900	9800	15000	12000
		4					20000	20000	25000	25000
		6								
		8								
225 250 280 315 355	364/5 404/5 444/5 445/7 447/9 L447/9 504/5 5008 5010/11 586/7 588/9	2	6314	27	18000	14400	4500	3600	5000	4000
		4			20000	20000	11600	9700	14000	12000
		6					16400	14200	20000	17000
		8					19700	17300	24000	20000
		2	6316	34	14000	*Upon request	3500	*Upon request	4000	*Upon request
		4			20000	20000	10400	8500	13000	10000
		6					14900	12800	18000	16000
		8					18700	15900	20000	20000
		2	6319	45	*Upon request					
		4			20000	20000	9000	7000	11000	8000
		6					13000	11000	16000	13000
		8					17400	14000	20000	17000
		4	6322	60	20000	20000	7200	5100	9000	6000
		6					10800	9200	13000	11000
		8					15100	11800	19000	14000

Table 8.2 - *Lubrication intervals for cylindrical roller bearings*

Frame		Poles	Bearing designation	Amount of grease (g)	LUBRICATION INTERVALS (hours)					
					ODP (Open Drip Proof)		W21 TEFC (Totally Enclosed Fan Cooled)		W22 TEFC (Totally Enclosed Fan Cooled)	
IEC	NEMA				50 Hz	60 Hz	50 Hz	60 Hz	50 Hz	60 Hz
160	254/6	2	NU309	13	20000	19600	13300	9800	16000	12000
		4				20000	20000	20000	25000	25000
		6								
		8								
180	284/6	2	NU311	18	18400	12800	9200	6400	11000	8000
		4			20000	20000	20000	19100	25000	25000
		6						20000		
		8								
200	324/6	2	NU312	21	15200	10200	7600	5100	9000	6000
		4			20000	20000	20000	17200	25000	21000
		6						20000		25000
		8								
225 250 280 315 355	364/5 404/5 444/5 445/7 447/9 L447/9 504/5 5008 5010/11 586/7 588/9	4	NU314	27	17800	14200	8900	7100	11000	9000
		6			20000	20000	13100	11000	16000	13000
		8					16900	15100	20000	19000
		4	NU316	34	15200	12000	7600	6000	9000	7000
		6			20000	19000	11600	9500	14000	12000
		8				20000	15500	13800	19000	17000
		4	NU319	45	12000	9400	6000	4700	7000	5000
		6			19600	15200	9800	7600	12000	9000
		8			20000	20000	13700	12200	17000	15000
		4	NU322	60	8800	6600	4400	3300	5000	4000
		6			15600	11800	7800	5900	9000	7000
		8			20000	20000	11500	10700	14000	13000

Table 8.3 - *Lubrication intervals for ball bearings - HGF line*

Frame		Poles	Bearing designation	Amount of grease (g)	Lubrication intervals (hours)	
IEC	NEMA				50 Hz	60 Hz
315L/A/B and 315C/D/E	5006/7/8T and 5009/10/11T	2	6314	27	3100	2100
		4 - 8	6320	50	4500	4500
			6316	34	4500	4500
355L/A/B and 355C/D/E	5807/8/9T and 5810/11/12T	2	6314	27	3100	2100
		4 - 8	6322	60	4500	4500
			6319	45	4500	4500
400L/A/B and 400 C/D/E	6806/7/8T and 6809/10/11T	2	6315	30	2700	1800
		4 - 8	6324	72	4500	4500
			6319	45	4500	4500
450	7006/10	2	6220	31	2500	1400
		4	6328	93	4500	3300
			6322	60	4500	4500
		6 - 8	6328	93	4500	4500
			6322	60	4500	4500
500	8006/10	4	6330	104	4200	2800
			6324	72	4500	4500
		6 - 8	6330	104	4500	4500
			6324	72	4500	4500
500	8006/10	4	6330	104	4200	2800
			6324	72	4500	4500
		6 - 8	6330	104	4500	4500
			6324	72	4500	4500
560	8806/10	4 - 8	*Upon request			
630	9606/10	4 - 8				

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Table 8.4 - *Lubrication intervals for cylindrical roller bearings - HGF line*

Frame		Poles	Bearing designation	Amount of grease (g)	Lubrication intervals (hours)	
IEC	NEMA				50 Hz	60 Hz
315L/A/B and 315C/D/E	5006/7/8 and 5009/10/11	4	NU320	50	4300	2900
		6 - 8			4500	4500
355L/A/B and 355C/D/E	5807/8/9 and 5810/11/12	4	NU322	60	3500	2200
		6 - 8			4500	4500
400L/A/B and 400C/D/E	6806/7/8 and 6809/10/11	4	NU324	72	2900	1800
		6 - 8			4500	4500
450	7006/10	4	NU328	93	2000	1400
		6			4500	3200
		8			4500	4500
500	8006/10	4	NU330	104	1700	1000
		6			4100	2900
		8			4500	4500
560	8806/10	4	NU228 + 6228	75	2600	1600
		6 - 8		106	4500	4500
630	9606/10	4	NU232 + 6232	92	1800	1000
		6		120	4300	3100
		8		140	4500	4500

Tabela 8.5 - *Lubrication intervals for ball bearings - W50 line*

	Frame		Poles	D.E. Bearing	Amount of grease (g)	50 Hz (h)	60 Hz (h)	N.D.E. Bearing	Amount of grease (g)	50 Hz (h)	60 Hz (h)
	IEC	NEMA									
Horizontal mounting Ball bearings	315 H/G	5009/10	2	6314	27	4500	3500	6314	27	4500	3500
			4 - 8	6320	50		4500	6316	34		4500
	355 J/H	5809/10	2	6314	27		3500	6314	27		3500
			4 - 8	6322	60		4500	6319	45		4500
	400 L/K and 400 J/H	6806/07 and 6808/09	2	6218	24	3800	2500	6218	24	3800	1800
			4 - 8	6324	72	4500	4500	6319	45	4500	4500
	450 L/K and 450 J/H	7006/07 and 7008/09	2	6220	31	3000	2000	6220	31	3000	2000
			4	6328	93	4500	3300	6322	60	4500	4500
			6 - 8				4500				
Vertical mounting Ball bearings	315 H/G	5009/10	2	7314	27	2500	1700	6314	27	2500	1700
			4	6320	50	4200	3200	6316	34	4500	4500
			6 - 8			4500	4500				
	355 J/H	5809/10	2	7314	27	2500	1700	6314	27	2500	1700
			4	6322	60	3600	2700	6319	45	4500	3600
			6 - 8			4500	4500				4500
	400 L/K and 400 J/H	6806/07 and 6808/09	2	7218	24	2000	1300	6218	24	2000	1300
			4	7324	72	3200	2300	6319	45	4500	3600
			6			4500	4300				4500
			8				4500				
	450 L/K and 450 J/H	7006/07 and 7008/09	2	7220	31	1500	1000	6220	31	1500	1000
			4	7328	93	2400	1700	6322	60	3500	2700
			6			4100	3500			4500	4500
			8			4500	4500				

Tabela 8.6 - *Lubrication intervals for cylindrical roller bearings - W50 line*

	Frame		Poles	D.E. Bearing	Amount of grease (g)	50 Hz (h)	60 Hz (h)	N.D.E. Bearing	Amount of grease (g)	50 Hz (h)	60 Hz (h)
	IEC	NEMA									
Horizontal mounting Roller bearings	315 H/G	5009/10	4	NU320	50	4300	2900	6316	34	4500	4500
			6 -8			4500	4500				
	355 J/H	5809/10	4	NU322	60	3500	2200	6319	45		
			6 - 8			4500	4500				
	400 L/K and 400 J/H	6806/07 and 6808/09	4	NU324	72	2900	1800				
			6 - 8			4500	4500				
	450 L/K and 450 J/H	7006/07 and 7008/09	4	NU328	93	2000	1400	6322	60		
			6			4500	3200				
			8				4500				

Tabela 8.7 - Lubrication intervals for ball bearings - W40 line

	Frame		Poles	D.E. Bearing	Amount of grease (g)	50 Hz (h)	60 Hz (h)	N.D.E. Bearing	Amount of grease (g)	50 Hz (h)	60 Hz (h)
	IEC	NEMA									
Horizontal mounting Ball bearings	315G/F	5010/11	2	6314	27	4500	4500	6314	27	4500	4500
			4 - 8	6319	45	4500	4500	6314	27	4500	4500
	355 J/H	L5010/11	2	6218	24	4500	4500	6218	24	4500	4500
			4 – 8	6224	43	4500	4500	6218	24	4500	4500
	400 J/H	L5810/11	2	6220	31	4500	3800	6220	31	4500	3800
			4 – 8	6228	52	4500	4500	6220	31	4500	4500
	450 K/J	L6808/09	2	6220	31	4500	3800	6220	31	4500	3800
			4 – 8	6228	52	4500	4500	6220	31	4500	4500

Tabela 8.8 - Lubrication intervals for cylindrical roller bearings - W40 line

	Frame		Poles	D.E. Bearing	Amount of grease (g)	50 Hz (h)	60 Hz (h)	N.D.E. Bearing	Amount of grease (g)	50 Hz (h)	60 Hz (h)
	IEC	NEMA									
Horizontal mounting Roller bearings	315G/F	5010/11	4 - 8	NU319	45	4500	4500	6314	27	4500	4500
	355 J/H	L5010/11	4 – 8	NU224	43	4500	4500	6218	24	4500	4500
	400 J/H	L5810/11	4 – 8	NU228	52	4500	3300	6220	31	4500	4500
	450 K/J	L6808/09	4 – 8	NU228	52	4500	3300	6220	31	4500	4500

For each increment of 15 °C above the bearing temperature, the relubrication intervals given in the Table must be halved. The relubrication interval of motors designed by the manufacturer for mounting in horizontal position, but installed in vertical position (with WEG authorization), must be halved.
For special applications, such as: high and low temperatures, aggressive environments, driven by frequency inverter (VFD - frequency inverter), etc., please contact WEG about the required amount of grease and the relubrication intervals.

8.2.1.1. Motor without grease fitting

Motors without grease fittings must be lubricated in accordance with the existing Maintenance Plan. Motor disassembly must be carried out as specified in Item 8.3. If motors are fitted with shielded bearings (for example, ZZ, DDU, 2RS, VV), these bearings must be replaced at the end of the grease service life.

8.2.1.2. Motor with grease fitting

To lubricate the bearings with the motor stopped, proceed as follows:
- Before lubricating, clean the grease nipple and immediate vicinity thoroughly;
- Lift grease inlet protection;
- Remove the grease outlet plug;
- Pump in approximately half of the total grease indicated on the motor nameplate and run the motor for about 1 (one) minute at rated speed;
- Switch-off the motor and pump in the remaining grease;
- Lower again the grease inlet protection and reinstall the grease outlet protection.

To grease the motor while running, proceed as follows:
- Before lubricating, clean the grease nipple and immediate vicinity thoroughly;
- Pump the total grease indicated on the motor nameplate;
- Lower again the grease inlet protection.



For lubrication, use only manual grease gun.

If Motors are provided with a spring device for grease removal, the grease excess must be removed by pulling the rod and cleaning the spring until the spring does not remove more grease.

8.2.1.3. Compatibility of the Mobil Polyrex EM grease with other greases

The Mobil Polyrex EM grease has a polyurea thickener and a mineral oil and it is not compatible with other greases.
If you need another type of grease, contact WEG.
It is not recommended to mix different types of greases. In such a case, clean the bearings and lubrication channels before applying new grease.
The used grease must have in its formulation corrosion and oxidation inhibitors.

8.2.2. Oil lubricated bearings

To change the oil of oil lubricated motor proceed as follows:
- Switch-off the motor;
- Remove threaded oil drain plug;
- Open the valve and drain the oil;
- Close the drain valve again;
- Reinstall the threaded oil drain plug;
- Fill-up with the type and amount of oil as specified on the nameplate;
- Check oil level. The oil level is OK when the lubricant can be viewed approximately in the center of the sight glass;
- Reinstall oil inlet plug;
- Check for oil leaks and ensure that all not used threaded plugs are closed with plugs.

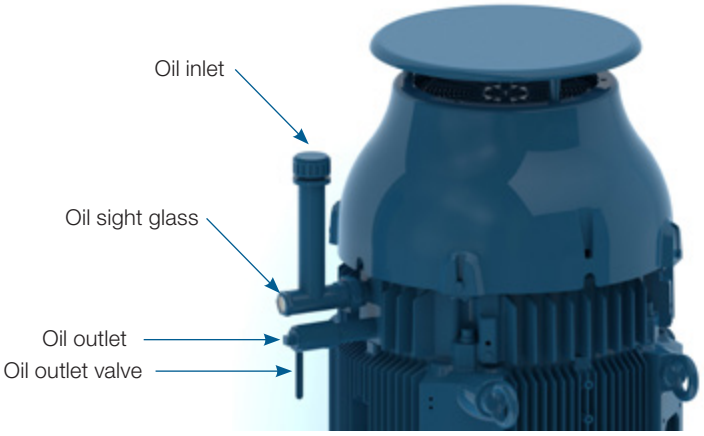


Figure 8.1 *- Oil lubricated bearing - vertical mounting*

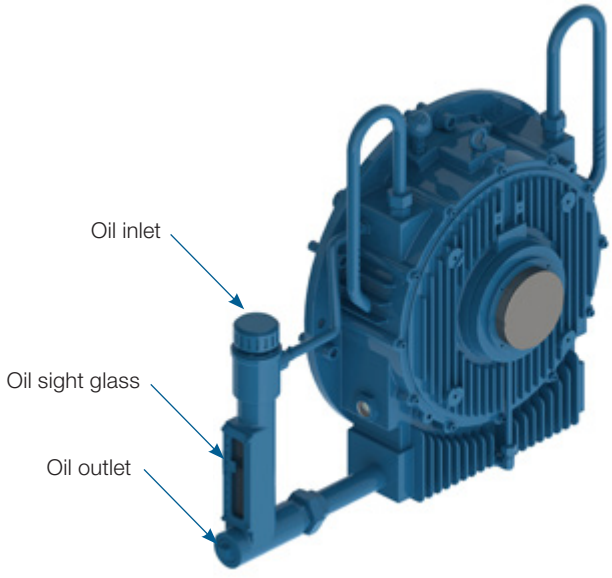


Figure 8.2 *- Oil lubricated bearing - horizontal mounting*

The bearing lubricating oil must be replaced as specified on the nameplate or whenever changes in the oil properties are noticed. The oil viscosity and pH must be checked periodically. The oil level must be checked every day and must be kept in the center of the sight glass.
Please contact WEG, when oils with different viscosities should be used.

***Note**:*
The HGF vertical mounted motors with high axial thrust are supplied with grease lubricated DE-bearings and with oil lubricated NDE-bearings. The DE-bearings must be lubricated according to recommendations in item 8.2.1. Table 8.9 specifies the oil type and the amount of oil required for this motor lubrication.

***Table 8.9** - Oil properties for HGF vertical mounted motors with high axial thrust*

Mounting - high axial thrust	Frame		Poles	Bearing designation	Oil (liters)	Interval (h)	Lubricant	Lubricant specification
	IEC	NEMA						
	315L/A/B e 315C/D/E	5006/7/8T e 5009/10/11T	4 - 8	29320	20	8000	FUCHS Renolin DTA 40 / Mobil SHC 629	ISO VG150 mineral oil with antifoam and antioxidant additives
	355L/A/B e 355C/D/E	5807/8/9T e 5810/11/12T	4 - 8	29320	26			
	400L/A/B e 400C/D/E	6806/7/8T e 6809/10/11T	4 - 8	29320	37			
	450	7006/10	4 - 8	29320	45			

8.2.3. Oil mist lubricated bearings

Check the service conditions of the seals and if replacement is required use only original components. Clean the seal components before assembly (bearing caps, end shields, etc.).
Apply joint sealant between the bearing caps and end shields. The joint sealant must be compatible with the used lubricating oil. Connect the oil lubricant tubes (oil inlet and oil outlet tubes and motor drain tube), as shown in Figure 6.12.

8.2.4. Sleeve bearings

The lubricating oil of sleeve bearings must be changed at the intervals specified in Table 8.10. To replace the oil, proceed as follows:

- NDE-bearing: remove the protection plate from the fan cover;
- Drain the oil through the drain hole located at the bottom of the bearing (see Figure 8.3);
- Close the oil drain hole;
- Remove the oil inlet plug;
- Fill the sleeve bearing with the specified oil and with the amount of oil specified in;
- Check the oil level and ensure it is kept close to the center of the sight glass;
- Install the oil inlet plug;
- Check for oil leaks.

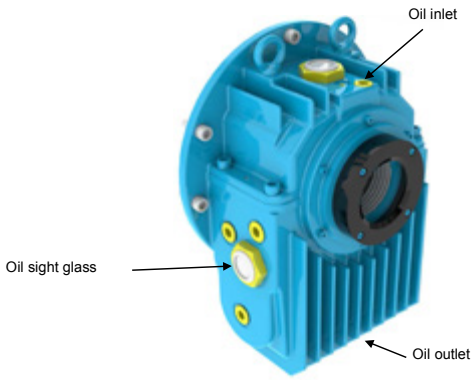


***Figure 8.3** - Sleeve bearing*

Table 8.10 - Oil properties for sleeve bearings

Frame		Poles	Bearing designation	Oil (liters)	Interval (h)	Lubricant	Lubricant specification
IEC	NEMA						
315	5000	2	9-80	2.8	8000	FUCHS Renolin DTA 10	ISO VG32 mineral oil with antifoam and antioxidant additives
355	5800						
400	6800						
450	7000						
315	5000	4 - 8	9-90	2.8	8000	FUCHS Renolin DTA 15	ISO VG46 mineral oil with antifoam and antioxidant additives
355	5800		9-100				
400	6800		11-110	4.7			
450	7000		11-125				
500	8000						

The lubricating oil must be replaced as specified on the nameplate or whenever changes on the oil properties are noticed. The oil viscosity and pH must be checked periodically. The oil level must be checked every day and kept in the center of the sight glass.
Please contact WEG, when oils with different viscosities are to be used.

8.3. MOTOR ASSEMBLY AND DISASSEMBLY

All repair services on motors should be always performed by qualified personnel and in accordance with the applicable laws and regulations in each country. Always use proper tools and devices for motor disassembly and assembly.

Disassembly and assembly services can be carried out only after the motor has been disconnected from the power supply and is completely stopped.

Dangerous voltages may be present at the motor terminals inside the terminal box since capacitors can retain electrical charge for long periods of time even when they are not connected directly to a power source or when space heaters are connected to the motor or when the motor windings are used as space heaters. Dangerous voltages may be present at the motor terminals when they are driven by frequency inverter even when they are completely stopped.

Record the installation conditions such as terminal connection diagram, alignment / leveling conditions before starting the disassembly procedures. These records should be considered for later assembly.

Disassemble the motor carefully without causing scratches on machined surfaces or damaging the threads.

Assemble the motor on a flat surface ensuring a good support base. Footless motors must be fixed/locked on the base to prevent accidents.

Handle the motor carefully to not damage the insulated components such as windings, insulated rolling bearings, power cables etc..

Seal elements, such as joint seals and bearing seals should always be replaced when wear or damage is noticed.
Motors with degree of protection higher than IP55 are supplied with joint and screw seal Loctite 5923 (Henkel) Clean the components and apply a new coat of Loctite 5923 on the surfaces before assembly.

For the W50 and HGF motor lines provided with axial fans, the motor and the axial fan have different markings for indicating the direction of rotation for prevent incorrect assembly.
The axial fan must be assembled so that the indicative arrow for direction of rotation is always visible, viewing the non-drive end side. The marking indicated on the axial fan blade, CW for clockwise direction of rotation or CCW for counterclockwise direction of rotation, indicates the direction of rotation of the motor viewing the drive end side.

8.3.1. Terminal box

Proceed as follows to remove the terminal box cover and to disconnect/connect the power supply cables and the cables of the accessory devices:

- Ensure that during the screw removal the terminal box cover does not damage the components installed inside the terminal box;
- If the terminal box cover is fitted with lifting eyebolt, lift the terminal box cover always by its lift eyebolt;
- If motors are supplied with terminal blocks, ensure the correct tightening torque on the motor terminals as specified in Table 8.11;
- Ensure that the cables do not contact sharp edges;
- Ensure that the original IP degree of protection is not changed and is maintained as indicate on the motor nameplate. The power supply cables and the control cables must always be fitted with components (cable glands, conduits) that meet the applicable standards and regulations of each country;
- Ensure that the pressure relief device is in perfect operating condition, if provided. The seals in the terminal box must be in perfect condition for reuse and must be reinstalled correctly to ensure the specified degree of protection;
- Ensure the correct tightening torque for the securing bolts of the terminal box cover as specified in Table 8.11.

Table 8.11 *- Tightening torque for the securing bolts [Nm]*

Screw type and seal	M4	M5	M6	M8	M10	M12	M14	M16	M20
Hex bolt/hex socket bolt (rigid joint)	-	3,5 to 5	6 to 9	14 to 20	28 to 40	45 to 70	75 to 110	115 to 170	230 to 330
Combined slotted screw (rigid joint)	1,5 to 3	3 to 5	5 to 10	10 to 18	-	-	-	-	-
Hex bolt/hex socket bolt (flexible joint)	-	3 to 5	4 to 8	8 to 15	18 to 30	25 to 40	30 to 45	35 to 50	-
Combined slotted screw (flexible joint)	-	3 to 5	4 to 8	8 to 15	-	-	-	-	-
Terminal blocks	1 to 1,5	2 to 4 1)	4 to 6,5	6,5 to 9	10 to 18	15,5 to 30	-	30 to 50	-
Grounding terminals	1,5 to 3	3 to 5	5 to 10	10 to 18	28 to 40	45 to 70	-	115 to 170	

Note: 1) For 12-pin terminal block, apply the minimum torque of 1.5 Nm and maximum torque of 2.5 Nm.

8.4. DRYING THE STATOR WINDING INSULATION

Dismantle the motor completely. Remove the end shields, the rotor with the shaft, the fan cover, the fan and the terminal box before the wound stator with the frame is transferred to the oven for the drying process. Place the wound stator in the oven heated to max. 120 °C for two hours. For larger motors a longer drying time may be required. After the drying process has been concluded, allow the stator to cool to room temperature. Measure the insulation resistance again as described in item 5.4. Repeat the stator drying process if the required insulation resistance does not meet the values specified in Table 5.3. If the insulation resistance does not improve despite several drying processes, evaluate the causes of the insulation resistance drop carefully and an eventual replacement of the motor winding may be required. If in doubt contact WEG.



To prevent electrical shock, discharge the motor terminals immediately before, and after each measurement. If the motor is equipped with capacitors, these must be discharged before beginning any repair.

8.5. SPARE PARTS

When ordering spare parts, always provide complete motor designation, indicating the motor type, the code number and the serial number, which are stated on the motor nameplate.

Spare parts must always be purchased from WEG authorized Service Centers. The use of non-original spare parts can cause motor failure, performance drop and void the product warranty.

The spare parts must be stored in a clean, dry and properly ventilated room, with relative air humidity not exceeding 60%, with ambient temperature between 5 °C and 40 °C, free of dust, vibrations, gases, corrosive smokes and at constant temperature. The spare parts must be stored in their normal mounting position without placing other components onto them.

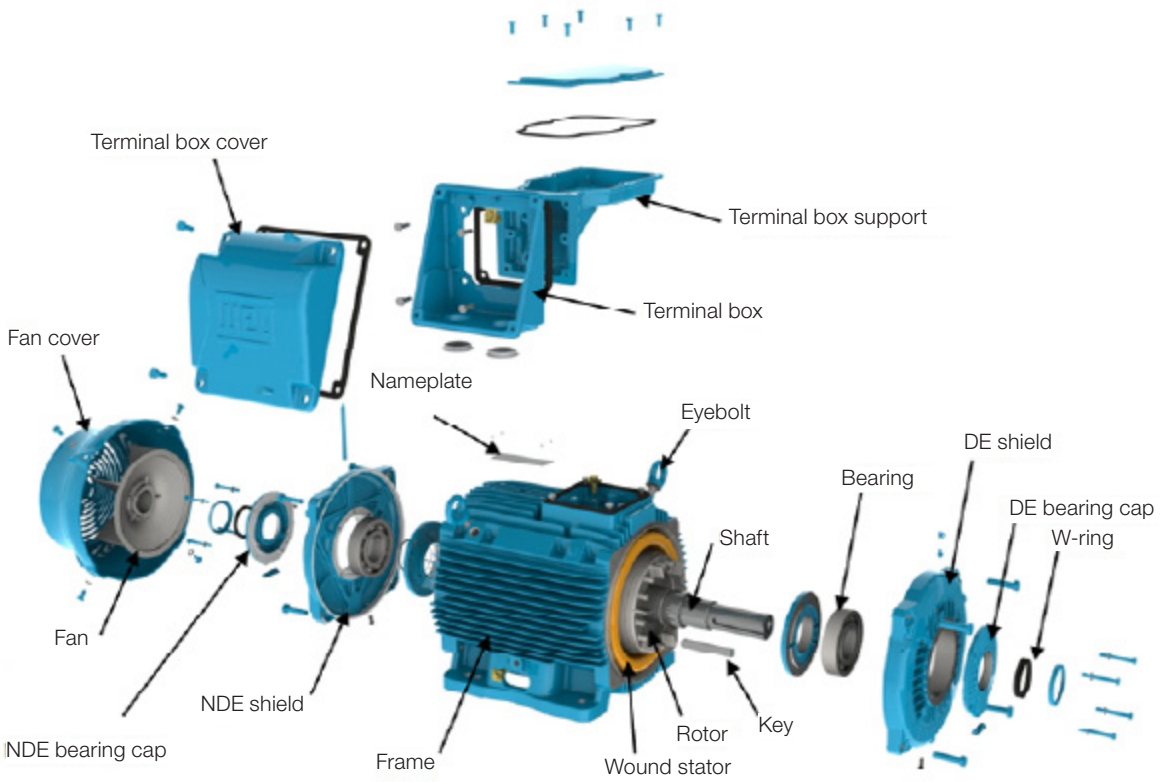


Figure 8.4 *- Exploded view of the components of a W22 motor*

9. ENVIRONMENTAL INFORMATION

9.1. PACKAGING

WEG electric motors are supplied in cardboard, plastic or wooden packaging. These materials can be recycled and must be disposed according to the applicable laws and regulations in each country. All wood used in the packaging of WEG motors come from the company reforestation program and is not submitted to any chemical conservation treatment.

9.2. PRODUCT

Electric motors consist mainly of ferrous metals (steel plates and cast iron), non ferrous metals (copper and aluminum) and plastic materials.

In general, electric motors have relatively long service live. However when they must be discarded, WEG recommends to dismantle the motor, sort the different materials and send them for recycling.

No-recyclable materials should be disposed of at industrial landfills according to the applicable environmental laws and regulations in each country, or co-processed in cement kilns or incinerated.

The recycling service providers, the disposal in industrial landfills, the waste co-processing or the incineration process must be properly authorized by the state environment agency to carry out these activities.

10. TROUBLESHOOTING CHART X SOLUTIONS

This troubleshooting chart provides a basic list of problems that may occur during motor operation, possible causes and recommended corrective actions. In case of doubts, please contact WEG Service Center.

Problem	Possible cause	Corrective action
Motor does not start, neither coupled nor decoupled	Power cables are interrupted	Check the control panel and the motor power supply cables
	Blown fuses	Replace blown fuses
	Wrong motor connection	Correct the motor connection according to connection diagram
	Locked rotor	Check motor shaft to ensure that it rotates freely
The motor starts at no-load, but fails when load is applied. It starts very slowly and does not reach the rated speed	Load toque is too high during start-up	Do not start the motor on load
	Too high voltage drop in the power cables	Check the installation dimensioning (transformer, cable cross section, relays, circuit breakers, etc.)
Abnormal/excessive noise	Defective transmission component or defective driven machine	Check the transmission force, the coupling and the alignment
	Misaligned / unleveled base	Align / level the motor with the driven machine
	Unbalanced components or unbalanced driven machine	Balance the machine set again
	Different balancing methods used for motor and coupling balancing (halve key, full key)	Balance the motor again
	Wrong motor direction of rotation	Reverse the direction of rotation
	Loose bolts	Retighten the bolts
	Foundation resonance	Check the foundation design
	Damaged bearings	Replace the bearings
Motor overheating	Insufficient cooling	Clean air inlet and outlet and cooling fins
		Check the minimum required distance between the fan cover and nearest walls. See item 7
		Check air temperature at inlet
	Overload	Measure motor current, evaluate motor application and if required, reduce the load
	Number of starts per hour is too high or the load inertia moment is too high	Reduce the number of starts per hour
	Power supply voltage too high	Check the motor power supply voltage. Power supply voltage must not exceed the tolerance specified in item 7.2
	Power supply voltage too low	Check the motor power supply voltage and the voltage drop. Power supply voltage must not exceed the tolerance specified in item 7.2
	Interrupted power supply	Check the connection of the power cables
	Voltage unbalance at the motor terminals	Check for blown fuses, wrong commands, voltage unbalance in the power line, phase fault or interrupted power cables
	Direction of rotation is not compatible with the unidirectional fan	Check if the direction of rotation matches the rotation arrow indicated on end shield
Bearing overheating	Excessive grease/oil	Clean the bearing and lubricate it according to the provided recommendations
	Grease/oil aging	
	The used grease/oil does not matches the specified one	
	Lack of grease/oil	Lubricate the bearing according to the provided recommendations
	Excessive axial or radial forces due to the belt tension	Reduce the belt tension
		Reduce the load applied to the motor

Section 3.4.1.3

Polymer Addition



EXCELL SERIES 6000PSA
LIQUID POLYMER FEEDER

The EXCELL Series 6000PSA Polymer Feeder uses a peristaltic type polymer metering pump. The peristaltic pump is ideal for low polymer feed applications. The main benefits of the peristaltic type pumps are:

* They are self priming.
* They can run dry.
* They do not have check valves.
* Capacity can be changed by switching the pump tube.
* Pump capacities range from less than 0.1 GPD, up to 43 GPD.

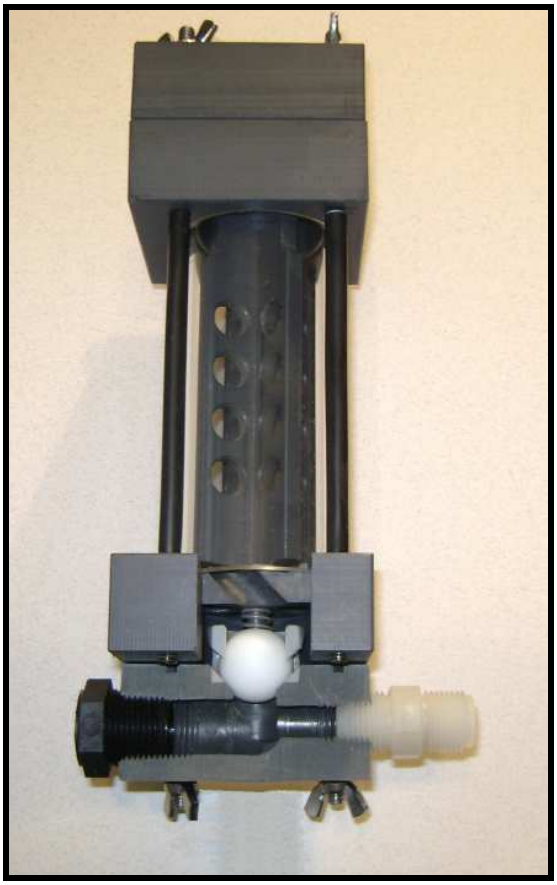
Polymer Activation Apparatus

The EXCELL activates polymer through a patented, motor-less, high energy, activation apparatus. The apparatus uses the energy available in the water flow to activate all types of liquid polymers.

The polymer is activated as it passes through the high turbulence generated by the patented orifice. The pressure required to operate the apparatus is less than 10 psi.

The orifice opening automatically compensates for solution flow changes. This assures that the polymer activation energy level remains adequate for the flow range of the feeder.

The activation apparatus components are made of corrosion resistant thermoplastics. The system is assembled with stainless steel rods and o-rings. It can be easily disassembled for quick repairs.



Self Cleaning Sight Tube

The activated polymer solution flows through a patented, self cleaning sight tube, before it exits the feeder. The sight tube allows the operator to see that the feeder is operating properly.

SERIES 6000PSA MODELS

MODEL NUMBER	POLYMER FEED RATE GPD (LPH)	WATER FLOW RATE GPH (LPH)
6005PSA-X	0.1 to 5 GPD (0.02 to 0.8 LPH)	10 to 60 GPH (40 to 230 LPH)
6005PSA2-X	0.1 to 5 GPD (0.02 to 0.8 LPH)	10 to 120 GPH (40 to 460 LPH)
6012PSA-X	0.5 to 12 GPD (0.1 to 1.9 LPH)	10 to 60 GPH (40 to 230 LPH)
6012PSA2-X	0.5 to 12 GPD (0.1 to 1.9 LPH)	10 to 120 GPH (40 to 460 LPH)
6020PSA-X	1 to 20 GPD (0.2 to 3.2 LPH)	15 to 150 GPH (55 to 570 LPH)
6020PSA2-X	1 to 20 GPD (0.2 to 3.2 LPH)	15 to 300 GPH (55 to 1140 LPH)
6025PSA2-X	1 to 25 GPD (0.2 to 3.9 LPH)	15 to 300 GPH (55 to 1140 LPH)
6043PSA2-X	2 to 43 GPD (0.4 to 6.8 LPH)	15 to 300 GPH (55 to 1140 LPH)

TECHNICAL INFORMATION

* The Model 60XXPSA has a one gallon (4 liter) blending-aging tank and primary water flow.
* The Model 60XXPSA2 has the blending-aging tank, primary, and post dilution water flow.
* The feeders operate with potable or filtered process dilution water at 30 to 65 psi (2 to 4.4 Bar).
* A water low-flow switch stops the polymer pump when the water flow drops below minimum.
* The frame is made of welded stainless steel. Frame dimensions are: 16” x 18” x 24” tall.
* The external injection valve is accessible without disturbing the activation apparatus. All components are modular and easy to access.
* Operating voltage is 120 VAC. Power consumption is less than 5 Amps.

AVAILABLE OPTIONS

* Solenoid water valve.
* Programmable pump, with digital display. It can accept a 4-20 mA signal.
* H-O-A Switch to allow remote start-stop control.
* Timer to allow a flush cycle.
* Pump speed controlled by the dilution water flow. This maintains solution concentration.
* Contacts for remote indication of Alarm, Pump Run, or Auto Mode.
* Low polymer flow alarm. The switch uses a thermal dispersion type sensor, with no moving parts. The trip point is adjustable down to 5 GPD (0.8 L/H).
* In-line aging tank. Tanks have a polyethylene liner and are fiberglass reinforced. They are rated for 125 psi (8.5 Bar). No additional level controls or pumps are needed.
* Voltages other than 120 VAC are available.
* Custom designed to meet your needs.

EXCELL FEEDERS, INC; Somerset, NJ USA
800-250-9037; 732-828-8655; Fax:732-828-2611
www.excellfeeders.com

EXCELL POLYMER FEEDER

MODEL 60XXPSA2-SX

OPERATING INSTRUCTIONS

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5.0 START-UP . . . . . Page 3

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DRAWINGS

COMPONENTS DESCRIPTION

EXCELL FEEDERS, INC., P.O. Box 7475, Somerset, NJ 08875
732-828-8655 800-250-9037 Fax: 732-828-2611
www.excellfeeders.com

EXCELL POLYMER FEEDER
OPERATING INSTRUCTIONS

1.0 **INTRODUCTION:** This manual addresses the installation, operation, maintenance, and troubleshooting for EXCELL polymer feeder, Model 60XXPSA2-SX. Please review the manual carefully. Pay special attention to warnings and precautions. Always follow good safety procedures, including the use of proper eye, face, and clothing protection.

2.0 **UNPACKING:** Your carton will contain the items listed on the packing slip.
Notify the carrier immediately if there are any signs of damage to the feeder or its parts.
Notify EXCELL if any of the parts are missing.

3.0 **PRE-INSTALLATION INSTRUCTIONS:**

3.1 **PROTECTIVE CLOTHING:** Refer to the MSDS precautions from the supplier of the polymer to be mixed in the feeder. Always wear the recommended apparel.

3.2 **SOLUTION COMPATIBILITY:** The feeder can mix a variety of solutions. Check that the feeder is compatible with the solutions you are intending to mix.

3.3 **PLUMBING:** Always adhere to your local plumbing codes and requirements. Be sure that installation does not constitute a cross connection. Check local plumbing codes for guidelines. If using potable water, a backflow preventer is required.

3.4 **ELECTRICAL:** All wiring must conform to local electrical codes. The feeder should be plugged into a grounded outlet protected by a Ground Fault Interrupter.

4.0 **INSTALLATION:**

4.1 **LOCATION:** This EXCELL FEEDER is suitable for indoor dry locations. The area is to be free of flammable vapors or dust. Ambient temperature is to be between 40 F and 120 F. (5 C and 50 C). Protect from freezing temperatures.

If the EXCELL FEEDER is to be used in areas exposed to flammable vapors or dusts, the Explosion Proof Option is required.

4.2 **ELECTRICAL CONNECTION**: The EXCELL FEEDER comes standard with a 7' long power cord with a 3-prong grounded plug. It should be plugged into a grounded outlet protected by a ground fault interrupter.

4.3 **WATER SUPPLY CONNECTION:** Provide a clean or filtered water supply to within 3' of the feeder. Water pressure should be at least 30 psi and must not exceed 100 psi or 100 F (38 C). Water pressure should be at least 25 psi higher than where the solution is being injected. Provide a shutoff valve.

4.4 CONTROLS:

1. **REMOTE START-STOP**: Connect wiring from the remote Start/Stop switch to the terminals in the junction box per the attached wiring diagram. The remote switch is to be a dry contact with no voltage. The feeder will provide the 120 VAC to power the circuit.

2. **REMOTE 4-20 mA PUMP SPEED CONTROL**: Connect wiring from a remote 4-20 mA signal source to the terminals in the junction box per the attached wiring diagram. A digital indicator provides local indication of pump speed, 0 to 100%.

3. **REMOTE ALARM:** A set of dry contacts allow remote indication when the water flow is below minimum. Connect wiring from the terminals in the junction box to the remote alarm per the attached wiring diagram. A light provides local alarm indication. The contacts are limited to 240 VAC, 5 Amps.

4.5 ACTIVATED SOLUTION CONNECTION:

1. Connect the feeder to the activated solution piping. Tighten all connections.
2. Use only pipe or tubing that is designed to withstand up to 100 psi pressure. Do not use clear unreinforced vinyl tubing.

4.6 POLYMER CONNECTION:

1. Install the pump tube on the metering pump. See pump manual for details.
   Note: If the feeder is not to be used for a long period of time, the tube should be removed to extend tube life.

2. The polymer can be supplied to the metering pump through a flooded suction or suction lift.

   a. Suction lift is to be less than 4'. Install the strainer supplied with the feeder at the end of the inlet tube. Insert the tube in the container.

   b. Flooded suction. For proper pump operation, to prevent over pumping and siphoning, the polymer level is to be less than 5' above the feeder. Connect the polymer supply to the inlet of the in-line strainer before the pump suction.

5.0 START-UP:

1. Turn on the water to the EXCELL FEEDER.

2. Turn the feeder selector switch to the "ON" position. This switch will open the water solenoid and turn on the metering pump. There must be adequate water flow to the feeder to trip the flow switch before the metering pump will turn on.

3. Adjust the low water flow switch setting. The switch has been preset for the primary water flowmeter minimum indication.

   Slowly close the valve on the primary dilution water flow meter until the flow is slightly higher than the lowest line on the flowmeter. Turn the adjusting screw on the low water flow-switch until it turns on the metering pump. Loosen the screw to reduce the trip point. Turn off the water flow. The flow-switch should turn the pump off.

   Adjust the primary and secondary flows to the desired rates.

4. Adjust the metering pump to the desired flow rate. See the pump manual.

5. The pump has been set as follows:

   a. Local. The pump speed is manually adjustable from 0 to 100% of capacity.

   b. Remote. The pump speed is adjustable from 0 to 100% of capacity by a 4-20 mA signal.

   The minimum pump speed is set at 0 % when the pump receives a 4mA signal.

   The maximum pump speed is set at 100 % when the pump receives a 20mA signal.

   The minimum and maximum pump speeds can be reset as desired.
   See the DC motor controller manual.

5.1 CALIBRATE THE METERING PUMP:

1. The metering pump can be calibrated only if the pump is supplied by flooded suction.
2. Fill the calibration cylinder with polymer.
3. Close the polymer supply valve and immediately open the calibration cylinder valve.
4. Measure the time needed to pump out a desired amount of polymer.

   The pump flow in Gallons Per Day equals:

   $\frac{22.8 \times (\#\text{ of ml})}{(\#\text{ of seconds})} = \#\text{ of GPD}$ EXAMPLE: $22.8 \frac{(20\text{ ml})}{90\text{ sec}} = 5.1\text{ GPD}$

6.0 CLEANING:

6.1 CLEANING THE SIGHT GLASS:

1. Turn the metering pump off.
2. Flow water through the feeder for about two minutes to flush it of polymer.
3. Turn the feeder main switch to "OFF."
4. Turn the water supply valve off. Don't use the flow meter valve to turn off water flow.
5. Drain the sight glass using the drain valve.
6. Remove the sight tube by removing the four nuts; save the nuts and O-Rings.
7. Rinse the sight tube cleaning assembly. Wipe the sight tube with a clean cloth.
8. Reinstall the top cap O-Ring and cap. Tighten the nuts. Check for leaks

6.2 CLEANING THE WATER FLOWMETER:

1. Turn the Feeder main switch to "OFF."
2. Close the water supply valve.
3. Open the drain valve to relieve system pressure. Close the valve.
4. Unscrew the plug on top of the flow meter.
5. Clean the flow tube with a soft brush and mild soap and water.
6. Apply petroleum jelly to the plug O-ring and reinstall. Don't over-tighten.

7.0 SHUT-DOWN FOR OVER 48 HOURS:

1. Fill the calibration column with oil that is compatible with the process. Pump the oil until all the polymer is displaced out of the system.
2. Turn the water supply valve off
3. Turn the feeder switch "OFF".
4. If needed, drain the feeder using the drain valve. Note that some feeder components will not fully drain and will be damaged if exposed to freezing temperatures.

8.0 MAINTENANCE: The EXCELL FEEDER was designed to require minimum maintenance, with all components easy to replace. The estimated life of the pump tube will range from two to six months, depending on operating parameters.

9.0 REPAIRS: Contact EXCELL at (732) 828-8655 for assistance or replacement parts.

9.1 METERING PUMP REPAIRS: See the attached manufacturer's manual.

9.2 RECOMMENDED SPARE PARTS:

1. Metering Pump Tube
2. Injection Valve
3. Blending Tank O-Ring Set
4. Relay
5. Solenoid Valve

10.0 TROUBLESHOOTING:

A. SYMPTOM: METERING PUMP WILL NOT RUN.

1. LIKELY CAUSE: Not enough water flow to satisfy the flow switch.
   SOLUTION: Increase water flow, until the flow switch closes, or adjust the flow switch setting.

2. LIKELY CAUSE: Not plugged in or no power at outlet.
   SOLUTION: Plug the feeder in; test the outlet for power.

3. LIKELY CAUSE: Pump is in “Remote” and not receiving a remote signal.
   SOLUTION: Set the switch to the proper setting.

B. SYMPTOM: METERING PUMP DOES NOT PUMP TO CAPACITY.

1. LIKELY CAUSE: Damaged tube.
   SOLUTION: Clean and replace parts as needed.

2. LIKELY CAUSE: Feeder injection valve is plugged.
   SOLUTION: Disconnect the polymer feed to the valve. Clean or replace the valve.

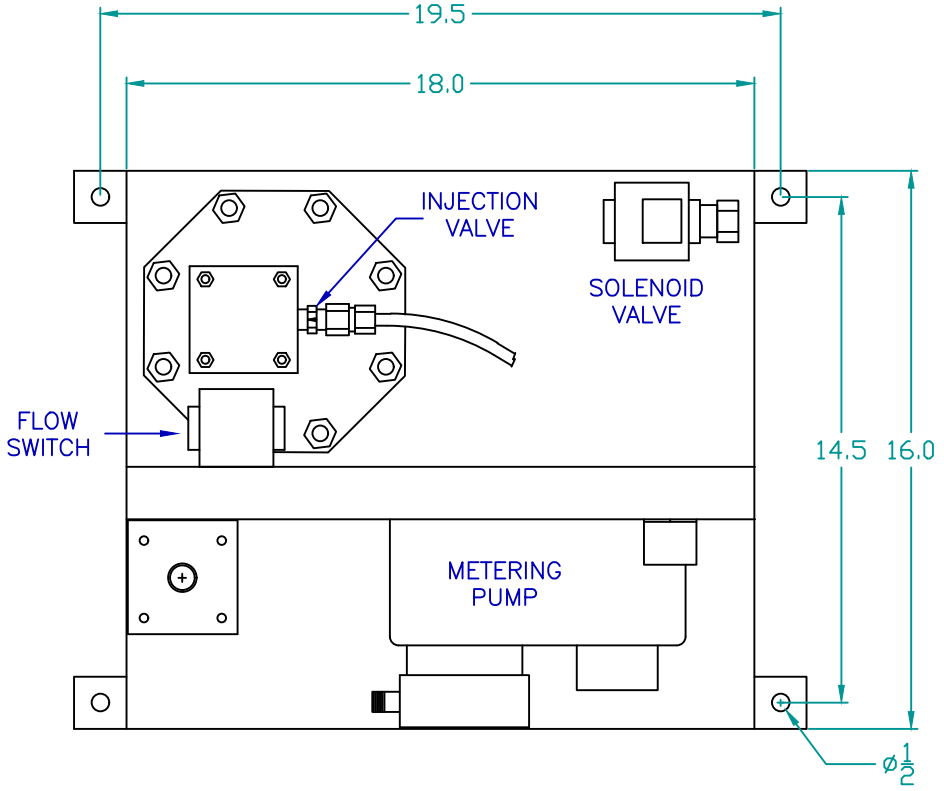
3. LIKELY CAUSE: Polymer viscosity is too high.

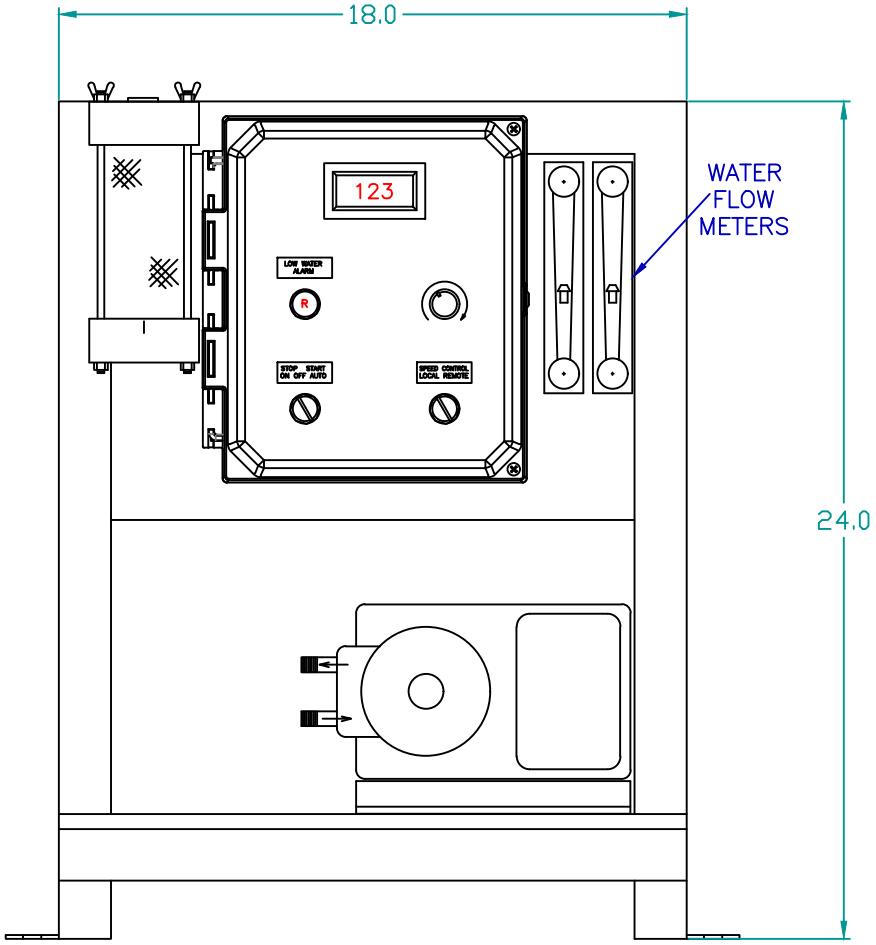
C. SYMPTOM: FEEDER INJECTION VALVE IS LEAKING.

1. LIKELY CAUSE: Debris in the valve.
   SOLUTION: Disconnect the polymer feed to the valve. Clean or replace the valve.

D. SYMPTOM: SIGHT TUBE WIPER IS NOT SPINNING.

1. LIKELY CAUSE: Not enough solution flow to operate the wiper.
   SOLUTION: Temporarily increase water flow until the wiper begins spinning.





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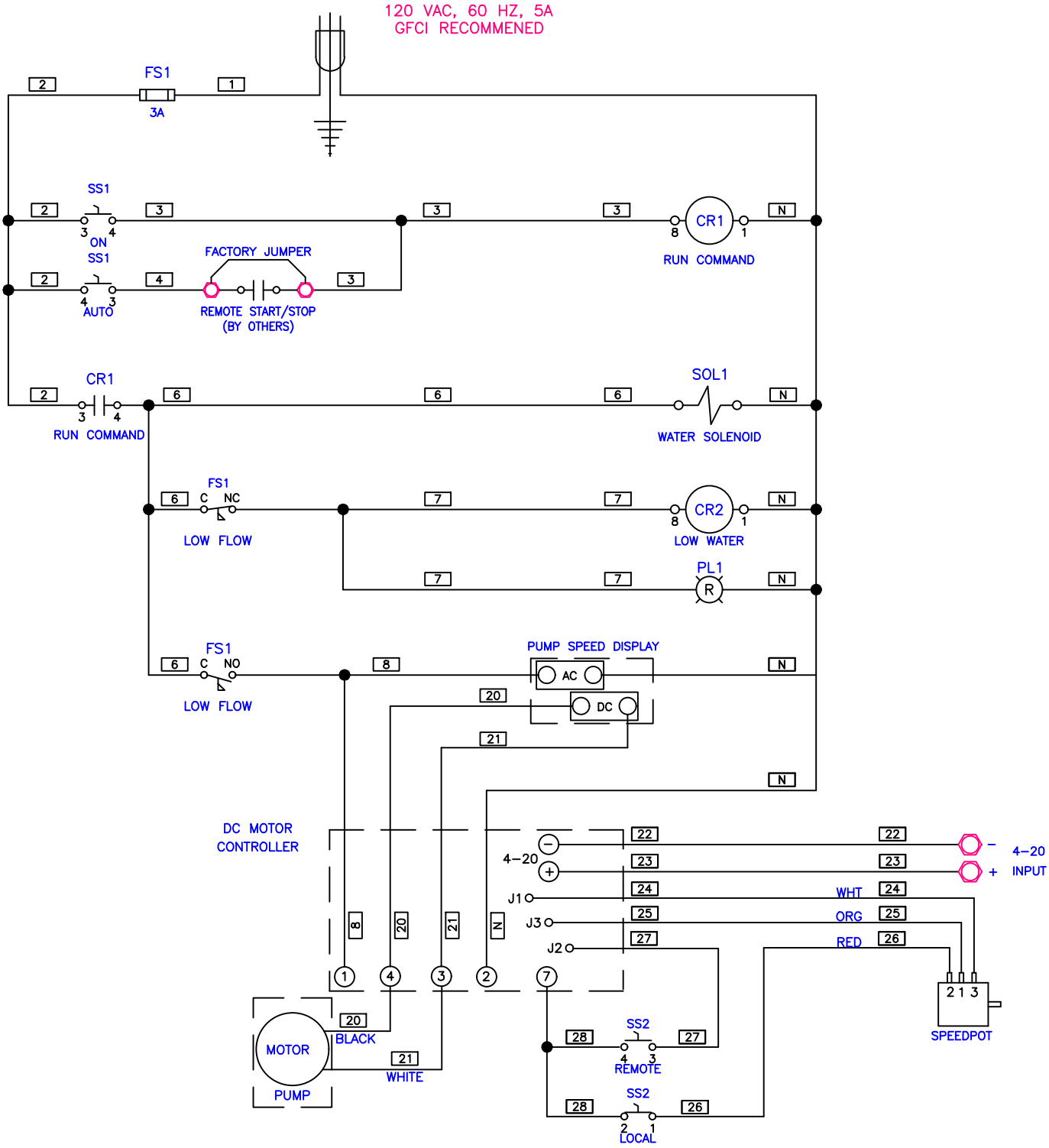
INDEX	DESCRIPTION	NAME	DATE
	REVISIONS		

CUSTOMER:

TITLE: 6000PSA2 GENERAL LAYOUT

TOLERANCE:	DRAWN BY:	DRAWN DATE:
N/A	A.P.M	02/11/2013
SCALE:	RLS. BY:	RLS. DATE:
NONE	A.M.M	12/22/2015

DWG NO.: 6PSA2-300-S-1



ELECTRICAL COMPONENTS

DESCRIPTION	PART NUMBER
ENCLOSURE, AMP, 10x8	EQX-AMP-1084H
DISPLAY, ALTECH	ALD-70313770
FUSE, AGC, 3A	ADI-AGC3
SWITCH, 3 WAY	ADI-GCX3320-22
SWITCH, 2 WAY	ADI-GCX3300
PILOT LIGHT, RED LED	ADI-ECX2051-127L
RELAY, DPDT, 120 VAC	ALD-70178595
RELAY BASE, DPDT	ALD-70179007
CONTROLLER, 1/8 HP	ADI-GSD4-240-1C
4-20 CIRCUIT	ADI-GSD4-AI-A
POTENTIOMETER	ALD-754-2057

ATTACH NAMEPLATE TO INSIDE OF CONTROL PANEL

Voltage: 120VAC 1PH 60HZ
Total FLA: 1.3A
Largest Motor FLA: 1.1A
Wiring Diagram No: 6PS-400-S-9
SCCR: 10kA
Enclosure Rating: UL NEMA 4X

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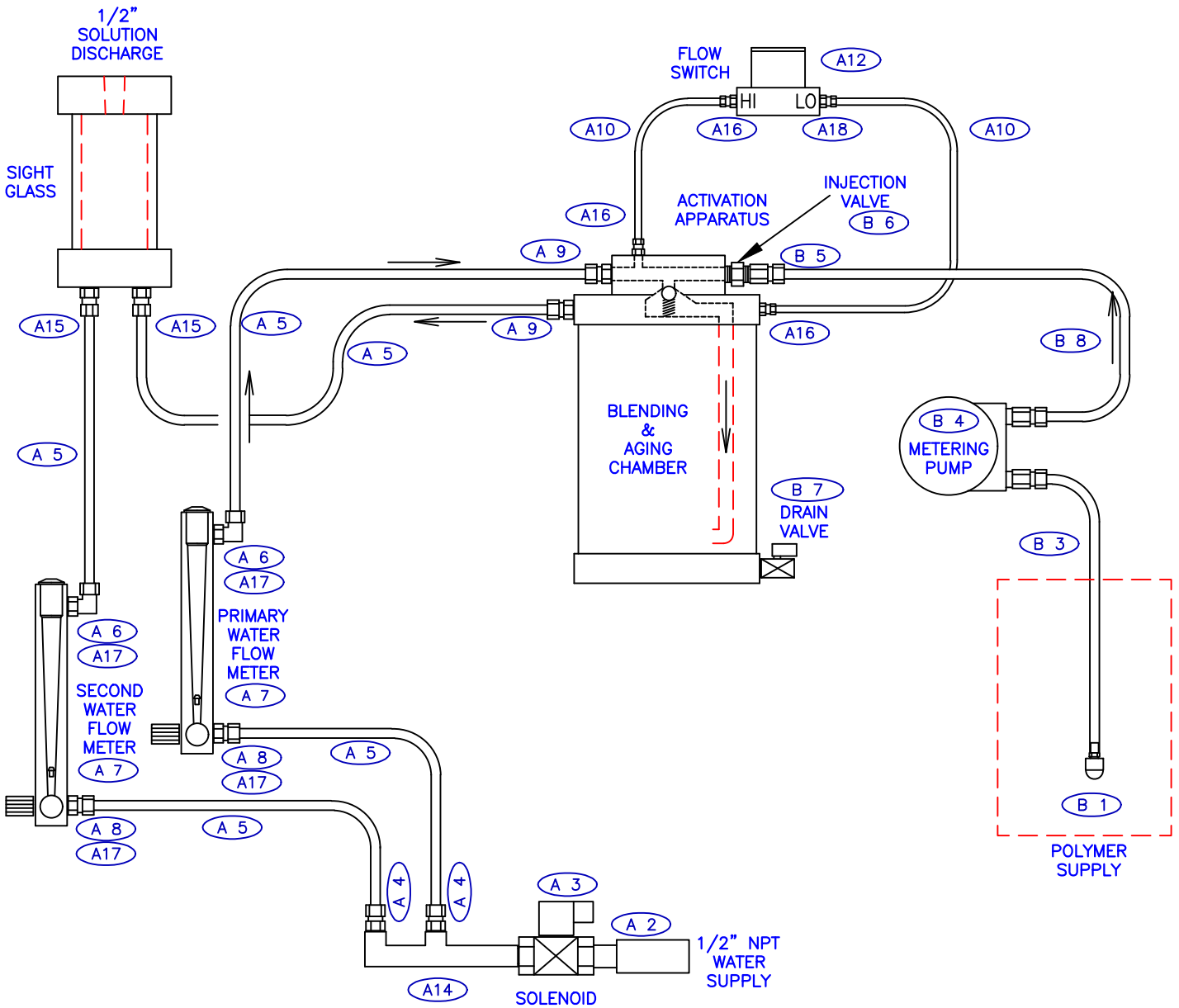
INDEX	DESCRIPTION	NAME	DATE
	REVISIONS		

CUSTOMER:

TITLE: 6PS-S Wiring Diagram

TOLERANCE:	DRAWN BY:	DRAWN DATE:
N/A	A.M.M	02/20/2013
SCALE:	RLS. BY:	RLS. DATE:
NONE	A.M.M.	12/13/2018

DWG NO.: 6PS-400-S-9



ITEM	DESCRIPTION
A2	COUPLING, BRASS, 1/2"
A3	SOLENOID VALVE, BR, 120 VAC COIL # 0075-BR-050-120
A4	FITTING, ELBOW, BR, 1/2 MPT x 1/2 TUBE # 0081-BR-050M-050T
A5	TUBE, PE, 1/2" OD # 0067-PE-050
A6	FITTING, ELBOW, BR, 1/4 MPT x 1/2 TUBE # 0081-BR-025M-050T
A7	FLOW METER, 60 GPH, BR VALVE # 0018-BR-60
A8	FITTING, STRAIGHT, BR, 1/4 MPT x 1/2 MPT # 0371-BR-025M-050M
A9	FITTING, ELBOW, PP, 3/8 MPT x 1/2 TUBE # 0063-PP-037M-050T
A10	TUBE, PE, 3/8" OD # 0067-PE-037
A12	WATER FLOW SWITCH, DP, 2-10 # DXW-11153-1
A13	FITTING, STRAIGHT, BR, 1/8 MPT x 1/4 TUBE # 0371-BR-012M-025T
A14	TEE, BR, 1/2" # 0061-BR-050
A15	FITTING, STRAIGHT, PP, 1/4 MPT x 1/2 TUBE # 0065-PP-012M-050T
A16	FITTING, ELBOW, PP, 1/4 MPT x 3/8 TUBE # 0063-PP-025M-037T
A17	FITTING, STRAIGHT, BR, 1/8 MPT x 1/4 FPT # 0371-BR-012M-025F
A18	FITTING, STRAIGHT, PP, 1/4 MPT x 3/8 TUBE # 0065-PP-025M-037T
B1	STRAINER, PVC, 1/4" # 0526-A
B3	HOSE, 1/4" ID # 0090-025-NR
B4	METERING PUMP, PERISTALTIC, X GPD # BLW-0529-X
B5	FITTING, STRAIGHT, PP, 1/2 FPT x 3/8 TUBE # 0065-PP-050F-037T
B6	INJECTION VALVE, 1/2" # 0027-H
B7	VALVE, BALL, CP, 3/8 # 0120-BL-CP-037
B8	TUBE, PE, 3/8 OD # 0067-PE-037

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INDEX	DESCRIPTION	NAME	DATE
	REVISIONS		

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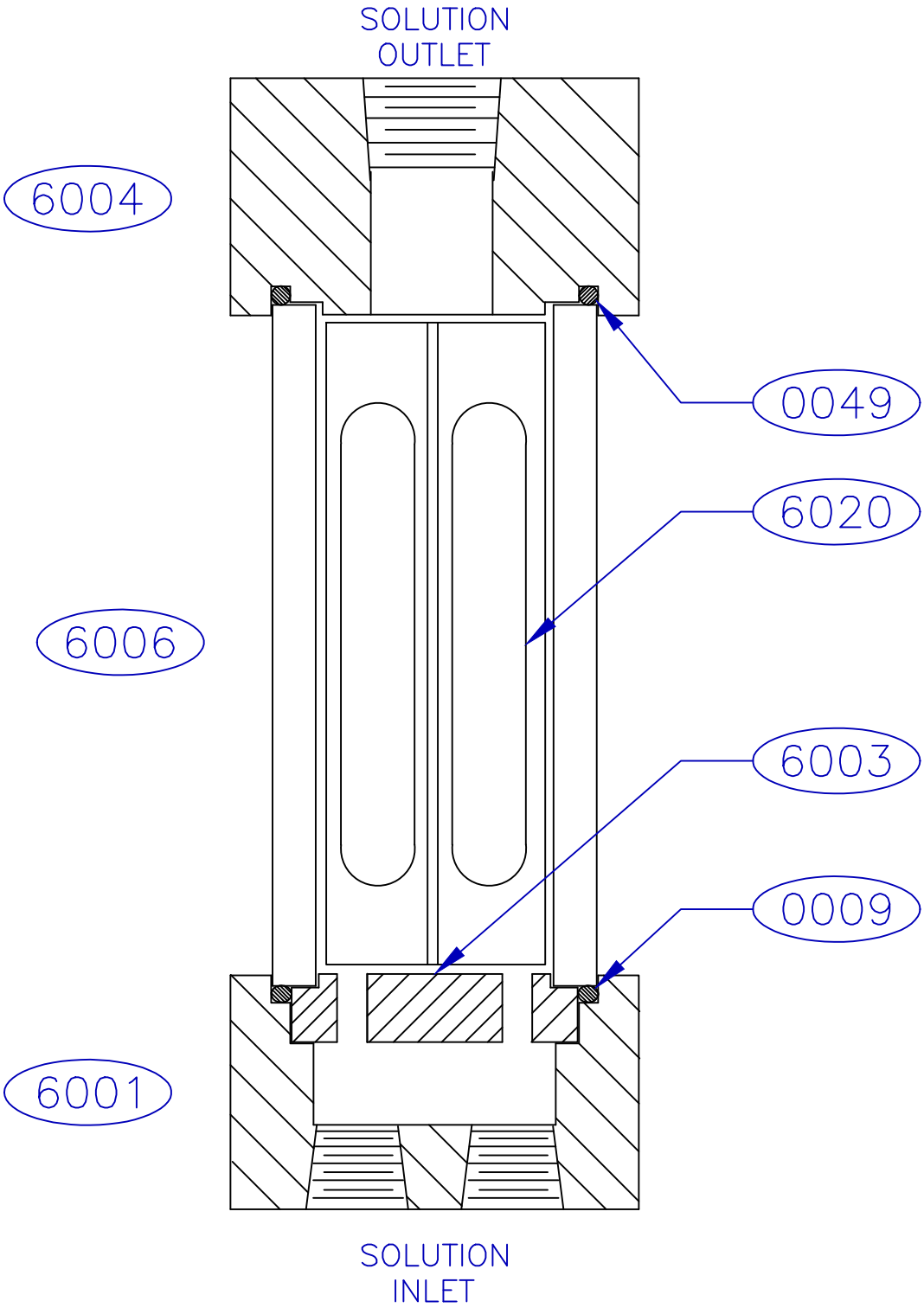
CUSTOMER:

TITLE: 6500PSA2-120 FLOW DIAGRAM

TOLERANCE:	DRAWN BY:	DRAWN DATE:
N/A	A.M.M	08/16/2017
SCALE:	RLS. BY:	RLS. DATE:
NONE	A.P.M	06/28/2019

DWG: 6PSA2-500-120-4

ITEM	DESCRIPTION
0049-B-227	SIGHT GLASS O-RING
6001-D1	SOLUTION INLET BLOCK
6003-A1	FLOW DIVERTER PLATE
6004-E0	SOLUTION DISCHARGE BLOCK
6006-A0	SIGHT GLASS
6020-B2	GLASS CLEANING APPARATUS



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INDEX	DESCRIPTION	NAME	DATE
	REVISIONS		

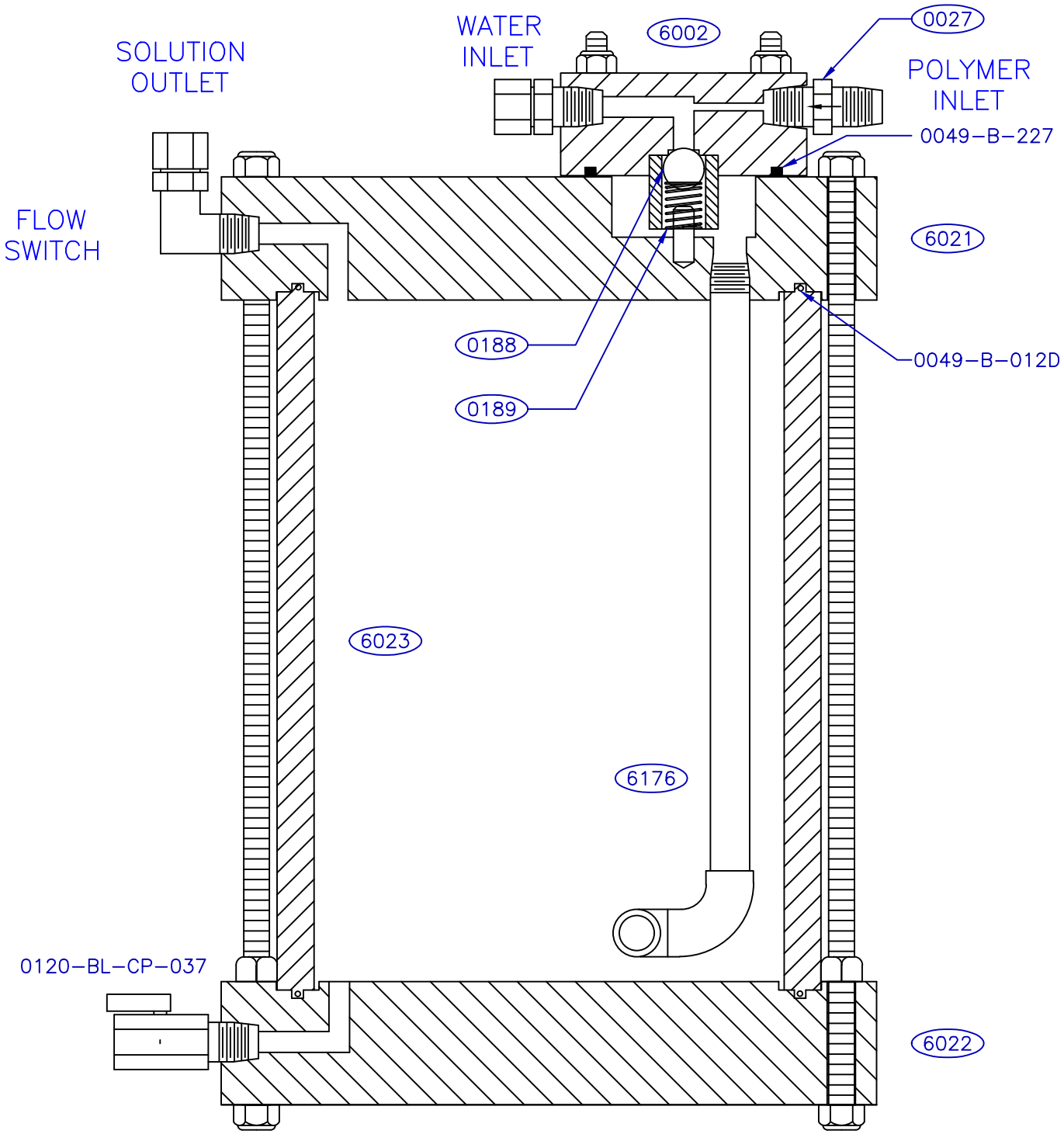
CUSTOMER:

TITLE: 6000PSA SIGHT GLASS

TOLERANCE:	DRAWN BY:	DRAWN DATE:
N/A	A.P.M	02/11/2013
SCALE:	RLS. BY:	RLS. DATE:
NONE	A.M.M	08/02/2017

DWG NO.: 6A-650-A-0

ITEM	DESCRIPTION	ITEM	DESCRIPTION
0049-B-227	APPARATUS O-RING	6002-K7	LIQUIDS INLET BLOCK
0120-BL-CP-037	DRAIN VALVE, CP, 3/8"	6021-A6	CHAMBER TOP BLOCK
0027-H	INJECTION VALVE, 1/2"	6022-A4	CHAMBER BOTTOM BLOCK
0188-A	ACTIVATION BALL	6023-A0	CHAMBER WALL
0189-A	COATED SPRING	6176-A0	TANK DIPLEG
0049-B-012D	TANK O-RING		



THIS DRAWING CONTAINS PROPRIETARY INFORMATION WHICH IS INTENDED FOR USE BY ONLY THOSE PARTIES LISTED AND MAY NOT BE MODIFIED, REPRODUCED, OR RETRANSMITTED WITHOUT THE CONSENT OF EXCELL FEEDERS.

excellfeeders

INDEX	DESCRIPTION	NAME	DATE
	REVISIONS		

CUSTOMER:

TITLE: 6000A BLEND TANK

TOLERANCE:	DRAWN BY:	DRAWN DATE:
N/A	A.M.M	02/20/2013
SCALE:	RLS. BY:	RLS. DATE:
NONE	A.P.M	04/09/2019

DWG NO.: 6A-700-A-3



MODEL 0529-X

Peristaltic Injector Pump

excellfeeders

PO Box 7475
Somerset, NJ 08875
USA
Phone: 732-828-8655 **FAX**: 732-828-2611
E-mail: support@excellfeeders.com
Website: www.excellfeeders.com

0529-X

Specifications

Maximum Working Pressure	65 psig / 4.5 bar (most models)
Maximum Fluid Temperature	130° F / 54°C
Ambient Temperature Range	14 to 110° F / -10 to 43° C
Duty Cycle	Continuous
Maximum Solids	50% by volume
Maximum Viscosity	5,000 Centipoise
Maximum Suction Lift	up to 30 ft. water
Power Requirements	90VDC 60 Watts,
Dimensions	6-1/8" H x 10-1/8" W x 9" D
Weight	8 lb.

Features

- Peristaltic Pump Tube does not require valves.
- Self priming under maximum pressure. Cannot vapor lock.
- High outlet pressure capability of 65 psig (most models).
- High inlet suction lift capability of 30 feet.
- Patented pump tube assembly design.
- Corrosion proof Valox housing.
- Tamper resistant electronic control panel cover.

Pump Capacity:

Model	#1 tube	#2 tube	#3 tube
0529-0-X:	5.7 GPD	12 GPD	28 GPD
0529-1-X	13 GPD	28 GPD	66 GPD
0529-2-X	20 GPD	43 GPD	99 GPD
0529-3-X	25 GPD	53 GPD	---------



MODEL 0529-X

Peristaltic Injector Pump
Operating Manual

excellfeeders

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1.0 Introduction

Congratulations on purchasing the 0529-X Peristaltic Metering Pump. The 0529-X is designed to inject chemicals into piping systems. The 0529-X can be equipped with control circuitry which allows the pump output to be externally controlled by a 4-20 mA signal.

2.0 Specifications

Maximum Working Pressure	65 psig / 4.5 bar (most models)
Maximum Fluid Temperature	130° F / 54°C
Ambient Temperature Range	14 to 110° F / -10 to 43° C
Duty Cycle	Continuous
Maximum Solids	50% by volume
Maximum Viscosity	5,000 Centipoise
Maximum Suction Lift	up to 30 ft. water
Power Requirements	90VDC 60 Watts,
Dimensions	6-1/8" H x 10-1/8" W x 9" D
Weight	8 lb.

3.0 Features

- Peristaltic Pump Tube does not require valves.
- Self priming under maximum pressure. Cannot vapor lock.
- High outlet pressure capability of 65 psig (most models).
- High inlet suction lift capability of 30 feet.
- Patented pump tube assembly design.
- Corrosion proof Valox housing.
- Tamper resistant electronic control panel cover.

4.0 Unpacking

Your pump package should contain the following:
1 - Injector pump with 1 pump tube assembly
1 - suction tube strainer
1 - ceramic tubing weight
1 - 5' Length of clear PVC suction tubing

5.0 Installation

CAUTION: Proper eye and skin protection must be worn when installing and servicing the pump.

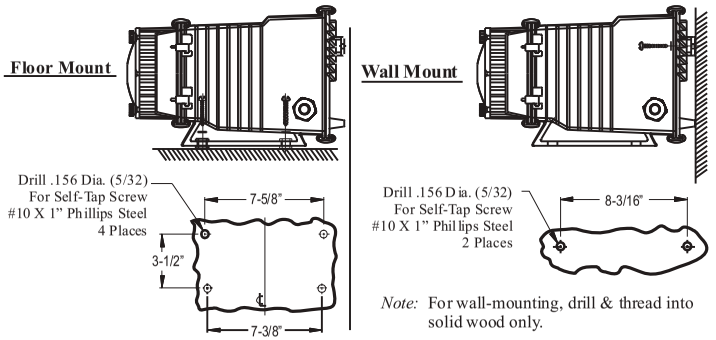
Note: *All diagrams are strictly for guideline purposes only. Always consult an expert before installing the pump into specialized systems. The pump should be* ***serviced by qualified persons only.***

5.1 Mounting Location

Choose an area located near the chemical supply tank, chemical injection point and electrical supply. Although the pump is designed to withstand outdoor conditions, a cool, dry, well ventilated location is recommended. Install the pump where it can be easily serviced.

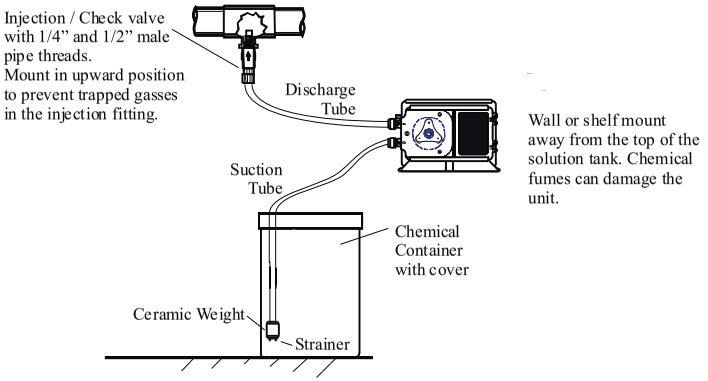
- Mount the pump to a secure surface or wall using the enclosed hardware. Wall mount to a solid surface only. Mounting to drywall with anchors is not recommended.
- Mount the pump close to the injection point. Keep the outlet (discharge) tubing as short as possible. Longer tubing increases the back pressure at the pump tube.
- Your solution tank should be sturdy. Keep the tank covered to reduce fumes. Do not mount the pump directly over your tank. Chemical fumes may damage the unit. Mount the pump off to the side or at a lower level than the chemical container.
- Mounting the pump lower than the chemical container will gravity feed the chemical into the pump. This "flooded suction" installation will reduce output error due to increased suction lift. You must install a shut-off valve, pinch clamp or other means to halt the gravity feed to the pump during servicing.
- Be sure your installation does not constitute a cross connection with the drinking water supply. Check your local plumbing codes.

INJECTOR MOUNTING

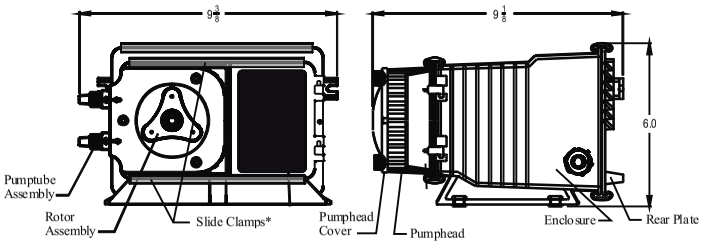


Note: For wall-mounting, drill & thread into solid wood only.

TYPICAL INSTALLATION



PARTS LOCATOR DRAWING



5.2 Input Power Connections

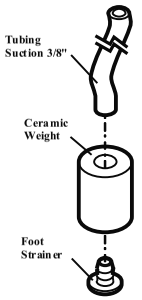
WARNING: Risk of electric shock.

- Be certain to connect the pump to the proper supply voltage. Using the incorrect voltage will damage the pump and may result in injury. The voltage requirement is printed on the pump serial label.

5.4 How To Install the Tubing and Fittings

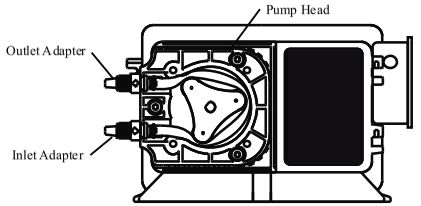
CAUTION: Proper eye and skin protection must be worn when installing and servicing the pump.

- **Inlet Tubing -** Locate the inlet fitting of the Pump Tube. Remove the tube nut. Push the clear PVC suction tubing onto the compression barb of the fitting. Use the tube nut to secure the tube. Hand tighten only.
- **Strainer** - Trim the inlet end of the suction tubing so that the strainer will rest approximately two inches from the bottom of the solution tank. This will prevent sediment from clogging the strainer. Slip the ceramic weight over the end of the suction tube. Press the strainer into the end of the tube. Secure the ceramic weight to the strainer. Drop the strainer into the solution tank.

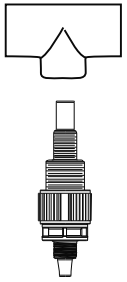


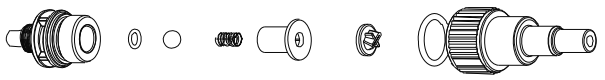
- **Outlet Tubing -** Locate the outlet fitting of the Pump Tube. Remove the tube nut. Push the opaque outlet (discharge) tubing onto the compression barb of the fitting. Use the tube nut to secure the tube. Hand tighten only.

  Keep outlet tube as short as possible.



- **Injection/Check Valve Fitting Installation** - The Injection/Check valve fitting is designed to install directly into either 1/4" or 1/2" female pipe threads. This fitting will require periodic cleaning, especially when injecting fluids that calcify such as sodium hypochlorite. See section 7.0. Install the Injection/Check valve directly into the piping system. To prevent trapped gasses, install the fitting in an upward direction. Use Teflon thread sealing tape on the pipe threads.
  Push the opaque outlet (discharge) tubing onto the compression barb of the Injection/Check valve fitting. Use the tube nut to secure the tube. Hand tighten only.





6.0 How to Maintain the Pump

CAUTION: Proper eye and skin protection must be worn when installing and servicing the pump.

6.1 Routine Inspection and Maintenance

The pump requires very little maintenance. However, the pump and all accessories should be checked weekly. This is especially important when pumping chemicals. Inspect all components for signs of leaking, swelling, cracking, discoloration or corrosion. Replace worn or damaged components immediately.

Cracking, crazing, discoloration and the like during the first week of operation are signs of severe chemical attack. If this occurs, immediately remove the chemical from the pump. Determine which parts are being attacked and replace them with parts that have been manufactured using more suitable materials. The manufacturer does not assume responsibility for damage to the pump that has been caused by chemical attack.

6.2 How to Clean and Lubricate the Pump

The pump will require occasional cleaning and lubricating. The amount will depend on the severity of service.

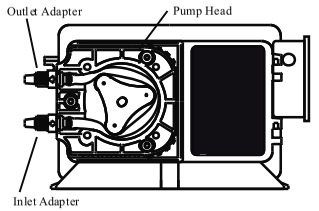
- When changing the pump tube assembly, the pump head chamber, roller assembly and pump head cover should be wiped free of any dirt and debris.
- The pump head cover bearing may require grease periodically. Apply a small amount of grease (Aeroshell aviation grease #5 or equivalent) when necessary.
- Although not necessary, 100% silicon lubrication may be used on the roller assembly and tube assembly.
- Periodically clean the injection/check valve assembly, especially when injecting fluids that calcify such as sodium hypochlorite. These lime deposits and other build ups can clog the fitting, increase the back pressure and interfere with the check valve operation.
- Periodically clean the suction strainer.
- Periodically inspect the air vents located under the motor compartment and on the rear panel. Clean if necessary.

6.3 How to Replace the Pump Tube

The pump tube assembly will eventually break if not replaced. The tube has been designed for a minimum service life of 500 hours. However, the life of the tube is affected by many factors such as the type of chemical being pumped, the amount of back pressure, the motor RPM, temperature and others. The pump tube assembly must be inspected and replaced regularly.

Remove the Old Pump Tube - The pump roller assembly spins in a counter clockwise direction. The pump head inlet (suction) side is located at the bottom of the pump and the outlet (discharge) is located at the top of the pump head.

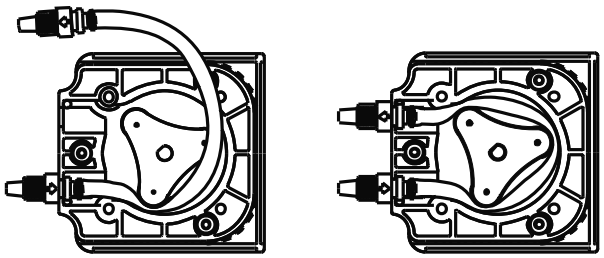
- Release any pressure that may be in the discharge tubing.
- Disconnect the suction and discharge tubes from the pump tube.
- Remove the pump head cover.
- With the pump running, pull the inlet fitting out of the pumphead. Guide the tube counter clockwise away from the rollers. Pull the outlet fitting out of the pump head.



Install the New Pump Tube - Be sure the pump head chamber is clean and free of any debris.

Remove and inspect the roller assembly. Be sure the rollers spin freely. If required, apply a small amount of grease to the pump head cover bearing.

- With the pump running, insert the inlet (suction) side of the Pump Tube fitting into the pump head.
- **Carefully** guide the Pump Tube into the pump head. Stretch the tube slightly and insert the outlet (discharge) fitting into the upper retaining slot in the pump head.
- Place the clear cover on the pump head and secure with three screws.



REPLACEMENT PARTS DRAWING

REPLACEMENT PARTS LIST

Item	Part No	Description	Qty.
1	71000-214	Enclosure Back With Gasket,	1
2	90011-094	Washer, #10 Stainless	2
3	90011-091	Screw, #10 X 1.0" Phillips Steel	4
6	90006-580	Gasket, Back Plate, Neoprene	1
9	90010-110	Power Cord, 1	1
10	A-033N	Cord Inlet Bushing	1
11	90003-359	Mounting Feet, Rubber	4
12	76001-000	Slide Clamp, Enclosure Rear	1
13	76000-999	Slide Clamp, Enclosure Front	1
15	90006-579	Gasket, Enclosure Front, Neoprene	1
16	90002-191	Door, Electronic Controls Cover	1
17	70002-241	G/motor, V/S 14Rpm, 90VDC	1
	70002-242	G/motor, V/S 30Rpm, 90VDC	1
	70002-243	G/motor, V/S 45Rpm, 90VDC	1
	70002-244	G/motor, V/S 60Rpm, 90VDC	1
22	90006-601	Motor Clip, 45, 60RPM	1
23	90006-583	Motor Clip, 14, 30RPM	1
24	90011-146	Screw, Motor Clip, 8-32 X .25	1
25	90007-515	Bushing, J-Box Connector, Alum.	1
26	76001-029	Junction Box, Valox	1
27	90011-129	Screw, 6-32 X .25 S Black	2
28	71000-133	Cover, J-Box w/Gasket &Label	1
29	70000-656	J-Box Assembly, Complete	1
30	90008-151	J-box Hole Plug .75 Dia Blk	1
31	C-330-6	Nut, Tube, .37 O.D. Tubing	1
36	C-335-6	Tubing, Outlet, .370.D.X5ft, Poly	1
37	C-334-6	Tubing, Inlet, .370.D.X5ft, Pvc	1
38	C-346	Weight, Inlet Tubing, Ceramic	1
39	C-342-2	Strainer, Inlet Tube, Polypro	1
40			1
	71000-350	Roller, -7 tubes (black rollers)	1
45	71000-156	Cover, P/head With Bearing	1
46	76001-003	Bearing, Sleeve, P/head Cover	1
48	90011-160	Screw, P/head Cover, 8-32 X .62	3
49	A-014N-6A	Inj Valve, .5-.25 Mpr X .37 O.D.	1
50	90006-583	Motor Clip, 14, 30RPM	1
51	90011-146	Screw, Motor Clip, 8-32 X .25	1
52	90007-515	Bushing, J-Box Connector, Alum.	1
53	76001-029	Junction Box, Valox	1
54	90011-129	Screw, 6-32 X .25 S Black	2
55	71000-133	Cover, J-Box w/Gasket &Label	1
56	70000-656	J-Box Assembly, Complete	1
N/s	90008-151	J-box Hole Plug .75 Dia Blk	1
			1
59	90011-023	Screw, Motor, 8-32 x .50 Phill	2
60	C-1814N-2	Motor brush set, 90VDC motor	1

LIMITED WARRANTY

Your new pump is a quality product and is warranted to be free of defects as set down in this policy. Peristaltic pump tube assemblies are not warranted. Parts are covered under warranty for 12 months from the date of purchase. Warranty coverage does not include damage to the pump that results from misuse, carelessness, abuse or alteration. Only the repair or the replacement of the pump is covered. Excell Feeders does not assume responsibility for any other loss or damage.

Warranty status is determined by the pump's serial label. The serial label must be on the pump to obtain warranty coverage. The warranty status of the pump will be verified by Excell Feeders.

PROCEDURE FOR IN WARRANTY REPAIR

Carefully pack the pump to be repaired. Enclose a brief description of the problem. Prepay all shipping costs. COD shipments will not be accepted. Warranty service must be performed by the factory. Damage caused by improper packaging is the responsibility of the sender.



Users of electrical and electronic equipment (EEE) with the WEEE marking per Annex IV of the WEEE Directive must not dispose of end of life EEE as unsorted municipal waste, but use the collection framework available to them for the return, recycle, recovery of WEEE and minimize any potential effects of EEE on the environment and human health due to the presence of hazardous substances. The WEEE marking applies only to countries within the European Union (EU) and Norway. Appliances are labeled in accordance with European Directive 2002/96/EC.
Contact your local waste recovery agency for a *Designated Collection Facility* in your area.

AUTOMATIONDIRECT.com

IRONHORSE™

GSD4 Series DC Drives User Manual

User Manual Number: IH-GSD4-User-M





WARNING

Thank you for purchasing automation equipment from Automationdirect.com®, doing business as AutomationDirect. We want your new automation equipment to operate safely. Anyone who installs or uses this equipment should read this publication (and any other relevant publications) before installing or operating the equipment.

To minimize the risk of potential safety problems, you should follow all applicable local and national codes that regulate the installation and operation of your equipment. These codes vary from area to area and usually change with time. It is your responsibility to determine which codes should be followed, and to verify that the equipment, installation, and operation is in compliance with the latest revision of these codes.

At a minimum, you should follow all applicable sections of the National Fire Code, National Electrical Code, and the codes of the National Electrical Manufacturer's Association (NEMA). There may be local regulatory or government offices that can also help determine which codes and standards are necessary for safe installation and operation.

Equipment damage or serious injury to personnel can result from the failure to follow all applicable codes and standards. We do not guarantee the products described in this publication are suitable for your particular application, nor do we assume any responsibility for your product design, installation, or operation.

Our products are not fault-tolerant and are not designed, manufactured or intended for use or resale as on-line control equipment in hazardous environments requiring fail-safe performance, such as in the operation of nuclear facilities, aircraft navigation or communication systems, air traffic control, direct life support machines, or weapons systems, in which the failure of the product could lead directly to death, personal injury, or severe physical or environmental damage ("High Risk Activities"). AutomationDirect specifically disclaims any expressed or implied warranty of fitness for High Risk Activities.

For additional warranty and safety information, see the Terms and Conditions section of our catalog. If you have any questions concerning the installation or operation of this equipment, or if you need additional information, please call us at 770-844-4200.

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GSD4 DC DRIVES USER MANUAL OVERVIEW

OVERVIEW OF THIS PUBLICATION

The IronHorse GSD4 Series DC Drives User Manual describes the installation, configuration, and methods of operation of the GSD4 Series DC Drives.

All information contained in this manual is intended to be correct. However, information and data in this manual are subject to change without notice. AutomationDirect (ADC) makes no warranty of any kind with regard to this information or data. Further, ADC is not responsible for any omissions or errors or consequential damage caused by the user of the product. ADC reserves the right to make manufacturing changes which may not be included in this manual.

WHO SHOULD READ THIS USER MANUAL

This manual contains important information for those who will install, maintain, and/or operate any of the GSD4 Series DC Drives.

TECHNICAL SUPPORT

By Telephone: 770-844-4200 (Mon.–Fri., 9:00 a.m.–6:00 p.m. E.T.)

On the Web: www.automationdirect.com

Our technical support group is glad to work with you in answering your questions. If you cannot find the solution to your particular application, or, if for any reason you need additional technical assistance, please call Technical Support at 770-844-4200. We are available weekdays from 9:00 a.m. to 6:00 p.m. Eastern Time.

We also encourage you to visit our web site where you can find technical and non-technical information about our products and our company. Visit us at www.automationdirect.com.

SPECIAL SYMBOLS



WHEN YOU SEE THE "NOTEPAD" ICON IN THE LEFT-HAND MARGIN, THE PARAGRAPH TO ITS IMMEDIATE RIGHT WILL BE A SPECIAL NOTE.



WHEN YOU SEE THE "EXCLAMATION MARK" ICON IN THE LEFT-HAND MARGIN, THE PARAGRAPH TO ITS IMMEDIATE RIGHT WILL BE A ***WARNING.*** *THIS INFORMATION COULD PREVENT INJURY, LOSS OF PROPERTY, OR EVEN DEATH (IN EXTREME CASES).*

IRONHORSE GSD4 SERIES DC DRIVES GENERAL INFORMATION

IronHorse GSD4 DC drives are designed to control DC Permanent Magnet, Shunt Wound, and some Universal (AC/DC) motors. Incoming AC voltage is converted to adjustable full-wave rectified DC voltage to operate the DC motor. Also, a full-wave field voltage is provided for shunt wound motors.



CAREFULLY CHECK THE DC DRIVE FOR SHIPPING DAMAGE. REPORT ANY DAMAGE TO THE CARRIER IMMEDIATELY. DO NOT ATTEMPT TO OPERATE THE DRIVE IF VISIBLE DAMAGE IS EVIDENT TO EITHER THE CIRCUIT OR TO THE ELECTRONIC COMPONENTS.

STANDARD FEATURES

- Input voltages 24/36VAC or 120/240VAC @ 50/60Hz; output 0–24/36VDC or 0–90/180VDC.
- Adjustable horsepower settings.
- Barrier terminal strip.
- Full-wave bridge supply.
- 1% speed regulation with armature voltage feedback; ±1/2% with tachometer feedback.
- Adjustable Minimum speed, Maximum speed, IR Compensation, Current Limit, Acceleration & Deceleration (enclosed models).
- Line voltage compensation.
- 5kΩ speed potentiometer with leads, dial, and knob included.
- 50:1 speed range.
- Transient voltage protection.
- Voltage following mode or DC tachometer follower by supplying ungrounded 0–12VDC analog input signal.
- DC tachometer feedback (6V at base speed).
- Inhibit circuit permits start & stop without breaking AC lines.
- Shunt field supply provided.
- GSD4-240-10N4X only: NEMA 4X enclosure, Power ON/OFF switch, Power ON indicator, Adjustable acceleration and deceleration.

CONTROL FEATURES

MINIMUM SPEED – Allows adjustment of the motor speed when the speed pot is set at minimum (CCW). This permits the user to eliminate "Deadband" on the main speed control, permitting zero calibration. Clockwise rotation of "MIN" trim pot increases speed.

MAX SPEED (Maximum Speed) – Allows adjustment of the motor speed when the speed pot is set at maximum (CW). This permits the user to eliminate the top end "Deadband", which will provide full speed at maximum rotation. Rotation of the "MAX" trim pot in the clockwise direction increases the maximum motor speed.

I.R. COMP (Speed Regulation) – This allows for adjustment of the circuitry that controls the speed regulation of the motor. The circuitry controls armature speed by changing the armature voltage to compensate for increased or decreased motor loading. Clockwise rotation of the "IR COMP" trim pot will increase compensation.

CUR. LIM. (Current Limit) – Provides protection from excessive armature current by limiting the maximum armature current the drive can provide. This enables adjustment of the maximum torque the motor can deliver. Torque adjustment (Cur. Lim.) is preset at 125% of rated motor torque (current) based on horsepower. Clockwise rotation of the "CUR. LIM." trim pot increases the torque (current) the drive will provide.

INHIBIT TERMINAL PIN – An adjustable acceleration ramp that allows the user a choice of stopping and starting hard (fast), or stopping hard with a soft start (without breaking the AC lines).

There are two ways to Inhibit a drive:

1) For all GSD drives (using the drive's speed pot):

   Remove power from the Speed Pot Wiper, which makes the input to the drive drop to Zero volts. A switch or contact can be placed in either the Speed Pot High lead, or in the Speed Pot Wiper lead.

2) For GSD4, GSD5, and GSD7 drives (using the drive's inhibit feature):

   The inhibit feature provides a way to start/stop output of these drives by using a low-power rated contact (12VDC, mA of current), as opposed to a high-power contact that would be required to switch the source power to the drive.

   Close the circuit between the Inhibit pin (GSD4 & GSD5 Series) or the +TACH terminal (GSD7 only), and the drive's Speed Pot Hi terminal. The drive will stop and start quickly – bypassing any fixed or adjustable ACCEL or DECEL setting. When this connection is CLOSED, the drive's 12VDC logic supply is collapsed by connecting it to a chassis COMMON point – the board logic shuts down and output to the motor ceases. Output to the motor resumes when this contact is opened again.

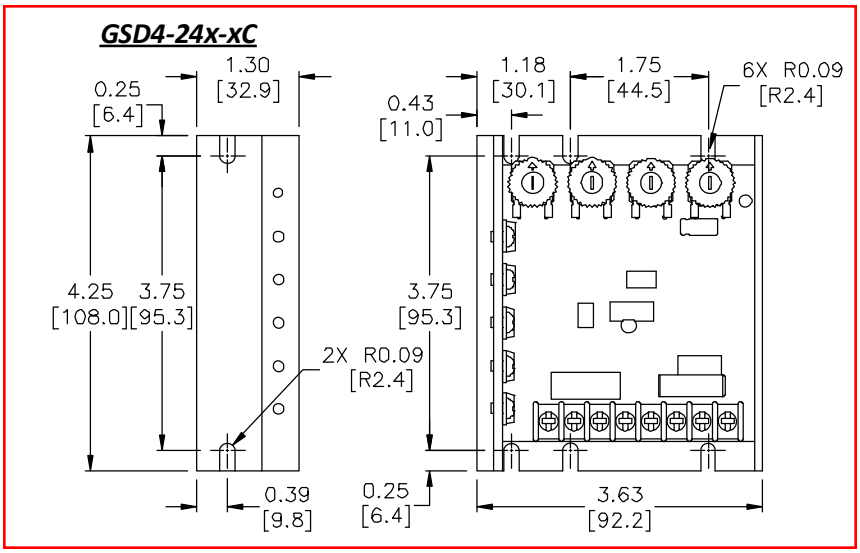
SELECTION AND SPECIFICATIONS

GSD4 Series DC Drives – Selection & Specifications					
Model		***GSD4-24A-5C***	***GSD4-240-1C***	***GSD4-240-5C***	***GSD4-240-10N4X***
Package Configuration		open frame			NEMA 4X
Power Quality Form Factor		1.4			
Input Voltage (@50/60Hz)		24/36 VAC ±10%	120/240 VAC ±10%		
Output Voltage		0–24/36 VDC	0–90/180 VDC		
Shunt Field Voltage		20VDC @ 24VAC in 30VDC @ 36VAC in (1A max)	100VDC @ 120VAC in 200VDC @ 240VAC in (1A max)		100VDC @ 120VAC in 200VDC @ 240VAC in (0.5A max)
Motor Rating @ Low V (hp) ***Motor Rating @ High V (hp)***		1/50 – 1/6	1/50 – 1/8 1/25 – 1/4	1/8 – 1/2 1/4 – 1	1/8 – 1 1/4 – 2
Output Current (continuous)		5.5A (DC)	1.2A (DC)	5.5A (DC)	10A (DC)
Current Overload Capacity		200% for 60s			
Current Limit (adjustable)		1–15A (DC)	0.3–2.5A (DC)	1–15A (DC)	
Transient Protection		–	Metal Oxide Varistor (MOV)		
I.R. Compensation		adjustable			
Speed Adjustment	***Potentiometer***	5kΩ potentiometer or 0–10VDC isolated input signal (See "GSDA-AI-V4" on page 18.)			
	Current	4–20mA			n/a
	Voltage	n/a	0–5VDC thru 0–250VDC		
Speed Range		50:1			
Speed Regulation		±1% of base speed			
Maximum Speed		adjustable from 60% to 110% of base speed			
Minimum Speed		0–30% of adjustable maximum speed			
Acceleration		0.5 seconds			adjustable 0.5–8 seconds
Deceleration					
Dynamic Braking		no			
Plugging Capability **		no			
Electrical Connections		8-position terminal strip; 22–14 AWG			
External Fusing Required		Bussman ABC or Littlefuse 314 series ceramic fuses or equivalent For details, refer to "Fusing" on page page 8.			
Operating Temperature		-10 to 45 °C [14 to 113 °F]			-10 to 40 °C [14 to 104 °F]
Thermal Protection		current limiting			
Mounting Orientation		can be mounted in any orientation			
Corrosive Gases		NOT compatible with any corrosive gases			
Weight		8.0 oz [203g]	37 oz [1049g]	10.5 oz [297g]	59.5 oz [1687g]
Agency Approvals		RoHS, CE	$_{C}UL_{US}$ Listed (E198015), RoHS, CE		$_{C}UL_{US}$ Listed (E198015), RoHS
Optional Accessories*					
Replacement Potentiometer		GSDA-5K			
Digital Potentiometer		GSDA-DP			
Manual Reverse Switch		GSDA-MREV			
Accel/Decel Adjustment Card		GSDA-ACCDEC-4			
Analog Current Input Card			GSDA-AI-A		–
Analog Voltage Input Card		–	GSDA-AI-V4		–
Heatsink		GSDA-HTSNK-4			–

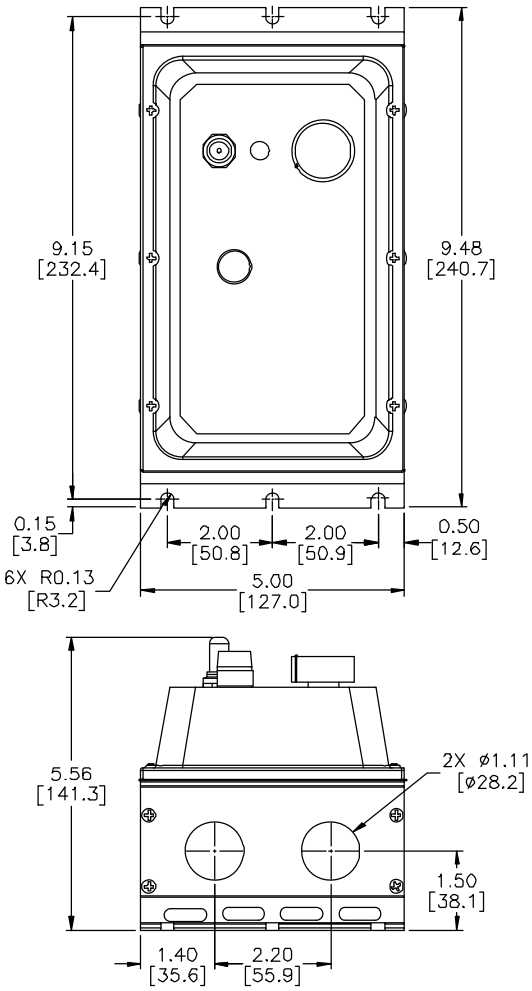
** For accessories details, please visit www.AutomationDirect.com.*
*** Plugging is a method of rapidly changing motor direction by reversing motor armature polarity, while the motor is still running.*

DIMENSIONS (dimensions = in [mm])

GSD4-24x-xC



GSD4-240-10N4X



Installation and Wiring

Install open-frame drives in an enclosure with a volume at least three times the volume of the open-frame drive.

Do not mount GSD4-24x-xxxxx DC drive where ambient temperature is outside the range of -10 to 45 °C (14 to 113 °F).

Size all wires that carry armature or line currents as specified by applicable national, state, and/or local codes. All other wires may be 18AWG or smaller as permitted by the codes.

Separate control wires from the armature and AC lines when routed in conduit or wire trays.

These drives do not provide motor over-temperature sensing or motor overload protection. The need for additional motor overload and motor over-temperature protection shall be determined based on conditions in the end installation in accordance with the NEC.

CAUTION!! Turn power OFF while making wiring connections.

Improper installation or operation of this DC Drive may cause injury to personnel or drive failure. The drive must be installed in accordance with local, state, and national safety codes. Make certain that the power supply is disconnected before attempting to service or remove any components!!! If the power disconnect point is out of sight, lock it in disconnected position and tag it to prevent unexpected application of power. Only a qualified electrician or service personnel should perform any electrical troubleshooting or maintenance. At no time should circuit continuity be checked by shorting terminals with a screwdriver or other metal device.

Before attempting to wire the DC Drive, make sure all power is disconnected. Recheck code designation to assure proper voltage is present for the DC Drive. Carefully select proper wire size for current and voltage drop. Limit the voltage drop through the wiring to 5% of the line voltage at full load

CAUTION!! Do not attempt to perform a hi-pot test across the AC lines with the DC drive in the circuit. This will result in immediate or long-term damage to the drive.

1) *Ensure that the GSD4 drive chassis is properly grounded.*
2) *Motor armature connections must not be switched or broken while the GSD4 drive is ON. Serious damage may result.*
3) *The inputs to the speed pot terminals (P1-6, P1-7, P1-8) must not be grounded. Serious damage may result.*

Fusing

Fuse Selection *				
	GSD4-24A-5C	Select fusing based on 200% of motor Full-Load Current		
	GSD4-240-xC		GSD4-240-10N4X	
Motor HP	Fuse @ 120 VAC Input	Fuse @ 240 VAC Input	Fuse @ 120 VAC Input	Fuse @ 240 VAC Input
1/50	2A	–	–	–
1/20	2A	1A	–	–
1/8	3A	2A	2A	–
1/4	4A	3A	4A	2A
1/3	6A	3A	6A	3A
1/2	8A	4A	8A	4A
3/4	12A	6A	12A	6A
1.0	15A	8A	15A	8A
1.5	–	12A	–	12A
2.0	–	15A	–	15A

** Select fuse type Bussman ABC or Littlefuse 314 series or equivalent. Fuse hot legs only; do not fuse AC neutrals. (AutomationDirect sells ABC series fuses.)*

WIRING TERMINALS

GSD4 Wiring Terminals			
Type	**Wire Range**	**Customer Wiring Temp Rating**	**Tightening Torque**
8-position terminal strip	22–14 AWG	300V, 75 °C [167 °F] minimum	9.0 lb·in [1.0 N·m]

WIRING TERMINAL FUNCTIONS

GSD4-xxx-xC WIRING TERMINALS

GSD4-xxx-xC Series DC Drives – Terminal Strip Functions CAUTION: BE SURE DRIVE HOUSING IS PROPERLY GROUNDED.	
Number	**Purpose**
P1-1	(L / AC1) 120VAC – Connect incoming hot AC (black wire) to this terminal. (L / AC1) 240VAC – Connect either hot side. Connect ground (green wire) to drive chassis.
P1-2	(N / AC2) 120VAC – Connect the neutral AC (white wire) to this terminal. (N / AC2) 240VAC – Connect either hot side. Connect ground (green wire) to drive chassis.
P1-3	(+ ARM) – Connects to the plus (+) Armature wire on the motor. 0-90VDC for 120VAC input or 0-180VDC for 240 VAC input. See "SPECIFICATIONS" for output rating. *CAUTION: ARMATURE CONNECTION MUST NOT BE SWITCHED OR BROKEN WHILE DRIVE IS ON, OR SERIOUS DAMAGE TO THE DRIVE MAY RESULT.*
P1-4	(- ARM / -FIELD) – Connects to minus (-) Armature wire on the motor, and, if necessary, (-) Field wire of Shunt Wound motor.
P1-5	(+ FIELD) – DO NOT use for Permanent Magnet motor. This supplies (+) Field voltage for a Shunt Wound motor. For motors with dual voltage field (i.e. 50/100V or 100/200V), make sure the highest value is connected.
P1-6	(SPEEDPOT HI) – Connects to high side (white wire) of the Speed pot (CW end). This is internal +12 volts. *INPUT MUST NOT BE GROUNDED !*
P1-7	(SPEEDPOT WIPER) – Connects to the wiper (red wire) of the Speed pot (center lead). For voltage-follower applications, this *INPUT MUST NOT BE GREATER THAN +12V MAXIMUM AND MUST NOT BE GROUNDED !* *Speed pot can be replaced by 0–10V analog signal. See "GSDA-AI-V4" on page 18, or use FC-33 or equivalent.*
P1-8	(SPEEDPOT LO) – Connects to the low side (orange wire) of the 5kΩ Speed pot (normally the CCW end). This input is raised and lowered by the MIN trim pot. Electronic speed input voltage (voltage follower) may be referenced to Speed pot LO if the MIN trim pot adjustments are to be active. Otherwise, inputs may be referenced to -ARM (P1-4), which will bypass the MIN trim pot. *INPUT MUST NOT BE GROUNDED !*

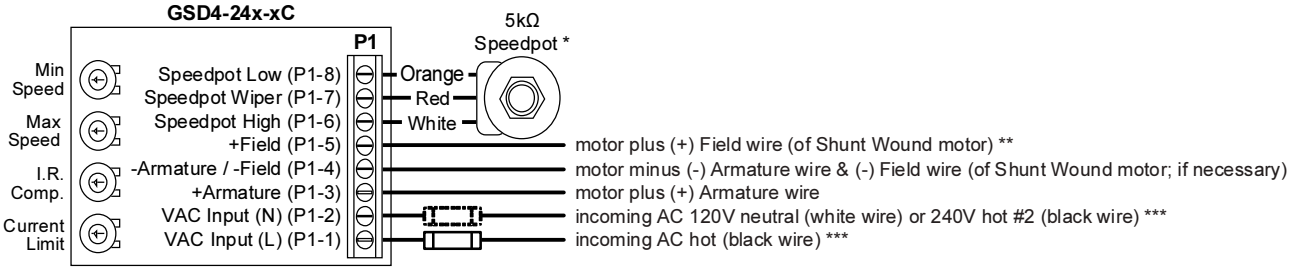
GSD4-240-10N4X WIRING TERMINALS

GSD4-240-10N4X Series DC Drives – Terminal Strip Functions CAUTION: BE SURE DRIVE HOUSING IS PROPERLY GROUNDED.	
Number	**Purpose**
	P4 – Terminal Strip for Power & Motor Armature Wiring
P4-1	(L / AC1) 120VAC – Connect incoming hot AC (black wire) to this terminal. (L / AC1) 240VAC – Connect either hot side. Connect ground (green wire) to drive ground lug.
P4-2	(N / AC2) 120VAC – Connect the neutral AC (white wire) to this terminal. (N / AC2) 240VAC – Connect either hot side. Connect ground (green wire) to drive ground lug.
P4-3	(+ ARM) – Connects to the plus (+) Armature wire on the motor.
P4-4	(- ARM) – Connects to minus (-) Armature wire on the motor.
	P1 – Terminal Strip for Shunt-Wound Motor Field Wiring
P1-4	(-FIELD) – Connects to minus (-) Field wire of shunt-wound motors ONLY.
P1-5	(+ FIELD) – DO NOT use for Permanent Magnet motor. This supplies (+) Field voltage for a Shunt-Wound motor. For motors with dual voltage field (i.e. 50/100V or 100/200V), make sure the highest value is connected

WIRING DIAGRAMS

GSD4-24x-xC BASIC WIRING DIAGRAM

SPEED POT CAN BE REPLACED BY AN 0–10V ANALOG SIGNAL FOR SPEED CONTROL (FROM A PLC, ETC.). SEE "GSDA-AI-V4" ON PAGE 18.



* *P1-6 has internal +12V, and connects to Speedpot High (white wire). THIS INPUT MUST NOT BE GROUNDED!*
For start-stop applications, the connection between P1-6 and Speedpot High can be opened and closed by a SPST switch.

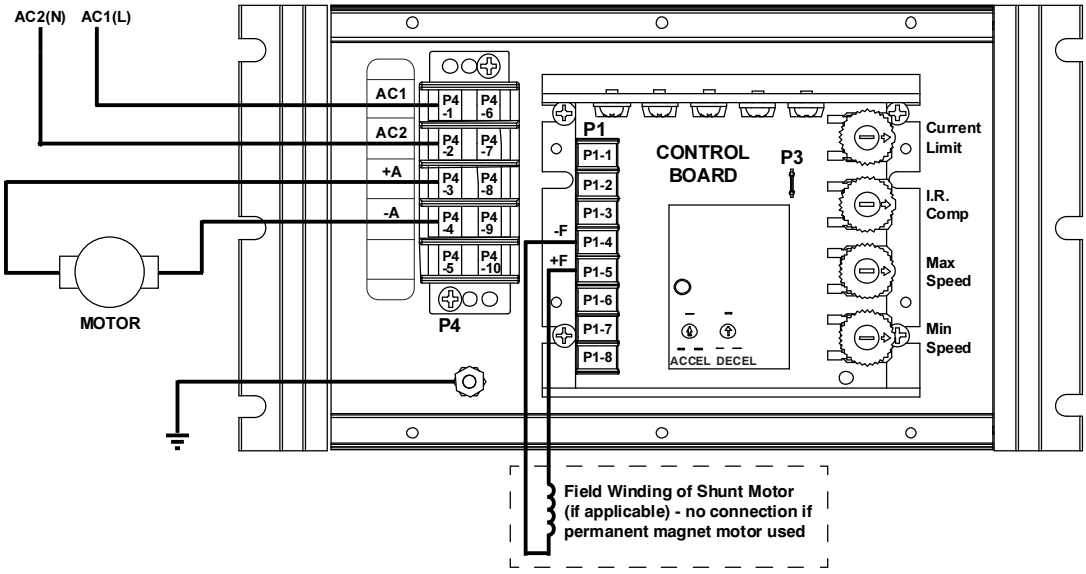
* *P1-7 connects to Speedpot Wiper (red wire). THIS INPUT MUST NOT BE GROUNDED!*
For Voltage-Follower applications, THIS INPUT MUST NOT BE GREATER THAN +12V MAXIMUM!

* *P1-8 connects to Speedpot Low, and is raised and lowered by the Min Speed trimpot. THIS INPUT MUST NOT BE GROUNDED!*
Electronic speed input (voltage follower) may be referenced to this input if the Min Speed trimpot adjustments are to be active.
Otherwise, inputs may be referenced to -Armature, which will bypass the Min Speed trimpot.

** *+F connection is only for Shunt Wound motor; NOT for Permanent Magnet motor.*
For motors with dual voltage field, i.e. 50/100V or 100/200V, connect the highest value.

*** *Fuse hot AC inputs only; refer to Fusing section for size and type. Fuse both AC lines for 240 VAC input. Do NOT fuse AC(N) on 120V systems.*
Connect incoming AC ground (green wire) to GSD4 chassis.

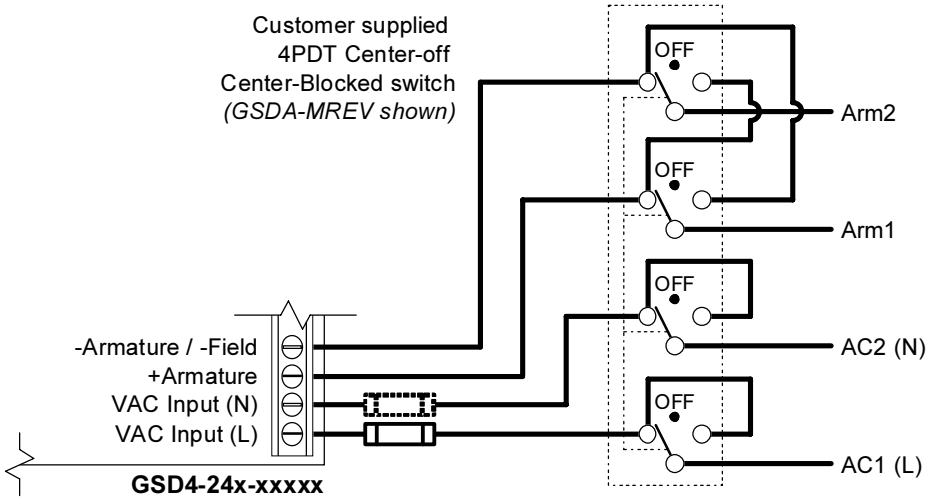
GSD4-240-10N4X BASIC WIRING DIAGRAM



INSTALLATION AND WIRING – WIRING DIAGRAMS (CONTINUED)

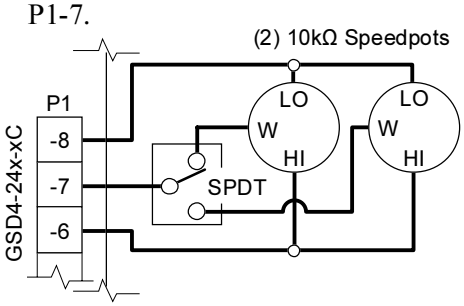
GSD4-24x-xxx REVERSING WIRING DIAGRAM

CAUTION: WHEN REVERSING A SPINNING PERMANENT MAGNET DC MOTOR, CAUTION MUST BE TAKEN THAT THE RESULTING CURRENT THROUGH THE ARMATURE OF THE MOTOR DOES NOT EXCEED THE OVERLOAD RATINGS OF THE DC DRIVE, OR THE DEMAGNETIZE RATING OF THE MOTOR BEING REVERSED. A CENTER-BLOCKED SWITCH WILL DELAY SWITCHING THE MOTOR DIRECTION. IF USING RELAYS TO AUTOMATICALLY REVERSE THE MOTOR, MAKE SURE TO HAVE A DELAY BETWEEN CHANGING MOTOR DIRECTIONS.



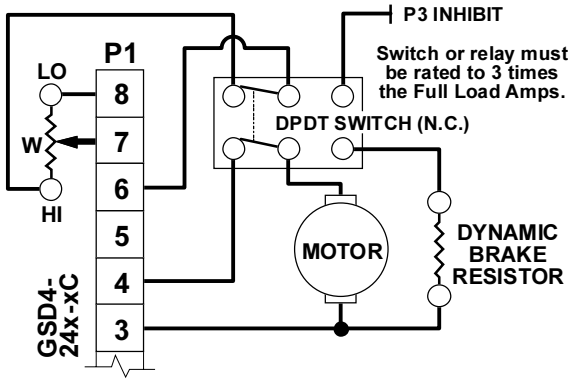
GSD4-24x-xC TWO-SPEED OPERATION

Two-speed operation is done using two 10 kΩ speed potentiometers in parallel, with both Highs connected to terminal P1-6, and both Lows connected to P1-8. A SPDT switch selects which pot Wiper is connected to terminal P1-7.



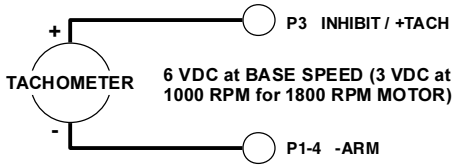
GSD4-24x-xC DYNAMIC BRAKING

A DPDT switch is used to control and to connect a customer-supplied Dynamic Braking Resistor (DBR). Typical values for the DBR are 35–50W at 5Ω for 120V, or 10Ω for 240V. Motor horsepower, inertia, and cycle time affect the sizing of the DBR.



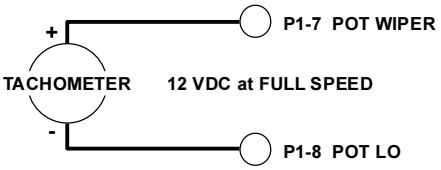
GSD4-24x-xxx TACHOMETER FEEDBACK

Improves regulation to ± 1/2% of base speed.



GSD4-24x-xxx TACHOMETER FOLLOWER

Allows drive output to follow tachometer voltage.



TACHOMETER CONTROL NEEDS TACHOMETER OUTPUT OF 7VDC/1000RPM WITH RIPPLE LIMITED TO 1% OR LESS.

INSTALLATION AND WIRING – WIRING DIAGRAMS (CONTINUED)

INHIBIT FEATURE START/STOP CONTROL

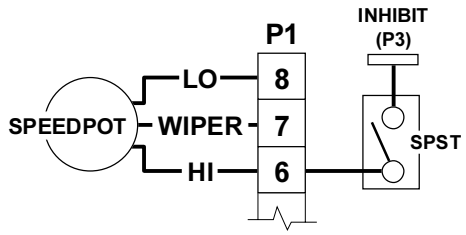
The inhibit feature allows the motor to be remotely started and stopped using a lower-rated 12VDC contact in the drive control circuit, instead of a higher-rated contact in the power circuit.

GSD4-24X-XC INHIBIT (USED INDEPENDENTLY)

This inhibit method bypasses the drive's Accel and Decel settings to start and stop the motor. It instantly shuts off the drive's output, and the motor freewheels to a stop. Start and stop rates are determined by the inertia of the load.

The customer-supplied SPST switch is connected in series between the Speed Pot High (P1-6) and the Inhibit pin (P3). To inhibit (stop motor), close Speed Pot High to the Inhibit pin. To restart, return the switch to open.

Fast Stop & Start:

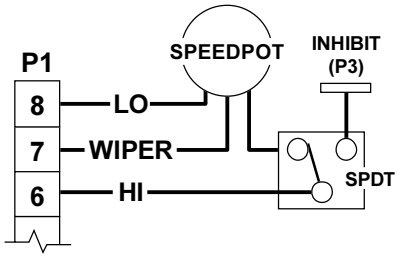


GSD4-24X-XC INHIBIT (USED WITH SPEED POT)

This inhibit method bypasses the drive's Decel settings when stopping the motor, and the motor freewheels to a stop at a rate determined by the inertia of the load. However, the start rate is determined by drive's Accel setting.

The common of the SPDT switch is connected to control pot High, and is switched between Speed Pot High (P1-6) and the Inhibit pin (P3). To inhibit (stop motor), Speed Pot High is closed to the Inhibit pin. To restart, return the switch to Speed Pot High.

Fast Sop. Soft Start (thru accel range):



1) IN THE EVENT OF SCR FAILURE OR FALSE TRIGGERING, THE INHIBIT CIRCUIT WILL NOT STOP THE MOTOR.
2) ALWAYS USE SHIELDED WIRE WHEN CONNECTING TO THE INHIBIT TERMINAL, AND CONNECT THE SHIELD TO THE -ARMATURE OR COMMON OF THE DRIVE.

START-UP

START-UP FOR GSD4-24X-XC

3) Recheck all wiring. Accidental grounds, loose or pinched wires on armature or speed pot wires may damage the DC drive when power is applied.
4) Check to see that the incoming power is of the correct voltage.
5) Turn the speed pot to zero (fully CCW).
6) Turn power on, and advance the speed pot while observing motor.
   Power must be turned off again before step 5 can be accomplished!
7) If the motor rotation is incorrect, turn power off at external disconnect, and reverse the +ARM and -ARM connections.
8) Check for satisfactory operation throughout the speed range.
9) *If operation is satisfactory, no readjustments are needed.*
10) If instability or surging is observed, or if maximum speed is higher than desired, refer to the "Trim Pot Adjustments" section."
11) For other problems, consult the "Troubleshooting" section.

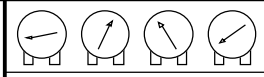
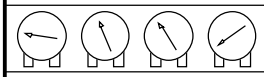
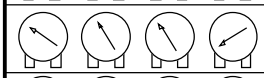
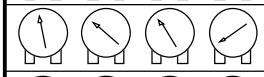
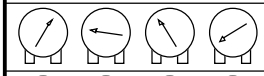
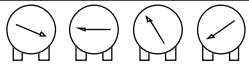
START-UP FOR GSD4-240-10N4X

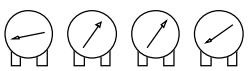
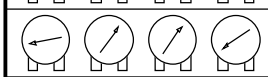
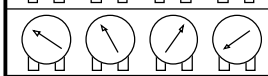
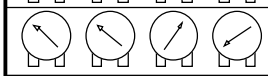
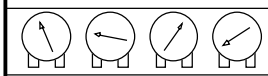
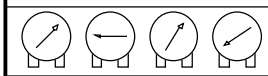
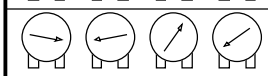
1) Safety Precautions:
   a) Observe the normal safety precautions for the voltages involved. We strongly suggest that only qualified electricians or service people should install, troubleshoot, maintain, or service the drive, motor, and interconnect wiring.
   b) Be sure power is disconnected or shut OFF at fuse box or circuit breaker when installing the drive and making adjustments (except running adjustments).
   c) Remove the load from motor (or gearmotor) before running it.
   d) Use an insulated screwdriver to make trim pot adjustments.



WHEN MAKING RUNNING ADJUSTMENTS, BE VERY CAREFUL NOT TO TOUCH ANY COMPONENTS EXCEPT THE ADJUSTING POTS.

2) On the drive front panel, turn the drive ON-OFF switch to off and set the drive pot knob fully counterclockwise (CCW) and check line fuse. The fuse should be as specified by the Fuse Selection Table.
3) Check all the connections at the drive terminals and at the motor. Make sure that they are tight and are made according to the "Installation and Wiring" section.
4) Rotate the motor's shaft manually to make sure it turns freely. A slight resistance may be noticed.
5) Turn the drive ON-OFF switch to the ON position and then slowly turn the Speed Control knob clockwise (CW) while observing direction of motor rotation. If opposite direction of rotation is desired, correct by turning OFF the drive and then reverse the motor armature connections.
6) With AC line power and control back ON, slowly turn Speed Control knob fully CW while observing the motor. Motor should accelerate smoothly to top speed.
7) Turn OFF control and AC power to drive.
8) Reconnect the motor load that the motor will normally drive.
9) Turn AC power and the drive back ON and adjust the trim pots as shown below for the motor horsepower and voltage being used.

	CL IR MAX MIN	HP
GSD-240-10NX4 **INPUT 120 VAC** **OUTPUT 0-90 VDC**		1/8
		1/4
		1/3
		1/2
		3/4
		1.0
Operation of the control beyond ±10% of the normal line voltage could result in re-adjustment. These adjustments are permanent; periodic re-adjustment is normally not needed.		

	CL IR MAX MIN	HP
GSD-240-10NX4 **INPUT 230 VAC** **OUTPUT 0-180 VDC**		1/4
		1/3
		1/2
		3/4
		1.0
		1.5
		2.0

10) Test the drive and motor under actual operating and load conditions; run the motor through the entire range of speeds required while it is fully loaded. Check motor speed with a tachometer. If control/motor performance is still not satisfactory, continue adjusting the control by following the procedures given in the "GSD4-240-10N4X Trim Pot Adjustment" section on page 15.

TRIM POT ADJUSTMENTS

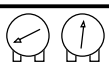
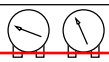
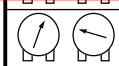
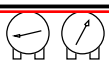
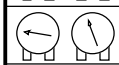
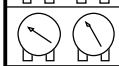
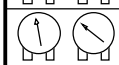
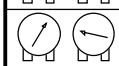
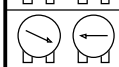
If the system is unstable after the previous Start-Up procedure, then adjust the trim pots as described in this section.

GSD4-24A-5C TRIM POT ADJUSTMENT

GSD4-24A-5C Trim Pot Adjustment *		
Trim Pot	***Function***	***Adjustment***
Min	Sets minimum motor speed when speed pot is set at zero. CW rotation will increase minimum motor speed.	1) Set Speed pot to zero (fully CCW). 2) Rotate MIN trim pot CW until motor starts to rotate. 3) Slowly rotate MIN trim pot CCW until motor stops. NOTE: If motor rotation is desired, rotate MIN trim pot CW until desired MIN speed is reached.
IR Comp	Provides a means of improving motor speed regulation in the armature feedback mode. If a slowdown due to load change is of no concern, rotate this trim pot fully CCW.	1) Set Speed pot at 50%. 2) Observe motor speed at no load condition. 3) Apply full load to motor. 4) Turn IR COMP trim pot CW to obtain the same motor speed as with no load.
Max	Sets maximum motor speed when speed pot is set at maximum (fully CW rotation). CW rotation of MAX trim pot increases maximum motor speed.	1) TURN DRIVE POWER OFF!! 2) Connect a DC Voltmeter: + to +ARM; - to -ARM. *NOTE: Meter must not be grounded!!* 3) Set meter voltage range: (90 VDC for 120 VAC; 180 VDC for 240 VAC). 4) Turn power on. Set Speed pot at 100%. 5) Adjust MAX trim pot to rated motor armature voltage as shown on meter. *NOTE: A tachometer or strobe may be used in lieu of a meter.* Follow above steps, except adjust MAX trim pot to rated motor base speed indicated by tachometer or strobe.
Cur Lim	Limits DC motor armature current (torque) to prevent damage to the motor or drive. The current limit is set for the rated motor current. CW rotation of this trim pot increases the armature current (or torque produced).	1) TURN DRIVE POWER OFF! 2) Connect a DC Ammeter between A1 on motor and +ARM on drive. This is in series with the motor. 3) Turn power on. 4) Set Speed pot at the 50% position. 5) Apply friction braking to motor shaft until motor stalls. 6) With motor stalled, set current at 125% of rated motor armature current by adjusting CUR. LIM. trim pot.
** This adjustment procedure is only for the GSD4-24A-5C DC Drive. Adjustments are done with motor connected to drive.*		

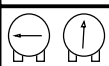
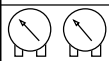
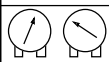
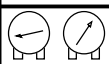
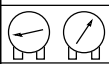
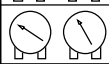
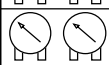
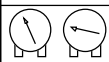
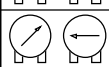
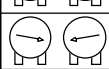
GSD4-240-xC TRIM POT ADJUSTMENT

Settings apply when using a 5K ohm master speedpot. This chart is used in conjunction with the adjustment procedure and is approximate.

	C.L.	I.R.	MAX	MIN	HP
GSD4-240-1C 120 VAC input; 0-90 VDC output					**1/50**
					**1/20**
					**1/8**
GSD4-240-5C 120 VAC input; 0-90 VDC output					**1/8**
					**1/4**
					**1/3**
					**1/2**
					**3/4***
					**1.0***

Operation of the control beyond ±10% of the normal line voltage could result in re-adjustment. These adjustments are permanent; periodic re-adjustment is normally not needed.

Settings apply when using a 5K ohm master speedpot. This chart is used in conjunction with the adjustment procedure and is approximate.

HP	C.L.	I.R.	MAX	MIN	
1/20					**GSD4-240-1C** 240 VAC input; 0-180 VDC output
1/8					
1/4					
1/4					**GSD4-240-5C** 240 VAC input; 0-180 VDC output
1/3					
1/2					
3/4					
1.0					
1.5*					
2.0*					

* ADDITIONAL CUSTOMER HEATSINK REQUIRED for GSD4-240-5C with 120 VAC input & motors > 1/2 hp, and with 240 VAC input & motors > 1hp. Extrusion temperatures must not exceed 70 °C.

TRIM POT ADJUSTMENTS (CONTINUED)

GSD4-240-10N4X TRIM POT ADJUSTMENT

Use the applicable sections of the following procedures if the "Start-Up" procedures did not provide satisfactory motor/control performance. Follow the Safety Precautions given in the "Start-Up" section.

MAX SETTING

If a different maximum speed or voltage is desired, adjust the MAX trim pot (on circuit board) as follows:

1) Turn ON AC power to the control.
2) Set Speed Control knob fully (100%) CW.
3) Check motor speed and voltage with a tachometer and a DC Voltmeter.
4) Using an insulated handle screwdriver, adjust the MAX trim pot on the drive PC board. CW adjustment of the pot increases the maximum output to the motor; CCW adjustment decreases the maximum output to the motor.
   NOTE: Do not increase maximum motor speed above 1800 RPM for motors rated at 1725 RPM. Do not operate motor continuously above the rated DC voltage.

MIN SETTING

If a minimum speed is desired, adjust as follows:

1) Turn ON AC power to the drive.
2) Turn Speed Control knob CCW as far as possible.
3) Check motor output speed or voltage
4) Adjust the MIN trim pot on the drive PC board. CW adjustment of the pot increases output to the motor; CCW adjustment decreases.
   NOTE: Typically the MIN pot should be set at Deadband which is the point in the CW rotation just before getting an output.

IR SETTING

If better speed regulation is needed, then adjust the IR pot as follows:

1) Set speed at 50%.
2) Check speed with Tach at no load.
3) Apply normal load to the motor.
4) Adjust the IR pot CW to increase speed regulation or CCW to decrease speed regulation until loaded motor speed is equal to unloaded motor speed.

CUR LIM SETTING

Limits DC motor current to prevent damage to the motor or drive. CW rotation of this trim pot increases the maximum allowable armature current (or torque produced). To set:

1) Connect a DC current meter between A1 on motor and +ARM on the control (in series with the motor).
2) Set Speed pot at 50% or above.
3) Turn CL trim pot full CCW.
4) Stall and lock motor shaft so it can not spin.
5) With motor stalled, set current at 125% of rated motor current by adjusting CL trim pot CW.

ACCEL/DECEL SETTING

Individually Adjustable Linear Accel and Decel. These trim pots provide independently adjustable linear accel and decel from 0.5 to 8.0 seconds. Adjustment of both trim pots are accomplished via the labeled access holes on adder board. Full CCW rotation equals minimum accel or decel time, and full CW rotation equals maximum accel or decel time. Note: Each trim pot operates independently of the other.

TROUBLESHOOTING

If a newly installed DC Drive will not operate, it is likely that a terminal connection is loose. Check the terminal connections and ensure that they are secure and correct. If the drive is still inoperative, refer to the Troubleshooting Table.

Troubleshooting		
Problem	***Possible Cause(s)***	***Corrective Action***
Motor doesn't run	1) Blown fuse or circuit breaker 2) Incorrect or no power 3) Speed pot set at zero 4) Worn motor brushes	1) Replace fuse or reset breaker 2) Install proper power service 3) Rotate Speed pot CW to start 4) Replace motor brushes
Armature output voltage cannot be adjusted; output is a constant DC level ***Motor stalls, or runs very slowly with speed control set fully CW***	1) No motor or load connected 2) Speed pot low connection open 3) Low voltage 4) Overload condition 5) Worn motor brushes 6) Max speed set incorrectly	1) Ensure that motor or load is connected to armature terminals 2) Ensure that Speed pot Low wire is connected 3) Ensure that VAC is above 100VAC 4) Reduce load or increase motor size Current Limit setting 5) Replace brushes 6) Consult "Trim Pot Adjustments" section
Motor "hunts"	1) Motor current less than 150 mA 2) Too much IR Comp 3) Motor is in Current Limit 4) Motor speed is above rated speed 5) Max set too high	1) Motor current must be greater than 150 mA (DC) 2) Consult "Trim Pot Adjustments" section 3) Consult "Trim Pot Adjustments" section 4) Reduce speed 5) Consult "Trim Pot Adjustments" section
Repeated fuse blowing	1) Low voltage 2) Overload condition 3) Worn motor brushes 4) Defective motor bearings 5) Defective electrical components	1) Ensure that VAC is above 100 VAC for 120V systems and above 200V for 240V systems 2) Reduce load – disconnect to test 3) Replace brushes 4) Replace bearings 5) Contact AutomationDirect "Product Returns" for replacement

MV15 Series (LED Voltage Meters)

FEATURES

- Measurement Function
  - **1 Ø Voltage (True RMS)**
- 3 Digit LED Display

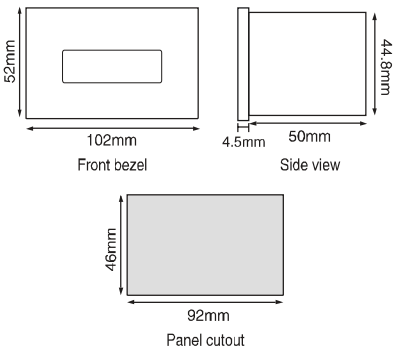


E253771



CAT. NO.	MV15-110V-CU	~~MV15-DC-20V-110V-CU~~ MV15-DC-200V-110V-CU
Display		
Display Type	7 segment LED Display	7 segment LED Display
Digits	3 digits	3 digits
Bargraph	–	–
Display Range	0 - 516V	0 - 516V
Supply Specification	110 VAC +/-20% (60Hz)	110 VAC +/-20% (60Hz)
Input Specification		
Electrical Wire System	1 Phase (2 wire)	1 Phase (2 wire)
Input Voltage Range	50 ~ 516 VAC	**0 ~ 20 VDC (MV15-20V) 0 ~ 200 VDC (MV15-200V)**
Frequency	50/60 Hz	50/60 Hz
Input Impedance	1 MΩ (+/-5%)	1 MΩ (+/-5%)
Parameter Resolution		
Voltage	1V	1V
Sample Rate	3 samples / sec.	3 samples / sec.
Accuracy Class		
Voltage	+/- 0.5% of Full-Scale Value	+/- 0.5% of Full-Scale Value
Output Specifications		
Pulse Output	–	–
Communication	–	–
Programmable Parameters	–	–
Environmental Specifications		
Temperature	Operating: -10°C~55°C, Storage: -20°C~ 75°C	Operating: -10°C~55°C, Storage: -20°C~ 75°C
Humidity	Up to 85% RH	Up to 85% RH
Protection Level	IP65 for Faceplate	IP65 for Faceplate
Physical Specifications		
Size	1/8 DIN, 48 mmx 96 mm	1/8 DIN, 48 mmx 96 mm
Weight	0.38 lbs (170g)	0.38 lbs (170g)
Terminal Size Acceptability and Torque	20-14 AWG (0.5 - 2.5mm²), 6-7 lb-in. (0.68 - 0.79Nm)	20-14 AWG (0.5 - 2.5mm²), 6-7 lb-in. (0.68 - 0.79Nm)

DIMENSIONS



MV15 Series

TERMINAL CONNECTIONS



MV15-110V-CU (AC Type)



MV15-DC-20V-110V-CU (DC Type)
MV15-DC-200V-110V-CU (DC Type)

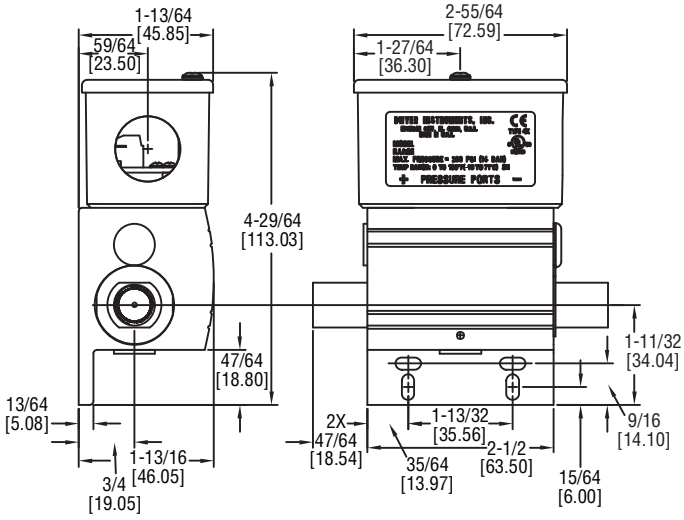
230 VAC versions also available, please consult Altech.

Altech Corp.® • 35 Royal Road • Flemington, NJ 08822-6000 • Phone (908)806-9400 • FAX (908)806-9490 • www.altechcorp.com

Series DX Differential Pressure Switch

Specifications - Installation and Operating Instructions





The Series DX is a pressure switch that makes a contact output based on the differential pressure between two pressure sources. Unit incorporates a SPDT snap switch in a weatherproof, type 4X enclosure. Series DX features low differential pressure set points with high single pressure limit.

OPERATING PRINCIPLE

The DX uses opposing diaphragms to sense the high and low pressure. A pivot mechanism transfers the difference of the two pressures to the switch.

Example	DX	W	1	1	153	2	M	DXW-11-153-2-M
Series	DX							Differential Pressure Switch
Construction		W						Weatherproof
Wetted Materials			1					Brass/Fluoroelastomer
Process Connection				1				1/4″ NPT
Circuit Options					153			SPDT
Range						1 2 3 4		2.5 to 10 psi 10 to 25 psi 25 to 50 psi 50 to 75 psi
Options							SST PRESET	Stainless Steel tag Preset set point

SPECIFICATIONS

Service: Compatible gases and liquids.
Wetted Materials: Connection: Brass; Diaphragm: Fluoroelastomer.
Temperature Limits: 30 to 140°F (-1 to 60°C).
Pressure Limits: 200 psig (13.8 bar).
Enclosure Rating: Weatherproof UL type 4X (IP65).
Repeatability: ±2% of full range.
Switch Type: SPDT snap switch.
Electrical Rating: 5A @ 125/250 VAC (~), 5A res. @ 30 VDC (⎓).
Electrical Connection: Removable terminal block.
Conduit Connection: 0.871″ diameter hole for 1/2″ conduit fitting.
Process Connection: 1/4″ NPT female. Continuous single side only pressure should not exceed 1.25 x full differential range.
Mounting Orientation: Ports on horizontal plane, ±10°.
Set Point Adjustment: External screw.
Housing Materials: Body: Aluminum; Housing: Polycarbonate; Cover: 300 SS.
Vibration and Shock: Set point repeats after 2.5 Gs, 5 to 500 Hz. Set point repeats after a 15 Gs, 10 millisecond duration.
Altitude Limit: 6560 ft (2000 m).
Humidity Limit: 80% (non-condensing).
Pollution Degree: 2.
Environment: Intended for indoor and outdoor use.
Weight: 1 lb 3 oz (0.54 kg).
Agency Approvals: CE, UL.

Adjustable Range psid (bar)	Fixed Deadband psid (bar)	
	At Low Set Point	At High Set Point
2.5 to 10 (0.17 to 0.69)	1.5 (0.10)	2.5 (0.17)
10 to 25 (0.69 to 1.72)	2.5 (0.17)	3.5 (0.24)
25 to 50 (1.72 to 3.45)	3.5 (0.24)	6.0 (0.41)
50 to 75 (3.46 to 5.17)	6.0 (0.41)	8.0 (0.55)

Approximate Deadbands

DWYER INSTRUMENTS, INC.
P.O. BOX 373 • MICHIGAN CITY, INDIANA 46361, U.S.A.
Phone: 219/879-8000
Fax: 219/872-9057
www.dwyer-inst.com
e-mail: info@dwyer-inst.com

UNPACKING

Remove the DX from the shipping carton and inspect for damage. If damage is found, notify the carrier immediately.

INSTALLATION

⚠CAUTION Insure that the process fluid is compatible with the wetted materials.

⚠CAUTION Do not exceed the maximum device ratings.

⚠CAUTION Insure that the system is not pressurized before installing or removing this device or other objects from the system.

The DX is to be mounted with the pressure connections horizontal ±10°.

For pipe mounting, mount the unit from the pressure connections to the pipe. Make sure the piping is properly supported to handle the weight of the pressure switch.

For surface mounting, mount the unit to the selected surface using the mounting ear holes provided using two #6 or #8 screws. See the Figure 2 for mounting hole spacing.

Make sure that connections are connected to the proper port. The high pressure port is marked with the "+" sign and is on the left side of the unit with the label side facing you. The low pressure port is marked by the "-" sign and is the right side of the unit. Piping or tubing should always be turned into the pressure port, do not turn the pressure switch. When installing the piping or tubing into the switch always use a wrench on the flats of the pressure connection. Use pipe thread sealant tape or other suitable pipe joint compound when making the pressure connection.

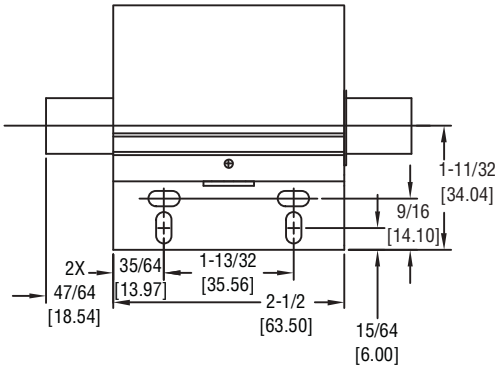


Figure 2: Mounting Hole Dimensions

ELECTRICAL CONNECTION

A SPDT snap action switch is provided. The output logic is shown in Table 1.

Condition	NO	NC
Differential Pressure Above Set Point	Closed	Open
Differential Pressure Below Set Point	Open	Closed

Table 1: Switch Action

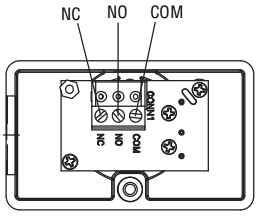


Figure 2: Wiring Diagram

⚠WARNING Power must be off while wiring connections are being made.

NOTICE Installation must be made in accordance with local codes and regulations.

Electrical connections are made to the removable terminal block inside the enclosure. Remove the terminal block from the circuit board for wiring if desired. Feed stripped and tinned leads through the conduit opening and connect them as shown in Figure 2. 250V @ 60C 14 to 24 AWG / 2.5 to .25 mm² wiring with PVC or equivalent insulation with 94-V0 or FV-0 flammability rating is recommended for the switch. Replace terminal block after wiring. The DX provides one 0.871″ diameter hole for 1/2″ conduit fitting. The conduit connections must be made such that condensation is not allowed to enter the sensor housing. If necessary install a conduit breather drain in a separate conduit body to prevent buildup of moisture.

NOTICE For weatherproof applications, install directly to conduit or use the optional cable gland accessory.

SETPOINT ADJUSTMENT

The set point is adjusted with a standard slotted head screw driver.

1) Remove rubber plug over set point adjustment screw located on the right side of the unit (with the label side facing you).
2) Insert the screw driver to turn the set point adjustment.
3) A clockwise rotation is an increase in differential pressure set point and a counterclockwise rotation is a decrease in differential pressure set point. (The set point screw can be turned too far as to fall out; do not turn the screw to the point that there are no longer any female threads visible in the switch body).
4) Using a pressure source and pressure gauge adjust the set point screw to the set point desired while monitoring the contact output.
5) Once desired set point is achieved replace set point adjustment cover.

NOTICE Design a fail-safe system that takes into consideration the possibility of switch failure, power failure, and operator error.

Explanation of Symbols:

Symbol	Publication	Description
⎓	IEC 50417 - 5031	Direct current
~	IEC 50417 - 5032	Alternating current
⏚	IEC 50417 - 5019	Protective conductor terminal

MAINTENANCE & REPAIR

Inspect and clean switch with water or damp cloth as needed. Disassembly or modifications made by the user will void the warranty and could impair the continued safety of the product. If repair is required obtain a Return Goods Authorization (RGA) number and send the unit, freight prepaid, to the address below. Please include a detailed description of the problem and conditions under which the problem was encountered.

Dwyer Instruments, Inc.
Attn: Repair Department
102 Indiana Hwy 212
Michigan City, IN 46360

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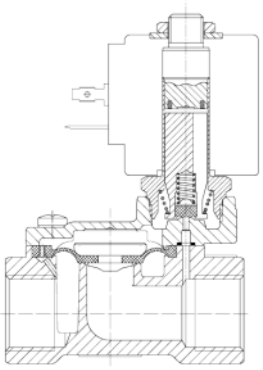
DWYER INSTRUMENTS, INC.
P.O. BOX 373 • MICHIGAN CITY, INDIANA 46361, U.S.A.
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e-mail: info@dwyer-inst.com

GRANZOW® INC.

Series W
SOLENOID VALVE

Model
W4B11-000

2-way, internally piloted, normally closed solenoid valve





1/2"	1/2"	4.90	120 VAC	8 watts	3–232 psi
Pipe Size (Inch)	Orifice Size (Inch)	Flow Factor (CV)	Voltage (AC)	Wattage (W)	Pressure Range (PSI)

NBR	14°–195° F	Conduit DIN	Air, Inert gas, Water
Sealing Material	Temperature Range	Connector Supplied	Medium Examples

Materials of Construction

Body:	**Brass**
Armature Tube:	**Stainless Steel 300**
Fixed Core:	**Stainless Steel 400**
Plunger:	**Stainless Steel 400**
Spring:	**Stainless Steel 300**
Shading Ring:	**Copper**
Orifice:	**Brass**
Pipe Threading:	**NPT**

Electrical Specifications

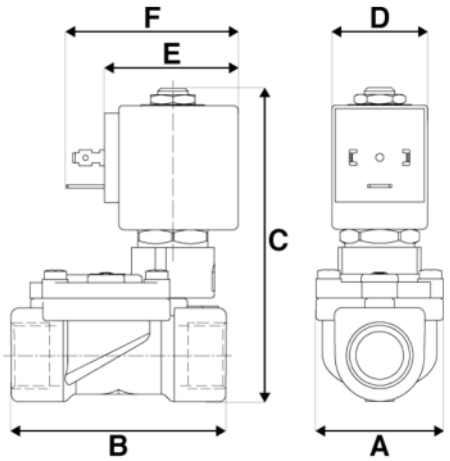
Rating:	**NEMA 4**
Inrush VA:	**25.0**
Holding VA:	**14.5**

Spare Part Numbers

Armature Tube:	**AT-A001**
Repair Kit:	**RK-W001**
Coil/Connector:	**C-B11**

Valve Dimensions

Valve Width **(A)**:	**1 9/16"**
Valve Length **(B)**:	**2 19/32"**
Valve Height **(C)**:	**3 13/16"**
Coil Width **(D)**:	**1 3/16"**
Coil Length **(E)**:	**1 21/32"**
Coil Length **(F)**:	**2 1/8"**



Note: Valve is pictured above with a sample coil, which may not reflect the exact specifications of this particular part number.

Granzow, Inc.• 2300 Crownpoint Executive Drive, Charlotte, NC 28227-6702 • Phone (704) 845-2300 • Fax (704) 845-2301

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Flo-Rite™ Series FR Flowmeters

DESCRIPTION

Series FR2000/FR4000/FR4500/FR5000 is a standard precision-machined acrylic flow meter for liquids or gases, has direct reading air or water scales and is available in either English or Metric scales.

The FR2000/FR4000/FR4500 flowmeters can be configured with a control valve on the inlet or no valve at all; fittings and valve can be specified in either brass or stainless steel; O-rings can be provided with Buna-N, Viton® or other optional elastomers.

FR5000 flowmeters have 1" FNPT PVC fittings with either an inline (FR5000-I) or panel mount (FR5000-S) configuration. The panel mount version is available with an integral valve on the inlet (FR5000-V) or no valve at all.

FEATURES

- Easy-to-read English or Metric Scales
- Water ranges from 4 CCM to 20 GPM
- Air ranges from 40 CCM to 4000 LPM
- Threaded brass inserts for quick installation
- Easy disassembly and assembly for maintenance
- Durable one-piece clear acrylic construction
- Stable, easy-to-read float
- Superior quality

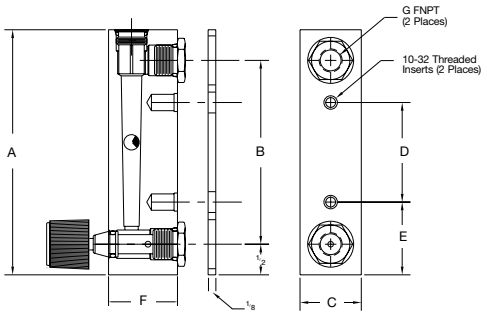
APPLICATIONS

- Air sampling equipment aquaculture
- Desalinization equipment
- Gas analyzers
- Medical systems
- Photoprocessing equipment
- Water treatment and distribution systems

SPECIFICATIONS

Accuracy	~~Model FR2000 ±5% Full Scale~~ Model FR4000 & FR4500 ±3% Full Scale ~~Model FR5000 ±2% Full Scale~~
Floats	Black Glass, Stainless Steel, Delrin®
Body	Clear Acrylic
Seals	Buna-N O-Rings with Brass Fittings ~~Viton® O-Rings with Stainless Steel Fittings~~
Pressure	100 PSIG Max
Temperature	150°F/65°C Max
Fittings	Brass, Stainless Steel or FNPT Pipe Connections
Valves ~~(optional)~~	Model FR2000/4000/4500 Brass or Stainless Steel Model FR5000 Integral Valve on "V" Models Inline Gate Valve is available for the "S" & "I"

SERIES FR2000/FR4000/FR4500 FLOWMETER

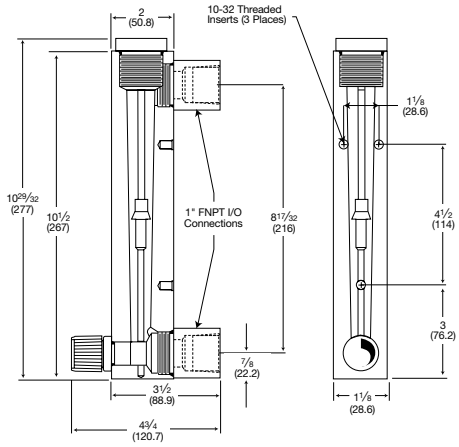


DIMENSIONS inches/millimeters (mm)

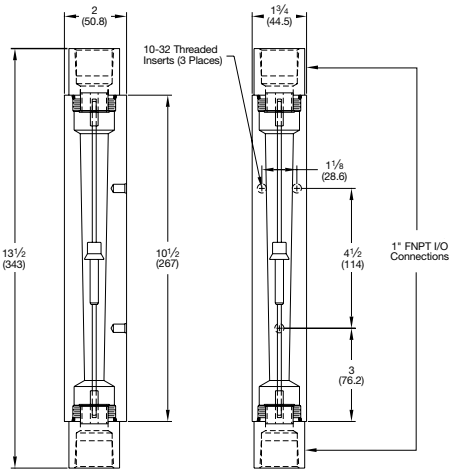
MODEL	A	B	C	D	E	F	G
FR2000	4" (102)	3" (76.2)	1" (25.4)	1⅝" (41.3)	1³⁄₁₆" (30.2)	1⅛" (28.6)	1/8"
FR4000	6½" (165)	5½" (140)	1⅜" (34.9)	3½" (88.9)	1½" (38.1)	1⅛" (28.6)	1/8"
FR4500*	6⅝" (168)	5½" (140)	1⅛" (28.6)	3½" (88.9)	1½" (38.1)	1⅜" (34.9)	1/4"

* Does not include 1/8" back plate

SERIES FR5000-S OR V



SERIES FR5000-I



KEY INSTRUMENTS • 250 Andrews Road • Trevose, PA 19053 • 800.356.7483 • 215.357.0893 • Fax: 215.357.9239
www.KeyInstruments.com • sales@keyinstruments.com

Flo-Rite™ Series FR Flowmeters

SERIES FR2000 FLOW RATES TABLE A **

Range SCFH of Air	Model Code	Range LPM of Air	Model Code
.1-1	2A00	.04-.5	2A12
.2-2	2A01	.1-1	2A13
.4-5	2A02	.2-2.5	2A29
1-10	2A03	.4-5	2A14
2-20	2A04	1-10	2A15
3-30	2A05	2-25	2A16
4-50	2A06	4-50	2A17
10-100	2A07	10-100	2A18
20-200	2A08	**GPH of Water**	
CCM of Water		.2-2	2L28
5-50	2L09	.4-5	2L19
10-100	2L10	1-10	2L20
20-240	2L11	2-20	2L21
		4-40	2L22

SERIES FR4000 FLOW RATES TABLE B **

Range SCFH of Air	Model Code	Range CCM of Water	Model Code
.4-5	4A30	4-50	4L38
1-10	4A31	10-120	4L56
2-20	4A32	25-225	4L51
4-40	4A33	40-400	4L50
10-100	4A34	40-660	4L52
14-150	4A35	100-1500	4L53
20-200	4A36	200-3000	4L54
CCM of Air		300-3700	4L55
100-1000	4A39*	**GPH of Water**	
LPM of Air		1-10	4L45
.4-5	4A40	2-25	4L48
1-10	4A41	4-50	4L49
2-20	4A42	6-60	4L46
3-30	4A43	**SCFM of Air**	
4-50	4A44	.3-3	4A37
10-100	4A47		

* Uses Delrin® Float
** Available with millimeter scales. Flow curves for a variety of gases and liquids for specific applications may also be ordered.

SERIES FR4500 FLOW RATES TABLE C

Range SCFM of Air	Model Code	Range GPM of Water	Model Code
.5-5	4A67	.2-2.5	4L64
1-10	4A65	.4-5	4L66
*2-20	4A68	**LPM of Water**	
LPM of Air		.8-9	4L69
14-140	4A72	1.5-20	4L71
30-280	4A70	Dual scales: SCFM/SCFH, GPM/GPH, and LPM/LPH	
*60-560	4A73		

* Not Available with Valves

SERIES FR5000-S OR V FLOW RATES TABLE D

Range SCFM of Air	Model Code	Range GPM of Water	Model Code
3-25	5A50	.4-5	5L56
4-50	5A51	1-10	5L57
10-100	5A52	2-20	5L58
LPM of Air		**LPM of Water**	
100-700	5A53	1-19	5L59
100-1400	5A54	4-36	5L60
400-3400	5A55	5-75	5L61

SERIES FR5000-I FLOW RATES TABLE E

Range SCFM of Air	Model Code	Range GPM of Water	Model Code
3-25	5A50	.4-5	5L56
4-50	5A51	1-10	5L57
10-100	5A52	2-20	5L58
LPM of Air		**LPM of Water**	
100-700	5A53	1-19	5L59
100-1400	5A54	4-36	5L60
400-4000	5A55	5-75	5L61

Periodically, product revisions occur. Please consult the factory for the latest specifications.

ORDERING INFORMATION 2 INCH / 4 INCH SCALE

Catalog Number Ordering Example: **FR2A04BVBN**

EXAMPLE:	FR	2A04	B	V	BN

Acrylic Flowmeter
Product Code

Model Number
From Tables A, B & C

Fittings
B = Brass (std), S = Stainless Steel

Valve
N = No Valve, V = Standard Inlet Valve

Seals
BN = Buna-N (std with brass fittings),
VT = Viton® (std with stainless steel),
S = Special (specify compound)

Catalog Number Ordering Example: **FR4A30SNVT**

EXAMPLE:	FR	4A30	S	N	VT

Acrylic Flowmeter
Product Code

Model Number
From Tables A, B & C

Fittings
B = Brass (std), S = Stainless Steel

Valve
N = No Valve, V = Standard Inlet Valve

Seals
BN = Buna-N (std with brass fittings),
VT = Viton® (std with stainless steel),
S = Special (specify compound)

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ECX Series 22 mm Plastic Indicator Lights

Plastic incandescent indicator lights



ECX1051-24

These indicators have a key to prevent rotation when mounted.

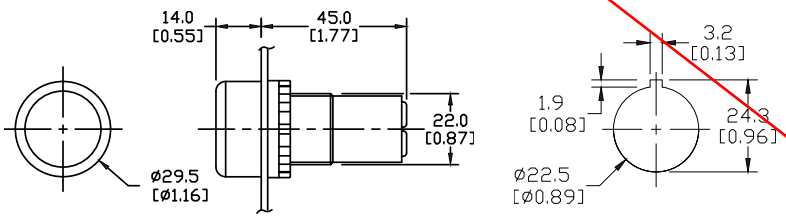
12 models available:

- Available in six colors
- 24V and 120V models
- Incandescent bulbs included
- Accepts LED replacement lamps
- Monoblock design for easy mounting
- Side wire entry with back screw terminals for easy wiring and maintenance
- IP20 rated before installation
- IP65 rated after installation

Note: When using LED replacement lamps with these indicators, it may be necessary to remove the frosted diffuser for enhanced illumination.

Part Number	Lamp Color	Price	Description	Replacement Incandescent Bulb	Replacement Lamp
ECX1051-24	Red	<--->	22 mm monoblock incandescent indicator light, **24VDC/VAC**	ECX1902-5 5/pk 80mA	ECX1911-2 2/pk 26mA
ECX1051-120	Red	<--->	22 mm monoblock incandescent indicator light, **120VDC/VAC**	ECX1904-5 5/pk 20mA	ECX1921-2 2/pk 5mA
ECX1052-24	Green	<--->	22 mm monoblock incandescent indicator light, **24VDC/VAC**	ECX1902-5 5/pk 80mA	ECX1912-2 2/pk 26mA
ECX1052-120	Green	<--->	22 mm monoblock incandescent indicator light, **120VDC/VAC**	ECX1904-5 5/pk 20mA	ECX1922-2 2/pk 5mA
ECX1053-24	Yellow	<--->	22 mm monoblock incandescent indicator light, **24VDC/VAC**	ECX1902-5 5/pk 80mA	ECX1913-2 2/pk 26mA
ECX1053-120	Yellow	<--->	22 mm monoblock incandescent indicator light, **120VDC/VAC**	ECX1904-5 5/pk 20mA	ECX1923-2 2/pk 5mA
ECX1054-24	Blue	<--->	22 mm monoblock incandescent indicator light, **24VDC/VAC**	ECX1902-5 5/pk 80mA	ECX1914-2 2/pk 26mA
ECX1054-120	Blue	<--->	22 mm monoblock incandescent indicator light, **120VDC/VAC**	ECX1904-5 5/pk 20mA	ECX1924-2 2/pk 5mA
ECX1055-24	Clear	<--->	22 mm monoblock incandescent indicator light, **24VDC/VAC**	ECX1902-5 5/pk 80mA	ECX1915-2 2/pk 26mA
ECX1055-120	Clear	<--->	22 mm monoblock incandescent indicator light, **120VDC/VAC**	ECX1904-5 5/pk 20mA	ECX1925-2 2/pk 5mA
ECX1056-24	White	<--->	22 mm monoblock incandescent indicator light, **24VDC/VAC**	ECX1902-5 5/pk 80mA	ECX1915-2 2/pk 26mA
ECX1056-120	White	<--->	22 mm monoblock incandescent indicator light, **120VDC/VAC**	ECX1904-5 5/pk 20mA	ECX1925-2 2/pk 5mA

Dimensions: mm [inches]



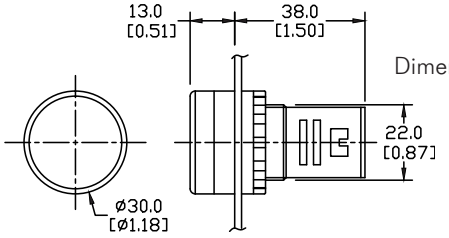
Plastic LED indicator lights



10 models available:

- Available in five colors
- 24V and 120V models
- Non-replaceable LEDs
- Side wire entry with back screw terminals for easy wiring and maintenance
- IP20 rated before installation
- IP65 rated after installation
- 12 mA @ 120V, 65 mA @ 24V

Part Number	Lamp Color	Price	Description
ECX2051-24L	Red	<--->	22 mm non-metal monoblock LED indicator light, **24VDC/VAC**
ECX2051-127L	Red	<--->	22 mm non-metal monoblock LED indicator light, **120VDC/VAC**
ECX2052-24L	Green	<--->	22 mm non-metal monoblock LED indicator light, **24VDC/VAC**
ECX2052-127L	Green	<--->	22 mm non-metal monoblock LED indicator light, **120VDC/VAC**
ECX2053-24L	Yellow	<--->	22 mm non-metal monoblock LED indicator light, **24VDC/VAC**
ECX2053-127L	Yellow	<--->	22 mm non-metal monoblock LED indicator light, **120VDC/VAC**
ECX2054-24L	Blue	<--->	22 mm non-metal monoblock LED indicator light, **24VDC/VAC**
ECX2054-127L	Blue	<--->	22 mm non-metal monoblock LED indicator light, **120VDC/VAC**
ECX2055-24L	Clear	<--->	22 mm non-metal monoblock LED indicator light, **24VDC/VAC**
ECX2055-127L	Clear	<--->	22 mm non-metal monoblock LED indicator light, **120VDC/VAC**



Dimensions: mm [inches]

For accessories, see 22 mm Plastic Pilot Device Accessories in this section.

Octal Base Plug-In General-Purpose Relay — MKS Series

RoHS

Reliable, high quality, long life. Silver contacts rated at 10 amps. UL, CSA rated. Built-in indicator standard. **Options Include:** LED indicator, diode or varistor suppression and reverse polarity coil connections. All MKS models with "I" also come with push-to-test button.



With Test Button

DPDT, 10 Amp

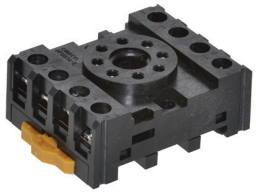
Stock No.	Mfr.'s Type	Coil Rating			Features	EACH
		Voltage (V)	Curr. (mA)	Res. (Ohms)		
70178929	MKS2PI DC12	12 VDC	126.0	95.0	Button	12.44
70178930	MKS2PI DC24	24 VDC	56.0	430.0	Button	11.66
70178934	MKS2PIN DC24	24 VDC	56.0	430.0	Button/LED	15.10
70178935	MKS2PN DC24	24 VDC	56.0	430.0	LED	15.10
70178931	MKS2PI DC48	48 VDC	29.5	1630.0	Button	12.49
70178928	MKS2PI DC110	110 VDC	15.1	7300.0	Button	12.49
70178924	MKS2PI AC12	12 VAC	180.0	16.3	Button	12.44
70178926	MKS2PI AC24	24 VAC	88.0	68.0	Button	12.44
70178933	MKS2PIN AC24	24 VAC	88.0	68.0	Button/LED	15.10
70178925	MKS2PI AC120	120 VAC	18.0	1578.0	Button	13.35
70178932	MKS2PIN AC120	120 VAC	18.0	1578.0	Button/LED	15.37
70178927	MKS2PI AC240	240 VAC	9.2	6737.0	Button	14.22

3PDT, 10 Amp

70178948	MKS3PI DC12	12 VDC	126.0	95.0	Button	15.09
70178946	MKS3PI-5 DC12	12 VDC	126.0	95.0	Button	14.21
70178947	MKS3PI-5 DC24	24 VDC	56.0	430.0	Button	14.21
70178950	MKS3PIN-5 DC24	24 VDC	56.0	430.0	Button/LED	16.86
70178945	MKS3PI-5 DC110	110 VDC	15.1	7300.0	Button	15.99
70178943	MKS3PI-5 AC24	24 VAC	88.0	68.0	Button	14.21
70178942	MKS3PI-5 AC120	120 VAC	18.0	1578.0	Button	15.09
70178949	MKS3PIN-5 AC120	120 VAC	18.0	1578.0	Button/LED	14.99
70178944	MKS3PI-5 AC240	240 VAC	9.2	6737.0	Button	15.99

Quality Sockets and Clips for Relays

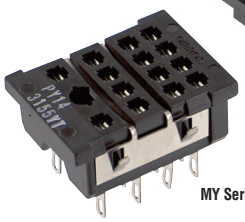
RoHS



MK Series



LY Series



MY Series

Stock No.	Mfr.'s Type	For Relay Series	Application	EACH		
				1-49	50-99	100-249
70179013	PF083A-E	MK 2-Pole	Surface- or Rail-Mount	3.72	3.50	3.33
70179014	PF113A-E	MK 3-Pole	Surface- or Rail-Mount	5.27	4.95	4.72
70179022	PL08	MK 2-Pole	Solder	1.87	1.76	1.67
70179023	PL11	MK 3-Pole	Solder	2.26	2.13	2.02
70179024	PLE08-0	MK 2-Pole	PCB Terminal	2.87	2.72	2.58
70179025	PT08	LY 1- and 2-Pole	Solder	1.75	1.65	1.56
70179026	PT08-0	LY 1- and 2-Pole	PCB Terminal	1.44	1.35	1.31
70179027	PT14-0	LY 4-Pole	PCB Terminal	2.28	2.16	2.04
70179028	PTF08A-E	LY 1- and 2-Pole	Surface- or Rail-Mount	4.19	3.93	3.75
70179029	PTF11A	LY 3-Pole	Surface- or Rail-Mount	6.69	6.32	6.00
70179033	PTF14A-E	LY 4-Pole	Surface- or Rail-Mount	6.01	5.64	5.38
70179032	PTF14A-E	LY 4-Pole	Surface- or Rail-Mount	10.32	9.79	9.35
70179048	PYF14A-N	MY 4-Pole	Surface- or Rail-Mount	6.68	6.32	5.99
70179037	PY08-02	MY 2-Pole	PCB Terminal	1.24	1.17	1.11
70179038	PY14	MY 4-Pole	Solder	1.71	1.61	1.52
70179039	PY14-02	MY 4-Pole	PCB Terminal	1.71	1.61	1.52
70179042	PYF08A-E	MY 2-Pole	Surface- or Rail-Mount	4.90	4.61	4.35
70179047	PYF14A-E	MY 4-Pole	Surface- or Rail-Mount	6.54	6.12	5.86
70179049	PYF14S	MY 4-Pole	Screwless Socket	9.72	9.12	8.71

Accessories

Stock No.	Mfr.'s Type	Description	Used With	EACH		
				1-24	25-49	50-99
70179016	PFP-100N	DIN Rail, 1 m	All Relay Sockets	6.30	5.93	5.60
70179015	PFC-A1	Hold-Down clip	PF083A-E, PF113A-E	.76	.70	.66
70179040	PYC-A1	Hold-Down Clip	PTF08A-E, PTF11A, PTF14A-E, PYF08A-E, PYF08A-N, PYF14A-E, PYF14A-N	.22	.21	.20

Slim, Space-Saving Power Plug-In Relay — G2RS Series

RoHS



One and two pole plug-in relays. **Specifications. Contact Form:** G2R-1-S — SPDT; G2R-2-S — DPDT. **Contact Resistance:** 100 mΩ. **Contact Ratings:** G2R-1-S — 10 A @ 250 VAC; G2R-2-S — 5 A @ 250 VAC (resistive). **Operate Time:** 15 ms max. **Release Time:** 1 pole = AC — 10 ms max.; DC — 5 ms max.; 2 pole = AC — 15 ms max.; DC — 10 ms max.; Diode version = 20 ms max. Available options include LED indicators, push-to-test button, and diode suppression (DC coils). Other coil voltages available.

General-Purpose Relays

Stock No.	Mfr.'s Type	Contact Form	Coil Ratings				EACH		
			Voltage	Current (mA)	Res. (Ohms)	Power Consump.	1-24	25-49	50-99
70178581	G2R-1-S DC6(S)	SPDT	6 VDC	88.2	68	0.530 W	4.24	3.92	3.60
70178579	G2R-1-S-DC12(S)	SPDT	12 VDC	43.2	278	0.530 W	4.72	4.43	4.23
70178580	G2R-1-S-DC24(S)	SPDT	24 VDC	21.6	1113	0.530 W	3.80	3.63	3.48
70178578	G2R-1-S-AC24(S)	SPDT	24 VAC	37.4	253	0.900 VA	5.92	5.57	5.30
70178577	G2R-1-S-AC120(S)	SPDT	120 VAC	7.5	7286	0.900 VA	6.94	6.50	6.21
70179136	G2R-2-S-DC12(S)	DPDT	12 VDC	43.2	278	0.530 W	4.88	4.66	4.39
70178598	G2R-2-S-DC24(S)	DPDT	24 VDC	21.6	1113	0.530 W	5.40	5.04	4.83
70178596	G2R-2-S-AC24(S)	DPDT	24 VAC	37.4	253	0.900 VA	7.51	7.04	6.72
70178595	G2R-2-S-AC120(S)	DPDT	120 VAC	7.5	7286	0.900 VA	7.40	7.06	6.65

Relays with Diode

70178582	G2R-1-SD DC24(S)	SPDT	24 VDC	21.8	1100	0.530 W	6.05	5.74	5.48
70178599	G2R-2-SD-DC24(S)	DPDT	24 VDC	21.6	1113	0.530 W	6.75	6.54	6.34

Relays with LED Indicator

70178586	G2R-1-SN-DC12(S)	SPDT	12 VDC	43.2	278	0.530 W	7.37	7.14	6.92
70178587	G2R-1-SN-DC24(S)	SPDT	24 VDC	21.6	1113	0.530 W	7.72	7.24	6.92
70178590	G2R-1-SNDI DC24(S)	SPDT	24 VDC	21.6	1113	0.530 W	10.10	9.60	8.54
70178585	G2R-1-SN AC24(S)	SPDT	24 VAC	37.4	253	0.900 VA	7.53	7.20	6.76
70178583	G2R-1-SN-AC110(S)	SPDT	110 VAC	8.2	5566	0.900 VA	9.54	8.95	8.56
70178584	G2R-1-SN-AC120(S)	SPDT	120 VAC	7.5	7286	0.900 VA	11.32	10.61	10.14
70178602	G2R-2-SN-DC24(S)	DPDT	24 VDC	21.6	1113	0.530 W	10.50	9.85	9.40
70178600	G2R-2-SN-AC120(S)	DPDT	120 VAC	7.5	7286	0.900 VA	10.95	10.27	9.80

Relays with LED Indicator and Diode

70178588	G2R-1-SND-DC12(S)	SPDT	12 VDC	43.2	278	0.530 W	11.14	10.42	9.96
70178589	G2R-1-SND-DC24(S)	SPDT	24 VDC	21.6	1113	0.530 W	8.74	8.32	7.52
70178603	G2R-2SND-DC12(S)	DPDT	12 VDC	43.2	278	0.530 W	10.36	10.05	9.73
70178604	G2R-2-SND-DC24(S)	DPDT	24 VDC	21.6	1113	0.530 W	12.39	11.63	11.11
70178605	G2R-2-SNI DC24(S)	DPDT	24 VDC	21.6	1113	0.530 W	8.40	7.93	7.52
70178601	G2R-2-SN AC24(S)	DPDT	24 VAC	37.4	253	0.900 VA	9.67	9.14	8.67

Accessories

Stock No.	Mfr.'s Type	Description	EACH
70179003	P2RF-05	Track (DIN) mounted socket for G2R-1-S, Solder Terminals	6.15
70179004	P2RF-05-E	Track (DIN) mounted socket for G2R-1-S, Screw Terminals	3.61
70179001	P2R-05P	PCB Back mount socket for G2R-1-S	1.60
70179006	P2RF-08	Track (DIN) mounted socket for G2R-2-S, Solder Terminals	7.39
70179007	P2RF-08-E	Track (DIN) mounted socket for G2R-2-S, Screw Terminals	6.38
70179002	P2R-08P	PCB Back mount socket for G2R-2-S	1.78

Octal Base Dual Coil Magnetic Latching Relay — MK2KP Series

RoHS



Reliable, high quality, long life. Silver contacts rated at 10 amps. UL, CSA rated. Built-in indicator standard. **Options Include:** LED indicator, suppression diode or varistor.

Stock No.	Mfr.'s Type	Contact Form	Coil Rating			EACH		
			Voltage (V)	Curr. (mA)	Res. (Ohms)	1-24	25-49	50-99
70178907	MK2KP-UA-AC24	DPDT-S*	24 VAC	66.0	105.0	43.97	41.56	39.40
		DPDT-R*		10.8	965.0			
70178906	MK2KP-UA-AC120	DPDT-S*	120 VAC	19.0	1900.0	39.90	37.41	35.72
		DPDT-R*		4.2	12400.0			
70178908	MK2KP-UA-DC12	DPDT-S*	12 VDC	205.0	52.0	38.45	37.07	35.14
		DPDT-R*		50.0	240.0			
70178909	MK2KP-UA-DC24	DPDT-S*	24 VDC	110.0	210.0	47.03	43.41	40.31
		DPDT-R*		22.8	1050.0			

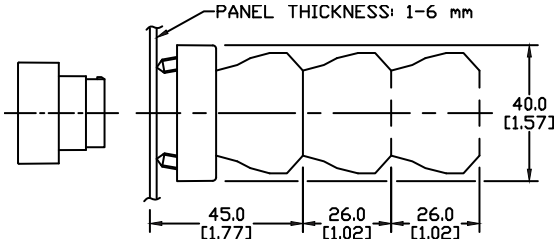
*S = Set coil, R = Reset coil DPDT — 11-pin octal socket.

GCX Series 22 mm Plastic Pilot Devices Specifications

Assembly information

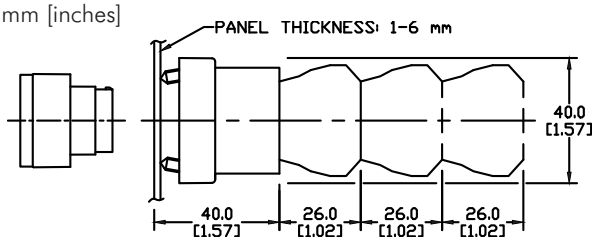
These pushbuttons and indicator lights are supplied with the appropriate contact blocks, unless otherwise indicated. Use these drawings as a guide to make sure there is adequate clearance behind the panel.

Pushbuttons and selector switches



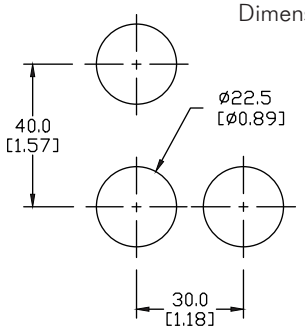
Dimensions: mm [inches]

Illuminated pushbuttons and selector switches/indicator lights

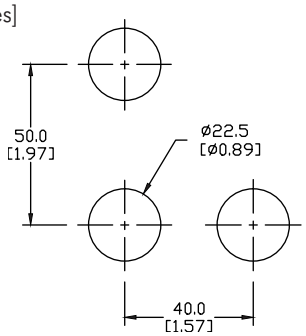


Mounting

Dimensions: mm [inches]



This layout is suitable if all switches are 230V or less and the same polarity.

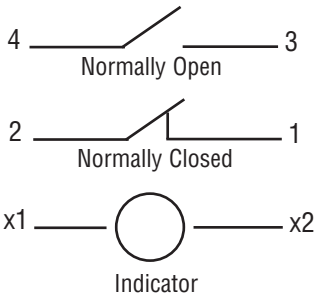


This layout is suitable if all switches are 400V or less and different polarity.



NOTE: Contact blocks can be arranged up to three deep by two wide.

Typical Wiring



Specifications

These specifications apply to all the GCX and ECX 22 mm plastic pushbuttons and switches.

Physical Specifications	
Standards Reference	CEI EN 60947-5-1, CSA C22-2 n.14
Approvals	CSA, IMQ (where specified), UL File E189258
Enclosure Material	Fiberglass reinforced thermoplastic
Contacts Material	Silver
Protection Degree	IP 40 for GCX3151-24, GCX3151-120, GCX3153-24 and GCX3153-120. IP 65 for all others.(See Appendix of this catalog for explanation of IP ratings according to IEC 144 CEI 70-1.)
Electric Shock Protection	IEC 536, Class II
Temperature Ratings	Storage: -40° -to 80°C (-40° to 176° F) Operating: -25° to +70°C (-13° to 158° F)
Working Positions	All working positions are allowed
Mechanical Life	Pushbuttons, selector switches, joy stick switches: 1,000,000 operations Emergency mushrooms and push-push pushbuttons: 300,000 operations
Positive Opening Operation	(according to IEC 947-5-1) All functions incorporating an NC contact are positive opening operation

Electrical Specifications	
Rated Thermal Current (contact block)	A300, Q300 (Refer to E22 Series mounting/contact rating section for details)
Rated Insulation Voltage	Ui 660V according to CEI EN 60947-5-1, 300V according to CSA C22-2 n.14 and UL 508
Dielectric Strength	3kV (1 second)
Insulation Resistance	2MΩ min. (500VDC)
Initial Contact Resistance	≤25mΩ
Short-Circuit Protection*	Cartridge fuses gl 10 A-500V 10, 3x38l1 100 KA
Terminal Markings	According to CENELEC EN 50013
Connections	Single screw with non-loosening plate clamp,14AWG max., Tighten to 0.8Nm max
Contacts Operation	Self-cleaning types EN01 (N.C.) EN 10 (N.O.) slow action, positive opening
Operation Frequency	3600 operations per hour max.
Utilization Category	**AC15** (Control of AC electromagnetic loads) 24 volts AC at 10 amps 130 volts AC at 6.5 amps **DC13** (Control of DC electromagnetic loads) 24 volts DC at 1.5 amps 110 volts DC at 0.5 amps

Note: Recommended, not supplied

GCX Series 22 mm Plastic Key Switches and Selector Switches

Key-operated selector switches



GCX3420 (2-position maintained)
- Keyed switches come with two keys.

Part Number	Price	Description
GCX3420	<--->	22 mm plastic selector switch, key-operated, **two-position maintained**, key can be removed in all positions. **One N.O.** contact block. Replacement keys available
GCX3430	<--->	22 mm plastic selector switch, key-operated, **two-position spring-return from right.** **One N.O.** contact block. Replacement keys available
GCX3470-22	<--->	22 mm plastic selector switch, key-operated, **three-position maintained**, key can be removed in all positions. **Two N.O.** and **two N.C.** contact blocks. Replacement keys available

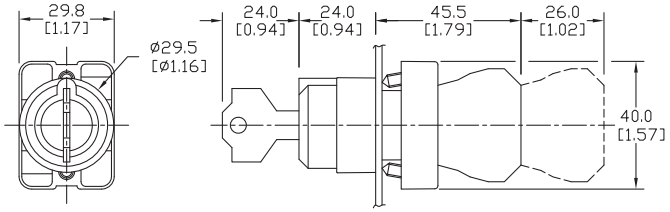


Note: Keyed switches come with two keys. All plastic 22 mm keyed switches are keyed the same. Replacement keys are available. Order part no. ECX1067-2 (pkg. of 2). Keys for plastic 22 mm keyed switches are not compatible with Cutler-Hammer key switches.



Note: When using switches having two-deep contact blocks (such as, Model GCX3470-22) with the 22 mm plastic enclosures, be sure to use enclosures that are 74 mm deep. 51 mm-deep enclosures are too shallow and the switch body will not fit.

Dimensions: mm [inches]



Two-position selector switches

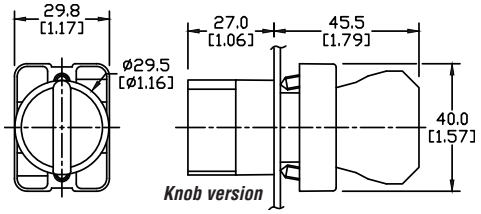


GCX3300 Knob version



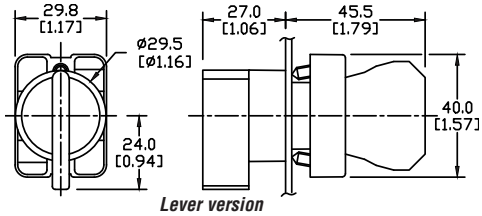
GCX3350 Lever version

Part Number	Price	Description - 2-Position Switches
GCX3300	<--->	22 mm plastic selector switch, two-position **maintained**, black knob. **One N.O.** contact block
GCX3310	<--->	22 mm plastic selector switch, two-position **spring-return from right**, black knob. **One N.O.** contact block
GCX3350	<--->	22 mm plastic selector switch, two-position **maintained**, black lever. **One N.O.** contact block
GCX3360	<--->	22 mm plastic selector switch, two-position **spring-return from right,** black lever. **One N.O.** contact block



Knob version

Dimensions: mm [inches]



Lever version

Contact Closure Sequence for Two-Position Switch

Contact Closure Sequence - 2-Position Switch				
Contact Blocks	Contact Arrangement (viewed from front)		Switch Position (viewed from front)	
	Left	Right	Left (Note 1)	Right (Note 2)
1 x NC	NC		X	
		NC	X	
1 x NO	NO			X
		NO		X
2 x NC	NC	NC	XX	
2 x NO	NO	NO		XX

Note 1: Left switch position deactivates all contacts.
Note 2: Right switch position activates all contacts.

For accessories, see 22 mm Plastic Pilot Device Accessories in this section.

GCX Series 22 mm Plastic Selector Switches

Three-position selector switches

Part Number	Price	Description - 3-Position Switches
GCX3320-22	<--->	22 mm plastic selector switch, three-position **maintained**, black knob, **Two N.O.** and **two N.C.** contact blocks
GCX3330-22	<--->	22 mm plastic selector switch, three-position **spring-return to center**, black knob, **Two N.O.** and **two N.C.** contact blocks
GCX3370-22	<--->	22 mm plastic selector switch, three-position, **maintained**, black lever, **Two N.O.** and **two N.C.** contact blocks
GCX3380-22	<--->	2 mm plastic selector switch, three-position **spring-return to center**, black lever, **Two N.O.** and **two N.C.** contact blocks



Note: When using switches having two-deep contact blocks with the 22 mm plastic enclosures, be sure to use enclosures that are 74 mm deep; 51 mm-deep enclosures are too shallow and the switch body will not fit.

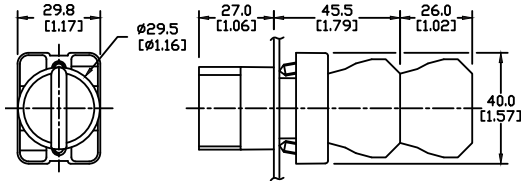


GCX3330-22 Knob version

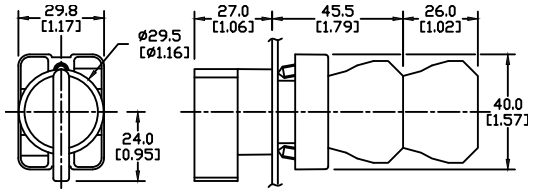


GCX3370-22 Lever version

Dimensions: mm [inches]



Knob version



Lever version

Contact Closure Sequence for Three-Position Switch

Contact Closure Sequence - 3-Position Switch					
Contact Blocks	Contact Arrangement (viewed from front)		Switch Position (viewed from front)		
	Left	Right	Left (Note 1)	Center (Note 2)	Right (Note 3)
1 x NC	NC			X ——— X	
		NC	X ——— X		
1 x NO	NO		X		
		NO			X
2 x NC	NC	NC	X ——— XX ——— X		
2 x NO	NO	NO	X		X

Note 1: Left switch position activates left side contacts (viewed from front).
Note 2: Center switch position deactivates all contacts.
Note 2: Right switch position activates right side contacts (viewed from front).

For accessories, see 22 mm Plastic Pilot Device Accessories in this section.

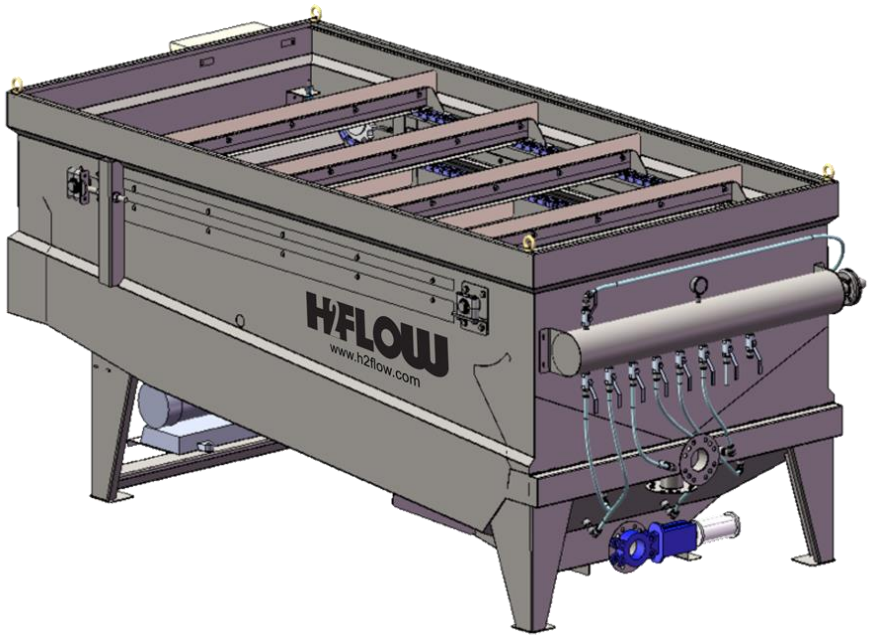
Section 3.4.2

DAF Package

Section 3.4.2.1

DAF Tank

Product Information Sheet



GENERAL INFORMATION		
Type	:	Dissolved Air Flotation
Model	:	ALPHA 10

DESIGN DETAILS			
Hydraulic Capacity (maximum)	:	10 m^3/hr	44 usgpm
Overflow Rate	:	4 m/hr	1.6 usgpm/ft^2
Recirculation Flow	:	2 m^3/hr (6 bar)	8.8usgpm, 85 psi
Free Surface Area	:	2.5 m^2	26.9 ft^2

CONSTRUCTION DETAILS			
Unit Length	:	3475 mm	136.8 in
Unit Width	:	1320 mm	52 in
Unit Height	:	1560 mm	61.4 in
Inlet	:	DIN 80 mm	3” ANSI
Float Discharge	:	DIN 80 mm	3” ANSI
Outlet	:	DIN 80 mm	3” ANSI
Bottom Sludge	:	DIN 80 mm	3” ANSI
Weight Empty	:	700 kg	1540 lbs
Weight Full	:	2500 kg	5512lbs
Skimmer Drive Model	:	NORD	
Recycle pump	:	ANSI	
Bottom Valve	:	Keystone or equal	
Stairs and Sidewalk (Optional)	:	L-Shape, 800 mm width	

Product Information Sheet

ELECTRICAL AND CONTROL			
Power Supply	:	575V, 3 phase, 60 Hz	
Control Voltage	:	24 VDC	
Skimmer	:	0.37 kW	0.5 Hp
Recirculation Pump	:	5.5 kW	7.5 Hp
Air Consumption	:	5Nl/min, 6 bar	0.2 scfm, 85 psi
Pneumatic Panel	:	24 VDC	
Local Control Panel	:	Optional	

MATERIAL OF CONSTRUCTION		
DAF Tank	:	Duplex Stainless Steel
Static Sludge Thickener	:	304 SS, optional 316 SS
Skimmer System	:	SS with fiberglass blades
Chain	:	Plastic
Chain Wheel	:	Plastic
Recirculation Pump	:	Duplex Stainless steel with SS shaft and impeller
DAF Cover (Optional)	:	Plastic or SS
Lifting Lugs	:	304 SS
Dissolved Air Make Up System	:	Duplex Stainless Steel
AerationValves	:	Stainless steel
Pneumatic Panel	:	Fiberglass
Bottom Valve (Butterfly)	:	Body cast iron GGG-50, disc duplex SS, seal EPDM
Stairs and Sidewalk (Optional)	:	Galvanized steel or fiberglass

Contact H2FLOW:

USA: (312) 789-4851

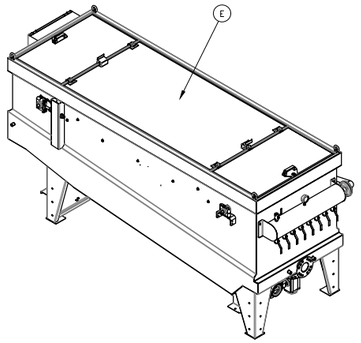
CANADA: TORONTO: (905) 660-9775
MONTREAL: (514) 228-3327
VANCOUVER: (604) 908-7398

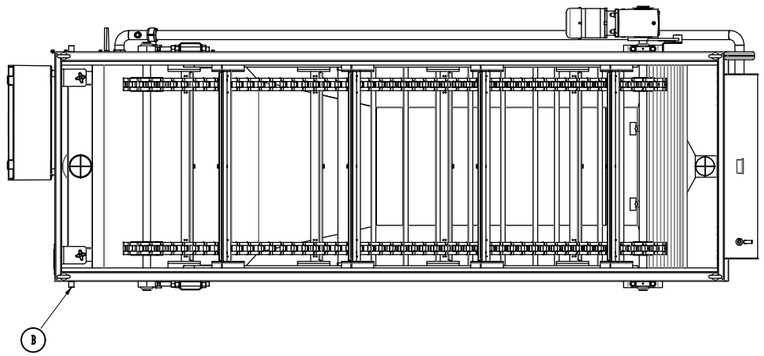
Toll free from anywhere in North America: 1-888-575-8642

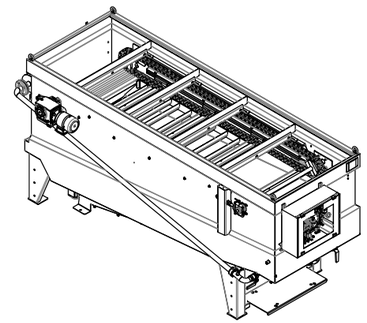
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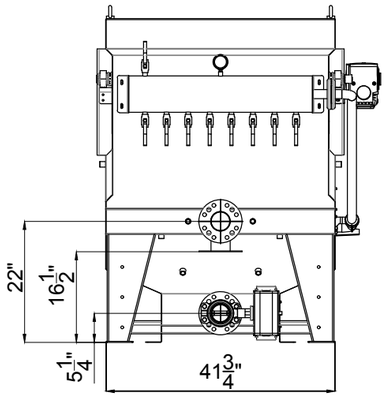
www.h2flowDAF.com

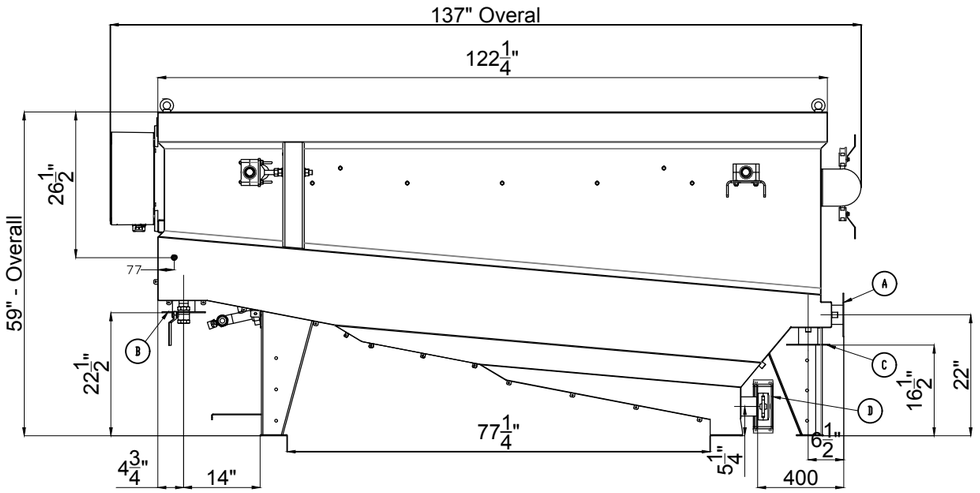
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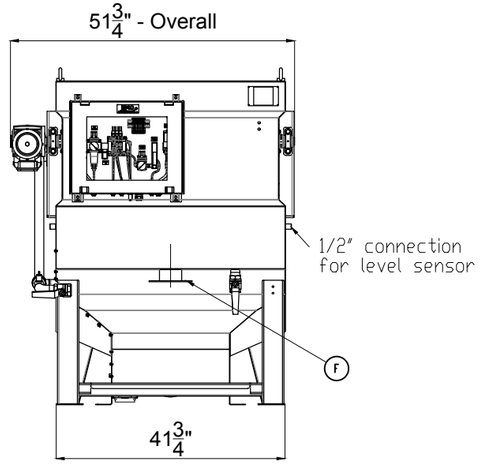


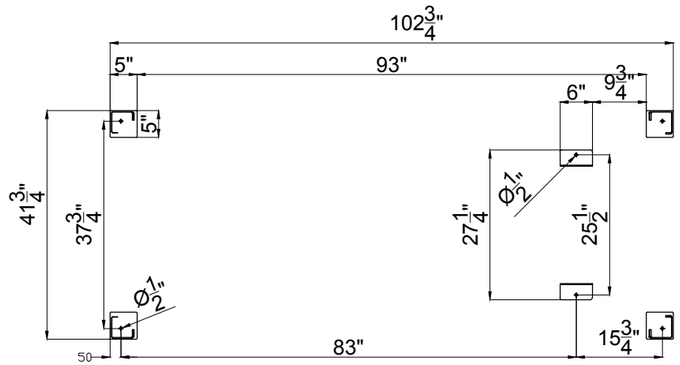












Full weight : 5500 lb
Empty weight: 1550 lb

Rep	Description	Size
F	Cover	
E	Pump	
D	Bottom sludge	3"
C	Float discharge	3"
B	Effluent	3"
A	Inlet	3"

NOTES:
ALL DIMENSIONS ARE SUBJECT TO CHANGE WITHOUT PRIOR NOTICE

H2FLOW EQUIPMENT INC.
WATER AND WASTEWATER TREATMENT EQUIPMENT
580 OSTER LANE, VAUGHAN, ON. L4K 2C1 CANADA
TEL: (905) 660-9775 FAX: (905) 660-9744
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APP'D BY: LB	DATE: 12/21/15		DRAWING No.: DAF ALPHA 10
SCALE: NTS			REV: 0
		ALL DIMENSION ARE IN INCHES UNLESS OTHERWISE SPECIFIED	SHEET 1 OF 1

OPERATION AND MAINTENANCE MANUAL FOR:

ALPHA 10 DISSOLVED AIR FLOTATION UNIT

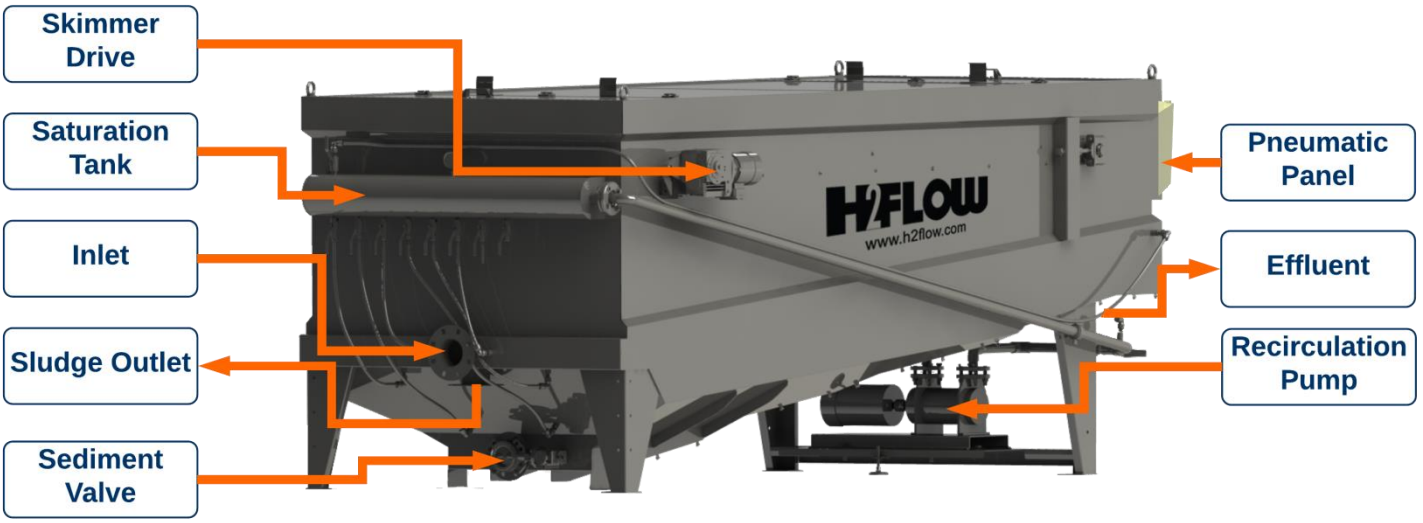


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1.1 DAF SPECIFICATIONS

Connections

Influent:	DIN 80 mm flange connection	3” ANSI
Effluent:	DIN 80 mm flange connection	3” ANSI
Bottom sediment discharge:	DIN 80 mm flange connection	3” ANSI
Float discharge:	DIN 80 mm flange connection	3” ANSI

DAF Unit Data

Model:	ALPHA 10	
Dimensions:	3475mm x 1320mm x 1560mm	136.8in x 52.0in x 61.4in
Hydraulic capacity:	$10m^3/hr$	44 usgpm
Surface hydraulic loading rate:	4 m/hr	1.6 usgpm/ft^2
Solids loading rate:	Up to 40kg/hr	88.1 lbs/hr
Float solids concentration:	3-6%	
Air bubble size:	20-50 micron	
Air flow rate:	5 NL/min @ 100psi (min)	0.2 cfm @ 85 psi
Material:	SS 304	
Operating weight:	2500kg	5512 lbs
Empty weight:	700kg	1540 lbs
Noise level:	Less than 80dB(A)	

Electrical

Voltage:	600V, 3ph + N
Frequency:	60Hz
Control voltage:	24VAC

Skimmer

An electric driven skimmer made from non-metallic components is mounted on the DAF separator. All parts in contact with the liquid are constructed from reinforced fiberglass.

Installed Power:	0.37 kW	0.5 hp

Recirculation Pump

Type:	Regenerative Turbine	
Output:	$2m^3/hr$ at 6 bar	8.8usgpm at 85 psi
Material housing:	Cast iron	
Impeller material:	AISI 316	
Installed power:	3kW	4.0hp

Air Supply: Oil-free and dry compressed air

Air pressure:	6 bar	85 psi
Air consumption:	5NL/min	0.2 cfm

Wastewater Parameters

Minimum pH value:	6	
Maximum pH value:	9	
Temperature:	10-30^{0}C	50-86^{0}F

1.2 DAF DESCRIPTION

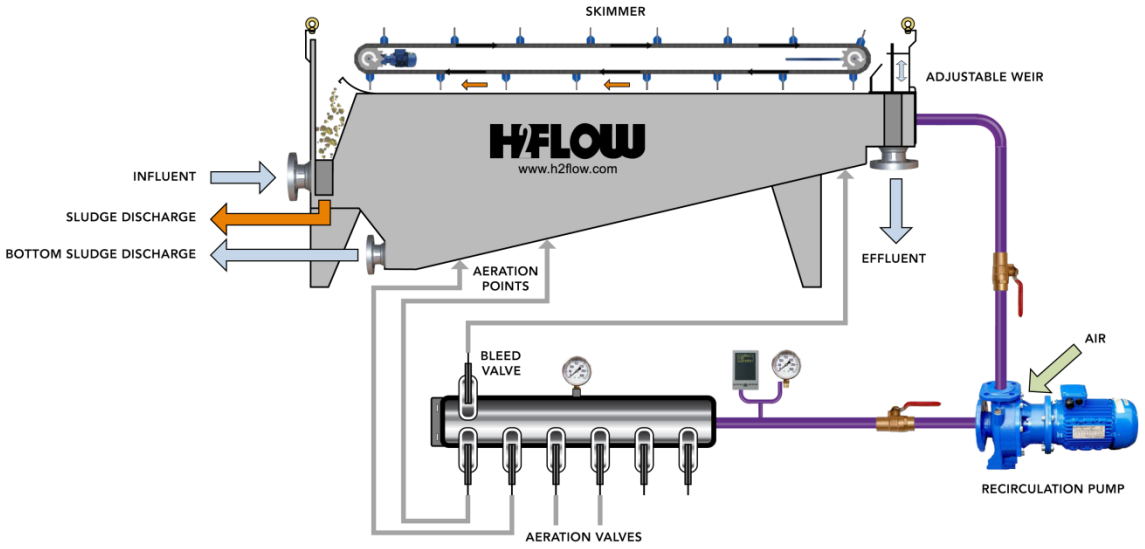


Figure 1: DAF Schematic

1.2.1 Dissolved Air Flotation Process

Wastewater enters the dissolved air flotation (DAF) unit through an inlet compartment (via gravity or a DAF Feed Pump) and is evenly distributed over the length of the DAF. The treated wastewater exits over an effluent weir. A portion of the effluent stream is recirculated, pressurized and mixed with compressed air via a recirculation pump.

The air/water mixture is introduced at specific locations throughout the bottom of the DAF. When the air/water mixture is exposed to atmospheric pressure, the dissolved air is released from the water and forms microbubbles. Pressure and flowrate are essential to creating optimally sized bubbles. The right sized microbubbles can be observed by a milky white appearance to the water. We call this 'whitewater.'

Whitewater attaches to suspended solids granting them enhanced buoyancy and rapidly floats them to the surface. A DAFs flow-through design allows for quick and efficient removal

of suspended solids, FOGs, and non-soluble BODs. This rapid floatation process is what makes DAF treatment so effective.

Proper chemistry is required for the best removal efficiency. It involves correcting the pH, adding a suitable coagulant, and a flocculating polymer to generate the largest size and number of floated solid particles (flocs) possible. The most effective way to identify the best chemistry is by jar testing.

1.2.2 Sludge Formation

At the surface of the DAF, the flocs concentrate and form a layer of sludge. There are several angled plates (stabilization plates) that prevent the accumulated sludge from sinking back down into the DAF.

The thickness of the sludge layer can be adjusted by manipulating the height of the effluent weir. A thick sludge will be drier, but may not pump easily, whereas a thin sludge layer can be pumped easily but will contain excess water. Finding an optimal thickness depends on a variety of variables, and is best adjusted on site.

Typical solids concentrations are between 3-8%. If the process produces a sludge that contains large volumes of water, decanting or dewatering are viable options.

1.2.3 Skimming System & Sludge Removal

A chain and flight skimming mechanism transfers the sludge from the water surface into a sludge hopper for discharge. The rate of sludge removal can be adjusted by varying the speed of the skimmer with a variable frequency drive (VFD) (optional).

Heavier Solids will sink to the bottom of the DAF and are removed by the sediment discharge valve. The sediment discharge valve operates on a timed on/off sequence that is adjustable through the PLC. In some cases an augur can be included to remove settled sludge, if there is a significant amount.

A sludge pump empties the sludge hopper, and the sludge is either sent for further treatment or to a holding tank to be removed by a third party.

1.2.4 Effluent Discharge

The treated water flows into the effluent compartment and over an adjustable weir for discharge into city drains, or in some cases to further treatment. As mentioned earlier the effluent weir is adjustable and can increase or decrease the effluent discharge flow rate.

1.3 FIRST START UP, EQUIPMENT CHECK

When the equipment is installed properly, the mechanical and electrical installation is finished, the DAF unit should be checked and tested prior to start-up.

Visually check the following:

- Please make sure DAF unit is free of any dirt and debris.
- Check and secure all bolted connections.
- Visually check the components, motors, hose connections etc for damage.
- Check the connections on the pneumatic cabinet.
- Check if all connections are made according to P&ID. Correct if necessary.
- Check if the installation and the components are properly earthed.
- Check if all electrical connections are made according to the electrical scheme, check if all instructions in the electrical scheme are followed.
- Check if the motor directions are according to the equipment manual.
- Check if the instrument signals reach the control panel.
- Check the chain tension of the skimmer chain. Adjust if necessary. See maintenance section for instructions.
- Check the skimmer blade clearance at the sludge thickener. The distance must be >20 mm.
- Check the skimmer blade clearance at the sludge collection plate. The distance must be appr. 0.5mm. Adjust if necessary. See maintenance section for instructions.
- Check the turning direction of the skimmer according to the driver manual. Change the rotation direction if necessary. Refer to the driver manual for instructions.
- Check the turning direction of the (optional) auger according to the driver manual. Change the rotation direction if necessary. Refer to the driver manual for instructions.

NOTE: NEVER RUN SKIMMER SYSTEM IN OPPOSITE DIRECTION. IT WILL BREAK. LOWER BLADES MUST MOVE TOWARD SLUDGE HOPPER / BEACH.

1.4 DAF OPERATION

1.4.1 Automatic Mode

The wastewater usually comes from a sump and is collected in an equalization tank. From the equalization tank, it is pumped to the DAF. A level sensor controls the operation of the feed pump. When the preset level in the equalization tank is reached, the control panel initiates the DAF preparation sequence.

1.4.1.1 DAF Preparation (Before Each Start)

The DAF unit needs a preparation time of approx. 5 -10 minutes before receiving wastewater. This function is PLC controlled with a preset delay timer (adjustable). During the preparation sequence, the following operations are initialized:

1. The DAF Feed Pumps are OFF until the preparation sequence is completed.
2. The DAF Recirculation Pump turns OFF (provided minimum water level in DAF is

reached.)

*Note: Tank may have to be filled manually (via city water) if this is the very first operation sequence. Refer to the Quick Start-up guide for more information on initial start-up.

3. The pressure switch in the pneumatic panel monitors for the pressure on the recirculation line to build up to 40-110 psi.
4. If the set-point is reached, The Air Supply Valve OPEN and introduces pressurized air into the recirculation pump. The air / water mixture is released into the DAF producing whitewater. The whitewater floats to the top of the tank, picking up any flocculated solid particles along with it.
    a. If the pressure set-point is not achieved within 30 seconds, the recirculation Air Supply Valve is closed until the pressure builds up from water alone. This will repeat 3 times, and if the pressure is not reached, an alarm will sound.
5. The Sludge Skimmer Drive turns ON skimming floated sludge into the sludge hopper. The speed is adjustable via a VFD (optional).
6. Sediment Discharge Valve OPEN for 3 seconds to flush out any buildup, and the auger system is activated at this time (if supplied). This is controlled by an adjustable timed sequence.
7. Chemical Feeding pumps are OFF.

Once the preparation sequence is completed, the DAF will enter normal operation. This involves the DAF feed pump running, and automatic chemical dosing.

1.4.1.2 DAF Normal Operation

The normal operation continues after the preparation sequence, so most of the equipment will continue running. A quick summary of the initialization sequence is below.

1. DAF Feed Pump ON.
2. Recirculation Pump ON.
3. Recirculation Air Supply Valve OPEN.
4. Skimmer Drive ON.
5. Sediment Discharge Valve in timed OPEN/CLOSED sequence.

1.4.1.3 DAF Stand-by Mode/Temporary Shutdown

When the wastewater feed to the DAF is stopped, or the level in the tank drops, the DAF will undergo a cleaning process and the following will be carried out. This usually lasts 5 minutes.

1. Chemical Feed System OFF.
2. Recirculation Pump ON.
3. Skimmer Drive ON.
4. Recirculation Air Supply Valve OPEN.
6. Sediment Discharge Valve in timed OPEN/CLOSED sequence

1.4.1.4 DAF Extended Shut-Down Mode

After the 5 minute stand-by the DAF will enter an extended shutdown mode where it will await the next normal operation. The following sequence will be carried out.

1. DAF Feed pump OFF
2. Recirculation Pump Air Supply Valve OFF
3. Recirculation Pump will be in an ON/OFF sequence to prevent the tank from settling too long.
4. Sediment Valve will remain on Timed ON/OFF Sequence.
5. Chemical Feed System OFF.

1.4.2 Manual Mode

Any of the following units can be overridden during Automatic mode and can be operated in Manual mode by accessing the HMI on the control panel. This can be done by placing the main selector switch on the panel to manual – HAND mode.

- Recirculation Pump – ON/OFF
- Skimmer Drive and speed – ON/OFF
- Sediment Valve – OPEN/CLOSE

For further information on any of the equipment, please refer to the individual sections corresponding to that specific equipment.

1.4.3 DAF Operation Sequence

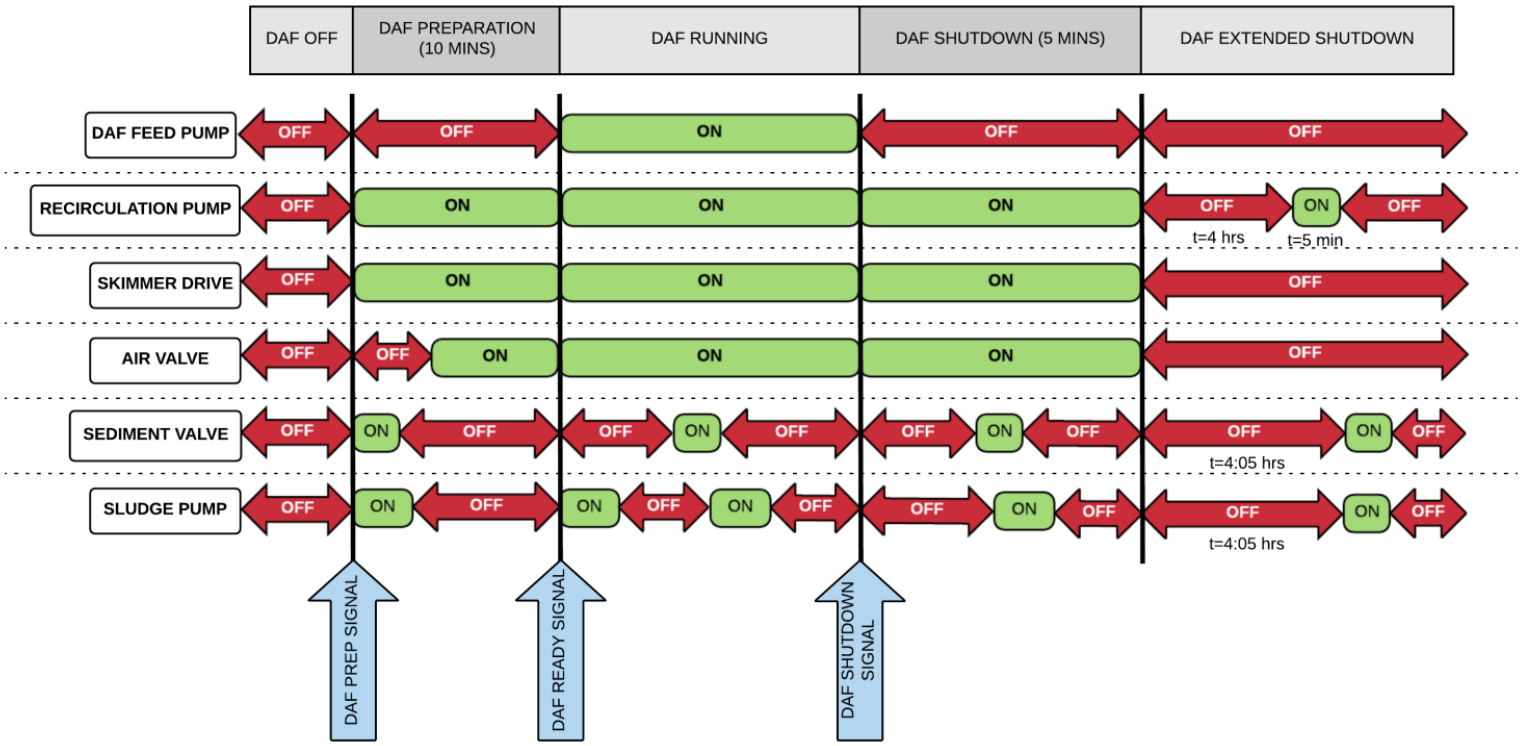


Figure 1: DAF Operation Sequence

1.5 DAF SYSTEM COMPONENTS

The water enters the DAF floatation unit through the inlet compartment (1). In the inlet compartment, the water is mixed with whitewater from the saturation tank (2) and is evenly distributed over the length of the DAF. The microbubbles in the whitewater attach to the flocs enhancing their buoyancy. The flocs float to the surface where they are held in place by the stabilization plates (3). The thickness of the sludge can be adjusted by changing the height of the effluent weir (4). The sludge is skimmed off by the chain and flight system (5) into the sludge compartment (6). Part of the effluent is recirculated with the recirculation pump (7) to the saturation tank (2). The heavy particles sink, and are discharged with bottom sludge discharge valve (8).

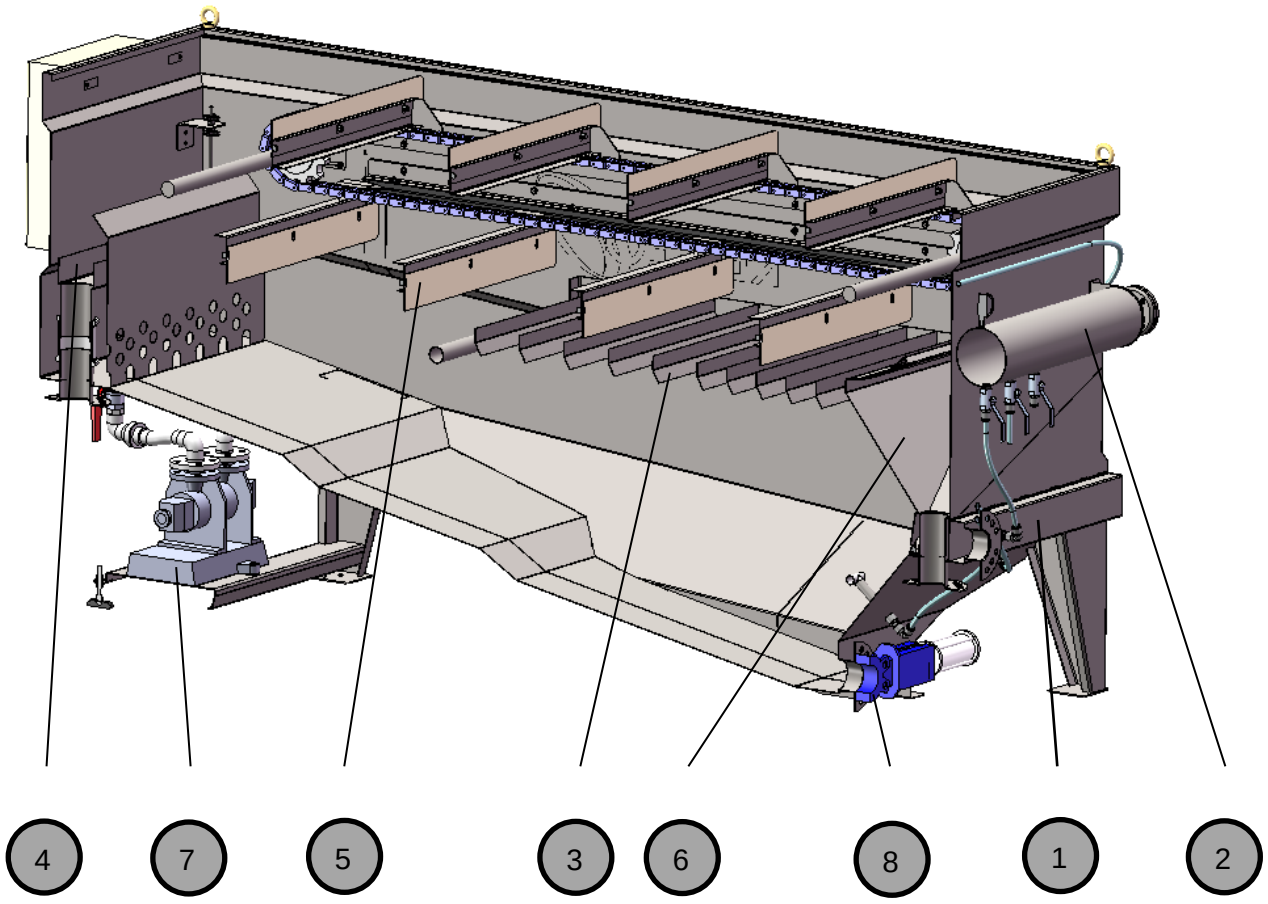


Figure 2: DAF System Components Diagram

1.5.1 Inlet Compartment

The inlet compartment mixes the influent with whitewater and evenly distributes it over the length of the DAF. The inlet consists of a primary distribution and a secondary distribution compartment.

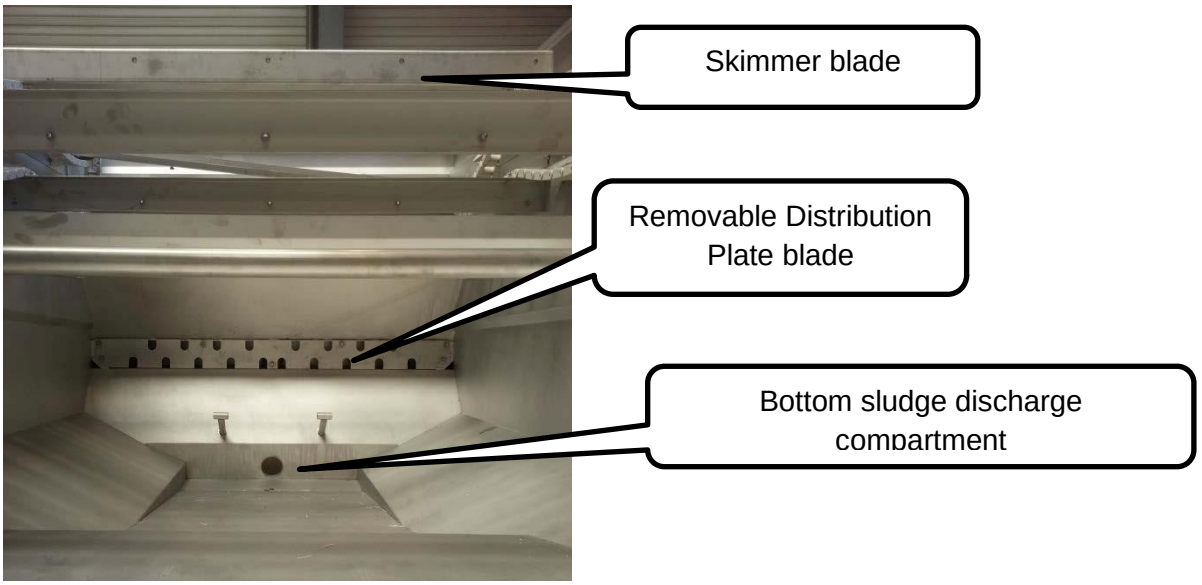


Figure 3 Cut-Through Section Showing Inlet Compartment Inside DAF

Adjustment:

If necessary, the pressure drop over the flotation unit can be reduced by removing the distribution plate.

1.5.2 Skimmer System

The skimmer system skims the sludge off the surface into to the sludge hopper. From the sludge hopper, the sludge can be discharged by a pump or gravity.

Figure 4: Skimmer System



Adjustment:

The speed of the skimmer can be adjusted (if equipped with a VFD) in the electrical cabinet. Skimming at a higher speed will result in thinner sludge. A lower speed will result in thicker sludge.

During non-running hours, a hard sludge layer may appear due to evaporation. The hard top layer can possibly damage the skimming system, and should be avoided. Running the skimmer and the recirculation system for 15 minutes every 4 hours will prevent this layer from forming (This can be set automatically by the PLC).

1.5.3 Sludge Hopper

The skimmer moves the sludge over the curved beach, and into the sludge hopper. From the sludge hopper, the sludge can be discharged by gravity or sludge pump. Optional level control in the sludge hopper is used to control the sludge pump.

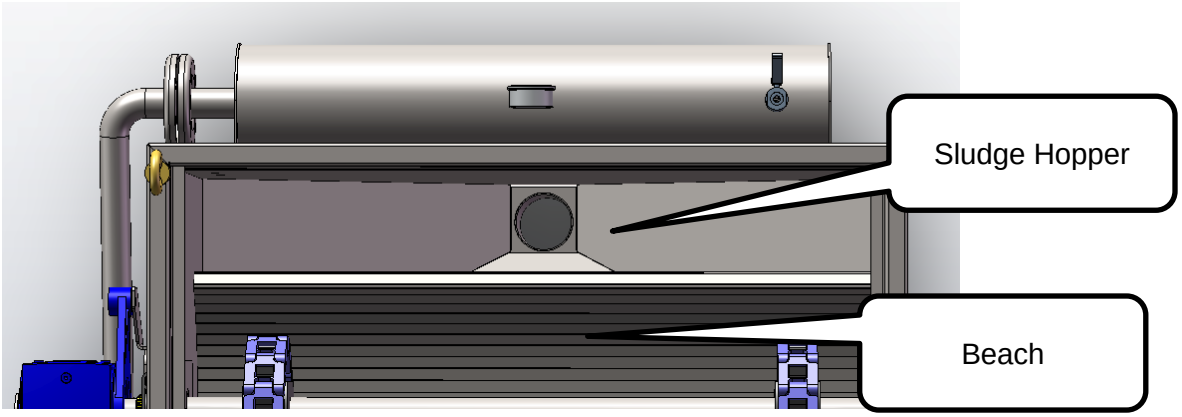


Figure 5: Sludge Hopper – Top View

1.5.4 Sediment Discharge

The heavy solids sink to the bottom of the DAF and are discharged by the sludge discharge valve. The sediment must be discharged regularly to prevent accumulation and fermentation.

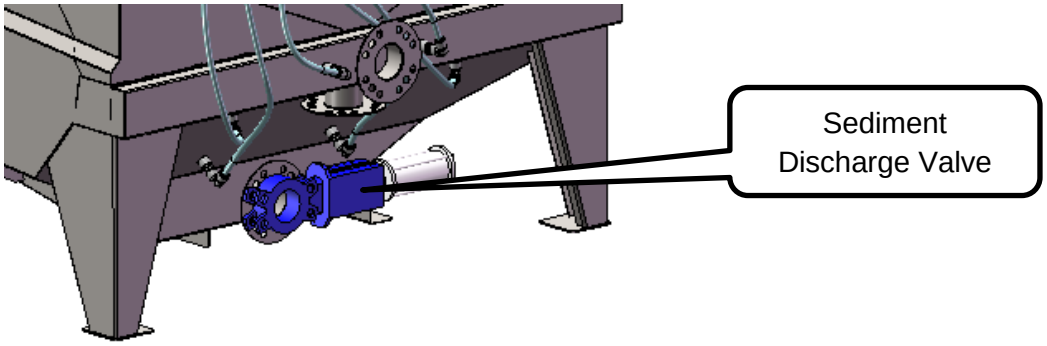


Figure 6: Sediment Discharge Valve

Adjustment:

Speed adjustment

The sludge valve is equipped with speed adjustment. The opening time of the valve should be as short as possible. The closing time of the valve can be set slower to prevent water hammer in the discharge line.

Open/Close timer adjustment

The Open/Close timer of the sediment discharge can be adjusted with the PLC.
The Standard setting for the discharge should be set for OPEN 4 sec CLOSED 2 hours.
The following should be checked to adjust the settings.

- At the start of the discharge cycle, the flow should contain sediment.
- At the end of the discharge cycle, the flow should be clear.
- If the flow is clear from the start of the discharge, the closed time should be extended to maximum 6 hours. If the flow is still clear at the start of the discharge, shorten the open time to minimal 3 seconds.
- If the flow is not clear at the end of the discharge, increase the length of the open time to maximum 6 seconds.
- If the flow is still not clear at the end of the discharge, the closed time should be decreased.

1.5.5 Effluent Discharge

The treated water leaves the flotation unit over the effluent weir into the effluent discharge. The level in the flotation unit influences the solids contents of the sludge, a higher level in the tank will result in wetter sludge.

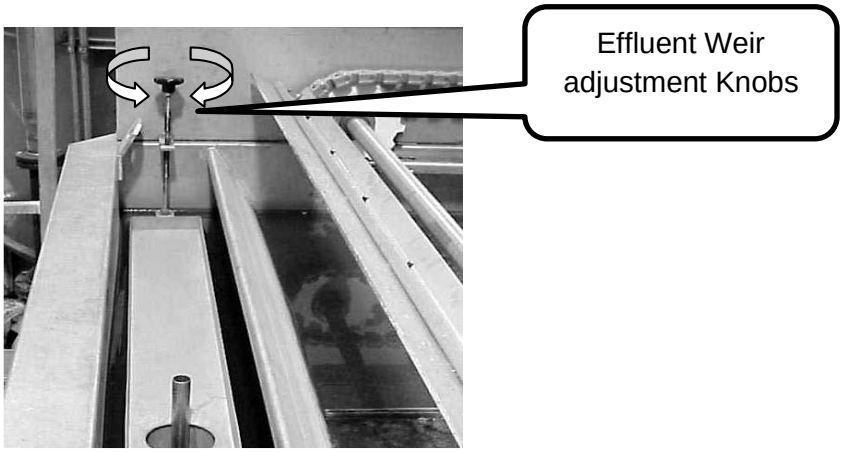


Figure 7: Effluent Discharge

Adjustment:

The effluent weir can be adjusted to change the water level in the flotation unit with the adjustment knobs (see figure 7). The overflow level over effluent weir corresponds with the level inside the flotation unit. Setting the weir higher will increase the water level in that tank and increase the amount of water carried over into the sludge hopper. A lower level will produce the opposite result.

1.5.6 Recirculation System

The recirculation system produces the whitewater in the DAF. The whitewater is saturated with microbubbles that enhance the flocs buoyancy. The recirculation pump is fed from the effluent and pumps at about 20% of the flow-through capacity. The pump mixes air and water at a specified pressure to create the optimally sized microbubbles. The standard pressure in the recirculation system is approx. 5 - 6 bar.

The air/water mixture is collected in the saturation tank which distributes it throughout specific points in the DAF. Aeration valves are used to control the amount of mixture sent to each distribution point. When the air/water mixture is released to atmospheric pressure in the DAF, it creates the whitewater needed to float the solids.

On top of the saturation tank, a bleed valve is placed to discharge the excess air in the pressurized tank.

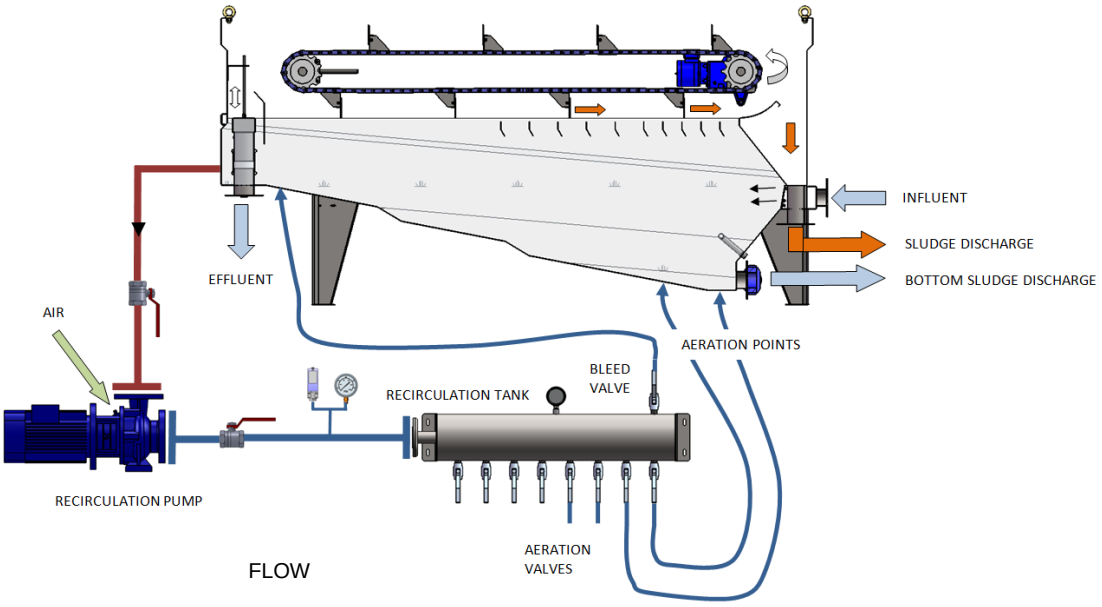


Figure 8 Recirculation System

Adjustment:

Aeration Valves

Normally, all the valves should be opened at about the same angle to get an even distribution of air bubbles over the flotation unit, but it's possible to distribute unevenly if desired. It is advisable to have all the valves partially open to prevent clogging of the valve and the feed line. In case of process upsets or low performance, the aeration valves may be clogged. In most cases, the obstruction can be flushed by opening each valve shortly and flushing out the obstruction.

Bleed Valve

The bleed valve on top of the pressurized tank should always be (partly) open to discharge access air. A closed bleed valve can cause a non-functioning recirculation system and an air/water eruption at the shut-down of the recirculation system.

Influence of water temperature

In case of cold water (<10º Celsius) the pressure in the recirculation system should be increased to 7 bar.

In case of hot water (>30º Celsius) the pressure in the recirculation system should be decreased to 5 - 5.5 bar.

1.5.7 Pneumatic Panel

The pneumatic panel contains the following items:

- Pressure indicator recirculation water
- Pressure switch recirculation
- Pressure switch pressurized air
- Pressure control with indicator
- Solenoid valves to control the pneumatic valves
- Air flow meter for the recirculation system

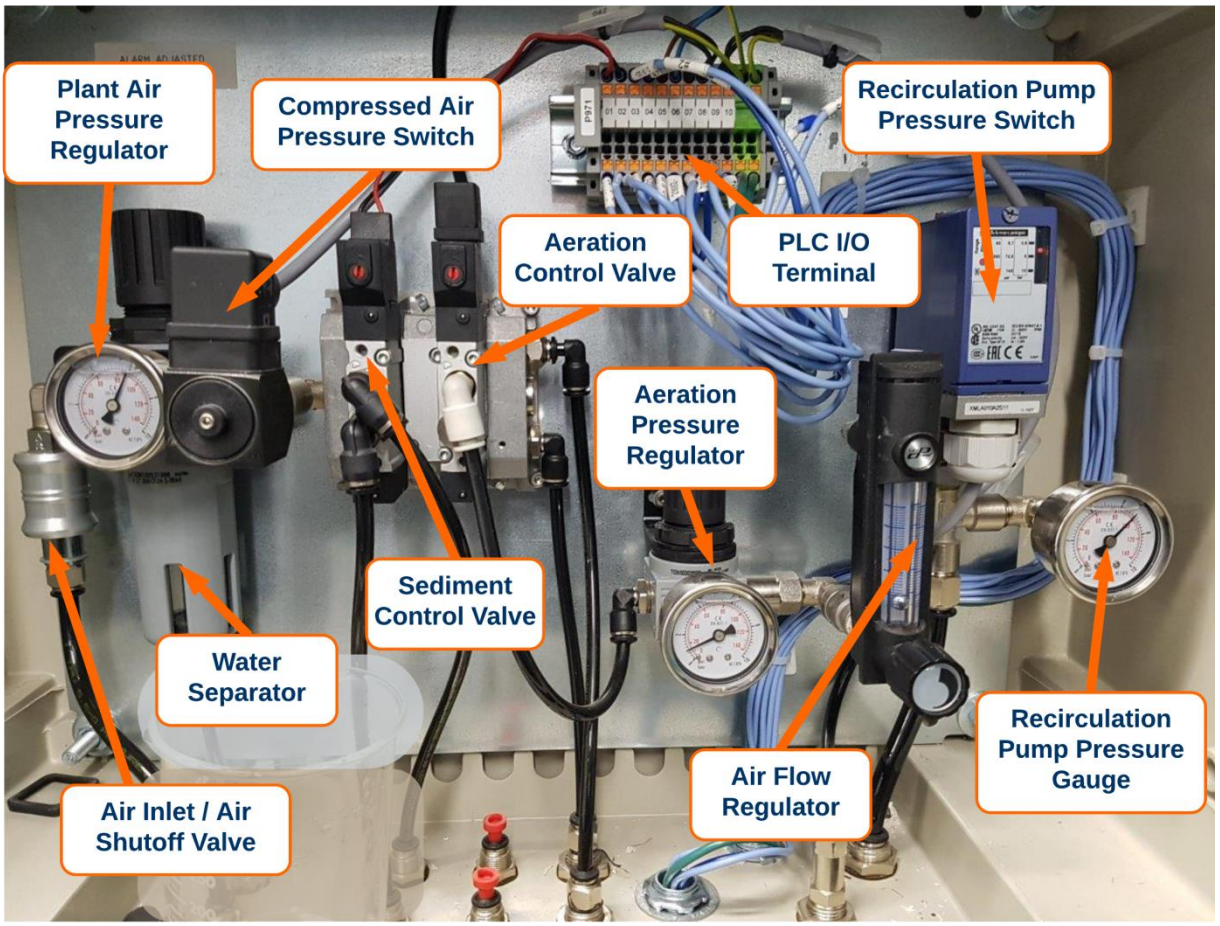


Figure 9: Pneumatic Panel

Adjustment:

Air and air pressure Adjustment

The rotameter can adjust the amount of air added to the recirculation pump. The amount of air must be high enough to saturate the recirculation water, which is about 5% of the recirculation flow rate. The recirculation air pressure regulator should be set to about 0.5 to 1 bar. The air is injected on the suction side or discharge of the recirculation pump depending on the pump model.

(Alpha 10 --> 2 m^3/h recirculation -> 1.7 L/min airflow)

The airflow can be increased to produce more whitewater in the DAF. Check the pump performance when doing so. In case of cavitation in the pump or sudden pressure drops in the recirculation system, the amount of air should be decreased again.

Pressure Switch Adjustment

The pressure switch for protection of the recirculation pump is adjusted to the make contact in the 4-8 bar range. Normally this range is sufficient, but it can be adjusted. See component manual for instructions.

2.0 TROUBLESHOOTING

Symptom	Procedure
Effluent is not clear	<u>Check chemical dosing:</u> • Check dosing rates • Check quality of flocs • Consult chemical supplier to check chemicals • Check if flow rate is within design limits <u>Check recirculation system:</u> • Check recirculation pressure and air flow in pneumatic panel • See section 1.4 for component operation description of “recirculation system and pneumatic cabinet” • Check if recirculation system, aeration hoses and valves are clogged or blocked. • If recirculation flow / pressure is low and cannot be properly adjusted anymore, the recirculation pump may be worn out and needs replacement.
No/Little whitewater	<u>Check flow meter valve and recirculation pressure:</u> • Check recirculation pressure and airflow volume in pneumatic panel • See section 1.4 for component operation description of “recirculation system and pneumatic panel” • Check if recirculation system, aeration hoses and valves are

Symptom	Procedure
	clogged or blocked. • If recirculation flow / pressure is low and cannot be properly adjusted anymore, the recirculation pump may be worn out and needs replacement.
Air bubbles in flotation unit at the inlet side	Check bleed valve: • See section 1.4 for component operation description of “Bleed valve”
Sludge layer is too solid	Increase level in flotation unit: • See section 1.4 for component operation description of “effluent discharge”
Too much water in sludge	Decrease level in the flotation unit • See section 1.4 for component operation description of “effluent discharge”
Water eruption at shut down recirculation pump	Check bleed valve • See section 1.4 for component operation description of “bleed valve”
Thermal alarm	Check motor switches • Measure motor current • Check system for obstructions
Drain valve/sediment discharge valve does not work	Check air supply pressure • See section 1.4 for component operation description of “pneumatic cabinet” Check Piping • The drain valve may be obstructed

3.0 INSPECTION AND MAINTENANCE

3.1 General

In this section the procedures for inspection and maintenance are explained.

Refer to the control panel manual for instructions related to the electrical control of the equipment.

The maintenance of the components like skimmer drive, auger drive and recirculation pump should be done according to components' supplier manual.

3.2 Inspections

The following inspections should be carried out daily:

- Check the flotation unit according to the daily checklist (see section 3.3.1).
- Check the skimmer system for overall function and excessive fouling.
- Check the sludge hopper for excessive fouling.
- Check the recirculation system for leakage and overall function.
- Check the effluent discharge for irregularities.

3.3 Maintenance

The following maintenance should be done on a regular basis:

- Weekly maintenance:
  - Clean the flotation system with a pressure hose
  - Check/adjust chain tension
- Monthly maintenance:
  - Check/adjust the chain length.
  - Check/adjust skimmer blade clearance
  - Check/adjust auger gasket
- Yearly maintenance:
  - Check all bolted connections.
  - Check all parts subjected to wear. If unusual wear is found, consult H2Flow Equipment.

3.3.1 Maintenance checklist

Description	Frequency
MAIN DAF COMPONENTS	
Record Flow	Daily
Monitor pressures and flows to ensure settings are within desired range.	Daily
Each aeration valve on the pressure tank should be opened to flush out excess build up of solids in the recirculation tubing. The flushing should be done one valve and a time, each time returning the valve to its throttled position (pressure tank should read at 6 bar)	Weekly
Skimmer blades, effluent chamber and sludge chamber should be periodically washed to removed excess solid buildup	Weekly
Check chain tension and blade clearance. Adjust as necessary	Weekly
Check Oil level in Skimmer drive gear box	Monthly
Lubricate the skimmer bearings system with bearing grease	Monthly
Check chain length – See “chain length”	Monthly
Check/ adjust skimmer clearance	Monthly
Check all bolted connections	Yearly
Check all parts subjected to wear	Yearly
CHEMICAL DOSING	
Isolate pH probe and remove probe for cleaning	Weekly
Calibrate pH probe	Bi-weekly
Secure fit of liquid end screws – Moisture indicates probable diaphragm failure)	Monthly

NOTE: For detailed and/or long term maintenance requirements please review appropriate section for each piece of equipment. All equipment, fittings and valves should be checked on a regular basis for leaks and/or breaks. Frequency of maintenance items listed below should be conducted as required for proper operation.

3.4 Technical Instructions and Repair

This part of the manual gives detailed technical instructions how to adjust and maintain the flotation unit.

3.4.1 Draining the Flotation Unit

If possible, remove the sludge layer in the flotation unit with the skimmer system by increasing the level in the flotation unit, prior to shut down. You can fill the tank with city water to increase the level until all the sludge is removed. The unit can be drained by opening the bottom sludge discharge valve.

3.4.2 Chain Tension Adjustment

The chain must be checked regularly for proper tension. To check the tension, pull the chain up and down without much strength, the chain should move a few centimeters up and down. If the chain hardly moves, or moves more than a few centimeters, adjust the tension. The chain tension can be adjusted by moving the chain wheel bearing. Loosen the small bolts on the mounting plate, and tighten the chain by turning the adjusting bolts on the threaded pipe.

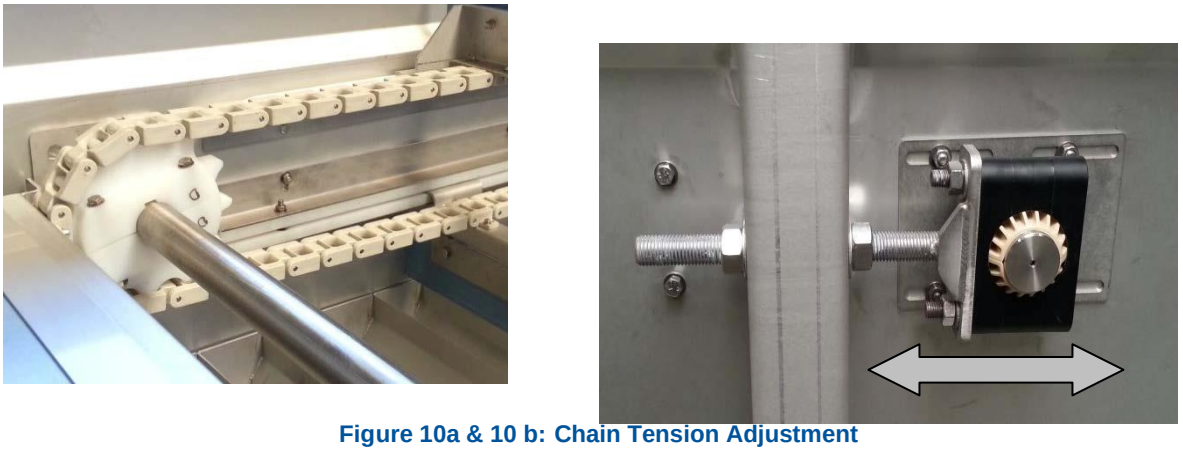


Figure 10a & 10 b: Chain Tension Adjustment

3.4.3 Chain Length

Replace the chain if clearance between 10 chain links exceeds a distance of 510 mm. See “Chain and tooth wheel replacement” section below for instructions.

3.4.4 Skimmer Blade Clearance

The distance between the skimmer blades and the beach can be adjusted. The blade clearance can be changed by loosening the bolts and nuts on the skimmer blades. The clearance between the reinforced glass-fiber blades and the beach must be approx. 5mm to prevent the blades from scraping to heavily over the beach.

3.4.5 Chain and Tooth Wheel Replacement

In case of wear on the chain and/or tooth wheels, the chain and tooth wheels must be replaced.

The disassembly procedure is as follows:

- Remove all skimmer blades by removing the two lock nuts on each side of the skimmer blade (see figure 11a and 11b).
- Take tension off the chain by loosening the chain wheel bearing (see section 3.4.2: chain tension adjustment).
- Remove the stainless steel pin in one of the chain links of each chain. The chain can now be removed.
- The tooth wheels consist of two half tooth wheels which can be separated by releasing the 2 lock nuts in the chain wheel (see figure 12).





Figure 11a &11b

The two new chains must be made identical to the old ones, with the skimmer connection parts at the same location. Mount the new tooth wheels in same location and direction as the old tooth wheels.

They are not symmetrical and are meant to be installed in one direction.

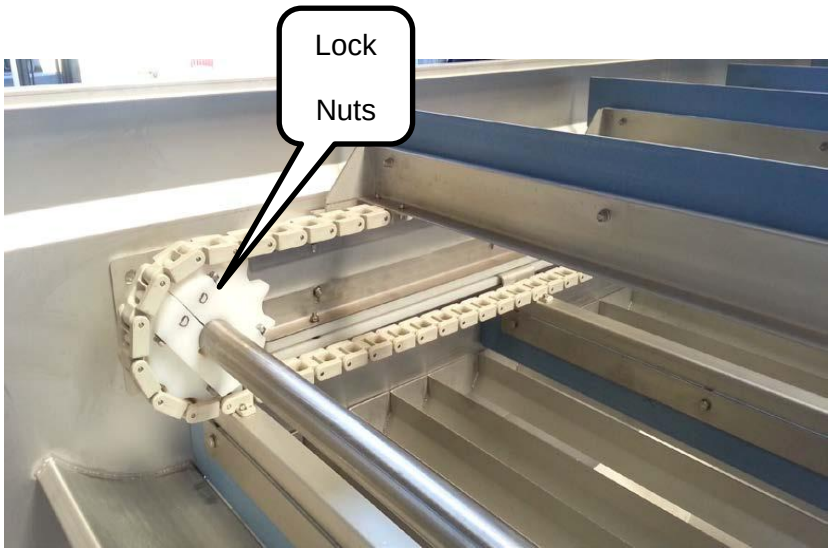


Figure 12: Skimmer Tooth Wheel

Check if both chains are similar before placing them. Difference in chain length or skimmer mounting position will cause failure

- Mount the new chains in the correct running direction, which is marked on the inside of the chain. Close the chain with the steel pin.
- Adjust the chain tension
- The skimmer blades, when mounted, should have a 90º angle to the chain.
- Place a skimmer blade in position, with the glass-fiber scraper plate mounted in the skimming direction.
- Tighten the lock nut and ring.
- Adjust the blade clearance.

3.4.6 Recirculation Pump

The recirculation pump is subject to wear and tear. The normal life time of the recirculation pump is approx. 2 years, but it depends on the circumstances. If the pump does not reach its performance anymore, it should be replaced. It is advised to keep one pump on stock for easy replacement.

The pump is equipped with mechanical seals. Mechanical seals can't be adjusted but have to be replaced when leaking. For information on the type of seal refer to the supplier's manual for instructions.

4.0 SPARE PARTS

It is recommended to have the following spare parts on stock:

Article	Description	Quantity
Chain set	Complete chain	1 set
Bearing skimmer	Skimmer bearing	4
Tooth-wheel skimmer	Skimmer tooth wheel	4
Skimmer set	Skimmer blade set 1m	2
Skimmer drive	Drive SK12063	1
Recirculation pump	Complete pump	1
Solenoid Valve	Pneumatic Cabinet	1
Pressure Switch	Pressure switch air pressure	1
Pressure Switch	Pressure switch recirculation pressure	1
Aeration valves	½" valves recirculation tank	6
Recirculation hose and fittings	Set with 10m hose 15mm and 2x10 connection pieces	1
Bottom sludge valve	Knife gate valve DN80	1

5.0 TRANSPORT, STORAGE AND INSTALLATION

5.1 Lifting and transport

Before lifting or transport, empty and clean the unit.

The unit is equipped with lifting lugs. The unit should be lifted with a crane using these lifting lugs. Use a spreader beam when the unit is 1.5m or wider to prevent deformation of the unit.

The unit should be transported in upright position, well fastened and secured.

Ensure that vulnerable parts of the flotation unit are not damaged by the lifting gear.

Use appropriate and approved lifting gear and transport equipment to lift and transport the unit.

The maximum weight per lifting lug is dependent on the lifting angle of the cable.

The maximum weight per lifting lug at a lifting angle of 0 degrees (vertical lifting cable) is as follows:

⌀1/2":	340 kg	750 lbs
⌀5/8":	700 kg	1543 lbs
⌀3/4":	1200 kg	2646 lbs
⌀1":	1800 kg	3986 lbs

5.2 Storage

The unit must be stored in a dry storage facility, temperature between 5 - 40˚C (4 - 104˚F). Before storage, clean and empty the unit and fill the recirculation pump with glycol to prevent corrosion. Store the unit in a safe area to protect the unit against damage by falling objects or traffic. Protect electrical components against dust and dirt.

In case the unit is stored for a longer period of time, spray the unit with oil to prevent corrosion.

5.3 Installation

Preferably, install the unit in a dry, clean and frost-free area.

In case of possible low temperatures during installation, protect the unit against frost by using a coolant in the recirculation system to protect the pump etc. The floor must be designed to take the full weight of the flotation unit. Leave enough space around and above the flotation unit for maintenance and inspection purposes.

The unit is equipped with supports and footplates. Check if the anchor plan is according to the actual footprint of the unit. The unit must be perfectly leveled. In case of a perfect flat and horizontal floor, simple stainless-steel anchors are sufficient. If the floor is uneven, use adjustable stainless-steel anchors with stainless steel shim plates or level the anchors to level the unit. Install inlet, outlet and discharge connections according to the P&ID. Use sufficient diameters for the connections. The effluent discharge connection must be sloped to have a smooth discharge. The supply and discharge lines should be properly engineered to secure a properly working supply and discharge.

The installation must be properly grounded.

5.3.1 Electrical Installation

Refer to the related component manuals and electrical manuals for the guidelines regarding the electrical installation instructions.

Refer to the electrical drawings for instructions regarding electrical installation instructions.

6.0 WARRANTY

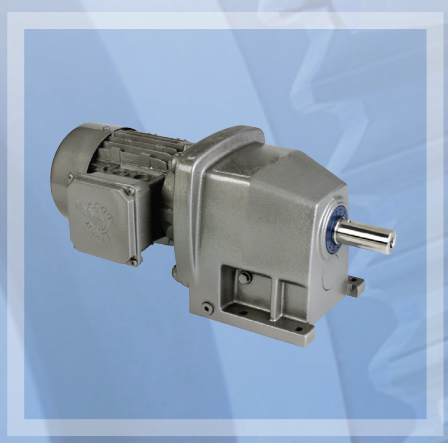
H2flow will provide warranty against any defects in design, material or workmanship.
The warranty shall extend for a period of 12 months from date of start-up but not exceeding 18 months from delivery date.

Any warranty service shall be provided by our service department in Vaughan, ON.

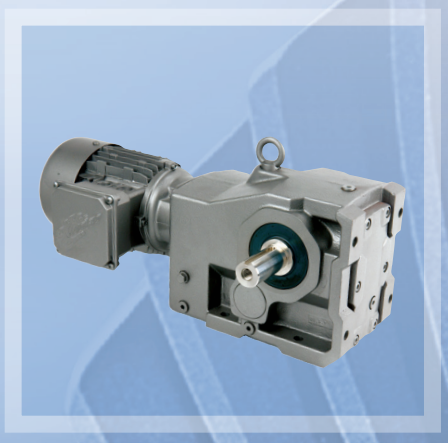
Section 3.4.2.2

Skimmer Gear Drive

CONSTANT SPEED DRIVES







SAFE • RELIABLE • EFFICIENT

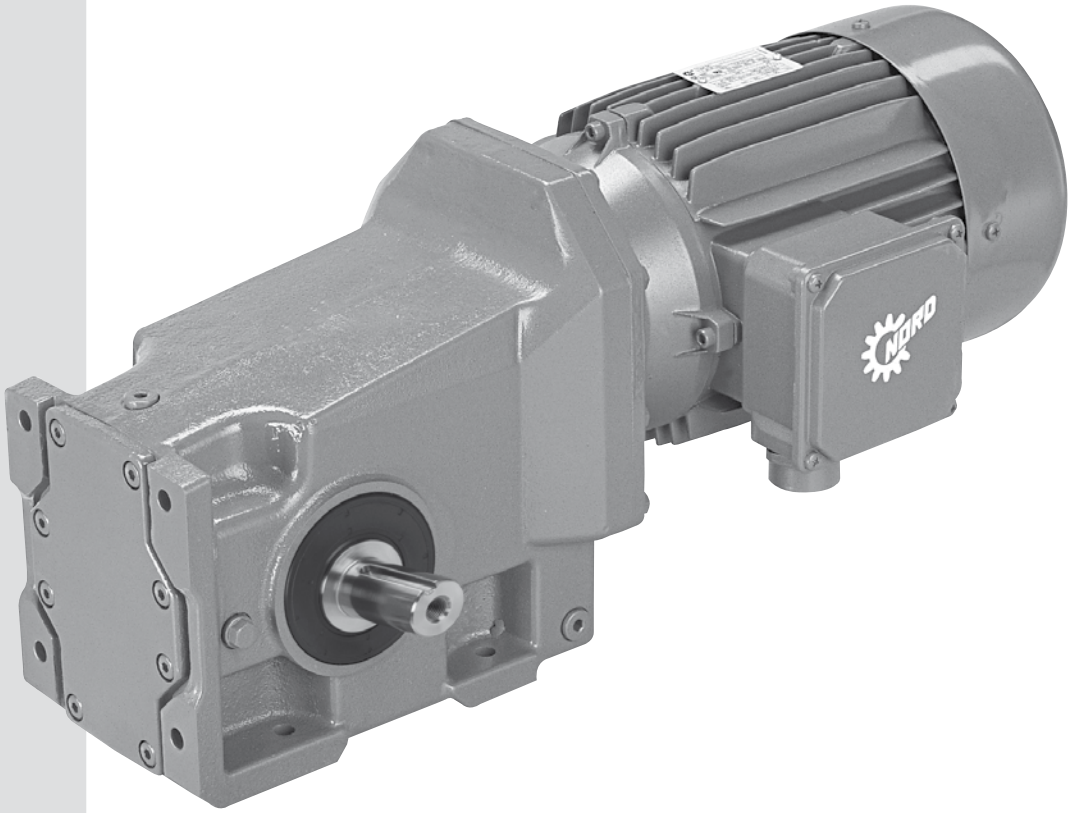
UNICASE™

NORD® DRIVESYSTEMS

Right-angle Helical-bevel Gearmotors

Selection

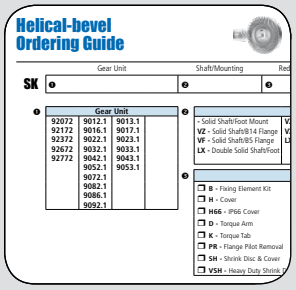
- Order Form
- Unit Examples
- 0.16 hp
- 0.25 hp
- 0.33 hp
- 0.50 hp
- 0.75 hp
- 1.0 hp
- 1.5 hp
- 2.0 hp
- 3.0 hp
- 5.0 hp
- 7.5 hp
- 10 hp
- 15 hp
- 20 hp
- 25 hp
- 30 hp
- 40 hp
- 50 hp
- 60 hp
- 75 hp
- 100 hp
- 125 hp
- 150 hp
- 175 hp
- 200 hp

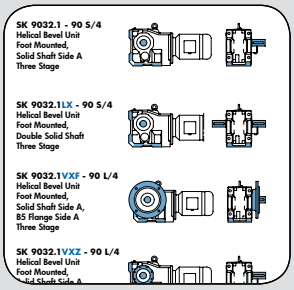


DRIVESYSTEMS

UNICASE™

www.nord.com





Motor Power P_n [hp]	Output Speed n_2 [rpm]	Output Torque T_a [lb-in]	Service Factor f_B	AGMA Class	Gear Ratio i_{tot}
15	65	14614	2.8	III	27.35
	57	16714	2.5	III	31.28
	49	19348	2.2	III	36.21
	45	21223	2	III	39.72
	39	24023	1.8	II	44.96
	32	29153	1.5	II	54.56
	28	33352	1.3	I	62.42
	25	38599	1.1	I	72.24
	20	47111	0.9	*	88.17
	50	18803	3.3	III	35.19
	43	21966	3.1	III	41.11
	35	26903	2.7	III	50.35

Helical-bevel Ordering Guide



NORD DRIVESYSTEMS

	Gear Unit	Shaft/Mounting	Reducer Options		Motor/Input	Motor Options
SK	❶	❷	❸	-	❹	
					see page 690	see page 690

❶

Gear Unit			
92072	9012.1	9013.1	9072.1/32
92172	9016.1	9017.1	9072.1/42
92372	9022.1	9023.1	9082.1/42
92672	9032.1	9033.1	9082.1/52
92772	9042.1	9043.1	9086.1/52
	9052.1	9053.1	9092.1/52
	9072.1		9096.1/62
	9082.1		
	9086.1		
	9092.1		
	9096.1		

❷

Shaft/Mounting		
- Solid Shaft/Foot Mount	**VXZ -** Solid Shaft/Foot/B14 Flange	**AZ** - Hollow Shaft/B14 Flange
VZ - Solid Shaft/B14 Flange	**VXF -** Solid Shaft/Foot/B5 Flange	**AF** - Hollow Shaft/B5 Flange
VF - Solid Shaft/B5 Flange	**LXZ -** Double Solid Shaft/Foot/ B14 Flange	**AX** - Hollow Shaft/Foot Mount
LX - Double Solid Shaft/Foot		**AXZ -** Hollow Shaft/Footed/B14 Flange
		AXF - Hollow Shaft/Footed/B5 Flange

❸

Reducer Options		
❒ **B -** Fixing Element Kit	❒ **VL -** Heavy Duty Output Bearings	❒ **VI -** Flouro-rubber Seals
❒ **H -** Hollow Shaft Cover	❒ **VL2 -** Spread Bearing Design	❒ **OSG -** Oil Sight Glass
❒ **H66 -** IP66 Hollow Shaft Cover	❒ **VL3 -** Oil Safe Spread Bearings	❒ **OA -** Oil Expansion Chamber
❒ **D -** Torque Arm	❒ **VL4 -** Drywell	❒ **OC -** Oil Cooler
❒ **K -** Bottom Mount Torque Arm	❒ **SM5 -** Stainless Steel Shaft	❒ **WC -** Water Cooling Cover
❒ **PR -** Flange Pilot Removal	❒ **SWA -** Special Hollow Shaft	❒ **LL -** Long Term Storage
❒ **SH -** Shrink Disc & Cover	❒ **SWV -** Special Solid Shaft	❒ **MDP -** Magnetic Drain Plug
❒ **VSH -** Heavy Duty Shrink Disc & Cover	❒ **R -** Backstop	❒ **ADP -** Additional Drain Plug

❹

Input Shaft	NEMA Adapter	IEC Adapter	Integral Motors		Integral Energy Efficent Motors		Scoop	Motor Platform	Servo Adapter (Keyed)
W	**N56C**	**IEC 63**	**63S/4** - 0.16hp	**160L/4** - 20hp	**80LH/4** - 1hp	**200LH/4** - 40hp	**S56**	**MKN056**	**SEP 100**
	N140TC	**IEC 71**	**63L/4** - 0.25hp	**180MX/4** - 25hp	**90SH/4** - 1.5hp	**225SH/4** - 50hp	**S140T**	**MKN140**	**SEP 130**
	N180TC	**IEC 80**	**71S/4** - 0.33hp	**180LX/4** - 30hp	**90LH/4** - 2hp	**2525MH/4** - 60hp	**S180T**	**MKN180**	**SEP 165**
	N210TC	**IEC 90**	**71L/4** - 0.50hp	**200L/4** - 40hp	**100LH/4** - 3hp	**250MH/4** - 75hp	**S210T**	**MKN210**	**SEP 215**
	N250TC	**IEC 100**	**80S/4** - 0.75hp	**225S/4** - 50hp	**112MH/4** - 5hp	**280SH/4** - 100hp	**S250T**	**MKN250**	**SEP 300**
	N280TC	**IEC 112**	**80L/4** - 1hp	**2525M/4** - 60hp	**132SH/4** - 7.5hp	**280MH/4** - 125hp	**S280T**	**MKN280**	**Servo Adapter (Clamp)**
	N320TC	**IEC 132**	**90S/4** - 1.5hp	**250M/4** - 75hp	**132MH/4** - 10hp	**315SH/4** - 150hp	**S320T**	**MKN320**	
	N360TC	**IEC 160**	**90L/4** - 2hp	**280S/4** - 100hp	**160MH/4** - 15hp	**315MH/4** - 175hp	**S360T**	**MKN360**	**SEK 100**
	N400TC	**IEC 180**	**100L/4** - 3hp	**280M/4** - 125hp	**160LH/4** - 20hp	**315MAH/4** - 200hp	**S400T**	**MKN400**	**SEK 130**
		IEC 200	**100LA/4** - 5hp	**315S/4** - 150hp	**180MH/4** - 25hp	**315LH/4** - 250hp			**SEK 165**
		IEC 225	**112M/4** - 5.4hp	**315M/4** - 175hp	**180LH/4** - 30hp				**SEK 215**
		IEC 250	**132S/4** - 7.5hp	**315MA/4** - 200hp					**SEK 300**
		IEC 280	**132M/4** - 10hp	**315L/4** - 250hp					
		IEC 315	**160M/4** - 15hp	Other Speeds Available		Other Speeds Available			

Product Specifications

Ratio

_____ :1

see pages 398 - 446

OR

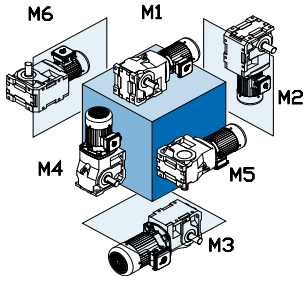
Output Speed

_____ rpm

see pages 398 - 446

Mounting Position

- ❍ M1
- ❍ M2
- ❍ M3
- ❍ M4
- ❍ M5
- ❍ M6
- ❍ Special _____



Paint

- ❍ Standard Stainles Steel Paint
- ❍ NSD+ (gray)
- ❍ NSD+W (white)
- ❍ NSD-X3 (gray)
- ❍ NSD-X3W (white)
- ❍ Casting Primed
- ❍ Special _____

Lubricant

- ❍ Standard
- ❍ Synthetic
- ❍ Food Grade
- ❍ Other _____

Solid Shaft Side (if required)

- ❍ Shaft Side A
- ❍ Shaft Side B
- ❍ Shaft Side A&B

see page 18

Hollow Shaft Diameter (if required)

_____

see pages 566 - 573

B5 Flange Side (if required)

- ❍ Flange Side A
- ❍ Flange Side B
- ❍ Flange Side A&B

see page 18

B5 Flange Diameter (if required)

_____

Torque Arm Side & Location (if required)

- ❍ Side A
- ❍ Side B

_____ Location

see page 18

Shrink Disc Side (if required)

- ❍ Side A
- ❍ Side B

see page 18

H66 Side (if required)

- ❍ H66 Side A
- ❍ H66 Side B

see page 18

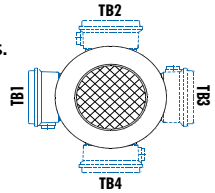
Gearmotor Only Details

Voltage & Frequency

- ❍ 230/460V-60Hz (460V only ≥ 40 hp)
- ❍ 575V-60Hz
- ❍ 208V-60Hz
- ❍ 400V-50Hz
- ❍ 115/230V-60Hz, 1 ph.
- ❍ Other _____

Terminal Box Pos.

- ❍ TB1
- ❍ TB2
- ❍ TB3
- ❍ TB4

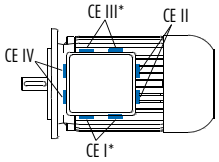


Mtg. Pos. M1 Shown

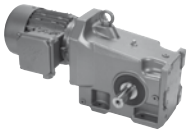
Conduit Entry Loc.

- ❍ CE I *
- ❍ CE II
- ❍ CE III *
- ❍ CE IV

* Brakemotor

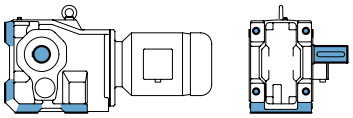


Mtg. Pos. M1 Shown

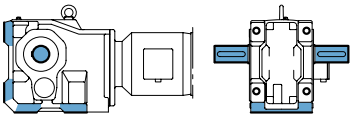


Examples of Available Helical-bevel Units with Solid Shaft Design

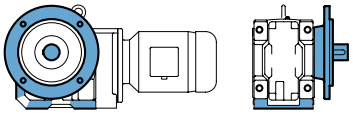
SK 9032.1 - 90 S/4
Helical Bevel Unit
Foot Mounted,
Solid Shaft Side A
Three Stage



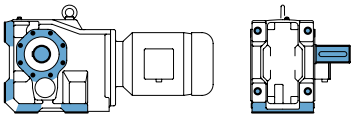
SK 9032.1LX - 90 S/4
Helical Bevel Unit
Foot Mounted,
Double Solid Shaft
Three Stage



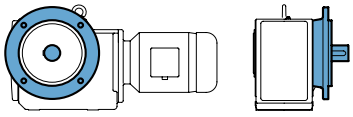
SK 9032.1VXF - 90 L/4
Helical Bevel Unit
Foot Mounted,
Solid Shaft Side A,
B5 Flange Side A
Three Stage



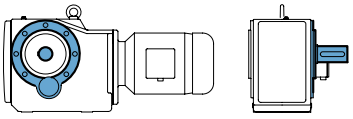
SK 9032.1VXZ - 90 L/4
Helical Bevel Unit
Foot Mounted,
Solid Shaft Side A
B14 Flange Side A & B
Three Stage



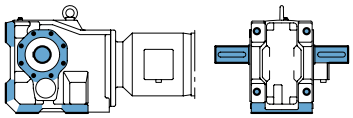
SK 9032.1VF - 90 L/4
Helical Bevel Unit
Solid Shaft Side A
B5 Flange Side A
Three Stage



SK 9032.1VZ - 90 L/4
Helical Bevel Unit
Solid Shaft Side A
B14 Flange Side A & B
Three Stage

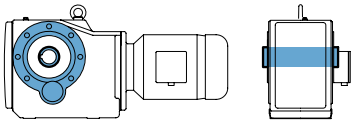


SK 9032.1LXZ - 90 L/4
Helical Bevel Unit
Double Solid Shaft
B14 Flange Side A & B
Three Stage

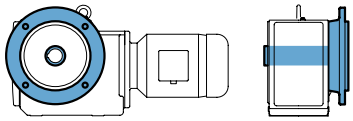


Examples of Available Helical-bevel Units with Hollow Shaft Design

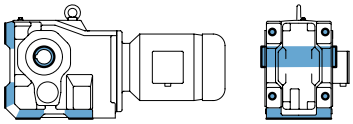
SK 9032.1AZ - 90 S/4
Helical Bevel Unit
Hollow Shaft,
B14 Flange Side A & B
Three Stage



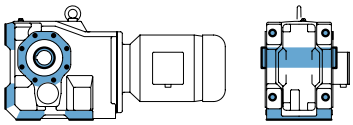
SK 9032.1AF - 90 S/4
Hollow Shaft,
B5 Flange Side A
Three Stage



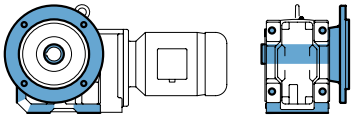
SK 9032.1AX - 90 L/4
Helical Bevel Unit
Hollow Shaft,
Foot Mounted
Three Stage



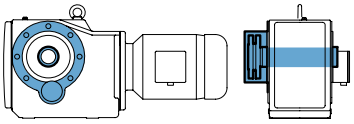
SK 9032.1AXZ - 90 L/4
Helical Bevel Unit
Hollow Shaft, Foot Mounted,
B14 Flange Side A & B
Three Stage



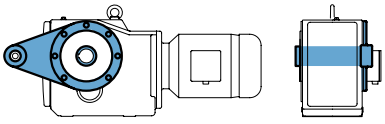
SK 9032.1AXF - 90 L/4
Helical Bevel Unit
Hollow Shaft, Foot Mounted,
B5 Flange Side A
Three Stage



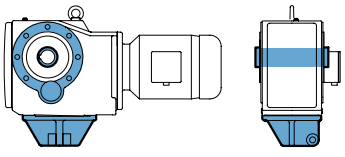
SK 9032.1AZSH - 90 L/4
Helical Bevel Unit
Hollow Shaft,
B14 Flange Side A & B,
Shrink Disc & Cover Side B
Three Stage



SK 9032.1AZD - 90 L/4
Helical Bevel Unit
Hollow Shaft,
B14 Flange Side A & B
Torque Arm Side A at 180°
Three Stage



SK 9032.1AZK - 90 L/4
Helical Bevel Unit
Hollow Shaft,
B14 Flange Side A & B
Bottom Mount Torque Arm Side A
Three Stage



0.33, 0.5 hp Gearmotors



DRIVESYSTEMS

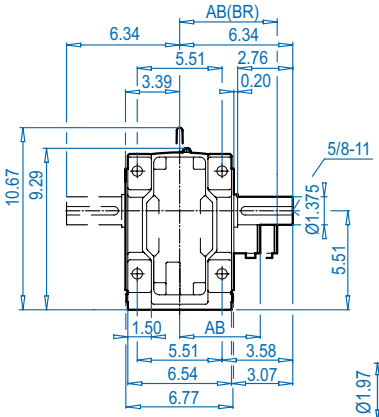
Motor Power P_n [hp]	Output Speed n_2 [rpm]	Output Torque T_2 [lb-in]	Service Factor f_B	AGMA Class	Gear Ratio i_{tot}	Standard Bearings F_{RN} OHL [lb]	Standard Bearings F_{AN} Thrust [lb]	Heavy Duty Bearings (VL) F_{RVL} OHL [lb]	Heavy Duty Bearings (VL) F_{AVL} Thrust [lb]	Model Type	Weight [lb]	Dim. Page
0.33	4.7	4539	1.2	I	367.33	1829	4500	2025	4500	**SK 9017.1 - 71S/4**	91	496
	3.5	6093	0.9	*	493.12	1422	4500	2025	4500			
	3.1	6898	0.8	*	558.25	1089	4500	2025	4500			
	7.3	2878	2.2	III	232.92	1969	2700	2700	4790	**SK 9022.1 - 71S/4**	96	500
	6.2	3421	2.1	III	276.86	1901	2700	2700	5002			
	3.6	5838	1.3	I	472.43	1379	2700	2441	5596	**SK 9023.1 - 71S/4**	107	504
	3	6939	1.1	I	561.55	909	2700	2210	5625			
	2.5	8381	0.9	*	678.31		2700	1787	5625			
	2.3	9315	0.8	*	753.86		2700	1388	5625			
	6.8	3086	4.4	III	249.72	3368	3263	3375	5013	**SK 9032.1 - 71S/4**	140	508
	5.8	3656	3.8	III	295.85	3341	3263	3375	5234			
	4.3	4927	2.8	III	398.77	3265	3263	3375	5625	**SK 9033.1 - 71S/4**	157	512
	3.2	6661	2.1	III	539.1	3119	3263	3375	6008			
	2.5	8545	1.6	II	691.55	2898	3263	3375	6325			
	2	10795	1.3	I	873.65	2527	3263	3375	6604			
	1.5	14207	1.0	I	1149.8	1559	3263	3375	6750			
	1.3	16822	0.8	*	1361.37		3263	3047	6750			
	3	7019	3.5	III	568.04	6246	9000	6300	9000	**SK 9043.1 - 71S/4**	277	520
	2.7	7972	3.1	III	645.18	6215	9000	6300	9000			
	1.9	10893	2.3	III	881.6	6093	9000	6300	9000			
	1.5	13756	1.8	II	1113.24	5933	9000	6300	9000			
	1.1	18747	1.3	I	1517.17	5549	9000	6300	9000			
0.5	447	71	6.1	III	3.85	592	819			**SK 92072 - 71L/4**	25	464
	328	95	5.5	III	5.24	653	920					
	297	105	6.2	III	5.79	673	961					
	267	117	5.0	III	6.44	693	995					
	219	143	5.5	III	7.87	736	1078					
	191	163	4.9	III	8.99	734	1136					
	178	176	4.5	III	9.68	734	1148					
	156	201	4.0	III	11.06	731	1148					
	127	246	2.7	III	13.55	729	1148					
	98	319	1.7	II	17.56	722	1148					
	84	370	2.2	III	20.37	716	1148					
	74	423	1.9	II	23.28	709	1148					
	65	480	1.7	II	26.39	702	1148					
	57	548	1.1	I	30.15	689	1148					
	50	631	1.1	I	34.73	673	1148					
	43	721	1.0	I	39.67	650	1148					

(AGMA Class I = f_B 1.0 - 1.39 II = f_B 1.4 - 1.99 III = f_B ≥ 2.0 * = f_B < 1.0)

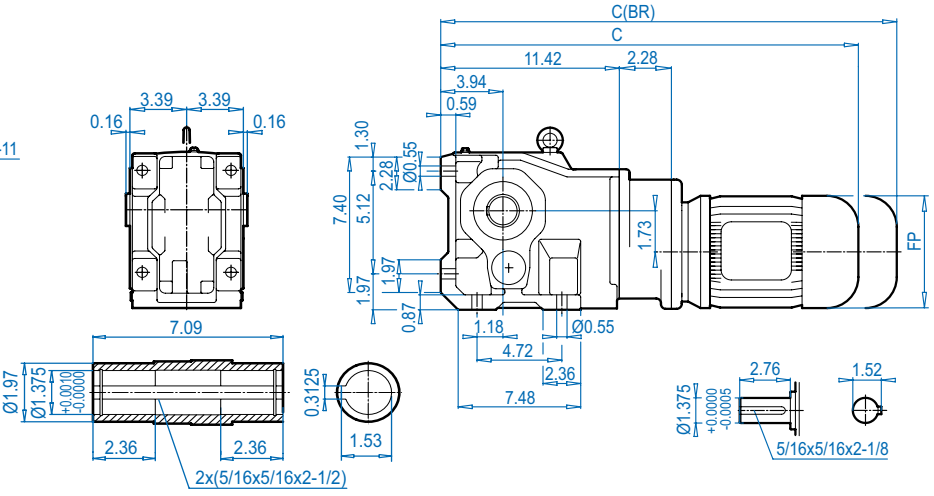




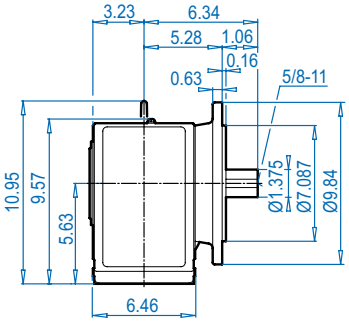
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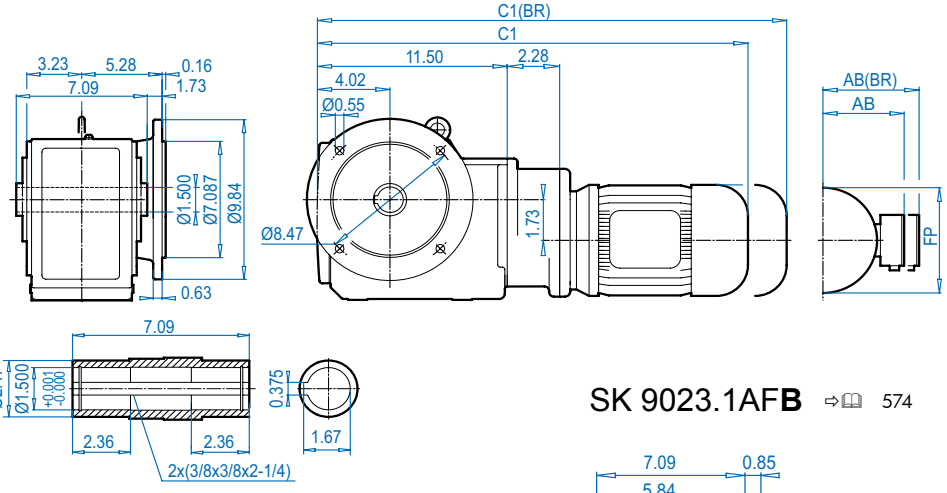
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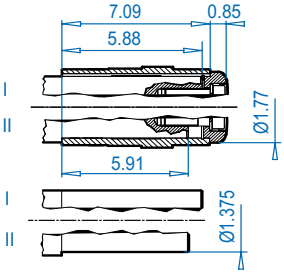
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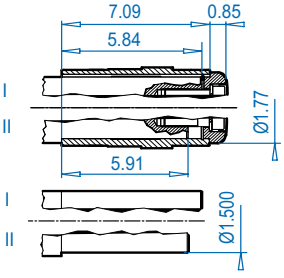
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SK 9023.1AX**B** ⇨🕮 574



SK 9023.1AF**B** ⇨🕮 574



ALTERNATE SHAFTS SEE PAGES 566 - 573

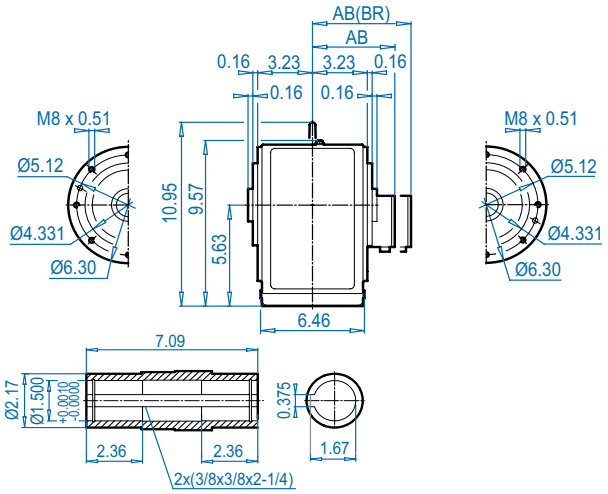
Motor dimensions

Standard efficiency	63S/L	71S/L			For Other Connection Possibilities please see ⇨🕮 555 & 557
Energy efficiency					
AB	4.53	4.88			
AB (BR)	4.84	5.24			
C1	21.50	23.07			
C1 (BR)	23.70	25.35			
C	21.42	22.99			
C (BR)	23.62	25.28			
FP	5.12	5.71			

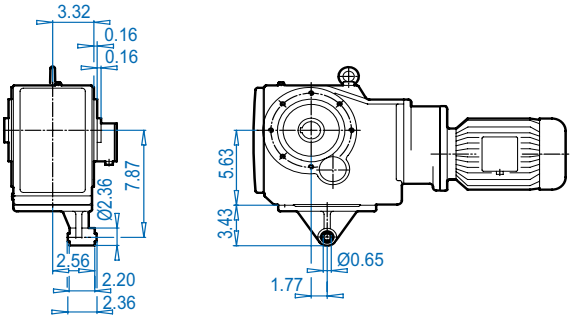


(BR) denotes Brakemotor

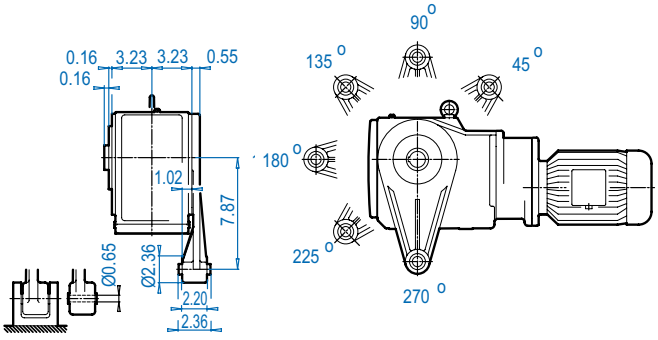
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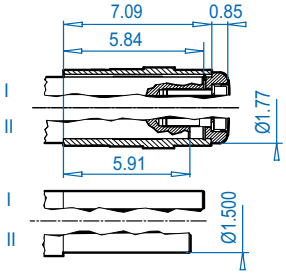
SK 9023.1AZ**K**



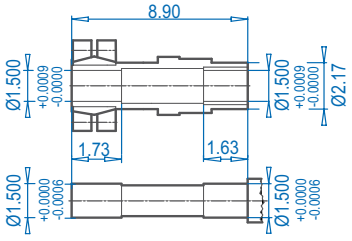
SK 9023.1AZ**D**



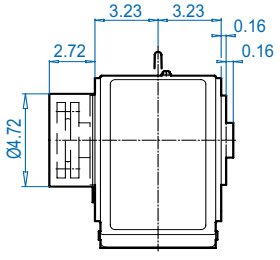
SK 9023.1AZ**B** ⇨🕮 574



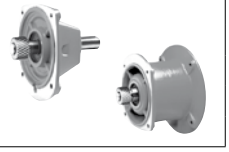
SK 9023.1AZ**S** ⇨🕮 571



SK 9023.1AZ**SH**



Motor dimensions

Standard efficiency	63S/L	71S/L			For Other Connection Possibilities please see ⇨🕮 555 & 557
Energy efficiency					
AB	4.53	4.88			
AB (BR)	4.84	5.24			
C1	21.50	23.07			
C1 (BR)	23.70	25.35			
FP	5.12	5.71			

(BR) denotes Brakemotor

Intelligent Drivesystems



B1000

Operating & Instruction Manuals For Gear Units

B1000

NORD DRIVESYSTEMS

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Troubleshooting	U19000
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Terms & Conditions of Sale	Terms

1. Importance of the operating instructions

These operating instructions are intended to provide general information and safety guidelines. It is the responsibility of the buyer, machine builder, installer and user of the NORD product to make sure that all the proper safetynotes and operating instructions have been reviewed and understood. If the contents of this instruction or any applicable operating instructions are not understood, please consult NORD.

⚠ *WARNING* ⚠

Electric motors, gearmotors, electrical brakes, variable frequency drives, and gear reducers contain potentially dangerous high-voltage, rotating-components and surfaces that may become hot during operation. All work involved in the transport, connection, commissioning and maintenance of any NORD product must be carried out by qualified and responsible technicians.

2. Inspect incoming freight

Before accepting shipment from the freight company, thoroughly inspect the NORD equipment for any shipping and handling damage. If any goods called for in the bill of lading or express receipt are damaged, or if the quantity is short, do not accept until the freight express agent makes an appropriate notation on your freight bill or express receipt. If any concealed loss or damage is discovered later, notify your freight carrier or express agent at once, and request a formal review of your claim.

Claims for loss or damage in shipment must not be deducted from the NORD invoice, nor should payment of the NORD invoice be withheld awaiting adjustment of such claims, as the carrier guarantees safe delivery. NORD will try to assist in collecting claims for loss or damage during shipment; however, this willingness on our part does not remove the transportation company's responsibility in reimbursing you for collection of claims or replacement of material.

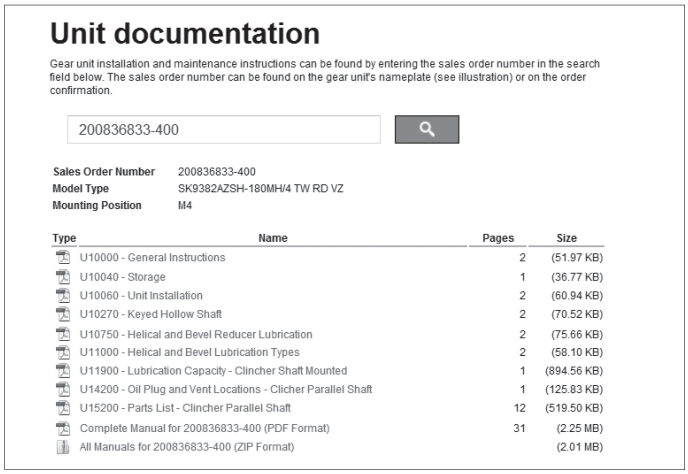
3. Obtaining detailed operating instructions

One can receive the detailed installation and maintenance instructions by entering a serial number (or NORD order number) at the appropriate location on the NORD web site.

i. Record the serial number from your gearmotor, gear reducer, or motor nameplate, or record the serial number found on your order confirmation.

ii. Go to **www.nord.com/docs** to download the appropriate operating instructions.

EXAMPLE: www.nord.com/docs



Unit documentation

Gear unit installation and maintenance instructions can be found by entering the sales order number in the search field below. The sales order number can be found on the gear unit's nameplate (see illustration) or on the order confirmation.

200836833-400

Sales Order Number	200836833-400
Model Type	SK9382AZSH-180MH/4 TW RD VZ
Mounting Position	M4

Type	Name	Pages	Size
	U10000 - General Instructions	2	(51.97 KB)
	U10040 - Storage	1	(36.77 KB)
	U10060 - Unit Installation	2	(60.94 KB)
	U10270 - Keyed Hollow Shaft	2	(70.52 KB)
	U10750 - Helical and Bevel Reducer Lubrication	2	(75.66 KB)
	U11000 - Helical and Bevel Lubrication Types	2	(58.10 KB)
	U11900 - Lubrication Capacity - Clincher Shaft Mounted	1	(894.56 KB)
	U14200 - Oil Plug and Vent Locations - Clicher Parallel Shaft	1	(125.83 KB)
	U15200 - Parts List - Clincher Parallel Shaft	12	(519.50 KB)
	Complete Manual for 200836833-400 (PDF Format)	31	(2.25 MB)
	All Manuals for 200836833-400 (ZIP Format)		(2.01 MB)

4. Intended use

NORD is a supplier of electric motors, gearmotors, reducers, electromechanical brakes, mechanical variators, and electrical variable frequency drives that are intended for commercial installations on larger systems and machines.

⚠ *WARNING* ⚠

NORD does not accept any liability for damage or injury caused by:

- Inappropriate use, operation or adaptation of the drive system.
- Unauthorized removal of housing covers, safety and inspection covers, guarding, etc.
- Unauthorized modifications to the drive system.
- Improper servicing or repair work on the drive system.
- Damage caused during shipment or transportation.
- Disregard of the important Safety Notes or Operating Instructions.

5. Notes concerning warranty and liability

All units are supplied according to the terms described in our standard "Conditions of Sale." The unit limited warranty is also defined in our "Conditions of Sale" and is located in the back of our product catalogs as well as the back of your order invoice.

All NORD Safety Notes and all related NORD Operating instructions shall be considered up-to-date at the time in which they were compiled by the buyer, machine builder, installer or user. NORD reserves the right to incorporate technical modifications and information updates to any safety/operating instructions that are within the scope of providing additional knowledge or clarification, communicating design changes, or product enhancements. Information updates may include any NORD product, or subsequent products purchased and supplied by NORD; No specific claims can be derived from the information or illustrations and descriptions contained in the safety notes or related operating instructions.

⚠ *WARNING* ⚠

NORD assumes no liability for personal injury, equipment damage or malfunctions resulting from failure to comply with any installation safety notes. The applicable national, regional, and local work regulations and safety requirements must also be complied with. Failure to comply with any safety notes or regulations may result in serious injury, damage to property, or even death.

6. Checklist for installation and operation

☑ Verify that the purchased NORD product has been supplied with the expected accessories & options. Check the received goods and packing slip to make sure items are properly received.

☑ Make sure that you have all of the required Operating Instructions for your NORD electric motor, gearmotor, reducer, electromechanical brake, mechanical variable speed drives, or electrical variable frequency drives.

☑ Consult NORD if you feel you are missing any documentation or if you have questions.

SAFETY NOTES

1. Safety & information symbols

All work including transportation, storage, installation, electrical connection, commissioning, servicing, maintenance and repair must be performed **only by qualified specialists or personnel**. It is recommended that repairs to NORD Products are carried out by the NORD Service Department. Instructions related to operational safety will be emphasized as shown.

Symbol	Meaning
⚠	**General Warning or Hazard -** Severe risk or danger of personal injury or death by working around dangerously high electrical voltage or moving machinery. Proper safety precautions must be taken.
STOP	**Possible Harmful Situation -** Care must be taken to avoid the possibility of damaging the drive unit, driven machine, or the environment.
i	**Important Note -** Useful note or tip to help assure trouble-free operation.
♻	**Material Disposal Note -** Important note concerning suggested material disposal.

2. Safety warnings

⚠ GENERAL WARNINGS ⚠

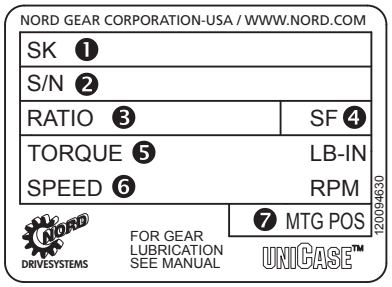
- All work involved in the transport, connection, commissioning and maintenance of any NORD product must be carried out by qualified and responsible technicians. All applicable national, regional, and local work regulations and safety requirements must also be complied with. **NORD assumes no liability for personal injury, accidental death, or equipment damage and malfunctions resulting from failure to comply with installation or operating instructions, safety notes, or any work regulations and laws!**
- Gear unit installation and maintenance work may only be performed when no power is available to the prime mover or motor. Electric motors, electrical brakes, and variable frequency drives, contain potentially dangerous high-voltage. Prior to installation or maintenance, shut down the power at the circuit breaker or power switch. **While working on the drive, make sure the power from the prime mover is isolated or secured on "lock-out" to prevent accidental start-up and to safeguard against injury!**
- Surfaces of motors and gear units may become hot during operation or shortly after start-up. In some instances additional protection against accidental contact may be necessary. **Use caution to avoid burns or serious injury!**

3. Observe published performance range & nameplate data

STOP HARMFUL SITUATION STOP

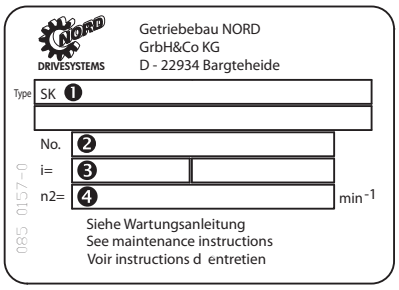
Observe the data on all reducer nameplates and verify published ratings for the NORD item/s in question. Do not operate any NORD equipment outside the published performance range. Failure to comply may result in damage to the drive unit, driven machine, or the environment.

U.S. Nameplate



❶ Model/Type
❷ Serial Number
❸ Gear Ratio
❹ Service Factor
❺ Torque Rating
❻ Output Speed RPM
❼ Mounting Position

European Nameplate



❶ Model/Type
❷ Serial Number
❸ Gear Ratio
❹ Speed

4. Transportation and handling

Make sure that all eyebolts and lifting lugs are tight and lift only at designed points. Protect the mounting surface from possible damage during transportation.

⚠ WARNING ⚠

Do not attach other machinery or loads to the NORD assembly, since the supplied lifting bolts are not designed for this purpose.

If the gearmotor or assembly is equipped with two suspension eye bolts, then both locations should be used for transportation and placement of the unit; in this case the tension force of the slings must not exceed a 45° angle.

In some instances it may be appropriate to use additional lifting straps or slings in order to assure safe transportation of the assembly. Always use sufficiently rated handling equipment and ensure that adequate safety measures are taken to protect personnel from injury during transportation. Once the NORD assembly is properly installed, remove the transportation fixtures.

7. DISPOSAL

MATERIAL DISPOSAL

Properly dispose of all used gear units and internal parts in accordance with all local regulations. In particular, all lubricants must be properly collected and disposed.

For confirmation of specific materials used in a specific reducer or gearmotor assembly, please consult NORD with the appropriate unit identification or serial number.

Components	Material
Gear wheels, shafts, rolling bearings, parallel keys, snap rings, spacers, shims, etc.	Steel
Gear housing and housing components	Cast iron or Aluminum (depending on type and size)
Worm gears	Bronze alloy
Radial seals, sealing caps, and rubber components	Elastomers with some steel
Coupling components	Plastic or Elastomer with Steel
Housing gaskets and flat oil seals	Asbestos-free sealing or gasket material (various types used)
Gear Oil	Mineral, SHC-Synthetic or PG-Synthetic (can vary)

STORAGE & COMMISSIONING

1. Storage

IMPORTANT NOTE

For storage periods longer than 9 months, or for storage in less than desirable conditions, please consult NORD for recommendations.

Storage for up to 9 months is possible, so long as the following conditions are observed:

- Store the gear unit in its actual mounting position in accordance with the specified oil fill-level, in a clean and dry temperature controlled area. Avoid temperature fluctuations within the range of 0°C and 40°C (32°F to 104°F) and avoid relative humidity conditions in excess of 60%.
- Protect all exposed or unpainted shaft and flange surfaces with an anti-corrosion agent or grease.
- Store in a location free from shock and vibration, to avoid false brinelling of bearing elements and raceways.
- Whenever possible, rotate the shafts periodically, by hand if necessary, to help prevent brinelling (bearing damage) and to help keep the shaft seals pliable.
- Avoid direct exposure to the sun or UV light and aggressive or corrosive materials in the environment (ozone, gases, solvents, acids, caustic solutions, salts, radioactivity, etc.

2. Commissioning

Prior to gear unit start-up, complete the following:

- Check the lubricant and be sure the gear unit is filled with the proper oil type, to the proper level, as determined by the mounting position.

IMPORTANT NOTE

Some smaller gear units are supplied as maintenance free/ lubricated for life gear units. Oil level may not be checked on some of these units.

- Check the condition of all shaft seals and all assembled flange gasket areas. If any change is detected in the shape, color, hardness or permeability, or if any leaks are detected, the corresponding shaft seals and/or gaskets must be replaced.
- Remove all anti-corrosive metal protectant from otherwise bare metal surfaces. Follow product manufacturers directions and warnings during surface protection removal.
- Check the resistance of all motor and brake windings to verify the integrity of the winding insulation and inspect all terminal box openings and wire connection areas to verify that all components are dry and free of corrosion.

3. Long-Term Storage

By taking special precautions, problems such as seal leakage and reducer failure due to the lack of lubrication, improper lubrication quantity, or contamination can be avoided. The following precautions will protect gear reducers during periods of extended storage:

- Store the gear unit in its actual mounting position in accordance with the specified oil fill-level, in a clean and dry temperature controlled area. Avoid temperature fluctuations within the range of 0°C and 40°C (32°F to 104°F) and avoid relative humidity conditions in excess of 60%.
- Fill the reducer full with oil that is compatible with the product normally used or recommended during service.
- Apply grease to all unpainted or unprotected shafts, bores, keyways, flange surfaces, tapped holes, and to the exterior of all oil seals.
- Store in a location free from shock and vibration, to avoid false brinelling of bearing elements and raceways.
- Once every few months rotate the input shaft approximately 10-20 revolutions to redistribute the weight of gears and shafts and to prevent brinnelling of the bearings and drying of the seal track.
- Avoid direct exposure to the sun or UV light and aggressive or corrosive materials in the environment (ozone, gases, solvents, acids, caustic solutions, salts, radioactivity, etc.)

4. Commissioning After Long-Term Storage

- Remove all anti-corrosive metal protectant from otherwise bare metal surfaces. Follow product manufacturers directions and warnings during surface protection removal.
- Drain the reducer and refill it with the proper type and amount of lubricant.
- Observe start-up and initial operation to make sure there are no seal or gasket leaks, or unusual sounds, vibration or heat rise during operation.
- Check the resistance of all motor and brake windings to verify the integrity of the winding insulation and inspect all terminal box openings and wire connection areas to verify that all components are dry and free of corrosion.

UNIT INSTALLATION

1. Installation site

Drives must be properly installed if they are to produce the rated torque. Improper installation may lead to oil leaks, reduced life, or even catastrophic failure. NORD gear drives and motors are intended to be installed at a suitable mounting site under the following conditions:

- Unimpeded airflow to and around the units.
- Accessibility to oil drain, level and breather plugs.
- On brakemotors, allow adequate space for removing the fan guard and replacing and adjusting the brake.
- Mounting surfaces must be flat, torsionally rigid, and dampened against vibration.
- Unless special measures are taken, the immediate vicinity around the gear drive or motor should not be exposed to any aggressive or corrosive substances, contaminated air, ozone, gases, solvents, acids, alkalis, salts, radioactivity, etc.

2. Mounting position

Reducer mounting position charts illustrate the standard mounting positions for horizontal and vertical mounting. All gear units are assembled with the oil fill-level, oil-drain and vent plugs installed in their proper locations, **according to the customer-specified mounting position**. For mounting orientations other than shown consult NORD Gear.

STOP *HARMFUL SITUATION* STOP

The gear reducer may not receive proper lubrication if the unit is not mounted in the position for which it is designed. Observe the mounting position designated on the reducer nameplate, or specified in the order acknowledgement. Consult NORD prior to changing mounting position in the field. While it is often possible to simply relocate the oil fill-level and vent locations, and adjust the oil fill amount, in some cases, different mounting positions may lend themselves to different internal construction features.

3. Reducer mounting

- The support foundation must be straight, level and flat. Whether the gear unit is foot-mounted or flange-mounted, NORD recommends that the straightness and flatness of the customer-supplied support foundation follow **Table 1**.
- The gear unit must be properly aligned with the driven shaft of the machine in order to prevent additional stress or load forces from being imposed upon the gear unit.
- To facilitate oil drainage it may be desirable to elevate the gear box foundation above the surrounding support structure.
- All bolting surfaces must be clean and free from contamination and corrosion.

Table 1: Recommended Straightness and Flatness of Customer-Supplied Support Foundation

Above (in)	To & Including (in)	General Tolerance on Straigtness & Flatness ISO 2768-2, Tolerance Class K
0.00	0.39	+/- 0.002 in
0.39	1.18	+/- 0.004 in
1.18	3.9	+/- 0.008 in
3.9	11.8	+/- 0.016 in
11.8	39	+/- 0.024 in
39	118	+/- 0.031 in

Above (mm)	To & Including (mm)	General Tolerance on Straigtness & Flatness ISO 2768-2, Tolerance Class K
0	10	+/- 0.05 mm
10	30	+/- 0.1 mm
30	100	+/- 0.2 mm
100	300	+/- 0.4 mm
300	1000	+/- 0.6 mm
1000	3000	+/- 0.8 mm

Straightness: Based upon the length of the corresponding line.

Flatness: Based upon the longer lateral surface or the diameter of the circular surface.

STOP *HARMFUL SITUATION* STOP

The responsibility for the design and construction of the support foundation is with the user. The foundation must be adequate to withstand normal operating loads and possible overloads while maintaining alignment to attached system components under such loads. ***Motors and drive components mounted on prefabricated base plates can become misaligned during shipment. Always check alignment after installation.***

4. Steel foundation

An engineered structural steel foundation should be designed to provide adequate rigidity and prevent loads from distorting the housing or causing misalignment of internal gears and shafts. When foot-mounting the gear reducer, a base plate or sole plate with suitable thickness (generally equal or greater than the thickness of the drive feet) should be securely bolted to steel supports and extend under the entire gear drive assembly. When flange-mounting the gear unit, the bulk head plate must be engineered to minimize buckling distortions and support the cantilevered weight of the gear unit or gear motor.

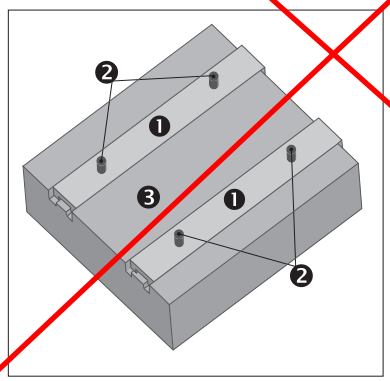
STOP *HARMFUL SITUATION* STOP

Do not weld on the gear unit or use the gear unit as an earth or ground connection for any welding procedure as this may cause permanent damage to the bearings and gears.

5. Concrete foundation

If a concrete foundation is used, allow the concrete to set firmly before bolting down the gear drive. Grout structural steel mounting pads and bolts of sufficient size into the concrete, to adequately distribute the load stress onto the concrete foundation.

Figure 1: Concrete Foundation



❶ Grouted Structural Steel Mounting Pads
❷ Mounting Bolts
❸ Concrete Foundation

6. Bolt connections for footed & flange mounted units

NORD footed reducers and flange-mount reducers (with B5 flange) have clearance designed into the mounting holes to allow for some minor adjustments in alignment. Bolt size, strength and quantity should be verified to insure proper torque reaction capacity whatever the mounting arrangement. Tightening torque for gear reducer mounting bolts, and recommended fastener grades, are provided in Table 2.

Table 2A: Tightening Torque for Inch Reducer Mounting Bolts

Thread Size	Grade SAE 5 / ASTM A449		Grade SAE 8	
(in)	(lb-ft)	(Nm)	(lb-ft)	(Nm)
1/4-20	7.1	9.6	10.0	13.6
5/16-18	16	21	22	30
3/8-16	28	37	39	53
1/2-13	69	93	98	132
5/8-11	138	188	195	264
3/4-10	247	334	348	472
7/8-9	396	537	558	757
1-8	592	802	833	1,130
1 1/8-7	-	-	1,233	1,672
1 1/4-7	-	-	1,717	2,327
1 3/8-6	-	-	2,267	3,073
1 1/2-6	-	-	2,983	4,045
1 3/4-5	-	-	4,458	6,045

- Calculated tightening torques are based a conventional 60°, clean and dry (un-lubricated) thread, with thread-friction and head-friction equal to 0.15.
- When using inch-fasteners, NORD recommends a minimum Grade SAE 5 (ASTM A-449) for sizes up to 1-8 UNC, and Grade SAE 8 for all larger sizes.

Table 2B: Tightening Torque for Metric Reducer Mounting Bolts

Above	ISO Grade 8.8		ISO Grade 10.9		ISO Grade 12.9	
(mm)	(lb-ft)	(Nm)	(lb-ft)	(Nm)	(lb-ft)	(Nm)
M4	2.4	3.2	3.5	4.7	4.1	5.5
M5	4.7	6.4	6.9	9.3	8.1	11
M6	8	11	12	16	14	19
M8	20	27	29	39	34	46
M10	39	53	58	78	67	91
M12	68	92	100	135	110	155
M14	107	145	159	215	180	250
M16	170	230	247	335	290	390
M18	240	325	343	465	400	540
M20	339	460	487	660	570	770
M22	465	630	664	900	770	1,050
M24	583	790	848	1,150	960	1,300
M27	848	1,150	1,217	1,650	1,440	1,950
M30	1,180	1,600	1,660	2,250	1,950	2,650
M36	2,050	2,780	2,884	3,910	3,470	4,710
M42	3,297	4,470	4,639	6,290	5,560	7,540
M48	4,940	6,700	7,010	9,500	8,260	11,200

- Calculated tightening torques are based on a conventional 60°, clean and dry (un-lubricated) thread, with thread-friction and head-friction equal to 0.15.
- When using metric-fasteners, NORD recommends a minimum ISO Grade 8.8 bolt.

7. Mounting the prime mover

When the motor is not flange mounted or integrally mounted to the gearbox, it is important to properly secure and align the gear drive with respect to the driven machine before attempting to align the prime mover or motor.

A. After the main gear drive is properly aligned and bolted in place, align the prime mover with respect to the reducer input shaft.

B. Use shims under the feet of the prime mover as needed, and secure in place with the proper mounting bolts. Dowel pins may be field-installed to help prevent misalignment and ensure proper realignment if removed for service.

IMPORTANT NOTE

When using a high speed coupling connection between the prime mover and the reducer, check alignment per the coupling manufacturers recommendations. If the coupling is misaligned, the reducer alignment or shimming is incorrect. Re-align the gear reducer and re-check the high-speed coupling alignment before re-aligning the motor.

1. Solid shaft diameter tolerance

Reducer input and output shaft extensions have a diameter tolerance as specified in **Table 1**.

Table 1: Solid Shaft Diameter Tolerance

Above ø (in)	To & Including ø (in)	Tolerance (in)
0.375	1.750	+0.0000 / -0.0005
1.750	7.500	+0.0000 / -0.0010

Above ø (mm)	To & Including ø (mm)	Tolerance (mm)	ISO 286-2 Fit Class
10	18	+0.012 / +0.001	k6
18	30	+0.015 / +0.002	k6
30	50	+0.018 / +0.002	k6
50	80	+0.030 / +0.011	m6
80	120	+0.035 / +0.013	m6
120	180	+0.040 / +0.015	m6
180	190	+0.046 / +0.017	m6

2. Fitting drive elements onto the reducer solid shaft

Solid input and output shaft extensions are provided with a drill and tap feature as indicated in Table 2. When installing drive elements such as coupling hubs, pulleys, sprockets, or gears, NORD recommends using the threaded hole in the end of the shaft, along with a suitable assembly device fitted into the threaded hole.

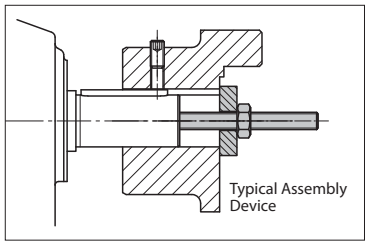


Table 2: Solid Shaft End - Threaded Holes

Above ø (in)	To & Including ø (in)	Tap size & Depth (in)
0.375	0.500	10-24 x 0.43 in
0.500	0.875	1/4-20 x 0.59 in
0.875	0.938	5/16-18 x 0.71 in
0.938	1.100	3/8-16 x 0.87 in
1.100	1.300	1/2-13 x 1.10 in
1.300	1.875	5/8-11 x 1.42 in
1.875	3.500	3/4-10 x 1.73 in
3.500	5.125	1-8 x 2.63 in
5.125	7.500	1 1/4 - 7 x 3.15

Above ø (mm)	To & Including ø (mm)	Tap Size & Depth (mm)
10	13	M4 x 10 mm
13	16	M5 x 12.5 mm
16	21	M6 x 16 mm
21	24	M8 x 19 mm
24	30	M10 x 22 mm
30	38	M12 x 28 mm
38	50	M16 x 36 mm
50	85	M20 x 42 mm
85	130	M24 x 50 mm
130	190	M30 x 60 mm

HARMFUL SITUATION

DO NOT DRIVE or **HAMMER** the coupling hub, pulley, sprocket, or gear into place. An endwise blow to the reducer shaft can generate damaging axial forces and cause damage to the reducer housing, bearings or internal components.

WARNING

To avoid serious injury the user must provide suitable safety guards for all rotating shafts and shaft components such as couplings, chain drives, belt drives, etc. All guarding must adhere to local regulations and safety standards.

3. Installing interference-fit hubs to the reducer shaft

Prior to installing any interference-fit hubs to the reducer shaft, consult with the manufacturer to determine proper assembly and fit. Interference-fits usually require heating the coupling, sprocket or gear hub, per the manufacturer's recommendations. Coupling hub installation typically follows ANSI/AGMA 9002-A86. Always make sure the reducer shaft seals are protected from the heat source. Apply uniform heat to the drive element hub to prevent distortion. NORD does not recommend heating the drive element hub beyond 212°F to 275°F (100°C to 135° C).

WARNING

When using heat to mount a drive element hub, do not use open flame in a combustible atmosphere or near flammable materials. Use suitable protection to avoid burns or serious injury.

HARMFUL SITUATION

When using external chain or belt drives, make sure the reducer is sized so that the shaft and bearings have adequate capacity. To avoid unnecessary bearing loads and additional shaft deflection, mount all power take-off devices (sprockets, pulleys, etc.) so that the applied load center is as close to the gear housing as possible and check component alignment and tension of any belts or chains per the manufacturer's recommendation. Do not over tighten the belts or chains.

4. Coupling installation

The performance and life of any coupling depends upon how well it is installed. Coupling hubs are typically mounted flush with the shaft ends, unless specifically ordered for overhung mounting. Shaft couplings should be installed according to the coupling manufacturer's recommendations for gap, angular and parallel alignment. To help obtain critical shaft alignment coupling hubs may be installed to the machine shafts prior to final shimming or tightening of the foundation bolts. Proper coupling alignment allows for thermal and mechanical shaft movement during operation and ensures that only torque (no radial load) is transmitted between the mating shafts.

Coupling gap and angular alignment

The shaft gap must be sufficient to accommodate any anticipated thermal or mechanical axial movement. When setting the coupling gap, insert a spacer or shim stock equal to the required spacing or gap between the coupling hub faces. Measure the clearance using feeler gauges at 90-degree intervals, to verify the angular alignment.

Parallel (or offset) alignment

Mount a dial indicator to one coupling hub, and rotate this hub, sweeping the outside diameter of the other hub. The parallel or offset misalignment is equal to one-half of the total indicator reading. Another method is to rest a straight edge squarely on the outside diameter of the hubs at 90° intervals and measure any gaps with feeler gauges. The maximum gap measurement is the parallel or offset misalignment.

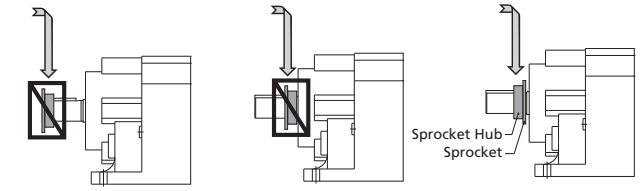
Check alignment

After both angular and parallel alignments are within specified limits, tighten all foundation bolts securely and re-check critical alignment. If any of the specified limits for alignment are exceeded, realign the coupling.

5. Installing sheaves (pulleys), sprockets and gears

To avoid unnecessary bearing loads and additional shaft deflection, mount all power take-off devices (sprockets, pulleys, gears, etc.) so that the applied load center is as close to the gear housing as possible, as shown in **Figure 2**.

Figure 2: Sprocket or Gear Mounting



Preferred Mounting of Sprocket or Gear

Align the driver sheave or sprocket with the driven sheave or sprocket by placing a straight-edge length-wise across the face of the sheaves or sprockets. Alignment of bushed sheaves and sprockets should be checked only after bushings have been tightened. Check horizontal shaft alignment by placing one leg of a square or a level vertically against the face of the sheave or sprocket.

Always check component alignment and tension any belts or chains per the manufacturer's recommendation. The ideal belt or chain tension allows proper wrap of the driver and driven wheels, while maintaining the lowest possible tension of the belts or chain, so that no slipping occurs under load conditions. Check belt or chain tension frequently over the first 24 to 48 hours of operation.

STOP *HARMFUL SITUATION* STOP

When using external chain or belt drives, make sure the reducer is sized so that the shaft and bearings have adequate capacity. To avoid unnecessary bearing loads and additional shaft deflection, mount all power take-off devices (sprockets, pulleys, etc.) so that the applied load center is as close the gear housing as possible and check component alignment and tension of any belts or chains per the manufacturer's recommendation. Do not over tension the belts or chains.

6. Outboard pinion gear alignment

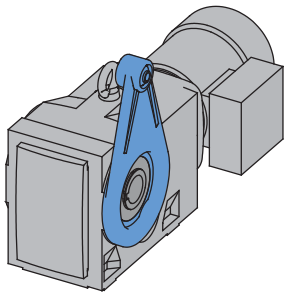
Align outboard pinion gears and adjust the gear tooth clearance according to the manufacturer's recommendations, checking for acceptable outboard pinion tooth contact. The foundation bolts may have to be loosened and the gear unit moved slightly to obtain proper gear tooth contact. After the unit is moved to correct tooth contact, the prime mover may need to be realigned.

RIGHT-ANGLE SHAFT-MOUNT WITH TORQUE ARM (D)

1. Torque arm (D)

The preferred method of installing a shaft-mounted reducer is to support the weight of the gear unit or gearmotor assembly from the driven solid machine shaft. A torque arm is required in order to restrain the gearbox, react the load torque, and keep the gear unit from spinning around the shaft.

Table 1 (Page 2) provides a list of Torque-Arm (D) part numbers available based upon reducer series and type. The torque-arm is a tear-drop shaped bracket that is mounted to the B14 flange-face of the reducer. Each torque-arm bracket is supplied with a resilient rubber bushing located at the fastening hole-end of the bracket.



IMPORTANT NOTE

The side of the reducer that the torque arm is mounted on, and the angular position can be specified at time of order. Consult the appropriate NORD catalog for specific Torque Arm (D) mounting options and ordering guidelines.

2. Purpose of the built-in resilient rubber bushing

The resilient rubber bushing installed into the fastening hole end of the torque-arm helps isolate and absorb all the load forces present in the system and increase the reducer's service life by reducing cumulative torsional shock loads.

- The primary load force acts in the direction of driven shaft rotation, reacts the load torque of the reducer, and prevents the gearbox from spinning on the shaft.
- Additional forces present themselves in the direction opposite of the shaft rotation, due to the typical slight out-of-round condition present in the machine shaft. This condition is the reason most shaft mounted-reducers have a slight shaft-wobble, which is normal.

HARMFUL SITUATION

Always make sure that the Torque Arm (D) has the resilient rubber bushing installed into the fastening hole end of the torque arm. Failure to do so will not properly cushion the reducer and can result in excessive binding, bearing stress, and damage to the reducer.

3. Machine support

The user must supply a suitably strong and rigid mating machine support that provides load bearing capacity on both sides of the torque-arm bracket.

WARNING

It is the responsibility of the machine builder to design a support bracket of adequate strength and rigidity, and supply an appropriate tightening bolt assembly. Failure to do so may result in injury caused from a damaged or broken torque-reaction assembly.

4. Installation of the right-angle reducer with torque arm (D)

A. Make sure the Torque-Arm (D) is mounted in the correct position on the reducer.
   - The torque-arm can be repositioned on the as-received unit by removing the fixing screws, re-position the torque-arm in the correct location, and re-securing the fixing screws to the proper tightening torque, as indicated in Table 2 (Page 2).
   - If the torque-arm was shipped loose, position the torque-arm in the correct location on the gear unit, and secure the torque-arm with the proper fixing screws & tightening torque, as indicated in Table 2 (Page 2).

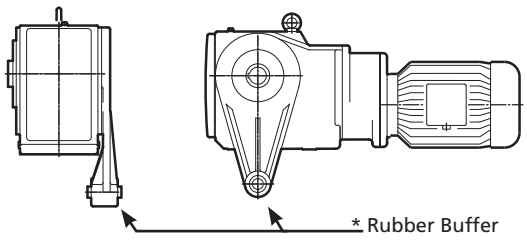
B. Install the right-angle hollow bore reducer onto the machine shaft. Line up the hole in the reducer's torque-arm with the hole in the machine's support bracket and temporarily hold the reducer in place

C. Properly secure the gear unit assembly to the driven shaft in an axial direction.

D. Place the fastening bolt through the rigid machine support bracket and reducer torque-arm. Then apply a thread locking compound to the end of the fixing bolt and loosely secure the nut onto the end of the bolt.

E. Tighten the fixing bolt to the proper tightening torque as indicated in Table 2 (Page 2).

Table 1 - Torque Arm (D) with rubber buffer



- For all 90.1 Series Helical-Bevel gear units, NORD also offers a bottom mount Torque Arm (K). See User Manual U10620.
- For the large 90.1 Series Helical-Bevel gear units sizes: SK9082.1, SK9086.1, SK9092.1, and SK9096.1, please use the Torque Arm (K).
- A metric fixing bolt is preferred for fastening the Torque-Arm(D) to the machine support bracket.

Series	Type	Torque Arm Assembly P/N	Rubber Buffer* P/N	Reducer Mounting Screws	Mounting Screw P/N	Fastening Hole in [mm]	Fastening Bolt Size
92 Series Helical- Bevel	SK92172AZD	69290600	29602505	(Qty 8) M6 X 16 SHCS	22106165	0.41 [10.5]	M10
	SK92372AZD	69390600	29602505	(Qty 8) M8 X 25 SHCS	22108250	0.41 [10.5]	M10
	SK92672AZD	69390600	29602505	(Qty 8) M8 X 25 SHCS	22108250	0.41 [10.5]	M10
	SK92772AZD	69590600	29603605	(Qty 8) M8 X 25 SHCS	22108250	0.65 [16.5]	M16
90.1 Series Helical-Bevel	SK9012.1AZD/SK9013.1AZD	61090600	29602505	(Qty 7) M8 X 20 SHCS	22108205	0.41 [10.5]	M10
	SK9016.1AZD/SK9017.1AZD	61090600	29602505	(Qty 7) M8 X 20 SHCS	22108205	0.41 [10.5]	M10
	SK9022.1AZD/SK9023.1AZD	68290600	29603605	(Qty 7) M8 X 25 SHCS	22108250	0.65 [16.5]	M16
	SK9032.1AZD/SK9033.1AZD	68390600	29603605	(Qty 7) M10 X 30 SHCS	22110305	0.65 [16.5]	M16
	SK9042.1AZD/SK9043.1AZD	68490600	29605205	(Qty 7) M12 X 35 SHCS	22112350	0.98 [25]	M24
	SK9052.1AZD/SK9053.1AZD	68590600	29605205	(Qty 7) M12 X 35 SHCS	22112350	0.98 [25]	M24
	SK9072.1AZD	68690600	29605205	(Qty 7) M16 X 45 SHCS	22116450	0.98 [25]	M24
Helical-Worm	SK02040AZD	60190600	29602505	(Qty 4) M6 X 20 SHCS	22106205	0.41 [10.5]	M10
	SK02050AZD/SK13050AZD	60290600	29602505	(Qty 4) M8 X 20 SHCS	22108205	0.41 [10.5]	M10
	SK12063AZD/SK13063AZD	61090600	29602505	(Qty 7) M8 X 22 SHCS	22108220	0.41 [10.5]	M10
	SK12080AZD/SK13080AZD	61290600	29602505	(Qty 7) M10 X 25 SHCS	22110255	0.41 [10.5]	M10
	SK32100AZD/SK33100AZD	63290600	29603605	(Qty 7) M12 X 30 SHCS	22112300	0.65 [16.5]	M16
	SK42125AZD/SK43125AZD	64290600	29603605	(Qty 7) M12 X 30 SHCS	22112300	0.65 [16.5]	M16
MINICASE® Worm	1SM31AZD	60390600	29602505	(Qty 4) M6 X 20 SHCS	22106205	0.41 [10.5]	M10
	1SM40AZD/2SM40AZD	60490600	29602505	(Qty 4) M8 X 20 SHCS	22008206	0.41 [10.5]	M10
	1SM50AZD/2SM50AZD	60490600	29602505	(Qty 4) M8 X 20 SHCS	22008206	0.41 [10.5]	M10
	1SM63AZD/2SM63AZD	60690600	29602505	(Qty 4) M8 X 20 SHCS	22008206	0.41 [10.5]	M10
FLEXBLOC™ Worm	SK1SI31AZD	60393900	29602505	(Qty 4) M6 X 16 SHCS	22106160	0.41 [10.5]	M10
	SK1SI40AZD	60493900	29602505	(Qty 4) M8 X 22 SHCS	22108220	0.41 [10.5]	M10
	SK1SI50AZD	60593900	29602505	(Qty 4) M8 X 22 SHCS	22108220	0.41 [10.5]	M10
	SK1SI63AZD	60693900	29602505	(Qty 4) M10 X 25 SHCS	22110250	0.41 [10.5]	M10
	SK1SI75AZD	60793900	29602505	(Qty 4) M12 X 30 SHCS	22112300	0.41 [10.5]	M10

Thread Size	Tightening Torque					
	ISO Grade 8.8			ISO Grade 10.9		
(mm)	(lb-in)	(lb-ft)	(N-m)	(lb-in)	(lb-ft)	(Nm)
M6	97	8	11	142	12	16
M8	239	20	27	345	29	39
M10	469	39	53	690	58	78
M12	814	68	92	1,195	100	135
M16	2,036	170	230	2,965	247	335
M20	4,071	339	460	5,841	487	660
M24	6,992	583	790	10,178	848	1,150

HELICAL-WORM REDUCER LUBRICATION

7. The importance of routine oil analysis

Routine oil analysis, sound lubrication practices, and good tracking of oil performance trends will help establish proper lubrication maintenance and change-out intervals. To maximize equipment reliability, NORD Gear generally recommends a condition-based lubrication maintenance program. One may take exceptions to this general recommendation on sealed-for-life or maintenance-free gear units or smaller and less costly gear units. In these instances, the replacement cost of the gear unit is often small compared to the costs associated with this type of oil analysis program.

STOP *HARMFUL SITUATION* **STOP**

NORD suggests replacing the gear oil if oil analysis indicates any of the following:

- Viscosity has changed by approximately 10% or more.
- Debris particles (silicon, dust, dirt or sand) exceed 25 ppm.
- Iron content exceeds 150-200 ppm.
- Water content is greater than 0.05% (500 ppm).
- The total acid number (TAN) tests indicate a significant level of oxidative break-down of the oil, and a critical reduction in performance; If the TAN number measured changes by more than 5% over the new oil, then an oil change would be recommended.

8. Mounting position and oil fill quantity

All NORD Gear reducers are shipped from the factory with a pre-determined oil fill level in accordance to the specified reducer size and mounting position. ***For additional information, please see the seperate mounting position diagrams and the corresponding oil fill quantity tables for the specified gear unit.***

The gearbox nametag will indicate the mounting position that was provided. ***For mounting orientations other than shown in the mounting position charts, please consult NORD Gear.***

STOP *HARMFUL SITUATION* **STOP**

Actual oil volume can vary slightly depending upon the gear case size, mounting and ratio. Prior to commissioning the reducer, check the oil-fill level using the reducer's oil-level plug and drain or add additional oil as needed. The minimum acceptable oil level is 0.15 in (4mm) below the oil level hole.

9. Oil plug locations

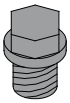
All gear units are assembled with the oil fill-level, oil-drain and vent plugs installed in their proper locations, according to the specified mounting position. All standard plugs are metric and utilize sealing gaskets between the head of the plug and the reducer housing.

10. Drain and fill-level plugs

All reducer drain plugs are metric socket head cap screws. For easier identification, it is NORD's standard practice to provide a hex-head screw for the fill-level plug. For ease of draining the used oil from the gear reducer, use the socket head screw located at the lowest part of the gearbox.



Drain Plug



Fill Level Plug

11. Vent plug locations

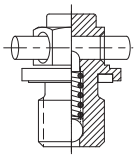
Reducer venting allows for air pressure differences that occur during operation, between the inner space of the reducer and the atmosphere, while ensuring leak-free operation. The AUTOVENT™ is standard for all vented gear units, unless otherwise noted.

AUTOVENT™ - The AUTOVENT™ helps prevent bearing and gear damage by behaving like a check valve to block the entry of foreign material (water, dust, corrosives, etc.). The breather opens at approximately 2-3 psi during operation and closes tightly as the gearbox cools. This option is perfect for humid conditions and wash-down environments, helping to maintain proper oil cleanliness, and reducing foaming and oxidation. NORD may choose to offer one of two style options as shown in Figure 1. The Type 2 AUTOVENT™ comes closed upon delivery with a transportation sealing plug (see Warning).

Figure 1 AUTOVENT™ Types



Type 1





Type 2 with transportation plug

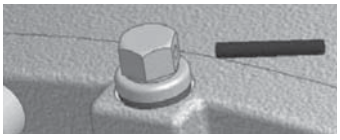
Open Vent - An optional open vent can be supplied by NORD. The open vent comes closed upon delivery with a transportation sealing plug (see Warning).

⚠ *WARNING* ⚠

To prevent build-up of excessive pressure, sealed vents must be activated as shown prior to gear unit start up.



Sealed vent



Activated vent

Filtered Vent - NORD may offer an optional filtered vent, which allows gases to permeate, but does not allow dust and debris to pass through the vent.

HELICAL-WORM REDUCER LUBRICATION TYPES

Lubrication Tables – Helical Worm Gear Units

Standard Oil Lubricants

ISO Viscosity	Oil Type	Ambient Temperature Range	Manufacturer Brand/Type	Notes
VG680	PAO	0 to 60°C (32 to 140°F)	Mobil SHC636	♦

Optional Oil Lubricants

ISO Viscosity	Oil Type	Ambient Temperature Range	Manufacturer Brand/Type	Notes
VG460	PAO	0 to50°C (32 to 122°F)	Mobil SHC 634	-
	FG-PAO	0 to50°C (32 to 122°F)	Mobil SHC Cibus 460	-

Grease Options (applied to greased bearings and seal cavities)

NLGI Grade	Grease Type/Thickener	Ambient Temperature Range	Manufacturer Brand/Type	Notes
NLGI 2	Standard (Li-Complex)	-30 to 60°C (-22 to 140°F)	Mobil Grease XHP222	♦
	High Temp (Polyurea)	-40 to 80°C (-40 to 176°F)	Mobil / Polyrex EP 2	♦
	Food-Grade (Polyurea)	-30 to 40°C (-22 to 104°F)	Mobil SHC Polyrex 222	♦

♦ **Stocked Lubricants**

IMPORTANT NOTES

- The "Ambient Temperature" is intended to be an operation guideline based upon the typical properties of all the lubricant. The viscosity and other properties of the lubricant change based upon load, speed, ambient conditions, and reducer operating temperatures. The user should consult with their lubrication supplier & NORD Gear before considering changes in oil type or viscosity.
- To prevent reducer overheating, observe the maximum operating oil temperature limits:

  Synthetic Oil: 105 °C (225 °F).
- In the following instances, please consult NORD for specific recommendations:

√ Gear units will operate in high ambient temperature conditions exceeding 40 °C (104 °F).
√ Gear units will operate in cold ambient temperature conditions approaching 0 °C (32 °F) or lower.
√ Lower than an ISO VG100 viscosity oil is being considered for a cold-temperature service.
√ Fluid grease is required for lubricating the gear unit.

- Observe the general lubrication guidelines outlined in user manual U10770.

