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B 1091 en-3517



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1 General

These operating instructions must be read before NORD motors are transported, installed, commissioned, serviced or repaired. All persons who are involved in these tasks must observe these operating instructions. In order to prevent injury or damage, all of the safety information in these operating instructions must be strictly observed.

The information and instructions in the instructions, safety and commissioning information which is supplied, as well as all other instructions must be observed.

This is essential to prevent injury and damage.

The applicable national, local and plant-specific regulations and requirements and regulations must be observed.

Technical details may vary for special designs and constructions. In case of doubt, we urgently recommend that the manufacturer is contacted, giving details of the type designation and the motor number.

Qualified personnel are persons who due to their training, experience and instruction, and their knowledge of the relevant standards, accident prevention regulations and operating conditions are authorised to carry out the necessary activities.

This also includes knowledge of first aid measures and the local emergency services.

It is assumed that the work for transport, assembly, installation, commissioning, maintenance and repair will be performed by qualified staff.

In particular, the following must be observed:

- Technical data and information regarding permissible use, installation, connection, ambient and operating conditions, which are contained in the catalogue, the order documents and other documentation for the product.
- · Local and plant-specific regulations and requirements
- · Correct use of tools, lifting and transportation equipment
- Use of personal protective equipment

For reasons of clarity, the operating instructions do not contain detailed information about possible versions and therefore do not consider all possible cases of installation, operation or servicing.

Because of this, these operating instruction essentially only contain the information which is necessary for proper use by qualified personnel.

In order to prevent faults it is necessary that the prescribed service and inspection work is carried out by appropriately qualified personnel.

- For the operation on an inverter, the planning guideline B1091-1 forms a part of these operating instructions.
- The supplementary operating instructions must be observed if an external fan is present.
- For braking motors, the supplementary brake operating instructions must be observed...

If the operating instructions or the planning guide are lost for any reason, these documents must be obtained from NORD.



1.1 Safety and installation notes

The devices are operating materials intended for use in industrial high voltage systems, and are operated at voltages that could lead to severe injuries or death if they are touched.

The device and its accessories must only be used for the purpose which is intended by the manufacturer. Unauthorised modifications and the use of spare parts and additional equipment which has not been purchased from or recommended by the manufacturer of the device may cause fire, electric shock and injury.

All of the associated covers and protective devices must be used.

Installation and other work may only be carried out by qualified electricians with strict adherence to the operating instructions. Therefore keep these Operating Instructions at hand, together with all supplementary instructions for any options which are used, and give them to each user.

Local regulations for the installation of electrical equipment and accident prevention must be complied with.

1.1.1 Explanation of labels used

1	Note	Indicates hints for use and useful information.
r. M	NOTICE	Indicates a possibly harmful situation, which may cause damage to the product or the environment.
A	CAUTION	Indicates a possibly dangerous situation, which may result in slight or minor injuries.
A	WARNING	Indicates a possibly dangerous situation, which may result in death or serious injury.
A	DANGER	Indicates an immediate danger, which may result in death or serious injury.



1.1.2 List of safety and installation notes



DANGER!

Electric shock

The motor is operated with a dangerous voltage. Touching certain conducting components (connection terminals and supply cables) will cause electric shock with possibly fatal consequences.

Even when the motor is at a standstill (e.g. due to the electronic block of a connected frequency inverter or a jammed drive unit) the connection terminals and supply cables may carry a dangerous voltage. A motor standstill is not identical to electrical isolation from the mains.

Even if the drive unit has been disconnected from the mains, a connected motor may rotate and possibly generate a dangerous voltage.

Installation and work must only be carried out when the motor is at a standstill and is **disconnected** (all phases disconnected from the mains).

Follow the **5 Safety Rules** (1. Switch off the power, 2. Secure against switching on, 3. Check for no voltage, 4. Earthing and short circuiting, 5. Cover or fence off neighbouring live components).



WARNING

Hazard due to heavy loads

The large weight of the motor must be taken into account during any transportation or installation work.

Incorrect handling may cause the motor to fall or swing without control and therefore cause severe, and possibly fatal injuries due to impact, crushing and other physical injuries. In addition, severe damage to the motor and its surroundings are possible.

Therefore:

- Do not stand under suspended loads
- Only use the attachment points provided
- Check that lifting equipment and lashings have and adequate load capacity and are undamaged
- Avoid hectic movements
- Use personal protective equipment



WARNING

Injury due to movement

Under certain conditions (e.g. switching on the power supply, releasing a holding brake) the motor may start to move. The machinery which it drives (press / chain hoist / roller / fan etc.) may then make an unexpected movement. This may cause various injuries, including to third parties.

Before switching on, secure the danger area by warning and removing all persons from the danger area.



WARNING

Hazard due to loose parts

Care must be taken that there are no loose parts on the motor. Otherwise, these may cause injury during transportation and installation work, or when the motor in in operation.

Loose carrying or lifting eyes may cause the motor to fall during transportation.

Parallel keys on the motor shaft may be thrown out when the motor shaft rotates.

Fasten or remove loose parts and carrying or lifting eyes; secure or remove free parallel shaft keys on the motor shaft(s).



A

CAUTION

Danger of burns

The surface of the motor may heat up to temperatures in excess of 70°C.

Touching the motor may cause local burns to the affected parts of the body (hands, fingers, etc.).

To prevent such injuries, allow sufficient time for cooling down before starting work - the surface temperature should be checked with suitable measuring equipment. In addition, keep sufficient distance from adjacent components during installation, or install protection against contact.

1.2 Field of use

Use of the motors:

The motors may only be used for their intended purpose (to drive machinery).

The motors are constructed with at least protection class IP55 (for the protection class: see rating plate). They may be installed in dusty or damp environments.

In principle the conditions of use and the ambient conditions determine the necessary protection class and any other additional measures. For outdoor installation and vertical versions, e.g. V1 or V5 with the shaft pointing downwards, Getriebebau NORD recommends the use of the double fan cover option [RDD].

Motors must be protected against intensive sunlight, e.g. by the use of a protective cover. The insulation is tropicalised.

Installation altitude:

≤ 1000 m

Ambient temperature:

-20°C...+40°C

For standard motors an extended ambient temperature range from -20°C...+60°C is permissible.. In this case, the rated power must be reduced to 82% of the value stated in the catalogue. If the maximum ambient temperature is between +40°C and +60°C, the power output should be inversely linearly interpolated between 100% and 82%.

The motor connection cables and the cable glands must be suitable for temperatures ≥ 90°C.

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1.3 Correct handling of electric motors

All work must only be carried out with the power to the system switched off.

1.3.1 Transport, storage



Danger of falling

Incorrect handling during transport may cause the motor to fall or swing without control and therefore cause severe, and possibly fatal injuries due to impact, crushing and other physical injuries. In addition, severe damage to the motor and its surroundings are possible.

Therefore:

- Use all available carrying eyes on the motor during transport
- Do not attach any additional loads The lifting eyes are only designed for the weight of the motor
- Only use the intended carrying eyes or bolts for transporting attached machinery (e.g. gear unit attachments)
- Sets of machinery must not be lifted by suspension from the individual machines.

To prevent damage to the motor, the motor must always be used with suitable lifting equipment. The roller bearings should be replaced if the time from delivery to commissioning of the motor exceeds 4 years in good conditions (storage in dry, dust and vibration-free areas). This time is greatly reduced in case of unfavourable conditions. If necessary, unprotected machined surfaces (flange surfaces, shaft ends) must be treated with corrosion inhibitors. If necessary, the insulating resistance of the windings must be checked (1.3.8 "Checking the insulation resistance").

Changes in comparison with normal operation (higher current consumption, higher temperatures or vibrations, unusual noises or smells, triggering of monitoring devices, etc.) are indications that the function is impaired. To prevent injury and damage, the responsible maintenance personnel must be informed of these changes.

In case of doubt, switch off the motor as soon as the state of the plant permits.



1.3.2 Installation

- · After installation, screwed-on lifting lugs must be tightened or removed.
- Smooth running: Precise alignment of the clutch and a well-balanced drive element (clutch, pulleys, fan, etc.) are prerequisites for smooth vibration-free running.
- Complete balancing of the motor and the drive elements may be necessary.
- The top section of the terminal box and the position of the terminal box can be rotated by 4 x 90 degrees.
- Even if not required, on IEC B14 motors **all four** fixing screws, must be screwed into the flanged bearing plate! The fixing screw threads must be inserted with a sealant, e.g. Loctite 242.



Electric shock

The **maximum** depth for screwing into the type plate is 2 x d. There is a danger that the motor windings may be damaged if longer screws are used. This creates a danger of potential transfer to the housing and danger of electric shock if touched.

- The motor must be inspected for damage before installation and commissioning. A damaged motor must not be commissioned.
- Rotating shaft ends and unused shaft ends must be protected against contact. Unused parallel shaft keys must be secured against being thrown out.
- The motor must be suitable for the installation location. (requirements prescribed by standards, ambient conditions, installation altitude)
- Motor surfaces may become very hot during operation. Suitable protective measures must be taken if there is a danger of contact or a hazard to the vicinity of the installation.

1.3.3 Balancing, drive elements

The fitting and removal of drive elements (clutch, pulley, gear wheel,...) must be performed with suitable equipment. As standard the rotors are balanced with half key balancing. The appropriate form of balancing must be observed if drive elements are installed on the motor shaft. Drive elements must be balanced according to ISO 1940.

The generally required measures for protection against touching the drive elements must be observed. If a motor is started without a drive element, the parallel key must be secured against being thrown out. This also applies for any second shaft end. Alternatively, the parallel shaft key must be removed.

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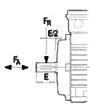


1.3.4 Alignment

In particular with direct coupling, the motor shafts and the driven machine must be axially and radially aligned to each other. Incorrect alignment may result in damage to the bearings, excessive vibration and breakage of the shaft.

1.3.5 Output shafts

The maximum permissible axial (F_A) and radial forces (F_R) for the A side end of the motor shaft can be obtained from the table below. Getriebebau NORD should be consulted if the radial force (F_R) is applied at a distance which is greater than the length E/2.



Туре	F _R [N]	F _A [N]
63	530	480
71	530	480
80	860	760
90	910	810
100	1300	1100
112	1950	1640
132	2790	2360
160	3500	3000
180 .X	3500	3000
180	5500	4000
200 .X	5500	4000
225	8000	5000

 $\underline{\textbf{No}}$ axial (FA) and radial forces (FR) are permissible for the B side shaft end.

NOTICE! Attachments must not cause rubbing (danger of excessive temperatures and sparking) or impair the necessary flow of cooling air.



1.3.6 Electrical Connection

The connection cables must be passed through the cable glands in the terminal box. The terminal box must be sealed against dust and water. The mains voltage and frequency must conform to the data on the rating plate. ±5% voltage or ±2% frequency deviations are permissible without reduction of the power. The connection and configuration of the jumpers must be made according to the circuit diagram in the terminal box. Please refer to the following table for the labelling of the auxiliary terminals

	Auxiliary terminal designation				
Additional equipment	Labelling of auxiliary terminals New: EN 60034-8	Comments			
Thermistor	TP1 – TP2 1TP1 – 1TP2 2TP1 – 2TP2 3TP1 – 3TP2 4TP1 – 4TP2	Switch-off Warning Winding 1 Switch-off Winding 1 Warning Winding 2 Switch-off Winding 2			
Option: TF	5TP1 – 5TP2	Brake			
Bi-metal temperature sensor Normally closed Option: TW	1TB1 - 1TB2 2TB1 - 2TB2 3TB1 - 3TB2 4TB1 - 4TB2	Warning Winding 1 Switch-off Winding 1 Warning Winding 2 Switch-off Winding 2			
Bi-metal temperature sensor, normally open	1TM1 - 1TM2 2TM1 - 2TM2 3TM1 - 3TM2 4TM1 - 4TM2	Warning Winding 1 Switch-off Winding 1 Warning Winding 2 Switch-off Winding 2			
PT100	1R1 – 1R2 2R1 – 2R2 3R1 – 3R2	Winding 1 (Phase U) Winding 1 (Phase V) Winding 1 (Phase W)			
KTY Silicon temperature sensor	(+) 4R1 – 4R2 (-) (+) 5R1 – 5R2 (-)	Winding 1 Winding 2			
Heating band Option: SH	1HE1 – 1HE2 2HE1 – 2HE2				
Capacitor Motor version: EAR/EHB/EST	1CA1 – 1CA2 2CA1 – 2CA2 3CA1 – 3CA2 4CA1 – 4CA2	with operating capacitor 1 with operating capacitor 2 with starting capacitor 1 with starting capacitor 2			
Direct current brake Option: BRE	BD1 – BD2				
Option: DBR	Brake 1: BD1-BD2 Brake 2: BD3-BD4				



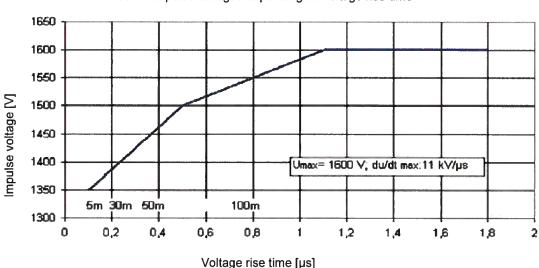
1.3.7 Operation with frequency inverter

Type SK 63 ./. – SK 225 ./. three phase asynchronous motors are qualified for operation with link circuit inverters according to DIN EN 60034-18-41 (2014).

Please also observe the operating instructions for the frequency inverter which is used.

The insulation system used by NORD consists of suitable varnished copper wire, phase insulation, homogeneous impregnation and groove lining as insulation against earth, and in the standard version is designed for the increased requirements for link circuit inverters.

The maximum permissible FI input voltage is 500 V +10%. Link circuit voltages in excess of 750 V DC are not permissible. When the motor is warm due to operation, the peak voltages due to the system, the inverter, the cable or the motor must not exceed the following values.



Permissible impulse voltages depending on voltage rise-time

If the values are outside of the permissible range, du/dt or sine wave filters may be used (not the additional voltage drop).

The cable lengths shown in the diagram are for guidance only and may deviate according to the specific conditions.

For additional information for operation with a frequency inverter, especially with regard to information about the maximum speed, thermal design and possible torques, please refer to the current NORD motor catalogue M7000.



1.3.8 Checking the insulation resistance

Prior to initial commissioning of the motor after a long period of storage or standstill (approx. 6 months) the insulation resistance of the windings must be checked. During and immediately after the measurements, the terminals have voltages which can be dangerous, and must not be touched.

Insulation resistance

The insulation resistance of new, cleaned, repaired windings against the housing and against each other is > 200 $M\Omega$.

Measurement

The insulation of the windings against the housing for operation voltages up to 400 V must be measured with 500 V DC. For operating voltages up to 725 V the measurement must be made with 1000 V DC. The temperature of the windings should be 25° C \pm 15° C.

Testing

If the minimum insulation resistance of the winding against earth is less than 50 M Ω , this may be due to moisture. The windings must then be dried.

The insulation resistance may reduce after long periods of operation. As long as the measured value does not fall below the calculated value for the critical insulation resistance of < 50 M Ω , operation of the motor may continue. If the value is less than this, the cause must be established and if necessary the windings or parts of the windings must be repaired, cleaned or dried.

1.3.9 Commissioning

1 Information

Electromagnetic compatibility

NORD motors comply with the EU-Directive 2014/30/EU. Assembly or installation work must not cause impermissible interference. Immunity from interference must still exist.

Production of interference: In cases of large differences of torque (e.g. when driving a piston compressor) a non-sine wave motor current is induced, whose harmonics can cause an impermissible effect on the mains and therefore impermissible production of interference.

With supply by frequency inverters, various strengths of interference are produced according to the design of the frequency inverter (type, interference suppression, manufacturer). The EMC information of the inverter manufacturer must be observed. If a shielded motor supply cable is recommended, the shielding is most effective if a large area is electrically connected to the metal terminal box of the motor (with metal EMC cable gland). With motors with integrated sensors (e.g. thermistors) interference voltages due to the inverter may be produced in the sensor cables.

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Interference immunity: For motors with integrated sensors (e.g. thermistors) the operator must ensure adequate immunity to interference by the selection of a suitable sensor cable (possibly with screening, with connection as for the motor supply cable) and evaluation device. The information and instructions in the operating instructions for the inverter and all other instructions must be observed before commissioning. After installation of the motor, it must be checked for correct functioning. In the case of brake motors, the correct function of the brake must also be checked.

1.3.10 Disposal

NOTICE

Environmental damage

Incorrect disposal of the product may cause damage to the environment.

- · Ensure correct disposal
- · Comply with current local regulations

Content: aluminium, iron, electronic components, copper

Please observe the additional documentation for the attachments



2 Maintenance and servicing

DANGER!

Electric shock

The motor is operated with a dangerous voltage. Touching certain conducting components (connection terminals and supply cables) will cause electric shock with possibly fatal consequences.

Even when the motor is at a standstill (e.g. due to the electronic block of a connected frequency inverter or a jammed drive unit) the connection terminals and supply cables may carry a dangerous voltage. A motor standstill is not identical to electrical isolation from the mains.

Even if the drive unit has been disconnected from the mains, a connected motor may rotate and possibly generate a dangerous voltage.

Installation and work must only be carried out when the motor is at a standstill and is **disconnected** (all phases disconnected from the mains).

Follow the **5 Safety Rules** (1. Switch off the power, 2. Secure against switching on, 3. Check for no voltage, 4. Earthing and short circuiting, 5. Cover or fence off neighbouring live components).



WARNING

Injury due to movement

Under certain conditions (e.g. switching on the power supply, releasing a holding brake) the motor may start to move. The machinery which it drives (press / chain hoist / roller / fan etc.) may then make an unexpected movement. This may cause various injuries, including to third parties.

Before switching on, secure the danger area by warning and removing all persons from the danger area.

2.1 Safety measures

Before starting any work on the motor or the device, but especially before opening the covers of active components, the motor must be isolated according to regulations. In addition to the main power circuits, any additional or auxiliary circuits must be taken into account.

The usual "5 Safety Rules" e.g. according to DIN VDE 0105 are:

- Disconnect
- Secure to prevent reactivation
- · Check for no voltage on all poles
- · Earth and short circuit
- · Cover or cordon off adjacent live components

These measures may only be removed when the maintenance work is complete.



Motors must be properly inspected at regular intervals; current national standards and regulations must be complied with. In particular, special attention must be paid to any mechanical damage, free path of the cooling air, abnormal noises and correct electrical connection.

Only original parts may be used as spare parts with the exception of standardised, commercially available and equivalent parts.

Swapping parts between motors of the same type is not permissible.

1 Information

Condensation outlets

If the motors are designed with closed condensation outlets, these must be opened occasionally in order to allow any accumulated condensation to drain off. Condensation outlets must always be located at the lowest point of the motor. During installation of the motor care must be taken that the condensation outlets point downwards and are closed. Open condensation outlets cause a reduction of the protection class.

2.2 Bearing replacement intervals

Under normal operating conditions, with horizontal installation of the motor, depending on the coolant temperature and the motor speed, the bearing replacement interval [h] for IEC motors is:

	25°C	40°C	60°C
up to 1,800 rpm	approx. 40,000 h	approx. 20,000 h	approx. 8,000 h
up to 3,600 rpm	approx. 20,000 h	approx. 10,000 h	approx. 4,000 h

Under special operating conditions, e.g. vertical motor installation, large stresses due to vibration and shock, or operation with frequent reversing, the operating hours stated above are significantly reduced.



2.3 Maintenance intervals

The motor must be checked weekly, or every 100 operating hours for unusual running noise and/or vibrations.

Please check the roller bearings at an interval of at least 10,000 h and replace them as required. In addition, the electric connections, cables and wires as well as the fan are firmly fastened and free from damage. Furthermore, the function of the insulation system must be checked.

Replace the shaft sealing rings every 10,000 hours.

The surface of the motor must not have any dirt deposits which could impair cooling.

A general overhaul of the motor must be carried out every 5 years.

2.4 General overhaul

For this the motor must be dismantled. The following work must be carried out:

- · All components of the motor must be cleaned
- · All components of the motor must be examined for damage
- · All damaged components must be replaced
- · All roller bearings must be replaced
- · All seals and shaft sealing rings must be replaced

The general overhaul must be carried out by qualified personnel in a specialist workshop with appropriate equipment. We urgently recommend that the general overhaul is carried out by NORD Service.

If the drive unit is subjected to special operating conditions, the intervals stated above may be considerably reduced.



3 ATEX Explosion hazard areas

3.1 Motors with increased ignition protection, type Ex e



DANGER!

Explosion hazard



All work must only be carried out with the machine at a standstill and the **power to the** system switched off.

Higher temperatures than the maximum permitted surface temperature of the housing may be present inside the motor. The motor must therefore never be opened in an explosive atmosphere!

Failure to comply with this may result in the ignition of an explosive atmosphere.



WARNING

Explosion hazard



Excessively heavy dust deposits must be avoided, as these impair the cooling of the device!

Impairment or obstruction of the flow of cooling air, for example due to partial or large area coverage of the fan cover or the entry of foreign bodies fall into the fan must be avoided in order to ensure adequate cooling.

Only cable glands and reducers which are approved for use in explosion hazard areas may be used.

All cable glands which are not used must be closed with blind screw plugs which are approved for potentially explosive areas.

Only the original seals may be used.

Failure to comply increases the risk of ignition of an explosive atmosphere.

The following supplementary or special information applies for these motors.

The motors are suitable for use in Zone 1 and correspond to Device Group II, Category 2G and may be used at an ambient temperature from -20°C to +40°C

Type supplement: 2G E.g.: 80 L/4 2G TF
Labelling: II 2G Ex e IIC T3 Gb

If the motor is attached to a gear unit, the EX labelling of the gear unit must also be observed!

Explosive gas mixtures or dust concentrations may cause severe or fatal injuries in combination with hot, electrically live and moving components of electrical machines.



