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Operating and Maintenance Instructions
Progressive Cavity Pump

range | size | pressure stage | 17.01.2006

MD

commission-No.

Job#

2109552

This operating and maintenance instruction includes important safety information and instructions for installation, commissioning, operating and maintenance of the seepex machinery. It is essential therefore, that the responsible specialist refers to it before starting any work on the machinery as well as prior to commissioning. Futhermore, this instruction must always be available on site.

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Offer No. 5357/0556/09-MA

John Meunier Inc/Veolia Water Water Treatment, Saint-Laurent

05/11/2009 **Item 1**

qty. 1 **seepex progressive cavity pump**
MD 006-12 / A6-A7-A7-R0-GA-X
X= 0802, 11R0, 20A7

Application data

Pumped liquid	Sodium Hydroxide
Viscosity	78 cPs
Solids content	no advice
Size of solids	no advice
Spec. gravity	1.27 kg/L
Temperature	32 to 113F
pH value	no advice
Composition/Concentr.	25%
Kind of operation	8h/day
Site of installation	indoors

Performance data

	Flow rate	Pressure	Speed	
	3.3 l/h	100 psi	27 rpm	min
	50 l/h	100 psi	307 rpm	max
Starting torque	3 lb.ft			
Max. power absorbed	0.03 hp			
NPSH required	6.73 ft			
Suction pressure	ass. flooded			
Discharge pressure	100 psi			
Differential pressure	100 psi			

Materials and executions

Installation	horizontal
Rotation	counter clockwise (left)
Lantern / drive casing	lantern, standard
Lantern / drive casing material	1.0037 (St 37-2) / A 283 C
Wetted casing parts	standard
Wetted casing parts material	1.4408 / A 743 CF8M
Joint execution	encapsulated (closed) joints with universal joint sleeve
Joints material	standard
Universal joint sleeve material	EPDM - ethylene-propylene diene
Coupling rod	standard
Coupling rod material	1.6582 encapsulated
Rotor	standard
Rotor material	1.4571 / 316 TI SS
Rotor coating	without
Stator	standard
Stator material	EPDM - ethylene-propylene-diene
Shaft sealing	mechanical seal, single acting elastomer bellows, either sense of rotation, unbalanced
Shaft seal casing material	1.4571 / 316 TI SS

Offer No. 5357/0556/09-MA

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Shaft seal material	rotating seal face: SiC solid stationary seal face: SiC solid elastomers: EPDM spring: 1.4571 / 316 TI SS metal parts: 1.4571 / 316 TI SS
Plug-in shaft	standard
Plug-in shaft material	1.4571 / 316 TI SS
Pump screw fitting	bolting entirely in stainless steel inclusive tie rods
Painting	standard RAL 5013 (blue)

Connections

Branch / hopper position	branch / hopper position 1
Casing parts connections	Suction connection NPT thread: NPT 1" discharge connection NPT thread: NPT 1/2"

Drive

Type	**gear box for mounting of a NEMA motor**		
Manufacturer	Nord		
Model	SK02F-56C		
Design	B3/B5		
Gear ratio	i = 6.89		
	Nom.	**Min.**	**Max.**
Output speed (rpm)	261	27	307
Motor speed (rpm)	1800	186	2115
Frequency (Hz)	60	6	71

Electr. motor

Type	**NEMA Motor**
Manufacturer	Baldor
Model	VEM3581T-5
Rated output	1 hp
Rated speed	1800 rpm
Starting	direct on frequency inverter
Voltage	3 x 575 VAC
Frequency	60 Hz Premium Efficient Super-E Motor 20:1 Variable Speed

Dry-running protection device

Dry running protection device	TSE 115AC consisting of: - sensor sleeve fitted to the stator of the pump with installed NTC temperature sensor in IP55 connection head inst. in pump stator - TSE control device for installation in a control panel - 110-115V / 50-60 Hz

quit product catalog

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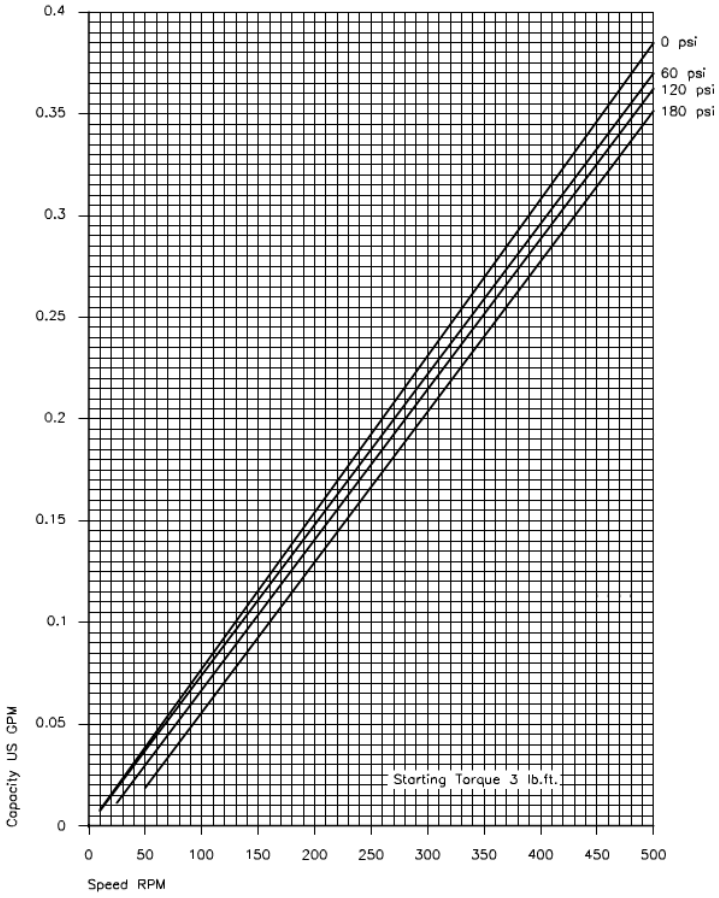
instructions for printing

12 Pumps

Characteristic Curves
Size
006–12

006–12.s



Values based upon water 68°F

CHA.006–12.s B 01.03us

1.0
General

1.1
Application

These operating instructions contain basic information on the installation, commissioning and maintenance of seepex machines. Compliance with the work steps described in the individual sections is essential.

1.2
Details of the seepex machines

1.2.1
Operating Instructions

The Commission Number (comm. no) assigns the operating instructions to a particular seepex machine. The operating instructions are produced in relation to a specific job/commission and are valid only for the machine whose comm. no. is identical with that indicated on the cover sheet and possessing the associated data sheet, Point 9.

1.2.2
Manufacturer

The machines were manufactured by seepex.

1.2.3
Range, Size, Version

of the machines are stated in the appended data sheet, Point 9.

1.2.4
Machine Comm. No. and Year of Construction

are stated on the type plate at the machine.

1.2.5
Release Date of the Operating Instructions

is stated on the cover sheet of the operating instructions.

1.2.6
Modifications, Notes of Modification

If modifications to the machines are carried out in agreement with seepex, a new set of operating instructions will be provided, or the existing operating instructions will be supplemented by an additional sheet together with a new cover sheet. The date of modification and modification index will be noted on the new cover sheet.

1.2.7
EEC Machine Directive

1.2.7.1
Manufacturer's Declaration

seepex Manufacturer's Declaration as required by the EEC Machine Directive 89/392/EEC, Appendix II B:

The seepex machines delivered in accordance with our design are intended to be fitted in one machine or assembled together with other machines to form one machine/plant. The commissioning of the machine is forbidden until such a time as has been established that the entire machine/plant satisfies the requirements of the EEC Directive for Machines as amended 91/368/EEC and 93/44/EEC.

Particular attention must be paid to the safety requirements specified in EN809 (s and Equipment for Fluids) as well as the information in these operating instructions.

1.2.7.2
Declaration of Conformity

seepex machines possessing no safety accessories do not fulfill the requirements of the EEC Machine Directive 89/392/EEC as amended 91/368/EEC and 93/44/EEC.

For this reason, no Declaration of Conformity as required by the EEC Machine Directive 89/392/EEC, Appendix IIA can be issued before appropriate safety devices have been installed/mounted on the machine and/or plant with due regard to the information given in these operating instructions.

The following harmonized standards are particularly applicable:
EN 809, EN292T1, EN292T2
Applicable national standards and specifications must be taken into consideration.

Following assessment of the conformity of the machine/plant with the EEC Machine Directive, customers may on their own initiative place on the full machine/plant the EEC symbol 'CE' as defined in Identification Directive 93/68/EEC.

CAUTION

This documentation must be kept available for at least 10 years.

1.2.8
Copyright and Industrial Property Rights

These operating instructions are copyrighted. The reproduction, in particular by photocopying, of these instructions is not permitted (§§ 54, 54 UrhG) and constitutes a criminal offence (§ 106 UrhG). Proceedings will be instituted if the copyright is violated.

1.2.9
Specifications Required for Inquiries and Orders

The following information must be included when inquiring about replacement parts or placing orders:
- comm. no.
- / machine type
This information is given on the type plate mounted the machine.

1.2.10
Technical Data Sheet
see Point 9.

1.2.11
Performance Data, Load Index, Power Consumption

are indicated in the associated data sheet, Point 9.

1.2.12
Sound Pressure Level

The sound pressure level and/or noise characteris-tics of the seepex machines are ascertained in accordance with DIN 45635. The measuring guidelines are largely identical with the international standards ISO 3740-1980 and ISO 3744-1981.

1.2.13
Operating Range

Employment of the machine is not permissible for purposes other than those stated in the data sheet, see Point 9. seepex cannot accept liability for damage arising through failure to comply with this operating range.

1.3
Supplementary Information

1.3.1
Accessories, Optional Extras

Please refer to the data sheet, Point 9.

1.3.2
Company Address, Service Addresses

see Point 11

2.0
Safety

These operating instructions contain basic requirements to be observed during the installation, operation and maintenance of the machine. Therefore, the instructions must be read by the mechanical fitter and by the technical personnel/operator responsible for the machine prior to assembly and commissioning, and kept available at the operating site of the machine/plant at all times.

Compliance is required not only with the general safety instructions given in this section but also with the detailed instructions, e.g. for private usage, given under the other main headings in these operating instructions.

2.1
Labeling of Advice in the Operating Instructions

In these operating instructions safety advice whose non-observance could lead to danger for life or limb is labeled with the following general hazard symbol:

safety symbol acc. to ISO 3864 - B.3.1

Warnings regarding electric power are labeled with:

safety symbol acc. to ISO 3864 - B.3.6

Safety instructions whose non-observance could jeopardize the machine and its functions are labeled by the word

CAUTION

Always comply with instructions mounted directly on the machine, e.g.
- rotational direction arrow
- fluid connection indicators

and ensure that the information remains legible.

2.2
Personnel Qualifications and Training

Personnel charged with operation, maintenance, inspection and assembly must be in possession of the appropriate qualifications for the tasks. The company operating the machine must define exact areas of responsibility, accountabilities and personnel supervision schemes. Personnel lacking the required skills and knowledge must receive training and instruction. If necessary, the opera-ting company may commission the manufacturer/ supplier to conduct these training courses. Furthermore, the operating company must ensure that the personnel fully understand the contents of the operating instructions.

2.3
Dangers Resulting from Failure to Observe Safety Instructions

Failure to comply with the safety instructions may lead to hazards to life and limb as well as dangers for the environment and the machine. Non-observance of safety instructions can invalidate the right of claim to damages.

The following are just some **examples** of possible dangers resulting from failure to comply with the safety instructions:

- Failure of important machine/plant functions
- Failure of prescribed methods of service and maintenance
- Danger to life and limb due to electrical, mechanical and chemical influences
- Danger to the environment due to the leakage of hazardous substances

2.4
Safety-conscious Working

Always comply with the safety instructions listed in this document, the existing national accident prevention regulations and any company-internal work, operating and safety rules.

2.5
Safety Instructions for the Operating Company/Machine Operator

- Any potentially hazardous hot or cold machine parts must be provided with protection against accidental contact at the customer´s premises.

- Protective guards for moving parts (e.g. coupling) must never be removed while the machine is in operation.

- Leakages (e.g. in the shaft seal) of hazardous conveying liquids (e.g. explosive, toxic, hot) must be drained in such a way that no danger arises for persons or for the environment. Always observe the relevant statutory requirements.

- The risk of exposure to electrical power must be eliminated (for details, see the VDE regulations, for example, or those of the local power supply company).

2.6
Safety Instructions for Maintenance, Inspection and Assembly Work

The operator must ensure that all maintenance, inspection and assembly tasks are carried out by authorized and qualified personnel who have studied the operating instructions closely and become sufficiently familiar with the machine.

As a basic rule, the machine must be brought to a standstill before work is carried out. Always comply with the de-commissioning procedure described in this document.

Any machiness or assemblies conveying media that are detrimental to health must be decontaminated.

Immediately following completion of work, all safety and protective devices must be replaced in position and, where applicable, re-activated.

Before re-starting the machine, observe the points listed under the heading "Initial Startup".

2.7
Unauthorized Modification and Manufacture of Replacement Parts

Conversions or modifications of the machine are permissible only in consultation with the manufacturers. Original manufacturer replacement parts and manufacturer-approved accessories enhance the operational safety of the machine. The usage of unauthorized parts may lead to the nullification of the manufacturer's liability for any resultant damages.

2.8
Impermissible Modes of Operation

The operational safety of the machines supplied is warranted only for employment in accordance with the intended use as defined in Section 1 - General - of these operating instructions. Never allow the threshold values specified in the data sheet to be exceeded.

3.0
Transport and Intermediate Storage

3.1
Safety Precautions

Employ appropriate transport means, hoists and tools when transporting and storing the machine, always observing the safety instructions.

3.2
Transport

Depending on its weight, the seepex machine must be transported manually or with appropriate transport means. Comply with the transport instructions on the packing.

3.3
Unpacking

The design of the packing is such that the equip-ment can be removed manually or, if demanded by the weight, by means of appropriate hoists.

Any screw fittings between the machine and the packing must be undone. Comply with the attached information notices and symbols.

3.4
Intermediate Storage/Preservation

Unless otherwise indicated in the data sheet, seepex machines are provided with preservation only for the duration of transport. If a long period of intermediate storage is foreseen before the machine is commissioned, it is necessary to pro-vide supplementary preservation. If necessary, the appropriate measures should be drawn up in consultation with seepex.

Intermediate storage in extreme climatic conditions is permissible only for machine whose design is appropriate to the circumstances. If necessary, seepex must be consulted.

CAUTION

Pumps of the range MAP
If the period from supply and subsequent storage until the commissioning is more than 4 weeks, the hoses should be dismantled, refer to Point 7.

3.5
Protection against Environmental Influences

To afford protection against environmental influences, the intermediate storage location must be dry, enclosed and free from frost.

4.
Description of the seepex Progressive Cavity Pump and Accessories

4.1
General Description, Design and Mode of Operation

Like all progressive cavity pumps, seepex pumps belong to the rotating positive-displacement pump family. The characteristic attribute of these pumps is the special formation and arrangement of the two conveying elements, namely the rotor and the stator.

The difference in the number of threads possessed respectively by the rotor and stator produces a chamber that opens and closes alternately in line with the constant turning motion of the rotor, effecting the continuous transportation of the conveying product from the suction side to the pressure side.

The geometrical formation of the two conveying elements combined with the constant contact that exists between them result in sealing lines that effect an airtight seal between the suction and pressure side in every position of the eccentric screw, even when the pump is stationary. The pump owes its high suction capacity to this
sealing between the suction and pressure sides.

4.2
Mechanical Design

Please consult the sectional drawing, Point 9, for the mechanical design of the pump. The data sheet, Point 9, gives information on the design of the pump housing, stator, rotor and rotating components.

Refer to document OM. SEA. __, for information on the design of the shaft seal.

The data sheet, specifies details of the design of the drive engine. Further details are
given in the appended manufacturer's documents, Point 10.

4.3
Accessories

Consult the data sheet for information.

4.4
Dimensions, Weight

Consult the appended dimensional drawing,

4.5
Design Variants

Refer to the data sheet, Point 9, for the design of the seepex progressive cavity pump. Other design variants are possible, whereby seepex must first check whether a particular pump is suitable for the intended purpose.

4.6
Operating Site Specifications

Operating site specifications are listed in the data sheet, Point 9. Details of the space required for installation, operation and maintenance are given in Point 5.2.1.

5.0
Assembly / Installation

5.1
Mounting Tools / Hoists

No special tools are required for the assembly and installation of the pump.

The customer must check the dimensions and weight of the seepex progressive cavity pump to ascertain whether the available hoisting apparatus is sufficient for the assembly and fitting of the pump.

5.2
Initial Assembly

5.2.1
Inspection Prior to Commencement of Assembly

5.2.1.1
Location

The place of installation for the pump must con-form with the site stated in the data sheet in Point 9. Any change of location must be checked and approved by seepex.

5.2.1.2
Space Requirements

Customers are responsible for determining the space requirements; the following factors must be taken into consideration:

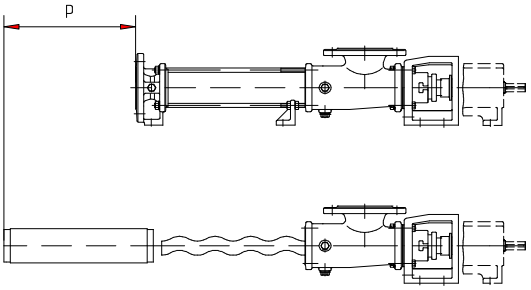
- dimensions and weight of the machine
- required transport and hoisting equipment
- possible piping layout with allowance for the space allowing disassembly of the rotor as defined in 5.2.1.3
- freedom of movement to:
  operate the drive /
  speed regulation
  read speed and pressure indicators
  adjust a stator retensioning device, if fitted
  operate a buffer fluid supply unit, if fitted
- space required for lubrication / renewal of lubricants
- disassembly of mechanical protective devices, e.g. V-belt or coupling protection
- space required for handling the mounting tools, e.g. sufficient wall clearance

5.2.1.3
Space Allowing Disassembly of Stator P

A specific space must be allowed for exchanging the stator. The required dimension "P" is indicated in the index of these operating instructions or in the appended dimensional drawing, Point 9.

CAUTION

Ensure also that the pipe work can be dismounted at this location too.



5.2.2
Installation of the Fully Assembled Pump

- Installation in conformity with data sheet
  Installation of the pump is permissible only in accordance with the data sheet specifications and the associated basic drawing, see Point 9. Any change in the position must be checked and approved by seepex.

- Tension-free mounting of pump
  This rule applies to pumps with and without drives, to versions with and without baseplate, for mounting on the foundation or other bearing elements. The entire area of all bearing surfaces of the machine must rest on the ground. Any unevenness must be corrected by appropriate supports.

- Correct seating of drives
  All drives have been aligned ready for operation and mounted by seepex. However, displace-ments may occur during transport or installation. For this reason, check that the alignment and fastening of the drive and coupling are correct.

- Protective devices
  On completion of the assembly and installation work, immediately mount all safety and protective devices in their proper locations and set them in operation.

5.2.3
Protective and Controlling Equipment

Information on equipment of this nature, where fitted, is provided in the data sheet, Point 9. Consult the attached manufacturer's specifications, Point 10, for instructions on assembly and installation.

5.2.4
Electric Connection of Electric Motor and Frequency Converter

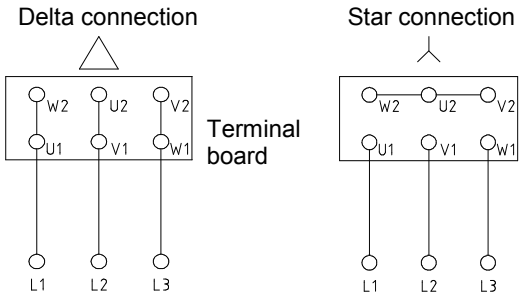
The electric connections must be established in accordance with the manufacturer's specifications, Point 10, as well as the safety specifications applying at the installation site. The mains voltage and frequency must match the ratings indicated on the type and rating plates.

- Switch on electric motor „direct-on-line“

CAUTION

An increased starting torque is necessary due to the clamping between the rotor and stator conveying elements. This means the electric motors that drive the progressive cavity pumps must always be switched on directly. As a rule, star-delta startup is not possible unless special arrangements have been made with seepex.

Three-phase cage motor



low . . . high . . .
. . . voltage indicated on rating plate

- Speed regulation via frequency inverter
  When progressive cavity pumps with frequency-controlled drives are started up problems may occur due to unsuitable or wrongly set frequency inverters. For this reason we recommend the purchase of the complete drive, including frequency inverter, from seepex, so that the frequency inverter can be tuned on the seepex test field along with a trial run.

  Ensure that customer-supplied frequency inverters comply with the starting torque and running power specified in the appended data sheet, Point 9.

CAUTION

Consult the appended document TI.FRU.01, see Point 9, for further information on the electric connection and the setting of frequency inverter and variable-speed motor.

5.2.5
Piping

5.2.5.1
Suction and Pressure Flanges

The position, nominal width and standard of the suction and pressure flange of the progressive cavity pump are specified in the dimension drawing, Point 9, and data sheet, Point 9. Always observe the rotational direction and flow direction defined in Point 6.2.5.

5.2.5.2
Piping Dimensioning

CAUTION

The pipe diameters on the suction and pressure sides must be dimensioned in accordance with the customer's pressure-loss calculation in such a way that the pressures specified in the data sheet, Point 9, are not exceeded. The nominal width of the suction pipe should at least match that of the pump suction flange.

5.2.5.3
Residue-free Piping

CAUTION

Prior to starting up the pump, ensure that all pipelines are free from foreign bodies. Installation residues (such as weld spatter, screws, steel chips etc.) will lead to damage of the **seepex** pump for which guarantee claims will not be accepted.

5.2.5.4
Tension-free Mounting

CAUTION

Pipelines and other components requiring to be connected with the pump must be mounted without stresses.

5.2.5.5
Fluid Connections for Optional Extras

Consult the data sheets, Point 9, for information regarding the optional extras, if any, that are fitted. The technical description is given under Point 9.

6.0
Commissioning/De-commissioning

6.1
Engineering Data

Details regarding all technical specifications and operating conditions are given in these operating instructions together with the data sheet, Point 9.

To guarantee the correct assignment of documentation to pump, the commission number on the
- cover sheet
- and data sheet of these operating instructions must match the commission number stated on
- the nameplate of the pump.

6.1.1
See Point 7.2.2 for Lubricant Chart

6.2
Preparation for Operation

6.2.1
Bearing

6.2.1.1
See Point 7.2.1.4 for pump bearing.

6.2.1.2
See manufacturer's documents, Point 10, for drive bearings.

6.2.2
Shaft Sealing

See document OM.SEA.__,.

6.2.3
Filling Up of Suction Side to Avoid Dry Running at Startup

CAUTION

Before switching on the pump, fill the suction-sided pump casing with fluid so that the first rotations will lubricate the conveying elements immediately. A small quantity of fluid is sufficient for lubrication; the subsequent operation of the pump is self-priming, even if an air column up to the liquid level remains.

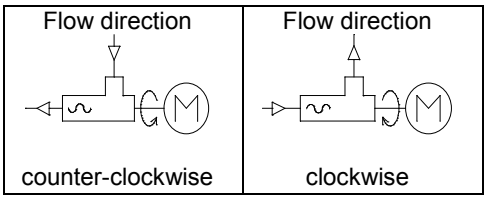
6.2.4
Electric/Hydraulic Connections

The connections are listed in the appended manufacturer's documents, Point 10.

The risk of exposure to electrical hazards must be ruled out. Always observe the safety regulations valid at the site of installation.

6.2.5
Checking Direction of Rotation

The rotational direction of the pump determines the flow direction of the conveying medium.



Prior to commissioning the rotational direction of the pump must be checked for compliance with the data sheet specification and the rotational direction arrow on the type plate of the pump.

6.3
Control and Monitoring Equipment

Where applicable, please refer to the associated documents, Point 10, for information on commissioning.

6.3.1
Performance Check

Any optional extras must be subjected to a performance check in conformity with the specifications by seepex or other manufacturers, see manufacturer's documents.

6.3.2
Setting

Unless already performed in the factory, setting must be carried out in accordance with the appended manufacturer's specifications, Point 10. Pay attention to the operating specifications in the data sheet.

6.4
Equipment for Protection of Persons

Machines must be fitted with mechanical protective devices complying with DIN EN 809.

- Moving or working parts must be protected against accidental contact.
- However, safety considerations demand it be possible at all times to check without hindrance whether the shaft seal is fully functional. A protective guard is necessary in this area only if components are mounted on the rotating, smooth shaft.

- If pumps are operated with an open suction flange/feed hopper, a suitable protective guard complying with DIN EN 294 must be mounted.
- Country-specific protective regu-lations must be observed at the site of installation. Prior to activation of the pump, check the proper function of all protective equipment.

6.5
Commissioning

6.5.1
Initial Startup/Re-starting

CAUTION

Every seepex progressive cavity pump is designed for the specific operating conditions documented in the data sheet. Commissioning is permissible only if the operating conditions conform with those indicated in the data sheet. Although the potential usages of the seepex pump are not confined to the specified operating conditions, any change in the original conditions must be checked and approved by seepex.

The right to make claims under the warranty agreement will be annulled if operating conditions are changed without prior approval by seepex.

6.5.2
Avoid Dry Running of Pump

CAUTION

The dry running of a pump increases the friction between rotor and stator, quickly causing an unacceptably high temperature to develop on the inner surface of the stator. This overheating leads to burning of the stator material and the total failure of the pump.

For this reason it is necessary to ensure that the suction-sided flow never dries up completely. If a continuous flow cannot be guaranteed for the plant, it is essential to fit the seepex dry running protection device TSE, available as an optional accessory.

6.5.3
Check Pressure at Suction and Pressure Flanges

6.5.3.1
Safeguard Pump Against Excessive Pressure at the Suction Flange

The seepex pump is designed to operate with the pressure at the suction flange (suction head or inlet pressure) specified in the data sheet. Deviating pressure conditions may lead to the failure and/or destruction of the shaft seal or entire pump.

For this reason the suction pressure specified in the data sheet must be guaranteed. Appropriate monitoring devices are oil-filled contact mano-meters that deactivate the pump.

6.5.3.2
Safeguard Pump Against Excessive Pressure at the Pressure Flange

The seepex pump operates according to the positive displacement principle. Operation of the pump against an excessive pressure caused by closed valves, by high pressure losses in the piping or by product sedimentation will lead to the destruction of the pump, drive, pipe work and/or downstream equipment. Every progressive cavity pump must therefore be protected against overpressure. Safety valves with bypass pipes or oil-filled contact manometers that disactivate the pump are appropriate protective devices.

6.5.4
Drive Engine

Consult the attached manufacturer's operating instructions, Point 10, for information on commissioning the drive engine.

6.5.5
Establish Clear Passage Through Pipelines

CAUTION

To prevent damage to the pump the unhindered flow of liquid must be guaranteed between the points of entry to and exit from the pipeline. For this reason, open all relevant valves etc. prior to activation of the pump.

6.6
De-commissioning

6.6.1
De-activation

The electric connections must be switched off and protected against accidental re-activation. Observe the safety regulations applying to the plants.

6.6.2
Stationary Pump

The pump and all optional equipment must be provided with the following protection modes while at a standstill:

- Frost protection
- Protection against solid particle deposits
- Protection against sedimentation of the medium
- Corrosion protection for parts in contact with the medium

We recommend that the pipeline and pump be emptied for the duration of the plant standstill. Following evacuation, the pump should be preserved.

6.6.3
Evacuation of the Pump

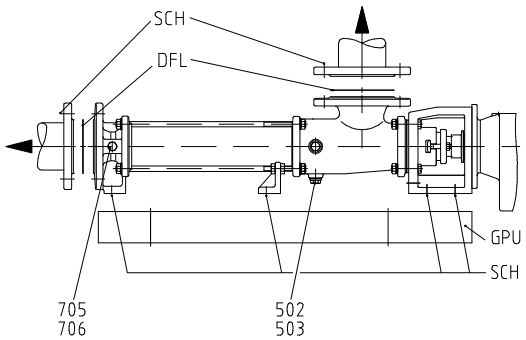
The pipeline must be evacuated on the suction and pressure side or shut-off directly behind the pump connections. Drain any residual liquid in the pump casing by opening/ removing the screwed sealing plugs (705) and (502), sealing rings (706) and (503). Casings without screwed plug must be evacuated by the connection branch (SAG and DRS). Refer to the data sheet and the sectional drawing of the associated operating instruction, Point 9, for information on the pump design. Conveying medium residues always remain in the rotor/ stator chambers and may run out during transport or disassembly of the pump. If conveying aggressive or hazardous media, therefore, wear appropriate protective gear during all installation work.

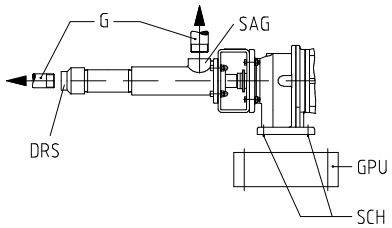
6.6.4
Disassembling the Pump

Dismantle the pipe work by removing the flange bolts (SCH) and flange seals (DFL) or the threaded connections (G).

Disassemble the pump together with the baseplate (GPU) or, as applicable, without the baseplate (GPU) following removal of the bolts (SCH) at the pump feet.

Block-design pumps with direct flange-mounted drive engine are liable to become unstable during disassembly. Stability can be restored by propping up the drive engine.





6.6.5
Preservation/Storage

The pump must be preserved prior to storage. Appropriate preservation measures must be agreed with **seepex**. Always state the pump commission number when making inquiries.

These operating instructions are valid for range MD (stainless steel-design) size 0015-24 to 012-24

7.0
Service and Maintenance

Contents
7.1 General Instructions
7.2 Service and Inspection
7.3 Dismantling
7.4 Re-assembly

The sectional drawing and parts list relevant for Points 7.3 and 7.4 can be found in Point 9.

7.1
General Instructions

A requirement for the reliable operation of any pump is service and maintenance in compliance with instructions. Maintenance personnel must therefore have access to these operating instructions and adhere to them meticulously. seepex will accept no liability for damages arising through non-observance of these operating instructions.

7.2
Maintenance and Inspection

7.2.1
Lubrication

7.2.1.1
Rotor and Stator

The rotor and stator are lubricated by the conveying medium.

7.2.1.2
Shaft Sealing

Consult document OM.SEA.__ for information on lubricating the shaft seal.

7.2.1.3
Pin Joint

The pin joints are filled with special grease and lubricated for the expected duration of service. The seepex joint grease specified in the index of these operating instructions should be used exclusively for any required maintenance work.

CAUTION

Usage of other grease types will lead to premature joint failure and render invalid any right to claims under guarantee.

7.2.1.4
Bearing of the Pump/Drive Engine

The bearing of the rotating pump parts is effected by the drive engine. Lubrication instructions are therefore included in the appended drive engine operating instructions.

7.2.2
Lubricant Filling Levels

Details are specified in the index.

7.2.3
Drives and Optional Extras

For maintenance and inspection specifications, see the appended manufacturer's documents.

7.2.4
Supervision during Operation

7.2.4.1
Shaft Sealing

See document OM.SEA.__.

7.2.4.2
Optional Extras

These must be monitored in accordance with the separate documents, Point 9/Point 10.

7.2.4.3
Drive Engines

These must be monitored in accordance with the separate manufacturer's documents, Point 10.

7.2.5
Preventive Measures

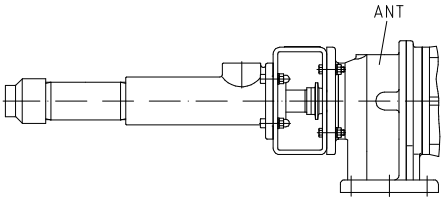
To avoid the expenses incurred by lengthy stop periods of the pump, seepex recommends the acquisition of a set of wearing parts and a set of gaskets. The contents are listed in the document OM.WPS.40.

7.3
Dismantling the seepex Progressive Cavity Pump

Tools are required for dismantling and re-assembly. These tools are listed in Point 9 of the document OM.SPT.01.

The stator (601) and the rotating pump parts can be exchanged in site. The rotating pump parts can be dismantled as a complete rotating unit (RTE) (Point 7.3.4) or as individual components (Point 7.3.5).

Before commencing the dismantling of pump parts, safeguard the pump against tipping over or falling down by fastening it at the drive (ANT).

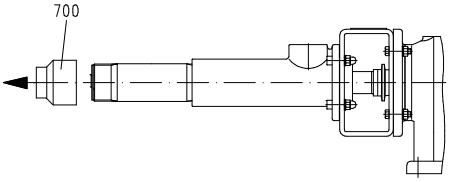


7.3.1
Pressure Flange (700) - Dismantling

Prior to dismantling see Point 7.3.2

CAUTION

Pressure branch (700) is glued in place with an adhesive of medium strength.
Therefore, to break the seal / adhesive compound it is recommended to heat upto a maximum of 80 °C.

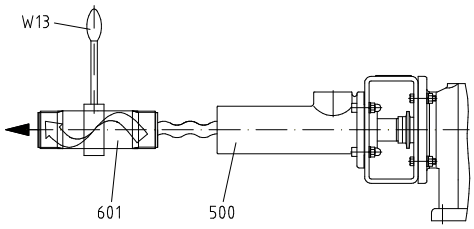


7.3.2
Stator (601) - Dismantling

- Maintenance tip:
  Disassembly of the stator can be made considerably easier by first moistening the inner surface of the stator with antiseize agent (soft or liquid soap). Before removing the pressure flange (700), pour the antiseize agent into the opening between rotor and stator on the pressure flange side. Several clockwise (see Point 6.2.5) revolutions of the rotor will then distribute the antiseize agent over the inner surface of the stator and reduce the friction between rotor and stator considerably.
- Lock drive shaft against rotation.

CAUTION

Stator (601) is glued in place with an adhesive of medium strength. Therefore, to break the seal / adhesive compound it is recommended to heat upto a maximum of 80 °C. Dismantling the stator (601) with tool (W13/see Point 9).



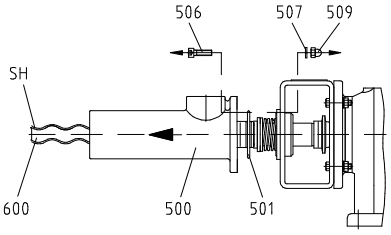
7.3.3
Suction Casing (500), Casing Gasket (501) - Dismantling

Fit the rotor (600) with a protective cover (SH).

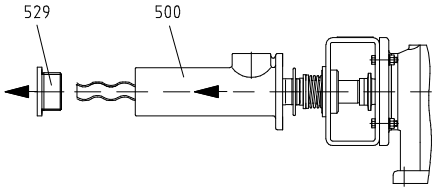
CAUTION

Suction casing (500) with reducing unit (529)
Reducing unit (529) is glued in place with an adhesive of medium strength.
Therefore, to break the seal /adhesive compound it is recommended to heat upto a maximum of 80°C.

Suction casing (500) **without** reducing unit (529)



Suction casing (500) **with** reducing unit (529)

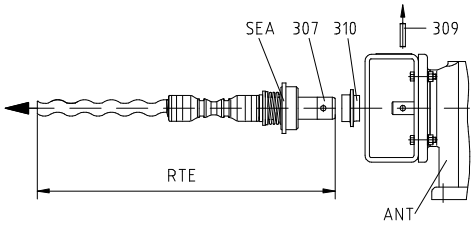


7.3.4
Rotating Unit (RTE) - Dismantling

CAUTION

Before dismantling the rotating unit it is essential to comply with the specifications in document OM.SEA.__ Shaft Seal Dismantling, see Point 9..

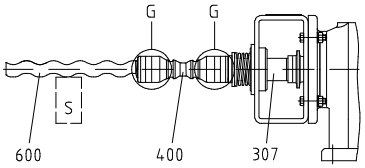
- Remove flushing connections at shaft seal housing (SEA).
- Raise/shift splash ring (310) and eject plug-in shaft pin (309) in horizontal direction.
- Remove rotating unit (RTE)/plug-in shaft (307), together with shaft seal (SEA) from output shaft of the drive (ANT). See Document OM.SPT.01, in Point 9 for tool (W10) used for pulling off.
- See in document OM.SEA.__ for removal of the shaft seal (SEA) from the plug-in shaft (307).



7.3.5
Rotating Pump Parts - Dismantling

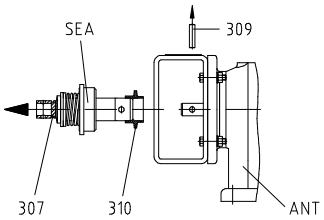
7.3.5.1
Rotor (600), Coupling Rod (400)

Detach the rotor (600) and coupling rod (400) from the plug-in shaft (307) by dismantling the joint (G) in accordance with Point 7.3.6.



7.3.5.2
Plug-in Shaft (307)

The plug-in shaft (307) is removed in the same way as the rotating unit (RTE), see Point 7.3.4.



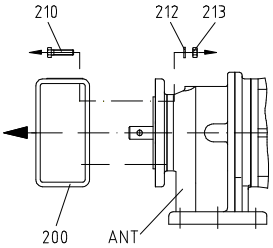
7.3.6
Dismantling of Joint

see document OM.PJT.04 Point 1.

7.3.7
Shaft Sealing

See document OM.SEA.__ for information on dismantling the shaft sealing.

7.3.8
Lantern (200)/Drive (ANT) - Dismantling

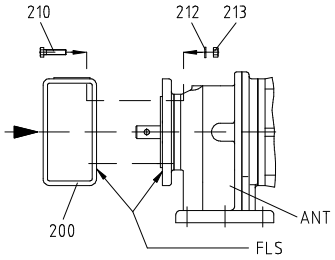


7.4
Re-assembly

Before commencing the re-assembly, fasten the drive (ANT) in such a way that it cannot tip over or fall down during the re-assembly of the drive and all pump components.

7.4.1
Lantern (200)/Drive (ANT) - Assembly

Clean flange bearing surfaces (FLS), centering diameter and output pivot of the drive (ANT).

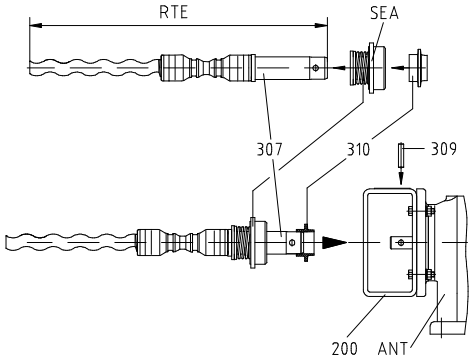


7.4.2
Rotating Unit (RTE) - Re-assembly

The rotating unit (RTE) has been assembled in accordance with the description in document OM.PJT.04

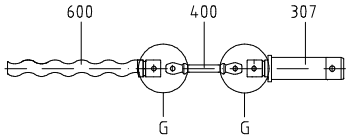
- Mount shaft seal (SEA) on plug-in shaft (307) in the way described in document OM.SEA.__, see Point 9.

- Moisten splash ring (310) and plug-in shaft (307) with joint grease (see index for type) and slide splash ring (310) onto plug-in shaft (307), observing the fitting position of the splash ring, (see lettering on the splash ring).
- Apply antiseize graphite petroleum to the output pivot of the drive (ANT) and slide on the rotating unit (RTE). Insert plug-in shaft pin (309) horizontally.
- Splash ring position (310)
  Outer edge of splash ring (310) has to occlude with outer edge of plug-in shaft (309).



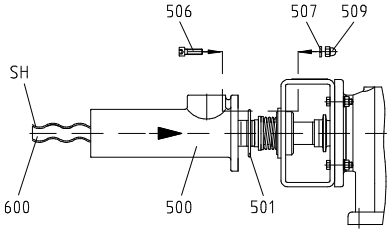
7.4.3
Rotating Pump Parts - Re-assembly

Prepare main components:
Prepare rotor (600), coupling rod (400) and plug-in shaft (307) as described in document OM.PJT.04 Point 2. to 2.3
Joint (G) re-assembly as described in document OM.PJT.04 Point 3.



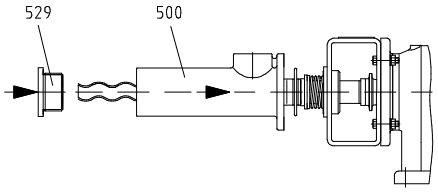
7.4.4
Suction Casing (500), Casing Gasket (501) - Re-assembly

Fit protective cover (SH) on rotor (600).
Assemble casing gasket (501) and suction casing (500).



CAUTION

Install reducing unit (529) to suction casing (500) with an adhesive of medium strength

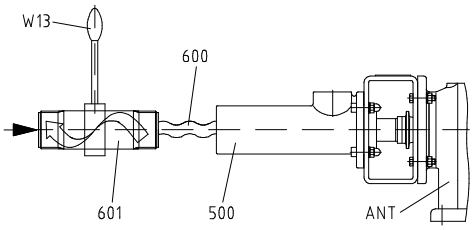


7.4.5
Stator (601) - Assembly / Re-assembly

Maintenance tip:
Disassembly of the stator can be facilitated considerably by first moistening the inner surface of the stator with antiseize agent (soft or liquid soap).
Before removing the pressure flanges (700), pour the antiseize agent into the opening between rotor and stator on the pressure flange side. Several clockwise (see Point 6.2.5) revolutions of the rotor will then distribute the antiseize agent over the inner surface of the stator and reduce the friction between rotor and stator considerably
Lock drive (ANT) shaft against rotation.

CAUTION

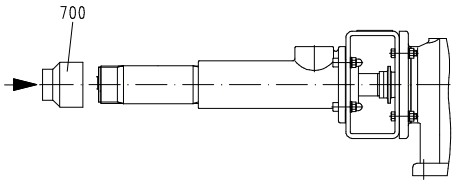
Install external thread of stator (601) with an adhesive of medium strength. Turn stator (601) to the right using a tool (W13/see Point 9), slip it onto rotor (600) and screw it into the suction casing (500) at the same time.



7.4.6
Pressure Flange (700) - Assembly

CAUTION

Install pressure branch (700) with an adhesive of medium strength



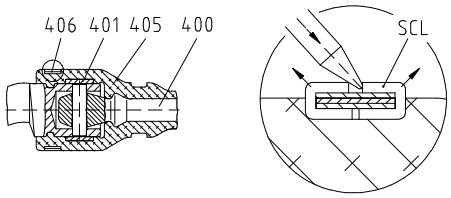
1.0
Dismantling of Joint

1.1
Holding Band (406) - Dismounting

Cut through loop (SCL) of the holding band (406) with a metal saw.

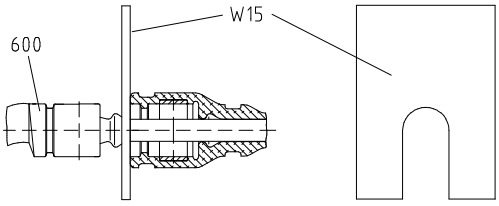
Wear protective goggles when squeezing out the two halves of the holding band loop (SCL).

Remove holding band (406).



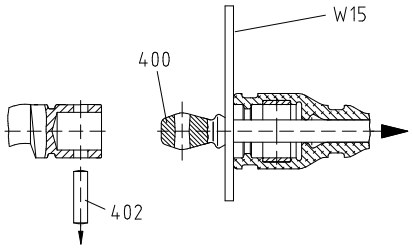
1.2
Rotor (600) - Dismantling

Withdraw universal joint sleeve (405) with retaining sleeve (401) in coupling rod direction and fix it by using a special maintenance tool (W15/see document OM.SPT.01)

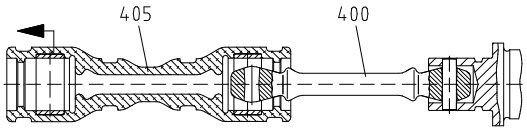


- **Separation of Joint**

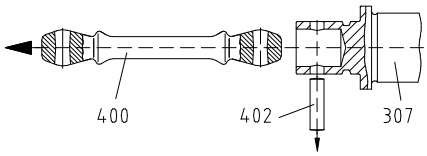
  Eject coupling rod pins (402). Pull coupling rod (400) out of joint top.



1.3
Universal Joint Sleeve (405)

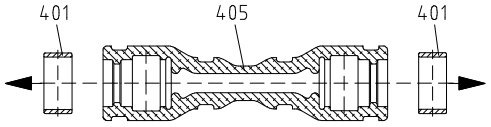


1.4
Coupling Rod (400)



1.5
Retaining Sleeve (401)

Remove retaining sleeve (401) from universal joint sleeve (405).



2.0
Prepare main components for Re-assembly

2.1
Rotor (600) - Preparation for Joint Assembly

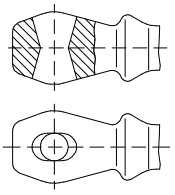
First remove any burr, flaws or similar defects from the rotor, then clean it.
If the hole for the coupling rod pin (402) has worn out, a new rotor (600) has to be installed.

2.2
Coupling Rod (400) - Preparation for the Joint Assembly

Clean coupling rod and check top drilling regarding wear.

CAUTION

If the top drilling shows wear, a new coupling rod will have to be used.



Correct top drilling

2.3
Plug-in Shaft (307) - Preparation for Joint Assembly

Remove any burr, flaws or similar defects from the plug-in shaft (307), then clean it.
If the hole for the coupling rod pin (402) has worn out, a new plug-in shaft (307) has to be installed.