Oil Formulation Codes

PAO - Synthetic Polyalphaolefin Oil
PG - Synthetic Polyglycol Oil
FG-PAO - Food-Grade, Synthetic Poyalphaolefin Oil
FG-PG - Food-Grade, Synthetic Polyglycol Oil

Lubrication Notes

- Avoid using (EP) gear oils in worm gears that contain sulfur-phosphorous chemistries, as these additives can react adversely with bronze worm gears and accelerate wear.
- Food grade lubricants must be in compliance with FDA 212 CFR 178.3570 and qualify as a NSF-H1 lubricant. Please consult with lubrication manufacturer for more information.
- When making a lubrication change, check with the lubrication supplier to assure compatibility and to obtain recommended cleaning or flushing procedures.
- Do not to mix different oils with different additive packages or different base oil formulation types. Polyglycol (PG) oils are not miscible with other oil types and should never be mixed with mineral oil or polyalphaolefin (PAO) synthetic oil.

HELICAL-WORM REDUCER LUBRICATION TYPES

Oil Cross-reference Chart

ISO Viscosity	Oil Type	Ambient Temperature Range	Mobil	Shell	Castrol	FUCHS	KLÜBER LUBRICATION
VG 100	PAO	-35 to 25°C (-31 to 77°F)	Mobil SHC627	N/A	N/A	N/A	Klübersynth GEM 4-100N
	PG	-25 to 25°C (-13 to 77°F)	Mobil Glygoyle 100	N/A	N/A	N/A	Klübersynth GH 6-100
	FG-PAO	-35 to 25°C (-31 to 77°F)	Mobil SHC Cibus 100	N/A	N/A	N/A	Klüberoil 4 UH 1-100N
	FG-PG	-25 to 25°C (-13 to 77°F)	Mobil Glygoyle 100	N/A	N/A	N/A	Klübersynth UH1 6-100
VG150	PAO	-35 to 25°C (-31 to 77°F)	Mobil SHC629	Omala RL 150	Alphasyn T150	N/A	Klübersynth GEM 4-150N
	PG	-25 to 25°C (-13 to 77°F)	Mobil Glygoyle 150	Tivela S150	Alphasyn PG150	Renolin PG150	Klübersynth GH 6-150
	FG-PAO	-15 to 25°C (5 to 77°F)	Mobil SHC Cibus 150	N/A	N/A	Cassida GL150	Klüberoil 4 UH 1-150N
	FG-PG	-25 to 25°C (-13 to 77°F)	Mobil Glygoyle 150	N/A	N/A	N/A	Klübersynth UH1 6-150
VG220	PAO	-15 to 40°C (5 to 104°F)	Mobil SHC630	Omala RL220	Alphasyn T220	N/A	Klübersynth GEM 4-220N
	PG	-25 to 40°C (-13 to 104°F)	Mobil Glygoyle 220	Tivela S220	Alphasyn PG220	Renolin PG220	Klübersynth GH 6-220
	FG-PAO	-25 to 40°C (-13 to 104°F)	Mobil SHC Cibus 220	N/A	N/A	Cassida GL220	Klüberoil 4 UH 1-220N
	FG-PG	-25 to 40°C (-13 to 104°F)	Mobil Glygoyle 220	N/A	N/A	Cassida WG220	Klübersynth UH1 6-220
VG460	PAO	0 to50°C (32 to 122°F)	Mobil SHC 634	Omala RL460	Alphasyn T460	N/A	Klübersynth GEM 4-460N
	PG	0 to50°C (32 to 122°F)	Mobil Glygoyle 460	Tivela S460	Alphasyn PG460	N/A	Klübersynth GH 6-460
	FG-PAO	0 to50°C (32 to 122°F)	Mobil SHC Cibus 460	N/A	N/A	Cassida GL460	Klüberoil 4 UH 1-460N
	FG-PG	0 to50°C (32 to 122°F)	Mobil Glygoyle 460	N/A	N/A	Cassida WG460	Klübersynth UH1 6-460
VG680	PAO	0 to 60°C (32 to 140°F)	Mobil SHC636	Omala RL680	N/A	N/A	Klübersynth GEM 4-680N
	PG	0 to 60°C (32 to 140°F)	Mobil Glygoyle 680	Tivela S680	N/A	N/A	Klübersynth GH 6-680
	FG-PAO	0 to 60°C (32 to 140°F)	N/A	N/A	N/A	Cassida GL680	Klüberoil 4 UH1-680N
	FG-PG	0 to 60°C (32 to 140°F)	Mobil Glygoyle 680	N/A	N/A	Cassida WG680	Klübersynth UH1 6-680

Low-end service temperature limit may vary for a specific lubricant; Please also see the important notes on Page 1.

HELICAL-WORM FOOTED OIL FILL QUANTITIES

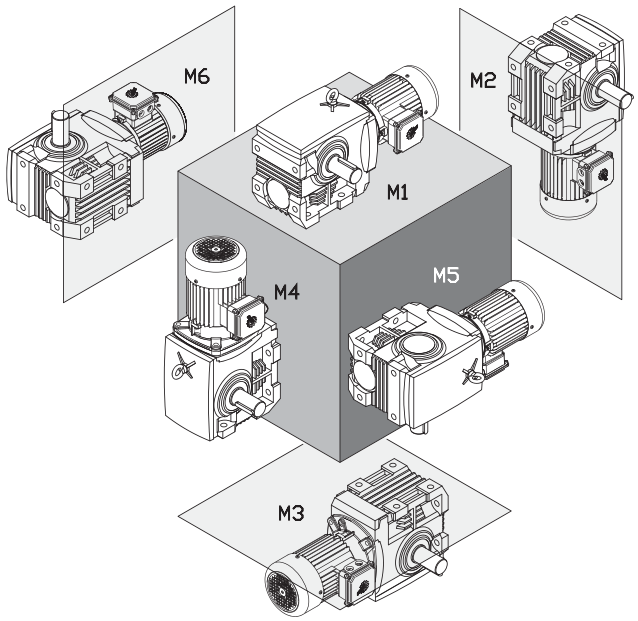
Helical-worm footed lubrication

The following NORD Gear reducers are shipped from the factory with a pre-determined oil fill level in accordance to the specified reducer size and mounting position. For additional information, please refer to the "Oil Plug & Vent Locations" documentation for your gear unit.

STOP *HARMFUL SITUATION* **STOP**

Actual oil volume can vary slightly depending upon the gear case size, mounting and ratio. Prior to commissioning the reducer, check the oil-fill level using the reducer's oil level plug and drain or add addition oil as needed. The minimum acceptable oil level is 0.15 in (4mm) below the oil level hole.

For mounting orientations other than shown please consult NORD Gear. Reducer modifications may be required.



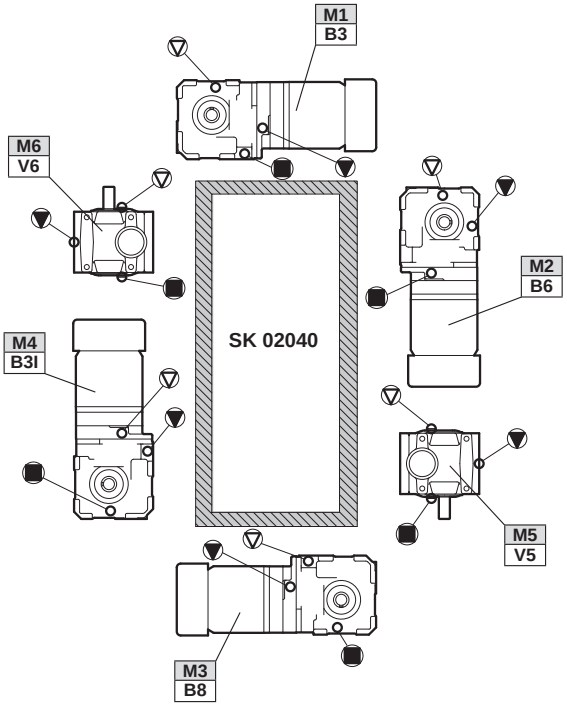
Type	M1		M2		M3		M4		M5		M6	
	Quarts	Liters	Quarts	Liters	Quarts	Liters	Quarts	Liters	Quarts	Liters	Quarts	Liters
SK 02040	0.480	0.450	0.630	0.600	0.630	0.600	0.630	0.600	0.530	0.500	0.530	0.500
SK 02050	0.420	0.400	1.27	1.20	0.740	0.700	1.22	1.15	0.740	0.700	0.740	0.700
SK 13050	1.000	0.950	1.64	1.55	1.16	1.10	1.53	1.45	1.000	0.950	1.000	0.950
SK 12063	0.630	0.600	1.80	1.70	1.27	1.20	1.64	1.55	1.06	1.000	1.06	1.000
SK 13063	0.900	0.850	2.43	2.30	1.69	1.60	2.11	2.00	1.32	1.25	1.32	1.25
SK 12080	0.850	0.800	2.75	2.60	1.80	1.70	2.85	2.70	1.80	1.70	1.80	1.70
SK 13080	1.80	1.70	3.38	3.20	2.22	2.10	3.59	3.40	2.06	1.95	2.06	1.95
SK 32100	1.69	1.60	5.81	5.50	3.59	3.40	5.71	5.40	3.38	3.20	3.38	3.20
SK 33100	2.22	2.10	8.03	7.60	4.23	4.00	7.19	6.80	3.91	3.70	3.91	3.70
SK 42125	2.96	2.80	11.63	11.00	6.55	6.20	10.89	10.30	6.13	5.80	6.13	5.80
SK 43125	8.24	7.80	14.80	14.00	7.61	7.20	14.27	13.50	7.08	6.70	7.08	6.70

HELICAL-WORM
OIL PLUG & VENT LOCATIONS

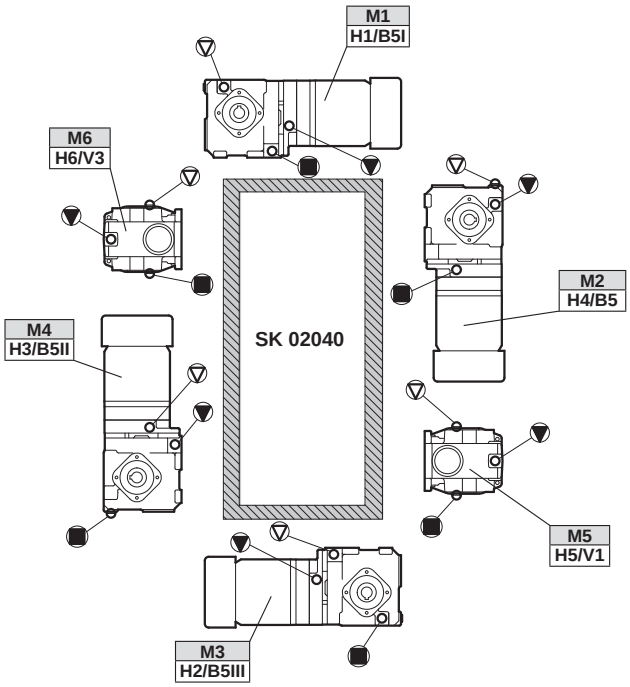
Oil plug connections

Prior to commissioning the reducer, check the oil-fill level using the reducer's oil-level plug and drain or add additional oil as needed. The minimum acceptable oil level is 0.15 in (4mm) below the oil level hole. ***For mounting orientations other than shown please consult NORD Gear. New plug locations may be required.***

Foot Mount



Shaft/Flange Mount



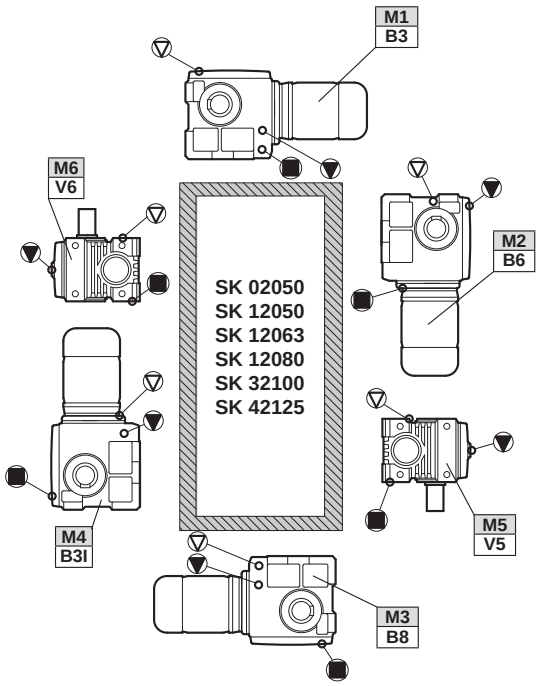
▽ = Vent

▼ = Oil Level

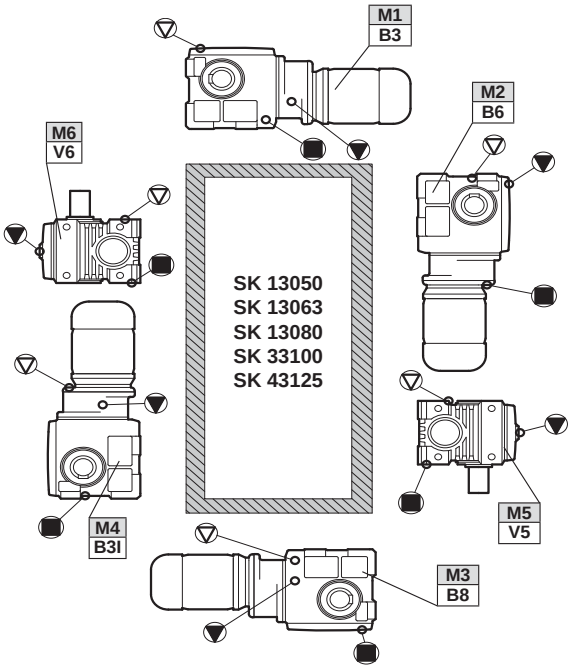
■ = Oil Plug

HELICAL-WORM OIL PLUG & VENT LOCATIONS

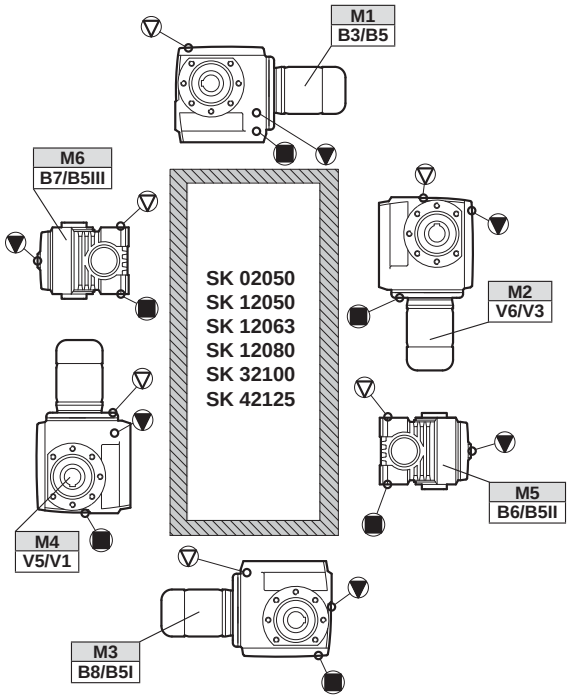
Foot Mount



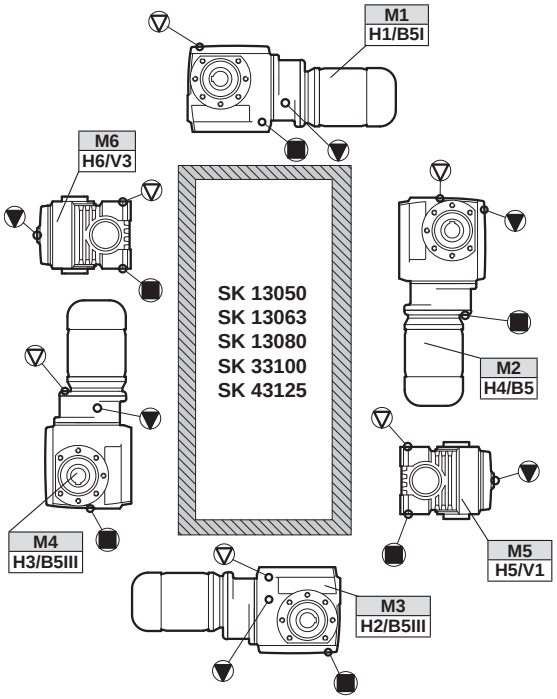
Foot Mount



Shaft/Flange Mount



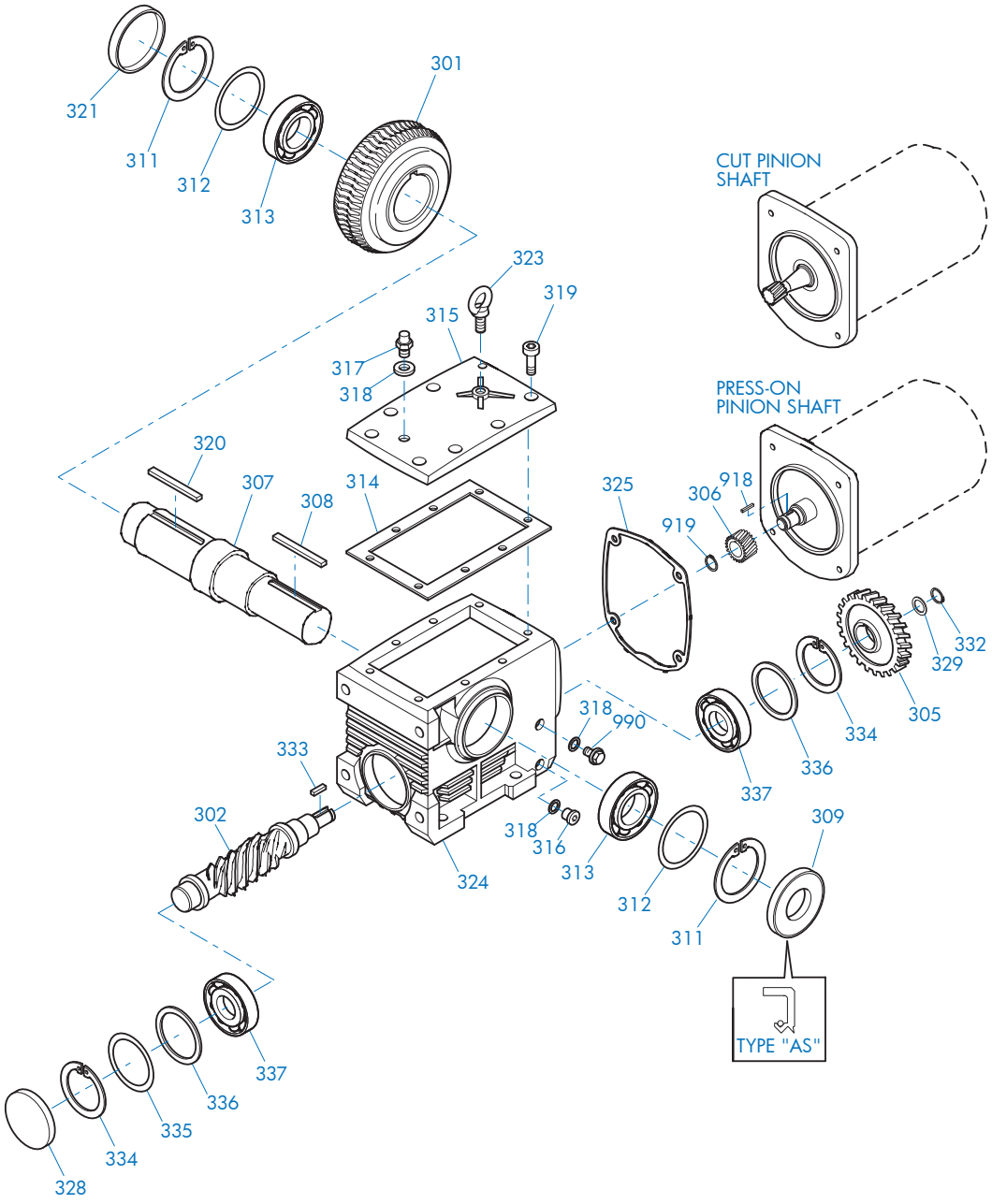
Shaft/Flange Mount



▽ = Vent
▼ = Oil Level
■ = Oil Drain

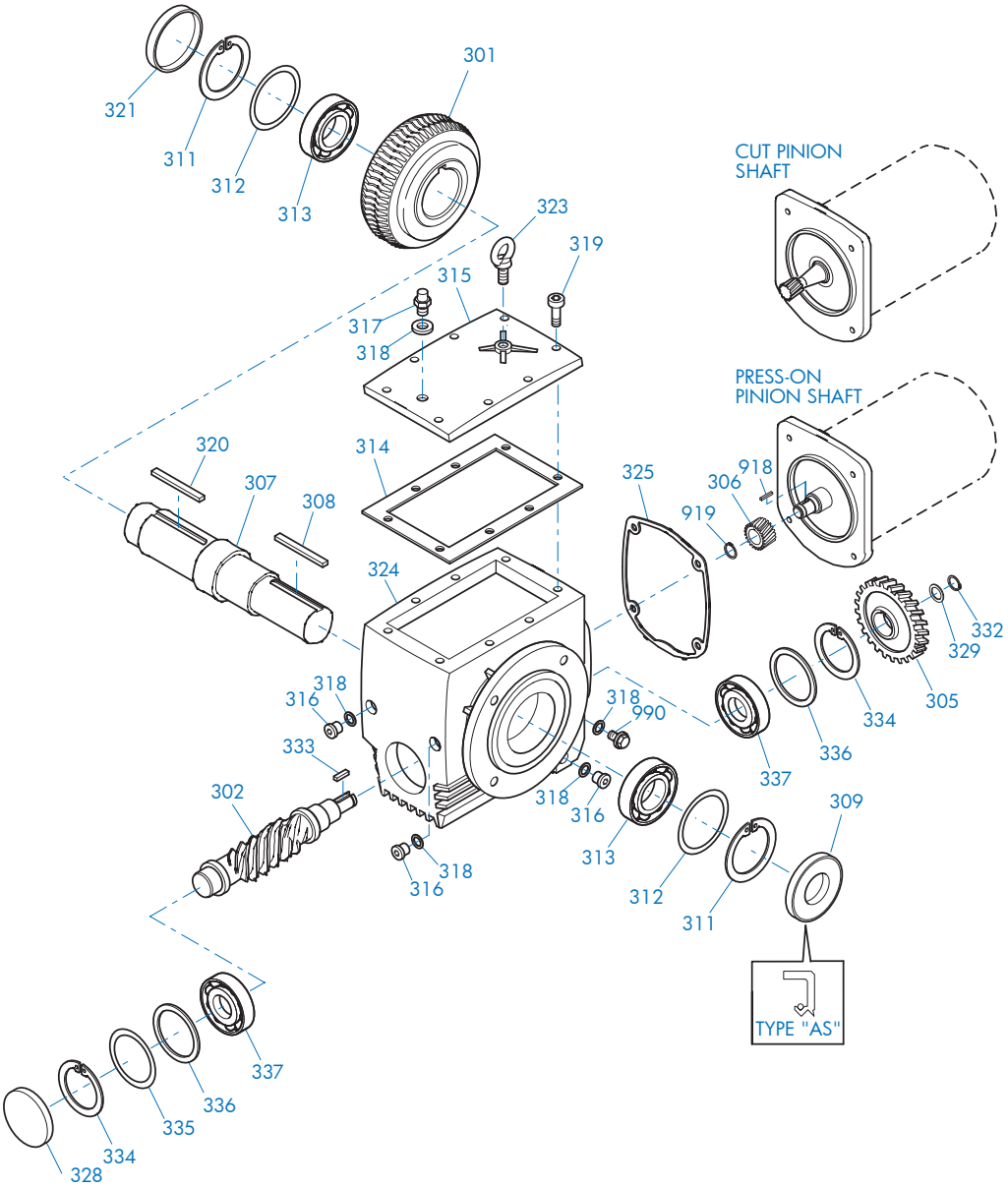
NORD Gear Limited
Toll Free in Canada: 800.668.4378

NORD Gear Corporation
Toll Free in the United States: 888.314.6673



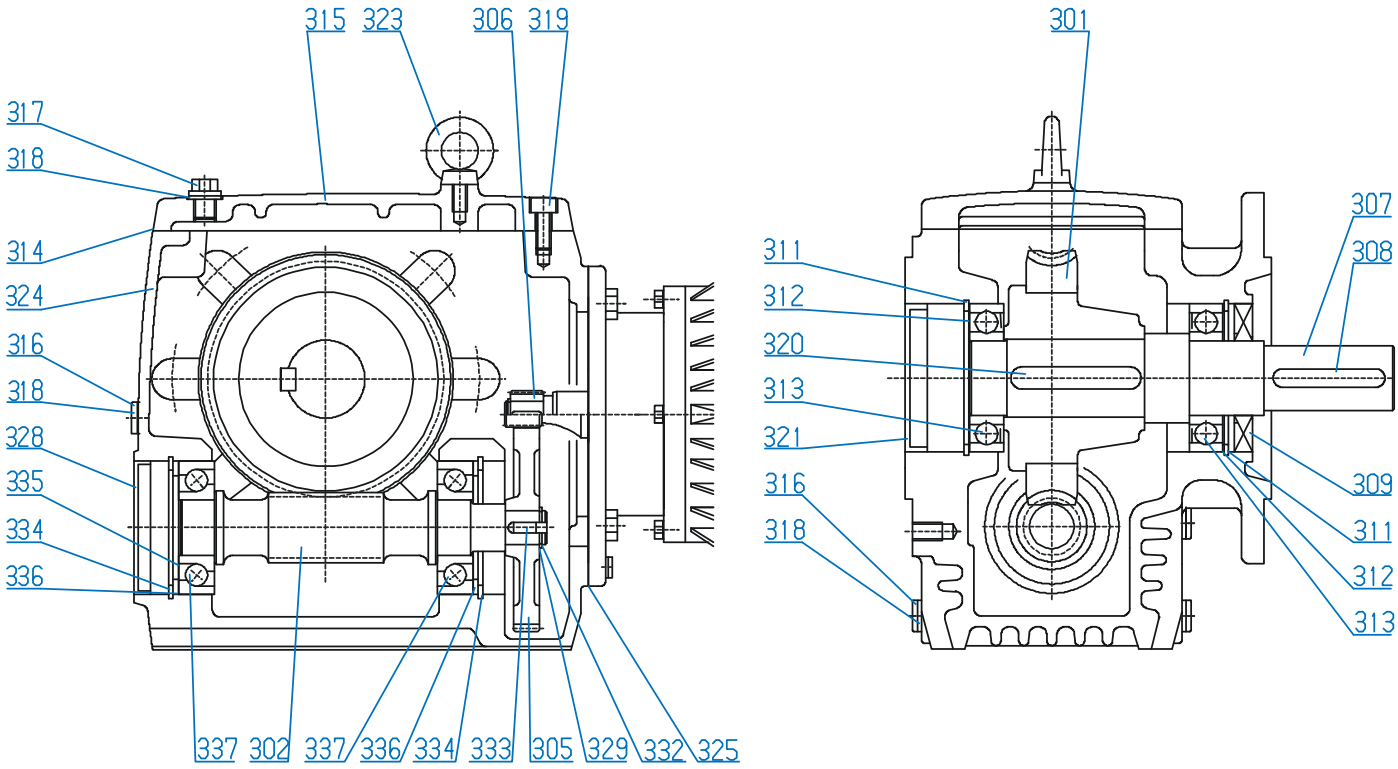
SK 02040 - SK 42125 Foot Mounted

301 Worm Wheel	315 Inspection Cover	329 Thrust Washer
302 Worm	316 Drain Plug	332 Snap Ring
305 Gear	317 Vent Plug	333 Key
306 Pinion	318 Gasket	334 Snap Ring
307 Output Shaft	319 Socket Head Screw	335 Shim
308 Key	320 Key	336 Thrust Washer
309 Oil Seal	321 Bore Plug	337 Anti-Friction Bearing
311 Snap Ring	323 Flanged Eye Bolt	918 Key
312 Shim	324 Gearcase	919 Snap Ring
313 Anti-Friction Bearing	325 Gasket	990 Oil Level Plug
314 Gasket	328 Bore Plug	



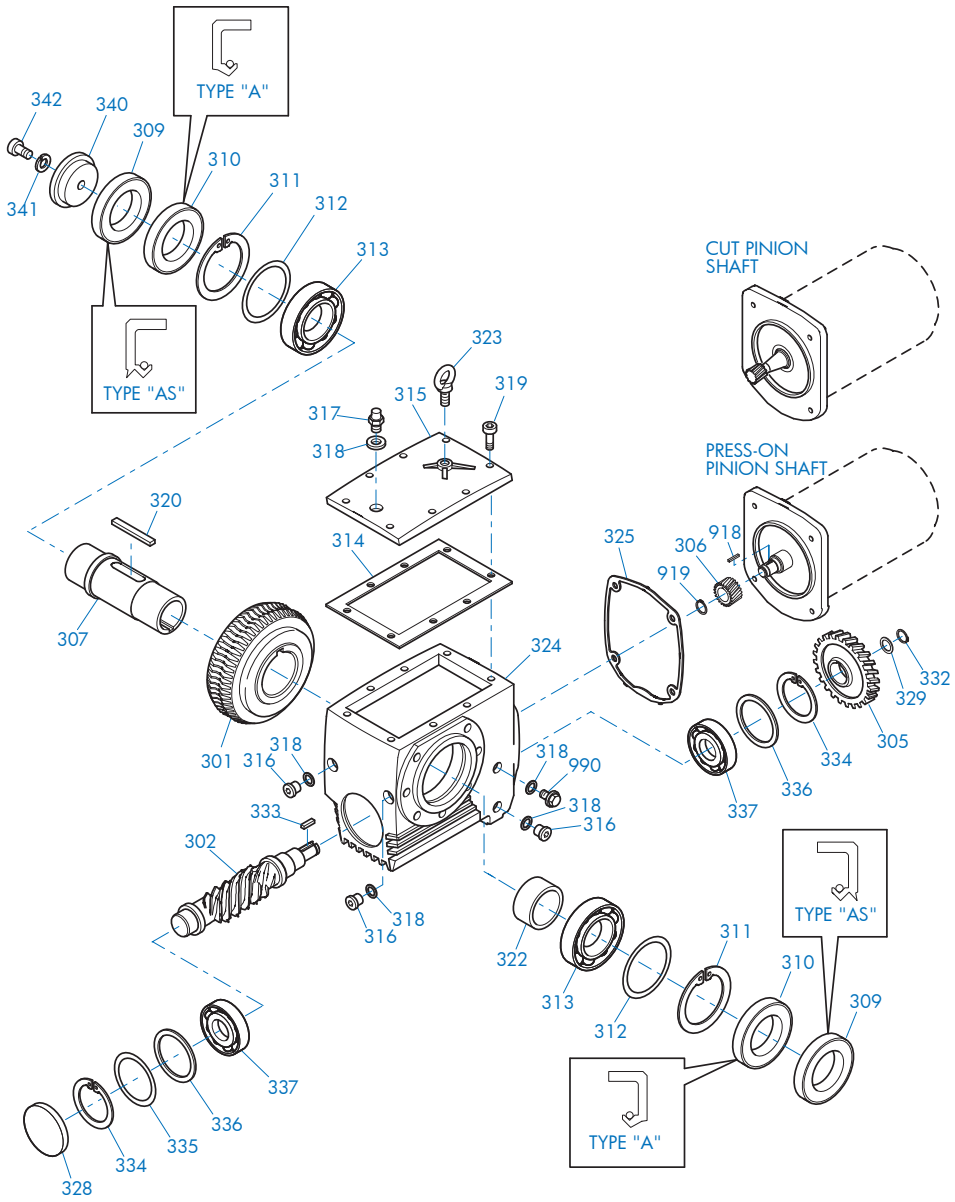
SK 02040 - SK 42125 Flange Mounted

301 Worm Wheel	315 Inspection Cover	329 Thrust Washer
302 Worm	316 Drain Plug	332 Snap Ring
305 Gear	317 Vent Plug	333 Key
306 Pinion	318 Gasket	334 Snap Ring
307 Output Shaft	319 Socket Head Screw	335 Shim
308 Key	320 Key	336 Thrust Washer
309 Oil Seal	321 Bore Plug	337 Anti-Friction Bearing
311 Snap Ring	323 Flanged Eye Bolt	918 Key
312 Shim	324 Gearcase	919 Snap Ring
313 Anti-Friction Bearing	325 Gasket	990 Oil Level Plug
314 Gasket	328 Bore Plug	



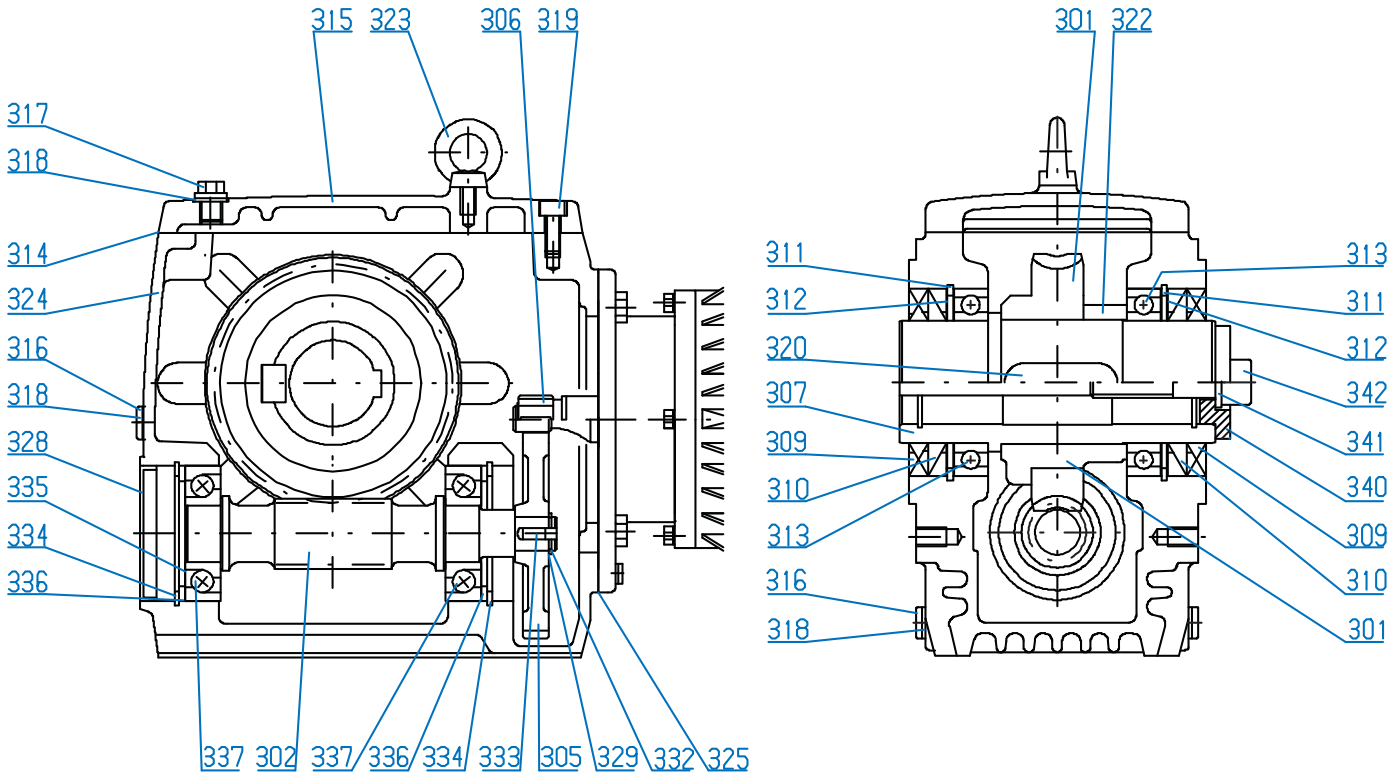
SK 02040 - SK 42125 Flange Mounted

301 Worm Wheel	314 Gasket	325 Gasket
302 Worm	315 Inspection Cover	328 Bore Plug
305 Gear	316 Drain Plug	329 Thrust Washer
306 Pinion	317 Vent Plug	332 Snap Ring
307 Output Shaft	318 Gasket	333 Key
308 Key	319 Socket Head Screw	334 Snap Ring
309 Oil Seal	320 Key	335 Shim
311 Snap Ring	321 Bore Plug	336 Thrust Washer
312 Shim	323 Flanged Eye Bolt	337 Anti-Friction Bearing
313 Anti-Friction Bearing	324 Gearcase	



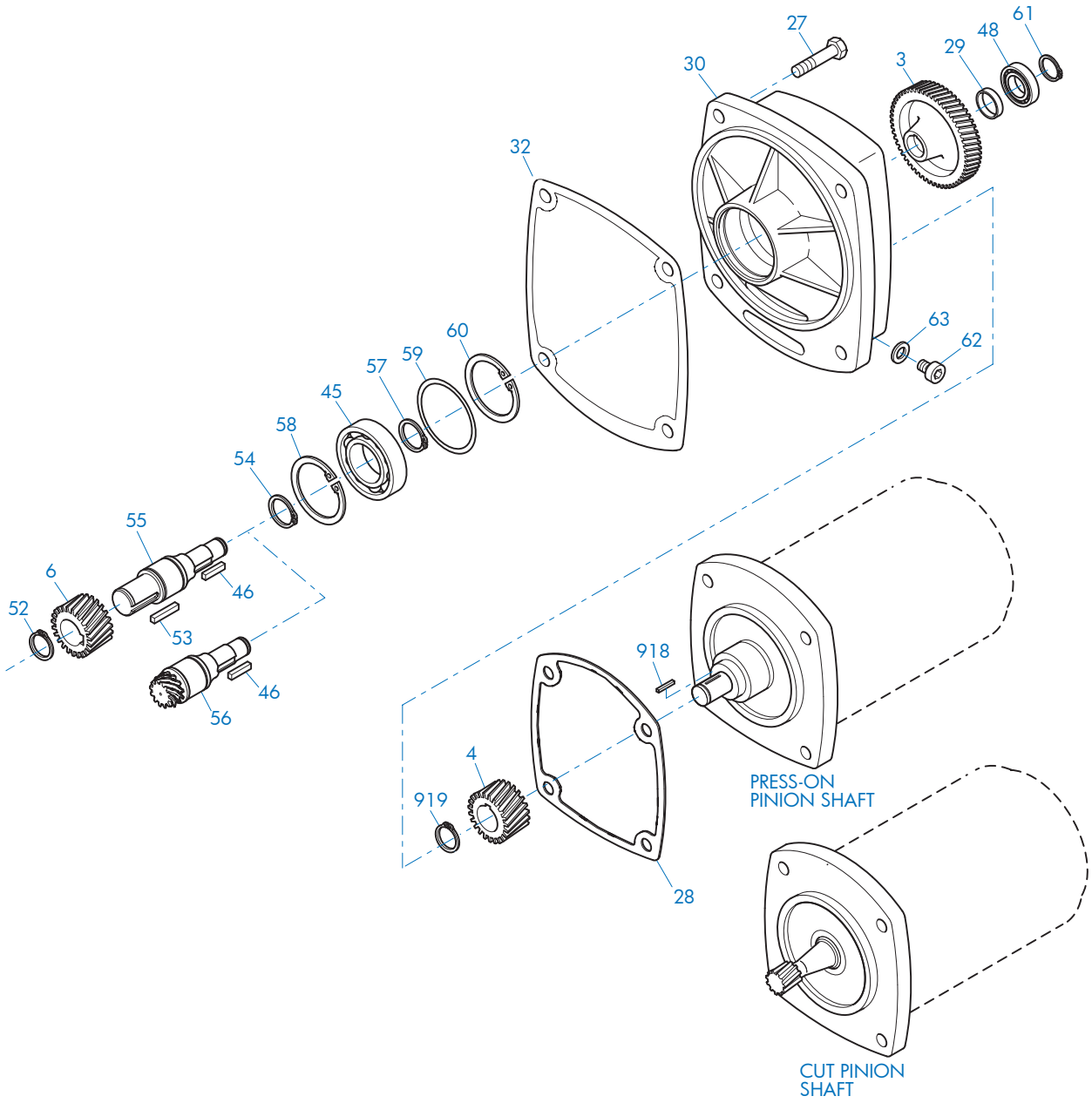
SK 02040 - SK 42125 Shaft Mounted

301 Worm Wheel
302 Worm
305 Gear
306 Pinion
307 Output Shaft
309 Oil Seal
310 Oil Seal
311 Snap Ring
312 Shim
313 Anti-Friction Bearing
314 Gasket
315 Inspection Cover
316 Drain Plug
317 Vent Plug
318 Gasket
319 Socket Head Screw
320 Key
322 Spacer
323 Flanged Eye Bolt
324 Gearcase
325 Gasket
328 Bore Plug
329 Thrust Washer
332 Snap Ring
333 Key
334 Snap Ring
335 Shim
336 Thrust Washer
337 Anti-Friction Bearing
340 Retaining Washer
341 Lock Washer
342 Bolt
350 Flange
351 Bolt
918 Key
919 Snap Ring
990 Oil Level Plug



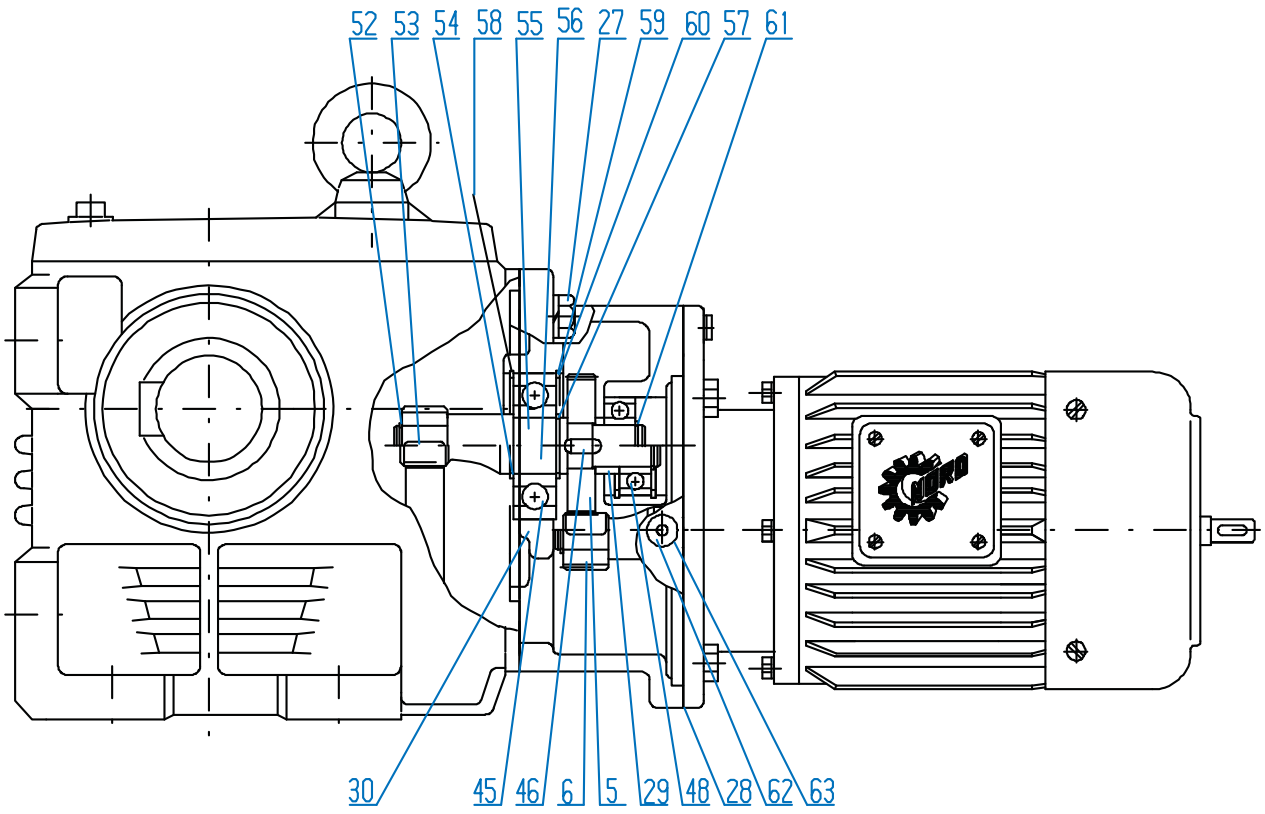
SK 02040 - SK 42125 Shaft Mounted

301 Worm Wheel	316 Drain Plug	333 Key
302 Worm	317 Vent Plug	334 Snap Ring
305 Gear	318 Gasket	335 Shim
306 Pinion	319 Socket Head Screw	336 Thrust Washer
307 Output Shaft	320 Key	337 Anti-Friction Bearing
309 Oil Seal	322 Spacer	340 Retaining Washer
310 Oil Seal	323 Flanged Eye Bolt	341 Lock Washer
311 Snap Ring	324 Gearcase	342 Bolt
312 Shim	325 Gasket	350 Flange
313 Anti-Friction Bearing	328 Bore Plug	351 Bolt
314 Gasket	329 Thrust Washer	
315 Inspection Cover	332 Snap Ring	



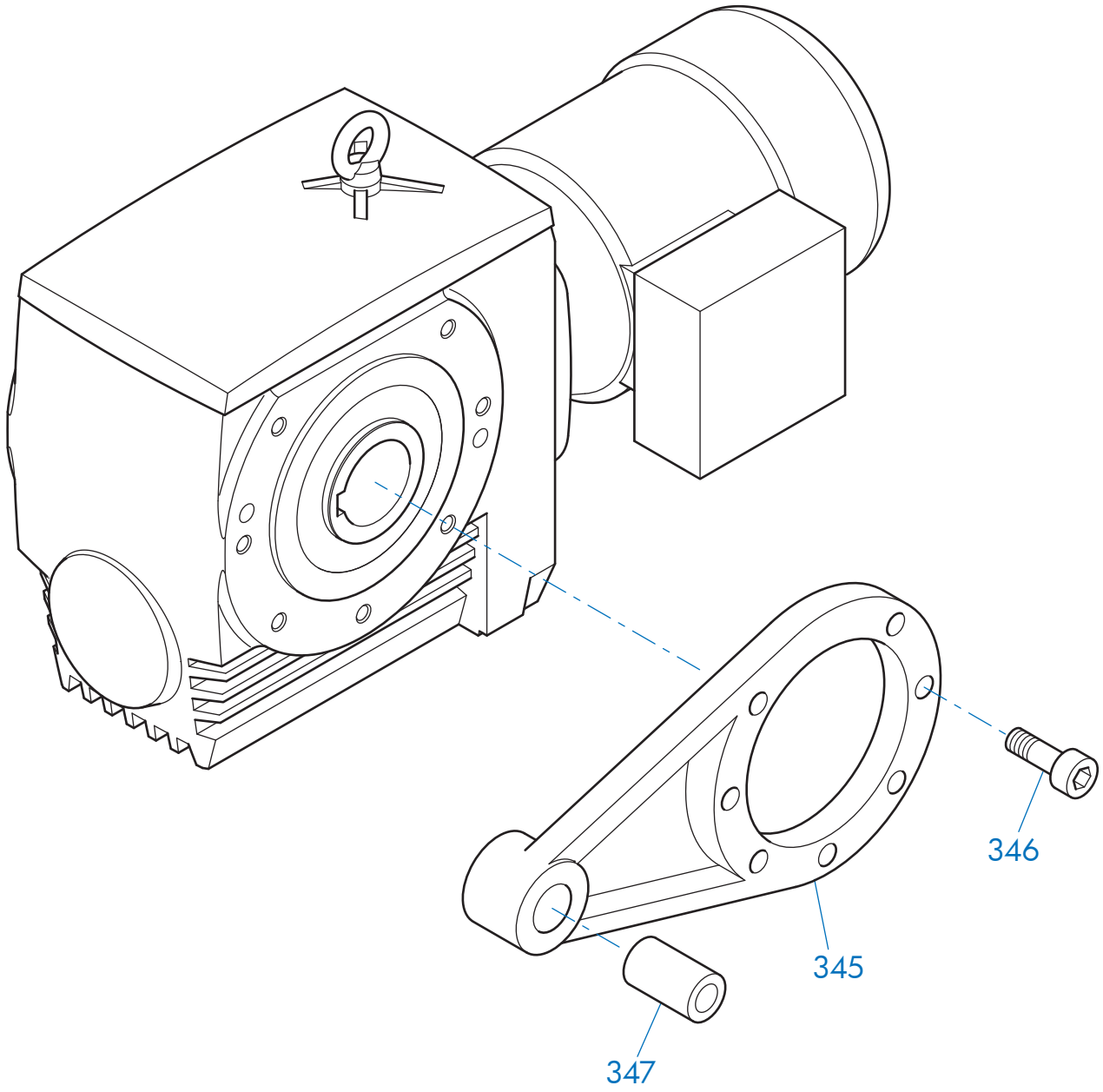
SK13050 - SK43125 Third Stage Reduction Gear

3	Gear	46	Key	59	Shim
4	Pinion	48	Anti-Friction Bearing	60	Snap Ring
6	Pinion	52	Snap Ring	61	Snap Ring
27	Bolt	53	Key	62	Oil Plug
28	Gasket	54	Snap Ring	63	Gasket
29	Spacer	55	Intermediate Shaft, Plain	918	Key
30	Third Reduction Gearcase	56	Intermediate Shaft, Gearcut	919	Snap Ring
32	Gasket	57	Snap Ring		
45	Anti-Friction Bearing	58	Snap Ring		



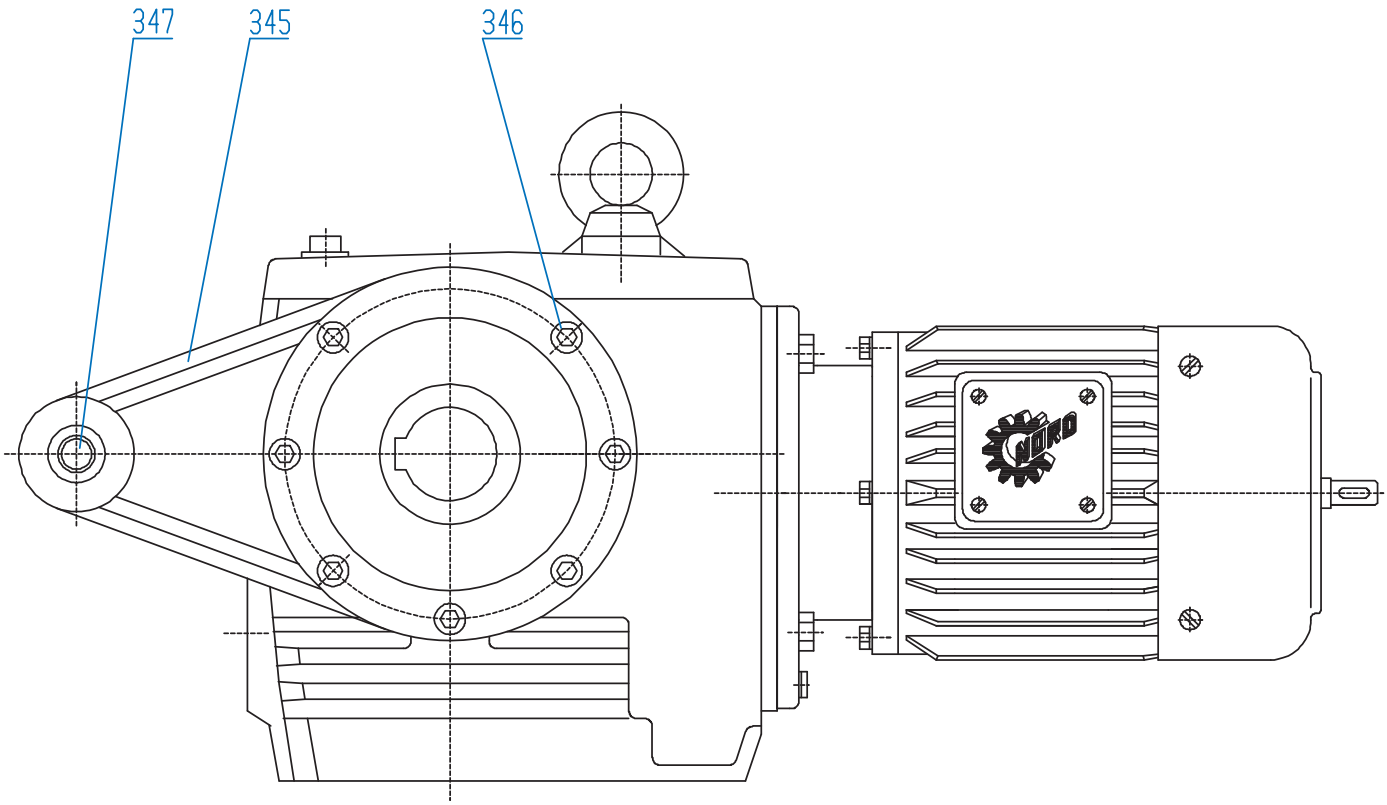
SK13050 - SK43125 Third Stage Reduction Gear

3	Gear	46	Key	58	Snap Ring
4	Pinion	48	Anti-Friction Bearing	59	Shim
27	Bolt	52	Snap Ring	60	Snap Ring
28	Gasket	53	Key	61	Snap Ring
29	Spacer	54	Snap Ring	62	Oil Plug
30	Third Reduction Gearcase	55	Intermediate Shaft, Plain	63	Gasket
32	Gasket	56	Intermediate Shaft, Gearcut		
45	Anti-Friction Bearing	57	Snap Ring		



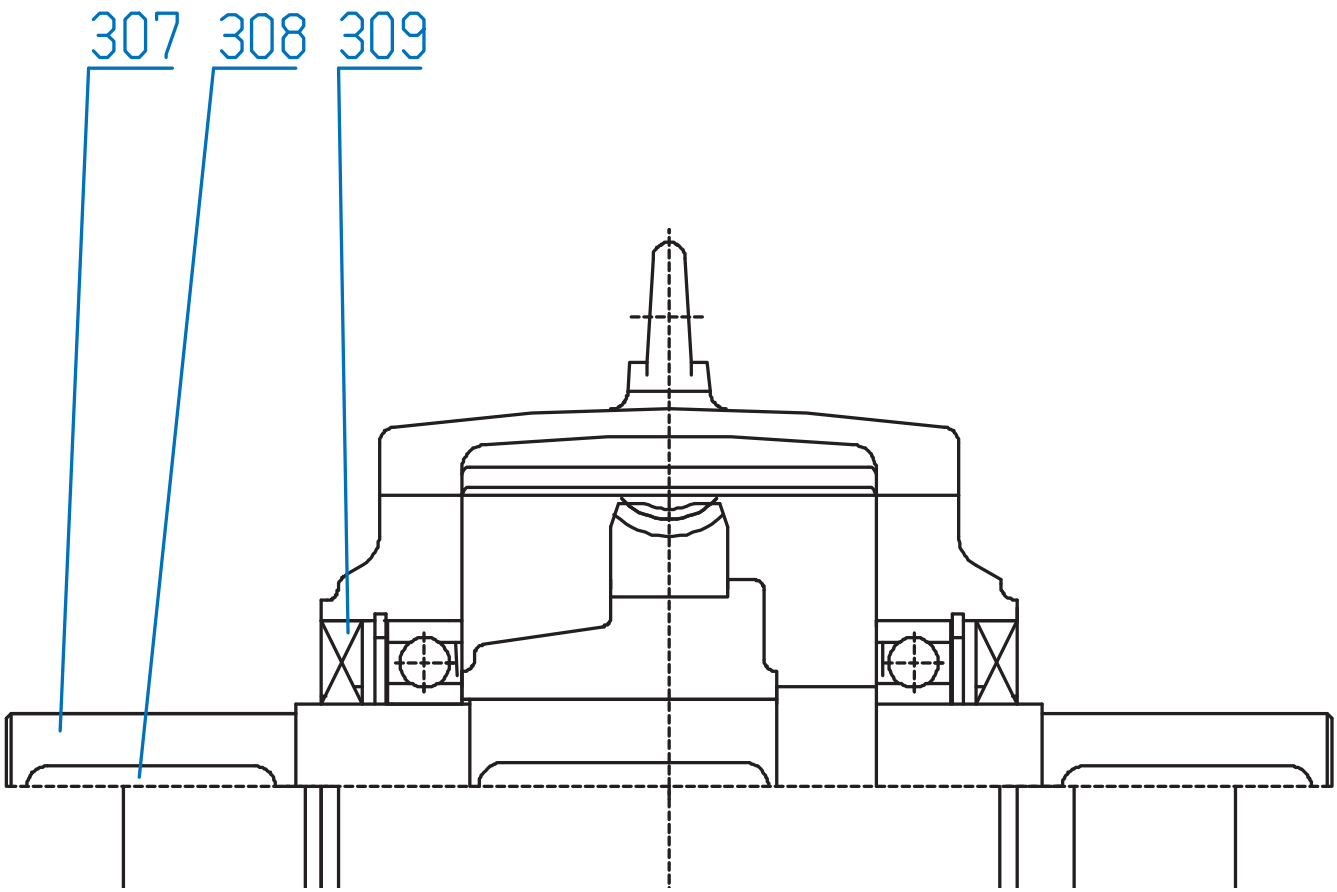
SK13050 - SK43125 Torque Arm

345 Torque Arm	346 Bolt	347 Bushing



SK13050 - SK43125 Torque Arm

345 Torque Arm	346 Bolt	347 Bushing



SK13050 - SK43125

307 Output Shaft	309 Oil Seal	350 Flange
308 Key	346 Screw	354 Shrink Disc Connector

Troubleshooting

This section identifies some of the most common issues involved with NORD Gear speed reducers , and provides recommendations to assist you in defining and answering your questions as you work with our products. You may also contact our Engineering/Application departments if your questions are not answered in the table below.

Problem With the Reducer		Possible Causes	Suggested Remedy
Runs Hot	Overloading	Load exceeds the capacity of the reducer	Check rated capacity of reducer, replace with unit of sufficient capacity or reduce the load.
	Improper lubrication	Insufficient lubrication	Check lubricant level and adjust up to recommended levels
		Excessive lubrication	Check lubricant level and adjust down to recommended levels.
		Wrong lubrication	Flush out and refill with correct lubricant as recommended
Runs Noisy	Loose foundation bolts	Weak mounting structure	Inspect mounting of reducer. Tighten loose bolts and/or reinforce mounting and structure.
		Loose hold down bolts	Tighten bolts
	Failure of bearings	May be due to lack of lubricant	Replace bearing. Clean and flush reducer and fill with recommended lubricant.
		Overload	Check rated capacity of reducer.
	Insufficient lubricant	Level of lubricant in reducer not properly maintained.	Check lubricant level and adjust to factory recommended level.
Output shaft does not turn	Internal parts are broken or missing	Overloading of reducer can cause damage	Replace broken parts. Check rated capacity of reducer.
		Key missing or sheared off on input shaft.	Replace key.
		Coupling loose or disconnected	Properly allign reducer and coupling. Tighten coupling.
Oil Leakage	Worn seals	Caused by dirt or grit entering seal.	Replace seals. Autovent may be clogged. Replace or clean.
	Unit runs hot or leaks	Overfilled reducer	Check lubricant level and adjust to recommended level.
		Vent clogged.	Clean or replace, being sure to prevent any dirt from falling into the reducer.
	Incorrect fill level	Improper mounting position, such as wall or ceiling mount of horizontal reducer.	Check mounting position on the name tag & verify with mounting chart in manual.

MOTORS - AC INDUCTION, SINGLE & POLYPHASE

1. Overview

This user manual applies to NORD Motor products and it provides general information for motor operation, installation, maintenance, inspection, repair, and trouble shooting, which is relevant to most of the motor products shipped by NORD. Information and instructions provided in this manual, safety and commissioning information and all other manuals applicable to any items supplied by NORD must be observed.

This instruction manual is not intended to include comprehensive details and information related to all possible design variations or accessories options available with NORD motors. If there is any uncertainty about specific procedures, instructions or motor details, then please refer these questions to NORD for additional information or clarification.

Before installing, operating, or performing maintenance on any electrical motor become familiar with the following:

- The detailed operating instructions and wiring diagrams.
- All applicable national, local and system-specific regulations, codes and practices.
- The national / regional regulations governing safety and accident prevention.
- The proper use of any tools, transportation or hoisting equipment, and safety equipment needed to complete the installation.
- To avoid serious injury or possible damage to the equipment or machine, compliance with all safety and information notes is mandatory!

⚠ WARNING ⚠

All work involved in the transport, connection, commissioning and maintenance of any NORD product must be carried out by qualified and responsible technicians. All applicable national, regional, and local work regulations and safety requirements must also be complied with. NORD assumes no liability for personal injury, accidental death, or equipment damage and malfunctions resulting from failure to comply with installation or operating instructions, safety notes, or any work regulations and laws!

⚠ WARNING ⚠

To avoid electrocution, injury or death, make certain the motor is properly grounded, completely de-energized and brought to a no-voltage condition prior to working on any electrical connections.

2. Motor Types

NORD AC electric induction motors described in this manual generally include the following types:

- Single speed or two-speed design.
- Three phase alternating current or single phase design.
- Enclosure types: TEFC, TENV, and TEBC.

3. Enclosure Types

Totally enclosed fan cooled (TEFC).

TEFC motor designs rely on fan that is mounted on the motor's rotor shaft so the cooling capacity can vary based upon the motor's operating speed.

Totally enclosed, non-ventilated (TENV)

The TENV motor designs rely purely on convection cooling and they have no fan. Often TENV designs are labeled for intermittent or periodic duty or at a lower power rating than is typical for the given motor frame size.

Totally enclosed, blower cooled (TEBC)

The TEBC design uses separate blower or ventilator fan, with its own low wattage motor and a separate power supply, to provide continuous airflow and cooling. The blower can be used to extend the speed range of the motor and allow extreme slow speed operation without causing a concern for overheating. Blower data is provided in Table 6, page 11.

4. Voltage and Frequency Variation

Voltage and frequency variations are based upon the assumption that the nameplate horsepower will not be exceeded and that the motor temperature may increase. Standard allowable deviations are based upon the type of motor labeling.

NEMA and CSA Labeled Motors

Variations are based upon the nominal utilization voltage, and not the service (supply) voltage as per ANSI C84.1.

Service Voltages	Utilization Voltages
120V, 208V, 240V, 480V, 600V	115V, 200V, 230V, 460V, 575V

- Voltage variation at rated frequency = ±10%.
- Frequency variations at rated voltage = ±5%.
- Combined voltage/frequency variation = ±5%.

CE Labeled Motors

Per IEC 60038, allowable service voltage variations on in the current system, compared to the previous system, are as indicated.

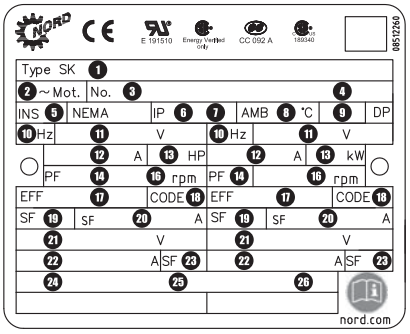
Previous Service Voltages	Current Service Voltages
220V, 380V, 660V	230V, 400V, 690V +6/-10%
240V, 415V	230V, 400V +10/-6%

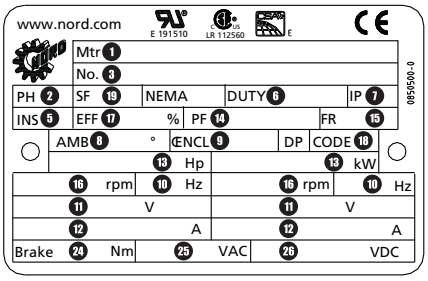
- Per EN 60034-1 a ±5% voltage variation and a ±2% frequency variation can be tolerated.
- The allowed variations are based upon the voltage (or voltage range) indicated on the motor nameplate.

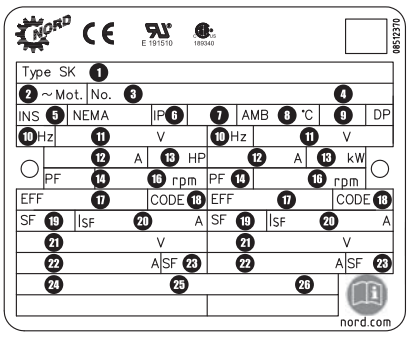
MOTORS - AC INDUCTION, SINGLE & POLYPHASE

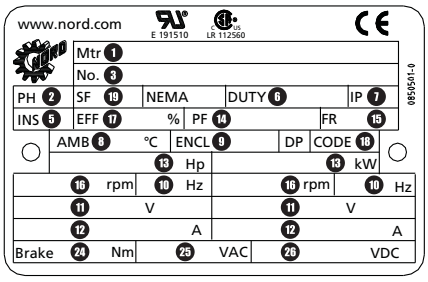
5. Motor Nameplate Information

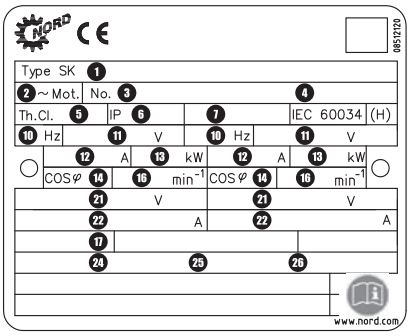
The motor nameplate and the display of technical information may vary slightly depending upon the global standard/s that the motor conforms to and the efficiency level. Please reference the examples below.











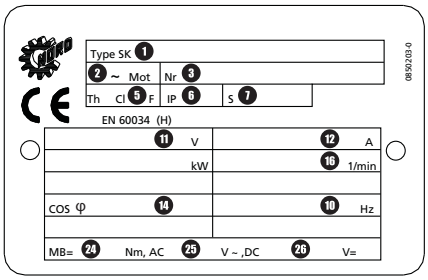


Table 1. Nameplate Data

Field	Definition
1	Model / Type
2	Number of Phases
3	Order Number
4	Serial Number
5	Insulation Class
6	IP (Ingress Protection) Enclosure Rating
7	Duty Cycle
8	Ambient Temperature Rating (°C)
9	Enclosure Type
10	Motor Frequency (Hz)
11	Voltage Rating (V)
12	Current Rating (A)
13	Rated Power (HP or kW)

Field	Definition
14	Power Factor
15	Motor Frame Size
16	Full Load Speed (rpm or 1/min^2)
17	Efficiency
18	NEMA Code Letter
19	Service Factor
20	Current Rating (If Service Factor ≥ 1.15)
21	Operating Voltage Rage (A)
22	Current Rating at Operating Voltage Range (A)
23	Service Factor at Operating Voltage Range (A)
24	Brake Rating (Nm)
25	Brake Supply Voltage (VAC)
26	Brake Coil Voltage (VDC)

6. Motor Options And Nomenclature

NORD offers many options for its motors. The option code will be shown in the motor nomenclature. Below are commonly used options.

Code	Description
AICM	Additional Internal Insulation Coating Applied
BRE	With Brake
EAR	Single Phase, Start Cap/Run Cap
ECR	Single Phase, Start Cap/Run Cap Increased SF
EHB	Single Phase, Run Capacitor Only
EP	Epoxy Dipped Windings
F	Blower Cooling Fan - 3ph & 1ph
FC	Blower Cooling Fan - 1ph
FHL	Brake – Lockable Manual Release
H	Energy Efficient
HL	Brake – Manual Hand Release
IG	Incremental Encoder
IP66	IP66 Environmental Protection
IR	Brake – Current Sensing Relay
KB	Condensation Holes - Removable Plugs
KD	Condensation Holes - Open
MIK	Brake – Microswitch
MS	Power Plug Connector

Code	Description
OL	TENV Motor – Without Fan / With Cover
OL/H	TENV Motor - Without Fan & Cover
P	Premium Efficient Motors
RD	Canopy Cover
RDD	Double Canopy Cover
RG	Brake – Corrosion Protected
RLS	Backstop
SH	Motor Space Heater
SR	Brake – Dust Protected
TF	Thermistor
TW	Thermostat
VN	10:1 Constant Torque Rated Motor
VR	5:1 Constant Torque Rated Motor
VW	20:1 Constant Torque Rated Motor
VZ-F	1000+:1 Constant Torque Rated Motor
WE	2nd Motor Shaft End
WU	High Slip Rotor
Z	High Inertia Motor Fan

Motor Nomenclature

100L / 4 BRE 40 ...

- **...** — Other Options
- **40** — Brake Size Nm
- **BRE** — Brake
- **4** — Number of Poles
- **100L** — Frame Size

Ordering Examples

100L 4 BRE 100 HL RG

- **RG** — Corrosion Protection
- **HL** — Hand Release Lever
- **100** — 100 Nm Brake Torque
- **BRE** — Brake
- **4** — 4 Poles
- **100L** — Motor Frame Size

100 Frame Motor with 4 poles, Brake, 100 Nm with a hand release lever, corrosion protected brake, and a current sensing relay.

160L 2 BRE 40 FHL SR

- **SR** — Dust & Corrosion Prot.
- **FHL** — Locking Hand Release Lever
- **40** — 40 Nm Brake Torque
- **BRE** — Brake
- **2** — 2 Poles
- **160L** — Motor Frame Size

63 Frame Energy efficient motor with 4 poles, Brake, 40 Nm with a locking hand release lever and dust & corrosion protection.

7. Application Conditions

Standard NORD motors are designed to operate in dusty or moist environments and have anti-fungal, thermal class F insulation.

- Enclosure Protection Rating = IP55 (minimum).
- Maximum Installation Height = 3300 ft (1000 m).
- Ambient Temperature = -4 to 104°F (-20 to 40 °C).
- Tropical-proof, Thermal Class F insulation.

The protection level and maximum ambient temperature are stated on the motor nameplate.

IMPORTANT NOTE

NORD can provide motors for an expanded range of applications and service conditions including higher protection levels, extreme ambient conditions and, higher altitudes.

WARNING

Consult NORD for recommendations if motors are operated under extreme loading conditions, exposed to high inertia loads, or need to operate under unusually high cycling conditions with high starting and stopping frequency.

WARNING

Special design and assembly considerations are needed if NORD motors are subject to any of the following conditions:

- Outdoor installation with motor in a vertical position.
- Direct contact with aggressive or corrosive materials (acids, bases, salts, certain gases, etc.).
- Exposure to extreme high or low temperatures, high relative humidity, condensation moisture or very wet environments.
- Subject to extreme material build-up on the unit (dirt, dust, sand, etc.).
- Hazardous Locations (risk of fire or explosion).

8. Transportation

During transportation observe the following:

- Make sure that all eyebolts and lifting lugs are tight and firmly against their supporting surface.
- Use all the lifting eyes that are intentionally supplied with the motor.
- Lift only at designed points.
- Protect the mounting surface from possible damage during transportation.
- Always use sufficiently rated handling equipment, lift mechanisms and lifting straps.
- With heavier objects or unbalanced loads, it may be appropriate to use more than one lifting point or an additional strap or sling to assure safe transportation of the assembly. This is especially true of assembled gearmotors and motorized reducers.
- Once the NORD motor or assembly is properly installed, remove the transportation fixtures completely or make certain they are properly re-secured and tightened.

WARNING

Transportation – Use of Lifting Devices

To avoid death, serious injury or equipment damage…

- Hoisting lugs or lifting eyes attached to the motor are designed for the weight of the motor only! Do not attach any additional loads!
- The motor must only be transported and lifted using the lifting eyes, in a position that is appropriate for its type of construction. Otherwise, it could fall over or slip in the lifting tackle.
- During suspended transport, two straps must be able to carry the entire load weight safely.
- When required use additional, suitable means of support for transportation, installation or removal.
- Always secure the support equipment to prevent it from slipping.

9. Storage

If the motor is not in service, store it according to the following conditions:

- Store the motor in a clean, dry, dirt-free, vibration free area.
- Storage temperatures of 10°C (50°F) to 50°C (120°F) must be maintained.
- Relative humidity must not exceed 60%.
- If vibration in the area exceeds 0.002 inch (0.05 mm) at 60 hertz, then vibration isolation pads are suggested to prevent brinelling of the bearings.
- Treat the unprotected shaft end and mating flange surfaces with a corrosion inhibitor that can be cleaned off prior to commissioning.
- Before placing the motor into service, visually inspect the motor exterior for evidence of deterioration during storage. Turn the motor shaft by hand to make sure the shaft turns freely.
- Motor space heaters, when provided, are to be connected and energized whenever there is a possibility that the storage ambient conditions will reach the dew point. Space heaters are optional. Remove motor from the storage container when the heater is energized.
- If the motor needs to be stored for extended periods, or if it is stored in less than favorable conditions, it is recommend that the winding insulation resistance be checked prior to commissioning (page 7).
- Even if stored in favorable conditions, the antifriction motor bearings and motor shaft seals may need to be replaced if the storage period is more than 4 years.

10. Safety Considerations

When installing, servicing or replacing electric motors it is important to be working in a “voltage-free” state. Observe the following safety rules.

Five Safety Rules

1. Disconnect the system. Disconnect the auxiliary circuits (brakes, space heaters, etc.).
2. Prevent reconnection (follow safe lock-out/tag-out practices).
3. Make sure that the equipment is at zero voltage.
4. Make certain the equipment is properly grounded and short-circuited.
5. Cover or isolate nearby components that are still electrically live.

To energize the system, apply the measures in reverse order.

Qualified Personnel

All work involved in the transport, connection, commissioning and maintenance of any NORD product must be carried out by qualified and responsible technicians.

For the purpose of this documentation, a qualified personnel is taken to mean a person or people who fulfill the following requirements:

- Through appropriate training and experience, they are able to recognize and avoid risks and potential dangers in their particular field of activity.
- They have been instructed to carry out work on the machine by the appropriate person responsible.
- They are responsible for knowing and complying with all applicable national, regional, and local work regulations and safety requirements.

10. Safety Considerations Ctd.

General Warnings and Cautions

⚠ *WARNING* ⚠

To avoid electrocution, injury or death, make certain all electrical devices (motors, brakes, variable frequency drives, etc.) are properly grounded, completely de-energized, and brought to a no-voltage condition prior to working on any electrical connections. Remember that most of these devices carry potentially dangerous energy levels for a period of time after power is removed. Always follow proper lock-out/tag-out procedures.

⚠ *WARNING* ⚠

Electrical machines contain dangerous voltage levels, electrically live parts, rotating surfaces and hot surfaces. To prevent injury, death or possible equipment damage always observe the following:

- Keep all safety covers and guards in place during operation. Remove and replace covers in compliance with the applicable safety regulations.
- Allow the machine to cool down before starting any work on it.
- Operate the machines properly.
- Perform regular maintenance on the machine.
- Secure and guard free-standing shaft extensions.

⚠ *WARNING* ⚠

Electrically Live Parts

Electrical machines contain electrically live parts. Fatal or severe injuries and substantial material damage can occur if the required covers are removed or if the machines are not handled, operated, or maintained properly.

⚠ *WARNING* ⚠

Rotating Parts

Electrical machines contain dangerous rotating parts. Fatal or severe injuries and substantial material damage can occur if the required covers are removed or if the machines are not handled, operated, or maintained properly.

⚠ *WARNING* ⚠

Hot Surfaces

Electrical machines have hot surfaces. Fatal or severe injuries and substantial material damage can occur if the required covers are removed or if the machines are not handled, operated, or maintained properly. Allow the machine to cool down before starting any work on it.

⚠ *WARNING* ⚠

Maintain Proper Cooling

Operating the motor without the intended cooling fan may cause overheating and result in very hot surfaces, personal injury and material damage. Never commission a motor intended to be fan cooled when it is missing the shaft-driven fan or external blower assembly.

⚠ *WARNING* ⚠

Condensation Drain Holes (Optional)

Inserting objects into the condensation drain holes can damage the winding and can result in death, serious injury and damage to property!

- Before opening sealed drain holes, make sure the motor is in a no-voltage condition. Close the condensation drain holes before re-commissioning.
- Exercise caution around drain holes that are intended to be left open, especially when the motor is energized.

STOP *HARMFUL SITUATION* STOP

Before start-up check the following:

- All electrical connections are secure, well grounded and properly made.
- The motor is rotating in the correct direction (when de-coupled from the driven load).
- There are no temperature-sensitive parts (cables etc.), in contact with motor enclosure.
- Condensation drain holes are always located at the lowest point of the motor.

11. Checking the Insulation

Before putting the motor into operation for the first time, after a lengthy period of storage or standstill (approx. 6 months), the insulation resistance of the winding should be checked.

⚠ WARNING ⚠

During and directly after measurement the motor connection terminals carry hazardous voltages.

A. Control

The insulation resistance of new, cleaned, or repaired motor windings against the grounded housing and against one another should be > 200 Mega-Ohms.

B. Measurement

Using a Mega-Ohm meter apply a DC voltage of 500 VDC to the motor winding for a period of 60 seconds and record the winding insulation resistance compared to ground.

- The 500 VDC test voltage is applicable to low voltage motors up to 1000 VAC.
- When performing this test the temperature of the windings should be 25°C ± 15°C (77°F ± 27°F).

C. Verification

- If the insulation resistance of the winding is less than 50 Mega-Ohms, the cause may be moisture. The windings should be dried and the test should be repeated.
- After any lengthy period of operation the insulation resistance may drop. So long as the measured value does not fall below the critical value of 50 Mega-Ohm, the motor may continue to be operated.
- If the measured value falls below the critical 50 Mega-Ohm level, the cause must be established and the windings or winding sections must be cleaned, dried, repaired, or replaced as needed.

12. Bearing Lubrication

NORD motor frame sizes 63 up to and including 225 are normally supplied with internally grease lubricated bearings and require no lubrication during normal operation.

NORD motor frame sizes 250 and larger are supplied with grease fittings for re-greasing the motor bearings.

IMPORTANT NOTE

Motors with grease fittings are normally supplied with a label indicating the grease type used, the suggested re-lubrication interval, and the amount of new grease to be applied. General bearing maintence guidelines are listed in Table 3.

Typical motor bearing grease is an NLGI No. 2 consistency, high grade product with a polyurea base thickener, synthetic or blended mineral/synthetic oil, and stabilizing agents to protect against heat and oxidation.

Table 3 – Motor Bearing Maintence Guidelines

Frame Size	Power	Poles	Re-greasing Interval
63-225	0.16-60 HP (0.12-45 kW)	All	Maintence Free
250 to 280	75-125 HP (55-75 kW)	2	4000 h
		4 to 8	8000 h
315	150-250 HP (132-200 kW)	2	3000 h
		4 to 8	6000 h

STOP HARMFUL SITUATION STOP

When re-greasing motor bearings do not to mix different greases without verifying the compatibility with a reputable grease lubrication supplier. Mixing incompatible products can lead to bearing failure.

13. Mechanical Installation

Integral motors, NEMA C-face motors, and IEC flange mounted motors must be rigidly secured to their mating connection surface using all fastening screws tightened to the proper bolt torque. It is good practice to apply a medium strength thread- locking agent (Loctite® 242) to the mounting screws.

Foot mounted motors must be securely installed to a rigid and level foundation or mounting surface to minimize vibration and maintain alignment between the motor and shaft load. All mounting hole locations must be utilized. Tighten all hold down screws or bolts to the proper bolt torque.

STOP HARMFUL SITUATION STOP

Failure to provide a proper mounting surface may cause vibration, misalignment and bearing damage.

Accurate alignment and proper balancing of output devices (couplings, belts, pulleys, etc.) is required to assure quite, low vibration, trouble free operation. When the motor is directly coupled to a gear drive or a driven machine make sure that the motor shaft and driven machine shaft are aligned with one another axially.

STOP HARMFUL SITUATION STOP

Inaccurate alignment may lead to bearing damage, excessive vibrations and shaft breakage.

IMPORTANT NOTE

For motor replacement guidelines see section 20 on page 15 and section 21 on page 16.

14. Electrical Connections

⚠ WARNING ⚠

To avoid electrocution, injury or death, make certain all electrical devices (motors, brakes, variable frequency drives, etc.) are properly grounded, completely de-energized, and brought to a no-voltage condition prior to working on any electrical connections. Remember that most of these devices potentially dangerous energy levels for a period of time after power is removed. Always follow proper lock-out/tag-out procedures.

IMPORTANT NOTE

External motor brakes have their own connection requirements as indicated in the appropriate brake instruction manuals.

⚠ WARNING ⚠

If the motor has an integral brake, make certain there is no load connected to the driven equipment before releasing the brake. Otherwise serious injury, death, or damage to the equipment may result.

- The supply voltage and frequency must agree with the motor nameplate data.
- Always feed the connecting leads into the terminal box using appropriate mating cable glands. The mating connection cables and cable glands should be suitable for temperatures ≥ 194°F (90°C).
- Provide the ends of the connecting leads and ground lead with cable lugs or curved ring eyelets before connecting them to the terminal board.
- Make certain that the wiring connections and arrangement of the terminal board jumpers conform to the appropriate wiring diagram as provided in the motor terminal box and/or page 9 of this manual.
- Tighten the terminal board screw connections on the on the main terminal board per the table below.

Table 4 – Tightening Torque: Terminal Board and Grounding Screws

Thread Size	Nut Size [mm]	Tightening Torque [lb-ft]	Tightening Torque [N-m]
M4	7	0.6-0.9	0.8-1.2
M5	8	1.3-1.8	1.8-2.5
M6	10	2.0-3.0	2.7-4
M8	13	4.0-5.9	5.5-8
M10	17	6.6-9.6	9-13
M12	19	11.8-14.8	16-20

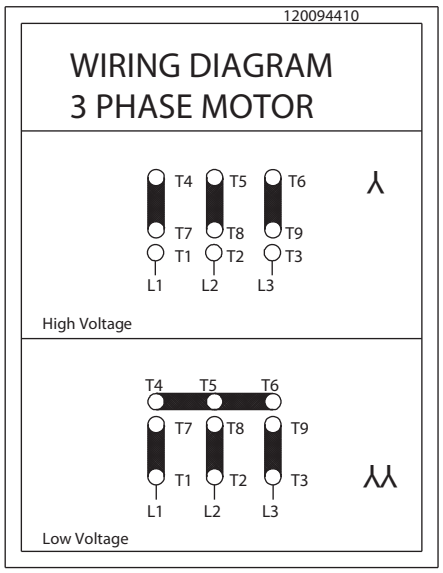
- Upon final assembly, the terminal box cover must be sealed so that it is dust-tight and water-tight.

Table 5 – Tightening Torque: Terminal Box Cover Screws

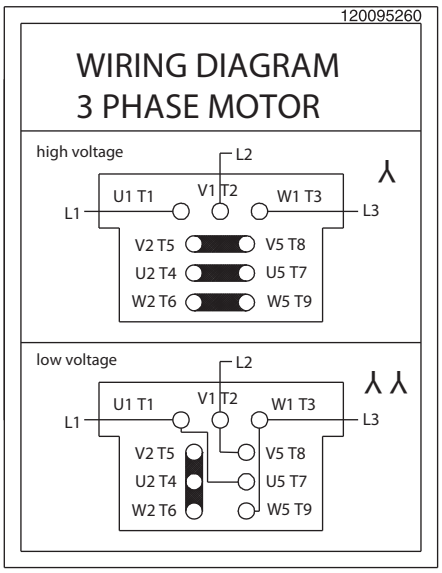
Thread Size	Tightening Torque [lb-ft]	Tightening Torque [N-m]
M4	0.6-0.9	0.8-1.2
M5	0.9-1.3	1.2-1.8
M6	1.1-1.8	1.5-2.5
M8	2.2-3.7	3.0-5.0

15. Wiring Diagrams

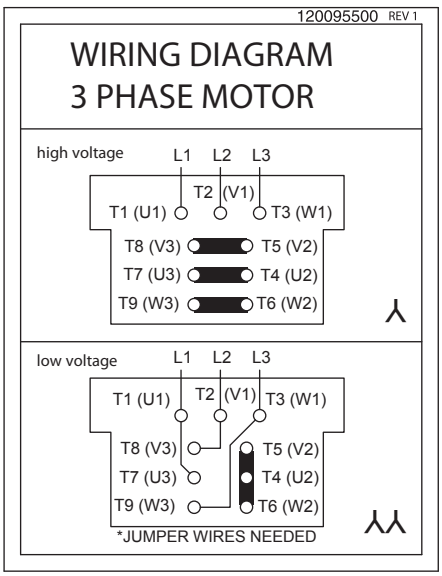
Frames 63-132
230 / 460V, 60Hz, 3Ø | 200 / 400V, 50Hz, 3Ø
190 / 380V, 60Hz, 3Ø



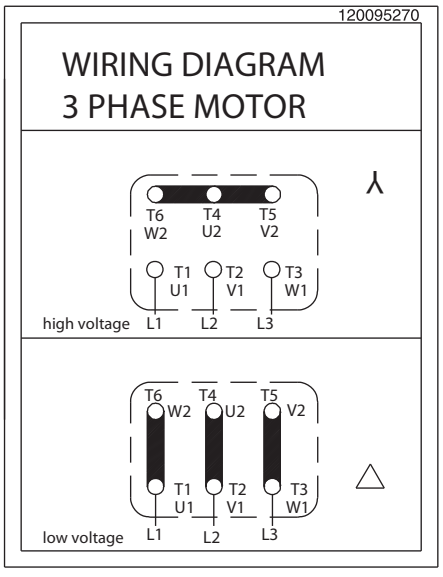
Frames 160 +
230 / 460V, 60Hz, 3Ø | 200 / 400V, 50Hz, 3Ø
190 / 380V, 60Hz, 3Ø



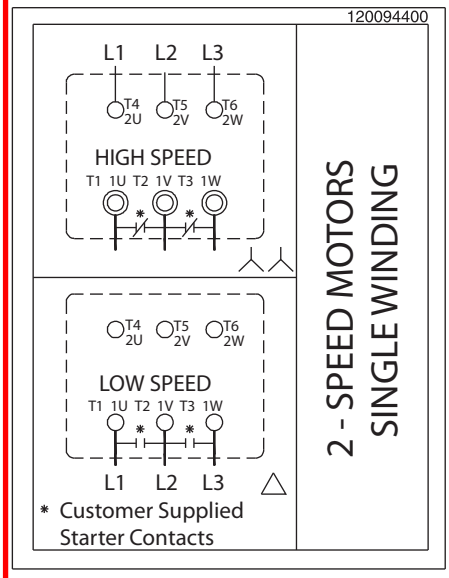
Frames 160 +
230 / 460V, 60Hz, 3Ø | 200 / 400V, 50Hz, 3Ø
190 / 380V, 60Hz, 3Ø



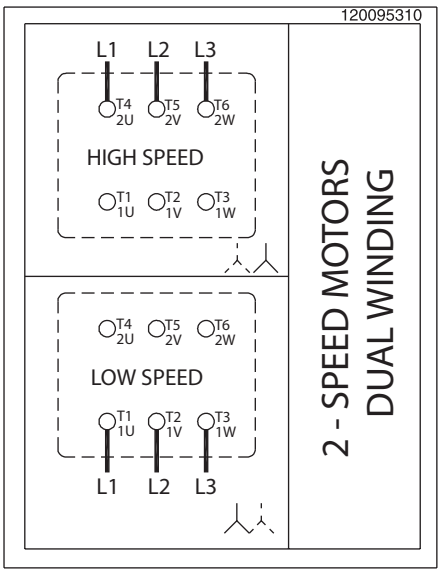
460 / 800V, 60Hz, 3Ø | 230 / 400V, 50Hz, 3Ø
208 / 360V, 60Hz, 3Ø | 400 / 690V, 50Hz, 3Ø
332 / 575V, 60Hz, 3Ø



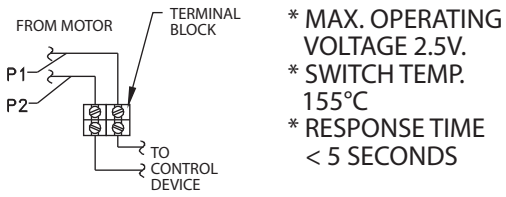
2 - SPEED MOTORS
SINGLE WINDING (4-2 & 8-4 POLE)



2 - SPEED MOTORS
DUAL WINDING (8-2 POLE)



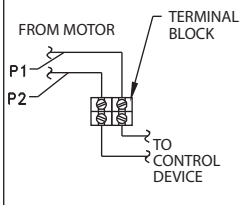
15. Wiring Diagrams Ctd.



* MAX. OPERATING VOLTAGE 2.5V.
* SWITCH TEMP. 155°C
* RESPONSE TIME < 5 SECONDS

THERMISTOR
"TF" OPTION

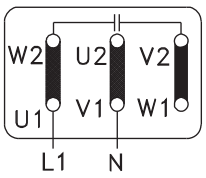
120095240



* NC (NORMALLY CLOSED)
* CONTACTS RATED 1.6A AT 2.50 VAC
* 6-500 VAC WORKING RANGE
* AUTOMATIC RESET AT 30 ± 15°C TEMP. DROP

THERMISTATS
"TW" OPTION

120095230



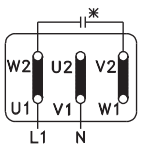
1 PHASE
115V*
50/60 Hz

* CAPACITOR IS SUPPLIED

BLOWER COOLING FAN
"FC" OPTION

120095450

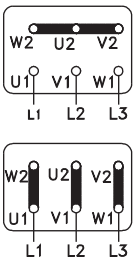
OPTION "F" 1 PH



230V
50 / 60 Hz

* CAPACITOR IS SUPPLIED

OPTION "F" 3 PH

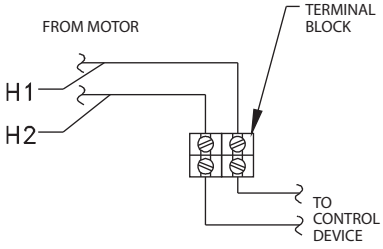


380-575V
50 / 60 Hz

220-332V
50 / 60 Hz

BLOWER COOLING FAN
"F" OPTION

120095250



SPACE HEATER
"SH" OPTION

120095220

16. Motor Accessories

Blower Cooling Fan (Option F & FC)

- Connection Diagram Shown on page 10
- Option FC is 1-phase, 115V
- Option F has capability of 1 phase by connecting a supplied capacitor

Option F – 3ph & 1ph 220-575V 50/60Hz

Motor Frame	60Hz Ratings			50Hz Ratings		
	Voltage [V]	Current [A]	Power [W]	Voltage [V]	Current [A]	Power [W]
Single phase connection - ⊥ (Delta)						
63	230 – 277	0.11	38	230 – 277	0.10	27
71	230 – 277	0.12	41	230 – 277	0.10	28
80	230 – 277	0.13	44	230 – 277	0.11	29
90	230 – 277	0.25	88	230 – 277	0.26	72
100	230 – 277	0.28	88	230 – 277	0.26	70
112	230 – 277	0.31	107	230 – 277	0.26	73
132	230 – 277	0.27	89	230 – 277	0.29	82
160 - 225	230 – 277	0.41	140	230 – 277	0.45	128
Three phase low-voltage connection - (Delta)						
63	220 – 332	0.08	23	220 – 290	0.10	27
71	220 – 332	0.08	24	220 – 290	0.10	30
80	220 – 332	0.08	25	220 – 290	0.01	29
90	220 – 332	0.21	64	220 – 290	0.28	86
100	220 – 332	0.21	66	220 – 290	0.27	86
112	220 – 332	0.23	70	220 – 290	0.27	85
132	220 – 332	0.25	74	220 – 290	0.32	96
160 - 225	220 – 322	0.49	165	220 – 290	0.52	155
Three phase high-voltage connection - (Y)						
63	380 – 575	0.04	23	380 – 500	0.05	29
71	380 – 575	0.04	25	380 – 500	0.05	30
80	380 – 575	0.04	26	380 – 500	0.05	29
90	380 – 575	0.12	62	380 – 500	0.16	82
100	380 – 575	0.12	66	380 – 500	0.16	83
112	380 – 575	0.13	70	380 – 500	0.16	82
132	380 – 575	0.14	75	380 – 500	0.18	96
160 - 225	380 – 575	0.28	165	380 – 500	0.29	155

Option FC – 115V 50/60Hz 1ph

Motor Frame	60Hz Ratings			50Hz Ratings		
	Voltage [V]	Current [A]	Power [W]	Voltage [V]	Current [A]	Power [W]
Single Phase Connection - ⊥ (Delta)						
63	100 – 135	0.23	42	100 – 135	0.30	42
71	100 – 135	0.23	47	100 – 135	0.30	44
80	100 – 135	0.27	57	100 – 135	0.30	43
90	100 – 135	0.46	102	100 – 135	0.57	78
100	100 – 135	0.53	105	100 – 135	0.54	78
112	100 – 135	0.60	115	100 – 135	0.55	80

Table 6 – Option F & FC

16. Motor Accessories Ctd.

Thermostats (Option TW and Option 2TW)

Standard connection	Series connected, one per phase
Contact	NC (Normally Closed)/ Auto Re-setting
Response Temperature (Option TW)	311 °F (155 °C) Shut-Off Device
Response Temperature (Option 2TW)	311 °F (155 °C) Shut-Off Device + 266°F (130 °C) Alarm Device
Nominal Current	1.6 Amp at 250 V
Resistance	< 50 mΩ
Switch Rebound	< 1ms
Insulation Rating	2000 VAC
Cycles	10,000 max
Lead Identification (inside terminal box)	P1 and P2 or TB1 and TB2 / 2TB1 and 2TB2

Motor thermostats or bi-metallic switches can be wired directly into the control circuit without a separate control module or tripping device. Thermostats operate on a relatively high control voltage so they are much less sensitive to voltage interference from the main power supply. Often one can run thermostat leads and motor power leads next to each other when using the appropriate shielded cable. The installer is responsible to wire the thermostats into the motor control circuit. The leads may be labeled in a variety of ways as indicated.

Thermistors (Option TF)

Standard Connection	Three devices, series connected, one per phase
Type	Positive temperature coefficient (PTC)
Transition Temperature	150°C±5 °C
Resistance	20… 500Ω (below transition) > 4 kΩ (above transition)
Reed Current	< 1mA
Max Voltage	30V
Lead Identification (inside terminal box)	P1 and P2 or TP1 and TP2

With a separate control module or tripping device (ex. Kirwan INT69) thermistors are used to sense motor overload/ over temperature conditions by converting the critical operating temperature limit into large internal resistance change. Due to their small size, heat sink construction, and high change in resistance value, minor resistance variations caused by relatively long lead runs can be tolerated. This feature also allows for one controller to be used for several temperature sensing locations. Many variable frequency drives come with on-board thermistor inputs. NORD does not supply the thermistor control module.

⚠ WARNING ⚠

Thermostats and Thermistors will automatically reset.

⚠ WARNING ⚠

All wiring must be completed by qualified personal and adhere to all local codes.

Space Heaters (Option SH)

- Connection Diagram shown on Page 9
- Space Heaters are mounted directly on the motor winding
- The leads are brought into the terminal box and labeled H1 and H2
- They require a separate voltage supply and must not be energized when the motor is energized
- The heaters will keep the winding of the motor approximately 5°C above the surrounding ambient

Table 5. Space Heater Data

Frame Size	Wattage	Voltages	Heater Strips/MTR
63 & 71	18W	110V	1
		230V	
		460V	
80	25W	110V	1
		230V	
		460V	
90 – 112	50W	110V	2
		230V	
		460V	
132-180	100W	110V	2
		230V	
		460V	
200 & 225	120W	110V	2
		230V	
		460V	

Encoder (Option IG)

- Most standard encoders will be enclosed inside the fan cover
- Incremental, Quadrature, Differential, Marker Channel
- IP66 Protection
- IG1 = 1024PPR, IG2 = 2048PPR, IG4 = 4096PPR
- TTL/RS422, HTL/Push-Pull, Line Driver.
- 5V or 10-30V available.
- Absolute encoders also available.
- Seperate encoder wiring instructions are provided by NORD.

17. Inspection

Inspect the motor after every 500 operating hours.

⚠ *WARNING* ⚠

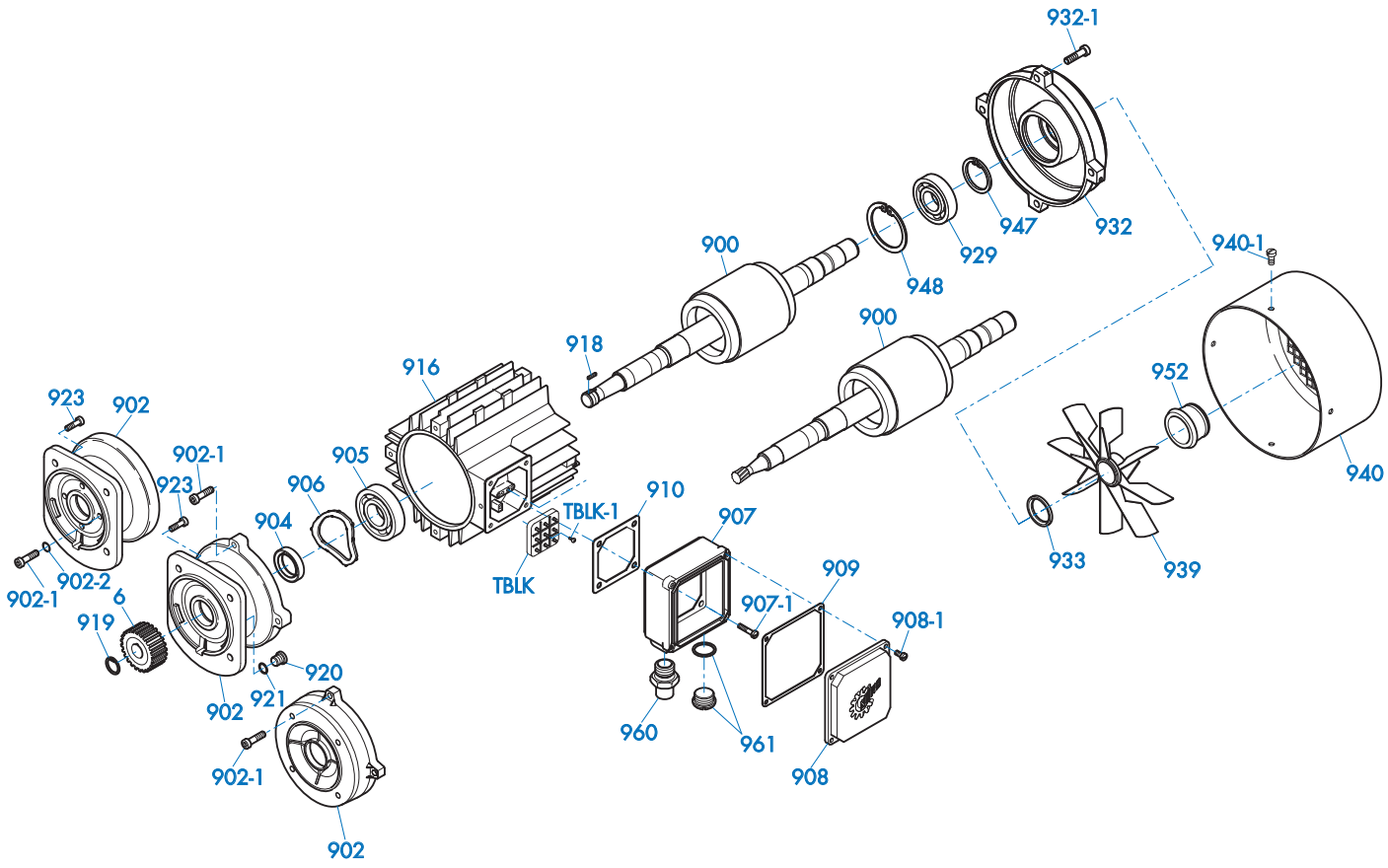
If it is necessary to clean the motor exterior, do not use shop air. Shop air can force contaminents into the motor and may cause parts damage or result in blowing debris causing injury.

Table 8 - Inspection Guidelines

Inspect	Check	Action
Motor Exterior	Check the external surfaces for contamination. Accumulation of dirt and fibrous deposits must be removed.	Clean the motor external surfaces using clean, lint-free cloths.
		Clean deposits from between cooling fins using a vacuum cleaner and a stiff-bristled nylon brush.
	Check the external surfaces for oil film and greasy deposits.	Clean the oil film and greasy deposits from the motor surface using clean, lint-free cloths.
		If necessary, moisten the cloth with an approved non-flammable, residue-free solvent. Do not pour solvent on the motor.
	Check for evidence of damage or overheating.	If the motor has physical damage, replace the motor.
Motor Mountings	Make sure the mounting hardware is secure.	If the mounting hardware is not secure, check the motor/gearbox alignment, and tighten the mounting hardware.
Motor Electrical Connections	Check that all electrical connections are secure.	If the electrical connections are not secure, tighten them.
	Check the electrical connections for evidence of arcing.	Loose electrical connections can cause arcing, which is evident by discoloration and charring. If you find evidence of arcing, replace the damaged connections.
Insulation Resistance	Using an ohmmeter, check and record the resistance of motor winding insulation.	Compare the current resistance reading to previous readings. If the resistance drops significantly, perform an internal inspection for insulation damage or deterioration.
Motor Brake	On motors that have a brake, use a feeler gauge to check the air gap in between the brake pad and the rotor according to the appropriate user manual.	If the air gap exceeds the maximum allowed for that brake configuration provided in the manual, adjust the air gap or replace the brake pad according to user manual U35000.

18. Parts List

If you are ordering a part, provide the model and order number (table 1, page 2) of your motor. This will determine the specific part number you need.



Part Number	Part Description	Qty per Assembly
6	Input Pinion	1
900	Rotor Assembly	1
902	A-Endbell	1
902-1	Screw	4
902-2	Dubo Seal	4
904	Oil Seal	1
905	Bearing	1
906	Preload Spring	1
907	Terminal Box Frame	1
907-1	Screw	4
908	Terminal Box Cover	1
908-1	Screw	4
909	Gasket - Terminal Box Frame	1
910	Gasket - Terminal Box Cover	1
916	Stator	1
918	Key	1
919	Retaining Ring	1
920	Oil Plug	1

Part Number	Part Description	Qty per Assembly
921	Gasket	1
923	Screw	4
929	Bearing	1
932	B-Endbell	1
932-1	Screw	4
933	Oil Seal	1
939	Fan	1
940	Fan Cover	1
940-1	Screw	4
947	Retaining Ring	1
948	Retaining Ring	1
952	Fan Clip	1
960	NPT Thread Adapter	1
961	Plug (includes O-ring)	1
TBLK	Terminal Block	1
TBLK-1	Screw, Terminal Block Mounting	2
	Jumper Bar (not illustrated)	AR

19. Repair

Reference the parts list drawing on page 14 for clarification.

A. Disassemble the motor according to the general exploded view in PARTS INFORMATION. Disassemble only as far as necessary to replace the failed parts.

B. Whenever the motor is disassembled, clean all dust and contamination from the motor interior using a vacuum cleaner and a soft-bristled nylon brush.

C. The following parts must be replaced if they are removed:

- Oil seal (904), Oil seal (933)
- Gasket (909), Gasket (910), Gasket (921)
- Gasket on plug (961) • Self-locking screws (907-1, 908-1, 923, 932-1, 940-1)
- Dubo Seals (902-2)

D. If the following parts are removed, inspect them, and replace them if they are deformed or damaged:

- Retaining ring (919), Retaining ring (947), Retaining ring (948)
- Fan clip (952)

20. Removing and Replacing Integral Motors

Reference the parts list on Page 14 for clarification.

A. Disconnect the power to the electric motor. Make certain the motor is properly grounded, de-energized and secured with a lock-out/tag-out device.

B. Drain the oil from the mating gearbox, or rotate the motor/gearbox assembly so that the motor is up, to prevent oil from spilling from the gearbox when the motor is removed.

C. Support the motor and prepare it for removal. Steady the motor and support it. For larger motors, use of mechanical lifting or support devices to may be appropriate.

D. Remove the fastening screws that hold the motor to the reducer input.

IMPORTANT NOTE

Most integral motor installations have mounting bolts accessible from the motor exterior. If the bolts are not clearly visible, unbolt the input flange from the gearbox. Remove the bolts securing the motor to the reducer input flange, and discard the old DUBO sealing rings that were under the screw heads.

E. Maintain motor shaft alignment and move the motor directly away from its mounting surface until the motor shaft and mating input gear clear both the internal gear mesh and reducer input.

F. Remove and discard the old flange gasket.

G. Clean the gasket faces on the motor and gearbox, making sure no cleaning debris enters the gearbox.

H. Check the replacement motor to make sure the motor flange, motor shaft, and motor pinion are identical to the motor that was removed.

I. Place a new gasket between the gearbox and new motor.

J. Position the motor on the gearbox, making sure the input pinion meshes with the input gear. Rotate the motor as necessary to align the bolt holes and seat the motor flange. Make sure the gasket remains properly aligned and seated

K. Apply a medium strength thread locking compound to the bolt threads. Install the bolts and tighten them to the appropriate torque.

IMPORTANT NOTE

If the motor/gearbox installation uses an input flange, first mount the input flange to the motor using the four mounting bolts and NEW DUBO sealing rings under the head of each fastening screw. Make sure the fastening screws are clean and apply new thread sealant if necessary.

L. Check the gearbox oil level in accordance with the appropriate User Manual/s. If necessary fill or add oil to the gearbox.

HARMFUL SITUATION

Do not mix different types of oil!

M. Re-establish the electrical connection to the motor.

N. Observe the subsequent start-up closely to make certain the equipment is operating properly and there are no seal or gasket leaks.

21. Removing and Replacing NEMA C-Face or IEC Fange-Mounted Motors

For further clarification of these instructions, reference the parts list on Page 14 of this manual.

A. Disconnect the power to the electric motor. Make certain the motor is properly grounded, de-energized and secured with a lock-out/tag-out device.

B. Support the motor and prepare it for removal. Steady the motor and support it. For larger motors, use of mechanical lifting or support devices to may be appropriate.

C. Remove the fastening screws that hold the motor to the C-face or IEC mounting flange.

D. Maintain motor shaft alignment, and move the motor directly away from its mounting surface until the motor shaft and mating coupling clear the mounting flange surface of the driven equipment.

E. Measure and record the proper placement of the motor shaft coupling prior to removing it from the old motor.

F. Make sure the new motor shaft, key and key slot are free of all nicks, burrs, and lubrication or grease.

G. Install the new shaft key on the new motor. If the shaft key is not captured or if an open-ended key slot is utilized it is good practice to secure the key into the key slot with a medium strength thread locking agent or alternatively one may stake the key in place.

H. Re-install the coupling on the new motor shaft, making sure the placement of the coupling is in the same location as it was on the old motor (See Step E).

I. Clean all old gasket material, sealants, contamination, and corrosion from the flange surface on the driven equipment.

J. If the motor is utilized in a wet or wash down environment apply a sealing gasket or gasket eliminating compound to the mating flange surface, as would seem most appropriate for the application.

K. Support the new motor and mount it flush against the mating flange surface of the driven equipment.

L. Apply a medium strength thread locking agent to the bolt threads.

M. Install the bolts and tighten them to the appropriate torque.

N. Re-establish the electrical connection to the motor.

O. Observe the subsequent start-up closely to make certain the equipment is operating properly.

22. Testing

IMPORTANT NOTE

NORD electric motors do not require periodic testing. However, if a motor is removed from its installation, NORD recommends that the motor be checked according to the following static and dynamic testing procedures before it is reinstalled. Finding a condition that will require future repair before the motor is reinstalled decreases the overall maintenance time.

This section provides general test information and functional checks for the types of motors covered by this manual. Read and understand the tests and checks before performing them on your motor.

Record and date all measurements taken.

If the motor fails any of the test procedures provided below, use the troubleshooting guide to determine the motor problem.

Static Testing

A. The motor can only be static tested if it is disconnected from the component it drives and securely mounted on a fixture or mounting plate. These tests are usually conducted when a motor has been removed for any reason other than failure

B. Turn the motor shaft slowly by hand. Feel and listen for evidence of a failed bearing, which is indicated by a rough feel as the shaft rotates, and by noise.

C. Check for smooth rotation, with no evidence of binding or catching. If the shaft does not rotate smoothly, or binds or catches, the bearings are worn or failing, lack lubrication, or are contaminated.

D. Check the motor shaft for side play by applying pressure at right angles to the shaft in several places around the circumference. If the shaft moves perceptibly, the front bearing may be worn.

Dynamic Testing

A. Find the motor voltage and rated load current values as listed on the motor nameplate.

B. Using a volt-ohmmeter, verify that the motor power supply is in the correct range.

C. Run the motor with no load. As the motor is operating, listen for unusual motor noise and check for excessive vibration. Vibration and motor noise are indications of bearing contamination, lack of lubrication, damage, or failure.

D. Use an ammeter to measure the no-load current. Record the no-load current for comparison with previous readings, and for reference during future testing.

E. If the motor passes the no-load test, operate the motor at rated load and check and record the current.

F. Check the motor operating temperature at rated load. If the motor operates at a higher than normal temperature, the motor may be damaged, overloaded or failing.

MOTORS - AC INDUCTION, SINGLE & POLYPHASE

23. Troubleshooting

Fault	Likely Cause	Corrective Action
Motor fails to start.	• Motor is mis-wired • Brake is may not be releasing. • Fan guard damaged and contacting fan. • Motor protection device has tripped or does not switch • 1-Ph Capacitor or start switch has failed.	• Verify and correct motor wiring. • Troubleshoot brake per User Manual U35000. • Replace damaged fan guard. • Check motor protection device for correct setting and correct error. • Discharge capacitor and use a volt-ohm meter to check the capacitor for an open circuit - replace if needed. Inspect switch and connections. Replace if contacts look burned or pitted.
Fuses blow or motor protection faults immediately.	• Short circuit in line. • Lines connected incorrectly. • Fuse or circuit breaker tripped. • Motor is overloaded or equipment jammed. • Stator is shorted or went to ground.	• Rectify short circuit. • Check circuit diagram and make corrections. • Replace fuse or circuit breaker. • Make sure load is free. Verify motor amp draw compared to nameplate rating. • A damaged or blown stator will show a burn mark. Stator must be repaired or replaced.
Motor hums and has high current consumption	• Brake may not be releasing. • Rotor may be rubbing stator. • Defective or incorrect stator winding.	• Troubleshoot brake per User Manual U35000. • Send motor to a repair specialist.
Severe speed loss under load or excessive acceleration time.	• Overload. • Excessive voltage drop. • Damaged or failing motor bearings. • Damaged or worn gear unit. • 1-Ph Capacitor or start switch has failed.	• Check load conditions and make certain system is unobstructed. Reduce load or consider a larger motor. • Verify service voltage is within specification. Check if nearby equipment is affecting incoming power. Make sure connection harness and wiring is adequate. • Replace motor bearings. • Replace or repair damaged gear unit. • See instructions under "Motor fails to start".
Motor runs the incorrect direction.	• Incorrect wiring.	• Rewire motor according to system schematic and/or switch two incoming motor phases.
Motor heats up excessively or thermal overload protection trips	• Overload. • Ambient temperature is too high. • Inadequate cooling. • Operation is outside the allowed duty cycle. • Motor protection device may be defective. • Excessive supply voltage. • System short or damaged stator.	• Make sure load is free. Verify motor amp draw compared to nameplate rating. Reduce load or consider a larger motor. • Do not operate above the rated conditions. • Correct cooling air supply. Open and clear cooling air passages. Retrofit with forced ventilator fan if needed. • Adjust operating duty cycle or contact a specialist to select a suitable motor or drive. • Replace motor protection device. • Adapt motor supply voltage. • Check for loose, cut or damaged wires. Check stator winding for defects or burn damage.
Excessive Noise or Vibration	• Motor bearings contaminated or damaged. • Excessive motor shaft end play. • Misaligned or imbalanced load.	• Test motor by itself. If bearings are bad noise may be heard or roughness detected. Replace bearings. Add lubrication if bearings have grease fittings. • Check shaft endplay with motor and system power disconnected. If shaft movement is excessive replace motor shaft bearings. • Check all mating shaft connections for proper alignment and correct all imbalanced load conditions.
1 Ph Start Capacitor Failures	• Motor is not coming up to speed quickly enough. • Motor is being cycled frequently • Start switch is defective or damaged.	• Verify motor size to load conditions. Motor should come up to speed in no more than 2-3 seconds. • Verify duty cycle and consult specialist for recommendations. • Replace start switch.
1 Ph Run Capacitor Failures	• Possible power surge to motor caused by transient voltage or lightening. • Excessive ambient temperature.	• Install proper surge protection. • Verify ambient conditions do not exceed nameplate value.

Section 3.4.2.3

Recirculation Pump

Nikuni KTM Series Pumps

(Micro Bubble Generator for DAF System)

Client :
Project :
Model : KTM25N-000 (SS304 Material)

Date :
Doc. No. :
Revision No. :

Japan Headquarters :
843-5, Kuji, Takatsu-Ku, Kawasaki-Shi,
Kanagawa, Japan Post-code 213-0032
URL : http://www.nikuni.co.jp

Phone: +81-44-833-6500 (English)
+81-44-833-1121 (Japanese)
Fax : +81-44-833-6482

MAIN OFFFICE :
843-5 KUJI, TAKATU-KU, KAWASAKI, KANAGAWA, JAPAN 2130032
TEL : +81(0)-44-833-6500 FAX: +81(0)44-833-6482

NIKUNI BUBBLE GENERATOR FOR DAF SYSTEM

NIKUNI KTM (DAF) PUMP DATA SHEET

Company				Date	
Project				Data sheet No.	
Service				Rev.	
Item No				PID No.	
No.Operating		No.Spare		Total Required	
Pump Model	KTM25N-000 (SS304 Material)				
Pump Type	Coupling Type (Base plate, Coupling set & Coupling guard only)				

PROCESS AND PERFORMANCE DATA

Conditions of Service, Each Pump

Fluid	Treated Water	Design Capacity (L/min / gpm)	/
Normal Capacity (L/min / m3/Hr)	42 / 2.5	Suction Press. (MPa / bar)	-0.03 / -0.3
Temperature (℃)		Disch. Press. (MPa / bar)	/
Specific Gravity (at P.T.)		Differential Press. (MPa / bar)	/
Viscosity (at P.T. MPa･s)		Total Head (m / bar)	30 or 40 / 3 or 4
Air Flow rate (NL/min / Nm3/Hr)	3.3 / 0.20	Differential Head (m / bar)	
NPSH Ava. (m)		NPSH Req. (m)	

Motor Driver

*Electric motor should be prepared by purchaser

Phase		Output (kW / HP)	1.5kW / 2 HP	Frequency	60 Hz
Voltage		Pole	2	Speed	3600 min-1
Type					

* Original base plate will be fixed to IEC Motor frame size 90L .

Connection

(Suction.)	Size	25 A	Rating	Rc 1
(Discharge.)	Size	20 A	Rating	Rc 3/4

Materials

Casing	SCS13	Shaft	SUS304	Cover O-ring	PTFE
Impeller	SUS304	Side plate	N/A	Slinger	NBR
Cover	SCS13	Mechanical Seal	Sic - Sic , PTFE		

Painting

MUNSELL N3

Remarks

Accessory :

Air In-take nozzle.

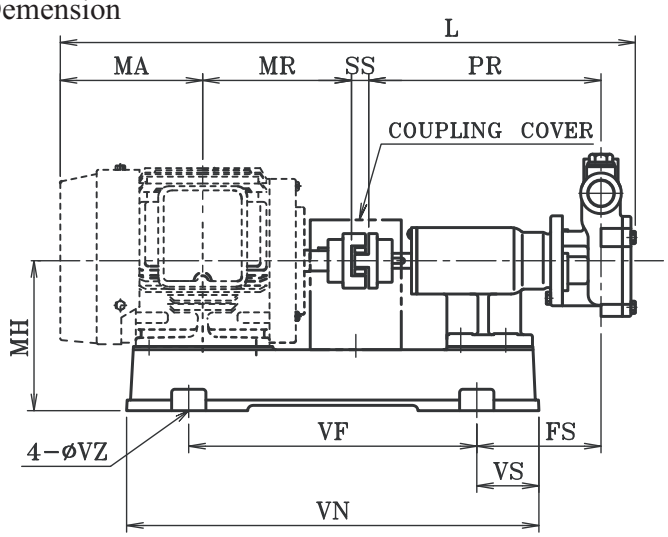
Please refer to attached recommendation of the air-parameter & guages ranges and other accessories.

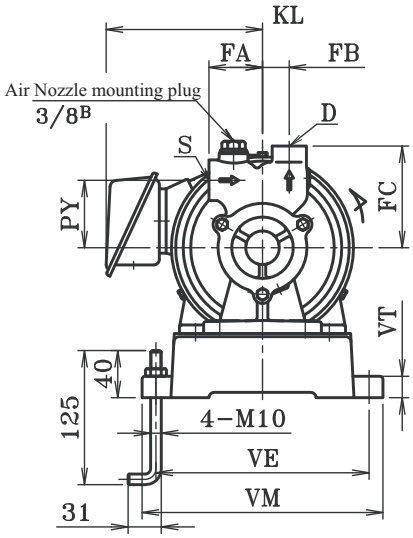
REV.	DATE	COMMENT	DESCRIPTION	DRAWN BY	CHECK BY	APPROVED BY

NIKUNI MODEL : KTM_N

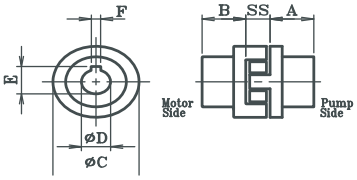
50Hz / 60Hz

Demension





Coupling Dimension for KTM_N / KTM_F



Coupling Dimensions

kw	A	B	C	D	E	F	SS
0.75	22	35	51	19	21.8	6	14
1.5, 2.2	36	53	71	24	27.3	8	18
3.7	36	53	71	28	31.3	8	18

Applicable motor frame size or original base-plate.

kW	IEC Frame
0.75	80M
1.5	90L
2.2	90L
3.7	112M

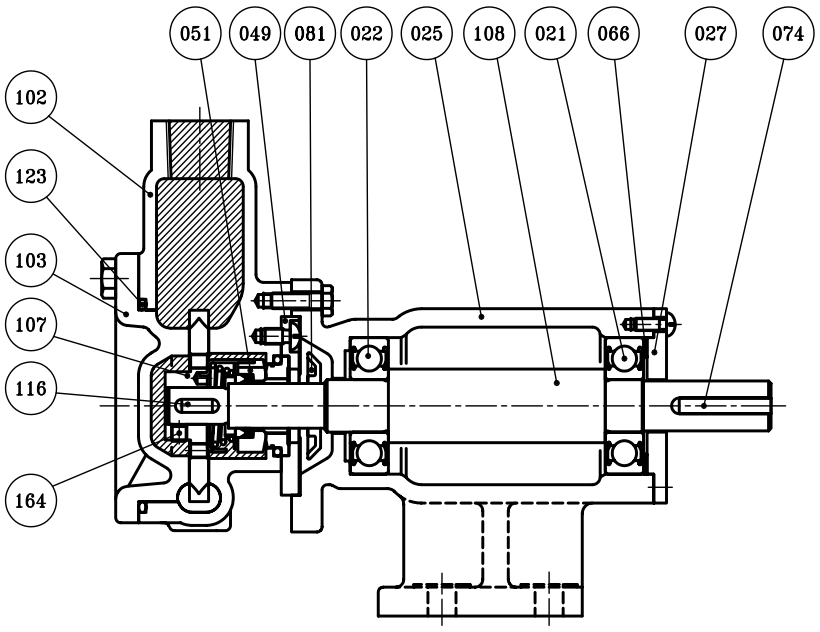
Demension & net weight

Unit : mm

Model	kw	HP	S	D	PR	PY	FA	FB	FS	FC	MH	L	MA	MR	SS	VE	VF	VM	VN	VS	VT	VZ	KL	Weight
KTM20N	0.75	1	Rc 3/4	Rc1/2	218	63	50	25	116	95	140	537	133	140	14	199	269	225	385	58	20	12	146	18
KTM25N	1.5	2	Rc1	Rc3/4	224	70	60	28	129	105	150	592	143	169	18	214	300	240	430	65	20	12	147	20
KTM32N	2.2	3	Rc1.1/4	Rc1	224	80	65	35	129	120	150	597.5	143	169	18	214	300	240	430	65	20	12	147	25
KTM40N	3.7	5	Rc 1.1/2	Rc1.1/4	238	85	70	40	82	130	180	692	186	200	18	280	425	310	616	96	25	12	154	30

*Approx. packing weight
(Motor weight not included)

Sectional Drawing



Materials

No.	NAME OF PARTS	SET	MATERIALS
021	Ball Bearing	1	SUJ
022	Ball Bearing	1	SUJ
025	Bracket	1	FC200
027	Bearing Gland	1	FC200
049	Mechanical Gland	1	SUS304
051	Mechanical Seal	1	SiC-SiC
074	Key	1	S45C
081	Slinger	1	NBR
102	Casing	1	SCS13
103	Cover	1	SCS13
107	Impeller	1	SUS304
108	Shaft	1	SUS304
116	Key	1	SUS316
123	O-Ring	1	PTFE
164	Set Screws	2	SUS304

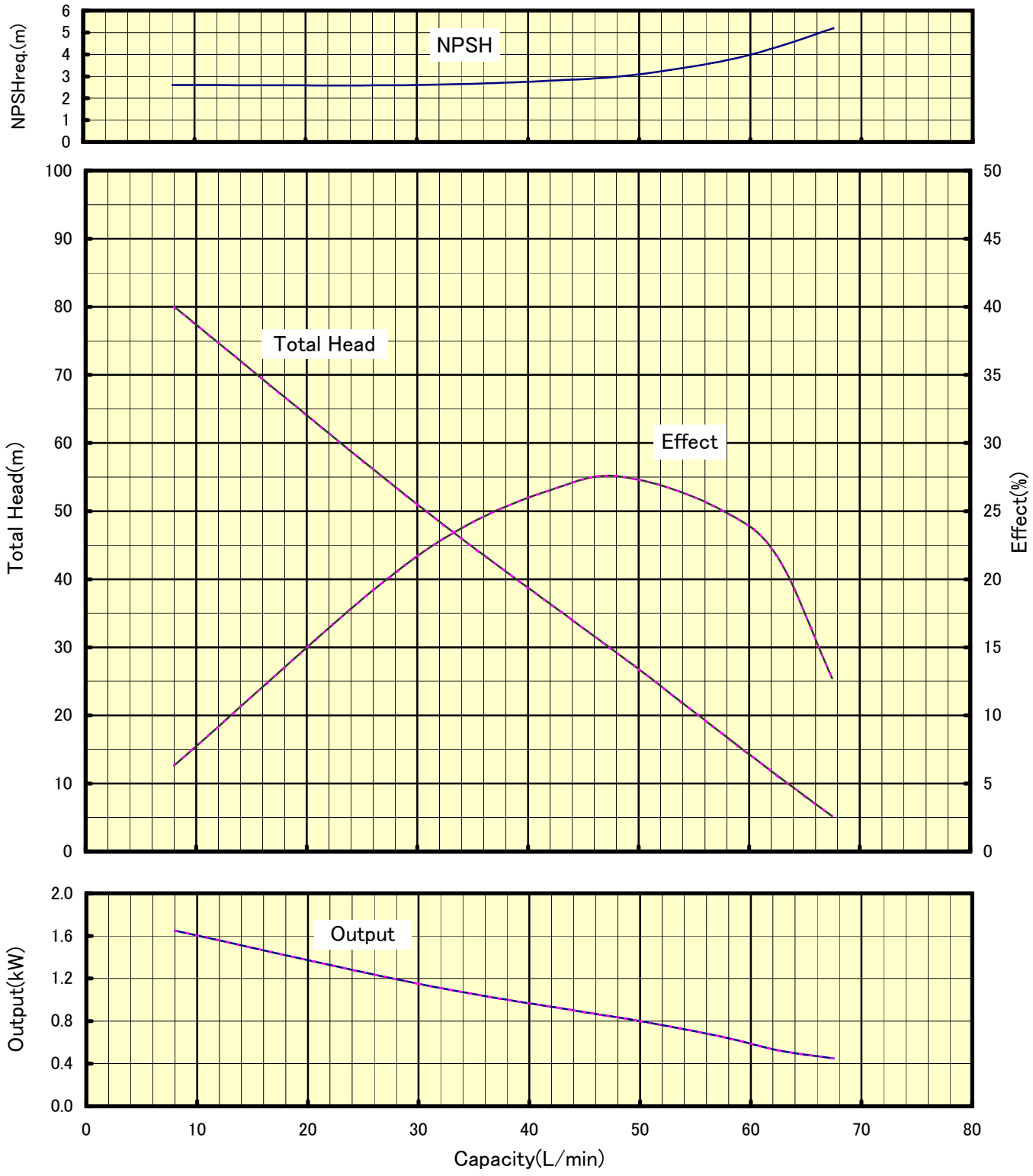
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NIKUNI

PUMP SUPPOSITON CURVE

60Hz

Model KTM25N

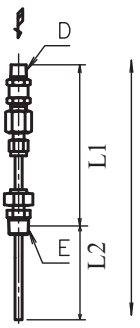


NIKUNI Co.,Ltd.

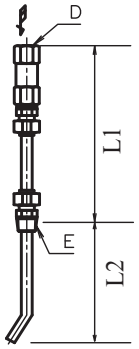
Accessories

Air Intake Nozzle (Included in every package)

How to connect the nozzle to Air Flow Meter (Air Intake Nozzle will be attached to every pump)



Standard Type

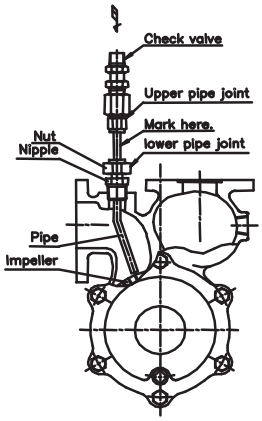


Large-scaled Tpye

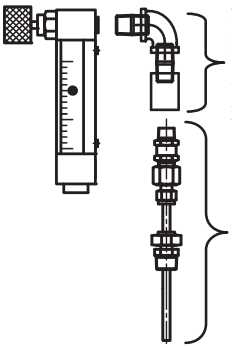
Applicalbe Model (Standard)	Dia. (E)	Length (L1)	Length (L2)	Length (L)	Dia. (D)
KTM15 (F)(N)(D)	R 3/8^{B}	121	73	157	R 1/4^{B}
KTM20 (F)(N)(D)	R 3/8^{B}	121	88	162	R 1/4^{B}
KTM25 (F)(N)(D)	R 3/8^{B}	121	97	167	R 1/4^{B}
KTM32 (F)(N)(D)	R 3/8^{B}	121	114	172	R 1/4^{B}
KTM40 (F)(N)(D)	R 3/8^{B}	121	120	177	R 1/4^{B}
KTM50 (F)(S)1,2,3	R 3/8^{B}	129	210	268	R 1/4^{B}

Applicable Model (Large-scaled Type)	Dia. (E)	Length (L1)	Length (L2)	Length (L)	Dia. (D)
KTM65S2 / F2	Rc 3/8	183	240	304	Rc 3/8
KTM80S / F	Rc 3/8	193	240	319	Rc 3/8

* In case of KTM80S / F model, connect “E” part with Bushing (3/4 x 3/8)



1) Loosen the nuts of the lower pipe joint to allow a nipple to freely move.
2) Mark the pipe bending direction on the pipe surface between the upper and lower pipe joints.
3) Wind a sealing tape around the lower pipe joint’s nipple of the suction nozzle, insert it into the nozzle junction of the pump, and turn the nipple to firmly fix it.
4) Turn the pipe to align the mark on the pipe surface so that the bend nose (gas discharge port) of the pipe will be directed to the center of the impeller.
5) Tighten the nuts of the lower pipe joint firmly. Make sure that the suction nozzle is not manually rotated.
6) Rotate the motor manually (rotate the shaft end of the motor with a screwdriver) to make sure that the pipe nose of the nozzle is not interfering with the impeller.

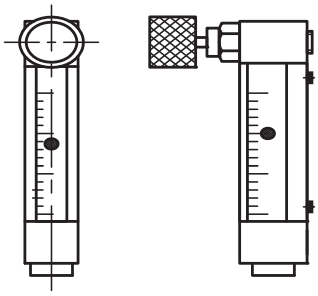


Noted :
Fitting connections & Air Flow meter should be prepared by purchaser

Air In-iake Nozzle will be attached to every pump

Recommended Accessories (To be prepared by Purchaser)

Air Parameter



Guages



Compound Guage
Minus 0.1 MPa to + 0.25MPa
Minus 1.0 Bar to + 2.5 Bar
Minus 15psi to + 35 psi



Pressure Guage
0 MPa to + 1.0MPa
0 Bar to + 10 Bar
0 psi to + 150 psi

Operation air flow rate & Air Parameter ranges

50Hz Frequency

Applicalbe Model (Standard)	Water Flow Rate m^3/Hr x 4Bar	Operation Air flow rate (N･L/min)	Air Flow Meter Range (N･L/min)
KTM20 (F)(N)(D)	1.0	1.3	0 to 5
KTM25 (F)(N)(D)	1.5	2.0	0 to 5
KTM32 (F)(N)(D)	3.0	4.0	0 to 10
KTM40 (F)(N)(D)	4.8	6.4	0 to 10
KTM50S1 / F1	8.0	10.6	0 to 20
KTM50S2 / F2	12.0	16.0	0 to 20
KTM50S3 / F3	15.0	20.0	0 to 30
KTM65S2 / F2	20.0	26.6	0 to 40
KTM80S / F	42.0	56.0	0 to 80

60Hz Frequency

Water Flow Rate m^3/Hr x 4Bar	Operation Air flow rate (N･L/min)	Air Flow Meter Range (N･L/min)
1.3	1.7	0 to 5
2.5	3.3	0 to 5
4.0	5.3	0 to 10
7.0	9.3	0 to 20
11.5	15.0	0 to 30
15.0	20.0	0 to 40
18.0	24.0	0 to 40
28.0	38.0	0 to 60
58.0	78.0	0 to 100

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Excess Air Device / Separation Tank

The KTM Series pump user manual must be fully read and understood before operating the pump. Failure to do so may result in death, serious injury, or property damage. This page is intended for a basic understanding of the KTM startup operation and is not a substitute for the user manual.

PRE-OPERATION CHECK (POWER OFF)

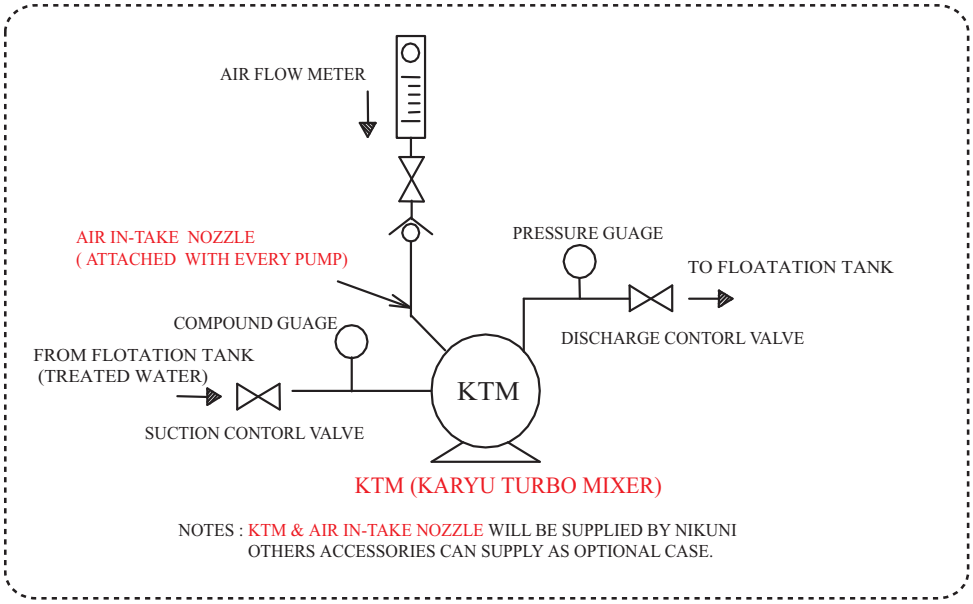
1) Prime KTM with effluent or water
2) Fully open Suction valve and Discharge valve. Do not run KTM with these valves closed.

STARTING THE KTM

1) Discharge side adjustments:
   Slowly tighten the Discharge valve until the discharge pressure falls within the desired range of 0.3MPa to 0.4Mpa (approximately 3 bar to 4 bar) with reference to the Pressure gauge.
   In the case where the Discharge valve (or KTM) is located far from the flotation tank, bubbles will tend to grow larger. In order to maintain microbubble size, an additional control valve should be installed on the flotation tank side to control the discharge pressure.

2) Suction side adjustments:
   Check to see if the Compound gauge indicates a negative suction pressure between the range of -0.02MPa to -0.03MPa (approximately -0.2 bar to -0.3 bar). If the pressure is higher than this range, slightly tighten the Suction valve to bring the pressure into the range stated above.

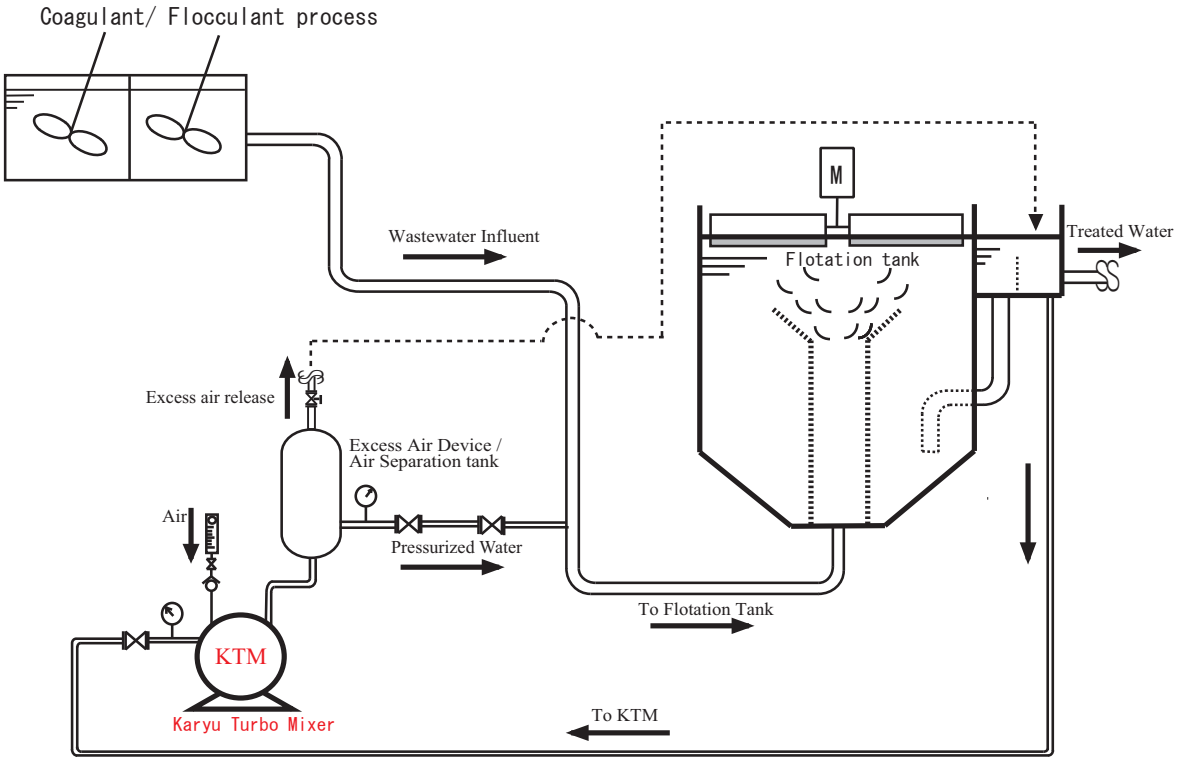
3) Air injection adjustments:
   Open the knob of Air-Parameter (Air flow meter) and adjust to an air flow rate that is 8% of the water flow rate.



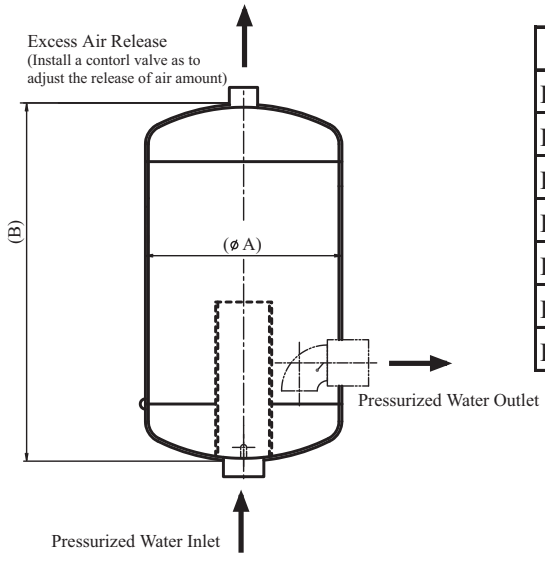
In case of mini bubbles occur and effect to flotation process,
please consider installing Excess Air Device / Separation Tank as shown in next page.

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Reference P&ID for DAF System



Recommended Separation Tank Capacity



Model	A (mm)	B (mm)	Capacity (Liter)
KTM20N(F)(D)	100	260	2
KTM25N(F)(D)	120	350	4
KTM32N(F)(D)	260	400	20
KTM40N(F)(D)	260	400	20
KTM50S(F)1,S(F)2,S(F)3	300	850	60
KTM65S(F)2	450	900	140
KTM80S(F)	450	900	140

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Total Advanced Technology

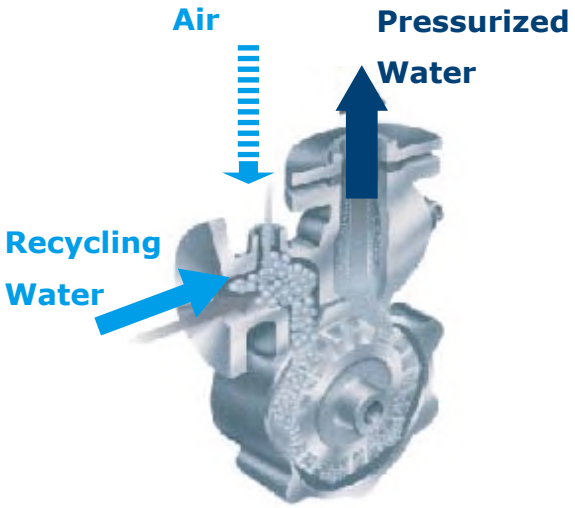
Nikuni Micro-Bubble Generator Technical Handbook



KTM Karyu Turbo Mixer

Introduction

NIKUNI' s unique compact micro-bubble generating KTM pumps, along with a small amount of chemical aid, remove contaminant particles in water purifying plants.



Suction, Mixing / Dissolving and Pressurization with only a single KTM pump

The KTM has a highly precise and sophisticated pumping mechanism that generates plenty of micro-bubbles using three hydro-dynamic principles:
Negative pressure sucks both air and water simultaneously from eachport; air is effectively mixed into water; pressurized air-enriched discharge is produced.
The pressurized air-enriched water is transferred into the bottom of the dissolved air flotation tank. It then makes a layer of micro-bubbles, spreads and floats up to the water surface, and finally forms a sludge mat that will be skimmed off.

KTM Selection Guide

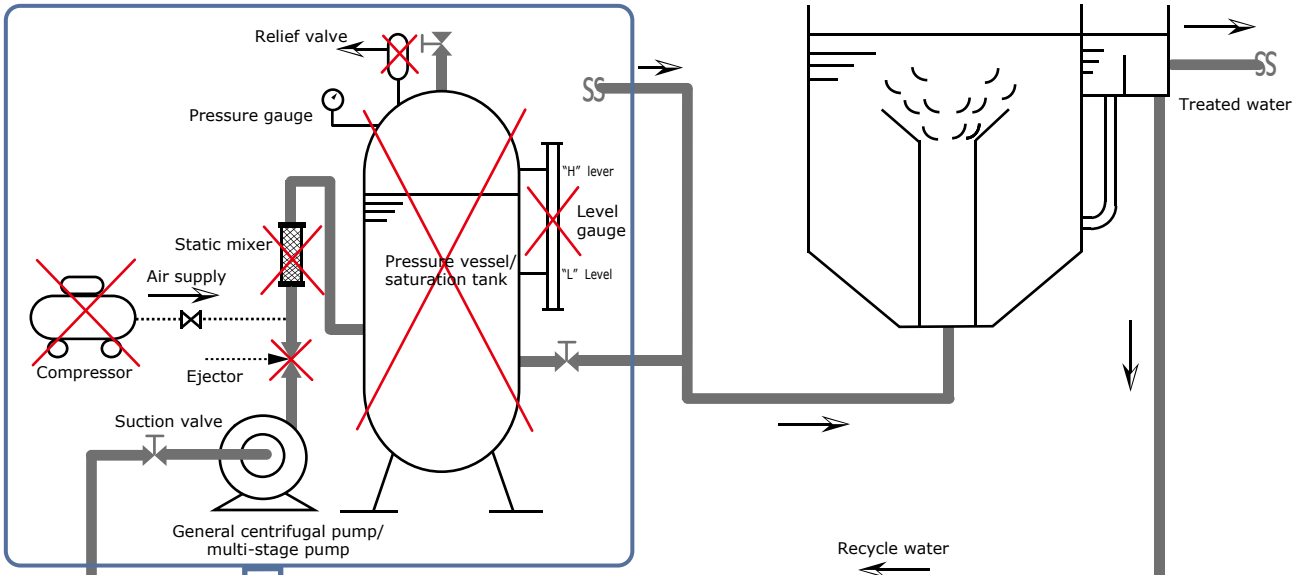
The KTM series, with a wide selection for suitability with various plant designs, are roughly classified into three types; close-coupled type, bare shaft pump and coupling type.
Material of the wetted parts can be selected in cast iron (stainless steel impeller and shaft), SS304, or SS316 for each series. In addition, a check valve with an injection nozzle will be packed in every KTM package.

1. Coupling Type
   The coupling type KTM models are most popular in the market. Nikuni will supply a bare pump, pump base (base-plate), and coupling set with coupling guard only.
   Depending on your plant site environmental situation, various type of electric motor protection can be applied.
2. Bare Shaft Pump
   The core of the coupling type, including only the bare pump. The base and coupling are not included.
3. Close-coupled Type / Monoblock Type
   A series of the most compact and complete set of the micro-bubbles generator has been put in our arrangement, eliminating pump base. This option is restricted within the range of KTM20N/F to KTM40N/F.

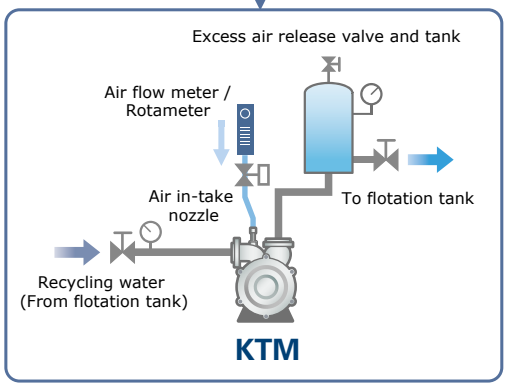
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Features of KTM

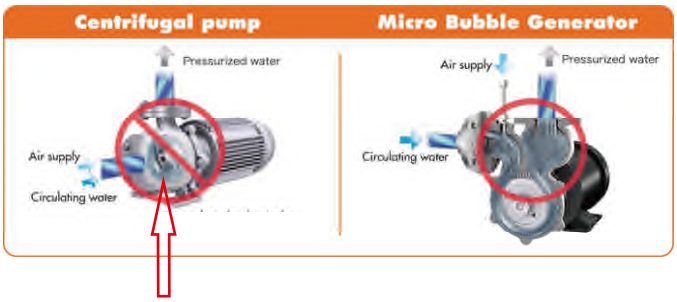
Typical schematic drawing of DAF system



* Note: Ancellary components marked with X are not required for KTM



Comparision on basic principal of general centrifugal pump with KTM



Air pocket developes in the center of casing causing failures of suction

Advantages of KTM compared to Conventional System

1. Three funtions in one pump

- The KTM simultaneously draws in air and water, dissolves air with its turbine impeller, and pumps pressurized water to the flotation tank or other process

2. Highly Efficient Air-water Dissolution

- Precision turbine pump technology and a unique design make possible extremely high levels of efficiency in dissolving air into water

3***. Simplified DAF Operation and Stable Pump Performance***

- The multifunctional KTM eliminates the need for ancillary equipment such as air compressors, large saturation tanks with difficult level control, and truly simplifies DAF systems and their operation

4. Compact and Small Footprint

- Easily retrofit or upgrade existing DAF systems

5. Minimal Power Consumption and Maintenance Cost

- Highly efficient process with only a small pump and motor, no compressor power required, while the simple and robust structure of the KTM minimizes maintenance cost

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KTM selection chart

Performance Table

Close-coupled / Monoblock type

Model	50Hz Frequency				60Hz Frequency			
	Water Flow Rate		Air Flow Rate	Motor Power	Water Flow Rate		Air Flow Rate	Motor Power
	L / min	m^3 / h	NL / min (Range)*	kW / Poles	L / min	m^3 / h	NL / min (Range)*	kW / Poles
KTM20F(N)D-04P(S)	17	1.0	1.3 (0 to 5)	0.56kW/2P	Not available for 60Hz frequency			
KTM20F(N)D-07P	Not available fo 50Hz frequency				22	1.3	1.7 (0 to 5)	0.56kW/2P
KTM25F(N)D-07P	25	1.5	2.0 (0 to 5)	0.975kW/2P	Not available for 60Hz frequency			
KTM25F(N)D-15P	Not available fo 50Hz frequency				42	2.5	5.3 (0 to 10)	1.975kW/2P
KTM32F(N)D-15P	50	3.0	6.4 (0 to 20)	1.975kW/2P	67	4.0	9.3 (0 to 20)	1.975kW/2P
KTM40F(N)D-22P	80	4.8	11.0 (0 to 20)	2.42kW/2P	117	7.0	15.0 (0 to 30)	2.42kW/2P

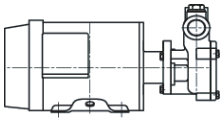
*Note:
1. Values in brackets show the recommended range of the air flow meter
2. Model code
   - F = Wetted parts in cast iron material with stainless steel impeller and shaft
   - N = Wetted parts in standard SS304 material, SS316 as aptional models also available

Coupling connection / Base-mounted model

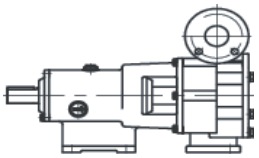
Model	50Hz Frequency				60Hz Frequency			
	Water Flow Rate		Air Flow Rate	Required Motor Power	Water Flow Rate		Air Flow Rate	Required Motor Power
	L / min	m^3 / h	NL / min (Range)*	kW / Poles	L / min	m^3 / h	NL / min (Range)*	kW / Poles
KTM20F / N	17	1.0	1.3 (0 to 5)	0.75kW/2P	22	1.3	1.7 (0 to 5)	0.75kW/2P
KTM25F / N	25	1.5	2.0 (0 to 5)	1.5kW/2P	42	2.5	3.3 (0 to 5)	1.5kW/2P
KTM32F / N	50	3.0	4.0 (0 to 10)	2.2kW/2P	67	4.0	5.3 (0 to 10)	2.2kW/2P
KTM40F / N	80	4.8	6.4 (0 to 20)	3.7kW/2P	117	7.0	9.3 (0 to 20)	3.7kW/2P
KTM50F1 / S1	133	8.0	11.0 (0 to 20)	5.5kW/4P	192	11.5	15.0 (0 to 30)	7.5kW/4P
KTM50F2 / S2	200	12.0	16.0 (0 to 20)	7.5kW/4P	250	15.0	20.0 (0 to 40)	11kW/ 4P
KTM50F3 / S3	250	15.0	20.0 (0 to 30)	11kW/ 4P	300	18.0	24.0 (0 to 40)	15kW/ 4P
KTM65F2 / S2	333	20.0	27.0 (0 to 40)	15kW/ 4P	467	28.0	37.0 (0 to 60)	18.5kW/4P
KTM80F / S	700	42.0	56.0 (0 to 80)	22kW/ 4P	967	58.0	77.0 (0 to 100)	30kW/ 4P

*Note:
1. Values in brackets show the recommended range of the air flow meter
2. Model code
   - F = Wetted parts in cast iron material with stainless steel impeller and shaft
   - N & S = Wetted parts in standard SS304 material, SS316 as aptional material is also available

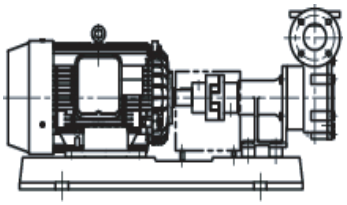
Configurations



Close-coupled / Monoblock type



Bare shaft pump only
(Refer to page 7 for standard base-plate dimensions)

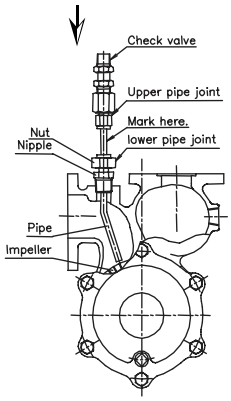


Coupling connection / Base-mounted model
(Electric motor will not be supplied by NIKUNI)

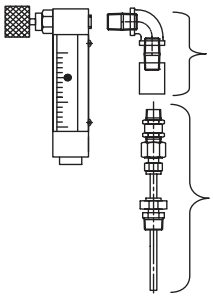
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Dimensions

Technical Description of Air-Intake Nozzle



Configuration of Air-Intake Nozzle mounted in KTM



Note:
1. Fitting connections and air flow meter / rotameter shold be prepared by purchaser
2. Air in-take nozzle will be attached for every KTM

Dimensions

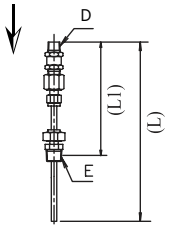


Fig. 1

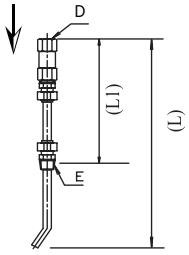
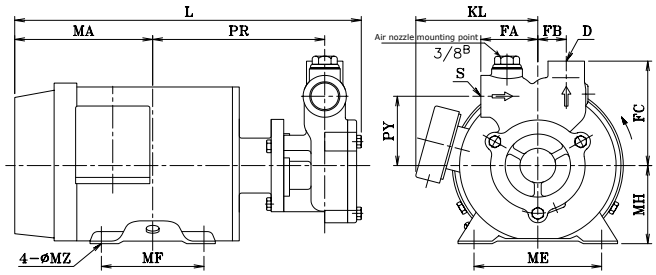


Fig. 2

Unit : mm

Applicable model	Figure	Dia.(E)	Dia.(D)	Length(L1)	Length(L)
KTM20F/FD (N/ND)	Fig.1	R 1/4 (R 3/8)	R 1/4	121	209
KTM25F/FD (N/ND)		R 1/4 (R 3/8)	R 1/4	121	218
KTM32F/FD (N/ND)		R 1/4 (R 3/8)	R 1/4	121	235
KTM40F/FD (N/ND)		R 1/4 (R 3/8)	R 1/4	121	241
KTM50F1/F2/F3/S1/S2/S3		R 3/8	R 1/4	129	339
KTM65F2/S2	Fig.2	R 3/8	R 3/8	183	304
KTM80F/S		R 3/8	R 3/8	193	319

Close-coupled / Monoblock Type



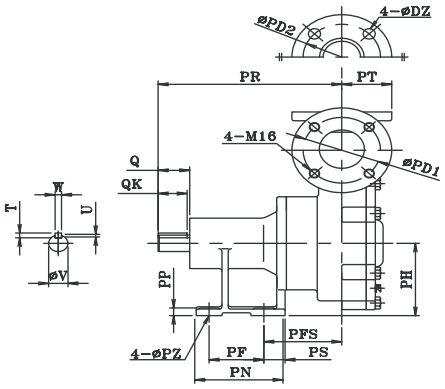
Unit : mm,kg

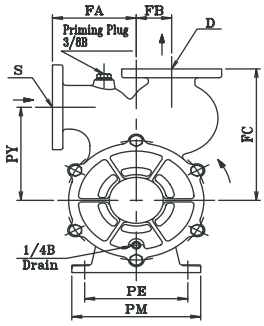
Model	S	D	PR	PY	FA	FB	FC	MH	L	MA	ME	MF	MZ	KL	Weight
KTM20ND04S	Rc 3/4	Rc 1/2	165	63	50	25	95	80	312	115	125	100	10x17	91	14
KTM20ND04Z	Rc 3/4	Rc 1/2	151	63	50	25	95	71	304	121	112	90	7x8	107	12
KTM20ND07Z	Rc 3/4	Rc 1/2	145	63	50	25	95	80	325	148	125	100	10x8	146	18
KTM25ND07Z	Rc 1	Rc 3/4	145	70	60	28	105	80	331	148	125	100	10x8	146	22
KTM25ND15Z	Rc 1	Rc 3/4	168	70	60	28	105	90	361	155	140	125	10x12	156	26
KTM32ND15Z	Rc 1 1/4	Rc 1	168	80	65	35	120	90	366	155	140	125	10x12	156	27
KTM40ND22Z	Rc 1 1/2	Rc 1 1/4	172	85	70	40	130	90	405	184	140	125	10x12	156	32

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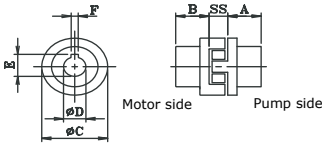
Dimensions

Bare Shaft Pump KTM50S1,S2 & S3





Coupling Dimension



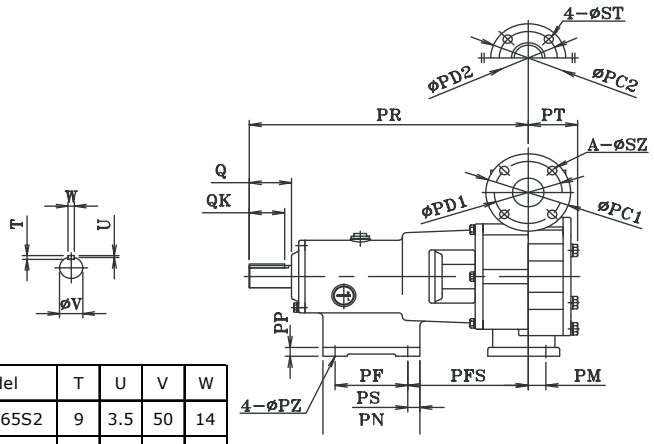
Unit : mm

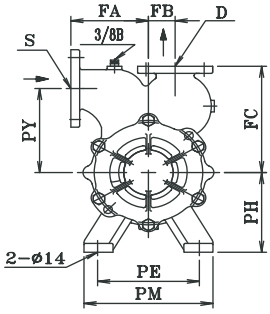
kW	A	B	C	D	E	F	SS
5.5 & 7.5	45	45	90	38	41.3	10	24
11 & 15	55	55	120	42	45.3	12	40

Unit : mm,kg

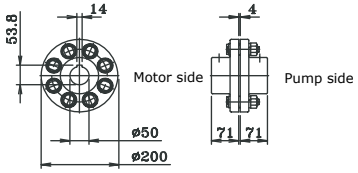
Model	S	D	PR	PY	FA	FB	FC	PE	PM	PT	PD1	PD2	PH	PFS	PS	PF	PN	PP	PZ	Q	QK	T	U	V	W	Weight
KTM50S1	50A	50A	285	160	130	55	230	160	200	77.5	120	120	132	121	33	85	138	14	14	49	45	7	3	30	8	45
KTM50S2	50A	50A	285	170	130	55	240	160	200	77.5	120	120	132	121	33	85	138	14	14	49	45	7	3	30	8	50
KTM50S3	50A	50A	285	170	130	55	240	160	200	77.5	120	120	132	121	33	85	138	14	14	49	45	7	3	30	8	50

Bare Shaft Pump KTM65S2 & 80S





Coupling Dimension



Model	T	U	V	W
KTM65S2	9	3.5	50	14
KTM80S	9	3.5	50	14

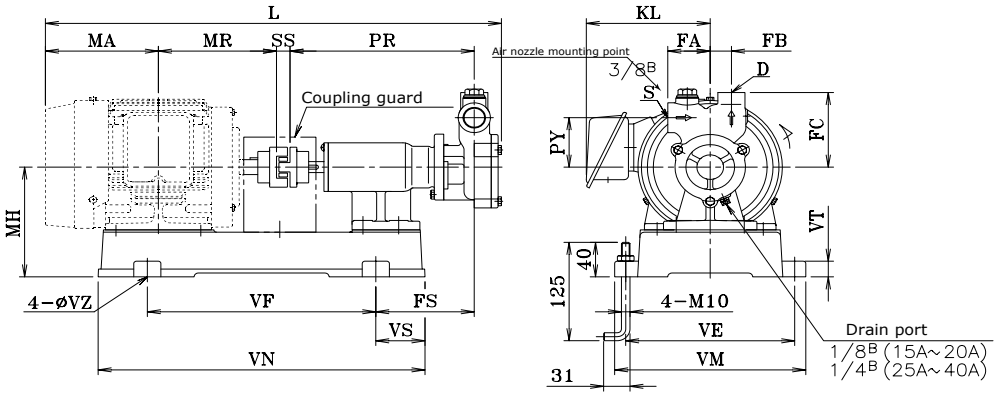
Unit : mm,kg

Model	S	D	PR	PY	FA	FB	FC	PH	PE	PM	PT	PD1	PD2	PC1	PC2	PM	PFS	PS	PF	PN	PP	PZ	SZ	ST	TS	TZ	Q	QK	Weight
KTM65S2	65A	50A	575.5	190	160	55	240	180	210	266	102	140	120	175	155	36.5	248.5	25	150	200	20	14	19	19	230	280	87	74	150
KTM80S	80A	65A	582	180	170	80	280	180	270	326	127	150	140	185	175	45	255	25	150	200	20	19	19	19	230	280	87	74	200

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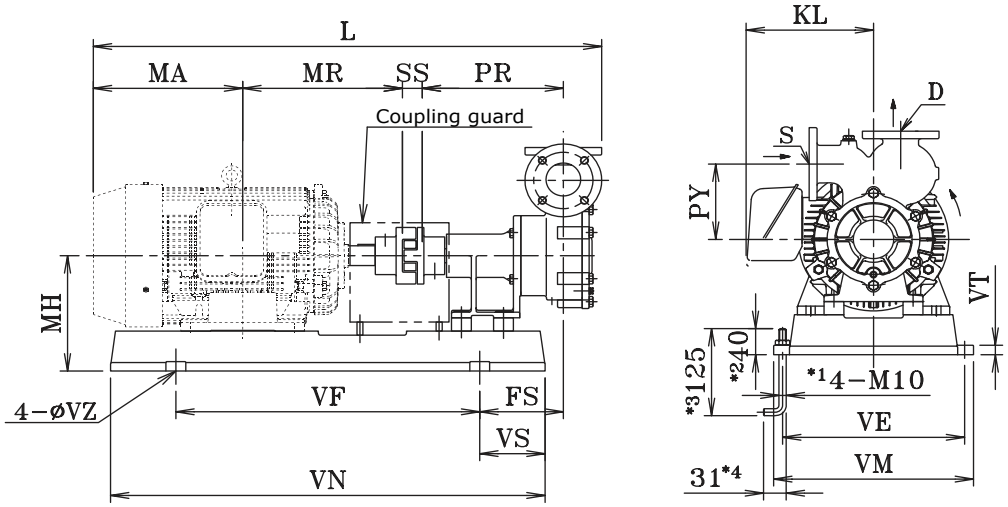
Dimensions

Coupling Connection / Base-mounted Type



Unit : mm,kg

Model	S	D	PR	PY	FA	FB	FS	FC	MH	L	MA	MR	SS	VE	VF	VM	VN	VS	VT	VZ	KL	Weight
KTM20N	Rc 3/4	Rc 1/2	218	63	50	25	116	95	140	526	122	140	14	199	269	225	385	58	20	12	146	27
KTM25N	Rc 1	Rc 3/4	224	70	60	28	129	105	150	604	155	169	18	214	300	240	430	65	20	12	156	36
KTM32N	Rc 1 1/4	Rc 1	224	80	65	35	129	120	150	609	155	169	18	214	300	240	430	65	20	12	156	42
KTM40N	Rc 1 1/2	Rc 1 1/4	238	85	70	40	82	130	180	692	186	200	18	280	425	310	616	96	25	12	175	61
KTM20F	Rc 3/4	Rc 1/2	214	63	50	25	112	95	140	522	122	140	14	199	269	225	385	58	20	12	146	27
KTM25F	Rc 1	Rc 3/4	219	70	60	28	124	105	150	599	155	169	18	214	300	240	430	65	20	12	156	36
KTM32F	Rc 1 1/4	Rc 1	224	80	65	35	129	120	150	609	155	169	18	214	300	240	430	65	20	12	156	42
KTM40F	Rc 1 1/2	Rc 1 1/4	238	85	70	40	82	130	180	692	186	200	18	280	425	310	616	96	25	12	175	61



Unit : mm,kg

Model	kW	S	D	PR	PY	FA	FB	FS	FC	MH	L	MA	MR	SS	VE	VF	VM	VN	VS	VT	VZ	KL	Weight
KTM50F1/S1	5.5	50A	50A	285	160	130	55	150	230	204	836	211	239	24	324	448	352	690	121	20	12	189	105
	7.5	50A	50A	285	160	130	55	160	230	204	874	230	258	24	324	448	352	690	121	20	12	189	111
KTM50F2/S2 KTM50F3/S3	7.5	50A	50A	285	170	130	55	160	240	204	874	230	258	24	324	448	352	690	121	20	12	189	115
	11	50A	50A	285	170	130	55	169	240	245	1028	302	323	40	368	614	404	878	132	20	15	256	162
	15	50A	50A	285	170	130	55	169	240	245	1028	280	345	40	368	614	404	878	132	20	12	256	177
KTM65F2/S2	15	65A	50A	576	190	160	55	103	240	300	1277	250	345	4	462	835	512	1285	225	30	19	256	303
	18.5	65A	50A	576	190	160	55	103	240	300	1353	292	352	4	462	835	512	1285	225	30	19	335	338
KTM80F/S	22	80A	65A	582	180	170	80	109	280	300	1356	292	352	4	462	835	512	1285	225	30	19	279	372
	30	80A	65A	582	180	170	80	40	280	360	1429	346	371	4	356	950	430	1250	150	18	19	314	498

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Recommendation of Baseplates Dimensions

KTM_N/F Series

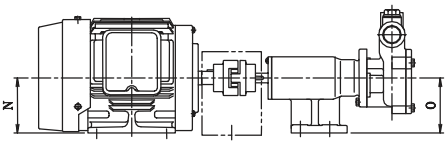
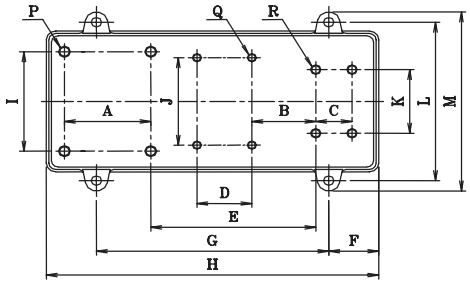


Fig.1



KTM50S/F Series

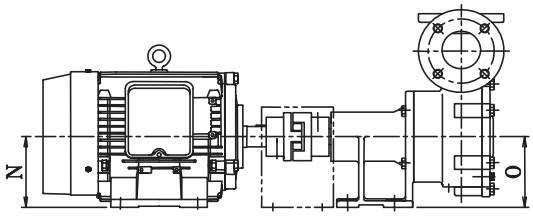
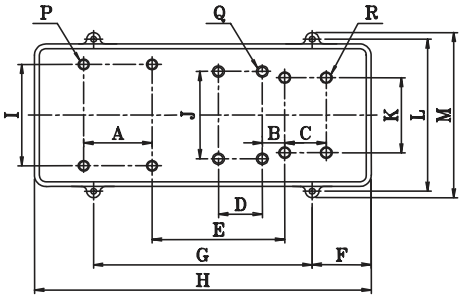


Fig.2



KTM65 & 80S/F Series

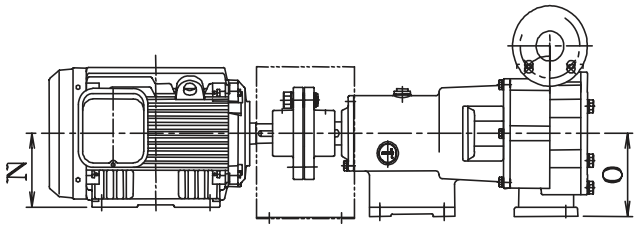
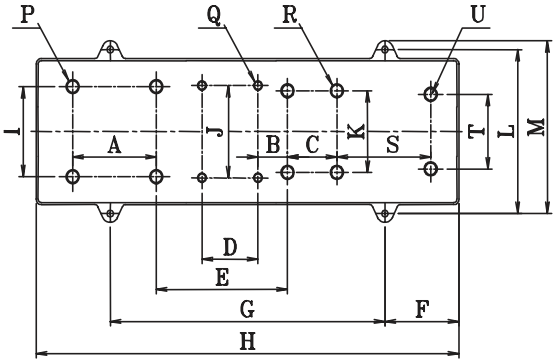


Fig.3

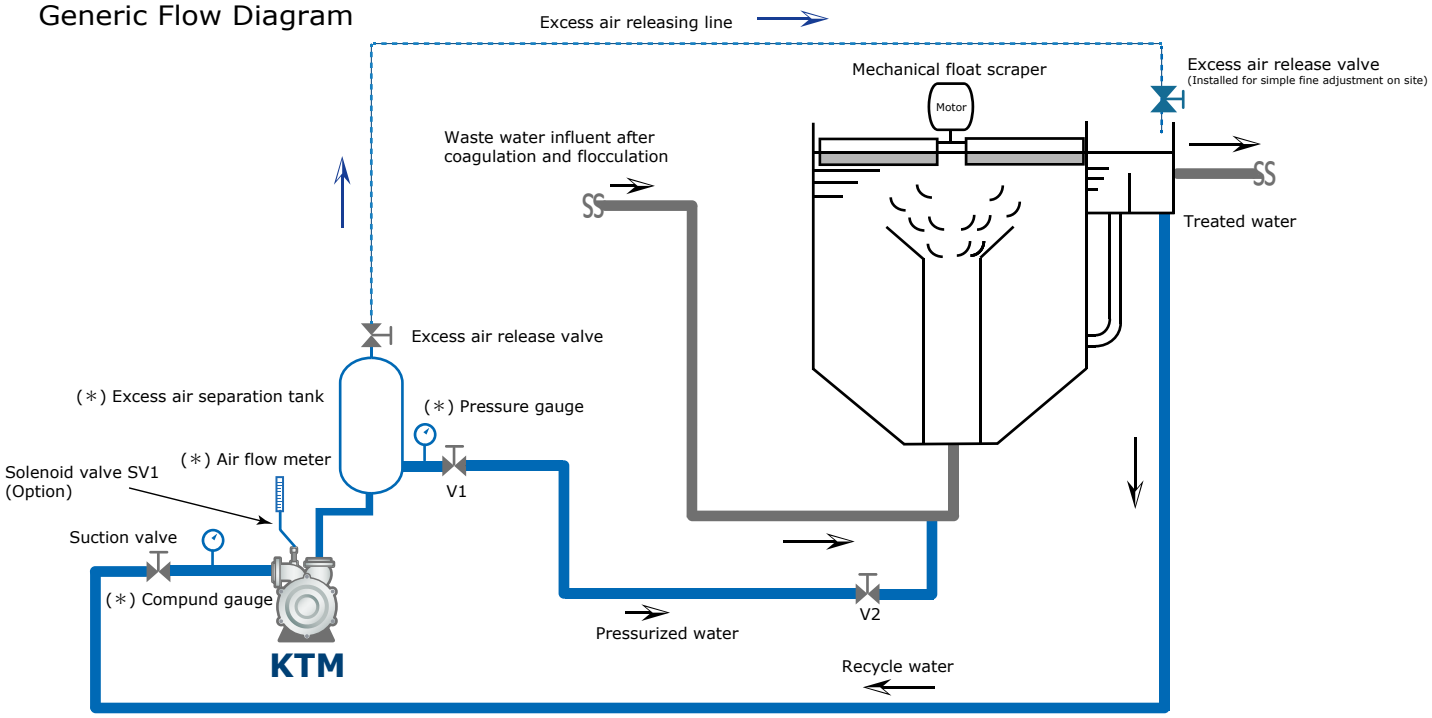


Unit : mm

Model	Figue	kW	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U
KTM20N	Fig. 1	0.75	100	97	42	-	191	58	269	385	125	90	80	199	225	80	80	4-M8	2-M6	4-M10	-	-	-
KTM25N		1.5	125	90	42	-	211	65	300	430	140	120	80	214	240	90	80	4-M8	2-M8	4-M10	-	-	-
KTM32N		2.2																					
KTM40N		3.7	140	70	58	90	254	96	425	616	190	130	100	280	310	112	90	4-M10	4-M8	4-M10	-	-	-
KTM50S1	Fig.2	5.5	140	48	85	90	272	121	448	690	216	178	160	324	352	132	132	4-M10	4-M8	4-M12	-	-	-
		7.5	178	48	85	90	272	121	448	690	216	178	160	324	352	132	132	4-M10	4-M8	4-M12	-	-	-
KTM50S2 KTM50S3		7.5	178	48	85	90	272	121	448	690	216	178	160	324	352	132	132	4-M10	4-M8	4-M12	-	-	-
		11	210	45	85	160	337	132	614	878	254	190	160	368	404	160	132	4-M12	4-M8	4-M12	-	-	-
		15	254	45	85	160	337	132	614	878	254	190	160	368	404	160	132	4-M12	4-M8	4-M12	-	-	-
KTM65S2	Fig.3	15	254	90	150	170	399	225	835	1285	254	260	230	462	512	160	180	4-M12	4-M8	4-M12	285	210	2-M12
		18.5	241	90	150	170	412	225	835	1285	279	260	230	462	512	180	180	4-M12	4-M8	4-M12	285	210	2-M12
KTM80S		22	241	90	150	170	412	225	835	1285	279	260	230	462	512	180	180	4-M12	4-M8	4-M12	300	270	2-M12
		30	279	95	150	170	412	150	950	1250	279	260	230	356	430	180	180	4-M12	4-M8	4-M12	300	270	2-M12

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Generic Flow Diagram



(＊) Please refer to the catalog for more details

Initial Adjustments

1. All of the necessary valves, gauges, and the air parameter should be installed properly before operation.
2. Prime water into the KTM.
2. Inching test - Check whether the KTM is rotating smoothly in the prescribed direction.
3. Suction and discharge valves should be fully opened and the air parameter or rotameter should be fully closed before turning on the power.
4. After checking that the KTM is operating correctly, close the discharge valve as to lift the discharge pressure up to 0.4MPa (4 Bar / 58psi).
5. Close the suction valve as to set the suction pressure to a negative pressure range within -0.02 to -0.03MPa (-0.2 to -0.3 Bar / -3 to -4.5psi).
6. Open the air valve of the air flow meter or rotameter as to drawn in the prescribed air flow into the KTM. Refer to page 3 for the recommended air capacity for each model.
7. Slightly open the "excess air release valve" as to release surplus air with a small amount of water from the top of the separation tank back to the source of the treated water tank. Optimal water flow rate is approximately 0.5 L/min.
8. If the KTM and separation tank are installed far from the flotation tank, install a valve (V2) close to the dosing point at the flotation tank. In this case adjust the discharge pressure at this point and fully open V1 during operation.
9. For the system where the KTM has negative suction head, install a solenoid valve (SV1) at the air drawn-in line between flow meter or rotameter and the KTM. Set the air valve to open with approximately a 60 second delay after starting the operation of KTM as to let water fully prime the KTM before air injection. Set that valve to close when operation is stopped.
10. To simplify adjustments of the surplus air capacity, another "excess air release valve" is recommended to be installed close to the source of the treated water tank.

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User Manual

KARYU turbo mixer

KTM__N Series

KTM15N. KTM20N. KTM25N. KTM32N. KTM40N

Thank you for purchasing the KARYU turbo mixer. Please read the user manual completely before using the KARYU turbo mixer and use KARYU turbo mixer correctly and safely. After reading the manual, please store in the place so that it is accessible easily.
Please ensure that the person using this can access this manual easily.

In order for you to use this KARYU turbo mixer safely,
The usage method and the points to take care are described in this user manual. Since it may result in unexpected problems if used in a wrong manner, please read the manual carefully before installation, wiring, operation, maintenance and inspection of the KARYU turbo mixer and then use correctly.

In order to prevent harm, injury or any damage to the user and the people in the vicinity in a precautionary way, the safety instructions are classified into ranks like [Warning] and [Note].

Warning	**In case of wrong usage, it may result in the death or serious injury of the user or the persons nearby. Hence, please understand the contents of this manual completely and please follow the instructions exactly.**
Note	**In case of wrong usage, it may result in the medium or slight wound to the user or the persons nearby, or in the physical damage. Hence, please understand the contents of this manual completely and please follow the instructions exactly.**

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1. Introduction

Thank you very much for using the KARYU turbo mixer (KTM). We have taken utmost care while manufacturing so that you can use this KTM safely. However, if this is used in a wrong manner, it may result in unexpected accident. Please use the KTM carefully and correctly by referring to this manual.

2. Unpacking check

Once you receive the KTM, please check the following.
1) Confirm whether the model number printed on the nameplate is the same as the one you had ordered for.
2) Confirm whether no damages have occurred during the transportation and whether nuts and bolts are not loosened.
3) Confirm whether the coupling can be turned by hand.
4) Confirm that all accessories and spare parts exist.
If there is any problem, please contact the seller by explicitly mentioning the model number printed on the nameplate and the manufacturing number (serial number).

3. Installation

3-1 Place of installation

1) Please install at the place with surrounding temperature within 40℃, humidity within 95% and altitude within 1,000 m. (These conditions may differ based on the specifications of the motor. Please contact the seller or us, if any condition is exceeded.)
2) Select a place with good air circulation and with less dust as much as possible.
3) Select the place where maintenance and inspection is possible.
4) Please use a fence or enclosure to ensure that non-related persons do not access the KTM.
5) Please install the KTM in a place near to the water source so that the length of the suction pipe is short.

3-2 Foundation work

1) Since the Foundation concrete sinks or inclines if the ground is weak, please see that there is sufficient area and volume to withstand the mass of the KTM. Also, depth should be sufficient enough to prevent frost heaving in the winter.
2) In order to embed the foundation bolt into the concrete, make the hole with enough space based on the drawing or the actual bolt itself, and see that the surface is as horizontal as possible.
3) Start the installation work after confirming that the concrete has dried up sufficiently.

3-3 Installation position

1) Once the foundation concrete gets dried and hardened, place the KTM on it.
2) Please check whether the common bed is horizontal or not using the spirit level, and if necessary, please insert a wedge (Taper liner) underneath the common bed and make it horizontal.
3) Once these adjustments are over, please pour the mortar below the common bed and strengthen (harden) it. During this, please ensure that the mortar is distributed evenly below the common bed and there are no cavities inside.
4) Once the mortar gets dried up, please tighten the foundation bolt evenly so that it is not tightened on one side only.

3-4 Plumbing work

1) Suction piping

(1) Please restrict the curves of the suction pipe to the minimum and connect to the water tank keeping the distance at the minimum. Also, for the KTM inlet, use a straight pipe whose length is more than 6 times of the inlet diameter. However, if the above conditions cannot be met due to the restrictions at the place of installation, please implement the piping by carefully considering NPSH.

(2) Please ensure that the diameter of the suction pipe is as large as possible. (At least same as the Inlet diameter)

(3) If the water level of the water tank is below the KTM, fix the foot valve at the bottom of the suction line. Also, fix the suction pipe in such a way that, the end of the suction pipe is inserted at the depth of more than 4 times of the inlet diameter from the water level, and more than 2 times the diameter from the bottom of the tank.

(4) Upgrade the suction pipe towards the KTM (1/100 or more) so that air lock is not created. Also, please fix the coupling of the suction pipe with utmost care so that air does not enter it.

(5) Please note that if particles like threading cuts, welding slag, sand etc. are inside the pipe, then the same would

enter the KTM and this would reduce the life of the KTM considerably. We recommend you to fix strainer (around 100 meshes). Please clean this strainer neatly.

NOTE: (6) The gate valve attached to the suction side must be fully opened when starting up the KTM.

(7) Please restrict the curves of the suction pipe to the minimum and connect to the water tank keeping the distance at the minimum. In case of high water temperature or if suction head is high or in case of volatile liquid etc. at the inlet, if the piping is done without considering NPSH, the KTM cannot lift the water properly or the KTM may run unstably and the KTM may get damaged. In some cases, pushing may be necessary if water temperature is high or the liquid is volatile etc.

(8) We recommend the fixing of the sluice valve to enable convenient disassembling and inspection in case of flowing and pushing, at the inlet.

2) Discharge piping

(1) Implement the discharge piping so that the piping length from the discharge outlet is minimum. If you cannot avoid creation of air locks, please fix air vent valves at such positions. However, the air vent valves cannot be fixed at places with negative pressures such as in Suction pipe. In such case, the air would be sucked in.

NOTE: (2) In case of KTM, if the discharge pressure increases, then load of the motor also increases. Hence, if due to some reason the discharge outlet is closed, the motor power increases beyond limit. If the motor is under operation in such situation for a long time, the KTM temperature increases and this may lead to complete burn out of the motor. To avoid this, please fix the relief valve in between the KTM and the sluice valve to ensure that the discharge pressure does not exceed the specified limits. With this, the KTM can be operated in safe manner.

(3) If there is danger of the occurrence of the water hammer, you are needed to use the check valve to close rapidly or other measures to avoid it.

NOTE 3) Other instructions for piping, plumbing

1) Support the piping enough in order to ensure that there is no unnecessary load on the KTM suction inlet and discharge outlet. If piping is done when the position of the KTM suction inlet and the discharge outlet does no match with the position of the pipe, there will be high force on the KTM and this may result in the breakage of the suction inlet or discharge outlet and this results in reduced life of the KTM.

2) Implement the discharge piping in such a way that it is an erect piping at least 700 mm away from the discharge outlet. Otherwise the self-primed air does not get discharged, leading the long duration for the discharge of water and hence water does not get pumped.

3-5 Centering (Fig-1 Refer Coupling tolerance value)

The KTM would be delivered out of the factory after adjusting the centering perfectly. However, please ensure that the bed does not get twisted while tightening the foundation bolt during the installation, by inserting wedge under the bed and adjusting. Then make sure that the coupling circumference lies within the range as shown in the Fig-1. If you have purchased the KTM without the motor and you wish to connect to the motor at the place of installation, insert the liner below the motor and implement the centering in such a way that the tolerance is within the limits as shown in the Fig-1.

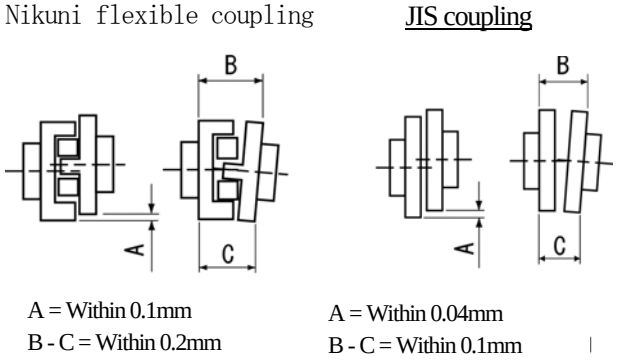


Fig-1 Tolerance value of Coupling

WARNING Remove the Coupling cover during centering. However, fix it back without fail before operation.

3-6 Electrical wiring

WARNING Please go through the Motor user manual, Electrical equipments technical standards and extension regulations and the follow them perfectly during the installation of Electric power equipments for the Motor and during the wiring. Please avoid the incomplete wiring work, earthing done by unqualified personnel since it is not only illegal but also very dangerous. Also, in order to prevent electric shock accidents, the law forces the use of electric leakage breaker. Further, please install the Motor protection device in order to prevent the burn out due to motor overload etc.

4. Operation

4-1 Attention when starting

WARNING

1) Please confirm that the vicinity of the body of rotation is not dangerous when it drives.

2) If the electric power switch and the KTM are far from each other, then please do this work with the help of 1 or more persons and confirm that the region around the body of rotation is not dangerous.

NOTE

3) Confirm that there is no problem with rotation direction and the operation (no vibration and no noise) by switching ON/Off of the switch 1-2 times(inching). If everything is fine, then proceed for the continuous operation. If the rotation is in the opposite direction, do the wire connection so that the rotation direction is corrected.

4) Please check whether there is no water leakage, air entry at each plug, cock, packing material, pipe connection joints etc.

4-2 Operating Procedure

1) Rotate the KTM by hand to check if it rotates lightly. If it does not move smoothly, the vanes may be interfered.

2) Be sure to prime the KTM to fill the pump with water. If operated without priming, the KTM will go out of order.
Fully open the suction pressure control valve (V1) and discharge pressure control valve (V2). (They should never be fully closed.)
Fully close the airflow control knob of the airflow meter (Q).

NOTE : 3) Be sure to turn on/off (inch) the switch once or twice to check the KTM for its rotating direction and any abnormalities (vibrations, noise, etc.), and then, start continuous operation. If it rotates in the reverse direction, reconnect the wires so that it will rotate in the forward direction.

4) Start the KTM.

5) Seeing the discharge pressure gauge (PG), close the discharge pressure control valve (V2) gradually to adjust to the specified pressure.

6) Seeing the compound gauge (CPG), close the suction pressure control valve (V1) gradually to adjust to approx. –0.04 to –0.05MPa-G.

7) Open the airflow meter's (Q) knob to inject the air by approx. 5 to 10 % of a discharge rate. Too high an air injection rate will result in idling, causing a mechanical leakage, etc.

8) If the suction pressure is raised to –0.02MPa-G by injecting the air, close the suction pressure control valve (V1) gradually. If, as a result, the discharge pressure is lowered to –0.02 to –0.03MPa-G from the specified pressure, close the discharge pressure control valve (V2) gradually to finely adjust to the specified pressure, and the air injection rate as well.

9) Solenoid valve ((SV) when attached to the suction nozzle (N)): Option
Purpose: Prevention of counterflow of the fluid to the airflow meter (Q) when the pump is stopping.
Control: This has been set to Open at the time of power-on. In case of forcing, ensure that the solenoid valve will be opened (ON) by turning on the system, interlocked with the motor, and closed (OFF) by turning off the system. In case of suction, however, when starting the KTM, use the solenoid valve in combination with a flow switch so that it will be opened (ON) after pumping has been completed, or open it (ON) 30 to 60

seconds after starting the KTM and close it at the same time of stopping the KTM. If the air is injected prior to successful operation of the KTM, pumping will not be performed.

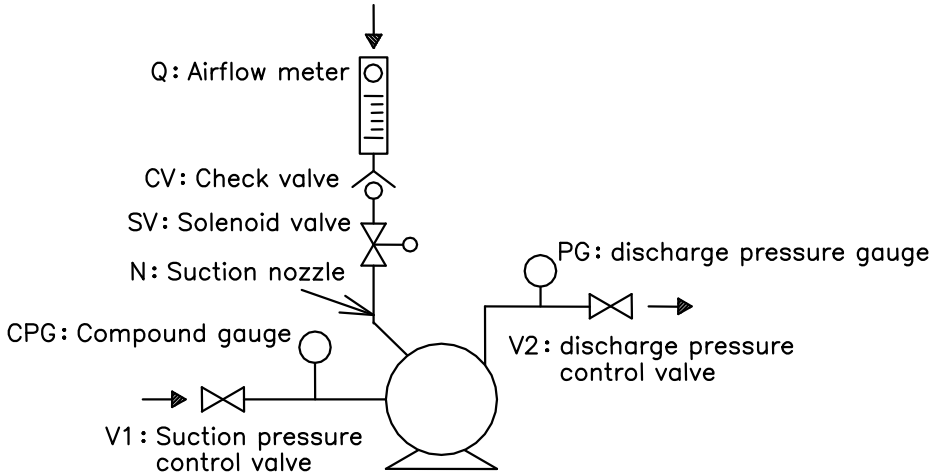


Fig-2 KTM : KARYU turbo mixer

4-3 Attention when driving

WARNING 1) Please do not touch the rotating body to prevent the danger.

2) Check whether the KTM is operating smoothly without vibration and noise.
(The small metallic sound such as Kiiinn… is the characteristic sound of the KTM and it is not an abnormality.)

3) Use the pressure gauge cock and vacuum gauge cock after squeezing in order to protect these instruments.
If they are left open always, the instruments may be damaged due to the water hammering action during ON/OFF of the KTM. In order to measure the pressure of the polluted water, use the instruments with diaphragm.

4) Please pay attention to the pressure, KTM discharge volume, power value, operating sound.
If foreign bodies get clogged up in the Foot valve, Strainer, impeller etc., these values changes suddenly (vibration of the pressure gauge needle, the vibration of the Vacuum Gauge needle, reduction in water level, change in electric current value, abnormal sound) and this enables you to detect the problem at an early stage and also allows you to rectify the problem at an early stage and hence serves as the measure to prevent big accidents

5)Please confirm whether the actual measured values in 4) meets the discharge volume, head, power value being used.
(The pressure gauge displays the value multiplying the head and the specific gravity. Also, if the specific gravity , viscosity of the water is high, the electric current value increases.)

NOTE 6) In order to protect the mechanical seal, use with the discharge head (head) of at least 10 m. If the head is less than 10 m, please contact the dealer or our company. Please avoid the idle run of the KTM.

7) Once the lifetime of the mechanical seal is over, the leakage increases very rapidly. It is strongly recommended to have a spare with you. Please ensure that you run the spare KTM once in a while, in order to ensure that it is in the working condition.

8) If the KTM is operated continuously, the temperature of the shaft bearing increases. However, if it can be touched by hand, then there is no concern.
(The tolerable increase in temperature of the shaft bearing on the surface of the bracket is within surrounding temperature + 40 ℃ and the maximum temperature is within 75 ℃)

NOTE 9) Do not loosen the plugs, bolts or nuts during the operation. This may result in scattering of the liquid inside the KTM or dislocation of the parts, which is dangerous.

4-4 Stop

Open the discharge adjustment valve completely and switch OFF. If there is a electric power failure during the operation, please switch OFF the power immediately and open the discharge adjustment valve completely.

NOTE Irrespective of the long term stoppage and short-term stoppage, drain out the water completely without fail.

5.Maintenance

5-1 General Precautions

NOTE 1) Before inspecting the KTM, please cutoff the main power without fail. This is to avoid dangers like sudden start of the KTM due to Automatic operation etc.

2) Do not allow persons other than repair technicians to disassemble, repair, renovate etc. This may result in fire ignition, abnormal operations which would be dangerous.

3) Check whether the KTM is operating smoothly without vibrations.

4) Check the water level in the tank and the pressure at the suction inlet.

5) Compare the discharge pressure, power value during the operation with the values printed on the nameplates on the KTM, motor and check the operating load of the KTM.

6) Please note the pressure gauge displays the value, which is the sum of the head and the specific gravity.

7) Open the cock of the pressure gauge, vacuum gauge during the measurement, and close after the measurement. If it were left open always, then the instruments would be damaged due to the abnormal pressure of the water hammer etc. For the measurement of the pressure of the polluted water, measure via U-tube with water (if the pressure is below 0.1 MPa [gauge]) or measure using the instrument with diaphragm.

8) Make notes of the standard control values of the gas injection rate and the compound gauge and pressure gauge indication values to check them periodically.

5-2 Inspection of the Shaft bearing

1) Since Grease leak proof seal is used, it is not necessary to refill the Grease.
The time limit for the change (replacement) of the shaft bearing is 2-3 years if water or dust does not enter into it.

2) Check the shaft bearing temperature during the operation. The tolerable increase in temperature of the shaft bearing on the surface of the bracket is within surrounding temperature + 40℃ and the maximum temperature is within 75℃.

5-3 Inspection of the shaft seal

Mechanical Seal

NOTE 1)After implementing the priming completely, start the operation. Please avoid the idle operation.

2) Confirm that there is no abnormal noise, vibration, and heat generation during the operation.

3) Since the mechanism of the mechanical seal is in such a way that, the tight sealing is achieved by liquid membrane is created on the sliding surfaces due the lubrication of the liquid used, even though there is no leakage visible, there would be a minute leakage of the liquid. Due to this mechanism, the leakage of the liquid may occur due to the nature of the liquid, pressure, operation method etc. If you face liquid leakage problem, you have to either install the drain piping/ drain pan or replace the mechanical seal upon consulting the dealer or our company. (Please refer to Section 8-2 Consumables for the replacement)

5-4 Precautions in the case of long-term stoppage

1) There is a danger of damage to the KTM not only in the case of long-term stoppage of operation, but also due to the freezing of the liquid during winter even if operation is stopped for a short duration. Please completely drain out the liquid of KTM inside.

2) Take care that the finishing of the shaft bearing, motor does not get rusted, when stopping the operation for a long duration.

3) Please follow 4) Operation, when resuming the operation.

5-5 Precautions for Long-term Storage

1) Please implement 2) Unpacking check without fail.

2) Please ensure that finishing of the motor shaft does not get rusted.

3) Please ensure that foreign bodies do not enter into suction inlet and the discharge outlet.

6. Disassembly (Refer Fig-3 KTM_N Cross section diagram)

NOTE Shut off the POWER before disassembling/ assembling the KTM. This is to avoid dangers like sudden start of the KTM due to Automatic operation etc.

1) Detach the cover [103] and the O-ring [123].
2) Loosen the hexagon socket setscrew [164] of the impeller [107] and detach the impeller [107].
   Note : If it is difficult to detach the impeller, then screw in the bolt into the Tap hole of the impeller and then remove the impeller by pulling this bolt.
3) Detach the key [116].
4) Detach the rotating part of the mechanical seal [051]. Please take care that mechanical seal face is not get wounded by the key groove.
5) Detach the body [102]. Please ensure that the fixed part of the mechanical seal [051] is not damaged during this.
6) Detach the fixed part of the mechanical seal [051] from the body [102].
7) Detach the slinger [081].
8) Detach the key [074].
9) Detach the bearing holder [027] and the wave washer [066].
10) Detach the shaft [108].
11) Detach the bearings [021] [022].

This completes the disassembly process.

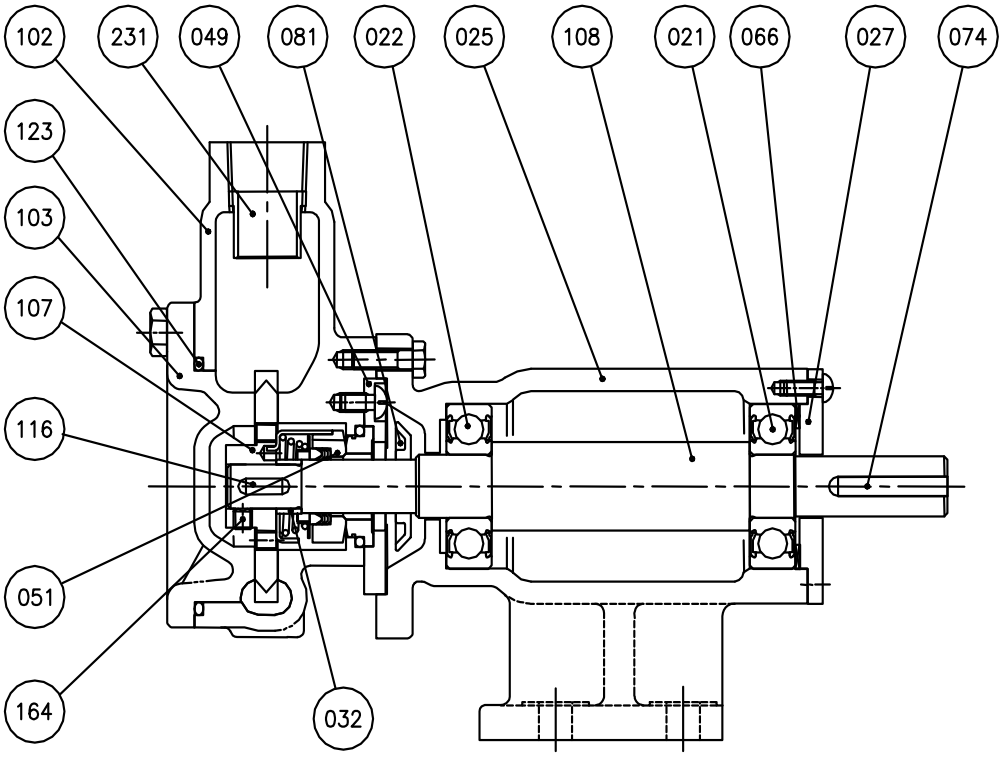
7. Assembly

It is fine if you can assemble in the reverse order of the disassembly. However, please assemble each part perfectly using the following procedure.

1) Implant the bearings [021] and [022] into the shaft [108].
2) Fit the shaft of Step 1 into the bracket [025].
3) Fit the wave washer [066] and the bearing holder [027].
4) Fit the key [074] and the slinger [081].
5) Fit the fixed part of the mechanical seal [051] to the body [102] and then fit to the bracket [025]. Please ensure that the fixed part of the mechanical seal [051] is not damaged during this.
6) Fit the rotating part of the mechanical seal [051]. During this, please ensure that the nail of the coil spring is in 180 ° opposite side of the key groove.
7) Fit the key [116], assemble the impeller [107] and tighten by using the hexagon socket setscrew[164]. Ensure that the impeller does not touch the body [102] and the cover [103]. Adjust the position accordingly.
8) Fit the O-ring [123] to the cover [103] and then fix it to the body [102].

This completes the assembly.
Further, please take care about the following points.

NOTE : Confirm that the coupling turns smoothly by turning it by hand. If the rotation is abnormal or if it does not rotate properly, there is a problem in the parts or the assembly.



049	Mechanical seal holder	103	Cover		
032	Color	102	Body	164	Hexagon socket setscrew
027	Bearing holder	081	Slinger	123	O-ring
025	Bracket	074	Key	116	Key
022	Bearing	066	Wave washer	108	Shaft
021	Bearing	051	Mechanical Seal	107	Impeller
No.	Name	No.	Name	No.	Name

Fig-3 KTM_N Cross section diagram

8. Mounting the Gas Suction Nozzle

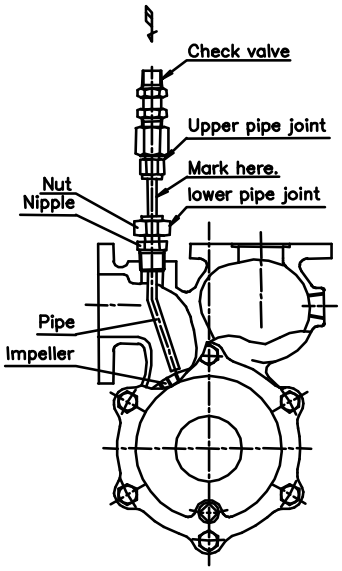


Fig-4 Mounting the Gas Suction Nozzle

1) Loosen the nuts of the lower pipe joint to allow a nipple to freely move.
2) Mark the pipe bending direction on the pipe surface between the upper and lower pipe joints.
3) Wind a sealing tape around the lower pipe joint's nipple of the suction nozzle, insert it into the nozzle junction of the pump, and turn the nipple to firmly fix it.
4) Turn the pipe to align the mark on the pipe surface so that the bend nose (gas discharge port) of the pipe will be directed to the center of the impeller.
5) Tighten the nuts of the lower pipe joint firmly. Make sure that the suction nozzle is not manually rotated.
6) Rotate the motor manually (rotate the shaft end of the motor with a screwdriver) to make sure that the pipe nose of the nozzle is not interfering with the impeller.

9. Ordering of the spare parts and the consumables

1) Order

Please mention the KTM model number and the serial number printed on the nameplate correctly, when ordering the spare parts and the consumables. Also, please specify the Part number and the Part name of the required spare parts and the consumables by referring to the Fig-3 Cross Section diagram.

2) Consumables

Please replace the consumables regularly based on the Table-1 as the indication.

Table-1 Replacement of consumables

Consumable parts	Symptom of consumption	Replacement time
Mechanical seal	Increase in liquid leakage	Once in a year (Note 1)
Shaft coupling rubber	If the rubber deteriorates, wears out, abrades on one side, this may result in vibration and noise.	Once in an year
Shaft bearing, Bearings	Noise becomes severe. Abnormal sound is generated (Note 2)	Once in 2-3 years
Gasket, O-ring	-	During disassembly inspection

(Note 1) The average replacement frequency of the mechanical seal is 1-2 years. However, it varies depending on the usage. (Refer 5-3.3)

(Note 2) In case of such symptom, even other parts are damaged.

10. Troubleshooting (Cause and Measure)

1) Trouble during Startup

Symptom	Cause	Countermeasure
. Motor does not rotate	. Electrical power related problem	Inspect and repair
. Motor growls and does not rotate	. Motor breakdown	Disassemble, inspect and then repair
	. Rotating parts touch something else	Get it repaired by the manufacturer
	. Rotating part is rusted	
	. Rotating part is in seizure	
	. Foreign body clogged in the rotating part	

2) Trouble related to Pumping

Symptom	Cause	Countermeasure
Cannot pump the water Specified discharge volume, specified head not met Water is pumped initially, but stops immediately	Water priming is not done	Do water priming
	Sluice valve is closed and partially open	Open the valve completely
	Actual head is more than the head	Reduce the actual head
	Suction lift is too much for this KTM	Reduce the suction lift
	Air vent valve is closed	Open the air vent valve
	Suction pipe end is not submerged in the water	Immerse the suction pipe end into the water
	Direction of rotation is reverse	Correct the wiring, and confirm the direction using the arrow mark on the KTM
	Operating under 50Hz instead of 60Hz	Adjust to the specified rotation speed
	Number of poles in the motor is different	Change the motor
	Voltage drop	Supply the correct voltage
	Strainer or the foot valve is blocked	Remove the foreign bodies
	Pipe is blocked	Remove the foreign bodies
	Air is being sucked	Inspect the suction pipe, shaft seal part and repair accor dingly
	Leakage in the discharge pipe	Inspect and repair
	Horizontal pipe is very long	Reduce the length
	Impeller is corroded	Replace the impeller
	Impeller is worn out	Get it repaired by the manufacturer Check the body also
	Cavitations has occurred	Improve the suction piping
	Too much pressure loss in piping	Reduce
	Air is accumulated (locked) inside the dischar ge pipe	Provide air vent
	Entrained air from the Gland packing part	Close the gland packing Inject water into the gland

3) Overload problems

Symptom	Cause	Countermeasure
Overload	Operating under 50Hz instead of 60Hz	Adjust to the specified rotation speed
	Number of poles in the motor is different	Change the motor
	Voltage drop	Supply the correct voltage
	Centering of the shaft coupling is not done	Readjust the centering
	Foreign bodies have entered into the internal portion of the KTM	Remove the foreign bodies
	Head is very high and discharge flow volume is very less	Open the discharge valve
	Shaft bearing is damaged	Replace the shaft bearing
	Rotating parts are touching other things and the shaft is bent	Get it repaired by the manufacturer
	The strainer is blocked	Inspect the strainer and clean it

4) Problems related to Shaft bearing, Shaft seal and others

Symptom	Cause	Countermeasure
Overheat or abnormal noise is generated in the Shaft bearing	Centering is not correct	Redo the centering and adjust correctly
	Shaft bearing is damaged	Replace the shaft bearing
	Shutoff operation for long duration	Stop the shutoff operation
Overleakage of water from the shaft seal portion	Wrong fixture of mechanical seal	Fix correctly
	Mechanical seal is damaged	Replace the mechanical seal
	Shaft is worn out	Replace with new one
	Shaft is bent	Replace with new one
Vibration of the KTM High operating sound	Foundation is incomplete	Repair the foundation
	Installation, centering is defective	Repair the installation and centering status
	Shaft bearing is damaged	Replace the shaft bearing
	Direction of rotation is reverse	Correct the wiring, and confirm the direction using the arrow mark on the KTM
	Rotating parts are touching other things and the shaft (axis) is bent	Get it repaired by the manufacturer
	Cavitations has occurred	Improve the suction piping
	Piping is resonating	Improve the piping Install flexible pipe, vibration isolating rubber cushion
	Shaft coupling rubber is deteriorated, worn out or abraded on one side	Replace the shaft coupling rubber

5) Causes for unstable microbubbles

Symptom	Cause	Countermeasure
Unstable gas-liquid mixing	Descending pipe or arch piping after releasing the discharge pressure	Improve the piping
	Inappropriate air injection rate	Adjust the air injection rate appropriately
	Inappropriate suction/discharge pressure	Adjust the suction/discharge pressure
	Clogged piping after releasing the discharge pressure	Eliminate foreign substances
	Unstable air suction	Insufficient negative load
	Mixed large bubbles	Install a separation tank (option). *1

*1: To generate more stable microbubbles, use a microbubble generator (MBG).

11. Repair and Warranty

In case of repair or maintenance of the product, please contact the seller or our company. We are at your service. For this product, we guarantee our product as per the WARRANTY LETTER FORM as attached.

THE WARRANTY LETTER FORM

Dear Sirs,

WARRANTY OF QUALITY

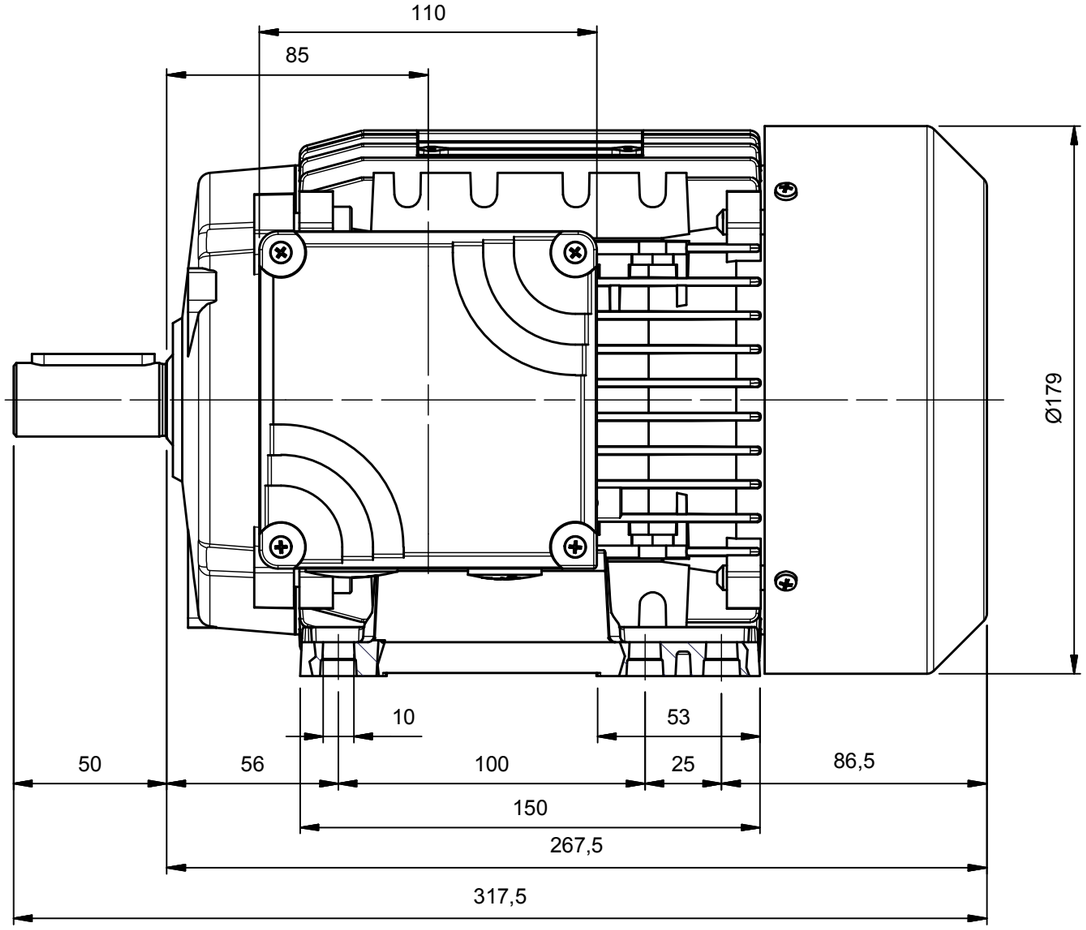
We hereby guarantee the quality of our product supplied to you in the following conditions:

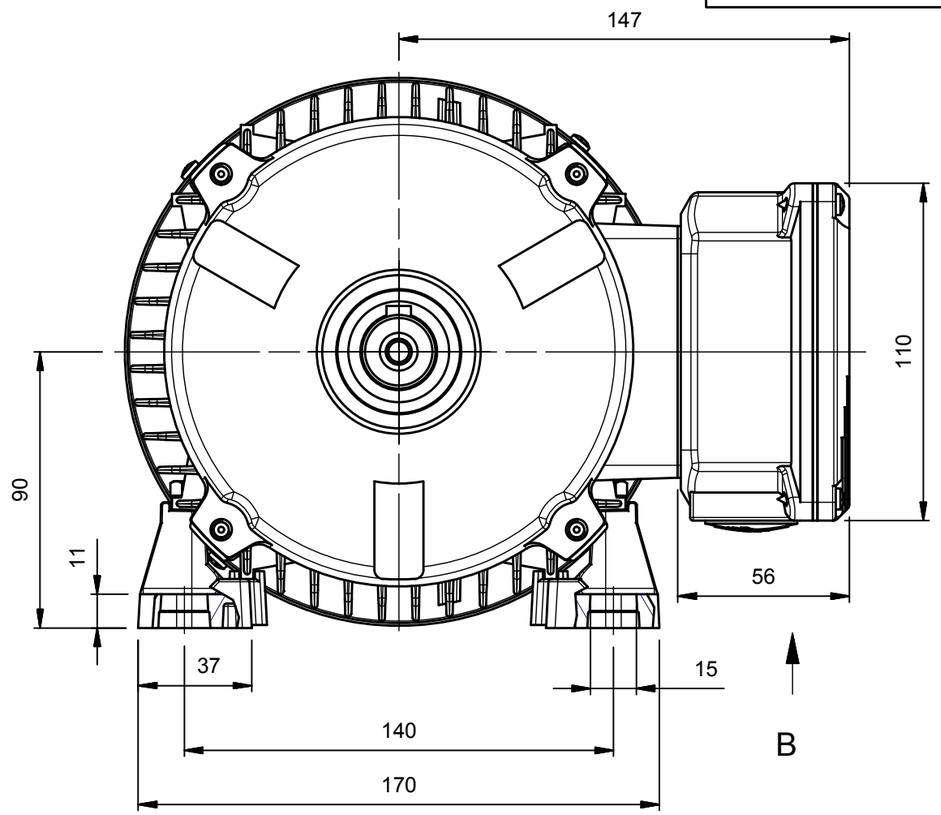
1) Nikuni warrants our product to be free of defects in material and workmanship for a period of one (1) year of our shipment from our factory in Japan, or our factory in China. Any parts which fails during the warranty period due to defective material or workmanship will be replaced without charge, Ex-Go Nikuni factory, provided (a)the claim for warranty is given in writing describing details of the defect within warranty period; (b)Nikuni accept to return of defective part(s) for service: and (c)the defective part(s) is delivered to Nikuni, transportation charge prepaid, in accordance with instruction of Nikuni. In case of difference of opinion of the parties concerned regarding the warranty is applicable or not, the judgement of Nikuni is final.
2) Nikuni's liability is limited to the replacement or repair (at our option) of the defective parts as originally supplied by us. We shall not be liable for any loss, damage, or expenses directly or indirectly related to the use of its products or from any other cause or for consequential damages (including, without limitation, loss of time, inconvenience, and loss of production). It is expressly understood that Nikuni is not responsible for damage or injury caused to other products, machinery, buildings, property, or persons by reason of the installation or use of its products.
3) The warranty shall be null and void if any component of a product has been (a) tampered with, disassembled, repaired or altered (except as may be authorized by Nikuni in writing); (b) subject to misuse, neglect or accident; or (c) used to materials which it was not designed to handle, which may attack or harm the materials used in construction of the product, or which may otherwise harm the operation of the product.
4) The warranty does not cover or apply to (a) the effects of corrosion, abrasion or normal wear; (b) repairs or service adjustments required due to lack of proper maintenance, natural causes or acts of God; or (c) any field expense for service or replacement of parts.
5) This warranty is Nikuni's sole warranty and in lieu of all other warranties, express or implied , which are hereby disclaimed, including in particular all warranties of merchantability or fitness for a particular purpose.

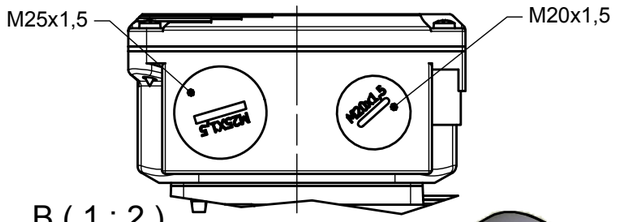
Yours faithfully,

Nikuni Co.,Ltd.

COM 01670

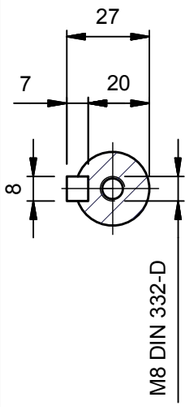


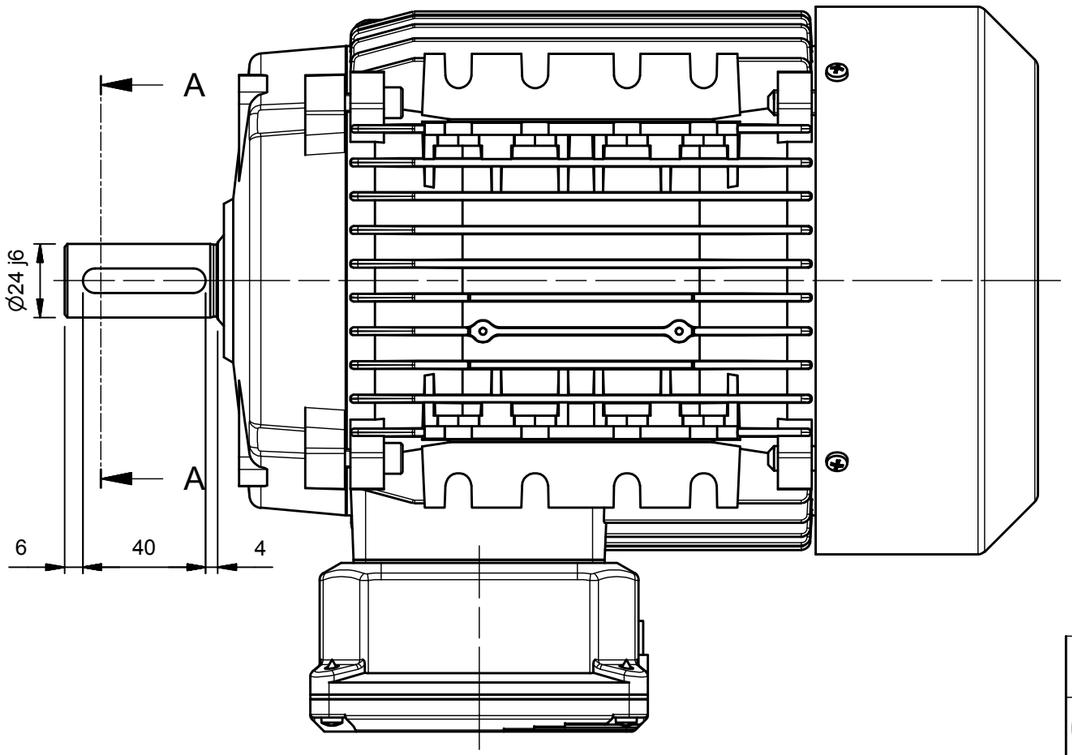


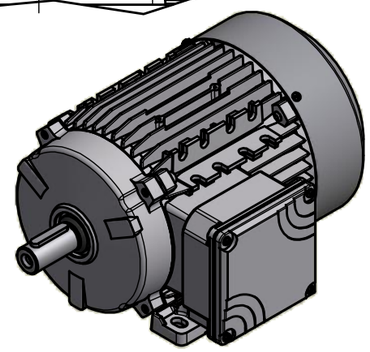


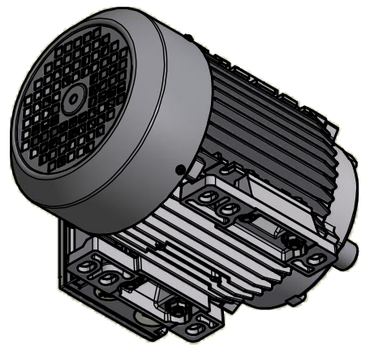
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DENOMINAZIONE \ DESCRIPTION

Complessivo motore tipo AMPH 90S-L B3 destro

N. DIS \ N. DWG	REVISIONE \ REVISION	DATA \ DATE
COM 01670	00	21/07/2010

La LAFERT S.p.A. si riserva a termini di legge la proprietà del presente disegno con divieto di riprodurlo o comunicarlo a terzi senza sua autorizzazione

LAFERTMOTORS

ASYNCHRONOUS MOTORS

THREE-PHASE MOTORS
SINGLE-PHASE MOTORS
BRAKE MOTORS

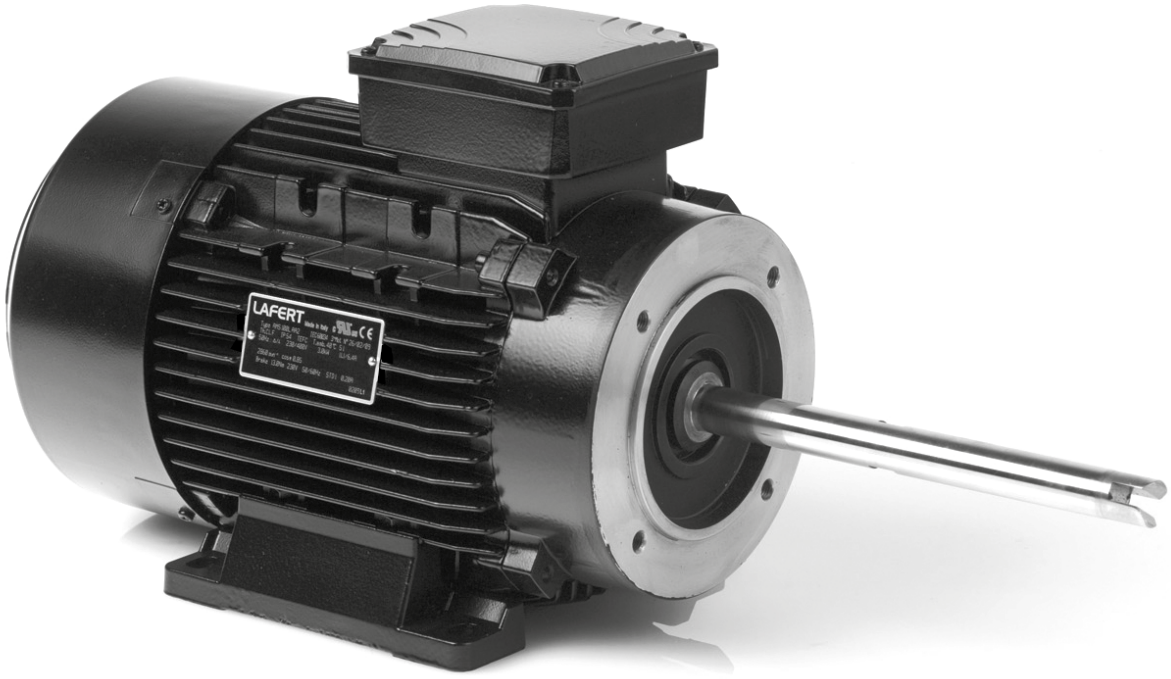


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GENERAL INFORMATION



MISSION

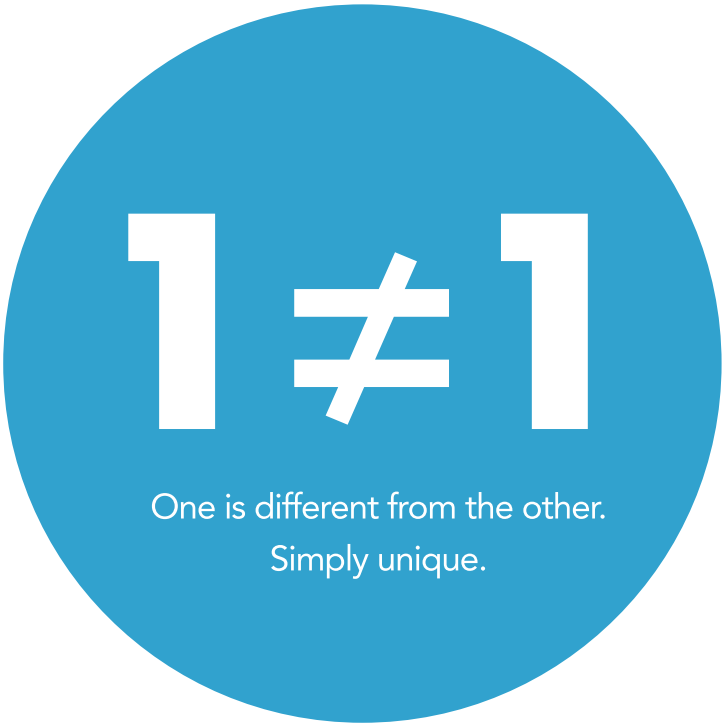
The Lafert Group, a leading European Motor Company, is committed to continuous growth by being the global leading manufacturer of **customised engineered Electric Motors and Drives** with specific focus on Industry Automation, Energy Saving, and Renewables.

The Lafert Group will strive to be the ideal partner in the Electric Motors and Drives industry through focus on meeting specific customer demands. Mutually beneficial partnerships are developed by continuous process improvements utilising state-of-the-art products and techniques by a skilled, motivated and professional workforce.

ONE IS DIFFERENT FROM THE OTHER. SIMPLY UNIQUE.

Lafert design and build customised electric motors with unique characteristics, because the needs of our customers are unique. The control of the whole manufacturing process allows for any aspect of the motor to be modified. This gives the ability to engineer customized motors that fit the final application/work environment for maximum efficiency and reliability.

Lafert leverages over 50 years of experience in partnering with Global Companies from its 12 locations spread across Europe, North America, Asia and Australia.



ASYNCHRONOUS MOTORS, Three-phase Motors Premium Efficiency - IE3 and High Efficiency - IE2 customized to specific applications and OEM requirements

BRAKE MOTORS, Asynchronous Motors, DC and AC brake, for heavy duty applications

HP RANGE, Permanent Magnet Synchronous Motors and Drives, Super Premium Efficiency – IE4/IE5, IPM and SMPM technology, designed for HVAC applications

SERVO MOTORS & DRIVES, Brushless Servomotors and Drives for Industrial Automation

LIFT RANGE, Synchronous Gearless Machines for M.R.L. Elevators

ASYNCHRONOUS MOTORS

HIGH EFFICIENCY, ENERGY SAVING

AC motors have a significant impact on the total energy operation cost for industrial, institutional and commercial buildings. Today, the major factor influencing the motor industry is energy efficiency driven by both increasingly demanding legislation and industry's greater awareness of green issue responsibilities.

Premium Efficiency and High Efficiency Three-phase Motors meeting the requirements of IE3 and IE2 efficiency levels in accordance with IEC 60034-30-1:2014 and test method IEC 60034-2-1;2014.

Premium Efficiency IE3 motors provide compliance with the requirements of EU MEPS for all motors 0.75 to 375kW in force since January 1, 2017 and NEMA EPAct/EISA in force since December 2010 in the USA and January 2011 in Canada.

High Efficiency IE2 motors comply with the EU's IE2 efficiency requirements, that are allowed in the EU market exclusively for motors 0.75 to 375kW put into operation with a variable speed drive (VSD) from January 2017.

IE2 IE3 c UL Energy Verified ENERGY C US



BRAKE MOTORS

EXTENSIVE CONFIGURATION OPTIONS MATCH MOTORS TO APPLICATIONS

The harsher the working environment the greater the demand on engineering standards, and non-standard then becomes the norm. Custom-design and engineering fulfil this need to give the reliability and performance demanded.

The Lafert Brake Motor series is engineered according to the client's specification. Total control over all aspects of production permits **multiple design options** including flanges, shafts, brakes plus optimum resistance to external agents and offshore environments for paints, seals, and magnet surfaces.

The result is a range of AC motors with DC and AC brake, produced entirely in-house which incorporates Lafert's own technical solutions for achieving robustness and performance, combined with the option for application-specific customization.

IE1 IE2 c UL us



HP RANGE

THE IE4 AVAILABLE SOLUTION

High Performance (HP) is a generation of **PM (Permanent Magnet) Synchronous Motors, achieving IE4 and IE5 Super Premium Efficiency** level, that offer improved electrical efficiency at stable and reduced production costs without applying rare earth magnets.

This uniquely engineered product combines the electrical design of Brushless Servomotors with the mechanical design of AC Induction Motors. The result is a compact motor primarily targeted toward HVAC applications in fans, compressors, and blowers, where there is emphasis on reducing the operating cost or weight and size of the motors.

The complete range 0.37 kW to 30 kW are supplied as s**tand-alone motors** (HPS/HPF) to be controlled by a separate drive or as **motor/drive integrated units** (HPI), specifically designed for their energy saving potential.

A separate catalogue is available.

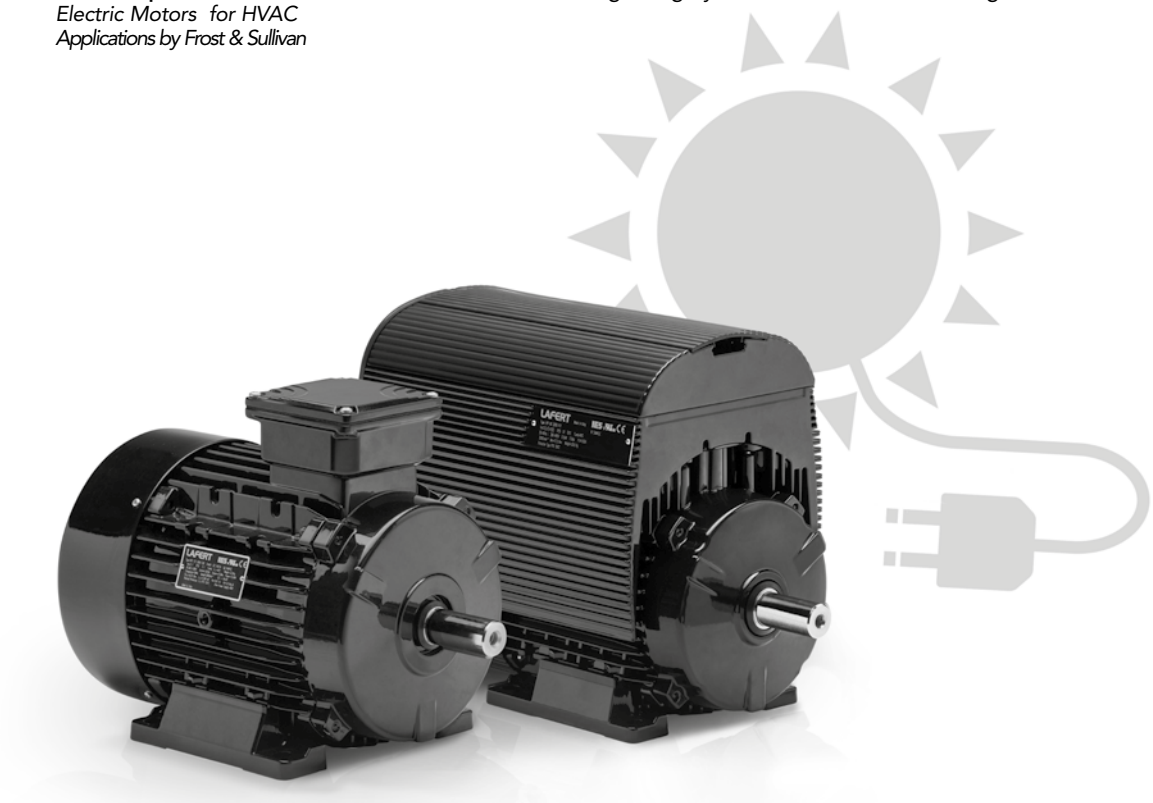
IE4 IE5 c UL us

The Awards

2013 European New Product Innovation Leadership Award:
Electric Motors for HVAC Applications by Frost & Sullivan

2014 AHR Expo Innovation Awards:
Green Building Category

ADI Index Design 2012:
Best Italian design in manufacturing



SERVO MOTORS & DRIVES

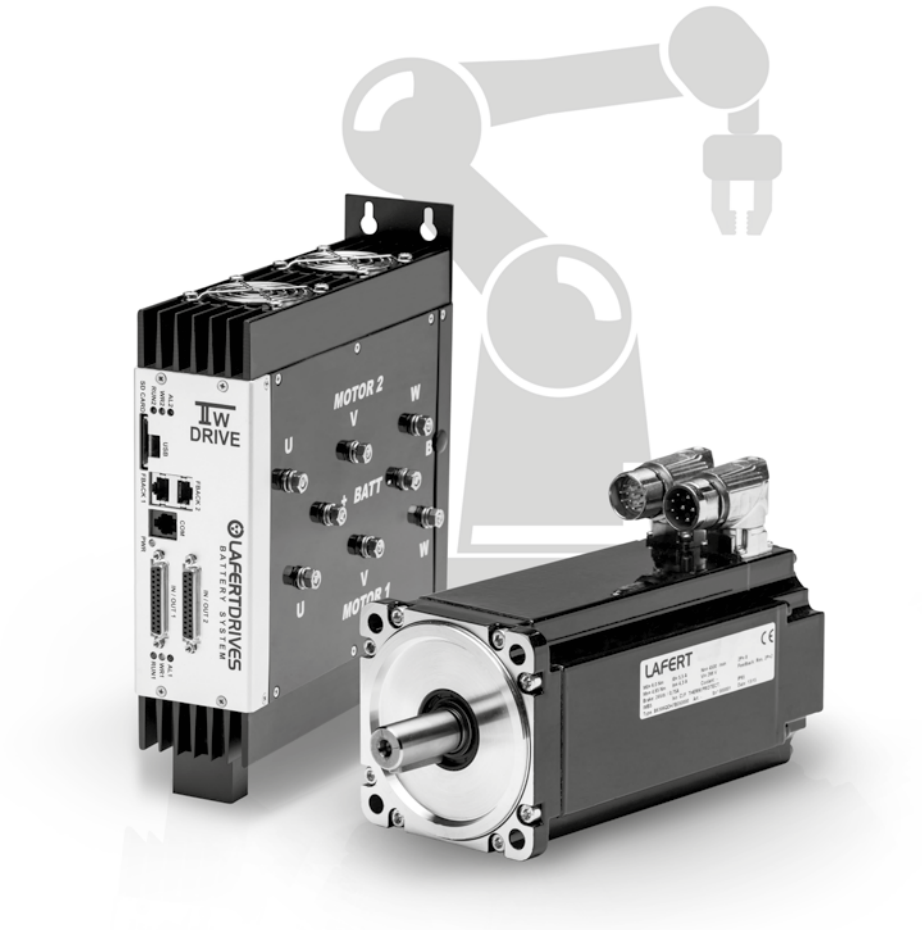
PRECISION IS STANDARD, ONLY THE MOTOR IS CUSTOMIZED!

Lafert know-how in manufacturing permanent magnet motors is combined with the company's on-going drive for excellence and its ability to offer **non-standard solutions**, all of which is invested in this product range. On-going research and development, often in conjunction with customers, continues to bestow superior performance in terms of speed, accuracy and control **to satisfy application needs**.

The range of brushless Servo Motors is one of the most complete available on the market, with nominal torques 0.15 Nm to 390 Nm. Direct Drive Motors cover torques 10 Nm to 500 Nm. The full range is available with **ATEX Certification – Zone 2-22**, for use in potentially explosive atmospheres.

Lafert's Servo Drive range includes standard products and custom solutions that ensure high performance and cost reductions for diverse applications across the fields of **Industrial Automation and battery-powered applications** such as the automated handling of material and/or people.

A separate catalogue is available.



LIFT RANGE

HIGHER & FASTER

Lafert's LIFT range has established the company internationally as one of leading manufacturer.The motor's innovative design, with its protected encoder and no external cabling, offers compactness and low weight, ideal for **home lift systems or new concept M.R.L..**

Its novel **inner rotor and fractional slot gearless technology** are of products of Lafert's in-house design and manufacturing expertise. It provides the highest levels of performance and energy efficiency plus enhanced response to satisfy today's needs and trends in the elevator market i.e. higher speed to greater heights.

Motors with torque up to 850 Nm for systems with a capacity load up to 1,600 kg, machines with TÜV SÜD Certifications, in compliance with the Specifications UNI EN 81-1:1998+A3:2009 and Lifts Directive 2014/33/EC.

A separate catalogue is available.





QUALITY SYSTEM CERTIFICATE

The strictness of our quality control assures the flawless operation and reliability of our products. Our quality is confirmed by the **Certificate ISO 9001:2008** awarded by KIWA-CERMET, a certification body authorized by ACCREDIA.

SAFETY STANDARDS

Our motors comply with the requirements of the International Standard **IEC 60034** for rotating electrical machines as well as with the following European Directives: **Low Voltage Directive** (LV) 2014/35/EC, **Electromagnetic Compatibility Directive** (EMC) 2014/30/EC and **RoHS Directive** 2011/65/EC on the restriction of hazardous substances in electrical and electronic equipment.

All products comply with the requirements of the **Directive Machines** (MD) 2006/42/EC. In accordance with this Directive, induction motors are components and intended solely for integration into other machines. Commissioning is forbidden until conformity of the end-product with this Directive is proved.

CE The CE marking was applied for the first time in 1995.

When operating the motor, the observance of the Regulation EN 60204-1 and safety instructions indicated in our Operating Instructions must be complied with.

c UL us Motors complied with many other international standards are available on request:
Motors approved by UL Underwriters Laboratories Inc.

Motors approved by CSA

Motors approved by CQC (small motors)

EAC Motors approved by SERCONS (Russian Certification Authority in Europe)

EFFICIENCY STANDARDS

IE1 IE2 IE3 Efficiencies are harmonized to the **International Standard IEC 60034-30-1:2014** that states new efficiency levels: Standard Efficiency IE1, High Efficiency IE2 and Premium Efficiency IE3. The efficiency levels are in accordance with the testing method IEC 60034-2-1;2014.

ENERGY c UL us High Efficiency motors according to **EPAct** legislation.
Verified by UL Underwriters Laboratories Inc.

c UL Energy Verified Premium Efficiency motors according to **EISA** Directive.
Verified by UL Environment.

Motors with China Energy Label.



INTERNATIONAL EFFICIENCY LEVELS: IE CODES

The International Standard **IEC 60034-30-1;2014** ensures an international common base for electric motor designing and classification, as well as for national legislative activities, increasing the level of harmonization in **MEPS** (Minimum Energy Performance Standard) all over the world. The IEC 60034-30-1 states the efficiency levels (IE codes) and requirements, provides test conditions and efficiency measurement methods specified in **IEC 60034-2-1;2014**. It doesn't state the motors to be supplied or the minimum efficiency level (MEPS). This depends on any national legislative activities and government targets to save energy and reduce environmental impact.

The efficiency levels provided by the standard for single speed and three-phase motors – brake included - 50 Hz or 50/60 Hz, with rated output 0.75kW to 375kW, 2, 4 or 6 poles, on the basis of continuous duty operation S1 or intermittent periodic duty operation S3 are the following:

• IE1 = Standard Efficiency **• IE2 = High Efficiency** **• IE3 = Premium Efficiency**

EFFICIENCY VALUES FOR 50 HZ ACCORDING TO IEC 60034-30-1:2014

Efficiency standard calculation: IEC 60034-2-1;2014

Output	Standard Efficiency - IE1			High Efficiency - IE2			Premium Efficiency - IE3		
kW	2 poles	4 poles	6 poles	2 poles	4 poles	6 poles	2 poles	4 poles	6 poles
0.12	45.0	50.0	38.3	53.6	59.1	50.6	60.8	64.8	57.7
0.18	52.8	57.0	45.5	60.4	64.7	56.6	65.9	69.9	63.9
0.20	54.6	58.5	47.6	61.9	65.9	58.2	67.2	71.1	65.4
0.25	58.2	61.5	52.1	64.8	68.5	61.6	69.7	73.5	68.6
0.37	63.9	66.0	59.7	69.5	72.7	67.6	73.8	77.3	73.5
0.40	64.9	66.8	61.1	70.4	73.5	68.8	74.6	78.0	74.4
0.55	69.0	70.0	65.8	74.1	77.1	73.1	77.8	80.8	77.2
0.75	72.1	72.1	70.0	77.4	79.6	75.9	80.7	82.5	78.9
1.1	75.0	75.0	72.9	79.6	81.4	78.1	82.7	84.1	81.0
1.5	77.2	77.2	75.2	81.3	82.8	79.8	84.2	85.3	82.5
2.2	79.7	79.7	77.7	83.2	84.3	81.8	85.9	86.7	84.3
3	81.5	81.5	79.7	84.6	85.5	83.3	87.1	87.7	85.6
4	83.1	83.1	81.4	85.8	86.6	84.6	88.1	88.6	86.8
5.5	84.7	84.7	83.1	87.0	87.7	86.0	89.2	89.6	88.0
7.5	86.0	86.0	84.7	88.1	88.7	87.2	90.1	90.4	89.1
11	87.6	87.6	86.4	89.4	89.8	88.7	91.2	91.4	90.3
15	88.7	88.7	87.7	90.3	90.6	89.7	91.9	92.1	91.2
18.5	89.3	89.3	88.6	90.9	91.2	90.4	92.4	92.6	91.7
22	89.9	89.9	89.2	91.3	91.6	90.9	92.7	93.0	92.2
30	90.7	90.7	90.2	92.0	92.3	91.7	93.3	93.6	92.9
37	91.2	91.2	90.8	92.5	92.7	92.2	93.7	93.9	93.3
45	91.7	91.7	91.4	92.9	93.1	92.7	94.0	94.2	93.7
55	92.1	92.1	91.9	93.2	93.5	93.1	94.3	94.6	94.1
75	92.7	92.7	92.6	93.8	94.0	93.7	94.7	95.0	94.6
90	93.0	93.0	92.9	94.1	94.2	94.0	95.0	95.2	94.9
110	93.3	93.3	93.3	94.3	94.5	94.3	95.2	95.4	95.1
132	93.5	93.5	93.5	94.6	94.7	94.6	95.4	95.6	95.4
160	93.7	93.8	93.8	94.8	94.9	94.8	95.6	95.8	95.6
200-375	94.0	94.0	94.0	95.0	95.1	95.0	95.8	96.0	95.8

EFFICIENCY VALUES FOR 60 HZ ACCORDING TO IEC 60034-30-1:2014

Efficiency standard calculation: IEC 60034-2-1;2014

0.12	57.5	62.0	48.0	59.5	64.0	50.5	62.0	66.0	64.0
0.18	62.0	66.0	52.5	64.0	68.0	55.0	65.6	69.5	67.5
0.25	64.0	68.0	57.5	68.0	70.0	59.5	69.5	73.4	71.4
0.37	70.0	70.0	62.0	72.0	72.0	64.0	73.4	78.2	75.3
0.55	72.0	74.0	66.0	74.0	75.5	68.0	76.8	81.1	81.7
0.75	74.0	77.0	72.0	75.5	78.0	73.0	77.0	83.5	82.5
1.1	78.5	79.0	75.0	82.5	84.0	85.5	84.0	86.5	87.5
1.5	81.0	81.5	77.8	84.0	84.0	86.5	85.5	86.5	88.5
2.2	81.5	83.0	78.5	85.5	87.5	87.5	86.5	89.5	89.5
3.7	84.5	85.0	83.5	87.5	87.5	87.5	88.5	89.5	89.5
5.5	86.0	87.0	85.0	88.5	89.5	89.5	89.5	91.7	91.0
7.5	87.5	87.5	86.0	89.5	89.5	89.5	90.2	91.7	91.0
11	87.5	88.5	89.0	90.2	91.0	90.2	91.0	92.4	91.7
15	88.5	89.5	89.5	90.2	91.0	90.2	91.0	93.0	91.7
18.5	89.5	90.5	90.2	91.0	92.4	91.7	91.7	93.6	93.0
22	89.5	91.0	91.0	91.0	92.4	91.7	91.7	93.6	93.0
30	90.2	91.7	91.7	91.7	93.0	93.0	92.4	94.1	94.1
37	91.5	92.4	91.7	92.4	93.0	93.0	93.0	94.5	94.1
45	91.7	93.0	91.7	93.0	93.6	93.6	93.6	95.0	94.5
55	92.4	93.0	92.1	93.0	94.1	93.6	93.6	95.4	94.5
75	93.0	93.2	93.0	93.6	94.5	94.1	94.1	95.4	95.0
90	93.0	93.2	93.0	94.5	94.5	94.1	95.0	95.4	95.0
110	93.0	93.5	94.1	94.5	95.0	95.0	95.0	95.8	95.8
150	94.1	94.5	94.1	95.0	95.0	95.0	95.4	96.2	95.8
185-375	94.1	94.5	94.1	95.4	95.4	95.0	95.8	96.2	95.8

GLOBALLY MINIMUM EFFICIENCY STANDARDS

Country	Product range	Law / Regulation	MEPS	Next steps
EUROPE	400 V ± 10%; 50 Hz 0.75 - 375 kW - 2-6 poles	EC 4/2014 60034-30-1:2014	IE3 or IE2 (only with VSD) motors from 0.75 to 375 kW compulsory 01.01.2017	No further changes expected
SWITZERLAND	400 V ± 10%; 50 Hz 0.75 - 375 kW - 2-6 poles	EC 4/2014 60034-30-1:2014	IE3 or IE2 (only with VSD) motors from 0.75 to 375 kW compulsory 01.01.2017	No further changes expected
TURKEY	400 V ± 10%; 50 Hz 0.75 - 375 kW - 2-6 poles	EC 4/2014 60034-30-1:2014	IE3 or IE2 (only with VSD) motors from 0.75 to 375 kW compulsory 01.01.2017	No further changes expected
RUSSIA	up to 690 V ± 10%; 50 Hz 1 - 400 kW - All poles	GOST R 51677-2000	-	
USA	460 V ± 10%; 60 Hz 1 - 500 HP - 2-8 poles	Nema EPAct EISA 2007	IE3 compulsory 01.06.2016	No further changes expected
CANADA	460 V/575 V ± 10%; 60 Hz 1 - 500 HP - 2-8 poles	CSA C390-10	IE3 compulsory 01.06.2016	No further changes expected
MEXICO	460 V ± 10%; 60 Hz 1 - 200 HP - 2-6 poles	NOM-016-ENER 2010 CSA 390	IE2 compulsory 01.01.2011	Will follow USA model
BRAZIL	220/380/440/460/480 V ± 10%; 60 Hz 0.75 - 250 kW - 2-8 poles	NBR 17094-1:2013 Regulation 553	IE2 compulsory 08.12.2009	It is expected that the scope of regulation will be extended
CHILE	380/400/420/440/460/690 V ± 10%; 50 Hz 0.75 Kw - 7.5 kW - 2-6 poles	NCH 3086	IE2 compulsory 04.01.2011	
AUSTRALIA NEW ZEALAND	415 V/690 V ± 10%; 50 Hz 0.75 - 186 kW - 2-8 poles	AS/NZS 1359.5-2004	IE2 compulsory 01.04.2006	IE3 expected for near future
CHINA	380 V ± 10%; 50 Hz 0.75 - 315 kW - 2-6 poles	GB 18613-2012	IE3 (Grade 2) motors from 7.5 to 375 kW compulsory 01.09.2016	01.09.2017 - IE3 (Grade 2) from 0.75 to 375 kW
HONG KONG	380 V ± 10%; 50 Hz 0.75 - 375 kW - 2-6 poles	Mandatary Buildings Energy Efficiency Bill	IE3 or IE2 (only with VSD) motors from 0.75 to 375 kW compulsory 01.01.2017	No further changes expected
INDIA	415 V/690 V ± 10%; 50 Hz 0.37 - 315 kW - 2-8 poles	IS:12615	IE2 compulsory 01.06.2011	
ISRAEL	400 V ± 10%; 50 Hz 0.75 - 185 kW - 2-8 poles	IS:5289	IE2 compulsory 01.02.2008	
JAPAN	200/220/400/440 V ± 10%; 50/60 Hz 0.2 - 160 kW - 2-6 poles	JIS C 4210 JIS C 4212	IE3 compulsory 01.04.2015	
KOREA	up to 600 V ± 10%; 60 Hz 0.75 - 200 kW - 2-6 poles	IEC 60034-30-1:2014	IE3 motors from 0.75 to 200KW compulsory 01.01.2017	No further changes expected
SINGAPORE	415 V ± 10%; 50 Hz 1.1 - 90 kW - 2-4 poles	SS530:2006	IE2	Only government projects compulsory IE2
SAUDI ARABIA	380 V/ 400 V ± 5%; 60 Hz 0.75 - 375 kW - 2-6 poles	SASO IEC 60034-30:2013	IE3 compulsory 01.01.2017	No further changes expected
UNITED ARAB EMIRATES	400 V ± 10%; 50 Hz 0.75 - 375 kW - 2-6 poles	No regulation	-	

EU – COMMISSION REGULATION EC 4/2014

The **Commission Regulation EC 4/2014** specifies efficiency requirements for three-phase AC motors from 0.75 to 375kW, 2, 4 and 6 poles, and introduces in all countries of the European Community the following MEPS from 1st January 2017:
- motors from 0.75 to 375kW - **IE3 minimum efficiency or IE2 only for motors with variable speed drive (VSD**) and marked with specific label.

Motors to be exclusively exported out of the EEA (machine distributors or manufacturers) may be produced and distributed with IE1 and IE2 efficiency level even after relevant deadline. To that end, a statement will have to be made to the manufacturer.



Regulation-Standard	EC 4/2014 IEC 60034-30-1:2014
Testing Method	IEC 60034-2-1:2014
Product Range	• Three-phase squirrel cage asynchronous motors: 0.75 kW - 375 kW, 2,4 and 6 poles • Continuous duty S1 • Up to 1000 V • 50 Hz or 50/60 Hz
Meps	**Since 01.01.2017** **Energy Efficient (IE3) or (IE2) only with VSD - 0.75 to 375kW**
Exclusions	• Brake Motors • Motors for explosive atmospheres
Future	No further changes are expected in the near future

USA – EISA 2007

The **Energy Independence and Security Act of 2007 (EISA)** was signed into law on Dec 2007 and enforced in Dec 2010 (last revision in 2014).
EISA replaces the previous EPAct (Energy Policy Act 1992) approved by the U.S. Congress in 1992, and sets Nema Super Premium Efficiency **IE3 as minimum level** for general purpose, three-phase AC industrial motors from 1 to 500HP which are manufactured or imported for sale in USA.

The U.S. **Department of Energy (DOE)** is responsible for establishing the rules to implement. The rating plate must be market with the motor's nominal full load efficiency (NEMA nominal efficiency) and the manufacturer's CC-number (compliance certificate number).

Regulation-Standard	EPAct 2007 EISA (NEMA-MG-1)
Testing Method	IEEE 112-B or CSA390-10
Product Range	• Asynchronous three-phase motors: 1HP-500HP, 2,4,6 e 8 poles • Continuous duty S1; up to 600V; 60Hz • Configuration NEMA design A, B and C or IEC design N and H • *Partial motors*
Minimum Efficiency	Since 01.06.2016 **NEMA Premium (IE3)**
Exclusions	• Multi Speed Motors • Not line start motors • Intermittent duty • TEAO enclosures
Future	No further changes are expected in the near future

CANADA - ENERGY EFFICIENCY ACT

Canada has had minimum energy performance standards in place since 1995. These standards were amended in 1997 to include Explosion Proof Motors and Integral Gear Assembly Motors.

The regulation regarding electric motors was progressively revised and, as of June 2016, has a more stringent scope; the **minimum efficiency level** is **IE3**.

The rating plate must show NEMA nominal efficiency at 100% load and the safety certificate marking, such us CSA.

Regulation-Standard	EEA C390-10 (Nema-MG-1)
Testing Method	CSA C390-10
Product Range	• Asynchronous three-phase motors: 1HP-500HP, 2,4,6 e 8 poles • Continuous duty S1; up to 600V; 60Hz • Configuration NEMA design A, B and C or IEC design N and H • *Partial motors*
Minimum Efficiency	Since 01.06.2016 **NEMA Premium (IE3)**
Exclusions	• Multi Speed Motors • Not line start motors • Intermittent duty • TEAO enclosures
Future	No further changes to the regulations are expected in the near future

AUSTRALIA – MEPS SCHEME

The **Australian MEPS Scheme** was announced in 2001 by the Australian Greenhouse Office (AGO), and was revised in 2006. All motors covered by the scheme that will be sold in the Australian and New Zealand markets must be registered in a National online database system, www.energyrating.gov.au/appsearch/motors.asp.

Standards AS/NZS 1359,5:2004 stipulates two efficiency levels: the **compulsory minimum efficiency level IE2** or better, and a **voluntary high efficiency level IE3** or better.

The scheme is monitored by a regulatory body which conducts random testing to ensure compliance. Importing unregistered motors is subject to strict penalties.

Regulation-Standard	AS/NZS 1359,5:2004
Testing Method	Method A (equivalent to IEC60034-2-1:2014 and IEEE112-B) or Method B (equivalent to the old IEC 60034-2)
Product Range	• The phase electric motors: 0.73kW -185kW, 2 to 8 poles, Up to 1100V 50Hz
Minimum Efficiency	Since 2001 (2002 in New Zealand), revision in both countries 2006 **Energy Efficient (IE2)**
Exclusions	• Submersible motors • Integral geared motor systems • Multispeed motors • Motors rated for short duty cycles
Future	IE3 expected for near future

BRAZIL – PBE LABELING PROGRAM

The **PBE Brazilian Labeling Program** has been in force since December 2009 and is overseen by INMETRO. From 2012 the **minimum efficiency level** is **IE2**.
All motors covered by NBR standards must be provided with specific rating plate marking and additional stickers depending on a degree of protection.

All motors must be registered on the INMETRO, website at www.inmetro.gov.br.

Regulation-Standard	553/NBR17094-1
Testing Method	NBR17094
Product Range	• Electric Motors, single speed for continuous duty IEC design N or Nema Design A,B or C, TEFC and Exn 0.75kW-185kW, 2&4 poles; 0.75kW-150kW 6 poles; 0.75kW-110kW 8 poles, Up to 600V 60Hz
Minimum Efficiency	Since 2012 **Energy Efficient (IE2)**
Exclusions	• Servo Motors • Permanent Magnet Motors • IP23 • S2 to S10 according to NBR 7094.2003 • Exd(e), EX(e), DIP
Future	It is expected thet the scope of regulation will be extended

CHINA – ENERGY LABEL SCHEME

The **China Energy Label Scheme** has been mandatory since 01.09.2008 and was revised in 2012. From 01.09.2016 motors must meet **Grade 2 (IE3)** requirements. China has taken a major step towards harmonizing its national standards with IEC standards.

Standard GB/T1032 defining the efficiency measuring method, has been updated and brought in line with IEC 60034-2-1 and the grades are in line with efficiency classes defined in IEC 60034-30-1.

In addition to energy efficiency requirements, low power motors are subject to CCC certification.

Regulation-Standard	GB 18613-2012
Testing Method	IEC 60034-2-1, efficiency grades in line with IEC 60034-30-1 (IE2,IE3)
Product Range	• Three phase electric induction motors, design N, TEFC 0.75kW to 375kW 2 to 6 poles, Up to 1000V 50Hz
Minimum Efficiency	Since 01.09.2016 **Energy Efficient (IE3) - Grade 2 : 7.5-375kW**
Exclusions	• Marine motors • Brake motors • Motors completely integrated into a machine • Motors with electro-magnetic braking incorporated • Motors with a duty type other than S1, or S3 with cyclic factor of 80% or higher • Multispeed motors • Inverter fed motors
Future	IE3 (Grade 2) from 01.09.2017: 0.75kW-375kW

KOREA – MEPS SCHEME

The **Korean MEPS Scheme** was introduced on 1.7.2008 by the Ministry of Commerce, Industry and Energy (MOCIE) and implemented in three steps. Certification is granted by the Korea Energy Management Corporation (KEMCO).

Korean MEPS is identical to **IE3 (60HZ)**. A specific sticker is required and all motors must be registered with the authorities. Motors that do not have the MEPS sticker will not be allowed into Korea.

Regulation-Standard	IEC 60034-30-1
Testing Method	IEC60034-2-1 or IEEE112-B
Product Range	• Three phase induction motor, single speed, foot or flange design A or B 0.75kW-200kW (2,4 poles); 0.75kW-160kW (6 poles) 0.75kW-110kW (8 poles) Up to 600V 60Hz
Minimum Efficiency	Since 01.01.2017 **Energy Effecient (IE3) : 0.75 to 200kW**
Exclusions	• TENV motors • Air over motors • Permanent Magnet motors
Future	No further changes are expected in the near future

REST OF THE WORLD

Many Countries are recognizing the importance of Energy Efficiency in electric motors and its potential economic and environmental impact and are working on developing mandatory minimum energy performance standards to be implemented in the near future.
These standards are expected to follow the IEC60034-30-1 classification.

CONDITIONS OF INSTALLATION

The motors comply with the relevant standards and regulations, especially:

ELECTRICAL	Rating and performance	IEC 60034-1
	Methods for determining losses and efficiency using tests	IEC 60034-2
	Standard method for determing losses and efficiency from tests	IEC 60034-2-1
	Efficiency classes of single speed, three-phase, cage-induction motors (IE-code)	IEC 60034-30-1
	Terminal markings and direction of rotation	IEC 60034-8
	Starting performance	IEC 60034-12
	Standard voltages	IEC 60038
	Insulating materials	IEC 60085
MECHANICAL	Dimensions and output ratings	IEC 60072
	Mounting dimensions and relationship frame sizes-output ratings, IM B3, IM B5, IM B14	IEC 60072
	Cylindrical shaft ends for electric motors	IEC 60072
	Degrees of protection	IEC 60034-5
	Methods of cooling	IEC 60034-6
	Mounting arrangements	IEC 60034-7
	Noise limits	IEC 60034-9
	Mechanical vibration	IEC 60034-14
	Mounting flanges	DIN 42948
	Tolerances of mounting and shaft extensions	DIN 42955
	Classification of environmental conditions	IEC 60721-2-1
	Mechanical vibration; balancing	ISO 8821

The motors are designed for operation at **altitudes ≤ 1000 m** above sea-level and at **ambient temperatures of up to 40° C**. Exceptions are indicated on the rating plate. The motors conform to **degree of protection IP 55** to IEC 60034-5[1)]. Higher protection on request.

The standard design for horizontal mounting is suitable for indoor and protected outdoor installation, climate group **moderate** (see page 21) (temperature of coolant -20° to +40° C). For unprotected outdoor installation or severe climatic conditions (moisture category wet, climate group **worldwide**, extremely dusty site conditions, aggressive industrial atmosphere, danger of storm rain and coastal climate, danger of attack by termites, etc.), as well as vertical mounting, special protective measures are recommended, such as:

- Protective cowl (for vertical shaft-down motors)
- For vertical shaft-up motors additional bearing seal and flange drainage
- Special paint finish
- Treatment of winding with protective moisture-proof varnish
- Anti-condensation heating (possibly winding heating)
- Condensation drain holes

The special measures to be applied have to be agreed with the factory once the conditions of installation have been settled.

The corresponding conditions of installation have to be clearly indicated in the order.

1) IP54 for brake motors AMS and for AMBZ, AMBY from size 63 to 132

ELECTRICAL TOLERANCES

For industrial motors to **EN 60034-1**, certain tolerances must be allowed on guaranteed values, taking into consideration the necessary tolerances for the manufacture of such motors and the materials used. The standard includes the following remarks:

1- It is not intended that guarantees necessarily have to be given for all or any of the items involved. Quotations including guaranteed values subject to tolerances should say so, and the tolerances should be in accordance with the table.
2- Attention is drawn to the different interpretation of the term guarantee. In some countries a distinction is made between guaranteed values and typical or declared values.
3- Where a tolerance is stated in only one direction, the value is not limited in the other direction.

Values for	Tolerance
Efficiency (η) (by indirect determination)	- 0.15 (1 - η) at $P_N \leq 150$ kW - 0.1 (1 - η) at $P_N > 150$ kW
Power factor ($\cos \varphi$)	$\frac{1 - \cos \varphi}{6}$, minimum 0.02, maximum 0.07
Slip (s) (at rated load and at working temperature)	± 20 % of the guaranteed slip at $P_N \geq 1$ kW ± 30 % of the guaranteed slip at $P_N < 1$ kW
Breakaway starting current (I_A) (in the starting circuit envisaged)	+ 20 % of the guaranteed starting current (no lower limit)
Breakaway torque (M_A)	- 15 % and + 25 % of the guaranteed breakaway torque (+ 25 % may be exceeded by agreement)
Pull-up torque (M_S)	- 15 % of the guaranteed value
Pull-out torque (M_K)	- 10 % of the guaranteed value (after allowing for this tolerance, M_K/M_N not less than 1.6)
Moment of inertia (J)	± 10 % of the guaranteed value

MECHANICAL TOLERANCES

According to **IEC 60072-1**, the following tolerances on mechanical dimensions of electric motors are permitted:

Parameter	Code	Tolerance	
Shaft height	H	- up to 250 - over 250	-0.5 mm -1 mm
Diameter of shaft end[1)]	D-DA	- from 11 to 28 mm - from 38 to 48 mm - from 55 to 100 mm	j6 k6 m6
Hub key width	F-FA		h9
Flange spigot	N	- up to 132 - over size 132	j6 h6

1) Centering holes in shaft extension to DIN 332 part 2

DEGREES OF PROTECTION

Degrees of mechanical protection for machines are designated in accordance with **IEC 60034-5** by the letters **IP** and two characteristic numerals.

First numeral: Protection against contact and ingress of foreign bodies

IP	Description
0	No special protection
1	Protection against solid foreign bodies larger than 50 mm (Example: inadvertent contact with the hand)
2	Protection against solid foreign bodies larger than 12 mm (Example: inadvertent contact with the fingers)
3	Protection against solid foreign bodies larger than 2.5 mm (Example: Wires, tools)
4	Protection against solid foreign bodies larger than 1 mm (Example: Wires, bands)
5	Protection against dust (harmful deposits of dust)
6	Complete protection against dust

Second numeral: Protection against ingress of water

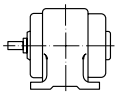
IP	Description
0	No special protection
1	Protection against vertically falling water drops (condensation)
2	Protection against dropping water when inclined by up to 15°
3	Protection against waterspray at up to 60° from vertical
4	Protection against water splashed from any direction
5	Protection against water projected by a nozzle from any direction
6	Protection against heavy seas or water projected in powerful jets
7	Protection when submerged between 0.15 and 1 m.
8	Protection when continuously submerged in water at conditions agreed between the manufacturer and the user

MOUNTING ARRANGEMENTS

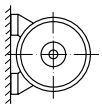
Mounting arrangements for rotating electrical machines are designated according to **IEC 60034-7**, *Code I* (in brackets Code II).

Foot mounting

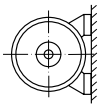
IM B3 (IM 1001)



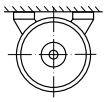
IM B6 (IM 1051)



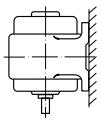
IM B7 (IM 1061)



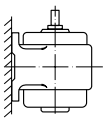
IM B8 (IM 1071)



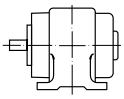
IM V5 (IM 1011)



IM V6 (IM 1031)

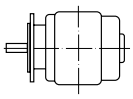


IM B34 (IM 2101)
Flange type C to DIN 42 948 at drive end

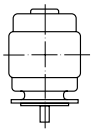


Flange mounting

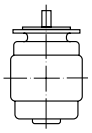
IM B5 (IM 3001)
Flange type A to DIN 42 948 at drive end



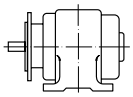
IM V1 (IM 3011)
Flange type A to DIN 42 948 at drive end



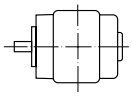
IM V3 (IM 3031)
Flange type A to DIN 42 948 at drive end



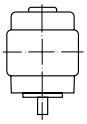
IM B35 (IM 2001)
Flange type A to DIN 42 948 at drive end



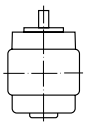
IM B14 (IM 3601)
Flange type C to DIN 42 948 at drive end



IM V18 (IM 3611)
Flange type C to DIN 42 948 at drive end

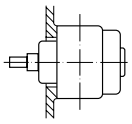


IM V19 (IM 3631)
Flange type C to DIN 42 948 at drive end

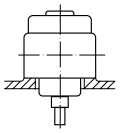


Motors without endshield

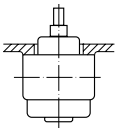
IM B9 (IM 9101)
without endshield and without ball bearings on drive end



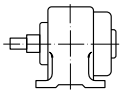
IM V8 (IM 9111)
without endshield and without ball bearings on drive end



IM V9 (IM 9131)
without endshield and without ball bearings on drive end



IM B15 (IM 1201)
without endshield and without ball bearings on drive end



All standard motors can be installed according to the following mounting arrangements:

Frame Size	B3	B5	B35	Based on B5		Based on B3					Based on B35	
				V1	V3	V5	V6	B6	B7	B8	V15	V36
56-160	√	√	√	√	√	√	√	√	√	√	√	√
180-225	√	√	√	√	*	*	*	*	*	*	*	*
250-315	√	*	√	*	*	*	*	*	*	*	*	*

* for high loads refer to us

It is essential to state the desired mounting arrangement when ordering, as the constructive design depends partly on the mounting arrangement.

MATERIALS

Motor parts	Frame size	Material
Motor housing	56 - 160 180 - 315	Aluminium alloy Cast iron
Endshield	56 - 160 180 - 315	Aluminium alloy* Cast iron
Flanged endshield	56 - 160 180 - 315	Aluminium alloy* Cast iron
Fan cover	56 - 112 56 - 112 132 - 315	Plastics Sheet steel (optional) [1)] Sheet steel
Fan	56 - 315 56 - 160	Plastics Aluminium alloy (optional)
Terminal box	56 - 112 56 - 112 132 - 160 180 - 315	Plastics Aluminium alloy (optional) [2)] Aluminium alloy Cast iron

1) Standard for brake motors type AMBY and AMBZ and for AMS 112
2) For three-phase motors only

* Cast iron option for 112-132

PAINT FINISH

NORMAL FINISH

Suitable for climate group **Moderate** to IEC 60721-2-1, e.g. indoor and outdoor installation.
For short periods: up to 100% rel. humidity at temperatures up to +30° C.
Continuously: up to 85% rel. humidity at temperatures up to +25° C.
Standard paint color: RAL 9005.

SPECIAL FINISH K1

Suitable for climate group **Worldwide** to IEC 60721-2-1, e.g. outdoor installation in corrosive chemical and marine atmospheres.
For short periods: up to 100% rel. humidity at temperatures up to +35° C.
Continuously: up to 98% rel. humidity at temperatures up to +30° C.

BEARINGS

CLASSIFICATION OF BEARINGS (STANDARD DESIGN) [1)]

Bearings for standard design have permanent lubrication. Ball bearings to ISO15 (DIN 625).

		IE2 Motors		IE3 Motors	
Frame size	Poles	DE - NDE	Dimension	DE - NDE	Dimension
56	2 - 4	6201-2Z	12x32x10	6201-2Z	12x32x10
63	2 - 4	6202-2Z	15x35x11	6202-2Z	15x35x11
71	2 - 8	6203-2Z	17x40x12	6203-2Z	17x40x12
80	2 - 8	6204-2Z	20x47x14	6204-2Z	20x47x14
90	2 - 8	6205-2Z	25x52x15	6205-2Z	25x52x15
100	2 - 8	6206-2Z	30x62x16	6206-2Z	30x62x16
112	2 - 8	6306-2Z	30x72x19	6306-2Z	30x72x19
132	2 - 8	6208-2Z	40x80x18	6208-2Z	40x80x18
160	2 - 8	6309-2Z	45x100x25	6309-2Z	45x100x25
180	2 - 8	6311 C3	55x120x29	6311 C3	55x120x29
200	2 - 8	6312 C3	60x130x31	6312 C3	60x130x31
225	2 - 8	6313 C3	65x140x33	6313 C3	65x140x33
250	2 - 8	6314 C3	70x150x35	6314 C3	70x150x35
280	2 - 8	6316 C3	80x170x39	6316 C3	80x170x39
315	2	6317 C3	85x180x41	6317 C3	85x180x41
315	4 - 8	NU319 - 6319 C3	95x200x45	NU319 - 6319 C3	95x200x45

[1)] With regard on bearings for special design, consult us

LUBRICATION

Permanent lubrication up to 160 frame
180 frame up with regreasing facility lubrication nipple is a flat M10x1 to DIN 3404

ROLLER BEARINGS

Roller bearings available as an option. Please consult us.

BEARING ARRANGEMENT

Frame size	Bearing DE	Bearing NDE	Spring-loaded
56 - 160 Standard motors	Non-locating bearing	Non-locating bearing	Non-drive end
63 - 160 Brake motors	Non-locating bearing	Locating bearing	Drive end
180 - 315 Standard motors	Locating bearing	Non-locating bearing	Non-drive end

RELUBRICATION INTERVALS

Relubrication intervals for operating temperatures up to 70° C (hours)

	3000 RPM		1500 RPM		1000 RPM		Quantity
Frame Size	Horizontal	Vertical	Horizontal	Vertical	Horizontal	Vertical	gr
180	4.000	2.000	9.000	4.500	13.000	7.500	15
200	3.500	1.750	8.000	4.000	12.000	6.000	20
225	3.000	1.500	7.500	3.750	11.000	5.500	23
250	2.000	1.000	7.000	3.500	10.000	5.000	26
280	1.500	750	6.500	3.250	9.000	4.500	40
315	1.000	500	4.000	2.000	8.000	4.000	55

BELT DRIVE

The data apply only to the normal drive end shaft extension of IM B3 motors with one speed.
Calculation of belt drive:

$$F_R = \frac{19120 \cdot P \cdot k}{D_1 \cdot n}$$

F_R = Radial shaft load in N
P = Output in kW
n = Speed in min^{-1}
D_1 = Pulley diameter in m
k = Belt tension factor, varying with the type of belt, assumed to be approximately:
3-4 for normal flat belt without idler pulley
2-2.5 for normal flat belt with idler pulley
2.2-2.5 for V-belt
For exact data apply to the belt manufacturer.

PERMISSIBLE AXIAL FORCES

Maximum permissible axial forces without additional radial forces*

Frame size	Horizontal shaft				Vertical shaft - force upwards				Vertical shaft - force downwards			
	3000 min $^{-1}$ kN	1500 min $^{-1}$ kN	1000 min $^{-1}$ kN	750 min $^{-1}$ kN	3000 min $^{-1}$ kN	1500 min $^{-1}$ kN	1000 min $^{-1}$ kN	750 min $^{-1}$ kN	3000 min $^{-1}$ kN	1500 min $^{-1}$ kN	1000 min $^{-1}$ kN	750 min $^{-1}$ kN
56	0.16	0.21	-	-	0.18	0.22	-	-	0.15	0.19	-	-
63	0.19	0.26	-	-	0.21	0.28	-	-	0.17	0.24	-	-
71	0.23	0.33	0.33	0.37	0.26	0.35	0.36	0.39	0.21	0.30	0.31	0.34
80	0.32	0.44	0.46	0.50	0.34	0.47	0.48	0.53	0.29	0.41	0.43	0.47
90	0.34	0.48	0.49	0.54	0.38	0.47	0.53	0.58	0.31	0.44	0.46	0.51
100	0.48	0.68	0.70	0.77	0.54	0.74	0.76	0.83	0.43	0.62	0.64	0.71
112	0.48	0.68	0.70	0.77	0.56	0.75	0.77	0.84	0.40	0.60	0.62	0.69
132 S	0.80	1.13	1.16	1.28	1.00	1.32	1.36	1.47	0.61	0.93	0.97	1.08
132 M	0.78	1.09	1.13	1.24	0.99	1.30	1.33	1.45	0.58	0.89	0.92	1.03
160 M	0.84	1.18	1.21	1.33	1.18	1.52	1.56	1.68	0.50	0.83	0.87	0.99
160 L	0.82	1.15	1.18	1.30	1.18	1.51	1.55	1.67	0.46	0.79	0.82	0.94
180	0.82	1.15	1.18	1.30	1.18	1.51	1.55	1.67	0.46	0.79	0.82	0.94
200	0.82	1.15	1.18	1.30	1.18	1.51	1.55	1.67	0.46	0.79	0.82	0.94
225	1.10	1.60	1.90	2.40	2.10	2.60	2.90	3.40	0.30	0.70	1.00	1.50
250	1.00	1.60	2.00	2.50	2.30	2.70	3.20	3.70	0.20	0.60	1.10	1.50
280	1.70	1.90	2.40	2.90	2.90	3.10	3.60	3.70	0.15	0.30	0.80	1.00
315	2.00	-	-	-	3.60	8.00	9.20	7.40	1.00	1.90	2.40	2.90

Values for 50 Hz. For service on 60 Hz, reduce values by 10%

* Consult according to direction of force

PERMISSIBLE RADIAL FORCES

Without additional axial force (Ball bearings)

Nominal life = 20.000 h (Lh10)

F_R = permissible radial force in kN in load point corresponding to half shaft extension

Frame size	3000 min^{-1} kN	1500 min^{-1} kN	1000 min^{-1} kN	750 min^{-1} kN
56	0.34	0.42	-	-
63	0.38	0.48	-	-
71	0.46	0.58	0.67	0.73
80	0.59	0.83	0.86	0.94
90	0.67	0.94	0.97	1.07
100	0.92	1.29	1.33	1.47
112	0.93	1.30	1.34	1.48
132 S	1.35	1.90	1.96	2.15
132 M	1.40	1.97	2.03	2.23
160 M	1.55	2.17	2.23	2.46
160 L	1.58	2.22	2.29	2.52
180 M	3.00	4.44	4.55	4.76
180 L	3.02	4.47	4.58	4.79
200	5.24	6.85	8.01	8.94
225	6.11	7.80	9.09	10.12
250	6.79	8.82	10.31	11.45
280 S	7.76	11.90	13.87	15.44
280 M	7.79	11.99	13.97	15.55
315 S/M	7.02	11.35	13.40	15.13
315 L	7.03	11.37	13.35	15.09

SPECIAL ENDSHIELDS AND FLANGES

Full range of smaller sized and over sized flanges

Frame size	Smaller sized Flange		Over sized Flange	
	IM B5 [1]	IM B14	IM B5	IM B14
56	NA	NA	NA	63
63	56	56	71 [3]	71-80
71	56-63	63	80-90	80-90
80	63-71	63-71	NA	90-100
90 S-L	63-71	71-80	100 [3]	100-112
100 L	71-80	90	NA	132
112 M	80 [2] -90 [2]	90	132 [7]	132
132 S	112 [2]	112	NA	160 [1] [4]
132 M	112	112	160 [4]	160
160 M	NA	132	NA	NA
160 L	NA	132	NA	NA

Possibility to fit over sized bearings

Frame size	IM B3	IM B5	IM B14
56	NA	NA	NA
63	6203-6205	6203	6203-6205
71	6204-6205	6204-6205	6204-6205
80	6205-6206	6205-6206	6205-6206
90 S-L	6206	6206-6308	6206
100 L	6306	6306-6208	6306
112 M	6208	6208	6208
132 S	6308-6309	6308	6308 [4]
132 M	6308-6309	6308-6309	6309
160 M	NA	6310	6310
160 L	NA	6310	6310

For higher output (progressive motor) please consult us

Aluminium endshields and flanges with steel insert

Frame size	Endshield DE	Endshield NDE	IM B5	IM B14
71	A	A	A	NA
80	A	A	A	A
90 S-L	A	A	NA	NA
100 L	A	A	A	NA
112 M	A	A	A	NA
132 S	NA	NA	NA	NA
132 M	NA	NA	A [5]	NA
160 M	NA	NA	NA	NA
160 L	NA	NA	NA	NA

Cast iron endshields and flanges

Frame size	Endshield DE	Endshield NDE	IM B5	IM B14	Regreasing device DE	Regreasing device NDE	Regreasing device IM B5	Regreasing device IM B14
71	NA	NA	NA	NA	NA	NA	NA	NA
80	A [6]	A [6]	NA	NA	NA	NA	NA	NA
90 S-L	A [6]	A [6]	NA	NA	NA	NA	NA	NA
100 L	A [6]	A [6]	NA	NA	NA	NA	NA	NA
112 M	A [6]	A [6]	NA	NA	NA	NA	NA	NA
132 S	A	A	A	A	NA	NA	A	A
132 M	A	A	A	A	A	A	A	A
160 M	A	A	A	A	A	A	A	A
160 L	A	A	A	A	A	A	A	A

A Available NA Not available

1) Not available for all motor ratings; consult us
2) Cast iron endshield with radial slotted holes
3) Not interchangeable with standard execution
4) Cast iron endshield
5) Only with oversized bearing (6308)
6) Special mechanical design
7) Only with oversized bearing (6208)

COOLING

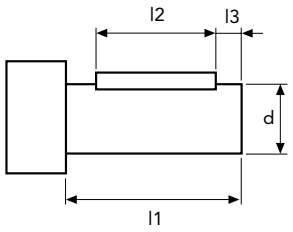
Surface cooling, independent of the direction of rotation.
Motors type AM available without internal fan as type AG, e.g. for installation in a directed air stream (outputs on request).

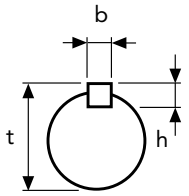
VIBRATION

The amplitude of vibration in electric motors is governed by **EN 60034-14** *Mechanical vibration of rotating electrical machines with shaft heights 56 and larger - methods of measurement and limits.*
Standard motors are designed to vibration grade A (normal). Vibration grade B is available at extra cost.

Rotors are at present dynamically balanced with **half** key fitted as per DIN ISO 8821. Other balancing only on request.
The motors are identified as follows:

"H" or "blank" means balanced with *half key*
"F" means balanced with *full key*
"N" means *no key*





POSITION AND DIMENSIONS OF KEY

Frame size	Poles	d x l1	b x h	l2	l3	t
56		9 x 20	3 x 3	15	2.5	10.2
63		11 x 23	4 x 4	15	4	12.5
71		14 x 30	5 x 5	20	6	16
80		19 x 40	6 x 6	30	6	21.5
90		24 x 50	8 x 7	40	6	27
100		28 x 60	8 x 7	50	6	31
112		28 x 60	8 x 7	50	6	31
132		38 x 80	10 x 8	70	6	41
160		42 x 110	12 x 8	100	6	45
180		48 x 110	14 x 9	90	5	51.5
200		55 x 110	16 x 10	90	5	59
225	2	55 x 110	16 x 10	90	5	59
225	4	60 x 140	18 x 11	110	5	64
250	2	60 x 140	18 x 11	110	5	64
250	4	65 x 140	20 x 11	110	5	74.5
280	2	65 x 140	18 x 11	110	5	69
280	4	75 x 140	20 x 12	140	5	85
315	2	65 x 140	18 x 11	125	5	69
315	4	80 x 170	22 x 14	160	5	85

Dimensions in mm.
For larger shafts in special design the dimensions l2 and l3 are maintained.

ANTI-CONDENSATION HEATER

On request, motors which due to strong temperature fluctuations are exposed to condensation during standstill, can be fitted against surcharge with an anti-condensation heater (space heater).
For supply voltage and heater rating please refer to the following table:

Frame size	Supply voltage (V)	Heater rating per motor (W)
112 - 160	110 or 230	25
180 - 225	110 or 230	50
250 - 280	110 or 230	50
315	110 or 230	75

During operation of the motor, the heating must be switched off.

NOISE

The noise level of an electrical machine is determined by measuring the sound pressure level in accordance with curve A of the sound level meter to EN 60651 and is indicated in dB (A).
The permitted noise levels of electrical machines are fixed in EN 60034-9 (IEC 34-9). The noise level of our motors is well below these limit values.
Air-borne sound measurements are carried out in an anechoic testing chamber to EN 21680-ISO 1680.
Speed corresponding to a mains frequency of 50 Hz and the number of poles.

NOISE LEVELS

The noise values listed below refer to 50 Hz at rated voltage with a tolerance of up to + 3 dB(A). Values for pole-changing motors on request. For 60 Hz supply values are 3-5 dB(A) higher.
Sound pressure level L_{pA} and sound power level L_{WA} for three-phase single-speed motors with dimensions and output ratings to IEC 60072

Frame size	2 poles		4 poles		6 poles		8 poles	
	LWA	LpA	LWA	LpA	LWA	LpA	LWA	LpA
56	57	48	47	38				
63	58	49	47	38				
71	61	52	51	42	49	40		
80	72	60	60	48	52	40	47	35
90	74	62	61	49	58	46	54	42
100	78	66	62	50	62	51	58	46
112	80	68	65	53	65	53	58	46
132	81	72	71	59	69	57	64	52
160	87	74	75	62	71	58	69	56
180	90	77	78	66	74	62	72	60
200	91	78	80	68	77	65	74	62
225	92	80	88	76	80	68	75	64
250	93	81	88	76	80	68	75	64
280	93	82	89	79	83	71	81	70
315	93	82	89	79	83	71	81	70

RATED VOLTAGE

For the rated voltage of the motors, **EN 60034-1** allows a **tolerance of ± 5 %**. According to **IEC 60038**, the mains voltages may have a **tolerance of ± 10 %**.

Therefore the three-phase motors are designed for the following rated voltage ranges (exceptions are shown in the data tables):

Mains voltage to IEC 60038	Rated voltage range of motor
230 V ± 10%	218-242 V ± 5%
400 V ± 10%	380-420 V ± 5%
690 V ± 10%	655-725 V ± 5%

Within the rated motor voltage range, the permissible maximum temperature is not exceeded. When the motors are operated at the limits of the voltage tolerance, the permissible overtemperature of the stator winding may be exceeded by 10 K.

Nameplates are marked with the maximum rated currents within the stated voltage ranges.

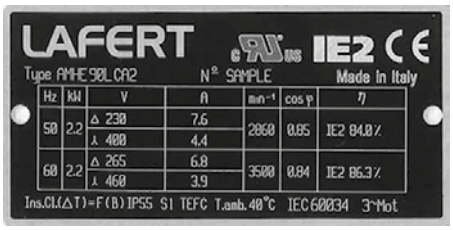
For brake motors, for motors in 500 V, 50 Hz design, and all not standard voltages, no voltage range is marked. The voltage tolerances to EN 60034-1 apply.

RATED FREQUENCY

Three-phase 50 Hz motors can also be operated on 60 Hz mains, provided the mains voltage increases proportionally to the frequency. The relative values for starting and breakaway torque remain nearly unchanged and slightly increase for the starting current. The rated speed increases by the factor 1.2 and output by factor 1.15. Should a motor designed for 50 Hz be operated at 60 Hz without the voltage being increased, the rated output of the motor cannot be increased. Under these operating conditions, rated speed increases by factor 1.2. The relative values for starting and breakaway torque are reduced by factor 0.82 and for starting current by factor 0.9.

Additionally to the voltage range for 50 Hz operation, three-phase single-speed motors (not brake motors) are also marked with the voltage range for 60 Hz operation.

Nameplates examples:





RATED CURRENT

For three-phase motors the rated currents listed in the data tables apply to an operating voltage of 400 V. The conversion to other operating voltages, with output and frequency remaining unchanged, is to be made as follows:

Nominal voltage (V)	230	380	**400**	440	500	660	690
Conversion factor x I_N	1.74	1.05	**1.0**	0.91	0.80	0.61	0.58

RATED TORQUE

$$\text{Rated torque in Nm} = 9550 \times \frac{\text{Rated power in kW}}{\text{Rated speed in min}^{-1}}$$

OUTPUT

The outputs stated in this catalogue are for constant load in continuous running duty S1 according to EN 60034-1, based on an ambient temperature of 40° C and installation at altitudes up to 1000 m above sea level.

For severe operating conditions, e.g. high switching rate, long run-up time or electric braking, a thermal reserve is necessary, which could call for higher thermal class or the use of a motor with a higher rating. In these cases we recommend to enquire with detailed information on the operating conditions.

OVERLOAD

At operating temperature three-phase motors are capable of withstanding an overload for 15 seconds at 1.5 times the rated torque at rated voltage. This overload is according to EN 60034-1 and will not result in excessive heating.
Utilizing thermal class F, motors can be operated continuously with an overload of 12%. Nevertheless this is not valid for motors which to catalogue are utilized to thermal class F.

CONNECTION

Motor output at 50 Hz	**230 V Δ 400 V Y**	**400 V Δ 690 V Y**	**500 V Y**	**500 VΔ**	**690 VΔ**
under 3 kW	standard	on request	on request	on request	-
4 to 5.5 kW	standard	standard	on request	on request	on request
≥ 7.5 kW	on request	standard	on request	on request	on request

INSULATION AND TEMPERATURE RISE

Class F insulation to EN 60034-1 is used throughout.
In standard design motors are intended for operation at 40° C ambient temperature with class B temperature rise only, with an overtemperature limit of 80 K. This also applies for the rated voltage range to IEC 60038. Exceptions are shown on the data tables.

Temperature rise (ΔT*) and maximum temperatures at the hottest points of the winding (T_{max}) according to the temperature classes of EN 60034-1.

	ΔT*	T_{max}
Class B	80 K	125° C
Class F	105 K	155° C
Class H	125 K	180° C

*Measurement by resistance method

Output reduction at ambient temperatures over 40° C

Ambient temperature	45° C	50° C	55° C	60° C
Class B Reduction of nominal output to approx.	95 %	90 %	85 %	80 %

When a winding is utilized to temperature class F (105K), no output reduction is required up to an ambient temperature of 55° C. *This does not apply to motors which in their standard design are already utilized to thermal class F.*

Installation at altitudes of more than 1000 m above sea level (see also EN 60034-1)

Altitude of installation	**2000 m**	**3000 m**	**4000 m**
At 40°C ambient temperature and thermal class B Rated output reduced to approx.	92 %	84 %	76 %
At 40°C ambient temperature and thermal class F Rated output reduced to approx.	89 %	79 %	68 %
Full nominal output to data tables with thermal class B and ambient temperature of	32° C	24° C	16° C
Full nominal output to data tables with thermal class F and ambient temperature of	30° C	19° C	9° C

STARTING RATE

The permissible number of starts per hour can be taken as given in the table below, provided the following conditions are met.
Additional moment of inertia ≤ moment of inertia of the rotor: load torque rising with the square of the speed up to nominal torque; starts at even intervals.

Shaft height	Permissible no. of starts per hour for		
	2 poles	4 poles	≥ 6 poles
56 - 71	100	250	350
80 - 100	60	140	160
112 - 132	30	60	80
160 - 180	15	30	50
200 - 225	8	15	30
250 - 315	4	8	12

For permissible number of starts for pole-changing motors and brake motors please consult us, indicating the complete operating conditions.

For the motors AMME and AMDE series, time between stop and restart of the motor must be higher than 15 s.

THERMAL PROTECTION

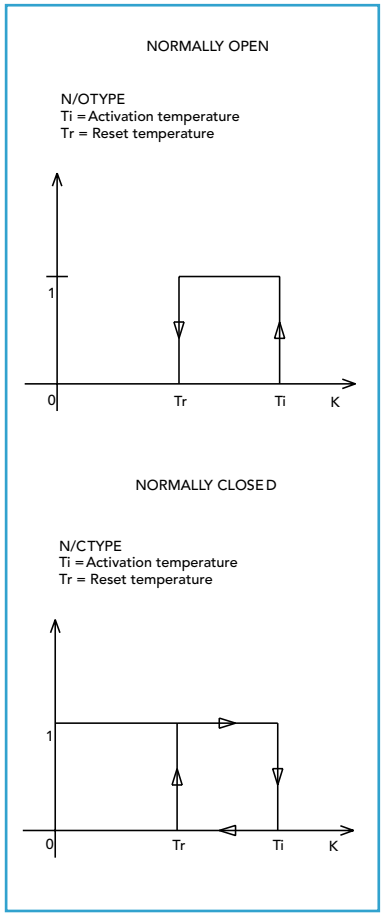
The decision on a particular type of thermal protection should be taken according to the actual operating conditions. Motors may be protected by means of current-dependent thermal protection switches, overcurrent relays and temperature detectors.

Thermal protection is possible as follows:

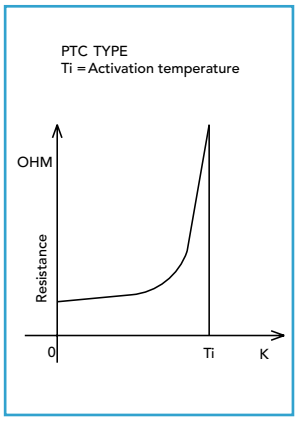
- Thermal protection switch with bimetal release
- Thermistor protection with semiconductor temperature detectors (PTC) in the stator winding in connection with release (if required, with additional motor protection switch).
- Bimetal temperature detector as N/C or N/O in the stator winding (if required, with additional motor protection switch).
- Resistance thermometer for monitoring winding and bearing temperature.

Should protection of the motor be required, we install protection switch with bimetal release (semiconductor temperature detectors on request).

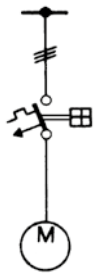
Operating specifications
Thermal cut-out



Operating specifications
of the thermistors



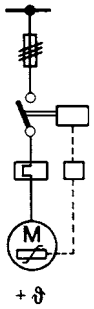
EXAMPLES OF CONNECTION



Protection method

Motor protection switch with thermal and electromagnetic overcurrent release

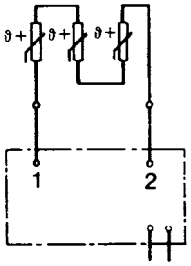
Protection against:
- Overload in continuous service
- Locked rotor



Contactor with overcurrent relay
Thermistor protection and fuse

In service against:
- Overload in continuous service
- Long starting and braking periods
- High switching rate

In case of fault against:
- Obstruction of cooling
- Increased ambient temperature
- Single-phase operation
- Frequency fluctuations
- Switching against locked rotor



Semiconductor temperature detector with release

In service against:
- Overload in continous service
- Long starting and braking periods
- High switching rate

In case of fault against:
- Obstruction of cooling
- Increased ambient temperature
- Single-phase operation
- Frequency fluctuations
- Switching against locked rotor

AUXILIARIES

Encoder (standard design)

Pulses per revolution	200-2048
Max outputs frequency	100 kHz
Power supply	$5V_{dc}$
Electronics	line driver
Current consumption without load	100 mA
Outputs	2 signals with rectangular pulses $\overline{A}$, $\overline{B}$ 2 signals with inverted rectangular pulses A, B zero pulse and inverted zero pulse
Pulse displacement between outputs	90°
Protection	IP 54
Max speed	3000 (6000) min^{-1}
Operating temperature	-10°C ÷ 85°C

MOTORS FOR NORMAL CONTINUOUS DUTY (S1) AND NORMAL OPERATING CONDITIONS

Quotation (if submitted): No./Date
Quantity: Units
Efficiency level to IEC 60034-30-1; 2014: IE code
Designation: Type
Output (for pole-changing motors, outputs referred to speeds): kW
Speed (for pole-changing motors, outputs referred to speeds): min-1
Direction of rotation (viewed on drive end)
Mounting arrangement (to IEC 60034-7)
Degree of protection, motor/terminal box (to IEC 60034-5)
Mains voltage: V
Mains frequency: Hz
Method of starting (direct-on-line or Y-Δ)
Location of terminal box
Machine to be driven

ADDITIONAL INFORMATION FOR SPECIAL DESIGNS

Double shaft or non-standard shaft extension
Radial sealing ring
Paint coating
Corrosive protection level
Vibration level
Anti-condensation heating
Temperature detectors (PTC, PTO, ...)
Noise requirements
Mechanical or electrical brake
Special requests

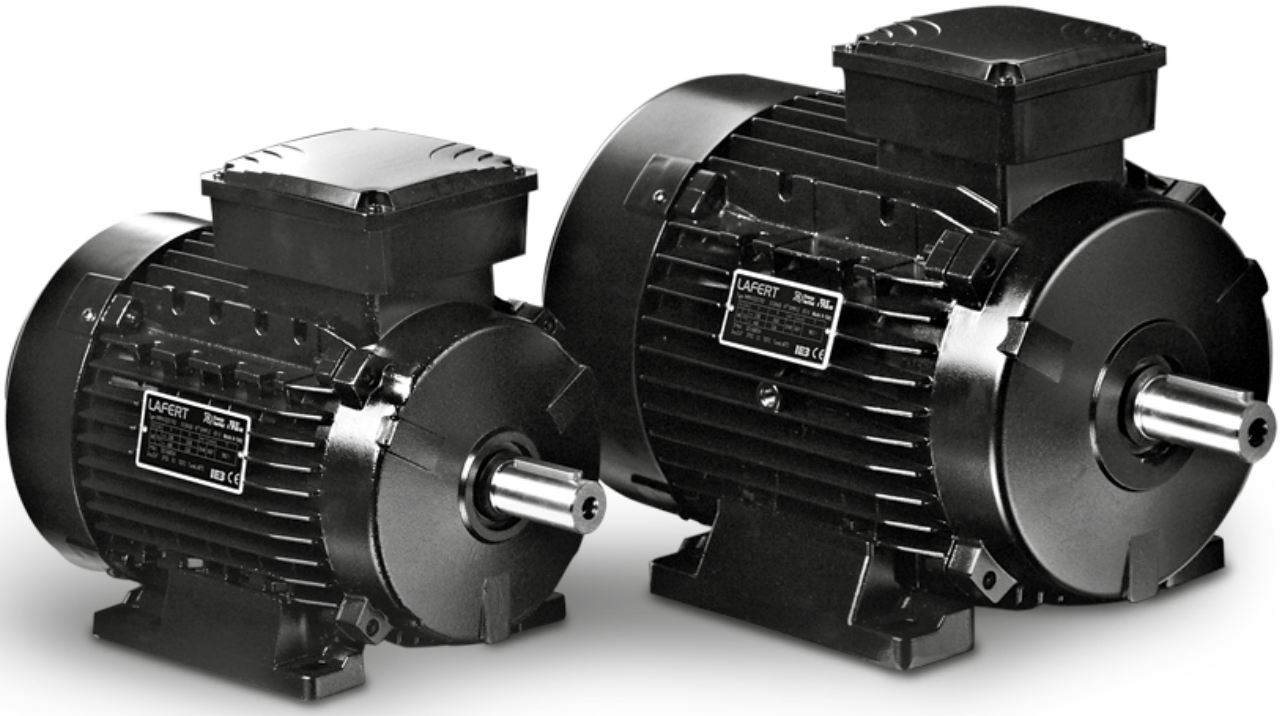
ADDITIONAL INFORMATION FOR SPECIAL DUTIES

S 2: ... min (short-time duty)
S 3: ... % - ... min (intermittent duty)
S 4: ... % - J_M ... kgm^2 - J_{ext} ... kgm^2 (intermittent duty with starting)
S 5: ... % - J_M ... kgm^2 - J_{ext} ... kgm^2 (intermittent duty with electric braking)
S 6: ... % - min (continuous-operation periodic duty with intermittent load)
S 7: .J_M ... kgm^2 - J_{ext} ... kgm^2 (continuous-operation periodic duty with electric braking)
S 8: .J_M ... kgm^2 - J_{ext} ... kgm^2 (continuous-operation periodic duty with speed changes)
S 9: ... kW (continuous duty with non-periodic load and speed variations).
For this duty type suitable full load values should be taken as the overload concept.
S10: p/Δt .... r .... TL (Duty with discrete constant loads).

ADDITIONAL INFORMATION FOR SPECIAL OPERATING CONDITIONS

Starting conditions (no-load or loaded starting)
Shock loads
Load torque curve during run-up (characteristic)
Moment of inertia (J_{ext}) referred to the motor shaft: kgm^2
Description of the type of drive (direct coupling, flat or V-belt, straight or helical gears, sprocket, crank, eccentric cam, etc.)
Radial force (or diameter of drive element): N
Direction of force and point of application (distance from shaft shoulder or width of drive element): mm
Axial force and direction of application (pull/thrust): N
Ambient conditions (e.g. increased humidity, dust accumulation, corrosive gases or vapours, increased or extremely low ambient temperature, outdoor installation, installation at altitudes over 1000 m above sea level, external vibration, etc.)

THREE-PHASE MOTORS



TERMINAL BOX

The location of the terminal box in standard design is on top; on the right or on the left are possible.

Motors 71-160 frame size have removable feet for easy change of terminal box position

For motors with mountings IM B6, IM B7, IM B8, IM V5, IM V6 the location of the terminal box is related to an IM B3 mounting.

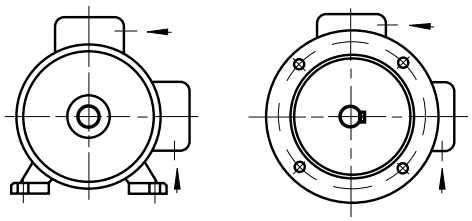
The position of the entry openings can be adjusted to suit the existing connection facilities by turning through 90°. Should special accessories be used (temperature detectors, anti-condensation heating, etc.) please enquire.

For motors in standard design, the cable gland does not belong to our scope of delivery.

For plastic terminal boxes, only plastic glands may be used (shock protection).

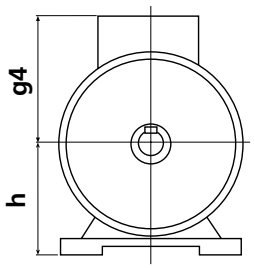
When using screened leads, a metal terminal box is required.

Direction of cable entries

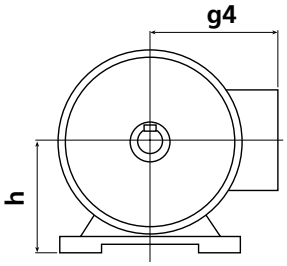


Frame size	Degree of protection	Thread for cable entry		Max. cable section	Terminal thread	Max. external cable diam.
		Metric [1]	Pg [2]	mm²		mm
56 - 71	IP 55	1 x M16/1 x M20	1 x Pg 11/1 x Pg 13.5	2.5	M4	12
80	IP 55	1 x M25/1 x M20	1 x Pg 13.5/1 x Pg 16	2.5	M4	16
90 - 112	IP 55	1 x M25/1 x M20	1 x Pg 13.5/1 x Pg 16	4	M5	16
132	IP 55	2 x M32	2 x Pg 21	4	M5	20
160	IP 55	2 x M40	2 x Pg 29	16	M6	28
180	IP 55	2 x M40/1 x M20		35	M8	28
200	IP 55	2 x M40/1 x M25		35	M8	34
225	IP 55	2 x M50/1 x M25		50	M10	34
250 - 280	IP 55	2 x M50/1 x M25		50	M10	40
315	IP 55	2 x M63/1 x M25 [3]		185	M12	48

1) Pitch 1.5
2) Pg thread to DIN 40 430 (on request)
3) Terminal box with unscrewable cable entry plate



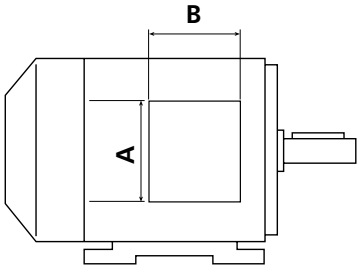
Terminal box on top



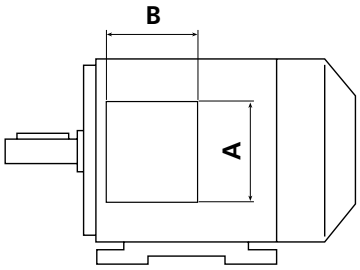
Terminal box at the side

STANDARD DESIGN

Frame size h	g_4	A	B	Material
56	98	91	93	Plastic UL 94 V0
63	103	91	93	Plastic UL 94 V0
71	112	91	93	Plastic UL 94 V0
80	129	111	116	Plastic UL 94 V0
90	138	111	116	Plastic UL 94 V0
100	145	111	116	Plastic UL 94 V0
112	161	111	116	Plastic UL 94 V0
132	198	133	133	Aluminium
160	238	150	150	Aluminium
180	268	187	162	Cast Iron
200	300	233	186	Cast Iron
225	335	233	186	Cast Iron
250	366	260	218	Cast Iron
280	408	260	218	Cast Iron
315	530	320	280	Cast Iron



left [1)]



right

SPECIAL DESIGN

Frame size h	g_4	A	B	Material
56	100	94	94	Aluminium
63	105	94	94	Aluminium
71	114	94	94	Aluminium
80	139	110	110	Aluminium
90	148	110	110	Aluminium
100	155	110	110	Aluminium
112	171	110	110	Aluminium
180	285	209	220	Cast Iron
200	310	241	246	Cast Iron
225	334	272	254	Cast Iron
250	375	272	254	Cast Iron
280	409	272	254	Cast Iron

1) On frame size 56-63 the terminal box is supplied displaced towards the non-drive end

CONNECTION DIAGRAMS

Windings of standard three-phase single speed motors can be connected either in star or delta connection.

STAR CONNECTION

A star connection is obtained by connecting W2, U2, V2 terminals to eachother and the U1, V1, W1 terminals to the mains. The phase current and voltage are:

$I_{ph} = I_n$; $U_{ph} = U_n / \sqrt{3}$

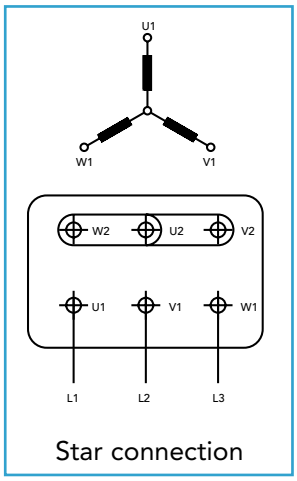
where I_n is the line current and U_n the line voltage referred to the star connection.

DELTA CONNECTION

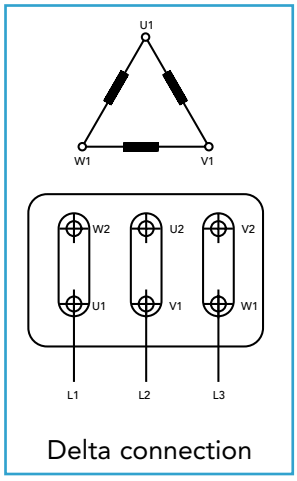
A delta connection is obtained by connecting the end of a phase to the beginning of the next phase.
The phase current I_{ph} and the phase voltage U_{ph} are:

$I_{ph} = I_n / \sqrt{3}$; $U_{ph} = U_n$

where I_n and U_n are referred to the delta connection.



Star connection



Delta connection

STAR-DELTA STARTING

Star-delta starting allows a peak current reduction. It can be used only when the reduced starting torque obtained is higher than the resistant torque. Actually, it should be noted that the torque of an induction squirrel-cage motor is directly proportional to the square of the voltage. Motors whose rated voltage with delta connection corresponds to the mains voltage, can be started with the star-delta method.

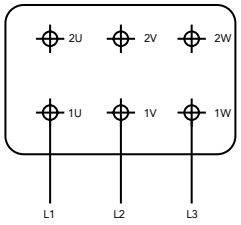
All motors can be supplied with windings designed for star-delta starting (for example: 400 V Δ / 690 V Y).

TWO SPEED MOTORS

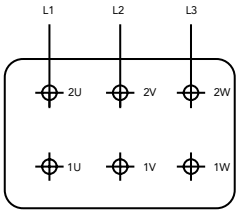
Standard pole-changing motors are designed for single voltage and direct-on-line starting.

When the ratio between the two speeds is from 1 to 2, the standard motors have one single winding (Dahlander connection). For the other speeds, the motors have two separate windings.

AM/AMV - two separate windings

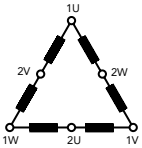


Low speed

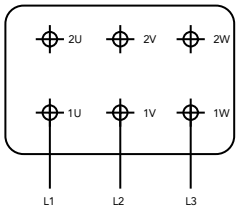


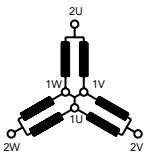
High speed

AM - Dahlander connection Δ/YY

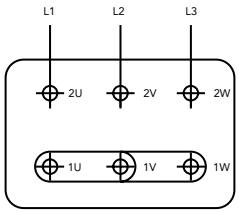


Low speed

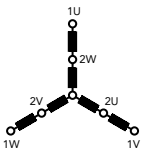




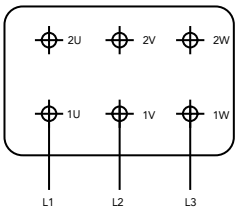
High speed

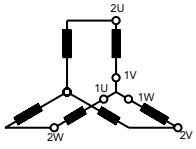


AMV - Dahlander connection Y/YY

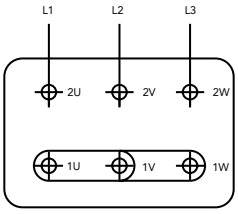


Low speed





High speed

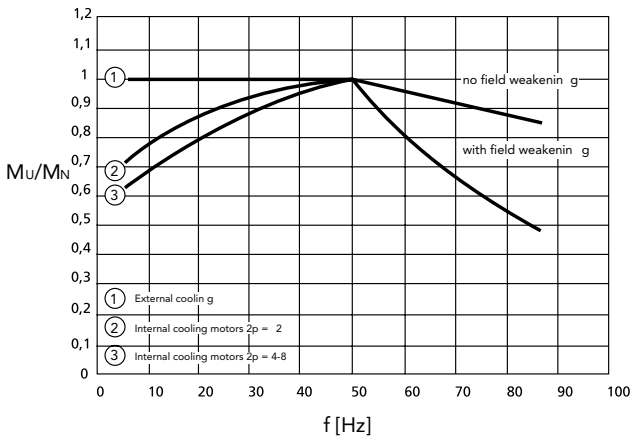


CAGE MOTORS DRIVEN BY FREQUENCY CONVERTERS

Motors frame sizes 90 upwards in standard design are suitable for operation on static frequency converters, taking into account the following remarks:

- Maximum converter output voltage 500V at peak voltages $\hat{U} \leq 1460V$ and $du/dt \leq 13$ kV/us. For higher converter output voltages or stresses, a special insulation is required.
- With square characteristic of the load torque, motors can be driven with their rated torque.
- For constant torque, the rated torque of motors with internal cooling must be reduced due to reduced cooling air inlet. Depending on the control range, the use of an external fan would be advisable.
- The motors frame sizes 90 – 112 are suitable for a maximum output frequency of the converter of 60 Hz (e.g. applications with square torque, control range 1:10, such as pumps and fans). For higher frequencies, a special range is available on request. From frame size 132 upwards, motors designed Δ/Y 230/400 V, 50 Hz can be operated in delta with a maximum frequency of 87 Hz (observe mechanical limit speed).
- The motors frame size 56 – 80 can be operated on single-phase converters up to maximum 60 Hz. Special range for operation on three-phase converters with output voltage ≥ 400 V and output frequency > 60 Hz is available on request.

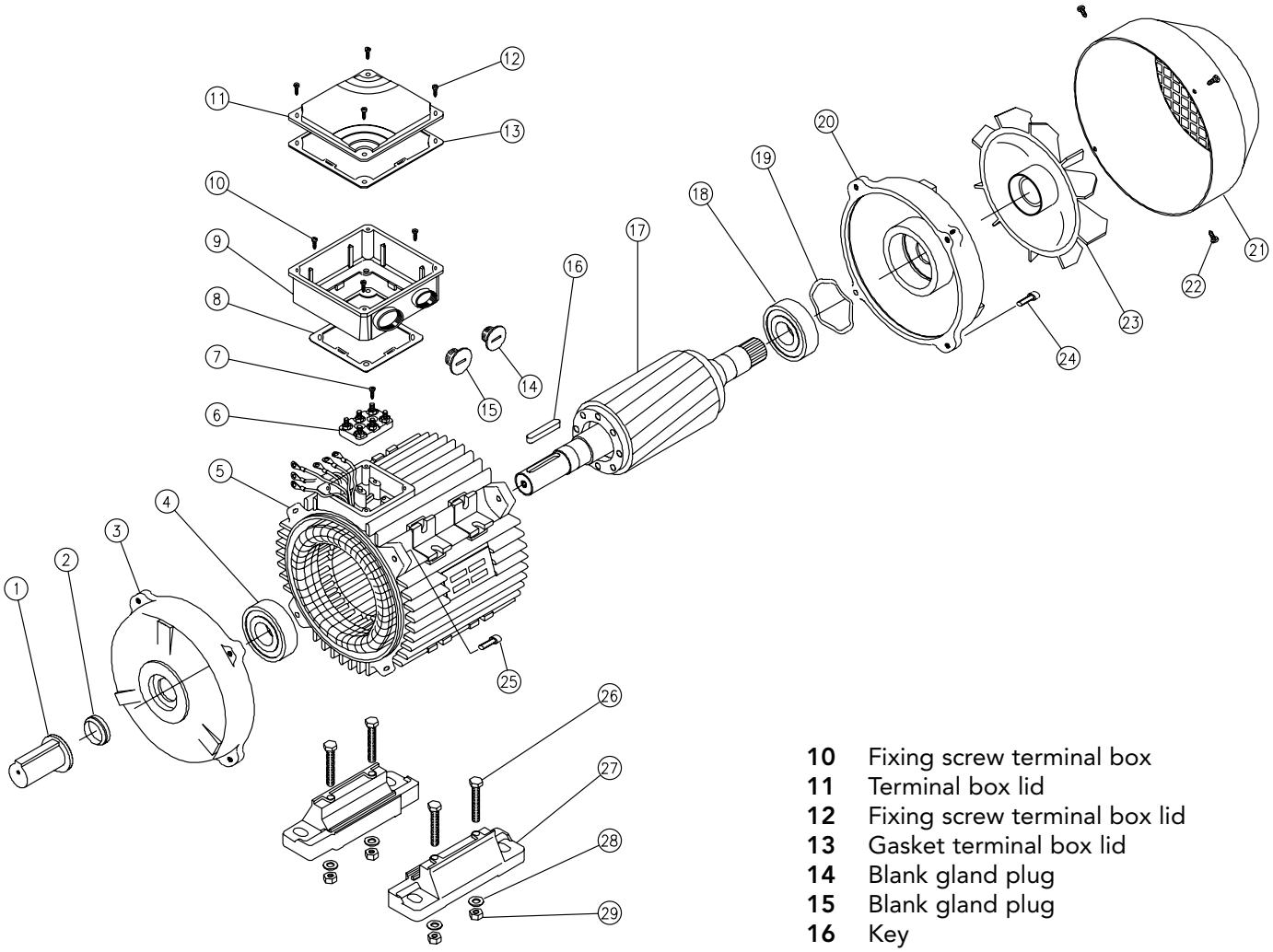
Note: Motors 75 kW, 2 poles and up - insulated bearing are recommended when inverter fed.



Torque caracteristics of three-phase motors driven by frequency converters.

NOISE

Depending on the operating point and converter type, converter-fed motors produce between approx. 4 - 10 dB(A) higher noise values than when supplied from the mains. For motors driven with a frequency over 50 Hz, more fan noise is produced. We recommend the use of an external fan.



PART DESCRIPTION

1 Shaft protection
2 Dust seal drive end
3 Endshield drive end
4 Bearing drive end
5 Stator frame
6 Terminal board
7 Fixing screw terminal board
8 Gasket terminal box
9 Terminal box
10 Fixing screw terminal box
11 Terminal box lid
12 Fixing screw terminal box lid
13 Gasket terminal box lid
14 Blank gland plug
15 Blank gland plug
16 Key
17 Rotor complete
18 Bearing non-drive end
19 Pre-load washer
20 Endshield non-drive end
21 Fan cover
22 Fixing screw fan cover
23 Fan
24 Fixing bolt endshield non-drive end
25 Fixing bolt endshield drive end
26 Fixing bolt motor feet
27 Motor feet
28 Fixing washer motor feet
29 Fixing nut motor feet

Only motors 71-160 frame size have removable feet for easy change of terminal box position

In enquires and orders for spare parts please state always:
Designation of spare part, motor type, mounting arrangement, motor serial number (Product No. when available)
Enquires and orders cannot be handled without these data.

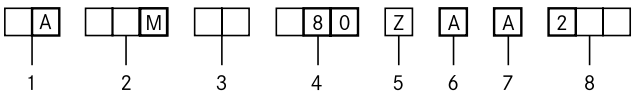
TYPE DESIGNATION

Apart from other information, it is necessary to specify the exact type designation in all enquiries, when ordering spare parts or replacement motors or when asking for documentary information.

The type designation of our motors comprises 8 points of reference, each of which may consist of several letters and/or numerals. The meaning of each symbol can be seen from the following table. For motors not included in our standard range, special symbols may be used which are not listed here.

Ref. point	Meaning	Description of symbols used for our motors	
1	Type of motor	A	Asynchronous motor
2	Cooling	M	Surface cooled with external fan, cooling fins
		G	Surface cooled without external fan, cooling fins
		MFV	Surface cooled with forced ventilation, cooling fins
3	Type of motor	blank	Three-phase motor, standard efficiency IE1code
		EE	Three-phase motor, high efficiency IE2 code
		H	Three-phase motor, efficiency to EPACT regulations
		HE	Three-phase motor, high efficiency IE2 code 50 - 60 Hz
		PE	Three-phase motor, premium efficiency IE3 code
		PH	Three-phase motor, premium efficiency EISA regulations
		V	Three-phase two speed motor for driving fans
		I	Special design for three-phase motor driven with frequency converter
4	Shaft centre height	56, 63, 71, 80, 90, 100, 112, 132,160, 180, 200, 225, 250, 280, 315	
5	Frame length	Z	
		S	Mechanical dimension (short)
		M	Mechanical dimension (medium)
		L	Mechanical dimension (long)
6	Mechanical design and output value	A	
		B	
		...	
		Z	
7	Frame material	A	Aluminium frame
		G	Cast iron frame
8	Number of poles	2	- 4/2
		4	- 8/4
		6	- 4/6
		8	- 6/8

Example



PREMIUM EFFICIENCY THREE-PHASE MOTORS – IE3

EFFICIENCY LEVEL ACCORDING TO IEC 60034-30-1:2014
EFFICIENCY TESTING METHOD IEC 60034-2-1;2014

NOMINAL FULL LOAD EFFICIENCY ACCORDING TO IE3 CODE @ 400 V - 50 HZ

FOR MAINS VOLTAGE
400 V - 50 HZ

IE3

TEMPERATURE RISE TO CLASS B

Type		kW	HP	min^{-1}	M_N Nm	IE3 η 50%	IE3 η 75%	IE3 η 100%	cos φ	I_N 400V	I_A/I_N	M_A/M_N	M_S/M_N	M_K/M_N	J 10^{-3} kgm^2	kg
3000 min^{-1} (2 poles)																
ALUMINIUM DESIGN																
AMPE 71Z AA	**2**	0.75	1	2880	2.5	76.5	80.8	80.7	0.70	1.9	5.5	3.1	3.0	3.2	0.7	8.2
AMPE 80Z AA	**2**	0.75	1	2910	2.5	77.8	81.2	82.0	0.78	1.7	8.9	4.7	4.5	4.8	0.7	9.5
AMPE 80Z BA	**2**	1.1	1.5	2870	3.7	78.7	81.7	82.7	0.76	2.4	9.3	5.0	4.9	5.3	0.9	11.1
AMPE 80Z CA	**2***	1.5	2	2810	5.1	78.8	82.2	84.2	0.76	3.6	7.8	4.9	3.7	4.3	1.1	13.5
AMPE 90S AA	**2**	1.5	2	2875	5.0	83.2	84.8	84.2	0.85	3.0	8.4	3.6	3.2	3.8	1.6	14.0
AMPE 90L BA	**2**	2.2	3	2880	7.3	85.0	86.2	86.5	0.82	4.6	9.2	4.0	3.8	4.2	1.8	16.0
AMPE 90L DA	**2***	3	4	2865	10.0	85.2	86.3	87.1	0.80	6.3	8.7	4.5	4.0	4.6	2.0	18.0
AMPE 100L AA	**2**	3	4	2900	9.9	82.3	85.8	87.1	0.89	5.6	8.8	5.5	3.5	4.5	4.1	22.8
AMPE 100L BA	**2***	4	5.5	2920	13.1	85.4	87.2	88.1	0.81	8.2	10.9	6.1	5.2	5.7	7.3	26.5
AMPE 112M AA	**2**	4	5.5	2910	13.1	86.8	87.8	88.1	0.93	7.0	9.6	3.6	3.0	4.0	6.5	27.4
AMPE 112M BA	**2***	5.5	7.5	2935	17.9	85.6	88.3	89.2	0.87	10.2	11.2	4.2	3.5	4.3	8.6	33.6
AMPE 112M CA	**2***	7.5	10	2930	24.5	88.0	89.7	90.1	0.84	14.4	10.4	4.5	3.5	4.6	10.5	36.0
AMPE 132S ZA	**2**	5.5	7.5	2920	18.0	88.0	88.5	89.2	0.90	10.0	8.9	3.0	2.5	3.6	14.0	46.0
AMPE 132S TA	**2**	7.5	10	2910	24.6	88.6	89.2	90.1	0.92	13.1	8.9	3.0	2.6	3.6	16.0	53.0
AMPE 132M ZA	**2**	9.2	12.4	2930	30.0	88.6	89.8	90.7	0.89	16.5	10.1	3.7	3.3	4.0	17.5	58.0
AMPE 132M RA	**2***	11	15	2935	35.8	90.0	90.8	91.2	0.89	19.9	9.7	4.4	3.5	4.6	25.0	59.0
AMPE 132M TA	**2***	15	20	2915	49.2	91.0	92.2	91.9	0.88	26.8	9.6	3.7	2.6	3.8	28.0	68.0
AMPE 160M YA	**2**	11	15	2950	35.6	87.4	89.8	91.2	0.89	19.7	9.1	4.0	3.0	4.2	51.7	87.8
AMPE 160M ZA	**2**	15	20	2940	48.7	91.0	91.3	91.9	0.89	26.7	9.7	4.7	3.5	4.8	53.4	88.9
AMPE 160L ZA	**2**	18.5	25	2950	59.9	91.6	92.8	92.4	0.88	33.0	10.7	4.6	3.1	4.7	64.0	104.0
AMPE 160L TA	**2**	22	30	2950	71.3	92.2	93.7	92.7	0.87	39.4	10.4	4.5	3.0	4.6	64.0	104.0
CAST IRON DESIGN																
AMPE 180M ZG	**2**	22	30	2930	71.7	92.6	93.1	92.7	0.89	38.5	7.5	2.3	2.0	2.8	97	210
AMPE 200L PG	**2**	30	40	2925	97.9	92.9	93.5	93.3	0.88	52.7	6.7	2.4	2.0	2.7	173	234
AMPE 200L RG	**2**	37	50	2930	120.6	93.7	94.1	93.7	0.90	63.3	6.3	2.3	2.0	2.7	200	250
AMPE 225M PG	**2**	45	60	2930	146.7	93.8	94.2	94.0	0.88	78.5	6.9	2.3	2.0	2.8	344	322
AMPE 250M PG	**2**	55	75	2940	178.6	93.2	94.1	94.3	0.88	95.7	8.0	2.3	1.9	2.7	444	420
AMPE 280S G	**2**	75	100	2940	243.6	93.6	94.5	94.7	0.92	124.3	8.0	2.2	1.9	2.7	829	630
AMPE 280M G	**2**	90	125	2940	292.3	93.6	94.7	95.0	0.92	148.6	7.7	2.2	1.9	2.6	982	650
AMPE 315S G	**2**	110	150	2940	357.3	94.6	95.5	95.2	0.90	185.3	7.7	2.0	1.8	2.3	1509	930
AMPE 315M G	**2**	132	180	2940	428.7	94.7	95.5	95.4	0.91	219.5	7.6	2.0	1.8	2.3	1938	1030
AMPE 315M RG	**2**	160	200	2945	518.8	94.5	95.8	95.6	0.90	267.9	7.8	2.0	1.8	2.3	2197	1070
AMPE 315L G	**2**	200	270	2945	648.5	94.7	96.0	95.8	0.89	338.6	7.9	2.0	1.8	2.3	2554	1140

* Higher output (Progressive motor)

PREMIUM EFFICIENCY THREE-PHASE MOTORS – IE3

EFFICIENCY LEVEL ACCORDING TO IEC 60034-30-1:2014
EFFICIENCY TESTING METHOD IEC 60034-2-1;2014

NOMINAL FULL LOAD EFFICIENCY ACCORDING TO IE3 CODE @ 400 V - 50 HZ

FOR MAINS VOLTAGE
400 V - 50 HZ

IE3

TEMPERATURE RISE TO CLASS B

Type		kW	HP	min^{-1}	M_N Nm	η 50%	η 75%	η 100%	cos φ	I_N 400V	I_A/I_N	M_A/M_N	M_S/M_N	M_K/M_N	J 10^{-3} kgm^2	kg
1500 min^{-1} (4 poles)																
ALUMINIUM DESIGN																
AMPE 80Z AA	**4**	0.75	1	1435	5.0	80.7	81.5	82.5	0.74	1.8	5.5	2.7	2.6	2.8	2.5	11.0
AMPE 90S AA	**4**	1.1	1.5	1440	7.3	83.3	84.3	84.1	0.75	2.5	7.1	4.3	3.4	4.4	3.6	15.8
AMPE 90L BA	**4**	1.5	2	1430	10.0	84.1	85.2	85.3	0.72	3.6	6.6	4.3	3.8	4.4	3.7	16.4
AMPE 90L CA	**4**	1.8	2.4	1430	12.0	83.5	86.1	86.0	0.69	4.5	8.5	4.3	3.7	4.4	3.9	20.0
AMPE 100L AA	**4**	2.2	3	1455	14.4	83.2	86.2	86.7	0.63	4.8	7.2	3.7	3.0	3.9	5.9	22.8
AMPE 100L BA	**4**	3	4	1440	19.9	85.1	87.1	87.7	0.73	6.8	8.1	4.1	3.8	4.1	7.3	26.5
AMPE 112M BA	**4**	4	5.5	1450	26.4	87.2	88.3	88.6	0.80	8.2	8.5	2.7	2.4	3.5	16.4	36.0
AMPE 132S ZA	**4**	5.5	7.5	1450	36.2	89.8	90.2	89.6	0.84	10.6	8.7	3.7	3.2	4.3	36.0	65.0
AMPE 132M ZA	**4**	7.5	10	1465	48.9	89.9	90.9	90.4	0.78	15.3	8.2	4.4	3.1	5.1	45.0	63.0
AMPE 132M TA	**4**	9.2	12.4	1455	60.4	88.6	91.1	91.0	0.74	19.7	8.2	4.9	3.3	5.5	57.0	98.0
AMPE 160M ZA	**4**	11	15	1475	71.3	90.5	91.5	91.4	0.77	22.4	10.1	2.5	2.2	3.1	105.0	108.0
AMPE 160L ZA	**4**	15	20	1465	97.8	91.8	92.5	92.1	0.78	30.5	8.9	3.2	2.1	2.8	120.7	124.0
CAST IRON DESIGN																
AMPE 180M ZG	**4**	18.5	25	1445	122.3	92.3	92.9	92.6	0.87	33.1	7.8	2.4	2.1	3.0	155	160
AMPE 180L ZG	**4**	22	30	1460	143.9	92.8	93.3	93.0	0.89	38.4	7.5	2.3	2.0	3.0	194	186
AMPE 200L RG	**4**	30	40	1460	196.2	92.5	93.5	93.6	0.88	52.6	7.9	2.4	2.0	2.7	287	245
AMPE 225S PG	**4**	37	50	1470	240.4	93.5	94.1	93.9	0.80	71.1	6.7	2.4	2.0	2.7	578	320
AMPE 225M PG	**4**	45	60	1480	290.3	93.7	94.3	94.2	0.80	86.2	7.0	2.3	2.0	2.8	653	350
AMPE 250M PG	**4**	55	75	1480	354.9	94.0	94.6	94.6	0.88	95.4	7.4	2.4	1.9	2.7	765	460
AMPE 280S G	**4**	75	100	1480	483.9	94.8	95.2	95.0	0.91	125.2	7.5	2.2	1.9	2.6	1887	620
AMPE 280M G	**4**	90	125	1480	580.7	94.3	95.1	95.2	0.92	148.3	7.7	2.2	1.9	2.6	2183	673
AMPE 315S G	**4**	110	150	1480	109.7	94.6	95.7	95.4	0.90	184.9	7.8	2.0	1.8	2.3	3718	1027
AMPE 315M G	**4**	132	180	1480	851.7	95.0	95.8	95.6	0.91	219.0	7.8	2.0	1.8	2.3	4297	1070
AMPE 315M RG	**4**	160	200	1480	1032.4	95.1	96.0	95.8	0.91	264.9	7.9	2.0	1.8	2.3	5120	1150
AMPE 315L G	**4**	200	270	1480	1290.4	95.3	96.2	96.0	0.90	334.1	7.7	2.0	1.8	2.3	6173	1230

PREMIUM EFFICIENCY THREE-PHASE MOTORS – IE3

EFFICIENCY LEVEL ACCORDING TO IEC 60034-30-1:2014
EFFICIENCY TESTING METHOD IEC 60034-2-1;2014

NOMINAL FULL LOAD EFFICIENCY ACCORDING TO IE3 CODE @ 400 V - 50 HZ

FOR MAINS VOLTAGE
400 V - 50 HZ

IE3

TEMPERATURE RISE TO CLASS B

Type		kW	HP	min^{-1}	M_N Nm	η 50%	η 75%	η 100%	cos φ	I_N 400V	I_A/I_N	M_A/M_N	M_S/M_N	M_K/M_N	J 10^{-3} kgm^2	kg
1000 min^{-1} (6 poles)																
ALUMINIUM DESIGN																
AMPE 90S AA	**6**	0.75	1	940	7.6	78.1	79.2	78.9	0.62	2.2	4.6	1.7	1.6	1.8	6.0	18.1
AMPE 90L BA	**6**	1.1	1.5	935	11.2	79.1	81.2	81.0	0.64	3.1	4.2	1.8	1.7	2.3	6.5	19.0
AMPE 100L AA	**6**	1.1	1.5	960	10.9	78.9	81.3	81.0	0.65	3.0	6.2	2.2	1.8	2.8	11.6	25.0
AMPE 100L BA	**6**	1.5	2	920	15.6	81.1	82.7	82.5	0.68	3.8	5.7	1.7	1.3	2.3	14.2	26.0
AMPE 112M BA	**6**	2.2	3	920	22.8	83.3	85.1	84.3	0.68	5.4	5.3	2.0	1.8	2.4	20.1	34.2
AMPE 132S YA	**6**	3	4	975	29.4	84.1	85.8	85.6	0.65	8.0	5.5	2.1	1.9	3.1	37.7	42.0
AMPE 132M YA	**6**	4	5.5	975	39.2	85.2	87.1	86.8	0.66	10.3	5.4	2.2	1.7	3.2	44.4	46.0
AMPE 132M TA	**6**	5.5	7.5	975	53.9	87.1	88.1	88.0	0.64	14.2	5.4	2.1	1.8	2.9	54.1	48.0
AMPE 160M YA	**6**	5.5	7.5	975	53.9	87.5	88.5	88.0	0.77	11.8	8.6	2.2	1.8	2.8	103.0	84.0
AMPE 160M ZA	**6**	7.5	10	980	73.1	88.3	89.3	89.1	0.78	15.7	8.7	2.4	1.9	3.1	132.0	97.0
AMPE 160L ZA	**6**	9.2	12.4	970	87.6	88.9	90.1	89.8	0.74	19.9	8.3	3.1	2.2	3.5	136.0	105.0
AMPE 160L TA	**6**	11	15	970	108.3	89.1	90.4	90.3	0.78	22.9	8.0	2.7	2.4	3.2	136.0	105.0
CAST IRON DESIGN																
AMPE 180L ZG	**6**	15	20	960	149.2	90.3	92.0	91.2	0.83	28.6	7.8	2.3	2.1	2.9	257	152
AMPE 200L PG	**6**	18.5	25	965	183.1	91.2	92.0	91.7	0.85	34.3	7.8	2.4	2.1	3.2	383	188
AMPE 200L RG	**6**	22	30	965	217.7	91.5	92.4	92.2	0.86	40.0	7.9	2.3	1.9	3.1	449	250
AMPE 225M PG	**6**	30	40	975	293.8	93.5	93.6	92.9	0.85	54.8	7.9	2.2	1.9	2.7	670	252
AMPE 250M PG	**6**	37	50	975	362.4	91.8	94.0	93.3	0.83	69.0	7.5	2.3	2.1	2.7	992	345
AMPE 280S G	**6**	45	60	980	438.5	92.2	93.5	93.7	0.86	80.6	7.2	2.3	2.0	2.8	2046	410
AMPE 280M G	**6**	55	75	980	535.9	92.8	93.9	94.1	0.86	98.1	7.7	2.2	1.9	2.7	2573	520
AMPE 315S G	**6**	75	100	980	730.8	93.2	94.8	94.6	0.89	128.6	7.9	2.1	1.9	2.5	4157	530
AMPE 315M G	**6**	90	125	980	877.0	93.4	95.0	94.9	0.90	152.1	8.0	2.0	1.8	2.3	3530	860
AMPE 315L RG	**6**	110	150	980	1071.9	94.0	95.4	95.1	0.90	185.5	7.7	2.0	1.8	2.3	4173	970
AMPE 315L G	**6**	132	180	980	1286.2	94.2	95.7	95.4	0.89	224.4	8.0	2.0	1.8	2.3	5167	1010

PREMIUM EFFICIENCY THREE-PHASE MOTORS – IE3

EFFICIENCY LEVEL ACCORDING TO EISA
EFFICIENCY TESTING METHOD CSA C390-10
VERIFIED BY UL ENVIRONMENT

EFFICIENCY LEVEL ACCORDING TO IEC 60034-30-1;2014
EFFICIENCY TESTING METHOD IEC 60034-2-1;2014

FOR MAINS VOLTAGE
460 V - 60 HZ

TEMPERATURE RISE TO CLASS B

Type		kW	HP	min^{-1}	M_N Nm	η 50 %	η 75 %	η 100 %	cos φ	I_N 460 V	I_A/I_N	M_A/M_N	M_S/M_N	M_K/M_N	J 10^{-3} kgm^2	kg
3600 min^{-1} (2 poles)																
AMPH 80Z AA2	**2**	0.75	1	3525	2.0	81.2	84.2	77.0	0.77	1.5	9.4	5.2	4.1	5.5	0.7	9.5
AMPH 80Z BA2	**2**	1.1	1.5	3490	3.0	81.9	84.6	84.0	0.80	2.0	8.3	4.4	3.9	4.5	0.9	11.1
AMPH 80Z CA2	**2**	1.5	2	3460	4.1	82.1	84.9	85.5	0.77	2.8	8.2	4.7	3.6	4.4	1.1	13.5
AMPH 90S AA	**2**	1.5	2	3515	4.1	81.2	84.7	85.5	0.78	2.8	10.0	3.7	3.6	4.3	1.6	16.4
AMPH 90L BA	**2**	2.2	3	3480	6.0	83.6	86.1	86.5	0.84	3.8	8.5	4.4	4	4.4	1.8	18.3
AMPH 90L DA	**2**	3	4	3510	8.2	85.9	88.6	88.5	0.82	5.3	9.4	4.1	3.9	4.3	2.0	18.0
AMPH 100L AA	**2**	3	4	3515	8.2	85.8	88.1	88.5	0.86	4.9	10.5	5.6	5.3	5.3	4.0	23.6
AMPH 100L BA	**2**	3.7	5	3540	10.0	86.2	88.0	88.5	0.75	7.0	9.6	4.9	4.3	4.9	7.3	26.5
AMPH 100L CA	**2**	4	5.5	3530	10.8	86.6	88.1	88.5	0.76	7.4	9.0	4.5	4.0	4.5	7.3	26.5
AMPH 112M AA	**2**	3.7	5	3535	10.0	84.0	87.6	88.5	0.90	5.8	11.0	3.4	1.9	4.0	6.5	27.4
AMPH 112M BA	**2**	4	5.5	3520	10.9	85.3	88.0	88.5	0.91	6.2	10.5	3.2	1.7	3.8	6.5	27.4
AMPH 112M CA	**2**	5.5	7.5	3530	14.9	86.2	89.0	89.5	0.86	8.9	14.4	4.5	2.5	4.3	8.6	35.5
AMPH 112M DA	**2**	7.5	10	3530	20.3	87.9	90.1	90.2	0.88	11.9	11.0	4.5	2.6	4.7	10.5	36.5
AMPH 132S ZA	**2**	5.5	7.5	3540	14.8	87.3	89.6	89.5	0.88	8.8	10.2	3.0	2.6	3.3	20.5	42.0
AMPH 132S TA	**2**	7.5	10	3540	20.2	88.0	90.3	90.2	0.87	12.0	12.0	3.4	2.9	3.9	22.8	48.0
AMPH 132M TA	**2**	9.2	12.4	3545	24.8	87.7	90.1	90.2	0.88	14.5	10.0	4.0	3.5	4.7	25.0	50.0
AMPH 132M RA	**2**	11	15	3535	29.7	87.5	90.4	91.0	0.86	17.7	10.7	4.0	3.5	4.7	25.0	60.1
AMPH 132M ZA	**2**	15	20	3530	40.6	89.6	90.7	91.0	0.88	23.5	9.7	4.1	3.4	4.2	28.0	68.0
AMPH 160M YA	**2**	11	15	3550	29.6	86.6	90.0	91.0	0.89	17.0	10.8	3.5	2.5	4.5	51.7	90.0
AMPH 160M ZA	**2**	15	20	3555	40.3	90.1	92.0	91.0	0.88	23.4	10.0	3.5	3.1	4.5	53.4	92.0
AMPH 160L ZA	**2**	18.5	25	3555	49.7	90.0	92.2	91.7	0.82	31.0	12.5	4.6	3.3	6.0	64.0	108.0
AMPH 160L TA	**2**	22	30	3540	59.3	90.7	92.5	91.7	0.84	35.8	10.6	3.9	2.8	5.0	64.0	108.0

Type		kW	HP	min^{-1}	M_N Nm	η 50 %	η 75 %	η 100 %	cos φ	I_N 460 V	I_A/I_N	M_A/M_N	M_S/M_N	M_K/M_N	J 10^{-3} kgm^2	kg
1800 min^{-1} (4 poles)																
AMPH 80 Z AA	**4**	0.75	1	1740	4.1	82.6	86.1	85.5	0.76	1.45	6.5	3.4	2.5	3.5	2.5	11.0
AMPH 90S AA	**4**	1.1	1.5	1745	6.0	82.8	85.6	86.5	0.71	2.2	8.2	4.4	4.3	4.6	3.7	18.8
AMPH 90L BA	**4**	1.5	2	1735	8.3	83.5	86.2	86.5	0.74	2.9	7.5	3.8	3.7	4.0	3.7	18.8
AMPH 90L CA	**4**	1.8	2.4	1730	9.9	85.2	86.7	86.5	0.68	3.8	7.8	3.9	3.8	4.1	3.7	18.8
AMPH 100L AA	**4**	2.2	3	1760	11.9	87.8	88.9	89.5	0.81	3.8	8.3	2.8	2.7	3.3	10.7	25.0
AMPH 100L BA	**4**	3	4	1765	16.2	88.2	89.1	89.5	0.80	5.3	8.2	2.7	2.5	3.2	14.9	28.0
AMPH 112M AA	**4**	3.7	5	1765	20.0	87.3	89.3	89.5	0.80	6.5	9.6	3.1	2.5	4.6	16.4	35.7
AMPH 112M BA	**4**	4	5.5	1760	21.7	87.7	89.4	89.5	0.81	6.9	9	2.9	2.3	4.3	16.4	35.7
AMPH 132S ZA	**4**	5.5	7.5	1760	29.8	91.0	92.1	91.7	0.81	9.3	9.1	3.5	3.0	4.1	36.0	54.0
AMPH 132M ZA	**4**	7.5	10	1760	40.7	90.8	91.5	91.7	0.79	13.0	9.4	4.1	3.5	4.8	45.0	63.0
AMPH 132M TA	**4**	9.2	12.4	1760	49.9	90.9	91.6	91.7	0.73	17.2	9.5	4.7	4	5.5	57.0	70.5
AMPH 160M ZA	**4**	11	15	1770	59.3	91.5	92.5	92.4	0.80	18.7	9.8	4.4	3.1	4.6	120.7	104.0
AMPH 160L ZA	**4**	15	20	1765	81.2	92.4	93.0	93.0	0.77	26.3	9.8	4.2	3.0	4.4	135.0	123.0

PREMIUM EFFICIENCY THREE-PHASE MOTORS – IE3

EFFICIENCY LEVEL ACCORDING TO EISA
EFFICIENCY TESTING METHOD CSA C390-10
VERIFIED BY UL ENVIRONMENT

EFFICIENCY LEVEL ACCORDING TO IEC 60034-30-1;2014
EFFICIENCY TESTING METHOD IEC 60034-2-1;2014

FOR MAINS VOLTAGE
460 V - 60 HZ

IE3 c UL us c UL Energy Verified

TEMPERATURE RISE TO CLASS B

Type		kW	HP	min^{-1}	M_N Nm	η 50 %	η 75 %	η 100 %	cos φ	I_N 460 V	I_A/I_N	M_A/M_N	M_S/M_N	M_K/M_N	J 10^{-3} kgm^2	kg
1200 min^{-1} (6 poles)																
AMPH 90S AA	**6**	0.75	1	1155	6.2	78.5	81.8	82.5	0.58	2.05	4.5	1.8	1.7	2.1	6.0	18.1
AMPH 100L AA	**6**	1.1	1.5	1175	8.9	85.8	87.8	87.5	0.64	2.5	6.1	2.1	1.6	2.2	13.3	28.0
AMPH 112M AA	**6**	1.1	1.5	1180	8.9	86.0	88.0	87.5	0.63	2.5	6.5	2.8	2.0	2.9	20.1	34.2
AMPH 112M BA	**6**	1.5	2	1180	12.1	85.6	88.1	88.5	0.63	3.5	6.2	2.9	2.5	3.1	23.1	36.5
AMPH 112M CA	**6**	1.8	2.4	1170	14.7	86.3	88.3	88.5	0.66	3.9	6.4	3.0	2.6	3.2	23.1	36.5
AMPH 132S AA	**6**	2.2	3	1175	17.9	87.4	89.6	89.5	0.65	4.7	6.0	2.3	1.7	3.0	45	46
AMPH 132S BA	**6**	3	4	1175	24.4	88.2	89.8	89.5	0.66	6.4	6.5	2.5	1.7	3.2	45	48
AMPH 132M CA	**6**	4	5.5	1175	32.5	89.5	90.0	89.5	0.7	7.9	6.2	2.1	1.6	2.9	54	50
AMPH 160M AA	**6**	5.5	7.5	1180	44.5	88.4	90.4	91	0.78	9.8	8.2	2.8	2.6	3.5	103	84
AMPH 160M BA	**6**	7.5	10	1180	60.7	89.4	91.1	91	0.76	13.6	8.5	3.1	2.8	3.4	130	105
AMPH 160L CA	**6**	9.2	12.4	1175	74.8	90.0	91.5	91	0.77	16.4	8.1	3.0	2.7	3.6	136	115

HIGH EFFICIENCY THREE-PHASE MOTORS – IE2

EFFICIENCY LEVEL ACCORDING TO IEC 60034-30-1:2014
EFFICIENCY TESTING METHOD IEC 60034-2-1;2014

NOMINAL FULL LOAD EFFICIENCY ACCORDING TO IE2 CODE @ 400 V - 50 HZ; IE2 CODE @ 460 V - 60 HZ AND NEMA MG 1 - TABLE 12-11 (EPACT) @ 460 V - 60 HZ

Performance data referred @ 400 V - 50 Hz. For performance data @ 460 V - 60 Hz, please consult us.