The increased danger in explosion hazard areas requires especially strict observance of the general safety and commissioning information. The person responsible must be qualified according to the national and local regulations.

Explosion protected electrical machines with ignition protection class Ex e correspond to the standard series EN 60034 (VDE 0530), as well as EN 60079-0:2014 and EN 60079-7:2007. The degree of the explosion hazard determines the zone categorisation. DIN EN 60079, Part 10 provides information with regard to this. The operator is responsible for the categorisation of the zones. The use of motors which are not certified for explosion hazard areas in explosion hazard areas is prohibited.

3.1.1 Cable gland

The cable glands must be approved for explosion hazard areas. Unused openings must be closed with approved blind plugs. When connecting the installation cables, the connections to the motor terminals and to the earth lead must use U shaped bent cables placed under the relevant terminals so that the clamping bars and the terminal bolts are equally loaded and are not deformed in any way. Alternatively, the connections may be made with a cable lug. If increased thermal requirements are made for the cables, these must be obtained from the information plate on the rotor.

For Sizes 63 to 132 an insulated cable lug must be used, if this is used to connect the earth lead in the terminal box.

The nuts of the terminal board bolts must be tightened according to the following table.

	Tightening torques for terminal board connections						
623	Thread diameter	M4	M5	M6	M8		
	Tightening torque (Nm)	1.2	2.0	3.0	6.0		

Use of aluminium connecting wires is not permitted.

3.1.2 Cable connections

All motors with ignition protection class Ex e are delivered with a certified cable gland.

If the supplied cable glands are used, cables with a circular cross-section must be used. The clamping nuts of the cable gland must be tightened to the torque specified in the following table.

	Clamping nut tightening torques						
(00)	Cable gland	M20x1.5	M25x1.5	M32x1.5	M40x1.5		
	Tightening torque (Nm)	5.0	5.0	10.0	13.5		

Use of reduction adapters according to Directive 94/9 EEC or 2014/34/EU and/or cable glands with ignition protection class Ex e is permissible. For this, a minimum certified temperature of 80°C is necessary.

When connecting, care must be taken that the permissible air gaps of at least 10 mm and the permissible leakage tracks of at least12 mm between the electrically live components and components with the same potential as the housing, or between live components are maintained.

Check that the terminal nuts and the screw for the earth lead are tight before closing the terminal box. The terminal box seals and the seals of the cable glands must be correctly seated and must not be damaged.



3.1.3 Terminal box cover seals

The terminal box cover gasket is captively mounted on the terminal box cover. Please only use an original seal when replacing the seal.

If the terminal box is opened during installation, maintenance, repair, troubleshooting or overhaul, the terminal box cover must be re-fitted after the work is complete. There must be no dirt on the surface of the seal or the sealing surface of the terminal box frame.

The screws for the terminal box cover must be tightened with a torque according to the list below.



Tightening torques for terminal box cover screws							
Thread diameter	M4	M5	M6	M8			
Tightening torque (Nm)	0.8 - 1.2	1.2 - 1.8	1.5 - 2.5	3.0 - 5.0			

3.1.4 Motor position – special features for IM V3, IM V6

If the end of the shaft faces upwards, e.g. version IMV3, IMV6, a cover must be provided by the operator / installer, which prevents foreign bodies from falling into the fan cover of the motor (see DIN EN 60079-0). This must not obstruct the fan from cooling the motor. If the end of the shaft faces downwards (AS), e.g. versions IMV1, IMV5, the motors are normally provided with a protective cover on the fan cover. A hand wheel on the second end of the shaft is not permitted.



3.1.5 Further operating conditions

The motors are designed for continuous operation and normal, non recurring starting, in which no significant starting heat occurs.

Range A in EN 60034-1 (VDE 0530 Part 1) - Voltage \pm 5%, Frequency \pm 2%, curve form, mains symmetry - must be complied with so that the development of heat remains within the permissible limits. Any major deviations from the rated values can cause an impermissible increase in the development of heat in the motor.

The motor temperature class stated on the type plate must at least conform to the temperature class of any combustible gas that may occur.

3.1.6 Protective devices

Each machine must be protected against excess heating by means of a current-dependent delayed protection switch whose function is tested by a designated facility, with phase failure protection according to VDE 0660 or an equivalent device. Protective devices must be adjusted to the rated current. For windings with a delta circuit, the triggers are connected in series with the windings and adjusted to 0.58x the rated current. If this circuit is not possible, additional protective measures are necessary (e.g. thermal protection of the machine).

In case of a jammed rotor, the protective device must switch of within the specified t_E -time for the relevant temperature class.

Electrical machines with heavy starting (start-up time > $1.7 \times t_E$ -time) must be protected by means of starting monitoring according to the details in the EEC type test certificate.

Thermal protection of the machine by means of direct temperature monitoring of the windings with a thermistor temperature sensor is permissible, if this is certified and stated on the rating plate.

Do not apply voltages greater than 30 V to the thermistor temperature sensor.

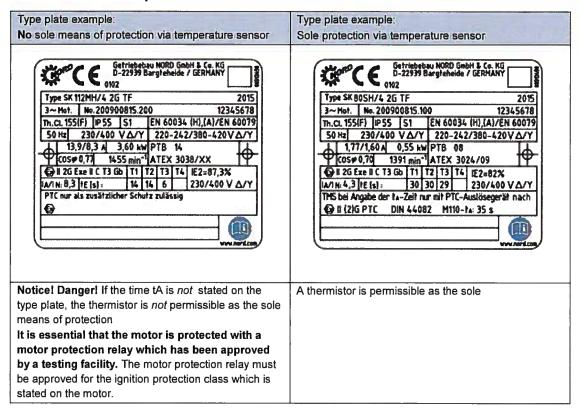
If the only protection is a PTC thermistor temperature sensor, a performance-tested, PTC tripping device certified by a designated body must be used. The PTC triggering device must be equipped with the following protection class label:



II (2) G



Information for motor protection



3.1.7 Operation with frequency inverter

Operation with a frequency inverter must be explicitly certified. The separate manufacturer's information must be observed. The EMC Directive must be complied with.



3.1.8 Repairs

Repairs must be carried out by Getriebebau NORD or by an officially recognised expert. The work must be indicated with an additional repair plate. With the exception of standard, commercially available and equivalent components, only original spare parts (see spare parts list) may be used. The particularly applies for seals and connecting components.

For motors with closed condensation outlets, the threads of the closing screws must be coated with Loctite 242 or Loxeal 82-21 after the condensation has been drained. The closing screws must be reinserted immediately. The electrical connections must be checked at regular intervals.

Check that the connection terminals, and the electrical bonding terminal are firmly fastened. Check that the cable gland and the terminal box gasket are in good condition

All work on electrical machinery must be performed when the machine is at a standstill and with all poles disconnected from the mains.

The motor must be removed for any measurement of the insulation resistance. The measurement must not be performed in the explosion hazard area. As soon as measurement has been completed, discharge the connecting terminals again immediately by shorting them in order to prevent any spark discharges occurring in the explosive area.



DANGER!

Explosion hazard



Insulation measurements may cause sparks and therefore ignition of an explosive atmosphere.

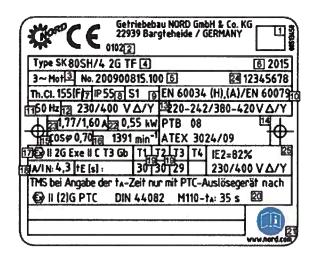
- · Only perform insulation measurements outside of an explosive atmosphere.
- Discharge the connection terminals by short circuiting them after the measurement and before returning to an explosive atmosphere.

3.1.9 Painting

Motors are provided with suitable painting ex-works. Subsequent painting may only be carried out after consultation with Getriebebau NORD or a workshop which is approved for the repair of explosion protected motors. Compliance with the valid standards and regulations is mandatory.



3.1.10 Type plate for NORD Ex e motors according to EN 600079



_					
11	Data matrix code				
2	Identification number of designated body				
3	Number of phases				
4	Type designation				
5	Order number / motor number				
6	Year of manufacture:				
7	Thermal class of the insulation system				
8	IP protection class				
9	Operating mode				
10	Standard specifications				
11	Nominal frequency				
12	Nominal voltage				
13	Permissible voltage range				
14	EEC type test certificate number				
15	Power factor				
16	Speed				
17	Explosion protection marking				
18	Starting current / nominal current				
19	tE times				
20	Note: TMS with specification of tA time only with PTC triggering device in accordance with (5) If (2)G PTC DIN 44082				
	(£) II (2)G PTC DIN 44082				
21	Notice! Pay attention to operating instructions B1091				
22	Rated power (mechanical power delivered to shaft)				
23	Nominal current				
24	Individual serial number				
25	Efficiency				

Before commissioning, the type plate must be compared with the requirements of the aforementioned declaration, which result from the local regulations and operating conditions.

Explanation of standard specification in rating plate

EN 60034	(H),	(A)/	EN 60079	
				Used range of standards for explosion protection
				(Please pay attention to conformity declaration.)
				Voltage range A in accordance with EN 60034-1
				Half key balancing in accordance with EN 60034-14
				Product standard

3.1.11 Applied standards

EN Standard	Issue	IEC Standard	Issue
EN 60034-7	2001-12	IEC 60034-7	2001-02
EN 60034-6	1996-08	IEC 60034-6	1991-10
EN 60079-0	2014-06	IEC 60079-0	2011, modified; cor.:2012; cor.:2013
EN 60079-7	2007-08	IEC 60079-7	2006
EN 60529	2014-09	IEC 60529	1989 +A1:1999 + A2:2013



3.2 Motors with ignition protection class Non Sparking Ex n



DANGER!

Explosion hazard



All work must only be carried out with the machine at a standstill and the **power to the** system switched off.

Higher temperatures than the maximum permitted surface temperature of the housing may be present inside the motor. The motor must therefore never be opened in an explosive atmosphere!

Failure to comply with this may result in the ignition of an explosive atmosphere.



WARNING

Explosion hazard



Excessively heavy dust deposits must be avoided, as these impair the cooling of the device!

Impairment or obstruction of the flow of cooling air, for example due to partial or large area coverage of the fan cover or the entry of foreign bodies fall into the fan must be avoided in order to ensure adequate cooling.

Only cable glands and reducers which are approved for use in explosion hazard areas may be used.

All cable glands which are not used must be closed with blind screw plugs which are approved for potentially explosive areas.

Only the original seals may be used.

Failure to comply increases the risk of ignition of an explosive atmosphere.

The following supplementary or special information applies for these motors.

The motors are suitable for use in Zone 2 and correspond to Device Group II, Category 3G and may be used at an ambient temperature from -20°C to +40°C.

Type supplement:

Labelling:

3G

E.g.:

80 L/4 3G TF

CE

II 3G Ex nA IIC T3

r

With indication of the temperature class

If the motor is attached to a gear unit, the EX labelling of the gear unit must also be observed!

Explosive gas mixtures or dust concentrations may cause severe or fatal injuries in combination with hot, electrically live and moving components of electrical machines.

The increased danger in explosion hazard areas requires especially strict observance of the general safety and commissioning information. The persons responsible must be qualified according to the national and local regulations.

Explosion protected electrical machines with ignition protection class Ex n correspond to the standard series EN 60034 (VDE 0530), as well as EN 60079-0:2014 and EN 60079-15:2010. The degree of the explosion hazard determines the zone categorisation. DIN EN 60079, Part 10 provides information with regard to this. The operator is responsible for the categorisation of the zones. The use of motors which are not certified for explosion hazard areas in explosion hazard areas is prohibited.



3.2.1 Cable gland

The cable glands must be approved for explosion hazard areas. Unused openings must be closed with approved blind plugs. When connecting the installation cables, the connections to the motor terminals and to the earth lead must use U shaped bent cables placed under the relevant terminals so that the clamping bars and the terminal bolts are equally loaded and are not deformed in any way. Alternatively, the connections may be made with a cable lug. If increased thermal requirements are made for the cables, these must be obtained from the information plate on the rotor.

For Sizes 63 to 132 an insulated cable lug must be used, if this is used to connect the earth lead in the terminal box.

The nuts of the terminal board bolts must be tightened according to the following table.

	Tightening torques for terminal board connections								
623	Thread diameter	M4	M5	M6	M8				
	Tightening torque (Nm)	1.2	2.0	3.0	6.0				

Use of aluminium connecting wires is not permitted.

3.2.2 Cable connections

If the supplied cable glands are used, cables with a circular cross-section must be used. The clamping nuts of the cable gland must be tightened to the torque specified in the following table.

	Clamping nut tightening torques								
(DOD)	Cable gland	M20x1.5	M25x1.5	M32x1.5	M40x1.5				
	Tightening torque (Nm)	5.0	5.0	10.0	13.5				

Use of reduction adapters according to Directive 94/9 EEC or 2014/34/EU and/or cable glands approved according to Directive 94/9 EEC with ignition protection class Ex n is permissible. For this, a minimum certified temperature of 80°C is necessary.

When connecting, care must be taken that the permissible air gaps of at least 10 mm and the permissible leakage tracks of at least12 mm between the electrically live components and components with the same potential as the housing, or between live components are maintained.

Check that the terminal nuts and the screw for the earth lead are tight before closing the terminal box. The terminal box seals and the seals of the cable glands must be correctly seated and must not be damaged.

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3.2.3 Terminal box cover seals

The terminal box cover gasket is captively mounted on the terminal box cover. Please only use an original seal when replacing the seal.

If the terminal box is opened during installation, maintenance, repair, troubleshooting or overhaul, the terminal box cover must be re-fitted after the work is complete. There must be no dirt on the surface of the seal or the sealing surface of the terminal box frame.

The screws for the terminal box cover must be tightened with a torque according to the list below.



Tightening torques for terminal box cover screws						
Thread diameter	M4	M5	M6	M8		
Tightening torque (Nm)	0.8 - 1.2	1.2 - 1.8	1.5 - 2.5	3.0 - 5.0		

3.2.4 Motor position - special features for IM V3, IM V6

If the end of the shaft faces upwards, e.g. version IMV3, IMV6, a cover must be provided by the operator / installer, which prevents foreign bodies from falling into the fan cover of the motor (see DIN EN 60079-0). This must not obstruct the fan from cooling the motor. If the end of the shaft faces downwards (AS), e.g. versions IMV1, IMV5, the motors are normally provided with a protective cover on the fan cover. A hand wheel on the second end of the shaft is not permitted.



3.2.5 Further operating conditions

The motors are designed for continuous operation and normal, non recurring starting, in which no significant starting heat occurs.

Range A in EN 60034-1 (VDE 0530 Part 1) - Voltage ± 5%, Frequency ± 2%, curve form, mains symmetry - must be complied with so that the development of heat remains within the permissible limits. Any major deviations from the rated values can cause an impermissible increase in the development of heat in the motor.

The motor temperature class stated on the type plate must at least conform to the temperature class of any combustible gas that may occur.

3.2.6 Protective devices

Protective devices must be adjusted to the rated current. For windings with a delta circuit, the triggers are connected in series with the windings and adjusted to 0.58x the rated current.

Alternatively, the motors can be protected with thermistor temperature sensors. Protection with thermistor temperature sensors is mandatory for inverter operation.

Do not apply voltages greater than 30 V to the thermistor temperature sensor.

We recommend the use of a functionally tested, certified PTC trigger device for protection with a thermistor temperature sensor.

The following standards must be observed for the installation of electrical systems in explosion hazard areas in Germany: DIN EN 60079-14 (VDE 0165-1), the Technical Rules for Operating Safety (TRBS), the Operating Safety Regulations (BetrSichV), the Hazardous Substances Regulation (GefStoffV) as well as the Explosion Protection Regulations (Ex-RL). Other regulations must be observed if applicable. The applicable national regulation must be observed outside of Germany.

3.2.7 Operation with frequency inverter

The design of the insulation of NORD ATEX motors with ignition protection class Ex nA is suitable for operation with a frequency inverter. Due to the variable speed range, temperature monitoring by means of thermistors or temperature sensors is necessary. For safe planning and use, the planning guide for the operating and installation instructions B1091-1 must be observed. The planning guide provides information regarding the necessary conditions for inverter operation and the approved speed ranges. Option Z (additional high inertia cast iron fan) is not permitted for inverter operation.

If the frequency inverter is not approved for operation within the explosive atmosphere, the frequency inverter must be installed outside of the explosive atmosphere.



3.2.8 Repairs

Repairs must be carried out by Getriebebau NORD or by an officially recognised expert. The work must be indicated with an additional repair plate. With the exception of standard, commercially available and equivalent components, only original spare parts (see spare parts list) may be used. The particularly applies for seals and connecting components.

For motors with closed condensation outlets, the threads of the closing screws must be coated with Loctite 242 or Loxeal 82-21 after the condensation has been drained. The closing screws must be reinserted immediately. The electrical connections must be checked at regular intervals.

Check that the connection terminals, and the electrical bonding terminal are firmly fastened. Check that the cable gland and the terminal box gasket are in good condition

All work on electrical machinery must be performed when the machine is at a standstill and with all poles disconnected from the mains.

The motor must be removed for any measurement of the insulation resistance. The measurement must not be performed in the explosion hazard area. As soon as measurement has been completed, discharge the connecting terminals again immediately by shorting them in order to prevent any spark discharges occurring in the explosive area.



DANGER!

Explosion hazard



Insulation measurements may cause sparks and therefore ignition of an explosive atmosphere.

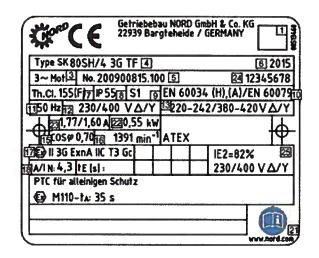
- · Only perform insulation measurements outside of an explosive atmosphere.
- Discharge the connection terminals by short circuiting them after the measurement and before returning to an explosive atmosphere.

3.2.9 Painting

Motors are provided with suitable painting ex-works. Subsequent painting may only be carried out after consultation with Getriebebau NORD or a workshop which is approved for the repair of explosion protected motors. Compliance with the valid standards and regulations is mandatory.



3.2.10 Type plate for NORD Ex n motors according to EN 600079



1	Data matrix code
3	Number of phases
4	Type designation
5	Order number / motor number
6	Year of manufacture:
7.	Thermal class of the insulation system
8	IP protection class
9	Operating mode
10	Standard specifications
11	Nominal frequency
12	Nominal voltage
13	Permissible voltage range
15	Power factor
16	Speed
17	Explosion protection marking
18	Starting current / nominal current
21	Notice! Pay attention to operating instructions B1091
22	Rated power (mechanical power delivered to shaft)
23	Nominal current
24	Individual serial number
25	Efficiency

Before commissioning, the type plate must be compared with the requirements of the aforementioned declaration, which result from the local regulations and operating conditions.

Explanation of standard specification in rating plate

EN 60034	(H),	(A)/	EN 60079	
				Used range of standards for explosion protection
			1	(Please pay attention to conformity declaration.)
				Voltage range A in accordance with EN 60034-1
			_	Half key balancing in accordance with EN 60034-14
				Product standard

3.2.11 Applied standards

EN Standard	Issue	IEC Standard	Issue
EN 60034-7	2001-12	IEC 60034-7	2001-02
EN 60034-6	1996-08	IEC 60034-6	1991-10
EN 60079-0	2014-06	IEC 60079-0	2011, modified; cor.:2012; cor.:2013
EN 60079-15	2010	IEC 60079-15	2010
EN 60529	2014-09	IEC 60529	1989 +A1:1999 + A2:2013



3.3 Motors for use in Zone 21 and Zone 22 according to EN 60079-0 and IEC 60079



DANGER!

Explosion hazard



All work must only be carried out with the machine at a standstill and the power to the system switched off.

Higher temperatures than the maximum permitted surface temperature of the housing may be present inside the motor. The motor must therefore never be opened in an explosive atmosphere!

Failure to comply with this may result in the ignition of an explosive atmosphere.

A

WARNING

Explosion hazard



Excessively heavy dust deposits must be avoided, as these impair the cooling of the device!

Impairment or obstruction of the flow of cooling air, for example due to partial or large area coverage of the fan cover or the entry of foreign bodies fall into the fan must be avoided in order to ensure adequate cooling.

Only cable glands and reducers which are approved for use in explosion hazard areas may be used.

All cable glands which are not used must be closed with blind screw plugs which are approved for potentially explosive areas.

Only the original seals may be used.

Failure to comply increases the risk of ignition of an explosive atmosphere.

The following supplementary or special information applies for these motors.

Motors which comply with EN 60079 and IEC 60079 are suitable according to their labelling for use in Zone 21 or Zone 22 - non-conductive dust.

Type supplement:					
according to EN 60079	Zone 21	2D	e. g.:	80 L/4 2D TF	
	Zone 22	3D	e. g.:	80 L/4 3D TF	
according to IEC 60079	Zone 21	EPL Db	e. g.:	80 L/4 IDB TF	
	Zone 22	EPL Dc	e. g.:	80 L/4 IDC TF	
Labelling:			_		4)
according to IEC 60079 and 2014/34 EU (94/9 EC old)	CE	102	€ x >	II 2D Ex th IIIC T125°C Db	for category 2 (Zone 21) ¹⁾
	(€		$\langle E_{x} \rangle$	II 3D Ex to IIIB T125°C Dc	for category 3 (Zone 22 – non-conducting dust) ¹⁾
according to IEC 60079				EX th IIIC T125°C Db	for category 2 1)
				Ex tc IIIB T125°C Dc	for category 3 (Zone 22 – non-conducting dust) ¹⁾

The details of the surface temperature may deviate from 125 °C and may be obtained from the type plate.

If the motor is attached to a gear unit, the EX labelling of the gear unit must also be observed!



A

DANGER

Explosion hazard



The increased danger in areas with inflammable dust demands the strict observation of the general safety and commissioning information. Explosive concentrations of dust may cause explosions if ignited by hot or sparking objects. Such explosions may cause serious or fatal injuries to persons or severe material damage.