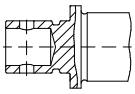
3.0
Joint - Re-assembly

CAUTION

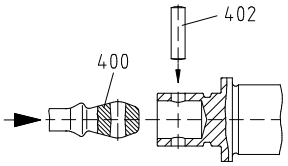
To ensure a perfect operation of the joints, coupling rod pins (402) and coupling rods (400) showing wear should be replaced. Refer to Point 2.2

3.1
Joint Grease (098)

Joint head at rotor (600) and plug-in shaft (307)
Fill joint head with joint grease (098).
(Regarding joint grease (098) refer to index of operating instruction)

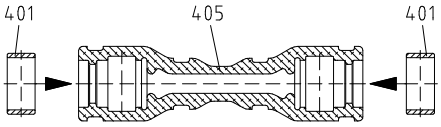


3.2
Coupling Rod (400)



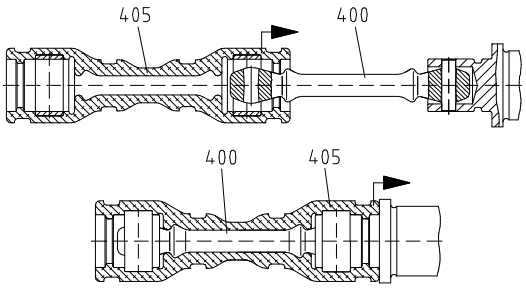
3.3
Retaining Sleeve (401)

Moisten both sides of retaining sleeve (401) with joint grease and insert this unit in universal joint sleeve (405).



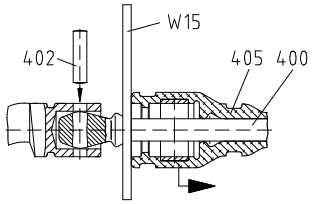
3.4
Universal Joint Sleeve (405)

Moisten surface of coupling rod (400) and inner surface of universal joint sleeve with joint grease Regarding joint grease (098) refer to index of operating instruction.
Slip universal joint sleeve (405) with fitted retaining sleeves (401) onto coupling rod (400) and joint head.



3.5
Rotor (600)

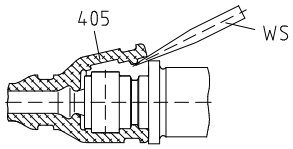
Push back universal joint sleeve (405) at rotor side towards coupling rod (400) and fix it using the relevant tool (W15/refer to document OM.SPT.01).



Slip universal joint sleeve (405) onto joint head.

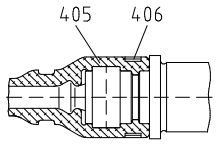
3.6
Universal Joint Sleeve - Deaeration

Deaerate interior space of joint at the side of plug-in shaft and rotor using relevant tool/screw driver (WS)



3.7
Holding Band Re-assembly

Mount holding band (406) using tool (W3/OM:SPT.01) as described in document OM.HBD.01.



Holding Band (HBD) - Assembly

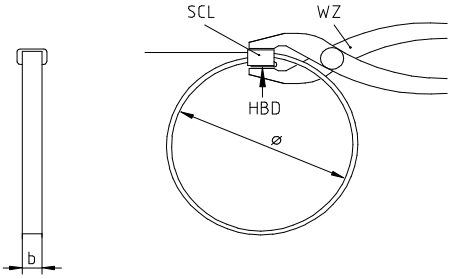
Tools required for the re-assembly, see document OM.SPT.01.

- Prepare holding band

  Only prefabricated double-band holding bands should be used. The diameter (∅) and in particular the breadth (b) of the holding band is matched to the universal joint sleeve.

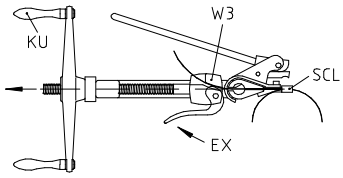
- Test holding band

  The bent holding band (HBD) must fit against the holding band loop (SCL), if necessary apply pressure with the tool/pliers (WZ).

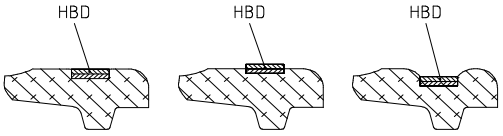


- Assembly of holding band

  Insert holding band in tool (W3/ see Point 9). Hold free end of holding band with control lever (EX), turn crank (KU) until the holding band is strained and fitting against the holding band loop (SCL). Carefully contract holding band until it fits inside the circular groove of the universal joint sleeve.



- Correct holding band tension (HBD)



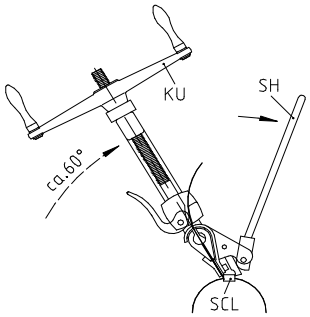
Correct
Holding band (HBD) has slightly con-tracted outer form of univers-al joint sleeve and is stuck in position.

Incorrect
Holding band (HBD) is too slack and liable to slip.

Incorrect
Holding band (HBD) is too tight. Universal joint sleeve will be damaged/sheared off.

- Folding back the holding band (HBD)

  Slowly swivel mounting tool upward by 60°, at the same time slackening the crank (KU) by approximately one half revolution. Swivel cutting lever (SH) forward until the pressure plate fits against the holding band loop (SCL).

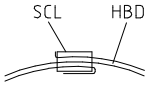


- Shearing off holding band (HBD) made of material AISI 304 and AISI 316

  A blow with the palm of the hand against the cutting lever (SH) causes the end of the holding band behind the loop (SCL) to be folded back and sheared off. If the holding band on the sheared off side is slightly raised as a result, it must be straightened carefully.

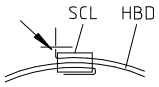
  CAUTION

  Never tap or hammer against the loop of the holding band (SCL), otherwise damage to the universal joint sleeve may occur.



- Shearing off holding band (HBD) made of Hastelloy C

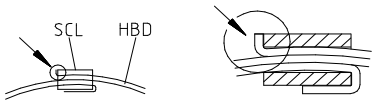
  The high strength of this material makes it impossible to shear off the holding band (HBD) with the cutting lever (SH). Once the end of the holding band is folded back, cut off the holding band (HBD), file off projecting edges and remove burr.



- Check after mounting of holding band

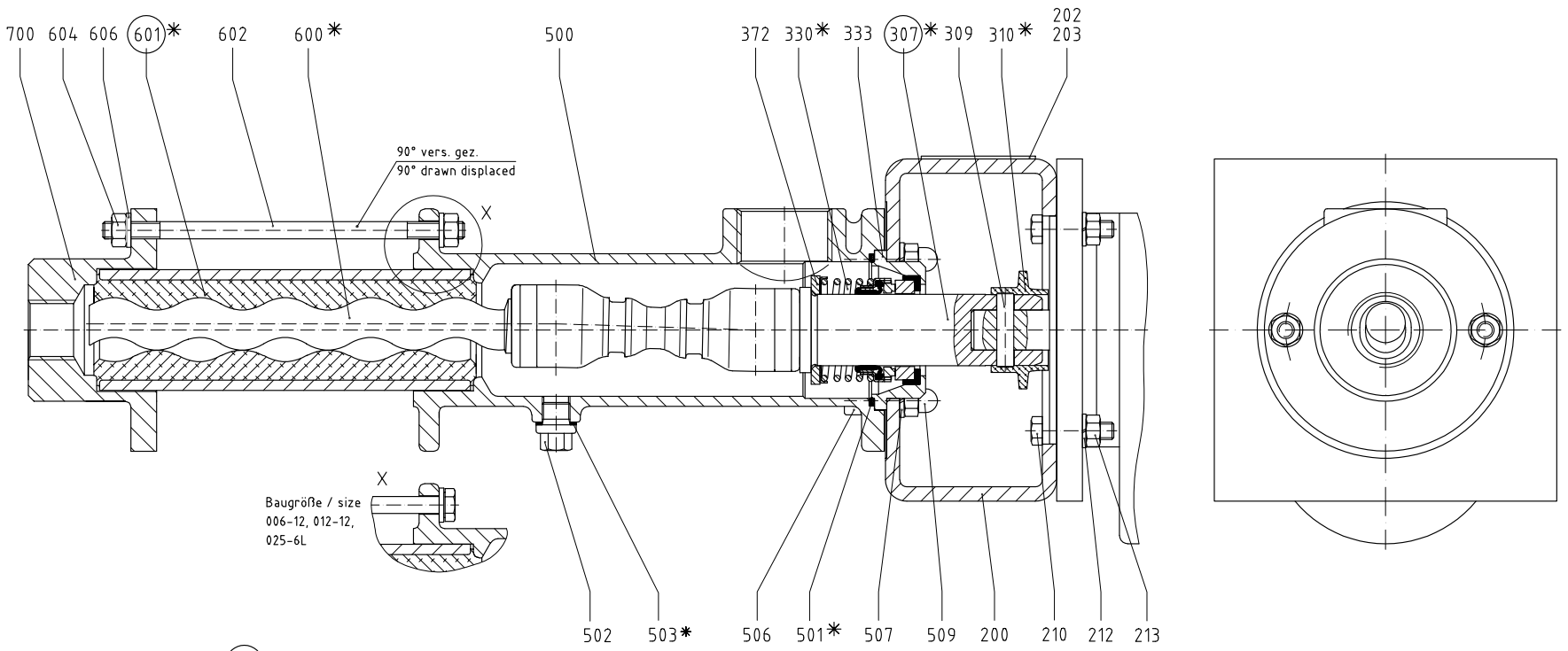
  The holding band must run all the way round the groove of the universal joint sleeve.

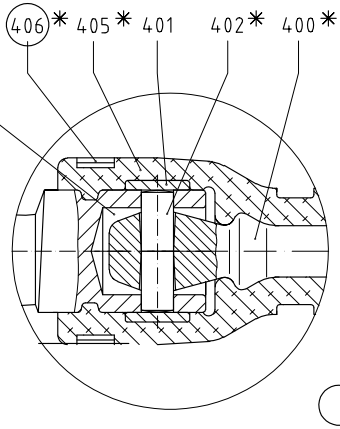
  The holding band (HBD) must be bent back and sheared off at the holding band loop (SCL) in such a way that the holding band (HBD) is unable to slip back through the holding band loop (SCL). If this has not been accomplished, then the holding band (HBD) must be replaced by a new one.



Breakdown											
pump has no suction	pump conveys irregularly	the conveying capacity is not achieved	pressure is not achieved	pump does not start	pump has seized or has stopped conveying	pump operates noisily	motor becomes too warm	the stator wears out early	shaft sealing leaks	seepex progressive cavity pumps will operate trouble-free if they are used in accordance with our data sheet (see item 9) and our operating and maintenance instructions:	
1	2	3	4	5	6	7	8	9	10		Reasons / Remedies
				X			X			a	Adhesion between rotor and stator excessive (as delivered). Lubricate (soft soap, genuine soap) between stator and rotor. Then turn the pump by means of the tool W2 .
X										b	Check rotational direction of the pump per data sheet and nameplate. In case of wrong direction, change wiring of motor.
X	X	X			X	X				c	Suction pipe or shaft sealing leak. Eliminate the leakage.
X	X	X				X				d	Suction head too high (item 6.5.3.1). Check suction head with vacuum gauge. Increase the suction pipe diameter and fit larger filters. Open the suction valve fully.
X	X	X								e	Viscosity of the liquid too high. Check and accommodate per data sheet.
		X		X			X			f	Wrong pump speed. Correct pump speed per data sheet.
	X	X								g	Avoid inclusions of air in the conveying liquid.
		X		X	X		X	X		h	Pressure head too high (point 6.5.3.2). Check pressure head with manometer. Reduce the pressure head by increasing the pressure pipe diameter or by shortening the pressure pipe.
X	X	X			X			X		i	Pump runs partially or completely dry (point 6.5.2). Check flow in the suction chamber. Install dry running protection TSE.
						X	X			j	Check coupling, possibly pump shaft is misaligned to drive. Check whether coupling gear is worn. Realign coupling. The coupling gear has perhaps to be replaced.
X		X								k	Speed too low. Increase the speed when high suction performances are required and when the liquid is very thin.
X	X					X				l	Speed too high. Reduce the speed when pumping products with high viscosities - danger of cavitation.
						X				m	Check the axial play in the coupling rod linkage. Check that the bush has been installed correctly see document OM.PJT.__.
X		X		X	X			X		n	Check for foreign substances in the pump. Dismantle the pump, remove foreign substances and replace worn parts.
X		X	X		X					o	Stator or rotor worn. Dismantle the pump and replace defective parts.
X		X			X	X				p	Joint parts worn. Replace worn parts and fill with special pin joint grease .
X		X			X			X		q	Suction pipework partially or completely blocked. Clean suction pipework.
X				X	X		X	X		r	Temperature of the pumping liquid too high. Excessive expansion of the stator. Check temperature and install rotor with diameter smaller than specified.
X		X		X			X		X	s	Gland packing too strongly tightened or worn. Ease or tighten stuffing box. Replace defective packing rings.
X				X	X			X		t	Solid contents and/or size of solids too large. Reduce pump speed and install perhaps a screen with suitable meshes. Increase fluid share.
X				X				X	X	u	When the pump is non operational the solids settle out and become hard. Clear and flush the pump immediately.
X				X	X			X	X	v	The liquid becomes hard when temperature falls below a certain limit. Heat the pump.
				X	X		X	X		w	Stator swollen and unsuitable for the pumped liquid. Select a suitable stator material. Use perhaps rotor with diameter smaller than specified.
						X			X	x	The bearing in the drive casing of the pump or in the drive engine is defective. Replace bearing.
									X	y	Mechanical seal defective. Check seal faces and O-rings. If necessary replace corresponding defective parts.

9.0
Auxiliary seepex documentation





seepex Gelenkfett

Typ und Füllmenge:
Betriebs- und Wartungsanleitung entnehmen

seepex joint grease

type and filling quantity:
see operating and maintenance instruction

Werkzeug
Betriebs- und Wartungsanleitung entnehmen

tool
see operating and maintenance instruction

* Verschleißteile und Dichtungen
Betriebs- und Wartungsanleitung entnehmen

Wearing parts and sealings
see operating and maintenance instruction

Werkstoff-Ausführung 4440-,
material-construction 4440-,

Stück Unit	Norm Standard	Pos./Item	Benennung/Denomination Zeichnungs-Nummer/Drawing-Number	Werkstoff/Material	Bemerkung/Remark	Gewicht Weight kg

seepex.com

seepex
GmbH + Co KG
Schornhölzstraße 344
46240 Bottrop
www.seepex.com

	Ausgabe Issue	Änderung Modification	Name Name	Datum Date

Maßstab/Scale: %

Werkstoff/Material

Gewicht/Weight

Bezeichnung/Denomination
Schnittzeichnung Baureihe "MD"
sectional drawing range "MD"
mit 2 Spannschrauben
with 2 tie bolts

	Name Name	Datum Date
Bearbeitet/Drawn	ov	18.08.1997
Geprüft/Checked	hue	18.08.1997
Normiert/Standard		
Gedruckt/Printed		

Zeichnungs-Nummer/Drawing-Number
103-007A2

EDV-Nr./EDP-No. L:\LFDZCHNG.245\24646

Ersatz für/Replacement for:

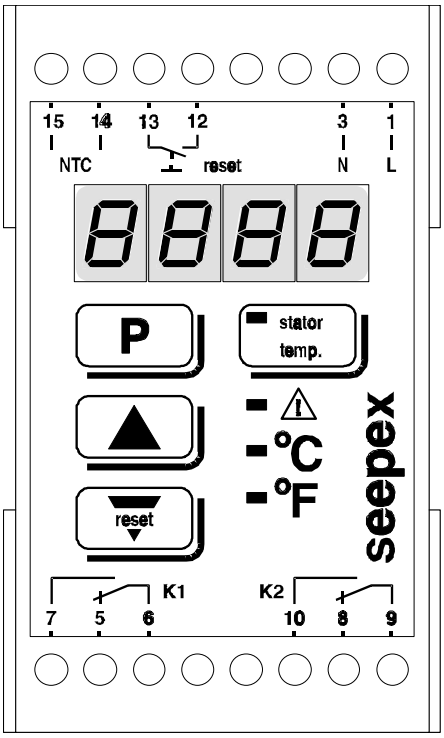
Ersetzt durch/Replacement by:

Allgemeintoleranzen für Maße ohne einzelne Toleranzeintragung DIN ISO 2768-mittel
General tolerances for mass without individual tolerance entry DIN ISO 2768-average

Rauheit für Oberflächenzeichen DIN ISO 1302 Reihe 2
Roughness for surface finish indication DIN ISO 1302 Reihe 2

Stückliste
Parts List
Liste des pièces

Stck.	Pos.	DE **Baureihe MD** **Schnittzeichnung Nr. 103-007_2** **Benennung Stck. / Pos.**	GB **range MD** **sectional drawing No. 103-007_2** **denomination Qty. / item**	FR **série MD** **plan no. 103-007_2** **désignation Qté. / Poste**
1	200	Laterne	lantern	lanterne
2	202	Halbrundkerbnägel	round head grooved pin	rivet
1	203	Typenschild	type plate	plaque signalitique
4	210	6kt-Schraube	hexagon bolt	vis
4	212	Federring	spring washer	rondelle frein
4	213	6kt-Mutter	hexagon nut	écrou
1	307	Steckwelle	plug-in shaft	arbre à broche
1	309	Steckwellenbolzen	plug-in shaft pin	cheville pour arbre à broche
1	310	Spritzring	splash ring	bague de projection
1	330	Gleitringdichtung	mechanical seal	garniture mécanique
1	333	Gleitringdichtungsgehäuse	mechanical seal casing	carter de la garniture mécanique
1	372	Stützring	support ring	bague d'appui
1	400	Kuppelstange	coupling rod	barre d'accouplement
2	401	Gelenkhülse	retaining sleeve	douille d'articulation
2	402	Kuppelstangenbolzen	coupling rod pin	axe d'articulation
1	405	Manschette	universal joint sleeve	manchette
2	406	Halteband	holding band	collier de serrage
1	500	Sauggehäuse	suction casing	carter d'aspiration
1	501	Sauggehäusedichtung	casing gasket	étanchéité du carter d'aspiration
4	506	Zylinderschraube	socket screw	vis à tête cylindrique
4	507	Federring	spring washer	rondelle frein
4	509	6kt-Mutter	hexagon nut	écrou
1	600	Rotor	rotor	rotor
1	601	Stator	stator	stator
2	602	6kt-Schraube	hexagon bolt	vis
2	604	6kt-Mutter	hexagon nut	écrou
2	606	Scheibe	washer	rondelle
1	700	Druckstutzen	pressure branch	bride de refoulement
	098	seepex Gelenkfett Typ und Füllmenge: Betriebs- und Wartungsanleitung entnehmen	seepex joint grease type and filling quantity: see Operating and Maintenance Instruction	seepex graisse d' articulations sommaire pour type et quantité: voir Instructions de service et d'entretien
		Verschleißteile und Dichtungen: Betriebs- und Wartungsanleitung entnehmen	Wear parts and sealings: see Operating and Maintenance Instruction	pièces d'usure et étanchéités: voir Instructions de service et d'entretien
		Werkzeuge: Betriebs- und Wartungsanleitung entnehmen	Tools: see Operating and Maintenance Instruction	Outils: voir Instructions de service et d'entretien
		versetzt gezeichnet	drawn displaced	plan separé



CONTENTS:

1.0 General

1.1 Introduction

Progressive cavity pumps should generally be protected against dry-running. Due to the increased friction between the main conveying elements ie. rotor and stator, which occurs in the event of dry-running the pump, the temperature at the internal surface of the stator can quickly rise depending on the pump speed.
When exceeding the max. permissible operating temperature the internal surface of the stator will burn and cease operation. If this occurs the stator needs to be replaced. The possible malfunction of an progressive cavity pump can be easily avoided by using the patented dry-running protection device TSE.

1.2 Function

The general operating principle of the dry-running protection device TSE is to continuously monitor the temperature in the stator and to trip the pump when reaching a limit temperature. The temperature in the pump stator is compared with the pre-set trip temperature via a NTC temperature sensor, which is fitted in the stator of the pump as well as the TSE control device, which is positioned in the control panel. In case of dry-running of the pump and a temperature increase in the stator up to the pre-set switch-off value, two relays will switch.

The drive motor of the pump will be switched-off via the potential-free changeover contacts and a fault message will be released. After rectification of the cause of the dry-running and the cooling down of the stator, the fault message at the TSE device can be acknowledged and the pump can be switched on again.

By acknowledging the fault message an automatic re-connection without inspection and correction of the cause of the dry-running is avoided.

2. 0 Technical Data

2.1 Temperature Sensor

The NTC thermister is installed in a stainless steel protection sleeve in the stator of the pump.
Permissible Temperature Range: 0-150 ºC
Standard Resistance: 10 kOhm at 25 ºC

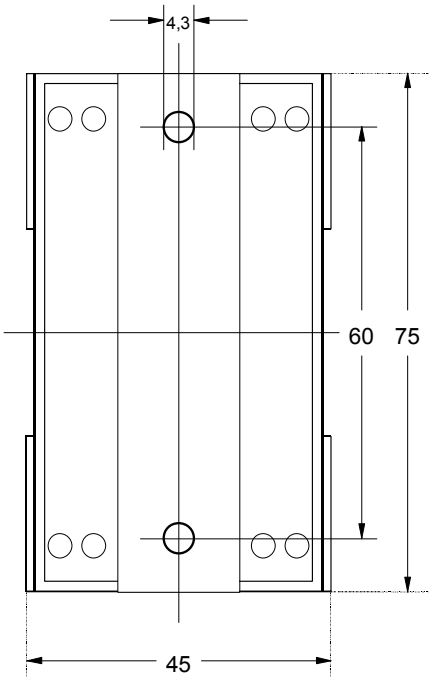
Temp. °C	Resistance Ohm	Temp. °C	Resistance Ohm
0	32.650	70	1.752
10	19.900	80	1.255
20	12.490	90	915
25	**10.000**	100	678
30	8.057	110	510
40	5.327	120	389
50	3.603	130	301
60	2.488	140	235

2.2 TSE Control Device for Installation in Control Panel

2.2.1 Technical Data

Type:	SGRTSE 230 AC, SGRTSE 115 AC, SGRTSE 24 AC, SGRTSE 24 DC
Temperature Range:	0-150 ºC
Input:	NTC temperature sensor 10 kOhm (at 25 ºC) with sensor breaking protection at - 25 ºC.
Relay Output: changeover	2 potential-free contacts (K1,K2), breaking capacity 500 VA at 110/230 V Ohmic load.
Deliverable Operating Voltage:	24V, 115V, 230V AC; 24V DC
Power Consumption:	max. 4VA
Sensor Circuit:	No load voltage max. 2.5 VDC Short circuit current 0.5 mA DC
Display at Device:	Fault/Dry Running Trip temperature Stator temperature
Operation at Device:	Adjustment of trip temperature. Reset of fault message.
Casing Material:	ABS
Fastening:	Mounting on standard rail 35 mm acc. to standards or screw fixings acc. to standards
Kind of Protection:	Casing IP 40 Terminals IP 20
Ambient Temperature:	0-50 ºC
Dimension:	45x75x110 mm (WxHxD)
EMV (89/336/EEC)	CE conform acc. to standards

2.2.2
Dimensions and Wall Mounting



Installation Depth = 110 mm

3.0
Electrical Connection of the TSE

3.1
Installation Instructions

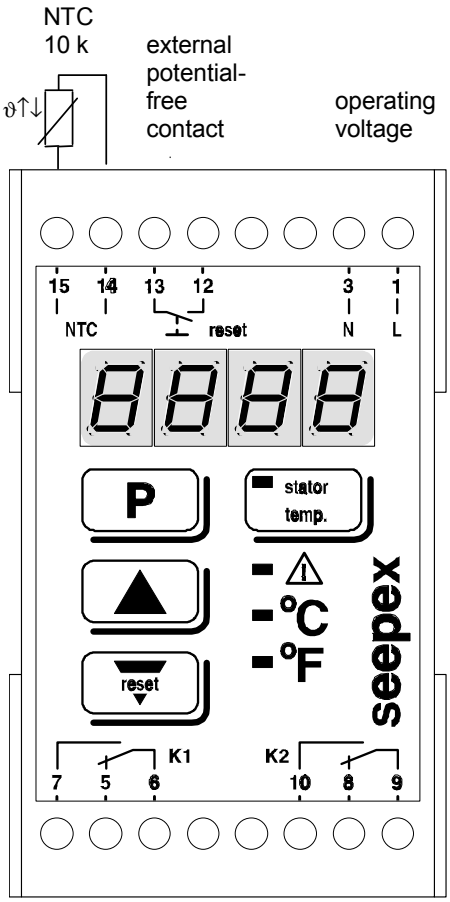
Prior to the connection and the commissioning of the device it has to be ensured that the supply voltage corresponds to the nominal voltage shown on the name plate. Nominal voltage fluctuations are permissible in the range of +/- 10 % of the device's nominal voltage.

The electrical connections have to be carried out in accordance with the wiring diagram and the regulation of the local EVV or the VDE directions.

In case of power fluctuations which lead to a malfunction of the device, adequate procedures have to be taken to avoid its reoccurrence. Alternatively these errors could be filtered out by an external supply filter. The device has to be provided with an internal supply filter.

Sensor leads have to be shielded. The shield has to be earthed at one end.

3.2
Connection Diagram of TSE Control Device



Should the TSE control device be reset after a dry-running from the control panel door or another remote position, a button ("make contact") at the terminals 12 +13 can be used.

3.3.
Relay Function

Actual temperature ‹ trip temperature
(trouble free operation)
Contacts 6 to 7 and 9 to 10 closed
Contacts 6 to 5 and 9 to 8 open

Actual temperature › trip temperature
(Malfunction/Dry Running)
Contacts 6 to 5 and 9 to 8 closed
Contacts 6 to 7 and 9 to 10 open

Relays K1 and K2 are switched parallel to each other and operate simultaneously. K1 is integrated in the motor contactor control serving as a switch-off provision. K 2 is optional as stand by for additional connection to a fault indicator or as a reserve to the process control computer.

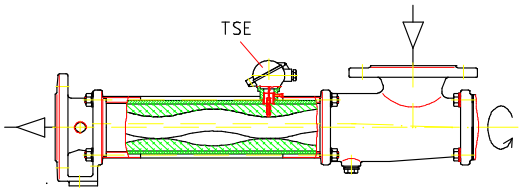
4.0
Procedures prior to Commissioning

4.1
Check Position of the Temperature Measuring Point at the Pump

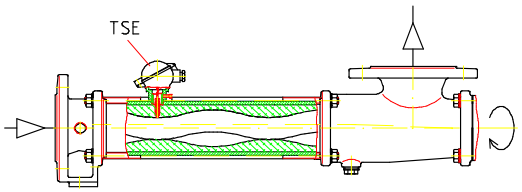
Considering the rotating direction and thus the conveying direction of the pump, the temperature sensor is fitted in our factory as per the following figures.

When changing direction of the pump and when replacing the stator the specified installation position of the temperature measuring point has to be checked. The temperature sensor must always be installed at the product entry side of the stator as the quickest temperature increase in case of dry-running will arise at this point.

4.1.1
Pump "counter clockwise rotation" - standard construction



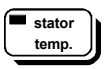
4.1.2
Pump "clockwise rotation" special construction



4.2
Function Check

After the electrical connection of the TSE and prior to the initial operation of the pump the following function check has to be carried out.

Switch-on control voltage at terminals 1 and 3 (Digital display at the TSE control device illuminates).



Press and hold button "stator temp" and read the temperature value.

If the shown temperature correspond to the ambient temperature in the pump the TSE is functioning correctly. In case of deviation proceed as per paragraph 7 - Malfunctioning.

4.3
Approximate Adjustment of Trip Temperature

The TSE control device is pre-set to a trip temperature of 50 ºC prior to leaving our factory. In order to achieve the shortest trip time after a dry-run and thus the max. protection of the pump stator, the trip temperature at the TSE control device has to be set as low as possible.

For the initial commissioning the temperature value pre-set in our factory should be maintained. Should the product have higher temperatures the value has to be adjusted to 20 to 30 ° C above the temperature of the conveying product.

Switch on control voltage. After self-check of the control device the actual pre-set temperature will show at the display.

Press and release button. Adjusting Mode is activated. The displays shows alternately "set" and the last set trip temperature.

Increasing the trip temperature - press button and release.
The adjusted temperature increases by + 1ºC. Press button and hold approx. 3 seconds in + 10 ° C steps.

Decreasing of trip temperature - press button and release.
The adjusted temperature decreases by - 1º C. Press button and hold approx. 3 sec. in - 10º C steps.

Press and release button. Return the unit to the operating mode. The adjusted trip temperature is transferred to a continuous memory and shown on the display.

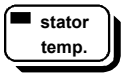
Note: During the adjusting mode, if a button is not pressed within 10 seconds the controller automatically returns to the operating mode and disregards any previous adjustment.

Following the above approximate instruction, the seepex pump can operate for a limited period of time (approx. 1 hour). Then a correction of the adjustment according to paragraph 5 - Fine Adjustment - has to be carried out.

5.0 Commissioning and Operation

5.1 Fine Adjustment of the Trip Temperature

Following the instruction for approximate adjustment in paragraph 4.3 the seepex pump has to operate for at least 30 to 60 minutes to allow the operating temperature in the stator become stable.



While the pump is in operation the temperature of the pump is shown on the display of the TSE controller by continuously pressing the button.

The final trip temperature has now to be set 10 ºC higher then the indicated operating temperature according to the instructions in paragraph 4.3.

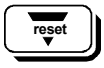
Attention

For all adjustments the max. product temperature occurring during operation has always to be considered. In case of a product temperature higher than 40 ºC, it always has to be checked if this is mentioned in the data sheet of the pump and has therefore been considered in the rotor/stator design. If the temperature shown on the data sheet does not correspond to the actual temperature, please contact seepex.

5.2 Resetting of the Control Device after Dry-Running

In the event of dry-running of the pump and temperature increase in the stator above the pre-set limit value, the installed relays trip and maintain locked in this position. After the pump has cooled down the remaining fault message (red LED) has to be acknowledged using one of the following procedures, so that the relay will be reset.

5.2.1



Press at the TSE control device for at least 1 sec.

5.2.2

Switch-off operating voltage at TSE control device (terminals 1-3).

5.2.3

With external contact (reset button, closed for at least 1 sec.)

5.3 Changeover of the Display from ºC to ºF.

Press and hold button for 10 secs. until display changes over.

The selected temperature units are shown via an LED next to the Symbol ºC or ºF.

6.0 Replacement of Stator

6.1 Order of Replacement Stator

When ordering a replacement stator for a seepex pump, please quote:

Stator drilled for TSE fitted with sensor sleeve in 1.4571.

If the pump is used to convey highly corrosive products where 1.4571 material is not resistant, a sensor sleeve made of 2.4610 (Hastelloy C4) has to be ordered.

Attention

The sensor sleeve is fitted in our factory. It is pre-set for operation and may not be adjusted.

6.2 Dismantling/Re-Assembly of the Connection Head and Temperature Sensor.

The following drawings apply:

- For TSE in elastic stators:
  Drawing No. 702-000/0000-0-009 __
  for pump sizes 006-12 and 025-6L.

  Drawing No. 702-000/0000-0-008 __
  for pump sizes 025-12 to 500-6LA.

- For TSE in fixed stators:
  Drawing No. 702-000/0000-0-005 __

6.2.1 Dismantling

Lift the cover of the connection head and disconnect wires of the temperature sensor. After having loosened the side screw slide the connection head off the threaded sleeve. Remove threaded sleeve from the stator and remove clamping ring, rubber ring and temperature sensor from sensor sleeve. The temperature sensor cannot be re-used and can thus be disposed off with the damaged stator.

6.2.2
Re-Assembly

The items mentioned in paragraph 6.2.1 have to be re-installed into the new stator. It is vital to consider the temperature measuring point when installing the stator (refer to paragraph 4.1).

Do not further adjust or change the sensor sleeve setting as this has already been done in our factory.

Remove protective pipe (protective transport packaging).

Push the thermistor sensor with clamping screws and rubber ring to the bottom of the sensor sleeve and adjust.

Screw the threaded sleeve with 2 O-Rings in the tapped hole at the stator.

When installing the connection head, the connection wires of the thermistor sensor must be threaded through the hole in the junction box. After fastening the connection head on the threaded stator barred, recannect wires and put the cover back onto the connection head.

7.0
Malfunction

7.1
General

Fault messages and switch-off of the pump without actual dry-running or overload might be caused by a defect in the temperature sensor wire, the TSE control device or other electrical switch devices.

The following reasons might have caused this error alarm at the TSE control device:

break of sensor or line
short circuit of sensor or line
measuring range (-25 ...150°C) is exceeded or remained under

The following procedure is recommended to check the TSE control device and the sensor circuit including temperature sensor:

7.2
Function Check of Sensor Circuit

Disconnect the temperature sensor wire at the TSE control device terminals 14 and 15 and connect a resistance measuring device (Multimeter or Ohmmeter). The measured electrical resistance must conform with the value in the table shown in paragraph 2.1 in accordance with the pump temperature. In case of deviations of the resistance value of more than 10% of the set value, measure the resistance at the connection head of the TSE at the pump. To do this the wire to the control device at the connection head of the pump needs to be removed. If the same deviations occur when measuring the resistance at the temperature sensor
directly at the pump, the temperature sensor is damaged and needs to be replaced (refer to paragraph 6.2 and 6.3).

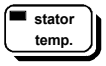
Should the resistance check at the temperature sensor show correct values, then damage to the connection cable or the connection terminal is the cause of malfunction.

7.3
Function Check of TSE Control Device

If an trouble-free sensor circuit has been determined during the testing according to paragraph 7.2, damage to the TSE control device is most likely. In order to carry out the check, remove the sensor wires at terminals 14 and 15 and connect a commercial deposited carbon or metal film resistor as per the following list.:

Resistance (Ohm)	Switching Temp. °C
10.000	25
5.600	39
2.200	63
1.000	87
560	107
220	143

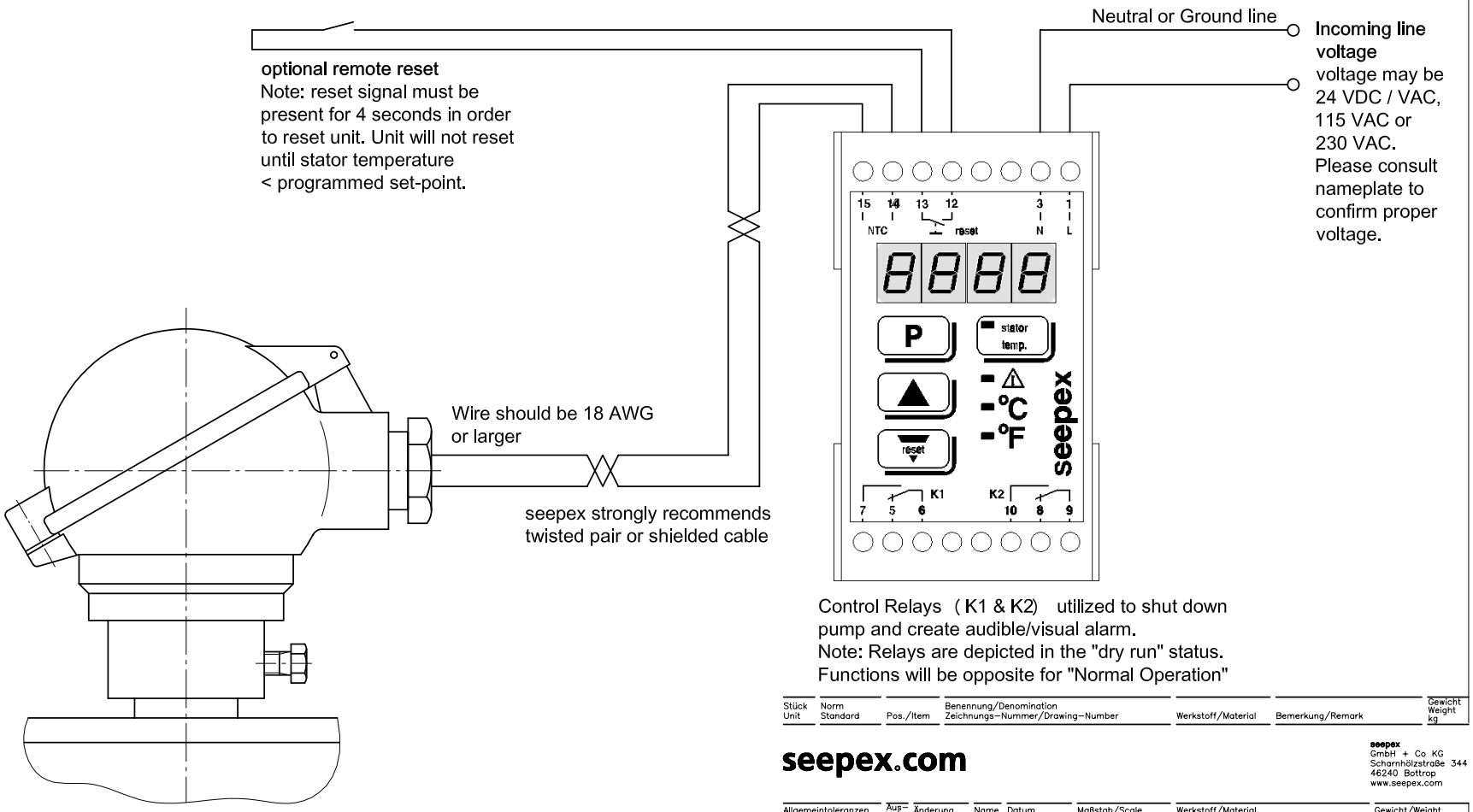
Switch-on control voltage at terminal 1+3
(Digital Display at the TSE device illuminates)



Press and hold button “stator temp.” and read the temperature value.

The shown value must correspond to the switch temperature, which applies to the resistance used. Should the shown value deviate by more than 5-10 ºC or should the value be absent at all, the TSE control device must be sent to seepex for repair.

TSE Control Unit



Control Relays (K1 & K2) utilized to shut down pump and create audible/visual alarm.
Note: Relays are depicted in the "dry run" status. Functions will be opposite for "Normal Operation"

TSE Pump side parts

Stück Unit	Norm Standard	Pos./Item	Benennung/Denomination Zeichnungs-Nummer/Drawing-Number	Werkstoff/Material	Bemerkung/Remark	Gewicht Weight kg

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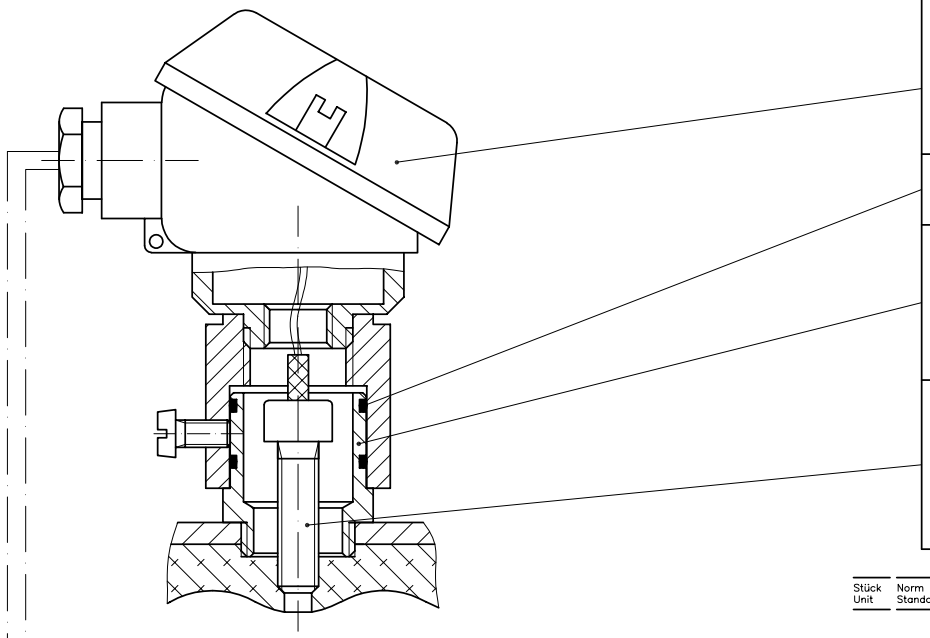
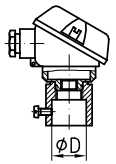
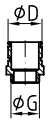
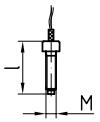
46240 Bottrop
www.seepex.com

Allgemeintoleranzen für Maße ohne einzelne Toleranzeintragung DIN ISO 2768-mittel General tolerances for mass without individual tolerance entry DIN ISO 2768-average	Ausgabe Issue	Änderung Modification	Name Name	Datum Date	Maßstab/Scale %	Werkstoff/Material	Gewicht/Weight
					Bezeichnung/Denomination: Simplified wiring instruction for seepex TSE dry running protection (seepex Inc.)		