FOR MAINS VOLTAGE
400 V - 50 HZ
460 V - 60 HZ

IE2

TEMPERATURE RISE TO CLASS B

Type		kW	HP	min^{-1}	M_N Nm	IE2 η 50%	IE2 η 75%	IE2 η 100%	cos φ	I_N 400V	I_A/I_N	M_A/M_N	M_S/M_N	M_K/M_N	J 10^{-3} kgm^2	kg
3000 min^{-1} (2 poles)																
ALUMINIUM DESIGN																
AMHE 71Z AA	**2***	0.75	1	2865	2.5	75.0	78.1	79.4	0.71	1.9	5.2	3.1	3.0	3.1	0.69	8.2
AMHE 80Z AA	**2**	0.75	1	2900	2.5	77.3	78.5	80.5	0.78	1.7	8.4	3.6	3.4	3.6	0.7	9.5
AMHE 80Z BA	**2**	1.1	1.5	2880	3.6	79.5	81.2	81.5	0.78	2.5	9.5	3.6	3.4	3.6	0.89	11.1
AMHE 80Z CA	**2***	1.5	2	2880	5.0	80.5	82.1	82.4	0.78	3.4	7.8	3.5	3.4	3.6	1.1	13.5
AMHE 90S AA	**2**	1.5	2	2880	5.0	81.0	82.8	82.8	0.80	3.2	10.1	3.6	3.1	4.0	1.56	14.0
AMHE 90L CA	**2**	2.2	3	2860	7.3	82.5	84.0	84.0	0.85	4.4	10.1	3.5	3.2	3.7	1.8	16.0
AMHE 90L DA	**2***	3	4	2880	9.9	85.0	86.0	85.6	0.82	6.1	9.9	3.5	3.3	3.8	2.0	18.0
AMHE 100L AA	**2**	3	4	2920	9.8	84.1	85.8	85.5	0.84	5.9	10.3	3.5	3.0	4.0	4.05	22.8
AMHE 100L BA	**2***	4	5.5	2920	13.1	85.2	86.4	86.1	0.86	7.8	10.4	3.3	3.0	3.8	4.1	22.8
AMHE 112M AA	**2**	4	5.5	2940	13.0	85.5	87.0	86.8	0.88	7.6	10.7	2.9	2.1	3.3	6.48	27.4
AMHE 112M BA	**2***	5.5	7.5	2920	18.0	85.8	87.4	87.3	0.88	10.4	9.9	3.0	2.1	3.2	8.58	34.0
AMHE 112M CA	**2***	7.5	10	2900	24.7	86.5	88.3	88.3	0.87	14.2	9.1	3.0	2.2	3.4	10.50	36.0
AMHE 132S YA	**2**	5.5	7.5	2900	18.1	86.0	88.0	87.9	0.89	10.2	8.6	2.7	2.3	3.2	14.0	46.0
AMHE 132S ZA	**2**	7.5	10	2900	24.7	86.3	88.6	88.4	0.89	13.8	8.9	2.8	2.5	3.3	16.0	53.0
AMHE 132M ZA	**2**	9.2	12.5	2920	30.1	88.4	89.9	90.0	0.87	16.9	9.4	3.2	3	3.8	17.5	58.0
AMHE 132M RA	**2***	11	15	2920	36.0	88.1	90.0	89.7	0.90	19.8	9.7	3.8	2.6	4.0	17.5	58.0
AMHE 132M TA	**2***	15	20	2920	49.1	88.9	90.6	90.3	0.89	27.0	9.7	3.8	2.2	4.0	21.0	64.0
AMHE 160M YA	**2**	11	15	2930	35.9	88.9	90.2	90.0	0.87	20.4	9.3	2.4	2.2	3.1	51.75	77.0
AMHE 160M ZA	**2**	15	20	2930	48.9	90.0	91.0	90.8	0.88	27.2	9.6	2.5	2.3	3.1	55.4	87.1
AMHE 160L ZA	**2**	18.5	25	2935	60.2	90.3	91.6	91.2	0.88	33.3	9.6	2.8	2.4	3.4	59.7	97.5
AMHE 160L TA	**2***	22	30	2935	71.6	91.0	91.7	91.5	0.89	38.6	9.9	3.0	2.6	3.7	64.0	108.7
CAST IRON DESIGN																
AMHE 180M ZG	**2**	22	30	2930	71.7	89.7	91.1	91.3	0.89	39.1	7.5	2.3	2.0	2.8	915	177
AMHE 200L PG	**2**	30	40	2925	97.9	91.5	92.3	92.0	0.88	53.5	6.7	2.4	2.0	2.7	1513	233
AMHE 200L RG	**2**	37	50	2930	120.6	92.4	92.9	92.5	0.90	64.2	6.3	2.3	2.0	2.7	1646	246
AMHE 225M PG	**2**	45	60	2930	146.7	92.5	93.1	92.9	0.88	79.5	6.9	2.3	2.0	2.8	2490	322
AMHE 250M PG	**2**	55	75	2940	178.6	92.0	93.0	93.2	0.88	96.8	8.0	2.3	1.9	2.7	4333	420
AMHE 280S G	**2**	75	100	2940	243.6	93.0	93.8	93.8	0.92	125.5	8.0	2.2	1.9	2.7	7986	572
AMHE 280M G	**2**	90	125	2940	292.3	92.9	93.9	94.1	0.92	150.1	7.7	2.2	1.9	2.6	9149	637
AMHE 315S G	**2**	110	150	2940	357.3	93.2	94.5	94.3	0.90	187.1	7.7	2.0	1.8	2.3	1542	920
AMHE 315M G	**2**	132	180	2940	428.7	93.4	94.8	94.6	0.91	221.3	7.6	2.0	1.8	2.3	1712	1020
AMHE 315MR G	**2**	160	220	2945	518.9	93.7	95.0	94.8	0.90	270.7	7.8	2.0	1.8	2.3	1906	1060
AMHE 315L G	**2**	200	270	2945	648.5	93.9	95.3	95.0	0.89	341.4	7.9	2.0	1.8	2.3	2197	1130

* Higher output (progressive motor)

HIGH EFFICIENCY THREE-PHASE MOTORS – IE2

EFFICIENCY LEVEL ACCORDING TO IEC 60034-30-1:2014
EFFICIENCY TESTING METHOD IEC 60034-2-1;2014

NOMINAL FULL LOAD EFFICIENCY ACCORDING TO IE2 CODE @ 400 V - 50 HZ; IE2 CODE @ 460 V - 60 HZ AND NEMA MG 1 - TABLE 12-11 (EPACT) @ 460 V - 60 HZ

Performance data referred @ 400 V - 50 Hz. For performance data @ 460 V - 60 Hz, please consult us.

FOR MAINS VOLTAGE
400 V - 50 HZ
460 V - 60 HZ

IE2

TEMPERATURE RISE TO CLASS B

Type		kW	HP	min^{-1}	M_N Nm	IE2 η 50%	IE2 η 75%	IE2 η 100%	cos φ	I_N 400V	I_A/I_N	M_A/M_N	M_S/M_N	M_K/M_N	J 10^{-3} kgm^2	kg
1500 min^{-1} (4 poles)																
ALUMINIUM DESIGN																
AMHE 80Z AA	**4**	0.75	1	1430	5.0	79.2	80.3	80.2	0.76	1.8	5.5	2.8	2.7	3.0	2.5	11.0
AMHE 90S AA	**4**	1.1	1.5	1430	7.3	81.4	82.7	82.5	0.77	2.5	6.1	4.0	3.9	4.1	3.73	18.0
AMHE 90L BA	**4**	1.5	2	1430	10.0	81.0	83.5	83.0	0.77	3.4	7.9	3.9	3.8	4.0	3.73	19.0
AMHE 100L AA	**4**	2.2	3	1450	14.5	84.0	85.3	85.1	0.74	5.1	6.0	3.2	3	3.4	5.58	22.4
AMHE 100L BA	**4**	3	4	1440	19.9	82.6	84.7	86.4	0.77	6.5	8.5	3.4	3.1	3.6	7.3	26.5
AMHE 112M AA	**4**	4	5.5	1450	26.3	86.0	87.3	87.1	0.78	8.5	6.1	3.1	2.8	3.3	13.3	30.4
AMHE 132S RA	**4**	5.5	7.5	1450	36.2	87.5	88.3	88.1	0.78	11.4	7.4	3.3	2.7	3.6	30.0	55.0
AMHE 132M TA	**4**	7.5	10	1450	49.4	88.5	89.4	89.2	0.74	16.4	7.4	3.0	2.4	3.3	36.0	65.0
AMHE 160M ZA	**4**	11	15	1460	71.9	89.4	90.3	90.1	0.82	22.0	7.9	2.3	2.1	2.9	105.0	108.0
AMHE 160L ZA	**4**	15	20	1460	98.1	90.6	91.2	91.0	0.84	29.0	7.4	2.5	2.2	3.1	120.7	114.0
CAST IRON DESIGN																
AMHE 180M ZG	**4**	18.5	25	2930	71.7	89.7	91.1	91.3	0.89	39.1	7.5	2.3	2.0	2.8	915	177
AMHE 180L ZG	**4**	22	30	1460	143.9	91.9	92.2	91.6	0.89	39.0	7.5	2.3	2.0	3.0	1702	183
AMHE 200L RG	**4**	30	40	2925	97.9	91.5	92.3	92.0	0.88	53.5	6.7	2.4	2.0	2.7	1513	233
AMHE 225S PG	**4**	37	50	2930	120.6	92.4	92.9	92.5	0.90	64.2	6.3	2.3	2.0	2.7	1646	246
AMHE 225M PG	**4**	45	60	1480	290.4	91.5	92.9	93.1	0.80	87.2	7.0	2.3	2.0	2.8	6531	352
AMHE 250M PG	**4**	45	60	2930	146.7	92.5	93.1	92.9	0.88	79.5	6.9	2.3	2.0	2.8	2490	322
AMHE 280S G	**4**	75	100	1480	483.9	93.8	94.3	94.0	0.91	126.6	7.5	2.2	1.9	2.6	1597	570
AMHE 280M G	**4**	55	75	2940	178.6	92.0	93.0	93.2	0.88	96.8	8.0	2.3	1.9	2.7	4333	420
AMHE 315S G	**4**	110	150	1480	709.8	93.2	94.8	94.5	0.90	186.7	7.8	2.0	1.8	2.3	3279	940
AMHE 315M G	**4**	75	100	2940	243.6	93.0	93.8	93.8	0.92	125.5	8.0	2.2	1.9	2.7	7986	572
AMHE 315M RG	**4**	90	125	2940	292.3	92.9	93.9	94.1	0.92	150.1	7.7	2.2	1.9	2.6	9149	637
AMHE 315L G	**4**	200	270	1480	1290.5	93.9	95.3	95.1	0.90	337.3	7.7	2.0	1.8	2.3	5046	1220

HIGH EFFICIENCY THREE-PHASE MOTORS – IE2

EFFICIENCY LEVEL ACCORDING TO IEC 60034-30-1:2014
EFFICIENCY TESTING METHOD IEC 60034-2-1;2014

FOR MAINS VOLTAGE
400 V - 50 HZ

IE2

TEMPERATURE RISE TO CLASS B

Type		kW	HP	min^{-1}	M_N Nm	IE2 η 50%	IE2 η 75%	IE2 η 100%	cos φ	I_N 400V	I_A/I_N	M_A/M_N	M_S/M_N	M_K/M_N	J 10^{-3} kgm²	kg
1000 min^{-1} (6 poles) ALUMINIUM DESIGN																
AMEE 90S AA	**6**	0.75	1	925	7.7	75.3	75.8	76.2	0.65	2.2	4.6	1.7	1.6	1.8	4.78	15.0
AMEE 90L BA	**6**	1.1	1.5	935	11.2	78.5	78.7	78.9	0.67	3.0	4.2	1.8	1.8	2.3	6.45	20.3
AMEE 100L AA	**6**	1.1	1.5	950	11.1	75.7	77.6	79.5	0.67	3.0	5.5	1.9	1.9	2.4	7.48	19.4
AMEE 100L BA	**6**	1.5	2	950	15.1	78.5	79.4	79.8	0.69	3.9	5.5	2.1	1.5	2.2	11.6	27.1
AMEE 112M AA	**6**	2.2	3	960	21.9	79.4	81.0	81.8	0.73	5.3	6.1	3.1	2.2	3.1	18.7	39.0
AMEE 132S YA	**6**	3	4	960	29.8	82.3	82.9	83.5	0.58	8.9	5.6	2.2	1.4	3.2	37.7	55.8
AMEE 132M YA	**6**	4	5.5	955	40.0	84.1	84.8	85.2	0.66	10.3	5.8	2.1	1.2	2.9	44.4	65.5
AMEE 132M TA	**6**	5.5	7.5	970	54.1	85.0	86.2	86.5	0.75	12.2	7.0	1.9	1.1	2.7	54.1	64.1
AMEE 160M YA	**6**	5.5	7.5	975	53.9	84.7	85.6	86.1	0.78	11.7	7.4	2.3	2.3	3.0	75.2	70.5
AMEE 160M ZA	**6**	7.5	10	970	73.8	85.8	87.3	87.5	0.78	15.8	7.7	3.0	2.8	3.8	103	96.6
AMEE 160L ZA	**6**	9.2	12.4	965	91.0	86.3	87.4	88.2	0.83	18.1	8.3	3.1	2.7	3.5	125	103
AMEE 160L TA	**6**	11	15	965	108.9	87.9	88.2	88.7	0.79	22.5	8.0	2.7	2.4	3.2	156	129

NOMINAL FULL LOAD EFFICIENCY ACCORDING TO IE2 CODE @ 400 V - 50 HZ; IE2 CODE @ 460 V - 60 HZ AND NEMA MG 1 - TABLE 12-11 (EPACT) @ 460 V - 60 HZ

Performance data referred @ 400 V - 50 Hz. For performance data @ 460 V - 60 Hz, please consult us.

FOR MAINS VOLTAGE
400 V - 50 HZ
460 V - 60 HZ

IE2

Type		kW	HP	min^{-1}	M_N Nm	IE3 η 50 %	IE3 η 75 %	IE3 η 100 %	cos φ	I_N 400 V	I_A/I_N	M_A/M_N	M_S/M_N	M_K/M_N	J 10^{-3} kgm²	kg
CAST IRON DESIGN																
AMHE 180LZ G	**6**	15	20	960	149.2	86.9	89.1	89.7	0.83	29.1	7.8	2.3	2.1	2.9	287	183
AMHE 200LP G	**6**	18.5	25	965	183.1	89.2	90.4	90.4	0.85	34.8	7.8	2.4	2.1	3.2	405	232
AMHE 200LR G	**6**	22	30	965	217.7	90.2	91.1	90.9	0.86	40.6	7.9	2.3	1.9	3.1	471	250
AMHE 225MP G	**6**	30	40	975	293.8	91.7	92.1	91.7	0.85	55.6	7.9	2.2	1.9	2.7	670	335
AMHE 250MP G	**6**	37	50	975	362.4	91.4	92.3	92.2	0.83	69.8	7.5	2.3	2.1	2.7	992	398
AMHE 280S G	**6**	45	60	980	438.5	92.6	93.1	92.7	0.86	81.5	7.2	2.3	2.0	2.8	1774	505
AMHE 280M G	**6**	55	75	980	535.9	92.5	93.2	93.1	0.86	99.2	7.7	2.2	1.9	2.7	2197	596
AMHE 315S G	**6**	75	100	980	730.8	92.3	94.0	93.7	0.89	129.8	7.9	2.1	1.9	2.5	3530	807
AMHE 315M G	**6**	90	125	980	877.0	92.3	94.6	94.0	0.90	153.6	8.0	2.0	1.8	2.3	4270	960
AMHE 315M RG	**6**	110	150	980	1071.9	92.4	94.8	94.3	0.90	187.1	7.7	2.0	1.8	2.3	4995	1000
AMHE 315L G	**6**	132	160	980	1286.2	92.4	94.9	94.6	0.89	226.3	8.0	2.0	1.8	2.3	6081	1080

HIGH EFFICIENCY THREE-PHASE MOTORS – IE2

EFFICIENCY LEVEL ACCORDING TO EPACT
EFFICIENCY TESTING METHOD CSA C390
VERIFIED BY UL UNDERWRITERS LABORATORIES INC.

NOMINAL FULL LOAD EFFICIENCY ACCORDING TO NEMA MG 1 - TABLE 12-11 (EPACT) AND IE2 CODE

FOR MAINS VOLTAGE
460 V - 60 HZ

IE2 ENERGY C UL US

TEMPERATURE RISE TO CLASS B
S.F. 1.15

Type		kW	HP	min^{-1}	M_N Nm	IE2 η 50%	IE2 η 75%	IE2 η 100%	cos φ	I_N 460V	I_A/I_N	M_A/M_N	M_S/M_N	M_K/M_N	J 10^{-3} kgm^2	kg
3600 min^{-1} (2 poles)																
AMH 80Z AA	**2**	0.75	1	3480	2.1	77.1	81.5	83.2	0.80	1.5	9.7	4.50	4.5	4.8	1.1	9.5
AMH 80Z BA	**2**	1.1	1.5	3480	3.0	77.8	81.5	83.3	0.80	2.0	9.6	3.5	3.4	3.7	1.2	11.1
AMH 90S AA	**2**	1.5	2	3470	4.1	83.8	84.9	84.3	0.88	2.7	10.4	3.1	3	3.6	1.6	14.0
AMH 90L BA	**2**	2.2	3	3500	6.0	85.4	86.6	86.3	0.84	3.9	9.8	4.4	4	4.4	1.8	16.0
AMH 100L AA	**2**	2.2	3	3530	6.0	86.5	87.9	87.8	0.84	3.9	11.5	4.7	4.1	5.5	3.3	19.7
AMH 100L BA	**2**	3	4	3525	8.1	86.4	87.8	87.7	0.82	5.0	10.5	5.6	5.3	5.8	4.0	22.8
AMH 112M AA	**2**	3.7	5	3530	10.0	86.1	88.4	88.1	0.84	6.3	16.5	5.7	2.1	5.8	8.6	33.6
AMH 112M AA	**2**	4	5.5	3540	10.8	86.1	88.3	88.0	0.87	6.6	15.5	5.3	1.9	5.4	8.6	33.6
AMH 112M BA	**2***	5.5	7.5	3500	15.0	85.0	88.6	88.5	0.85	9.3	13.6	4.5	2.5	4.3	8.6	34.0
AMH 132S ZA	**2**	5.5	7.5	3520	14.9	86.1	88.2	88.5	0.87	9.2	10.9	3.3	2.9	3.7	20.5	53.0
AMH 132S TA	**2**	7.5	10	3510	20.4	89.7	90.1	89.5	0.91	11.0	12.9	3.4	2.9	3.9	20.5	53.0
AMH 132M TA	**2**	9.2	12.4	3520	25.0	88.8	89.9	89.5	0.91	14.0	12.1	3.3	2.9	3.9	25	59.0
AMH 160M YA	**2**	11	15	3550	29.6	90.1	91.0	91.0	0.88	17.3	13.6	2.8	2.2	3.6	51.7	87.8
AMH 160M ZA	**2**	15	20	3545	40.4	91.2	89.9	91.0	0.88	23.5	12.2	2.8	2.2	3.6	64	104
AMH 160L ZA	**2**	18.5	25	3550	49.8	91.5	92.0	91.7	0.87	28.8	12.4	2.8	2.2	3.6	64	105

* Higher output (progressive motor)

Type		kW	HP	min^{-1}	M_N Nm	IE2 η 50%	IE2 η 75%	IE2 η 100%	cos φ	I_N 460V	I_A/I_N	M_A/M_N	M_S/M_N	M_K/M_N	J 10^{-3} kgm^2	kg
1800 min^{-1} (4 poles)																
AMH 80Z AA	**4**	0.75	1	1740	4.1	77.8	81.5	82.8	0.72	1.6	6.5	3.3	3.4	3.8	2.4	10.6
AMH 90L AA	**4**	1.1	1.5	1745	6.0	82.2	84.2	84.2	0.76	2.1	8	3.8	4	4.6	3.7	16.4
AMH 90L BA	**4**	1.5	2	1735	8.3	82.1	84.4	84.4	0.73	3.1	8.7	4	3.9	4.2	3.7	16.4
AMH 90L CA	**4**	1.8	2.4	1720	10.0	82.2	84.3	84.3	0.77	3.4	8.2	4.4	3.3	4	3.7	16.4
AMH 100L AA	**4**	2.2	3	1750	12.0	85.8	87.6	87.5	0.70	4.6	8.4	3.8	3.1	3.9	5.6	22.4
AMH 100L BA	**4**	3	4	1740	16.5	85.7	87.7	87.6	0.76	5.6	9.4	3	2.8	3.2	7.3	26.5
AMH 112M AA	**4**	3.7	5	1750	20.2	86.3	87.9	87.8	0.79	6.8	6.9	4.2	3.5	4.5	13.3	30.4
AMH 112M AA	**4**	4	5.5	1745	21.9	86.5	88.1	88	0.81	7.0	6.7	3.9	3.2	4.2	13.3	30.4
AMH 132S ZA	**4**	5.5	7.5	1755	29.9	88.8	89.8	89.5	0.84	9.4	8.5	3.4	2.8	3.7	30	56.0
AMH 132M ZA	**4**	7.5	10	1750	40.9	89.5	90.2	89.5	0.84	12.4	9.1	3.5	2.9	3.8	36	65.0
AMH 132M TA	**4**	9.2	12.4	1745	50.3	89.2	90.0	89.5	0.84	16.0	8.8	3.6	2.9	3.9	36	63.0
AMH 160M ZA	**4**	11	15	1770	59.3	90.8	91.4	91	0.84	18.5	8.9	3.2	2.3	3.4	105.7	108
AMH 160L ZA	**4**	15	20	1770	80.9	91.4	91.6	91	0.84	24.0	8.2	3.2	2.3	3.4	120.7	114

HIGH EFFICIENCY THREE-PHASE MOTORS – IE2

EFFICIENCY LEVEL ACCORDING TO EISA
EFFICIENCY TESTING METHOD CSA C390-10
VERIFIED BY UL ENVIRONMENT

NOMINAL FULL LOAD EFFICIENCY ACCORDING TO NEMA MG 1 - TABLE 12-11

FOR MAINS VOLTAGE
460 V - 60 HZ

IE2 ENERGY C UL US

TEMPERATURE RISE TO CLASS B
S.F. 1.15
IEC - DESIGN H

Type		kW	HP	min^{-1}	M_N Nm	IE2 η 50%	IE2 η 75%	IE2 η 100%	cos φ	I_N 460V	I_A/I_N	M_A/M_N	M_S/M_N	M_K/M_N	J 10^{-3} kgm^2	kg
1200 min^{-1} (6 poles)																
AMH 90S AA	**6**	0.75	1	1145	6.3	78.6	80.5	80.0	0.60	2.0	4.3	2.6	2.3	2.8	6.0	18.1
AMH 90L BA	**6**	0.9	1.2	1150	7.5	76.0	80.1	80.0	0.56	2.5	5.1	3.1	2.8	3.4	6.5	19.0
AMH 100L AA	**6**	1.1	1.5	1180	8.9	83.0	85.2	85.5	0.52	3.1	5.8	2.4	1.9	3.9	14.2	26.0
AMH 112M AA	**6**	1.1	1.5	1175	8.9	84.3	85.6	85.5	0.62	2.5	6.3	3.0	2.5	3.6	12.9	26.7
AMH 112M BA	**6**	1.5	2	1175	12.2	85.2	86.4	86.5	0.60	3.6	6.0	2.9	2.5	3.5	15.5	29.3
AMH 112M CA	**6**	2.2	3	1175	17.9	85.2	87.4	87.5	0.60	5.2	6.1	2.8	2.5	3.3	20.1	34.2
AMH 132S YA	**6**	3	4	1175	24.4	86.2	87.4	87.5	0.64	6.6	6.0	2.3	1.7	3.2	37.7	42.0
AMH 132M YA	**6**	4	5.5	1170	32.6	86.5	87.6	87.5	0.61	9.2	6.1	2.3	1.7	3.2	44.4	46.0
AMH 132M TA	**6**	5.5	7.5	1180	44.5	88.0	89.6	89.5	0.55	14.5	6.0	2.3	1.8	3.6	54.1	48.0
AMH 160M ZA	**6**	7.5	10	1170	61.2	88.1	89.3	89.5	0.77	13.7	8.0	2.8	2.6	3.5	103.0	84.0
AMH 160L TA	**6**	11	15	1170	89.8	89.1	90.4	90.2	0.78	19.2	8.6	3.1	2.9	4.0	136.0	105.0

HIGH EFFICIENCY THREE-PHASE MOTORS – IE2

EFFICIENCY LEVEL ACCORDING TO IEC 60034-30-1:2014
EFFICIENCY TESTING METHOD IEC 60034-2-1;2014

FOR MAINS VOLTAGE
400 V - 50 HZ

IE2

TEMPERATURE RISE TO CLASS B

Type		kW	HP	min^{-1}	M_N Nm	IE2 η 50%	IE2 η 75%	IE2 η 100%	cos φ	I_N 400V	I_A/I_N	M_A/M_N	M_S/M_N	M_K/M_N	J 10^{-3} kgm^2	kg
3000 min^{-1} (2 poles)																
AMEE 71Z AA	**2***	0.75	1	2820	2.5	73.3	76.5	77.5	0.74	1.9	5.5	3.4	3.2	3.4	0.61	7.2
AMEE 80Z AA	**2**	0.75	1	2825	2.5	71.7	76.1	77.4	0.74	1.9	7.5	4.3	4.1	4.4	0.75	8.4
AMEE 80Z BA	**2**	1.1	1.5	2820	3.7	77.6	80.0	79.6	0.78	2.5	7.6	4.3	4.1	4.4	0.96	12.0
AMEE 80Z CA	**2***	1.5	2	2880	5.0	80.5	82.1	82.3	0.83	3.4	7.7	4.3	4.1	4.4	1.1	13.5
AMEE 90S AA	**2**	1.5	2	2850	5.0	79.1	81.4	81.3	0.80	3.4	6.8	3.0	3.0	3.1	1.37	12.7
AMEE 90L CA	**2**	2.2	3	2870	7.3	80.5	83.2	83.6	0.81	4.7	6.8	3.0	3.0	3.2	1.8	16.0
AMEE 90L DA	**2***	3	4	2870	10.0	82.4	84.5	84.6	0.79	6.6	6.8	3.4	3.4	3.9	2.1	18.7
AMEE 100L AA	**2**	3	4	2900	9.9	83.5	84.6	84.6	0.86	5.9	9.8	4.3	3.6	4.0	3.3	19.7
AMEE 100L BA	**2***	4	5.5	2910	13.1	85.3	86.7	86.6	0.83	8.0	9.8	4.2	3.6	4.0	4.1	22.8
AMEE 112M AA	**2**	4	5.5	2900	13.2	82.8	85.2	85.8	0.82	8.3	9.1	3.2	3.2	3.5	12.2	29.5
AMEE 112M BA	**2***	5.5	7.5	2920	18.0	85.8	87.4	87.3	0.88	10.4	8.7	3.1	2.6	3.5	8.58	34.0
AMEE 112M CA	**2***	7.5	10	2900	24.7	86.5	88.3	88.3	0.92	13.2	9.6	3.4	2.8	3.7	10.5	36.0
AMEE 132S YA	**2**	5.5	7.5	2910	18.0	85.9	87.8	87.8	0.84	11.0	8.2	2.7	2.7	3.2	10.63	37.0
AMEE 132S ZA	**2**	7.5	10	2910	24.6	89.3	89.5	88.9	0.86	14.1	8.2	2.7	2.7	3.2	13.8	42.6
AMEE 132M ZA	**2**	9.2	12.5	2920	30.1	89.1	90.4	89.4	0.90	16.3	9.4	3.0	2.8	4.0	16.0	53.0
AMEE 132M RA	**2***	11	15	2920	36.0	88.1	90.0	89.7	0.90	19.8	9.6	3.0	2.9	4.2	17.5	58.0
AMEE 132M TA	**2***	15	20	2920	49.1	88.9	90.6	90.3	0.89	27.0	9.6	3.8	2.2	4.0	21.0	64.0
AMEE 160M YA	**2**	11	15	2935	35.8	87.7	89.4	89.6	0.81	22.0	8.6	3.6	2.8	3.1	40.0	77.0
AMEE 160M ZA	**2**	15	20	2930	48.9	89.9	90.8	90.3	0.89	26.7	9.2	3.5	2.6	3.3	51.8	77.0
AMEE 160L ZA	**2**	18.5	25	2930	60.3	89.0	90.6	90.9	0.81	36.3	8.7	3.3	3.1	3.9	53.4	88.9
AMEE 160L TA	**2**	22	30	2935	71.6	91.0	91.7	91.5	0.90	38.6	9.0	4.4	4.3	3.6	64.0	108.7

* Higher output (progressive motor)

HIGH EFFICIENCY THREE-PHASE MOTORS – IE2

EFFICIENCY LEVEL ACCORDING TO IEC 60034-30-1:2014
EFFICIENCY TESTING METHOD IEC 60034-2-1;2014

FOR MAINS VOLTAGE
400 V - 50 HZ

IE2

TEMPERATURE RISE TO CLASS B

Type		kW	HP	min^{-1}	M_N Nm	IE2 η 50%	IE2 η 75%	IE2 η 100%	cos φ	I_N 400V	I_A/I_N	M_A/M_N	M_S/M_N	M_K/M_N	J 10^{-3} kgm^2	kg
1500 min^{-1} (4 poles)																
AMEE 80Z AA	**4**	0.75	1	1410	5.1	78.6	80.2	80.0	0.80	1.7	6.0	3.0	2.7	2.9	2.3	9.9
AMEE 80Z BA	**4***	1.1	1.5	1420	7.4	78.3	81.0	81.4	0.72	2.7	6.0	3.0	2.7	2.9	2.5	11.0
AMEE 90S AA	**4**	1.1	1.5	1420	7.4	78.5	81.1	81.4	0.72	2.7	7.7	3.8	3.7	3.8	2.7	11.5
AMEE 90L BA	**4**	1.5	2	1415	10.1	81.3	82.8	82.8	0.70	3.8	7.8	3.9	3.8	4.1	3.1	14.5
AMEE 90L CA	**4**	1.8	2.4	1420	12.1	84.1	84.9	84.0	0.77	4.0	7.8	3.9	3.8	4.1	3.7	16.4
AMEE 100L AA	**4**	2.2	3	1440	14.6	83.0	84.6	84.3	0.77	4.9	7.2	3.7	3.2	3.9	5.6	22.5
AMEE 100L BA	**4**	3	4	1430	20.0	83.7	84.9	85.5	0.74	6.8	7.3	3.7	3.2	3.9	6.05	25.0
AMEE 112M AA	**4**	4	5.5	1450	26.3	86.0	87.3	87.1	0.78	8.5	7.4	2.6	2.4	3.2	13.3	30.4
AMEE 112M BA	**4***	5.5	7.5	1445	36.3	86.8	88.3	88.1	0.78	11.6	8.6	2.8	2.6	3.3	17.4	38.9
AMEE 132S RA	**4**	5.5	7.5	1455	36.1	86.2	86.9	87.8	0.76	11.8	7.9	3.7	3.5	3.8	26.5	49.0
AMEE 132M TA	**4**	7.5	10	1450	49.4	87.5	88.8	88.7	0.74	15.6	7.8	3.7	3.5	3.8	36.0	65.0
AMEE 132M ZA	**4**	9.2	12.4	1450	60.6	86.9	89.2	89.3	0.77	19.5	8.1	3.6	3.5	3.9	42.0	63.0
AMEE 160M ZA	**4**	11	15	1460	71.9	89.4	90.3	90.1	0.82	22.0	7.9	3.6	2.6	2.7	105.0	108.0
AMEE 160L ZA	**4**	15	20	1460	98.1	90.6	91.2	91.0	0.84	29.0	7.9	3.6	2.6	2.7	120.7	114.0

* Higher output (progressive motor)

Type		kW	HP	min^{-1}	M_N Nm	IE2 η 50%	IE2 η 75%	IE2 η 100%	cos φ	I_N 400V	I_A/I_N	M_A/M_N	M_S/M_N	M_K/M_N	J 10^{-3} kgm^2	kg
1000 min^{-1} (6 poles)																
AMEE 90S AA	**6**	0.75	1	925	7.7	75.3	75.8	76.2	0.65	2.2	4.6	1.7	1.6	1.8	4.78	15.0
AMEE 90L BA	**6**	1.1	1.5	935	11.2	78.5	78.7	78.9	0.67	3.0	4.2	1.8	1.8	2.3	6.45	20.3
AMEE 100L AA	**6**	1.1	1.5	950	11.1	75.7	77.6	79.5	0.67	3.0	5.5	1.9	1.9	2.4	7.48	19.4
AMEE 100L BA	**6**	1.5	2	950	15.1	78.5	79.4	79.8	0.69	3.9	5.5	2.1	1.5	2.2	11.6	27.1
AMEE 112M AA	**6**	2.2	3	960	21.9	79.4	81.0	81.8	0.73	5.3	6.1	3.1	2.2	3.1	18.7	39.0
AMEE 132S YA	**6**	3	4	960	29.8	82.3	82.9	83.5	0.58	8.9	5.6	2.2	1.4	3.2	37.7	55.8
AMEE 132M YA	**6**	4	5.5	955	40.0	84.1	84.8	85.2	0.66	10.3	5.8	2.1	1.2	2.9	44.4	65.5
AMEE 132M TA	**6**	5.5	7.5	970	54.1	85.0	86.2	86.5	0.75	12.2	7.0	1.9	1.1	2.7	54.1	64.1
AMEE 160M YA	**6**	5.5	7.5	975	53.9	84.7	85.6	86.1	0.78	11.7	7.4	2.3	2.3	3.0	75.2	70.5
AMEE 160M ZA	**6**	7.5	10	970	73.8	85.8	87.3	87.5	0.78	15.8	7.7	3.0	2.8	3.8	103	96.6
AMEE 160L ZA	**6**	9.2	12.4	965	91.0	86.3	87.4	88.2	0.83	18.1	8.3	3.1	2.7	3.5	125	103
AMEE 160L TA	**6**	11	15	965	108.9	87.9	88.2	88.7	0.79	22.5	8.0	2.7	2.4	3.2	156	129

STANDARD EFFICIENCY THREE-PHASE MOTORS – IE1

EFFICIENCY LEVEL ACCORDING TO IEC 60034-30-1:2014
EFFICIENCY TESTING METHOD IEC 60034-2-1;2014

IE code not applicable to motors 2, 4, 6 poles with PN < 0.75 kW. Efficiency testing method: IEC 60034-2;1996

FOR MAINS VOLTAGE
400 V - 50 HZ

IE1

TEMPERATURE RISE TO CLASS B

Type		kW	HP	min^{-1}	M_N Nm	IE1 η 50%	IE1 η 75%	IE1 η 100%	cos φ	I_N 400V	I_N 380-420V	I_A/I_N	M_A/M_N	M_S/M_N	M_K/M_N	J 10^{-3} kgm^2	kg
3000 min^{-1} (2 poles)																	
AM 56Z AA	**2**	0.09	0.12	2810	0.3	49.0	53.0	59.0	0.67	0.35	0.40	3.9	3.8	3.8	3.9	0.09	3.4
AM 56Z BA	**2**	0.12	0.16	2800	0.4	51.0	56.0	62.0	0.68	0.40	0.45	3.5	3.4	3.4	3.5	0.10	3.5
AM 63Z AA	**2**	0.18	0.25	2790	0.6	54	58	63.0	0.73	0.60	0.65	3.7	3.0	3.0	3.1	0.14	3.6
AM 63Z BA	**2**	0.25	0.33	2790	0.9	57	62	66.0	0.70	0.80	0.75	4.5	3.2	3.2	3.3	0.17	4.1
AM 63Z CA	**2***	0.37 [1]	0.50 [1]	2800	1.3	54	58	65.0	0.70	1.20	1.25	4.6	3.4	3.3	3.4	0.20	4.4
AM 71Z AA	**2**	0.37	0.50	2820	1.3	58.0	64.0	70.0	0.78	1.0	1.2	4.7	3.6	3.4	3.6	0.32	5.8
AM 71Z BA	**2**	0.55	0.75	2830	1.9	57.0	64.0	71.0	0.77	1.5	1.6	4.8	3.2	3.1	3.3	0.37	6.2
AM 71Z CA	**2***	0.75 [1]	1 [1]	2800	2.6	58.9	65.7	72.6	0.76	2.0	2.1	5.2	3.1	3.2	3.1	0.48	7.2
AM 80Z AA	**2**	0.75	1	2840	2.5	66.3	71.5	73.0	0.78	1.9	2.0	5.0	2.8	2.8	2.9	0.6	8.4
AM 80Z BA	**2**	1.1	1.5	2810	3.7	72.1	75.0	75.3	0.82	2.5	2.6	4.6	2.4	2.8	2.9	0.75	9.5
AM 80Z CA	**2***	1.5 [1]	2 [1]	2825	5.1	74.7	77.5	77.8	0.83	3.3	3.4	5.0	2.9	3.0	3.3	1.92	11.1
AM 90S AA	**2**	1.5	2	2830	5.1	75.6	78.7	78.6	0.82	3.4	3.5	5.0	3.1	2.9	3.0	1.23	12.7
AM 90S BA	**2***	1.8	2.5	2805	6.1	74.9	78.0	78.2	0.80	4.2	4.3	4.5	2.6	2.4	2.5	1.23	12.7
AM 90L CA	**2**	2.2	3	2860	7.3	81.5	82.8	81.8	0.81	4.9	4.9	7.1	4.1	3.6	4.0	1.68	16.0
AM 90L DA	**2***	3 [1]	4 [1]	2860	10.0	78.7	81.8	82.2	0.80	6.6	6.8	7.2	3.9	3.4	3.8	2.16	18.7
AM 100L AA	**2**	3	4	2860	10.0	78.9	81.4	81.5	0.85	6.4	6.7	6.0	3.1	3.1	3.3	2.36	19.3
AM 100L BA	**2***	4 [1]	5.5 [1]	2835	13.5	81.1	82.5	81.7	0.88	8.0	8.1	6.2	2.9	2.5	2.9	2.90	19.7
AM 100L CA	**2***	5.5 [1]	7.5 [1]	2865	18.3	83.7	84.6	83.3	0.86	11.1	11.3	7.2	3.5	3.4	4.1	3.90	25.9
AM 112M AA	**2**	4	5.5	2880	13.3	81.9	84.0	83.5	0.82	8.4	8.7	8.0	3.4	3.5	3.6	4.65	24.3
AM 112M BA	**2***	5.5	7.5	2900	18.1	83.6	84.7	85.0	0.86	10.9	11.2	7.8	3.5	3.4	3.6	5.80	27.4
AM 112M CA	**2***	7.5	10	2900	24.7	86.7	87.8	87.1	0.87	14.3	14.8	8.7	4.0	3.9	4.0	8.50	33.6
AM 132S YA	**2**	5.5	7.5	2890	18.2	83.2	84.7	85.0	0.83	11.3	11.4	6.0	2.2	2.1	2.3	9.50	37.0
AM 132S ZA	**2**	7.5	10	2880	24.9	85.6	86.7	86.1	0.87	14.5	14.9	6.4	2.9	2.7	3.1	12.30	42.6
AM 132M ZA	**2***	9.2	12.5	2900	30.3	84.7	86.8	87.0	0.84	18.4	18.8	7.0	2.8	2.4	3.2	13.20	48.0
AM 132M RA	**2***	11	15	2880	36.5	87.1	88.1	88.0	0.85	21.3	21.7	6.9	3.2	2.8	3.8	16.00	52.5
AM 132M TA	**2***	15 [1]	20 [1]	2920	49.1	86.4	88.6	88.9	0.83	29.5	30.5	7.0	3.2	2.8	3.7	21.20	59.0
AM 160M VA	**2**	11	15	2940	35.7	83.4	86.4	87.7	0.83	21.9	22.7	7.4	2.5	2.3	3.1	33.10	77.0
AM 160M XA	**2**	15	20	2940	48.7	87.3	88.9	88.9	0.85	28.6	29.2	8.1	3.1	2.6	3.7	43.90	94.0
AM 160L XA	**2**	18.5	25	2950	59.9	88.2	89.7	89.6	0.87	34.3	34.8	8.5	3.6	3.0	4.2	57.00	107.8
AM 160L RA	**2***	22	30	2940	71.5	88.7	90.5	90.4	0.90	39.1	39.4	8.4	3.0	2.6	3.7	57.00	108.7

1) Temperature rise to class F
* Higher output (progressive motor)

STANDARD EFFICIENCY THREE-PHASE MOTORS – IE1

EFFICIENCY LEVEL ACCORDING TO IEC 60034-30-1:2014
EFFICIENCY TESTING METHOD IEC 60034-2-1;2014

IE code not applicable to motors 2, 4, 6 poles with PN < 0.75 kW. Efficiency testing method: IEC 60034-2;1996

FOR MAINS VOLTAGE
400 V - 50 HZ

IE1

TEMPERATURE RISE TO CLASS B

Type		kW	HP	min^{-1}	M_N Nm	IE1 η 50%	IE1 η 75%	IE1 η 100%	cos φ	I_N 400V	I_N 380-420V	I_A/I_N	M_A/M_N	M_S/M_N	M_K/M_N	J 10^{-3} kgm^2	kg
1500 min^{-1} (4 poles)																	
AM 56Z AA	**4**	0.06	0.08	1300	0.4	42.0	44.0	48.0	0.70	0.28	0.32	2.6	2.1	2.0	2.1	0.14	2.7
AM 56Z BA	**4**	0.09	0.12	1330	0.6	43.0	47.0	51.0	0.74	0.35	0.40	2.5	2.2	2.1	2.2	0.16	2.9
AM 63Z AA	**4**	0.12	0.16	1350	0.8	46.0	50.0	57.0	0.65	0.50	0.55	2.4	2.0	1.9	2.0	0.25	3.3
AM 63Z BA	**4**	0.18	0.25	1330	1.3	47.0	50.0	58.0	0.70	0.65	0.70	2.3	1.9	1.8	1.9	0.27	4.1
AM 63Z CA	**4***	0.25	0.33	1360	1.8	49.0	52.5	58.0	0.74	0.85	0.90	2.7	2.2	2.0	2.1	0.30	4.2
AM 71Z AA	**4**	0.25	0.33	1340	1.8	55.0	59.0	64.0	0.66	0.90	1.00	3.2	1.9	1.8	2.0	0.65	5.7
AM 71Z BA	**4**	0.37	0.50	1370	2.6	60.0	63.0	67.0	0.67	1.20	1.25	3.3	2.2	2.1	2.2	0.76	6.0
AM 71Z CA	**4***	0.55 [1]	0.75 [1]	1380	3.8	61.0	64.0	69.0	0.68	1.70	1.80	3.6	2.4	2.3	2.4	1.00	7.3
AM 80Z AA	**4**	0.55	0.75	1400	3.8	67.0	69.0	70.0	0.72	1.6	1.7	3.6	2.6	2.5	2.6	1.38	8.2
AM 80Z BA	**4**	0.75	1	1410	5.1	68.7	70.8	72.4	0.72	2.1	2.2	4.4	2.8	2.3	2.8	1.78	9.3
AM 80Z CA	**4***	1.1 [1]	1.5 [1]	1385	7.6	73.4	75.7	75.2	0.77	2.8	2.9	4.4	2.5	2.5	2.6	2.18	10.6
AM 90S AA	**4**	1.1	1.5	1400	7.5	75.8	76.0	75.4	0.78	2.7	2.9	5.2	2.5	2.4	2.8	2.20	12.5
AM 90L BA	**4**	1.5	2	1400	10.2	77.6	77.8	77.5	0.78	3.6	3.7	5.7	2.8	2.6	3.0	2.80	14.5
AM 90L CA	**4**	1.8 [1]	2.5 [1]	1380	12.5	76.3	76.5	75.9	0.81	4.2	4.3	5.5	2.7	2.5	2.9	3.35	14.5
AM 90L DA	**4***	2.2 [1]	3 [1]	1400	15.0	78.3	78.5	77.9	0.77	5.3	5.5	4.8	2.9	2.8	3.2	3.65	17.0
AM 100L AA	**4**	2.2	3	1435	14.6	76.5	79.1	79.9	0.74	5.4	5.6	5.3	2.5	2.4	2.7	4.50	19.5
AM 100L BA	**4**	3	4	1425	20.1	82.0	83.0	81.6	0.78	6.8	6.9	4.6	2.4	2.3	2.5	5.75	22.5
AM 100L CA	**4***	4 [1]	5.5 [1]	1400	27.3	80.8	81.8	80.4	0.78	9.2	9.3	6.0	2.6	2.4	2.9	6.30	25.0
AM 112M AA	**4**	4	5.5	1430	26.7	83.2	83.9	83.1	0.82	8.5	8.8	6.3	2.2	2.0	2.8	10.70	29.5
AM 112M BA	**4***	5.5 [1]	7.5 [1]	1430	36.7	84.1	84.8	84.0	0.83	11.4	11.7	6.5	2.2	2.0	2.9	13.50	34.0
AM 132S ZA	**4**	5.5	7.5	1430	36.7	87.2	87.1	86.1	0.82	11.3	11.7	5.8	3.0	2.7	3.0	21.20	41.9
AM 132M ZA	**4**	7.5	10	1440	49.7	87.3	87.2	86.2	0.83	15.3	15.5	6.8	3.1	2.7	3.1	27.80	51.0
AM 132M RA	**4**	9.2	12.5	1440	61.0	86.5	87.5	87.3	0.86	17.7	17.9	8.0	3.5	3.2	3.5	31.50	65.0
AM 132M TA	**4***	11.0 [1]	15 [1]	1440	72.9	83.5	83.9	84.5	0.87	21.5	22.0	8.3	3.1	3.0	3.3	31.50	65.0
AM 160M XA	**4**	11	15	1460	71.9	88.5	89.3	88.7	0.80	22.4	22.7	7.5	2.5	2.2	3.1	66.8	88.5
AM 160L XA	**4**	15	20	1460	98.1	89.4	90.2	89.6	0.84	28.8	29.6	7.0	2.5	2.2	3.3	87.8	106.5
AM 160L ZA	**4***	18.5	25	1460	121.8	89.9	90.7	90.1	0.84	35.4	36	7.6	2.5	2.2	3.3	100.50	117.3
AM 160L RA	**4***	22	30	1460	143.9	90.4	91.2	90.6	0.86	41.0	42	7.8	2.4	2.2	3.2	112.50	128.1

1) Temperature rise to class F
* Higher output (progressive motor)

STANDARD EFFICIENCY THREE-PHASE MOTORS – IE1

EFFICIENCY LEVEL ACCORDING TO IEC 60034-30-1:2014
EFFICIENCY TESTING METHOD IEC 60034-2-1;2014

IE code not applicable to motors 2, 4, 6 poles with PN < 0.75 kW. Efficiency testing method: IEC 60034-2;1996

FOR MAINS VOLTAGE
400 V - 50 HZ

IE1

TEMPERATURE RISE TO CLASS B

Type		kW	HP	min^{-1}	M_N Nm	IE1 η 50%	IE1 η 75%	IE1 η 100%	cos φ	I_N 400V	I_N 380-420V	I_A/I_N	M_A/M_N	M_S/M_N	M_K/M_N	J 10^{-3} kgm^2	kg
1000 min^{-1} (6 poles)																	
AM 71Z AA	**6**	0.18	0.25	880	2.0	46.0	48.0	53.0	0.60	0.85	0.9	2.2	1.6	1.5	1.6	1.00	6.1
AM 71Z BA	**6**	0.25 [1]	0.33 [1]	880	2.7	46.0	50.0	54.0	0.62	1.10	1.2	2.5	1.7	1.6	1.7	1.19	6.6
AM 80Z AA	**6**	0.37	0.5	920	3.8	47.0	58.0	60.0	0.70	1.25	1.3	2.7	1.6	1.6	2.1	1.83	8.0
AM 80Z BA	**6**	0.55	0.75	920	5.7	60.0	64.0	68.0	0.67	1.75	1.8	2.9	2.2	2.1	2.1	2.36	9.4
AM 90S AA	**6**	0.75	1	910	7.9	70.5	72.5	71.5	0.63	2.4	2.5	2.9	1.7	1.5	1.7	2.90	11.6
AM 90L BA	**6**	1.1	1.5	920	11.4	72.0	73.5	73.0	0.66	3.3	3.4	3.0	1.7	1.5	1.7	4.38	15.0
AM 100L AA	**6**	1.5	2	930	15.4	73.3	75.8	75.3	0.69	4.2	4.4	3.7	1.8	1.8	2.3	6.35	17.5
AM 100L BA	**6**	1.8	2.5	940	18.3	74.6	77.1	76.6	0.67	5.1	5.3	4.2	2.4	2.4	2.8	9.00	22.0
AM 112M AA	**6**	2.2	3	940	22.4	77.0	79.0	78.0	0.74	5.3	5.4	4.4	2.4	2.4	2.6	12.85	26.0
AM 112M CA	**6***	3	4	940	30.5	81.8	82.8	82.8	0.74	7.0	7.2	5.3	2.9	2.9	2.9	17.90	39.0
AM 132S ZA	**6**	3	4	950	30.2	79.5	81.5	81.3	0.72	7.4	7.5	4.9	2.0	1.8	2.4	21.40	36.7
AM 132M YA	**6**	4	5.5	950	40.2	81.4	83.1	82.7	0.71	9.9	10.5	4.5	2.2	2.0	2.5	28.90	42.5
AM 132M ZA	**6**	5.5	7.5	950	55.3	82.2	83.6	83.6	0.71	13.5	13.5	4.1	2.2	1.9	2.2	37.40	55.5
AM 132M TA	**6***	7.5 [1]	10 [1]	960	74.6	82.8	83.5	82.9	0.75	17.4	17.6	5.0	2.3	1.9	2.8	46.70	64.1
AM 160M ZA	**6**	7.5	10	970	73.8	84.4	86.5	86.3	0.78	16.0	16.3	6.2	2.8	2.7	3.2	103	96.6
AM 160L ZA	**6**	11	15	960	109.4	88.1	88.5	87.8	0.78	23.4	24.0	6.0	2.5	2.2	3.5	136	113.6

1) Temperature rise to class F
* Higher output (progressive motor)

EFFICIENCY TESTING METHOD IEC 60034-2-1;1996

Type		kW	HP	min^{-1}	M_N Nm	η 50%	η 75%	η 100%	cos φ	I_N 400V	I_N 380-420V	I_A/I_N	M_A/M_N	M_S/M_N	M_K/M_N	J 10^{-3} kgm^2	kg
750 min^{-1} (8 poles)																	
AM 71Z AA	**8**	0.12	0.16	670	1.7	40	44	50	0.55	0.65	0.7	2.4	2.5	2.4	2.5	0.76	6.0
AM 80Z AA	**8**	0.25	0.33	680	3.5	40	47	51	0.62	1.1	1.2	2.2	1.8	1.9	2.0	1.83	8.0
AM 90S AA	**8**	0.37	0.5	680	5.2	52	58	59	0.53	1.7	1.8	2.1	1.4	1.3	1.6	2.91	11.4
AM 90L BA	**8**	0.55	0.75	680	7.7	52	58	59	0.54	2.5	2.7	2.1	1.4	1.3	1.6	4.40	15.0
AM 100L AA	**8**	0.75	1	690	10.4	59	64	65	0.65	2.6	2.8	3.0	1.6	1.5	1.7	6.35	17.6
AM 100L BA	**8**	1.1	1.5	690	15.2	59	67	68	0.62	3.9	4.0	3.0	1.9	1.3	1.6	9.00	22.6
AM 112M AA	**8**	1.5	2	696	20.6	66	69	70	0.66	4.6	4.8	4.0	1.8	2.0	2.4	15.35	35.0
AM 132S ZA	**8**	2.2	3	710	29.6	79.3	80.5	78.8	0.64	6.4	6.6	3.4	1.7	1.6	1.7	28.90	45.5
AM 132M ZA	**8**	3	4	710	40.4	81.3	82.0	79.8	0.67	8.1	9.2	3.6	1.7	1.6	1.9	37.40	54.5
AM 160M YA	**8**	4	5.5	700	54.6	84.9	84.5	84.4	0.72	9.5	9.7	4.5	1.8	1.6	2.2	76.70	75.0
AM 160M ZA	**8**	5.5	7.5	720	72.9	85.6	85.2	85.0	0.73	12.8	13.3	4.0	1.8	1.6	2.3	103.70	92.0
AM 160L ZA	**8**	7.5	10	710	100.9	86.3	85.8	85.5	0.74	17.1	17.8	4.0	1.8	1.6	2.3	136.00	113

DESIGNED FOR RANGE
OF RATED VOLTAGE
380-420 V ± 5% - 50 HZ

FOR MAINS VOLTAGE
400 V - 50 HZ

TEMPERATURE RISE TO CLASS B

Type		kW	HP	min^{-1}	M_N Nm	η 100%	cos φ	I_N 400V	I_N 380-420V	I_A/I_N	M_A/M_N	J 10^{-3} kgm^2	kg
1500/3000 min^{-1} (4/2 poles) - Dahlander connection Δ/YY													
AM 63Z AA	**4/2**	0.20/0.30	0.27/0.40	1345/2700	1.4/1.1	56/65	0.65/0.81	0.8/0.83	0.89/0.88	2.4/3.2	2.1/2.1	0.40	4.6
AM 71Z AA	**4/2**	0.30/0.45	0.40/0.65	1374/2830	2.1/1.5	61/66	0.78/0.73	1.0/1.35	1.2/1.5	3.3/3.0	2.3/2.1	0.76	6.3
AM 80Z AA	**4/2**	0.45/0.60	0.65/0.80	1390/2760	3.1/2.1	64/68.8	0.75/0.80	1.4/1.6	1.5/1.7	3.8/4.0	2.3/2.2	1.58	8.3
AM 80Z BA	**4/2**	0.55/0.75	0.75/1.0	1435/2850	3.7/2.5	70/71.2	0.67/0.77	1.7/2.0	1.8/2.1	4.5/5.0	2.6/2.8	2.00	11.5
AM 80Z CA	**4/2**	0.8/1.1	1.1/1.5	1425/2830	5.4/3.7	76.1/77.2	0.70/0.79	2.2/2.6	2.5/2.8	4.5/4.9	2.5/2.7	2.41	14.7
AM 90L AA	**4/2**	1.2/1.55	1.6/2.1	1435/2850	8/5.2	77.4/78.3	0.71/0.79	3.2/3.7	3.4/3.9	4.7/5.1	2.6/2.7	3.10	15.6
AM 90L BA	**4/2**	1.6/2.0 [1]	2.15/2.7 [1]	1390/2810	11/6.8	73.5/75.5	0.78/0.86	4.0/4.6	4.1/4.7	4.1/5.5	2.7/2.6	3.73	17.1
AM 100L AA	**4/2**	1.8/2.5	2.5/3.35	1420/2865	12.1/8.3	78.5/77.4	0.76/0.84	4.5/5.6	4.7/5.8	5.2/5.5	2.2/2.2	4.60	21.4
AM 100L BA	**4/2**	2.2/3.0	3.0/4.0	1410/2830	14.9/10.1	74.6/71.4	0.72/0.82	5.9/7.4	6.1/7.7	4.2/4.3	1.8/2.0	4.60	22.5
AM 100L CA	**4/2**	2.6/3.3	3.5/4.4	1430/2890	17.4/10.9	82.6/78.6	0.78/0.76	5.9/8.0	6.1/8.5	4.7/5.5	1.9/2.2	5.58	23.2
AM 112M AA	**4/2**	3.3/4.4	4.4/5.9	1410/2800	22.4/15	77.4/75.4	0.82/0.85	7.5/9.9	7.8/10.6	4.5/5.1	2.1/2.4	13.30	36.1
AM 132S ZA	**4/2**	4.4/5.5	6.0/7.5	1450/2925	29/18	83.0/84.6	0.70/0.87	11.0/10.8	12.0/11.8	4.4/7.2	2.2/2.7	13.83	42.6
AM 132M ZA	**4/2**	6.6/8.1	9.0/11.0	1460/2920	43.2/26.5	85.4/84.5	0.76/0.90	14.7/15.4	15.5/16.4	5.5/7.5	2.6/2.9	17.13	51.4
AM 160M ZA	**4/2**	8.8/11.0	12.0/15.0	1460/2940	57.6/35.7	87.1/87.5	0.79/0.91	18.5/20.0	19.0/21.0	5.5/7.5	2.0/1.9	51.75	94.0
AM 160L ZA	**4/2**	12.5/15.0	17.0/20.4	1470/2955	81.2/48.5	89.4/90.0	0.74/0.90	27.4/26.8	29.0/28.2	4.8/7.4	2.1/2.3	64.00	108.7

Type		kW	HP	min^{-1}	M_N Nm	η 100%	cos φ	I_N 400V	I_N 380-420V	I_A/I_N	M_A/M_N	J 10^{-3} kgm^2	kg
750/1500 min^{-1} (8/4 poles) - Dahlander connection Δ/YY													
AM 71Z AA	**8/4**	0.09/0.15	0.12/0.20	610/1310	1.4/1.1	40/56	0.61/0.75	0.53/0.52	0.59/0.57	2.5/3.2	1.6/1.6	0.71	6.3
AM 80Z AA	**8/4**	0.18/0.37	0.25/0.50	700/1370	2.5/2.6	43.2/58.7	0.63/0.83	1.0/1.1	1.1/1.2	2.6/3.4	1.8/1.6	1.97	7.9
AM 80Z BA	**8/4**	0.26/0.51	0.35/0.68	700/1360	3.5/3.6	44.1/61.2	0.60/0.88	1.2/1.4	1.3/1.5	2.5/3.6	2.0/1.6	2.47	9.2
AM 90S AA	**8/4**	0.37/0.75	0.50/1.0	690/1385	5.1/5.2	52.2/67.1	0.58/0.82	1.8/2.0	1.9/2.1	2.8/3.9	1.9/1.8	3.18	13.5
AM 90L BA	**8/4**	0.5/1.0	0.67/1.34	690/1410	6.9/6.8	52.2/72.5	0.58/0.80	2.4/2.4	2.5/2.5	3.3/4.0	2.3/1.9	4.78	15.7
AM 100L AA	**8/4**	0.7/1.4	0.94/1.9	700/1440	9.5/9.3	57.2/78.5	0.50/0.78	3.5/3.3	3.7/3.4	2.8/4.3	2.1/1.9	5.58	21.9
AM 100L BA	**8/4**	0.9/1.8 [1]	1.2/2.5 [1]	690/1415	12.5/12.1	62/76	0.56/0.87	3.8/4.0	4.0/4.3	2.5/4.5	1.9/1.8	6.00	23.7
AM 112M AA	**8/4**	1/1.8	1.34/2.5	710/1445	13.5/11.9	66.1/78.5	0.61/0.82	4.1/4.1	4.4/4.2	3.9/6.3	2.2/2.1	14.18	31.7
AM 112M BA	**8/4**	1.3/2.6 [1]	1.75/3.0 [1]	705/1420	17.6/17.5	70.0/76.3	0.65/0.88	4.6/5.7	4.8/5.9	3.2/4.8	2.1/2.0	16.70	34.2
AM 132S ZA	**8/4**	2.1/3.7	2.9/5.0	710/1440	28.2/24.5	70.2/76.1	0.66/0.84	6.5/8.4	6.7/8.6	4.0/5.2	1.9/1.7	29.50	42.5
AM 132M ZA	**8/4**	2.6/4.8	3.5/6.5	715/1450	34.7/31.6	71.6/78.8	0.60/0.80	8.8/11.0	9.8/12.0	4.3/5.5	2.3/1.8	37.75	55.5
AM 160M YA	**8/4**	4.0/6.3	5.5/8.6	710/1410	53.8/42.7	80.0/81.0	0.64/0.88	11.3/12.8	12.3/13.5	4.6/6.5	1.8/ 1.7	81.25	88.5
AM 160L YA	**8/4**	4.8/7.5	6.5/10.0	730/1470	62.8/48.7	80.0/85.0	0.65/0.85	13.2/15.0	14.0/16.0	4.5/6.5	1.8/1.6	105.75	106.5
AM 160L ZA	**8/4**	5.9/10.3	8.0/14.0	725/1450	77.7/67.8	81.0/87.0	0.66/0.88	16.1/19.5	17.0/20.4	5.0/6.0	1.9/1.6	127.50	110.5

1) Temperature rise to class F

DESIGNED FOR RANGE
OF RATED VOLTAGE
380-420 V ± 5% - 50 HZ

FOR MAINS VOLTAGE
400 V - 50 HZ

TEMPERATURE RISE TO CLASS B

Type		kW	HP	min^{-1}	M_N Nm	η 100%	cos φ	I_N 400V	I_N 380-420V	I_A/I_N	M_A/M_N	J 10^{-3} kgm²	kg
1500/1000 min^{-1} (4/6 poles) - separate windings													
AM 71Z AA	**4/6**	0.22/0.15	0.30/0.20	1430/900	1.5/1.6	61/44	0.7/0.64	0.78/0.68	0.83/0.73	1.9/3.4	1.5/1.8	0.73	6.2
AM 80Z AA	**4/6**	0.37/0.26	0.50/0.35	1385/905	2.6/2.7	61.4/48.1	0.82/0.80	1.1/1.0	1.1/1.1	3.7/2.6	1.7/1.3	1.97	8.3
AM 80Z BA	**4/6**	0.55/0.37	0.75/0.50	1380/900	3.8/3.9	60.5/51.1	0.64/0.82	1.5/1.3	1.6/1.4	3.7/2.7	1.6/1.2	2.47	10.0
AM 90S AA	**4/6**	0.75/0.5	1.0/0.67	1400/930	5.1/5.1	63/64	0.81/0.61	2.2/1.9	2.3/2.1	3.0/3.5	1.4/1.8	4.10	13.4
AM 90L BA	**4/6**	1/0.65	1.34/0.87	1380/920	6.9/6.7	68.8/67.1	0.81/0.62	2.6/2.3	2.8/2.5	2.9/3.4	1.1/1.6	4.78	16.4
AM 100L AA	**4/6**	1.2/0.8	1.6/1.07	1460/940	7.8/8.1	76.0/67.9	0.66/0.70	3.5/2.5	3.8/2.6	4.7/3.0	2.1/1.5	4.60	24.4
AM 100L BA	**4/6**	1.6/1.0	2.15/1.34	1445/935	10.6/10.2	77.6/69.5	0.73/0.63	4.1/3.3	4.3/3.5	5.8/3.0	2.8/1.7	5.58	33.2
AM 112M AA	**4/6**	1.8/1.3	2.5/1.75	1445/950	11.9/13.1	74.6/69.5	0.85/0.78	4.2/3.6	4.4/3.7	5.9/3.8	1.9/1.3	14.18	33.3
AM 112M BA	**4/6**	2.6/1.85	3.5/2.5	1445/950	17.2/18.6	73.8/71.6	0.86/0.73	6.0/5.2	6.2/5.4	6.1/4.4	2.0/1.7	17.53	37.0
AM 132S ZA	**4/6**	3.1/2.2	4.2/3.0	1440/965	20.6/21.8	80/78	0.80/0.74	7/5.5	7.5/6	5.8/5.6	2.1/2.0	22.4	41.9
AM 132M ZA	**4/6**	4.0/2.6	5.5/3.5	1470/975	26/25.5	81.0/79.3	0.83/0.74	8.6/6.4	9.3/7.0	7.7/5.2	2.0/1.9	29.25	51.0
AM 160M YA	**4/6**	5.5/3.7	7.5/5.0	1480/970	35.5/36.4	84.0/81.4	0.79/0.73	12.0/9.0	12.9/9.6	7.5/4.5	2.5/1.6	81.25	88.5
AM 160M ZA	**4/6**	7.5/4.8	10.2/6.5	1465/960	48.9/47.7	85.0/82.6	0.83/0.75	15..4/11.2	15.8/11.5	7.4/4.6	2.4/1.6	81.25	88.5
AM 160L ZA	**4/6**	11.0/6.6	15.0/9.0	1470/960	71.5/65.7	86.0/83.8	0.86/0.75	21.6/15.2	22.5/16.0	7.2/5.0	2.3/1.8	105.75	106.5

Type		kW	HP	min^{-1}	M_N Nm	η 100%	cos φ	I_N 400V	I_N 380-420V	I_A/I_N	M_A/M_N	J 10^{-3} kgm²	kg
1000/750 min^{-1} (6/8 poles) - separate windings													
AM 80Z AA	**6/8**	0.37/0.18	0.50/0.25	915/700	3.9/2.5	51.1/44.2	0.81/0.65	1.3/1.0	1.4/1.0	2.8/2.5	1.4/1.7	2.47	9.5
AM 90L AA	**6/8**	0.55/0.30	0.75/0.40	950/710	5.5/4	65.2/45.1	0.62/0.52	2.0/1.8	2.1/1.9	3.9/2.6	2.5/1.9	4.78	16.2
AM 100L AA	**6/8**	0.75/0.45	1.0/0.60	960/720	7.5/6	72.6/61.8	0.67/0.54	2.2/2.0	2.3/2.1	4.1/2.9	1.9/1.9	6.73	23.4
AM 112M AA	**6/8**	0.95/0.65	1.3/0.90	965/715	9.4/8.7	65.2/62.1	0.78/0.70	3.0/2.2	3.2/2.3	4.5/3.8	1.4/1.7	14.18	32.0
AM 112M BA	**6/8**	1.5/0.75	2.0/1.0	970/720	14.8/9.9	75.3/64.6	0.66/0.60	4.4/2.8	4.6/3.0	4.6/3.8	2.2/2.1	18.70	36.2
AM 132S ZA	**6/8**	2.2/1.2	3.0/1.6	970/730	21.7/15.7	73.5/66.0	0.69/0.60	6.3/4.4	6.6/4.8	4.5/3.7	1.6/1.7	29.5	42.5
AM 132M ZA	**6/8**	3.0/1.7	4.1/2.3	980/730	29.2/22.2	78.2/72.5	0.72/0.64	7.7/5.3	8.2/5.9	5.4/4.3	1.7/1.7	37.75	55.5
AM 160M YA	**6/8**	4.8/2.6	6.5/3.5	970/730	47.3/34	83.0/74.0	0.80/0.70	10.5/7.3	11.0/7.7	4.8/3.6	1.9/1.8	112.7	88.0
AM 160L ZA	**6/8**	5.9/3.3	8.0/4.5	970/730	58.1/43.2	83.2/73.0	0.76/0.60	13.5/10.9	14.5/11.4	6.5/5.0	2.2/2.1	150.25	97.5

DESIGNED FOR RANGE
OF RATED VOLTAGE
380-420 V ± 5% - 50 HZ

FOR MAINS VOLTAGE
400 V - 50 HZ

TEMPERATURE RISE TO CLASS B

Type		kW	HP	min^{-1}	M_N Nm	η 100%	cos φ	I_N 400V	I_N 380-420V	I_A/I_N	M_A/M_N	J 10^{-3} kgm²	kg
1500/3000 min^{-1} (4/2 poles) - Dahlander connection Y/YY													
AMV 63Z AA	**4/2**	0.07/0.33	0.095/0.45	1350/2700	0.5/1.2	55/60	0.70/0.80	0.25/0.95	0.27/1.1	2.5/2.6	1.8/1.6	0.37	5.0
AMV 71Z AA	**4/2**	0.08/0.37	0.11/0.5	1350/2870	0.6/1.2	60/64	0.65/0.68	0.30/1.3	0.35/1.4	3.2/4.3	2.0/2.8	0.82	7.9
AMV 71Z BA	**4/2**	0.12/0.55	0.16/0.75	1430/2835	0.8/1.9	70/68	0.65/0.72	0.40/1.6	0.42/1.7	4.1/4.0	3/2.8	1.08	10.0
AMV 80Z AA	**4/2**	0.15/0.75	0.2/1.0	1400/2710	1/2.6	70/68	0.68/0.80	0.45/1.9	0.45/2.0	2.6/4.6	2.8/2.9	1.58	8.3
AMV 80Z BA	**4/2**	0.22/1.1	0.3/1.5	1420/2820	1.5/3.7	70/73	0.75/0.84	0.6/2.5	0.65/2.6	4.6/4.7	2.7/2.9	2.0	11.5
AMV 90L AA	**4/2**	0.30/1.5	0.4/2.0	1400/2830	2/5.1	69/70	0.70/0.84	0.9/3.5	1.0/3.7	4.7/5.0	2.7/3.0	3.13	15.6
AMV 90L BA	**4/2**	0.44/2.2	0.6/3.0	1430/2830	2.9/7.4	74/72	0.76/0.89	1.1/4.8	1.2/5.0	4.5/5.2	2.6/2.8	3.73	17.1
AMV 100L AA	**4/2**	0.50/2.5	0.67/3.3	1430/2840	3.3/8.4	72/73	0.77/0.88	1.3/5.3	1.4/5.6	4.6/5.0	2.2/2.3	4.6	21.4
AMV 100L BA	**4/2**	0.60/3.0	0.8/4.0	1440/2850	4/10.1	78/77	0.79/0.87	1.3/6.2	1.4/6.5	4.5/4.5	2.2/2.1	5.58	23.2
AMV 112M AA	**4/2**	0.75/3.70	1.0/5.0	1440/2850	5/12.4	74/72	0.80/0.90	1.7/7.9	1.9/2.2	4.5/5.1	2.0/2.4	13.3	36.1
AMV 112M BA	**4/2**	0.9/4.5	1.2/6.1	1440/2850	6/15.1	75/73	0.82/0.90	2.0/9.5	2.1/9.8	4.5/5.5	2.0/2.3	14.75	40.0
AMV 132S AA	**4/2**	1.1/5.5	1.5/7.5	1440/2880	7.3/18.2	81.5/84.8	0.78/0.90	2.5/10.4	2.6/11.0	5.0/6.0	2.1/2.8	13.83	42.6
AMV 132S BA	**4/2**	1.5/7 [1]	2/9.5 [1]	1440/2900	9.9/23.1	82.0/86.0	0.78/0.92	3.4/12.8	3.8/13.0	5.3/6.5	2.2/2.9	13.83	42.6
AMV 132M CA	**4/2**	1.9/8.0	2.6/10.9	1450/2930	12.5/26.1	83.7/88.0	0.82/0.87	4.0/15.1	4.0/16.0	5.5/7.0	2.2/3.0	17.13	51.4
AMV 160M AA	**4/2**	2.8/11	3.8/15.0	1440/2940	18.6/35.7	82.5/88.2	0.78/0.90	6.3/20.0	7.0/20.4	5.0/7.5	2.0/2.1	51.75	94
AMV 160M BA	**4/2**	3.3/13.5 [1]	4.5/18.3 [1]	1440/2920	21.9/44.2	83.0/88.5	0.80/0.92	7.2/24.0	7.5/24.0	5.5/7.5	2.0/2.2	51.75	94
AMV 160L CA	**4/2**	4.4/18.5 [1]	6.0/25.1 [1]	1450/2940	29/60.1	85.5/89.5	0.83/0.92	9.0/32.5	9.5/33.0	5.5/7.5	2.0/2.2	64.0	108.7

Type		kW	HP	min^{-1}	M_N Nm	η 100%	cos φ	I_N 400V	I_N 380-420V	I_A/I_N	M_A/M_N	J 10^{-3} kgm²	kg
750/1500 min^{-1} (8/4 poles) - Dahlander connection Y/YY													
AMV 71Z AA	**8/4**	0.08/0.37	0.11/0.5	660/1370	1.2/2.6	26/57	0.63/0.72	0.60/1.25	0.65/1.35	2.8/3.4	1.9/1.7	1.24	6.8
AMV 80Z AA	**8/4**	0.12/0.55	0.16/0.75	685/1420	1.7/3.7	50/69	0.60/0.74	0.58/1.53	0.65/1.6	1.9/3.3	1.4/1.5	2.47	9.2
AMV 80Z BA	**8/4**	0.18/0.75	0.25/1.0	660/1380	2.6/5.2	53/67	0.73/0.81	0.65/1.9	0.7/2.0	2.0/3.5	1.6/1.7	2.41	10.6
AMV 90L AA	**8/4**	0.18/1.1	0.25/1.5	680/1400	2.5/7.5	60/70	0.65/0.82	0.9/2.7	1.0/2.8	2.8/4.0	1.5/2.0	2.98	15.7
AMV 90L CA	**8/4**	0.4/1.6	0.54/2.15	675/1400	5.7/10.9	61.5/75	0.64/0.79	1.8/4.0	1.8/4.1	3.1/5.0	1.6/2.2	3.70	19.6
AMV 100L AA	**8/4**	0.45/2.2	0.60/3.0	680/1420	6.3/14.8	63.1/75.3	0.60/0.80	1.7/5.0	1.9/5.3	2.7/4.7	1.7/2.0	5.58	21.9
AMV 100L BA	**8/4**	0.6/2.6	0.80/3.5	680/1435	8.4/17.3	64.0/76.2	0.63/0.75	2.2/6.5	2.3/6.7	2.7/4.8	1.7/2.2	6.00	23.7
AMV 112M AA	**8/4**	0.7/3.3	0.94/4.5	690/1420	9.7/22.2	62/78	0.70/0.80	2.2/7.4	2.3/7.6	3.4/6.5	1.8/2.4	16.70	34.2
AMV 112M CA	**8/4**	1.0/4.0	1.34/5.5	720/1420	13.3/26.9	60/77	0.70/0.82	3.1/8.6	3.3/9.0	3.5/5.0	2.3/1.9	19.50	40.0
AMV 132S AA	**8/4**	1.1/4.5	1.5/6.1	725/1450	14.5/29.6	77.0/85.5	0.58/0.82	3.6/9.3	4.0/9.7	3.5/5.4	2.2/2.7	22.4	41.9
AMV 132M BA	**8/4**	1.4/5.5	1.9/7.5	720/1440	18.6/36.5	78.0/86.0	0.62/0.82	4.2/11.3	4.5/12	3.6/5.5	2.0/2.5	29.25	51.0
AMV 132M CA	**8/4**	1.8/7.5	2.4/10.2	720/1450	23.9/49.4	78.2/86.5	0.64/0.86	5.2/14.6	5.5/15.0	4.6/6.0	2.0/2.5	37.25	65.0
AMV 160M ZA	**8/4**	2.2/10.0	3.0/13.0	720/1450	29.2/65.9	80.0/88.0	0.61/0.83	6.6/19.9	6.8/20.4	3.5/6.0	1.8/1.7	81.25	88.5
AMV 160L ZA	**8/4**	3.2/15.0 [1]	4.3/20.0 [1]	720/1450	42.4/98.8	81.0/90.0	0.61/0.88	9.4/27.3	9.8/28	3.5/6.5	1.7/1.8	105.75	106.5

1) Temperature rise to class F

DESIGNED FOR RANGE
OF RATED VOLTAGE
380-420 V ± 5% - 50 HZ

FOR MAINS VOLTAGE
400 V - 50 HZ

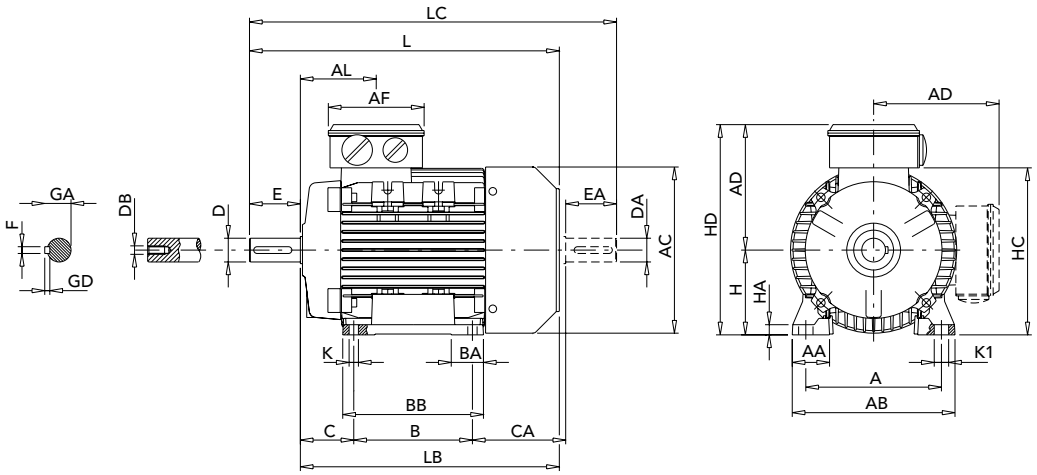
TEMPERATURE RISE TO CLASS B

Type		kW	HP	min^{-1}	M_N Nm	η 100%	cos φ	I_N 400V	I_N 380-420V	I_A/I_N	M_A/M_N	J 10^{-3} kgm²	kg
1500/1000 min^{-1} (4/6 poles) - separate windings													
AMV 71Z AA	**4/6**	0.25/0.08	0.33/0.11	1370/900	1.7/0.4	60/40	0.80/0.70	0.75/0.4	0.8/0.45	3.0/2.5	1.6/1.6	1.15	6.7
AMV 71Z BA	**4/6**	0.37/0.13	0.50/0.18	1360/880	2.6/1.4	62/44	0.80/0.70	1.0/0.6	1.1/0.7	3.2/2.6	1.6/1.6	1.24	7.2
AMV 80Z AA	**4/6**	0.55/0.18	0.75/0.25	1380/920	3.8/1.9	60/42	0.83/0.82	1.60/0.75	1.7/0.8	3.5/2.4	1.6/1.0	1.97	8.3
AMV 80Z BA	**4/6**	0.75/0.25	1.0/0.33	1400/940	5.1/2.5	70/60	0.82/0.72	1.8/0.8	1.9/0.9	4.2/2.6	1.6/1.3	4.05	14
AMV 90S AA	**4/6**	0.75/0.24	1.0/0.32	1400/950	5.1/2.4	70/60	0.82/0.72	1.9/0.8	2.0/0.9	4.2/2.6	1.6/1.3	4.05	14
AMV 90L BA	**4/6**	1.1/0.37	1.5/0.50	1400/930	7.5/3.8	70/60	0.81/0.74	2.8/1.2	3.0/1.3	4.3/2.7	1.6/1.2	4.78	16.4
AMV 90L CA	**4/6**	1.5/0.5	2.0/0.67	1420/950	10.1/5	73/64	0.80/0.70	3.52/1.52	3.7/1.6	4.8/2.6	1.5/1.3	5.98	20.5
AMV 100L AA	**4/6**	1.85/0.60	2.5/0.75	1400/920	12.6/6.2	74/64	0.80/0.73	4.6/1.9	4.8/2.1	4.8/3.1	1.8/1.5	6.73	23.4
AMV 100L BA	**4/6**	2.2/0.75	3.0/1.0	1420/950	14.8/7.5	76/66	0.79/0.75	5.1/2.1	5.3/2.2	5.0/3.5	1.7/1.3	9.25	22.6
AMV 112M AA	**4/6**	3/1.0	4.0/1.34	1440/970	19.9/9.8	80/73	0.81/0.65	6.6/3.0	6.8/3.2	5.8/4.6	2.5/2.1	13.3	30.4
AMV 132S AA	**4/6**	3.8/1.3	5.2/1.8	1460/970	24.9/12.8	85.0/75.0	0.8/0.72	8.1/3.5	8.5/4	6.5/4.0	2.2/1.7	22.4	41.9
AMV 132M BA	**4/6**	4.4/1.5	6.0/2.0	1460/970	28.8/14.8	86.0/78.2	0.85/0.73	8.7/3.8	9.2/4.3	6.5/4.4	2.2/1.7	29.25	51.0
AMV 132M CA	**4/6**	5.5/1.8	7.5/2.4	1460/970	36/17.7	86.8/80.0	0.84/0.74	10.9/4.4	12.0/4.	7.0/4.7	2.6/1.8	37.25	65.0
AMV 132M DA	**4/6**	6.3/2.2 [1]	8.6/3.0 [1]	1460/970	41.2/21.7	86.8/81.0	0.84/0.73	12.5/5.4	13.5/5.	7.2/4.8	2.6/1.9	37.25	66.0
AMV 160M AA	**4/6**	7.5/2.5	10.0/3.4	1470/975	48.7/24.5	87.5/83.0	0.83/0.75	14.9/5.8	15.6/6.0	8.3/4.5	2.5/1.9	81.25	88.5
AMV 160L BA	**4/6**	11.0/3.7	15.0/5.0	1470/970	71.5/36.4	88.0/84.2	0.81/0.73	22.5/8.7	23.4/9.0	8.0/4.8	2.4/1.8	105.75	106.5
AMV 160L CA	**4/6**	13.0/4.0 [1]	17.7/5.4 [1]	1460/970	85/39.4	88.0/84.5	0.81/0.72	26.3/9.5	27.5/10	8.0/4.8	2.4/1.9	105.75	106.5

Type		kW	HP	min^{-1}	M_N Nm	η 100%	cos φ	I_N 400V	I_N 380-420V	I_A/I_N	M_A/M_N	J 10^{-3} kgm²	kg
1000/750 min^{-1} (6/8 poles) - separate windings													
AMV 80Z AA	**6/8**	0.25/0.11	0.33/0.15	930/720	2.6/1.5	53/49	0.79/0.62	0.9/0.55	1.0/0.7	2.9/3.0	1.6/1.8	1.97	7.9
AMV 80Z BA	**6/8**	0.37/0.15	0.50/0.25	920/715	3.8/2	52/47	0.81/0.63	1.3/0.8	1.4/0.9	2.8/2.8	1.4/1.9	2.47	9.5
AMV 90L AA	**6/8**	0.55/0.22	0.75/0.30	960/740	5.5/2.8	65/47	0.62/0.51	2.0/1.4	2.1/1.5	3.9/2.9	2.5/2.1	4.78	16.2
AMV 90L BA	**6/8**	0.75/0.30	1.0/0.40	940/720	7.6/4	64/45.5	0.67/0.52	2.5/1.85	2.7/1.9	3.4/2.6	2.2/1.9	4.78	16.2
AMV 100L AA	**6/8**	1.1/0.45	1.5/0.60	950/710	11.1/6.1	70.6/58	0.71/0.67	3.1/1.7	3.3/1.8	4.3/2.8	2.0/1.3	9.43	22.0
AMV 112M AA	**6/8**	1.5/0.6	2.0/0.80	970/720	14.8/8	75.8/65	0.65/0.60	4.4/2.3	3.7/2.5	5.5/3.4	2.8/2.1	18.70	39.0
AMV 132S ZA	**6/8**	2.2/0.9	3.0/1.2	970/715	21.7/12	78.0/69.0	0.67/0.55	6.1/3.5	6.7/4.0	4.8/4.0	1.6/1.6	29.5	42.5
AMV 132M YA	**6/8**	3/1.2	4.0/1.6	960/715	29.8/16	80/72	0.7/0.55	7.8/4.4	8.2/4.8	4.8/4.1	1.6/1.6	37.75	55.5
AMV 132M ZA	**6/8**	4/1.6	5.5/2.2	960/715	39.8/21.4	81.0/74.0	0.78/0.6	9.2/5.2	9.8/5.6	5.3/4.4	1.7/1.7	44.5	64.1
AMV 160M YA	**6/8**	5.5/2.2	7.5/3.0	970/730	54.1/28.8	83/76	0.77/0.6	12.5/7	13.5/7.5	5.7/5.6	1.6/1.9	112.7	88.0
AMV 160M ZA	**6/8**	7/3	9.5/4.1	970/730	68.9/39.2	84/77	0.80/0.65	15/8.7	16/9.3	6.0/5.8	1.7/2.2	150.25	97.5

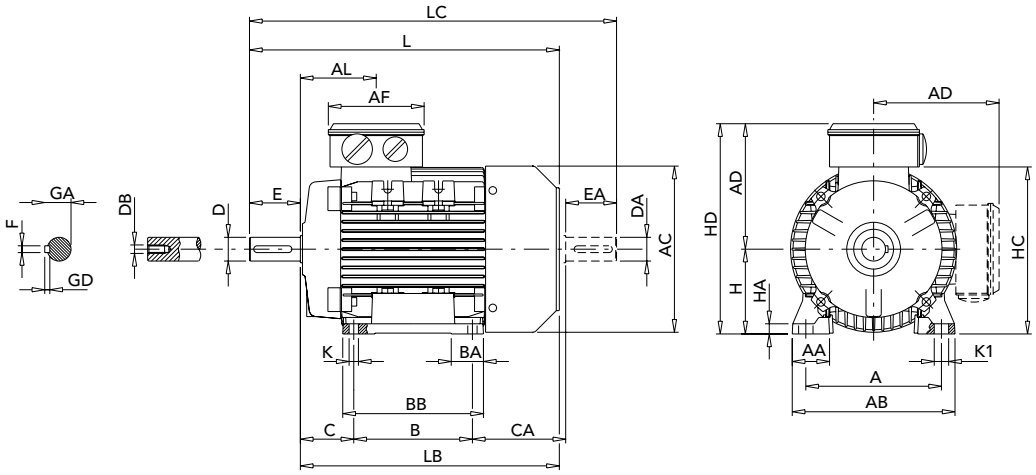
1) Temperature rise to class F

THREE-PHASE FRAME SIZE 80 - 160 IM B3
AMPE SERIES - ALUMINIUM ALLOY FRAME



IEC	Poles	kW	H	A	B	C	K [1]	AB	BB	CA	AD [2]	HD [2]	AC	HC
71	**2**	**all**	71	112	90	45	8	135	108	83	110	181	139	142
80	**2 - 4**	**all**	80	125	100	50	10	153	125	89	129	209	160	162
90S	**2 - 4 - 6**	**all**	90	140	100	56	10	170	150	116	138	228	180	181
90L	**2**	**2.2**	90	140	125	56	10	170	150	91	138	228	180	181
	2	**3**	90	140	125	56	10	170	150	114	138	228	180	181
	4	**1.8**	90	140	125	56	10	170	150	114	138	228	180	181
	4 - 6	**all**	90	140	125	56	10	170	150	91	138	228	180	181
100L	**2**	**all**	100	160	140	63	11	192	166	110	145	245	196	198
	4 - 6	**all**	100	160	140	63	11	192	166	110	145	245	198	192
112M	**2**	**4 - 5.5**	112	190	140	70	12.5	220	176	126	160	272	225	225
	2	**7.5**	112	190	140	70	12.5	220	176	148	160	272	222	225
	4 - 6	**all**	112	190	140	70	12.5	220	176	126	160	272	225	225
132S	**2**	**5.5**	132	216	140	89	12	256	180	134	194	326	248	261
	2	**7.5**	132	216	140	89	12	256	180	154	194	326	248	261
	4 - 6	**all**	132	216	140	89	12	256	180	134	194	326	248	261
132M	**2**	**9.2 - 11**	132	216	178	89	12	256	218	156	194	326	248	261
	2	**15**	132	216	178	89	12	256	218	207	194	326	248	261
	4	**7.5**	132	216	178	89	12	256	218	156	194	326	248	261
	4	**9.2**	132	216	178	89	12	256	218	207	194	326	248	261
	6	**4**	132	216	178	89	12	256	218	136	194	326	248	261
	6	**5.5**	132	216	178	89	12	256	218	156	194	326	248	261
160M	**2 - 4 - 6**	**all**	160	254	210	108	14	320	270	180	238	398	317	316
160L	**2 - 4 - 6**	**all**	160	254	254	108	14	320	310	180	238	398	317	316

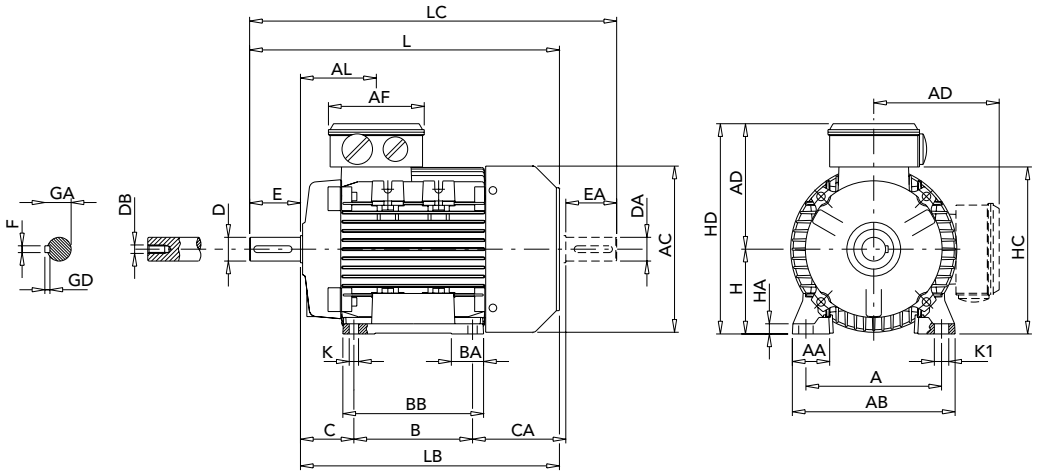
THREE-PHASE FRAME SIZE 80 - 160 IM B3
AMPE SERIES - ALUMINIUM ALLOY FRAME



IEC	Poles	kW	HA	K1	L	LB	LC	AL	AF	BA	AA	D/DA	E/EA	F	GD	GA	DB[3]
71	**2**	**all**	9	11	246	216	278	69	92	28	31	14	30	5	5	16	M5
80	**2 - 4**	**all**	9.5	14	272	232	319	79	116	28.5	34.5	19	40	6	6	21.5	M6
90S	**2 - 4 - 6**	**all**	11	15	317	267	372	85	116	28/53	37	24	50	8	7	27	M8
90L	**2**	**2.2**	11	15	317	267	372	85	116	28/53	37	24	50	8	7	27	M8
	2	**3**	11	15	340	290	395	85	116	28/53	37	24	50	8	7	27	M8
	4	**1.8**	11	15	340	290	395	85	116	28/53	37	24	50	8	7	27	M8
	4 - 6	**all**	11	15	317	267	372	85	116	28/53	37	24	50	8	7	27	M8
100L	**2**	**all**	12	17	366	306	433	91	116	38	44	28	60	8	7	31	M10
	4 - 6	**all**	12	17	366	306	433	92	118	41	44	28	60	8	7	31	M10
112M	**2**	**4 - 5.5**	15	19	388	328	456	92	116	46	48	28	60	8	7	31	M10
	2	**7.5**	15	19	410	350	478	92	116	46	48	28	60	8	7	31	M10
	4 - 6	**all**	15	19	388	328	456	92	116	46	48	28	60	8	7	31	M10
132S	**2**	**5.5**	17	20	445	365	523	100	133	45	59	38	80	10	8	41	M12
	2	**7.5**	17	20	465	385	543	100	133	45	59	38	80	10	8	41	M12
	4 - 6	**all**	17	20	445	365	523	100	133	45	59	38	80	10	8	41	M12
132M	**2**	**9.2 - 11**	17	20	505	425	583	120	133	45	59	38	80	10	8	41	M12
	2	**15**	17	20	556	476	640	120	133	45	59	38	80	10	8	41	M12
	4	**7.5**	17	20	505	425	583	120	133	45	59	38	80	10	8	41	M12
	4	**9.2**	17	20	556	476	640	120	133	45	59	38	80	10	8	41	M12
	6	**4**	17	20	485	405	563	120	133	45	59	38	80	10	8	41	M12
	6	**5.5**	17	20	505	425	583	120	133	45	59	38	80	10	8	41	M12
160M	**2 - 4 - 6**	**all**	23	18	608	498	668	146	150	65	76	42/28	110/60	12/8	8/7	45/31	M16/M10
160L	**2 - 4 -6**	**all**	23	18	652	542	712	168	150	65	76	42/28	110/60	12/8	8/7	45/31	M16/M10

1) Clearance hole for screw
2) Maximun distance
3) Centering holes in shaft extensions to DIN 332 part 2

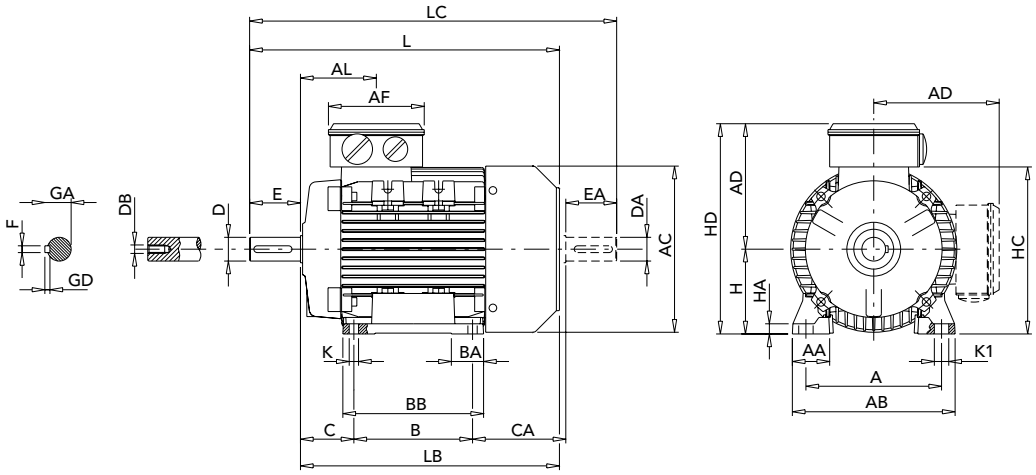
THREE-PHASE FRAME SIZE 80 - 160 IM B3
AMPH SERIES - ALUMINIUM ALLOY FRAME



IEC	Poles	kW	H	A	B	C	K[1]	AB	BB	CA	AD[2]	HD[2]	AC	HC
80	**2 - 4**	**all**	80	125	100	50	10	153	125	89	140	220	160	162
90S	**2 - 4**	**all**	90	140	100	56	10	170	150	116	149	239	180	181
	6	**0.75**	90	140	100	56	10	170	150	116	149	239	180	181
90L	**2**	**2.2**	90	140	125	56	10	170	150	91	149	239	180	181
	2	**3**	90	140	125	56	10	170	150	114	138	239	180	181
	4	**all**	90	140	125	56	10	170	150	91	149	239	180	181
100L	**2**	**all**	100	160	140	63	11	192	166	110	156	256	196	198
	4 - 6	**all**	100	160	140	63	11	192	166	110	156	256	198	192
112M	**2**	**3.7-4-5.5**	112	190	140	70	12.5	220	176	126	172	284	225	225
	2	**7.5**	112	190	140	70	12.5	220	176	148	172	284	222	225
	4	**all**	112	190	140	70	12.5	220	176	126	172	284	225	225
	6	**1.1**	112	190	140	70	12.5	220	176	126	172	284	222	225
	6	**1.5 - 1.8**	112	190	140	70	12.5	220	176	148	172	284	225	225
132S	**2**	**5.5**	132	216	140	89	12	256	180	134	194	326	248	261
	2	**7.5**	132	216	140	89	12	256	180	154	194	326	248	261
	4	**5.5**	132	216	140	89	12	256	180	174	194	326	248	261
	6	**2.2-3**	132	216	140	89	12	256	180	154	194	326	248	261
132M	**2**	**9.2-11**	132	216	178	89	12	256	218	156	194	326	248	261
	2	**15**	132	216	178	89	12	256	218	207	194	326	248	261
	4	**7.5**	132	216	178	89	12	256	218	156	194	326	248	261
	4	**9.2**	132	216	178	89	12	256	218	207	194	326	248	261
	6	**4**	132	216	178	89	12	256	218	136	194	326	248	261
160M	**2-4-6**	**all**	160	254	210	108	14	320	270	180	238	398	317	316
160L	**2-4-6**	**all**	160	254	254	108	14	320	310	180	238	398	317	316

1) Clearance hole for screw 2) Maximun distance 3) Centering holes in shaft extensions to DIN 332 part 2

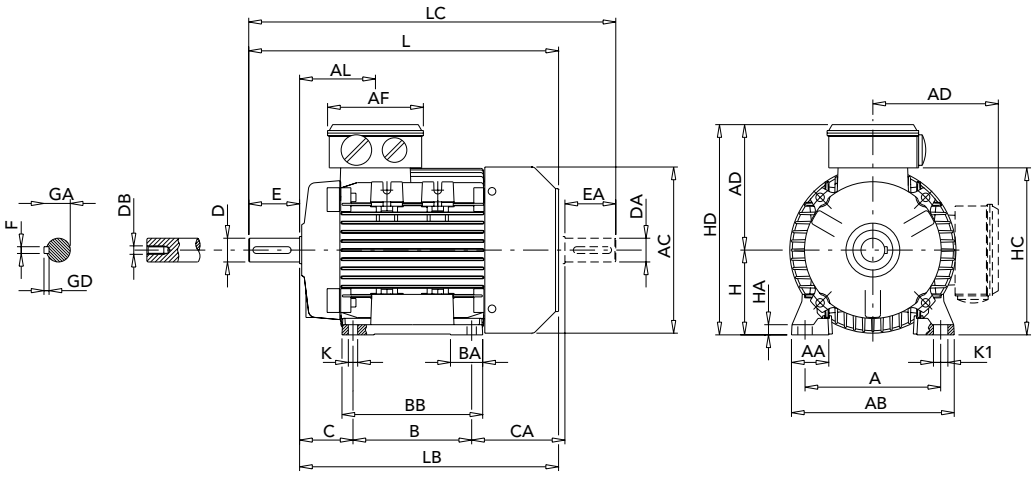
THREE-PHASE FRAME SIZE 80 - 160 IM B3
AMPH SERIES - ALUMINIUM ALLOY FRAME



IEC	Poles	kW	HA	K1	L	LB	LC	AL	AF	BA	AA	D/DA	E/EA	F/FA	GD/GF	GA/GC	DB/DC[3]
80	**2 - 4**	**all**	9.5	14	272	232	319	79	116	28.5	34.5	19	40	6	6	21,5	M6
90S	**2 - 4**	**all**	11	15	317	267	372	85	116	28/53	37	24	50	8	7	27	M8
	6	**0.75**	11	15	317	267	372	85	116	28/53	37	24	50	8	7	27	M8
90L	**2**	**2.2**	11	15	317	267	372	85	116	28/53	37	24	50	8	7	27	M8
	2	**3**	11	15	340	290	395	85	116	28/53	37	24	50	8	7	27	M8
	4	**all**	11	15	317	267	372	85	116	28/53	37	24	50	8	7	27	M8
100L	**2**	**all**	12	17	366	306	433	91	110	38	44	28	60	8	7	31	M10
	4 - 6	**all**	12	17	366	306	433	92	118	41	44	28	60	8	7	31	M10
112M	**2**	**3.7-4-5.5**	15	19	388	328	456	92	116	46	48	28	60	8	7	31	M10
	2	**7.5**	15	19	410	350	478	92	116	46	48	28	60	8	7	31	M10
	4	**all**	15	19	388	328	456	92	116	46	48	28	60	8	7	31	M10
	6	**1.1**	15	19	388	328	456	92	116	46	48	28	60	8	7	31	M10
	6	**1.5 - 1.8**	15	19	410	350	478	92	116	46	48	28	60	8	7	31	M10
132S	**2**	**5.5**	17	20	445	365	523	100	133	45	59	38	80	10	8	41	M12
	2	**7.5**	17	20	465	385	543	100	133	45	59	38	80	10	8	41	M12
	4	**5.5**	17	20	485	405	563	100	133	45	59	38	80	10	8	41	M12
	6	**2.2-3**	17	20	465	385	543	100	133	45	59	38	80	10	8	41	M12
132M	**2**	**9.2-11**	17	20	505	425	583	120	133	45	59	38	80	10	8	41	M12
	2	**15**	17	20	556	476	640	120	133	45	59	38	80	10	8	41	M12
	4	**7.5**	17	20	505	425	583	120	133	45	59	38	80	10	8	41	M12
	4	**9.2**	17	20	556	476	640	120	133	45	59	38	80	10	8	41	M12
	6	**4**	17	20	485	405	563	120	133	45	59	38	80	10	8	41	M12
160M	**2-4-6**	**all**	23	18	608	498	668	146	150	65	76	42/28	110/60	12/8	8/7	45/31	M16/M10
160L	**2-4-6**	**all**	23	18	652	542	712	168	150	65	76	42/28	110/60	12/8	8/7	45/31	M16/M10

1) Clearance hole for screw 2) Maximun distance 3) Centering holes in shaft extensions to DIN 332 part 2

THREE-PHASE FRAME SIZE 71-160 IMB3
AMHE SERIES - ALLUMINIUM ALLOY FRAME

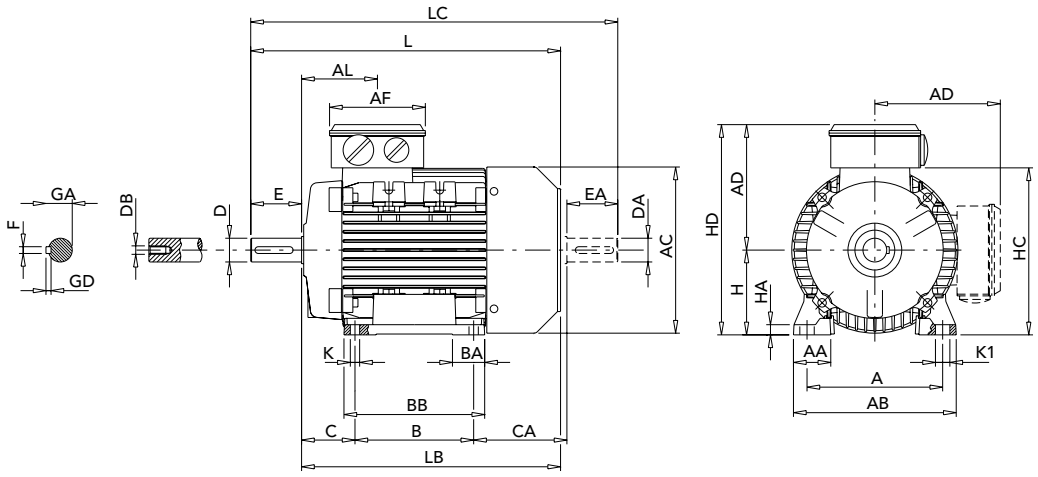


IEC	Poles	kW	H	A	B	C	K [1]	AB	BB	CA	AD [2]	HD [2]	AC	HC
71	**2**	**0.75**	71	112	90	45	8	135	108	83	110	181	139	142
80	**2 - 4**	**all**	80	125	100	50	10	153	125	89	129	209	160	162
90S	**2 - 4**	**all**	90	140	100	56	10	170	150	116	138	228	180	181
90L	**2**	**2.2**	90	140	125	56	10	170	150	91	138	228	180	181
	2	**3**	90	140	125	56	10	170	150	114	138	228	180	181
	4	**all**	90	140	125	56	10	170	150	91	138	228	180	181
100	**2**	**all**	100	160	140	63	11	192	166	110	145	245	196	198
	4	**2.2**	100	160	140	63	11	192	166	110	145	245	196	198
	4	**3**	100	160	140	63	11	192	166	125	145	245	194	198
112	**2**	**4 - 5.5**	112	190	140	70	12.5	220	176	126	160	272	225	225
	2	**7.5**	112	190	140	70	12.5	220	176	148	160	272	222	225
	4	**all**	112	190	140	70	12.5	220	176	126	160	272	225	225
132S	**2**	**5.5**	132	216	140	89	12	256	180	134	194	326	248	261
	2	**7.5**	132	216	140	89	12	256	180	154	194	326	248	261
	4	**5.5**	132	216	140	89	12	256	180	134	194	326	248	261
132M	**2**	**9.2 - 11**	132	216	178	89	12	256	218	156	194	326	248	261
	2	**15**	132	216	178	89	12	256	218	207	194	326	248	261
	4	**all**	132	216	178	89	12	256	218	136	194	326	248	261
160M	**2 - 4**	**all**	160	254	210	108	14	320	270	180	238	398	317	316
160L	**2 - 4**	**all**	160	254	254	108	14	320	310	180	238	398	317	316

IEC	Poles	kW	HA	K1	L	LB	LC	AL	AF	BA	AA	D/DA	E/EA	F	GD	GA	DB [3]
71	**2**	**0.75**	9	11	246	216	278	69	92	28	31	14	30	5	5	16	M5
80	**2 - 4**	**all**	9.5	14	272	232	319	79	116	28.5	34.5	19	40	6	6	21.5	M6
90S	**2 - 4**	**all**	11	15	317	267	372	85	116	28/53	37	24	50	8	7	27	M8
90L	**2**	**2.2**	11	15	317	267	372	85	116	28/53	37	24	50	8	7	27	M8
	2	**3**	11	15	340	290	395	85	116	28/53	37	24	50	8	7	27	M8
	4	**all**	11	15	317	267	372	85	116	28/53	37	24	50	8	7	27	M8
100L	**2**	**all**	12	17	366	306	433	91	116	38	44	28	60	8	7	31	M10
	4	**2.2**	12	17	366	306	433	91	116	38	44	28	60	8	7	31	M10
	4	**3**	12	17	381	321	448	91	116	38	44	28	60	8	7	31	M10
112M	**2**	**4 - 5.5**	15	19	388	328	456	92	116	46	48	28	60	8	7	31	M10
	2	**7.5**	15	19	410	350	478	92	116	46	48	28	60	8	7	31	M10
	4	**all**	15	19	388	328	456	92	116	46	48	28	60	8	7	31	M10
132S	**2**	**5.5**	17	20	445	365	523	100	133	45	59	38	80	10	8	41	M12
	2	**7.5**	17	20	465	385	543	100	133	45	59	38	80	10	8	41	M12
	4	**5.5**	17	20	445	365	523	100	133	45	59	38	80	10	8	41	M12
132M	**2**	**9.2 - 11**	17	20	505	425	583	120	133	45	59	38	80	10	8	41	M12
	2	**15**	17	20	556	476	634	120	133	45	59	38	80	10	8	41	M12
	4	**all**	17	20	485	405	563	120	133	45	59	38	80	10	8	41	M12
160M	**2 - 4**	**all**	23	18	608	498	668	146	150	65	76	42/28	110/60	12/8	8/7	45/31	M16/M10
160L	**2 - 4**	**all**	23	18	652	542	712	168	150	65	76	42/28	110/60	12/8	8/7	45/31	M16/M10

1) Clearance hole for screw 2) Maximun distance 3) Centering holes in shaft extensions to DIN 332 part 2

THREE-PHASE FRAME SIZE 80 - 160 IM B3
AMH SERIES - ALUMINIUM ALLOY FRAME

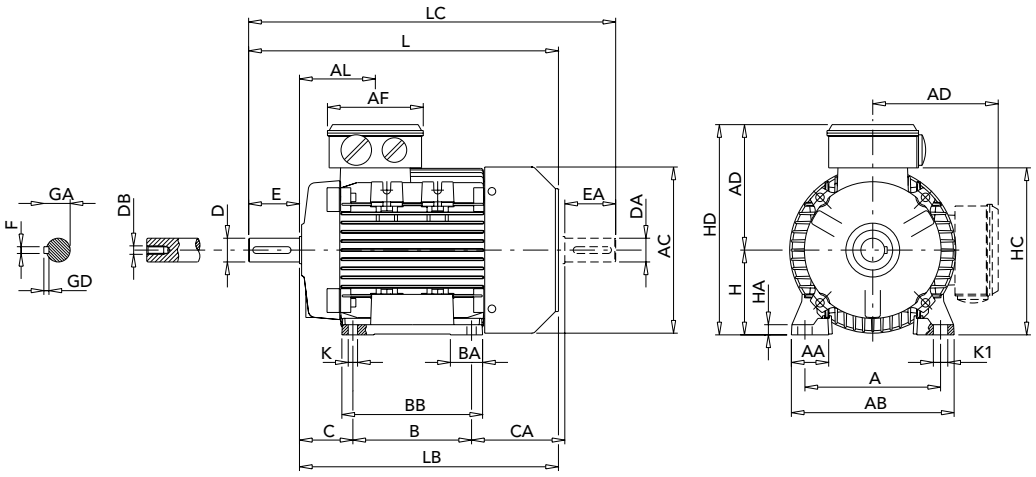


IEC	Poles	kW	H	A	B	C	K [1]	AB	BB	CA	AD [2]	HD [2]	AC	HC
80	**2 - 4**	**all**	80	125	100	50	10	153	125	89	129	209	160	162
90S	**2 - 4**	**all**	90	140	100	56	10	170	150	116	138	228	180	181
90L	**2-4-6**	**all**	90	140	125	56	10	170	150	91	138	228	180	181
100L	**2**	**all**	100	160	140	63	11	192	166	110	145	245	196	198
	4	**2.2**	100	160	140	63	11	192	166	110	145	245	196	198
	4	**3**	100	160	140	63	11	192	166	125	145	245	194	198
	6	**1.1**	100	160	140	63	11	192	166	125	145	245	194	198
112M	**2-4-6**	**all**	112	190	140	70	12.5	220	176	126	160	272	225	225
132S	**2**	**5.5**	132	216	140	89	12	256	180	134	194	326	248	261
	2	**7.5**	132	216	140	89	12	256	180	154	194	326	248	261
	4	**5.5**	132	216	140	89	12	256	180	134	194	326	248	261
	6	**3**	132	216	140	89	12	256	180	134	194	326	248	261
132M	**2**	**all**	132	216	178	89	12	256	218	156	194	326	248	261
	4	**all**	132	216	178	89	12	256	218	136	194	326	248	261
	6	**4**	132	216	178	89	12	256	218	136	194	326	248	261
	6	**5.5**	132	216	178	89	12	256	218	156	194	326	248	261
160M	**2-4-6**	**all**	160	254	210	108	14	320	270	180	238	398	317	316
160L	**2-4-6**	**all**	160	254	254	108	14	320	310	180	238	398	317	316

IEC	Poles	kW	HA	K1	L	LB	LC	AL	AF	BA	AA	D/DA	E/EA	F	GD	GA	DB [3]
80	**2 - 4**	**all**	9.5	14	272	232	319	79	116	28.5	34.5	19	40	6	6	21.5	M6
90S	**2 - 4**	**all**	11	15	317	267	372	85	116	28/53	37	24	50	8	7	27	M8
90L	**2-4-6**	**all**	11	15	317	267	372	85	116	28/53	37	24	50	8	7	27	M8
100L	**2**	**all**	12	17	366	306	433	91	116	38	44	28	60	8	7	31	M10
	4	**2.2**	12	17	366	306	433	91	116	38	44	28	60	8	7	31	M10
	4	**3**	12	17	381	321	448	91	116	38	44	28	60	8	7	31	M10
	6	**1.1**	12	17	381	321	448	91	116	38	44	28	60	8	7	31	M10
112M	**2-4-6**	**all**	15	19	388	328	456	92	116	46	48	28	60	8	7	31	M10
132S	**2**	**5.5**	17	20	445	365	523	100	133	45	59	38	80	10	8	41	M12
	2	**7.5**	17	20	465	385	543	100	133	45	59	38	80	10	8	41	M12
	4	**5.5**	17	20	445	365	523	100	133	45	59	38	80	10	8	41	M12
	6	**3**	17	20	445	365	523	100	133	45	59	38	80	10	8	41	M12
132M	**2**	**all**	17	20	505	425	583	120	133	45	59	38	80	10	8	41	M12
	4	**all**	17	20	485	405	563	120	133	45	59	38	80	10	8	41	M12
	6	**4**	17	20	485	405	563	120	133	45	59	38	80	10	8	41	M12
	6	**5.5**	17	20	505	425	583	120	133	45	59	38	80	10	8	41	M12
160M	**2-4-6**	**all**	23	18	608	498	668	146	150	65	76	42/28	110/60	12/8	8/7	45/31	M16/M10
160L	**2-4-6**	**all**	23	18	652	542	712	168	150	65	76	42/28	110/60	12/8	8/7	45/31	M16/M10

1) Clearance hole for screw 2) Maximun distance 3) Centering holes in shaft extensions to DIN 332 part 2

THREE-PHASE FRAME SIZE 71-160 IMB3
AMEE SERIES - ALLUMINIUM ALLOY FRAME

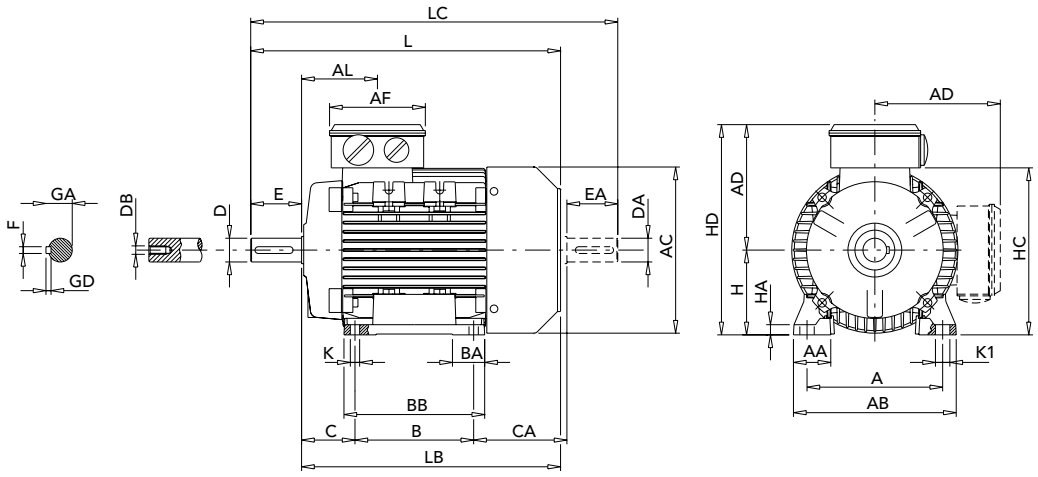


IEC	Poles	kW	H	A	B	C	K[1]	AB	BB	CA	AD[2]	HD[2]	AC	HC
71	**2**	**0.75**	71	112	90	45	8	135	107	81	110	181	139	142
80	**2-4**	**all**	80	125	100	50	10	153	125	89	129	209	160	162
90S	**2-4-6**	**all**	90	140	100	56	10	170	150	116	138	228	180	181
90L	**2-4-6**	**all**	90	140	125	56	10	170	150	91	138	228	180	181
100	**2-4-6**	**all**	100	160	140	63	11	192	166	110	145	245	196	198
112	**2**	**4-5.5**	112	190	140	70	12.5	220	176	126	160	272	225	225
	2	**7.5**	112	190	140	70	12.5	220	176	148	160	272	222	225
	4	**4**	112	190	140	70	12.5	220	176	126	160	272	225	225
	4	**5.5**	112	190	140	70	12.5	220	176	148	160	272	222	225
	6	**all**	112	190	140	70	12.5	220	176	126	160	272	225	225
132S	**2-4-6**	**all**	132	216	140	89	12	256	180	134	194	326	248	261
132M	**2**	**9.2**	132	216	178	89	12	256	218	136	194	326	248	261
	2	**11**	132	216	178	89	12	256	218	156	194	326	248	261
	2	**15**	132	216	178	89	12	256	218	207	194	326	248	261
	4	**7.5**	132	216	178	89	12	256	218	136	194	326	248	261
	4	**9.2**	132	216	178	89	12	256	218	136	194	326	248	261
	6	**4**	132	216	178	89	12	256	218	136	194	326	248	261
	6	**5.5**	132	216	178	89	12	256	218	136	194	326	248	261
160M	**2-4-6**	**all**	160	254	210	108	14	320	270	180	238	398	317	316
160L	**2-4-6**	**all**	160	254	254	108	14	320	310	180	238	398	317	316

IEC	Poles	kW	HA	K1	L	LB	LC	AL	AF	BA	AA	D/DA	E/EA	F	GD	GA	DB[3]
71	**2**	**0.75**	9	11	246	216	278	69	92	28	31	14	30	5	5	16	M5
80	**2-4**	**all**	9.5	14	272	232	319	79	116	29	35	19	40	6	6	21.5	M6
90S	**2-4-6**	**all**	11	15	317	267	372	85	116	28/53	37	24	50	8	7	27	M8
90L	**2-4-6**	**all**	11	15	317	267	372	85	116	28/53	37	24	50	8	7	27	M8
100	**2-4-6**	**all**	12	17	366	306	433	91	116	38	44	28	60	8	7	31	M10
112	**2**	**4-5.5**	15	19	388	328	456	92	116	46	48	28	60	8	7	31	M10
	2	**7.5**	15	19	410	350	478	92	116	46	48	28	60	8	7	31	M10
	4	**4**	15	19	388	328	456	92	116	46	48	28	60	8	7	31	M10
	4	**5.5**	15	19	410	350	478	92	116	46	48	28	60	8	7	31	M10
	6	**all**	15	19	388	328	456	92	116	46	48	28	60	8	7	31	M10
132S	**2-4-6**	**all**	17	20	445	365	523	102	133	45	59	38	80	10	8	41	M12
132M	**2**	**9.2**	17	20	485	405	563	122	133	45	59	38	80	10	8	41	M12
	2	**11**	17	20	505	425	583	122	133	45	59	38	80	10	8	41	M12
	2	**15**	17	20	556	476	634	122	133	45	59	38	80	10	8	41	M12
	4	**7.5**	17	20	485	405	563	122	133	45	59	38	80	10	8	41	M12
	4	**9.2**	17	20	505	425	583	122	133	45	59	38	80	10	8	41	M12
	6	**4**	17	20	485	405	563	122	133	45	59	38	80	10	8	41	M12
	6	**5.5**	17	20	505	425	583	122	133	45	59	38	80	10	8	41	M12
160M	**2-4-6**	**all**	23	18	608	498	668	146	150	65	76	42/28	110/60	12/8	8/7	45/31	M16/M10
160L	**2-4-6**	**all**	23	18	652	542	712	168	150	65	76	42/28	110/60	12/8	8/7	45/31	M16/M10

1) Clearance hole for screw 2) Maximun distance 3) Centering holes in shaft extensions to DIN 332 part 2

THREE-PHASE FRAME SIZE 56 - 160 IM B3
AM SERIES - ALUMINIUM ALLOY FRAME

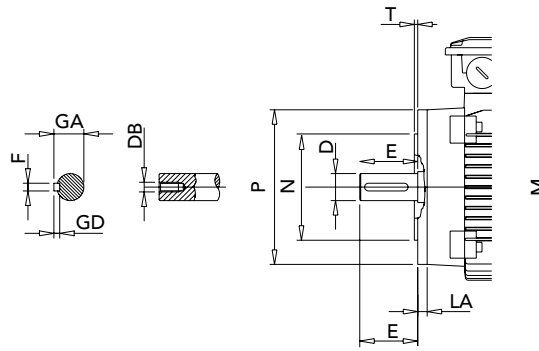


IEC	H	A	B	C	K [1]	AB	BB	CA	AD [2]	HD [2]	AC	HC	HA
56	56	90	71	36	6	107	86	64	92	148	110	109	8
63	63	100	80	40	7	120	100	72	96	159	124	120	8
71	71	112	90	45	8	135	108	83	110	181	139	142	9
80	80	125	100	50	10	153	125	89	129	209	160	162	9.5
90S	90	140	100	56	10	170	150	116	138	228	180	181	11
90L	90	140	125	56	10	170	150	91	138	228	180	181	11
100	100	160	140	63	11	192	166	110	145	245	196	198	12
112	112	190	140	70	12.5	220	175	126	161	273	225	226	15
132S	132	216	140	89	12	256	180	134	195	327	248	261	17
132M	132	216	178	89	12	256	218	136	195	327	248	261	17
132M [4]	132	216	178	89	12	256	218	166	195	327	248	261	17
160M	160	254	210	108	14	320	270	180	238	398	317	316	23
160L	160	254	254	108	14	320	310	180	238	398	317	316	23
160L [5]	160	254	254	108	14	320	310	210	238	398	317	316	23

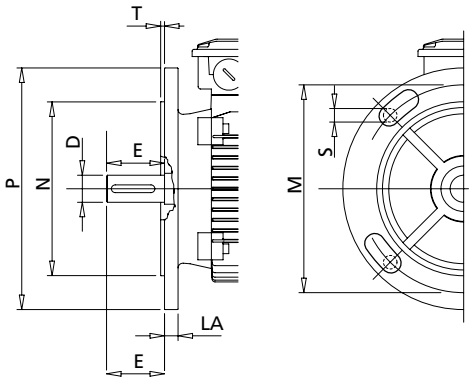
IEC	K1	L	LB	LC	AL	AF	BA	AA	D/DA	E/EA	F	GD	GA	DB [3]
56	9	188	168	211	61	92	27	27	9	20	3	3	10.2	M3
63	11	211	188	238	63	92	29	30	11	23	4	4	12.5	M4
71	11	246	216	278	69	92	28	31	14	30	5	5	16	M5
80	14	272	232	319	79	116	28.5	34.5	19	40	6	6	21.5	M6
90S	15	317	267	372	85	116	28/53	37	24	50	8	7	27	M8
90L	15	317	267	372	85	116	28/53	37	24	50	8	7	27	M8
100L	17	366	306	433	91	116	38	44	28	60	8	7	31	M10
112M	19	388	328	456	91.5	116	46	48	28	60	8	7	31	M10
132S	20	442	362	523	100	133	45	59	38	80	10	8	41	M12
132M	20	482	402	563	120	133	45	59	38	80	10	8	41	M12
132M [4]	20	500	420	593	120	133	45	59	38	80	10	8	41	M12
160M	18	608	498	718	146	150	65	76	42	110	12	8	45	M16
160L	18	652	542	762	168	150	65	76	42	110	12	8	45	M16
160L [5]	18	678	568	678	168	150	65	76	42	110	12	8	45	M16

1) Clearance hole for screw
2) Maximum dimension
3) Centering holes in shaft extensions to DIN 332 part 2
4) Only for MT A2
5) Only for LR A4

IM B14

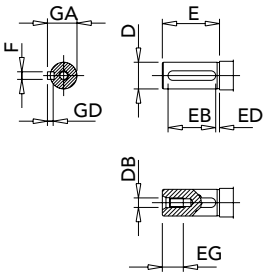


IM B5



	FLANGE B14						OVERSIZED FLANGE B14[2]						FLANGE B5					
IEC	P	N	LA	M	T	S	P	N	LA	M	T	S	M	N	P	T	LA	S[1]
56	80	50	8	65	2.5	M5	105	70	8	85	2.5	M6	100	80	120	2.5	7	M6
63	90	60	8	75	2.5	M5	120	80	8	100	2.5	M6	115	95	140	3	8	M8
71	105	70	8	85	2.5	M6	140	95	8	115	3	M8	130	110	160	3.5	10	M8
80	120	80	9	100	3	M6	160	110	8.5	130	3.5	M8	165	130	200	3.5	10	M10
90	140	95	9	115	3	M8	160	110	9	130	3.5	M8	165	130	200	3.5	12	M10
100	160	110	10	130	3.5	M8	200	130	12	165	3.5	M10	215	180	250	4	14	M12
112	160	110	10	130	3.5	M8	200	130	12	165	3.5	M10	215	180	250	4	14	M12
132	200	130	30	165	3.5	M10	250	180	12	215	4	M12	265	230	300	4	14	M12
160	250	180	12	215	4	M12	300	230	12	265	5	M16	300	250	350	5	15	M16

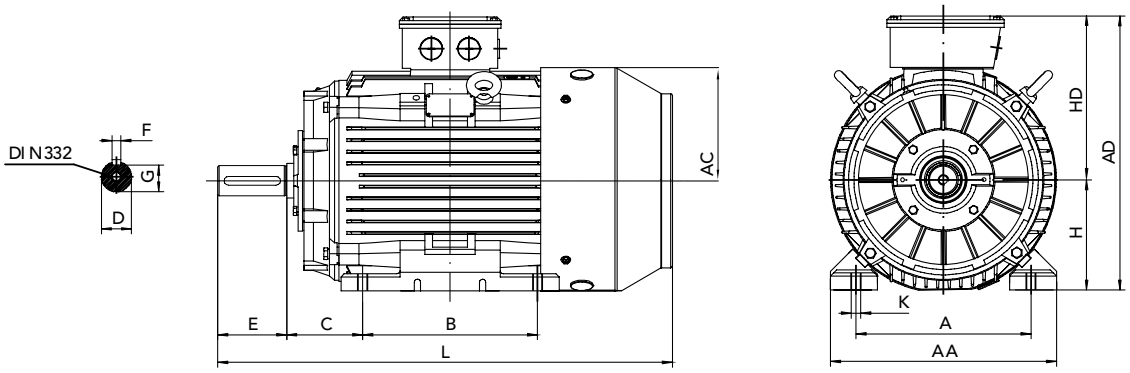
1) Clearence hole for screw. Hole as standard for 132 to 160 frame size
2) Available on request. Please refer to price list "PL 1.1 - Optional features".



IEC	D	E	F h9	GD	GA	DB[1]	EG	EB	ED
56	9 j6	20	3	3	10.2	M3	10	15	2.5
63	11 j6	23	4	4	12.5	M4	10	15	4
71	14 j6	30	5	5	16	M5	12.5	20	4
80	19 j6	40	6	6	21.5	M6	16	30	4
90	24 j6	50	8	7	27	M8	19	40	4
100	28 j6	60	8	7	31	M10	22	50	4
112	28 j6	60	8	7	31	M10	22	50	4
132	38 k6	80	10	8	41	M12	28	70	4
160	42 k6	110	12	8	45	M16	36	100	4

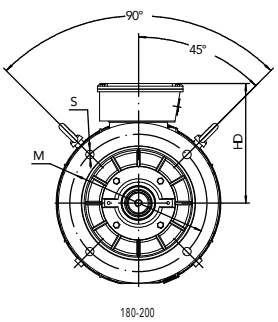
1) Centering holes in shaft extension to DIN 332 part 2

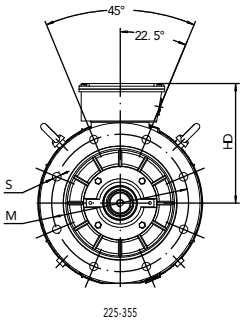
THREE-PHASE FRAME SIZE 180 - 315 IM B3
AMPE - AMHE SERIES - CAST IRON FRAME

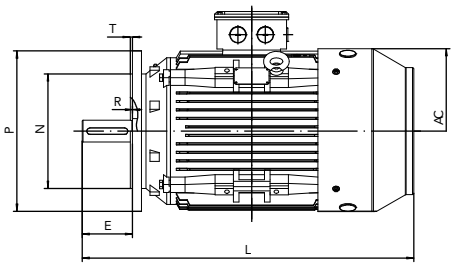


IEC	Poles	H	A	B	C	K	AD	HD	AC	L	AA	D	E	F	G
180M	**2-4-6**	180	279	241	121	15	439	259	360	687	348	48	110	14	42.5
180L	**2-4-6**	180	279	279	121	15	439	259	360	725	348	48	110	14	42.5
200	**2-4-6**	200	318	305	133	19	497	297	399	768	388	55	110	16	49
225S	**≥ 4**	225	356	286	149	19	553	328	465	814	436	60	140	18	53
225M	**2**	225	356	311	149	19	553	358	465	809	436	55	110	16	49
	≥ 4	225	356	311	149	19	553	328	465	839	436	60	140	18	53
250	**2**	250	406	349	168	24	616	366	506	918	484	60	140	18	53
	≥ 4	250	406	349	168	24	616	366	506	918	484	65	140	18	58
280S	**2**	280	457	368	190	24	668	388	559	984	557	65	140	18	58
	≥ 4	280	457	368	190	24	668	388	559	984	557	75	140	20	67.5
280M	**2**	280	457	419	190	24	668	388	559	1035	557	65	140	18	58
	≥ 4	280	457	419	190	24	668	388	559	1035	557	75	140	20	67.5
315S	**2**	315	508	457	216	28	845	530	680	1355	630	65	140	18	58
	≥ 4	315	508	457	216	28	845	530	680	1385	630	80	170	22	71
315M	**2**	315	508	508	216	28	845	530	680	1355	630	65	140	18	58
	≥ 4	315	508	508	216	28	845	530	680	1385	630	80	170	22	71
315L	**2**	315	508	508	216	28	845	530	680	1355	630	65	140	18	58
	≥ 4	315	508	508	216	28	845	530	680	1385	630	80	170	22	71

THREE-PHASE FRAME SIZE 180 - 315 IM B5
AMPE - AMHE SERIES - CAST IRON FRAME







IEC	Poles	AC	HD	L	M	N	P	T	S	D	E	F	G
180M		360	259	687	300	250	350	5	19	48	110	14	42.5
180L		360	259	725	300	250	350	5	19	48	110	14	42.5
200		399	297	768	350	300	400	5	19	55	110	16	49
225S	≥ **4**	465	328	814	400	350	450	5	19	60	140	18	53
225M	**2**	465	358	809	400	350	450	5	19	55	110	16	49
	≥ **4**	465	328	839	400	350	450	5	19	60	140	18	53
250	**2**	506	366	918	500	400	550	5	19	60	140	18	53
	≥ **4**	506	366	918	500	400	550	5	19	65	140	18	58
280S	**2**	559	388	984	500	400	550	5	19	65	140	18	58
	≥ **4**	559	388	984	500	400	550	5	19	75	140	20	67.5
280M	**2**	559	388	1035	500	400	550	5	19	65	140	18	58
	≥ **4**	559	388	1035	500	400	550	5	19	75	140	20	67.5
315S	**2**	680	530	1205	600	550	660	6	24	65	140	18	58
	≥ **4**	680	530	1235	600	550	660	6	24	80	170	22	71
315M	**2**	680	530	1355	600	550	660	6	24	65	140	18	58
	≥ **4**	680	530	1385	600	550	660	6	24	80	170	22	71
315L	**2**	680	530	1355	600	550	660	6	24	65	140	18	58
	≥ **4**	680	530	1385	600	550	660	6	24	80	170	22	71

Section 3.4.2.4

Water Level Sensor

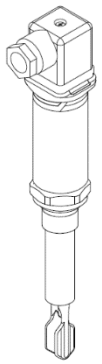
INSTRUCTIONS

PRODUCT LINE	: DAF	INSTRUCTION NUMBER		: H2F-17-001	
TOPIC	: DAF LEVEL SENSOR	REVISION	B	DATE	Feb 22 2018

Overview:

Applies to any DAF with Endress+Hauser Liquiphant FTL31 installed. These instructions will provide information for correctly wiring FTL31 level sensor with valve plug.

Procedure:



Identify if your sensor has a valve plug connection. See Figure 1.0

For a normal DAF installation follow the (MIN) Operating Mode wiring diagram.

Wire Pin connections as follows:
(K represents external Load)

Brown - 24V
Blue - Common
Black - Signal

Ground – Wire to ground in Control panel
Pin 1 – Wire to (-) 24vdc
Pin 2 – Wire to (+) 24vdc
Pin 3 – Wire to (+) Connection to Digital Input in Control Panel.
K (-) – Internal wiring on Digital Input card within the control panel.

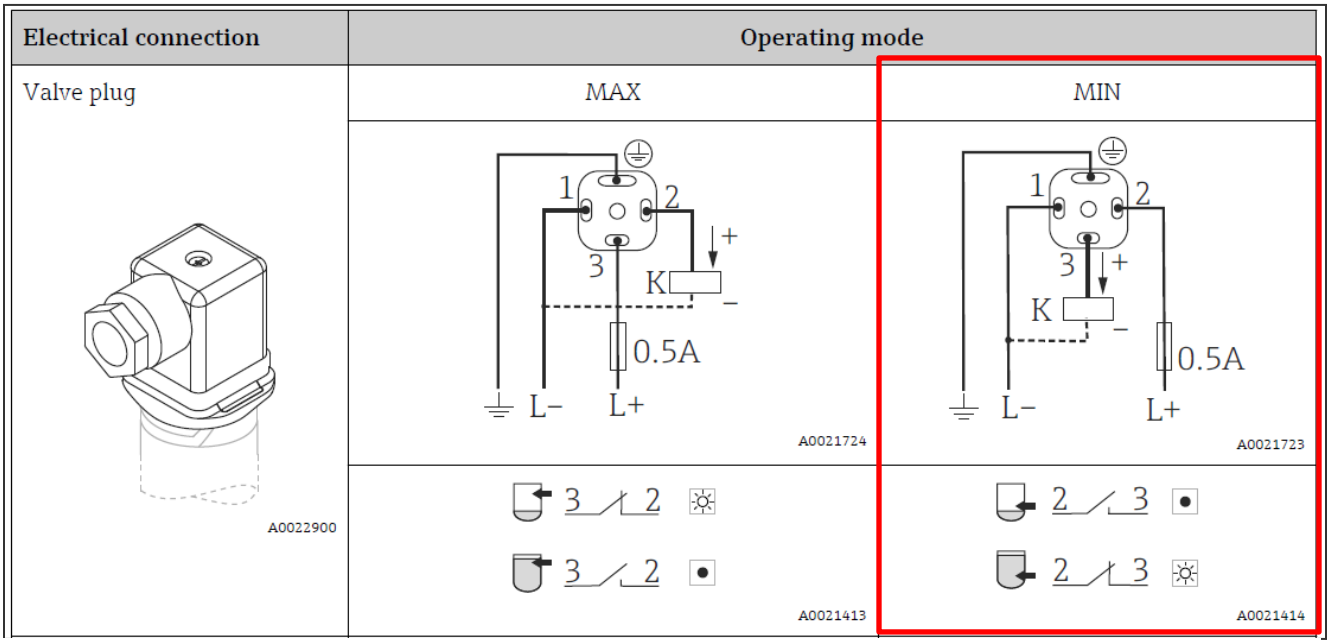


Figure 1.0

If wired correctly with MIN operation the sensor should display the following:

No water detected	Lit Green light indicating power and not lit yellow	● ○
Water detected	Lit Green light indicating power and lit yellow	● ●
Fault	If red light solid or flashing there's a fault in the wiring and will need to be checked	●

See https://portal.endress.com/wa001/dla/5000998/5452/000/00/BA01285FA2_0315.pdf for full manual.

TECHNOLOGIES FOR CLEAN WATER, WASTEWATER, BIOSOLIDS, AND BIOGAS TREATMENT
580 Oster Lane, Vaughan, Ontario, Canada L4K 2C1 CANADA TEL (905) 660-9775 / FAX (905) 660-9744
info@h2flow.com www.h2flow.com

Technical Information
Liquiphant FTL31

Vibronic



Point level switch for liquids

Application

The Liquiphant FTL31 is a point level switch for liquids and is used in tanks, vessels and pipes.

It is used for overfill prevention or pump protection in cleaning and filter systems as well as in cooling and lubrication vessels, for instance.

Ideal for applications in which float switches or conductive, capacitance and optical sensors have been used up to now. The Liquiphant FTL31 also works in areas where these measuring principles are not suitable due to conductivity, buildup, turbulence, flow conditions or air bubbles.

The Liquiphant FTL31 can be used for process temperatures up to:
- 100 °C (212 °F)
- 150 °C (302 °F)

Not suitable for hazardous areas.

The use of the Liquiphant FTL33 is recommended for hygiene areas.

Your benefits

- Operational safety, reliability and universal application thanks to the tuning fork measuring principle
- Robust stainless steel housing (316L)
- External function test with test magnet
- Onsite function check possible thanks to LED indication
- Compact design for easy installation even in confined conditions or hard-to-access areas

Endress+Hauser
People for Process Automation

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Document conventions

Safety symbols

Symbol	Meaning
 A0011189-EN	**DANGER!** This symbol alerts you to a dangerous situation. Failure to avoid this situation will result in serious or fatal injury.
 A0011190-EN	**WARNING!** This symbol alerts you to a dangerous situation. Failure to avoid this situation can result in serious or fatal injury.
 A0011191-EN	**CAUTION!** This symbol alerts you to a dangerous situation. Failure to avoid this situation can result in minor or medium injury.
 A0011192-EN	**NOTE!** This symbol contains information on procedures and other facts which do not result in personal injury.

Electrical symbols

Symbol	Meaning
 A0011200	**Ground connection** A grounded terminal which, as far as the operator is concerned, is grounded via a grounding system.
 A0011199	**Protective ground connection** A terminal which must be connected to ground prior to establishing any other connections.

Symbols for certain types of information

Symbol	Meaning
 A0011182	**Permitted** Indicates procedures, processes or actions that are permitted.
 A0011184	**Forbidden** Indicates procedures, processes or actions that are forbidden.
 A0011193	**Tip** Indicates additional information.
 A0011194	**Reference to documentation** Refers to the corresponding device documentation.
 A0011195	**Reference to page** Refers to the corresponding page number.

Symbols in graphics

Symbol	Meaning
1, 2, 3 ...	Item numbers
A, B, C, ...	Views

Function and system design

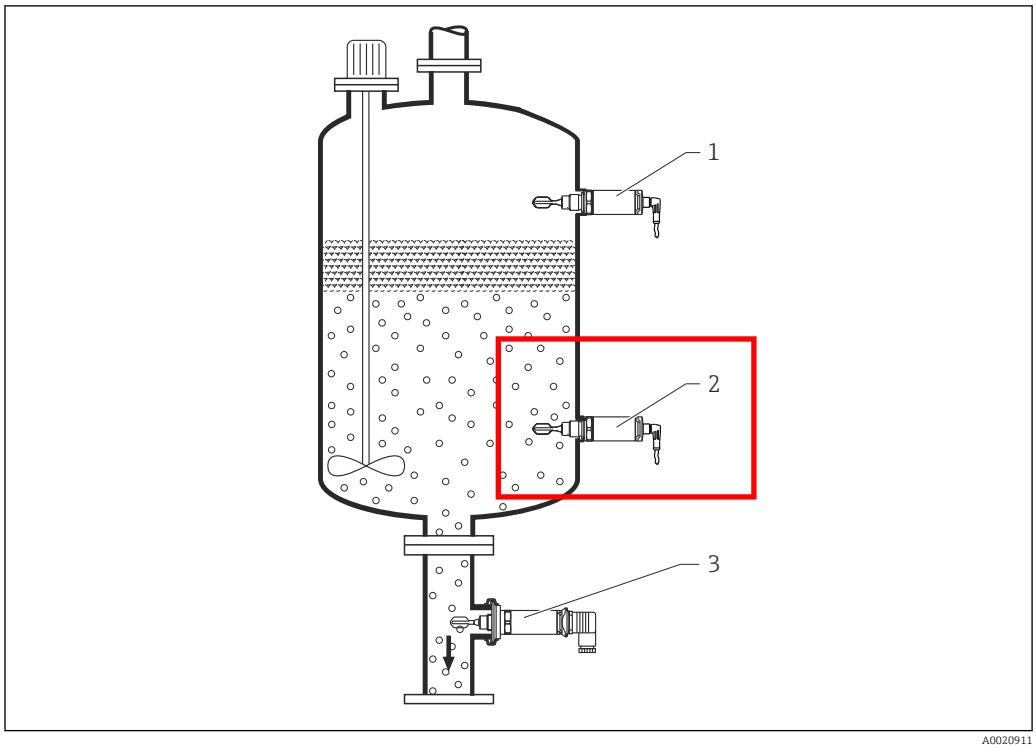
Measuring principle

A piezoelectric drive causes the tuning fork of the Liquiphant FTL31 to vibrate at its resonance frequency. When the tuning fork is immersed in a liquid, its intrinsic frequency changes due to the change in density of the surrounding medium. The electronics system in the point level switch monitors the resonance frequency and indicates whether the tuning fork is vibrating in air or is covered by liquid.

A signal is output via the DC-PNP or AC/DC electrical connection.

Measuring system

The measuring system consists of a Liquiphant FTL31 point level switch, e.g. for connection to programmable logic controllers (PLC), a mini-contactor or solenoid valve.



A0020911

1 Overfill prevention or upper level detection MAX (maximum safety)
2 Lower level detection MIN (minimum safety)
3 Lower level detection MIN, e.g. dry running protection for pump

Input

Measured variable

Density

Measuring range

> 0.7 g/cm³ (optionally available: > 0.5 g/cm³)

Output

Switch output

Switching behavior: On/Off

Function

3-wire DC-PNP:
Positive voltage signal at the switch output of the electronics (PNP), switching capacity 200 mA
2-wire AC/DC:
Load switching in the power supply line, switching capacity 250 mA

Operating modes

The device has two operating modes: maximum safety (MAX) and minimum safety (MIN).

By choosing the corresponding operating mode, the user ensures that the device also switches in a safety-oriented manner even in an alarm condition, e.g. if the power supply line is disconnected.

- **Maximum safety (MAX)**
  The device keeps the electronic switch closed as long as the liquid level is below the fork. Sample application: overfill prevention
- **Minimum safety (MIN)**
  The device keeps the electronic switch closed as long as the fork is immersed in liquid. Sample application: Dry running protection for pumps

The electronic switch opens if the limit is reached, if a fault occurs or the power fails (quiescent current principle).

Power supply

Supply voltage

DC-PNP: 10 to 30 V DC, 3-wire
AC/DC: 20 to 253 V AC/DC, 2-wire

Power consumption

DC-PNP: < 975 mW
AC/DC: < 850 mW

Current consumption

DC-PNP: < 15 mA
AC/DC: < 3.8 mA

Residual ripple

DC-PNP: 5 Vss 0 to 400 Hz
AC/DC: –

Electrical connection

Two electronic versions and three different connections are available for the device.

- Electronic version 3-wire DC-PNP with connection; M12 plug, valve plug or cable
- Electronic version 2-wire AC/DC with connection; valve plug or cable

A fine-wire fuse is necessary for operation: 500 mA slow-blow.

Electronic version 3-wire DC-PNP

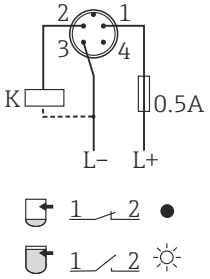
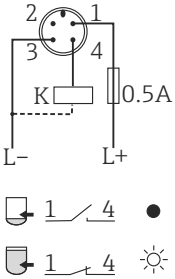
3-wire DC-PNP is preferably used in conjunction with programmable logic controllers (PLC), DI modules as per EN 61131-2. Positive signal at the switch output of the electronics (PNP).

Voltage source: non-hazardous contact voltage or Class 2 circuit (North America).

Connection with M12 plug

Depending on the analysis of the switch outputs, the device works in the MAX (maximum safety) or MIN (minimum safety) mode.

A cable is optionally available for order, see "Accessories" section → 27.

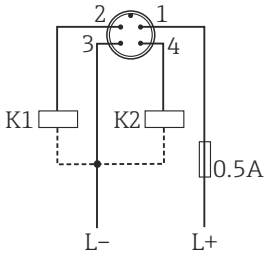
3-wire DC-PNP	Operating mode	
M12 connector	MAX	MIN
 A0022901		

Symbols	Description
☼	Yellow LED (ye) lit
•	Yellow LED (ye) not lit
K	external load

Function monitoring with M12 connector

Using a two-channel analysis, function monitoring of the sensor can be implemented in addition to level monitoring, e.g. per relay switch, PLC, AS-i Bus I/O module, ...).

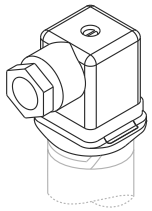
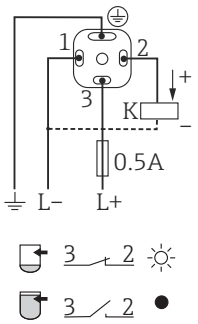
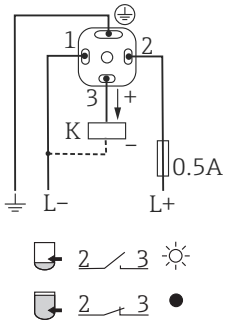
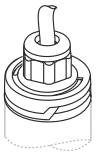
When both outputs are connected, the MIN and MAX outputs assume opposite states when the device is operating fault-free (XOR). In the event of an alarm condition or a line break, both outputs are deenergized.

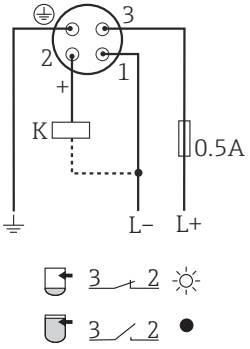
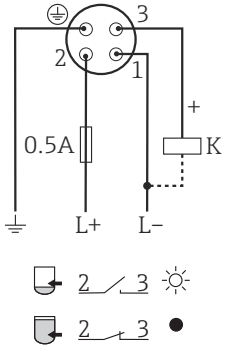
Connection with 3-wire DC-PNP for function monitoring based on XOR logic		Yellow LED (ye)	Red LED (rd)
 A0022917	**Sensor covered**	☼	●
	Sensor exposed	●	●
	Fault	●	☼

Symbols	Description
☼	LED lit
•	LED not lit
↯	Fault or warning
K1 / K2	external load

Connection with valve plug or cable

Depending on the assignment of the connector or the wiring of the cable, the device works in either the MAX or MIN operating mode.

<table>
<tr><th>3-wire DC-PNP</th><th colspan="2">Operating mode</th></tr>
<tr><td rowspan="2">Valve plug
 
A0022900</td><td>MAX</td><td>MIN</td></tr>
<tr><td>  </td><td>  </td></tr>
<tr><td>Cable (cannot be dismantled)
 
A0022902

Core colors:
1 = BK (black)
2 = GR (gray)
3 = BN (brown)
Ground = GNYE (green-yellow)</td><td>  </td><td>  </td></tr>
</table>

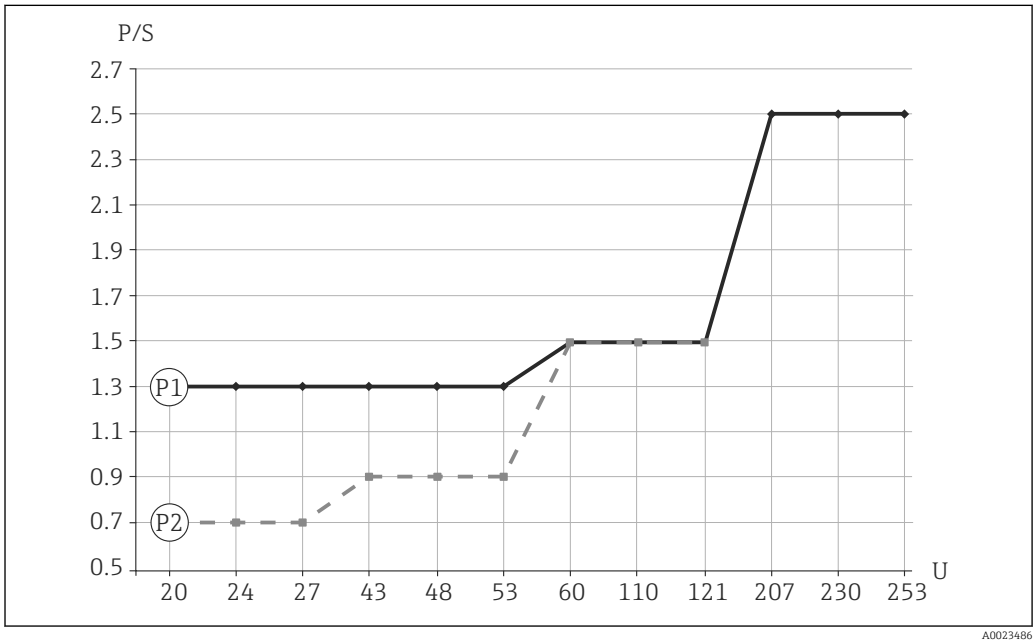
Symbols	Description
☼	Yellow LED (ye) lit
•	Yellow LED (ye) not lit
K	external load

Electronic version 2-wire AC/DC

The load is switched via an electronic switch directly in the power supply circuit. Always connect in series with a load!

Not suitable for connection to low-voltage PLC inputs!

Selection tool for relays



1 Minimum rated power of the load

P/S Rated power in [W] / [VA]
U Operating voltage in [V]

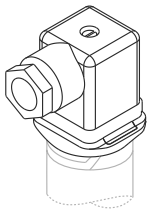
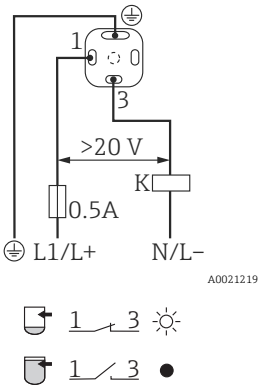
Item	Supply voltage	Rated power	
		min	max
P1 AC mode	24 V 110 V 230 V	> 1.3 VA > 1.5 VA > 2.5 VA	< 6 VA < 27.5 VA < 57.5 VA
P2 DC mode	24 V 48 V 60 V	> 0.7 W > 0.9 W > 1.5 W	< 6 W < 12 W < 15 W

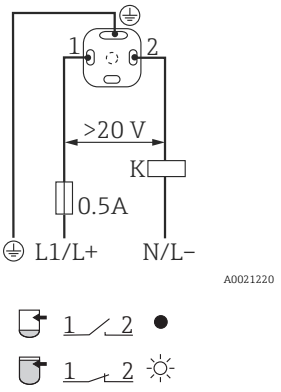
Relays with a lower rated power can be operated by means of an RC module connected in parallel (optional).

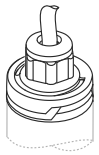
Connection with valve plug or cable

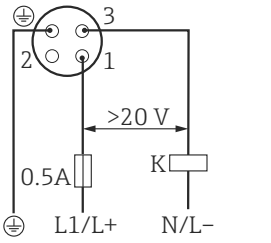
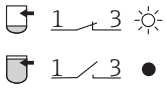
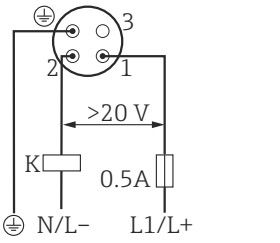
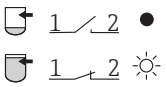
Depending on the assignment of the connector or the wiring of the cable, the device works in either the MAX or MIN operating mode.

When the cable is wired, one wire of the cable does not have any function in each of the operating modes (brown in the case of MIN, and gray in the case of MAX). The cable with no function must be secured against inadvertent contact.

<table>
<tr><th>2-wire AC/DC</th><th colspan="2">Operating mode</th></tr>
<tr><td rowspan="2">Valve plug
 
A0022900</td><td>MAX</td><td>MIN</td></tr>
<tr><td> 
A0021219

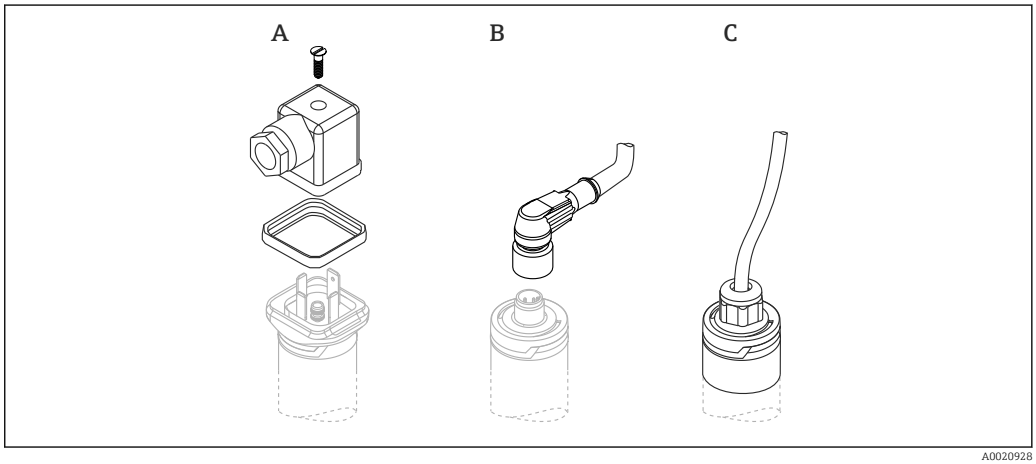
A0021418</td><td> 
A0021220

A0021420</td></tr>
<tr><td>Cable (cannot be dismantled)
 
A0022902

Core colors:
1 = BK (black)
2 = GR (gray)
3 = BN (brown)
Ground = GNYE (green-yellow)</td><td> 
A0022161
 
A0021418</td><td> 
A0022225
 
A0021420</td></tr>
</table>

Symbols	Description
☼	Yellow LED (ye) lit
•	Yellow LED (ye) not lit
K	external load

Cable entry



A0020928

A Valve plug (M16x1.5; NPT ½"; QUICKON)
B M12 connector
C Cable 5 m (16 ft); secured in place on delivery and cannot be disassembled

Cable specification

- Valve plug
  - Cable cross-section: max. 1.5 mm^2 (AWG 16)
  - Ø 3.5 to 8 mm (0.14 to 0.26 in)
- M12 connector: IEC 60947-5-2
- Cable (3LPE)
  - Cable cross-section: 0.75 mm^2 (AWG 20)
  - Ø 6 to 8 mm (0.24 to 0.31 in)
  - Material: PUR

Overvoltage protection

Overvoltage category II

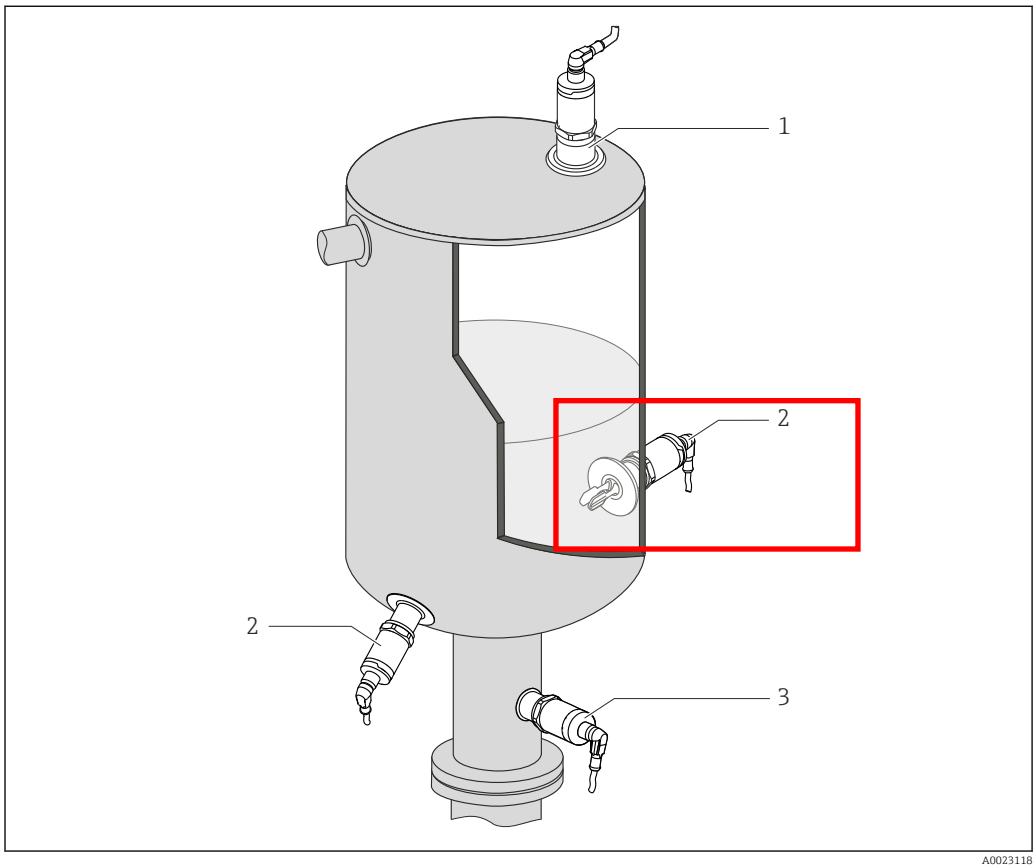
Performance characteristics

Reference operating conditions	Ambient temperature:	+25 °C (+77 °F)
	Process pressure:	1 bar (14.5 psi)
	Fluid:	Water (density: approx. 1 g/cm³, viscosity 1 mm²/s)
	Medium temperature:	25 °C (77 °F)
	Density setting:	> 0.7 g/cm³
	Switching time delay:	Standard (0.5 s, 1 s)
Switch point	13 mm (0.51 in)±1 mm	
Hysteresis	max. 3 mm (0.12 in)	
Non-repeatability	±1 mm (0.04 in) in accordance with DIN 61298-2	
Influence of ambient temperature	Negligible	
Influence of medium temperature	−25 µm (984 µin)/°C	
Influence of medium pressure	−20 µm (787 µin)/bar	
Switching delay	▪ 0.5 s when tuning fork is covered ▪ 1.0 s when tuning fork is uncovered ▪ Optionally available: 0.2 s; 1.5 s or 5 s (when the tuning fork is covered and uncovered)	
Switch-on delay	max. 3 s	
Measuring frequency	approx. 1 100 Hz in air	
Measured error	In event of device change: ±2 mm (0.08 in) as per DIN 61298-2	

Installation

Orientation

The point level switch can be installed in any position in a vessel, pipe or tank. Foam formation does not affect the function.



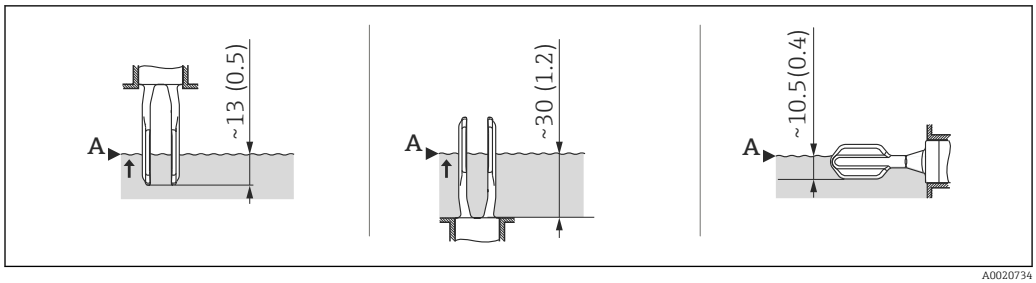
2 *Installation options*

1 Overfill prevention or upper level detection
2 Lower level detection
3 Dry running protection for pump

Installation instructions

Switch point

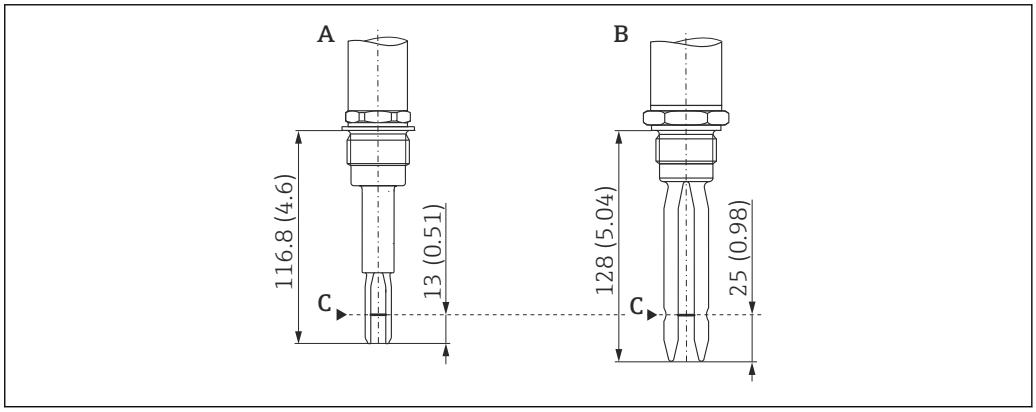
The switch point (A) on the sensor depends on the orientation of the point level switch (water +25 °C (+77 °F), 1 bar (14.5 psi).



3 *Vertical and horizontal orientation, dimensions in mm (in)*

Short tube version

The use of the short tube ensures that the switch point is at the same level as in the previous Liquiphant FTL260 model when an identical thread is selected. In this way, the device can be replaced quickly and easily. (Applies for process connections G 1" weld-in adapter for flush-mounted installation, MNPT 1" and R 1")

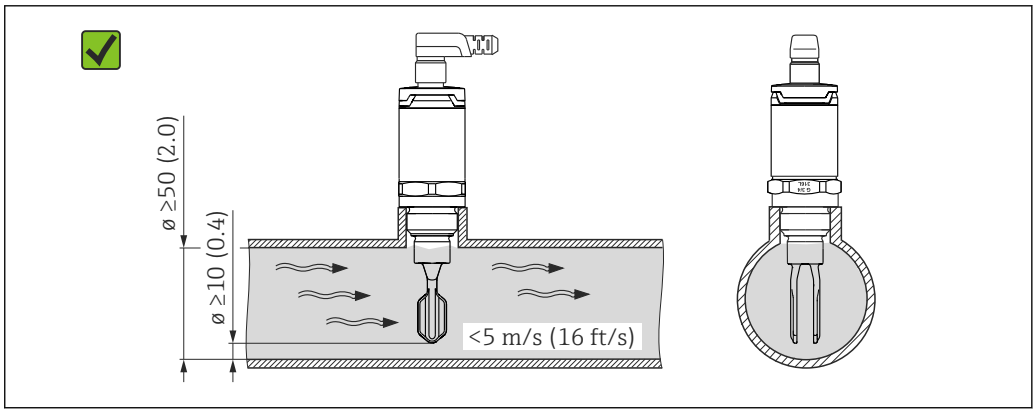


Dimensions mm (in)

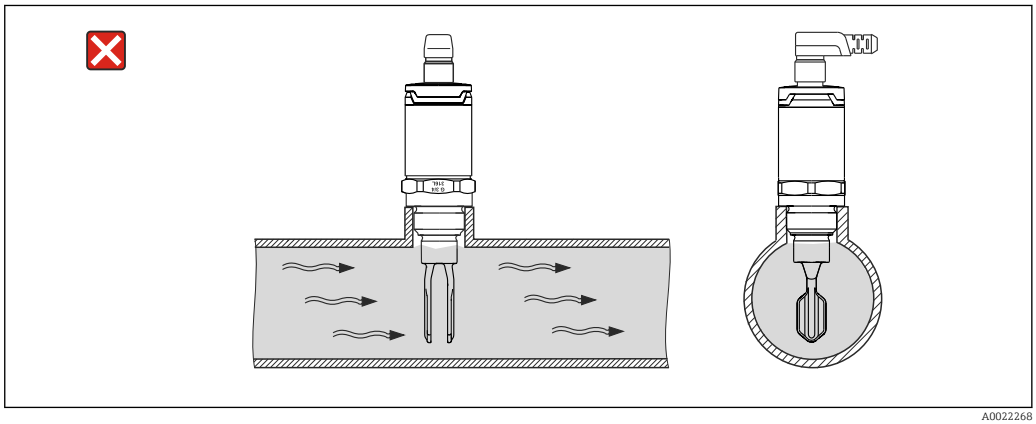
A Liquiphant FTL31 with short tube
B Liquiphant FTL260
C Switch point

Installation in pipes

During installation, pay attention to the position of the fork in order to minimize turbulence in the pipe.



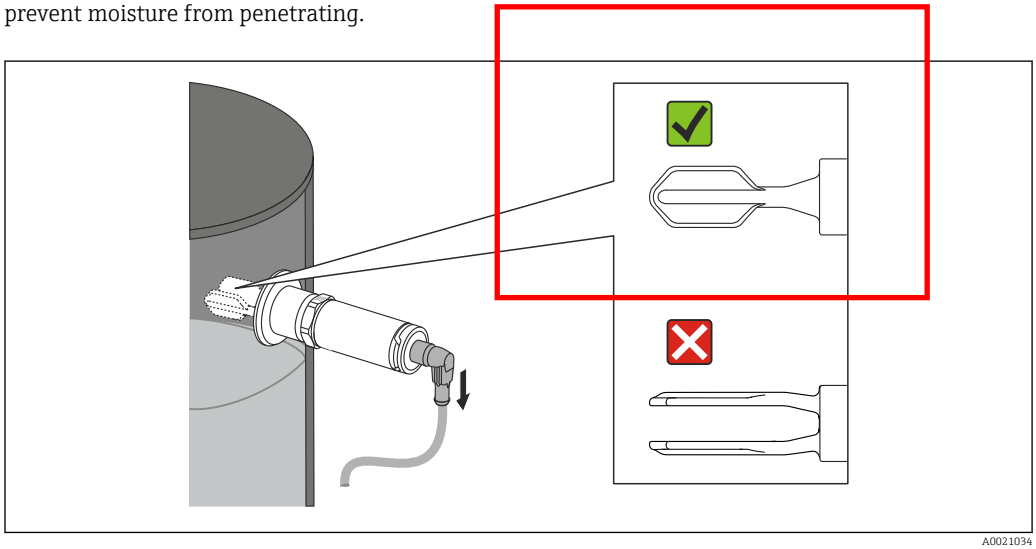
Dimensions mm (in)



Installation in vessels

If installed horizontally, pay attention to the position of the tuning fork to ensure that the liquid can drip off easily.

The electrical connection, e.g. M12 connector, should be pointing down with the cable. This can prevent moisture from penetrating.

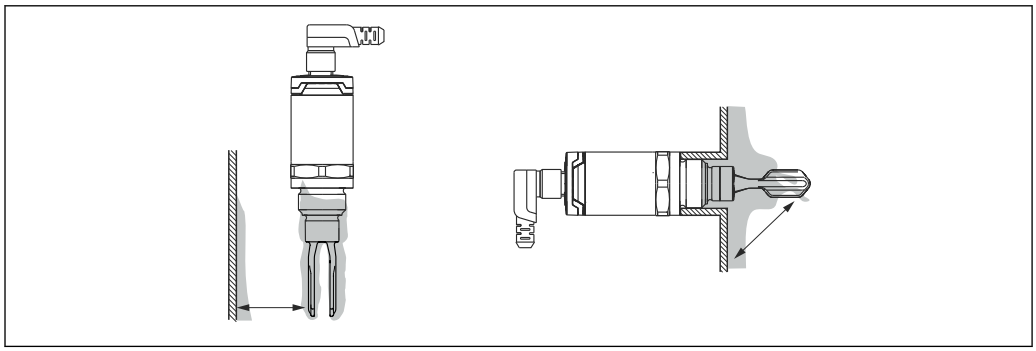


A0021034

4 *Position of the fork in the case of horizontal installation in a vessel*

Distance from wall

Ensure that there is sufficient distance between the expected buildup on the tank wall and the fork. Recommended distance from wall ≥10 mm (0.39 in).



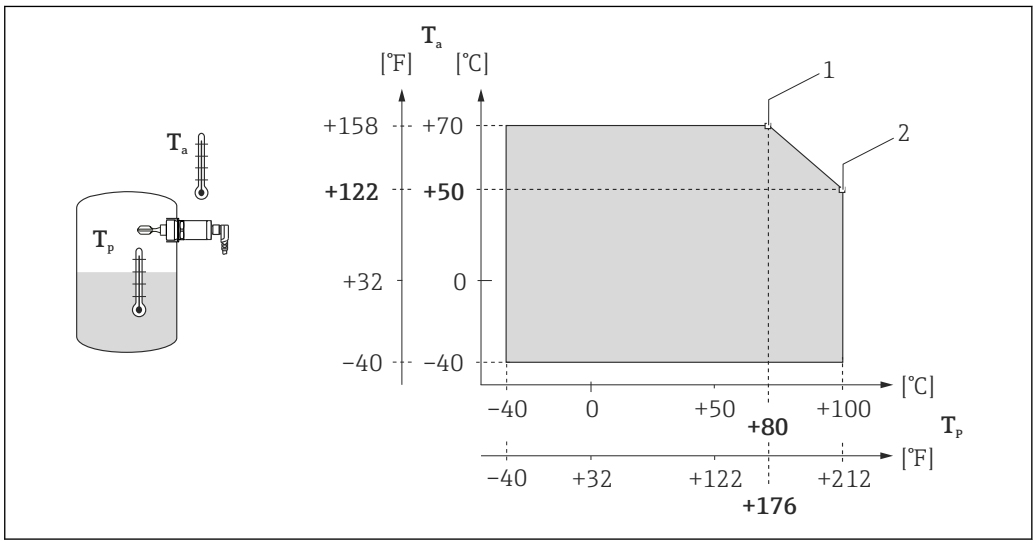
A0022272

Length of connecting cable

- to1 000 m (3 281 ft)
- max. 25 Ω/wire, total capacitance < 100 nF

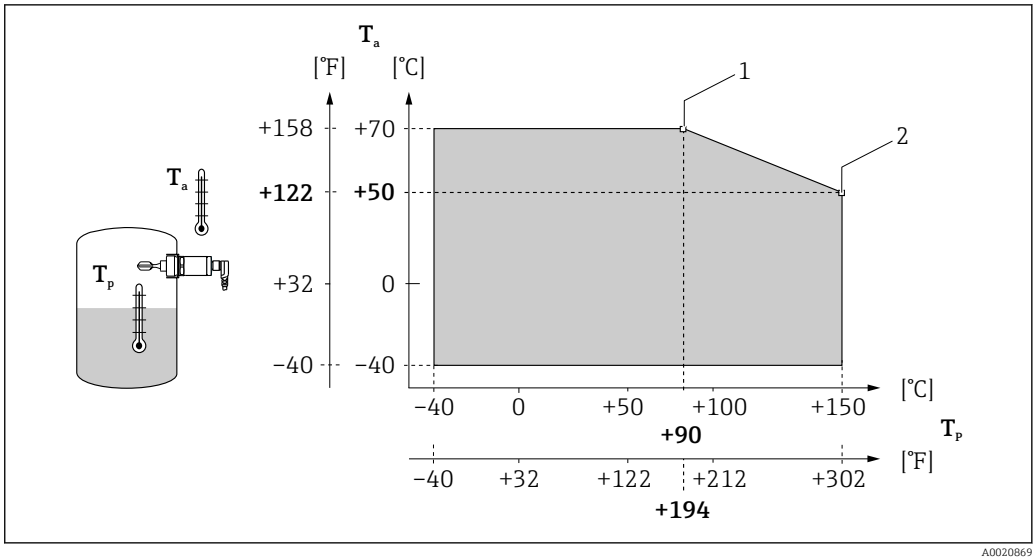
Environment

Ambient temperature range −40 to +70 °C (−40 to +158 °F)



5 *Derating curve: 100 °C (212 °F)*

1 I_{max}*: 200 mA (DC-PNP), 250 mA (AC/DC)*
2 I_{max}*: 150 mA (DC-PNP), 150 mA (AC/DC)*
Ta Ambient temperature range
Tp Process temperature



6 *Derating curve: 150 °C (302 °F)*

1 I_{max}*: 200 mA (DC-PNP), 250 mA (AC/DC)*
2 I_{max}*: 150 mA (DC-PNP), 150 mA (AC/DC)*
Ta Ambient temperature range
Tp Process temperature

Storage temperature −40 to +85 °C (−40 to +185 °F)

Climate class DIN EN 60068-2-38/IEC 68-2-38: test Z/AD

Altitude Up to 2 000 m (6 600 ft) above sea level

Degree of protection	▪ IP65/67 NEMA Type 4X Enclosure (M12 connector) ▪ IP65 NEMA Type 4X Enclosure (valve plug) ▪ IP66/68 NEMA Type 4X/6P Enclosure (cable)
Shock resistance	a = 300 m/s² = 30 g, 3 planes x 2 directions x 3 shocks x 18 ms, as per test Ea, prEN 60068-2-27:2007
Vibration resistance	a(RMS) = 50 m/s², ASD = 1.25 (m/s²)²/Hz, f = 5 to 2000 Hz, t = 3 x 2 h, as per test Fh, EN 60068-2-64:2008
Electromagnetic compatibility	Electromagnetic compatibility in accordance with all relevant requirements of the EN 61326 series and NAMUR recommendation EMC (NE21). For details, refer to the EC Declaration of Conformity. The EC Declaration of Conformity is available in the Download Area of the Endress+Hauser website: www.endress.com → Downloads.
Reverse polarity protection	**2-wire AC/DC** ▪ AC mode: the device has reverse polarity protection. ▪ DC mode: in the event of reverse polarity the maximum safety mode is always detected. Check the wiring and perform a function check before commissioning. The device is not damaged in the event of reverse polarity. **3-wire DC-PNP** Integrated. In the event of reverse polarity, the device is deactivated automatically.
Short-circuit protection	**2-wire AC/DC** During switching the sensor checks whether a load, e.g. relay or contactor, is present (load check). If an error occurs, the sensor is not damaged. Smart monitoring: normal operation is resumed once the error is fixed. **3-wire DC-PNP** Overload protection/short-circuit protection at I > 250 mA; the sensor is not destroyed. Intelligent monitoring: Testing for overload at intervals of approx. 1.5 s; normal operation resumes once the overload/short-circuit has been rectified.

Process

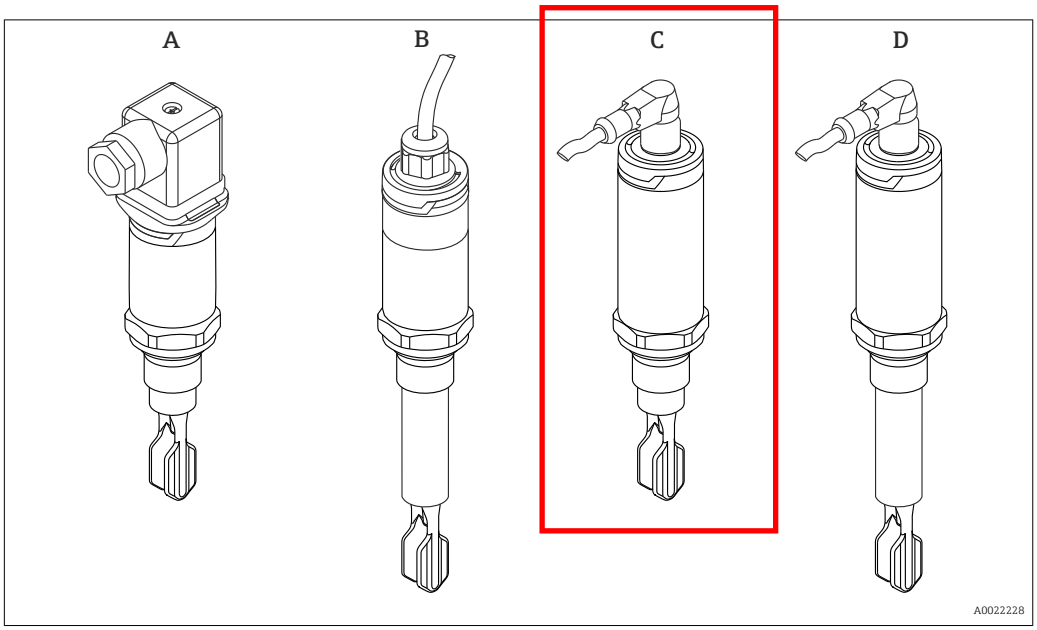
Process temperature range	−40 to +100 °C (−40 to +212 °F) −40 to +150 °C (−40 to +302 °F)
Process pressure range	Max. −1 to +40 bar (−14.5 to +580 psi)
Density	> 0.7 g/cm³ (optionally available: > 0.5 g/cm³)
State of aggregation	Liquid
Viscosity	1 to 10 000 mPa·s, dynamic viscosity
Solids contents	ø < 5 mm (0.2 in)
Lateral loading capacity	Lateral loading capacity of the tuning fork: maximum 200 N

Mechanical construction

Design

Various versions of the point level switch are available, the features of which can be selected to suit your user needs.

The versions can be selected via the product structure in the Product Configurator, see the "Ordering information" section → 27. Examples can be seen in the following diagram:



Versions	Examples			
	A	B	C	D
Electrical connection	Valve plug	Cable (cannot be dismantled)	M12 connector	M12 connector
Housing (sensor design) for process temperatures up to:	100 °C (212 °F)	100 °C (212 °F)	150 °C (302 °F)	150 °C (302 °F)
Sensor type	Compact version	Short tube version	Compact version	Short tube version

Detailed information on the process connections is provided in the "Sensor type" section → 20.

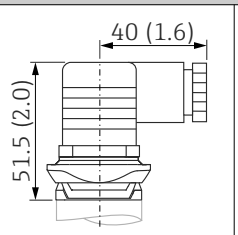
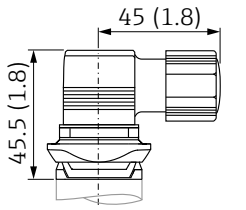
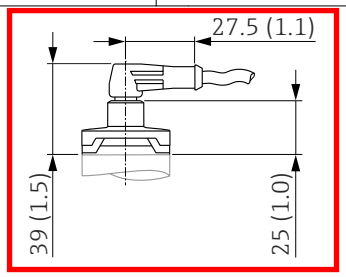
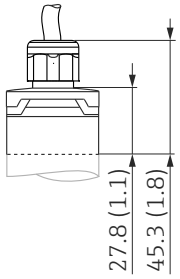
Information on the short tube version is provided in the "Installation instructions" section → 13.

Connector

Dimensions

Dimensions mm (in)

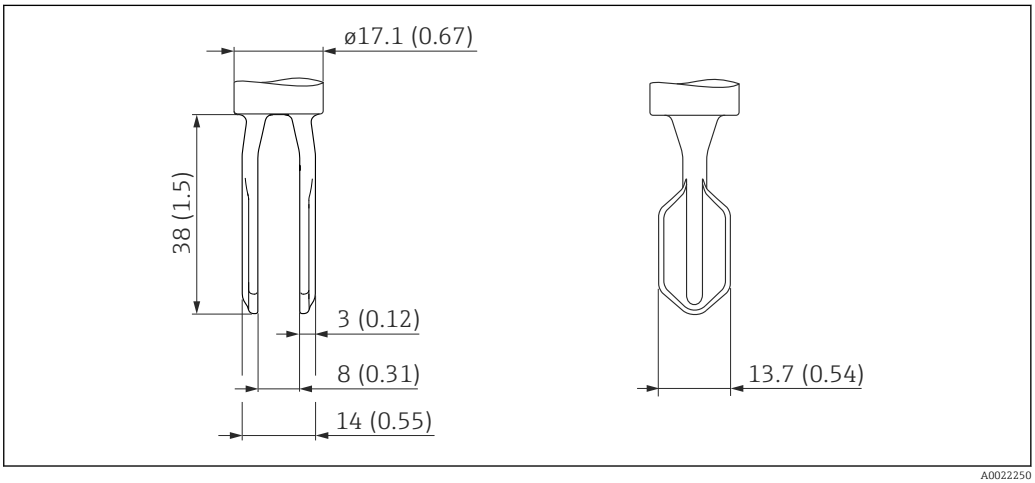
The following graphics illustrate the connectors together with the suitable housing covers on the housing of the point level switch.

Electrical connection with housing cover	Designation
A  B 	**A:** Valve plug M16, NPT ½" for housing cover: PPSU plastic **B:** Valve plug QUICKON for housing cover: PPSU plastic
	M12 connector for housing cover: PPSU plastic (IP65/67)
	Captive cable with housing cover: PPSU plastic

Tuning fork

Dimensions

Dimensions mm (in)



Sensor type

Dimensions

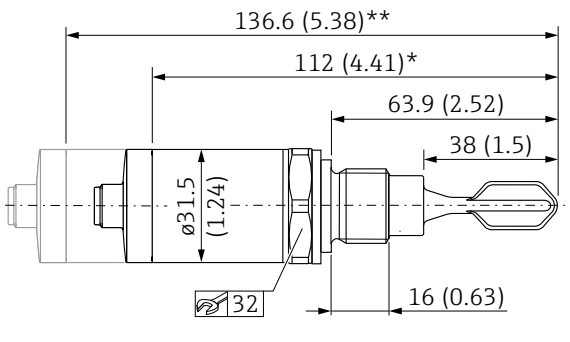
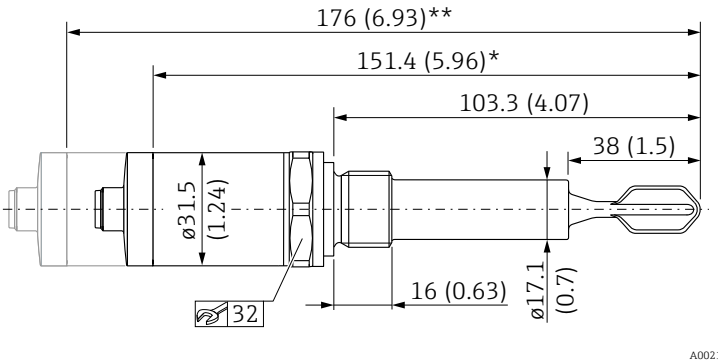
Dimensions mm (in)

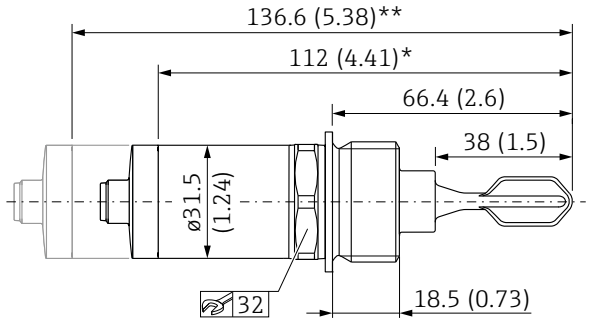
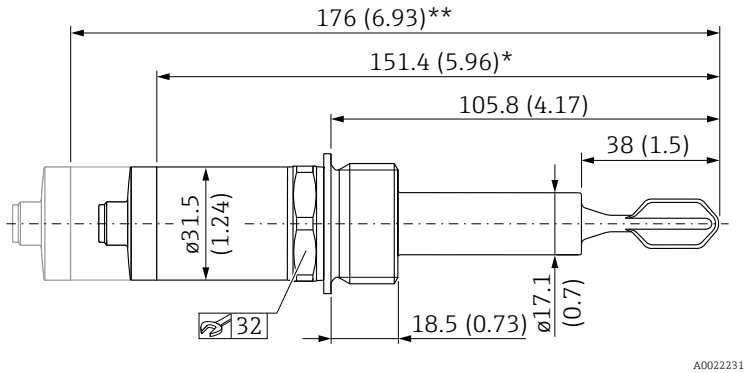
The total dimensions of the device can vary depending on the connector selected. To determine the total dimensions, please refer also to the "Electrical connection" section → 19.

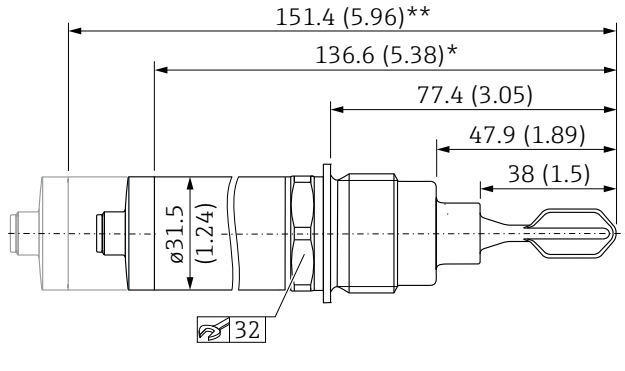
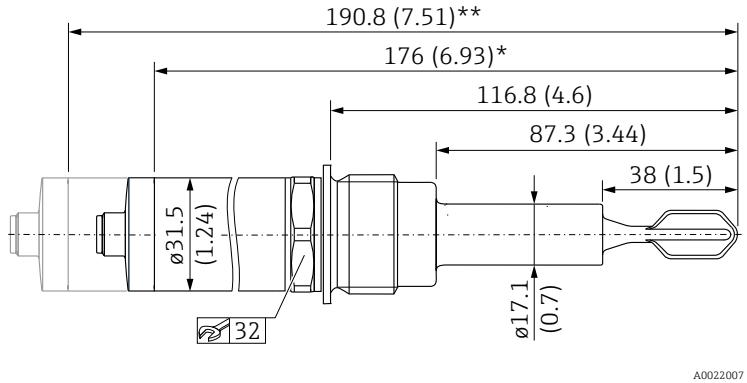
Information on the following tables

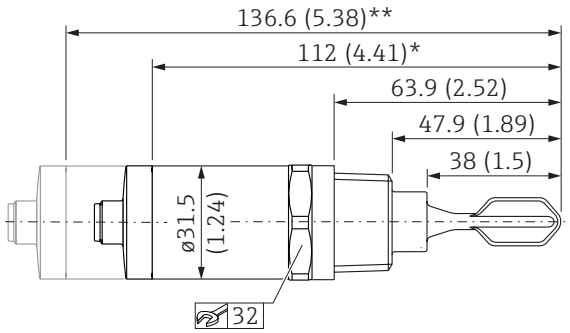
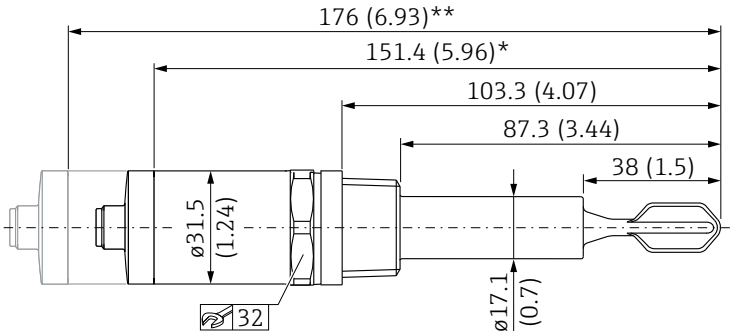
- Meaning of symbols:
  * Dimension for process temperature max. 100 °C (212 °F)
  ** Dimension for process temperature max. 150 °C (302 °F)
- If several versions have the same dimensions, one example of the compact version and one example of the short tube version is given.
- The versions in the second column refer to the process connections in the product structure.

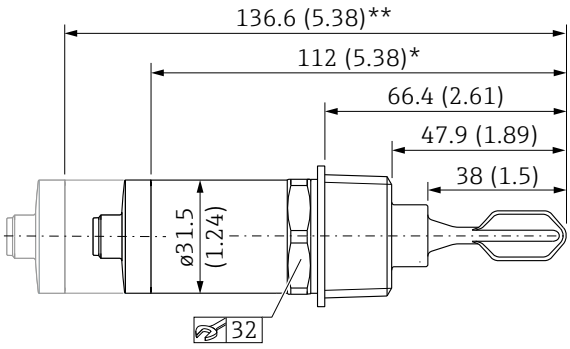
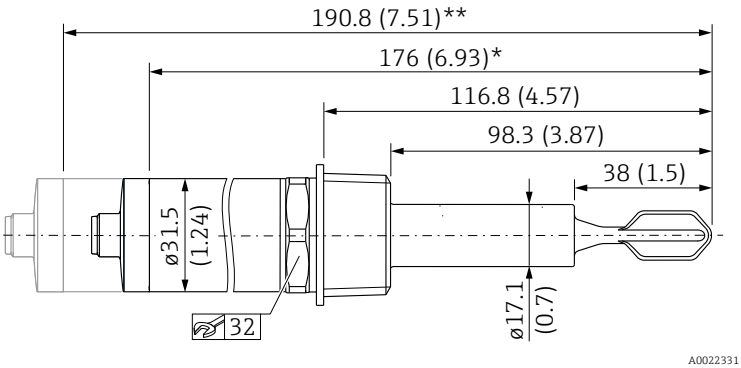
Information on weld-in adapters can be found in the "Weld-in adapters, process adapters and flanges" documentation, TI00426F/00.→ 29.

Dimensions	Version	Description
 *7 Compact version, example G ½"*	WBJ WCJ	**Thread ISO 228 G ½"** **Thread ISO 228 G ¾"** ▪ Material: 316L ▪ Scope of delivery: flat seal (FA) ▪ Pressure and temperature (maximum): +40 bar (+580 psi) at +150 °C (+302 °F)
	W5J	**Thread ISO 228 G ¾" for flush-mounted installation in weld-in adapter** ▪ Material: 316L ▪ Scope of delivery: flat seal (FA) Accessory: weld-in adapter – Scope of delivery: seal (VMQ) – Pressure and temperature (maximum): +25 bar (+352 psi) at +150 °C (+302 °F) +40 bar (+580 psi) at +100 °C (+212 °F) The dimensions apply for G ½"; G ¾" and G ¾" for flush-mounted installation.
 *8 Short tube version, example G ½"*		

Dimensions	Version	Description
 9 Compact version  10 Short tube version	WDJ	**Thread ISO 228 G 1"** ▪ Material: 316L ▪ Scope of delivery: flat seal (FA) ▪ Pressure and temperature (maximum): +40 bar (+580 psi) at +150 °C (+302 °F)

Dimensions	Version	Description
 11 Compact version  12 Short tube version	WSJ	**Thread ISO 228 G 1"** **for flush-mounted installation in weld-in adapter** ▪ Material: 316L ▪ Scope of delivery: flat seal (FA) Accessory: weld-in adapter – Scope of delivery: seal (VMQ) – Pressure and temperature (maximum): +25 bar (+362 psi) at +150 °C (+302 °F) +40 bar (+580 psi) at +100 °C (+212 °F)

Dimensions	Version	Description
 *13 Compact version, example MNPT ¾"*	VAJ	**Thread ASME MNPT ½"**
	VBJ	**Thread ASME MNPT ¾"**
	XBJ	**Thread EN10226 R ½"**
	XCJ	**Thread EN10226 R ¾"** Pressure and temperature (maximum): +40 bar (+580 psi) at +150 °C (+302 °F) The dimensions apply for MNPT ½", MNPT ¾"; R ½" and R ¾".
 *14 Short tube version, example MNPT ¾"*		

Dimensions	Version	Description
 15 Compact version, example MNPT 1"	VCJ	**Thread ASME MNPT 1"**
	XDJ	**Thread EN10226 R 1"** Pressure and temperature (maximum): +40 bar (+580 psi) at +150 °C (+302 °F) The dimensions apply for MNPT 1" and R 1".
 16 Short tube version, example MNPT 1"		

Pay attention to the temperature and pressure specifications for seals used at the customer site.

Endress+Hauser supplies DIN/EN process connections with threaded connection in stainless steel in accordance with AISI 316L (DIN/EN material number 1.4404 or 14435). With regard to their stability-temperature property, the materials 1.4404 and 1.4435 are grouped together under 13E0 in EN 1092-1, Tab. 18. The chemical composition of the two materials can be identical.

Weight

Sensor type	Weight
Compact version with process adapter G ½" and valve plug for process temperature up to 100 °C (212 °F)	Approx. 140 g (4.938 oz)
Short tube version with process adapter G ½" and valve plug for process temperature up to 150 °C (302 °F)	Approx. 169 g (5.961 oz)

Materials

Material specifications in accordance with AISI and DIN EN.

Materials in contact with process

Component part	Material
Tuning fork	316L
Process adapter	316L (1.4404/1.4435)
Short tube	316L (1.4404/1.4435)
Seal for weld-in adapter with G ¾", G 1"	VMQ
Flat seal	FA (composite material based on aramid fibers combined with NBR)

Materials not in contact with process

Component part	Material
Housing cover with M12 connector (IP65/67)	PPSU
Housing cover with valve plug (IP65)	
Housing cover with cable (IP66/68)	
Cable gland	PVDF
Design ring	PBT/PC
Housing	316L (1.4404/1.4435)
Nameplate	Plastic foil (attached to housing)

Surface roughness

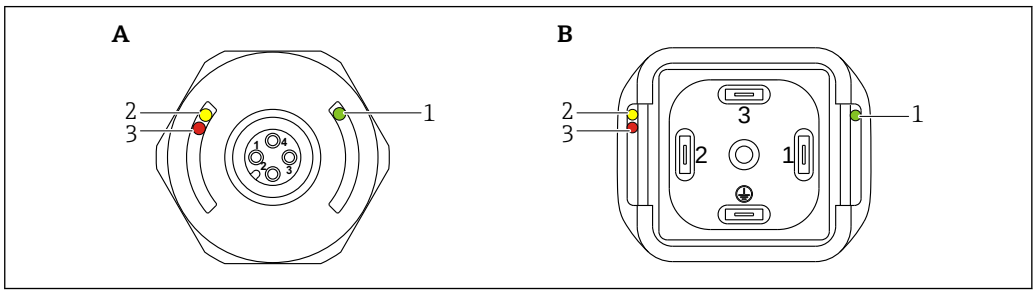
Metallic surface in contact with process:

Ra ≤3.2 µm (126 µin)

The surface is not defined in the area of the welding seam.

Operability

LED display



A0016856

A M12 connector, (cable without graphic)
B Valve plug

Item	Function	Description
1	Green LED (gn) Lit	Device is operational
2	Yellow LED (ye) Lit	**M12 connector** Indicates the sensor state: tuning fork is covered by liquid **Valve plug / cable** Indicates the switching state: ▪ MAX operating mode (overfill prevention): sensor is **not** covered by liquid ▪ MIN operating mode (dry running protection): the sensor is covered by liquid
3	Red LED (rd) Flashing Lit	Warning/maintenance required: Fault can be remedied, e.g. incorrect wiring; protective function if test magnet is held against the sensor for longer than 30 s Fault/device failure: error cannot be rectified, e.g. electronic error

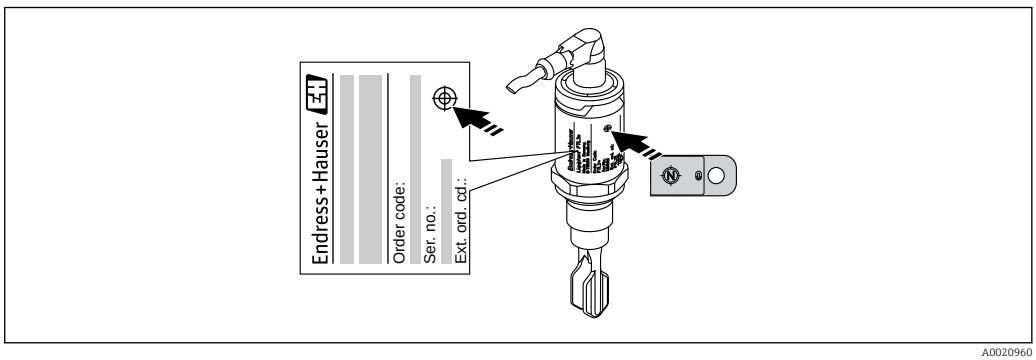
Function test with test magnet

Carry out a function test while the device is in operation.

▶ Hold the test magnet against the marking on the housing for at least 2 seconds.
↳ This inverts the current switch status, and the yellow LED changes state. When the magnet is removed, the switching status valid at that time is adopted.

If the test magnet is held against the marking for longer than 30 seconds, the red LED will flash: The device returns automatically to the current switch status.

The test magnet is not included in the scope of delivery. It can be ordered as an optional accessory → 27.



A0020960

17 *Position for test magnet on housing*

Certificates and approvals

The following documents are also available in the Download Area of the Endress+Hauser website:www.endress.com → Downloads.

CE mark

The measuring system is in conformity with the statutory requirements of the applicable EC Directives. These are listed in the corresponding EC Declaration of Conformity along with the standards applied. Endress+Hauser confirms successful testing of the device by affixing to it the CE mark.

EAC conformity

The measuring system meets the legal requirements of the applicable EAC guidelines. These are listed in the corresponding EAC Declaration of Conformity together with the standards applied.

Endress+Hauser confirms successful testing of the device by affixing to it the EAC mark.

RCM-Tick marking

The supplied product or measuring system meets the ACMA (Australian Communications and Media Authority) requirements for network integrity, interoperability, performance characteristics as well as health and safety regulations. Here, especially the regulatory arrangements for electromagnetic compatibility are met. The products are labelled with the RCM- Tick marking on the name plate.



A0029561

Approval

CSA C/US General Purpose

Overfill prevention

Prior to mounting the device, pay attention to the WHG approval documents which can be found on the Endress+Hauser web site: www.endress.com → Downloads.

WHG

- Overfill detection system: Z-65.11-531
- Leak detection system: Z-65.40-532

Marine approvals

- GL (German Lloyd)
- ABS (American Bureau of Shipping)
- LR (Lloyds Register)
- BV (Bureau Veritas)
- DNV (Det Norske Veritas)

CRN approval

Versions with a CRN approval (Canadian Registration Number) are listed in the corresponding registration documents. CRN-approved devices are labeled with registration number 0F16950.5C on the nameplate. You can find further details on the maximum pressure values in the Download Area of the Endress+Hauser website.

Inspection certificates

The following documents can be ordered with the device (optional):

- Acceptance test certificate as per EN 10204-3.1
- Final inspection report

Manufacturer declarations

The following manufacturer declarations can be ordered (optional):

- FDA conformity
- TSE-free, materials free from animal origin
- ROHS-compliant in accordance with Endress+Hauser regulation

Pressure Equipment Directive

The device does not fall within the scope of Pressure Equipment Directive 97/23/EC as it does not have a pressurized housing as defined in Article 1, Section 2.1.4 of the directive.

Other standards and guidelines

The applicable European guidelines and standards can be found in the relevant EU Declarations of Conformity.

Ordering information

Ordering information

Detailed ordering information is available from the following sources:
- In the Product Configurator on the Endress+Hauser website: www.endress.com -> Click "Corporate" -> Select your country -> Click "Products" -> Select the product using the filters and search field -> Open product page -> The "Configure" button to the right of the product image opens the Product Configurator.
- From your Endress+Hauser Sales Center: www.addresses.endress.com

Product Configurator - the tool for individual product configuration
- Up-to-the-minute configuration data
- Depending on the device: Direct input of measuring point-specific information such as measuring range or operating language
- Automatic verification of exclusion criteria
- Automatic creation of the order code and its breakdown in PDF or Excel output format
- Ability to order directly in the Endress+Hauser Online Shop

Services (optional)

In addition, the following services can be selected via the product structure in the Product Configurator:

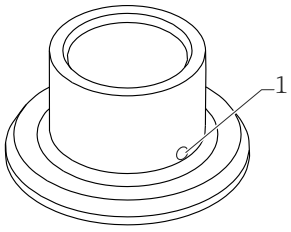
- Cleaned of oil+grease
- PWIS-free (PWIS = paint-wetting impairment substances)
- Density setting > 0.5 g/cm³
- Switching delay setting → 🖹 11

Accessories

Weld-in adapter

Various weld-in adapters are available for installation in vessels or pipes.

The adapters are optionally available with inspection certificate 3.1 EN10204.

View (example)	Description
 *1 Leakage hole*	**G ¾"** ø29 pipe installation ø50 vessel installation FDA-listed materials as per 21 CFR Part 175-178
	G 1" ø53 pipe installation ø60 vessel installation

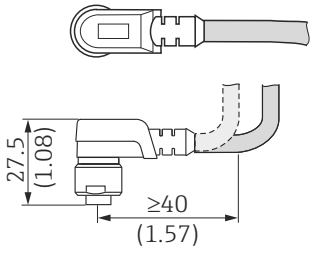
If installed horizontally and weld-in adapters with a leakage hole are used, ensure that the leakage hole is pointing down. This allows leaks to be detected as quickly as possible.

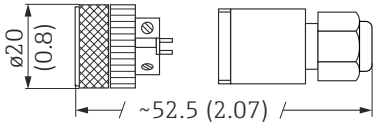
Detailed information can be found in TI00426F/00/EN "Weld-in adapters, process adapters and flanges" and in the supplementary documentation → 🖹 29.

Plug-in jack, cable

The plug-in jacks listed are suitable for use in the temperature range −25 to +70 °C (−13 to +158 °F).

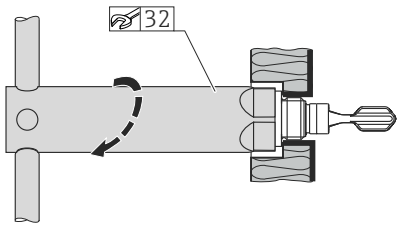
Engineering unit mm (in)

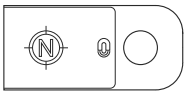
Plug-in jack M12 IP67	Description	Order number
	▪ elbowed 90° ▪ 5 m (16 ft)PVC cable (gray) ▪ Slotted nut Cu Sn/Ni ▪ Body: PUR (blue)	52010285

Plug-in jack M12 IP67	Description	Order number
	▪ Self-terminated connection to M12 connector ▪ Slotted nut Cu Sn/Ni ▪ Body: PBT	52006263

Wire colors for M12 connector: 1 = BN (brown), 2 = WT (white), 3 = BU (blue), 4 = BK (black)

Additional accessories

Socket wrench for mounting	Description	Order number
	▪ Hexagonal ▪ Size across flats AF32	52010156

Test magnet	Description	Order number
	Information in section on Operation → 🖹 25	71267011

Supplementary documentation

The following document types are available in the Download Area of the Endress+Hauser website: www.endress.com → Downloads.

Operating Instructions	Liquiphant FTL31 → BA01285F/00
Additional documentation	TI00426F/00 → Weld-in adapters, process adapters and flanges (overview) SD01622Z/00 → Weld-in adapter (installation instructions) SD00356F/00→ Valve plug (installation instructions)
Certificates	ZE01010F/00→ Overfill protection ZE01011F/00→ Leaks



www.addresses.endress.com

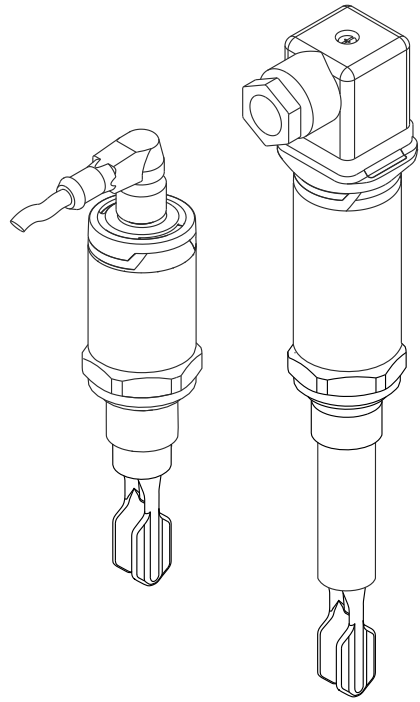
Endress+Hauser

People for Process Automation

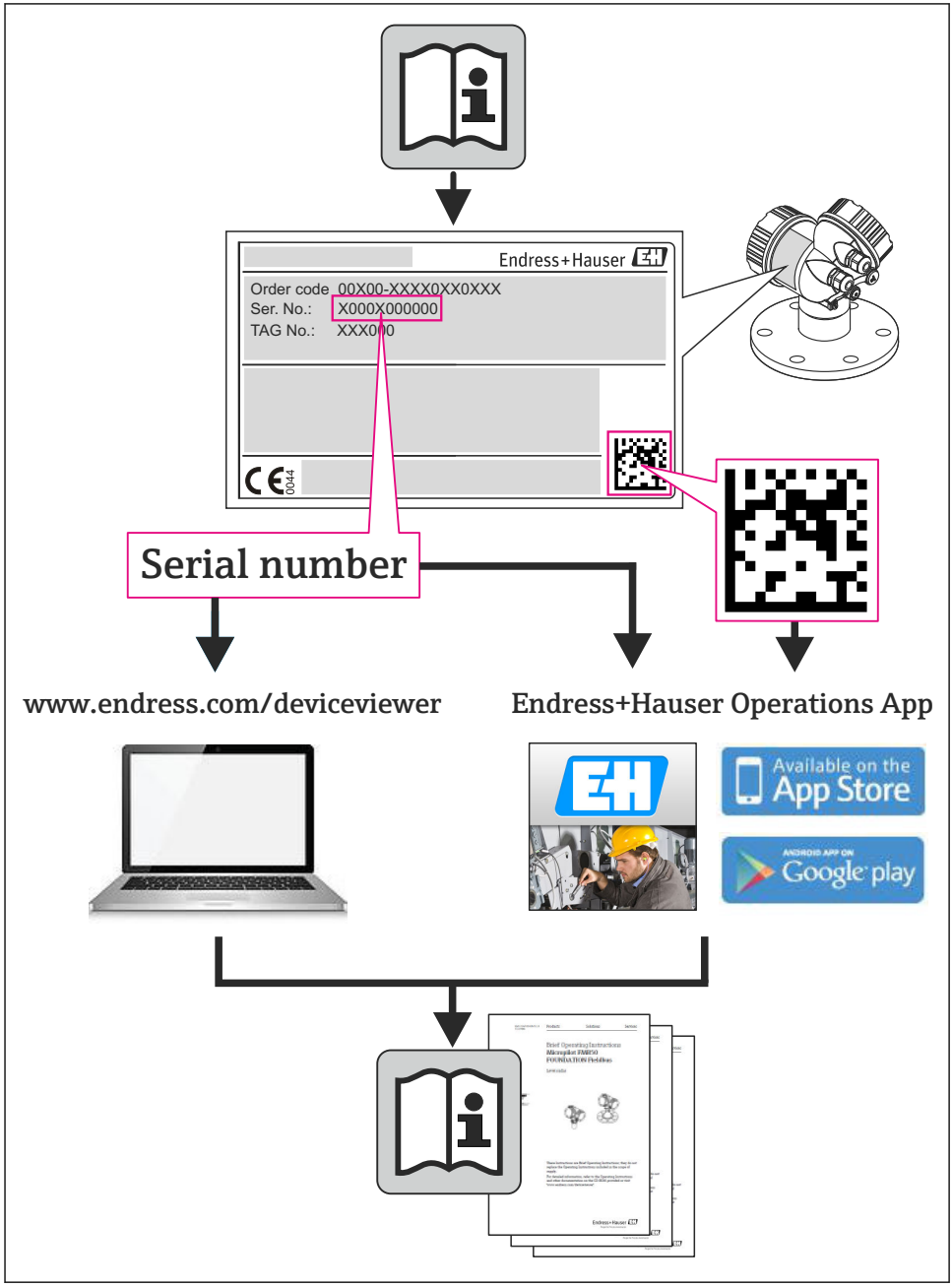
BA01285F/00/A2/03.15
71279307

Operating Instructions
Liquiphant FTL31

Point level switch for liquids



Endress+Hauser
People for Process Automation


Endress+Hauser
Order code 00X00-XXXX0XX0XXX
Ser. No.: X000X000000
TAG No.: XXX000
0044
Serial number
www.endress.com/deviceviewer
Endress+Hauser Operations App
Available on the App Store
ANDROID APP ON Google play

A0023555

Liquiphant FTL31

Point level switch for liquids

Betriebsanleitung 5

Operating Instructions 37

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1 Hinweise zum Dokument

1.1 Dokumentfunktion

Diese Anleitung liefert alle Informationen, die in den verschiedenen Phasen des Lebenszyklus des Geräts benötigt werden: Von der Produktidentifizierung, Warenannahme und Lagerung über Montage, Anschluss, Bedienungsgrundlagen und Inbetriebnahme bis hin zur Störungsbeseitigung, Wartung und Entsorgung.

1.2 Symbole

1.2.1 Sicherheitshinweise

Symbol	Bedeutung
 A0011189-DE	**GEFAHR!** Dieser Hinweis macht auf eine gefährliche Situation aufmerksam, die, wenn sie nicht vermieden wird, zu Tod oder schwerer Körperverletzung führen wird.
 A0011190-DE	**WARNUNG!** Dieser Hinweis macht auf eine gefährliche Situation aufmerksam, die, wenn sie nicht vermieden wird, zu Tod oder schwerer Körperverletzung führen kann.
 A0011191-DE	**VORSICHT!** Dieser Hinweis macht auf eine gefährliche Situation aufmerksam, die, wenn sie nicht vermieden wird, zu leichter oder mittelschwerer Körperverletzung führen kann.
 A0011192-DE	**HINWEIS!** Dieser Hinweis enthält Informationen zu Vorgehensweisen und weiterführenden Sachverhalten, die keine Körperverletzung nach sich ziehen.

1.2.2 Elektrische Symbole

Symbol	Bedeutung
 A0011200	**Erdanschluss** Eine geerdete Klemme, die vom Gesichtspunkt des Benutzers über ein Erdungssystem geerdet ist.
 A0011199	**Schutzleiteranschluss** Eine Klemme, die geerdet werden muss, bevor andere Anschlüsse hergestellt werden dürfen.

1.2.3 Symbole für Informationstypen

Symbol	Bedeutung
 A0011182	**Erlaubt** Kennzeichnet Abläufe, Prozesse oder Handlungen, die erlaubt sind.
 A0011184	**Verboten** Kennzeichnet Abläufe, Prozesse oder Handlungen, die verboten sind.
 A0011193	**Tipp** Kennzeichnet zusätzliche Informationen.
 A0011194	**Verweis auf Dokumentation** Verweist auf die entsprechende Dokumentation zum Gerät.
 A0011195	**Verweis auf Seite** Verweist auf die entsprechende Seitenzahl.

1.2.4 Symbole für Grafiken

Symbol	Bedeutung
1, 2, 3 ...	Positionsnummern
A, B, C, ...	Ansichten

1.2.5 Symbole für Werkzeuge

Symbol	Bedeutung
 A0011222	Gabelschlüssel

1.3 Dokumentation

Die aufgelisteten Dokumenttypen sind verfügbar im Download-Bereich der Endress+Hauser Internetseite: www.endress.com → Download

Dokument	Zweck und Inhalt des Dokuments
Technische Information TI01147F/00/DE	Das Dokument liefert alle technischen Daten zum Gerät und enthält einen Überblick, welches Zubehör bestellt werden kann.
Zusatzdokumentationen TI00426F/00/DE SD00352F/00/A6 SD00356F/00/EN	 Einschweißadapter und Flansche (Übersicht) Einschweißadapter G 1", G ¾" (Montageanleitung) Ventilstecker (Montageanleitung)

2 Grundlegende Sicherheitshinweise

2.1 Anforderungen an das Personal

Das Personal für Installation, Inbetriebnahme, Diagnose und Wartung muss folgende Bedingungen erfüllen:

- Ausgebildetes Fachpersonal: Verfügt über Qualifikation, die dieser Funktion und Tätigkeit entspricht
- Vom Anlagenbetreiber autorisiert
- Mit den nationalen Vorschriften vertraut
- Vor Arbeitsbeginn: Anweisungen in Anleitung und Zusatzdokumentation sowie Zertifikate (je nach Anwendung) lesen und verstehen
- Anweisungen und Rahmenbedingungen befolgen

Das Bedienpersonal muss folgende Bedingungen erfüllen:

- Entsprechend den Aufgabenanforderungen vom Anlagenbetreiber eingewiesen und autorisiert
- Anweisungen in dieser Anleitung befolgen

2.2 Bestimmungsgemäße Verwendung

Das in dieser Anleitung beschriebene Messgerät darf nur als Füllstandgrenzschalter für Flüssigkeiten verwendet werden. Bei unsachgemäßem Einsatz können Gefahren von ihm ausgehen. Um den einwandfreien Zustand des Messgerätes für die Betriebszeit zu gewährleisten,

- dürfen Messgeräte nur für Messstoffe eingesetzt werden, gegen die die prozessberührenden Materialien hinreichend beständig sind.
- müssen Grenzwerte in "Technische Daten" eingehalten werden.

2.2.1 Fehlgebrauch

Der Hersteller haftet nicht für Schäden, die aus unsachgemäßer oder nicht bestimmungsgemäßer Verwendung entstehen.

Restrisiken

Das Elektronikgehäuse und die darin eingebauten Baugruppen können sich im Betrieb durch Wärmeeintrag aus dem Prozess bis zu 80 °C (176 °F) erwärmen.

Mögliche Verbrennungsgefahr bei Berührung von Oberflächen!

- ▶ Bei erhöhter Messstofftemperatur: Berührungsschutz sicherstellen, um Verbrennungen zu vermeiden.

2.3 Arbeitssicherheit

Bei Arbeiten am und mit dem Gerät:

- ▶ Erforderliche persönliche Schutzausrüstung gemäß nationaler Vorschriften tragen.
- ▶ Versorgungsspannung ausschalten, bevor Sie das Gerät anschließen.

2.4 Betriebssicherheit

Verletzungsgefahr!

- Das Gerät nur in technisch einwandfreiem und betriebssicherem Zustand betreiben.
- Der Betreiber ist für den störungsfreien Betrieb des Geräts verantwortlich.

2.5 Produktsicherheit

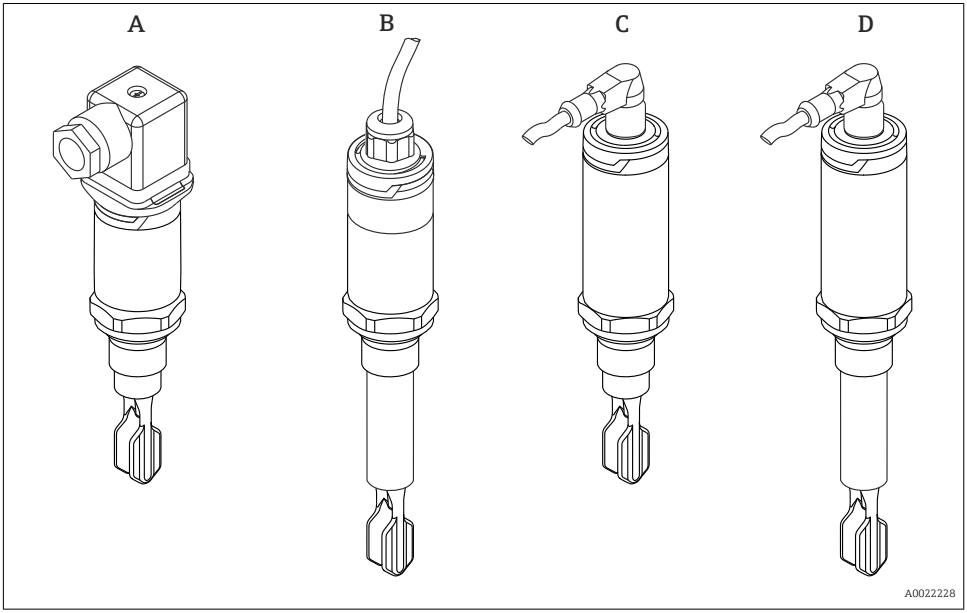
Dieses Messgerät ist nach dem Stand der Technik und guter Ingenieurspraxis betriebssicher gebaut und geprüft und hat das Werk in sicherheitstechnisch einwandfreiem Zustand verlassen. Es erfüllt die allgemeinen Sicherheitsanforderungen und gesetzlichen Anforderungen. Zudem ist es konform zu den EG-Richtlinien, die in der gerätespezifischen EG-Konformitätserklärung aufgelistet sind. Mit der Anbringung des CE-Zeichens bestätigt Endress+Hauser diesen Sachverhalt.

3 Produktbeschreibung

Der Liquiphant FTL31 ist ein Grenzschalter und universell in allen Flüssigkeiten einsetzbar. Er kommt vorzugsweise in Lagertanks, Rührwerksbehältern und Rohrleitungen zum Einsatz.

3.1 Produktaufbau

Den Grenzschalter gibt es in verschiedenen Varianten, die anwenderspezifisch zusammengestellt werden können. Beispiele sehen Sie in der folgenden Abbildung:



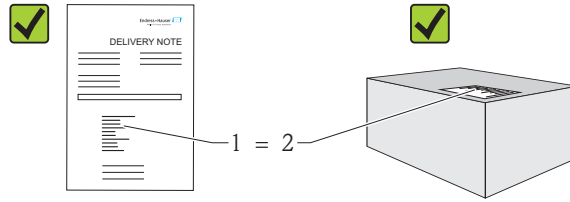
Varianten	Beispiele			
	A	B	C	D
Elektrischer Anschluss	Ventilstecker	Kabel (nicht demontierbar)	Stecker M12	Stecker M12
Gehäuse (Sensordesign) für Prozesstemperaturen bis:	100 °C (212 °F)	100 °C (212 °F)	150 °C (302 °F)	150 °C (302 °F)
Sensortyp	Kompaktversion	Kurzrohrversion	Kompaktversion	Kurzrohrversion

Detaillierte Informationen zur Kurzrohrversion und zu den Prozessanschlüssen finden Sie in der Technischen Dokumentation TI01147F/00/DE.

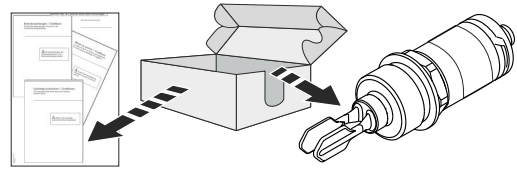
4 Warenannahme und Produktidentifizierung

4.1 Warenannahme

A0015502



A0016051



A0021096

Bestellcode auf Lieferschein (1) mit Bestellcode auf Produktaufkleber (2) identisch?

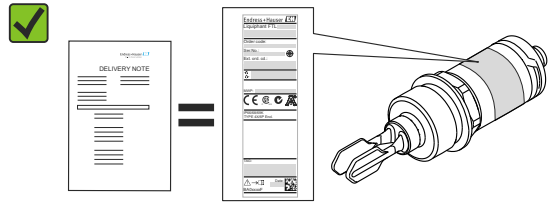
A0015502



A0021097

Ware unbeschädigt?

A0015502



A0021098

Entsprechen die Daten auf den Typenschildern den Bestellangaben auf dem Lieferschein?

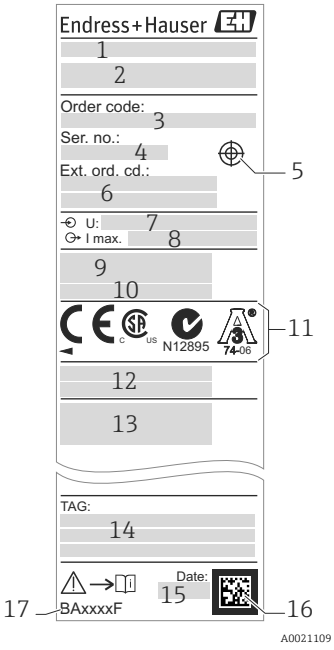
Wenn eine dieser Bedingungen nicht zutrifft, wenden Sie sich bitte an Ihre Endress+Hauser-Vertriebsstelle.

4.2 Produktidentifizierung

Folgende Möglichkeiten stehen zur Identifizierung des Messgerätes zur Verfügung:
- Typenschildangabe
- Bestellcode (Order code) mit Aufschlüsselung der Gerätemerkmale auf dem Lieferschein
- Seriennummer von Typenschildern in *W@M Device Viewer* eingeben (www.endress.com/deviceviewer): Alle Angaben zum Messgerät werden angezeigt

Eine Übersicht zum Umfang der mitgelieferten Technischen Dokumentation erhalten Sie ebenfalls über die Seriennummer auf dem Typenschild in *W@M Device Viewer* (www.endress.com/deviceviewer)

4.2.1 Typenschild



1: Gerätename
2: Herstelleradresse
3: Bestellcode
4: Seriennummer
5: Markierung für Testmagnet
6: Erweiterter Bestellcode
7: Betriebsspannung
8: Signalausgang
9: Prozess- und Umgebungstemperatur
10: Prozessdruck
11: Zertifikatssymbole (optional)
12: Schutzart: z.B. IP, NEMA
13: Zertifikats- und zulassungspezifische Daten
14: Messstellenkennzeichnung (optional)
15: Herstellungsdatum (Jahr, Monat)
16: Data Matrix Code
17: Dokumentnummer der Betriebsanleitung

Der Testmagnet ist als Zubehör bestellbar → 32.

4.3 Lagerung und Transport

4.3.1 Lagerungsbedingungen

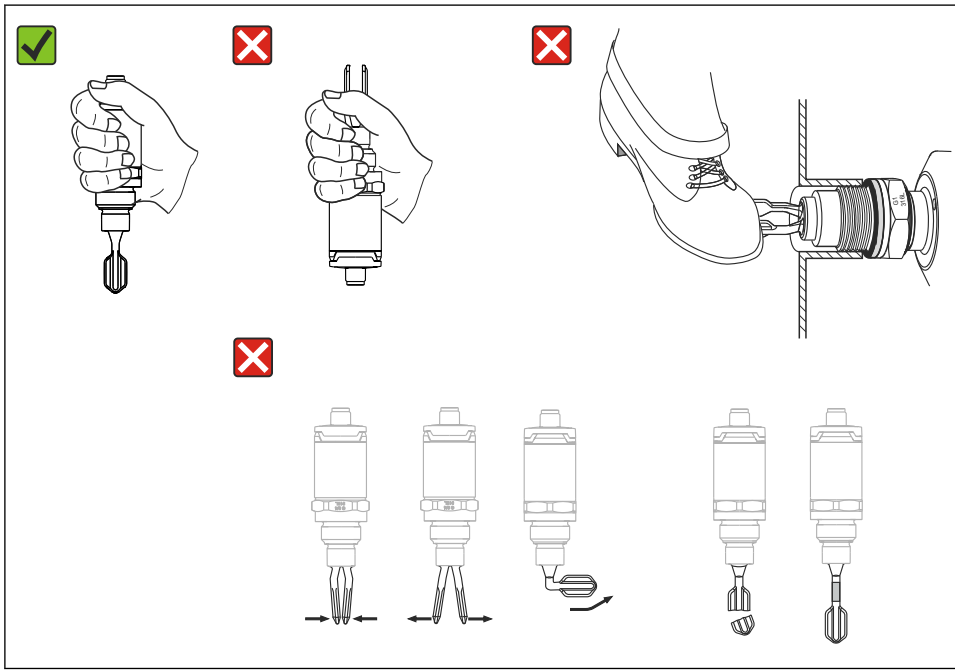
- Zulässige Lagerungstemperatur: −40…+85 °C (−40…+185 °F)
- Originalverpackung verwenden.

4.3.2 Handhabung des Gerätes

HINWEIS

Verletzungsgefahr! Gehäuse oder Schwinggabel kann beschädigt werden oder abreißen!

- ▶ Gerät in Originalverpackung oder am Gehäuse zur Messstelle transportieren.
- ▶ Das Gerät nicht an der Schwinggabel halten!
- ▶ Gerät nicht als Steighilfe verwenden!
- ▶ Schwinggabel nicht verbiegen!
- ▶ Schwinggabel nicht kürzen oder verlängern!



A0020845

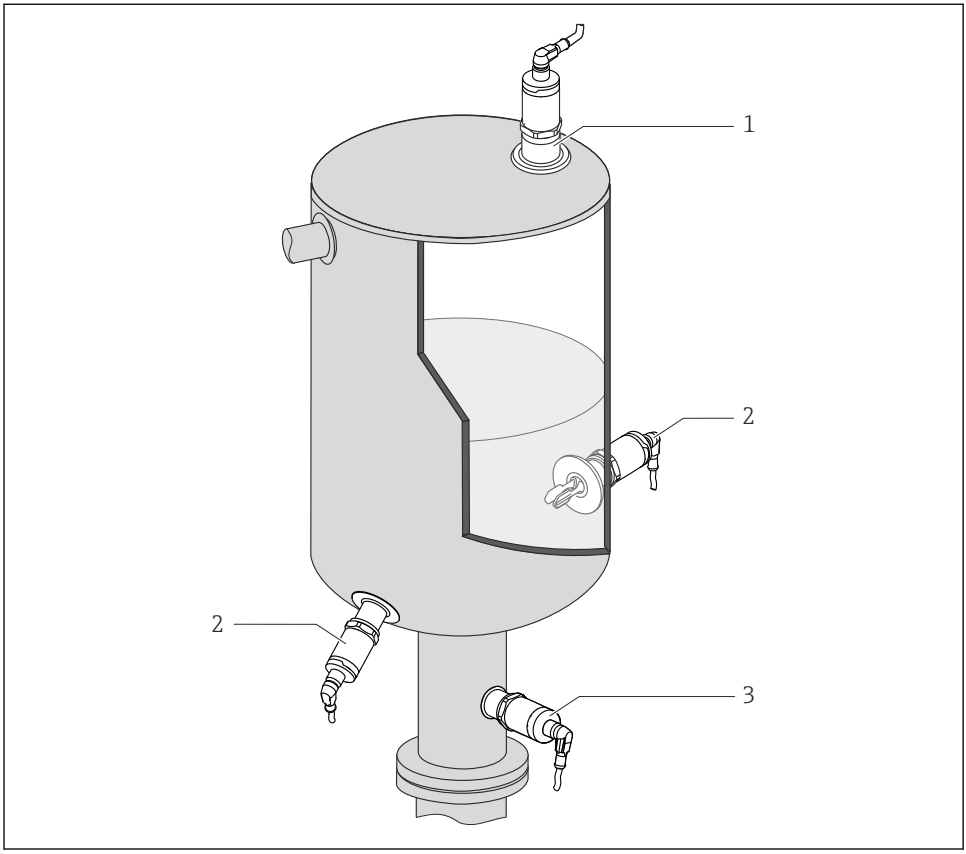
1 *Handhabung des Gerätes*

5 Montage

5.1 Montagebedingungen

5.1.1 Einbaulage

Der Grenzschalter kann in jeder beliebigen Lage in einem Behälter, Rohr oder Tank eingebaut werden.

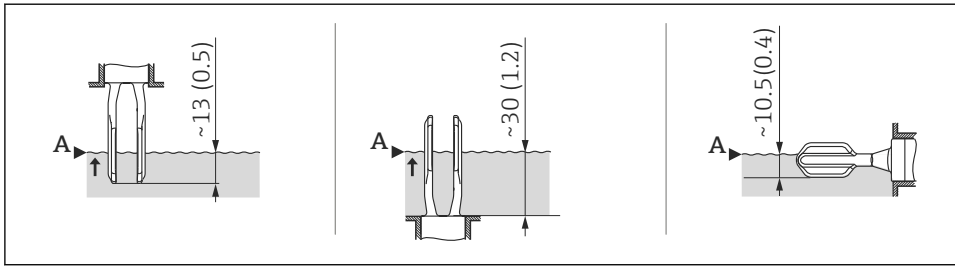


2 Einbaumöglichkeiten

1 Überfüllsicherung oder obere Füllstanddetektion
2 Untere Füllstanddetektion
3 Trockenlaufschutz für Pumpe

5.1.2 Schaltpunkt

Der Schaltpunkt (A) am Sensor ist abhängig von der Einbaulage des Grenzschalters (Wasser +25 °C (+77 °F), 1 bar (14,5 psi).

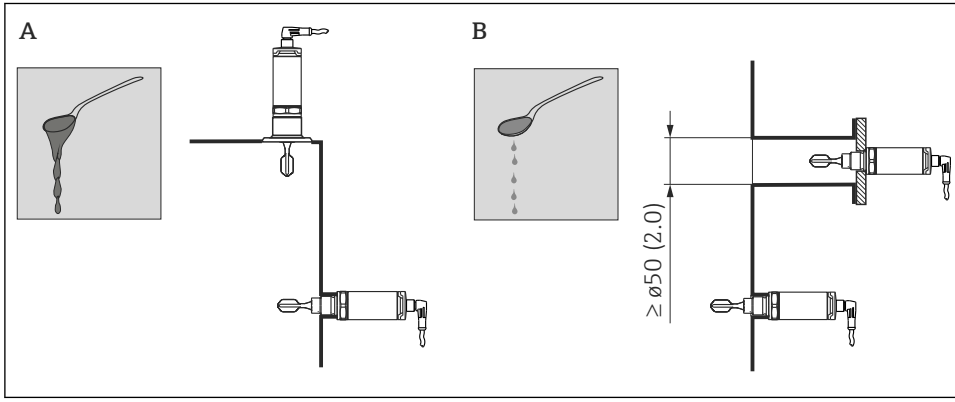


3 Vertikale und horizontale Einbaulage, Maßangabe mm (in)

5.1.3 Viskosität

Bei Flüssigkeiten hoher Viskosität kann es zu Schaltverzögerungen kommen. Stellen Sie sicher, dass die Flüssigkeit gut von der Schwinggabel abfließen kann:

- Bei horizontalem Einbau in Behältern mit Flüssigkeiten hoher Viskosität (A), darf sich die Schwinggabel **nicht** im Einbaustutzen befinden!
- Bei horizontalem Einbau in Behältern mit Flüssigkeiten geringer Viskosität (B), darf sich die Schwinggabel im Einbaustutzen befinden.
- Der Einbaustutzen darf den Mindestdurchmesser von 50 mm (2,0 in) nicht unterschreiten.



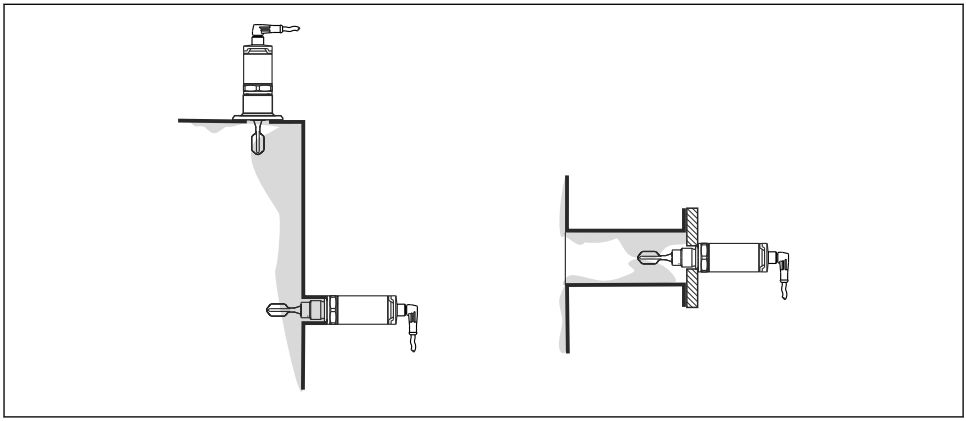
4 Einbaumöglichkeiten unter Berücksichtigung der Viskosität, Maßangabe mm (in)

A Hohe Viskosität (< 10 000 mPa·s)
B Geringe Viskosität (< 2 000 mPa·s)

5.1.4 Ansatz

Achten Sie darauf, dass der Einbaustutzen eine bestimmte Länge nicht überschreitet, damit die Schwinggabel frei in den Behälter ragen kann.

Optimierungsmöglichkeiten:
- Eine vertikale Einbaulage des Grenzschalters hält Ablagerungen gering.
- Vorzugsweise frontbündiger Einbau an Behältern oder in Rohrleitungen.



A0022057

5 Ansatz an Tank-, Rohrwand und Schwinggabel

5.1.5 Einschweißadapter mit Leckagebohrung

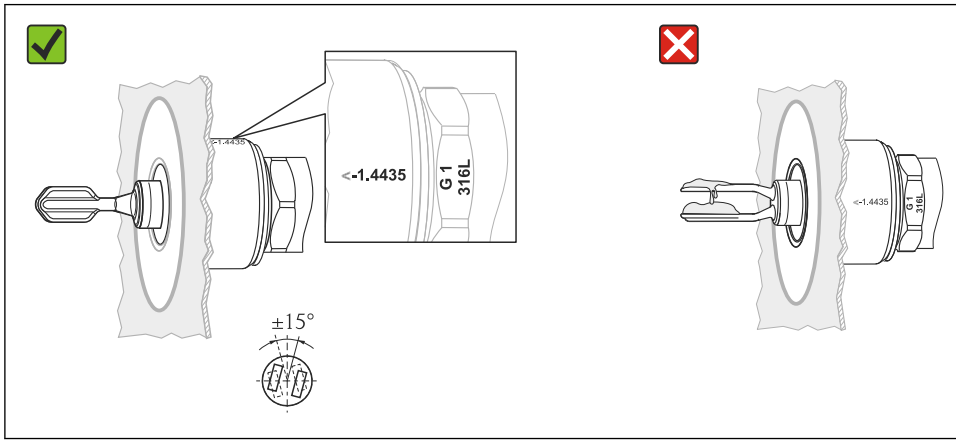
Achten Sie darauf, dass bei horizontalem Einbau die Leckagebohrung nach unten ausgerichtet ist, um eine Undichtigkeit schnellstmöglich zu erkennen.

5.1.6 Markierung

Die Markierung weist auf die Position der Schwinggabel hin. Bei horizontalem Einbau in Behältern zeigt die Markierung nach oben.

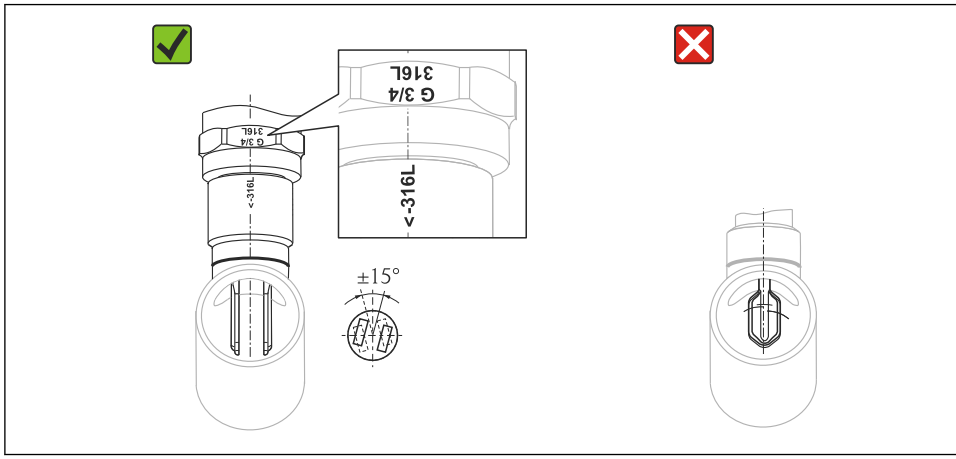
Die Markierung befindet sich entweder als Materialangabe (z.B. 316L) oder als Gewindebezeichnung (z.B. G ½")

- auf dem Sechskant des Prozessadapters
- auf dem Typenschild
- auf dem Einschweißadapter



A0022641

6 *Einbaulage im Behälter*

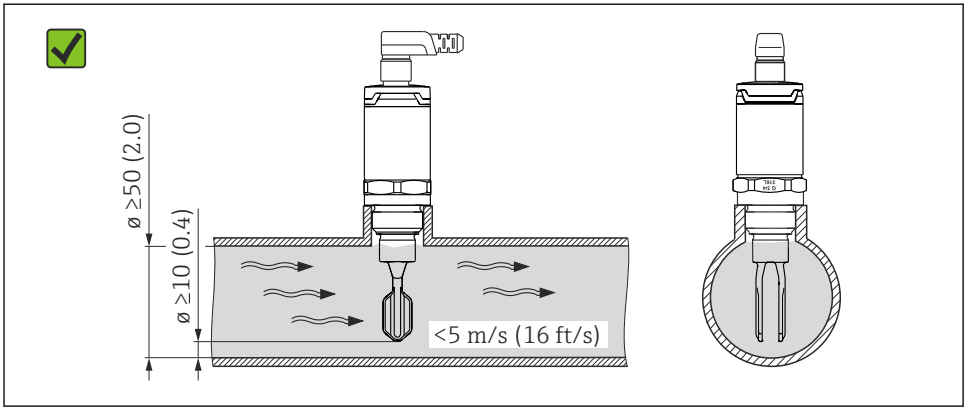


A0022804

7 *Einbaulage im Rohrleitung*

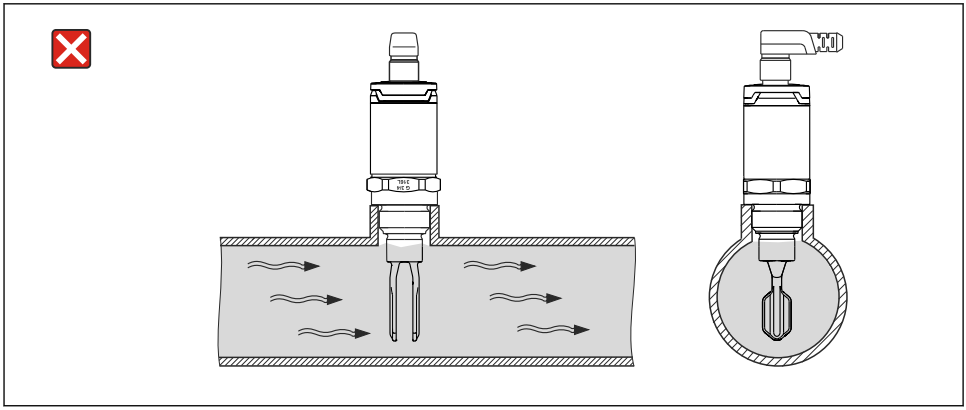
5.1.7 Einbau in Rohrleitungen

Achten Sie beim Einbau auf die Stellung der Schwinggabel, um Verwirbelungen in der Rohrleitung zu minimieren.



A0021357

Maßangabe mm (in)

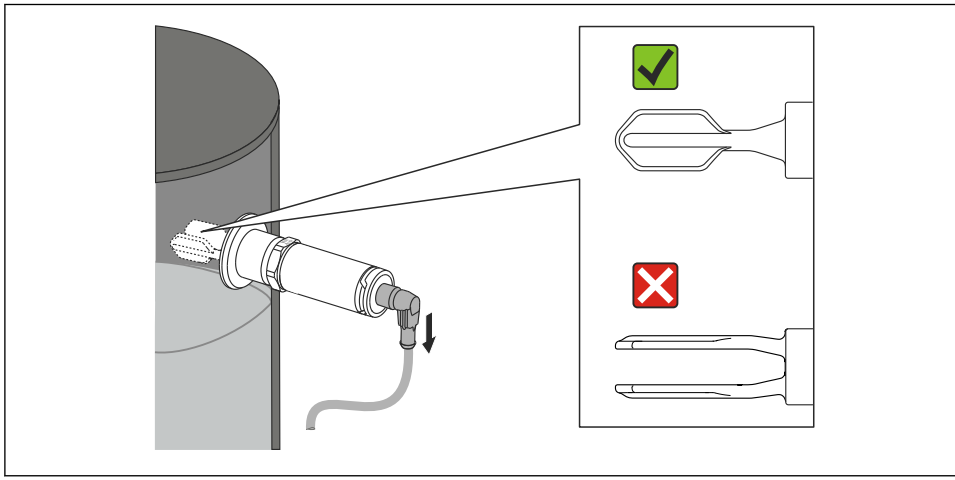


A0022268

5.1.8 Einbau in Behälter

Achten Sie bei horizontalem Einbau auf die Stellung der Schwinggabel, damit die Flüssigkeit gut abtropfen kann.

Der elektrische Anschluss, z.B. Stecker M12, sollte mit dem Kabel nach unten ausgerichtet sein. Dadurch kann das Eindringen von Feuchtigkeit vermieden werden.

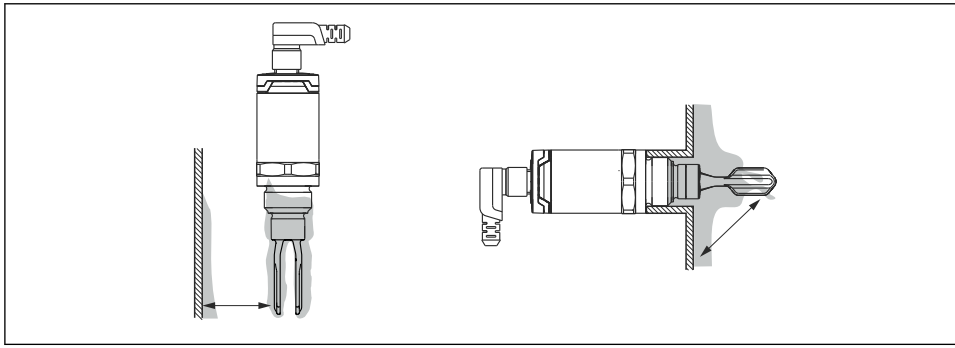


A0021034

8 Stellung der Schwinggabel bei horizontalem Einbau im Behälter

5.1.9 Abstand zur Wand

Achten Sie auf ausreichenden Abstand zwischen dem zu erwartendem Füllgutansatz an der Tankwand und der Schwinggabel. Empfohlener Wandabstand ≥10 mm (0,39 in).



A0022272

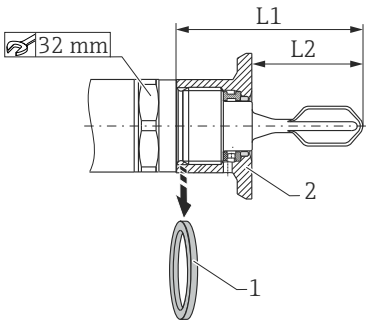
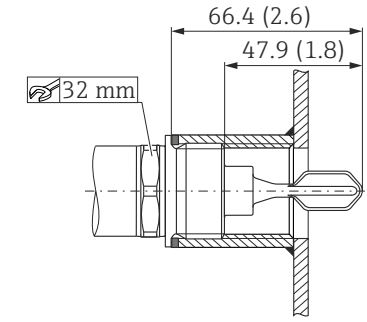
5.2 Messgerät montieren

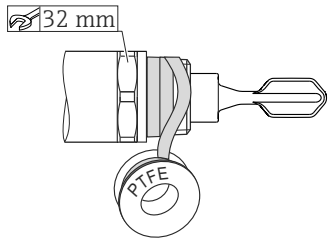
Einsatz gemäß WHG: Beachten Sie vor der Montage des Gerätes die WHG-Zulassungsunterlagen. Die Unterlagen finden Sie im Download-Bereich der Endress +Hauser Internetseite: www.endress.com → download

5.2.1 Benötigtes Werkzeug

- Gabelschlüssel: Beim Einschrauben nur am Sechskant drehen. Maximales Drehmoment: ≤ 30 Nm (22 lbf ft).
- Steckschlüssel: Der Steckschlüssel SW32 ist als Zubehör erhältlich → 32.

Beachten Sie die Temperatur- und Druckangaben bei kundenseitig verwendeten Dichtungen.

Ansicht, Maßangabe mm (in)	Beschreibung
 *1 Flachdichtung* *2 Einschweißadapter*	**Gewinde Zubehör Einschweißadapter** **Beispiel G ¾" (Beispiel Abbildung links)** ▪ L1: 63,9 mm (2,52 in) ▪ L2: 38,0 mm (1,5 in) **G 1"** ▪ L1: 66,4 mm (2,61 in) ▪ L2: 48,0 mm (1,89 in) **Druck und Temperatur (maximal):** +25 bar (+362 psi) bei +150 °C (+302 °F) +40 bar (+580 psi) bei +100 °C (+212 °F) Bei Verwendung eines Einschweißadapters mit frontbündiger Dichtung muss die mitgelieferte Flachdichtung (1) vom Gewinde entfernt werden.
	**Gewinde metrisch in Kundenstutzen** **Beispiel G 1"** **Druck und Temperatur (maximal):** +40 bar (+580 psi) bei 150 °C (302 °F)

Ansicht, Maßangabe mm (in)	Beschreibung
 A0022028	**Gewinde NPT** (ANSI B 1.20.1) **Druck und Temperatur (maximal):** +40 bar (+580 psi) bei +150 °C (+302 °F) Bei Bedarf mit Dichtungsmaterial umwickeln.

5.3 Montagekontrolle

❍	Ist das Gerät unbeschädigt (Sichtkontrolle)?
❍	Erfüllt das Gerät die Messstellenspezifikationen? Zum Beispiel: ▪ Prozesstemperatur ▪ Prozessdruck ▪ Umgebungstemperatur ▪ Schaltpunkt
❍	Sind Messstellenkennzeichnung und Beschriftung korrekt (Sichtkontrolle)?
❍	Ist das Gerät gegen Nässe und direkte Sonneneinstrahlung ausreichend geschützt?
❍	Ist das Gerät sachgerecht befestigt?

6 Elektrischer Anschluss

Das Gerät hat zwei Betriebsarten: Maximum-Sicherheit (MAX) und Minimum-Sicherheit (MIN). Mit der Wahl der entsprechenden Betriebsart wird sichergestellt, dass das Gerät auch im Störungsfall sicherheitsgerichtet schaltet, z.B. bei Unterbrechung der Versorgungsleitung.

- **Maximum-Sicherheit (MAX)**
  Das Gerät hält den elektronischen Schalter geschlossen, solange der Flüssigkeitsstand unterhalb der Schwinggabel liegt. Beispielanwendung: Überfüllsicherung
- **Minimum-Sicherheit (MIN)**
  Das Gerät hält den elektronischen Schalter geschlossen, solange die Schwinggabel von Flüssigkeit bedeckt ist. Beispielanwendung: Trockenlaufschutz für Pumpen

Bei Erreichen des Grenzstands, bei Störungen und bei Stromausfall öffnet der elektronische Schalter (Ruhestromprinzip).

6.1 Gerät anschließen

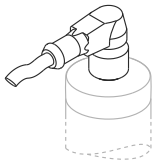
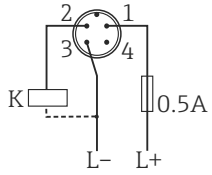
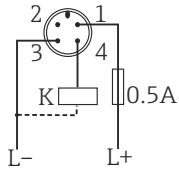
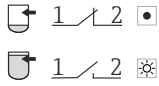
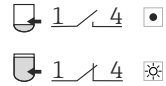
Gemäß IEC/EN61010 ist für das Gerät ein geeigneter Trennschalter vorzusehen.

6.1.1 Elektronikvariante 3-Leiter DC-PNP

Spannungsquelle: Berührungsungefährliche Spannung oder Class 2 circuit (Nordamerika)

Stecker M12

Je nach Auswertung der Schaltausgänge arbeitet das Gerät in der Betriebsart MAX oder MIN.

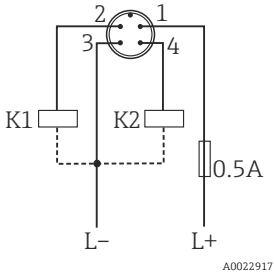
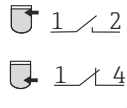
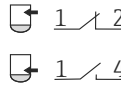
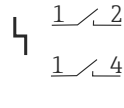
<table>
<tr><th>Elektrischer Anschluss</th><th colspan="2">Betriebsart</th></tr>
<tr><td rowspan="3">Stecker M12
 
A0022901</td><td>MAX</td><td>MIN</td></tr>
<tr><td> 
A0022858</td><td> 
A0022859</td></tr>
<tr><td> 
A0021416</td><td> 
A0021417</td></tr>
</table>

⊡	LED gelb (ye) leuchtet nicht
☼	LED gelb (ye) leuchtet
K	externe Last

Funktionsüberwachung mit Stecker M12

Mit einer zweikanaligen Auswertung kann neben der Füllstandsüberwachung auch eine Funktionsüberwachung des Sensors realisiert werden, z.B. per Relais-Schaltung, SPS, AS-i Bus I/O Modul, ...).

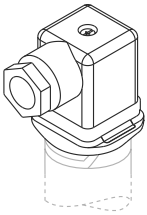
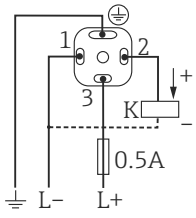
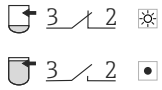
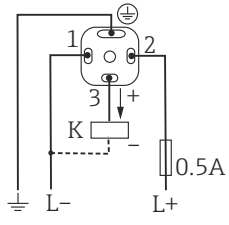
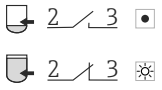
Bei der Beschaltung beider Ausgänge nehmen der MIN- und MAX-Ausgang im störungsfreien Betrieb gegenläufige Zustände (Antivalenz) ein. Im Störungsfall oder bei Leitungsbruch fallen beide Ausgänge ab.

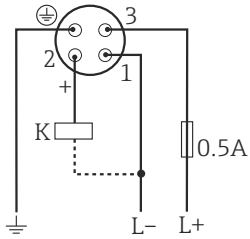
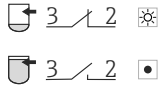
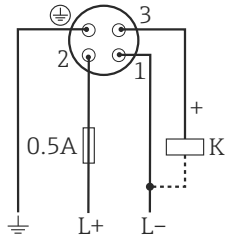
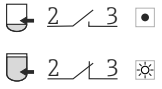
Anschluss für Funktionsüberwachung durch Antivalenz			**LED gelb (ye)**	**LED rot (rd)**
	**Sensor bedeckt**		☼	•
	Sensor frei		•	•
	Störung		•	☼

☼ LED leuchtet
• LED leuchtet nicht
ϟ Störung oder Warnung
K1 / K2 externe Last

Ventilstecker, Kabel

Abhängig von der Belegung des Anschlussstekkers oder der Verdrahtung des Kabels, arbeitet das Gerät entweder in der Betriebsart MAX oder MIN.

<table>
<tr><th>Elektrischer Anschluss</th><th colspan="2">Betriebsart</th></tr>
<tr><td rowspan="2">Ventilstecker
 
A0022900</td><td>MAX</td><td>MIN</td></tr>
<tr><td> 
A0021724
 
A0021413</td><td> 
A0021723
 
A0021414</td></tr>
<tr><td rowspan="2">Kabel
 
A0022902

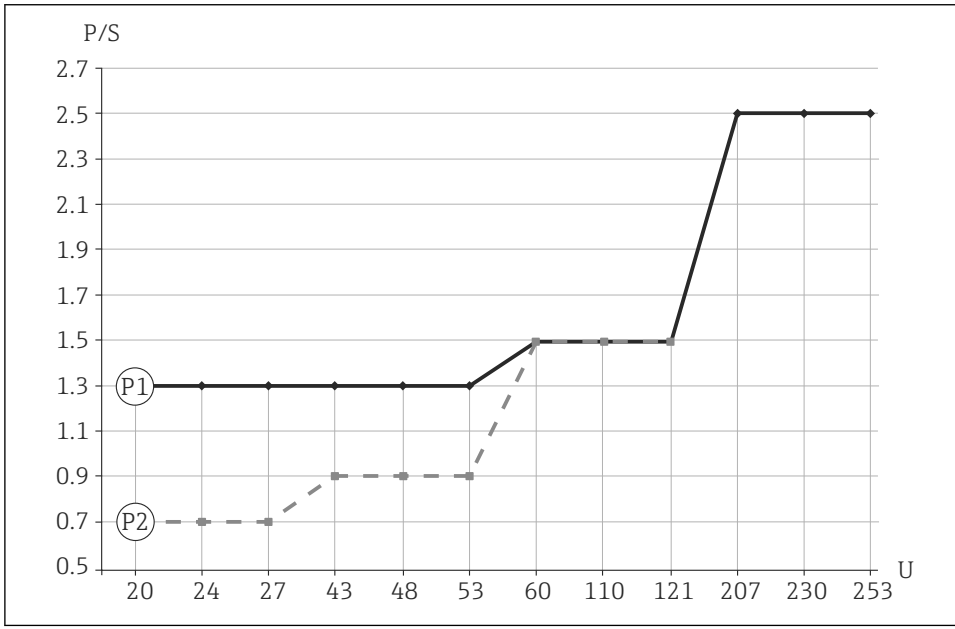
Adernfarben:
1 = BK (schwarz)
2 = GR (grau)
3 = BN (braun)
Erde = GNYE (grün-gelb)</td><td> 
A0022226
 
A0021413</td><td> 
A0022227
 
A0021414</td></tr>
</table>

●	LED gelb (ye) leuchtet nicht
☼	LED gelb (ye) leuchtet
K	externe Last

6.1.2 Elektronikvariante 2-Leiter AC/DC

Nicht geeignet für den Anschluss an Niederspannungs-SPS-Eingänge!

Auswahlhilfe für Relais



9 Minimale Nennleistung der Last

P/S Nennleistung in [W] / [VA]
U Betriebsspannung in [V]

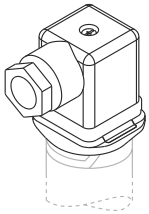
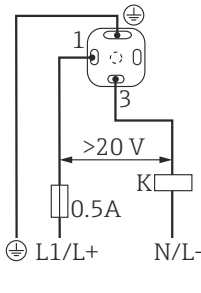
Position	Betriebsspannung	Nennleistung	
		min	max
P1 AC-Betrieb	24 V 110 V 230 V	> 1,3 VA > 1,5 VA > 2,5 VA	< 6 VA < 27,5 VA < 57,5 VA
P2 DC-Betrieb	24 V 48 V 60 V	> 0,7 W > 0,9 W > 1,5 W	< 6 W < 12 W < 15 W

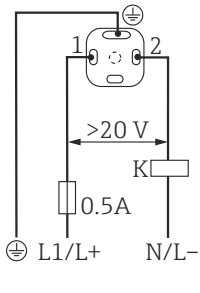
Relais mit geringerer Nennleistung können über ein parallel geschaltetes RC-Glied betrieben werden (optional).

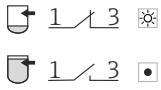
Ventilstecker, Kabel

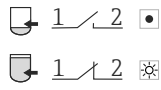
Abhängig von der Belegung des Anschlusssteckers oder der Verdrahtung des Kabels, arbeitet das Gerät entweder in der Betriebsart MAX oder MIN.

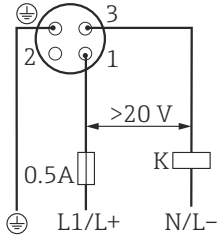
Bei der Verdrahtung des Kabels ist jeweils eine Ader des Kabels ohne Funktion (grau bei MAX, braun bei MIN). Das Kabel ohne Funktion muss gegen unbeabsichtigtes Kontaktieren gesichert werden.

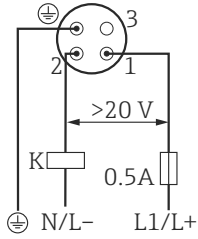
<table>
<tr><th>Elektrischer Anschluss</th><th colspan="2">Betriebsart</th></tr>
<tr><td>Ventilstecker</td><td>MAX</td><td>MIN</td></tr>
<tr><td rowspan="2"> 
A0022900</td><td> 

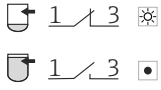
A0021219</td><td> 

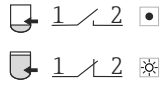
A0021220</td></tr>
<tr><td> 

A0021418</td><td> 

A0021420</td></tr>
<tr><td rowspan="2">Kabel
 
A0022902</td><td> 

A0022161</td><td> 

A0022225</td></tr>
<tr><td>Adernfarben:
1 = BK (schwarz)
2 = GR (grau)
3 = BN (braun)
Erde = GNYE (grün-gelb)</td><td> 

A0021418</td><td> 

A0021420</td></tr>
<tr><td colspan="3">☐ LED gelb (ye) leuchtet nicht
☼ LED gelb (ye) leuchtet
K externe Last</td></tr>
</table>

6.2 Anschlusskontrolle

❍	Sind Gerät oder Kabel unbeschädigt (Sichtkontrolle)?
❍	Erfüllen die verwendeten Kabel die Anforderungen?
❍	Sind die montierten Kabel von Zug entlastet?
❍	Sind die Kabelverschraubungen montiert, fest angezogen?
❍	Stimmt die Versorgungsspannung mit den Angaben auf dem Typenschild überein?
❍	Ist die Verdrahtung korrekt?
❍	3-Leiter DC-PNP: Falls erforderlich, ist die Funktionserde angeschlossen?
❍	2-Leiter AC/DC: Ist die Schutzleiterverbindung hergestellt?
❍	Wenn Versorgungsspannung vorhanden: Leuchtet die grüne LED?

7 Inbetriebnahme

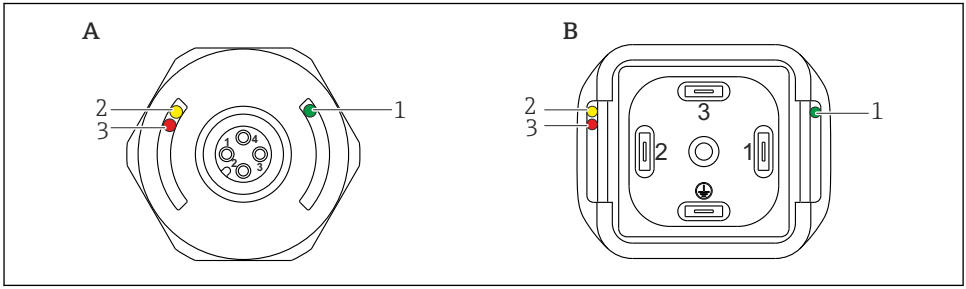
7.1 Installations- und Funktionskontrolle

Vergewissern Sie sich, dass die Einbau- und Anschlusskontrolle durchgeführt wurde, bevor Sie Ihre Messstelle in Betrieb nehmen:

- Checkliste "Montagekontrolle" → 21
- Checkliste "Anschlusskontrolle" → 27

Die Funktion der Schwinggabel lässt sich leicht prüfen, in dem Sie die Schwinggabel in einen Behälter mit Wasser tauchen.

7.2 LED-Anzeige

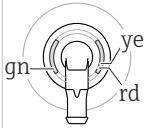
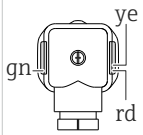
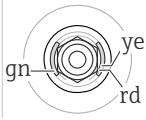


A0016856

A Stecker M12, (Kabel ohne Abbildung)
B Ventilstecker

Position	Funktion	Beschreibung
1	LED grün (gn) leuchtet	Gerät ist betriebsbereit
2	LED gelb (ye) leuchtet	**Stecker M12** Anzeige des Sensorzustandes: Schwinggabel ist von Flüssigkeit bedeckt **Ventilstecker / Kabel** Anzeige des Schaltzustandes: ▪ Betriebsart MAX (Überfüllsicherung): Sensor ist **nicht** von Flüssigkeit bedeckt ▪ Betriebsart MIN (Trockenlaufschutz): Sensor ist von Flüssigkeit bedeckt
3	LED rot (rd) blinkt leuchtet	 Warnung/Wartungsbedarf: Fehler behebbar, z.B. Fehlverdrahtung Störung/Geräteausfall: Fehler nicht behebbar, z.B. Elektronikfehler

7.2.1 Funktion der LEDs

Anschluss	Betriebsarten					
	Maximum-Sicherheit (MAX)		Minimum-Sicherheit (MIN)		Warnung	Störung
1 						
2 						
3 						
4 						
A0023003	A0023004	A0023005	A0023006	A0023007	A0023008	A0023009

1: Füllstandanzeige
2: Stecker M12
3: Ventilstecker
4: Kabel

● leuchtet nicht
☼ leuchtet
☼ blinkt
↳ Störung/Warnung

LED-Farben: gn = green (grün), ye = yellow (gelb), rd = red (rot)
Weitere Informationen zur LED-Anzeige → 🖹 28

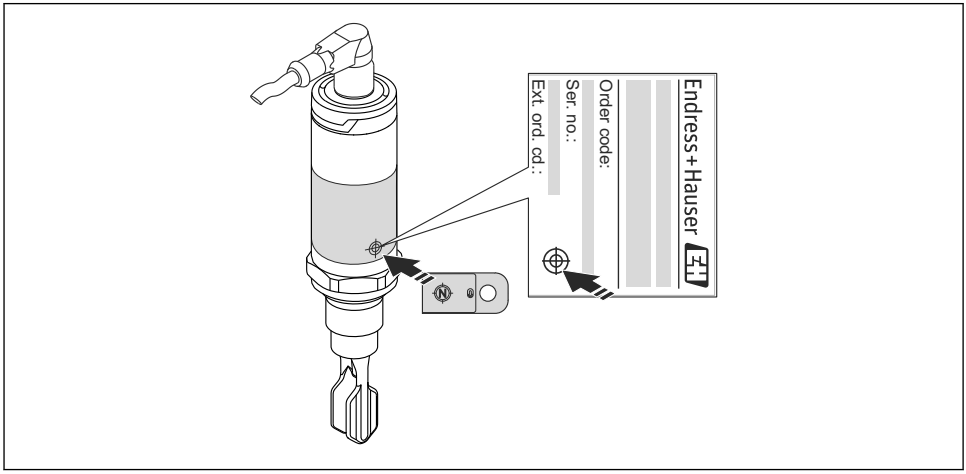
7.3 Funktionstest mit Testmagnet

⚠ WARNUNG

Verletzungsgefahr!

▶ Stellen Sie sicher, dass keine gefährlichen Prozesse an der Anlage ausgelöst werden.

Um einen Funktionstest durchzuführen, halten Sie den Testmagnet an die Markierung auf dem Typenschild (mindestens 2 Sekunden). Dadurch invertiert der aktuelle Schaltzustand und die gelbe LED ändert ihren Zustand. Beim Entfernen des Magnets wird der dann gültige Schaltzustand angenommen.



10 Testmagnet und Markierung

Der Testmagnet ist nicht im Lieferumfang enthalten und kann optional als Zubehör bestellt werden. → 32

8 Diagnose und Störungsbehebung

8.1 Diagnoseinformation via LED-Anzeige

LED-Anzeige an der Gehäusekappe

Fehlfunktion	Mögliche Ursache	Maßnahme
LED grün leuchtet nicht	Keine Spannungsversorgung	Stecker, Kabel und Spannungsversorgung prüfen
LED rot blinkt	Überlast oder Kurzschluss im Laststromkreis	▪ Kurzschluss beheben ▪ Maximalen Laststrom auf unter 250 mA reduzieren
LED rot leuchtet	Interner Sensorfehler oder Sensor korrodiert	Gerät austauschen

Anschluss: 2-Leiter AC/DC an 20...253 V DC

Fehlfunktion	Mögliche Ursache	Maßnahme
Unerwartetes Verhalten der LED gelb	Falsche Belegung des Steckers oder falsche Verdrahtung des Kabels	Polarität der Spannungsversorgung beachten! **Korrekter Anschluss:** Ventilstecker: L+ an PIN1, L- an PIN 3 Kabel: L+ BK (schwarz), L- BN (braun) **Ergebnis** ▪ Schwinggabel bedeckt: LED gelb leuchtet. ▪ Schwinggabel frei: LED gelb leuchtet **nicht.**

9 Wartung

Es sind keine speziellen Wartungsarbeiten erforderlich.

9.1 Reinigung

Der Sensor ist bei Bedarf zu reinigen. Die Reinigung kann auch im eingebauten Zustand erfolgen (z.B. CIP Cleaning in Place / SIP Sterilization in Place). Es ist darauf zu achten, dass der Sensor dabei nicht beschädigt wird.

10 Reparatur

Für den Grenzschalter ist keine Reparatur vorgesehen.

10.1 Ersatzteile

Die Website zum W@M Device Viewer (www.endress.com/deviceviewer): Dort werden alle Ersatzteile zum Messgerät inklusive Bestellcode aufgelistet und lassen sich bestellen. Wenn vorhanden, steht auch die dazugehörige Einbauanleitung zum Download zur Verfügung.

10.2 Rücksendung

Im Fall einer Reparatur, Werkskalibrierung, falschen Lieferung oder Bestellung muss das Messgerät zurückgesendet werden. Als ISO-zertifiziertes Unternehmen und aufgrund gesetzlicher Bestimmungen ist Endress+Hauser verpflichtet, mit allen zurückgesendeten Produkten, die mediumsberührend sind, in einer bestimmten Art und Weise umzugehen.

Um eine sichere, fachgerechte und schnelle Rücksendung Ihres Geräts sicherzustellen: Informieren Sie sich über Vorgehensweise und Rahmenbedingungen auf der Endress+Hauser Internetseite www.services.endress.com/return-material

10.3 Entsorgung

Bei der Entsorgung ist auf eine stoffliche Trennung und Verwertung der Gerätekomponenten zu achten.

11 Zubehör

Detaillierte Informationen zum Zubehör finden Sie in der Technischen Dokumentation TI01147F.

Bezeichnung	Ergänzung
Einschweißadapter	Detaillierte Informationen zu Einschweißadaptern finden Sie in der TI00426F/00/DE sowie in den Zusatzdokumentationen → 🖹 7.
Dichtungen, O-Ringe	
Steckerbuchse M12 mit Kabel 5 m (16 ft)	IP67, Überwurfmutter (Cu Sn/Ni) ▪ Gerade, Bestellnummer: 52006263 ▪ Gewinkelt 90°, Bestellnummer: 52010285
Montagesteckschlüssel	Sechskant, SW32, Bestellnummer: 52010156
Testmagnet	Bestellnummer: 71267011

12 Technische Daten

Weitere Angaben der technischen Daten finden Sie in der Technischen Dokumentation TI01147F/00/DE.

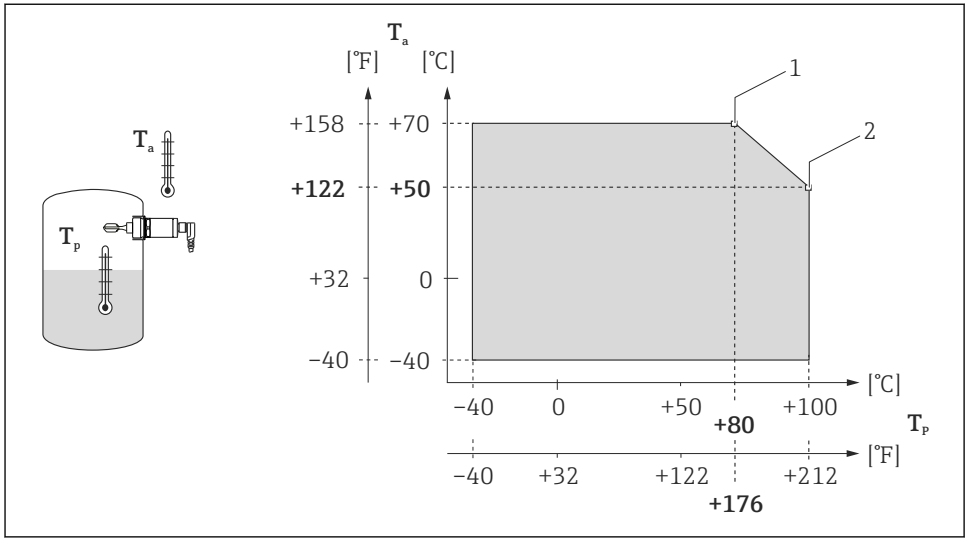
12.1 Energieversorgung

Elektronikvariante	Versorgungsspannung	Leistungsaufnahme	Stromaufnahme
3-Leiter DC-PNP	10...30 V DC	< 975 mW	< 15 mA
2-Leiter AC/DC	20...253 V	< 850 mW	< 3,8 mA

12.2 Umgebung

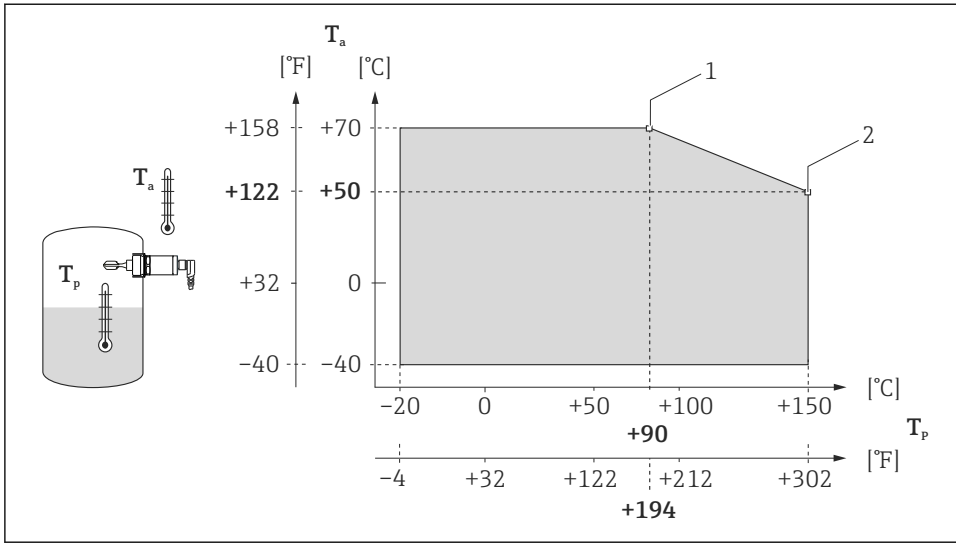
Umgebungstemperaturbereich	−40...+70 °C (−40...+158 °F), siehe Derating → 🖹 34
Lagerungstemperatur	−40...+85 °C (−40...+185 °F)
Klimaklasse	DIN EN 60068-2-38/IEC 68-2-38: Prüfung Z/AD
Einsatzhöhe	Bis 2 000 m (6 600 ft) über Normalnull
Stoßfestigkeit	a = 300 m/s² = 30 g, 3 Achsen x 2 Richtungen x 3 Stösse x 18 ms, gem. Prüfung Ea, prEN 60068-2-27:2007
Schwingungsfestigkeit	a(RMS) = 50 m/s², ASD = 1,25 $(m/s^2)^2$/Hz, f = 5 ... 2000 Hz, t = 3 x 2 h, gem. Prüfung Fh, EN 60068-2-64:2008
Verpolungsschutz	**2-Leiter AC/DC** ▪ AC-Betrieb: Gerät ist verpolsicher. ▪ DC-Betrieb: Bei Verpolung wird immer die Betriebsart Maximum-Sicherheit erkannt. Überprüfen Sie vor der Inbetriebnahme die Verdrahtung und führen Sie einen Funktionstest durch. Das Gerät wird bei Verpolung nicht beschädigt. **3-Leiter DC-PNP** Integriert. Bei Verpolung wird das Gerät automatisch deaktiviert.
Kurzschlussschutz	**2-Leiter AC/DC** Beim Schaltvorgang überprüft der Sensor, ob eine Last, z.B. Relais oder Schütz, vorhanden ist (Load- Check). Tritt ein Fehler auf, wird der Sensor nicht zerstört. Intelligente Überwachung: Nach Beheben des Fehlers erfolgt der Normalbetrieb. **3-Leiter DC-PNP** Überlastschutz/Kurzschlussschutz bei I > 250 mA; der Sensor wird nicht zerstört. Intelligente Überwachung: Überprüfung auf Überlast im Abstand von ca. 1,5 s; nach Beheben der Überlast/des Kurzschlusses erfolgt der Normalbetrieb.
Schutzart	▪ IP65/67 NEMA Type 4X Enclosure (Stecker M12) ▪ IP65 NEMA Type 4X Enclosure (Ventilstecker) ▪ IP66/68 NEMA Type 4X/6P Enclosure (Kabel)
Elektromagnetische Verträglichkeit	Elektromagnetische Verträglichkeit gemäß allen relevanten Anforderungen der EN 61326-Serie und NAMUR- Empfehlung EMV (NE21). Details sind aus der EG-Konformitätserklärung ersichtlich. Verfügbar im Download-Bereich der Endress+Hauser Internetseite: www.endress.com.

12.2.1 Derating



11 Derating-Kurve: 100 °C (212 °F)

1 I_{max}: 200 mA (DC-PNP), 250 mA (AC/DC)
2 I_{max}: 150 mA (DC-PNP), 150 mA (AC/DC)
Ta Umgebungstemperatur
Tp Prozesstemperatur



12 *Derating-Kurve: 150 °C (302 °F)*

1 I_{max}*: 200 mA (DC-PNP), 250 mA (AC/DC)*
2 I_{max}*: 150 mA (DC-PNP), 150 mA (AC/DC)*
Ta Umgebungstemperatur
Tp Prozesstemperatur

12.3 Prozess

HINWEIS

▶ Beachten Sie das Druck- und Temperatur-Derating in Abhängigkeit des gewählten Prozessanschlusses.

Prozesstemperaturbereich	−40…+100 °C (−40…+212 °F) −40…+150 °C (−40…+302 °F)
Prozessdruckbereich	max. −1…+40 bar (−14,5…+580 psi)
Messstoffdichte	> 0,7 g/cm³ (optional bestellbar: > 0,5 g/cm³)
Aggregatzustand	flüssig
Viskosität	1…10 000 mPa · s dynamische Viskosität
Feststoffanteil	ø < 5 mm (0,2 in)
Seitliche Belastbarkeit	Seitliche Belastbarkeit der Schwinggabel: max. 200 N

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1 Document information

1.1 Document function

These Operating Instructions contain all the information that is required in various phases of the life cycle of the device: from product identification, incoming acceptance and storage, to mounting, connection, operation and commissioning through to troubleshooting, maintenance and disposal.

1.2 Symbols

1.2.1 Safety instructions

Symbol	Meaning
 A0011189-EN	**DANGER!** This symbol alerts you to a dangerous situation. Failure to avoid this situation will result in serious or fatal injury.
 A0011190-EN	**WARNING!** This symbol alerts you to a dangerous situation. Failure to avoid this situation can result in serious or fatal injury.
 A0011191-EN	**CAUTION!** This symbol alerts you to a dangerous situation. Failure to avoid this situation can result in minor or medium injury.
 A0011192-EN	**NOTE!** This symbol contains information on procedures and other facts which do not result in personal injury.

1.2.2 Electrical symbols

Symbol	Meaning
 A0011200	**Ground connection** A grounded terminal which, as far as the operator is concerned, is grounded via a grounding system.
 A0011199	**Protective ground connection** A terminal which must be connected to ground prior to establishing any other connections.

1.2.3 Symbols for certain types of information

Symbol	Meaning
 A0011182	**Permitted** Indicates procedures, processes or actions that are permitted.
 A0011184	**Forbidden** Indicates procedures, processes or actions that are forbidden.

Symbol	Meaning
 A0011193	**Tip** Indicates additional information.
 A0011194	**Reference to documentation** Refers to the corresponding device documentation.
 A0011195	**Reference to page** Refers to the corresponding page number.

1.2.4 Symbols for graphics

Symbol	Meaning
1, 2, 3 ...	Item numbers
A, B, C, ...	Views

1.2.5 Symbols for tools

Symbol	Meaning
 A0011222	Open-ended wrench

1.3 Documentation

The document types listed are available in the Download Area of the Endress+Hauser website: www.endress.com → Download

Document	Purpose and content of the document
Technical Information TI01147F/00/EN	This document contains all the technical data for the device and provides an overview of the accessories that can be ordered.
Additional documentation TI00426F/00/EN SD00352F/00/A6 SD00356F/00/EN	 Weld-in adapter and flanges (overview) Weld-in adapter G 1", G ¾" (installation instructions) Valve plug (installation instructions)

2 Basic safety instructions

2.1 Requirements for the personnel

The personnel for installation, commissioning, diagnostics and maintenance must fulfill the following requirements:

- Trained, qualified specialists must have a relevant qualification for this specific function and task
- Are authorized by the plant owner/operator
- Are familiar with federal/national regulations
- Before beginning work, the specialist staff must have read and understood the instructions in the Operating Instructions and supplementary documentation as well as in the certificates (depending on the application)
- Following instructions and basic conditions

The operating personnel must fulfill the following requirements:

- Being instructed and authorized according to the requirements of the task by the facility's owner-operator
- Following the instructions in these Operating Instructions

2.2 Designated use

The measuring device described in these Operating Instructions may only be used as a level limit switch for liquids. Incorrect use may pose a hazard. To ensure that the measuring device remains in proper condition for the operation time:

- the measuring devices may only be used for media against which the process-wetted materials are adequately resistant.
- the limit values in "Technical Data" must be observed.

2.2.1 Incorrect use

The manufacturer is not liable for damage caused by improper or non-designated use.

Residual risks

Heat transfer from the process can heat up the electronics housing and the modules it contains to up to 80 °C (176 °F) during operation.

Danger of burns from contact with surfaces!
- ▶ For elevated fluid temperature, ensure protection against contact to prevent burns.

2.3 Workplace safety

For work on and with the device:
- ▶ Wear the required personal protective equipment according to federal/national regulations.
- ▶ Switch off the supply voltage before connecting the device.

2.4 Operational safety

Risk of injury!

- Operate the device in proper technical condition and fail-safe condition only.
- The operator is responsible for interference-free operation of the device.

2.5 Product safety

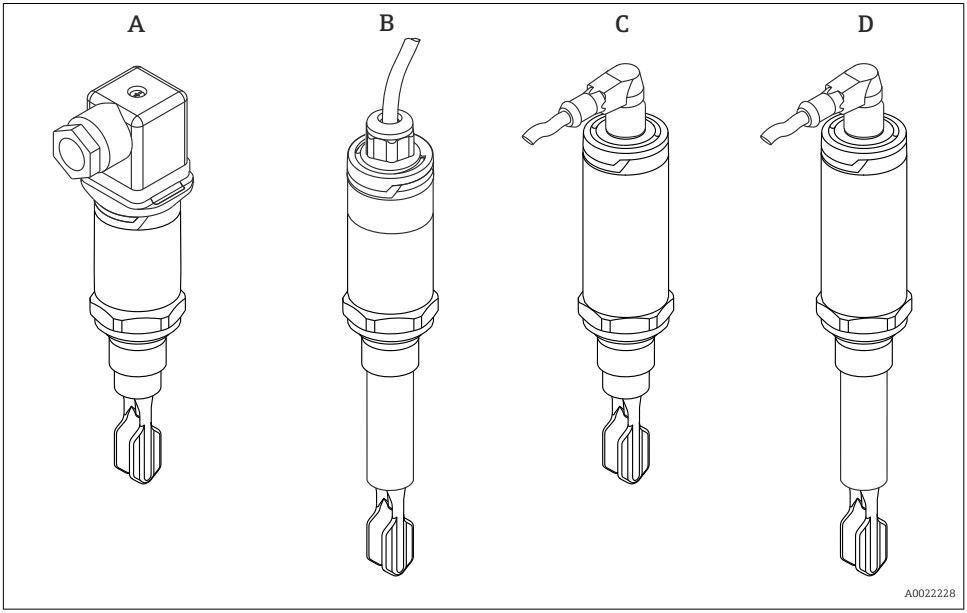
This measuring device is designed in accordance with good engineering practice to meet state-of-the-art safety requirements, has been tested, and left the factory in a condition in which it is safe to operate. It meets general safety standards and legal requirements. It also complies with the EC directives listed in the device-specific EC Declaration of Conformity. Endress +Hauser confirms this by affixing the CE mark to the device.

3 Product description

The Liquiphant FTL31 is a point level switch for universal use in all liquids. It is used preferably in storage tanks, mixing vessels and pipes.

3.1 Product design

The point level switch is available in different versions which can be assembled in accordance with user specifications. Examples can be seen in the following diagram:



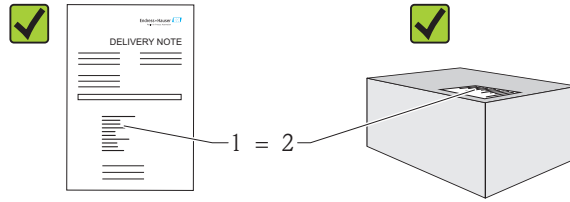
Versions	Examples			
	A	B	C	D
Electrical connection	Valve plug	Cable (cannot be dismantled)	M12 connector	M12 connector
Housing (sensor design) for process temperatures up to:	100 °C (212 °F)	100 °C (212 °F)	150 °C (302 °F)	150 °C (302 °F)
Sensor type	Compact version	Short tube version	Compact version	Short tube version

Detailed information on the short tube version and the process connections is available in Technical Documentation TI01147F/00/EN.

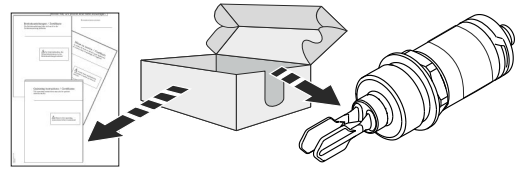
4 Incoming acceptance and product identification

4.1 Incoming acceptance

A0015502



A0016051



A0021096

Is the order code on the delivery note (1) identical to the order code on the product sticker (2)?

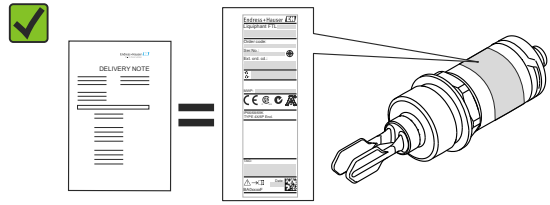
A0015502



A0021097

Are the goods undamaged?

A0015502



A0021098

Do the data on the nameplates correspond to the order specifications on the delivery note?

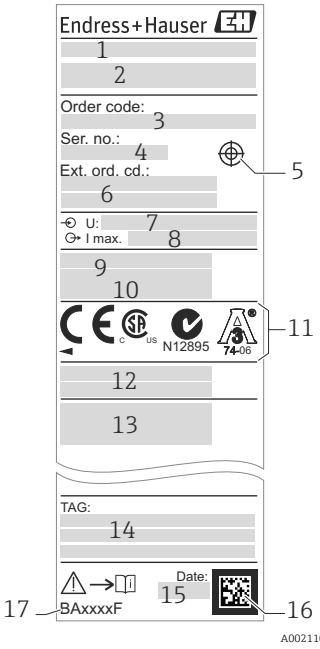
If one of these conditions is not met, please contact your Endress+Hauser sales office.

4.2 Product identification

The following options are available for identification of the measuring device:
- Nameplate data
- Order code with breakdown of the device features on the delivery note
- Enter serial number of nameplates in *W@M Device Viewer* (www.endress.com/deviceviewer): All information on the measuring device is displayed

An overview of the scope of the technical documentation supplied can be obtained by entering the serial number on the nameplate in *W@M Device Viewer* (www.endress.com/deviceviewer)

4.2.1 Nameplate



1: Device name
2: Manufacturer's address
3: Order code
4: Serial number
5: Marking for test magnet
6: Extended order code
7: Supply voltage
8: Signal output
9: Process and ambient temperature
10: Process pressure
11: Certificate symbols (optional)
12: Degree of protection: e.g. IP, NEMA
13: Certificate- and approval-specific data
14: Measuring point identification (optional)
15: Date of manufacture (year, month)
16: Data Matrix code
17: Document number of Operating Instructions

The test magnet can be ordered as an accessory → 64.

4.3 Storage and transport

4.3.1 Storage conditions

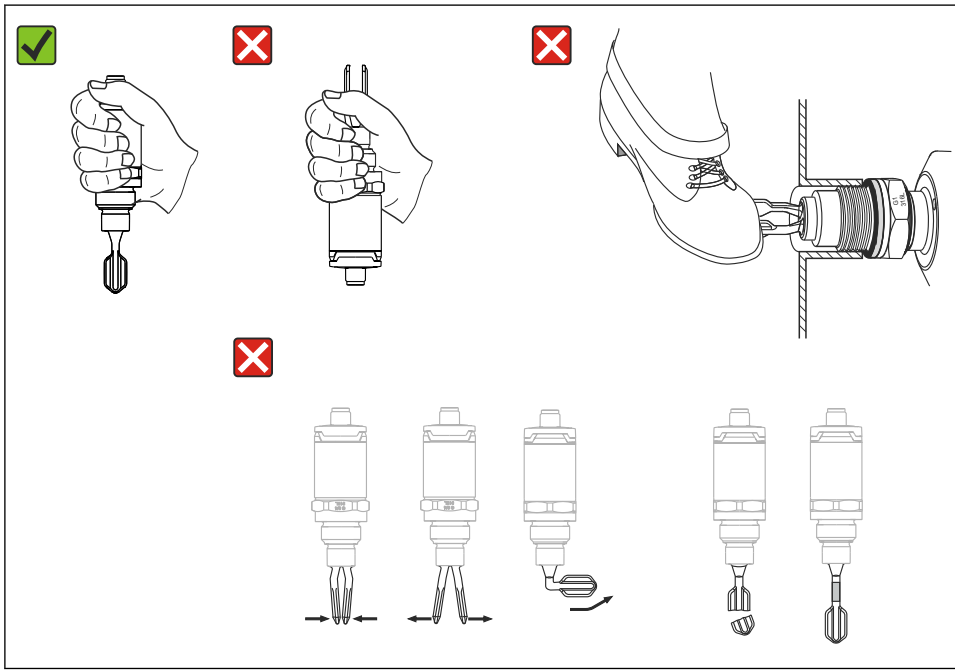
- Permitted storage temperature: −40 to +85 °C (−40 to +185 °F)
- Use original packaging.

4.3.2 Handling of the device

NOTICE

Risk of injury! Housing or fork may become damaged or tear!

- ▶ Transport the device to the measuring point in its original packaging or by the housing.
- ▶ Do not hold the device by the fork!
- ▶ Do not use the device as a ladder or climbing aid!
- ▶ Do not bend the fork!
- ▶ Do not shorten or lengthen the fork!



A0020845

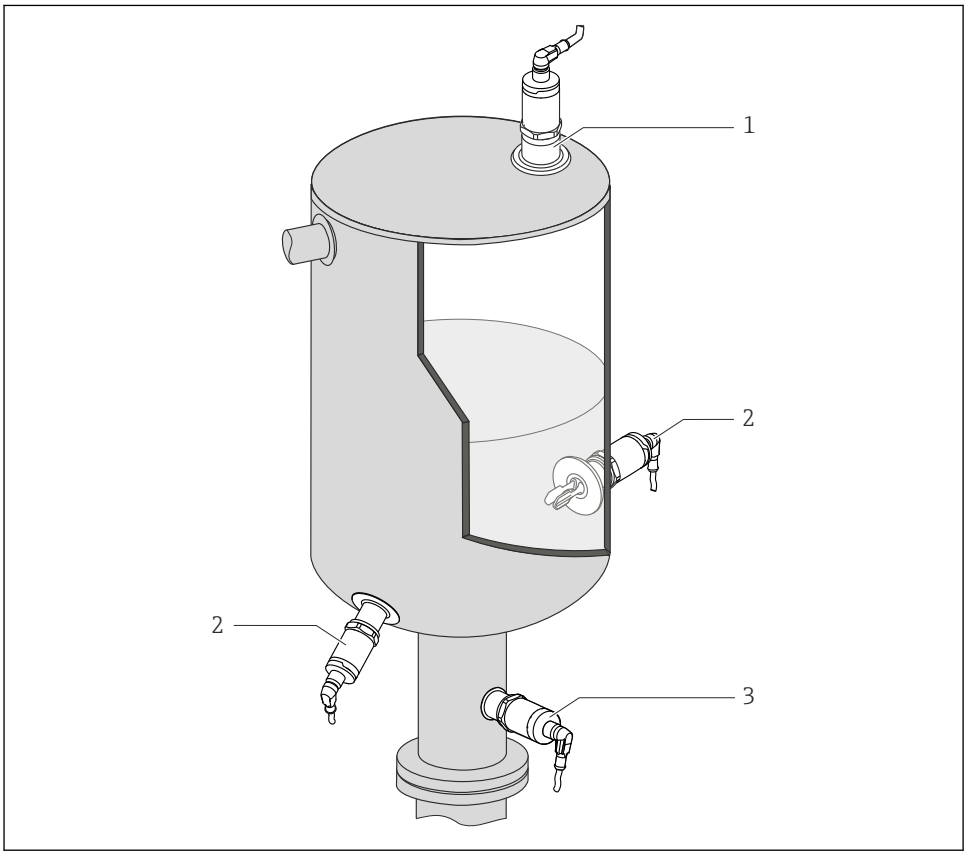
13 *Handling of the device*

5 Installation

5.1 Installation conditions

5.1.1 Orientation

The point level switch can be installed in any position in a vessel, pipe or tank.

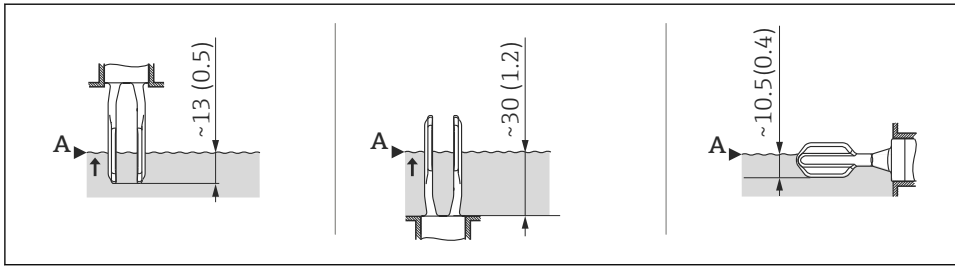


14 Installation options

1 Overfill prevention or upper level detection
2 Lower level detection
3 Dry running protection for pump

5.1.2 Switch point

The switch point (A) on the sensor depends on the orientation of the point level switch (water +25 °C (+77 °F), 1 bar (14.5 psi).

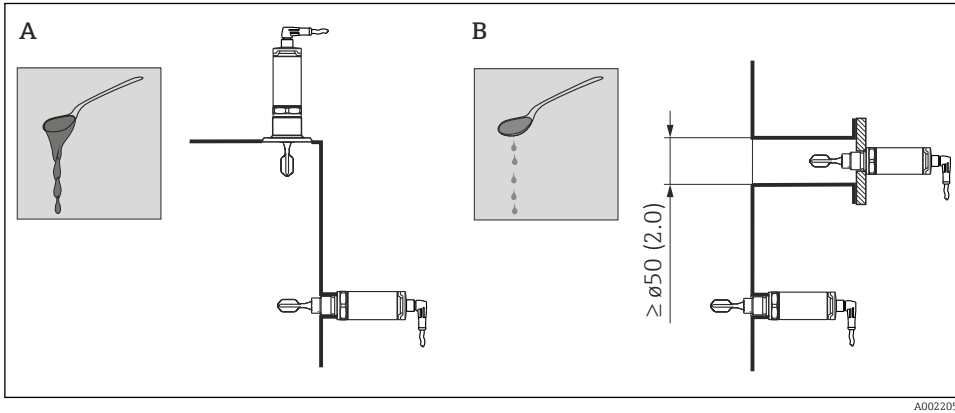


15 *Vertical and horizontal orientation, dimensions in mm (in)*

5.1.3 Viscosity

Switching delays may occur in the case of highly viscous liquids. Ensure that the liquid can easily run off the tuning fork:

- If installing in vessels with high-viscosity liquids (A), the tuning fork may **not** be located in the installation socket!
- If installing in vessels with low-viscosity liquids (B), the tuning fork may be located in the installation socket!
- The installation nozzle must be no less than the minimum diameter of 50 mm (2.0 in).



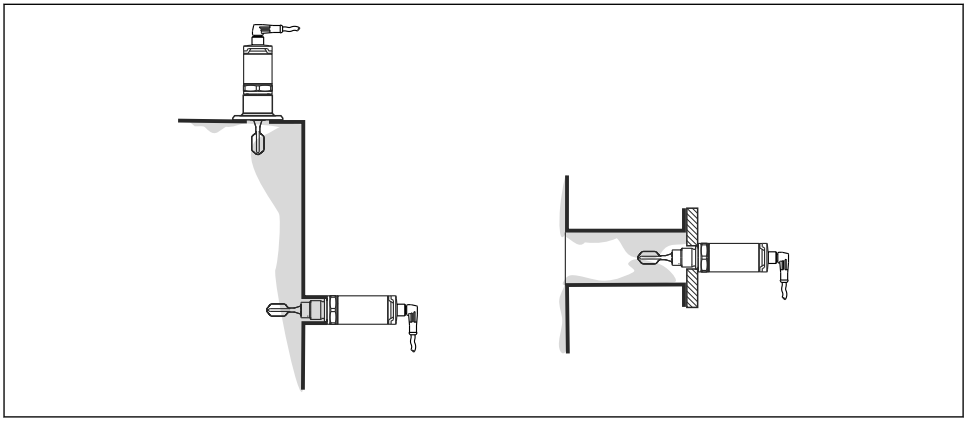
16 *Installation options with consideration given to the liquid viscosity, dimensions in mm (in)*

A High viscosity (< 10 000 mPa·s)
B Low viscosity (< 2 000 mPa·s)

5.1.4 Buildup

Make sure that the installation socket does not exceed a certain length so that the tuning fork can project freely into the vessel.

Possibilities for optimization:
- A vertical orientation of the point level switch keeps buildup to a minimum.
- Preferably flush-mounted on vessels or in pipes.



A0022057

17 Buildup on tank wall, pipe wall and tuning fork

5.1.5 Weld-in adapter with leakage hole

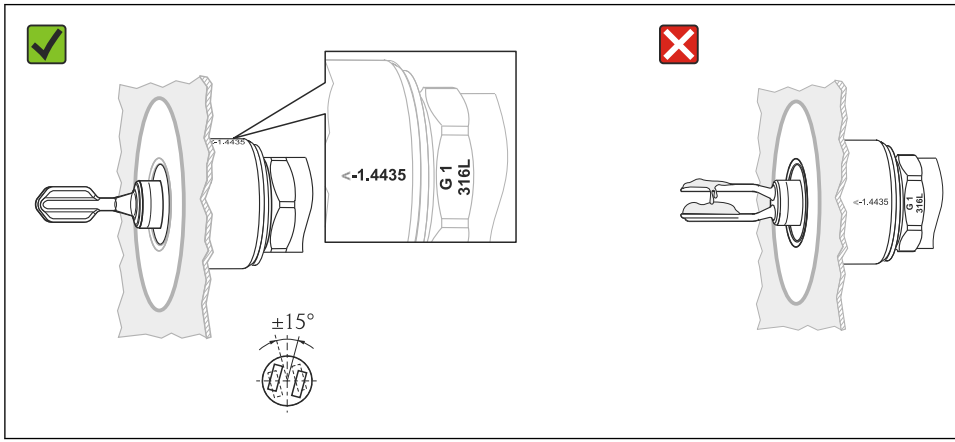
If installed horizontally, ensure that the leakage hole is pointing down. This allows leaks to be detected as quickly as possible.

5.1.6 Marking

The marking indicates the position of the tuning fork. If installed horizontally in vessels, the marking is face up.

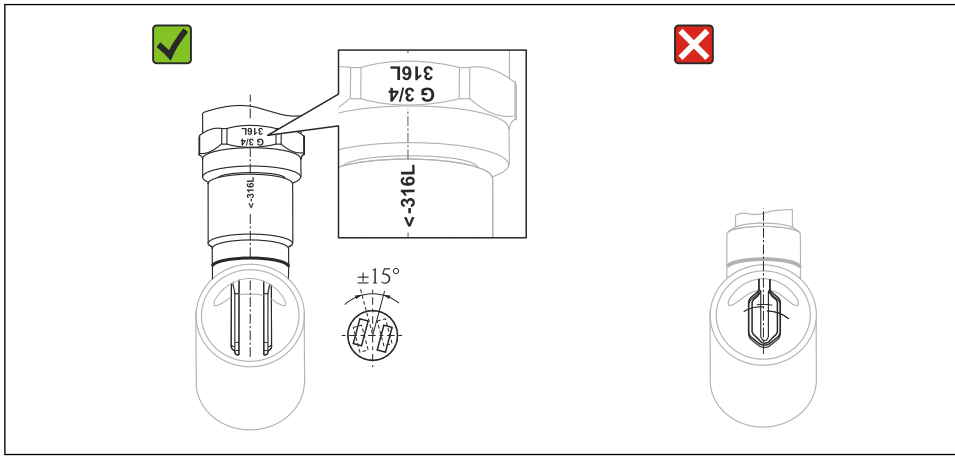
The marking appears either as a material specification (e.g. 316L) or a thread designation (e.g. G ½") in the following locations:

- On the hexagonal bolt of the process adapter
- On the nameplate
- On the weld-in adapter



A0022641

18 *Orientation in the vessel*

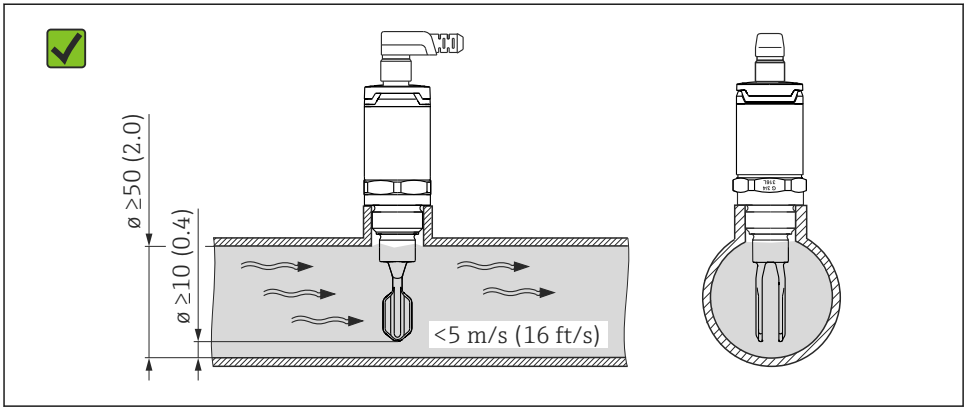


A0022804

19 *Orientation in the pipe*

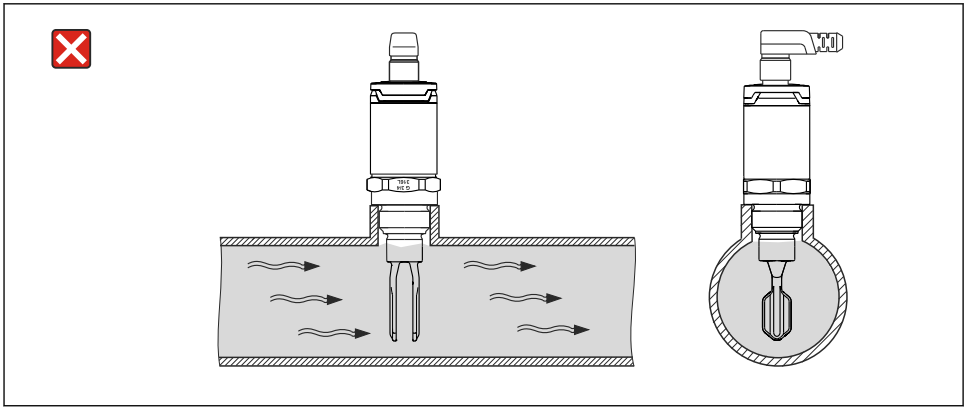
5.1.7 Installation in pipes

During installation, pay attention to the position of the fork in order to minimize turbulence in the pipe.



A0021357

Dimensions mm (in)

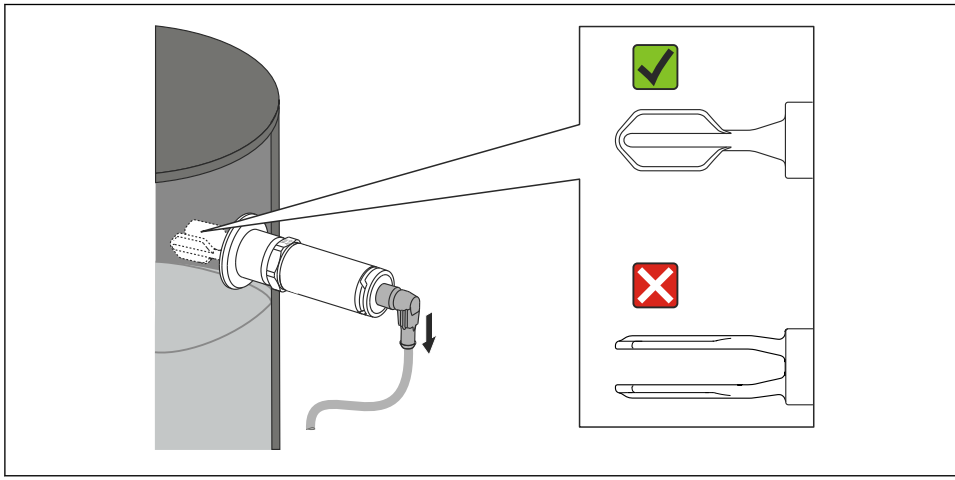


A0022268

5.1.8 Installation in vessels

If installed horizontally, pay attention to the position of the tuning fork to ensure that the liquid can drip off easily.

The electrical connection, e.g. M12 connector, should be pointing down with the cable. This can prevent moisture from penetrating.

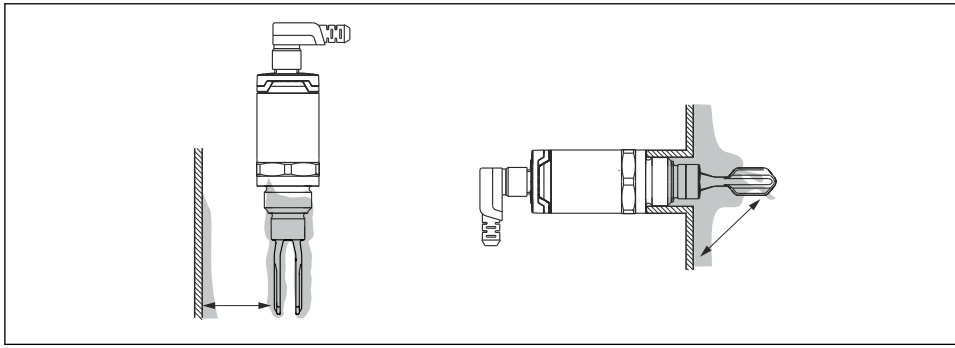


A0021034

20 Position of the fork in the case of horizontal installation in a vessel

5.1.9 Distance from wall

Ensure that there is sufficient distance between the expected buildup on the tank wall and the fork. Recommended distance from wall ≥10 mm (0.39 in).



A0022272

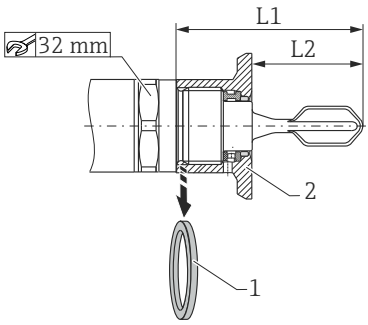
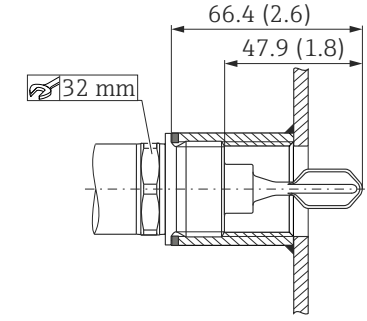
5.2 Mounting the measuring device

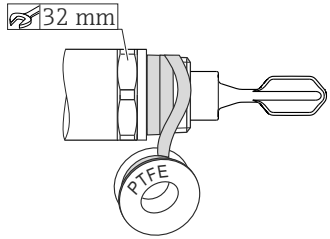
Service in accordance with WHG: Prior to mounting the device, pay attention to the WHG approval documents. The documents can be found in the Download Area of the Endress +Hauser website: www.endress.com → Download

5.2.1 Required tools

- Open-ended wrench: only turn by the hex bolt when screwing in.
  Maximum torque: ≤ 30 Nm (22 lbf ft).
- Socket wrench: The socket wrench AF32 is available as an accessory → 64.

Pay attention to the temperature and pressure specifications for seals used at the customer site.

View, dimensions in mm (in)	Description
 *1 Flat seal* *2 Weld-in adapter*	**Thread accessory weld-in adapter** **Example G ¾" (example in graphic on left)** ▪ L1: 63.9 mm (2.52 in) ▪ L2: 38.0 mm (1.5 in) **G 1"** ▪ L1: 66.4 mm (2.61 in) ▪ L2: 48.0 mm (1.89 in) **Pressure and temperature (maximum):** +25 bar (+362 psi) at +150 °C (+302 °F) +40 bar (+580 psi) at +100 °C (+212 °F) When using a weld-in adapter with flush-mounted seal, the flat seal (1) supplied must be removed from the thread.
	**Metric thread in customer nozzle** **Example G 1"** **Pressure and temperature (maximum):** +40 bar (+580 psi) at 150 °C (302 °F)

View, dimensions in mm (in)	Description
 A0022028	**NPT thread** (ANSI B 1.20.1) **Pressure and temperature (maximum):** +40 bar (+580 psi) at +150 °C (+302 °F) Wrap in sealing material if necessary.

5.3 Post-installation check

❍	Is the device undamaged (visual inspection)?
❍	Does the device conform to the measuring point specifications? For example: ▪ Process temperature ▪ Process pressure ▪ Ambient temperature ▪ Switch point
❍	Are the measuring point identification and labeling correct (visual inspection)?
❍	Is the device adequately protected from precipitation and direct sunlight?
❍	Is the device secured properly?

6 Electrical connection

The device has two operating modes: maximum safety (MAX) and minimum safety (MIN). By choosing the corresponding operating mode, the user ensures that the device also switches in a safety-oriented manner even in an alarm condition, e.g. if the power supply line is disconnected.

- **Maximum safety (MAX)**
  The device keeps the electronic switch closed as long as the liquid level is below the fork.
  Sample application: overfill prevention
- **Minimum safety (MIN)**
  The device keeps the electronic switch closed as long as the fork is immersed in liquid.
  Sample application: Dry running protection for pumps

The electronic switch opens if the limit is reached, if a fault occurs or the power fails (quiescent current principle).

6.1 Connecting the device

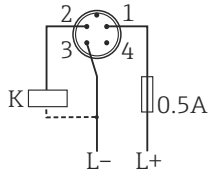
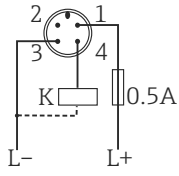
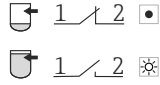
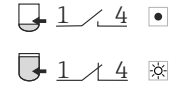
In accordance with IEC/EN61010 a separate circuit breaker must be provided for the device .

6.1.1 Electronic version 3-wire DC-PNP

Voltage source: non-hazardous contact voltage or Class 2 circuit (North America)

M12 connector

Depending on the analysis of the switch outputs, the device works in MAX oder MIN mode.

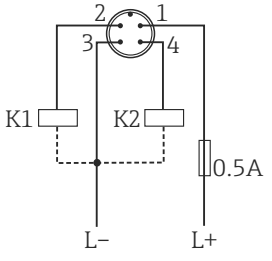
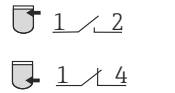
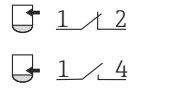
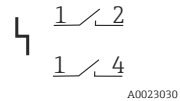
Electrical connection	Operating mode	
M12 connector	MAX	MIN
 A0022901	 A0022858	 A0022859
	 A0021416	 A0021417

⊡	Yellow LED (ye) not lit
☼	Yellow LED (ye) lit
K	external load

Function monitoring with M12 connector

Using a two-channel analysis, function monitoring of the sensor can be implemented in addition to level monitoring, e.g. per relay switch, PLC, AS-i Bus I/O module, ...).

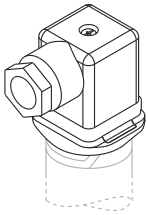
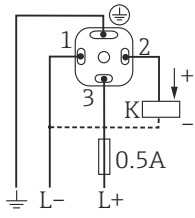
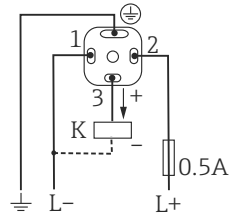
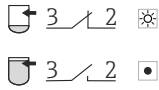
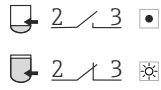
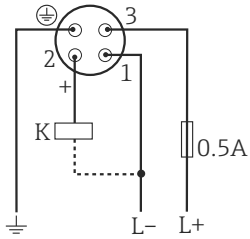
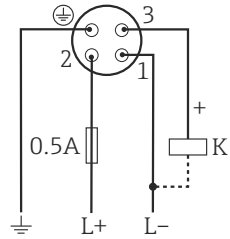
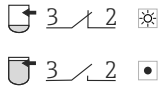
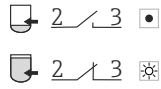
When both outputs are connected, the MIN and MAX outputs assume opposite states when the device is operating fault-free (XOR). In the event of an alarm condition or a line break, both outputs are deenergized.

Connection for function monitoring with antivalence			Yellow LED (ye)	Red LED (rd)
	**Sensor covered**		☼	•
	Sensor exposed		•	•
	Fault		•	☼

☼ LED lit
• LED not lit
ϟ Fault or warning
K1 / K2 external load

Valve plug, cable

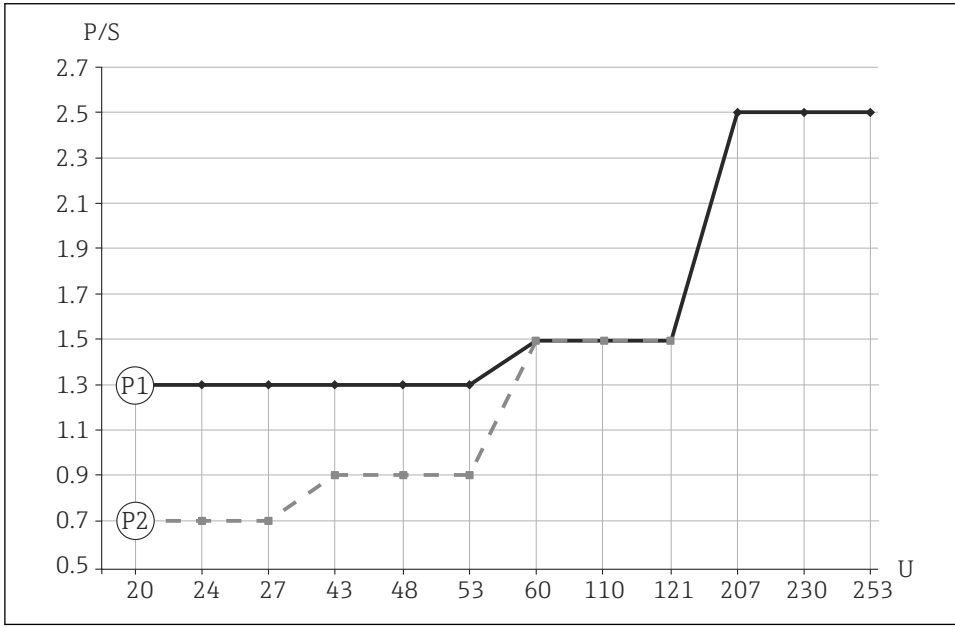
Depending on the assignment of the connector or the wiring of the cable, the device works in either the MAX or MIN operating mode.

<table>
<tr><th>Electrical connection</th><th colspan="2">Operating mode</th></tr>
<tr><td rowspan="2">Valve plug
 
A0022900</td><td>MAX</td><td>MIN</td></tr>
<tr><td> 
A0021724</td><td> 
A0021723</td></tr>
<tr><td></td><td> 
A0021413</td><td> 
A0021414</td></tr>
<tr><td rowspan="2">Cable
 
A0022902</td><td> 
A0022226</td><td> 
A0022227</td></tr>
<tr><td>Core colors:
1 = BK (black)
2 = GR (gray)
3 = BN (brown)
Ground = GNYE (green-yellow)</td><td> 
A0021413</td><td> 
A0021414</td></tr>
<tr><td colspan="3">⊡ Yellow LED (ye) not lit
☼ Yellow LED (ye) lit
K external load</td></tr>
</table>

6.1.2 Electronic version 2-wire AC/DC

Not suitable for connection to low-voltage PLC inputs!

Selection tool for relays



21 Minimum rated power of the load

P/S Rated power in [W] / [VA]
U Operating voltage in [V]

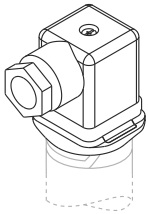
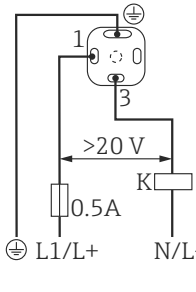
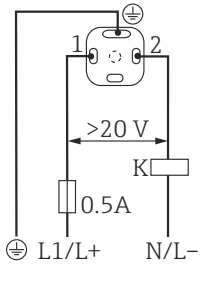
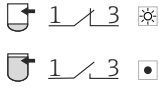
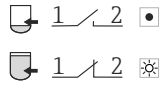
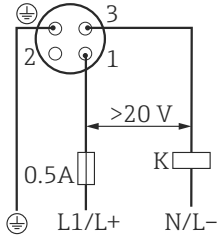
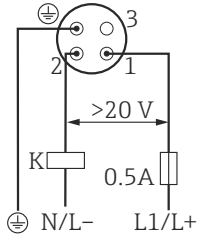
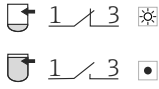
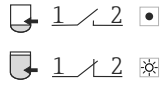
Position	Supply voltage	Rated power	
		min	max
P1 AC mode	24 V 110 V 230 V	> 1.3 VA > 1.5 VA > 2.5 VA	< 6 VA < 27.5 VA < 57.5 VA
P2 DC mode	24 V 48 V 60 V	> 0.7 W > 0.9 W > 1.5 W	< 6 W < 12 W < 15 W

Relays with a lower rated power can be operated by means of an RC module connected in parallel (optional).

Valve plug, cable

Depending on the assignment of the connector or the wiring of the cable, the device works in either the MAX or MIN operating mode.

When the cable is wired, one wire of the cable does not have any function in each of the operating modes (gray in the case of MAX, and brown in the case of MIN). The cable with no function must be secured against inadvertent contact.

<table>
<tr><th>Electrical connection</th><th colspan="2">Operating mode</th></tr>
<tr><td rowspan="2">Valve plug
 
A0022900</td><td>MAX</td><td>MIN</td></tr>
<tr><td> 
A0021219</td><td> 
A0021220</td></tr>
<tr><td></td><td> 
A0021418</td><td> 
A0021420</td></tr>
<tr><td rowspan="2">Cable
 
A0022902</td><td> 
A0022161</td><td> 
A0022225</td></tr>
<tr><td>Core colors:
1 = BK (black)
2 = GR (gray)
3 = BN (brown)
Ground = GNYE (green-yellow)</td><td> 
A0021418</td><td> 
A0021420</td></tr>
<tr><td colspan="3">▪ Yellow LED (ye) not lit
☼ Yellow LED (ye) lit
K external load</td></tr>
</table>

6.2 Post-connection check

❍	Is the device or cable undamaged (visual check)?
❍	Do the cables comply with the requirements ?
❍	Do the cables have adequate strain relief?
❍	Are the cable glands mounted and firmly tightened?
❍	Does the supply voltage match the specifications on the nameplate?
❍	Is the wiring correct?
❍	3-wire DC-PNP: If required, is the functional earth connected?
❍	2-wire C/DC: Has the protective ground connection been established?
❍	If supply voltage is present, is the green LED lit?