The persons responsible must be qualified according to the national and local regulations.

Impact test

Special condition:

According to 26.4.2 of EN 60079-0:2009 and IEC 60079-0:2007 motors with an X labelling for Category 2D and 3D are subjected to an impact test with 4J. If higher impacts on the motor are possible, it must be provided with additional mechanical protection.

3.3.1 Commissioning information / Field of application

If the motors are required for use with frequency inverters, this must be stated in the order. The supplementary operating instructions B1091-1 must be observed. The motors must be protected against overheating with suitable monitoring equipment! The thickness of dust deposits must not exceed 5 mm! The motors are designed for the voltage and frequency range B of EN 60034 Part 1.

Exception: Size 132MA/4 2D, 132MA/4 3D, 132LH/4 2D, 132LH/4 3D motors comply with the voltage and frequency range A.

Motors for use in Zone 21 and Zone 22, with labelling TF may be thermally monitored via the built-in PTC in combination with a suitable triggering device as the sole protection.

Electrical equipment for use in areas with inflammable dust comply with the standards DIN EN 60079-0, IEC 60079-0, EN 60079-31, IEC 60079-31, as well as DIN EN 60034 and IEC 60034.

The valid version of the standard can be obtained from the EC Declaration of Conformity or the IECEx CoC. The degree of the explosion hazard determines the zone categorisation. The operator / employer is responsible for the assignment of zones (in Europe: RL 1999/92/EC).

If the certification is supplemented with an "X" the special conditions in the EC prototype certification, the IECEX CoC and/or the relevant documentation must be observed. The use of standard motors which are not certified for explosion hazard areas in explosion hazard areas is prohibited.



3.3.2 Terminal box cover seals

The terminal box cover gasket is captively mounted on the terminal box cover. Please only use an original seal when replacing the seal.

If the terminal box is opened during installation, maintenance, repair, troubleshooting or overhaul, the terminal box cover must be re-fitted after the work is complete. There must be no dirt on the surface of the seal or the sealing surface of the terminal box frame.

The screws for the terminal box cover must be tightened with a torque according to the list below.



Tightening torques for terminal box cover screws						
Thread diameter	M4	M5	M6	M8		
Tightening torque (Nm)	0.8 - 1.2	1.2 - 1.8	1.5 - 2.5	3.0 – 5.0		

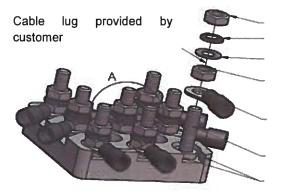
3.3.3 Electrical Connection

The electrical connections of the terminal board are protected against twisting. The voltage supply to the terminal board must be made by means of suitable ring terminals. The ring terminals are installed between the two brass washers below the lock washer. The nuts must be tightened with a torque according to the table below. The contact pressure is permanently maintained by means of the specified torque and the lock washer. In addition, twisting of the ring terminals of the voltage supply is prevented. The connection elements are corrosion-proof.



Tightening torques for terminal board connections						
Thread diameter	M4	M5	M6	M8		
Tightening torque (Nm)	0.8 - 1.2	1.8 - 2.5	2.7 - 4.0	5.5 - 8.0		

Exploded diagram of electrical connection



Brass nut Lock washer

Brass washer

Brass nut

Ring terminal

Brass thread with collar

Mechanical protection against twisting



3.3.4 Cable and wiring glands

For Zone 21, the cable glands must be approved for Ex areas (minimum protection class IP 66) and must be secured against accidental loosening. Unused apertures must be sealed with authorised plugs (minimum protection class IP 66).

For Zone 22, the cable glands which are implemented according to EN 60079-0 and IEC 60079-0 must as a minimum correspond to the protection type specified on the type plate. Unused openings must be closed with plugs, which as a minimum correspond to the protection class of the motor and the requirements of EN 60079-0 and IEC 60079-0. The cable glands and blank plugs must be suitable for a temperature of at least 80 °C.

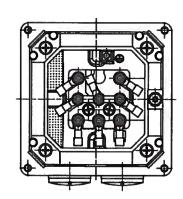
The motor must not be opened under hazardous atmospheres to connect the electrical cables or for any other work. The voltage must always be switched off and secured against being switched on again before opening the motor!

The motors are equipped with cable glands according to the following overview.

	Assignment of Cable Glands to Motor Size												
	Ca	ble glan	ds for st	andard m	otors				Cable	glands f	or brake	motors	
Туре	Numbe	Thread	Number	Thread	Number	Thread		Number	Thread	Number	Thread	Number	Thread
63	2	M20x1.5						4	M20x1.5	2	M12x1.5		
71	2	M20x1.5						4	M20x1.5	2	M12x1.5		
80	2	M25x1.5						4	M25x1.5	2	M12x1.5		
90	2	M25x1.5						4	M25x1.5	2	M12x1.5		
100	2	M32x1.5						4	M32x1.5	2	M12x1.5		-
112	2	M32x1.5					hulti.	4	M32x1.5	2	M12x1.5		
132	2	M32x1.5						4	M32x1.5	2	M12x1.5	2	M16x1.5
160/ 180/X	2	M40x1.5	2	M12x1.5	2	M16x1.5		2	M40x1.5	2	M12x1.5	2	M16x1.5
180/ 200/X	2	M40x1.5	2	M12x1.5	2	M16x1.5	-	2	M40x1.5	2	M12x1.5	2	M16x1.5
225	2	M50x1.5	2	M12x1.5	2	M16x1.5		2	M50x1.5	2	M12x1.5	2	M16x1.5
250 WP	2	M63x1.5	2	M12x1.5	2	M16x1.5		2	M63x1.5	2	M12x1.5	2	M16x1.5

If the motor is supplied with a certified cable gland, the clamping nuts of the cable gland must be tightened to the torque specified in the following table.

Cable gland



M63x1.5



		Clampin	g nut tight	ening torq	les	
(SED)	Cable gland	M20x1.5	M25x1.5	M32x1.5	M40x1.5	M50x1.5
	Tightening torque (Nm)	5.0	5.0	10.0	13.5	20.0

3.3.5 Permissible ambient temperature range

For all motors, the permissible ambient temperature range is -20 °C...+40 °C. For motors for operation in Zones 21 and 22, an extended ambient temperature range from -20 °C...+60 °C is permissible. In this case, the rated power must be reduced to 72% of the value stated in the catalogue.

If the maximum ambient temperature is between +40 °C and +60 °C, the power output should be inversely linearly interpolated between 100% and 72%. In this case thermal protection of the motor by means of a thermistor sensor is essential. The motor connection cables and the cable glands must be suitable for temperatures of at least 80 °C.

The extended ambient temperature range does not apply for optional conversions such as a brake and/or external fan. Contact the manufacturer in case of doubt with regard to permissibility!

3.3.6 Painting

Motors are provided with suitable painting ex-works. Subsequent painting may only be carried out after consultation with Getriebebau NORD or a workshop which is approved for the repair of explosion protected motors. Compliance with the valid standards and regulations is mandatory.

3.3.7 IEC-B14 motors

Please comply with the information in Section 1.3.2. Otherwise, explosion protection is not ensured.

3.3.8 Motor position – special features for IM V3, IM V6

If the end of the shaft faces upwards, e.g. version IMV3, IMV6, a cover must be provided by the operator / installer, which prevents foreign bodies from falling into the fan cover of the motor (see DIN EN 60079-0). This must not obstruct the fan from cooling the motor. If the end of the shaft faces downwards (AS), e.g. versions IMV1, IMV5, the motors are normally provided with a protective cover on the fan cover. A hand wheel on the second end of the shaft is not permitted.



3.3.9 Further operating conditions

Unless otherwise specified for operating modes and tolerances in the test certificate, the power rating plate or in IECEx CoC, electrical machinery is designed for continuous operation and normal infrequent start-ups where insignificant start-up heating occurs. The motors may only be used for the type of operation stated on the name plate.

The installation instructions must be strictly observed.

3.3.10 Structure and method of use

The motors are self-cooling. Shaft sealing rings are fitted both on the output side (DS) and on the ventilation side (VS). Motors for Zone 21 and Zone 22 have metal fans. Motors with brakes for Zone 22 (Category 3D, non-conducting dust) have a special plastic fan. The motors have protection class IP55, optionally protection class IP 66 (Zone 22 . non-conducting dust, EPL Dc) or IP 66 (Zone 21, EPL, Db). Under normal operating conditions, the surface temperature does not exceed the surface temperature stated on the name plate.

3.3.11 Minimum cross section of bonding conductors

Cross section of the phase conductor of the installation S [mm²]	Minimum cross section of the associated protective conductor S _P [mm ²]		
S ≤ 16	S		
16 < S ≤ 35	16		
S > 35	0.5 S		



3.3.12 Maintenance

The voltage must always be switched off and secured against being switched on again before opening the motor!

Notice! Higher temperatures than the maximum permitted surface temperature of the housing may be present inside the motor. The motor must therefore never be opened in hazardous dust atmospheres! The motors must be checked and tested regularly for functional safety! The applicable national standards and regulations must be complied with!

Impermissibly thick dust deposits > 5 mm must not be allowed to build up! If functional safety cannot be ensured, the motor may not be operated! When the ball bearings are replaced, the rotary shaft seals must also be replaced. FKM rotary shaft seals as specified by Getriebebau NORD must be used. Ensure that they are fitted correctly! The rotary shaft seals must be lubricated on the external rings and on the seal lips. If an explosion protected gear is flanged dust-tight to the motor, an NBR rotary shaft seal can be used on the drive side of the motor if the gear oil temperature does not exceed 85°C. Only original parts may be used as spare parts with the exception of standardised, commercially available and equivalent parts. This particularly applies to seals and connection components. Parts for terminal boxes or spare parts for external grounding must be ordered as per the spare parts list in the operating instructions.

The functionality of seals, rotary shaft seals and cable glands must be regularly checked!

Maintaining dust protection for the motors is of paramount importance for explosion protection. Maintenance must be carried out by qualified personnel in a specialist workshop with appropriate equipment. We urgently recommend that the general overhaul is carried out by NORD Service.

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3.4 Options for motors for use in Zone 21 and Zone 22



DANGER!

Explosion hazard



All work must only be carried out with the machine at a standstill and the **power to the** system switched off.

Higher temperatures than the maximum permitted surface temperature of the housing may be present inside the motor. The motor must therefore never be opened in an explosive atmosphere!

Failure to comply with this may result in the ignition of an explosive atmosphere.



WARNING

Explosion hazard



Excessively heavy dust deposits must be avoided, as these impair the cooling of the device!

Impairment or obstruction of the flow of cooling air, for example due to partial or large area coverage of the fan cover or the entry of foreign bodies fall into the fan must be avoided in order to ensure adequate cooling.

Only cable glands and reducers which are approved for use in explosion hazard areas may be used.

All cable glands which are not used must be closed with blind screw plugs which are approved for potentially explosive areas.

Only the original seals may be used.

Failure to comply increases the risk of ignition of an explosive atmosphere.

3.4.1 Operation with frequency inverter

The design of the insulation of NORD ATEX motors with ignition protection class to and to is suitable for operation with a frequency inverter. Due to the variable speed range, temperature monitoring by means of thermistors or temperature sensors is necessary. For safe planning and use, the planning guide for the operating and installation instructions <u>B1091-1</u> must be observed. The planning guide provides information regarding the necessary conditions for inverter operation and the approved speed ranges. Option Z (additional high inertia cast iron fan) is not permitted for inverter operation.

If the frequency inverter is not approved for operation within the explosive atmosphere, the frequency inverter must be installed outside of the explosive atmosphere.



3.4.2 External fan

Motors with the additional labelling F (e.g. 80S/4 3D F) are equipped with an external fan and must be monitored with the integrated temperature sensor.



WARNING

Explosion hazard



The motor must only be operated together with the external fan. Failure of the external fan may cause the motor to overheat and therefore cause damage and/or injury up to and including ignition of the explosive atmosphere.

The operating instructions for the external fan must be observed.

The power supply to the external fan is provided separately via the terminal box of the external fan. The supply voltage of the external fan must comply with the voltage which is stated on the type plate. The external fan must be protected against overheating with suitable monitoring equipment! The IP protection class of the external fan may differ from that of the motor. The lower protection class applies for the drive unit. The cable glands must as a minimum correspond to the protection class which is specified on the type plate. Unused openings must be closed with plugs, which as a minimum correspond to the protection class of the motor.

External fans and motors for use in explosion hazard areas have Ex labelling according to RL 94/9 EEC or 2014/34/EU. The labelling must be present on both the external fan and the motor. If there is a difference between the labelling on the external fan and the motor, the lower labelled explosion protection applies for the entire drive unit. The details of surface temperatures apply for the entire drive unit; the stated max, temperature applies for the individual components. Any gear unit which is present must also be taken into account. Please contact Getriebebau NORD in case of doubt. If any component of the entire drive unit is not provided with Ex labelling, the entire drive unit may not be used in an explosion hazard area.

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3.4.3 Second temperature sensor 2TF

Category 3D motors (Zone 22, non-conducting dust) can be supplied with a second temperature sensor (2TF). This option can be used to implement a warning signal (overheating in the winding). It should be noted that the temperature sensor with the lower trigger temperature should be used for the warning; the temperature sensor with the higher trigger temperature must be used to evaluate the switch-off signal.

3.4.4 Back stop

Motors with the additional code RLS (e.g. 80S/4 3D RLS) are equipped with a back stop. For motors with a back stop, the direction of rotation is indicated by an arrow on the fan cover. The head of the arrow points in the direction of the drive shaft. When connecting the motor and during motor control, it must be ensured that the motor can only operate in the rotation direction, e.g. by means of a rotary field test. Switching of the motor into the blocked direction of rotation, i.e. the wrong direction of rotation may cause damage.

Back stops operate without wear above a speed of approx. 800 rpm. To prevent excessive heating and premature wear of the back stop, back stops must not be operated below a speed of 800 rpm. This must be observed for motors with a frequency of 50 Hz and pole numbers ≥ 8 as well as for motors with a frequency inverter.

3.4.5 Brake

Motors with the additional labelling BRE (e.g. 80S/4 3D **BRE 10**) are equipped with a brake and must be monitored with the integrated temperature sensor. Triggering of the temperature sensor of one of the components (motor or brake) must result in the safe shut-down of the entire drive unit. The motor and brake thermistors must be connected in series.

If the motor is operated with a frequency inverter, an external fan must be used for stator frequencies less than 25 Hz. Operation with stator frequencies of 25 Hz is not permissible without an external fan.

The brake may be used as a holding brake with up to 4 activations per hour.

An optional manual release (with a lockable manual release lever) may only be used if no explosive atmosphere is present.

NOTICE! The operating instructions for the brake must also be observed.

The DC supply for the brake is via a rectifier in the motor terminal box or via a direct DC supply. The brake voltage which is stated on the type plate must be complied with.

The power supply cables must not be laid in the same cable as the temperature sensor lines. The function of the brake must be checked before commissioning. No rubbing noises may occur, as impermissibly high heating could occur.

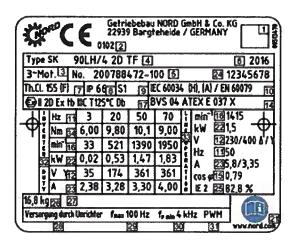


3.4.6 Overview of brake installation for NORD ATEX motors

		1 6111	nissible b	ane Size	o Tor Cat	ador à an	motora			
Size	LKZ	Braking torque [Nm]								
63	S, L	5								
71	S, L	5								
80	S, SH	5	10							
80	L, LH	5	10							
90	S, SH		10	20						
90	L, LH		10	20						
100	L, LH			20	40					
100	LA, AH			20	40	1				
112	M, SH, MH			20	40					
132	S, SH					60				
132	M, MH					60				
132	MA					60				
160	МН						100	150	250	
160	LH						100	150	250	
180	МН								250	
180	LH								250	
200	ХН								250	
225	SP, MP									40
250	WP									40



3.4.7 NORD Ex motor type plate (Ex, tb, EX tc) according to EN 60079 for operation with a frequency inverter



1	Data matrix code
	Code number of the designated facility (only for
2	Ex tb)
3	Number of phases
4	Type designation
5	Order number / motor number
6	Year of manufacture:
7	Thermal class of the insulation system
8	IP protection class
9	Operating mode
10	Standard specifications
111	Stator frequency
12	Stator voltage
14	EEC type test certificate number
15	Power factor
16	Speed
17	Explosion protection marking
21	Notice! Pay attention to operating instructions B1091
22	Rated power (mechanical power delivered to shaft)
23	Rated current at operating point
24	Individual serial number
25	Efficiency
26	Weight
27	Brake information (option only for Ex tc)
28	Note: Supply by frequency inverter
29	Maximum permissible stator frequency
30	Minimum pulse frequency of frequency inverter
31	Frequency inverter modulation method
32	Data field for operation with frequency inverters
33	Data field for mains operation
34	Rated torque on the motor shaft

Before commissioning, the type plate must be compared with the requirements of the aforementioned declaration, which result from the local regulations and operating conditions.



4 Synchronous motors – special information

The following supplementary or special information applies for these motors.



DANGER!

Electric shock

The motor is operated with a dangerous voltage. Touching certain conducting components (connection terminals and supply cables) will cause electric shock with possibly fatal consequences.

Even when the motor is at a standstill (e.g. due to the electronic block of a connected frequency inverter or a jammed drive unit) the connection terminals and supply cables may carry a dangerous voltage. A motor standstill is not identical to electrical isolation from the mains.

Even if the drive unit has been disconnected from the mains, a connected motor may rotate and possibly generate a dangerous voltage.

Installation and work must only be carried out when the motor is at a standstill and is **disconnected** (all phases disconnected from the mains).

Follow the **5 Safety Rules** (1. Switch off the power, 2. Secure against switching on, 3. Check for no voltage, 4. Earthing and short circuiting, 5. Cover or fence off neighbouring live components).

4.1 Type designation

80	ט	7	/4	
				Number of poles
				Package length: The 19 code depends on the axis height and the length of the active component
				Winding type: T=2100 rpm in Y circuit, 3000 rpm in ∆ circuit
				Axis height: 80, 90, 100

4.2 Connection

Notice! Hazardous voltages occur at the motor terminals when the motor shaft is rotating!

The motors must only be operated with suitable inverters For energy-efficient operation, the inverter must detect the position of the rotor. Various methods both with and without encoders are available for this. See also $\overline{1180}$ $\overline{0010}$

Motors are normally supplied with a star circuit. Some operating points can only be used in a delta circuit. For this, the bridges must be changed according to the circuit diagram in the terminal box cover.

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4.3 Encoders

Incremental encoder with zero track

The incremental encoder is located under the fan cover and is attached to this. After installation, the zero point offset is measured in the final test. The offset is provided with an adhesive label in the terminal box.

Absolute encoders

The synchronisation of the encoder is adjusted by NORD prior to delivery of the geared motor and does not require determination of the offset.

If the encoder is not synchronised, or has come out of adjustment due to an impact or removal of the motor, the zero track of the encoder must be synchronised to the rotor position.

4.4 Commissioning

The choice of inverter must be checked with regard to the motor allocation. In addition to the information in Section 1 "General" the operating manual for the frequency inverter must be observed. Further information can be obtained from <u>TI80 0010</u>.

4.5 Maintenance and servicing

CAUTION! The motors contain magnetic components Dismantling without specialist knowledge and suitable aids may result in injuries. This type of work must only be carried out by trained personnel.



5 Replacement parts

Please note our spare parts catalogue PL 1090 under www.nord.com. We will be pleased to send you the spare parts catalogue on request.

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Declarations of Conformity

GETRIEBEBAU NORD

Member of the NORD DRIVESYSTEMS Group

Getriebebau NORD GmbH & Co. KG

Groveholen Herd Str. 1 - 22543 Barytchelde, Germany , Fan. +45(2)4532-225 - 0 , Fax +45(2)4532-225 - 2253 , orloghord.com

EC/EU Declaration of Conformity

in the manning of the directive 94/3/EC Annex VIII, 2004/108/EC Annex II, 2009/125/EC Annex IV, 2011/65/EU Annex VI resp. from 20. April 2016 in the meaning of the directive 2014/34/EU Annex VIII and 2014/30/EU Annex II

Getriebebau NORD GmbH & Co. KG as manufacturer hereby declares, that the three-phase asynchronous motors from the product series

Page 1 of 1

SK 63+1/+2 2D +1 to SK 200+1/+2 2D +7

Fower code: S, SA, SX, M, MA, MB, MX, L, LA, LB, LX, R, X, Y, A, W-optionally supplemented by: H, P

Number of poles: 2, 4, 6

8 Additional options

with ATEX labeling (x) || 2D Ex th till T . . . *C Db

comply with the following regulations:

ATEX Directive for products

(until 19. April 2016) OJ. L 100 of 19.4.1994, P. 1-29

2014/34/EU (from 20. April 2016) OJ. L 096 of 29.3.2014, P. 309-356

Eco-design Directive 2009/125/EC (VO No. 640/2009) Ol. L 285 of 31.10.2009, P. 10-35 **EMC Directive**

2004/108/EC (until 19, April 2016) OJ, L 390 of 31,12,2004, P. 24-37

2014/30/EU (from 20. April 2016) OJ. L 96 of 29.3.2014, P. 79-106

RoHS Directive 2011/65/EU OJ. L 174 of 1.7.2011, P. 88-11

Applied standards:

EN 60079-0:2009 EN 60034-1:2010+Cor.:2010 EN 60034-6:1993 EN 60034-9:2005+A1:2007 EN 60034-30-1:2014 EN 61000-6-4:2007+A1:2011 EN 60079-31:2009 EN 60034-2-1:2014 EN 60034-7:1993+A1:2001 EN 60034-11:2004 EN 55011:2009+A1:2010 EN 60204-1:2006+A1:2009+Cor.:2010 EN 60529:2000 EN 60034-5:2001+A1:2007 EN 60034-8:2007+A1:2014 EN 60034-14:2004+A1:2007 EN 61000-6-3:2007+A1:2011 EN 50581:2012

EC-Type-Dramination Certificates: BVS 04 ATEX E 037 X

Notified body for the assessment of the quality management system:

Physikalisch-Technische Bundesanstalt PTB) Bundesallee 100

Identity number: 0102

38116 Braunschweig

Notified body to issue for the EC-Type-Examination Certificate:

DEKRA EXAM GmbH Identity number: 0158 Dinnendahlstraße 9 44809 Bochum

Die erste Kennzeichnung erfolgte in 2004.