Rauheit für Oberflächenzeichen DIN ISO 1302 Reihe 2 Roughness for surface finish indication DIN ISO 1302 Reihe 2		Name Name	Datum Date	Zeichnungs-Nummer/Drawing-Number
	Bearbeitet/Drawn	hof	20.03.2006	711-TSE/0000-0-005A3
	Geprüft/Checked	ham	20.03.2006	EDV-Nr./EDP-No. 75657.dwg
	Normiert/Standard			Ersatz für/Replacement for: / Ersetzt durch/Replacement by:
	Gedruckt/Printed			



Elektrischer Anschluß siehe TSE-Betriebs- und Montageanleitung
Electric connection see TSE operating and assembly instructions

			Pumpen-Baugröße pumpe size
			006-12 006-24 012-12 012-24 025-6L
	Anschlußkopf connection head	Pos. item	650
		Typ type	MA
		ØD	20.1+0.2
	O-ring o-ring	Pos. item	651
		Größe size	ø16x1.5
	Gewindehülse screw socket	Pos. item	652
		ØD	ø19.9-0.1
		ØG	G3/8"
	Thermistor- Fühlerschraube thermistor sensor screw	Pos. item	653
		Größe size	F6-25
		M	M6
		l	31

Stück Unit	Norm Standard	Pos./Item	Benennung/Denomination Zeichnungs-Nummer/Drawing-Number	Werkstoff/Material	Bemerkung/Remark	Gewicht Weight kg

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Allgemeintoleranzen für Maße ohne einzelne Toleranzeintragung DIN ISO 2768-mittel

General tolerances for mass without individual tolerance entry DIN ISO 2768-average

Rauheit für Oberflächenzeichen DIN ISO 1302 Reihe 2

Roughness for surface finish indication DIN ISO 1302 Reihe 2

Ausgabe Issue	Änderung Modification	Name Name	Datum Date
B	überarbeitet	hof	17.06.1996
C	Baugröße 01-48	ov	23.09.1998
D	01-48 entfällt	hof	15.12.1998
E	Nachtrag 025-6L	hof	06.01.1999
F	025-12T,05-6LT	hof	29.04.2002
G	025-12,05-6LT raus	hof	18.02.2003

	Name Name	Datum Date
Bearbeitet/Drawn	hof	17.06.1996
Geprüft/Checked	wgr	18.06.1996
Normiert/Standard		
Gedruckt/Printed		

Maßstab/Scale 1:1

Werkstoff/Material

Gewicht/Weight

Bezeichnung/Denomination

TSE / Pumpenseitige Teile
TSE / pumpsided parts
für elastische Statoren / for elastic stators

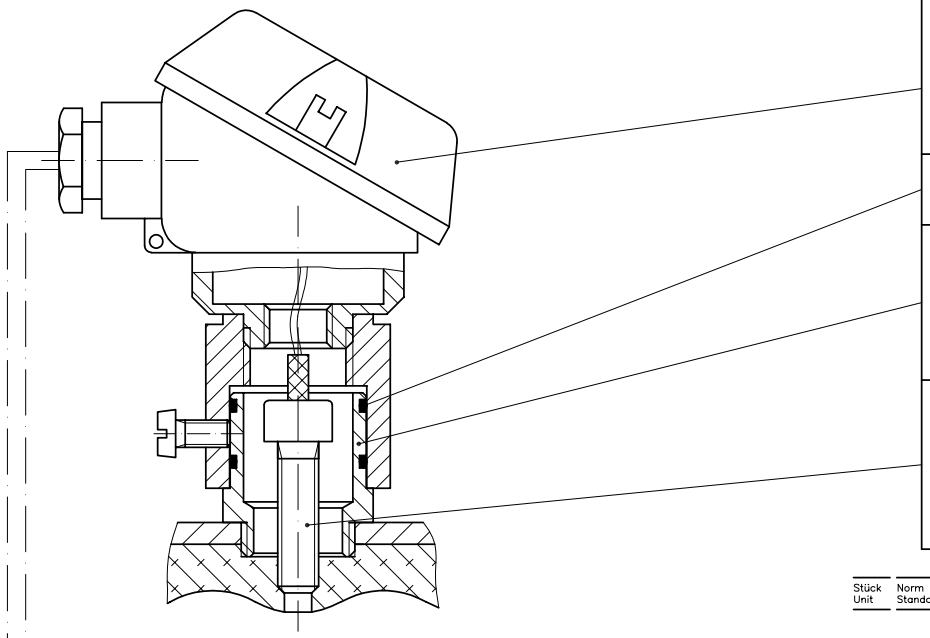
Zeichnungs-Nummer/Drawing-Number

702-000/0000-0-009G3

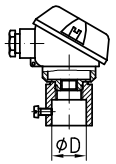
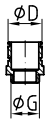
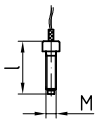
EDV-Nr./EDP-No. 14998.dwg

Ersatz für/Replacement for: A2428-4

Ersetzt durch/Replacement by:



Elektrischer Anschluß siehe TSE-Betriebs- und Montageanleitung
Electric connection see TSE operating and assembly instructions

			Pumpen-Baugröße pumpe size
			006-12 006-24 012-12 012-24 025-6L
	Anschlußkopf connection head	Pos. item	650
		Typ type	MA
		ØD	20.1+0.2
	O-ring o-ring	Pos. item	651
		Größe size	ø16x1.5
	Gewindehülse screw socket	Pos. item	652
		ØD	ø19.9-0.1
		ØG	G3/8"
	Thermistor- Fühlerschraube thermistor sensor screw	Pos. item	653
		Größe size	F6-25
		M	M6
		l	31

Stück Unit	Norm Standard	Pos./Item	Benennung/Denomination Zeichnungs-Nummer/Drawing-Number	Werkstoff/Material	Bemerkung/Remark	Gewicht Weight kg

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Allgemeintoleranzen für Maße ohne einzelne Toleranzeintragung DIN ISO 2768-mittel

General tolerances for mass without individual tolerance entry DIN ISO 2768-average

Rauheit für Oberflächenzeichen DIN ISO 1302 Reihe 2

Roughness for surface finish indication DIN ISO 1302 Reihe 2

Ausgabe Issue	Änderung Modification	Name Name	Datum Date
B	überarbeitet	hof	17.06.1996
C	Baugröße 01-48	ov	23.09.1998
D	01-48 entfällt	hof	15.12.1998
E	Nachtrag 025-6L	hof	06.01.1999
F	025-12T,05-6LT	hof	29.04.2002
G	025-12,05-6LT raus	hof	18.02.2003

	Name Name	Datum Date
Bearbeitet/Drawn	hof	17.06.1996
Geprüft/Checked	wgr	18.06.1996
Normiert/Standard		
Gedruckt/Printed		

Maßstab/Scale 1:1

Werkstoff/Material

Gewicht/Weight

Bezeichnung/Denomination

TSE / Pumpenseitige Teile
TSE / pumpsided parts
für elastische Statoren / for elastic stators

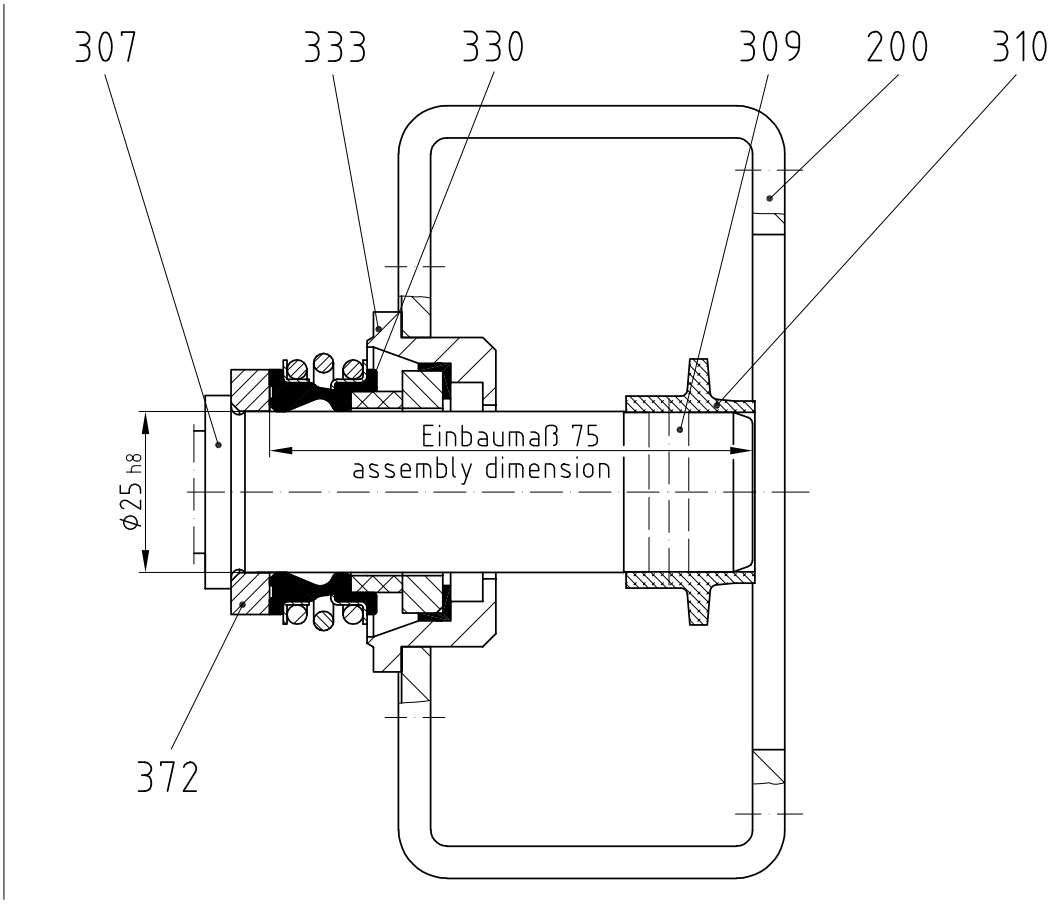
Zeichnungs-Nummer/Drawing-Number

702-000/0000-0-009G3

EDV-Nr./EDP-No. 14998.dwg

Ersatz für/Replacement for: A2428-4

Ersetzt durch/Replacement by:



Stück Unit	Norm Standard	Pos./Item	Benennung/Denomination Zeichnungs-Nummer/Drawing-Number	Werkstoff/Material	Bemerkung/Remark	Gewicht Weight kg
1		372	Stützring / support ring 062-372/M120-0-060A4			
1		333	GLRD-Gehäuse / mechanical seal casing 103-333/M120-0-005A4			
1		330	GLRD / mechanical seal MG1/ϕ25-G60		Fabrikat / make : Burgmann	
1		310	Spritzring / splash ring 062-310/M120-0-001A4			
1		309	Steckwellenbolzen / plug-in shaft pin 062-309/M120-0-001A4			
1		307	Steckwelle / plug-in shaft 103-307/M120-0-304E4			
1		200	Laterne / lantern 103-200/M120-0-____			

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Allgemeintoleranzen für Maße ohne einzelne Toleranzeintragung DIN ISO 2768-mittel

General tolerances for mass without individual tolerance entry DIN ISO 2768-average

Rauheit für Oberflächenzeichen DIN ISO 1302 Reihe 2

Roughness for surface finish indication DIN ISO 1302 Reihe 2

Ausgabe Issue	Änderung Modification	Name Name	Datum Date

	Name Name	Datum Date
Bearbeitet/Drawn	hgg	28.05.2004
Geprüft/Checked	kno	28.04.2004
Normiert/Standard		
Gedruckt/Printed		

Maßstab/Scale: 1:1 ◎▷

Werkstoff/Material:

Gewicht/Weight:

Bezeichnung/Denomination

GLRD Schnittzeichnung
mechanical seal sectional drawing

Burgmann MG1/ϕ25/G60 für Sondermaterial / for special material
mit erhöhter Vorspannung/ with increased pre-clamping

Zeichnungs-Nummer/Drawing-Number: 103-0GB/M120-0-129A4

EDV-Nr./EDP-No. 62810.dwg

Ersatz für/Replacement for:

Ersetzt durch/Replacement by:

1.
General

- Please take the appertaining drawing from respective pump data sheet.

- The mechanical seal is suitable for the operating conditions indicated in the pump data sheet. Modifications are only admissible after the customer has consulted with **seepex**. Additionally, attention must be paid to the manufacturer's operating manual.

2.
Safety

Any mode of operation impairing the operating safety of the mechanical seal has to be avoided.

The operator is advised to consider the possible effects on the environment which could be caused by a defective mechanical seal and what additional measures must be taken to protect the environment and the public.

The pump must be mounted and operated in such a way that operation with a defective mechanical seal will not result in injury or harm to the public and that any leakage can be safely and properly dealt with.

Mechanical seals are often used to seal hazardous material (chemicals, drugs, etc.). It is essential that rules pertaining to the handling of hazardous materials are adhered to.

Modifications effected by the customer himself and changes influencing the safety of the mechanical seal are not allowed.

3.
Emissions

A mechanical seal is a dynamic seal and leakage is unavoidable.

ATTENTION

Components that may contact leakage must be resistant to corrosion or be protected accordingly.

Mechanical seal leakage must be drained in a safe and proper manner.

1.0
General

- Please take the appertaining drawing from respective pump data sheet.
- The mechanical seal is suitable for the operating conditions indicated in the pump data sheet. Modifications are only admissible after the customer has consulted with seepex. Additionally, attention must be paid to the manufacturer's operating manual.

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Any mode of operation impairing the operating safety of the mechanical seal has to be avoided.

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3.0
Emissions

A mechanical seal is a dynamic seal and leakage is unavoidable.

ATTENTION

Components that may contact leakage must be resistant to corrosion or be protected accordingly.

Mechanical seal leakage must be drained in a safe and proper manner.

4.0
Flushing or circulation of single-acting mechanical seals

Single-acting mechanical seals contacting the conveying liquid require no additional flushing or a circulation pipe because sufficient flushing and heat exchange occurs around the seal due to the conveying liquid.

However, in particular cases, a direct flushing pipe can be installed into the flushing connection on the mechanical seal housing.

5.0
Commissioning

Regardless of the pump's operating status, the conveying medium to be sealed must always be in liquid form at the mechanical seal. This particularly applies to the pump's commissioning and its placing out of service.

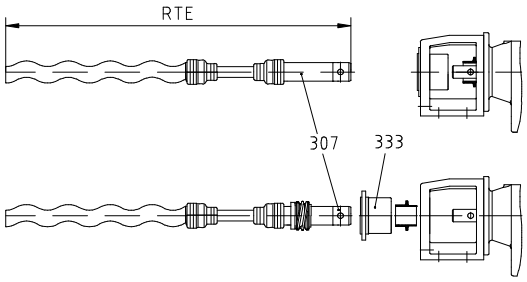
6.0
Maintenance

When operating the pump according to the instructions, no maintenance is required.

**7.0
Disassembly / Reassembly**

**7.1
Disassembly**

- Remove flushing connections at shaft seal housing (SEA).
- Lift / displace splash ring (310) and eject plug-in shaft pin (309) horizontally.
- Withdraw rotating unit (RTE) together with shaft seal parallel from output shaft of drive and avoid chocking.
- Clean plug-in shaft (307) and remove burrs etc., which may damage sealing elements. Moisten plug-in shaft (307) with slip additive (diluted fluid soap).
- Loosen axial safety device of mechanical seal (330 or 372) and withdraw mechanical seal (330) from plug-in shaft (307).
- Remove mechanical seal housing (333) from lantern (200).
- Press counter-ring of mechanical seal with o-ring out of mechanical seal housing (333).



**7.2
Reassembly**

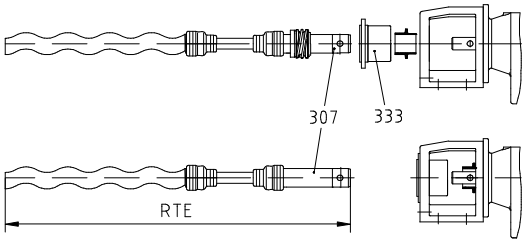
ATTENTION

Mechanical seals are precision parts of high quality. Therefore, the installation must be effected with care. Gentle handling and extreme neatness are essential.

- Clean mechanical seal housing (333)
- Evenly press counter-ring with o-ring into mechanical seal housing (333). To facilitate assembly, the o-ring should be moistened with a lubricant (diluted fluid soap).

ATTENTION

- Oil or grease must not be used to facilitate assembly.
- Install mechanical seal housing (333) to lantern (200) and onsure correct position of flushing connections.
- Remove plug-in shaft (307), burrs and roughness and clean the unit.
- Check / adjust set dimension of mechanical seal on plug-in shaft (307). Moisten plug-in shaft (307) and elastomer parts of mechanical seal with lubricant (diluted fluid soap).
- Slip mechanical seal onto plug-in shaft (307) as far as set ring.
- Lubricate drive shaft (ANT) with antiseize graphite petroleum.
- Moisten splash ring (310) and plug-in shaft (307) with pin joint grease, (for type, please see index) and slip splash ring (310) onto output shaft of drive. Note installating position of splash ring and refer to description on splash ring.
- Move rotating unit (RTE) through mechanical seal housing (333) and splash ring (310) and slip splash ring (310) onto output shaft of drive (ANT). Push in plug-in shaft pin (309) in horizontal position.
- Position of splash ring:
  Collar of splash ring shall be fitted in a distance of about 0.5 mm to lantern (200).

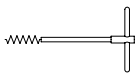
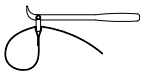
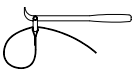


Range: MD, MDF

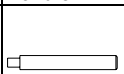
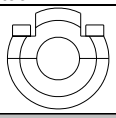
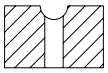
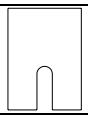
To avoid the expenses incurred by lengthy stop periods of the pump, seepex recommend the acquisition of a set of wearing parts and a set of gaskets.
The table below shows the contents of these sets.

Part designation	small set of wearing parts	big set of wearing parts	set of gaskets	Item number acc. to sectional drawing of pump and parts list
	Number			
Rotor		1		600
Stator 2)	1	1		601
Universal joint sleeve		1		405
Coupling rod pin		2		402
Guide bush 2)		-		-
Coupling rod		1		400
Coupling rod bush 2)		-		-
Casing gasket			1	501
Holding band, small 2)		-		-
Holding band, large 2)		2		406
Packing ring set 2) 3)	1	1		301
Mechanical seal 3)			1	330
Sealing ring			4	571, 726
Splash ring			1	310
O-ring			1	572
Plug-in shaft 2)		1		307
Special joint grease				098 1 cart. 300 gr (c. 315cm³) grease quantity per pin joint, see tech.
Tool				Essential for assembly, see Point 9, document OM.SPT.01

2) see tools Point 9., document OM.SPT.01
3) Item 330 and item 301 (as an alternative) depend on the pump design. With regard to the pump design, refer to the appertaining data sheet and the sectional drawing. See Point 9.

	Allgemeine normierte Werkzeuge / Standardized tools						
Werkzeug Nr. tool No.	W1	W2	W5	W6	W9	W11	W13
zur Montage von: tool for mounting of:	Packung packing	Stator stator	Gelenk joint	Lager bearing	allgemein general	Mutter für Teflon-manschette nut for teflon universal joint sleeve	Stator Stator 1)
Benennung: denomination:	Packungszieher packing lever	Ketten-Rohrzange + Ersatzkette chain pipe wrench +replacement chain	Durchschlag drift	Bolzen pin	Montierhebel mounting lever	Bandschlüssel strap wrench	Bandschlüssel strap wrench
Baugröße **size**							
0005-24, 0015-24 003-12/-24 006-12/-24 012-12/-24 025-6L 025-12T, 05-6LT	PKZ XX 000 0000 0 X35M0	**Siehe W 13** **see W 13**					WKZ BDS 027 0 430
025-12, 025-24 05-12, 1-6L	PKZ XX 000 0000 0 X0FQ0	KRZ XX Z55 0250 0 00000 KEZ XX Z55 0250 0 00000	DHS XX 020 0000 0 A2620		2 Stück 2 pieces MHL XX SA 610		
05-24, 01-48, 025-48, 1-12, 2-6L 1-24, 1-12V 2-12, 5-6L			DHS XX 050 0000 0 A2620	BLZ XX 020 0008 0 A2619		WKZ BDS 027 0 430	
2-24, 2-12V 5-12, 8-12T 10-6L, 15-6LT 05-48	PKZ XX 000 0000 0 XOHV0		DHS XX 050 0000 0 A2620	BLZ XX 020 0010 0 A2619			
5-24, 5-12V 10-12, 17-6L, 30-6LT, 15-12T, 10-24R, 1-48		KRZ XX Z55 0300 6 00000 KEZ XX Z55 0300 6 00000	DHS XX 100 0000 0 A2620	BLZ XX 020 0010 0 A2619			
14-12, 26-6L, 40-6LT 10-24, 10-12V 17-12, 35-6L, 26-12, 52-6L, 55-6LT, 75-6LT 30-12T, 10-24, 17-24R 2-48	PKZ XX 000 0000 0 XA01A		DHS XX 120 0000 0 A2620	BLZ XX 025 0012 0 A2619			
17-24, 17-12V 35-12, 52-12, 70-6L, 100-6L, 110-6LT, 55-12T 34-24R 5-48		KRZ XX Z55 0300 8 00000 KEZ XX Z55 0300 8 00000	DHS XX 160 0200 0 A2620	BLZ XX 030 0012 0 A2619			
35-24, 35-12V 70-12, 130-6L, 200-6L, 110-12T 70-24R, 10-48 200-6L			DHS XX 200 0200 0 A2620	BLZ XX 035 0012 0 A2619			
130-12, 202-6L, 300-6L, 200-12T 70-18, 100-18, 130-18 70-24, 70-12V 130-24R 17-48		KRZ XX Z55 0301 2 00000 KEZ XX Z55 0301 2 00000	DHS XX 240 0250 0 A2620	BLZ XX 040 0015 0 A2619			
240-12, 300-12T 130-18, 130-24 35-48/70-48							

1) Gilt nur für Pumpen in Edelstahl Ausführung / only valid for pumps in special steel design

	Empfohlene seepex Werkzeuge Aufgrund der Ausführung für bestimmte Montagen empfohlen, durch allgemeine normierte Werkzeuge bedingt ersetzbar. **Recommended seepex tools** Due to the design recommended for certain repairs, these tools partially replace the standardized tools.							
Werkzeug Nr. tool No.	W4	W7	W8	W10	W12	W14	W15	W16
zur Montage von: tool for mounting of:	Gelenk joint	Lager bearing	Schmier-nippel lubrication nipple	Steckwelle plug-in shaft	Teflon-manschette teflon universal joint sleeve	Kuppelstangen-buchsen coupling rod bushing	Manschette universal joint sleeve	Lippendichtung lip seal
Benennung: denomination:	Montagedorn assembly mandrel	Montage-hülse mounting sleeve	Einschlag-hülse drive-in sleeve	Demontage-werkzeug dismantling tool	Montage-werkzeug mounting tool	Presswerkzeug pressing tool	Montageplatte mounting plate	Montagehülse Mounting sleeve
Baugröße **size**								
0005-24, 0015-24 003-12/-24 006-12/-24 012-12/-24 025-6L 025-12T, 05-6LT	MTD L2 060 M120 0 XXXXX 2)						MTP A7 703 M500 0 002XX	MTH B7 703 M120 0 W0260
025-12, 025-24 05-12, 1-6L	MTD L2 060 M500 0 XXXXX	MTH M8 060 M500 0 XXXXX		AZV B2 262 M500 0 XXXXX			MTP A7 703 M500 0 002XX	
05-24, 01-48, 025-48, 1-12, 2-6L 1-24, 1-12V 2-12, 5-6L	MTD L2 060 0020 0 XXXXX	MTH M8 060 0020 0 XXXXX		AZV B2 262 0020 0 XXXXX	MMT M8 060 0020 0 XXXXX	PWZ C6 060 0020 0 XXXXX		
2-24, 2-12V 5-12, 8-12T 10-6L, 15-6LT 05-48	MTD L2 060 0050 0 XXXXX	MTH M8 060 0050 0 XXXXX		AZV B2 262 0050 0 XXXXX	MMT M8 060 0050 0 XXXXX	PWZ C6 060 0050 0 XXXXX		
5-24, 5-12V 10-12, 17-6L, 30-6LT, 15-12T, 10-24R, 1-48	MTD L2 060 0100 0 XXXXX	MTH M8 060 0100 0 XXXXX		AZV B2 262 0100 0 XXXXX	MMT M8 060 0100 0 XXXXX	PWZ C6 060 0100 0 XXXXX		
14-12, 26-6L, 40-6LT	MTD L2 060 0140 0 XXXXX	MTH M8 060 0140 0 XXXXX		AZV B2 262 0170 0 XF5XX		PWZ C6 060 1400 0 XXXXX		
10-24, 10-12V 17-12, 35-6L, 26-12, 52-6L, 55-6LT, 75-6LT 30-12T, 10-24, 17-24R 2-48	MTD L2 060 0170 0 XXXXX	MTH M8 060 0170 0 XXXXX	ESH N0 000 0000 0 A01A4	AZV B2 262 0170 0 XG0XX	MMT M8 060 0170 0 XXXXX	PWZ C6 060 0170 0 XXXXX		
17-24, 17-12V 35-12, 52-12, 70-6L, 100-6L, 110-6LT, 55-12T 34-24R, 5-48	MTD L2 060 0350 0 XXXXX	MTH M8 060 0350 0 XXXXX		AZV B2 262 0350 0 XH0XX		PWZ C6 060 0350 0 XXXXX		
35-24, 35-12V 70-12, 130-6L, 200-6L, 110-12T 70-24R, 10-48, 200-6L	MTD L2 060 0700 0 XXXXX	MTH M8 060 0700 0 XXXXX		AZV L7 703 0700 0 XK0XX		PWZ C6 060 0700 0 XXXXX		
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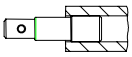
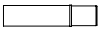
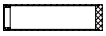
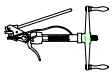
240-12, 300-12T 130-18, 130-24 35-48/70-48						PWZ C6 060 2400 0 XXXXX		

2) entfällt ab Pumpen-Herstellungsdatum 01.04.93 / can be omitted as from 01.04.93 (pump manufacturing date)

	Empfohlene seepex Werkzeuge Aufgrund der Ausführung für bestimmte Montagen empfohlen, durch allgemeine normierte Werkzeuge bedingt ersetzbar. **Recommended seepex tools** Due to the design recommended for certain repairs, these tools partially replace the standardized tools.								**Spezial-werkzeuge** **Special tools**
Werkzeug Nr. tool No.	W17	W18	W19	W20	W22	W23	W24	W25	W3
zur Montage von: tool for mounting of:	Lippendichtung lip seal	Gleitlager-buchse plain bearing bush	Wellen-schonhülse shaft securing sleeve	Cartridge-Einheit cartridge-unit	Wellen-dichtring lip seal	Wellen-dichtring lip seal	Antriebs-gehäuse drive casing	Steckwellen-bolzen plug-in shaft pin	Halteband holding band
Benennung: denomination:	Schlagzylinder Zentrierdorn Montagebolzen cylinder centering mandrel mounting pin	Montagedorn mounting mandrel	Montagehülse mounting sleeve	Aufnahme intake	Montage-werkzeug mounting tool	Montage-werkzeug mounting tool	Aufhänge-vorrichtung suspension device	Montagedorn mounting mandrel	Montage-werkzeug mounting tool
Baugröße **size**									
0005-24, 0015-24 003-12/-24 006-12/-24 012-12/-24 025-6L, 025-12T, 05-6LT	ZSH B7 703 M120 0 W0171 ZDR B7 703 M120 0 W0172 MBL A7 703 M120 0 W0173								MHB WH A00 1WHV 0 01000
025-12, 025-24 05-12, 1-6L									
05-24, 01-48, 025-48, 1-12, 2-6L 1-24, 1-12V 2-12, 5-6L								MTD L8 703 0050 0 SXX0J	
2-24, 2-12V									
5-12, 8-12T 10-6L, 15-6LT 05-48									
5-24, 5-12V									
10-12, 17-6L, 30-6LT, 15-12T, 10-24R, 1-48								MTD L8 703 0170 0 SXX0J	
14-12, 26-6L, 40-6LT									
10-24, 10-12V									
17-12, 35-6L, 26-12, 52-6L, 55-6LT, 75-6LT 30-12T, 10-24, 17-24R, 2-48			SPT B4 703 0170 0 01000	SPT M8 703 0170 0 00900	SPT B4 703 0170 0 01100				
17-24, 17-12V									
35-12, 52-12, 70-6L, 100-6L, 110-6LT, 55-12T 34-24R, 5-48								MTD L8 703 0350 0 SXX0J	
35-24, 35-12V									
70-12, 130-6L, 200-6L, 110-12T 70-24R, 10-48, 200-6L		SPT M8 703 1300 0 01000	SPT M8 703 1300 0 01100	SPT M8 703 1300 0 00900	SPT B4 703 1300 0 0A200	SPT B4 703 1300 0 0A300		MTD L8 703 0700 0 SXX0J	
130-12, 202-6L, 300-6L, 200-12T 70-18, 100-18, 130-18 70-24, 70-12V 130-24R 17-48								MTD L8 703 1300 0 SXX0J	
240-12, 300-12T 130-18, 130-24 35-48/70-48							SPT M8 703 2400 0 01400		

10.0
Manufacturer's documents from sub-supplier

Burgmann
INDUSTRIES

OPERATING MANUAL

This document was drawn up observing the EC directives
"Machinery" 98/37/EC, EN ISO 12100-2 and the German Standard VDI 4500

In case of this mechanical seal is operated in **explosion area an appropriate additional operating manual,** following EC directives 94/9/EC (ATEX 95), has to be observed **by all means**! If required this could be ordered at BURGMANN.

BURGMANN MECHANICAL SEAL (M.S.)

Type MG1/dw-00 and versions

applies to all mechanical seals of the same series

dw = specified shaft diameter

These instructions are intended for the assembly, operating and control personnel and should be kept at hand on site.

PLEASE READ this manual carefully and OBSERVE the information contained as to:

- **Safety**
- **Installation**
- **Transport / Storage**
- **Operation**
- **Information about the product**
- **Servicing**

If there are any unclear points please contact BURGMANN by all means!

Table of Contents

Keywords and Symbols

Following symbols for particularly important information are used:

"Attention, please pay special attention to these sections of text"

DANGER! Draws attention to a direct hazard that will lead to injury or death of persons

WARNING! Draws attention to the risk that a hazard could lead to serious injury or death of persons

CAUTION! Draws attention to a hazard or unsafe method of working that could lead to personal injury or damage to equipment

ATTENTION! Identifies a potentially dangerous situation. If it is not avoided the product or something in its vicinity could be damaged

IMPORTANT! Identifies tips for use and other particularly useful information.

GENERAL SAFETY NOTES

Any person being involved in assembly, disassembly, start up, operation and maintenance of the BURGMANN Mechanical Seal must have read and understood this Instruction Manual and in particular the safety notes. We recommend the user to have this confirmed.

BURGMANN Mechanical Seals are manufactured on a **high quality level** (quality management EN ISO 9001: 2000) and they keep a **high working reliability**. Yet, if they are **not operated** within their **intended purpose** or handled **inexpertly** by untrained personnel they may cause **risks**.

The machine has to be set up in such a way that seal leakage can be led off and disposed properly and that any personal injury caused by spurting product in the event of a seal failure is avoided.

Any operation mode that affects the **operational safety** of the mechanical seal is not permitted.

Unauthorised modifications or alterations are **not permitted** as they affect the **operational safety** of the mechanical seal.

BURGMANN mechanical seals must be installed, operated, maintained, removed or repaired by **authorised**, **trained and instructed personnel only.**

The **responsibilities** for the respective jobs to be done **have to be determined clearly and observed** in order to prevent unclear competencies from the point of **security**.

Any work to be done on the mechanical seal is **generally** only **permitted** when the seal is **neither operating nor pressurised**.

WARNING! Seals that have been used with **hazardous substances must be properly cleaned** so that there is no possible **danger** to people or to the environment.

Apart from the notes given in this manual the general **regulations for worker's protection and those for prevention of accidents** have to be observed.

Instructions for worker's protection

WARNING! If the **medium to be sealed** and/or the **supply liquid** is subject to the **Hazardous Substances Regulation** (GefStoffV), the **instructions for handling dangerous substances** (safety data sheets to EU Directive 91/155/EEC) and the **accident prevention regulations** have be observed.

Medium to be sealed and/or **supply medium may escape** if the seal **fails**. Injury of persons and environment may be **prevented by the user** providing for splash protection and wearing safety goggles. Care has to be taken by the user for **proper disposal** of the leakage. The user has to control these measures.

The **user** has to **check** what **effects a failure** of the mechanical seal might have and what safety measures have to be taken to prevent **personal** injury or damage to the environment.

TRANSPORT / STORAGE

Transport

If not specified differently by contract the BURGMANN standard packing is used which is suitable for dry transport by truck, train or plane. The warning signs and notes on the packing must be observed.

In addition seaworthy packing may become necessary.

Notes for income inspection:
- Check packaging for visible damages.
- Open packaging carefully. Do not damage or lose parts supplied separately.
- Check if consignment is complete (delivery note). Inform the supplier immediately in writing if parts are damaged or missing.

The mechanical seal has to be protected from damage during transport and storage. The transport case in which the seal is supplied is well suited for this purpose and should be kept for a possible return transport.

ATTENTION! If the machine as well as the mechanical seal installed into the machine are transported together the shaft has to be protected from deflection and shocks.

Packing and storage

The following recommendations apply to all BURGMANN mechanical seals which have been supplied and stored in their **undamaged original packaging**, as well as to seals which have been installed in a machine (e.g. pump, compressor, agitator, etc.) but have not yet been put into operation.

BURGMANN mechanical seals and spare parts are super finished and repeatedly tested machine elements. For the storage special conditions have to be followed.

Sliding materials and elastomers are subject to material-specific and time-based alterations (distortion, ageing) which might reduce the full efficiency of the mechanical seals. Yet, this may be avoided by observing the storage instructions.

For the stock keeping of elastomers special conditions are required. For all rubber-elastic parts the rules of DIN 7716 resp. of ISO 2230-1973 (E) are valid.

Conveniences for storing of mechanical seals
- dust free
- moderately ventilated
- constantly tempered
  - relative air humidity below 65 %,
  - temperature between 15 °C and 25 °C.

Protect the seal from
- direct exposure to heat (sun, heating)
- **ultraviolet light** (halogen or fluorescent lamps, sunlight, arc welding)
- presence or development of **ozone** (arc welding, mercury vapour lamps, high-voltage devices, electric motors)

➢ **risk of embrittlement** of elastomeric materials

It has to be differentiated between:
- ▫ **M.S. stored** in the stock room
- ▫ **M.S. installed** in the machine, but not yet in operation.

☐ **M.S. in the stock**

IMPORTANT! Store the **seal in the original packing** lying on a **flat surface**.

- Check the packaging periodically for damages.
- Plastic sheet packagings with humidity indicators have to be checked every 8 weeks. The check has to be recorded.

➢ Packings **exceeding 50 % rel. humidity** values have to be sent to the manufacturer or the **nearest BURGMANN service centre** for inspection and new packaging.

Duly stored mechanical seal:
- Latest 3 years after delivery of the mechanical seal
- For reasons of safety shipment of the M.S. to BURGMANN resp. nearest BURGMANN service centre for

➢ Exchange of all secondary seals and springs
➢ Verification of the flatness of the faces
➢ Perhaps static pressure test.

☐ **M.S. installed into the machine:**

ATTENTION! A **preservation** of the BURGMANN mechanical seals is **not allowed**.

Check in case of a preservation of complete machines with mechanical seals installed BURGMANN has to be contacted.
- **Do not** use corrosion protection agents.

➢ Risk of deposition and possibly chemical attack of the secondary seals.

Due to longer erecting times of new designed plants the period between delivery of the mechanical seal and on the other hand its installation and start up may exceed the period of 2-3 years.

Latest after 3 years and in time before the planned start-up of the plant the seal has to be dismantled and to be sent to the manufacturer or the nearest BURGMANN service centre where it can be checked and reconditioned, if necessary.

Damages caused by **improper** storage may **not** be claimed with reference to the **warranty** on the BURGMANN company**.**

INFORMATION ABOUT THE PRODUCT

All technical information given is based on the results of extensive testing and on BURGMANN's long term practical experience. However, in view of the great diversity of possible applications the technical data can only be taken as being of approximate nature. We can only guarantee the safe and efficient functioning in individual cases if we have been comprehensively informed of the operating conditions to which they will be subject, and if this has been confirmed in a separate agreement.

Manufacturer and country of origin

Burgmann Industries GmbH & Co. KG
Äußere Sauerlacher Str. 6-10
D - 82515 Wolfratshausen

Germany

Declaration by the manufacturer

within the meaning of the EC-directive "MACHINERY" 98/37/EG

A mechanical seal does **not function independently**. It is intended to be incorporated into or assembled with machinery.

Type designation

BURGMANN Mechanical Seal **MG1/dw-00**

Designated use

This mechanical seal is **exclusively** designed for the use in the specified application. A **different utilisation** or a utilisation going beyond the specification is considered **contrary to its designated use** and excludes a liability by the manufacturer.

Operation under conditions lying **outside** those limits stated in paragraph **"Operating limits"** is considered **contrary to its designated use**.

Should the seal be **operated under different conditions or at a different application** BURGMANN has to be asked for **recognition as safe in advance**.
- **Changes** to operating conditions **have to** be documented.

Operating limits

ATTENTION! Operating limits depend on the materials, the media to be sealed and the diameter of the sealing. (If there are any unclear points please contact BURGMANN.)

Shaft diameter	(dw)	:	10 - 100 mm
Pressure to be sealed	(p1)	:	12 bar g
Temperature to be sealed	(t1)	:	-20 ... 120° C
Max. sliding speed	(vg)	:	10 m/s

Operation under several limit values **simultaneously** should be **avoided** as higher loads (pressure, temperature, speed) can increase wear or lead to **damage** of sliding faces or elastomers. This could result in a shorter service life and in the **risk** of a sudden seal failure **endangering** men and environment.

The **selection** of the mechanical seal (type, suitability, materials) should be done **by BURGMANN staff** or other **authorised** persons. A wrong selection by unauthorised persons is **not covered by** BURGMANN's **warranty**.

Further information about the operating conditions can be found in the BURGMANN assembly drawing MG1/dw-00 or in the specification sheets of the machine manufacturer.

Materials

The materials of the mechanical seal depend on the application and are fixed in the order.

Drawings, diagrams

Assembly drawing MG1/dw-00

The original assembly drawing in its latest edition (latest revision) only is decisive for both the design of M.S. as well as the utilisation of this manual.

In the following description all figures in parentheses, e.g. (2) define the respective part item no. in fig. 1. The part item no. may vary from those stated in the assembly drawing.

Versions

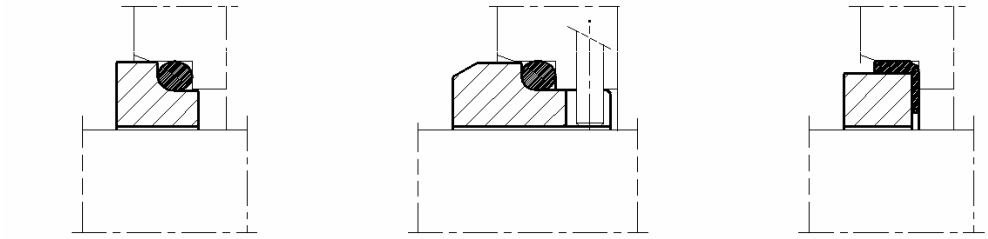
- **MG12/…**
- **MG13/…**
- **MG1S20/…**
- **RMG12/…**
- **MG1 MULTIPLE M.S.**

The mechanical seal type MG1 can also be used as **multiple mechanical seal** (also in combination with seal types of other series) in **tandem arrangement** with quench (API, plan 52) or as **dual mechanical seal** with barrier fluid (API, plan 53). Consultation with the BURGMANN company is recommended.

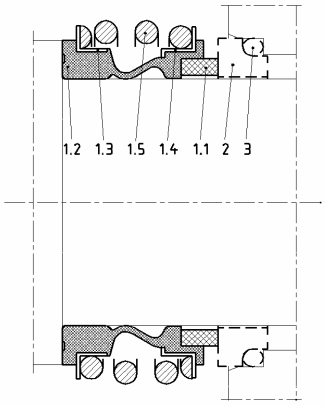
ATTENTION! PTFE o-rings or double-PTFE-wrapped o-rings **may** not be used at seat versions **without torsion lock**.

This operating manual applies also to the mentioned seal versions with slight modifications and/or to combinations with seats not stated in this manual.

Seat Versions



Description and function



- **single seal**
- **unbalanced**
- **bi-directional**
- **stationary seat** (2)
- **o-ring** (3)
- **rotating seal face** (1.1)
- **elastomeric bellow** (1.2)
- **cylindrical single spring** (1.5)
- **no glued joints**
- **materials of the sliding parts replaceable**
- **for media containing solids** (e.g. sewage applications)
- **rotating, torsion-free elastomeric bellows** serving as
  - face housing
  - secondary sealing element
  - drive collar
- **torque transmission** from the seal face by means of "L"-rings and a rotating, cylindrical single spring
- **axial movability**
  d_w: 10 … 12 mm ±0,5 mm
  d_w: 14 … 18 mm ±1,0 mm
  d_w: 20 … 26 mm ±1,5 mm
  d_w: 28 … 100 mm ±2,0 mm

Required space, connecting dimensions

The required mounting space for the mechanical seal is decisive for the design of the housing parts by the machine manufacturer. The connecting dimensions have to be checked by the machine manufacturer by means of the BURGMANN drawing before mounting the mechanical seal.

Supply of M.S.

The mechanical seal has to be constantly wetted by liquid medium. The medium to be sealed must not damage the M.S. neither chemically (e.g. corrosion, embrittlement) nor physically (e.g. erosion, abrasion).

For a safe operation of the mechanical seal we recommend to apply **at inboard** the most suitable **type of circulation** described in **API 610 / 682**. This measure protects the seal cavity from deposition of solids.

To operate multiple seals special supply systems are required. Please contact BURGMANN.

Emissions

A mechanical seal is a **dynamic seal** that **cannot be free of leakage** due to physical and technical reasons. Seal design, manufacture tolerances, operating conditions, running quality of the machine, etc. mainly define the leakage value. In fact, compared to other sealing systems there is **few leakage**.

WARNING! If the **medium to be sealed** and/or the **supply liquid** is subject to the **Hazardous Substances Regulation** (GefStoffV), the **instructions for handling dangerous substances** (safety data sheets to EU Directive 91/155/EEC) and the **accident prevention regulations** have be observed.

A possibly increased leakage during start-up will decrease to a normal quantity after the running-in period of the sliding faces.

If this is not the case or if there are other malfunctions the mechanical seal has to be shut down, removed and checked for reasons of safety.

The leakage can be liquid or gaseous. Its aggressiveness corresponds to that of the medium to be sealed.

Leakage of mechanical seal at outboard side has to be drained and disposed properly.

IMPORTANT! Components which may get in contact with the leakage have to be corrosion-resistant or have to be adequately protected.

INSTALLATION

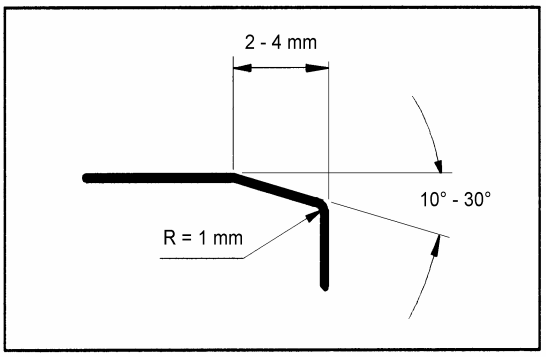
Assembly utilities

- ethyl alcohol
- cellulose-tissue (no rag, no cloth!)
- o-ring lifter
- water and washing up liquid
- cardboard discs

Preparation for assembly

ATTENTION! The seal should remain **packed** until the following working steps have been completely **terminated**.

Check the parts of the machine for:



- **chamfered edges**
  (sliding cones i.e. 2 mm / 30° or in accordance with EN 12756)
- radiused transitions
- **mating fits** and o-ring surfaces:
  fine finished **Rz 10 µm** (= N7 = CLA 63)

- **Shaft surface** in the area of the mechanical seal finished according to EN 12756: **Ra = 0.8 µm** (= N6 = CLA 32).
- **Shoulder** or stop device for the bellows of the mech. seal to take up axial forces

Check at the machine:
- damage of connecting surfaces to the M.S.
- mating dimensions, rectangularity and concentricity to the shaft axis.

Run-out accuracy of the shaft (acc. to DIN ISO 5199):
- Shaft diameters up to 50 mm: max. 0.05 mm
- Shaft diameters 50 mm - 100 mm: max. 0.08 mm

- Prepare the place of assembly, take away any not required tool, cuttings, dirty cleaning wool etc.

- Cover the work bench with a piece of clean, non-fibrous cardboard.

Assembly / installation

BURGMANN mechanical seals are super-finished and repeatedly tested machine elements whose handling during assembly in particular of sliding materials and elastomers requires special care during several procedures.

For installation the assembly drawing of mechanical seal has to be observed.

IMPORTANT! The mechanical seal has to be installed under the cleanest conditions and very carefully.

- Unpack the seal and check seal face, seat and elastomer bellows for possible damages.
- ➢ Never place the seal faces or seats on their sliding faces without having covered them adequately.

- Check before starting assembly:
  - complete availability of all components by means of the drawing
  - all components have to be clean and in perfect condition.

- Sprinkle the elastomer bellows and the shaft with low-surface-tension water (add washing up liquid) or ethyl alcohol to decrease frictional force during assembly of the seal.

⚠

Oil or grease as assembly agent is not permitted in any case.

ATTENTION! **Do never force** during installation.

ATTENTION! **Avoid unnecessary rotation** of the shaft (damage of the sliding faces is possible).

ATTENTION! **Avoid knocking the seal!** Damage to mechanical seals has an adverse effect on their safe operation.

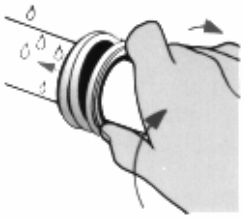
Possible installation order:

- Feed the **degreased** sealing element (o-ring, rubber cup) onto the seat.

If present:
- At the seat mark the position of the rear slot beside the sliding face.
- Align the seat with the torque transmission pin.

- Cover the sliding face of the seat with a cardboard washer
- Press the seat slowly and without interruption into its position.
  - ➢ Use plenty of water or alcohol as lubricant.
  - ➢ Use a distance sleeve, if necessary.
- Remove the cardboard washer from the sliding face.
- Check the rectangular position of the seat to the shaft axis.

- Mount the seal cover with the seat installed before.
- Clean the sliding faces thoroughly with ethyl alcohol and paper tissues (**no fabric, no cloths!**).
- ➢ In case of material **"BUKO"** (carbon graphite) wipe it until the paper tissues stay clean.
- ➢ Do not touch the sliding faces any more with bare fingers.
- ➢ Mount the sliding faces absolutely dry, dust-free and clean. Do not use any lubricants!



- Push rotating seal unit (bellows unit) with a slow clockwise turn onto the shaft.
- Stick to the dimensions in the assembly drawing!
- ➢ If necessary use a mounting sleeve.
- ➢ For long pushing distances add liquid several times.

- Check "L" rings, spring and seal face for correct fit.

- Mount stop device for bellows unit to take up axial forces.
- ➢ Stick to the dimensions in the assembly drawing **by all means!**

- Further assembly of the machine in accordance with the instructions of the machine manufacturer.

OPERATION

Instructions for safe operation

For a single mechanical seal the **pressure in the seal chamber** (stuffing box pressure) has to be **higher** than the ambient pressure at the machine at any time. Otherwise the machine will **suck in air** via the sliding faces, which will result in **dry-running** and consequent **failure** of the mechanical seal.

Damages due to dry-running are excluded from the warranty.

During every state of operation the mechanical seal has to be constantly wetted by the **medium** to be sealed **in its liquid form**, in particular when the machine is **started** or **stopped**. The machine design has to be such as to take this necessity into consideration.

If the medium to be pumped builds deposits or tends to solidify during cooling down or standstill of the machine the stuffing box has to be flushed with suitable clean liquid. The flow and the liquid should be determined by the user.

If the operation limit values and the instructions given in this manual are followed a trouble-free operation of the mechanical seal can be expected.

Instructions for start up

Safety checks before start up

- Torque transmission between mechanical seal and shaft duly installed
- Supply connections tightened pressure-sealed
- Disposal connections installed environmentally safe

For a safe operation of the mechanical seal we recommend to apply **at inboard** the most suitable **type of circulation** described in **API 610 / 682**. This measure protects the seal cavity from deposition of solids.

- Flood machine and seal cavity (stuffing box) with medium and vent thoroughly.

▫ Now the seal is ready for operation.

SERVICING

Maintenance

A correctly operated mechanical seal needs **low maintenance**. Wear parts, however, have to be replaced, if necessary.

A duly operation includes a regular check of the following parameters:
- Temperature
- Leakage (drainage) rate of the mechanical seal

An inspection of the mechanical seal should be carried out during a revision of the complete plant. We recommend to have this inspection be performed by responsible BURGMANN personnel.

If the mechanical seal is removed during a revision of the plant it has to be replaced by a new one.

Directives in case of failure

Try to define the kind of failure and record it.

- In the event of **excessive leakage**, note changes in the leakage amount and switch the pump off if necessary.
- If a constant amount is leaking in a steady flow, the mechanical seal is damaged.
- In the event of a **inadmissible temperature rise**, the machine **has to** be stopped for safety reasons.

If there is a **malfunction** which you cannot correct on your own, or if the cause of malfunction is not clearly recognisable please immediately contact the nearest **BURGMANN agency**, a BURGMANN service centre or the BURGMANN headquarters.

During the **warranty period** the BURGMANN mechanical seal must only be disassembled with approval of the manufacturer or when a representative is present.

After-sales service by BURGMANN

BURGMANN's customer service department offers a comprehensive service package covering consultancy, engineering, standardisation, installation, commissioning as well as damage analysis right through to seminars on sealing technology.

Addresses are listed in the known BURGMANN Design Manuals as well as in various other BURGMANN brochures.

Address of headquarters:

Burgmann Industries GmbH & Co. KG
Postfach 1240
D - 82515 Wolfratshausen

Germany

☎ +49 (0) 81 71-23 0
Fax +49 (0) 81 71-23 12 14
www.burgmann.com

Reconditioning (repair)

If **reconditioning** is necessary, the complete **seal** should be sent **to the manufacturer**, as this is the best way to find out which components can be reconditioned or which parts must be replaced in order to ensure an optimum tightness.

If, **for compelling reasons**, **a reconditioning** has to be carried out **on site** (e.g. no. spare seal on stock, long transport, problems with customs) the seal may be repaired in a clean room by **trained** personnel of the user under the direction of **BURGMANN mechanics**.

Disassembly / removal

- Stop the machine as instructed, allow to cool, depressurise and ensure that pressure cannot build up again.
- Work on the M.S. is only permitted when the machine is at a standstill and depressurised.
- There must be no product on the M.S. ⇒ if necessary drain the machine and rinse it out.
- Isolate the machine to prevent it starting up unexpectedly.
- Comply with the safety notes (safety data sheets).

IMPORTANT! When removing, please observe **by all means**:

- current **accident prevention regulations**
- **regulations for handling hazardous substances**

WARNING! Seals that have been used with **hazardous substances must be properly cleaned** so that there is no possible **danger** to people or to the environment.