7 Commissioning

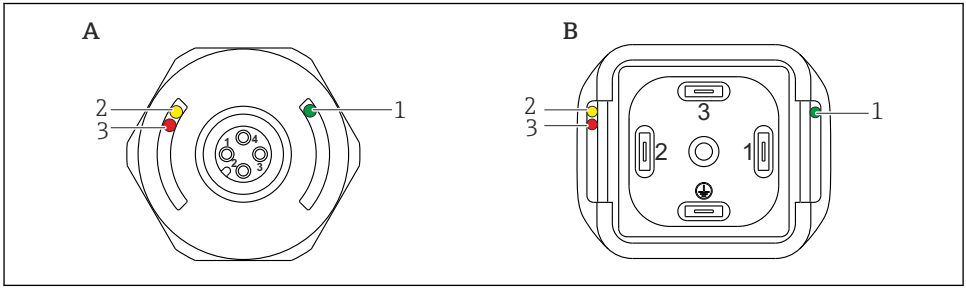
7.1 Function check

Before commissioning your measuring point, ensure that the post-installation and post-connection checks have been performed.

- "Post-installation check" checklist → 53
- "Post-connection check" checklist → 59

The function of the tuning fork can be easily tested by immersing the tuning fork in a vessel containing water.

7.2 LED display

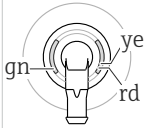
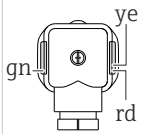
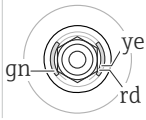


A0016856

A M12 connector, (cable without graphic)
B Valve plug

Item	Function	Description
1	Green LED (gn) Lit	Device is operational
2	Yellow LED (ye) Lit	**M12 connector** Indicates the sensor state: tuning fork is covered by liquid **Valve plug / cable** Indicates the switching state: ▪ MAX operating mode (overfill prevention): sensor is **not** covered by liquid ▪ MIN operating mode (dry running protection): the sensor is covered by liquid
3	Red LED (rd) flashing Lit	 Warning/maintenance required: error can be rectified, e.g. incorrect wiring Fault/device failure: error cannot be rectified, e.g. electronic error

7.2.1 Function of LEDs

Connection	Operating modes					
	Maximum safety (MAX)		Minimum safety (MIN)		Warning	Fault
1 						
2 						
3 						
4 						
A0023003	A0023004	A0023005	A0023006	A0023007	A0023008	A0023009

1: Level display
2: M12 connector
3: Valve plug
4: Cable

● unlit
☼ lit
☼ flashing
ϟ fault/warning

LED colors: gn = green, ye = yellow, rd = red
More information on LED display → 🖹 60

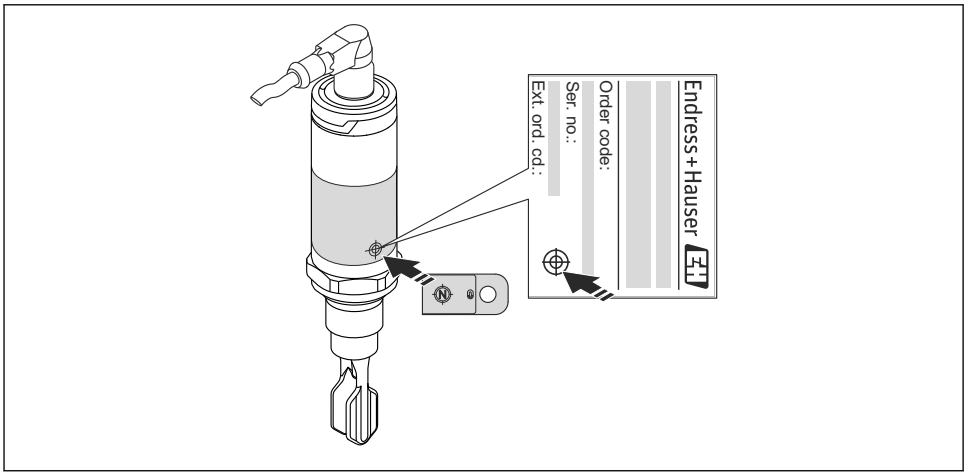
7.3 Function test with test magnet

WARNING

Risk of injury!

- Ensure that no dangerous processes are activated in the system.

To perform a function test, hold the test magnet against the marking on the nameplate (for at least 2 seconds). This inverts the current switching status and the yellow LED changes state. When the magnet is removed, the switching status valid at that time is adopted.



22 Test magnet and marking

The test magnet is not included in the delivery and can be ordered as an optional accessory. → 64

8 Diagnostics and troubleshooting

8.1 Diagnostic information via LED display

LED display on housing cover

Malfunction	Possible cause	Corrective action
Green LED Unlit	No power supply	Check connector, cable and power supply
Red LED flashing	Overload or short-circuit in load circuit	▪ Rectify short-circuit ▪ Reduce maximum load current to below 250 mA
Red LED Lit	Internal sensor failure or sensor corroded	Replace device

Connection: 2-wire AC/DC to 20 to 253 V DC

Malfunction	Possible cause	Corrective action
Unexpected behavior of yellow LED	Incorrect connector assignment or incorrect cable wiring	Pay attention to the polarity of the power supply! **Correct connection:** Valve plug: L+ to PIN1, L- to PIN 3 Cable: L+ BK (black), L- BN (brown) **Result** ▪ Tuning fork covered: yellow LED lit. ▪ Tuning fork not covered: yellow LED **not** lit.

9 Maintenance

No special maintenance work is required.

9.1 Cleaning

The sensor must be cleaned if necessary. It can also be cleaned while installed (e.g. CIP Cleaning in Place / SIP Sterilization in Place). Care must be taken to ensure that no damage occurs to the sensor in the process.

10 Repair

Repair is not envisaged for the point level switch.

10.1 Spare parts

The web site for the W@M Device Viewer (www.endress.com/deviceviewer): All spare parts for the measuring device are listed here together with the order code and can be ordered here. If available, users can also download the associated Installation Instructions.

10.2 Return

The measuring device must be returned if repairs or a factory calibration are required, or if the wrong measuring device has been ordered or delivered. According to legal regulations, Endress+Hauser, as an ISO-certified company, is required to follow certain procedures when handling returned products that are in contact with medium.

To ensure swift, safe and professional device returns, please read the return procedures and conditions on the Endress+Hauser website at www.services.endress.com/return-material

10.3 Disposal

When disposing, separate and recycle the device components based on the materials.

11 Accessories

Detailed information on accessories can be found in the technical documentation TI01147F.

Designation	Additional information
Weld-in adapter	Detailed information on the weld-in adapters can be found in TI00426F/00/EN and in the supplementary documentation → 39.
Seals, o-rings	
Plug-in jack M12 with cable 5 m (16 ft)	IP67, coupling nut (Cu Sn/Ni) ▪ Straight, order number: 52006263 ▪ Elbowed 90°, order number: 52010285
Socket wrench for mounting	Hexagon bolt, AF32, order number: 52010156
Test magnet	Order number: 71267011

12 Technical data

Further information on the technical data is provided in Technical Documentation TI01147F/00/EN.

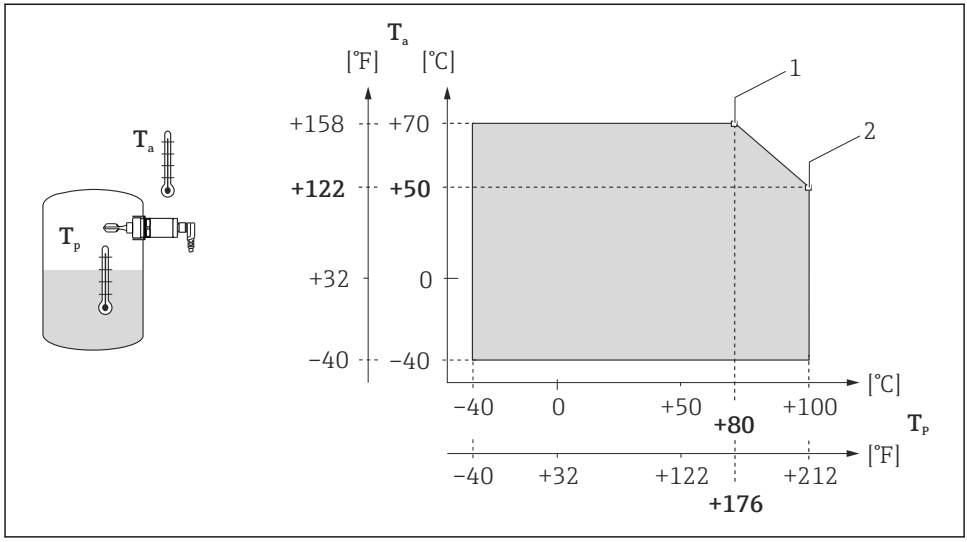
12.1 Power supply

Electronic version	Supply voltage	Power consumption	Current consumption
3-wire DC-PNP	10 to 30 V DC	< 975 mW	< 15 mA
2-wire AC/DC	20 to 253 V	< 850 mW	< 3.8 mA

12.2 Environment

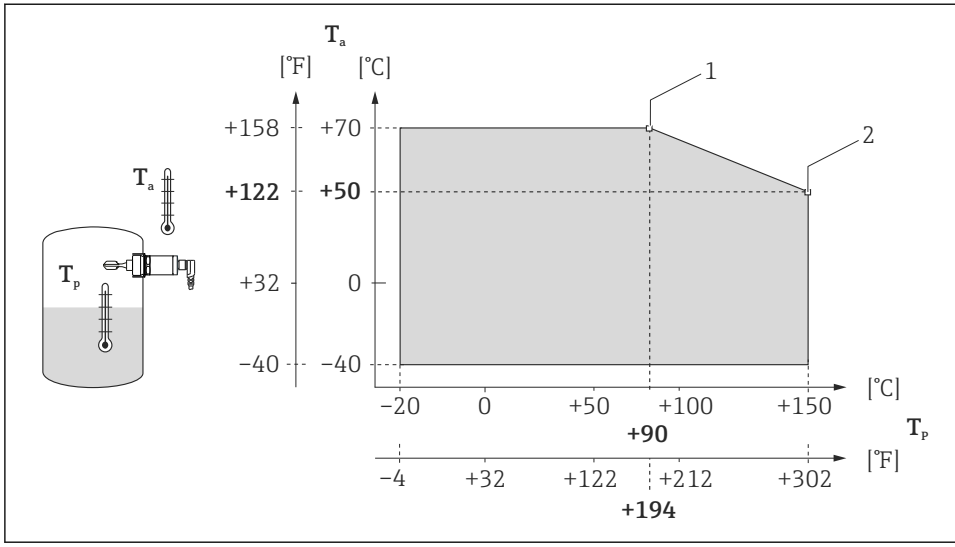
Ambient temperature range	−40 to +70 °C (−40 to +158 °F), see derating → 66
Storage temperature	−40 to +85 °C (−40 to +185 °F)
Climate class	DIN EN 60068-2-38/IEC 68-2-38: test Z/AD
Altitude	Up to 2 000 m (6 600 ft) above sea level
Shock resistance	a = 300 m/s² = 30 g, 3 planes x 2 directions x 3 shocks x 18 ms, as per test Ea, prEN 60068-2-27:2007
Vibration resistance	a(RMS) = 50 m/s², ASD = 1.25 (m/s²)²/Hz, f = 5 to 2000 Hz, t = 3 x 2 h, as per test Fh, EN 60068-2-64:2008
Reverse polarity protection	**2-wire AC/DC** ▪ AC mode: the device has reverse polarity protection. ▪ DC mode: in the event of reverse polarity the maximum safety mode is always detected. Check the wiring and perform a function check before commissioning. The device is not damaged in the event of reverse polarity. **3-wire DC-PNP** Integrated. In the event of reverse polarity, the device is deactivated automatically.
Short-circuit protection	**2-wire AC/DC** During switching the sensor checks whether a load, e.g. relay or contactor, is present (load check). If an error occurs, the sensor is not damaged. Smart monitoring: normal operation is resumed once the error is fixed. **3-wire DC-PNP** Overload protection/short-circuit protection at I > 250 mA; the sensor is not destroyed. Smart monitoring: check for overload in intervals of approx. 1.5 s; normal operation is resumed once the overload/short-circuit is fixed.
Degree of protection	▪ IP65/67 NEMA Type 4X Enclosure (M12 connector) ▪ IP65 NEMA Type 4X Enclosure (valve plug) ▪ IP66/68 NEMA Type 4X/6P Enclosure (cable)
Electromagnetic compatibility	Electromagnetic compatibility in accordance with all relevant requirements of the EN 61326 series and NAMUR recommendation EMC (NE21). For details, refer to the EC Declaration of Conformity. Available in the Download Area of the Endress+Hauser website: www.endress.com.

12.2.1 Derating



23 Derating curve: 100 °C (212 °F)

1 I_{max}: 200 mA (DC-PNP), 250 mA (AC/DC)
2 I_{max}: 150 mA (DC-PNP), 150 mA (AC/DC)
Ta Ambient temperature
Tp Process temperature



24 *Derating curve: 150 °C (302 °F)*

1 *I_{max}: 200 mA (DC-PNP), 250 mA (AC/DC)*
2 *I_{max}: 150 mA (DC-PNP), 150 mA (AC/DC)*
Ta *Ambient temperature*
Tp *Process temperature*

12.3 Process

NOTICE

▶ Pay attention to the pressure and temperature derating depending on the selected process connection .

Process temperature range	−40 to +100 °C (−40 to +212 °F) −40 to +150 °C (−40 to +302 °F)
Process pressure range	Max. −1 to +40 bar (−14.5 to +580 psi)
Density	> 0.7 g/cm³ (optionally available: > 0.5 g/cm³)
State of aggregation	Liquid
Viscosity	1 to 10,000 mPa · s dynamic viscosity
Solids contents	ø < 5 mm (0.2 in)
Lateral loading capacity	Lateral loading capacity of the tuning fork: max. 200 N

www.addresses.endress.com

Endress+Hauser

People for Process Automation

REV	DESCRIPTION	DATE	BY	APP'D
0	FOR REFERENCE ONLY	10/20/20	JC	LB

NOTE

EACH GROUNDING CABLE WIRE IS CONNECTED DIRECTLY TO THE GROUNDING BAR

SHIELD OF EACH CABLE IS SEPARATED FOR GROUNDING

H2FLOW EQUIPMENT INC.

WATER AND WASTEWATER TREATMENT EQUIPMENT
580 OSTER LANE, VAUGHAN, ON. L4K 2C1 CANADA
TEL: (905) 660-9775 FAX: (905) 660-9744
www.h2flow.com

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DRAWN BY: JC	DATE: 10/20/20	PROJECT NAME: H2FLOW PNEUMATIC PANEL TERMINAL STRIP	TITLE: TERMINAL STRIP WIRING
APP'D BY: LB	DATE: 10/20/20		DRAWING No.: 20201020-00-00
SCALE: NTS			REV: 0
		ALL DIMENSION ARE IN INCHES UNLESS OTHERWISE SPECIFIED	SHEET 1 OF 1

Section 3.4.2.5

Sludge Level Switch

Conductive Sensors
2 to 4-point level controller
Type CL with potentiometer

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- Conductive level controller
- Adjustment of sensitivity – operating resistance from 250Ω to 500KΩ
- Multiple combinations of filling and emptying applications
- Low-voltage AC electrodes
- Easy installation on DIN rails or with 11 pin circular plug
- Rated operational voltage: 24 VAC/DC, 115 VAC or 230 VAC
- Output 2x8A/250 VAC SPDT relay
- LED indication for: Output ON and Power ON

Product Description

µ-Processor based level controller for liquids with a wide sensitivity range (like sewage water, chemicals, salt water etc.). The controller has a separate output for alarm indication in case of a tank running dry or if an overflow condition occurs.
8A SPDT/SPST relay output, NO/NC.
Sensitivity control by potentiometer level in 3 ranges.

Ordering Key

CLD4MA2DM24

- Type
- DIN rail mounting
- Inputs
- Function
- Adjustment
- Outputs
- Relay versions
- Power supply

Type Selection

Mounting	Relay	Ordering no. Supply: 24 VAC/DC	Ordering no. Supply: 115 VAC	Ordering no. Supply: 230 VAC
DIN-rail	SPDT + SPST	**CLD4MA2DM24**	CLD4MA2D115	CLD4MA2D230
11-p circular plug	2 SPST	CLP4MA2AM24	CLP4MA2A115	CLP4MA2A230

Specifications

Rated operational voltage (U_B)		
Pin 2 & 10	230	195 to 265 VAC, 45 to 65 Hz
	115	98 to 132 VAC, 45 to 65 Hz
Supply class 2	24	19.2 to 28.8 VAC/DC
Rated insulation voltage		<2.0 kVAC (rms)
Rated impulse withstand voltage		4 kV (1.2/50 µs) (line/neutral)
Rated operational power		
AC supply		5 VA
AC/DC supply		5 VA / 5 W
Delay on operate (t_v)		< 300 mS
Outputs		Make or break on rotary-switch
Rated insulation voltage		250 VAC (rms) (cont./elec.)
Relay Rating (AgCdO)		µ (micro gap)
Resistive loads	AC1	8 A / 250 VAC (2500 VA)
	DC1	1 A / 250 VDC (250 W) or 10 A / 25 VDC (250 W)
Small induc. Loads	AC15	0,4 A / 250 VAC
	DC13	0,4 A / 30 VDC
Mechanical life (typical)		≥ 30 x 10^6 operations @ 18'000 imp/h
Electrical life (typical)	AC1	> 250'000 operations
Level probe supply		Max. 5 VAC
Level probe current		Max. 2 mA
Sensitivity		250Ω to 500KΩ Factory settings standard range "S" 100KΩ
Ranges L (Low sensitivity)		250 Ω to 5 KΩ, C_F* = 4.7 nF
Ranges S (Standard sensitivity)		5 KΩ to 100 KΩ, C_F* = 2.2 nF
Ranges H (High sensitivity)		50 KΩ to 500 KΩ, C_F* = 1.0 nF

Dielectric voltage		>2.0 KVAC (rms) (contacts / electronics)
Rated impulse withstand volt.		4 kV (1.2/50 µS) (contacts / electronics) (IEC 664)
Operating frequency (f)		
Relay output		0.5 HZ
Response time		
OFF-ON (t_{on})		1 s
ON-OFF (t_{off})		1 s
Environment		
Overvoltage category		III (IEC 60664)
Degree of protection		IP 20 (IEC 60529, 60947-1)
Pollution degree		2 (IEC 60664/60664A, 60947-1)
Temperature		
Operating		-20° to +50°C (-4° to + 122°F)
Storage		-50° to +85°C (-58° to +185°F)
Housing material	CLP	NORYL PPO, light grey
	CLD	ABS VO, light grey
Screw type		M3
Tightening tourque min/max		0.4Nm/0.8Nm
Weight		
AC supply		200 g
AC/DC supply		125 g
UL Approvals	cURus	UL508, UL325, CSA-C22.2 No.247
CE marking		Yes

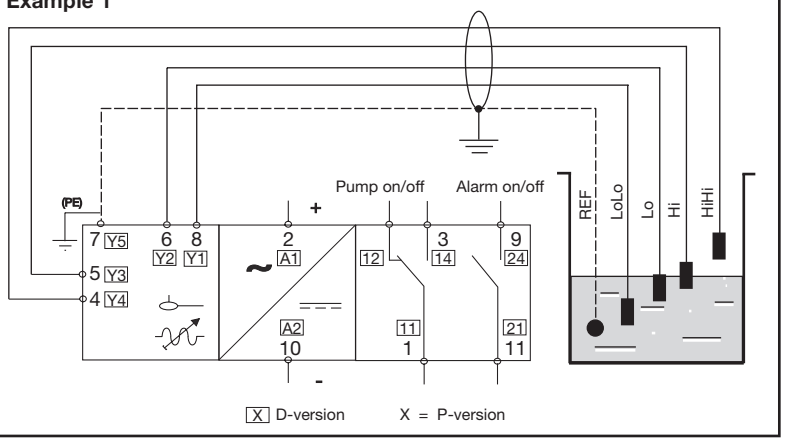
*C_F = maximum Cable Capacitance

Mode of Operation

Connection cable
2, 3, 4 or 5 conductor PVC cable, normally screened. Cable length: max. 100 m. The resistance between the cores and the ground must be at least 500k. Normally, it is recommended to use a screened cable between probe and controller, e.g. where the cable is placed in parallel to the load cables (mains). The screen has to be connected to Y5 (reference).

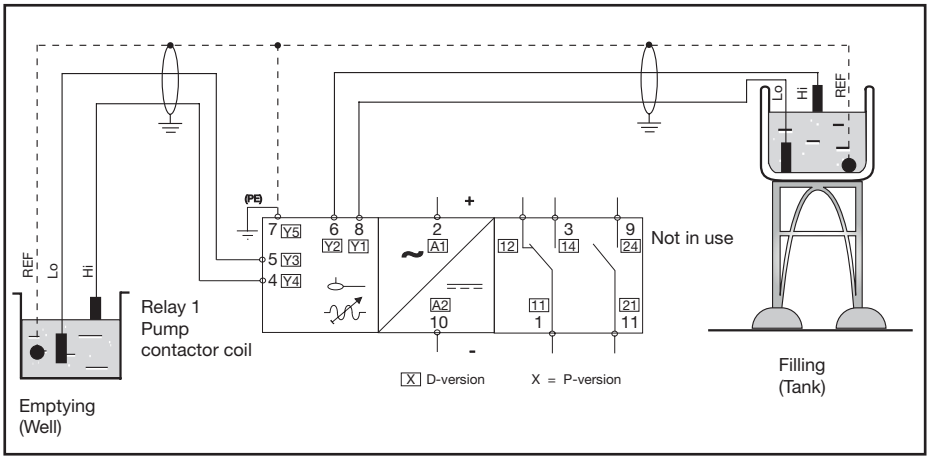
Example 1
The diagram shows the level control connected as max. and min. control, i.e. registration of 2 levels + 2 alarm levels. The relays react to the low alternating current created when the electrodes are in contact with the liquid.
The reference (Ref) must be connected to the container or if the container consists of a non-conductive material, to an additional electrode. (To be connected to pin Y5).
In the diagram this electrode is shown by the dotted line.)
The alarm outputs utilize electrodes on Y4 for HiHi alarm - and Y1 for LoLo alarm outputs.

Example 1

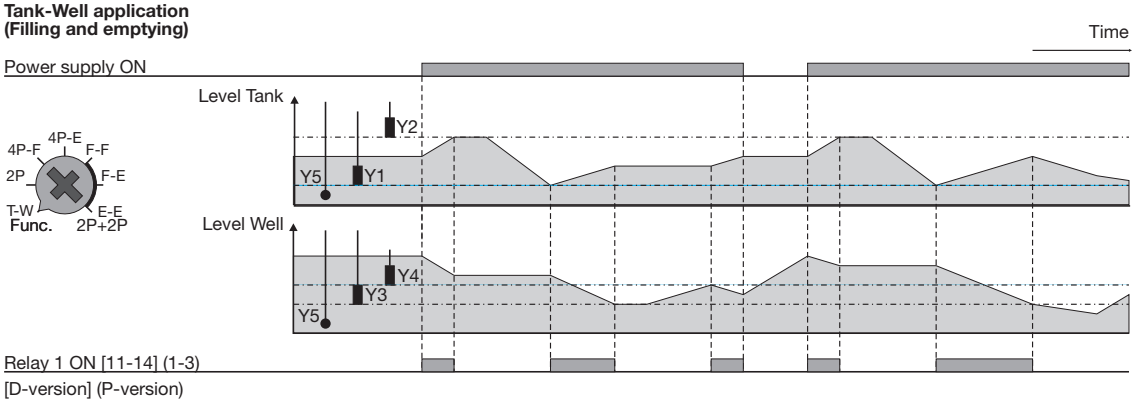


Operation Diagram

Function: Filling or Emptying
The Multifunction Controller can be used as a minimum-maximum control for two systems, a filling system and a emptying system, with the same kind of liquid to be measured and one common pump.



Tank-Well application (Filling and emptying)

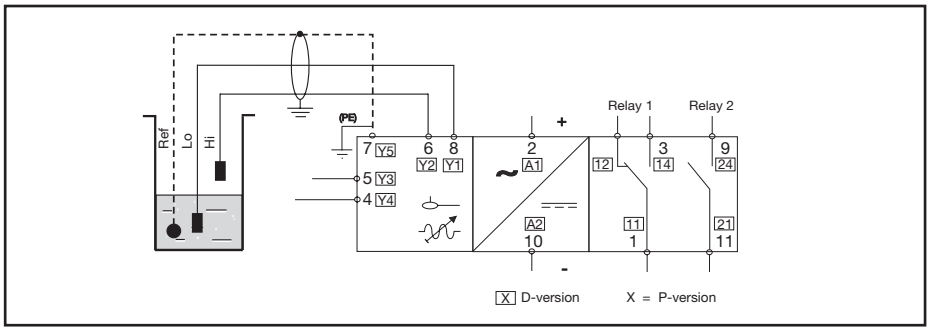


Specifications are subject to change without notice (14.12.2015)

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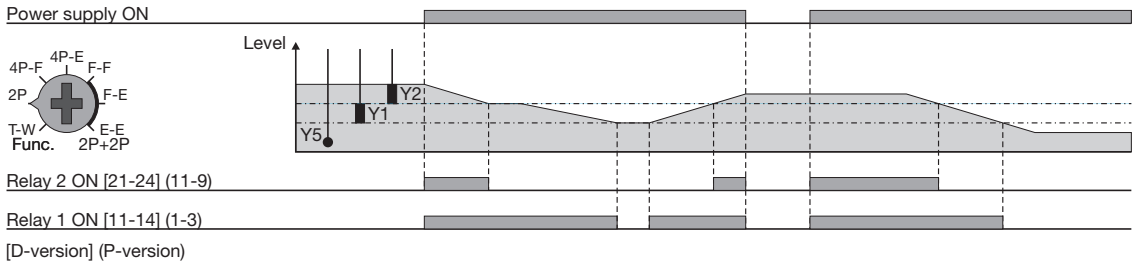
Operation Diagram

Function: Direct input- output
The Multifunction Controller can be used as direct input/ output, where each of the two inputs (electrodes) controls an individual relay output:
Electrode no. 1 = Relay no. 1
Electrode no. 2 = Relay no. 2.

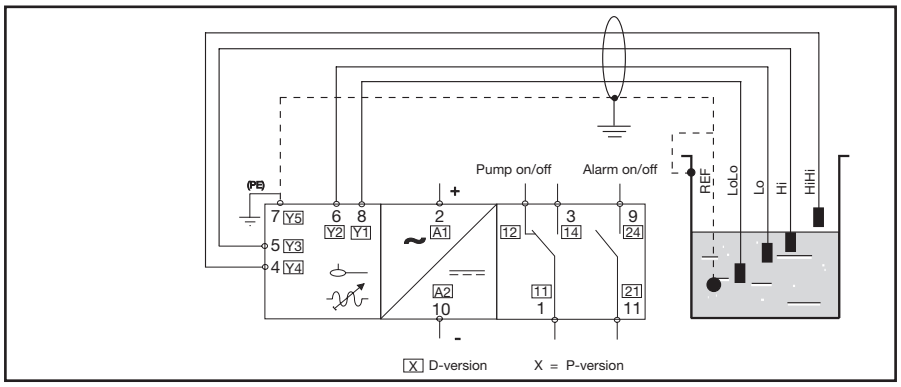


2-Probe
(Direct Input to output)

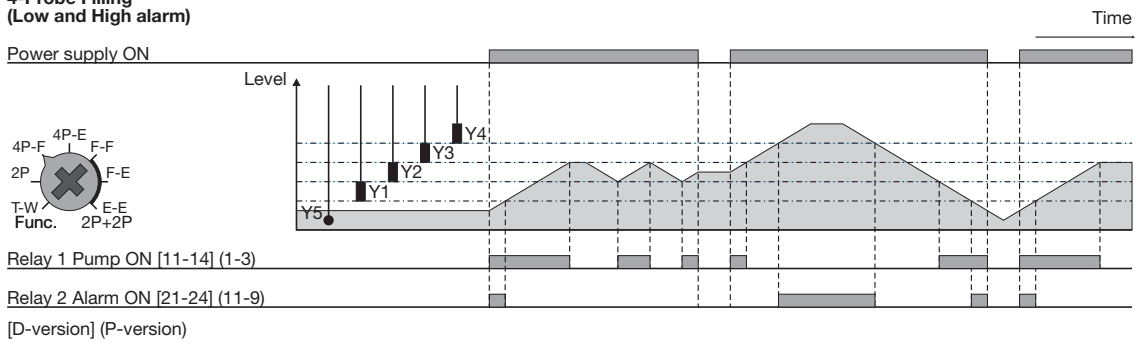
Time independent



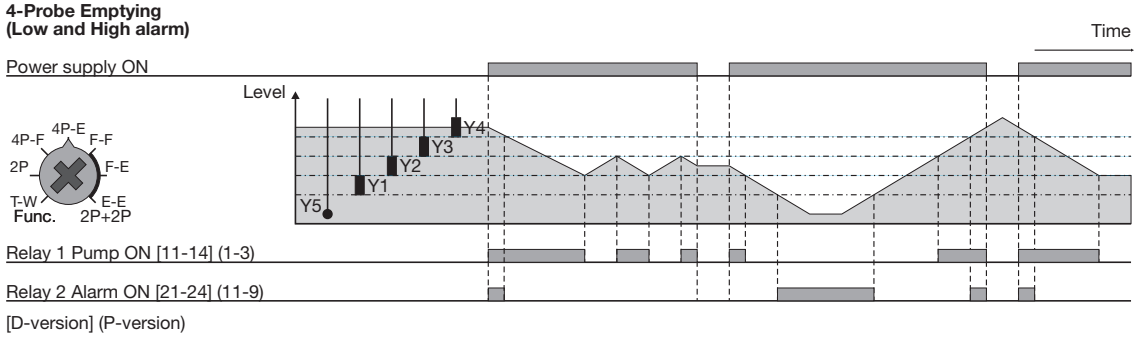
Function: Filling or Emptying with high and low alarms
The Multifunction Controller can be used as a minimum-maximum control filling or emptying system, with HiHi and LoLo Alarm output.



4-Probe Filling
(Low and High alarm)

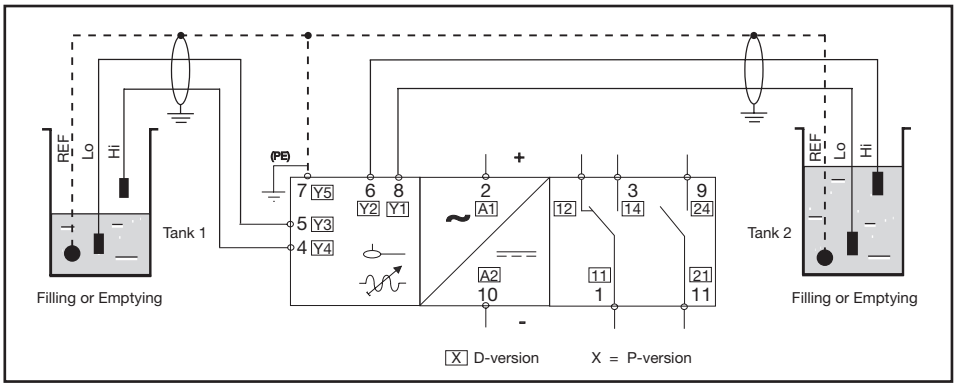


4-Probe Emptying
(Low and High alarm)

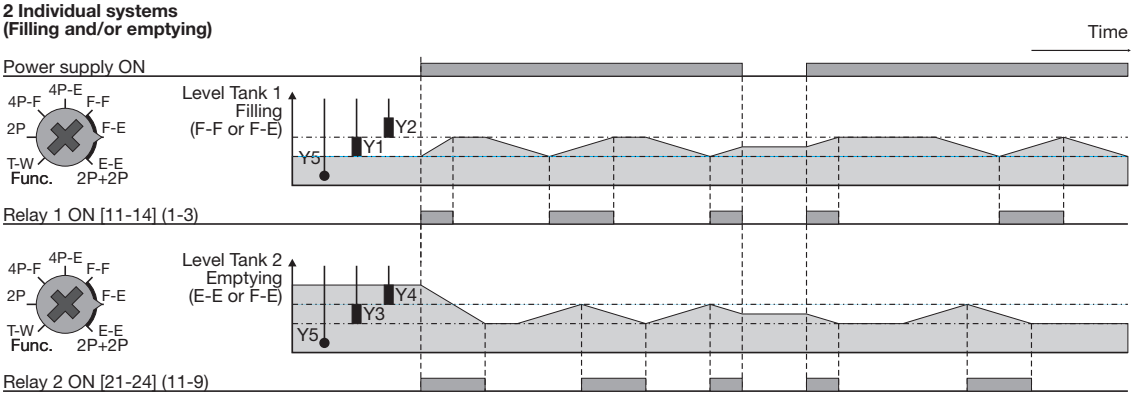


Operation Diagram

Function: Filling or Emptying
The Multifunction Controller can be used as a minimum-maximum control for up to two individual systems, with the same kind of liquid to be measured.



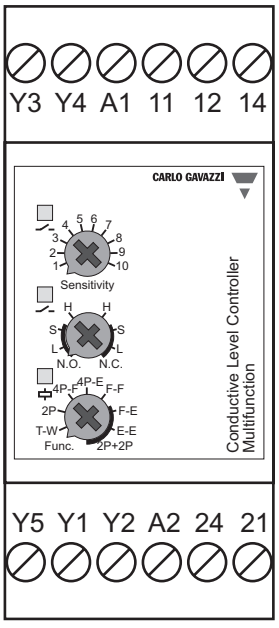
2 Individual systems (Filling and/or emptying)



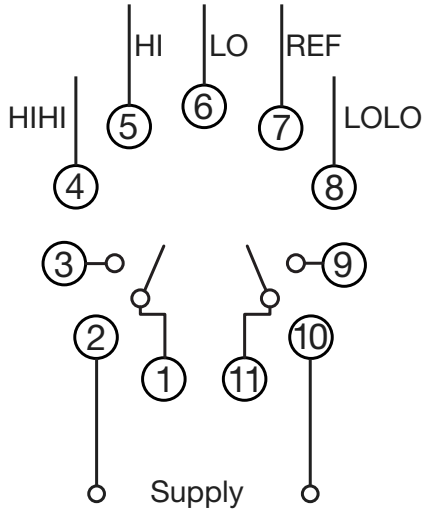
[D-version] (P-version)

Wiring Diagram

Din-rail version



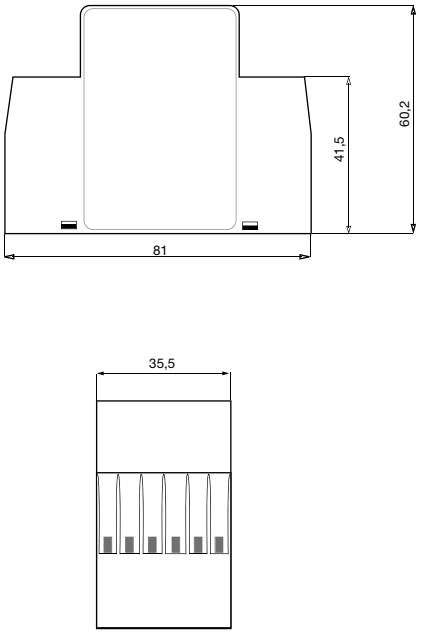
Plug version



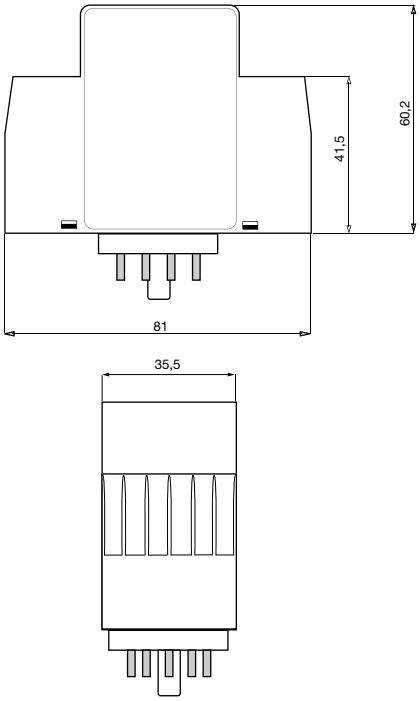
Bottom view

Dimension Drawings

Din-rail version



Plug version



Accessories

• 11 pole circular socket	ZPD11
• Retaining spring	HF

Delivery Contents

- Amplifier
- Packaging: Carton box
- Manual

Conductive Sensors
Level Probes
Types CLH



- **Flexible conductive level probe**
- **1 to 5 electrodes**
- **User defined electrode length**
- **Isolated or unisolated electrodes**
- **1 1/2” pipe thread according to ISO 228/1-G1$^1/_2$A**

CE

Product Description

A compact and flexible level probe for measuring the level of conductive liquids, i.e overfill, dry run protection or pump control.
A total measurements system consist of a multiple probe-head, 1-5 electrodes and a control unit.
The electrode length can be freely defined be means of electrode extention units - with or without isolation.

Ordering Key

CLH 5

Type
Head mounting
Number of electrodes

Type Selection - Probe

Pipe thread	Housing Material	Ordering no. for 3 electrodes	Ordering no. for 5 electrodes
1 1/2”	PP	**CLH3**	**CLH5**

Type Selection - Electrode

Type	Ordering no. 1000 mm Basic Thread in one end	Ordering no. 2000 mm Extended	Ordering no. Extension 1000 mm Thread in both ends
Electrode without isolation	**CLE1**	**CLE2**	**CLE1X**
Electrode with isolation, Kynar (PVDF)	**CLE1K**	**CLE2K**	**CLE1KX**
Electrode with isolation, Polyolefine (FR)	**CLE1P**	**CLE2P**	**CLE1PX**
Description	1000 mm Basic electrode for no further extension	1000 mm Basic electrode for extension 1000 mm extension electrode 1 extension joint 1 isolation tube (not CLE2)	1000 mm extension electrode 1 extension joint 1 isolation tube (not CLE1X)

Specifications

Probe Head		
Material		PP (Polypropylen)
No of electrodes	CLH3	3
	CLH5	5
Electrode connection		M4
Tightening torque		2.7 Nm by hand -K & -P
Cable connection		Screw terminals
Electrodes		
Material		Stainless steel AISI316/DIN1.4401
Length	CLE1	1000 mm
	CLE2	2000 mm
Diameter		Ø 4 mm
Isolation	CLE.K.	Kynar (PVDF)
	CLE.P.	Polyolefine (FR)
Environment		
Overvoltage category		III (IEC 60664)
Degree of protection		
Housing		IP 65
Electrode connections		IP 68
Pollution degree		2(IEC 60664/60664A, 60947-1)
Operating temperature		-20° to +90°C (-4° to +194°F)
Storage temperature		-40° to +100°C (-40° to +212°F)
Pressure		5 bar at 60°C

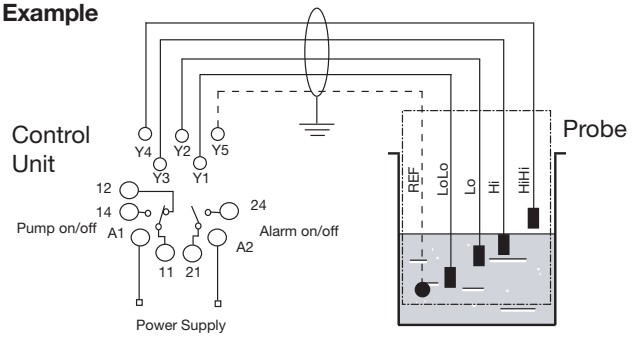
Specifications (cont.)

Weight	
Probe Head	260 g
Electrodes	107 g
CE marking	IEC 529

Mode of Operation

Functionality - example
The diagram shows the level control system connected as max. and min control, i.e. registration of 2 levels + 2 alarm levels. The relays react to the low alternating current created when the electrodes is in contact with the liquid.
The reference (Ref) must be connected to the container or if the container are made of a nonconductive material, to an additional electrode. In the diagram this electrode is shown by the dotted line.

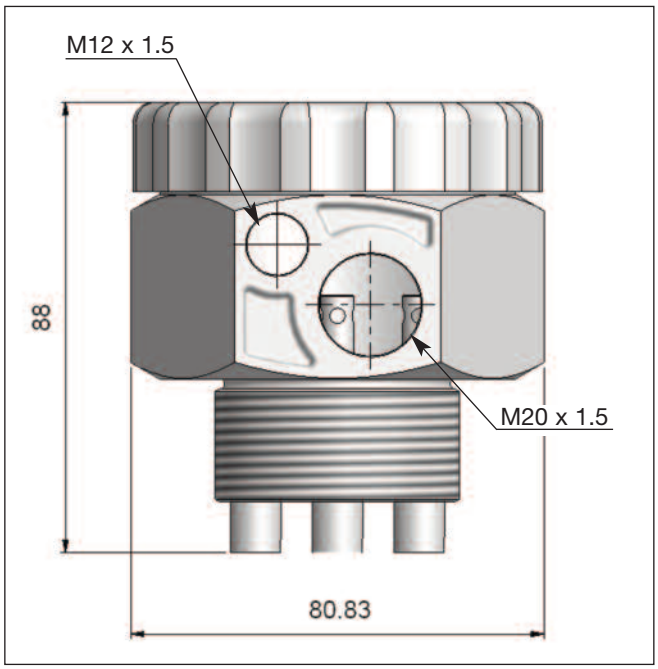
Example



Electrodes
Cut or extend the electrodes to the desirable length. If using extended electrodes, place the enclosed isolation tube over the extension joint, and heat it with a heat gun. Mount the electrodes in the probehead by means of the M4 screw inserts. Take care not to damage the isolation material of the isolated electrodes.

Connection cable
2, 3, 4 or 5 conductor PVC cable, normally screened. Cable length: max. 100 m. The resistance between the cores and the ground must be at last 200k. In normal cases it is recommended to use screened cable between probe and controller, e.g. where the cable is placed in parallel to the load cables (mains). The screen has to be connected to Y5 (reference).

Dimensions



Accessories

Extension joint Ø4	VD
60 mm Kynar for isolation	VDK
60 mm Polyolefine for isolation	VDP
M12 Cable Gland	M12 Cable Gland
M20 Cable Gland	M20 Cable Gland

Delivery Contents

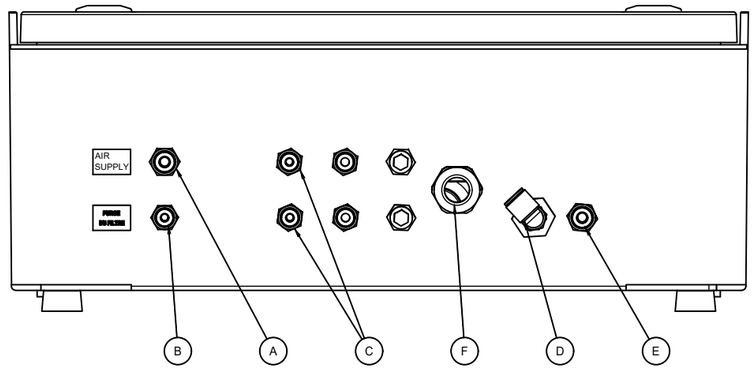
Probe Head
M20 Cable Gland
M12 Blind flange
Installation Instruction

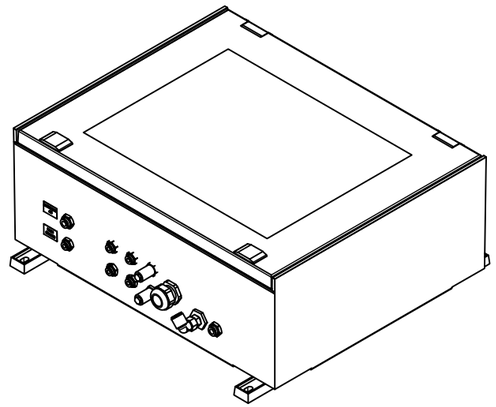
Specifications are subject to change without notice (08.04.2011)

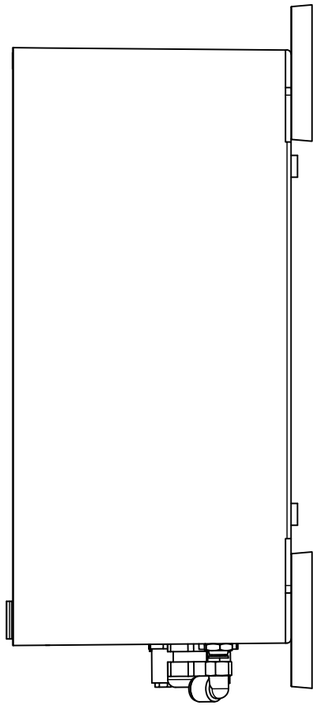
Section 3.4.2.6

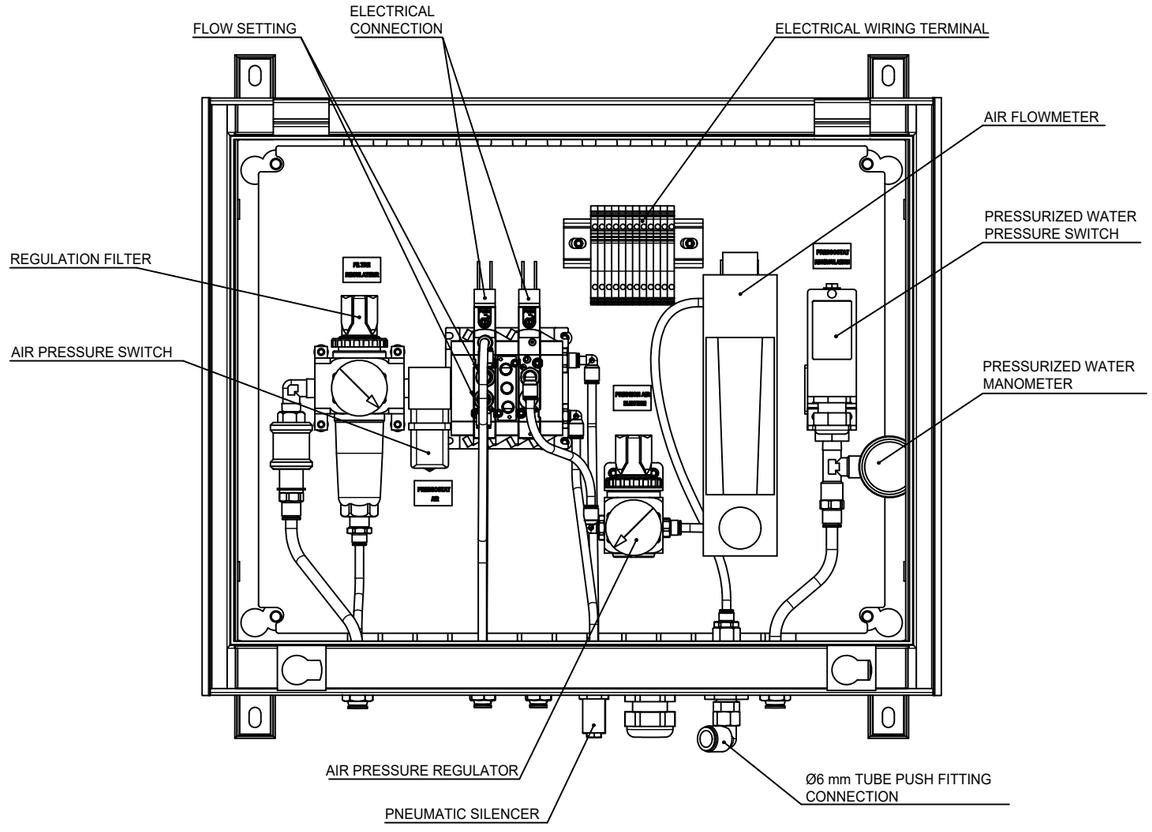
Pneumatic Panel

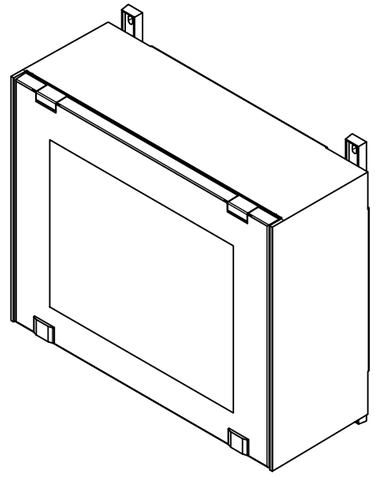
REV	DESCRIPTION	DATE	BY	APP'D
0	FOR REFERENCE ONLY	10/30/19	JG	JC











Item	Description	Tube Connection	Comment
A	COMPRESSED AIR INLET	Ø8 mm or Ø5/16"	Connect to compressed air supply
B	DRAIN FILTER	Ø6 mm	Customer connection
C	SEDIMENT VALVE OPEN/CLOSE	2 x Ø6 mm	Connect to sediment valve of DAF
D	WHITE WATER AIR OUTLET	Ø6 mm	Connect to recirculation line of DAF
E	PRESSURIZED WATER PRESSURE SWITCH	Ø8 mm or Ø5/16"	Connect to recirculation line of DAF
F	ELECTRICAL CONNECTION		Customer connection to control panel

H2FLOW EQUIPMENT INC.

WATER AND WASTEWATER TREATMENT EQUIPMENT
580 OSTER LANE, VAUGHAN, ON. L4K 2C1 CANADA
TEL: (905) 660-9775 FAX: (905) 660-9744
www.h2flow.com

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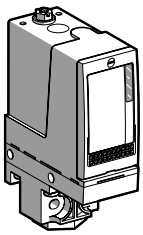
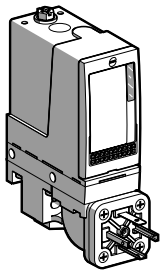
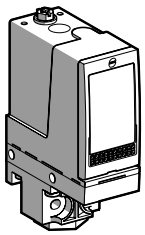
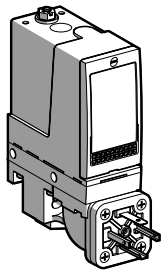
DRAWN BY: JG	DATE: 10/30/19	PROJECT NAME: H2FLOW TYPICAL PNEUMATIC PANEL	TITLE: PNEUMATIC PANEL - TURBINE STYLE PUMP
APP'D BY: JC	DATE: 10/30/19		DRAWING No.: Q-XXXXX-10-01
SCALE: NTS			REV: 0
		ALL DIMENSION ARE IN "mm" UNLESS OTHERWISE SPECIFIED	SHEET 1 OF 1

Electromechanical pressure switches - Nautilus®

Size 10 bar (145 psi). For detection of a single threshold (fixed differential)
Fluid connection 1/4" BSP female
Switches with single-pole C/O contact

Accessories :
page 30364/2
Dimensions :
pages 30364/3 to 30364/5

References, characteristics

Pressure switches type XML-A	With setting scale		Without setting scale	
				
Adjustable range of switching point (PH) (Rising pressure)	**0.6…10 bar (8.7…145 psi)**			
Electrical connections	Terminals	DIN connector	Terminals	DIN connector

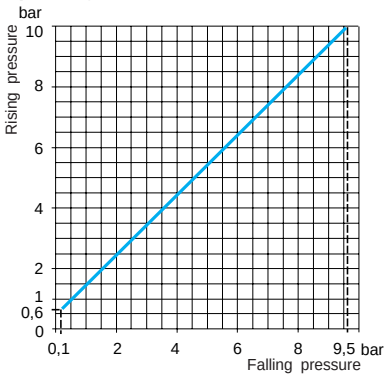
References (▲ Available 2nd half 1997)

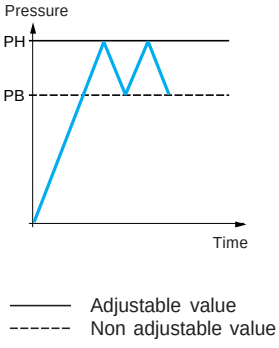
Fluids controlled (1)				
Hydraulic oils, fresh water, sea water, air, up to + 70°C	**XML-A010A2S11**	**XML-A010A2C11**	**XML-A010A1S11**	**XML-A010A1C11**
Hydraulic oils, fresh water, sea water, air, up to + 160°C	**XML-A010B2S11**	**XML-A010B2C11**	**XML-A010B1S11**	**XML-A010B1C11**
Corrosive fluids, up to + 160°C	**XML-A010C2S11**	**XML-A010C2C11**	**XML-A010C1S11**	**XML-A010C1C11**
Viscous products, up to + 70°C	**XML-A010P2S11 ▲**	**XML-A010P2C11 ▲**	**XML-A010P1S11 ▲**	**XML-A010P1C11 ▲**
Weight (kg)	0.685	0.715	0.685	0.715

Complementary characteristics not shown under general characteristics (page 30350/3)

Natural differential (subtract from PH to give PB)	At low setting (2)	0.5 bar (7.25 psi)
	At high setting (2)	0.5 bar (7.25 psi)
Maximum permissible pressure	Per cycle	12.5 bar (181.25 psi)
	Occasional surge	22.5 bar (326.25 psi)
Destruction pressure		45 bar (326.25 psi)
Mechanical life		5 x 10^6 operating cycles
Cable entry for terminal models		1 entry tapped for n°13 cable gland, conforming to NF C 68-300 (DIN Pg 13.5). Clamping capacity : Ø 9 to 13 mm.
Connector type for connector models		DIN 43650A, 4-pin male. For suitable female connector, see page 30364/2.
Pressure switch type		Diaphragm

Operating curves

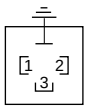




Connections
Terminal model



Connector model
Switch connector pin view



1 → 11 and 13
2 → 12
3 → 14

(1) Check the compatibility of the switch for the fluid to be controlled (compatibility tables shown on pages 30373/2 to 30373/11).
(2) Deviation of the differential at high and low setting points for switches of the same size : ± 0.05 bar (± 0.72 psi).

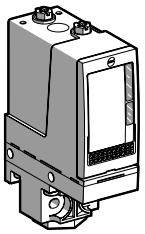
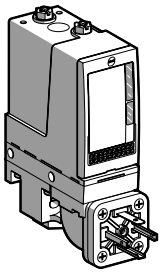
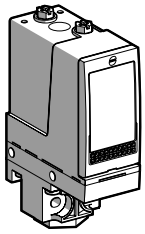
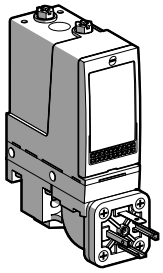
Other versions Pressure switches with alternative tapped entries : ISO, NPT, etc.
Please consult your Regional Sales Office.

Electromechanical pressure switches - Nautilus®

Size 10 bar (145 psi). For regulation between 2 thresholds (adjustable differential)
Fluid connection 1/4" BSP female
Switches with single-pole C/O contact

Accessories :
page 30364/2
Dimensions :
pages 30364/3 to 30364/5

References, characteristics

Pressure switches type XML-B	With setting scale		Without setting scale	
				
Adjustable range of switching point (PH) (Rising pressure)	**0.7...10 bar (10.15...145 psi)**			
Electrical connections	Terminals	DIN connector	Terminals	DIN connector

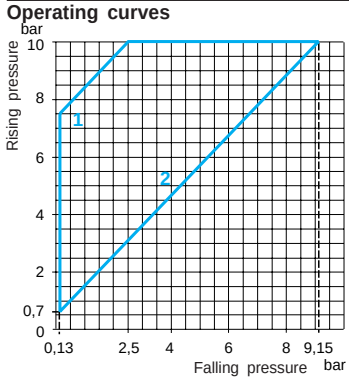
References (▲ Available 2nd half 1997)

Fluids controlled (1)				
Hydraulic oils, fresh water, sea water, air, up to + 70°C	**XML-B010A2S11**	**XML-B010A2C11**	**XML-B010A1S11**	**XML-B010A1C11**
Hydraulic oils, fresh water, sea water, air, up to + 160°C	**XML-B010B2S11**	**XML-B010B2C11**	**XML-B010B1S11**	**XML-B010B1C11**
Corrosive fluids, up to + 160°C	**XML-B010C2S11**	**XML-B010C2C11**	**XML-B010C1S11**	**XML-B010C1C11**
Viscous products, up to + 70°C	**XML-B010P2S11 ▲**	**XML-B010P2C11 ▲**	**XML-B010P1S11 ▲**	**XML-B010P1C11 ▲**
Weight (kg)	0.705	0.735	0.705	0.735

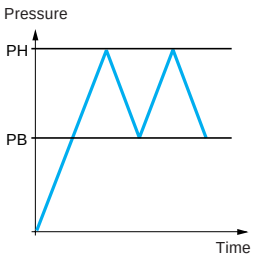
Complementary characteristics not shown under general characteristics (page 30350/3)

Possible differential (subtract from PH to give PB)	Min. at low setting (2)	0.57 bar (8.26 psi)
	Min. at high setting (3)	0.85 bar (12.32 psi)
	Max. at high setting	7.5 bar (108.75 psi)
Maximum permissible pressure	Per cycle	12.5 bar (181.25 psi)
	Occasional surge	22.5 bar (326.25 psi)
Destruction pressure		45 bar (652.5 psi)
Mechanical life		5 x 10^6 operating cycles
Cable entry for terminal models		1 entry tapped for n°13 cable gland, conforming to NF C 68-300 (DIN Pg 13.5). Clamping capacity : Ø 9 to 13 mm.
Connector type for connector models		DIN 43650A, 4-pin male. For suitable female connector, see page 30364/2.
Pressure switch type		Diaphragm

Operating curves



1 Maximum differential
2 Minimum differential

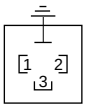


Adjustable value

Connections
Terminal model



Connector model
Switch connector pin view



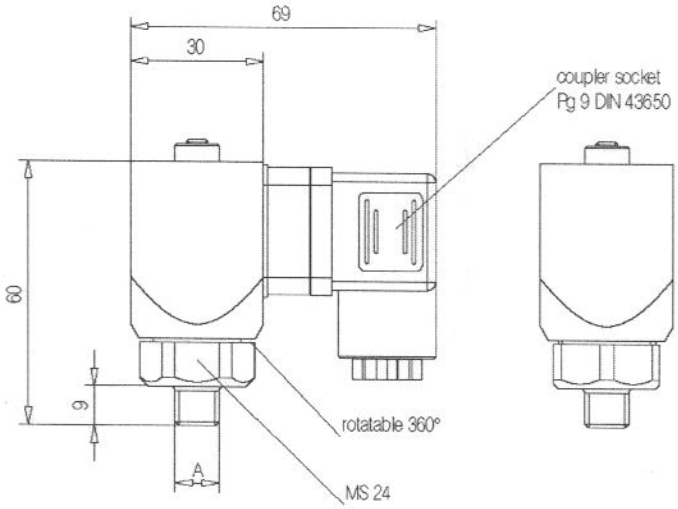
1 → 11 and 13
2 → 12
3 → 14

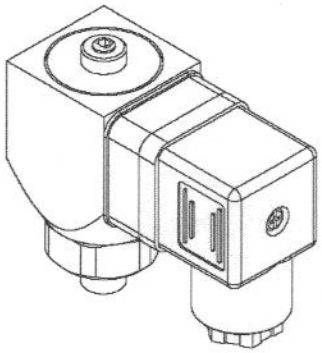
(1) Check the compatibility of the switch for the fluid to be controlled (compatibility tables shown on pages 30373/2 to 30373/11).
(2) Deviation of the differential at low setting point for switches of the same size : ± 0.05 bar (± 0.72 psi).
(3) Deviation of the differential at high setting point for switches of the same size : - 0.1 bar, + 0.15 bar (- 1.45 psi, + 2.17 psi).

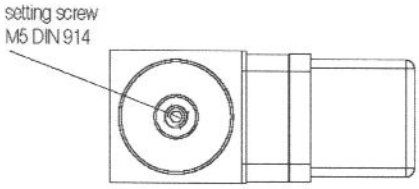
Other versions
Pressure switches with alternative tapped entries : ISO, NPT, etc.
Please consult your Regional Sales Office.

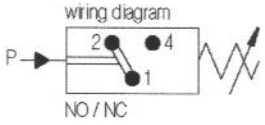
LAYHER Manometric Switch Typ 600

NO / NC









TECHNICAL DATES

order no.	600 002	600 010	600 070	600 200
pressure setting range	0,3 – 2 bar	1 – 10 bar	10 – 70 bar	50 – 200 bar
working pressure max.	2 bar	10 bar	70 bar	200 bar
bursting pressure	5 bar	20 bar	120 bar	300 bar
design	spring safety membranes			spring-loaded piston
diaphragm/seal	NBR, special design VITON, CR, EPDM, KALREZ			UR, special design NBR, VITON
manner of fastening	male thread			
fitting thread >A<	G 1/4", G 1/8", M12 x 1.5, M 10x1, M10 x 1 cone			
mounting position	any			
ambient temperature	–25°C bis + 85°C, higher temperatures on demand			
medium	air, hydraulic oil, oil emulsions, water, others on demand			
adjustability	under pressure			
switch back difference	15% – 25%			
mechanical life	10^6			
material	galvanized steel, special design brass or VA			
weight	230 gr			
switching element	microswitch - silver-plated contacts / special gold-plated contacts			
reference voltage	250 V			
reference frequency	not over 100 Hz			
switching frequency max.	200/min.			
electrical connection	by coupler socket PG9 DIN 43 650			
protective system	IP65, terminale IP00 DIN 40 050			

breaking capacity	A.C.		D.C.				
voltage up to	125 V	250 V	30 V	50 V	75 V	125 V	250 V
resistance load	5 A	5 A	5 A	2 A	1 A	0,5 A	0,25 A
incandescent lamp load	0,5 A	0,5 A	0,5 A	0,4 A	0,3 A	0,2 A	0,1 A
inductive load	5 A	5 A	5 A	2 A	1 A	0,06 A	0,03 A

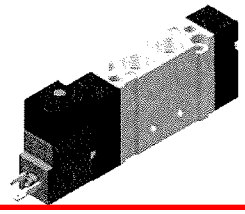
It is recommended not to use only the manometric switch to separate the device from the mains.
for inductively loaded DC circuits e. g. for magnets, spark extinguishers have to be provided.

Technical data subject to change without notice.

LAYHER GmbH, Kalkwerkstr. 23, 71737 Kirchberg, Germany, Tel.+49 7144 3204, Fax +49 7144 3 43 07, E-mail:info@layher-gmbh.de, www.layher-gmbh.de

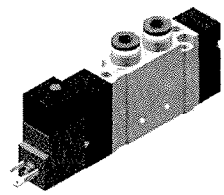
as of date 08.05

Modularität
Elektrisch betätigt mit Gewindeanschluss
Magnetventil als Einzelventil oder für die Montage auf Anschlussplatten.



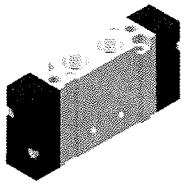
Range
Electrical version, threaded body
Solenoid valves for single or modular use.

Elektrisch betätigt mit Schnellsteckanschluss
Magnetventil als Einzelventil oder für die Montage auf Anschlussplatten.



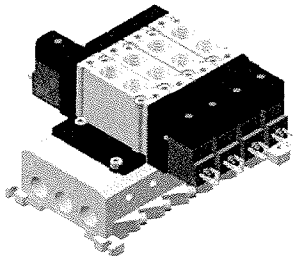
Electrical version with fittings
Solenoid valves for single or modular use with push-in fittings.

Pneumatisch betätigt
Magnetventil als Einzelventil oder für die Montage auf Anschlussplatten.



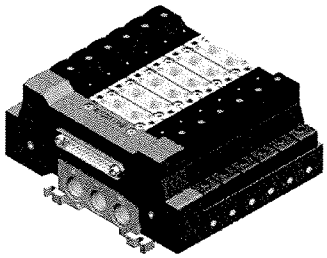
Pneumatic version
Pneumatic valves for single or modular use.

Flexibles Anschlussplattensystem
Ventilgrößen 15 mm und 18 mm sind in allen Ausführungen auf einer Anschlussplatte kombinierbar.



Multiple subplate
Modular assembly of any combination of 5/2 – 5/3, LPP770 – LPP772

Sub-D Ventilinseln
Schutzart IP65

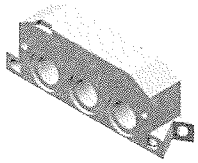


Sub-D Valve Islands
Protection class IP65

Flexibilität

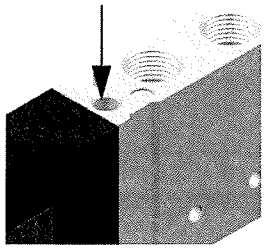
Flexibility

Verbindungsmodul
Mit dem Verbindungsmodul werden verschiedene Ventilgrößen 15 mm und 18 mm auf eine Anschlussplatte montiert.



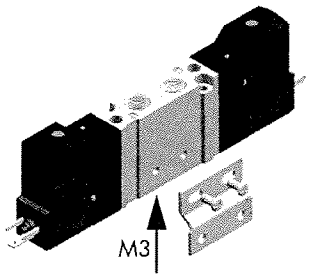
Matching interface
It is possible to assemble 15 mm and 18 mm valves together using the matching interface.

Externe Steuerluft
Die Baureihe der 15 mm und 18 mm Ventile ist mit externem Steuerluftanschluss erhältlich.
Siehe Bestellschlüssel Seite 1-257.



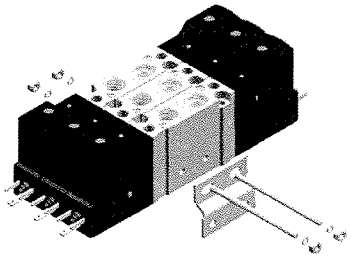
External pilot supply
External pilot supply available for both 15 mm and 18 mm versions.
See Order Code on page 1-257.

Befestigung 15 mm/18 mm
Befestigungswinkel



Fixing 15 mm/18 mm
Mounting Flange

Paketierung mit Zugstangen



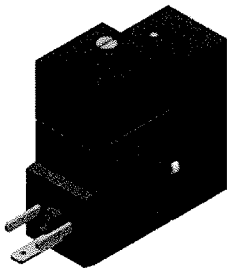
Tie Rod Packaging

Handhilfsbetätigung

Manual Override

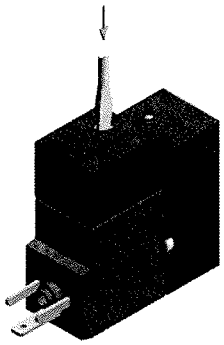
1. Taste nicht betätigt

1. Button not actuated



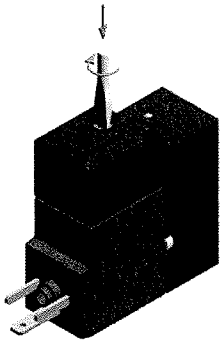
2. Betätigung durch Druck
(Taste wird mit einem Schraubendreher heruntergedrückt)

2. Push actuation
(pushing the button with a screwdriver)



3. Betätigung durch Einrasten
(Taste wird mit einem Schraubendreher heruntergedrückt und im Uhrzeigersinn gedreht)

3. Lock actuation
(pushing and turning the button clockwise with a screwdriver)



Elektrische Daten / Electrical Specifications

	LPP770	LPP772	
Nennspannung	12/24/48/110 VDC 12/24/48/110/230 VAC		Nominal voltage
Nennspannungstoleranz	± 10 %		Nam. voltage tolerance
Spulennennleistung DC AC	 1,1 W 2 VA		Nominal coil power DC AC
Einschaltdauer	100 %		Duty cycle
Isolationsklasse	Klasse F class F		Insulation class
Schutzart	IP 65 mit Steckanschluss IP 65 with plug in socket		Protection
Optische Anzeige	nein no		Coil status led

Allgemeine Daten / General Specifications

	LPP770	LPP772	
Druckbereich 5/2-Wege 5/3-, 2 x 3/2-Wege	 2 – 8 bar 3 – 8 bar		Pressure range 5/2-way 5/3-, 2 x 3/2-way
Nennweite	6 mm	8 mm	Nominal orifice
Umgebungstemperatur	-5 – 50 °C		Ambient temperature
Mediumtemperatur	0 – 50 °C		Operating medium temperature
Dichtelement	weichgedichteter Steuerschieber soft spool		Sealing element
Einbaulage	beliebig any position		Mounting
Druckmittelanschluss Eingang 1/Ausgang 2/4 Entlüftung 3/5 Druckmittelanschluss Platte Eingang 1/Entlüftung 3/5 Ausgang 2/4	 G1/8 G1/8 G1/4 –	 G1/4 G1/8 G1/4 –	Port dimensions input 1/output 2/4 exhaust 3/5 Port dimensions plate input 1/exhaust 3/5 output 2/4
Elektrische Anschlussart	Stecker Plug		Electrical connections
Handbetätigung	Rastend und tastend Push and lock	Rastend Push	Manual override
Durchfluss Q 5/2-Wege 5/3-Wege	 800 Nl/min 600 Nl/min	 1200 Nl/min 700 Nl/min	Flowrate Q 5/2-way 5/3-way
Medium	Druckluft, gefiltert 5 µm, geölt oder nicht geölt compressed air, 5 micron filtered, lubricated or non-lubricated		Operating medium

Zulassungen

LPP Typ	CE	e24	LPP type
LPP770 modulares System Sub-D	EU Richtlinie 89/336/EC EMV EU directive 89/336/EC EMC	EU Richtlinie 95/54/EC Kraftfahrzeuge EU directive 95/54/EC vehicles	LPP770 modular system Sub-D

Bestellschlüssel für **Einzelventile**

Order code for **single valves**

Bestellformel	xx.x	x	x.	xx.	xx	**Order specifications**
Typ-Nr.						Series no.
15 mm Ventil	77.0					15 mm valve
18 mm Ventil	77.2					18 mm valve
Betätigung						Actuation
elektrisch		1				solenoid
pneumatisch		2				pneumatic
elektrisch, externe Steuerung		3				solenoid, external feeding
Ausführung						Version
Standard			2			standard
mit 2 Steckarmaturen			4			with 2 push-in fittings
Pneumatische Anschlüsse						Pneumatic connection
5/2 monostobil, pneum. Rückstellung				90		5/2 monostable, pneumatic return
5/2 monostabil, Federrückstellung				91		5/2 monostable, spring retur
5/2 bistabil				92		5/2 bistable
5/2 bistabil mit Vorrangstellung				93		5/2 bistable with priority
5/3, Mittelstellung geschlossen				12		5/3, all ports closed
5/3, Mittelstellung entlüftet				22		5/3, all ports exhaust
5/3, Mittelstellung Druck on 2, 4				32		5/3, 1 -> 4/2 open
2 x 3/2 normal geschlossen				14		2 x 3/2 normally closed
2 x 3/2 normal offen				24		2 x 3/2 normally open
2 x 3/2 offen / geschlossen				34		2 x 3/2 open / closed
Spannung						Voltage
ohne Spulen					00	without coils

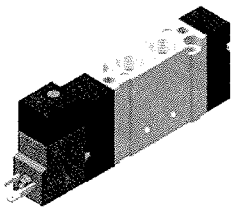
Diese Bestell-Nummer bezieht sich auf das Ventil ohne Spule. Bitte bestellen Sie die entsprechende Spule separat.

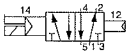
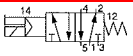
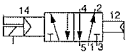
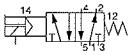
This order number refers to the valve without coil. Please order the respective coil separately.

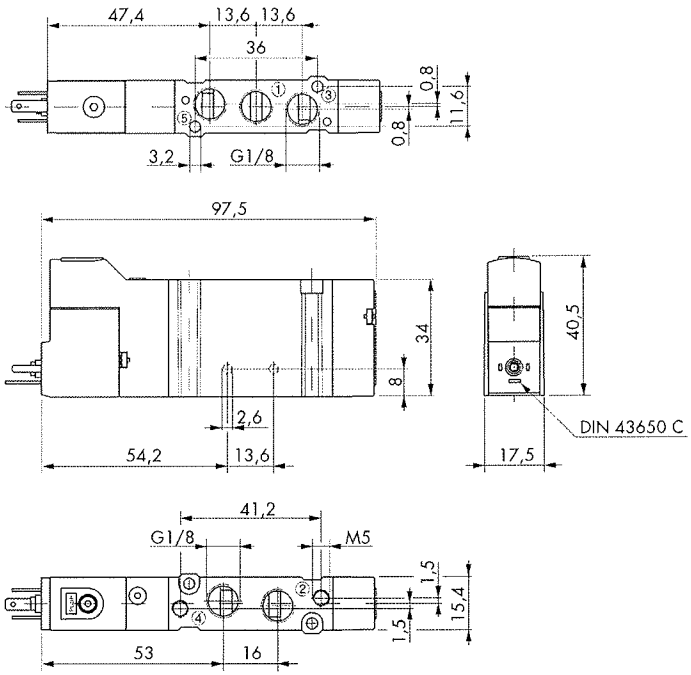
5/2-Wege monostabil

5/2-Way Monostable Solenoid

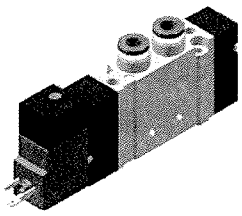
LPP770

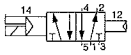
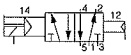
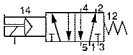


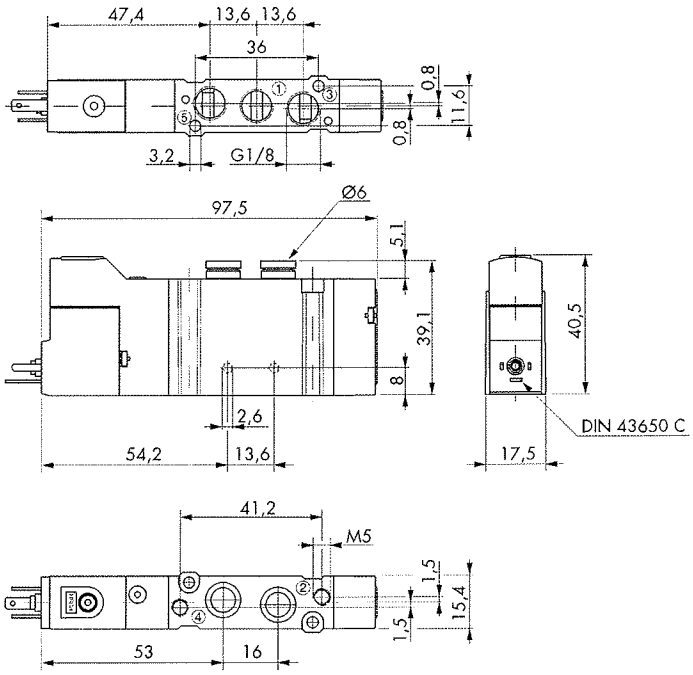
77.012.90.00	
77.012.91.00	
77.032.90.00	
77.032.91.00	



LPP770



77.014.90.00	
77.014.91.00	
77.034.90.00	
77.034.91.00	

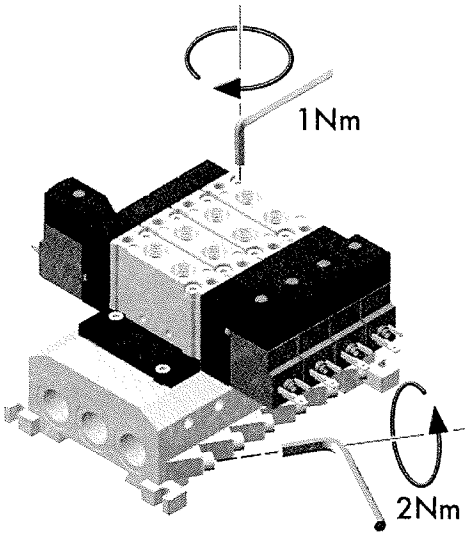


Montagehinweise

Assembly Instructions

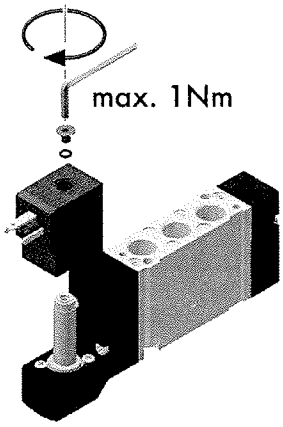
Montage der Anschlussplatten und Ventile zu Ventilinseln.
Schrauben wechselseitig anziehen!

Assembly of valves and subplates to valve islands.
Fasten the screws alternately!



Montage des Magnetsystems

Assembly of solenoid systems

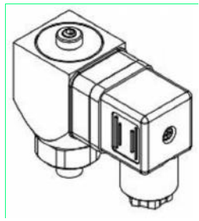


REV	DESCRIPTION	DATE	BY	APP'D
0	FOR REFERENCE ONLY	MM/DD/YY	BY	XX

IMPORTANT NOTE

BEFORE POWER SETTING OPERATOR MUST CHECK

CONNECTED EQUIPMENT VOLTAGE & ANY SPECIAL REQUIREMENTS



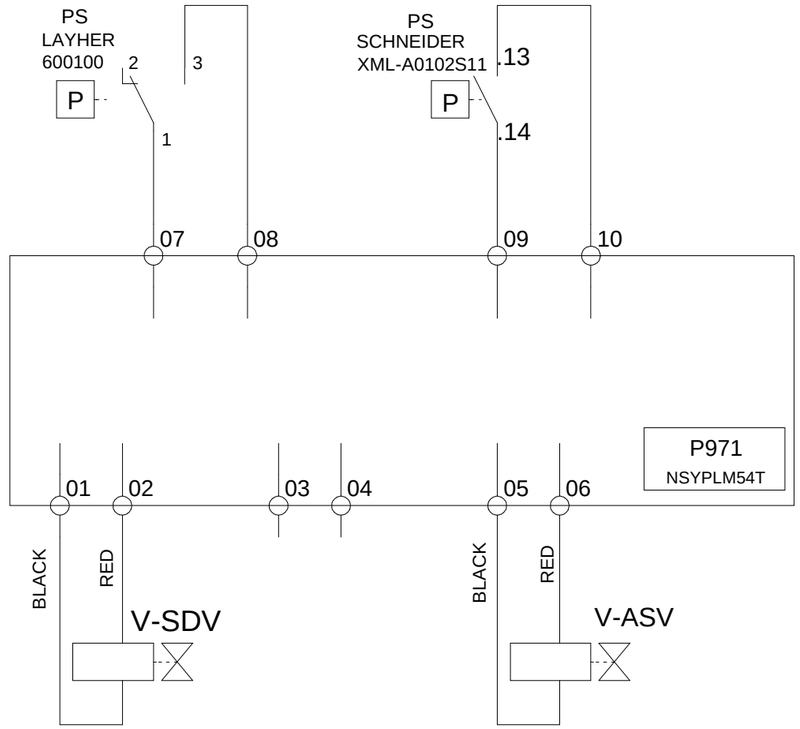
LAYHER 600010
OUTPUT: INV 240 VAC - 3A



SCHNEIDER XML-A0102S11
OUTPUT : NO/NC 240VAC - 1.5A

AIR PRESSURE SW

WHITE WATER PRESSURE SW.



SEDIMENT DISCHARGE VALVE

AERATION SOLENOID VALVE (WHITE WATER)

H2FLOW EQUIPMENT INC.

WATER AND WASTEWATER TREATMENT EQUIPMENT
580 OSTER LANE, VAUGHAN, ON. L4K 2C1 CANADA
TEL: (905) 660-9775 FAX: (905) 660-9744
www.h2flow.com

THIS DRAWING IS THE PROPERTY OF H2FLOW EQUIPMENT INC. AND SHALL NOT BE COPIED OR TRANSFERRED WITHOUT THE WRITTEN CONSENT OF H2FLOW EQUIPMENT INC.

DRAWN BY: AP	DATE: 11/07/18	PROJECT NAME: H2FLOW DAF PNEUMATIC PANEL ELECTRICAL	TITLE: ELECTRICAL WIRING DIAGRAM
APP'D BY: LB	DATE: 11/07/18		DRAWING No.: Q-XXXXX-XXX-XXX
SCALE: NTS		ALL DIMENSION ARE IN INCHES UNLESS OTHERWISE SPECIFIED	REV: 0
			SHEET 1 OF 1

REV	DESCRIPTION	DATE	BY	APP'D
0	FOR REFERENCE ONLY	MM/DD/YY	BY	XX

NOTE

EACH GROUNDING CABLE WIRE IS CONNECTED DIRECTLY TO THE GROUNDING BAR

SHIELD OF EACH CABLE IS SEPARATED FOR GROUNDING

H2FLOW EQUIPMENT INC.

WATER AND WASTEWATER TREATMENT EQUIPMENT
580 OSTER LANE, VAUGHAN, ON. L4K 2C1 CANADA
TEL: (905) 660-9775 FAX: (905) 660-9744
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DRAWN BY: AP	DATE: 11/07/18	PROJECT NAME: H2FLOW PNEUMATIC PANEL TERMINAL STRIP	TITLE: TERMINAL STRIP WIRING
APP'D BY: LB	DATE: 11/07/18		DRAWING No.: Q-XXXXX-XXX-XXX
SCALE: NTS			REV: 0
		ALL DIMENSION ARE IN INCHES UNLESS OTHERWISE SPECIFIED	SHEET 1 OF 1

Section 3.5

Effluent Treatment – UV System

Last Updated: Nov 2012

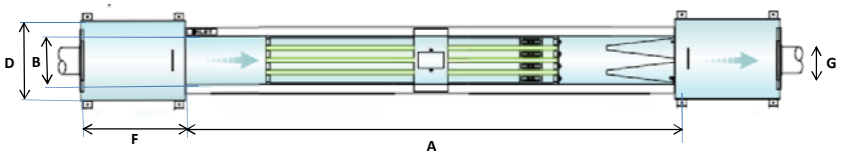
TrojanUV3000™PTP Technical Data Sheet - Stainless Steel Single/Double Units

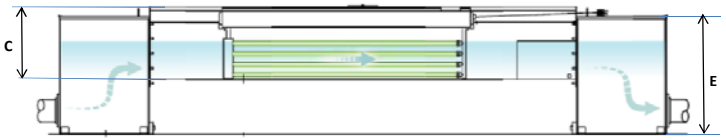
	Single	3025K	3050K	3075K	3100K	3200K	3300K	3400K	3600K	3800K	3001M
	Double	D3025K	D3050K	D3075K	D3100K	D3200K	D3300K	D3400K	D3600K	D3800K	D3001M
General											
Peak Flow Rate gpd (m^3/hr)	Single	37,000(5.8)	74,000 (11.7)	112,000(17.7)	140,000(22)	280,000(44)	420,000 (66)	560,000 (88)	840,000 (132.5)	1,120,000(176.7)	1,400,000 (220.8)
	Double	74,000 (11.7)	148,000 (23.3)	224,000 (35.3)	280,000 (44)	560,000 (88)	840,000 (132.5)	1,120,000 (176.7)	1,680,000 (265)	2,240,000 (353)	2,800,000 (441.6)
Retention Time (Seconds)		4.9			5.2						
UV Transmittance Range:		30% to 80%									
Bioassay Dose ($\mu Ws/cm^2$):		Approximately 30,000 (In correspondence to a UVT of 65%)									
Water Temperature		1°C to 40°C (34°F to 104°F)									
Headloss Through Channel inches (cm)	Single	4.32 (10.97)			5.04 (12.8)						
	Double	4.5 (11.4)			6.0 (15.2)						
UV Bank											
Lamps per Bank (Quantity)		2	4	6	4	8	12	16	24	32	40
Lamps per Module (Quantity)		2						4			
Number of Modules (Quantity)	Single	1	2	3	2	4	6	4	6	8	10
	Double	2	4	6	4	8	12	8	12	16	20
Total Lamps (Quantity)	Single	2	4	6	4	8	12	16	24	32	40
	Double	4	8	12	8	16	24	32	48	64	80
Input Power per Lamp & Lamp Type c/w Lamp Part Number		45 W input (Low-Pressure Low-Output) (302417)			87.5 W input (Low-Pressure Low-Output) (302418)						
Arc Length inch (mm)		30 (762)			58 (1,470)						
Maximum Mercury Content		<10 mg			<50 mg						
Lamp to Lamp Spacing inch(mm)		3 (76.2) Both Vertically and Horizontally									
Ballast		Electronic - One ballast drives two (2) lamps									
Ballast Power Level		Electronic Constant Output (runs at 100% power)									
Lamp Warm Up Period		instantaneous									
Power Cable Length ft.(m)		**Standard** 10 (3.05) **Options** 16 (4.9), 25 (7.6) * Contact Trojan for Pricing									
Quartz Sleeve		214 Quartz - Fully Annealed with 89% transmittance									
Wiping System		None - Manual Recommended with Lime Away (Note Lime Away has to be supplied by others)									
Power Distribution Receptacles											
Number of PDRs (quantity)	Single	1	1	2	1	2	3	2	3	4	5
	Double	2	2	4	2	4	6	4	6	8	10
Number of PDRs per Modules (quantity)		One (1) PDR for every two (2) modules									
Electrical Voltage (PDR) Single phase, 2 wire + gnd, 50/60 Hz L-L		120 V									
Rated Power Requirements (watts)	Single	90	180	270	350	700	1,050	1,400	2,100	2,800	3,500
	Double	180	360	540	700	1,400	2,100	2,800	4,200	5,600	7,000
Electrical Current Draw (Amps)	Single	0.9	1.7	2.5	3.2	6.4	9.6	12.7	19.2	25.4	31.7
	Double	1.64	3.26	4.9	6.34	12.68	19.02	25.36	38.04	50.72	63.4

Last Updated: Nov 2012

TrojanUV3000™PTP Technical Data Sheet - Stainless Steel Single/Double Units

			Single	3025K	3050K	3075K	3100K	3200K	3300K	3400K	3600K	3800K	3001M
Monitoring System													
UV Sensor				One (1) sensor per bank									
Sensor Cable Length ft.(m)				**Standard** 20 (6.1) Actual cable length, Sensor must be within 12 (3.7) of monitor. **Optional Extension** 5 (1.5),10(3),25(7.6),50(15.2) * Contact Trojan for Pricing									
Electrical Voltage (PDR) Single phase, 2 wire + gnd, 50/60 Hz L-L				120V only									
Electrical Current Draw (Amps)				5									
Display Indication				UV Intensity - 3 character display, Elapsed Time - 5 character display, LEDs									
Panel	**Dimensions** inches (mm)	**Type 4X**		12.5 x 10.8 x 6.25 (317.5 x 274.3 x 158.75)									
	Material			Fiberglass Option SST (See AMPS book for pricing)									
I/O - Discrete Outputs (24 - 240V DC or AC)				1- Low intensity alarm/bank									
I/O - Analog Outputs (4-20mA)				1 - isolated signal for remote indication of UV intensity / bank									
Other													
Languages				English, French, German, Spanish, Italian, Portuguese									
Operator Kit				one (1) or more									
Dimensions													
Module Dimensions L"xW"xH" in (cm)				40.2 x 2.26 x 14.16 (102.1 x 5.7 x 35.9)			68.2 x 2.26 x 14.16 (173.2 x 5.7 x 35.9)			68.2 x 2.26 x 20.1 (173.2 x 5.7 x 51.2)			
Module Weight lbs(kg)				22 (10)			30 (14)			38 (17)			
Channel Weight w/UV Modules lbs(kg)		Single		75 (34)	105 (48)	135 (61)	170 (77)	245 (111)	330 (150)	360 (163)	475 (215)	595 (270)	700 (318)
		Double		150 (68)	210 (95)	270 (122)	340 (154)	490 (222)	660 (299)	720 (326)	950 (431)	1190 (540)	1400 (635)
Transition Box Weight lbs (kg)				40 (18)	45 (20)	45 (20)	50 (23)	55 (25)	70 (32)	100 (45)	105 (48)	125 (57)	135 (61)
End Transition Box Weight lbs (kg)		Double		78 (35)	100 (45)	121 (55)	113 (51)	151 (68)	198 (90)	332 (151)	463 (210)	634 (288)	795 (361)
Crate Size Channel L"x W"x H" in (cm)		Single		57 x 39 x 31 (145 x 99 x 78.7)			105 x 41 x 31 (267 x 104 x 78.7)		105 x 51 x 31 (367 x 130 x 78.7)	124 x 34 x 41 (315 x 86.5 x 104)		124 x 43 x 41 (315 x 109 x 104)	
		Double		108 x 15 x 25 (274 x 38 x 64)	108 x 18 x 25 (274 x 46 x 64)	108 x 21 x 25 (274 x 53 x 64)	204 x 18 x 27 (518 x 46 x 69)	204 x 24 x 27 (518 x 61 x 69)	204 x 30 x 27 (518 x 76 x 69)	242 x 24 x 33 (615 x 61 x 84)	242 x 30 x 33 (615 x 76 x 84)	242 x 36 x 33 (615 x 91 x 84)	242 x 42 x 33 (615 x 107 x 84)
Crate Size Transition box L"x W"x H" in (cm)		Single								59 x 40 x 45 (150 x 101.6 x 114.3)			
		Double		31 x 25 x 34 (79 x 64 x 86)	50 x 29 x 33 (127 x 74 x 84)	70 x 30 x 34 (178 x 76 x 86)	51 x 30 x 35 (130 x 76 x 89)	96 x 32 x 35 (244 x 81 x 89)	142 x 38 x 38 (361 x 97 x 97)	174 x 37 x 48 (442 x 94 x 122)	255 x 48 x 51 (648 x 122 X 130)	335 x 59 x 48 (851 x 150 x 122)	418 x 68 x 48 (1062 x 173 x 122)
Dimensions in(cm)		**A:**		48 (121.9)	48 (121.9)	48 (121.9)	96 (243.8)	96(243.8)	96 (243.8)	115 (292.1)	115(292.1)	115(292.1)	115 (292.1)
		B:		3 (7.62)	6(15.2)	9 (22.9)	6 (15.2)	12 (30.5)	18 (45.7)	12 (30.5)	18 (45.7)	24 (61)	30 (76.2)
		C:		17.08 (43.38)						20.75 (52.7)		23.08 (58.62)	
		D:		13 (33)	16 (40.6)	18 (45.7)		20 (50.8)	26 (66)	23 (58.4)	26 (66)	32 (81.3)	38 (96.5)
		E:		21.75 (55.3)			24.5 (61.6)		25.5 (64.7)	36 (91.44)			
		F:		18.25 (46.4)						24.25 (61.6)			
		Flange Size		4 (100DN)	6 (150DN)	6 (150DN)	8 (200DN)	8 (200DN)	10 (250DN)	12 (300DN)			



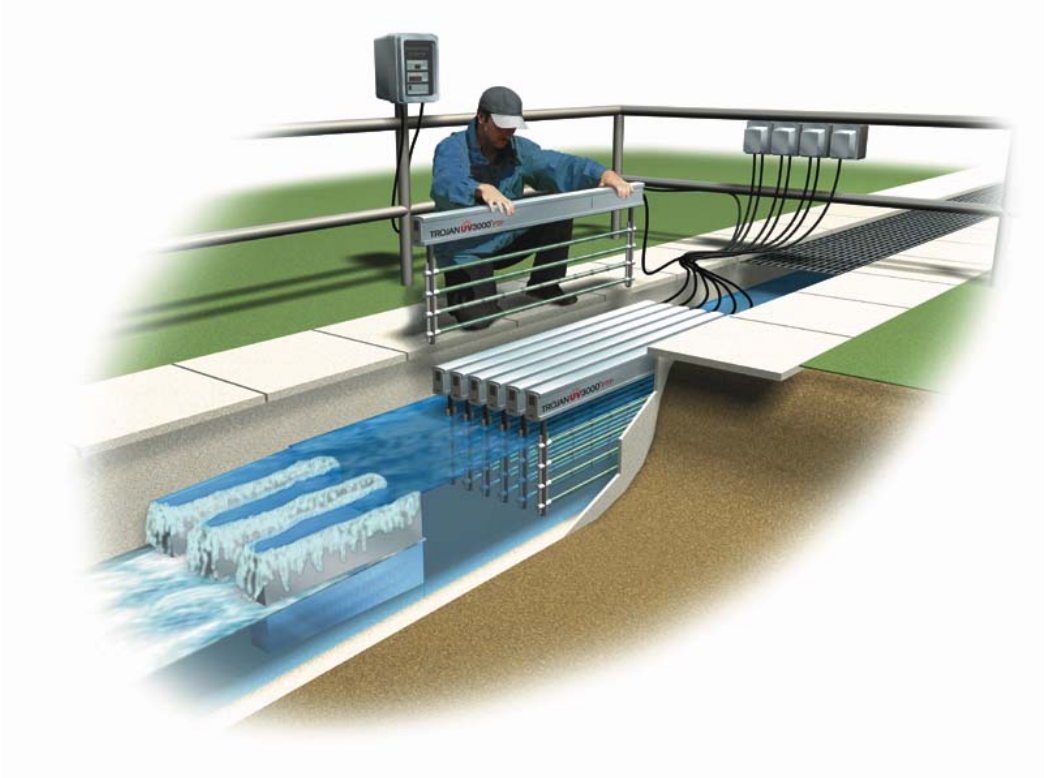


TROJAN UV™
A TROJAN TECHNOLOGIES BUSINESS

TROJANUV3000™ PTP

Operation and Maintenance
User Manual
Original Instructions

Edition 7



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If you require technical assistance, please contact your local representative. If you require additional assistance, please contact the Technical Assistance Center (TAC) using the contact information below:

North America:	1-866-388-0488
All other areas:	1-519-457-2318
E-mail:	tac@trojanuv.com

At the time of publishing, the information within this document is current. Due to continuous improvements, we may have future changes and recommendations which will be sent via product bulletins.

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Section 1 Specifications

Specifications are subject to change without notice.

UV Module	
Lamp driver enclosure material	Anodized aluminum
Module frame material	Stainless steel, 316
UV lamps per module	2 or 4 UV lamps
UV lamp spacing	76.2 mm (3 in.)
UV lamp type	36 inches - 45W, Low Pressure
	64 inches - 78W, Low Pressure
Input	36 inches - 120 VAC + 10%, 0.9 A, 50-60 Hz, 100W
	64 inches - 120 VAC + 10%, 1.6 A, 50-60 Hz, 175W
Output	36 inches - 2 x 45 W
	64 inches - 2 x 78 W
UV Channel (Optional)	
Material	Stainless Steel
Lamp Sleeves	
Material	Type 214 clear fused quartz circular tubing
UV transmittance	No less than 90.8% UV light
UV Sensor	
Input power	Designed to function with a supply voltage between 15 and 30 VDC
Storage temperature	-40 ºC to +80 ºC (-40 ºF to 176 ºF)
Operating temperature	0.5 ºC to 60 ºC (33 ºF to 140 ºF)
Level Control Weir	
Type	Serpentine, Trapezoidal
Material	Stainless Steel
UV Module Rack	
UV module rack	Stainless steel
System Control Center [System Monitor]	
Dimension	12 x 10 x 6 in.
Enclosure type and material	Type 4X reinforced fiberglass
Weight	6.8 kg (15 lbs)

Section 2 Safety Information

Please read this entire manual before operating this equipment. Pay attention to all danger, warning and caution statements in this manual. Failure to do so could result in serious personal injury or damage to the equipment.

Make sure that the protection provided by this equipment is not impaired. Do not use or install this equipment in any manner other than that specified in installation manual.

2.1 Use of Hazard Information

⚠ DANGER
Indicates a potentially or imminently hazardous situation which, if not avoided, will result in death or serious injury.
⚠ WARNING
Indicates a potentially or imminently hazardous situation which, if not avoided, could result in death or serious injury.
⚠ CAUTION
Indicates a potentially hazardous situation which, if not avoided, could result in minor or moderate injury.
NOTICE
Indicates a situation that is not related to personal injury.

2.2 Precautionary Labels

Read all labels and tags attached to the instrument. Personal injury or damage to the instrument could occur if not observed.

	Electrical equipment marked with this symbol may not be disposed of in European public disposal systems. In conformity with European local and national regulations (EU Directive 2002/96/EC), European electrical equipment users must now return old or end-of life equipment to the Producer for disposal at no charge to the user. ***Note:*** *For recycling, please contact the equipment producer or supplier for instructions on how to return end-of-life equipment, producer-supplied electrical accessories, and all auxiliary items for proper disposal. No equipment is to be returned without authorization. Local recycling programs may be used. For the manufacturer recycling UV lamp program or producer-supplied electrical accessories and auxiliary items, contact the equipment supplier for proper disposal instructions.*
	This symbol indicates there is Mercury present.
	This is the safety alert symbol. Obey all safety messages that follow this symbol to avoid potential injury. When on the equipment, refer to the Operational and Maintenance manual for additional safety information.
	This symbol indicates a risk of electrical shock and/or electrocution exists.
	This symbol indicates the marked item has stored energy. Obey procedures to wait 5 (five) minutes after disconnecting main power, to allow stored energy to dissipate.
	This symbol indicates corrosive material. Avoid inhalation, ingestion, or exposure to eyes and skin. Wear appropriate clothing and personal protective equipment.

	This symbol indicates the components of the system have been exposed to biohazardous waste and / or bioaerosols.
	This symbol indicates a trained and competent lift operator should be used to move the equipment.
	This symbol indicates a body crush hazard. People should stay clear from under overhead loads.
	This symbol indicates there is a potential fall from height hazard.
	This symbol indicates surfaces may be slippery and there is a potential fall hazard.
	This symbol indicates there is a potential UV hazard. Proper protection must be worn.
	This symbol indicates the marked item could be hot and should not be touched without care.
	This symbol indicates the presence of devices sensitive to Electro-static Discharge (ESD). Proper care must be taken to prevent damage to the equipment.
	This symbol indicates the marked item should not be touched.
	This symbol indicates a risk of electrical shock and/or electrocution exists. All appropriate lockout tag out procedures must be obeyed.
	This symbol indicates the equipment should be secured with a safety device / hook.
	This symbol indicates a safety glasses with side protection is required for protection against UV exposure.
	This symbol indicates a UV rated full face shield is required. Face shields are to be worn with safety glasses or safety goggles.
	This symbol indicates gloves must be worn.

	This symbol indicates safety boots must be worn.
	This symbol indicates a hard hat must be worn.
	This symbol indicates safety harness or fall protection equipment must be worn.
	This symbol indicates the operator must read all available documentation to perform required procedures.

2.3 Safety Precautions

Read the safety precautions in this section before doing maintenance, service or repair. Obey the instructions in the safety precautions. Failure to follow the instructions in the safety precautions can result in serious injury or death.

⚠ DANGER




Arc Flash and Shock Hazard - Live Electrical Circuit Present.

- Failure to follow these instructions will result in electrical shock, injury or death from electrocution.
- Lockout tag out all sources of power before performing any inspection, repair, or maintenance. ***There may be more than one source of power!***

⚠ DANGER




Fall Hazard.

- Failure to follow these instructions will result in injuries due to fall.
- Always use appropriate fall resistant procedures and equipment while working near an uncovered channel, when a fall hazard is present, in compliance with local regulations.

⚠ WARNING




Body Crush Hazard.

- Failure to follow these instructions could result in serious injury or death due to improper lifting procedures, underrated lifting equipment, and moving parts.
- ALWAYS secure with safety device.
- ALWAYS stay clear of elevated loads.
- ALWAYS comply with local safety regulations.

⚠ CAUTION





UV Light Hazard.

- Failure to follow these instructions may result in serious burns to unprotected eyes and skin.
- ALWAYS use UV protective gear, including gloves and clothing and face shield, when UV light is present.
- NEVER look directly at illuminated UV lamp, even with protective gear.
- NEVER illuminate UV lamp if personnel may be directly exposed to UV light.

⚠ CAUTION





Burn Hazard.

- Failure to follow these instructions may result in minor or moderate injury due to burns.
- NEVER touch hot surface.
- Allow UV lamps to cool for a minimum of 10 (ten) minutes before handling.

⚠ CAUTION



Slip and Fall Hazard.

- Failure to follow these instructions may result in injuries from slip and fall.
- ALWAYS ensure safe footing.
- ALWAYS clean up spills promptly.
- ALWAYS comply with site-specific safety protocols and procedures.

NOTICE



A health risk exists.

This system uses ultraviolet light to reduce the concentration of pathogens to a noninfectious level. Failure to observe maintenance instructions or the alarm messages will diminish the effectiveness of this system. This will result in the effective disinfection no longer being guaranteed and the requirement of the water supply regulations no longer being met.

NOTICE



Mercury Chemical Hazard.

- UV lamps contain a small amount of mercury in either elemental or bound amalgam state, depending on lamp type. These lamps are similar to fluorescent and compact fluorescent lamps (CFL). Always comply with local regulations governing the disposal of lamps containing mercury and the waste associated with breakage.
- NEVER use a vacuum cleaner to clean up broken lamps containing mercury. Vacuuming could spread mercury-containing powder or vapor.
- Thoroughly collect broken glass and trace amounts of mercury and place into a sealable bag or container. For further reference see the U.S. EPA guidelines. http://www.epa.gov/cfl/cleaning-broken-cfl.
- If you have further questions about the safe clean-up of mercury containing lamps, contact the TrojanUV Technical Assistance Center at tac@trojanuv.com.

NOTICE



Personal Protective Equipment Required.

- ALWAYS use appropriate eye, hand, and foot protection.
- ALWAYS wear UV-C safety glasses when around equipment or a UV-C face shield with safety glasses or safety goggles when inspecting open running equipment.
- ALWAYS follow plant safety procedures and protocols.
- ALWAYS take all necessary precautions when working around, operating, or working on this equipment, if contamination of components is expected within this application due to effluent biological or chemical contaminants.

NOTICE



Only competent personnel should undertake operation, repairs, maintenance, or servicing of equipment described in this manual. Maintain the continuity of the lockout tag out between shifts. If you do not understand the information or procedure explanations in this manual, STOP and contact your Service Provider for assistance.



WARNING: This product can expose you to chemicals including phthalates, which is known to the State of California to cause cancer, and mercury, which is known to the State of California to cause birth defects or other reproductive harm. For more information go to www.P65Warnings.ca.gov.

Notes: 1) *Dispose of contaminated parts/components as per country requirements.*

2) *Refer to the Safety Data Sheets for additional exposure to supplied materials.*

Section 3 General Information

The information in this manual has been carefully checked and is believed to be accurate. However, the manufacturer assumes no responsibility for any inaccuracies that may be contained in this manual. In no event will the manufacturer be liable for direct, indirect, special, incidental or consequential damages resulting from any defect or omission in this manual, even if advised of the possibility of such damages. In the interest of continued product development, the manufacturer reserves the right to make improvements in this manual and the products it describes at any time, without notice or obligation.

3.1 Acceptable Noise Levels

The airborne noise emissions, A-weighted emission sound pressure level, is not more than 70dB(A).

3.2 Patents and Permissions

The products described in this document may be protected by one or more patents in The United States of America, Canada and/or other countries. For a list of patents owned by Trojan Technologies, go to: www.trojantechnologies.com/patents.

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3.3 Abbreviations and Acronyms

Table 1 describes the abbreviations and acronyms included in this manual.

Table 1 Abbreviations and Acronyms

Abbreviation/Acronym	Description
LED	Light Emitting Diode
GFCI	Ground Fault Circuit Interrupter
MCB	Module Control Board
SCC	System Control Center
UV	Ultraviolet
UVT	UV Transmittance

3.4 System Overview

3.4.1 UV Module

UV lamps are mounted on UV modules installed in open channels. The UV lamps are enclosed in lamp sleeves, and positioned horizontally and parallel to water flow. Multiple UV modules are configured into UV banks and work in parallel. All lamp drivers and UV lamp wiring is inside the UV module frame.

The UV module enclosure contains the electronic lamp drivers (one for every two UV lamps), which supply power to the UV lamps, and a Module Control Board (MCB). The UV module power cable is located at one end of the lamp driver enclosure.

The module support rack supports the UV modules at the correct height in the channel.

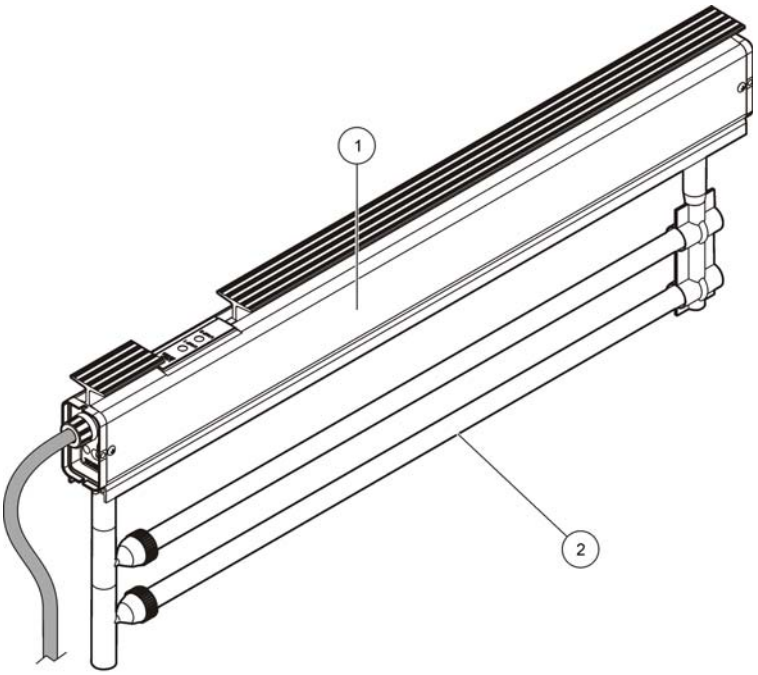


Figure 1 UV Module

1	Lamp driver enclosure	**2**	UV lamp

3.4.2 UV Lamps and Lamp Sleeves

The germicidal UV lamp is a low pressure, low output UV lamp, preheated to promote longevity and contains a rugged filament to withstand shock and vibration. UV lamps are also designed to produce zero levels of ozone.

Each UV lamp is enclosed in its individual lamp sleeve, to prevent moisture from entering the module frame, and each UV lamp is rated for continuous submergence. One end of the lamp sleeve is a closed dome shape, and is held in place by a retaining O-ring. The other open end is sealed against the UV lamp holder seal assembly with an O-ring and a Sleeve Nut. A compression spring is located inside the domed end of the lamp sleeve. The spring is used to support the UV lamp during shipping, and to supply a continuous connection while in use.

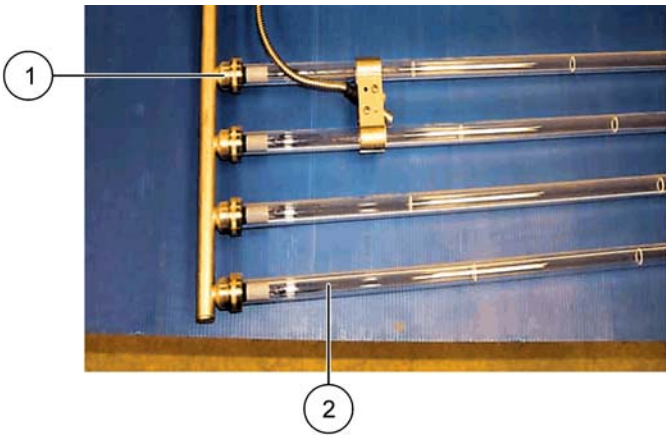


Figure 2 UV Lamp Assembly

1	Sleeve cup	**2**	UV lamp and lamp sleeve

3.4.3 System Control Center [System Monitor] (Optional)

The System Control Center (SCC) in this product is commonly called the System Monitor. Throughout the rest of the manual, it will only be referenced as a System Monitor. The System Monitor includes a submersible UV sensor, and provides digital output of UV intensity at each UV bank. Elapsed time display provides continuous readout of actual hours of operation (lamp hours). A dry contact enables a remote low UV intensity alarm. Refer to Figure 3.

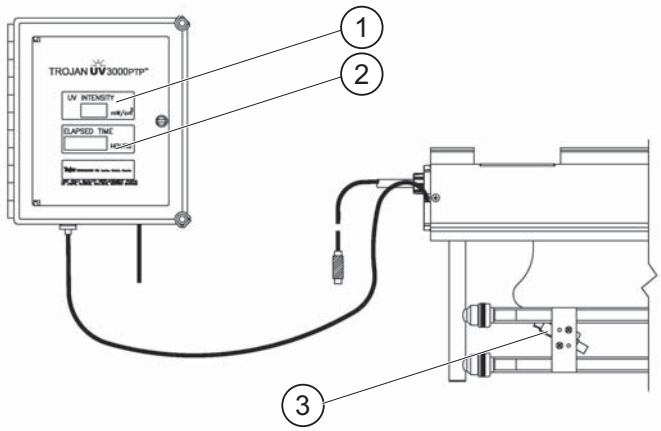


Figure 3 System Monitor

1	UV Intensity	**3**	UV Sensor
2	Elapsed time in hours		

3.4.4 UV Sensor

The UV sensor continuously measures the UV intensity produced in each UV bank. Refer to Figure 3. The submersible UV sensor measures only the germicidal portion of the light emitted by the low-pressure UV lamps, which converts into an analog signal and displayed in mW/cm^2 on the System Monitor (optional).

3.4.5 Level Control Weir

A water level control weir controls the effluent level within the UV channel. Refer to Figure 4. Depending on the system model provided and its configuration, the level control weir will be preinstalled in either the stainless steel channel, transition box or ready to install in a concrete channel if a stainless steel channel and transition boxes are not supplied

To achieve proper disinfection, the top of the weir is set at an elevation to control the depth of water above the top UV lamp. The weir height makes sure that the UV lamps will remain submerged in zero or low flow conditions.

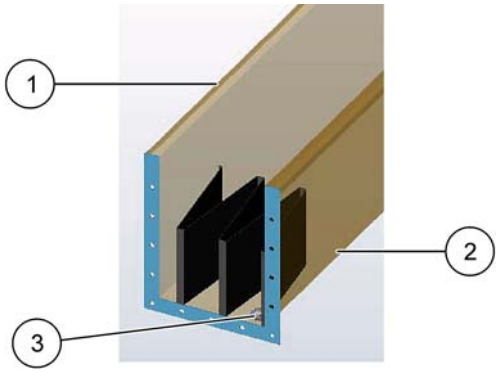


Figure 4 Sample Weir Configuration

1	Channel, Stainless Steel shown	**3**	Drain plug
2	Level control weir		

3.4.6 UV Channels

3.4.6.1 Stainless Steel Channel (type K Model)

The stainless steel channel can be supplied with or without transition boxes and an turn box. Stainless steel channels with transition boxes and the turn box form a freestanding structure that connects to flanged pipes supplied by others. Refer to Figure 5.

Multiple channels may be connected in parallel, or series with a turn box, depending on the application requirements.

UV modules are mounted in the stainless steel channel module rack. The UV module rack is welded in the channel. Each channel must support one bank of UV modules. Refer to Figure 5.

Due to variations in effluent quality and flow characteristics, debris may settle at the bottom of the channel. A built-in drain helps facilitate channel cleaning.

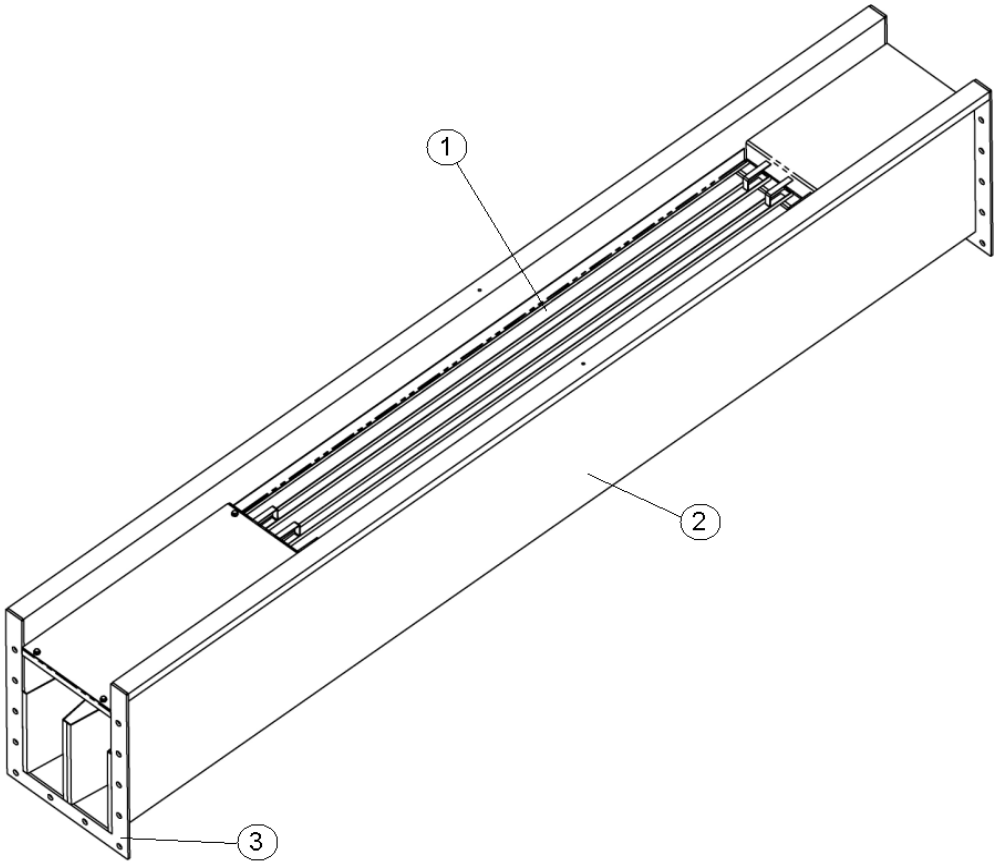


Figure 5 Type K UV Channel

1	UV module rack	**3**	Channel flange
2	UV channel		

3.4.6.2 Concrete Channel (Type K-1 Model)

For installations where a concrete channel will be used, stainless steel channel(s) and transition boxes will not be provided. UV module rack(s) and level control weir(s) must be installed by the customer or a contractor. The poured concrete is also the responsibility of the customer.

Refer to Table 2 for reference on models that are available for concrete channel installation.

Table 2 Models available for Concrete Channel Installation

Model	Concrete channels
3025 - 3300 and D3025 - D3300	N/A
3400 to 3001 and D3400 to D3001	✓

3.4.6.3 UV Module Rack for Concrete Channels (Type K-1 models)

The module support rack supports the UV modules in the channel so that the lowest UV lamp is located at a specified height above the channel floor and the UV lamp driver enclosure sits above the water.

The UV module rack is fastened to four channel brackets attached to the concrete channel walls. The rack weldments are mounted to the side of the channel with angle brackets.

3.4.6.4 Transition Boxes (Type K models only)

For installations where a stainless steel channel is used, optional transition boxes can be provided for each end of the stainless steel channel. Refer to Figure 6.

Transition boxes are designed to provide transition between the UV channel and flanged inlet and outlet pipes. The inlet transition box helps to ensure a plug flow condition that is conducive to more efficient disinfections. The transition boxes should be subjected to the same periodic maintenance as the channel.

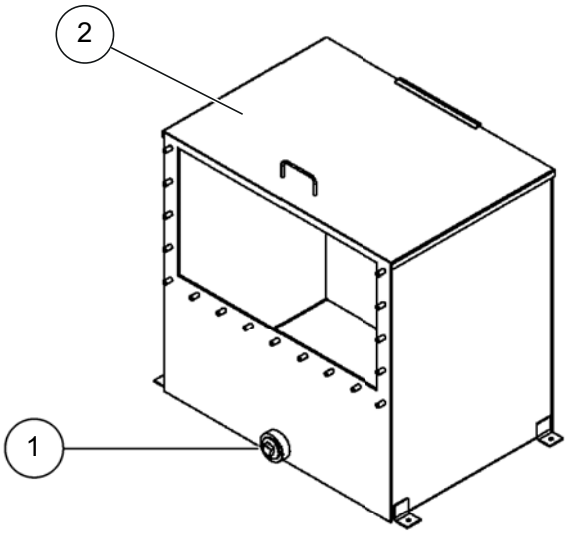


Figure 6 Transition Box for Type K UV Channels

1	Drain plug	**2**	Lid

3.4.6.5 Turn Box (Type K models only)

A stainless steel turn box is provided to connect two channels in a U-shape configuration. Refer to Figure 7. This is an optional configuration for all stainless steel models (both standard and double flow). Not available on 3800K-3001M or D3800K or D3001M.

Effluent flow enters the upstream transition box, passes through the first channel, enters the turn box where the flow is reversed 180°, passes through the second channel, to exit through a downstream transition box. Refer to Figure 8.

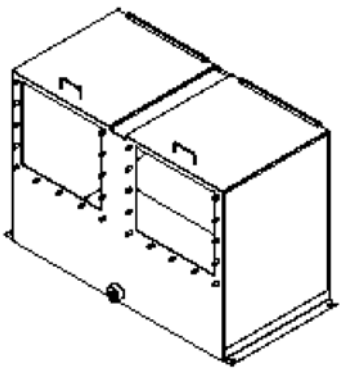


Figure 7 Turn Box for Type K UV Channels

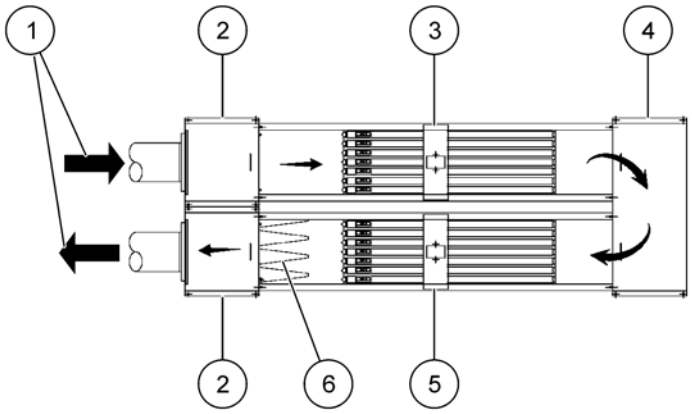


Figure 8 Turn Box Flow

1	Flow	**4**	Turn box
2	Transition box (2)	**5**	Downstream channel
3	Upstream channel	**6**	Weir, located in downstream channel

Section 4 Lockout Tag Out

DANGER



Obey all warning and caution statements. Refer to Section 2.

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The procedure in Section 4 is the minimum lockout requirement. Use additional precautions, as needed. Obey all site-specific protocols.

4.1 Lockout Tag Out Procedure

4.1.1 Equipment Shutdown

Contact the plant manager or shift supervisor for help regarding equipment location and identification.

1. Ensure that no hazards will be created by equipment shutdown.
2. Shut down all equipment that will need lockout tag out.
3. Ensure that all moving parts come to a complete stop.

4.1.2 Deactivate Energy Sources

A hazardous energy source is any energy source that can cause serious personal injury or death. The potential hazardous energy sources in this manual are:

1. Identify and deactivate the main isolating device of each energy source:
   -  Electrical Energy (Incoming Power)
   -  Water Pressure (Potential Energy)
   -  Thermal (Thermal Energy)
   -  UV Light (Radiation Energy)
2.  Disconnect all electrical equipment from power:
   - Disconnect all electrical equipment
3. Close all shut-off valves.

4.1.3 Lockout Tag Out Energy Sources



1. Use a multi-lock scissor adaptor to lockout each energy source.
2. Attach a completed lockout tag. Include the required information:
   - Person and company applying the lockout
   - Reason for the lockout
   - Date of the lockout
3. Apply a personal lock.

4.1.4 Verify the Lockout



1. Ensure that the meter is working correctly with a test before and after measuring the de-energized source:
   a. Test the voltmeter to a known, energized 24 VAC/120 VAC source.
   b. Use the same voltmeter to test the locked-out energy sources to verify that there is no voltage.
   c. Test the voltmeter again to a known, energized 24 VAC/120 VAC source.
2. Ensure that the stored energy sources have dissipated.
3. Try to start the de-energized equipment.

4.2 Remove the Lockout Tag Out

When the work is finished, the lockout tag out can be removed.

1. Ensure that no hazards will be created by removal of the lockout.
2. Obey manufacturer's instructions and safe work procedures to energize and start the equipment.

Section 5 System Start Up and Shut Down

⚠ DANGER



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5.1 Start Up the UV System

This procedure applies to the start up of the UV system after it has been installed and initially started up by an authorized manufacturer representative only. Typically, this would be after the system has been shut down for maintenance, or in the case of seasonally operated systems, is being started up for the beginning of the disinfection season. In either case, the UV modules are not in the channel prior to the start up procedure.

Materials:



Procedure:



1. Inspect the UV channel. Make sure that it is clean and clear of debris.
2. Make sure that there is adequate effluent flow through the UV channel.
3. Inspect the UV modules for the items listed:
   - UV modules, sleeves and UV sensor are clean.
   - Sleeves are not cracked.
   - Sleeve nuts are hand-tight.
   - UV module power cable strain relief on each UV module is hand-tight.
   - UV module power cables are clean and free of debris.
4. Put the UV modules in the UV channel. Depending on the size of the UV modules and local codes, this may require two people.
5. Locate and energize the supply breakers.
6. Verify Ground Fault Circuit Interruption (GFCI).
7. Make sure that the System Monitor is energized by inspecting the LED display. If the display is not energized, refer to Section 9.
8. Plug in the UV modules. Verify the UV modules are energized by inspecting the lamp status LEDs.
9. Plug the UV sensor into the receptacle at the base of the System Monitor.
10. Wait 15 minutes. Make sure the UV intensity reading on the System Monitor is OK.
11. Record the UV intensity and lamp hours in a maintenance log book for reference.

5.2 Shut Down the UV System

Procedure:



1. Unplug the UV modules.
2. Apply lockout tag out devices as necessary. Refer to Section 4.1.3.
3. Unplug the UV sensor from the base of the System Monitor.
4. Allow the sleeves drying time. If there is any residue or hazing, clean them again with the Lime-A-Way®.
5. Clean the UV channel of any debris. The UV system is now ready for servicing or winterization.

5.3 Shut Down for Extended Periods

The system should always be left **ON**. It is not designed to be cycled **ON/OFF** except for maintenance and troubleshooting. For wastewater treatment plants that operate on a seasonal basis. Refer to Section 5.3.2.

Note: *The UV lamp warranty is based on 4 (four)* ***ON/OFF*** *cycles a day.*

5.3.1 UV Modules

The primary concern for UV modules during the winter season is the potential for damage to the lamp sleeves and UV lamps if effluent is allowed to freeze. Where possible, de-water the channel before seasonal shutdown, or remove UV modules from the channel.

After removal, each UV module should be cleaned immediately to prevent dirt and debris from drying onto the lamp sleeves and stainless steel frame. Refer to Section 8.3.3.3.

5.3.2 Seasonal Shutdown of the UV System - UV Channel de-water required

A de-energized System Monitor may accumulate condensation over the winter season, especially if the enclosure is not properly sealed.

Materials:



Procedure:



1. Bypass effluent from entering channel.
2. De-water the UV channel before de-energizing banks. Make sure that untreated effluent is not discharged.
3. Shutdown the UV System. Refer to Section 5.2.
4. Remove UV modules (Section 8.3.1) from the channel and store in an indoor location.
5. Clean the UV Lamp Sleeves. Refer to Section 8.3.3.3.
6. If in an outdoor location, remove the System Monitor circuit board and place it in an ESD bag or container and store in a clean, dry location.

5.3.3 Seasonal Shutdown of the UV System - UV Channel de-watering not required

Materials:



Procedure:



1. Shutdown the UV System. Refer to Section 5.2.
2. Remove UV modules from the channel and store in an indoor location.
3. If in an outdoor location, remove the System Monitor circuit board and place it in an ESD bag or container and store in a clean, dry location.

Section 6 Installation

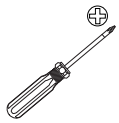
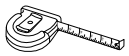
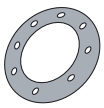
⚠ DANGER

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6.1 Tools and Materials

Symbols	Description	Symbols	Description
	Phillips Screwdriver		Adjustable Wrench
	Torque Wrench		Measuring Tape
	Level		Lint free cloth
	Power Drill		Outdoor Sealant
	Grout		Gasket

6.2 Unpacking the System

The system is typically delivered to the site by truck. The components of the system are packed in wooden crates. A forklift and 4-point lifting sling may be used to unload these crates.

The wooden shipping crates are labeled with the component name and symbols showing a glass to indicate fragile and an umbrella to indicate that the contents of the crates should be kept dry.

The system is usually shipped in one crate depending on the size of the system and optional equipment provided. For larger systems, transition boxes (if required) and maintenance racks (if required) will be crated separately.

Do not unpack the equipment until ready for installation.

The complete crates weigh from 170 kg (375 lbs) to 460 kg (1015 lbs), depending on the system size.

Read the instructions that list the proper removal procedure for each component and how they are shipped.

If transportation of the UV equipment between the storage location and the installation location is required, use a flatbed truck. Secure the equipment to the truck. Use proper loading and unloading procedures to load and unload equipment from the flatbed.

Note: *Improper handling of equipment during removal from flatbed may void the warranty.*

UV module rack and UV modules



- Shipped together
- Shipped with stainless steel channel (optional)
- Mass dependent upon system configuration. See the submittal manual for specific weights
- Lift the channel with UV module rack and UV module with a 4-point lifting sling. Use a stationary overhead crane for channel placement. Smaller systems can be lifted by hand.
- When no channel is provided, the UV module rack and UV modules can be lifted by using a 4-point lifting sling.
- Maintenance rack, shipped in a separate crate.

System Monitor (optional)

- Do not dent or mark the System Monitor
- Shipped in same crate as the UV module rack and UV modules

Optional equipment

- UV Photometer is an industrial control system housed in a panel. Care should be taken not to dent or mark the panel.

Spare parts

- Mass dependent upon system configuration. See the submittal manual for specific weights.
- Depending on the size and number of spare parts, they could be shipped in a separate crate.

6.3 Storage Requirements

The manufacturer recommends indoor storage of the equipment. The equipment should be stored in a dry warehouse. Heating is not necessary during storage. However, prior to system start up the equipment must be warmed to an ambient minimum temperature of 15 °C (60 °F) for a period of 24 hours.

- Storage volume is estimated to be 300 cubic feet or 10 cubic meters. Storage will depend on size of the system.
- Ambient air temperature between -40 ºC to 55 ºC (-40 ºF to 130 ºF).
- Relative humidity from 10% to 90%, non-condensing.
- Free from dust and dirt ingress.
- Must not contain corrosive or explosive gases.
- Free from salt air.
- Vermin free.

If indoor storage is not possible, the UV modules, channel, transition boxes, and cleaning equipment may be stored outdoors under the specified conditions:

- Equipment is stored on high ground that is not susceptible to flooding.
- Equipment is elevated a minimum of 300 mm (12 in.) above the ground or as appropriate to prevent flooding.
- Equipment is completely covered with waterproof tarps to prevent exposure to the elements (i.e. rain, snow, sand, etc.).
- Equipment is completely covered with waterproof tarps to prevent exposure to the elements (e.g., rain, snow, sand, dust, etc.). Tarps must be tight fitting, attached securely and examined regularly. Water and snow accumulation should be removed regularly.
- Equipment stored in crates should not be exposed to direct sunlight.
- Equipment can be stored in sea containers.

6.4 General Installation Instructions

Note: *The dimensions and location of the system components may vary.*

No special tools are required for installation, other than those used in the day-to-day operation of a mechanical and electrical contracting firm. An appropriately sized crane may be required for off loading and installation of the unit. Size is dependent upon each project configuration.

The general steps in this section are to be obeyed by the contractor.

- For installation where stainless steel channels will not be used, a concrete channel is to be poured by a qualified contractor according to the dimensions specified on the drawings supplied by the manufacturer or by the contractor.
- Necessary equipment interconnections need to be allowed for prior to pouring the concrete pad (if applicable), as identified in the drawings supplied by the manufacturer or a qualified contractor. There are no special requirements beyond those for a typical electrical panel (electrical service, communication, etc.)

6.5 Channel Installation

6.5.1 Stainless Steel Channel Installation (without turn or transition boxes)

This procedure is for installations where a stainless steel UV channel has been provided without turn or transition boxes.

Prerequisites:

- Remove the UV modules. Refer to Section 8.3.1.

Materials:



Procedure:

1. Attach the downstream flange (on the weir side of the channel) to the plate prior to discharge. Refer to Figure 9. Connection of the channel flange and plate must be water-tight.
2. Use the supplied gasket and apply outdoor sealant between the gasket and the flange surfaces.
3. Support the channel with blocks in two places (UV3025K - UV3075K) or in three equally distant places (UV3100K - UV3001M).

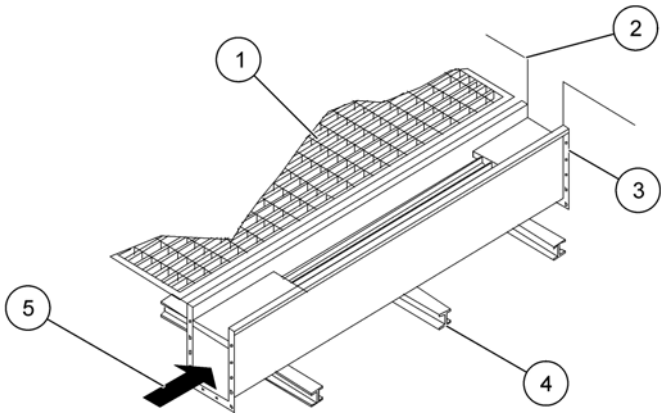


Figure 9 Channel bolted to plate prior to discharge

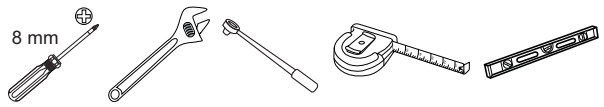
1	Access grating (supplied by others)	**4**	Support beam
2	Plate before discharge	**5**	Flow
3	Water-tight seal		

6.5.2 Stainless Steel Channel Installation (with turn or transition boxes)

Prerequisites:

- Remove the UV modules. Refer to Section 8.3.1.

Tools:



Materials:



Procedure:

1. Reverse the handle(s) on the transition box(es). Refer to Figure 10.

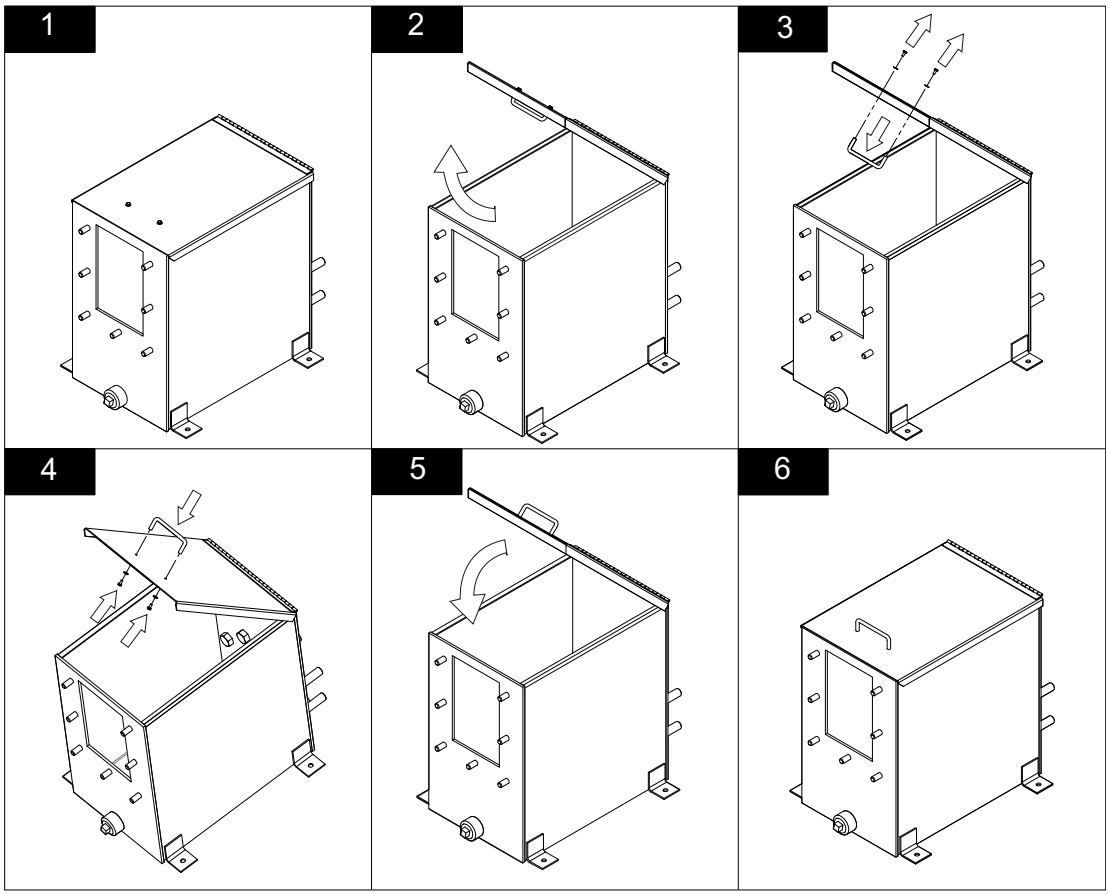


Figure 10 Reversing Handle on Transition Box

2. Make sure that the channel flange and transition box flange connection surfaces are clean and dry.

3. Apply outdoor water proof sealant between the gasket and flange surfaces.

4. Assemble the channel and transition box. Refer to Figure 11 and Figure 13.

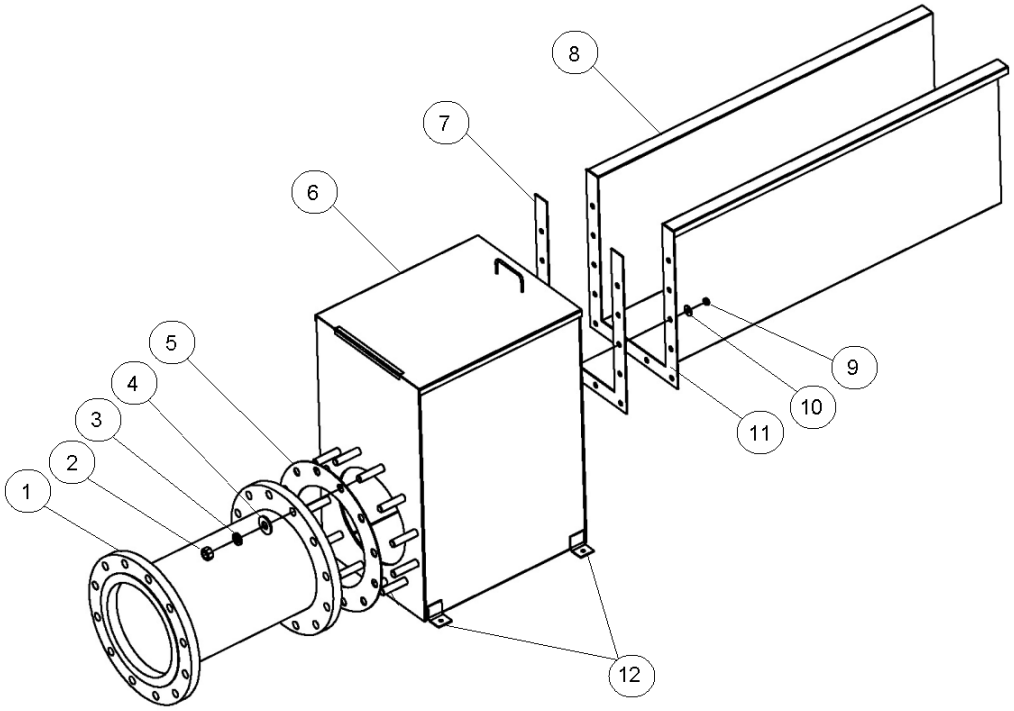


Figure 11 Assembly of Transition Box and UV Channel

1	Inlet / outlet pipe and connection flanges*	**7**	Gasket, channel
2	Nut*	**8**	UV Channel
3	Lock Washer*	**9**	Nut
4	Flat washer*	**10**	Flat washer
5	Gasket, pipe flange*	**11**	UV Channel connection flange
6	Transition box	**12**	Transition mounting brackets (4)

** Indicates item is to be supplied by customer or Contractor.*

5. If a turn box is supplied to connect multiple channels, refer to Section 6.5.3. For installations without a turn box, go to the next step.
6. Tighten channel flange, gasket and transition box together by using hardware provided. A channel with transition boxes forms a self-supporting structure, which is bolted to the concrete slab through bottom angles of turn box and transition boxes.
   a. Hand tighten bolts, then pre-tighten bolts to 10-20 ft-lbs torque. But do not exceed 20% of the target torque.
   b. Check gap for uniformity.

NOTICE

Final bolt torque value is to be the preferred torque for the selected flange gaskets. The torque value is not to exceed the standard dry torque of the 316 stainless steel bolt.

Table 3 Standard Dry Torque Values

Bolt size (inches)	Standard dry torque (ft-lbs)
1/2 - 13	45
5/8 - 11	96
3/4 -10	131
7/8 -9	202

7. Connect inlet pipe flange, gasket and transition box together using hardware provided.
   a. Apply outdoor water proof sealant between the gasket and flange surfaces.
   b. Support the connection of the inlet pipe flange and transition box from the bottom to reduce stress on the transition box.
   c. Apply anti-seize gel to the bolts before installing washers and nuts.
   d. Install flat washers, lock washers and nuts onto the transition box bolts.
8. Use the cross pattern tightening sequence. Refer to Figure 12 and Table 4.

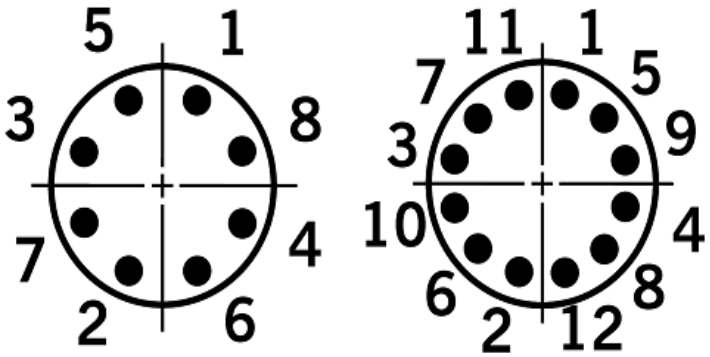


Figure 12 Cross Pattern Tightening Sequence

Table 4 Final Torque Percentage

Round	Percentage of final torque (%)
1	25
2	50
3	100

9. Check gap around the circumference between each round, measured at every other bolt. If the gap is not reasonably uniform around the circumference, make the appropriate adjustment by selective bolt tightening before proceeding.

NOTICE

Short term bolt pre-load loss can occur between 4 to 24 hours after initial tightening due to relaxation. Consider re-tightening to help recover this loss.

10. Repeat steps 6 through 9 for outlet pipe flange.
11. Attach the channel to the slab with the transition boxes. Refer to Figure 13.

    Note: *For installations with turn boxes, refer to Figure 16 and Figure 17.*

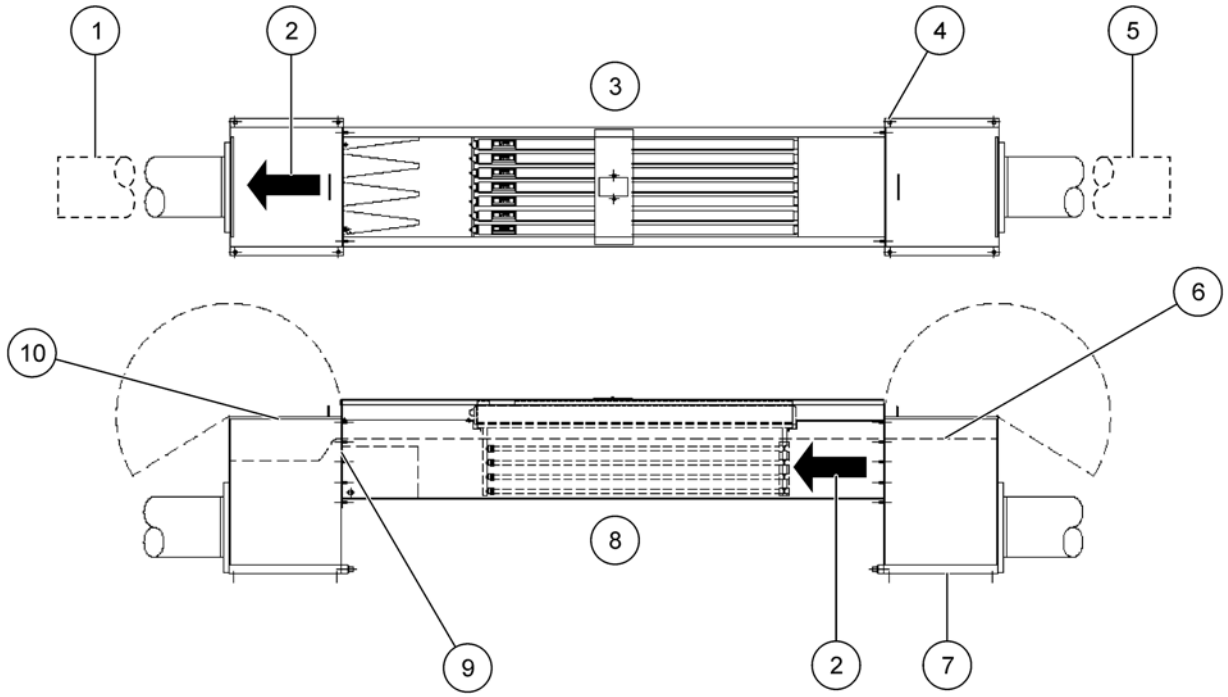


Figure 13 Stainless Steel Channel with Transition Boxes

1	Outlet pipe (customer-supplied)	**6**	Water level
2	Flow direction	**7**	Translation box (typical installation at both ends)
3	Plan view	**8**	Side view
4	Anchor bolts, 10 mm (3/8 in.), (customer supplied) (4)	**9**	Water-tight seal (typical installation at both ends)
5	Inlet pipe (customer-supplied)	**10**	Hinged lid with handle (typical installation at both ends)

12. Make sure that the channel is level with a tolerance of 6.4 mm (¼ in.) at either end. Refer to Figure 14.

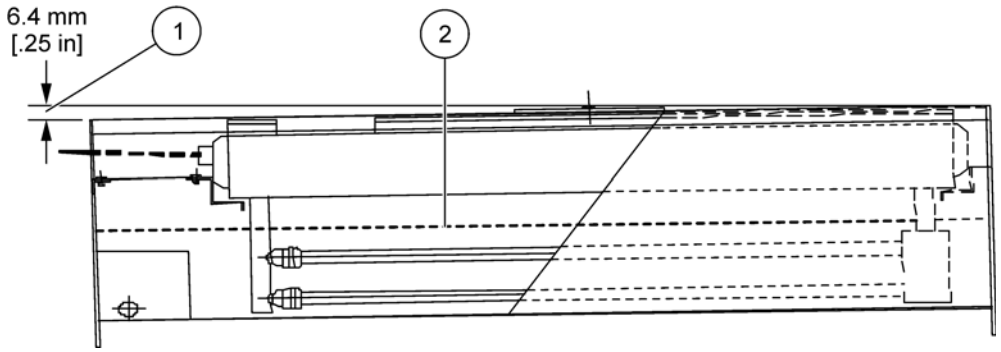


Figure 14 Level the Channel

1	Level tolerance	**2**	Water level

13. Make sure that the weir is in a free discharge at peak flow. Minimal discharge is 2.5 to 3 in. Refer to Figure 15.

14. Make sure that the correct water level heights are available for peak flow conditions. Refer to Figure 15.

Table 5 Peak Flow Conditions

Peak Flow	Water Level Heights
UV3025K-UV3300K	150 - 180 mm (6-7 in.)
D3025K-D3300	165 - 200 mm (6.5-8 in.)
UV3400K to UV3001M	305 - 320 mm (12-12.5 in.)
D3300-D3001M	355 mm (14 in.)

15. Insert UV modules back into the channel and plug them into suitable outdoor outlets.

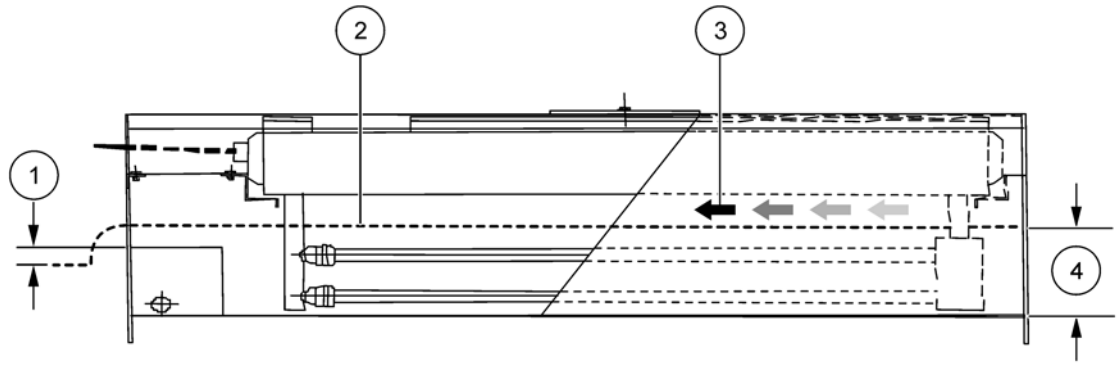


Figure 15 Free Discharge and Hydraulic Profile Verification[1]

1	Minimal distance after weir at peak flow	**3**	Water flow
2	Water level	**4**	Water height for peak flow

[1] To convert inches to millimeters (mm), multiply by 25.4.

6.5.3 Turn Box Installation Option

Prerequisites:

- Remove the UV modules. Refer to Section 8.3.1.
- Connect the inlet and outlet transition boxes Refer to Section 6.5.2.

Tools:

- Turn box

Materials:



Procedure:

1. Make sure that the turn box flange surfaces are clean and dry.
2. Apply outdoor sealant between the gasket and flange surfaces.
3. Assemble the channels and turn box. Refer to Figure 16.

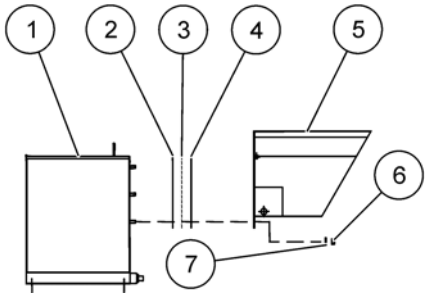


Figure 16 Turn Box and Channel Assembly

1	Turn box	**5**	Channel
2	Outdoor sealant	**6**	Nut
3	Gasket	**7**	Flat washer
4	Outdoor sealant		

4. Tighten the channel flanges, gaskets and turn box together by using the hardware provided.
5. Return to Section 6.5.2 to complete the installation instructions.

Note: *All interconnecting piping, associated material, such as gaskets, will be supplied by the customer.*

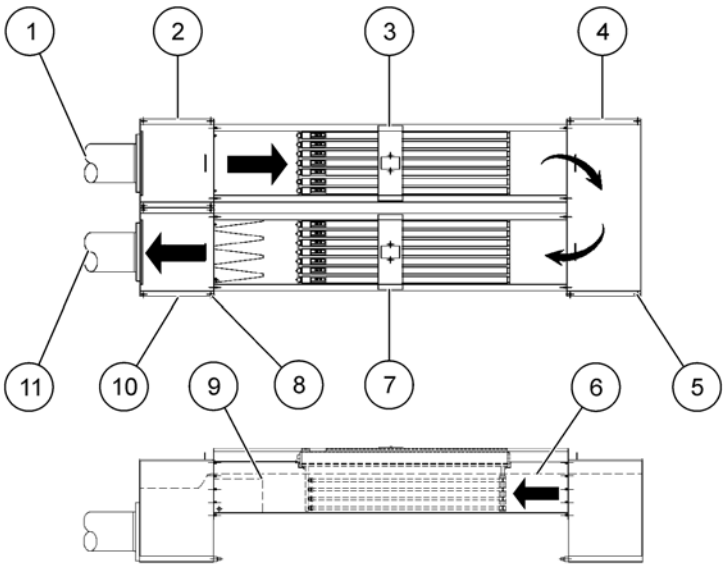


Figure 17 Stainless Steel Channel with Transition Boxes and Turn Box

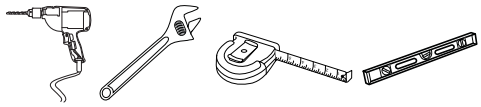
1	Inlet, (customer-supplied)	**7**	Downstream channel
2	Transition box, upstream	**8**	Anchor bolts, 10 mm ($^{3}/_{8}$ in.), (customer-supplied) (4)
3	Upstream channel	**9**	Level control weir
4	Turn box	**10**	Transition box, downstream
5	Anchor bolts, 13 mm (0.5 in.), (customer-supplied) (4)	**11**	Outlet, (customer-supplied)
6	Water level		

6.5.4 Concrete Channel Installation Option

For installation where stainless steel channels will not be used, a concrete channel must be poured by a customer-supplied contractor according to the dimensions specified on the drawings supplied by Trojan Technologies. Install all needed conduits (electrical and communication) before the concrete pad is poured. The manufacturer recommends that concrete not be poured around a stainless steel channel, transition or turn box.

UV module racks and level control weirs are installed in a poured concrete channel by qualified contractors.

Tools:



Materials:



Procedure:



Refer to Figure 18 for the installation procedure.

1. Secure the UV module support rack to the channel walls with 10 mm ($^3/_8$ in.) anchor bolts. The center line of the anchor bolt should be mounted 400 mm (15.75 in.) from the channel floor.
2. Verify the correct height of the rack and install the UV modules. The dimension from the bottom of the channel to the top of the top lamp sleeve should be 279 mm (11 in.). An additional reference dimension is measured from the channel floor to the center of the first lamp, 38 mm (1.5 in.).
3. Attach the level control weir to channel floor and walls with 10 mm ($^3/_8$ in.) anchor bolts. Put grout around all outside edges for a watertight seal.

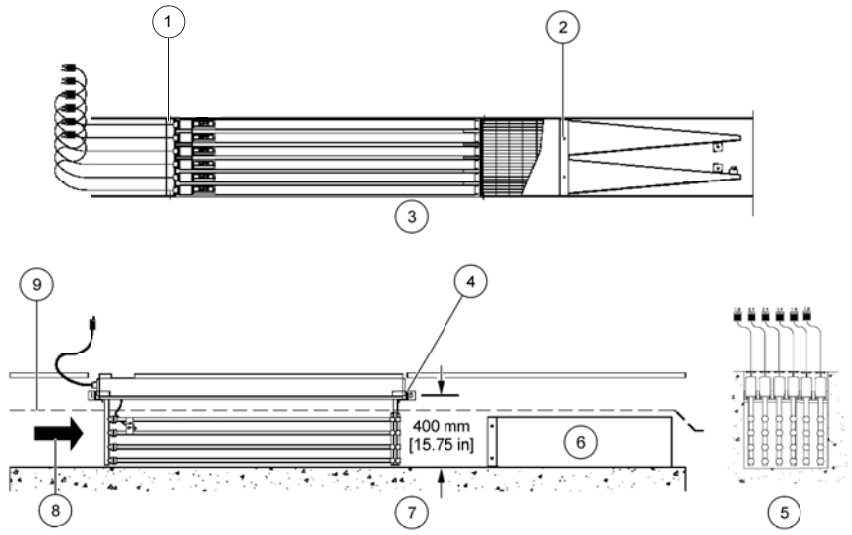


Figure 18 Concrete Channel Installation[1]

1	Anchor bolts, 3/8 in., (customer supplied) (x4)	**6**	Level control weir
2	Seal, anchor bolts, 3/8 in., (customer supplied)	**7**	Side view of channel
3	Plan view of channel	**8**	Flow direction
4	UV rack, vertical adjustment ± 0.5 in.	**9**	Hydraulic profile
5	End view of channel		

[1] To convert inches to millimeters (mm), multiply by 25.4.

6.6 UV Sensor

The UV sensor is mounted on one UV module per bank of UV modules, and its installation is typically located on the second lamp sleeve from the top of a UV module. The UV sensor is mounted such that it faces away from the effluent flow.

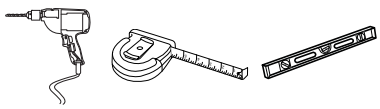
6.7 Install the System Monitor (Optional)

Prerequisites:



- Apply lockout tag out devices as necessary. Refer to Section 4.

Tools:



Materials:



Procedure:

1. Put the System Monitor in the final installed position.
2. Attach the System Monitor enclosure to the wall as required with 6-mm (¼ in.) bolts. Put the user interface at a height that will allow the operator to read the screen easily.

3. Drill holes in the bottom of the System Monitor enclosure. Clean up any shavings.
4. Attach and terminate the power supply (in the appropriate conduit, wire tray, etc.). Refer to the enclosure assembly drawing in the electrical drawings.
5. Plug in the power cords from the UV sensor.

6.8 Water Level Controller

For systems installed in a *concrete channel* a level control weir may need to be installed. Refer to the layout drawings provided by Trojan for location of the water level controller. Refer to **DC4501xx** for Water Level Controller installation instructions.

For systems installed in a *stainless steel channel*, the level control weir will be located in either the UV Channel or in the outlet transition box also known as a weir box. Follow Section 6.5.1 or Section 6.5.2 as required for installation instructions.

6.9 Equipment Interconnections

The system interconnections are shown in the drawings supplied by the manufacturer or a qualified contractor.

- One main power feed terminated at the service entrance for each of the splitter panels
- One power supply is to be terminated at the System Monitor

6.9.1 UV Intensity Output

The 4-20mA output port, TB3 may be used to remotely monitor the UV Intensity. The output is optically isolated so does not require external isolation. The output will drive the UV Intensity signal into a load of up to 500 ohms. This output is scaled such that 4mA represents 0 mW/cm^2 and 20mA represents 14 mW/cm^2.

6.10 Startup and System Commission

After the shipment of the UV system, the contractor will be issued documentation for a start-up request (issued by the local representative). These documents must be completed and returned to the issuer before a commission date can be scheduled.

⚠ DANGER

Obey all warning and caution statements. Refer to Section 2.

Read and understand this manual before operating this equipment. Read all user documentation before performing operations, inspections, repair, or maintenance on this equipment.

Only competent personnel should undertake operation, repairs, maintenance, or servicing of equipment described in this section of the manual. If you do not understand the information or procedure explanations in this manual, STOP and contact your Service Provider for assistance.

7.1 System Monitor Operation

7.1.1 System Monitor Configuration

Refer to Figure 19 for the System Monitor configuration

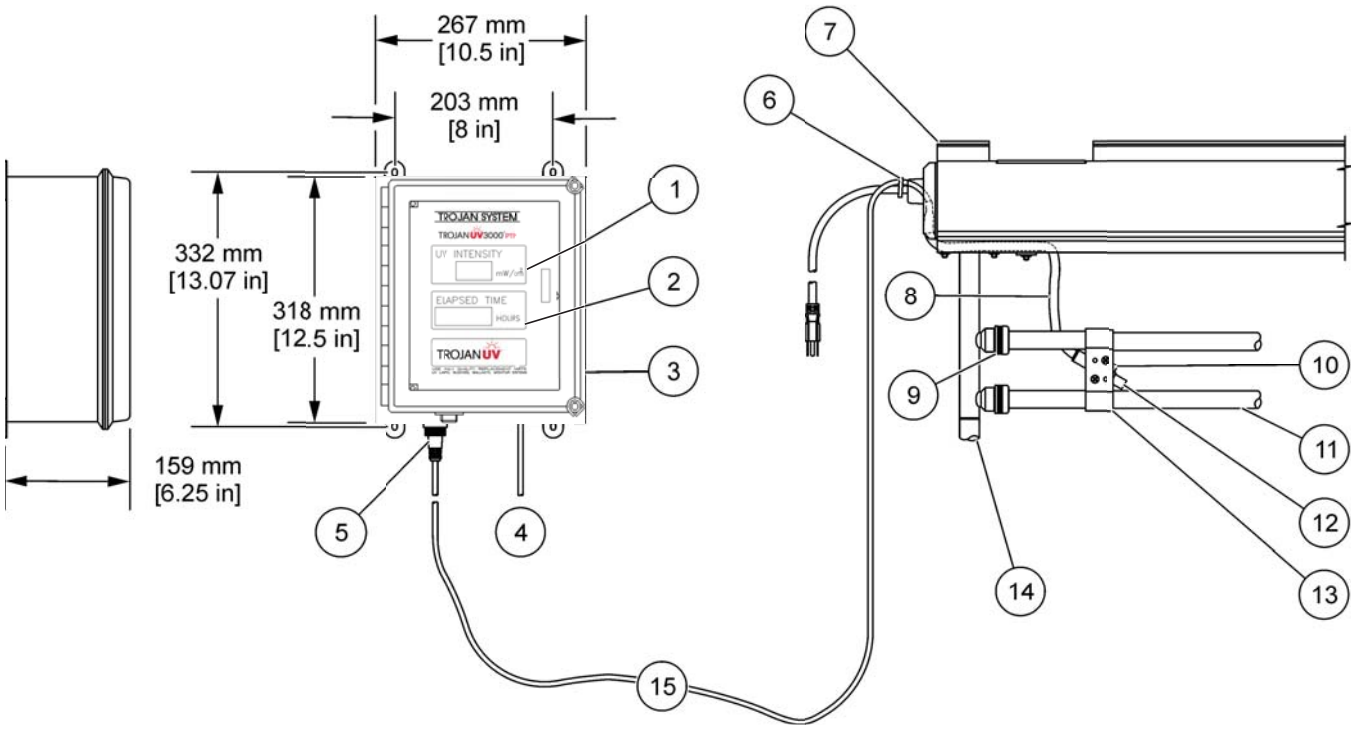


Figure 19 System Configuration

1	UV intensity display	**9**	Sleeve nut
2	Elapsed time display	**10**	UV sensor assembly
3	System Monitor enclosure	**11**	Lamp sleeve
4	Power supply	**12**	UV sensor window[1]
5	Connector	**13**	Brackets and Teflon®[2] sleeves
6	Cable tie	**14**	UV module leg
7	UV module extrusion	**15**	Cable, 4.57 m (15 ft)
8	Armor cable		

[1] Make sure that the Teflon ring in the UV lamp does not interfere with the alignment of the UV sensor window.

[2] Teflon is a registered trademark of DuPont Corporation.

7.1.2 Read the UV Sensor

Refer to Figure 20 for System Monitor setup information.

This is the normal mode of operation for the System Monitor display.

1. Set the dip switch #1 to the ON position.
2. Set switches #2, 3, and 4 to the OFF position.

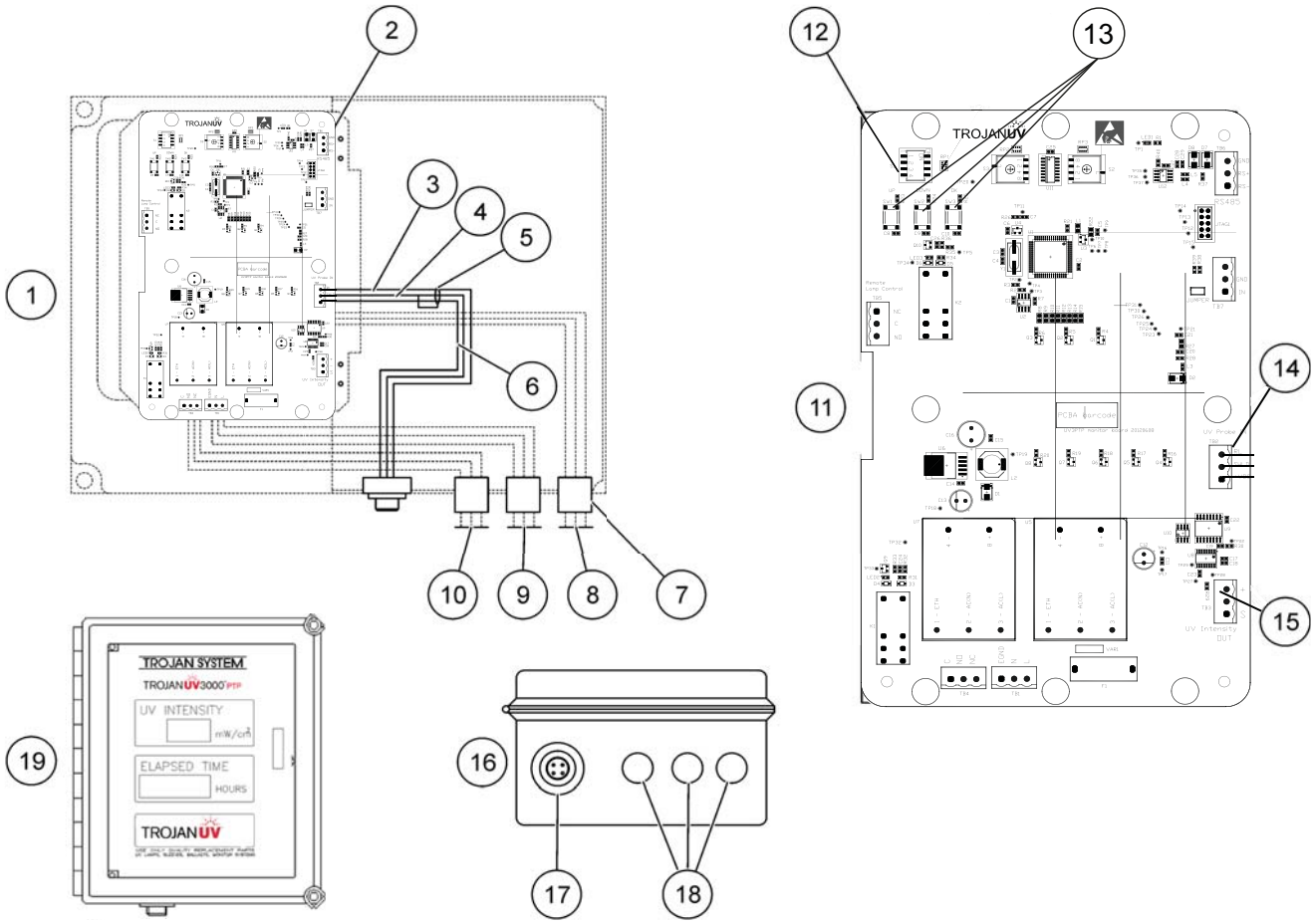


Figure 20 System Setup

1	System Monitor enclosure, open view	**11**	Printed circuit board
2	Printed circuit board	**12**	DIP switches, 1 through 4
3	Wire, red and black	**13**	Keys (Up/Down/OK)
4	Wire, green	**14**	UV sensor, IN
5	Shield	**15**	UV intensity, OUT
6	Wire, red	**16**	System Monitor enclosure, bottom view
7	Sealed strain relief or conduit hub	**17**	UV sensor receptacle, female
8	Remote UV sensor, 4-20 mA	**18**	Conductors (power, alarm, remote UV sensor) and fittings, customer supplied
9	Power supply	**19**	Swing-out panel, front view
10	Remote alarm		

7.1.3 Clear the Elapsed Time Display

Refer to Figure 20.

To clear the hour reading on the display:

1. In normal mode, set DIP switch #3 to the ON position to enter clearing elapsed time mode.
2. Wait for 5 seconds, the elapsed time LEDs should display 0 hours and flicker, means that clearing operation succeed.
3. Return the DIP switch to normal mode.

7.1.4 Set the UV Intensity Alarm

Refer to Figure 20.

1. Remove all connectors from old Monitor Board.
2. Install connectors in the same positions on the new Monitor Board as they were on the old Monitor Board.
3. Remove Lockout Tag Out and restore power to the UV System.

   Note: *Lamp Hours in the new board is set to 0. During lamp replacement, the elapsed time recorded in the prerequisites must be added to the time displayed.*

4. If required, set the UV Intensity Alarm Set Point using the DIP Switches.

   Note: *All boards are pre-configured with the default value of 1.6 mW/cm^2.*

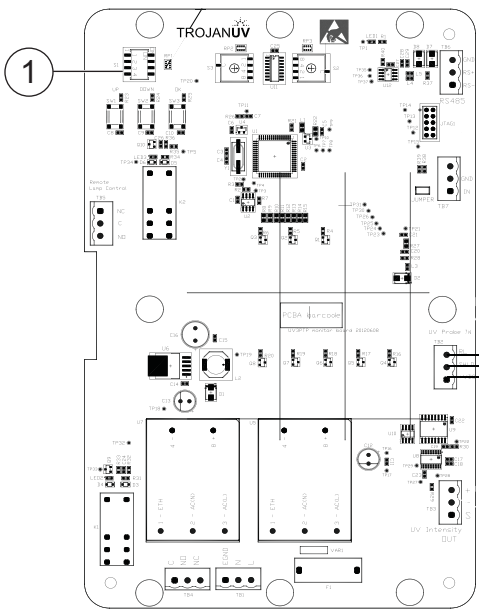
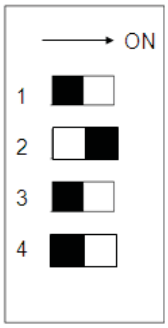


Figure 21 DIP Switches - Location

1	DIP Switches

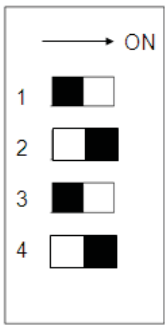
   a. Set the DIP Switch #2 to the ON position.

b. Set DIP Switches #1, #3 and #4 to the OFF position, the UV Intensity display LED's will now show the alarm set point.



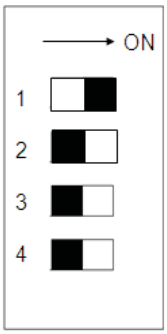
c. On the back side of the board, press the “UP” and “DOWN” buttons to adjust the UV Intensity set point to the desired level.

d. Set DIP Switch #4 to the ON position, wait five (5) seconds. The UV Intensity display will flicker, indicating that the change has been accepted.



e. Set DIP Switch #1 to the ON position.

f. Set DIP Switches #2, #3 and #4 to the OFF position.



Section 8 Maintenance

⚠ DANGER



Obey all warning and caution statements. Refer to Section 2.

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Only competent personnel should undertake operation, repairs, maintenance, or servicing of equipment described in this section of the manual. If you do not understand the information or procedure explanations in this manual, STOP and contact your Service Provider for assistance.

Refer to Section 10 for replacement part numbers.

8.1 Preventative Maintenance Schedule

Scheduled maintenance and inspections can extend the life of the system and prevent problems. Routine maintenance may include partial disassembly to access components for cleaning and visual evaluation. Table 6 shows the maintenance schedule. During any maintenance activity, the manufacturer recommends inspection of all components that can be seen. Some of the preventative maintenance tasks may also need to be done to remove a condition that caused a system alarm.

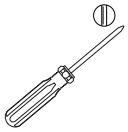
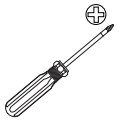
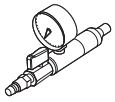
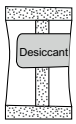
Table 6 Preventive Maintenance Schedule

System component	Maintenance requirement	On Removal	Daily	Monthly	Every 2 Months	Annually	12,000 hours
UV System	Visual walk-about inspection		x				
	Clean the UV channel around the UV system. Perform semi-annually for poor water quality conditions					x	
Water Level Control	Inspect for algae or debris and remove as needed. Perform once every two weeks for poor water quality conditions.			x			
	Inspect grouting/seals and repair/replace if any signs of cracking or damage					x	
UV Module	Inspect and if required remove debris from UV module. Use a low pressure washer (e.g. a garden hose). Perform once every two months for poor water quality conditions.	x			x		
	Remove the UV module. Replace UV lamps and lamp sleeve O-ring seals at 12,000 hrs EOLL. Refer to Section 8.3.						x
	Inspect lamp sleeve for debris or buildup. Clean if necessary. Refer to Section 8.3.3.	x		x			
	Check the UV module power cable strain relief for tightness. Refer to Section 8.3.				x		
System Monitor	Clean enclosure with a damp cloth.			x			
	Check the door seal, check for moisture.						

Table 7 Daily Visual walk -about Inspection Checklist

System component	Maintenance requirement
System Monitor	Check the display for UV intensity (if applicable).
UV Module	Check the top of the UV module for lamp status
Water Level Controller	Clean any algae or debris build-up off the weir.

8.2 Tools and Materials

Symbols	Description	Symbols	Description
	Slot screwdriver		Isopropyl alcohol
	#2 Phillips screwdriver		Rubbing alcohol
	Silicone lubricant		ActiClean™ Gel (or approved cleaning solution as per Table 8)
	Adjustable Wrench		Soapy water
	Open wrench		Household cleaner
	Socket wrench		Lint free cloth
	Allen wrench		Sand paper
	Pressure washer		Air pressure test tool - Trojan Part Number 907631
	Wire stripper		Water
	Pliers		Desiccant bag

8.3 UV Module

8.3.1 Remove a UV Module

Remove the UV modules for cleaning, UV lamp replacement and lamp driver replacement.

Prerequisites:



- Make a note of the UV lamp(s) that are not energized.
- Shut down the UV system. Refer to Section 5.2.
- Apply lockout tag out devices as necessary. Refer to Section 4.

Materials:



Procedure:



1. Unplug the UV modules.
2. Use two people to lift the UV modules out of the channel.

   Note: *The manufacturer recommends that when there are more than five UV modules, the remaining UV modules should be removed from the opposite side of the channel.*
3. Put the module on a clean, dry work surface or a maintenance rack.
4. Remove debris from the module with low pressure potable water, such as a garden hose.

8.3.2 Lamp Driver

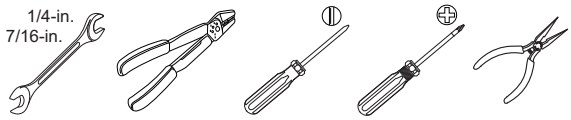
8.3.2.1 Remove and Install the Lamp Driver Tray

Prerequisites:



- Shut down the UV system. Refer to Section 5.2.
- Apply lockout tag out devices as necessary. Refer to Section 4.
- Remove the UV module. Refer to Section 8.3.1.
- Brush or wipe away any large debris from the End Cap by using a soft bristled brush or rag.

Tools:



Materials:



Procedure:

NOTICE
Use caution when sliding lamp driver tray into extrusion. Avoid damage to the lamp driver tray wiring.

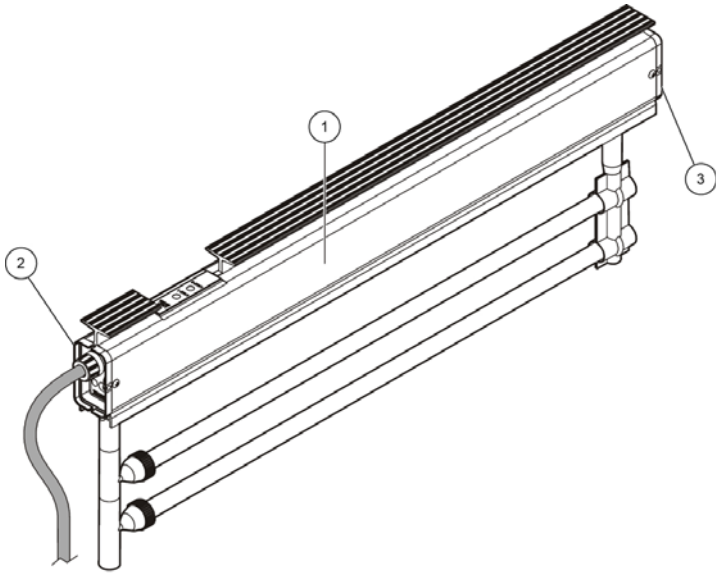
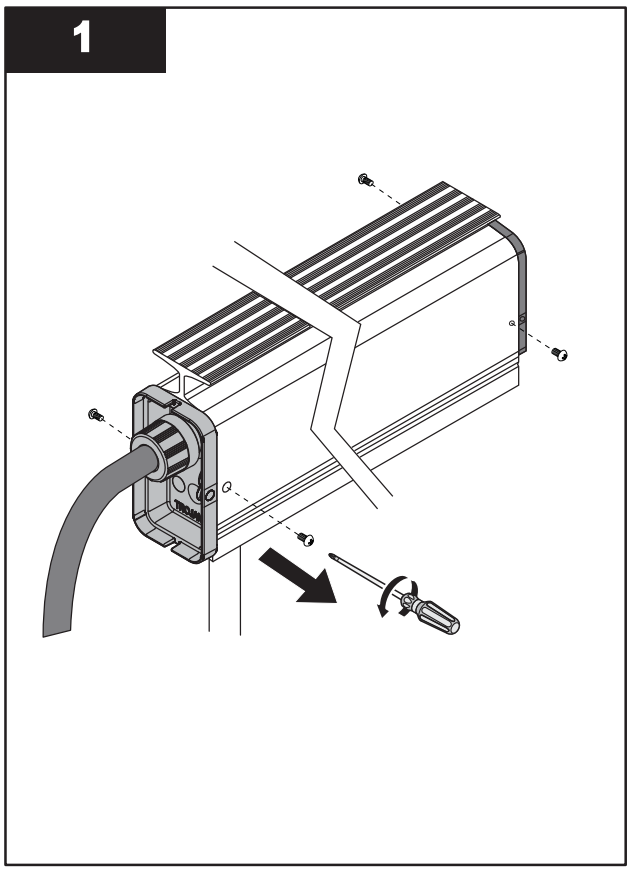
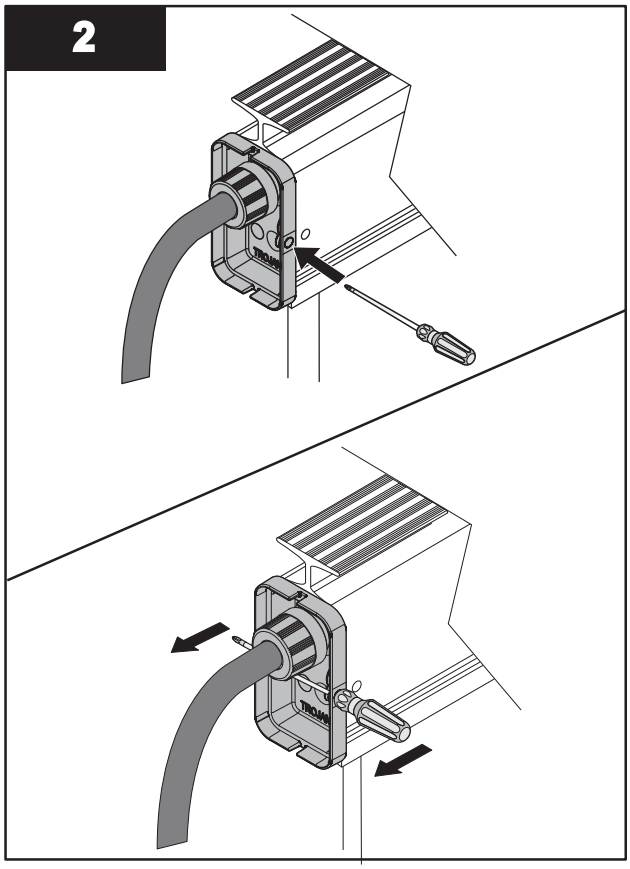
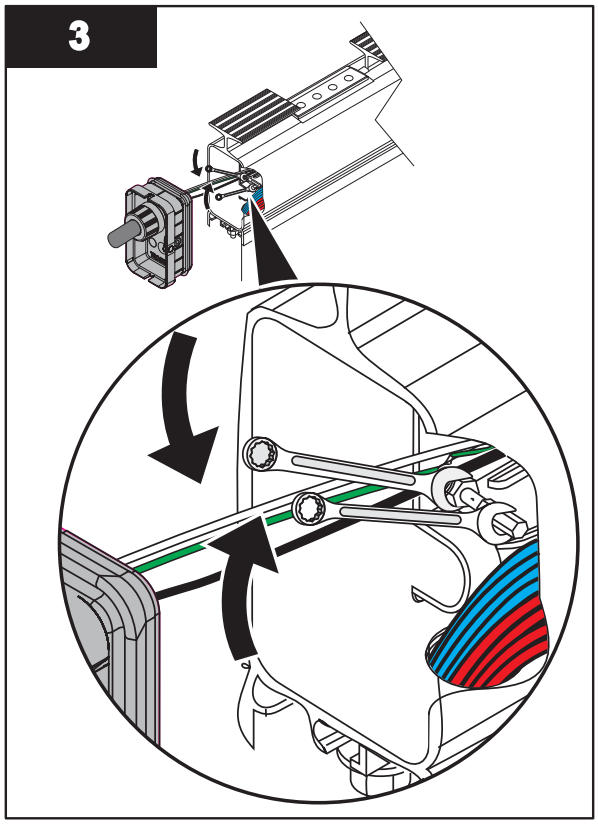


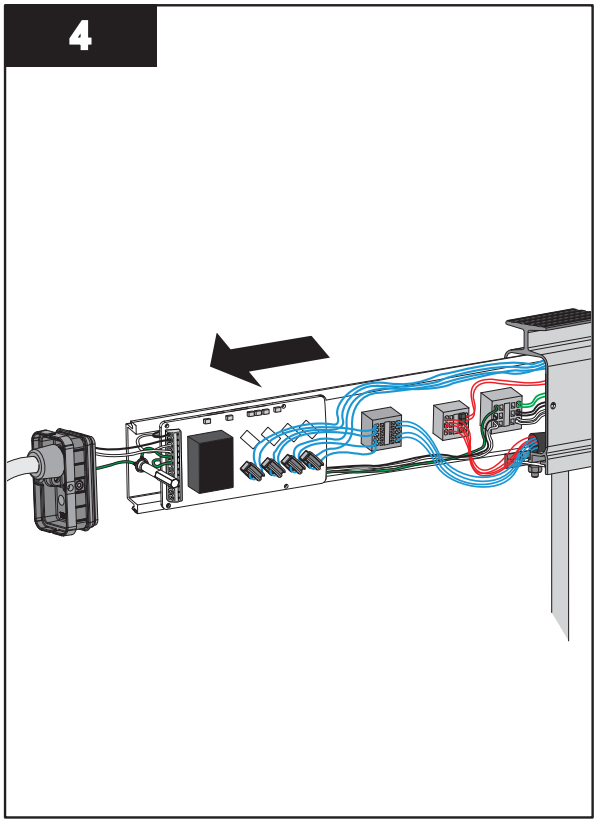
Figure 22 Lamp Driver Enclosure for the UV Module

1	Lamp driver enclosure	**3**	Plain service end cap
2	Power service end cap		

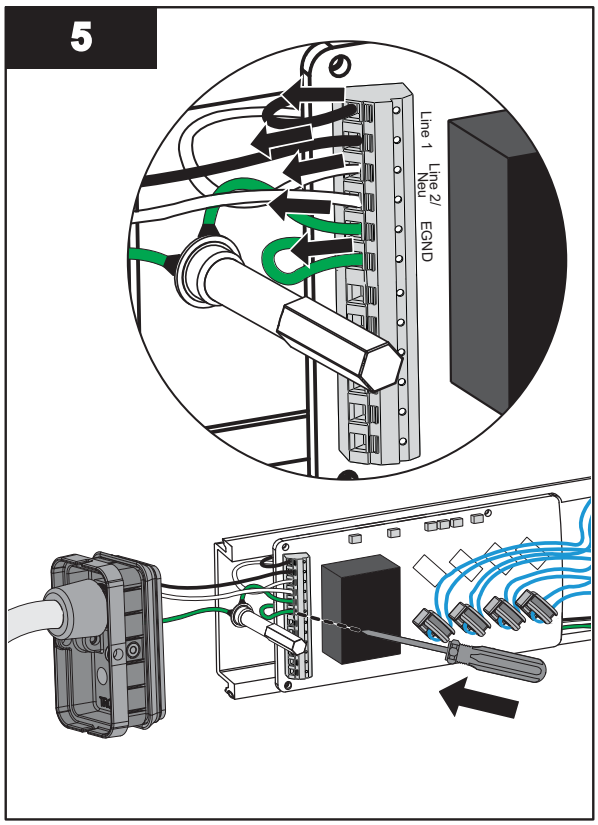


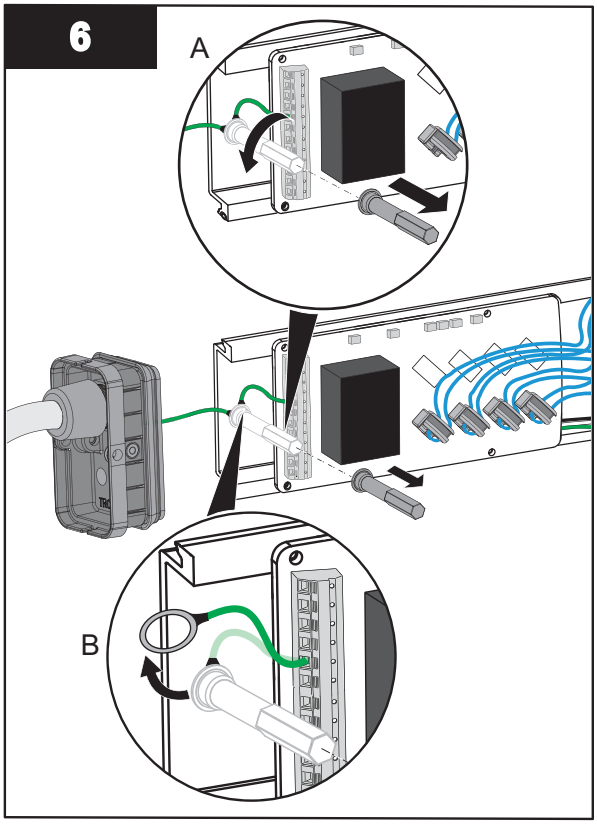


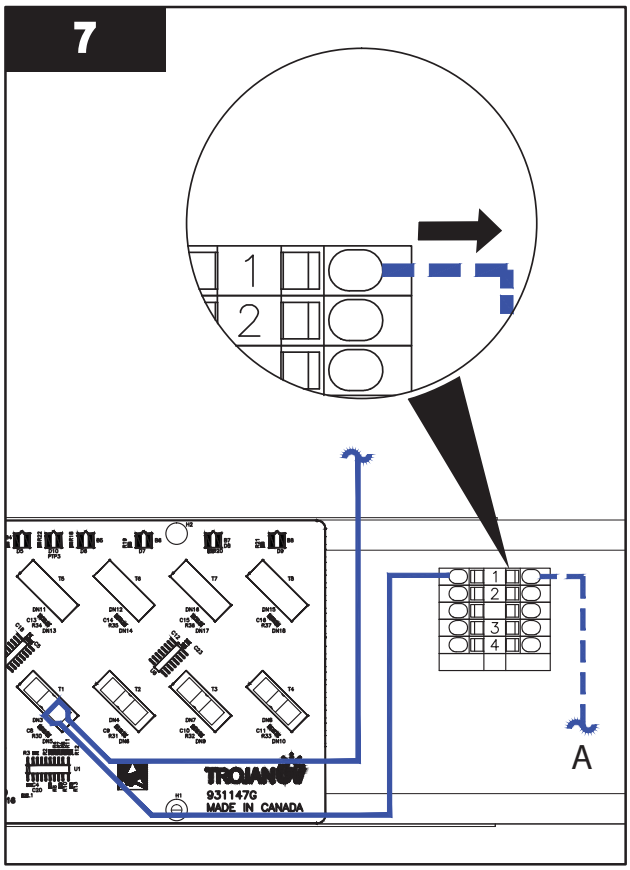




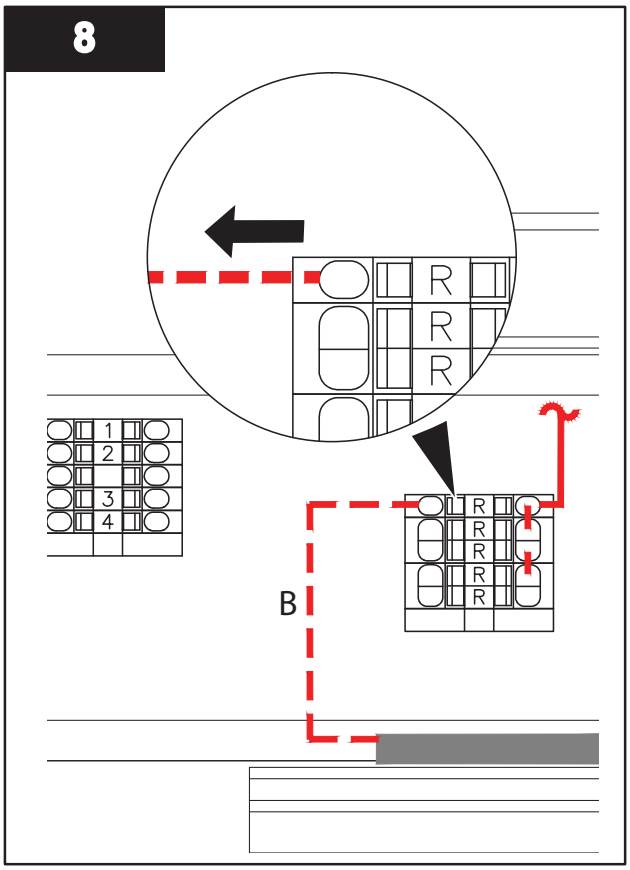
Note: *Loosen the pressure cone and nut at each end of the enclosure.* ***Note:*** *Partially remove the Lamp Driver tray from the enclosure.*



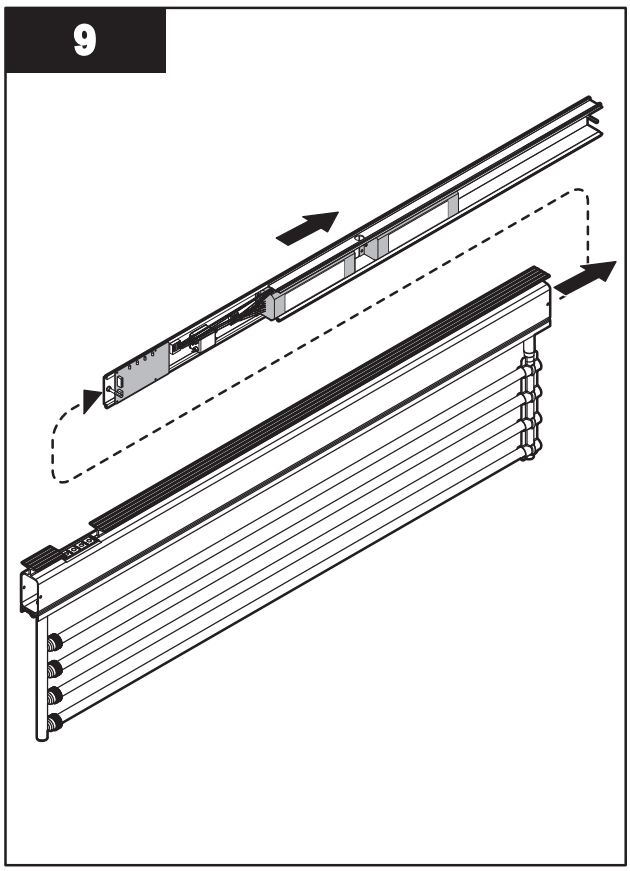




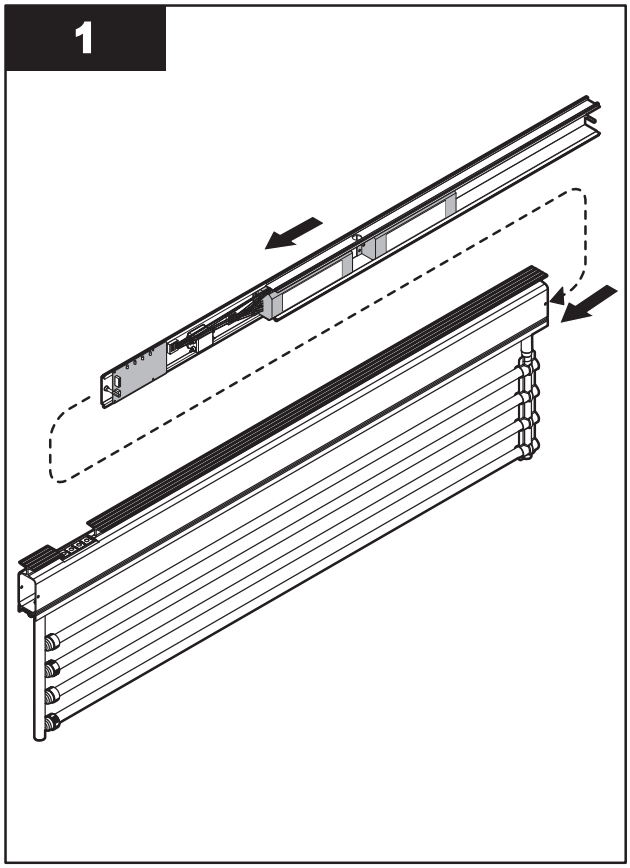
Note: *Disconnect all blue lamp wires (A) from the terminal block.*

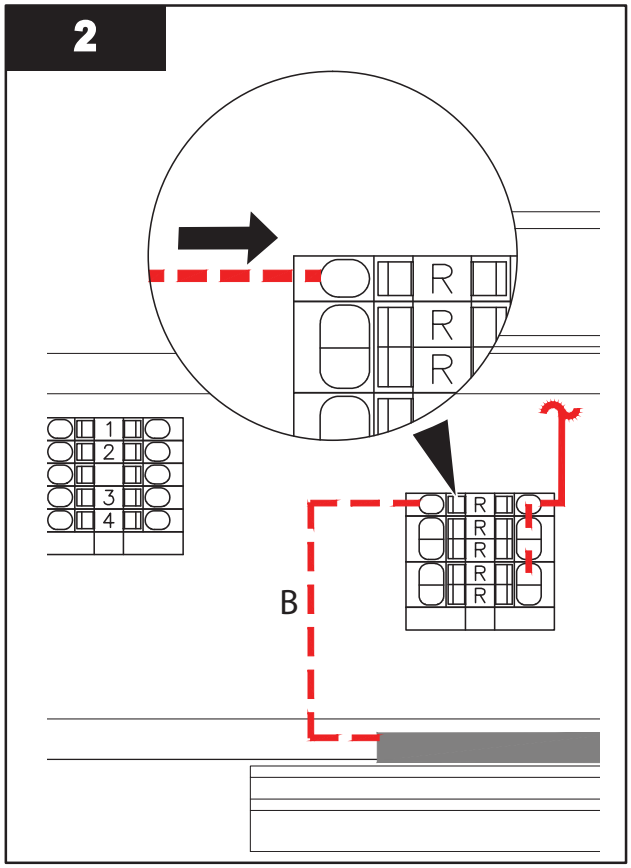


Note: *Disconnect all red lamp wires (B) from the terminal block.*

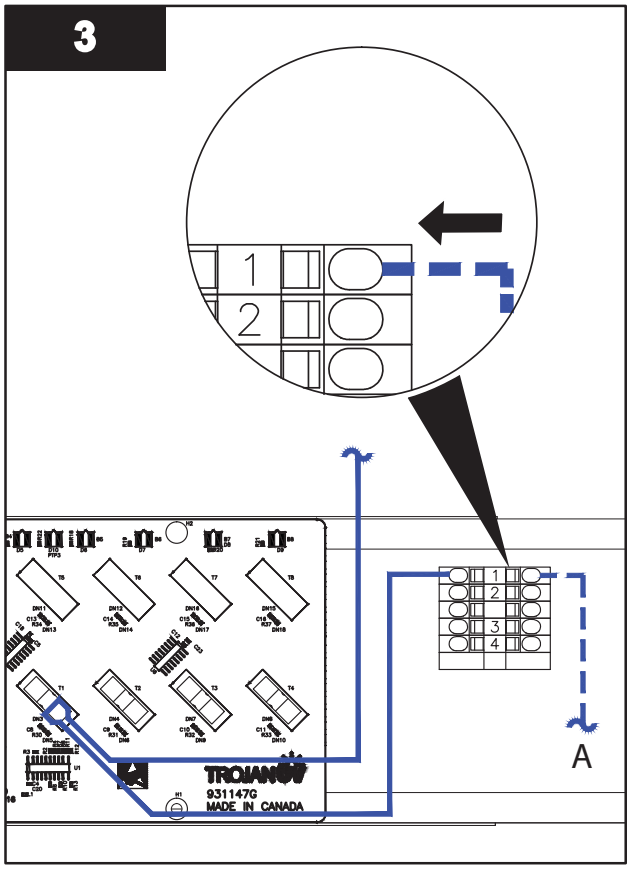


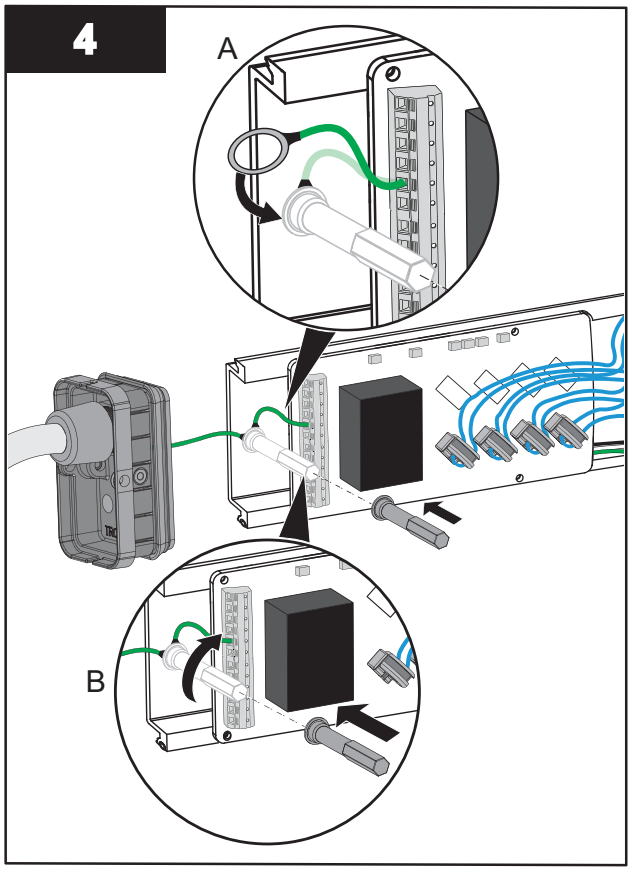
Install:



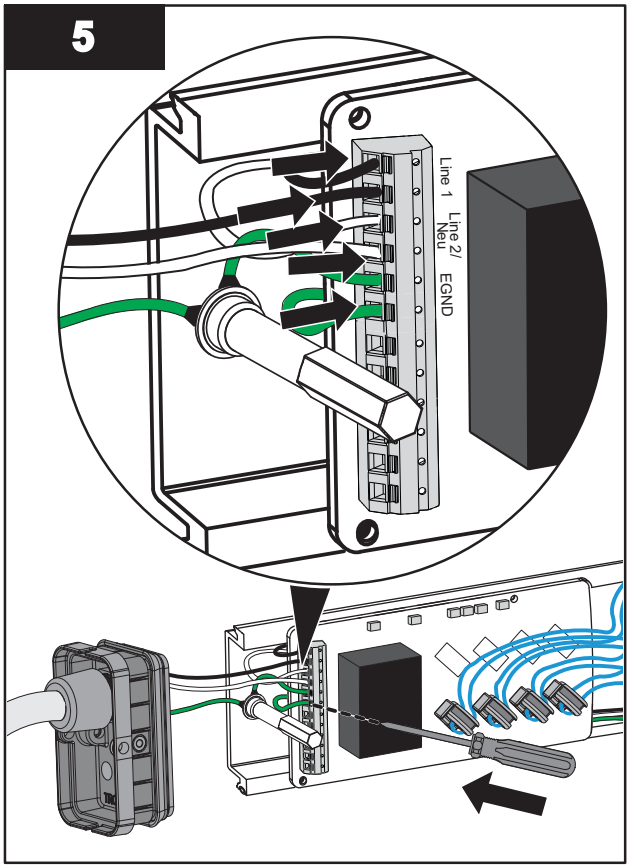


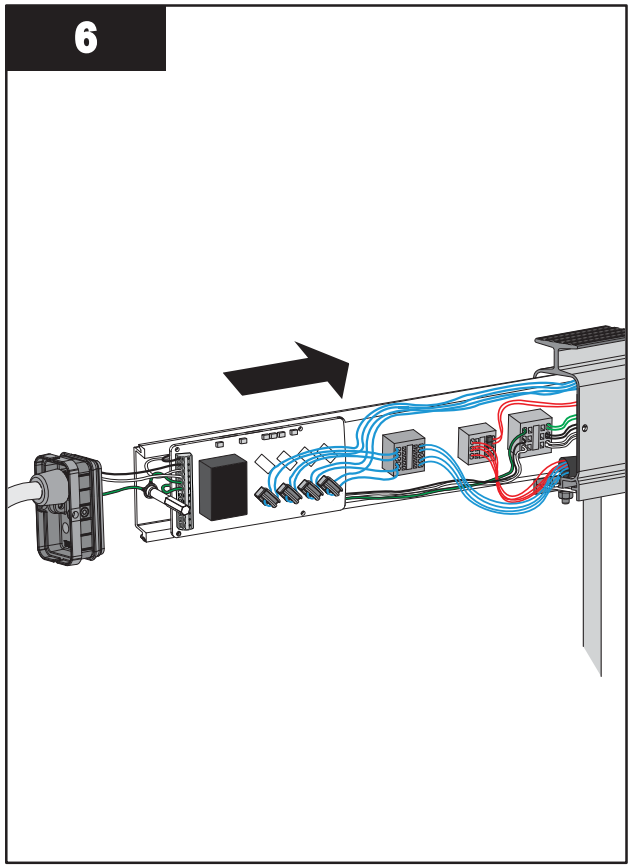
Note: *Connect all red lamp wires (B) to the terminal block.*





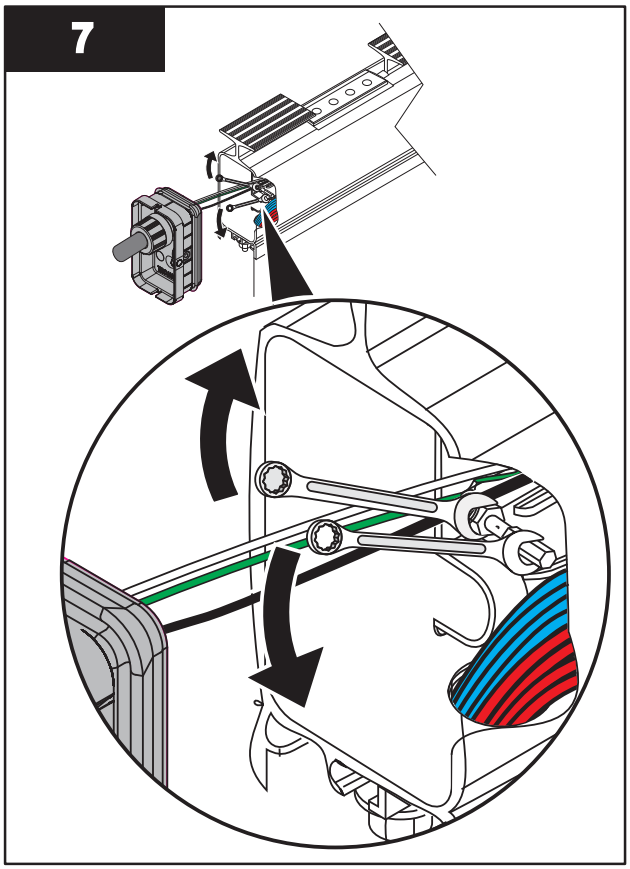
Note: *Connect all blue lamp wires (A) to the terminal block.*

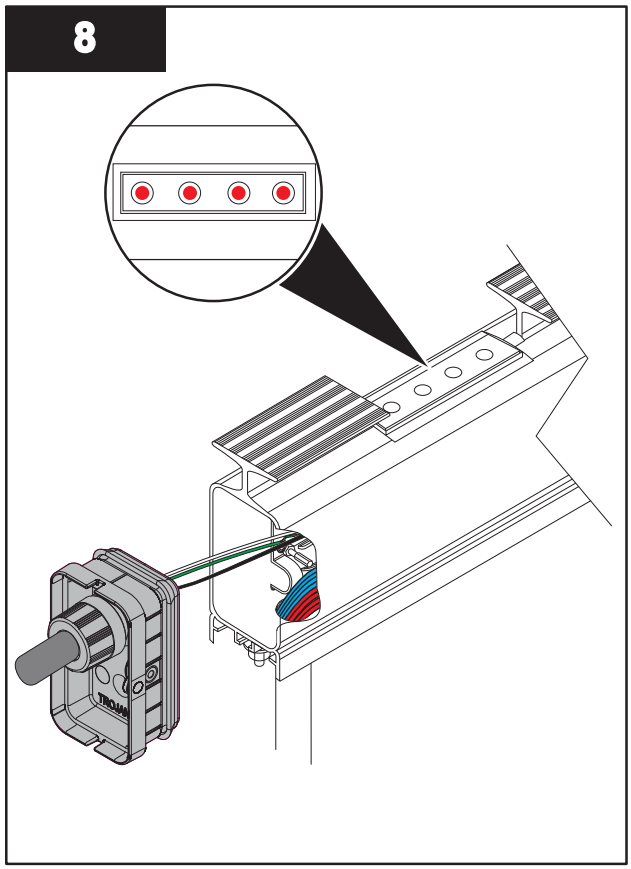




Notes: *1) The power cord strain relief must be installed toward the top of the enclosure.*

2) Terminate the black wires to Line 1, the white wires to Line 2/Neu and the green wires to EGND.





Note: *Tighten the pressure cone and nut at each end of the enclosure.* ***Note:*** *Verify that the LED's align on the viewing window.*

Post-requisites:

- Install the Service End Cap. Refer to Section 8.3.2.3.

8.3.2.2 Remove and Replace Lamp Driver

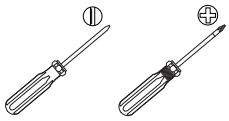
Replace a Lamp Driver when a Lamp Driver failure alarm occurs.

Prerequisites:



- Remove the Lamp Driver Tray. Refer to Section 8.3.2.1.

Tools:



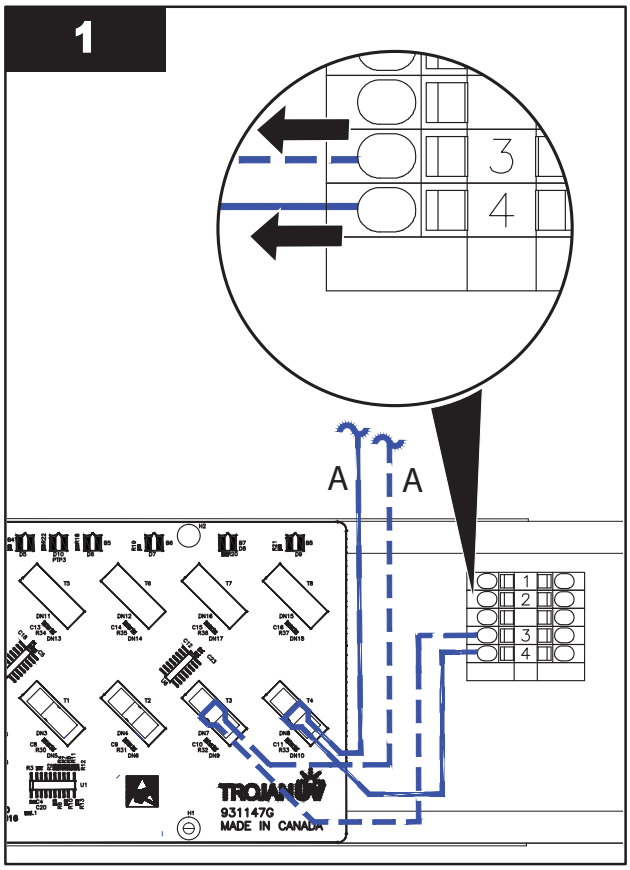
Materials:



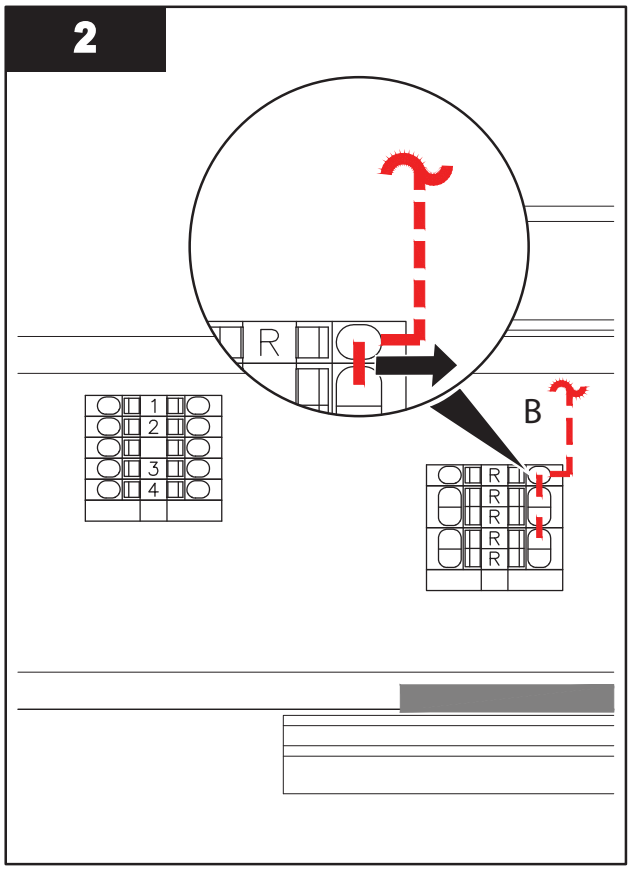
- Lamp Driver

Procedure:

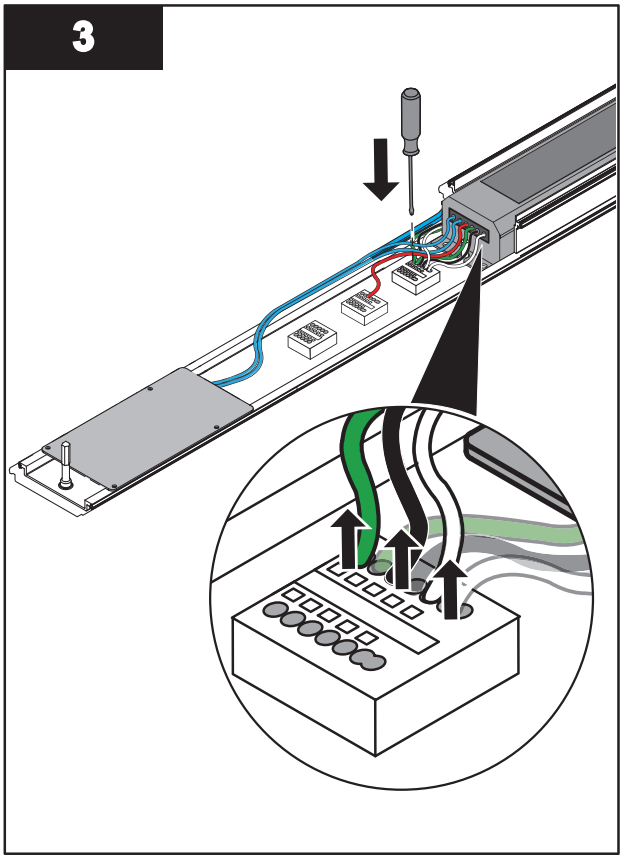
Remove:

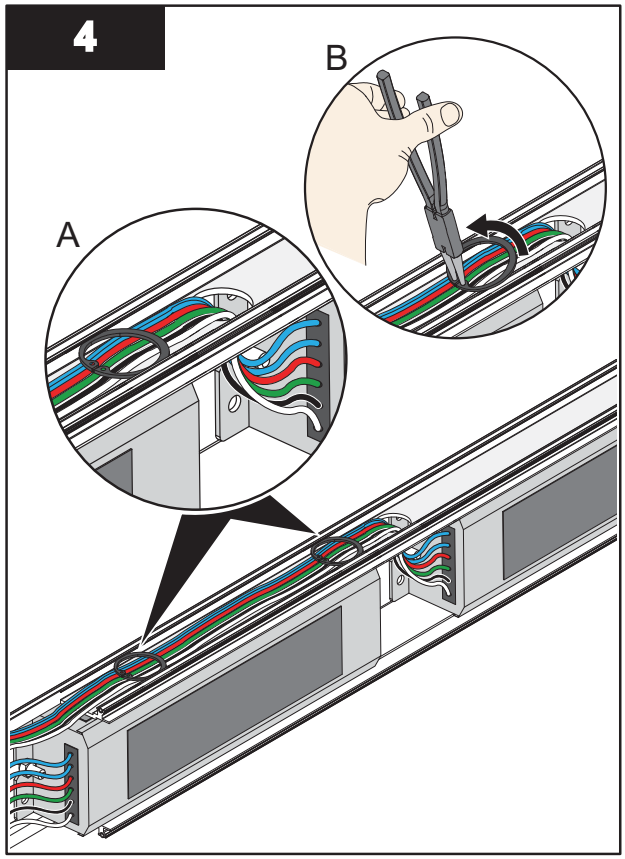


Note: *Disconnect the blue Lamp Driver wires (A) [x2] from the terminal block for the Lamp Driver that needs to be replaced.*

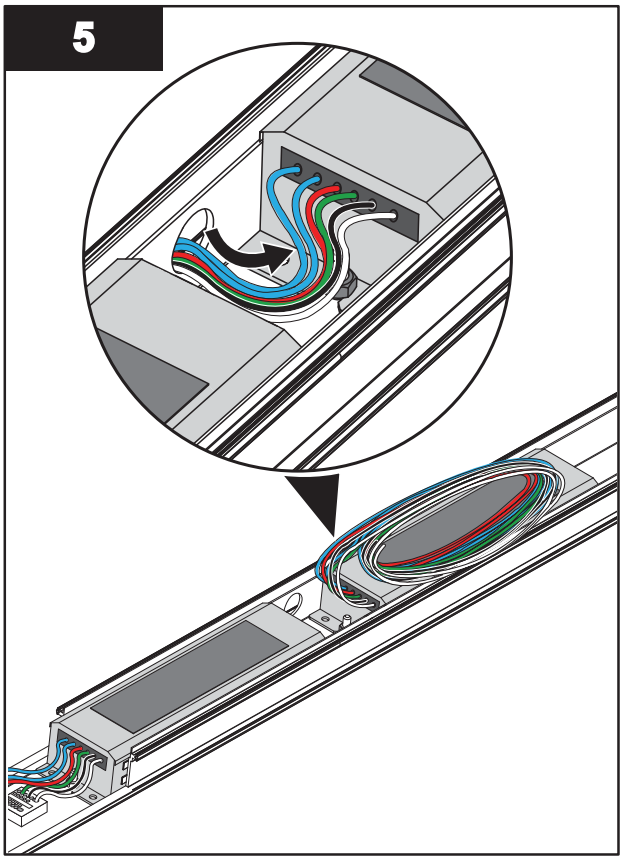


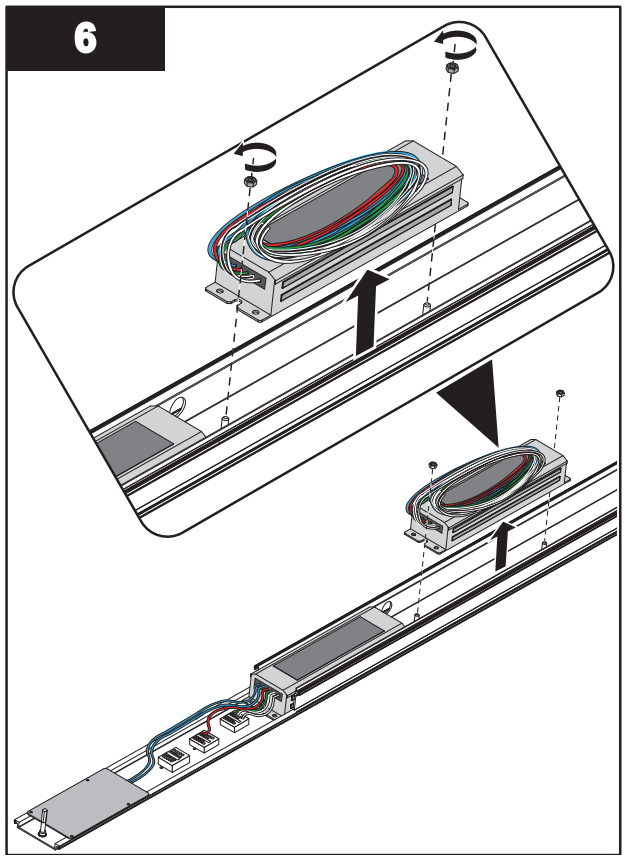
Note: *Disconnect the red Lamp Driver wire (B) from the return block for the Lamp Driver that needs to be replaced. Depending on the quantity of Lamp Drivers, the terminal block may be located in between the Lamp Drivers.*





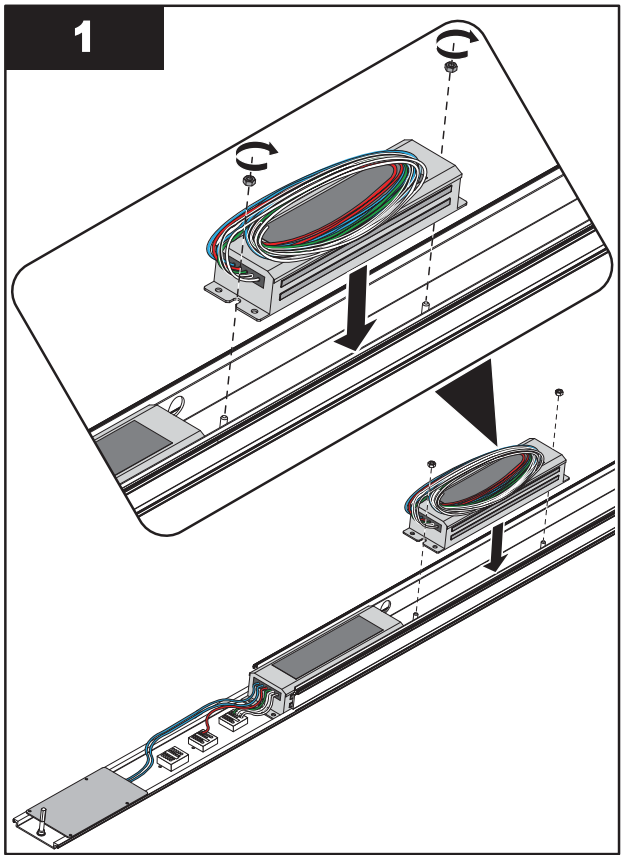
Note: *Disconnect the power wires for the Lamp Driver that needs to be replaced. Depending on the quantity of Lamp Drivers, the terminal block may be located in between the Lamp Drivers.*

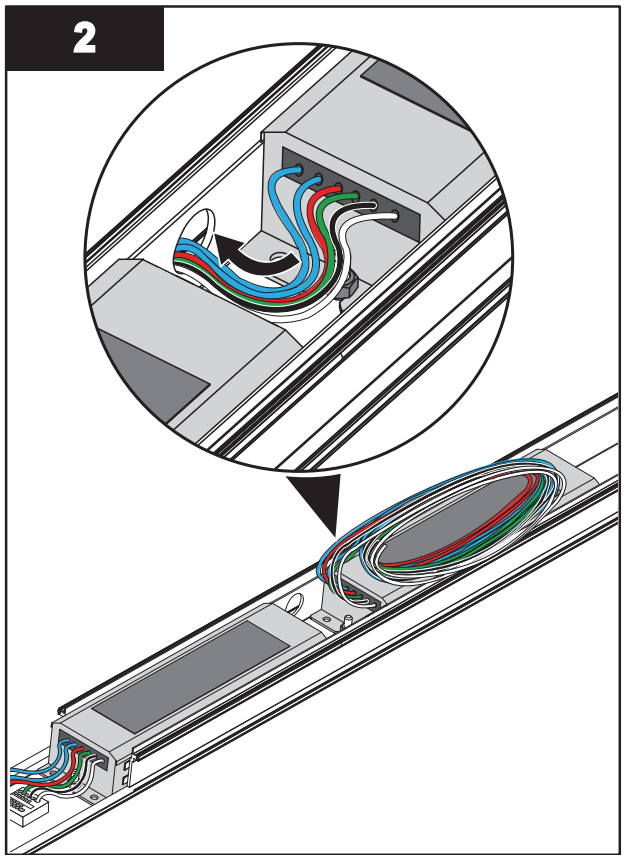


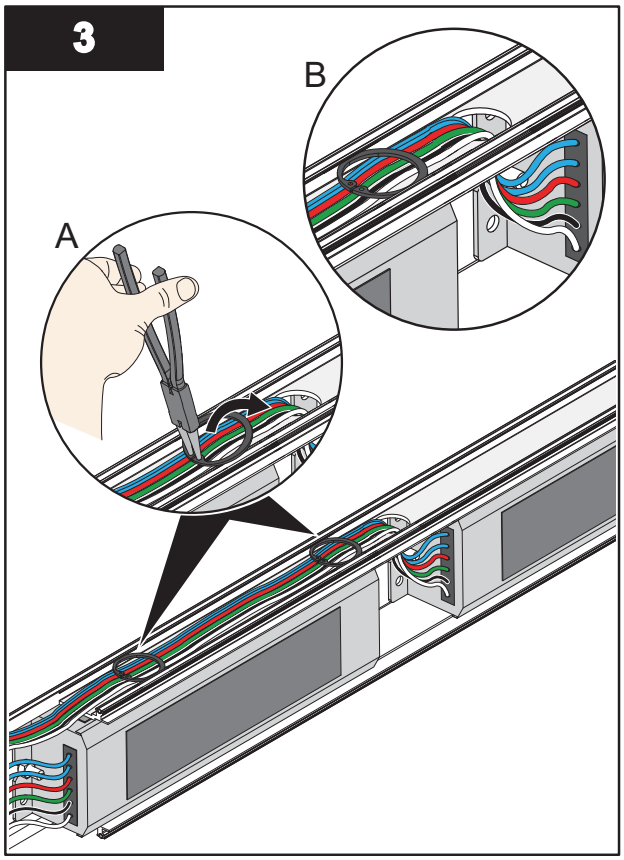


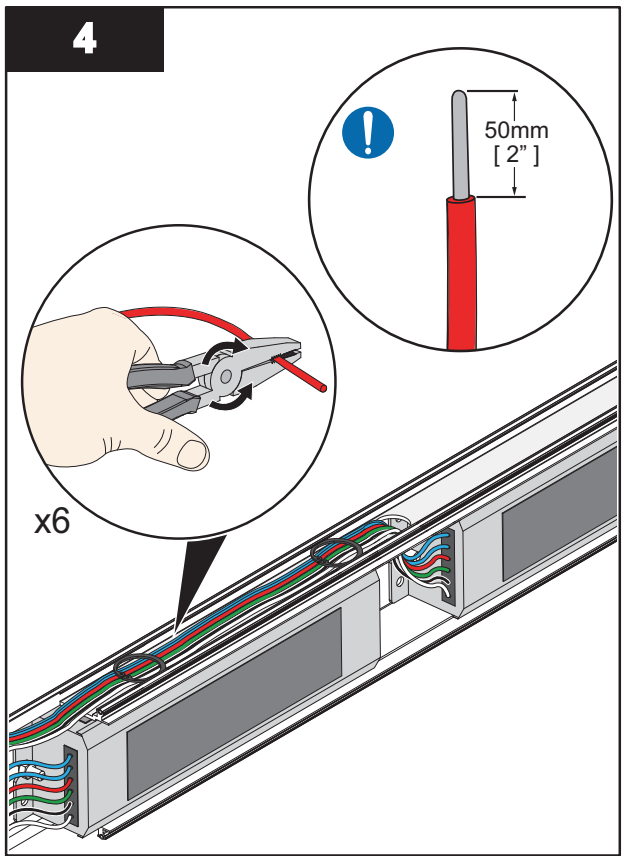
Note: *Loosen and remove Lamp Driver mounting hardware.*

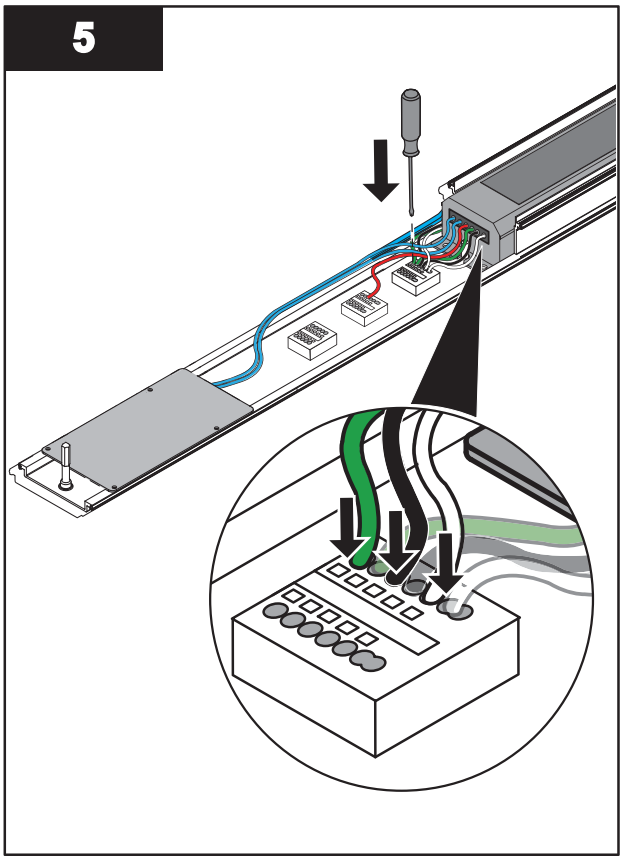
Install:



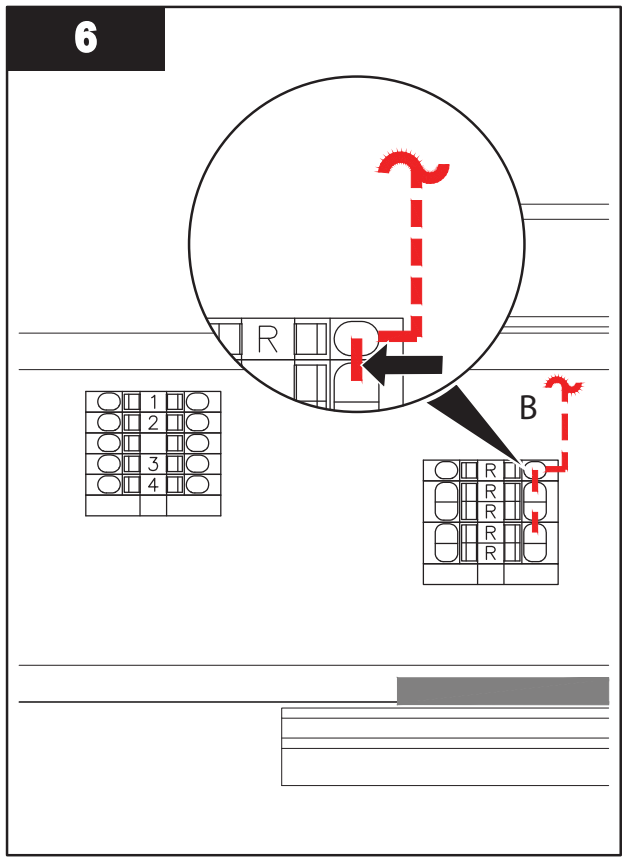




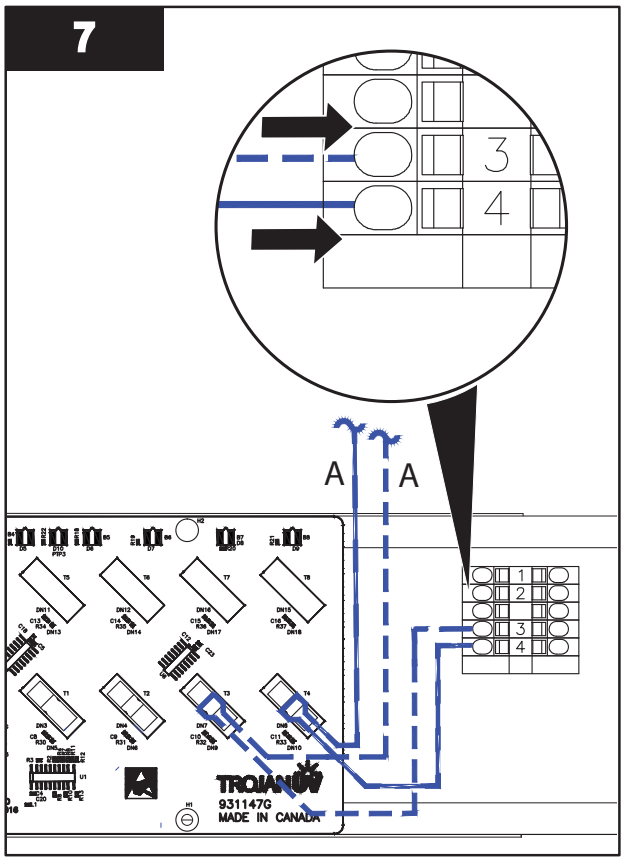




Note: *Connect the power wires for the new Lamp Driver. Depending on the quantity of Lamp Drivers, the power terminal block may be located in between the Lamp Drivers.*



Note: *Connect the red Lamp Driver wire (B) to the terminal block. Depending on the quantity of Lamp Drivers, the terminal block may be located in between the Lamp Drivers.*



Note: *Route the blue Lamp Driver wires (A) [x2] through the toroid core and connect to the terminal block.*

Post-requisites:

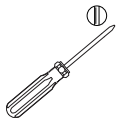
- Install the Lamp Driver Tray. Refer to Section 8.3.2.1.

8.3.2.3 Install the Service End Cap

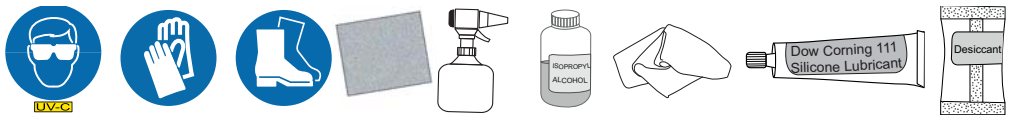
Prerequisites:

- Install the Lamp Driver Tray. Refer to Section 8.3.2.1.

Tools:



Materials:



- Silicone Seal (if needed)
- Service End Cap (if needed)

Procedure:

NOTICE

The enclosure must be securely sealed to keep the Module Control Board dry and free of debris.

1. Remove the silicone seal.
2. Clean sealing groove with household cleaner and cloth.
3. Inspect the sealing groove. If damaged, replace service end cap.
4. Inspect silicone seal for cuts or excessive wear marks along the surface shown in item 2 of Figure 23.
   a. If damaged, replace silicone seal.

      Note: *Remove the service end cap power cord wire leads from the terminal block.*

   b. If not damaged, clean silicone seal with household cleaner and cloth. Make sure the seal is completely dry before installation.

      Note: *The manufacturer recommends replacement of the seal during maintenance or service. Keep new seals in sealed bags until they are needed for installation.*
5. Use all supplied lubricant on the seal.
6. Inspect for deep gouges in the interior wall of the lamp driver enclosure.
   a. Use emery cloth sandpaper to remove gouges and sharp edges around cross-drilled holes.
   b. Use isopropyl alcohol to clean the first 51mm (2 in.) of the interior of the lamp driver enclosure to remove debris.

      Note: *If seal was replaced, install wire leads back to terminal block and install lamp driver tray. Insert desiccant packages on each side of the enclosure before putting end caps back on.*

NOTICE

The power cord strain relief must be installed toward the top of the enclosure.

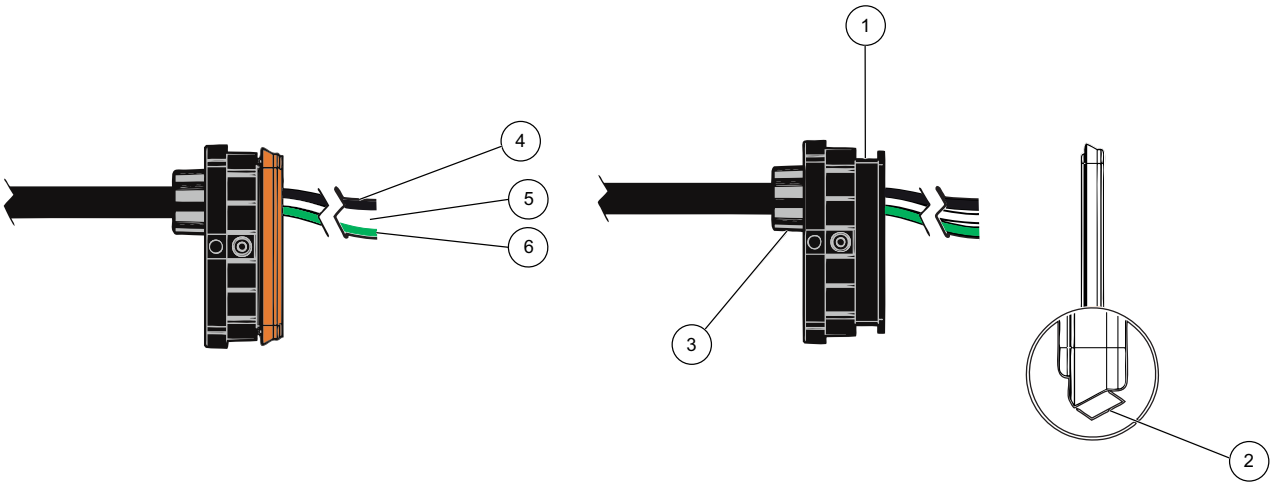
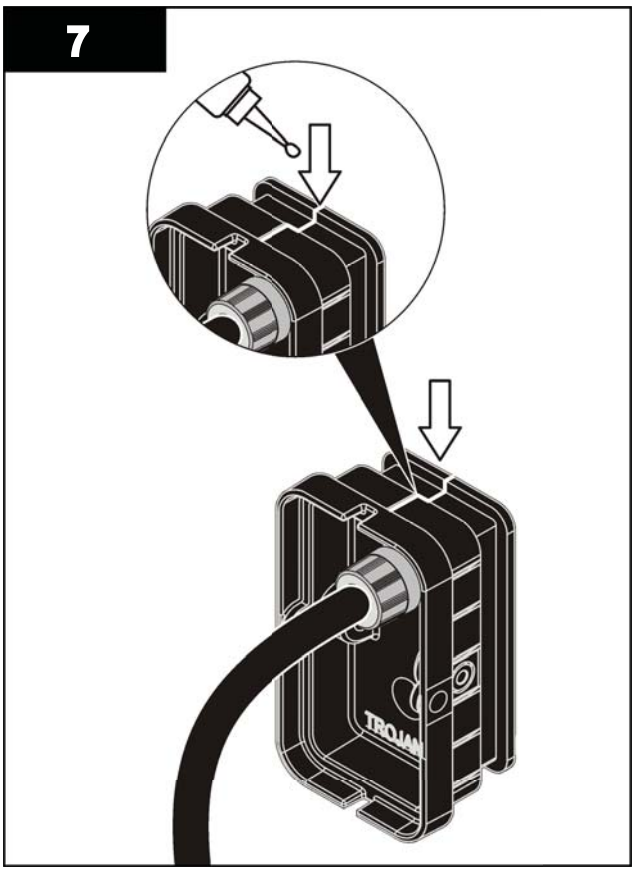
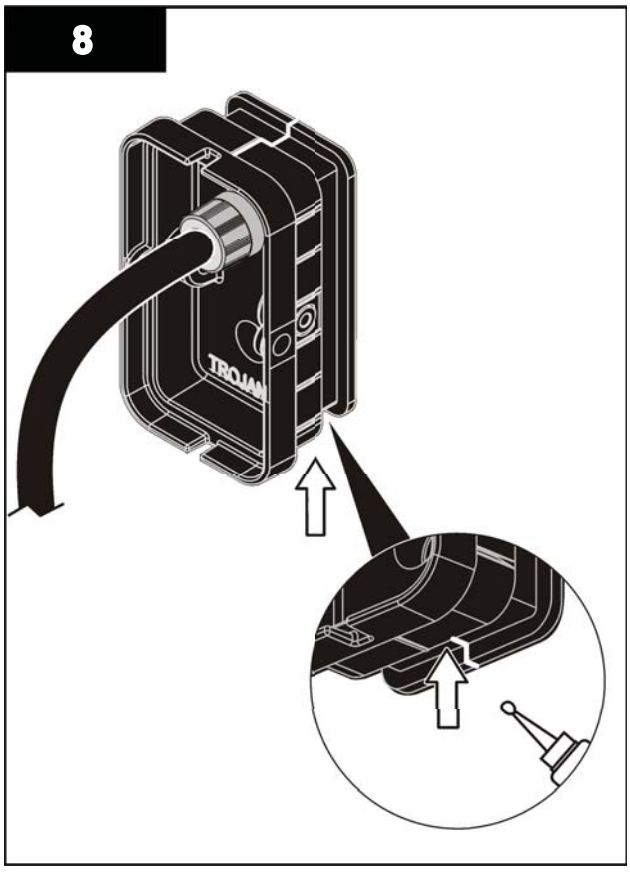
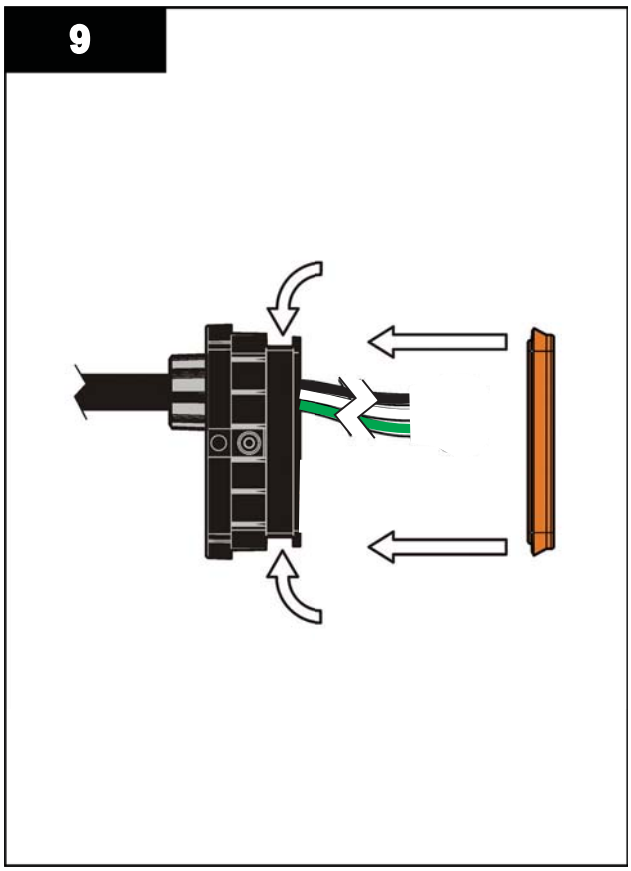


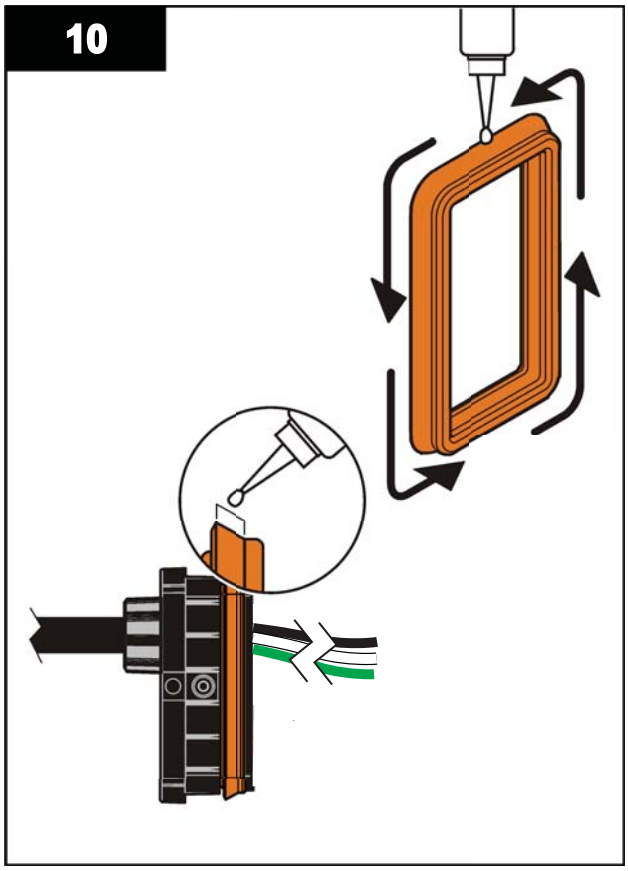
Figure 23 Service End Cap Seal Inspection

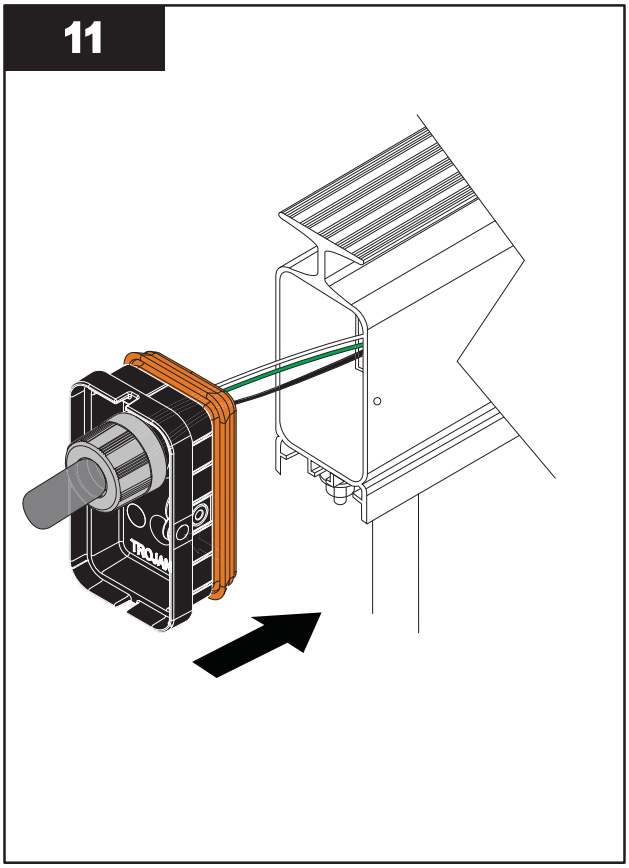
1	Service end cap	**4**	Black Wire
2	Silicone seal surface	**5**	White Wire
3	Strain relief	**6**	Ground - Green Wire



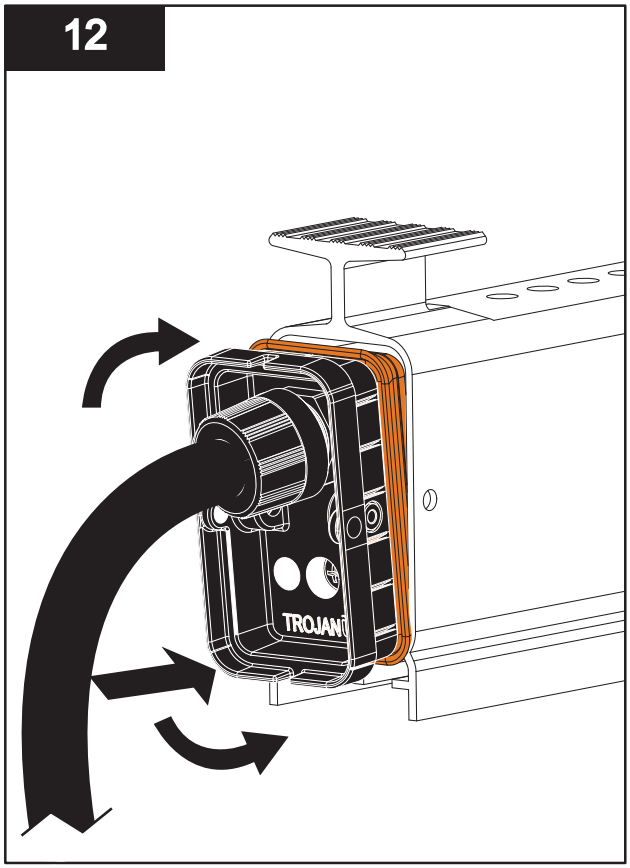




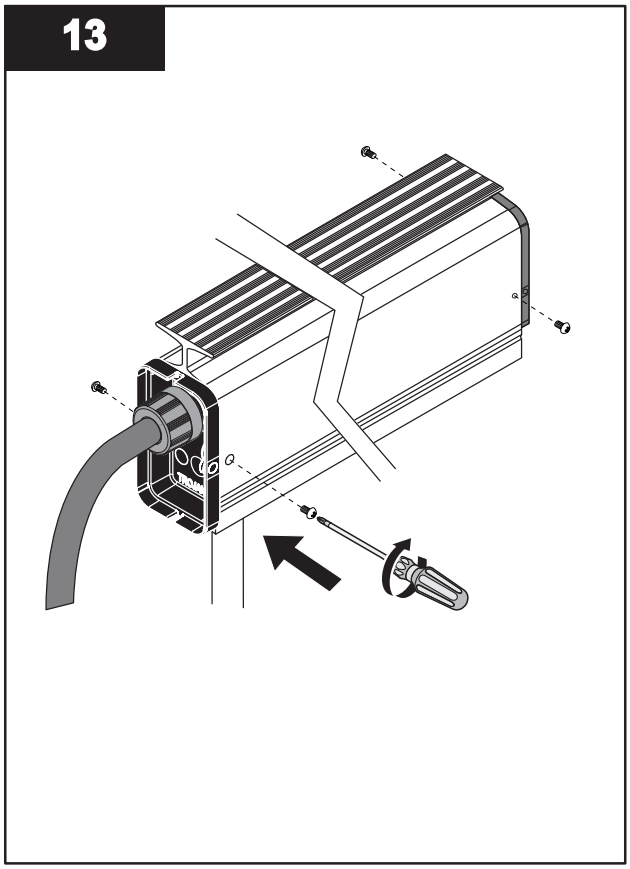




Note: *The power cord strain relief must be installed toward the top of the enclosure.*



Note: *Insert the seal slowly to allow enough time for the seal to react with the enclosure. If the seal is inserted too fast, the corner of the seal may be pinched or damaged. Push the service end cap until it is in full contact with the enclosure body.*



14. Install screws on the sides of the service end caps, and turn by hand until contact is made with the enclosure.
15. When the service end cap is installed, tighten each screw an additional 1/4 turn.
16. Make sure that the power cord strain relief is tight.
17. Repeat steps for the plain end cap.
18. To do the optional air pressure test, refer to Section 8.3.2.4. Otherwise, return the UV module to service.
19. When the service is complete, assemble the prerequisites in the reverse order of disassembly.

8.3.2.4 Air Pressure Test

Use the air pressure test tool to validate Type 6P rating for the lamp driver enclosure.

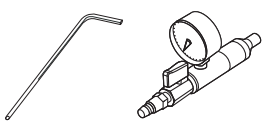
NOTICE

The enclosure must be securely sealed to keep the Module Control Board dry and free of debris.

Prerequisites:

- Install the Service End Caps. Refer to Section 8.3.2.3.

Tools:

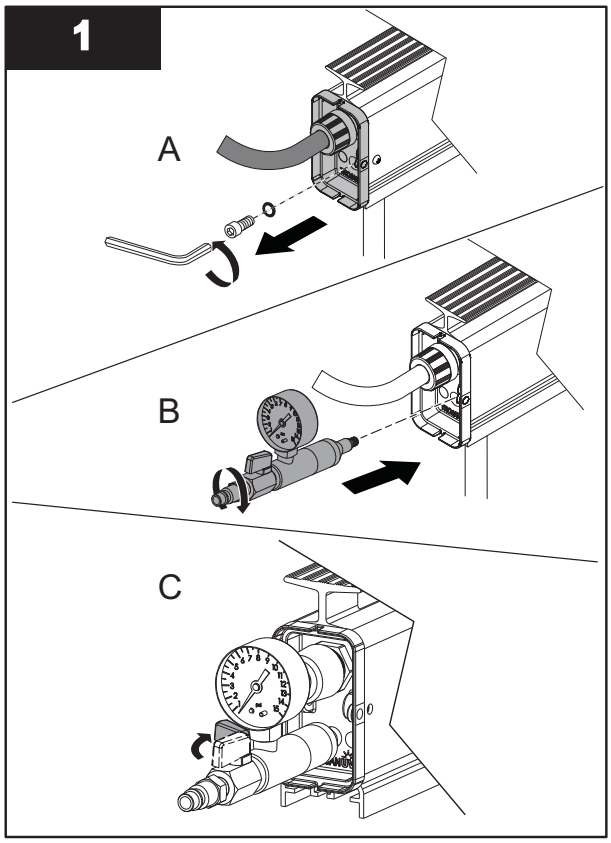


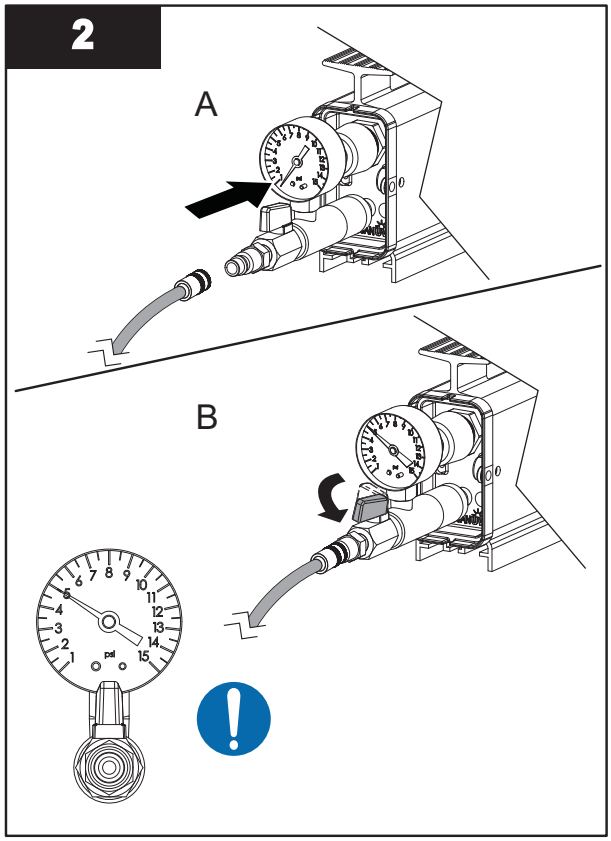
Materials:



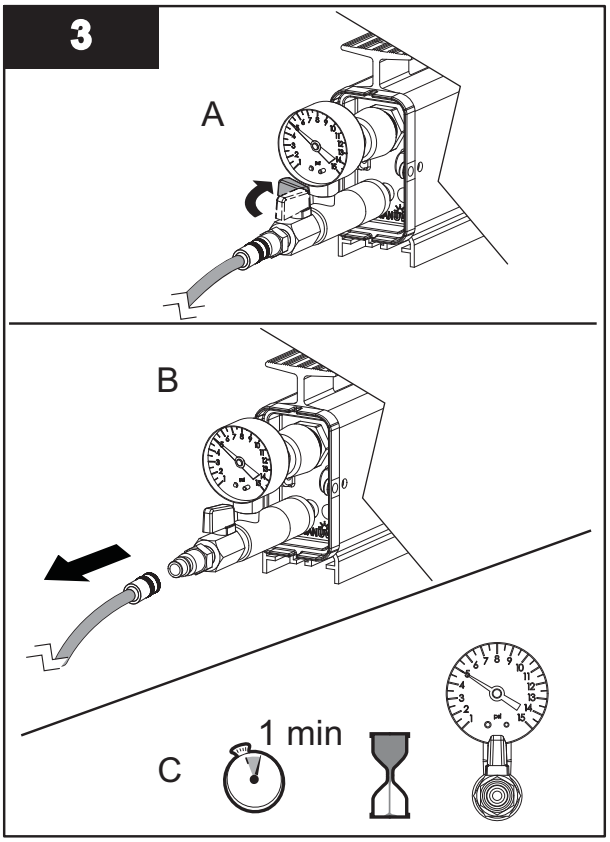
Procedure:

NOTICE
The enclosure must be securely sealed to keep the Module Control Board dry and free of debris. To prevent damage, pressurize the Lamp Driver Enclosure to 5 PSI, DO NOT exceed 10 PSI.

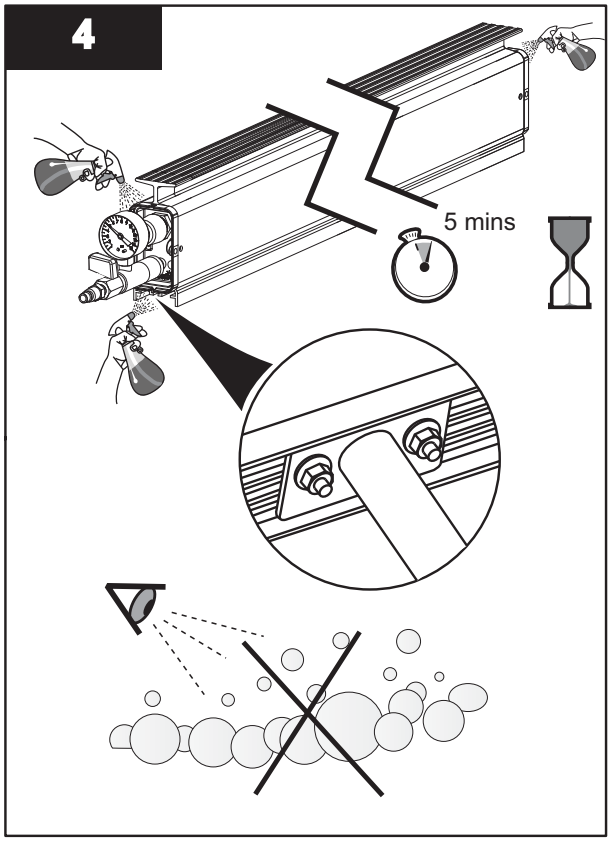




Notes: *1) Slowly open the valve to pressurize to 5 PSI.*
DO NOT *exceed 10 PSI.*
2) Where possible, use a regulator set to 5 psi maximum, to control the maximum air pressure.



Note: *Verify that the pressure is stable (5 PSI) for 1 minute.*

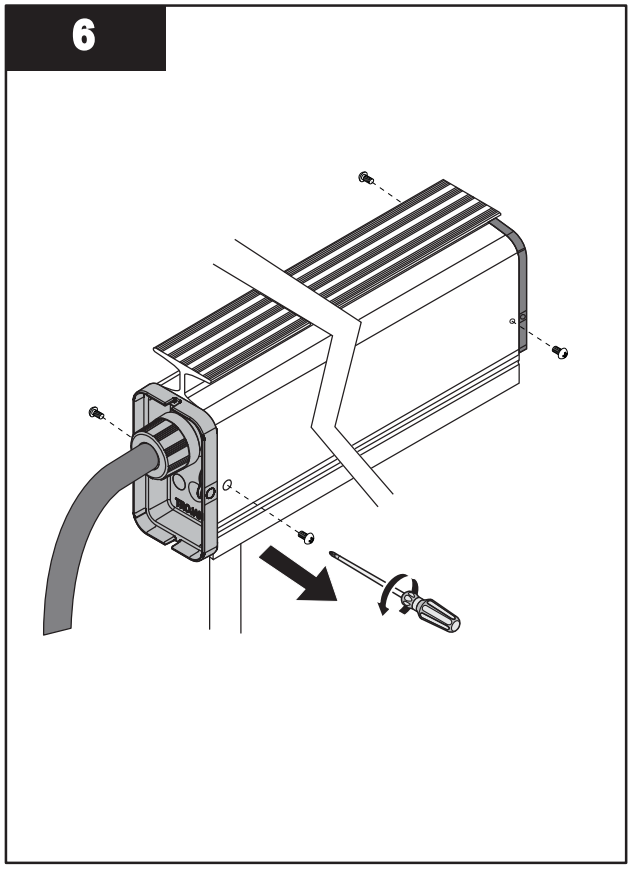


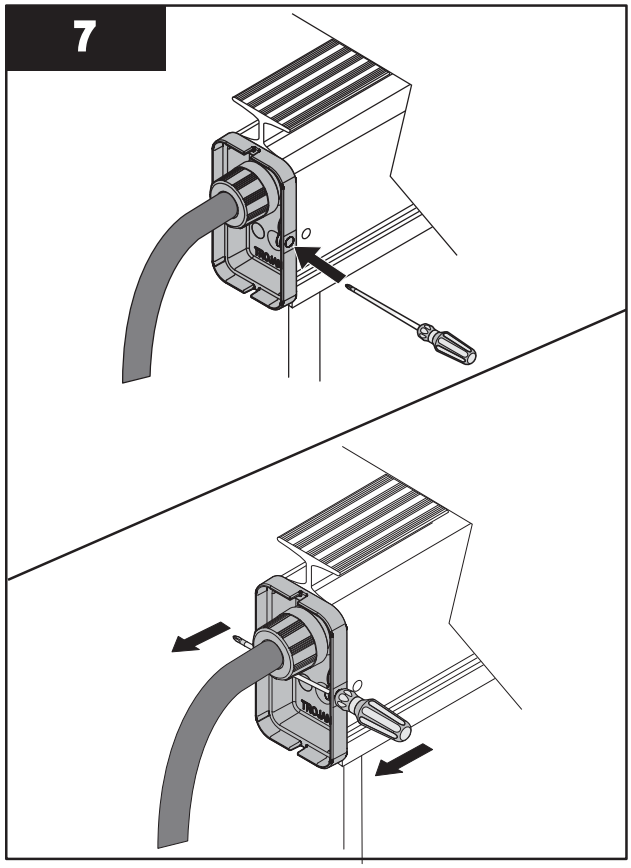
Note: *Spray with soapy water. After 5 minutes, if the air pressure gauge on the air pressure test tool is still at 5 PSI and no air bubbles are present, the end cap is installed correctly and is safe for 6P rating.*

5. Open the air valve on the air pressure test tool to release the air pressure (0 PSI). Remove the Air Pressure Test Tool.

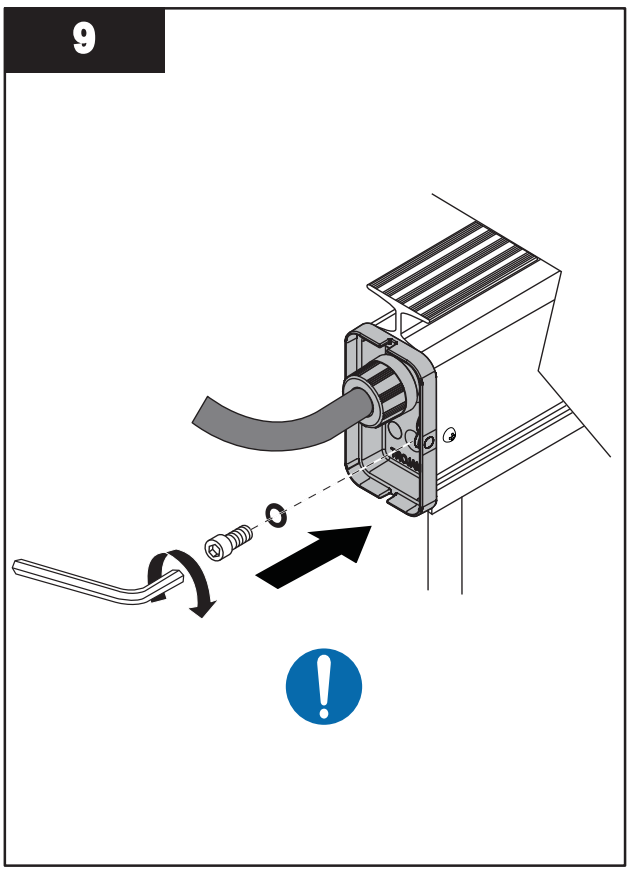
a. If bubbles were present, go to step 6.

b. If bubbles were not present, go to step 9.





8. Go to Section 8.3.2.3, perform steps 1 - 13. Repeat Air Pressure Test as required (Section 8.3.2.4).



When service is complete, assemble the prerequisites in the reverse order of disassembly.

8.3.3 UV Lamps and Lamp Sleeves



NOTICE

UV lamps contain mercury (Section 2.3).

8.3.3.1 Storage Requirements for Used UV Lamps

Put used UV lamps into the replacement UV lamp shipping container, or a similar container. It is preferable that the original packing materials be used where possible, or materials adequate to prevent breakage during storage and transportation.

Boxes of used UV lamps should be labeled as such and stored in a location where the potential for accidental breakage is minimized.

A UV lamp re-cycler may have specific procedures and UV lamp storage requirements. Consult with a UV lamp re-cycler to determine all applicable policies.

8.3.3.2 Inspect the Lamp Sleeves

UV lamps and lamp sleeves are made of fragile quartz tubing and easily fractured. Do not strike, bend or apply pressure, or it will break. Make sure lamp sleeves are clean internally and externally. Fouling will block UV and compromise disinfection. Fouling can also result in higher UV lamp operating temperatures and reduce UV lamp efficiency. Excessive moisture in the lamp sleeve can cause corrosion of the UV lamp shunt and pins, which results in shorter UV lamp life.

8.3.3.3 Clean the Lamp Sleeves

Clean the lamp sleeves when the UV intensity falls below 2.8 mW/cm^2.

NOTICE

Do not use abrasive materials to clean the lamp sleeves. Abrasive materials will scratch and damage the UV lamps.

If the cleaning solution comes in contact with the lamp driver enclosure, immediately flush and clean the enclosure with potable water to prevent permanent damage. Damage due to the cleaning solution will void the warranty.

NOTICE

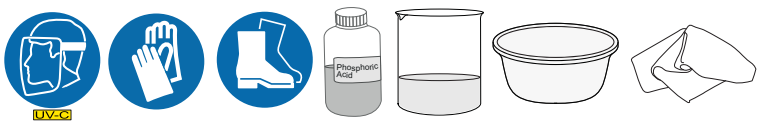
Only use Trojan Technologies approved cleaning solutions on the lamp sleeves. Use of unapproved chemicals may result in damage to the equipment. For a list of approved cleaning solutions refer to Table 8.

Prerequisites:



- Remove the UV module. Refer to Section 8.3.1.

Materials:



Procedure:



1. Refer to Table 8 for dilution ratio's.

- Mix the solution thoroughly. Use pH indicator strips to make sure that pH is between 1.0-1.5. The solution is effective in cleaning UV modules when the pH is less than 3.0. Above pH 3.0, the cleaning solution should be recharged with acid or replaced.

Table 8 Approved Cleaning Solution and Dilution Ratio's

Solution	Dilution
ActiClean™ Gel	Not Required
20% Phosphoric Acid	2 parts ActiClean™ Gel to 1 part acid
40% phosphoric Acid	5 parts ActiClean™ Gel to 1 part acid
75% phosphoric Acid	10 parts ActiClean™ Gel to 1 part acid
80% phosphoric Acid	12 parts ActiClean™ Gel to 1 part acid

Note: *When mixing the solution, always add the acid to the tank filled with water.*

Clean with a maintenance rack (wash by hand)

1. Remove debris from the UV module with low pressure potable water, such as a garden hose. Secure the UV module on a maintenance rack or flat surface.
2. Apply a manufacturer approved cleaning agent (ActiClean™ Gel or diluted Phosphoric Acid. Refer to Table 8 for dilution ratio's) to a sponge, paper towel or plastic scrub pad. Rub the outside of the lamp sleeve until all deposits are gone.

   Note: *Clean up spills to avoid slipping and dispose of cleaning solution as per site and country protocols.*

   - If heavy internal fouling is present, replace the lamp sleeve.
   - Clean all visible moisture inside of the lamp sleeve with a clean, dry paper towel or Kimwipe®
3. Let the lamps sleeves dry for minimum ten (10) minutes and reinspect, repeat manual cleaning as required.

   Note: *A completely clean lamp sleeve will have the clarity of a new, unused lamp sleeve.*
4. Install the UV Module into the UV Channel.

8.3.3.4 Remove and Replace a UV Lamp and Lamp Sleeve

Prerequisites:



- Remove the UV module. Refer to Section 8.3.1.

Materials:



- New UV lamp (if required)
- New Lamp Sleeve (if required)
- O-ring

Procedure:

1. Support the UV module on a flat surface.
2. Turn the lamp sleeve nut until it loosens from the lamp sleeve cup. Slide the lamp sleeve nut and O-ring along the lamp sleeve.
3. Apply water to the dome end. Gently rotate the lamp sleeve while pulling it away from the lamp sleeve cup. The lamp sleeve should be extended 18-20 cm (7 to 8 in.) beyond the formed leg of the UV module.

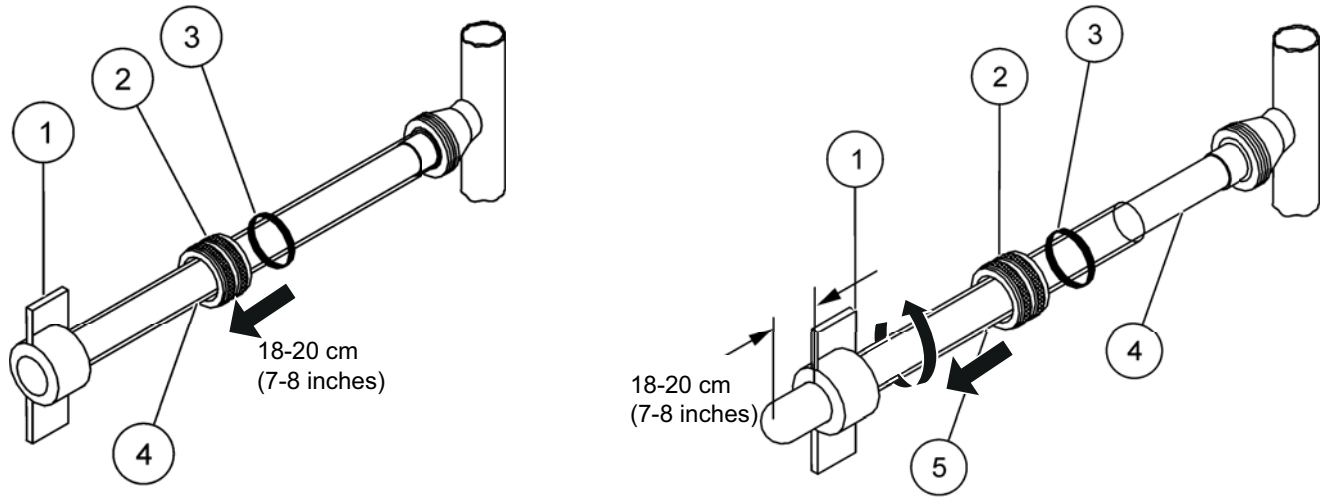


Figure 24 Remove the Lamp Sleeve from Sleeve Cup

1	Formed leg	**4**	UV lamp
2	Sleeve nut	**5**	Lamp sleeve
3	O-ring		

4. Pull the UV lamp away from the UV lamp holder to disconnect it. Do not remove the molded UV lamp holder from the steel sleeve cup. Support the lamp sleeve. Refer to Figure 25.

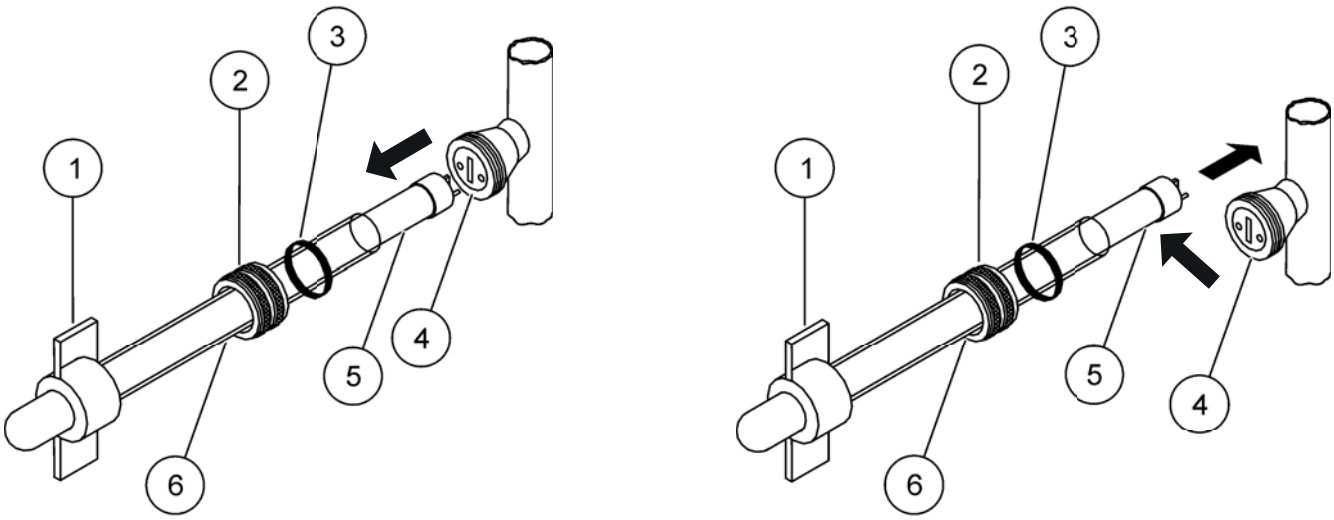


Figure 25 Remove the UV Lamp

1	Formed leg	**4**	Lamp holder
2	Sleeve nut	**5**	UV lamp
3	O-ring	**6**	Lamp sleeve

5. Remove the UV lamp from the lamp sleeve. To replace the UV lamp only, slide the lamp sleeve only as far as needed to safely remove and replace the UV lamp.

6. Pull the entire lamp sleeve and UV lamp together from the UV module leg. Remove the lamp sleeve nut and the O-ring from the dome end of the lamp sleeve. Replace lamp sleeve, if damaged.

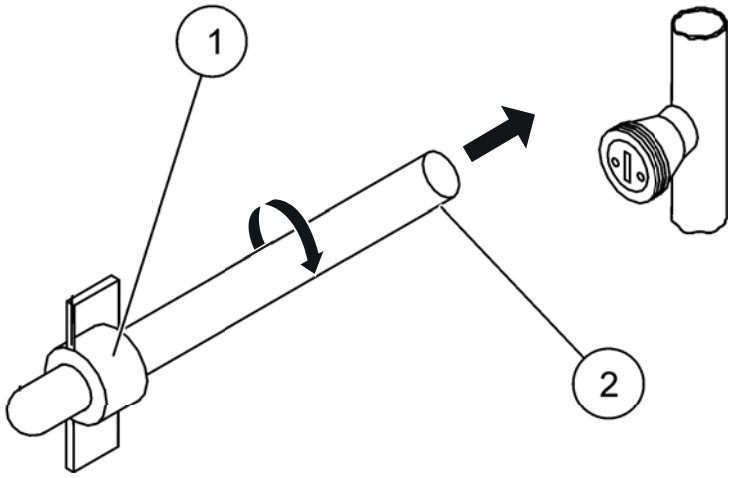


Figure 26 Remove the Lamp Sleeve

1	Formed leg	**2**	Lamp sleeve

7. Put the new UV lamp into the lamp sleeve. Make sure that the lamp connection end is at the open end of the lamp sleeve.
8. Install the sleeve nut and an O-ring onto the lamp sleeve.
9. Put the lamp sleeve through the formed leg.

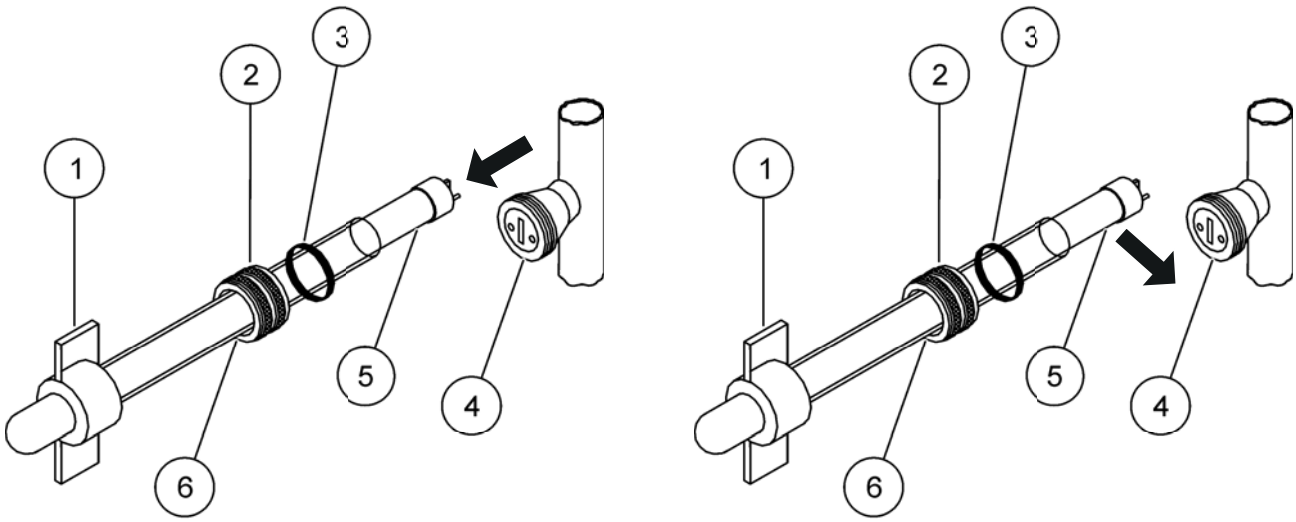


Figure 27 Replace the UV Lamp and Lamp Sleeve

1	Formed leg	**4**	Lamp holder
2	Sleeve nut	**5**	UV lamp
3	O-ring	**6**	Lamp sleeve

10. Connect the UV lamp to the lamp holder. Move the lamp sleeve nut along the lamp sleeve to the lamp sleeve cup. Hand-tighten the lamp sleeve nut.
11. Make sure the lamp sleeve is in full contact with the rubber sleeve stop and not just in contact with the internal lamp sleeve seal.

12. Push the sleeve until it is past the internal sleeve seal and against the rubber sleeve stop.

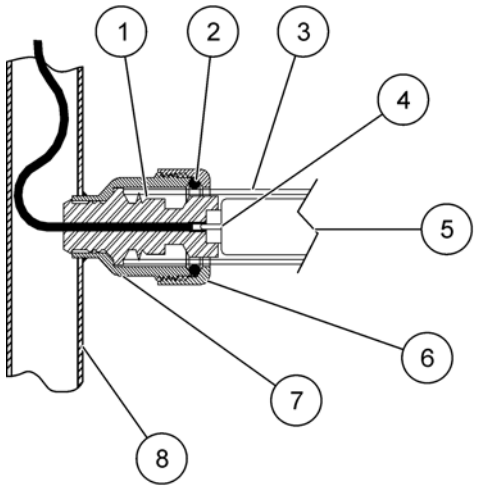


Figure 28 Replace the UV Lamp and Lamp Sleeve

1	Internal lamp sleeve seal	**5**	Lamp end
2	External O-ring lamp sleeve seal	**6**	Sleeve nut
3	Lamp sleeve	**7**	Stainless steel sleeve cup
4	Lamp pin	**8**	UV module frame

13. When service is complete, assemble in reverse order of disassembly.

8.4 UV Sensor

The UV sensor system is calibrated in the factory and should not be altered, or its calibration changed, in any way.

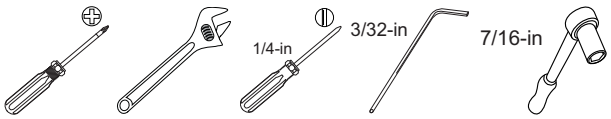
8.4.1 Remove the UV Sensor

Prerequisites:



- Remove the UV module. Refer to Section 8.3.1.

Tools:



Materials:



Procedure:

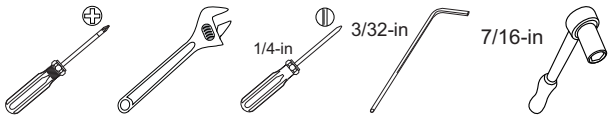
1. Remove the nylon cable ties and release UV sensor cable from the UV module leg and power cable.
2. Disassemble UV sensor mounting bracket from Teflon sleeves (Teflon sleeves remain in place).
3. Remove setscrew from the U-bracket and remove UV sensor body from the U-bracket.
4. Unsnap bushing from light lock channel.
5. Un-thread UV sensor cable and strain relief from the hole in the light lock channel.

8.4.2 Install a New UV Sensor

Prerequisites:

- Remove the UV sensor. Refer to Section 8.4.1.

Tools:



Materials:



Procedure:

1. If necessary, remove UV sensor body from new sensor assembly. Refer to Figure 29.

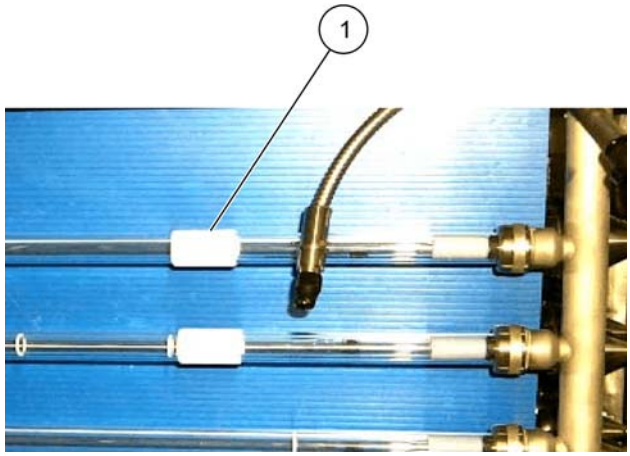


Figure 29 UV Sensor

1	Teflon sleeve

2. Insert the sensor body into the sensor U-bracket until flush with the bracket. Secure in place with #10 set screw. Refer to Figure 30.

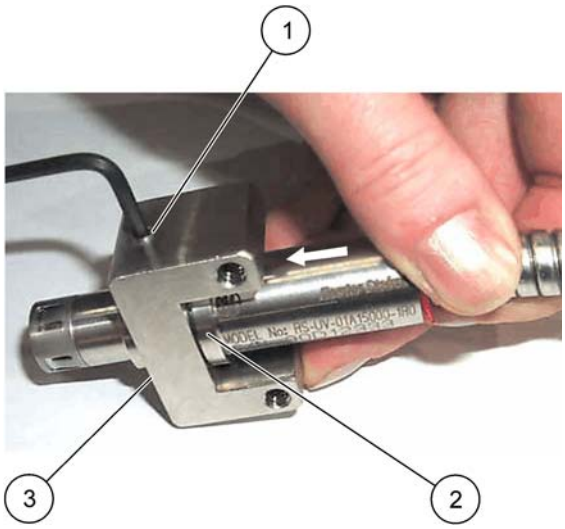


Figure 30 UV Sensor U-Bracket

1	Set screw, #10	**2**	UV Sensor	**3**	U-bracket

3. Position one side of mounting bracket on U-shaped sensor bracket and attach loosely with screws and split lock washers. Refer to Figure 31.

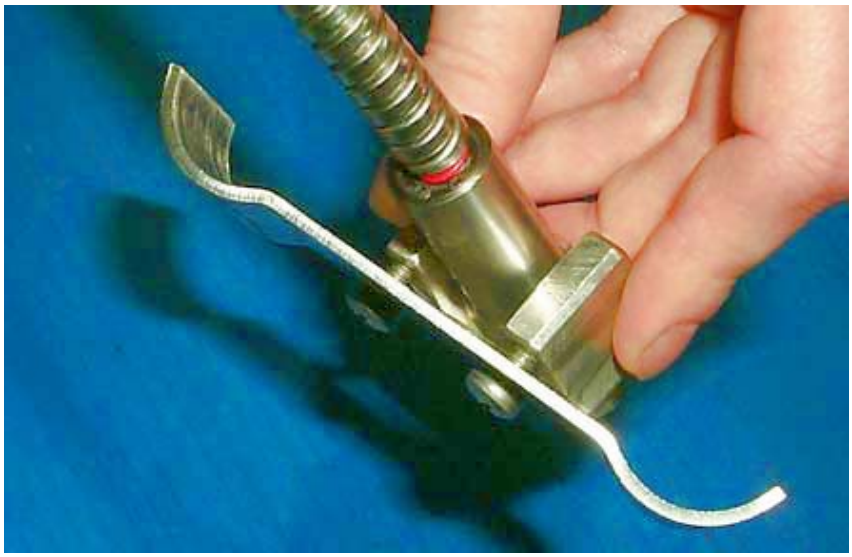


Figure 31 UV Sensor Mounting Bracket

4. Assemble sensor mounting bracket over Teflon®* sleeves, leaving screws loose.
5. While sensor bracket is loosely connected to U-bracket, place pressure on the UV sensor head to position UV sensor as close to the UV lamp as the bracket will allow. Tighten all 4 screws. Refer to Figure 32.

   Note: *UV sensor window is mounted such that it faces away from effluent flow.*
6. Use nylon ties to secure the UV sensor cable to the UV module leg and power cable. Trim excess from cable ties.

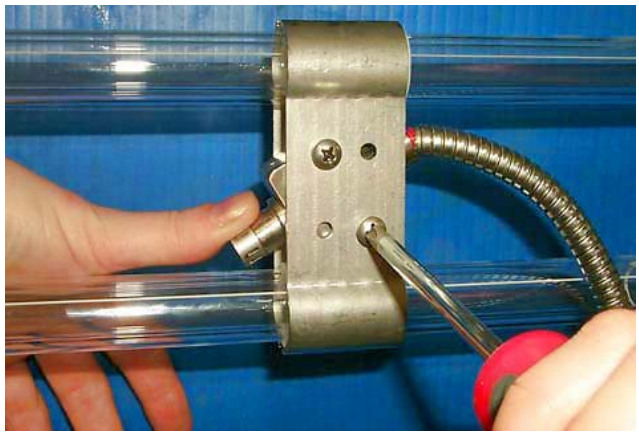


Figure 32 Mount the Sensor

8.4.2.1 Clean the UV Sensor

UV sensor cleaning frequency depends on the effluent quality. Fouling on the UV sensor will lead to lower UV sensor readings. The UV sensor should be checked and cleaned at least as often as the lamp sleeves.

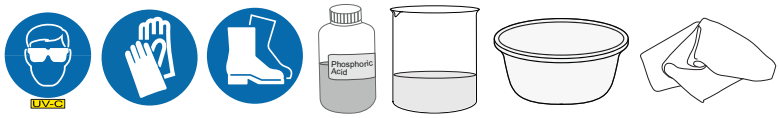
*Teflon is a registered trademark of Dupont Company.

Prerequisites:



- Remove the UV module. Refer to Section 8.3.1.

Materials:



Procedure:

1. Apply a solution of 50% water and 50% manufacturer approved cleaning agent (spray or wipe on, using a cleaning cloth), and then wipe the solution off.
2. Check the UV sensor window and lamp sleeve for cleanliness and repeat step 1, if needed.
3. When service is complete, assemble the prerequisites in the reverse order of disassembly.

8.5 System Monitor

8.5.1 Inspect and Clean the System Monitor

Prerequisites:



- Shut down the UV system. Refer to Section 5.2.
- Apply lockout tag out devices as necessary. Refer to Section 4.

Materials:



Procedure:

1. Use soft cloth with soap and water to clean the exterior of the panel.

   Note: *Do not use high-pressure hose and corrosive cleansers.*
2. Inspect the panel interior for signs of moisture.
3. Inspect the door seal for signs of wear or damage. Replace, as required.

8.5.2 Remove / Replace System Monitor Board Fuse

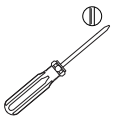
An AC power supply fuse located beside the power termination strip, may require replacement if a power surge or short circuit occurs.

Prerequisites:



- Shut down the UV system. Refer to Section 5.2.
- Apply lockout tag out devices as necessary. Refer to Section 4.

Tools:



Materials:



- Fuse

Procedure:

1. Disconnect the AC supply to the circuit board.
2. Remove the fuse with a screwdriver and test.
3. Replace the fuse with an identical spare.

8.6 Level Control Weir

8.6.1 Inspect and Clean

Tools:



Materials:



Procedure:



1. Inspect the crest of the weir periodically.
2. If necessary, use a power washer to remove algae or other buildup on the weir.

Section 9 Troubleshooting

⚠ DANGER



Obey all warning and caution statements. Refer to Section 2.

Read and understand this manual before operating this equipment. Read all user documentation before performing operations, inspections, repair, or maintenance on this equipment.

Only competent personnel should undertake operation, repairs, maintenance, or servicing of equipment described in this section of the manual. If you do not understand the information or procedure explanations in this manual, STOP and contact your Service Provider for assistance.

NOTICE

Injury or damage to the equipment due to improper testing, handling or maintenance will not be covered under the manufacturer's warranty and is the responsibility of the individual performing the troubleshooting.

Instructions:

1. Locate the condition in one of the tables below that best matches the condition onsite
2. Review the symptoms and possible causes corresponding to the given condition.
3. Review the corresponding solution(s) provided and obey the correct procedures as outlined in this manual.

Notes: *1) Power is disconnected before any work is done on the circuit boards.*

2) If at any time you are unsure of the procedure, call a local certified service provider before proceeding. Injury or damage to the equipment due to improper testing, handling, or maintenance will not be covered under the manufacturer's warranty and is the responsibility of the individual performing the troubleshooting.

9.1 UV Module

Condition	Symptom	Possible cause	Solution
One UV lamp status LED is OFF	Corresponding UV lamp is OFF.	UV lamp failure	Replace the UV lamp.
		Lamp holder / wiring	Inspect the lamp holder and wiring and replace as necessary.
		Water intrusion	Inspect and replace the UV lamp, sleeve and O-ring as necessary.
	Corresponding UV lamp is ON.	Module Control Board (MCB)	Replace the module board. Refer to Instruction Number DC010601-001.
Two UV lamp status LEDs are OFF (lamps 1 and 2 or lamps 3 and 4)	Corresponding UV lamps are OFF.	UV lamp failure	Replace the UV lamps.
		Lamp holder / wiring	Inspect the lamp holder and wiring and replace as necessary.
		Water intrusion	Inspect and replace the UV lamp, sleeve and O-ring as necessary.
		Lamp driver failure	Replace the lamp driver.
	Both LEDs are OFF in a 2-lamp UV module.	No power to the UV module.	Inspect the UV module power cable- is it plugged-in or damaged? Reset ground fault.
	Corresponding UV lamps are ON	Module Control Board (MCB)	Replace the module board. Refer to Instruction Number DC010601-001.

9.1 UV Module (continued)

Condition	Symptom	Possible cause	Solution
All the UV lamp status LEDs are OFF.	All the UV lamps are OFF.	UV lamp failure	Replace the UV lamps.
		Lamp holder / wiring	Inspect the lamp holder and wiring and replace as necessary.
		Water intrusion	Inspect and replace the UV lamp, sleeve and O-ring as necessary.
		Lamp driver failure	Replace the lamp driver.
	All the UV lamps are ON.	Module Control Board (MCB)	Replace the module board. Refer to Instruction Number DC010601-001.
Note: *If you have checked all possible causes, call your Service Provider for assistance.*			

9.2 GFCI Receptacle

Condition	Symptom	Possible cause	Solution
Ground fault (GFCI) trips	GFCI trips for a specific UV module only.	Cracked sleeve is causing water intrusion.	Replace the lamp sleeve.
		Faulty O-ring is causing water intrusion.	Replace the O-ring.
		End-cap assembly is causing water intrusion.	Inspect and repair or replace the end-cap assembly.
		Faulty or cut wiring	Inspect and repair or replace the faulty wiring.
	GFCI trips for any UV module.	Faulty wiring at GFCI	Inspect and repair or replace the wiring as necessary.
		Faulty GFCI receptacle	Replace the GFCI receptacle.
Note: *If you have checked all possible causes, call your Service Provider for assistance.*			

9.3 System Monitor

Condition	Possible cause	Solution
Elapsed time display flashing	Elapsed time displays 12000 -12,500, 24,000-24,500… hours. The system is powering up.	Replace the UV lamps. Display will stop flashing after 12,000, 24,000… hours. The alarm will automatically be reset 5 minutes after a good signal is present.

9.3 System Monitor

Condition	Possible cause	Solution
UV intensity display is flashing and displaying 0.0mW/cm^2.	Sensor cable is not connected to the System Monitor.	Reconnect the UV sensor to the System Monitor.
	Fouled sleeve and/or sensor	Clean the lamp sleeve and UV sensor as required with a manufacturer approved cleaning agent.
	Loose or no connection at TB5 terminal in System Monitor enclosure.	Tighten or reconnect the wiring at the terminal.
UV intensity display is flashing and displaying value less than alarm set point (1.6 mW/cm^2).	Fouled sleeve and/or sensor	Clean the lamp sleeve and UV sensor as required with manufacturer approved cleaning agent.
Note: *If you have checked all possible causes, call your Service Provider for assistance.*		

9.4 Disinfection Performance

Condition	Symptom	Possible cause	Solution
Disinfection limit has been exceeded.	Indicator organism is greater than the legislated limit.	UV lamps are beyond 12,000 hours of operation.	Replace the UV lamps. Refer to Section 8.3.3.
		UV lamps are out within the UV modules.	Replace the defective UV lamps.
			Replace the defective lamp drivers.
		Lamp sleeves are fouled.	Clean the sleeves with manufacturer approved cleaning agent.
		Debris within the UV modules.	Remove the debris from UV modules.
		Effluent level within the channel is greater than 1 inch above top UV lamp.	Channel flow is within system design parameters.
			Weir is clean of debris.
			Channel is clean.
		Contaminated sample, sample container.	Repeat sample, using proper sampling techniques.
		Channel has collected a build up of debris and solids.	De-water channel and clean.
		Effluent percent UV transmittance (%UVT) is below system design parameter.	Review plant process to return % UVT within system design parameters.
		Peak flow is greater than system design limits.	System peak flow is within system design limits.
		Effluent total suspended solids (TSS) is greater than system design parameter.	Review plant process to return TSS within system design parameters.
		Effluent particle size distribution (PSD) is high.	Review plant process to address the size of effluent solids.
		UV absorbent agents have entered plant process.	Review to changes to plant process (e.g., Iron).
Note: *If you have checked all possible causes, call your Service Provider for assistance.*			

Section 10 Replacement Parts and Accessories

Contact Trojan Technologies with the listed information to order replacement parts.

Provide the:

- Product name and model number (refer to the front of this manual)
- Part number and description of the replacement part or accessory

If a replacement part is not listed, contact Trojan Technologies.

10.1 Optional Equipment

Item	Description	Part number
1	Operator Kit	906015-320
2	Photometer Kit	905107
	• Photometer, UV 100/240 VAC	905253
	• Quartz Cuvette 10 mm	905262
	• Solution, 100%T 1 Gal	905036
	• Solution, Cuvette Cleaner	P19311
	• UV Lamp, 254 NM, Realtech	905260

*This component contains Mercury. Dispose according to Local, State, or Federal Laws.

10.2 Service End Cap

Refer to Figure 22 for components.

Item	Description	Part number
1	Strain relief	914478-129
2	Service end cap, power cord end	316559-001
3	Silicone seal, service end cap	316558
4	Screw, service end cap, Philips head, 2x	013039
5	O-ring, air pressure test access	002226G
6	Screw, socket head plug for pressure test access	303314
7	Service end cap, blank end	316559-002

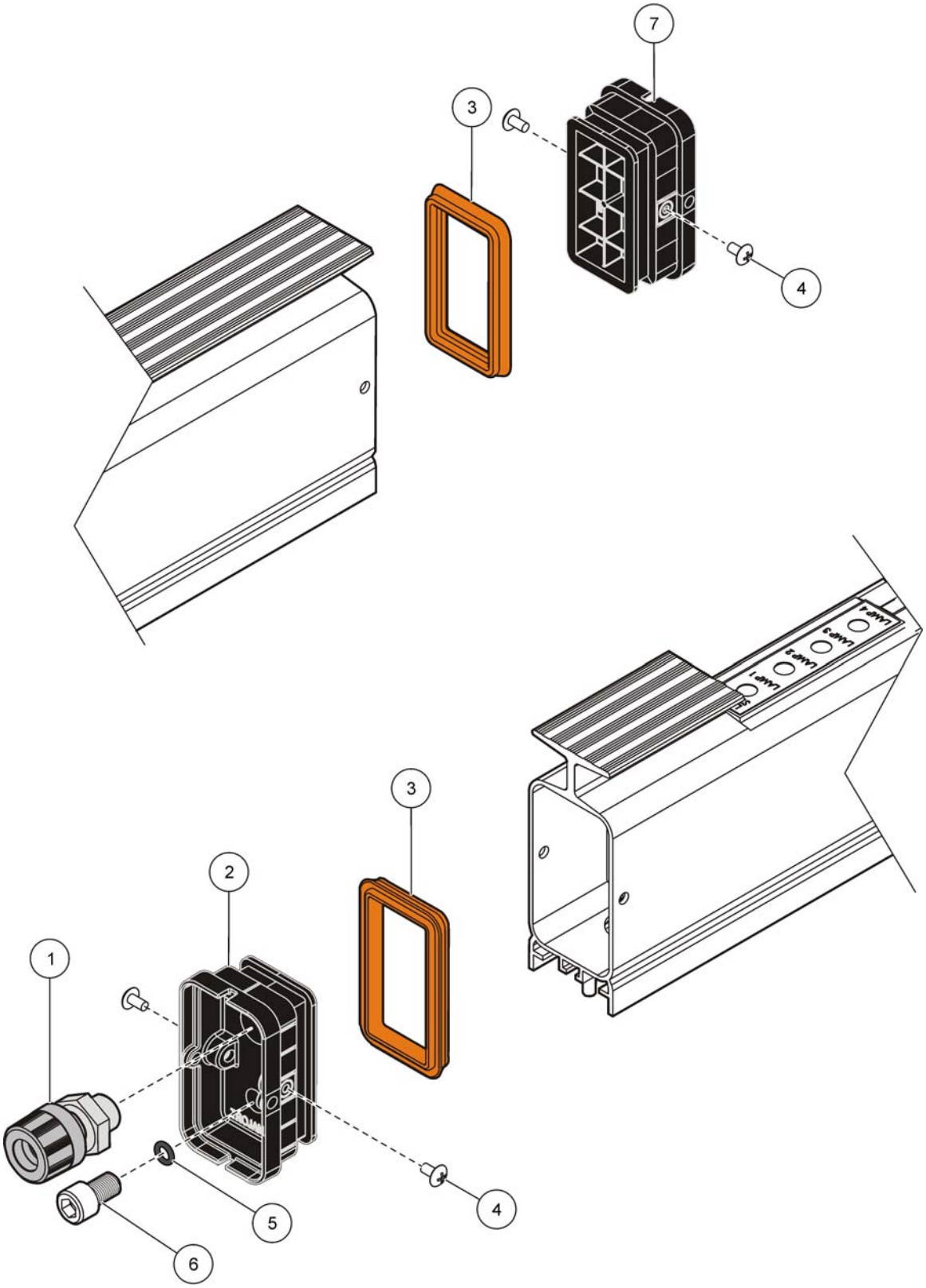


Figure 22 Service End Cap Components

10.3 UV Module

Item	Description	Part number
1	Lamp Driver, 120 V/60 Hz	302403
2	Module Control Board (MCB)	931147-001
3	Power Cord	
	10 Feet	915570-010
	25 Feet	915570-025
	35 Feet	915570-035
4	Sleeve Cup Nut	302312
5	O-ring, Sleeve Support	302314
6	O-ring, Sleeve Seal	302300
7	Compression Spring	700105
8	UV Lamp*	
	36 inch, Models 3025K to 3075K	302417
	64 inch, Models 3100M to 3001M	302418
9	Lamp Sleeve	
	900mm, Models 3025K to 3075K	302108
	1610mm, Models 3100M to 3001M	302208

* This component contains Mercury (Hg). Dispose according to Local, State, or Federal Laws.

10.4 UV Sensor

Item	Part Description	Part number
1	UV Sensor Assembly - 20 ft.	015200
2	UV Sensor Bracket Kit	015306

10.5 Air Pressure Test Tool

Description	Part number
Air pressure test tool	907631

10.6 System Monitor

Description	Part number
Monitor Board	931115

Appendix A Log Book

The following section has been provided to assist the operator in maintaining the TrojanUV3000™PTP. The manufacturer suggests that copies be made of the following checklists and charts to be used as a reference and guide when performing system checks and routine maintenance.

A.1 Mechanical System Status Check

Date	Time		Sleeve Check	Cleanliness Check (performed once per week)
		Bank: Module: Module:		
		Bank: Module: Module:		
		Bank: Module: Module:		
		Bank: Module: Module:		
		Bank: Module: Module:		
		Bank: Module: Module:		
		Bank: Module: Module:		
		Bank: Module: Module:		
		Bank: Module: Module:		

A.2 System Operating Parameters Checks

Table 9 System Operating Parameters Checks

Date	Time	Flow (MGD)	Lamp Sleeve Check	UV Intensity (%) if applicable	UV Transmittance (%) if applicable	TSS	System Hours	Operator	UV Lamp Failures	Comments

Section 3.6

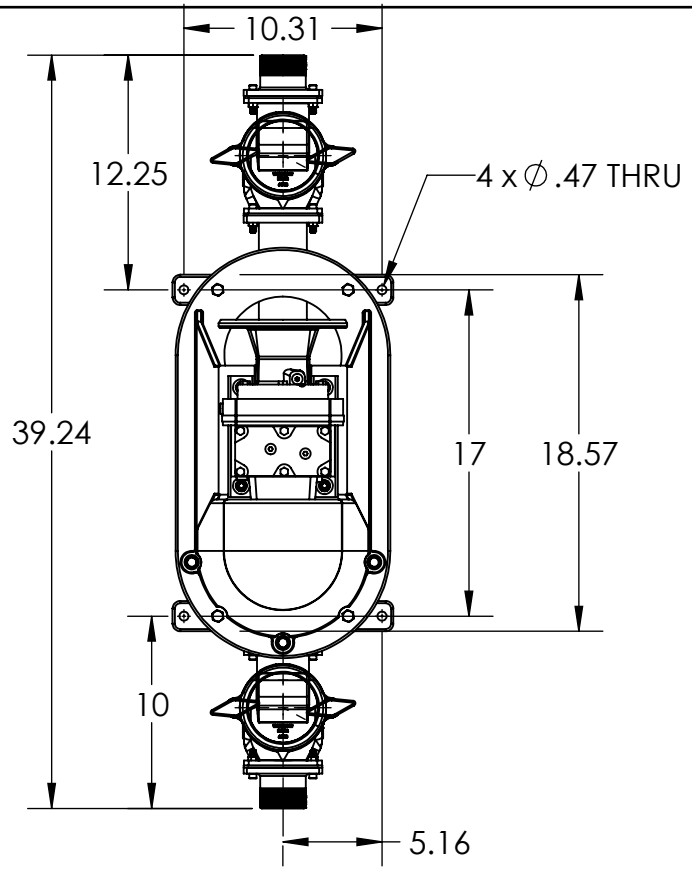
Sludge Handling

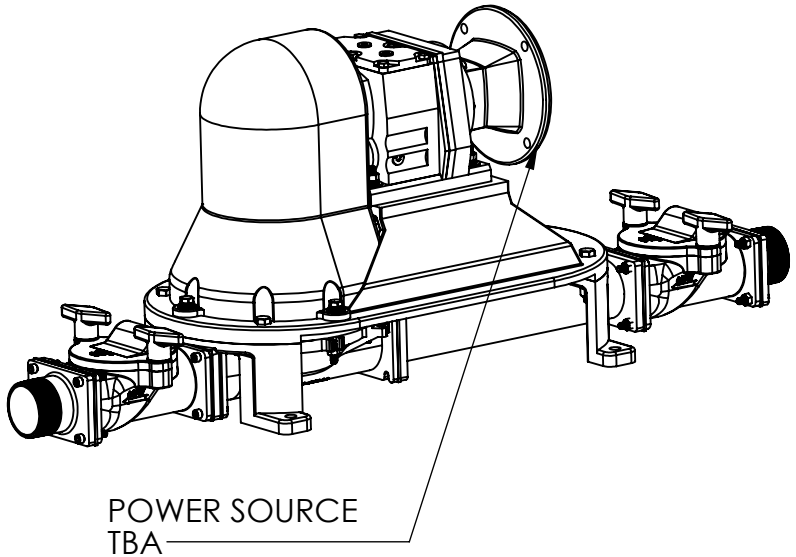
Section 3.6.1

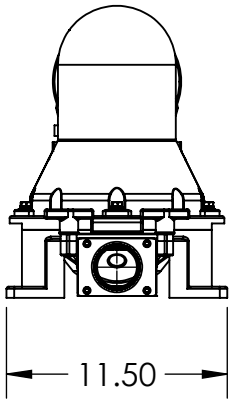
Sludge Transfer Pump

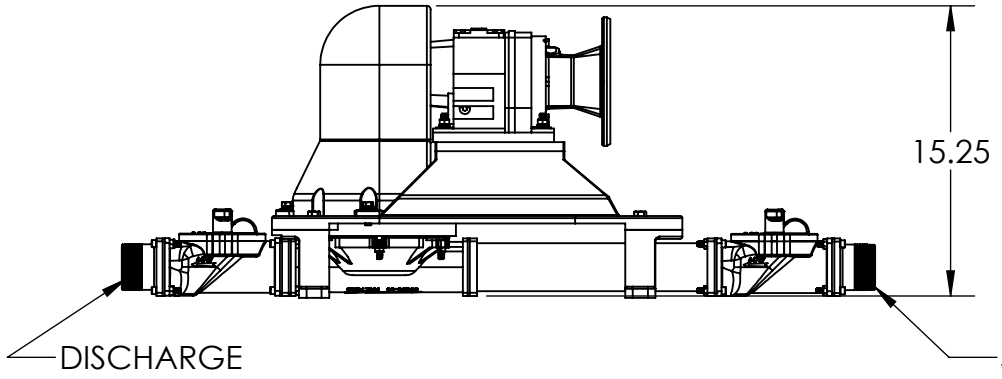
IF IN DOUBT, ASK

NOTE: NOT FOR CONSTRUCTION UNLESS CERTIFIED.









TOLERANCES UNLESS OTHERWISE SPECIFIED	PATTERN MAKER TOLERANCES
1. ANGULAR ±1/2° 2. FRACTIONAL FINISH DIM ± .005" 3. FRACTIONAL FINISHED DIM ± 1/8" FOR CASTING 4. FRACTIONAL FINISHED DIM ± 1/16" FOR STEEL 5. PART TO BE FREE OF BURRS 6. FINISH SHOWN IN R.M.S. 030" CUT OFF	± 1/32" NON ACCUMULATIVE ON FINISHED SUFACES 1/16" FINISH ON FINISHED SURFACES UP TO 8" 3/16" FINISH ON FINISHED SURFACES OVER 8"

THIRD ANGLE PROJECTION

DIMENSIONS ARE IN INCHES

LTR.	REVISION	DATE	BY	APP.
A	INITIAL RELEASE	01/15/19	MT	JD

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TITLE

WASTECORP MUD SUCKER
MODEL: 2FAC-BARE INLINE

DRAWN MT	CHKD MJ
PR ENG	APPD JD
SCALE 1:3	
DATE 01-15-2019	

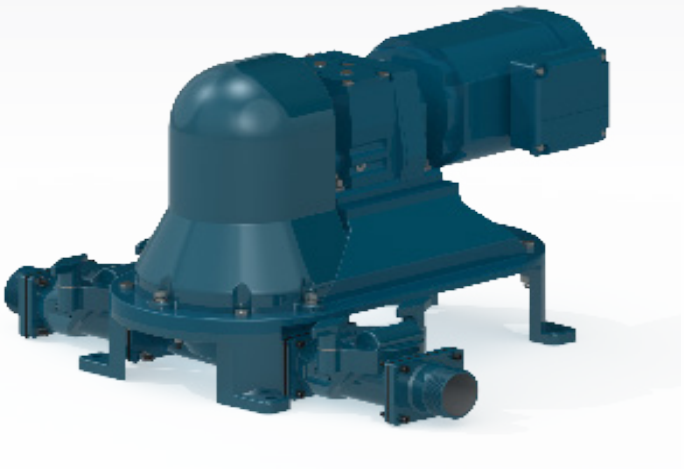
WASTECORP. Pumps

DRAWING NUMBER 65074-BARE

SHEET 1 OF 1

5 4 3 2 1

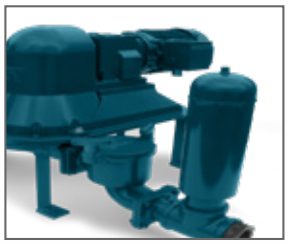
Wastecorp Mud Sucker® 2FAC-EC™ Series





Completely redesigned flapper valve features easy access to the flappers. No special tools required. Gain access in seconds.

Air chambers available for suction and discharge to reduce pulsation when pumping thinner liquids.



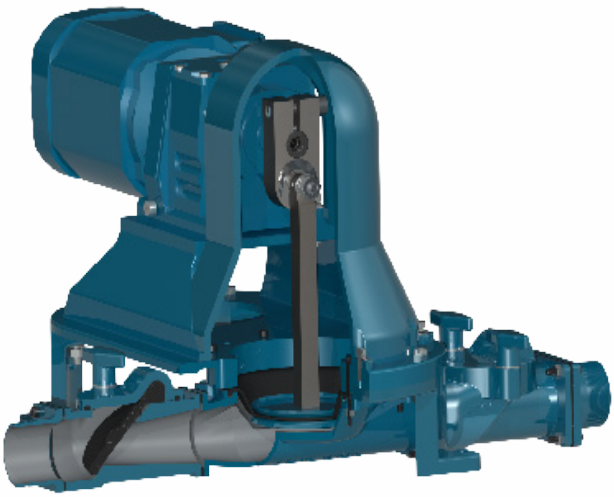
Performance Range

Max. capacity	20 GPM
Max. suction lift	20' vertical or 75' horizontal (with foot valve)
Max. discharge head	50' vertical or 22 psi max
Solids handling	1½" dia or 50% by volume

Pump and Motor Specifications

Suction inlet/outlet size	1½" or 2" MNPT (optional male camlock)
Max. liquid temperature	140°F (60°C) continuous
Pump body casing	Aluminum A356, heat treated
Diaphragm	7" OD fabric reinforced
Flapper Valves	EPDM
Gearbox	SEW Eurodrive or Siemens
Crankarm & Pump Rod Assembly	AISI 12L14 carbon steel
Max. Pump Operating Speed	70 RPM

2FAC-EC™ Cutaway



2FAC-EC™ Series Model Selection

Model	Part no.
Three Phase - 1 hp, 1800 RPM/3/60/230/460V	64722-00
Single Phase - 1 hp, 1800 RPM/1/60/115/230V	64722-10
Explosion Proof (Three Phase), TEXP 1 hp, 1800 RPM/3/60/230/460V	64722-20
Explosion Proof (Single Phase), TEXP 1 hp, 1800 RPM/1/60/115/230V	64722-30
Also available with 12V DC Power, 24V DC, gas, diesel, air or hydraulic drives.	Call
Inline configuration	65074-00

Accessories

Description	Part no.
Pressure sensor assembly (advised)	64093-02
Hose, non-collapsible EPDM rubber, 2"x20 ft. Camlocks included.	60718-00
Hose, discharge, lay flat, brown, 2"x50 ft	51333-10
Air Chamber with tee assembly; Camlock Fittings; Hoses recommended for pumping water to reduce pulsation	65041-00
Male camlock, 2"	60460-00
Wheel mount kit with handles	61315-00
SEW MoviMot 24V key pad speed control	62301-00

Spare Parts Kits

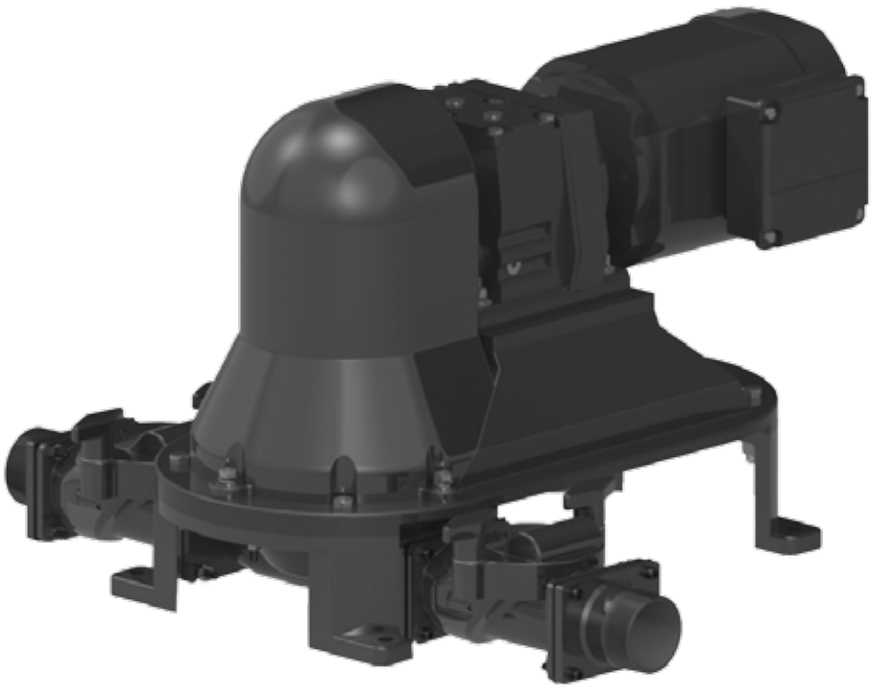
Description	Part no.
Basic spare parts kit	65039-00
Comprehensive spare parts kit	60444-00

WASTECORP. Pumps®

Operator's Manual

Mud Sucker® DIAPHRAGM PUMPS

Model No.	
1.5FAC-EC	2FAC-EC
1.5FAC-M	2FAC-M
1.5FAC-AP	2FAC-AP
1.5FAC-HP	2FAC-HP





READ AND UNDERSTAND ALL OPERATORS MANUALS RELATING TO YOUR PUMP BEFORE USING YOUR MUD SUCKER® DIAPHRAGM PUMP

Before and After Using Your Pump, Ensure You Take The Proper Precautions.
Wear Safety Glasses. Wear Gloves. Wear Safety Boots. Wash Hands After Use.

Register Your Product at www.wastecorp.com

Original Instructions (EN)
Rev. 06/16 DSO

BEFORE YOU BEGIN START-UP, ENSURE THAT YOU ARE FAMILIAR WITH ALL OF THE OPERATOR MANUALS RELATING TO THE PUMP, MOTOR, ENGINE, AND GEAR REDUCER.

ENSURE THAT BOTH THE SUCTION AND DISCHARGE LINES ARE OPEN AND CLEAR OF DEBRIS.

MAKE CERTAIN THAT ANY POSITIVE SHUT-OFF VALVE INSTALLED IN THE SUCTION LINE IS OPEN BEFORE OPERATING THE PUMP; EXCESSIVE RESTRICTION WILL CAUSE INCOMPLETE FILLING OF THE DIAPHRAGM CHAMBER AND RESULT IN SHORTENED DIAPHRAGM LIFE.

WEAR PROPER CLOTHING INCLUDING STEEL TOE SAFETY BOOTS, PROTECTIVE EYE WEAR AND PROTECT YOUR HANDS WHEN WORKING ON OR AROUND THE PUMP.

DO NOT SERVICE , INSTALL OR REMOVE THE MUD SUCKER IF YOU ARE UNDER THE INFLUENCE OF ALCOHOL OR DRUGS

DO NOT SERVICE PUMP UNDER PRESSURE. SERVICING A PUMP UNDER PRESSURE MAY LEAD TO PERSONAL INJURY OR DEATH.

Congratulations on your purchase of a Wastecorp® Mud Sucker® Diaphragm Pump, manufactured by Wastecorp Pumps in North America (WPCI). The pump has been carefully inspected by our quality assurance department and subjected to final factory tests before it was released from the factory for shipment.

USA	CANADA
Wastecorp Pumps, LLC P.O. Box 70 Grand Island, NY 14072 USA Phone: 888-829-2783 FAX: 888-883-3320 www.wastecorp.com	Wastecorp Pumps Canada Inc. 55 Six Point Road Toronto, ON M8Z-2X3 Canada Phone: 888-829-2783 FAX: 888-883-3320 www.wastecorp.ca

For technical or parts QUESTIONS, please contact Wastecorp Pumps Customer Support or Technical Support team toll free at 1-888-829-2783. Please have your serial number available.

To ORDER SERVICE PARTS, please contact Wastecorp Pumps above.

Pump Model:	
Pump Serial No.	
Pump Spec. No.	
Recommended Diaphragm Part No.	

Your new Wastecorp® Mud Sucker® is one of the leading and most dependable positive displacement pumping designs in the world. When the diaphragm is pulled up it creates a vacuum of up to 8 - 12 Mercury causing the suction flapper to open, pulling liquid into the pump body. On the down stroke, the diaphragm pressure forces the suction flapper closed and pushes or discharges the liquid through the outlet flapper side. Most Mud Sucker pumps are designed to handle spherical solids up to 1.5" in diameter. This reciprocating motions creates low shear. Due to some pipe lay-outs, excessive water hammer or pulses in the pipe may occur. Pulsation dampeners or air chambers will greatly relieve this problem and are available as optional accessories for your pump. (Consult with a Wastecorp technical support for more details).

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PUMP TESTING

YOUR HIGH PERFORMANCE WASTECORP MUD SUCKER® DIAPHRAGM PUMP WAS FACTORY TESTED FOR QUALITY ASSURANCE PRIOR TO SHIPMENT. THERE MAY BE TRACES OF CLEAR WATER IN THE PUMP WHEN IT ARRIVES.

• Be Safety Conscious – observe all local safety codes and OSHA regulations. Do not operate equipment under unsafe conditions.

• Read Instruction Manual – The instruction manual must be read and thoroughly understood by those responsible for the installation, operation and maintenance of this equipment.

• Operator Training – Operators must be trained in the proper and safe use of equipment.

• Safety Guards must be in Place – All guards must be in place while equipment is running to protect against bodily injury.

• Stop Equipment – The equipment should always be stopped before any attempt is made to repair, maintain, climb on, or remove tramp material.

• Stay Clear of Moving Machinery – Do not put your hands, feet or any part of your body in the equipment while it is running.

• Dress Properly – Do not operate equipment while wearing jewelry, loose fitting clothing, ties, shirt sleeves or unprotected long hair.

• Stay Alert – Do not operate equipment while under the influence of medication, drugs or alcohol.

• Maintain Equipment – Do not operate equipment in need of repair or service. Proper maintenance will help avoid equipment downtime, loss of production and injury to personnel.

• Electrical Repair – Electrical power must be turned off before attempting any repairs to electrical components. Lock out control panel and all starting switches so that another person cannot accidentally start the equipment.

• Hydraulic/Pneumatic Repair – Do not repair or service pneumatic or hydraulic components while equipment remains connected to the pneumatic/hydraulic power supply or is under pressure.

• Handle Chemicals with Care – Always consult vendor safety data sheets before handling chemicals. Do not handle or inhale chemicals for process conditioning, cleaning or any other purpose without the proper eye, skin and respiratory protection.

SERVICE

•Your dependable Mud Sucker® is backed by years of technical innovation and application. Complete records of this pump are on file at the factory. Replacement parts are available from the factory for prompt delivery. When contacting the factory for parts or service information, always give the pump model, specification and serial numbers from the pump nameplate.

• If you have any questions pertaining to the safe operation of the equipment, contact Wastecorp Pumps.

RECEIVING

Our shipping container has been specifically designed to prevent transit damage. However, upon receipt of the shipment, note IMMEDIATELY on the freight bill and bill of lading any damage or shortage. Check carefully to make sure that all equipment has been received and is in good condition. Shortages must be reported to Wastecorp. Pumps, and the freight carrier within two (2) days.
Caution: Do not turn speed control wheels on variable speed drives unless the motor is running.

RECOMMENDED PRECAUTIONS

•Avoid system pressures that may exceed one and a half times the operating point selected from the pump performance curve.

•To prevent rupture of castings, gaskets or diaphragms, always install a by-pass line or relief valve on the discharge side of any positive displacement pump when a throttled discharge is required.

•No modifications, additions or deletions should be made to the pump, without prior approval of the factory.

•Prime movers powering the pumps may operate at high temperatures and to avoid burns – keep hands off mufflers and manifolds.

•Should the fluid temperature rise more than 50°F above ambient, expansion joints must be installed on both the suction and discharge ports to relieve any stress on the pump casing.

•All electrical wiring of the pump installation must be done by a licensed electrician who will observe all national and local electrical codes. All motors require a magnetic starter with current over-load protection.

•Do not re-fill engine fuel tank while power unit is running. Prevent splashing of gasoline or other fuel while filling supply tank.

•Systems containing discharge check valves, gate valves, etc., will not prime against a closed valve. Do not operate pump with a closed discharge valve, death or injury may occur .Check to ensure that the discharge valve is open before starting pump. Optional air release valve is available from Wastecorp, to bleed off entrapped air.

•This pump is designed primarily for water transfer. Before pumping other liquids, please read the CAUTION section.

•Drain casing completely when servicing pump.

•Do not use in a combustible atmosphere environment without proper and adequate ventilation.

•Make periodic checks of the tightness of suction and discharge pipe, drain, filler plug and pump gaskets. Check tightness of gasoline tank filler cap each time tank is filled. Operation should not proceed until all of the above items have been checked and are tight.

•After servicing the pump, always install the coupling guards, belt guards and other safety devices as originally found prior to disassembly.

CARE OF EQUIPMENT

Do not leave motors or gearboxes uncovered or subject to water damage. Be particularly careful about water entry into any machinery under freezing conditions.

Wastecorp Pump equipment is properly prepared for shipment by packaging and covering with polyethylene film for protection against dirt, rain, snow and general exposure to the elements. It is not intended for outside storage. "Clear" film is used instead of black to permit easy visual inspection or identification of the equipment shipped. If the equipment is meant for outside storage, the purchaser must advise Wastecorp of special packaging requirements. Regular shipping plastic packaging film will deteriorate and crack if subjected to prolonged sunlight exposure. Special storage packaging is optional and must be expressed to the factory at the time of the order.

MOVING & HANDLING

⚠ Do not move the pump assembly using pipe rollers unless the fabricated steel base is well supported across the entirety of the base. Handling or moving the equipment must ensure that the distribution of weight is equal to prevent distortion, loss of alignment, and damage during operation.

Proper equipment must be available to unload the pumps from the truck.

1. WINTER STORAGE

During freezing weather or adverse temperature conditions, it is especially important to follow these procedures to prevent ice or extreme heat from cracking the pump casing or its component parts.
a) Drain all of the water (or liquid) from the pump body after use.
b) Follow motor or engine manufacturer's storage instructions for extreme duty conditions..

2. OUTDOOR STORAGE

a) Provide adequate cover with proper ventilation
b) Place the pump rod in the up position to drain water from the cavity above the diaphragm.
A. Effects

Any metallic equipment can be subject to water condensation as result of fluctuating ambient temperatures during storage, and this condensation can cause severe rusting which will either detract from the appearance of the equipment or contribute to premature failure.

B. Need for Proper Protection

Equipment that is to be stored (or installed but not started up and operated) for a long period of time should be given proper protection to ensure that it will be in good operating condition when ready for use. Equipment shipped by Wastecorp. Pumps, has been protected in such a way that sheltered storage for three months before operation will cause no problems.

On the other hand, if field conditions are such that storage prior to operation should occur for longer than three months, the contractor or owner must make arrangements for additional protection beyond that supplied by the manufacturer.

If special arrangements have been made between Wastecorp. Pumps, and its customer for extra protection for longer periods of time or against abnormal environmental conditions, the equipment will have been protected accordingly and any needed supplementary instructions will be attached.

C. Basis for Recommendations

The suggestions that follow are provided for guidance only in securing satisfactory and trouble-free operation after long term storage, and are not to be regarded as prescriptive or construed as an extension of standard warranty coverage. These are referred to on a general basis by product or component and the sections applying to specific component(s) or product(s) should be reviewed accordingly:

For Example, a motor driven gear reducer will require reference to sections for gear reducers and sections for motors in determining the proper gear reducers and sections for information related to motors and gear drives.

Regardless of how well protected the equipment may be, periodic inspection at intervals of one month or less should be made to determine whether or not the protection provided is adequate. The user's particular operating environment will involve applicable maintenance procedures, for example, deterioration of coatings, protective closures, etc. Proactive maintenance is the best insurance against costly downtime and parts and or pump replacement.

3. STANDARD PRE-SHIPMENT PREPARATION

Major machine components and motors have been wrapped with a reinforced plastic covering which should be left in place until the unit has been mounted in its permanent location indoors. Continuing protection may be provided during installation. After installation touch-up and other modifications may be required.

All exposed machine parts have a coating of anti-seize lubricant including the diaphragm chamber and parts within it. Proper maintenance including greasing and oil level, as well as, other lubricating points must be periodically inspected and serviced. Storage of equipment requires other procedures and steps.

The entire pump has been greased by Wastecorp Pumps prior to shipment.

All motors, gear boxes, and grease fittings have been lubricated according to the manufacturer's specifications. Grease fittings are covered, and should be left on their fittings and used to re-cap the fitting between lubrications.

4. MAINTENANCE DURING STORAGE BY CONTRACTOR/OWNER

LOCATION

• Indoors: Equipment should preferably be stored inside a building which will have a temperature between 50°F and 120°F (10°C and 50°C). The building should be clean and dry with good air circulation, and the temperature should not vary widely or rapidly.

• Outdoors: If no building is available, and outside storage is the only alternative, the equipment should be properly supported and adequately protected with a covering which will give protection similar to that provided by a building.

• Equipment should be stored elevated eighteen (18) inches above the ground (or higher if necessary to keep equipment out of high water levels) using properly sized timber beams and planks for support. The pumps are skidded at the factory for this reason.

Proper waterproof fabric or fabric reinforced plastic or rubber tarpaulins should be used to enclose the equipment and prevent damage from the elements. The tarpaulins should be securely fastened with ropes to prevent ballooning or wind affect.

• Immediately after the equipment is placed on the timber supports, and before it is covered with tarpaulins, it should be inspected and any damage to rust protective coatings, paint or wrappings repaired.

EQUIPMENT SUPPORT

Equipment should be placed level, with sufficient support to eliminate stress or distortion of frames or bases.

SURFACE PROTECTION

• Painted Surfaces: All equipment, which is prime coat painted only should be finish coat painted as soon as it is practical to do so. Every year or by the appearance of the painted surfaces, deteriorated areas should be spot primed or finish painted, as required, and using appropriate surface preparation. Paint and primer may be purchased from Wastecorp.

• Rubber Components: Rubber/ Thermoplastic components such as check valve and diaphragm should be protected from excessive sunlight (UV) and welding fumes by being kept covered in a well ventilated area away from extensive welding activity (light, fumes, spatter, etc.).

• Unpainted or machined metal Surfaces: These are coated with an anti-seize lubricant. They should be inspected frequently (at least monthly) and additional equivalent coatings applied if necessary.

5. DRIVES: Reference should be made to the manufacturer's manuals for the specific items involved for detailed instructions.

WARRANTY

• Manufacturer's Manuals: Reference should be made to the manufacturer's manuals for the specific items involved for detailed instructions.
Wastecorp's Standard Terms & Conditions of Sale shall also apply and are available for review upon request
Wastecorp. Pumps LLC, is designated "Seller" and warrants that its products and parts shall be free from defects in material and workmanship as noted herein:
COVERAGE: Wastecorp warrants for a period of twelve (12) months from date of installation but not more than eighteen (18) months from date of shipment ("the warranty period"), that the product sold hereunder will be free from defects in material and workmanship. Wastecorp's obligation under this warranty attaches with its examination, determination and satisfaction that the part(s) is defective in material or workmanship. Purchaser shall assume all responsibility and expense for removal, installation of the defective part(s) including freight. Repaired or replaced parts under this warranty will be covered for the Warranty Period only.

EXCEPTIONS TO WARRANTY COVERAGE:

- This warranty shall not apply to the following products and parts: engines, motors, gauges, trade accessories, electrical control equipment and other products, components or materials not manufactured by Wastecorp. Any warranty for these products and parts shall be provided by the manufacturer(s) of those products and parts.
- This Warranty shall not apply to any Wastecorp product or part, which: a) has been subjected to misuse, misapplication, alteration, neglect or physical damage resulting from these causes; b) has been installed, operated, used, and/or maintained in a manner which is not in accordance with Wastecorp's printed instructions;
c) product damage as a result of improper power supply, improper electrical production, faulty installation, lack of maintenance, improper installation, ordinary wear and tear, corrosion or chemical attack, an Act of God, and Act of War or Terrorism or, which has been damaged as a result of the use with other equipment not provided by Wastecorp.
- This Warranty does not cover costs for any standard and/or scheduled maintenance, nor does it cover parts that, by nature of their function, require replacement as a result of normal wear ("wear parts"), unless Wastecorp has determined the wear part to be defective in material or workmanship. Wear parts include, but are not limited to, connecting rod and liner, plunger, ball valves, valve seats, packing, diaphragms, flappers, impeller, mechanical seal, check valve flapper, wear plate, wearing, volute, gaskets, O-rings, seals, oil, grease, bearings and/or other items which are required for operation of the pump and are subject to regular inspection and maintenance.

- Determination of Warranty coverage or exceptions to Warranty coverage claims are solely at the discretion of Wastecorp.