Bargteheide, 17.02,2016

U. Küchenmeister **Managing Director**

pp F. Wiedemann Head of Motors Division



GETRIEBEBAU NORD Member of the NORD DRIVESYSTEMS Group



Getriebebau NORD GmbH & Co. KG

Gesrebetau/Nord Str. 1., 22941 Bargtohode, Garmany , Fox. +49(Q4532-289 - 8 , Fax. +49(Q4532-289 - 2153), Info@cond.com

EC/EU Declaration of Conformity

In the meaning of the directive 94/9/EC Annex VIII, 2004/108/EC Annex II, 2009/115/EC Annex IV, 2011/55/EU Annex VII resp. from 20, April 2016 in the meaning of the directive 2014/34/EU Annex VIII and 2014/30/EU Annex II

Getriebebau NORD GmbH & Co. KG as manufacturer hereby declares, that the three-phase asynchronous motors from the product series

Page 1 of 1

- SK 63*1/** 3D ** to SK 200*1/** 3D **
 - Power code: S, SA, SX, M, MA, MB, MX, £, LA, LB, LX, R, X, Y, A, W -optionally supplemented by: H, P
 - Number of poles: 2, 4, 6
 - 3) Additional options

with ATEX labeling () II 3D Ex to IIIB T . . . *C Do

comply with the following regulations:

ATEX Directive for products

(until 19. April 2016) OJ. L 100 of 19.4.1994, P. 1-29

2014/34/EU (from 20. April 2016) OJ. L 096 of 29.3.2014, P. 309-356

Eco-design Directive

2009/125/EC (VO No. 640/2009) OJ. L 285 of 31.10.2009, P. 10-35

EMC Directive

2004/108/EC (until 19. April 2016) OJ. L 390 of 31.12.2004, P. 24-37 2014/30/EU (from 20. April 2016) OJ. L 96 of 29.3.2014, P. 79-106

2011/65/EU

OJ. L 174 of 1.7.2011, P. 88-11

RoHS Directive Applied standards:

EN 60079-0:2009 EN 60034-1:2010+Cor.:2010 EN 60034-6:1993 EN 60034-9:2005+A1:2007 EN 60034-30-1:2014 EN 61000-6-4:2007+A1:2011 EN 60079-31:2009 EN 60034-2-1:2014 EN 60034-7:1993+A1:2001 EN 60034-11:2004 EN 55011:2009+A1:2010

EN 60204-1:2006+A1:2009+Cor.:2010

EN 60529:2000

EN 60034-5:2001+A1:2007 EN 60034-8:2007+A1:2014 EN 60034-14:2004+A1:2007 EN 61000-6-3:2007+A1:2011

EN 50581:2012

First marking was carried out in 2011.

Bargteheide, 17.02.2016

II. Küchenmeister **Managing Director**

pp F. Wiedemann **Head of Motors Division**



GETRIEBEBAU NORD

Member of the NORD DRIVESYSTEMS Group



Getriebekeu NORD Smith & Co. IDS

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EC/EU Declaration of Conformity

In the meaning of the directive 94/8/EC Annex VIII, 2004/108/EC Annex II, 2009/125/EC Annex IV, 2011/E5/EU Annex VII resp. from 20. April 2016 in the meaning of the directive 2014/34/EU Annex VIII and 2014/30/EU Annex II

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 - Power code: S, SA, SX, M, MA, MB, MX, L, LA, LB, LX, R, X, Y, A, W -optionally supplemented by: H, P
 - Number of poles: 2, 4, 6
 - 3) Additional options

with ATEX labeling (Ex) II 2G Ex e IIC T3 Gb

comply with the following regulations:

ATEX Directive for products

94/9/EG

(until 19. April 2016) OJ. L 100 of 19.4.1994, P. 1-29 2014/34/EU (from 20. April 2016) OJ. L 096 of 29.3.2014, P. 309-356

Eco-design Directive

2009/125/EC (VO No. 640/2009) OJ. i. 285 of 31.10.2009, P. 10-35

EMC Directive

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EN 60034-2-1:2014 EN 60034-7:1993+A1:2001 EN 60034-11:2004 EN 55011:2009+A1:2010

EN 60204-1:2006+A1:2009+Cor.:2010

EN 60529:2014

EN 60034-5:2001+A1:2007 EN 60034-8:2007+A1:2014 EN 60034-14:2004+A1:2007 EN 61000-6-3:2007+A1:2011

EN S0581:2012

EC-Type-Examination Certificates:

PTB 14 ATEX 3030, PTB 14 ATEX 3032, PTB 08 ATEX 3024-2, PTB 14 ATEX 3034, PTB 14 ATEX 3036, PTB 14 ATEX 3038, PTB 14 ATEX 3040, PTB 14 ATEX 3042 PTB 14 ATEX 3044, PTB 14 ATEX 3046

Notified body for the assessment of the quality management system:

Physikalisch-Technische Bundesanstalt (PTB) Identity number: 0102

Bundesallee 100

Notified body to issue for the EC-Type-Examination Certificate:

38116 Braunschweig

Physikalisch-Technische Bundesanstalt (PTB)

identity number: 0102

Bundesallee 100 38116 Braunschweig

First marking was carried out in 2008.

Bargtehelde, 17.02.2016

U. Küchenmeister **Managing Director**

pp F. Wiedemann **Head of Motors Division**



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EC/EU Declaration of Conformity

in the meaning of the directive 94/8/TC Arnex VIII, 2004/108/EC Annex II, 2009/125/TC Annex IV, 2011/65/EU Annex VI resp. from 20. April 2016 in the meaning of the directive 2014/34/EU Annex VIII und 2014/30/EU Annex II

Getriebebau NORD GmbH & Co. KG as manufacturer hereby declares, that the three-phase asynchronous motors from the product series

Page 1 of 1

- SK 63+1/+2 3G +3 to SK 200+1/+2 3G +2
 - ³⁾ Power code: S, SA, SX, M, MA, MB, MX, E, LA, LB, LX, R, X, Y, A, W -optionally supplemented by: H, P
 - Number of poles: 2, 4, 6
 - ²⁰ Additional options

with ATEX labeling (Ex) # 3G Ex nA HC T3 Gc

comply with the following regulations:

ATEX Directive for products

94/9/EG

(until 19. April 2016) OJ. L 100 of 19.4.1994, P. 1-29 2014/34/EU (from 20. April 2016) OJ. L 096 of 29.3.2014, P. 309-356

Eco-design Directive EMC Directive

2009/125/EC (VO No. 640/2009) OJ. L 285 of 31.10.2009, P. 10-35

2004/108/EC (until 19. April 2016) OJ. £ 390 of 31.12.2004, P. 24-37 2014/30/EU (from 20. April 2016) OI. L 96 of 29.3.2014, P. 79-106

RoHS Directive 2011/65/EU OJ. L 174 of 1.7.2011, P. 88-11

Applied standards:

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EN 60034-2-1:2014 EN 60034-7:1993+A1:2001 EN 60034-11:2004 EN 55011:2009+A1:2010 EN 60204-1:2006+A1:2009+Cor.:2010 EN 50581:2012

EN 60079-15:2010

EN 60529:2014 EN 60034-5:2001+A1:2007 EN 60034-8:2007+A1:2014 EN 60034-14:2004+A1:2007 EN 61000-6-3:2007+A1:2011

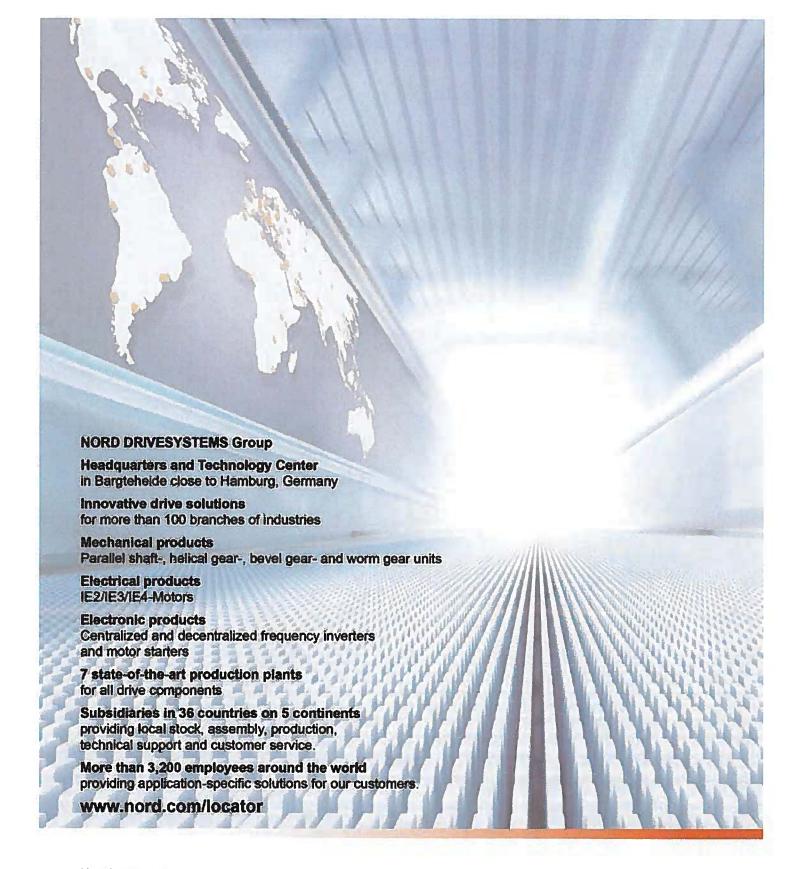
First marking was carried out in 2014.

Bargteheide, 17.02.2015

Managing Director

Head of Motors Division





Headquarters:

Getriebebau NORD GmbH & Co. KG Getriebebau-Nord-Straße 1 22941 Bargteheide, Germany Fon +49 (0) 4532 / 289-0 Fax +49 (0) 4532 / 289-2253 info@nord.com, www.nord.com

Member of the NORD DRIVESYSTEMS Group





MANUFACTURER INSTALLATION OPERATION AND MAINTENANCE MANUAL AMARUQ WTP – NUNAVUT VEOLIA PROJECT: 5000 218 009

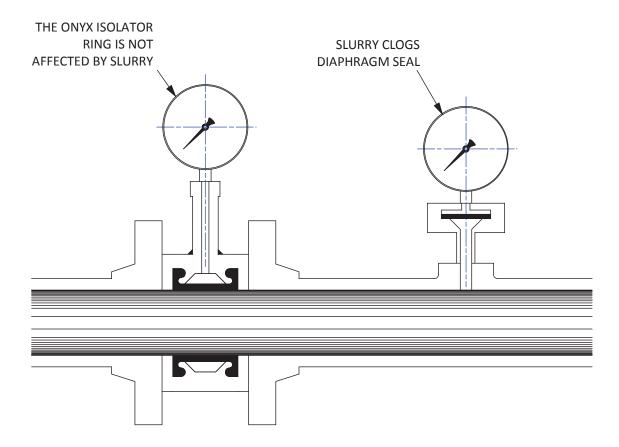
ONYX VALVE SERIES PSW, PRESSURE GAUGE ISOLATOR RING

ONYX VALVE CO ISOLATOR RING

Installation & Maintenance

Operation: (02-2010)

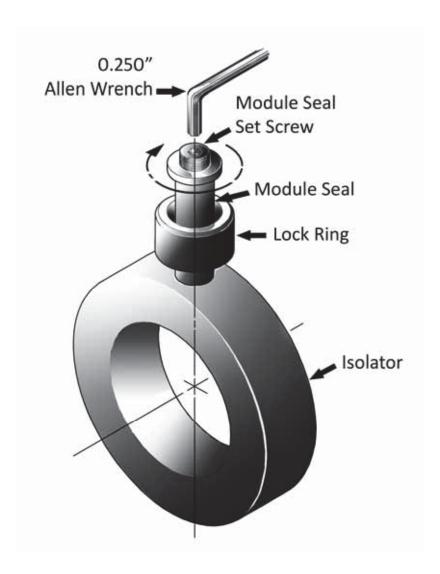
Obtaining accurate pressure readings on slurry lines is difficult because slurries, abrasives and solids clog pressure elements such as gauges, switches and transmitters.



Onyx Isolator rings consist of rubber "inner tube" captured in a steel ring. The assembly is installed between flanges in the process pipe. Clear instrument oil behind the rubber membrane transmits pressure to the gauge

Onyx Isolator ring are vacuum filled at the factory with high viscosity silicone fluid. (Other fluids available on special order.)

After vacuum filling, the Isolator Ring is permanently sealed with our patented "Module Seal". The Module Seal enables the users to remove or replace the gauges and other pressure instruments while the Isolator Ring remains in the process pipe without having to vacuum fill the rings.



Onyx Isolator rings are usually supplied with instrumentation such as gauges, transducers, and pressure switches; refers to specific manufacturer's literature concerning maintenance for these accessories.

If you detect instrument oil weeping from under the Lock Ring, the Module seal may require minor adjustment.

To adjust the Module Seal:

- a) Loosen the Lock Ring, and then carefully remove the pressure measuring instruments.
- b) Insert a 0.250 inch Allen key into the Module Seal Set Screw and turn clockwise 1/8 revolution.
- c) Reinstall the pressure measuring instruments and tighten Lock Ring.

Turning the Module Seal Set Screw clockwise eliminates weeping but makes the fit around the needle tighter.

If the Module Seal is too tight to reinstall the pressure measuring instrument, do not force the needle in or you will risk bending or breaking the needle. Instead, loosen the Set Screw until the needle can be inserted easily. If fluid weeping persists, it may be necessary to tighten the Set Screw further. When tightening the Set Screw, turn clockwise 1/8 revolution at a time.

PRESSURE RATING:

Onyx isolator rings are rated for operation up to 1,000 psi.

STORAGE:

Correct storage extends service life. Rubber is perishable. Ideal storage conditions are 50°F / 60% relative humidity. We recommend the following precautions for Isolators and spare parts stored for any length of time prior to installation.

- 1. Keep Isolators cool. They can be stored in an unheated area, but allow maximum ventilation in storage areas subject to high ambient temperatures. Trailers and storage sheds become incredibly hot during summer months. Avoid such locations.
- 2. Avoid sunlight. Ultra-violet light deteriorates rubber. Leave the Isolator in its box.
- 3. Avoid ozone. DO NOT STORE Isolator near active electrical equipment.
- 4. The Isolator may be supplied with sensitive instrumentation. Refer to specific manufacturer's literature concerning proper storage.
- 5. Separate instruments may be supplied with a stinger fitting attached. DO NOT REMOVE RUBBER TIP PROTECTOR FROM THE STINGER FITTING NEEDLE UNTIL ATTACHING THE FITTING TO THE ISOLATOR RING.

INSTALLATION:

1. Safety Considerations:

- a) Isolators rings frequently handle chemically reactive and abrasive fluids; it is reasonable to expect the elastomer sleeve to eventually wear out. Instrument fill fluid must be compatible with the process liquid. Mixing incompatible fluids may cause a violent chemical reaction resulting in equipment damage or personal injury.
- b) Make certain that instruments such as gauges, pressure switches, etc, have pressure and temperature rating suitable for actual operating conditions. Exceeding manufacturer's design limits may result in equipment damage or personal injury.

- c) The rubber sleeve elastomer must be compatible with the chemistry and temperature of the process fluid.
- d) Do not use Onyx Isolator rings for oxygen service.
- 2. Inspect prior to installation. Onyx Isolator rings should not show any indication of leakage, and rubber sleeve should be free from cuts or punctures.
- 3. Onyx Isolator rings can be installed in any attitude with flow in either direction. Install in straight pipe run as far from tees and elbows as possible.
- 4. Onyx Isolator rings may be installed without pressure instruments attached. This minimizes damage to gauges and sensitive pressure instruments during pipe fitting and construction.
- 5. Onyx Isolator rings are vacuum filled at the factory to insure high accuracy in operation. DO NOT DISASSEMBLE UNLESS NECESSARY FOR REPAIRS.
- 6. To install, sandwich the Isolator between two flanges in the process pipe line. Center as carefully as possible. Install gaskets on both sides of Isolator ring. Insert flange bolts. Tighten flange bolts in criss cross pattern.

OPERATING INSTRUCTIONS:

- 1. Onyx Isolator Rings and pressure instruments are vacuum filled at the factory. They may be shipped assembled or shipped separately for field assembly.
 - a) Do not disassemble the ring except to replace the rubber membrane.
 - b) Do not break connections between the stinger fitting and pressure instruments.
 - c) Do not remove the rubber seal (#5) from the stinger.
- 2. To attach a pressure instrument to the Isolator Ring:

Pressure measuring element and stinger fitting must be pre-assembled and vacuum filled prior to attaching to the Isolator ring!!!

- a) Instruments can be attached to an Isolator Ring installed in the pipe line while the system is pressurized.
- b) Hold the pressure instrument and stinger fitting assembly upright above the Isolator Ring.
- c) Remove the rubber tip protector from the stinger needle (#5F). (Save the rubber tip protector.)

- d) Gently push the needle (#5F) through the rubber seal (#5) until it hits bottom.
- e) Thread the lock ring (#5C) onto the stinger fitting (#5E). **HAND TIGHTENED.**
- f) Gauges can be rotated to face any direction by loosening the coupling ring, turning the gauge, and re-tightening the ring.
- 3. To attach instruments which did not come with a stinger fitting, refer to instructions on attaching stinger fitting to instruments at the end of this booklet.

4. To remove pressure instruments from the Isolator Ring:

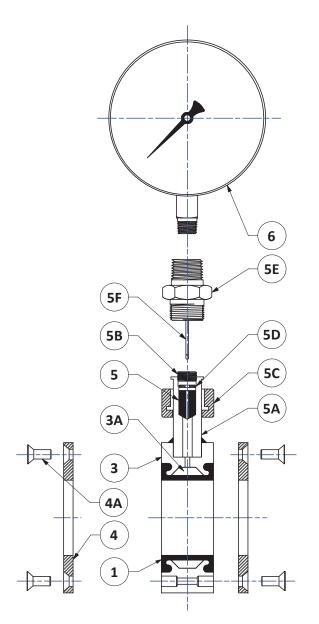
- A) It is NOT necessary to remove the Isolator Ring from the process pipe.
- B) In order to minimize fluid loss, reduce process pressure as low as possible before removing gauges or other instruments from the Isolator Ring.

Turn off pump prior to removing instrument from the Isolator Ring (The interruption will be brief. Instruments can be removed from the Isolator in about 10 seconds.)

- B) Loosen knurled lock ring (#5C).
- C) Gently lift the gauge and stinger assembly out of the module seal.
- D) Immediately attach a rubber tip protector to the end of the stinger needle.
- E) Now your process can be re-pressurized without loosing fluid from the Isolator Ring.

SLEEVE AND MODULE SEAL REPLACEMENT:

- 1. Remove Isolator Ring from process line.
- 2. Remove gauge or auxiliary instrument.
- 3. Remove end plate screws (#4A).
- 4. Remove end plates (#4).
- 5. Remove old sleeve (#1).
- 6. Use a 0.250 inch hex key to remove the module seal set screw (#5B).
- 7. Use a packing extractor to remove the old rubber seal (#5).
- 8. Clean all components thoroughly.
- 9. Press new rubber seal (#5) into the module seal tube (#5A). Drive all the way to bottom of bore. Replace module seal set screw (#5B). Do not over tighten.
- 10. Collapse new sleeve (#l), push through center housing (#3) and work sleeve lips into housing grooves.



ITEM	DESCRIPTION				
1	SLEEVE				
3	CENTER HOUSING				
3A	SENSING LIQUID, CENTER				
4	END PLATE				
4A	SCREW, END PLATE				
5	RUBBER SEAL				
5A	TUBE, MODULE SEAL				
5B	SET SCREW, MODULE SEAL				
5C	LOCK RING, MODULE SEAL				
5D	SEAL WASHER				
5E	STINGER FITTING				
5F	NEEDLE, STINGER FITTING				
6	GAUGE				

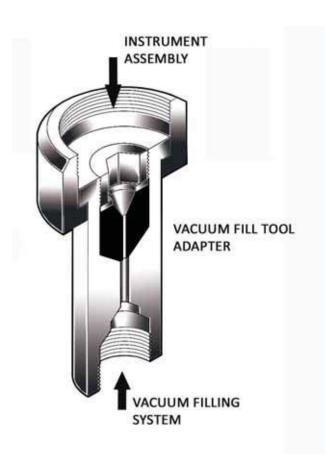
- 11. Reinstall end plates (#4).
- 12. Replace end plate screws (#4A).
- 13. Connect a separate stinger fitting (#5E), to vacuum filling system, evacuate air from the ring assembly, and refill with fresh instrument fluid. Use Onyx silicone fluid.
- 14. The Isolator Ring can now be returned to service.

TO ATTACH STINGER FITTING TO INSTRUMENTS:

1. Attach gauge or other instrument to the stinger fitting (#5E).

.

- 2. Connect an **Onyx Vacuum Fill Tool Adapter**, **P/N #T75132-01-00**, to your vacuum filling system.
- 3. Attach the instrument assembly to the adapter fitting.
- 4. Evacuate all the air from the instrument, and fill with silicone fluid.
- 5. Detach the instrument from the filling system.
- 6. The instrument can now be attached to an Isolator Ring, or stored for future use.