IMPORTANT! The packaging used to transport the seal must

- be **identified** with the relevant **hazard symbol** and
- **include** the **safety data sheet** for the product and/or supply medium

The order of disassembly to remove the mechanical seal out of the machine depends on the design of the machine and should be determined by the machine manufacturer.

- Remove the seal in the reverse sequence as described for assembly (set up).

Spare parts

- Only BURGMANN original spare parts must be used. Otherwise
  - **Risks** of a seal failure, **endangering** persons and environment.
  - The BURGMANN guarantee for the mechanical seal **lapses**.
- For a quick exchange a complete **spare seal** should be on stock.

Required details for enquiries and orders

For enquiries and orders the following details are required:

- BURGMANN commission no.
- Drawing no. of M.S. **MG1/dw-00**
  dw = specified shaft diameter
- Part item no., designation, material, number of pieces with reference to the drawing.

Address of headquarters product field **FA**
Standard Mechanical Seals

Burgmann Industries GmbH & Co. KG
Postfach 1240
D - 82502 Wolfratshausen

Germany

☎ +49 (0) 81 71 - 23 0
Fax +49 (0) 81 71 - 23 14 44

Disposal of the BURGMANN mechanical seal

Usually, the BURGMANN mechanical seals can be easily disposed after a thorough cleaning.

- Metal parts (steels, stainless steels, non-ferrous heavy metals) divided into the different groups belong to scrap metal waste.
- Ceramic materials (synthetic carbons, ceramics, carbides) belong to waste products. They can be separated from their housing materials, as are physiologically recognised as safe.
- Synthetic materials/plastics (elastomers, PTFE) belong to special waste.

CAUTION! Material containing fluorine must not be burnt.

IMPORTANT! Some of the synthetic materials, divided into the different groups can be recycled.

Copyright

We reserve the right to carry out technical modifications of the product, even if they have not yet been considered in this manual.

June 13, 2006
Department Technical Documentation

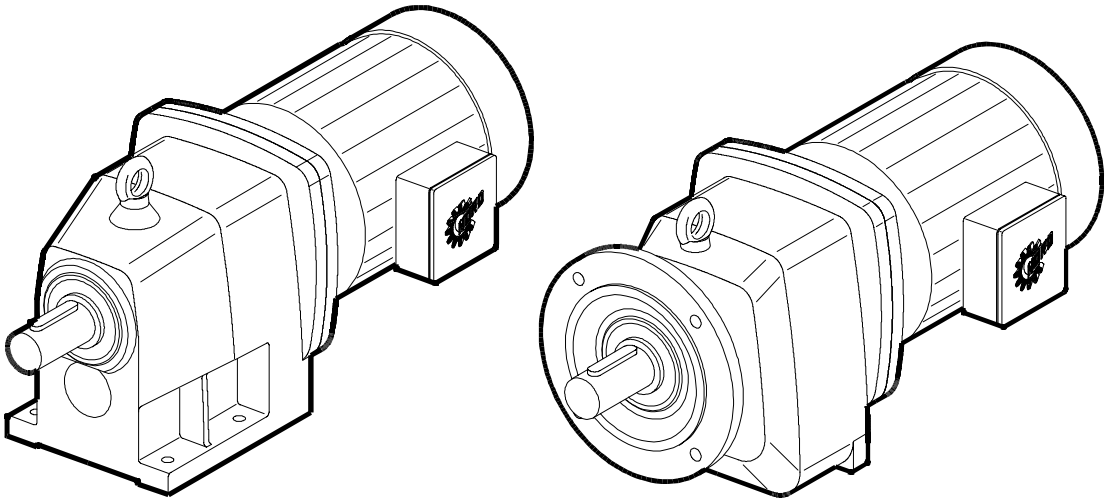
UNICASE® Helical Inline Gearboxes
Installation and Maintenance Instructions

BIM 1010

USA

CDN

Retain These Safety Instructions For Future Use



INSPECTION OF UNIT

Thoroughly inspect the equipment for any shipping and handling damage before accepting shipment from the freight company. If any of the goods called for in the bill of lading or express receipt are damaged or the quantity is short, do not accept until the freight or 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 him to make an inspection. We will be very happy to assist you 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. Claims for loss or damage in shipment must not be deducted from the NORD Gear invoice, nor should payment of the NORD Gear invoice be withheld awaiting adjustment of such claims, as the carrier guarantees safe delivery.

If considerable damage has been incurred and the situation is urgent, contact the nearest NORD Gear Sales Office for assistance. Please keep a written record of all communications.

RECORD NAMEPLATE DATA

Locate the gear reducer nameplate and record all nameplate data for future reference.

SK _____ S/N _____

RATIO _____ MAX TORQUE _____ RPM _____ MTG. POS _____

STORAGE

PROPER STORAGE UNTIL INSTALLED

Keep unit in a dry, temperature controlled area. If stored other than said, long term storage methods must be applied to the unit including complete fill with lubricant. Protect machined surfaces and rotate shafts periodically. Prior to putting unit into service, drain lubricant and refill to proper level as determined by the mounting position.

PROPER HANDLING OF THE UNIT

Exercise care to prevent damage to the unit when moving. Lift only at designed lifting points. Do not attach other machinery and lift by the unit lifting points. The lifting points are to be used to lift the unit only. Insure that adequate safety measures are taken to protect personnel during transportation. Protect the mounting surface from damage.

INSTALLATION OF UNIT

To ensure long service and dependable performance, an enclosed gear drive must be rigidly supported and the shafts accurately aligned. The following describes the minimum precautions required to accomplish this end.

FOUNDATION
The responsibility for the design and construction of the foundation lies 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.

MOUNTING POSITION
Unless a unit is specifically ordered for inclined mounting, the foundation must be level and flat. The lubrication system may not operate properly if the unit is not mounted in the position for which it is designed. It may be desirable to elevate the foundation to facilitate oil drainage.

CONCRETE FOUNDATION
If a concrete foundation is used, steel mounting pads and bolts of sufficient size to distribute the stress into the concrete should be grouted into the foundation.

STEEL FOUNDATION
If a structural steel foundation is used (i.e. wide flange beams or channels), a base plate or sole plate of suitable thickness should be used and should extend under the entire unit.

FOOT MOUNTED UNITS
Use shims under the feet of the unit 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 reduce the life of the unit and may cause failure. Dowel pins may be installed to prevent misalignment and ensure proper realignment if removed for service.

FLANGE MOUNTED UNITS
If a structural steel foundation is used (i.e. wide flange beams or channels), a base plate or sole plate of suitable thickness should be used and should extend under the entire unit. If a bulk head plate is used it should be of proper strength to minimize buckling distortions.

Flange Pilot 'AK' or 'AK1' tolerance
Metric (mm)

> ∅ 50 ≤ ∅ 80 = +0.012/-0.007
> ∅ 80 ≤ ∅ 120 = +0.013/-0.009
> ∅ 120 ≤ ∅ 180 = +0.014/-0.011
> ∅ 180 ≤ ∅ 230 = +0.016/-0.013
> ∅ 230 ≤ ∅ 315 = +0.000-0.032
> ∅ 315 ≤ ∅ 400 = +0.000/-0.036
> ∅ 400 ≤ ∅ 500 = +0.000/-0.040

Inch

> ∅ 1.969 ≤ ∅ 3.150 = +0.005/-0.0003
> ∅ 3.150 ≤ ∅ 4.724 = +0.005/-0.0004
> ∅ 4.724 ≤ ∅ 7.087 = +0.006/-0.0004
> ∅ 7.087 ≤ ∅ 9.055 = +0.006/-0.0005
> ∅ 9.055 ≤ ∅ 12.402 = +0.000/-0.0013
> ∅ 12.402 ≤ ∅ 15.748 = +0.000/-0.0014
> ∅ 15.748 ≤ ∅ 19.685 = +0.000/-0.0016

BOLT STRENGTH
Bolt size, strength and quantity should be verified to insure proper torque reaction capacity whatever the mounting arrangement.

PRIME MOVER MOUNTING
Align the prime mover to the reducer-input shaft using shims under the feet. Make sure that the feet are supported. Dowel the prime mover to its foundation.

SHAFT CONNECTIONS
When connecting shafts to either the input or output of the reducer, consider the following instructions.

FITS
Clearance or interference fits for coupling hubs should be in accordance with ANSI/AGMA 9002-A86 or as follows.

Output and Input shaft Diameter tolerance
Metric (mm)

≤ ∅ 18 = +0.012/+0.001
> ∅ 18 ≤ ∅ 30 = +0.015/+0.002
> ∅ 30 ≤ ∅ 50 = +0.018/+0.002
> ∅ 50 ≤ ∅ 80 = +0.030/+0.011
> ∅ 80 ≤ ∅ 120 = +0.035/+0.013
> ∅ 120 ≤ ∅ 180 = +0.040/+0.015

Inch

≤ ∅ 1.750 = +0.0000/-0.0005
> ∅ 1.750 = +0.0000/-0.0010

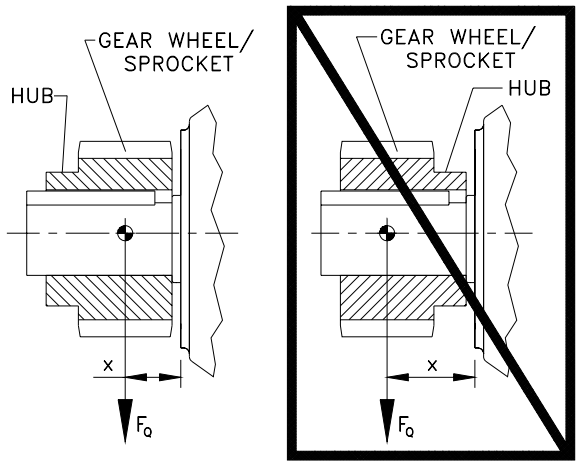
Output and Input shaft Drill and tap shaft end
Metric (mm)

≤ ∅ 16 = M5
> ∅ 16 ≤ ∅ 21 = M6
> ∅ 21 ≤ ∅ 24 = M8
> ∅ 24 ≤ ∅ 30 = M10
> ∅ 30 ≤ ∅ 38 = M12
> ∅ 38 ≤ ∅ 50 = M16
> ∅ 50 ≤ ∅ 85 = M20
> ∅ 85 ≤ ∅ 130 = M24

Inch

≤ ∅ 0.438 = #10-24 x 0.4 deep
> ∅ 0.438 ≤ ∅ 0.813 = ¼-20 x 0.6 deep
> ∅ 0.813 ≤ ∅ 0.938 = 5/16-18 x 0.7 deep
> ∅ 0.938 ≤ ∅ 1.125 = 3/8-16 x 0.9 deep
> ∅ 1.125 ≤ ∅ 1.375 = 1/2-13 x 1.1 deep
> ∅ 1.375 ≤ ∅ 1.875 = 5/8-11 x 1.4 deep
> ∅ 1.875 ≤ ∅ 3.250 = 3/4-10 x 1.7 deep
> ∅ 3.250 = 1-8 x 2.2 deep

Outboard pinion and sprocket fits should be as recommended by the pin sprockets with interference fits should be heated according to the manufacturer's recommendations, generally 250°F to 300°F, (120°C to 150° C) before assembling to the shaft.



LOCATION
Coupling hubs should be mounted flush with the shaft ends, unless specifically ordered for overhung mounting. Pinions, sprockets and sheaves should be mounted as close as possible to the unit housing to minimize bearing loads and shaft deflections.

COUPLING ALIGNMENT
Shaft couplings should be installed according to the coupling manufacturer's recommendations for gap, angular and parallel alignment. In many installations, it is necessary to allow for thermal and mechanical shaft movement when determining shaft alignment. The coupling manufacturer's recommendations should be followed.

AXIAL DISPLACEMENT
The gap between shaft ends should be the same as the specified coupling gap unless overhung mounting of the coupling hub is specified. The coupling gap and shaft gap must be sufficient to accommodate any anticipated thermal or mechanical axial movement.

ANGULAR ALIGNMENT
Insert a spacer or shim stock equal to the required coupling gap between the coupling hub faces and measure the clearance using feeler gauges. Repeat this at the same depth at 90-degree intervals to determine the amount of angular misalignment.

PARALLEL ALIGNMENT
Mount a dial indicator to one coupling hub, and rotate this hub, sweeping the outside diameter of the other hub. The parallel 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-degree intervals and measure any gaps with feeler gauges. The maximum gap measurement is the parallel misalignment.

CHECKING ALIGNMENT
After both angular and parallel alignments are within specified limits, tighten all foundation bolts securely and repeat the above procedure to check alignment. If any of the specified limits for alignment are exceeded, realign the coupling.

SPROCKET OR SHEAVE ALIGNMENT
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.

OUTBOARD PINION ALIGNMENT
Align the pinion by adjusting the gear tooth clearance according to the manufacturer's recommendations and checking for acceptable outboard pinion tooth contact. The foundation bolts may have to be loosened and the unit moved slightly to obtain this contact. When the unit is moved to correct tooth contact, the prime mover should be realigned.

RECHECK ALIGNMENT
After a period of operation, recheck alignment and adjust as required.

1. Properly install unit on a rigid foundation
   - adequately supported
   - securely bolted into place
   - leveled so as not to distort the gear case
2. Properly install couplings suitable for the application and connected equipment.
3. Ensure accurate alignment with other equipment.
4. Furnish and install adequate machinery guards as needed to protect operating personnel and as required by the applicable standards of the Occupational Safety and Health Administration (OSHA), and by other applicable safety regulations;
5. Ensure that driving equipment is running in the correct direction before coupling to reducers with backstops (designed to operate only in a specific direction) or machinery designed to operate only in one direction.

CHANGES IN PERFORMANCE SPECIFICATIONS

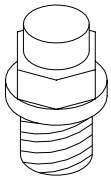
Owner has the responsibility to consult with NORD GEAR if such items such as applied loads, operating speeds or other operating conditions have changed.

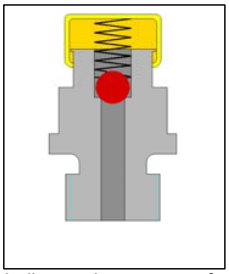
WARNING:
LOCK OUT POWER before any maintenance is performed. Make absolutely sure that no voltage is applied while work is being done on the gearbox.

START-UP

1. Ensure that switches, alarms, heaters, coolers and other safety and protection devices are installed and operational for their intended purpose.
2. Verify that the installed mounting position is the same as the nametag mounting position. If not, adjust the oil level accordingly and relocate the vent plug, fill plug and drain plug according to the mounting position. See following.

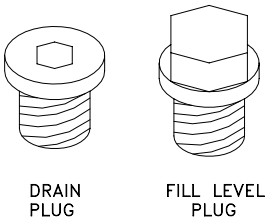
AUTOVENT PLUG
The Autovent plug is brass in color and will be located at the highest point on the gearbox. It operates like a check-valve to allow the reducer to relieve internal pressure while preventing lubricant contamination during cooling. A spring presses a ball or plunger against a machined orifice until pressure exceeds 2 psi. Above 2 psi the air is allowed to escape depressurizing the gearcase. When internal pressure drops below 2 psi, the autovent re-seals closing the unit to the outside environment. After shutdown, the reducer cools along with the air inside the reducer. The unit will temporarily maintain a slight vacuum until normalization occurs. NORD Gear supplies an Autovent as a standard feature.


AUTOVENT PLUG


The Autovent releases built-up air pressure from inside the gearbox (Max. pressure 2 psi).

FILL LEVEL & DRAIN PLUGS

The drain plugs are metric socket head cap screws. They will be located at the lowest part of the gearbox for ease of draining. The fill level plug is a hex head cap screw. It will be located between the Autovent and drain plug. Both types of plugs will have gaskets included to prevent oil from leaking.



Two types of plugs for maintenance

LUBRICANT

All NORD reducers are shipped from the factory properly filled with lubricant and all plugs are installed according to the mounting position given on the reducer nametag. Acceptable oil fill level is within ½ inch of the bottom of the fill plug threads.

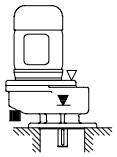
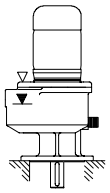
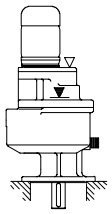
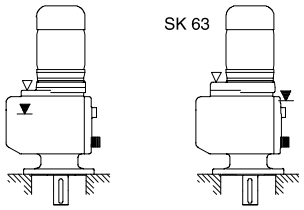
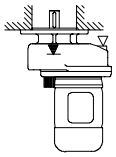
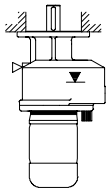
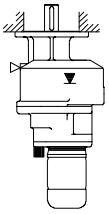
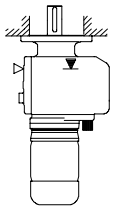
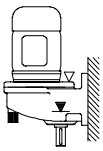
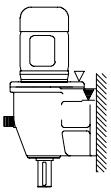
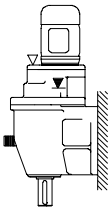
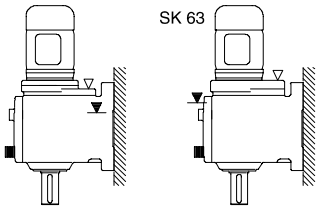
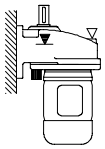
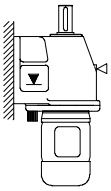
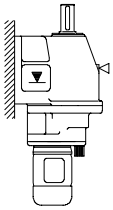
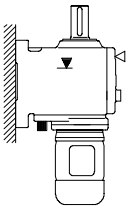
OPERATION AND MAINTENANCE CHECKLIST

1. Operate the equipment as it was intended to be operated
2. Do not overload.
3. Run at correct speed.
4. Maintain lubricant in good condition and at proper level.
5. Dispose of used lubricant in accordance with applicable laws and regulations.
6. Apply proper maintenance to attached equipment at prescribed intervals recommended by the manufacturer.
7. Perform periodic maintenance of the gear drive as recommended by NORD.

MOUNTING POSITIONS

These charts detail the mounting positions for horizontal and vertical mounting. The Autovent, oil fill plug and drain plug are indicated on each mounting position picture. The factory set mounting position and plug locations match that shown on the gearbox nametag. For mounting orientations other than shown consult NORD Gear.

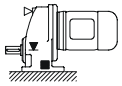
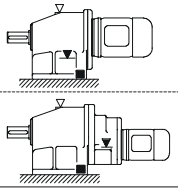
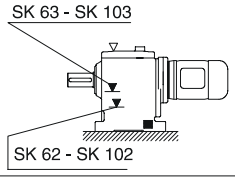
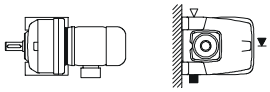
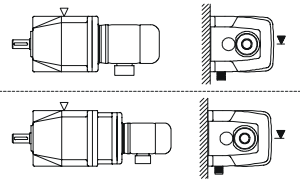
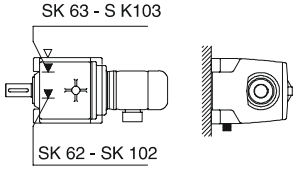
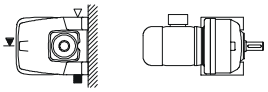
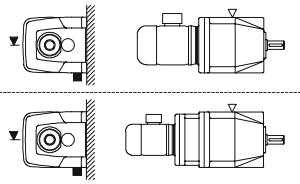
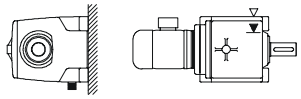
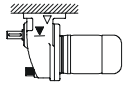
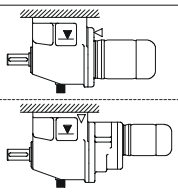
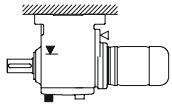
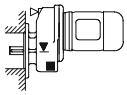
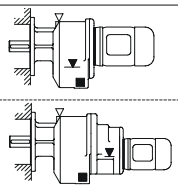
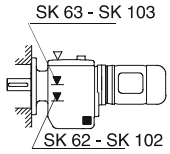
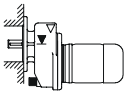
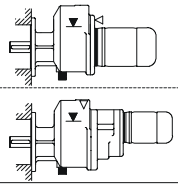
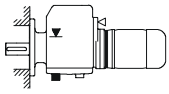
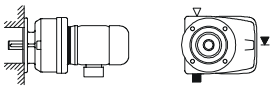
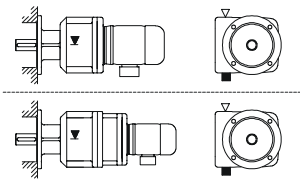
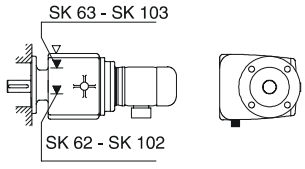
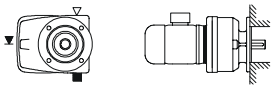
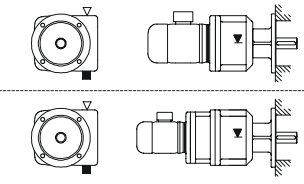
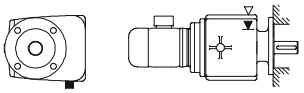
VERTICAL POSITION

	SK 11E - SK 51 E	SK 02 - SK 52	SK 03 - SK 53	SK 62 - SK 103
V1 *				
V3				
V5 *				
V6				

Symbols: ▽ Vent plug ▼ Oil level ■ Drain plug ▨ Mounting surface

* Mounting position V1 or V5 with lubricant expansion unit

HORIZONTAL POSITION

	SK 11 E - SK 51 E	SK 02 - SK 52 SK 03 - SK 53	SK 62 - SK 103
B3			
B6			
B7			
B8			
B5			
B5I			
B5II			
B5III			

Symbols: ▽ Vent plug ▼ Oil level ■ Drain plug ▨ Mounting surface

MAINTENANCE

Mineral lubricant should be changed every 10,000 service hours or after two years. For synthetic oils, the lube should be changed every 20,000 service hours or after four years. In case of extreme operating (e.g. high humidity, aggressive environment or large temperature variations), shorter intervals between changes are recommended.

OIL SPECIFICATIONS

NORD supplies all reducers filled with oil from the factory. Consult the sticker adjacent to the fill plug to determine the type of lubricant installed at the factory. Standard lubricant is ISO VG220 mineral-based oil. However, some units have special lubricants designed to operate in certain environments or to extend the service life of the lubricant. If in doubt about which lubricant is needed, contact NORD Gear.

STANDARD OIL – ISO VG220

Ambient Temperature	Formulation
20 to 104°F (-5 to 40°C)	Mineral

TYPICAL OILS

Viscosity ISO NLGI	Formulation	Service Temperature Range	Mobil	Shell	Castrol	KLÜBER LUBRICATION	bp	Tribol
VG 460	Conventional Mineral	20°C to +50°C 68F to +122°F	Mobilgear 634	Omala 460	7EP	Klüberoil GEM 1-460	Energol GR-XP 460	Tribol 1100/460
	Synthetic PAO	-30°C to +80°C -22°F to +176°F	Mobil SHC 634	Omala 460 HD	Isolube EP 460	Klübersynth EG 4-460	N/A	Tribol 1510/460
VG 320	Conventional Mineral	0°C to +30°C 32°F to +86°F	Mobilgear 632	Omala 320	6EP	Klüberoil GEM 1-320	Energol GR-XP 320	Tribol 1100/320
	Synthetic PAO	-35°C to +80°C -31°F to +176°F	Mobil SHC 632	Omala 320 HD	Isolube EP 460	Klübersynth EG 4-320	N/A	Tribol 1510/320
VG 220	Conventional Mineral	-5°C to +40°C +20°F to +104°F	Mobilgear 630	Omala 220	5EP	Klüberoil GEM 1-220	Energol GR-XP 220	Tribol 1100/220
	Synthetic PAO	-34°C to +80°C -30°F to +176°F	Mobil SHC 630	Omala 220 HD	Isolube EP 220	Klübersynth EG 4-220	N/A	Tribol 1510/220
VG 150 & VG 100	Conventional Mineral	-15°C to +25°C 5°F to +77°F	Mobilgear 629	Omala 100	4EP	Klüberoil GEM 1-150	Energol GR-XP 100	Tribol 1100/100
	Synthetic PAO	-37°C to +10°C -35°F to +50°F	Mobil SHC 629	Omala 150 HD	Isolube EP 150	Klübersynth EG 4-150	N/A	N/A
VG 68	Conventional Mineral	-15°C to +25°C 5°F to +77F	Mobilgear 626	Omala 68	2EP	Klüberoil GEM 1-68	Energol GR-XP 68	Tribol 1100/68
	Synthetic PAO	-40°C to +10°C -40°F to +50F	Mobil SHC 626	N/A	Isolube EP 68	N/A	N/A	N/A
VG 32	Synthetic PAO	-40°C to +10°C -40°F to +50°F	Mobil SHC 624	N/A	N/A	Klüber-Summit HySyn FG-32	N/A	N/A

PAO = Poly Alpha Olefin

SPECIAL PURPOSE LUBRICANTS

Ambient Temperature	Formulation	Manufacturer	Oil Brand Name
20 to 104°F (-5 to 40°C)	*Food Grade* Oil - Synthetic	Chevron	FM ISO 220
20 to 104°F (-5 to 40°C)	*Food Grade* Oil - Synthetic	OilJAX	Magnaplate 85W140-FG
5 to 125°F (-20 to 50°C)	Fluid Grease	Mobil	Mobilux EP023
-30 to 140°F (-35 to 60°C)	Fluid Grease - Synthetic	Mobil	Mobilith SHC 007
-30 to 140°F (-35 to 60°C)	Fluid Grease - Synthetic	Shell	Albida LC

STANDARD BEARING GREASE – NLGI 2EP Lithium

Ambient Temperature	Formulation
-20 to 140°F (-30 to 60°C)	Mineral

OPTIONAL BEARING GREASES

Ambient Temperature	Formulation	Manufacturer	Grease Brand Name
-40 to 230°F (-40 to 110°C)	Synthetic	Shell	Aeroshell 6
-40 to 230°F (-40 to 110°C)	*Food Grade* - Synthetic	Lubriplate	SFL1

LUBRICANT CAPACITY

Each reducer has the oil level and oil quantity adjusted according to the mounting position shown in the tables. When replacing the oil, consult the tables below to determine the proper amount of oil to be installed according to the reducer size and mounting position. Note that this is approximate and the final level will be adjusted when the reducer is installed. Acceptable oil fill level is within ½ inch of the bottom of the fill plug threads.

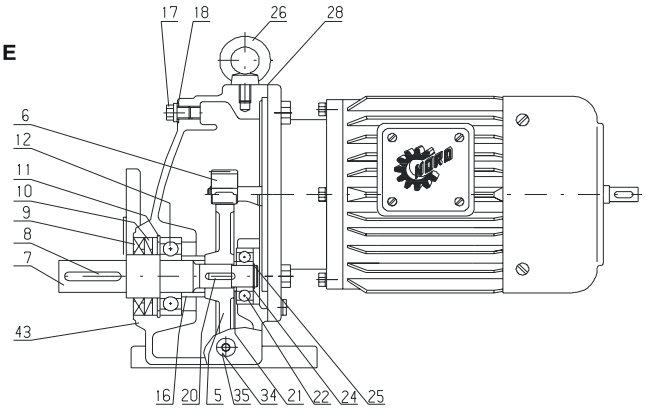
LUBRICATION CAPACITY – HELICAL INLINE GEARBOXES

Mounting position		*Horizontal position*								*Vertical position*			
		single reduction											
		B 3	**B 6**	**B 7**	**B 8**	**B 5**	**B 5I**	**B 5II**	**B 5III**	**V 1**	**V 3**	**V 5**	**V 6**
SK 11E	quarts	0.26	0.37	0.37	0.58	0.32	0.53	0.42	0.42	0.32	0.37	0.42	0.53
	liters	0.25	0.35	0.35	0.55	0.30	0.50	0.40	0.40	0.30	0.35	0.40	0.50
SK 21E	quarts	0.63	1.06	1.06	1.27	0.53	1.16	0.95	0.95	0.74	1.48	1.06	1.27
	liters	0.60	1.00	1.00	1.20	0.50	1.10	0.90	0.90	0.70	1.40	1.00	1.20
SK 31E	quarts	1.16	1.80	1.80	2.32	0.85	1.74	2.11	2.11	1.16	1.37	2.43	2.85
	liters	1.10	1.70	1.70	2.20	0.80	1.65	2.00	2.00	1.10	1.30	2.30	2.70
SK 41E	quarts	1.80	2.75	2.75	3.49	1.06	2.96	3.49	3.49	1.69	2.75	2.64	2.75
	liters	1.70	2.60	2.60	3.30	1.00	2.80	3.30	3.30	1.60	2.60	2.50	2.60
SK 51E	quarts	2.32	3.59	3.59	4.97	1.90	4.33	4.02	4.02	3.17	3.70	4.23	4.65
	liters	2.20	3.40	3.40	4.70	1.80	4.10	3.80	3.80	3.00	3.50	4.00	4.40
Mounting position		**double reduction**											
		B 3	**B 6**	**B 7**	**B 8**	**B 5**	**B 5I**	**B 5II**	**B 5III**	**V 1**	**V 3**	**V 5**	**V 6**
SK 02	quarts	0.16	0.42	0.42	0.74	0.26	0.63	0.53	0.53	0.63	0.63	0.63	0.63
	liters	0.15	0.40	0.40	0.70	0.25	0.60	0.50	0.50	0.60	0.60	0.60	0.60
SK 12	quarts	0.26	0.53	0.53	0.90	0.37	0.95	0.63	0.63	0.95	0.90	0.79	0.79
	liters	0.25	0.50	0.50	0.85	0.35	0.90	0.60	0.60	0.90	0.85	0.75	0.75
SK 22	quarts	0.53	1.43	1.43	2.11	0.74	2.11	1.64	1.64	1.90	2.11	1.90	1.90
	liters	0.50	1.35	1.35	2.00	0.70	2.00	1.55	1.55	1.80	2.00	1.80	1.80
SK 32	quarts	0.95	2.11	2.11	3.17	1.37	3.49	2.54	2.54	3.28	3.06	3.06	2.64
	liters	0.90	2.00	2.00	3.00	1.30	3.30	2.40	2.40	3.10	2.90	2.90	2.50
SK 42	quarts	1.37	3.38	3.38	4.76	1.90	4.76	3.91	3.91	4.23	4.65	4.54	6.13
	liters	1.30	3.20	3.20	4.50	1.80	4.50	3.70	3.70	4.00	4.40	4.30	5.80
SK 52	quarts	2.64	5.39	5.39	7.19	3.17	6.55	5.92	5.92	7.82	7.19	7.19	7.40
	liters	2.50	5.10	5.10	6.80	3.00	6.20	5.60	5.60	7.40	6.80	6.80	7.00
SK 62	quarts	6.87	15.85	15.85	13.74	7.40	14.79	16.91	16.91	19.55	15.85	16.91	15.85
	liters	6.50	15.00	15.00	13.00	7.00	14.00	16.00	16.00	18.50	15.00	16.00	15.00
SK 72	quarts	9.51	24.30	24.30	19.02	10.57	19.55	24.30	24.30	29.59	24.30	27.47	24.30
	liters	9.00	23.00	23.00	18.00	10.00	18.50	23.00	23.00	28.00	23.00	26.00	23.00
SK 82	quarts	14.79	33.81	33.81	28.53	15.85	30.64	36.46	36.46	47.55	39.10	46.49	36.98
	liters	14.00	32.00	32.00	27.00	15.00	29.00	34.50	34.50	45.00	37.00	44.00	35.00
SK 92	quarts	26.42	54.95	54.95	49.66	27.47	49.66	54.95	54.95	82.42	77.14	80.31	77.14
	liters	25.00	52.00	52.00	47.00	26.00	47.00	52.00	52.00	78.00	73.00	76.00	73.00
SK 102	quarts	38.04	75.02	75.02	69.74	42.27	69.74	76.08	76.08	109.90	85.59	107.78	83.48
	liters	36.00	71.00	71.00	66.00	40.00	66.00	72.00	72.00	104.00	81.00	102.00	79.00
Mounting position		**triple reduction**											
		B 3	**B 6**	**B 7**	**B 8**	**B 5**	**B 5I**	**B 5II**	**B 5III**	**V 1**	**V 3**	**V 5**	**V 6**
SK 03	quarts	0.32	0.63	0.63	0.85	0.53	0.95	0.85	0.85	1.16	0.86	0.95	1.32
	liters	0.30	0.60	0.60	0.80	0.50	0.90	0.80	0.80	1.10	0.81	0.90	1.25
SK 13	quarts	0.63	0.74	0.74	1.16	0.85	1.27	1.00	1.00	1.27	1.27	1.27	1.32
	liters	0.60	0.70	0.70	1.10	0.80	1.20	0.95	0.95	1.20	1.20	1.20	1.25
SK 23	quarts	1.37	1.69	1.69	2.43	2.64	1.59	2.96	2.96	2.96	2.75	2.48	2.54
	liters	1.30	1.60	1.60	2.30	2.50	1.50	2.80	2.80	2.80	2.60	2.35	2.40
SK 33	quarts	1.69	2.43	2.43	3.38	2.01	3.70	2.75	2.75	4.65	3.59	4.44	3.06
	liters	1.60	2.30	2.30	3.20	1.90	3.50	2.60	2.60	4.40	3.40	4.20	2.90
SK 43	quarts	3.17	3.80	3.80	5.49	3.70	5.28	4.33	4.33	6.45	6.02	6.97	5.92
	liters	3.00	3.60	3.60	5.20	3.50	5.00	4.10	4.10	6.10	5.70	6.60	5.60
SK 53	quarts	4.76	6.34	6.34	8.14	5.49	7.40	7.08	7.08	9.40	8.88	9.19	9.19
	liters	4.50	6.00	6.00	7.70	5.20	7.00	6.70	6.70	8.90	8.40	8.70	8.70
SK 63	quarts	10.57	13.74	13.74	11.62	11.62	12.68	14.79	14.79	19.02	14.79	16.91	15.32
	liters	10.00	13.00	13.00	11.00	11.00	12.00	14.00	14.00	18.00	14.00	16.00	14.50
SK 73	quarts	14.79	21.13	21.13	18.49	14.79	19.02	21.13	21.13	29.06	23.78	28.53	21.13
	liters	14.00	20.00	20.00	17.50	14.00	18.00	20.00	20.00	27.50	22.50	27.00	20.00
SK 83	quarts	23.25	34.87	34.87	27.47	24.30	28.53	35.93	35.93	42.27	35.93	39.10	32.76
	liters	22.00	33.00	33.00	26.00	23.00	27.00	34.00	34.00	40.00	34.00	37.00	31.00
SK 93	quarts	42.27	51.78	51.78	46.49	42.27	46.49	51.78	51.78	78.19	73.97	76.08	73.97
	liters	40.00	49.00	49.00	44.00	40.00	44.00	49.00	49.00	74.00	70.00	72.00	70.00
SK 103	quarts	58.12	70.80	70.80	58.12	58.12	62.34	70.80	70.80	104.61	82.42	102.50	75.02
	liters	55.00	67.00	67.00	55.00	55.00	59.00	67.00	67.00	99.00	78.00	97.00	71.00

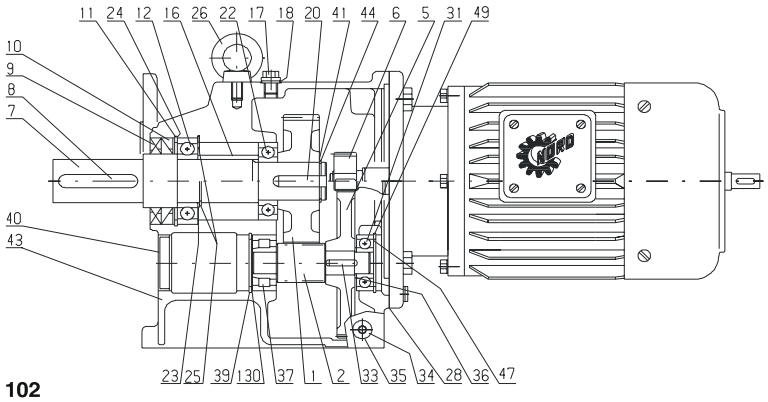
Note: Filling quantities are approximate figures. Oil level must be checked according to oil level plug after final installation. Acceptable oil fill level is within ½ inch of the bottom of the fill plug threads For mounting angles not shown, consult factory.

PARTS LIST

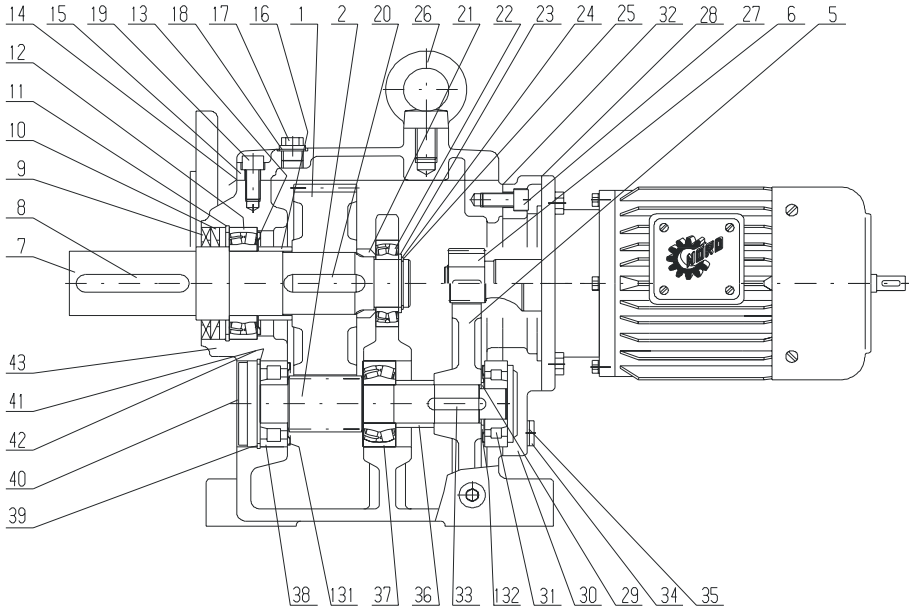
SK 11 E - SK 51 E



SK 02 - SK 52



SK 62 - SK 102



1	Driven gear
2	Pinion shaft
5	Driving gear
6	Driving pinion
7	Output shaft
8	Key
9	Shaft seal
10	Shaft seal
11	Circlip
12	Output shaft bearing
13	NILOS ring
14	Seal
15	Gearcase cover
16	Spacer
17	Vent plug
18	Seal
19	Socket head screw
20	Key
21	Spacer
22	Output shaft bearing
23	Supporting disc
24	Shim
25	Circlip
26	Flanged eye bolt
27	Bolt
28	Seal
29	Spacer
30	Gearbox cover
31	Pinion shaft bearing
32	Seal
33	Key
34	Drain plug
35	Seal
36	Spacer
37	Pinion shaft bearing
38	Pinion shaft bearing
39	Circlip
40	Locking cap
41	Shim
42	Supporting disc
43	Gear case
44	Circlip
47	Shim
49	Circlip
130	Shim
131	NILOS ring
132	NILOS ring

RECOMMENDED SPARE PARTS

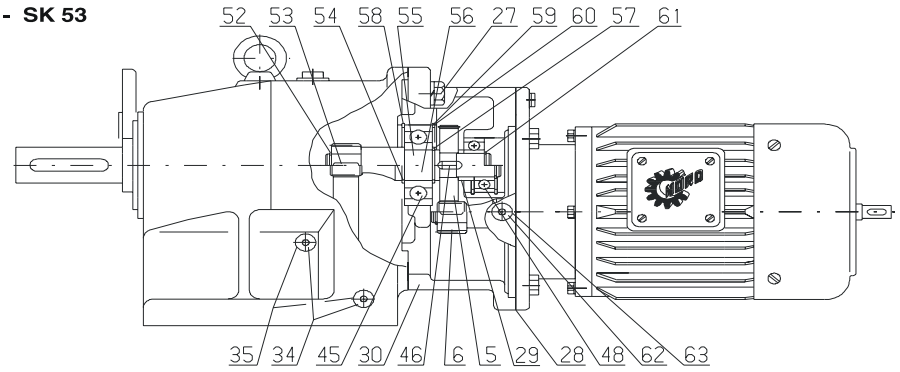
Bearings – *all* Gaskets – *all* Shims – *all*
Seals – *all* Seal Plugs – *all*

IMPORTANT!

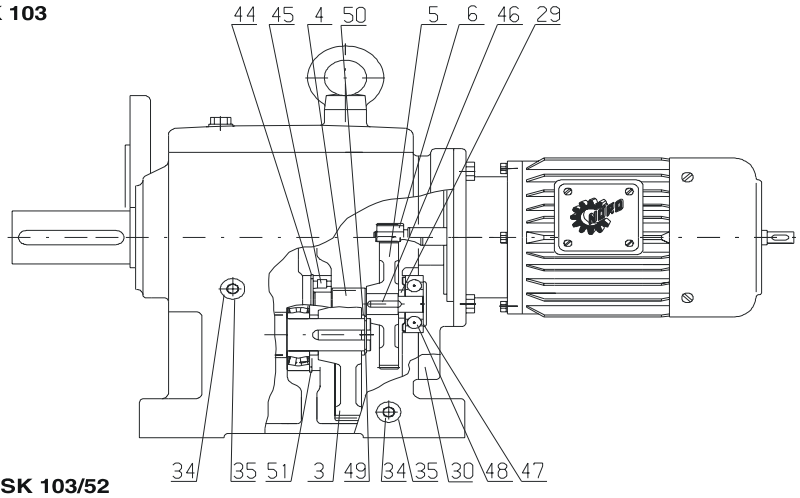
When ordering parts, it is necessary to have the ***NORD SERIAL NUMBER*** from the unit the parts are for. The serial number will dictate the correct parts for that particular unit. The gearbox nameplate will have the serial number on it.

PARTS LIST

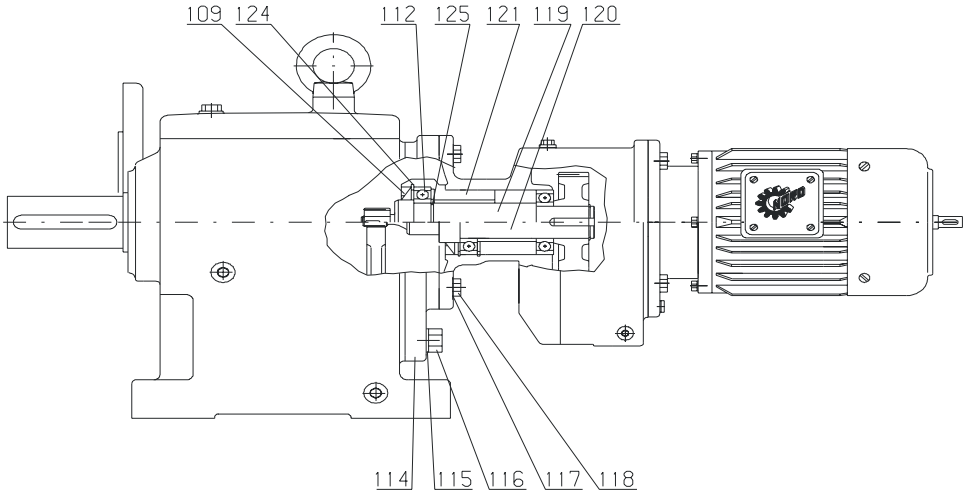
SK 03 - SK 53



SK 63 - SK 103



SK 12/02 - SK 103/52



3	Driven gear
4	Pinion shaft SK 63 - SK 103
5	Driving gear
6	Driving pinion
27	Fixing bolt
28	Seal
29	Spacer
30	Third reduction gearcase
34	Drain plug
35	Seal
44	Circlip
45	Ball bearing
46	Key
47	Shim
48	Ball bearing
49	Circlip
50	Supporting disc
51	Circlip
52	Circlip
53	Key
54	Circlip
55	Intermediate shaft, plain
56	Intermediate shaft, gearcut
57	Circlip
58	Circlip
59	Shim
60	Circlip
61	Circlip
62	Oil-plug
63	Seal
109	Shaft seal
112	Ball bearing
114	Intermediate flange
115	Spring washer
116	Bolt
118	Bolt
119	Intermediate shaft, plain
120	Intermediate shaft, gearcut
121	Bearing sleeve
124	Circlip
125	Circlip

NOTES

TROUBLE SHOOTING

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 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
	Worn RV Disc	Overloading unit may result in damage to disc	Disassemble and replace disc. Recheck rated capacity of reducer.
	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 the reducer not properly maintained.	Check lubricant level and adjust to factory recommended level.
Output Shaft Does Not Turn	Internal parts are broken	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 align 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.
		Overfilled reducer.	Check lubricant level and adjust to recommended level.
		Autovent clogged.	Clean or replace, being sure to prevent any dirt from falling into the reducer.
		Improper mounting position, such as wall or ceiling mount of horizontal reducer.	Check mounting position. Name tag & verify with mounting chart in manual.

NORD Gear Corporation
National Customer Service Toll Free 888-314-6673

www.nord.com

NORD Gear Limited
Toll Free in Canada 800-668-4378

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1121 Railroad Street
Building 101
Corona, CA 92882
Phone 951-279-2600
Fax 888-408-6673

MIDWEST
PO Box 367
800 Nord Drive
Waunakee, WI 53597
Phone 608-849-7300
Fax 800-373-6673

SOUTH
100 Forsyth Hall Dr.
Building 100B
Charlotte, NC 28273
Phone 704-529-1255
Fax 888-259-6673

CANADA
41 West Drive
Brampton, Ontario L6T 4A1
Phone 905-796-3606
Fax 905-796-8130

Installation, Operation and Maintenance Instructions

for AC Induction Motors
56- 6800 Frames (NEMA)
63 – 280 Frames (IEC)

MARATHON ELECTRIC
Contact Motor Customer Service at:
Phone: (715) 675-3311
www.marathonelectric.com

Form 5554E

INSTALLER: PLEASE LEAVE THIS MANUAL FOR THE OWNER'S USE
OWNER: READ AND SAVE THESE INSTRUCTIONS

SAFETY INSTRUCTIONS

⚠ This is the safety alert symbol. It is used to alert you to potential personal injury hazards. Obey all safety messages that follow this symbol to avoid possible injury or death.