LIMITATION OF LIABILITY:

- EXCEPT AS PROVIDED ABOVE, WASTECORP MAKES NO OTHER WARRANTY OF ANY KIND, WHATSOEVER EXPRESS OR IMPLIED, AND ALL IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE ARE HEREBY DISCLAIMED AND EXCLUDED FROM THIS WARRANTY.
- EQUIPMENT SELECTED OR SUPPLIED BY OTHERS WILL BE LIMITED SOLELY TO THE WARRANTY, IF ANY, PROVIDED BY THE MANUFACTURER OF THE EQUIPMENT.
EXCLUSIVE REMEDY:
The sole and exclusive remedy under the Warranty by Wastecorp, and the entire extent of its liability for allowable claims for damages arising and/or resulting from the use
of the products and parts covered by this Warranty shall be as follows:
- REPAIR OR REPLACEMENT: If inspection shows that any Wastecorp product or part covered under this Warranty is defective in materials or workmanship, Wastecorp shall repair or replace the defective product or part(s) at its option, without charge. The product or part(s) claimed to be defective must have been properly maintained and used in accordance with the maintenance schedule and/or instructions contained in the manual which comes with the product. Parts which are subject to wear and tear under normal use are not covered under Seller's Warranty. No allowance will be made for labor, freight, transportation or other charges incurred in connection with such repair or replacement.
- Immediately notify Wastecorp at the address below of the claimed defect in materials or workmanship and provide the serial number of the product and/or part(s) and provide a copy of the invoice or bill of sale referencing the product and/or part by no later than the expiration date of the Warranty period.
- Wastecorp will advise whether inspection of the product and/or part(s) will be necessary and whether and how inspection, repair or replacement will be effected. If inspection is necessary, Wastecorp will, at its discretion, provide field inspection by an authorized agent or require that the product or part(s) be sent freight prepaid to Wastecorp at designated location. If the product or part(s) is returned to Wastecorp for inspection, return shipment of the repaired product or part(s) will be FOB the designated location.
- DAMAGES: SELLER'S SOLE LIABILITY FOR DAMAGES UNDER THIS LIMITED WARRANTY SHALL NOT EXCEED THE AMOUNT OF THE PURCHASE
PRICE OF THE PRODUCT OR PART IN RESPECT OF WHICH DAMAGES ARE CLAIMED. IN NO EVENT SHALL WASTECORP BE LIABLE FOR ANY DIRECT,
INCIDENTAL, SPECIAL OR CONSEQUENTIAL DAMAGES PURSUANT TO THIS LIMITED WARRANTY OTHER THAN AS STATED

⚠ BEFORE BEGINNING START-UP, PLEASE READ CAREFULLY THE RECOMMENDED PRECAUTIONS IN SECTION A OF THE MANUAL. FAILURE TO FOLLOW INSTRUCTIONS MAY RESULT IN PERSONAL INJURY, DEATH OR PROPERTY DAMAGE.

⚠ UPON RECEIVING YOUR PUMP, INSPECT FOR ANY TRANSIT DAMAGE. ANY INDICATIONS OF DAMAGE SHOULD BE CAREFULLY NOTED ON THE DELIVERY TICKET AND A CLAIM FILED PROMPTLY WITH THE CARRIER. YOU MUST CONTACT THE CARRIER AND FILE A CLAIM IMMEDIATELY.

⚠ THIS PUMP IS DESIGNED TO HANDLE NON-VOLATILE, NON-FLAMMABLE LIQUIDS CONTAINING SPECIFIED ENTRAINED SOLIDS. DO NOT ATTEMPT TO PUMP VOLATILE, CORROSIVE OR FLAMMABLE LIQUIDS (WITHOUT PRIOR CONSENT FROM THE PUMP MANUFACTURER) WHICH MAY DAMAGE THE PUMP OR ENDANGER PERSONNEL AND PROPERTY AS A RESULT OF PUMP FAILURE.

1. PROPER LOCATION

Place the pump on a firm, level foundation above the source of liquid. This is necessary in order that proper check valve operation and pump performance is assured. Leave sufficient space around the pump for future servicing. Locate the pump in an accessible place as close as practical to the liquid being pumped. (Maximum priming ability is 20 foot vertical lift.) The pump may have to be supported or shimmed to provide for level operation or to eliminate vibration. After the pump has been positioned, block the wheels to prevent rolling, if applicable, and secure the pump to prevent creeping. Never place the pump on the edge of a ditch or at an unstable or unsecured place

⚠ CAUTION: DO NOT EXCEED STATIC DISCHARGE HEAD ABILITIES OF THE PUMPING UNIT. CONTACT WASTECORP FOR DETAILED INFORMATION.

⚠ ALWAYS REMEMBER THAT PUMPS WILL “PUSH” LIQUID BETTER THAN THEY WILL “PULL” LIQUID. ALWAYS PLACE THE PUMP AS CLOSE AS POSSIBLE TO THE LIQUID BEING PUMPED (SUCTION INLET).

2. ANCHOR BOLTS, IF APPLICABLE:

Correctly sized anchor bolts should be placed and set as shown in the dimensional drawing for mounting foot holes in accordance to ASTM standards. Concrete foundation poured to the proper elevation. The purpose of the foundation bolts are to anchor the pump unit to the concrete foundation, so that the foundation and pump unit become a single structural unit. Because of the pulsing nature of the pump operation, anchoring, leveling and shimming the pump base is key to a rigid single structural unit. A simple check of the above procedure is to loosen two anchor bolts at one end of the pump base and see if there is any movement. If movement is detected, re-shim and tighten. For optimum results your pump should be free of all piping, etc., when checking base alignment.

After the pump has been set in place and before piping, etc., begins, the entire pump, including motor should be covered to protect the equipment from dust or foreign matter causing abrasion. This will greatly simplify the start-up procedure later on and ensure that key components are not affected.

3. PUMPING

Under normal conditions at sea level, this pump is capable of handling water up to a 20 ft., suction lift. Your pump will operate best with some pressure on the discharge side. If operating with the discharge below the pump, the discharge hose can be carried over an object to lift the hose or piping. Should pulsating occur and continue, it may be that the conditions require an air chamber. If the pump was supplied with one, then a flooding condition has occurred. Drain the excess liquid from the chamber. Tighten all plugs securely after draining.

4. SUCTION & DISCHARGE CONNECTIONS
Either pipe or hose maybe used for suction and discharge lines; however, the materials must be compatible with the liquid being pumped. Keep suction and discharge lines as straight as possible to minimize friction losses. Make minimum use of elbows and fittings, which substantially increase friction loss. If elbows are necessary, use the long-radius type to minimize friction loss. Never pull a line into place by tightening connections at the pump. Lines near the pump must be independently supported to avoid strain on the pump which could cause excessive vibration and increased diaphragm and gear train wear. If hose type lines are used, they should have adequate support to secure them when filled with liquid and under pressure.

5. HOSING
Connections at the easily accessible suction port should be made using strongly reinforced non-collapsible suction hose recommended and supplied by Wastecorp. This type of hose will not collapse during operation. COLLAPSIBLE HOSE MAY BE USED ON THE DISCHARGE SIDE ONLY. New hose washers should be used at the couplings to prevent air leaks. All hosing should be independently supported to eliminate excessive strain on the pump. Make sure that the hose does not rest on sharp edges of any material or obstruction. Over a period of time a slight chafing may cut or wear a hole in the hose. The hose should be replaced to prevent air entraining. Suction and discharge hose should be of the nominal pipe size of the pump connections. Do not employ reducers at the suction inlet.

6. FIXED OR RIGID PIPING
All piping, especially the suction line, should be as short as possible with the fewest number of fittings to reduce friction loss. Installation with long pipe lines or when handling hot liquids, requires expansion and contraction relief provisions. Provide adequate support for the piping to eliminate severe strains on the pump. It is important that suction piping should continuously rise to the pump to avoid air pockets. Gate valves should not be used on the discharge side for flow control. Capacity may be altered by pump speed (engine and variable speed drives only).
If the pump is mounted in a system with fixed, rigid piping, it is recommended that a flexible connection be installed at or near the suction and discharge ports to absorb shock which would otherwise be transmitted through the drive train and greatly accelerate pump wear.

7. PULSATION DAMPENERS
In a fixed piping installation, properly sized surge suppressors are recommended to be installed in both suction and discharge lines. If commercial surge suppressors are not readily available, air chambers may be fabricated from pipe. Note that air chambers can be installed off tees to avoid turbulence within the chambers, if applicable. Air chambers are available from Wastecorp. Please contact Wastecorp to purchase pulsation dampeners for your pump, or for the recommended size of the surge suppressors and, or air chambers for your pump model. The following is for illustrative purposes only and may vary from your pump model. Some Mud Sucker models are equipped with standard integral suction accumulator chamber which promotes an efficient flow of liquid and acts as an air cushion against shock. Depending on the pipe lay-out, particularly in a rigid pipe installation, additional air chambers are necessary to reduce water hammer. The second illustration below shows these air chambers installed off tees to avoid turbulence within the chambers. In fixed, rigid piping applications, it is recommended that a flexible connection be installed at or near the suction and discharge ports to absorb shock which would otherwise be transmitted through the drive train greatly accelerate pump wear or damage to piping from water hammer.



8. SUCTION LINES
To avoid air pockets which could affect pump priming, the suction line must be as short and direct as possible. When operation involves a suction lift, the line must always slope upward to the pump from the source of the liquid being pumped; if the line slopes down to the pump at any point along the suction run, air pockets will be created.

⚠ **NOTE: MAX. PUMP PERFORMANCE IS REALIZED AT SUCTION LIFTS OF 5 FEET OR LESS. USE THE SHORTEST POSSIBLE LENGTH OF SUCTION HOSE OR PIPING; LENGTHS OF 25 FEET OR LONGER WILL REDUCE THE CAPACITY OF THE PUMP.**

It is strongly recommended that no positive shut-off valve be installed in the suction line; excessive restrictions will cause incomplete filling of the diaphragm chamber and result in short diaphragm life.

Suction lines should be the same size as the pump inlet. If reducers are used in suction lines, they should be the eccentric type, and should be installed with the flat part of the reducers uppermost to avoid creating air pockets. The suction line should not be restricted more than 1 inch below the nominal suction size.
The use of pipe couplings in the suction line is not recommended.

9. ROTATION:
The diaphragm should be pivoting towards the discharge side of the pump during the compression stroke. Directing the liquid towards the outlet, will reduce friction losses and increase efficiency. The location of your discharge pipe (right or left side) will determine if the motor needs to run in a clockwise or counter clockwise direction.

10. STRAINER (ADVISABLE)
Protect your investment; use a strainer. Strainers are attached to the suction line to prevent stones and foreign debris from clogging the line and pump. A large overall straining area is necessary and should be kept clear of debris. Keep the strainer from working into the sediment by suspending it from measured rope at least 6 inches (15 cm) from the bottom. Strainers are available from Wastecorp.

11. DISCHARGE LINES
THE DISCHARGE LINE MUST BE THE SAME DIAMETER AS THE FACTORY SUPPLIED DISCHARGE CONNECTION, OR LARGER. A RESTRICTED DISCHARGE LINE WILL CAUSE EXCESSIVE FRICTION LOSS RESULTING IN OVERLOADING AND DESTRUCTION OF THE PUMP AND DRIVE COMPONENTS DUE TO OVER PRESSURIZATION. NEVER INSTALL A POSITIVE SHUT-OFF VALVE IN THE DISCHARGE LINE; DISCHARGE RESTRICTIONS WILL CAUSE EXCESSIVE FRICTION LOSS RESULTING IN OVERLOADING AND DESTRUCTION OF THE PUMP AND DRIVE COMPONENTS. IT IS STRONGLY RECOMMENDED THAT UNLESS ABSOLUTELY NECESSARY, NO POSITIVE SHUT-OFF VALVE BE INSTALLED IN THE SUCTION LINE; EXCESSIVE RESTRICTION WILL CAUSE INCOMPLETE FILLING OF THE DIAPHRAGM CHAMBER AND RESULT IN SHORTENED DIAPHRAGM LIFE.

12. FLOW CONTROL
Flow volume can be controlled by reducing the motor speed with an optional variable speed drive or variable frequency drive.

13. ENGINES (IF APPLICABLE)
NEVER TAMPER WITH THE GOVERNOR TO GAIN MORE POWER. THE GOVERNOR ESTABLISHES SAFE OPERATING LIMITS THAT SHOULD NOT BE EXCEEDED. THE MAXIMUM CONTINUOUS OPERATING SPEED FOR ENGINE DRIVEN PUMPS IS 2600 RPM.

⚠ THE GEARBOX PROVIDED ON THESE PUMPS IS DESIGNED FOR OPERATION AT 2600 RPM MAXIMUM SYNCHRONOUS INPUT SPEED. IF OPERATED AT A HIGHER RPM, PUMP COMPONENTS MAY BE DESTROYED.

⚠ DO NOT OPERATE AN INTERNAL COMBUSTION ENGINE IN AN EXPLOSIVE ATMOSPHERE. WHEN OPERATING INTERNAL COMBUSTION ENGINES IN AN ENCLOSED AREA, MAKE CERTAIN THAT EXHAUST FUMES ARE PIPED TO THE OUTSIDE. THESE FUMES CONTAIN CARBON MONOXIDE, A DEADLY GAS THAT IS COLOR-LESS TASTELESS, AND ODORLESS.

1. EXAMINE THE PUMP:

An important part of preventative maintenance and operational safety is to inspect the pump prior to use. Visible or apparent problems need to be corrected. Before starting the pump. Periodic inspection should include looking for broken parts, loose connections and that bolts and nuts are tight.

2. PLACING THE PUMP INTO OPERATION:

Ensure that the pump is set on a firm, flat and level surface. If the pump is stationary, use appropriately sized anchor bolts to secure the unit. If pump is wheel mounted, ensure that wheels are blocked to prevent rolling. Never place the pump on the edge of a ditch or at an unstable or unsecured place. Always place the pump as close as possible to the liquid being pumped (suction inlet). Always remember that pumps will “push” liquid better than they will “pull” it.

3. HOSES & CONNECTIONS:

If the pump is stationary, hard PVC or iron piping is recommended. If the unit is portable, a non-collapsible wire reinforced suction hose and a blue lay flat discharge fire hose is recommended. Both the pipe and hose should be self-supporting so as not to put any strain or stress on the pump castings. On most applications, a flange-nipple or cam-lock fitting is supplied on the pump. If you are using your own piping, ensure that the fittings are rated at a minimum of 50 PSI and that they are correctly sized to the pump. Always ensure that clamps and fittings are tight and in good condition prior to use. A strainer or foot valve is recommended in most applications to prevent large solids from entering into the piping & pump (causing blockage) and to aid in priming.

4. STARTING THE PUMP:

Before you begin start-up, ensure that the operator manual relating to the pump includes the engine or motor manufacture’s manual. Ensure that both the suction and discharge line are open and clear of debris. There is a cast arrow at the base of the pump and lettering on the top (Inlet / Outlet) indicating flow direction (see picture below).



Figure 1

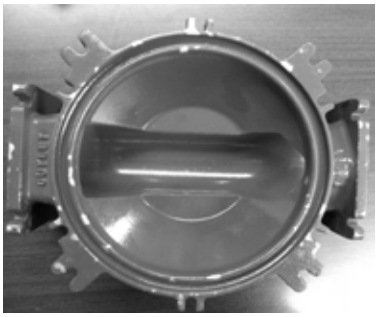


Figure 2

Precautions

Always wear protective eye wear when working in or around your pump, wastewater, waste oil or other types of fluids

Wear protective gloves

Wash your hands after use

SYMPTOMS	PROBABLE CAUSE	RECOMMENDED ACTION
WILL NOT PRIME	1. Air leaks 2. Blocked line 3. Check valves not seating properly 4. Suction lift too high or horizontal run too long 5. Loose or worn diaphragm 6. Engine speed too low	1. Tighten all suction line joints and hoses. 2. Clean hose and strainer 3. Clean debris from valve chamber and check ball 4. Relocate pump closer to supply 5. Tighten bolts or replace diaphragm. 6. Increase throttle
PUMP WILL NOT PUMP OR POOR PERFORMANCE (at proper speed)	1. Suction line not properly submerged 2. Suction hose lining collapsed 3. Blocked line/ strainer clogged 4. Check valves not seating properly, clogged or binding 5. Suction lift too high or horizontal run too long 6. Loose or worn diaphragm or not securely in place 7. Engine speed too low	1. Ensure proper installation 2. Replace suction hose 3. Clean hose and strainer 4. Clean debris from check valves and seat, ensure flange nuts are tightened. 5. Relocate pump closer to supply 6. Replace diaphragm and, or ensure diaphragm is secured 7. Increase throttle
PUMP FREQUENTLY CLOGS	1. Check valves not seating properly, clogged or binding 2. Liquid being pumped is too thick	1. Clean debris from check valves and seat, ensure flange nuts are tightened. 2. Dilute liquid being pumped, if possible
BEARINGS ARE OVERHEATING	1. Bearing temperatures are high, but within limits 2. Incorrect lubricant or insufficient lubrication 3. Misalignment of pump and drive unit.	1. Check bearing temperature regularly to monitor any substantial increases. 2. Check for proper lubricant type and ensure sufficient level and frequency of lubrication is applied. 3. Realign drive assembly.
PUMP REQUIRES TOO MUCH POWER	1. Liquid being pumped is too thick 2. Pump speed is too high 3. Discharge check valve clogged or binding 4. Worn bearings	1. Dilute liquid being pumped , if possible 2. Check engine throttle output 3. Clean debris from check valves and seat, or replace 4. Check bearings in engine or gearbox
EXCESSIVE NOISE	1. Improper lubrication of gearbox, engine or motor 2. Pump, gearbox, engine or motor are not securely mounted.	1. Refer to LUBRICATION maintenance of gearbox, engine or motor manual. 2. Check installation and ensure mounting bolts are properly tightened.

5. REPLACING THE DIAPHRAGM (APPROX. 10-15 MINUTES):

All Wastecorp Mud Sucker® diaphragms are made of high quality reinforced rubber materials which have been engineered for Wastecorp Pumps, and designed for good wear and long life properties. Certain applications, however, place greater stress and cause fatigue to the diaphragm. Changing the diaphragm on Wastecorp Pumps is straight forward and user friendly:

a. Ensure that there is no pressure exerted on the pump, and the pressure has been released and all power sources have been disconnected. (lock-out).

b. Remove pump guard (35) from upper body (29) by unbolting the three cap screws (34).

c. With an adjustable wrench, rotate the crank arm (23) to the six o-clock position so the diaphragm is in the down position.

d. Remove the six machine screws and nuts (31, 36) that hold the pump body (1) to the upper body (29).

e. Remove the capscrew (17) and loosen the set screw (18) then slide off the pump rod (14) from the cam follower shaft (19).

f. Lower the diaphragm assembly down through the hole in the upper body.

g. Remove the cap screw (9).

h. Remove the lower clamping plate (10) and diaphragm (11).

i. Install new diaphragm (11) and reinstall clamping plate (10).

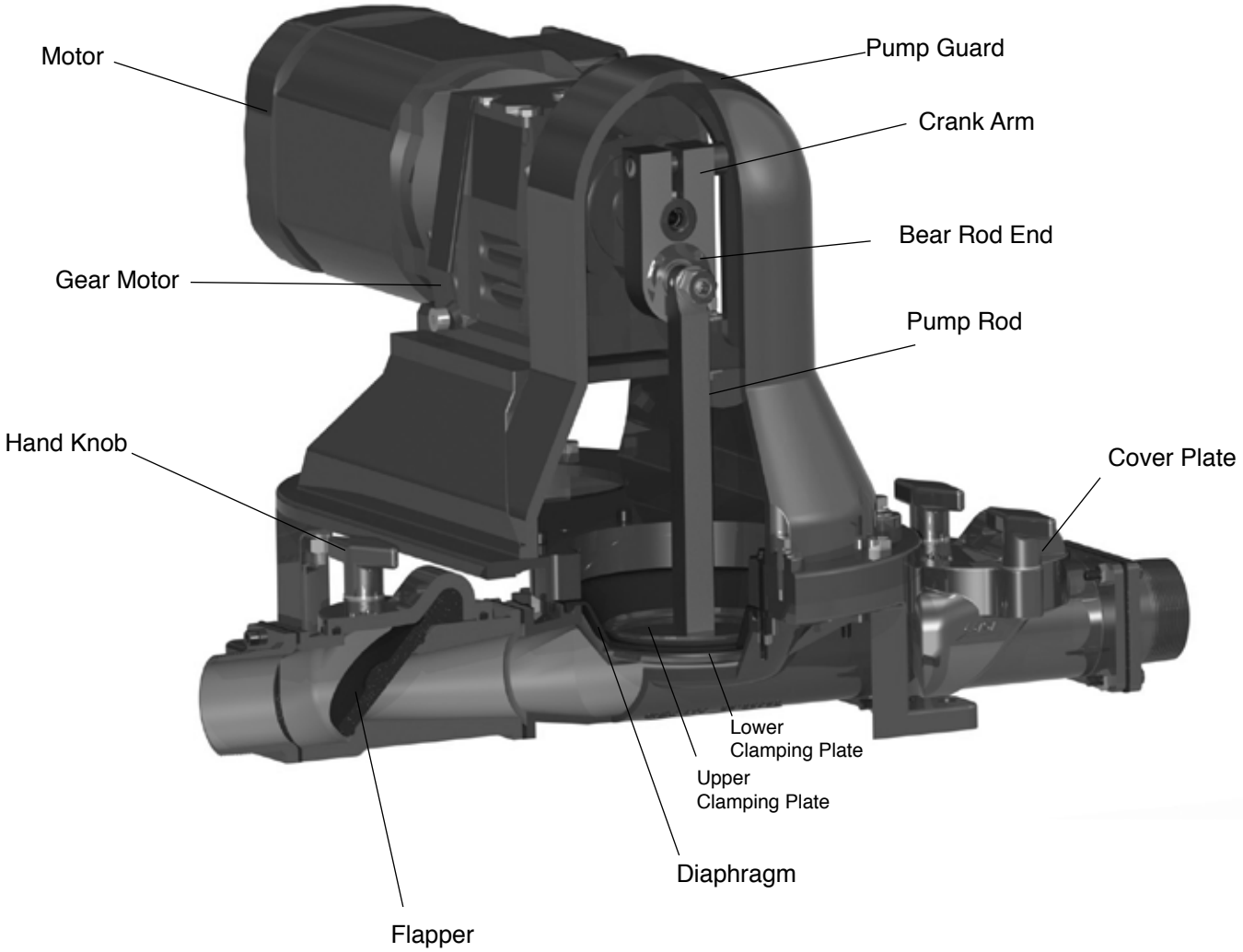
j. Apply a small amount of silicon to the threads (9) and torque to 60 foot pounds.

k. Insert the diaphragm assembly up through the upper body hole (29) and install the pump body (1), ensuring that the diaphragm is properly seated into the pump body groove to prevent leakage.

l. Re-install the six machine screws and nuts tightly (31, 36) as well as the bearing rod (14) set screw (18) and hex nut (17) tightly with loctite # 427 then finally install Guard (32) and capscrews (33,34).



BEFORE PERFORMING ANY MAINTENANCE ON THE UNIT, LOCK OUT THE MOTOR/ ENGINE SO THAT AUTOMATIC START-UP CANNOT OCCUR.


Motor
Pump Guard
Crank Arm
Bear Rod End
Gear Motor
Pump Rod
Hand Knob
Cover Plate
Lower
Clamping Plate
Upper
Clamping Plate
Diaphragm
Flapper

7. REPLACING THE CRANK ARM AND CAM FOLLOWER ASSEMBLY (APPROX. 10-15 MINUTES):

a. Remove the hex nut (17) and loosen the set screw (18) then slide off the pump rod end and spacer washer (21) from the cam follower shaft (20).

b. Loosen the socket head cap screw (24) and slide the crank arm (23) off of the gear reducer shaft.

c. Clamp the crank arm (23) down, then unscrew the three brass machine screws (19) which allow removal of the cam follower washer (22).

d. Place the crank arm (23) into a manual press and use 5/16" dowel pin to press out the cam follower (20) from the crank arm (23).

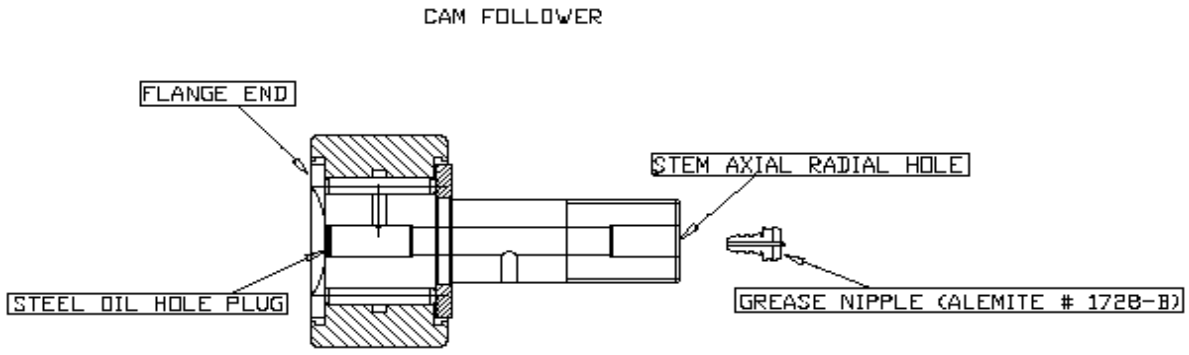
**⚠ DO NOT OPERATE WITH A CLOSED DISCHARGE VALVE.
OPERATING WITH A CLOSED DISCHARGE VALVE MAY RESULT IN DAMAGE
TO THE UNIT AND/OR PERSONAL INJURY/DEATH.**

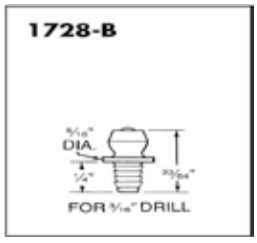
CAM FOLLOWER LUBRICATING INSTRUCTIONS:

For re lubrication of the cam follower, an Alemite # 1728-B Grease nipple fitting is recommended to assist in directing the grease through the stem axial radial hole with a grease gun.

A steel oil hole plug has been installed on the flange end of the axial radial hole which is designed to withstand normal grease gun pressures.

It is recommended to grease the cam follower weekly or every 120 hours of use. Insert the Alemite #1728-B grease nipple into the 3/16" stem axial radial hole. Insure that the steel oil hole plug on the opposite flange end is installed to prevent grease blow out. The cam follower is pre factory lubricated before shipping. Recommended lubricant is a multi-purpose soap based Lithium Hydroxystearate grease such as Shell Alvanie RL2, Castrol EPL-1 Spheerol (or equal). When inserting the grease, force enough into the cam follower until the grease starts to purge through the flange end. Wipe away any excess grease.







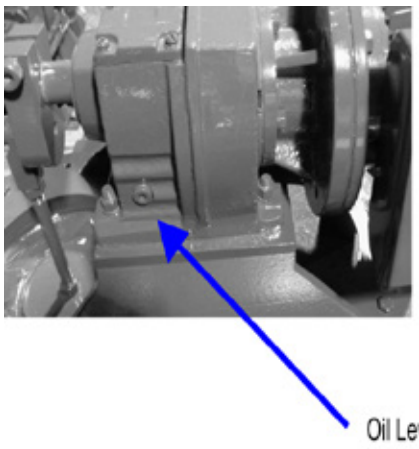


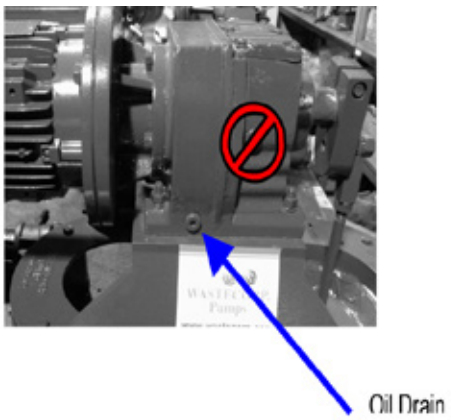
DRIVE END LUBRICATION

1. GEAR REDUCER: CHECK THE OIL LEVEL IN THE GEAR BOX EVERY WEEK WHEN IN CONTINUED USE. REFER TO GEAR REDUCER MANUFACTURER'S MANUAL FOR INSTRUCTIONS. RECOMMENDED GEAR OIL SHELL OMALA # 220.

2. ENGINE: FOLLOW INSTRUCTIONS IN THE ENGINE MANUFACTURER'S MANUAL.

3. MOTOR: FOLLOW THE MOTOR MANUFACTURER'S LUBRICATION INSTRUCTIONS.







ORDER GENUINE FACTORY PARTS FOR YOUR MUD SUCKER® PUMP

YOUR DEPENDABLE WASTECORP MUD SUCKER® DIAPHRAGM PUMP IS BACKED BY YEARS OF PRACTICAL KNOWLEDGE. THEY ARE DESIGNED TO REQUIRE LITTLE SERVICE DUE TO ITS RUGGED DESIGN. COMPLETE RECORDS OF THIS PUMP ARE ON FILE AT WASTECORP.

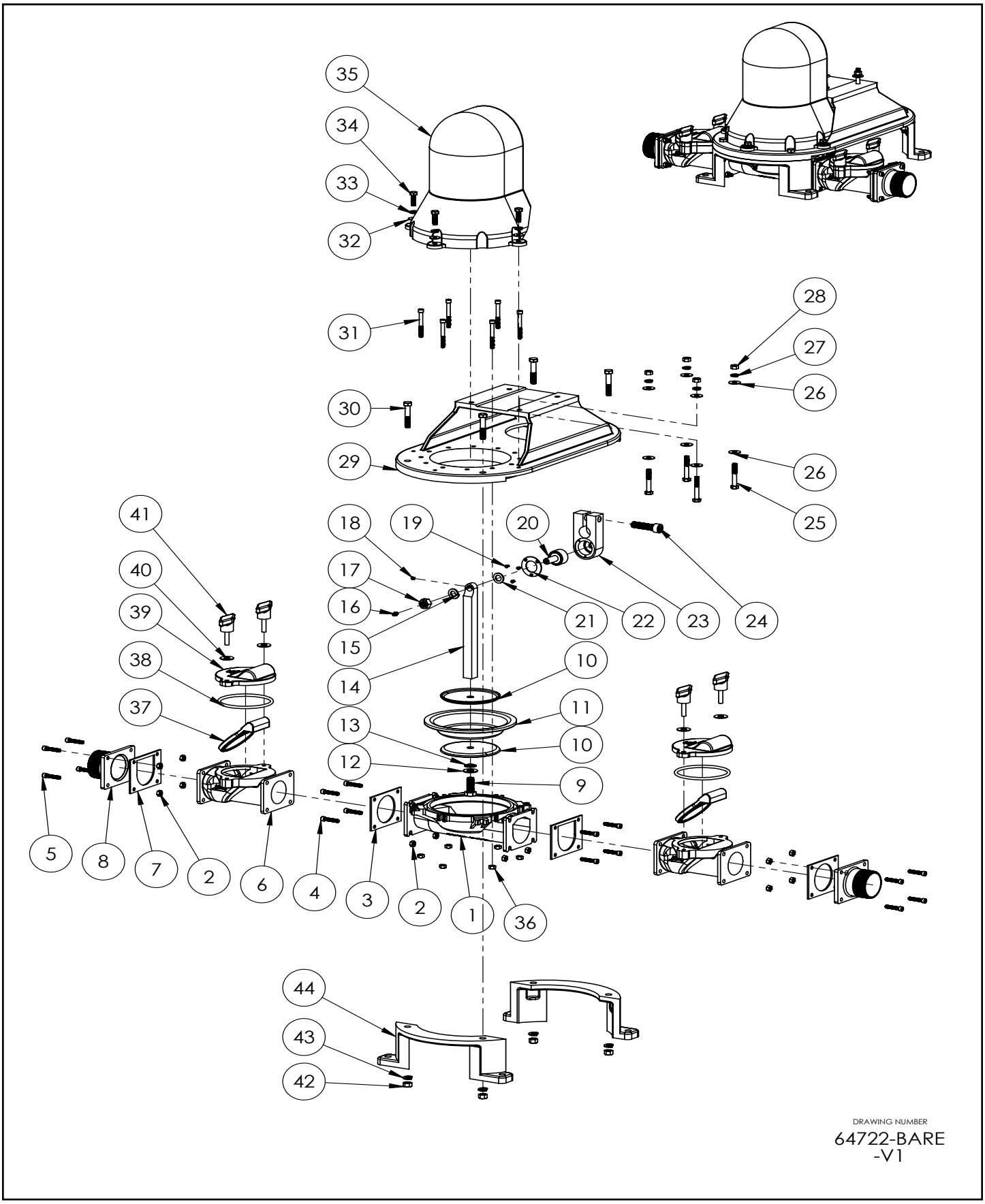
YOU SHOULD ONLY USE ORIGINAL EQUIPMENT MANUFACTURED REPLACEMENT PARTS IN YOUR MUD SUCKER® DIAPHRAGM PUMP, WHICH ARE AVAILABLE FROM WASTECORP FOR PROMPT DELIVERY.

WHEN CONTACTING THE FACTORY FOR REPAIR PARTS OR SERVICE INFORMATION, PLEASE PROVIDE THE PUMP MODEL, SPECIFICATION NUMBER AND SERIAL NUMBER WHICH CAN ALL BE FOUND ON THE PUMP NAMEPLATE. IF APPLICABLE, YOUR LOCAL AUTHORIZED REPRESENTATIVE IS ACCESSIBLE TO ALL GENUINE MUD-SUCKER® DIAPHRAGM PUMP PARTS AND ARE ALWAYS AVAILABLE TO ASSIST YOU AT ANY TIME. IF YOU HAVE ANY QUESTIONS PERTAINING TO THE SAFE OPERATION OF THE EQUIPMENT, CONTACT YOUR LOCAL FACTORY:

Canada
Wastecorp Pumps Canada Inc.
55 Six Point Road
Toronto, ON M8Z-2X3
Canada
Phone: 888-829-2783
FAX: 888-883-3320
www.wastecorp.ca

USA
Wastecorp Pumps, LLC
P.O. Box 70
Grand Island, NY 14072
USA
Phone: 888-829-2783
FAX: 888-883-3320
www.wastecorp.com

Date	Maintenance Performed	Notes


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43
42
DRAWING NUMBER
64722-BARE
-V1

ITEM NO.	PART NUMBER	DESCRIPTION	QTY.
1	60490-00	PUMP BODY W/O FEET	1
2	50203-00	HARDWARE - HEX NUT	16
3	61012-02	GASKET, CHECK VALVE & CHAMBER (EPDM) (FA & B)	2
4	61393-00	HARDWARE - CAPSCREW (HEX)	8
5	61336-00	HARDWARE - CAPSCREW (SOCKET STD HD)	8
6	64707-00	VALVE CHAMBER	2
7	60635-06	GASKET, CHECK VALVE & CHAMBER (VITON)	2
8	62903-00	FLANGE, INLET/OUTLET - 2" MNPT (STL)	2
9	62691-00	HARDWARE - CAPSCREW (HEX) - SS	1
10	60452-02	CLAMPING PLATE, STEEL	2
11	60444-00	DIAPHRAGM, 7" OD (RUBBER W/ NYLON REINFORCEMENT)	1
12	63410-06	FLAT WASHER	1
13	61201-00	SEALING WASHER (NBR/SL)	1
14	62677-02	PUMP ROD	1
15	50626-00	LOCK WASHER (REGULAR)	1
16	61518-00	GREASE FITTING, CAM FOLLOWER	1
17	50204-00	HARDWARE - HEX NUT	1
18	61049-00	SOCKET SETSCREW (STEEL)	1
19	60991-00	HARDWARE - MACHINE SCREW (SS)	3
20	60993-00	CAM FOLLOWER ONLY	1
21	60955-00	SPACER, CAM (STEEL)	1
22	60954-00	FRONT WASHER, CAM (STEEL)	1
23	60952-00	CRANKARM, 1" (STEEL)	1
24	42190-00	HARDWARE - CAPSCREW (SOCKET STD. HD)	1
25	50312-00	HARDWARE - CAPSCREW (HEX)	4
26	50576-00	FLAT WASHER	8
27	50622-00	LOCK WASHER (REGULAR)	4
28	50206-00	HARDWARE - HEX NUT	4
29	60689-04	PUMP BODY, UPPER - PERPENDICULAR (STD)	1
30	50327-00	HARDWARE - CAPSCREW (HEX)	4
31	61264-00	HARDWARE - CAPSCREW (SOCKET STD HD)	6
32	50575-00	FLAT WASHER	3
33	50622-00	LOCK WASHER (REGULAR)	3
34	50299-00	HARDWARE - CAPSCREW (HEX)	3
35	60691-04	PUMP GUARD (ALUM.)	1
36	50203-00	HARDWARE - HEX NUT	6
37	64709-00	FLAPPER CHECK VALVE	2
38	64710-00	GASKET	2
39	64708-00	COVER VALVE CHAMBER	2
40	50580-00	FLAT WASHER	4
41	25780-00	HAND KNOB WITH INTEGRAL STUD (1.5B & 2B)	4
42	25898-00	HARDWARE - HEX NUT	4
43	50623-00	LOCK WASHER (REGULAR)	4
44	60690-04	FOOT SUPPORT (PERPENDICULAR)	2

FOR WARRANTY TO BECOME VALID, A SIGNED COPY OF THE START UP INSPECTION REPORT MUST BE EITHER EMAILED, FAXED OR MAILED TO WASTECORP PUMPS WITHIN 90 DAYS OF RECEIVING YOUR MUD SUCKER® DIAPHRAGM PUMP.

ORDER #: _____

MODEL:_____

SERIAL NO.:_____

END-USER: _____

ENGINEER (if applicable):_____

CHECK LIST (Initial)

____1. Check condition of pump unit upon arrival

____2. Ensure that all components have been shipped as per your order

____3. Check gear reducer oil level on pump and fill as required.

____4. Install flapper or ball check valves and ensure that cover is properly clamped and sealed.

____5. Install pressure gauge on discharge side of pump after valve chamber.

____7. Start motor and note average pressure gauge reading.

____8. If pressure reading spikes or is over normal pressure, shut down pump and check for closed valve.

____9. Run pump for approx. 30 min. For variable speed motors, test the motor thru its entire speed range. Adjust the motor speed only when the motor is running.

NOTES:_____
_____

ACCEPTANCE: Based on the above inspection & comments, we hereby certify that this equipment is ready for permanent operation and that there is nothing in the installation that will render the manufacturer's warranty void.

AUTHORIZED SIGNATURE:_____

Company _____

Print Name,_____

Title_____

Date _____

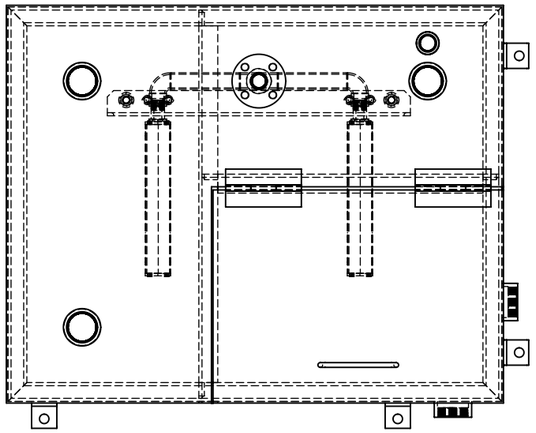
Section 3.6.2

Sludge Holding Tank

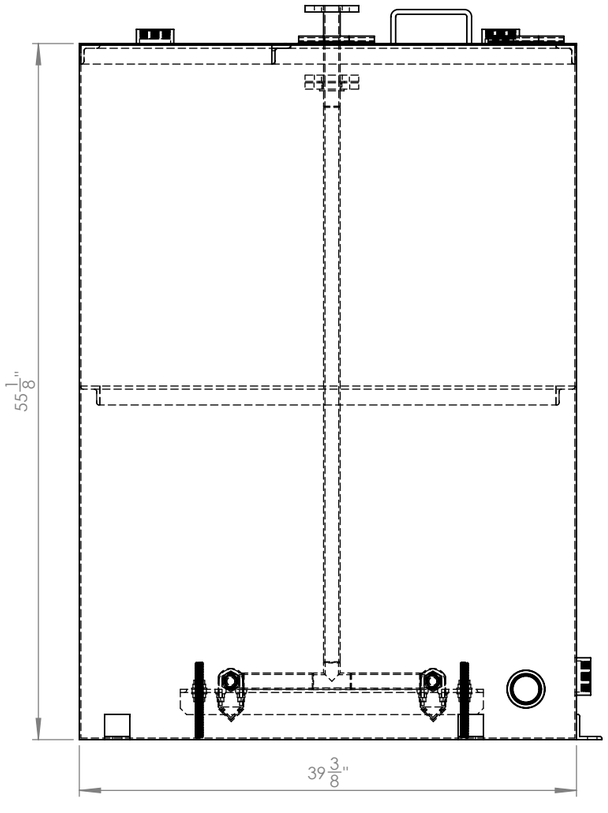
REV	DESCRIPTION	DATE	BY	APP'D
0	FOR FABRICATION	03/23/2022	DM	JC

NOTES:

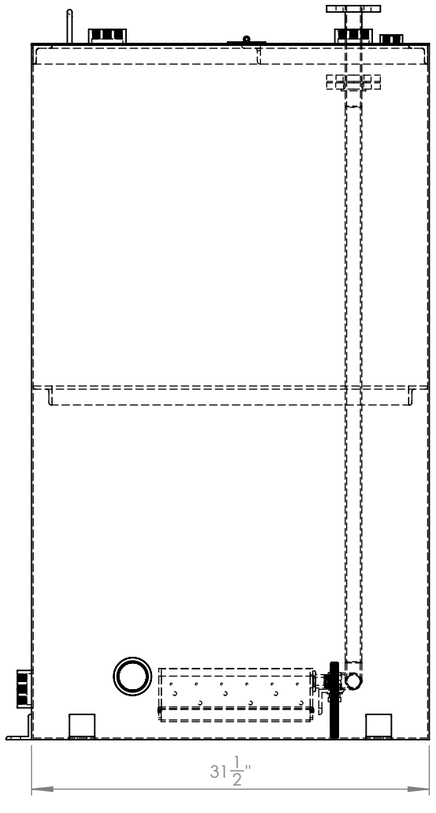
1. QTY: 1 UNIT
2. MATERIAL: SS 304, GAUGE 10-TANK WALL,
3. ALL DIMENSIONS ARE EDGE TO EDGE UNLESS OTHERWISE NOTED
4. TOLERANCES: ANGULAR MACH. ±1°, BEND ± 1°, DECIMAL ±0.5mm OR ±1/64"



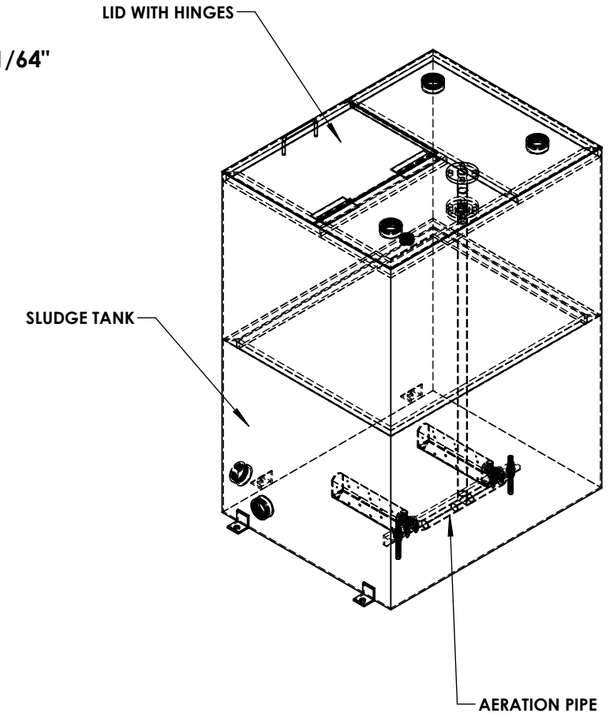
TOP VIEW



FRONT VIEW



RIGHT VIEW



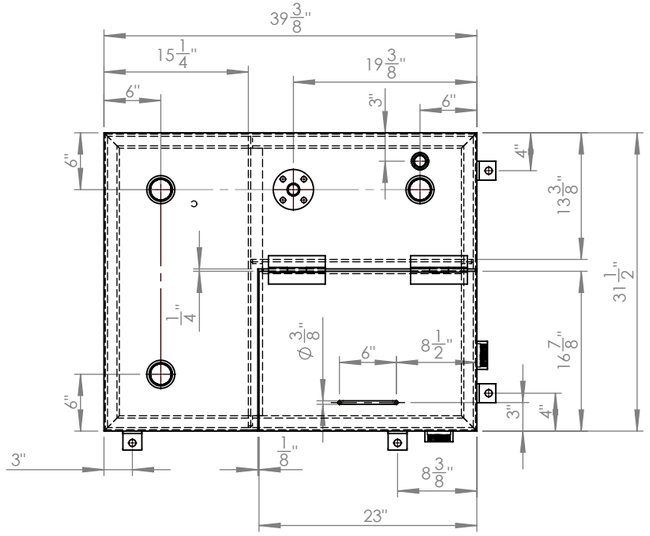
H2FLOW EQUIPMENT INC.

WATER AND WASTEWATER TREATMENT EQUIPMENT
580 OSTER LANE, CONCORD, ON L4K 2C1 CANADA
TEL: (905) 660-9775 FAX: (905) 660-9744
www.h2flow.com

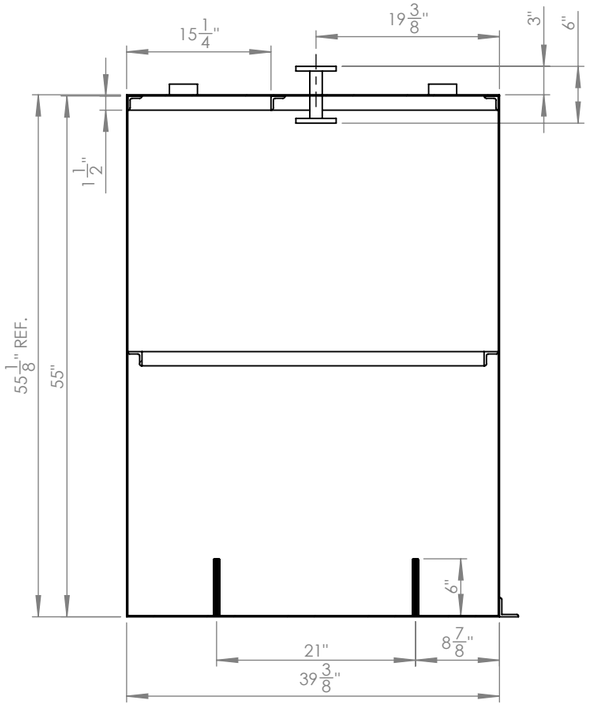
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DRAWN BY: DM	DATE: 03/23/2022	PROJECT NAME: SABINA GOLD STP NUNAVUT	TITLE: SLUDGE TANK ASSEMBLY
APP'D BY: JC	DATE: 03/23/2022		DRAWING No.: Q-23119-30-02
SCALE: NTS		ALL DIMENSION ARE IN INCHES UNLESS OTHERWISE SPECIFIED	REV: 0
			SHEET 1 OF 3

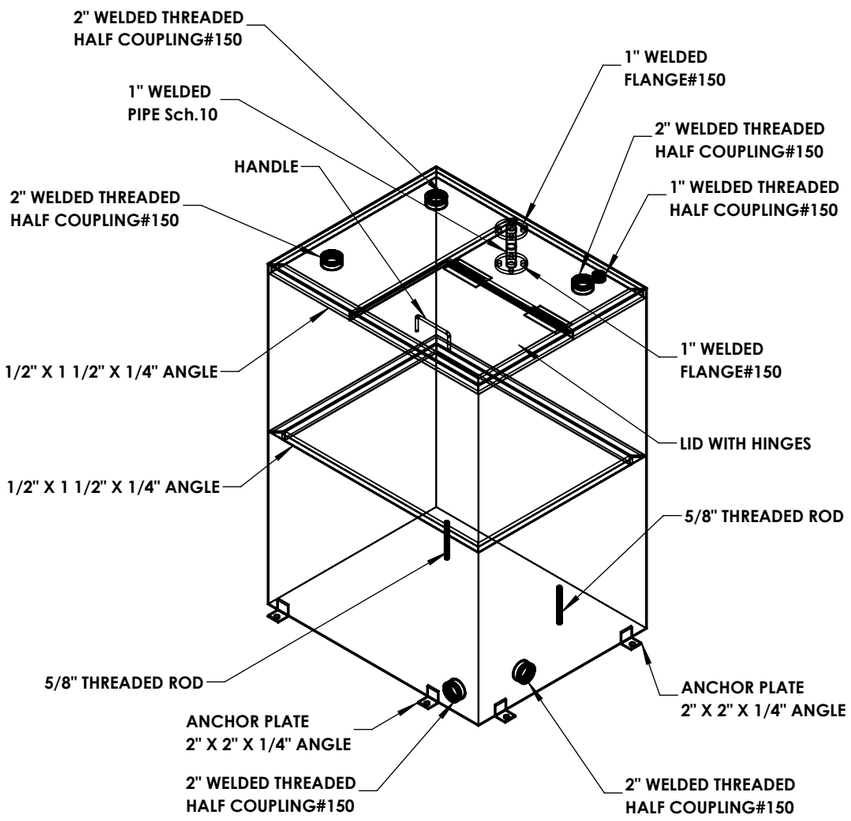
REV	DESCRIPTION	DATE	BY	APP'D
0	FOR FABRICATION	03/23/2022	DM	JC

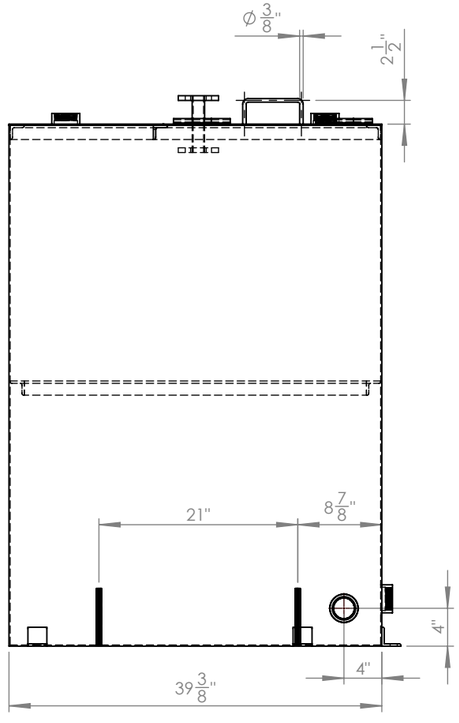


TOP VIEW

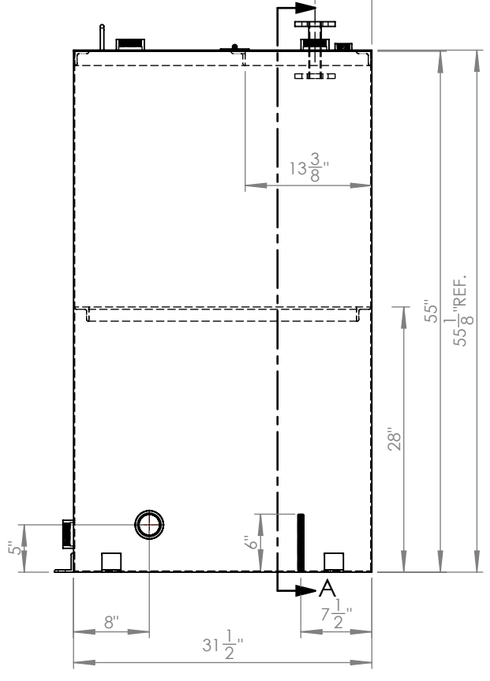


SECTION A-A

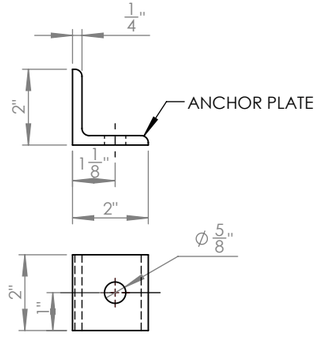




FRONT VIEW



RIGHT VIEW



NOTES:

1. QTY: 1 UNIT
2. MATERIAL: SS 304, GAUGE 10-TANK WALL,
3. ALL DIMENSIONS ARE EDGE TO EDGE UNLESS OTHERWISE NOTED
4. TOLERANCES: ANGULAR MACH. ±1°, BEND ± 1°, DECIMAL ±0.5mm OR ±1/64"

H2FLOW EQUIPMENT INC.

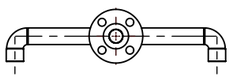
WATER AND WASTEWATER TREATMENT EQUIPMENT
580 OSTER LANE, CONCORD, ON L4K 2C1 CANADA
TEL: (905) 660-9775 FAX: (905) 660-9744
www.h2flow.com

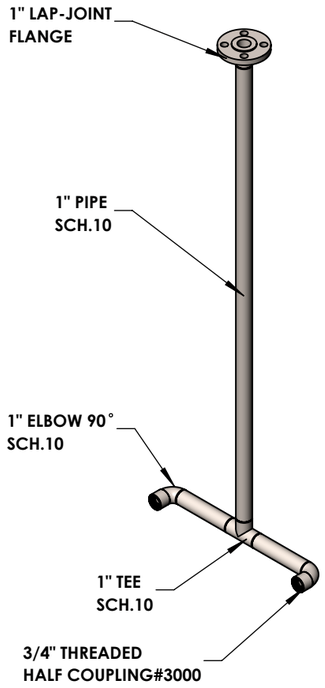
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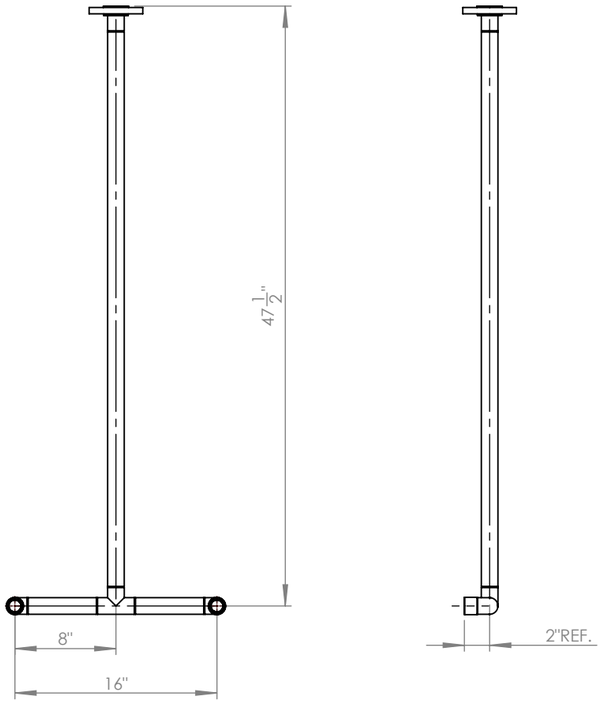
DRAWN BY: DM	DATE: 03/23/2022	PROJECT NAME: SABINA GOLD STP NUNAVUT	TITLE: SLUDGE TANK DETAILS
APP'D BY: JC	DATE: 03/23/2022		DRAWING No.: Q-23119-30-02
SCALE: NTS		ALL DIMENSION ARE IN INCHES UNLESS OTHERWISE SPECIFIED	REV: 0

NOTES:

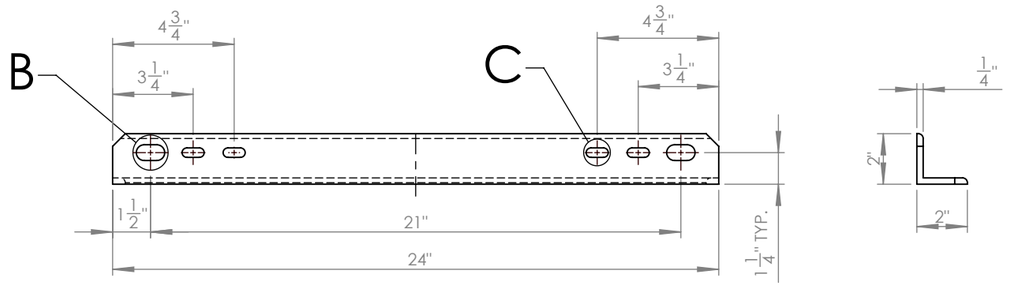
1. QTY: 1 UNIT
2. MATERIAL: SS 304, GAUGE 10-TANK WALL,
3. ALL DIMENSIONS ARE EDGE TO EDGE UNLESS OTHERWISE NOTED
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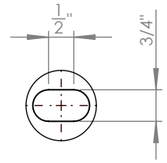




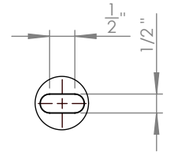


REV	DESCRIPTION	DATE	BY	APP'D
0	FOR FABRICATION	03/23/2022	DM	JC





DETAIL B
SCALE 1 : 3



DETAIL C
SCALE 1 : 3

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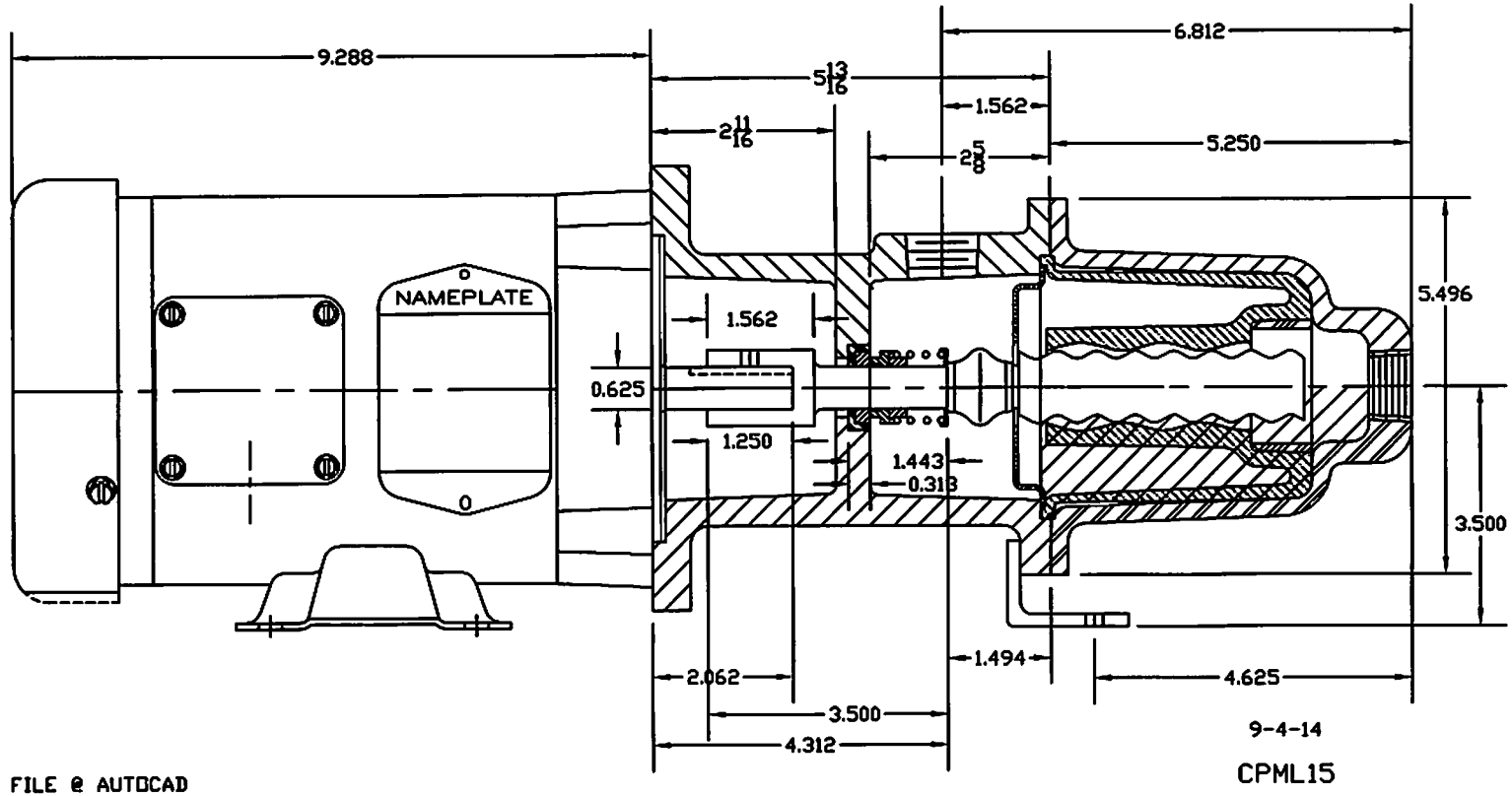
WATER AND WASTEWATER TREATMENT EQUIPMENT
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DRAWN BY: DM	DATE: 03/23/2022	PROJECT NAME: SABINA GOLD STP NUNAVUT	TITLE: AERATION PIPE DETAILS
APP'D BY: JC	DATE: 03/23/2022		DRAWING No.: Q-23119-30-02
SCALE: NTS		ALL DIMENSION ARE IN INCHES UNLESS OTHERWISE SPECIFIED	REV: 0
			SHEET 3 OF 3

Section 3.6.3

Sludge Dewatering Pumps



9-4-14

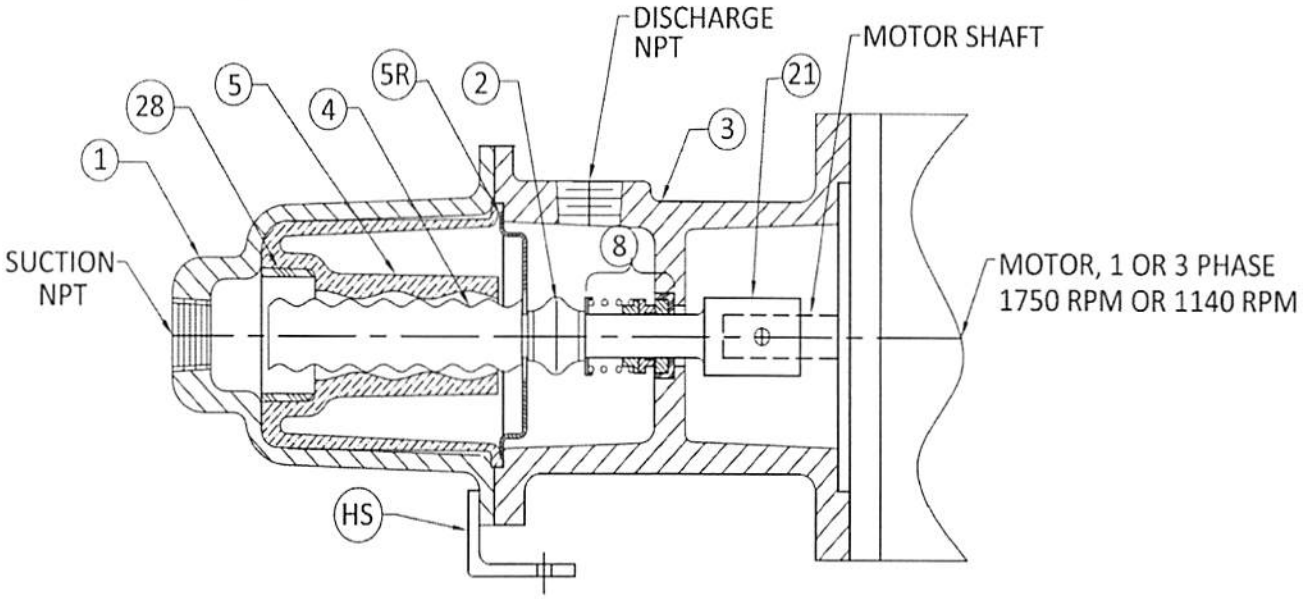
CPML15

CPML15-SECTION FILE @ AUTOCAD

PARTS LIST

FRAMES:CPML15, 22, 33 & 44

CLOSED COUPLED PUMP



PLEASE SPECIFY MODEL NUMBER AND/OR SERIAL NUMBER OF PUMP WHEN ORDERING PARTS

ITEM NO.	PART NAME	PART NO. 15 FRAME	PART NO. 22 FRAME	PART NO. 33 FRAME	PART NO. 44 FRAME
1	SUCTION HOUSING	CP1-15C CP1-15S	CP1-15C CP1-15S	CP1-15C CP1-15S	CP1-15C CP1-15S
2	FLEXIBLE JOINT- THREADED	U2-15TQS	U2-15TQS	U2-15TQS	U2-15TQS
3	DISCHARGE HOUSING	CPML3-15C CPML3-15S	CPML3-15C CPML3-15S	CPML3-15C CPML3-15S	CPML3-15C CPML3-15S
4	ROTOR, PINNED AND THREADED	U4-15PTS	U4-22PTS	U4-33PTS	U4-44PTS
5	STATOR	U5-15Q	U5-22Q	U5-33Q	U5-44Q
5R	STATOR BARRIER**	U5R-15S	U5R-15S	U5R-15S	U5R-15S
8	MECHANICAL SEAL	U8-15Q	U8-15Q	U8-15Q	U8-15Q
21	MOTOR COUPLING	U21-15S	U21-15S	U21-15S	U21-15S
28	STATOR RING	U28-15S	U28-15S	NOT USED	NOT USED
HS	HOUSING SUPPORT	HS-15	HS-15	HS-15	HS-15

**=OPTIONAL

T= THREADED

P=PINNED

MATERIALS OF CONSTRUCTION

C=CAST IRON / CARBON STEEL

S= STAINLESS STEEL

Q= BUNA N / NITRILE

B= EPDM

F= VITON

CPML-15

REV. 4/20/12

Continental Pump Company

29425 State Hwy B | Warrenton, Missouri 63383| Tel: 636-456-6006 | Fax: 636-456-4337| Email: sales@con-pump.com

www.continentalultrapumps.com

Dimensions & Weights

CP Model

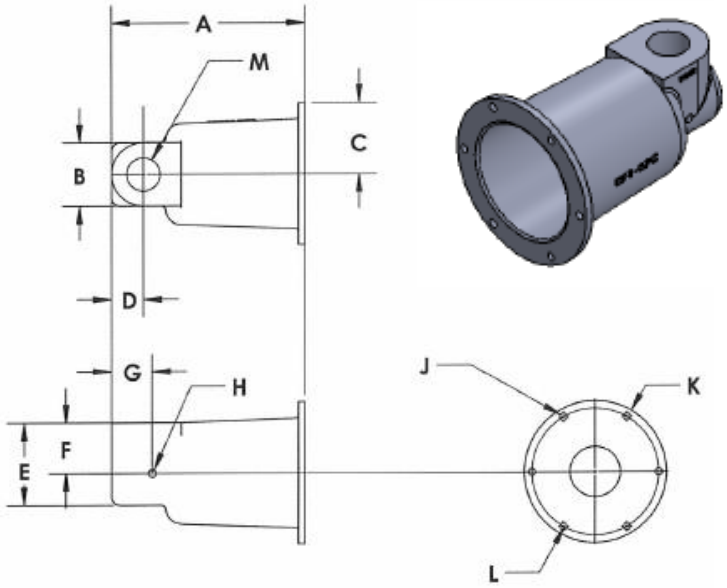
PUMPS	DIMENSIONS (INCHES)											WEIGHT (LBS)	PORT SIZES	
	A	B	C	D	E	F	G	H	J	K	U		INLET SUCTION	OUTLET DISCHARGE
CP15 · CP22 · CP33 · CP44	12- 7/16"	6-13/16"	5- 5/8"	3- 1/2"	5- 3/4"	5- 1/2"	3- 1/4"	3- 11/16"	3- 3/8"	1- 7/16"	5/8"	15	3/4"	3/4"
CP56	16- 11/16"	9- 3/4"	6- 15/16"	4- 9/32"	7- 9/32"	7- 1/2"	6"	4- 3/4"	3- 9/16"	2- 3/8"	3/4"	40	1-1/2"	1-1/4"
CP67	19- 9/16"	11- 15/16"	7- 5/8"	4- 1/2"	8- 1/4"	8- 1/4"	6"	4- 7/8"	4- 9/16"	2- 1/8"	1"	85	2"	2"
PACKED CP15 · CP22 · CP33 · CP44	14- 3/4"	6- 1/4"	8- 1/2"	3- 1/2"	5- 7/8"	5- 1/2"	3- 1/4"	3"	6- 7/16"	1- 7/16"	5/8"	18	3/4"	3/4"
PACKED CP56	18- 13/16"	9- 3/4"	9- 1/16"	4- 9/32"	7- 9/32"	7- 1/2"	6"	4- 3/4"	5- 11/16"	2- 3/8"	3/4"	44	1-1/2"	1-1/4"
PACKED CP67	22"	12"	10"	4- 1/2"	8- 1/4"	8- 1/4"	6"	4- 3/4"	7- 1/8"	2- 1/8"	1"	90	2"	2"
CPM15 ·CPM22 ·CPM33 ·CPM44	18- 3/4"	12"	6- 13/16"	3- 1/2"	5- 7/8"	5- 3/4"	6- 1/2"	4"	10- 3/4"	7"		48	3/4"	3/4"
CPM56	22- 15/16"	13- 3/16"	9- 3/4"	4- 1/2"	7- 1/2"	7- 1/2"	9"	10"	12- 15/16"	8- 1/4"		80	1-1/2"	1-1/4"
CPM67	25- 1/4"	13- 5/16"	12"	4- 1/2"	7- 3/4"	8- 1/4"	9"	10"	15- 5/16"	8- 5/8"		117	2"	2"
CPML15 ·CPML22 ·CPML33 ·CPML44	20- 3/8"	13- 9/16"	6- 13/16"	3- 1/2"	5- 3/4"	6- 1/2"	6- 1/2"	4"	13- 1/8"	6-3/4'		52	3/4"	3/4"
CPML56	25- 3/8"	13- 3/4"	9- 3/4"	4- 1/2"	7- 1/2"	7- 1/2"	9"	10"	13- 1/12"	8- 1/4"		85	1-1/2"	1-1/4"
CPML67	27- 7/8"	15- 7/8"	12"	4- 1/2"	7- 3/4"	8- 3/8"	9"	10"	17- 7/8"	8- 11/16"		125	2"	2"

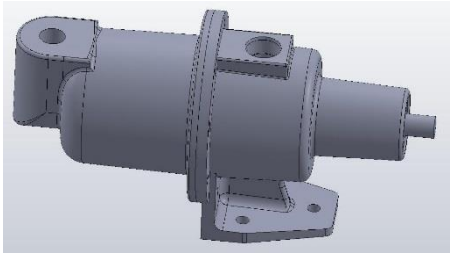
Dimensions are for reference only.
Do not use above dimensions for limited space installations, request certified drawing.
Ø = diameter

All CP pumps are offered with vertical housing option. See vertical housing dimensions.

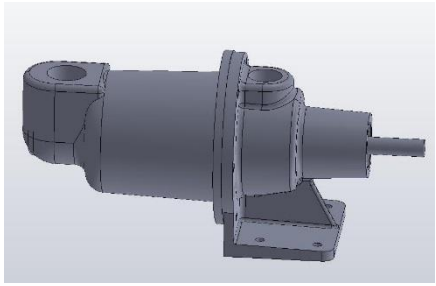
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Vertical Housing Dimensions





CP15 · CP22 · CP33 · CP44



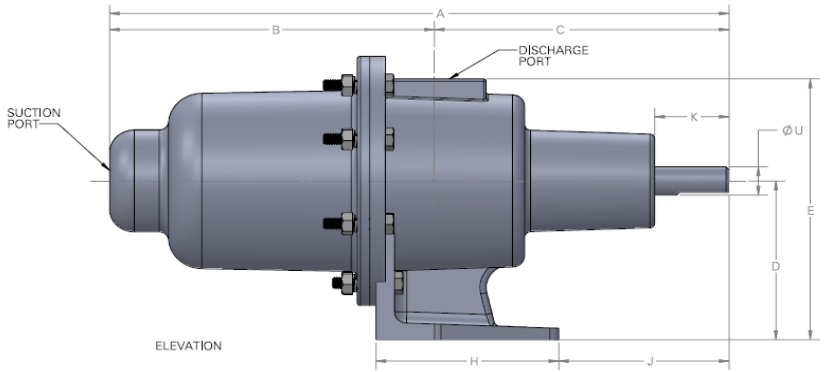
CP56 · CP67

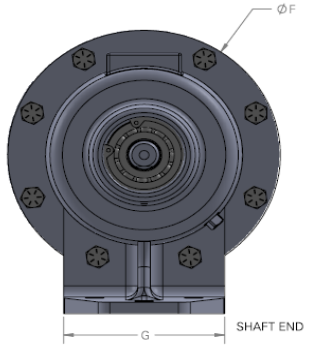
VERTICAL HOUSING P/N	A	B	C	D	E	F	G	H	J	K	L	M
CPV1-15	5-1/2	2-1/16	2-3/4	1	3	1-15/16	NA	NA	1/4 x 8	5-1/2	4-7/8	3/4 NPT
CPV1-56	9	3	3-3/4	1-7/8	4-1/8	2-5/8	1-1/2	1/4	7/16 x 6	7-1/2	6-3/4	1-1/2 NPT
CPV1-67	11-1/4	3-11/16	4-1/8	1-13/16	4-3/4	2-15/16	2-3/8	1/4	7/16 x 6	8-1/4	7-3/8	2 NPT

All dimensions are in inches

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CP Model

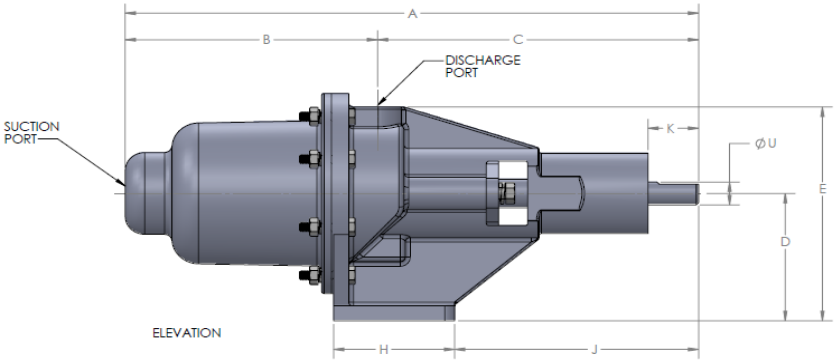


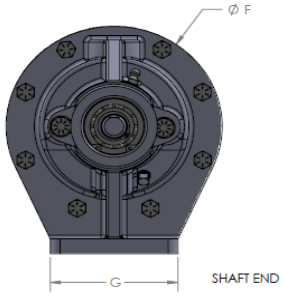




CP15 - CP22 - CP33 - CP44 - CP56 - CP67
MECHANICAL SEAL PUMP

*Designate a "M" in pump nomenclature for a Mechanical Seal Pump *Example:* CP15-CSQMP





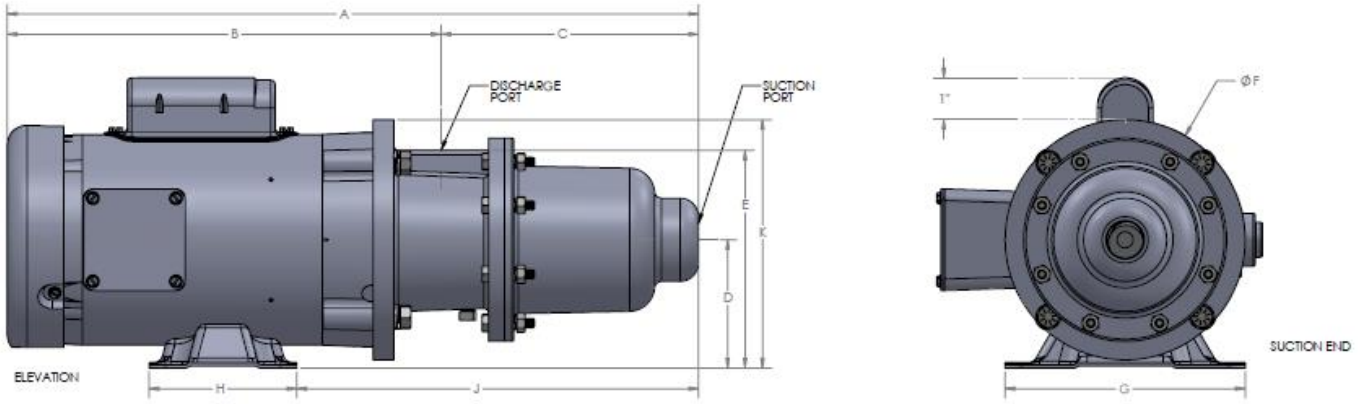


CP15 - CP22 - CP33 - CP44 - CP56 - CP67
PACKED SEAL PUMP

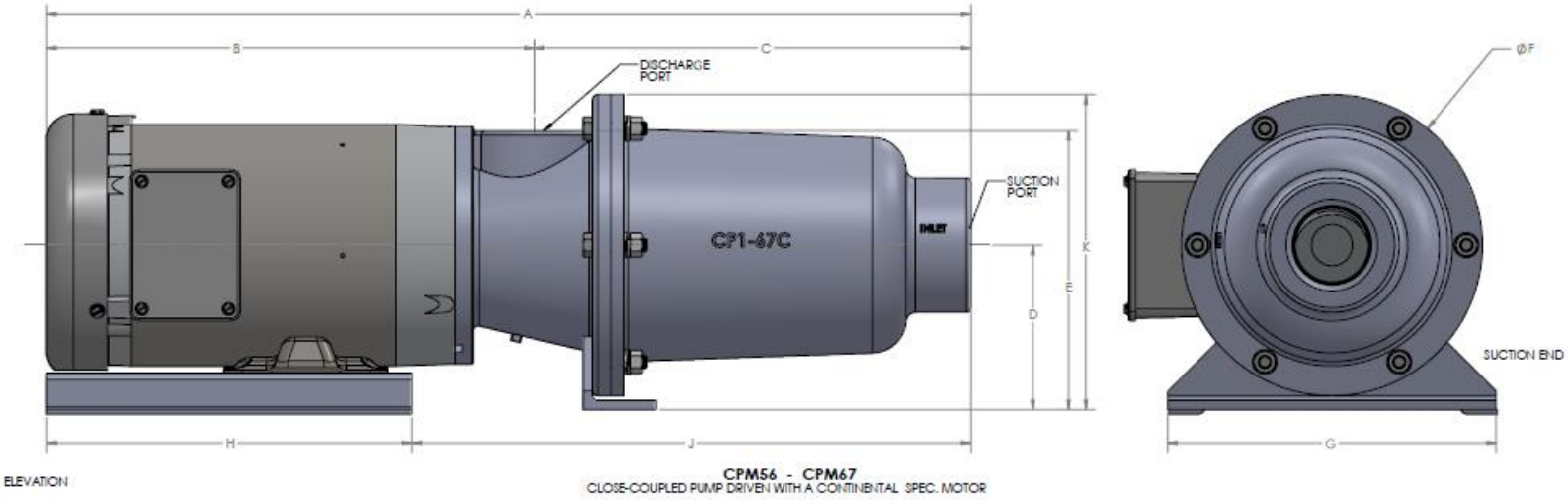
*Desingate a "D" in pump nomenclature for a Packing Gland Pump *Example:* CP15-CSQDP

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CPM Model



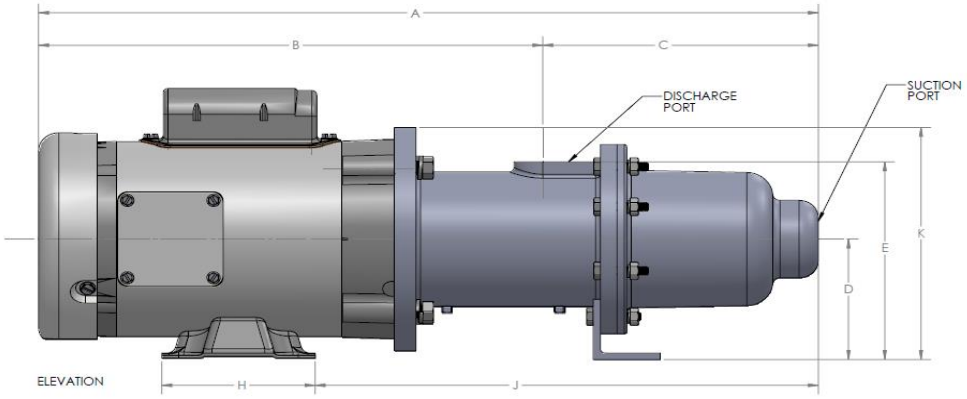
CPM15 - CPM22 - CPM33 - CPM44
CLOSE-COUPLED PUMP DRIVEN WITH A CONTINENTAL SPEC. MOTOR

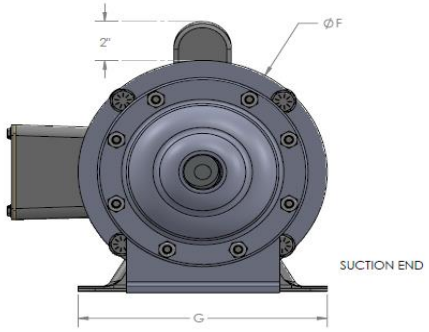


CPM56 - CPM67
CLOSE-COUPLED PUMP DRIVEN WITH A CONTINENTAL SPEC. MOTOR

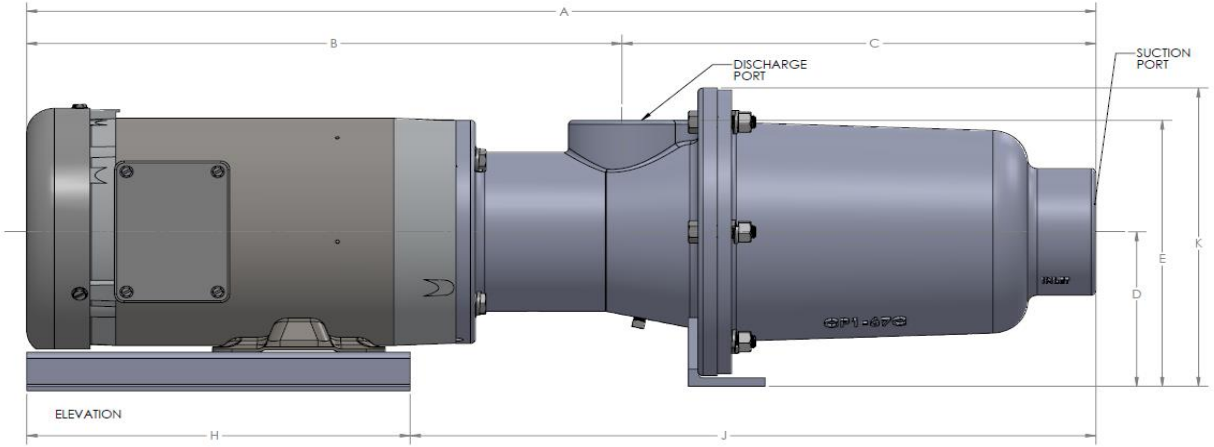
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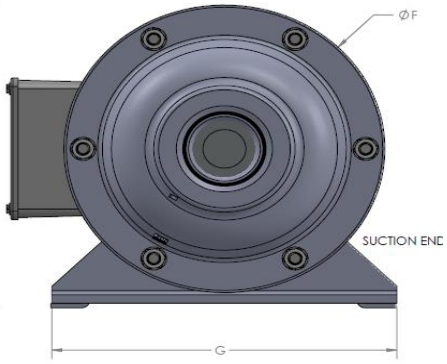
CPML Model





CPML15 - CPML22 - CPML33 - CPML44
CLOSE-COUPLED PUMP DRIVEN WITH A STANDARD MOTOR





CPML56 - CPML67
CLOSE-COUPLED PUMP DRIVEN WITH A STANDARD MOTOR

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Performance Data

CP Model

PERFORMANCE DATA							
PUMP	DIFFERENTIAL PRESSURE	CAPACITY- Gallons per Minute (Water at 70°F)					MOTOR HORSE POWER
		PUMP SPEED					
		1750 RPM	1150 RPM	870 RPM	580 RPM	430 RPM	
CP-15	0	1.9	1.3	1.0	0.7	0.5	1/2
	25	1.7	1.0	0.5	0.2	0.1	
	50	1.5	0.9	0.2			
	75	1.2	0.8				
	100	1.0	0.7				
	125	0.8	0.5				
	150	0.6	0.4				
CP-22	0	4.9	3.2	2.0	1.6	1.2	1/2
	25	4.1	2.7	2.0	1.3	0.9	
	50	3.4	2.2	1.6	1.0	0.7	
	75	2.6	1.7	1.3	0.8	0.6	
	100	2.0	1.5	1.0	0.6	0.4	
CP-33	0	9.4	6.0	4.6	3.1	2.3	1/2
	25	7.0	4.5	3.4	2.3	1.7	
	50	4.2	2.7	2.0	1.3	0.9	
CP-44	0	15.0	9.7	7.3	4.9	3.6	3/4
	25	12.0	7.8	5.9	4.0	3.0	
	50	9.4	6.1	4.6	3.1	2.3	
CP-56	0	24.0	15.6	11.7	7.9	5.8	1 1/2
	25	22.0	14.3	10.7	7.2	5.3	
	35	20.5	13.3	10.0	6.7	4.9	
	50	19.5	12.7	9.5	6.4	4.1	
CP-67	0	53.0	34.5	26.0	17.5	13.0	2
	10	48.0	31.0	23.4	15.8	11.7	
	20	43.0	28.0	21.0	14.0	10.3	
	35	34.0	22.0	16.5	11.0	8.1	
	50	25.0	16.3	12.3	8.3	6.1	

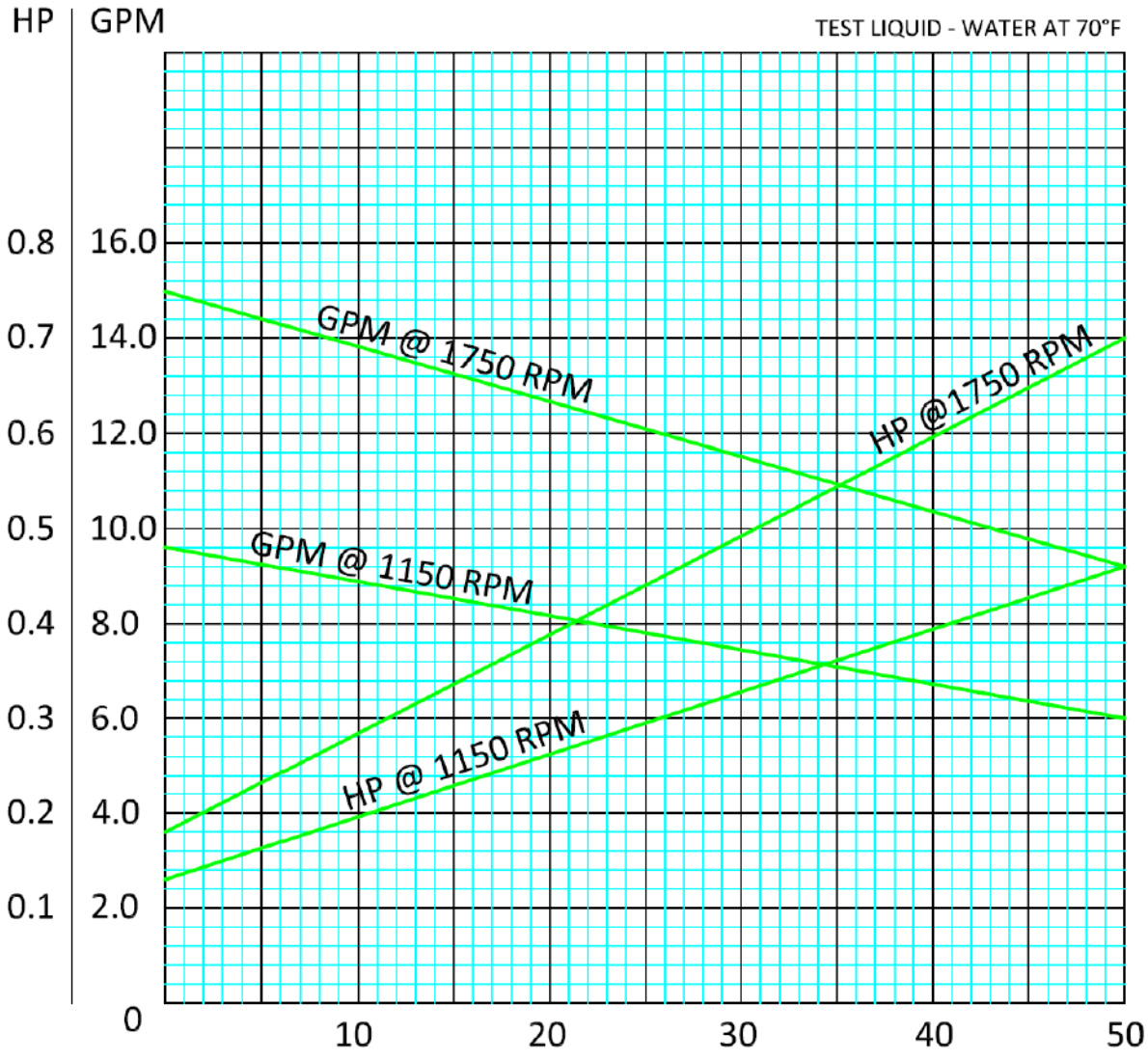
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Suggested Maximum Operating Speed of the Pump							
2800 RPM	1750 RPM	1150 RPM	870 RPM	580 RPM	430 RPM	180 RPM	100 RPM
VISCOSITY (Centipoise)							
1	3 to 100	100 to 500	500 to 1000	1000 to 3000	3000 to 5000	5000 to 10,000	10,000 to 20,000
Water	Canned Milk	30 Weight Oil	Table Syrup	Honey	Molasses	Paste	Peanut Butter
ABRASIVE FLUIDS							
None	None	None	Light	Medium	Medium	Heavy	Heavy
Clear Water Gasoline			Dirty Water	Clay Slurries Porcelain Enamel		Lapping Compounds Mill Scale in Water	

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PERFORMANCE DATA
MODEL CP-44

NPSH REQUIRED 4.1



DIFFERENTIAL PRESSURE (P.S.I)

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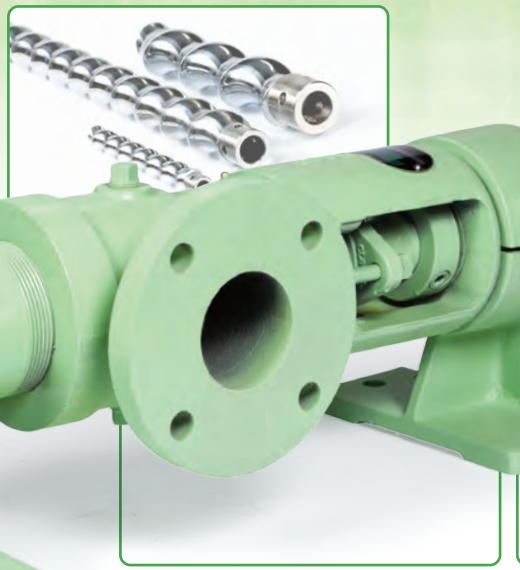
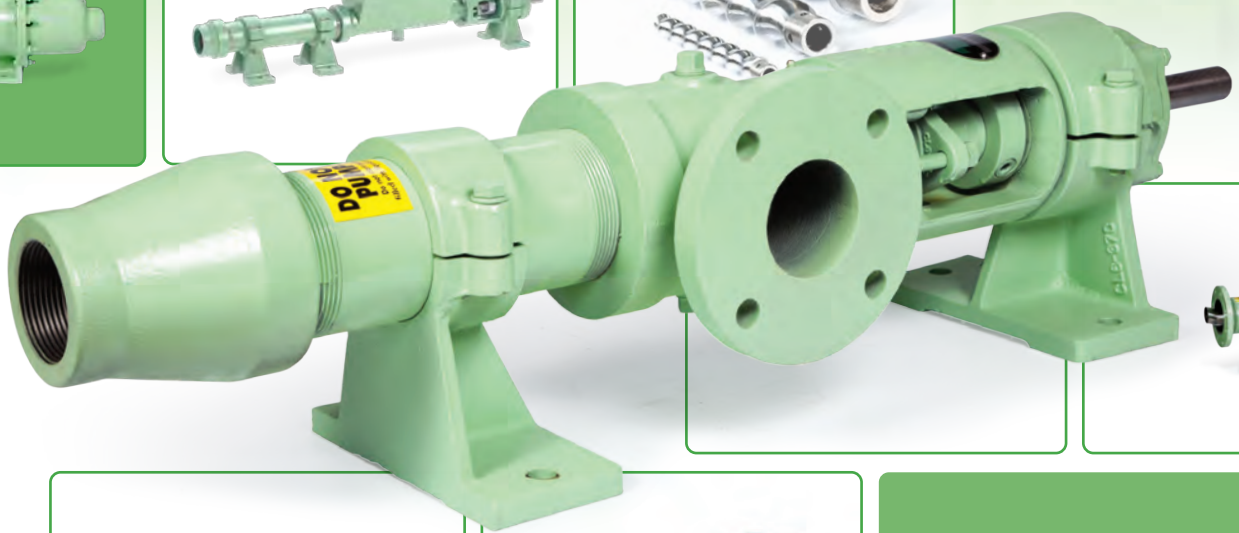
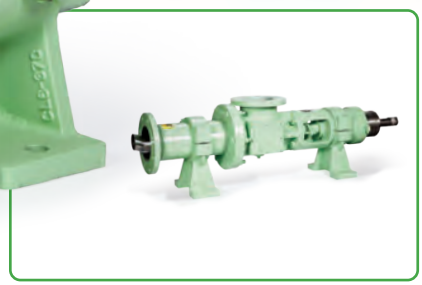
CONTINENTAL

PROGRESSIVE CAVITY PUMPS

QUALITY FROM START TO FINISH










CONTINENTAL®
PROGRESSING CAVITY
ULTRAPUMP

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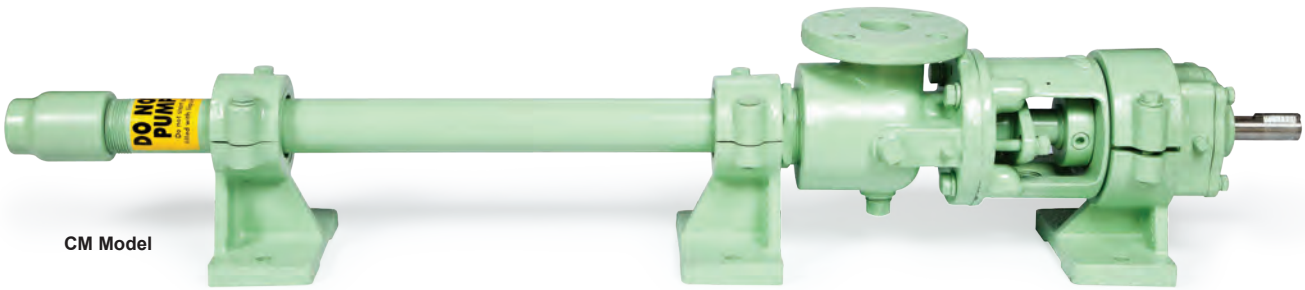
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QUALITY FROM START TO FINISH

EXPERIENCE

PRODUCTS

PEOPLE



CM Model

CONTINENTAL® PROGRESSING CAVITY ULTRAPUMP

Our experience and knowledge — along with our broad product line, short lead times, and additional features and services — make Continental Pump the company you can rely on for your progressive cavity pump needs.

Experience

We offer a complete line of Progressive Cavity Pumps for the commercial industries, wastewater and numerous other markets. Our goal is to offer quality products and services at a competitive price. Our success is supported by a long standing relationship to quality, a service oriented sales staff, a facility housing thousands of parts and pumps, and a commitment to helping our valued distributors and customers. We strive to keep you informed by providing all the materials and knowledge we have to offer through our staff, engineers and website. Continental Pump Company has grown its distributorship from a small handful to over 300 distributors in North America, Canada and overseas. So, no matter your location we have a wide network to handle your needs.

We pride ourselves in the manufacturing and delivery of our pumps and parts. We sell to our distributors and Original Equipment Manufacturers, in addition to contractors and utility and municipal plants.

Progressive cavity pumps are most commonly used in these industries: gas and oil, mining and industrial wastes with by-products but are very versatile. They are the perfect pumps for: abrasives, transferring, circulating, metering, pastes, slurries, sludge, wastewater, sewage and more.

With a variety of models to choose from Continental Progressive Cavity Pumps are the solution to handling many types of fluids.



THE PERFECT PUMP FOR:

• Transferring	• Circulating	• Metering
• Filling	• Irrigating	• Sludge
• Spraying	• Sampling	• Abrasives
• Cementing	• Caulking	• Mixing
• Aerating	• Pastes	• Slurries
• Cleaning	• Wastewater	• Sewage
• Viscous Products		• Industrial Waste











Continental Progressive Cavity Pumps have been time tested with proven unique characteristics that excel in performance unlike other types of Pumps. They are built from various materials and come in many sizes with capacities from less than 1 GPM to 2400 GPM and pressures up to 780 PSI.

MATERIALS OF CONSTRUCTION

All Continental Pump casting materials are Class 40# grey cast iron and CF8M (316) stainless steel. The best metal for your application would depend on the corrosiveness of your liquid. We offer an epoxy coating for an additional charge and can be applied to the suction housing and reducer. The epoxy seals the cast iron from the material being pumped.

Stators are available in several types of elastomers. The most common rubber materials are: Buna Nitrile (Q), Natural Rubber (R), EPDM (B), High Nitrile (HNBR) and Viton® (F). The rubber that is best for your application depends on what liquid you are pumping and the temperature, as it plays a vital role in which to select.

Maximum allowable temperatures for stators: EPDM 300°F, Viton® 400°F, Buna Nitrile 220°F, Natural Rubber 175°F and High Nitrile 300°F.

The rotors are available in chrome plated alloy steel and stainless steel, but is dependent on the pH level and if your liquid is corrosive. In certain pH levels, a non-plated rotor may be needed as it could lift the chrome off of the rotor.

When Carbon 'D' rotors are used the drive shaft and connecting rod will be Chrome-Plated Carbon Steel (CS). When Stainless 'S' rotors are used the drive shaft and connecting rod will be Chrome-Plated Stainless Steel (S).

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PUMPS

Our **Rigid Stator** Pump Line consist of our CL, CM, CG, CJ and CK 2000 Series Models. Based on your piping situation the suction housing can be rotated from 90° to 270° upon request.

The **CL** and **CJ Models** are suitable for a wide variety of applications and are the most frequently used. When properly applied they give excellent long life performance at the most economical cost.

The **CM Model** is similar to the CL Model, except has a larger drive head to handle the increased horsepower that is needed to produce the higher pressures that can be developed by these pumps.

Our **Crown Gear Joint** Pumps consist of our CG and CK 2000 Series Models. These model's suction housing can also be rotated from 90° to 270° upon request.

The **CG and CK 2000 Series Models** are designed to handle the heavier applications of sewage, industrial waste, polluted liquids and slurries. Incorporated into this more rugged pump is a drive train using crown gear joint connections to the rotor and drive shaft.

Our **Wobble Stator** Pump Line consist of our CP, CPM and CPML Models. These models are available with horizontal or vertical suctions based on your piping or space limitations.

The **CP Model**, also known as a bare shaft pump, operates with low costs and are compact making them ideal for light duty use.

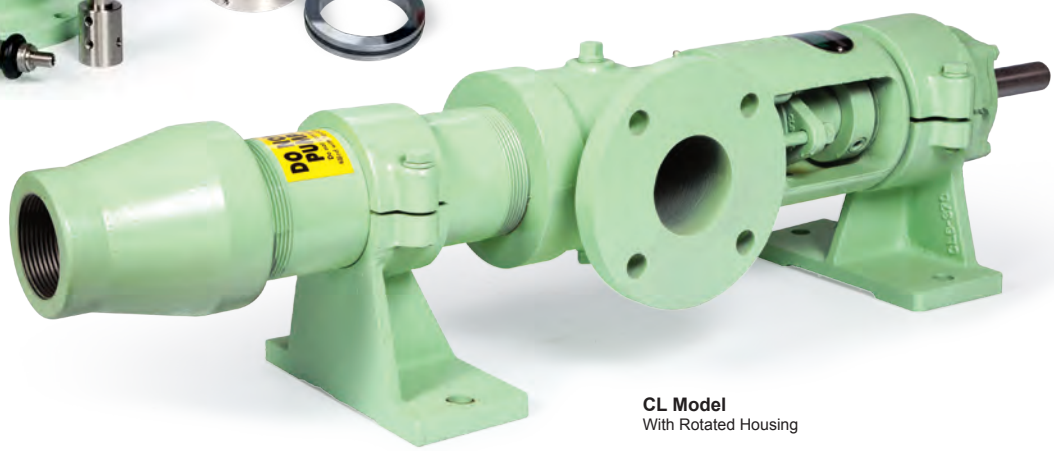
The **CPM Model** is similar to the CP Model, except it is a close-coupled type pump that is driven by a Continental spec. motor that is directly bolted to the pump.

The **CPML Model** is similar to the CPM Model, except it is driven by a standard motor attached by a specific motor coupling for different drive arrangements.



CPML Pump End Kit

Component Seal



CL Model
With Rotated Housing



CK 2000 Series Model™

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People/Service

Get personal interaction every time you call.

Since 1946, the driving force behind Continental Pump Company has been the ability to build relationships and adapt to customer's needs. This is evident in every aspect of the company from it's knowledgeable sales and service staff to it's product engineers.

We offer extensive service

We stand behind our distributors. Continental Pump is centrally located. Our location provides our distributors with economical and quick delivery transit times to anywhere in the US. We have dedicated ourselves to provide quality pumps and parts with unmatched delivery. We have been able to do this by striving to build our inventory to support you, our customer. Our sales staff is always ready to help assist in sizing the best pump for your application, as well as quick replies on part and pump quotes so you can get the job. Continental Pump has a full in-house service department to handle all your repair needs.



Continental pump manufactures the CG Model that is equivalent to the discontinued Moyno® Centennial SWG Series.

We offer:

1. CK 2000 Series Model™ pumps and parts
2. CJ Hopper style pumps
3. Pre-assembled drive ends
4. Pump end kits for our CPML Model
5. Pump rebuild kits for our Wobble Stator pumps
6. Continental pumps are interchangeable with other progressive cavity brands
7. Vast inventory of parts readily available to support our pump line
8. Quality OEM parts
9. In stock orders ship same day

We also offer:

1. Abrasive resistant seals
2. Stator barriers
3. Epoxy coating
4. Complete base units

We provide detailed support

Our knowledgeable and experienced sales and engineering force offers detailed technical support that is backed by our full product line.

No time for down time?

Ask about our expedited service. We are centrally located in the USA for prompt domestic shipments.

PARTS

Continental Pump provides replacement parts for some of the most common progressive cavity pump manufacturers. With growing relationships with other pump manufacturers, we offer other types of replacement pumps and parts.







Connecting Rod Kits

Connecting Rods are used in our standard CL and CM models. The kits are available in either carbon steel or stainless steel components as well as connecting rod washers of Buna Nitrile, EPDM, Natural Rubber or Viton®.



CP “Wobble Stator” Pump Rebuild Kits

Continental CP, CPM and CPML model rebuild kits are offered in 3 different types of elastomers: Buna Nitrile, EPDM, Viton® and stainless steel metal components. Other options consist of mechanical seal or packed seal and pinned or threaded flex joint, drive shaft and rotor.

A stator barrier is a great option for negative vacuum applications in our Wobble Stator pumps.









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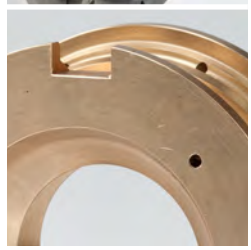
Gear Joint Kits

Continental CG Model and CK 2000 Series pumps have a more unique drive train which uses two crown gear joint connections for these rugged pumps. It consists of a splined connecting rod with a ball and ring gear, along with front and rear thrust plates which help make a very strong connection between the rotor and driveshaft.









Sealing Options

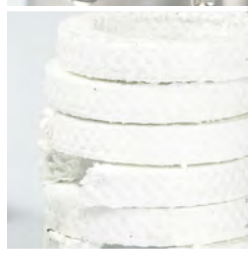
Whether it is application based or personal preference Continental can provide you with many options.

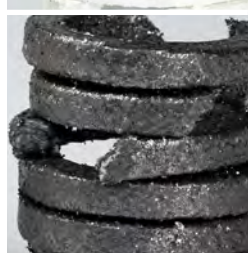
- Component Mechanical Seal and Stainless Steel Gland
- Cartridge Mechanical Seals
- Standard Type 21 Seals
- Graphite and Teflon Packing Sets

Upgrade your mechanical seal to a hard-faced seal (A/R) for abrasive applications.









CUSTOM PUMPS



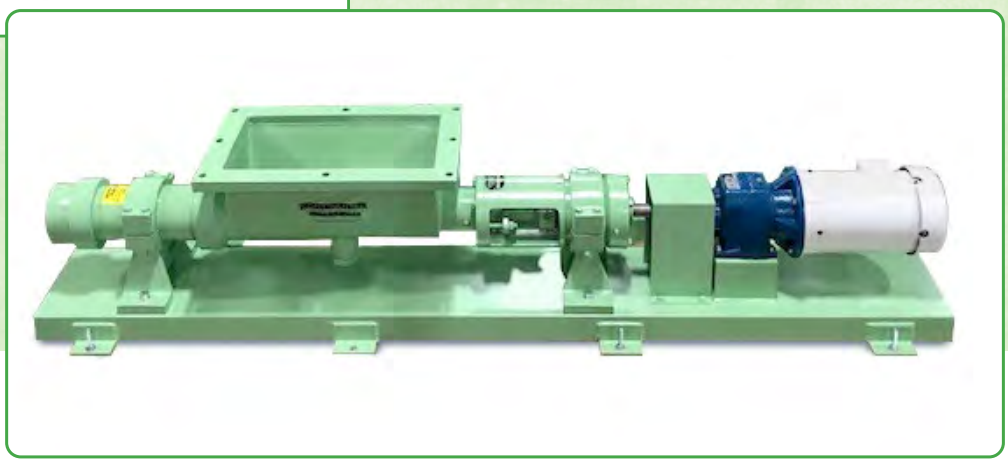
CP pump base unit with drip rail, packed seal and gas motor



CP pump with air motor



CP inline base unit with hydraulic motor

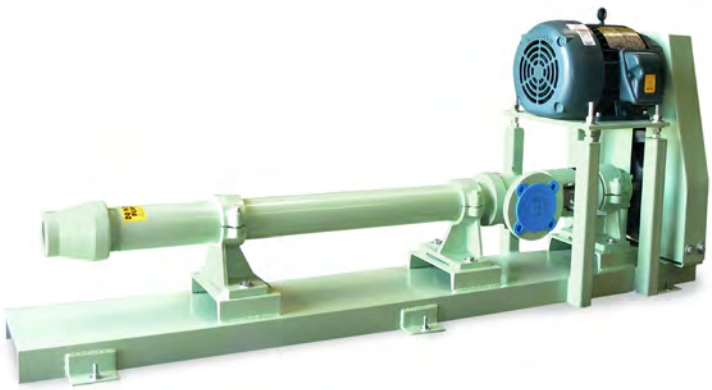


CJ hopper inline base unit with gear reduction and motor

CUSTOM PUMPS

CG inline base unit with suction housing cleanouts, gear reduction and motor





CM piggy back base unit driven with a V-Belt and suction has been rotated to 270°

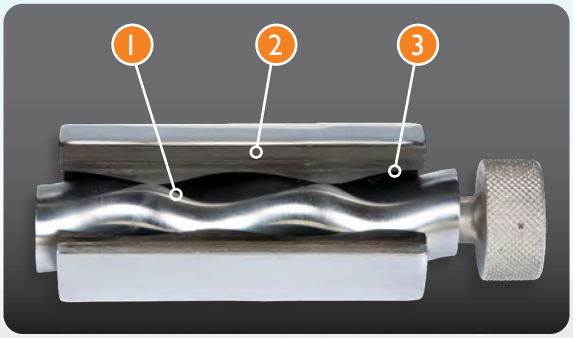
CL inline base unit with gear reduction and motor





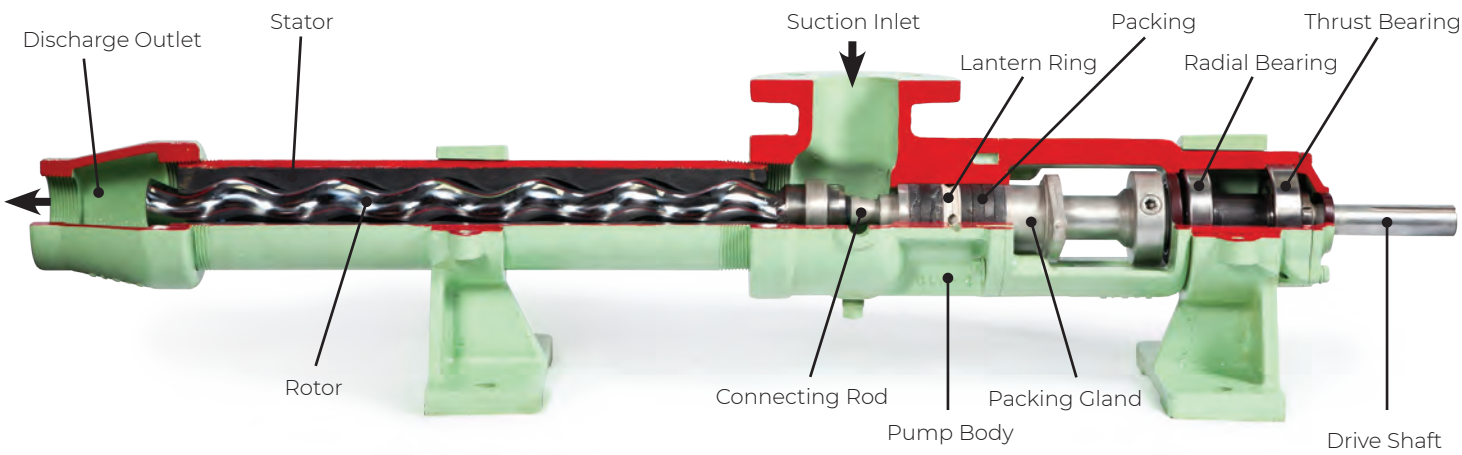
CL piggy back base unit driven with a V-Belt

HOW THEY WORK



1. **Rotor turns within the flexible rubber stator**
2. **Tightly sealed cavities are formed**
3. **Forces materials to the discharge port**

Pumping action begins when the rotor turns. Liquid acts as a lubricant.

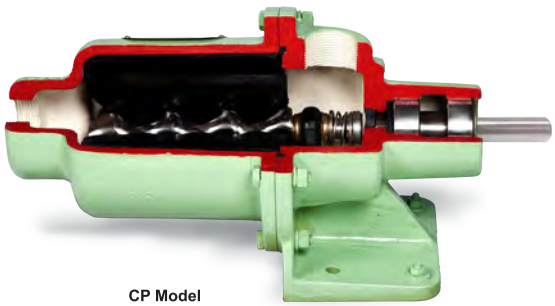


CHOOSING THE RIGHT PUMP

Progressive Cavity Pumps have similar characteristics to rotary or reciprocating pumps, such as piston, diaphragm, lobe, and screw pumps. The one common feature being the sealed cavities with operational similarities like being able to pump at extremely low rates, to even high pressures.

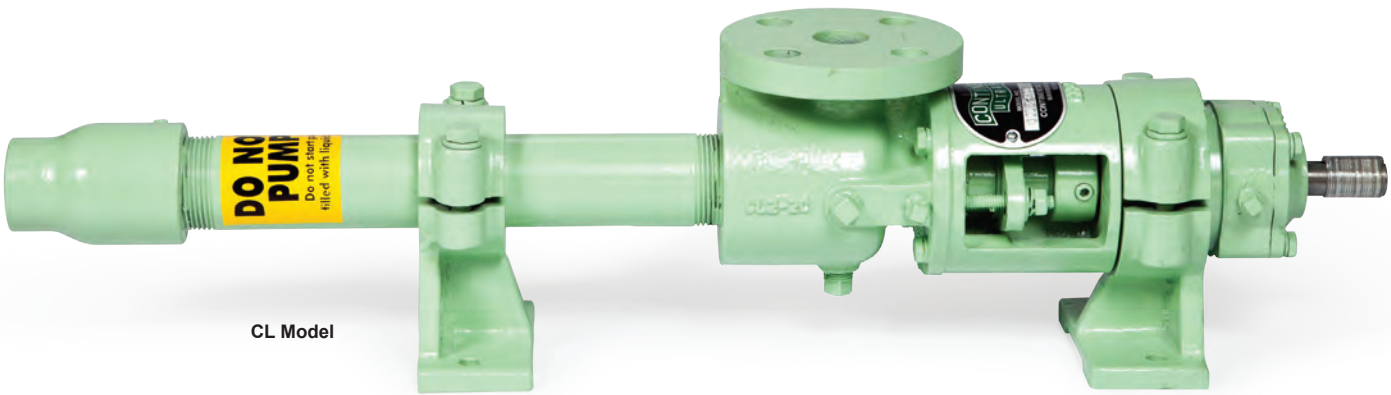
The similarity between other pumps and progressive cavity pumps generally ends there. Of all the types of pumps available, progressive cavity pumps are able to handle a wider range of fluid viscosities and properties than any other type of pump. The unique design of the pump makes them useful for a variety of pumping applications, such as transferring and metering while handling shear sensitive, abrasive and viscous fluids.

The Rotor seals tightly against the flexible rubber inside the stator as it rotates, forming tightly sealed cavities which carry the liquid diagonally toward the discharge port. The liquid does not change in shape or size when pumped due to the tightly sealed cavities. The effect of the progressive cavity design is that the fluid is moved at a very predictable and steady rate. Positive displacement of the pump starts the instant the Rotor turns. **The liquid acts as the lubricant between the pumping elements and should not be ran dry.**



CP Model

The reason Progressive Cavity pumps are used is because they are durable with only one moving part, rated for longevity. In operation our pumps are primarily a fixed flow rate pump and offers long life and reliable service transporting thick, viscous fluids. Abrasive fluids can shorten the life of the stator, but by slowing down the RPM's will help reduce wear. Slurries can also be pumped reliably if the slurry is viscous enough to maintain a lubrication layer around the particles and protect the stator.



CL Model

CHOOSING THE RIGHT PUMP

We offer a variety of options for our pumps, such as:

Vertical and rotated suctions are used if the piping is different and our normal horizontal pumps are not needed. The vertical suction is available for our CP, CPM and CPML Models and the rotated suction is available for our CL, CM, CG and CK 2000 Series models.

Close-coupled is an option when both a pump and motor are needed. This combines the pump and motor together.

A **V-Belt** is a pulley-type system that is driven by an electric or gas motor.

A **gas engine** is an option when a portable unit is needed.

We offer **hydraulic adapter** units when hydraulics are the source of power to drive the pump.

The **complete base unit** includes pump, gearbox, motor, and steel base, which we can build to your particular specifications.

A **gearbox** is required to control the maximum RPM of the pump. It also provides added torque at low start up speeds.

VFD or **Variable Frequency Drive**, is an option to control the pump at various speeds.
The most common types of **motors** offered are: general purpose, explosion proof, inverter duty, severe duty, wash down, and single or three-phase. Contact us for more types that are available.

Looking for simplicity?

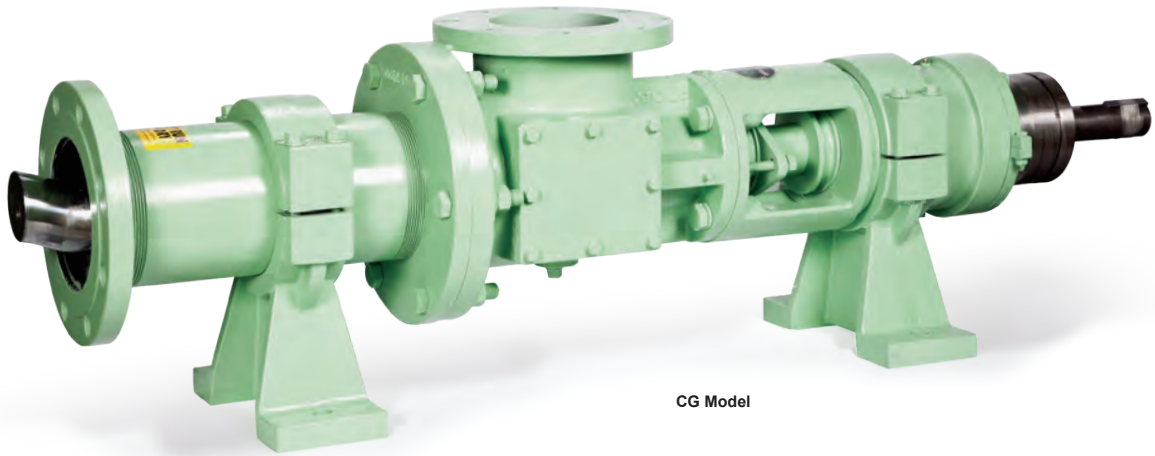
We offer complete progressive cavity pump units. They are constructed on a steel base to fit your specific application needs. The unit consists of a pump, a steel base and guard, a gear reducer and motor. Also available are belt drive units, VFDs and many other base options.

Space Challenged?

If you are needing a different arrangement from traditional piping, we can rotate the housing up to 270° for the CL, CM, CG and CK 2000 Series model pumps, or we can build piggyback or L-Frame base unit.

Don't need a complete pumping unit but looking for drive options?

We can still help, whether attached to a pump or sold separately we can supply you with hydraulic adapters, VFD's, gearboxes, couplings, custom guards and motors.



CG Model

THE 7 KEY ADVANTAGES OF PROGRESSIVE CAVITY PUMPS

Positive Displacement

This occurs at the turning of the rotor which develops a positive pumping action similar to a piston moving through a cylinder. The pump pressure developed does not depend upon the speed of the rotating rotor. The capacity of the pump, the approximate viscosity, and pressure can be projected for particular operating conditions.

Uniform Discharge Flow

Fluids are uniformly discharged without pulsation in a constant steady flow. Displacement remains the same with each revolution of the rotor permitting accurate and predictable metering relative to the fluid being pumped. Due to the unique flow characteristics, these pumps are well suited for low-shear applications.

Internal Velocity of Fluids

When the pump is in process, all fluids are pumped with a minimum amount of turbulence, agitation, pulsation or separation disturbance.

Self-Priming

Pumping action starts at the time the rotor is turned and it is capable of **28 feet of suction lift based on water**. The liquid being pumped acts as a lubricant between the rotor and stator, and forms a continuous seal to create good suction and discharge capabilities. **Do Not Run Dry.**

Solids in Suspension

Solid particles over a wide range of size and shapes, as large as 2 inches in diameter, are pumped with no difficulty.

Reversible

Our pumps can be operated clockwise or counter-clockwise with effective performance in most installations. Contact us to see if your application is suitable for reverse operation.

Installation

Our pumps can be purchased separately or built into complete units. These units can be mounted on welded steel bases with flexible couplings, v belts, gearbox reducers, or hydraulic motor adapters. If variable speed drives are needed the units can be driven by either electric motors, gasoline engines, diesel engines or air motors. Our pumps can also be mounted horizontally or vertically and the suction port can be rotated up to 270 ° position for appropriate entry of the liquid.



CPML Model

PUMP SELECTION GUIDE

Understanding the pump terminology helps to properly select the best performing Continental Progressive Cavity Pump to fit your pumping needs. Here are a few things you should know:

The **Capacity or Volume** is the rate of flow in Gallons Per Minute or GPM.

Pressure is determined by how much is required to move the liquid that is being pumped through the piping system and the kind of liquid being handled. The difference between the pressure required at the pump discharge and the pressure being introduced into the pump suction is the differential pressure and is expressed as Pounds per Square Inch or PSI.

Viscosity is the resistance to flow as expressed by various scales of measurement; however, the most commonly used is centipoise. The viscosity usually changes with temperature and should always be considered.

Temperature refers to the maximum and minimum temperatures at which the fluid is to be pumped. This is a highly important factor in pump selection. High temperatures can cause distortion and swelling of the stator materials and low temperatures can affect viscosity that reflects in flow characteristics and horsepower requirements.

Operating time or the operating cycle of the pump should also be considered; whether the pump is to run continuously or intermittently can be a factor in the selection of the drive.

Corrosion depends on whether the fluid being pumped is neutral, acid or alkaline. All should be considered when selecting the proper materials of pump construction. The pH value of the fluid should be known or determined. A pH of 7 is neutral, below 7 is acid and above 7 is alkaline.

Abrasion: The abrasive properties of the fluid to be pumped should be classified. Abrasives can look alike and appear to have similar properties; however, they can wear differently. You must classify the fluid in order to select the proper pump construction and operating speed. These 4 classifications will serve as a guide and help in the determination of the necessary materials needed in the pump construction:

NO ABRASIVES
Example: Clear Water, Gasoline, Fuel Oil, Lubricating Oil.

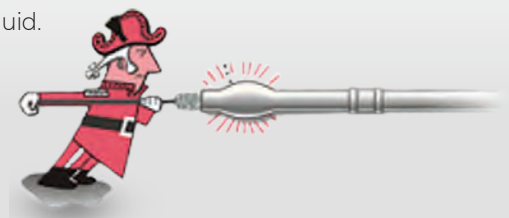
LIGHT ABRASIVES
Example: Dirty Water containing Silt and/or small amounts of Sand or Earth.

MEDIUM ABRASIVES
Example: Clay Slurries, Potters Glazes, Porcelain Enamel, Frit, Sludge, Wood Dust in Water.

HEAVY ABRASIVES
Example: Slurries containing large amounts of Sand, Emery Dust, Lapping Compounds, Mill Scale, Plaster, Grout, Roof Gypsum.

PUMP FAILURE IS A POSSIBILITY IF INACCURATE PUMP APPLICATION INFORMATION IS GIVEN.

The various materials used in the manufacturing of Continental Pumps allows our pumps to handle almost any fluid.



If it will push through pipe, you can pump it with Continental Progressive Cavity Pumps. Whether it be acidic, abrasive or viscous, we can help you with your application needs.

Please see the compatibility chart on the following pages for a few of the liquids that can be handled by our progressive cavity pumps. Your liquid not listed? Please contact us for assistance.

LIQUID COMPATIBILITY

PUMP NOMENCLATURE

2CL4 - CDQ
1 2 3 4 5 6

(1): Indicates the number of stages for the rotor and stator
(2): Indicates the pump model designation (CL, CM, CG, CJ Model)
(3): Indicates the frame size
(4): Indicates the pump body casting material
(5): Indicates the rotor and internal parts material
(6): Indicates the stator material

PART	LETTER	MATERIAL
Pump Body	C	Cast Iron
	S	Stainless Steel (CS8M)
Rotor	D	Chrome Plated Alloy Steel
	S	Chrome Plated Stainless Steel
Stator	B	Butyl/EPDM Rubber
	F	Viton® Rubber
	Q	Buna Nitrile Rubber
	R	Natural Rubber
	Y	High Nitrile

Materials used in the construction of the pumps are based on the fluid to be handled and are indicated in the model number nomenclature. The chart to the right shows a list of liquids and the compatible materials recommended for the pump body, the rotor and stator.

LIQUID COMPATIBILITY CHART

LIQUID	PUMP BODY		ROTOR		STATOR			
Acetic Acid (cold dilute)		S		S*	B		Q	R
Acetone	C	S	D	S	B			
Acid Mine Water	C			S			Q	R
Alcohol, Ethyl (grain)	C		D				Q	R
Alcohol, Methyl (wood)	C		D				Q	R
Alum (paper mill)		S		S	B	F	Q	R
Aluminum Hydroxide	C		D				Q	R
Aluminum Sulfate		S		S	B	F	Q	R
Ammonium Bicarbonate	C	S	D	S	B			R
Ammonium Chloride		S		S*	B		Q	R
Ammonium Phosphate	C	S	D	S	B		Q	R
Ammonuim Nitrate	C	S	D	S	B		Q	R
Ammonium Sulfate	C	S		S*	B		Q	R
Aromatic Hydrocarbons	C	S	D	S		F		
Asphalt	C	S	D	S		F		
Barium Chloride	C	S		S	B	F	Q	R
Barium Hydroxide	C	S	D	S	B	F	Q	R
Barium Nitrate	C	S	D	S			Q	R
Barium Sulfate	C	S	D	S			Q	R
Beer		S		S			Q	R
Beer Wort		S		S				R
Beer Sugar Liquor		S		S	B	F	Q	R
Benzene (coal tar product)	C		D	S		F		
Benzine (petroleum product)	C	S	D			F	Q	
Black Liquor	C	S	D	S		F	Q	
Boiler Feed Water	C		D				Q	
Bordeaux Mixture	C		D				Q	R
Boric Acid		S		S		F	Q	R
Brine, Calcium Chloride	C	S		S*	B	F	Q	R
Brine, Sodium Chloride	C	S		S*	B	F	Q	R
Calcium Chlorate	C	S	D	S		F		
Calcium Chloride	C	S	D	S	B	F	Q	R
Calcium Hypochlorite	C	S		S	B	F		
Calgon (sodium hexametaphosphate)		S		S			Q	R
Carbon Bisulfide	C	S	D	S		F		
Carbon Disulphide	C	S	D	S		F		
Carbonic Acid	C			S			Q	R
Castor Oil	C	S	D	S		F	Q	R
Caustic Potash (lye)	C	S	D	S			Q	R
Caustic Soda (lye)	C	S	D	S	B		Q	R
Caustic Zinc Chloride		S		S			Q	R
China Wood or Tung Oil								
-Drying Oil	C		D				Q	
-Vegetable Oils	C		D				Q	

LIQUID COMPATIBILITY

LIQUID COMPATIBILITY CHART								
LIQUID	**PUMP BODY**		**ROTOR**		**STATOR**			
Chlorinated Hydrocarbons								
-Chloroform		S		S		F		
-Dichloroethylene	C	S	D	S			Q	
-Methyl Chloride	C	S	D	S		F		
-Tri Chloroethyline		S		S		F		
Chromic Acid (diluted)		S		S		F		
Citric Acid		S		S	B	F	Q	R
Clay Slip	C		D			F	Q	R
Copper Nitrate		S		S			Q	R
Copper Sulphate		S		S*		F	Q	R
Copperas		S		S*			Q	R
Corn Oil	C	S	D	S		F	Q	
Cotton Seed Oil	C	S		S		F	Q	
Creosote	C	S	D	S		F	Q	
Cyanide	C		D				Q	R
Cyanide of Potassium	C		D		B	F	Q	R
Diethylene Glycol (alcohol)	C	S	D	S		F	Q	R
Distilled Water or Deionized	C	S		S			Q	R
Distillery Wort	C	S	D	S			Q	R
Epsom Salts	C	S	D	S	B	F	Q	
Ethyl Alcohol	C	S	D	S	B	F		
Fatty Acids	C	S	D	S		F		
Ferric Hydroxide		S		S	B		Q	R
Ferrous Sulphate		S		S*			Q	R
Formaldehyde		S		S		F	Q	
Formic Acid		S		S		F		
Fuel Oils	C	S	D	S		F	Q	
Furural	C	S	D	S	B			
Fusel Oils	C		D				Q	
Gasoline	C		D				Q	
Glucose	C	S	D	S	B	F	Q	R
Glue	C	S	D	S	B	F	Q	R
Glycerine	C	S	D	S	B	F	Q	R
Glycerol	C	S	D	S	B	F	Q	R
Grain Alcohol	C		D				Q	R
Hops	C	S	D	S			Q	R
Hydrocyanic Acid		S		S	B	F		
Hydrogen Peroxide		S		S		F		
Hydrogen Sulfide		S		S	B	F		
Kerosene	C		D				Q	
Lard	C	S	D	S		F	Q	
Lime Water	C		D				Q	R
Linseed Oil	C	S	D	S	B	F	Q	
Lubricating Oils	C		D				Q	
Lye (sodium hydroxide)	C	S	D	S	B	F	Q	R
Magnesium Chloride	C	S	D	S	B	F	Q	R
Magnesium Sulphate	C	S	D	S*	B	F	Q	
Mercury	C	S	D	S			Q	R
Methanol	C	S	D	S	B		Q	R
Methyl Chloride	C		D				Q	R
Milk of Lime	C			S			Q	R
Mine Water	C			S			Q	R
Molasses	C		D	S	B	F	Q	R
Naphtha	C		D				Q	
Nickel Chloride		S		S	B	F	Q	R

LIQUID COMPATIBILITY

LIQUID COMPATIBILITY CHART								
LIQUID	**PUMP BODY**		**ROTOR**		**STATOR**			
Nickel Sulphate		S		S*	B	F	Q	
Oil - Paraffin Base	C		D				Q	
Oil - Vegetable	C		D				Q	
Paints - Water Base	C		D				Q	R
Palmitic Acid	C		D			F	Q	
Phosphoric Acid		S		S		F		
Potassium Carbonate	C		D				Q	R
Potassium Chloride	C		D		B	F	Q	R
Potassium Nitrate	C		D		B	F	Q	R
Potassium Phosphate	C		D				Q	R
Potassium Sulphate	C		D		B	F	Q	
Salammoniac		S		S	B		Q	R
Salt Brine (to 30%)	C	S		S			Q	R
Sea Water	C			S			Q	R
Sewage	C		D				Q	R
Shellac	C		D				Q	
Soap Liquor (thin)	C	S	D	S	B	F	Q	
Sodium Aluminate	C		D		B		Q	R
Sodium Bicarbonate	C			S	B	F	Q	R
Sodium Bisulfite		S		S	B		Q	R
Soduim Carbonate	C			S	B	F	Q	R
Sodium Chloride	C	S		S*	B	F	Q	R
Sodium Hydroxide	C	S	D	S	B		Q	R
Sodium Nitrate	C		D		B			
Sodium Silicate	C		D		B	F	Q	R
Sodium Sulfate		S		S	B	F	Q	
Soy Bean Oil	C		D			F	Q	
Starch	C	S	D	S	B		Q	R
Steric Acid		S	D				Q	
Sugar	C		D				Q	R
Tar	C		D				Q	
Tar & Ammonia in Water	C		D				Q	
Titanium Chloride		S		S		F		
Toluene (toluol)	C		D			F		
Trub Sludge	C		D				Q	R
Turpentine	C		D			F	Q	
Varnish	C		D			F		
Vinegar		S		S*	B	F	Q	
Vitriol - Blue		S		S	B	F	Q	
Vitriol - Green		S		S			Q	R
Waste Water	C		D				Q	R
Whiskey	C	S	D	S			Q	R
Wine		S		S	B		Q	R
Wood Pulp	C		D				Q	R
Yeast		S		S	B		Q	R
Zinc Chloride		S		S*	B	F	Q	R
Zinc Nitrate		S		S			Q	R
Zinc Sulfate		S		S*	B		Q	R

***** — Represents non-plated rotor
D — Represents chrome-plated carbon steel rotors with carbon steel (CS) drive shaft and connecting rod.
S — Represents chrome-plated stainless steel rotors with stainless steel (S) drive shaft and connecting rod.

Note - Maximum allowable temperatures for stators: B (EPDM) 300°F, (Viton®) 400°F, Q (Buna Nitrile) 200°F, R (Natural Rubber) 175°F and Y (High Nitrile) 300°F.

MODEL CP



CP Model



Vertical CP Model

Performance data based on gallons per minute (water at 70°F)

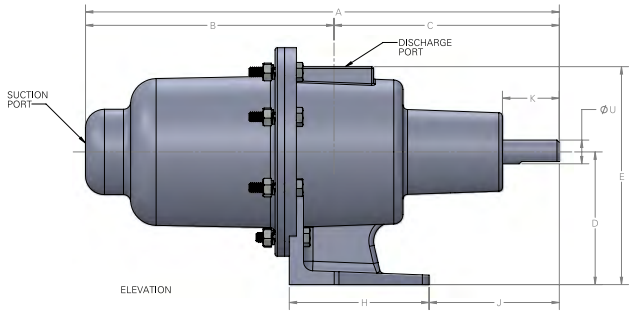
PERFORMANCE DATA - MODEL CP

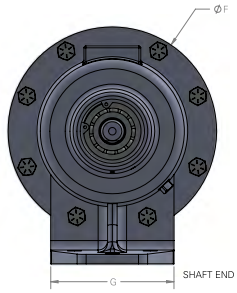
PUMP	DIFFERENTIAL PRESSURE	PUMP SPEED 1750 RPM	1150 RPM	870 RPM	580 RPM	430 RPM	MOTOR HORSE POWER
	0	1.9	1.3	1.0	0.7	0.5	
	25	1.7	1.0	0.5	0.2	0.1	
	50	1.5	0.9	0.2			
CP15	75	1.2	0.8				1/2
	100	1.0	0.7				
	125	0.8	0.5				
	150	0.6	0.4				
	0	4.9	3.2	2.0	1.6	1.2	
	25	4.1	2.7	2.0	1.3	0.9	
CP22	50	3.4	2.2	1.6	1.0	0.7	1/2
	75	2.6	1.7	1.3	0.8	0.6	
	100	2.0	1.5	1.0	0.6	0.4	
	0	9.4	6.0	4.6	3.1	2.3	
CP33	25	7.0	4.5	3.4	2.3	1.7	1/2
	50	4.2	2.7	2.0	1.3	0.9	
	0	15.0	9.7	7.3	4.9	3.6	
CP44	25	12.0	7.8	5.9	4.0	3.0	3/4
	50	9.4	6.1	4.6	3.1	2.3	
	0	24.0	15.6	11.7	7.9	5.8	
CP56	25	22.0	14.3	10.7	7.2	5.3	1-1/2
	35	20.5	13.3	10.0	6.7	4.9	
	50	19.5	12.7	9.5	6.4	4.1	
	0	53.0	34.5	26.0	17.5	13.0	
	10	48.0	31.0	23.4	15.8	11.7	
CP67	20	43.0	28.0	21.0	14.0	10.3	2
	35	34.0	22.0	16.5	11.0	8.1	
	50	25.0	16.3	12.3	8.3	6.1	

DIMENSIONS AND WEIGHTS – MODEL CP

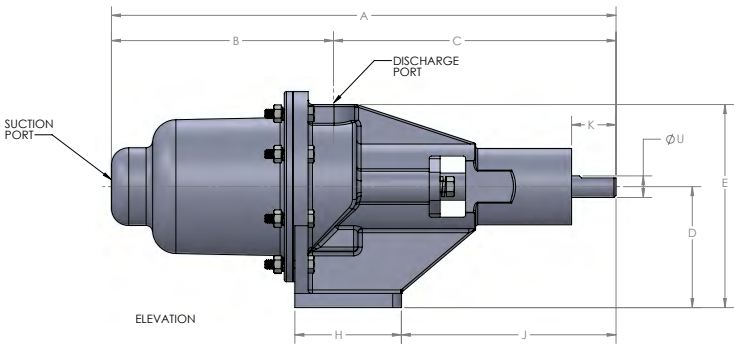
PUMPS	DIMENSIONS (INCHES) A	B	C	D	E
CP15, CP22, CP33, CP44 (horizontal)	12-7/16	6-13/16	5-5/8	3-1/2	5-3/4
CP56 (horizontal)	16-11/16	9-3/4	6-15/16	4-9/32	7-9/32
CP67 (horizontal)	19-9/16	11-15/16	7-5/8	4-1/2	8-1/4
PACKED CP15, CP22, CP33, CP44	14-3/4	6-1/4	8-1/2	3-1/2	5-7/8
PACKED CP56	18-13/16	9-3/4	9-1/16	4-9/32	7-9/32
PACKED CP67	22	12	10	4-1/2	8-1/4
CP15, CP22, CP33, CP44 (vertical)	12-13/16	6-1/16	5-5/8	3-1/2	5-3/4
CP56 (vertical)	17-7/16	8-5/8	6-15/16	4-9/32	7-9/32
CP67 (vertical)	20-15/16	11-3/16	7-5/8	4-1/2	8-1/4

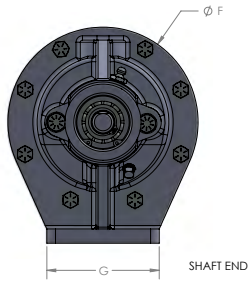
MODEL CP



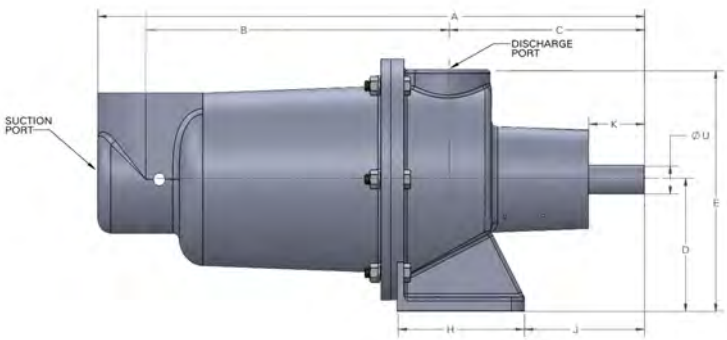


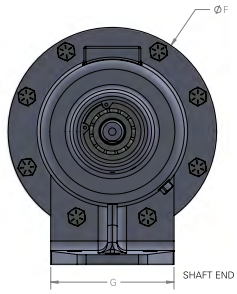
CP15 - CP22 - CP44 - CP56 - CP67
MECHANICAL SEAL PUMP





CP15 - CP22 - CP44 - CP56 - CP67
PACKED SEAL PUMP





VERTICAL: CP15 - CP22 - CP44 - CP56 - CP67
MECHANICAL SEAL PUMP

Model CP pumps are great for low GPM and viscous applications and can pump many different types of materials. It's a low cost pump that is compact with many drive options as well as the availability of horizontal or vertical suction housings.

Continental CP, CPM and CPML Model pumps and parts are interchangeable with many progressing cavity pump brands.

Features and Benefits of Vertical Pumps:

- Offers better flow with flooded suction
- Space-saving construction
- Solution for non-traditional piping configurations

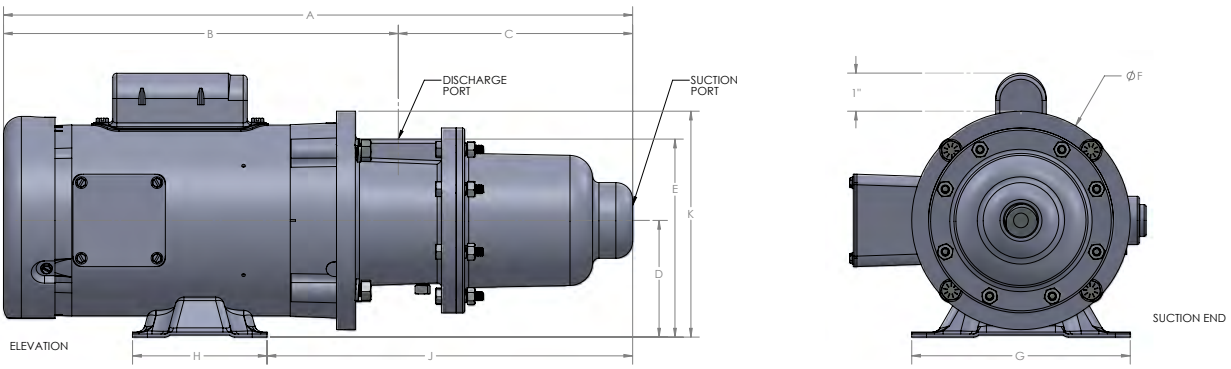
Ø = Diameter

	F	G	H	J	K	U	WEIGHT (LBS)	PORT SIZES	
								INLET SUCTION	OUTLET DISCHARGE
	5-1/2	3-1/4	3-11/16	3-3/8	1-7/16	5/8	15	3/4"	3/4"
	7-1/2	6	4-3/4	3-9/16	2-3/8	3/4	40	1-1/2"	1-1/4"
	8-1/4	6	4-7/8	4-9/16	2-1/8	1	85	2"	2"
	5-1/2	3-1/4	3	6-7/16	1-7/16	5/8	18	3/4"	3/4"
	7-1/2	6	4-3/4	5-11/16	2-3/8	3/4	44	1-1/2"	1-1/4"
	8-1/4	6	4-3/4	7-1/8	2-1/8	1	90	2"	2"
	5-1/2	3-1/4	3-11/16	3-3/8	1-7/16	5/8	15	3/4"	3/4"
	7-1/2	6	4-3/4	3-9/16	2-3/8	3/4	40	1-1/2"	1-1/4"
	8-1/4	6	4-7/8	4-9/16	2-1/8	1	85	2"	2"

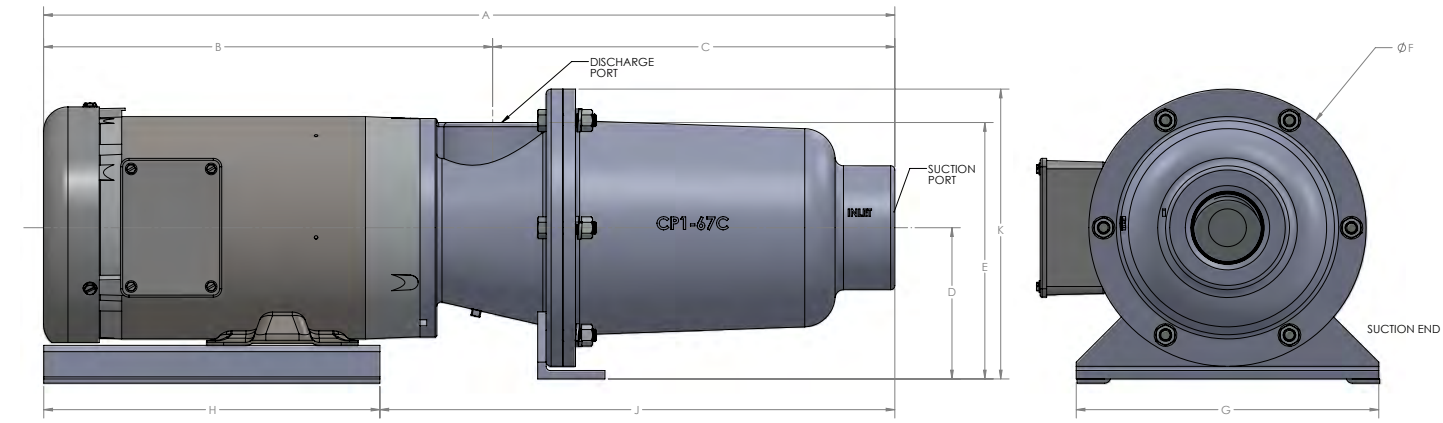
MODEL CPM



CPM Model



CPM15 - CPM22 - CPM33 - CPM44
CLOSE-COUPLED PUMP DRIVEN WITH A CONTINENTAL SPEC. MOTOR



CPM56 - CPM67
CLOSE-COUPLED PUMP DRIVEN WITH A CONTINENTAL SPEC. MOTOR

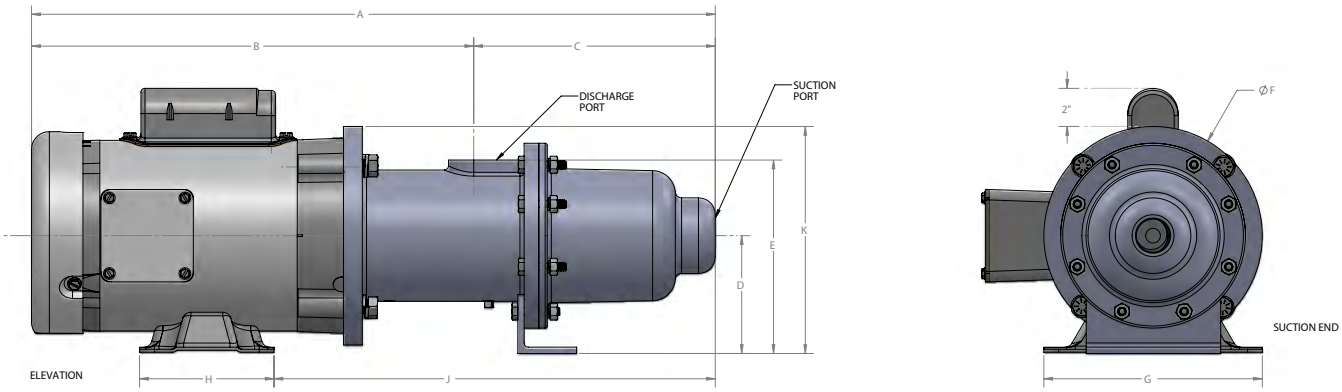
DIMENSIONS AND WEIGHTS – MODEL CPM AND CPML

PUMPS	DIMENSIONS (INCHES)					
	A	B	C	D	E	
CPM15, CPM22, CPM33, CPM44	18-3/4	12	6-13/16	3-1/2	5-7/8	
CPM56	22-15/16	13-3/16	9-3/4	4-1/2	7-1/2	
CPM67	25-1/4	13-5/16	12	4-1/2	7-3/4	
CPML15, CPML22, CPML33, CPML44	20-3/8	13-9/16	6-13/16	3-1/2	5-3/4	
CPML56	25-3/8	13-3/4	9-3/4	4-1/2	7-1/2	
CPML67	27-7/8	15-7/8	12	4-1/2	7-3/4	

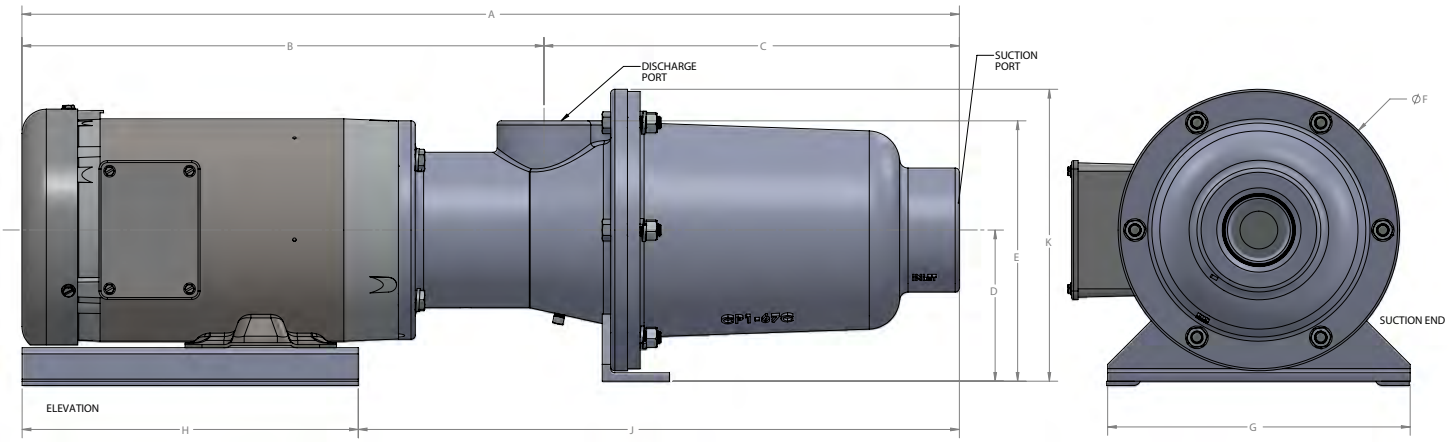
MODEL CPML



CPML Model



CPML15 - CPML22 - CPML33 - CPML44
CLOSE-COUPLED PUMP DRIVEN WITH A STANDARD MOTOR



CPML56 - CPML67
CLOSE-COUPLED PUMP DRIVEN WITH A STANDARD MOTOR

Ø = Diameter

F	G	H	J	K	U	WEIGHT (LBS)	PORT SIZES	
							INLET SUCTION	OUTLET DISCHARGE
5-3/4	6-1/2	4	10-3/4	7		48	3/4"	3/4"
7-1/2	9	10	12-15/16	8-1/4		80	1-1/2"	1-1/4"
8-1/4	9	10	15-5/16	8-5/8		117	2"	2"
6-1/2	6-1/2	4	13-1/8	6-3/4		52	3/4"	3/4"
7-1/2	9	10	13-1/12	8-1/4		85	1-1/2"	1-1/4"
8-3/8	9	10	17-7/8	8-11/16		125	2"	2"

MODEL CL

Performance data based on gallons per minute (water at 70°F)

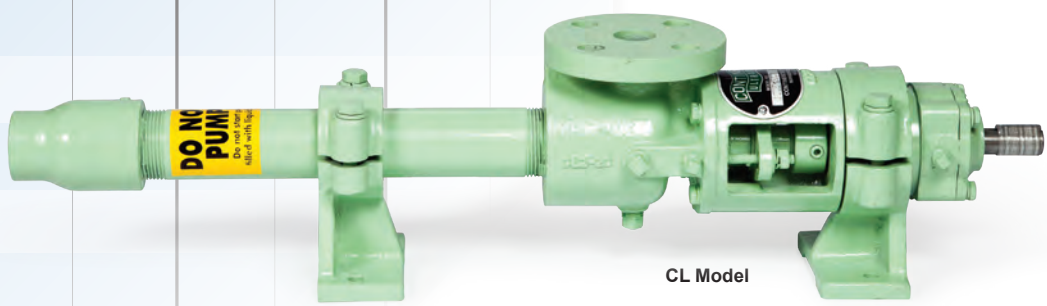
PERFORMANCE DATA - MODEL CL

FRAME SIZE	GAL./100 REV.	PUMP SPEED DIFF. PRESS PSI	300 RPM GPM	300 RPM MIN. HP	450 RPM GPM	450 RPM MIN. HP
1CL2	.260	0 30 60	.54 .51 .40	1/8 1/8 1/8	1.1 .95 .50	1/6 1/6 1/6
2CL2	.260	0 60 120	.54 .51 .40	1/4 1/4 1/4	1.1 .95 .50	1/4 1/4 1/4
3CL2	.260	0 90 180	.54 .51 .40	1/4 1/4 1/4	1.1 .95 .50	1/4 1/4 1/4
1CL3	.860	0 40 75	2.5 1.6 –	1/3 1/3 –	3.8 3.0 1.5	1/3 1/3 1/3
2CL3	.860	0 80 150	2.5 1.6 –	1/3 1/3 –	3.8 3.0 1.4	1/3 1/3 1/3
3CL3	.860	0 120 225	2.5 1.6 –	1/3 1/3 –	3.8 3.0 1.6	1/2 1/2 3/4
1CL4	2.02	0 40 75	5.8 4.0 –	1/2 1/2 –	9.0 6.7 2.7	1/2 1/2 3/4
2CL4	2.02	0 80 150	5.8 4.0 –	3/4 3/4 –	9.0 6.7 2.7	1/2 3/4 1
3CL4	2.02	0 120 225	5.0 4.0 2.0	3/4 3/4 1	9.0 6.7 3.7	3/4 1 1-1/2
1CL6	5.20	0 40 75	15 11 6.5	1 1 1	23 19 13	1 1 1-1/2
2CL6	5.20	0 80 150	15 11 5	1 1 2	23 19 13	1-1/2 1-1/2 3
3CL6	5.20	0 120 225	15 11 5	1-1/2 1-1/2 3	23 19 13	2 3 5
1CL8	11.7	0 40 75	33 27 17	2 2 2	51 45 35	2 2 3
2CL8	11.7	0 80 150	33 27 18	3 3 5	51 45 35	3 5 7-1/2
3CL8	11.7	0 120 225	33 27 18	5 5 7-1/2	51 45 35	5 5 10
1CL10	18.8	0 40 75	56 46 26	2 2 5	84 74 53	3 3 5
2CL10	18.8	0 80 150	56 46 24	3 5 7-1/2	84 74 53	5 7-1/2 10
3CL10	18.8	0 120 225	56 46 22	5 5 10	84 74 53	7-1/2 10 15
1CL10H	27.7	0 40 75	83 73 55	3 3 5	127 117 100	5 5 7-1/2
2CL10H	27.7	0 80 150	83 73 64	5 5 10	127 117 100	7-1/2 7-1/2 15
1CL12	43.5	0 40 75	130 118 85	5 7-1/2 10	196 184 149	7-1/2 10 15
2CL12	43.5	0 80 150	130 118 85	10 10 15	196 184 149	15 15 25
3CL12	43.5	0 120 225	130 118 85	15 15 25	196 184 149	20 20 30
1CL12H	66.2	0 40 75	195 173 123	7-1/2 7-1/2 15	293 272 220	10 15 20
2CL12H	66.2	0 80 150	195 173 123	15 15 25	293 272 220	20 20 30

MODEL CL

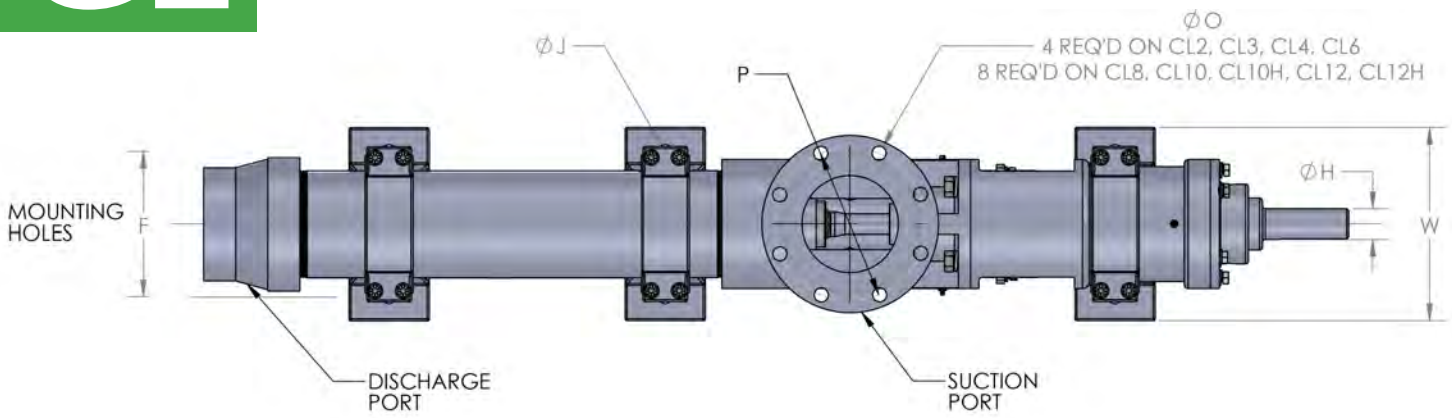
Model CL pumps are suitable for a wide variety of applications and are the most frequently used. When properly applied they give excellent long life performance at the most economical cost.

600 RPM		750 RPM		900 RPM		1200 RPM	
GPM	MIN. HP	GPM	MIN. HP	GPM	MIN. HP	GPM	MIN. HP
1.5	1/6	2.0	1/4	2.2	1/4	3.0	1/3
1.3	1/6	1.8	1/4	2.1	1/4	2.8	1/3
.9	1/6	1.4	1/4	1.7	1/4	2.3	1/3
1.5	1/4	2.0	1/3	2.2	1/3	3.0	1/2
1.3	1/4	1.8	1/3	2.1	1/3	2.8	1/2
.9	1/4	1.4	1/3	1.7	1/3	2.3	1/2
1.5	1/3	2.0	1/3	2.2	1/3	3.0	3/4
1.3	1/3	1.8	1/3	2.1	1/3	2.8	3/4
.9	1/3	1.4	1/3	1.7	1/3	2.3	3/4
5.1	1/3	6.4	1/3	7.5	1/2	10	3/4
4.3	1/3	5.5	1/2	6.8	1/2	9.3	3/4
2.7	1/3	4.2	1/2	5.0	3/4	7.7	3/4
5.1	1/2	6.4	1/2	7.5	3/4	10	1
4.3	1/2	5.5	3/4	6.8	3/4	9.3	1
2.7	1/2	4.2	3/4	5.0	1	7.7	1-1/2
5.1	3/4	6.4	3/4	7.5	3/4	10	1
4.3	3/4	5.5	1	6.8	1	9.3	1-1/2
2.7	1	4.2	1-1/2	5.0	1-1/2	7.7	2
2.0	1/2	15	1/2	18	3/4	24	1
9.5	1/2	12.5	3/4	16	1	22	1
5.5	3/4	8.5	1	12	1-1/2	18	1-1/2
12.0	3/4	15	3/4	18	1	24	1-1/2
9.5	1	12.5	1-1/2	16	1-1/2	22	2
5.5	1-1/2	8.5	2	12	2	18	3
12.0	1	15	1	18	1-1/2	24	2
9.5	1-1/2	12.5	1-1/2	16	2	22	3
5.5	2	8.5	3	12	3	18	5
31	1-1/2	39	1-1/2	47	2		
27	1-1/2	35	2	43	2		
21	2	28	3	36	3		
31	2	39	2	47	3		
27	2	35	3	43	3		
21	5	28	5	36	5		
31	3	39	3	47	5		
27	3	35	2	43	5		
21	5	28	7-1/2	36	7-1/2		
68	3	87	3	100	5		
62	3	76	5	94	5		
52	5	66	7-1/2	84	7-1/2		
68	5	87	5	100	7-1/2		
62	5	76	7-1/2	94	7-1/2		
52	7-1/2	66	10	84	10		
68	7-1/2	87	7-1/2	100	10		
62	7-1/2	76	10	94	10		
52	10	66	15	84	15		
115	5	140	5				
105	5	130	7-1/2				
84	7-1/2	106	10				
115	7-1/2	140	7-1/2				
105	7-1/2	130	10				
84	15	106	20				
115	10	140	10				
105	10	130	15				
84	20	106	25				
168	7-1/2	210	7-1/2				
158	7-1/2	202	10				
143	10	187	15				
168	10	210	10				
158	10	202	15				
143	20	187	25				
255	10						
240	15						
210	20						
255	20						
240	20						
208	30						
255	25						
240	25						
210	40						
380	15						
363	20						
310	25						
380	25						
363	30						
300	50						



CL Model

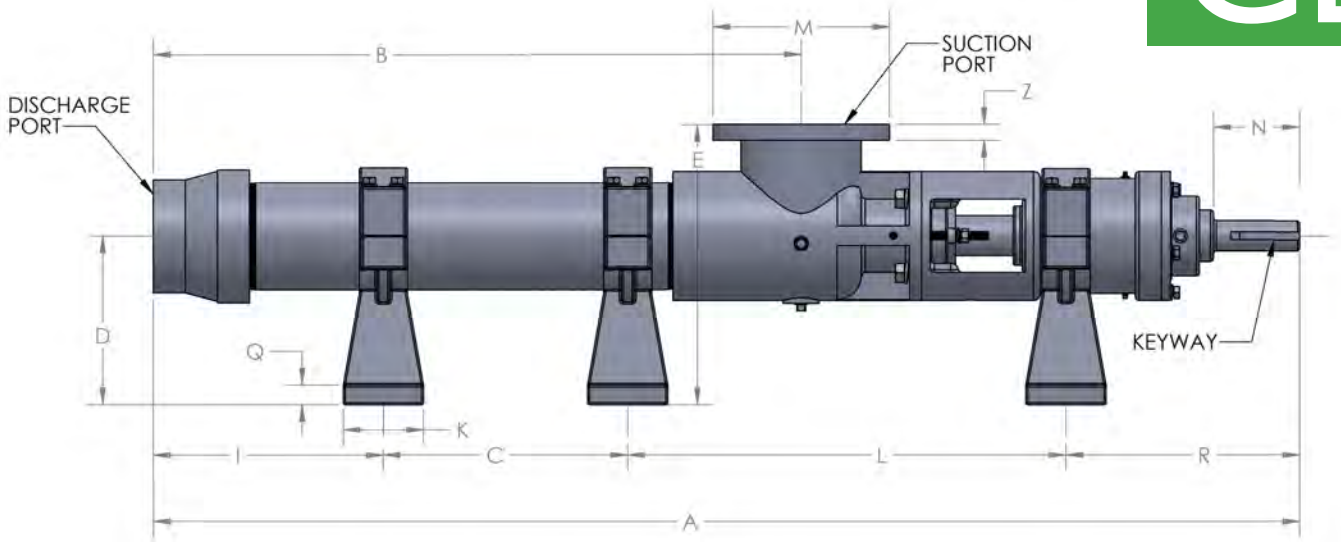
MODEL CL



DIMENSIONS AND WEIGHTS - MODEL CL

PUMP SIZE	DIMENSIONS (INCHES)											
	A	B	C	D	E	F	G	H	I	J	K	L
1CL2	17	7-5/16	N/A	3-1/4	5-7/8	3-1/8	2	5/8	4-1/4	3/8	2	8-1/2
2CL2	20-1/2	10-7/8	N/A	3-1/4	5-7/8	3-1/8	2	5/8	5-3/4	3/8	2	10-1/2
3CL2	24-1/16	14-7/16	N/A	3-1/4	5-7/8	3-1/8	2	5/8	7-13/16	3/8	2	12
1CL3	22-3/4	10-1/8	N/A	4-1/8	7-5/16	4-1/4	3	3/4	5-9/16	7/16	3	11-1/2
2CL3	28-1/16	15-7/16	N/A	4-1/8	7-5/16	4-1/4	3	3/4	9-3/8	7/16	3	13
3CL3	33-3/8	20-3/4	N/A	4-1/8	7-5/16	4-1/4	3	3/4	11-3/16	7/16	3	16-1/2
1CL4	30	13-1/8	N/A	5-1/2	9-7/8	5-1/2	3-1/2	15/16	7-1/4	9/16	3	15-3/4
2CL4	37-1/8	20-1/4	N/A	5-1/2	9-7/8	5-1/2	3-1/2	15/16	8-1/8	9/16	3	22
3CL4	44-1/4	27-5/8	N/A	5-1/2	9-7/8	5-1/2	3-1/2	15/16	14-1/2	9/16	3	22-3/4
1CL6	39-1/8	17-13/16	N/A	6-1/4	11-1/4	7	4	1-1/8	10-9/16	11/16	4	20
2CL6	49-3/4	28-7/16	N/A	6-1/4	11-1/4	7	4	1-1/8	15-3/16	11/16	4	26
3CL6	60-3/8	39-1/16	18	6-1/4	11-1/4	7	4	1-1/8	13-13/16	11/16	4	20
1CL8	46	20-3/16	N/A	8	14	9	5	1-3/8	9-3/4	7/8	5	27
2CL8	58-3/8	32-5/8	N/A	8	14	9	5	1-3/8	17-1/8	7/8	5	32
3CL8	70-13/16	45	24	8	14	9	5	1 3/8	12-9/16	7/8	5	25
1CL10	53-1/8	21-7/8	N/A	9-3/4	16-11/16	9	5	1-7/8	9-5/8	7/8	5	30
2CL10	63-1/2	32-1/4	N/A	9-3/4	16-11/16	9	5	1-7/8	14-1/2	7/8	5	35-1/2
3CL10	73-7/8	42-5/8	18	9-3/4	16-11/16	9	5	1-7/8	12-3/8	7/8	5	30
1CL10H	58-1/2	27-1/4	N/A	9-3/4	16-11/16	9	5	1-7/8	15	7/8	5	30
2CL10H	73-7/8	42-5/8	18	9-3/4	16-11/16	9	5	1-7/8	12-3/8	7/8	5	30
1CL12	70	31	N/A	12-1/2	21	12-5/8	6	2-1/4	14-1/2	1	6	37-1/2
2CL12	85-1/2	46-1/2	20-1/2	12-1/2	21	12-5/8	6	2-1/4	12	1	6	35
3CL12	101-1/8	62-1/8	27	12-1/2	21	12-5/8	6	2-1/4	14-1/8	1	6	42
1CL12H	77-3/4	38-3/4	N/A	12-1/2	21	12-5/8	6	2-1/4	17-3/4	1	6	42
2CL12H	101-1/8	62-1/8	27	12-1/2	21	12-5/8	6	2-1/4	14-1/8	1	6	42

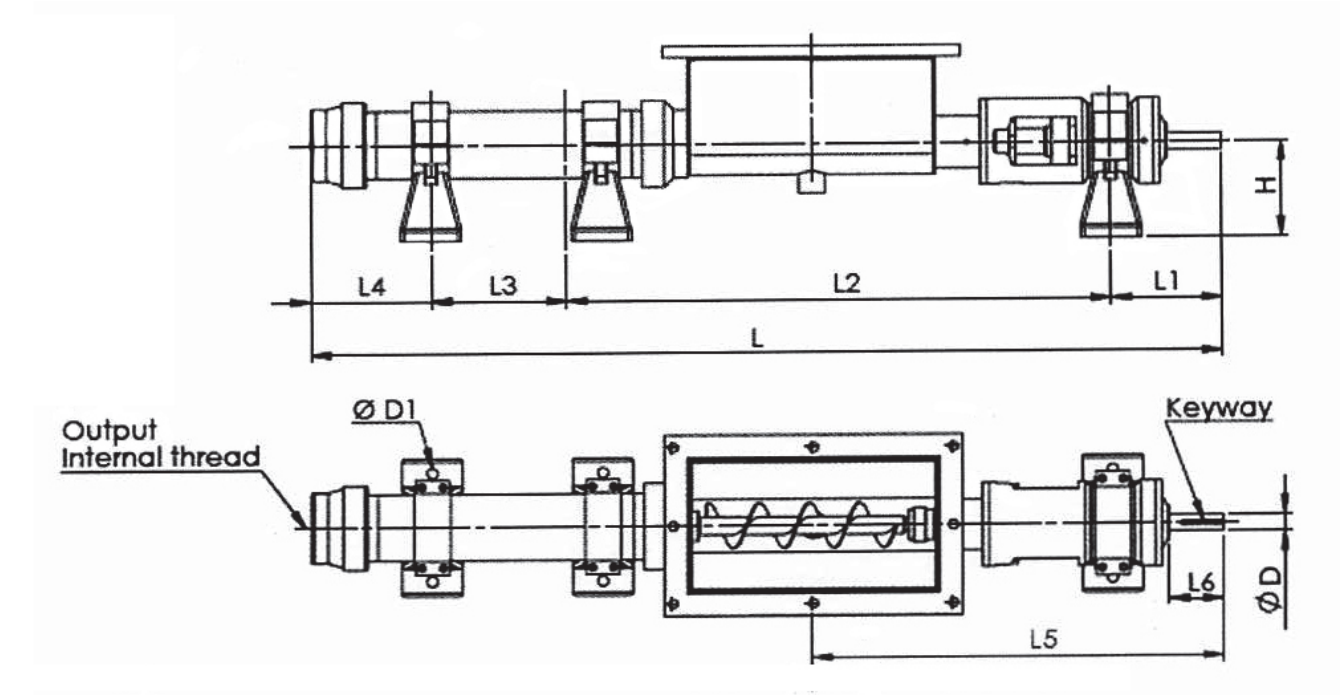
MODEL CL



										WEIGHT (LBS)	PORT SIZES	
	M	N	O	P	Q	R	W	Z	KEYWAY		SUCTION	DISCHARGE
	4-1/4	1-1/2	9/16	3-1/8	3/8	4-1/4	4	7/16	3/16 x 3/4	22	1”	3/4”
	4-1/4	1-1/2	9/16	3-1/8	3/8	4-1/4	4	7/16	3/16 x 3/4	25	1”	3/4”
	4-1/4	1-1/2	9/16	3-1/8	3/8	4-1/4	4	7/16	3/16 x 3/4	31	1”	3/4”
	5	2-1/8	9/16	3-7/8	1/2	5-11/16	5-3/8	9/16	3/16 x 1-1/2	47	1-1/2”	1-1/4”
	5	2-1/8	9/16	3-7/8	1/2	5-11/16	5-3/8	9/16	3/16 x 1-1/2	51	1-1/2”	1-1/4”
	5	2-1/8	9/16	3-7/8	1/2	5-11/16	5-3/8	9/16	3/16 x 1-1/2	55	1-1/2”	1-1/4”
	7	3-1/8	3/4	5-1/2	5/8	7	7	11/16	1/4 x 2	85	2-1/2”	2”
	7	3-1/8	3/4	5-1/2	5/8	7	7	11/16	1/4 x 2	91	2-1/2”	2”
	7	3-1/8	3/4	5-1/2	5/8	7	7	11/16	1/4 x 2	97	2-1/2”	2”
	7-1/2	4-3/8	3/4	6	11/16	8-9/16	8-5/8	7/8	1/4 x 2-1/4	141	3”	2-1/2”
	7-1/2	4-3/8	3/4	6	11/16	8-9/16	8-5/8	7/8	1/4 x 2-1/4	159	3”	2-1/2”
	7-1/2	4-3/8	3/4	6	11/16	8-9/16	8-5/8	7/8	1/4 x 2-1/4	192	3”	2-1/2”
	9	4-9/16	3/4	7-1/2	1-1/8	9-1/4	11-1/2	15/16	3/8 x 3	303	4”	4”
	9	4-9/16	3/4	7-1/2	1-1/8	9-1/4	11-1/2	15/16	3/8 x 3	332	4”	4”
	9	4-9/16	3/4	7-1/2	1-1/8	9-1/4	11-1/2	15/16	3/8 x 3	372	4”	4”
	11	5-3/8	7/8	9-1/2	1-1/8	13-1/2	11-1/2	1	1/2 x 3-1/2	412	6”	5”
	11	5-3/8	7/8	9-1/2	1-1/8	13-1/2	11-1/2	1	1/2 x 3-1/2	500	6”	5”
	11	5-3/8	7/8	9-1/2	1-1/8	13-1/2	11-1/2	1	1/2 x 3-1/2	545	6”	5”
	11	5-3/8	7/8	9-1/2	1-1/8	13-1/2	11-1/2	1	1/2 x 3-1/2	424	6”	5”
	11	5-3/8	7/8	9-1/2	1-1/8	13-1/2	11-1/2	1	1/2 x 3-1/2	545	6”	5”
	13-1/2	6	7/8	11-3/4	1-1/8	18	14-1/2	1-1/8	1/2 x 4	880	8”	6”
	13-1/2	6	7/8	11-3/4	1-1/8	18	14-1/2	1-1/8	1/2 x 4	1075	8”	6”
	13-1/2	6	7/8	11-3/4	1-1/8	18	14-1/2	1-1/8	1/2 x 4	1200	8”	6”
	13-1/2	6	7/8	11-3/4	1-1/8	18	14-1/2	1-1/8	1/2 x 4	945	8”	6”
	13-1/2	6	7/8	11-3/4	1-1/8	18	14-1/2	1-1/8	1/2 x 4	1205	8”	6”

MODEL CJ

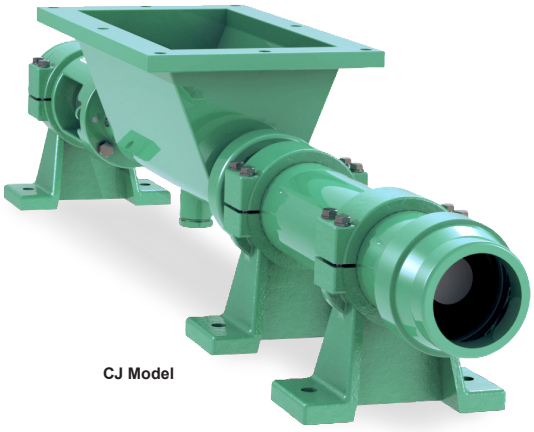
Model CJ Pumps are similar to the Model CL Pumps, except they have a hopper and auger to allow them to transfer materials with high percentages of solids or abrasives. The wide hopper ensures the mixture is fed directly into the pumping element for optimal efficiency.



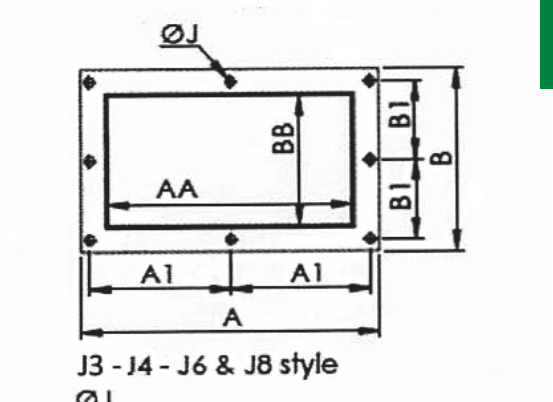
PERFORMANCE DATA - MODEL CG

PUMP SIZE	STAGES	L	L1	L2	L3	L4	L5	L6	H	H1	W	W1	ØD	ØD1	
J3	1	33.5	5.70	22.2	---	5.6	19.3	2	4.1	8.2	5.4	4.3	0.75	0.4	
	2	38.5		23.4	---	9.4									
	3	43.5		21.6	9	7.2									
J4	1	38.1	7.00	23.9	---	7.2	21.75	2.75	5.46	11	7.16	5.5	0.9374	9/16	
	2	45.2		30.1	---	8.1									
	3	52.3		23.8	11	10.5									
J6	1	51.2	8.50	32.1	---	10.6	27.4	4.33	6.24	12.5	8.74	7	1.1248	11/16	
	2	62.2		31.5	12	9.2									
	3	73.0		31.5	18	13.8									
J8	1	63.0	9.25	44.0	---	9.8	33.11	4.33	8	16	11.5	9	1.3748	7/8	
	2	75.4		42.2	14	10.0									
	3	87.9		42.0	24	12.6									
J10	1	73.8	13.50	50.7	---	9.6	42.12	5.27	9.74	19.5	11.5	9	1.8748	7/8	
	2	84.2		50.7	10.5	9.5									
	3	94.6		50.8	18	12.4									
J10H	1	79.3	13.50	50.8	---	15.0	42.12	5.27	9.74	19.5	11.5	9	1.8748	7/8	
	2	94.6		50.8	18	12.4									

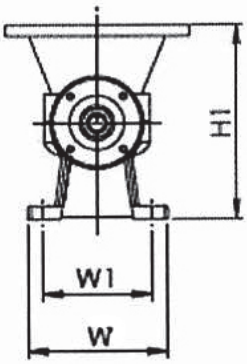
MODEL CJ

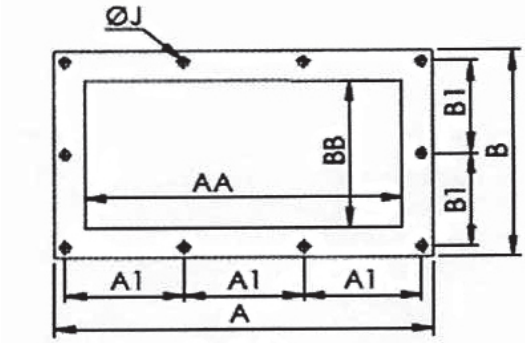


CJ Model



J3 - J4 - J6 & J8 style



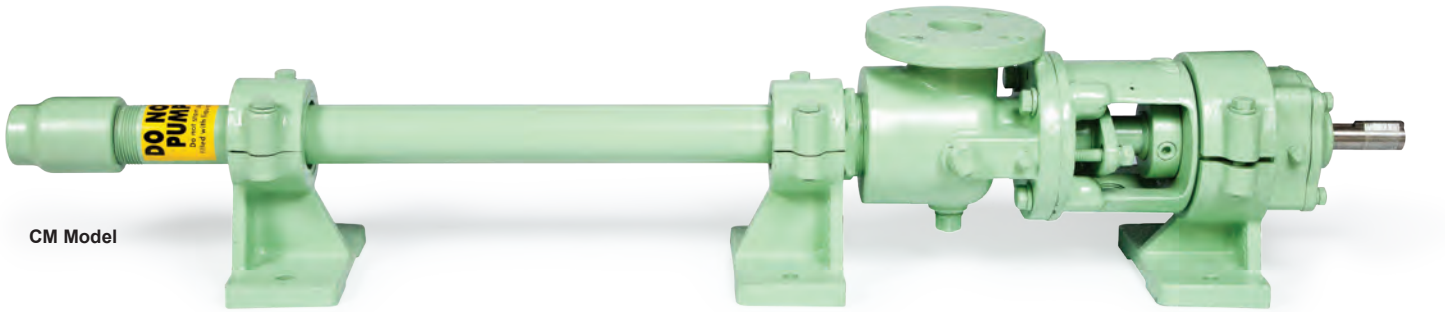


J10 style

	KEYWAY	AA	A	A1	BB	B	B1	ØJ	OUTPUT	WEIGHT (LBS.)
	3/16" x 1/8"	9.75	14.1	6.25	5.0	9.4	3.88	9/16"	NPT 1 1/4" x 11 1/2"	61 68 74
	1/4" x 3/16" x 2 1/4"	11.75	16.25	7.374	7.0	11.5	5.0	3/4"	NPT 2" x 11"	130 136 143
	1/4" x 3/16" x 2 1/4"	14.5	19	8.748	8.11	12.5	5.5	3/4"	NPT 2 1/2" x 8"	161 192 209
	3/8" x 3/16" x 3"	20	24.5	11.496	10.63	14.5	6.5	3/4"	NPT 4" x 8"	341 370 410
	1/2" x 1/4" x 3 1/2"	26	31	9.751	12	17	7.625	3/4"	NPT 5" x 8"	510 627 630
	1/2" x 1/4" x 3 1/2"	26	31	9.751	12	17	7.625	3/4"	NPT 5" x 8"	562 650

MODEL CM

Model CM Pumps are similar to the Model CL Pumps, except they have a larger drive head to handle the increased horsepower that is needed to produce the higher pressures that can be developed by these pumps.



CM Model

Performance data based on gallons per minute (water at 70°F)

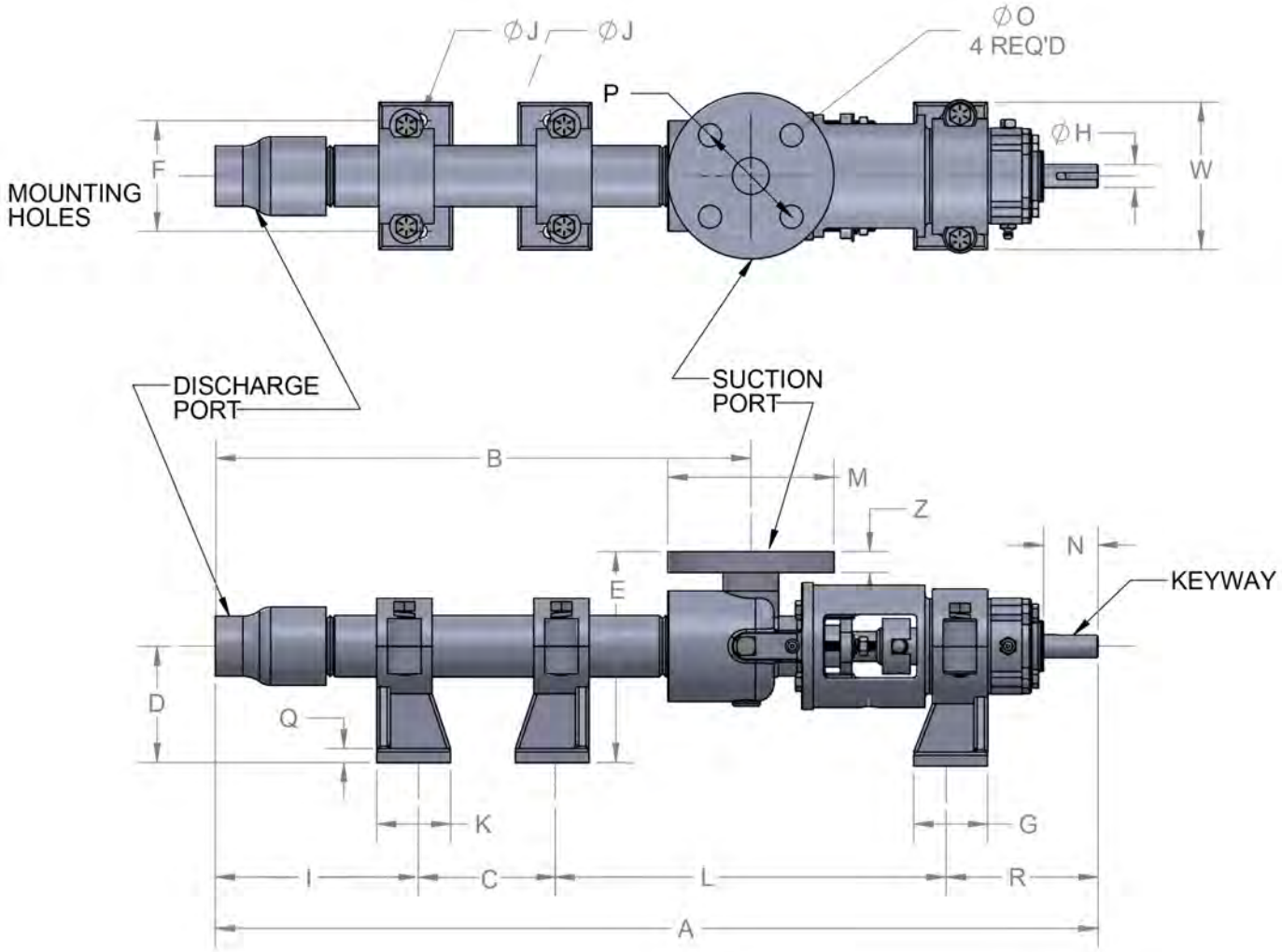
PERFORMANCE DATA - MODEL CM

FRAME SIZE	GAL./100 REV.	PUMP SPEED	300 RPM		450 RPM		600 RPM		750 RPM		900 RPM		1200 RPM	
		DIFF. PRESS PSI	GPM	MIN. HP	GPM	MIN. HP	GPM	MIN. HP	GPM	MIN. HP	GPM	MIN. HP	GPM	MIN. HP
2CM1	.056	0 60 120	.14 .12 .10	1/8 1/8 1/8	.22 .20 .15	1/8 1/8 1/8	.29 .26 .22	1/4 1/4 1/4	.37 .33 .30	1/4 1/4 1/4	.43 .41 .37	1/4 1/4 1/4	.58 .55 .51	1/4 1/4 1/4
6CM1	.056	0 180 360	.14 .12 .10	1/8 1/8 1/8	.22 .20 .15	1/6 1/6 1/6	.29 .26 .22	1/4 1/4 1/4	.37 .33 .30	1/4 1/4 1/4	.43 .41 .37	1/3 1/3 1/3	.58 .55 .51	1/3 1/3 1/3
6CM2	.260	0 180 360	.54 .51 .50	1/4 1/4 1/4	1.1 .9 .45	1/2 1/2 1/2	1.5 1.3 .9	3/4 3/4 3/4	2.0 1.8 1.4	1/3 1/3 1/2	2.2 2.1 1.7	1/2 1/2 1	3.0 2.8 2.3	3/4 3/4 3/4
6CM3	.860	0 240 450	2.50 1.80 –	1/2 1/2 –	3.8 2.9 1.7	3/4 3/4 1-1/2	5.1 4.3 2.7	1 1 1-1/2	6.4 5.5 4.2	1-1/2 1-1/2 2	7.5 6.8 5.0	1-1/2 1-1/2 2	10 9.3 7.7	2 2 3
6CM4	2.02	0 240 450	6.00 5.00 1.80	1-1/2 2 2	9.0 7.4 4.5	2 2 3	12 10 7	3 3 5	15 12.5 8.5	5 5 7-1/2	18 16 13	5 5 7-1/2	24 22 19	5 5 7-1/2

DIMENSIONS AND WEIGHTS – MODEL CM

PUMPS	DIMENSIONS (INCHES)											
	A	B	C	D	E	F	G	H	I	J	K	L
2CM1	17-1/2	7-13/16	–	3-1/4	5-7/8	3-1/8	2	5/8	4-1/2	3/8	2	8-3/4
6CM1	24-7/8	15-1/4	–	3-1/4	5-7/8	3-1/8	2	5/8	4-7/8	3/8	2	15-3/4
6CM2	39-1/8	26-3/8	14	4-1/8	7-5/16	4-1/4	3	3/4	7-15/16	7/16	3	11-1/2
6CM3	55	38	22	5-1/2	9-7/8	5-1/2	3-1/2	15/16	9-7/8	9-16	3	15-1/2
6CM4	70-7/8	49-3/4	25	6-1/4	11-1/4	7	4	1-1/8	17-7/16	11/16	4	20

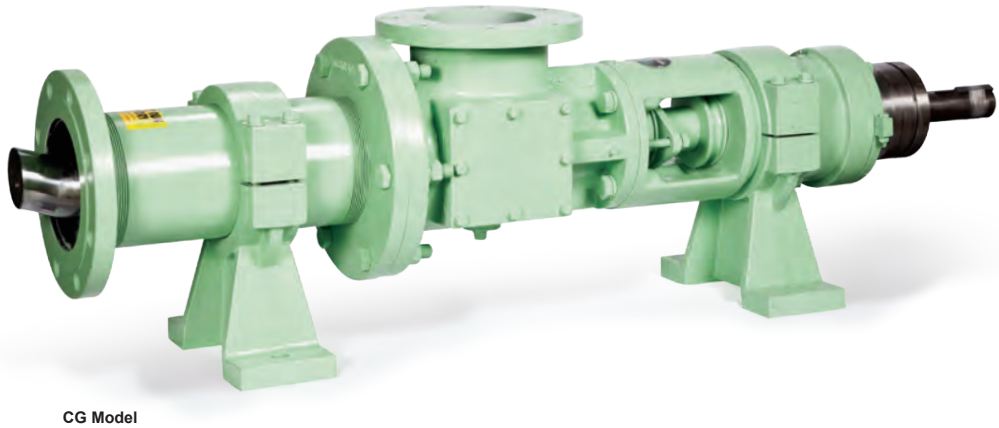
MODEL CM



Ø = Diameter

	M	N	O	P	Q	R	W	Z	KEYWAY	WEIGHT (LBS)	PORT SIZES	
											INLET SUCTION	OUTLET DISCHARGE
	4-1/4	1-1/2	5/8	3-1/8	3/8	4-1/4	4	9/16	3/16 X 7/8	22	1"	3/4"
	4-1/4	1-1/2	5/8	3-1/8	3/8	4-1/4	4	9/16	3/16 X 7/8	30	1"	3/4"
	5	2-1/8	5/8	3-7/8	1/2	5-11/16	5-3/8	9/16	3/16 X 1- 1/2	55	1-1/2"	3/4"
	7	3-1/8	3/4	5-1/2	5/8	7	7	11/16	1/4 X 2	105	2-1/2"	2"
	7-1/2	4-3/8	3/4	6	11/16	8-9/16	8-5/8	7/8	1/4 X 2	171	3"	2-1/2"

MODEL CG



CG Model

Performance data based on gallons per minute (water at 70°F)

PERFORMANCE DATA - MODEL CG

FRAME SIZE	GAL./100 REV.	PUMP SPEED DIFF. PRESS PSI	100 RPM		150 RPM		200 RPM	
			GPM	MIN. HP	GPM	MIN. HP	GPM	MIN. HP
1CG8	11.7	0 25 50	12 8 3	3/4 3/4 1	17 13 7	1 1-1/2 1-1/2	26 18 14	1-1/2 1-1/2 1-1/2
2CG8	11.7	0 50 100	12 8 2	1 1 1	17 13 8	1-1/2 1-1/2 2	22 18 14	2 2 3
3CG8	11.7	50 100 150	9 6 2	2 2 2	14 11 7	2 3 3	20 15 11	3 3 5
1CG10	18.8	0 25 50	19 12 2	1 1 1	28 22 14	1 1 1-1/2	36 32 22	1-1/2 1-1/2 2
2CG10	18.8	0 50 100	18 12 3	2 2 3	26 20 12	3 3 3	36 30 22	3 3 5
3CG10	18.8	50 100 150	14 10 2	3 3 3	22 18 10	3 3 5	32 28 22	3 5 5
1CG10H	27.7	0 25 50	26 20 12	1 1 2	40 36 26	2 2 2	54 48 40	1 2 3
2CG10H	27.7	0 50 100	30 24 16	2 2 3	44 38 30	3 5 5	58 52 45	5 5 5
1CG12	43.5	0 25 50	42 35 22	3 3 5	62 56 42	5 5 5	84 78 65	5 5 5
2CG12	43.5	0 50 100	42 36 21	5 5 6	65 58 48	5 5 7-1/2	85 80 67	7-1/2 7-1/2 7-1/2
3CG12	43.5	50 100 150	40 35 25	7-1/2 7-1/2 7-1/2	60 53 45	7-1/2 7-1/2 10	82 78 67	10 10 10
1CG12H	65.2	0 25 50	60 55 33	5 5 5	95 85 65	5 5 5	125 120 98	5 5 7-1/2
2CG12H	65.2	0 50 100	60 55 35	5 7-1/2 7-1/2	95 85 75	7-1/2 7-1/2 10	125 120 95	10 10 10

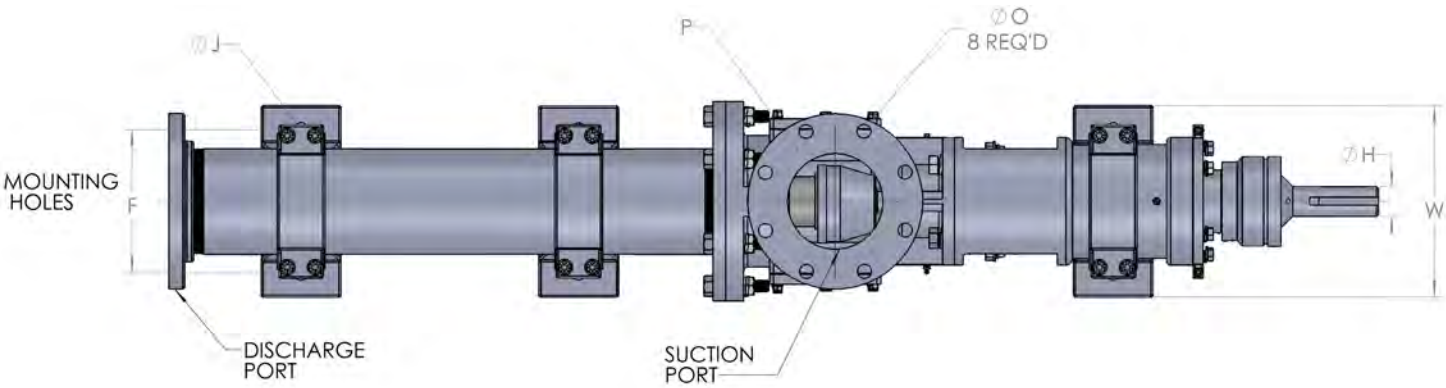
MODEL CG



Model CG pumps are designed to handle the heavier applications of sewage, industrial waste, polluted liquids, and slurries. Incorporated into this more rugged pump is a unique drive train using gear joint connections to the rotor and drive shaft.

	250 RPM		300 RPM		350 RPM		400 RPM	
	GPM	MIN. HP	GPM	MIN. HP	GPM	MIN. HP	GPM	MIN. HP
	29	1-1/2	34	2	40	2	45	3
	24	1-1/2	21	2	37	2	41	3
	18	2	25	2	32	3	35	3
	27	2	33	3	40	3	45	3
	24	3	29	3	35	5	42	5
	21	3	25	3	32	5	35	5
	25	3	34	5	36	5	43	5
	22	5	28	5	33	5	39	5
	19	5	24	5	29	7-1/2	34	7-1/2
	48	1-1/2	56	2	64	2	74	3
	42	2	52	2	60	3	70	5
	35	2	42	3	50	5	59	5
	46	3	54	3	66	5	72	5
	40	5	50	5	58	5	68	7-1/2
	32	5	41	5	50	7-1/2	59	7-1/2
	41	5	52	5	60	7-1/2	72	7-1/2
	36	5	48	7-1/2	56	7-1/2	67	10
	30	5	41	7-1/2	50	10	63	10
	70	3	82	3	96	5	108	5
	64	3	76	3	90	5	104	5
	54	3	68	5	82	5	96	5
	70	5	84	5	98	7-1/2	112	7-1/2
	66	5	78	5	92	7-1/2	106	10
	58	7-1/2	72	7-1/2	86	10	100	10
	108	5	127	5	147	7-1/2	169	7-1/2
	100	5	123	7-1/2	142	7-1/2	165	10
	87	7-1/2	108	7-1/2	128	7-1/2	153	10
	105	10	125	10	145	15	167	15
	100	10	120	10	140	15	163	15
	90	10	108	15	133	15	150	15
	103	15	125	15	145	15	168	15
	97	15	119	15	140	15	161	20
	90	15	110	20	130	20	152	25
	180	5	190	7-1/2	220	7-1/2	252	10
	175	7-1/2	185	7-1/2	215	10	249	10
	130	10	160	10	190	15	225	15
	155	15	190	15	220	20	253	20
	150	15	182	15	215	15	247	20
	130	15	160	15	195	20	225	25

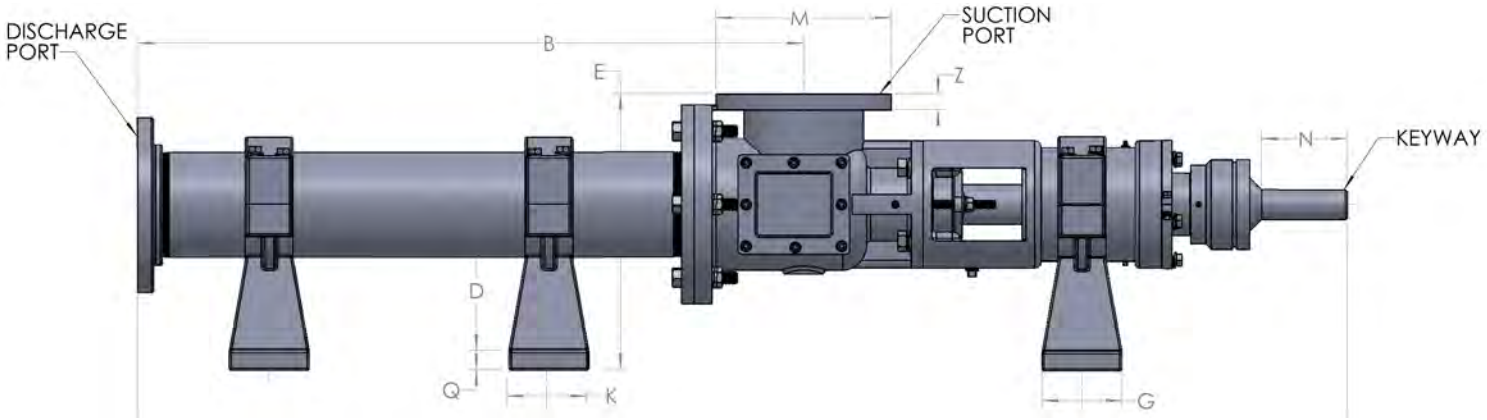
MODEL CG



DIMENSIONS AND WEIGHTS – MODEL CG

PUMP SIZE	DIMENSIONS (INCHES)											
	A	B	C	D	E	F	G	H	I	J	K	L
1CG8	52-3/4	19-1/2	-	9-3/4	16-11/16	9	5	1-7/8	6-1/8	7/8	5	31
2CG8	65-3/16	31-15/16	-	9-3/4	16-11/16	9	5	1-7/8	15-9/16	7/8	5	34
3CG8	77-5/8	44-3/8	27	9-3/4	16-11/16	9	5	1-7/8	6	7/8	5	29
1CG10	50-11/16	17-7/16	-	9-3/4	16-11/16	9	5	1-7/8	5-1/16	7/8	5	30
2CG10	61-1/8	27-7/8	-	9-3/4	16-11/16	9	5	1-7/8	10-1/2	7/8	5	35
3CG10	71-7/16	38-3/16	18	9-3/4	16-11/16	9	5	1-7/8	7-13/16	7/8	5	30
1CG10H	56	22-3/4	-	9-3/4	16-11/16	9	5	1-7/8	10- 3/8	7/8	5	30
2CG10H	71-7/16	38-3/16	18	9-3/4	16-11/16	9	5	1-7/8	7-13/16	7/8	5	30
1CG12	63-3/4	24-3/4	-	12-1/2	21	12-5/8	6	2-1/4	8-1/4	1	6	37-1/2
2CG12	79-7/16	40-7/16	18	12-1/2	21	12-5/8	6	2-1/4	5-15/16	1	6	37-1/2
3CG12	95-1/16	56	27	12-1/2	21	12-5/8	6	2-1/4	8-1/16	1	6	42
1CG12H	71-9/16	32-9/16	-	12-1/2	21	12-5/8	6	2-1/4	11-9/16	1	6	42
2CG12H	95	56	27	12-1/2	21	12-5/8	6	2-1/4	8	1	6	42

MODEL CG



Ø = Diameter

										WEIGHT (LBS)	PORT SIZES	
	M	N	O	P	Q	R	W	Z	KEYWAY		SUCTION	DISCHARGE
	11	5-3/8	7/8	9-1/2	1-1/8	15-5/8	11-1/2	1	1/2 X 3-1/2	450	6”	5”
	11	5-3/8	7/8	9-1/2	1-1/8	15-5/8	11-1/2	1	1/2 X 3-1/2	545	6”	5”
	11	5-3/8	7/8	9-1/2	1-1/8	15-5/8	11-1/2	1	1/2 X 3-1/2	596	6”	5”
	11	5-3/8	7/8	9-1/2	1-1/8	15-5/8	11-1/2	1	1/2 X 3-1/2	492	6”	6”
	11	5-3/8	7/8	9-1/2	1-1/8	15-5/8	11-1/2	1	1/2 X 3-1/2	580	6”	6”
	11	5-3/8	7/8	9-1/2	1-1/8	15-5/8	11-1/2	1	1/2 X 3-1/2	615	6”	6”
	11	5-3/8	7/8	9-1/2	1-1/8	15-5/8	11-1/2	1	1/2 X 3-1/2	494	6”	6”
	11	5-3/8	7/8	9-1/2	1-1/8	15-5/8	11-1/2	1	1/2 X 3-1/2	615	6”	6”
	13-1/2	6-1/8	7/8	11-3/4	1-1/8	18	14-1/2	1	1/2 x 4	960	8”	8”
	13-1/2	6-1/8	7/8	11-3/4	1-1/8	18	14-1/2	1	1/2 x 4	1155	8”	8”
	13-1/2	6-1/8	7/8	11-3/4	1-1/8	18	14-1/2	1	1/2 x 4	1285	8”	8”
	13-1/2	6-1/8	7/8	11-3/4	1-1/8	18	14-1/2	1	1/2 x 4	1025	8”	8”
	13-1/2	6-1/8	7/8	11-3/4	1-1/8	18	14-1/2	1	1/2 x 4	1285	8”	8”

MODEL CK 2000 SERIES



CK 2000 Series Model™

All Moyno® Parts, models and identification numbers are listed for reference purposes only. Continental Pump Co, Inc. is not affiliated with or a representative of neither Moyno® nor its parent company.

Continental CK 2000 Series model is designed to handle the heavier applications of sewage, industrial waste, polluted liquids and slurries. The CK 2000 Series pumps offers a long-lasting and low-maintenance solution for a wide variety of applications.



KEY BENEFITS AND FEATURES TO CK 2000 SERIES PUMPS

- Industrial design well known and used in wastewater and municipal industries
- Self-priming with suction lift up to 28ft (based on water)
- Suction chamber allows full 360° rotation for easier piping installation (Available upon request)
- Positive displacement and non-pulsating flow
- Heavy duty gear joint drive connections
- Handles heavy radial thrust loads (like pulley drives)
- Low maintenance unit & easier to service
- Flow rates up to 2,400gpm and pressures up to 780psi
- Handles sheer-sensitive materials with little to no agitation
- Capable of pumping foreign materials with particle sizes up to 2 in. in diameter
- Performs with equal efficiency in either direction

MODEL CK

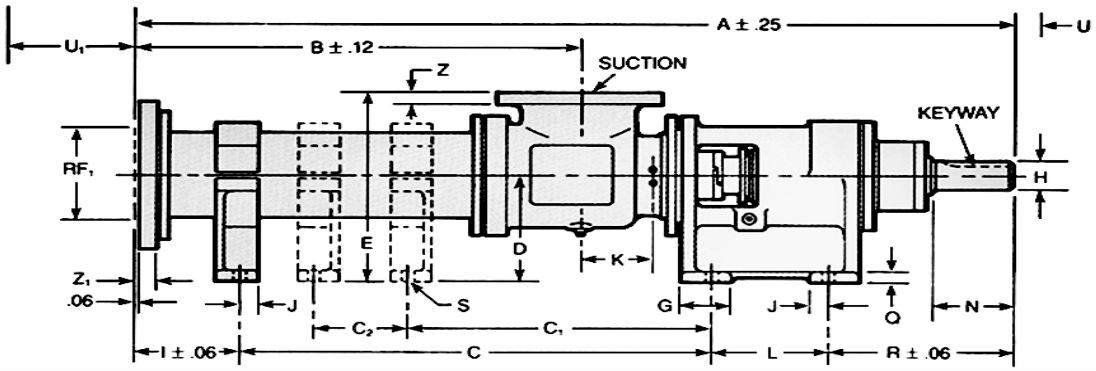
2000 SERIES

PUMP		PRESSURE, PSI											
MAX RPM	MODEL NO.	0		45		87		175		300		450	
		GPM	HP	GPM	HP	GPM	HP	GPM	HP	GPM	HP	GPM	HP
750	1E008	44	2	41	2	40	3	-	-	-	-	-	-
750	2E008	44	3	42	3	39	3	34	7.5	-	-	-	-
750	4E008	44	5	40	5	36	7.5	30	10	28	-	-	-
750	6E008	44	7.5	38	7.5	34	10	27	10	25	12.5	-	-
750	1E012	89	5	85	5	76	7.5	-	-	-	-	-	-
750	2E012	89	7.5	88	7.5	85	7.5	76	15	-	-	-	-
750	4EO12	89	10	89	10	88	10	85	15	80	20	-	-
750	6E012	89	15	89	15	88	15	87	15	84	20	-	-
750	6F012	89	15	89	15	88	15	87	20	84	25	80	30
725	1E022	158	5	149	7.5	128	10	-	-	-	-	-	-
725	2E022	158	7.5	155	7.5	149	15	128	20	-	-	-	-
650	4E022	142	7.5	141	7.5	139	15	133	20	-	-	-	-
650	4F022	142	15	141	15	139	15	133	20	119	30	-	-
650	6F022	142	20	142	20	141	20	138	20	132	30	-	-
650	1F036	223	7.5	211	10	178	15	-	-	-	-	-	-
650	2F036	223	15	220	15	211	20	178	30	-	-	-	-
600	4F036	206	20	205	25	203	25	194	30	-	-	-	-
600	6G036	206	30	206	30	205	30	202	40	195	50	-	-
600	1F050	300	7.5	316	15	267	20	-	-	-	-	-	-
600	2F050	300	10	330	25	317	25	267	40	-	-	-	-
600	4F050	280	15	308	60	305	30	291	40	-	-	-	-
600	6G050	280	20	309	40	308	40	303	50	293	60	-	-
575	1G065	368	15	346	20	278	25	-	-	-	-	-	-
575	2G065	368	20	362	20	346	30	278	50	-	-	-	-
500	4G065	320	30	319	30	316	30	299	50	-	-	-	-
450	6H065	288	40	287	40	283	40	279	50	260	75	-	-
575	1G090	552	20	519	25	417	30	-	-	-	-	-	-
575	2G090	552	20	543	25	519	40	417	60	-	-	-	-
500	4G090	480	30	479	30	474	40	449	75	-	-	-	-
450	6H090	432	40	431	30	425	50	419	75	390	90	-	-
500	1H115	563	20	537	25	482	40	-	-	-	-	-	-
500	2H115	563	25	555	30	538	40	482	75	-	-	-	-
450	4H115	507	50	504	50	499	50	482	75	-	-	-	-
400	6J115	450	50	449	60	447	60	438	75	420	100	-	-
450	1J175	748	25	711	40	633	60	-	-	-	-	-	-
450	2J175	748	40	737	50	713	60	632	100	-	-	-	-
400	4J175	665	60	662	60	655	75	630	100	-	-	-	-
400	6K175	665	75	663	75	660	100	648	125	621	175	-	-
400	1J220	900	60	850	35	675	60	-	-	-	-	-	-
400	2J220	900	120	850	70	675	110	-	-	-	-	-	-
400	1J345	1122	30	1067	50	950	75	-	-	-	-	-	-
400	2J345	1122	40	1105	60	1070	75	948	150	-	-	-	-
400	3J345	998	50	993	75	983	100	940	150	-	-	-	-
400	3K345	998	50	993	75	983	100	940	150	-	-	-	-
400	4K345	998	60	995	100	990	120	972	150	-	-	-	-
300	1K345	985	30	907	50	744	75	-	-	-	-	-	-
300	2K345	985	60	961	60	912	100	742	150	-	-	-	-
300	3K345	985	75	973	75	947	100	863	150	-	-	-	-
300	1K620	1860	75	1700	100	1200	150	-	-	-	-	-	-
300	2K620	1860	100	1810	100	1700	150	-	-	-	-	-	-
300	1K800	2418	100	2210	125	1560	150	-	-	-	-	-	-
300	2K800	2418	125	2210	125	1560	175	-	-	-	-	-	-

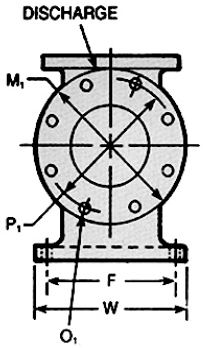
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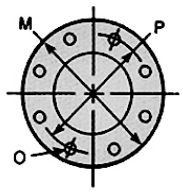
MODEL CK

2000 SERIES



MODEL NO.	STANDARD PUMP DIMENSIONS (INCHES)																	
	A	B	C	C1	C2	D	E	F	G	H	I	J	K	L	Q	R	S	W
1E008	38.88	13.00	16.75	—	—	6.00	11.50	6.50	3.12	1.88	4.69	1.12	4.75	5.50	0.75	11.94	0.88	8.00
2E008	47.00	21.12	20.00	—	—	6.00	11.50	6.50	3.12	1.88	9.56	1.12	4.75	5.50	0.75	11.94	0.88	8.00
4E008	63.50	37.62	36.00	18.00	—	6.00	11.50	6.50	3.12	1.88	10.06	1.12	4.75	5.50	0.75	11.94	0.88	8.00
6E008	79.50	53.62	48.00	30.00	—	6.00	11.50	6.50	3.12	1.88	14.06	1.12	4.75	5.50	0.75	11.94	0.88	8.00
1E012	42.00	16.12	18.00	—	—	6.00	11.50	6.50	3.12	1.88	6.56	1.12	4.75	5.50	0.75	11.94	0.88	8.00
2E012	53.12	27.25	22.00	—	—	6.00	11.50	6.50	3.12	1.88	13.69	1.12	4.75	5.50	0.75	11.94	0.88	8.00
4E012	75.62	49.75	48.00	18.00	—	6.00	11.50	6.50	3.12	1.88	10.19	1.12	4.75	5.50	0.75	11.94	0.88	8.00
6E012	97.88	72.00	70.00	30.00	—	6.00	11.50	6.50	3.12	1.88	10.44	1.12	4.75	5.50	0.75	11.94	0.88	8.00
1E022	43.31	17.19	18.00	—	—	6.00	12.50	6.50	3.12	1.88	7.88	1.12	5.00	5.50	0.75	11.94	0.88	8.00
2E022	56.19	30.06	27.00	—	—	6.00	12.50	6.50	3.12	1.88	11.75	1.12	5.00	5.50	0.75	11.94	0.88	8.00
4E022	82.94	56.81	56.00	20.00	—	6.00	12.50	6.50	3.12	1.88	9.50	1.12	5.00	5.50	0.75	11.94	0.88	8.00
6F012	102.38	72.50	67.00	27.00	—	7.00	13.50	8.50	3.62	2.12	15.62	1.25	6.12	6.75	1.00	13.00	0.88	10.00
4F022	86.69	56.81	56.00	20.00	—	7.00	13.50	8.50	3.62	2.12	10.06	1.25	6.12	6.75	1.00	13.00	0.88	10.00
6F022	112.19	82.31	80.00	20.00	30.00	7.00	13.50	8.50	3.62	2.12	12.44	1.25	6.12	6.75	1.00	13.00	0.88	10.00
1F036	48.62	19.62	21.00	—	—	7.00	14.00	8.50	3.62	2.12	7.88	1.25	5.25	6.75	1.00	13.00	0.88	10.00
2F036	63.12	34.12	29.00	—	—	7.00	14.00	8.50	3.62	2.12	14.38	1.25	5.25	6.75	1.00	13.00	0.88	10.00
4F036	92.12	63.12	59.00	29.00	—	7.00	14.00	8.50	3.62	2.12	13.38	1.25	5.25	6.75	1.00	13.00	0.88	10.00
1F050	53.94	24.94	24.00	—	—	7.00	14.00	8.50	3.62	2.12	10.19	1.25	5.25	6.75	1.00	13.00	0.88	10.00
2F050	73.75	44.75	45.00	20.00	—	7.00	14.00	8.50	3.62	2.12	9.00	1.25	5.25	6.75	1.00	13.00	0.88	10.00
4F050	113.50	84.50	77.00	48.00	—	7.00	14.00	8.50	3.62	2.12	16.75	1.25	5.25	6.75	1.00	13.00	0.88	10.00
6G022	116.88	84.75	72.00	36.00	—	9.00	16.00	9.50	4.00	2.38	22.62	1.50	5.62	7.75	1.00	14.50	0.88	11.50
4G036	97.06	64.94	60.00	30.00	—	9.00	16.00	9.50	4.00	2.38	14.81	1.50	5.62	7.75	1.00	14.50	0.88	11.50
6G036	125.81	93.69	90.00	30.00	30.00	9.00	16.00	9.50	4.00	2.38	13.56	1.50	5.62	7.75	1.00	14.50	0.88	11.50
4G050	118.44	86.31	78.00	48.00	—	9.00	16.00	9.50	4.00	2.38	18.19	1.50	5.62	7.75	1.00	14.50	0.88	11.50
6G050	158.19	126.06	112.00	30.00	46.00	9.00	16.00	9.50	4.00	2.38	13.94	1.50	5.62	7.75	1.00	14.50	0.88	11.50
1G065	56.88	23.75	26.00	—	—	9.00	17.50	9.50	4.00	2.38	8.62	1.50	6.62	7.75	1.00	14.50	0.88	11.50
2G065	74.75	41.62	34.00	—	—	9.00	17.50	9.50	4.00	2.38	18.50	1.50	6.62	7.75	1.00	14.50	0.88	11.50
4G065	110.50	77.38	70.00	34.00	—	9.00	17.50	9.50	4.00	2.38	18.25	1.50	6.62	7.75	1.00	14.50	0.88	11.50
1G090	63.38	30.25	26.00	—	—	9.00	17.50	9.50	4.00	2.38	15.12	1.50	6.62	7.75	1.00	14.50	0.88	11.50
2G090	87.88	54.75	56.00	26.00	—	9.00	17.50	9.50	4.00	2.38	9.62	1.50	6.62	7.75	1.00	14.50	0.88	11.50
6H065	150.62	115.00	115.00	35.00	40.00	11.00	19.50	13.00	4.00	2.88	11.00	1.50	6.75	9.50	1.12	15.12	1.00	15.00
4H090	141.50	105.88	102.00	30.00	36.00	11.00	19.50	13.00	4.00	2.88	14.88	1.50	6.75	9.50	1.12	15.12	1.00	15.00
6H090	182.40	146.70	147.80	27.50	40.10	11.00	19.5	13.00	4.00	2.88	10.40	1.50	6.75	8.90	1.12	15.40	1.00	15.00
1H115	66.50	30.88	30.00	—	—	11.00	19.50	13.00	4.00	2.88	11.88	1.50	6.75	9.50	1.12	15.12	1.00	15.00
2H115	89.88	54.25	54.00	30.00	—	11.00	19.50	13.00	4.00	2.88	11.25	1.50	6.75	9.50	1.12	15.12	1.00	15.00
4H115	136.62	101.00	102.00	30.00	36.00	11.00	19.50	13.00	4.00	2.88	10.00	1.50	6.75	9.50	1.12	15.12	1.00	15.00
4J115	141.88	102.00	102.00	30.00	36.00	11.00	19.50	13.00	4.00	3.38	11.88	1.50	7.44	12.00	1.12	16.00	1.00	15.00
6J115	188.62	148.75	140.00	30.00	55.00	11.00	19.50	13.00	4.00	3.38	20.62	1.50	7.44	12.00	1.12	16.00	1.00	15.00
1J175	74.75	33.88	30.00	—	—	11.00	21.50	13.00	4.00	3.38	16.75	1.50	8.44	12.00	1.12	16.00	1.00	15.00
2J175	101.38	60.50	60.00	30.00	—	11.00	21.50	13.00	4.00	3.38	13.38	1.50	8.44	12.00	1.12	16.00	1.00	15.00
4J175	154.62	113.75	110.00	30.00	40.00	11.00	21.50	13.00	4.00	3.38	16.62	1.50	8.44	12.00	1.12	16.00	1.00	15.00
1J345	94.30	53.50	49.50	—	—	11.00	21.50	13.00	4.00	3.38	16.70	1.50	8.44	12.00	1.12	16.00	1.00	15.00
2J345	140.21	99.48	84.00	42.00	42.00	11.00	21.50	13.00	4.00	3.38	28.20	1.50	8.44	12.00	1.12	16.00	1.00	15.00
4K175	167.19	117.38	117.25	37.25	40.00	13.00	23.50	14.50	4.12	3.88	14.12	1.62	9.19	15.00	1.25	20.81	1.00	17.00
6K175	220.19	170.38	157.25	37.25	60.00	13.00	23.50	14.50	4.12	3.88	27.12	1.62	9.19	15.00	1.25	20.81	1.00	17.00
3K345	198.31	148.50	142.00	42.00	50.00	13.00	23.50	14.50	4.12	3.88	20.50	1.62	9.19	15.00	1.25	20.81	1.00	17.00
4K345	245.20	195.40	181.50	36.00	86.00	13.00	23.50	14.50	4.20	3.88	27.77	1.62	9.19	15.00	1.25	20.81	1.00	17.00
1K620	140.19	90.38	84.00	42.00	—	13.00	23.50	14.50	4.12	3.88	20.38	1.62	9.19	15.00	1.25	20.81	1.00	17.00
2K620	220.81	171.00	162.00	42.00	60.00	13.00	23.50	14.50	4.12	3.88	23.00	1.62	9.19	15.00	1.25	20.81	1.00	17.00
1K800	131.62	80.75	86.00	46.00	—	13.00	23.50	14.50	4.12	3.88	9.75	1.62	9.19	15.00	1.25	20.81	1.00	17.00
2K800	190.44	139.62	146.00	46.00	50.00	13.00	23.50	14.50	4.12	3.88	8.62	1.62	9.19	15.00	1.25	20.81	1.00	17.00





MODEL CK

2000 SERIES

SUCTION FLANGE DATA (INCHES)															
SIZE	M	P	Z	O	SIZE	M1	P1	Z1	RF1	O1	U	U1	N	KEYWAY	
4	9.00	7.50	0.94	0.75 (8)	4	9.00	7.50	1.00		0.625-11 (8)	1.50	7.00	5.50	0.50 x 0.25	360
4	9.00	7.50	0.94	0.75 (8)	4	9.00	7.50	1.00		0.625-11 (8)	1.50	7.00	5.50	0.50 x 0.25	390
4	9.00	7.50	0.94	0.75 (8)	4	10.00	7.88	1.25	6.19	0.750-10 (8)	1.50	7.00	5.50	0.50 x 0.25	440
4	9.00	7.50	0.94	0.75 (8)	4	10.00	7.88	1.25	6.19	0.750-10 (8)	1.50	7.00	5.50	0.50 x 0.25	490
4	9.00	7.50	0.94	0.75 (8)	4	9.00	7.50	1.00	—	0.625-11 (8)	1.50	7.00	5.50	0.50 x 0.25	360
4	9.00	7.50	0.94	0.75 (8)	4	9.00	7.50	1.00	—	0.625-11 (8)	1.50	7.00	5.50	0.50 x 0.25	390
4	9.00	7.50	0.94	0.75 (8)	4	10.00	7.88	1.25	6.19	0.750-10 (8)	1.50	7.00	5.50	0.50 x 0.25	440
4	9.00	7.50	0.94	0.75 (8)	4	10.00	7.88	1.25	6.19	0.750-10 (8)	1.50	7.00	5.50	0.50 x 0.25	490
6	11.00	9.50	1.00	0.88 (8)	6	11.00	9.50	1.00	—	0.750-10 (8)	1.50	7.00	5.50	0.50 x 0.25	440
6	11.00	9.50	1.00	0.88 (8)	6	11.00	9.50	1.00	—	0.750-10 (8)	1.50	7.00	5.50	0.50 x 0.25	520
6	11.00	9.50	1.00	0.88 (8)	6	11.00	9.50	1.00	—	0.750-10 (8)	1.50	7.00	5.50	0.50 x 0.25	600
6	11.00	9.50	1.00	0.88 (8)	4	10.75	8.50	1.50	6.19	0.875-9 (8)	1.50	8.00	5.50	0.50 x 0.25	665
6	11.00	9.50	1.00	0.88 (8)	6	12.50	10.62	1.44	8.50	0.750-10 (12)	1.50	8.00	5.50	0.50 x 0.25	675
6	11.00	9.50	1.00	0.88 (8)	6	12.50	10.62	1.44	8.50	0.750-10 (12)	1.50	8.00	5.50	0.50 x 0.25	775
6	11.00	9.50	1.00	0.88 (8)	6	11.00	9.50	1.00	—	0.750-10 (8)	1.50	8.00	5.50	0.50 x 0.25	565
6	11.00	9.50	1.00	0.88 (8)	6	11.00	9.50	1.00	—	0.750-10 (8)	1.50	8.00	5.50	0.50 x 0.25	715
6	11.00	9.50	1.00	0.88 (8)	6	11.00	9.50	1.00	—	0.750-10 (8)	1.50	8.00	5.50	0.50 x 0.25	1055
6	11.00	9.50	1.00	0.88 (8)	6	11.00	9.50	1.00		0.750-10 (8)	1.50	8.00	5.50	0.50 x 0.25	565
6	11.00	9.50	1.00	0.88 (8)	6	11.00	9.50	1.00		0.750-10 (8)	1.50	8.00	5.50	0.50 x 0.25	715
6	11.00	9.50	1.00	0.88 (8)	6	11.00	9.50	1.00		0.750-10 (8)	1.50	8.00	5.50	0.50 x 0.25	1055
6	11.00	9.50	1.00	0.88 (8)	6	14.00	11.50	1.88	8.50	1.00-8 (12)	2.50	7.00	6.00	0.62 x 0.31	975
6	11.00	9.50	1.00	0.88 (8)	6	12.50	10.62	1.44	8.50	0.750-10 (12)	2.50	7.00	6.00	0.62 x 0.31	1275
6	11.00	9.50	1.00	0.88 (8)	6	12.50	10.62	1.44	8.50	0.750-10 (12)	2.50	7.00	6.00	0.62 x 0.31	1370
6	11.00	9.50	1.00	0.88 (8)	6	12.50	10.62	1.44	8.50	0.750-10 (12)	2.50	7.00	6.00	0.62 x 0.31	1275
6	11.00	9.50	1.00	0.88 (8)	6	12.50	10.62	1.44	8.50	0.750-10 (12)	2.50	7.00	6.00	0.62 x 0.31	1370
8	13.50	11.75	1.12	0.88 (8)	8	13.50	11.75	1.12	—	0.750-10 (8)	2.50	7.00	6.00	0.62 x 0.31	1125
8	13.50	11.75	1.12	0.88 (8)	8	13.50	11.75	1.12	—	0.750-10 (8)	2.50	7.00	6.00	0.62 x 0.31	1225
8	13.50	11.75	1.12	0.88 (8)	8	13.50	11.75	1.12	—	0.750-10 (8)	2.50	7.00	6.00	0.62 x 0.31	1490
8	13.50	11.75	1.12	0.88 (8)	8	13.50	11.75	1.12		0.750-10 (8)	2.50	7.00	6.00	0.62 x 0.31	1125
8	13.50	11.75	1.12	0.88 (8)	8	13.50	11.75	1.12		0.750-10 (8)	2.50	7.00	6.00	0.62 x 0.31	1225
8	13.50	11.75	1.12	0.88 (8)	8	15.00	13.00	1.62	10.62	0.875-9 (12)	2.50	10.00	6.50	0.75 x 0.38	2155
8	13.50	11.75	1.12	0.88 (8)	8	15.00	13.00	1.62	10.62	0.875-9 (12)	2.50	10.00	6.50	0.75 x 0.38	1900
8	13.50	11.75	1.12	0.88 (8)	8	15.00	13.00	1.62	10.62	0.750-10 (8)	2.50	10.00	6.50	0.75 x 0.38	2050
8	13.50	11.75	1.12	0.88 (8)	8	13.50	11.75	1.12	—	0.750-10 (8)	2.50	10.00	6.50	0.75 x 0.38	1700
8	13.50	11.75	1.12	0.88 (8)	8	13.50	11.75	1.12	—	0.750-10 (8)	2.50	10.00	6.50	0.75 x 0.38	1850
8	13.50	11.75	1.12	0.88 (8)	8	13.50	11.75	1.12	—	0.750-10 (8)	2.50	10.00	6.50	0.75 x 0.38	2250
8	13.50	11.75	1.12	0.88 (8)	8	15.00	13.00	1.62	10.62	0.875-9 (12)	2.50	12.00	6.50	0.88 x 0.44	2900
8	13.50	11.75	1.12	0.88 (8)	8	15.00	13.00	1.62	10.62	0.875-9 (12)	2.50	12.00	6.50	0.88 x 0.44	3100
10	16.00	14.25	1.25	1.00 (12)	10	16.00	14.25	1.25	—	0.875-9 (12)	2.50	12.00	6.50	0.88 x 0.44	2250
10	16.00	14.25	1.25	1.00 (12)	10	16.00	14.25	1.25	—	0.875-9 (12)	2.50	12.00	6.50	0.88 x 0.44	2400
10	16.00	14.25	1.25	1.00 (12)	10	16.00	14.25	1.25	—	0.875-9 (12)	2.50	12.00	6.50	0.88 x 0.44	2800
10	16.00	14.25	1.25	1.00 (12)	10	16.00	14.25	1.25		0.875-9 (12)	2.50	12.00	6.50	0.88 x 0.44	3000
10	16.00	14.25	1.25	1.00 (12)	10	16.00	14.25	1.25		0.875-9 (12)	2.50	12.00	6.50	0.88 x 0.44	3300
10	16.00	14.25	1.25	1.00 (12)	10	17.50	15.25	1.88	12.75	1.00-8 (16)	3.00	13.00	7.50	1.00 x 0.50	3550
10	16.00	14.25	1.25	1.00 (12)	10	17.50	15.25	1.88	12.75	1.00-8 (16)	3.00	13.00	7.50	1.00 x 0.50	4000
10	16.00	14.25	1.25	1.00 (12)	10	16.00	14.25	1.25		0.880-9 (12)	3.00	13.00	7.50	1.00 x 0.50	3750
10	16.00	14.25	1.25	1.00 (12)	10	17.50	15.25	1.88		1.00-8 (16)	3.00	13.00	7.50	1.00 x 0.50	4000
10	16.00	14.25	1.25	1.00 (12)	10	16.00	14.25	1.25	—	0.875-9 (12)	3.00	13.00	7.50	1.00 x 0.50	3300
10	16.00	14.25	1.25	1.00 (12)	10	17.50	15.25	1.88	12.75	1.00-8 (16)	3.00	13.00	7.50	1.00 x 0.50	3800
12	19.00	17.00	1.25	1.00 (12)	14	21.00	18.75	1.62		1.000-8 (12)	3.00	13.00	7.50	1.00 x 0.50	3500
12	19.00	17.00	1.25	1.00 (12)	14	21.00	18.75	1.62		1.000-8 (12)	3.00	13.00	7.50	1.00 x 0.50	4000

PUMP APPLICATION REFERENCE GUIDE

The **Pump Application Data Sheet** is a convenient tool used to transmit the required information to our Application Specialists for proper pump selection.

Step 1:

For proper selection of a pump it is necessary to determine the size required for your application. The Model Selection table below relates capacity and pressure required for each model available. The size is also determined by how other variables (viscosity, and abrasiveness) affect horsepower requirements. The CL and CJ Models are the standard bearing unit that is a pin driven pump. The CM Model is similar to the CL Model but utilizes the bearing drive unit from the next larger pump size. The CG and CK Models are standard bearing-drive unit but is a crown gear joint driven pump. Select the size which will most appropriately meet your application needs.

MODEL SELECTION FOR CONTINENTAL PROGRESSIVE CAVITY PUMPS

Pump Model	Approximate GPM Range	Approximate Maximum Pressure	Frame Size
CL	.9 - 400	225 PSI	2, 3, 4, 6, 8, 10, 10H, 12, 12H
CM	.1 - 24	450 PSI	1, 2, 3, 4
CG	3 - 400	225 PSI	8, 10, 10H, 12, 12H
CK	5 - 2400	780 PSI	E, F, G. H, J, K
CJ	.9 - 400	225 PSI	3, 4, 6, 8, 10, 10H

How to Size Example: Application request: 10 GPM, 100 PSI, 3500 centipoise (viscosity), .30" particle size, with light abrasives.

CL and CJ Models are for general commercial use, CM Model is for high pressure applications and the CG and CK Models are for Industrial uses.

For this application the CL Model is the best option.

Step 2:

Select the pump that is large enough to deliver more than the required capacity when operating at the maximum speed shown.

The table below is based on viscosities for one fluid and will not be correct for slurries or emulsions where each of which have different viscosities. The recommended pump speed for a mixture of fluids having different viscosities should be an approximate average of the fluids.

VISCOSITY FOR SINGLE FLUIDS FOR CONTINENTAL PROGRESSIVE CAVITY PUMPS

Pump Model	Maximum RPM and GPM	Viscosity Measured in Centipoise						
		1 to 1000	1000 to 2500	2500 to 5000	5000 to 10,000	10,000 to 50,000	50,000 to 100,000	100,000 to 150,000
2CM1, 6CM1	Max RPM	1200	900	450	250	125	40	20
	Max GPM	0.58	0.50	0.25	.014	0.07	0.02	0.01
1CL2, 2CL2, 3CL3, 6CM2	Max RPM	1200	900	450	250	125	40	20
	Max GPM	3	2.4	1.2	0.7	0.35	0.1	0.05
1CL3, 2CL3, 3CL3, 6CM3	Max RPM	1200	900	450	250	125	40	20
	Max GPM	10	7.8	3.9	2.2	1.1	0.35	0.17
1CL4, 2CL4, 3CL4, 6CM4	Max RPM	1200	900	450	250	125	40	20
	Max GPM	24	18	9	5	2.5	0.8	0.04
1CL6, 2CL6, 3CL6	Max RPM	900	900	450	250	125	40	20
	Max GPM	47	47	23.5	13	6.5	2	1
1CL8, 2CL8, 3CL8	Max RPM	900	900	450	250	125	40	20
	Max GPM	100	100	53	29	14.5	4.7	2.3
1CL10, 2CL10, 3CL10	Max RPM	750	750	450	250	125	40	20
	Max GPM	140	140	85	47	24	7.5	3.8
1CL10H, 2CL10H	Max RPM	750	750	450	250	125	40	20
	Max GPM	210	210	125	70	35	11	5.5
1CL12, 2CL12, 3CL12	Max RPM	600	600	450	250	125	40	20
	Max GPM	261	261	196	109	54.4	17.4	8.7
1CL12H, 2CL12H	Max RPM	600	600	450	250	125	40	20
	Max GPM	391	391	293	163	81.5	26	13

PUMP APPLICATION REFERENCE GUIDE

How to Size Example: Determine the maximum RPM and GPM for this application. What we already know is that we need 10 GPM within the 450 RPM range and we have a fluid with 3500 centipoise. Go to the Viscosity Measured in Centipoise columns and choose the one that fits the application. In the 2500 to 5000 column we see that the maximum RPM is 450 for all pumps with this viscosity. We now need to determine which pump can run the required 10 GPM. The 1CL4, 2CL4, 3CL4, 6CM4 states it is 9, which is too low so we look at the next larger pump where the maximum GPM is 23.5 at 450 RPM. The CL6 pump fits within our requested application.

Step 3:

If particles in suspension are to be pumped, determine the pump that will handle the maximum dimension of the particle. Refer to the Maximum Particle Size table.

MAXIMUM PARTICLE SIZE FOR CONTINENTAL PROGRESSIVE CAVITY PUMPS

Pump Model	2CM1 6CM1	1CL2 2CL2 3CL2 6CM2	1CL3 2CL3 3CL3 6CM3	1CL4 2CL4 3CL4 6CM4	1CL6 2CL6 3CL6	1CL8 2CL8 3CL8	1CL10 2CL10 3CL10 1CL10H 2CL10H	1CL12 2CL12 3CL12 1CL12H 2CL12H
Maximum Particle Size	.08”	.15”	.20”	.30”	.40”	.60”	.80”	1.0”

How to Size Example: Our application has .30” particle size and the CL6 pump can handle .40”. Our chosen pump still meets the requirements with no adjustments to be made.

Step 4:

If the fluid in the application has abrasive materials, refer to the Abrasive Characteristics table below for the proper operating speed of the pump. When the speed selected results in a lower capacity than required in the application, you may need to change your pump selection, even if the pump will operate below the maximum recommended speed. The speed requirements for viscosity must be also be considered when selecting the proper pump. When pumping abrasive materials it is always better to run your pump at a slower speed to prolong the life of the pump.

ABRASIVE CHARACTERISTICS FOR CONTINENTAL PROGRESSIVE CAVITY PUMPS

Pump Model	Maximum RPM and GPM	Abrasive Characteristics			
		None	Light	Medium	Heavy
2CM1, 6CM1	Max RPM	1200	900	600	300
	Max GPM	0.58	0.50	0.34	.17
1CL2, 2CL2, 3CL2, 6CM2	Max RPM	1200	900	600	300
	Max GPM	3	2.4	1.6	0.8
1CL3, 2CL3, 3CL3, 6CM3	Max RPM	1200	900	600	300
	Max GPM	10	7.8	5.2	2.6
1CL4, 2CL4, 3CL4, 6CM4	Max RPM	1200	900	600	300
	Max GPM	24	18	12	6
1CL6, 2CL6, 3CL6	Max RPM	900	675	450	225
	Max GPM	47	35.5	23.5	12
1CL8, 2CL8, 3CL8	Max RPM	900	675	450	225
	Max GPM	100	70	52.5	26.5
1CL10, 2CL10, 3CL10	Max RPM	750	565	375	190
	Max GPM	140	106	70	36
1CL10H, 2CL10H	Max RPM	750	565	375	190
	Max GPM	210	156	105	52.5
1CL12, 2CL12, 3CL12	Max RPM	600	450	300	150
	Max GPM	261	196	130	65
1CL12H, 2CL12H	Max RPM	600	450	300	150
	Max GPM	391	293	195	97.5

How to Size Example: The application states they are pumping light abrasive materials. Find the light abrasive characteristic column and the CL6 pump model to see what the maximum RPM and Maximum GPM are allowed. The maximum RPM is 675 and 35.5 GPM which falls within the application since the requirements are below the maximums.

PUMP APPLICATION REFERENCE GUIDE

Step 5:

The length of the rotor and stator are designated by stages. The approximate Pressure Per Stage (PSI) where the fluid pumped has no abrasives or contains light, medium or heavy abrasives is shown in the Pressure by Stage of Rotor/ Stator table below.

PRESSURE BY STAGE OF ROTOR/STATOR FOR CONTINENTAL PROGRESSIVE CAVITY PUMPS				
Frame Size	**Approximate Pressure Per State (PSI)**			
	Abrasive Characteristics			
	None	**Light**	**Medium**	**Heavy**
1 and 2	60	40	25	10
3 thru 12	75	60	35	15

How to Size Example: Our pumping fluid has light abrasives and the frame size is 6 which states that the pressure per stage for a 1CL6 is 60 PSI; if it is a 2CL6 the total pressure would be 120 PSI, and a 3 stage would be 180 PSI. Our application states that the required PSI is 100 so a 2CL6 would be the appropriate stage.

Step 6:

The performance chart at the right, also known as a pump curve, helps determine the pumping abilities of the pump model in measurements of GPM, RPM and HP (Horsepower).

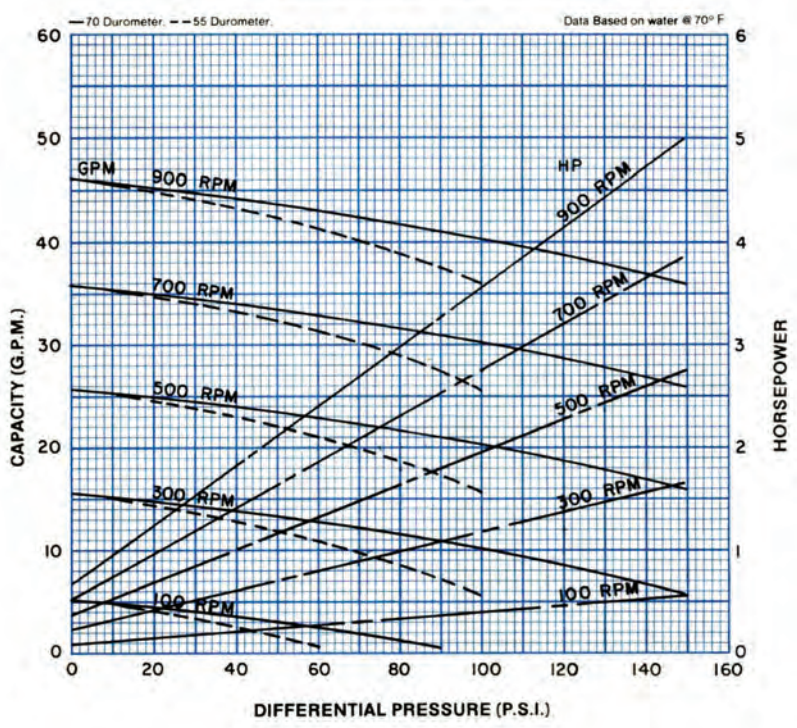
The pump curve lists all 3 items listed above, left side is for GPM, Bottom is PSI and the right is HP. The graph indicates the RPM's for both GPM and HP.

On the chart locate 10 GPM and 100 PSI, follow both lines to the intersection of the graph. The intersection occurs at the 300 RPM. This determines the RPM that the pump will be operating to get the capacity and PSI needed. This pump will be operating at: 10 GPM, 100 PSI and 300 RPM. *Please note that this solid line is for a 70 durometer elastomer and not 55 durometer, which is dotted.

How to Size Example: Review your application information: 10 GPM/ 100 PSI/ maximum 450 RPM

PERFORMANCE DATA MODEL: 2CL6

RPM	100	300	500	700	900
NPSH REQ'D	.6	1.7	2.9	4.1	6.9
MIN. HP	1/2	1 1/2	2	3	3



Step 7:

The required horsepower will need to be determined by using the same pump curve shown above.

How to Size Example: The right side of the graph translates RPM for horsepower. The HP lines start at the right of the graph and runs diagonally to the left. Find the 300 RPM in the HP section of the pump curve. Find the intersection of the 300 RPM in HP diagonal line and the 100 PSI from the bottom of the graph. Follow the straight blue line to the right from that intersection and notice that the required horsepower states 1.3 HP.

Step 8:

Having selected the pump, the number of stages of the rotor/stator, and the performance data for the initial horsepower required to drive the pump handling fluid with relatively no viscosity (1 to 2500 Centipoise). For fluids containing increasing amounts of abrasives the horsepower needed will be greater, refer to the Horsepower Adder due to Viscosity table below for the additional HP needed for the application.

HORSEPOWER ADDER DUE TO VISCOSITY FOR CONTINENTAL PROGRESSIVE CAVITY PUMPS

Pump	Horsepower Adder per 100 Revolutions and per Stage Viscosity Measured in Centipoise						
	1 to 2500	2500 to 5000	5000 to 10,000	10,000 to 50,000	50,000 to 100,000	100,000 to 150,000	150,000 to 200,000
2CM1, 6CM1	0	0.002	0.0025	0.003	0.007	0.01	0.0142
1CL2, 2CL2, 3CL2, 6CM2	0	0.01	0.015	0.016	0.032	0.046	0.056
1CL3, 2CL3, 3CL3, 6CM3	0	0.03	0.04	0.05	0.11	0.15	0.19
1CL4, 2CL4, 3CL4, 6CM4	0	0.06	0.09	0.12	0.25	0.35	0.44
1CL6, 2CL6, 3CL6	0	0.17	0.23	0.31	0.64	0.91	1.12
1CL8, 2CL8, 3CL8	0	0.37	0.52	0.71	1.43	2.05	2.52
1CL10, 2CL10, 3CL10	0	0.6	0.83	1.13	2.3	3.29	4.06
1CL10H, 2CL10H	0	0.88	1.22	1.67	3.39	4.83	5.97
1CL12, 2CL12, 3CL12	0	1.4	2	2.7	5.3	4.7	9
1CL12H, 2CL12H	0	2.1	2.9	4	8	11.3	13.2

How to Size Example: Our application states the viscosity is 3500 centipoise, so additional HP will be required to perform up to the required standards. Using the chart above find the column for the needed 3500 centipoise and the 2CL6 model, which is 0.17. Multiply the increased horsepower (0.17) per 100 revolutions (3 for 300 RPM) per stage (2 stage rotor/stator). 0.17 x 3 x 2 = 1.02. Add this amount to the initial horsepower to determine the final horsepower required. 1.3 + 1.02 = 2.32. Rounding up the final HP needed is 2.5 HP

Step 9:

Having selected the horsepower required to drive the pump, additional HP is needed to overcome the starting torque for the pump. We recommend multiplying the HP by **1.3—1.5** to determine the final HP you should use.

HORSEPOWER NEEDED FOR STARTING TORQUE

INITIAL HP		RECOMMENDED HP
2 HP	x1.5	3HP

We know for this specific application that a 2CL6 pump can be used. Please refer to **www.continentalultrapumps.com** for the **How Progressive Cavity Pumps Work** reference sheet for the **Model Number Nomenclature** and **Chemical Compatibility** to determine for the material of construction for your Continental Progressive Cavity Pump.













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Installation and Operational Instructions for Continental Models CP, CL, CM, and CG

1. **Dry friction is harmful to Progressing Cavity Pumps.** **Do no operate the pump until it is filled with the liquid to be pumped**. This liquid serves as a lubricant and as a seal between the rotor and stator and is not a priming operation. Approximately 10% of the pump's displacement rating will satisfy the cooling and lubricant requirements until full displacement capacity is attained.

2. Mount the pump on a properly machined and fabricated steel base that is anchored with bolts on a level solid foundation.

3. **Alignment of direct driven pumps** that are driven by a motor or a speed reducer should be carefully checked after the pump base has been mounted on the foundation. Check the alignment of the coupling halves with a straight edge. Alignment should be checked at least four points 90° around the O.D. of the coupling. A space between the pump and driver shaft ends should be held to no less than 1/8".

4. **Belt driven pumps** should be checked after mounting the pump base on the foundation. Make sure, with the help of a straight edge, that the belts and pulleys are in alignment and that the belts have the proper tension.

5. **Pump rotation:** The recommended operating direction is clockwise when viewing the pump from the driveshaft end. However, the pump can be operated in either a clockwise or counterclockwise direction when viewing the pump form the driveshaft end. The inlet and discharge ports are related to the rotation of the pump.

6. **Piping** to pump should always be the same size as the pump inlet port and discharge port openings. Those systems handling viscous, volatile high pressure or high temperature materials may have to be more appropriately sized.

    a. All threaded joints should be coated and sealed with pipe compound.
    b. Provide for expansion in the piping system to all for movement and deflection.
    c. Use pipe supports to keep the weight of the piping system from causing strain on the pump.
    d. Make all lines as direct and free of fittings as possible. Minimize suction line by locating the pump below or close to the liquid being pumped.
    e. When the pump is handling abrasive, corrosive liquids, slurries, sludges, cements, adhesives or any liquids that harden, it should be flushed clean. The rotation of the

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pump can be operated both clockwise and counterclockwise to accomplish this operation most thoroughly.

f. It is a good practice to consider installing pressure and/or vacuum gauges in both the inlet and outlet pipes to the pump to check that it conforms to your operating specifications.

Progressing Cavity Pumps are **positive displacement** and the discharge outlet must be kept open or a **relief valve** or a **by-pass piping** arrangement should be provided. If the discharge or inlet into the system is to be shut off or closed, provisions must be made for a relief valve or by-pass arrangement or damage can be done to the pump and the drive, including the motor. Strainers, filters and foot valves should be properly sized so as not to affect performance of the pump and should usually be installed in the suction line.

7. **Pump Bearings** are anti-friction ball type and should be periodically greased. They are initially packed when assembled at the factory.

   a. **Do not over lubricate.**
   b. Use quality anti-friction bearing grease.
   c. It is recommended that under normal use, that no lubrication be added for the first 1200 hours of operation unless it is uncomfortable to hold the hand on the bearing housing.
   d. The bearing shaft assembly should be inspected and cleaned after running the pump for approximately 2500 hours.
   e. All old grease should be removed from the bearing and bearing housing. Inspect bearings for wear and repack the bearings with new grease.
   f. Add a few drops of oil to bearing seals before reassembling.

8. **Packing maintenance procedures**
   a. The packing gland should be firmly tightened so as to prevent excessive leakage through the packing, but not so tight that it will cause overheating. Always adjust packing gland evenly. Align the packing gland so that it evenly goes into the packing gland cavity of the pump housing.
   b. **Continental Progressing Cavity Pumps** are supplied with a lantern ring in the midsection of the packing with access to a lubrication fitting on the external surface of the pump body. Lubricating the packing regularly with small amounts of lubricant or flushing with water will extend the life of the packing and help maintain a good seal.
   c. A scored driveshaft reduces the life of packing and should be replaced.
   d. When replacing worn packing use standard die-cut formed packing. Do not use one piece spiral packing. Press into place the die-cut and preformed packing rings and stagger the joints 180° apart.

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e. After packing is installed, tighten the gland bolts finger-tight and evenly. The packed stuffing box is designed to control leakage, not to stop it completely. Leakage is necessary to reduce friction and dissipate heat. Bolts should be backed off gradually as the stuffing box warms up, to avoid overheating of the packing area.

f. A small amount of leakage through the packing can be normal and helpful for good operation and easily drained away from the base. A leakage rate of 50-100 drops per minute until the packing has seated and adjusted to the operating temperature (approximately 10-15 minutes). If excessive leakage is present after 15 minutes of operation, tighten the gland bolts 1/6 of a turn. Tighten the bolts another 1/6 of a turn after an additional 15 if necessary, and repeat until desired leakage of 1-2 drops per minute is obtained. **Note:** Do not tighten until zero leakage is obtained. Over tightening of the packing gland may result in accelerated wear on the packing and damage to the shaft.

Pre-Start-Up Checks

1. Read and understand all information furnished with pump.
2. Review operating conditions.
3. Check setting of relief valve in discharge line.
4. Check for proper position of belt or coupling guards. Do not operate pump without guards.
5. Fill the pump with the liquid to be pumped. **Do not operate pump dry**.
6. **Rotate driveshaft** of pump four or five rotations. This creates a seal between the rotor and stator to create pumping action.
7. Make sure the inlet and discharge lines are open.
8. Start the unit.
9. Check to see if the pump is delivering liquid. If it is not, refer to the section on checking pump performance.

General Storage Guidelines

- Loosen packing gland to decompress packing set.
- Base units that will be stored for long periods can be rotated every 6 months or remove the stator and belts. If they cannot be removed seal the discharge port. Do not use oil on natural rubber.
- Rotate shaft manually up to 180° every 3 months.
- Spray unprotected metals with a good rust preventative and re-inspect every 3 months.
- It is best to store in warm, dry area with low humidity. Inside is preferred, but if stored outside wrap tightly with a weatherproof cover.

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Start-up after storage

- Fill with fluid
- Check packing. Tighten or replace if necessary.
- Refer to Pre-Start-Up Checks for procedures.

Troubleshooting Pump Performance

A summary of possible causes of improper performance of Progressing Cavity Pumps

No liquid delivered

1. Pump rotating in wrong direction
2. Suction lift too high
3. Clogged suction line
4. Air pockets or vapor lock
5. Air leaks in suction line
6. Faulty relief valve in system
7. Pump not properly primed
8. Suction line not submerged in product
9. Worn pump

Pump Takes Too Much Power

1. Speed too high
2. Liquid more viscous that anticipated
3. Operating pressure higher than specified. Check this with gauge at the pump outlet
4. Outlet line obstructed
5. Mechanical defect, such as bent shaft, tight packing gland, or misalignment of piping
6. Relief valve in system not operating properly

Insufficient Liquid Delivered

1. Air leaks in suction line
2. Air leaks in through packing
3. Speed too low
4. Suction lift too high
5. Partial air pockets or vapor lock
6. Restricted suction line
7. Faulty relief valve in system
8. Worn pump

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Excessive Noise

1. Starved pump, liquid not getting into pump
2. Air leaks in suction line
3. Air or gases in liquid
4. Pump speed too high
5. Improper mounting, check alignment thoroughly
6. Excessive discharge pressure

Rapid Wear of Stator

1. Pump ran dry
2. Grit or dirt in liquid
3. Pump running too fast
4. Excessive pressure
5. Corrosion

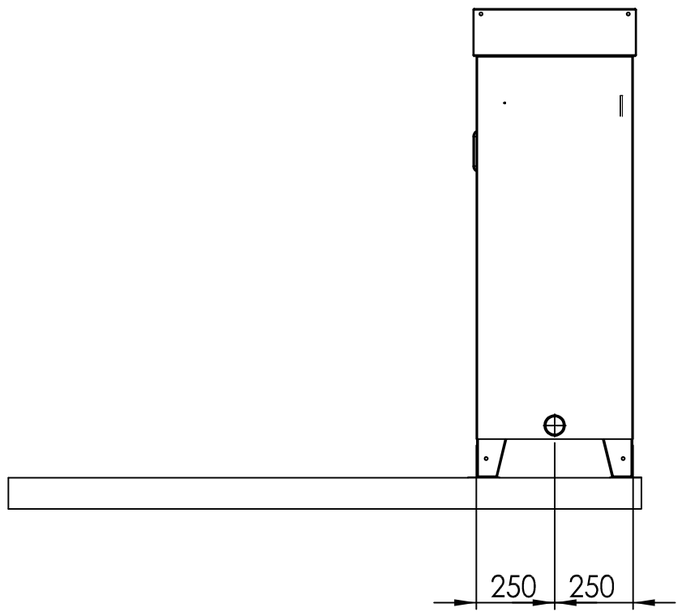
Loss of Suction after Start-up

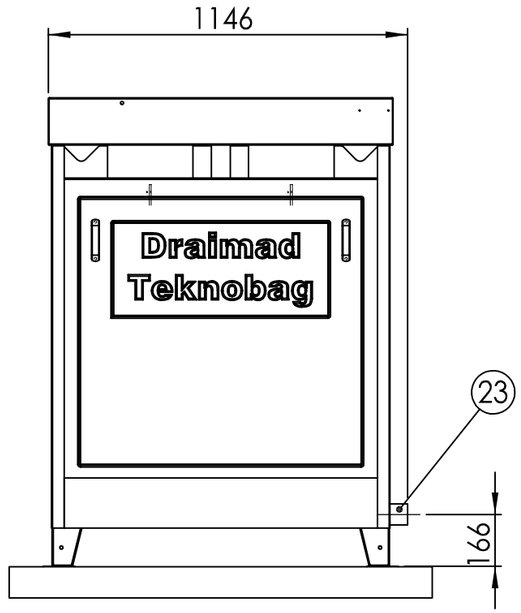
1. Pump not properly primed
2. Suction piping not submerged
3. Suction piping too small
4. Air leaks in suction
5. Insufficient liquid supply

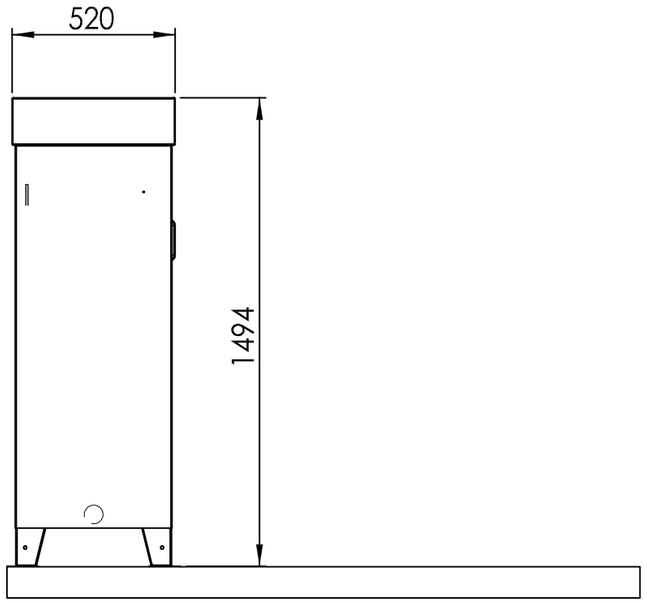
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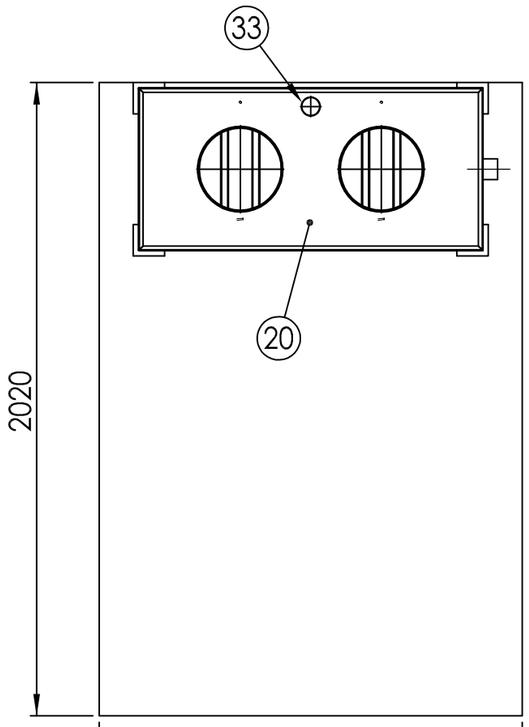
Section 3.6.4

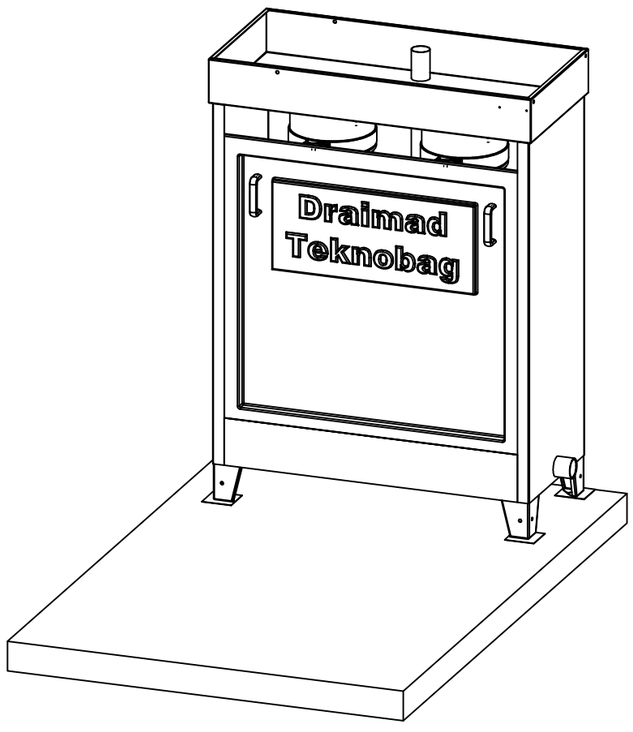
Sludge Dewatering System











Recommended minimum working height: 2,5 mt

	DESCRIPTION	DESCRIZIONE
20	SLUDGE INLET	INGRESSO FANGHI
23	FILTRATE OUTLET	SCARICO FILTRATO
33	OVERFLOW	TROPPO PIENO

Teknofanghi s.r.l.

Via Brescia,18 Cernusco sul Naviglio 20063 (MI) ITALIA

Tel. +39 0292143037 Fax +39 0292143038 Web: www.teknofanghi.com

DATE: 01/02/2011	DIMENSIONS NOT BINDING
REVISION: 00	OUR REF.
CUSTOMER: .	

TITLE: Filtering module TEKNOBAG DRAIMAD type 02BM

DWG NO. 02BM

A3

SCALE: 1:20

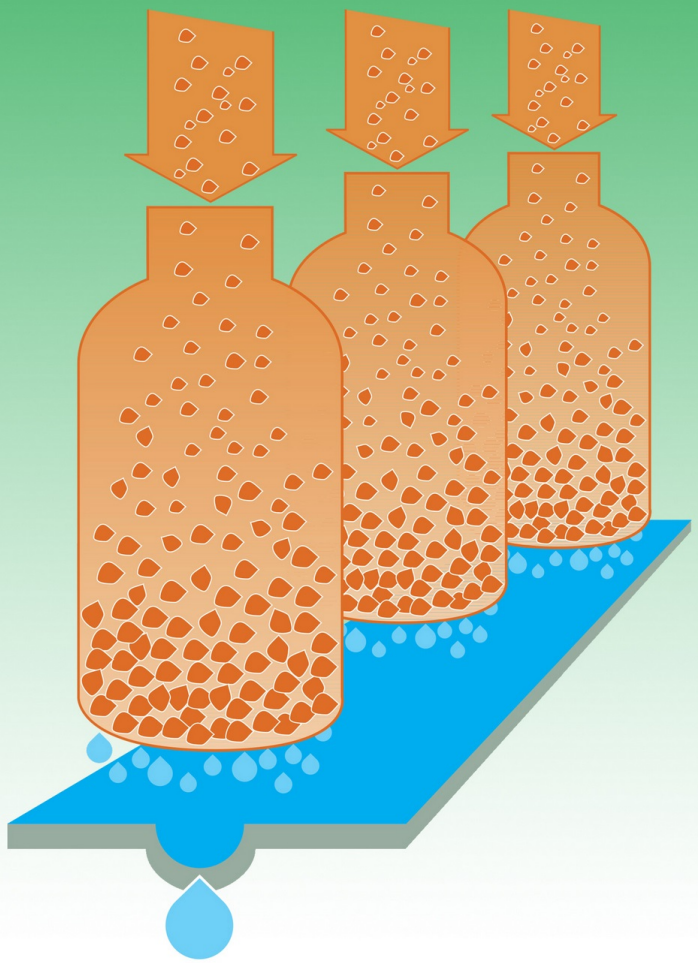
SHEET: 1 OF 1

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Teknofanghi

TEKNOBAG-DRAIMAD®

BM



ACCERTA
UNI EN ISO 9001:2015

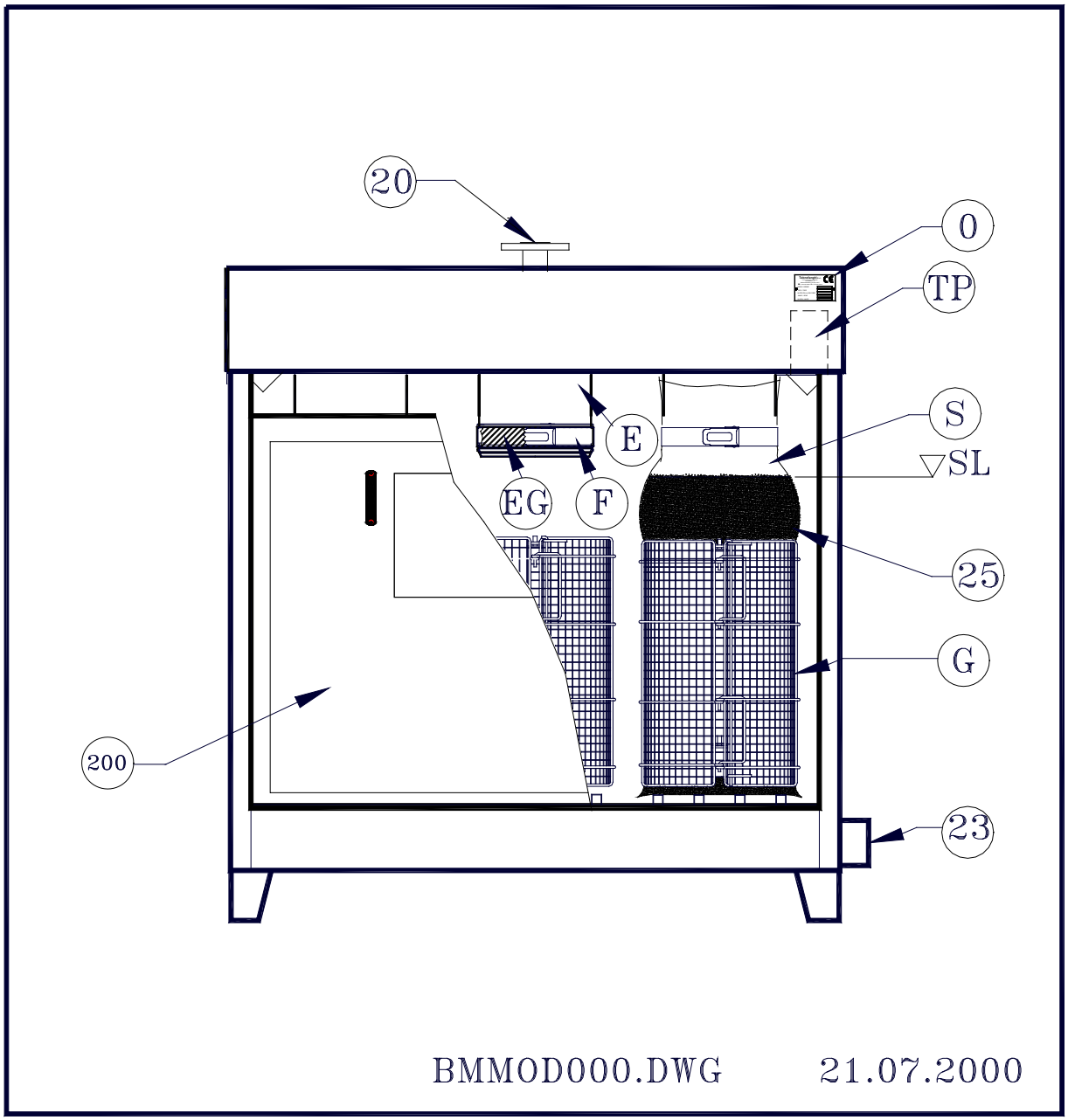
Since 1987

Teknofanghi S.r.l. / Via Brescia 18, 20063, Cernusco S/N, (Milano), Italy
C.F. - P.IVA: 08969100158 / R.I. di Milano N.277169 / Cap. Soc. 25.850,00 i.v. / R.E.A. 1264620
Tel. +39 02 92143037 / Fax +39 02 92143038 / E-mail: info@teknofanghi.it / Web: www.teknofanghi.it

This guide refers to models: **“02BM”; “03BM”; “06BM”.**

Before installing the machine, the user must:

- have identified the type of the machine (see the metal label “0”).
- have prepared the area of the installation according the drawing of the “foundation” and of the “dimensions”.
- have identified the operators which will carry out the installation, the first start up and the daily usage of the machine.



INTENDED USES OF THE MACHINE AND PROHIBITED USES

The TEKNOBAG®-DRAIMAD® are machines for dewatering sludge coming from any waste water treatment plant.

The sludge must be stabilised, with neutral pH and with a temperature between 10°C and 30°C.

Average treatment capacities of the TEKNOBAG®-DRAIMAD® are indicated in the table below. Please note that these values are obtained with a well flocculated sludge and that they can vary on the basis of the different specific characteristics of the sludge to be treated.

TEKNOBAG®-DRAIMAD®	Hydraulic flow (m^3/h)	Dry Solids (%)	m^3/day (D.S. 1%)	D.S./day (Kg)
02BM	1 – 2	0,5 - 4	2 – 4	10 - 20
03BM	1 – 3	0,5 - 4	3 – 6	15 – 30
06BM	2 - 6	0,5 - 4	6 – 12	30 - 60

The TEKNOBAG®-DRAIMAD® can dewater sludge without a previous treatment with flocculant, even though with poorer result.

It is not permitted:
To treat or use substances with different chemical, physical and biological properties from those indicated above;
To tamper with the safety guards and devices;
To modify any of the parts of the machine mentioned in this handbook;
To use power supply (electric, hydraulic, pneumatics) with different characteristics from the ones shown in this handbook.



WARNING! **The characteristics of the sludge generated by the waste water treatment plants make it possible to be exposed to hazardous chemical/biological substances.**
Users and operators must be aware.
All the operators must be familiar with the potential hazards connected with the sludge being dewatered, and how to protect themselves.

TEKNOFANGHI will not be held responsible for damage to persons and/or property and/or to the machine itself due to non-implemented and/or inadequate safety precautions.

INSTALLATION

Refer to drawing at back of the frontal cover:

- Connect to point 20 the sludge supply line using a pipe flanged DN50 PN10 UNI2277 (Model "02BM" has no connection flange, provide a pipe over the upper tank to allow the filling). Fasten the piping so that they are not supported by the machine.

- Connect to the filtrate outlet (point 23) a gasketed plastic pipe DN100 UNI 8320 DIN19560 DIN4102-B1 (Model "02BM" has a 2" GF manifold).

- Provide the installation of a control panel to start / stop the sludge and polyelectrolyte pumps. If the supply of the sludge is made by gravity feeding, provide the installation of an interception valve.

Once that all above indicated has been done, the installation is complete.

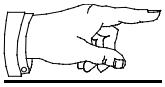
DAILY USAGE

Operators must follow the instructions below, in order to properly operate the TEKNOBAG®-DRAIMAD® daily.

On the TEKNOBAG®-DRAIMAD® unit must be installed the TEKNOBAG®-DRAIMAD® bags (see point S): follow the table here below reported to operate the removal / installation of the bags. If some clumps of sludge are present inside the bag enclosure, remove them by means of the water hose.

Once that each funnel has its own new bag, the unit is ready to operate the dewatering: activate the sludge pump or open the interception valve in order to fill the bags (FILLING CYCLE). Stops the sludge before it arrives to the "TP" overflow outlet of the hood ("02BM" unit has the overflow in the middle of the hood).

Once the unit is filled, and the filtrate start to drain it does not need to be manned continuously, however visual checking is suggested (DRAINING CYCLE).



CAUTION: ***Before leaving the working machine, the operator must ensure that:***
The plant has no leaks.
The filtrate discharging from 23 is as clear as expected.
The sludge does not leak from around the clamps of the bags.

Once the level inside the bags is quite below the point "SL", it can be operated the FILLING CYCLE again. These two cycles should be repeated until the bag are full of dewatered sludge. After that it will be necessary to change the bags.

BAG REMOVAL AND STORAGE

OPERATION	EFFECT	DISPLAY
Look inside the top tank.	The top tank is empty.	The access of the funnels of the bags is visible.
Remove the safety guard which closes the access to the bags by pulling it towards the right then lift it and extract it from the unit	The bags are accessible.	It is possible to verify whether the level of the sludge is near point "SL" (see picture at page 1).
If the cages “G” are available, lift the fastening rod of one of them and open it.	The hand cart fork can enter up to the bag	The shield of the hand cart fork touches the bag.
Slide the hand cart fork under the bag and crank it up.	The bag is lifted off the bottom supports.	The bag does not touch the bottom supports.
Release the clamp "F".	The upper part of the bag is free.	It is possible to see inside the bag
Squeeze the bag together at the top of the sludge line.	The bag is ready to be sealed	
Wrap two wire ties together at the top of the sludge line.	The wire ties are ready to be tightened.	
Insert the tying tool into the loops and pull several times. Do not pull too much otherwise they will break.	The bag is sealed and can be easily removed and stacked.	
Remove the bag and lay it on a pallet.	The funnel of the unit is free.	
Stack the bags with one layer horizontally and the next perpendicularly and so on. The bags can be stacked as high as convenient. New bags can be stacked on old bags.	The bags are ready to be moved to the storage area before the disposal.	

Repeat this sequence for every bag. If some sludge drops are spilled, wash them away with the water hose.

INSTALLATION OF THE NEW BAGS

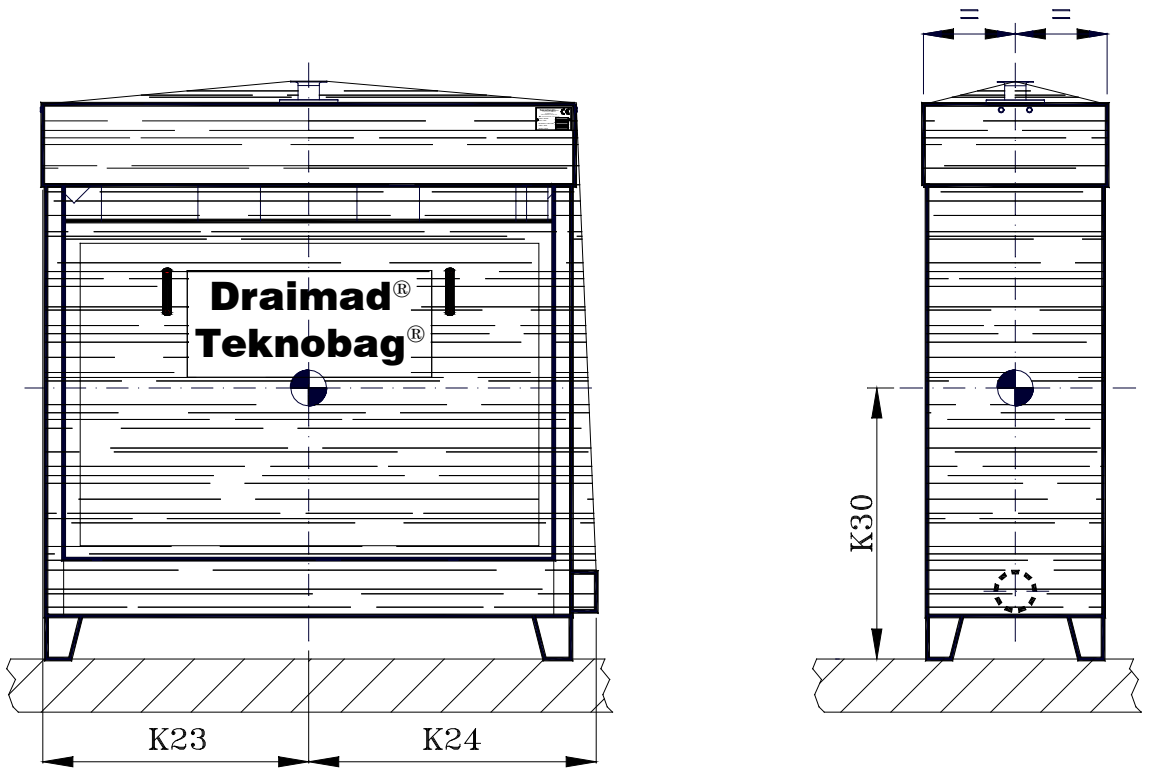
OPERATION	EFFECT	DISPLAY
Remove the bags from the carton.	Verify the integrity of the bag.	The bag has no holes or cuts or bad welding or bad sewing.
Open the clamp "F"; if available open also cages "G".	The operator can fit one bag	
Slip the bag "S" over the funnel nearly all the way to the top. Place the vertical seal of the bag to the rear. Holding the bag tight against the funnel at the front, pull the loose out and forward, and tuck under, to form a tight seal to the funnel.	The bag is ready to be clamped to the funnel "E"	The upper part of the bag touches the hood, the bottom part is perpendicular to the bottom support and the vertical seal is opposite to the operator.
Bring the clamp "F" around the bag and tighten	The bag is sealed to the funnel.	There are no gaps between the clamp and the bags, all around the funnel
Push the bottom of the bag into the cage, and slip the cage fastening rod through the loops provided on the cage.	The bag is ready to be filled.	The bag can be moved without entanglement in the cage.

Repeat this sequence for every bag. Once all the bags are fitted, replace the safety guard used to keep the filtrate splash inside the unit.

TROUBLE SHOOTING

PROBLEM	DIAGNOSIS	ACTION
During the "FILLING CYCLE" the sludge does not enter the bags	The sludge supply line is clogged or there is a problem with the sludge and polyelectrolyte pumps.	Check the sludge supply line and the rotation direction of the motor of the sludge pump.
There is leakage between a funnel and a clamp.	The clamp is not properly tightened or the gasket “EG is broken, missing or bad positioned.	At the next bag change, adjust the clamp grip so it tightens properly. Check whether the gasket is present.
There is a lot of sludge in the filtrate coming from the bags.	Bad flocculation.	Check the sludge and polyelectrolyte feeding rates and the flocculation.
The filtrate has a lot of foam.	Bad flocculation.	Check the sludge and polyelectrolyte feeding rates and the flocculation.

WEIGHTS AND CENTRE OF GRAVITY



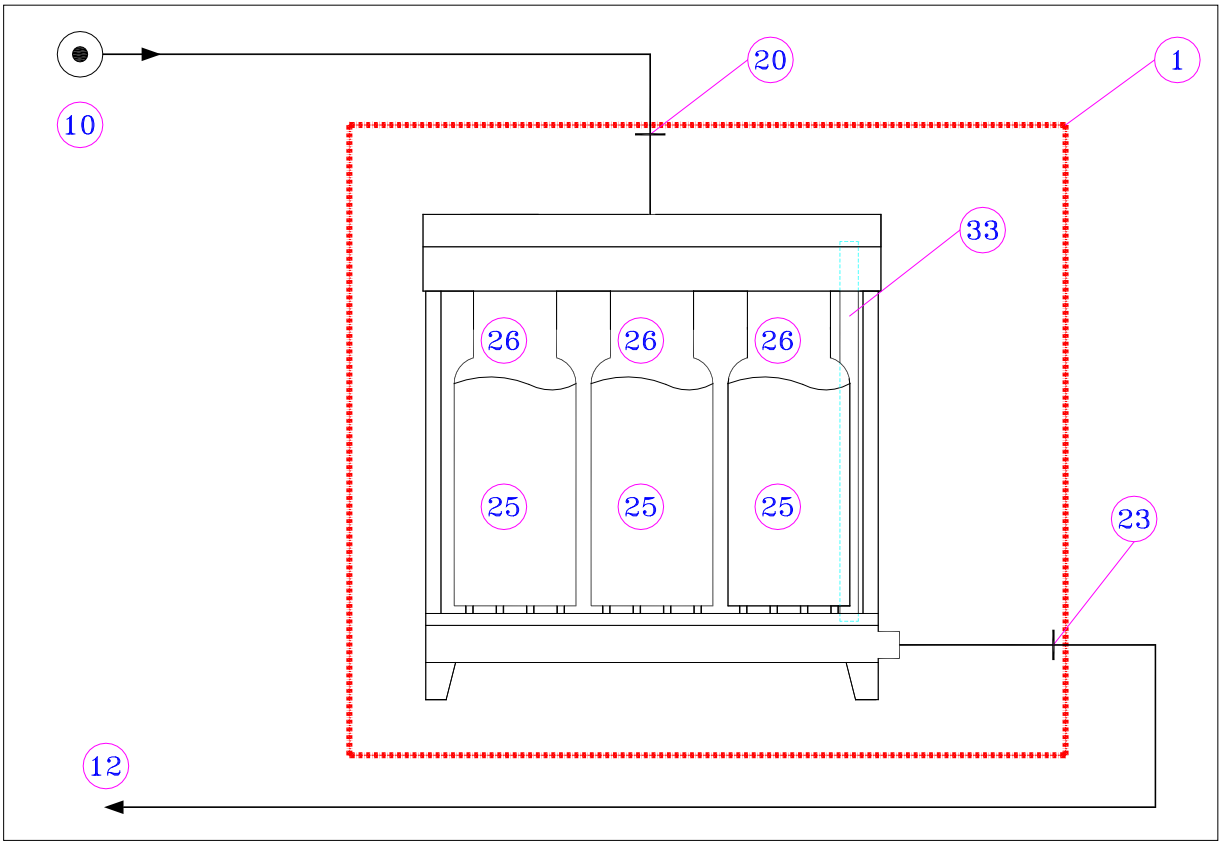
	K23	K24	K30	Kg. (*)
02BM	550	580	700	100
03BM	751	814	730	140
06BM	751	814	750	260

(*) Mass
Massa

Centre of gravity
Baricentro

BRCDR001M.DWG 02.10.2000

P&I

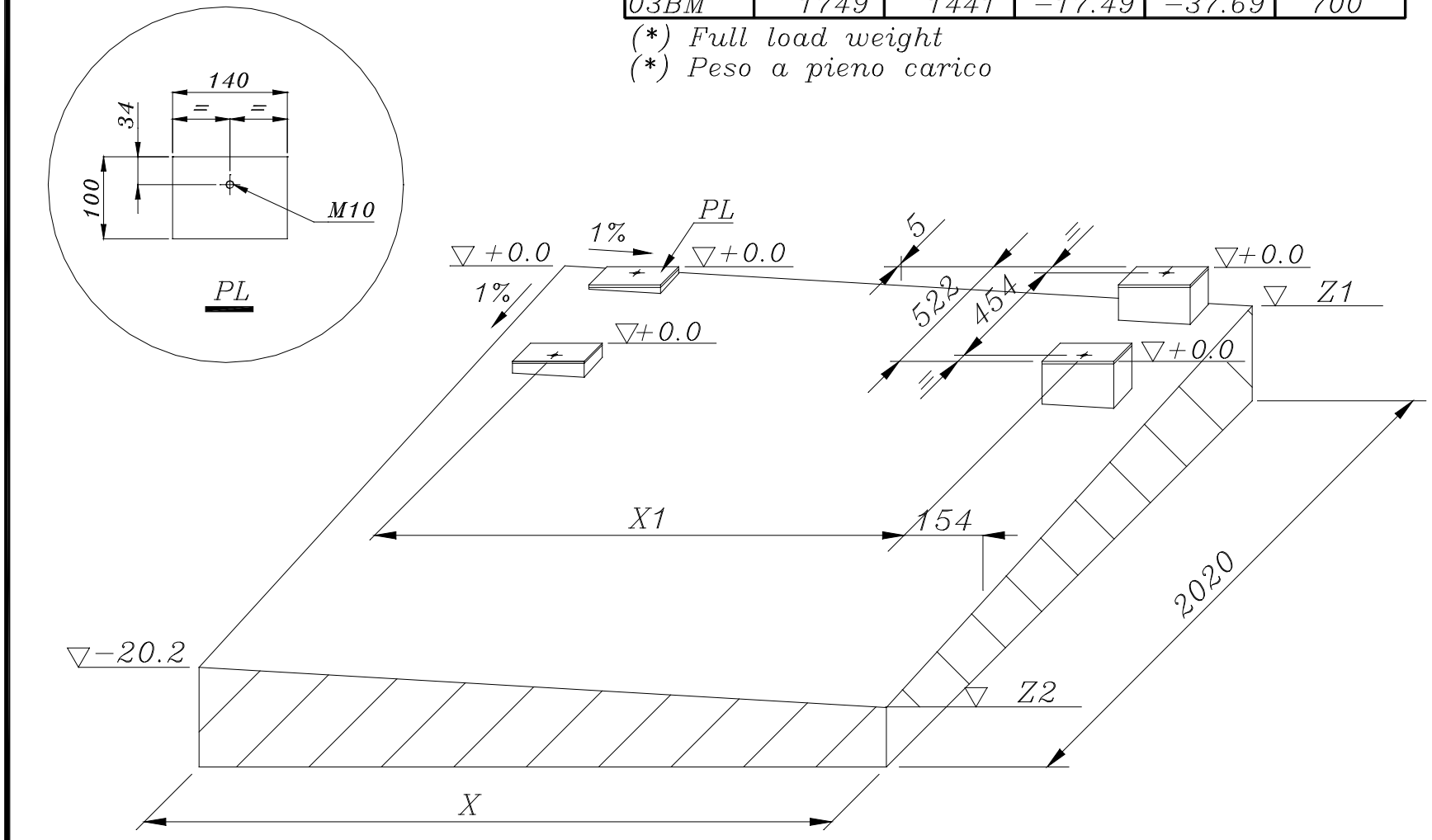


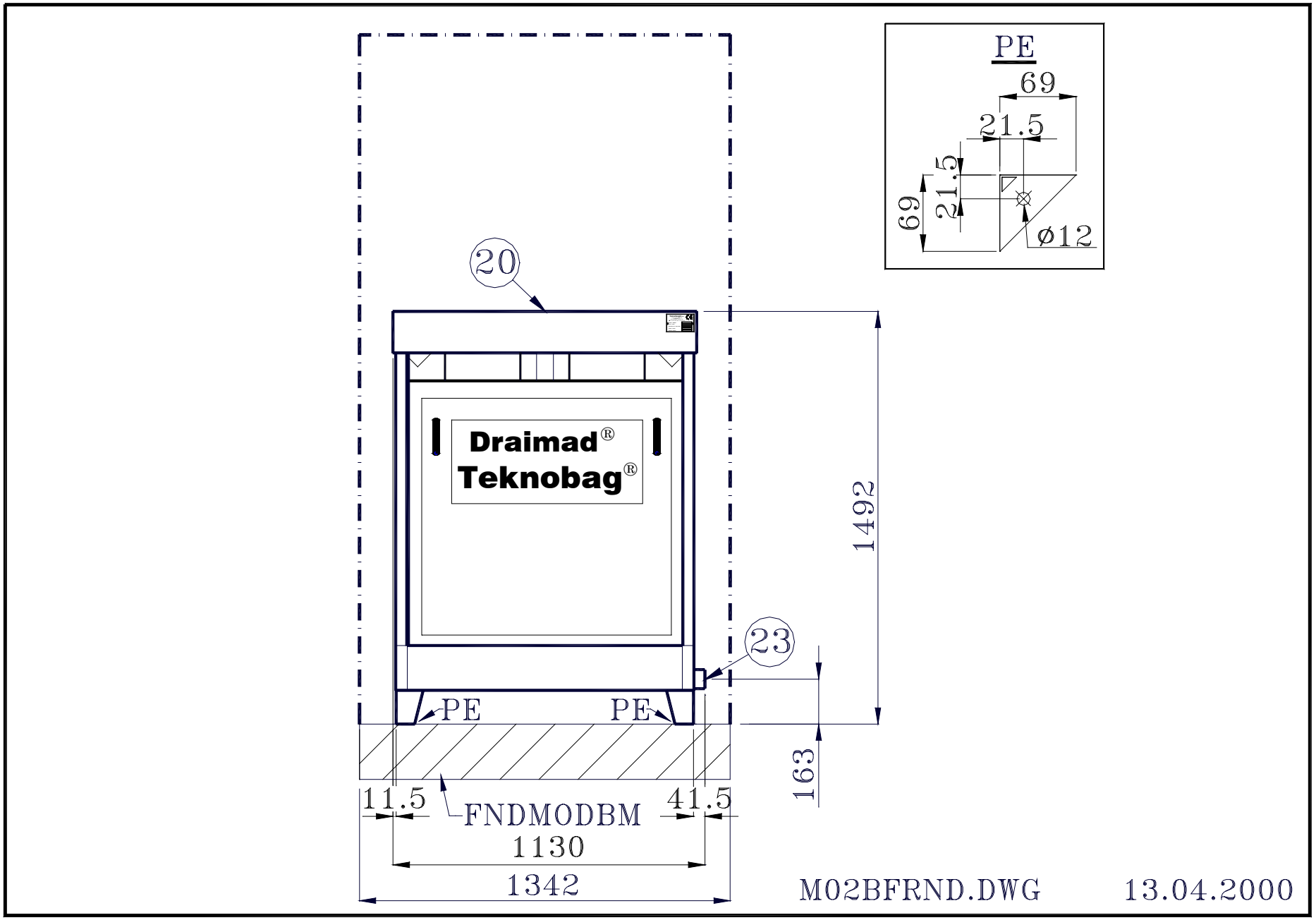
POS	DESCRIPTION
1	TEKNOFANGHI SUPPLY LIMIT
10	SLUDGE SUPPLY LINE
12	HEAD OF THE PLANT
20	SLUDGE INLET: OPEN ROOF (02BM – 02BMGR) FLANGE DN50 PN10 EN 1092-1 (03BM- 06BM)
23	FILTRATE OUTLET: 2" GF UNI ISO 228-1 (02BM/02BMGR) DN 100 PIPE COMPATIBLE WITH PLASTIC GASKETED PIPING, DN110 UNI 1451-1 DIN 19560 DIN 4102 B1 (03BM/06BM)
25	DEWATERED SLUDGE
26	TEKNOBAG®-DRAIMAD® BAG
33	OVERFLOW DN80

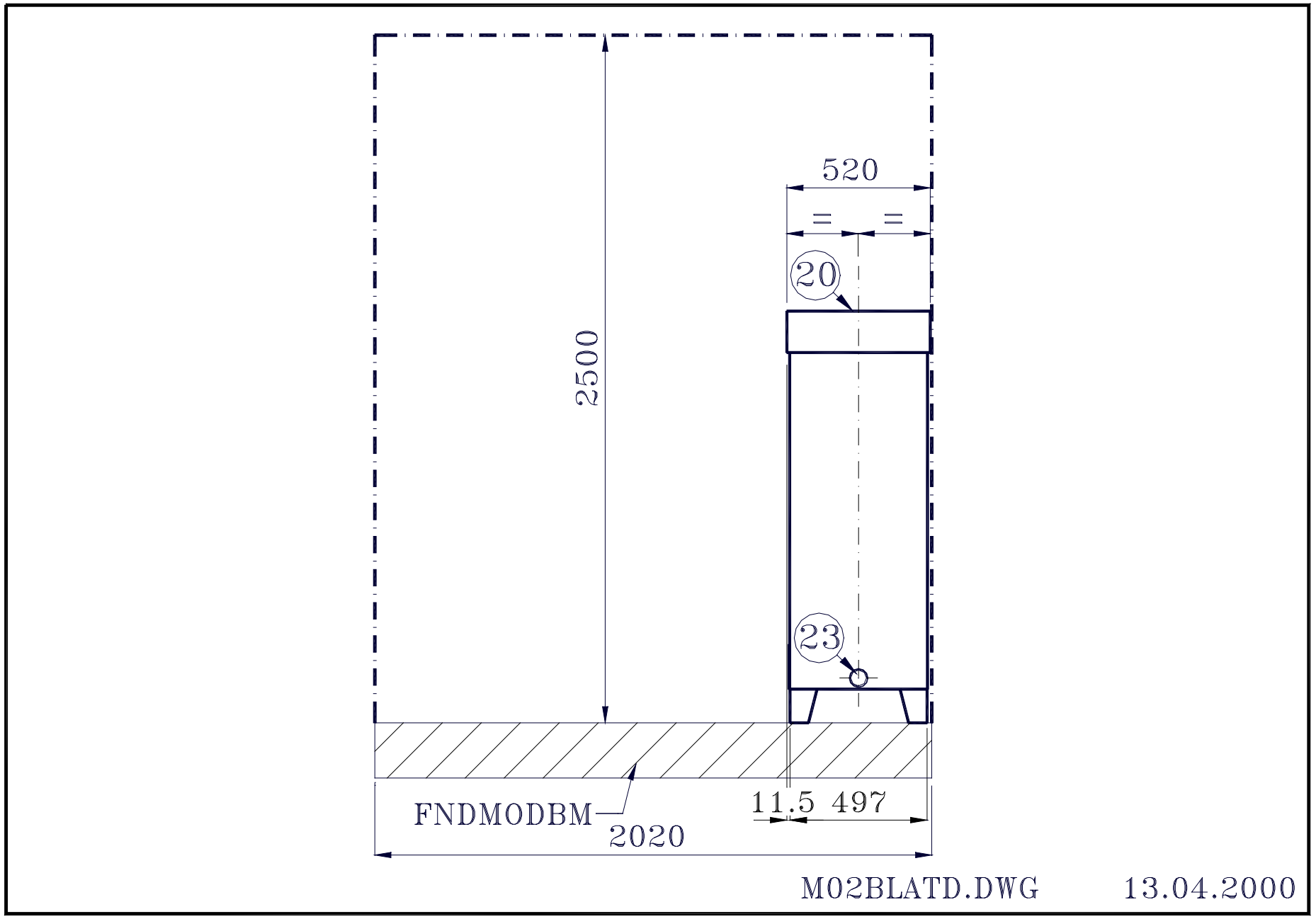
FOUNDATIONS AND DIMENSIONS "02BM" & "03BM"

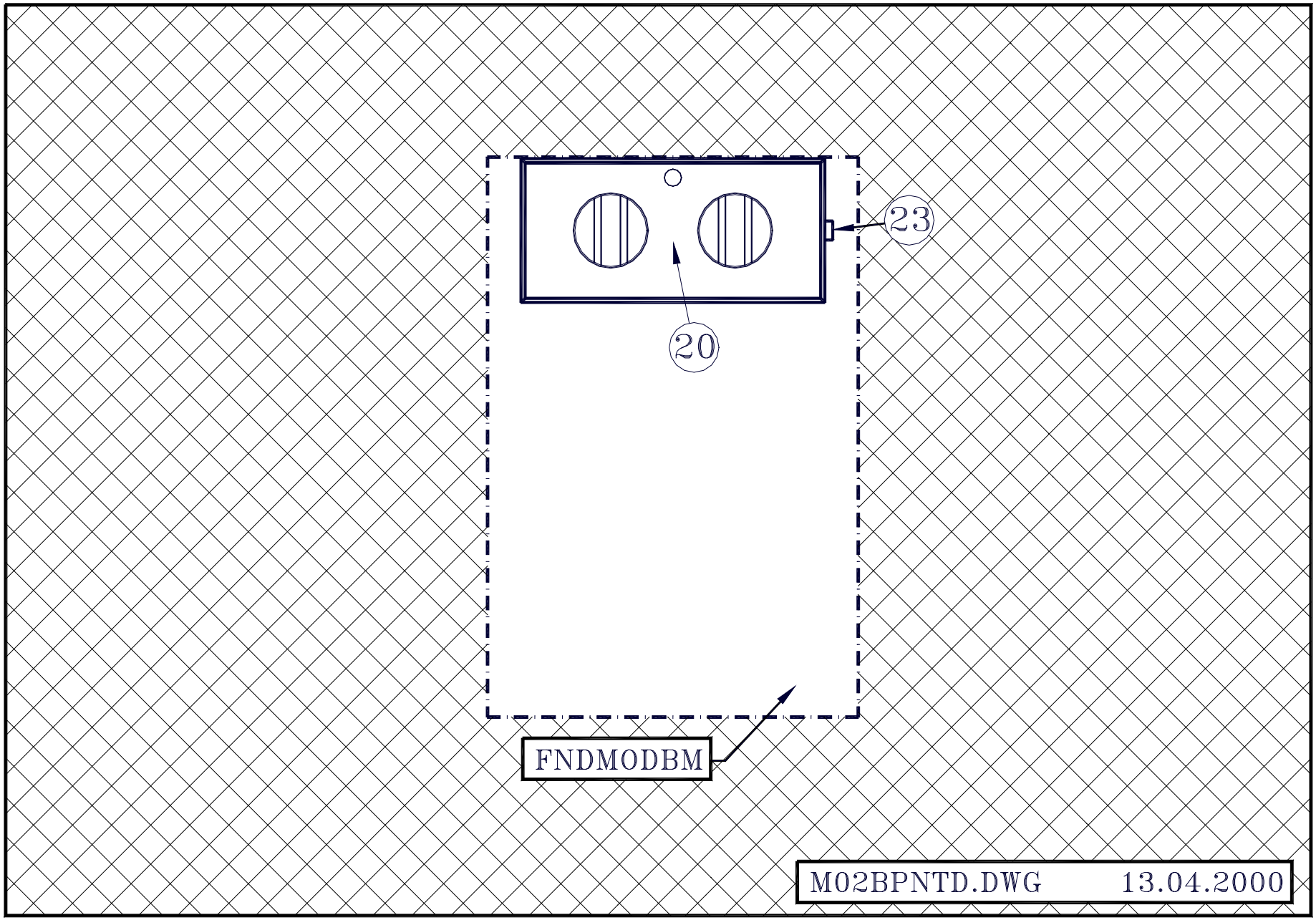
	X	X1	Z1	Z2	Kg. (*)
02BM	1342	1034	−13.42	−33.62	450
03BM	1749	1441	−17.49	−37.69	700

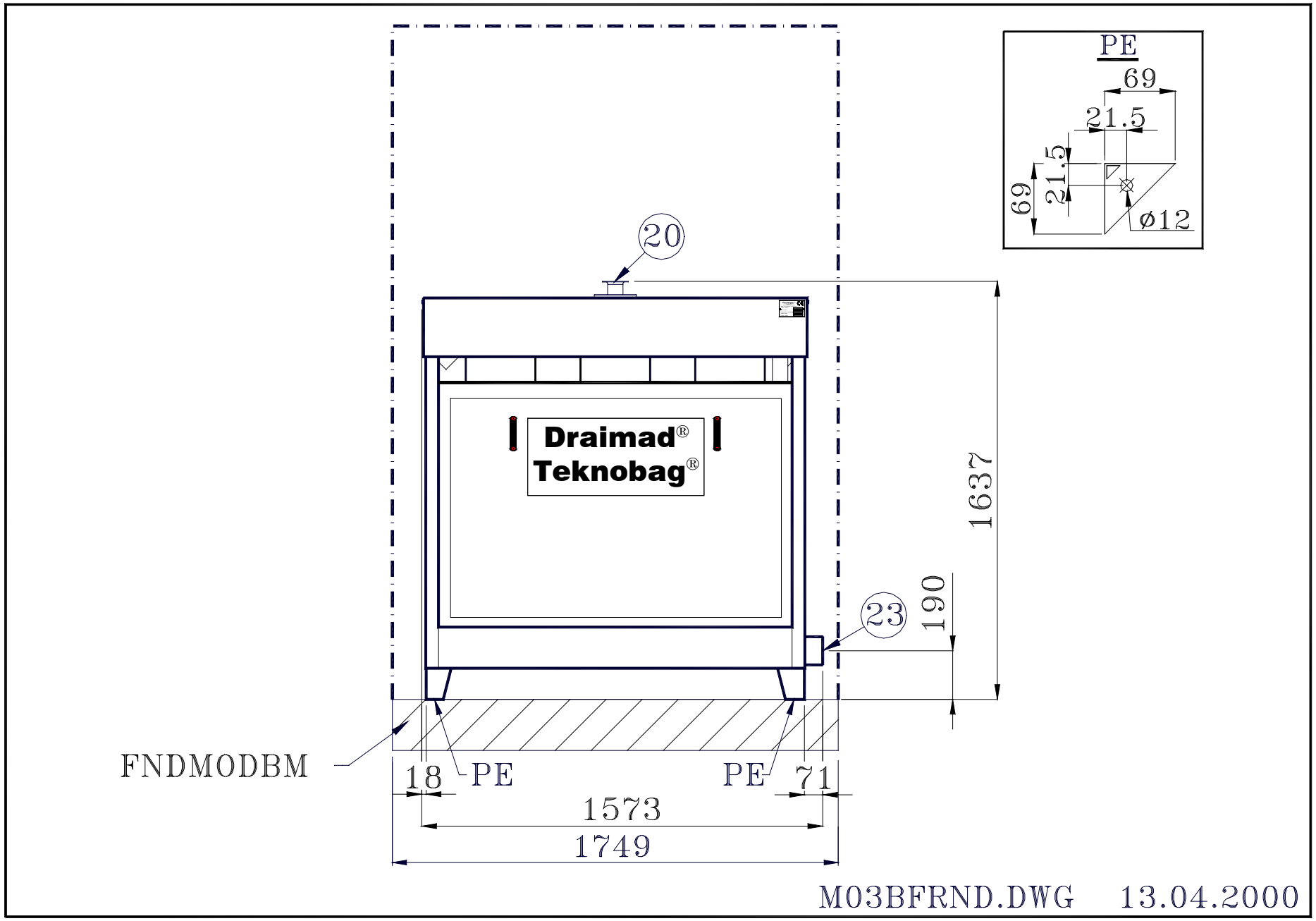
(*) Full load weight
(*) Peso a pieno carico

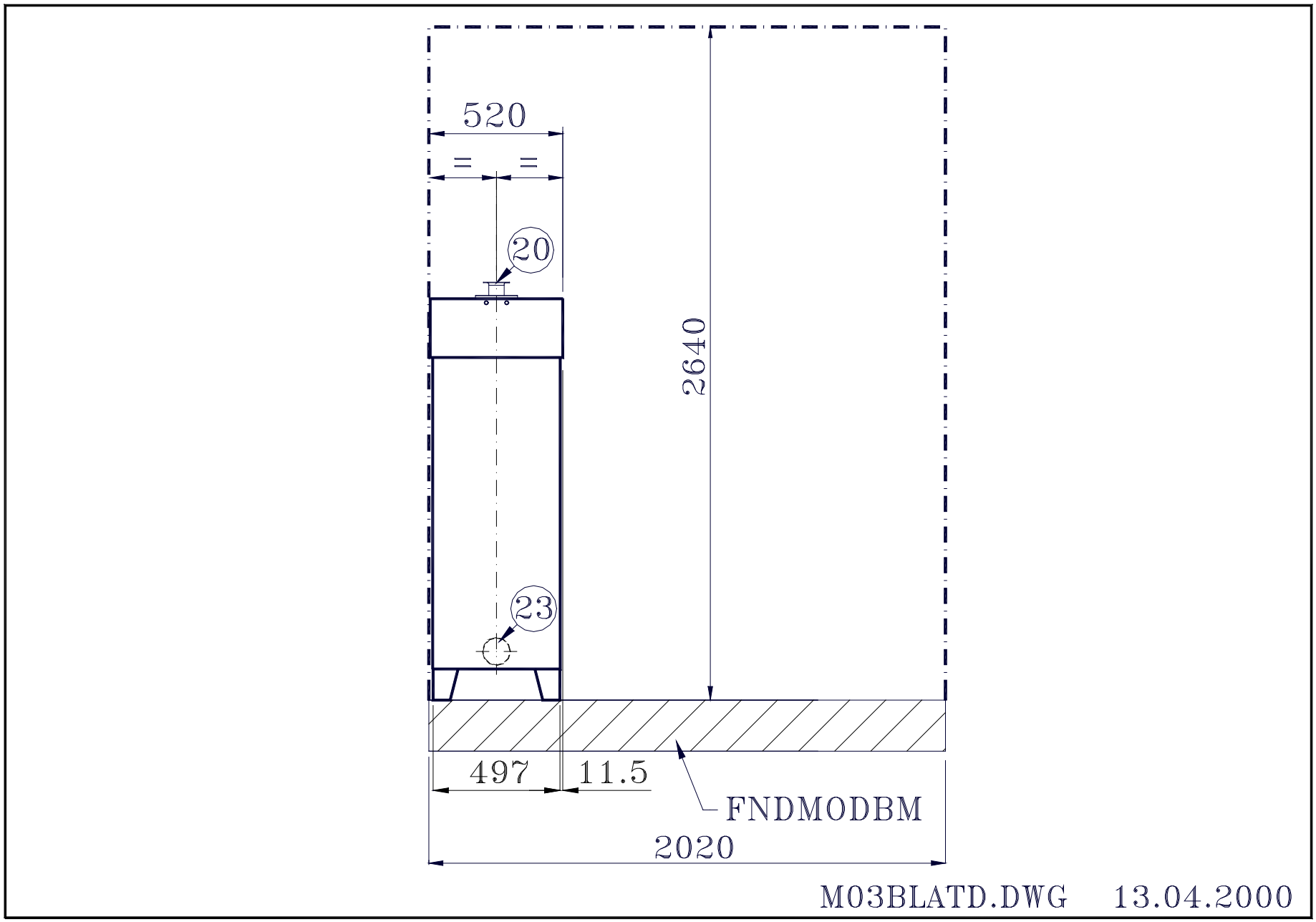


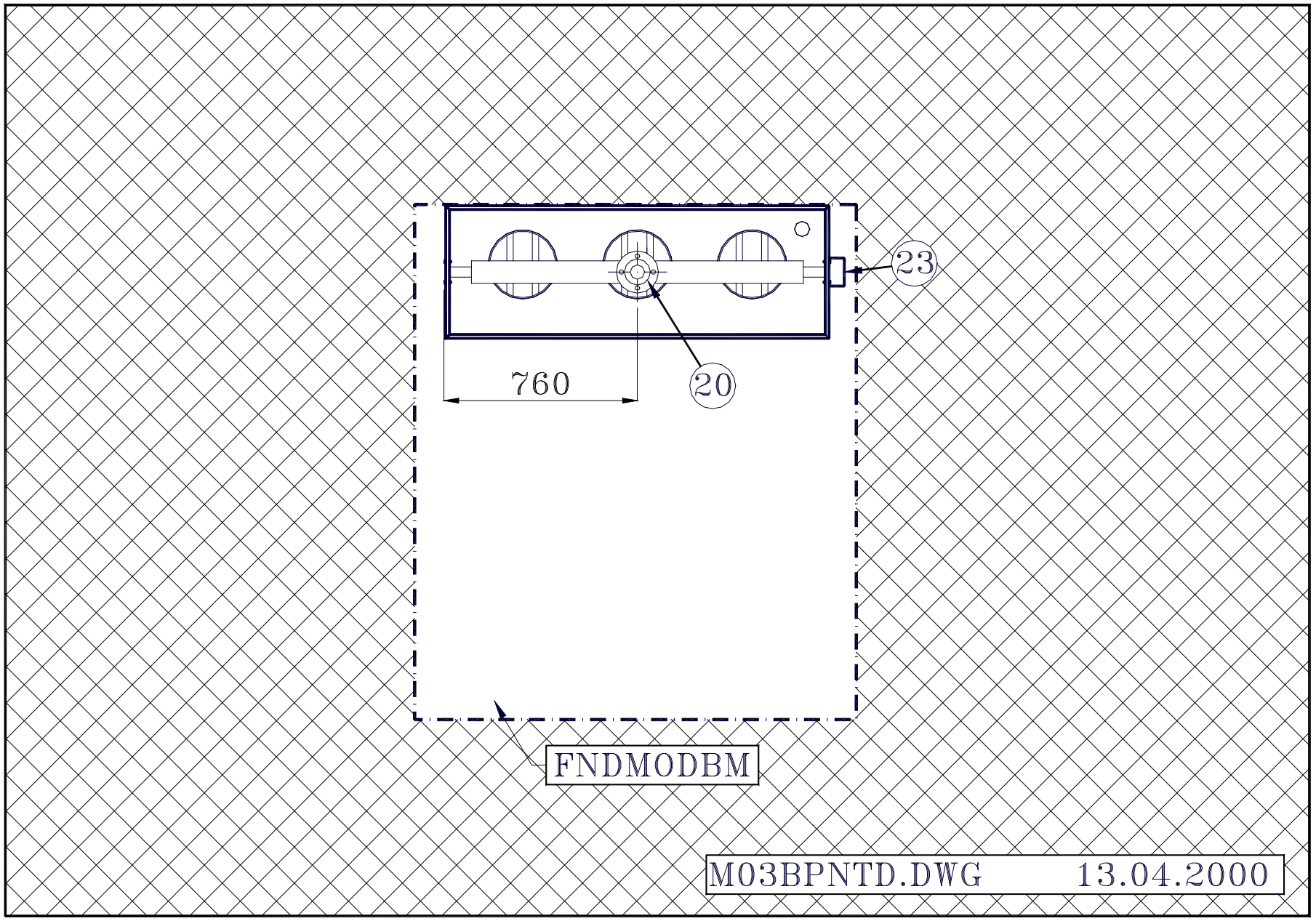

PE
69
21.5
21.5
69
ø12
20
Draimad®
Teknobag®
1492
23
PE
PE
163
11.5
FNDMODBM
41.5
1130
1342
M02BFRND.DWG
13.04.2000


520
2500
20
23
FNDMODBM
2020
11.5 497
M02BLATD.DWG 13.04.2000

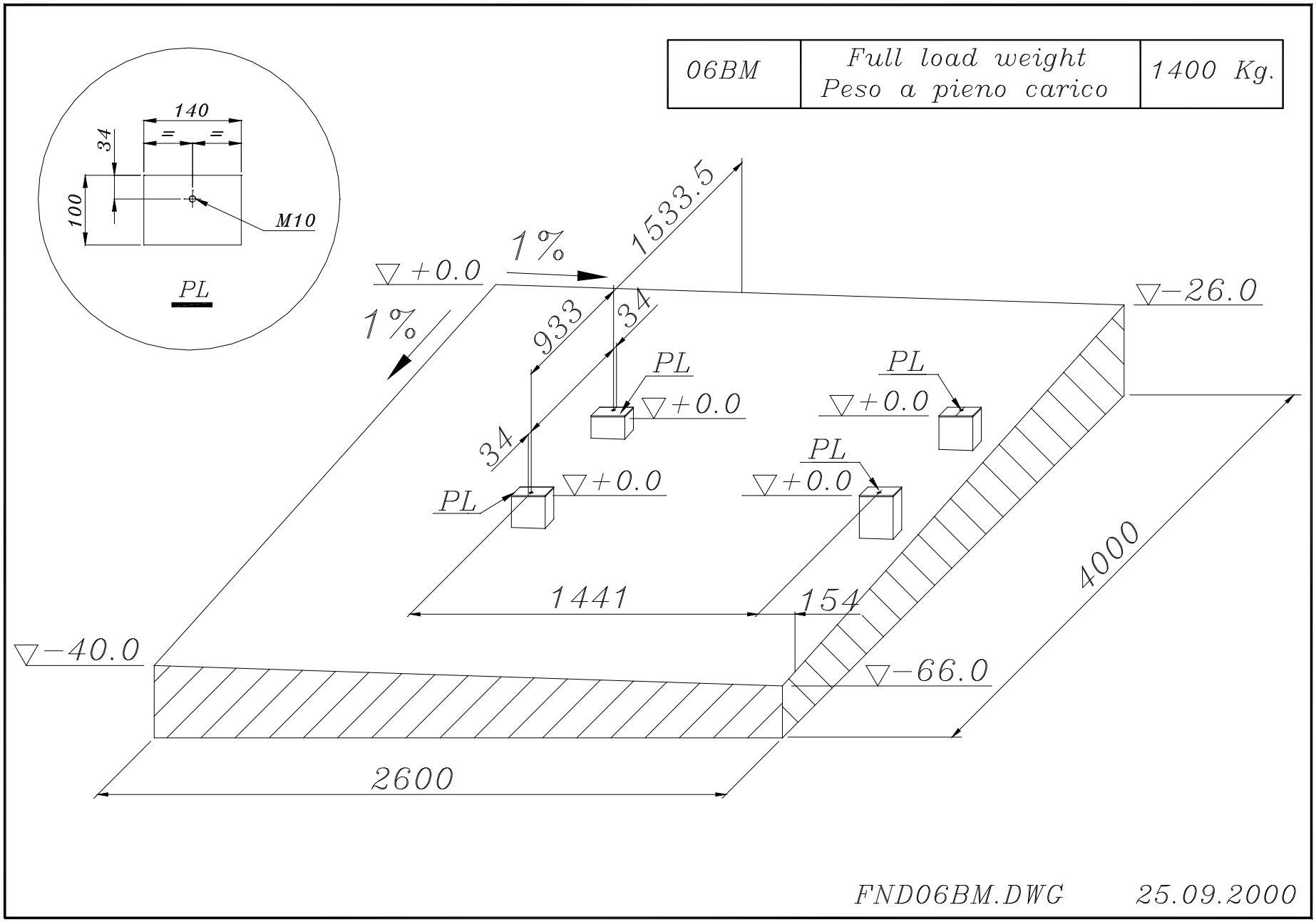

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FNDMODBM
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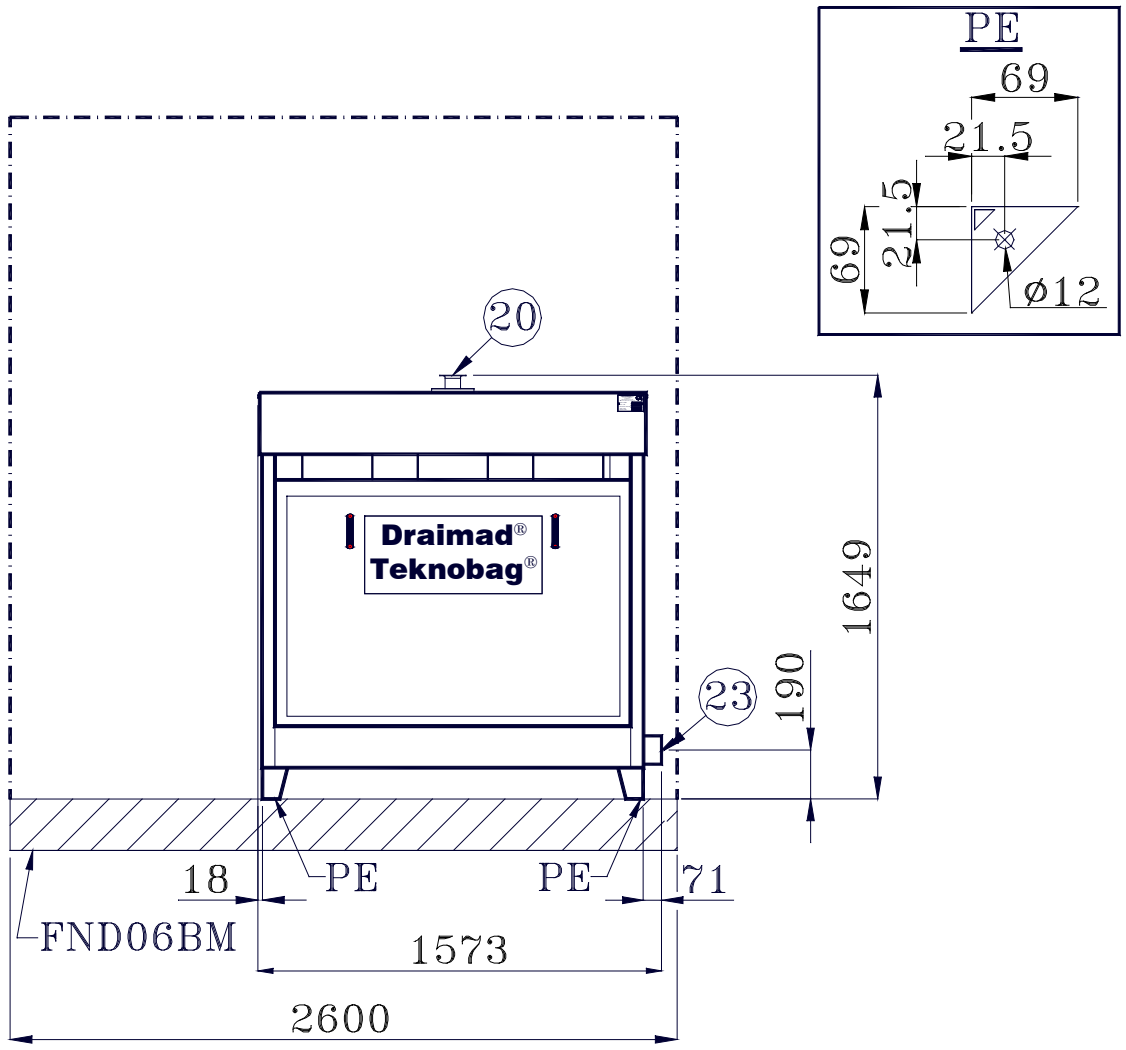

PE
69
21.5
21.5
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ø12
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Draimad®
Teknobag®
1637
23
190
FNDMODBM
18
PE
PE
71
1573
1749
M03BFRND.DWG 13.04.2000


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FNDMODBM
2020
M03BLATD.DWG 13.04.2000

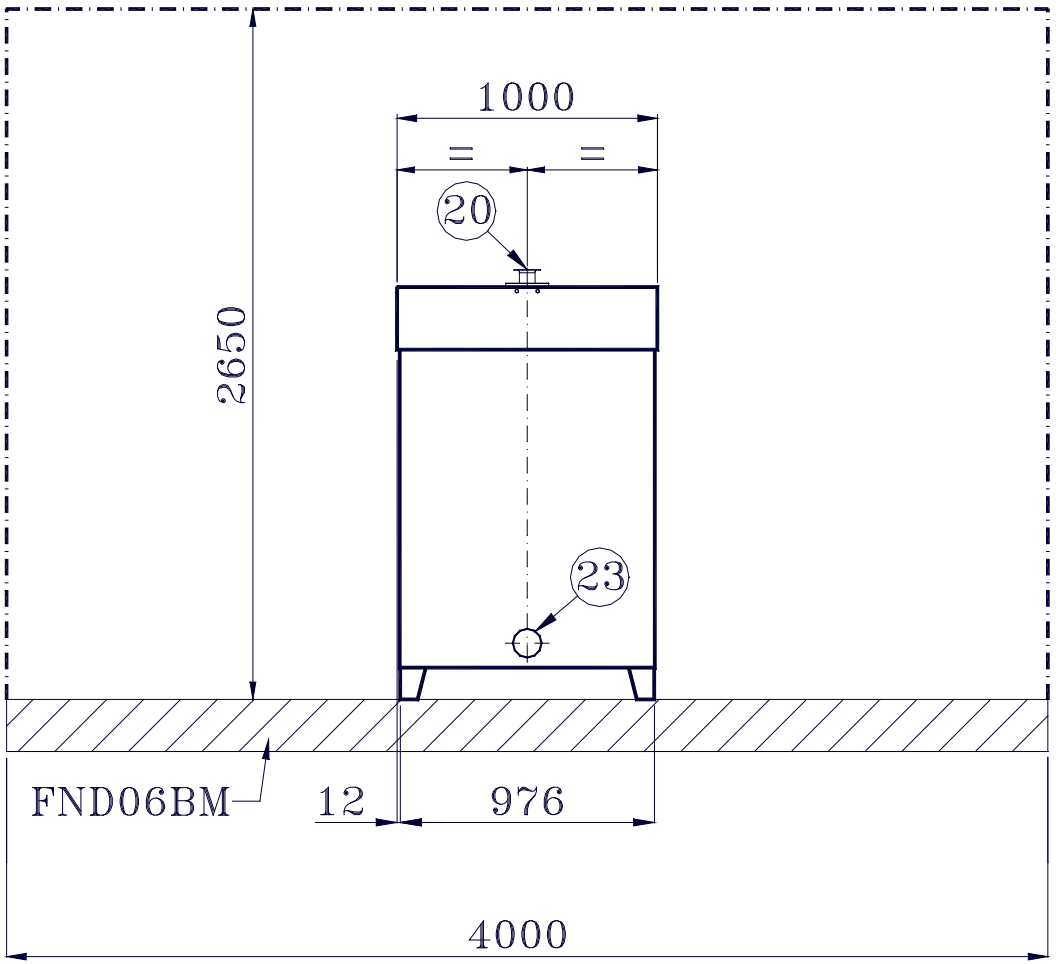

23
760
20
FNDMODBM
M03BPNTD.DWG 13.04.2000

FOUNDATIONS AND DIMENSIONS "06BM"

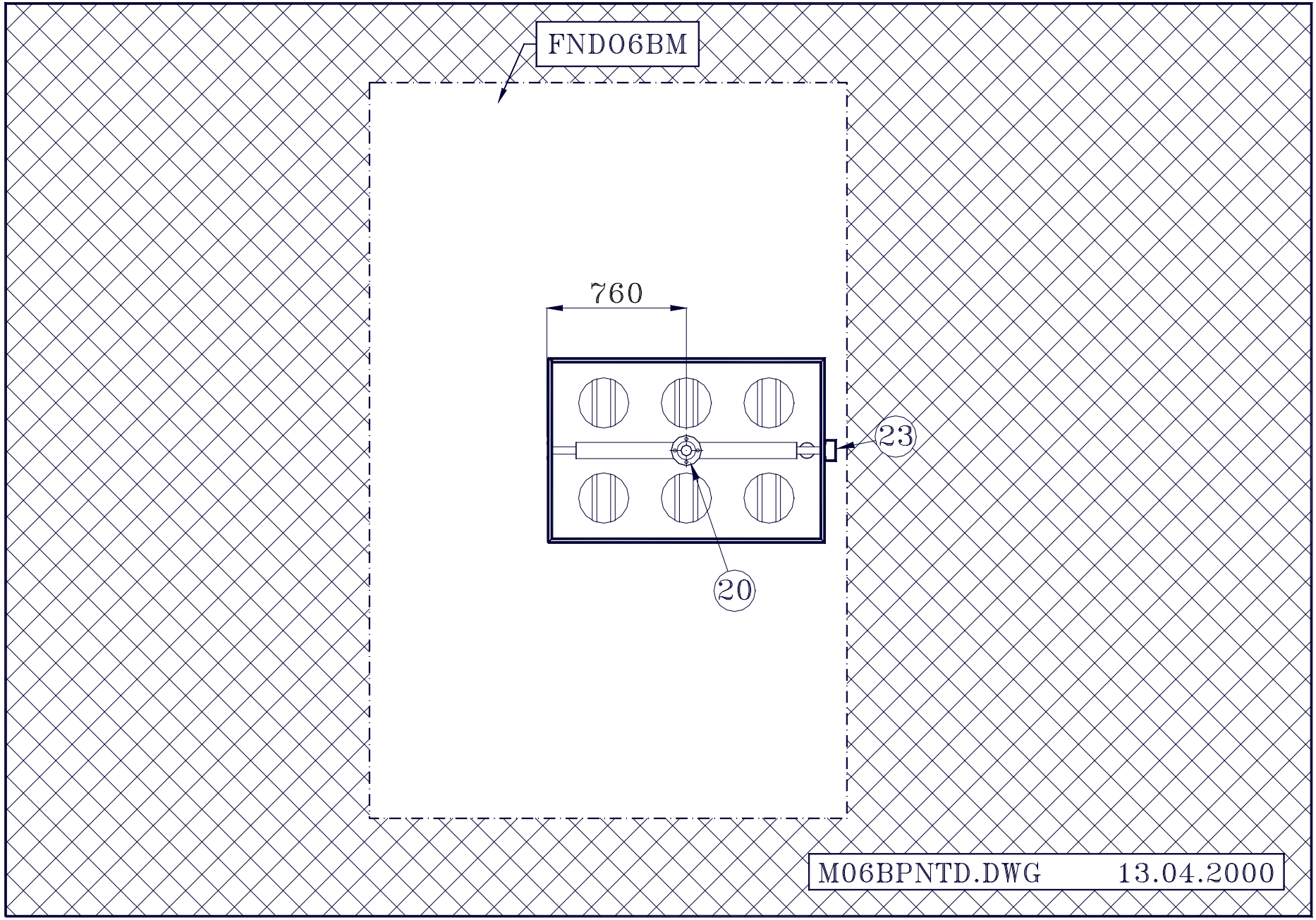




M06BFRND.DWG 13.04.2000



M06BLATD.DWG 13.04.2000


FND06BM
760
23
20
M06BPNTD.DWG 13.04.2000

Section 3.6.5

Polymer Addition



EXCELL SERIES 6000PSA

EMULSION POLYMER FEEDER

EXCELL SERIES 6000PSA
EMULSION POLYMER FEEDER

The EXCELL Series 6000PSA Polymer Feeder uses a peristaltic type polymer metering pump. The peristaltic pump is ideal for low polymer feed applications. The main benefits of the peristaltic type pumps are:

* They are self-priming.
* They can run dry.
* They do not have check valves.
* Capacity can be changed by switching the pump tube.
* Pump capacities range from less than 0.3 GPD, up to 43 GPD.

Polymer Activation Apparatus

The EXCELL activates polymer through a patented, motor-less, high energy, activation apparatus. The apparatus uses the energy available in the water flow to activate all types of liquid polymers. The polymer is activated as it passes through the high turbulence generated by the patented orifice. The pressure required to operate the apparatus is less than 5 psi.

The orifice opening automatically compensates for solution flow changes. This assures that the polymer activation energy level remains adequate for the flow range of the feeder. The activation apparatus components are made of corrosion resistant plastics. The open frame design allows easy access for quick repairs.

Self-Cleaning Sight Tube

The activated polymer solution flows through a patented, self cleaning sight tube, before it exits the feeder. The sight tube allows the operator to see that the feeder is operating properly.

SERIES 6000PSA MODELS

MODEL NUMBER	POLYMER FEED RATE GPD (LPH)	WATER FLOW RATE GPH (LPH)
6005PSA-SZX	0.3 to 5 GPD (0.05 to 0.8 LPH)	2 to 25 GPH (8 to 95 LPH)
6005PSA-SX	0.3 to 5 GPD (0.05 to 0.8 LPH)	6 to 60 GPH (25 to 230 LPH)
6005PSA2-SX	0.3 to 5 GPD (0.05 to 0.8 LPH)	6 to 120 GPH (25 to 460 LPH)
6012PSA-SX	0.6 to 12 GPD (0.1 to 1.9 LPH)	6 to 60 GPH (25 to 230 LPH)
6012PSA2-SX	0.6 to 12 GPD (0.1 to 1.9 LPH)	6 to 120 GPH (25 to 460 LPH)
6020PSA2-SX	1 to 20 GPD (0.2 to 3.2 LPH)	15 to 300 GPH (55 to 1140 LPH)
6043PSA2-SX	2 to 43 GPD (0.4 to 6.8 LPH)	15 to 300 GPH (55 to 1140 LPH)

TECHNICAL INFORMATION

* The Model 60XXPSA has a one-gallon (4 liter) blending-aging tank and primary water flow.
* The Model 60XXPSA2 has the blending-aging tank, primary, and post dilution water flow.
* The feeders operate with potable or filtered process dilution water at 30 to 65 psi (2 to 4.4 Bar).
* A solenoid valve is included.
* The pump speed can be controlled locally or by a remote 4-20 mA signal.
* A digital display indicates pump speed.
* An H-O-A Switch allows remote start-stop control.
* A water low-flow switch stops the polymer pump when the water flow is interrupted. A light provides local alarm indication. Alarm contacts allow remote indication.
* The frame is made of welded stainless steel. Frame dimensions are: 16” x 18” x 24” tall. Various frame configurations are available.
* The external injection valve is accessible without disturbing the activation apparatus. All components are modular and easy to access from the front.
* Operating voltage is 120 VAC. Power consumption is less than 3 Amps.

AVAILABLE OPTIONS

* A polymer strainer and a pump calibration cylinder are available.
* Pump cycle timer to allow pump feed rates below 0.3 GPD.
* Timer to allow a flush cycle.
* Pump speed controlled by the dilution water flow to maintain solution concentration.
* Voltages other than 120 VAC are available.
* Custom designed to meet your needs.

EXCELL FEEDERS, INC; Pittston, PA USA
732-828-8655; Email: sales@excellfeeders.com
www.excellfeeders.com

EXCELL POLYMER FEEDER

MODEL 60XXPSA-NSX

OPERATING INSTRUCTIONS

INDEX

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3.0 PRE-INSTALLATION INSTRUCTIONS . . . . . Page 1

4.0 INSTALLATION . . . . . Page 1

5.0 START-UP . . . . . Page 3

6.0 CLEANING . . . . . Page 4

7.0 SHUT-DOWN FOR OVER 48 HOURS . . . . . Page 4

8.0 MAINTENANCE . . . . . Page 4

9.0 REPAIRS . . . . . Page 5

10.0 TROUBLESHOOTING . . . . . Page 5

DRAWINGS

COMPONENTS DESCRIPTION

EXCELL FEEDERS, INC., P.O. Box 7475, Somerset, NJ 08875
732-828-8655 800-250-9037 Fax: 732-828-2611
www.excellfeeders.com

EXCELL POLYMER FEEDER
OPERATING INSTRUCTIONS

1.0 **INTRODUCTION:** This manual addresses the installation, operation, maintenance, and troubleshooting for EXCELL polymer feeder, Model 60XXPSA-SX. Please review the manual carefully. Pay special attention to warnings and precautions. Always follow good safety procedures, including the use of proper eye, face, and clothing protection.

2.0 **UNPACKING:** Your carton will contain the items listed on the packing slip.
Notify the carrier immediately if there are any signs of damage to the feeder or its parts.
Notify EXCELL if any of the parts are missing.

3.0 **PRE-INSTALLATION INSTRUCTIONS:**

3.1 **PROTECTIVE CLOTHING:** Refer to the MSDS precautions from the supplier of the polymer to be mixed in the feeder. Always wear the recommended apparel.

3.2 **SOLUTION COMPATIBILITY:** The feeder can mix a variety of solutions. Check that the feeder is compatible with the solutions you are intending to mix.

3.3 **PLUMBING:** Always adhere to your local plumbing codes and requirements. Be sure that installation does not constitute a cross connection. Check local plumbing codes for guidelines. If using potable water, a backflow preventer is required.

3.4 **ELECTRICAL:** All wiring must conform to local electrical codes. The feeder should be plugged into a grounded outlet protected by a Ground Fault Interrupter.

4.0 **INSTALLATION:**

4.1 **LOCATION:** This EXCELL FEEDER is suitable for indoor dry locations. The area is to be free of flammable vapors or dust. Ambient temperature is to be between 40 F and 120 F. (5 C and 50 C). Protect from freezing temperatures.

If the EXCELL FEEDER is to be used in areas exposed to flammable vapors or dusts, the Explosion Proof Option is required.

4.2 **ELECTRICAL CONNECTION**: The EXCELL FEEDER comes standard with a 7' long power cord with a 3-prong grounded plug. It should be plugged into a grounded outlet protected by a ground fault interrupter.

4.3 **WATER SUPPLY CONNECTION:** Provide a clean or filtered water supply to within 3' of the feeder. Water pressure should be at least 30 psi and must not exceed 100 psi or 100 F (38 C). Water pressure should be at least 25 psi higher than where the solution is being injected. Provide a shutoff valve.

4.4 CONTROLS:

1. **REMOTE START-STOP**: Connect wiring from the remote Start/Stop switch to the terminals in the junction box per the attached wiring diagram. The remote switch is to be a dry contact with no voltage. The feeder will provide the 120 VAC to power the circuit.

2. **REMOTE 4-20 mA PUMP SPEED CONTROL**: Connect wiring from a remote 4-20 mA signal source to the terminals in the junction box per the attached wiring diagram. A digital indicator provides local indication of pump speed, 0 to 100%.

3. **REMOTE ALARM:** A set of dry contacts allow remote indication when the water flow is below minimum. Connect wiring from the terminals in the junction box to the remote alarm per the attached wiring diagram. A light provides local alarm indication. The contacts are limited to 240 VAC, 5 Amps.

4.5 ACTIVATED SOLUTION CONNECTION:

1. Connect the feeder to the activated solution piping. Tighten all connections.
2. Use only pipe or tubing that is designed to withstand up to 100 psi pressure. Do not use clear unreinforced vinyl tubing.