Questions?

Contact Onyx Valve Company

Tel: 856-829-2888 Fax: 856-829-3080

E-mail: david@onyxvalve.com



MANUFACTURER INSTALLATION OPERATION AND MAINTENANCE MANUAL AMARUQ WTP – NUNAVUT VEOLIA PROJECT: 5000 218 009

PMP MODEL A201, BALL VALVE



2 Piece Ball Valve Full Port

A201 1000 WOG 1/4" – 3" NPT



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NO	PART NAME	QTY	SPECIFICATION		
1	BODY	1	WCB	CF8M	
2	END CAP	1	WCB	CF8M	
3	SEATS	2	RPTFE RPTF		
4	THRUST WASHER	1	PTFE	PTFE	
5	BODY GASKET	1	PTFE	PTFE	
6	STEM PACKING	3	PTFE	PTFE	
7	PACKING GLAND	1	SS304	SS304	
8	HANDLE	1	C.S.	SS304	
9	HANDLE WASHER	1	C.S.	SS304	
10	HANDLE NUT	1	C.S.	SS304	
11	STEM	1	SS304	SS316	
12	HANDLE SLEEVE	1	PLASTIC	PLASTIC	
13	LOCKING DEVICE	1	C.S.	SS304	
14	BALL	1	SS304	SS316	

S	IZE	1/4"	3/8"	1/2"	3/4"	1"	1-1/4"	1-1/2"	2"	2-1/2"	3"
D	in	0.46	0.50	0.50	0.75	1.00	1.25	1.50	2.00	2.50	3.00
L	mm	10	12	15	20	25	32	40	50	65	80
	in	2.13	2.13	2.68	3.03	3.58	3.98	4.25	4.88	7.28	8.07
<u>_</u> _	mm	54	54	68	77	91	101	108	124	185	205
Н	in	2.32	2.32	2.36	2.91	3.03	3.43	3.66	4.21	5.71	6.10
L''	mm	59	59	60	74	77	87	93	107	145	155
Е	in	4.49	4.49	4.49	5.43	5.43	7.28	7.68	7.68	10.24	10.24
-	mm	114	114	114	138	138	185	195	195	260	260



MANUFACTURER INSTALLATION OPERATION AND MAINTENANCE MANUAL AMARUQ WTP – NUNAVUT VEOLIA PROJECT: 5000 218 009

PRATT SERIES 601, BALLCENTRIC PLUG VALVE

PRAM®

Ballcentric® Plug Valve

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Installation Instructions	2-3
Operation Instructions	4-5
Maintenance	6
Troubleshooting	7

Parts Information

8-9

WARNING:

- 1. Read all applicable directions and instructions prior to any maintenance, troubleshooting or installation.
- 2. Personnel involved in the installation or maintenance of valves should be constantly alert to potential emission of pipeline material and take appropriate safety precautions. Always wear suitable protection when dealing with hazardous pipeline materials.
- 3. Order parts from your local Pratt sales representative or directly from Henry Pratt Company. When ordering parts, please include the serial number located on the valve tag.

NOTE: "WARNING" and "CAUTION" messages (flagged with an exclamation symbol) indicate procedures that must be followed exactly to avoid equipment damage, physical injury, or death.

HENRY PRATT COMPANY
Customer Service
401 South Highland Avenue
Aurora, IL 60506
877.436.7977
www.henrypratt.com
moreinfo@henrypratt.com

Ballcentric® Plug Valve

General Information / Installation

FUNCTIONAL DESCRIPTION

Plug valves are designed with eccentric rubber disc seating surfaces. The plug rotates 1/4 turn to provide shutoff in pipes. The eccentric seating action provides for tighter shutoff as the actuator is adjusted to provide for more rotation. The valve can be adjusted to a maximum of 10 degrees over travel. The valves can be used to regulate flow rate by positioning the plug between 15 and 90 degrees open.

Manually operated plug valves are powered with one of the following: 2" direct nut, lever handle or gear actuators, which convert multiple handwheel, chainwheel, or nut input turns into 1/4 turn valve operation. The travel of the valve plug is limited by physical stops in the torque collar for wrench operated valves.

ACAUTION: Forcing the handwheel, chainwheel or nut against the stops will not provide tighter shutoff of the valve and may damage the actuator. Only actuator adjustments will affect valve shutoff.



Motor Operated Valve

Motor operated valves are powered with gear actuators, which convert multiple motor input turns into 1/4 turn valve operation. The travel of the valve plug is limited by limit switches in the motor housing and physical stop in the actuator housing. Valve shutoff is affected by limit switch and physical stop settings.

A CAUTION: Improperly set limit switches and/or physical stops may damage the motor and/or actuator.

Hydraulically operated valves are powered with a gear box and double acting cylinder. The linear stroke of the cylinder is converted to 1/4 turns operation by the gear box. Auxiliary controls are provided to direct hydraulic power to the cylinder and to control the operating speed of the cylinder.

INSTALLATION

When installing the plug valves, the seat end should be noted. The seat end of the valve is cast in raised letters on the appropriate flange of the valve. Generally, straightway valves should be installed with the highest pressure applied from the opposite end from the seat. This will tend to push the plug into the seat On pump discharge installations the seat end should be towards the pump.

In cases where shut-off is required in both directions, the valve should be installed so that the highest differential pressure at shut-off is opposite the seat end. When the service is of a clogging type, with suspended solids likely to build up in the valve body, it is recommended that the valve be installed with the media entering the seat end first. In extreme cases, the valve should be installed with the plug horizontal and rotating upward into the top portion of the valve body cavity to open. See Page 6 for recommended installation options.

Class 125 flanged end valves have ANSI B16.1 flat faced 125/150 flanges. Standard ANSI B16.21 flanges and gaskets should be used to install the valves in the pipeline. Certain size valves utilize tapped holes on the top and bottom of the flange where a backing nut is not possible. Please check specific drawings for detailed information on sizes and quantities of hexagon head screws required on these valves.

Prior to installing valves, they should be cycled open and closed several times to ensure they are in good working order and have not been damaged during shipment or storage.

Ballcentric® Plug Valve

Installation

INSTALLATION OPTIONS

The type of materials carried in the pipeline and the location of the valve determine the correct installation orientation.

Liquids Without Suspended Solids

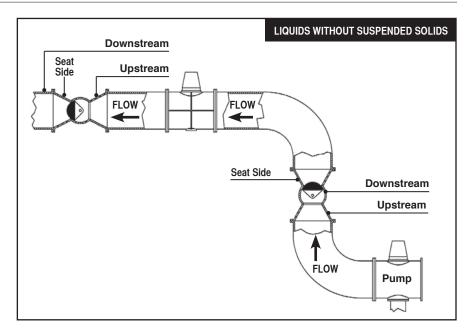
Valve may be installed with plug shaft vertical or horizontal. For vertical pipe installations, install valve with seat facing downstream.

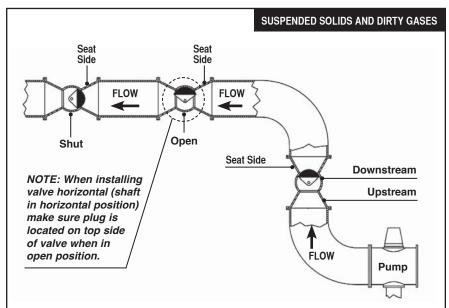
Before installation, blow out pipeline to remove all foreign materials.

Suspended Solids and Dirty Gases

Install valve with plug facing upstream. Ensure plug rotates up to the fully open position thus preventing plug from sweeping through settled debris.

NOTE: For pump isolation service install the discharge valve with the seat downstream from the pump and with the plug rotating to the top of the pipeline in the open position.





Ballcentric® Plug Valve

Operation

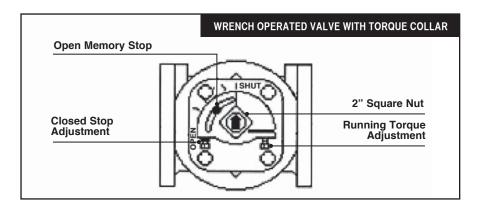
WRENCH OPERATED PLUG VALVES

Do not permit use and operation of a Wrench operated eccentric plug valves close by turning the valve 90 degrees clockwise. All wrench operated eccentric valves are equipped with a multifunction device referred to here as a torque collar. This device serves as:

- 1. Wrench Adapter 2" Square
- 2. Position Indicator
- 3. Open Memory Stop
- 4. Closed Memory Stop
- 5. Running Torque Adjustment

Position Indicator: The top of the plug has an indicator plate to show the approximate plug position. Cast onto the torque collar is an indicator mark which corresponds to a graduated scale cast on the bonnet of the valve. This scale is divided into 15 degree lines and indicates the exact valve opening from full open to full closed.

Open Memory Stop: The torque collar also incorporates an open memory stop feature. The plug can be set by tightening the open memory stop adjustment bolt after the correct flow is achieved. The valve can then be closed for maintenance and reopened to the proper position without resetting the flow.



Closed Memory Stop: The closed memory stop is provided to allow for adjustment to compensate for wear of either the plug coating or the seat. The closed stop is pre-set at the factory and should not require readjustment unless wear occurs.

To adjust the plug for excess plug or seat wear simply rotate the closed stop two turns counter-clockwise then rotate the plug (clockwise) further into the seat and check the flow. Should this movement fail to shut off the flow repeat the above step. Afterward re-set the lock nut to prevent the position from being altered.

Running Torque Adjustment:

The nature of eccentric plug valves "camming" action eliminates the majority of the torque prior to seating. To prevent the plug from creeping open or slamming closed, the torque collar maintains a constant drag on the shoulder of the valve bonnet. This component is factory adjusted. However, once the valve has been installed, it is recommended that the torque adjustment nut be further tightened to assure proper friction exists to prevent unwanted closure.

To prevent the plug from unnecessary movement, rotate the hex head bolt clockwise until there is a substantial drag on the plug but not so much as to prevent the movement of the plug with the supplied wrench.

Operation

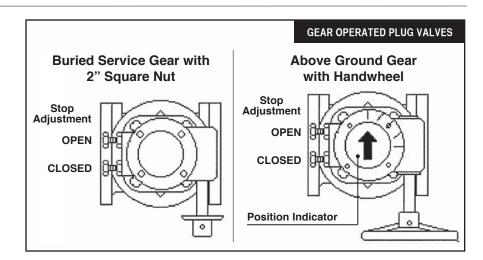
GEAR OPERATED PLUG VALVES

Gear operated eccentric valves close by turning the gear input shaft clockwise until closed.

Position Indicator (above ground units only): The top of the gear operator has an indicator plate to show the plug position. This scale, cast onto the gear housing, is divided into 15 degree lines and indicates the exact valve opening from full open to full closed. Buried service units are totally enclosed and sealed for use below grade.

Open and Closed Memory

Stops: The closed memory stop is provided to allow for adjustment to compensate for wear of either the plug coating or the seat. The closed stop is pre-set at the factory and should not require readjustment unless wear occurs.



To adjust the plug for excess plug or seat wear simply rotate the closed stop two turns counterclockwise then rotate the handwheel or nut (clockwise) to move the plug further into the seat and check the flow.

Should movement fail to shut off the flow repeat the above step. Afterward re-set the lock nut to prevent the position from being altered.

ACTUATED PLUG VALVES

Described below are the operating instructions for an eccentric plug valve equipped with an electric motor actuator. General arrangement drawings are provided in conjunction with this manual to illustrate the fitup and installation of the valve and wiring of the motor. Specific wiring details are contained in the electric motor actuator manual. As with any plug valve, the

actuator will cause the valve plug to rotate through 1/4 turn to open or close the valve.

The output motion of the actuator is limited to about 100 degrees of output rotation by mechanical stops in the gearing. These are factory set and should not need adjustment. The actual positioning of the valve plug will be done by limit switches in the motor actuator.

The switches are also set at the factory, but adjustment is sometimes required if the motor unit is installed on a separate mounting base or floor stand. Detailed procedures are given in the motor manual if adjustment is needed for the mechanical stops or the limit switches. The wiring and power requirements are noted on the wiring diagrams included with this instruction manual.

Maintenance

MAINTENANCE

The eccentric valve is designed and manufactured to be a long life valve under normal circumstances. It does not require any routine maintenance. Cycling the valve from full open to full closed on an annual basis will increase the life of the valve and operator components. However, if maintenance is required due to unusual wear or service conditions, the following procedure should be followed:

ACAUTION: Valve should be depressurized for all maintenance activities

Disassembly Procedure

Body: The plug valve is a top entry valve; therefore the body can remain in line during this operation.

Gear Operated Valves: Remove the bolts holding the gear operator housing cover in place. Remove the housing cover and the internal bolts holding the gear operator to the valve body. Remove the gear operator and set aside.

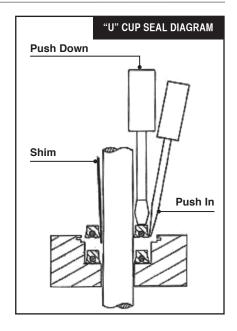
Wrench Operated Valves: Remove the star washer fastening the torque collar to the plug stem. Remove the torque collar and set aside. With the valve de-pressurized, remove the hexagonal head cap screws that hold the bonnet to the valve body.

Remove the bonnet, leaving the plug in the body. At this point, the plug, PTFE thrust washers, journal bearings and bonnet stem seals are accessible and can be removed and replaced.

Reverse the above process for reassembling the valve only. For stem seal replacement follow procedure below.

Stem Seals: With the valve de-pressurized, using internal snap ring pliers, remove the snap ring and thrust washer. The "U" cup seals can now be pried out of the seal cavity. To replace, reverse the above process.

"U" Cup Seals: To replace "U" cup seals on actuated eccentric plug valves, depressurize the valve, remove the actuator, and remove internal bolts fastening the actuator to the valve body. Remove the actuator and set aside. Remove the internal snap ring using snap ring pliers. Remove thrust washer. The "U" cup seals are now visible. Using a screwdriver, pry out the old seals. Apply a small amount of silicone or grease to the new "U" cup seals. This will help them slide in the packing cavity. Put a piece of shim stock into the cavity and put the "U" cup over it. Slide the "U" cup over the stem with shim stock



against the stem. This will let any trapped air out of the packing cavity. Now, using two screwdrivers, coax the outer lip of the "U" cup into the cavity while pressing down on the top of the "U" cup with the other screwdriver (see above diagram). Continue to do this all the way around until the "U" cup is at the bottom of the packing cavity.

Repeat the procedure with the second "U" cup, and replace the thrust washer and snap ring. Now you can remount the actuator on the valve.

Troubleshooting

TROUBLESHOOTING

Wrench Operated Plug Valve

PROBLEM	CAUSE	SOLUTION
Valve will not open	broken or misadjusted torque collar obstruction in line excessive line pressure elastomer damage	adjust or replace torque collarremove obstructionreduce pressurereplace plug
Valve will not close	broken or misadjusted torque collar obstruction in line excessive line pressure elastomer damage	 adjust or replace torque collar remove obstruction reduce pressure replace plug
Valve will not shutoff flow	improper stop adjustment obstruction in line excessive line pressure elastomer damage	adjust closed stop remove obstruction reduce pressure replace plug
Valve leaks at plug stem	damaged "U" cup seal	• replace "U" cups

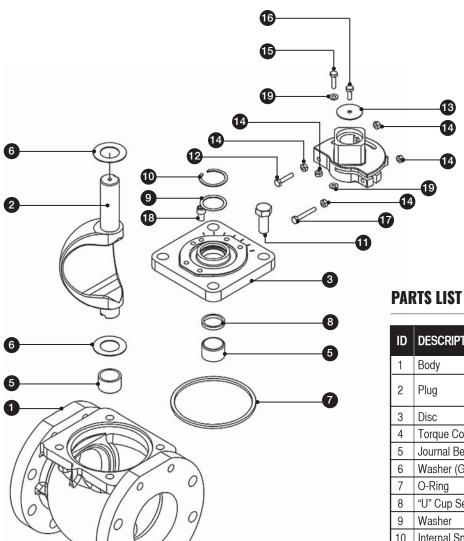
Gear Operated Plug Valve

PROBLEM	CAUSE	SOLUTION
Valve will not open	 bent input shaft obstruction in line excessive line pressure elastomer damage 	replace worn shaftremove obstructionreduce pressurereplace plug
Valve will not close	 bent input shaft obstruction in line excessive line pressure elastomer damage 	replace worn shaftremove obstructionreduce pressurereplace plug
Valve will not shut off flow	improper stop adjustment obstruction in line excessive line pressure elastomer damage	adjust closed stop remove obstruction reduce pressure replace plug
Valve leaks at plug stem	damaged "U" cup seal	• replace "U" cups

Actuated Plug Valve

PROBLEM	CAUSE	SOLUTION
Valve will not close/open	no power sourceimproper signalburned out or impaired component	check incoming power source and/or replace fuses check actuating signal sequence check and repair or replace motor or relay devices
Valve will not shut off flow	improper stop adjustment actuator torques out	re-set limit switch check for obstructions in valve

2" – 12" Ballcentric Plug Valve Parts



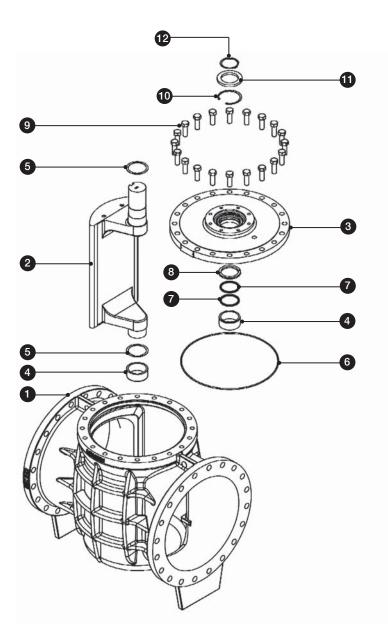
ID	DESCRIPTION	MATERIAL
1	Body	Cast Iron ASTM A-126 Class B
2	Plug	Rubber Coated Ductile Iron ASTM A-536
3	Disc	Cast Iron ASTM A-126 Class B
4	Torque Collar	Ductile Iron ASTM A-536
5	Journal Bearing	303 Stainless Steel
6	Washer (Grit Seal)	PTFE
7	O-Ring	Elas. as Spec.
8	"U" Cup Seal	Elas. as Spec
9	Washer	Brass - ASTM B138-675
10	Internal Snap Ring	Spring Steel
11	Setscrew	Steel (Zinc Plated)
12*	Closed Stop	Steel (Zinc Plated)
13*	Locking Washer	Steel
14*	Nut	Steel (Zinc Plated)
15*	Open Stop	Steel (Zinc Plated)
16*	Set Screw	Steel (Zinc Plated)
17*	Torque Bolt	Steel (Zinc Plated)
18*	Travel Stop	Steel
19*	Washer	Steel

^{*}Torque Collar Assembly on 8" and Smaller

TO ORDER: Contact our Parts Department. Henry Pratt Company 401 South Highland Avenue Aurora, IL 60506-5563 (630) 844-4000

When ordering parts, please include the serial no. located on the valve tag and the part description.

14" – 36" Ballcentric Plug Valve Parts



PARTS LIST

ID	DESCRIPTION	MATERIAL
1	Body	Cast Iron ASTM A-126 Class B
2	Plug	Rubber Coated Ductile Iron ASTM A-536
3	Сар	Cast Iron ASTM A-126 Class B
4	Sleeve Bearing	303 Stainless Steel
5	Washer (Grit Seal)	PTFE
6	Cap O-Ring	Elas. as Spec.
7	"U" Cup Seal	Elas. as Spec.
8	Seal Retaining Ring	(See Note 1)
9	Cap Screw	Steel (Zinc Plated)
10	Internal Snap Ring	Spring Steel
11	Support Collar	Steel
12	Internal Snap Ring	Spring Steel

Notes:

1. Seal Retaining Ring: Brass – ASTM B-138-675 on 14" – 20", Steel on 24" and larger.

TO ORDER: Contact our Parts Department. Henry Pratt Company 401 South Highland Avenue Aurora, IL 60506-5563 (630) 844-4000

When ordering parts, please include the serial no. located on the valve tag and the part description.



Henry Pratt Company 1.630.844.4000 www.henrypratt.com moreinfo@henrypratt.com International 1.423.490.9555 www.mueller-international.com international@muellercompany.com



MANUFACTURER INSTALLATION OPERATION AND MAINTENANCE MANUAL AMARUQ WTP – NUNAVUT VEOLIA PROJECT: 5000 218 009

PRIMARY FLUID SYSTEM ACCUDRAW PVC SERIES, CALIBRATION CYLINDER



ACCUDRAW® PVC Calibration Instructions

Note: Before starting either of the calibration procedures below, ensure that the pump is primed and void of any trapped air.

Using the USGPH scale: (scale is based on <u>time</u>, in one (1) minute volume discharge)

- 1. Fill the calibration to the top "0" mark on the USGPH scale.
- 2. Close isolation valve (#2) from supply tank, open isolation valve (#1) below cylinder and start the pump.
- Use a stopwatch to measure the time of one

 (1) minute (60 seconds) and record the
 volume dispensed by the metering pump,
 using the draw down scale.
- 4. Adjust the pump volume control higher or lower to meet with your desired output.
- 5. Repeat above steps 1 through 4, until the desired output is met.
- 6. Divide the measured USGPH number by 60 to determine the **USGPM volume**, if required.

If you wish to shorten the time of dispensing for calibration by one half (1/2) or one quarter (1/4), you must multiply the measured volume by the same number used to divide the time by.