⚠ WARNING
Before installing, using, or servicing this product, carefully read and fully understand the instructions including all warnings, cautions, & safety notice statements. To reduce risk of personal injury, death and/or property damage, follow all instructions for proper motor installation, operation and maintenance.

These instructions are not intended as a complete listing of all details for installation, operation, and maintenance. If you have any questions concerning any of the procedures, STOP, and call the appropriate Regal-Beloit motor company.

Table of Contents

motor is suitable for use on Pulse Width Modulated (PWM) type VFD power. In addition, the nameplate must be marked with the inverter rating; for example, "2:1 CT", "2 to 1 Constant Torque", etc.

1.0 INSTALLER/OWNER/OPERATOR RESPONSIBILITY:

1.1 ELECTRICAL SAFETY

WARNING: ELECTRICAL SHOCK HAZARD

Electrical connections shall be made by a qualified electrical personnel in accordance with all applicable codes, ordinances and sound practices. Failure to follow these instructions could result in serious personal injury, death and/or property damage. Only qualified personnel who are familiar with the applicable National Code (USA = NEC) and local codes should install or repair electrical motors and their accessories.

WARNING: ELECTRICAL LIVE CIRCUIT HAZARD

Do not touch electrically live parts. Disconnect, lockout and tag input power supply before installing or servicing motor (includes accessory devices). Use a voltmeter to verify that power is off before contacting conductors.

WARNING: ELECTRICAL GROUNDING HAZARD

Failure to properly ground motors, per the National Electrical Code (NEC) Article 430 and local codes may cause serious injury or death to personnel. For general information on grounding refer to NEC Article 250. (Also see "Ground Connections section 3.4.4").

WARNING: AUTOMATIC RESET PROTECTOR HAZARD

Do not use automatic reset protectors if automatically restarting the motor will place personnel or equipment at risk. . Failure to follow this instruction could result in serious personal injury, death and/or property damage

WARNING: MANUAL RESET PROTECTOR HAZARD

If a tripped manual reset thermal protector is exposed to a temperature less than –7°C (20°F) it may reset and restart the motor automatically. If an application requires a motor with a manual reset thermal protector that will be operated at temperatures less than –7°C (20°F) contact the manufacturer to review the application / motor requirements. Failure to follow this instruction could result in serious personal injury, death and/or property damage

1.2 MECHANICAL SAFETY

WARNING: LOOSE PARTS HAZARD

Before starting the motor, remove all unused shaft keys and loose rotating parts to prevent them from flying off. Failure to follow these instructions could result in serious personal injury, death and/or property damage.

WARNING: ROTATING PARTS HAZARD

Keep extremities, hair, jewelry and clothing away from moving parts. Failure to follow these instructions could result in serious personal injury, death and/or property damage.

1.3 ENVIRONMENTAL SAFETY

WARNING: HAZARDOUS LOCATIONS

(1) The NEC and the local authority having jurisdiction must be consulted concerning the installation and suitability of motors for use in Hazardous Locations. The local authority having jurisdiction must make the final determination of what type of motor is required. The application and operation is beyond the control of the motor manufacturer.

(2) Division 1 Hazardous Locations motors can only be modified or reworked by the manufacturer or a facility that is Listed under UL's category "Motors and Generators, Rebuilt for use in Hazardous Locations". Failure to follow these instructions could result in serious personal injury, death and/or property damage.

(3) Do not use a Hazardous Locations motor with a Variable Frequency Drive (VFD) unless the motor nameplate specifically states that the

2.0 RECEIVING AND INSPECTION

2.1 INITIAL INSPECTIONS

2.1.1 CHECK PACKING LIST AND INSPECT the packaging to make certain no damage has occurred in shipment. If there is visible damage to the packaging, unpack and inspect the motor immediately. Claims for any damage done in shipment must be made by the purchaser against the transportation company.

2.1.2 TURN MOTOR SHAFT by hand to be certain that it rotates freely. Note: Shaft seals and bearing seals may add drag.

2.1.3 CHECK NAMEPLATE for conformance with purchase order requirements and compliance with power supply and control equipment requirements.

2.2 HANDLING:

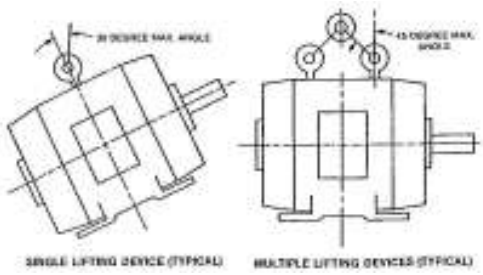
WARNING: FALLING OBJECT HAZARD

Eyebolts or lifting lugs, where provided, are intended for lifting only the motor and accessories mounted by the motor manufacturer (unless specifically stated otherwise on the motor). Utilizing the motor lifting provision to lift other components such as pumps and gear boxes could result in serious personal injury, death and/or property damage.

WARNING: FALLING OBJECT HAZARD

Before using the lifting provision, check the eyebolts and/or other lifting means to assure they are not bent or damaged and are completely threaded, seated & secured to the motor. Equipment to lift motor must have adequate lifting capacity. While lifting the motor DO NOT stand under or in the vicinity of the motor. Failure to follow these instructions could result in serious personal injury, death and/or property damage.

2.2.1 LIFTING ANGLE LIMITATIONS



2.3 STORAGE: Motors, not put into service immediately, must be stored indoors in a clean, dry location. Avoid locations with large temperature swings that will result in condensation. Motors must be covered to eliminate airborne dust and dirt. If the storage location exhibits high vibration, place isolation pads under motor to minimize damage to motor bearings.

2.3.1 BEARING LUBRICATION: Bearings are grease packed at the factory; relubrication upon receipt of motor or while in storage is not necessary. If stored more than one year, add grease per lubrication instructions (Table 4-4) before start-up.

2.3.2 SHAFT ROTATION: It is recommended that the motor shaft be rotated 5 to 10 rotations every three months to distribute the grease in the bearings. This will reduce the chance for corrosion to form on the bearing rolling elements and raceways. Note: Shaft seals and bearing seals may add drag.

2.3.3 DAMP OR HUMID STORAGE LOCATIONS: Treat unpainted flanges, shafts, and fittings with a rust inhibitor. Apply appropriate power to the motor's space heaters (if so equipped)

3.0 INSTALLATION AND OPERATION

⚠ **WARNING:** Only qualified personnel who are familiar with the appropriate national code, local codes and sound practices should install or repair electrical motors and their accessories. Installation should conform to the appropriate national code as well as local codes and sound practices. Failure to follow these instructions could result in serious personal injury, death and/or property damage.

⚠ **WARNING: ELECTRICAL LIVE CIRCUIT HAZARD**
Do not touch electrically live parts. Disconnect, Lockout and Tag input power supply before installing or servicing motor (includes accessory devices). Use a voltmeter to verify that power is off before contacting conductors.

3.1 LOCATION

3.1.1 SELECTING A LOCATION: Consideration should be given to environment and ventilation. Motors should be installed in an area that is protected from direct sunlight, corrosives, harmful gases or liquids, dust, metallic particles, and vibration. A motor with the proper enclosure for the expected operating condition should be selected. Provide accessible clearance for cleaning, repair, service, and inspections (See section 3.1.3 for construction clearances). The location should be considered for possible future motor removal / handling. The free flow of air around the motor should not be obstructed.

3.1.2 AMBIENT TEMPERATURE LIMITS: The ambient temperatures of the air inlet to the motor should not exceed 40°C (104°F) or be less than -30°C (-22°F) unless the motor nameplate specifically states an ambient temperature outside of these limits. The ambient inside an enclosure built around the motor shall not exceed the nameplate ambient. For ambient temperatures outside of these limits consult the motor manufacturer.

⚠ **CAUTION: INSULATION DEGRADATION WARNING**
Insulation at high temperatures ages at an accelerated rate. Each 10°C increase in temperature reduces the insulation life by one half.

⚠ **WARNING: HAZARDOUS LOCATIONS AMBIENT LIMIT:** Division 1 Hazardous Locations motors shall **NOT** be operated below –25°C (-13°F) ambient. (Low temperatures reduce the component mechanical properties.)

3.1.3 CONSTRUCTION SELECTION per LOCATION:

3.1.3.1 DRIPPROOF (OPEN) MOTORS are intended for use indoors where the atmosphere is relatively clean, dry, and non-corrosive. Recommended a minimum clearance of ½ the shaft height between vent openings and the nearest obstruction.

3.1.3.2 TOTALLY ENCLOSED MOTORS are suitable for indoor or outdoor standard service applications.

TEAO or AOM (Totally Enclosed Air Over) motors must be mounted in the air stream. When the motor nameplate states a minimum airflow the motor must be mounted in an air stream meeting this minimum value.

TEFC (Totally Enclosed Fan Cooled) motors must meet a minimum distance of ½ the shaft height between the fan guard grill openings and the nearest obstruction.

3.1.3.3 HAZARDOUS LOCATIONS MOTORS: Hazardous Locations motors are intended for installations in accordance with NEC Article 500. For all installations involving Hazardous Locations motors, consult the applicable national codes, local codes, and the authority having jurisdiction.

Division 1 Installations – includes Class I & II: Use only motors that are UL Listed and CSA Certified or UL Listed and UL Certified for Canada. These motors bear a separate nameplate that includes the UL Listing Mark and CSA Certification Mark or includes the UL Listing Mark and the UL Mark for Canada. This plate also bears the phrase: " Electric motor for Hazardous Locations" and is marked with the Class, Group and Operating Temperature Code.

Division 2 Installations – Class I only: Use only motors that are CSA Certified and bear the CSA Certification Mark. These motors include a phrase on the main motor nameplate that indicates the motor is CSA Certified for Class I, Division 2 / Zone 2 locations.

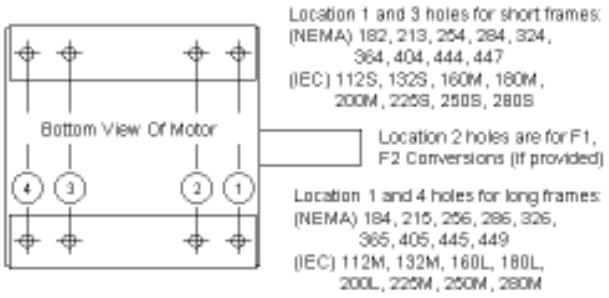
Division 2 Installation – Class II only: Use only Class II motors as described above under "Division I Installations".

⚠ **WARNING: EXPLOSION HAZARD**
A motor should never be placed in an area with a hazardous process or where flammable gases or combustible materials may be present unless it is specifically designed and nameplated for this type of service. Hazardous Locations motors are intended for installations in accordance with NEC Article 500. For all installations involving Hazardous Locations motors, consult the NEC, local codes, and the authority having jurisdiction. Failure to follow these instructions could result in serious personal injury, death and/or property damage. (For other limitations see section 1.3)

3.2 MOUNTING MOTOR:

3.2.1 RIGID BASE (FOOTED): The motor must be securely installed to a rigid foundation or a mounting surface to minimize vibration and maintain alignment between the motor shaft and the load's shaft. The mounting surfaces of the four mounting pads must be flat within 0.01 inches for 210 frame & smaller; 0.015 inches for 250 frame & larger. [IEC 0.25 mm for 130 frame & smaller, 0.38 mm for 160 frame & larger]. This may be accomplished by shims under the motor feet. For special isolation mounting, contact manufacturer for assistance

3.2.2 RIGID BASE HOLE SELECTION -6 OR 8 HOLES



3.2.3 VERTICAL MOUNTING:

CAUTION: ENCLOSURE PROTECTION CAUTION: Most Dripproof rigid base (footed) motors do **NOT** meet "Dripproof" requirements when mounted vertically. If the motor is located in unprotected environments, the addition of a drip cover may be available. Drip covers not available for cast iron rigid base motors.

⚠ **WARNING: FALLING OBJECT HAZARD**
The lifting provision on standard horizontal footed motors is not designed for lifting the motor in a vertical shaft up or shaft down position. (see 2.2.1 lifting angles). Lifting method / provisions for

mounting a rigid base (footed) motor vertically is the responsibility of the installer.

VERTICAL SHAFT DOWN: Most standard horizontal motors thru 449 Fr. (excluding brake motors) can be mounted in a vertical shaft down orientation. For vertical brake motors see section 3.3.6.2.

VERTICAL SHAFT UP:

WARNING: HAZARDOUS LOCATIONS VERTICAL MOUNT: Hazardous locations motors must **NOT** be mounted vertically shaft up without approval by the motor manufacturer. Without proper retaining provisions the rotor may move axially and contact components, creating a spark hazard.

Belted or Radial Load when mounted vertically: The following frame sizes / constructions with applied (axial) down loads within the limit stated are acceptable when mounted vertical shaft up.

Table 3-1 Belted or Radial Load Applications (All speeds)

Frame Size	Enclosure	Construction	Shaft Up OK	Max Applied Down Load[3]
56	TEFC & ODP	Steel	Yes	25 lbs
140	TEFC	Steel & Cast Iron	Yes	25 lbs
	ODP	Steel	Yes	25 lbs
180	TEFC	All	Yes	35 lbs
	ODP	Steel	Yes	35 lbs
210	TEFC	All	Yes	40 lbs
	ODP	Steel	Yes	40 lbs
250	TEFC	All	Yes	40 lbs
	ODP	Steel	Yes	40 lbs
		Cast Iron	No[2]	N/A
280-320	320 TTFC models	Cast Iron	Eng[1]	N/A
	All Other TEFC	Cast Iron & Aluminum	Yes	30 lbs
	ODP	Cast Iron	No[2]	N/A
	TEFC & ODP	Steel	Build Up Only[4]	N/A
360 & Up	TEFC	Cast Iron	Build Up Only[4]	N/A
	ODP	Cast Iron	No[2]	N/A
	TEFC & ODP	Steel	Build Up Only[4]	N/A

Notes:

1 For TEFC model numbers beginning with 324TTFC or 326TTFC consult the motor manufacturer to determine if a build up motor is required.

2 The max applied down load is any applied load external to the motor, including such things as sheave weight, fan loads, axial belt force, pump load, etc. If the application is direct drive with no applied radial load, consult the motor manufacturer.

3 "Build-up only", refers to motors that are specifically ordered and built for shaft up applications. It does not imply that all build-up motors are suitable for shaft up applications.

3.3 APPLICATION ASSEMBLY TO MOTOR:

CAUTION: EQUIPMENT DAMAGE:
Do not connect or couple motor to load until correct rotational direction is established.

3.3.1 GENERAL: PROPER ALIGNMENT of the motor and driven equipment minimizes vibration levels, maximizes bearing life, and extends the overall life of the machinery. Consult the drive or equipment manufacturer for more information.

CAUTION: BEARING FAILURE
During assembly do NOT force components onto the shaft. Striking or hammering the component may result in bearing damage.

3.3.2 DIRECT COUPLING: Use flexible couplings if possible. For applications that apply radial, axial or moment loading on the motor shaft see section 3.3.3.

CAUTION: BEARING FAILURE
Unless approved by the motor manufacturer do **NOT** direct couple a vertical shaft up or roller bearing motor. Direct coupling a vertical shaft up motor or a motor with a roller bearing may result in bearing damage.

3.3.3 DIRECT CONNECTED: Radial loading for direct connected equipment (gears, fans etc.) must be approved by the motor manufacturer unless within the maximum overhung load limits (Table 3-2). Combined loading (axial, radial and/or moments) must be approved by motor manufacturer. For belted loads see section 3.3.4.

Table 3-2 Maximum Radial Load (lbf) @ Middle of the Shaft Extension Length

Frame Number	Motor Rated RPM			
	3600	1800	1200	900
143T	106	166	193	210
145T	109	170	199	218
182T	187	230	261	287
184T	193	237	273	301
213T	319	317	470	510
215T	327	320	480	533
254T	500	631	729	793
256T	510	631	736	820
284T	-	866	990	1100
286T	-	871	1005	1107
324T	-	950	1100	1215
326T	-	950	1113	1230
364T	-	1078	1365	1515
365T	-	1078	1380	1540
404T	-	1388	1590	1762
405T	-	1400	1610	1780
444T	-	1580	1795	2005
445T	-	1520	1795	1985
447T	-	1455	1765	1985
449T	-	1640	1885	2130

Values based on 26,280 hrs B-10 Life
For "End of Shaft" Load multiply value by 0.88
To convert from lbf to N multiply value by 4.4482.

3.3.4 BELTED:

The goal of any belted system is to efficiently transmit the required torque while minimizing the loads on the bearings and shafts of the motor and driven equipment. This can be accomplished by following four basic guidelines:

1. Use the largest practical sheave diameter.
2. Use the fewest number of belts possible.
3. Keep sheaves as close as possible to support bearings.
4. Tension the belts to the lowest tension that will still transmit the required torque without slipping. It is normal for V-belts to squeal initially when line starting a motor

3.3.4.1 Sheave Diameter Guidelines:

In general, smaller sheaves produce greater shaft stress and shaft deflection due to increased belt tension. See Table 3-3 for recommended minimum sheave diameters. Using larger sheaves increases the contact with belts which reduces the number of belts required. It also increases the belt speed, resulting in higher system efficiencies. When selecting sheaves, do not exceed the manufacturer's recommended maximum belt speed, typically 6,500 feet per minute for cast iron sheaves. Determine belt speed by the following formula:

Figure 1

$$\textbf{BELT SPEED (Ft/min)} = \frac{Shaft\ RPM\ x\ 3.14\ x\ Sheave\ Dia\ (inches)}{12}$$

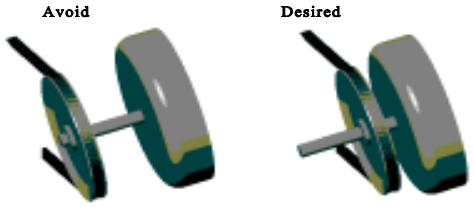
3.3.4.2 Number of Belts

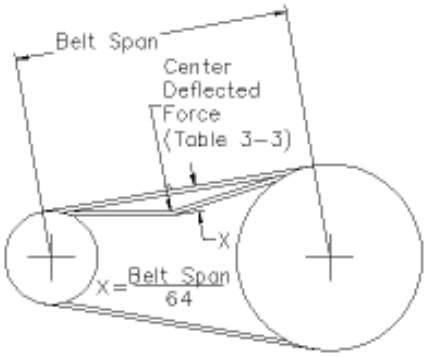
In general, use the fewest number of belts that will transmit the required torque without slipping. See Table 3-3 for recommended maximum number of belts. Each belt adds to the tension in the system, which increases load on the shafts and bearings. Belts are most efficient when operated at or near their rated horsepower.
If the sheaves have more grooves than the number of belts required, use the grooves closest to the motor.

3.3.4.3 Sheave Location

Install sheaves as close to the housing as possible to increase the bearing life of the motor and driven equipment

Figure 2





3.3.4.4 Belt Tension

CAUTION: Equipment Failure Caution
Belt tensioning by feel is **NOT** acceptable. Tensioning by "feel" can be very misleading, and can damage motor and equipment.
It is normal for V-belts to squeal initially when line starting a motor.

In general, belt tensions should be kept as loose as possible while still transmitting the required torque without slipping. Belt tensions must be measured with a belt tension gage. These inexpensive gages may be obtained through belt manufacturers, or distributors.

Proper belt tension is determined by measuring the force required to deflect the center of the belt a given distance. The proper deflection (in inches) is determined by dividing the belt span in inches by 64. Calculate the proper deflection and then see Table 3-3 for the required “Deflected Force” to achieve that deflection.
After tensioning the belt, rotate the sheaves for several rotations or operate the system for a few minutes to seat belts into the grooves, then re-tension the belts. New belts will stretch during use, and should be retensioned after the first eight hours of use.

Table 3-3 Recommended Minimum Sheave Diameters, Belt Type, Number of Belts and Deflected Force

Motor Hp	1200 rpm				1800 rpm				3600 rpm			
	Min Sheave Dia (in)	Belt Type	Max # of Belts	Avg. Deflected Force (lbs)	Min Sheave Dia (in)	Belt Type	Max # of Belts	Avg. Deflected Force (lbs)	Min Sheave Dia (in)	Belt Type	Max # of Belts	Avg. Deflected Force (lbs)
0.75	2.2	3VX	1	3.4	2.2	3VX	1	2.2	2.2	3VX	1	1.3
1	2.4	3VX	1	4.0	2.2	3VX	1	3.1	2.2	3VX	1	1.6
1.5	2.4	3VX	2	3.1	2.4	3VX	2	2.1	2.2	3VX	1	2.5
2	2.4	3VX	3	2.8	2.4	3VX	2	2.9	2.4	3VX	1	2.7
3	3.0	3VX	2	3.3	2.4	3VX	3	2.9	2.4	3VX	2	2.3
5	3.0	3VX	3	4.0	3.0	3VX	3	3.7	2.4	3VX	3	2.5
7.5	3.8	3VX	4	4.7	3.0	3VX	4	4.1	3.0	3VX	2	4.2
10	4.4	3VX	4	5.4	3.8	3VX	4	4.3	3.0	3VX	3	3.8
15	4.4	3VX	5	5.4	4.4	3VX	4	5.4	3.8	3VX	3	4.4
20	5.2	3VX	6	6.0	4.4	3VX	6	4.8	4.4	3VX	3	5.0
25	6.0	3VX	7	5.6	4.4	3VX	7	5.2	4.4	3VX	4	4.7
30	6.8	3VX	7	5.9	5.2	3VX	7	5.3				
40	6.8	5VX	4	11.6	6.0	3VX	7	6.0				
50	8.2	5VX	4	14.6	6.8	3VX	8	5.9				
60	8.2	5VX	5	14.1	7.4	5VX	4	13.3				
75	10.0	5VX	5	14.5	8.6	5VX	4	14.3				
100	10.0	5VX	6	16.0	8.6	5VX	6	13				
125	12.0	5V	7	14.1	10.5	5V	6	13.1				
150	13.2	5V	7	15.4	10.5	5V	7	13.4				
200	15.0	5V	8	16.0	13.2	5V	8	13.1				
250	15.0	8V	6	27.6	14.0	5V	9	13.8				
300	16.0	8V	7	27.1	14.0	5V/**8V**	11 / **7**	23.4				
350	16.5	8V	7	30.3	14.5	5V/**8V**	12 / **7**	26.0				
400	17.5	8V	8	29.1	15.0	5V/**8V**	13 / **8**	25.7				
450	18	8V	8	31.6	16.0	5V/**8V**	14 / **9**	25.2				
500	18.5	8V	9	30.7	16.5	5V/**8V**	15 / **9**	26.9				
600					17.5	8V	11	26.3				
700					19.0	8V	12	27.3				
800					20.0	8V	13	28.2				

Contact Motor Manufacturer when Belting 3600 rpm Motors Greater than 25 HP

Notes:

1. Horsepower is the nameplate motor horsepower, and RPM is the motor (driver) speed.
2. Minimum sheave diameters are from NEMA standards where applicable.
3. **For variable speed applications or values outside these recommendations, consult motor manufacturer.**
4. Selections are based on a 1.4 service factor, 5 to 1 speed ratio and various Power Transmission Manufacturers' catalogs.
5. These selections are for Narrow V-belt sections only. Consult manufacturer for details on conventional V-belt sections (A, B, C, D and E), or other belt types.
6. "Average Deflected Force is per section 3.3.4.4 of this document and is the force required to deflect the center of a belt 1/64 of the belt span distance. Tolerance on this force is ±1 lbf for forces ≤10 lbs, and ±2 lbs for forces >10 lbs as measured utilizing a belt tension gage.
7. When more than one belt is required the belts must be a matched set (matched for length).
8. If possible, the lower side of the belt should be the driving side to increase the length of wrap on the sheave).
9. For belted loads do not exceed 125% of 60 Hz operating RPM.

3.3.5 VFD (Variable Frequency Drives) OPERATION:

⚠ WARNING: VFD Motors with Reset Thermal Protectors
UL Recognition, UL Listing, or CSA certification does not apply to motors that are equipped with a manual or automatic reset thermal protector when the motor is operated on VFD power.

⚠ WARNING: Power Factor Correction Capacitors:
Power factor correction capacitors should never be installed between the drive and the motor.

⚠ CAUTION: VFD / Motor Setup:
It is the responsibility of the startup personnel during set up of the VFD / motor system to properly tune the drive to the motor for the specific application per the VFD user manual. The correct voltage boost and volts per hertz settings are application dependent and unique to each motor design. Failure to connect over temperature devices (when provided) will void the warranty.

3.3.5.1 Overspeed Capability:

Belted loads: Do not exceed 125% of 60 Hz operating RPM.

Table 3-4 Maximum Safe Continuous Speed (RPM) For Coupled and Direct Connected Loads

NEMA / [IEC] Frame Size	2-Pole	4, 6, or 8 Pole
56-180 [80-110]	7200 *	5400 *
210-250 [130-160]	5400 *	4200*
280 [180]	5400 *	3600
320 [200]	4500 *	3600
360 [225]	4500 *	2700
400-440 [250-280]	3600	2700
>440 [>280]	3600	1800

* = Fan cooled motors (Totally Enclosed & Hazardous Locations Motors) are limited to a maximum safe continuous speed of 4000 RPM **For higher speeds or shortened duty cycle contact motor manufacturer**

3.3.5.2 Cable Lengths: For optimum insulation life, limit VFD to motor cable lengths of general purpose motors

to Table 3-5 values. Definite purpose VFD motors may accommodate longer cable lengths. For additional information contact motor manufacturer.

Table 3-5 Max Cable Lengths General Purpose Motors
These values are based on 3 kHz carrier frequency. Add suitable VFD output-side filters when exceeding the listed values.

Frame Size	230V	460 V	575 V
NEMA 56-320	600 ft.	125 ft.	40 ft.
NEMA 360-5011	1000 ft.	225 ft.	60 ft.
IEC 80-200	180 m.	40 m.	12 m.
IEC 225-280.	300 m.	70 m.	18 m.

3.3.5.3 VFD Grounding: Equipment grounding conductors may be run in the same conduit as the AC motor power leads. This wire must be used as the equipment ground for the motor and not as the fourth current carrying wire of a "WYE" motor circuit. The grounded metal conduit carrying the output power conductors can provide EMI shielding, but the conduit does not provide an adequate ground for the motor; a separate grounding conductor must be used. Grounding the motor neutral (WYE) of a VFD powered motor may result in a VFD ground fault trip. Improper grounding of an inverter fed motor may result in frame voltages in excess of 500 Volts. Refer to Grounding section 3.4.4

3.3.5.4 VFD – Single Phase:

CAUTION: SINGLE PHASE MOTOR FAILURE:
Single Phase motors are **NOT** suitable for use on VFD power. Connecting a Single Phase Motor to a VFD voids the warranty.

3.3.5.5 Stray Voltage on Accessory Leads:

VFD's will couple stray (common-mode) voltage to motor-mounted RTDs, thermistors, thermostats and space heaters. The leads of these elements must be properly insulated and control input circuits must be designed to withstand this common-mode voltage.

3.3.6 ACCESSORIES / PROVISIONS:

3.3.6.1 General: Carefully read and understand the accessory manufacturer's instructions, supplied with motor. Contact the manufacturer for additional information.

3.3.6.2 Brake Motors:

CAUTION: Vertical Motor Premature Brake Failure
Motors with brakes that are designed for vertical applications are equipped with springs to support the brake pressure plate. Mounting a horizontal brake motor vertically shaft up or down may require a pressure plate spring modification. Failure to modify the brake for the vertical application may result in premature brake failure. If in question, consult brake literature or brake manufacturer.

Brake Solenoid Wiring: Do NOT connect the brake solenoid to the output of a VFD. The brake solenoids must be wired to 50/60 Hz line power

3.3.6.3 Space Heaters:

Motors provided with space heaters have two leads that are brought into the conduit box or into an auxiliary box. These leads are marked "H1", "H2" ("H3", "H4" if a second space heater is supplied). See the space heater nameplate on motor for heater rating.

WARNING: DIVISION 2 EXPLOSION HAZARD
The space heater temperature rating when used in Class I, Division 2 motors shall **NOT** exceed 80% of the auto ignition temperature of the hazardous gas or vapor. See the space heater nameplate on motor for heater Temperature Code and heater rating. Failure to follow this instruction could result in serious personal injury, death and/or property damage

3.3.6.4 Thermal Protection:

General Information: When thermal protection is provided, one of the following will be stamped on the nameplate:

1. **"THERMALLY PROTECTED"** This motor has built in thermal protection. Thermal protectors open the motor circuit electrically when the motor overheats or is overloaded. The protector cannot be reset until the motor cools. If the protector is automatic, it will reset itself. If the protector is manual, disconnect motor from power supply. After protector cools (five minutes or more) press the reset button and reapply power to the motor. In some cases a motor is marked "Auto" and the connection diagram on the motor will identify T'Stat leads – see "2 " below. (See warnings on Manual and Automatic reset protectors - section 1.1)

2. **"WITH OVERHEAT PROTECTIVE DEVICE"**: This motor is provided with an overheat protective device that does not directly open the motor circuit. Motors nameplated with this phrase have either thermostats, thermisters or RTD's. The leads to these devices are routed into the motor conduit box or into an auxiliary box. The lead markings are defined on the nameplate (normally "P1", "P2") . The circuit controlled by the overheat protection device must be limited to a maximum of 600 volts and 360 volt-amps. See connection decal provided inside the terminal box cover. Failure to connect these over temperature devices (when provided) will void the warranty.

   WARNING: EXPLOSION HAZARD
   For Hazardous Locations motors provided with thermostats UL and the NEC require connection of thermostat leads into the control portion of a manual reset start circuit. Failure to follow this instruction could result in serious personal injury, death and/or property damage

Resistance Temperature Detectors (RTD): When winding and/or bearing RTDs are provided the RTD lead markings are defined on the nameplate. (Normally "R1", "R2", "R3" etc.)

3.3.6.5 RTD Alarm & Trip Settings:

Tables 3-6 & 3-7 are suggested initial RTD alarm and trip settings. For motors found to operate significantly below these values the settings may be reduced accordingly.

Table 3-6 Winding RTD – Temperature Limit (°C) 40 °C Max Ambient

Motor Load	Class B Temp Rise≤ 80°C		Class F Temp Rise≤ 105°C	
	Alarm	Trip	Alarm	Trip
Up to 1.0 SF	130	140	155	165
>1.0 to 1.15 SF	140	150	160	165

Table 3-7 Bearing RTD – Temperature Limit (°C) 40 °C Max Ambient

Ambient	Alarm	Trip
Up to 40**°C**	95	100
> 40**°C**	110	115
Bearings that are Heat Stabilized to 150 **°C**	130	135

3.3.7 GUARDS:

WARNING: ROTATING PARTS HAZARD
When devices are assembled to the motor shaft, be sure to install protective devices such as belt guards, chain guards, and shaft covers. These devices must protect against accidental contact with extremities, hair, and clothing. Consider the application and provide guarding to protect personnel. Remove all unused shaft keys and loose rotating parts to prevent them from flying off and causing bodily injury. Failure to follow this warning could result in serious personal injury, death and/or property damage.

3.4 ELECTRICAL CONNECTIONS:

WARNING: ELECTRICAL HAZARDS
Before proceeding read Section 1-1 on Electrical Safety. Failure to follow the instructions in Section 1-1 could result in serious personal injury, death and/or property damage

3.4.1 POWER SUPPLY / BRANCH CIRCUIT

WARNING: POWER SUPPLY INCOMPATIBILITY HAZARD
Check power supply to make certain that voltage, frequency and current carrying capacity are in accordance with the motor nameplate. Failure to match motor nameplate values could result in serious personal injury, death and/or property damage

WARNING: BRANCH CIRCUIT SUPPLY HAZARD
Motor and control wiring, fusing, overload protection, disconnects, accessories and grounding must always conform to the applicable electrical codes as well as local codes and sound practices.

3.4.1.1 Branch Circuit Supply to a motor should include a disconnect switch, short circuit current fuse or breaker protection, motor starter (controller) and correctly sized thermal elements or overload relay protection.

3.4.1.2 Fuses, Breakers, Overload Relays

Short Circuit Current Fuses or Breakers are for the protection of the branch circuit. Starter or motor controller overload relays are for the protection of the motor. Each of these should be properly sized and installed per the applicable electrical codes as well as local codes and practices.

WARNING: PROTECTIVE DEVICE DISABLED HAZARD
DO NOT bypass or disable protective devices. Protection removal could result in serious personal injury, death and/or property damage

3.4.1.3 AC Power Supply Limits

Motors are designed to operate within the following limits at the motor terminals:
1- AC power is within +/- 10 % of rated voltage with rated frequency applied. (Verify with nameplate ratings) **OR**
2- AC power is within +/- 5% of rated frequency with rated voltage **OR**
3- A combined variation in voltage and frequency of +/- 10% (sum of absolute values) of rated values, provided the frequency variation does not exceed +/-5% of rated frequency.
4- For 3 phase motors the line to line full load voltage must be balanced within 1%.
5- If the motor is rated 208-230V, the voltage deviations must be calculated from 230V.

CAUTION: Reduced Motor Performance
Operation outside of these limits will degrade motor performance and increase operating temperature.

3.4.2 TERMINAL BOX:

3.4.2.1 Conduit Opening: For ease of connections, motors are typically provided with large terminal boxes. Most motors have conduit access in 90 degree increments, the terminal box conduit opening is typically provided via knockouts, holes with covers, or the terminal box is rotate-able. Fabricated conduit boxes may have a removable plate for the installer to provide correctly sized hole(s).

3.4.2.2 Hazardous Locations Motors:

WARNING: EXPLOSION HAZARDS
(1) Terminal Boxes mounted to motor with a pipe nipple: If a pipe nipple mounted terminal box is removed or rotated it must be reassembled with a minimum of five full threads of engagement.
(2) Component Removal: Do not set a terminal box component on its machined surfaces. Prior to component reassembly wipe clean all machined surfaces.
(3) Machined Surface Gap (Hazardous Locations Terminal Boxes): The gap between mating surfaces with the machined terminal box MUST BE LESS THAN 0.002 inches. This gap must be checked with a feeler gage along the entire perimeter. If there is visible damage to the mating surfaces, or if the gap between these surfaces exceeds 0.002 inches, DO NOT complete the installation and contact the motor manufacturer. Failure to follow these instructions could result in serious personal injury, death and/or property damage

3.4.3 LEAD CONNECTIONS

Electrical connections to be made per nameplate connection diagram or separate connection plate. In making connections follow the applicable electrical code as well as local codes and practices.

WARNING: ELECTRICAL CONNECTION HAZARD
Failure to correctly connect the motor leads and grounding conductor can result in injury or death. Motor lead connections can short and cause damage or injury if not well secured and insulated.

3.4.3.1 Wire Size (Single Phase) Requirements

The minimum wire size for Single Phase, 115 & 230 Volt Circuits must meet table 3-8 for a given distance between motor and either Fuse or Meter Box.

Table 3-8 Minimum Wire Gage Size Single Phase 115 & 230 Volt Circuits

Distance (Feet) - Motor to Fuse or Meter Box								
Motor	100 Ft.		200 Ft.		300 Ft.		500 Ft.	
HP	115	230	115	230	115	230	115	230
1/4	14	14	10	12	8	10	6	8
1/3	12	14	10	12	6	10	4	8
1/2	10	12	8	10	6	8	4	6
3/4	10	12	6	10	4	8	2	6
1	8	10	6	8	4	6		4
1 1/2	4	10	0	8		6		4
2		8		6		4		2
3		8		6		4		2
5		6		4		2		0

3.4.3.2 Extension Cords (Single Phase Motors):

Where an extension cord(s) is utilized to provide power to the motor the extension cord(s) must be…(1) the proper gauge size per table 3-8, (2) in good working condition (3) properly grounded.

3.4.4 GROUND CONNECTION(S):

WARNING: ELECTRICAL GROUNDING HAZARD
For general information on grounding (USA) refer to NEC Article 250. Improper grounding of an inverter fed motor may result in frame voltages in excess of 500 Volts. In making the ground connection, the installer must make certain that a good electrical connection is obtained between motor and grounding lead. Failure to properly ground motors, per the applicable national code (such as NEC Article 430) and local codes may cause serious injury or death to personnel.

Primary "Internal" Ground: A grounding conductor must be connected to the grounding terminal provided in the terminal housing. This grounding terminal is either a ground screw, ground lug, or a tapped hole to be used with a separately provided ground screw. The internal grounding feature is accessible inside the terminal housing and must be used as the primary grounding connection.
Secondary "External" Ground: Some motors are provided with a supplemental grounding terminal located on the external surface of the motor frame or feet. This external terminal is for supplemental bonding connections where local codes permit or require such connection

3.4.5 START UP:

WARNING: ELECTRICAL SHOCK HAZARD:
Be certain that all connections are secure and the conduit box cover is fastened in place before electrical power is connected. Failure to follow these instructions could result in serious personal injury, death, and/or property damage.

⚠ WARNING: LOOSE & ROTATING PARTS HAZARD
Before proceeding read Section 1-2 on Mechanical Safety. Failure to follow the instructions in Section 1-2 could result in serious personal injury, death and/or property damage

⚠ WARNING: EXCESSIVE SURFACE TEMPERATURE HAZARD
Motors with the temperature code stated on the nameplate are designed to operate within this limit. Improper application or operation can cause the maximum surface temperature to be exceeded. A motor operated in a Hazardous Location that exceeds this surface temperature limit increases the potential of igniting hazardous materials. *Therefore, motor selection, installation, operation, and maintenance must be carefully considered to ensure against the following conditions:* (1) Motor load exceeds service factor value, (2) Ambient temperature above nameplate value, (3) Voltages outside of limits (3.4.1.3), (4) Loss of proper ventilation, (5) VFD operation exceeding motor nameplate rating, (6) Altitude above 3300 feet / 1000 meters, (7) Severe duty cycles, (8) Repeated starts, (9) Motor stall, (10) Motor reversing, and (10) Single phase operation. Failure to follow these instructions could result in serious personal injury, death and/or property damage.

⚠ CAUTION: HOT SURFACE
Normal motor surface temperatures may exceed 90 ° C (194° F). Touching the motor frame may cause discomfort or injury. Surface temperatures should only be measured with suitable instruments and not estimated by hand touch.

3.4.5.1 Start Up - No Load Procedure

1. **Check Instructions:** Before startup carefully read and fully understand these instructions including all warnings, cautions, and safety notice statements.
2. **Motor out of storage after more than three months:** Check winding insulation integrity with a Megger. If winding resistance to ground is less than 1.5 Meg-ohms consult the local authorized service shop before energizing the motor.
3. **Check Installation: Mechanical** - Check tightness of all bolts and nuts. Manually rotate the motor shaft to ensure motor shaft rotates freely. Note: Shaft & bearing seals will add drag.
   Electrical - Inspect all electrical connections for proper terminations, clearance, mechanical tightness and electrical continuity. Be sure to verify connections are made per the nameplate connection diagram or separate connection plate. Replace all panels and covers that were removed during installation before energizing the motor.
4. **Energize Motor: Check Rotation**
   If practical check motor rotation before coupling to the load. Unlock the electrical system. Momentarily provide power to motor to verify direction of rotation. If opposite rotation is required, lock out power before reconnecting motor. If motor has a rotational arrow only operate the motor in the rotation identified. Reapply power to ensure proper operation.
5. **Record No Load Amps, Watts & Voltage:**
   Recommend - To establish a baseline value check and record the no load amps, watts, and voltage.

3.4.5.2 Start Up – Load Connected Procedure

1. **Check Instructions:** Before startup carefully read and fully understand these instructions including all warnings, cautions, & safety notice statements.
2. **Coupling Installation:** Check that the connected equipment is properly aligned and not binding. Check that all guards and protective devices are properly installed.
3. **Energize Motor:** When all personnel are clear of the machine, apply power and verify that the load is not transmitting excessive vibration back to the motor though the shaft or the foundation. Verify that motor amps are within nameplate rating. For repeated starts see 3.4.5.3. The equipment can now be fully loaded and operated within specified limits as stated on the nameplate.

3.4.5.3 Jogging and/or Repeated Starts

Do not start more than twice in succession under full load. Repeated starts and/or jogs of induction motors can cause overheating and immediate failure. Contact the motor manufacturer if it is necessary to repeatedly start or jog the motor.

4.0 MAINTENANCE:

⚠ WARNING: Hazardous Locations Motor Repair HAZARD:
Division 1 Hazardous Locations motors can only be modified or repaired by the manufacturer or a facility that is Listed under UL's category "Motors and Generators, Rebuilt for use in Hazardous Locations". Failure to follow these instructions could result in serious personal injury, death and/or property damage.

⚠ WARNING: ELECTRICAL SHOCK HAZARD
Electrical connections are to be made by qualified electrical personnel in accordance with all applicable codes, ordinances and sound practices. Failure to follow these instructions could result in serious personal injury, death and/or property damage. Only qualified personnel who are familiar with the applicable national codes, local codes and sound practices should install or repair electric motors and their accessories.

⚠ WARNING: ELECTRICAL LIVE CIRCUIT HAZARD
Do not touch electrically live parts. Disconnect, lockout and tag input power supply before installing or servicing motor (includes accessory devices).

4.1 GENERAL INSPECTION

Inspect the motor approximately every 500 hours of operation or every three months, whichever occurs first. Keep the motor clean and the ventilation and fin openings clear. The following steps should be performed at each inspection:

4.1.1 VENTILATION: Check that the ventilation openings and/or exterior of the motor is free of dirt, oil, grease, water, etc, which can accumulate and block motor ventilation. If the motor is not properly ventilated, overheating can occur and cause early motor failure.

4.1.2 INSULATION: Use a "Megger" periodically to ensure that the integrity of the winding insulation has been maintained. Record the Megger readings. If winding resistance to ground is less than 1.5 Meg-ohms consult the local authorized service shop before re-energizing the motor.

4.1.3 ELECTRICAL CONNECTIONS: Check all electrical connectors to be sure that they are tight.

4.2 LUBRICATION & BEARINGS:

The lubricating ability of grease (over time) depends primarily on the type of grease, the size of the bearing, the speed at which the bearing operates and the severity of the operating conditions. Longer bearing life can be obtained if the listed recommendations are followed:

NOTE: If lubrication instructions are provided on the motor nameplate, the nameplate instructions will supersede these instructions. Motors marked "Permanently Lubricated" do not require additional service.

⚠ CAUTION: BEARING / MOTOR DAMAGE WARNING
Lubricant should be added at a steady moderate pressure. If added under heavy pressure bearing shield(s) may collapse. Over greasing bearings greatly increases bearing friction and can cause premature bearing and/or motor failure.

4.2.1 GREASE TYPE (unless nameplate states otherwise):
Nameplate Ambient Temperature between -30°C (-22°F) to 65°C (150°F) inclusive: Recommended grease for standard service conditions is Mobil Polyrex ® EM. Equivalent and compatible greases include: Texaco Polystar RB, Rykon Premium #2, Pennzoil Pen 2 Lube, Chevron SRI & Mobil SHC 100.

Nameplate Ambient Temperature below -30°C (-22°F): Special low temperature grease is recommended, such as Aeroshell 7 or Beacon 325 for ball bearings and Mobil SHC 100 for roller bearings.

Nameplate Ambient Temperature above 65°C (150°F): Dow Corning DC44 or equivalent, a special high temperature grease is required. Note that Dow Corning DC44 grease does not mix with other grease types.

4.2.2 BEARING OPERATING TEMPERATURE:

⚠ CAUTION: HOT SURFACE

The external surface temperature of the end shield (bracket) bearing hub may reach 100° C (212° F) during normal operation. Touching this surface may cause discomfort or injury. Surface temperatures should only be measured with suitable instruments and not estimated by hand touch.

For RTD settings see Table 3-7.

4.2.3 LUBRICATION INTERVALS: (For motors with regreasing provisions)

Eq. 4.2 Lubrication Interval = [(Table 4-1) hrs] x [Interval Multiplier (Table 4-2)] x [Construction Multiplier (Table 4-3)]

Table 4-1 Lubrication Intervals (Hours) These values are based on average use.

NEMA / [IEC] Frame Size	Operating Speed – RPM (See Table 3.4 for Maximum Operating Speed)					
	<7200	<5400	<4500	<3600	<1800	<1200
56-180 [80-110]	2500 Hrs.	4000 Hrs	5000 Hrs	6000 Hrs.	17000 Hrs.	20000 Hrs.
210-250 [130-160]		2500 Hrs	4000 Hrs	5000 Hrs.	12000 Hrs.	16000 Hrs.
280 [180]		2000 Hrs	3000 Hrs	4000 Hrs.	10000 Hrs.	14000 Hrs.
320 [200]			2000 Hrs	3000 Hrs.	9000 Hrs.	12000 Hrs.
360 [225]			1500 Hrs	2000 Hrs.	8000 Hrs.	10000 Hrs.
400-440 [250 – 280]				1500 Hrs.	4000 Hrs.	7000 Hrs.
>440 [>280]				1000 Hrs.	3000 Hrs.	5000 Hrs.

Seasonal Service: If motor remains idle for more than six months, Lubricate at the beginning of the season, then follow lubrication interval.

Do not exceed maximum safe operating speed Table 3-4 without manufacturer's approval

Table 4-2 Service Conditions

Use highest level Multiplier: Maximum Ambient Temperature and Contamination are independent factors

Severity of Service	Maximum Ambient Temperature	Atmospheric Contamination	Multiplier
Standard	Less than 40° C (104° F)	Clean, Slight Corrosion, indoors, less than 16 hrs per day	1.0
Severe	Above 40° C (104° F) to 50° C	Moderate dirt or Corrosion or outdoors or more than 16 hrs per day	0.5
Extreme	Greater than 50° C or Class H Insulation	Severe dirt or Abrasive dust or Corrosion	0.2

Table 4-3 Construction Multiplier

Construction	Multiplier
Angular Contact or Roller Bearing	0.5
Vertical Motor	0.5
All others	1.0

Table 4-4 Relubrication Amounts

Frame Size		Volume		
NEMA	IEC	Cu. In.	Fluid oz	ml
48-56	80	0.25	0.14	4.0
143-145	90	0.25	0.14	4.0
182-184	110	0.50	0.28	8.0
213-215	130	0.75	0.42	12.5
254-256	160	1.00	0.55	16.0
284-286	180	1.50	0.83	25.0
324-326	200	2.00	1.11	33.0
364-365	225	3.00	1.66	50.0
404-405	250	3.80	2.11	62.0
444-449	280	4.10	2.27	67.0
>449	>280	4.50	2.50	74.0

For regreasing while operating multiply volume by 125%.