4.6 POLYMER CONNECTION:

1. Install the pump tube on the metering pump. See pump manual for details.
   Note: If the feeder is not to be used for a long period of time, the tube should be removed to extend tube life.

2. The polymer can be supplied to the metering pump through a flooded suction or suction lift.

   a. Suction lift is to be less than 4'. Install the strainer supplied with the feeder at the end of the inlet tube. Insert the tube in the container.

   b. Flooded suction. For proper pump operation, to prevent over pumping and siphoning, the polymer level is to be less than 5' above the feeder. Connect the polymer supply to the inlet of the in-line strainer before the pump suction.

5.0 START-UP:

1. Turn on the water to the EXCELL FEEDER.

2. Turn the feeder selector switch to the "ON" position. This switch will open the water solenoid and turn on the metering pump. There must be adequate water flow to the feeder to trip the flow switch before the metering pump will turn on.

3. Re-adjust the low water flow switch setting, if necessary. The switch has been preset for the water flowmeter minimum indication.

   Slowly close the valve on the dilution water flow meter until the flow is slightly higher than the lowest line on the flowmeter. Turn the adjusting screw on the low water flow-switch until it turns on the metering pump. Loosen the screw to reduce the trip point.
   Turn off the water flow. The flow-switch should turn the pump off.

   Adjust the flow to the desired rates.

4. Adjust the metering pump to the desired flow rate. See the pump manual.

5. The pump has been set as follows:

   a. Local. The pump speed is manually adjustable from 0 to 100% of capacity.

   b. Remote. The pump speed is adjustable from 0 to 100% of capacity by a 4-20 mA signal.

   The minimum pump speed is set at 0 % when the pump receives a 4mA signal.

   The maximum pump speed is set at 100 % when the pump receives a 20mA signal.

   The minimum and maximum pump speeds can be reset as desired.
   See the DC motor controller manual.

5.1 CALIBRATE THE METERING PUMP:

1. The metering pump can be calibrated only if the pump is supplied by flooded suction.
2. Fill the calibration cylinder with polymer.
3. Close the polymer supply valve and immediately open the calibration cylinder valve.
4. Measure the time needed to pump out a desired amount of polymer.

   The pump flow in Gallons Per Day equals:

   $\frac{22.8 \times (\#\text{ of ml})}{(\#\text{ of seconds})} = \#\text{ of GPD}$ EXAMPLE: $22.8\ \frac{(20\text{ ml})}{90\text{ sec}} = 5.1\text{ GPD}$

6.0 CLEANING:

6.1 CLEANING THE SIGHT GLASS:

1. Turn the metering pump off.
2. Flow water through the feeder for about two minutes to flush it of polymer.
3. Turn the feeder main switch to "OFF."
4. Turn the water supply valve off. Don't use the flow meter valve to turn off water flow.
5. Drain the sight glass using the drain valve.
6. Remove the sight tube by removing the four nuts; save the nuts and O-Rings.
7. Rinse the sight tube cleaning assembly. Wipe the sight tube with a clean cloth.
8. Reinstall the top cap O-Ring and cap. Tighten the nuts. Check for leaks

6.2 CLEANING THE WATER FLOWMETER:

1. Turn the Feeder main switch to "OFF."
2. Close the water supply valve.
3. Open the drain valve to relieve system pressure. Close the valve.
4. Unscrew the plug on top of the flow meter.
5. Clean the flow tube with a soft brush and mild soap and water.
6. Apply petroleum jelly to the plug O-ring and reinstall. Don't over-tighten.

7.0 SHUT-DOWN FOR OVER 48 HOURS:

1. Fill the calibration column with oil that is compatible with the process. Pump the oil until all the polymer is displaced out of the system.
2. Turn the water supply valve off
3. Turn the feeder switch "OFF".
4. If needed, drain the feeder using the drain valve. Note that some feeder components will not fully drain and will be damaged if exposed to freezing temperatures.

8.0 MAINTENANCE: The EXCELL FEEDER was designed to require minimum maintenance, with all components easy to replace. The estimated life of the pump tube will range from two to six months, depending on operating parameters.

9.0 REPAIRS: Contact EXCELL at (732) 828-8655 for assistance or replacement parts.

9.1 METERING PUMP REPAIRS: See the attached manufacturer's manual.

9.2 RECOMMENDED SPARE PARTS:

1. Metering Pump Tube
2. Injection Valve
3. Blending Tank O-Ring Set
4. Relay
5. Solenoid Valve

10.0 TROUBLESHOOTING:

A. SYMPTOM: METERING PUMP WILL NOT RUN.

1. LIKELY CAUSE: Not enough water flow to satisfy the flow switch.
   SOLUTION: Increase water flow, until the flow switch closes, or adjust the flow switch setting.

2. LIKELY CAUSE: Not plugged in or no power at outlet.
   SOLUTION: Plug the feeder in; test the outlet for power.

3. LIKELY CAUSE: Pump is in “Remote” and not receiving a remote signal.
   SOLUTION: Set the switch to the proper setting.

B. SYMPTOM: METERING PUMP DOES NOT PUMP TO CAPACITY.

1. LIKELY CAUSE: Damaged tube.
   SOLUTION: Clean and replace parts as needed.

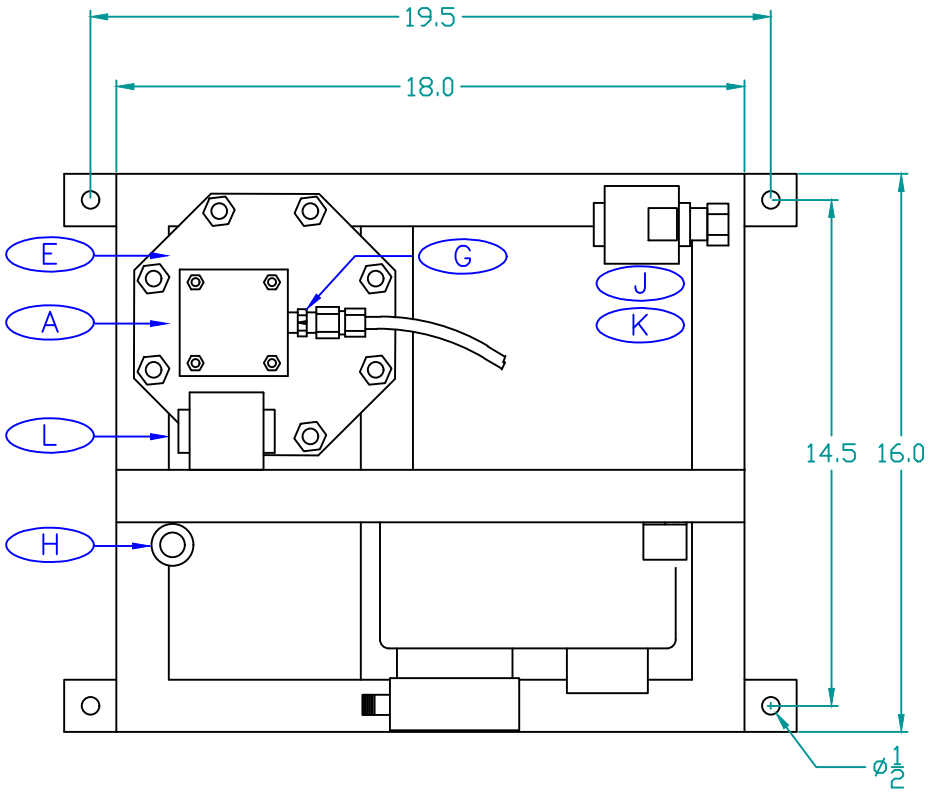
2. LIKELY CAUSE: Feeder injection valve is plugged.
   SOLUTION: Disconnect the polymer feed to the valve. Clean or replace the valve.

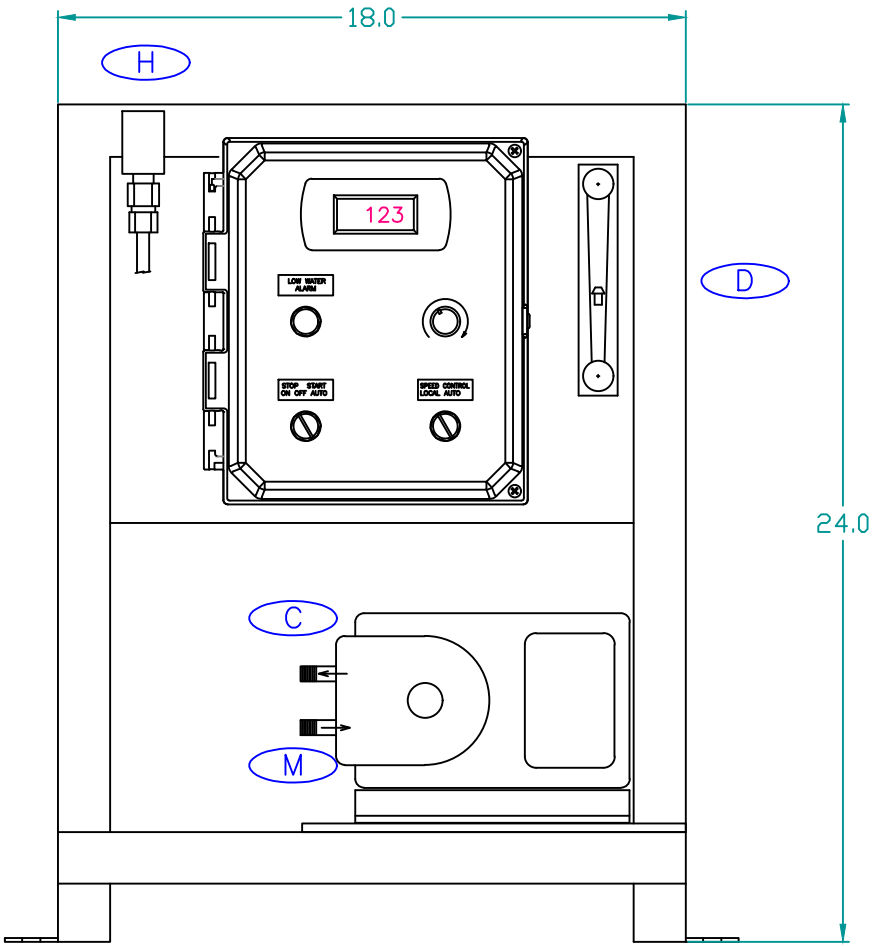
3. LIKELY CAUSE: Polymer viscosity is too high.

C. SYMPTOM: FEEDER INJECTION VALVE IS LEAKING.

1. LIKELY CAUSE: Debris in the valve.
   SOLUTION: Disconnect the polymer feed to the valve. Clean or replace the valve.

ITEM	DESCRIPTION
A	POLYMER ACTIVATING APPARATUS
C	METERING PUMP
D	WATER FLOWMETER
E	BLENDING–AGING CHAMBER
G	POLYMER INJECTION VALVE
H	SOLUTION DISCHARGE–1/2" NPT
J	WATER INLET – 1/2" NPT
K	WATER SOLENOID
L	WATER FLOW SWITCH
M	POLYMER INLET – 3/8" HOSE





THIS DRAWING CONTAINS PROPRIETARY INFORMATION WHICH IS INTENDED FOR USE BY ONLY THOSE PARTIES LISTED AND MAY NOT BE MODIFIED, REPRODUCED, OR RETRANSMITTED WITHOUT THE CONSENT OF EXCELL FEEDERS.

excellfeeders

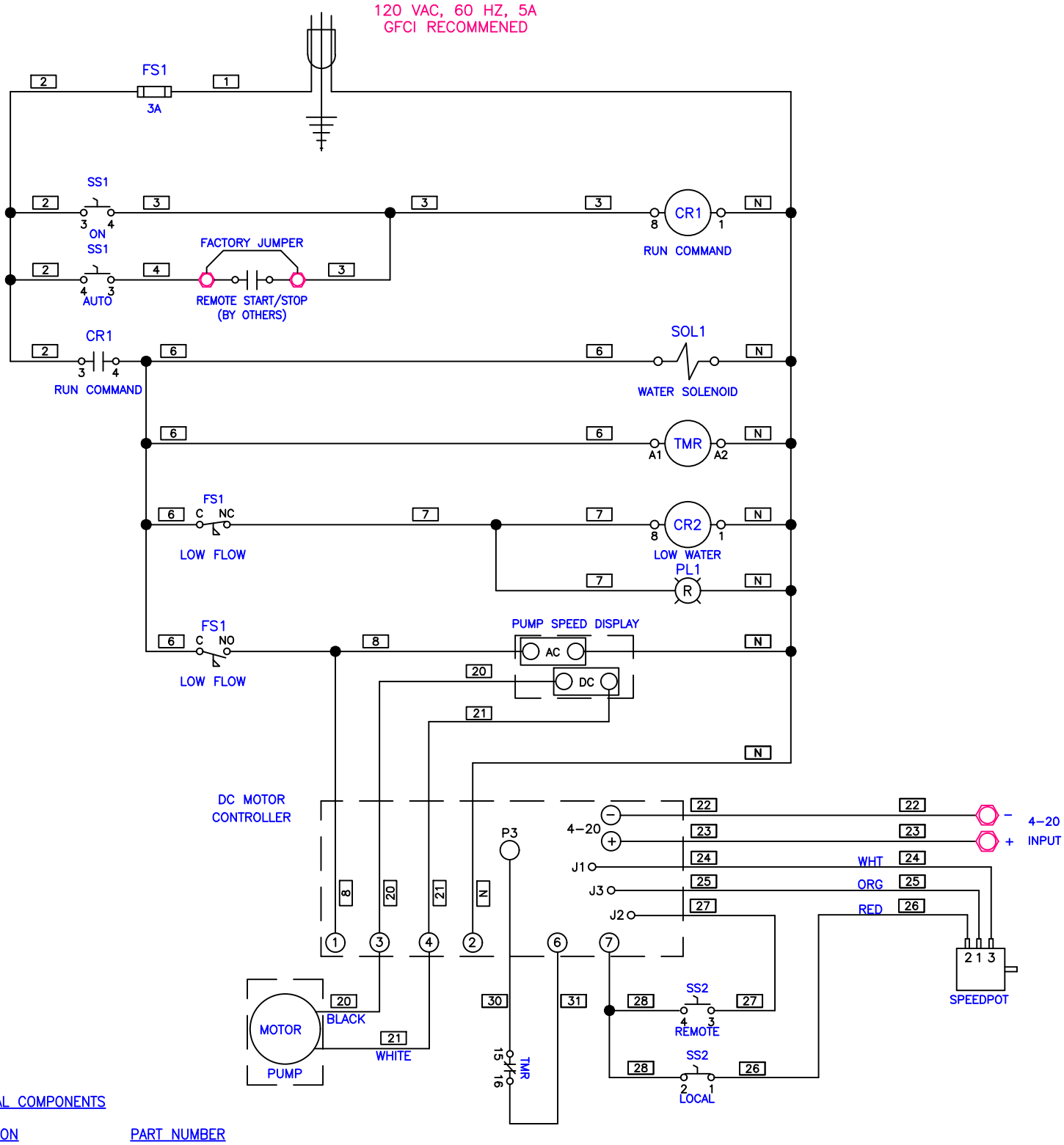
INDEX	DESCRIPTION	NAME	DATE
	REVISIONS		

CUSTOMER:

TITLE: 60XXPSA–NS GENERAL LAYOUT

TOLERANCE:	DRAWN BY:	DRAWN DATE:
N/A	A.P.M	02/11/2013
SCALE:	RLS. BY:	RLS. DATE:
NONE	A.M.M	08/02/2017

DWG NO.: 6PSA–300–NS–0



ELECTRICAL COMPONENTS

DESCRIPTION	PART NUMBER
ENCLOSURE, AMP, 10x8	EQX-AMP-1084H
DISPLAY, ALTECH	ALD-70313770
FUSE, AGC, 3A	ADI-AGC3
SWITCH, 3 WAY	ADI-GCX3320-22
SWITCH, 2 WAY	ADI-GCX3300
PILOT LIGHT, RED LED	ADI-ECX2051-127L
RELAY, DPDT, 120 VAC	ALD-70178595
RELAY BASE, DPDT	ALD-70179007
CONTROLLER, 1/8 HP	ADI-GSD4-240-1C
4-20 CIRCUIT	ADI-GSD4-AI-A
POTENTIOMETER	ALD-754-2057
TIMER, REPEAT CYCLE	SEL-600DT-CU

ATTACH NAMEPLATE TO INSIDE OF CONTROL PANEL

Voltage: 120VAC 1PH 60HZ
Total FLA: 1.3A
Largest Motor FLA: 1.1A
Wiring Diagram No: 6PS-400-MS-6
SCCR: 10kA
Enclosure Rating: UL NEMA 4X

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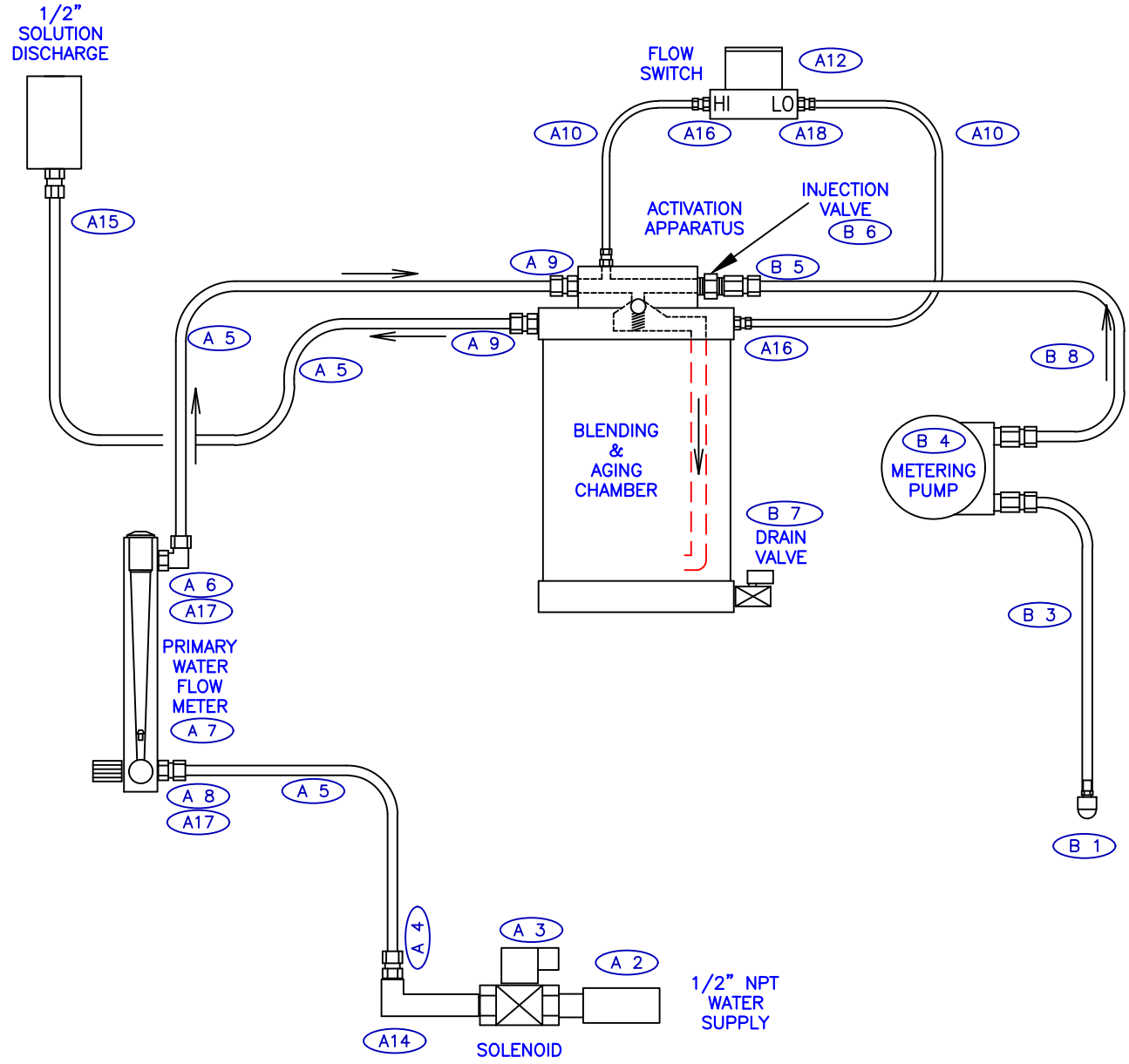
INDEX	DESCRIPTION	NAME	DATE
	REVISIONS		

CUSTOMER:

TITLE: 6PS-MS Wiring Diagram

TOLERANCE:	DRAWN BY:	DRAWN DATE:
N/A	A.M.M	02/20/2013
SCALE:	RLS. BY:	RLS. DATE:
NONE	A.P.M	07/02/2020

DWG NO.: 6PS-400-MS-6



ITEM	DESCRIPTION
A2	COUPLING, BR, 1/2"
A3	SOLENOID VALVE, BR, 120 VAC COIL # 0577-BR-050-120
A4	FITTING, ELBOW, BR, 1/2 MPT x 1/2 TUBE # 0081-BR-050M-050T
A5	TUBE, PE, 1/2" OD # 0067-PE-050
A6	FITTING, ELBOW, BR, 1/4 MPT x 1/2 TUBE # 0081-BR-025M-050T
A7	FLOW METER, 25 GPH, BR VALVE # 0018-BR-25
A8	FITTING, STRAIGHT, BR, 1/4 MPT x 1/2 MPT # 0371-BR-025M-050M
A9	FITTING, ELBOW, PP, 3/8 MPT x 1/2 TUBE # 0063-PP-037M-050T
A10	TUBE, PE, 3/8" OD # 0067-PE-037
A12	WATER FLOW SWITCH, DP, 2-10 # DXW-11153-1
A13	FITTING, STRAIGHT, BR, 1/8 MPT x 1/4 TUBE # 0371-BR-012M-025T
A14	TEE, BR, 1/2" # 0061-BR-050
A15	FITTING, STRAIGHT, PP, 1/4 MPT x 1/2 TUBE # 0065-PP-025M-050T
A16	FITTING, ELBOW, PP, 1/4 MPT x 3/8 TUBE # 0063-PP-025M-037T
A17	FITTING, STRAIGHT, BR, 1/8 MPT x 1/4 FPT # 0371-BR-012M-025F
A18	FITTING, STRAIGHT, PP, 1/4 MPT x 3/8 TUBE # 0065-PP-025M-037T
B1	STRAINER, PVC, 1/4" # 0526-A
B3	HOSE, 1/4" ID # 0090-025-NR
B4	METERING PUMP, PERISTALTIC, X GPD # BLW-0529-X
B5	FITTING, STRAIGHT, PP, 1/2 FPT x 3/8 TUBE # 0065-PP-050F-037T
B6	INJECTION VALVE, 1/2" # 0027-H
B7	VALVE, BALL, CP, 3/8 # 0120-BL-CP-037
B8	TUBE, PE, 3/8 OD # 0067-PE-037

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INDEX	DESCRIPTION	NAME	DATE
	REVISIONS		

NOTES:

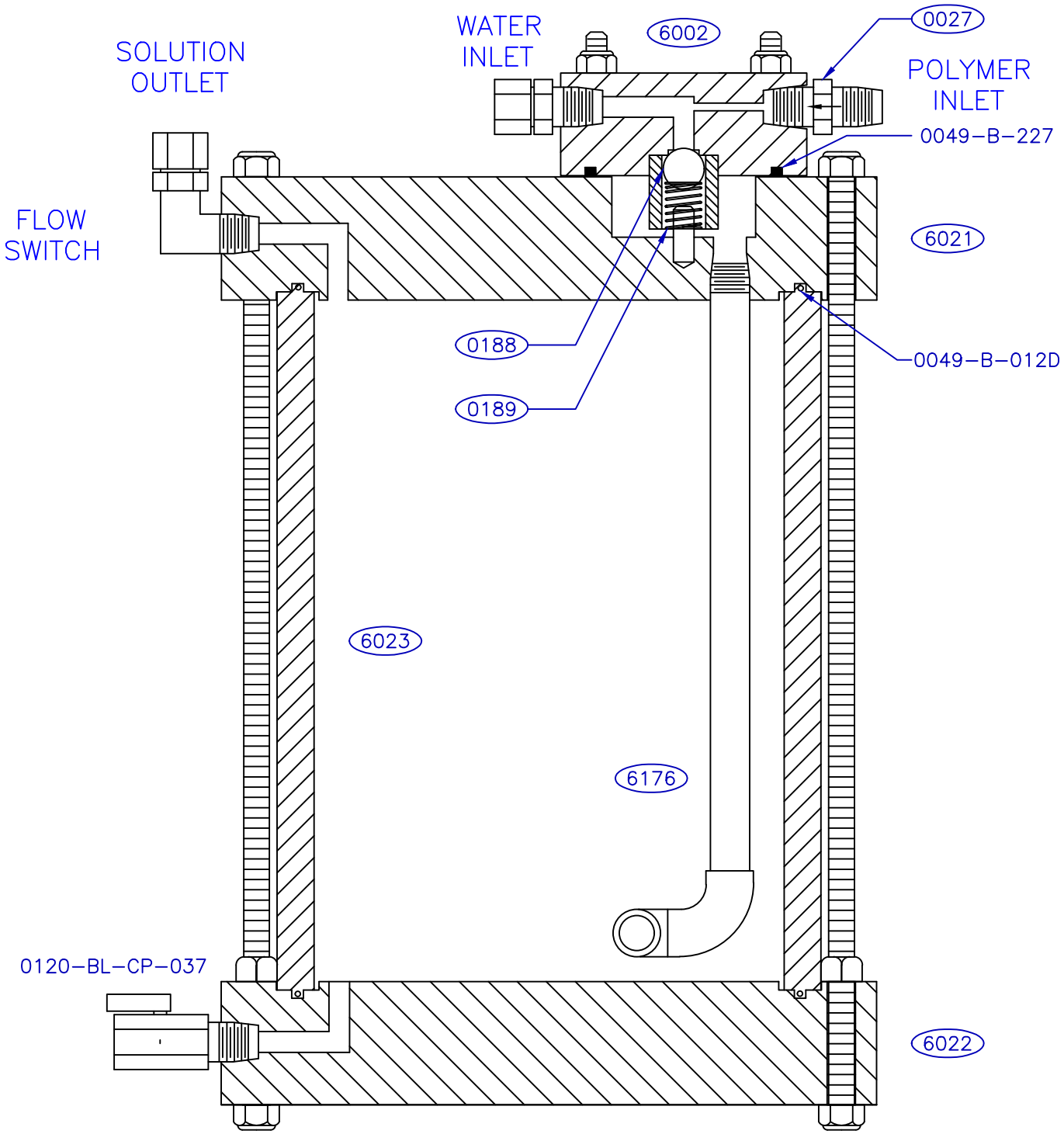
CUSTOMER:

TITLE: 6500-PSA-25 FLOW DIAGRAM

TOLERANCE:	DRAWN BY:	DRAWN DATE:
N/A	A.M.M	08/16/2017
SCALE:	RLS. BY:	RLS. DATE:
NONE	A.P.M	08/22/2019

DWG: 6PSA-500--N-25-2

ITEM	DESCRIPTION	ITEM	DESCRIPTION
0049-B-227	APPARATUS O-RING	6002-K7	LIQUIDS INLET BLOCK
0120-BL-CP-037	DRAIN VALVE, CP, 3/8"	6021-A6	CHAMBER TOP BLOCK
0027-H	INJECTION VALVE, 1/2"	6022-A4	CHAMBER BOTTOM BLOCK
0188-A	ACTIVATION BALL	6023-A0	CHAMBER WALL
0189-A	COATED SPRING	6176-A0	TANK DIPLEG
0049-B-012D	TANK O-RING		



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INDEX	DESCRIPTION	NAME	DATE
	REVISIONS		

CUSTOMER:

TITLE: 6000A BLEND TANK

TOLERANCE:	DRAWN BY:	DRAWN DATE:
N/A	A.M.M	02/20/2013
SCALE:	RLS. BY:	RLS. DATE:
NONE	A.P.M	04/09/2019

DWG NO.: 6A-700-A-3



MODEL 0529-X

Peristaltic Injector Pump

excellfeeders

PO Box 7475
Somerset, NJ 08875
USA
Phone: 732-828-8655 **FAX**: 732-828-2611
E-mail: support@excellfeeders.com
Website: www.excellfeeders.com

0529-X

Specifications

Maximum Working Pressure	65 psig / 4.5 bar (most models)
Maximum Fluid Temperature	130° F / 54°C
Ambient Temperature Range	14 to 110° F / -10 to 43° C
Duty Cycle	Continuous
Maximum Solids	50% by volume
Maximum Viscosity	5,000 Centipoise
Maximum Suction Lift	up to 30 ft. water
Power Requirements	90VDC 60 Watts,
Dimensions	6-1/8" H x 10-1/8" W x 9" D
Weight	8 lb.

Features

- Peristaltic Pump Tube does not require valves.
- Self priming under maximum pressure. Cannot vapor lock.
- High outlet pressure capability of 65 psig (most models).
- High inlet suction lift capability of 30 feet.
- Patented pump tube assembly design.
- Corrosion proof Valox housing.
- Tamper resistant electronic control panel cover.

Pump Capacity:

Model	#1 tube	#2 tube	#3 tube
0529-0-X:	5.7 GPD	12 GPD	28 GPD
0529-1-X	13 GPD	28 GPD	66 GPD
0529-2-X	20 GPD	43 GPD	99 GPD
0529-3-X	25 GPD	53 GPD	---------



MODEL 0529-X

Peristaltic Injector Pump
Operating Manual

excellfeeders

PO Box 7475
Somerset, NJ 08875
USA
Phone: 732-828-8655 **FAX**: 732-828-2611
E-mail: support@excellfeeders.com
Website: www.excellfeeders.com

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3.....**Features**.....**3**
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1.0 Introduction

Congratulations on purchasing the 0529-X Peristaltic Metering Pump. The 0529-X is designed to inject chemicals into piping systems. The 0529-X can be equipped with control circuitry which allows the pump output to be externally controlled by a 4-20 mA signal.

2.0 Specifications

Maximum Working Pressure	65 psig / 4.5 bar (most models)
Maximum Fluid Temperature	130° F / 54°C
Ambient Temperature Range	14 to 110° F / -10 to 43° C
Duty Cycle	Continuous
Maximum Solids	50% by volume
Maximum Viscosity	5,000 Centipoise
Maximum Suction Lift	up to 30 ft. water
Power Requirements	90VDC 60 Watts,
Dimensions	6-1/8" H x 10-1/8" W x 9" D
Weight	8 lb.

3.0 Features

- Peristaltic Pump Tube does not require valves.
- Self priming under maximum pressure. Cannot vapor lock.
- High outlet pressure capability of 65 psig (most models).
- High inlet suction lift capability of 30 feet.
- Patented pump tube assembly design.
- Corrosion proof Valox housing.
- Tamper resistant electronic control panel cover.

4.0 Unpacking

Your pump package should contain the following:
1 - Injector pump with 1 pump tube assembly
1 - suction tube strainer
1 - ceramic tubing weight
1 - 5' Length of clear PVC suction tubing

5.0 Installation

CAUTION: Proper eye and skin protection must be worn when installing and servicing the pump.

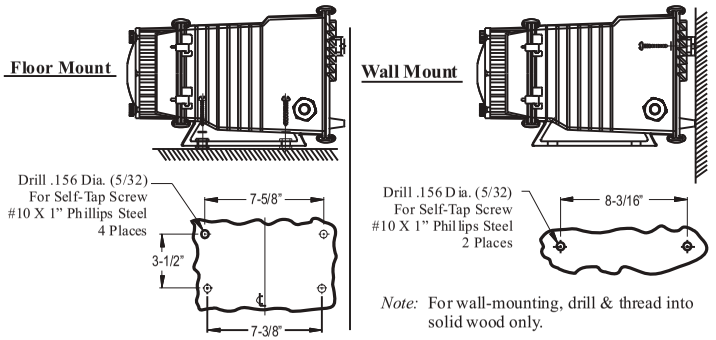
Note: *All diagrams are strictly for guideline purposes only. Always consult an expert before installing the pump into specialized systems. The pump should be* ***serviced by qualified persons only.***

5.1 Mounting Location

Choose an area located near the chemical supply tank, chemical injection point and electrical supply. Although the pump is designed to withstand outdoor conditions, a cool, dry, well ventilated location is recommended. Install the pump where it can be easily serviced.

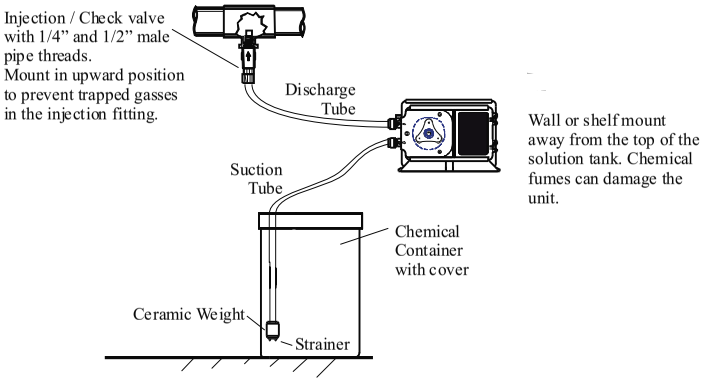
- Mount the pump to a secure surface or wall using the enclosed hardware. Wall mount to a solid surface only. Mounting to drywall with anchors is not recommended.
- Mount the pump close to the injection point. Keep the outlet (discharge) tubing as short as possible. Longer tubing increases the back pressure at the pump tube.
- Your solution tank should be sturdy. Keep the tank covered to reduce fumes. Do not mount the pump directly over your tank. Chemical fumes may damage the unit. Mount the pump off to the side or at a lower level than the chemical container.
- Mounting the pump lower than the chemical container will gravity feed the chemical into the pump. This "flooded suction" installation will reduce output error due to increased suction lift. You must install a shut-off valve, pinch clamp or other means to halt the gravity feed to the pump during servicing.
- Be sure your installation does not constitute a cross connection with the drinking water supply. Check your local plumbing codes.

INJECTOR MOUNTING

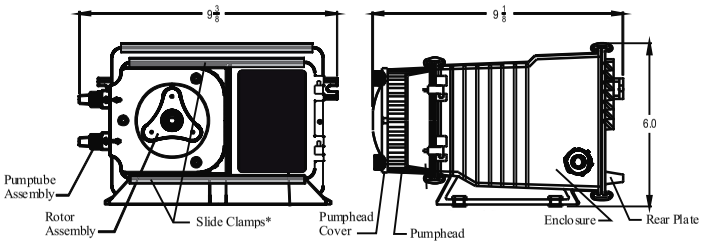


Note: For wall-mounting, drill & thread into solid wood only.

TYPICAL INSTALLATION



PARTS LOCATOR DRAWING



5.2 Input Power Connections

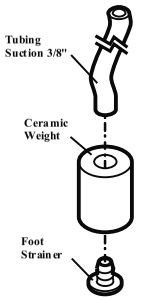
WARNING: Risk of electric shock.

- Be certain to connect the pump to the proper supply voltage. Using the incorrect voltage will damage the pump and may result in injury. The voltage requirement is printed on the pump serial label.

5.4 How To Install the Tubing and Fittings

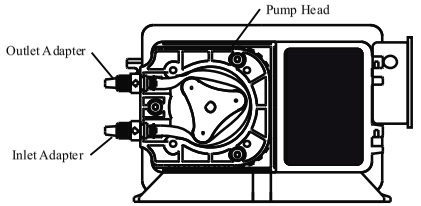
CAUTION: Proper eye and skin protection must be worn when installing and servicing the pump.

- **Inlet Tubing -** Locate the inlet fitting of the Pump Tube. Remove the tube nut. Push the clear PVC suction tubing onto the compression barb of the fitting. Use the tube nut to secure the tube. Hand tighten only.
- **Strainer** - Trim the inlet end of the suction tubing so that the strainer will rest approximately two inches from the bottom of the solution tank. This will prevent sediment from clogging the strainer. Slip the ceramic weight over the end of the suction tube. Press the strainer into the end of the tube. Secure the ceramic weight to the strainer. Drop the strainer into the solution tank.

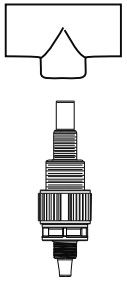


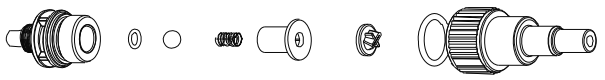
- **Outlet Tubing -** Locate the outlet fitting of the Pump Tube. Remove the tube nut. Push the opaque outlet (discharge) tubing onto the compression barb of the fitting. Use the tube nut to secure the tube. Hand tighten only.

  Keep outlet tube as short as possible.



- **Injection/Check Valve Fitting Installation** - The Injection/Check valve fitting is designed to install directly into either 1/4" or 1/2" female pipe threads. This fitting will require periodic cleaning, especially when injecting fluids that calcify such as sodium hypochlorite. See section 7.0. Install the Injection/Check valve directly into the piping system. To prevent trapped gasses, install the fitting in an upward direction. Use Teflon thread sealing tape on the pipe threads.
  Push the opaque outlet (discharge) tubing onto the compression barb of the Injection/Check valve fitting. Use the tube nut to secure the tube. Hand tighten only.





6.0 How to Maintain the Pump

CAUTION: Proper eye and skin protection must be worn when installing and servicing the pump.

6.1 Routine Inspection and Maintenance

The pump requires very little maintenance. However, the pump and all accessories should be checked weekly. This is especially important when pumping chemicals. Inspect all components for signs of leaking, swelling, cracking, discoloration or corrosion. Replace worn or damaged components immediately.

Cracking, crazing, discoloration and the like during the first week of operation are signs of severe chemical attack. If this occurs, immediately remove the chemical from the pump. Determine which parts are being attacked and replace them with parts that have been manufactured using more suitable materials. The manufacturer does not assume responsibility for damage to the pump that has been caused by chemical attack.

6.2 How to Clean and Lubricate the Pump

The pump will require occasional cleaning and lubricating. The amount will depend on the severity of service.

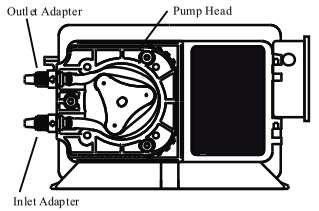
- When changing the pump tube assembly, the pump head chamber, roller assembly and pump head cover should be wiped free of any dirt and debris.
- The pump head cover bearing may require grease periodically. Apply a small amount of grease (Aeroshell aviation grease #5 or equivalent) when necessary.
- Although not necessary, 100% silicon lubrication may be used on the roller assembly and tube assembly.
- Periodically clean the injection/check valve assembly, especially when injecting fluids that calcify such as sodium hypochlorite. These lime deposits and other build ups can clog the fitting, increase the back pressure and interfere with the check valve operation.
- Periodically clean the suction strainer.
- Periodically inspect the air vents located under the motor compartment and on the rear panel. Clean if necessary.

6.3 How to Replace the Pump Tube

The pump tube assembly will eventually break if not replaced. The tube has been designed for a minimum service life of 500 hours. However, the life of the tube is affected by many factors such as the type of chemical being pumped, the amount of back pressure, the motor RPM, temperature and others. The pump tube assembly must be inspected and replaced regularly.

Remove the Old Pump Tube - The pump roller assembly spins in a counter clockwise direction. The pump head inlet (suction) side is located at the bottom of the pump and the outlet (discharge) is located at the top of the pump head.

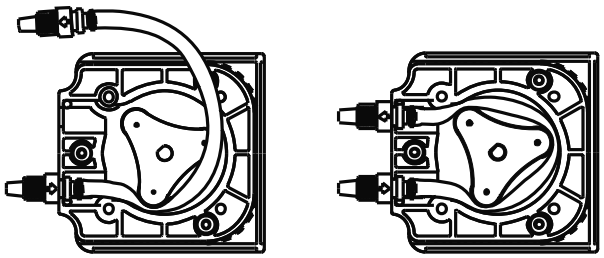
- Release any pressure that may be in the discharge tubing.
- Disconnect the suction and discharge tubes from the pump tube.
- Remove the pump head cover.
- With the pump running, pull the inlet fitting out of the pumphead. Guide the tube counter clockwise away from the rollers. Pull the outlet fitting out of the pump head.



Install the New Pump Tube - Be sure the pump head chamber is clean and free of any debris.

Remove and inspect the roller assembly. Be sure the rollers spin freely. If required, apply a small amount of grease to the pump head cover bearing.

- With the pump running, insert the inlet (suction) side of the Pump Tube fitting into the pump head.
- **Carefully** guide the Pump Tube into the pump head. Stretch the tube slightly and insert the outlet (discharge) fitting into the upper retaining slot in the pump head.
- Place the clear cover on the pump head and secure with three screws.



REPLACEMENT PARTS DRAWING

REPLACEMENT PARTS LIST

Item	Part No	Description	Qty.
1	71000-214	Enclosure Back With Gasket,	1
2	90011-094	Washer, #10 Stainless	2
3	90011-091	Screw, #10 X 1.0" Phillips Steel	4
6	90006-580	Gasket, Back Plate, Neoprene	1
9	90010-110	Power Cord, 1	1
10	A-033N	Cord Inlet Bushing	1
11	90003-359	Mounting Feet, Rubber	4
12	76001-000	Slide Clamp, Enclosure Rear	1
13	76000-999	Slide Clamp, Enclosure Front	1
15	90006-579	Gasket, Enclosure Front, Neoprene	1
16	90002-191	Door, Electronic Controls Cover	1
17	70002-241	G/motor, V/S 14Rpm, 90VDC	1
	70002-242	G/motor, V/S 30Rpm, 90VDC	1
	70002-243	G/motor, V/S 45Rpm, 90VDC	1
	70002-244	G/motor, V/S 60Rpm, 90VDC	1
22	90006-601	Motor Clip, 45, 60RPM	1
23	90006-583	Motor Clip, 14, 30RPM	1
24	90011-146	Screw, Motor Clip, 8-32 X .25	1
25	90007-515	Bushing, J-Box Connector, Alum.	1
26	76001-029	Junction Box, Valox	1
27	90011-129	Screw, 6-32 X .25 S Black	2
28	71000-133	Cover, J-Box w/Gasket &Label	1
29	70000-656	J-Box Assembly, Complete	1
30	90008-151	J-box Hole Plug .75 Dia Blk	1
31	C-330-6	Nut, Tube, .37 O.D. Tubing	1
36	C-335-6	Tubing, Outlet, .370.D.X5ft, Poly	1
37	C-334-6	Tubing, Inlet, .370.D.X5ft, Pvc	1
38	C-346	Weight, Inlet Tubing, Ceramic	1
39	C-342-2	Strainer, Inlet Tube, Polypro	1
40			1
	71000-350	Roller, -7 tubes (black rollers)	1
45	71000-156	Cover, P/head With Bearing	1
46	76001-003	Bearing, Sleeve, P/head Cover	1
48	90011-160	Screw, P/head Cover, 8-32 X .62	3
49	A-014N-6A	Inj Valve, .5-.25 Mpr X .37 O.D.	1
50	90006-583	Motor Clip, 14, 30RPM	1
51	90011-146	Screw, Motor Clip, 8-32 X .25	1
52	90007-515	Bushing, J-Box Connector, Alum.	1
53	76001-029	Junction Box, Valox	1
54	90011-129	Screw, 6-32 X .25 S Black	2
55	71000-133	Cover, J-Box w/Gasket &Label	1
56	70000-656	J-Box Assembly, Complete	1
N/s	90008-151	J-box Hole Plug .75 Dia Blk	1
			1
59	90011-023	Screw, Motor, 8-32 x .50 Phill	2
60	C-1814N-2	Motor brush set, 90VDC motor	1

LIMITED WARRANTY

Your new pump is a quality product and is warranted to be free of defects as set down in this policy. Peristaltic pump tube assemblies are not warranted. Parts are covered under warranty for 12 months from the date of purchase. Warranty coverage does not include damage to the pump that results from misuse, carelessness, abuse or alteration. Only the repair or the replacement of the pump is covered. Excell Feeders does not assume responsibility for any other loss or damage.

Warranty status is determined by the pump's serial label. The serial label must be on the pump to obtain warranty coverage. The warranty status of the pump will be verified by Excell Feeders.

PROCEDURE FOR IN WARRANTY REPAIR

Carefully pack the pump to be repaired. Enclose a brief description of the problem. Prepay all shipping costs. COD shipments will not be accepted. Warranty service must be performed by the factory. Damage caused by improper packaging is the responsibility of the sender.



Users of electrical and electronic equipment (EEE) with the WEEE marking per Annex IV of the WEEE Directive must not dispose of end of life EEE as unsorted municipal waste, but use the collection framework available to them for the return, recycle, recovery of WEEE and minimize any potential effects of EEE on the environment and human health due to the presence of hazardous substances. The WEEE marking applies only to countries within the European Union (EU) and Norway. Appliances are labeled in accordance with European Directive 2002/96/EC.
Contact your local waste recovery agency for a *Designated Collection Facility* in your area.

AUTOMATIONDIRECT.com

IRONHORSE™

GSD4 Series DC Drives User Manual

User Manual Number: IH-GSD4-User-M





WARNING

Thank you for purchasing automation equipment from Automationdirect.com®, doing business as AutomationDirect. We want your new automation equipment to operate safely. Anyone who installs or uses this equipment should read this publication (and any other relevant publications) before installing or operating the equipment.

To minimize the risk of potential safety problems, you should follow all applicable local and national codes that regulate the installation and operation of your equipment. These codes vary from area to area and usually change with time. It is your responsibility to determine which codes should be followed, and to verify that the equipment, installation, and operation is in compliance with the latest revision of these codes.

At a minimum, you should follow all applicable sections of the National Fire Code, National Electrical Code, and the codes of the National Electrical Manufacturer's Association (NEMA). There may be local regulatory or government offices that can also help determine which codes and standards are necessary for safe installation and operation.

Equipment damage or serious injury to personnel can result from the failure to follow all applicable codes and standards. We do not guarantee the products described in this publication are suitable for your particular application, nor do we assume any responsibility for your product design, installation, or operation.

Our products are not fault-tolerant and are not designed, manufactured or intended for use or resale as on-line control equipment in hazardous environments requiring fail-safe performance, such as in the operation of nuclear facilities, aircraft navigation or communication systems, air traffic control, direct life support machines, or weapons systems, in which the failure of the product could lead directly to death, personal injury, or severe physical or environmental damage ("High Risk Activities"). AutomationDirect specifically disclaims any expressed or implied warranty of fitness for High Risk Activities.

For additional warranty and safety information, see the Terms and Conditions section of our catalog. If you have any questions concerning the installation or operation of this equipment, or if you need additional information, please call us at 770-844-4200.

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GSD4 DC DRIVES USER MANUAL OVERVIEW

OVERVIEW OF THIS PUBLICATION

The IronHorse GSD4 Series DC Drives User Manual describes the installation, configuration, and methods of operation of the GSD4 Series DC Drives.

All information contained in this manual is intended to be correct. However, information and data in this manual are subject to change without notice. AutomationDirect (ADC) makes no warranty of any kind with regard to this information or data. Further, ADC is not responsible for any omissions or errors or consequential damage caused by the user of the product. ADC reserves the right to make manufacturing changes which may not be included in this manual.

WHO SHOULD READ THIS USER MANUAL

This manual contains important information for those who will install, maintain, and/or operate any of the GSD4 Series DC Drives.

TECHNICAL SUPPORT

By Telephone: 770-844-4200 (Mon.–Fri., 9:00 a.m.–6:00 p.m. E.T.)

On the Web: www.automationdirect.com

Our technical support group is glad to work with you in answering your questions. If you cannot find the solution to your particular application, or, if for any reason you need additional technical assistance, please call Technical Support at 770-844-4200. We are available weekdays from 9:00 a.m. to 6:00 p.m. Eastern Time.

We also encourage you to visit our web site where you can find technical and non-technical information about our products and our company. Visit us at www.automationdirect.com.

SPECIAL SYMBOLS



WHEN YOU SEE THE "NOTEPAD" ICON IN THE LEFT-HAND MARGIN, THE PARAGRAPH TO ITS IMMEDIATE RIGHT WILL BE A SPECIAL NOTE.



WHEN YOU SEE THE "EXCLAMATION MARK" ICON IN THE LEFT-HAND MARGIN, THE PARAGRAPH TO ITS IMMEDIATE RIGHT WILL BE A ***WARNING.*** *THIS INFORMATION COULD PREVENT INJURY, LOSS OF PROPERTY, OR EVEN DEATH (IN EXTREME CASES).*

IRONHORSE GSD4 SERIES DC DRIVES GENERAL INFORMATION

IronHorse GSD4 DC drives are designed to control DC Permanent Magnet, Shunt Wound, and some Universal (AC/DC) motors. Incoming AC voltage is converted to adjustable full-wave rectified DC voltage to operate the DC motor. Also, a full-wave field voltage is provided for shunt wound motors.



CAREFULLY CHECK THE DC DRIVE FOR SHIPPING DAMAGE. REPORT ANY DAMAGE TO THE CARRIER IMMEDIATELY. DO NOT ATTEMPT TO OPERATE THE DRIVE IF VISIBLE DAMAGE IS EVIDENT TO EITHER THE CIRCUIT OR TO THE ELECTRONIC COMPONENTS.

STANDARD FEATURES

- Input voltages 24/36VAC or 120/240VAC @ 50/60Hz; output 0–24/36VDC or 0–90/180VDC.
- Adjustable horsepower settings.
- Barrier terminal strip.
- Full-wave bridge supply.
- 1% speed regulation with armature voltage feedback; ±1/2% with tachometer feedback.
- Adjustable Minimum speed, Maximum speed, IR Compensation, Current Limit, Acceleration & Deceleration (enclosed models).
- Line voltage compensation.
- 5kΩ speed potentiometer with leads, dial, and knob included.
- 50:1 speed range.
- Transient voltage protection.
- Voltage following mode or DC tachometer follower by supplying ungrounded 0–12VDC analog input signal.
- DC tachometer feedback (6V at base speed).
- Inhibit circuit permits start & stop without breaking AC lines.
- Shunt field supply provided.
- GSD4-240-10N4X only: NEMA 4X enclosure, Power ON/OFF switch, Power ON indicator, Adjustable acceleration and deceleration.

CONTROL FEATURES

MINIMUM SPEED – Allows adjustment of the motor speed when the speed pot is set at minimum (CCW). This permits the user to eliminate "Deadband" on the main speed control, permitting zero calibration. Clockwise rotation of "MIN" trim pot increases speed.

MAX SPEED (Maximum Speed) – Allows adjustment of the motor speed when the speed pot is set at maximum (CW). This permits the user to eliminate the top end "Deadband", which will provide full speed at maximum rotation. Rotation of the "MAX" trim pot in the clockwise direction increases the maximum motor speed.

I.R. COMP (Speed Regulation) – This allows for adjustment of the circuitry that controls the speed regulation of the motor. The circuitry controls armature speed by changing the armature voltage to compensate for increased or decreased motor loading. Clockwise rotation of the "IR COMP" trim pot will increase compensation.

CUR. LIM. (Current Limit) – Provides protection from excessive armature current by limiting the maximum armature current the drive can provide. This enables adjustment of the maximum torque the motor can deliver. Torque adjustment (Cur. Lim.) is preset at 125% of rated motor torque (current) based on horsepower. Clockwise rotation of the "CUR. LIM." trim pot increases the torque (current) the drive will provide.

INHIBIT TERMINAL PIN – An adjustable acceleration ramp that allows the user a choice of stopping and starting hard (fast), or stopping hard with a soft start (without breaking the AC lines).

There are two ways to Inhibit a drive:

1) For all GSD drives (using the drive's speed pot):

   Remove power from the Speed Pot Wiper, which makes the input to the drive drop to Zero volts. A switch or contact can be placed in either the Speed Pot High lead, or in the Speed Pot Wiper lead.

2) For GSD4, GSD5, and GSD7 drives (using the drive's inhibit feature):

   The inhibit feature provides a way to start/stop output of these drives by using a low-power rated contact (12VDC, mA of current), as opposed to a high-power contact that would be required to switch the source power to the drive.

   Close the circuit between the Inhibit pin (GSD4 & GSD5 Series) or the +TACH terminal (GSD7 only), and the drive's Speed Pot Hi terminal. The drive will stop and start quickly – bypassing any fixed or adjustable ACCEL or DECEL setting. When this connection is CLOSED, the drive's 12VDC logic supply is collapsed by connecting it to a chassis COMMON point – the board logic shuts down and output to the motor ceases. Output to the motor resumes when this contact is opened again.

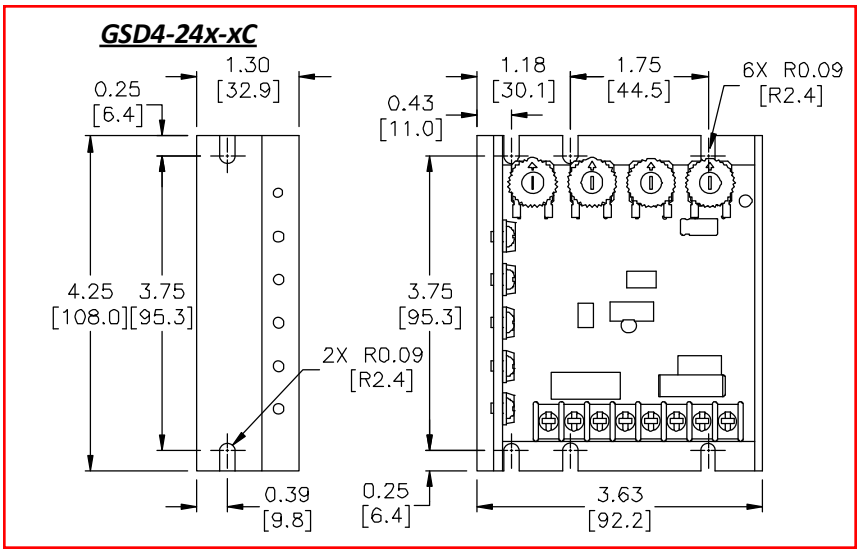
Selection and Specifications

GSD4 Series DC Drives – Selection & Specifications					
Model		***GSD4-24A-5C***	***GSD4-240-1C***	***GSD4-240-5C***	***GSD4-240-10N4X***
Package Configuration		open frame			NEMA 4X
Power Quality Form Factor		1.4			
Input Voltage (@50/60Hz)		24/36 VAC ±10%	120/240 VAC ±10%		
Output Voltage		0–24/36 VDC	0–90/180 VDC		
Shunt Field Voltage		20VDC @ 24VAC in 30VDC @ 36VAC in (1A max)	100VDC @ 120VAC in 200VDC @ 240VAC in (1A max)		100VDC @ 120VAC in 200VDC @ 240VAC in (0.5A max)
Motor Rating @ Low V (hp) ***Motor Rating @ High V (hp)***		1/50 – 1/6	1/50 – 1/8 1/25 – 1/4	1/8 – 1/2 1/4 – 1	1/8 – 1 1/4 – 2
Output Current (continuous)		5.5A (DC)	1.2A (DC)	5.5A (DC)	10A (DC)
Current Overload Capacity		200% for 60s			
Current Limit (adjustable)		1–15A (DC)	0.3–2.5A (DC)	1–15A (DC)	
Transient Protection		–	Metal Oxide Varistor (MOV)		
I.R. Compensation		adjustable			
Speed Adjustment	***Potentiometer***	5kΩ potentiometer or 0–10VDC isolated input signal (See "GSDA-AI-V4" on page 18.)			
	Current	4–20mA			n/a
	Voltage	n/a	0–5VDC thru 0–250VDC		
Speed Range		50:1			
Speed Regulation		±1% of base speed			
Maximum Speed		adjustable from 60% to 110% of base speed			
Minimum Speed		0–30% of adjustable maximum speed			
Acceleration		0.5 seconds			adjustable 0.5–8 seconds
Deceleration					
Dynamic Braking		no			
Plugging Capability **		no			
Electrical Connections		8-position terminal strip; 22–14 AWG			
External Fusing Required		Bussman ABC or Littlefuse 314 series ceramic fuses or equivalent For details, refer to "Fusing" on page page 8.			
Operating Temperature		-10 to 45 °C [14 to 113 °F]			-10 to 40 °C [14 to 104 °F]
Thermal Protection		current limiting			
Mounting Orientation		can be mounted in any orientation			
Corrosive Gases		NOT compatible with any corrosive gases			
Weight		8.0 oz [203g]	37 oz [1049g]	10.5 oz [297g]	59.5 oz [1687g]
Agency Approvals		RoHS, CE	$_{C}UL_{US}$ Listed (E198015), RoHS, CE		$_{C}UL_{US}$ Listed (E198015), RoHS
Optional Accessories*					
Replacement Potentiometer		GSDA-5K			
Digital Potentiometer		GSDA-DP			
Manual Reverse Switch		GSDA-MREV			
Accel/Decel Adjustment Card		GSDA-ACCDEC-4			
Analog Current Input Card		GSDA-AI-A			–
Analog Voltage Input Card		–	GSDA-AI-V4		–
Heatsink		GSDA-HTSNK-4			–

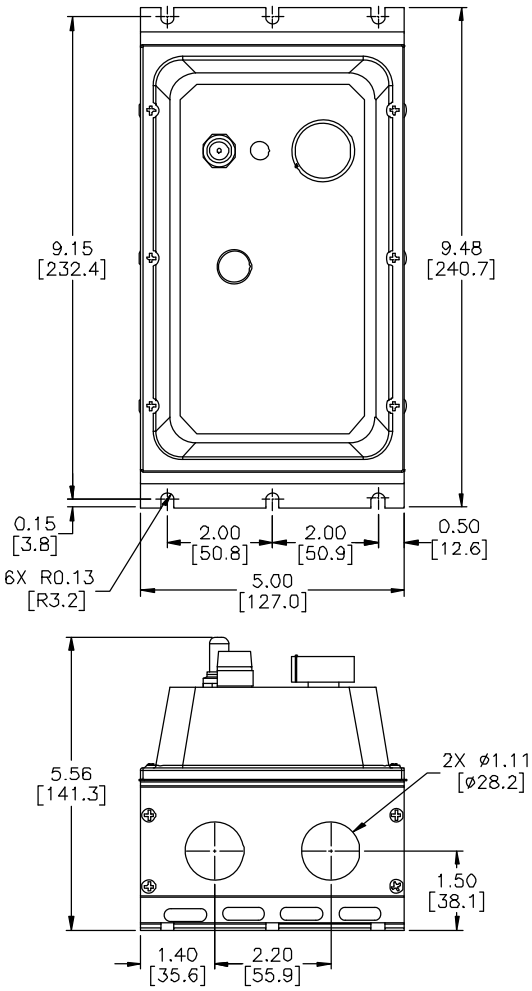
** For accessories details, please visit www.AutomationDirect.com.*
*** Plugging is a method of rapidly changing motor direction by reversing motor armature polarity, while the motor is still running.*

DIMENSIONS (dimensions = in [mm])

GSD4-24x-xC



GSD4-240-10N4X



Installation and Wiring

Install open-frame drives in an enclosure with a volume at least three times the volume of the open-frame drive.

Do not mount GSD4-24x-xxxxx DC drive where ambient temperature is outside the range of -10 to 45 °C (14 to 113 °F).

Size all wires that carry armature or line currents as specified by applicable national, state, and/or local codes. All other wires may be 18AWG or smaller as permitted by the codes.

Separate control wires from the armature and AC lines when routed in conduit or wire trays.

These drives do not provide motor over-temperature sensing or motor overload protection. The need for additional motor overload and motor over-temperature protection shall be determined based on conditions in the end installation in accordance with the NEC.

CAUTION!! Turn power OFF while making wiring connections.

Improper installation or operation of this DC Drive may cause injury to personnel or drive failure. The drive must be installed in accordance with local, state, and national safety codes. Make certain that the power supply is disconnected before attempting to service or remove any components!!! If the power disconnect point is out of sight, lock it in disconnected position and tag it to prevent unexpected application of power. Only a qualified electrician or service personnel should perform any electrical troubleshooting or maintenance. At no time should circuit continuity be checked by shorting terminals with a screwdriver or other metal device.

Before attempting to wire the DC Drive, make sure all power is disconnected. Recheck code designation to assure proper voltage is present for the DC Drive. Carefully select proper wire size for current and voltage drop. Limit the voltage drop through the wiring to 5% of the line voltage at full load

CAUTION!! Do not attempt to perform a hi-pot test across the AC lines with the DC drive in the circuit. This will result in immediate or long-term damage to the drive.

1) *Ensure that the GSD4 drive chassis is properly grounded.*
2) *Motor armature connections must not be switched or broken while the GSD4 drive is ON. Serious damage may result.*
3) *The inputs to the speed pot terminals (P1-6, P1-7, P1-8) must not be grounded. Serious damage may result.*

Fusing

Fuse Selection *				
	GSD4-24A-5C	Select fusing based on 200% of motor Full-Load Current		
	GSD4-240-xC		GSD4-240-10N4X	
Motor HP	Fuse @ 120 VAC Input	Fuse @ 240 VAC Input	Fuse @ 120 VAC Input	Fuse @ 240 VAC Input
1/50	2A	–	–	–
1/20	2A	1A	–	–
1/8	3A	2A	2A	–
1/4	4A	3A	4A	2A
1/3	6A	3A	6A	3A
1/2	8A	4A	8A	4A
3/4	12A	6A	12A	6A
1.0	15A	8A	15A	8A
1.5	–	12A	–	12A
2.0	–	15A	–	15A

** Select fuse type Bussman ABC or Littlefuse 314 series or equivalent. Fuse hot legs only; do not fuse AC neutrals. (AutomationDirect sells ABC series fuses.)*

WIRING TERMINALS

GSD4 Wiring Terminals			
Type	**Wire Range**	**Customer Wiring Temp Rating**	**Tightening Torque**
8-position terminal strip	22–14 AWG	300V, 75 °C [167 °F] minimum	9.0 lb·in [1.0 N·m]

WIRING TERMINAL FUNCTIONS

GSD4-xxx-xC WIRING TERMINALS

GSD4-xxx-xC Series DC Drives – Terminal Strip Functions CAUTION: BE SURE DRIVE HOUSING IS PROPERLY GROUNDED.	
Number	**Purpose**
P1-1	(L / AC1) 120VAC – Connect incoming hot AC (black wire) to this terminal. (L / AC1) 240VAC – Connect either hot side. Connect ground (green wire) to drive chassis.
P1-2	(N / AC2) 120VAC – Connect the neutral AC (white wire) to this terminal. (N / AC2) 240VAC – Connect either hot side. Connect ground (green wire) to drive chassis.
P1-3	(+ ARM) – Connects to the plus (+) Armature wire on the motor. 0-90VDC for 120VAC input or 0-180VDC for 240 VAC input. See "SPECIFICATIONS" for output rating. *CAUTION: ARMATURE CONNECTION MUST NOT BE SWITCHED OR BROKEN WHILE DRIVE IS ON, OR SERIOUS DAMAGE TO THE DRIVE MAY RESULT.*
P1-4	(- ARM / -FIELD) – Connects to minus (-) Armature wire on the motor, and, if necessary, (-) Field wire of Shunt Wound motor.
P1-5	(+ FIELD) – DO NOT use for Permanent Magnet motor. This supplies (+) Field voltage for a Shunt Wound motor. For motors with dual voltage field (i.e. 50/100V or 100/200V), make sure the highest value is connected.
P1-6	(SPEEDPOT HI) – Connects to high side (white wire) of the Speed pot (CW end). This is internal +12 volts. *INPUT MUST NOT BE GROUNDED !*
P1-7	(SPEEDPOT WIPER) – Connects to the wiper (red wire) of the Speed pot (center lead). For voltage-follower applications, this *INPUT MUST NOT BE GREATER THAN +12V MAXIMUM AND MUST NOT BE GROUNDED !* *Speed pot can be replaced by 0–10V analog signal. See "GSDA-AI-V4" on page 18, or use FC-33 or equivalent.*
P1-8	(SPEEDPOT LO) – Connects to the low side (orange wire) of the 5kΩ Speed pot (normally the CCW end). This input is raised and lowered by the MIN trim pot. Electronic speed input voltage (voltage follower) may be referenced to Speed pot LO if the MIN trim pot adjustments are to be active. Otherwise, inputs may be referenced to -ARM (P1-4), which will bypass the MIN trim pot. *INPUT MUST NOT BE GROUNDED !*

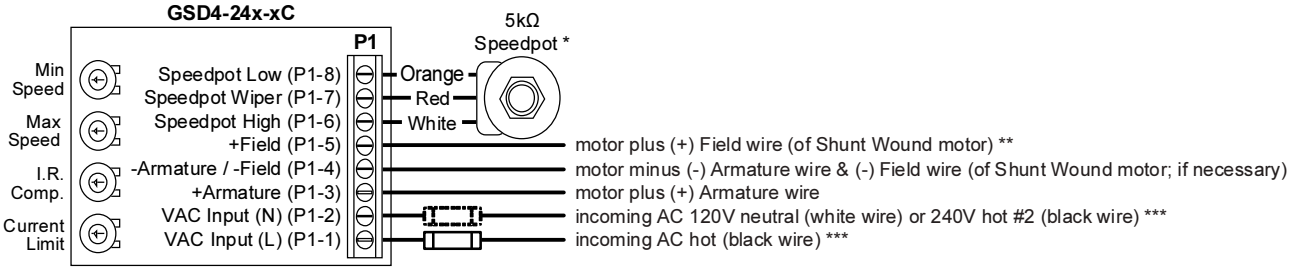
GSD4-240-10N4X WIRING TERMINALS

GSD4-240-10N4X Series DC Drives – Terminal Strip Functions CAUTION: BE SURE DRIVE HOUSING IS PROPERLY GROUNDED.	
Number	**Purpose**
	P4 – Terminal Strip for Power & Motor Armature Wiring
P4-1	(L / AC1) 120VAC – Connect incoming hot AC (black wire) to this terminal. (L / AC1) 240VAC – Connect either hot side. Connect ground (green wire) to drive ground lug.
P4-2	(N / AC2) 120VAC – Connect the neutral AC (white wire) to this terminal. (N / AC2) 240VAC – Connect either hot side. Connect ground (green wire) to drive ground lug.
P4-3	(+ ARM) – Connects to the plus (+) Armature wire on the motor.
P4-4	(- ARM) – Connects to minus (-) Armature wire on the motor.
	P1 – Terminal Strip for Shunt-Wound Motor Field Wiring
P1-4	(-FIELD) – Connects to minus (-) Field wire of shunt-wound motors ONLY.
P1-5	(+ FIELD) – DO NOT use for Permanent Magnet motor. This supplies (+) Field voltage for a Shunt-Wound motor. For motors with dual voltage field (i.e. 50/100V or 100/200V), make sure the highest value is connected

WIRING DIAGRAMS

GSD4-24x-xC BASIC WIRING DIAGRAM

SPEED POT CAN BE REPLACED BY AN 0–10V ANALOG SIGNAL FOR SPEED CONTROL (FROM A PLC, ETC.). SEE "GSDA-AI-V4" ON PAGE 18.



* *P1-6 has internal +12V, and connects to Speedpot High (white wire). THIS INPUT MUST NOT BE GROUNDED!*
For start-stop applications, the connection between P1-6 and Speedpot High can be opened and closed by a SPST switch.

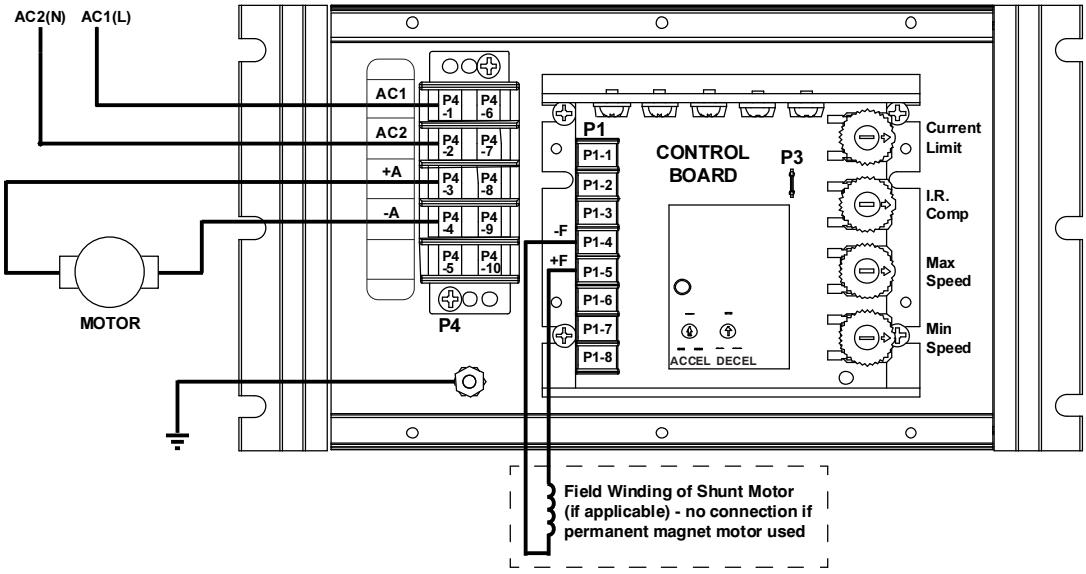
* *P1-7 connects to Speedpot Wiper (red wire). THIS INPUT MUST NOT BE GROUNDED!*
For Voltage-Follower applications, THIS INPUT MUST NOT BE GREATER THAN +12V MAXIMUM!

* *P1-8 connects to Speedpot Low, and is raised and lowered by the Min Speed trimpot. THIS INPUT MUST NOT BE GROUNDED!*
Electronic speed input (voltage follower) may be referenced to this input if the Min Speed trimpot adjustments are to be active.
Otherwise, inputs may be referenced to -Armature, which will bypass the Min Speed trimpot.

** *+F connection is only for Shunt Wound motor; NOT for Permanent Magnet motor.*
For motors with dual voltage field, i.e. 50/100V or 100/200V, connect the highest value.

*** *Fuse hot AC inputs only; refer to Fusing section for size and type. Fuse both AC lines for 240 VAC input. Do NOT fuse AC(N) on 120V systems.*
Connect incoming AC ground (green wire) to GSD4 chassis.

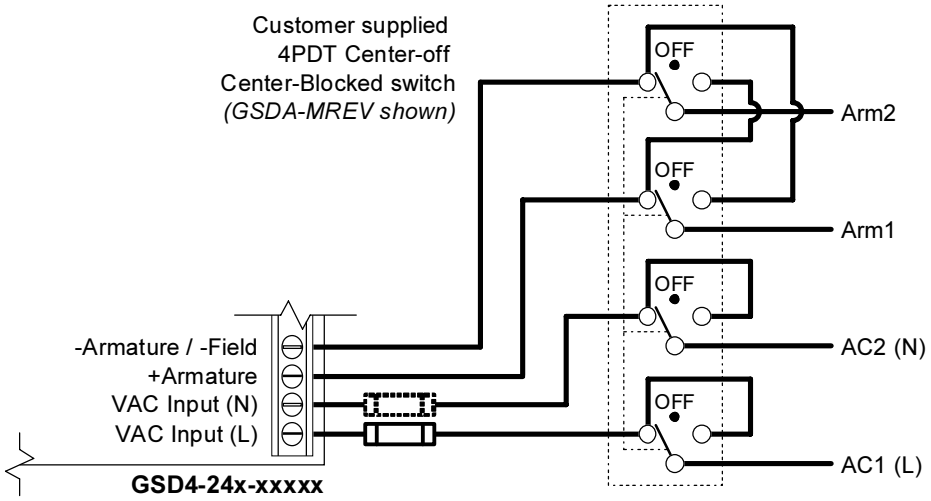
GSD4-240-10N4X BASIC WIRING DIAGRAM



INSTALLATION AND WIRING – WIRING DIAGRAMS (CONTINUED)

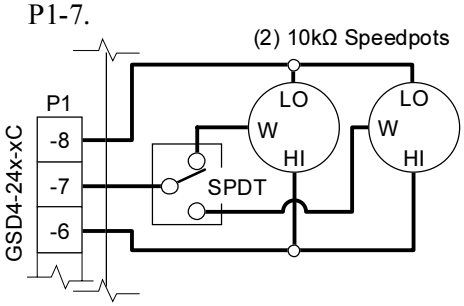
GSD4-24x-xxx REVERSING WIRING DIAGRAM

CAUTION: WHEN REVERSING A SPINNING PERMANENT MAGNET DC MOTOR, CAUTION MUST BE TAKEN THAT THE RESULTING CURRENT THROUGH THE ARMATURE OF THE MOTOR DOES NOT EXCEED THE OVERLOAD RATINGS OF THE DC DRIVE, OR THE DEMAGNETIZE RATING OF THE MOTOR BEING REVERSED. A CENTER-BLOCKED SWITCH WILL DELAY SWITCHING THE MOTOR DIRECTION. IF USING RELAYS TO AUTOMATICALLY REVERSE THE MOTOR, MAKE SURE TO HAVE A DELAY BETWEEN CHANGING MOTOR DIRECTIONS.



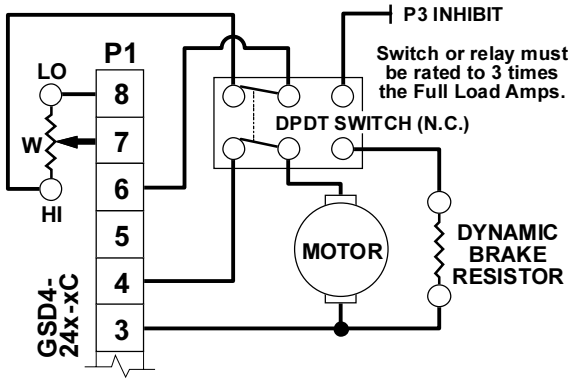
GSD4-24x-xC TWO-SPEED OPERATION

Two-speed operation is done using two 10 kΩ speed potentiometers in parallel, with both Highs connected to terminal P1-6, and both Lows connected to P1-8. A SPDT switch selects which pot Wiper is connected to terminal P1-7.



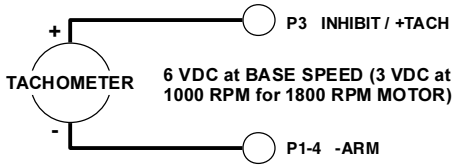
GSD4-24x-xC DYNAMIC BRAKING

A DPDT switch is used to control and to connect a customer-supplied Dynamic Braking Resistor (DBR). Typical values for the DBR are 35–50W at 5Ω for 120V, or 10Ω for 240V. Motor horsepower, inertia, and cycle time affect the sizing of the DBR.



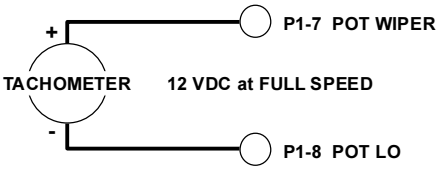
GSD4-24x-xxx TACHOMETER FEEDBACK

Improves regulation to ± 1/2% of base speed.



GSD4-24x-xxx TACHOMETER FOLLOWER

Allows drive output to follow tachometer voltage.



TACHOMETER CONTROL NEEDS TACHOMETER OUTPUT OF 7VDC/1000RPM WITH RIPPLE LIMITED TO 1% OR LESS.

INSTALLATION AND WIRING – WIRING DIAGRAMS (CONTINUED)

INHIBIT FEATURE START/STOP CONTROL

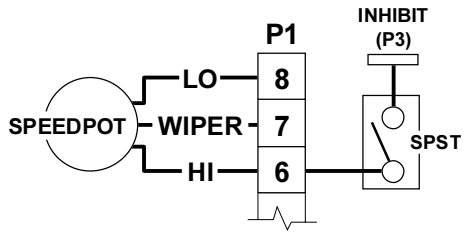
The inhibit feature allows the motor to be remotely started and stopped using a lower-rated 12VDC contact in the drive control circuit, instead of a higher-rated contact in the power circuit.

GSD4-24X-XC INHIBIT (USED INDEPENDENTLY)

This inhibit method bypasses the drive's Accel and Decel settings to start and stop the motor. It instantly shuts off the drive's output, and the motor freewheels to a stop. Start and stop rates are determined by the inertia of the load.

The customer-supplied SPST switch is connected in series between the Speed Pot High (P1-6) and the Inhibit pin (P3). To inhibit (stop motor), close Speed Pot High to the Inhibit pin. To restart, return the switch to open.

Fast Stop & Start:

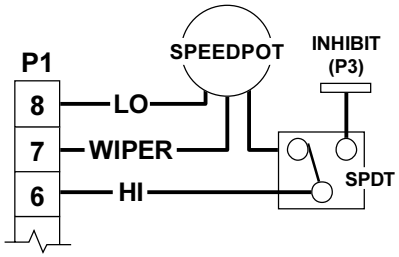


GSD4-24X-XC INHIBIT (USED WITH SPEED POT)

This inhibit method bypasses the drive's Decel settings when stopping the motor, and the motor freewheels to a stop at a rate determined by the inertia of the load. However, the start rate is determined by drive's Accel setting.

The common of the SPDT switch is connected to control pot High, and is switched between Speed Pot High (P1-6) and the Inhibit pin (P3). To inhibit (stop motor), Speed Pot High is closed to the Inhibit pin. To restart, return the switch to Speed Pot High.

Fast Sop. Soft Start (thru accel range):



1) IN THE EVENT OF SCR FAILURE OR FALSE TRIGGERING, THE INHIBIT CIRCUIT WILL NOT STOP THE MOTOR.
2) ALWAYS USE SHIELDED WIRE WHEN CONNECTING TO THE INHIBIT TERMINAL, AND CONNECT THE SHIELD TO THE -ARMATURE OR COMMON OF THE DRIVE.

START-UP

START-UP FOR GSD4-24X-XC

3) Recheck all wiring. Accidental grounds, loose or pinched wires on armature or speed pot wires may damage the DC drive when power is applied.
4) Check to see that the incoming power is of the correct voltage.
5) Turn the speed pot to zero (fully CCW).
6) Turn power on, and advance the speed pot while observing motor.
   Power must be turned off again before step 5 can be accomplished!
7) If the motor rotation is incorrect, turn power off at external disconnect, and reverse the +ARM and -ARM connections.
8) Check for satisfactory operation throughout the speed range.
9) *If operation is satisfactory, no readjustments are needed.*
10) If instability or surging is observed, or if maximum speed is higher than desired, refer to the "Trim Pot Adjustments" section."
11) For other problems, consult the "Troubleshooting" section.

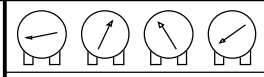
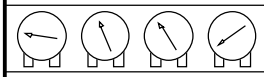
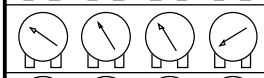
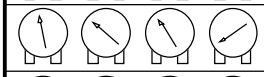
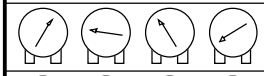
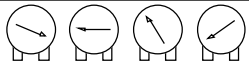
START-UP FOR GSD4-240-10N4X

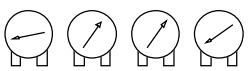
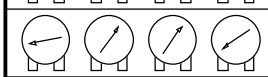
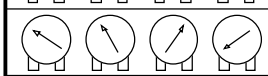
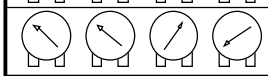
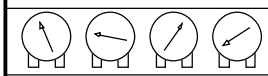
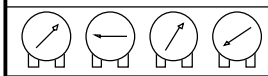
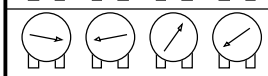
1) Safety Precautions:
   a) Observe the normal safety precautions for the voltages involved. We strongly suggest that only qualified electricians or service people should install, troubleshoot, maintain, or service the drive, motor, and interconnect wiring.
   b) Be sure power is disconnected or shut OFF at fuse box or circuit breaker when installing the drive and making adjustments (except running adjustments).
   c) Remove the load from motor (or gearmotor) before running it.
   d) Use an insulated screwdriver to make trim pot adjustments.



WHEN MAKING RUNNING ADJUSTMENTS, BE VERY CAREFUL NOT TO TOUCH ANY COMPONENTS EXCEPT THE ADJUSTING POTS.

2) On the drive front panel, turn the drive ON-OFF switch to off and set the drive pot knob fully counterclockwise (CCW) and check line fuse. The fuse should be as specified by the Fuse Selection Table.
3) Check all the connections at the drive terminals and at the motor. Make sure that they are tight and are made according to the "Installation and Wiring" section.
4) Rotate the motor's shaft manually to make sure it turns freely. A slight resistance may be noticed.
5) Turn the drive ON-OFF switch to the ON position and then slowly turn the Speed Control knob clockwise (CW) while observing direction of motor rotation. If opposite direction of rotation is desired, correct by turning OFF the drive and then reverse the motor armature connections.
6) With AC line power and control back ON, slowly turn Speed Control knob fully CW while observing the motor. Motor should accelerate smoothly to top speed.
7) Turn OFF control and AC power to drive.
8) Reconnect the motor load that the motor will normally drive.
9) Turn AC power and the drive back ON and adjust the trim pots as shown below for the motor horsepower and voltage being used.

	CL IR MAX MIN	HP
GSD-240-10NX4 **INPUT 120 VAC** **OUTPUT 0-90 VDC**		1/8
		1/4
		1/3
		1/2
		3/4
		1.0
Operation of the control beyond ±10% of the normal line voltage could result in re-adjustment. These adjustments are permanent; periodic re-adjustment is normally not needed.		

	CL IR MAX MIN	HP
GSD-240-10NX4 **INPUT 230 VAC** **OUTPUT 0-180 VDC**		1/4
		1/3
		1/2
		3/4
		1.0
		1.5
		2.0

10) Test the drive and motor under actual operating and load conditions; run the motor through the entire range of speeds required while it is fully loaded. Check motor speed with a tachometer. If control/motor performance is still not satisfactory, continue adjusting the control by following the procedures given in the "GSD4-240-10N4X Trim Pot Adjustment" section on page 15.

TRIM POT ADJUSTMENTS

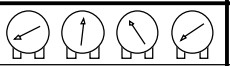
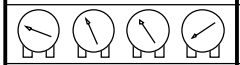
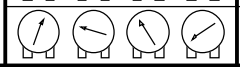
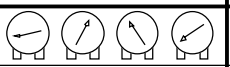
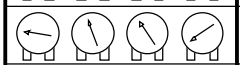
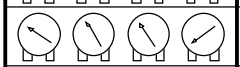
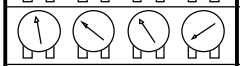
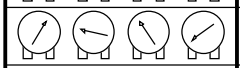
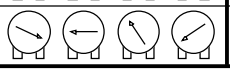
If the system is unstable after the previous Start-Up procedure, then adjust the trim pots as described in this section.

GSD4-24A-5C TRIM POT ADJUSTMENT

GSD4-24A-5C Trim Pot Adjustment *		
Trim Pot	***Function***	***Adjustment***
Min	Sets minimum motor speed when speed pot is set at zero. CW rotation will increase minimum motor speed.	1) Set Speed pot to zero (fully CCW). 2) Rotate MIN trim pot CW until motor starts to rotate. 3) Slowly rotate MIN trim pot CCW until motor stops. NOTE: If motor rotation is desired, rotate MIN trim pot CW until desired MIN speed is reached.
IR Comp	Provides a means of improving motor speed regulation in the armature feedback mode. If a slowdown due to load change is of no concern, rotate this trim pot fully CCW.	1) Set Speed pot at 50%. 2) Observe motor speed at no load condition. 3) Apply full load to motor. 4) Turn IR COMP trim pot CW to obtain the same motor speed as with no load.
Max	Sets maximum motor speed when speed pot is set at maximum (fully CW rotation). CW rotation of MAX trim pot increases maximum motor speed.	1) TURN DRIVE POWER OFF!! 2) Connect a DC Voltmeter: + to +ARM; - to -ARM. *NOTE: Meter must not be grounded!!* 3) Set meter voltage range: (90 VDC for 120 VAC; 180 VDC for 240 VAC). 4) Turn power on. Set Speed pot at 100%. 5) Adjust MAX trim pot to rated motor armature voltage as shown on meter. *NOTE: A tachometer or strobe may be used in lieu of a meter.* Follow above steps, except adjust MAX trim pot to rated motor base speed indicated by tachometer or strobe.
Cur Lim	Limits DC motor armature current (torque) to prevent damage to the motor or drive. The current limit is set for the rated motor current. CW rotation of this trim pot increases the armature current (or torque produced).	1) TURN DRIVE POWER OFF! 2) Connect a DC Ammeter between A1 on motor and +ARM on drive. This is in series with the motor. 3) Turn power on. 4) Set Speed pot at the 50% position. 5) Apply friction braking to motor shaft until motor stalls. 6) With motor stalled, set current at 125% of rated motor armature current by adjusting CUR. LIM. trim pot.
** This adjustment procedure is only for the GSD4-24A-5C DC Drive. Adjustments are done with motor connected to drive.*		

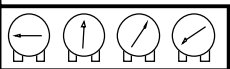
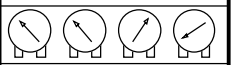
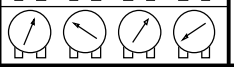
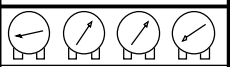
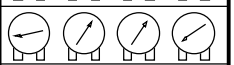
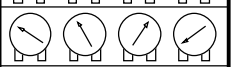
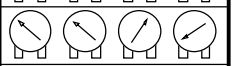
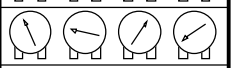
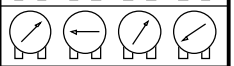
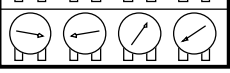
GSD4-240-xC TRIM POT ADJUSTMENT

Settings apply when using a 5K ohm master speedpot. This chart is used in conjunction with the adjustment procedure and is approximate.

	C.L.	I.R.	MAX	MIN	HP
GSD4-240-1C 120 VAC input; 0-90 VDC output					**1/50**
					**1/20**
					**1/8**
GSD4-240-5C 120 VAC input; 0-90 VDC output					**1/8**
					**1/4**
					**1/3**
					**1/2**
					**3/4***
					**1.0***

Operation of the control beyond ±10% of the normal line voltage could result in re-adjustment. These adjustments are permanent; periodic re-adjustment is normally not needed.

Settings apply when using a 5K ohm master speedpot. This chart is used in conjunction with the adjustment procedure and is approximate.

HP	C.L.	I.R.	MAX	MIN	
1/20					**GSD4-240-1C** 240 VAC input; 0-180 VDC output
1/8					
1/4					
1/4					**GSD4-240-5C** 240 VAC input; 0-180 VDC output
1/3					
1/2					
3/4					
1.0					
1.5*					
2.0*					

* ADDITIONAL CUSTOMER HEATSINK REQUIRED for GSD4-240-5C with 120 VAC input & motors > 1/2 hp, and with 240 VAC input & motors > 1hp. Extrusion temperatures must not exceed 70 °C.

TRIM POT ADJUSTMENTS (CONTINUED)

GSD4-240-10N4X TRIM POT ADJUSTMENT

Use the applicable sections of the following procedures if the "Start-Up" procedures did not provide satisfactory motor/control performance. Follow the Safety Precautions given in the "Start-Up" section.

MAX SETTING

If a different maximum speed or voltage is desired, adjust the MAX trim pot (on circuit board) as follows:

1) Turn ON AC power to the control.
2) Set Speed Control knob fully (100%) CW.
3) Check motor speed and voltage with a tachometer and a DC Voltmeter.
4) Using an insulated handle screwdriver, adjust the MAX trim pot on the drive PC board. CW adjustment of the pot increases the maximum output to the motor; CCW adjustment decreases the maximum output to the motor.
   NOTE: Do not increase maximum motor speed above 1800 RPM for motors rated at 1725 RPM. Do not operate motor continuously above the rated DC voltage.

MIN SETTING

If a minimum speed is desired, adjust as follows:

1) Turn ON AC power to the drive.
2) Turn Speed Control knob CCW as far as possible.
3) Check motor output speed or voltage
4) Adjust the MIN trim pot on the drive PC board. CW adjustment of the pot increases output to the motor; CCW adjustment decreases.
   NOTE: Typically the MIN pot should be set at Deadband which is the point in the CW rotation just before getting an output.

IR SETTING

If better speed regulation is needed, then adjust the IR pot as follows:

1) Set speed at 50%.
2) Check speed with Tach at no load.
3) Apply normal load to the motor.
4) Adjust the IR pot CW to increase speed regulation or CCW to decrease speed regulation until loaded motor speed is equal to unloaded motor speed.

CUR LIM SETTING

Limits DC motor current to prevent damage to the motor or drive. CW rotation of this trim pot increases the maximum allowable armature current (or torque produced). To set:

1) Connect a DC current meter between A1 on motor and +ARM on the control (in series with the motor).
2) Set Speed pot at 50% or above.
3) Turn CL trim pot full CCW.
4) Stall and lock motor shaft so it can not spin.
5) With motor stalled, set current at 125% of rated motor current by adjusting CL trim pot CW.

ACCEL/DECEL SETTING

Individually Adjustable Linear Accel and Decel. These trim pots provide independently adjustable linear accel and decel from 0.5 to 8.0 seconds. Adjustment of both trim pots are accomplished via the labeled access holes on adder board. Full CCW rotation equals minimum accel or decel time, and full CW rotation equals maximum accel or decel time. Note: Each trim pot operates independently of the other.

TROUBLESHOOTING

If a newly installed DC Drive will not operate, it is likely that a terminal connection is loose. Check the terminal connections and ensure that they are secure and correct. If the drive is still inoperative, refer to the Troubleshooting Table.

Troubleshooting		
Problem	***Possible Cause(s)***	***Corrective Action***
Motor doesn't run	1) Blown fuse or circuit breaker 2) Incorrect or no power 3) Speed pot set at zero 4) Worn motor brushes	1) Replace fuse or reset breaker 2) Install proper power service 3) Rotate Speed pot CW to start 4) Replace motor brushes
Armature output voltage cannot be adjusted; output is a constant DC level ***Motor stalls, or runs very slowly with speed control set fully CW***	1) No motor or load connected 2) Speed pot low connection open 3) Low voltage 4) Overload condition 5) Worn motor brushes 6) Max speed set incorrectly	1) Ensure that motor or load is connected to armature terminals 2) Ensure that Speed pot Low wire is connected 3) Ensure that VAC is above 100VAC 4) Reduce load or increase motor size Current Limit setting 5) Replace brushes 6) Consult "Trim Pot Adjustments" section
Motor "hunts"	1) Motor current less than 150 mA 2) Too much IR Comp 3) Motor is in Current Limit 4) Motor speed is above rated speed 5) Max set too high	1) Motor current must be greater than 150 mA (DC) 2) Consult "Trim Pot Adjustments" section 3) Consult "Trim Pot Adjustments" section 4) Reduce speed 5) Consult "Trim Pot Adjustments" section
Repeated fuse blowing	1) Low voltage 2) Overload condition 3) Worn motor brushes 4) Defective motor bearings 5) Defective electrical components	1) Ensure that VAC is above 100 VAC for 120V systems and above 200V for 240V systems 2) Reduce load – disconnect to test 3) Replace brushes 4) Replace bearings 5) Contact AutomationDirect "Product Returns" for replacement

MV15 Series (LED Voltage Meters)

FEATURES

- Measurement Function
  - **1 Ø Voltage (True RMS)**
- 3 Digit LED Display

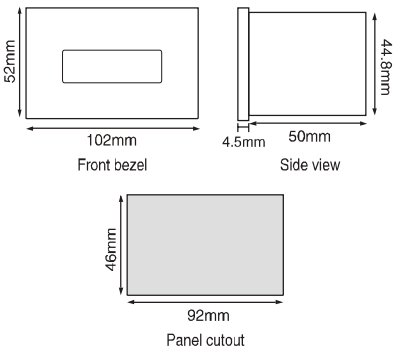


E253771



CAT. NO.	MV15-110V-CU	~~MV15-DC-20V-110V-CU~~ MV15-DC-200V-110V-CU
Display		
Display Type	7 segment LED Display	7 segment LED Display
Digits	3 digits	3 digits
Bargraph	–	–
Display Range	0 - 516V	0 - 516V
Supply Specification	110 VAC +/-20% (60Hz)	110 VAC +/-20% (60Hz)
Input Specification		
Electrical Wire System	1 Phase (2 wire)	1 Phase (2 wire)
Input Voltage Range	50 ~ 516 VAC	**0 ~ 20 VDC (MV15-20V) 0 ~ 200 VDC (MV15-200V)**
Frequency	50/60 Hz	50/60 Hz
Input Impedance	1 MΩ (+/-5%)	1 MΩ (+/-5%)
Parameter Resolution		
Voltage	1V	1V
Sample Rate	3 samples / sec.	3 samples / sec.
Accuracy Class		
Voltage	+/- 0.5% of Full-Scale Value	+/- 0.5% of Full-Scale Value
Output Specifications		
Pulse Output	–	–
Communication	–	–
Programmable Parameters	–	–
Environmental Specifications		
Temperature	Operating: -10°C~55°C, Storage: -20°C~ 75°C	Operating: -10°C~55°C, Storage: -20°C~ 75°C
Humidity	Up to 85% RH	Up to 85% RH
Protection Level	IP65 for Faceplate	IP65 for Faceplate
Physical Specifications		
Size	1/8 DIN, 48 mmx 96 mm	1/8 DIN, 48 mmx 96 mm
Weight	0.38 lbs (170g)	0.38 lbs (170g)
Terminal Size Acceptability and Torque	20-14 AWG (0.5 - 2.5mm²), 6-7 lb-in. (0.68 - 0.79Nm)	20-14 AWG (0.5 - 2.5mm²), 6-7 lb-in. (0.68 - 0.79Nm)

DIMENSIONS



MV15 Series

TERMINAL CONNECTIONS



MV15-110V-CU (AC Type)



MV15-DC-20V-110V-CU (DC Type)
MV15-DC-200V-110V-CU (DC Type)

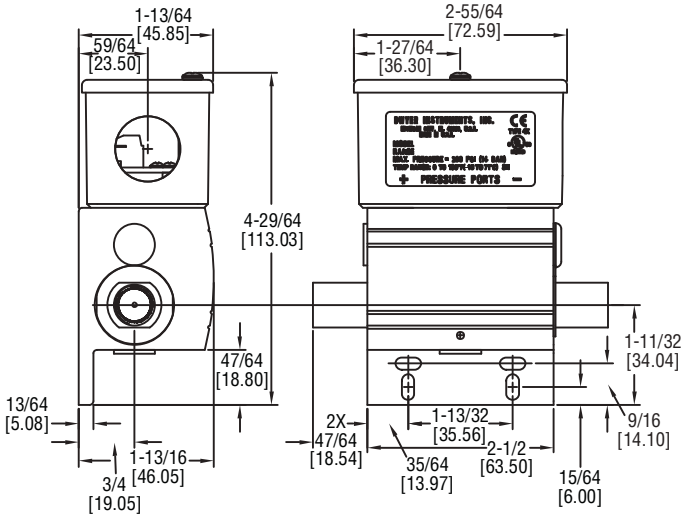
230 VAC versions also available, please consult Altech.

Altech Corp.® • 35 Royal Road • Flemington, NJ 08822-6000 • Phone (908)806-9400 • FAX (908)806-9490 • www.altechcorp.com

Series DX Differential Pressure Switch

Specifications - Installation and Operating Instructions





The Series DX is a pressure switch that makes a contact output based on the differential pressure between two pressure sources. Unit incorporates a SPDT snap switch in a weatherproof, type 4X enclosure. Series DX features low differential pressure set points with high single pressure limit.

OPERATING PRINCIPLE

The DX uses opposing diaphragms to sense the high and low pressure. A pivot mechanism transfers the difference of the two pressures to the switch.

Example	DX	W	1	1	153	2	M	DXW-11-153-2-M
Series	DX							Differential Pressure Switch
Construction		W						Weatherproof
Wetted Materials			1					Brass/Fluoroelastomer
Process Connection				1				1/4″ NPT
Circuit Options					153			SPDT
Range						1 2 3 4		2.5 to 10 psi 10 to 25 psi 25 to 50 psi 50 to 75 psi
Options							SST PRESET	Stainless Steel tag Preset set point

SPECIFICATIONS

Service: Compatible gases and liquids.
Wetted Materials: Connection: Brass; Diaphragm: Fluoroelastomer.
Temperature Limits: 30 to 140°F (-1 to 60°C).
Pressure Limits: 200 psig (13.8 bar).
Enclosure Rating: Weatherproof UL type 4X (IP65).
Repeatability: ±2% of full range.
Switch Type: SPDT snap switch.
Electrical Rating: 5A @ 125/250 VAC (~), 5A res. @ 30 VDC (⎓).
Electrical Connection: Removable terminal block.
Conduit Connection: 0.871″ diameter hole for 1/2″ conduit fitting.
Process Connection: 1/4″ NPT female. Continuous single side only pressure should not exceed 1.25 x full differential range.
Mounting Orientation: Ports on horizontal plane, ±10°.
Set Point Adjustment: External screw.
Housing Materials: Body: Aluminum; Housing: Polycarbonate; Cover: 300 SS.
Vibration and Shock: Set point repeats after 2.5 Gs, 5 to 500 Hz. Set point repeats after a 15 Gs, 10 millisecond duration.
Altitude Limit: 6560 ft (2000 m).
Humidity Limit: 80% (non-condensing).
Pollution Degree: 2.
Environment: Intended for indoor and outdoor use.
Weight: 1 lb 3 oz (0.54 kg).
Agency Approvals: CE, UL.

Adjustable Range psid (bar)	Fixed Deadband psid (bar)	
	At Low Set Point	At High Set Point
2.5 to 10 (0.17 to 0.69)	1.5 (0.10)	2.5 (0.17)
10 to 25 (0.69 to 1.72)	2.5 (0.17)	3.5 (0.24)
25 to 50 (1.72 to 3.45)	3.5 (0.24)	6.0 (0.41)
50 to 75 (3.46 to 5.17)	6.0 (0.41)	8.0 (0.55)

Approximate Deadbands

DWYER INSTRUMENTS, INC.
P.O. BOX 373 • MICHIGAN CITY, INDIANA 46361, U.S.A.
Phone: 219/879-8000
Fax: 219/872-9057
www.dwyer-inst.com
e-mail: info@dwyer-inst.com

UNPACKING

Remove the DX from the shipping carton and inspect for damage. If damage is found, notify the carrier immediately.

INSTALLATION

⚠CAUTION Insure that the process fluid is compatible with the wetted materials.

⚠CAUTION Do not exceed the maximum device ratings.

⚠CAUTION Insure that the system is not pressurized before installing or removing this device or other objects from the system.

The DX is to be mounted with the pressure connections horizontal ±10°.

For pipe mounting, mount the unit from the pressure connections to the pipe. Make sure the piping is properly supported to handle the weight of the pressure switch.

For surface mounting, mount the unit to the selected surface using the mounting ear holes provided using two #6 or #8 screws. See the Figure 2 for mounting hole spacing.

Make sure that connections are connected to the proper port. The high pressure port is marked with the "+" sign and is on the left side of the unit with the label side facing you. The low pressure port is marked by the "-" sign and is the right side of the unit. Piping or tubing should always be turned into the pressure port, do not turn the pressure switch. When installing the piping or tubing into the switch always use a wrench on the flats of the pressure connection. Use pipe thread sealant tape or other suitable pipe joint compound when making the pressure connection.

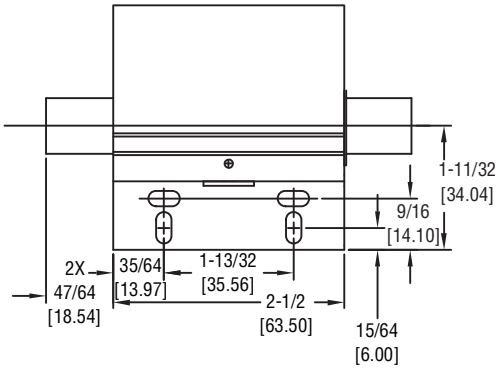


Figure 2: Mounting Hole Dimensions

ELECTRICAL CONNECTION

A SPDT snap action switch is provided. The output logic is shown in Table 1.

Condition	NO	NC
Differential Pressure Above Set Point	Closed	Open
Differential Pressure Below Set Point	Open	Closed

Table 1: Switch Action

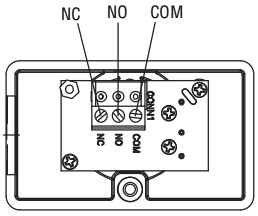


Figure 2: Wiring Diagram

⚠WARNING Power must be off while wiring connections are being made.

NOTICE Installation must be made in accordance with local codes and regulations.

Electrical connections are made to the removable terminal block inside the enclosure. Remove the terminal block from the circuit board for wiring if desired. Feed stripped and tinned leads through the conduit opening and connect them as shown in Figure 2. 250V @ 60C 14 to 24 AWG / 2.5 to .25 mm² wiring with PVC or equivalent insulation with 94-V0 or FV-0 flammability rating is recommended for the switch. Replace terminal block after wiring. The DX provides one 0.871″ diameter hole for 1/2″ conduit fitting. The conduit connections must be made such that condensation is not allowed to enter the sensor housing. If necessary install a conduit breather drain in a separate conduit body to prevent buildup of moisture.

NOTICE For weatherproof applications, install directly to conduit or use the optional cable gland accessory.

SETPOINT ADJUSTMENT

The set point is adjusted with a standard slotted head screw driver.

1) Remove rubber plug over set point adjustment screw located on the right side of the unit (with the label side facing you).
2) Insert the screw driver to turn the set point adjustment.
3) A clockwise rotation is an increase in differential pressure set point and a counterclockwise rotation is a decrease in differential pressure set point. (The set point screw can be turned too far as to fall out; do not turn the screw to the point that there are no longer any female threads visible in the switch body).
4) Using a pressure source and pressure gauge adjust the set point screw to the set point desired while monitoring the contact output.
5) Once desired set point is achieved replace set point adjustment cover.

NOTICE Design a fail-safe system that takes into consideration the possibility of switch failure, power failure, and operator error.

Explanation of Symbols:

Symbol	Publication	Description
⎓	IEC 50417 - 5031	Direct current
~	IEC 50417 - 5032	Alternating current
⏚	IEC 50417 - 5019	Protective conductor terminal

MAINTENANCE & REPAIR

Inspect and clean switch with water or damp cloth as needed. Disassembly or modifications made by the user will void the warranty and could impair the continued safety of the product. If repair is required obtain a Return Goods Authorization (RGA) number and send the unit, freight prepaid, to the address below. Please include a detailed description of the problem and conditions under which the problem was encountered.

Dwyer Instruments, Inc.
Attn: Repair Department
102 Indiana Hwy 212
Michigan City, IN 46360

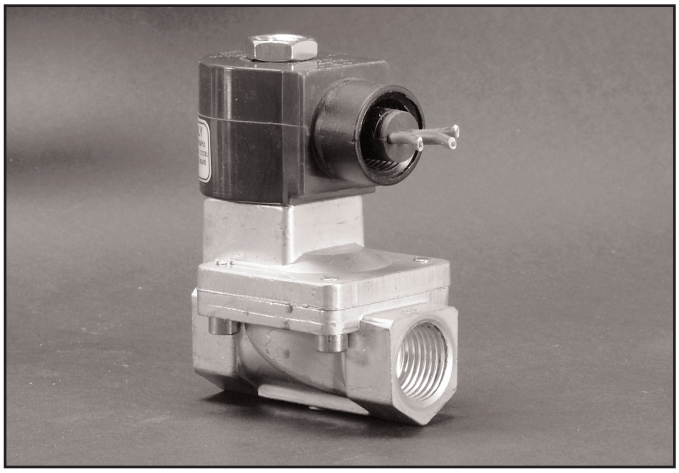
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S71 Series

GC VALVES

- 1/2" NPT
- Brass Body
- 2-Way Piloted Diaphragm
- Normally Closed



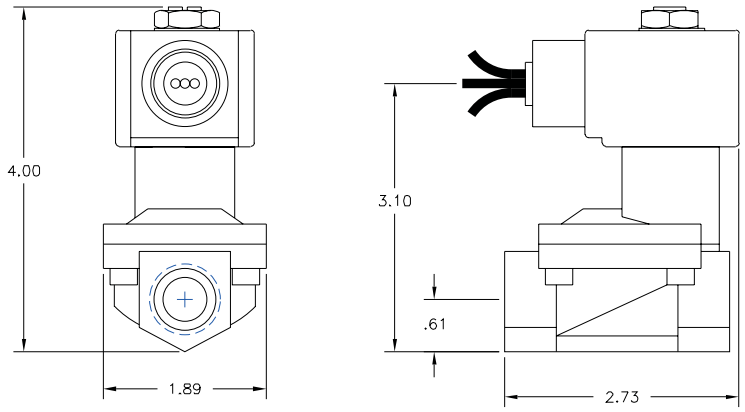
Materials	Seals:		Nitrile, Viton®, Ethylene Propylene
	Orifice:	Pilot Main	Brass Brass Ø 9/16”
Electrical	Standard Housing:		Encapsulated Waterproof Conduit (NEMA 4/4X)
	Optional Housings:		Metallic Conduit, Explosion-proof (NEMA 7), Grommet, Open Frame, Junction Box (single or dual knockouts), DIN; Contact GC Valves Customer Service for others.
	Standard Voltages:		24, 120, 240 AC 60 Hz; 50 Hz available 6, 12, 24 DC; Contact GC Valves Customer Service for Additional Voltages.
	Voltage Tolerance:		±10% of applicable voltage
	Coil Classes:		F, H, N
	Standard Lead Length:		24 inch
Operating Temperature	Ambient (Nominal):		32°F to 125°F
Mounting	Position:		Any
Approvals*	Agency:		UL Recognized, CSA Approved

* Not available for all variations

® Registered Trademark of DuPont Co.

Dimensions/Weight

Weight (lbs.)
2.5

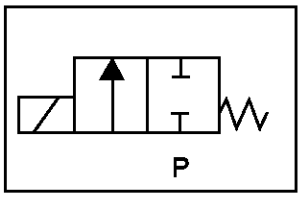


GC Valves Customer Service: 800-828-0484 (7:30am to 4pm ET) or 800-582-4232 (7:30am to 4pm PT)

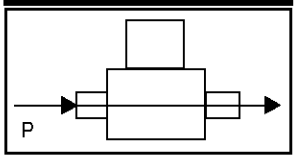
S711 – 1/2" NPT, Brass Body, Normally Closed

Valve Selection List

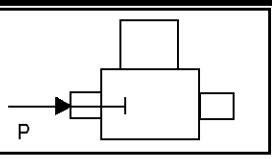
Normally Closed



Energized



De-Energized



Pipe Size	Orifice Size	CV	Operating Pressure Differential (psi)								Max Fluid Temp.	Seal Material	Power Consumption (Watts)		Model Code (120V/60HZ — 110V/50HZ Shown)
			Minimum	Maximum											
				Air/Gas		Water		Light Oil		Steam*					
NPT	IN			AC	DC	AC	DC	AC	DC	AC	DC	°F		AC	DC	Brass Body
1/2	1/2	4.3	8	200	150	150	100	—	—	—	—	295	EPR	8	9	S711GF02C9DG1
	1/2	4.3	8	200	150	150	100	150	100	—	—	180	Nitrile	8	9	S711GF02N9DG1
	1/2	4.3	8	200	150	150	100	150	100	—	—	230	Viton	8	9	S711GF02V9DG1
	1/2	4.3	8	—	—	—	—	—	—	50*	50*	295	EPR	8	9	S711GH02C9DG1

*** Class H Coil Recommended for Steam and Other High Temperature Applications**

Part Numbering

1 2 3	4	5	6	7 8	9	10	11	12 13
S71	1	F	F	02	V	9	D	G1
Series	Mode	Housing	Coil Class	Voltage	Seal Material	Body Material	Connection	Orifice Size
S71	1: Normally Closed	G: Conduit F: DIN	F: Class F H: Class H	02: 120/60 110/50	C: EPR N: Nitrile V: Viton	9: Brass	D: 1/2" NPT	G1: 1/2"

* See the "Engineering Guide" for additional voltages, variations and options.

Coil Data

Coil Family

Type	Size
ALL	S3

		60	50
Frequency (Hz)			
Nominal Power (VA)	Inrush	36	36
	Holding	13	14

Flo-Rite™ Series FR Flowmeters

DESCRIPTION

Series FR2000/FR4000/FR4500/FR5000 is a standard precision-machined acrylic flow meter for liquids or gases, has direct reading air or water scales and is available in either English or Metric scales.

The FR2000/FR4000/FR4500 flowmeters can be configured with a control valve on the inlet or no valve at all; fittings and valve can be specified in either brass or stainless steel; O-rings can be provided with Buna-N, Viton® or other optional elastomers.

FR5000 flowmeters have 1" FNPT PVC fittings with either an inline (FR5000-I) or panel mount (FR5000-S) configuration. The panel mount version is available with an integral valve on the inlet (FR5000-V) or no valve at all.

FEATURES

- Easy-to-read English or Metric Scales
- Water ranges from 4 CCM to 20 GPM
- Air ranges from 40 CCM to 4000 LPM
- Threaded brass inserts for quick installation
- Easy disassembly and assembly for maintenance
- Durable one-piece clear acrylic construction
- Stable, easy-to-read float
- Superior quality

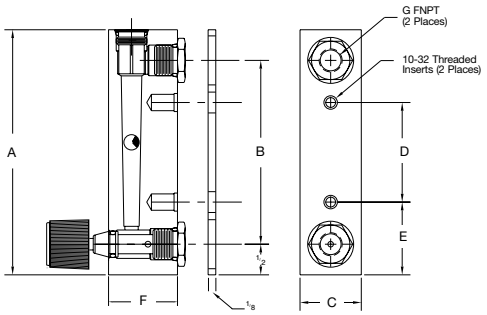
APPLICATIONS

- Air sampling equipment aquaculture
- Desalinization equipment
- Gas analyzers
- Medical systems
- Photoprocessing equipment
- Water treatment and distribution systems

SPECIFICATIONS

Accuracy	~~Model FR2000 ±5% Full Scale~~ Model FR4000 & FR4500 ±3% Full Scale ~~Model FR5000 ±2% Full Scale~~
Floats	Black Glass, Stainless Steel, Delrin®
Body	Clear Acrylic
Seals	Buna-N O-Rings with Brass Fittings ~~Viton® O-Rings with Stainless Steel Fittings~~
Pressure	100 PSIG Max
Temperature	150°F/65°C Max
Fittings	Brass, Stainless Steel or FNPT Pipe Connections
Valves ~~(optional)~~	Model FR2000/4000/4500 Brass or Stainless Steel Model FR5000 Integral Valve on "V" Models Inline Gate Valve is available for the "S" & "I"

SERIES FR2000/FR4000/FR4500 FLOWMETER

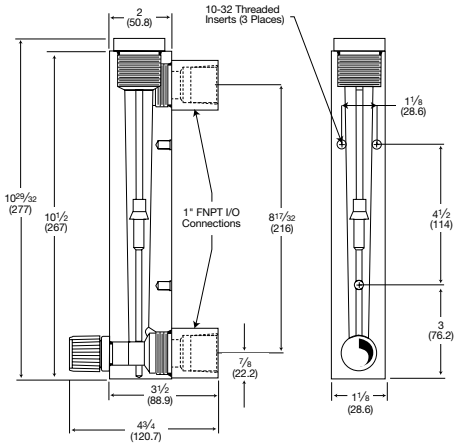


DIMENSIONS inches/millimeters (mm)

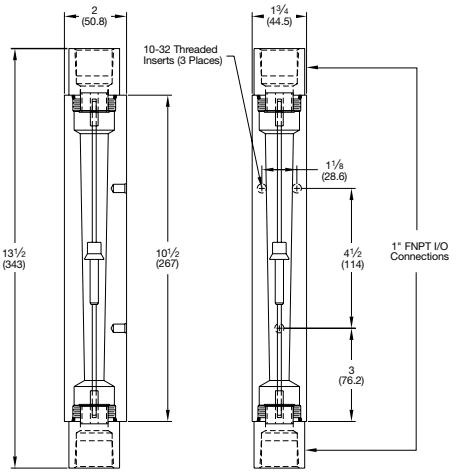
MODEL	A	B	C	D	E	F	G
FR2000	4" (102)	3" (76.2)	1" (25.4)	1⅝" (41.3)	1 3/16" (30.2)	1⅛" (28.6)	1/8"
FR4000	6½" (165)	5½" (140)	1⅜" (34.9)	3½" (88.9)	1½" (38.1)	1⅛" (28.6)	1/8"
FR4500*	6⅝" (168)	5½" (140)	1⅛" (28.6)	3½" (88.9)	1½" (38.1)	1⅜" (34.9)	1/4"

* Does not include 1/8" back plate

SERIES FR5000-S OR V



SERIES FR5000-I



KEY INSTRUMENTS • 250 Andrews Road • Trevose, PA 19053 • 800.356.7483 • 215.357.0893 • Fax: 215.357.9239
www.KeyInstruments.com • sales@keyinstruments.com

Flo-Rite™ Series FR Flowmeters

SERIES FR2000 FLOW RATES TABLE A **

Range SCFH of Air	Model Code	Range LPM of Air	Model Code
.1-1	2A00	.04-.5	2A12
.2-2	2A01	.1-1	2A13
.4-5	2A02	.2-2.5	2A29
1-10	2A03	.4-5	2A14
2-20	2A04	1-10	2A15
3-30	2A05	2-25	2A16
4-50	2A06	4-50	2A17
10-100	2A07	10-100	2A18
20-200	2A08	**GPH of Water**	
CCM of Water		.2-2	2L28
5-50	2L09	.4-5	2L19
10-100	2L10	1-10	2L20
20-240	2L11	2-20	2L21
		4-40	2L22

SERIES FR4000 FLOW RATES TABLE B **

Range SCFH of Air	Model Code	Range CCM of Water	Model Code
.4-5	4A30	4-50	4L38
1-10	4A31	10-120	4L56
2-20	4A32	25-225	4L51
4-40	4A33	40-400	4L50
10-100	4A34	40-660	4L52
14-150	4A35	100-1500	4L53
20-200	4A36	200-3000	4L54
CCM of Air		300-3700	4L55
100-1000	4A39*	**GPH of Water**	
LPM of Air		1-10	4L45
.4-5	4A40	2-25	4L48
1-10	4A41	4-50	4L49
2-20	4A42	6-60	4L46
3-30	4A43	**SCFM of Air**	
4-50	4A44	.3-3	4A37
10-100	4A47		

* Uses Delrin® Float
** Available with millimeter scales. Flow curves for a variety of gases and liquids for specific applications may also be ordered.

SERIES FR4500 FLOW RATES TABLE C

Range SCFM of Air	Model Code	Range GPM of Water	Model Code
.5-5	4A67	.2-2.5	4L64
1-10	4A65	.4-5	4L66
*2-20	4A68	**LPM of Water**	
LPM of Air		.8-9	4L69
14-140	4A72	1.5-20	4L71
30-280	4A70	Dual scales: SCFM/SCFH, GPM/GPH, and LPM/LPH	
*60-560	4A73		

* Not Available with Valves

SERIES FR5000-S OR V FLOW RATES TABLE D

Range SCFM of Air	Model Code	Range GPM of Water	Model Code
3-25	5A50	.4-5	5L56
4-50	5A51	1-10	5L57
10-100	5A52	2-20	5L58
LPM of Air		**LPM of Water**	
100-700	5A53	1-19	5L59
100-1400	5A54	4-36	5L60
400-3400	5A55	5-75	5L61

SERIES FR5000-I FLOW RATES TABLE E

Range SCFM of Air	Model Code	Range GPM of Water	Model Code
3-25	5A50	.4-5	5L56
4-50	5A51	1-10	5L57
10-100	5A52	2-20	5L58
LPM of Air		**LPM of Water**	
100-700	5A53	1-19	5L59
100-1400	5A54	4-36	5L60
400-4000	5A55	5-75	5L61

Periodically, product revisions occur. Please consult the factory for the latest specifications.

ORDERING INFORMATION 2 INCH / 4 INCH SCALE

Catalog Number Ordering Example: **FR2A04BVBN**

EXAMPLE:	FR	2A04	B	V	BN

Acrylic Flowmeter
Product Code

Model Number
From Tables A, B & C

Fittings
B = Brass (std), S = Stainless Steel

Valve
N = No Valve, V = Standard Inlet Valve

Seals
BN = Buna-N (std with brass fittings),
VT = Viton® (std with stainless steel),
S = Special (specify compound)

Catalog Number Ordering Example: **FR4A30SNVT**

EXAMPLE:	FR	4A30	S	N	VT

Acrylic Flowmeter
Product Code

Model Number
From Tables A, B & C

Fittings
B = Brass (std), S = Stainless Steel

Valve
N = No Valve, V = Standard Inlet Valve

Seals
BN = Buna-N (std with brass fittings),
VT = Viton® (std with stainless steel),
S = Special (specify compound)

KEY INSTRUMENTS • 250 Andrews Road • Trevose, PA 19053 • 800.356.7483 • 215.357.0893 • Fax: 215.357.9239
www.KeyInstruments.com • sales@keyinstruments.com

ECX Series 22 mm Plastic Indicator Lights

Plastic incandescent indicator lights



ECX1051-24

These indicators have a key to prevent rotation when mounted.

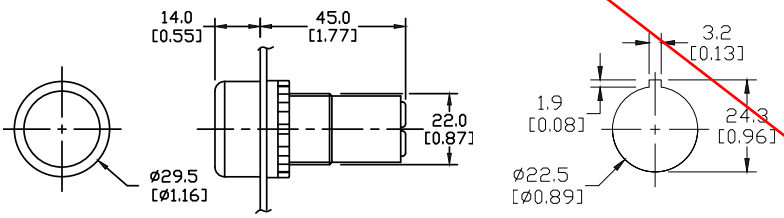
12 models available:

- Available in six colors
- 24V and 120V models
- Incandescent bulbs included
- Accepts LED replacement lamps
- Monoblock design for easy mounting
- Side wire entry with back screw terminals for easy wiring and maintenance
- IP20 rated before installation
- IP65 rated after installation

Note: When using LED replacement lamps with these indicators, it may be necessary to remove the frosted diffuser for enhanced illumination.

Part Number	Lamp Color	Price	Description	Replacement Incandescent Bulb	Replacement Lamp
ECX1051-24	Red	<--->	22 mm monoblock incandescent indicator light, **24VDC/VAC**	**ECX1902-5** 5/pk 80mA	**ECX1911-2** 2/pk 26mA
ECX1051-120	Red	<--->	22 mm monoblock incandescent indicator light, **120VDC/VAC**	**ECX1904-5** 5/pk 20mA	**ECX1921-2** 2/pk 5mA
ECX1052-24	Green	<--->	22 mm monoblock incandescent indicator light, **24VDC/VAC**	**ECX1902-5** 5/pk 80mA	**ECX1912-2** 2/pk 26mA
ECX1052-120	Green	<--->	22 mm monoblock incandescent indicator light, **120VDC/VAC**	**ECX1904-5** 5/pk 20mA	**ECX1922-2** 2/pk 5mA
ECX1053-24	Yellow	<--->	22 mm monoblock incandescent indicator light, **24VDC/VAC**	**ECX1902-5** 5/pk 80mA	**ECX1913-2** 2/pk 26mA
ECX1053-120	Yellow	<--->	22 mm monoblock incandescent indicator light, **120VDC/VAC**	**ECX1904-5** 5/pk 20mA	**ECX1923-2** 2/pk 5mA
ECX1054-24	Blue	<--->	22 mm monoblock incandescent indicator light, **24VDC/VAC**	**ECX1902-5** 5/pk 80mA	**ECX1914-2** 2/pk 26mA
ECX1054-120	Blue	<--->	22 mm monoblock incandescent indicator light, **120VDC/VAC**	**ECX1904-5** 5/pk 20mA	**ECX1924-2** 2/pk 5mA
ECX1055-24	Clear	<--->	22 mm monoblock incandescent indicator light, **24VDC/VAC**	**ECX1902-5** 5/pk 80mA	**ECX1915-2** 2/pk 26mA
ECX1055-120	Clear	<--->	22 mm monoblock incandescent indicator light, **120VDC/VAC**	**ECX1904-5** 5/pk 20mA	**ECX1925-2** 2/pk 5mA
ECX1056-24	White	<--->	22 mm monoblock incandescent indicator light, **24VDC/VAC**	**ECX1902-5** 5/pk 80mA	**ECX1915-2** 2/pk 26mA
ECX1056-120	White	<--->	22 mm monoblock incandescent indicator light, **120VDC/VAC**	**ECX1904-5** 5/pk 20mA	**ECX1925-2** 2/pk 5mA

Dimensions: mm [inches]



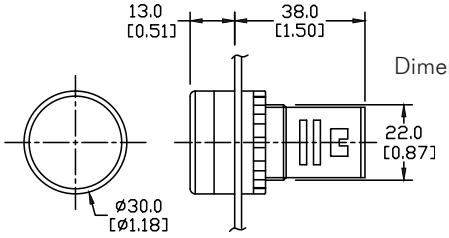
Plastic LED indicator lights



10 models available:

- Available in five colors
- 24V and 120V models
- Non-replaceable LEDs
- Side wire entry with back screw terminals for easy wiring and maintenance
- IP20 rated before installation
- IP65 rated after installation
- 12 mA @ 120V, 65 mA @ 24V

Part Number	Lamp Color	Price	Description
ECX2051-24L	Red	<--->	22 mm non-metal monoblock LED indicator light, **24VDC/VAC**
ECX2051-127L	Red	<--->	22 mm non-metal monoblock LED indicator light, **120VDC/VAC**
ECX2052-24L	Green	<--->	22 mm non-metal monoblock LED indicator light, **24VDC/VAC**
ECX2052-127L	Green	<--->	22 mm non-metal monoblock LED indicator light, **120VDC/VAC**
ECX2053-24L	Yellow	<--->	22 mm non-metal monoblock LED indicator light, **24VDC/VAC**
ECX2053-127L	Yellow	<--->	22 mm non-metal monoblock LED indicator light, **120VDC/VAC**
ECX2054-24L	Blue	<--->	22 mm non-metal monoblock LED indicator light, **24VDC/VAC**
ECX2054-127L	Blue	<--->	22 mm non-metal monoblock LED indicator light, **120VDC/VAC**
ECX2055-24L	Clear	<--->	22 mm non-metal monoblock LED indicator light, **24VDC/VAC**
ECX2055-127L	Clear	<--->	22 mm non-metal monoblock LED indicator light, **120VDC/VAC**



Dimensions: mm [inches]

For accessories, see 22 mm Plastic Pilot Device Accessories in this section.

Octal Base Plug-In General-Purpose Relay — MKS Series

RoHS

Reliable, high quality, long life. Silver contacts rated at 10 amps. UL, CSA rated. Built-in indicator standard. **Options Include:** LED indicator, diode or varistor suppression and reverse polarity coil connections. All MKS models with "I" also come with push-to-test button.



With Test Button

DPDT, 10 Amp

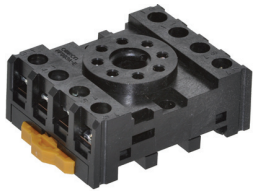
Stock No.	Mfr.'s Type	Coil Rating			Features	EACH
		Voltage (V)	Curr. (mA)	Res. (Ohms)		
70178929	MKS2PI DC12	12 VDC	126.0	95.0	Button	12.44
70178930	MKS2PI DC24	24 VDC	56.0	430.0	Button	11.66
70178934	MKS2PIN DC24	24 VDC	56.0	430.0	Button/LED	15.10
70178935	MKS2PN DC24	24 VDC	56.0	430.0	LED	15.10
70178931	MKS2PI DC48	48 VDC	29.5	1630.0	Button	12.49
70178928	MKS2PI DC110	110 VDC	15.1	7300.0	Button	12.49
70178924	MKS2PI AC12	12 VAC	180.0	16.3	Button	12.44
70178926	MKS2PI AC24	24 VAC	88.0	68.0	Button	12.44
70178933	MKS2PIN AC24	24 VAC	88.0	68.0	Button/LED	15.10
70178925	MKS2PI AC120	120 VAC	18.0	1578.0	Button	13.35
70178932	MKS2PIN AC120	120 VAC	18.0	1578.0	Button/LED	15.37
70178927	MKS2PI AC240	240 VAC	9.2	6737.0	Button	14.22

3PDT, 10 Amp

70178948	MKS3PI DC12	12 VDC	126.0	95.0	Button	15.09
70178946	MKS3PI-5 DC12	12 VDC	126.0	95.0	Button	14.21
70178947	MKS3PI-5 DC24	24 VDC	56.0	430.0	Button	14.21
70178950	MKS3PIN-5 DC24	24 VDC	56.0	430.0	Button/LED	16.86
70178945	MKS3PI-5 DC110	110 VDC	15.1	7300.0	Button	15.99
70178943	MKS3PI-5 AC24	24 VAC	88.0	68.0	Button	14.21
70178942	MKS3PI-5 AC120	120 VAC	18.0	1578.0	Button	15.09
70178949	MKS3PIN-5 AC120	120 VAC	18.0	1578.0	Button/LED	14.99
70178944	MKS3PI-5 AC240	240 VAC	9.2	6737.0	Button	15.99

Quality Sockets and Clips for Relays

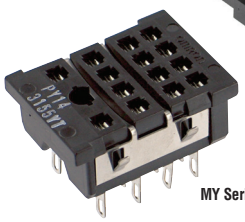
RoHS



MK Series



LY Series



MY Series

Stock No.	Mfr.'s Type	For Relay Series	Application	EACH		
				1-49	50-99	100-249
70179013	PF083A-E	MK 2-Pole	Surface- or Rail-Mount	3.72	3.50	3.33
70179014	PF113A-E	MK 3-Pole	Surface- or Rail-Mount	5.27	4.95	4.72
70179022	PL08	MK 2-Pole	Solder	1.87	1.76	1.67
70179023	PL11	MK 3-Pole	Solder	2.26	2.13	2.02
70179024	PLE08-0	MK 2-Pole	PCB Terminal	2.87	2.72	2.58
70179025	PT08	LY 1- and 2-Pole	Solder	1.75	1.65	1.56
70179026	PT08-0	LY 1- and 2-Pole	PCB Terminal	1.44	1.35	1.31
70179027	PT14-0	LY 4-Pole	PCB Terminal	2.28	2.16	2.04
70179028	PTF08A-E	LY 1- and 2-Pole	Surface- or Rail-Mount	4.19	3.93	3.75
70179029	PTF11A	LY 3-Pole	Surface- or Rail-Mount	6.69	6.32	6.00
70179033	PTF14A-E	LY 4-Pole	Surface- or Rail-Mount	6.01	5.64	5.38
70179032	PTF14A-E	LY 4-Pole	Surface- or Rail-Mount	10.32	9.79	9.35
70179048	PYF14A-N	MY 4-Pole	Surface- or Rail-Mount	6.68	6.32	5.99
70179037	PY08-02	MY 2-Pole	PCB Terminal	1.24	1.17	1.11
70179038	PY14	MY 4-Pole	Solder	1.71	1.61	1.52
70179039	PY14-02	MY 4-Pole	PCB Terminal	1.71	1.61	1.52
70179042	PYF08A-E	MY 2-Pole	Surface- or Rail-Mount	4.90	4.61	4.35
70179047	PYF14A-E	MY 4-Pole	Surface- or Rail-Mount	6.54	6.12	5.86
70179049	PYF14S	MY 4-Pole	Screwless Socket	9.72	9.12	8.71

Accessories

Stock No.	Mfr.'s Type	Description	Used With	EACH		
				1-24	25-49	50-99
70179016	PFP-100N	DIN Rail, 1 m	All Relay Sockets	6.30	5.93	5.60
70179015	PFC-A1	Hold-Down clip	PF083A-E, PF113A-E	.76	.70	.66
70179040	PYC-A1	Hold-Down Clip	PTF08A-E, PTF11A, PTF14A-E, PYF08A-E, PYF08A-N, PYF14A-E, PYF14A-N	.22	.21	.20

Slim, Space-Saving Power Plug-In Relay — G2RS Series

RoHS



One and two pole plug-in relays. **Specifications. Contact Form:** G2R-1-S — SPDT; G2R-2-S — DPDT. **Contact Resistance:** 100 mΩ. **Contact Ratings:** G2R-1-S — 10 A @ 250 VAC; G2R-2-S — 5 A @ 250 VAC (resistive). **Operate Time:** 15 ms max. **Release Time:** 1 pole = AC — 10 ms max.; DC — 5 ms max.; 2 pole = AC — 15 ms max.; DC — 10 ms max.; Diode version = 20 ms max. Available options include LED indicators, push-to-test button, and diode suppression (DC coils). Other coil voltages available.

General-Purpose Relays

Stock No.	Mfr.'s Type	Contact Form	Coil Ratings				EACH		
			Voltage	Current (mA)	Res. (Ohms)	Power Consump.	1-24	25-49	50-99
70178581	G2R-1-S DC6(S)	SPDT	6 VDC	88.2	68	0.530 W	4.24	3.92	3.60
70178579	G2R-1-S-DC12(S)	SPDT	12 VDC	43.2	278	0.530 W	4.72	4.43	4.23
70178580	G2R-1-S-DC24(S)	SPDT	24 VDC	21.6	1113	0.530 W	3.80	3.63	3.48
70178578	G2R-1-S-AC24(S)	SPDT	24 VAC	37.4	253	0.900 VA	5.92	5.57	5.30
70178577	G2R-1-S-AC120(S)	SPDT	120 VAC	7.5	7286	0.900 VA	6.94	6.50	6.21
70179136	G2R-2-S-DC12(S)	DPDT	12 VDC	43.2	278	0.530 W	4.88	4.66	4.39
70178598	G2R-2-S-DC24(S)	DPDT	24 VDC	21.6	1113	0.530 W	5.40	5.04	4.83
70178596	G2R-2-S-AC24(S)	DPDT	24 VAC	37.4	253	0.900 VA	7.51	7.04	6.72
70178595	G2R-2-S-AC120(S)	DPDT	120 VAC	7.5	7286	0.900 VA	7.40	7.06	6.65

Relays with Diode

70178582	G2R-1-SD DC24(S)	SPDT	24 VDC	21.8	1100	0.530 W	6.05	5.74	5.48
70178599	G2R-2-SD-DC24(S)	DPDT	24 VDC	21.6	1113	0.530 W	6.75	6.54	6.34

Relays with LED Indicator

70178586	G2R-1-SN-DC12(S)	SPDT	12 VDC	43.2	278	0.530 W	7.37	7.14	6.92
70178587	G2R-1-SN-DC24(S)	SPDT	24 VDC	21.6	1113	0.530 W	7.72	7.24	6.92
70178590	G2R-1-SNDI DC24(S)	SPDT	24 VDC	21.6	1113	0.530 W	10.10	9.60	8.54
70178585	G2R-1-SN AC24(S)	SPDT	24 VAC	37.4	253	0.900 VA	7.53	7.20	6.76
70178583	G2R-1-SN-AC110(S)	SPDT	110 VAC	8.2	5566	0.900 VA	9.54	8.95	8.56
70178584	G2R-1-SN-AC120(S)	SPDT	120 VAC	7.5	7286	0.900 VA	11.32	10.61	10.14
70178602	G2R-2-SN-DC24(S)	DPDT	24 VDC	21.6	1113	0.530 W	10.50	9.85	9.40
70178600	G2R-2-SN-AC120(S)	DPDT	120 VAC	7.5	7286	0.900 VA	10.95	10.27	9.80

Relays with LED Indicator and Diode

70178588	G2R-1-SND-DC12(S)	SPDT	12 VDC	43.2	278	0.530 W	11.14	10.42	9.96
70178589	G2R-1-SND-DC24(S)	SPDT	24 VDC	21.6	1113	0.530 W	8.74	8.32	7.52
70178603	G2R-2SND-DC12(S)	DPDT	12 VDC	43.2	278	0.530 W	10.36	10.05	9.73
70178604	G2R-2-SND-DC24(S)	DPDT	24 VDC	21.6	1113	0.530 W	12.39	11.63	11.11
70178605	G2R-2-SNI DC24(S)	DPDT	24 VDC	21.6	1113	0.530 W	8.40	7.93	7.52
70178601	G2R-2-SN AC24(S)	DPDT	24 VAC	37.4	253	0.900 VA	9.67	9.14	8.67

Accessories

Stock No.	Mfr.'s Type	Description	EACH
70179003	P2RF-05	Track (DIN) mounted socket for G2R-1-S, Solder Terminals	6.15
70179004	P2RF-05-E	Track (DIN) mounted socket for G2R-1-S, Screw Terminals	3.61
70179001	P2R-05P	PCB Back mount socket for G2R-1-S	1.60
70179006	P2RF-08	Track (DIN) mounted socket for G2R-2-S, Solder Terminals	7.39
70179007	P2RF-08-E	Track (DIN) mounted socket for G2R-2-S, Screw Terminals	6.38
70179002	P2R-08P	PCB Back mount socket for G2R-2-S	1.78

Octal Base Dual Coil Magnetic Latching Relay — MK2KP Series

RoHS



Reliable, high quality, long life. Silver contacts rated at 10 amps. UL, CSA rated. Built-in indicator standard. **Options Include:** LED indicator, suppression diode or varistor.

Stock No.	Mfr.'s Type	Contact Form	Coil Rating			EACH		
			Voltage (V)	Curr. (mA)	Res. (Ohms)	1-24	25-49	50-99
70178907	MK2KP-UA-AC24	DPDT-S*	24 VAC	66.0	105.0	43.97	41.56	39.40
		DPDT-R*		10.8	965.0			
70178906	MK2KP-UA-AC120	DPDT-S*	120 VAC	19.0	1900.0	39.90	37.41	35.72
		DPDT-R*		4.2	12400.0			
70178908	MK2KP-UA-DC12	DPDT-S*	12 VDC	205.0	52.0	38.45	37.07	35.14
		DPDT-R*		50.0	240.0			
70178909	MK2KP-UA-DC24	DPDT-S*	24 VDC	110.0	210.0	47.03	43.41	40.31
		DPDT-R*		22.8	1050.0			

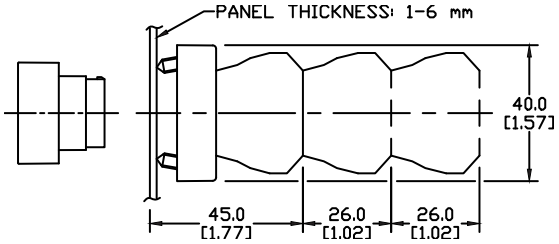
*S = Set coil, R = Reset coil DPDT — 11-pin octal socket.

GCX Series 22 mm Plastic Pilot Devices Specifications

Assembly information

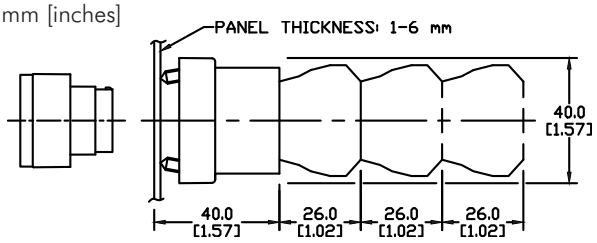
These pushbuttons and indicator lights are supplied with the appropriate contact blocks, unless otherwise indicated. Use these drawings as a guide to make sure there is adequate clearance behind the panel.

Pushbuttons and selector switches



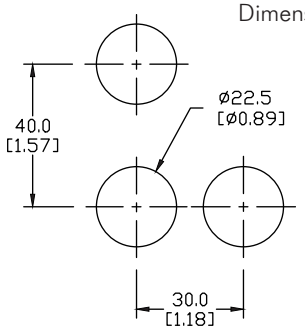
Dimensions: mm [inches]

Illuminated pushbuttons and selector switches/indicator lights

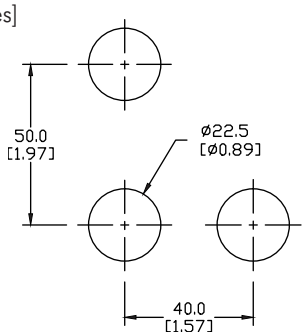


Mounting

Dimensions: mm [inches]



This layout is suitable if all switches are 230V or less and the same polarity.

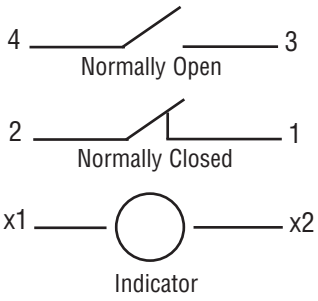


This layout is suitable if all switches are 400V or less and different polarity.



NOTE: Contact blocks can be arranged up to three deep by two wide.

Typical Wiring



Specifications

These specifications apply to all the GCX and ECX 22 mm plastic pushbuttons and switches.

Physical Specifications	
Standards Reference	CEI EN 60947-5-1, CSA C22-2 n.14
Approvals	CSA, IMQ (where specified), UL File E189258
Enclosure Material	Fiberglass reinforced thermoplastic
Contacts Material	Silver
Protection Degree	IP 40 for GCX3151-24, GCX3151-120, GCX3153-24 and GCX3153-120. IP 65 for all others.(See Appendix of this catalog for explanation of IP ratings according to IEC 144 CEI 70-1.)
Electric Shock Protection	IEC 536, Class II
Temperature Ratings	Storage: -40° -to 80°C (-40° to 176° F) Operating: -25° to +70°C (-13° to 158° F)
Working Positions	All working positions are allowed
Mechanical Life	Pushbuttons, selector switches, joy stick switches: 1,000,000 operations Emergency mushrooms and push-push pushbuttons: 300,000 operations
Positive Opening Operation	(according to IEC 947-5-1) All functions incorporating an NC contact are positive opening operation

Electrical Specifications	
Rated Thermal Current (contact block)	A300, Q300 (Refer to E22 Series mounting/contact rating section for details)
Rated Insulation Voltage	Ui 660V according to CEI EN 60947-5-1, 300V according to CSA C22-2 n.14 and UL 508
Dielectric Strength	3kV (1 second)
Insulation Resistance	2MΩ min. (500VDC)
Initial Contact Resistance	≤25mΩ
Short-Circuit Protection*	Cartridge fuses gl 10 A-500V 10, 3x38l1 100 KA
Terminal Markings	According to CENELEC EN 50013
Connections	Single screw with non-loosening plate clamp,14AWG max., Tighten to 0.8Nm max
Contacts Operation	Self-cleaning types EN01 (N.C.) EN 10 (N.O.) slow action, positive opening
Operation Frequency	3600 operations per hour max.
Utilization Category	**AC15** (Control of AC electromagnetic loads) 24 volts AC at 10 amps 130 volts AC at 6.5 amps **DC13** (Control of DC electromagnetic loads) 24 volts DC at 1.5 amps 110 volts DC at 0.5 amps

Note: Recommended, not supplied

GCX Series 22 mm Plastic Key Switches and Selector Switches

Key-operated selector switches



GCX3420 (2-position maintained)
- Keyed switches come with two keys.

Part Number	Price	Description
GCX3420	<--->	22 mm plastic selector switch, key-operated, **two-position maintained**, key can be removed in all positions. **One N.O.** contact block. Replacement keys available
GCX3430	<--->	22 mm plastic selector switch, key-operated, **two-position spring-return from right.** **One N.O.** contact block. Replacement keys available
GCX3470-22	<--->	22 mm plastic selector switch, key-operated, **three-position maintained**, key can be removed in all positions. **Two N.O.** and **two N.C.** contact blocks. Replacement keys available

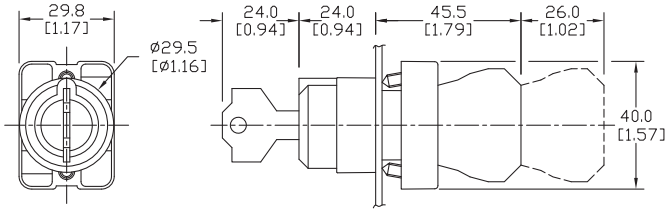


Note: Keyed switches come with two keys. All plastic 22 mm keyed switches are keyed the same. Replacement keys are available. Order part no. ECX1067-2 (pkg. of 2). Keys for plastic 22 mm keyed switches are not compatible with Cutler-Hammer key switches.



Note: When using switches having two-deep contact blocks (such as, Model GCX3470-22) with the 22 mm plastic enclosures, be sure to use enclosures that are 74 mm deep. 51 mm-deep enclosures are too shallow and the switch body will not fit.

Dimensions: mm [inches]



Two-position selector switches

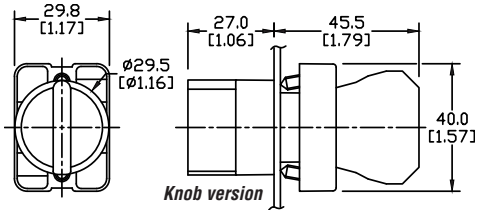


GCX3300 Knob version



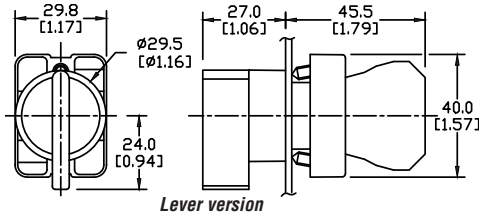
GCX3350 Lever version

Part Number	Price	Description - 2-Position Switches
GCX3300	<--->	22 mm plastic selector switch, two-position **maintained**, black knob. **One N.O.** contact block
GCX3310	<--->	22 mm plastic selector switch, two-position **spring-return from right**, black knob. **One N.O.** contact block
GCX3350	<--->	22 mm plastic selector switch, two-position **maintained**, black lever. **One N.O.** contact block
GCX3360	<--->	22 mm plastic selector switch, two-position **spring-return from right,** black lever. **One N.O.** contact block



Knob version

Dimensions: mm [inches]



Lever version

Contact Closure Sequence for Two-Position Switch

Contact Closure Sequence - 2-Position Switch				
Contact Blocks	Contact Arrangement (viewed from front)		Switch Position (viewed from front)	
	Left	Right	Left (Note 1)	Right (Note 2)
1 x NC	NC		X	
		NC	X	
1 x NO	NO			X
		NO		X
2 x NC	NC	NC	XX	
2 x NO	NO	NO		XX

Note 1: Left switch position deactivates all contacts.
Note 2: Right switch position activates all contacts.

For accessories, see 22 mm Plastic Pilot Device Accessories in this section.

GCX Series 22 mm Plastic Selector Switches

Three-position selector switches

Part Number	Price	Description - 3-Position Switches
GCX3320-22	<--->	22 mm plastic selector switch, three-position **maintained**, black knob, **Two N.O.** and **two N.C.** contact blocks
GCX3330-22	<--->	22 mm plastic selector switch, three-position **spring-return to center**, black knob, **Two N.O.** and **two N.C.** contact blocks
GCX3370-22	<--->	22 mm plastic selector switch, three-position, **maintained**, black lever, **Two N.O.** and **two N.C.** contact blocks
GCX3380-22	<--->	2 mm plastic selector switch, three-position **spring-return to center**, black lever, **Two N.O.** and **two N.C.** contact blocks



Note: When using switches having two-deep contact blocks with the 22 mm plastic enclosures, be sure to use enclosures that are 74 mm deep; 51 mm-deep enclosures are too shallow and the switch body will not fit.

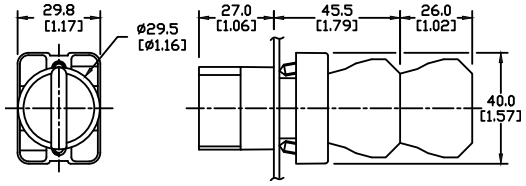


GCX3330-22 Knob version

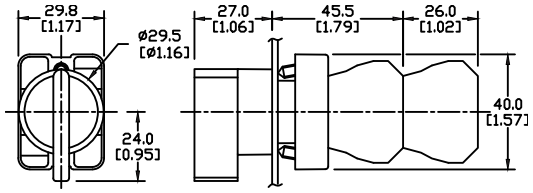


GCX3370-22 Lever version

Dimensions: mm [inches]



Knob version



Lever version

Contact Closure Sequence for Three-Position Switch

Contact Closure Sequence - 3-Position Switch					
Contact Blocks	Contact Arrangement (viewed from front)		Switch Position (viewed from front)		
	Left	Right	Left (Note 1)	Center (Note 2)	Right (Note 3)
1 x NC	NC			X ——— X	
		NC	X ——— X		
1 x NO	NO		X		
		NO			X
2 x NC	NC	NC	X ——— XX ——— X		
2 x NO	NO	NO	X		X

Note 1: Left switch position activates left side contacts (viewed from front).
Note 2: Center switch position deactivates all contacts.
Note 2: Right switch position activates right side contacts (viewed from front).

For accessories, see 22 mm Plastic Pilot Device Accessories in this section.

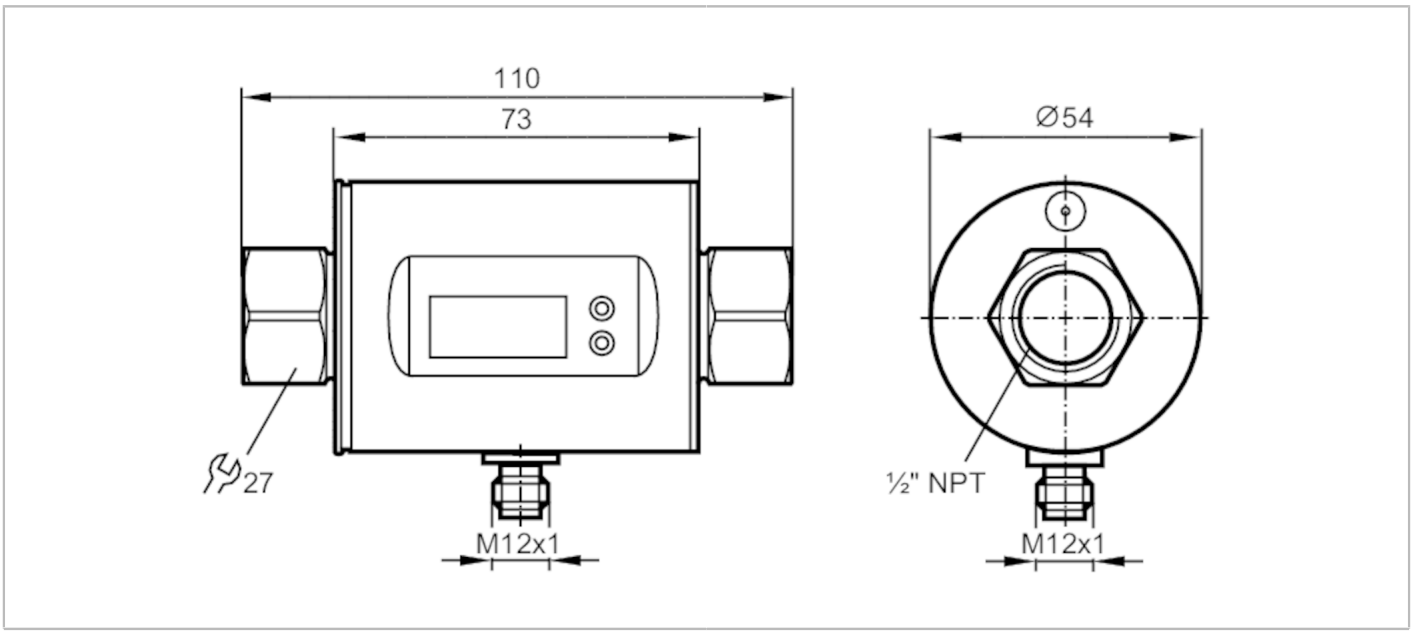
Section 3.6.6

Sludge Line Flowmeter

SM6601

Magnetic-inductive flow meter

SMN12GGXFRKG/US-100



CE CRN cULus LISTED EAC EC 1935/2004 IO-Link UKCA

Product characteristics			
Number of inputs and outputs		Number of digital outputs: 2; Number of analog outputs: 1	
Measuring range		1.5...396 gph	0.03...6.6 gpm
Process connection		threaded connection 1/2" NPT DN15	
Application			
System		gold-plated contacts	
Application		Totalizer function; for industrial applications	
Media		Conductive liquids; water; water-based media	
Note on media		conductivity: ≥ 20 µS/cm viscosity: < 70 mm²/s (40 °C)	
Medium temperature	[°F]	14...158	
Pressure rating	[bar]	16	
Pressure rating	[psi]	232	
MAWP (for applications according to CRN)	[bar]	17.7	
Electrical data			
Operating voltage	[V]	18...30 DC; (according to EN 50178 SELV/PELV)	
Current consumption	[mA]	95; (24 V)	
Min. insulation resistance	[MΩ]	100; (500 V DC)	
Protection class		III	
Reverse polarity protection		yes	
Power-on delay time	[s]	5	
Inputs / outputs			
Number of inputs and outputs		Number of digital outputs: 2; Number of analog outputs: 1	
Inputs			
Inputs		counter reset	

SM6601

Magnetic-inductive flow meter

SMN12GGXFRKG/US-100

Outputs			
Total number of outputs		2	
Output signal		switching signal; analog signal; pulse signal; IO-Link; (configurable)	
Electrical design		PNP/NPN	
Number of digital outputs		2	
Output function		normally open / closed; (configurable)	
Max. voltage drop switching output DC	[V]	2	
Permanent current rating of switching output DC	[mA]	200	
Number of analog outputs		1	
Analog current output	[mA]	4...20; (scalable)	
Max. load	[Ω]	500	
Analog voltage output	[V]	0...10; (scalable)	
Min. load resistance	[Ω]	2000	
Pulse output		flow rate meter	
Short-circuit protection		yes	
Type of short-circuit protection		yes (non-latching)	
Overload protection		yes	
Measuring/setting range			
Measuring range		1.5...396 gph	0.03...6.6 gpm
Display range		-475.5...475.5 gph	-7.925...7.925 gpm
Resolution		0.5 gph	0.01 gpm
Set point SP		3.5...396.5 gph	0.06...6.6 gpm
Reset point rP		1.5...394 gph	0.03...6.57 gpm
Analog start point ASP		0...318 gph	0...5.3 gpm
Analog end point AEP		78...396 gph	1.3...6.6 gpm
In steps of		0.5 gph	0.01 gpm
Volumetric flow quantity monitoring			
Pulse value		0.01...30 000 000 gal	
Pulse length	[s]	0,01...2	
Temperature monitoring			
Measuring range	[°F]	-4...176	
Resolution	[°F]	0.1	
Set point SP	[°F]	-2.5...176	
Reset point rP	[°F]	-3.5...175	
Analog start point	[°F]	-4...140.5	
Analog end point	[°F]	31.5...176	
In steps of	[°F]	0.5	
Accuracy / deviations			
Flow monitoring			
Accuracy (in the measuring range)		± (0,8 % MW + 0,5 % MEW)	
Repeatability		± 0,2% MEW	

SM6601

Magnetic-inductive flow meter

SMN12GGXFRKG/US-100

Temperature monitoring			
Accuracy	[K]	± 2,5 (Q > 0,26 gpm)	
Reaction times			
Flow monitoring			
Response time	[s]	0.15; (dAP = 0, T19)	
Delay time programmable dS, dr	[s]	0...50	
Damping for the switching output dAP	[s]	0...5	
Temperature monitoring			
Dynamic response T05 / T09	[s]	T09 = 20 (Q > 0,26 gpm)	
Software / programming			
Parameter setting options		Flow monitoring; quantity meter; Preset counter; Temperature monitoring; hysteresis / window; normally open / closed; switching logic; current/ voltage/pulse output; Start-up delay; display can be deactivated; Display unit	
Interfaces			
Communication interface		IO-Link	
Transmission type		COM2 (38,4 kBaud)	
IO-Link revision		1.1	
SDCI standard		IEC 61131-9	
Profiles		Smart Sensor: Process Data Variable; Device Identification, Device Diagnosis	
SIO mode		yes	
Required master port class		A	
Process data analog		3	
Process data binary		2	
Min. process cycle time	[ms]	5	
Supported DeviceIDs		Type of operation	DeviceID
		default	570
Operating conditions			
Ambient temperature	[°F]	14...140	
Storage temperature	[°F]	-13...176	
Protection		IP 67	
Tests / approvals			
EMC		DIN EN 60947-5-9	
Shock resistance		DIN EN 68000-2-27	20 g (11 ms)
Vibration resistance		DIN EN 60068-2-6	5 g (10...2000 Hz)
MTTF	[years]	145	
Pressure equipment directive		sound engineering practice; can be used for group 2 fluids; group 1 fluids on request	
Mechanical data			
Weight	[g]	593.5	
Material		stainless steel (1.4404 / 316L); PBT-GF20; PC; FKM; TPE	
Materials (wetted parts)		stainless steel (1.4404 / 316L); PEEK; FKM	
Process connection		threaded connection 1/2" NPT DN15	

SM6601

Magnetic-inductive flow meter

SMN12GGXFRKG/US-100

Displays / operating elements

Display	Display unit	6 x LED, green (gpm, gph, gal, °F, 10^3, 1000 x 10^3)
	Switching status	2 x LED, yellow
	Measured values	alphanumeric display, 4-digit
	Programming	alphanumeric display, 4-digit

Remarks

Remarks	MW = Measured value
	MEW = Final value of the measuring range
Pack quantity	1 pcs.

Electrical connection

Connector: 1 x M12; Contacts: gold-plated

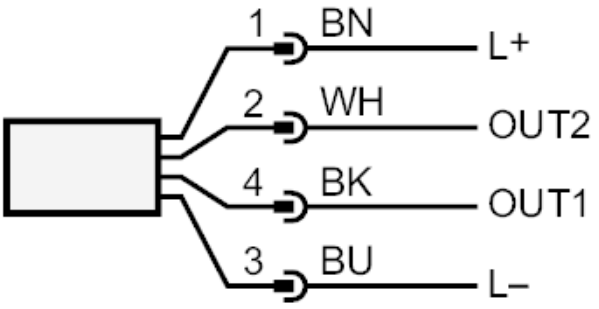


SM6601

Magnetic-inductive flow meter

SMN12GGXFRKG/US-100

Connection



	Colors to DIN EN 60947-5-2
OUT1:	Switching output Volumetric flow quantity monitoring
	Pulse output quantity meter
	signal output Preset counter
	IO-Link
OUT2:	Switching output Volumetric flow quantity monitoring
	Switching output Temperature monitoring
	analog output Volumetric flow quantity monitoring
	analog output Temperature monitoring
	Input counter reset
	Core colors :
BK =	black
BN =	brown
BU =	blue
WH =	white

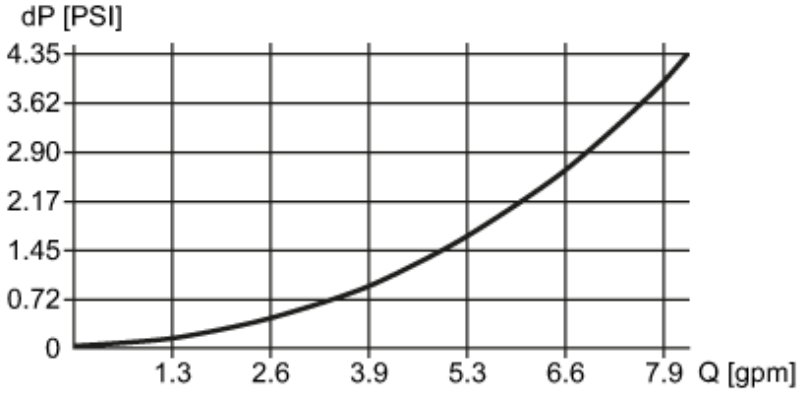
SM6601

Magnetic-inductive flow meter

SMN12GGXFRKG/US-100

Diagrams and graphs

Pressure loss



dP Pressure loss

Q volumetric flow quantity

345 Carlingview Drive
Toronto, Ontario
CANADA M9W 6N9
Tel.: 416.734.3300
Fax.: 416.231.1626
Toll Free: 1.877.682.8772
www.tssa.org

April 18, 2018

KARL KLINGER
IFM EFECTOR INC
1100 ATWATER DR
MALVERN PA 19355
US

Service Request Type: BPV-Fitting Registration
Service Request No.: 2079952
Your Reference No.:
Registered to: IFM PROVER GMBH

Dear KARL KLINGER,

Technical Standards and Safety Authority (TSSA) is pleased to inform you that your submission has been reviewed and registered as follows:

CRN No.: 0F20267.5

Main Design No.: SCOPE OF REGISTRATION - IFM SENSORS
Expiry Date: 18-Apr-2028

Please be advised that a valid quality control system must be maintained for the fitting registration to remain valid until the expiry date.

The stamped copy of the approved registration and the invoice are mailed separately. Should you have any questions or require further assistance, please contact a Customer Service Advisor at 1.877.682.TSSA (8772) or e-mail customerservices@tssa.org. We will be happy to assist you. When contacting TSSA regarding this file, please refer to the Service Request number provided above

Yours truly,

Liliana Constantinescu
Tel. : 416-734-3425

NOTE: You cannot save the DATA you entered on this form, you must print a copy and FAX it or MAIL it!

Technical Standards and Safety Authority
345 Carlingview Drive
Toronto, Ontario M9W 6N9
www.tssa.org

Show facsimile of manufacturer's logo or trademark, as it will appear on the fitting, in the space below

STATUTORY DECLARATION
Registration of Fittings

I, Karl Klinger, Director of Marketing
(Name and Position, e.g. President, Plant Manager, Chief Engineer)

of ifm efector, inc.
(Name of Manufacturer)

Located at 1100 Atwater Drive, Malvern, PA 19355 610-524-2000 610-524-2800
(Plant Address) *(Telephone No.)* *(Fax No.)*

☐ do solemnly declare that the fittings listed hereunder, which are subject to the ***Technical Standards and Safety Act***, Boilers and Pressure Vessels Regulation, comply with all of the requirements of

(Title of recognized North American Standard)

which specifies the dimensions, materials of construction, pressure/temperature ratings, identification marking the fittings and service;

☑ or are not covered by the provisions of a recognized North American standard and are therefore manufactured to comply with ASME B31.3 2012 ED. as supported by the attached data which identifies the dimensions, material of construction, pressure/temperature ratings and the basis for such ratings, the marking of the fitting for identification and service.

I further declare that the manufacture of these fittings is controlled by a quality system meeting the requirements of ISO 9001:2008 which has been verified by the following authority, DQS GmbH.

The items covered by this declaration, for which I seek registration, are category F type fittings. In support of this application, the following information and/or test data are attached as follows:

Test reports and drawings for sensor families LM (level), PG, PI & PM (pressure) and SA, SB, SI, SM & SV (flow)
(drawings, calculations, test reports, etc.)

Declared before me at 1100 Atwater Dr **in the** State **of** PA

the 4th **day of** May **AD 20** 17.

COMMONWEALTH OF PENNSYLVANIA
NOTARIAL SEAL
Maureen G. Marabella, Notary Public
West Whiteland Twp., Chester County
My Commission Expires July 27, 2018
MEMBER, PENNSYLVANIA ASSOCIATION OF NOTARIES

Commissioner for Oaths:

Maureen Marabella
(Printed name)

Maureen G Marabella
(Signature)

K. Klinger
(Signature of Declarer)

FOR OFFICE USE ONLY

To the best of my knowledge and belief, the application meets the requirements of the ***Technical Standards and Safety Act***, Boilers and Pressure Vessels Regulation, and CSA Standard B51 and is accepted for registration in Category F.

CRN: OF20267.5

Registered by:

Dated: April 18, 2018

NOTE: This registration expires on: April 18, 2028

Technical Standards and Safety Authority — Boilers and Pressure Vessels Safety Program
REGISTERED
C.R.N.: OF20267.5
Signed:
Date: April 18, 2018

**Information provided in this application is releasable under the Freedom of Information and Privacy Protection Act and may be disclosed upon request.*

PV 09553 (04/17)

See attached stamped Scope of registration

IFM Flow Sensors - CRN Scope of Registration

Design Code: ASME B31.3 2014 Edition
Design Pressure and Temperature: See Chart Below
Hydrotest Pressure: See Chart Below
Corrosion Allowance: None
Impact Testing: Exempt per paragraph 323.2.2
Radiography: None

Nearest equivalent ASME or ASTM material specification:		
1.4404	ASTM A276 Type 316L	UNS S31603
1.4404	ASTM A312 Type TP316L	UNS S31603

Cat. No.	Description	Pressure / bar				Temp. Range	1: Process Connection						2: gasket					3: Tube					4: Sensor tip				
		Tested Bursting Pressure B	Factor of safety	Rated MAWP	MAWP in Data Sheet		Dimension	Material Number	Material Name	ref. to Standard	Art. No.	Refer to Assembly Drawing	Material Number	Material Name	ref. to Standard	Art. No.	Refer to Assembly Drawing	Material Number	Material Name	ref. to Standard	Art. No.	Refer to Assembly Drawing	Material Number	Material Name	ref. to Standard	Art. No.	Refer to Assembly Drawing
SA2000	tested sensor				85	-20...90 °C -4...194 °F	G1/2"	1.4404	X2CrNiMo17-12-2	DIN EN 10088-3: 2014	80230120	11121114	FKM	na	na	700426	11121114	No tube					1.4404	X2CrNiMo17-12-2	DIN EN 10088-3: 2014	80235277	11121114
SA2004	ref to SA2000				85	-20...90 °C -4...194 °F	G1/2"	1.4404	X2CrNiMo17-12-2	DIN EN 10088-3: 2014	80230120	11121114	FKM	na	na	700426	11121114	No tube					1.4404	X2CrNiMo17-12-2	DIN EN 10088-3: 2014	80235277	11121114
SA6010	tested sensor				100	-20...90 °C -4...194 °F	1/2-14 NPT male	1.4404	X2CrNiMo17-12-2	DIN EN 10088-3: 2014	80230119	11136109	No gasket					No tube					1.4404	X2CrNiMo17-12-2	DIN EN 10088-3: 2014	80235277	11136109
SA6014	ref to SA6010				100	-20...90 °C -4...194 °F	1/2-14 NPT male	1.4404	X2CrNiMo17-12-2	DIN EN 10088-3: 2014	80230119	11136109	No gasket					No tube					1.4404	X2CrNiMo17-12-2	DIN EN 10088-3: 2014	80235277	11136109
SA4100	tested sensor				50	-20...100 °C -4...212 °F	Dia 8mm	1.4404	X2CrNiMo17-12-2	DIN EN 10088-3: 2014	80230118	11120039	No gasket					1.4404	X2CrNiMo17-12-2	DIN EN 10088-3: 2014	80221732	11120039	1.4404	X2CrNiMo17-12-2	DIN EN 10088-3: 2014	80235277	11120039
SA4104	ref to SA4100				50	-20...100 °C -4...212 °F	Dia 8mm	1.4404	X2CrNiMo17-12-2	DIN EN 10088-3: 2014	80230118	11120039	No gasket					1.4404	X2CrNiMo17-12-2	DIN EN 10088-3: 2014	80221732	11120039	1.4404	X2CrNiMo17-12-2	DIN EN 10088-3: 2014	80235277	11120039
SA4110	ref to SA4100				50	-20...100 °C -4...212 °F	Dia 8mm	1.4404	X2CrNiMo17-12-2	DIN EN 10088-3: 2014	80230118	11120039	No gasket					1.4404	X2CrNiMo17-12-2	DIN EN 10088-3: 2014	80221732	11120039	1.4404	X2CrNiMo17-12-2	DIN EN 10088-3: 2014	80235277	11120039
SA4300	ref to SA4100				50	-20...100 °C -4...212 °F	Dia 8mm	1.4404	X2CrNiMo17-12-2	DIN EN 10088-3: 2014	80230118	11120039	No gasket					1.4404	X2CrNiMo17-12-2	DIN EN 10088-3: 2014	80221238	11120039	1.4404	X2CrNiMo17-12-2	DIN EN 10088-3: 2014	80235277	11120039
SA4304	ref to SA4100				50	-20...100 °C -4...212 °F	Dia 8mm	1.4404	X2CrNiMo17-12-2	DIN EN 10088-3: 2014	80230118	11120039	No gasket					1.4404	X2CrNiMo17-12-2	DIN EN 10088-3: 2014	80221238	11120039	1.4404	X2CrNiMo17-12-2	DIN EN 10088-3: 2014	80235277	11120039
SA4310	ref to SA4100				50	-20...100 °C -4...212 °F	Dia 8mm	1.4404	X2CrNiMo17-12-2	DIN EN 10088-3: 2014	80230118	11120039	No gasket					1.4404	X2CrNiMo17-12-2	DIN EN 10088-3: 2014	80221238	11120039	1.4404	X2CrNiMo17-12-2	DIN EN 10088-3: 2014	80235277	11120039
SA5000	tested sensor				100	-20...90 °C -4...194 °F	Conic 24° / Dia: 9,8mm	1.4404	X2CrNiMo17-12-2	DIN EN 10088-3: 2014	80230117	11119714	FKM	na	na	580801	11119714	1.4404	X2CrNiMo17-12-2	DIN EN 10088-3: 2014	80011927	11119714	1.4404	X2CrNiMo17-12-2	DIN EN 10088-3: 2014	80235277	11119714
SA5004	ref to SA5000				100	-20...90 °C -4...194 °F	Conic 24° / Dia: 9,8mm	1.4404	X2CrNiMo17-12-2	DIN EN 10088-3: 2014	80230117	11119714	FKM	na	na	580801	11119714	1.4404	X2CrNiMo17-12-2	DIN EN 10088-3: 2014	80011927	11119714	1.4404	X2CrNiMo17-12-2	DIN EN 10088-3: 2014	80235277	11119714
SA5030	ref to SA5000				100	-20...90 °C -4...194 °F	Conic 24° / Dia: 9,8mm	1.4404	X2CrNiMo17-12-2	DIN EN 10088-3: 2014	80230117	11119714	FKM	na	na	580801	11119714	1.4404	X2CrNiMo17-12-2	DIN EN 10088-3: 2014	80011927	11119714	1.4404	X2CrNiMo17-12-2	DIN EN 10088-3: 2014	80235277	11119714

THIS IS PART OF
CRN 0F20267.5
Technical Standards & Safety Authority
Boilers & Pressure Vessels
Safety Program

IFM Level Sensors - CRN Scope of Registration

Design Code: ASME B31.3 2014 Edition
Design Pressure and Temperature: See Chart Below
Hydrotest Pressure: See Chart Below
Corrosion Allowance: None
Impact Testing: Exempt per paragraph 323.2.2
Radiography: None

Nearest equivalent ASME or ASTM material specification:		
1.4404	ASTM A276 Type 316L	UNS S31603
CW614N	ASTM B455	UNS C38500

Cat. No.	Description	Pressure / bar				Temp. Range	1: PCB				2: Process Connection					3: Potting Compound				4: Gasket				5: O-Ring				6: Filler				7: Electrode				7: Sensor Tip				Assembly Group / Dimension Drawing
		Tested Bursting Pressure B	Factor of safety	Max. MAWP	MAWP in Data Sheet		Material No.	Material Name	ref. to Standard	Art. No.	Dimension	Material No.	Material Name	ref. to Standard	Art. No.	Material No.	Material Name	ref. to Standard	Art. No.	Material No.	Material Name	ref. to Standard	Art. No.	Material No.	Material Name	ref. to Standard	Art. No.	Material No.	Material Name	ref. to Standard	Art. No.	Material No.	Material Name	ref. to Standard	Art. No.	Material No.	Material Name	ref. to Standard	Art. No.	Drawing No.
LMC100	Level Sensor	[redacted]			40	-40 .... 100 °C -40 .... 212 °F	-	FR4	-	80261079	G 1/2	1.4404	X2CrNiMo17-12-2	DIN EN 10088	80254822	-	Epoxy Resin	-	5740203 / 703246	-	U-Ring NBR	-	80236282	-	FKM	-	80254403	-	PP GF30	-	80254196	CW614N	CuZn39Pb3	DIN EN 12164	80254946	-	PEEK	-	80236617	11120069
LMC110	Level Sensor				40	-40 .... 100 °C -40 .... 212 °F	-	FR4	-	80261079	G 1/2	1.4404	X2CrNiMo17-12-2	DIN EN 10088	80254822	-	Epoxy Resin	-	5740203 / 703246	-	U-Ring NBR	-	80236282	-	FKM	-	80254403	-	PP GF30	-	80254196	CW614N	CuZn39Pb3	DIN EN 12164	80254946	-	PEEK	-	80236617	11120069
LMC400	Level Sensor				40	-40 .... 100 °C -40 .... 212 °F	-	FR4	-	80261079	G 1/2	1.4404	X2CrNiMo17-12-2	DIN EN 10088	80254824	-	Epoxy Resin	-	5740203 / 703246	-	U-Ring NBR	-	80236282	-	FKM	-	80254403	-	PP GF30	-	80254196	CW614N	CuZn39Pb3	DIN EN 12164	80254946	-	PEEK	-	80236617	11120069
LMC410	Level Sensor				40	-40 .... 100 °C -40 .... 212 °F	-	FR4	-	80261079	G 1/2	1.4404	X2CrNiMo17-12-2	DIN EN 10088	80254824	-	Epoxy Resin	-	5740203 / 703246	-	U-Ring NBR	-	80236282	-	FKM	-	80254403	-	PP GF30	-	80254196	CW614N	CuZn39Pb3	DIN EN 12164	80254946	-	PEEK	-	80236617	11120069
LMC500	Level Sensor				40	-40 .... 100 °C -40 .... 212 °F	-	FR4	-	80261079	1/2 NPT	1.4404	X2CrNiMo17-12-2	DIN EN 10088	80254823	-	Epoxy Resin	-	5740203 / 703246	-	-	-	-	-	FKM	-	80254403	-	PP GF30	-	80254196	CW614N	CuZn39Pb3	DIN EN 12164	80254946	-	PEEK	-	80236617	11120069
LMC510	Level Sensor				40	-40 .... 100 °C -40 .... 212 °F	-	FR4	-	80261079	1/2 NPT	1.4404	X2CrNiMo17-12-2	DIN EN 10088	80254823	-	Epoxy Resin	-	5740203 / 703246	-	-	-	-	-	FKM	-	80254403	-	PP GF30	-	80254196	CW614N	CuZn39Pb3	DIN EN 12164	80254946	-	PEEK	-	80236617	11120069

THIS IS PART OF
CRN OF20267.5
Technical Standards & Safety Authority
Boilers & Pressure Vessels
Safety Program

IFM Flow Sensors - CRN Scope of Registration

Design Code: ASME B31.3 2014 Edition
Design Pressure and Temperature: See Chart Below
Hydrotest Pressure: See Chart Below
Corrosion Allowance: None
Impact Testing: Exempt per paragraph 323.2.2
Radiography: None

Nearest equivalent ASME or ASTM material specification:		
1.4404	ASTM A276 Type 316L	UNS S31603
CW617N	ASTM B124	UNS C37700

Cat. No.	Description	Pressure Data				Temp. Range	1: Process Connection						2: Mandrel					3: Plug						4: Connecting Piece				
		Tested Bursting Pressure B	Factor of safety	Max. MAWP	MAWP in Data Sheet		Dimension	Material Number	Material Name	ref. to Standard	Art. No.	Refer to Assembly Drawing	Material Number	Material Name	ref. to Standard	Art. No.	Refer to Assembly Drawing	Dimension	Material Number	Material Name	ref. to Standard	Art. No.	Refer to Assembly Drawing	Material Number	Material Name	ref. to Standard	Art. No.	Refer to Assembly Drawing
SBY232	Flow Sensor	[redacted]			40	-10...100 °C 14...212 °F	Rp 3/4	[redacted]					PPS GF40	[redacted]				G3/4	1.4404	X2CrNiMo17-12-2	DIN EN 10088-3	80225910	11128406	n/a	n/a	n/a	n/a	11128406
SBY233	Flow Sensor				40	-10...100 °C 14...212 °F	Rp 3/4						PPS GF40					G3/4	1.4404	X2CrNiMo17-12-2	DIN EN 10088-3	80225910	11128406	n/a	n/a	n/a	n/a	11128406
SBY234	Flow Sensor				40	-10...100 °C 14...212 °F	Rp 3/4						PPS GF40					G3/4	1.4404	X2CrNiMo17-12-2	DIN EN 10088-3	80225910	11128406	n/a	n/a	n/a	n/a	11128406
SBG232	Flow Sensor				40	-10...100 °C 14...212 °F	G 1/2						PPS GF40					G3/4	1.4404	X2CrNiMo17-12-2	DIN EN 10088-3	80225910	11128406	n/a	n/a	n/a	n/a	11128406
SBG233	Flow Sensor				40	-10...100 °C 14...212 °F	G 1/2						PPS GF40					G3/4	1.4404	X2CrNiMo17-12-2	DIN EN 10088-3	80225910	11128406	n/a	n/a	n/a	n/a	11128406
SBG234	Flow Sensor				40	-10...100 °C 14...212 °F	G 1/2						PPS GF40					G3/4	1.4404	X2CrNiMo17-12-2	DIN EN 10088-3	80225910	11128406	n/a	n/a	n/a	n/a	11128406
SBN232	Flow Sensor				40	-10...100 °C 14...212 °F	NPT 3/4						PPS GF40					G3/4	1.4404	X2CrNiMo17-12-2	DIN EN 10088-3	80225910	11128406	n/a	n/a	n/a	n/a	11128406
SBN233	Flow Sensor				40	-10...100 °C 14...212 °F	NPT 3/4						PPS GF40					G3/4	1.4404	X2CrNiMo17-12-2	DIN EN 10088-3	80225910	11128406	n/a	n/a	n/a	n/a	11128406
SBN234	Flow Sensor				40	-10...100 °C 14...212 °F	NPT 3/4						PPS GF40					G3/4	1.4404	X2CrNiMo17-12-2	DIN EN 10088-3	80225910	11128406	n/a	n/a	n/a	n/a	11128406
SBY246	Flow Sensor				25	-10...100 °C 14...212 °F	Rp 1						PPS GF40					G1	1.4404	X2CrNiMo17-12-2	DIN EN 10088-3	80225936	11128449	n/a	n/a	n/a	n/a	11128449
SBG246	Flow Sensor				25	-10...100 °C 14...212 °F	G 3/4						PPS GF40					G1	1.4404	X2CrNiMo17-12-2	DIN EN 10088-3	80225936	11128449	n/a	n/a	n/a	n/a	11128449
SBN246	Flow Sensor				25	-10...100 °C 14...212 °F	NPT 1						PPS GF40					G1	1.4404	X2CrNiMo17-12-2	DIN EN 10088-3	80225936	11128449	n/a	n/a	n/a	n/a	11128449
SBY257	Flow Sensor				25	-10...100 °C 14...212 °F	Rp 1 1/2						PPS GF40					G 1 1/2	1.4404	X2CrNiMo17-12-2	DIN EN 10088-3	80225937	11128449	1.4404	X2CrNiMo17-12-2	DIN EN 10088-3	80225938	11128449
SBG257	Flow Sensor				25	-10...100 °C 14...212 °F	G 1 1/2						PPS GF40					G 1 1/2	1.4404	X2CrNiMo17-12-2	DIN EN 10088-3	80225937	11128449	1.4404	X2CrNiMo17-12-2	DIN EN 10088-3	80225938	11128449
SBN257	Flow Sensor				25	-10...100 °C 14...212 °F	NPT 1 1/2						PPS GF40					G 1 1/2	1.4404	X2CrNiMo17-12-2	DIN EN 10088-3	80225937	11128449	1.4404	X2CrNiMo17-12-2	DIN EN 10088-3	80225938	11128449

THIS IS PART OF CRN OF20267.5
Technical Standards & Safety Authority
Boilers & Pressure Vessels
Safety Program

IFM Pressure Sensors - CRN Scope of Registration

Design Code: ASME B31.3 2014 Edition
Design Pressure and Temperature: See Chart Below
Hydrotest Pressure: See Chart Below
Corrosion Allowance: None
Impact Testing: Exempt per paragraph 323.2.2
Radiography: None

Nearest equivalent ASME or ASTM material specification:		
1.4435	ASTM A276 Type 316L	UNS S31603
CW614N	ASTM B455	UNS C38500

THIS IS FAR
CRN 0F20267.5
Technical Standards & Safety Authority
Boilers & Pressure Vessels
Safety Program

Cat. No.	Description	Pressure / bar				Temp. Range	1: Process Connection						2: Pressure Cell					3: Cell Fixing					4: Gasket Support					5: Gasket					Assembly Group / Dimension Drawing	Grouping Reason
		Tested Bursting Pressure B	Factor of safety	Max. MAWP	MAWP in Data Sheet		Dimension	Material Number	Material Name	ref. to Standard	Art. No.	Refer to Assembly Drawing	Nominal Pressure	Material Number	Material Name	ref. to Standard	Art. No.	Refer to Assembly Drawing	Material Number	Material Name	ref. to Standard	Art. No.	Refer to Assembly Drawing	Material Number	Material Name	ref. to Standard	Art. No.	Refer to Assembly Drawing	Material Number	Material Name	ref. to Standard	Art. No.	Refer to Assembly Drawing	Drawing No.	Drawing No.
PG2734	Pressure Sensor				50	-25...150 °C -13...302 °F	G1 EXTERNAL ASEPTOFLEX VARIO	1.4435	X2CrNiMo18-14-3	DIN EN 10088-3	50015939	11128653	1000 kPa (10 bar)	AL2O3 99.9%	n/a	n/a	585584	11128653												PTFE	n/a	n/a	583739	11128653	11128653	11128653
PG2789	Pressure Sensor				4	-25...150 °C -13...302 °F	G1 EXTERNAL ASEPTOFLEX VARIO	1.4435	X2CrNiMo18-14-3	DIN EN 10088-3	80234172	11128662	0,1 bar	AL2O3 99.9%	n/a	n/a	585589	11128662												PTFE	n/a	n/a	583738	11128662	11128662	11128662
PG2793	Pressure Sensor				60	-25...150 °C -13...302 °F	G1 EXTERNAL ASEPTOFLEX VARIO	1.4435	X2CrNiMo18-14-3	DIN EN 10088-3	50015939	11128653	25 bar	AL2O3 99.9%	n/a	n/a	585583	11128653												PTFE	n/a	n/a	583739	11128653	11128653	11128653
PG2794	Pressure Sensor				50	-25...150 °C -13...302 °F	G1 EXTERNAL ASEPTOFLEX VARIO	1.4435	X2CrNiMo18-14-3	DIN EN 10088-3	50015939	11128653	10 bar	AL2O3 99.9%	n/a	n/a	585584	11128653												PTFE	n/a	n/a	583739	11128653	11128653	11128653
PG2795	Pressure Sensor				30	-25...150 °C -13...302 °F	G1 EXTERNAL ASEPTOFLEX VARIO	1.4435	X2CrNiMo18-14-3	DIN EN 10088-3	50015939	11128653	4 bar	AL2O3 99.9%	n/a	n/a	585585	11128653												PTFE	n/a	n/a	583739	11128653	11128653	11128653
PG2796	Pressure Sensor				20	-25...150 °C -13...302 °F	G1 EXTERNAL ASEPTOFLEX VARIO	1.4435	X2CrNiMo18-14-3	DIN EN 10088-3	50015939	11128653	2,5 bar	AL2O3 99.9%	n/a	n/a	585586	11128653												PTFE	n/a	n/a	583739	11128653	11128653	11128653
PG2797	Pressure Sensor				10	-25...150 °C -13...302 °F	G1 EXTERNAL ASEPTOFLEX VARIO	1.4435	X2CrNiMo18-14-3	DIN EN 10088-3	50015939	11128653	1 bar	AL2O3 99.9%	n/a	n/a	585587	11128653												PTFE	n/a	n/a	583739	11128653	11128653	11128653
PG2798	Pressure Sensor				10	-25...150 °C -13...302 °F	G1 EXTERNAL ASEPTOFLEX VARIO	1.4435	X2CrNiMo18-14-3	DIN EN 10088-3	80234172	11128662	0,25 bar	AL2O3 99.9%	n/a	n/a	585588	11128662												PTFE	n/a	n/a	583738	11128662	11128662	11128662
PG2799	Pressure Sensor				10	-25...150 °C -13...302 °F	G1 EXTERNAL ASEPTOFLEX VARIO	1.4435	X2CrNiMo18-14-3	DIN EN 10088-3	50015939	11128653	±1 bar	AL2O3 99.9%	n/a	n/a	585587	11128653												PTFE	n/a	n/a	583739	11128653	11128653	11128653
PG2889	Pressure Sensor				4	-25...150 °C -13...302 °F	G1 EXTERNAL SEALING CONE WITH UNION NUT	1.4435	X2CrNiMo18-14-3	DIN EN 10088-3	50019345	11130069	0,1 bar	AL2O3 99.9%	n/a	n/a	585589	11130069												PTFE	n/a	n/a	583738	11130069	11130069	11130069
PG2893	Pressure Sensor				60	-25...150 °C -13...302 °F	G1 EXTERNAL SEALING CONE WITH UNION NUT	1.4435	X2CrNiMo18-14-3	DIN EN 10088-3	50018943	11130072	25 bar	AL2O3 99.9%	n/a	n/a	585583	11130072												PTFE	n/a	n/a	583739	11130072	11130072	11130072
PG2894	Pressure Sensor				50	-25...150 °C -13...302 °F	G1 EXTERNAL SEALING CONE WITH UNION NUT	1.4435	X2CrNiMo18-14-3	DIN EN 10088-3	50018943	11130072	10 bar	AL2O3 99.9%	n/a	n/a	585584	11130072												PTFE	n/a	n/a	583739	11130072	11130072	11130072
PG2895	Pressure Sensor				30	-25...150 °C -13...302 °F	G1 EXTERNAL SEALING CONE WITH UNION NUT	1.4435	X2CrNiMo18-14-3	DIN EN 10088-3	50018943	11130072	4 bar	AL2O3 99.9%	n/a	n/a	585585	11130072												PTFE	n/a	n/a	583739	11130072	11130072	11130072
PG2896	Pressure Sensor				20	-25...150 °C -13...302 °F	G1 EXTERNAL SEALING CONE WITH UNION NUT	1.4435	X2CrNiMo18-14-3	DIN EN 10088-3	50018943	11130072	2,5 bar	AL2O3 99.9%	n/a	n/a	585586	11130072												PTFE	n/a	n/a	583739	11130072	11130072	11130072
PG2897	Pressure Sensor				10	-25...150 °C -13...302 °F	G1 EXTERNAL SEALING CONE WITH UNION NUT	1.4435	X2CrNiMo18-14-3	DIN EN 10088-3	50018943	11130072	1 bar	AL2O3 99.9%	n/a	n/a	585587	11130072												PTFE	n/a	n/a	583739	11130072	11130072	11130072
PG2898	Pressure Sensor				10	-25...150 °C -13...302 °F	G1 EXTERNAL SEALING CONE WITH UNION NUT	1.4435	X2CrNiMo18-14-3	DIN EN 10088-3	50019345	11130069	0,25 bar	AL2O3 99.9%	n/a	n/a	585588	11130069												PTFE	n/a	n/a	583738	11130069	11130069	11130069
PG2899	Pressure Sensor				10	-25...150 °C -13...302 °F	G1 EXTERNAL SEALING CONE WITH UNION NUT	1.4435	X2CrNiMo18-14-3	DIN EN 10088-3	50018943	11130072	±1 bar	AL2O3 99.9%	n/a	n/a	585587	11130072												PTFE	n/a	n/a	583739	11130072	11130072	11130072
PI2714	Pressure Sensor				60	-25...150 °C -13...302 °F	G1 EXTERNAL ASEPTOFLEX VARIO	1.4435	X2CrNiMo18-14-3	DIN EN 10088-3	80255321	11128653	16 bar	AL2O3 99.9%	n/a	n/a	80236654	11128653												PTFE	n/a	n/a	583739	11128653	11128653	11128653
PI2715	Pressure Sensor				30	-25...150 °C -13...302 °F	G1 EXTERNAL ASEPTOFLEX VARIO	1.4435	X2CrNiMo18-14-3	DIN EN 10088-3	80255321	11128653	6 bar	AL2O3 99.9%	n/a	n/a	585585	11128653												PTFE	n/a	n/a	583739	11128653	11128653	11128653
PI2717	Pressure Sensor				15	-25...150 °C -13...302 °F	G1 EXTERNAL ASEPTOFLEX VARIO	1.4435	X2CrNiMo18-14-3	DIN EN 10088-3	80255321	11128653	1,6 bar	AL2O3 99.9%	n/a	n/a	80236653	11128653												PTFE	n/a	n/a	583739	11128653	11128653	11128653
PI2789	Pressure Sensor				4	-25...150 °C -13...302 °F	G1 EXTERNAL ASEPTOFLEX VARIO	1.4435	X2CrNiMo18-14-3	DIN EN 10088-3	80237713	11128662	0,1 bar	AL2O3 99.9%	n/a	n/a	585589	11128662												PTFE	n/a	n/a	583738	11128662	11128662	11128662
PI2793	Pressure Sensor				60	-25...150 °C -13...302 °F	G1 EXTERNAL ASEPTOFLEX VARIO	1.4435	X2CrNiMo18-14-3	DIN EN 10088-3	50020668	11128653	25 bar	AL2O3 99.9%	n/a	n/a	583883	11128653												PTFE	n/a	n/a	583739	11128653	11128653	11128653
PI2794	Pressure Sensor				50	-25...150 °C -13...302 °F	G1 EXTERNAL ASEPTOFLEX VARIO	1.4435	X2CrNiMo18-14-3	DIN EN 10088-3	50020668	11128653	10 bar	AL2O3 99.9%	n/a	n/a	583884	11128653												PTFE	n/a	n/a	583739	11128653	11128653	11128653
PI2795	Pressure Sensor				30	-25...150 °C -13...302 °F	G1 EXTERNAL ASEPTOFLEX VARIO	1.4435	X2CrNiMo18-14-3	DIN EN 10088-3	50020668	11128653	4 bar	AL2O3 99.9%	n/a	n/a	583885	11128653												PTFE	n/a	n/a	583739	11128653	11128653	11128653
PI2796	Pressure Sensor				20	-25...150 °C -13...302 °F	G1 EXTERNAL ASEPTOFLEX VARIO	1.4435	X2CrNiMo18-14-3	DIN EN 10088-3	50020668	11128653	2,5 bar	AL2O3 99.9%	n/a	n/a	583886	11128653												PTFE	n/a	n/a	583739	11128653	11128653	11128653
PI2797	Pressure Sensor				10	-25...150 °C -13...302 °F	G1 EXTERNAL ASEPTOFLEX VARIO	1.4435	X2CrNiMo18-14-3	DIN EN 10088-3	50020668	11128653	1 bar	AL2O3 99.9%	n/a	n/a	583887	11128653												PTFE	n/a	n/a	583739	11128653	11128653	11128653
PI2798	Pressure Sensor				10	-25...150 °C -13...302 °F	G1 EXTERNAL ASEPTOFLEX VARIO	1.4435	X2CrNiMo18-14-3	DIN EN 10088-3	80237713	11128662	0,25 bar	AL2O3 99.9%	n/a	n/a	583888	11128662												PTFE	n/a	n/a	583738	11128662	11128662	11128662
PI2799	Pressure Sensor				10	-25...150 °C -13...302 °F	G1 EXTERNAL ASEPTOFLEX VARIO	1.4435	X2CrNiMo18-14-3	DIN EN 10088-3	50020668	11128653	±1 bar	AL2O3 99.9%	n/a	n/a	583889	11128653												PTFE	n/a	n/a	583739	11128653	11128653	11128653
PI2814	Pressure Sensor				50	-25...150 °C -13...302 °F	G1 EXTERNAL SEALING CONE WITH UNION NUT	1.4435	X2CrNiMo18-14-3	DIN EN 10088-3	80256382	11130072	16 bar	AL2O3 99.9%	n/a	n/a	80236654	11130072												PTFE	n/a	n/a	583739	11130072	11130072	11130072
PI2815	Pressure Sensor				30	-25...150 °C -13...302 °F	G1 EXTERNAL SEALING CONE WITH UNION NUT	1.4435	X2CrNiMo18-14-3	DIN EN 10088-3	80256382	11130072	6 bar	AL2O3 99.9%	n/a	n/a	585585	11130072												PTFE	n/a	n/a	583739	11130072	11130072	11130072
PI2817	Pressure Sensor				15	-25...150 °C -13...302 °F	G1 EXTERNAL SEALING CONE WITH UNION NUT	1.4435	X2CrNiMo18-14-3	DIN EN 10088-3	80256382	11130072	1,6 bar	AL2O3 99.9%	n/a	n/a	80236653	11130072												PTFE	n/a	n/a	583739	11130072	11130072	11130072
PI2889	Pressure Sensor				4	-25...150 °C -13...302 °F	G1 EXTERNAL SEALING CONE WITH UNION NUT	1.4435	X2CrNiMo18-14-3	DIN EN 10088-3	50019345	11130069	0,1 bar	AL2O3 99.9%	n/a	n/a	585589	11130069												PTFE	n/a	n/a	583738	11130069	11130069	11130069
PI2893	Pressure Sensor				60	-25...150 °C -13...302 °F	G1 EXTERNAL SEALING CONE WITH UNION NUT	1.4435	X2CrNiMo18-14-3	DIN EN 10088-3	50018943	11130072	25 bar	AL2O3 99.9%	n/a	n/a	585583	11130072												PTFE	n/a	n/a	583739	11130072	11130072	11130072
PI2894	Pressure Sensor				50	-25...150 °C -13...302 °F	G1 EXTERNAL SEALING CONE WITH UNION NUT	1.4435	X2CrNiMo18-14-3	DIN EN 10088-3	50018943	11130072	10 bar	AL2O3 99.9%	n/a	n/a	585584	11130072												PTFE	n/a	n/a	583739	11130072	11130072	11130072
PI2895	Pressure Sensor				30	-25...150 °C -13...302 °F	G1 EXTERNAL SEALING CONE WITH UNION NUT	1.4435	X2CrNiMo18-14-3	DIN EN 10088-3	50018943	11130072	4 bar	AL2O3 99.9%	n/a	n/a	585585	11130072												PTFE	n/a	n/a	583739	11130072	11130072	11130072
PI2896	Pressure Sensor				20	-25...150 °C -13...302 °F	G1 EXTERNAL SEALING CONE WITH UNION NUT	1.4435	X2CrNiMo18-14-3	DIN EN 10088-3	50018943	11130072	2,5 bar	AL2O3 99.9%	n/a	n/a	585586	11130072												PTFE	n/a	n/a	583739	11130072	11130072	11130072
PI2897	Pressure Sensor				10	-25...150 °C -13...302 °F	G1 EXTERNAL SEALING CONE WITH UNION NUT	1.4435	X2CrNiMo18-14-3	DIN EN 10088-3	50018943	11130072	1 bar	AL2O3 99.9%	n/a	n/a	585587	11130072												PTFE	n/a	n/a	583739	11130072	11130072	11130072
PI2898	Pressure Sensor				10	-25...150 °C -13...302 °F	G1 EXTERNAL SEALING CONE WITH UNION NUT	1.4435	X2CrNiMo18-14-3	DIN EN 10088-3	50019345	11130069	0,25 bar	AL2O3 99.9%	n/a	n/a	583888	11130069												PTFE	n/a	n/a	583738	11130069	11130069	11130069
PI2899	Pressure Sensor				10	-25...150 °C -13...302 °F	G1 EXTERNAL SEALING CONE WITH UNION NUT	1.4435	X2CrNiMo18-14-3	DIN EN 10088-3	50018943	11130072	±1 bar	AL2O3 99.9%	n/a	n/a	585587	11130072												PTFE	n/a	n/a	583739	11130072	11130072	11130072
PM1603	Pressure Sensor				45	-25...150 °C -13...302 °F	G1 EXTERNAL SEALING CONE	1.4435	X2CrNiMo18-14-3	DIN EN 10088-3	80255344	11128633	25 bar	AL2O3 99.9%	n/a	n/a	583883	11128633												PTFE	n/a	n/a	583739	11128633	11128633	11128633
PM1604	Pressure Sensor				50	-25...150 °C -13...302 °F	G1 EXTERNAL SEALING CONE	1.4435	X2CrNiMo18-14-3	DIN EN 10088-3	80255344	11128633	10 bar	AL2O3 99.9%	n/a	n/a	583884	11128633												PTFE	n/a	n/a	583739	11128633	11128633	11128633
PM1605	Pressure Sensor				30	-25...150 °C -13...302 °F	G1 EXTERNAL SEALING CONE	1.4435	X2CrNiMo18-14-3	DIN EN 10088-3	80255344	11128633	4 bar	AL2O3 99.9%	n/a	n/a	583885	11128633												PTFE	n/a	n/a	583739	11128633	11128633	11128633
PM1606	Pressure Sensor				20	-25...150 °C -13...302 °F	G1 EXTERNAL SEALING CONE	1.4435	X2CrNiMo18-14-3	DIN EN 10088-3	80255344	11128633	2,5 bar	AL2O3 99.9%	n/a	n/a	583886	11128633												PTFE	n/a	n/a	583739	11128633	11128633	11128633
PM1607	Pressure Sensor				10	-25...150 °C -13...302 °F	G1 EXTERNAL SEALING CONE	1.4435	X2CrNiMo18-14-3	DIN EN 10088-3	80255344	11128644	1 bar	AL2O3 99.9%	n/a	n/a	583887	11128644												PTFE	n/a	n/a	583739	11128644	11128644	11128644
PM1608	Pressure Sensor				10	-25...150 °C -13...302 °F	G1 EXTERNAL SEALING CONE	1.4435	X2CrNiMo18-14-3	DIN EN 10088-3	80233143	11128645	0,25 bar	AL2O3 99.9%	n/a	n/a	583888	11128645												PTFE	n/a	n/a	583738	11128645	11128645	11128645
PM1609	Pressure Sensor				10	-25...150 °C -13...302 °F	G1 EXTERNAL SEALING CONE	1.4435	X2CrNiMo18-14-3	DIN EN 10088-3	80255344	11128644	1 bar	AL2O3 99.9%	n/a	n/a	583887	11128644												PTFE	n/a	n/a	583739	11128644	11128644	11128644

IFM Pressure Sensors - CRN Scope of Registration

Design Code: ASME B31.3 2014 Edition
Design Pressure and Temperature: See Chart Below
Hydrotest Pressure: See Chart Below
Corrosion Allowance: None
Impact Testing: Exempt per paragraph 323.2.2
Radiography: None

Nearest equivalent ASME or ASTM material specification:		
1.4435	ASTM A276 Type 316L	UNS S31603
CW614N	ASTM B455	UNS C38500

Cat. No.	Description	Pressure / bar				Temp. Range	1: Process Connection						2: Pressure Cell						3: Cell Fixing					4: Gasket Support					5: Gasket					Assembly Group / Dimension Drawing	Grouping Reason
		Tested Bursting Pressure B	Factor of safety	Max. MAWP	MAWP in Data Sheet		Dimension	Material Number	Material Name	ref. to Standard	Art. No.	Refer to Assembly Drawing	Nominal Pressure	Material Number	Material Name	ref. to Standard	Art. No.	Refer to Assembly Drawing	Material Number	Material Name	ref. to Standard	Art. No.	Refer to Assembly Drawing	Material Number	Material Name	ref. to Standard	Art. No.	Refer to Assembly Drawing	Material Number	Material Name	ref. to Standard	Art. No.	Refer to Assembly Drawing	Drawing No.	Drawing No.
PM1614	Pressure Sensor	[redacted]			55	-25...150 °C -13...302 °F	G1 EXTERNAL SEALING CONE	1.4435	X2CrNiMo18-14-3	DIN EN 10088-3	80255344	11128633	16 bar	AL2O3 99.9%	n/a	n/a	80236654	11128633	[redacted]										PTFE	n/a	n/a	583739	11128633	11128633	11128633
PM1615	Pressure Sensor				30	-25...150 °C -13...302 °F	G1 EXTERNAL SEALING CONE	1.4435	X2CrNiMo18-14-3	DIN EN 10088-3	80255344	11128633	6 bar	AL2O3 99.9%	n/a	n/a	585585	11128633											PTFE	n/a	n/a	583739	11128633	11128633	11128633
PM1617	Pressure Sensor				15	-25...150 °C -13...302 °F	G1 EXTERNAL SEALING CONE	1.4435	X2CrNiMo18-14-3	DIN EN 10088-3	80255344	11128633	1,6 bar	AL2O3 99.9%	n/a	n/a	80236653	11128633											PTFE	n/a	n/a	583739	11128633	11128633	11128633
PM1689	Pressure Sensor				4	-25...150 °C -13...302 °F	G1 EXTERNAL SEALING CONE	1.4435	X2CrNiMo18-14-3	DIN EN 10088-3	80233143	11128645	0,1 bar	AL2O3 99.9%	n/a	n/a	585489	11128645											PTFE	n/a	n/a	583738	11128645	11128645	11128645
PM1703	Pressure Sensor				60	-25...150 °C -13...302 °F	G1 EXTERNAL ASEPTOFLEX VARIO	1.4435	X2CrNiMo18-14-3	DIN EN 10088-3	80255341	11128653	25 bar	AL2O3 99.9%	n/a	n/a	583883	11128653											PTFE	n/a	n/a	583739	11128653	11128653	11128653
PM1704	Pressure Sensor				59	-25...150 °C -13...302 °F	G1 EXTERNAL ASEPTOFLEX VARIO	1.4435	X2CrNiMo18-14-3	DIN EN 10088-3	80255341	11128653	10 bar	AL2O3 99.9%	n/a	n/a	583884	11128653											PTFE	n/a	n/a	583739	11128653	11128653	11128653
PM1705	Pressure Sensor				30	-25...150 °C -13...302 °F	G1 EXTERNAL ASEPTOFLEX VARIO	1.4435	X2CrNiMo18-14-3	DIN EN 10088-3	80255341	11128653	4 bar	AL2O3 99.9%	n/a	n/a	583885	11128653											PTFE	n/a	n/a	583739	11128653	11128653	11128653
PM1706	Pressure Sensor				20	-25...150 °C -13...302 °F	G1 EXTERNAL ASEPTOFLEX VARIO	1.4435	X2CrNiMo18-14-3	DIN EN 10088-3	80255341	11128653	2,5 bar	AL2O3 99.9%	n/a	n/a	583886	11128653											PTFE	n/a	n/a	583739	11128653	11128653	11128653
PM1707	Pressure Sensor				10	-25...150 °C -13...302 °F	G1 EXTERNAL ASEPTOFLEX VARIO	1.4435	X2CrNiMo18-14-3	DIN EN 10088-3	80233008	11128659	1 bar	AL2O3 99.9%	n/a	n/a	583887	11128659											PTFE	n/a	n/a	583739	11128659	11128659	11128659
PM1708	Pressure Sensor				10	-25...150 °C -13...302 °F	G1 EXTERNAL ASEPTOFLEX VARIO	1.4435	X2CrNiMo18-14-3	DIN EN 10088-3	80234172	11128662	0,25 bar	AL2O3 99.9%	n/a	n/a	583888	11128662											PTFE	n/a	n/a	583738	11128662	11128662	11128662
PM1709	Pressure Sensor				10	-25...150 °C -13...302 °F	G1 EXTERNAL ASEPTOFLEX VARIO	1.4435	X2CrNiMo18-14-3	DIN EN 10088-3	80255341	11128659	1 bar	AL2O3 99.9%	n/a	n/a	583887	11128659											PTFE	n/a	n/a	583739	11128659	11128659	11128659
PM1714	Pressure Sensor				60	-25...150 °C -13...302 °F	G1 EXTERNAL ASEPTOFLEX VARIO	1.4435	X2CrNiMo18-14-3	DIN EN 10088-3	80255341	11128653	16 bar	AL2O3 99.9%	n/a	n/a	80236654	11128653											PTFE	n/a	n/a	583739	11128653	11128653	11128653
PM1715	Pressure Sensor				30	-25...150 °C -13...302 °F	G1 EXTERNAL ASEPTOFLEX VARIO	1.4435	X2CrNiMo18-14-3	DIN EN 10088-3	80255341	11128653	6 bar	AL2O3 99.9%	n/a	n/a	585585	11128653											PTFE	n/a	n/a	583739	11128653	11128653	11128653
PM1717	Pressure Sensor				15	-25...150 °C -13...302 °F	G1 EXTERNAL ASEPTOFLEX VARIO	1.4435	X2CrNiMo18-14-3	DIN EN 10088-3	80255341	11128653	1,6 bar	AL2O3 99.9%	n/a	n/a	80236653	11128653											PTFE	n/a	n/a	583739	11128653	11128653	11128653
PM1789	Pressure Sensor				4	-25...150 °C -13...302 °F	G1 EXTERNAL ASEPTOFLEX VARIO	1.4435	X2CrNiMo18-14-3	DIN EN 10088-3	80234172	11128662	0,1 bar	AL2O3 99.9%	n/a	n/a	585489	11128662											PTFE	n/a	n/a	583738	11128662	11128662	11128662

PM1789

IFM Flow Sensors - CRN Scope of Registration

Design Code: ASME B31.3 2014 Edition
Design Temperature: See Chart Below
Burst Pressure: See Chart Below
Corrosion Allowance: None
Impact Testing: Exempt per paragraph 323.2.2
Radiography: None

Nearest equivalent ASME or ASTM material specification:		
1.4404	ASTM A276 Type 316L	UNS S31603
1.4310	ASTM A240 Type 301	UNS S30100
1.4301	ASTM A193 Type 304	UNS S30400

Cat. No.	Description	Pressure / bar				Temp. Range	1: Process Connection						2: gasket process connetction					3: Sensor tube					4: Sensor with gasket					5: adapter nut					
		Tested Bursting Pressure B	Factor of safety	Rated MAWP	MAWP in Data Sheet		Dimension	Material Number	Material Name	ref. to Standard	Art. No.	Refer to Assembly Drawing	Material Number	Material Name	ref. to Standard	Art. No.	Refer to Assembly Drawing	Material Number	Material Name	ref. to Standard	Art. No.	Refer to Assembly Drawing	Material Number	Material Name	ref. to Standard	Art. No.	Refer to Assembly Drawing	Material Number	Material Name	ref. to Standard	Art. No.	Refer to Assembly Drawing	M N
SV4200	tested sensor				3.9	-10...90 °C -14...194 °F	G1/2" female	1.4404	X2CrNiMo17-12-2	DIN EN 10088-3: 2014	80227509	11120324	na	FKM	na	80223885	11120324											1.4404	X2CrNiMo17-12-2	DIN EN 10088-3: 2014	80227508	11120324	
SV4204	ref to SV4200				3.9	-10...90 °C -14...194 °F	G1/2" female	1.4404	X2CrNiMo17-12-2	DIN EN 10088-3: 2014	80227509	11120324	na	FKM	na	80223885	11120324											1.4404	X2CrNiMo17-12-2	DIN EN 10088-3: 2014	80227508	11120324	
SV4610	ref to SV4200				3.9	-10...90 °C -14...194 °F	1/2-14NPT female	1.4404	X2CrNiMo17-12-2	DIN EN 10088-3: 2014	80227504	11120324	na	FKM	na	80223885	11120324											1.4404	X2CrNiMo17-12-2	DIN EN 10088-3: 2014	80227508	11120324	
SV4614	ref to SV4200				3.9	-10...90 °C -14...194 °F	1/2-14NPT female	1.4404	X2CrNiMo17-12-2	DIN EN 10088-3: 2014	80227504	11120324	na	FKM	na	80223885	11120324											1.4404	X2CrNiMo17-12-2	DIN EN 10088-3: 2014	80227508	11120324	
SV5200	tested sensor				4.8	-10...90 °C -14...194 °F	G1/2" female	1.4404	X2CrNiMo17-12-2	DIN EN 10088-3: 2014	80227509	11120324	na	FKM	na	80223885	11120324											1.4404	X2CrNiMo17-12-2	DIN EN 10088-3: 2014	80227508	11120324	
SV5204	ref to SV5200				4.8	-10...90 °C -14...194 °F	G1/2" female	1.4404	X2CrNiMo17-12-2	DIN EN 10088-3: 2014	80227509	11120324	na	FKM	na	80223885	11120324											1.4404	X2CrNiMo17-12-2	DIN EN 10088-3: 2014	80227508	11120324	
SV5610	ref to SV5200				4.8	-10...90 °C -14...194 °F	1/2-14NPT female	1.4404	X2CrNiMo17-12-2	DIN EN 10088-3: 2014	80227504	11120324	na	FKM	na	80223885	11120324											1.4404	X2CrNiMo17-12-2	DIN EN 10088-3: 2014	80227508	11120324	
SV5614	ref to SV5200				4.8	-10...90 °C -14...194 °F	1/2-14NPT female	1.4404	X2CrNiMo17-12-2	DIN EN 10088-3: 2014	80227504	11120324	na	FKM	na	80223885	11120324											1.4404	X2CrNiMo17-12-2	DIN EN 10088-3: 2014	80227508	11120324	
SV7200	tested sensor				4.3	-10...90 °C -14...194 °F	G3/4" female	1.4404	X2CrNiMo17-12-2	DIN EN 10088-3: 2014	80228487	11120564	na	FKM	na	80223884	11120564											1.4404	X2CrNiMo17-12-2	DIN EN 10088-3: 2014	80228486	11120564	
SV7204	ref to SV7200				4.3	-10...90 °C -14...194 °F	G3/4" female	1.4404	X2CrNiMo17-12-2	DIN EN 10088-3: 2014	80228487	11120564	na	FKM	na	80223884	11120564											1.4404	X2CrNiMo17-12-2	DIN EN 10088-3: 2014	80228486	11120564	
SV7610	ref to SV7200				4.3	-10...90 °C -14...194 °F	3/4-14 NPT female	1.4404	X2CrNiMo17-12-2	DIN EN 10088-3: 2014	80229060	11120564	na	FKM	na	80223884	11120564											1.4404	X2CrNiMo17-12-2	DIN EN 10088-3: 2014	80228486	11120564	
SV7614	ref to SV7200				4.3	-10...90 °C -14...194 °F	3/4-14 NPT female	1.4404	X2CrNiMo17-12-2	DIN EN 10088-3: 2014	80229060	11120564	na	FKM	na	80223884	11120564											1.4404	X2CrNiMo17-12-2	DIN EN 10088-3: 2014	80228486	11120564	

THIS IS PART OF
CRN OF20267.5
Technical Standards & Safety Authority
Boilers & Pressure Vessels
Safety Program

IFM Flow Sensors - CRN Scope of Registration

Design Code: ASME B31.3 2014 Edition
Design Temperature: See Chart Below
Burst Pressure: See Chart Below
Corrosion Allowance: None
Impact Testing: Exempt per paragraph 323.2.2
Radiography: None

THIS IS PART OF CRN OF20267.5
Technical Standards & Safety Authority
Boilers & Pressure Vessels
Safety Program

Nearest equivalent ASME or ASTM material specification:		
1.4404	ASTM A276 Type 316L	UNS S31603
1.4571	ASTM A276 Type 316Ti	UNS S31635
1.4301	ASTM A276 Type 304	UNS S30400
EN AW-6082	6082 ASTM B221	UNS A96082
EN AW-6060	6060 ASTM B221	UNS A96060
2.4610	ASTM B574	UNS N06455

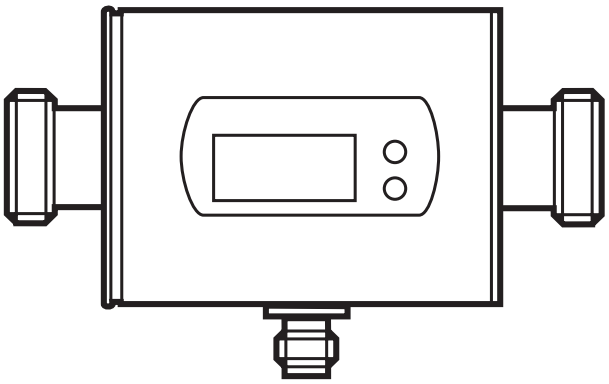
Cat. No.	Description	Pressure / bar				Temp. Range	1: Process Connection						2: gasket process connetction					3: Sensor tube					4: Sensor electrode					5: temperature electrode					
		Tested Bursting Pressure B	Factor of safety	Rated MAWP	MAWP in Data Sheet		Dimension	Material Number	Material Name	ref. to Standard	Art. No.	Refer to Assembly Drawing	Material Number	Material Name	ref. to Standard	Art. No.	Refer to Assembly Drawing	Material Number	Material Name	ref. to Standard	Art. No.	Refer to Assembly Drawing	Material Number	Material Name	ref. to Standard	Art. No.	Refer to Assembly Drawing	Material Number	Material Name	ref. to Standard	Art. No.	Refer to Assembly Drawing	Mat Num
SM2000	tested sensor				16.5	-10...70 °C -14...158 °F	G2" male	1.4571	X6CrNiMoTi17-12-2	DIN EN 10088: 2014	50025336	11119889	na	FKM	na	50024186	11119889																n
SM2001	ref to SM2000				16.5	-10...70 °C -14...158 °F	G2" male	1.4571	X6CrNiMoTi17-12-2	DIN EN 10088: 2014	50025336	11119889	na	FKM	na	50024186	11119889																n
SM2004	ref to SM2000				16.5	-10...70 °C -14...158 °F	G2" male	1.4571	X6CrNiMoTi17-12-2	DIN EN 10088: 2014	50025336	11119889	na	FKM	na	50024186	11119889																n
SM2100	ref to SM2000				16.5	-10...70 °C -14...158 °F	G2" male	1.4571	X6CrNiMoTi17-12-2	DIN EN 10088: 2014	50025336	11119889	na	EPDM	na	80229726	11119889																n
SM2601	ref to SM2000				16.5	-10...70 °C -14...158 °F	2-11,5NPT female	1.4571	X6CrNiMoTi17-12-2	DIN EN 10088: 2014	80012058	11119889	na	FKM	na	50024186	11119889																n
SM2604	ref to SM2000				16.5	-10...70 °C -14...158 °F	2-11,5NPT female	1.4571	X6CrNiMoTi17-12-2	DIN EN 10088: 2014	80012058	11119889	na	FKM	na	50024186	11119889																n
SM9000	ref to SM2000				16.5	-10...70 °C -14...158 °F	G11/2" male	1.4571	X6CrNiMoTi17-12-2	DIN EN 10088: 2014	50025336	11119889	na	FKM	na	50024186	11119889																n
SM9001	ref to SM2000				16.5	-10...70 °C -14...158 °F	G11/2" male	1.4571	X6CrNiMoTi17-12-2	DIN EN 10088: 2014	50025336	11119889	na	FKM	na	50024186	11119889																n
SM9004	ref to SM2000				16.5	-10...70 °C -14...158 °F	G11/2" male	1.4571	X6CrNiMoTi17-12-2	DIN EN 10088: 2014	50025336	11119889	na	FKM	na	50024186	11119889																n
SM9100	ref to SM2000				16.5	-10...70 °C -14...158 °F	G11/2" male	1.4571	X6CrNiMoTi17-12-2	DIN EN 10088: 2014	50025336	11119889	na	EPDM	na	80229726	11119889																n
SM9601	ref to SM2000				16.5	-10...70 °C -14...158 °F	11/2-11,5NPT female	1.4571	X6CrNiMoTi17-12-2	DIN EN 10088: 2014	80012057	11119889	na	FKM	na	50024186	11119889																n
SM9604	ref to SM2000				16.5	-10...70 °C -14...158 °F	11/2-11,5NPT female	1.4571	X6CrNiMoTi17-12-2	DIN EN 10088: 2014	80012057	11119889	na	FKM	na	50024186	11119889																n
SM6000	tested sensor				17.7	-10...70 °C -14...158 °F	G 1/2" male	1.4404	X2CrNiMo17-12-2	DIN EN 10088: 2014	50014379 50014387	11119987	na	FKM	na	50017755	11119987																n
SM6001	ref to SM6000				17.7	-10...70 °C -14...158 °F	G 1/2" male	1.4404	X2CrNiMo17-12-2	DIN EN 10088: 2014	50014379 50014387	11119987	na	FKM	na	50017755	11119987																n
SM6004	ref to SM6000				17.7	-10...70 °C -14...158 °F	G 1/2" male	1.4404	X2CrNiMo17-12-2	DIN EN 10088: 2014	50014379 50014387	11119987	na	FKM	na	50017755	11119987																n
SM6050	ref to SM6000				17.7	-10...70 °C -14...158 °F	G 1/2" male	1.4404	X2CrNiMo17-12-2	DIN EN 10088: 2014	50014379 50014387	11119987	na	FKM	na	50017755	11119987																n
SM6100	ref to SM6000				17.7	-10...70 °C -14...158 °F	G 1/2" male	1.4404	X2CrNiMo17-12-2	DIN EN 10088: 2014	50014379 50014387	11119987	na	EPDM	na	80229663	11119987																n
SM6601	ref to SM6000				17.7	-10...70 °C -14...158 °F	1/2-14 NPT female	1.4404	X2CrNiMo17-12-2	DIN EN 10088: 2014	80012032 80010316	11119987	na	FKM	na	50017755	11119987																n
SM6604	ref to SM6000				17.7	-10...70 °C -14...158 °F	1/2-14 NPT female	1.4404	X2CrNiMo17-12-2	DIN EN 10088: 2014	80012032 80010316	11119987	na	FKM	na	50017755	11119987																n
SM7000	tested sensor				11.2	-10...70 °C -14...158 °F	G 3/4" male	1.4404	X2CrNiMo17-12-2	DIN EN 10088: 2014	50014420 50014421	11120033	na	FKM	na	50014580	11120033																n
SM7001	ref to SM7000				11.2	-10...70 °C -14...158 °F	G 3/4" male	1.4404	X2CrNiMo17-12-2	DIN EN 10088: 2014	50014420 50014421	11120033	na	FKM	na	50014580	11120033																n
SM7004	ref to SM7000				11.2	-10...70 °C -14...158 °F	G 3/4" male	1.4404	X2CrNiMo17-12-2	DIN EN 10088: 2014	50014420 50014421	11120033	na	FKM	na	50014580	11120033																n
						-10...70 °C																										

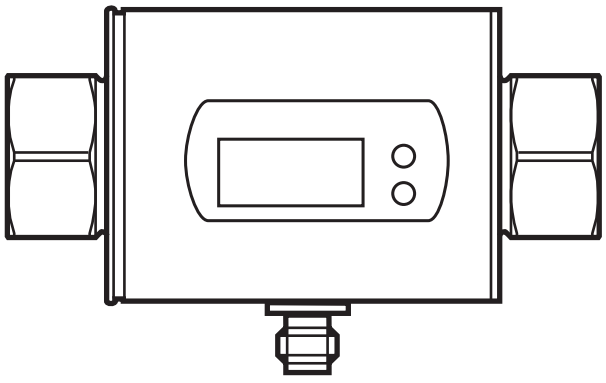
SM7050	ref to SM7000	11.2	-10...70 °C -14...158 °F	G 3/4" male	1.4404	XZCrNiMo17-12-2	DIN EN 10088: 2014	500144Z0 500142Z1	1112003Z	na	FKM	na	5001458Ø	1112003Z					
SM7100	ref to SM7000	11.2	-10...70 °C -14...158 °F	G 3/4" male	1.4404	XZCrNiMo17-12-2	DIN EN 10088: 2014	500144Z0 500142Z1	1112003Z	na	EPDM	na	8022966S	1112003Z					
SM7601	ref to SM7000	11.2	-10...70 °C -14...158 °F	3/4-14 NPT female	1.4404	XZCrNiMo17-12-2	DIN EN 10088: 2014	8001Z03Z 8001Z034	1112003Z	na	FKM	na	5001458Ø	1112003Z					
SM7604	ref to SM7000	11.2	-10...70 °C -14...158 °F	3/4-14 NPT female	1.4404	XZCrNiMo17-12-2	DIN EN 10088: 2014	8001Z03Z 8001Z034	1112003Z	na	FKM	na	5001458Ø	1112003Z					
SM0505	ref to SM7000	11.2	-10...70 °C -14...158 °F	G 3/4" male	1.4404	XZCrNiMo17-12-2	DIN EN 10088: 2014	500144Z0 500144Z1	1112003Z	na	FKM	na	5001458Ø	1112003Z					
SM8000	ref to SM7000	11.2	-10...70 °C -14...158 °F	G 1" male	1.4404	XZCrNiMo17-12-2	DIN EN 10088: 2014	500144Z2 500144Z5	1112003Z	na	FKM	na	5001458Ø	1112003Z					
SM8001	ref to SM7000	11.2	-10...70 °C -14...158 °F	G 1" male	1.4404	XZCrNiMo17-12-2	DIN EN 10088: 2014	500144Z2 500144Z5	1112003Z	na	FKM	na	5001458Ø	1112003Z					
SM8004	ref to SM7000	11.2	-10...70 °C -14...158 °F	G 1" male	1.4404	XZCrNiMo17-12-2	DIN EN 10088: 2014	500144Z2 500144Z5	1112003Z	na	FKM	na	5001458Ø	1112003Z					
SM8050	ref to SM7000	11.2	-10...70 °C -14...158 °F	G 1" male	1.4404	XZCrNiMo17-12-2	DIN EN 10088: 2014	500144Z2 500144Z5	1112003Z	na	FKM	na	5001458Ø	1112003Z					
SM8100	ref to SM7000	11.2	-10...70 °C -14...158 °F	G 1" male	1.4404	XZCrNiMo17-12-2	DIN EN 10088: 2014	500144Z2 500144Z5	1112003Z	na	EPDM	na	8022966S	1112003Z					
SM8601	ref to SM7000	11.2	-10...70 °C -14...158 °F	1-11,5 NPT female	1.4404	XZCrNiMo17-12-2	DIN EN 10088: 2014	8001Z03S 8001Z056	1112003Z	na	FKM	na	5001458Ø	1112003Z					
SM8604	ref to SM7000	11.2	-10...70 °C -14...158 °F	1-11,5 NPT female	1.4404	XZCrNiMo17-12-2	DIN EN 10088: 2014	8001Z03S 8001Z056	1112003Z	na	FKM	na	5001458Ø	1112003Z					

Operating instructions
Magnetic-inductive flow meter

UK

SM4x00
SM6x00
SM7x00
SM8x00
SM6x01
SM7x01
SM8x01





11393456 / 00 06 / 2020

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1 Preliminary note

▶ Instructions

> Reaction, result

[…] Designation of keys, buttons or indications

→ Cross-reference

Important note
Non-compliance may result in malfunction or interference.

Information
Supplementary note.

⚠ CAUTION

Warning of personal injury.
Slight reversible injuries may result.

2 Safety instructions

- Read this document before setting up the product and keep it during the entire service life.
- The product must be suitable for the corresponding applications and environmental conditions without any restrictions.
- Only use the product for its intended purpose (→ 3 Functions and features).
- Only use the product for permissible media (→ Technical data).
- If the operating instructions or the technical data are not adhered to, personal injury and/or damage to property may occur.
- The manufacturer assumes no liability or warranty for any consequences caused by tampering with the product or incorrect use by the operator.
- Installation, electrical connection, set-up, operation and maintenance of the unit must be carried out by qualified personnel authorised by the machine operator.
- Protect units and cables against damage.
- For medium temperatures above 50 °C (122 °F) some parts of the housing can heat up to over 65 °C (149 °F). Moreover, during installation or in case of a fault (e.g. housing damage) media under high pressure or hot media can leak from the system. To avoid personal injury, take the following measures:

- ▶ Install the units according to the applicable rules and regulations.
- ▶ Ensure that the system is free of pressure during installation.
- ▶ Protect the housing against contact with flammable substances and unintentional contact. To do so, equip the units with suitable protection (e.g. protective cover).
- ▶ Do not press the pushbuttons manually. instead use another object (e.g. ballpoint pen).

3 Functions and features

The unit monitors liquid media. It detects the 3 process categories volumetric flow, consumed quantity, medium temperature.

Pressure Equipment Directive (PED)

The units comply with the Pressure Equipment Directive and are designed and manufactured for group 2 fluids in accordance with the sound engineering practice. Use of group 1 fluids on request.

Application area

Conductive liquids with the following properties:

- Conductivity: ≥ 20 µS/cm
- Viscosity: < 70 mm^2/s at 40 °C; < 70 cSt at 104 °F

4 Function

- The unit detects the flow based on the magnetic-inductive volumetric flow measuring principle.
- The unit also detects the medium temperature.
- It features an IO-Link interface.
- The unit displays the current process value.

4.1 Processing of the measured signals

The unit generates 2 output signals according to the parameter settings:

OUT1/IO-Link: 4 selection options	Parameter setting
- Switching signal for volumetric flow quantity limit	→ 10.2.1
- Pulse signal for quantity meter	→ 10.3.1
- Switching signal for preset counter	→ 10.3.2
- Switching signal for direction of flow	→ 10.2.4

OUT2: 6 selection options	Parameter setting
- Switching signal for volumetric flow quantity limit	→ 10.2.2
- Switching signal for temperature limit	→ 10.4.1
- Analogue signal for volumetric flow quantity	→ 10.2.3
- Analogue signal for temperature	→ 10.4.2
- Switching signal for direction of flow	→ 10.2.4
- Input for external counter reset signal (InD)	→ 10.3.7

4.2 Direction of flow

In addition to the flow velocity and the volumetric flow quantity, the unit also detects the direction of flow.

4.2.1 Determination of the direction of flow (Fdir)

An arrow with the text "flow direction" on the unit indicates the positive flow direction. The flow direction can be inversed (→ 10.5.9).

▶ Use the supplied label to mark the changed flow direction (new positive direction of flow).

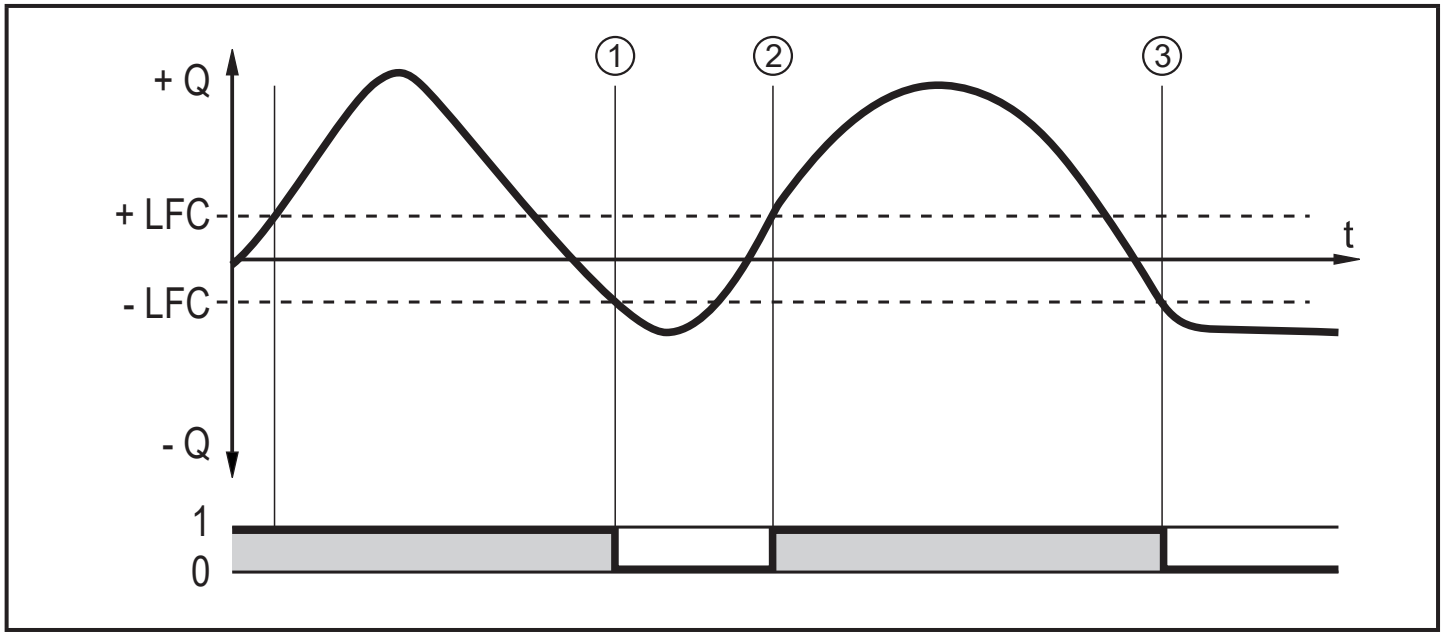
Flow...	Process value display
corresponds to the marked flow direction	+ (positive)
against the marked flow direction	- (negative)

4.2.2 Detection of the direction of flow (dir.F)

When dir.F is activated (→ 10.2.4), the direction of flow is indicated by a switching signal.

The output is switched on until the set minimum volumetric flow quantity in negative direction of flow (- LFC) is not reached (1).
Afterwards the following applies:

- The output switches ON when + LFC is exceeded (2).
- The output switches OFF when - LFC is not reached (3).



+ Q : Flow in positive direction of flow
- Q : Flow in negative direction of flow
+ LFC: Minimum volumetric flow quantity in positive direction of flow
- LFC : Minimum volumetric flow quantity in negative direction of flow

Positive direction of flow = marked direction of flow,
with the factory setting marked by the arrow on the unit or after change via Fdir marked by the attached label (→ 4.2.1).

4.3 Consumed quantity monitoring (ImP)

The unit has an internal quantity meter (totaliser). It continuously totals the consumed quantity after the last reset. Pulse signals or a switching signal can be used to monitor the consumed quantity.
→ 10.3.1 Quantity monitoring by pulse output (OUT1)
→ 10.3.2 Quantity monitoring by preset counter (OUT1)

4.3.1 Display and counting method of the quantity meter

Meter reading:

- The current meter count can be indicated (→ 11.2).
- In addition the value before the last reset is saved. This value can also be displayed (→ 11.2).

The meter saves the totalled volumetric flow quantity every 10 minutes. After a power failure this value is available as the current meter reading. If a time-controlled reset is set, the elapsed time of the set reset interval is also saved. So the possible data loss can be maximum 10 minutes.

Counter reset:

- There are different ways to reset the quantity meter.
  → 10.3.4 Manual counter reset
  → 10.3.5 Time-controlled counter reset
  → 10.3.7 Counter reset using an external signal
- If the quantity meter is not reset using one of the above-mentioned processes, an automatic reset will be made when the maximum volumetric flow quantity that can be displayed is exceeded (overflow).

Taking into consideration the direction of flow:

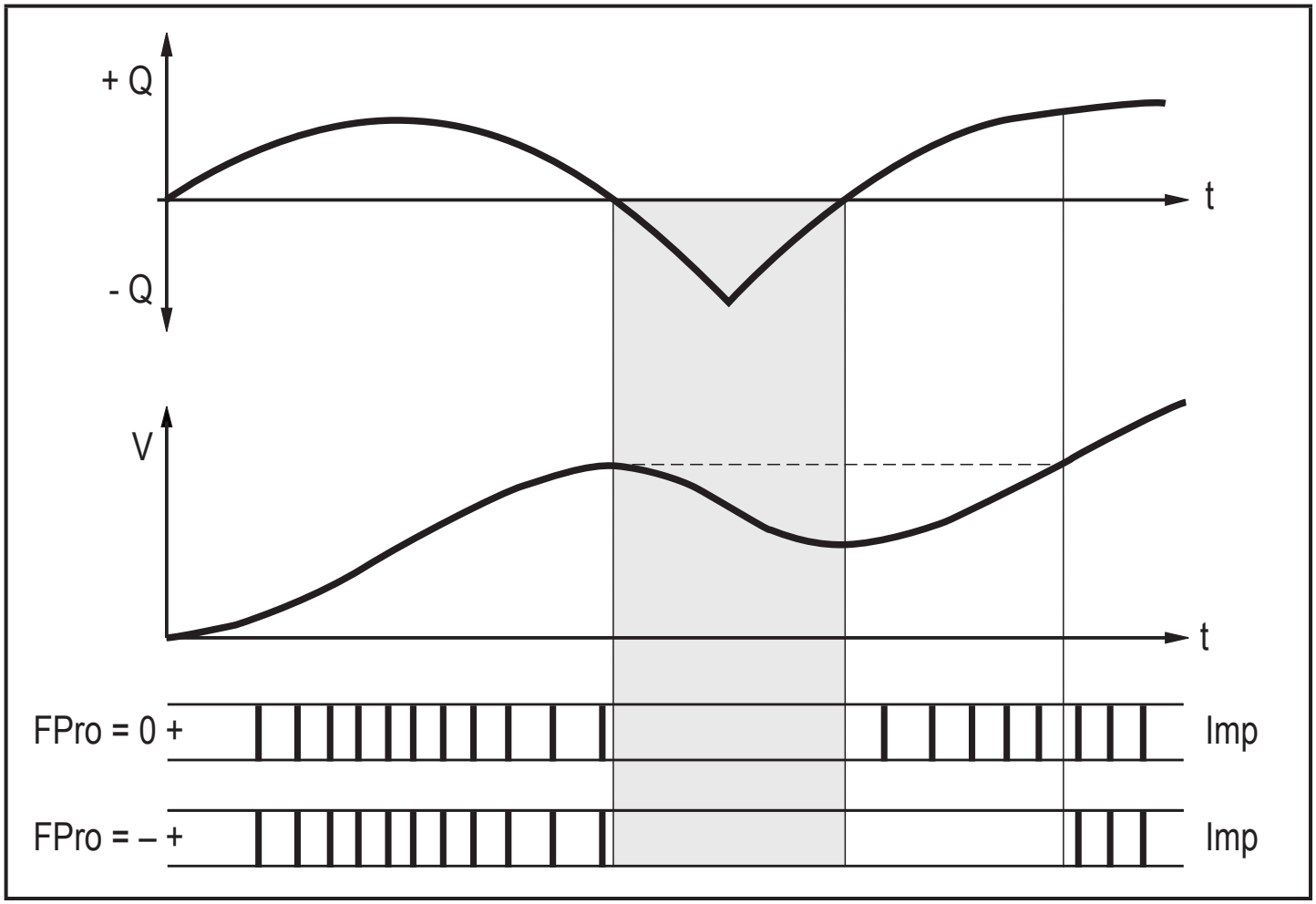
- The quantity meter takes account of the flow direction for totalisation. The following counting methods can be defined via the parameter [FPro] (→ 10.5.8):

[FPro]	Counting method
0+	Negative flow values (against the marked direction of flow) are not taken into consideration for totalling.
– +	Negative flow values are subtracted from the consumed quantity.

4.3.2 Consumed quantity monitoring via pulse output

Output 1 indicates a pulse signal when the set volumetric flow quantity has been reached (pulse value → 10.3.3).

Depending on the setting of the counting method [FPro] totalling of the volumetric flow quantity takes into account the flow in negative direction of flow (– +) or does not take it into account (0+) → 4.3.1.



+ Q = volumetric flow quantity in positive direction
- Q = volumetric flow quantity in negative direction
V = volumetric flow quantity absolute (= sum of negative and positive flow)

4.3.3 Consumed quantity monitoring via preset counter

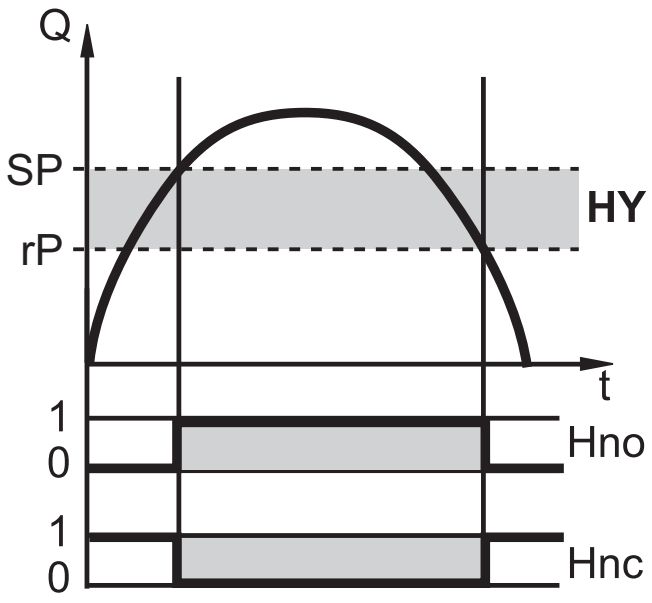
2 kinds of monitoring are possible which can be set via the parameter [rTo].

[rTo]	Output	Counter reset
OFF (→ 10.3.6)	OUT1 switches when the volumetric flow quantity set with [ImPS] has been reached.	The preset counter is only reset - when a manual reset is made (→ 10.3.4) or - when the maximum display range has been exceeded.
1, 2,... h 1, 2,... d 1, 2,... w (→ 10.3.5)	OUT1 switches when the volumetric flow quantity set with [ImPS] is reached within the set time.	The preset counter is reset automatically when the time has elapsed and counting starts again.

4.4 Switching function

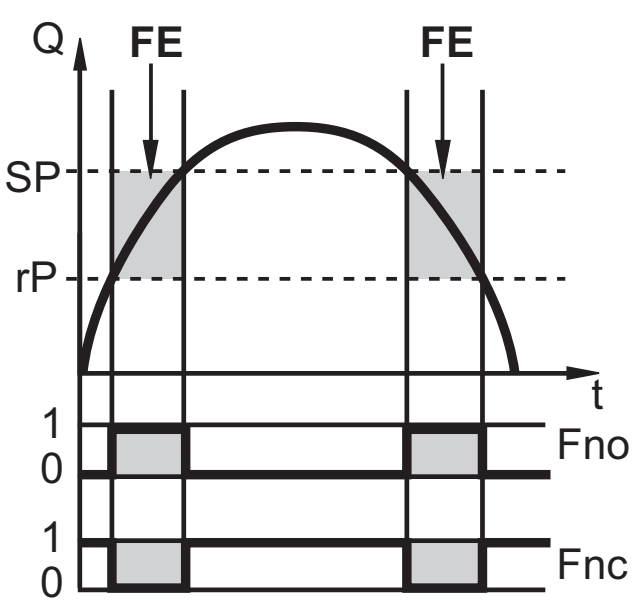
OUTx changes its switching status if it is above or below the set switching limits (flow or temperature). Hysteresis or window function can be selected. Example of volumetric flow monitoring:

Hysteresis function



SP = set point
rP = reset point
HY = hysteresis
Hno = hysteresis NO (normally open)
Hnc = hysteresis NC (normally closed)

Window function



SP = upper limit
rP = lower limit
FE = window
Fno = window NO (normally open)
Fnc = window NC (normally closed)

When the hysteresis function is set, the set point [SP] is defined first and then the reset point [rP] which must have a lower value. If only the set point is changed, the reset point remains constant.

When set to the window function, the upper limit [SP] and the lower limit [rP] have a fixed hysteresis of 0.5 % of the final value of the measuring range. This keeps the switching status of the output stable if the flow rate varies slightly.

4.5 Analogue function

- The unit provides an analogue signal that is proportional to the volumetric flow quantity and the medium temperature.
- The analogue signal can be provided as current or voltage signal.
- Within the measuring range the analogue signal is 4...20 mA (current output) or 0...10 V (voltage output).
- If the measured value is outside the measuring range or in the event of an internal error, the current or voltage signals indicated in Figure 1 are provided.
- The measuring range is scalable:
  [ASP2] determines at which measured value the output signal is 4 mA or 0 V.
  [AEP2] determines at which measured value the output signal is 20 mA or 10 V.

  Minimum distance between [ASP2] and [AEP2] = 20 % of the final value of the measuring range.

MAW	Initial value of the measuring range	For non-scaled measuring range (= factory setting)
MEW	Final value of the measuring range	
ASP2	Analogue start point	For scaled measuring range
AEP2	Analogue end point	

Table 1: Definitions

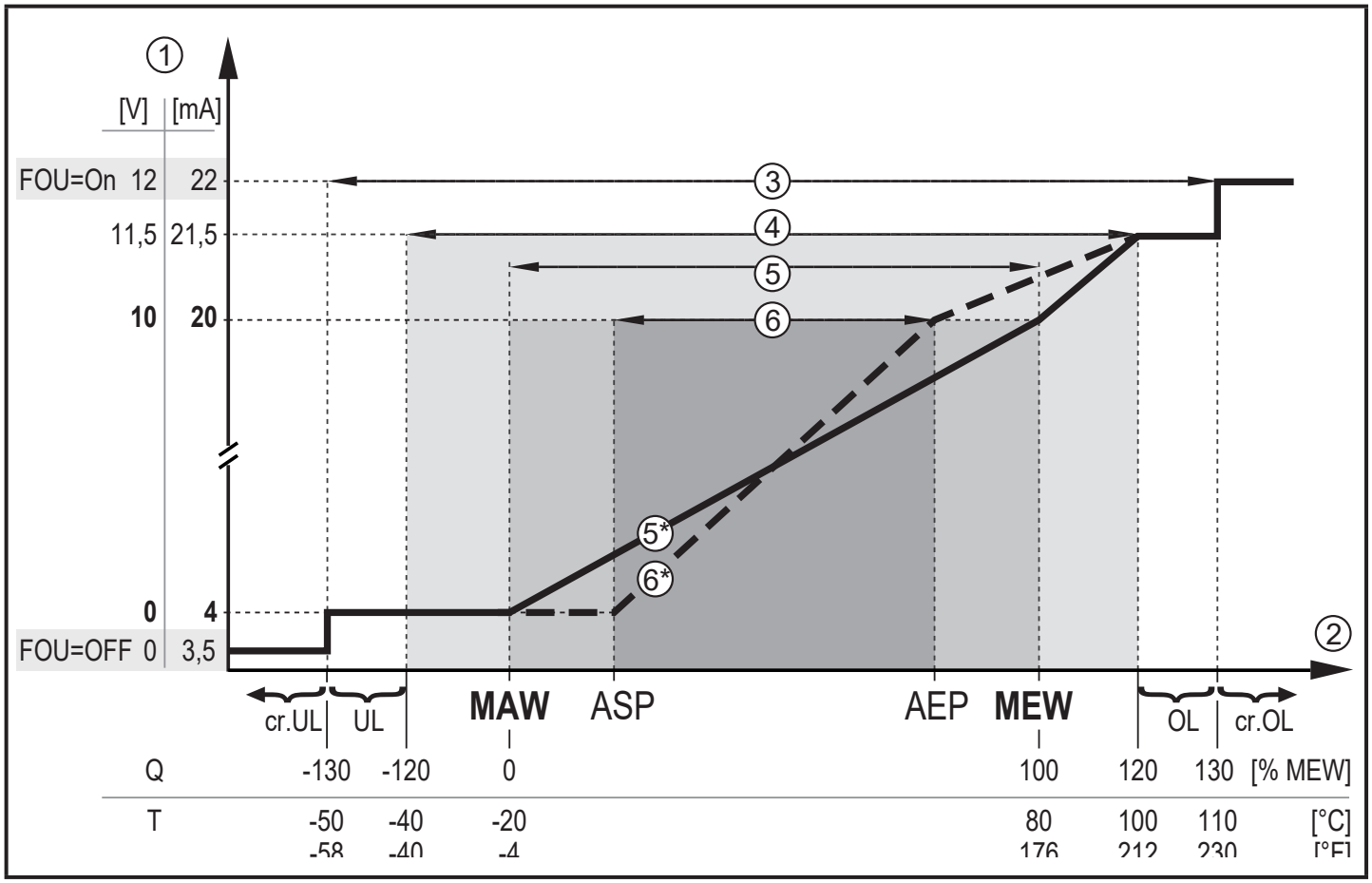


Figure 1: Characteristics of the analogue output according to the standard IEC 60947-5-7.

Q: Flow (a negative flow value means flow against the marked flow direction)
T: Temperature
UL: Below the display range
OL: Above the display range
cr.UL: Below the detection zone (error)
cr.OL: Above the detection zone (error)
FOU=On: Default setting at which the analogue signal goes to the upper final value in case of an error.*
FOU=OFF: Default setting at which the analogue signal goes to the lower final value in case of an error.*

* The type of error is displayed: cr.UL, cr.OL, Err (→ 12).

① Analogue signal (voltage or current)
② Measured value (flow or temperature)
③ Detection zone
④ Display range
⑤ Measuring range
⑤* Analogue signal in the measuring range with factory setting
⑥ Scaled measuring range
⑥* Analogue signal for scaled measuring range

4.6 Measured value damping (dAP)

The damping time allows to set after how many seconds the output signal has reached 63 % of the final value if the flow value changes suddenly. The set damping time stabilises the outputs, the display and the process value transfer via the IO-Link interface. The signals [UL] and [OL] (→ 12 Troubleshooting) are defined under consideration of the damping time.

4.7 Start-up delay (dST)

The start-up delay [dST] influences the switching outputs of the volumetric flow monitoring.

If the start-up delay is active ([dST] > [0]), note: As soon as the volumetric flow exceeds the LFC value (→ 4.8), the following processes are carried out:

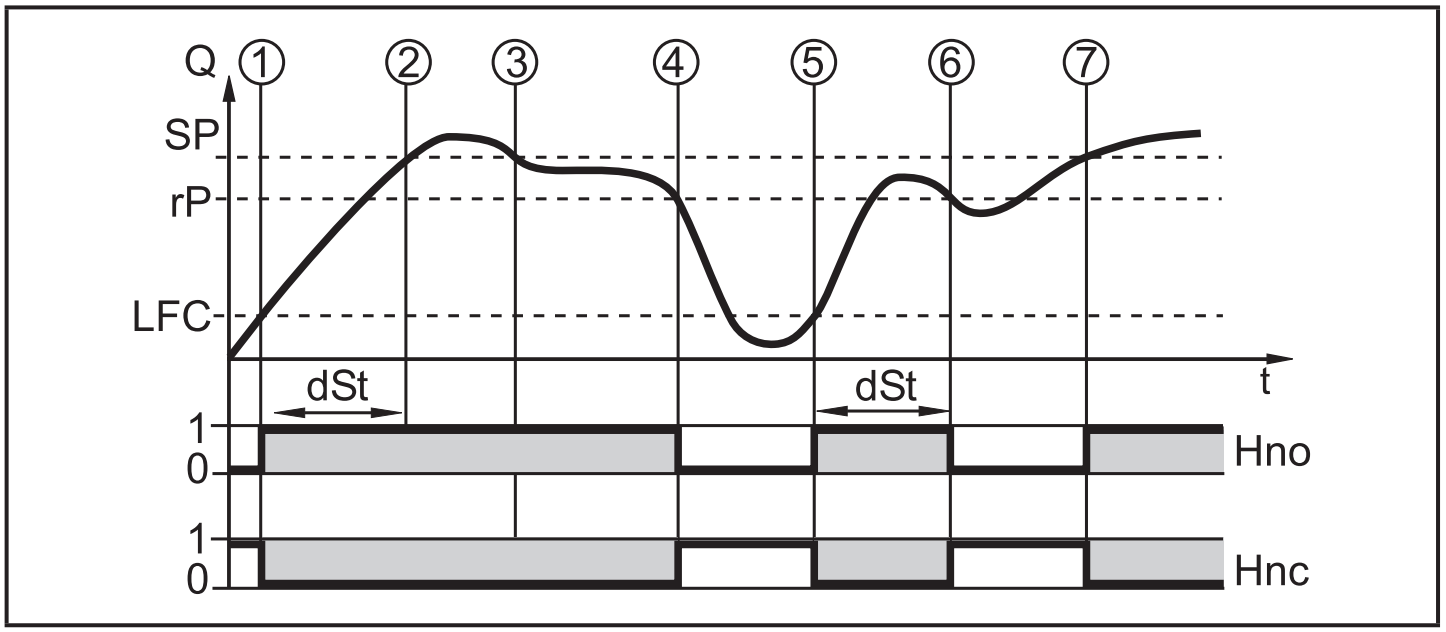
> The start-up delay is activated.

> The outputs switch as programmed: ON for NO function, OFF for NC function.

After the start of the start-up delay there are 3 options:

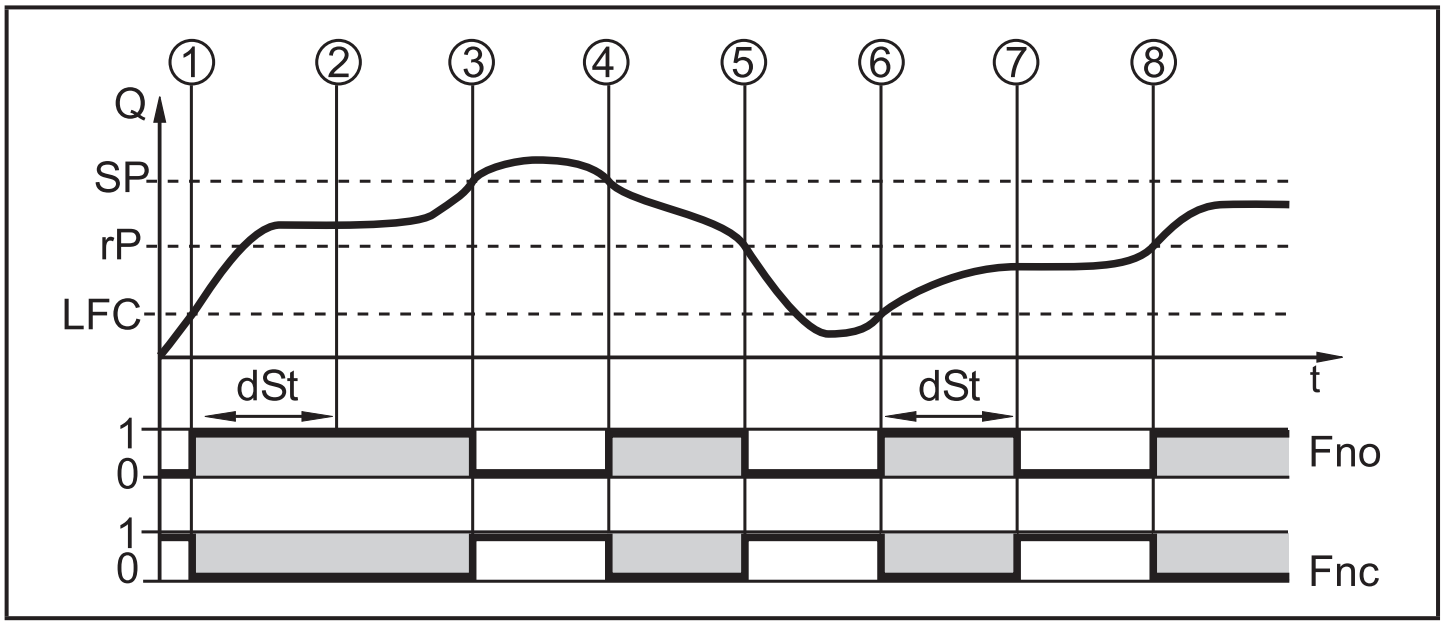
1. The volumetric flow increases quickly and reaches the set point / good range within [dST].
   > Outputs remain active.
2. The volumetric flow increases slowly and does not reach the set point /good range within [dST] > Outputs are reset.
3. Volumetric flow quantity falls below [LFC] within [dST].
   > Outputs are reset at once; [dST] is stopped.

Example: dST for hysteresis function



	Condition	Reaction
1	Volumetric flow quantity Q reaches LFC	dST starts, output becomes active
2	dST elapsed, Q reached SP	Output remains active
3	Q below SP but above rP	Output remains active
4	Q below rP	Output is reset
5	Q reaches again LFC	dST starts, output becomes active
6	dST elapsed, Q has not reached SP	Output is reset
7	Q reaches SP	Output becomes active

Example: dST for window function



	Condition	Reaction
1	Volumetric flow quantity Q reaches LFC	dST starts, output becomes active
2	dST elapsed, Q reached good range	Output remains active
3	Q above SP (leaves good range)	Output is reset
4	Q again below SP	Output becomes active again
5	Q below rP (leaves good range)	Output is reset again
6	Q reaches again LFC	dST starts, output becomes active
7	dST elapsed, Q has not reached good range	Output is reset
8	Q reaches good range	Output becomes active

4.8 Low flow cut-off (LFC)

With the function Low Flow cut-off small volumetric flow quantities can be suppressed (→ 10.5.7). Flows below the LFC value are evaluated by the sensor as standstill (Q = 0).

4.9 IO-Link

This unit has an IO-Link communication interface which enables direct access to process and diagnostic data. In addition it is possible to set the parameters of the unit during operation. Operation of the unit via IO-Link interface requires an IO-Link capable module (IO-Link master).

With a PC, suitable IO-Link software and an IO-Link adapter cable communication is possible when the system is not in operation.

For the IODDs necessary for the configuration of the unit, detailed information about process data structure, diagnostic information, parameter addresses and the necessary information about the required IO-Link hardware and software visit www.ifm.com.

5 Mounting

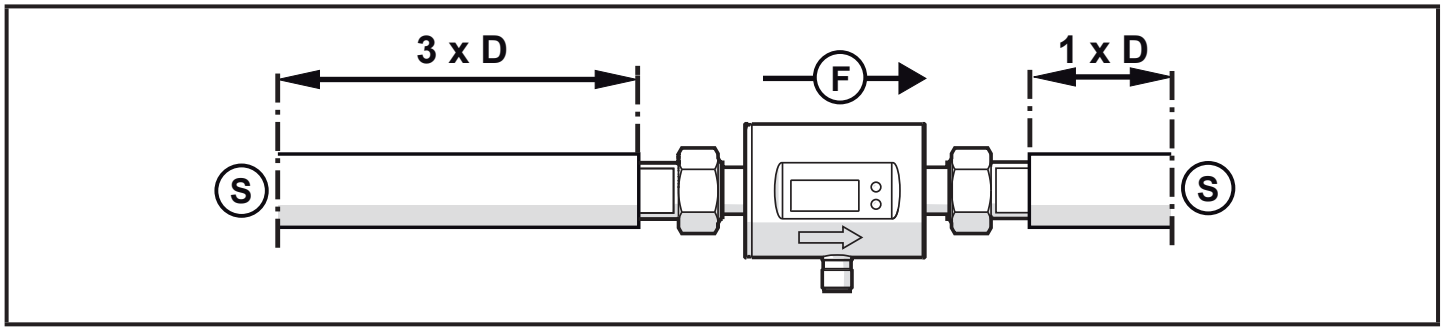
- ▶ Ensure that the system is free of pressure during installation.
- ▶ Ensure that no media can leak at the mounting location during installation.
- ▶ Attach the supplied warning label to the sensor cable.

The unit can be installed independently of the orientation if the following is ensured:

- No air bubbles can form in the pipe system.
- The pipes are always completely filled.

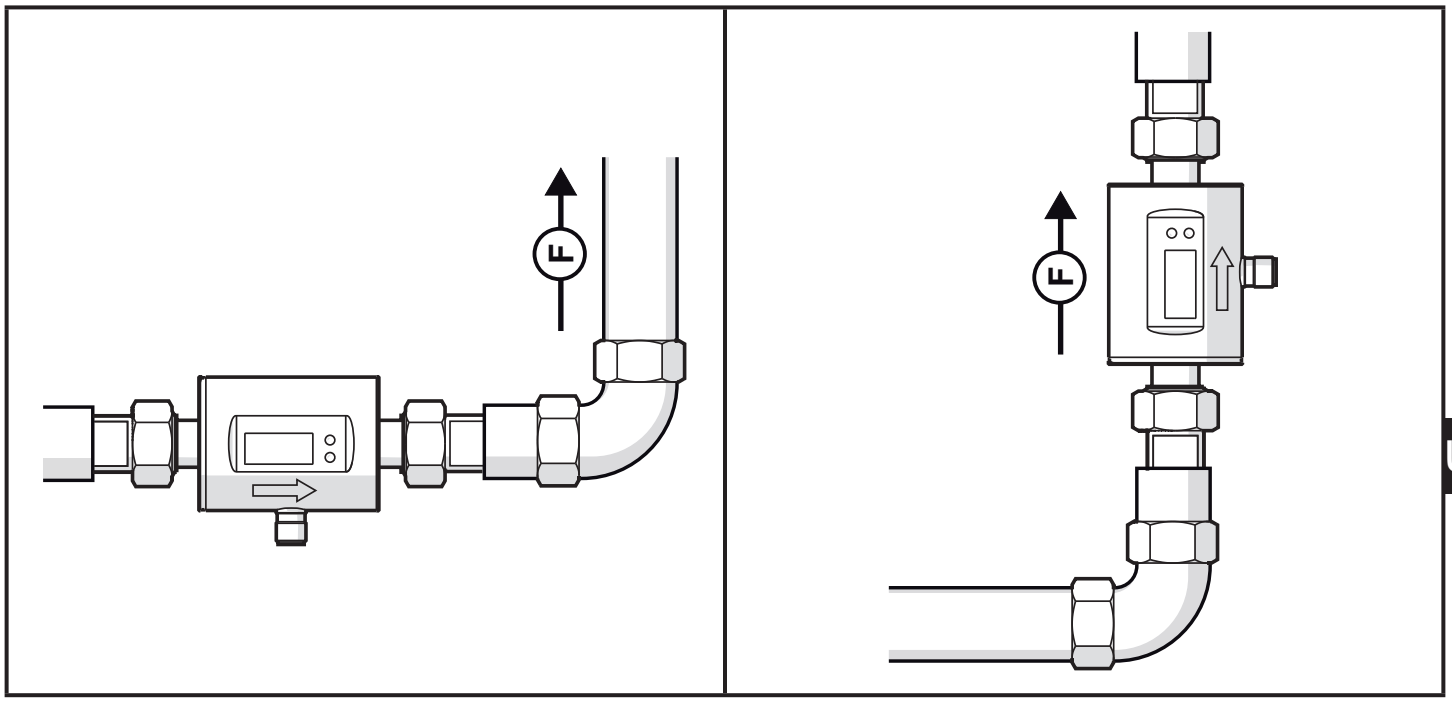
5.1 Recommended installation position

- ▶ Install the unit so that the measuring pipe is always completely filled.
- ▶ Arrange for inlet and outlet pipe lengths. Disturbances caused by bends, valves, reductions, etc. are compensated for. It applies in particular: no shut-off and control devices are allowed directly in front of the unit.



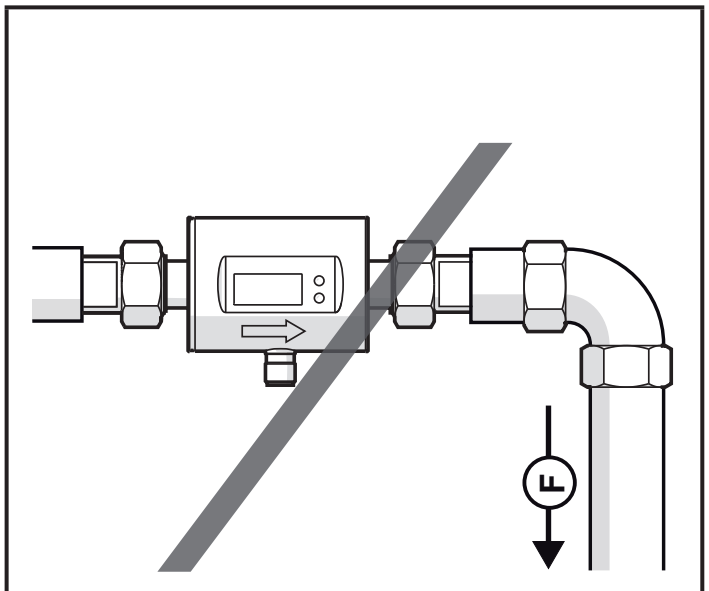
S = disturbance (e.g. shut-off / control device, pump, bends)
D = pipe diameter
F = direction of flow

▶ Install in front of or in a rising pipe.

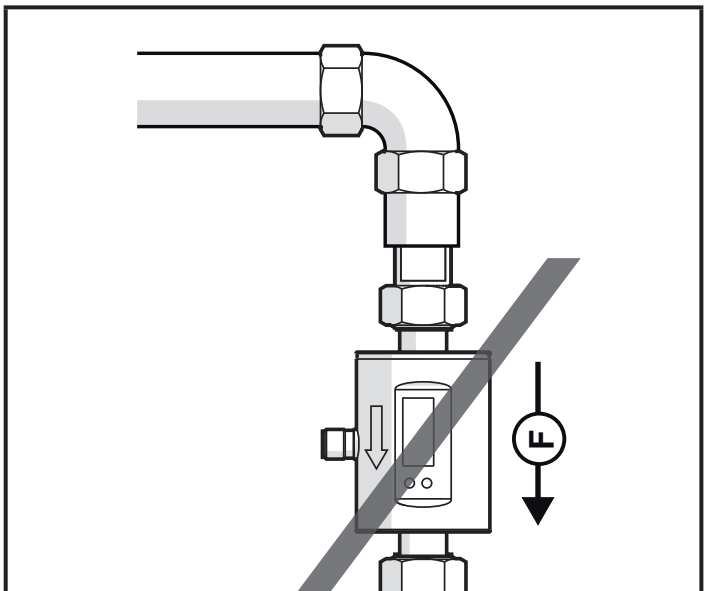


5.2 Not recommended installation position

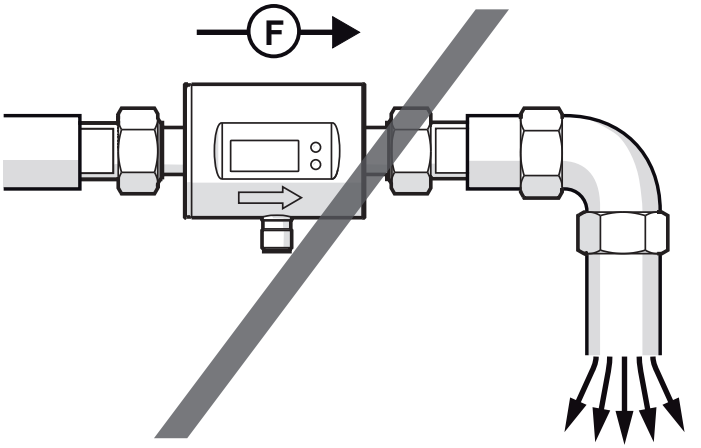
▶ Avoid the following installation positions:



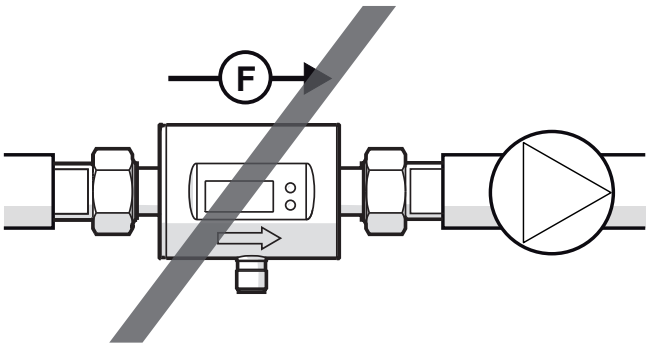
Directly in front of a falling pipe.



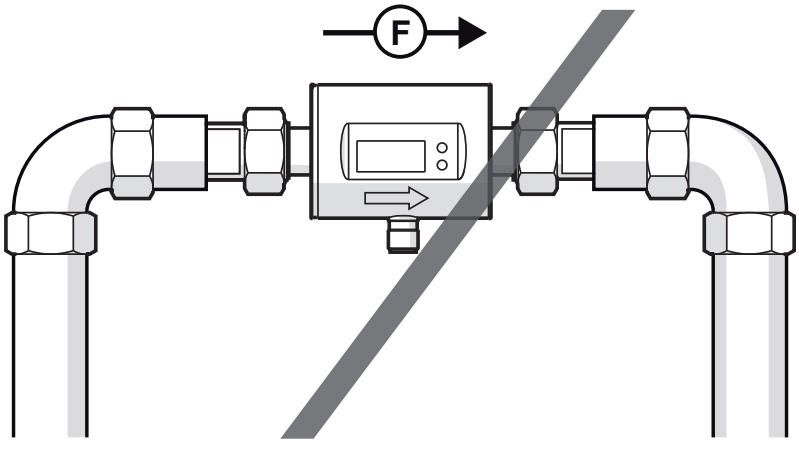
In a falling pipe.



Directly in front of
the spout of the pipe.



On the suction side of a pump.



At the highest point
of the pipe system.

F = flow direction

5.3 Grounding

If installed in an ungrounded pipe system (e.g. plastic pipes), the unit must be grounded (functional earth).

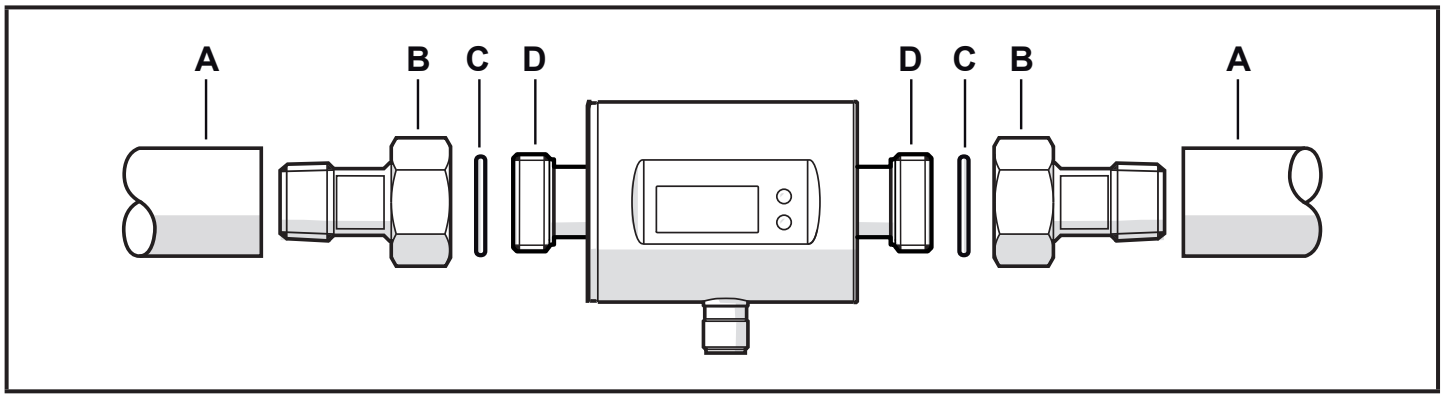
Ground brackets for the M12 connector are available as accessories
→ www.ifm.com.

5.4 Installation in pipes

The units with a G thread can be installed in the pipes using adapters.

Information about the available mounting accessories at www.ifm.com.

A correct fit of the unit and ingress resistance of the connection are only ensured using ifm adapters.



1. Grease the threads of the process connection, adapter and sensor. Use a lubricating paste which is suitable and approved for the application.
2. Screw the adapter (B) into the pipe (A).
3. Place the seals (C) and install the unit according to the marked flow direction.
4. Screw the adapter (B) with the threads (D) until it is hand-tight.
5. Tighten the two adapters in opposite direction:
   Tightening torque: SM6/SM7/SM8 = 30 Nm; SM4 = 15 Nm.

After installation air bubbles in the system can affect the measurement.

▶ Corrective measures: Rinse the system after installation for ventilation.

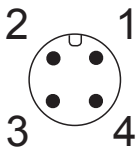
In case of horizontal installation:
As a result of design requirements a small quantity of the medium always remains in the measuring channel after switching off the pump.

6 Electrical connection

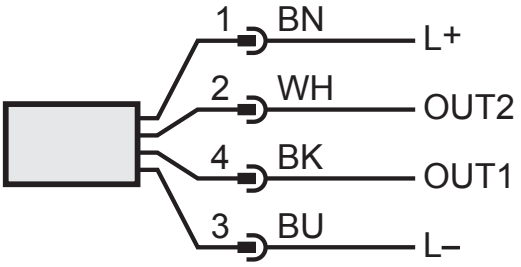
The unit must be connected by a qualified electrician.
The national and international regulations for the installation of electrical equipment must be adhered to.
Voltage supply according to EN 50178, SELV, PELV.

▶ Disconnect power.

▶ Connect the unit as follows:



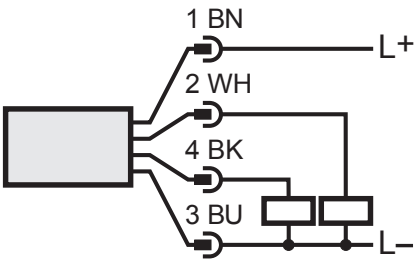
BK: black
BN: brown
BU: blue
WH: white



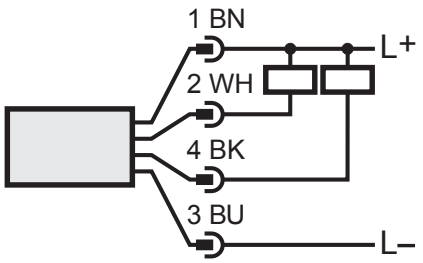
Colours to DIN EN 60947-5-2

Sample circuits:

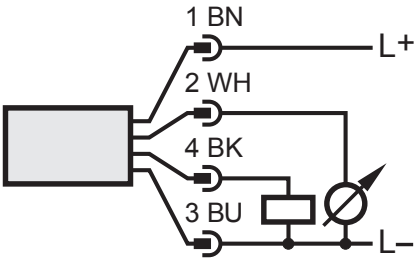
2 x positive switching



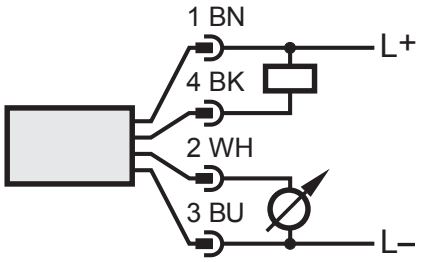
2 x negative switching



1 x positive switching / 1 x analogue

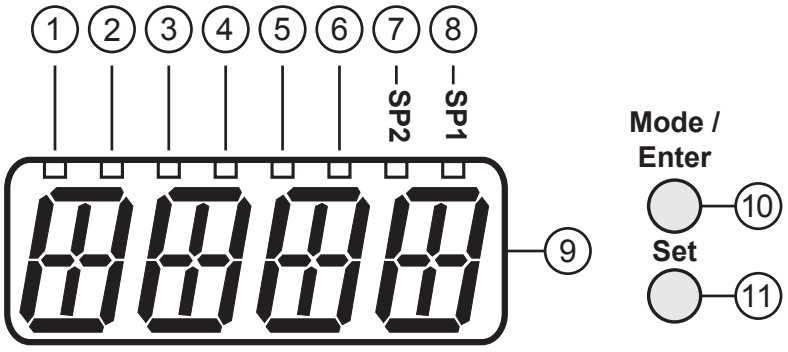


1 x negative switching / 1 x analogue



Pin 1	L+
Pin 3	L-
Pin 4 (OUT1)	• Switching signal: limits for volumetric flow • Pulse signal: 1 pulse every time the defined volumetric flow quantity is reached • Switching signal: quantity meter reached preset value • Switching signal for direction of flow • IO-Link
Pin 2 (OUT2/ InD)	• Switching signal: limits for volumetric flow • Switching signal: limits for temperature • Analogue signal for volumetric flow quantity • Analogue signal for temperature • Switching signal for direction of flow • Input for external counter reset signal (InD)

7 Operating and display elements



1-6: Indicator LEDs for process value indication

SMxx00:

LED		Process value display		Unit SMxx00	Unit SM4x00
1	□	Current flow volume per minute		l/min	ml/min
2	□	Current flow volume per hour		m^3/h	l/h
3	□	Current consumed quantity (= meter reading) since the last reset	Totaliser *	l	l
4	□			m^3	m^3
4 + 6	□			$m^3 \times 10^3$	$m^3 \times 10^3$
3	⌑	Consumed quantity (= meter reading) before the last reset		l	l
4	⌑			m^3	m^3
4 + 6	⌑			$m^3 \times 10^3$	$m^3 \times 10^3$
5	□	Current medium temperature		°C	°C

SMxx01:

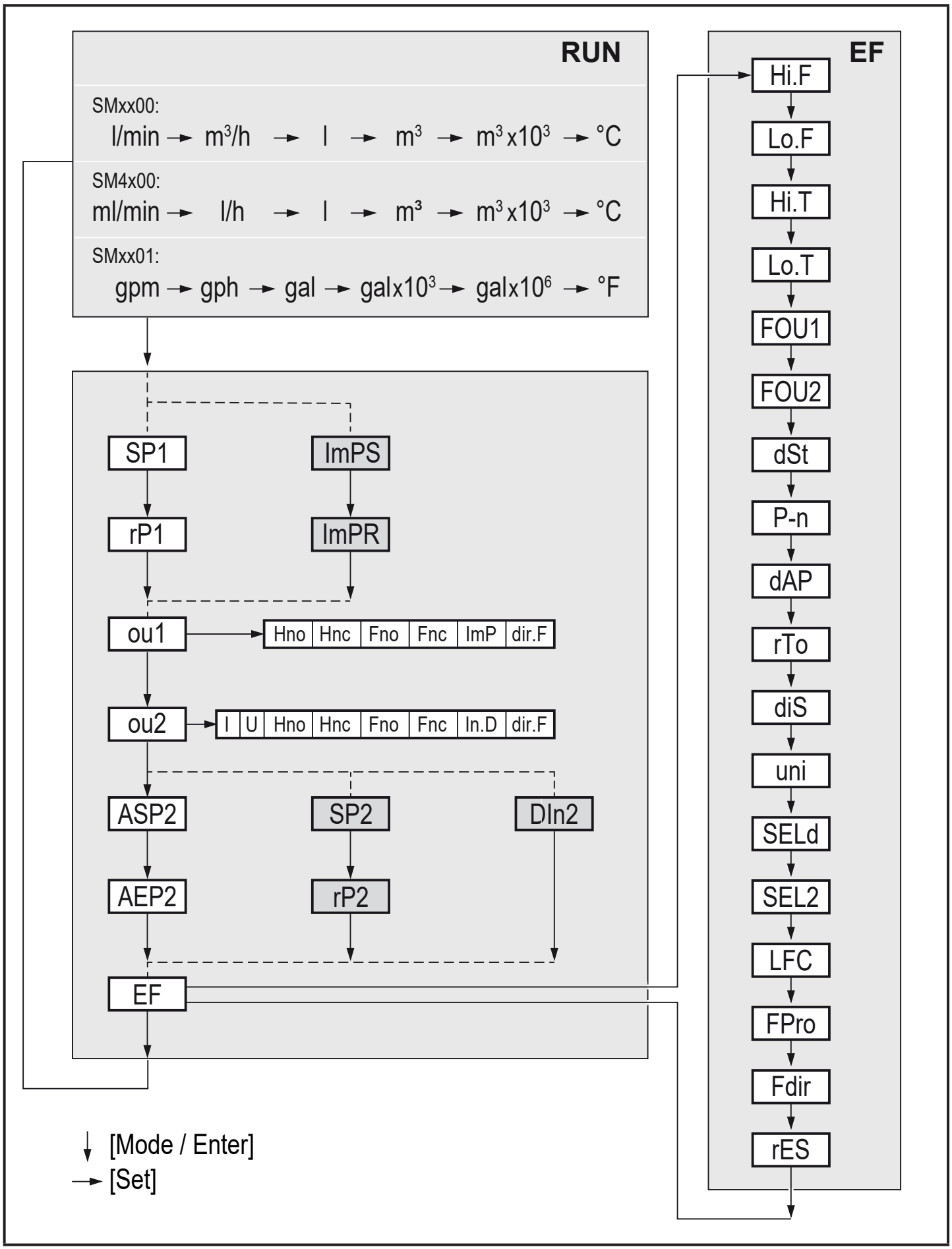
LED		Process value display		Unit
1	□	Current flow volume per minute		gpm
2	□	Current flow volume per hour		gph
3	□	Current consumed quantity (= meter reading) since the last reset	Totaliser *	gal
3 + 5	□			gal x 10^3
3 + 6	□			gal x 10^6
3	⌑	Consumed quantity (= meter reading) before the last reset		gal
3 + 5	⌑			gal x 10^3
3 + 6	⌑			gal x 10^6
4	□	Current medium temperature		°F

□ LED is lit; ⌑ LED flashes

* The consumed quantity is automatically displayed in the unit of measurement providing the highest accuracy.

7-8: Indicator LEDs for switching output
LED 7: Switching status OUT2 (lights when output 2 is switched) LED 8: Switching status OUT1 (lights when output 1 is switched)
9: Alphanumeric display, 4 digits
• Current volumetric flow quantity with setting [SELd] = FLOW • Meter reading of the totaliser with setting [SELd] = TOTL • Current medium temperature with setting [SELd] = TEMP • Parameters and parameter values
10: [Mode/Enter] button
• Change from the RUN mode to the main menu • Select parameters • Acknowledge the set parameter value
11: [Set] button
• Change parameter values (hold button pressed) • Change of the display unit in the normal operating mode (RUN mode)

8 Menu



Parameters with white background are indicated in case of factory setting (→ 14). Parameters with grey background are indicated in case of changes of the preset for ou1 and ou2.

Parameters	Explanation and setting options (→ 4 Function)
SP1 / rP1	Maximum / minimum value for volumetric flow on OUT1.
ImPS	Pulse value = volumetric flow quantity at which 1 pulse is delivered.
ImPR	Configuration of the output for consumed quantity monitoring: YES (pulse signal), no (switching signal).
ou1	Output function for OUT1 (volumetric flow): - Hno, Hnc, Fno, Fnc: switching signal for the limits - ImP: consumed quantity monitoring (totaliser function) - dir.F: detection of direction
ou2	Output function for OUT2 (volumetric flow or temperature): - Hno, Hnc, Fno, Fnc: switching signal for the limits - I (current signal 4...20 mA), U (voltage signal 0...10 V) - dir.F: detection of direction Input function for OUT2: - In.D: input for external meter reset signal
ASP2 / AEP2	Analogue start point / analogue end point for volumetric flow or temperature on OUT2.
SP2 / rP2	Maximum / minimum value for volumetric flow or temperature on OUT2.
DIn2	Configuration of the input for external meter reset signal: HIGH, +EDG, LOW, -EDG (→ 10.3.7)
EF	Extended functions: opening of the lower menu level.
Hi.F / Hi.T	Maximum value memory for volumetric flow / temperature.
Lo.F / Lo.T	Minimum value memory for volumetric flow / temperature.
FOU1 / FOU2	Behaviour of OUT1 / OUT2 in case of an internal fault: OU, On, OFF (→ 10.5.6).
dST	Start-up delay in seconds.
P-n	Output logic: PnP, nPn.
dAP	Measured value damping: damping constant in seconds.
rTo	rES.T (meter reset: manual), h/d/w (time-controlled: hours/days/weeks), OFF.
diS	Update rate and orientation of the display: d1...d3, rd1...rd3, OFF (→ 10.5.2).
uni	Standard unit of measurement for volumetric flow
SELd	Standard measured variable of the display: FLOW (volumetric flow value), TEMP (medium temperature), TOTL (meter reading).
SEL2	Standard unit of measurement for evaluation by OUT2: FLOW (volumetric flow) or TEMP (temperature).

LFC	Low flow cut-off.
FPro	Counting method of the totaliser: –+ or 0+ (→ 10.5.8).
Fdir	Direction of flow: + or - (→ 10.5.9).
rES	Restoring the factory settings.

9 Set-up

After power on and expiry of the power-on delay time of approx. 5 s the unit is in the RUN mode (= normal operating mode). It carries out its measurement and evaluation functions and generates output signals according to the set parameters.

- During the power-on delay time the outputs are switched as programmed:
  - ON with normally open function (Hno / Fno)
  - OFF with normally closed function (Hnc / Fnc).
  - ON for detection of direction (dir.F)
- If output 2 is configured as analogue output, the output signal is at 20 mA (current output) or 10 V (voltage output).

10 Parameter setting

Parameters can be set before installation or during operation.

If you change parameters during operation, this will influence the function.

▶ Ensure that there will be no malfunctions in your plant.

During parameter setting the unit remains in the operating mode. It continues to monitor with the existing parameter until the parameter setting has been completed.

The parameters can also be set via the IO-Link interface (→ 4.9).

⚠ CAUTION

For medium temperatures above 50 °C (122 °F) some parts of the housing can heat up to over 65 °C (149 °F).

▶ Do not press the pushbuttons manually. Instead use another object (e.g. ballpoint pen).

10.1 Parameter setting in general

1. Change from the RUN mode to the main menu and selection of the requested parameter	[Mode/Enter]
2. Acknowledge the set parameter value	[Set]
3. Change the setting mode	[Set] > 5 s
4. Modification of the parameter value - incrementally by pressing once - continuously by keeping the button pressed To reduce the value: let the display move to the maximum setting value. Then the cycle starts again at the minimum setting value.	[Set]
5. Acknowledge the set parameter value	[Mode/Enter]
6. Return to the RUN mode	> 30 seconds (timeout) or [Mode/Enter] until the RUN mode is reached.

10.1.1 Change to the menu "Extended functions"

1. Change from the RUN mode to the main menu and selection of the parameter EF	[Mode/Enter]
2. Change to sub-menu EF	[Set]

10.1.2 Locking / Unlocking

The unit can be locked electronically to prevent unintentional settings. On delivery: not locked.

Locking	▶ Make sure that the unit is in the normal operating mode. ▶ Press [Mode/Enter] and [Set] simultaneously for 10 s until [Loc] is displayed.
Unlocking	▶ Make sure that the unit is in the normal operating mode. ▶ Press [Mode/Enter] and [Set] simultaneously for 10 s until [uLoc] is displayed.

10.1.3 Timeout

If no button is pressed for 30 s during parameter setting, the unit returns to the operating mode with unchanged values.

10.2 Settings for volumetric flow monitoring

10.2.1 Limit monitoring volumetric flow (OUT1)

- ▶ Select [ou1] and set the switching function: Hno, Hnc, Fno or Fnc.
- ▶ Select [SP1] and set the upper limit of the volumetric flow.
- ▶ Select [rP1] and set the lower limit of the volumetric flow.

10.2.2 Limit monitoring volumetric flow (OUT2)

- ▶ Select [SEL2] and set FLOW.
- ▶ Select [ou2] and set the switching function: Hno, Hnc, Fno or Fnc.
- ▶ Select [SP2] and set the upper limit of the volumetric flow.
- ▶ Select [rP2] and set the lower limit of the volumetric flow.

10.2.3 Analogue output flow rate (OUT2)

- ▶ Select [SEL2] and set FLOW.
- ▶ Select [ou2] and set the analogue function: I (4...20 mA) or U (0...10 V).
- ▶ Select [ASP2] and set the volumetric flow value at which the minimum current or voltage value is provided.
- ▶ Select [AEP2] and set the volumetric flow value at which the maximum current or voltage value is provided.

10.2.4 Detection of the direction of flow (OUT1 or OUT2)

- ▶ Select [ou1] or [ou2] and set dir.F.

10.3 Settings for consumed quantity monitoring

10.3.1 Quantity monitoring by pulse output (OUT1)

- ▶ Select [ou1] and set ImP.
- ▶ Select [ImPR] and set YES.
- ▶ Select [ImPS] and set the volumetric flow quantity at which 1 pulse is provided (→ 10.3.3).

10.3.2 Quantity monitoring by preset counter (OUT1)

- ▶ Select [ou1] and set ImP.
- ▶ Select [ImPR] and set no.
- ▶ Select [ImPS] and set the volumetric flow quantity at which output 1 switches (→ 10.3.3).

10.3.3 Pulse value

- ▶ Select [ou1] and set the consumed quantity monitoring: → 10.3.1 or → 10.3.2.
- ▶ Select [ImPS].
- ▶ Press [Set] briefly.
- > The currently set value is displayed.
- ▶ Keep [Set] pressed until "⊏⊏⊏⊏" is displayed.
- ▶ Press [Set] to select the setting range.
- > With each press of the pushbutton the display changes to the next setting range (decimal point shifts and / or LED* changes).
- ▶ Press [Mode/Enter] to confirm the setting range.
- ▶ Press [Set] until the requested numerical value is displayed.
- ▶ Press [Mode/Enter] briefly.

* LED 1...6 → 7 Operating and display elements

10.3.4 Manual counter reset

- ▶ Select [rTo] and set rES.T.
- > The counter is reset to zero.

10.3.5 Time-controlled counter reset

- ▶ Select [rTo] and set the requested value (intervals of hours, days or weeks).
- > The counter is reset automatically with the value now set.

10.3.6 Deactivation of the counter reset

▶ Select [rTo] and set OFF.
> The meter is only reset after overflow (= factory setting).

10.3.7 Counter reset using an external signal

▶ Select [ou2] and set In.D.
▶ Select [DIn2] and set the counter reset signal:
HIGH = reset for high signal
LOW = reset for low signal
+EDG = reset for rising edge
-EDG = reset for falling edge

10.4 Settings for temperature monitoring

10.4.1 Limit monitoring temperature (OUT2)

▶ Select [SEL2] and set TEMP.
▶ Select [ou2] and set the switching function: Hno, Hnc, Fno or Fnc.
▶ Select [SP1] and set the upper temperature limit.
▶ Select [rP2] and set the lower temperature limit.

10.4.2 Analogue output temperature (OUT2)

▶ Select [SEL2] and set TEMP.
▶ Select [ou2] and set the analogue function: I (4...20 mA) or U (0...10 V).
▶ Select [ASP2] and set the temperature value at which the minimum current or voltage value is provided.
▶ Select [AEP2] and set the temperature value at which the maximum current or voltage value is provided.

10.5 User settings (optional)

10.5.1 Standard unit of measurement for volumetric flow

▶ Select [uni] and set the unit of measurement.

The setting only has an effect on the volumetric flow value. The consumed quantity (meter reading) is automatically displayed in the unit of measurement providing the highest accuracy.

10.5.2 Standard display

▶ Select [SELd] and define the standard unit of measurement
FLOW = display shows the current volumetric flow value in the standard unit of measurement.
TOTL = display shows the current meter reading in the unit providing the highest accuracy.
TEMP = the current medium temperature in °C / F° is displayed.
▶ Select [diS] and set the update rate and orientation of the display:
d1 = update of the measured values every 50 ms.
d2 = update of the measured values every 200 ms.
d3 = update of the measured values every 600 ms.
rd1, rd2, rd3 = display like d1, d2, d3; rotated by 180.
OFF = the display is switched off in the operating mode. The LEDs remain active even if the display is deactivated. Error messages are displayed even if the display is deactivated.

10.5.3 Output logic

▶ Select [P-n] and set PnP or nPn.

10.5.4 Start-up delay

▶ Select [dST] and set the numerical value in seconds.

10.5.5 Measured value damping

▶ Select [dAP] and set the damping constant in seconds (τ value 63 %).

10.5.6 Error behaviour of the outputs

▶ Select [FOU1] and set the value:
- On = Output 1 switches ON in case of a fault.
- OFF = Output 1 switches OFF in case of an error.
- OU = Output 1 switches irrespective of the fault as defined with the parameters.

▶ Select [FOU2] and set the value:

1. Switching output:
   - On = Output 2 switches ON in case of a fault.
   - OFF = Output 2 switches OFF in case of a fault.
   - OU = Output 2 switches irrespective of the fault as defined with the parameters.
2. Analogue output:
   - On = The analogue signal goes to the upper fault value (→ 4.5).
     OFF = The analogue value goes to the lower fault value (→ 4.5).
     OU = The analogue signal corresponds to the measured value.

10.5.7 Low flow cut-off

▶ Select [LFC] and set the limit.

10.5.8 Counting method of the totaliser

▶ Select [FPro] and set the value:
-+ = totalling the volumetric flow values with the correct sign.
0+ = totalling only positive volumetric flow values.

10.5.9 Direction of flow

▶ Select [Fdir] and set the direction of flow:
+ = flow in the direction of the flow arrow (= factory setting)
- = flow against the flow arrow ▶ label over the arrow

10.6 Service functions

10.6.1 Read min/max values

Read minimum or maximum measured values:
▶ Select Hi.x or Lo.x.
Hi.F = maximum volumetric flow, Lo.F = minimum volumetric flow
Hi.T = maximum temperature, Lo.T = minimum temperature

Delete memory:
▶ Select Hi.x or Lo.x.
▶ Press and hold [Set] until [----] is displayed.
▶ Briefly press [Mode/Enter].



It makes sense to delete the memories as soon as the unit operates under normal operating conditions for the first time.

10.6.2 Restoring the factory settings

▶ Select [rES].
▶ Press and hold [Set] until [----] is displayed.
▶ Briefly press [Mode/Enter].



→ 14 Factory setting. We recommend taking down your own settings in that table before carrying out a reset.

11 Operation

11.1 Reading the process value

The LEDs 1-6 signal which process value is currently displayed.
The process value to be displayed as standard (temperature, volumetric flow quantity or meter reading of the totaliser) can be preset → 10.5.2 Standard display.
A standard unit of measurement can be defined for the volumetric flow quantity → 10.5.1.

11.2 Changing the process value display in the RUN mode

▶ Briefly press [Set] in the RUN mode. Press the pushbutton to move to the next display unit.

> The unit displays the current measured value in the selected display unit for approx. 30 s, the corresponding indicator LED lights (→ 7).

11.3 Reading the set parameters

▶ Briefly press [Mode/Enter] to scroll through the parameters.

▶ Briefly press [Set] when the requested parameter is displayed.

> The unit displays the corresponding parameter value. After about 30 s it returns to the RUN mode.

12 Troubleshooting

The unit has many self-diagnostic options. It monitors itself automatically during operation.

Warnings and error states are displayed, even when the display is switched off. Error indications are also available via IO-Link.

Display	Type	Description	Fault correction
Err	Error	Unit faulty / malfunction	▶ Replace the unit.
No display	Error	• Supply voltage too low. • Setting [diS] = OFF	▶ Check the supply voltage. ▶ Change the setting [diS] → 10.5.2
Loc	Warning	Setting pushbuttons on the unit locked, parameter change rejected.	▶ Unlock the unit → 10.1.2
C.Loc	Warning	Setting buttons on the unit temporarily locked, parameter setting via IO-Link communication active.	▶ Finish parameter setting via IO-Link communication.
S.Loc	Warning	Setting buttons locked via parameter software, parameter change rejected.	▶ Unlock the unit via IO-Link interface using the parameter setting software.
UL	Warning	Below the display range. • Current value between -130 % ... -120 % MEW • Temperature value between -50...-40 °C or -58...-40 °F	▶ Check flow range / temperature range.
cr.UL	Error	Below the detection zone. • Flow value < -130 % MEW • Temperature value < - 50 °C or -58 °F	▶ Check flow range / temperature range.
OL	Warning	Display range exceeded. • Current value between 120 % ... 130 % MEW • Temperature value between 100...110 °C or 212...230 °F	▶ Check flow range / temperature range.
cr.OL	Error	Detection zone exceeded. • Flow value > 130 % MEW • Temperature value > 110 °C or 230 °F	▶ Check flow range / temperature range.

Display	Type	Description	Fault correction
PArA	Error	Parameter setting outside the valid range.	▶ Repeat parameter setting.
SC1	Warning	Switching status LED for OUT1 flashing: short circuit OUT1.	▶ Check switching output OUT1 for short-circuit or excessive current.
SC2	Warning	Switching status LED for OUT2 flashing: short circuit OUT2.	▶ Check switching output OUT2 for short-circuit or excessive current.
SC	Warning	Switching status LEDs for OUT1 and OUT2 flashing: short circuit in both outputs.	▶ Check switching outputs OUT1 and OUT2 for short-circuit or excessive current.

MEW = final value of the measuring range

13 Technical data

Technical data and scale drawing at www.ifm.com.

14 Factory setting

Parameter	Factory setting	User setting
SP1	20 %	
rP1	19.5 %	
ImPS	SM4x00: 0.001 l SMxx00: 0.01 l SMxx01: 0.01 gal	
ImPR	Yes	
OU1	Hno	
OU2	I	
SP2 (FLOW)	40 %	
rP2 (FLOW)	39.5 %	
SP2 (TEMP)	40 %	
rP2 (TEMP)	39.5 %	
ASP2 (FLOW)	0 %	
AEP2 (FLOW)	100 %	
ASP2 (TEMP)	0 %	
AEP2 (TEMP)	100 %	
Fdir	+	
FPro	0+	
LFC	SM4x00: 20 ml SMxx00 / SMxx01: MAW	
DIn2	+EDG	
FOU1	OFF	
FOU2	OFF	
dST	0	
P-n	PnP	

Parameter	Factory setting	User setting
dAP	0.6 s	
rTo	OFF	
diS	d3	
Uni	SM4x00: ml/min SMxx00: l/min SMxx01: gpm	
SELd	FLOW	
SEL2	FLOW	

MAW = Initial value of the measuring range

The percentage values refer to the final value of the measuring range.

Technical data, approvals, accessories and further information at www.ifm.com.

Section 3.6.7

Sludge Blowers

SCL R20 / R30 / R40

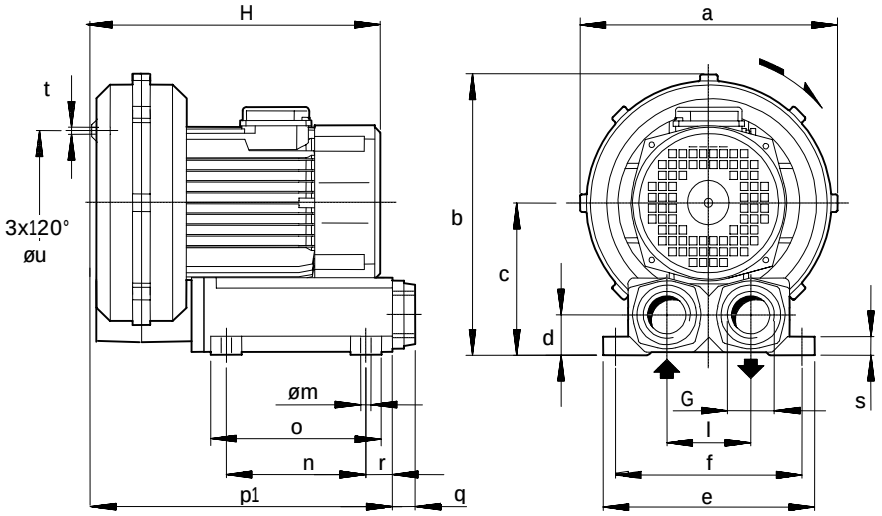
MD SERIES

SN 2464-7 1/2

STANDARD FEATURES
- Low weight cast aluminum construction.
- Quiet operation with integral inlet and outlet muffling.
- Recognized TEFC - cURus motor.
- High efficiency / low noise impeller design.
- No lubrication / maintenance required.
- Allowed ambient: +5 °F to +104 °F.
- Mountable in any plane.

OPTIONS
- Remote drive models (belt or coupling).
- Special voltages.
- Surface treatment or plating.
- Gas tight sealing.
- Special designs available.

ACCESSORIES
- Inlet and/or inline filters.
- Additional inlet/outlet silencers.
- Relief valves.
- Flow converting devices.
- Optionals connectors



Dimensions in inches.
Dimension for reference only.

Model	a	b	c	d	e	f	G	l	m	n	o	p1	q	r	s	t	u
R20-MD	11.14	12.17	6.57	1.85	9.25	8.27	1" ¼ NPT	3.54	0.39	5.91	7.87	13.58	0.71	1.77	0.87	M6	5.91
R30-MD	12.56	13.62	7.36	1.85	9.25	8.27	1" ¼ NPT	3.54	0.39	5.91	7.87	13.94	0.71	1.77	0.87	M6	7.09
R40-MD	13.78	14.65	7.76	1.85	9.25	8.27	1" ¼ NPT	3.54	0.39	5.91	7.87	14.33	0.71	1.77	0.87	M8	8.86

Model	Maximum flow Scfm		Installed power Hp		Maximum differential pressure Δp (In WG)		Noise level Lp dB (A) (1)		Overall dimensions H	Weight
	60 Hz 3500 rpm	50 Hz 2900 rpm	60 Hz 3500 rpm	50 Hz 2900 rpm	60 Hz 3500 rpm	50 Hz 2900 rpm	60 Hz 3500 rpm	50 Hz 2900 rpm	Inches	Lbs
R20-MD	41	35	1 ½	1 ½	161	161	68.5	66.5	13.39	48.5
R30-MD	65	54	2	2	140	170	72.2	69.2	15.58	57.3
			3	-	191	-	72.8	69.7	15.55	66.1
R40-MD	78	69	3	3	141	170	72.8	70.8	16.22	77.2
			4	4	201	201	73.3	71.3	17.09	88.2

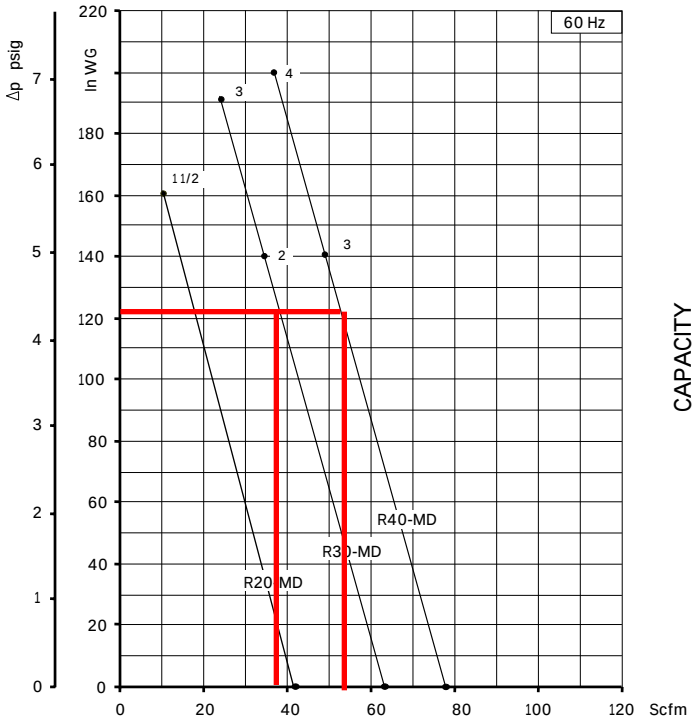
(1) Noise measured at 1 m distance with inlet and outlet ports piped, in accordance to ISO 3744.

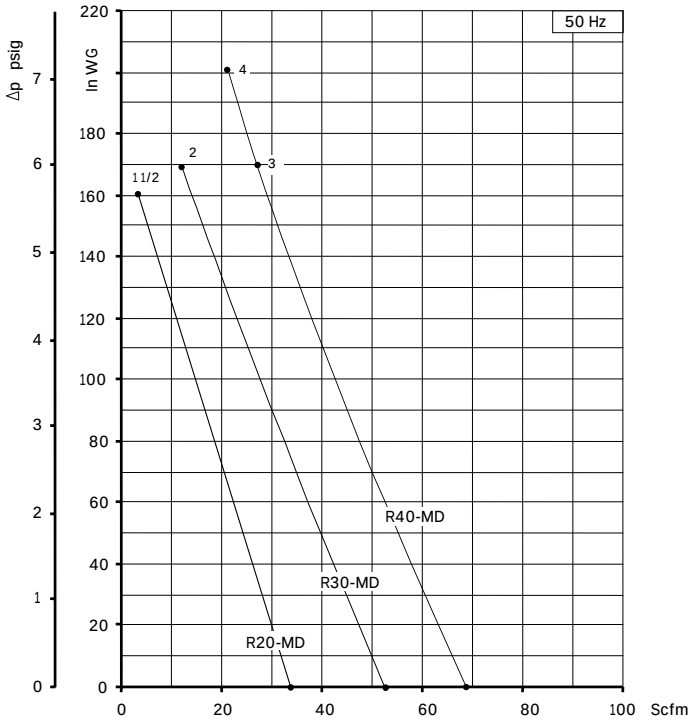
- For proper use, the blower should be equipped with inlet filter and relief valve; other accessories available on request.
- Ambient temperaturefrom +5° to +104°F.
- Specifications subject to change without notice.

SCL R20 / R30 / R40 MD SERIES

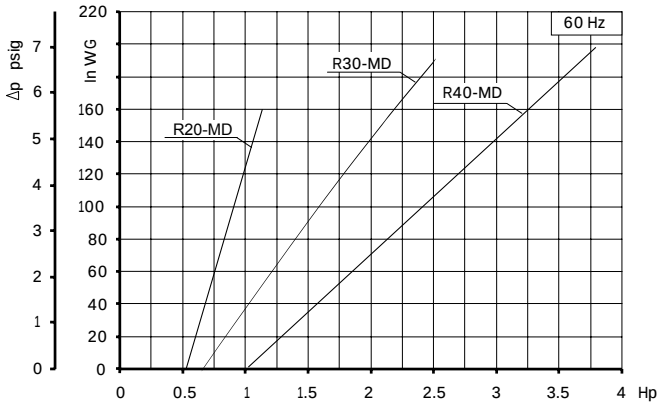
SN 2464-7 2/2

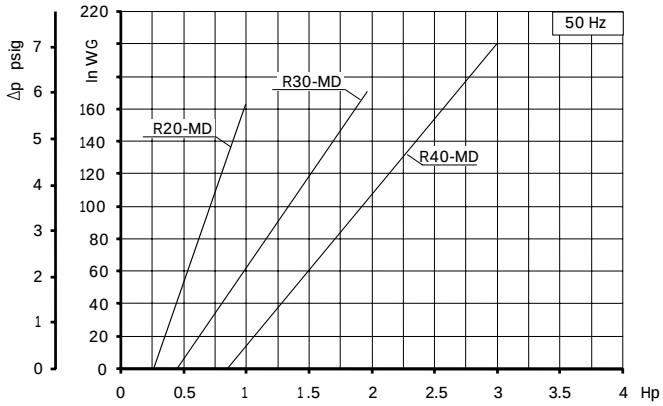
CAPACITY



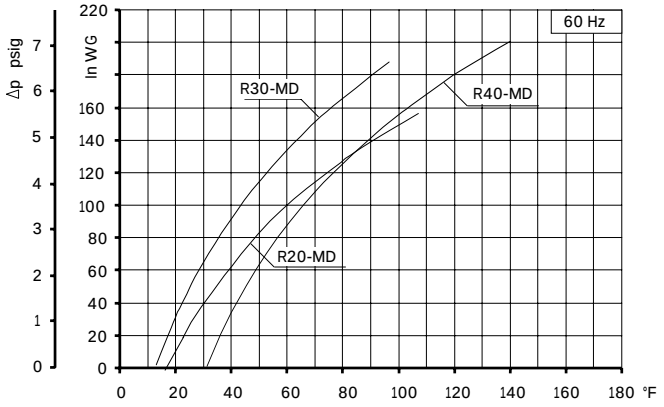


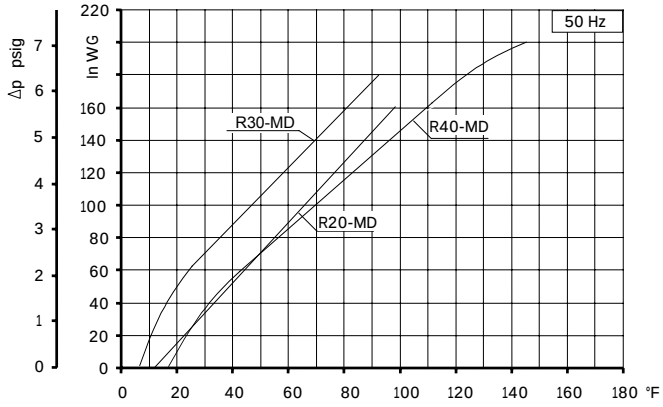
ABSORBED POWER





TEMPERATURE INCREASE





Curves refer to air at 68°F temperature and 29.92 In Hg atmospheric pressure (abs) measured at inlet port.
Values for flow, power consumption and temperature rise: +/-10% tolerance.
Data subject to change without notice.

Safety Valves

SN 1733 -7 1/1

The VRL valves are designed to protect blowers and / or motors from over pressurization or excess vacuum. When there is over pressurization, the valve opens and discharges to the outside. When there is excess in vacuum, the valve opens and takes flow from outside.

The valves have been designed for low pressure / low vacuum, with minimal difference between the initial value at which the valve begins to open and its fully opened position. The valves are supplied with 2 different springs to maximize their efficiency. These compact valves, made of aluminum alloy, are both easy to install and calibrate, and operate in a wide range of capacities. The VRL can be plumbed to divert excess primary flow through a secondary external outlet when working in pressure conditions, or to pipe in a secondary flow when working in vacuum.

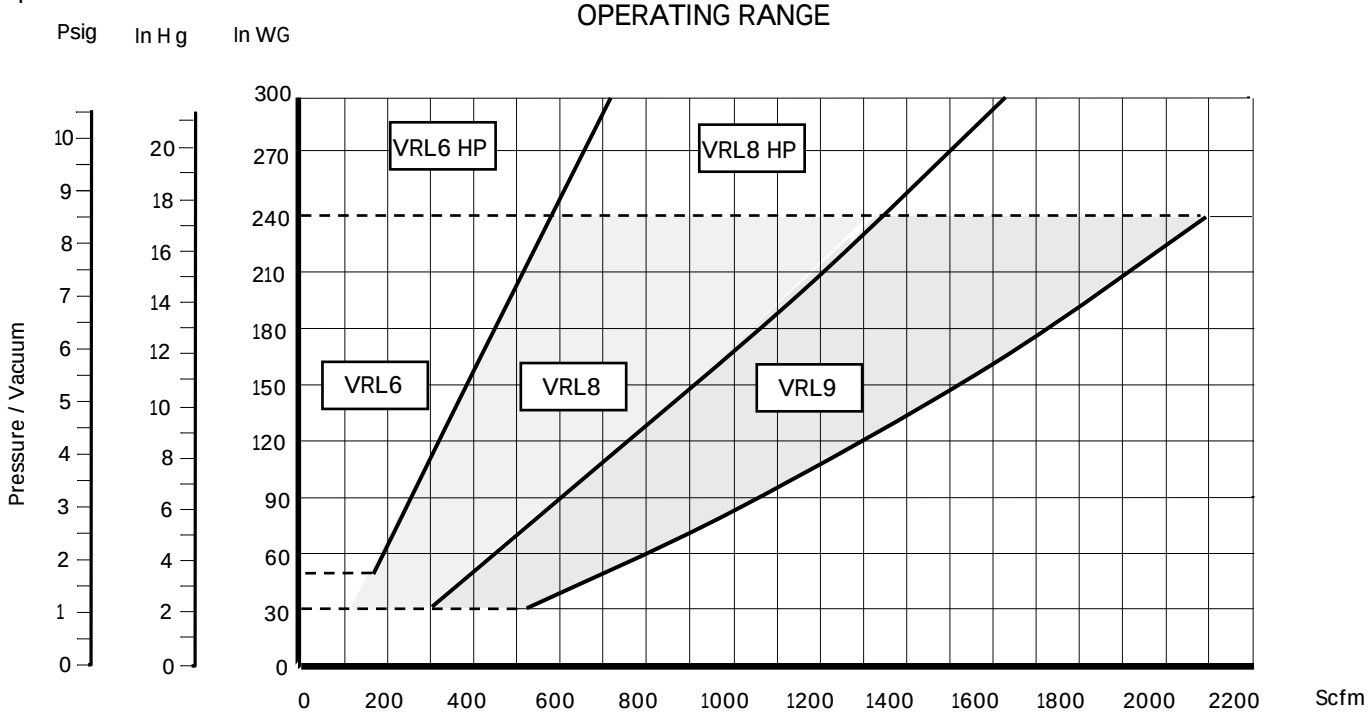
"HP" valves are used for pressures >240" H2O.

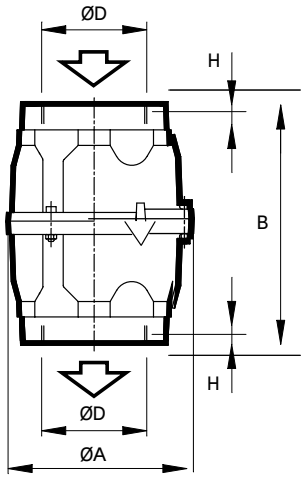
Maximum efficiency is achieved by keeping operating values (flow versus pressure or vacuum) within the operating range (shaded area on graph). Capacity refers to air having a density equal to 0.075 lbs./cu.ft .



VRL6 VRL6 HP | VRL8 VRL8 HP | VRL9

OPERATING RANGE





OVERALL DIMENSIONS

TYPE	ND	D	A	B	H	WEIGHT (Lbs)
VR6 & VRL6 HP	2”	2” NPT	4.02	6.90	0.47	1.9
VRL8 & VRL8HP	3”	3” NPT	5.31	7.48	0.59	4.2
VRL9	4”	4” NPT	6.30	8.11	0.71	5.7

- Dimensions in inches.
- Specifications subject to change without prior notice.

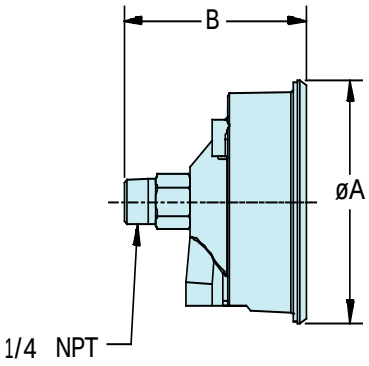
VRL valves are supplied uncalibrated - contact FPZ for calibration options.

FPZ, Inc. 150 N. Progress Drive Saukville, WI 53080 USA Tel. (262) 268-0180 usa@fpz.com www.fpzusa.com

Gauges, Check Valves, Silencers, Enclosures

SS1708

Gauges



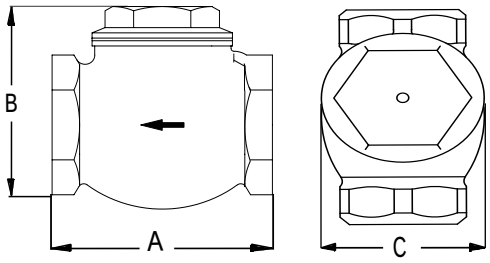
Gauges are important for monitoring the operating pressure or vacuum of the blower. Gauges should be positioned as close to the blower as possible.

Part number	Duty	Scale	A	B
VG25-60	Vacuum	0-60" H_2O	2.88	2.59
VG25-200	Vacuum	0-200"H_2O		
VG25-300	Vacuum	0-300" H_2O		
PG25-60	Pressure	0-60" H_2O		
PG25-200	Pressure	0-200" H_2O		
PG25-300	Pressure	0-300" H_2O		
PG25-15*	Pressure	0-15 psi	2.7	2.25

Dimensions in inches. Tolerance on given values ± 10% - unbinding and can be changed without prior notice.

*PG25-15 is suitable for outdoor use

Check Valves

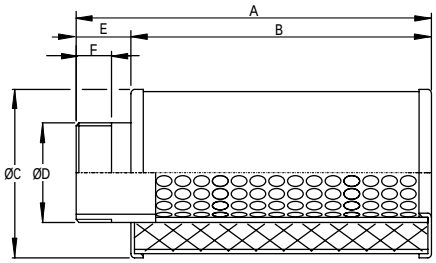


Swing check valves allow air to flow in one direction. These valves prevent backflow into the blower and are supplied in bronze or brass.

Part Number	NPT	A	B	C
CV075	0.75"	2.4		
CV10	1"	2.8	2.7	1.9
CV125	1.25"	3.2	3.2	2.2
CV15	1.5"	3.6	3.5	2.5
CV20	2"	4.3	4.2	3.1
CV30	3"	5.8	6.1	4.2
CV40	4"	6.9	7.1	5.5

Dimensions in inches. Tolerance on given values ± 10% - unbinding and can be changed without prior notice.

Silencers



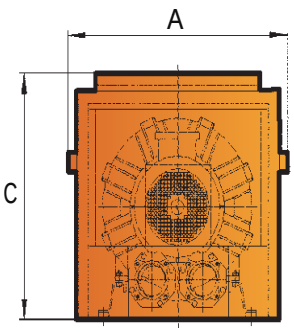
Silencers provide additional sound attenuation.

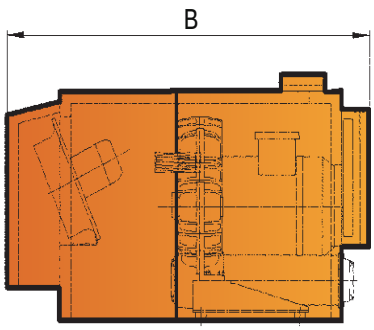
TYPE	D	A	B	C	E	F	lbs
SS 4	1" 1/4	7.5	5.5	2.8	2	0.6	0.8
SS 5	1" 1/2	7.9	6.7	3.1	1.2	0.8	1.1
SS 6	2"	9.1	7.9	3.5	1.2	0.8	1.3
SS 8	3"	19.1	15.7	6.0	3.3	0.8	4.8
SS 9	4"	18.3	16.9	6.7	1.1	0.8	9.9

Steel manufactured (apart from SI 9 / SS 9 - entirely in aluminium) with sound absorbing polyurethane element.

Dimensions in inches. Tolerance on given values ± 10% - unbinding and can be changed without prior notice.

Sound Enclosures





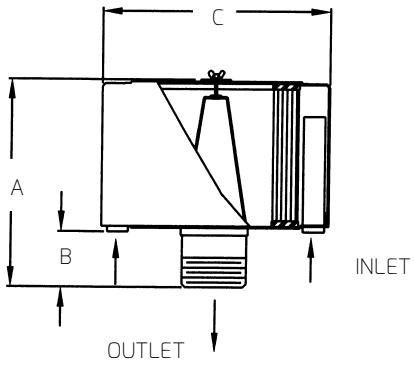
Part #	Used on models	A	B	C
IH1	SCL K03-MS	13.4	18.2	15.8
IH3	SCL K04-MS	14.3	19.7	16.5
IH5	SCL K05-6 MS + 30-40DH	16.9	26.8	21.3
IH7	SCL K07-8 MS / MD	31.7	64.4	26
IH8	SCL K07-8 TD	31.7	64.4	26
IH9	SCL K07-8 TS	31.7	64.4	26
IH10	SCL K09-12 MS/MD	31.7	67.2	30
IH11	SCL K09-10 TD	31.7	67.2	30
IH12	SCL K11-TD	31.7	67.2	30
IH13	SCL K09-11 TS	31.7	67.2	31.5

Dimensions in inches - unbinding and can be changed without prior notice.

Inlet Filters

SS1905

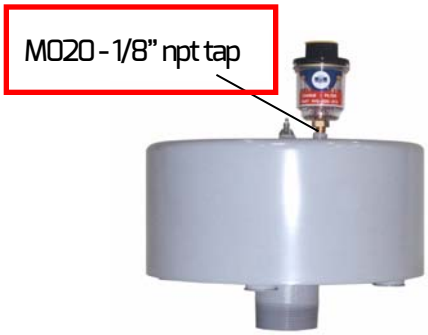
FPZ inlet filters are used for pressure applications. The inlet filters combine filtration and sound attenuation into a compact package. Inlet filters consist of a filter cartridge enclosed by a carbon steel weather hood. Elements are easily serviceable by simply removing the weather hood.



Dimension tolerance ± 1/8"



VG-020-013



FEATURES & SPECIFICATIONS

- Polyester: 99%+ removal efficiency standard to 5 micron. (Other media available upon request.)
- Fully drawn weather hood - no welds to rust or vibrate apart
- Tubular silencing design - tube is positioned to maximize sound attenuation and air flow while minimizing pressure drop
- Durable carbon steel construction with baked enamel finish
- Filter change out differential: 10"-15" H_2O Over Initial Delta P.

OPTIONAL DIRTY FILTER INDICATOR

The **VG-020-013** dirty filter indicator is used to maximize filter life for pressure applications only. The yellow indicator in the site window drops as dirt accumulates on the filter element. The element is ready for change out or servicing when the yellow indicator reaches the red zone. The filter condition can be determined without removing the weather hood even after the blower has been shut down.

The indicator can be mounted in the inlet piping between the blower and filter or directly to the filter housing by having a 1/8" npt tap installed in the hood. If a tap is required, FPZ part number **M020*** should be ordered.

Polyester Element	NPT	Dimensions (Inches) A	B	C	Used on Models	Approx Wt. Lbs
FS-15-050	½"	4	1 ½	6	10DL	2
FS-15-075	¾"	4	1 ½	6	15DH	2
FS-15-100	1"	4	1 ½	6	06	2
FS-19P-125	1 ¼"	6 5/8"	1 5/8"	6	K03-MS, R20-MD, R30-MD, R40-MD	3
FS-19P-150	1 ½"	6 5/8"	1 5/8"	6	K04-MS	4
FS-31P-200	2"	7 ¼"	2 ¼"	10	K05-MS, K05-TD	8
FS-231P-200	2"	12 ¼"	2 ¼"	10	K06-MS, K06-TD, K07R-MD, K08R-MD	14
FS-231P-300	3"	13"	3"	10"	K07-MS, K05-TS, K07-TD	15
FS-235P-300	3"	13"	3"	16"	K08-MS, K06-TS, K08-TD	29
FS-235P-400	4"	14"	4"	16"	K09-MS, K10-MS, K09-MD, K10-MD, K11-MD, K12-MD, K09-TD, K10-TD	30
FS-245P-400	4"	14"	4"	16"	K07-TS, K08-TS, K11-MS, K12-MS, K11-TD, K12TD	31
FL10**	NA	14 3/8"	1 3/8"	16 3/16"	K09-TS, K10-TS, K11-TS, K12-TS,	18

*M020 1/8" npt filter tap will be added to filter part number suffix if ordered.

**FL10 utilizes 15 micron paper element and does not include tubular silencers. FL10 filters are normally ordered with CA10

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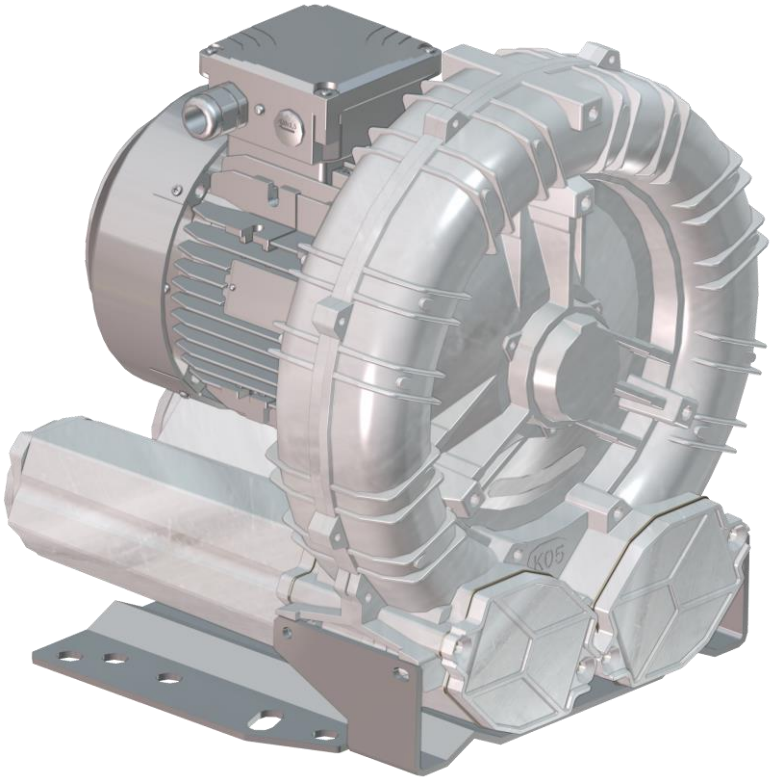
COMPRESSORI-ASPIRATORI A CANALE LATERALE — ISTRUZIONI — I
LATERAL CHANNEL BLOWERS-EXHAUSTERS — INSTRUCTIONS — GB



WARNING

Leggere e seguire le istruzioni prima dell'uso e conservare il manuale come riferimento per il futuro. Il mancato rispetto di tutte le istruzioni del produttore, inclusa l'installazione impropria o l'uso improprio del prodotto, le alterazioni del prodotto e/o il mancato utilizzo del prodotto in conformità al presente manuale, possono causare danni, lesioni gravi o morte. — I

Read and follow all instructions before use and keep manual for future reference. Failure to comply with all manufacturer's instructions, including improper installation or use of the product, alterations to the product, and/or failure to use the product in accordance with this manual can result in property damage, serious injury or death. — *GB*



Per ulteriori informazioni o assistenza all'installazione, prego contattare:
For further information or assistance with installation, please contact:

@ service@fpz.com +39 039 690981

COMPANY WITH QUALITY SYSTEM CERTIFIED BY DNV GL = ISO 9001 =

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1 GENERAL INFORMATION

Read the manual for safety information on correct installation, operation and maintenance.

1.1 PURPOSE OF MANUAL

- The purpose of the manual is to complete the information contained in the *operative instructions* (Figure 1*)* supplied with the blower in order to give "instructions for use" to the skilled operator to prevent and minimize risks during the interaction between man and machine.
- For safe installation, carefully read this manual before installing the product and follow all instructions exactly as shown.
- The information was prepared by the manufacturer in the original language (ITALIAN) considering the content communication effectiveness for the interested parties also depending on the operator's qualifications and perspicacity.
- Keep the *operative instructions* (Figure 1*)* for the entire service life of the unit in a known and easy to access place to make it always at hand for reference.
- Any observations made by recipients can be an important contribution to improve the after-sales services provided by the manufacturer.
- The information contained in this manual is intended for use by specialized operators whose definition is contained in the document MAN_PIC (Figure 2).
- For electric components and motors that may be installed to the blower, please refer to the manuals of their own manufacturers.

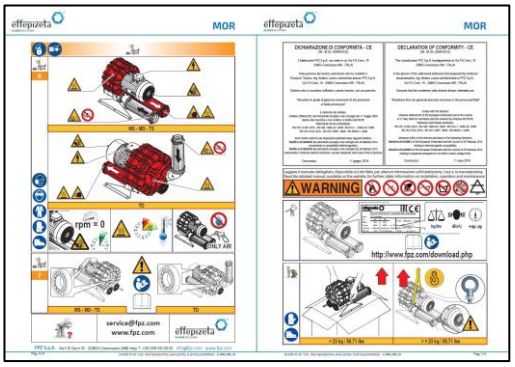


Figure 1 – *Operating Instruction*

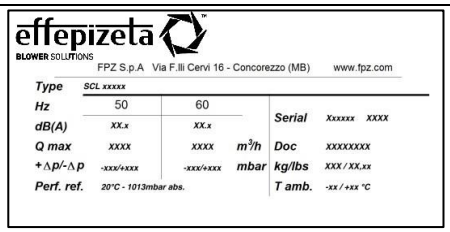


Figure 2 - Document MAN_PIC

1.2 TECHNICAL DATA – NAMEPLATE

On the product nameplate are stated:

• Unit description
• Performance (Noise [dB], Flow [m^3/h] and Pressure [mbar]) at 50 Hz and 60 Hz frequency referring to 20°C and 1013 mbar abs.
• Serial number and year of manufacture
• Reference Doc. (*Operating Instruction)*
• Weight [kg/lbs]
• Reference temperature for the working blower (T. amb.)





It is strictly forbidden to remove or tamper with the product label.

1.3 TESTING, WARRANTY AND LIABILITY

Testing and inspection

- The entire unit is sent to the customer ready for installation, after passing the tests and inspections required by the manufacturer, in conformity with the applicable laws and the mandatory technical standards.

Warranty

- Warranties are defined in the general terms and conditions of sale.

Liability

- See document MAN_PIC.

2 SAFETY RULES

2.1 IMPORTANT SAFETY INFORMATION

WARNING	**The instructions listed below must be read carefully and become a fundamental part of daily procedures in the normal use and maintenance of all the equipment, in order to prevent any kind of personal or domestic animals (even serious) injury (or death) or damage to equipment.**

- Do not start the unit until its operation is clearly understood.
- All installation, commissioning and maintenance operations must be carried out by specialized operators only (see doc MAN_PIC).
- Keep the area around the unit constantly free of obstructions.
- Use appropriate PPE (Personal Protective Equipment) such as boots, gloves, goggles and work clothes.
- Pay attention to all danger and caution signs placed on the unit.
- Do not wear clothes, jewellery or accessories that can get caught in the cooling fan of the electric motor or that can be sucked into the blower.
- Do not modify the electrical connections on the unit.
- Observe all local, state and national electrical codes.
- Before starting the unit and/or with weekly frequency, the operator must check the efficiency of the devices that ensure the operation of the unit and any other unit defects. In case of any defects, immediately notify FPZ S.p.A.
- Devices that ensure the operation of the unit must never be removed or rendered useless.
- During maintenance or repair work, it may be necessary to exclude some mentioned devices from the service. This operation must be carried out by specialized operators only (see doc MAN_PIC).
- Always apply and enforce the safety rules; in case of any doubts, always consult this manual before acting.

WARNING	**Non-compliant installation with the unit's intended use can cause personal (even serious) injury (or death) or damage to equipment.**

The unit must only be started:

- in conformity with the purposes of use, transport and handling specified in "FORESEEN USE";
- respecting the values given in the nameplate data.

2.2 PROHIBITIONS

WARNING	**Failure to comply the following PROHIBITIONS can cause personal (even serious) injury (or death) or damage to equipment.**

- NEVER suck up and convey aggressive, corrosive, and/or harmful fluids.
- NEVER use the unit under conditions that differ from those indicated on the nameplate.
- NEVER use the unit without having installed a suction filter.
- NEVER operate with the suction and/or delivery openings closed.
- NEVER make conversions or changes to the unit, maintenance or repair work on one's own initiative or not envisaged in the manual. Maintenance work can be carried out only in compliance with what is described in this user manual, exclusively by specialized operators (see document MAN_PIC).
- NEVER use the unit in places where ATEX classification does not comply with Annex II of Directive 1999/92/EC.
- NEVER use the unit without having first installed and connected the sensors and/or regulators required to the plant and correctly installed and checked the seal system of the machine.
- NEVER use the unit with ambient temperatures below -15°C (+5°F) and above +40°C (+104°F).
- NEVER use the unit before ensuring correspondence between grid voltage and motor label voltage.

3 PROPER AND IMPROPER USE

3.1 OPERATING CONDITIONS

WARNING **Failure to observe the temperature, altitude, differential pressure and filtering modes for design and operation specifications there can be an impeller break which can cause personal (even serious) injury (or death) or damage to equipment .**

- The maximum permissible differential pressure indicated on the product nameplate must never be exceeded.
- It is important to install the unit at a maximum altitude of 1000 m (3300 ft.) above sea level, for higher altitudes contact FPZ.
- The unit is designed to operate at ambient temperature between -15°C (+5°F) and +40°C (+104°F).
- In case of suction in the environment or on the plant, protect the suction pipe using a suitable filter with a maximum degree of filtration of 25µm. Contact FPZ for filters with a different filtration degree. Check the compliance with the data of maximum pressure/vacuum listed on the nameplate. For ATEX blower we recommend an ATEX filter with a filtration degree of 20 µm / 25 µm.
- Installation, operation and maintenance of the blower must be carried out by specialized operators (see document MAN_PIC). Due to incorrect maintenance or an unauthorized modification, a non-compliant condition of use is determined, so the responsibility lies with the customer or end user.