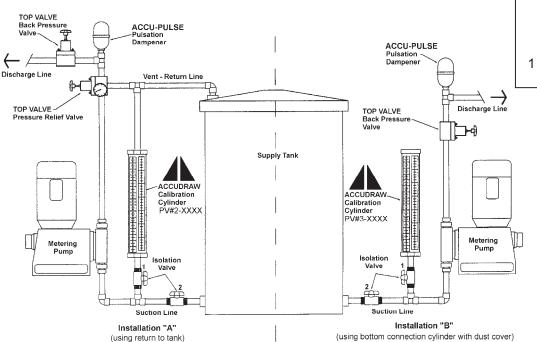
e.g. 10 USGPH in 1 minute equals 5 USGPH X 2 in 30 seconds or 2.5 USGPH X 4 in 15 seconds **Using the ml scale:** (scale is based on <u>volume</u> pumped, over any given time)

- 1. Fill the calibration cylinder to the top "0" mark on the ml scale.
- 2. Close isolation valve (#2) from supply tank, open isolation valve (#1) below cylinder and start the pump.
- Use a stopwatch to measure the time it takes to pump down a given volume (ml) in 60 seconds.
- 4. Multiply the volume by 60 to determine the <u>ml per hour</u> volume, if required.
- 5. Adjust the pump volume control higher or lower to meet with your desired output.
- 6. Repeat above steps 1 through 5, until the desired output is met.

If you wish to shorten the time of dispensing for calibration by one half (1/2) or one quarter (1/4), you must multiply the volume by the same number used to divide the time by to determine ml per minute or hour.

e.g. 100 ml in 60 seconds equals 50 ml X 2 in 30 seconds or 25 ml X 4 in 15 seconds

Typical Installations ("A" and "B")



Conversion Factors

1ml = 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

Caution:

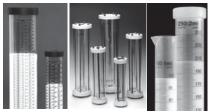
Do not use as a Pressure Vessel.



Call Toll Free 1-800-776-6580 Tel: (905) 333-8743 Fax: (905) 333-8746

Metering Pump Accessories Save \$\$\$\$ Prevent unsafe and inefficient systems by design.

ACCUDRAW Calibration Cylinders



- PVC, glass, polypropylene
- translucent, chemical resistant
- coloured graduations and letterina
- threaded or socket connections
- standard sizes 100 ml to 20.000 ml

Custom built in other sizes and materials.

TOP VALVE Back Pressure/Pressure Relief



- long life diaphragm
- range of 0 150 PSIG
- air release, optional gauge port
- PVC, CPVC, PVDF, Teflon, polypropylene, stainless, Alloy 20 and Hastellov C
- 7 sizes 1/4" 2" NPT
- colour coded handles indicate

Designed to enhance the accuracy and safety of your metering pumps.

ACCU-PULSE

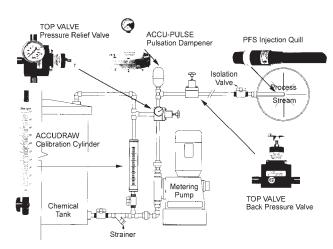
Pulsation Dampeners



Designed to remove pulsating flows from positive displacement pumps.

- · increase system efficiency and pump life
- decrease maintenance and costs
- protect pipes, meters, valves and instrumentation from pulsation and vibration
- ensure meter accuracy, longevity and repeatability
- prevent foaming and splashing
- · extensive range of materials and
- · lightweight, compact design

Typical Metering Pump System



AutoCad drawings available from our web site.

Visit www.primaryfluid.com

PFS Injection Quills



Designed to inject chemical into the center stream of process.

- provides for a more homogenous mix in the pipeline
- built-in checks to prevent back siphonina
- 2 sizes 6" and 8" length
- PVC, CPVC, PVDF, polypropylene, stainless and Hastellov C
- pressure to 3000 PSIG
- temperature to 260°C (500°F)

Custom built in other sizes and materials.

Accu-Vent



Designed to automatically vent gases and vapours.

- vents gases and vapors released from Sodium Hypochlorite, Sulfuric Acid & Hvdrogen Peroxide
- · CPVC (Corzan) and Viton corrosion resistant wetted materials of
- specially designed float material automatically vents built up gases on system start up and under working pressure
- standard 1/2" or 3/4" NPT threaded connections or optional socket weld
- · available in other materials

PFS Corporation Stops



Designed to inject chemical into the center stream of process.

- 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

Custom built in other sizes & materials.



MANUFACTURER INSTALLATION OPERATION AND MAINTENANCE MANUAL AMARUQ WTP – NUNAVUT VEOLIA PROJECT: 5000 218 009

PRIMARY FLUID SYSTEM ACCUDRAW GLASS SERIES, CALIBRATION CYLINDER



Glass Cylinder Calibration Instructions

Note: Before starting the calibration procedure below, ensure that the pump is primed and void of any trapped air.

Using the ml scale: (scale is based on **volume** pumped, over any given time)

1. Fill the calibration cylinder to the top mark with the liquid to be dispensed. This can be accomplished by manually filling the cylinder, or, if the feed tank level is higher than the cylinder, by opening the isolation valve below the cylinder and back filling the cylinder.

Caution: Never leave unattended when back filling the cylinder.

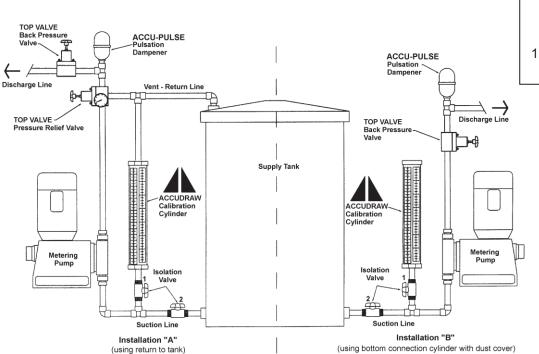
- 2. With the calibration cylinder full of the liquid to be dispensed, start the metering pump and operate at 100% output until all air is removed from both suction lines and pump head.
- 3. Shut pump "OFF".
- 4. With calibration cylinder full, close isolation Valve (#2) from supply tank, and open isolation valve (#1) below cylinder.
- 5. Start the pump.

- 6. Using a stop watch, measure the volume dispensed in 60 seconds.
- 7. Multiply the measured volume by 60 to find your **ml per hour** volume.
- 8. Adjust the pump volume control, higher or lower to meet with your desired output.
- 9. Repeat above steps 4 through 8 until your desired output is met.

If you wish to shorten the time of dispensing for calibration by one half (1/2) or one quarter (1/4), you must multiply the volume by the same number used to divide the time by to determine ml per minute or hour.

e.g. 100 ml in 60 seconds equals 50 ml X 2 in 30 seconds or 25 ml X 4 in 15 seconds

Typical Installations ("A" and "B")



Conversion Factors

1ml = 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

Caution:

<u>Do not</u> use as a Pressure Vessel



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ACCUDRAW Calibration Cylinders



PVC Glass

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- PVC, glass, polypropylene
- translucent, chemical resistant
- coloured graduations and lettering
- threaded or socket connections
- standard sizes 100 ml to 20,000 ml

Custom built in other sizes and materials.

TOP VALVE Back Pressure/Pressure Relief



- long life diaphragm
- range of 0 150 PSIG
- air release, optional gauge port
- PVC, CPVC, PVDF, PTFE, polypropylene, stainless, Alloy 20 and Hastelloy C
- 7 sizes ½" 2" NPT
- colour coded handles indicate size

Designed to enhance the <u>accuracy</u> and <u>safety</u> of your metering pumps.

ACCU-PULSE

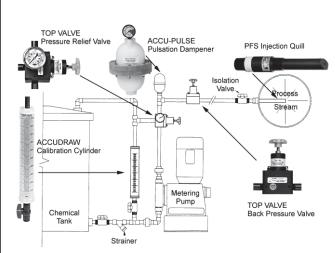
Pulsation Dampeners



Designed to remove pulsating flows from positive displacement pumps.

- increase system efficiency and pump life
- · decrease maintenance and costs
- protect pipes, meters, valves and instrumentation from pulsation and vibration
- ensure meter accuracy, longevity and repeatability
- prevent foaming and splashing
- extensive range of materials and sizes
- lightweight, compact design

Typical Metering Pump System



AutoCad drawings available from our web site.

Visit www.primaryfluid.com

PFS Injection Quills



Designed to inject chemical into the center stream of process.

- provides for a more homogenous mix in the pipeline
- built-in checks to prevent back siphoning
- · 2 sizes 6" and 8" length
- ½" or ¾" NPT, BPST, or Flg'd Conn.
- PVC, CPVC, PVDF, polypropylene, Stainless, Hastelloy C & Titanium
- pressure to 3000 PSIG
- temperature to 260°C (500°F)

Custom built in other sizes and materials.

Accu-Vent



Designed to automatically vent gases and vapours.

- vents gases and vapors released from Sodium Hypochlorite, Sulfuric Acid & Hydrogen Peroxide
- CPVC (Corzan) and Viton corrosion resistant wetted materials of construction
- specially designed float material automatically vents built up gases on system start up and under working pressure
- standard 1/2" or 3/4" NPT threaded connections or optional socket weld
- available in other materials

PFS Corporation Stops



Designed to inject chemical into the center stream of process.

- 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

Custom built in other sizes & materials.

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MANUFACTURER INSTALLATION OPERATION AND MAINTENANCE MANUAL AMARUQ WTP – NUNAVUT VEOLIA PROJECT: 5000 218 009

PRIMARY FLUID SYSTEM ACCUPULSE SERIES, PULSATION DAMPENER

ACCU-PULSE Installation and Operation Instructions

Chargeable Models

ACCU-PULSE Unit Inform	nation	
Serial Number:		Model Number:
Material of Construction:	Body: Bladder:	
Pump Area & Number: Date of Purchase:		
Onutant		
Phone:		

Notes:

- Primary Fluid Systems Inc. recommends installing a pressure relief valve such as TOP VALVE in all pump systems to ensure compliance with pressure limits on system equipment
- Mount ACCU-PULSE as close to pump discharge, inlet and/or quick closing valve as possible
- Temperature and pressure affect the strength and chemical resistancy of plastic and rubber; Consult Primary Fluid Systems Inc. for assistance
- Remove all pressure from ACCU-PULSE unit and pump system before attempting maintenance
- Do not exceed 150 PSI for standard models; 300 PSI for metallic units
- If a system pressure test is to be performed, ACCU-PULSE must be charged with 80% of the system test pressure, prior to test. This will avoid possible bladder damage.

Limited Warranty:

Primary Fluid Systems Inc. (Primary) warrants its products against defects in workmanship or materials for one (1) year under normal use. Primary's obligations and liabilities under this warranty shall be limited to replacement of the product, or a refund of an amount not to exceed the purchase price of the product(s) to which such warranty claim is made. Repairs or replacements are made subject to our inspection of the returned product(s). Primary's decision of one of these alternatives shall be the buyer's exclusive remedy.

This warranty does not extend to damage by corrosion or other decomposition by chemical action. Primary does not warrant damages caused by (a) improper use of the product, (b) unauthorized modification or attachment to product, (c) misuse, abuse, accident or negligent handling or installation of product, or (e) alterations or repairs made by purchaser. The materials of construction offered are recommendations subject in all cases to acceptance by purchaser. These recommendations do not constitute guarantee against corrosion or decomposition, but are based on previous experience and best available information of the industry.

Statements and instructions set forth herein are based on the best information and practices known to Primary, but it should not be assumed that every acceptable safety procedure is contained herein. Of necessity Primary cannot guarantee that actions in accordance with such statements and instructions will result in the complete elimination of hazards and it assumes no liability for accidents that may occur.

Except as specifically provided herein, Primary makes no warranty, representations, promise or guarantee, either express or implied, statutory or otherwise, with respect to the product and technical information including their quality, performance, merchantability, or fitness for a particular purpose. In no event will Primary be liable for indirect, special, incidental, economic, covert or consequential damages arising out of the use or inability to use the product, including without limitation, damages or costs relating to the loss of profits, business and goodwill even if advised of the possibility of such damages. In no event shall Primary's liability exceed the amount paid by you for the product.

The warranty and remedies set forth herein are exclusive and in lieu of all others, oral or written, express or implied. No Primary dealer, distributor, agent or employee is authorized to make any modification or addition to this warranty. This warranty gives you specific legal rights and you may also have other rights which vary from state to state.



Pump Discharge Installation: Chargeable Models

Step 1: Mounting Position

Mount ACCU-PULSE as close to the pump discharge as possible to absorb the pulse at its source. The pulsation dampener will optimally perform if mounted at the first 90 ° turn in the discharge piping. If using a flexible connector from the pump to your point of discharge, ACCU-PULSE should be hard piped to the pump discharge manifold, then continue with flexible tubing from dampener. Since pressure is equal in all directions, ACCU-PULSE can be installed in any position - vertically, horizontally, upside down. Primary Fluid Systems Inc. does recommend a vertical position for better draining of the unit.

Limitations for horizontal and upside down mounting include high specific gravity, high viscosity, settling of heavy material or possible air entrapment.

Step 2: Air Line Connection

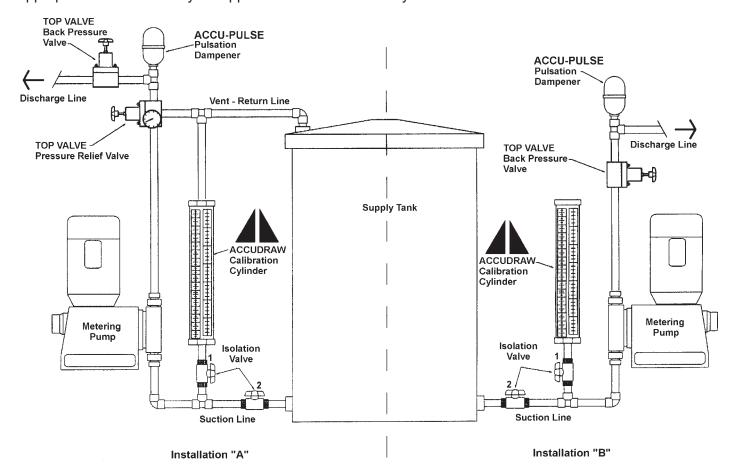
Chargeable models do not require an air line connection, the units must be charged with compressed air or nitrogen, using a hand pump, tank or compressor.

Step 3: Charging and Start Up

Prior to starting the pump, charge ACCU-PULSE with compressed air or nitrogen to approximately 70 to 85% of expected system pressure, to a maximum of 150 PSI for standard models; 300 PSI for metallic models. Start the pump to generate working or system pressure. Once working pressure is achieved, adjustment may be necessary; gradually increase or decrease the gas charge in the dampener by bleeding or filling through the gas valve. Allow the system to respond to each adjustment (this may take a minute or two) before continuing any further adjustments. Generally, pulsation is most effectively minimized when the gas charge is 80 to 85 % of system/pump discharge pressure. Pressure should be checked periodically. Recharge when necessary.

Typical Installations

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



ACCU-PULSE Safety Warnings

This dampener should only be installed and used by experienced and trained professional mechanics. Observe all safety warnings. Read all safety warnings and operating manuals before using or repairing this Pulsation Dampener (hereafter referred to as "dampener").

General Safety

This dampener is not intended to be used as a stand alone machine. EU member states must note: Do not use this dampener before it is combined into another machine or assembly that complies with all relevant EU safety directives and that the assembler's CE mark is affixed on completion.

The internal dampener pressure will equal the maximum fluid pressure of the system in which it is installed.

Do not exceed maximum pressure as stated on dampener tag. If tag is missing, do not use this dampener without consulting distributor or factory for maximum pressure rating.

Always make sure safety shut off valves, regulators, pressure relief valves, gauges etc. are working properly before starting system or assembly.

Always wear protective gloves, safety glasses, etc. when working on or near this dampener.

Before starting a system or assembly, make certain the discharge point of the piping system is clear and safe, and all persons have been warned to stand clear.

Always wear safety glasses when installing, charging or repairing this dampener.

Do not put your face or body near dampener when the system assembly is operating or dampener is pressurized.

Do not operate a dampener that is leaking, damaged, corroded or otherwise unable to contain internal fluid, air or gas pressure.

Do not pump incompatible fluids through the dampener. Consult your distributor or the factory if you are not sure of the compatibility of the fluids with the dampener materials.

Dampeners are designed to operate with compressed air or nitrogen. Other compressed gases have not been tested and may be unsafe to use in dampeners.

Bleed all pressure from system and dampener before removing equipment from the system.

Always shut off air supply, bleed internal dampener pressure and shut isolation valve before performing maintenance or repair on dampener.

Static spark can cause an explosion resulting in severe injury or death. Ground dampeners and pumping system when pumping flammable fluids.

Equipment Misuse Hazard

General Safety:

Any misuse of this equipment such as over pressurization, modifying parts, incompatible chemicals, using worn or damage parts or using gases other than air or nitrogen to charge dampener is not recommended. Any of these circumstances could result in serious bodily injury, death, fire, explosion or property damage.

Over-Pressurization:

Never exceed the maximum operating pressure recommended for the dampener model being used. Maximum operating pressure is stated on tag. Pressure limits are stated at 20°C / 70°F.

Temperature Limits

Do not exceed the recommended operating temperatures for the shell and elastomer materials, independently. Excessive temperature will result in dampener failure.

Temperature limits are stated at zero psig / bar.

Installation and Start Up Hazards:

Install dampener before charging or pressurizing.

Do not start system or assembly without first charging or pressurizing dampener. Failure to charge may result in damage to the elastomeric bladder.

Temperature & Pressure Hazard:

Temperature and pressure reduce the strength and chemical resistance of plastic, metal and rubber.

Charging / Pressurization:

Charge or pressurize the dampener with compressed air or nitrogen only. **Do NOT use oxygen.**

Dampener Bladder Failure:

Dampeners utilize an elastomeric membrane to separate system fluid from the air supply or gas charge. When this membrane ruptures, system fluid may be expelled from the air valve. Always perform preventive maintenance and replace elastomers before excessive wear occurs.

Maintenance Hazards:

Never over-tighten clamp bands. This may cause leakage of system fluid and damage to dampener shell.



MANUFACTURER INSTALLATION OPERATION AND MAINTENANCE MANUAL AMARUQ WTP – NUNAVUT VEOLIA PROJECT: 5000 218 009

PULSAFEEDER PULSAR SHADOW SERIES, MECHANICAL DIAPHRAGM DOSING PUMP

SPULSAFEEDER[®] ENGINEERED PRODUCTS

Installation, Operation & Maintenance Manual



Bulletin: IOM-PSRM-1501 REV B

PULSAR® Shadow MECHANICAL DIAPHRAGM METERING PUMP

PULSAR® Factory Service Policy

Should you experience a problem with your *PULSAR* pump, first consult the troubleshooting guide in your operation and maintenance manual. If the problem is not covered or cannot be solved, please contact your local Pulsafeeder Sales Representative, or our Technical Services Department for further assistance. You may also visit our website at www.pulsa.com

Trained technicians are available to diagnose your problem and arrange a solution. Solutions may include purchase of replacement parts or returning the unit to the factory for inspection and repair. All returns require a Return Authorization number to be issued by Pulsafeeder. Parts purchased to correct a warranty issue may be credited, after an examination of original parts by Pulsafeeder. Warranty parts returned as defective which test good will be sent back freight collect. No credit will be issued on any replacement electronic parts.

Any modifications or out-of-warranty repairs will be subject to bench fees and costs associated with replacement parts.

Safety Considerations:

- 1. Read and understand all related instructions and documentation before attempting to install or maintain this equipment
- 2. Observe all special instructions, notes, and cautions.
- 3. Act with care and exercise good common sense and judgment during all installation, adjustment, and maintenance procedures.
- 4. Ensure that all safety and work procedures and standards that are applicable to your company and facility are followed during the installation, maintenance, and operation of this equipment.

Notice

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Conventions

The following Conventions are used in this document.

A \ G DEFINES A CONDITION THAT COULD CAUSE DAMAGE TO BOTH THE EQUIPMENT AND THE PERSONNEL OPERATING IT. PAY CLOSE ATTENTION TO ANY WARNING.

S ARE GENERAL INFORMATION MEANT TO MAKE OPERATING THE EQUIPMENT

Revision History:

REV A Release date February, 2016

Branding and document number updated

REV B Release date May, 2016

Appendix III, Bolt torque table updated

1. Introduction

PULSAR Shadow[®] metering pumps are positive displacement reciprocating pumps. They combine the high efficiency of the plunger pump with diaphragm sealing to prevent product leakage. Each pump consists of a power end and a process end separated by a mechanically operated diaphragm. Individual pumps will vary in appearance due to various liquid ends, accessories, and multiplexing; however, the basic principles of operation remain the same.

1.1 Overall Operation

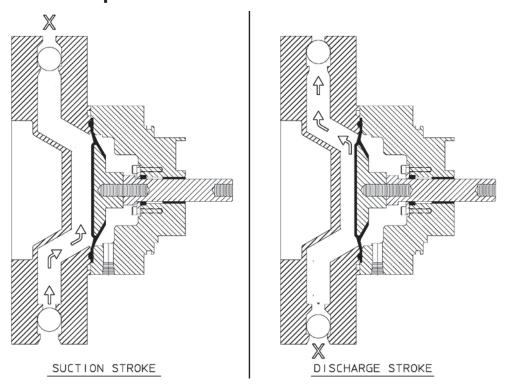


Figure 1

A diaphragm reciprocates at a preset stroke length, displacing an exact volume of process fluid. Diaphragm retraction causes the product to enter through the suction check valve. Diaphragm advance causes the discharge of an equal amount of the product through the discharge check valve.