4.2.4 LUBRICATION PROCEDURE: (For Motors with Regreasing Provisions)

CAUTION: BEARING DAMAGE WARNING
Added grease must be compatible with the original equipment's grease. If a grease other than those stated in 4.2.1 is to be utilized contact the motor manufacturer. Nameplate information supersedes section 4.2.1 (GREASE TYPE). New grease must be free of dirt. Failure to follow these instructions and procedure below may result in bearing and/or motor damage.

For an extremely dirty environment, contact the motor manufacturer for additional information.

LUBRICATION PROCEDURE:

1. Clean the grease inlet plug or zerk fittings prior to regreasing.
2. (If present) Remove grease drain plug and clear outlet hole blockage.

CAUTION: GREASE DRAIN PLUGGED:
Old grease may completely block the drain opening and must be mechanically removed prior to regreasing. Forcing a blocked drain open by increased greasing pressure may collapse bearing shields and / or force excess grease through the bearings and into the motor.

3. Add grease per Table 4-4
4. Re-install grease inlet and drain plugs (if removed).

WARNING: EXPLOSION HAZARD
Do NOT energize a Hazardous Locations motor without all grease fittings properly installed.

4.2.5 EXAMPLE: LUBRICATION

Assume - NEMA 286T (IEC 180), 1750 RPM Vertical motor driving an exhaust fan in an ambient temperature of 43° C and the atmosphere is moderately corrosive.

1. Table 4-1 list 10,000 hours for standard conditions.
2. Table 4-2 classifies severity of service as "Severe" with a multiplier of 0.5.
3. Table 4-3 lists a multiplier value of 0.5 for "Vertical"
4. (Eq. 4.2) Interval = 10,000 hrs x 0.5 x 0.5 = 2500 hrs

Table 4-4 shows that 1.5 in^3 of grease is to be added.

Relubricate every 2,500 hrs of service with 1.5 in^3 of recommended grease.

4.3 TROUBLE-SHOOTING

WARNING: READ INSTRUCTIONS:
Before trouble-shooting a motor, carefully read and fully understand the warnings, cautions, *&* safety notice statements in this manual.

WARNING: Hazardous Locations Motor Repair:
Motors nameplated for use in Division 1 Hazardous Locations can only be disassembled, modified or repaired by the plant of manufacturer or a facility that is Listed under UL's category "Motors and Generators, Rebuilt for use in Hazardous Locations". Failure to follow these instructions could result in serious personal injury, death and/or property damage

CAUTION: DISASSEMBLY APPROVAL REQUIRED:
Motor disassembly must be performed by a party approved by the motor manufacturer. To disassemble the motor without approval voids the warranty.

4.3.1 GENERAL TROUBLE-SHOOTING WARNINGS

1. **DISCONNECT POWER TO THE MOTOR BEFORE PERFORMING SERVICE OR MAINTENANCE.**
2. **Discharge all capacitors before servicing motor.**
3. **Always keep hands and clothing away from moving parts.**
4. **Be sure required safety guards are in place before starting equipment.**
5. **If the problem persists contact the manufacturer.**

4.3.2 Motor Trouble-shooting Cause / Corrective Action - Table 4-5

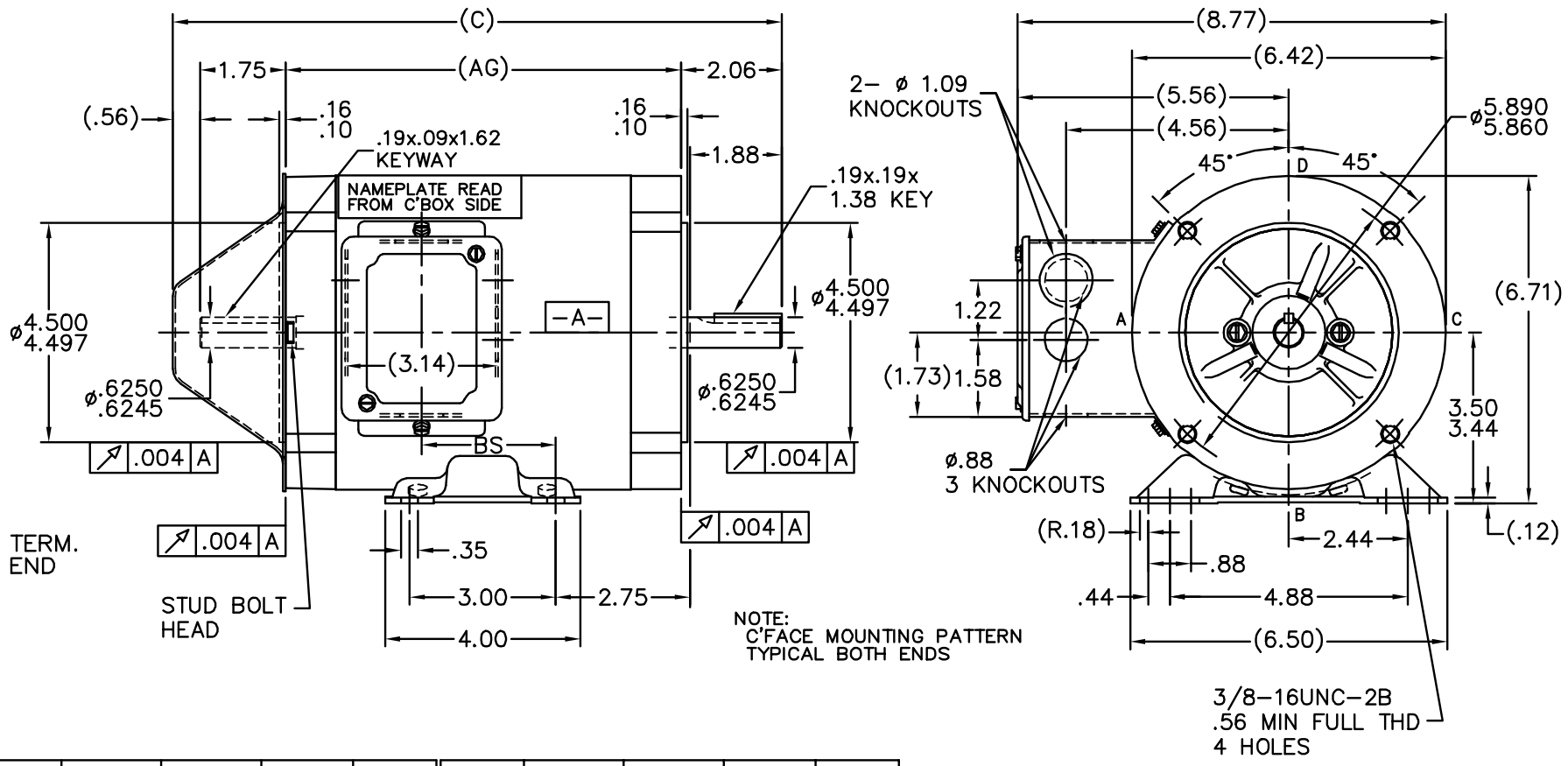
Issue:	Likely Cause:	Corrective Action:
Motor fails to start upon initial installation:		
A.)	Supply voltage is too low or is severely unbalanced (one phase is low or missing).	(1) Check power supply fuses (2) Match motor lead wiring to nameplate connection diagram and supply voltage (3) Ensure that steady state supply voltage at motor terminals is within limits (see section 3.4.1.3). Correct as needed (4) Obtain correct motor to match actual supply voltage.
B.)	Motor leads are miswired at conduit box.	
C.)	Driven load exceeds motor capacity	(1) Verify that motor & load turn freely (2) Disconnect motor from load & ensure motor turns freely. Note: Roller bearings make noise when motor is uncoupled and shaft is rotated (3) Verify that motor starts when disconnected from load (4) Remove excessive / binding load if present.
D.)	Load is jammed.	
E.)	Fan guard is bent and making contact with fan	Replace fan guard & fan (if blades are damaged)
F.)	VFD with power factor capacitors installed	Remove power factor correction capacitors if equipped
G.)	VFD with motor neutral lead grounded	Ensure that motor neutral lead is ungrounded
H.)	VFD programmed incorrectly	(1) Repeat checks listed above (2) Verify that VFD current limit and starting boost are set correctly (5) Double-check motor and feedback parameter settings and VFD permissives (6) Repeat autotune (for vector drives) procedure (7) Consult VFD supplier.
Motor has been running, then slow down, stalls, or fails to restart:		
A.)	Supply voltage has drooped or has become severely unbalanced	(1) Replace fuse or reset circuit breaker. Allow motor to cool down before resetting manual protector on motor. **Warnings** - See section 1.1 for automatic and manual reset protector warnings (2) Verify that rated and balanced supply voltage has been restored before restarting motor. Measure voltage during restart. Ensure that steady state supply voltage at motor terminals is within limits (see section 3.4.1.3).
B.)	Motor is overloaded	(1) Verify that motor & load turn freely. Repair binding components as needed (2) Reduce driven load to match motor capacity or increase motor size to match load requirements.
C.)	Motor bearings are seized	
D.)	Load Is jammed.	
E.)	VFD will not restart motor after tripping	(1) Check fault codes on VFD and follow VFD troubleshooting procedures (2) Verify that VFD input voltage is balanced and within limits (3) Remove excessive mechanical load if present.
F.)	Capacitor failure on single phase motor (if equipped)	**Warning: Potential Shock Hazard**: Contact service shop to check capacitor.
Motor takes too long to accelerate:		
A.)	Motor leads are not connected correctly	Match motor lead wiring to nameplate diagram.
B.)	Supply voltage has drooped or become severely unbalanced.	(1) Ensure that steady state supply voltage at motor terminals is within limits (see section 3.4.1.3). Correct as needed (2) Obtain correct motor to match actual supply voltage.
C.)	Load exceeds motor capability	Determine correct motor size and contact motor representative to obtain replacement motor.
D.)	Faulty start capacitor (Single Phase)	Motor may be too small for load. Record acceleration time. Start capacitors may fail if acceleration time exceeds 3 seconds.
E.)	Mechanical Failure	(1) Check to make sure motor & load turn freely (2) Disconnect motor from load & ensure motor turns freely
Motor rotates in the wrong direction:		
A.)	Incorrect wiring connection at motor	[Single Phase] Reconnect motor according to wiring schematic provided. Note: Some motors are non-reversible
		[Three Phase] Interchange any two power supply (phase) leads.
Motor overheats or overload protector repeatedly trips		
A.)	Driven Load is excessive	(1) If motor current exceeds nameplate value, ensure that driven load has not increased. Correct as needed. (2) If new motor is a replacement, verify that the rating is the same as the old motor. If previous motor was a special design, a general purpose motor may not have the correct performance.
B.)	Ambient temperature too high	Most motors are designed to operate in an ambient up to 40 °C. (See section 4.2.2 Hot Surface Caution)
C.)	Motor cooling fins and/or vent openings blocked	Remove foreign materials – clear vent openings, fan guard air inlets and frame fins (TEFC motors)
D.)	Insufficient Air Flow	TEAO (Totally Enclosed Air Over) motors: Measure airflow next to motor surface and obtain minimum requirements from motor manufacturer.

	E.)	Motor is started too frequently	See section 3.4.5.3
	F.)	Supply voltage too low, too high, or unbalanced	(1) Ensure that steady state supply voltage at motor terminals is within limits (see section 3.4.1.3) Correct as needed (2) Reconnect motor per input voltage (3) Obtain correct motor to match power supply.
Motor Vibrates			
	A.)	Motor misaligned to load.	Realign load
	B.)	Load out of balance (Direct drive application)	(1) Ensure that load is dynamically balanced: (2) Remove motor from load and inspect motor by itself. Verify that motor shaft is not bent. Rule of thumb is 0.002" runout for shafts extension lengths up to 3.00". Add 0.0005" per every additional inch of shaft length beyond 3.00".
	C.)	Uneven tension on multiple belts	Mixing new with used belts. Replace multiple belt applications with a complete set of matched belts.
	D.)	Driven load operating at resonant point / natural frequency.	(1) De-energize motor and record vibration as load coasts from 100% speed to 0 RPM. If vibration drops immediately, vibration source is electrical. If levels do not drop immediately, source is mechanical (2) Redesign system to operate below the resonant point (3) On VFD-driven loads, program skip frequencies to bypass resonant points (4) Increase carrier frequency to obtain <3% THD current (5) On variable torque loads reduce volts/hertz below base speed.
	E.)	VFD torque pulsations	(1) Adjust VFD to obtain <3% THD current @ rated motor current (2) Adjust VFD stability for smooth operation. Vector drives may be unstable at light load.
	F.)	Motor miswired at terminal box	Match motor lead wiring to nameplate connection diagram.
	G.)	Uneven, weak or loose mounting support.	Shim, strengthen or tighten where required.
	H.)	Motor bearings defective	Test motor by itself. If bearings are bad, you will hear noise or feel roughness. Roller bearings are normally noisy when operated without load. If sleeve bearing, add oil per nameplate instructions. For motors with regreasing provisions, add grease per relubricating instructions (see section 4.2.3). If noise persists contact warranty service.
	I.)	Motor out of balance	Disconnect from load. Set motor on rubber pads on solid floor. Secure a ½ height key in shaft keyway and energize from balanced power supply @ rated voltage. Record vibration levels and compare with appropriate standards. If excessive vibration persists contact motor manufacturer.

Bearings repeatedly fail.			
	A.)	Load to motor may be excessive or unbalanced	(1) If belt drive check system per section 3.3.4. (2) Other than belting, check loading on motor shaft. An unbalanced load will also cause the bearings to fail. (3) Check runouts of mating components, such as a C-face and pump flange.
	B.)	Bearings contaminated.	Motor enclosure not suitable for environment. Replace with correct enclosure construction
	C.)	Incorrect grease or bearings for ambient extremes.	See section 4.2.1
	D.)	VFD bearing damage	Ground brush, common mode filter, or insulated bearings must be added. Contact motor manufacturer.
Motor, at start up, makes a loud rubbing, grinding, or squealing noise.			
	A.)	Contact between rotating and stationary components	Belt squeal during across the line starting is normal: (1) Verify that supply voltage is within limits (see section 3.4.1.3). (2) Ensure that motor lead wiring matches nameplate connection diagram: (3) Isolate motor from load. (4) To locate point of contact turn motor shaft by hand. (5) If point of contact is not located contact motor service shop.
Start capacitors repeatedly fail.			
	A.)	The motor acceleration time is too long	Motor may be too small for load. Record acceleration time. Start capacitors may fail if acceleration time exceeds 3 seconds.
	B.)	Motor is being started too frequently	Excessive starting will damage motor capacitors. Contact motor manufacturer if motor is started more than 20 times/hour or if acceleration time exceeds 3 seconds.
	C.)	Motor voltage low	Verify that voltage at the motor terminals is within limits (see section 3.4.1.3).
	D.)	Defective start switch inside motor	Motor internal switch failure overheats start capacitor. Contact service shop or motor manufacturer.
Run capacitor fails.			
	A.)	High ambient temperature	Verify that the ambient does not exceed motor's nameplate value

	B.)	Input voltage exceeds limit	Verify that voltage to the motor terminals is within limits (see section 3.4.1.3).
	C.)	Power surge to motor (caused by lightning strike or other high transient voltage).	If a common problem, install surge protector.

104043



DASH	FR.	C	AG	BS	DASH	FR.	C	AG	BS
606	56-60	12.48	8.11	2.75	756	56-75	13.98	9.61	4.25
656	56-65	12.98	8.61	3.25	806	56-80	14.48	10.11	4.75
706	56-70	13.48	9.11	3.75	856	56-85	14.98	10.61	5.25

NOTES:
1- REMOVABLE BASE
2- CONDUIT BOX CAN BE ROTATED 180°

NO.	REVISION	BY & DATE	CHK
5	REDRAWN IN AUTOCAD	TAT 07-06-2004	ML
4	ADDED KEYWAY TO FRONT EXT. CN 27200-169	CAV 02-21-2000	
3	REMOVED KEYWAY FROM FRONT EXT. CN 27400-442	CAV 10-08-1999	
2	REV. BLACK MAX 56 FR. -706 WAS -856 CN27400-264	BLR 07-14-1999	

TOLERANCES UNLESS SPECIFIED	
DEC.	INCHES
.X	±.1
.XX	±.03
.XXX	±.005
.XXXX	±.0005
ANG	±7'30"

MARATHON ELECTRIC

TITLE OUTLINE
56 FR. - TENV - BB - DBL. C' FACE

MAT'L.

FINISH

CAD FILE 104043

RFP

DIST WP

DRAWN	CEB 08-16-1995
CHK	DA 08-18-1995
APPD	EAB 08-21-1995
SCALE	5=16
REF	
FMF	
PREV	

SIZE	DRAWING NO.	PAGE OF	REV.
A	104043		5

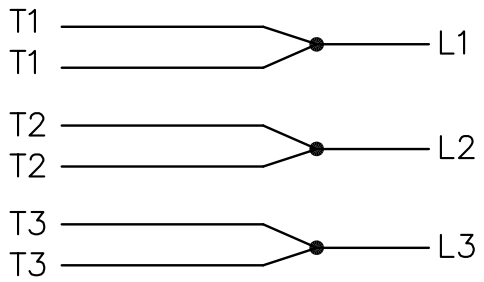
EE7300T

THREE PHASE – SINGLE VOLTAGE
MOTOR – CONDUIT BOX @ 'A'

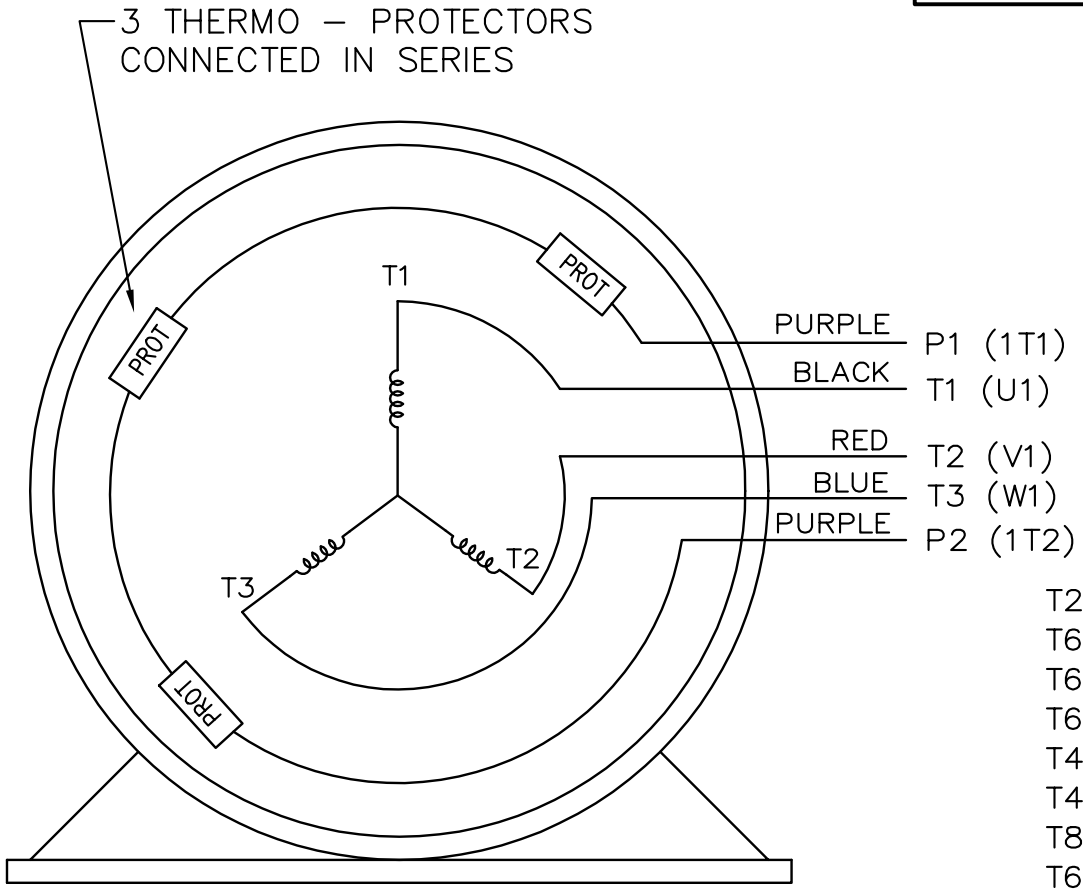
TO REVERSE ROTATION:
INTERCHANGE ANY TWO LINE
LEAD CONNECTIONS

NOTE FOR FACTORY USE ONLY:
TO SURGE TEST:
FOR 3 LEAD COMMON CONNECT:
CONNECT P1 TO T1 THEN P2 TO L1
FOR 6 LEAD COMMON CONNECT:
CONNECT P1 TO BOTH T1
THEN P2 TO L1

IF MOTOR HAS MULTIPLE
T'S PER LEAD CONNECT
TOGETHER LIKE T'S



A–9806 DECAL



VIEW OF TERMINAL END

T2BM
T6AW
T6AL
T6Z
T4EG
T4BF
T8A
T6H
T6A
T4AX
T4A
T2A
T2F

NO.	REVISION	BY & DATE	CHK
17	ADDED LEAD COLORS CN 40472	TAT 08-01-2006	ML
16	ADDED FEC TERM MARKINGS MU72670	DRS	
15	REVISED "IF MOTOR HAS MULTIPLE		
	T'S PER LEAD... NOTE CN26568	MRB 10-16-1998	
14	ADDED SURGE TESTER NOTE – FOR		
	FACTORY USE ONLY CN24255	MH 03-13-1997	

TOLERANCES UNLESS SPECIFIED

DEC.	INCHES
.X	± –
.XX	± –
.XXX	± –
.XXXX	± –
ANG	± –

MARATHON ELECTRIC

TITLE CONNECTION DIAGRAM
3ø – SINGLE VOLT – MOTOR WITH PROTECTOR

DRAWN	LZ 01-04-1994
CHK	ML 01-20-1994
APPD	GK 01-20-1994
SCALE	1=1
REF	
MAT'L.	
FMF	
FINISH	
PREV	

RFP
DIST WA-LB-SB

CAD FILE EE7300T

SIZE	DRAWING NO.	PAGE OF	REV.
A	EE7300T		17

Warranty Card

Complete and return to validate warranty

Please complete this card and return it to **seepex** Inc. By using this card, the valid warranty period will commence at the pump "start-up" date. If this card is not completed the warranty coverage period will commence on the date the pump is shipped from the **seepex** factory. This card must be completed and mailed no later than one year from the date of shipment.

User Entity: _____

Mailing Address: _____

_____

_____

Contact Person: _____

Phone Number: _____

Fax Number: _____

Pump Model # _____

Pump Commission #: _____

Pumped Product: _____

Diff. Pressure: _____ Flow Rate: _____

Temperature: _____ Visosity: _____

Solids Size: _____ Solids %: _____

Was the pump delivered as scheduled? __ Yes __ No

Was the appearance of the pump acceptable? __ Yes __ No

Did the pump suffer any freight damage? __ Yes __ No

Did the pump perform as expected? __ Yes __ No

Did you receive: - Data Sheets? __ Yes __ No

-O&M Manuals? __ Yes __ No

Did you local seepex distributor contact you to arrange a start-up? __ Yes __ No

Other Comments: _____

_____

Name of person completing card (please print): _____

Date: _____ Signature: _____

seepex.com
all things flow

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TERMS & CONDITIONS OF SALES AND/OR REPAIR

The following terms and conditions shall apply to an order for all or any part the articles covered by this quotation unless specifically excepted therein:

Prices
Any prices quoted shall only be valid for orders placed within 30 days from the date of issue of the quotation. Prices are F.O.B. our plant in U.S. or Canadian dollars. We reserve the right to correct typographical or clerical errors.

Terms
All orders are subject to approval by our Credit Department. Unless otherwise stated, if payment for the invoice due is not made within thirty (30) days after shipment, administration fees of eighteen percent (18%) per year (equivalent to a nominal monthly interest rate of 1½%) will be applied on overdue accounts. The terms and conditions herein set forth are based upon tariffs, taxes, foreign exchange rates, delivery, and other conditions in effect on the date of this contract. In the event changed conditions, legislations, regulations, or other matters shall become applicable to any quotation, contract, or delivery hereunder, any increased exchange, duties, taxes, ocean freight, or other charges resulting from such action shall be for the customer's account and **seepex**, Inc. may charge such increased duties, taxes, or charges to the customer.

Unless the order includes the appropriate exemption certificates and/or licenses, duties, and taxes levied by Federal, State, or other governments are required to be charged automatically at the rate imposed at time of importation/shipment. Any change in law, regulations, or Government Department practice which causes a variation of any kind in the applicable charges from the amounts allowed for the quotation, shall result in an equivalent change in the price quoted.

Until payment is made in full, **seepex**, Inc. shall retain the right, without notice, to repossess and/or retain the items, and/or dispose of them, for its benefit and hold the customer responsible for any loss. Customer agrees to enter into any agreements, contracts, or notices required to confirm such rights.

Security
In order to secure any obligations due to **seepex**, Inc. from the customer (whether or not under this contract) the customer grants and confirms in **seepex**, Inc. a security interest in:

a) the merchandise covered by this contract, and
b) in all property and funds of the customer now or hereafter in **seepex**, Inc. possession, whether or not arising out of this contract, and in all additions, accessions, and proceeds of such merchandise and/or property. The customer hereby authorizes **seepex**, Inc. to sign alone any financing statement or statements and to do all and any other things which may be necessary to perfect such security interest.

Cancellation
After acceptance, orders may be canceled only with our approval and payment in accordance with contract by the customer for work performed and/or material expenses incurred by us to date of cancellation. We reserve the right to cancel the order if the customer's financial condition, in our sole judgment, places the payment in jeopardy.

Return
No credit will be allowed for returns unless our authorization in writing for such returns has been obtained beforehand. A copy of this authorization is to be returned with the item as the packing slip.

Shipment

a) Handling Charge: Customer shall be responsible for making all arrangements for shipment of the order with a suitable carrier. In the event that customer requests that seepex make arrangements for shipment, then customer agrees to pay to seepex, in addition to the applicable shipping charges, a handling charge in the amount of 10% of the shipping charges with a minimum $5.00 to a maximum charge of $150.00, with special services requiring additional charges.
b) New Articles: Where shipping instructions indicate no exact routing, our best judgement will be used in determining routing but we shall not be liable for any charges beyond F.O.B. point. If changes are made at customer's request in a) F.O.B. point, b) in our normal routing from either the manufacturers' or our own plants and in these changes involve extra costs, such costs shall be for the customer's account, unless otherwise noted on the **seepex** price quotation.
c) Repair Work: Defined as work and services performed by **seepex**, Inc. All orders shall be delivered to and picked up from our plant unless otherwise specified. All costs of delivery shall be for the customer's account unless otherwise agreed to in writing prior to shipment.
d) All Orders: On collect freight shipments, cartage charges from plant to carrier are for customer's account. Title to articles passes to customer upon delivery to carrier acting as customer's agent subject to any right of retention by us. All claims for shortage in, and damages in, shipment or otherwise must be reported to carrier immediately upon receipt with copy or report to ourselves within five (5) days.

Guarantee

a) New Articles: We guarantee articles of our manufacture against defects in material and/or workmanship for a period of three (3) years from date of acceptance, providing that the articles have been installed, maintained, and operated in accordance with our recommendations and instructions.
b) Repair Work: Defined herein as work and services performed by **seepex**, Inc. We guarantee all work and services performed by us against defect arising from workmanship and/or materials provided by us for a period of ninety (90) calendar days from the date of shipment to customer.
c) All Orders: Claims shall be submitted promptly in writing to **seepex**, Inc. Replacement and/or repair under guarantee shall be made F.O.B. our plant. Our liability under these guarantees is limited to the replacement and/or repair only of defective material or workmanship and in no event shall **seepex**, Inc. be liable for any loss or damage of whatever kind of nature out of defects in material and/or workmanship, or resulting from delay, or loss of use of articles, or any installation into which the article may be installed, or arising out, of the contract of the work or service or from negligence.

seepex, Inc. shall not be liable for any loss or damage resulting from delay and/or late delivery due to causes beyond our reasonable control. In no event shall seepex, Inc. be liable for any claim exceeding the amount of this order. Our guarantee on products of other than our own manufacture is limited to the guarantee extended to us by the original manufacturer. On any claims for repairs and/or replacement under such guarantee, all costs incurred by us which are not underwritten by the original manufacturers shall be for the claimant's account. Except as stated above no representations, conditions, or warranties are made with respect to products, work, or services, express or implied verbal or otherwise, including warranties of merchantability and fitness. Our guarantee and warranty shall not apply to materials or workmanship which have been subject to misuse, neglect, or accident.
seepex, Inc. shall be held free and harmless from any dispute or claim anywhere arising relating to infringement of patent, design, trademark, or copyright of items, sold or repaired under this contract.

Property **rights and risks**
The customer's property at all times shall remain at the risk of the customer while being worked on by our personnel or on our premises and shall not be responsible for any loss or damage to the customer's property resulting from any cause whatsoever.

Title to and rights in relation to item sold under this contract/quotations shall remain with **seepex**, Inc. until such items are paid for, subject to risk on products sold passing to the customer upon acceptance by a carrier or other, which shall constitute good delivery.

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Fax +86.931.260 4239
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SAFETY RELIEF VALVE

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TOP VALVE * PAT

Back Pressure & Pressure Relief Valves

Designed to Enhance the ACCURACY and SAFETY of Metering Pumps

Back Pressure/Anti-Siphon and Pressure Relief Valves

- Long life diaphragm
- Range to 350 PSIG
- Built-in air release and optional gauge port
- Available in PVC, CPVC, PVDF, polypropylene, Teflon, stainless steel, Alloy 20 and Hastelloy C
- 7 sizes (1/4" - 2" threaded, flanged or socket)
- Color coded handles indicate size at a glance
- High temperature valves available to (300°F/149°C)

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TOP VALVE*PAT

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Back Pressure/Anti-Siphon and Pressure Relief Valves

Description

This line of diaphragm style, back pressure/anti-siphon and pressure relief valves features a completely adjustable pressure range to 350 PSIG and a built-in air release to reduce priming difficulties. The valves are available in sizes from 1/4" through 2", eight materials of construction, offer a three year warranty and are available with socket weld, flanged or special threaded connections. High temperature to (300°F/149°C) valves are available. *CRN certification available. Please contact factory.*

Ordering Information e.g. Part # TVBP50-S/S-V-S

TV - B - P - 50 - S/S - V - S

TOP VALVE

Valve Type:
B = Backpressure
P = Pressure Relief
P2 = Pressure Relief (2 port)

Valve Style or Connection:
P = Backpressure, FNPT thr'd
R = Pressure Relief, FNPT thr'd
FW = Welded Flange
FT = Thr'd Companion Flanged
F = Flanged Non-Metallic
S = Socket
B = BSP thread
T = High Temperature (300°F/149°C)
H = High Pressure (to 350 psig)

Valve Port Connection Size:
25 = 1/4" 10 = 1"
45 = 1/4" X 1/2" 15 = 1 1/2"
50 = 1/2" 20 = 2"
75 = 3/4"

Standard Top: PVC/CPVC
Top Options:
A = Aluminum Top
S = 316L S/S Top
C = CPVC Top
P = Polycarbonate Top

Miscellaneous Options:
E = EPDM Diaphragm
P = PVC Diaphragm
V = Viton Diaphragm
G = Gauge Port

Body Material of Construction:
PVC = polyvinylchloride
CPVC= Corzan
PP = polypropylene
TFE = 24% glass filled Teflon
PVDF= polyvinylfluoride
S/S = 316L Stainless Steel
ALL20= Alloy 20
Hast = Hastelloy C 276

Flow Rates

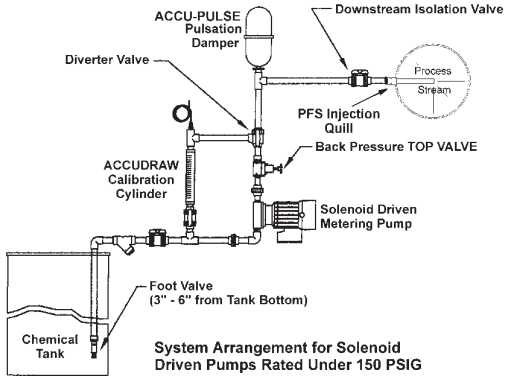
Flow capacity through TOP VALVE back pressure/anti-siphon and pressure relief valves under continuous flow conditions **@ 50 PSIG** with ambient temperature water.

Size	1/4"	1/4" / 1/2"	1/2"	3/4"	1"	1 1/2"	2"
Flow rate USGPM	4	4	6	8	14	25	40

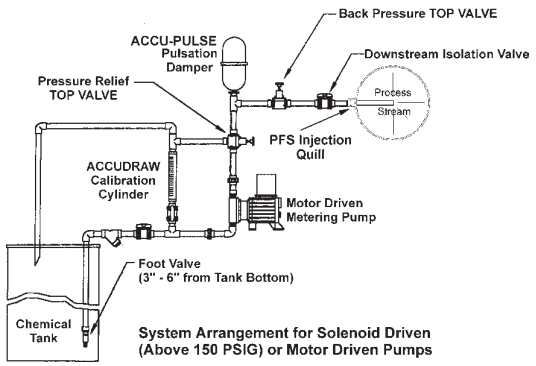
Note: Capacities will increase with pressure. If pressure is doubled, flow rate wll approximately double. For capacities of valves with pulsating flow, use approximately 1/3 of the given flow rates.

Typical Installations

The installations below are typical installation examples only. Consult your engineering department for the appropriate installation of your application or call Primary Fluid Systems Inc. for advice.



System Arrangement for Solenoid Driven Pumps Rated Under 150 PSIG



System Arrangement for Solenoid Driven (Above 150 PSIG) or Motor Driven Pumps

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CALIBRATION CYLINDER

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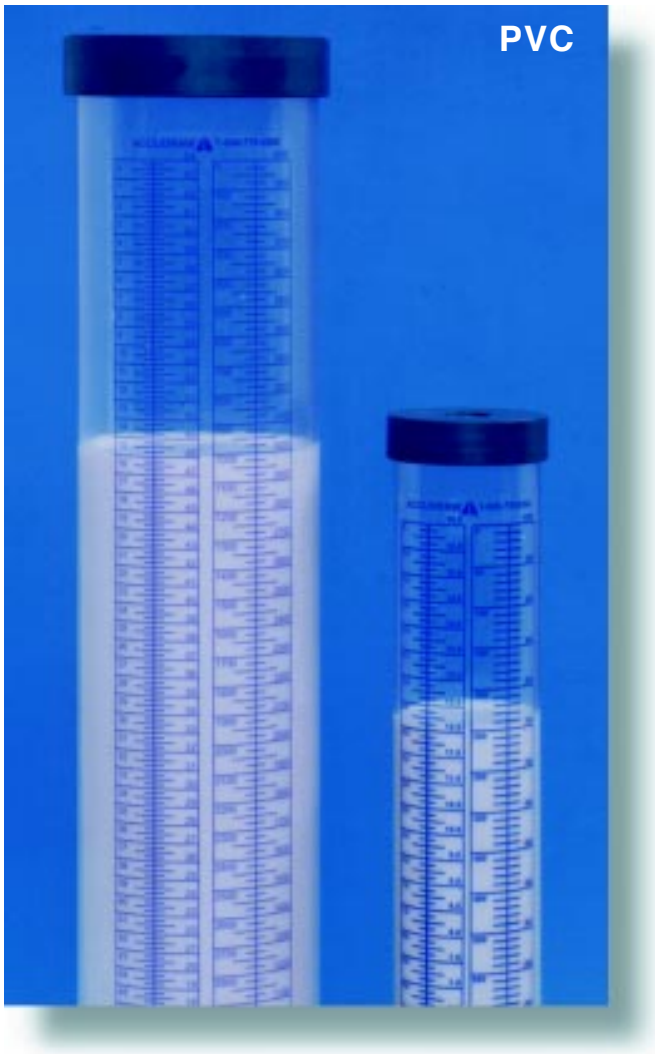
ACCUDRAW® Calibration Cylinders



ACCUDRAW® ***has been developed for the accurate calibration of metering pumps. Standard features include:***

- translucent
- chemical resistant
- break resistant
- threaded or socket
- colored graduations and lettering

- PVC has dual scale USGPH & ml
- PVC sizes 100 - 20000 ml
- POLY sizes 100 - 4000 ml
- POLY meets ISO standards
- custom sizes and other materials (acrylic, glass) on request

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ACCUDRAW® Calibration Cylinders

"For Accuracy That Counts"

caustic soda

Sizing and Ordering Information

Polypropylene Construction

Size	*Conn.*	*BC*	*BTC*	*BDC*
100 ml	1/2" NPT	AC#1-100	AC#2-100	AC#3-100
250 ml	1/2" NPT	AC#1-250	AC#2-250	AC#3-250
500 ml	1/2" NPT	AC#1-500	AC#2-500	AC#3-500
1000 ml	1/2" NPT	AC#1-1000	AC#2-1000	AC#3-1000
2000 ml	1.0" NPT	AC#1-2000	AC#2-2000	AC#3-2000
4000 ml	1.0" NPT	AC#1-4000	AC#2-4000	AC#3-4000

BC = bottom connection only, open top
BTC= bottom and top connections
BDC= bottom connection and dust cover top

PVC Construction

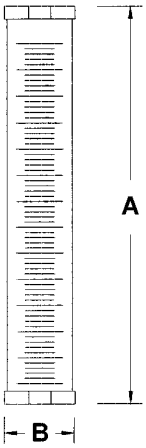
Size/Scale	*Conn*	*BC*	*BTC*	*BDC*
100 ml/ 1.6 GPH	1/2" NPT	PV#1-100	PV#2-100	PV#3-100
250 ml/ 4 GPH	1/2" NPT	PV#1-250	PV#2-250	PV#3-250
500 ml/ 8 GPH	1/2" NPT	PV#1-500	PV#2-500	PV#3-500
1000 ml/ 16 GPH	1/2" NPT	PV#1-1000	PV#2-1000	PV#3-1000
2000 ml/ 32 GPH	1.0" NPT	PV#1-2000	PV#2-2000	PV#3-2000
4000 ml/ 64 GPH	1.0" NPT	PV#1-4000	PV#2-4000	PV#3-4000
10000 ml/ 160 GPH	2.0" NPT	PV#1-10000	PV#2-10000	PV#3-10000
20000 ml/ 320 GPH	2.0" NPT	PV#1-20000	PV#2-20000	PV#3-20000

Note: PVC cylinders available with socket weld connections.
Add suffix "S" to model # e.g. PV#3-100S
For BSP threads, add suffix "B" to model # e.g. PV#3-100B

Dimensional Information

Polypropylene Construction

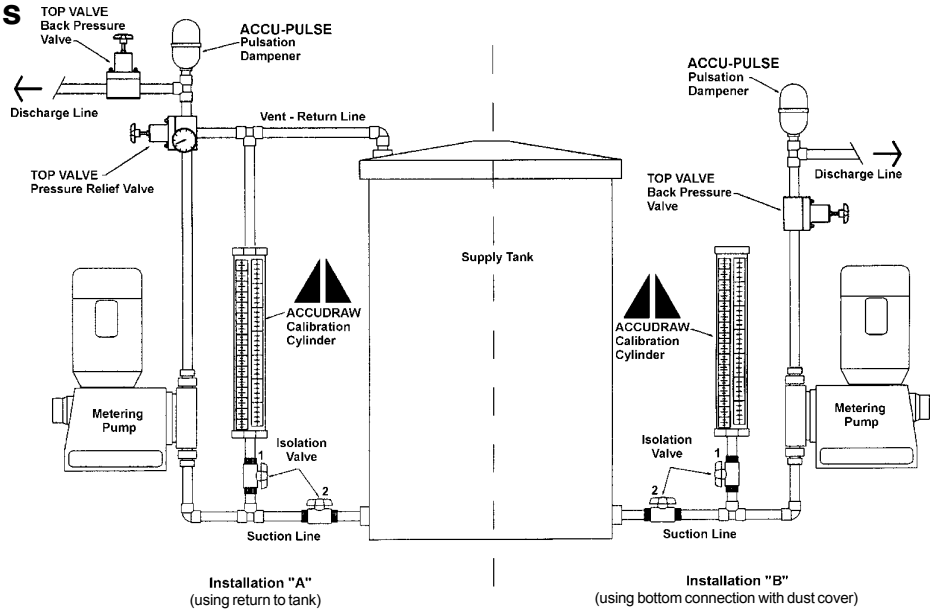
Model	Size (ml)	Dev (ml)	A (inches)	B (inches)
AC#1	100	1	9.88	1.38
AC#1	250	2	12.44	1.75
AC#1	500	5	14.1	2.33
AC#1	1000	10	17.19	2.63
AC#1	2000	20	20.88	3.38
AC#1	4000	50	23.56	4.38
AC#2/AC#3	100	1	9.25	1.38
AC#2/AC#3	250	2	11.63	1.75
AC#2/AC#3	500	5	13	2.32
AC#2/AC#3	1000	10	16.5	2.69
AC#2/AC#3	2000	20	19.5	3.38
AC#2/AC#3	4000	50	22.13	4.38



PVC Construction

Model	Size (ml)	Divisions (ml)	Size (GPH)	Divisions (GPH)	A (inches)	B (inches)
PV#1	100	1	1.6	0.02	10.24	1.388
PV#1	250	2	4	0.05	11.04	1.888
PV#1	500	5	8	0.05	12.25	2.388
PV#1	1000	10	16	0.125	16.24	2.765
PV#1	2000	20	32	0.25	20.16	3.517
PV#1	4000	25	64	0.25	22.16	4.521
PV#1	10000	200	160	2	22.64	6.906
PV#1	20000	200	320	2	42.19	6.906
PV#2/PV#3	100	1	1.6	0.02	10.75	1.388
PV#2/PV#3	250	2	4	0.05	11.51	1.888
PV#2/PV#3	500	5	8	0.05	12.75	2.388
PV#2/PV#3	1000	10	16	0.125	16.76	2.765
PV#2/PV#3	2000	20	32	0.25	20.67	3.517
PV#2/PV#3	4000	25	64	0.25	22.66	4.521
PV#2/PV#3	10000	200	160	2	23.16	6.906
PV#2/PV#3	20000	200	320	2	42.69	6.906

Installations



Installation "A"
(using return to tank)

Installation "B"
(using bottom connection with dust cover)

Conversion Factors

1 ml = 1 cc
1000 ml = 1 liter
ml/sec X 60 = ml/min
1 US gal/min X 0.063 = liters/sec
1 US gal = 3.786 liters

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CORPORATION STOPS

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PFS Corporation Stops

PFS Corporation Stops have been designed to inject chemical into the center stream of the flow.

- **isolation valve allows for ease of maintenance**
- **available in 6 materials of construction**
- **wetted components have comparable or greater chemical resistance than quill construction material**
- **standard and custom lengths available**
- **connection in NPT, metric or flanged**
- **standard 1/8" orifice discharge and optional 1/4" for higher flow**

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PFS Corporation Stops

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Sizing and Ordering Information

Model	Body Material	Valve Material	Gland Material	Gland Seal Material**	Ball Check Material	Check Spring Material	Pressure* Max. PSIG	Temperature Max.
CCS-56-PVC	PVC	PVC	PVC	VITON	Ceramic	316 S/S	150	140°F(60°C)
CCS-56-CPVC	CPVC	CPVC	CPVC	VITON	Ceramic	316 S/S	150	210°F(98°C)
CCS-56-PP	PP	PP	PVDF	VITON	Ceramic	316 S/S	150	195°F(90°C)
CCS-56-PVDF	PVDF	PVDF	PVDF	VITON	Ceramic	316 S/S	150	260°F(125°C)
CCS-56-316S/S	316S/S	316S/S	316 S/S	VITON	316 S/S	316 S/S	2000	350°F(176°C)
CCS-56-HastC	HASTC	HASTC	HASTC	VITON	HASTC	HASTC	2000	350°F(176°C)
CCS-58-PVC	PVC	PVC	PVC	VITON	Ceramic	316 S/S	150	140°F(60°C)
CCS-58-CPVC	CPVC	CPVC	CPVC	VITON	Ceramic	316 S/S	150	210°F(98°C)
CCS-58-PP	PP	PP	PVDF	VITON	Ceramic	316 S/S	150	195°F(90°C)
CCS-58-PVDF	PVDF	PVDF	PVDF	VITON	Ceramic	316 S/S	150	260°F(125°C)
CCS-58-316S/S	316S/S	316S/S	316S/S	VITON	316 S/S	316 S/S	2000	350°F(176°C)
CCS-58-HastC	HASTC	HASTC	HASTC	VITON	HASTC	HASTC	2000	350°F(176°C)

Notes:

* maximum pressure @ 70°F (21°C) working temperature; ** optional gland seal material available

Options:

Hastelloy C springs
Suffix Model number with -H for this option(e.g. CCS-56-PVC-H)

Hastelloy C ball check
Suffix Model number -I (e.g. CCS-56-PVC-I)

PVDF ball check
Suffix Model number -K (e.g. CCS-56-PVC-K)

TFE ball check
Suffix Model number -T (e.g. CCS-56-PVC-T)

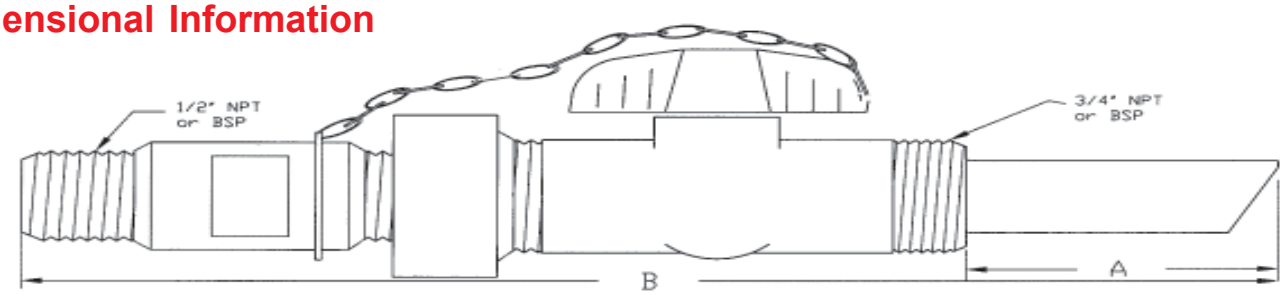
BSPT Thread
Suffix Model -B

Flanged
Suffix Model -F

CRN certification available. Please contact factory.