NOTICE If installed outdoors, protect the unit against exposure to sunlight and to atmospheric agents.
If the flow rate has to be reduced, use a draw-off valve rather than throttling back the suction or delivery lines.

3.2 STANDARD SIDE CHANNEL BLOWER

FPZ side channel blowers / exhausters are designed to generate vacuum and overpressure for conveying non-explosive, non-flammable, non-dangerous gases and air in continuous use in a non-explosive environment. Side channel blowers are not designed to transport dusts of any grain size.

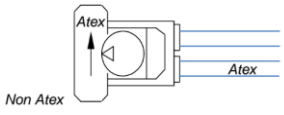
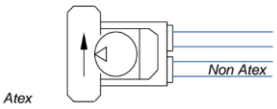
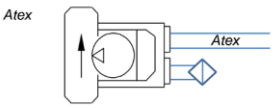
FPZ side channel blowers / exhausters are designed and built for use in industrial plants and are equipped with three-phase or single-phase asynchronous bipolar electric motors in compliance with IEC 60034-1.

3.3 ATEX BLOWERS (Category 3GD – Category 2G)

Atex blowers are designed and built in accordance with 2014/34/UE Directive and European standards EN 1127-1, EN 80079-36, EN 80079-37, EN 14986, considering the compatibility of unit components with treated fluids (contact FPZ for components compatibility details). Accessories and monitoring systems linked to the unit have to be compliant with 2014/34/UE Directive.
It is recommended that the connections and suction and delivery pipes are in metal or antistatic material.

Units are group II devices for use in environments classified as explosive for the presence of Gas (G) zone 1/2 and/or Dust (D) zone 22.

- For motors that may be installed to the blower refer to the Atex complementary instructions of the motor manufacturer.
- In case the blower is disposed vertically, thus standing on the cover, foreign objects shall be prevented from falling into the ventilation openings. If necessary the motor can be provided of a fan cover with protecting canopy.
- If not specifically indicated, the ATEX label refers to the equipment “indoor” and “outdoor” area.
- In the case of a double indication separated by the “/” symbol, the first number indicates the “indoor” category (internal surface of the blower), the second number the “outdoor” category (outside of the blower, including the electric motor).
- The blower protection mode is constructive (“EX **c**”).
- Electric motors have different protection modes depending on the category and the environment they are designed for.
- All “2G” e “3/2G” configurations have explosion-proof motors (EX d protection).
- Classification of work zones:

1	Use of blower for conveying flammable gas	**Equipment with internal potentially explosive atmospheres, intended for use in areas that are not classified**	
2	Use of blower for conveying non-hazardous fluids in ATEX classified environment	**Equipment with internal non-explosive atmospheres and intended for use in areas that are classified**	
3	Use of blower with suction of ambient air and operating in a classified zone	**Equipment with internal explosive atmospheres, interfaced with process atmospheres and intended for use in areas that are classified**	

3.4 IMPROPER USE AND ASSOCIATED RISKS

⚠WARNING	**Non-compliance with the unit's intended use or with prohibitions/obligations can cause personal (also serious) injury (or death) or equipment damage.**

- Listed below are some improper uses, identified through risk assessment and experiences. Improper uses are subdivided according to the conditions that they may generate.
- The list is a non-exhaustive and representative example of improper use and associated risks.

IMPROPER USE	POSSIBLE CONSEQUENCES	RISKS
IMPROPER USE LINKED TO NORMAL OPERATION		
Absence of cyclic monitoring and control.	Anomalous operation not detected / hidden.	Risk of damage to the unit, with possible injury (or death) for the operator if present nearby.
Different installation with respect to manufacturer's suggestion.	Yielding / break of fastening points.	Risk of damage to the unit, with possible injury (or death) for the operator if present nearby. The unit may fall or be subject to damage due to incorrect load at support.
Operation outside the performance indicated on the blower and electric nameplate.	Seizure of the impeller.	Risk of damage to the unit, with possible injury (or death) for the operator if present nearby. The unit may break.
Proceeding at all stages without consulting the *operating instructions* and this manual.	Using the unit for unforeseen purposes and without considering the associated risk factors.	Risk of damage to the unit, with possible injury (or death) for the operator if present nearby.
IMPROPER USE LINKED TO METHODS OF USE		
Use of a fluid different from that indicated / forbidden.	Incorrect workload.	Risk of damage to the unit, with possible injury (or death) for the operator if present nearby. The unit may break.
Physical load applied to the machine (no element excluded).	Breakage and/or presence of leakage of fluid collected.	Risk of damage to the unit, with possible injury (or death) for the operator if present nearby due to inhalation of harmful substances.
IMPROPER USE LINKED TO THE STOPPAGE OF A BLOWER		
Manipulation of the machine still rotating / moving.	Direct contact of the operator with moving parts and with the surface unit still hot.	Risk of possible injury for the operator such as burns and entanglement.
Disconnecting the unit from the electricity with the voltage inserted.	Direct contact of the operator with the live parts.	Risk of possible injuries for the operator through electrocution.
IMPROPER USE LINKED TO MAINTENANCE WORK		
Handling the machine differently from instructions for use.	Falling or sudden movement of the unit.	Risk of damage to the unit, with possible injury for the operator if present nearby.
Use of liquid during unit cleaning operations.	In case of stagnation, characteristics of the material may be compromised.	Risk of damage to the unit, with possible injury for the operator if present nearby.
Use of types of spare parts different to those supplied by FPZ.	Different performance from design (pressure, noise, vibration, sealing).	Risk of damage to the unit, with possible injury for the operator if present nearby.
BREAKDOWN AND EMERGENCY CONDITIONS		
Not stopping the machine when it is making an unusual noise.	Seizure of the impeller and overheating of the unit and of the electric motor.	Risk of damage for the unit, with possible injury (or death) for the operator if present nearby. The unit may break down.

4 STORAGE AND TRANSPORT

4.1 RECEIPT AND CHECK OF THE PACKAGE

- When receiving the unit, it is necessary to check that the packaging is intact and free from signs of damage due to transport or storage conditions.
- In the case of damage to the packaging, immediately inform the shipping agent and the manufacturer.

4.2 HANDLING AND TRANSPORT



Danger of crushing and / or impacting various parts of the body

During the transport and handling phases due to the sudden drop or displacement of the packaging, there may be a risk of crushing and / or impacting various parts of the body. During the activities around the unit, the operator may fall due to stumbling or slipping.
Use equipment compliant with the laws and follow the handling and manual handling procedures described in the operating manual, based on the weight indications on the packaging and in accordance with applicable regulations in the state in which this activity takes place. Use safety shoes during this phase.

4.3 STORAGE

- Store in a dry place, possibly keeping the machine in the packaging.
- Do not remove the protective covers of the openings.
- In the event of long-term storage, remove dust deposits on external surfaces and, before commissioning, check the unit's functional status with a start-up test.

5 INSTALLATION

5.1 INSTALLATION CONDITIONS



Commissioning and operation must only take place under the following installation conditions:

- The unit must be completely assembled and intact (not damaged or tampered).
- Silencers must be connected to the pipe system (see *operating instructions*); if silencers are not present, make sure that the connection is made by flexible sleeve.
- The machine must be securely fastened to the predetermined site and in the recommended modes (see *operating instructions*).
- The motor must be connected to a suitable control panel.
- Ensure the visibility of the unit installed from the position of the control elements.



Danger of ejection of objects

The entry of foreign bodies into the unit, even if very small, can cause personal serious injury (or death) and/or equipment damage with probable breakage of the impeller blades, including the danger of debris can be thrown out of the machine violently.
Remove the closure caps from the silencers and connect the pipes of the system, making sure to carry out the operation in a non-dusty area to prevent the entry of foreign bodies.



Danger of crushing and / or impacting various parts of the body

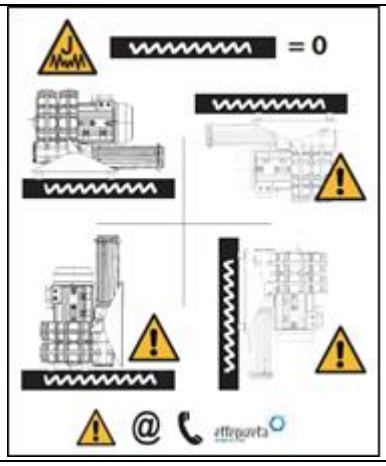
During the installation phase due to the sudden drop or displacement of the packaging, there may be a risk of crushing and / or impacting various parts of the body. During work around the unit, the operator may fall due to stumbling or slipping. Use the appropriate device (e.g. toe) to hook and lift the unit properly.



Danger of injury to upper limbs

The risk of injury to upper limbs may arise due to a combination of hazards during the mechanical assembly phase and the connection of the machine to the piping. Observe the operating manual to install the unit safely.

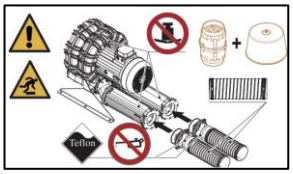
- The support surface of the unit must be flat, robust, stable and absolutely levelled.
- It is important that the unit is installed on supports that do not transmit vibration for example structures or antivibration

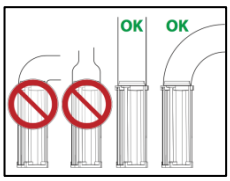


- Connect the pipes with flexible sleeves and avoid the unit bears pipes weight; except for the filter in the case of suction in the environment.

Size the pipes and choose accessories that minimize the load losses, therefore:

- do not fit pipes with diameters smaller than those of the machine's outlets and inlets;
- install multiple machines in parallel, sizing the manifold and main line proportionally;
- do not use angle-pipe, but bends with a large radius of curvature;
- do not install valves with passages smaller than the nominal value and check valves with a stopper pushed by a spring (the check valve with the lowest load loss is the type with a light disc);
- in the case of use for oxygenation, choose low-resistance diffusers (low load loss).





⚠WARNING	To avoid overloads caused by pressure variations, it's recommended that you install a relief valve on aspiration in the case of operation as suction, and on discharge in the case of operation as a compressor.



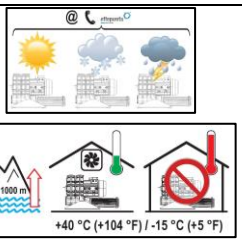
⚠WARNING	If you need to reduce the flow rate, use a branch valve instead of throttling the suction or discharge.



⚠WARNING	Protect the intake duct with a suitable filter with a filtration degree of 25 µm. Foreign bodies are: dust, sand, calcite, impurities in the pipes, cutting blades and shavings, drops and waste from welding, metal burrs, and residues of sealants produced during connection of pipes. Replace the filters regularly.



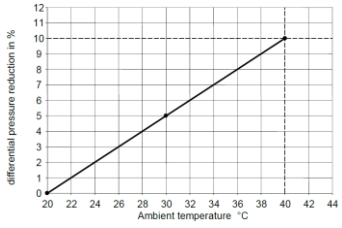
- When installing outdoors, protect the unit against direct exposure to the sun and atmospheric agents. For outdoor installations without the use of protections contact FPZ S.p.A..
- Ventilation of the motor must not be hampered by obstacles placed in the immediate vicinity. For this purpose, the electric motor air intake must remain free and a minimum distance between the electric motor fan cover and any other structure as defined by the manufacturer of electric motor.
- The unit must be installed at a maximum height of 1000 m a.s.l., for different conditions contact FPZ S.p.A..



The ambient temperature, and the conveyed gas intake temperature, is permissible inside the range -15°C (+5°F) ÷ +40°C (+104°F) with the following provisions:

- For ambient temperature +30°C (+86°F) **reduce** the maximum pressure differential given in the Data Sheet by 5%;
- For ambient temperature +40°C (+104°F) **reduce** the maximum pressure differential given in the Data Sheet 10%.

The graph on the right has to be used to reduce the maximum pressure differential in case of ambient temperature between +21°C and +40°C (+70°F and +104°F)



- Check dimensions to allow adequate space for installing the unit with its accessories and ensure sufficient ventilation of the electric motor.

⚠WARNING	In the case of ATEX side channel blower intended for classified areas, the unit must be installed outdoors or in an air conditioned environment.

5.2 BLOWER WITHOUT ELECTRIC MOTOR (GOR – GVR EXECUTION)

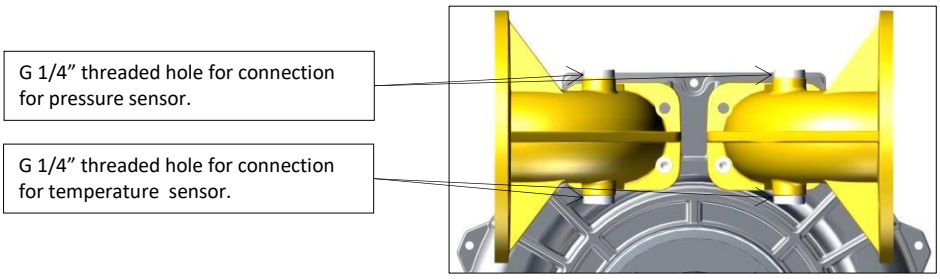
NOTICE	Units supplied without an electric motor, GOR execution (with horizontal coupling) or GVR (with vertical coupling) are considered as partly completed machinery, so the designer has to check the compatibility of the electric motor chosen with the data in the data sheets downloadable from the website. During installation and maintenance, to install or dismantle the elastomeric coupling; it is recommended not to use a hammer, but pushers or extractors, to fit or remove the coupling flanges from the shaft. . Percussion can damage the slope of the bearings by reducing their durability. Coupling requires axial and angular alignment accuracy. Also refer to the coupling instruction manual.

5.3 ATEX 2G BLOWER (EXCLUDED TMD VERSION)

The blower is arranged for the installation of measurement/control systems in order to prevent machine faults that can produce potential sources of triggering:

- pressure sensor
- temperature sensor.

	**Danger of explosion. The unit is designed to convey flammable gas and is sealed. Do not start the machine before connecting and activating the unit and surveillance system**



Pressure sensor

	**ALWAYS use a pressure sensor**

Given the likelihood of an explosive atmosphere, the use of pressure measuring instruments is compulsory in order to check that the difference between the delivery and suction pressures respects the levels given in the "specifications" and on the machine's rating plate.

NOTICE	The use of an alarm and stop device (non-automatic reset) that automatically shuts off the power to the machine is advisable.

Temperature sensor

A possible temperature sensor is deemed functional for the customer's measurement needs, but can in any way replace the pressure sensor for monitoring any dangerous machine conditions.

⚠WARNING	**All the sensors must be protected against possible impacts, damage and atmospheric agents.**

5.4 GOR TMD ATEX 2G BLOWER

The blower is designed for the installation of control systems which must be set up by the installer for the purpose of monitoring machine breakdowns which could produce possible sources of combustion:

- vibration sensor;
- pressure switch / vacuum switch;
- thermostat.

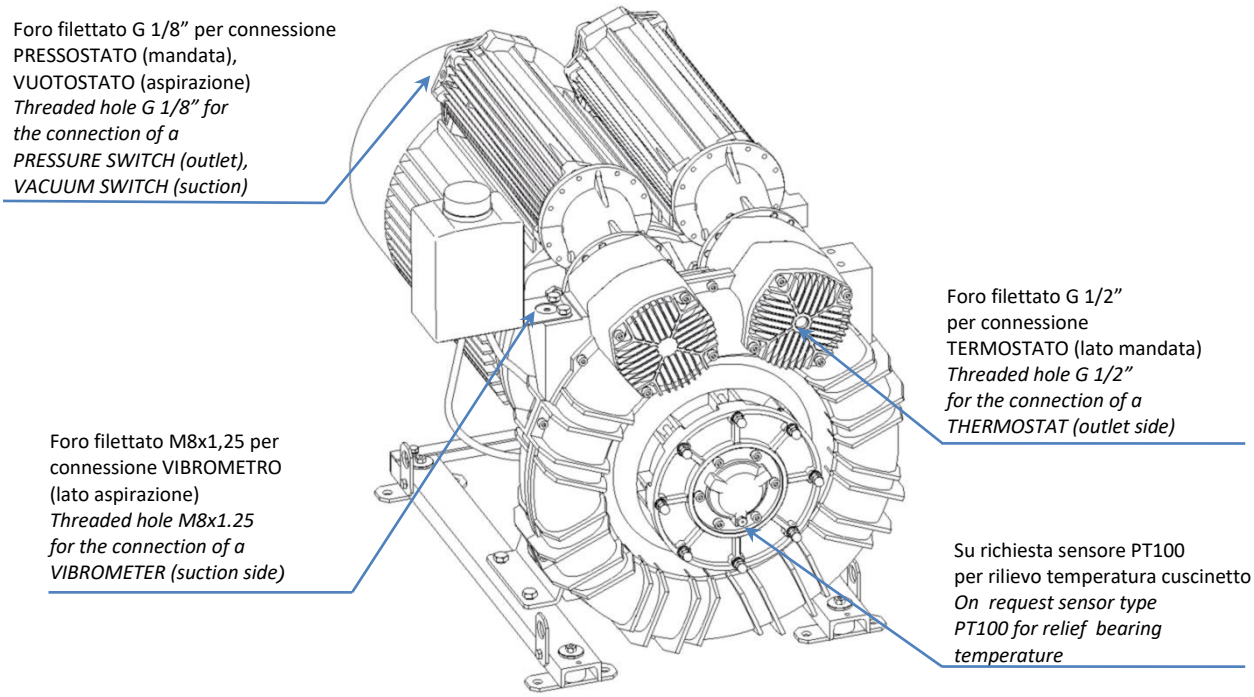
The mechanical seal installed also requires the following operations:

- refilling of the oil tray, as indicated below;
- connection of the oil level sensor.

If necessary, in order to avoid overloads caused by pressure variations, provide a vent device in conformity with EN 1127-1 branching off from the suction pipe, in the case of operation as a suction pump, and on the delivery pipe, in the case of operation as a compressor.

5.4.1 INSTALLATION OF SENSOR GOR TMD ATEX 2G BLOWERS

Install the machine on the plant. Fit the sensors (suitable for the purpose and especially for the Atex environment in question) in their places and connect them to the control system as specified in the instructions provided with the sensors and as required in the plant diagram:



- Vibration sensor

The signal from the sensor must monitor the vibrations of the machine constantly. This signal must be connected to an alarm and block device with manual reset, which automatically interrupts the power supply to the compressor/suction pump at the moment the level of the vibration signal exceeds the predetermined limits.

Effective vibration velocity value [mm/s]	***Class I*** (≤ 15kW)
a<**2.2**	***A***

Effective vibration velocity value [mm/s]	***Class II*** (> 15kW)
a<**3.5**	***A***

- Pressure switch and vacuum switch

The pressure or vacuum switch installed must be calibrated to the maximum pressure or vacuum level specified on the plate of the machine or in accordance with the operating limits of the plant.
The signal must be connected to an alarm and block device, with manual reset, that automatically interrupts the power supply to the machine.

- Thermostat

The thermostat must be set to come on at a temperature not exceeding 125°C to interrupt the power supply to the machine automatically.
The signal must be connected to an alarm and block device, with manual reset, that automatically interrupts the power supply to the machine.

⚠WARNING | **All sensors installed must be protected against impact, damage and weathering**. FPZ can supply a protective casing, on request and after receiving the dimensions of the sensors installed.

5.4.2 CONNECTION OF THE MECHANICAL SEAL FOR GOR TMD ATEX 2G BLOWER

	**Danger of slipping**

Oil spills can make the floor slippery. Clean the floor with absorbent and /or degreasing products.

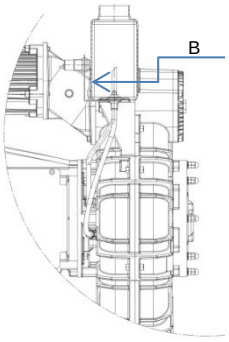
	**Danger of electrostatic charges**

Do not clean or rub the oil reservoir with dry clothes.

- Refilling the cooling oil tray

Refill the cooling circuit of the mechanical seal. For good circulation of the cooling liquid, it is important not to have air bubbles inside the circuit. To achieve this, refill by pouring the liquid into the vessel repeatedly in small amounts without exceeding level (B) of the return line. Top up completely only when the level at the return line has covered the bottom of the vessel.

The cooling liquid must be kept at least 10 mm above the level of the return line (B); top up as necessary.

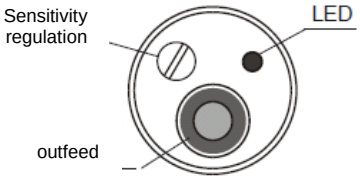


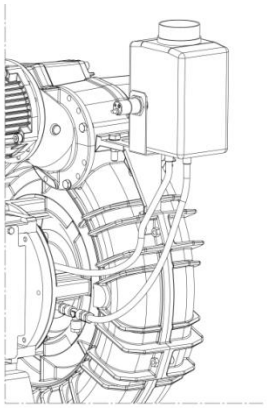
Recommended cooling liquid:	SAE 10W-40 oil Or SAE 5W-40 oil
First filling quantity:	Approx. 1,5 kg

A small leak of fluxing liquid is normal, especially when the seals are settling down.

- Connection of the cooling oil level sensor

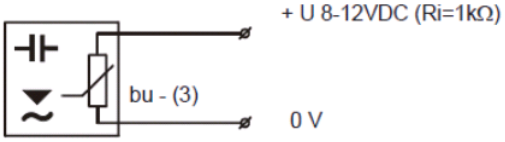
The capacitive oil level sensor consists of a stainless steel cylindrical body and is suitable for use in explosion risk zones. It is fitted with a potentiometer to regulate sensitivity and a LED display on the back end, which is normally on.





This sensor must be connected to an alarm and block system with manual reset which automatically interrupts the power supply to the machine. Connect the sensor to the control system following the specific instructions enclosed with this manual.

CPS-24Xi □-R□



Note: the connection cable must not be cut or tampered with.

5.5 ELECTRIC MOTOR

WARNING	**Comply with safety measures and instructions indicated in the instruction manual for the electric motor.**

Before starting working on the unit or system, the following precautions must be taken:

- make sure that the unit is NOT connected to electrical power mains;
- take precautions to prevent electricity from being reconnected;
- open the terminal box only after making sure that there is absolutely no live current.

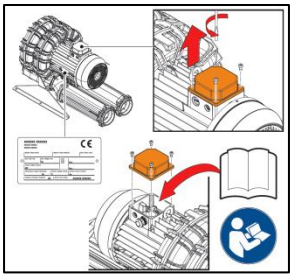
	Danger due to electricity

- If connecting operations are carried out without removing the voltage from the electrical system or without setting up a system to avoid reinsertion, direct contact between the operator and the live parts can occur. This can also cause personal serious injury (or death).
- Work on electrical equipment (installation and maintenance) has to be done only by specialized operators (see document MAN_PIC), wearing PPE.
- In the event of contact with a defective unit there is a risk of electrocution. Always have seals and electrics checked regularly by a specialized operator (see document MAN_PIC).
  - The terminal box must not contain foreign bodies, impurities or humidity. Close the terminal box with the cover, and seal the cable gland openings to prevent dust, water and humidity from getting inside.

NOTICE	In the case of several motor starts during an hour, there is a limitation of 6 start-ups per hour, evenly distributed; failure to respect this can severely damage the unit.

5.5.1 ELECTRIC CONNECTION

Incorrect motor connection may seriously damage the unit.



- Check that the details on the data plate are compatible with the line voltage and frequency.
- Always connect the motor's earth cable to the relevant terminal marked with this symbol  before connecting to the mains supply and check the dispersion capacity. The earth cable can be recognized by its color (yellow/green).
- Connect the machine to the earth system too, using the specific hole (marked with the relative symbol) located on the base of the unit. Connection to the power grid must be carried out in compliance with what is shown in the diagram inside the terminal box.
- Use the cable gland openings to allow power supply cables to pass into the terminal box.
- Proceed to tighten the power supply cables, taking the section of the electrical cables into account each time.
- The terminal boards for the electrical connections must be tightened properly to avoid high contact resistances and resulting overheating.
- Check that the insulation gaps between the various conductors are kept in the air and between surfaces, as indicated in the standards.
- All the screws used to close the terminal board must be tightened properly. Damaged screws must be replaced immediately, using screws of the same or better quality.

The connection must guarantee:

- long-lasting safety;
- that no wire ends are sticking out;
- protection with a (thermal or amperometric) trip switch is essential for dealing with risks of overloading, a loss of one phase in the mains supply, excessive voltage fluctuations, or the rotor getting stuck;
- that the motor trip switch has been set to a value that does not exceed the maximum current level shown on the nameplate. Warning: the trip switch does not always protect the blower in case the maximum pressure differential is exceeded. Verify the maximum pressure or vacuum as per chapter 6.2.
- motors may be equipped with thermal protectors PTO or PTC. To avoid that the motor is damaged by temperature rise over the admissible limit: PTO or PTC have to be connected to a suitable cut off device that opens the line that feed the motor itself.
- if the application requires protection against accidental start-up, this must be carried out on the electrical control circuit of the motor.

5.5.2 ELECTRIC MOTOR POWERED BY FREQUENCY CONVERTER

The unit's nominal pressure or vacuum characteristics for service at mains frequency cannot be maintained if the unit is powered via a frequency converter. Contact FPZ S.p.A. for information about the performance of a unit powered by a frequency converter. Download from the website www.fpz.com the "RPM Table" of your blower and do not exceed the maximum pressure differentials shown for every rotation speed.

When power is supplied with a frequency converter, the installer is responsible for:

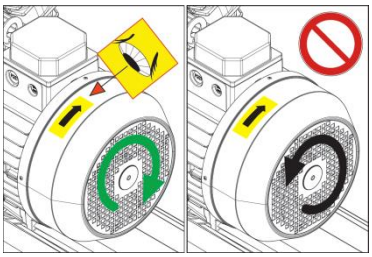
- respecting the laws;
- checking with FPZ assistance if the motor can be powered by a frequency converter, if it doesn't appear on data sheet;
- checking and making any measures necessary to comply with the immunity and emission limits set by the standards;
- checking the suitability of the plant and the frequency converter for operation with standard motors (class F), or the need to use specific motors for these types of operation.

5.5.3 ROTATION DIRECTION

The machines must be used respecting the rotation direction indicated by the arrow on the electric motor fan cover.

- To check the rotation direction, switch the motor on briefly and observe the fan.
- To change the rotation direction, invert the power cable connections, leaving the earth connection unchanged.

Refer to the connection diagram located inside the terminal box and to this section.



6 START UP AND NORMAL OPERATION

6.1 PRELIMINARY CHECKS

WARNING! Before starting the machine for use, carry out the following preliminary checks:

- if the unit has not been started up for some time, check its condition and, if necessary, remove any dust from the external surfaces, to avoid compromising the heat dissipation during the unit work;
- deactivate/open any pipe closing devices (shut-off valves, solenoid valves, etc.) before starting the unit;
- never start and operate the unit with the inlet and/or outlet ports closed;
- make sure the ambient and conveyed gas suction temperatures come within the levels: -15°C (+5 °F)÷ +40°C (+104 °F);
- check the operation of any flow control/limiting devices (not supplied).

6.2 OPERATION

- If the side channel blower is put into operation without being fixed to a surface, a sudden displacement of the starting torque on ignition of the electric motor may occur.
- The information on the product nameplate must always be considered when commissioning and operating.

The unit can be started for use after carrying out the preliminary checks

- Start the unit by switching on the power to the electric motor.
- Respect the maximum pressure differential stated in the blower's nameplate.
  To evaluate the pressure differential Δp across the blower take into account:
  - For compression operating: add up to the outlet pressure the inlet vacuum if applied.
  - For vacuum operation: add up to the inlet vacuum the outlet pressure if applied.
- Pressure losses in the pipes are often underestimated but are decisive factors for the operating differential pressure.
- Measure the motor absorption and check compliance with the rated nameplate value. An amperage below nameplate does not always guarantee that the blower is not exceeding the maximum permitted pressure differential.

WARNING	**Non-compliance with the unit's use or with prohibitions/obligations can cause personal (also serious) injury (or death) or equipment damage**

	Danger of burns

Danger of burns caused by contact with hot surfaces of the unit, which at start-up and operation may reach high surface temperatures, as specified on the product nameplate.
Apply adequate PPE against the risk of burns.



Danger of suction

Danger of injury due to depression, which can cause a sudden suction of objects, hair and clothes.
Start the machine only if it is properly connected to the system.



Danger of vibration

Regularly check that the unit is firmly fixed to the support frame.
Excessive vibration of the unit can cause serious damage to the machine, such as the seizure of the impeller.



Danger due to noise

Some machines can produce loud noise, even over 80 dB (A).
Reference levels are shown on the table of characteristic data that does not consider environmental reverb.
Warning to be taken:
Measure the acoustic pressure of the machine in the installation environment.
In the case of levels above the threshold defined by local standards:

- report the noise hazard
- prepare the use of PPE
- isolate the environment



Danger of ejection of objects

- Danger due to exceeding performance levels that may cause seizure of the impeller.
  Check that operating conditions are in accordance with values declared on the nameplate.
  Avoid operating with the inlet and/or outlet ports closed even temporarily.
  Install a limit valve or equivalent circuit that can avoid excessive vacuum and / or overpressure and allow the compliance with levels shown on the product plate
- Danger of injury due to objects and fluids aspirated and thrown at high speed (injury to the skin or eyes).
  Only start the unit (first start) if it is properly connected and check it accurately.
  In the case of unusual noise from the impeller, switch off the unit immediately and check it accurately.



Danger of injury to upper limbs

During the start-up (first start) phase due to a combination of hazards, the risk of injury to upper limbs may arise.



Danger of sudden leakage and/or aspiration of fluids (even harmful ones)

They could cause damage to the respiratory system due to the leakage of gas while the unit is in use and/or the slowing down of connection to the gas flow circuit.



Danger due to a limited view of the place in which the unit is installed.

Make sure you always have the unit installed in your sight while carrying out any activities close to it.

6.3 STOPPING

- The unit must be stopped by switching off the power supply to the motor.
- On shutdown, make sure to operate the unit with open outlet (suction / delivery) for about 20 minutes. This operation allows the removal of any condensation inside.

7 MAINTENANCE

In order to prevent faults and damage it is important to check periodically the units in operation; therefore it is advisable to adopt a maintenance plan in line with this manual, providing for:

- periodical checks;
- periodical maintenance.

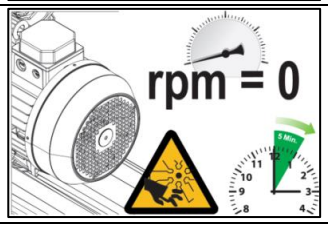
7.1 MAINTENANCE AND FAILURE CONDITIONS

WARNING **Before starting any maintenance, either periodical or due to malfunction, take the following safety measures in order to prevent personal (also serious) injury (or death) or equipment damage:**

- unplug the unit from the power supply by unplugging the main switch;
- apply a sign to the system and to the control unit **"DANGER! Maintenance work in progress";**
- cool the unit for at least 15 minutes;



- wait until the unit has completely stopped, checking through the motor fan that the impeller is not rotating;



- make sure that there is no depression or overpressure in the unit through a pressure gauge and make sure that no fluid can escape from the unit (through its stopping) and / or the system (through its insulation).

Danger due to electricity

- If connecting operations are carried out without removing the voltage from the electrical system or without setting up a system to avoid reinsertion, a direct contact of the operator with live parts can occur. This can also cause personal serious injury (or death).
- Work on electrical equipment (installation and maintenance) must be done only by specialized operators (see document MAN_PIC), wearing PPE.
- In the event of contact with a defective unit there is a risk of electrocution.

Danger of moving parts

High risk of cuts caused by rotating impellers. By removing the manifolds or blind flanges, it is possible to access the rotating impeller through the openings of the body and the cover of the side channel blower.
Never put your hands or objects through the openings.

Danger of burns

Danger of burns caused by contact with hot surfaces of the unit, which at startup and in operation may reach high surface temperatures, as specified on the product nameplate.
Apply adequate PPE against the risk of burns.

Danger of injury to upper limbs

During the maintenance phase due to use of improper tools, lack of PPE, bad illumination of the workplace or unauthorized start-up, the operator fails to perform the required procedures, the machine can be put into unmanaged operation, and the risk of injury to upper limbs may arise.

Danger due to noise

Some machines can produce loud noise, even over 80 dB (A) therefore the operator may be subject to acoustic pressure which may cause buzzing in the headset and reduced attention.

WARNING **Danger of sudden spillage of gas (also harmful) suction**

Respiratory damage could occur due to gas leakage during operation and / or loosening of the connections to the gas flow circuits.

7.2 PERIODICAL CHECKS

In order to avoid any defects that may directly or indirectly cause damage, it is important that the unit is inspected by specialized operators (see document MAN_PIC).

A) When the unit is running, routinely carry out the following checks:

- delivery temperature;
- operating pressure and/or vacuum;
- electric motor current absorption;
- vibrations;
- state of the filter and related load loss.

⚠WARNING	**Danger of seizure of the impeller due to excess vibration. Vibrations above the threshold (see table below) are considered NOT eligible and can cause damage to the machine and consequently personal injury even serious (or death) and / or damage to things.** **In the event of unusual noise and / or vibration over parameters, that may indicate the possibility the impeller is seizing up, turn off the unit immediately.**

Class I (Blower with electric motor of power ≤15kW)	Class II (Blower with electric motor of power >15kW)
a > 2,2	a > 3,5
a = effective vibration speed level [mm/s]	

Changes to normal working conditions (power ups, abnormal noise, vibrations, excessive overheating of the service fluid) are indications that the units is not working properly.

B) With the unit stopped and cooled, periodically carry out the following checks:

- dust: check and remove deposits from the external surfaces of the unit;
- suction filter (if fitted): every 10-15 days, check and clean or replace the filter cartridge. The dirty cartridge creates strong suction resistance and consequently a higher pressure differential, power absorption and operating temperature;
- for unit supplied with elastic joint, check the condition of the elastic joint as indicated in its operating manual;
- condensation discharge (if present): every 8-10 days, turn the yellow valve counterclockwise 90° to allow draining of the condensation that has built up inside the blower;
- check for oil leaks (TMD version) near the joint; if leaks are found, maintenance work must be scheduled to replace the seals.

7.3 ROUTINE MAINTENANCE REPAIR OF BREAKDOWNS

See the following chapter “TROUBLESHOOTING” for identifying possible critical situations and types of breakdowns.
Always disconnect the unit and remove it from the plant to do routine maintenance, cleaning and replacing components and in the event of a breakdown.

⚠WARNING	**Danger due to residual overpressure or drop in pressure:**

- with residual overpressure, process fluids can leak, with the risk of injury to the skin and eyes;
- with a drop in pressure there is the risk that hair and clothes can be trapped;
- disconnect the unit only after closing and bleeding the system connected to it.

7.4 LIFESPAN OF BEARINGS

Under normal operating conditions, the bearings of the unit must be replaced by a specialized operator (see document MAN_PIC), after a time fixed by the manufacturer (see details in the table below).

NOT ATEX BLOWERS

Every model, except the models at the following line	25000 hours or 3 years
e07 / e08 / e09 / e10 / e11 MS – TS – TD	40000 hours or 5 years

SOFFIANTI ATEX

Every Atex model	18000 hours or 3 years

NOTICE Replace the bearings of the unit only if you have all the instructions, the parts list and the section/explosion of the unit

7.5 DISMANTLING AND DEMOLITION



Danger of crushing and / or impacting various parts of the body

During the dismantling and demolition phases due to the sudden drop or displacement of the packaging, there may be a risk of crushing and / or impacting various parts of the body. During work around the unit, the operator may fall due to stumbling or slipping.

8 RESIDUAL RISKS

During the design of the machines or system on which the blower will be installed, the following residual risks should be considered.



Danger during the transport phase

Danger of crushing or slipping during the unit transport steps. The *operating instructions* (attached to the unit) and this manual describe how to carry out safe transport operations according to tested procedures.



Danger during the installation phase

Danger of crushing or slipping during the installation phases of the unit. The *operating instructions* (attached to the unit) and this manual describes how to carry out safe installation operations and according to tested procedures.



Danger during the start-up and operating phase

Danger of electrocution, burns, noise, unauthorized start-up of the unit, and ejection of objects or fluids during the start-up and operation phases of the unit. The *operating instructions* (attached to the unit) and this manual describe how to perform the operations mentioned safely and according to tested procedures.



Danger during maintenance and dismantling phases

Danger of electrocution, burns, noise, unauthorized start-up of the unit, and ejection of objects or fluids during the maintenance and dismantling phases of the unit. The *operating instructions* (attached to the unit) and this manual describe how to perform the operations mentioned safely and according to tested procedures.

9 TROUBLESHOOTING

Problem	Serious page	Cause	Solution	Precaution
The unit does not start	F	Electrical wiring incorrect	The electrical connection has to be checked by a technician referring to the wiring diagram contained in the terminal board box	Turn off the power to the electrical system or set up a system that avoids reinsertion
	F	Power supply voltage unsuitable	Check that the power supply voltage, measured at the motor terminals, is within +/- 10% of the rated voltage	Use PPE against the electrical hazards
	G	The impeller is stuck	Call FPZ assistance to repair the unit	
No or insufficient air flow	G	The suction filter is clogged	A specialized operator (see MAN_PIC) has to clean or replace the cartridge	Avoid entering foreign bodies into the unit
	G	Wrong frequency (for units powered through an inverter)	Correct the frequency	Check the rating plate
	G	Profile of the impeller blades modified (due to deposits on the profile)	Call FPZ assistance personnel to check the impeller	
No or insufficient pressure differential	F	Incorrect direction of rotation	The direction of rotation has to be inverted by a specialized operator (see MAN_PIC) switching two of the electrical power supply wires.	Turn off the power to the electrical system or set up a system that avoids reinsertion
	G	Leaks in the plant	Locate the leak and seal	Use proper sealants
Current absorption exceeding the admissible level	F	Electrical wiring incorrect	The electrical connection has to be checked by a technician referring to the wiring diagram contained in the terminal board box	Take off the power to the electrical system or set up a system that avoids reinsertion
	F	Drop in mains supply voltage	The power supply voltage has to be restored by a specialized operator (see MAN_PIC) at the terminals and at the established values.	
	G	The suction filter is clogged	The cartridge has to be cleaned or replaced by a specialized operator (see MAN_PIC)	Avoid entering foreign bodies into the unit.
	G	The unit has accumulated deposits inside	Call FPZ assistance personnel to clean the inside of the unit	Avoid entering foreign bodies into the unit.
	G	The unit is operating at a pressure and/or vacuum that exceeds the admissible level	Adjust the system and/or the regulating valve to lower pressure differentials.	Use appropriate PPE to operate near the unit
High delivery air temperature	G	The suction filter is clogged	Adjust the system and/or the regulating valve to lower pressure differentials.	Use appropriate PPE (surge protectors, gloves) to operate near the unit
	G	The suction filter is clogged	The cartridge has to be cleaned or replaced by a specialized operator (see MAN_PIC)	Avoid entering foreign bodies into the unit.
	G	The unit has accumulated deposits inside	The unit has to be cleaned inside by a specialized operator (see MAN_PIC).	Avoid entering foreign bodies into the unit.
	G	Suction and/or delivery piping obstructed.	Obstructions have to be removed by a specialized operator (see MAN_PIC).	Avoid entering foreign bodies into the unit.
	G	Suction air temperature exceeds 40°C (+104°F)	Use heat exchangers to reduce the suction air temperature	
Abnormal noise	F	The soundproofing material is damaged	Soundproofing cloth has to be replaced by a technician.	Avoid entering foreign bodies into the unit.
	G	The impeller scrapes against the casing. - The unit is operating at a pressure and/or vacuum that exceeds the admissible level	Reduce the pressure differentials in the plant	Use appropriate PPE (surge protectors, gloves) to operate near the unit
	G	- Reduction of assembly tolerances due to internal deposits (dust, impurities in the pipes, process residues, etc.)	The unit has to be cleaned inside by a specialized operator (see MAN_PIC).	Avoid entering foreign bodies into the unit.
	G	Worn bearing	Bearings have to be replaced by a specialized operator (see MAN_PIC).	
	F	Unit's installation position unsuitable	The unit has to be installed by a technician on structures that cannot transmit or amplify noise (tanks, steel plating, etc.)	Use proper anti-vibration and move the units according to local regulations

Abnormal vibrations	G	The impeller is damaged	The impeller has to be replaced by a specialized operator (see MAN_PIC).	
	G	The impeller has accumulated deposits	The unit has to be cleaned inside by a specialized operator (see MAN_PIC).	Avoid entering foreign bodies into the unit
	G	Unit anchored without anti-vibration insulators	The unit has to be anchored with anti-vibration insulators by specialized operator (see MAN_PIC).	Use proper anti-vibration and move the units according to local regulations
	F	Rigid connection to the plant	Flexible hoses between the unit and the piping have to be fitted by a specialized operator (see MAN_PIC).	Carry out the activity only if the unit is disconnected to the power supply.
	G	Bearing on the blower or motor side defective	Bearings have to be replaced by a specialized operator (see MAN_PIC).	

Leaks	G	Defective silencer gaskets	Gaskets have to be checked by a specialized operator (see MAN_PIC), and if necessary have to be replaced.	Avoid entering foreign bodies into the unit.
	G	Defective casing gaskets	Gaskets have to be cleaned by a specialized operator (see MAN_PIC), and if necessary have to be replaced.	Avoid entering foreign bodies into the unit.

Seriousness: F for functional fault and G for serious fault.

10 REFERENCES

Documents quoted:

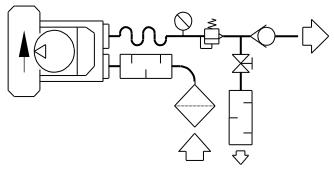
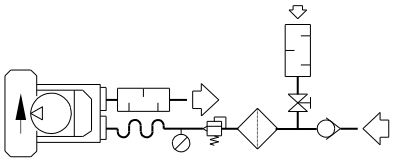
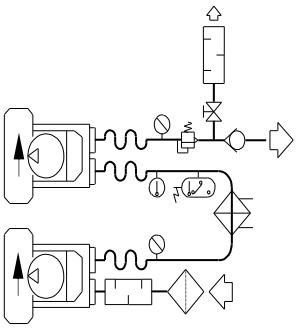
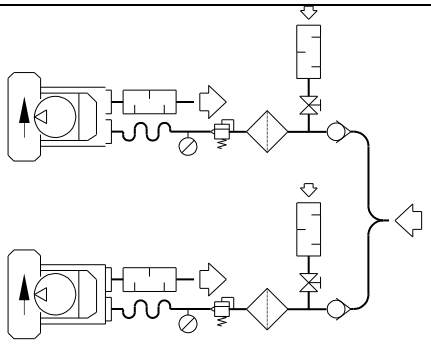
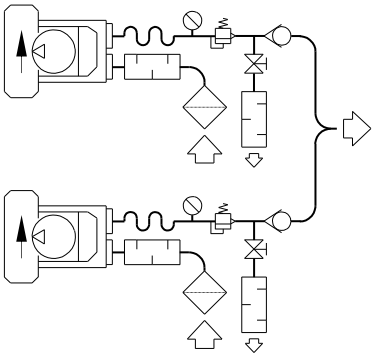
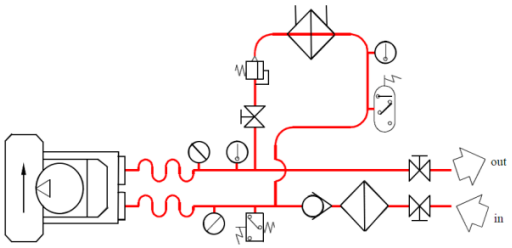
- Operating Instruction: supplied with the blower
- MAN_PIC: document with pictogram definitions
- Instruction manual of elastic joint
- Instruction manual of electric motor

Norme e direttive:

- Machinery directive 2006/42/EC
- Atex directive 2014/34/EU (Applies to Atex blowers only)
- EN ISO 12100: 2010
- EN 349:1993+A1: 2008
- EN 614-1: 2006+A1: 2009
- EN ISO 3746: 2010
- EN ISO 13857: 2008
- EN 60204-1: 2006
- EN 1127-1: 2011 (Applies to Atex blowers only)
- EN ISO 80079-36: 2016 (Applies to Atex blowers only)
- EN ISO 80079-37: 2016 (Applies to Atex blowers only)
- EN 14986: 2017 (Applies to Atex blowers only)

11 INSTALLATION DIAGRAMS

SCHEMI DI INSALLAZIONE I
INSTALLATION DIAGRAM GB

COMPRESSORE PRESSURE SERVICE	ASPIRATORE VACUUM SERVICE
	
COMPRESSORE IN SERIE SERIAL PRESSURE SERVICE	ASPIRATORE IN PARALLELO PARALLEL VACUUM SERVICE
	
COMPRESSORE IN PARALLELO PARALLEL PRESSURE SERVICE	ATEX BLOWERS SCHEMA D'INSTALLAZIONE INSTALLATION DIAGRAM
	

LEGENDA, KEY – ACCESSORIES

Item Item		Denominazione Name	Item Item		Denominazione Name
1		Filtro - Filtro in linea Filter - Inline filter	7		Valvola di ritegno Check valve
(2)		Silenziatore Silencer	8		Valvola Valve
3		Manicotto flessibile Flexible sleeve	(9)		Scambiatore Cooler
4		Manometro – Vuotometro Pressure gauge - Vacuum gauge	(10)		Termometro Thermometer
5		Pressostato – Vuotostato Pressure switch – Vacuum switch	(11)		Termostato Thermostat
6		Valvola limitatrice Pressure relief valve	(x) (x)	SE NECESSARIO IF NECESSARY	

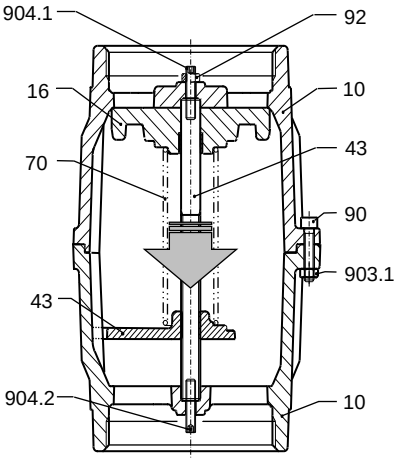
SN 1701-9

SAFETY VALVE VRL USE INSTRUCTIONS

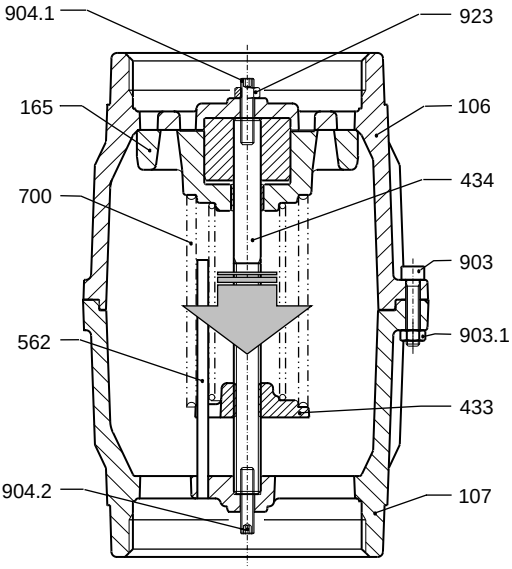
CAUTION! THE VALVE IS SUPPLIED NOT CALIBRATED



PLEASE READ CAREFULLY ALL INSTRUCTIONS AND KEEP THEM FOR FUTURE REFERENCE



VRL6
Fig. 1a



VRL8 - VRL9
Fig. 1b

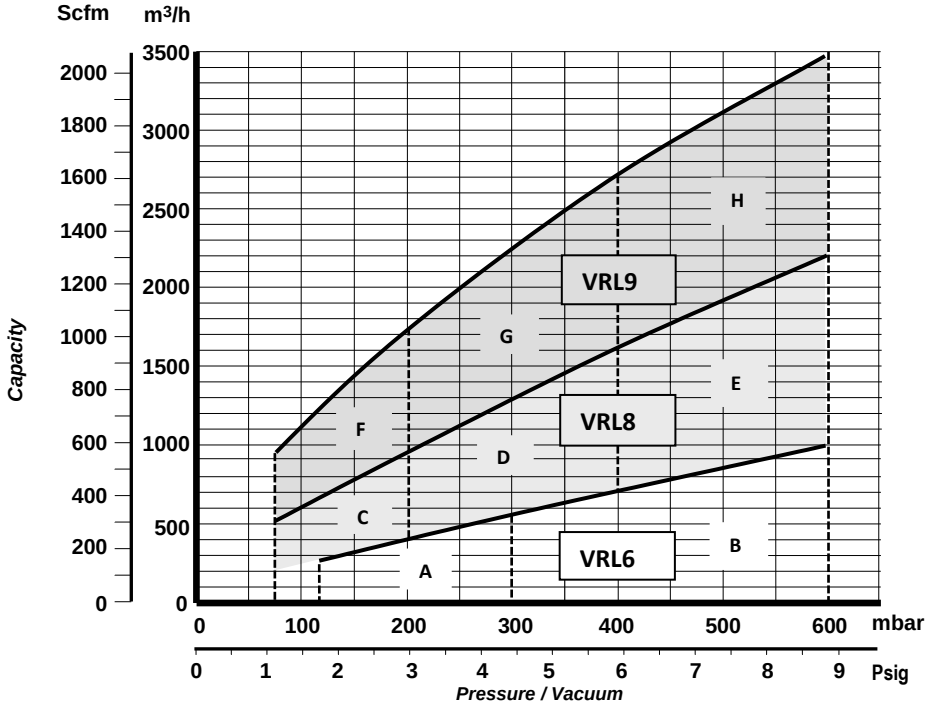
Description

106	*Housing*	700	*Spring*
107	*Cover*	903	*Screw*
165	*Shutter*	903.1	*Nut*
433	*Spring guide disc*	904.1	*Upper grub screw*
434	*Shutter guide*	904.2	*Lower grub screw*
562	Dowel pin	923	*Nut*

GB **CONDITIONS OF USE**

- ***THE VRL VALVES ARE DESIGNED FOR THE HANDLING OF AIR OR NON-EXPLOSIVE, NON-HAZARDOUS AND NON-FLAMMABLE GASES IN NON-EXPLOSIVE ENVIRONMENTS. THE GAS INLET TEMPERATURE MUST BE IN THE RANGE OF -15 TO +160 °C.***
- ***RELIEF VALVES ARE DESIGNED AND MANUFACTURED TO LIMIT THE OPERATING PRESSURE IN LOW PRESSURE/VACUUM APPLICATIONS. THEY ARE FOR USE SPECIFICALLY ON LOW PRESSURE BLOWERS AND VACUUM PUMPS ONLY;***
- ***THE VALVE CANNOT WITHSTAND HIGH INTERNAL PRESSURE, DESIGN MAXIMUM OF 2.8 bar A;***
- ***THERE IS SMALL LOSS OF THE AIR/GAS BEING HA***
- ***SOLID PARTICULES, HOWEVER SMALL, INCLUDING DIRT CAN CAUSE SERIOUS DAMAGE; THEREFORE IT IS ESSENTIAL THAT SUCH SUBSTANCES SHOULD BE REMOVED FROM THE GAS BY SUITABLE FILTERS UPSTREAM OF THE INLET.***

SELECTION DIAGRAM



SPRING SELECTION CHART

RANGE	*SPRING* N	*Pressure / Vacuum* MIN [mbar]	[psig]	*Pressure / Vacuum* MAX [mbar]	[psig]	*Colour of identification*
VRL6						
A	I	120	1.763	300	4.408	*SILVER*
B	II	300	4.408	600	8,820	*GREEN*
VRL8						
C	I	75	1.102	200	2.940	*SILVER*
D	II	200	2.940	400	5.880	GREEN
E	I + II	400	5.880	600	8,820	*SILVER & GREEN*
VRL9						
F	I	75	1.102	200	2.940	VERDE - GREEN - VERT - GRÜN - VERDE
G	II	200	2.940	400	5.880	*SILVER*
H	I + II	400	5.880	600	8,820	*SILVER & GREEN*

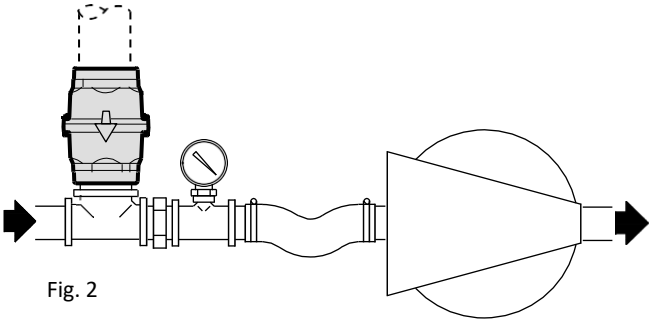


Fig. 2

INSTALLATION SKETCH – VACUUM RELIEF VALVE

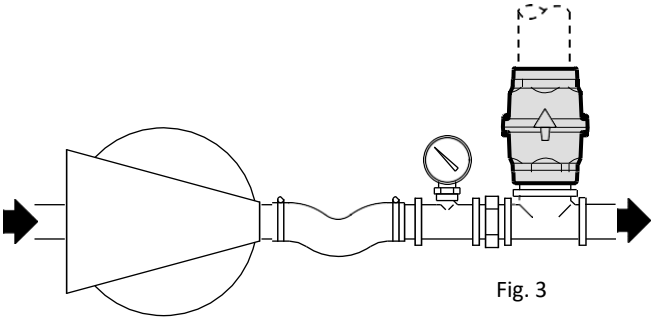


Fig. 3

INSTALLATION SKETCH – PRESSURE RELIEF VALVE

1. CHOICE OF SPRING

The valve is supplied with 2 different springs; each spring is to be used within a specific pressure-vacuum operating range. For the VRL8 and VRL9 there is the possibility to use both springs working in parallel. Referring to the SELECTION DIAGRAM, check that the valve is correctly sized and depending where the operating point (area A, B,…H) is located, choose one or two springs according to SPRING SELECTION CHART.
The valve is supplied with spring # I installed. If spring needs to be replaced or a supplementary spring is needed to be added (for VRL8 / VRL9), proceed to point # 2 otherwise, adjust valve as per point #3.

2. INSTRUCTIONS FOR SPRING REPLACEMENT (OR MOUNTING ADITIONAL SPRING FOR VRL8 / VRL9)

- Remove the two plastic caps on valve.
- **Ensure stop-nut 923 is locked on the upper housing 106.**
- Unscrew screw 903 from nut 903.1.
- Remove cover 107 from housing 106.
- Unscrew spring guide disc 433 taking it out from shutter guide 434.
- Remove spring 700 (only in case of replacement).
- Install the appropriate spring into shutter 165.
- Compress spring and screw spring guide disc 433 on shutter guide 434 for at least 20 full thread terms
- Check that both ends of the spring are properly positioned within their seats.
- Install the cover 107 on the housing 106 inserting:
  - for VRL6: the sliding guide on the slot in spring guide disc 433
  - for VRL8 and VRL9: dowel pin 562 on the slot in spring guide disc 433.
- Tighten screw 903 on nut 903.1

3. VALVE SETTING

A) Setting-up at allowed vacuum level

- Remove the two plastic caps on valve, if any.
- Position valve on the suction by-pass and connect a vacuum gage as close as possible to the exhauster inlet (Fig. 2).
- Unscrew nut 923.
- Relieve spring tension by backing off upper grub screw 904.1 with the fit key.
- Turn on exhauster. Induce highest attainable vacuum by throttling air intake upstream relief valve (normally reducing throttle to fully-closed).
- Adjust upper grub screw 904.1 until maximum allowable vacuum level is reached.
- Tighten nut 923 keeping blocked upper grub screw 904.1.
- Open suction line.

Double-check vacuum gauge to ensure no additional losses are induced by pipes or filters installed upstream relief valve

B) Setting-up at allowed pressure level

- Remove the two plastic caps on valve, if any.
- Remove nut 923 from upper grub screw 904.1 and place it on to the lower grub screw 904.2. Do not tighten.
- Position valve on the discharge by-pass and connect a pressure gage as close as possible to the blower outlet (Fig. 3).
- Relieve spring tension by backing on lower grub screw 904.2 with the fit key.
- Turn on blower. Induce highest attainable pressure by throttling air discharge downstream of the valve (normally reducing throttle to fully-closed).
- Unscrew lower grub screw 904.2 until maximum allowable pressure level is reached.
- Tighten nut 923 keeping blocked lower grub screw 904.2.
- Open discharge line.

Double-check pressure gauge to ensure no additional losses are induced by pipes or filters installed downstream the valve

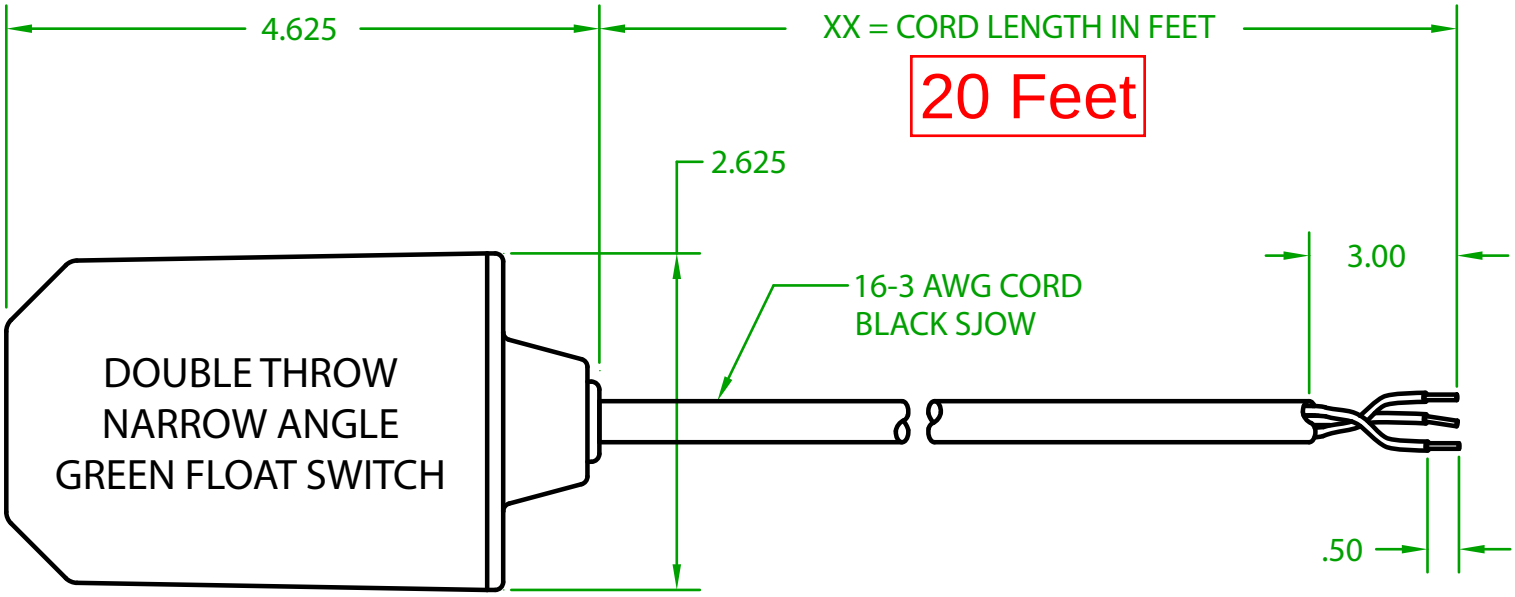
Section 3.6.8

Level Floats

MERCURY DISPLACEMENT INDUSTRIES, INC.
Post Office Box 710 - U.S. 12 East - Edwardsburg, Michigan 49112-0710
Phone (269) 663-8574 - Fax (269) 663-2924
(800) 634-4077

SKF-5034-*XX*

Mercury Free



OPERATING ANGLE: TETHERLESS/INTERNALLY WEIGHTED
SWITCHES @ 25° ABOVE AND 10° BELOW HORIZONTAL.
@ 25° ABOVE HORIZONTAL:
(RED IS CLOSED / WHITE IS OPEN)
@ 10° BELOW HORIZONTAL: (NORMAL POSITION)
(RED IS OPEN / WHITE IS CLOSED)

SWITCHING DIFFERENTIAL: 3 1/2"

ELECTRICAL RATINGS: 1/4 H.P. 10 AMPS @ 120/240 VAC. 34.8 LRA

FLOAT MATERIAL: A.B.S.

High High Alarm - Normally Closed
White - NC & Black - Common

J.J.S. OCTOBER 03, 2012

Revised 01-16-2014

Contactors - Relays - Switches

http://www.mdius.com

SJE SIGNALMASTER® SPDT Control Switch

Mechanically-activated, narrow-angle float switch designed to activate pump control panels and alarms.



This narrow-angle sensing device is used to accurately monitor liquid levels in:

- water
- sewage applications

The SJE SignalMaster® SPDT control switch can be wired to work in either normally open or normally closed applications. It is not sensitive to rotation.

When wired as Normally Open (high level)
The control switch turns on (closes) when the switch tips slightly **above** horizontal signaling a high level, and turns off (opens) when the switch drops slightly below horizontal.

When wired as Normally Closed (low level)
The control switch turns on (closes) when the switch tips slightly **below** horizontal signaling a low level, and turns off (opens) when the switch tips slightly above horizontal.

FEATURES

- Can be wired to work in either normally open or normally closed applications (Single Pole, Double Throw).
- Mechanically-activated, snap action contacts.
- High impact, corrosion resistant, polypropylene float housing.
- Not sensitive to rotation.
- Control differential of 1.5 inches (4 cm) above or below horizontal.
- Green colored cap for easy identification of SPDT control switch.
- UL Listed for use in water and sewage.
- CSA Certified.
- Five-year limited warranty.

SSPMA MEMBER
LR54245
LISTED 83N2
Member of Hydraulic Institute

SPECIFICATIONS

CABLE: flexible 18 gauge, 3 conductor (UL) SJOW, water-resistant (CPE)

FLOAT: 2.74 inch diameter x 4.83 inch long (7.0 x 12.3 cm) high impact, corrosion resistant, polypropylene housing for use in sewage and water up to 140°F (60°C)

MAXIMUM WATER DEPTH: 30 feet (9 meters), 13 PSI (90 kPa)

ELECTRICAL: 5 amp, 125/250 VAC, 50/60 Hz

NOTE: This switch is not recommended for controlling:

- electric loads less than 100 milliamps, 12 VAC
- non-arcing electric loads

OPTIONS

This switch is available:

- CE certified switch available upon request
- in standard cable lengths of 10, 15, 20, or 30 feet and 3, 5, 6, or 10 meters (longer lengths available)
- with two mounting options that allow for flexibility in installation:

  Mounting Clamp: for applications where the switch can be attached to a discharge pipe or similar mounting device.

  Externally Weighted: for applications where the switch can be suspended from above.

California Prop 65 requires the following: ⚠ WARNING Cancer and Reproductive Harm - www.P65Warnings.ca.gov

SEE REVERSE SIDE FOR ORDERING INFORMATION.
SEE PRICE BOOK FOR LIST PRICE.

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1-218-847-4617 Fax
email: customer.service@sjeinc.com
www.sjerhombus.com

SJE SIGNALMASTER® SPDT Control Switch

Mechanically-activated, narrow-angle float switch designed to activate pump control panels and alarms.

ORDERING INFORMATION

Normally Open or Normally Closed		Shipping Weight
Part Number	**Description**	
1006094	10SGMSPDTPC	1.20 lbs.
1006098	10SGMSPDTWE	2.29 lbs.
1006095	15SGMSPDTPC	1.61 lbs.
1006099	15SGMSPDTWE	2.69 lbs.
1006096	20SGMSPDTPC	2.01 lbs.
1006100	20SGMSPDTWE	3.10 lbs.
1006097	30SGMSPDTPC	2.82 lbs.
1006101	30SGMSPDTWE	3.91 lbs.

PC = **P**ipe **C**lamp **WE** = **W**eighted **E**xternally

Can be wired to work in either pump down (normally open) or pump up (normally closed) applications.

NOTE: Descriptions are grouped by cable length measured in feet (10, 15, 20, 30).

SEE PRICE BOOK FOR LIST PRICE.

OPTIONS

PACKAGING
Bagged - standard
Boxed - optional
Bulk - optional

ADDITIONAL CABLE
Longer cable lengths available. Please call for details.

Eq. & MBBR Tank

Septic Tank Level Floats

LISTED 83N2 LR54245

SSPMA MEMBER

SPECIFICATIONS

CABLE: flexible 18 gauge, 3 conductor (UL) SJOW, water-resistant (CPE)

FLOAT: 2.74 inch diameter x 4.83 inch long (7 cm x 12.3 cm), high impact, corrosion resistant polypropylene for use in sewage and water up to 140°F (60°C)

MAXIMUM WATER DEPTH: 30 feet (9 meters), 13 psi

ELECTRICAL: 5 amp, 125/250 VAC, 50/60 Hz

This switch is not recommended for controlling:

- electric loads less than 100 milliamps, 12 VAC
- non-arcing electric loads

OTHER INFORMATION

NORMALLY OPEN (high level) OPERATION
The control switch closes (turns on) when the float tips slightly **above** horizontal signaling a high level, and opens (turns off) when the float drops slightly **below** horizontal in water or sewage applications.

NORMALLY CLOSED (low level) OPERATION
The control switch closes (turns on) when the float tips slightly **below** horizontal signaling a low level, and opens (turns off) when the float tips slightly **above** horizontal in water or sewage applications.

SJE RHOMBUS

www.sjerhombus.com
customer.service@sjeinc.com

Call or fax your order!
1-888-DIAL-SJE (1-888-342-5753) • Fax 218-847-4617

Product offering and pricing are subject to change without notice.
*Please visit **www.sjerhombus.com** for the most current information.*

9500116E 10/18
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Accessories Installation Instructions

Cord Seal, Cable Weight, Cable Clamp Assembly, and Float Bracket.

CORD SEALS



Provides strain relief and a liquid-tight seal.

- Seals 1-4 cables in 2" terminal adapters
- Seals 1-6 cables in 2½" terminal adapters
- PVC plugs included (for unused cable positions)
- Ground wire

CABLE WEIGHT



U.S. Patent 5,306,885

Provides an accurate pivot point for suspended float switches.

- Gripper teeth on clip and weight channel securely lock float cable into place
- Cable Weight can be adjusted without the use of tools

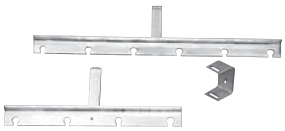
CABLE CLAMP ASSEMBLY



Provides cable anchor point and strain relief. Secures cable in vertical direction.

- For use with 18/16 gauge, 14 gauge, & 12 gauge cable
- Mounting clamp: ABS Nylon blend
- Hose clamp: highly corrosion resistant stainless steel

FLOAT BRACKET



Provides convenient installation of float switches.

- Six Float Bracket supports 1-6 floats
- Four Float Bracket supports 1-4 floats
- Can be directly mounted to wall or used with wall mounting device
- Provides convenient location to stow excess float cord
- Supplied with cord strain relief connectors

PREVENTATIVE MAINTENANCE

- Periodically inspect the product. Check that the cable has not become worn or that the housing has not been damaged so as to impair the protection of the product. Replace the product immediately if any damage is found or suspected.
- Periodically check to see that the float is free to move and operate the pump or alarm.
- Use only SJE-Rhombus® replacement parts.

SJE-RHOMBUS® THREE-YEAR LIMITED WARRANTY

SJE-RHOMBUS® warrants to the original consumer that this product shall be free of manufacturing defects for three years after the date of consumer purchase. During that time period and subject to the conditions set forth below, **SJE-RHOMBUS®** will repair or replace, for the original consumer, any component which proves to be defective due to defective materials or workmanship of **SJE-RHOMBUS®**.

ELECTRICAL WIRING AND SERVICING OF THIS PRODUCT MUST BE PERFORMED BY A LICENSED ELECTRICIAN.

THIS WARRANTY DOES NOT APPLY: (A) to damage due to lightning or conditions beyond the control of **SJE-RHOMBUS®**; **(B)** to defects or malfunctions resulting from failure to properly install, operate or maintain the unit in accordance with printed instructions provided; **(C)** to failures resulting from abuse, misuse, accident, or negligence; **(D)** to units which are not installed in accordance with applicable local codes, ordinances, or accepted trade practices, and **(E)** to units repaired and/or modified without prior authorization from **SJE-RHOMBUS®**.

Some states do not allow limitations on how long an implied warranty lasts, so the above limitation may not apply to you. Some states do not allow the exclusion or limitation of incidental or consequential damages, so the above limitation or exclusion may not apply to you. This warranty gives you specific legal rights, and you may also have other rights which vary from state to state.

TO OBTAIN WARRANTY SERVICE: The consumer shall assume all responsibility and expense for removal, reinstallation, and freight. Any item to be repaired or replaced under this warranty must be returned to **SJE-RHOMBUS®**, or such place as designated by **SJE-RHOMBUS®**.

ANY IMPLIED WARRANTIES OF MERCHANTABILITY OR FITNESS ARE LIMITED TO THE DURATION OF THIS WRITTEN WARRANTY. SJE-RHOMBUS® SHALL NOT, IN ANY MANNER, BE LIABLE FOR ANY INCIDENTAL OR CONSEQUENTIAL DAMAGES AS A RESULT OF A BREACH OF THIS WRITTEN WARRANTY OR ANY IMPLIED WARRANTY.

SJE-Rhombus®

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⚠ WARNING — **ELECTRICAL SHOCK HAZARD**
Disconnect power before installing or servicing this product. A qualified service person must install and service this product according to applicable electrical and plumbing codes.

⚠ WARNING — **EXPLOSION OR FIRE HAZARD**
Do not use this product with flammable liquids. Do not install in hazardous locations as defined by National Electrical Code, ANSI/NFPA 70.

Failure to follow these precautions could result in serious injury or death. Replace product immediately if switch cable becomes damaged or severed. Keep these instructions with warranty after installation. This product must be installed in accordance with National Electric Code, ANSI/NFPA 70 so as to prevent moisture from entering or accumulating within boxes, conduit bodies, fittings, float housing, or cable.

For detailed specifications on this product, or for the complete line of SJE-Rhombus® panel, alarm, and switch products, visit our web-site at www.sjerhombus.com.

CORD SEAL INSTALL

1. Pass the cables through the 2" or 2½" terminal adaptor.
2. Route cables through the seal, leaving adequate cable to work with. See **Figure A**.
   NOTE: If all hole positions are not used, plug open position(s) in the cord seal with the PVC plug(s) provided.
3. Insert the cord seal into the terminal adaptor and tighten hex nut until adequate strain relief is achieved.
4. Gather all ground wires, including ground conductor on the cord seal and secure to ground terminal.

CABLE WEIGHT INSTALL

1. Lay cable in weight as shown in Figure B.
2. Align clip with weight groove and slide clip towards cable as shown in Figure B. Snap clip snugly up to cable and manually force clip to tightest possible position.
3. See Figure C for proper tether length.

CABLE CLAMP INSTALL

1. Determine the required cord tether length according to product specifications.
2. Place the cord into the clamp as shown as shown in Figure D.
3. Locate clamp at desired activation level and secure the clamp to the discharge pipe as shown in Figure D.
   Note: Do not install cord under hose clamp.
4. Tighten the hose clamp using screwdriver. Over tightening may result in damage to the plastic clamp. Make sure the float cable is not allowed to touch the excess hose clamp band during operation.
5. Wire switch as shown in the Wiring Diagrams.
6. Check installation. Allow system to cycle to insure proper operation.

Note: All hose clamp components are made of 18-8 stainless steel material. See your SJE-Rhombus® supplier for replacements.

FLOAT BRACKET INSTALL

1. Drill holes in mounting surface 1-5/16 inches apart vertically.
2. Install the mounting bracket to the mounting surface using two fasteners shown in Figure E.
   NOTE: Use stainless steel fasteners appropriate for the mounting surface.
3. Snap the cord lock onto the cable shown in Figure E.
4. Drop the cord lock and cord into the top side of a desired hole in the float bracket as shown in Figure F.
5. Adjust the cord to the proper length, so that activation occurs at the desired level.
6. To lock the cord in place, turn the cord lock clockwise as shown in Figure F.
7. Slide the float bracket into the mounting bracket slots as shown in Figure F.
8. Confirm the float cords are set at a proper height to insure correct activation/deactivation levels.

Figure A

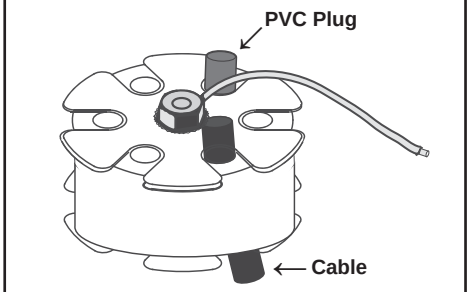


Figure B

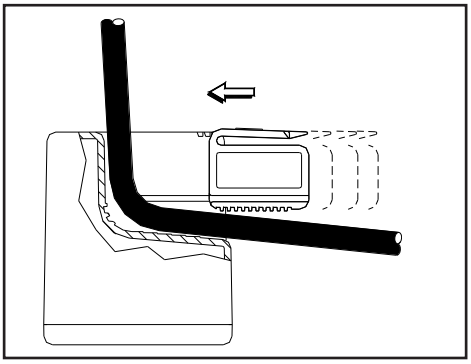
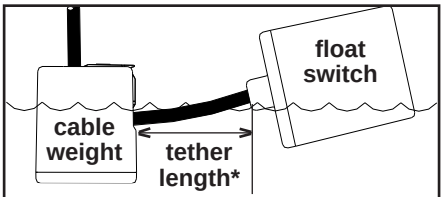


Figure C



***Control Switches:**
Recommended tether length is 4 inches (10 cm)

***Pump Switches:**
Minimum recommended tether length is 3.5 inches (9 cm)

Figure D

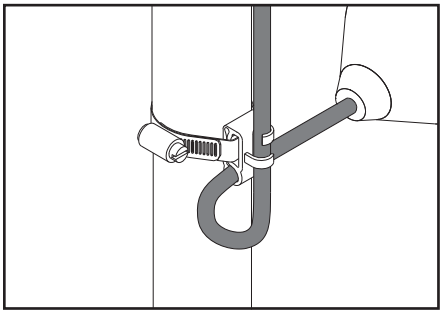


Figure E

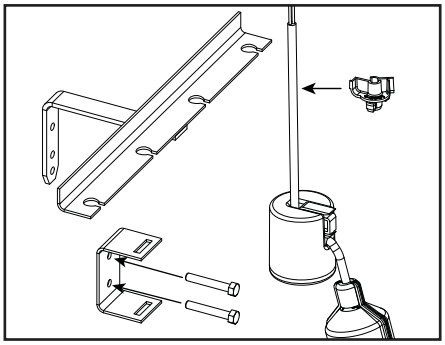
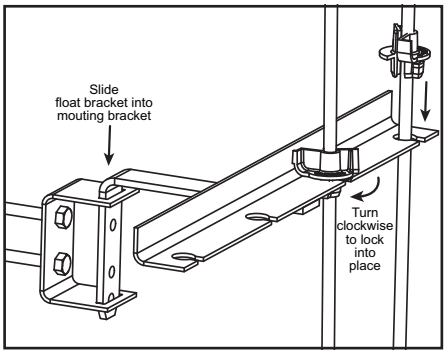


Figure F



Instl. Instr. PN 1041933A
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Section 3.7

Miscellaneous Equipment

Section 3.7.1

Air Compressor

CRAFTSMAN®

INSTRUCTION MANUAL | GUIDE D'UTILISATION | MANUAL DE INSTRUCTIONES

Air Compressor
Compresor de aire
Compresseur d'air

CMEC6150



IF YOU HAVE QUESTIONS OR COMMENTS, CONTACT US.
POUR TOUTE QUESTION OU TOUT COMMENTAIRE, NOUS CONTACTER.
SI TIENE DUDAS O COMENTARIOS, CONTÁCTENOS.

1-888-331-4569 **WWW.CRAFTSMAN.COM**

English ***(original instructions)*** 1

Français *(traduction de la notice d'instructions originale)* 11

Español *(traducido de las instrucciones originales)* 22

Definitions: Safety Alert Symbols and Words

This instruction manual uses the following safety alert symbols and words to alert you to hazardous situations and your risk of personal injury or property damage.

DANGER: *Indicates an imminently hazardous situation which, if not avoided,* ***will*** *result in* ***death or serious injury****.*

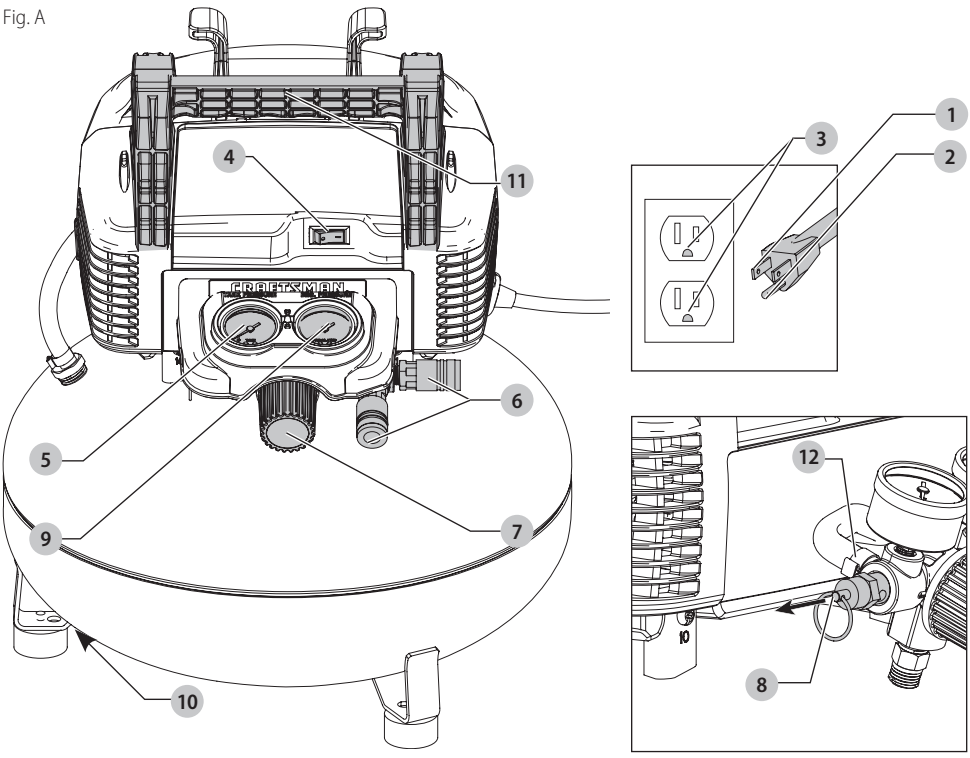
WARNING: *Indicates a potentially hazardous situation which, if not avoided,* ***could*** *result in* ***death or serious injury****.*

CAUTION: *Indicates a potentially hazardous situation which, if not avoided,* ***may*** *result in* ***minor or moderate injury****.*

(Used without word) Indicates a safety related message.

NOTICE: *Indicates a practice* ***not related to personal injury*** *which, if not avoided,* ***may*** *result in* ***property damage****.*

Fig. A



Components

1. Plug
2. Grounding pin
3. Grounded outlet
4. On/Off switch
5. Tank pressure gauge
6. Quick connects
7. Regulator knob
8. Safety valve
9. Outlet pressure gauge
10. Drain valve (not pictured)
11. Handle
12. Hose clamp

WARNING: Read all safety warnings and all instructions. *Failure to follow the warnings and instructions may result in electric shock, fire and/or serious injury.*

WARNING: *Never modify the product or any part of it. Damage or personal injury could result.*

WARNING: *To reduce the risk of injury, read the instruction manual.*

If you have any questions or comments about this or any product, call CRAFTSMAN toll free at: 1-888-331-4569.

Air Compressor
CMEC6150

IMPORTANT SAFETY INSTRUCTIONS

SAVE ALL WARNINGS AND INSTRUCTIONS FOR FUTURE REFERENCE

DANGER: RISK OF EXPLOSION OR FIRE

What can happen	How to prevent it
It is normal for electrical contacts within the motor and pressure switch to spark.	Always operate the compressor in a well ventilated area free of combustible materials, gasoline, or solvent vapors.
If electrical sparks from compressor come into contact with flammable vapors, they may ignite, causing fire or explosion.	If spraying flammable materials, locate compressor at least 20 feet (6.1 m) away from spray area. An additional length of hose may be required.
	Store flammable materials in a secure location away from compressor.
Restricting any of the compressor ventilation openings will cause serious overheating and could cause a fire.	Never place objects against or on top of compressor pump.
	Operate compressor in an open area at least 12" (30.5 cm) away from any wall or obstruction that would restrict the flow of fresh air to the ventilation openings.
	Operate compressor in a clean, dry well ventilated area. Do not operate unit indoors or in any confined area.
Unattended operation of this product could result in personal injury or property damage. To reduce the risk of fire, do not allow the compressor to operate unattended.	Always remain in attendance with the product when it is operating.
	Always turn off and unplug unit when not in use.

CAUTION: RISK FROM NOISE

What can happen	How to prevent it
Under some conditions and duration of use, noise from this product may contribute to hearing loss.	Always wear certified safety equipment: ANSI S12.6 (S3.19) hearing protection.

DANGER: RISK TO BREATHING (Asphyxiation)

What can happen	How to prevent it
The compressed air directly from your compressor is not safe for breathing. The air stream may contain carbon monoxide, toxic vapors, or solid particles from the air tank. Breathing these contaminants can cause serious injury or death.	Air obtained directly from the compressor should never be used to supply air for human consumption. In order to use air produced by this compressor for breathing, suitable filters and in-line safety equipment must be properly installed. In-line filters and safety equipment used in conjunction with the compressor must be capable of treating air to all applicable local and federal codes prior to human consumption.
Exposure to chemicals in dust created by power sanding, sawing, grinding, drilling, and other construction activities may be harmful.	Work in an area with good ventilation. Read and follow the safety instructions provided on the label or safety data sheets for the materials you are spraying. Always use certified safety equipment: OSHA/MSHA/NIOSH respiratory protection designed for use with your specific application.
Sprayed materials such as paint, paint solvents, paint remover, insecticides, weed killers, may contain harmful vapors and poisons.	

WARNING: RISK OF BURSTING

Air Tank: On February 26, 2002, the U.S. Consumer Product Safety Commission published Release # 02-108 concerning air compressor tank safety:

Air compressor receiver tanks do not have an infinite life. Tank life is dependent upon several factors, some of which include operating conditions, ambient conditions, proper installations, field modifications, and the level of maintenance. The exact effect of these factors on air receiver life is difficult to predict.

If proper maintenance procedures are not followed, internal corrosion to the inner wall of the air receiver tank can cause the air tank to unexpectedly rupture allowing pressurized air to suddenly and forcefully escape, posing risk of injury to consumers.

Your compressor air tank must be removed from service by the end of the year shown on your tank warning label.

The following conditions could lead to a weakening of the air tank, and result in a violent air tank explosion:

WARNING: *Some dust contains chemicals known to the State of California to cause cancer, birth defects or other reproductive harm such as asbestos and lead in lead based paint.*

What can happen	How to prevent it
Failure to properly drain condensed water from air tank, causing rust and thinning of the steel air tank.	Drain air tank daily or after each use. If air tank develops a leak, replace it immediately with a new air tank or replace the entire compressor.
Modifications or attempted repairs to the air tank.	Never drill into, weld, or make any modifications to the air tank or its attachments. Never attempt to repair a damaged or leaking air tank. Replace with a new air tank.
Unauthorized modifications to the safety valve or any other components which control air tank pressure.	The air tank is designed to withstand specific operating pressures. Never make adjustments or parts substitutions to alter the factory set operating pressures.
Attachments & Accessories:	
Exceeding the pressure rating of air tools, spray guns, air operated accessories, tires, and other inflatables can cause them to explode or fly apart, and could result in serious injury.	Follow the equipment manufacturers recommendation and never exceed the maximum allowable pressure rating of attachments. Never use compressor to inflate small low pressure objects such as children's toys, footballs, basketballs, etc.
Tires:	
Over inflation of tires could result in serious injury and property damage.	Use a tire pressure gauge to check the tires pressure before each use and while inflating tires; see the tire sidewall for the correct tire pressure. **NOTE:** Air tanks, compressors and similar equipment used to inflate tires can fill small tires similar to these very rapidly. Adjust pressure regulator on air supply to no more than the rating of the tire pressure. Add air in small increments and frequently use the tire gauge to prevent over inflation.

WARNING: RISK OF ELECTRICAL SHOCK

What can happen	How to prevent it
Your air compressor is powered by electricity. Like any other electrically powered device, If it is not used properly it may cause electric shock.	Never operate the compressor outdoors when it is raining or in wet conditions.
	Never operate compressor with protective covers removed or damaged.
Repairs attempted by unqualified personnel can result in serious injury or death by electrocution.	Any repairs required on this product should be performed by authorized service center personnel.
Electrical Grounding: Failure to provide adequate grounding to this product could result in serious injury or death from electrocution. See ***Grounding Instructions*** under **Installation**.	Make certain that the electrical circuit to which the compressor is connected provides proper electrical grounding, correct voltage and adequate fuse protection.

WARNING: RISK FROM FLYING OBJECTS

What can happen	How to prevent it
The compressed air stream can cause soft tissue damage to exposed skin and can propel dirt, chips, loose particles, and small objects at high speed, resulting in property damage or personal injury.	Always wear certified safety equipment: ANSI Z87.1 eye protection (CAN/CSA Z94.3) with side shields when using the compressor.
	Never point any nozzle or sprayer toward any part of the body or at other people or animals.
	Always turn the compressor off and bleed pressure from the air hose and air tank before attempting maintenance, attaching tools or accessories.

WARNING: RISK OF HOT SURFACES

What can happen	How to prevent it
Touching exposed metal such as the compressor head, engine head, engine exhaust or outlet tubes, can result in serious burns.	Never touch any exposed metal parts on compressor during or immediately after operation. Compressor will remain hot for several minutes after operation.
	Do not reach around protective shrouds or attempt maintenance until unit has been allowed to cool.

WARNING: RISK OF INJURY FROM LIFTING

What can happen	How to prevent it
Serious injury can result from attempting to lift too heavy an object.	The compressor is too heavy to be lifted by one person. Obtain assistance from others before lifting.

WARNING: RISK FROM MOVING PARTS

What can happen	How to prevent it
Moving parts such as the pulley, flywheel, and belt can cause serious injury if they come into contact with you or your clothing.	Never operate the compressor with guards or covers which are damaged or removed
	Keep your hair, clothing, and gloves away from moving parts. Loose clothes, jewelry, or long hair can be caught in moving parts.
	Air vents may cover moving parts and should be avoided as well.

Attempting to operate compressor with damaged or missing parts or attempting to repair compressor with protective shrouds removed can expose you to moving parts and can result in serious injury.	Any repairs required on this product should be performed by authorized service center personnel.

WARNING: RISK OF UNSAFE OPERATION

What can happen	How to prevent it
Unsafe operation of your air compressor could lead to serious injury or death to you or others.	Review and understand all instructions and warnings in this manual.
	Become familiar with the operation and controls of the air compressor.
	Keep operating area clear of all persons, pets, and obstacles.
	Keep children away from the air compressor at all times.
	Do not operate the product when fatigued or under the influence of alcohol or drugs. Stay alert at all times.
	Never defeat the safety features of this product.
	Equip area of operation with a fire extinguisher.
	Do not operate machine with missing, broken, or unauthorized parts.
	Never stand on the compressor.

WARNING: RISK OF FALLING

What can happen	How to prevent it
A portable compressor can fall from a table, workbench, or roof causing damage to the compressor and could result in serious injury or death to the operator.	Always operate compressor in a stable secure position to prevent accidental movement of the unit. Never operate compressor on a roof or other elevated position. Use additional air hose to reach high locations.

Specifications

Model	CMEC6150
Bore	1.875" (47.6 mm)
Stroke	1.250" (31.8 mm)
Voltage/Hz-Single Phase	120/60
Minimum Branch Circuit Requirement	15 amps
Fuse Type	Time Delay
Air Tank Capacity	6 Gallons (22.7 liters)
Approximate Cut-in Pressure	120 psig
Approximate Cut-out Pressure	150 psig
Model	CMEC6150
SCFM @ 40 psig	3.7 *
SCFM @ 90 psig	2.6 *
Regulated Pressure Rating (Approximate)	3–150 psi
Quick Connect Type	1/4" (6.4 mm) Industrial
Duty Cycle	5 minutes on/5 minutes off

*Tested per ISO 1217

Refer to ***Glossary*** for abbreviations.

Glossary

Become familiar with these terms before operating the unit.

CFM: Cubic feet per minute.

SCFM: Standard cubic feet per minute; a unit of measure of air delivery.

PSIG: Pounds per square inch gauge; a unit of measure of pressure.

Code Certification: Products that bear one or more of the following marks: UL®, CUL, CULUS, ETL®, CETL, CETLUS, have been evaluated by OSHA certified independent safety laboratories and meet the applicable Standards for Safety.

Cut-In Pressure: While the motor is off, air tank pressure drops as you continue to use your accessory. When the tank pressure drops to a certain lower level the motor will restart automatically. The low pressure at which the motor automatically restarts is called "cut-in" pressure.

Cut-Out Pressure: When an air compressor is turned on and begins to run, air pressure in the air tank begins to build. It builds to a certain high pressure before the motor automatically shuts off, protecting your air tank from pressure higher than its capacity. The high pressure at which the motor shuts off is called "cut-out" pressure.

Branch Circuit: Circuit carrying electricity from electrical panel to outlet.

Duty Cycle: For proper operation of your air compressor, it is recommended that a 50% duty cycle be maintained; that is, the air compressor should not run more than 5 minutes in any 10 minute period.

ASSEMBLY AND ADJUSTMENTS

WARNING: To reduce the risk of serious personal injury, turn unit off and disconnect it from power source before making any adjustments or removing/installing attachments or accessories. *An accidental start-up can cause injury.*

WARNING: Risk of unsafe operation. Unit cycles automatically when power is on. When performing maintenance, you may be exposed to voltage sources, compressed air, or moving parts. Personal injuries can occur. Before performing any maintenance or repair, disconnect power source from the compressor and bleed off all air pressure.

UNPACKING

Remove unit from carton and discard all packaging.

INSTALLATION

How To Set Up Your Unit

Location of the Air Compressor

- Locate the air compressor in a clean, dry and well ventilated area.
- The air compressor should be located at least 12" (30.5 cm) away from the wall or other obstructions that will interfere with the flow of air.
- The air compressor pump and shroud are designed to allow for proper cooling. The ventilation openings on the compressor are necessary to maintain proper operating temperature. Do not place rags or other containers on or near these openings.

Grounding Instructions (Fig. A)

WARNING: Risk of Electrical Shock. In the event of a short circuit, grounding reduces the risk of shock by providing an escape wire for the electric current. This air compressor must be properly grounded.

The portable air compressor is equipped with a cord having a grounding wire with an appropriate grounding plug ❶.

1. The cord set and plug ❶ with this unit contains a grounding pin ❷. This plug MUST be used with a grounded outlet ❸.
   IMPORTANT: The outlet being used must be installed and grounded in accordance with all local codes and ordinances.
2. Make sure the outlet being used has the same configuration as the grounded plug. DO NOT USE AN ADAPTER. Refer to Fig. A.
3. Inspect the plug and cord before each use. Do not use if there are signs of damage.
4. If these grounding instructions are not completely understood, or if in doubt as to whether the compressor is properly grounded, have the installation checked by a qualified electrician.

DANGER: Risk of Electrical Shock. IMPROPER GROUNDING CAN RESULT IN ELECTRICAL SHOCK.

- ***Do not modify the plug provided. If it does not fit the available outlet, a correct outlet should be installed by a qualified electrician.***
- ***Repairs to the cord set or plug MUST be made by a qualified electrician.***

Extension Cords

If an extension cord must be used, be sure it is:

- a 3-wire extension cord that has a 3-blade grounding plug, and a 3-slot receptacle that will accept the plug on the product
- in good condition
- no longer than 50' (15.2 m)
- 12 gauge (AWG) or larger. (Wire size increases as gauge number decreases. 10 AWG and 8 AWG may also be used. DO NOT USE 14 OR 16 AWG.)

NOTICE: *Risk of Property Damage. The use of an undersized extension cord will cause voltage to drop resulting in power loss to the motor and overheating. Instead of using an extension cord, increase the working reach of the air hose by attaching another length of hose to its end. Attach additional lengths of hose as needed.*

Voltage and Circuit Protection

Refer to ***Specifications*** for the voltage and minimum branch circuit requirements.

WARNING: *Risk of Overheating. Certain air compressors can be operated on a 15 amp circuit if the following conditions are met.*

- *Voltage supply to circuit must comply with the National Electrical Code.*
- *Circuit is not used to supply any other electrical needs.*
- *Extension cords comply with specifications.*
- *Circuit is equipped with a 15 amp circuit breaker or 15 amp time delay fuse.*
  NOTE: *If compressor is connected to a circuit protected by fuses, use only time delay fuses. Time delay fuses should be marked "D" in Canada and "T" in the US.*

If any of the above conditions cannot be met, or if operation of the compressor repeatedly causes interruption of the power, it may be necessary to operate it from a 20 amp circuit. It is not necessary to change the cord set.

OPERATION

WARNING: To reduce the risk of serious personal injury, turn unit off and disconnect it from power source before making any adjustments or removing/installing attachments or accessories. *An accidental start-up can cause injury.*

WARNING: Risk of unsafe operation. Unit cycles automatically when power is on. When performing maintenance, you may be exposed to voltage sources, compressed air, or moving parts. Personal injuries can occur. Before performing any maintenance or repair, disconnect power source from the compressor and bleed off all air pressure.

Know Your Air Compressor

READ THIS OWNER'S MANUAL AND SAFETY RULES BEFORE OPERATING YOUR UNIT. Compare the illustrations with your unit to familiarize yourself with the location of various controls and adjustments. Save this manual for future reference.

Description of Operation (Fig. A)

Become familiar with these controls before operating the unit.

On(I)/Off(O) Switch: Place this switch 4 in the On(I) position to provide automatic power to the pressure switch and Off(O) to remove power at the end of each use.

Pressure Switch (not shown): The pressure switch automatically starts the motor when the air tank pressure drops below the factory set "cut-in" pressure. It stops the motor when the air tank pressure reaches the factory set "cut-out" pressure.

Safety Valve: If the pressure switch does not shut off the air compressor at its "cut-out" pressure setting, the safety valve 8 will protect against high pressure by "popping out" at its factory set pressure (slightly higher than the pressure switch "cut-out" setting).

Tank Pressure Gauge: The tank pressure gauge 5 indicates the reserve air pressure in the tank.

Outlet Pressure Gauge: The outlet pressure gauge 9 indicates the air pressure available at the outlet side of the regulator. This pressure is controlled by the regulator and is always less than or equal to the tank pressure.

Regulator: Controls the air pressure shown on the outlet pressure gauge. Turn regulator knob 7 clockwise to increase pressure and counterclockwise to decrease pressure.

Cooling System (not shown): This compressor contains an advanced design cooling system. At the heart of this cooling system is an engineered fan. It is perfectly normal for this fan to blow air through the vent holes in large amounts. You know that the cooling system is working when air is being expelled.

Air Compressor Pump (not shown): Compresses air into the air tank. Working air is not available until the compressor has raised the air tank pressure above that required at the air outlet.

Drain Valve: The drain valve 10 is located at the base of the air tank and is used to drain condensation at the end of each use.

Check Valve (not shown): When the air compressor is operating, the check valve is "open", allowing compressed air to enter the air tank. When the air compressor reaches "cut-out" pressure, the check valve "closes", allowing air pressure to remain inside the air tank.

Motor Overload Protector (not shown): The motor has a thermal overload protector. If the motor overheats for any reason, the overload protector will shut off the motor. The motor must be allowed to cool down before restarting. To restart:

1. Set the On/Off switch to "Off" and unplug unit.
2. Allow the motor to cool.
3. Plug the power cord into the correct branch circuit receptacle.
4. Set the On/Off switch to "On" position.

Quick Connects : The quick connects 6 accepts industrial quick connect plugs. The two quick connect bodies allow the use of two tools at the same time.

How to Use Your Unit (Fig. A, B)

How to Stop

1. Set the On/Off switch 4 to "Off".
2. Unplug unit when not in use.

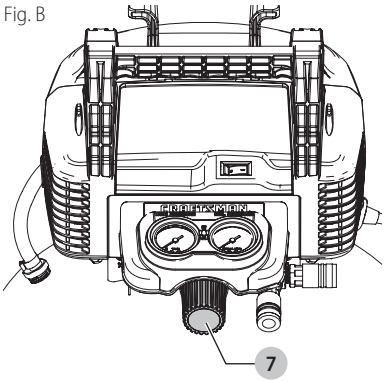
Before Starting

WARNING: Do not operate this unit until you read this instruction manual for safety, operation and maintenance instructions.

Before Each Start-Up

1. Set the On/Off switch 4 to "Off".
2. Plug the power cord into the correct branch circuit receptacle. (Refer to ***Voltage and Circuit Protection*** paragraph in the **Installation** section of this manual.)
3. Turn regulator knob 7 counterclockwise until fully closed. Ensure regulated pressure gauge reads 0 PSI (0 kPa).

Fig. B



4. Attach hose and accessories.
5. Ensure all covers and labels are in place, legible (for labels) and securely mounted. Do not use compressor until all items have been verified.

WARNING: Risk of unsafe operation. Firmly grasp air hose in hand when installing or disconnecting to prevent hose whip.

WARNING: Risk of unsafe operation. Do not use damaged or worn accessories.

NOTE: This unit is equipped with quick connects 6. The hose or accessory being connected will require a quick connect plug.

WARNING: Risk of Bursting. Too much air pressure causes a hazardous risk of bursting. Check the manufacturer's maximum pressure rating for air tools and accessories. The regulator outlet pressure must never exceed the maximum pressure rating.

NOTICE: *Risk of property damage. Compressed air from the unit may contain water condensation and oil mist. Do not spray unfiltered air at an item that could be damaged by moisture. Some air tools and accessories may require filtered air. Read the instructions for the air tools and accessories.*

How to Start

1. Set the On/Off switch 4 to "On" and allow tank pressure to build. Motor will stop when tank pressure reaches "cut-out" pressure.
2. Turn regulator knob 7 clockwise to increase pressure and stop when desired pressure is reached.

WARNING: Risk of unsafe operation. If any unusual noise or vibration is noticed, stop the compressor immediately and have it checked by a trained service technician.

The compressor is ready for use.

MAINTENANCE

WARNING: To reduce the risk of serious personal injury, turn unit off and disconnect it from power source before making any adjustments or removing/installing attachments or accessories. *An accidental start-up can cause injury.*

WARNING: Risk of unsafe operation. Unit cycles automatically when power is on. When performing maintenance, you may be exposed to voltage sources, compressed air, or moving parts. Personal injuries can occur. Before performing any maintenance or repair, disconnect power source from the compressor and bleed off all air pressure.

Customer Responsibilities

	Before each use	Daily or after each use	See tank warning label
Check Safety Valve	X		
Drain Tank		X	
Remove tank from service			X[1]

1- For more information, call our Customer Care Center at 1–888–331–4569

NOTE: See **Operation** section for the location of controls.

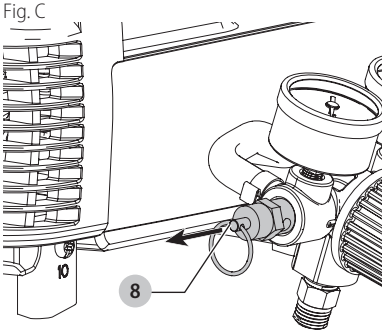
To Check Safety Valve (Fig. C)

WARNING: Risk of Bursting. If the safety valve does not work properly, over-pressurization may occur, causing air tank rupture or an explosion.

WARNING: Risk from Flying Objects. Always wear certified safety equipment: ANSI Z87.1 eye protection (CAN/CSA Z94.3) with side shields.

Before starting compressor, pull the ring on the safety valve 8 to make sure that the safety valve operates freely. If the valve is stuck or does not operate smoothly, it must be replaced with the same type of valve.

Fig. C



To Drain Tank (Fig. A, D)

WARNING: Risk of Unsafe Operation. Air tanks contain high pressure air. Keep face and other body parts away from outlet of drain. Use ANSI Z87.1 eye protection (CAN/CSA Z94.3) when draining as debris can be kicked up into face.

WARNING: Risk from noise. Always wear proper hearing protection during use. Under some conditions and duration of use, noise from this product may contribute to hearing loss.

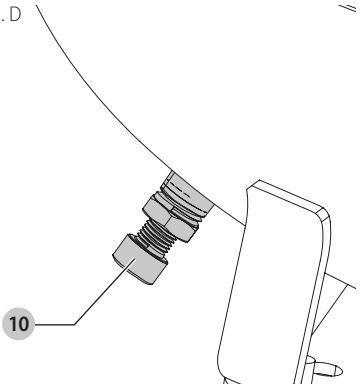
NOTE: All compressed air systems generate condensate that accumulates in any drain point (e.g., tanks, filter, aftercoolers, dryers). This condensate contains lubricating oil and/or substances which may be regulated and must be disposed of in accordance with local, state, and federal laws and regulations.

WARNING: Risk of Bursting. Water will condense in the air tank. If not drained, water will corrode and weaken the air tank causing a risk of air tank rupture.

NOTICE: *Risk of Property Damage. Drain water from air tank may contain oil and rust which can cause stains.*

1. Set the On/Off switch 4 to "Off".
2. Turn the regulator knob 7 counterclockwise to set the outlet pressure to zero.
3. Remove the air tool or accessory.
4. Place a suitable container under the drain valve to catch discharge.
5. Pull ring on safety valve 8 allowing air to bleed from the tank until tank pressure is approximately 20 psi. Release safety valve ring.
6. Drain water from air tank by opening drain valve 10 on bottom of tank.

Fig. D



7. After the water has been drained, close the drain valve. The air compressor can now be stored.

NOTE: If drain valve is plugged, release all air pressure. The valve can then be removed, cleaned, the reinstalled.

Cleaning

WARNING: *Blow dirt and dust out of all air vents with clean, dry air at least once a week. To minimize the risk of eye injury, always wear ANSI Z87.1 approved eye protection when performing this.*

WARNING: *Never use solvents or other harsh chemicals for cleaning the non-metallic parts of the tool. These chemicals may weaken the plastic materials used in these parts. Use a cloth dampened only with water and mild soap. Never let any liquid get inside the tool; never immerse any part of the tool into a liquid.*

Repairs

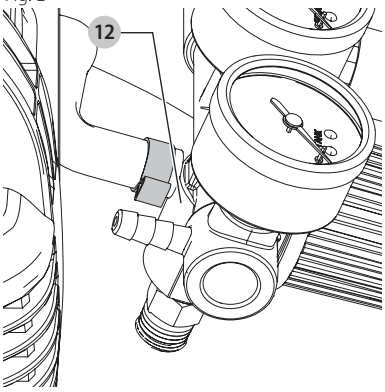
WARNING: *To assure product SAFETY and RELIABILITY, repairs, maintenance and adjustment (including brush inspection and replacement, when applicable) should be performed by a CRAFTSMAN factory service center or a CRAFTSMAN authorized service center. Always use identical replacement parts.*

WARNING: *Risk of Unsafe Operation. Unit cycles automatically when power is on. When servicing, you may be exposed to voltage sources, compressed air, or moving parts. Before servicing unit unplug or disconnect electrical supply to the air compressor, bleed tank of pressure, and allow the air compressor to cool.*

To Replace Regulator (Fig. A, E)

1. Release all air pressure from air tank. See ***To Drain Tank*** in the **Maintenance** section.
2. Unplug unit.
3. Remove the console cover.
4. Using an adjustable wrench remove the safety valve **8** from the regulator manifold **7**.
5. Remove the hose by removing the hose clamp **12**. **NOTE:** The hose clamp is not reusable. You must purchase a new hose clamp.

Fig. E



6. Remove three pump mounting screws securing pump.
7. Carefully lift pump up away from brackets and out of the way.
8. Using an adjustable wrench remove the regulator knob **7**.
9. Apply pipe sealant to new regulator manifold and assemble, tighten with wrench.
10. Reapply pipe sealant to safety valve.
11. Reassemble all components in reverse order of removal. Make sure to orient gauges to read correctly and use wrenches to tighten all components.

Storage

Before you store the air compressor, make sure you do the following:

1. Review the **Maintenance** section on the preceding pages and perform scheduled maintenance as necessary.
2. Drain water from air tank. See ***To Drain Tank*** under **Maintenance**.

WARNING: Risk of Bursting. Water will condense in the air tank. If not drained, water will corrode and weaken the air tank causing a risk of air tank rupture.

3. Protect the electrical cord and air hose from damage (such as being stepped on or run over). Wind air hose loosely around the compressor handle. Wrap electrical cord onto the cord wrap.
4. Store the air compressor in a clean and dry location.

Accessories

WARNING: *Since accessories, other than those offered by CRAFTSMAN, have not been tested with this product, use of such accessories with this tool could be hazardous. To reduce the risk of injury, only CRAFTSMAN recommended accessories should be used with this product.*

Recommended accessories for use with your tool are available at extra cost from your local dealer or authorized service center. If you need assistance in locating any accessory, please contact CRAFTSMAN, call **1-888-331-4569**.

Register Online

Thank you for your purchase. Register your product now for:

- **WARRANTY SERVICE:** Registering your product will help you obtain more efficient warranty service in case there is a problem with your product.
- **CONFIRMATION OF OWNERSHIP:** In case of an insurance loss, such as fire, flood or theft, your registration of ownership will serve as your proof of purchase.
- **FOR YOUR SAFETY:** Registering your product will allow us to contact you in the unlikely event a safety notification is required under the Federal Consumer Safety Act.

Register online at **www.craftsman.com/registration**

One Year Limited Warranty

CRAFTSMAN will repair or replace, without charge, any defects due to faulty materials or workmanship for one year from the date of purchase. This warranty does not cover part failure due to normal wear or tool abuse. For further detail of warranty coverage and warranty repair information, visit **www.craftsman.com** or call **1-888-331-4569**. This warranty does not apply to accessories or damage caused where repairs have been made or attempted by others. THIS LIMITED WARRANTY IS GIVEN IN LIEU OF ALL OTHERS, INCLUDING THE IMPLIED WARRANTY OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE, AND EXCLUDES ALL INCIDENTAL OR CONSEQUENTIAL DAMAGES. Some states do not allow limitations on how long an implied warranty lasts or the exclusion or limitation of incidental or consequential damages, so these limitations may not apply to you. This warranty gives you specific legal rights and you may have other rights which vary in certain states or provinces.

90 DAY MONEY BACK GUARANTEE

If you are not completely satisfied with the performance of your CRAFTSMAN Power Tool or Nailer for any reason, you can return it within 90 days from the date of purchase with a receipt for a full refund – no questions asked.

LATIN AMERICA: This warranty does not apply to products sold in Latin America. For products sold in Latin America, see country specific warranty information contained either in the packaging, call the local company or see website for warranty information.

TROUBLESHOOTING

WARNING: Risk of Unsafe Operation. Unit cycles automatically when power is on. When servicing, you may be exposed to voltage sources, compressed air, or moving parts. Before servicing unit unplug or disconnect electrical supply to the air compressor, bleed tank of pressure, and allow the air compressor to cool.

PROBLEM	CAUSE	CORRECTION
Excessive tank pressure - safety valve pops off.	Pressure switch does not shut off motor when compressor reaches "cut-out" pressure.	Move On/Off lever to the "Off" position, if the outfit does not shut off contact a Trained Service Technician.
	Pressure switch "cut-out" too high.	Contact a Trained Service Technician.
Air leaks at fittings.	Tube fittings are not tight enough.	Tighten fittings where air can be heard escaping. Check fittings with soapy water solution. **Do Not Overtighten.**
Air leaks in air tank or at air tank welds.	Defective air tank.	Air tank must be replaced. Do not repair the leak. ***WARNING: Risk bursting. Do not drill into, weld or otherwise modify air tank or it will weaken. The tank can rupture or explode.***
Air leaks between head and valve plate.	Leaking seal.	Contact a Trained Service Technician.
Air leak from safety valve.	Possible defect in safety valve.	Operate safety valve manually by pulling on ring. If valve still leaks, it should be replaced.
Knocking Noise.	Possible defect in safety valve.	Operate safety valve manually by pulling on ring. If valve still leaks, it should be replaced.
Pressure reading on the regulated pressure gauge drops when an accessory is used.	It is normal for "some" pressure drop to occur.	If there is an excessive amount of pressure drop when the accessory is used, adjust the regulator following the instructions in the ***Description of Operation*** paragraph in the **Operation** Section. **NOTE:** Adjust the regulated pressure under flow conditions (while accessory is being used).
Compressor is not supplying enough air to operate accessories.	Prolonged excessive use of air.	Decrease amount of air usage.
	Compressor is not large enough for air requirement.	Check the accessory air requirement. If it is higher than the SCFM or pressure supplied by your air compressor, you need a larger compressor.
	Hole in hose.	Check and replace if required.
	Check valve restricted.	Have checked by a Trained Service Technician.
	Air leaks.	Tighten fittings.
Regulator knob has continuous air leak.	Damaged regulator.	Replace.
Regulator will not shut off air outlet.	Damaged regulator.	Replace.
Motor will not run.	Fuse blown, circuit breaker tripped.	Check fuse box for blown fuse and replace as necessary. Reset circuit breaker. Do not use a fuse or circuit breaker with higher rating than that specified for your particular branch circuit.
		Check for proper fuse. You should use a time delay fuse.
		Check for low voltage problem.
		Check the extension cord.
		Disconnect the other electrical appliances from circuit or operate the compressor on its own branch circuit.
	Extension cord is wrong length or gauge.	Check the extension cord.
	Loose electrical connections.	Check wiring connection inside terminal box.
	Faulty motor.	Have checked by a Trained Service Technician.
	Motor overload protection switch has tripped.	Refer to ***Motor Overload Protector*** under **Description of Operation**. If motor overload protection trips frequently, contact a Trained Service Technician.

Définitions : symboles et termes d'alarmes sécurité

Ces guides d'utilisation utilisent les symboles et termes d'alarmes sécurité suivants pour vous prévenir de situations dangereuses et de risques de dommages corporels
ou matériels.

DANGER : *indique une situation dangereuse imminente qui, si elle n'est pas évitée,* ***entraînera*** *la* ***mort ou des blessures graves****.*

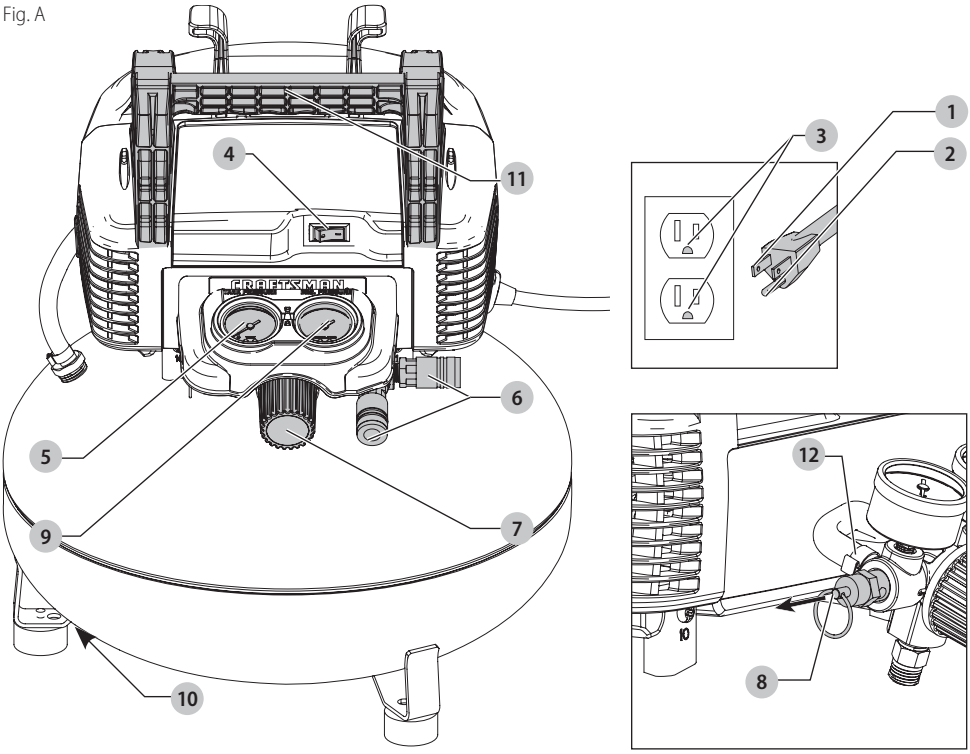
AVERTISSEMENT : *indique une situation potentiellement dangereuse qui, si elle n'est pas évitée,* ***pourrait*** *entraîner la* ***mort ou des blessures graves****.*

ATTENTION : *indique une situation potentiellement dangereuse qui, si elle n'est pas évitée,* ***pourrait*** *entraîner des* ***blessures légères ou modérées****.*

(Si utilisé sans aucun terme) Indique un message propre à la sécurité.

AVIS : *indique une pratique ne posant* ***aucun risque de dommages corporels*** *mais qui par contre, si rien n'est fait pour l'éviter,* ***pourrait*** *poser des* ***risques de dommages matériels****.*

Fig. A



Components

1. Fiche appropriée de mise à la terre
2. Broche de mise à la terre
3. Prise de courant mise à la terre
4. L'interrupteur On/Off
5. Manomètre du réservoir
6. Raccords rapides
7. Régulateur
8. Soupape de sûreté
9. Manomètre de sortie
10. Robinet de vidange
11. Poignée
12. Collier du Boyau

AVERTISSEMENT : lire tous les avertissements de sécurité et toutes les directives. *Le non-respect des avertissements et des directives pourrait se solder par un choc électrique, un incendie et/ou une blessure grave.*

AVERTISSEMENT : *ne jamais modifier l'outil électrique ni aucun de ses composants, car il y a risques de dommages corporels ou matériels.*

AVERTISSEMENT : *afin de réduire le risque de blessures, lire le mode d'emploi de l'outil.*

Pour toute question ou remarque au sujet de cet outil ou de tout autre outil CRAFTSMAN composez le numéro sans frais : 1-888-331-4569.

Compresor de aire
CMEC6150

CONSIGNES DE SÉCURITÉ IMPORTANTES

CONSERVER TOUS LES AVERTISSEMENTS ET TOUTES LES DIRECTIVES POUR UN USAGE ULTÉRIEUR

DANGER : RISQUE D'EXPLOSION OU D'INCENDIE

Ce qui peut se produire	Comment l'Éviter
Il est normal que des contacts électriques dans le moteur et le manocontacteur fassent une étincelle.	Faites toujours fonctionner le compresseur dans une zone bien aérée sans matière combustible, essence ou vapeur de solvant.
Si une étincelle électrique provenant du compresseur entre en contact avec des vapeurs inflammables, elle peut s'enflammer et causer un incendie ou une explosion.	Si vous aspergez des matériaux inflammables, placez le compresseur à au moins 6,1 m (20 pieds) de la zone pulvérisée. Il est possible que vous ayez besoin d'une longueur de tuyau additionnelle.
	Entreposez les matières inflammables dans un endroit sécuritaire, éloigné du compresseur.
Restreindre toute prise d'air de ventilation entraînera une grave surchauffe et pourrait causer un incendie.	Ne jamais placer d'objets contre la pompe du compresseur ou sur celle-ci.
	Faites fonctionner le compresseur dans un endroit aéré à au moins 30,5 cm (12 po) du mur ou de l'obstruction qui pourrait limiter le débit d'air frais dans les ouvertures d'aération.
	Faites fonctionner le compresseur dans un endroit propre, sec et bien aéré. Ne pas utiliser l'appareil à l'intérieur ou dans un endroit exigu.
Le fonctionnement de ce produit sans surveillance pourrait se solder par des blessures personnelles ou des dommages à la propriété. Afin de réduire le risque d'incendie, ne pas laisser le compresseur fonctionner sans surveillance.	Être toujours présent lorsque le produit est en marche.
	Toujours éteindre et débrancher l'appareil si non utilisé.

ATTENTION : RISQUE ASSOCIÉ AU BRUIT

Ce qui peut se produire	Comment l'Éviter
Dans certaines conditions et selon la durée d'utilisation, le bruit provoqué par ce produit peut contribuer à une perte auditive.	Toujours utiliser un équipement de sécurité homologué : protection auditive conforme à la norme ANSI S12.6 (S3.19).

DANGER: RISK TO BREATHING
(Asphyxie)

Ce qui peut se produire	Comment l'Éviter
Il est dangereux de respirer l'air comprimé sortant du compresseur. Le flux d'air peut contenir du monoxyde de carbone, des vapeurs toxiques ou des particules solides provenant du réservoir d'air. L'inhalation de ces contaminants peut provoquer de sérieuses blessures, voire un décès.	L'air qui s'obtient directement du compresseur ne devrait jamais être utilisé pour alimenter l'air destiné à la consommation humaine. Pour utiliser l'air produit par le compresseur pour la respiration, installer correctement des filtres convenables et un équipement de sécurité en ligne. Les filtres en ligne et l'équipement de sécurité utilisés avec le compresseur doivent être capables de traiter l'air conformément à tous les codes locaux et fédéraux en vigueur avant toute consommation humaine.
Une exposition aux produits chimiques présents dans la poussière générée par les activités de ponçage, sciage, meulage, perçage et autres, peut être nocive.	Travaillez dans un endroit ayant une bonne ventilation. Lisez et suivez toutes les instructions de sécurité fournies sur l'étiquette ou les fiches signalétiques des matières que vous vaporisez. Utilisez toujours un équipement de sécurité certifié : Protection respiratoire OSHA/ MSHA/NIOSH conçue pour votre application particulière
Les matériaux vaporisés comme la peinture, les solvants de peinture, les décapants, les insecticides, les herbicides, pourraient contenir des vapeurs nocives et du poison.	

AVERTISSEMENT : RISQUE D'ÉCLATEMENT



Réservoir d'air comprimé : Le 26 février 2002, la U.S. Consumer Product Safety Commission américaine a publié la règle nº 02-108 portant sur la sécurité en matière de réservoir d'air comprimé des compresseurs :

Les réservoirs d'air comprimé des compresseurs n'ont pas une durée de vie illimitée. La durée de vie des réservoirs dépend de plusieurs facteurs, qui comprennent entre autres: les conditions d'utilisation, les conditions ambiantes, une installation adéquate, les modifications sur site, et le niveau de maintenance. L'effet exact que peut avoir ces facteurs sur la durée de vie des réservoirs d'air est difficilement prévisible.

Si les procédures adéquates de maintenance ne sont pas suivies, la corrosion sur la paroi interne du réservoir d'air comprimé peut faire que celui-ci éclate de façon inopinée laissant soudainement l'air pressurisé s'échapper avec force, posant ainsi des risques de dommages corporels à l'utilisateur.

Le réservoir d'air de votre compresseur doit être mis hors service à la fin de l'année mentionnée sur l'étiquette d'avertissement apposée sur le réservoir.

Les conditions suivantes peuvent amener la dégradation du réservoir d'air, et faire que ce dernier explose violemment :

AVERTISSEMENT : *certaines poussières comme l'amiante ou le plomb dans la peinture à base de plomb contiennent des produits chimiques reconnus dans l'État de la Californie pour causer le cancer et des anomalies congénitales ou autres effets nuisibles sur la reproduction.*

Ce qui peut se produire	Comment l'Éviter
L'eau condensée n'est pas correctement vidangée du réservoir d'air provoquant ainsi la formation de rouille et un amincissement du réservoir d'air en acier.	Vidanger le réservoir d'air quotidiennement ou après chaque utilisation. Si le réservoir présente une fuite, le remplacer immédiatement par un nouveau réservoir d'air ou par un nouveau compresseur.
Modifications apportées au réservoir d'air ou tentatives de réparation.	Ne jamais percer un trou dans le réservoir d'air ou ses accessoires, y faire de la soudure ou y apporter quelque modification que ce soit. Ne jamais essayer de réparer un réservoir d'air endommagé ou avec des fuites. Le remplacer par un nouveau réservoir d'air.
Des modifications non autorisées de la soupape de sûreté ou de tous autres composants qui régissent la pression du réservoir d'air.	Le réservoir d'air a été conçu pour supporter des pressions spécifiques de fonctionnement. Ne faites jamais effectuer de réglages ou de substitutions de pièces en vue de modifier les pressions de fonctionnement réglées en usine.
Assemblage et Ajustements::	
Lorsqu'on excède la pression nominale des outils pneumatiques, des pistolets pulvérisateurs, des accessoires à commande pneumatique, des pneus et d'autres dispositifs pneumatiques, on risque de les faire exploser ou de les projeter et ainsi entraîner des blessures graves.	Respecter les recommandations du fabricant de l'équipement et ne jamais dépasser la pression nominale maximale permise des accessoires. Ne jamais utiliser le compresseur pour gonfler de petits objets à basse pression comme des jouets d'enfant, des ballons de football et de basket-ball, etc.
Pneus :	
Des pneus surgonflés pourraient provoquer des blessures graves et des dommages à la propriété.	Utiliser un manomètre pour vérifier la pression des pneus avant chaque utilisation et lors du gonflage; consulter le flanc de pneu pour obtenir la pression correcte. **REMARQUE :** Des réservoirs d'air, des compresseurs et d'autres appareils similaires utilisés pour gonfler les pneus peuvent remplir de petits pneus à ces pressions très rapidement. Régler le régulateur de pression d'air à une pression moindre que celle indiquée sur le pneu. Ajouter de l'air par petite quantité et utiliser fréquemment le manomètre pour empêcher un surgonflage.

AVERTISSEMENT : RISQUE DE CHOC ÉLECTRIQUE

Ce qui peut se produire	Comment l'Éviter
Votre compresseur d'air est alimenté à l'électricité. Tout comme n'importe quel autre dispositif alimenté de façon électrique, s'il n'est pas utilisé correctement, il peut causer un choc électrique.	Ne faites jamais fonctionner le compresseur à l'extérieur lorsqu'il pleut ou dans des conditions humides.
	Ne faites jamais fonctionner le compresseur avec les couvercles de protection enlevés ou endommagés.
Les tentatives de réparation par un personnel non qualifié peuvent résulter en de graves blessures, voire la mort par électrocution.	Tout câblage électrique ou toute réparation nécessaire pour ce produit doit être pris en charge par un un centre de réparation conformément aux codes électriques nationaux et locaux.
Mise à la terre électrique : le fait de ne pas faire une mise à la terre adéquate de ce produit pourrait résulter en des blessures graves voire la mort par électrocution. Consulter les ***Directives relatives à la mise à la terre*** sous **Installation.**	Assurez-vous que le circuit électrique auquel le compresseur est branché fournit une mise à la terre électrique adéquate, une tension appropriée et une bonne protection des fusibles.

AVERTISSEMENT : RISQUE PROVENANT DES OBJETS PROJETÉS EN L'AIR



Ce qui peut se produire	Comment l'Éviter
Le flux d'air comprimé peut endommager les tissus mous de la peau exposée et peut projeter la poussière, des fragments, des particules détachées et des petits objets à haute vitesse, ce qui entraînerait des dommages et des blessures personnelles.	Toujours utiliser de l'équipement de sécurité homologué : protection oculaire conforme à la norme ANSI Z87.1 (CAN/CSA Z94.3) munie d'écrans latéraux lors de l'utilisation du compresseur.
	Ne jamais pointer une buse ou un pulvérisateur vers une partie du corps ou vers d'autres personnes ou des animaux.
	Toujours mettre le compresseur hors tension et purger la pression du tuyau à air et du réservoir d'air avant d'effectuer l'entretien, de fixer des outils ou des accessoires.

AVERTISSEMENT : ATTENTION SURFACES CHAUDES



Ce qui peut se produire	Comment l'Éviter
Toucher à du métal exposé comme la tête du compresseur ou du moteur, la tubulure des gaz d'échappement ou de sortie, peut se solder en de sérieuses brûlures.	Ne jamais toucher à des pièces métalliques exposées sur le compresseur pendant ou immédiatement après son utilisation. Le compresseur reste chaud pendant plusieurs minutes après son utilisation.
	Ne pas toucher ni effectuer des réparations aux coiffes de protection avant que l'appareil n'ait refroidi

AVERTISSEMENT : RISQUE DE BLESSURE EN SOULEVANT LE PRODUI



Ce qui peut se produire	Comment l'Éviter
Soulever un objet trop lourd peut se solder par de graves blessures.	Le compresseur est trop lourd pour être soulevé par une seule personne. Demander de l'aide avant de le soulever.

AVERTISSEMENT : RISQUE ASSOCIÉ AUX PIÈCES MOBILES



Ce qui peut se produire	Comment l'Éviter
Les pièces mobiles comme une poulie, un volant ou une courroie peuvent provoquer de graves blessures si elles entrent en contact avec vous ou vos vêtements.	Ne jamais utiliser le compresseur si les protecteurs ou les couvercles sont endommagés ou retirés.
	Tenir les cheveux, les vêtements et les gants hors de portée des pièces en mouvement. Les vêtements amples, bijoux ou cheveux longs peuvent s'enchevêtrer dans les pièces mobiles.
	S'éloigner des évents car ces derniers pourraient camoufler des pièces mobiles.
Utiliser le compresseur avec des pièces endommagées ou manquantes ou le réparer sans coiffes de protection risque de vous exposer à des pièces mobiles et peut se solder par de graves blessures.	Toutes les réparations requises pour ce produit devraient être effectuées par un centre de réparation autorisé.

AVERTISSEMENT : RISQUE ASSOCIÉ À UTILISATION DANGEREUSE



Ce qui peut se produire	Comment l'Éviter
Une utilisation dangereuse de votre compresseur d'air pourrait provoquer de graves blessures, voire votre décès ou celle d'autres personnes.	Revoir et comprendre toutes les directives et les avertissements contenus dans le présent mode d'emploi.
	Se familiariser avec le fonctionnement et les commandes du compresseur d'air.
	Dégager la zone de travail de toutes personnes, animaux et obstacles.
	Tenir les enfants hors de portée du compresseur d'air en tout temps.
	Ne pas utiliser le produit en cas de fatigue ou sous l'emprise d'alcool ou de drogues. Rester vigilant en tout temps.
	Ne jamais rendre inopérant les fonctionnalités de sécurité du produit.
	Installer un extincteur dans la zone de travail.
	Ne pas utiliser l'appareil lorsqu'il manque des pièces ou que des pièces sont brisées ou non autorisées.
	Ne jamais se tenir debout sur le compresseur.

AVERTISSEMENT : RISQUE DE CHUTE



Ce qui peut se produire	Comment l'Éviter
Un compresseur portatif peut tomber d'une table, d'un établi ou d'un toit et causer des dommages au compresseur, ce qui pourrait résulter en de graves blessures, voire la mort de l'opérateur.	Toujours faire fonctionner le compresseur alors qu'il est dans uns position sécuritaire et stable afin d'empêcher un mouvement accidentel de l'appareil. Ne jamais faire fonctionner le compresseur sur un toit ou sur toute autre position élevée. Utiliser un tuyau d'air supplémentaire pour atteindre les emplacements en hauteur.

Spécifications

Model	CMEC6150
Modèle no	47,6 mm (1,875 po.)
Alésage	31,8 mm (1,250 po.)
Tension monophasée	120/60
Exigence minimale du circuit de dérivation	15 amps
Genre de fusibles	Time Delay
Capacité du réservoir d'air	22,7 liters (6 Gallons)
Pression l'amorçage approx	120 psig
Pression de rupture approx.	150 psig
pi^3/min standard (SCFM) à 40 lb/po^2	3,7 *
pi^3/min standard (SCFM) à 90 lb/po^2	2,6 *
Pression nominale stabilisée (approximative)	3–150 psi
Type de raccord à connexion rapide	6,4 mm (1/4 po.) Industrial
Cycle de service	5 minutes en marche / 5 minutes hors fonction

**Testé conformément à la norme ISO 1217

Refiérase al ***Lexique*** para descifrar las abreviaturas.

Lexique

Veuillez vous familiariser avec ces termes avant d'utiliser l'appareil.

CFM : pieds cubes par minute (pi^3/min).

SCFM : pieds cubes par minute (pi^3/min) standard. Une unité de mesure de débit d'air.

PSIG : jauge indiquant le nombre de livres par pouce carré (lb/po^2). Une unité de mesure de pression.

Codes de certification : les produits portant une ou plusieurs des mentions suivantes (UL®, CUL, CULUS, ETL®, CETL, CETLUS) ont été évalués par des laboratoires indépendants de sécurité certifiés par l'OSHA et répondent aux normes de sécurité applicables.

Pression d'amorçage : lorsque le moteur est arrêté, la pression du réservoir d'air s'abaisse tandis qu'on continue d'utiliser l'accessoire. Quand la pression du réservoir tombe à un niveau bas réglé à l'usine, le moteur se remet automatiquement en marche. La basse pression à laquelle le moteur se remet automatiquement en marche s'appelle la « pression d'amorçage ».

Pression de rupture : lorsqu'on met un compresseur d'air en marche et qu'il commence à fonctionner, la pression d'air dans le réservoir commence à s'accumuler. La pression monte et atteint un niveau élevé réglé à l'usine, avant que le moteur ne s'arrête automatiquement, protégeant ainsi le réservoir d'air d'un taux de pression qui excèderait sa capacité. La haute pression à laquelle le moteur s'arrête s'appelle la « pression de rupture ».

Circuit de dérivation : le circuit acheminant l'électricité du tableau électrique vers la prise murale.

Cycle de service: pour un fonctionnement approprié de votre compresseur d'air, il est recommandé que le facteur de charge de 50 % soit maintenu et que le compresseur ne soit pas en marche durant plus de 5 minutes pour toute période de temps de 10 minutes.

ASSEMBLAGE ET AJUSTEMENTS

AVERTISSEMENT : pour réduire le risque de blessures graves, éteindre l'outil et retirer le débrancher avant d'effectuer tout réglage et d'enlever ou d'installer tout accessoire. *Un démarrage accidentel peut provoquer des blessures.*

AVERTISSEMENT : risque d'une utilisation dangereuse. L'unité est automatiquement en cycle quand le courant est présent. Durant le service, vous pourriez être exposé à des sources de tension, à l'air comprimé ou à des pièces mobiles. Avant de faire le service de l'unité, débranchez ou déconnectez l'alimentation électrique au compresseur d'air, purgez la pression du réservoir et laissez le compresseur d'air se refroidir.

DÉBALLAGE

Retirez l'appareil de sa boîte et jetez tout l'emballage.

INSTALLATION

Montage de l'appareil

Emplacement du compresseur d'air

- Le compresseur d'air doit être situé dans un endroit propre, sec et bien aéré.
- Le compresseur d'air devrait être situé à une distance d'au moins 30,5 cm (12 po.) de tout mur ou autre obstruction qui pourrait bloquer le débit d'air.
- La pompe et la tôle de protection du compresseur sont conçus pour permettre un refroidissement approprié. Les ouvertures d'aération du compresseur sont nécessaires pour maintenir la température de fonctionnement appropriée. Ne placez pas de chiffons ou de contenants sur ou à proximité de ces ouvertures.

Directives de mise à la terre (Fig. A)

AVERTISSEMENT : risque de choc électrique ! En cas de court-circuit, la mise à la terre réduit le risque de choc en fournissant un fil de fuite pour le courant électrique. Ce compresseur d'air doit être adéquatement mis à la terre.

Ce compresseur d'air portatif est doté d'un cordon muni d'un fil de mise à la terre et d'une fiche appropriée de mise à la terre ❶.

1. Le cordon fourni avec cet appareil comprend une fiche ❶ avec broche de mise à la terre ❷. La fiche DOIT être insérée dans une prise de courant mise à la terre ❸.
   IMPORTANT: La prise de courant utilisée doit être

installée et mise à la terre conformément à tous les codes et ordonnances électriques locaux.

2. Assurez-vous que la prise de courant utilisée a la même configuration que la fiche de mise à la terre. NE PAS UTILISER UN ADAPTATEUR. Voir Figura A.
3. Inspectez la fiche et le cordon avant chaque utilisation. Ne pas les utiliser s'il y a des signes de dommages.
4. Si vous ne comprenez pas tout à fait ces directives de mise à la terre, ou s'il y a des doutes que le compresseur soit mis à la terre de manière appropriée, faire vérifier l'installation par un électricien qualifié.

DANGER : risque de choc électrique ! UNE MISE À LA TERRE INAPPROPRIÉE PEUT ENTRAÎNER DES CHOCS ÉLECTRIQUES.

- ***Ne modifiez pas la fiche fournie. Si elle ne convient pas à la prise de courant disponible, une prise appropriée doit être installée par un électricien qualifié.***
- ***Toute réparation du cordon ou de la fiche DOIT être effectuée par un électricien qualifié.***

Rallonges

Si une rallonge doit être utilisée, s'assurer :

- d'utiliser une rallonge à trois fils, munie d'une fiche à trois lames avec mise à la terre et une prise de courant à trois fentes qui accepte la fiche de la rallonge;
- qu'elle est en bon état;
- qu'elle n'excède pas 15,2 m (50 pi);
- que les fils sont d'un calibre minimum de 12 AWG. (La grosseur du fil augmente comme le numéro de calibre diminue. Les fils de calibre 10 AWG et 8 AWG peuvent également être utilisés. NE PAS UTILISER UN FIL DE CALIBRE 14 OU 16 AWG.)

AVIS : *risque de dommages à la propriété. L'utilisation d'une rallonge produira une chute de tension qui entraînera une perte de puissance au moteur ainsi qu'une surchauffe. Au lieu d'utiliser une rallonge électrique, augmentez plutôt la longueur du boyau d'air en connectant un autre boyau à l'extrémité. Connectez des boyaux supplémentaires au besoin.*

Protection contre la surtension et protection du circuit

Consulter le ***Spécifications*** pour connaître les exigences minimums concernant la tension et le circuit de dérivation.

AVERTISSEMENT : *risques de surchauffe. Certains modèles de compresseur d'air peuvent fonctionner sur un circuit de 15 ampères si les conditions suivantes sont satisfaites :*

- *Le courant d'alimentation au circuit doit être conforme aux exigences du code natianal de l'électricité.*
- *Le circuit n'est pas utilisé pour alimenter d'autres dispositifs électriques.*
- *Les rallonges sont conformes aux spécifications;*
- *Le circuit est muni d'un coupe-circuit de 15 A ou d'un fusible retardé de 15 A.*

REMARQUE : *Si un compresseur est relié à un circuit protégé par des fusibles, n'utilisez que des fusibles à retardement. Les fusibles à retardement portent un « D » au Canada et un « T » aux États-Unis.*

Si une des conditions ci-dessus ne peut être satisfaite, ou si l'utilisation du compresseur entraîne continuellement une panne de courant, il sera peut être nécessaire de brancher le compresseur sur un circuit de 20 ampères. Il n'est pas nécessaire de remplacer le cordon dans un tel cas.

UTILISATION

AVERTISSEMENT : pour réduire le risque de blessures graves, éteindre l'outil et retirer le débrancher avant d'effectuer tout réglage et d'enlever ou d'installer tout accessoire. *Un démarrage accidentel peut provoquer des blessures.*

AVERTISSEMENT : risque d'une utilisation dangereuse. L'unité est automatiquement en cycle quand le courant est présent. Durant le service, vous pourriez être exposé à des sources de tension, à l'air comprimé ou à des pièces mobiles. Avant de faire le service de l'unité, débranchez ou déconnectez l'alimentation électrique au compresseur d'air, purgez la pression du réservoir et laissez le compresseur d'air se refroidir.

Familiarisez-vous avec votre compresseur d'air

LISEZ CE GUIDE DE L'UTILISATEUR ET TOUTES LES MESURES DE SÉCURITÉ AVANT D'UTILISER CET APPAREIL. Comparez les illustrations à votre appareil pour vous familiariser avec l'emplacement des commandes et boutons de réglage. Conservez ce guide pour références ultérieures.

Description du fonctionnement (Fig. A)

Familiarisez-vous avec ces commandes avant d'utiliser l'appareil.

Interrupteur marche(I)/arrêt(O) [On(I) /Off(O)] : Placez cet interrupteur **4** à la position de marche (I) pour alimenter automatiquement le manostat et à la position d'arrêt (O) pour couper l'alimentation après chaque utilisation.

Manostat (non illustré) : Le manostat démarre automatiquement le moteur lorsque la pression dans le réservoir d'air tombe à une valeur inférieure à la « pression d'amorçage » réglée à l'usine. Il arrête le moteur lorsque la pression dans le réservoir d'air atteint la « pression de rupture » réglée à l'usine.

Soupape de sûreté : Si le manostat n'arrête pas le compresseur d'air lorsque la « pression de rupture » est atteinte, la soupape de sûreté **8** protège contre toute surpression en « sautant » à la valeur de pression établie à

l'usine une pression (légèrement supérieure à la « pression de rupture » établie pour le manostat).

Manomètre du réservoir : Le manomètre du réservoir **5** indique la pression d'air en réserve dans le réservoir.

Manomètre de sortie : Le manomètre de sortie indique la pression d'air disponible à la sortie **9** du régulateur. Cette pression est contrôlée par le régulateur et est toujours inférieure à ou égale à la pression du réservoir.

Régulateur : Contrôle la pression d'air indiquée sur la jauge à pression de sortie. Tournez la poignée du régulateur **7** dans le sens des aiguilles d'une montre pour augmenter et dans le sens contraire pour réduire la pression.

Système de refroidissement (non illustré) : Le compresseur d'air est doté d'un système de refroidissement d'avant garde. Le cœur de ce système est un ventilateur à technologie avancée. Il est tout à fait normal que ce ventilateur souffle de l'air au-dessus de la tête de la pompe, le manchon du cylindre et le carter. Vous savez que le système de refroidissement fonctionne bien lorsque de l'air est expulsé.

Pompe du compresseur d'air (non illustrée) : La pompe comprime l'air pour le forcer dans le réservoir d'air. L'air n'est pas disponible pour travailler avant que le compresseur n'ait élevé la pression du réservoir d'air au niveau requis à la sortie d'air.

Robinet de vidange : Le robinet de vidange **10** est situé à la base du réservoir d'air et est utilisé pour vidanger la condensation après chaque utilisation.

Soupape de retenue (non illustrée) : Lorsque le compresseur fonctionne, la soupape de retenue est « ouverte », permettant à l'air comprimé d'entrer dans le réservoir d'air. Quand le compresseur d'air atteint la « pression de rupture », la soupape de retenue « se ferme », permettant à l'air pressurisé de demeurer à l'intérieur du réservoir d'air.

Protecteur de surcharge du moteur (non illustrée): Le moteur dispose d'un protecteur de surcharge thermique. Si le moteur surchauffe, peu importe la raison, le protecteur de surcharge met le moteur hors tension. Il faut donner au moteur le temps de refroidir avant de le redémarrer. Redémarrage :

1. Mettre le levier On/Off en position « Off », puis débrancher l'appareil.
2. Laisser le moteur refroidir.
3. Brancher le cordon d'alimentation dans le bon réceptacle de circuit de dérivation.
4. Mettre le levier On/Off en position de « On ».

Raccord à connexion rapide : Le raccord à connexion rapide **6** accepte les industrielle styles de raccord à connexion rapide. Les deux raccord à connexion rapide permettent d'utiliser deux outils en même temps.

Utilisation de l'appareil (Fig. A, B)

Arrêt de l'appareil

1. Réglez l'interrupteur On/Off **4** à la position "Off".
2. Débranchez l'appareil après utilisation.

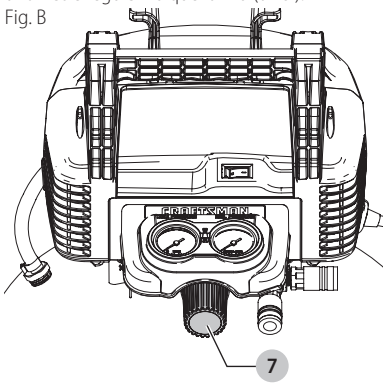
Avant le démarrage

AVERTISSEMENT : ne pas utiliser cet appareil avant d'avoir lu et compris le mode d'emploi ainsi que l'intégralité des directives de sécurité, d'utilisation et d'entretien.

Avant chaque mise en marche

1. Réglez l'interrupteur On/Off **4** à la position « Off ».
2. Branchez le cordon d'alimentation dans la prise de courant du circuit de dérivation approprié. (Consultez le paragraphe sur ***Protection contre la surtension et la protection du circuit*** de la section sur **Installation** de ce guide.)
3. Tourner le bouton du régulateur **7** en sens antihoraire jusqu'à fermeture complète. S'assurer que le manomètre régulé indique 0 kPa (0 PSI).

Fig. B



4. Fixez le tuyau et les accessoires.
5. S'assurer que tous les couvercles et étiquettes sont présents, lisibles (dans le cas des étiquettes) et bien fixés. Ne pas utiliser le compresseur avant de vérifier tous ces points.

AVERTISSEMENT : risque d'utilisation dangereuse. Saisir fermement le tuyau en main lors du raccordement ou de la déconnexion pour empêcher un à-coup du tuyau.

AVERTISSEMENT : risque d'utilisation dangereuse. N'utilisez pas les accessoires endommagés ou portés.

REMARQUE : Cet appareil est muni de raccords rapides **6**. Le tuyau ou l'accessoire étant raccordé nécessitera une fiche de raccordement rapide.

AVERTISSEMENT : risque d'éclatement. Une pression d'air trop élevée conduit à un risque dangereux d'éclatement. Vérifiez la pression nominale maximum du fabricant pour tous les outils pneumatiques et accessoires utilisés. La pression de sortie du régulateur ne doit jamais excéder la pression nominale maximum.

AVIS : *risque de dommages à la propriété. L'air comprimé de l'appareil pourrait contenir de l'eau condensée et des brumes d'huile. Ne pas vaporiser de l'air non filtré sur un article que l'humidité*

pourrait endommager. Certains outils ou dispositifs pneumatiques pourraient requérir de l'air filtré. Lire les directives pour l'outil ou le dispositif pneumatique.

Mise en marche

1. Réglez l'interrupteur On/Off 4 à la position de « On ». Le moteur s'arrêtera lorsque la pression dans le réservoir atteint la « pression de rupture ».
2. Tournez la poignée du régulateur 7 dans le sens des aiguilles d'une montre pour augmenter la pression et arrêtez quand la pression désirée est atteinte.

AVERTISSEMENT : risque d'une utilisation dangereuse. Si n'importe quel bruit ou vibration peu commun est noté, arrêtez le compresseur immédiatement et faites-vérifier le par un technicien qualifié de service.

Le compresseur d'air est maintenant prêt pour l'utilisation.

MAINTENANCE

AVERTISSEMENT : pour réduire le risque de blessures graves, éteindre l'outil et retirer le débrancher avant d'effectuer tout réglage et d'enlever ou d'installer tout accessoire. *Un démarrage accidentel peut provoquer des blessures.*

AVERTISSEMENT : risque d'une utilisation dangereuse. L'unité est automatiquement en cycle quand le courant est présent. Durant le service, vous pourriez être exposé à des sources de tension, à l'air comprimé ou à des pièces mobiles. Avant de faire le service de l'unité, débranchez ou déconnectez l'alimentation électrique au compresseur d'air, purgez la pression du réservoir et laissez le compresseur d'air se refroidir.

Responsabilités du client

	Avant chaque utilisation	À chaque jour ou après chaque utilisation	Se reporter à l'étiquette d'avertissement sur le réservoir
Vérifier la soupape de sûreté	X		
Vidanger le réservoir		X	
Mettre le réservoir hors service			X[1]
Pour plus d'informations, veuillez appeler notre service à la clientèle au 1–888–331–4569.			

REMARQUE : Consultez la section **Utilisation** pour connaître l'emplacement des commandes.

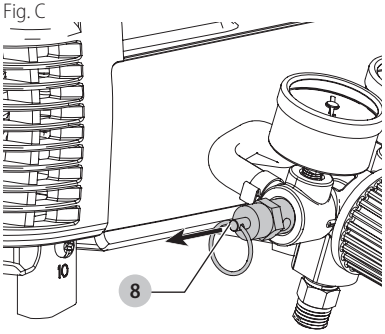
Vérification de la soupape de sûreté (Fig. C)

AVERTISSEMENT : risque d'éclatement. Si la soupape de sûreté ne fonctionne pas correctement, une surpression pourrait avoir lieu et causer une rupture ou une explosion du réservoir à air.

AVERTISSEMENT : risque provenant des objets projet. És Toujours utiliser de l'équipement de sécurité homologué : protection oculaire conforme à la norme ANSI Z87.1 (CAN/CSA Z94.3) munie d'écrans latéraux lors de l'utilisation du compresseur.

Avant de mettre en marche le compresseur, tirez sur l'anneau de la soupape de sûreté pour vous assurer que la soupape fonctionne librement. Si 8 la soupape est coincée ou qu'elle ne bouge pas librement, elle doit être remplacée par une autre soupape du même type.

Fig. C



Vidange du réservoir (Fig. A, D)

AVERTISSEMENT : risque d'utilisation dangereuse. Les réservoirs d'air contiennent de l'air sous haute pression. Éloigner le protection oculaire [ANSI Z87.1 (CAN/CSA Z94.3)] et toutes autres parties du corps de l'orifice de vidange. Porter des lunettes de sécurité lors de la vidange car il y a risque de projection de débris au visage.

AVERTISSEMENT : risques auditifs. Porter systématiquement une protection auditive appropriée durant l'utilisation. Sous certaines conditions et suivant la durée d'utilisation, le bruit émanant de ce produit pourrait contribuer à une perte de l'acuité auditive.

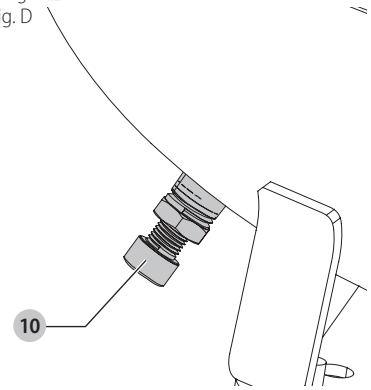
REMARQUE : Tous les systèmes de compression d'air génèrent des condensats qui s'accumulent à un point de vidange (par ex., réservoir, filtre, dispositifs de postrefroidissement ou sécheur). Le condensat contient de l'huile lubrifiante ou des substances contrôlées, ou les deux, et doivent être éliminés conformément aux lois et règlements municipaux, provinciaux, territoriaux et fédéraux.

AVERTISSEMENT : risque d'éclatement. L'eau dans le réservoir d'air peut condenser. Si l'eau n'est pas vidangée, cela risque de corroder et d'affaiblir le réservoir d'air, produisant ainsi un risque de rupture du réservoir d'air.

AVIS : *risque de dommages à la propriété. Évacuez l'eau le réservoir d'air peut contenir l'huile et se rouiller qui peut causer des taches.*

1. Placez le levier On/Off **4** à la position « Off » et débranchez l'unité.
2. Tirez le bouton du régulateur **7** vers l'extérieur et tournez-le dans le sens contraire des aiguilles d'une montre pour régler la pression de sortie à zéro.
3. Enlevez l'outil pneumatique ou l'accessoire.
4. Disposez un récipient adéquat sous le robinet de vidange pour récupérer tout drainage.
5. Tirez l'anneau de la soupape de sûreté **8** pour permettre à l'air de purger du réservoir jusqu'à ce que la pression dans le réservoir se situe à environ 20 lb/po^2. Relâchez l'anneau de la soupape de sûreté.
6. Vidangez l'eau du réservoir en ouvrant le robinet de vidange **10** .

Fig. D



7. Une fois la vidange de l'eau terminée, fermez le robinet de vidange (tournez dans le sens des aiguilles d'une montre). Le compresseur d'air peut maintenant être rangé.

REMARQUE : si la valve est bouchée, évacuer la totalité de l'air comprimé du réservoir. La soupape peut alors être enlevée, nettoyée puis réinstallée.

Nettoyage

AVERTISSEMENT : *enlever les saletés et la poussière hors des évents au moyen d'air comprimé propre et sec, au moins une fois par semaine. Pour minimiser le risque de blessure aux yeux, toujours porter une protection oculaire conforme à la norme ANSI Z87.1 lors du nettoyage.*

AVERTISSEMENT : *ne jamais utiliser de solvants ni d'autres produits chimiques puissants pour nettoyer les pièces non métalliques de l'outil. Ces produits chimiques peuvent affaiblir les matériaux de plastique utilisés dans ces pièces. Utiliser un chiffon humecté uniquement d'eau et de savon doux. Ne jamais laisser de liquide pénétrer dans l'outil et n'immerger aucune partie de l'outil dans un liquide.*

Réparations

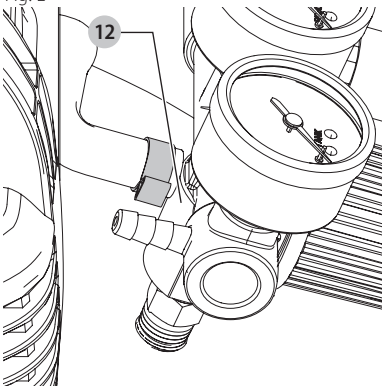
AVERTISSEMENT : *pour assurer la SÉCURITÉ et la FIABILITÉ du produit, les réparations, l'entretien et les réglages doivent être réalisés (cela comprend l'inspection et le remplacement du balai, le cas échéant) par un centre de réparation agréé. Toujours utiliser des pièces de rechange identiques.*

AVERTISSEMENT : *risque d'une utilisation dangereuse. L'unité est automatiquement en cycle quand le courant est présent. Durant le service, vous pourriez être exposé à des sources de tension, à l'air comprimé ou à des pièces mobiles. Avant de faire le service de l'unité, débranchez ou déconnectez l'alimentation électrique au compresseur d'air, purgez la pression du réservoir et laissez le compresseur d'air se refroidir.*

Pour remplacer le régulateu (Fig. A, E)

1. Déchargez tout l'air pressurisé du réservoir d'air. Voir la partie intitulée ***Vidange du réservoir*** de la section sur **Maintenance.**
2. Débranchez l'appareil.
3. Retirez le couvercle de la console.
4. À l'aide d'une clé à molette, retirez la soupape de sûreté **8** du collecteur du régulateur **7**.
5. Retirez le collier du boyau et ensuite le boyau **12**. **REMARQUE :** Le collier du boyau ne peut pas être réutilisé. Il faut se procurer un collier de boyau neuf.

Fig. E



6. Enlevez trois vis de montage de la pompe qui fixent cette dernière.
7. Soulever délicatement la pompe des supports pour la sortir.
8. À l'aide d'une clé à molette, retirez le collecteur du régulateur **7**.
9. Appliquez un produit d'étanchéité pour tuyaux au collecteur de régulateur neuf et montez-le. Serrez le collecteur avec une clé.
10. Appliquez un produit d'étanchéité pour tuyaux aux la soupape de sûreté.
11. Assemblez tous les composants dans l'ordre inverse du retrait. Assurez-vous d'orienter les manomètres pour que les relevés soient corrects et utilisez les clés pour bien serrer tous les composants.

Rangement

Avant de ranger le compresseur d'air, effectuez les étapes suivantes :

1. Revoyez la rubrique **Maintenance** dans les pages précédentes et effectuez tout entretien requis nécessaire.
2. Purgez l'eau du réservoir. Se reporter à la rubrique ***Vidange du réservoir*** sous **Maintenance**.

AVERTISSEMENT : risque d'éclatement. L'eau dans le réservoir d'air peut condenser. Si le réservoir n'est pas vidangé, l'eau corrodera et affaiblira les parois du réservoir d'air, causant ainsi un risque d'éclatement du réservoir.

3. Protégez le cordon électrique et le boyau d'air contre tout dommage (de façon à ce qu'ils ne soient pas coincés ou écrasés). Enroulez le boyau d'air sans contrinte, autour de la poignée du compresseur d'air. Enroulez le cordon électrique sur le porte-cordon.
4. Rangez le compresseur d'air dans un endroit propre et sec.

Accessoires

AVERTISSEMENT : *puisque les accessoires autres que ceux offerts par CRAFTSMAN n'ont pas été testés avec ce produit, leur utilisation pourrait s'avérer dangereuse. Pour réduire le risque de blessures, utiliser exclusivement les accessoires CRAFTSMAN recommandés avec le présent produit.*

Les accessoires recommandés pour cet outil sont vendus séparément au centre de service de votre région. Pour obtenir de l'aide concernant l'achat d'un accessoire, communiquer avec CRAFTSMAN., composer le **1-888-331-4569**.

Registre en ligne

Merci pour votre achat. Enregistrez dès maintenant votre produi:

- **RÉPARATIONS SOUS GARANTIE:** cette carte remplie vous permettra de vous prévaloir du service de réparations sous garantie de façon plus efficace dans le cas d'un probléme avec le produit.
- **CONFIRMATION DE PROPRIÉTÉ:** en cas de perte provoquée par un incendie, une inondation ou un vol, cette preuve de propriété vous servira de preuve auprès de votre compagnie d'assurances.
- **SÉCURITÉ:** l'enregistrement de votre produit nous permettra de communiquer avec vous dans l'éventualité peu probable de l'envoi d'un avis de sécurité régi par la loi fédérale américaine de la protection des consommateurs.

Registre en ligne à **www.craftsman.com/registration**

Garantie limitée d'un an

CRAFTSMAN réparera ou remplacera sans frais tout appareil défectueux pour cause de défaut de matériau ou de main-d'œuvre sur une période d'un an à partir de la date d'achat de l'outil. Cette garantie ne couvre pas les pièces en panne pour cause d'abus ou d'usure normale de l'outil. Pour plus de détails au sujet de la couverture de la garantie et l'information de réparation sous garantie, visitez **www.craftsman.com** ou composez le **1-888-331-4569**. Cette garantie ne s'applique pas aux accessoires ou dommages causés par des réparations effectuées ou tentées par d'autres. CETTE GARANTIE REMPLACE TOUTES LES AUTRES, INCLUANT LES GARANTIES IMPLICITES DE LA QUALITÉ MARCHANDE ET L'APTITUDE POUR UN BUT PARTICULIER, ET EXCLUT TOUS LES DOMMAGES ACCIDENTELS OU CONSÉCUTIFS. Certaines provinces ne permettent pas de limitation sur la durée de la garantie implicite ou l'exclusion ou la limitation de dommages indirects, alors ces limitations peuvent ne pas s'appliquer à vous. Cette garantie vous donne des droits légaux particuliers et vous pouvez avoir d'autres droits qui varient selon les états ou les provinces..

GARANTIE DE REMBOURSEMENT DE 90 JOURS

Si l'acheteur n'est pas entièrement satisfait, pour quelque raison que ce soit, du rendement de l'outil électrique ou de la cloueuse CRAFTSMAN , celui-ci peut le retourner, accompagné d'un reçu, dans les 90 jours à compter de la date d'achat pour obtenir un remboursement intégral, sans aucun problème.

AMÉRIQUE LATINE : cette garantie ne s'applique aux produits vendus en Amérique latine. Pour ceux-ci, veuillez consulter les informations relatives à la garantie spécifique présente dans l'emballage, appeler l'entreprise locale ou consulter le site Web pour les informations relatives à cette garantie.

DÉPANNAGE

AVERTISSEMENT : risque d'une utilisation dangereuse. L'unité est automatiquement en cycle quand le courant est présent. Durant le service, vous pourriez être exposé à des sources de tension, à l'air comprimé ou à des pièces mobiles. Avant de faire le service de l'unité, débranchez ou déconnectez l'alimentation électrique au compresseur d'air, purgez la pression du réservoir et laissez le compresseur d'air se refroidir.

PROBLÈME	CAUSE	CORRECTION
Pression excessive - la soupape de sûreté se soulève.	Le manostat n'arrête pas le moteur lorsque le compresseur d'air atteint la « pression de rupture ».	Déplacez le levier « On/Off » à la position « Off ». Si l'appareil ne s'arrête pas, contactez un technicien qualifié.
	La « pression de rupture » du manostat est trop élevée.	Contactez un technicien qualifié.
Fuites d'air aux raccords.	Les raccords des tubes ne sont pas assez serrés.	Resserrez les raccords là où on peut entendre l'air s'échapper. Vérifiez les raccords à l'aide d'une solution d'eau savonneuse. **Ne Pas Trop Serrer.**
Fuites d'air au réservoir d'air ou aux soudures du réservoir.	Réservoir d'air défectueux.	Le réservoir d'air doit être remplacé. Ne tentez pas de réparer les fuites. ***AVERTISSEMENT : risque d'éclatement. Évitez de percer, de souder ou de modifier le réservoir d'air de quelque façon. Celui-ci risquerait de rompre ou d'exploser.***
Fuites d'air entre la tête et la plaque de la soupape.	Joint d'étanchéité accusant une fuite.	Contactez un technicien qualifié.
Fuite d'air à la soupape de sûreté.	Défectuosité possible dans la soupape de sûreté.	Faites fonctionner la soupape manuellement en tirant sur l'anneau. Si les fuites ne sont pas éliminées, la soupape devrait être remplacée.
Cognements.	Défectuosité possible dans la soupape de sûreté.	Faites fonctionner la soupape manuellement en tirant sur l'anneau. Si les fuites ne sont pas éliminées, la soupape devrait être remplacée.
Le relevé de pression sur le manomètre du régulateur tombe lorsqu'un accessoire est utilisé.	Une légère chute de pression est considérée normale.	S'il y a une chute excessive de pression lorsqu'un accessoire est utilisé, ajustez le régulateur en suivant les directives du paragraphe intitulé ***Description du fonctionnement*** de la section sur **Utilisation**. **REMARQUE :** ajustez la pression du régulateur lorsqu'il y a un débit d'air (c.-à-d., pendant l'utilisation d'un accessoire).
Le compresseur d'air ne fournit pas suffisamment d'air pour faire fonctionner les accessoires.	Utilisation prolongée et excessive de l'air.	Utilisation prolongée et excessive de l'air.
	Le compresseur n'est pas assez gros pour la quantité d'air requise.	Le compresseur n'est pas assez gros pour la quantité d'air requise.
	Trou dans le boyau.	Trou dans le boyau.
	Soupape de retenue obstruée.	Contactez un technicien qualifié.
	Fuites d'air.	Fuites d'air.
Fuite d'air continue au bouton du régulateur.	Régulateur endommagé.	Remplacez le régulateur.
Le régulateur ne ferme pas l'orifice de sortie d'air.	Régulateur endommagé.	Remplacez le régulateur.
Le moteur ne tourne pas.	Fusible sauté ou coupe-circuit déclenché.	Vérifiez s'il y a un fusible sauté dans la boîte à fusibles et remplacez-le au besoin. Rétablissez le coupe-circuit. Ne pas utiliser un fusible ou un coupe-circuit à valeur nominale supérieure à la valeur spécifiée pour le circuit de dérivation utilisé. Vérifier si le fusible est du type approprié. Vous devriez utiliser un fusible retardé. Vérifier s'il y a une condition de tension basse. Vérifiez la rallonge. Déconnectez tout autre appareil électrique du circuit ou branchez le compresseur sur son propre circuit de dérivation.
	Rallonge de longueur ou de calibre inapproprié.	Vérifiez la rallonge.
	Connexions électriques desserrées.	Vérifiez les connexions de câblage dans la boîte à bornes.
	Moteur défectueux.	Faire vérifier par un technicien qualifié.
	Le commutateur de protection de surcharge du moteur a été déclenché.	Consulter la rubrique ***Surcharge du moteur*** sous **Utilisation.** Si la protection de surcharge de moteur se déclenche fréquemment. Communiquer avec un centre de réparation en usine de contactez un technicien qualifié.

Definiciones: Símbolos y palabras de alerta de seguridad

Este manual de instrucciones utiliza los siguientes símbolos y palabras de alerta de seguridad para alertarle de situaciones peligrosas y del riesgo de lesiones corporales o daños materiales.

PELIGRO: *Indica una situación de peligro inminente que, si no se evita, provocará* ***la muerte o lesiones graves****.*

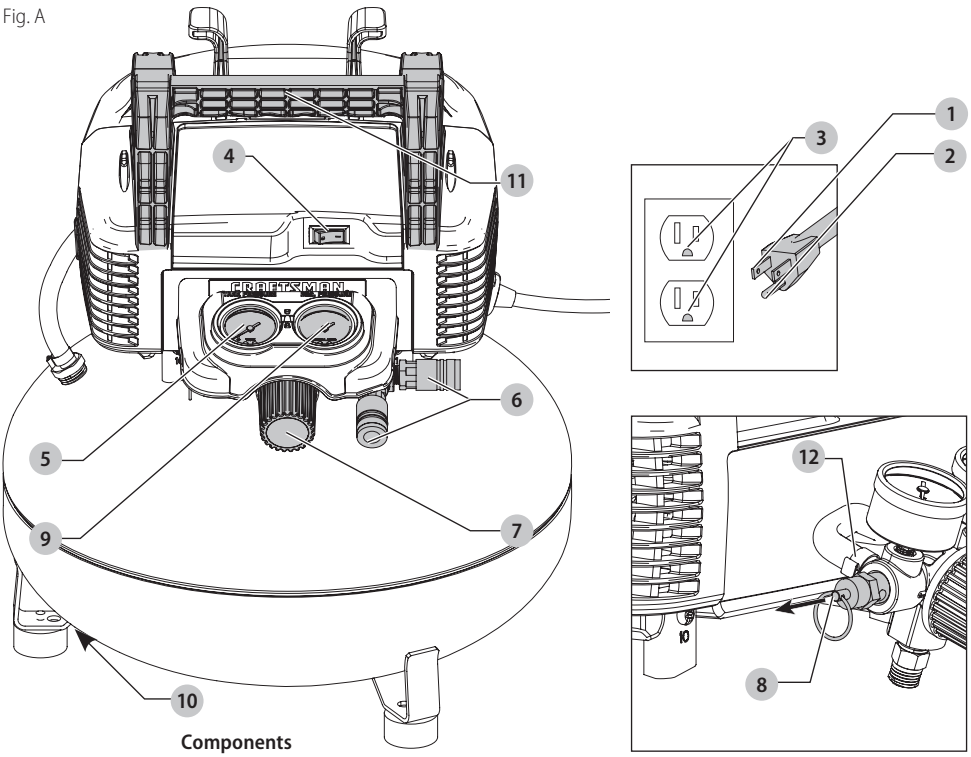
ADVERTENCIA: *Indica una situación de peligro potencial que, si no se evita,* ***podría*** *provocar* ***la muerte o lesiones graves.***

ATENCIÓN: *Indica una situación de peligro potencial que, si no se evita,* ***posiblemente*** *provocaría* ***lesiones leves o moderadas****.*

(Utilizado sin palabras) indica un mensaje de seguridad relacionado.

AVISO: *Se refiere a una práctica* ***no relacionada a lesiones corporales*** *que de no evitarse* ***puede*** *resultar en* ***daños a la propiedad****.*

Fig. A



Components

1. Enchufe
2. Espigas para conexión a tierra
3. Tomacorriente conectado a tierra
4. Interruptor Encendido
5. Manómetro que controla la presión del tanque
6. Conexiones rápidas
7. Regulador
8. Válvula de seguridad
9. Manometro que controla la presión del tanque
10. Válvula de drenaje (not pictured)
11. Manija
12. Abrazadera de la Manguera

ADVERTENCIA: Lea todas las advertencias de seguridad e instrucciones. *El incumplimiento de las advertencias e instrucciones puede provocar descargas eléctricas, incendios o lesiones graves.*

ADVERTENCIA: *Nunca modifique la herramienta eléctrica, ni tampoco ninguna de sus piezas. Podría producir lesiones corporales o daños.*

ADVERTENCIA: *Para reducir el riesgo de lesiones, lea el manual de instrucciones.*

Si tiene alguna duda o algún comentario sobre ésta u otra herramienta CRAFTSMAN, llámenos al número gratuito: 1-888-331-4569.

Compresseur d'air
CMEC6150

CONSERVE TODAS LAS ADVERTENCIAS E INSTRUCCIONES PARA FUTURAS CONSULTAS

PELIGRO: RIESGO DE EXPLOSIÓN O INCENDIO



¿Qué puede suceder?	Cómo evitarlo
Es normal que los contactos eléctricos dentro del motor y el interruptor de presión produzcan chispas.	Opere siempre el compresor en un área bien ventilada libre de materiales combustibles, gasolina o vapores de solventes.
Si las chispas eléctricas del compresor entran en contacto con vapores inflamables, pueden encenderse, provocando un incendio o una explosión.	Si se pulverizan materiales inflamables, ubique el compresor al menos a 6,1 m (20 pies) del área de pulverización. Se puede necesitar manguera adicional.
	Guarde los materiales inflamables en lugar seguro lejos del compresor.
	Guarde los materiales inflamables en lugar seguro lejos del compresor.
Restringir cualquiera de las aberturas de ventilación del compresor causará sobrecalentamiento serio y podría causar un incendio.	Nunca coloque objetos contra o sobre la bomba del compresor.
	Opere el compresor en un lugar abierto con una distancia de al menos 30,5 cm (12 ") a cualquier pared u obstrucción que pudiera restringir el flujo de aire fresco a las aberturas de ventilación.
	Opere el compresor en un área limpia, seca y bien ventilada. No opere la unidad dentro de la casa o en un área muy cerrada.
El funcionamiento sin atención de este producto podría provocar lesiones personales o daños a la propiedad. Para disminuir el riesgo de incendio, no permita que el compresor funcione sin que alguien lo controle.	Permanezca siempre controlando el producto cuando está en funcionamiento.
	Siempre apague y desenchufe la unidad cuando no esté en uso.

ATENCIÓN: RIESGO POR RUIDOS



¿Qué puede suceder?	Cómo evitarlo
En determinadas condiciones y según el período de uso, el ruido provocado por este producto puede originar pérdida de audición.	Utilice siempre equipo de seguridad certificado: protección auditiva ANSI S12.6 (S3.19).

PELIGRO: RIESGO RESPIRATORIO (ASFIXIA)



¿Qué puede suceder?	Cómo evitarlo
El aire comprimido que sale de su compresor no es seguro para respirarlo. El flujo de aire puede contener monóxido de carbono, vapores tóxicos o partículas sólidas del tanque de aire. Respirar estos contaminantes puede provocar lesiones graves o la muerte.	El aire que se obtiene directamente del compresor no se debe usar nunca para consumo humano. Para poder utilizar el aire producido por este compresor para respirar, se deben instalar correctamente filtros y equipos en línea adecuados. Los filtros y los equipos de seguridad en línea que se usan junto con el compresor deben ser capaces de tratar el aire según todos los códigos locales y federales antes de que sea consumido por seres humanos.
La exposición a productos químicos en el polvo producido por las herramientas eléctricas al lijar, aserrar, esmerilar, taladrar y otras actividades de la construcción puede ser peligrosa.	Trabaje en un área con buena ventilación. Lea y siga las instrucciones de seguridad provistas en la etiqueta o las hojas de datos de seguridad para los materiales que rocía. Siempre use equipo de seguridad certificado: Protección respiratoria OSHA/ MSHA/NIOSH diseñada para uso con su aplicación específica.
Los materiales pulverizados como pintura, solventes para pinturas, removedor de pintura, insecticidas y herbicidas pueden contener vapores dañinos y venenos.	

ADVERTENCIA: RIESGO DE EXPLOSIÓN



Tanque de aire: El 26 de febrero de 2002, la Comisión de Seguridad para Productos de Consumo delos Estados Unidos publicó el Comunicado # 02-108 sobre la seguridad en los tanques de compresores de aire:

Los tanques receptores de los compresores de aire no tienen una vida útil infinita. La vida útil del tanque depende de diversos factores, incluyendo las condiciones de operación, las condiciones ambientales, la instalación debida del mismo, modificaciones realizadas en el campo y el nivel de mantenimiento que reciba. Es difícil prever cuál será el efecto exacto de estos factores sobre la vida útil del tanque receptor de aire.

Si no se siguen procedimientos de mantenimiento debidos, la corrosión interna de la pared interior del tanque receptor de aire puede causar una ruptura imprevista en el tanque de aire, lo que hará que el aire presurizado escape con fuerza y repentinamente, pudiendo lesionar al usuario.

El tanque de su compresor de aire debe ser dado de baja al final del año que aparece en la etiqueta de advertencia de su tanque.

Las siguientes condiciones pueden llevar a debilitar el tanque de aire y ocasionar la explosión violenta del mismo:

ADVERTENCIA: *Algunos polvos contienen químicos conocidos por el Estado de California que causan cáncer, y defectos de nacimiento u otros daños reproductivos tales como asbesto y plomo en pintura a base de plomo.*

¿Qué puede suceder?	Cómo evitarlo
No drenar correctamente el agua condensada del tanque de aire, que provoca óxido y adelgazamiento del tanque de aire de acero.	Drene el tanque diariamente o luego de cada uso. Si un tanque de aire presenta una pérdida, reemplácelo inmediatamente con un tanque nuevo o reemplace todo el compresor.
Modificaciones o intento de reparación del tanque de aire.	Nunca perfore, suelde o haga ninguna modificación al tanque de aire o a sus elementos. Nunca intente reparar un tanque de aire dañado o con pérdidas. Reemplácelo con un tanque de aire nuevo.
Las modificaciones no autorizadas de la válvula de seguridad o cualquier otro componente que controle la presión del tanque.	El tanque está diseñado para soportar determinadas presiones de operación. Nunca realice ajustes ni sustituya piezas para cambiar las presiones de operación fijadas en la fábrica.
Elementos y Accesorios:	
Exceder las indicaciones de presión para las herramientas neumáticas, las pistolas pulverizadoras, los accesorios neumáticos, los neumáticos y otros artículos inflables puede hacer que exploten o revienten, y puede provocar lesiones graves.	Siga la recomendación del fabricante del equipo y nunca exceda el nivel máximo de presión aceptable para los elementos. Nunca utilice el compresor para inflar objetos pequeños de baja presión, tales como juguetes de niños, pelotas de fútbol o de basquetbol, etc.
Neumáticos:	
El inflado excesivo de los neumáticos podría causar lesiones graves y daño a la propiedad.	Utilice un medidor de presión de neumáticos para controlar la presión de éstos antes de cada uso y mientras los infla; observe el flanco para ver la presión correcta del neumático. **NOTA:** Los tanques de aire, los compresores y el equipo similar que se usa para inflar neumáticos pueden llenar neumáticos pequeños como éstos con mucha rapidez. Ajuste el regulador de presión en el suministro de aire a un valor que no supere el de la presión del neumático. Agregue aire en forma gradual y use con frecuencia el medidor de presión de neumáticos para evitar inflarlos.

ADVERTENCIA: RIESGO DE DESCARGA ELÉCTRICA



¿Qué puede suceder?	Cómo evitarlo
Su compresor de aire funciona con electricidad. Como cualquier otro mecanismo que funciona con electricidad, si no se lo utiliza correctamente puede provocar descargas eléctricas.	Nunca haga funcionar el compresor al aire libre cuando está lloviendo o en condiciones de humedad.
	Nunca haga funcionar el compresor sin las cubiertas de protección o si están dañadas.
Que personal no calificado intente realizar reparaciones puede provocar lesiones graves o muerte por electrocución.	Cualquier cableado eléctrico o las reparaciones requeridas para este producto deben ser realizadas por un centro de mantenimiento autorizado con los códigos eléctricos nacionales y locales.
Puesta a tierra: La no colocación de la puesta a tierra adecuada para este producto puede provocar lesiones graves o muerte por electrocución. Consulte las ***Instrucciones de Conexión a tierra*** en **Instalación**.	Asegúrese de que el circuito eléctrico al que se conecta el compresor suministre la conexión a tierra adecuada, el voltaje adecuado y el fusible de protección adecuado.

ADVERTENCIA: RIESGO DE OBJETOS DESPEDIDOS



¿Qué puede suceder?	Cómo evitarlo
La corriente de aire comprimido puede provocar lesiones en los tejidos blandos de la piel expuesta y puede impulsar suciedad, astillas, partículas sueltas y objetos pequeños a gran velocidad, que pueden producir daños en la propiedad y lesiones personales.	Utilice siempre equipo de seguridad certificado: anteojos de seguridad ANSI Z87.1 (CAN/CSA Z94.3) con protección lateral al usar el compresor.
	Nunca apunte ninguna boquilla ni pulverizador a ninguna parte del cuerpo o a otras personas o animales.
	Apague siempre el compresor y drene la presión de la manguera de aire y del tanque de aire antes de intentar hacer mantenimiento, conectar herramientas o accesorios.

ADVERTENCIA: RIESGO DE SUPERFICIES CALIENTES



¿Qué puede suceder?	Cómo evitarlo
Tocar metal expuesto como el cabezal del compresor, el cabezal del motor, el escape del motor, o los tubos de salida puede provocar quemaduras graves.	Nunca toque ninguna parte metálica expuesta del compresor durante o inmediatamente después de su funcionamiento. El compresor continuará caliente durante varios minutos después de su funcionamiento.
	No toque las cubiertas protectoras ni intente realizar mantenimiento hasta que la unidad se haya enfriado.

ADVERTENCIA: RIESGO DE LESIÓN POR LEVANTAR MUCHO PESO



¿Qué puede suceder?	Cómo evitarlo
El intento de levantar un objeto muy pesado puede provocar lesiones graves.	El compresor es demasiado pesado como para que lo levante una sola persona. Consiga ayuda de otras personas para levantarlo.

ADVERTENCIA: RIESGO POR PIEZAS MÓVILES



¿Qué puede suceder?	Cómo evitarlo
Las piezas móviles como la polea, el volante y la correa pueden provocar lesiones graves si entran en contacto con usted o con sus ropas.	Nunca haga funcionar el compresor sin los protectores o cubiertas o si los mismos están dañados.
	Mantenga el cabello, la ropa y los guantes alejados de las piezas en movimiento. Las ropas holgadas, las joyas o el cabello largo pueden quedar atrapados en las piezas móviles.
	Los orificios de ventilación pueden cubrir piezas en movimiento, por lo que también se deben evitar. Intentar hacer funcionar el compresor con partes dañadas o faltantes, o intentar reparar el compresor sin las cubiertas protectoras puede exponerlo a piezas móviles lo que puede provocar lesiones graves.
	Cualquier reparación requerida por este producto debe ser realizada por un centro de servicio autorizado.

ADVERTENCIA: RIESGO DE OPERACIÓN INSEGURA



¿Qué puede suceder?	Cómo evitarlo
La operación insegura de su compresor de aire podría producir lesiones graves o la muerte, a usted mismo o a otras personas.	Revise y comprenda todas las instrucciones y advertencias de este manual.
	Familiarícese con la operación y los controles del compresor de aire.
	Mantenga el área de operaciones libre de personas, mascotas y obstáculos.
	Mantenga a los niños alejados del compresor de aire en todo momento.
	No opere el producto cuando esté cansado o bajo la influencia de alcohol o drogas. Manténgase alerta en todo momento.
	Nunca anule las características de seguridad de este producto.
	Equipe el área de operaciones con un extintor de incendios.
	No opere la máquina si faltan piezas, si éstas están rotas o si no son las autorizadas.
	Nunca se pare sobre el compresor.

ADVERTENCIA: RIESGO DE CAÍDAS



¿Qué puede suceder?	Cómo evitarlo
Un compresor portátil se puede caer de una mesa, banco o techo, provocando daños al compresor y puede producir lesiones graves o la muerte del operador.	Opere siempre el compresor en una posición estable y segura para evitar que la unidad se mueva accidentalmente. Nunca opere el compresor sobre un techo u otra ubicación elevada. Utilice una manguera de aire adicional para alcanzar las ubicaciones elevadas.

Especificaciones

Modelo Nº	CMEC6150
Diámetro interior	47,6 mm (1,875")
Carrera	31,8 mm (1,250")
Voltaje-corriente manofásica	120/60
Circuito mínimo requerido	15 amps
Tipo de fusible	Acción retardada
Capacidad de aire en el tanque	22,7 litros (6 galones)
Presión de corte de entrada	120 psig
Presión de corte de salida	150 psig
SCFM a 40 psig	3,7 *
SCFM a 90 psig	2,6 *
Clasificación de presión regulada (aproximadamente)	3–150 psi
Conexiones rápidas	6,4 mm (1/4") Industrial
Ciclo de servicio	5 minutes on/5 minutes off

*Probado según la norma ISO 1217

Refiérase al ***Glosario*** para descifrar las abreviaturas.

Glosario

Familiarícese con los siguientes términos, antes de operar la unidad:

CFM: (cubic feet per minute) pies cúbicos por minuto.

SCFM: (stardard cubic feet per minute) pies cúbicos estándar por minuto; una unidad de medida que permite medir la cantidad de entrega de aire.

PSIG: (pound per square inch) libras por pulgada cuadrada.

Código de certificación: Los productos que usan una o más de las siguientes marcas: UL®, CUL, CULUS, ETL®, CETL, CETLUS, han sido evaluados por OSHA, laboratorios independientes certificados en seguridad, y reúnen los estándares suscriptos por a la certificación de la seguridad.

Presión mínima de corte: Cuando el motor está apagado, la presión del tanque de aire baja a medida que usted continúa usando su accesorio. Cuando la presión del tanque baja al valor fijado en fábrica como punto bajo, el motor volverá a arrancar automáticamente. La presión baja a la cual el motor arranca automáticamente, se llama presión "mínima de corte".

Presión máxima de corte: Cuando un compresor de aire se enciende y comienza a funcionar, la presión de aire en el tanque comienza a aumentar. Aumenta hasta un valor de presión alto fijado en fábrica antes de que el motor automáticamente se apague protegiendo a su tanque de aire de presiones más altas que su capacidad. La presión alta a la cual el motor se apaga se llama presión "máxima de corte".

Ramal: Circuito eléctrico que transporta electricidad desde el panel de control hasta el tomacorriente.

Ciclo de servicio: Para la operación adecuada de su compresor de aire, se recomienda que se mantenga un ciclo de servicio de 50%; esto es, el compresor de aire no debe operar por más de 5 minutos en cualquier periodo de 10 minutos.

MONTAJE Y AJUSTES

ADVERTENCIA: Para reducir el riesgo de lesiones personales graves, apague la herramienta y desconéctela de la fuente de alimentación antes de realizar ajustes o de retirar/instalar dispositivos o accesorios. *Un arranque accidental podría causar lesiones.*

ADVERTENCIA: La unidad arranca automáticamente cuando está conectada. Al hacer el mantenimiento puede quedar expuesto a fuentes de voltaje, de aire comprimido o a piezas movibles que pueden causar lesiones personales. Antes de intentar hacerle cualquier mantenimiento, desconecte el compresor del suministro eléctrico y drénele toda la presión de aire.

DESEMPAQUE

Extraiga la unidad de su caja y descarte todas las partes de embalaje.

INSTALACIÓN

Cómo preparar la unidad

Ubicación del compresor de aire

- Ubicar el compresor de aire en un lugar limpio, seco y bien ventilado.
- El compresor de aire debe colocarse alejado por lo menos 30,5 cm (12") de las paredes o de cualquier otra obstrucción que interfiera con el flujo de aire.
- La bomba del compresor de aire y su casco han sido diseñados para permitir un enfriamiento adecuado. Las aberturas de ventilación del compresor son necesarias para el mantenimiento de una temperatura adecuada de funcionamiento. No coloque trapos o contenedores, encima, ni en las proximidades de dichas aberturas.

Instrucciones para conectar a tierra (Fig. A)

ADVERTENCIA: Riesgo de choque eléctrico. Ante la eventualidad de un cortocircuito, la conexión a tierra reduce el riesgo de electrocución proveyendo un conductor de escape para la corriente eléctrica. Este compresor de aire debe estar adecuadamente conectado a tierra.

El compresor portátil de aire está equipado con un cable con un conductor y un enchufe adecuado para conexión a tierra ❶.

1. El cable de esta unidad tiene un enchufe ❶ de 3 espigas para conexión a tierra ❷ que DEBE enchufarse en un

tomacorriente conectado a tierra 3.
IMPORTANTE: El tomacorriente que que se use debe estar conectado a tierra conforme a todos los códigos y ordenanzas locales.

2. Asegúrese que el tomacorriente tenga la misma configuración que el enchufe de conexión a tierra. NO UTILICE UN ADAPTADOR. Vea la Figura A.
3. Inspeccione el enchufe y su cordón antes de cada uso. No lo use si existieran signos de daños.
4. Si las instrucciones de conexión a tierra no fueran completamente comprendidas, o si se estuviera ante la duda acerca de que el compresor estuviese adecuadamente conectado a tierra, haga verificar la instalación por un electricista competente.

PELIGRO: Riesgo de choque eléctrico. LA CONEXIÓN INADECUADA A TIERRA PUEDE CAUSAR UNA DESCARGA ELÉCTRICA.

- ***No modifique el enchufe provisto. Si no penetrara en el tomacorriente disponible, un electricista calificado debe instalar uno apropiado.***
- ***La reparación del cable o del enchufe DEBE hacerla un electricista calificado.***

Cables de extensión eléctrica

Si - no obstante - debe utilizarse una extensión de cable, asegúrese de que:

- La extensión eléctrica de 3 conductores, tenga un enchufe de conexión a tierra de 3 hojas, y que exista un receptáculo que acepte el enchufe del producto.
- Esté en buenas condiciones.
- No más largo que 15,2 m (50 pies).
- Sea calibre 12 (AWG) o mayor. (La capacidad de los cables se incrementa a medida que su número ordinal decrece. También pueden usarse calibres 10 y 8 AWG. NO USE 14 NI 16 AWG).

AVISO: *Riesgo de daño a la propiedad. El uso de cables de extensión eléctrica originará una caída de tensión, lo que determinará una pérdida de potencia del motor así como su recalentamiento. En lugar de utilizar un cable de extensión eléctrica, incremente el alcance de la manguera de aire dentro de la zona de trabajo, añadiéndole otro largo de manguera a su extremo. Conecte los largos adicionales de manguera de acuerdo a su necesidad.*

Protección del voltaje y del circuito

Acerca del voltaje y la mínima cantidad de circuitos requeridos, refiérase al cuadro de ***Especificaciones***.

ADVERTENCIA: *Existe riesgo de sobrecalentamiento. Ciertos compresores de aire pueden operearse en un circuito de 15 A, siempre que se cumplan las siguientes condiciones:*

- *Que el voltaje suministrado al ramal cumpla con el código eléctrico nacional.*
- *Que el circuito no sea utilizado para alimentar ninguna otra necesidad eléctrica.*
- *Que los cables de extensión cumplan con las especificaciones.*
- *Que el circuito cuente con un disyuntor de 15 amperios o un fusible de acción retardada de 15 amperios.*

NOTA: *Si el compresor está conectado a un circuito protegido por fusibles, use sólo fusibles de acción retardada. Los fusibles de acción retardada deben estar marcados con la letra "D" en Canadá y "T" en EE.UU.*

Si cualquiera de las condiciones enumeradas no pudiese cumplirse, o si el funcionamiento del compresor causara interrupciones reiteradas en el suministro eléctrico, podría ser necesario operarlo en un circuito de 20 amperios. Para ello no será necesario cambiar su cable de limentación.

OPERACIÓN

ADVERTENCIA: Para reducir el riesgo de lesiones personales graves, apague la herramienta y desconéctela de la fuente de alimentación antes de realizar ajustes o de retirar/instalar dispositivos o accesorios. *Un arranque accidental podría causar lesiones.*

ADVERTENCIA: La unidad arranca automáticamente cuando está conectada. Al hacer el mantenimiento puede quedar expuesto a fuentes de voltaje, de aire comprimido o a piezas movibles que pueden causar lesiones personales. Antes de intentar hacerle cualquier mantenimiento, desconecte el compresor del suministro eléctrico y drénele toda la presión de aire.

Conozca su compresor de aire

LEA ESTE MANUAL DEL PROPIETARIO Y SUS NORMAS DE SEGURIDAD ANTES DE OPERAR LA UNIDAD. Compare las ilustraciones contra su unidad a fin de familiarizarse con la ubicación de los distintos controles y regulaciones. Conserve este manual para referencias futuras.

Descripción de operaciones (Fig. A)

Familiarícese con estos controles antes de operar la unidad.

Interruptor Encendido (I)/ Apagado (O) [On (I)/Off (O)]: Para que el interruptor de presión 4 se energice automáticamente, coloque el interruptor en (I) y en (O) para desenergizarlo al final de cada uso.

Interruptor de presión (no mostrado): El interruptor de presión permite el arranque automático del motor cuando la presión del tanque disminuye a la presión de arranque regulada en fábrica. El motor se detendrá cuando la presión del tanque alcance la "presión de corte" regulada en fábrica.

Válvula de seguridad: Si el interruptor de presión dejara de cortar el suministro de presión del compresor conforme a los valores prefijados para la "presión de corte", la válvula de seguridad 8 protegerá contra la presión elevada, "abriéndose" a la presión prefijada (ligeramente superior a la "presión de corte").

Manómetro de la presión del tanque: El manómetro que controla la presión del tanque **5** ndica la reserva de presión del tanque de aire.

Manómetro para controlar la presión de salida: Este manómetro indicará la presión de aire disponible a la salida **9** del regulador. Esta presión está controlada por el regulador y siempre es menor o igual que la presión del tanque.

Regulador: Controla la presión de aire indicada en la salida del medidor de presión. Gire la perilla del regulador **7** en el sentido del reloj para aumentar la presión y contra el sentido del reloj para reducirla.

Sistema de enfriamiento (no mostrado): Este compresor contiene un sistema de enfriamiento de avanzada. El núcleo de este sistema de enfriamiento contiene un ventilador diseñado especialmente. Es normal que este ventilador sople grandes cantidades de aire por los orificios de ventilación. Usted sabrá que el sistema de enfriamiento funciona adecuadamente cuando perciba que sale aire.

Bomba de compresión del aire (no mostrada): Comprime el aire dentro del tanque. El aire de trabajo no se encuentra disponible hasta que el compresor haya alcanzado a llenar el tanque hasta un nivel de presión por encima del requerido para la salida del aire.

Válvula de drenaje: La válvula de drenaje **10** se encuentra ubicada en la base del tanque de aire y se usa para drenar la condensación al fin de cada uso.

Válvula de retención (no mostrada): Cuando el compresor de aire se encuentra funcionando, la válvula de retención está "abierta", permitiendo la entrada del aire comprimido al tanque de aire. Cuando el nivel de presión del tanque alcanza la "presión de corte", la válvula de retención "se cierra", reteniendo la presión del aire dentro del tanque.

Protector de sobrecalentamiento del motor (no mostrado): El motor tiene un reposicionado automático para la protección térmica. Si por cualquier razón el motor se recalentara, el protector por sobrecalentamiento lo detendrá. El motor deberá dejarse enfriar antes de volver a ponerlo en marcha. El compresor arrancará automáticamente luego que el motor se enfríe.

1. Coloque la palanca On/Off en la posición "Off" y desenchufe la unidad.
2. Espere que el motor se enfríe.
3. Enchufe el cable eléctrico en el receptáculo apropiado del circuito de derivación.
4. Coloque la palanca On/Off en la posición "On".

Conexión rápida: El conexión rápida **6** acepta los Industrial estilos más enchufes de conexión rápid. Los dos conectores rápidos permiten la utilización de dos herramientas al mismo tiempo.

Cómo utilizar su unidad (Fig. A, B)

Cómo detenerla

1. Coloque la posición de la llave interruptora On/Off **4** en la posición "Off".
2. Desenchufe la unidad de la toma de corriente cuando no esté en uso.

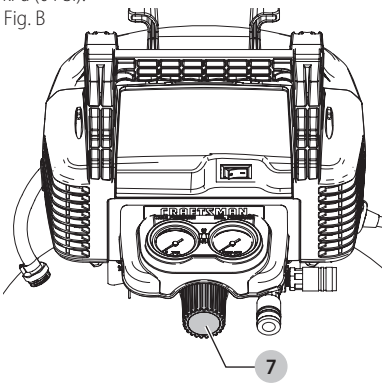
Antes de poner en marcha

ADVERTENCIA: No opere esta unidad hasta que haya leído y comprendido este manual de instrucciones de seguridad, operación y mantenimiento.

Antes de cada puesta en marcha

1. Coloque la posición de la llave interruptora On/Off **4** en la posición "Off".
2. Enchufe el cable de alimentación en el tomacorriente del ramal del circuito correcto. (Referirse al párrafo ***Protección del voltaje y del circuito*** en la sección **Instalación** de este manual).
3. Gire la perilla del regulador **7** en sentido contrario a las agujas del reloj hasta que esté completamente cerrada. Asegúrese de que el manómetro regulado marque 0 kPa (0 PSI).

Fig. B



4. Conecte la manguera y los accesorios.
5. Asegúrese de que todos los cubiertas y etiquetas estén en su lugar, sean legibles (en el caso de las etiquetas) y estén montados en forma segura. No utilice el compresor hasta que no haya verificado todos los puntos.

ADVERTENCIA: Riesgo de operación insegura. Sostenga la manguera firmemente con las manos al instalarla o desconectarla para evitar la desconexión repentina de la manguera.

ADVERTENCIA: Riesgo de operación insegura. No utilice los accesorios dañados o usados.

NOTA: La unidad está equipada con conexiones rápidas **6**. La manguera o accesorio que se conecta requerirá un tapón de conexión rápida.

ADVERTENCIA: Riesgo de Explosión. Demasiada presión de aire podrá ser la causa de riesgo de explosión. Verifique los valores de máxima presión dados por el fabricante de las herramientas neumáticas y los accesorios. La presión de salida del regulador jamás debe exceder los valores de máxima presión especificados.

AVISO: *Riesgo de daño a la propiedad. El aire comprimido de la unidad puede contener condensación de agua y emanación de aceite. No pulverice aire no filtrado sobre un artículo que podría dañarse con la humedad. Algunos dispositivos o herramientas neumáticas pueden requerir aire filtrado. Lea las instrucciones del dispositivo o la herramienta neumática.*

Cómo poner en marcha

1. Coloque la posición de la llave interruptora On/Off 4 en la posición "Off" y deje que se incremente la presión del tanque. El motor se detendrá una vez alcanzado el valor de "presión de corte" del tanque.
2. Gire la perilla del regulador 7 en el sentido del reloj para aumentar la presión y deténgase al alcanzar la presión deseada.

ADVERTENCIA: Riesgo de operación insegura. *Si observa algún ruido o vibración inusuales, apague el compresor y contacte a un técnico calificado en servicio.*

Ahora el compresor está listo para usarse.

MANTENIMIENTO

ADVERTENCIA: Para reducir el riesgo de lesiones personales graves, apague la herramienta y desconéctela de la fuente de alimentación antes de realizar ajustes o de retirar/instalar dispositivos o accesorios. *Un arranque accidental podría causar lesiones.*

ADVERTENCIA: La unidad arranca automáticamente cuando está conectada. Al hacer el mantenimiento puede quedar expuesto a fuentes de voltaje, de aire comprimido o a piezas movibles que pueden causar lesiones personales. Antes de intentar hacerle cualquier mantenimiento, desconecte el compresor del suministro eléctrico y drénele toda la presión de aire.

Responsabilidades del cliente

	Antes de cada uso	Diariamente o luego de cada uso	Remítase a la etiqueta de advertencia del tanque
Verifique la válvula de seguridad	X		
Drenaje del tanque		X	
El tanque debe ser dado de baja			X[1]

1 - Para mayor información, llame a nuestro Centro de Atención al Cliente al 1––888–331–4569.

NOTA: Vea en la sección **Operación** la ubicación de los controles.

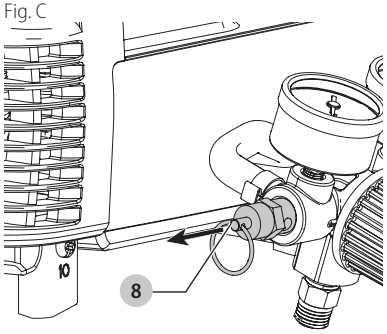
Cómo verificar la válvula de seguridad (Fig. C)

ADVERTENCIA: Riesgo de Explosión. Si la válvula de seguridad no trabaja adecuadamente, ello podrá determinar la sobrepresión del tanque, creando el riesgo de su ruptura o explosión.

ADVERTENCIA: Riesgo de objetos despedidos. Utilice siempre equipo de seguridad certificado: anteojos de seguridad ANSI Z87.1 (CAN/ CSA Z94.3) con protección lateral.

Antes de poner en marcha el motor, tire del anillo de la válvula de seguridad 8 para confirmar que opera libremente. Si la válvula quedase trabada o no trabajara suavemente, debe reemplazarse por el mismo tipo de rdar el compresor de aire.

Fig. C



Cómo drenar el tanque (Fig. A, D)

ADVERTENCIA: Riesgo de operación insegura. Los tanques de aire contienen aire de alta presión. Mantenga la cara y otras partes del cuerpo lejos de la salida del drenaje. Utilice anteojos de seguridad [ANSI Z87.1 (CAN/CSA Z94.3)], ya que al drenar se pueden desprender residuos hacia la cara.

ADVERTENCIA: Riesgo de ruido excesivo. Utilice siempre protección auditiva apropiada al usar esta herramienta. Bajo algunas condiciones y duraciones de uso, el ruido producido por este producto puede contribuir a la pérdida auditiva.

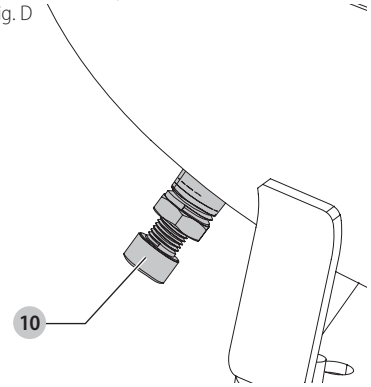
NOTA: Todos los sistemas de aire comprimido generan condensación que se acumula en cualquier punto de drenaje (por ejemplo, tanques, filtro, posenfriadores, secadores). Esta condensación contiene aceite lubricante y/o sustancias que pueden estar reguladas y que se deben desechar conforme a las leyes y reglamentaciones locales, estatales y federales.

ADVERTENCIA: Riesgo de Explosión. Dentro del tanque se producirá condensación de agua. Si no drena, el agua lo corroerá y debilitará causando un riesgo de ruptura del tanque de aire.

AVISO: *Riesgo de daño a la propiedad. Drene el agua del tanque de aire puede contener aceite y óxido, lo que puede provocar manchas.*

1. Coloque la posición de la llave interruptora On/Off **4** en la posición "Off".
2. Gire la perilla del regulador **7** contra el sentido del reloj para regular la presión de la salida a cero.
3. Remueva la herramienta neumática o el accesorio.
4. Coloque un contenedor adecuado debajo de la válvula de drenaje para contener la descarga.
5. Tire del aro de la válvula de seguridad **8** dejando purgar el aire del tanque hasta que este reduzca su presión aproximadamente a 20 psi. Suelte el aro de la válvula de seguridad.
6. Drene el agua contenida en el tanque de aire, abriendo la válvula de drenaje **10** (sentido antihorario) ubicada en la base del tanque.

Fig. D



7. Una vez drenada el agua, cierre la válvula de drenaje (sentido horario). Ahora el compresor de aire podrá ser guardado.

NOTA: Si la válvula está obstruida, libere toda la presión de aire del tanque. Así podrá quitar, limpiar y volver a instalar la válvula.

Limpieza

ADVERTENCIA: *Sople la suciedad y el polvo de todos los conductos de ventilación con aire seco, al menos una vez por semana. Para reducir el riesgo de lesiones, utilice siempre protección para los ojos aprobada ANSI Z87.1 al realizar esta tarea.*

ADVERTENCIA: *Nunca utilice solventes ni otros químicos abrasivos para limpiar las piezas no metálicas de la herramienta. Estos productos químicos pueden debilitar los materiales plásticos utilizados en estas piezas. Utilice un paño humedecido sólo con agua y jabón neutro. Nunca permita que penetre líquido dentro de la herramienta ni sumerja ninguna de las piezas en un líquido.*

Reparaciones

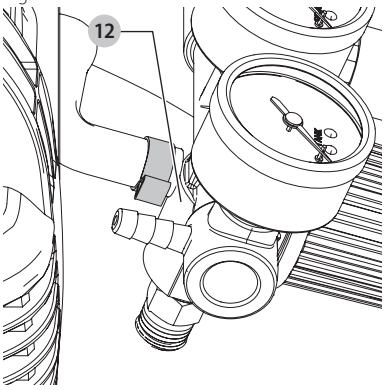
ADVERTENCIA: *Para asegurar la SEGURIDAD y la CONFIABILIDAD del producto, las reparaciones, el mantenimiento y los ajustes (inclusive la inspección y el cambio de las escobillas, cuando proceda) deben ser realizados en un centro de mantenimiento autorizado. Utilice siempre piezas de repuesto idénticas.*

ADVERTENCIA: *Riesgo de Operación Insegura. La unidad arranca automáticamente cuando está enchufada. Al hacer el mantenimiento, el operador puede quedar expuesto a fuentes de corriente y de aire comprimido o a piezas movibles. Antes de intentar hacer reparaciones, desconectar el compresor del tomacorriente, drenar la presión de aire del tanque y esperar a que el compresor se enfríe.*

Para reemplazar el regulador (Fig. A, E)

1. Drene la presión del tanque de aire. Vea las instrucciones para el ***Drenaje del tanque*** de aire en la sección **Mantenimiento**.
2. Desenchufe la unidad.
3. Extraiga el cubierta de la consola **14**.
4. Usando una llave de tuercas regulable, saque la válvula de seguridad **8** del regulador del múltiple **7**.
5. Saque la manguera quitándole la abrazadera **12**.
   NOTA: La abrazadera no es reutilizable; debe comprar otra nueva.

Fig. E



6. Quite los tres tornillos de montaje de la bomba **15** que sujetan la bomba.
7. Levante la bomba cuidadosamente de los soportes y retírela del camino.
8. Usando una llave de tuercas regulable o una de saque el múltiple del regulador **7**.
9. Aplique sellador para tuberías en el nuevo múltiple del regulador y ensamble ajustando con la llave.

10. Vuelva a aplicar sellador para tuberías a la válvula de seguridad.
11. Re-ensamble todos los componentes en orden inverso al que se sacaron. Asegúrese de orientar los medidores correctamente para que puedan leerse y ajuste todos los componentes con las llaves.

Almacenaje

Antes de guardar su compresor de aire, asegúrese de hacer lo siguiente:

1. Revise la sección **Mantenimiento** de las páginas precedentes y ejecute el mantenimiento programado de acuerdo a la necesidad.
2. Drene el agua contenida en el tanque de aire. Consulte el punto ***Cómo drenar el tanque*** en la sección **Mantenimiento**.

ADVERTENCIA: Riesgo de Explosión. El agua se condensa dentro del tanque de aire. Si no se drena, lo corroerá debilitando la paredes del tanque de aire, originando un riesgo de ruptura de sus paredes.

3. Proteja el cable eléctrico y las mangueras de aire de daños (tales como ser pisoteados o pasados por encima). Enróllelos las mangueras de aire en forma florja, alrededor de la manija del compresor. Enrolle el cable eléctrico alrededor del enrollador de cable.
4. Almacene el compresor de aire en un sitio limpio y seco.

Accesorios

ADVERTENCIA: *Debido a que no se han probado con este producto otros accesorios que no sean los que ofrece CRAFTSMAN , el uso de dichos accesorios con esta herramienta podría ser peligroso. Para reducir el riesgo de lesiones, con este producto deben usarse sólo los accesorios recomendados por CRAFTSMAN .*

Los accesorios que se recomiendan para utilizar con la herramienta están disponibles a un costo adicional en su distribuidor local o en un centro de mantenimiento autorizado. Si necesita ayuda para localizar algún accesorio, póngase en contacto con Craftsman. Tool Co., 701 East Joppa Road, Towson, MD 21286, llame al **1-888-331-4569** o visite nuestro sitio web: www.craftsman.com/registration.

Para reparación y servicio de sus herramientas eléctricas, favor de dirigirse al Centro de Servicio más cercano

CULIACAN, SIN

Blvd. Emiliano Zapata 5400-1 Poniente Col. San Rafael (667) 717 89 99

GUADALAJARA, JAL

Av. La Paz #1779 - Col. Americana Sector Juárez (33) 3825 6978

MEXICO, D.F.

Eje Central Lázaro Cárdenas No. 18 - Local D, Col. Obrera (55) 5588 9377

MERIDA, YUC

Calle 63 #459-A - Col. Centro (999) 928 5038

MONTERREY, N.L.

Av. Francisco I. Madero 831 Poniente - Col. Centro (818) 375 23 13

PUEBLA, PUE

17 Norte #205 - Col. Centro (222) 246 3714

QUERETARO, QRO

Av. San Roque 274 - Col. San Gregorio (442) 2 17 63 14

SAN LUIS POTOSI, SLP

Av. Universidad 1525 - Col. San Luis (444) 814 2383

TORREON, COAH

Blvd. Independencia, 96 Pte. - Col. Centro (871) 716 5265

VERACRUZ, VER

Prolongación Díaz Mirón #4280 - Col. Remes (229) 921 7016

VILLAHERMOSA, TAB

Constitución 516-A - Col. Centro (993) 312 5111

PARA OTRAS LOCALIDADES:

Si se encuentra en México, por favor llame al (55) 5326 7100

Si se encuentra en U.S., por favor llame al 1-888-331-4569

Póliza de Garantía

IDENTIFICACIÓN DEL PRODUCTO:

Sello o firma del Distribuidor.

Nombre del producto: _____

Mod./Cat.: _____

Marca: _____

Núm. de serie: _____

(Datos para ser llenados por el distribuidor)

Fecha de compra y/o entrega del producto:

_____

Nombre y domicilio del distribuidor donde se adquirió el producto:

_____

Este producto está garantizado por un año a partir de la fecha de entrega, contra cualquier defecto en su funcionamiento, así como en materiales y mano de obra empleados para su fabricación. Nuestra garantía incluye la reparación o reposición del producto y/o componentes sin cargo alguno para el cliente, incluyendo mano de obra, así como los gastos de transportación razonablemente erogados derivados del cumplimiento de este certificado.

Para hacer efectiva esta garantía deberá presentar su herramienta y esta póliza sellada por el establecimiento comercial donde se adquirió el producto, de no contar con ésta, bastará la factura de compra.

Excepciones

Esta garantía no será válida en los siguientes casos:

- *Cuando el producto se hubiese utilizado en condiciones distintas a las normales;*
- *Cuando el producto no hubiese sido operado de acuerdo con el instructivo de uso que se acompaña;*
- *Cuando el producto hubiese sido alterado o reparado por personas distintas a las enlistadas al final de este certificado.*

Anexo encontrará una relación de sucursales de servicio de fábrica, centros de servicio autorizados y franquiciados en la República Mexicana, donde podrá hacer efectiva su garantía y adquirir partes, refacciones y accesorios originales.

Solamente para propósito de México:
Importado por:Craftsman. Tool Co. S.A. de C.V.
Avenida Antonio Dovali Jaime, # 70 Torre B Piso 9
Colonia La Fe, Santa Fé
Código Postal : 01210
Delegación Alvaro Obregón
México D.F.
Tel. (52) 555-326-7100
R.F.C.: BDE810626-1W7

Registro en línea

Gracias por su compra. Registre su producto ahora para:

- **SERVICIO EN GARANTÍA:** Si completa esta tarjeta, podrá obtener un servicio en garantía más eficiente, en caso de que exista un problema con su producto.
- **CONFIRMATCIÓN DE PROPIEDAD:** En caso de una pérdida que cubra el seguro, como un incendio, una inundacíon o un robo, el registro de propiedad servirá como comprobante de compra.
- **PARA SU SEGURIDAD:** Si registra el producto, podremos comunicarnos con usted en el caso improbable que se deba enviar una notificación de seguridad conforme a la Federal Consumer Safety Act (Ley Federal de Seguridad de Productos para el Consumidor).

Registro en línea en **www.craftsman.com/registration**.

Garantía limitada de un año

CRAFTSMAN reparará o reemplazará, sin cargo, cualquier defecto debido a materiales o mano de obra defectuosos por un año desde la fecha de compra. Esta garantía no cubre falla de partes debido al desgaste normal o abuso de la herramienta. Para detalles adicionales de la cobertura de la garantía e información de reparación de garantía, visite **www.craftsman.com** o llame al **1-888-331-4569**. Esta garantía no se aplica a accesorios o daño causado cuando otros hayan realizado o intentado reparaciones. ESTA GARANTÍA LIMITADA SE OTORGA EN LUGAR DE TODAS LAS DEMÁS, INCLUIDA LA GARANTÍA IMPLÍCITA DE COMERCIABILIDAD E IDONEIDAD PARA UN PROPÓSITO EN PARTICULAR, Y EXCLUYE TODOS LOS DAÑOS INCIDENTALES O EN CONSECUENCIA. Algunos estados no permiten limitaciones sobre la duración de una garantía implícita o la exclusión o limitación de daños incidentales o en consecuencia, por lo que estas limitaciones pueden no aplicarse en su caso. Esta garantía le da derechos legales específicos y puede tener otros derechos que varían en ciertos estados o provincias..

GARANTÍA DE REEMBOLSO DE SU DINERO POR 90 DÍAS

Si no está completamente satisfecho con el desempeño de su máquina herramienta o clavadora CRAFTSMAN, cualquiera sea el motivo, podrá devolverlo hasta 90 días de la fecha de compra con su recibo y obtener el reembolso completo de su dinero – sin necesidad de responder a ninguna pregunta.

AMÉRICA LATINA: Esta garantía no se aplica a los productos que se venden en América Latina. Para los productos que se venden en América Latina, debe consultar la información de la garantía específica del país que viene en el empaque, llamar a la compañía local o visitar el sitio Web a fin de obtener esa información.

GUÍA DE DIAGNÓSTICO DE PROBLEMAS

ADVERTENCIA: El desarrollo de reparaciones puede exponer a sitios con corriente viva, partes en movimiento o fuentes de aire comprimido que podrían ocasionar lesiones personales. Antes de intentar reparación alguna, desenchufe el compresor de aire y purgue toda la presión de aire del tanque.

PROBLEMA	CAUSA	CORRECCIÓN
Presión excesiva del tanque - la válvula de seguridad se dispara.	El interruptor de presión no interrumpe al motor cuando el compresor alcanza la presión "de corte"	Mueva la palanca On/Off a la posición "Off", si el equipo no corta, contacte a un técnico calificado para el servicio.
	El interruptor de presión "de corte" esta calibrado demasiado alto.	Contacte a un técnico de servicio calificado.
Las conexiones pierden aire.	Las conexiones de los tubos no están suficientemente ajustadas.	Ajuste las conexiones en las que el aire puede ser escuchado escapándose. Verifique las conexiones con solución jabonosa y agua. **No sobreajuste.**
Pérdida de aire en el tanque de aire o en las soldaduras del tanque de aire.	Tanque de aire defectuoso.	El tanque de aire debe ser reemplazado. No repare la perdida. ***ADVERTENCIA: No efectúe perforación alguna sobre la soldadura o cosa semejante sobre el tanque de aire, ello lo debilitará. El tanque podría romperse o explotar.***
Pérdida de aire entre el cabezal y el plato de válvula.	Pérdida en el sellado.	Contacte a un técnico calificado en servicio.
Pérdida de aire en la válvula de seguridad.	Posible defecto en la válvula de seguridad.	Opere la válvula de seguridad manualmente tirando de su anillo. Si la válvula aun pierde, deberá ser reemplazada.
Golpeteo.	Posible defecto en la válvula de seguridad.	Opere la válvula de seguridad manualmente tirando de su anillo. Si la válvula aun pierde, deberá ser reemplazada.
La lectura de la presión sobre un manómetro desciende cuando se utiliza un accesorio.	Es normal que ocurra algún descenso en la presión.	Si hubiese una caída excesiva de presión durante el uso del accesorio, ajuste el regulador de ***Descripción de operaciones*** de la sección **Operación**. **NOTA:** Ajuste la presión regulada bajo condiciones de flujo (mientras se esté usando el accesorio).
El compresor no esta suministrando suficiente cantidad de aire para operar los accesorios.	Excesivo y prolongado uso del aire.	Disminuya la cantidad de uso de aire.
	El compresor no tiene suficiente capacidad para el requerimiento de aire al que está sometido.	Verifique el requerimiento de aire del accesorio. Si es mayor que SCFM o la presión suministrada por su compresor de aire, se necesita un compresor de mayor capacidad.
	Orificio en la manguera.	Verifique y reemplace si fuese necesario.
	Válvula reguladora restringida.	Contacte a un técnico de servicio calificado.
	Pérdida de aire.	Ajuste las conexiones.
El regulador tiene una fuga continua de aire.	Regulador dañado.	Reemplace.
El regulador no cierra la salida del aire.	Regulador dañado.	Reemplace.
El motor no funciona.	Fusible fundido; interruptor automático del circuito disparado.	Verifique la caja de fusibles observando la existencia de fusibles fundidos y sustitúyalos en caso de necesidad. Restablezca el interruptor automático. No use un fusible o interruptorautomático con valores que excedan los especificados para la rama de su circuito.
		Verifique el uso del fusible adecuado. Debe usarse un fusible de acción retardada.
		Verifique la existencia de problemas con el bajo voltaje.
		Verifique la extensión del conductor eléctrico.
		Desconecte los otros artefactos eléctricos del circuito u opere el compresor en su ramal de circuito correspondiente.
	El cable de extensión eléctrica tiene una longitud o calibre erróneo.	Verifique la extensión del conductor eléctrico.
	Conexiones eléctricas sueltas.	Verifique la conexión en la caja terminal.
	Falla el motor.	Haga verificar por un técnico de servicio calificado.
	Se activó el interruptor de sobrecarga del motor	Consulte ***Protector de sobrecalentamiento del motor*** en la sección **Operación**. Si la protección de la sobrecarga del motor dispara con frecuencia, comuníquese con un técnico de servicio calificado.

Craftsman,
701 East Joppa Road,
Towson, MD 21286
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03/18

Part No. N552169

Section 3.7.2

Space Heater

Section 3.7.2.1

Space Heater – Explosion Proof

ISO 9001:2015 CERTIFIED

Hazloc Heaters™

Safe heat when you need it!



CSA® C US 235730

Includes our EXCaliber™ HEAT EXCHANGER CORE

XEU1

New features and options now available!

Explosion-Proof Electric Air Heater For Hazardous Locations

Class I, Division 1 & 2, Groups C & D
Class II, Division 1 & 2, Groups F & G
Temperature Code T3B (3kW/35kW = T3A)

Class I, Zone 1 & 2, Groups IIA & IIB, T3

www.HazlocHeaters.com

Hazloc Heaters™ is a manufacturer of industrial-grade unit heaters suitable for hazardous and severe-duty locations.



The **XEU1** series of explosion-proof electric air heaters is designed to meet the most demanding requirements of heavy industry. The harsh operating conditions of this industry require heating equipment that is safe, reliable, dependable, and available when you need it. **XEU1** unit heaters are designed to provide primary or supplementary heating for comfort or freeze protection in areas that are classified as hazardous locations (Gas and Dust atmospheres).

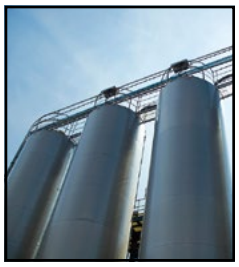
Designed for hazardous locations!

All ***Hazloc Heaters™*** **XEU1** models are **designed to meet U.S. and Canadian certification standards and the spark-resistant fan assembly is also compliant to AMCA 99-10, Type B.** The three sizes of **XEU1** heaters include our ***ExCaliber™*** high performance liquid-to-air heat-exchanger cores that are available in **35 model choices** of voltage and heat output combinations to meet your specific requirements.

The rugged and versatile **XEU1** heater incorporates a high quality immersion heater, high performance fan and motor assembly, a sturdy 14 GA steel cabinet with epoxy/polyester powder-coating for corrosion resistance, large control enclosure with an extra port for convenient wiring of an external room thermostat, and enclosure O-rings to minimize moisture ingress.



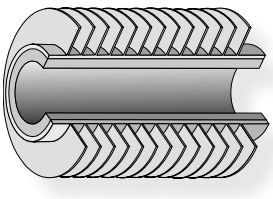
XEU1 heaters are suitable for a wide variety of applications that include but are not limited to oil & gas drilling rigs, petrochemical facilities, refineries, chemical storage and handling facilities, paint storage areas, sewage treatment plants, aircraft servicing areas, grain elevators, coal preparation areas, and other areas containing combustible dusts (flour, wood, plastics, chemicals, etc.).



Rugged design, but easily maintained!

All **XEU1** heaters are designed for industrial applications with all features being heavy-duty to meet your most demanding environments and long-life expectations. Even with heavy-gauge steel construction used throughout the heater it does not inhibit maintenance of the product since the **XEU1** has been designed for easy field servicing with a removable heat exchanger core assembly, split fan guard, and replaceable automatic and manual reset high-limits. An added benefit is our 36-month heater warranty!

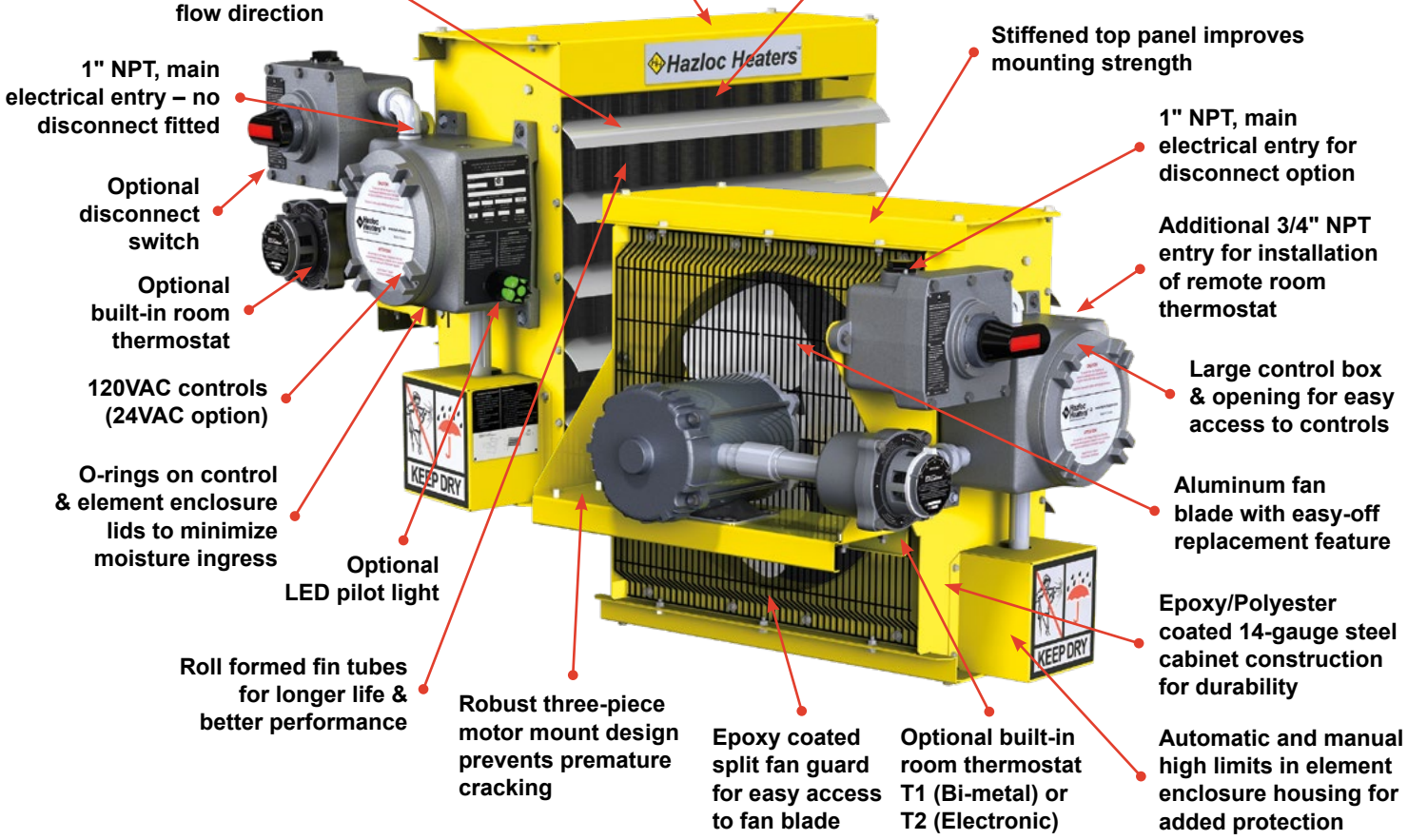
Maximum durability… rugged fin tubes!



All **XEU1** ***ExCaliber™*** liquid-to-air heat-exchanger cores are evacuated & sealed and are constructed using rugged carbon-steel tubes with copper-free, roll-formed aluminum fins to maximize heat transfer and carbon-steel headers for **maximum durability, resistance to corrosion, and longer life** in your demanding applications.

"Safe heat when you need it!"

Dedicated to Performance and Reliability!



C US 235730

NOTE: XEU1 heaters must not be exposed to rain or snow. This applies to both installed and stored heaters.

Suitable for the following hazardous location classifications:

- **Class I, Division 1 & 2, Groups C & D, T3B (3kW/35kW = T3A)**
- **Class II, Division 1 & 2, Groups F & G, T3B (3kW/35kW = T3A)**
- **Class I, Zone 1 & 2, Groups IIA & IIB, T3**

Limited 36-month Warranty



The ***ExCaliber***™ vacuum sealed liquid-to-air heat exchanger core is constructed using rugged, copper-free, roll-formed aluminum fins and protected by a pressure relief device, automatic reset high limit, and a back-up manual reset high limit.

The **XEU1** heater has the highest air temperature rise, on average, in the industry across our complete kW range.

ExCaliber™ heat-exchanger core is easy to remove

XEU1 Model Coding

Heater Model Code & Option Codes

Model Code												Option Codes
XEU	1	-	12	-	100	-	480	3	60	-	A	-	Y	-	B	T1, D, P, etc.

(stamped on separate field of data plate)

Model Series

Generation
For major revisions

Fan Size	
12 inches	12
16 inches	16
20 inches	20

Power Output		
3 kW	030	12 inch fan size
5 kW	050	12 inch fan size
7.5 kW	075	12 inch fan size
10 kW	100	12 inch fan size
15 kW	150	16 inch fan size
20 kW	200	16 inch fan size
25 kW	250	20 inch fan size
30 kW	300	20 inch fan size
35 kW	350	20 inch fan size

Heater Line Voltage		
208 Volts	208	3 to 15 kW sizes only
240 Volts	240	3 to 15 kW sizes only
480 Volts	480	All kW sizes
600 Volts	600	All kW sizes

Δ Contact factory for extended shipping lead time on Heresite coatings.

Product Revision No.
For minor revisions

Factory Built-in Options	
N	No options selected
Y	Yes, options selected

Options Codes (stamped on separate field of data plate)	
T1	Thermostat, Bi-metal **(BTX1-N-A)**
T2	Thermostat, Electronic **(XET1-1-N-A)**
D	Disconnect Switch
P	Pilot Light **(Heat On)**
F	Continuous Fan
H1Δ	Heresite Core
H2Δ	Heresite Cabinet
H3Δ	Heresite Core/Cabinet

Refer to page 8 for description >

Refer to Page 8 for description >
(Only available when 24VAC control voltage is selected)

Includes louvers & fan blade >

Includes louvers & fan blade >

Control Voltage	
A	120VAC
B	24VAC (safer)

Frequency	
60	60 Hertz

Phase	
1	1 Phase
3	3 Phase

Refer to Page 7 for availability
All kW sizes



Model Code Format

When requesting a quote or ordering refer to Page 7 and then please follow the **"Model Code"** format above.

Example:

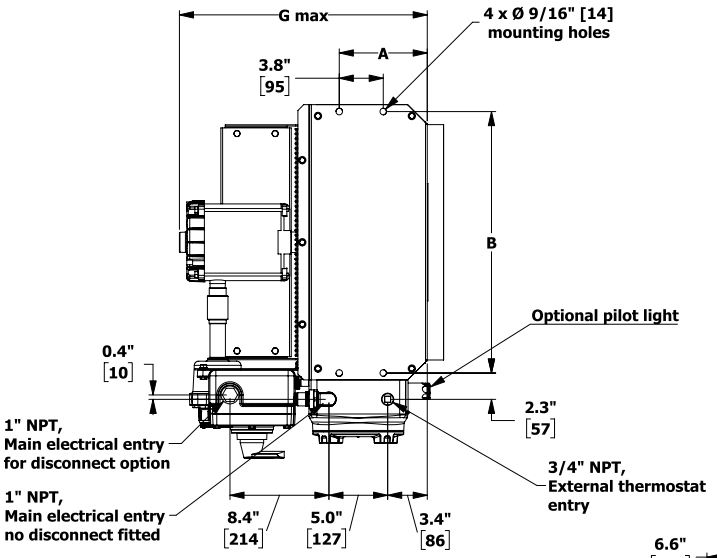
Model Code: **XEU1-12-100-480360-A-Y-B**

Option Code: **T1, D, P**

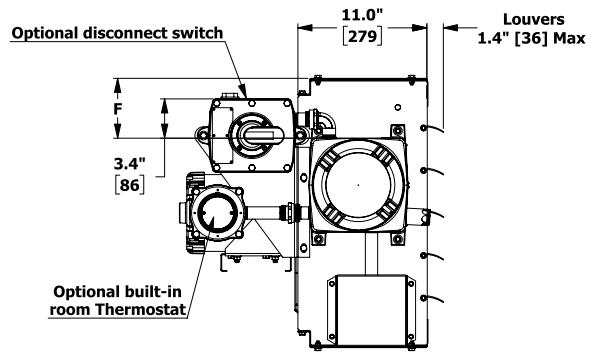
XEU1 Specifications By Model Size

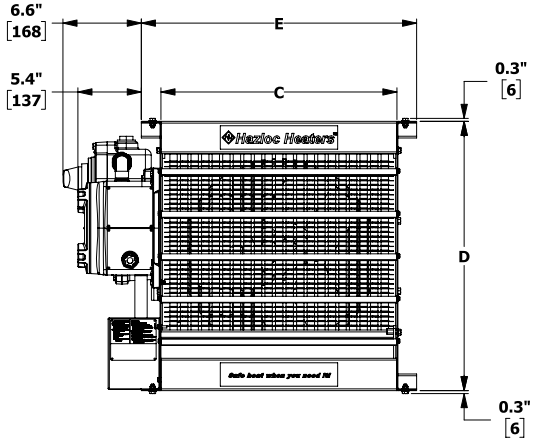
Model		XEU1-12				XEU1-16		XEU1-20		
Fan diameter	in (mm)	12 (304.8)				16 (406.4)		20 (508.0)		
Nominal kW		3	5	7.5	10	15	20	25	30	35
Air delivery	cfm m³/hr	350 595	400 680	600 1019	800 1359	1200 2039	1700 2888	2100 3568	3000 5097	3000 5097
Approximate air velocity	fpm m/s	422 2.1	479 2.4	718 3.6	958 4.9	808 4.1	1145 5.8	916 4.6	1309 6.6	1309 6.6
Approximate horizontal air throw	ft m	13 3.9	15 4.6	22 6.7	30 9.1	33 10.1	46 14.0	41 12.5	61 18.6	61 18.6
Motor power	hp (watts)	¼ (186)				¼ (186)		½ (373)		
Maximum mounting height (to underside of heater)	ft m	7 2.1	7 2.1	7.5 2.3	9.5 2.9	10 3.0	11 3.4	12 3.6	15 4.6	15 4.6
Approximate net weight (without disconnect) (with disconnect)	 lbs (kg) lbs (kg)	 129 (58.5) 142 (64.4)			 133 (60.3) 146 (66.2)	 161 (73.0) 174 (78.9)		 192 (87.1) 205 (92.9)		
Approximate shipping weight (without disconnect) (with disconnect)	 lbs (kg) lbs (kg)	 188 (85.3) 201 (91.2)			 192 (87.1) 205 (93.0)	 224 (101.6) 237 (107.5)		 261 (118.4) 274 (124.3)		
Wood crate dimensions Wood packaging material is in compliance with ISPM No. 15.	W x D x H in mm	31.5 x 29.5 x 29.25 800 x 749 x 743				35.5 x 29.5 x 31.75 902 x 749 x 806		39.5 x 29.5 x 35.75 1003 x 749 x 908		

XEU1 Physical Dimensions



Heater Size	12 (3-10kW)	16 (15-20kW)	20 (25-35kW)
Dim.	Inches (mm)	Inches (mm)	Inches (mm)
A	7.5 (191)	7.5 (191)	7.5 (191)
B	18.2 (462)	22.3 (566)	26.3 (668)
C	16.3 (414)	20.3 (516)	24.3 (617)
D	19.0 (483)	23.0 (584)	27.0 (686)
E	19.5 (495)	23.5 (597)	27.5 (699)
F	3.1 (79)	5.1 (130)	7.1 (180)
G	22.3 (566)	22.3 (566)	23.3 (592)





XEU1 General Specifications

	Certification	$_{c}CSA_{US}$ 235730 - Certified to Canadian and U.S. standards
Approvals	North American Hazardous Location Classifications	Class I, Division 1 & 2, Groups C & D Class II, Division 1 & 2, Groups F & G Temperature Code T3B (3kW/35kW =T3A) Class I, Zone 1 & 2, Groups IIA & IIB, T3
	Temperature Code	Division System - T3B 165°C (329°F); [3kW/35kW = T3A 180°C (356°F)] Zone System - T3 200°C (392°F)
Cabinet	Cabinet Material	14-gauge (0.075 in.) (1.9 mm) steel. Yellow epoxy/polyester powder coated with five-stage pretreatment, including iron phosphate.
	Fan Guard	Split design with close wire spacing. A 3/8 in. (9.5 mm) diameter probe will not enter. Black polyester powder coated.
	Louver Blades	Anodized extruded aluminum.
	Conduit Materials & Fittings	Plated steel and aluminum alloy for corrosion resistance.
	Fasteners	Zinc plated steel for corrosion resistance.
	Enclosures	Cast aluminum (non-copper alloy) NEMA 7 & 9 type with O-ring.
	Mounting Holes	9/16" diameter holes – Four located on the top face of heater.
Motor/Fan	Motor Type	Explosion-proof, thermally protected, 1725 RPM permanently lubricated ball bearing type with 56 frame and "easy-off" fan blade replacement feature.
	Fan	Three-blade spark-resistant aluminum, steel spider and hub with 5/8 in. bore.
	Fan Shroud	Spark-resistant aluminum. Compliant to AMCA 99-10, Type B.
Heat Exchanger	Heating Elements	Long-life, low watt-density, high grade metal-sheathed
	Heat Transfer Fluid	Ethylene glycol and water including corrosion inhibitors.
	Header Material	Carbon steel.
	ExCaliber™ Core	Carbon steel headers and element housing with O-ring. Fin tubes are carbon steel tubes with copper-free, roll-formed aluminum fins @ 10 fins per in. Vacuum sealed. Coated with black, high-heat enamel.
Protection	Temperature High Limits	One automatic reset rated for 100,000 cycles, and one manual reset. Both are snap-action bimetal type, open on temperature rise.
	Pressure Relief	High-quality stainless steel pressure relief device.
Controls	Control Circuit	Built-in 120VAC or 24VAC control (24VAC recommended).
	Control Contactor	40 FLA (50A resistive per pole) Definite Purpose. Rated for 500,000 mechanical operations.
	Control Transformer	Multitap primary, 120VAC or 24VAC secondary.
	Fuse Protection	Thermal delay fuse with spare, .25" x 1.25" , 120VAC = 1/4A, 24VAC = 1A.
	Room Thermostat With Lockable Temperature Dial (option code T1 or T2)	Built-in, **BTX1-N-A (T1) or XET1-1-N-A (T2)** explosion-proof thermostat, 40°F to 80°F (5°C to 25°C). Conduit is factory sealed between enclosures. Wall mount thermostats also available. See Page 8. *Note: Optional **BLK1-N-A** thermostat conversion kit allows simple interchangeability from a built-in to a wall mount configuration.*
Load Isolation	Disconnect Switch (option code D)	Built-in, **XDC-01** explosion-proof disconnect switch, 600VAC, 50A max with lock-out feature. Conduit is factory sealed between enclosures. Also available in a wall mount version.
Additional Options	Pilot Light (option code P)	Built-in "Heat on" Green LED pilot light with lens guard.
	Continuous Fan (option code F)	Continuous fan operation. Circulates air and prevents gas pockets from forming.
	Heresite Coating (option code H1, H2, H3)	H1 = Heresite Core; or H2 = Heresite Cabinet (includes louvers & fan blade); or H3 = Heresite Core and Cabinet. *Note: Contact factory for Heresite delivery lead time.*
Operating Limits	Ambient Temperature	-40°F to 104°F (-40°C to 40°C). Storage: -58°F to 140°F (-50°C to 60°C)
	Maximum Altitude	10,000 ft (3048 m) above sea level.

XEU1 Heater Performance Data

kW (btu/hr)	Line Volts	Ø	Fan Dia. in.	Model See page 4 to complete model coding	Temperature Classification Code	Total Current A	Air Temp. Rise °F	Air Temp. Rise °C
3 (10236)	208	1	12	XEU1-12-030-208160 *	T3A	16.7	32.2	18.0
	240	1	12	XEU1-12-030-240160 *	T3A	14.9	32.2	18.0
	208	3	12	XEU1-12-030-208360 *	T3A	9.4	32.2	18.0
	240	3	12	XEU1-12-030-240360 *	T3A	8.3	32.2	18.0
	480	3	12	XEU1-12-030-480360 *	T3A	4.2	32.2	18.0
	600	3	12	XEU1-12-030-600360 *	T3A	3.3	32.2	18.0
5 (17060)	208	1	12	XEU1-12-050-208160 *	T3B	26.3	44.0	24.5
	240	1	12	XEU1-12-050-240160 *	T3B	23.2	44.0	24.5
	208	3	12	XEU1-12-050-208360 *	T3B	15.0	44.0	24.5
	240	3	12	XEU1-12-050-240360 *	T3B	13.1	44.0	24.5
	480	3	12	XEU1-12-050-480360 *	T3B	6.6	44.0	24.5
	600	3	12	XEU1-12-050-600360 *	T3B	5.2	44.0	24.5
7.5 (25590)	208	1	12	XEU1-12-075-208160 *	T3B	38.4	42.5	23.7
	240	1	12	XEU1-12-075-240160 *	T3B	33.7	42.5	23.7
	208	3	12	XEU1-12-075-208360 *	T3B	21.9	42.5	23.7
	240	3	12	XEU1-12-075-240360 *	T3B	19.1	42.5	23.7
	480	3	12	XEU1-12-075-480360 *	T3B	9.6	42.5	23.7
	600	3	12	XEU1-12-075-600360 *	T3B	7.6	42.5	23.7
10 (34120)	240	1	12	XEU1-12-100-240160 *	T3B	44.1	41.8	23.2
	208	3	12	XEU1-12-100-208360 *	T3B	28.9	41.8	23.2
	240	3	12	XEU1-12-100-240360 *	T3B	25.2	41.8	23.2
	480	3	12	XEU1-12-100-480360 *	T3B	12.6	41.8	23.2
	600	3	12	XEU1-12-100-600360 *	T3B	10.1	41.8	23.2
15 (51180)	208	3	16	XEU1-16-150-208360 *	T3B	42.7	40.6	22.6
	240	3	16	XEU1-16-150-240360 *	T3B	37.2	40.6	22.6
	480	3	16	XEU1-16-150-480360 *	T3B	18.6	40.6	22.6
	600	3	16	XEU1-16-150-600360 *	T3B	14.9	40.6	22.6
20 (68240)	480	3	16	XEU1-16-200-480360 *	T3B	24.6	38.0	21.1
	600	3	16	XEU1-16-200-600360 *	T3B	19.7	38.0	21.1
25 (85300)	480	3	20	XEU1-20-250-480360 *	T3B	31.3	39.1	21.8
	600	3	20	XEU1-20-250-600360 *	T3B	25.1	39.1	21.8
30 (102360)	480	3	20	XEU1-20-300-480360 *	T3B	37.3	32.6	18.2
	600	3	20	XEU1-20-300-600360 *	T3B	29.9	32.6	18.2
35 (119420)	480	3	20	XEU1-20-350-480360 *	T3A	43.3	37.9	21.1
	600	3	20	XEU1-20-350-600360 *	T3A	34.7	37.9	21.1

(*) Refer to page 4 for Control Voltage and Factory Built-in Option codes to complete entire model code for ordering.

Nomenclature/Useful Formulas/Conversions

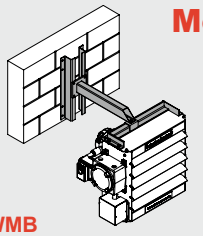
1 kW = 3,414 btu/hr; Final air temp. = Entering air temp. + Temp. rise; °C = 5/9 (°F - 32)

AC/DC Formulas			
To Find	**Direct Current**	**AC - 1 phase**	**AC - 3 phase**
Amps when horsepower is known	$\frac{HP \times 746}{E \times Eff}$	$\frac{HP \times 746}{E \times Eff \times PF}$	$\frac{HP \times 746}{1.73 \times E \times Eff \times PF}$
Amps when kilowatts is known	$\frac{kW \times 1000}{E}$	$\frac{kW \times 1000}{E \times PF}$	$\frac{kW \times 1000}{1.73 \times E \times PF}$
Amps when kVA is known	$\frac{KVA \times 1000}{E}$	$\frac{kVA \times 1000}{E}$	$\frac{kVA \times 1000}{1.73 \times E}$
Kilowatts	$\frac{I \times E}{1000}$	$\frac{I \times E \times PF}{1000}$	$\frac{I \times E \times 1.73\ PF}{1000}$
Kilovolt-Amps	$\frac{I \times E}{1000}$	$\frac{I \times E}{1000}$	$\frac{I \times E \times 1.73}{1000}$
Horsepower (output)	$\frac{I \times E \times Eff}{746}$	$\frac{I \times E \times Eff \times PF}{746}$	$\frac{I \times E \times Eff \times 1.73 \times PF}{746}$

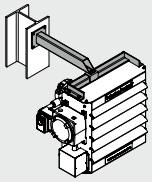
Where **I** = amps; **E** = phase-to-phase volts; **Eff** = efficiency expressed as a decimal; **PF** = power factor expressed as a decimal; **kW** = kilowatts; **KVA** = kilovolt amperes; **HP** = horsepower.

Accessories

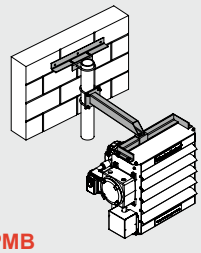
Mounting Brackets



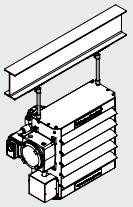
WMB
Wall Mounting Bracket
For use in buildings that have substantial walls. The Z sections provide additional support where necessary.



BMB
Basic Mounting Bracket
For applications where the support arm can be bolted or welded directly to structural steel or concrete.



PMB
Pipe Mounting Bracket
For buildings with insufficient strength to use other types of mounting brackets. Requires 3 in. pipe (3.5 in. O.D., min. Sch. 40, not supplied).



HMB
Hanging Mounting Bracket
Ideal and economical if adequate overhead structure exists. Requires 1/2 in. pipe, cut and threaded (min. Sch. 40 not supplied).

Note: When ordering mounting brackets, please specify the type of bracket preferred and the basic model code of the heater to be mounted. Example, **PMB-XEU1-16.** Mounting kits are made of carbon steel and coated with black enamel. Structural support of heater and bracket during transit is required.

Explosion-proof ExCaliber™ Series Thermostats, Remote Mount

BTX1-N-A (SPDT) Heating or Cooling (Bi-metal thermostat used on XEU1 heaters with built-in option code (T1) selected)

Class I, Division 1 & 2, Groups C & D
Class II, Division 1, Groups E, F & G
Class II, Division 2, Groups F & G; Class III; T6
-50°C ≤ T amb ≤ +40°C, IP66, Type 4
Class I, Zone 1 & 2, Ex db, Groups IIA, IIB, T6, Gb
Class I, Zone 1 & 2, AEx db, Groups IIA, IIB, T6, Gb
Class II, Zone 21 & 22, Ex tb, Groups IIIA, IIIB & IIIC, T85°C, Db
Class II, Zone 21 & 22, AEx tb, Groups IIIA, IIIB & IIIC, T85°C, Db



Temperature adjustment range: 40°F to 80°F (5°C to 25°C); 3/4" - NPT conduit opening on top and bottom; Ship wt - 3.5 lbs (1.6 kg)
22 Amps Resistive Load, 480VAC Max; 1/2HP @ 125VAC; 1HP @ 250VAC (suitable for 24VAC or 120VAC control circuit)

XET1-1-N-A (Electronic) Heating only (24VAC required)

Class I, Division 1 & 2, Groups B, C & D
Class II, Division 1, Groups E, F & G
Class II, Division 2, Groups F & G; Class III; T6
-50°C ≤ T amb ≤ +40°C, IP66, Type 4
Class I, Zone 1 & 2, Ex db, Groups IIA, IIB+H_2, T6, Gb
Class I, Zone 1 & 2, AEx db, Groups IIA, IIB+H_2, T6, Gb
Class II, Zone 21 & 22, Ex tb, Groups IIIA, IIIB & IIIC, T85°C, Db
Class II, Zone 21 & 22, AEx tb, Groups IIIA, IIIB & IIIC, T85°C, Db



Temperature adjustment range: 40°F to 80°F (5°C to 25°C); 3/4" – NPT conduit opening on top and bottom; Ship wt – 3.4 lbs (1.5 kg)
24VAC 50/60Hz; 1 Amp max continuous (suitable for 24 volt control circuit only)

BLK1-N-A Junction Box (Heater thermostat conversion kit)
The BLK1-N-A heater thermostat conversion kit allows simple interchangeability from a built-in to a wall mount configuration.



Explosion-proof Disconnect Switch, Remote Mount

XDC-01 (Disconnect switch used on XEU1 heaters with built-in option code (D) selected)
Class I, Division 1 & 2, Groups C & D; Class II, Division 1, Groups E, F & G; Class II, Division 2, Groups F & G; Class III
Class I, Zone 1 & 2, Grp IIA & IIB, T5
600V, 50A max;15 HP@208/240V, 3 phase; 30 HP@480/600V, 3 phase; 2 HP@120V, 1 phase; 7.5 HP@240V, 1 phase
Ship wt – 12.0 lbs (5.4 kg)



XEU1 Engineering Specifications

1.0 General

1.1 The explosion-proof unit heater(s) shall be supplied and installed, in accordance with the plans and specifications, with ratings as listed in the schedule of electrical heating equipment, and shall be Hazloc Heaters' XEU1 series.

1.2 The unit heater(s) shall be $_{C}CSA_{US}$ certified for use in Class I, Divisions 1 & 2, Groups C & D; Class II, Divisions 1 & 2, Groups F & G; and Class I, Zones 1 & 2, Groups IIA & IIB Hazardous Locations and shall be rated for National Electric Code and Canadian Electric Code Temperature Code T3B, 165°C (329°F); [3kW/35kW = T3A, 180°C (356°F)] for Division System and T3, 200°C (392°F) for Zone System.

2.0 Heat Exchanger

2.1 The Heat Exchanger shall be a liquid-to-air type consisting of steel tubes with integral aluminum fins @ 10 fins per inch and be evacuated, sealed and painted with black, high heat enamel.

2.2 The heat exchanger shall be protected by a high-quality stainless steel pressure relief device with no serviceable parts.

2.3 The Heat Exchanger shall be filled and sealed to design level with a custom-blended, long-life solution of ethylene-glycol and water including inhibitors to provide superior corrosion protection.

2.4 The Heat Exchanger shall include heavy-duty immersion heating elements brazed into a heavy steel flange. The elements shall consist of high-quality resistance wire embedded in a magnesium oxide refractory and sheathed in a metal tubing. The heater is to be protected by two snap-action bimetal temperature high-limit cutouts. The primary high-limit shall be an automatic reset type rated for 100,000 cycles, and the secondary high-limit a manual reset type and will shut off the heater if the fluid temperature rises due to a lack of heat dissipation. The high-limits shall not be effected by altitude or changes in atmospheric pressure.

3.0 Fan and Motor Assembly

3.1 The Fan Assembly shall include a ball bearing, permanently lubricated, thermally protected explosion-proof motor rated for continuous duty at 40°C (104°F). The motor shaft shall provide a method for easy field replacement of fan blade assembly without the use of special tools.

3.2 The Fan and Fan Shroud shall be aluminum to prevent sparking and be compliant to AMCA 99-10, Type B. The assembly shall be directly connected to the motor, dynamically balanced, and designed specifically for the heater application.

3.3 The Fan shall be shielded with a heavy-duty steel wire, polyester-coated guard. To provide easy maintenance and cleaning of the fan and motor, the fan guard shall be of a two piece construction. The guard shall not allow a 3/8 in. (9.5 mm) probe to enter.

4.0 Control Center

4.1 The Control Center shall be completely factory pre-wired and tested, and enclosed in a NEMA 7 and 9 type of explosion-proof control enclosure with O-ring and a large threaded cover for easy access.

4.2 The Control Center shall include a 40 FLA (50A resistive per pole) Definite Purpose magnetic contactor sized to handle the heater and motor current, and shall be rated for 500,000 cycles operation. The encapsulated severe-duty coil shall be rated 120VAC or 24VAC (specify one) and separately fuse protected.

4.3 The Control Center shall include a control voltage transformer, the primary voltage being the same as the heater voltage and the secondary to be 120VAC or 24VAC (specify one).

4.4 The Control Center shall include a terminal block for thermostat connection.

4.5 The Control Center shall include in-line thermal delay fuse protection on secondary side of transformer. The fuse holder shall be mounted on the printed circuit board and contain both an operating fuse and a spare fuse.

5.0 Cabinet Assembly

5.1 The Cabinet Assembly shall be fabricated from 14 gauge steel with a baked epoxy/polyester powder coating over a 5-stage pretreatment including iron phosphate, for protection from corrosive atmospheres.

5.2 The Cabinet shall include four 9/16 inch (14.3 mm) mounting holes located on top face of heater.

5.3 Louver blades shall be individually adjustable and made of anodized extruded aluminum.

6.0 Mounting Brackets

6.1 The heater shall be provided with a steel Mounting Bracket, coated with black enamel, specifically designed to bear the weight of the heater assembly.

6.2 The Mounting Bracket shall be – (select one):

- ☐ Type WMB – Wall Mounting Bracket
- ☐ Type BMB – Basic Mounting Bracket
- ☐ Type PMB – Pipe Mounting Bracket
- ☐ Type HMB – Hanging Mounting Bracket

7.0 Room Thermostat Options

7.1 The heater shall be supplied with (select one):

- ☐ Option Code T1. Built-in BTX1-N-A Bi-metal explosion-proof room thermostat mounted on the control enclosure side of the heater.
- ☐ Option Code T2. Built-in XET1-1-N-A Electronic explosion-proof room thermostat mounted on the control enclosure side of the heater (requires 24VAC control option).
- ☐ Field installed remote mount BTX1-N-A Bi-metal explosion-proof thermostat.
- ☐ Field installed remote mount XET1-1-N-A Electronic explosion-proof thermostat (requires 24VAC control option).

8.0 Disconnect Switch Options

8.1 The heater shall be supplied with (select one):

- ☐ Built-in XDC-01 explosion-proof disconnect switch mounted on the control enclosure side of the heater.
- ☐ Field installed remote mount XDC-01 explosion-proof disconnect switch.

9.0 Additional Options

9.1 The heater shall be supplied with (select one or more):

- ☐ Built-in Pilot light (Heat On) mounted on front of control enclosure.
- ☐ Continuous fan operation.
- ☐ Heresite coated core.
- ☐ Heresite coated cabinet (includes louvers & fan blade).

Guide to Hazardous Locations
North America/ATEX/IECEx

Classification of Divisions and Zones			
Hazard Level	**Division Scheme**	**Zone Scheme**	**Definitions**
Continuous Hazard	Division 1	Zone 0 / Zone 20	A location in which an explosive atmosphere is continually present.
Intermittent Hazard		Zone 1 / Zone 21	A location in which an explosive atmosphere is likely to occur in normal operation.
Hazard Under Abnormal Conditions	Division 2	Zone 2 / Zone 22	A location in which an explosive atmosphere is not likely to occur in normal operation, but may occur for short periods.

Atmosphere Groups			
Substance	**Hazard Class**	**Division Groups**	**Zone Groups**
Acetylene	Class I Flammable Gases	Group A	IIC
Hydrogen		Group B	IIB+H_2
Ethylene		Group C	IIB
Propane		Group D	IIA
Methane		Group D	IIA[#]
Combustible Metal Dusts	Class II Combustible Dusts	Group E*	IIIC
Combustible Carbonaceuous Dusts		Group F	IIIB
Combustible Dusts not in Group E or F (Flour, Grain, Wood, Plastics, Chemicals)		Group G	IIIB
Combustible Fibers and Flyings	Class III Fibers and Flyings	Not Applicable	IIIA

* Group E is applicable to Class II, Division 1 only
[#] Methane is a Group IIA gas for non-mining applications

Temperature Codes		
Max. Surface Temperature	**NEC® 500 / CEC®**	**NEC® 500 / IEC – Group II**
450°C (842°F)	T1	T1
300°C (572°F)	T2	T2
280°C (536°F)	T2A	
260°C (500°F)	T2B	
230°C (446°F)	T2C	
215°C (419°F)	T2D	
200°C (392°F)	T3	T3
180°C (356°F)	T3A	
165°C (329°F)	T3B	
160°C (320°F)	T3C	
135°C (275°F)	T4	T4
120°C (248°F)	T4A	
100°C (212°F)	T5	T5
85°C (185°F)	T6	T6

Note: Consult the current NEC and CEC codes for the latest technical and installation information

North American transition to the zone system

The U.S. and Canada have recently revised installation codes to recognize an international 3-Zone area classification system for equipment used in hazardous locations.

In Canada, all new installations must use the 3-Zone system. Existing installations may continue to use the 2-Division system or opt to re-classify using the 3-Zone system.

In the U.S., all installations (both new and existing) can either use the 2-Division system or use the 3-Zone system.

Additional Products Available

Hazloc Heaters™ offers a wide variety of steam/hydronic air heaters, explosion-proof electric air heaters, washdown/corrosion resistant air heaters, non-hazardous area air heaters, air sensing thermostats, disconnect switches and other related accessories.

Please visit **www.HazlocHeaters.com** and click on the *Products* link.



Hazloc Heaters™ ***"Safe heat when you need it!"***

Quality Mission Statement

Quality is… customers that come back, and products that don't.

Limited 36-Month Warranty

Hazloc Heaters™ warrants all **XEU1** series of explosion-proof electric heaters against defects in materials and workmanship under normal conditions of use for a period of thirty-six (36) months from date of purchase based on the following terms:

1. The heater must not be modified in any way.
2. The heater must be stored, installed and used only in accordance with the owner's manual and attached data plate information.
3. Replacement parts will be provided free of charge as necessary to restore any unit to normal operating condition, provided that the defective parts be returned to us freight prepaid and that the replacement parts be accepted freight collect.
4. The complete heater may be returned to our manufacturing plant for repair or replacement (at our discretion), freight charges prepaid.
5. Contamination by dirt, dust, etc. or corrosion will not be considered as defects.
6. This warranty shall be limited to the actual equipment involved and, under no circumstances, shall include or extend to installation or removal costs, or to consequential damages or losses.

Hazloc Heaters™

Safe heat when you need it!

Available from:

#1, 666 Goddard Ave. NE
Calgary, Alberta T2K 5X3 Canada
Tel.: +1-403-730-2488
Fax: +1-403-730-2482
Customer Toll Free (U.S. & Canada):
+1-866-701-Heat (4328)
www.HazlocHeaters.com

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Notes

1. Net weight

Without Disconnect Switch	With Disconnect Switch
3, 5 & 7.5kW = 129 lbs (58.5 kg)	3, 5 & 7.5kW = 142 lbs (64.4 kg)
10 kW = 133 lbs (60.3 kg)	10 kW = 146 lbs (66.2 kg)

2. Shipping Weight

Without Disconnect Switch	With Disconnect Switch
3, 5 & 7.5kW = 188 lbs (85.3 kg)	3, 5 & 7.5kW = 201 lbs (91.2 kg)
10 kW = 192 lbs (87.1 kg)	10 kW = 205 lbs (93.0 kg)

3. Ambient Temperature Limits and Altitude

Operating: -40°F to 104°F (-40°C to 40°C)
Storage: -58°F to 140°F (-50°C to 60°C)
Maximum Altitude: 10,000 ft (3048 m) ASL

4. Air Delivery

3 kW = 350 cfm (595 m^3/hr)
5 kW = 400 cfm (680 m^3/hr)
7.5 kW = 600 cfm (1019 m^3/hr)
10 kW = 800 cfm (1359 m^3/hr)

Note:
The fan shroud is made of spark resistant aluminum compliant to AMCA 99-10, Type B

5. Hazardous Location Classification

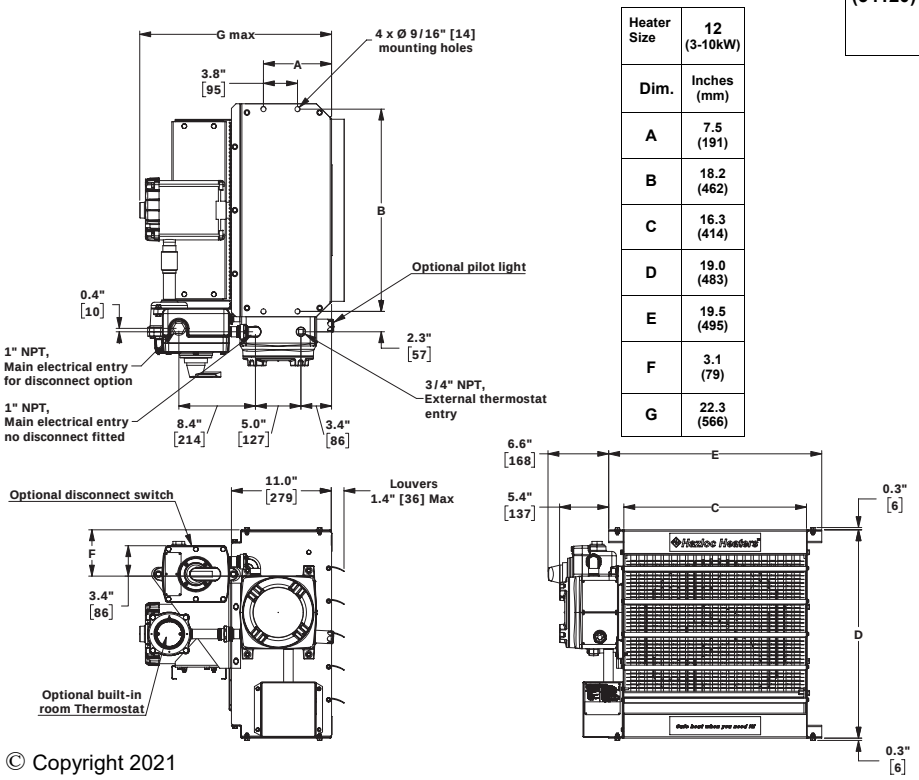
Class I, Divisions 1 & 2, Groups C & D
Class II, Divisions 1 & 2, Groups F & G
Temperature Code T3B (3kW = T3A)
Class I, Zones 1 & 2 , Groups IIA & IIB, T3

6. Materials

Cabinet: 14 Ga, Yellow Epoxy/Polyester Powder Coated
Core: Carbon Steel with Copper-free Integral Aluminum Fins Coated with Black, High Heat Enamel (Heresite coated core and/or cabinet available)

Table 1 Specifications For XEU1 Heater, 12" Fan Size With Available Options

KW (BTU/HR)	Line Volt	PH ø	Fan Dia. (inch)	Total Amps	Minimum Circuit Ampacity	Max Fuse Size	Supply Wire 90°C (AWG)	BASE MODEL	Control Voltage 120V or 24V		Built-in Thermostat T1 or T2		Built-in Disconnect Switch ☑	Built-in Pilot Light ☑	Continuous Fan ☑
									120 ☑	24 ☑	T1 ☑	T2 ☑			
3 (10236)	208	1	12	16.7	20.9	25	12	XEU1-12-030-208160	☐	☐	☐	☐	☐	☐	☐
		3		9.4	11.8	15	14	XEU1-12-030-208360	☐	☐	☐	☐	☐	☐	☐
	240	1		14.9	18.6	20	12	XEU1-12-030-240160	☐	☐	☐	☐	☐	☐	☐
		3		8.3	10.4	15	14	XEU1-12-030-240360	☐	☐	☐	☐	☐	☐	☐
	480	3		4.2	5.2	15	14	XEU1-12-030-480360	☐	☐	☐	☐	☐	☐	☐
	600	3		3.3	4.1	15	14	XEU1-12-030-600360	☐	☐	☐	☐	☐	☐	☐
5 (17060)	208	1	12	26.3	32.9	35	8	XEU1-12-050-208160	☐	☐	☐	☐	☐	☐	☐
		3		15.0	18.7	20	12	XEU1-12-050-208360	☐	☐	☐	☐	☐	☐	☐
	240	1		23.2	29.0	30	10	XEU1-12-050-240160	☐	☐	☐	☐	☐	☐	☐
		3		13.1	16.4	20	12	XEU1-12-050-240360	☐	☐	☐	☐	☐	☐	☐
	480	3		6.6	8.2	15	14	XEU1-12-050-480360	☐	☐	☐	☐	☐	☐	☐
	600	3		5.2	6.6	15	14	XEU1-12-050-600360	☐	☐	☐	☐	☐	☐	☐
7.5 (25590)	208	1	12	38.4	47.9	50	8	XEU1-12-075-208160	☐	☐	☐	☐	☐	☐	☐
		3		21.9	27.4	30	10	XEU1-12-075-208360	☐	☐	☐	☐	☐	☐	☐
	240	1		33.7	42.1	45	8	XEU1-12-075-240160	☐	☐	☐	☐	☐	☐	☐
		3		19.1	23.9	25	10	XEU1-12-075-240360	☐	☐	☐	☐	☐	☐	☐
	480	3		9.6	12.0	15	14	XEU1-12-075-480360	☐	☐	☐	☐	☐	☐	☐
	600	3		7.6	9.6	15	14	XEU1-12-075-600360	☐	☐	☐	☐	☐	☐	☐
10 (34120)	208	3	12	28.9	36.1	40	8	XEU1-12-100-208360	☐	☐	☐	☐	☐	☐	☐
	240	1		44.1	55.1	60	8	XEU1-12-100-240160	☐	☐	☐	☐	☐	☐	☐
		3		25.2	31.4	35	8	XEU1-12-100-240360	☐	☐	☐	☐	☐	☐	☐
	480	3		12.6	15.7	20	12	XEU1-12-100-480360	☐	☐	☐	☐	☐	☐	☐
	600	3		10.1	12.6	15	14	XEU1-12-100-600360	☐	☐	☐	☐	☐	☐	☐



Heater Size	12 (3-10kW)
Dim.	Inches (mm)
A	7.5 (191)
B	18.2 (462)
C	16.3 (414)
D	19.0 (483)
E	19.5 (495)
F	3.1 (79)
G	22.3 (566)

XEU | 1 | - | 12 | - | 100 | - | 480 | 3 | 60 | - | A | - | Y | - | B

Model Series

Generation
For major revisions

Fan Size

12 Inches	12

Power Output

3 kW	030 (12 inch fan size)
5 kW	050 (12 inch fan size)
7.5 kW	075 (12 inch fan size)
10 kW	100 (12 inch fan size)

Heater Line Voltage

208 Volts	208
240 Volts	240
480 Volts	480
600 Volts	600

Phase

1 Phase	1
3 Phase	3

Product Revision No.
For minor revisions

Factory Built-in Options

N	No options selected
Y	Yes, options selected

Options Codes (stamped on separate field of data plate)

T1	Thermostat (BTX1-N-A)
T2	Thermostat (XET1-1-N-A)
D	Disconnect Switch
P	Pilot Light (Heat On)
F	Continuous Fan
H1	Heresite Core
H2	Heresite Cabinet
H3	Heresite Core/Cabinet

Requires 24VAC control >
Includes louvers & fan blade >

Control Voltage

A	120 Volt
B	24 Volt

Frequency

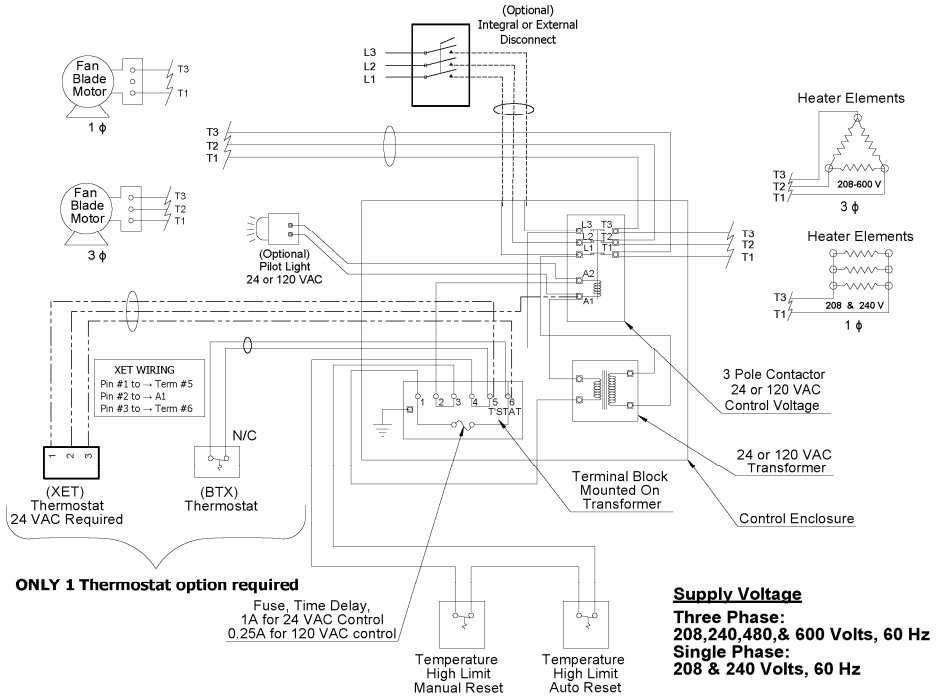
60	60 Hertz

Approval Drawing	XEU1, 12" Fan Size Heater
May 26, 2021	Version 4.1
Hazloc Heaters Inc.	Calgary, Alberta

Hazloc Heaters™
Safe heat when you need it!

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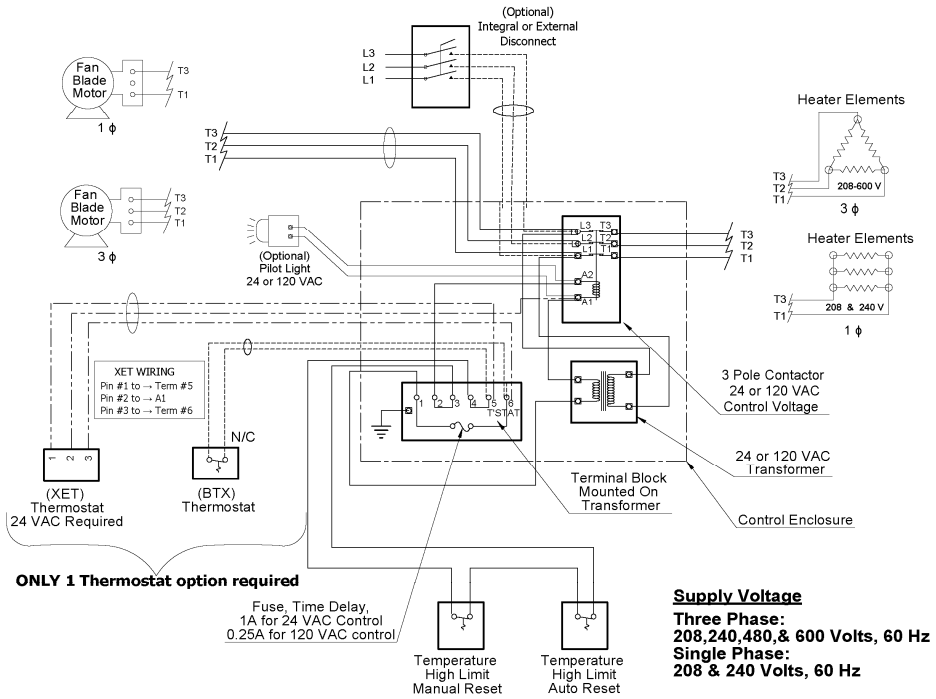
Wiring Diagram for Standard Fan Operation



Supply Voltage

Three Phase:
208,240,480,& 600 Volts, 60 Hz
Single Phase:
208 & 240 Volts, 60 Hz

Wiring Diagram for Continuous Fan Operation



Supply Voltage

Three Phase:
208,240,480,& 600 Volts, 60 Hz
Single Phase:
208 & 240 Volts, 60 Hz

Approval Drawing	XEU1, 12" Fan Size Heater
May 26, 2021	Version 4.1
Hazloc Heaters Inc.	Calgary, Alberta

Hazloc Heaters™
Safe heat when you need it!

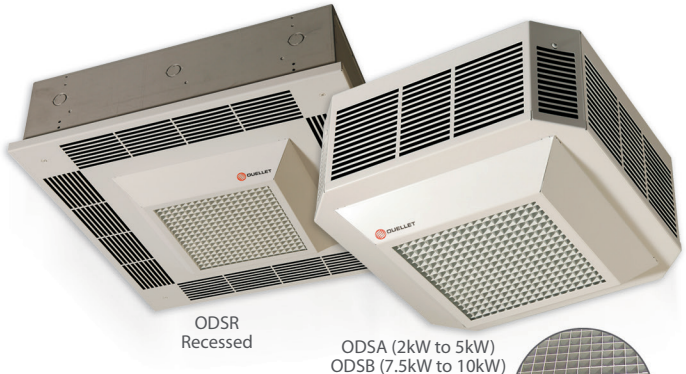
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Section 3.7.2.2

Space Heater – Nonexplosion Proof

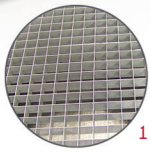
ODS Ceiling Fan Heater

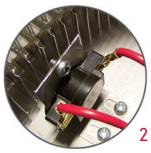


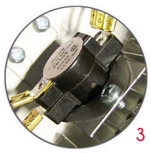


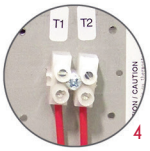
ODSR
Recessed

ODSA (2kW to 5kW)
ODSB (7.5kW to 10kW)
Surface

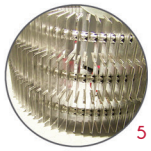

1


2


3



4


5

Features

Color
- Standard: white, almond.
- Optional (upcharge applicable): metallic silver, bronze, metallic charcoal, aluminum, semi-gloss black, sand.
- Custom colors available upon request.

Finish
- Standard: epoxy/polyester powder paint.

Voltage
- 208V, 240V, 277V, 347V, 480V, 600V, 1 or-3 phase.

Construction
- Outlet grille made of flat ribbon wire. 1
- High-limit temperature control with automatic reset. 2

Fan
- Totally enclosed and lifetime-lubricated ball bearing motor.
- Fan delay purges heater of residual heat. 3

Heating element
- Three stainless steel tubular heating elements with aluminum fins. 5

Control
- 240/208V control circuit standard (except for 2 to 5kW at 277V have 277V control standard).
- Built-in 240V contactor for some models (see table).
- 24V and 120V control circuit available.
- Built-in tamperproof thermostat available.
- 24V relay (with or without transformer) available.
- Continuous circulation controlled by a built-in switch with power-on indicator light available (-CV).

Any remote thermostat or relay must be connected to the heater control terminal block. 4

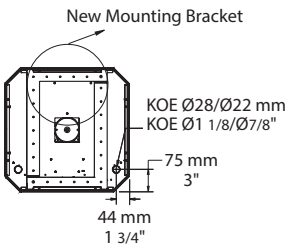
Installation
- Recommended height: between 8 ft. (2.4 m) and 12 ft. (3.6 m).
- Recessed into insulated or T-bar ceiling (ODSR).
- Surface mounting (ODSA and ODSB), T-BAR adaptor optional.

Note: We recommend installing this product on an outside ceiling to avoid vibrations spreading to an adjacent room.

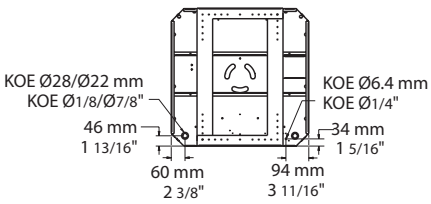
Warranty
- 3-year warranty against defects.
- 10-year warranty on the heating elements.

Application
- Apartment building, commercial building, drop ceiling, stairwell, garage.

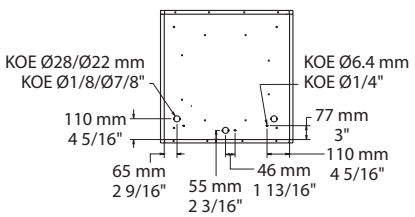
ODSA - Surface
2-5kW, 25 lbs (11.4 kg)

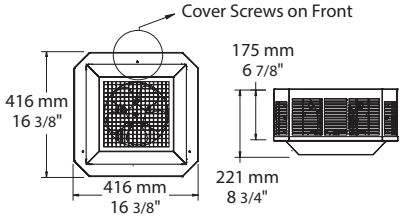


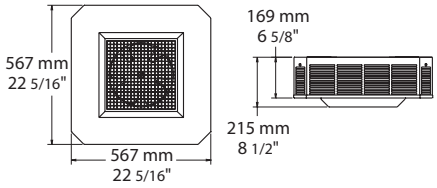
ODSB - Surface
7.5-10kW, 34 lbs (15.5 kg)

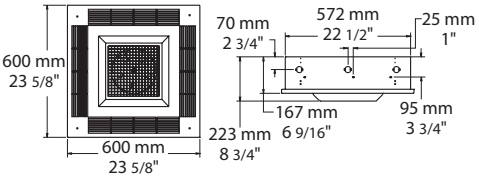


ODSR - Recessed
2-5kW, 31 lbs (14.1 kg)









Section 3.7.3

Exhaust Fan

Section 3.7.3.1

Exhaust Fan – Explosion Proof



FRONT VIEW

EXPLOSION PROOF STANDARD WALL EXHAUST FANS

Efficient, low maintenance and easy to install.

Canarm LFI's explosion proof fans follow a tradition of quality in design, materials and construction. Using our quality "Standard Fan" housing and motor mount as the basis for design, we have developed an efficient, economically priced Explosion Proof Fan. All Explosion Proof Fans have a single speed, dual voltage explosion proof motor that meets and conforms to all the standards that are listed below.

CLASS I, GROUP C *Atmospheres containing ethyl ether, ethylene, gases or vapors of equivalent hazard.*

CLASS I, GROUP D *Atmospheres such as acetone, ammonia, benzene, butane, cyclopropane, ethanol, gasoline, hexane, methane, natural gas, naphtha, propane, or gasses or vapors of equivalent hazard.*

CLASS II GROUP F *Atmospheres containing carbonaceous dust, including carbon black, charcoal, coal, or coke dusts that have more than 8% total entrapped volatiles, or dusts that have been sensitized by other materials so that they present an explosion hazard.*

CLASS II GROUP G *Atmospheres containing combustible dusts not included in group E or F, including flour, grain, wood, plastic and chemicals.*

FEATURES

- Totally enclosed, ball bearing motor with thermal overload protection.
- The fan blades are well-balanced, heavy gauge aluminum.
- The rugged steel welded box housing has a durable powder coated finish.
- Aluminum louver shutters are supported by long life nylon bushings.
- Heavy wire chrome plated OSHA guards on intake side of fan.
- All fans are shipped completely assembled.

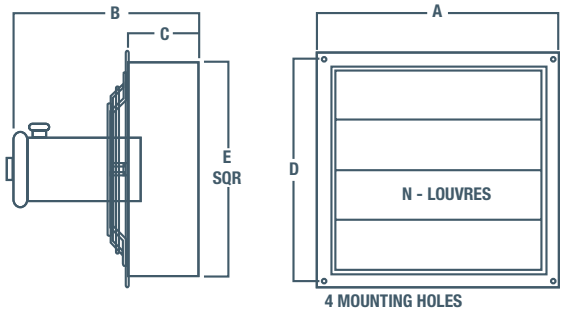
SPECIFICATIONS

	MODEL	FAN SIZE	HP	VOLTS	AMPS	SPEED	RPM	AIRFLOW CAPACITY - CFM				FRAMING DIMENSIONS	WEIGHT (LBS)
								0" SP	.05" SP	.10" SP	.25" SP		
NEW	SD08-XPF	8"	1/3	115/230	6.6/3.3	Single	1625	320	280	240	-	11" X 11"	38
NEW	SD10-XPF	10"	1/3	115/230	6.6/3.3	Single	1625	620	575	530	-	13" X 13"	39
	SD12-XPF	12"	1/3	115/230	6.6/3.3	Single	1625	1,640	1,600	1,540	1,390	15" x 15"	42
	SD18-XPF	18"	1/3	115/230	6.6/3.3	Single	1625	3,200	3,150	3,090	2,920	21" x 21"	60
	SD24-XPF	24"	1/3	115/230	6.6/3.3	Single	1625	5,500	5,400	5,310	5,100	27" x 27"	72

NOTE: RPM Min (Minimum) is determined when louvres are opened one inch.
Note: Wind has a significant effect on exhaust fans. A 10 mph wind creates a 0.05" pressure against the fan. A 20 mph wind creates 0.20" pressure and 30 mph a 0.45" pressure. These pressures are in addition to the static pressure in the building. Wind blocks or hoods should be included in all designs where fans will be subjected to winds above 10 mph.

DIMENSIONS

FAN SIZE	A X A SQUARE	B	C	D c/c	E	N
8"	13 1/4"	17 1/2"	4"	12"	10 3/4"	2
10"	15 1/4"	17 1/2"	4"	14"	12 3/4"	2
12"	17 1/4"	20 1/2"	6"	16"	14 3/4"	3
18"	23 1/4"	20 1/2"	6"	22"	20 3/4"	4
24"	29 1/4"	20 1/2"	6"	28"	26 3/4"	5



4 MOUNTING HOLES
.375" DIAMETER



BACK VIEW

ACCESSORIES

- Hoods

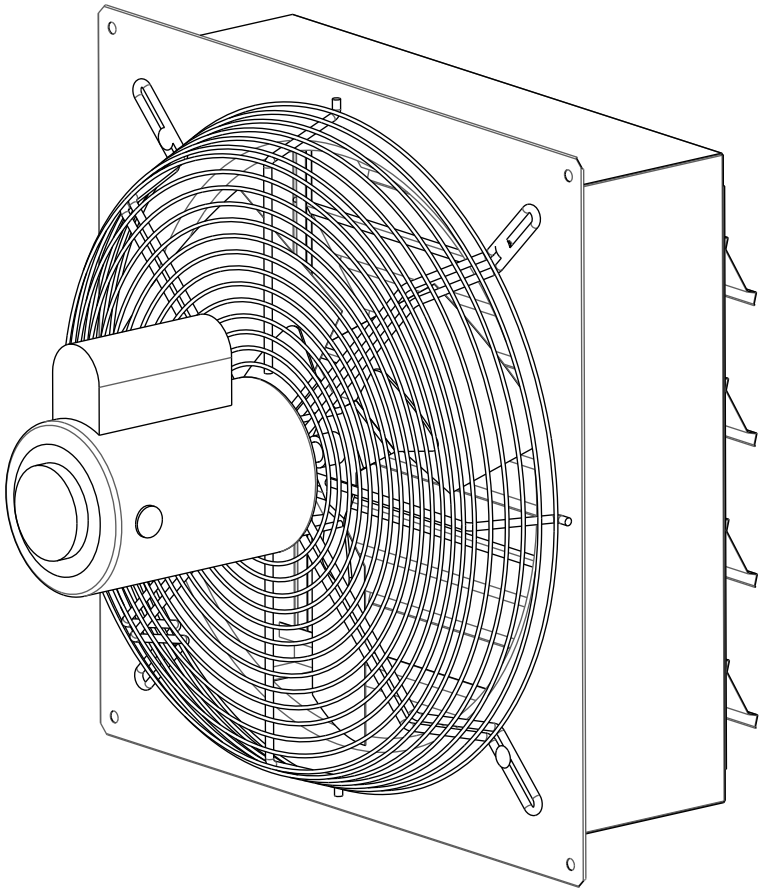
For a complete listing of all available hoods, see page D11.

STANDARD EXHAUST FANS

CANARM®

OPERATION INSTRUCTIONS AND PARTS MANUAL

READ AND SAVE THESE INSTRUCTIONS



WARRANTY

CANARM Ltd. warrants every new fan to be free of defects in material and workmanship, to the extent that, within a period of one year from the date of purchase CANARM Ltd. shall either repair or replace at CANARM's option, any unit or part thereof, returned freight prepaid, and found to be defective.

This warranty does not include any labour or transportation costs incidental to the removal and reinstallation of the unit at the user's premises. Components repaired or replaced are warranted through the remainder of the original warranty period only.

This warranty applies to the original purchaser-user only; it is null and void in case of alteration, accident, abuse, neglect, and operation not in accordance with instructions.

NOTICE: No warranty claims will be honored by CANARM Ltd. unless prior authorization is obtained.

INSTALLATION OR PRODUCT PROBLEMS? DO NOT RETURN TO STORE OF PURCHASE.
CONTACT CANARM SERVICE AT 1-800-265-1833 (CANADA) 1-800-267-4427 (U.S.A.)
1-800-567-2513 (EN FRANCAIS) MONDAY TO FRIDAY 8:00 - 5:00PM E.S.T.

INSTRUCTION MANUAL FOR STANDARD EXHAUST FANS

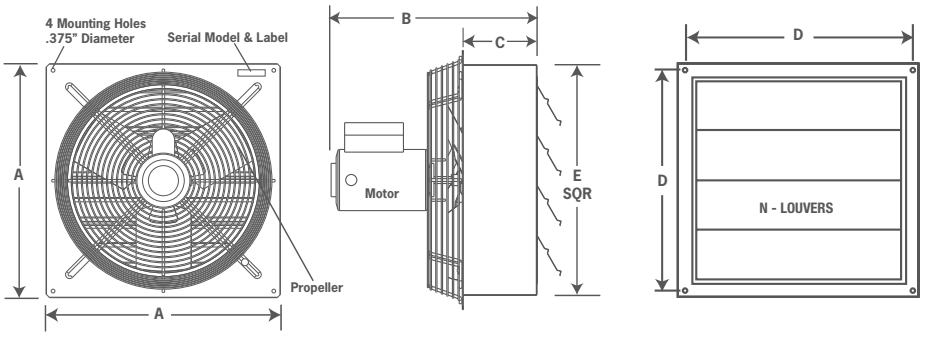
READ INSTRUCTIONS COMPLETELY BEFORE INSTALLATION & SAVE FOR REFERENCE

Congratulations on the purchase of your quality built direct drive, wall exhaust ventilation fan. All of these models use totally enclosed motors with thermal over load protection. Variable speed motors are high efficiency motors which save on electrical costs and can be run as a single speed motor. The motors are mounted on heavy gauge welded steel rod motor mounts that have a Bright Zinc finish. Fans come fully assembled and 100% of fans are tested for proper operation before shipping.

THESE ARE GENERAL INSTRUCTIONS WHICH COVER OUR SINGLE, VARIABLE AND TWO SPEED STANDARD FANS, AS WELL AS OUR SINGLE SPEED EXPLOSION PROOF MODELS..

STANDARD FANS:

These models have a rugged, welded steel box housing with a powder coated finish and aluminum or plastic exhaust louvers that are supported by long life nylon bushings. The louvers open automatically when the fan starts up and close when the fan stops



Fan Size	A	B	C	D (c/c)	E	N	Framing
8"	13 1/4"	11"	4"	12"	10 3/4"	2	11 X 11
10"	15 1/4"	11"	4"	14"	12 3/4"	2	13 X 13
12"	17 1/4"	17"	6"	16"	14 3/4"	3	15 X 15
14"	19 1/4"	17"	6"	18"	16 3/4"	3	17 X 17
16"	21 1/4"	17"	6"	20"	18 3/4"	4	19 X 19
18"	23 1/4"	15"	6"	22"	20 3/4"	4	21 X 21
20"	25 1/4"	18"	6"	24"	22 3/4"	5	23 X 23
24"	29 1/4"	18"	6"	28"	26 3/4"	5	27 X 27
30"	35 1/4"	19"	6"	34"	32 3/4"	16	33 X 33
36"	41 1/4"	18"	6"	40"	38 3/4"	20	39 X 39
42"	47 1/4"	18"	6 3/4"	46"	44 3/4"	24	45 X 45
48"	53 1/4"	19"	6 3/4"	52"	50 5/8"	26	51 X 51

EXPLOSION PROOF FANS:

Explosion proof fans are equipped with single speed explosion proof motors and aluminum blades so sparks cannot occur if a metal object obstructs the blade path. Explosion proof fans have the same quality welded steel box housing and heavy gauge welded guard as the standard fans. These fans should be used to ventilate hazardous areas. Locations are considered hazardous if the atmosphere contains or may contain gas, vapor, or dust in explosive quantities.

THE MOTOR AMBIENT TEMPERATURE IS NOT TO EXCEED +40°C OR -25°C UNLESS THE MOTOR NAMEPLATE SPECIFICALLY PERMITS ANOTHER VALUE. THE FOLLOWING TABLE INDICATES WHICH HAZARDOUS CLASSIFICATIONS CANARM EXPLOSION PROOF FANS DO AND DO NOT MEET.

Canarm explosion proof fans DO meet the following hazardous classifications.

CLASS 1, DIVISION 1 (GASES, VAPORS)

GROUP C Acetaldehyde, cyclopropane, diethlether, Ethylene, isoprene

GROUP D Acetone, acrylonitrile, ammonia, benzene, butane, ethylene dichloride, gasoline, hexane, methane, methanol, naphtha, propane, propylene styrene, toluene, vinyl, acetate, vinyl chloride, xylene

CLASS 2, DIVISION 1 (COMBUSTIBLE DUSTS)

GROUP F Carbon black, coke or coal dust

GROUP G Flour, starch or graindust

Canarm explosion proof fans DO NOT meet the following hazardous classifications.

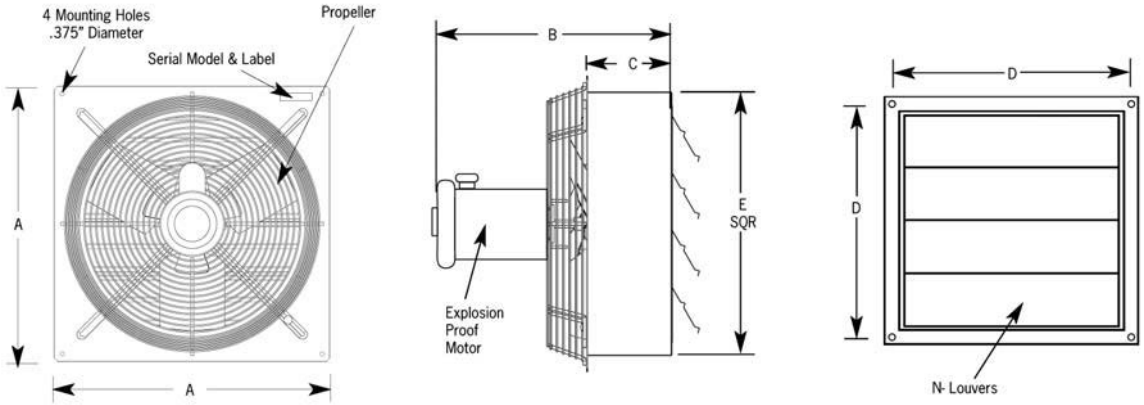
CLASS 1, DIVISION 1 (GASES, VAPORS)

GROUP A Acetylene

GROUP B Butadiene, ethylene oxide, hydrogen, propylene oxide

CLASS 2, DIVISION 1 (COMBUSTIBLE DUSTS)

GROUP E Aluminum, magnesium and other metal dusts with similar characteristics



Fan Size	A	B	C	D (c/c)	E	N	Framing
12"	17 1/4"	17"	6"	16"	14 3/4"	3	15 X 15
18"	23 1/4"	15"	6"	22"	20 3/4"	4	21 X 21
24"	29 1/4"	18"	6"	28"	26 3/4"	5	27 X 27

INSTALLATION

Installation is fast and simple. A sturdy framed wall opening should be prepared in advance to the size indicated for your fan in the charts above. With lag bolts for wooden frames or nut, bolt and lock washers for steel frames, secure the fan using the four mounting holes provided, one in each corner of the fan.

ELECTRICAL CONNECTIONS



WARNING: BE SURE POWER IS OFF AT THE ELECTRICAL PANEL BEFORE WIRING.

WARNING: ALL ELECTRICAL WORK SHOULD BE PERFORMED BY A QUALIFIED ELECTRICIAN.

These fans are supplied with single, two or variable speed motors. Single and two speed motors are 120V only. Variable speed motors are dual voltage. All dual voltage motors are pre-wired at 240V in our factory. Rewire motor as per motor nameplate if running fan at 120V. Please see the motor nameplate for wiring diagram. Make electrical connections in motor connection box as per the motor nameplate. Follow ***Chart #1*** for wire sizes. Two speed fans require a two speed control or 3 position toggle switch to change from high/ low/off. See wiring diagram with control for 2 speed wiring instructions.

CHART#1

Table A **Minimum Wire Sizes for Three-Phase Motors**

Motor HP	25 to 50 Feet			100 Feet			150 to 200 Feet		
	200V	230V	460V	200V	230V	460V	200V	230V	460V
1/8	14(18)*	14(18)*	14(18)*	14(18)*	14(18)*	14(18)*	14(16)*	14(16)*	14(18)*
1/6	14(18)*	14(18)*	14(18)*	14(18)*	14(18)*	14(18)*	14	14(16)*	14(18)*
1/4	14(18)*	14(18)*	14(18)*	14(16)*	14(18)*	14(18)*	14	14	14(18)*
1/3	14(18)*	14(18)*	14(18)*	14(16)*	14(16)*	14(18)*	12	14	14(18)*
1/2	14(16)*	14(18)*	14(18)*	12	14(16)*	14(18)*	10	12	14(18)*
3/4	14(16)*	14(16)*	14(18)*	12	14	14(18)*	10	10	14(16)*
1	14	14(16)*	14(18)*	12	12	14(18)*	8	10	14(16)*
1 1/2	12	14	14(18)*	10	10	14(16)*	6	8	14
2	12	12	14(18)*	8	10	14(16)*	6	6	12
3	10	12	14(18)*	6	8	14	4	6	12

Table B **Minimum Wire Sizes for Single-Phase Motors**

Motor HP	25 to 50 Feet			100 Feet			150 to 200 Feet		
	200V	230V	460V	200V	230V	460V	200V	230V	460V
1/8	14(18)*	14(18)*	14	14(18)*	12	14(18)*	10	8	14
1/6	14(16)*	14(18)*	12	14(18)*	10	14(18)*	6	6	12
1/4	14	14(18)*	10	14(16)*	6	14	6	4	10
1/3	14	14(18)*	10	14(16)*	8	14	6	4	10
1/2	12	14(18)*	8	14	6	12	4	3	8
3/4	10	14(16)*	6	12	4	10	2	1	6
1	10	14(16)*	6	12	4	10	2	1	6
1 1/2	8	14	6	12	3	8	1	1/0	6
2	6	14	4	10	2	8	1/0	2/0	4
3	6	12	3	8	1/0	6	2/0	4/0	3

NOTE:
- NEC Article 310-5 - *Minimum conductor size for general wiring at 115-440VAC is number 14AWG.
- Above wire sizes based on approximate 5% voltage drop during starting: copper conductors: and 75°C type THHW, THW, THWN, RH, RHW insulation etc. For aluminum wire, increase two wire size steps minimum. See NEC Article 310 for ampacities of aluminum conductors.
- Type S, SO, SJ, SJO, etc. flexible cable wire sizes. See NEC article 400 for ampacity.

OPERATION

WARNING: VARIABLE SPEED FANS SHOULD HAVE THE MINIMUM SPEED SET TO OPEN LOUVERS AT LEAST ONE INCH FOR PROPER MOTOR COOLING AND TO PREVENT MOTOR FAILURE.

All fans are direct drive. Fans with variable speed motors can be operated as an energy efficient single speed fan or in variable operation with the proper controller. As mentioned above two speed fans require a two speed control or 3 position toggle switch to change from high speed to low and off.



WARNING: GUARDING SHOULD BE USED IF FANS ARE MOUNTED LOWER THAN SEVEN FEET (2 METRES) OFF FLOOR OR GROUND LEVEL.

ACCESSORIES

Canarm provides a complete line of manual and thermostatic controls. Canarm also offers wall mount exhaust shutter kits, replacement shutter sets, and weather protection hoods.

MAINTENANCE

MOTORS ARE EQUIPPED WITH AUTOMATIC OVERLOAD PROTECTION AND MAY RESTART WITHOUT WARNING. ALWAYS DISCONNECT FROM POWER BEFORE ATTEMPTING SERVICE. Motor, blade and louvers should be kept clean of any buildup to prevent premature motor failure and to achieve proper performance. Automatic louvers should be kept operating freely. As with all mechanical equipment scheduled inspections should include checking that all hardware is secure and blade set screws are tight.

WARRANTY

CANARM Ltd. warrants every new fan to be free of defects in material and workmanship, to the extent that, within a period of one year from the date of purchase CANARM Ltd. shall either repair or replace at CANARM's option, any unit or part thereof, returned freight prepaid, and found to be defective. This warranty does not include any labour or transportation costs incidental to the removal and reinstallation of the unit at the user's premises. Components repaired or replaced are warranted through the remainder of the original warranty period only. This warranty applies to the original purchaser-user only; it is null and void in case of alteration, accident, abuse, neglect, and operation not in accordance with instructions.
NOTICE: NO WARRANTY CLAIMS WILL BE HONORED BY CANARM LTD. UNLESS PRIOR AUTHORIZATION IS OBTAINED.

CANARM®

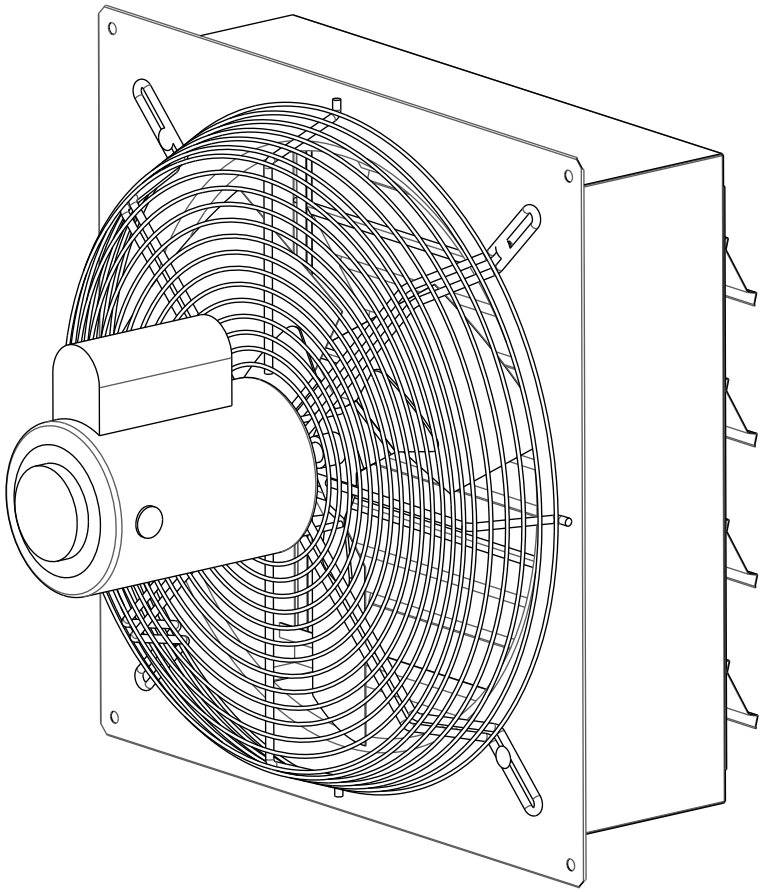
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ARTHUR MANUFACTURING FACILITY
#7686 CONCESSION 16, RR4
ARTHUR, ONTARIO N0G 1A0
TELEPHONE: (519) 848-3910
FAX: (519) 848-3948

VENTILATEURS D'ÉVACUATION STANDARD

MANUEL DE L'USAGER



GARANTIE

Canarm Ltée. garantie que chaque nouveau ventilateur ne comporte aucune défectuosité dans le matèriel et la main-d'oeuvre, et de ce fait, Canarm Ltée. remplacera ou réparera à son choix, tout unité ou partie de cette unité qui comporte une defectuosité, pour une période de un an suivant la date d'achat. L'unité doit être retournée frais de port payé et une défectuosité doit être décelée. Cette garantie ne couvre pas les frais de démontage et de réinstallation de l'unité sur les lieux de l'usager.

Les éléments réparés ou remplacés sont garanties pour la durée de la garantie originale seulement. Cette garantie s'applique à l'acheteur-usage initial seulement, elle est nulle dans le cas d'altérations, d'accident, d'abus, de négligence ou si l'opération n'est pas conforme aux instructions.

N.B.: Aucune réclamation ne sera honorée par Canarm Ltée. à moins d'autorisation obtenue au préalable.

PROBLÈMES D'INSTALLATION OU D'UTILISATION? NE RETOURNEZ PAS AU MAGASIN. COMMUNIQUEZ AVEC LE SERVICE À LA CLIENTÈLE CHEZ CANARM AU 1-800-265-1833 (CANADA) 1-800-267-4427 (USA) 1-800-567-2513 (EN FRANÇAIS) DU LUNDI AU VENDREDI ENTRE 8:00H ET 17:00H HNE

MODE D'EMPLOI DU VENTILATEUR D'ÉVACUATION STANDARD

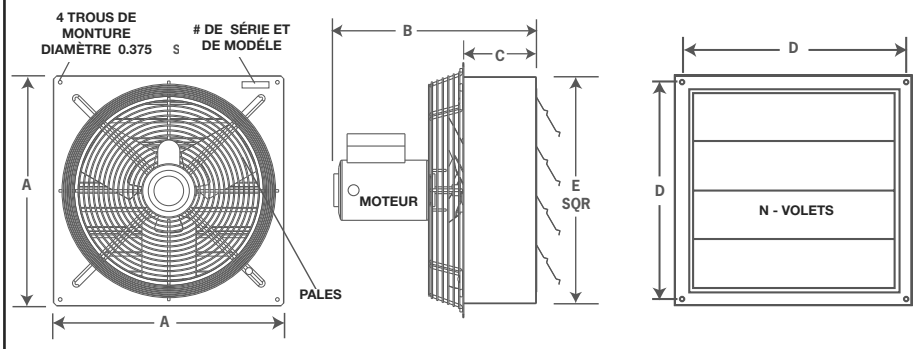
VEUILLEZ LIRE LES INSTRUCTIONS SUIVANTES AVANT DE PROCÉDER À L'INSTALLATION ET GARDEZ CE MANUEL COMME RÉFÉRENCE

Félicitations sur l'achat de votre ventilateur d'évacuation mural à entraînement direct de qualité. Tous ces modéles comportent un moteur fermé à avec une protection thermique contre la surcharge. Les moteurs à vitesse variable sont hautement efficaces et consomment peu d'énergie et de plus, ils peuvent être opérés comme un moteur à vitesse simple. Les moteurs sont soutenus par une monture de moteur trés robuste en tiges d'acier soudées de haut calibreet sont revÍtues d'un fini Zinc Brillant. Les ventilateurs vous sont livrés tout assemblé et 100% de nos ventilateurs sont testés avant la livraison.

Celui-ci est un mode d'emploi général décrivant nos ventilateurs à une vitesse, deux vitesses et à vitesse variable ainsi que notre ventilateur à une vitesse anti-explosif.

VENTILATEUR STANDARD

Ces modéles portent un boîtier robuste en acier soudé avec un fini poudré ainsi que des volets en aluminium ou en plastique qui sont retenus par des douilles en nylon de longue durée. Les volets s'ouvrent automatiquement lorsque le ventilateur démarre et se ferment lorsqu'il s'arrête.



Dimensions du Ventilateur							
Ventilateur	A	B	C	D (c/c)	E	N	Encadrement
8"	13 1/4"	11"	4"	12"	10 3/4"	2	11 X 11
10"	15 1/4"	11"	4"	14"	12 3/4"	2	13 X 13
12"	17 1/4"	17"	6"	16"	14 3/4"	3	15 X 15
14"	19 1/4"	17"	6"	18"	16 3/4"	3	17 X 17
16"	21 1/4"	17"	6"	20"	18 3/4"	4	19 X 19
18"	23 1/4"	15"	6"	22"	20 3/4"	4	21 X 21
20"	25 1/4"	18"	6"	24"	22 3/4"	5	23 X 23
24"	29 1/4"	18"	6"	28"	26 3/4"	5	27 X 27
30"	35 1/4"	19"	6"	34"	32 3/4"	16	33 X 33
36"	41 1/4"	18"	6"	40"	38 3/4"	20	39 X 39
42"	47 1/4"	18"	6 3/4"	46"	44 3/4"	24	45 X 45
48"	53 1/4"	19"	6 3/4"	52"	50 5/8"	26	51 X 51

VENTILATEUR ANTI-EXPLOSIF

Les ventilateurs anti-explosifs sont munis d'un moteur anti-explosif à une vitesse ainsi que des pales en aluminium afin de prévenir les étincelles lorsqu'un objet en métal obstrut la rotation de la pale. Les ventilateurs anti-explosifs sont fabriqués du même boîtier en acier robuste et de qualité et du même grillage à haut calibre que les ventilateurs Standard. Ces ventilateurs devront être utilisés pour ventilé les endroits hasardeux. L'endroit est considéré hasardeux si l'atmosphére contient ou peut contenir un gaz, une vapeur, ou de la poussiére en quantité explosive.

LA TEMPÉRATURE AMBIANTE DU MOTEUR NE DEVRAIT PAS EXCÉDER +40°C OU -25°C À MOINS QUE LA PLAQUE SUR LE MOTEUR INDIQUE SPÉCIFIQUEMENT UNE AUTRE VALEUR. LE TABLEAU SUIVANT INDIQUE LES CLASSES HASARDEUSES AUXQUELLES RÉPONDENT LES VENTILATEURS ANTI-EXPLOSIFS DE CANARM.

Les ventilateurs anti-explosifs de Canarm RÉPONDENT aux classifications hasardeuses suivantes :

CLASSE 1, DIVISION 1 (GAS ET VAPEURS)

GROUPE C ACÉTALDÉHYDE, CYCLOPROPANE, DIÉTHLÉTHER, ÉTHYLÈNE, ISOPRÈNE

GROUPE D ACÉTONE, ACRYLONITRILE, AMMONIAC, BENZÈNE, BUTANE, ÉTHYLÈNE DICHLORIDE, GAZOLINE, HEXANE, MÉTHANE, MÉTHANOL, NAPHTHA, PROPANE, PROPYLÈNE STYRÈNE, TOLUÈNE, VINYLE, ACÉTATE, VINYLE CHLORIDE, XYLÈNE

CLASSE 2, DIVISION 1 (POUSSIÈRES COMBUSTIBLES)

GROUPE F CARBON NOIR, COKE OU POUSSIÈRE DE CHARBON

GROUPE G FARINE, AMIDON OU POUSSIÈRE DE GRAIN

Les ventilateurs anti-explosifs de Canarm NE RÉPONDENT PAS aux classes hasardeuses suivantes :

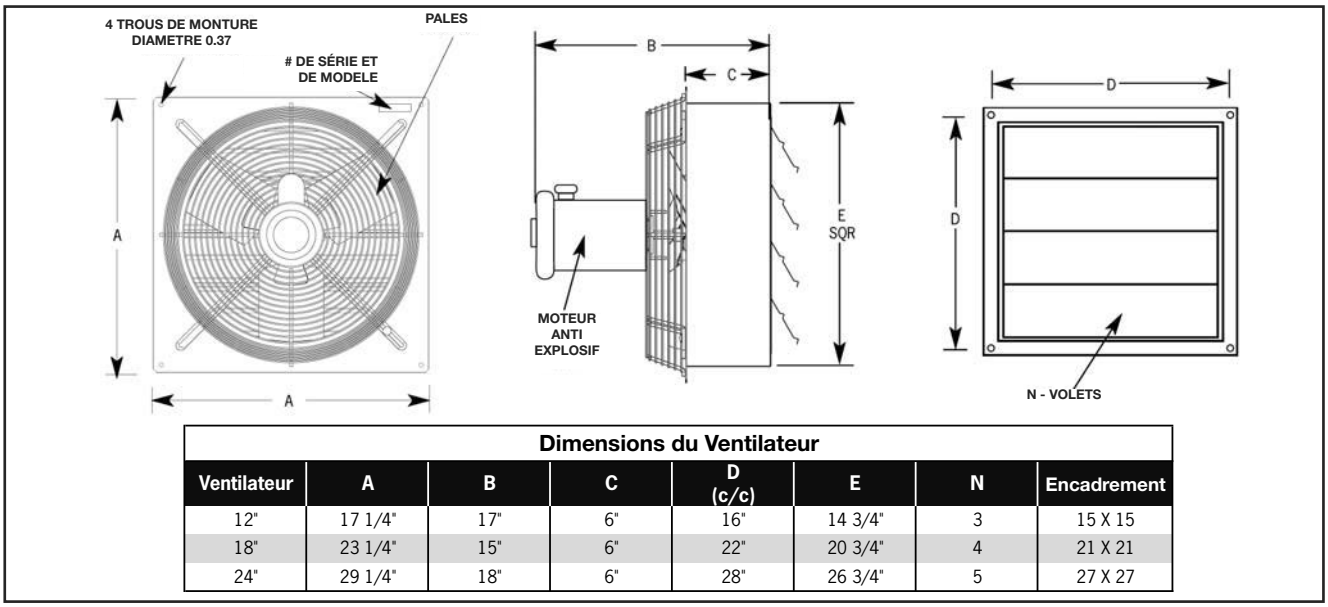
CLASSE 1, DIVISION 1 (GAS ET VAPEURS)

GROUPE A ACEETYLÈNE

GROUPE B BUTADIÈNE, OXYDE D'ÉTHYLÈNE, HYDROGÈNE, OXYDE DE PROPYLÈNE

CLASSE 2, DIVISION 1 (POUSSIÈRES COMBUSTIBLES)

GROUPE E ALUMINIUM, MAGNÉSIUM, ET AUTRES POUSSIÈRES DE MÉTAL AVEC DES CARACTERISTIQUES SIMILAIRES



Dimensions du Ventilateur

Ventilateur	A	B	C	D (c/c)	E	N	Encadrement
12"	17 1/4"	17"	6"	16"	14 3/4"	3	15 X 15
18"	23 1/4"	15"	6"	22"	20 3/4"	4	21 X 21
24"	29 1/4"	18"	6"	28"	26 3/4"	5	27 X 27

INSTALLATION

L'installation est simple et rapide. Un encadrement robuste dans l'ouverture du mur devrait être préparé à l'avance aux grandeurs mentionnes pour votre ventilateur dans le tableau ci-dessus. A l'aide de boulons pour cadrage de bois ou d'écrous, boulons et rondelles de blocage pour cadrage de métal, posez le ventilateur à l'aide des quatres trous de montage fournies, un dans chacun des coins.

CONNEXIONS ÉLECTRIQUES



MISE EN GARDE: FERMEZ LE COURANT AU DISJONCTEUR AVANT PROCÉDER AUX RACCORDEMENTS.

MISE EN GARDE: TOUS LES TRAVAUX ÉLECTRIQUES DEVRONT ÊTRE EXÉCUTÉS PAR UN ÉLECTRICIEN QUALIFIÉ.

Ces ventilateurs portent un moteur à une, deux ou vitesse variable. Les moteurs à une ou deux vitesses peuvent recevoir du 120V seulement. Les moteurs à vitesse variable sont à voltage double. Tous les moteurs à voltage double sont préparés en usine pour recevoir du 240V. Suivez les indications sur la plaque du moteur pour rebrancher le moteur sur le 120V. Faîtes les connexions dans la boîte de connexion du moteur selon les indications sur la plaque du moteur. Consultez le Tableau #1 pour la grandeur de fil à être utilisé. Les ventilateurs à deux vitesses demandent un contrôle à 2 vitesses ou un interrupteur à levier 3 postions pour changer la vitesse de grande/petite/fermé. Consultez le diagramme fournie avec le contrôle pour l'installation à 2 vitesses.

TABLEAU A

Tableau A Grosseur minium de fil pour moteur à trois phases

Moteur HP	25 à 50 Pieds			100 Pieds			150 à 200 Pieds		
	200V	230V	460V	200V	230V	460V	200V	230V	460V
1/8	14(18)*	14(18)*	14(18)*	14(18)*	14(18)*	14(18)*	14(16)*	14(16)*	14(18)*
1/6	14(18)*	14(18)*	14(18)*	14(18)*	14(18)*	14(18)*	14	14(16)*	14(18)*
1/4	14(18)*	14(18)*	14(18)*	14(16)*	14(18)*	14(18)*	14	14	14(18)*
1/3	14(18)*	14(18)*	14(18)*	14(16)*	14(16)*	14(18)*	12	14	14(18)*
1/2	14(16)*	14(18)*	14(18)*	12	14(16)*	14(18)*	10	12	14(18)*
3/4	14(16)*	14(16)*	14(18)*	12	14	14(18)*	10	10	14(16)*
1	14	14(16)*	14(18)*	12	12	14(18)*	8	10	14(16)*
1 1/2	12	14	14(18)*	10	10	14(16)*	6	8	14
2	12	12	14(18)*	8	10	14(16)*	6	6	12
3	10	12	14(18)*	6	8	14	4	6	12

Tableau B **Grosseur minium de fil pour moteur à phase simple**

Moteur HP	25 à 50 Pieds			100 Pieds			150 à 200 Pieds		
	200V	230V	460V	200V	230V	460V	200V	230V	460V
1/8	14(18)*	14(18)*	14	14(18)*	12	14(18)*	10	8	14
1/6	14(16)*	14(18)*	12	14(18)*	10	14(18)*	6	6	12
1/4	14	14(18)*	10	14(16)*	6	14	6	4	10
1/3	14	14(18)*	10	14(16)*	8	14	6	4	10
1/2	12	14(18)*	8	14	6	12	4	3	8
3/4	10	14(16)*	6	12	4	10	2	1	6
1	10	14(16)*	6	12	4	10	2	1	6
1 1/2	8	14	6	12	3	8	1	1/0	6
2	6	14	4	10	2	8	1/0	2/0	4
3	6	12	3	8	1/0	6	2/0	4/0	3

N.B.:
- Article 310-5 NEC grosseur minium de conducteur pour filage général à 115- 440VAC est le numéro 14AWG
- Les grandeurs de fils ci-dessus sont basés sur une baisse approximative de 5% lors du départ; conducteurs en cuivre; et isolation type 75C THHW, THW, RH, RHW etc. Pour un fil en aluminium, augmentez le fil d'un minimum de deux grandeurs. Voir Article 310 NEC pour ampacités des conducteurs en aluminium.
- Type S, SO, SJ, SJO, ETC. grandeur de fil de cable flexible. Voir article 400 NEC pour ampérage relatif.

OPÉRATION:

MISE EN GARDE: LES VENTILATEURS À VITESSE VARIABLE DEVRAIENT ÊTRE AJUSTÉS AFIN QUE LA VITESSE MINIUM OUVRE LES VOLETS D'AU MOINS 1" AFIN DE PERMETTRE UN AÉRATION ADÉQUATE DU MOTEUR. Tous les ventilateurs sont à entraînement direct. Les ventilateurs avec moteur à vitesse variable peuvent étre opérés comme moteur à une vitesse économe d'énergie ou comme moteur variable avec un contrôle adéquat. Tel que mentionné, les ventilateurs à 2 vitesses requièrent un contrôle à 2 vitesses ou un interrupteur à levier à 3 positions pour pouvoir changer la vitesse du moteur de grande à petite.



MISE EN GARDE: UNE GRILLE INTÉRIEUR DEVRAIT ÊTRE UTILSÉ SI LE VENTILATEUR EST INSTALLÉ À MOINS DE 7 PEIDS (2 METRE) DU SOL.

ACCESSOIRES:

Canarm vous offre une gamme complète de contrôle manuel et thermostatique. Canarm vous offre également des ensembles de volets muraux d'évacuation, les volets de remplacement ainsi que des capots de protection contre les intempéries.

ENTRETIEN:

LES MOTEURS COMPORTENT UNE PROTECTION AUTOMATIQUE CONTRE LA SURCHARGE ET POURRAIENT DÉMARRER SANS AVERTISSEMENT. DÉBRANCHER TOUJOURS L'UNITÉ AVANT DE PROCÉDER À L'ENTRETIEN. Le moteur, les pales et les volets devraient être nettoyés régulièrement pour éviter une accumulation de saleté qui pourrait endommager le moteur et nuire au bon fonctionnement de votre ventilateur. Les volets automatiques devraient pouvoir opérer librement. Comme pour tout les appareils mécaniques, des inspections régulières devront être entreprises afin de s'assurer que toute la quincaillerie et les vis à pales soient bien serrées.

GARANTIE

Canarm Ltée. garantie que chaque nouveau ventilateur ne comporte aucune défectuosité dans le matériel et la main-d'oeuvre, et de ce fait, Canarm Ltée. remplacera ou réparera à son choix, tout unité ou partie de cette unité qui comporte une defectuosité, pour une période d'un an suivant la date d'achat. L'unité doit être retournée frais de port payé et une défectuosité doit être décelée. Cette garantie ne couvre pas les frais de démontage et de réinstallation de l'unité sur les lieux de l'usager. Les éléments réparés ou remplacés sont garanties pour la durée de la garantie originale seulement. Cette garantie s'applique à l'acheteur-usager initial seulement; elle est nulle dans le cas d'altérations, d'accident, d'abus, de négligence ou si l'opération n'est pas conforme aux instructions.

N.B.: AUCUNE RÉCLAMATION NE SERA HONORÉE PAR CANARM LTÉE. À MOINS D'AUTORISATION OBTENUE AU PRÉALABLE.

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Section 3.7.3.2

Exhaust Fan – Nonexplosion Proof

Now Available with EC motors!
See Green Products for more info

SD - STANDARD WALL EXHAUST FANS

Efficient, low maintenance and easy to install.



8" & 10" MODELS FRONT VIEW



8" & 10" MODELS BACK VIEW



12" to 24" MODELS FRONT VIEW

Intertek



30", 36", 42" & 48" MODELS WITH PVC LOUVERS



12" to 48" MODELS BACK VIEW

Canarm/LFI's standard fans follow a tradition of quality in design, materials and construction. All our standard fans are developed to be efficient and economically priced. Fans are available in single, two and variable speed models. All variable speed standard fans use an energy efficient variable speed, dual voltage motor and blade combination. To determine the proper Canarm/LFI fan for your applications, use the formula and table shown on back of page.

FEATURES

8" & 10" Models *New Features!*

- Smooth, quiet, reliable, maintenance-free operation
- Durable steel construction with grey powder coat finish
- 2 speed fan with high efficiency Euro design external rotor motor
  - Totally enclosed with sealed ball bearings
  - Pull chain speed control
  - 9 foot cord with 115 volt, 3-prong plug
- Swept back, high efficiency, low noise blade design
- Quiet, aluminum shutters with tie bar to maximize airflow and a magnet to prevent flapping and provide a superior seal
- Zinc plated OSHA guard
- Fans shipped completely assembled
- Easy to install! Mount fan using four screws, plug it in and turn it on

12" to 48" Models

- Single, two and variable speed models are available.
- All fans use a totally enclosed, thermally protected motor.
- Rugged steel welded box housing has a durable powder coated finish.
- Aluminum louver shutters are supported by long life nylon bushings (30", 36", 42" & 48" have PVC louvers).
- 12" - 24" models have heavy wire chrome plated OSHA guards on intake side of fan.
  30", 36", 42" & 48" models have grey powder coated guards.
- All fans are shipped completely assembled.



SPECIFICATIONS

	MODEL	SPEED	BLADE DIAMETER	RPM	HP	VOLTAGE	AMPS (FLA)	WEIGHT (LBS)	dB(A) @5 ft	CFM @ STATIC PRESSURE				FRAMING DIMENSIONS
										0.00"	0.10"	0.125"	0.25"	
NEW	**SD08**	Two	8"	1600/1300	25W	115	0.2	13	48	360/292	270/150	230/110	--	11" X 11"
NEW	**SD10**	Two	10"	1480/1150	60W	115	0.5	15	55	500/388	420/300	400/250	--	13" X 13"
	S12-E1	Single	12"	1625	1/4	115	2.7	28	63	1640	1540	1510	1390	15" X 15"
	S12-E2	Two	12"	1725/1140	1/4	115	3.4	32	64	1650/1090	1550/950	1520/930	1390/0	15" X 15"
	S12-EVD	Variable	12"	1625	1/3	115/230	5.0/2.5	32	60	1650	1540	1510	1390	15" X 15"
	S14-E1	Single	14"	1625	1/4	115	2.7	30	67	2170	2070	2030	1860	17" X 17"
	S14-E2	Two	14"	1725/1140	1/4	115	3.4	34	65	2180/1350	2080/1190	2060/1160	1890/0	17" X 17"
	S16-E1	Single	16"	1625	1/4	115	2.7	33	68	2370	2270	2210	2060	19" X 19"
	S16-E2	Two	16"	1725/1140	1/4	115	3.4	36	69	2380/1640	2280/1490	2230/1430	2070/0	19" X 19"
	S16-EVD	Variable	16"	1625	1/3	115/230	5.0/2.5	36	63	2370	2270	2210	2063	19" X 19"
	S18-F1	Single	18"	1625	1/3	115	4.1	37	73	3200	3090	3040	2920	21" X 21"
	S18-F2	Two	18"	1725/1140	1/3	115	5.5/2.9	43	74	3200/2100	3090/1890	3040/1820	2920/0	21" X 21"
	S18-FVD	Variable	18"	1625	1/3	115/230	3.8/1.9	45	74	3150	3050	2980	2860	21" X 21"
	S20-F1	Single	20"	1625	1/3	115	4.1	41	77	3420	3220	3170	2920	23" X 23"
	S20-F2	Two	20"	1725/1140	1/3	115	5.5/2.9	45	77	3440/2300	3240/2000	3180/1950	2930/0	23" X 23"
	SD24-F1	Single	24"	1100	1/3	115	3.6	46	70	5000	4500	4300	3600	27" X 27"
	SD24-GVD	Variable	24"	1075	1/3	115/230	4.4/2.2	56	72	5050	4910	4810	4400	27" X 27"
	SD30-G1D	Single	30"	1075	1/3	115/230	4.4/2.2	72	82	8000	7000	6000	5000	33" X 33"
	SD36-G1D	Single	36"	850	1/2	115/230	6.6/3.3	88	72	10000	8500	8000	6200	39" X 39"
NEW	**SD42-H1D**	Single	42"	850	1	230	5	122	83	14900	13550	13210	10800	45" X 45"
NEW	**SD48-H1D**	Single	48"	850	1	230	5.0	140	84	17200	15300	14800	12500	51" X 51"

Some models are available with explosion proof motors. Please see next page.

NOTE: RPM Min (Minimum) is determined when louvres are opened one inch.
Note: Wind has a significant effect on exhaust fans. A 10 mph wind creates a 0.05" pressure against the fan. A 20 mph wind creates 0.20" pressure and 30 mph a 0.45" pressure. These pressures are in addition to the static pressure in the building. Wind blocks or hoods should be included in all designs where fans will be subjected to winds above 10 mph.

AIR CHANGES PER MINUTE

To determine the proper Canarm/LFI fan for your applications, use the following formula.
Number of cubic feet in room / Number of minutes per air change = Required C.F.M. Capacity

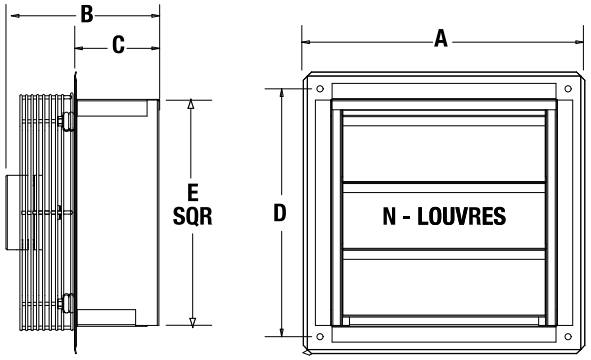
EXAMPLE: A general office, (see chart) which requires an air change every ten minutes, would require the following fan capacity.
If office is 100' x 40' x 10' = 40,000 cubic ft; 40,000 cubic ft / 10 minutes per air change = 4000 Required C.F.M.
From the chart, you would select a fan that is rated at 4000 C.F.M. at 1/8" S.P. (Static Pressure)

Application	Minutes per Air Change	Application	Minutes per Air Change	Application	Minutes per Air Change	Application	Minutes per Air Change
Assembly Hall	7	Church	15	Foundry	4	Pressing Room	1
Attic	2	Classroom	6	Garage	5	Projection Booth	2
Auditorium	10	Dance Hall	5	General Office	10	Summer Cooling	1
Barber Shop	6	Department Store	6	Gymnasium	8	Toilet	3
Basement	8	Dry Cleaning	5	Laundry	2	Transformer Room	1
Battery Room	4	Engine Room	6	Locker Room	3	Warehouse	12
Boiler Room	1	Factory	6	Machine Shop	8	Welding Shop	2
Bowling Alley	5	Forge Room	3	Plating Room	3		

DIMENSIONS

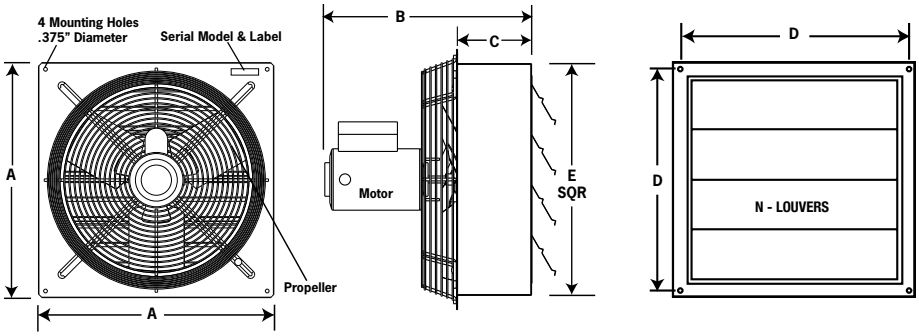
8" & 10" Models

FAN SIZE	A	B	C	D (c/c)	E SQR	N
8"	13 1/4"	7 9/16"	4"	12"	10 3/4"	2
10"	15 1/4"	7 7/8"	4"	14"	12 3/4"	3



12" to 48" Models

	FAN SIZE	A X A SQUARE	B	C	D (c/c)	E	N
	12"	17 1/4"	17"	6"	16"	14 3/4"	3
	14"	19 1/4"	17"	6"	18"	16 3/4"	3
	16"	21 1/4"	17"	6"	20"	18 3/4"	4
	18"	23 1/4"	18"	6"	22"	20 3/4"	4
	20"	25 1/4"	18"	6 3/4"	24"	22 3/4"	5
	24"	29 1/4"	18"	6 3/4"	28"	26 3/4"	5
	30"	35 1/4"	18"	6"	34"	32 3/4"	16
	36"	41 1/4"	18"	6"	40"	38 3/4"	20
NEW	42"	47 1/4"	18"	6 3/4"	46"	44 3/4"	24
NEW	48"	53 1/4"	19"	6 3/4"	52"	50 5/8"	26



ACCESSORIES

- Grey plastic weather hood
- Galvanized metal hood
- MC type & wet locations controls.

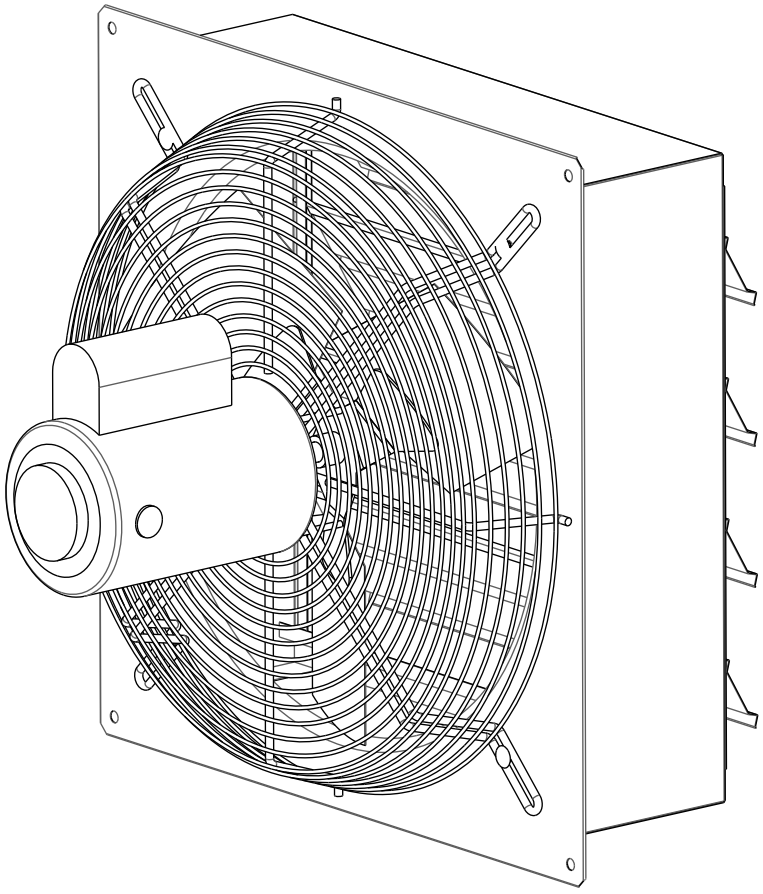
For a complete listing on all available accessories, see page D17.
For a complete listing of all available hoods, see page D11.
For all available control options, see Controls & Thermostats tab.

STANDARD EXHAUST FANS

CANARM®

OPERATION INSTRUCTIONS AND PARTS MANUAL

READ AND SAVE THESE INSTRUCTIONS



WARRANTY

CANARM Ltd. warrants every new fan to be free of defects in material and workmanship, to the extent that, within a period of one year from the date of purchase CANARM Ltd. shall either repair or replace at CANARM's option, any unit or part thereof, returned freight prepaid, and found to be defective.

This warranty does not include any labour or transportation costs incidental to the removal and reinstallation of the unit at the user's premises. Components repaired or replaced are warranted through the remainder of the original warranty period only.

This warranty applies to the original purchaser-user only; it is null and void in case of alteration, accident, abuse, neglect, and operation not in accordance with instructions.

NOTICE: No warranty claims will be honored by CANARM Ltd. unless prior authorization is obtained.

INSTALLATION OR PRODUCT PROBLEMS? DO NOT RETURN TO STORE OF PURCHASE.
CONTACT CANARM SERVICE AT 1-800-265-1833 (CANADA) 1-800-267-4427 (U.S.A.)
1-800-567-2513 (EN FRANCAIS) MONDAY TO FRIDAY 8:00 - 5:00PM E.S.T.

INSTRUCTION MANUAL FOR STANDARD EXHAUST FANS

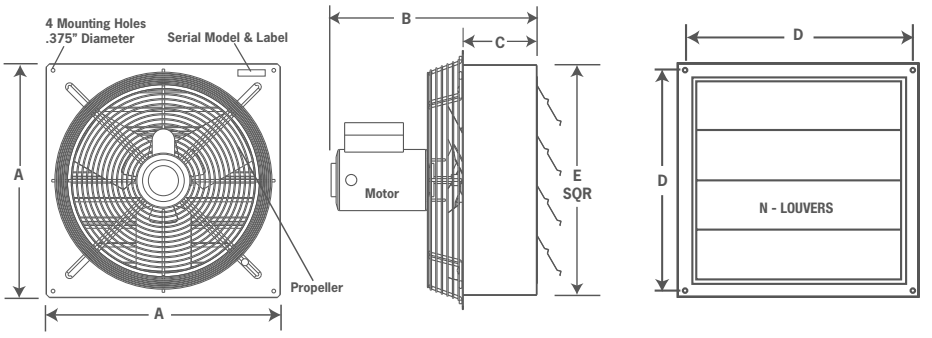
READ INSTRUCTIONS COMPLETELY BEFORE INSTALLATION & SAVE FOR REFERENCE

Congratulations on the purchase of your quality built direct drive, wall exhaust ventilation fan. All of these models use totally enclosed motors with thermal over load protection. Variable speed motors are high efficiency motors which save on electrical costs and can be run as a single speed motor. The motors are mounted on heavy gauge welded steel rod motor mounts that have a Bright Zinc finish. Fans come fully assembled and 100% of fans are tested for proper operation before shipping.

THESE ARE GENERAL INSTRUCTIONS WHICH COVER OUR SINGLE, VARIABLE AND TWO SPEED STANDARD FANS, AS WELL AS OUR SINGLE SPEED EXPLOSION PROOF MODELS..