1.2 Component Layout

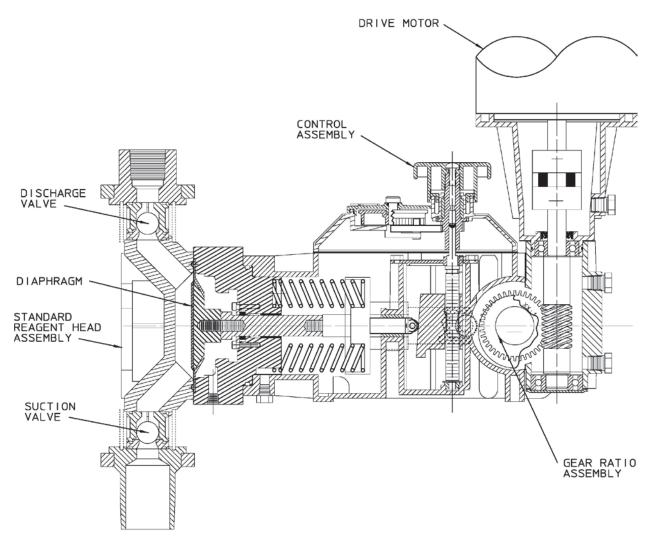


Figure 2

A typical model with manual external stroke adjustment is shown.

1.3 Standard Reagent Head Assembly

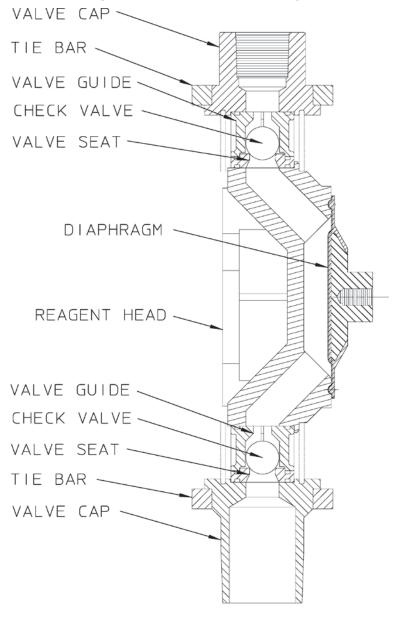


Figure 3

The typical reagent head assembly consists of reagent head, diaphragm, and suction and discharge check valves. This assembly is the only part of the pump to contact the process liquid; consequently, maintenance is critical to pump performance. For most pump configurations, suction and discharge check valve components are identical.

1.4 Leak Detection Assembly

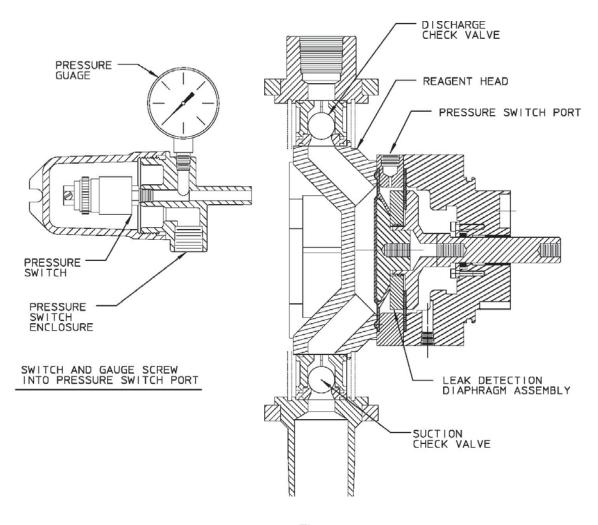


Figure 4

The Leak Detection Assembly (LDA) consists of a reagent head, suction and discharge check valves, primary diaphragm, leak detection diaphragm assembly, pressure switch port, and optional pressure switch and gauge. The reagent head, suction and discharge check valves, and primary diaphragm are the only parts of the pump to contact the process liquid; consequently, maintenance is critical to pump performance.

If there is a breach of the primary (product side) diaphragm, process liquid will enter the space between the primary and leak detection diaphragms. The liquid will be contained in this area and is prevented from contacting other components of the pump. On the discharge stroke, pressure will build in between the diaphragms. This pressure will activate the pressure switch. It is recommended that the pressure switch be integrated into a control system that will shut the pump off if a leak is detected. The pressure switch may be wired directly to a Pulsafeeder DLC or DLCM controller if the pump is so equipped.

1.5 Control Assembly

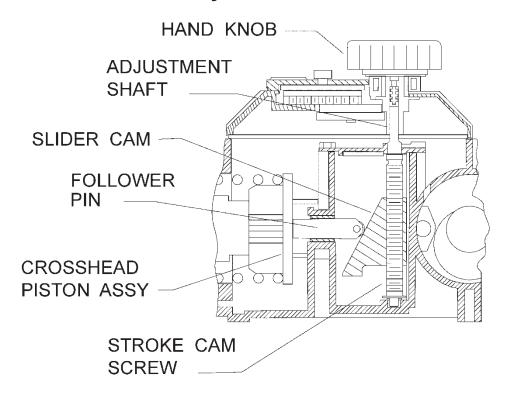


Figure 5

PULSAR Shadow® pumps incorporate a lost motion style of stroke length adjustment to limit diaphragm travel during the suction portion of each stroke. The stroke length setting is indicated by a (0 - 100) scale located on the top of the unit.

Stroke length is changed by depressing and turning the hand knob. This turns a screw, which locates a wedge-shaped slider cam to position the follower pin, which in turn limits rearward travel of the diaphragm.

To increase stroke length, the slider cam is moved downwards. This allows the follower pin to slide back, increasing the distance the diaphragm can travel with each pump stroke.

To decrease stroke length, the slider cam is moved upwards. This moves the follower pin forwards, decreasing the diaphragm travel, and therefore the flow rate of the pump.

1.6 Gear Ratio Assembly

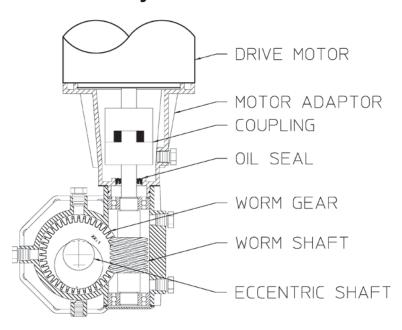
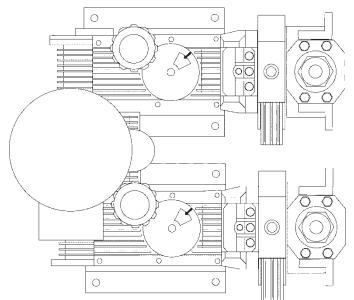


Figure 6

PULSAR Shadow[®] pumps are driven by a standard C-face electric motor mounted on the motor adaptor input flange. The motor drives a set of worm gears, which convert rotational speed into torque. They, in turn, power the eccentric shaft assembly that converts rotary motion into reciprocating motion. The drive motor can be wired to rotate in either direction.



More than one pump can be driven through a single drive assembly. This is referred to as multiplexing. The pumps are mounted to a common gearbox assembly, and driven by a common motor. Each pump is mounted on a standard simplex base.

Whenever pumps are multiplexed, the eccentric shafts are positioned to place a uniform load on the driver. Before full disassembly, always note the relative positions of the eccentric shafts to each other so they can be reassembled back in the same orientation.

Figure 7

2. Equipment Inspection

Check all equipment for completeness against the order and for any evidence of shipping damage. Shortages or damage should be reported immediately to the carrier and your authorized representative for PULSAR Shadow[®] pumps.

3. Storage Instructions

3.1 Short Term

Storage of PULSAR Shadow® pumps for up to 12 months is considered short-term. The recommended short-term storage procedures are:

- 1. Store the pump indoors at room temperature in a dry environment.
- 2. Within two months after date of shipment, fill the eccentric box to its normal operating level with Pulsalube 9M oil. If required by the operating environment, take any steps required to prevent entry of water or humid air into the eccentric enclosure.
- 3. Prior to start up, inspect housing, and gearbox. Replenish eccentric and gearbox oils as required to maintain operating levels. If water or condensation is present, change oil as described under Equipment Startup, Section 5.
- 4. Prior to startup, perform a complete inspection and then start up in accordance with instructions in this manual.

3.2 Long Term

Every twelve months, in addition to the above short-term procedures, power up the motor and operate the pump for a minimum of one hour. It is not necessary to have liquid in the reagent head during this operation, but the suction and discharge ports must be open to atmosphere.

After twelve months of storage, Pulsafeeder's warranty cannot cover items that are subject to deterioration with age such as seals and gaskets. If the pump has been in storage longer than 12 months it is recommended that such items be inspected and replaced as necessary prior to startup. Materials and labor to replace this class of item under these circumstance are the purchaser's responsibility. For a continuance of the initial warranty after extended storage, equipment inspection and any required refurbishing must be done by a Pulsafeeder representative.

4. Installation

4.1 Location

When selecting an installation site or designing a skid package, consideration should be given to access for routine maintenance.

PULSAR Shadow® pumps are designed to operate indoors and outdoors, but it is desirable to provide a hood or covering for outdoor service. External heating is required if ambient temperatures below 00 C (320 F) are anticipated. Check with the factory if concerned with the suitability of the operating environment.

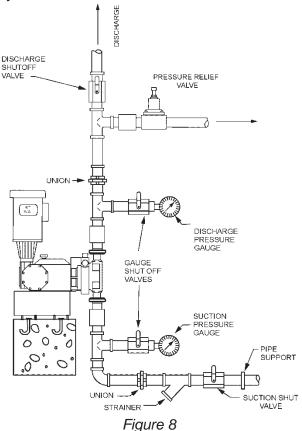
The pump must be rigidly bolted to a solid and flat foundation to minimize vibration, which can loosen connections. When the pump is bolted down, care must be taken to avoid distorting the base and affecting alignments. The pump must be level within 5O. This will assure that the eccentric and gear oils are maintained at the proper levels and that the check valves can operate properly.

4.2 Piping System

All piping systems should include:

A separate system relief valve to protect piping and process equipment, including the pump, from excess process pressures. *An external relief valve is required, as a mechanical diaphragm pump does not incorporate an internal relief.

Shutoff valves and unions (or flanges) on suction and discharge piping. This permits check valve inspection without draining long runs of piping. Shutoff valves should be of the same size as connecting pipe. Ball valves are preferred since they offer minimum flow restriction.



An inlet strainer, if the product is not a slurry. Pump check valves are susceptible to dirt and other solid contaminants unless designed for that service, and any accumulation can cause malfunction. The strainer should be located between the suction shutoff valve and the pump suction valve. It must be sized to accommodate the flow rate and the anticipated level of contamination. A 100-mesh screen size is recommended.

Vacuum/pressure gauges in the suction and discharge lines in order to check system operation. Gauges should be fitted with protective shutoff valves for isolation while not in use.

Piping weight must not be supported by valve housings or other portions of the reagent head, as the resulting stresses can cause leaks. If appropriate, provide for thermal expansion and contraction so that no excess force or moments are applied to the pump.

In piping assembly, use a sealing compound chemically compatible with the process material. Users of sealing tape are cautioned to ensure that the entering pipe thread ends are not taped, and that tape is removed from previously-used threads to the maximum practical extent prior to re-use. Both new and existing piping should be cleaned, preferably by flushing with a clean liquid (compatible with process material) and blown out with air, prior to connection to the pump.

4.3 Suction Pressure Requirements

Although PULSAR Shadow® metering pumps have suction lift capability, a flooded suction (i.e., suction pressure higher than atmospheric pressure) is preferable whenever possible. The pump should be located as close as possible to the suction side reservoir or other source.

For fluid with a vapor pressure of 5 psia or less (at operating temperature) the wet suction lift capability is ten (10) feet. If this requirement is not met, the pump will not provide reliable, accurate flow. The Net Positive Suction Head Required (NPSHR) is 0.35 bar (5 psi).

The maximum inlet pressure is limited to 0.35 bar (5 psi) below the operating discharge pressure.

Refer to Appendix I for procedures for the calculation of suction pressure.

4.4 Discharge Pressure Requirements

All PULSAR Shadow® Metering Pumps are designed for continuous service at the rated discharge pressure. If system suction pressure were to exceed system discharge pressure (a condition sometimes described as "pumping downhill"), flow would be generated (siphoning) in addition to that caused by the pump, resulting in a reduction in accuracy and loss of control over the metering process. To prevent this condition, commonly referred to as "flowthrough", the discharge pressure must exceed suction pressure by at least 0.35 Bar (or 5 psi). This can be achieved where necessary by the installation of a backpressure valve in the discharge line.

Damage to the pump will occur if operated at pressures beyond the maximum rating.

Refer to Appendix I for procedures for the calculation of discharge pressure.

4.5 Automatic Control

Pumps equipped with the DLC, DLCM, or ECA electronic stroke length controllers are provided with separate instructions. Refer to the latest Installation, Operation and Maintenance Manual specific to your controller. Follow all safety and operational information contained in those documents. Perform and verify all controller installation procedures prior to pump startup.

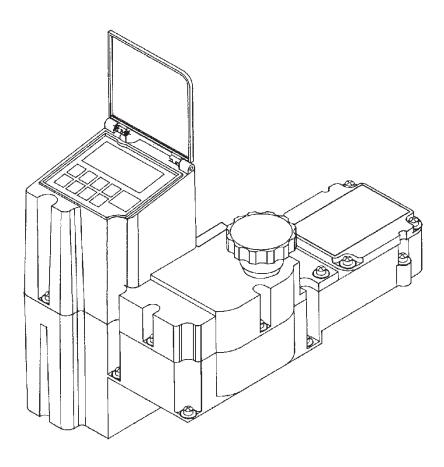
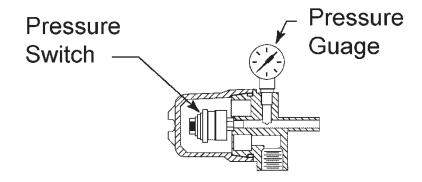


Figure 9

4.6 Leak Detection Assembly



Pressure Switch Enclosure

Figure 10

If the diaphragm leak detection system was specified with an optional pressure switch, install electrical wiring and conduit in accordance with local electrical codes. The switch is rated as follows:

The switch is rated as follows:

30 VDC or 125 VAC 1 Ampere Resistive.

The switch should be wired such that if a leak condition is detected, the pump will be shut down. The switch is the SPDT (single pole, double throw) type and can therefore be connected to either open or to close upon detection of diaphragm leak condition. Contacts or wires are identified as follows:

Normally Open (NO) wire color WHITE

Normally Closed (NC) wire color RED

Common (Com) wire color BLACK



THE ENCLOSURE IS LABELED WITH APPLICABLE SAFETY AGENCY RATINGS FOR HAZARDOUS AREA INSTALLATION. SINCE THE SWITCH IS OF THE MECHANICAL CONTACT TYPE, IT CAN NEVER QUALIFY AS NON-SPARKING (NON-INCENDIVE, OR "M") FOR OCCASIONAL AND SHORT-TERM HAZARDOUS AREA USE. PROTECTION MUST BE PROVIDED BY THE ENCLOSURE.

4.7 Drive Motor Installation

4.7.1 Motor Rotation

Motor can be operated in either direction, clockwise or counterclockwise. Verification of motor direction is not necessary at startup.

4.7.2 Motor Installation

PULSAR Shadow® pumps may be shipped with the drive motor packed separately. This is done to avoid damage during transport.

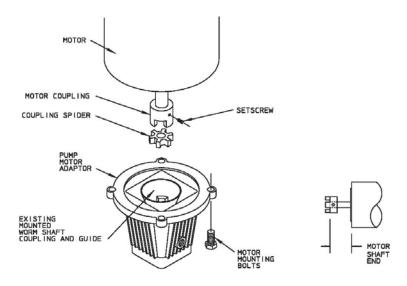


Figure 11

Remove the unattached coupling half from the motor adaptor. Ensure that the elastomer coupling spider remains in place, on the coupling half that remains attached to the worm shaft.

If applicable, remove any tape or retainer rings that hold the motor shaft key in place.

Place the loose coupling half on the motor shaft. Align the keyway with the key and align shaft end to inner coupling surface as shown in figure above.

Tighten the setscrew onto the shaft key.

Place the motor in a vertical position and align the coupling teeth.

Install the motor downwards onto the adaptor. The plastic guide will assist in aligning the coupling halves. Final position can be achieved by slightly rotating the motor until the coupling jaws align.

Rotate the motor until the clearance holes in the adaptor and the tapped holes in the motor align. Fasten the motor to the adaptor using the supplied bolts (4). Tighten bolts evenly to secure motor.

4.7.3 Electrical

Wire the PULSAR Shadow® drive motor according to the motor vendor's nameplates and instructions, and according to any appropriate national and local electrical codes and regulations.

If the motor is to be utilized with a Pulsafeeder controller, such as the DLC or DLCM, consult the appropriate Pulsafeeder IOM for further motor wiring instructions.

5. Equipment Startup



PULSAR SHADOW[®] PUMP USE TWO SEPARATE OILS: PULSALUBE 9M OIL FOR THE ECCENTRIC BOX AND PULSALUBE 8G, GEAR OIL FOR THE GEARBOX. CONFUSION BETWEEN THE TWO REDUCES PERFORMANCE OF THE PUMP.

5.1 Oil Capacities

Pulsalube 9M lubricating oil is available in 950 ml (1 quart) containers.

Pulsalube 8G gear oil is available in 200 ml (.21 quarts) or 950 ml (1 quart) containers.

It is recommended that adequate supplies of both PULSAlube oils be on hand for periodic changes and emergency requirements. The approximate amounts of oil required to fill PULSAR Shadow® pumps to specified levels are:

	Eccentric Box, all	Gearbox, Model 25B	Gearbox, Model 55B
Eccentric Oil, No. 9M	950 ml (1 Qt)		
Gear Oil, No. 8G		150 ml (0.16 Qt)	200 ml (0.21 Qt)

5.2 Eccentric Oil Fill

Fill the eccentric box with oil by removing the manual cover assembly or DLC/M or ECA controller if so equipped. Fill with the proper oil (Pulsalube 9M) to the upper edge of the crosshead assembly and return spring(s) or slightly above. Replace the cover or controller. Take care not to disturb the stroke length setting when reinstalling. See figure 12.

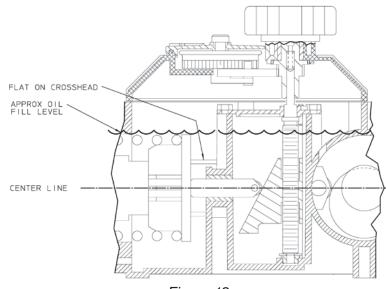


Figure 12

5.3 Gear Oil Fill

In all pump configurations, one pipe plug is present at the top of the gearbox and one is on the side at the centerline level. Remove the top plug and fill with Pulsalube 8G gear oil through the top port to the level of the eccentric shaft centerline, which is level with the side port. The side plug should be removed so that leakage from the side port indicates attainment of the required level. Replace both pipe plugs after filling.



GEAR OIL IS FILLED AT THE FACTORY, AND THE GEARBOX IS SHIPPED FULL.

DO NOT ADD OIL THROUGH THE PORT ON THE SIDE OF THE MOTOR ADAPTOR. THIS PORT IS FOR MOTOR COUPLING ACCESS ONLY.

5.4 Oil Changes

The recommended oil change intervals are dependent upon the operating environment and level of pump usage, classified as follows:

Normal service: Clean/dry atmosphere, an ambient operating temperature of 00°C to 400°C (320°F to 1040°F) and up to 2,000 annual operating hours.

Severe Service: Humid atmosphere, an ambient operating temperature below 00°C (320°F) or above 400°C (1040°F), and over 2,000 annual operating hours.

5.4.1 Eccentric Oil Change:

The recommended eccentric oil change interval is two (2) years for normal service and one (1) year for severe service. The procedure is as follows:

- 1. Disconnect the power source to the drive motor
- 2. Relieve all pressure from the piping system.
- 3. Remove the top cover or controller from the pump.
- 4. Drain the oil by removing the drain plug on the bottom of the eccentric box.
- 5. Replace the drain plug.
- 6. Fill the eccentric box with Pulsalube 9M oil as described under Eccentric Oil Fill.
- 7. Replace the top cover or controller.

5.4.2 Gear Oil Change:

The recommended gear oil change interval is five (5) years for normal service and two (2) years for severe service. The procedure is as follows:

- 1. Disconnect the power source to the drive motor
- 2. Relieve all pressure from the piping system.
- 3. Remove the fill plug from the top of the gearbox.
- 4. Drain the oil by removing the drain plug on the bottom of the gearbox.
- 5. Replace the drain plug.
- 6. Refill with fresh Pulsalube 8G (amber) gear oil as described under Gear Oil Fill.
- 7. Be sure to replace the top fill plug and side plug.

6. Startup

6.1 Output Adjustment

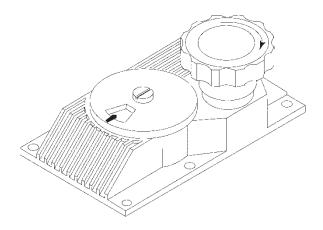


Figure 13

PULSAR Shadow[®] pumps have a handwheel for manual stroke length adjustment. Mounted atop the eccentric box, the handwheel can be adjusted at any point from (0 to 100%) stroke setting by pressing down and then rotating as required. Stroke length is locked during operation to prevent drift: pressing the handwheel down temporarily disengages the lock for adjustment; release after adjustment automatically resets the lock at the new setting. An indicator adjacent to the handwheel displays the output setting. Adjustments can be made while the pump is at rest or operating, although adjustments are easier to make while the pump is in operation. Manual adjustment serves as a backup for pumps provided with DLC/M controllers.