Other materials of construction and bubble tight/resilient seat check valve available on request.

Dimensional Information



Dimensions *(* subject to change without notice)*

Model	A	B*	Model	A	B*
CCS-56-PVC	2-5/8"	10.50"	**CCS-58-PVC**	4-5/8"	12.50"
CCS-56-CPVC	2-5/8"	10.50"	**CCS-58-CPVC**	4-5/8"	12.50"
CCS-56-PP	2-5/8"	11.25"	**CCS-58-PP**	4-5/8"	13.25"
CCS-56-PVDF	2-5/8"	11.25"	**CCS-58-PVDF**	4-5/8"	13.25"
CCS-56-316S/S	2-5/8"	9.50"	**CCS-58-316S/S**	4-5/8"	11.50"
CCS-56-HastC	2-5/8"	9.50"	**CCS-58-HastC**	4-5/8"	11.50"

Note:
Corporation stops have standard 1/8" discharge orifice for high velocity discharge.
Optional 1/4" discharge orifice available for higher capacity flow.

Capacities at Given Pressure (US & Metric)

Pressure		Flow Rate			
psi	*kPa*	1/8" Bore		1/4" Bore	
		USGPM	*LPM*	*USGPM*	*LPM*
20	138	0.05	0.19	0.70	2.65
30	207	1.35	5.11	1.42	5.38
40	276	1.68	6.36	2.51	9.50
50	345	2.03	7.68	3.43	12.98
60	414	2.25	8.52	4.24	16.05
70	483	2.51	9.50	4.94	18.70
80	552	2.76	10.45	5.52	20.90
90	621	2.99	11.32	6.13	23.20
100	689	3.21	12.15	6.81	25.78

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SERVICE WATER PUMPS

ST-090

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JOHN MEUNIER

NOMENCLATURE/ BILL OF MATERIALS

TITRE/ TITLE	Rev.	DESCRIPTION	PAR/ BY:	APPR:	DATE:	Affaire / Contract	Meadowbank Mining
Service water pumps	0	SUBMITTAL	Julie Trudel	J.T.	2009-03-26		
	1						
	2					REF. No.	NC01 Rev. 0
	3						
DESSIN /DWG # ST-090	4					Date:	2009-03-26

REV.	ITEM	QTE/QTY. Unit.	QTE/QTY. Total	DESCRIPTION	P&ID I.D./TAG	CAT. ACCPAC	SOURCE	FA/SA FI SITE	P / N
	NC01ST-090 1	1	2	**SERVICE WATER PUMPS**	P7-011	140		FI	
				Manufacturer:	P7-021				
				Aurora					
				Model:					
				PVMI8-60					
				Type:					
				Vertical multi-stage					
				Material:					
				Stainless steel 304					
				Suction diameter:					
				2" 250# flange					
				Discharge diameter:					
				2" 250# flange					
				Operation speed:					
				3500 rpm					
				Capacity:					
				52 usgpm @ 225 FT					
				NPSHr:					
				8 FT					
				Motor:					
				5 HP, 3500 rpm, 575/3/60, TEFC, frame 184TC					
				Note:					
				A foot check valve is required (by others)					

LEFT BLANK

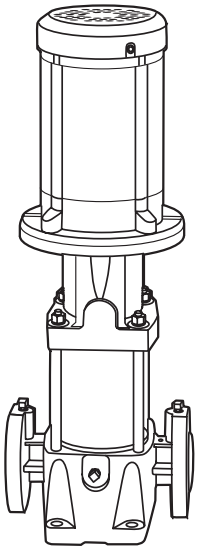
AURORA®
Pentair Water

OWNER'S MANUAL

INSTALLATION AND OPERATING INSTRUCTIONS
PVM (IX) 2 - PVM (IX) 16

VERTICAL MULTISTAGE PUMPS

Single and Three Phase 60 Cycle



Record the following information from the motor and pump nameplates for future reference:

Pump Model No. _____

Bill of Material No. _____

Motor Model No. _____

Motor Serial No. _____

H.P. _____ Volts/Hz/Ph _____

Rated Amp Draw _____

Aurora Pump, 800 Airport Road, North Aurora, IL 60542

TABLE OF CONTENTS

Carefully read and follow all safety instructions in this manual or on pump.

This is the safety-alert. When you see this symbol on your pump or in this manual, look for one of the following signal words and be alert to the potential for personal injury.

⚠ DANGER warns about hazards that **will** cause serious personal injury, death or major property damage if ignored.

⚠ WARNING warns about hazards that **can** cause serious personal injury, death or major property damage if ignored.

⚠ CAUTION warns about hazards that **will** or **can** cause minor personal injury or property damage if ignored.

The word **NOTICE** indicates special instructions which are important but not related to hazards.

To avoid serious or fatal personal injury and possible property damage, carefully read and follow the safety instructions.

1. **Install pump according to all code requirements.**
2. **Compare pump nameplate data with desired operating range.**
3. **Pump only liquids compatible with pump component materials (that is, liquids that will not attack the pump).**
4. **Make sure plumbing is adequate to handle system pressure.**
5. **Periodically perform maintenance inspection on pump and system components.**
6. **Wear safety glasses at all times when working on pumps.**

INSPECT THE SHIPMENT

The vertical multistage centrifugal inline pump has been carefully inspected and packaged to assure safe delivery. Inspect the pump and fittings and report to the carrier any items which are damaged or missing.

CONFIRM THAT YOU HAVE THE RIGHT PUMP

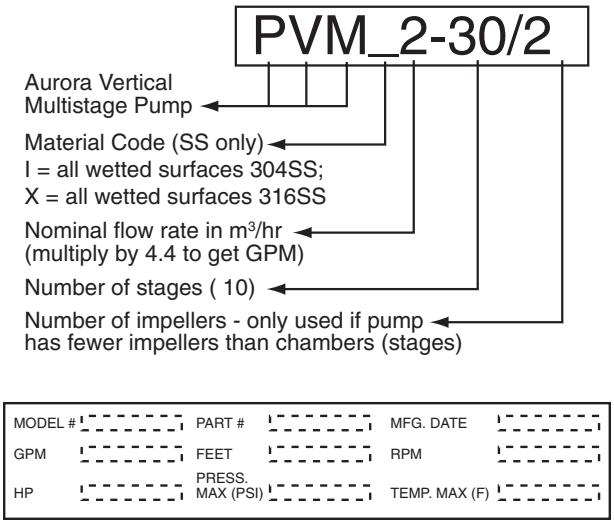


FIGURE 1 - Model Plate Information

APPLICATIONS AND OPERATING RANGES

Aurora multistage in-line centrifugal pumps are designed for liquid transfer, circulation, and pressure boosting of hot or cold clean water or other thin, non-explosive liquids, not containing solid particles or fibers, which will not chemically attack the pump materials.

Typical applications include:

- Municipal water supply and pressure boosting
- Boiler feed and condensate systems
- Cooling water systems
- Irrigation
- Fire fighting

Maximum Ambient Temperature.....104° F(40° C)

Liquid Temperature Range .....5° F to 250° F (-15° C to +121° C)

Maximum Permissible Operating Pressure Curves.....See Figure 4

Maximum Inlet Pressure: ..... Table II shows the maximum permissible inlet pressure. However, the actual inlet pressure plus the pressure when the pump is running against a closed valve must always be lower than the *"Maximum Permissible Operating Pressure".*

Electrical Data: .....See Motor Nameplate

Dimensions and Port to Port Lengths : .....See Figures 2A, 2B, 3A and 3B, Pages 3 and 4

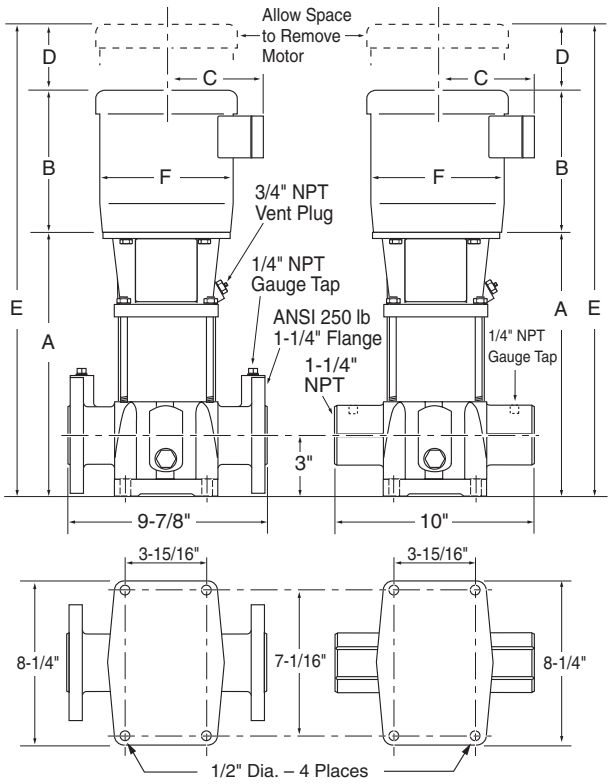


FIGURE 2A - Height, width and baseplate dimensions for PVM2 and PVM4 Series pumps

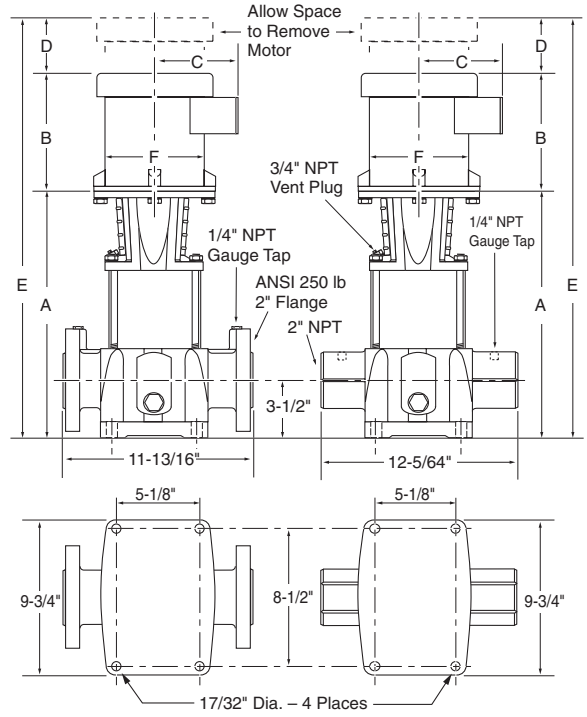


FIGURE 2B - Height, width, and baseplate dimensions for PVM8 and PVM16 Series pumps

TABLE I – Maximum Height and Width Dimensions*

Model Number	Dimension in Inches					
	A	B	C	D	E	F
PVM2-30/2	11-3/8	9-1/4	4-7/8	2	22-5/8	6
PVM2-30	11-3/8	9-7/8	4-7/8	2	23-1/4	6
PVM2-40	12	11-1/8	5-1/4	2	25-1/4	7-1/8
PVM2-50	12-3/4	11-1/8	5-3/4	2-1/8	26	7-1/4
PVM2-60	13-1/2	11-1/8	5-3/4	2-1/8	26-5/8	7-1/4
PVM2-70	14-1/8	12-1/8	5-3/4	2-1/8	28-1/4	7-1/4
PVM2-80	14-7/8	12-1/8	5-3/4	2-1/8	29	7-1/4
PVM2-90	15-15/16	12-5-16	6-7/8	2-7/8	31-1/8	8-1/2
PVM2-100	16-5/8	13-5/8	2-7/8	2-7/8	33-1/4	8-1/2
PVM2-110	17-3/8	12-5/16	6-7/8	2-7/8	32-17/32	8-1/2
PVM2-120	18-1/8	13-5/8	6-7/8	2-7/8	34-5/8	8-1/2
PVM2-130	18-13/16	12-5/16	6-7/8	2-7/8	34	8-1/2
PVM2-140	19-1/2	15-9/32	8	3-3/8	38-5/32	10-9/16
PVM2-150	20-1/4	15-1/4	8	3-3/8	38-7/8	10-5/8
PVM2-160	20-15/16	15-1/4	8	3-3/8	39-9/16	10-5/8
PVM2-170	21-9/16	15-1/4	8	3-3/8	40-9/32	10-5/8
PVM2-180	22-3/8	15-1/4	8	3-3/8	41	10-5/8
PVM4-20/1	11-3/8	9-1/4	4-7/8	2	22-5/8	6
PVM4-20	11-3/8	9-7/8	4-7/8	2	23-1/4	6
PVM4-30	12-3/8	11-1/8	5-1/4	2	25-5/8	7-1/8
PVM4-40	13-1/2	11-1/8	5-3/4	2-1/8	26-5/8	7-1/4
PVM4-50	14-1/2	12	5-3/4	2-1/8	28-5/8	7-1/4
PVM4-60	16	13-5/8	6-7/8	2-7/8	32-1/2	8-1/2
PVM4-80/7	18-1/8	13-5/8	6-7/8	2-7/8	34-5/8	8-1/2
PVM4-80	18-1/8	13-5/8	6-7/8	2-7/8	34-5/8	8-1/2
PVM4-90	19-5/32	15-1/4	8	3-3/8	37-13/16	10-5/8
PVM4-100	20-1/4	15-1/4	8	3-3/8	38-7/8	10-5/8
PVM4-110	21-1/4	15-1/4	8	3-3/8	39-15/16	10-5/8
PVM4-120	22-3/8	15-1/4	8	3-3/8	41	10-5/8
PVM4-130	23-13/32	15-1/4	8	3-3/8	42	10-5/8
PVM4-140	24-1/2	15-1/4	8	3-3/8	43-1/8	10-5/8
PVM4-150	25-1/2	15-1/4	8	3-3/8	44-3/16	10-5/8
PVM4-160	26-5/8	15-1/4	8	3-3/8	45-1/4	10-5/8
PVM8-20/1	15	9-7/8	4-7/8	2	27	6
PVM8-20	15	11-1/8	5-3/4	2-1/8	28-1/4	7-1/4
PVM8-30	17-3/4	13-5/8	6-7/8	2-7/8	34-1/4	8-1/2
PVM8-40	18-7/8	13-5/8	6-7/8	2-7/8	35-1/2	8-1/2
PVM8-50	20-1/8	15-1/4	8	3-3/8	38-3/4	10-5/8
PVM8-60	21-1/4	15-1/4	8	3-3/8	40	10-5/8
PVM8-70	21-5/16	15-1/4	8	3-3/8	39-15/16	10-5/8
PVM8-80	23-5/8	15-1/4	8	3-3/8	42-1/4	10-5/8
PVM8-90	26	15-1/4	8	3-3/8	44-21/32	10-5/8
PVM8-100	26	15-1/4	8	3-3/8	44-5/8	10-5/8
PVM8-110	27-3/16	16-3/8	8-3/4	3-3/8	47	10-5/8
PVM8-120	28-3/8	16-1/2	8-3/4	3-3/8	48-1/4	10-5/8
PVM8-130	29-9/16	16-3/8	8-3/4	3-3/8	49-5/16	10-5/8
PVM8-140	30-3/4	16-3/8	8-3/4	3-3/8	50-1/2	10-5/8
PVM8-150	33-9/16	19-21/32	9-1/2	4-1/4	57-9/16	12-15/16
PVM8-160	33-5/8	19-5/8	9-1/2	4-1/4	57-1/2	13
PVM16-30/2	19-1/2	15-1/4	8	3-3/8	38-1/4	10-5/8
PVM16-30	19-1/2	15-1/4	8	3-3/8	38-1/4	10-5/8
PVM16-40	21-3/8	15-1/4	8	3-3/8	40	10-5/8
PVM16-50	23-1/8	16-3/8	8-3/4	3-3/8	42-7/8	10-5/8
PVM16-60	25-3/8	19-5/8	9-1/2	4-1/4	49-1/4	13
PVM16-70	27-1/8	19-5/8	9-1/2	4-1/4	51	13
PVM16-80	28-7/8	19-5/8	9-1/2	4-1/4	52-7/8	13
PVM16-90	30-3/16	21-3/4	9-3/16	4	55-15/16	11-1/2
PVM16-100	32	21-3/4	9-1/8	4	57-3/4	11-1/2
PVM16-110	33-9/16	21-3/4	9-1/2	3-1/4	58-9/16	12-15/16
PVM16-120	35-3/8	21-3/4	9-1/2	3-1/4	60-3/8	13

* Measurements represent the largest number possible for each Model.

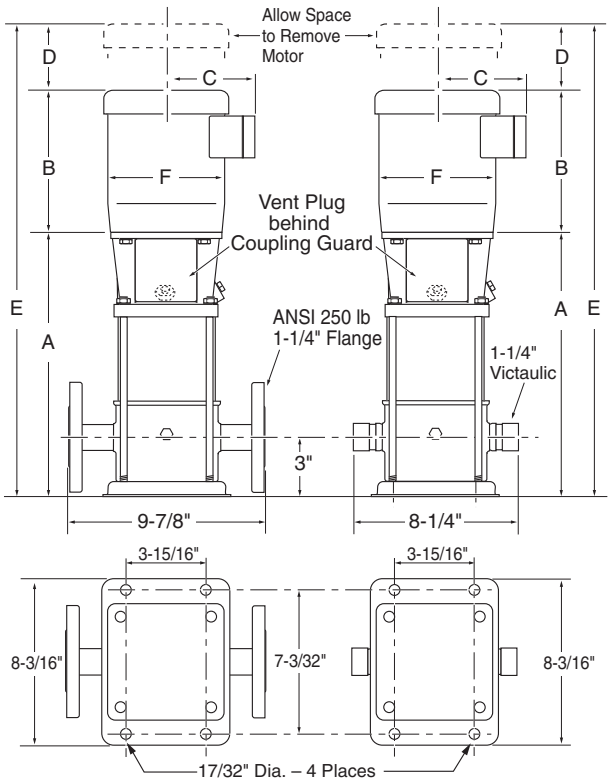


FIGURE 3A - Height, width and baseplate dimensions for PVMI/X2 and PVMI/X4 Series pumps

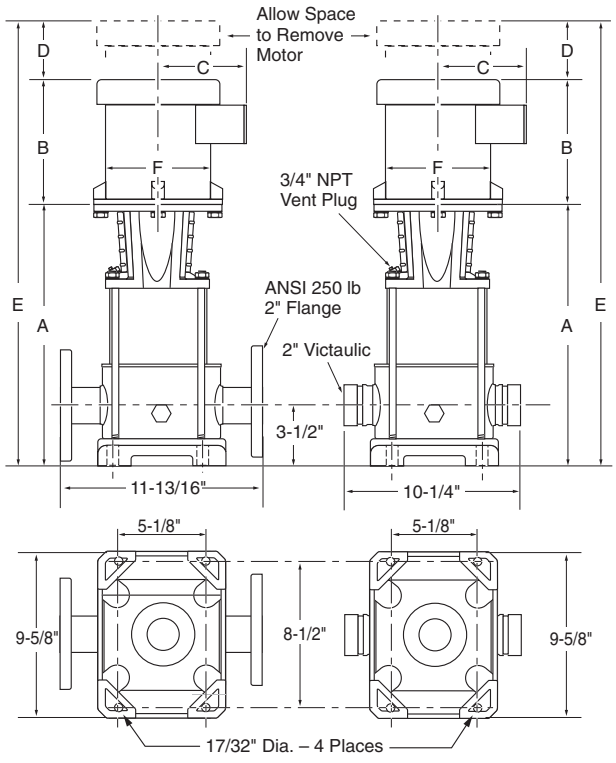


FIGURE 3B - Height, width, and baseplate dimensions for PVMI/X8 and PVMI/X16 Series pumps

TABLE II – Maximum Height and Width Dimensions*

Model Number	Dimension in Inches					
	A	B	C	D	E	F
PVMI/X2-30/2	11-3/4	9-1/4	4-7/8	2	23	6
PVMI/X2-30	11-3/4	9-7/8	4-7/8	2	23-5/8	6
PVMI/X2-40	12-3/8	11-1/8	5-1/4	2	25-5/8	7-1/8
PVMI/X2-50	13-1/8	11-1/8	5-3/4	2-1/8	26-3/8	7-1/4
PVMI/X2-60	13-7/8	11-1/8	5-3/4	2-1/8	27	7-1/4
PVMI/X2-70	14-1/2	12-1/8	5-3/4	2-1/8	28-5/8	7-1/4
PVMI/X2-80	15-1/4	12-1/8	5-3/4	2-1/8	29-3/8	7-1/4
PVMI/X2-90	16-3/8	12-5/16	6-7/8	2-7/8	31-17/32	8-1/2
PVMI/X2-100	17	13-5/8	2-7/8	2-7/8	33-5/8	8-1/2
PVMI/X2-110	17-3/4	12-5/16	6-7/8	2-7/8	33	8-1/2
PVMI/X2-120	18-1/2	13-5/8	6-7/8	2-7/8	35	8-1/2
PVMI/X2-130	19-3/16	12-5/16	6-7/8	2-7/8	34-3/8	8-1/2
PVMI/X2-140	19-15/16	15-1/4	8-1/16	3-3/8	38-9/16	10-5/8
PVMI/X2-150	20-5/8	15-1/4	8	3-3/8	39-1/4	10-5/8
PVMI/X2-160	21-5/16	15-1/4	8-1/16	3-3/8	40	10-5/8
PVMI/X2-170	22-1/32	15-1/4	8-1/16	3-3/8	40	10-5/8
PVMI/X2-180	22-3/4	15-1/4	8	3-3/8	41-3/8	10-5/8
PVMI/X4-20/1	11-3/4	9-1/4	4-7/8	2	23	6
PVMI/X4-20	11-3/4	9-7/8	4-7/8	2	23-5/8	6
PVMI/X4-30	12-3/4	11-1/8	5-1/4	2	26	7-1/8
PVMI/X4-40	13-7/8	11-1/8	5-3/4	2-1/8	27	7-1/4
PVMI/X4-50	14-7/8	12	5-3/4	2-1/8	29	7-1/4
PVMI/X4-60	16-3/8	13-5/8	6-7/8	2-7/8	32-7/8	8-1/2
PVMI/X4-80/7	18-1/2	13-5/8	6-7/8	2-7/8	35	8-1/2
PVMI/X4-80	18-1/2	13-5/8	6-7/8	2-7/8	35	8-1/2
PVMI/X4-90	19-17/32	15-1/4	8-1/16	3-3/8	38-3/16	10-5/8
PVMI/X4-100	20-5/8	15-1/4	8	3-3/8	39-1/4	10-5/8
PVMI/X4-110	21-9/16	15-1/4	8-1/16	3-3/8	40-3/16	10-5/8
PVMI/X4-120	22-3/4	15-1/4	8	3-3/8	41-3/8	10-5/8
PVMI/X4-130	23-13/16	15-1/4	8-1/16	3-3/8	42-1/2	10-5/8
PVMI/X4-140	24-7/8	15-1/4	8	3-3/8	43-1/2	10-5/8
PVMI/X4-150	25-15/16	15-1/4	8-1/16	3-3/8	44-17/32	10-5/8
PVMI/X4-160	27	15-1/4	8	3-3/8	45-3/8	10-5/8
PVMI/X8-20/1	15	9-7/8	4-7/8	2	27	6
PVMI/X8-20	15	11-1/8	5-3/4	2-1/8	28-1/4	7-1/4
PVMI/X8-30	17-3/4	13-5/8	6-7/8	2-7/8	34-1/4	8-1/2
PVMI/X8-40	18-7/8	13-5/8	6-7/8	2-7/8	35-1/2	8-1/2
PVMI/X8-50	20-1/8	15-1/4	8	3-3/8	38-3/4	10-5/8
PVMI/X8-60	21-1/4	15-1/4	8	3-3/8	40	10-5/8
PVMI/X8-70	21-3/8	15-1/4	8-1/16	3-3/8	40	10-5/8
PVMI/X8-80	23-5/8	15-1/4	8	3-3/8	42-1/4	10-5/8
PVMI/X8-90	26-1/8	15-1/4	8-1/16	3-3/8	44-3/4	10-5/8
PVMI/X8-100	26	15-1/4	8	3-3/8	44-5/8	10-5/8
PVMI/X8-110	28-1/2	16-3/8	8-7/8	3-3/8	48-1/4	10-5/8
PVMI/X8-120	28-3/8	16-1/2	8-3/4	3-3/8	48-1/4	10-5/8
PVMI/X8-130	28-1/2	16-3/8	8-7/8	3-3/8	48-1/4	10-5/8
PVMI/X8-140	30-3/4	16-3/8	8-3/4	3-3/8	50-1/2	10-5/8
PVMI/X8-150	33-3/4	19-11/16	9-1/2	4-1/4	57-5/8	12-15/16
PVMI/X8-160	33-5/8	19-5/8	9-1/2	4-1/4	57-1/2	13
PVMI/X16-30/2	19-1/2	15-1/4	8	3-3/8	38-1/4	10-5/8
PVMI/X16-30	19-1/2	15-1/4	8	3-3/8	38-1/4	10-5/8
PVMI/X16-40	21-3/8	15-1/4	8	3-3/8	40	10-5/8
PVMI/X16-50	23-1/8	16-3/8	8-3/4	3-3/8	42-7/8	10-5/8
PVMI/X16-60	25-3/8	19-5/8	9-1/2	4-1/4	49-1/4	13
PVMI/X16-70	27-1/8	19-5/8	9-1/2	4-1/4	51	13
PVMI/X16-80	28-7/8	19-5/8	9-1/2	4-1/4	52-7/8	13
PVMI/X16-90	30-5/16	21-3/4	9-3/16	4	56	11-1/2
PVMI/X16-100	32	21-3/4	9-1/8	4	57-3/4	11-1/2
PVMI/X16-110	33-11/16	21-3/4	9-1/2	3-1/4	58-11/16	12-15/16
PVMI/X16-120	35-3/8	21-3/4	9-1/2	3-1/4	60-3/8	13

* Measurements represent the largest number possible for each Model.

NOTE: PVMI models are 304 stainless steel; PVMX models are 316 stainless steel.

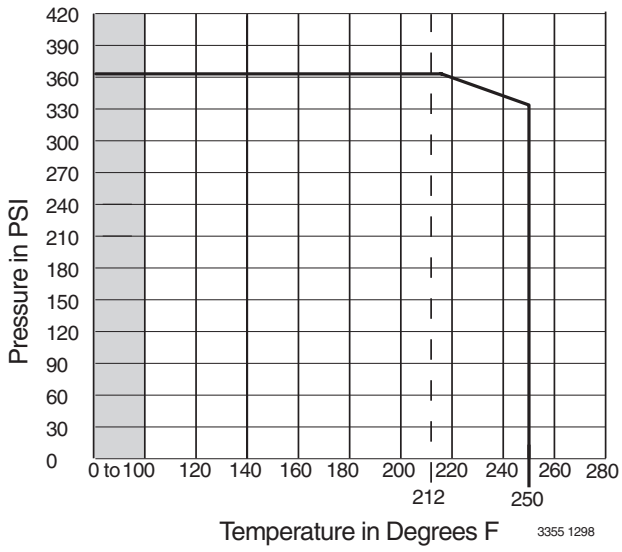


FIGURE 4 - Maximum Permissible Operating Pressure

TABLE III – Permissible Operating Pressures

PVM2-30/2 to PVM2-180
PVM4-20/1 to PVM4-160
PVM8-20/1 to PVM8-160
PVM16-30/2 to PVM16-120

Model Number		Maximum Inlet Pressure (PSI)
PVM2	30/2 - 60	145
	70 - 180	220
PVM4	20/1 - 20	90
	30 - 80/7	145
	80 - 160	220
PVM8	20/1 - 40	90
	50 - 160	145
PVM16	30/2 - 30	90
	40 - 120	145

INSTALLATION

⚠WARNING **Hazardous voltage. Voltage can shock, burn, or cause death.** Ground pump motor correctly before connecting to power supply, per article 250-80 of the National Electrical Code (NEC) in the U.S., or the Canadian Electrical Code (CEC), as applicable.

Location

Locate pump in a dry, well-ventilated area, not subject to freezing or extreme variations in temperature.

Mount pump a minimum of 6" from any obstruction or hot surface. Install the pump with the motor shaft vertical. Make sure that an adequate supply of cool air reaches the motor cooling fan. Maximum ambient air temperature is 104° F (40° C).

For open systems requiring suction lift, locate the pump as close to the water source as possible.

Foundation

Foundation should be concrete or a similarly rigid foundation to provide a secure, stable mounting base for the pump.

Secure pump to foundation using all bolt holes. Refer to Figures 2 and 3 for bolt plate dimensions. Be sure that all four pads on the base are properly supported.

Shim pump base to make sure that pump is level.

Piping

⚠WARNING **Explosion and burn hazard. Do not run pump with discharge valve closed; the water in the pump may boil, with risk of explosion and steam burns to anyone near.** If there is any danger of the pump running against a closed discharge valve, install a pressure relief or bypass valve in the discharge pipe to allow for minimum liquid flow through the pump. Minimum liquid flow through the pump is needed for cooling and lubrication of the pump (See Table IV). Run the bypass/relief valve and discharge pipe to a floor drain or a tank for collection.

Suction pipe should be adequately sized (See Table V) and run as straight and as short as possible to keep friction losses to a minimum. Pipes, valves, and fittings must have a pressure rating equal to or greater than the maximum system pressure.

TABLE IV – Minimum Pumping Rates

Type	Liquid Temperature +5° F to +250° F
PVM2	1 GPM
PVM4	2 GPM
PVM8	4 GPM
PVM16	8 GPM

TABLE V – Minimum Suction Pipe Sizes

Type	Pipe Size
PVM2	1-1/4" Nominal Diameter, Schedule 40 Pipe
PVM4	1-1/4" Nominal Diameter, Schedule 40 Pipe
PVM8	2" Nominal Diameter, Schedule 40 Pipe
PVM16	2" Nominal Diameter, Schedule 40 Pipe

Pressure check the discharge piping as required by codes or local regulations.

"Inlet" and "Outlet" are marked on the pump base to show the direction of the liquid flow through the pump.

Install anti-vibration mountings on either side of the pump if a minimum noise level is desired.

Install isolation valves in both inlet and outlet pipes near the pump (see Figure 5). This allows for removal of pump for service without draining the system and isolation of the pump in case of a flooded suction condition.

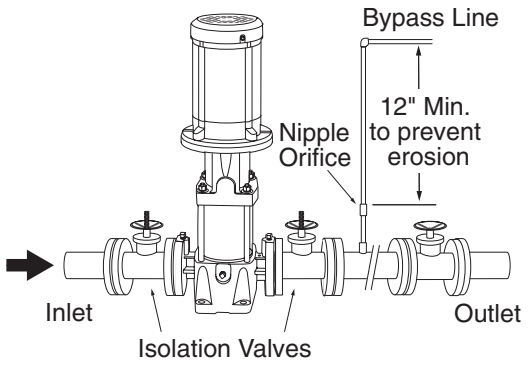


FIGURE 5 - Bypass required if pump might operate with discharge valve closed. See Table IV for minimum required flow through pump to prevent overheating and to ensure lubrication.

If the system pressure is greater than the pumps maximum inlet pressure the limits of the pump can be exceeded if the discharge pressure backs up to the inlet side of the pump. Installation of a check valve in the discharge pipe is recommended to prevent this condition.

Make sure, especially on the inlet side of the pump, that there are no airlocks in the system. See Figure 6 for correct pipe work to avoid airlocks. The suction pipe should be level or slightly rising.

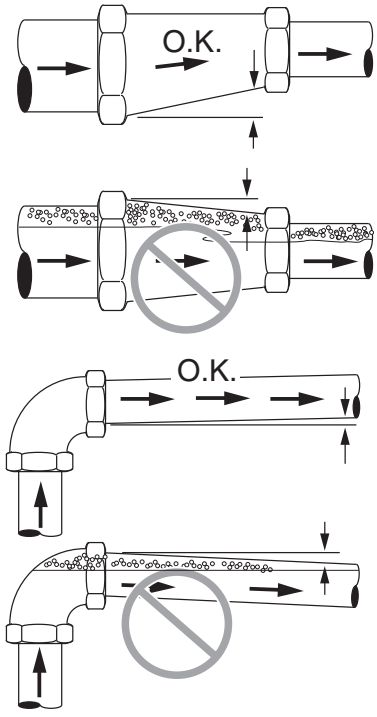


FIGURE 6 - Install Pipe Correctly to Prevent Air Locks

Support all piping independently of the pump so the weight of the piping system does not strain the pump case. Make sure that the expansion and contraction of the piping system from temperature variations cannot put a strain on the pump.

If the system or pump must be drained periodically (especially if the discharge pipe is horizontal or slopes downward away from the pump), install a loop and vacuum valve as shown in Figure 7 to protect the pump against running dry. The highest point of the loop should be at least as high as the lowest point of the motor. This loop/valve combination will allow the pump and the system to be drained independently of one another.

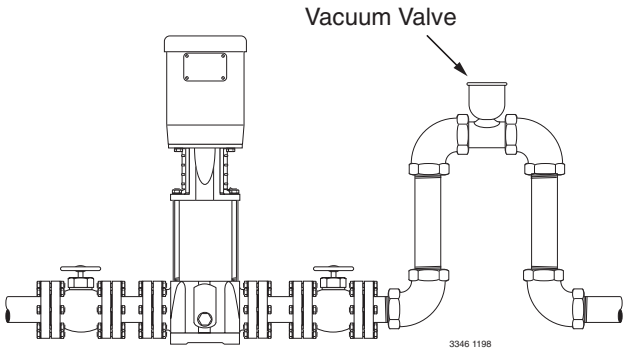


FIGURE 7 - Loop and Vacuum Valve Installation

ELECTRICAL

⚠WARNING **Hazardous voltage. Can shock, burn or cause death.** All electrical work should be performed by a qualified electrician in accordance with the National Electrical Code and all local codes and regulations. Make sure that the motor voltage, phase, and frequency match the incoming electrical supply. The proper operating voltage and other electrical information can be found on the motor nameplate. These motors are designed to run up to ±10% of the nameplate-rated voltage. The wiring connection diagram can be found on either a plate attached to the motor or on a diagram inside the terminal box cover.

- **If voltage variations are greater than ±10% do not operate the pump.**
- Incorrect voltage can cause fire or serious damage to the motor and voids warranty.
- Ground the pump motor correctly before connecting it to the power supply.
- Follow the wiring instructions when connecting the motor to the power lines.

Position of Terminal Box

To turn the motor so that the terminal box faces the right direction, proceed as follows:

1. Disconnect the power to the pump motor.

2. Remove the coupling guards (use a screwdriver).
3. Remove the couplings.
4. Remove the bolts that fasten the motor to the pump.
5. Turn the motor to the required position (in quarter-turn increments).
6. Follow steps 10 - 20 under "Motor Replacement", on Page 9.

Field Wiring

All wiring connections and wiring sizes must meet National Electrical Code and local requirements.

Motor Protection

See the motor nameplate for electrical connection/wiring diagram.

Aurora pumps must be used with the proper size and type of motor starter to ensure protection against damage from low voltage, phase failure, current imbalances and overloads. The overload should be sized to trip at the full-load current rating of the motor.

OPERATION

Priming

⚠WARNING **Hazardous pressure.** Do not run the pump with the discharge valve closed; the water in the pump may boil, causing risk of explosion and steam burns to anyone nearby.

⚠WARNING **Hazardous voltage.** Disconnect all power to the pump before servicing or working on the pump. Make sure that the power is locked out and that the pump cannot be accidentally started.

NOTICE: Under no circumstances should the pump be operated without flow through the pump. **Never** operate the pump dry.

Operation of closed systems or open systems with the liquid level above the pump priming plug:

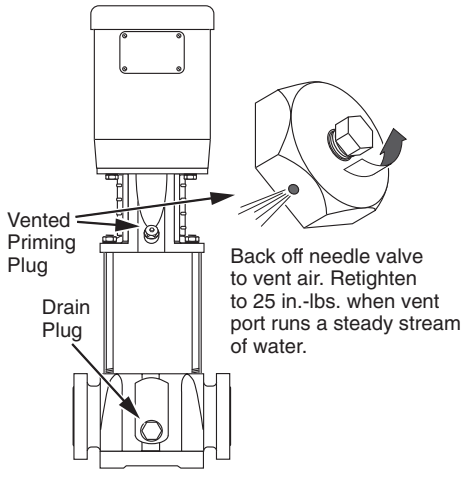


FIGURE 8 - Priming and Drain Plugs

1. Close the discharge isolating valve and loosen the needle valve located in the assembly in the pump head (Figure 8). Do not remove the needle valve.

NOTICE: On PVMI(X)2/4 models, remove the coupling guard for access to the vent plug.

⚠WARNING **Risk of water damage and injury. Watch the direction of the priming plug and make sure that the liquid escaping from it does not injure persons nearby or damage the motor or other components. In hot water installations, pay particular attention to the risk of injury from scalding hot water.**

2. Slowly open the isolation valve in the suction pipe until a steady stream of liquid runs out the vent in the priming port.
3. Tighten needle valve to 25 inch-pounds. Completely open isolation valves.

NOTICE: Please turn to "Starting", Page 8, before proceeding any further.

Operation of open systems with the liquid level below the top of the pump:

NOTICE: The suction pipe requires a check valve or isolation valve.

1. Close the discharge isolation valve.
2. Remove the vented priming plug.
3. Pour liquid through the priming port until the suction pipe and the pump are completely filled with liquid.
4. Replace the vented priming plug and tighten it securely.
5. Repeat steps 1-4 until the pump is primed.

NOTICE: Please turn to "Starting", Page 8, before proceeding any further.

Checking Direction of Rotation

NOTICE: Do not disconnect the motor from the shaft to check the direction of rotation. If you remove the coupling, then you must adjust the shaft position when you reinstall it. This must be done before starting the pump.

Arrows on the pump head show the correct direction of rotation. When seen from the motor fan, the pump should rotate *counterclockwise* (↶). For pump motors without a fan remove one of the coupling guards and look at the coupling to determine the direction of rotation. Turn off the pump and replace coupling guard.

NOTICE: Do not check the direction of rotation until the pump has been filled with liquid. See "Priming", at left and above.

1. Switch power off.
2. Remove the coupling guard and rotate the pump shaft to be certain it can turn freely. Replace the coupling guard.
3. Verify that the electrical connections are in accordance with the wiring diagram on the motor.
4. If the fan is visible, turn on and off to verify rotation.
5. To reverse the direction of rotation, first switch OFF the power supply.

6. On three-phase motors, switch 2 of the 3 power leads on the load side of the starter. On single-phase motors, see the connection diagram on the motor nameplate. Change the wiring as indicated.

⚠WARNING **Hazardous voltage.** Voltage can shock, burn or cause death. Ground the pump motor correctly before connecting to power supply per article 250-80 of National Electrical Code (NEC) in the U.S., or the Canadian Electrical Code (CEC), as applicable.

7. Switch on the power supply and recheck the direction of motor rotation.

Starting

1. If a suction line isolation valve has been installed, check to be sure that it is completely opened.
2. For initial starting, the isolation valve in the discharge pipe should be almost closed.
3. Start the pump.
4. When the piping system has been filled with liquid, slowly open the discharge isolation valve until it is completely open. Opening the valve too fast may result in water hammer in the discharge pipe. If the pump or system start to rattle, the pump is cavitating; to avoid damage to the pump, reduce the flow through the discharge isolation valve until the rattling stops. If this does not give adequate flow for your installation, call your installer or system designer.
5. Record the voltage and amperage of the motor. Adjust the motor overloads if required.
6. If pressure gauges have been installed, check and record operating pressures.
7. Check all controls for proper operation.

Motor Bearings

For the greasing schedule and greasing procedure of the motor bearings follow the motor manufacturers recommendations.

Calculating Minimum Inlet Pressure:

Minimum inlet pressure is required to avoid cavitation in the pump and is calculated as follows:

$H = Pb - NPSHR - H_f - H_V - H_S$

H = Minimum Inlet Pressure in Feet of Head

Pb = Barometric Pressure in Feet

1 Bar = 29.53 inches of Mercury (Hg)

1 PSI = 2.31 Ft of Head

1 Bar = 33.5 Ft. of Head

NPSHR = Net Positive suction head required. To be read from the NPSHR curve, Figure 9, at the highest flow the pump will be delivering.

H_f = Friction Loss in suction pipe in ft of head

H_V = Vapor pressure in feet of head (See Table VI).

H_S = A safety margin of 1.64 ft of head

Example for PVM8:

If: Flow = 60 GPM

Pb = 1 Bar = 29.53 Inches of Mercury*

(Convert from Bar to Feet of Head)

1 Inch of mercury = 1.13′ feet of water

T = 100° F

NPSHR = 10′ (See Figure 9)

H_f = 10′ of 2″ Steel Pipe @ 11.9′ of loss per 100′ of Pipe (H_f = 11.9′/10′ = 1.19′)

H_V = 2.195′ (from Table VI)

H_S = 1.64′ (safety factor from above)

Then: $H = 33.5'^* - NPSHR^{**} - H_f - H_V - H_S$

H = 33.5′ - 10′ - 1.19′ - 2.195′ - 1.64 = 18.475′

H = 18.475′ = Minimum Inlet Pressure

* 1 Bar = 14.5 PSI x 2.31 Ft of Head = 33.5′

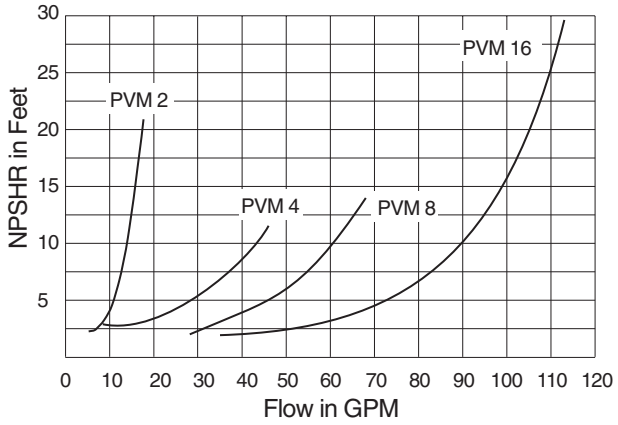


FIGURE 9 - PVM2 through PVM16
Net Positive Suction Head Requirement (NPSHR)

TABLE VI – Vapor Pressure of Water

Temperature in °F (°C)	Vapor Pressure in PSIA (kPa)	Absolute Pressure in Feet (M) of Water
32 (0)	0.089 (.61)	0.205 (.062)
40 (4.4)	0.122 (.84)	0.281 (.086)
60 (15.6)	0.256 (1.77)	0.592 (.180)
80 (26.7)	0.507 (3.50)	1.172 (.358)
100 (37.8)	0.95 (6.55)	2.195 (.669)
120 (48.9)	1.695 (11.69)	3.914 (1.193)
140 (60.0)	2.892 (19.94)	6.681 (2.036)
160 (71.1)	4.745 (32.72)	10.961 (3.341)
180 (82.2)	7.515 (51.84)	17.36 (5.291)
200 (93.3)	11.529 (79.49)	26.632 (8.117)
210 (98.9)	14.125 (97.39)	32.629 (9.945)
212 (100)	14.698 (101.34)	33.952 (10.349)
220 (104.4)	17.188 (118.51)	39.704 (12.102)
230 (110.0)	20.78 (143.28)	48.002 (14.631)
240 (115.6)	24.97 (172.17)	57.681 (17.581)
248 (120.0)	28.79 (188.51)	66.505 (20.271)

MAINTENANCE

Motor Replacement

For Key Numbers, refer to the Exploded View, Figure 14, Page 14 for PVM2 and PVM4 Series Models, Figure 16, Page 16 for PVMI/X2 and PVMI/X4 Models, Figure 15, Page 15 for PVM8 and PVM16 Series Models, and Figure 17, Page 17 for PVMI/X8 and PVMI/X16 Series Models.

⚠WARNING **Hazardous voltage.** Disconnect all power to the pump before servicing or working on pump. Make sure that power is locked out and that pump cannot be accidentally started.

1. Disconnect the power to the pump motor.
2. Close the nearest suction and discharge valves.
3. Remove the coupling guards (Key No. 4) by prying them loose with a screw driver.
4. Remove the socket head screws (Key No. 3) and the coupling halves (Key No. 2) from the shaft (Key No. 16A). For additional reference, see Figure 12, Page 10.

   NOTICE: Socket head screws are metric. See Table VIII on Page 12 for specific metric driver sizes.
5. Remove the shaft pin (Key No. 5).
6. Remove the capscrews (Key No. 12), flatwashers (Key No.10), and lockwashers (Key No.11) that hold the motor (Key No. 1) and the motor bracket (Key No. 7) together.
7. Pull the old motor up and off of the motor bracket. **NOTICE:** Note the location of the conduit box on the motor.
8. Thoroughly clean the surfaces of the mounting flanges on the new motor and the pump end.
9. Install the new motor on the pump with the conduit box in the desired position.
10. Lubricate the capscrews (Key No. 12) with oil.
11. Reinstall the lockwashers, flatwashers, and capscrews that hold the motor and the motor bracket together, then tighten evenly and diagonally. See Table VIII, Page 12 for torque specifications.
12. Reinstall the shaft pin (Key No. 5) in the shaft.
13. Reinstall the coupling halves (Key No. 2) on the pump and motor shaft. Make sure to engage the shaft pin (Key No. 5).