STANDARD FANS:

These models have a rugged, welded steel box housing with a powder coated finish and aluminum or plastic exhaust louvers that are supported by long life nylon bushings. The louvers open automatically when the fan starts up and close when the fan stops



Fan Size	A	B	C	D (c/c)	E	N	Framing
8"	13 1/4"	11"	4"	12"	10 3/4"	2	11 X 11
10"	15 1/4"	11"	4"	14"	12 3/4"	2	13 X 13
12"	17 1/4"	17"	6"	16"	14 3/4"	3	15 X 15
14"	19 1/4"	17"	6"	18"	16 3/4"	3	17 X 17
16"	21 1/4"	17"	6"	20"	18 3/4"	4	19 X 19
18"	23 1/4"	15"	6"	22"	20 3/4"	4	21 X 21
20"	25 1/4"	18"	6"	24"	22 3/4"	5	23 X 23
24"	29 1/4"	18"	6"	28"	26 3/4"	5	27 X 27
30"	35 1/4"	19"	6"	34"	32 3/4"	16	33 X 33
36"	41 1/4"	18"	6"	40"	38 3/4"	20	39 X 39
42"	47 1/4"	18"	6 3/4"	46"	44 3/4"	24	45 X 45
48"	53 1/4"	19"	6 3/4"	52"	50 5/8"	26	51 X 51

EXPLOSION PROOF FANS:

Explosion proof fans are equipped with single speed explosion proof motors and aluminum blades so sparks cannot occur if a metal object obstructs the blade path. Explosion proof fans have the same quality welded steel box housing and heavy gauge welded guard as the standard fans. These fans should be used to ventilate hazardous areas. Locations are considered hazardous if the atmosphere contains or may contain gas, vapor, or dust in explosive quantities.

THE MOTOR AMBIENT TEMPERATURE IS NOT TO EXCEED +40˚C OR -25˚C UNLESS THE MOTOR NAMEPLATE SPECIFICALLY PERMITS ANOTHER VALUE. THE FOLLOWING TABLE INDICATES WHICH HAZARDOUS CLASSIFICATIONS CANARM EXPLOSION PROOF FANS DO AND DO NOT MEET.

Canarm explosion proof fans DO meet the following hazardous classifications.

CLASS 1, DIVISION 1 (GASES, VAPORS)

GROUP C Acetaldehyde, cyclopropane, diethlether, Ethylene, isoprene

GROUP D Acetone, acrylonitrile, ammonia, benzene, butane, ethylene dichloride, gasoline, hexane, methane, methanol, naphtha, propane, propylene styrene, toluene, vinyl, acetate, vinyl chloride, xylene

CLASS 2, DIVISION 1 (COMBUSTIBLE DUSTS)

GROUP F Carbon black, coke or coal dust

GROUP G Flour, starch or graindust

Canarm explosion proof fans DO NOT meet the following hazardous classifications.

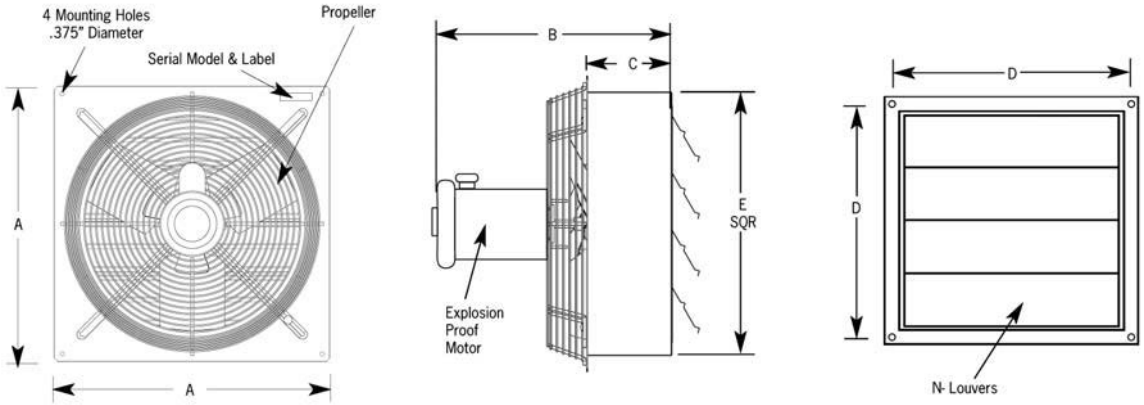
CLASS 1, DIVISION 1 (GASES, VAPORS)

GROUP A Acetylene

GROUP B Butadiene, ethylene oxide, hydrogen, propylene oxide

CLASS 2, DIVISION 1 (COMBUSTIBLE DUSTS)

GROUP E Aluminum, magnesium and other metal dusts with similar characteristics



Fan Size	A	B	C	D (c/c)	E	N	Framing
12"	17 1/4"	17"	6"	16"	14 3/4"	3	15 X 15
18"	23 1/4"	15"	6"	22"	20 3/4"	4	21 X 21
24"	29 1/4"	18"	6"	28"	26 3/4"	5	27 X 27

INSTALLATION

Installation is fast and simple. A sturdy framed wall opening should be prepared in advance to the size indicated for your fan in the charts above. With lag bolts for wooden frames or nut, bolt and lock washers for steel frames, secure the fan using the four mounting holes provided, one in each corner of the fan.

ELECTRICAL CONNECTIONS



WARNING: BE SURE POWER IS OFF AT THE ELECTRICAL PANEL BEFORE WIRING.

WARNING: ALL ELECTRICAL WORK SHOULD BE PERFORMED BY A QUALIFIED ELECTRICIAN.

These fans are supplied with single, two or variable speed motors. Single and two speed motors are 120V only. Variable speed motors are dual voltage. All dual voltage motors are pre-wired at 240V in our factory. Rewire motor as per motor nameplate if running fan at 120V. Please see the motor nameplate for wiring diagram. Make electrical connections in motor connection box as per the motor nameplate. Follow ***Chart #1*** for wire sizes. Two speed fans require a two speed control or 3 position toggle switch to change from high/ low/off. See wiring diagram with control for 2 speed wiring instructions.

CHART#1

Table A **Minimum Wire Sizes for Three-Phase Motors**

Motor HP	25 to 50 Feet			100 Feet			150 to 200 Feet		
	200V	230V	460V	200V	230V	460V	200V	230V	460V
1/8	14(18)*	14(18)*	14(18)*	14(18)*	14(18)*	14(18)*	14(16)*	14(16)*	14(18)*
1/6	14(18)*	14(18)*	14(18)*	14(18)*	14(18)*	14(18)*	14	14(16)*	14(18)*
1/4	14(18)*	14(18)*	14(18)*	14(16)*	14(18)*	14(18)*	14	14	14(18)*
1/3	14(18)*	14(18)*	14(18)*	14(16)*	14(16)*	14(18)*	12	14	14(18)*
1/2	14(16)*	14(18)*	14(18)*	12	14(16)*	14(18)*	10	12	14(18)*
3/4	14(16)*	14(16)*	14(18)*	12	14	14(18)*	10	10	14(16)*
1	14	14(16)*	14(18)*	12	12	14(18)*	8	10	14(16)*
1 1/2	12	14	14(18)*	10	10	14(16)*	6	8	14
2	12	12	14(18)*	8	10	14(16)*	6	6	12
3	10	12	14(18)*	6	8	14	4	6	12

Table B **Minimum Wire Sizes for Single-Phase Motors**

Motor HP	25 to 50 Feet			100 Feet			150 to 200 Feet		
	200V	230V	460V	200V	230V	460V	200V	230V	460V
1/8	14(18)*	14(18)*	14	14(18)*	12	14(18)*	10	8	14
1/6	14(16)*	14(18)*	12	14(18)*	10	14(18)*	6	6	12
1/4	14	14(18)*	10	14(16)*	6	14	6	4	10
1/3	14	14(18)*	10	14(16)*	8	14	6	4	10
1/2	12	14(18)*	8	14	6	12	4	3	8
3/4	10	14(16)*	6	12	4	10	2	1	6
1	10	14(16)*	6	12	4	10	2	1	6
1 1/2	8	14	6	12	3	8	1	1/0	6
2	6	14	4	10	2	8	1/0	2/0	4
3	6	12	3	8	1/0	6	2/0	4/0	3

NOTE:
- NEC Article 310-5 - *Minimum conductor size for general wiring at 115-440VAC is number 14AWG.
- Above wire sizes based on approximate 5% voltage drop during starting: copper conductors: and 75°C type THHW, THW, THWN, RH, RHW insulation etc. For aluminum wire, increase two wire size steps minimum. See NEC Article 310 for ampacities of aluminum conductors.
- Type S, SO, SJ, SJO, etc. flexible cable wire sizes. See NEC article 400 for ampacity.

OPERATION

WARNING: VARIABLE SPEED FANS SHOULD HAVE THE MINIMUM SPEED SET TO OPEN LOUVERS AT LEAST ONE INCH FOR PROPER MOTOR COOLING AND TO PREVENT MOTOR FAILURE.

All fans are direct drive. Fans with variable speed motors can be operated as an energy efficient single speed fan or in variable operation with the proper controller. As mentioned above two speed fans require a two speed control or 3 position toggle switch to change from high speed to low and off.



WARNING: GUARDING SHOULD BE USED IF FANS ARE MOUNTED LOWER THAN SEVEN FEET (2 METRES) OFF FLOOR OR GROUND LEVEL.

ACCESSORIES

Canarm provides a complete line of manual and thermostatic controls. Canarm also offers wall mount exhaust shutter kits, replacement shutter sets, and weather protection hoods.

MAINTENANCE

MOTORS ARE EQUIPPED WITH AUTOMATIC OVERLOAD PROTECTION AND MAY RESTART WITHOUT WARNING. ALWAYS DISCONNECT FROM POWER BEFORE ATTEMPTING SERVICE. Motor, blade and louvers should be kept clean of any buildup to prevent premature motor failure and to achieve proper performance. Automatic louvers should be kept operating freely. As with all mechanical equipment scheduled inspections should include checking that all hardware is secure and blade set screws are tight.

WARRANTY

CANARM Ltd. warrants every new fan to be free of defects in material and workmanship, to the extent that, within a period of one year from the date of purchase CANARM Ltd. shall either repair or replace at CANARM's option, any unit or part thereof, returned freight prepaid, and found to be defective. This warranty does not include any labour or transportation costs incidental to the removal and reinstallation of the unit at the user's premises. Components repaired or replaced are warranted through the remainder of the original warranty period only. This warranty applies to the original purchaser-user only; it is null and void in case of alteration, accident, abuse, neglect, and operation not in accordance with instructions.
NOTICE: NO WARRANTY CLAIMS WILL BE HONORED BY CANARM LTD. UNLESS PRIOR AUTHORIZATION IS OBTAINED.

CANARM®

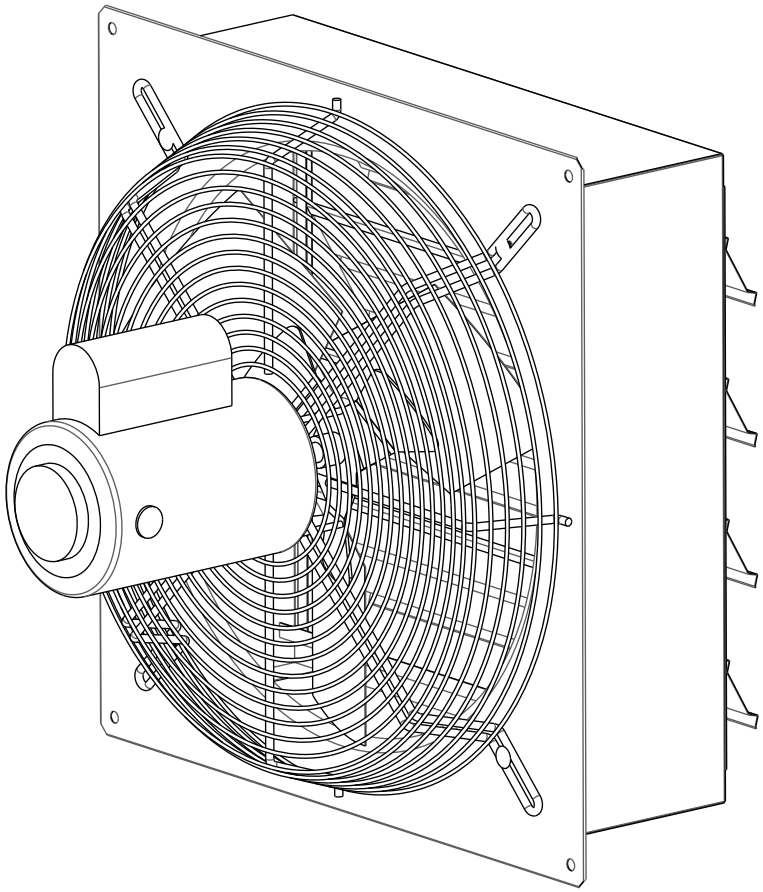
CANARM LTD.
2157 PARKEDALE AVE. PO BOX 367
BROCKVILLE, ONTARIO K6V 5V6
TELEPHONE: (613) 342-5424
FAX: 1-800-263-4598

CANARM LTEE.
2555 RUE BERNARD LEFEBVRE
LAVAL, QUEBEC H7C 0A5
TELEPHONE: (450) 665-2535
FAX: (450) 665-0910

ARTHUR MANUFACTURING FACILITY
#7686 CONCESSION 16, RR4
ARTHUR, ONTARIO N0G 1A0
TELEPHONE: (519) 848-3910
FAX: (519) 848-3948

VENTILATEURS D'ÉVACUATION STANDARD

MANUEL DE L'USAGER



GARANTIE

Canarm Ltée. garantie que chaque nouveau ventilateur ne comporte aucune défectuosité dans le matèriel et la main-d'oeuvre, et de ce fait, Canarm Ltée. remplacera ou réparera à son choix, tout unité ou partie de cette unité qui comporte une defectuosité, pour une période de un an suivant la date d'achat. L'unité doit être retournée frais de port payé et une défectuosité doit être décelée. Cette garantie ne couvre pas les frais de démontage et de réinstallation de l'unité sur les lieux de l'usager.

Les éléments réparés ou remplacés sont garanties pour la durée de la garantie originale seulement. Cette garantie s'applique à l'acheteur-usage initial seulement, elle est nulle dans le cas d'altérations, d'accident, d'abus, de négligence ou si l'opération n'est pas conforme aux instructions.

N.B.: Aucune réclamation ne sera honorée par Canarm Ltée. à moins d'autorisation obtenue au préalable.

PROBLÈMES D'INSTALLATION OU D'UTILISATION? NE RETOURNEZ PAS AU MAGASIN. COMMUNIQUEZ AVEC LE SERVICE À LA CLIENTÈLE CHEZ CANARM AU 1-800-265-1833 (CANADA) 1-800-267-4427 (USA) 1-800-567-2513 (EN FRANÇAIS) DU LUNDI AU VENDREDI ENTRE 8:00H ET 17:00H HNE

MODE D'EMPLOI DU VENTILATEUR D'ÉVACUATION STANDARD

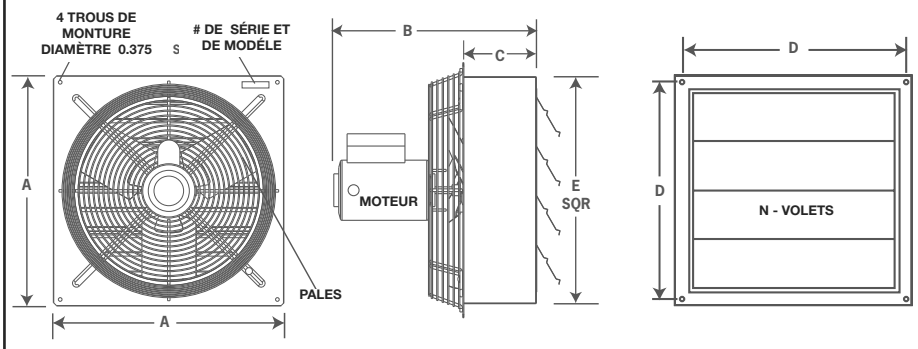
VEUILLEZ LIRE LES INSTRUCTIONS SUIVANTES AVANT DE PROCÉDER À L'INSTALLATION ET GARDEZ CE MANUEL COMME RÉFÉRENCE

Félicitations sur l'achat de votre ventilateur d'évacuation mural à entraînement direct de qualité. Tous ces modéles comportent un moteur fermé à avec une protection thermique contre la surcharge. Les moteurs à vitesse variable sont hautement efficaces et consomment peu d'énergie et de plus, ils peuvent être opérés comme un moteur à vitesse simple. Les moteurs sont soutenus par une monture de moteur trés robuste en tiges d'acier soudées de haut calibreet sont revÍtues d'un fini Zinc Brillant. Les ventilateurs vous sont livrés tout assemblé et 100% de nos ventilateurs sont testés avant la livraison.

Celui-ci est un mode d'emploi général décrivant nos ventilateurs à une vitesse, deux vitesses et à vitesse variable ainsi que notre ventilateur à une vitesse anti-explosif.

VENTILATEUR STANDARD

Ces modéles portent un boîtier robuste en acier soudé avec un fini poudré ainsi que des volets en aluminium ou en plastique qui sont retenus par des douilles en nylon de longue durée. Les volets s'ouvrent automatiquement lorsque le ventilateur démarre et se ferment lorsqu'il s'arrête.



Dimensions du Ventilateur							
Ventilateur	A	B	C	D (c/c)	E	N	Encadrement
8"	13 1/4"	11"	4"	12"	10 3/4"	2	11 X 11
10"	15 1/4"	11"	4"	14"	12 3/4"	2	13 X 13
12"	17 1/4"	17"	6"	16"	14 3/4"	3	15 X 15
14"	19 1/4"	17"	6"	18"	16 3/4"	3	17 X 17
16"	21 1/4"	17"	6"	20"	18 3/4"	4	19 X 19
18"	23 1/4"	15"	6"	22"	20 3/4"	4	21 X 21
20"	25 1/4"	18"	6"	24"	22 3/4"	5	23 X 23
24"	29 1/4"	18"	6"	28"	26 3/4"	5	27 X 27
30"	35 1/4"	19"	6"	34"	32 3/4"	16	33 X 33
36"	41 1/4"	18"	6"	40"	38 3/4"	20	39 X 39
42"	47 1/4"	18"	6 3/4"	46"	44 3/4"	24	45 X 45
48"	53 1/4"	19"	6 3/4"	52"	50 5/8"	26	51 X 51

VENTILATEUR ANTI-EXPLOSIF

Les ventilateurs anti-explosifs sont munis d'un moteur anti-explosif à une vitesse ainsi que des pales en aluminium afin de prévenir les étincelles lorsqu'un objet en métal obstrut la rotation de la pale. Les ventilateurs anti-explosifs sont fabriqués du même boîtier en acier robuste et de qualité et du même grillage à haut calibre que les ventilateurs Standard. Ces ventilateurs devront être utilisés pour ventilé les endroits hasardeux. L'endroit est considéré hasardeux si l'atmosphére contient ou peut contenir un gaz, une vapeur, ou de la poussiére en quantité explosive.

LA TEMPÉRATURE AMBIANTE DU MOTEUR NE DEVRAIT PAS EXCÉDER +40°C OU -25°C À MOINS QUE LA PLAQUE SUR LE MOTEUR INDIQUE SPÉCIFIQUEMENT UNE AUTRE VALEUR. LE TABLEAU SUIVANT INDIQUE LES CLASSES HASARDEUSES AUXQUELLES RÉPONDENT LES VENTILATEURS ANTI-EXPLOSIFS DE CANARM.

Les ventilateurs anti-explosifs de Canarm RÉPONDENT aux classifications hasardeuses suivantes :

CLASSE 1, DIVISION 1 (GAS ET VAPEURS)

GROUPE C ACÉTALDÉHYDE, CYCLOPROPANE, DIÉTHLÉTHER, ÉTHYLÈNE, ISOPRÈNE

GROUPE D ACÉTONE, ACRYLONITRILE, AMMONIAC, BENZÈNE, BUTANE, ÉTHYLÈNE DICHLORIDE, GAZOLINE, HEXANE, MÉTHANE, MÉTHANOL, NAPHTHA, PROPANE, PROPYLÈNE STYRÈNE, TOLUÈNE, VINYLE, ACÉTATE, VINYLE CHLORIDE, XYLÈNE

CLASSE 2, DIVISION 1 (POUSSIÈRES COMBUSTIBLES)

GROUPE F CARBON NOIR, COKE OU POUSSIÈRE DE CHARBON

GROUPE G FARINE, AMIDON OU POUSSIÈRE DE GRAIN

Les ventilateurs anti-explosifs de Canarm NE RÉPONDENT PAS aux classes hasardeuses suivantes :

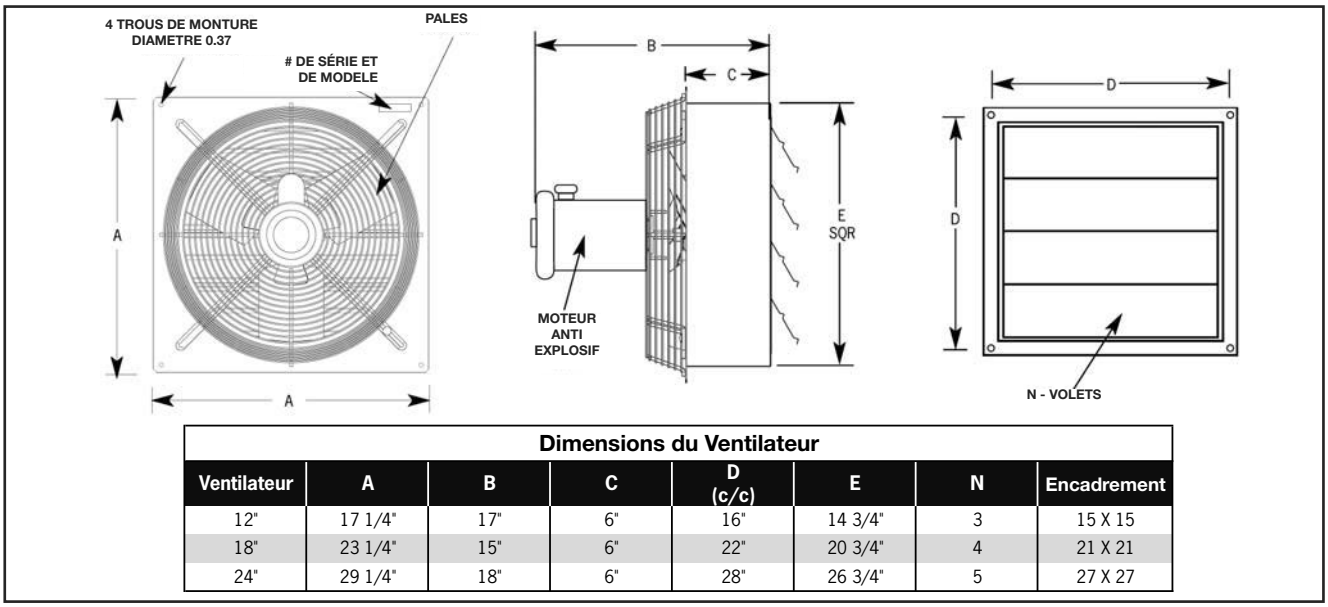
CLASSE 1, DIVISION 1 (GAS ET VAPEURS)

GROUPE A ACEETYLÈNE

GROUPE B BUTADIÈNE, OXYDE D'ÉTHYLÈNE, HYDROGÈNE, OXYDE DE PROPYLÈNE

CLASSE 2, DIVISION 1 (POUSSIÈRES COMBUSTIBLES)

GROUPE E ALUMINIUM, MAGNÉSIUM, ET AUTRES POUSSIÈRES DE MÉTAL AVEC DES CARACTERISTIQUES SIMILAIRES



Dimensions du Ventilateur

Ventilateur	A	B	C	D (c/c)	E	N	Encadrement
12"	17 1/4"	17"	6"	16"	14 3/4"	3	15 X 15
18"	23 1/4"	15"	6"	22"	20 3/4"	4	21 X 21
24"	29 1/4"	18"	6"	28"	26 3/4"	5	27 X 27

INSTALLATION

L'installation est simple et rapide. Un encadrement robuste dans l'ouverture du mur devrait être préparé à l'avance aux grandeurs mentionnes pour votre ventilateur dans le tableau ci-dessus. A l'aide de boulons pour cadrage de bois ou d'écrous, boulons et rondelles de blocage pour cadrage de métal, posez le ventilateur à l'aide des quatres trous de montage fournies, un dans chacun des coins.

CONNEXIONS ÉLECTRIQUES



MISE EN GARDE: FERMEZ LE COURANT AU DISJONCTEUR AVANT PROCÉDER AUX RACCORDEMENTS.

MISE EN GARDE: TOUS LES TRAVAUX ÉLECTRIQUES DEVRONT ÊTRE EXÉCUTÉS PAR UN ÉLECTRICIEN QUALIFIÉ.

Ces ventilateurs portent un moteur à une, deux ou vitesse variable. Les moteurs à une ou deux vitesses peuvent recevoir du 120V seulement. Les moteurs à vitesse variable sont à voltage double. Tous les moteurs à voltage double sont préparés en usine pour recevoir du 240V. Suivez les indications sur la plaque du moteur pour rebrancher le moteur sur le 120V. Faîtes les connexions dans la boîte de connexion du moteur selon les indications sur la plaque du moteur. Consultez le Tableau #1 pour la grandeur de fil à être utilisé. Les ventilateurs à deux vitesses demandent un contrôle à 2 vitesses ou un interrupteur à levier 3 postions pour changer la vitesse de grande/petite/fermé. Consultez le diagramme fournie avec le contrôle pour l'installation à 2 vitesses.

TABLEAU A

Tableau A Grosseur minium de fil pour moteur à trois phases

Moteur HP	25 à 50 Pieds			100 Pieds			150 à 200 Pieds		
	200V	230V	460V	200V	230V	460V	200V	230V	460V
1/8	14(18)*	14(18)*	14(18)*	14(18)*	14(18)*	14(18)*	14(16)*	14(16)*	14(18)*
1/6	14(18)*	14(18)*	14(18)*	14(18)*	14(18)*	14(18)*	14	14(16)*	14(18)*
1/4	14(18)*	14(18)*	14(18)*	14(16)*	14(18)*	14(18)*	14	14	14(18)*
1/3	14(18)*	14(18)*	14(18)*	14(16)*	14(16)*	14(18)*	12	14	14(18)*
1/2	14(16)*	14(18)*	14(18)*	12	14(16)*	14(18)*	10	12	14(18)*
3/4	14(16)*	14(16)*	14(18)*	12	14	14(18)*	10	10	14(16)*
1	14	14(16)*	14(18)*	12	12	14(18)*	8	10	14(16)*
1 1/2	12	14	14(18)*	10	10	14(16)*	6	8	14
2	12	12	14(18)*	8	10	14(16)*	6	6	12
3	10	12	14(18)*	6	8	14	4	6	12

Tableau B **Grosseur minium de fil pour moteur à phase simple**

Moteur HP	25 à 50 Pieds			100 Pieds			150 à 200 Pieds		
	200V	230V	460V	200V	230V	460V	200V	230V	460V
1/8	14(18)*	14(18)*	14	14(18)*	12	14(18)*	10	8	14
1/6	14(16)*	14(18)*	12	14(18)*	10	14(18)*	6	6	12
1/4	14	14(18)*	10	14(16)*	6	14	6	4	10
1/3	14	14(18)*	10	14(16)*	8	14	6	4	10
1/2	12	14(18)*	8	14	6	12	4	3	8
3/4	10	14(16)*	6	12	4	10	2	1	6
1	10	14(16)*	6	12	4	10	2	1	6
1 1/2	8	14	6	12	3	8	1	1/0	6
2	6	14	4	10	2	8	1/0	2/0	4
3	6	12	3	8	1/0	6	2/0	4/0	3

N.B.:
- Article 310-5 NEC grosseur minium de conducteur pour filage général à 115- 440VAC est le numéro 14AWG
- Les grandeurs de fils ci-dessus sont basés sur une baisse approximative de 5% lors du départ; conducteurs en cuivre; et isolation type 75C THHW, THW, RH, RHW etc. Pour un fil en aluminium, augmentez le fil d'un minimum de deux grandeurs. Voir Article 310 NEC pour ampacités des conducteurs en aluminium.
- Type S, SO, SJ, SJO, ETC. grandeur de fil de cable flexible. Voir article 400 NEC pour ampérage relatif.

OPÉRATION:

MISE EN GARDE: LES VENTILATEURS À VITESSE VARIABLE DEVRAIENT ÊTRE AJUSTÉS AFIN QUE LA VITESSE MINIUM OUVRE LES VOLETS D'AU MOINS 1" AFIN DE PERMETTRE UN AÉRATION ADÉQUATE DU MOTEUR. Tous les ventilateurs sont à entraînement direct. Les ventilateurs avec moteur à vitesse variable peuvent étre opérés comme moteur à une vitesse économe d'énergie ou comme moteur variable avec un contrôle adéquat. Tel que mentionné, les ventilateurs à 2 vitesses requièrent un contrôle à 2 vitesses ou un interrupteur à levier à 3 positions pour pouvoir changer la vitesse du moteur de grande à petite.



MISE EN GARDE: UNE GRILLE INTÉRIEUR DEVRAIT ÊTRE UTILSÉ SI LE VENTILATEUR EST INSTALLÉ À MOINS DE 7 PEIDS (2 METRE) DU SOL.

ACCESSOIRES:

Canarm vous offre une gamme complète de contrôle manuel et thermostatique. Canarm vous offre également des ensembles de volets muraux d'évacuation, les volets de remplacement ainsi que des capots de protection contre les intempéries.

ENTRETIEN:

LES MOTEURS COMPORTENT UNE PROTECTION AUTOMATIQUE CONTRE LA SURCHARGE ET POURRAIENT DÉMARRER SANS AVERTISSEMENT. DÉBRANCHER TOUJOURS L'UNITÉ AVANT DE PROCÉDER À L'ENTRETIEN. Le moteur, les pales et les volets devraient être nettoyés régulièrement pour éviter une accumulation de saleté qui pourrait endommager le moteur et nuire au bon fonctionnement de votre ventilateur. Les volets automatiques devraient pouvoir opérer librement. Comme pour tout les appareils mécaniques, des inspections régulières devront être entreprises afin de s'assurer que toute la quincaillerie et les vis à pales soient bien serrées.

GARANTIE

Canarm Ltée. garantie que chaque nouveau ventilateur ne comporte aucune défectuosité dans le matériel et la main-d'oeuvre, et de ce fait, Canarm Ltée. remplacera ou réparera à son choix, tout unité ou partie de cette unité qui comporte une defectuosité, pour une période d'un an suivant la date d'achat. L'unité doit être retournée frais de port payé et une défectuosité doit être décelée. Cette garantie ne couvre pas les frais de démontage et de réinstallation de l'unité sur les lieux de l'usager. Les éléments réparés ou remplacés sont garanties pour la durée de la garantie originale seulement. Cette garantie s'applique à l'acheteur-usager initial seulement; elle est nulle dans le cas d'altérations, d'accident, d'abus, de négligence ou si l'opération n'est pas conforme aux instructions.

N.B.: AUCUNE RÉCLAMATION NE SERA HONORÉE PAR CANARM LTÉE. À MOINS D'AUTORISATION OBTENUE AU PRÉALABLE.

CANARM®

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BROCKVILLE, ONTARIO K6V 5V6
TELEPHONE: (613) 342-5424
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CANARM LTEE.
2555 RUE BERNARD LEFEBVRE
LAVAL, QUEBEC H7C 0A5
TELEPHONE: (450) 665-2535
FAX: (450) 665-0910

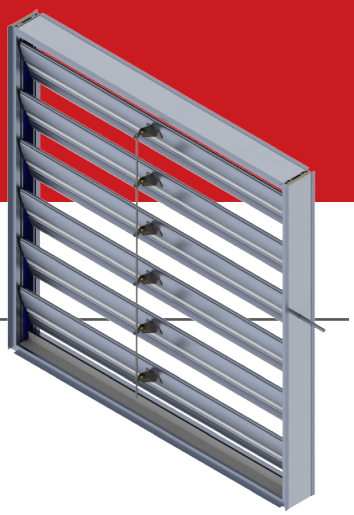
USINE D'ARTHUR
#7686 CONCESSION 16, RR4
ARTHUR, ONTARIO N0G 1A0
TELEPHONE: (519) 848-3910
FAX: (519) 848-3948

Section 3.7.4

Louver & Dampeners

VAPI-BF

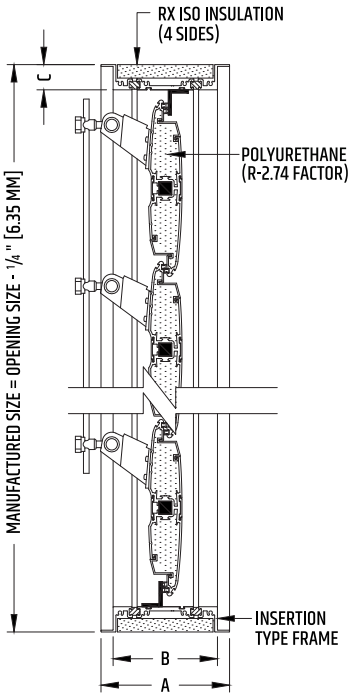
INSULATED EXTRUDED ALUMINUM DAMPERS



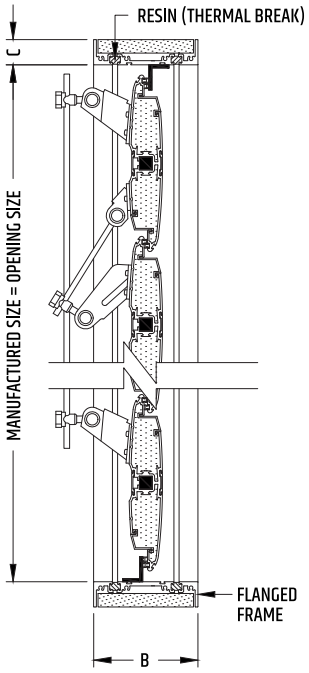
STANDARD CONSTRUCTION

MODEL VAPI-BF	SINGLE BLADE, MAX. HEIGHT OF 11-3/4" (298 MM)	
	PARALLEL ACTION, MIN. HEIGHT OF 12" (304.8 MM)	
	OPPOSED ACTION, MIN. HEIGHT OF 14" (355.6 MM)	
FRAME	EXTRUDED 6063-T6 ALUMINUM, 0.102" (2.6 MM) THICK	
BLADES	EXTRUDED 6063-T6 ALUMINUM, 0.08" (2 MM) THICK	
DRIVE AXLE	MACHINED 1/2" X 1/2" (12.7 MM X 12.7 MM) SQUARE TO Ø 1/2" (12.7 MM) ROUND STEEL BAR, BOLTED	
AXLES	1/2" X 1/2" (12.7 MM X 12.7 MM) ALUMINUM BAR, PUNCHED	
OPERATING TEMPERATURE	-40 °C TO 74 °C (-40 °F TO 165 °F)	
FRAME SEALS	SILICONE -62 °C TO 288 °C (-80 °F TO 550 °F)	
BLADE SEALS	SILICONE -62 °C TO 288 °C (-80 °F TO 550 °F)	
FRAME INSULATION	RESIN THERMAL BREAK AND RX ISO INSULATION (R-6 FACTOR)	
BLADE INSULATION	POLYURETHANE FOAM (R-2.74 FACTOR)	
BUSHINGS	INNER PART: CELCON (POLYMER)	
	OUTER PART: POLYCARBONATE	
STOPPERS	PVC	
HARDWARE	YELLOW ZINC PLATED	
WIDTH	MIN. 6" (152 MM)	MAX. 60" (1 524 MM)
HEIGHT	**SINGLE BLADE**	
	FLANGED FRAME	INSERTION-TYPE FRAME
	MIN. 6-1/2" (165 MM) MAX. 9-3/4" (248 MM)	MIN. 6-1/2" (165 MM) MAX. 11-3/4" (298 MM)
	MULTIPLE BLADES	
	MIN. 12" (305 MM)	MAX. 48" (1 219 MM)

PARALLEL ACTION



OPPOSED ACTION



AVAILABLE OPTIONS

FRAME	FLANGED
BUSHINGS	BRONZE
	STAINLESS STEEL
	BALL BEARINGS
ASSEMBLY	FACE AND BYPASS
	JACK SHAFT 3/4" (19 MM) - MAX. 45 FT² (4.18 M²)
FINISH	ANODIZED
	LECHLER ISOLACK (5-YEAR WARRANTY)
	DURANAR OR INTERPON D 2000 (20-YEAR WARRANTY)
	DURANAR XL OR INTERPON D 3000 (30-YEAR WARRANTY)
HARDWARE	STAINLESS STEEL
FRAME SEALS	ROUNDED STAINLESS STEEL STRIP

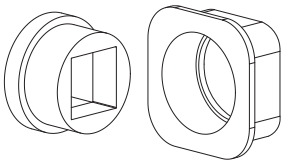
TYPE		A	B	C
INSERTION	Up to 30" X 30" (762 MM X 762 MM)	4" (99.9 MM)	3-1/8" (79.1 MM)	1" (25.4 MM)
	Greater than 30" X 30" (762 MM X 762 MM)	5-1/8" (129.5 MM)	4-1/8" (105.1 MM)	1" (25.4 MM)
FLANGED	Up to 30" X 30" (762 MM X 762 MM)	–	3-1/8" (79.1 MM)	1" (25.4 MM)
	Greater than 30" X 30" (762 MM X 762 MM)	–	4-1/8" (105.1 MM)	1" (25.4 MM)

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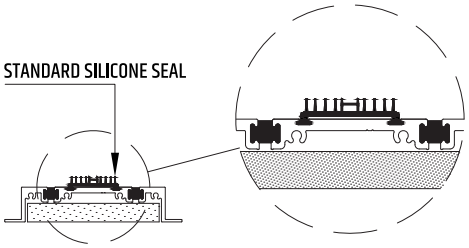
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VAPI-BF

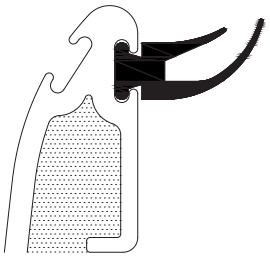
TWO-PART BUSHINGS
TO AVOID METAL TO METAL CONTACT



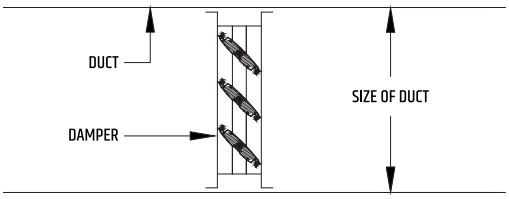
FRAME SEAL



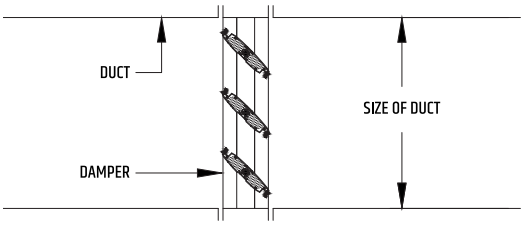
BLADE SEAL



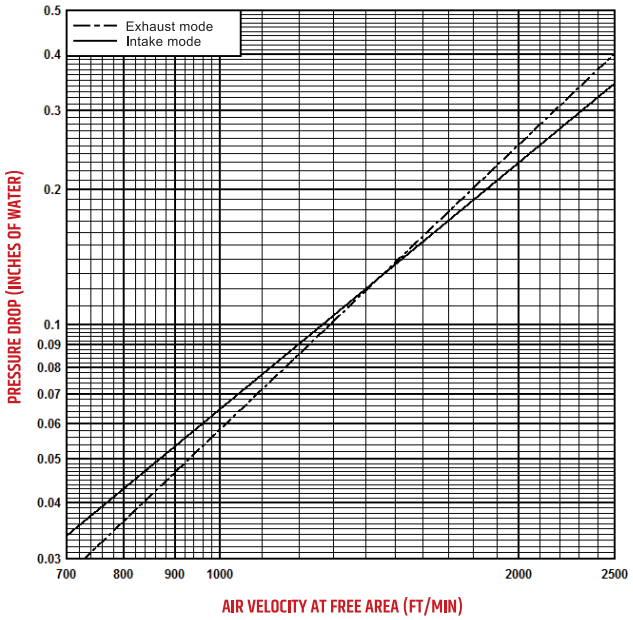
INSERTION-TYPE



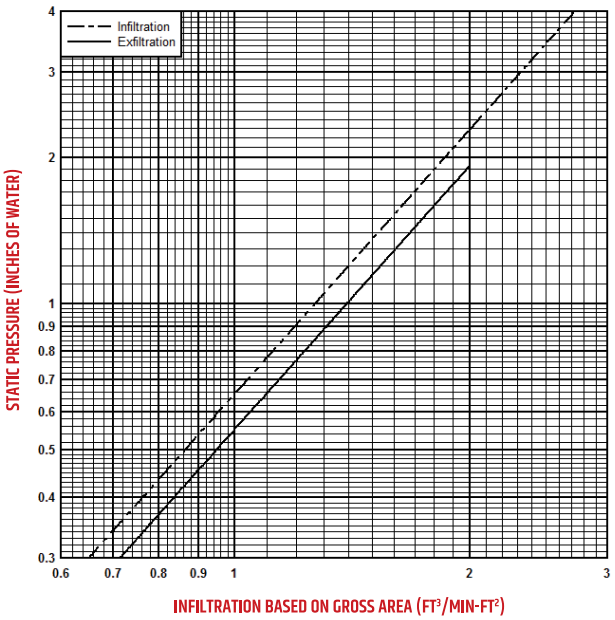
FLANGED



PRESSURE DROP VS AIR VELOCITY
MODEL VAPI AT 90 DEGREES



AIR LEAKAGE
MODEL VAPI



NOTE: Pressure drop and infiltration tests performed by Air-Ins Laboratories on a 48" x 48" damper section, in accordance with the AMCA 500 standard.

TROLEC DAMPER MAINTENANCE

When dampers are exposed to harsh worksite elements such as cement dust, it is sometimes necessary to lubricate the moving parts for maximum performance.

We recommend a penetrating lubricant such as Aerochem's MX-EP, which we use during the assembly process.

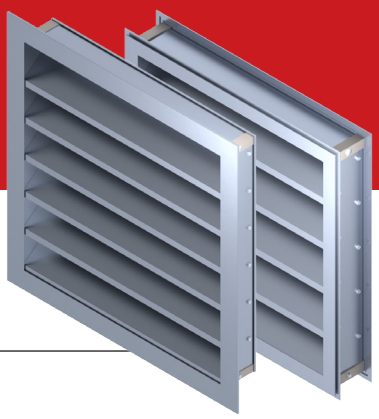
Trolec products are always carefully inspected before shipping. However, appropriate measures should be taken in the field to ensure maximum performance.

Trolec may not be held liable for any damage resulting from misuse of its products or inadequate installation.

Trolec reserves the right to modify these specifications without notice.

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TW-245 / HW-245



FIXED ALUMINUM LOUVERS
STORMPROOF

STANDARD CONSTRUCTION	
FRAME	EXTRUDED 6063-T6 ALUMINUM, 0.072" (1.8 MM) THICK
BLADES	EXTRUDED 6063-T6 ALUMINUM, 0.062" (1.6 MM) THICK
BLADE ANGLE	51°
BLADE SPACING	±2" (50.8 MM)
BLADE FASTENING	FASTENED TO FRAME WITH SCREWS
BIRD SCREEN	GALVANIZED ½" X ½" X 0.047" (12.7 MM X 12.7 MM X 1.2 MM)
FINISH	MILL
SINGLE SECTION	MIN. 6" (152 MM) X 6" (152 MM)
	MAX. 48" (1 219 MM) X 234" (5 944 MM)
MULTIPLE SECTIONS	VARIOUS CONFIGURATIONS AVAILABLE

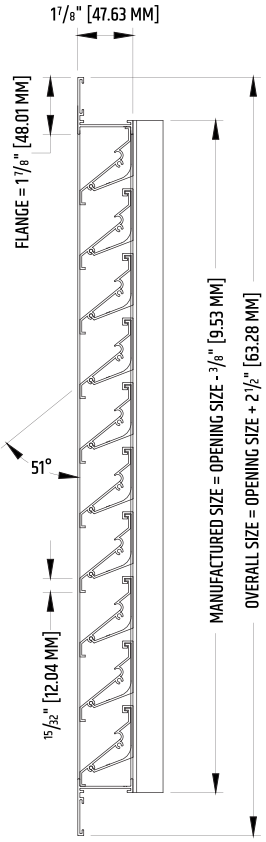
PERFORMANCE: 48" X 48" SECTION	
FREE AREA	6.43 FT² (0.597 M²)
PERCENTAGE OF FREE AREA	40%
BEGINNING POINT OF WATER PENETRATION	413 FT/MIN (2.10 M/S)
PRESSURE DROP AT BEGINNING POINT OF WATER PENETRATION	0.035" W.G. (8.7 PA)

NOTE: Louvers tested with bird screen installed

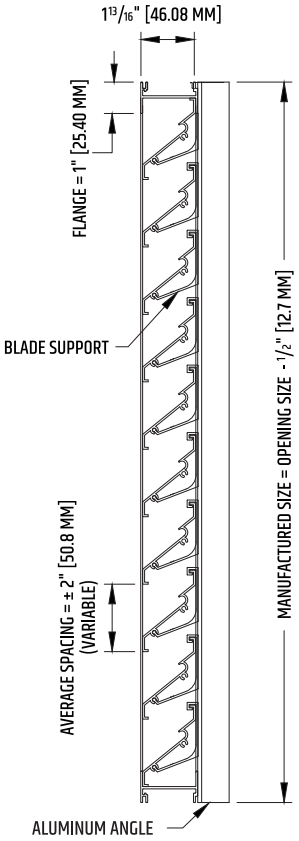
AVAILABLE OPTIONS	
BIRD SCREEN	GALVANIZED 1/4" X 1/4" (6.35 MM X 6.35 MM)
	GALVANIZED 1" X 1" (25.4 MM X 25.4 MM)
	EXPANDED ALUMINUM 1/2" - 051F (12.7 MM)
INSECT SCREEN	FASTENED
	REMOVABLE
BLANK-OFF PANEL	NON INSULATED
	INSULATED AND FASTENED (WITH THERMAL BARRIER)
	INSULATED AND REMOVABLE (WITH THERMAL BARRIER)
ACCESS LOUVER (DOOR)	MOUNTED ON HINGES

FINISHES AVAILABLE	
ANODIZED	CLEAR
	COLOR
PAINT	LECHLER ISOLACK (5-YEAR WARRANTY)
	DURANAR OR INTERPON D 2000 (20-YEAR WARRANTY)
	DURANAR XL OR INTERPON D 3000 (30-YEAR WARRANTY)

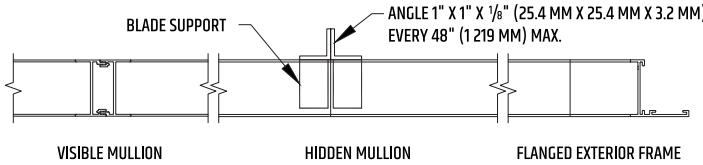
TW-245



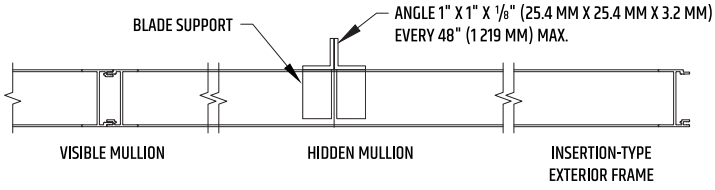
HW-245



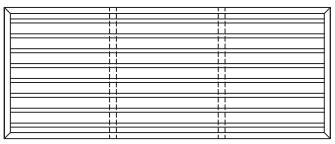
EXTERIOR FRAME OF FLANGED LOUVER



EXTERIOR FRAME OF INSERTED LOUVER (NO FLANGE)



LOUVERS WITH UNINTERRUPTED BLADE LINE



LOUVERS WITH VISIBLE MULLIONS



trolec INC. DAMPERS & LOUVERS

MAKING MASTERWORKS

OCTOBER 2016

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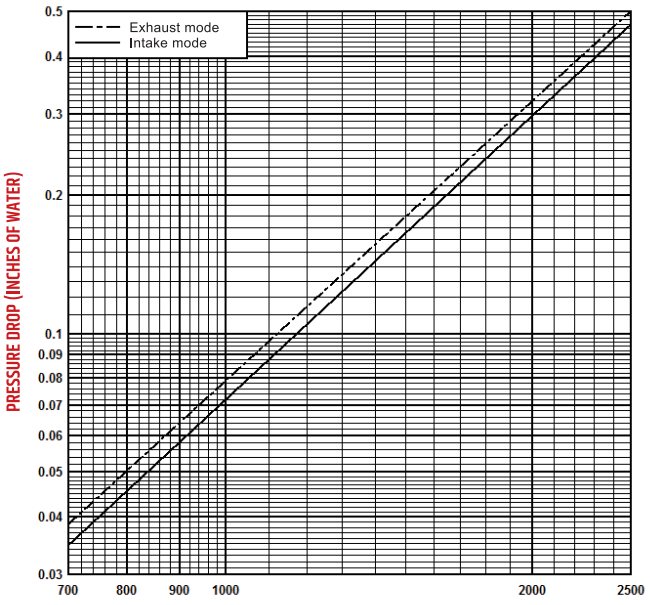
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LOUVER FREE AREA (IN²)

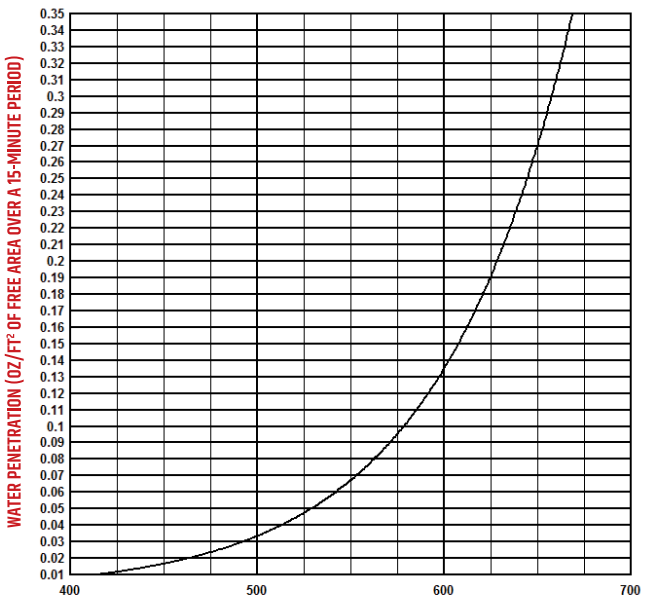
HEIGHT (IN)	WIDTH (IN)										
	12	18	24	30	36	42	48	54	60	66	72
12	0.26	0.40	0.54	0.68	0.82	0.96	1.10	1.19	1.33	1.47	1.61
18	0.42	0.65	0.87	1.10	1.33	1.55	1.78	1.93	2.16	2.38	2.61
24	0.68	1.05	1.41	1.77	2.14	2.50	2.87	3.11	3.48	3.84	4.20
30	0.85	1.31	1.76	2.22	2.67	3.13	3.58	3.89	4.34	4.80	5.25
36	1.11	1.70	2.30	2.89	3.48	4.08	4.67	5.07	5.66	6.26	6.85
42	1.27	1.94	2.62	3.30	3.98	4.66	5.33	5.79	6.46	7.14	7.82
48	1.53	2.35	3.16	3.98	4.80	5.62	6.43	6.98	7.80	8.62	9.43
54	1.69	2.60	3.50	4.40	5.31	6.21	7.12	7.72	8.63	9.53	10.44
60	1.96	3.01	4.05	5.10	6.15	7.20	8.25	8.94	9.99	11.04	12.09
66	2.11	3.23	4.36	5.49	6.62	7.74	8.87	9.62	10.75	11.88	13.00
72	2.37	3.63	4.90	6.17	7.43	8.70	9.96	10.81	12.07	13.34	14.61
78	2.54	3.89	5.25	6.61	7.97	9.32	10.68	11.59	12.94	14.30	15.66
84	2.82	4.32	5.83	7.34	8.85	10.35	11.86	12.87	14.37	15.88	17.39
90	2.98	4.57	6.16	7.75	9.35	10.94	12.53	13.59	15.19	16.78	18.37
96	3.23	4.96	6.69	8.42	10.15	11.88	13.60	14.76	16.49	18.22	19.94

NOTE : Louvers tested with bird screen installed

PRESSURE DROP VS AIR VELOCITY
MODEL TW-245



WATER PENETRATION
MODEL TW-245
BEGINNING POINT OF WATER PENETRATION AT 413 FT/MIN



NOTE : Water penetration and pressure drop tests performed by Air-Ins Laboratories, in accordance with the AMCA 500 standard.

CALCULATION METHOD FOR REQUIRED FREE AREA

To determine the free area required for a louver:

- Step 1: Divide the required flow (CFM) by the projected velocity at free area.
- Step 2: Choose the desired louver size from the free area table that meets the minimum requirements.
- Step 3: Compare specifications for certified water penetration and pressure drop.

Example for intake:

5 000 CFM flow at 400 FT/MIN :

$$\text{Min. free area} = \frac{\text{required CFM}}{\text{maximum projected velocity*}} \Rightarrow \frac{5\,000}{400} = 12.5\ \text{ft}^2$$

Select a louver measuring 60" x 78" with 12.94 ft² of free area

* Should not exceed beginning point of water penetration speed.

Trolec reserves the right to modify these specifications without notice.

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T. 1.888.656.2610 450.656.2610 // F. 1.888.305.1912 514.525.1912

Section 3.7.5

Pressure Gauge

Stainless Steel Liquid Filled Gauge, Lead Free Stainless Steel Liquid Filled Gauge

PFQ, PFQ-LF



1. Optional U-Clamp
2. Optional Front Flange

LEAD FREE

RoHS compliant

Note; RoHS applies SS internals only

Description & Features:

- Pulsation resistant, liquid filled stainless steel case
- Glycerin filled standard
- Brass, lead free brass or stainless steel internals
- Restricted orifice standard on dual scale
- Ventable plug on 2.5” (63mm) and 4” (100mm) bottom mount (excluding SAE connection)
- Crimp-On bezel
- Single (psi) or dual scale (psi/kPa)/(psi/bar) available
- Optional U-Clamps and front flanges
- Dry case available
- ASME B40.100 compliant (EN837-1 available on 2” (50mm) dial and up)
- CRN registered
- 5 year warranty

Applications:

- Ideal for pumps, compressors, hydraulic presses, machinery, pneumatic equipment and motors in harsh environments
- Use where harmful vibration and pulsation are present
- Lead free version for potable water systems

Specifications	
Dial	1.5” (40mm), 2” (50mm), 2.5” (63mm), 4” (100mm), white aluminum with black and red markings
Case	AISI 304 SS
Lens	Polycarbonate
Ring	AISI 304 SS, Crimp-On
Socket	PFQ: OT 58 brass or AISI 316 SS PFQ-LF: Lead free brass
Connection	1/8”, 1/4” or 1/2” NPT or 7/16-20 SAE standard with restricted orifice
Fill Liquid	Glycerin
Bourdon Tube	1.5” (40mm), 2” (50mm): Phosphor bronze C or coil shaped for brass socket SS C or coil shaped for 316 SS socket 2.5” (63mm), 4” (100mm): Phosphor bronze or lead free phosphor bronze C or coil shaped for brass socket, AISI 316 SS C or coil shaped for 316 SS socket
Movement	OT 59 brass or SS
Pointer	Aluminum, anodized black
Welding	Brass: Silver alloy, 316SS: TIG
Over-pressure Limit	25% for pressures up to 1,450 psi (9,998 kPa), 15% for pressures over 1,450 psi (9,998 kPa)
Socket Gasket	Buna N for two-piece internal socket seal
Fill Plug	Buna N
Lens Ring Gasket	Silicone rubber
Working Pressure	Maximum 75% of full scale value
Ambient/Process Temperature	Dry: -40°F to 200°F (-40°C to 93°C) Glycerin Filled: -4°F to 150°F (-20°C to 65°C)
Accuracy	1.5” (40mm), 2” (50mm): ±2.5% of full scale value 2.5” (63mm), 4” (100mm): ±1.5% of full scale value
Enclosure Rating	IP65

Dual Scale Order Codes (products in bold are normally stock in North America)

Dial Size	2.5" (63mm)			
Connection	1/4" Bottom	1/4" Back (CB)	1/4" Bottom	1/4" Back (CB)
Movement, Socket, Tube	Brass		SS	
30" Hg Vac/kPa	**PFQ801**	**PFQ900**	**PFQ106**	PFQ147
30"/0/15 psi/kPa	**PFQ790**	PFQ890	PFQ107	PFQ148
30"/0/30 psi/kPa	**PFQ798**	**PFQ898**	**PFQ108**	PFQ149
30"/0/60 psi/kPa	**PFQ799**	**PFQ899**	**PFQ109**	PFQ151
30"/0/100 psi/kPa	**PFQ791**	PFQ891	PFQ110	PFQ156
30"/0/150 psi/kPa	**PFQ792**	**PFQ892**	PFQ111	PFQ157
30"/0/200 psi/kPa	**PFQ794**	**PFQ894**	PFQ112	PFQ158
30"/0/300 psi/kPa	**PFQ795**	PFQ895	PFQ113	PFQ159
0/15 psi/kPa	**PFQ800**	**PFQ901**	**PFQ118**	PFQ162
0/30 psi/kPa	**PFQ802**	**PFQ902**	**PFQ119**	**PFQ163**
0/60 psi/kPa	**PFQ803**	**PFQ903**	**PFQ120**	**PFQ164**
0/100 psi/kPa	**PFQ804**	**PFQ904**	**PFQ121**	**PFQ169**
0/160 psi/kPa	**PFQ805**	**PFQ905**	**PFQ122**	**PFQ170**
0/200 psi/kPa	**PFQ806**	**PFQ906**	**PFQ123**	**PFQ171**
0/300 psi/kPa	**PFQ807**	**PFQ907**	**PFQ124**	**PFQ175**
0/400 psi/kPa	**PFQ817**	PFQ917	**PFQ125**	PFQ177
0/600 psi/kPa	**PFQ808**	**PFQ908**	**PFQ126**	**PFQ178**
0/1,000 psi/kPa	**PFQ809**	**PFQ909**	**PFQ127**	PFQ179
0/1,500 psi/kPa	**PFQ816**	**PFQ914**	**PFQ128**	PFQ180
0/2,000 psi/kPa	**PFQ810**	**PFQ910**	**PFQ129**	PFQ181
0/3,000 psi/kPa	**PFQ811**	**PFQ911**	**PFQ137**	**PFQ182**
0/4,000 psi/kPa	PFQ819	PFQ919	PFQ130	-
0/5,000 psi/kPa	**PFQ812**	**PFQ912**	**PFQ138**	**PFQ183**
0/6,000 psi/kPa	**PFQ814**	**PFQ915**	**PFQ139**	PFQ184
0/7,500 psi/kPa	**PFQ818**	PFQ918	PFQ144	PFQ186
0/10,000 psi/kPa	**PFQ813**	**PFQ913**	**PFQ145**	PFQ190
0/15,000 psi/kPa	-	-	PFQ146	PFQ191

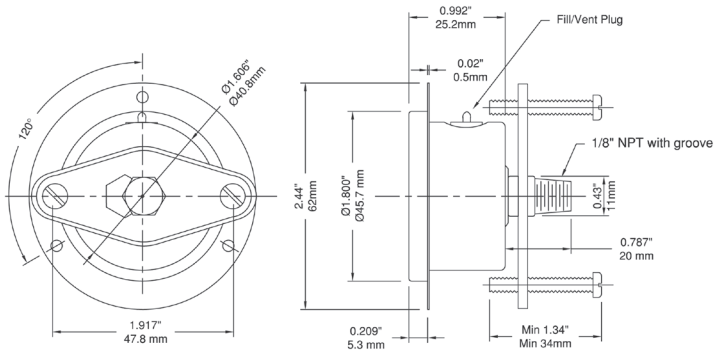
Dial Size	2.5" (63mm)	
Connection	1/4" Bottom	1/4" Back (CB)
Movement, Socket, Tube	Brass	
30" Hg Vac/bar	PFQ801R1R11	PFQ900R1R11
30"/0/15 psi/bar	PFQ790R1R11	PFQ890R1R11
30"/0/30 psi/bar	PFQ798R1R11	PFQ898R1R11
30"/0/60 psi/bar	PFQ799R1R11	PFQ899R1R11
30"/0/100 psi/bar	PFQ791R1R11	PFQ891R1R11
30"/0/160 psi/bar	PFQ792R1R11	PFQ892R1R11
30"/0/200 psi/bar	PFQ794R1R11	PFQ894R1R11
30"/0/300 psi/bar	PFQ795R1R11	PFQ895R1R11
0/15 psi/bar	PFQ800R1R11	PFQ901R1R11
0/30 psi/bar	PFQ802R1R11	PFQ902R1R11
0/60 psi/bar	PFQ803R1R11	PFQ903R1R11
0/100 psi/bar	PFQ804R1R11	PFQ904R1R11
0/160 psi/bar	PFQ805R1R11	PFQ905R1R11
0/200 psi/bar	PFQ806R1R11	PFQ906R1R11
0/300 psi/bar	PFQ807R1R11	PFQ907R1R11
0/400 psi/bar	PFQ817R1R11	PFQ917R1R11
0/600 psi/bar	PFQ808R1R11	PFQ908R1R11
0/1,000 psi/bar	PFQ809R1R11	PFQ909R1R11
0/1,500 psi/bar	PFQ816R1R11	PFQ914R1R11
0/2,000 psi/bar	PFQ810R1R11	PFQ910R1R11
0/3,000 psi/bar	PFQ811R1R11	PFQ911R1R11
0/4,000 psi/bar	PFQ819R1R11	PFQ919R1R11
0/5,000 psi/bar	PFQ812R1R11	PFQ912R1R11
0/6,000 psi/bar	PFQ814R1R11	PFQ915R1R11
0/7,500 psi/bar	PFQ818R1R11	PFQ918R1R11
0/10,000 psi/bar	PFQ813R1R11	PFQ913R1R11

Other ranges and connection sizes available upon request. For scale change, refer to How to Order Guide for scale codes.
For options, attach suffix to end of order code: i.e. PFQ801-25DRY for DRY CASE

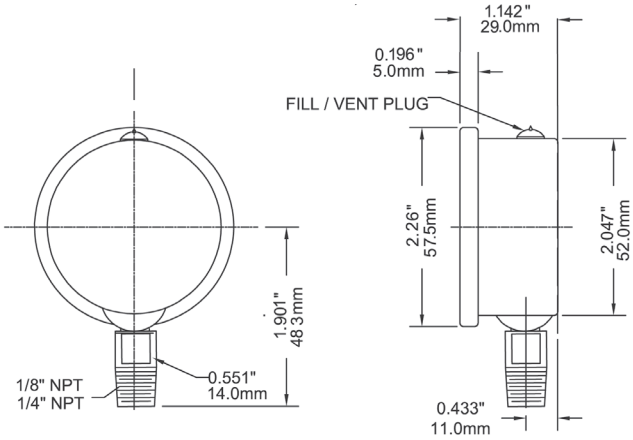
Option suffix:
25BF = 2.5" (63mm) Back flange
25DRY = Supply 2.5" (63mm) gauge dry
25FF = 2.5" (63mm) Front flange
25UC = 2.5" (63mm) U-Clamp
EN = EN837-1 compliant
SF25 = 2.5" (63mm) Silicone filled

Industrial

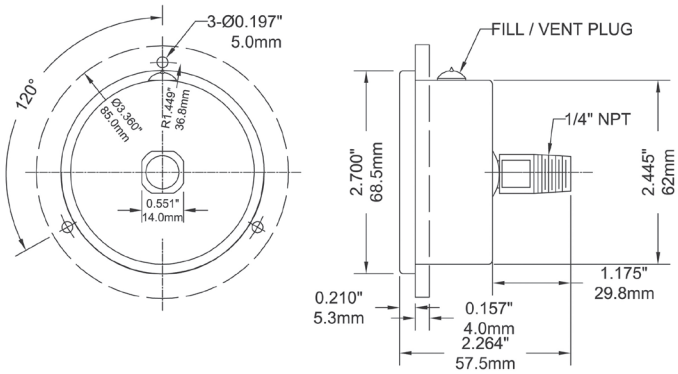
1.5” Back Connection with Front Flange and U-Clamp



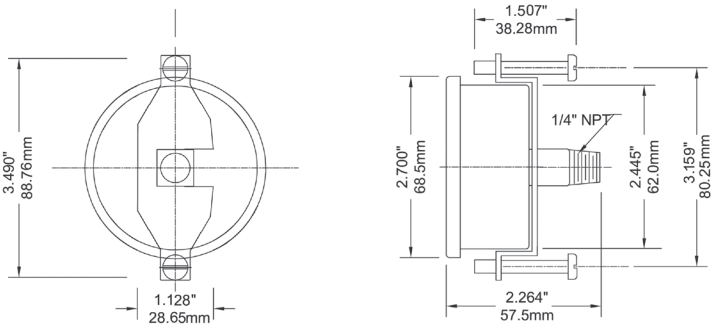
2” Bottom Connection



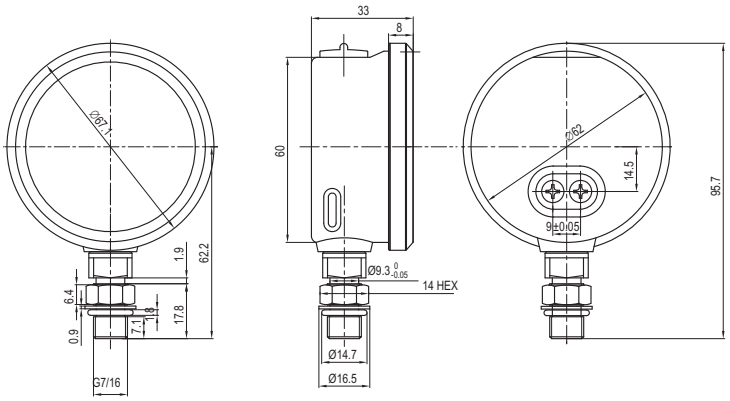
2.5” Back Connection with Front Flange



2.5” Back Connection with U-Clamp

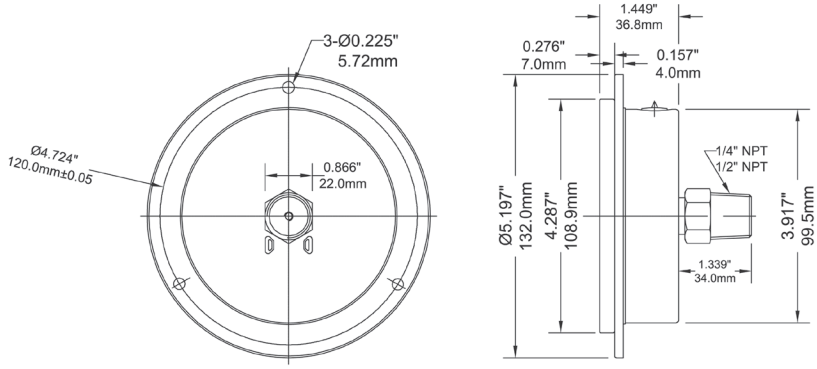


2.5” Bottom Connection SAE



Dimensions in mm

4” Back Connection with Front Flange



Section 3.7.6

Back Flow Preventor

For Non-Health Hazard Applications

Job Name _____ Contractor _____

Job Location _____ Approval _____

Engineer _____ Contractor's P.O. No. _____

Approval _____ Representative _____

Series 007
Double Check Valve Assemblies

Sizes: ½" – 3" (15 – 80mm)

Series 007 Double Check Valve Assemblies shall be installed at referenced cross-connections to prevent the backflow of polluted water into the potable water supply. Only those cross-connections identified by local inspection authorities as non-health hazard shall be allowed the use of an approved double check valve assembly.

Check with local authority having jurisdiction regarding vertical orientation, frequency of testing or other installation requirements.

The valve shall meet the requirements of ASSE Std. 1015 and AWWA Std. C510. Approved by the Foundation for Cross-Connection Control and Hydraulic Research at the University of Southern California.

Features

- Ease of maintenance — only one cover
- Top entry
- Replaceable seats and seat discs
- Modular construction
- Compact design
- Cast bronze body construction — ½" – 2" (15 – 50mm)
- Fused epoxy coated cast iron body — 2½" – 3" (65 – 80mm)
- Top mounted ball valve test cocks
- Low pressure drop
- No special tools required for servicing
- ½" – 1" (15 – 25mm) have tee handles

Specifications

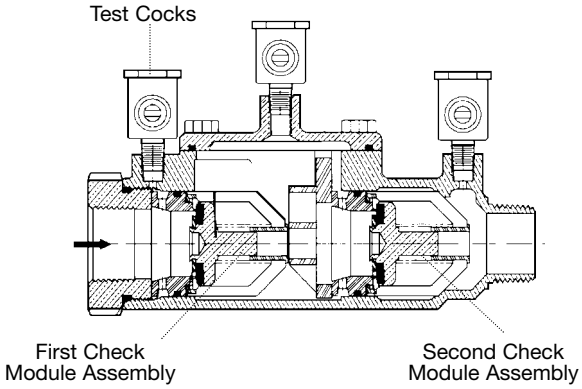
A Double Check Valve Assembly shall be installed at each noted location. The assembly shall consist of two positive seating check modules with captured springs and rubber seat discs. The check module seats and seat discs shall be replaceable. Service of all internal components shall be through a single bronze or stainless steel access cover secured with stainless steel bolts. The assembly shall also include two resilient seated isolation valves; four top mounted, resilient seated test cocks. The assembly shall meet the requirements of ASSE Std. 1015 and AWWA Std. C510. Approved by the Foundation for Cross-Connection Control and Hydraulic Research at the University of Southern California. Assembly shall be a Watts Series 007.



¾" (20mm) 007M3QT



2" (50mm) 007M1QT HC



The 007 Series features a modular design concept which facilitates complete maintenance and assembly by retaining the spring load.

Now Available
WattsBox Insulated Enclosures.
For more information, send for literature ES-WB.

IMPORTANT: *INQUIRE WITH GOVERNING AUTHORITIES FOR LOCAL INSTALLATION REQUIREMENTS*

Watts product specifications in U.S. customary units and metric are approximate and are provided for reference only. For precise measurements, please contact Watts Technical Service. Watts reserves the right to change or modify product design, construction, specifications, or materials without prior notice and without incurring any obligation to make such changes and modifications on Watts products previously or subsequently sold.

WATTS®

Pressure — Temperature

½" – 2" (15 – 50mm)

Temperature Range: 33°F – 180°F (0.5°C – 82°C).

Maximum Working Pressure: 175psi (12.1 bar).

2½" – 3" (65 – 80mm)

Temperature Range: 33°F – 110°F (0.5°C – 43°C) continuous, 140°F (60°C) intermittent.

Maximum Working Pressure: 175psi (12.1 bar).

Standards

ASSE Std. 1015, AWWA Std. C510

IAPMO PS31, CSA B64.5

Approvals

† ASSE, AWWA, IAPMO, CSA, UPC

▲ Approved by the Foundation for Cross-Connection Control and Hydraulic Research at the University of Southern California.

• Models LF and S are not listed.

◆ UL Classified (LF models only) ¾" – 2" (20 – 50mm) (except 007M3LF)

◆ UL Classified with OSY gate valves (2½" and 3" horizontal only.)

* Horizontal and vertical "flow up" approval on all sizes

Suffix:

S - bronze strainer

LF - without shutoff valves

LH - locking handle ball valves (open position)

SH - stainless steel ball valve handles

HC - 2½" inlet/outlet fire hydrant fittings (2" valve)

Prefix:

U - Union connections

2½" – 3" (65 – 80mm)

Suffix:

NRS - non-rising stem resilient seated gate valves

OSY - UL/FM outside stem and yoke resilient seated gate valves

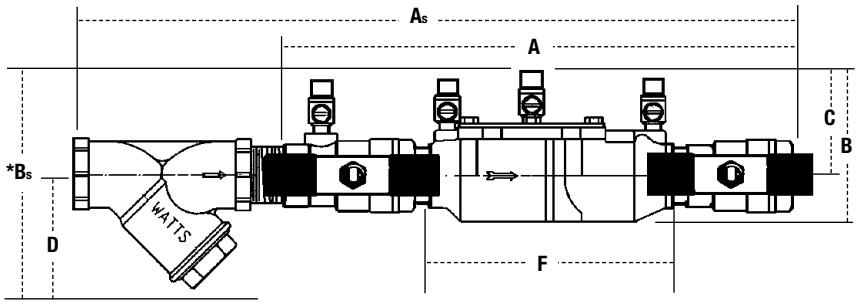
LF - without shutoff valves

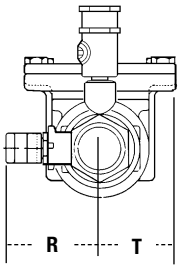
QT-FDA - FDA epoxy coated quarter-turn ball valves

Dimensions – Weights

Models

Sizes: ½" – 2" (15 – 50mm)





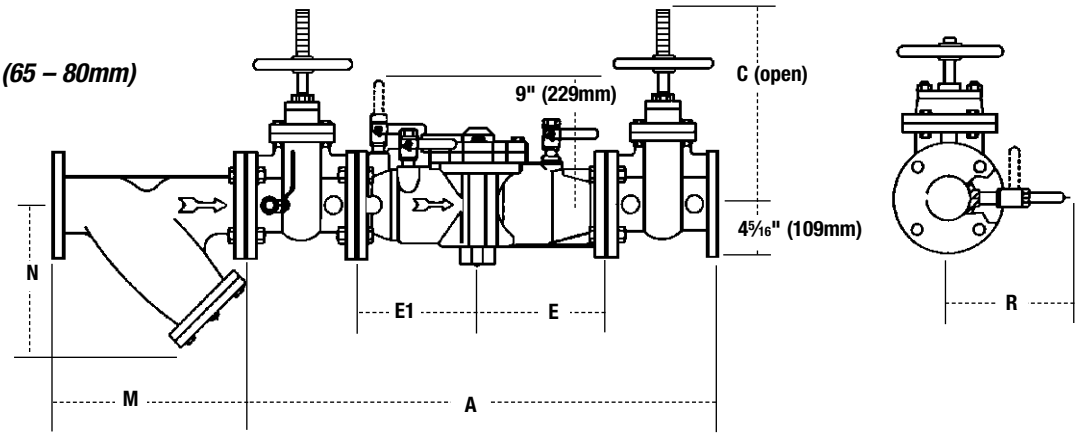
***Subscript 'S' = strainer model**

Suffix HC — Fire Hydrant Fittings dimension "A" = 23½" (594mm)

MODEL	SIZE (DN)		DIMENSIONS																WEIGHT	
			A		B		C		D		F		G		R		T			
	in.	mm	in.	mm	in.	mm	in.	mm	in.	mm	in.	mm	in.	mm	in.	mm	in.	mm	lbs.	kgs.
†▲007QT	½	15	10	254	4 5/8	117	2 7/16	62	—	—	5	127	3 3/8	85	2 5/16	59	2 1/16	52	4.5	2
†▲007M3QT	¾	20	11 1/8	282	4	102	3 1/8	79	—	—	6 3/16	157	3 7/16	87	2 1/8	54	1 5/16	33	5	2.3
†▲007M1QT	1	25	13 1/4	337	5 1/8	130	4	102	—	—	7 1/2	191	3 3/8	85	1 11/16	43	1 11/16	43	12	5.4
†▲007M2QT	1 1/4	32	16 3/8	416	5	127	3 5/16	84	—	—	9 1/2	241	5	127	3	76	2	50	15	6.8
†▲007M2QT	1 1/2	40	16 3/4	425	4 7/8	124	3 1/2	89	—	—	9 3/4	248	5 13/16	148	3 1/8	79	2 11/16	68	15.9	7.2
†▲007M1QT	2	50	19 1/2	495	6 1/4	159	4	102	—	—	13 3/8	340	6 1/8	156	3 7/16	87	2 11/16	68	25.7	11.7
• 007QT-S	½	15	13	330	6	152	2 7/16	62	3	76	5	127	3 3/8	85	2 5/16	59	2 1/16	52	5.5	2.5
• 007M3QT-S	¾	20	14 1/2	368	6 1/8	156	3 1/8	79	3	76	6 3/16	157	3 7/16	87	2 1/8	54	1 5/16	33	6.7	3.1
• 007M1QT-S	1	25	17 15/16	157	7 3/4	197	4	102	3 1/4	83	7 1/2	191	3 3/8	85	1 11/16	43	1 11/16	43	14	6.4
• 007M2QT-S	1 1/4	32	21 1/2	546	7 1/16	179	3 5/16	84	3 1/2	83	9 1/2	241	5	127	3	76	2	50	19	8.6
• 007M2QT-S	1 1/2	40	25 1/16	637	7 1/16	179	3 1/2	89	3 3/4	95	9 3/4	248	5 13/16	148	3 1/8	79	2 11/16	68	19.6	8.9
• 007M1QT-S	2	50	27 1/4	692	8 3/4	222	4	102	4	102	13 3/8	340	6 1/8	156	3 7/16	87	2 11/16	68	33.5	15.2

Dimensions – Weights

Sizes: 2½" – 3" (65 – 80mm)



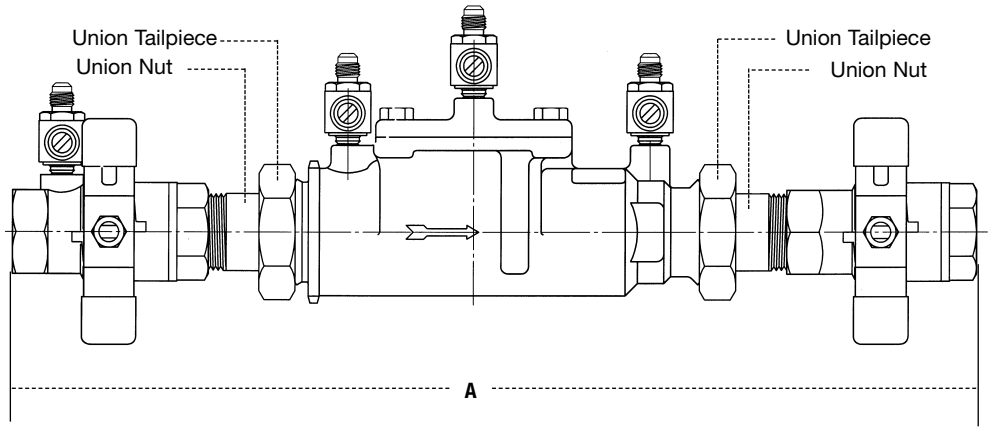
MODEL		SIZE (DN)		DIMENSIONS								WEIGHT	
				A		C		E, E1		R			
		in.	*mm*	*in.*	*mm*	*in.*	*mm*	*in.*	*mm*	*in.*	*mm*	*lbs.*	*kgs.*
	007QT-FDA	2½	65	33⅛	841	6⅜	162	9¹⁄₁₆	230	8¾	222	155	70
▲	007-NRS	2½	65	33⅛	841	9⅜	238	9¹⁄₁₆	230	8¾	222	155	70
▲◆	007-OSY	2½	65	33⅛	841	16⅜	416	9¹⁄₁₆	230	8¾	222	158	72
	007-QT-FDA	3	80	34⅛	867	6⅜	162	9¹⁄₁₆	230	8¾	222	155	70
▲◆	007-NRS	3	80	34⅛	867	10¼	260	9¹⁄₁₆	230	8¾	222	185	84
▲	007-OSY	3	80	34⅛	867	18⅞	479	9¹⁄₁₆	230	8¾	222	185	84

Strainer Dimensions

SIZE						WEIGHT	
		M		N			
in.	*mm*	*in.*	*mm*	*in.*	*mm*	*lbs.*	*kgs.*
2½	65	10	254	6½	165	28	13
3*	80	10⅛	267	7	178	34	15

*S Models only

1" U007M1QT



Sizes: ½" – 2" (15 – 50mm)

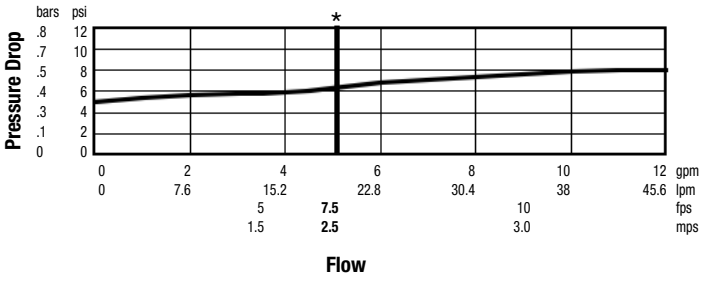
MODEL	SIZE (DN)		DIMENSIONS	
			A	
	in.	*mm*	*in.*	*mm*
U007QT	½	15	12¹³⁄₁₆	326
U007M2QT	¾	20	13¹³⁄₁₆	350
U007M2QT	1	25	16⅝	422
U007M2QT	1¼	32	20¾	527
U007M2QT	1½	40	21½	546
U007M1QT	2	50	24½	622

Capacity

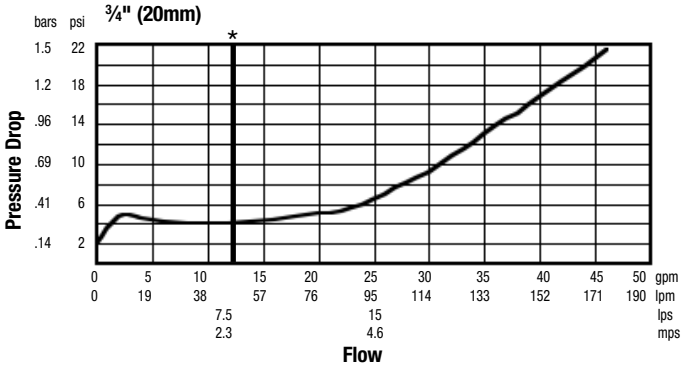
As complied from documented Foundation for Cross-Connection Control and Hydraulic Research at the University of Southern California lab tests.

* Typical maximum system flow rate (7.5 feet/sec., 2.3 meters/sec.)
** UL rated flow

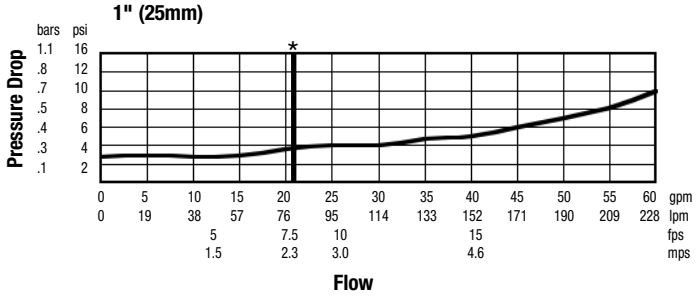
½" (15mm)



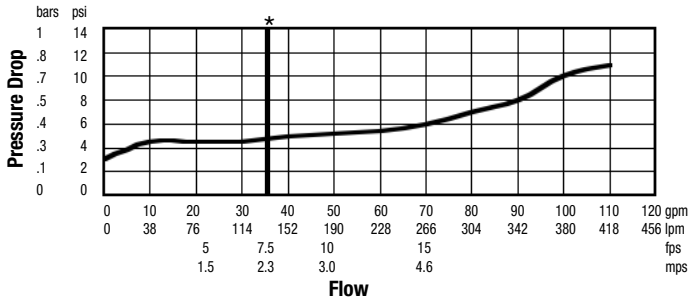
¾" (20mm)



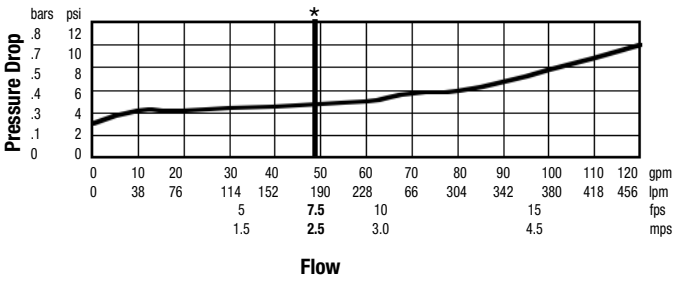
1" (25mm)



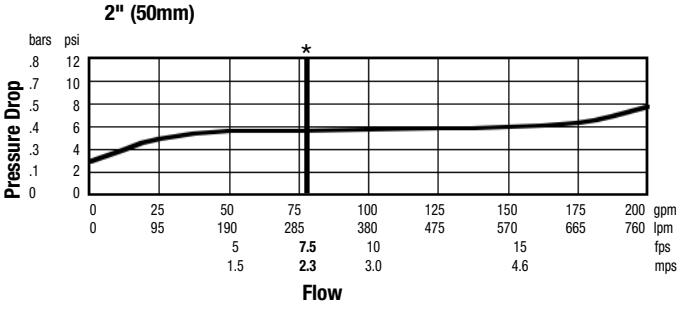
1¼" (32mm)



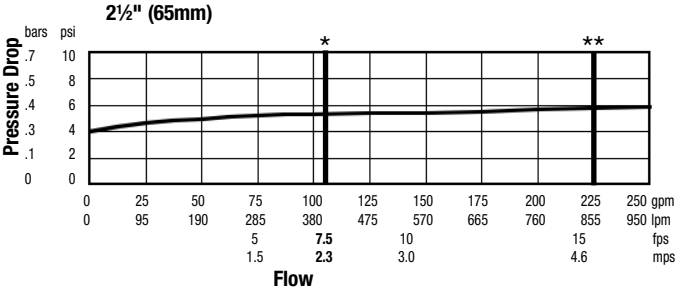
1½" (40mm)



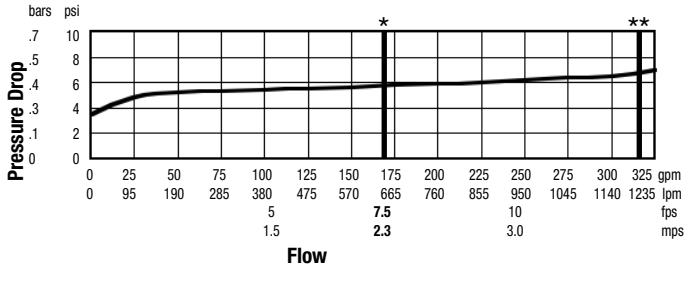
2" (50mm)



2½" (65mm)



3" (80mm)

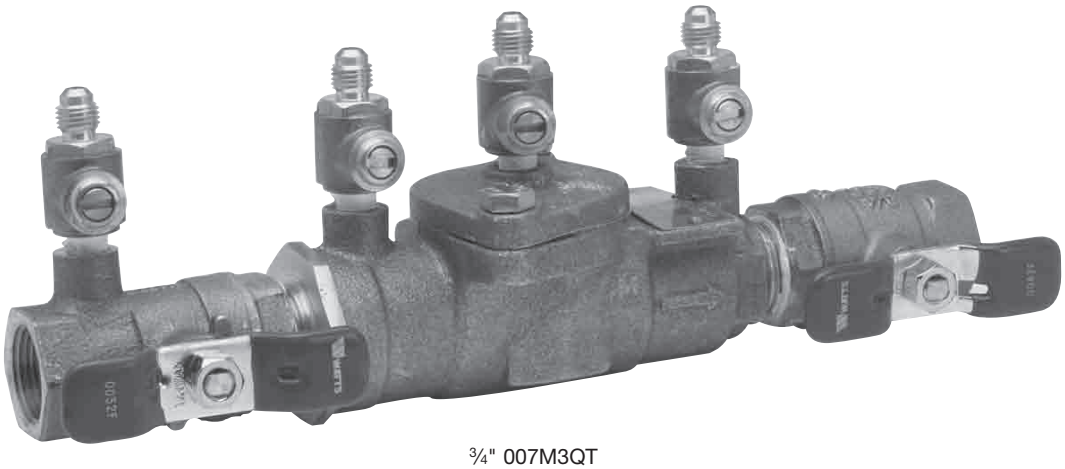


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Installation, Maintenance, & Repair Series 007 and LF007

Double Check Valve Assemblies

Sizes: ½" – 3" (15 - 80mm)



¾" 007M3QT

⚠ WARNING

You are required to thoroughly read all installation instructions and product safety information before beginning the installation of this product. **FAILURE TO COMPLY WITH PROPER INSTALLATION AND MAINTENANCE INSTRUCTIONS COULD RESULT IN PRODUCT FAILURE WHICH CAN CAUSE PROPERTY DAMAGE, PERSONAL INJURY AND/OR DEATH.** Watts is not responsible for damages resulting from improper installation and/or maintenance.

Local building or plumbing codes may require modifications to the information provided. You are required to consult the local building and plumbing codes prior to installation. If this information is not consistent with local building or plumbing codes, the local codes should be followed.

Need for Periodic Inspection/Maintenance: This product must be tested periodically in compliance with local codes, but at least once per year or more as service conditions warrant. Corrosive water conditions, and/or unauthorized adjustments or repair could render the product ineffective for the service intended. Regular checking and cleaning of the product's internal components helps assure maximum life and proper product function.

NOTE: For Australia and New Zealand, line strainers should be installed between the upstream shutoff valve and the inlet of the backflow preventer.

Watts product specifications in U.S. customary units and metric are approximate and are provided for reference only. For precise measurements, please contact Watts Technical Service. Watts reserves the right to change or modify product design, construction, specifications, or materials without prior notice and without incurring any obligation to make such changes and modifications on Watts products previously or subsequently sold.

Testing

For field testing procedure, send for IS-TK-DL, IS-TK-7, IS-TK-9A, IS-TK-99E AND IS-TK-99D.

For other repair kits and service parts, send for PL-RP-BPD.

For technical assistance, contact your local Watts representative.

Installation Instructions

Series 007 and LF007

½" - 2" (15 - 50mm)

Indoors - Figure 1

Check local codes for installation requirements. Pipe lines should be thoroughly flushed to remove foreign material before installing the unit. A strainer should be installed as shown, ahead of backflow preventer to prevent disc from unnecessary fouling. Install valve inline with arrow on valve body pointing in the direction of flow.

For indoor installations, it is important that the valve be easily accessible to facilitate testing and servicing. Do not install in a concealed location.

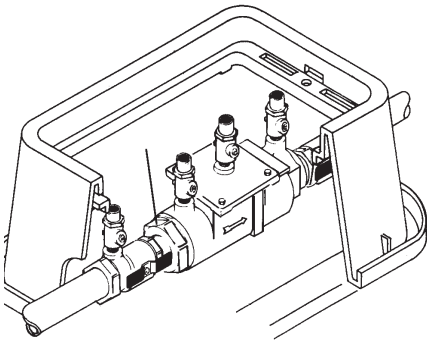
CAUTION:

Do not install with strainer when backflow preventer is used on seldom-used water lines which are called upon during emergencies, such as fire sprinkler lines, etc.

It is important that Series 007 and LF007 be tested periodically in compliance with local codes, but at least once a year or more often depending upon system conditions. Regular inspection, testing and cleaning assures maximum life and proper product function.

NOTE: Fire Protection System Installations

The National Fire Protection Agency (NFPA) Guidelines require a confirming flow test to be conducted whenever a "main line" valve such as the shutoff valves or a backflow assembly have been operated. Certified testers of backflow assemblies must conduct this test. The trim valves of the confirming flow test. When the test is completed, the trim valves must be returned to a fully open position.



Meter Box Installation

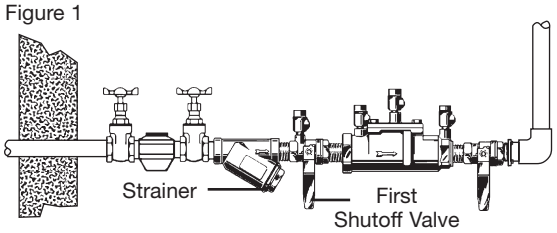
Parallel - Figure 3

Two or more Series 007 and LF007 smaller size valves may be piped in parallel (where approved) to serve a larger supply pipe main. This type of installation is employed whenever it is vital to maintain a continuous supply of water/where interruptions for testing and servicing would be unacceptable. It also has the advantage of providing increased capacity where needed beyond that provided by a single valve and permits testing or servicing of an individual valve without shutting down the complete line.

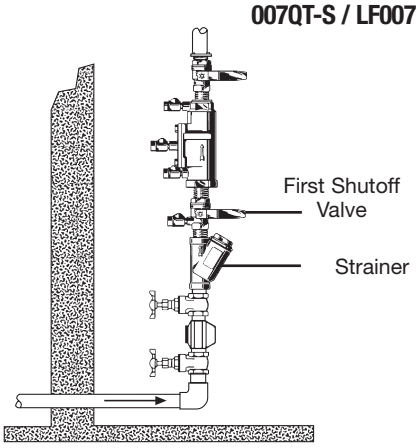
For two valve installations the total capacity of the devices should equal or exceed that required by the system.

The quantity of valves used in parallel should be determined by the engineers judgement based on the operating conditions of a specific installation.

Figure 1

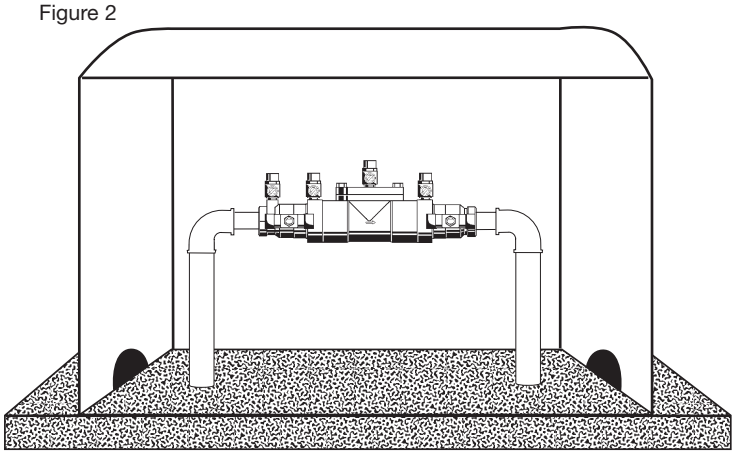


007QT-S / LF007



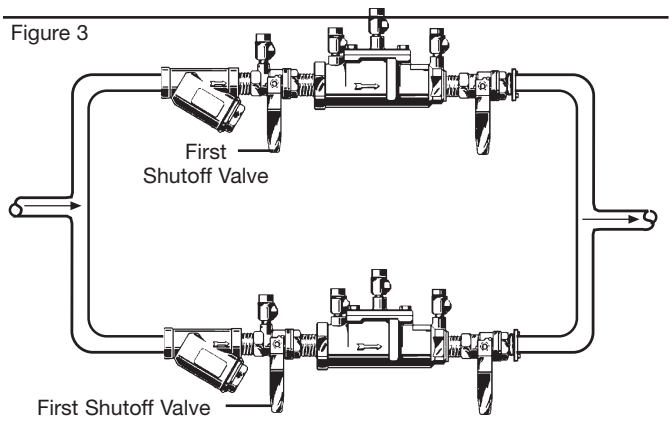
007QT-S Vertical flow-up installation

Figure 2



WattsBox Insulated Enclosure
Available in Aluminum or Fiberglass.
For more information, send for ES-WB.

Figure 3



007QT-S / LF007

Service, Replacement Parts and Maintenance

Series 007 and LF007

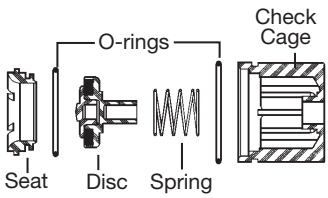
Servicing the First and Second Check Valves

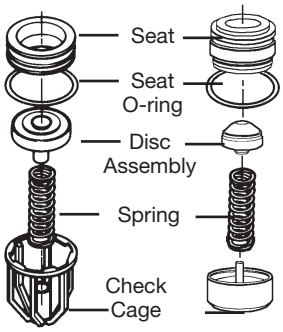
NOTE: Before servicing, ensure supply water is turned off or shutoff valves are in the closed position.

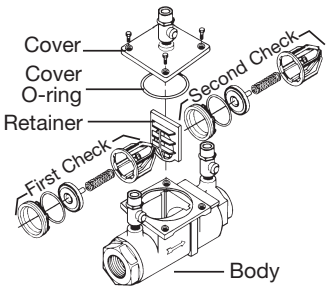
1. Remove the cover, then remove the retainer from the body valve. The check valve modules can now be removed from the valve by hand or with a screwdriver.

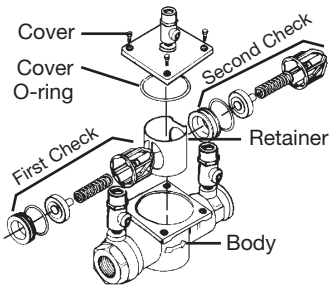
NOTE: For Series 007 and LF007 sizes ½" - 2" (15-50mm), the seats and springs of the first and second check modules are not interchangeable. The heavier spring and smaller diameter seat belong with the first check module. Series 007M1 sizes ¾" - 1" (20-25mm) and Series 007M2 ¾" (20mm) have interchangeable seats and springs.

2. The check seats are attached to the cage with a bayonet type locking arrangement. Holding the cage in one hand, push the seat inward and rotate clockwise against the cage. For ¾" (20mm) Series 007M2/LF007M2 and LF007 pull apart seat and cage. The seat, cage, spring and disc assembly are now individual components.
3. The disc assembly may now be cleaned and reassembled or, depending on its condition, it may be discarded and replace with a new assembly from the repair kit. O-rings should be cleaned or replaced as necessary.
4. Reassemble the check valve module in the reverse order. Check modules are installed in the valve body with the seats facing the valve inlet. The modules must be securely in place before the retainer can be replaced. On the ¾" - 1" (20-25mm) size, this retainer may have to be tilted slightly into place. Replace cover.



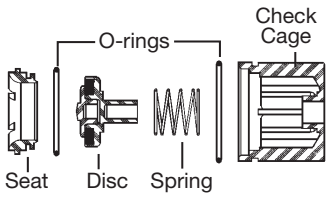


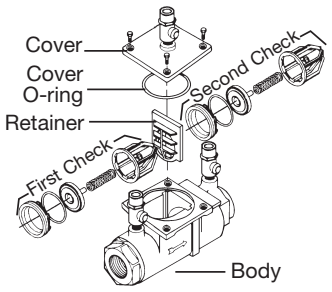


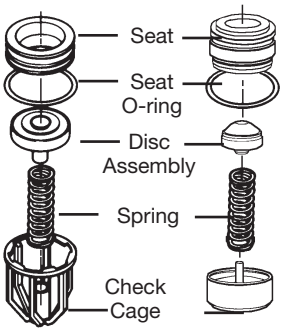


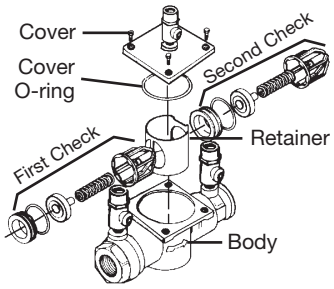
Service, Replacement Parts and Maintenance

Series 007 and LF007









Repair Kits

½" - 2"

When ordering, specify ordering code number, kit number and valve size

ORDERING CODE	KIT NO.	SIZE in.	SIZE mm
Total Repair Kits			
0887033	RK 007-T	½	15
0887724	RK 007M2-T	¾	20
0888554	RK 007M3-T	¾	20
0887027	RK 007-T	¾ – 1	20-25
0887044	RK 007M1-T	¾ – 1	20-25
0887723	RK 007M2-T	1¼ – 1½	32-40
0887034	RK 007-T	1½ – 2	40-50
0887192	RK 007M1-T	1½ – 2	40-50

LEAD FREE*

Kit includes: first check repair kit, second check repair kit, retainer (if plastic)

***The wetted surface of this product contacted by consumable water contains less than 0.25% of lead by weight.**

Repair Kits

½" - 2"

When ordering, specify ordering code number, kit number and valve size

ORDERING CODE	KIT NO.	SIZE in.	SIZE mm
Check Kits: 1st or 2nd Check			
0887193	RK 007 CK4	½	15
0887026	RK 007M1 CK4	¾ - 1	20-25
0887377	*RK SS007 CK4	½	15
0888070	*RK SS007M3 CK1	½ - ¾	15-20
0888071	*RK SS007M3 CK2	½ - ¾	15-20
0887393	*RK SS007M2 CK1	¾	20
0887397	*RK SS007M2 CK2	¾	20
0887373	*RK SS007M1 CK4	1	25
1st Check			
0887045	RK 007M2 CK1	¾	20
0888550	RK 007M3 CK1	¾	20
0887393	RK SS007M2 CK1	¾	20
0888070	RK SS007M3 CK1	½ – ¾	15-20
0887023	RK 007 CK1	¾ – 1	20-25
0887025	RK 007 CK1	1½ – 2	40-50
0887186	RK 007M1 CK1	1½ – 2	40-50
0887719	RK 007M2 CK1	1¼ – 1½	32-40
2nd Check			
0887046	RK 007M2 CK2	¾	20
0888551	RK 007M3 CK2	¾	20
0888071	RK SS007M3 CK2	½ – ¾	15-20
0887024	RK 007 CK2	¾ – 1	20-25
0887028	RK 007 CK2	1½ – 2	32-50
0887187	RK 007M1 CK2	1½ – 2	32-50
0887720	RK 007M2 CK2	1¼ – 1½	32-40
Stainless Steel 1st or 2nd Check			
0887022	RK 007 CK1 SS	¾ – 1	20-25
0887030	RK 007 CK2 SS	¾ – 1	20-25
0887032	RK 007M1 CK4 SS	¾ – 1	20-25
0887031	RK 007 CK1 SS	1½ – 2	40-50
0887035	RK 007 CK2 SS	1½ – 2	40-50
0887189	RK 007M1 CK1 SS	1½ – 2	40-50
0887190	RK 007M1 CK2 SS	1½ – 2	40-50

LEAD FREE*

Kit includes: Seat, seat o-ring, disc assembly, spring, check cage, cover o-ring.

Cover Kit			
0887195	RK 007 C	½	15
0887379	RK SS007 C	½	15
0888073	RK SS007M3 C	½ – ¾	15-20
0887039	RK 007M2 C	¾	20
0887380	RK SS007M2 C	¾	20
0888553	RK 007M3 C	¾	20
0887381	RK SS007M1 C	1	25
0887036	RK 007 C	¾ – 1	20-25
0887038	RK 007M1 C	¾ – 1	20-25
0887191	RK 007M1 C	1½ – 2	40-50
0887722	RK 007M2 C	1¼ – 1½	32-40
0794004	LFRK 007M1 C	¾ – 1	20-25
0794005	LFRK 007M1 C	¾ – 1	20-25

LEAD FREE* (0887379, 0888073, 0887380, 0887381, 0794004, 0794005)

Kit includes: Cover and cover o-ring

Complete Rubber Parts			
0887194	RK 007 RT	½	15
0887378	RK SS007 RT	½	15
0888072	RK SS007M3 RT	½ – ¾	15-20
0887394	RK SS007M2 RT	¾	20
0887043	RK 007M2 RT	¾	20
0888552	RK 007M3 RT	¾	20
0887374	RK SS007M1 RT	1	25
0887040	RK 007 RT	¾ – 1	20-25
0887042	RK 007M1 RT	¾ – 1	20-25
0887041	RK 007 RT	1½ – 2	40-50
0887188	RK 007M1 RT	1½ – 2	40-50
0887721	RK 007M2 RT	1¼ – 1½	32-40

LEAD FREE*

Kit includes: Cover o-ring, two seat discs and two seat o-rings.
NOTE: *SS prefix denotes stainless steel body.

Installation Instructions

Series 007 and LF007

2½" and 3"

Indoors - Figure 4

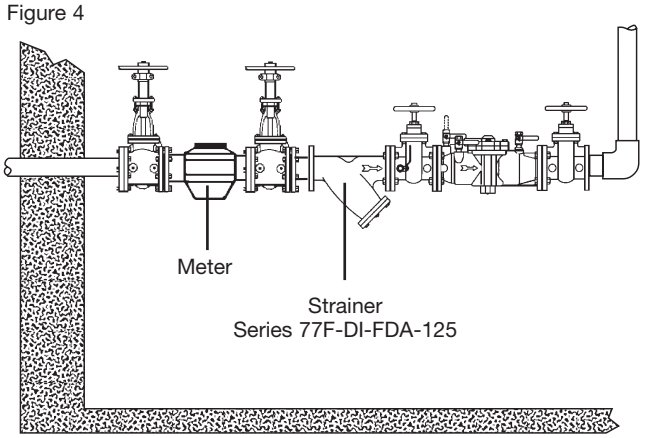
Series 007 may be installed in either a vertical or horizontal position. Pipe lines should be thoroughly flushed to remove foreign material before installing the unit. A strainer should be installed as shown, ahead of backflow preventer to prevent disc from unnecessary fouling. Install valve inline with arrow on valve body pointing in the direction of flow.
For indoor installations, it is important that the valve be easily accessible to facilitate testing and servicing. Do not install in a concealed location.

CAUTION:

Do not install with strainer when backflow preventer is used on seldom-used water lines which are called upon during emergencies, such as fire sprinkler lines, etc.
It is important that Series 007 and LF007 be tested periodically in compliance with local codes, but at least once a year or more often depending upon system conditions.

NOTE: Fire Protection System Installations
The National Fire Protection Agency (NFPA) Guidelines require a confirming flow test to be conducted whenever a “main line” valve such as the shutoff valves or a backflow assembly have been operated. Certified testers of backflow assemblies must conduct this test. The trim valves of the detector meter bypass line, on assemblies so equipped, should be shutoff during the confirming flow test. When the test is completed, the trim valves must be returned to a fully open position.

Figure 4



2½", 3" 007 / LF007

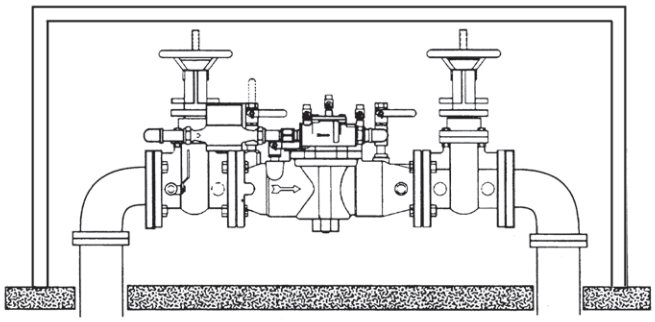
Outside Building Above Ground -

Figure 5

In an area where freezing conditions do not occur, Series 007 and LF007 can be installed outside of a building. The most satisfactory installation is above ground and should be installed in this manner whenever possible. In an area where freezing conditions can occur, Series 007 and LF007 should be installed above ground in an insulated enclosure.

Annual inspection of all water system safety and control valves is required and necessary. Regular inspection, testing and cleaning assures maximum life and proper product function.

Figure 5



WattsBox Insulated Enclosures
Available in Aluminum or Fiberglass.
For more information, send for ES-WB.

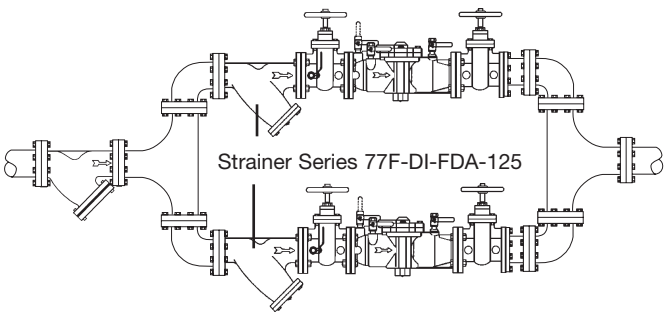
Parallel - Figure 6

Consult Local codes for Approval

Two or more Series 007 and LF007 smaller size valves may be piped in parallel (where approved) to serve a larger supply pipe main. This type of installation is employed whenever it is vital to maintain a continuous supply of water/where interruptions for testing and servicing would be unacceptable. It also has the advantage of providing increase capacity where needed beyond that provided by a single valve and permits testing or servicing of an individual valve without shutting down the complete line. For two valve installations the total capacity should equal or exceed that required by the system.
The quantity of valves used in parallel should be determined by the engineer's judgement based on the operating conditions of a specific installation. (See F-FC regarding flow curves)

INSTALLATION NOTE: The flange gasket bolts for the gate valves should be retightened during installation as the bolts may have loosened due to storage and shipping.

Figure 6



2½", 3" 007 / LF007

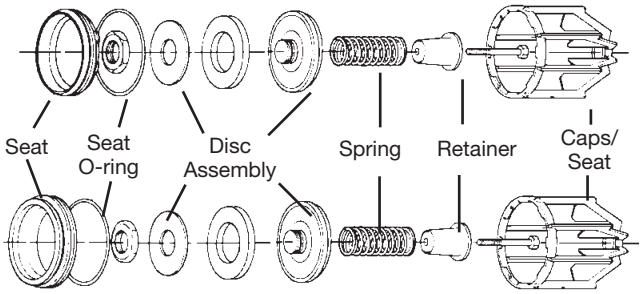
Servicing First and Second Check Valves

Series 007 and LF007

2½" and 3"

1. Remove cover bolts and cover.
2. Remove the retainer from the body bore. The check valve modules can now be removed from the valve by hand or with a screwdriver.
3. The check seats are attached to the cage with a bayonet type locking arrangement. Holding the cage in one hand, push the seat inward and rotate counterclock-wise against the cage. The seat, spring cage, spring and disc assembly are now individual components.
4. The disc assembly may now be cleaned and reassembled or depending on its condition, may be discarded and replaced with a new assembly from the repair kit. O-rings should be cleaned or replaced as necessary. For more information, refer to repair parts price list PL-RP-BPD.
5. Reassemble the Check valve modules. Check modules are installed in the valve body with the seats facing the valve inlet. The modules must be securely in place before the retainer can be replaced.

NOTE: No special tools required to service Series 007 and LF007.



Check Assemblies

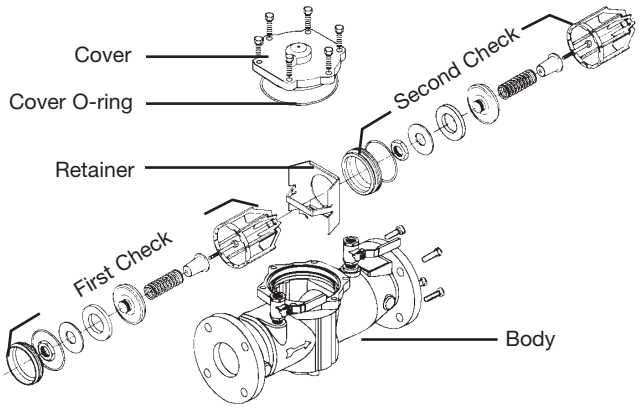
Repair Kits 007 and LF007

2½" and 3"

When ordering, specify ordering code number, kit number and valve size.

ORDERING CODE	KIT NO.	SIZE in.	SIZE mm
First Check Kit			
0887285	RK 007 CK1	2½, 3	65, 80
LEAD FREE* 0794006	LFRK 007 CK1	2½, 3	65, 80
Kit Includes: Seat, seat o-ring, disc assembly, spring, spring retainer, check cage and cover o-ring.			
Second Check Kit			
0887286	RK 007 CK2	2½, 3	65, 80
LEAD FREE* 0794008	LFRK 007 CK2	2½, 3	65, 80
Kit Includes: Seat, seat o-ring, disc assembly, spring, spring retainer, check cage and cover o-ring.			
Complete Rubber Parts			
0887287	RK 007 RT	2½, 3	65, 80
Kit Includes: Two seat discs, two seat o-rings, two cover o-rings.			
Cover Kit			
LEAD FREE* 0887288	RK 007 C	2½, 3	65, 80
Kit includes: Cover and cover o-ring.			
Seat Kit			
LEAD FREE* 0887289	RK 007 S	2½, 3	65, 80
0887280	RK 007 S2	2½, 3	65, 80
Kit Includes: Seat and seat o-ring.			

"Use only original equipment manufactured parts to protect the validated warranty."



***The wetted surface of this product contacted by consumable water contains less than 0.25% of lead by weight.**

Troubleshooting Guide

Series 007 and LF007

Symptom	Cause	Solution
1. Check valve fails to hold 1.0 PSID minimum	a. Debris on check disc sealing surface	Disassemble and clean
	b. Leaking gate valve	Disassemble and clean or repair
	c. Damaged seat disc or seat o-ring	Disassemble and replace
	d. Damaged guide holding check open	Disassemble clean or replace
	e. Weak or broken spring	Disassemble and replace spring
2. Chatter during flow conditions	a. Worn, damaged or defective guide	Disassemble and repair or replace guide
3. Low flows passing through mainline valve	a. Mainline check fouled	Disassemble and clean
	b. Meter strainer plugged	Disassemble and clean
	c. Damaged mainline seat disc or seat	Disassemble and replace
	d. Broken mainline spring	Disassemble and replace

For additional cross-connection control information, send for F-50 brochure.

For additional information, visit our web site at: www.watts.com

CALIFORNIA PROPOSITION 65 WARNING

WARNING: This product contains chemicals known to the State of California to cause cancer and birth defects or other reproductive harm.
(California law requires this warning to be given to customers in the State of California.)
For more information: www.watts.com/prop65

Limited Warranty: Watts Regulator Co. (the "Company") warrants each product to be free from defects in material and workmanship under normal usage for a period of one year from the date of original shipment. In the event of such defects within the warranty period, the Company will, at its option, replace or recondition the product without charge.
THE WARRANTY SET FORTH HEREIN IS GIVEN EXPRESSLY AND IS THE ONLY WARRANTY GIVEN BY THE COMPANY WITH RESPECT TO THE PRODUCT. THE COMPANY MAKES NO OTHER WARRANTIES, EXPRESS OR IMPLIED. THE COMPANY HEREBY SPECIFICALLY DISCLAIMS ALL OTHER WARRANTIES, EXPRESS OR IMPLIED, INCLUDING BUT NOT LIMITED TO THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE.
The remedy described in the first paragraph of this warranty shall constitute the sole and exclusive remedy for breach of warranty, and the Company shall not be responsible for any incidental, special or consequential damages, including without limitation, lost profits or the cost of repairing or replacing other property which is damaged if this product does not work properly, other costs resulting from labor charges, delays, vandalism, negligence, fouling caused by foreign material, damage from adverse water conditions, chemical, or any other circumstances over which the Company has no control. This warranty shall be invalidated by any abuse, misuse, misapplication, improper installation or improper maintenance or alteration of the product.
Some States do not allow limitations on how long an implied warranty lasts, and some States do not allow the exclusion or limitation of incidental or consequential damages. Therefore the above limitations may not apply to you. This Limited Warranty gives you specific legal rights, and you may have other rights that vary from State to State. You should consult applicable state laws to determine your rights. **SO FAR AS IS CONSISTENT WITH APPLICABLE STATE LAW, ANY IMPLIED WARRANTIES THAT MAY NOT BE DISCLAIMED, INCLUDING THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE, ARE LIMITED IN DURATION TO ONE YEAR FROM THE DATE OF ORIGINAL SHIPMENT.**

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ISO 9001-2008 CERTIFIED

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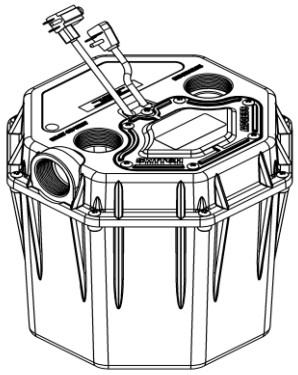
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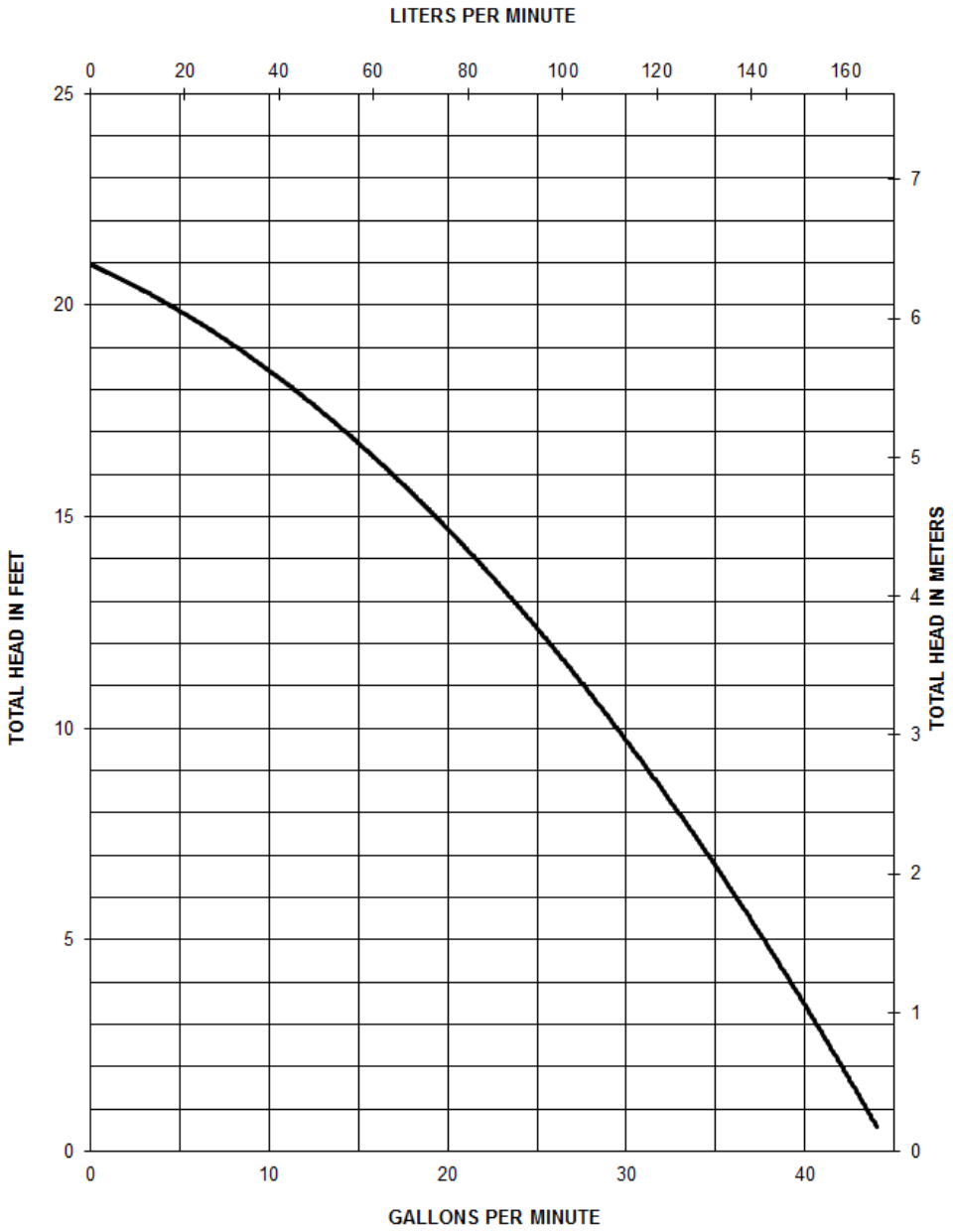
Section 3.7.7

Dewatering System Transfer Pump

Pump Specifications

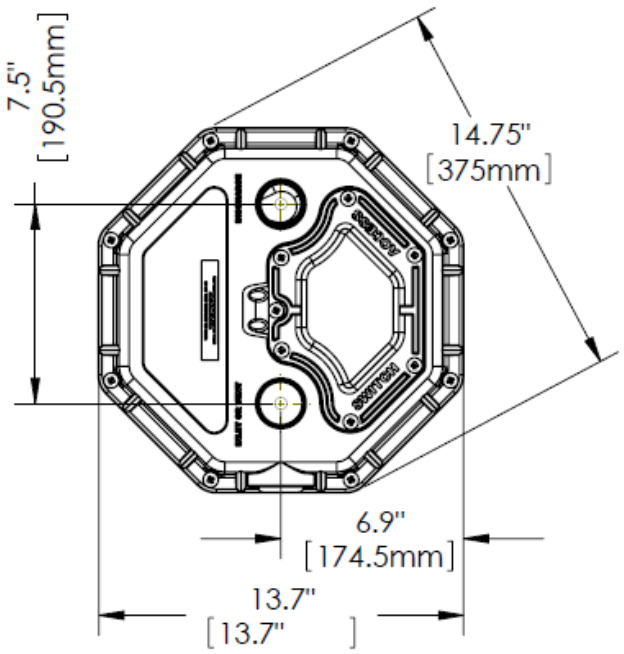
404 Series Drain Pump

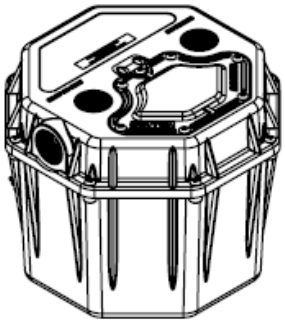




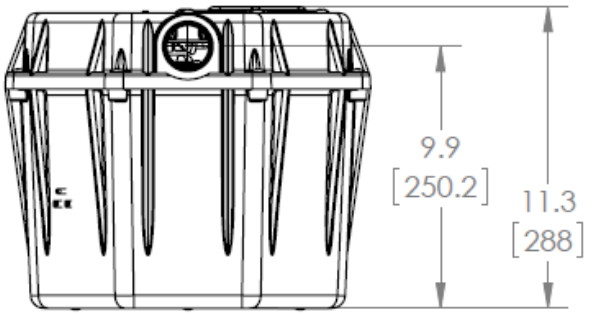
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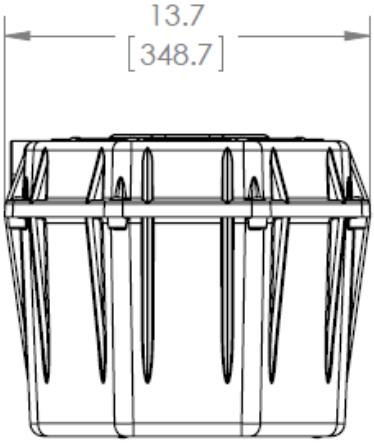
404-Series Dimensional Data





CORDS - 115V
PIGGY BACK - AUTOMATIC





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APPLICATION | DO NOT SCALE DRAWING

DWG. NO.
404 SERIES DIMENSIONAL

SIZE A | JAN / 2007 | REV. A

SCALE:1:4 | WEIGHT: 23 LBS | SHEET 1 OF 1

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404-Series Data

MODEL	HP	VOLTAGE	PH.	FULL LOAD AMPS	LOCKED ROTOR AMPS	THERMAL OVERLOAD TEMP	STATOR WINDING CLASS	CORD LENGTH FT.	DISCHARGE	AUTOMATIC	ALARM	CHECK VALVE
404	1/3	115	1	5.2	8	105˚C / 221°F	B	10	1 1/2”	YES		
404CV	1/3	115	1	5.2	8	105˚C / 221°F	B	10	1 1/2”	YES		YES
404/A	1/3	115	1	5.2	8	105˚C / 221°F	B	10	1 1/2”	YES	YES	
404CV/A	1/3	115	1	5.2	8	105˚C / 221°F	B	10	1 1/2”	YES	YES	YES
404/A-EYE	1/3	115	1	5.2	8	105˚C / 221°F	B	10	1 1/2”	YES	YES NIGHTEYE®	
404CV/A-EYE	1/3	115	1	5.2	8	105˚C / 221°F	B	10	1 1/2”	YES	YES NIGHTEYE®	YES
404L	1/3	115	1	5.2	8	105˚C / 221°F	B	10	2”	YES		

404CV models are c SA us Certified to UPC and IPC requirements of ASME A112.3.4 / CSA B45.9

404-Series Technical Data

IMPELLER	VORTEX HIGH TEMPERATURE ENGINEERED POLYMER
SOLIDS HANDLING	3/8”
PAINT (PUMP)	POWDER COAT
MAX LIQUID TEMP	40˚C / 104˚F CONTINUOUS, 60˚C / 140˚F INTERMITTENT
MAX STATOR TEMP	CLASS B 130˚C/ 266˚F
THERMAL OVERLOAD	105˚C / 221°F
POWER CORD TYPE	SJTW
MOTOR HOUSING	DEEP FINNED POWDER COATED ALUMINUM
VOLUTE	ENGINEERED POLYMER
SHAFT	STAINLESS
HARDWARE	STAINLESS
ORINGS	BUNA N
SHAFT SEAL	ENGINEERED DOUBLE LIP WITH STAINLESS SPRINGS
WEIGHT	13 LBS
TANK MATERIAL	POLYPROPYLENE
INLET SIZE	11/2” FEMALE NPT (2” FEMALE NPT on 404L)
DISCHARGE SIZE	11/2” FEMALE NPT (2” FEMALE NPT on 404L)
VENT SIZE	11/2” FEMALE NPT (2” FEMALE NPT on 404L)

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404-Series Specifications

1.01 GENERAL:

The contractor shall provide labor, material, equipment, and incidentals required to provide_____(QTY) commercial drain pumps as specified herein. The pump models covered in this specification are Series 404 single phase pumps. The pump furnished for this application shall be model _____as manufactured by Liberty pumps, and have a maximum fluid temperature rating of 140 degrees F.

2.01 OPERATING CONDITIONS:

Each drain pump shall be rated at 1/3 hp_____volts, single phase, 60 Hz. 3450 RPM. The unit shall produce_____G.P.M. at_____ feet of total dynamic head.

The drain pump shall be capable of handling effluent with 3/8" solid handling capability. The drain pump shall have a shut-off head of 21 feet and a maximum flow of 38 GPM @ 5 feet of total dynamic head.

The pump shall be controlled with a piggy back style on/off float switch.

3.01 CONSTRUCTION:

Each drain pump shall be equal to the Series 404 with c SA us Certified pump as manufactured by Liberty Pumps, Bergen NY. The motor housing shall be constructed of a deep finned powder coated aluminum. The motor housing shall be oil filled to dissipate heat. Air filled motors shall not be considered equal since they do not properly dissipate heat from the motor. All mating parts shall be machined and sealed with a Buna-N O-ring. All fasteners exposed to the liquid shall be stainless steel. The motor shall be protected on the top side with sealed cord entry plate with molded pins to conduct electricity eliminating the ability of water to enter internally through the cord. The motor shall be protected on the lower side with an engineered double lip seal with stainless steel springs. The tank shall be made of polypropylene.

4.01 ELECTRICAL POWER CORD

The drain pump shall be supplied with 10 feet of multiconductor power cord. It shall be cord type SJTW, capable of continued exposure to the pumped liquid. The power cord shall be sized for the rated full load amps of the pump in accordance with the National Electric Code. The power cable shall not enter the motor housing directly but will conduct electricity to the motor by means of a water tight compression fitting cord plate assembly, with molded pins to conduct electricity. This will eliminate the ability of water to enter internally through the cord, by means of a damaged or wicking cord.

5.01 MOTORS

Single phase motors shall be oil filled, permanent split capacitor, class B insulated, NEMA B design, rated for continuous duty. At maximum load the winding temperature shall not exceed 130 degrees C unsubmerged. Since air filled motors are not capable of dissipating heat they shall not be considered equal. The pump motor shall have an integral thermal overload switch in the windings for protecting the motor. The capacitor circuit shall be mounted internally in the pump.

6.01 BEARINGS AND SHAFT

Upper and lower ball bearings shall be required. The bearings shall be a single ball / race type bearing. Both bearings shall be permanently lubricated by the oil, which fills the motor housing. The motor shaft shall be made of 300 or 400 series stainless steel and have a minimum diameter of .311".

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7.01 SEALS

The pump shall have an engineered double lip seal with stainless steel springs. The motor plate / housing interface shall be sealed with a Buna-N o-ring.

8.01 IMPELLER

The impeller shall be molded engineered polymer, with pump out vanes on the back shroud to keep debris away from the seal area. It shall be threaded to the motor shaft.

9.01 CONTROLS

All units are supplied with CSA and UL approved automatic wide angle tilt float switches. The switches shall be equipped with piggy back style plug that allows the pump to be operated manually without the removal of the pump in the event that a switch becomes inoperable. The switches shall be mounted under a separately sealed access cover and tethered to a removable stainless steel rod for easy removal and serviceability.

10.01 PAINT

The exterior of the casting shall be protected with powder coat paint.

11.01 SUPPORT

The polyolefin tank shall be a free standing unit.

12.01 SERVICEABILTY

Components required for the repair of the pump shall be shipped within a period of 24 hours.

13.01 TESTING

The pump shall have a ground continuity check and the motor chamber shall be Hi-potted to test for electrical integrity, moisture content and insulation defects. The motor and volute housing shall be pressurized, and an air leak decay test is performed to ensure integrity of the motor housing. The pump shall be run, voltage current monitored, and the tester checks for noise or other malfunction.

14.01 QUALITY CONTROL

The pump shall be manufactured in an ISO 9001 certified Facility.

15.01 WARRANTY

Standard limited warranty shall be 3 years.

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Liberty Pumps®

A Family and Employee Owned Company

Installation Manual

7212000F

Automatic Drain Pumps

Models



404

1/3 hp Residential 115V

404

404/A
- *with Alarm*

404/A-EYE
- *with NightEye® Alarm*

404CV
- *with Check Valve*

404CV/A
- *with Check Valve and Alarm*

404CV/A-EYE
- *with Check Valve and NightEye® Alarm*

404L
- *with Larger Ports*

404L/A
- *with Larger Ports and Alarm*

404L/A-EYE
- *with Larger Ports and NightEye® Alarm*



405

1/2 hp Commercial High Temp 115V

405

405HV
- *High Voltage 230V*

405/A
- *with Alarm*

405/A-EYE
- *with NightEye® Alarm*

7000 Apple Tree Avenue
Bergen, NY 14416
ph: 800-543-2550
fax: 585-494-1839
www.libertypumps.com

C US
All Units Contain
Certified Pump

C US
Meets UPC
404CV Models Only

ASME A112.3.4
CSA B45.9

SSPMA CERTIFIED

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Contents

Safety Precautions 3
Dimensions 4
Application 4
Installation 4
Operation 5
Maintenance and Troubleshooting 5
Warranty 8

Safety Guidelines

	This safety alert symbol is used in the manual and on the pump to alert of potential risk for serious injury or death.
	This safety alert symbol identifies **risk of electric shock**. It is accompanied with an instruction intended to minimize potential risk of electric shock.
	This safety alert symbol identifies **risk of fire**. It is accompanied with an instruction intended to minimize potential risk of fire.
	This safety alert symbol identifies **risk of serious injury or death**. It is accompanied with an instruction intended to minimize potential risk of injury or death.
⚠DANGER	Warns of hazards, which if not avoided, **will** result in serious injury or death.
⚠WARNING	Warns of hazards, which if not avoided, **could** result in serious injury or death.
⚠CAUTION	Warns of hazards, which if not avoided, could result in minor or moderate injury.
NOTICE	Signals an important instruction related to the pump. Failure to follow these instructions could result in pump failure or property damage.

⚠WARNING	**Read every supplied manual before using pump system. Follow all the safety instructions in manual(s) and on the pump. Failure to do so could result in serious injury or death.**
NOTICE	**Installer: manual must remain with owner or system operator/maintainer.**

Keep this manual handy for future reference.

For replacement manual, visit libertypumps.com, or contact Liberty Pumps at 1-800-543-2550.

Retain dated sales receipt for warranty.

Record information from pump nameplate:

Pump Model #: _____

Pump Serial #: _____

Manufacture Date: _____

Install Date: _____

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Safety Precautions

⚠WARNING ⚠ RISK OF ELECTRIC SHOCK

- Accidental contact with electrically live parts, items, fluid, or water can cause serious injury or death.
- Always disconnect pump(s) from power source(s) before handling or making any adjustments to either the pump(s), the pump system, or the control panel.
- All installation and maintenance of pumps, controls, protection devices, and general wiring shall be done by qualified personnel.
- All electrical and safety practices shall be in accordance with the National Electrical Code®, the Occupational Safety and Health Administration, or applicable local codes and ordinances.
- Pump shall be properly grounded using its supplied grounding conductor. Do not bypass grounding wires or remove ground prong from attachment plugs. Failure to properly ground the pump system can cause all metal portions of the pump and its surroundings to become energized.
- Do not handle or unplug the pump with wet hands, when standing on damp surface, or in water unless wearing Personal Protective Equipment.
- Always wear dielectric rubber boots and other applicable Personal Protective Equipment (PPE) when water is on the floor and an energized pump system must be serviced, as submerged electrical connections can energize the water. Do not enter the water if the water level is higher than the PPE protection or if the PPE is not watertight.
- Do not lift or carry a pump or a float assembly by its power cord. This will damage the power cord, and could expose the electrically live wires inside the power cord.
- The electrical power supply shall be located within the length limitations of the pump power cord, and for below grade installations, it shall be at least 4 ft (1.22 m) above floor level.
- Do not use this product in applications where human contact with the pumped fluid is common (such as swimming pools, fountains, marine areas, etc.).
- Protect the power cord from the environment. Unprotected power and switch cords can allow water to wick through ends into pump or switch housings, causing surroundings to become energized.
- This pump is supplied with a grounding conductor and grounding-type attachment plug. To reduce the risk of electric shock, be certain that it is connected to a Ground Fault Circuit Interrupter (GFCI) receptacle that meets the latest requirements per UL 943 including Auto-Monitoring or Self-Test Function and Reverse Line-load Miswire Function – Repeated.

⚠WARNING ⚠ RISK OF FIRE

- Do not use an extension cord to power the product. Extension cords can overload both the product and extension cord supply wires. Overloaded wires will get very hot and can catch on fire.
- This product requires a separate, properly fused and grounded branch circuit, sized for the voltage and amperage requirements of the pump, as noted on the nameplate. Overloaded branch circuit wires will get very hot and can catch on fire.
- Explosion hazard during installation. PVC cleaners, primers, and cements can release explosive vapors. These heavier-than-air vapors can accumulate in the tank. The heat of soldering or sweating copper or other metal pipe can ignite these vapors causing a violent explosion. If the unit is to be connected to copper discharge or vent piping, all solvent-welded PVC joints must be allowed to cure a *minimum* of 24 hours. The access cover must be removed to allow the tank to be thoroughly ventilated prior to sweating copper pipe near the unit.
- For cord replacement: power cord must be of the same length and type as originally installed on the Liberty Pumps' product. Use of incorrect cord may lead to exceeding the electrical rating of the cord and could result in death, serious injury, or other significant failure.
- Do not use this product with or near flammable or explosive fluids such as gasoline, fuel oil, kerosene, etc. If rotating elements inside pump strike any foreign object, sparks may occur. Sparks could ignite flammable liquids.
- These pumps are not to be installed in locations classified as hazardous in accordance with the National Electric Code®, ANSI/NFPA 70.

⚠WARNING ⚠ RISK OF SERIOUS INJURY OR DEATH

- Do not modify the pump/pump system in any way. Modifications may affect seals, change the electrical loading of the pump, or damage the pump and its components.
- All pump/pump system installations shall be in compliance with all applicable Federal, State, and Local codes and ordinances.
- Do not allow children to play with the pump system.
- Do not allow any person who is unqualified, to have contact with this pump system. Any person who is unaware of the dangers of this pump system, or has not read this manual, can easily be injured by the pump system.
- Do not remove any tags or labels from the pump or its cord.
- Keep clear of suction and discharge openings. To prevent injury, never insert fingers into pump while it is connected to a power source.
- Do not use this product with flammable, explosive, or corrosive fluids. Do not use in a flammable and/or explosive atmosphere as serious injury or death could result.
- California Proposition 65 Warning: This product contains chemicals known to the State of California to cause cancer, birth defects, or other reproductive harm. For more information, go to www.p65warnings.ca.gov.

NOTICE

- **Model 404:** Do not use pumps with fluid over 140°F (60°C). Operating the pump in fluid above this temperature can overheat the pump, resulting in pump failure.
- **Model 405:** Do not use pumps with fluid over 180°F (82°C). Operating the pump in fluid above this temperature can overheat the pump, resulting in pump failure.
- Do not dispose of materials such as paint thinner or other chemicals down drains. Doing so could chemically attack and damage pump system components and cause product malfunction or failure.
- Do not use pump system with mud, sand, cement, hydrocarbons, grease, or chemicals. Pump and system components can be damaged from these items causing product malfunction or failure. Additionally, flooding can occur if these items jam the impeller or piping.
- Do not run dry.

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Dimensions

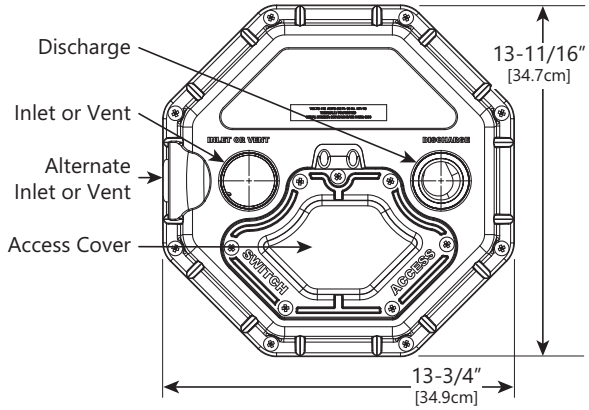


Figure 1. Model 404 and 405 Cover Dimensions

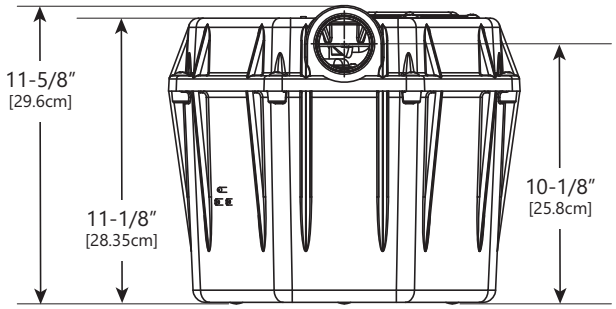


Figure 2. Model 404 Basin Dimensions

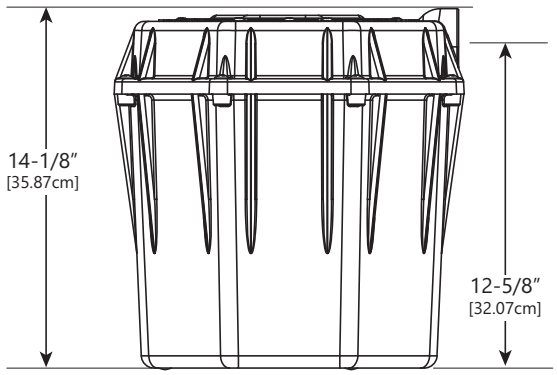


Figure 3. Model 405 Basin Dimensions

Application

The Model 404 and 405-Series drain pumps are designed for use in gray wastewater applications. They will handle small debris and solids, such as laundry lint (up to 3/8″), associated with normal gray water drainage from a sink. Larger solids should be kept out of the pump system. The 405-Series is designed for commercial applications where higher temperature drain water (up to 180°F) may be used.

Installation

Inlet

The drain pump has two available ports: one on the top, the other on the side. Either can be used as a vent or inlet. Using the appropriate piping (1-1/2″ on 404 and 404CV models and 2″ on 404L and all 405 models), connect the fixture (i.e., laundry tub, basement sink, washing machine) to the pump. Refer to Figure 4 for a typical installation.

NOTICE

- **Hand-tighten only**
- **Do not cross thread**

A trap shall be used between the fixture and pump; a flange type is recommended. Hand-tighten trap to pump.

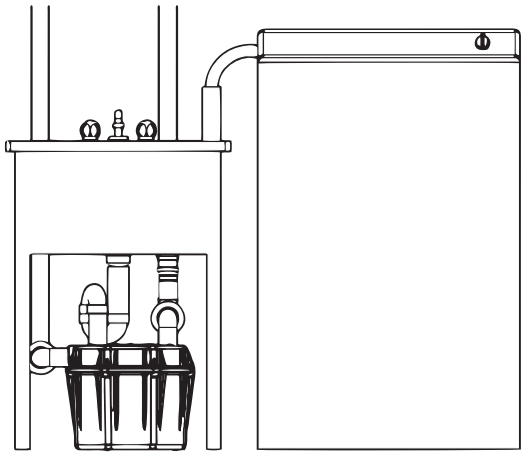


Figure 4. Typical Residential Installation

Discharge

NOTICE

- **Hand-tighten only**
- **Use appropriate thread sealing tape**
- **Do not cross thread**

Install a union just above the pump to facilitate removal, if necessary, for cleaning or service. Install a check valve (**not included** except for CV models listed below) just above the union and as close to the pump as possible to prevent the backflow of water after each pump cycle.

Check Valve for CV Models

Models 404/CV, 404CV/A, and 404CV/A-EYE come with a check valve in order to meet ASME A112.3.4/CSA B45.9. This check valve must be threaded into the discharge port of the 404 cover.

Vent

NOTICE

- **Hand-tighten only**
- **Do not cap-off vent**
- **Do not use one-way quick-vents or air admittance valves** as they will not guarantee proper fixture performance

Provision is made for a vent stack to allow extra volume for high suds conditions, and to ensure proper drainage of the fixture. The vent pipe should have a union to facilitate removal, if required, and shall be connected directly to a building or house vent.

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Inlet Air Hole (Alarm Units Only)

If the top port (hole) is used for the vent, the potential exists for an air pocket to form that would prevent the alarm float from activating. After the vent pipe has been installed, it is recommended that a 1/8" hole is drilled through both the unit and vent pipe to allow air to escape. Refer to Figure 5.

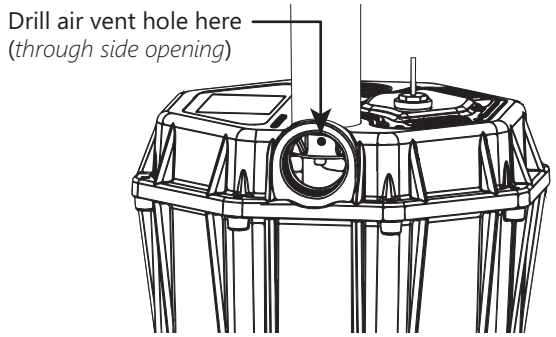


Figure 5. Air Vent Hole Location (Alarm units only)

Power Cord

⚠WARNING **RISK OF ELECTRIC SHOCK**

- All electrical and safety practices shall be in accordance with the National Electrical Code®, the Occupational Safety and Health Administration, or applicable local codes and ordinances.
- Always disconnect pump(s) from power source(s) before handling or making any adjustments to either the pump(s), the pump system, or the control panel.
- Pump shall be properly grounded using its supplied grounding conductor. Do not bypass grounding wires or remove ground prong from attachment plugs. Failure to properly ground the pump system can cause all metal portions of the pump and its surroundings to become energized.
- The electrical power supply shall be located within the length limitations of the pump power cord, and for below grade installations, it shall be at least 4 ft (1.22 m) above floor level.

⚠WARNING **RISK OF FIRE**

- Do not use an extension cord to power the product. Extension cords can overload both the product and extension cord supply wires. Overloaded wires will get very hot and can catch on fire.

The pump power cord is equipped with a grounding-type 3-prong plug. It must be connected to a separately fused, grounded, 3-wire grounding-type receptacle of 15-amp capacity with the proper pump voltage (all models are 115V, except the 405HV which is 230V). Refer to the pump nameplate to verify electrical specifications.

Alarm

Models 404 and 405 with /A or /A-EYE come with a Liberty Pumps alarm. For instructions on using this alarm, refer to the included alarm manual.

Operation

The Model 404 and 405-Series pumps come factory-equipped with a float switch mounted in the tank. There are two controlling cords—one to the float switch (float switch shown in Figure 7) and the other to the pump motor. The float switch cord has a series (piggyback) plug enabling the pump motor cord to be plugged into the back of it (see Figure 6). The purpose of this design is to allow temporary manual operation of the pump.

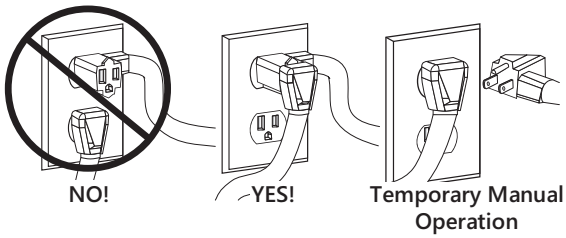


Figure 6. Piggyback Plug Installation

For automatic operation using Liberty Pumps' supplied switch, the two cords must be interconnected and plugged into a separately fused, grounded outlet.

For manual operation, or in the event of switch failure, the pump cord can be separated and plugged into the electrical outlet, directly bypassing the switch. **Note:** Model 405HV should only be operated without the float switch by using the circuit breaker or panel disconnect.

Maintenance and Troubleshooting

⚠WARNING **RISK OF ELECTRIC SHOCK**

- Always disconnect pump(s) from power source(s) before handling or making any adjustments to either the pump(s), the pump system, or the control panel.

Each unit is individually factory-tested to ensure proper adjustment and operation. If the unit fails to operate properly, re-read the instructions to verify they have been followed correctly. Replacement parts for this product are available at http://www.libertypumps.com/Services/Replacement-Parts.

Routine maintenance is not required on the pump itself, but associated connections may require occasional attention. Lint and foreign objects should be removed from the trap periodically. The check valve on the discharge should also be checked for freedom of operation at the same time.

The pump is automatically turned on and off by use of a float switch mounted within the tank. This switch can be easily removed and checked for operation by removing the access cover located on top of the unit. Once the access cover has been removed, a rubber plug must be lifted to free up the switch cord. The switch is mounted to a rod which can be removed by lifting or pulling upward.

IMPORTANT: Do not adjust the tether length (*tether length is the distance of cord measured between the clamp and top of float switch*). If replacing the switch, make sure to maintain the correct tether length for the model. Refer to Figure 7.

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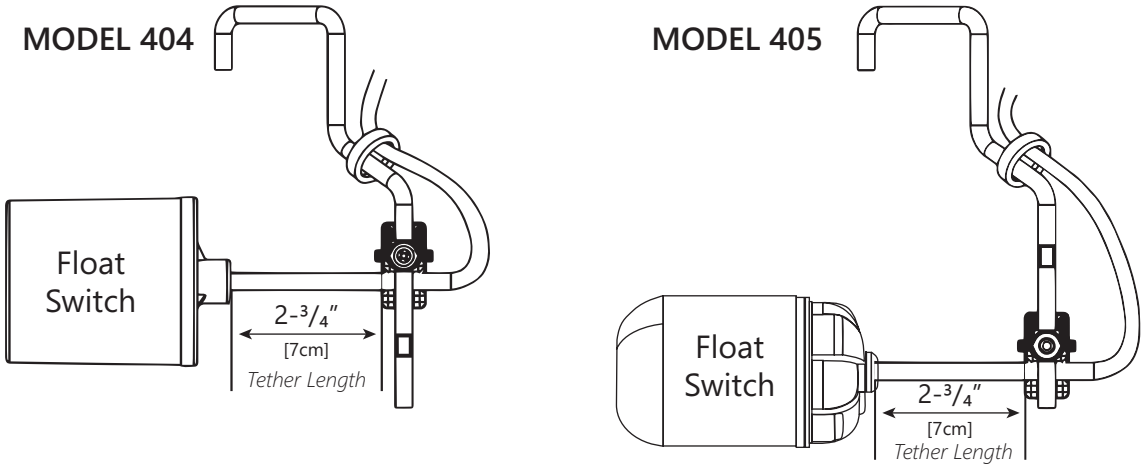


Figure 7. Pump Float Switch and Tether Length

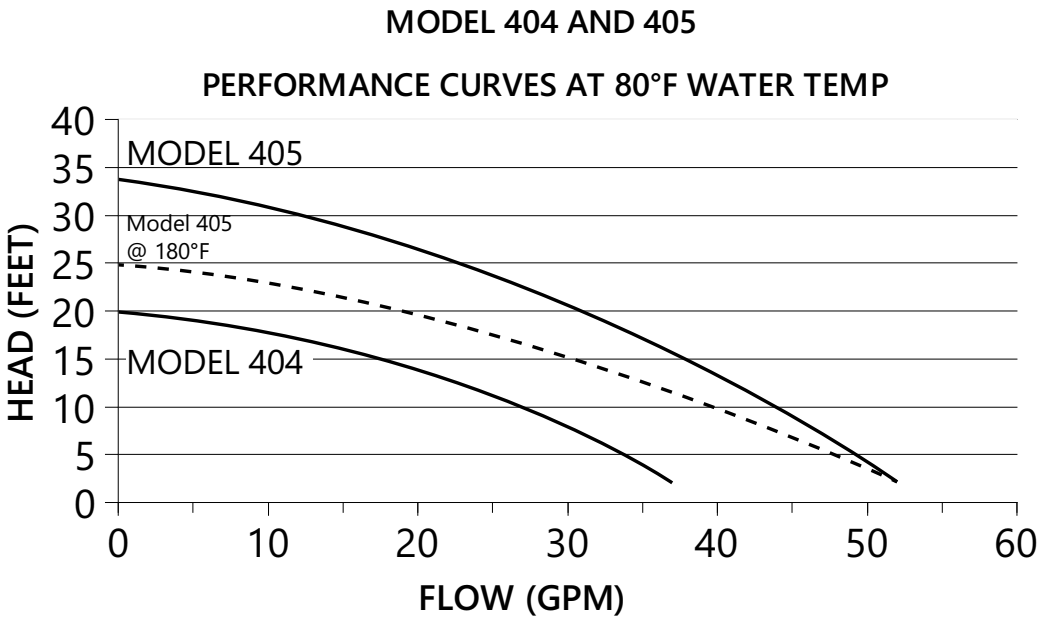


Figure 8. Performance Curves for Models 404 and 405

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Table 1. Troubleshooting Matrix

Problem	Possible Cause	Correction
Pump will not turn on or shut off.	Tripped circuit breaker, tripped GFCI, blown fuse, or other interruption of power.	Reset tripped circuit breaker, reset GFCI, replace blown fuse with properly sized fuse, check that the unit is securely plugged in, investigate power interruption.
	Improper voltage.	Have an electrician check all wiring for proper connections and adequate capacity.
	Plugged vent, or quick-vent in use.	Verify that an unrestricted vent at least 1-¼" in diameter is in use. ***Quick-vents shall not be used.***
	Defective float switch or build-up on tank wall restricting free movement of float switch.	*****Remove access cover and check that float is free to move. If build-up restricts float, clean and reinstall. If defective, replace switch.
Pump runs or hums but does not pump.	Discharge is blocked or restricted.	Check the discharge line for blockage, including ice if the line passes through or into cold areas.
	Check valve is stuck closed or installed wrong.	Remove and examine for freedom of operation and proper installation.
	Total head (lift height) has been reached (refer to Figure 8)	Try routing pipe to a lower level. If not possible, another pumping station may be required at a level of roughly half the total head (lift).
	Pump impeller is jammed.	*****Disassemble unit to expose pump impeller. Remove foreign material. Reassemble.
	Trap or inlet piping is clogged.	Check the trap and inlet piping for restrictions.
Pump short-cycles.	Plugged vent, or quick-vent in use.	Verify that an unrestricted vent at least 1-¼" in diameter is in use. ***Quick-vents shall not be used.***
	Defective float switch.	*****Remove access cover and check that float is free to move. If build-up restricts float, clean and reinstall. If defective, replace switch.
	Check valve was not installed, is stuck open, or is leaking.	Remove and examine for freedom of operation and proper installation.
Pump runs periodically when fixtures are not in use.	Check valve was not installed, is stuck open, or is leaking.	Remove and examine for freedom of operation and proper installation.
	Faucets are dripping.	Repair faucets to eliminate dripping.
Water or soap suds come out of vent pipe.	Vent pipe is too short or too small in diameter.	Verify that an unrestricted vent at least 1-¼" in diameter is in use.
	Defective float switch.	*****Remove tank cover and check that float is free to move. If build-up restricts float, clean and reinstall. If defective, replace switch.
	Rate of inflow exceeds pump output.	Use valve on the inlet to reduce rate of inflow.
Pump operates noisily.	Foreign objects in impeller cavity.	*****Disassemble unit to expose pump impeller. Remove foreign material. Reassemble.
	Piping to house structure is too rigid.	Replace a portion of the discharge pipe with rubber hose to absorb noise.

*****NOTE: Liberty Pumps, Inc. assumes no responsibility for damage or injury due to disassembly beyond float removal in the field. Disassembly, other than at Liberty Pumps or its authorized service centers, automatically voids warranty.

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Warranty

Liberty Pumps Wholesale Products Limited Warranty

Liberty Pumps, Inc. warrants that Liberty Pumps wholesale products are free from all factory defects in material and workmanship for a period of three (3) years from the date of purchase (excluding batteries). The date of purchase shall be determined by a dated sales receipt noting the model and serial number of the pump. The dated sales receipt must accompany the returned pump if the date of return is more than three years from the date of manufacture noted on the pump nameplate.

The manufacturer's sole obligation under this Warranty shall be limited to the repair or replacement of any parts found by the manufacturer to be defective, provided the part or assembly is returned freight prepaid to the manufacturer or its authorized service center, and provided that none of the following warranty-voiding characteristics are evident:

The manufacturer shall not be liable under this Warranty if the product has not been properly installed, operated, or maintained per manufacturer instructions; if it has been disassembled, modified, abused, or tampered with; if the electrical cord has been cut, damaged, or spliced; if the pump discharge has been reduced in size; if the pump has been used in water temperatures above the advertised rating; if the pump has been used in water containing sand, lime, cement, gravel, or other abrasives; if the product has been used to pump chemicals, grease, or hydrocarbons; if a non-submersible motor has been subjected to moisture; or if the label bearing the model and serial number has been removed.

Liberty Pumps, Inc. shall not be liable for any loss, damage, or expenses resulting from installation or use of its products, or for indirect, incidental, and consequential damages, including costs of removal, reinstallation or transportation.

There is no other express warranty. All implied warranties, including those of merchantability and fitness for a particular purpose, are limited to three years from the date of purchase. This Warranty contains the exclusive remedy of the purchaser, and, where permitted, liability for consequential or incidental damages under any and all warranties are excluded.

Liberty Pumps®

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Liberty Pumps®
A Family and Employee Owned Company

Manual de instalación

7212000F

Bomba de drenaje automática

Modelos



404

1/3 hp residencial 115V

404
404/A
- *alarma*

404/A-EYE
- *alarma NightEye®*

404CV
- *válvula de retención*

404CV/A
- *válvula de retención y alarma*

404CV/A-EYE
- *válvula de retención y alarma NightEye®*

404L
- *puertos más grandes*

404L/A
- *puertos más grandes y alarma*

404L/A-EYE
- *puertos más grandes y alarma NightEye®*



405

1/2 hp comercial alta temperatura 115V

405
405HV
- *alto voltaje 230V*

405/A
- *alarma*

405/A-EYE
- *alarma NightEye®*

7000 Apple Tree Avenue
Bergen, NY 14416 EUA
teléfono: 800-543-2550
fax: 585-494-1839
www.libertypumps.com

C US
Todas las unidades contienen Bomba certificada

C US
ASME A112.3.4
CSA B45.9
Meets UPC
Modelos 404CV unicamente

SSPMA CERTIFIED

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Contenido

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Aplicación 4
Instalación 4
Operación 5
Mantenimiento y solución de problemas 6
Garantía 8

Reglas de seguridad

	Este símbolo de alerta de seguridad se usa en el manual y en la bomba para alertar sobre el riesgo potencial de lesiones graves o la muerte.
	Este símbolo de alerta de seguridad identifica el **riesgo de descarga eléctrica**. Se acompaña con una instrucción destinada a minimizar el riesgo potencial de descarga eléctrica.
	Este símbolo de alerta de seguridad identifica el **riesgo de incendio**. Se acompaña con una instrucción destinada a minimizar el riesgo potencial de incendio.
	Este símbolo de alerta de seguridad identifica el **riesgo de lesiones graves o la muerte**. Se acompaña con una instrucción destinada a minimizar el riesgo potencial de lesión o muerte.
⚠ PELIGRO	Advierte sobre peligros que, si no se evitan, **provocarán** lesiones graves o la muerte.
⚠ ADVERTENCIA	Advierte sobre los peligros que, si no se evitan, **pueden provocar** lesiones graves o la muerte.
⚠ ATENCIÓN	Advierte sobre peligros que, si no se evitan, pueden ocasionar lesiones leves o moderadas.
AVISO	Señala una instrucción importante relacionada con la bomba. El incumplimiento de estas instrucciones puede ocasionar fallas en la bomba o daños a la propiedad.

⚠ ADVERTENCIA	**Lea todos los manuales suministrados antes de usar el sistema de bomba. Siga todas las instrucciones de seguridad de los manuales y de la bomba. De lo contrario, podrían producirse lesiones graves o la muerte.**
AVISO	**Instalador: el manual debe permanecer con el propietario o el operador/encargado del sistema.**

Mantenga este manual a mano para futuras referencias.

Para obtener un manual de reemplazo, visite libertypumps.com, o comuníquese con Liberty Pumps al 1-800-543-2550.

Conserve el recibo de venta fechado para la garantía.

Registre la información de la placa de identificación de la bomba:

N.° de modelo de la bomba: _____

N.° de serie de la bomba: _____

Fecha de fabricación: _____

Fecha de instalación: _____

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Medidas de seguridad

ADVERTENCIA **RIESGO DE SHOCK ELÉCTRICO**

- El contacto accidental con partes, elementos, fluido o agua bajo tensión puede causar lesiones graves o la muerte.
- Desconecte siempre las bombas de las fuentes de alimentación antes de manipular o realizar cualquier ajuste en las bombas, el sistema de bomba o el panel de control.
- Toda la instalación y el mantenimiento de bombas, controles, dispositivos de protección y cableado general deben ser realizados por personal calificado.
- Todas las prácticas eléctricas y de seguridad deben realizarse según el National Electrical Code®, la Administración de Seguridad y Salud Ocupacional, o los códigos y las ordenanzas locales aplicables.
- La bomba debe estar correctamente conectada a tierra utilizando el conductor de conexión a tierra suministrado. No puentee los cables de conexión a tierra ni quite la conexión a tierra de los enchufes. Si el sistema de la bomba no se conecta a tierra correctamente, se pueden energizar todas las partes metálicas de la bomba y sus alrededores.
- No manipule ni desenchufe la bomba con las manos mojadas, mientras esté de pie sobre una superficie húmeda o en agua, a menos que use el equipo de protección personal.
- Siempre use botas de goma dieléctrica y otros equipos de protección personal (EPP) aplicables cuando haya agua en el piso y se deba revisar un sistema de bomba energizado, ya que las conexiones eléctricas sumergidas pueden energizar el agua. No ingrese en el agua si el nivel es más alto que la protección del EPP o si el equipo no es hermético.
- No levante ni transporte una bomba o un conjunto de flotador por el lado del cable de alimentación. Esto dañará el cable de alimentación y podría exponer los hilos bajo tensión dentro del cable.
- El suministro de energía eléctrica se debe ubicar dentro de las limitaciones de longitud del cable de alimentación de la bomba, y para las instalaciones por debajo del nivel del suelo, debe ser de al menos 4 pies (1.22 m) por encima del nivel del suelo.
- No utilice este producto en aplicaciones donde el contacto humano con el fluido bombeado sea común (como piscinas, fuentes, áreas marinas, etc.).
- Proteja el cable de alimentación del medio ambiente. Los cables de alimentación y de interruptor desprotegidos pueden permitir que el agua se filtre a través de los extremos en la bomba o en la carcasa del interruptor y, de esta forma, energizar el entorno.
- Esta unidad viene con un conductor de conexión a tierra y un enchufe de toma a tierra. Para reducir el riesgo de descargas eléctricas conecte la bomba a un tomacorriente debidamente conectado a un interruptor de circuito con pérdida a tierra (GFCI por sus siglas en inglés) que cumpla con los requisitos más recientes de la norma UL 943, incluyendo Función de Auto-Monitoring o Self-Test y Reverse Line-Load Miswire Function - Repeated.

ADVERTENCIA **RIESGO DE FUEGO**

- No use un cable de extensión para alimentar el producto. Los cables de extensión pueden sobrecargar tanto el producto como los hilos de suministro del cable de extensión. Los hilos sobrecargados se pueden calentar mucho y prenderse fuego.
- Este producto requiere un circuito derivado separado, con fusibles adecuados y conectado a tierra, dimensionado para los requisitos de voltaje y amperaje de la bomba, como se indica en la placa de identificación. Los cables de circuitos derivados sobrecargados se pueden calentar mucho y prenderse fuego.
- Riesgo de explosión durante la instalación. Los limpiadores, las pinturas base y los cementos de tubos de PVC pueden liberar vapores explosivos. Estos vapores más densos que el aire se pueden acumular en el tanque. El calor emitido por soldadores de cobre o por el proceso de soldar cobre u otros tubos de metal puede incendiar estos vapores y causar una explosión violenta. Si la unidad se va a conectar a un desagüe de cobre o a una tubería de ventilación, todas las conexiones de los tubos de PVC unidas por solvente se deben curar durante un *mínimo de 24 horas*. La tapa de acceso se debe extraer para permitir que el tanque se ventile debidamente antes de soldar tubería de cobre cerca de la unidad.
- Para el reemplazo del cable: cable de alimentación debe ser del mismo largo y tipo que el cable originalmente instalado en el producto de Liberty Pumps. El uso de un cable incorrecto puede exceder la clasificación eléctrica y provocar la muerte, lesiones graves u otras fallas importantes.
- No utilice este producto con líquidos inflamables o explosivos como gasolina, aceite combustible, queroseno, etc., como así tampoco en sus cercanías. Si los elementos giratorios dentro de la bomba golpean cualquier objeto extraño, pueden producirse chispas. Las chispas podrían encender líquidos inflamables.
- Estas bombas no deben instalarse en ubicaciones clasificadas como peligrosas de acuerdo con el National Electric Code®, ANSI/NFPA 70.

ADVERTENCIA **RIESGO DE MUERTE**

- No modifique el sistema de bomba/la bomba de ninguna manera. Las modificaciones pueden afectar los sellos, cambiar la carga eléctrica de la bomba, o dañar la bomba y sus componentes.
- Todas las instalaciones del sistema de bomba/la bomba deberán cumplir con todos los códigos y las ordenanzas federales, estatales y locales aplicables.
- No permita que los niños jueguen con el sistema de bomba.
- No permita que ninguna persona no calificada tenga contacto con este sistema de bomba. Cualquier persona que no tenga conocimiento de los peligros de este sistema de bomba o que no haya leído este manual, puede resultar fácilmente lesionada.
- No quite etiquetas de la bomba ni del cable.
- Manténgase alejado de las aberturas de succión y descarga. Para evitar lesiones, nunca inserte los dedos en la bomba mientras está conectada a una fuente de alimentación.
- No use este producto con fluidos inflamables, explosivos o corrosivos. No lo use en una atmósfera inflamable o explosiva, ya que podría ocasionar lesiones graves o la muerte.
- Advertencia de la Propuesta 65 de California: Este producto contiene productos químicos que el estado de California sabe que causan cáncer, defectos de nacimiento u otros daños reproductivos. Para obtener más información, vaya a www.p65warnings.ca.gov.

AVISO

- **Modelo 404:** No utilice estas bombas con líquido a más de 140°F (60°C). Si lo hiciera, puede sobrecalentar la bomba y provocar una falla.
- **Modelo 405:** No utilice estas bombas con líquido a más de 180°F (82°C). Si lo hiciera, puede sobrecalentar la bomba y provocar una falla.

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- No utilice deseche por el drenaje materiales como solvente para pintura u otros químicos, ya que pueden llegar a atacar y dañar los componentes de la bomba y potencialmente causar que el equipo no funcione bien o deje de funcionar.
- No utilice el sistema de bomba con lodo, arena, cemento, hidrocarburos, grasa o productos químicos. Los componentes de la bomba y del sistema podrían dañarse, y provocar un mal funcionamiento o una falla del producto. Además, puede producirse una inundación si estos materiales atascan el impulsor o la tubería.
- No utilice el sistema en seco.

Dimensiones

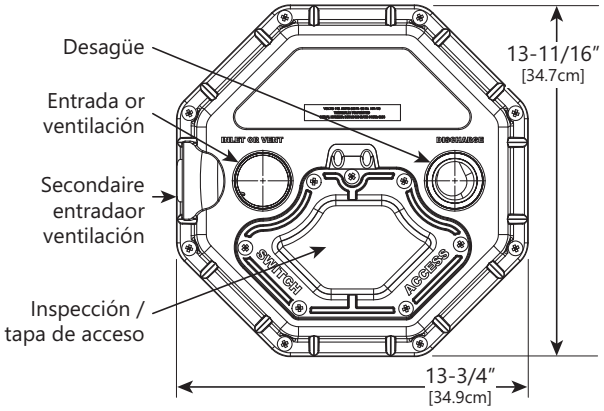


Figura 1. Modelo 404 y 405 dimensiones de la cubierta

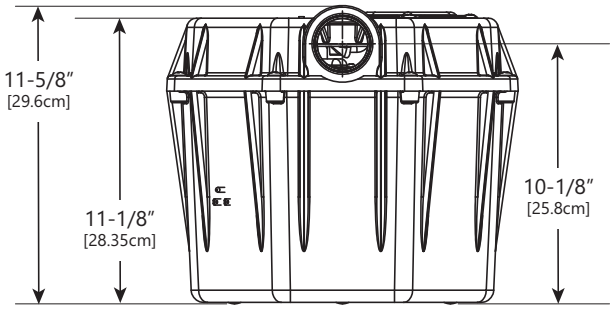


Figura 2. Modelo 404 dimensiones de la cuenca

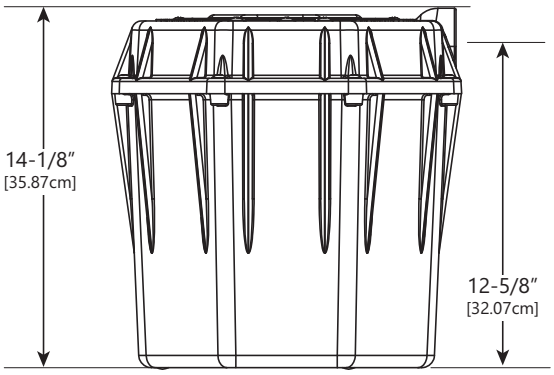


Figura 3. Modelo 405 dimensiones de la cuenca

Aplicación

Las bombas de drenaje de las series 404 y 405 se deben utilizar para bombear aguas residuales. Son capaces de admitir residuos de tamaño reducido, como por ejemplo la pelusa de la colada (hasta 0,95 cm ó 3/8 plg.) que sale con el desagüe normal de un fregadero. No permita que entren partículas sólidas de mayor tamaño en la bomba. La serie 405 ha sido diseñada para aplicaciones comerciales y se puede utilizar agua de desagüe a temperaturas superiores (82°C ó 180°F como máximo).

Instalación

Admisión

La bomba tiene dos puertos disponibles: uno en la parte superior y otro en el lateral. Ambos se pueden utilizar como respiradero o como admisión. Conecte la máquina a la bomba con una tubería del tamaño apropiado (3,81 cm ó 1-1/2 pulgadas para el modelo 404 y 404CV y 5,08 cm ó 2 pulgadas para los modelos 404L y 405). conecte el accesorio (es decir, lavadero, fregadero del sótano, lavadora) a la bomba. Consulte Figura 4 para una instalación típica.

AVISO

- **Apriete la conexión sólo con la mano**
- **No fuerce la rosca**

Se debe usar una trampa entre el accesorio y la bomba; se recomienda un tipo de brida. Apriete con la mano la trampa para bombear.

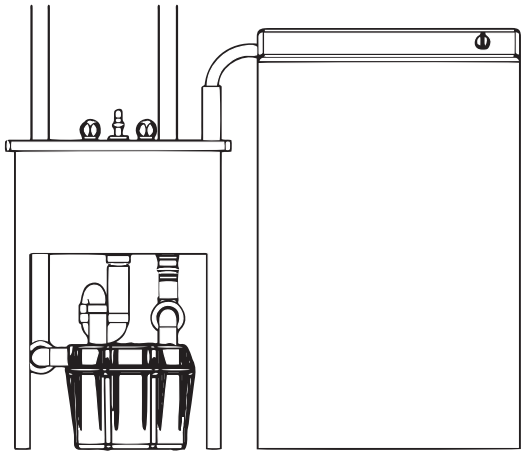


Figura 4. Instalación residencial típica

Desagüe

AVISO

- **Apriete la conexión sólo con la mano**
- **Utilizar el sellador de rosca o la cinta de teflón adecuados**
- **No fuerce la rosca**

Instale un empalme justo encima de la bomba para facilitar su desmontaje para tareas de limpieza y mantenimiento. Instale una válvula de retención (no incluido) justo encima del empalme, lo más cerca posible de la bomba, para evitar el contraflujo del agua después de cada ciclo de bombeo.

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Válvula de retención para modelos de CV

Los modelos 404/CV, 404CV/A y 404CV/A-EYE vienen con una válvula de retención para cumplir con la norma ASME112.3.4 / CSAB45.9. Esta válvula de retención debe enroscarse en el puerto de desagüe de la cubierta del 404.

Respiradero

AVISO

- **Apriete la conexión sólo con la mano**
- **No tape el respiradero**
- **No emplee ventilación rápida unidireccional o válvulas de admisión de aire**, ya que no garantizarán el desempeño adecuado de los dispositivos

La unidad tiene un respiradero para dar cabida al volumen extra del agua jabonosa y asegurar el drenaje completo de la unidad. El respiradero deberá contar con una unión que facilite su desmontaje y deberá estar conectado directamente a la tubería de ventilación del edificio o de la casa.

Orificio de entrada de aire (unidades de alarma solamente)

Si se usa el orificio superior (orificio) para la ventilación, existe la posibilidad de que se forme una bolsa de aire que evite que la alarma flotante se active. Después de instalar la tubería de ventilación, se recomienda perforar un orificio de 1/8 " a través de la unidad y la tubería de ventilación para permitir que escape el aire. Consulte la Figura 5.

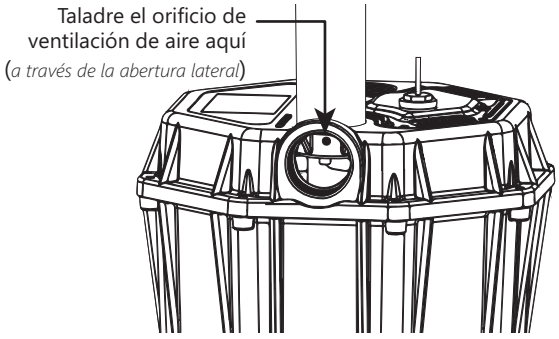


Figura 5. Ubicación del orificio de ventilación (solo unidades de alarma)

Cable de alimentación

ADVERTENCIA **RIESGO DE SHOCK ELÉCTRICO**

- Todas las prácticas eléctricas y de seguridad deben realizarse según el National Electrical Code®, la Administración de Seguridad y Salud Ocupacional, o los códigos y las ordenanzas locales aplicables.
- Desconecte siempre las bombas de las fuentes de alimentación antes de manipular o realizar cualquier ajuste en las bombas, el sistema de bomba o el panel de control.
- La bomba debe estar correctamente conectada a tierra utilizando el conductor de conexión a tierra suministrado. No puentee los cables de conexión a tierra ni quite la conexión a tierra de los enchufes. Si el sistema de la bomba no se conecta a tierra correctamente, se pueden energizar todas las partes metálicas de la bomba y sus alrededores.
- El suministro de energía eléctrica se debe ubicar dentro de las limitaciones de longitud del cable de alimentación de la bomba, y para las instalaciones por debajo del nivel del suelo, debe ser de al menos 4 pies (1.22 m) por encima del nivel del suelo.

ADVERTENCIA **RIESGO DE FUEGO**

- No use un cable de extensión para alimentar el producto. Los cables de extensión pueden sobrecargar tanto el producto como los hilos de suministro del cable de extensión. Los hilos sobrecargados se pueden calentar mucho y prenderse fuego.

El cable de potencia de la bomba lleva un conector a tierra y un enchufe de 3 clavijas con conexión a tierra. Se debe enchufar a un tomacorriente trifilar con fusibles independientes conectado a tierra con capacidad para 15 amperios, con el voltaje apropiado para el modelo (todos los modelos son de 115V, excepto el 405HV que es de 230V). Consulte la placa de identificación de la bomba para verificar las especificaciones eléctricas.

Alarma

Los modelos 404 y 405 con /A o /A-EYE vienen con una alarma Liberty Pumps. Para conocer las instrucciones sobre el uso de esta alarma, consulte el manual de alarmas adjunto.

Operación

Las bombas de las series 404 y 405 vienen equipadas con un interruptor de flotador montado dentro del tanque. Estos modelos vienen con dos cables: uno al interruptor de flotador (interruptor de flotador se muestra en la Figura 7) y el otro al motor. El cable del interruptor lleva un interruptor en serie (o cascada) en el que se puede enchufar el cable de la bomba (vea la Figura 6). Esto permite la operación manual de la bomba durante un tiempo limitado.

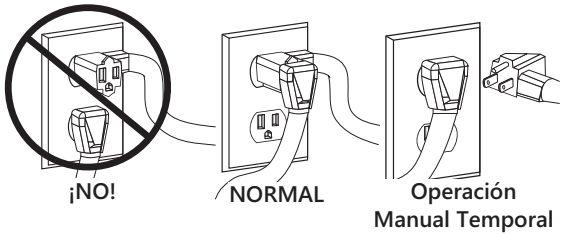


Figura 6. Instalación del enchufe multicapa

La operación automática con el interruptor de Liberty Pumps, se deberán interconectar los dos cables y enchufarse a un tomacorriente con conexión a tierra, con fusible independiente y el amperaje apropiado para el modelo. Ambos cables llevan enchufes de 3 clavijas y se deben enchufar en un tomacorrientes trifilar con toma a tierra.

Para la operación manual, o falla el interruptor, el cable de la bomba se puede separar y enchufar en un tomacorriente, evitando de esta manera el interruptor. La modelo 405HV se deben operar solamente sin el flotador por medio de un disyuntor o panel de desconexión.

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Mantenimiento y solución de problemas

ADVERTENCIA **RIESGO DE SHOCK ELÉCTRICO**

- Desconecte siempre las bombas de las fuentes de alimentación antes de manipular o realizar cualquier ajuste en las bombas, el sistema de bomba o el panel de control.

Todas las bombas se someten a prueba en fábrica como garantía de su funcionamiento. Si la unidad no funciona correctamente, vuelva a leer las instrucciones para asegurarse de que las siguió al pie de la letra. La bomba no necesita de mantenimiento periódico, pero sus conexiones sí pueden requerir atención ocasionalmente. Limpie el purgador regularmente. También se deberá comprobar que la válvula de retención en el desagüe funcione sin impedimentos. Las piezas de repuesto para este producto están disponibles en http://www.libertypumps.com/Services/Replacement-Parts.

El interruptor de flotador situado dentro del tanque apaga y enciende la bomba automáticamente. Este interruptor se puede desmontar con facilidad para comprobar su funcionamiento. Para hacerlo, retire la tapa de acceso en la parte superior de la unidad. Una vez retirada la tapa de acceso, levante el tapón de goma para soltar el cable del interruptor. El interruptor está montado en una varilla: para retirarla levántela o jale de ella hacia arriba.

IMPORTANTE: No cambie la longitud del amarre. Si necesita reemplazar el interruptor, compruebe que el amarre nuevo tenga la longitud indicada en Figura 8. (La longitud del amarre es la distancia que va desde la abrazadera hasta la parte superior del interruptor de flotador.)

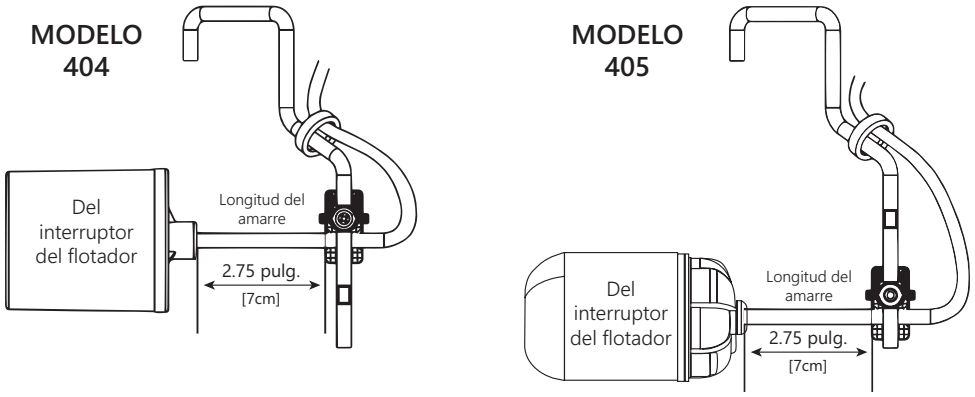


Figura 7. Longitud del amarre del interruptor del flotador

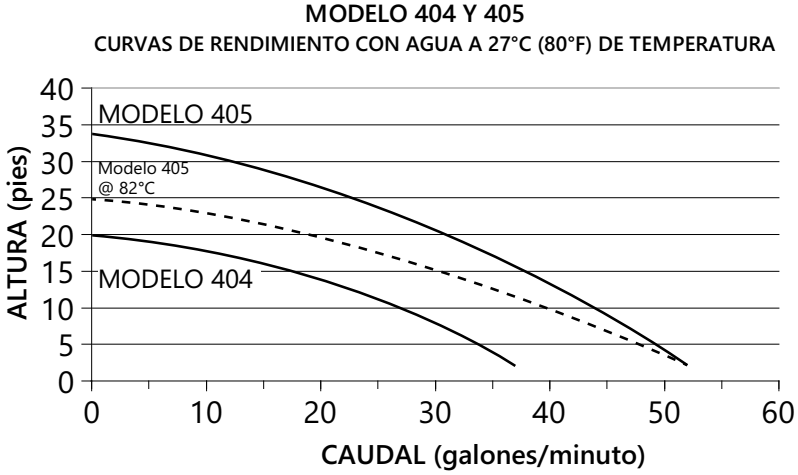


Figura 8. Curvas de rendimiento para 404 y 405

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Tabla 1. Resolución de problemas de la matriz

Problema	Causa posible	Acción correctiva
La bomba no se puede encender o apagar.	Se ha fundido un fusible o el flujo eléctrico se ha interrumpido de algún otro modo; voltaje incorrecto.	Compruebe que la bomba esté enchufada. Haga que un electricista compruebe que todos los cables estén correctamente conectados y la capacidad sea la necesaria.
	Respiradero atascado o respiradero de paso único instalado.	Compruebe que haya un respiradero libre de obstrucciones de 3,2 cm. (1-¼ plg.) de diámetro como mínimo. No deberá emplearse una ventilación rápida.
	Interruptor de flotador defectuoso o acumulaciones en las paredes del tanque que limitan el movimiento del interruptor.	*Quite la tapa de acceso y compruebe que el flotador se pueda mover sin impedimentos. Si el problema es que hay acumulaciones que impiden el movimiento, limpie el tanque y vuélvalo a instalar. Si el problema es que el interruptor está estropeado, reemplácelo.
La bomba funciona o zumba pero no bombea.	El desagüe está atascado o restringido.	Compruebe que no haya atascos en la línea de desagüe, como hielo, si la línea pasa por áreas frías.
	Compruebe que la válvula no se haya quedado cerrada o esté mal instalada.	Desmóntela y revísela para asegurarse de que funciona y se instaló correctamente.
	Se alcanzó la altura máxima (vea la Figura 8).	Intente llevar la tubería a un nivel más bajo. Si esto no fuera posible, puede que haga falta instalar otra bomba a la mitad de la altura total.
	El rotor de la bomba está atascado.	*Desmonte el depósito y la base de la bomba. Limpie la obstrucción. Vuelva a montar la bomba.
	El purgador o la tubería de admisión está atascado.	Compruebe que no haya obstrucciones en el purgador ni en la tubería de admisión.
Ciclos cortos.	Respiradero atascado o respiradero de paso único instalado.	Compruebe que haya un respiradero libre de obstrucciones de 3,2 cm. (1-¼ plg.) de diámetro como mínimo. No deberá emplearse una ventilación rápida.
	Interruptor defectuoso.	*Quite la tapa de acceso y compruebe que el flotador se pueda mover sin impedimentos. Si el problema es que hay acumulaciones que impiden el movimiento, limpie el tanque y vuélvalo a instalar. Si el problema es que el interruptor está estropeado, reemplácelo.
	No hay instalada una válvula de retención, se queda abierta o tiene una fuga.	Desmóntela y revísela para asegurarse de que funciona y se instaló correctamente.
La bomba se activa periódicamente cuando la maquinaria no está en uso.	No hay instalada una válvula de retención, se queda abierta o tiene una fuga.	Desmóntela y revísela para asegurarse de que funciona y se instaló correctamente.
	Los grifos gotean.	Repare los grifos.
Sale agua o jabón por el respiradero.	La tubería es demasiado estrecha o demasiado corta.	Compruebe que haya un respiradero libre de obstrucciones de 3,2 cm. (1-¼ plg.) de diámetro como mínimo.
	Interruptor defectuoso.	*Quite la tapa del tanque y compruebe que el flotador se puede mover sin impedimentos. Si el problema es que hay acumulaciones que impiden el movimiento, limpie el tanque y vuélvalo a instalar. Si el problema es que el interruptor está estropeado, reemplácelo.
	El caudal de entrada supera el caudal de salida de la bomba.	Cierre el caudal de entrada con la válvula en la admisión.
La bomba hace demasiado ruido.	Material foráneo en la cavidad del rotor.	*Desmonte el depósito y la base de la bomba. Limpie la obstrucción. Vuelva a montar la bomba.
	La tubería a la estructura es excesivamente rígida.	Reemplace una porción de la tubería de desagüe con un trozo de manguera de caucho para que absorba el ruido.

*NOTA: Liberty Pumps, Inc. no asume ninguna responsabilidad por desperfectos o lesiones resultantes del desmontaje de la bomba sobre el terreno, excepto si se trata de desmontar el flotador. Si el desmontaje de la bomba no lo lleva a cabo Liberty Pumps o uno de sus centros de servicio autorizados, la garantía quedará anulada.

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Garantía

Garantía limitada de Liberty Pumps Wholesale Products

Liberty Pumps, Inc. garantiza que los productos al por mayor de Liberty Pumps están libres de defectos de fábrica en cuanto a materiales y mano de obra por un período de tres (3) años a partir de la fecha de compra (sin incluir las baterías). La fecha de compra se determinará mediante un recibo de venta con fecha que indique el modelo y el número de serie de la bomba. El recibo de venta fechado debe acompañar a la bomba devuelta si la fecha de devolución es superior a tres años desde la fecha de fabricación indicada en la placa de identificación.

La única obligación del fabricante bajo esta Garantía se limitará a la reparación o el reemplazo de cualquier pieza que el fabricante considere defectuosa, siempre que la pieza o el ensamblaje se devuelvan con flete prepago al fabricante o al centro de servicio autorizado, y siempre que no se manifieste ninguna de las siguientes características de anulación de la garantía:

El fabricante no será responsable bajo esta Garantía si el producto no se ha instalado, operado o mantenido correctamente según las instrucciones del fabricante; si ha sido desmontado, modificado, utilizado indebidamente o alterado; si el cable eléctrico ha sido cortado, dañado o empalmado; si la descarga de la bomba se ha reducido en tamaño; si la bomba se ha utilizado en temperaturas de agua superiores a la calificación indicada; si la bomba se ha utilizado en agua que contiene arena, cal, cemento, grava u otros abrasivos; si el producto se ha utilizado para bombear productos químicos, grasa o hidrocarburos; si un motor no sumergible ha sido sometido a humedad; o si la etiqueta que lleva el modelo y el número de serie ha sido eliminada.

Liberty Pumps, Inc. no será responsable por ninguna pérdida, daño o gasto que resulte de la instalación o el uso de sus productos, ni por daños indirectos, incidentales y consecuentes, incluidos los costos de remoción, reinstalación o transporte.

No hay ninguna otra garantía expresa. Todas las garantías implícitas, incluidas las de comerciabilidad e idoneidad para un fin determinado, están limitadas a tres años a partir de la fecha de compra. Esta Garantía contiene el único recurso para el comprador y, donde esté permitido, se excluye la responsabilidad por daños consecuentes o incidentales bajo cualquiera y todas las garantías.

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Liberty Pumps®

A Family and Employee Owned Company

Manuel d'installation

7212000F

Pompe d'évacuation automatique

Modèles



404

1/3 hp résidentiel 115V

404

404/A
- *alarme*

404/A-EYE
- *alarme NightEye®*

404CV
- *clapet antiretour*

404CV/A
- *clapet antiretour et alarme*

404CV/A-EYE
- *clapet antiretour et alarme NightEye®*

404L
- *ports plus grands*

404L/A
- *ports plus grands et alarme*

404L/A-EYE
- *ports plus grands et alarme NightEye®*



405

1/2 hp commercial haute température 115V

405

405HV
- *haute tension 230V*

405/A
- *alarme*

405/A-EYE
- *alarme NightEye®*

7000 Apple Tree Avenue
Bergen, NY 14416 USA
téléphone: 800-543-2550
fax: 585-494-1839
www.libertypumps.com

C SA US
Tous les modèles contiennent une pompe homologuée

C SA US
ASME A112.3.4
CSA B45.9
Meets UPC
Modèle 404CV seulement

SSPMA CERTIFIED

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Consignes de sécurité

	Ce symbole d'alerte de sécurité est utilisé dans le manuel et sur la pompe pour signaler un risque éventuel de blessures graves ou mortelles.
	Ce symbole d'alerte de sécurité identifie le **risque de choc électrique**. Il est accompagné d'instructions destinées à minimiser le risque éventuel de choc électrique.
	Ce symbole d'alerte de sécurité identifie le **risque d'incendie**. Il est accompagné d'instructions destinées à minimiser les risques éventuels d'incendie.
	Ce symbole d'alerte de sécurité identifie le **risque de blessures graves ou mortelles**. Il est accompagné d'instructions destinées à minimiser les risques éventuels de blessures graves ou mortelles.
⚠ DANGER	Il met en garde contre les dangers qui, s'ils sont négligés, **vont** entraîner des blessures graves ou mortelles.
⚠ AVERTISSEMENT	Il met en garde contre les dangers qui, s'ils sont négligés, **pourraient** entraîner des blessures graves ou mortelles.
⚠ ATTENTION	Il met en garde contre les dangers qui, s'ils sont négligés, peuvent entraîner des blessures légères ou moyennes.
AVIS	Signale une instruction importante liée à la pompe. Le non-respect de ces instructions peut entraîner une défaillance de la pompe ou des dommages matériels.

⚠ AVERTISSEMENT	**Lire tous les manuels fournis avant d'utiliser le système de pompe. Suivre l'ensemble des consignes de sécurité décrites dans le (les) manuel(s) et celles qui apparaissent sur la pompe. Le non-respect de ces consignes pourrait entraîner des blessures graves ou mortelles.**
AVIS	**Message à l'installateur : le manuel doit demeurer auprès du propriétaire ou de l'opérateur/ responsable de l'entretien du système.**

Garder ce manuel à portée de main pour référence future.

Pour obtenir un manuel de remplacement, visiter le site libertypumps.com, ou communiquer avec Liberty Pumps au 1-800-543-2550.

Conserver le reçu de vente daté pour la garantie.

Enregistrer les informations de la plaque signalétique de la pompe:

Nº de modèle de pompe: _____

Nº de série de la pompe: _____

Date de fabrication: _____

Date d'installation: _____

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Mesures de sécurité

AVERTISSEMENT **RISQUE DE CHOC ELECTRIQUE**

- Un contact accidentel avec des pièces sous tension, des objets, du liquide ou de l'eau peut causer des blessures graves ou mortelles.
- Toujours débrancher la(les) pompe(s) de sa(leur) source d'alimentation avant de la(les) manipuler ou d'effectuer des réglages au niveau de la(des) pompe(s), du système de pompe ou du panneau de commande.
- Toute installation et entretien des pompes, des commandes, des dispositifs de protection et du câblage général doivent être effectués par du personnel qualifié.
- Toutes les pratiques électriques et de sécurité doivent être conformes au Code national de l'électricité[MC], aux normes établies par la *Occupational Safety and Health Administration* (l'Administration de la sécurité et de la santé au travail) ou aux codes et ordonnances locaux applicables.
- La pompe doit être mise à la terre correctement à l'aide du conducteur de mise à la terre fourni. Ne pas contourner les fils de mise à la terre et ne pas retirer la broche de masse des fiches de branchement. Si le système de pompe n'est pas correctement mis à la terre, toutes les parties métalliques de la pompe et de son environnement pourraient être mises sous tension.
- Ne pas manipuler et ne pas débrancher la pompe avec les mains mouillées, en vous tenant sur une surface humide ou dans de l'eau à moins de porter un équipement de protection individuelle.
- Les connexions électriques submergées peuvent produire un courant électrique dans l'eau. Toujours porter des bottes diélectriques en caoutchouc et autres équipements de protection individuelle (EPI) en entretenant un système de pompe sous tension lorsqu'il y a de l'eau au sol. Ne pas circuler dans les endroits où le niveau d'eau est supérieur à la protection EPI ou si l'EPI n'est pas étanche.
- Ne pas soulever ni transporter une pompe ou un ensemble de flotteur par son cordon d'alimentation. Cela endommagera le cordon d'alimentation et pourrait exposer les fils sous tension électrique à l'intérieur du cordon d'alimentation.
- La prise d'alimentation électrique doit se trouver à la portée du cordon d'alimentation de la pompe et à au moins 4 pi (1,22 m) au-dessus du niveau du plancher dans le cas des installations sous le niveau du sol.
- N'utilisez pas ce produit pour les installations où les ouvriers peuvent entrer fréquemment en contact avec les liquides pompés (comme les piscines, les fontaines, les zones marines, etc.).
- Protéger le cordon d'alimentation de l'environnement. Les cordons d'alimentation et de commutation non protégés peuvent laisser l'eau traverser les extrémités et pénétrer dans les caissons de la pompe et des commutateurs, entraînant la mise sous tension de l'environnement.
- Cette pompe est fournie avec un conducteur de mise à la terre et une fiche de branchement de type mise à la terre. Afin de réduire les dangers d'électrocution, s'assurer que la pompe est correctement mis à la terre avec un disjoncteur de fuite de terre (différentiel) qui conforme aux plus récentes normes UL 943, notamment les dispositions sur la fin de vie utile et les mauvais raccordements de lignes de charge. Fonction de surveillance automatique ou d'auto-test et fonction de mise en échec de charge de ligne inversée - répétée.

AVERTISSEMENT **RISQUE D'INCENDIE**

- Ne pas utiliser de rallonge électrique pour alimenter le dispositif. Les rallonges peuvent surcharger à la fois les fils d'alimentation du dispositif et des rallonges électriques. Les fils surchargés peuvent devenir très chauds et prendre feu.
- Ce produit nécessite un circuit de dérivation dédié, correctement protégé par un fusible et mis à la terre, dimensionné pour répondre aux exigences de tension et d'intensité de courant électrique de la pompe, conformément aux informations apparaissant sur la plaque signalétique. Les fils de circuit de dérivation surchargés deviennent très chauds et peuvent prendre feu.
- Danger d'explosion durant l'installation. Les nettoyants à PVC, les apprêts et les colles peuvent dégager des vapeurs explosives. Ces émanations plus lourdes que l'air peuvent s'accumuler dans le réservoir. La chaleur dégagée lors du soudage des tuyaux en cuivre ou autre métal peut allumer ces vapeurs et causer une violente explosion. Si l'appareil doit être raccordé à un tuyau d'évacuation ou à un évent en cuivre, il faut laisser tous les joints en PVC collés sécher pendant au moins 24 heures. Il faut retirer le couvercle d'accès afin de bien ventiler le réservoir avant de souder les tuyaux en cuivre situés à proximité de l'appareil.
- Pour le remplacement du cordon: cordon d'alimentation doit être de la même longueur et du même type que ceux installés à l'origine sur le produit Liberty Pumps. L'utilisation d'un cordon non-conforme peut entraîner un dépassement de la tension nominale du cordon et causer la mort, des blessures graves ou toute autre défaillance importante.
- Ne pas utiliser ce produit avec ou près de liquides inflammables ou explosifs tels que l'essence, le mazout, le kérosène, etc. Des étincelles peuvent se produire si des éléments rotatifs à l'intérieur de la pompe heurtent un corps étranger. Les étincelles pourraient enflammer les liquides inflammables.
- Cette pompe ne doit pas être installée dans un endroit classé dangereux selon la norme ANSI/NFPA 70 du NEC (code national de l'électricité).

AVERTISSEMENT **RISQUE DE BLESSURE GRAVE OU DE MORT**

- Ne pas modifier la pompe / le système de pompe de quelque façon que ce soit. Les modifications peuvent affecter les joints d'étanchéité, modifier la charge électrique de la pompe ou endommager la pompe et ses composants.
- Toutes les installations de pompes/systèmes de pompe doivent être conformes à tous les codes et ordonnances fédéraux, provinciaux et locaux applicables.
- Ne pas laisser les enfants jouer avec le système de pompe.
- Ne permettre à aucune personne non qualifiée d'être en contact avec ce système de pompe. Toute personne qui n'est pas consciente des dangers inhérents à ce dispositif, ou qui

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n'a pas lu ce manuel, peut facilement être blessée en manipulant ou en étant en contact avec ce système de pompe.

- Ne pas retirer les étiquettes de la pompe ou de son cordon.
- Demeurer à l'écart des orifices d'aspiration et d'évacuation. Pour éviter toute blessure, ne jamais introduire les doigts dans la pompe pendant qu'il est connecté à une source d'alimentation.
- Ne pas utilise ce produit pour pomper des liquides inflammables, explosifs ou corrosifs. Ne pas utiliser la pompe dans une atmosphère contenant des substances inflammables et/ou explosives au risque d'entraîner des blessure graves ou mortelles.
- Avertissement en vertu de la Proposition 65 de la Californie: Ce dispositif contient des produits chimiques reconnus par l'État de la Californie comme pouvant causer le cancer, des anomalies congénitales ou d'autres problèmes du système reproducteur. Pour plus d'informations, visiter le site www.p65warnings.ca.gov.

AVIS

- **Modèle 404:** Ne pas utiliser ces pompes avec un liquide dont la température est supérieure à 60°C (140°F). Le pompage de liquides à des températures plus élevées peut entraîner une surchauffe et causer une panne de pompe.
- **Modèle 405:** Ne pas utiliser ces pompes avec un liquide dont la température est supérieure à 82°C (180°F). Le pompage de liquides à des températures plus élevées peut entraîner une surchauffe et causer une panne de pompe.
- Ne pas disposer de matériaux comme du solvant à peinture ou d'autres produits chimiques en les vidant dans l'avaloir, car ils peuvent attaquer chimiquement et endommager les composants de la pompe, causant éventuellement son mauvais fonctionnement ou sa défaillance.
- Ne pas utiliser le système de pompage avec de la boue, du sable, du ciment, des hydrocarbures, de la graisse ou des produits chimiques. De telles substances peuvent endommager les composants mécaniques et entraîner un fonctionnement défectueux ou une défaillance de la pompe et du système de pompage. De plus, une inondation peut se produire si ces substances obstruent la pompe ou la tuyauterie.
- Ne pas faire fonctionner à sec.

Dimensions

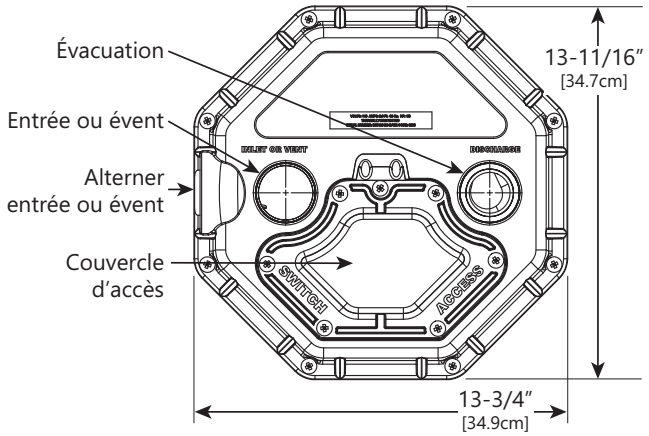


Figure 1. Modèles 404 et 405 dimensions de la couverture

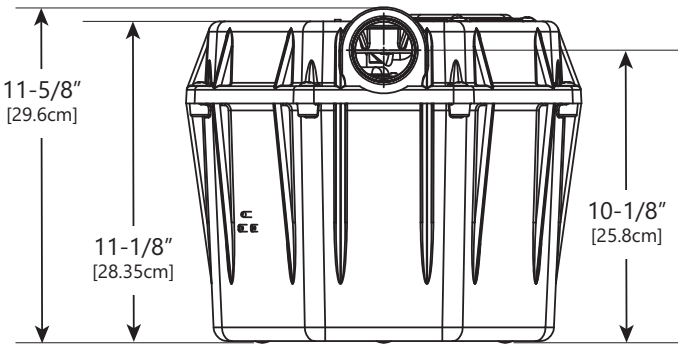


Figure 2. Modèle 404 dimensions du bassin

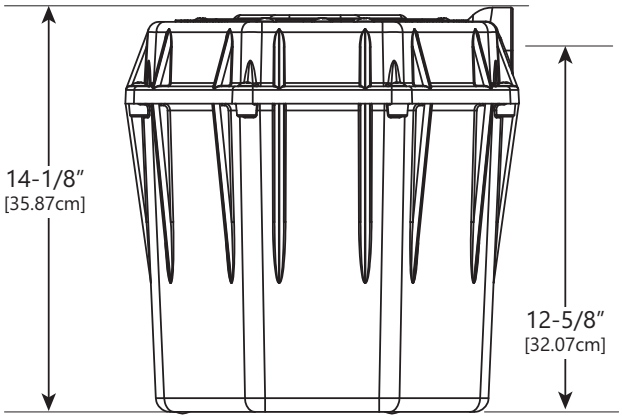


Figure 3. Modèle 405 dimensions du bassin

Utilisation

Les pompes d'évacuation des séries 404 et 405 sont conçues pour une utilisation dans les eaux usées. Elles peuvent tolérer de petits débris et solides, tels les fibres de buanderie (jusqu'à 10 mm [3/8 po]) associés à l'évacuation normale des eaux usées d'un évier. Les plus gros solides ne doivent pas pénétrer dans le système de la pompe. La série 405 est conçue pour une utilisation commerciale avec des eaux d'évacuation d'une température supérieure (jusqu'à 180 degrés F).

Installation

Entrée

La pompe est dotée de deux orifices : un sur le dessus et un sur le côté; ils peuvent tous deux être utilisés pour l'aération ou l'entrée. Raccorder le luminaire (c.-à-d., la cuve à lessive, l'évier du sous-sol, la machine à laver) à la pompe à l'aide de la tuyauterie appropriée (38 mm [1½ po] pour le modèle 404 et 51 mm [2 po] pour les modèles 404L et 405). Reportez-vous à la Figure 4 pour une installation typique.

AVIS

- **Resserrer à la main seulement**
- **Ne pas trop serrer ni fausser les filets**

Un conduit de type bride (recommandé) doit être utilisé entre l'accessoire et la pompe.

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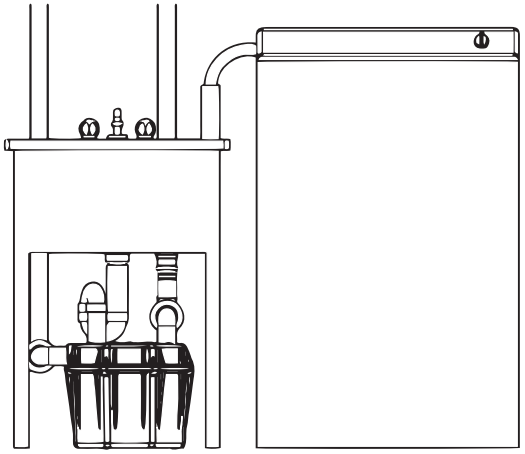


Figure 4. Installation résidentielle type

Évacuation

AVIS

- **Resserrer à la main seulement**
- **Utiliser un agent d'étanchement des filets ou du ruban de teflon**
- **Ne pas trop serrer ni fausser les filets**

Installer un raccord juste au-dessus de la pompe pour en faciliter le retrait s'il devient nécessaire de la nettoyer ou de la réparer. Installer un clapet anti-retour (non inclus sauf pour les modèles CV listés ci-dessous) tout juste au-dessus du raccord (aussi près que possible de la pompe) pour éviter le refoulement d'eau après chaque cycle de la pompe.

Clapet antiretour pour les modèles CV

Les modèles 404/CV, 404CV/A et 404CV/A-EYE sont munis d'un clapet antiretour afin de respecter les normes ASME112.3.4/ CSAB45.9. Ce clapet antiretour doit être vissé dans l'orifice d'évacuation du couvercle du modèle 404.

Évent

AVIS

- **Resserrer à la main seulement**
- **Ne pas boucher l'évent**
- **Ne pas utiliser d'évent rapide unidirectionnel ni de soupape d'admission d'air**, car ils ne sauraient garantir un fonctionnement adéquat de l'appareil

Une colonne de ventilation secondaire est prévue pour permettre plus de volume en présence de grandes quantités de mousse et assurer un écoulement adéquat de l'accessoire. Le tuyau d'évent doit être doté d'un raccord afin de faciliter son retrait (le cas échéant) et être raccordé directement au bâtiment ou à l'évent de la maison.

Trou d'air d'admission (unités d'alarme seulement)

Si l'orifice supérieur (trou) est utilisé pour l'évent, il existe un risque de formation d'une poche d'air qui empêcherait l'activation du flotteur d'alarme. Une fois le conduit d'évacuation installé, il est recommandé de percer un trou de 1/8 po à travers l'unité et le conduit d'évacuation pour permettre à l'air de s'échapper. Reportez-vous à la Figure 5.

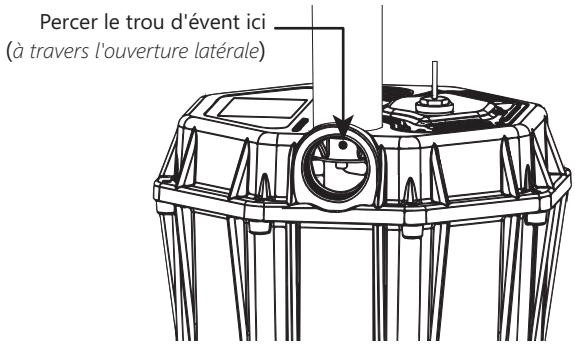


Figure 5. Emplacement du trou d'évent (unités d'alarme seulement)

Cordon d'alimentation

AVERTISSEMENT **RISQUE DE CHOC ELECTRIQUE**

- Toutes les pratiques électriques et de sécurité doivent être conformes au Code national de l'électricité[MC], aux normes établies par la *Occupational Safety and Health Administration* (l'Administration de la sécurité et de la santé au travail) ou aux codes et ordonnances locaux applicables.
- Toujours débrancher la(les) pompe(s) de sa(leur) source d'alimentation avant de la(les) manipuler ou d'effectuer des réglages au niveau de la(des) pompe(s), du système de pompe ou du panneau de commande.
- La pompe doit être mise à la terre correctement à l'aide du conducteur de mise à la terre fourni. Ne pas contourner les fils de mise à la terre et ne pas retirer la broche de masse des fiches de branchement. Si le système de pompe n'est pas correctement mis à la terre, toutes les parties métalliques de la pompe et de son environnement pourraient être mises sous tension.
- La prise d'alimentation électrique doit se trouver à la portée du cordon d'alimentation de la pompe et à au moins 4 pi (1,22 m) au-dessus du niveau du plancher dans le cas des installations sous le niveau du sol.

AVERTISSEMENT **RISQUE D'INCENDIE**

- Ne pas utiliser de rallonge électrique pour alimenter le dispositif. Les rallonges peuvent surcharger à la fois les fils d'alimentation du dispositif et des rallonges électriques. Les fils surchargés peuvent devenir très chauds et prendre feu.

Le cordon d'alimentation électrique de la pompe est muni d'un conducteur de mise à la terre et d'une fiche de branchement de type mise à la terre à trois broches. Il devrait être branché à une prise à trois fils avec fusibles indépendants et mise à la terre d'une intensité de 15 ampères dont la tension convient au modèle. Vérifier la tension de pompe appropriée (tous les modèles sont en 115 V, sauf le 405 HV en 230 V). Reportez-vous à la plaque signalétique de la pompe pour vérifier les spécifications électriques.

Alarme

Les modèles 404 et 405 avec /A ou /A-EYE sont vendus avec une alarme Liberty Pumps. Pour connaître le mode d'emploi de cette alarme, prière de consulter le manuel inclus.

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Opération

Les pompes de modèles 404 et 405 sont équipées en usine d'un interrupteur à flotteur sur la paroi du réservoir. Ces modèles sont munis de deux cordons : l'un relié à l'interrupteur à flotteur (interrupteur à flotteur illustré à la Figure 7) et l'autre au moteur de la pompe. Le cordon de l'interrupteur est muni d'un connecteur en série (siamois) permettant de brancher le cordon de la pompe sur son dos (voir Figure 6). Ce système a pour but de permettre le fonctionnement manuel temporaire de la pompe.

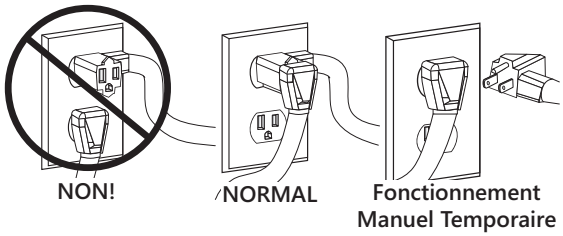


Figure 6. Utilisation de l'interrupteur/du cordon d'alimentation

Pour un fonctionnement automatique, les deux cordons doivent être interconnectés et branchés dans une prise d'une intensité en ampères suffisante pour le modèle de pompe choisi, avec fusibles indépendants et mise à la terre. (Consulter la plaque signalétique de la pompe pour connaître les caractéristiques électriques du modèle.) Les deux cordons sont munis de fiches à trois broches et doivent être branchés dans une prise à trois broches avec mise à la terre adéquate.

Pour permettre le fonctionnement manuel, ou en cas de défaillance de l'interrupteur, le cordon de la pompe peut être séparé et branché dans la prise électrique, en contournant directement l'interrupteur. On doit uniquement faire fonctionner les pompes 405HV monophasées sans l'interrupteur à flotteur en utilisant le disjoncteur ou l'interrupteur du panneau.

Entretien et dépannage

AVERTISSEMENT **RISQUE DE CHOC ELECTRIQUE**

- Toujours débrancher la(les) pompe(s) de sa(leur) source d'alimentation avant de la(les) manipuler ou d'effectuer des réglages au niveau de la(des) pompe(s), du système de pompe ou du panneau de commande.

Chaque appareil est testé individuellement en usine pour assurer un bon réglage et un fonctionnement adéquat. Si l'appareil ne fonctionne pas correctement, relire les directives pour s'assurer qu'elles ont été correctement suivies. Les pièces de rechange pour ce produit sont disponibles à http://www.libertypumps.com/Services/Replacement-Parts.

Il n'est pas nécessaire d'effectuer des travaux réguliers d'entretien sur la pompe en elle-même, mais les raccordements peuvent occasionnellement en nécessiter. Les charpies et les corps étrangers devraient êtres retirés régulièrement du conduit. Une vérification du clapet antiretour du tuyau d'évacuation devrait également être faite pour s'assurer de son libre fonctionnement.

La pompe est automatiquement actionnée et éteinte grâce à un interrupteur à flotteur situé à l'intérieur du réservoir. L'interrupteur peut facilement être retiré et son fonctionnement vérifié en retirant le couvercle d'accès situé sur le dessus de l'appareil. Une fois le couvercle d'accès retiré, un bouchon de caoutchouc doit être soulevé afin de libérer le cordon de l'interrupteur. L'interrupteur est monté sur une tige qui peut être retirée en soulevant ou en tirant vers l'avant.

IMPORTANT : Ne pas modifier la longueur de la sangle. S'il est nécessaire de remplacer l'interrupteur, veiller à ce que la longueur de la sangle demeure adéquate pour le modèle. La longueur de la sangle représente la longueur de cordon entre la pince et le flotteur. Se référer à la Figure 7.

Table 1. Matrice de dépannage

Problème	Cause possible	Mesure correctrice
La pompe refuse de s'allumer ou s'éteindre.	Fusible brûlé ou autre interruption d'alimentation, tension inadéquate.	S'assurer que le branchement de l'appareil est sécuritaire. Demander à un électricien de vérifier tous les câbles au niveau des branchements et de s'assurer que la capacité est adéquate.
	Évent bouché ou évent rapide en utilisation.	S'assurer qu'un évent dégagé d'un diamètre d'au moins 32 mm (1¼ po) est utilisé. Il ne faut pas utiliser d'évent rapide.
	Interrupteur défectueux ou accumulation sur la paroi du réservoir restreignant le mouvement libre de l'interrupteur à flotteur.	*Retirer le couvercle du réservoir et vérifier si le flotteur bouge librement. Si une accumulation limite les mouvements du flotteur, nettoyer et réinstaller. Remplacer l'interrupteur s'il est défectueux.

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Table 1. Matrice de dépannage

Problème	Cause possible	Mesure correctrice
La pompe tourne ou gronde, mais ne pompe pas.	Conduits d'évacuation bloqués ou restreints.	Vérifier dans la canalisation d'évacuation qu'il n'y ait pas de blocage, y compris la formation de glace si la canalisation se trouve dans des zones froides ou les traverse.
	Clapet antiretour bloqué en position fermée ou incorrectement installé.	Retirer et vérifier qu'il fonctionne librement et qu'il est bien installé.
	Capacité de charge ascensionnelle totale atteinte (voir Figure 8)	Essayer de rediriger le tuyau à un niveau inférieur. Si ce n'est pas possible, une autre station de pompage pourrait être nécessaire à une charge ascensionnelle d'environ la moitié.
	Rotor de la pompe bloqué.	*****Démonter le contenant et la base de la pompe. Retirer les corps étrangers. Remonter.
	Tuyau ou conduit d'entrée bloqué.	Vérifier le conduit et le tuyau d'entrée pour voir ce qui cause le blocage.
Cycles courts de la pompe.	Évent bouché ou évent rapide en utilisation.	S'assurer qu'un évent dégagé d'un diamètre d'au moins 32 mm (1¼ po) est utilisé. Il ne faut pas utiliser d'évent rapide.
	Interrupteur défectueux.	*Retirer le couvercle du réservoir et vérifier si le flotteur bouge librement. Si une accumulation limite les mouvements du flotteur, nettoyer et réinstaller. Remplacer l'interrupteur s'il est défectueux.
	Clapet antiretour non installé, bloqué en position ouverte ou qui fuit.	Retirer et vérifier qu'il fonctionne librement et qu'il est bien installé.
La pompe tourne périodiquement lorsque les accessoires ne sont pas utilisés.	Clapet antiretour non installé, bloqué en position ouverte ou qui fuit.	Retirer et vérifier qu'il fonctionne librement et qu'il est bien installé.
	Robinets qui fuient.	Réparer les robinets pour éliminer les fuites.
De l'eau ou de la mousse sort du tuyau d'évent.	Tuyau d'évent trop court ou de diamètre trop petit.	S'assurer qu'un évent dégagé d'un diamètre d'au moins 32 mm (1¼ po) est utilisé.
	Interrupteur défectueux.	*Retirer le couvercle du réservoir et vérifier si le flotteur bouge librement. Si une accumulation limite les mouvements du flotteur, nettoyer et réinstaller. Remplacer l'interrupteur s'il est défectueux.
	Débit entrant qui dépasse la capacité d'évacuation de la pompe.	Utiliser la soupape de l'orifice d'entrée pour diminuer le débit entrant.
La pompe fait du bruit.	Corps étrangers dans les cavités du rotor.	*****Démonter le contenant et la base de la pompe. Retirer les corps étrangers. Remonter.
	Tuyau trop rigide raccordé à la structure de la maison.	Remplacer une partie du tuyau d'évacuation par un boyau de caoutchouc pour absorber le bruit.
La pompe refuse de s'allumer ou s'éteindre.	Fusible brûlé ou autre interruption d'alimentation, tension inadéquate.	S'assurer que le branchement de l'appareil est sécuritaire. Demander à un électricien de vérifier tous les câbles au niveau des branchements et de s'assurer que la capacité est adéquate.

∗**REMARQUE :** Liberty Pumps, Inc. n'est pas responsable des dommages ou blessures résultant d'un démontage sur place, au-delà du retrait du flotteur. Le démontage effectué ailleurs que chez Liberty Pumps ou à l'un de ses centres de services autorisés annule automatiquement la garantie.

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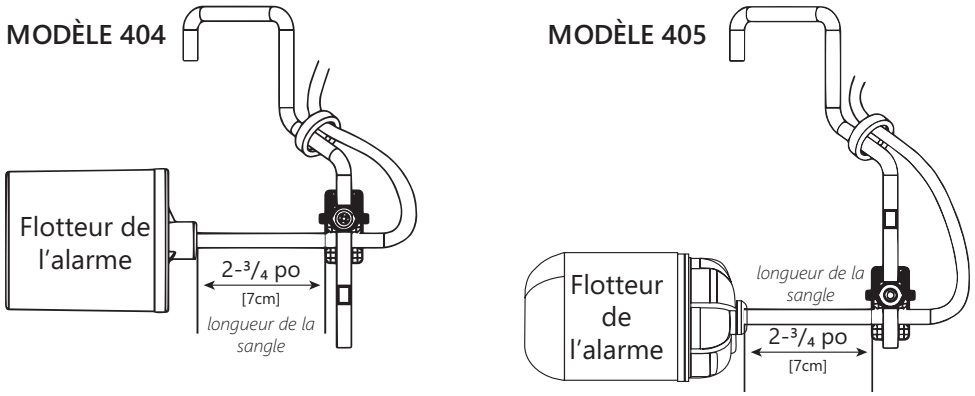


Figure 7. Longueur de la sangle de l'interrupteur à flotteur de la pompe

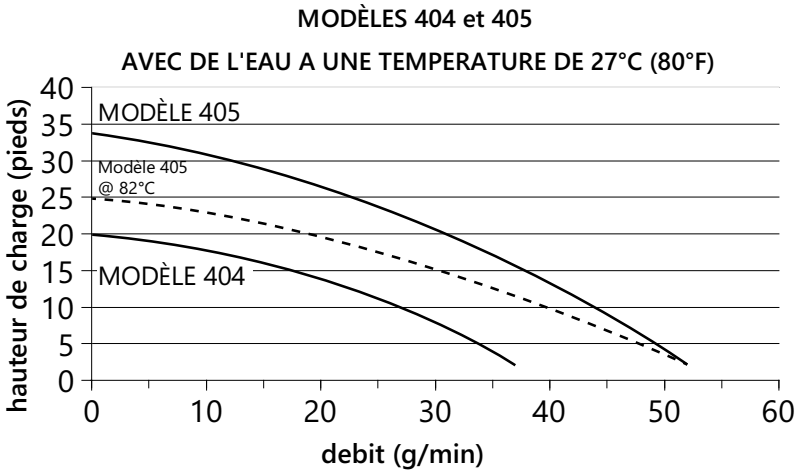


Figure 8. Courbes de rendement pour les modèles 404 et 405

Garantie

Liberty Pumps Wholesale Products Garantie limitée

Liberty Pumps, Inc. garantit que ses produits de gros sont exempts de tout défaut de matériau et de fabrication pour une période de trois (3) ans à partir de la date d'achat (à l'exception des batteries). La date d'achat est déterminée par un reçu de vente daté indiquant le modèle et le numéro de série de la pompe. Le reçu de vente daté doit accompagner la pompe retournée si la date de retour est supérieure de trois ans à la date de fabrication indiquée sur la plaque signalétique de la pompe.

L'obligation du fabricant en vertu de la présente garantie se limite à la réparation ou au remplacement de toute pièce jugée défectueuse par le fabricant, à condition que la pièce ou l'appareil soit retourné fret port payé au fabricant ou à son centre de service autorisé, et à condition qu'il n'y ait aucune preuve que les critères suivants annulant la garantie sont en cause:

Le fabricant ne sera pas responsable en vertu de la présente garantie si le produit n'a pas été installé, utilisé ou entretenu conformément aux instructions du fabricant; s'il a été démonté, modifié, dégradé ou altéré; si le cordon électrique a été coupé, endommagé ou épissé; si la sortie de la pompe a été réduite; si la pompe a été utilisée à des températures d'eau supérieures à celles d'un service normal, ou dans de l'eau contenant du sable, de la chaux, du ciment, du gravier ou autres abrasifs; si le produit a été utilisé pour pomper des produits chimiques, de la graisse ou des hydrocarbures; si un moteur non submersible a été soumis à une humidité excessive; ou si l'étiquette portant le modèle et le numéro de série a été retirée.

Liberty Pumps, Inc. ne sera pas responsable des pertes, dommages ou dépenses découlant de l'installation ou de l'utilisation de ses produits, ni des dommages indirects, accessoires et consécutifs, y compris les coûts de retrait, de réinstallation ou de transport.

Il n'y a aucune autre garantie expresse. Toute garantie implicite, y compris celles de qualité marchande et d'aptitude à une fin particulière, sont limitées à une durée de trois ans à partir de la date d'achat. La présente garantie comprend le recours exclusif de l'acheteur et exclut, lorsque permis par la loi, toute responsabilité pour dommages consécutifs ou accessoires en vertu de toutes autres garanties.

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Section 4

Electrical Drawings

Section 4.1

Single Line Diagram

REV	DESCRIPTION	DATE	BY	APP'D
0	FOR APPROVAL	03/03/22	GC	LB
1	AS BUILT	05/23/22	GC	LB

LEGEND

- EQUIPMENT LOCAL DISCONNECT
- EQUIPMENT (XXHP)
- TRANSFORMER
- CIRCUIT BREAKER
- FUSE
- POWER DISTRIBUTION PANEL (PDP)
- 575V/3PH POWER
- 120V/1PH POWER
- 208V/1PH POWER
- PLC I/O SIGNALS
- MODBUS CABLE (VFD'S)

MAIN POWER (BY OTHERS)
600V/200A/3PH/60HZ

POWER DISTRIBUTION PANEL
PDP-01-00
CONTAINER # 2
ELECTRICAL ROOM

200A MCB1

100A CB1 | 15A CB2 | 15A CB3 | 15A CB4 | 15A CB5 | 15A CB6 | 40A CB7

3 WIRE + GND, 6 AWG
208VAC/60HZ (POWER)

600V/208V STEPDOWN TRANSFORMER 45KVA

CONTAINER BULLDING # 3
GENERAL PURPOSE AREA

FIELD

	3 WIRE + GND, 1 AWG 600VAC/60HZ (POWER)	12 WIRE + GND, 12 AWG (C10-12) 600VAC/60HZ (POWER) (BY OTHERS)	3 WIRE + GND, 12 AWG 600VAC/60HZ (POWER) (BY OTHERS)	3 WIRE + GND, 12 AWG 600VAC/60HZ (POWER)	3 WIRE + GND, 12 AWG 600VAC/60HZ (POWER)	3 WIRE + GND, 12 AWG 600VAC/60HZ (POWER)	3 WIRE + GND, 3 AWG 208VAC/60HZ (POWER)
	DISC-01 100A, FU1-3 (600V)	3 WIRE + GND, 12 AWG 600VAC/60HZ (POWER); JB 1; LOCAL DISC. 30A	LOCAL DISC. 30A	LOCAL DISC. 30A	LOCAL DISC. 30A	LOCAL DISC. 30A	80A MC81
		6.7HP	6.7HP	6.7HP	6.7HP	6.7HP	
	MCP-01-00 MAIN CONTROL PANEL 80A	HTR-01-27 ELECTRIC HEATER 9A	HTR-60-34 ELECTRIC HEATER 9A	HTR-04-25 ELECTRIC HEATER 9A	HTR-07-03 ELECTRIC HEATER 9A	HTR-07-03 ELECTRIC HEATER 9A	PDP-01-01 LOW VOLTAGE PANEL 30A
	CONTAINER # 2 ELECTRICAL ROOM NON-CLASSIFIED AREA	CONTAINER # 1 SCREEN ROOM CLASS 1 DIV. 1 AREA	CONTAINER # 1 SLUDGE DEWATERING ROOM NON-CLASSIFIED AREA	CONTAINER # 2 BLOWER ROOM NON-CLASSIFIED AREA	CONTAINER # 2 DAF/CHEMICAL ROOM NON-CLASSIFIED AREA	CONTAINER # 2 CONTROL ROOM NON-CLASSIFIED AREA	CONTAINER # 2 ELECTRICAL ROOM NON-CLASSIFIED AREA

H2FLOW EQUIPMENT INC.

WATER AND WASTEWATER TREATMENT EQUIPMENT
580 OSTER LANE, VAUGHAN, ON. L4K 2C1 CANADA
TEL: (905) 660-9775 FAX: (905) 660-9744
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DRAWN BY: GC	DATE: 03/03/22	PROJECT NAME: SABINA GOLD STP NUNAVUT	TITLE: SINGLE LINE DIAGRAM
APP'D BY: LB	DATE: 03/03/22		DRAWING No.: Q-23119-40-00
SCALE: NTS		ALL DIMENSION ARE IN "mm" UNLESS OTHERWISE SPECIFIED	SHEET 1 OF 6
			REV: 1

R10 VERSION: 01 APRIL 07, 2021

REV	DESCRIPTION	DATE	BY	APP'D
0	FOR APPROVAL	03/03/22	GC	LB
1	AS BUILT	05/23/22	GC	LB

LEGEND

- EQUIPMENT LOCAL DISCONNECT
- XXHP — EQUIPMENT
- TRANSFORMER
- CIRCUIT BREAKER
- FUSE
- 600V/3PH POWER
- 120V/1PH POWER
- PLC I/O SIGNALS
- MODBUS CABLE (VFD'S)

600V/60A/3PH/60HZ
(FROM PDP-01-00)

MAIN CONTROL PANEL
MCP-01-00
CONTAINER # 2
ELECTRICAL ROOM

DISC-01
100A
FU1-3

600V/3PH/60HZ
(TO SHEET 3 OF 6)

6A CB1 — VFD-01-01
10A CB2 — MC2 — OL2
10A CB3 — MC3 — OL3
10A CB6 — VFD-02-08
10A CB7 — VFD-02-09
6A CB8 — VFD-02-16
10A CB9 — MC9 — OL9
10A CB10 — MC10 — OL10

12 WIRE + GND, 12 AWG (C1-3)
575VAC/60HZ (POWER)

12 WIRE + GND, 12 AWG (C4-6)
575VAC/60HZ (POWER)

12 WIRE + GND, 12 AWG (C7-9)
575VAC/60HZ (POWER)

6 WIRE + GND
14 AWG, 24VDC

MODBUS CABLE
(TO SHEET 2 OF 5)

PLC I/O SIGNALS

TO PLC INPUT / OUTPUT MODULES
(REFER TO MCP-01-00 ELECTRICAL SCHEMATIC)

CONTROL PANEL

FIELD

6 WIRE + GND
14 AWG, 24VDC

12 WIRE + GND, 12 AWG
575VAC/60HZ (POWER)
(BY OTHERS)

3 WIRE + GND, 12 AWG
575VAC/60HZ (POWER)

JB 1
JB 2

3 WIRE + GND, 12 AWG
575VAC/60HZ (POWER)

3 WIRE + GND, 12 AWG
575VAC/60HZ (POWER)

LOCAL DISC. 30A — 0.75HP — M-01-01 SCREW SCREEN 1.3A
LOCAL DISC. 30A — 2HP — M-01-16 EQ FEED PUMP 1 2.7A
LOCAL DISC. 30A — 2HP — M-01-17 EQ FEED PUMP 2 2.7A

SCREEN LOCAL ESTOP & HAND/AUTO SS
CP-20-04

CONTAINER # 1
SCREEN ROOM
CLASS 1 DIV. 1 AREA

LOCAL DISC. 30A — 1.5HP — P-02-08 MBBR FEED PUMP 1 2.4A
LOCAL DISC. 30A — 1.5HP — P-02-09 MBBR FEED PUMP 2 2.45A
LOCAL DISC. 30A — 0.75HP — P-02-16 SLUDGE DEWATERING PUMP 1.3A

3 WIRE + GND, 12 AWG
575VAC/60HZ (POWER)

CONTAINER # 1
SLUDGE DEWATERING ROOM
NON-CLASSIFIED AREA

LOCAL DISC. 30A — 2HP — BL-04-16 EQ & SLUDGE BLOWER 1 2.7A
LOCAL DISC. 30A — 2HP — BL-04-17 EQ & SLUDGE BLOWER 2 2.7A

3 WIRE + GND, 12 AWG
575VAC/60HZ (POWER)

CONTAINER # 2
BLOWER ROOM
NON-CLASSIFIED AREA

3-PHASE POWER SINGLE LINE DIAGRAM

H2FLOW EQUIPMENT INC.
WATER AND WASTEWATER TREATMENT EQUIPMENT
580 OSTER LANE, VAUGHAN, ON. L4K 2C1 CANADA
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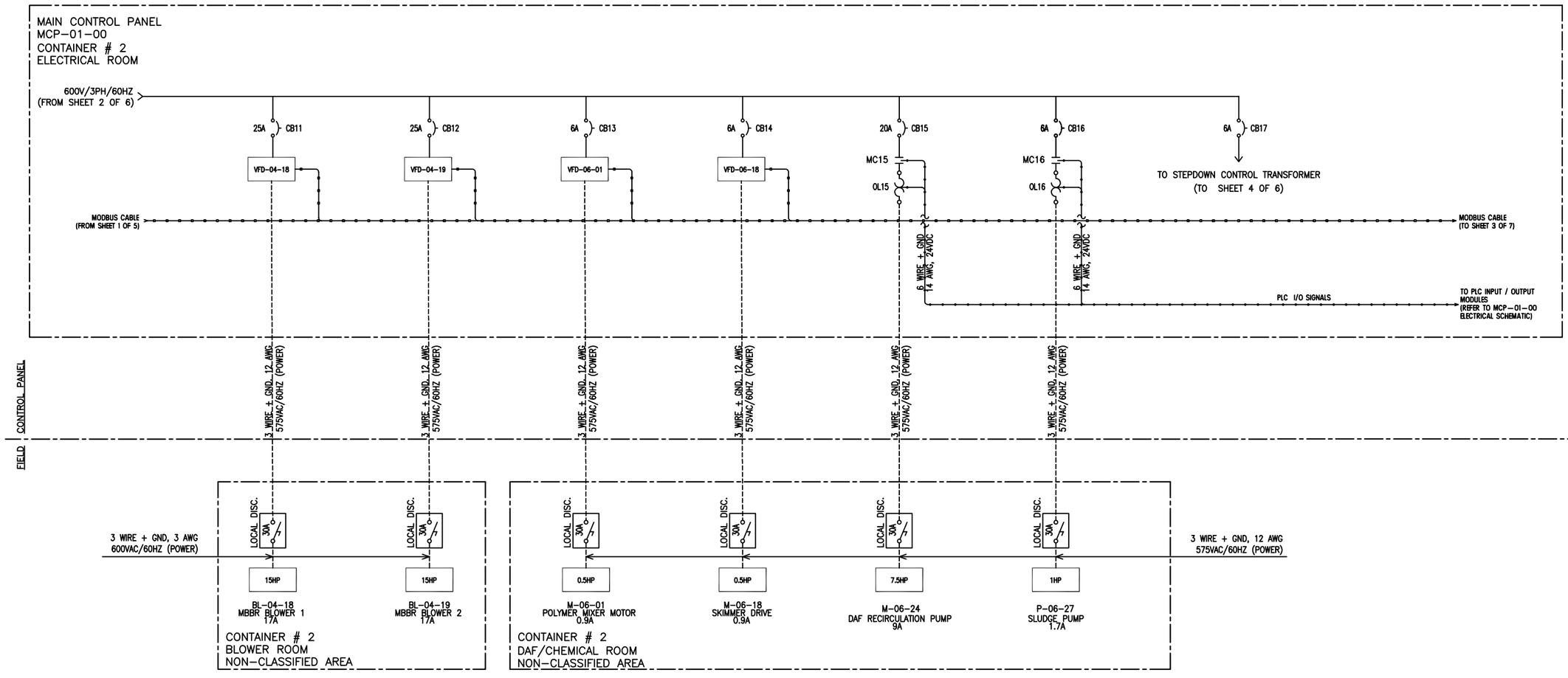
DRAWN BY: GC	DATE: 03/03/22	PROJECT NAME: SABINA GOLD STP NUNAVUT	TITLE: SINGLE LINE DIAGRAM
APP'D BY: LB	DATE: 03/03/22		DRAWING No.: Q-23119-40-00
SCALE: NTS			REV: 1
		ALL DIMENSION ARE IN "mm" UNLESS OTHERWISE SPECIFIED	SHEET 2 OF 6

R10 VERSION: 01 APRIL 07, 2021

REV	DESCRIPTION	DATE	BY	APP'D
0	FOR APPROVAL	03/03/22	GC	LB
1	AS BUILT	05/23/22	GC	LB

LEGEND

- EQUIPMENT LOCAL DISCONNECT
- EQUIPMENT (XXHP)
- TRANSFORMER
- CIRCUIT BREAKER
- FUSE
- 600V/3PH POWER
- 120V/1PH POWER
- PLC I/O SIGNALS
- MODBUS CABLE (VFD'S)



3-PHASE POWER SINGLE LINE DIAGRAM

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APP'D BY: LB	DATE: 03/03/22		DRAWING No.: Q-23119-40-00
SCALE: NTS			REV: 1
ALL DIMENSION ARE IN "mm" UNLESS OTHERWISE SPECIFIED			SHEET 3 OF 6

REV	DESCRIPTION	DATE	BY	APP'D
0	FOR APPROVAL	03/03/22	GC	LB
1	AS BUILT	05/23/22	GC	LB

LEGEND

- EQUIPMENT LOCAL DISCONNECT
- EQUIPMENT (XXXP)
- TRANSFORMER
- CIRCUIT BREAKER
- FUSE
- 600V/3PH POWER
- 120V/1PH POWER
- PLC I/O SIGNALS
- MODBUS CABLE (VFD'S)

MAIN CONTROL PANEL
MCP-01-00
CONTAINER # 2
ELECTRICAL ROOM

600V/1PH/60HZ
(FROM SHEET 3 OF 6)

600V/120V STEPDOWN CONTROL TRANSFORMER 3KVA

30A MCB2

120V/1PH/60HZ
(TO SHEET 5 OF 6)

FU3 5A — 2 WIRE + GND, 14 AWG 24VDC (SIGNAL)

FU4 1A

PLC I/O SIGNALS

TO PLC INPUT / OUTPUT MODULES (REFER TO MCP-01-00 ELECTRICAL SCHEMATIC)

CONTROL PANEL

FIELD

12 WIRE + GND 14 AWG, 24VDC (BY OTHERS)

2 PAIRS + SHLD 16 AWG, 24VDC (4-20mA & Alarm) (BY OTHERS)

4 WIRE + GND 14 AWG, 24VDC

2 PAIRS + SHLD 16 AWG, 24VDC (4-20mA AND PULSE SIGNAL)

2 PAIRS + SHLD 16 AWG, 24VDC (4-20mA AND PULSE SIGNAL)

2 WIRE + GND, 14 AWG 120 VAC (POWER)

2 PAIRS + SHLD 16 AWG, 24VDC (4-20mA AND ALARM SIGNAL)

5 WIRE + GND 14 AWG, 24VDC

2 WIRE + GND 14 AWG, 24VDC

2 WIRE + GND, 14 AWG 120 VAC (POWER)

2 WIRE + GND 14 AWG, 24VDC

JB 2

2 WIRE + GND 14 AWG, 24VDC

2 WIRE + GND 14 AWG, 24VDC

4 WIRE + GND 14 AWG, 24VDC

LE-01-05/06
SCREW SCREEN
HIGH/LOW LEVEL PROBES

SV-01-06
SCREW SCREEN
SOLENOID VALVE

LS-01-09/10/11/12
TRANSFER TANK
FLOAT LEVEL PROBES

CONTAINER # 1
SCREEN ROOM
CLASS 1 DIV. 1 AREA

JUNCTION BOX

LS-02-03/04
SLUDGE HOLDING TANK
FLOAT LEVEL SWITCHES

FIT-02-14
MBBR/DAF FEED
FLOW METER

FIT-02-19
DEWATERING SYSTEM
FLOW METER

MP-02-27
LIQUID POLYMER
MAKEDOWN SYSTEM

CONTAINER # 1
SLUDGE DEWATERING ROOM
NON-CLASSIFIED AREA

JUNCTION BOX

LS-03-02/03/04/05
HILT EQUALIZATION TANK
FLOAT LEVEL SWITCHES

OUTDOOR

JUNCTION BOX

LS-05-06
TILT MBBR#1 TANK
FLOAT LEVEL SWITCH

FE-05-03
TILT MBBR#1 TANK
FOAM LEVEL SWITCH

OUTDOOR

FIELD EQUIPMENT & INSTRUMENTS
SINGLE LINE DIAGRAM

H2FLOW EQUIPMENT INC.

WATER AND WASTEWATER TREATMENT EQUIPMENT
580 OSTER LANE, VAUGHAN, ON. L4K 2C1 CANADA
TEL: (905) 660-9775 FAX: (905) 660-9744
www.h2flow.com

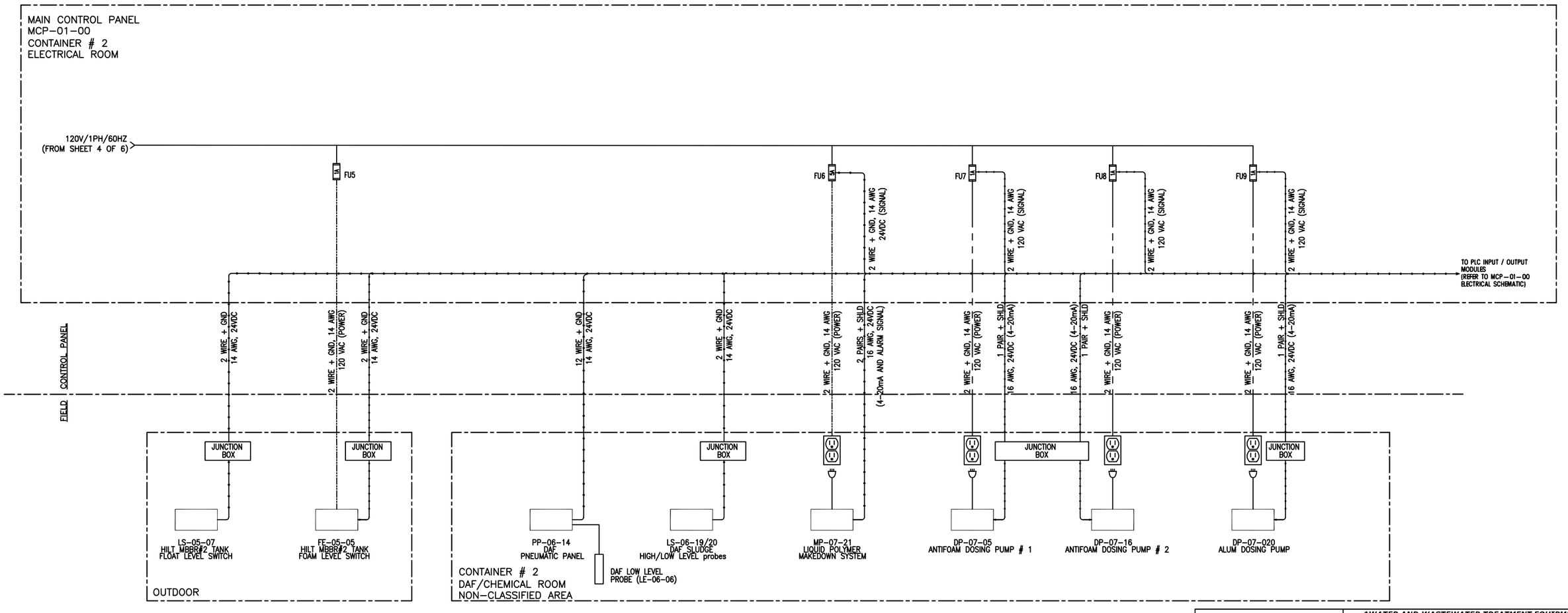
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DRAWN BY: GC	DATE: 03/03/22	PROJECT NAME: SABINA GOLD STP NUNAVUT	TITLE: SINGLE LINE DIAGRAM
APP'D BY: LB	DATE: 03/03/22		DRAWING No.: Q-23119-40-00
SCALE: NTS			REV: 1
ALL DIMENSION ARE IN "mm" UNLESS OTHERWISE SPECIFIED			SHEET 4 OF 6

REV	DESCRIPTION	DATE	BY	APP'D
0	FOR APPROVAL	03/03/22	GC	LB
1	AS BUILT	05/23/22	GC	LB

LEGEND

- EQUIPMENT LOCAL DISCONNECT
- EQUIPMENT (XXHP)
- TRANSFORMER
- CIRCUIT BREAKER
- FUSE
- 600V/3PH POWER
- 120V/1PH POWER
- PLC I/O SIGNALS
- MODBUS CABLE (VFD'S)



FIELD EQUIPMENT & INSTRUMENTS
SINGLE LINE DIAGRAM

H2FLOW EQUIPMENT INC.

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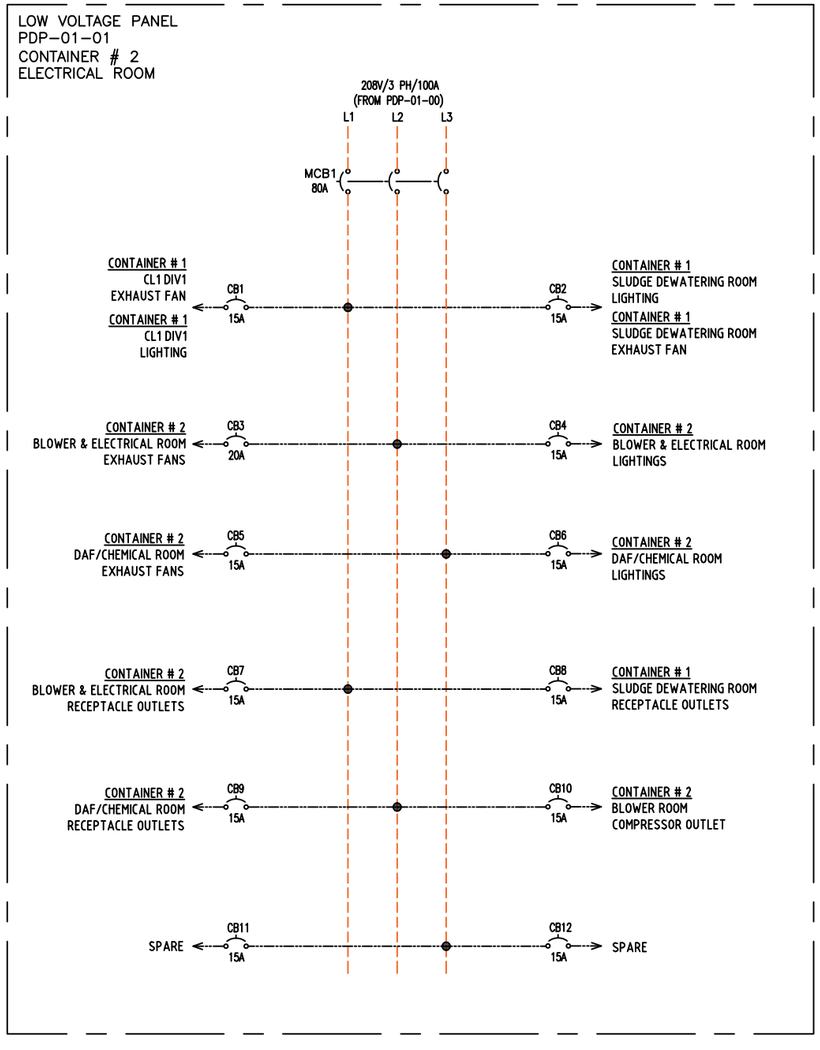
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APP'D BY: LB	DATE: 03/03/22		DRAWING No.: Q-23119-40-00
SCALE: NTS			REV: 1
		ALL DIMENSION ARE IN "mm" UNLESS OTHERWISE SPECIFIED	SHEET 5 OF 6

R10 VERSION: 01 APRIL 07, 2021

REV	DESCRIPTION	DATE	BY	APP'D
0	FOR APPROVAL	03/03/22	GC	LB
1	AS BUILT	05/23/22	GC	LB

LEGEND

- EQUIPMENT LOCAL DISCONNECT
- EQUIPMENT (XXHP)
- TRANSFORMER
- CIRCUIT BREAKER
- FUSE
- 600V/3PH POWER
- 120V/1PH POWER
- PLC I/O SIGNALS
- MODBUS CABLE (VFD'S)



LIGHTING PANEL SINGLE LINE DIAGRAM

H2FLOW EQUIPMENT INC.

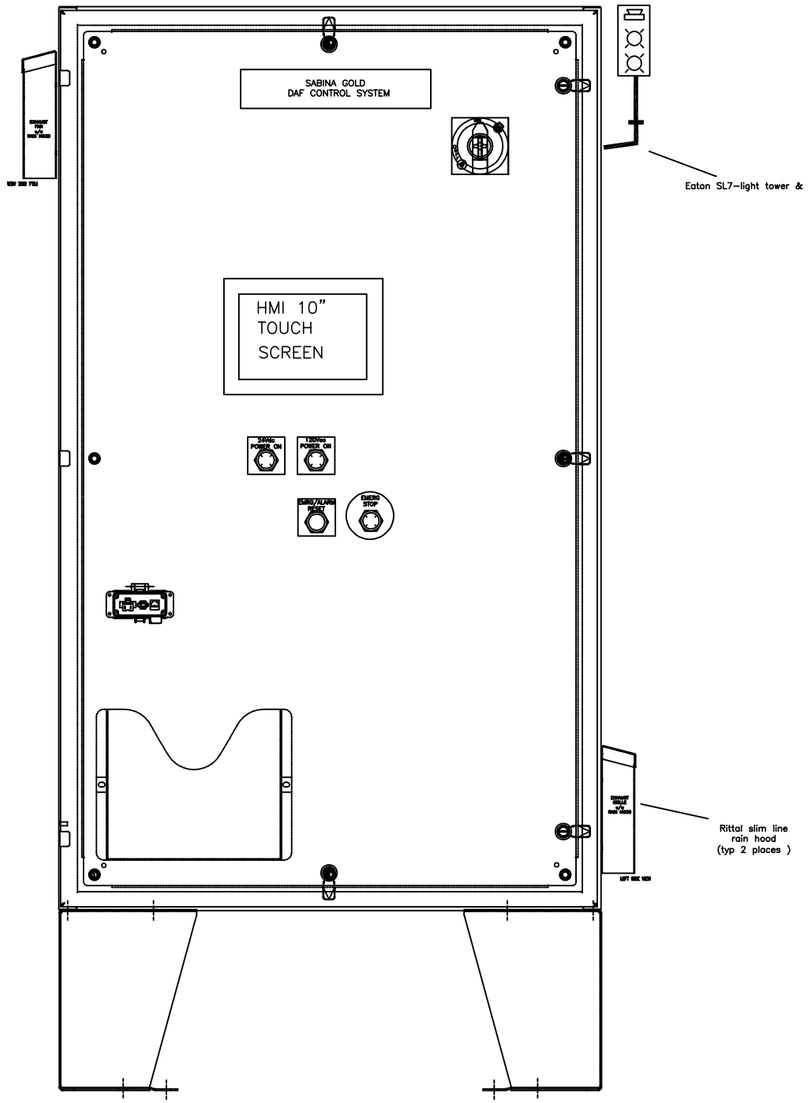
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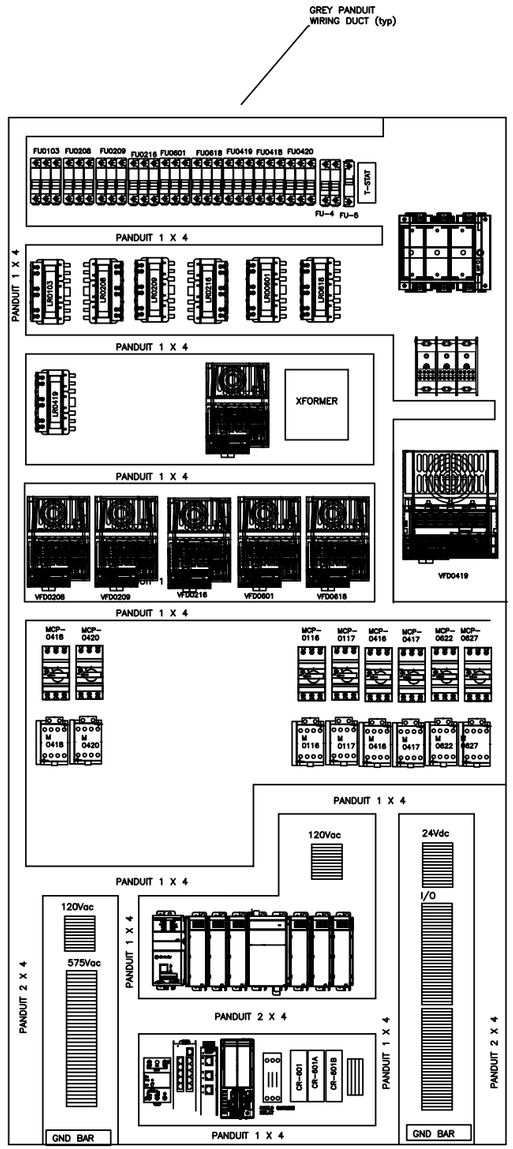
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APP'D BY: LB	DATE: 03/03/22		DRAWING No.: Q-23119-40-00
SCALE: NTS			REV: 1
ALL DIMENSION ARE IN "mm" UNLESS OTHERWISE SPECIFIED			SHEET 5 OF 6

Section 4.2

Control Panel Schematic



CRS ENCLOSURE
72"H X 36"W X 12"D
c/w 12" legs



DAF CONTROL PANEL
INNER PANEL DETAILS

Terminal Colors
Ground - Green or green yellow
24VDC - Blue
120VAC - Red
Neutral - White

All other I/O to be beige

REV	DATE	DESCRIPTION
2	5/22	Revised, Issued as built
1	5/22	Revised, Issued for approval
0	4/22	Issued for approval

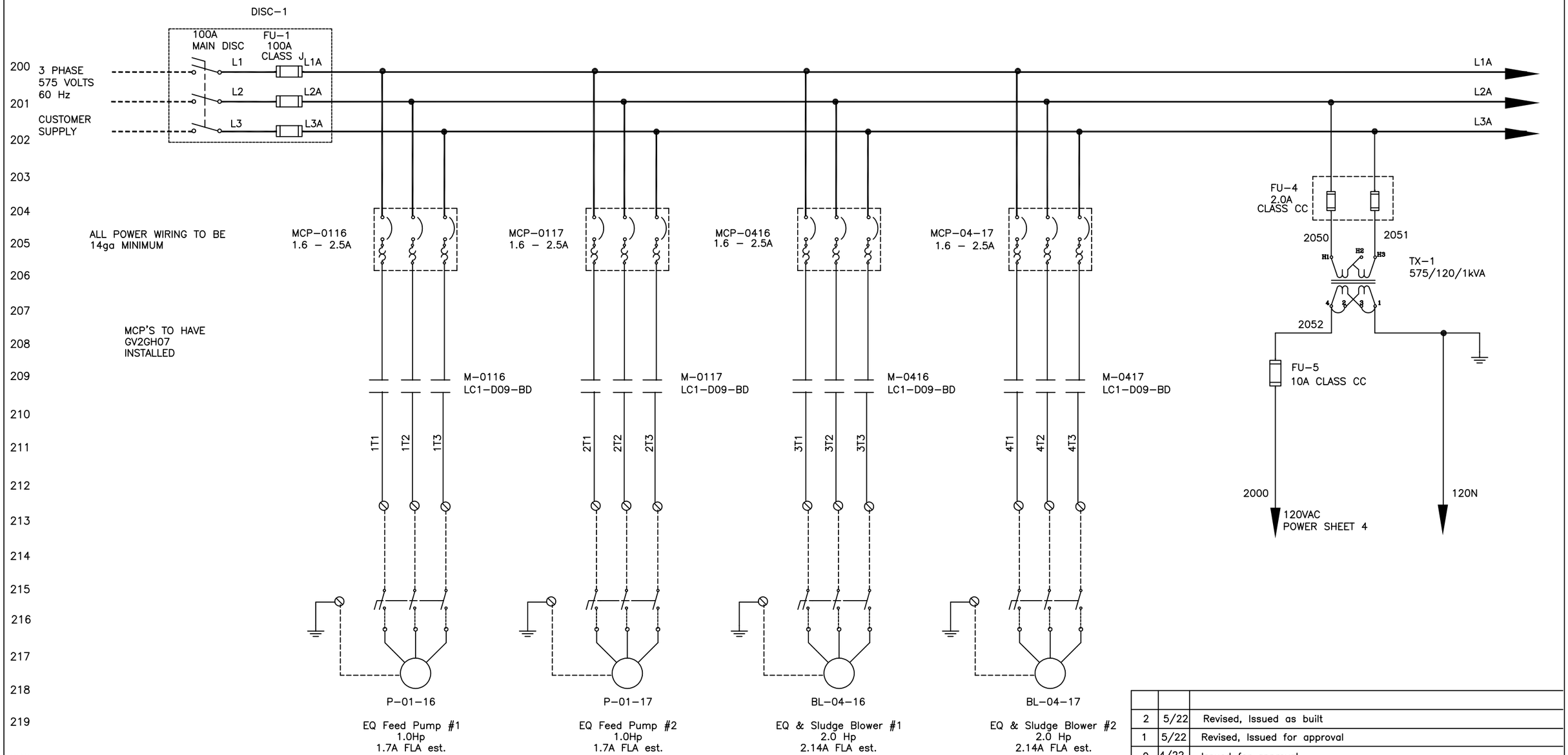
DRAWN BY: AN	DATE	Apr 22/22	
APPROVED	CAD REF	222759–01	
DRAWING NUMBER 222759–01	REVISION 2	SCALE NTS	

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ACA Control Systems Ltd.
Mississauga, Ontario

CUSTOMER	H2FLOW EQUIPMENT
TITLE	Sabina Gold Panel details

H2FLOW EQUIPMENT INC.



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2	5/22	Revised, Issued as built
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0	4/22	Issued for approval

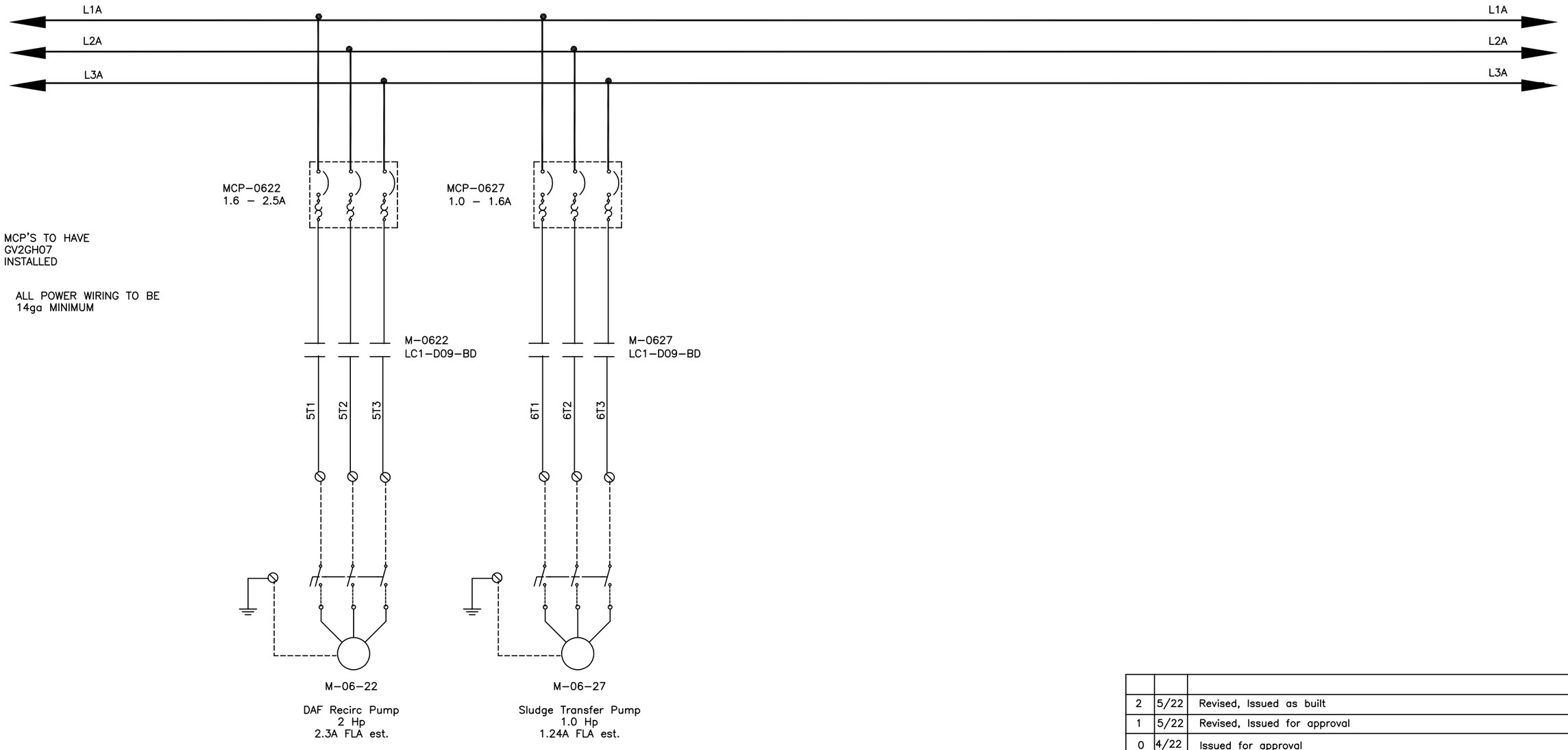
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ACA Control Systems Ltd.
Mississauga, Ontario

CUSTOMER H2FLOW EQUIPMENT

TITLE Sabina Gold
575V POWER DISTRIBUTION 1



REV	DATE	DESCRIPTION
2	5/22	Revised, Issued as built
1	5/22	Revised, Issued for approval
0	4/22	Issued for approval

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APPROVED		CAD REF	222759–02A
DRAWING NUMBER 222759–02A		REVISION 2	SCALE NTS

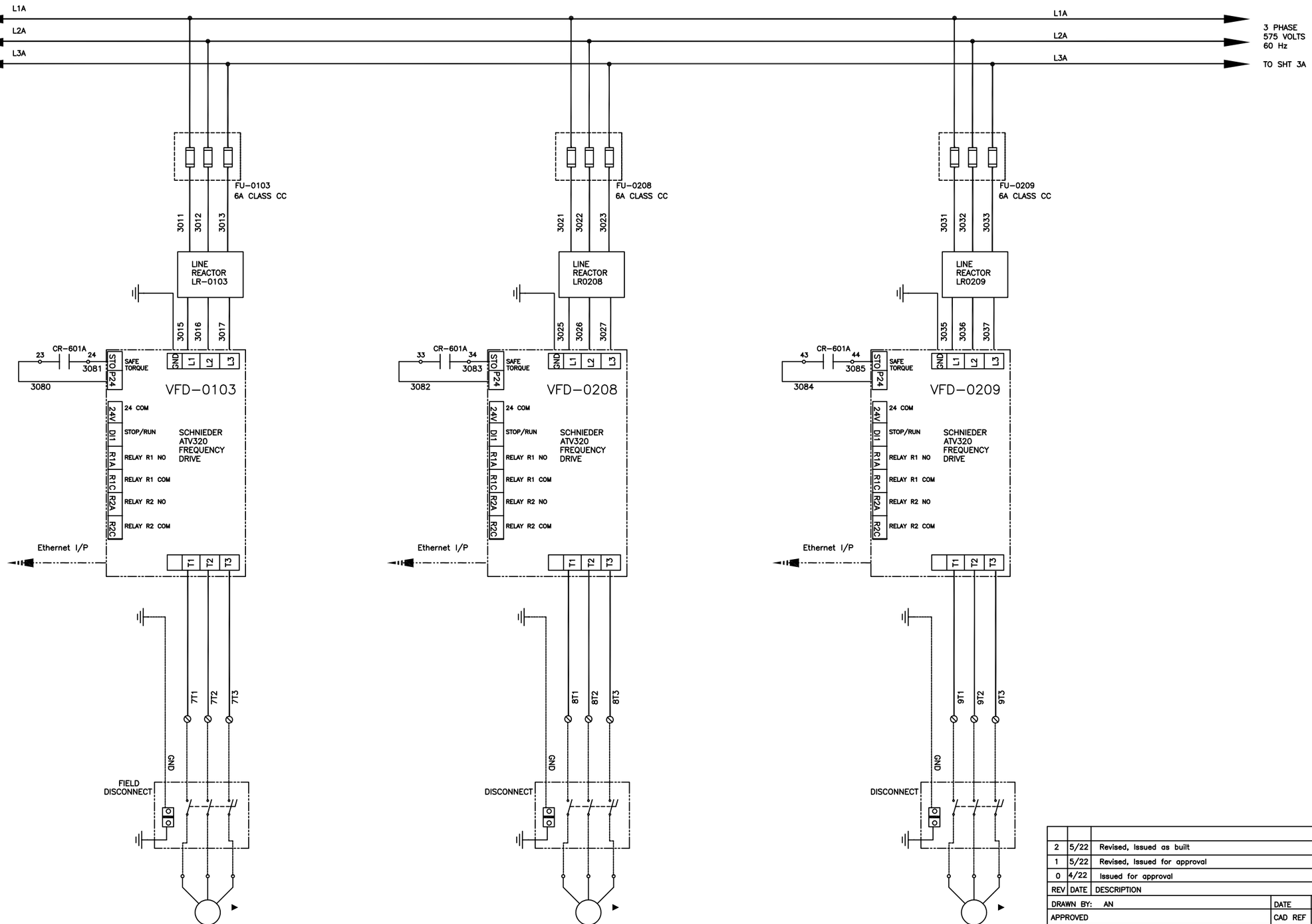
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H2FLOW EQUIPMENT INC.

CUSTOMER H2FLOW EQUIPMENT

TITLE Sabina Gold
575V POWER DISTRIBUTION 2



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0	4/22	Issued for approval

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APPROVED		CAD REF	222759-03
DRAWING NUMBER 222759-03		REVISION 2	SCALE NTS

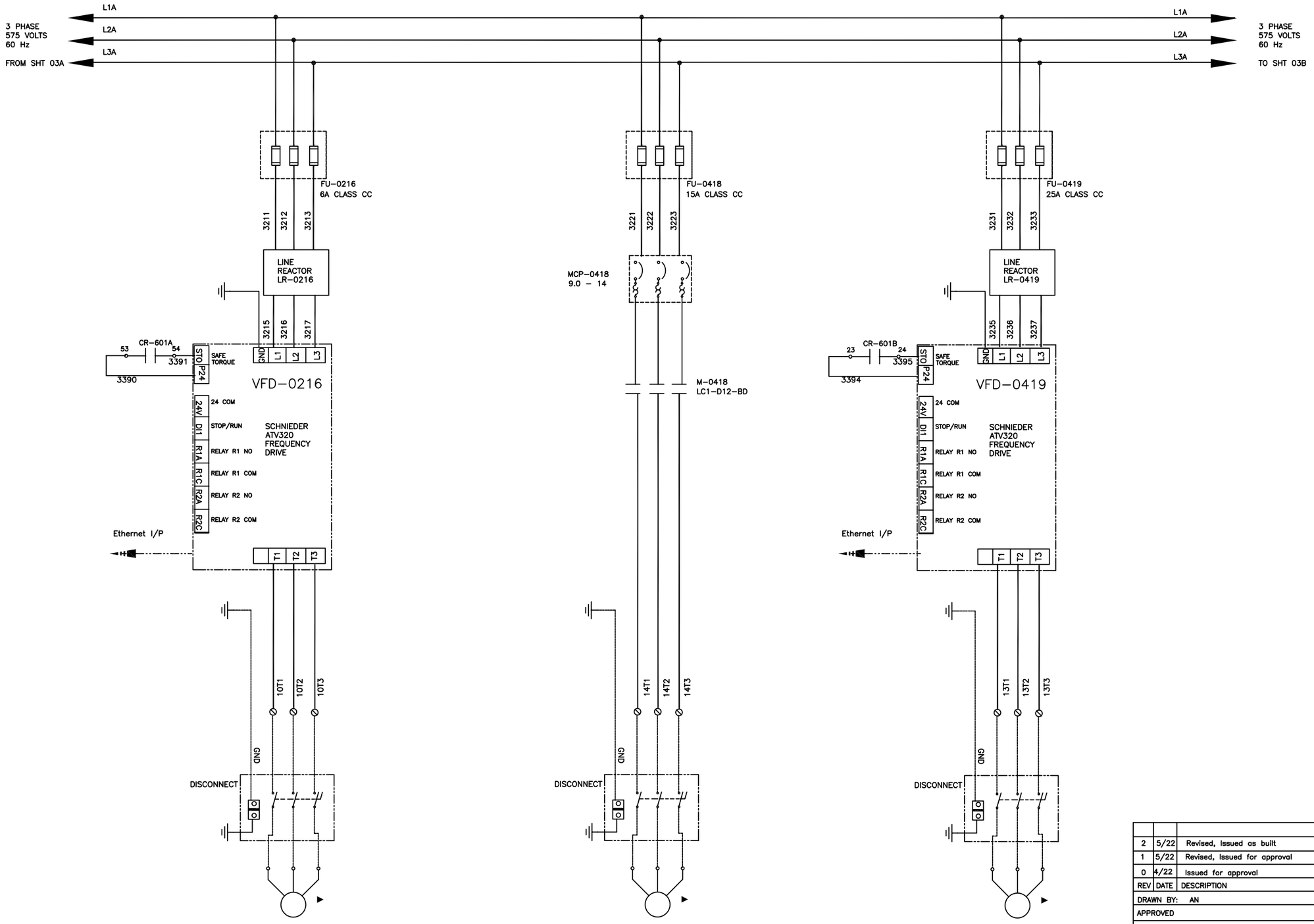
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ACA Control Systems Ltd.
Mississauga, Ontario

CUSTOMER: H2FLOW EQUIPMENT

TITLE: Sabina Gold
VFD Schematics 1

H2FLOW EQUIPMENT INC.



NOTE
ALL POWER WIRING TO BE
14ga MINIMUM

REV	DATE	DESCRIPTION
2	5/22	Revised, Issued as built
1	5/22	Revised, Issued for approval
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DRAWING NUMBER 222759-03A		REVISION 2	SCALE NTS

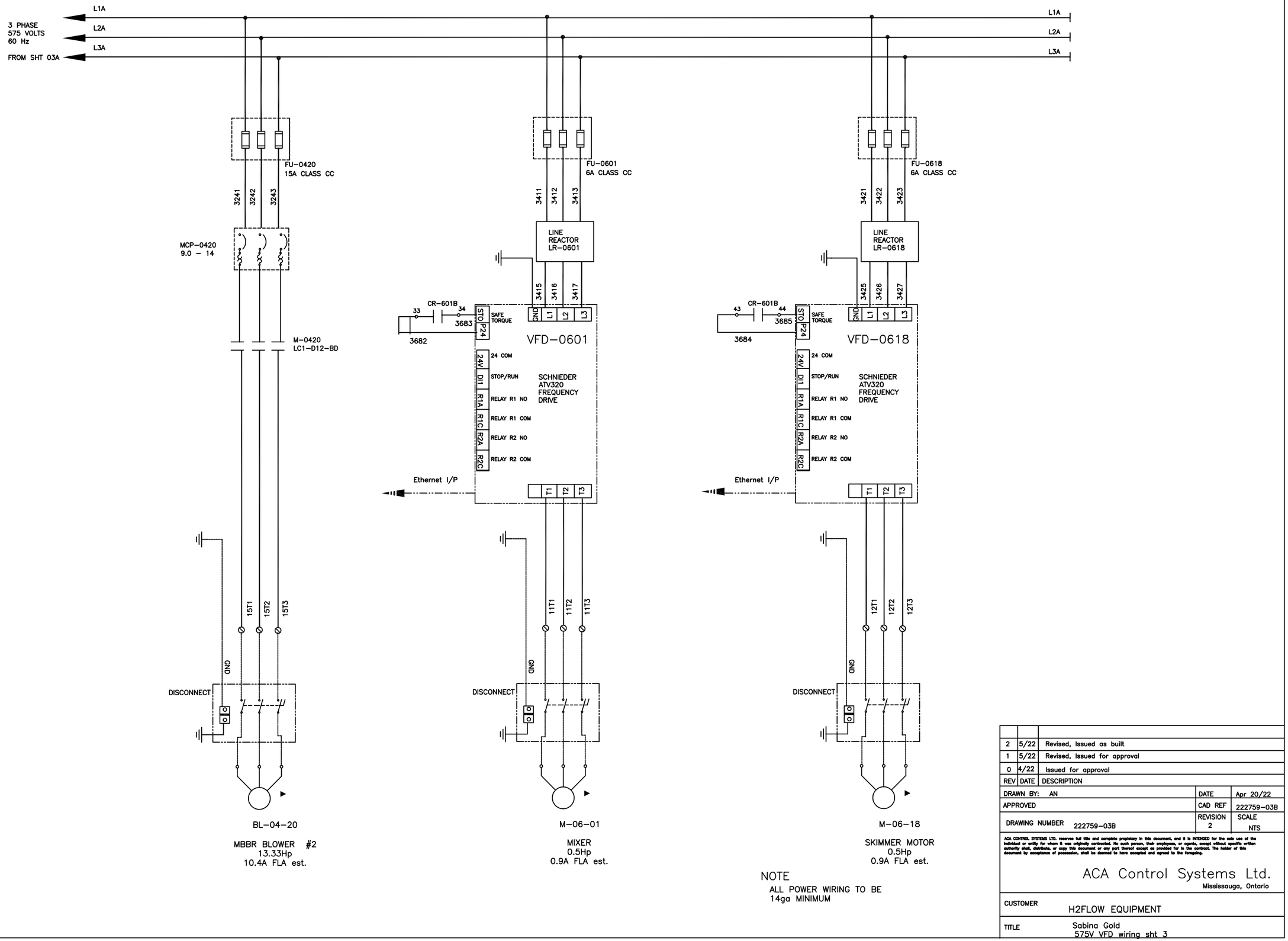
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Mississauga, Ontario

CUSTOMER H2FLOW EQUIPMENT

TITLE Sabina Gold
575V VFD wiring sht 2

H2FLOW EQUIPMENT INC.



NOTE

ALL POWER WIRING TO BE
14ga MINIMUM

REV	DATE	DESCRIPTION
2	5/22	Revised, Issued as built
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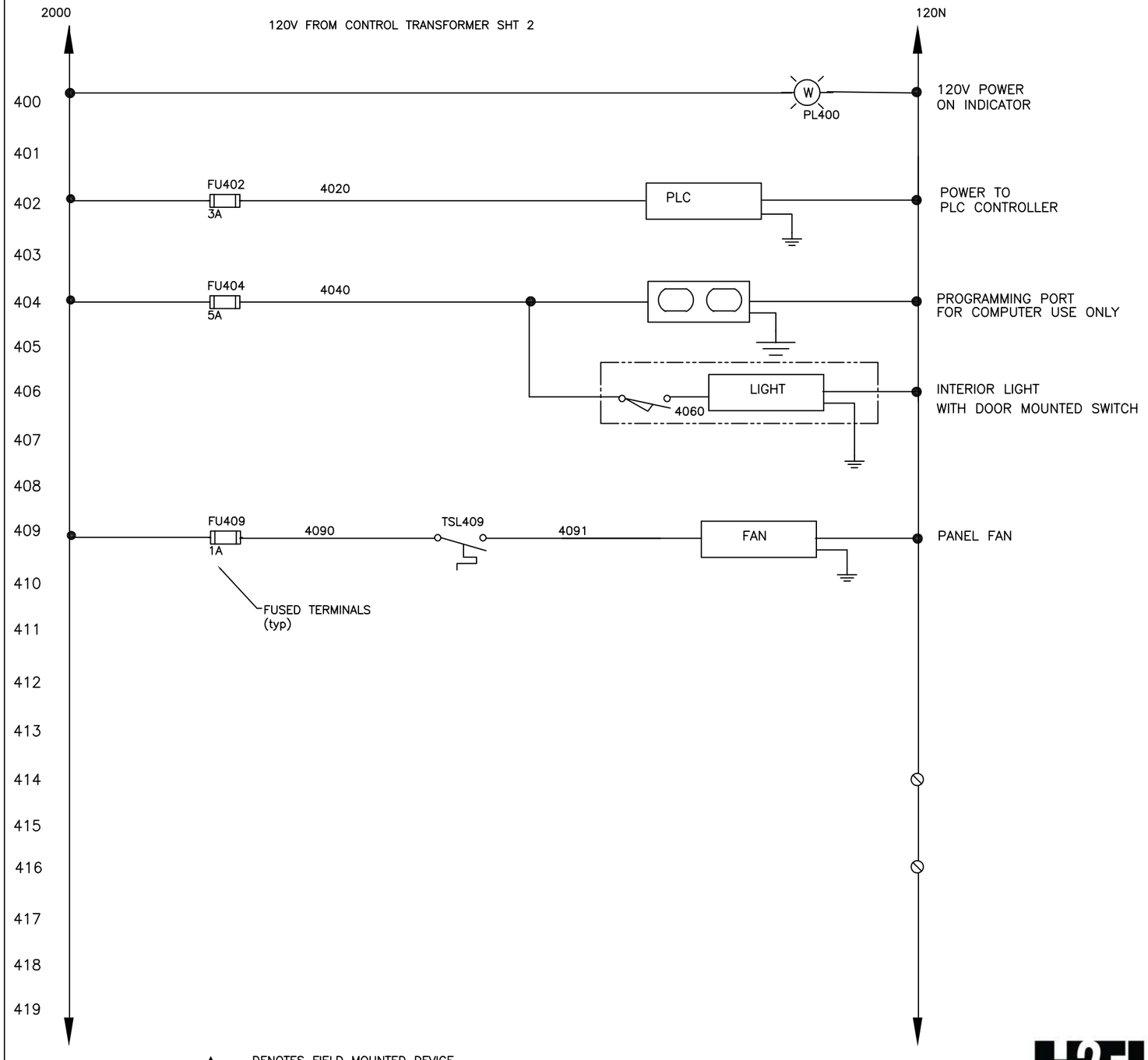
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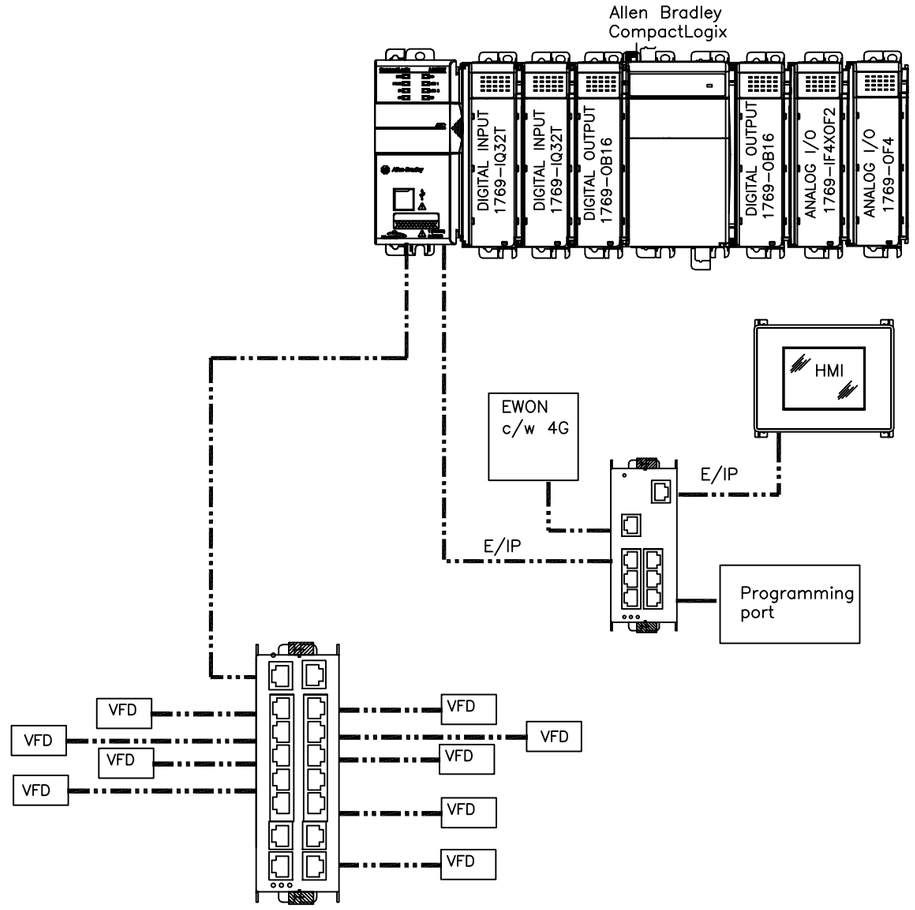
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Mississauga, Ontario

CUSTOMER H2FLOW EQUIPMENT

TITLE Sabina Gold
575V VFD wiring sht 3





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0	4/22	Issued for approval
REV	DATE	DESCRIPTION

DRAWN BY: AN	DATE	Apr 20/22
APPROVED	CAD REF	222759-04
DRAWING NUMBER 222759-04	REVISION 2	SCALE NTS

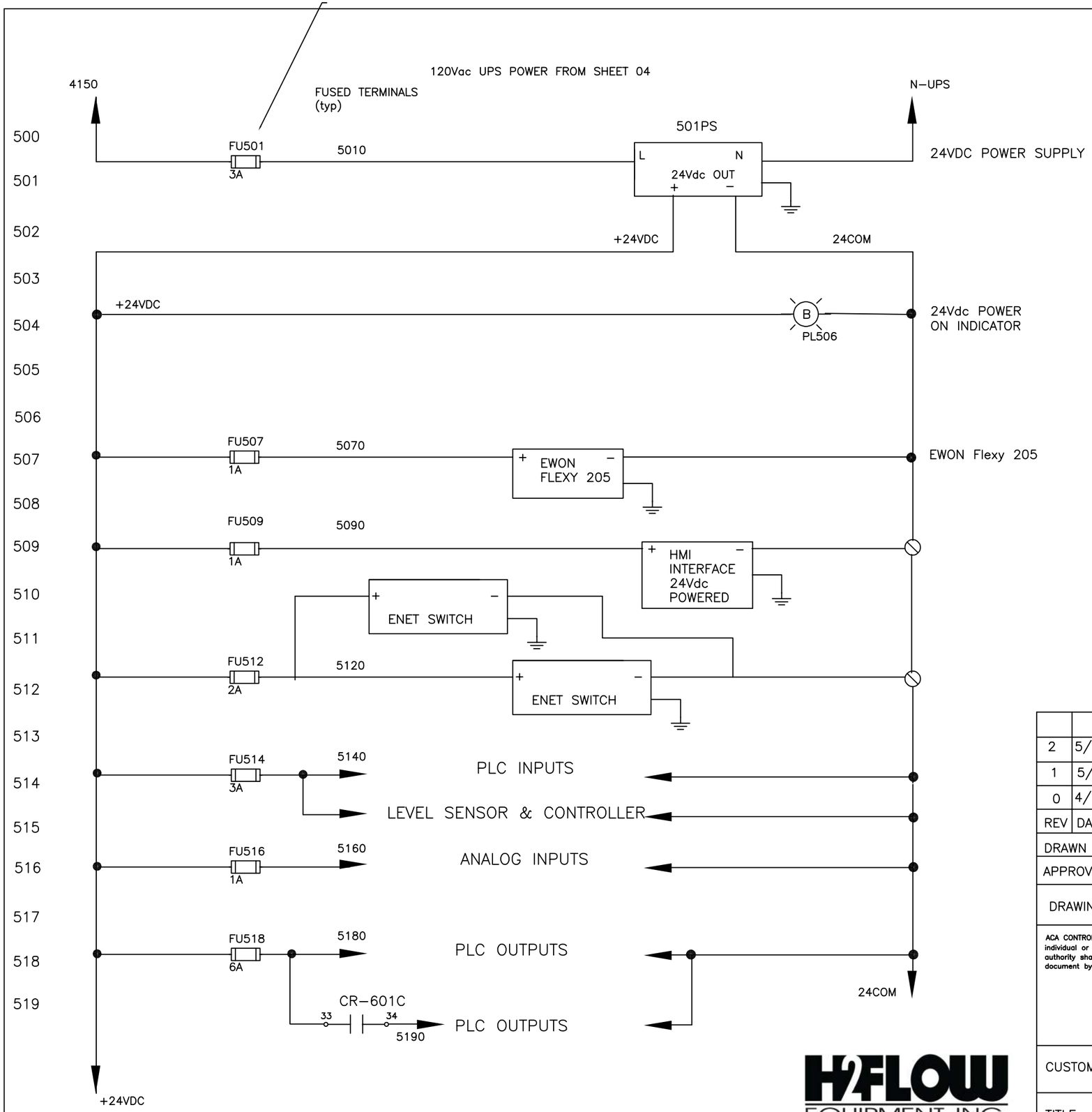
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Mississauga, Ontario

CUSTOMER H2FLOW EQUIPMENT

TITLE Sabina Gold
120Vac Power Distribution

H2FLOW EQUIPMENT INC.



▲ DENOTES FIELD MOUNTED DEVICE

---------- FIELD WIRING BY OTHERS

REV	DATE	DESCRIPTION
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1	5/22	Revised, Issued for approval
0	4/22	Issued for approval

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APPROVED		CAD REF	222759–05
DRAWING NUMBER 222759–05		REVISION 2	SCALE NTS

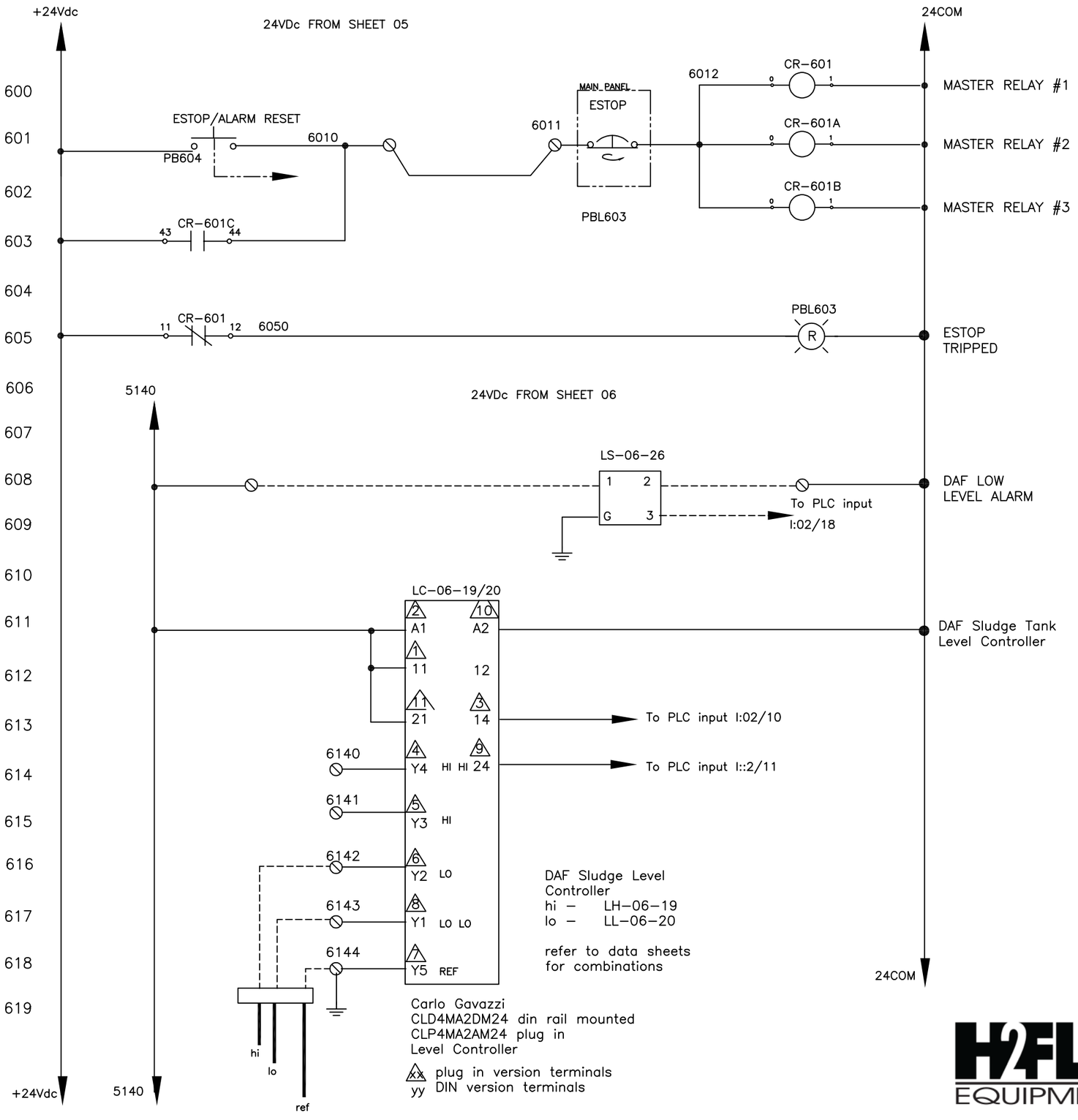
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CUSTOMER H2FLOW EQUIPMENT

TITLE Sabina Gold
24Vdc Power Distribution

H2FLOW EQUIPMENT INC.



REV	DATE	DESCRIPTION
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1	5/22	Revised, Issued for approval
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DRAWING NUMBER 222759-06		REVISION 2	SCALE NTS

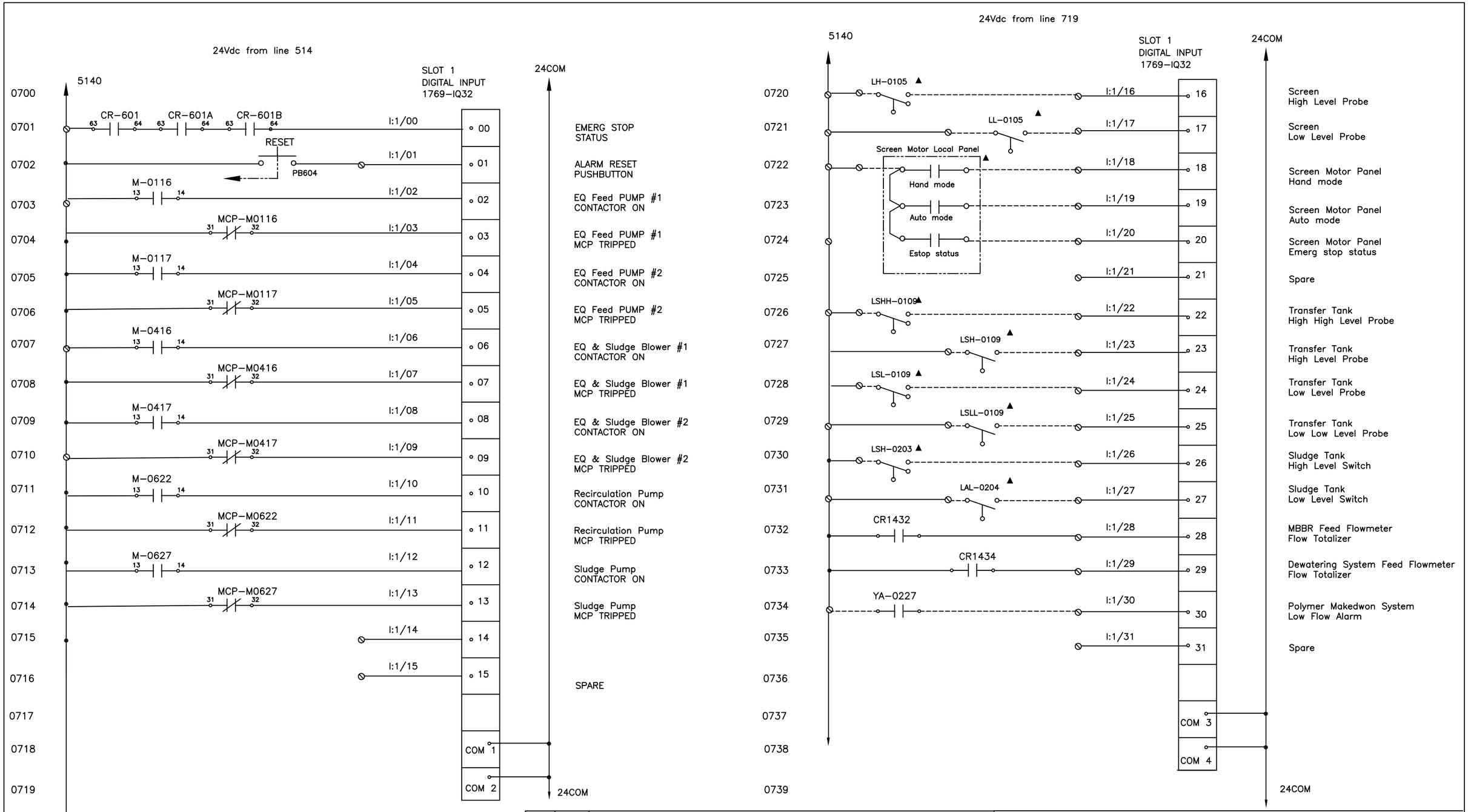
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ACA Control Systems Ltd.
Mississauga, Ontario

CUSTOMER H2FLOW EQUIPMENT

TITLE Sabina Gold
Emerg stop cct & Level Controls

H2FLOW EQUIPMENT INC.



▲ DENOTES FIELD MOUNTED DEVICE

---------- FIELD WIRING BY OTHERS

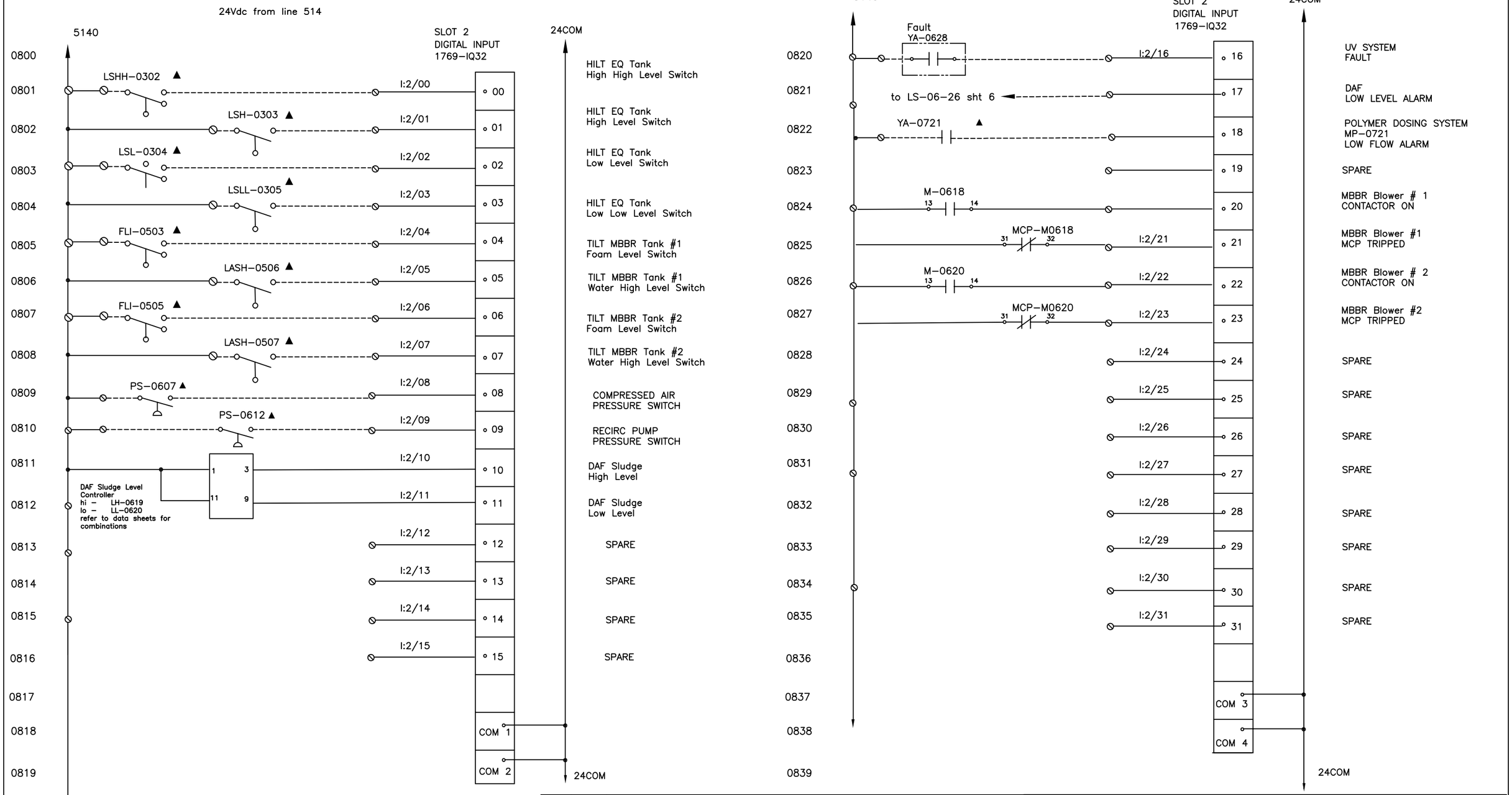
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Mississauga, Ontario

DRAWN BY: AN	DATE	Apr 20/22	CUSTOMER H2FLOW EQUIPMENT
APPROVED	CAD REF	222759–07	
DRAWING NUMBER 222759–07	REVISION 2	SCALE NTS	TITLE Sabina Gold PLC Digital input Slot 01



▲ DENOTES FIELD MOUNTED DEVICE

---------- FIELD WIRING BY OTHERS

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APPROVED	CAD REF	222759–08	
DRAWING NUMBER 222759–08	REVISION 2	SCALE NTS	TITLE Sabina Gold PLC Digital input Slot 02

0900

0901

0902

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2	5/22	Revised, Issued as built
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0	4/22	Issued for approval
REV	DATE	DESCRIPTION

DRAWN BY: AN	DATE	Apr 20/22
APPROVED	CAD REF	222759-09
DRAWING NUMBER 222759-09	REVISION 2	SCALE NTS

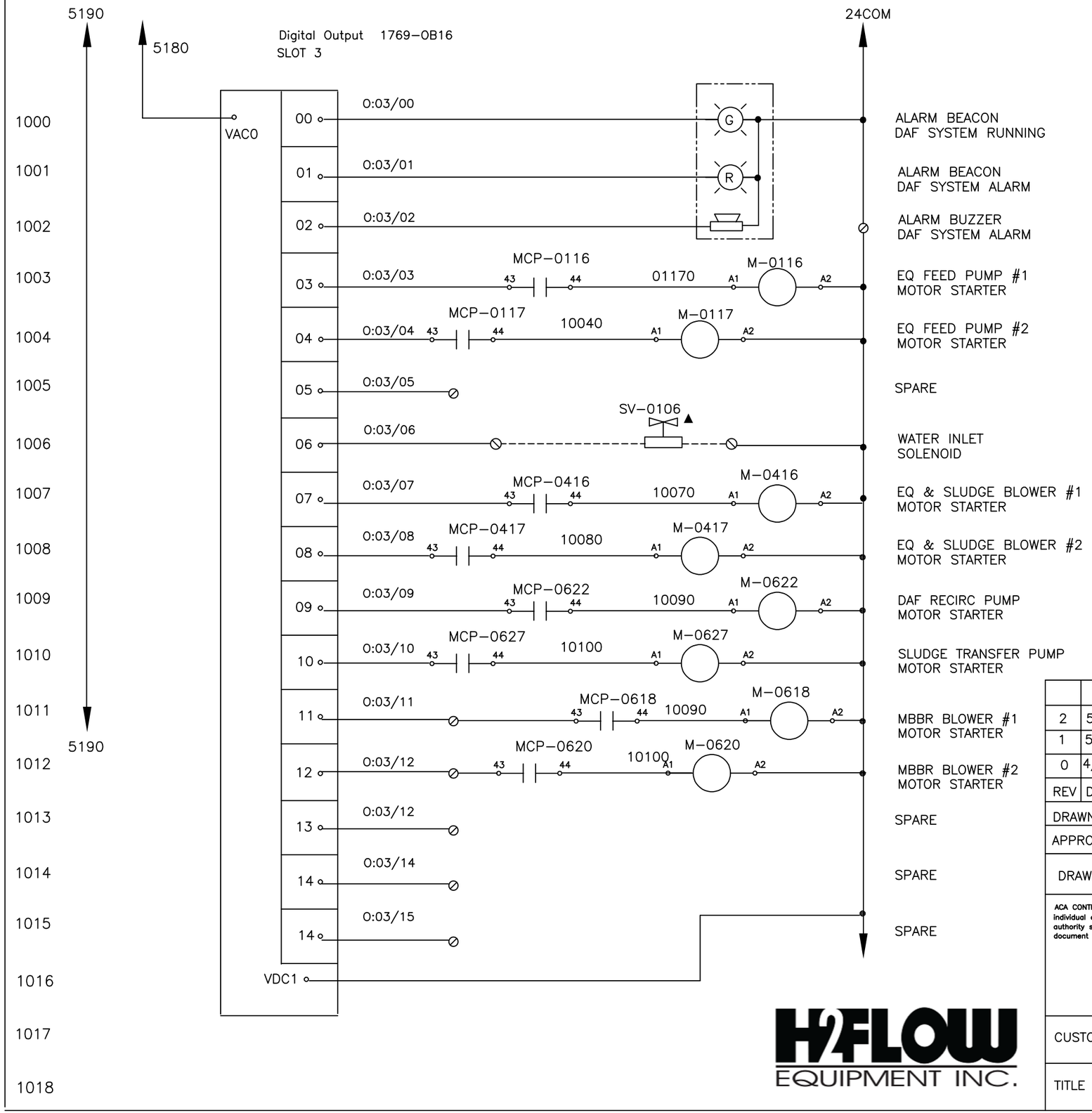
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Mississauga, Ontario

CUSTOMER H2FLOW EQUIPMENT

TITLE Sabina Gold
Blank Page

H2FLOW EQUIPMENT INC.



▲ DENOTES FIELD MOUNTED DEVICE

---------- FIELD WIRING BY OTHERS

REV	DATE	DESCRIPTION
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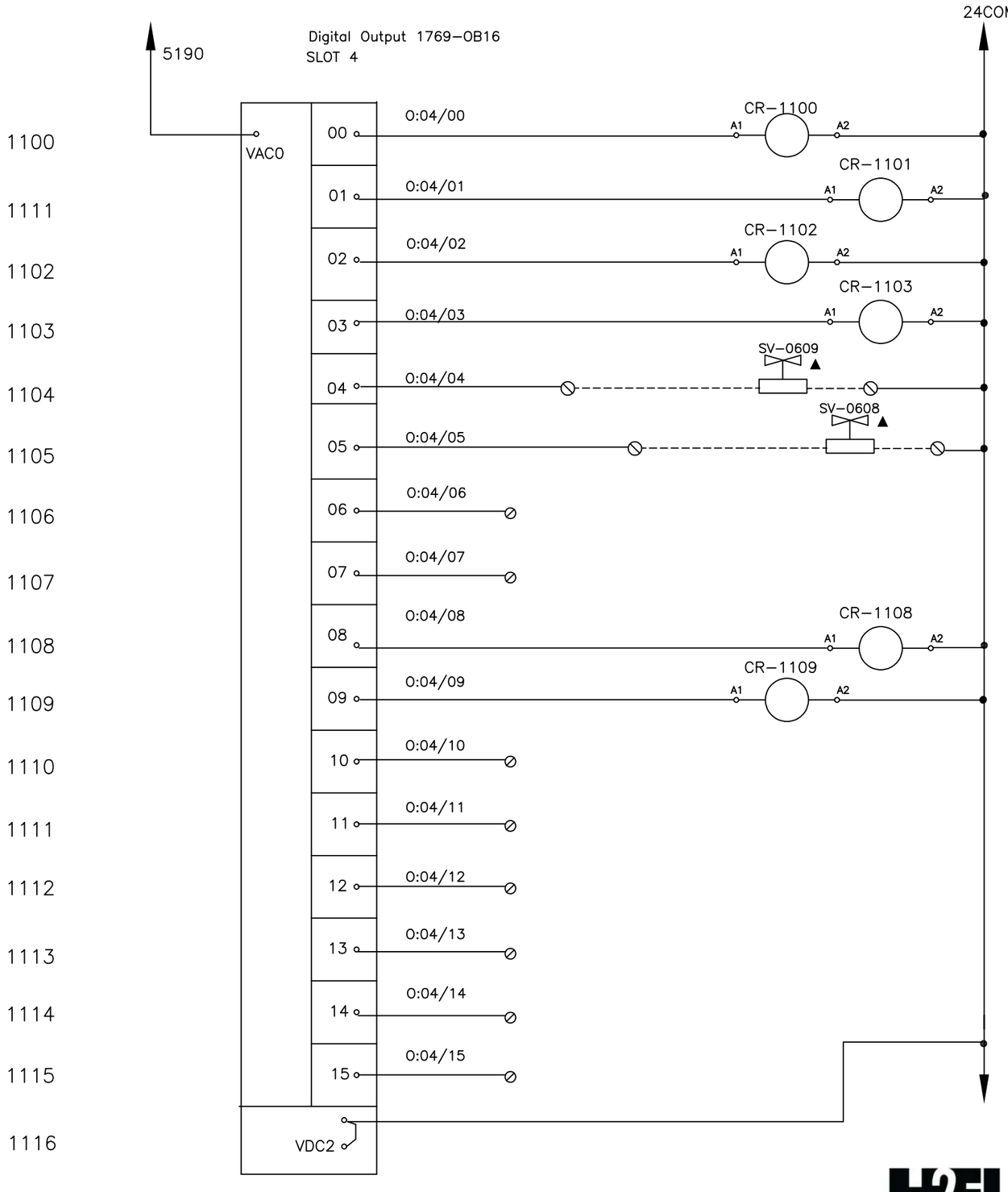
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Mississauga, Ontario

CUSTOMER H2FLOW EQUIPMENT

TITLE Sabina Gold
Expansion PLC output rev 0

H2FLOW EQUIPMENT INC.



POLYMER DOSING PUMP MP-02-27
Run Control Relay

ALUM DOSING PUMP DP-07-20
Run Control Relay

ANTIFOAM DOSING PUMP #1 DP-07-15
Run Control Relay

ANTIFOAM DOSING PUMP #2 DP-07-16
Run Control Relay

AIR INJECTION
SOLENOID

SEDIMENT
SOLENOID

Spare

Spare

UV SYSTEM UV-06-28
Run Control Relay

DAF POLYMER DOSING PUMP MP-0721
Run Control Relay

Spare

Spare

Spare

Spare

Spare

Spare

▲ DENOTES FIELD MOUNTED DEVICE

---------- FIELD WIRING BY OTHERS

H2FLOW EQUIPMENT INC.

REV	DATE	DESCRIPTION
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DRAWN BY: AN		DATE	Apr 20/22
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DRAWING NUMBER 222759-11		REVISION 2	SCALE NTS

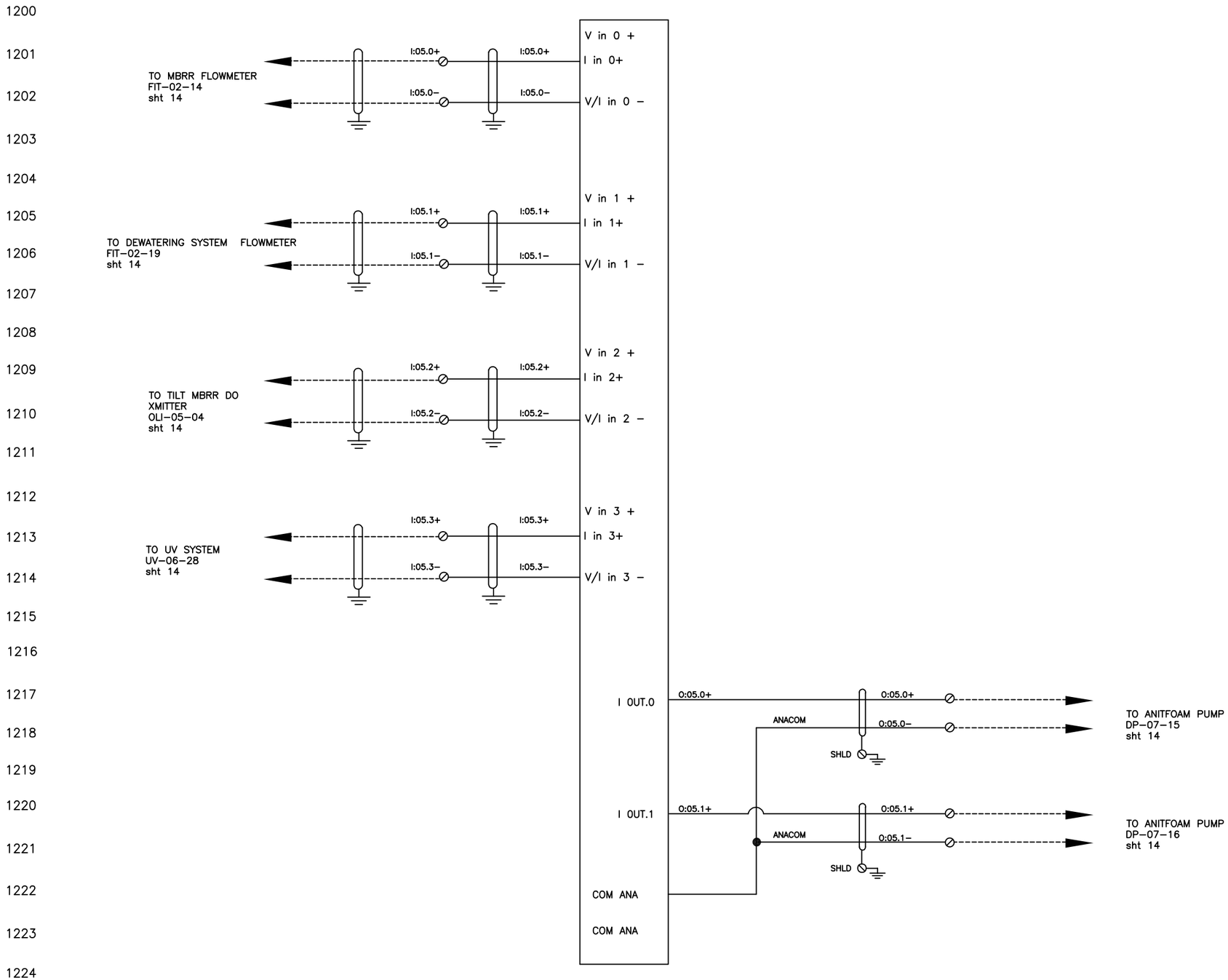
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Mississauga, Ontario

CUSTOMER H2FLOW EQUIPMENT

TITLE Sabina Gold
Expansion PLC output slot 4 rev 0

SLOT 5
ANALOG I/O 1769-IF4XOF2



DENOTES FIELD WIRING

▲ DENOTES FIELD MOUNTED DEVICE

REV	DATE	DESCRIPTION
2	5/22	Revised, Issued as built
1	5/22	Revised, Issued for approval
0	4/22	Issued for approval

DRAWN BY: AN		DATE	Apr 22/22
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DRAWING NUMBER 222759-12		REVISION 2	SCALE NTS

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Mississauga, Ontario

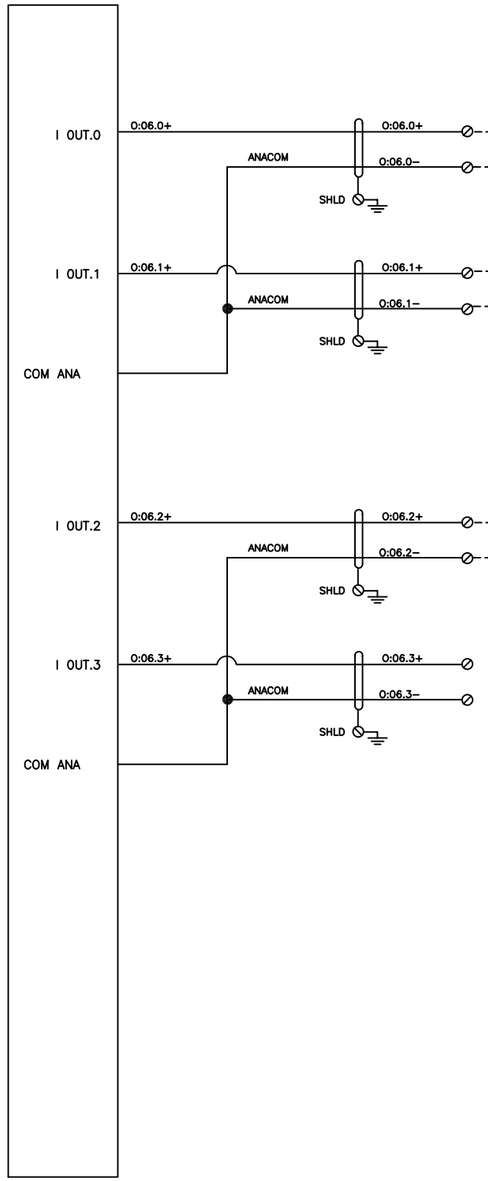
H2FLOW EQUIPMENT INC.

CUSTOMER H2FLOW EQUIPMENT

TITLE Sabina Gold
Expansion PLC analog slot 5 rev 0

SLOT 6
ANALOG I/O 1769–OF4

1300
1301
1302
1303
1304
1305
1306
1307
1308
1309
1310
1311
1312
1313
1314
1315
1316
1317
1318
1319



TO ALUM PUMP
DP–07–20
sht 14

TO POLYMER MAKEDOWN
MP–02–27
sht 14

TO DAF POLYMER MAKEDOWN
MP–07–21
sht 14

SPARE

DENOTES FIELD WIRING
▲ DENOTES FIELD MOUNTED DEVICE

▲ DENOTES FIELD MOUNTED DEVICE
---------- FIELD WIRING BY OTHERS

REV	DATE	DESCRIPTION
2	5/22	Revised, Issued as built
1	5/22	Revised, Issued for approval
0	4/22	Issued for approval

DRAWN BY: AN		DATE	Apr 20/22
APPROVED		CAD REF	222759–13
DRAWING NUMBER 222759–13		REVISION 2	SCALE NTS

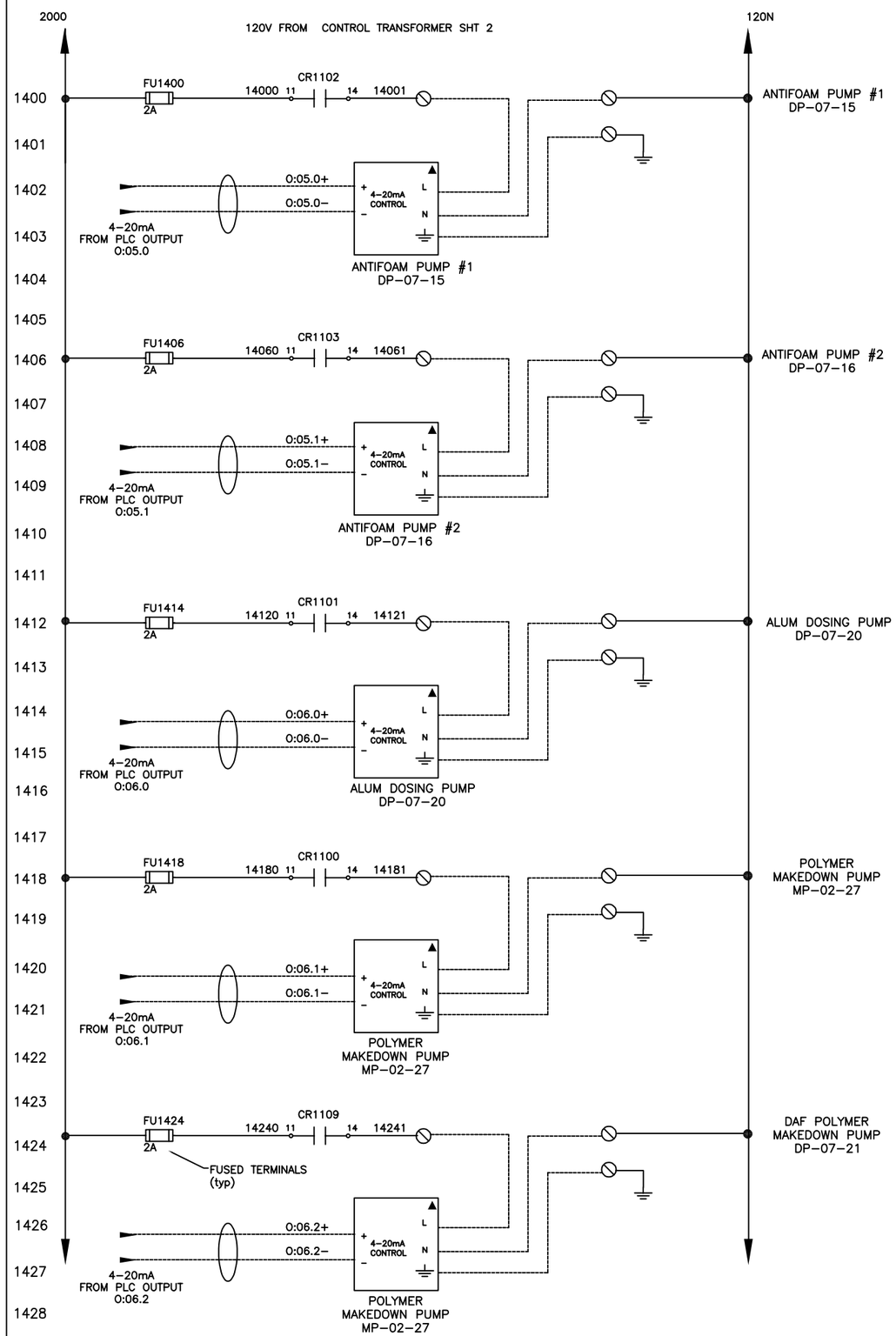
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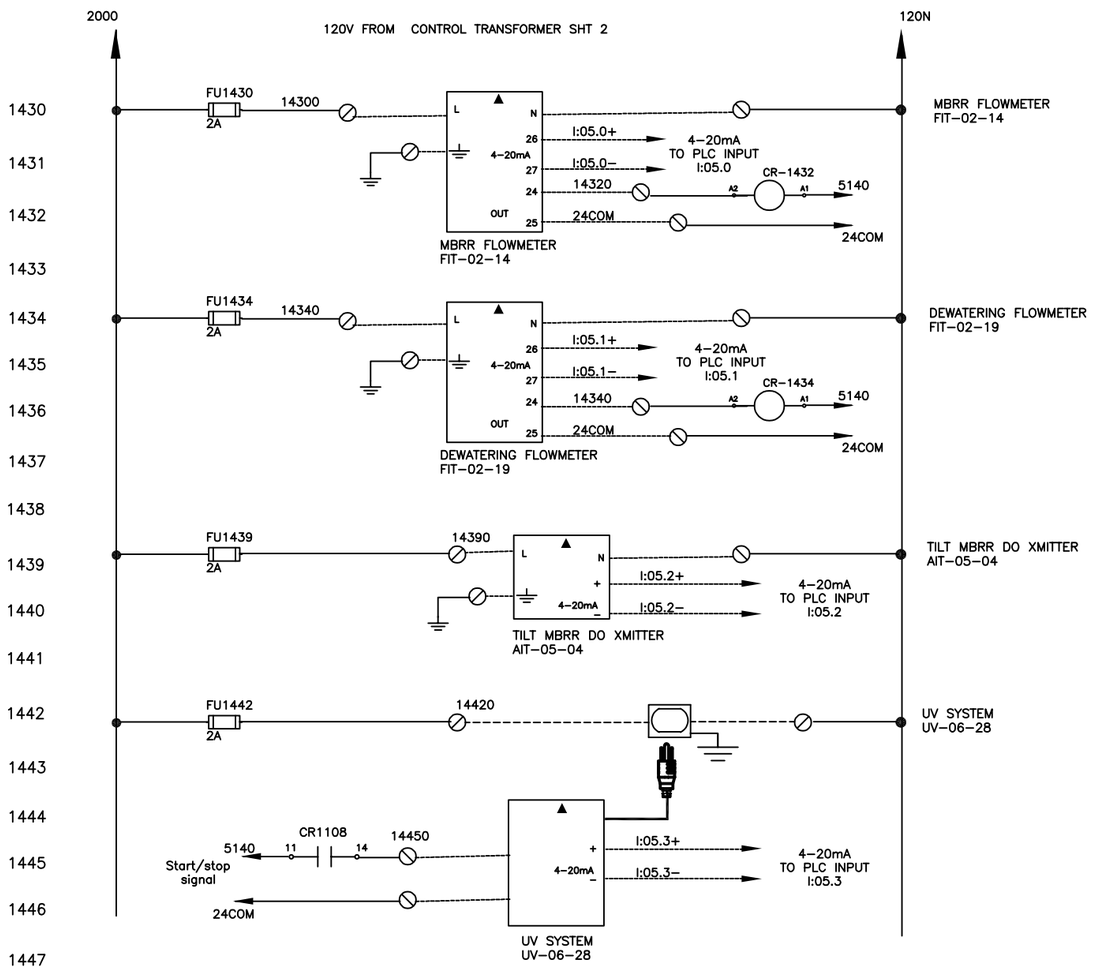
ACA Control Systems Ltd.
Mississauga, Ontario

CUSTOMER H2FLOW EQUIPMENT

TITLE Sabina Gold
Analog IO slot 6

H2FLOW EQUIPMENT INC.





REV	DATE	DESCRIPTION
2	5/22	Revised, Issued as built
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0	4/22	Issued for approval

DRAWN BY: AN		DATE	Apr 20/22
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DRAWING NUMBER 222759–14		REVISION 2	SCALE NTS

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ACA Control Systems Ltd.
Mississauga, Ontario

H2FLOW EQUIPMENT INC.

CUSTOMER H2FLOW EQUIPMENT

TITLE Sabina Gold
Plymer & Dosing pumps rev 0

REV	DESCRIPTION	DATE	BY	APP'D
0	AS BUILT	08/15/22	GC	LB

SCREEN ROOM EXPLOSIONPROOF JUNCTION BOXES

575V

CABLE TAGGING	TERMINAL BLK #		
	GRND		
	GRND		
	GRND		
	GRND		
7T1	01		
7T2	02		
7T3	03		
1T1	04		
1T2	05		
1T3	06		
2T1	07		
2T2	08		
2T3	09		
HTR271	10		
HTR272	11		
HTR273	12		

TO MAIN CONTROL PANEL

- 7T1, 7T2, 7T3 → SCREW SCREEN MOTOR (M-01-03)
- 1T1, 1T2, 1T3 → EQ FEED PUMP 1 (P-01-16)
- 2T1, 2T2, 2T3 → EQ FEED PUMP 2 (P-01-17)

TO DISTRIBUTION PANEL

- HTR271, HTR272, HTR273 → SCREEN ROOM HEATER (HTR-01-27)

I & C

CABLE TAGGING	BOTTOM TERMINAL	TOP TERMINAL	
5140	01		
I:1/18		02	
5140	03		
I:1/19		04	
5140	05		
I:1/20		06	
I:1/16	07		
I:1/17		08	
I:1/22	09		
I:1/23		10	
I:1/24	11		
I:1/25		12	
24VCOM	13		
O:03/06		14	
	15		
		16	
	17		
		18	
	19		
		20	
	GRND		
		21	
	GRND		
		22	
	GRND		
		23	
	GRND		
		24	

TO MAIN CONTROL PANEL

- 5140 / 01 — SCREEN MOTOR PANEL COMMON
- I:1/18 / 02 — SCREEN MOTOR PANEL HAND MODE
- 5140 / 03 — SCREEN TANK LEVEL COMMON
- I:1/19 / 04 — SCREEN MOTOR PANEL AUTO MODE
- 5140 / 05 — TRANSFER TANK LEVEL COMMON
- I:1/20 / 06 — SCREEN MOTOR PANEL E-STOP STATUS
- I:1/16 / 07 — SCREEN TANK LEVEL HIGH
- I:1/17 / 08 — SCREEN TANK LEVEL LOW
- I:1/22 / 09 — TRANSFER TANK LEVEL HIGH HIGH
- I:1/23 / 10 — TRANSFER TANK LEVEL HIGH
- I:1/24 / 11 — TRANSFER TANK LEVEL LOW
- I:1/25 / 12 — TRANSFER TANK LEVEL LOW LOW
- 24VCOM / 13 — WATER INLET SOL. VALVE
- O:03/06 / 14 — WATER INLET SOL. VALVE

120V

CABLE TAGGING	BOTTOM TERMINAL	TOP TERMINAL	
N	01		
LIGHT_L		02	
N	03		
EXH. FAN_L		04	
	05		
		06	
	07		
		08	
	09		
		10	
	11		
		12	
	GRND		
		14	
	GRND		
		15	

TO 208/120V PANEL

- N / 01 — SCREEN ROOM LIGHTING, NEUTRAL
- LIGHT_L / 02 — SCREEN ROOM LIGHTING, 120V
- N / 03 — SCREEN ROOM EXHAUST FAN, NEUTRAL
- EXH. FAN_L / 04 — SCREEN ROOM EXHAUST FAN, 120V

H2FLOW EQUIPMENT INC.

WATER AND WASTEWATER TREATMENT EQUIPMENT
580 OSTER LANE, VAUGHAN, ON. L4K 2C1 CANADA
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www.h2flow.com

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DRAWN BY: GC	DATE: 08/15/22	PROJECT NAME: SABINA GOLD CONTAINERIZED STP	TITLE: SCREEN ROOM JB TERMINAL STRIP
APP'D BY: LB	DATE: 08/15/22		DRAWING No.: Q-23119-40-02
SCALE: NTS			REV: 0
		ALL DIMENSION ARE IN INCHES UNLESS OTHERWISE SPECIFIED	SHEET 1 OF 2

REV	DESCRIPTION	DATE	BY	APP'D
0	AS BUILT	08/15/22	GC	LB

SLUDGE ROOM
JUNCTION BOXES

575V

CABLE TAGGING	TERMINAL BLK #			
	GRND			
	GRND			
	GRND			
	GRND			
8T1	01			MBBR FEED PUMP 1 MOTOR (M-02-08)
8T2	02			
8T3	03			
9T1	04			MBBR FEED PUMP 2 MOTOR (M-02-09)
9T2	05			
9T3	06			
10T1	07			SLUDGE DEWATERING PUMP MOTOR (M-01-16)
10T2	08			
10T3	09			
HTR234	10			SLUDGE DEWATERING ROOM HEATER (HTR-02-34)
HTR234	11			
HTR234	12			

TO MAIN CONTROL PANEL

TO DISTRIBUTION PANEL

I & C

CABLE TAGGING	BOTTOM TERMINAL	TOP TERMINAL		
5140	01			SLUDGE TANK LEVEL HIGH, LS-02-03
5140	02			SLUDGE TANK LEVEL LOW, LS-02-04
I:1/26	03			SLUDGE TANK LEVEL HIGH, LS-02-03
I:1/27	04			SLUDGE TANK LEVEL LOW, LS-02-04
5140	05			MBBR FEED FLOWMETER 24V+, FIT-02-14
I:05.0+	06			MBBR FEED FLOWMETER FLOW INDICATION, FIT-02-14
I:1/28	07			MBBR FEED FLOWMETER TOTALIZER, FIT-02-14
24VCOM	08			MBBR FEED FLOWMETER 24V-, FIT-02-14
5140	09			DEWATERING SYSTEM FEED FLOWMETER 24V+, FIT-02-14
I:05.1+	10			DEWATERING SYSTEM FEED FLOWMETER FLOW INDICATION, FIT-02-14
I:1/29	11			DEWATERING SYSTEM FEED FLOWMETER TOTALIZER, FIT-02-14
24VCOM	12			DEWATERING SYSTEM FEED FLOWMETER 24V-, FIT-02-14
5140	13			POLYMER MAKEDOWN LOW FLOW ALARM,YA-0227
I:1/30	14			POLYMER MAKEDOWN LOW FLOW ALARM,YC-02-27
O:06.1+	15			POLYMER MAKEDOWN SPEED SETPOINT +,SC-02-27
O:06.1-	16			POLYMER MAKEDOWN SPEED SETPOINT -,SC-02-27
GRND				
GRND				
GRND				

TO MAIN CONTROL PANEL

120V

CABLE TAGGING	BOTTOM TERMINAL	TOP TERMINAL		
REC_L	01			RECEPTACLE, 120V
EXH. FAN_L	02			EXHAUST FAN, 120V
PUMP REC_L	03			DRAIN PUMP REC. OUTET, 120V
LIGHTING_L	04			LIGHTING, 120V
SCR. EF TMR_L	05			SCREEN EXHAUST FAN TIMER, 120V
SCR. EF SW	06			SCREEN EXHAUST FAN SWITCH
POLY_L	07			POLYMER, 120V
REC_N	08		●	RECEPTACLE, N
EXH. FAN_N	09		●	EXHAUST FAN, N
PUMP REC_N	10		●	DRAIN PUMP REC. OUTET, N
LIGHTING_N	11		●	LIGHTING, N
SCR. EF TMR_N	12		●	SCREEN EXHAUST FAN TIMER, N
POLY_N	13		●	POLYMER, N
	14			
	15			
	GRND			
	GRND			
	GRND			
	GRND			

TO 208/120V PANEL

TO ELECT. ROOM EXH. FAN JB

TO 208/120V PANEL

TO ELECT. ROOM EXH. FAN JB

TO 208/120V PANEL

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DRAWN BY: GC	DATE: 08/15/22	PROJECT NAME: SABINA GOLD CONTAINERIZED STP	TITLE: SLUDGE ROOM JB TERMINAL STRIP
APP'D BY: LB	DATE: 08/15/22		DRAWING No.: Q-23119-40-02
SCALE: NTS			REV: 0
		ALL DIMENSION ARE IN INCHES UNLESS OTHERWISE SPECIFIED	SHEET 2 OF 2