    NOTICE: Be sure coupling surfaces are thoroughly clean prior to assembly.
14. Snug up the socket head screws (Key No. 3) until the coupling begins to bind and then loosen 1/2 turn.
15. Draw up the capscrews evenly so the gap between the coupling halves is equal on both sides (See Figure 10A).

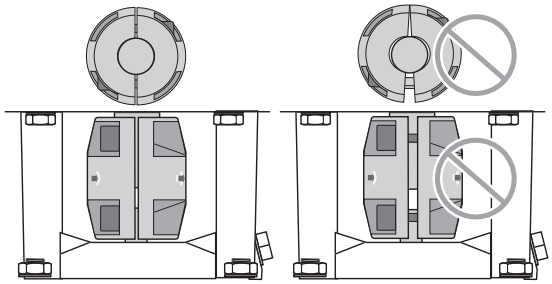


FIGURE 10A - Make Sure that the Coupling Halves are Evenly Tightened

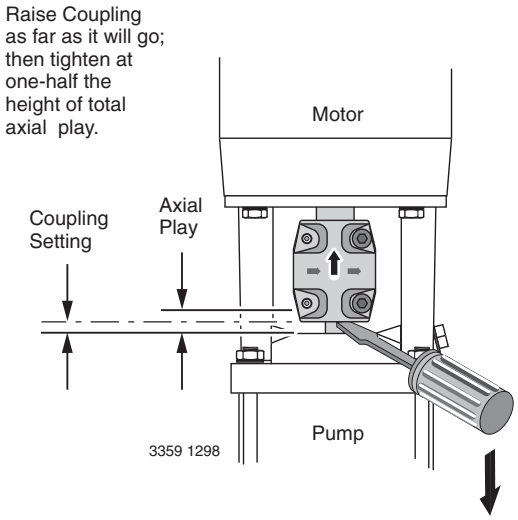


FIGURE 10B - Vertically (axial) Centering the Coupling

16. Insert a screw driver under the coupling (See Figure 10B).
17. Raise the pump shaft to its highest point.
18. Lower the shaft halfway back down the distance you just raised it and retighten the capscrews. See Figure 10.

    NOTICE: Torque settings are critical to prevent coupling movement. Refer to Table VIII, Page 12 for torque specifications.
19. Rotate the shaft to make sure that there is no interference. If rubbing is noted repeat steps 16, 17, and 18 above and readjust pump shaft height.
20. Reinstall the coupling guards by snapping them into place.

    NOTICE: The guards should be in place before the unit is run.
21. Open the suction and discharge valves. Turn the power back on.

Replacing Pump Stack

For Key Numbers, refer to the Exploded View, Figure 14 on Page 14, for the PVM2 and PVM4 Series Models and Figure 15 on Page 15 for PVM8 and PVM16 Series Models.

⚠WARNING Hazardous pressure. Do not run pump with discharge valve closed; the water in the pump may boil, causing risk of explosion and steam burns to anyone nearby.

1. Follow steps 1-8 under "Motor Replacement" section on Page 9; then proceed with step 2 below.
2. Remove the four staybolt nuts, flatwashers, and lockwashers (Key Nos. 8, 9A, and 9B) from the staybolts (Key No. 19).

   NOTICE: It is not necessary to remove the staybolts when replacing the stack.
3. Lift the motor bracket (Key No. 7) off of the pump body.

   NOTICE: Note the position of the priming plug. The priming plug must be returned to its original position during reassembly.
4. Remove and discard upper sleeve gasket (Key No. 17).
5. Clean gasket seat.
6. Remove and replace round spring ring (PVM2 and PVM4) or stack spring (PVM8 and PVM16) (Key No. 13).
7. Pull the old stack (16A through 16L) out of the stainless steel sleeve (Key No. 18) by pulling straight up on the pump shaft (Key No. 16A).
8. Remove the stainless steel sleeve (Key No. 18).
9. Remove and discard the bottom sleeve gasket (Key No. 17).
10. Clean the gasket seat.
11. Remove and discard the O-Ring (Key No. 21A) from the suction/discharge (Key No. 21 PVM2 and PVM4 only).
12. Cast Iron Models Only: Clean the O-Ring seat and install a new O-Ring (Key No. 21A).
13. Install a new lower sleeve gasket.
14. Install the new stack without the stainless steel sleeve.

    NOTICE: Be sure to align either the small priming hole or the suction interconnector pin hole (located on the bottom stage of the stack) properly in the base of the Suction/Discharge (Key No. 21). See Figure 11 (not necessary on PVMI/X models).
15. Use a rubber mallet to tap the stainless steel sleeve (Key No. 18) into place.
16. Install a new mechanical shaft seal (Key Nos. 14A and 14B, or Key Nos 15A through 15G). Refer to "Mechanical Seal Disassembly and Mechanical Seal Reassembly" sections, Pages 11 and 12.
17. Install a new upper sleeve gasket (Key No. 17).
18. Install a new round spring ring or stack spring (Key No. 13).
19. Reinstall the motor bracket (Key No. 7) on the pump body. Align the priming plug (Key No. 6) to its original position.
20. Oil the threads on the staybolts (Key No. 19).
21. Replace the lockwashers, flatwashers, and staybolt nuts (Key Nos. 8, 9A and 9B) and cross-torque the staybolts. See Table VIII, Page 12, for torque specifications.
22. Reinstall the motor (Key No. 1) on the motor bracket (Key No. 7) and turn the motor to the desired terminal box position.
23. Follow steps 10 - 21 under "Motor Replacement", Page 9. You have now finished changing out the impeller stack.

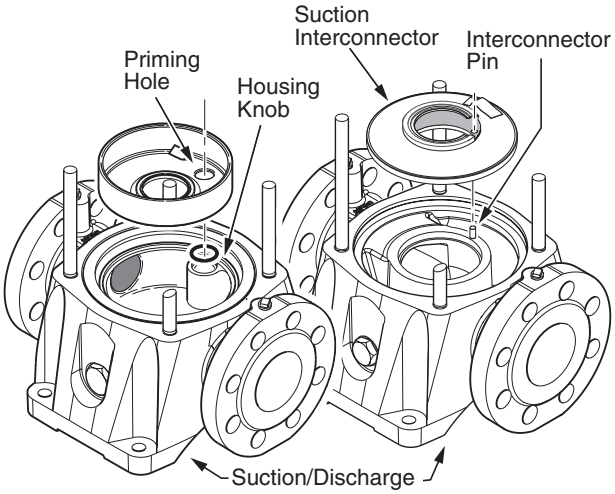


FIGURE 11 - PVM2, PVM4 – Align Small Priming Port. PVM8, PVM16 – Align Interconnector Pin. No alignment is necessary on PVMI/X models.

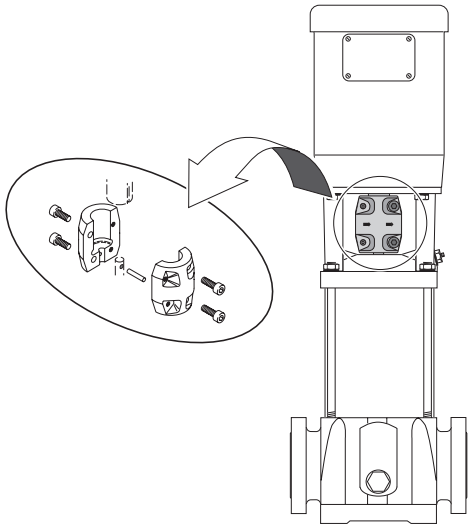


FIGURE 12 - Remove the Socket Head Screws and the Coupling Halves

Seven Part Mechanical Seal/Disassembly:

See Figure 13 for Seal Key Numbers.

See Figures 14 through 17 for Pump Key Numbers.

⚠WARNING Hazardous voltage. Can Shock, burn or cause death. Disconnect power to pump before disassembly.

1. Follow Steps 1-8 under "Motor Replacement" Page 9, and proceed with step 2 below.
2. Remove the four nuts, lockwashers and washers (Key Nos. 8, 9A, and 9B) from the staybolts (Key No. 19).
3. The shaft seal consists of an O-Ring (Key No. 15A), the stationary half of the mechanical seal (Key No. 15B), the rotating half of the mechanical seal (Key No. 15C), a second O-Ring (Key No. 15D - inside No. 15C), a flat washer (Key No. 15E), a spring (Key No. 15F), and a mechanical drive ring (Key No. 15G), in that order, see Figure 13, below. Turn the pump head upside down and remove the stationary part of the seal (Key No. 15B) from the seal seat in the base of the motor bracket.

   NOTICE: Use care not to chip or scratch the seal seat during disassembly and assembly.

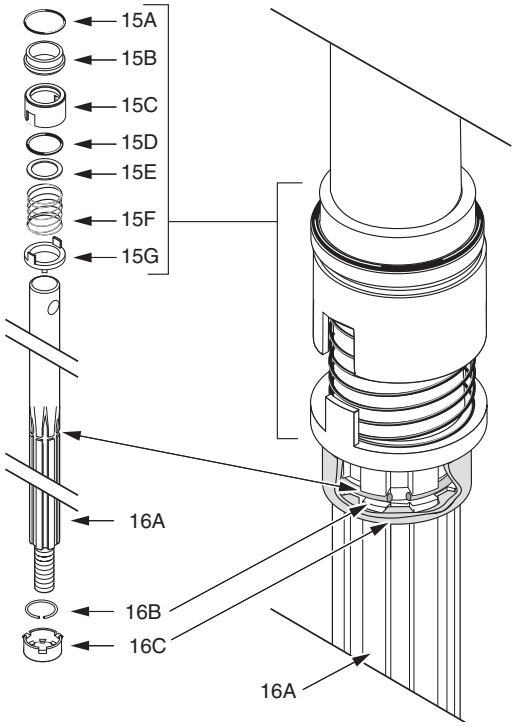


FIGURE 13

4. Clean the seal seat with a wet cloth.
5. Remove the rotating parts of the seal by twisting and pulling up on them until they come off of the shaft (Key Nos.15C and 15D, 15E, 15F, and 15G). Discard the old seal.

Seven Part Mechanical Seal Reassembly:

NOTICE: Before assembly check and clean all sealing and gasket surfaces with a clean wet cloth. Replace all seals, gaskets and O-Rings.

1. Turn the motor bracket (Key No.6) upside down.
2. Moisten the seal seat (in the motor bracket) with a small amount of water.
3. Lubricate the larger diameter O-Ring (Key No. 15A) with a small amount of water and install it on the stationary half of mechanical seal (Key No. 15B).
4. Press the stationary half of the shaft seal (Key No. 15B) with O-Ring (Key Nos. 15A and 15B) into the seal seat of the motor bracket. Use finger pressure only. If a tool is used, protect the seal face from tools with a clean cloth.

   NOTICE: Be sure the seal is installed evenly to avoid pinching the O-Ring.
5. Lubricate smaller diameter O-Ring (Key No. 15D) with water and press it into the rotating half of the mechanical seal (Key No.15C).
6. Install the mechanical drive ring (Key No. 15G) on the shaft (Key No. 16A). Be sure the drive ring butts up against the mechanical seal spacer (Key No. 16C).
7. Install the spring (Key No.15F) up against the drive ring on the shaft .
8. Install the flatwasher (Key No.15E) on the shaft, against the spring.
9. Install the rotating half of the mechanical seal (Key No.15C) on the shaft. Align the grooves on the rotating half of the mechanical seal with the teeth on the mechanical drive ring (Key No. 15G).
10. Follow Steps 11 - 23 under "Replacing Pump Stack", Page 10.

Frequency of Starts and Stops

Check pump cycling frequency and make sure that the pump is not starting more than:

TABLE VII – Maximum Number of Cycles

Cycles	Motor HP Rating
20 times per hour	1/2 - 5 HP motors
15 times per hour	7- 1/2 - 15 HP motors
10 times per hour	20 and 25 HP motors

Frost Protection

1. If you do not use your pump during seasons of frost, drain it and add a glycol based antifreeze (50/50 mixture) to avoid damage.

⚠ CAUTION **Risk of water damage and injury. Watch the direction of the priming plug and make sure that liquid escaping from it does not injure persons nearby or damage the motor or other components. In hot water installations, pay particular attention to the risk of injury from scalding hot water.**

2. Upon restart dispose of spent antifreeze properly.
3. Do not replace the drain plug or tighten the priming plug until you put the pump back in service again.

Regular Maintenance Checks

The following checks should be made at regular intervals:

1. The pump meets required performance and is operating smoothly and quietly.
2. There are no leaks.
3. The motor is not overheating.
4. Remove and clean all strainers and filters in the system.
5. Verify amp draw – check motor amperage.
6. Pump wear rings and shaft require no regular maintenance.

TABLE VIII – Torque Specifications (foot-lbs.) For Cast Iron and Stainless Steel Models

	Coupling			Motor		Staybolt		Stack Nut	
Pump Model Number	Socket Head Screw M6 x 20	Socket Head Screw M8 x 25	Socket Head Screw M10 x 25	Capscrew Hex Head 3/8 x 1-1/2	Capscrew Hex Head 1/2 x 1-1/2	Hex Nut 1/2 - 13	Hex Nut 5/8 - 11	Hex Nut M8	Hex Nut M12
PVM2 Series	15	20	–	30	35	45	–	10	–
PVM4 Series	15	20	–	30	35	45	–	10	–
PVM8 Series	15	20	45	30	35	–	75	–	30
PVM16 Series	–	20	45	–	35	–	75	–	30

TROUBLESHOOTING GUIDE

⚠WARNING Hazardous voltage and risk of sudden starts. Disconnect all power to the pump before servicing or working on pump. Make sure that power is locked out and that pump cannot be accidentally started.

PROBLEM	CAUSE
1. Motor does not run when started	A. Power failure B. Fuses blown C. Motor starter overload has tripped out D. Main contacts in motor starter are not making contact or the coil is faulty E Control circuit fuses are defective F. Motor is defective
2. Motor starter overload trips out immediately when power supply is switched on	A. One fuse has blown B. Contacts in motor overload relay are faulty C. Cable connections are loose or faulty D. Motor winding is defective E. Pump mechanically blocked F. Overload setting is too low
3. Motor starter overload trips out occasionally	A. Overload setting is too low B. Low voltage at peak times
4. Motor starter has not tripped out but the motor does not run	A. Check 1 A), B), D,) and E)
5. Pump capacity is not constant	A. Pump inlet pressure is too low B. Suction pipe/pump partly blocked C. Pump is sucking air
6. Pump runs but gives no water	A. Suction pipe/pump blocked B. Foot or non-return valve is blocked in closed position C. Leakage in suction pipe D. Air in suction pipe or pump E. Motor rotates in the wrong direction
7. Pump runs backwards when switched off	A. Leakage in suction pipe B. Foot or non-return valve is defective C. Foot valve is blocked in open or partly open position D. Non return valve leaks or is blocked in open or partly open position E. Discharge valve is defective
8. Leakage from shaft seal	A. Pump shaft position is incorrect B. Shaft seal is defective
9. Noise	A. Cavitation is occurring in the pump B. Pump does not rotate freely (That is, there is increased frictional resistance) because of incorrect shaft position

PVM2
PVM4

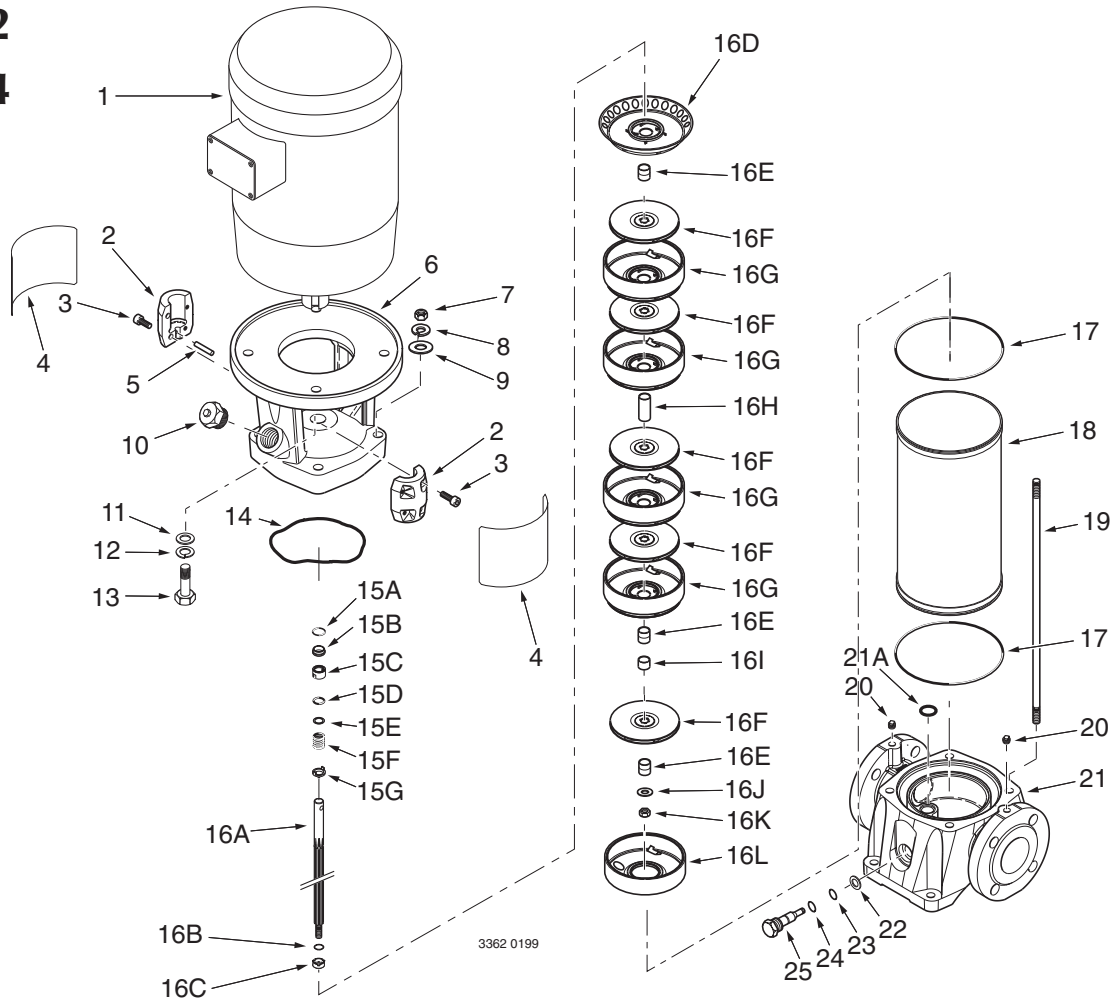


FIGURE 14 - Exploded View PVM2 and PVM4

SEE KIT SECTION FOR STACK KITS, SEAL KITS, GASKETS AND FLANGE KITS

Key No.	Description	Key No.	Description
1	Motor	15G	Mechanical Drive Ring
2	Coupling Half	16	Replacement Stack Kit (Incl. Key Nos. 16A thru 16L)
3	Socket Head Screw	16A	Shaft
4	Coupling Guard	16B	Stop Ring
5	Coupling Pin	16C	Mechanical Seal Spacer
6	Vented Priming Plug	16D	Upper Intermediate Chamber
7	Motor Bracket	16E	Spacer
8	Staybolt Nut	16F	Impeller
9A	Staybolt Lockwasher	16G	Diffuser
9B	Staybolt Flat Washer	16H	Spacer
10	Flatwasher	16I	Bearing
11	Lockwasher	16J	Shaft Washer
12	Capscrew	16K	Nut
13	Spring Ring	16L	Chamber without Diffuser
14	Two part Mechanical Seal (Includes 14A and 14B)	17	Sleeve Gasket
14A	Stationary Half of Mechanical Seal	18	Stainless Steel Sleeve
14B	Rotating Half of Mechanical Seal	19	Staybolt
15	Seven Part Mechanical Seal (Includes 15A thru 15G)	20	Pipe Plug
15A	O-Ring, Larger Diameter	21	Suction/Discharge
15B	Stationary Half of Mechanical Seal	21A	O-Ring (Bottom Chamber)
15C	Rotating Half of Mechanical Seal	22	Drain Plug Gasket
15D	O-Ring, Smaller Diameter	23	O-Ring
15E	Flat Washer	24	O-Ring
15F	Spring	25	Drain Plug

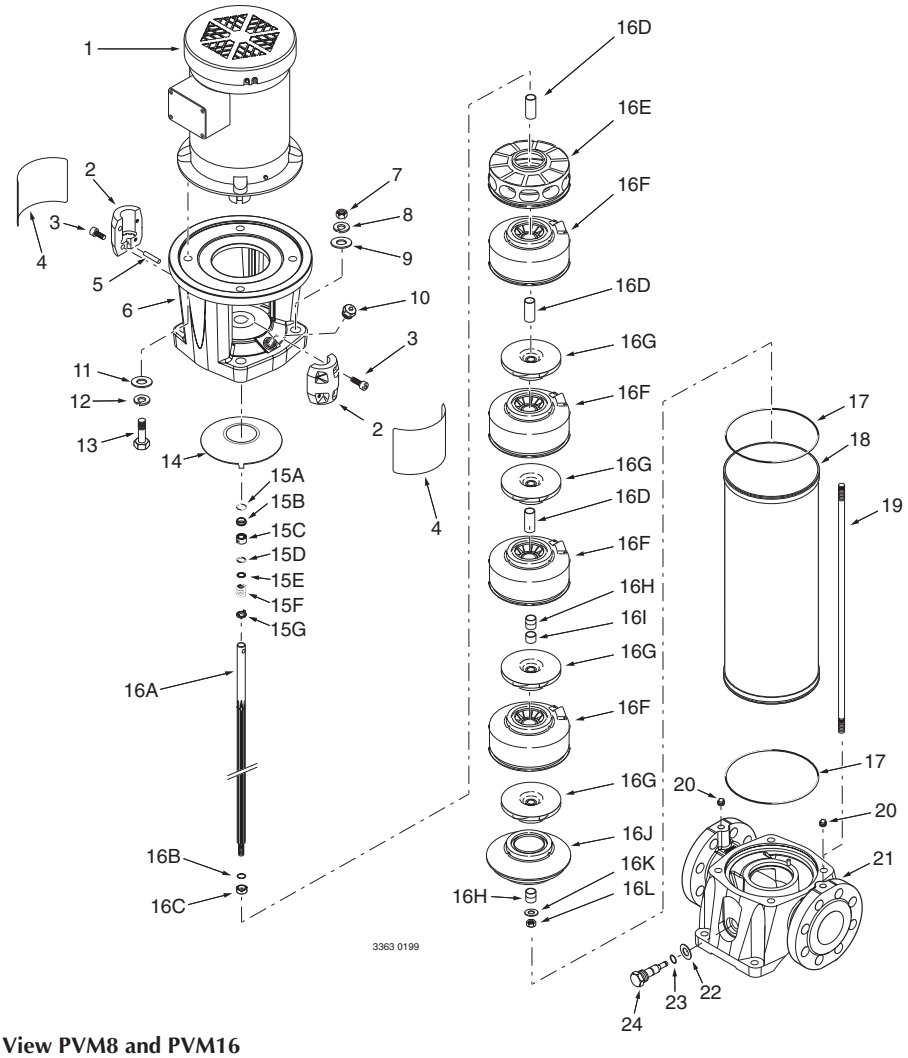


Figure 15 - Exploded View PVM8 and PVM16

SEE KIT SECTION FOR STACK KITS, SEAL KITS, GASKETS AND FLANGE KITS

Key No.	Description	Key No.	Description
1	Motor	15G	Mechanical Drive Ring
2	Coupling Half	16	Replacement Stack Kit (Incl.16A thru 16L)
3	Socket Head Screw	16A	Shaft
4	Coupling Guard	16B	Stop Ring
5	Coupling Pin	16C	Mechanical Seal Spacer
6	Vented Priming Plug	16D	Upper Intermediate Chamber
7	Motor Bracket	16E	Spacer
8	Staybolt Nut	16F	Impeller
9A	Staybolt Lockwasher	16G	Diffuser
9B	Staybolt Flat Washer	16H	Spacer
10	Flat Washer	16I	Bearing
11	Lock Washer	16J	Shaft Washer
12	Capscrew	16K	Nut
13	Spring Ring	16L	Chamber without Diffuser
14	Two Part Mechanical Seal (Includes 14A and 14B)	17	Sleeve Gasket
14A	Stationary Half of Shaft Seal	18	Stainless Steel Sleeve
14B	Rotating Half of Shaft Seal	19	Staybolt
15	Seven Part Mechanical Seal (Includes 15A thru 15G)	20	Pipe Plug
15A	O-Ring, Larger Diameter	21	Suction/Discharge
15B	Stationary Half of Mechanical Seal	21A	O-Ring (Bottom Chamber)
15C	Rotating Half of Mechanical Seal	22	Drain Plug Gasket
15D	O-Ring, Smaller Diameter	23	O-Ring
15E	Flat Washer	24	O-Ring
15F	Spring	25	Drain Plug

PVMI/X2
PVMI/X4

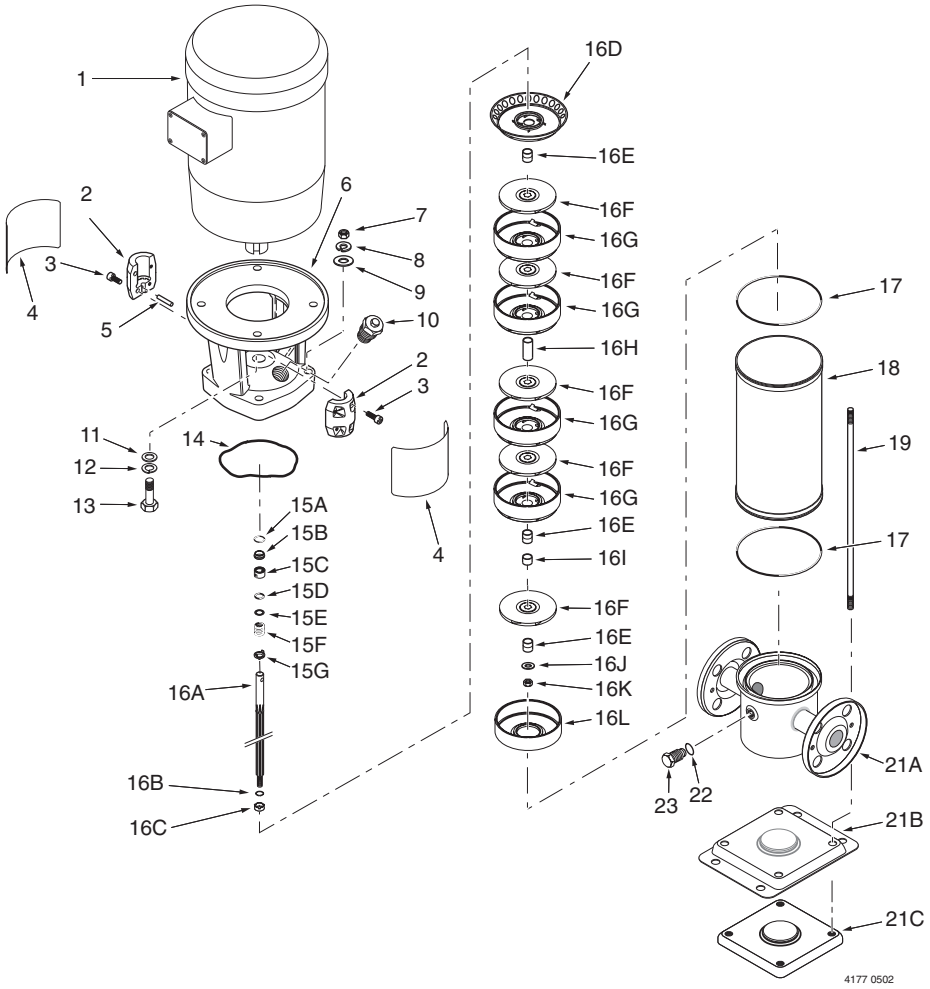


FIGURE 16 - Exploded View PVMI/X2 and PVMI/X4

SEE KIT SECTION FOR STACK KITS, SEAL KITS, GASKETS AND FLANGE KITS

Key No.	Description	Key No.	Description
1	Motor	15G	Mechanical Drive Ring
2	Coupling Half	16	Replacement Stack Kit (Incl. Key Nos. 16A thru 16L)
3	Socket Head Screw	16A	Shaft
4	Coupling Guard	16B	Stop Ring
5	Coupling Pin	16C	Mechanical Seal Spacer
6	Motor Bracket	16D	Upper Intermediate Chamber
7	Staybolt Nut	16E	Spacer
8A	Staybolt Lockwasher	16F	Impeller
8B	Staybolt Flat Washer	16G	Diffuser
9	Vented Priming Plug	16H	Spacer
10	Flatwasher	16I	Bearing
11	Lockwasher	16J	Shaft Washer
12	Capscrew	16K	Nut
13	Spring Ring	16L	Chamber without Diffuser
14	Two part Mechanical Seal (Includes 14A and 14B)	17	Sleeve Gasket
14A	Stationary Half of Mechanical Seal	18	Stainless Steel Sleeve
14B	Rotating Half of Mechanical Seal	19	Staybolt
15	Seven Part Mechanical Seal (Includes 15A thru 15G)	21A	Suction/Discharge
15A	O-Ring, Larger Diameter	21B	Base
15B	Stationary Half of Mechanical Seal	21C	Base Reinforcement
15C	Rotating Half of Mechanical Seal	22	O-Ring
15D	O-Ring, Smaller Diameter	23	O-Ring
15E	Flat Washer	24	Drain Plug (Low Pressure Side)
15F	Spring	25	Drain Plug (High Pressure Side)

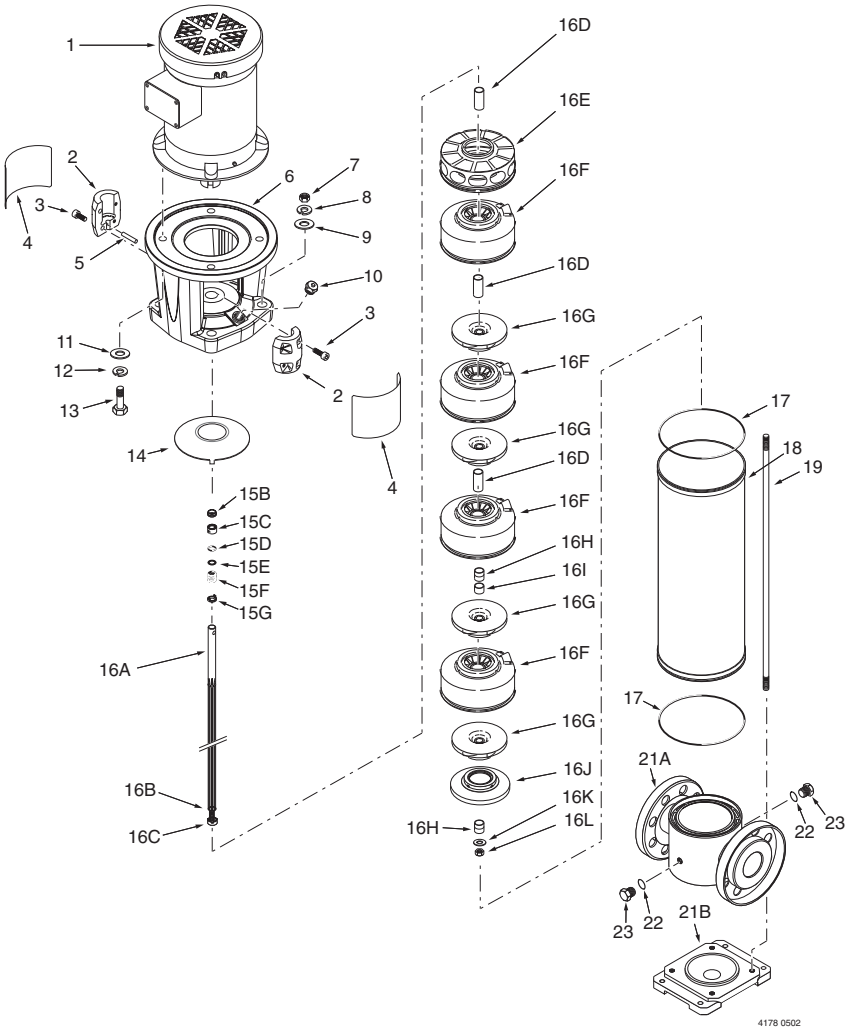


Figure 17 - Exploded View PVMI/X8 and PVMI/X16

SEE KIT SECTION FOR STACK KITS, SEAL KITS, GASKETS AND FLANGE KITS

Key No.	Description	Key No.	Description
1	Motor	15G	Mechanical Drive Ring
2	Coupling Half	16	Replacement Stack Kit (Incl.16A thru 16L)
3	Socket Head Screw	16A	Shaft
4	Coupling Guard	16B	Stop Ring
5	Coupling Pin	16C	Mechanical Seal Spacer
6	Vented Priming Plug	16D	Spacer
7	Motor Bracket	16E	Top Diffuser
8	Staybolt Nut	16F	Diffuser
9A	Staybolt Lockwasher	16G	Impeller
9B	Staybolt Flat Washer	16H	Spacer
10	Flat Washer	16I	Bearing
11	Lock Washer	16J	Suction Interconnector
12	Capscrew	16K	Washer
13	Spring Ring	16L	Lock Nut
14	Two Part Mechanical Seal (Includes 14A and 14B)	17	Sleeve Gasket
14A	Stationary Half of Shaft Seal	18	Stainless Steel Sleeve
14B	Rotating Half of Shaft Seal	19	Staybolt
15	Seven Part Mechanical Seal (Includes 15A thru 15G)	21A	Suction/Discharge
15A	O-Ring, Larger Diameter	21B	Base
15B	Stationary Half of Mechanical Seal	22	O-Ring
15C	Rotating Half of Mechanical Seal	23	O-Ring
15D	O-Ring, Smaller Diameter	24	Drain Plug (Low Pressure Side)
15E	Flat Washer	25	Drain Plug (High Pressure Side)
15F	Spring		

Sect.6-Item PVM2-16

MIXERS

ST-100

LEFT BLANK

JOHN MEUNIER

NOMENCLATURE/ BILL OF MATERIALS

TITRE/ TITLE	Rev.	DESCRIPTION	PAR/ BY:	APPR:	DATE:	Affaire / Contract	Meadowbank Mining
Mixers	0	SUBMITTAL	P.Ste-Marie	P.S.M.	2009-03-26		
	1						
	2					REF. No.	NC01 | | 0
	3						
DESSIN /DWG # ST-100	4					Date:	2009-03-26

REV.	ITEM	QTE/QTY. Unit.	QTE/QTY. Total	DESCRIPTION	P&ID I.D./TAG	CAT. ACCPAC	SOURCE	FA/SA FI SITE	P / N
	NC01ST-100-1	1	2	**COAGULATION MIXER**	M2-011	B44		SA	
				Application:	M2-021				
				Coagulation tank					
				Manufacturer					
				ENVIREQUIP W.T.E.M. INC					
				Model					
				MIX-TECH EVGX 4-3,0					
				Variable speed					
				no					
				Weight					
				568 lb (258 kg)					
				MIXING CHARACTERISTICS					
				Power number (Np)					
				0.45 s.u.					
				Pumping number (Nq)					
				0.72 s.u.					
				Rotational speed					
				67.23 rpm					
				Dissipated power					
				2,48 HP					
				IMPULSER					
				Number					
				1					
				Type					
				axial (F-4) 13,5 degrees					
				Diameter					
				49,3 in (1252,2 mm)					
				Distance from bottom					
				36,975 in (939 mm)					
				Rotation direction					
				cw down					
				Material					
				S.S. 304L					

JOHN MEUNIER

NOMENCLATURE/ BILL OF MATERIALS

TITRE/ TITLE	Rev.	DESCRIPTION	PAR/ BY:	APPR:	DATE:	Affaire / Contract	Meadowbank Mining
Mixers	0	SUBMITTAL	P.Ste-Marie	P.S.M.	2009-03-26		
	1						
	2					REF. No.	NC01 | 0
	3						
DESSIN /DWG # ST-100	4					Date:	2009-03-26

REV.	ITEM	QTE/QTY. Unit.	QTE/QTY. Total	DESCRIPTION	P&ID I.D./TAG	CAT. ACCPAC	SOURCE	FA/SA FI SITE	P / N
				COAGULATION MIXER (CONT'D)					
				SHAFT					
				Length					
				106,72 in (2711 mm)					
				Diameter					
				2,25 in (57,1mm)					
				Material					
				S.S. 304L					
				REDUCER					
				Manufacturer					
				NORD					
				Model					
				SK4282 AHZ/VL111					
				Type					
				Parallel shaft AGMA11 (LS) and AGMA 13 (HS)					
				Ratio					
				26,25:1					
				Service factor					
				1,21 on motor name plate					

JOHN MEUNIER

NOMENCLATURE/ BILL OF MATERIALS

TITRE/ TITLE	Rev.	DESCRIPTION	PAR/ BY:	APPR:	DATE:	Affaire / Contract	Meadowbank Mining
Mixers	0	SUBMITTAL	P.Ste-Marie	P.S.M.	2009-03-26		
	1						
	2					REF. No.	NC01 | 0
	3						
DESSIN /DWG # ST-100	4					Date:	2009-03-26

REV.	ITEM	QTE/QTY. Unit.	QTE/QTY. Total	DESCRIPTION	P&ID I.D./TAG	CAT. ACCPAC	SOURCE	FA/SA FI SITE	P / N
				COAGULATION MIXER (CONT'D)					
				MOTOR					
				Manufacturer/Model					
				Nord - frame size 100LH/4 outdoor protection					
				Type					
				Squirrel cage					
				Efficiency					
				87.5%					
				Enclosure					
				Isolation Class F / IP55					
				Speed					
				1765 rpm					
				Power					
				3 HP					
				Electrical feed					
				575 Vac / 3 ph / 60 Hz					
				Paint protection					
				Manufacturer standard					
				Lubrificant:					
				c/w food grade oil fill					

JOHN MEUNIER

NOMENCLATURE/ BILL OF MATERIALS

TITRE/ TITLE	Rev.	DESCRIPTION	PAR/ BY:	APPR:	DATE:	Affaire / Contract	Meadowbank Mining
Mixers	0	SUBMITTAL	P.Ste-Marie	P.S.M.	2009-03-26		
	1						
	2					REF. No.	NC01 0
	3						
DESSIN /DWG # ST-100	4					Date:	2009-03-26

REV.	ITEM	QTE/QTY. Unit.	QTE/QTY. Total	DESCRIPTION	P&ID I.D./TAG	CAT. ACCPAC	SOURCE	FA/SA FI SITE	P / N
	NC01ST-100-2	1	2	**INJECTION MIXER**	M2-012	B44		SA	
				Application:	M2-022				
				Injection tank					
				Manufacturer					
				ENVIREQUIP W.T.E.M. INC					
				Model					
				MIX-TECH EVGX 4-3,0					
				Variable speed					
				no					
				Weight					
				568 lb (258 kg)					
				MIXING CHARACTERISTICS					
				Power number (Np)					
				0.45 s.u.					
				Pumping number (Nq)					
				0.72 s.u.					
				Rotational speed					
				67.23 rpm					
				Dissipated power					
				2,48 HP					
				IMPULSER					
				Number					
				1					
				Type					
				axial (F-4) 13,5 degrees					
				Diameter					
				49,3 in (1252,2 mm)					
				Distance from bottom					
				36,975 in (939 mm)					
				Rotation direction					
				ccw up					
				Material					
				S.S. 304L					

JOHN MEUNIER

NOMENCLATURE/ BILL OF MATERIALS

TITRE/ TITLE	Rev.	DESCRIPTION	PAR/ BY:	APPR:	DATE:	Affaire / Contract	Meadowbank Mining
Mixers	0	SUBMITTAL	P.Ste-Marie	P.S.M.	2009-03-26		
	1						
	2					REF. No.	NC01 | 0
	3						
DESSIN /DWG # ST-100	4					Date:	2009-03-26

REV.	ITEM	QTE/QTY. Unit.	QTE/QTY. Total	DESCRIPTION	P&ID I.D./TAG	CAT. ACCPAC	SOURCE	FA/SA FI SITE	P / N
				INJECTION MIXER (CONT'D)					
				SHAFT					
				Length					
				106,72 in (2711 mm)					
				Diameter					
				2,25 in (57,1mm)					
				Material					
				S.S. 304L					
				REDUCER					
				Manufacturer					
				NORD					
				Model					
				SK4282 AHZ/VL111					
				Type					
				Parallel shaft AGMA11 (LS) and AGMA 13 (HS)					
				Ratio					
				26,25:1					
				Service factor					
				1,21 on motor name plate					

JOHN MEUNIER

NOMENCLATURE/ BILL OF MATERIALS

TITRE/ TITLE	Rev.	DESCRIPTION	PAR/ BY:	APPR:	DATE:	Affaire / Contract	Meadowbank Mining
Mixers	0	SUBMITTAL	P.Ste-Marie	P.S.M.	2009-03-26		
	1						
	2					REF. No.	**NC01**		**0**
	3						
DESSIN /DWG # **ST-100**	4					**Date:**	2009-03-26

REV.	ITEM	QTE/QTY. Unit.	QTE/QTY. Total	DESCRIPTION	P&ID I.D./TAG	CAT. ACCPAC	SOURCE	FA/SA FI SITE	P / N
				INJECTION MIXER (CONT'D)					
				MOTOR					
				Manufacturer/Model					
				Nord - frame size 100LH/4 outdoor protection					
				Type					
				Squirrel cage					
				Efficiency					
				87.5%					
				Enclosure					
				Isolation Class F / IP55					
				Speed					
				1765 rpm					
				Power					
				3 HP					
				Electrical feed					
				575 Vac / 3 ph / 60 Hz					
				Paint protection					
				Manufacturer standard					
				Lubrificant:					
				c/w food grade oil fill					

JOHN MEUNIER

NOMENCLATURE/ BILL OF MATERIALS

TITRE/ TITLE	Rev.	DESCRIPTION	PAR/ BY:	APPR:	DATE:	Affaire / Contract	Meadowbank Mining
Mixers	0	SUBMITTAL	P.Ste-Marie	P.S.M.	2009-03-26		
	1						
	2					REF. No.	NC01 | 0
	3						
DESSIN /DWG # ST-100	4					Date:	2009-03-26

REV.	ITEM	QTE/QTY. Unit.	QTE/QTY. Total	DESCRIPTION	P&ID I.D./TAG	CAT. ACCPAC	SOURCE	FA/SA FI SITE	P / N
	NC01ST-100-3	1	2	**MATURATION MIXER**	M2-013	B44		SA	
				Application:	M2-023				
				Maturation tank					
				Manufacturer					
				ENVIREQUIP W.T.E.M. INC					
				Model					
				MIX-TECH EVGX 6-5					
				Variable speed					
				yes (byt others)					
				Weight					
				1393 lb (633 kg)					
				MIXING CHARACTERISTICS					
				Power number (Np)					
				0.733 s.u.					
				Pumping number (Nq)					
				0.72 s.u.					
				Rotational speed					
				22,03 rpm					
				Dissipated power					
				2,99 HP					
				IMPULSER					
				Number					
				1					
				Type					
				axial (F-4) 22 degrees					
				Diameter					
				89,68 in (2277,9 mm)					
				Distance from bottom					
				44,84 in (1139 mm)					
				Rotation direction					
				cw down					
				Material					
				S.S. 304L					

JOHN MEUNIER

NOMENCLATURE/ BILL OF MATERIALS

TITRE/ TITLE	Rev.	DESCRIPTION	PAR/ BY:	APPR:	DATE:	Affaire / Contract	Meadowbank Mining
Mixers	0	SUBMITTAL	P.Ste-Marie	P.S.M.	2009-03-26		
	1						
	2					REF. No.	NC01 | 0
	3						
DESSIN /DWG # ST-100	4					Date:	2009-03-26

REV.	ITEM	QTE/QTY. Unit.	QTE/QTY. Total	DESCRIPTION	P&ID I.D./TAG	CAT. ACCPAC	SOURCE	FA/SA FI SITE	P / N
				MATURATION MIXER (CONT'D)					
				SHAFT					
				Length					
				98,86 in (2511 mm)					
				Diameter					
				3 in (76,2 mm)					
				Material					
				S.S. 304L					
				REDUCER					
				Manufacturer					
				NORD					
				Model					
				SK6282 AHZ/VL111					
				Type					
				Parallel shaft AGMA11 (LS) and AGMA 13 (HS)					
				Ratio					
				80,33:1					
				Service factor					
				1,68 on motor HP					

JOHN MEUNIER

NOMENCLATURE/ BILL OF MATERIALS

TITRE/ TITLE	Rev.	DESCRIPTION	PAR/ BY:	APPR:	DATE:	Affaire / Contract	Meadowbank Mining
Mixers	0	SUBMITTAL	P.Ste-Marie	P.S.M.	2009-03-26		
	1						
	2					REF. No.	NC01 | 0
	3						
DESSIN /DWG # ST-100	4					Date:	2009-03-26

REV.	ITEM	QTE/QTY. Unit.	QTE/QTY. Total	DESCRIPTION	P&ID I.D./TAG	CAT. ACCPAC	SOURCE	FA/SA FI SITE	P / N
				MATURATION MIXER (CONT'D)					
				MOTOR					
				Manufacturer/Model					
				Nord - frame size 112MH/4 outdoor protection					
				Type					
				Squirrel cage					
				Efficiency					
				87,5%					
				Enclosure					
				Isolation Class F / IP55					
				Speed					
				1770 rpm					
				Power					
				5 HP					
				Electrical feed					
				575 Vac / 3 ph /60 Hz					
				Paint protection					
				Manufacturer standard					
				Lubrificant:					
				c/w food grade oil fill					

LEFT BLANK

MIXERS

MIXERS

LEFT BLANK