6.2 Priming the Reagent Head

- 1. Open the suction and discharge line shutoff valves.
- 2. If the piping system design and the storage tank are such that the product flows due to gravity through the pump, reduce the discharge pressure and the system will self prime when the pump is started. In the event the discharge line contains a significant amount of pressurized air or other gas, it may be necessary to lower the discharge pressure to enable the pump to self-prime.
- 3. If the installation involves a suction lift, it may be necessary to prime the reagent head and suction line. Try priming the reagent head first. Refer to the Maintenance Section on Check Valves. Remove the discharge valve assembly. Fill the head through the discharge valve port with process (or compatible) liquid, and then reinstall the valve.
- 4. Start the pump at the zero stroke length setting and slowly increase the setting to 100 to prime the pump. If this does not work, it will be necessary to fill the suction line.
- 5. Filling of the suction line will necessitate the use of a foot valve or similar device at the end of the suction line so that liquid can be maintained above the reservoir level. Remove the suction valve assembly, fill the line, replace the valve, then remove the

discharge valve assembly and fill the reagent head as described in Step (3) above. The pump will now self-prime when started up per step (4) above.

6.3 Calibration

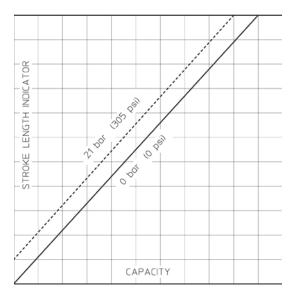


Figure 14

All metering pumps must be calibrated in order to accurately specify stroke length settings for required flow rates. For pumps provided with DLC/M electronic controls, refer to separate instructions provided with those controllers.

A typical calibration chart is shown in Figure 14. Although output is linear with respect to stroke length setting, an increase in discharge pressure decreases output uniformly, describing a series of parallel lines, one for each pressure (only two are shown).

The theoretical output flow rate at atmospheric discharge pressure is based on the displacement of the diaphragm, stroke length and the stroking rate of the pump. With increasing discharge pressure there is a some corresponding decrease in output flow. Pumps are rated at a certain flow at their rated pressure (check nameplate). Whenever possible, calibration should be performed under actual process conditions (i.e., the same or a similar process liquid at system operating pressure).

To construct a calibration chart, measure the flow rate several times at three or more stroke settings (i.e., 25, 50, 75, and 100), plot these values on linear graph paper, and draw a best-fit line through the points. For stable conditions, this line should predict settings to attain required outputs.

6.4 Leak Detection

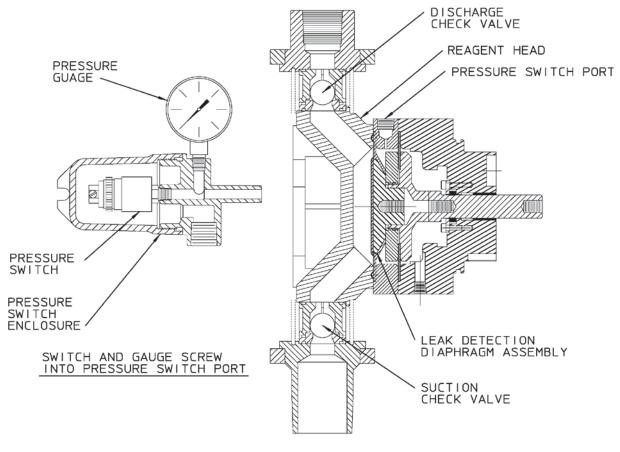


Figure 15

Follow the same priming procedure for a standard reagent for pumps equipped with the diaphragm leak detection system.

If the optional pressure switch has been supplied, apply power to the alarm circuit. It is recommended that this switch be integrated into the pump control system. If a failure of the diaphragm is detected, the pump should be shut down until a diagnosis of the fault can be made.

7. Maintenance



BEFORE PERFORMING ANY MAINTENANCE REQUIRING REAGENT HEAD OR VALVE (WET END) DISASSEMBLY, BE SURE TO RELIEVE PRESSURE FROM THE PIPING SYSTEM AND, WHERE HAZARDOUS PROCESS MATERIALS ARE INVOLVED, RENDER THE PUMP SAFE TO PERSONNEL AND THE ENVIRONMENT BY CLEANING AND CHEMICALLY NEUTRALIZING AS APPROPRIATE. WEAR PROTECTIVE CLOTHING AND EQUIPMENT AS REQUIRED.

Accurate records from the early stages of pump operation will indicate the type and levels of required maintenance. A preventative maintenance program based on such records will minimize operational problems. It is not possible to forecast the lives of wetted parts such as diaphragms and check valves. Since corrosion rates and operational conditions affect functional material life, each metering pump must be considered according to its particular service conditions.

PULSAR Shadow® KOPkits contain all replacement parts normally used in a preventative maintenance program. It is recommended that KOPkits and PULSAlube eccentric and gear oils be kept available at all times.

7.1 Wet End Removal, Inspection and Reinstallation



IF THE DIAPHRAGM HAS FAILED, PROCESS FLUID MAY HAVE CONTAMINATED THE PUMP ECCENTRIC OIL (ALTHOUGH NORMALLY, ANY PROCESS FLUID BEHIND A FAILED DIAPHRAGM WOULD PASS THROUGH THE BOTTOM DRAIN HOLE). HANDLE WITH APPROPRIATE CARE, CLEAN AND REPLACE OIL IF REQUIRED.

7.1.1 Standard Diaphragm

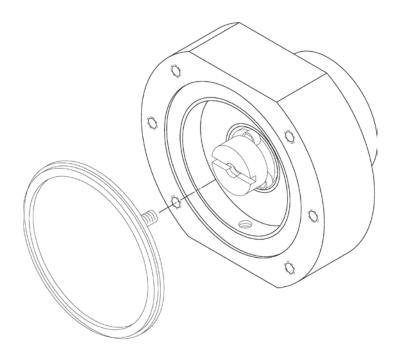


Figure 16

PULSAR Shadow® diaphragms do not have a specific cycle life; however, the accumulation of foreign material or debris sufficient to deform the diaphragm can eventually cause failure. Failure can also occur as a result of system over pressure or chemical attack. Periodic diaphragm inspection and replacement are recommended.

- 1. Adjust the stroke setting to 50 percent and disconnect the power source to the drive motor
- 2. Relieve all pressure from the piping system.
- 3. Take all precautions described in this manual to prevent environmental and personnel exposure to hazardous materials.
- 4. Close the inlet and outlet shutoff valves.
- 5. Disconnect piping to the reagent head and drain any process liquid, following material safety precautions described. Removal of the check valves may assist in this process.
- 6. Place a pan underneath the pump head adaptor to catch any liquid leakage.
- 7. Remove all but one top reagent head bolt. Product will leak out between the pump head adaptor and reagent head as the bolts are loosened.
- 8. Tilt the head and pour out any liquids retained into a suitable container, continuing to follow safety precautions as appropriate.
- 9. Remove the final bolt and rinse or clean the reagent head as required.
- Remove the diaphragm by turning counter-clockwise and inspect the diaphragm.
 The diaphragm must be replaced if any surface is cracked, separated, or obviously damaged.
- 11. To install a diaphragm, first ensure that the critical sealing areas of diaphragm, reagent head, and pump head are clean and free of debris. Lubricate the elastomer (back) side of the diaphragm liberally, where it is in contact against the pump head and deflection plate, with a lubricant compatible to the fluid being pumped (silicone grease is preferred ex. Parker 'Super O-Lube').
- 12. Thread the diaphragm (clockwise) fully onto the shaft. When reinstalling a used diaphragm it is not necessary to maintain the previous orientation relative to the reagent head or pump head hole pattern.
- 13. Install the reagent head and tighten the bolts in an alternating pattern to ensure an even seating force. Torque to the values recommended in Appendix III.
- 14. Replace the check valve assemblies. It is recommended that new o-ring seals be utilized when these components have been disassembled for maintenance.
- 15. Reprime the pump per the procedure outlined in Section 6.2

7.1.2 Leak Detection

Follow the same procedures as described for the standard diaphragm, steps 1-15.



IT IS NOT NECESSARY TO REMOVE OR REPLACE THE LDA SECONDARY (REAR) DIAPHRAGM UNLESS IT HAS BEEN DAMAGED.



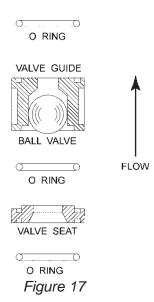
IF DISASSEMBLY OF THE HEAD IS REQUIRED, EXERCISE CAUTION DURING REMOVAL SINCE THE RETURN SPRING OF THE PISTON IS UNDER FULL LOAD. CONSULT FACTORY PRIOR TO PERFORMING THIS PROCEDURE.

7.2 Check Valves

7.2.1 General Description

Most fluid metering problems are related to check valves. Problems usually stem from solids accumulation between valve and seat, corrosion of seating surfaces, erosion, or physical damage due to wear or the presence of foreign objects.

The valve incorporates a ball, guide, and seat. Flow in the unchecked direction lifts the ball off the seat, allowing liquid to pass through the guide. Reverse flow forces the ball down, sealing it against the sharp edge of the seat. The guide permits the ball to rotate but restricts vertical and lateral movement in order to minimize "slip" or reverse flow. Ball rotation prolongs life by distributing wear over the entire surface of the ball. Since ball return is by gravity, the valve must be in the vertical position in order to function properly. Parts are sealed by "O"-rings.



7.2.2 Removal, Inspection, and Reinstallation

Use the following procedure to remove, inspect and reinstall the check valves:

- 1. Disconnect the power source to the drive motor.
- 2. Relieve all pressure from the piping system.
- 3. Take all precautions to prevent environmental and personnel exposure to hazardous materials.
- 4. Close the inlet and outlet shutoff valves.
- 5. Loosen the suction valve tiebar bolts and spring the suction piping slightly to drain any liquid from the reagent head cavity. If the piping is closely connected it may be necessary to disconnect a union or flange.
- 6. Remove the suction check valve assembly (ball contained within guide and seat), holding it together as a unit.
- 7. Loosen the tiebar bolts on the discharge valve and spring the piping slightly to drain any liquid.
- 8. Remove the discharge check valve assembly, holding it together as a unit as before.
- 9. Disassemble both valves and examine components for wear. Seats should have sharp edges or a small chamfer, free from dents or nicks. Hold the ball firmly against its mating seat in front of a bright light to inspect for fit.



OBSERVATION OF LIGHT BETWEEN BALL AND SEAT IS CAUSE FOR REPLACEMENT OF EITHER OR BOTH COMPONENTS. FOR BEST RESULTS, ALWAYS LOOSEN THE UNIONS OR FLANGES ON EITHER SIDE OF THE SYSTEM PIPING PRIOR TO RE-TIGHTENING OF THE CHECK VALVE ASSEMBLIES. RETIGHTEN THE UNIONS OR FLANGES AFTER THE CHECK VALVES ARE SECURELY TIGHTENED INTO POSITION.

- 10. Reassemble both valves using new parts as required. Sealing "O"-rings should generally be replaced.
- 11. Reinstall both valve assemblies, taking care to ensure that they are correctly oriented with balls above seats.
- 12. Tighten the tiebar bolts evenly, making sure the valve assemblies are assembled squarely. Refer to *Appendix III* for torque values.
- 13. Check for leaks and retighten tiebar bolts as necessary. Re-check any piping connections that may have been disturbed.

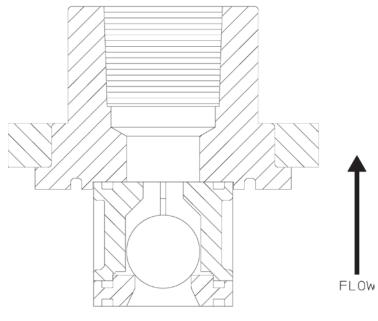


Figure 18

7.3 Oil Seals - General Description

The pump has four oil seals as follows:

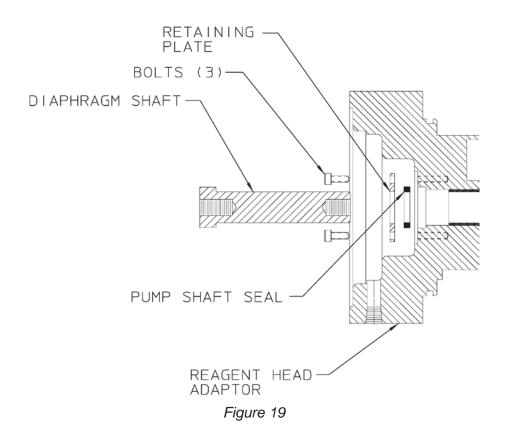
Seal	Location
Pump shaft	Inside the pump head
Motor adapter	Inside the motor adapter, below the worm shaft coupling
Gearbox oil	Inside the screwed end play adjustment cap on the side of the gearbox
Eccentric box	On the side of the gearbox where the eccentric shaft protrudes.

7.4 Removal and Replacement

To replace the pump shaft seal:

Following the instructions in the previous sections, remove the reagent head assembly. Then remove the diaphragm. Remove the pump shaft by unscrewing counter-clockwise. Take care not to allow any shims to drop into the eccentric box when removing the shaft. A thread-locking compound is used between the pump shaft and the crosshead assembly. Remove the three (3) socket head screws and seal retainer plate. The seal can now be removed. DO NOT reuse a damaged pump shaft or polish an old one too smooth. A shaft that is too smooth will weep oil over time when running.

Reinstall by reversing the disassembly procedure. Lubricate the ID of the seal liberally with silicone grease (ex. Parker 'Super O-Lube'). Refill the eccentric box with Pulsalube Oil 9M per the Lubrication Section.



To replace the motor adapter seal:

First remove the motor per Motor Removal and Reinstallation. Loosen the coupling setscrew through the access hole in the motor adapter and remove the worm coupling half. Remove the four motor adapter bolts and withdraw the motor adapter from the gearbox. Take care not to lose the shims from between motor adapter and gearbox. Remove the oil seal from the motor adapter. Lubricate the replacement seal with Pulsalube 8G gear oil and install by pressing into position. Reassemble by reversing the above disassembly procedure.

To replace the gearbox oil seal:

First drain the gearbox per the lubrication instructions. Remove the four gearbox bolts, and withdraw the gearbox from the eccentric box, sliding it off the eccentric shaft. Remove the seal. Lubricate the replacement with Pulsalube 8G gear oil and install by pressing into position. Reinstall by reversing the disassembly procedure. Refill the gearbox with Pulsalube 8G gear oil per Lubrication.

To replace the eccentric box seal:

First remove the gearbox per step 3 above. Remove the four bolts, which retain the eccentric side cap to the eccentric box. Remove the eccentric side cap and withdraw the eccentric shaft. Remove the seal. Lubricate the replacement with Pulsalube 8G gear oil and install by pressing it into position. Reinstall by reversing the disassembly procedure. Refill the gearbox with Pulsalube 8G gear oil per the lubrication instructions.

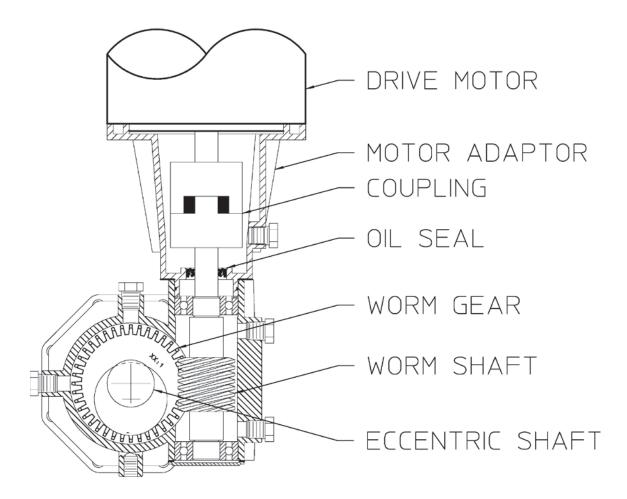


Figure 20

7.5 Cover Assembly

7.5.1 Removal and Reinstallation

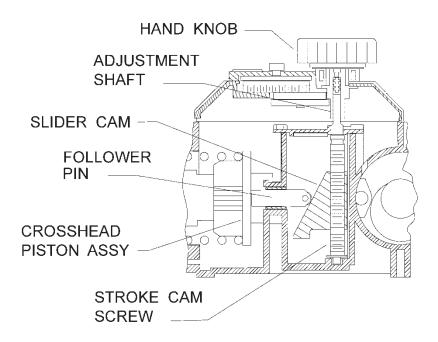


Figure 21

The hand knob linkage employs a slip type coupling which can be reassembled in either of two rotational orientations 180° apart from one another: therefore, the original orientation must be retained for reassembly so that pump calibration is retained.

7.5.2 Removal

- 1. Adjust the stroke length until the dial indicator is set at the zero stroke setting. Adjustment is easier with the drive motor running. Allow the locking mechanism to engage to the nearest detent
- 2. Disconnect the power source to the drive motor.
- 3. Remove the cover screws.
- 4. Using care not to rotate the adjustment shaft, remove the cover vertically from the eccentric box.

7.5.3 Reinstallation

- 1. Rotate the stroke cam screw clockwise until the slider cam is in a full upward position.
- 2. Verify that the cover dial indicates the zero stroke setting.
- 3. Using care not to disturb the adjustment shaft, install the cover assembly, engaging the drive coupling.
- 4. Replace the cover screws.
- 5. Press the adjustment knob down and rotate it clockwise until it stops. (Adjustment is easier with the drive motor running.) Verify that the cover dial indicates the zero stroke setting as before; if so, reinstallation is complete and if not, refer to step (6) below for realignment.
- 6. To re-align, loosen the screw in the center of the dial cover.
- 7. Adjust the dial cover to align the pointer with the 'zero' mark.
- 8. Retighten the screw in the center of the dial cover.

7.6 Motor

7.6.1 Removal

- 1. Disconnect the power source to the drive motor.
- 2. Disconnect the motor wiring from the motor.
- 3. Remove the four bolts retaining the motor to the motor adaptor and remove the motor
- 4. The coupling is an interlocking jaw design and uses an elastomer spider between the two coupling halves. One half of the coupling remains on the worm shaft and the other coupling half on the motor shaft. Loosen the setscrew, which retains the coupling half to the motor shaft and remove the coupling half, taking care to not lose the shaft key.

7.6.2 Reinstallation



See instructions, Section 4.7

MOTOR ROTATION MAY BE WIRED FOR CW OR CCW ROTATION.

8. Replacement Parts

8.1 PULSAR Shadow® KOPkit Program



Figure 22

PULSAR Shadow[®] KOPkits contain all replacement parts normally used in a preventative maintenance program. Having a KOPkit on hand can eliminate delays in repairing a pump and returning it to a critical service. Pulsalube 9M eccentric oil and Pulsalube 8G gear oils are also available for preventative maintenance programs, and should be kept on hand. There is a specific KOPkit for every PULSAR Shadow[®] pump model. Each KOPkit is vacuum-packed for extended storage. All PULSAR Shadow[®] pumps have the KOPkit number identified on the pump nameplate and Pulsafeeder order documents. KOPkits can also be selected from the technical data sheet shipped with the pump or with the assistance of a Pulsafeeder representative.

8.2 Ordering KOPkits or Parts

When ordering replacement parts always specify: Pump model and serial number (stamped on pump nameplate), e.g., Model No.L2 with Serial No. 9876303-1.

Provide the part number and description from the PULSAR Shadow® parts list. Include the three-character suffix. (Note: PULSAR Shadow® part numbers begin either with the letters 'NP', or the letter 'W', e.g., NP170001-TNR or W210221-001.)

9. Troubleshooting Chart

		<u>, </u>
Difficulty	Probable Cause	Remedy
Pump does not start	Coupling disconnected Faulty power source Blown fuse, and circuit breaker Broken wire Wired improperly Pipe line blockage	Connect coupling Check power source Replace - eliminate overload Locate and repair Check diagram Open valves
No delivery	Motor not running Supply tank empty Lines clogged Closed line valves Ball check valves held open with solids Vapor lock, cavitation Prime lost Strainer clogged	Check power source. Check wiring diagram Fill tank Clean and flush Open valves Clean and inspect Increase suction pressure Reprime, and check for leak Remove and clean. Replace screen if necessary
Low delivery	Motor speed too low Check valves worn or dirty Calibration system error Product viscosity too high Product cavitating	Check voltages, frequency, wiring, and Terminal connections. Check nameplate vs. Specifications Clean, replace if damaged Evaluate and correct Lower viscosity by increasing product temperature. Increase pump and/or piping size Increase suction pressure. Cool product as necessary
Delivery gradually drops	Check valve leakage Leak in suction line Strainer fouled Product change Supply tank vent plugged	Clean, replace if damaged Locate and correct Clean or replace screen Check viscosity Unplug vent
Delivery erratic	Leak in suction line Product cavitating Entrapped air or gas in product Motor speed erratic Fouled check valves	Locate and correct Increase suction pressure Consult factory for suggested venting Check voltage and frequency Clean, replace if necessary
Delivery higher than rated	Suction pressure higher than discharge pressure Back pressure valve set too low Back pressure valve leaks	Install backpressure valve or consult factory for piping recommendations Increase setting Repair, clean, or replace
Pump loses internal oil	Diaphragm ruptured Leaky seal Cover gasket leaks Pump overfilled	Replace Replace Replace or retighten Remove excess oil
Noisy gearing, knocking	Discharge pressure too high Water hammer Stroke length at partial setting No oil or level incorrect	Reduce pressure Install pulsation dampener Nondestructive knocking is characteristic of lost motion pumps Replace or refill oil

Increase size of piping - install pulsation Pipe size too small dampener Install pulsation dampener in line Pipe runs too long Piping noisy Replace with air or inert gas. If a pulsation Surge chambers flooded dampener is installed, replace diaphragm and recharge No surge chambers used Install pulsation dampener Pump overloaded Check operating conditions against pump design High or low voltage Check power source **Motor overheats** Loose wire Trace and correct Correct conditions so ratings of pump are not Excessive discharge pressure exceeded Vacuum/pressure leak Find and correct Leak Detection -Switch adjustment off Readjust switch False Alarm Switch malfunction Replace switch Switch adjustment off Readjust switch Leak Detection -Switch malfunction Replace switch Failure to Alarm Restore power Power off Alarm wiring discontinuity Find and correct

10. APPENDIX I Piping Calculations

10.1 Suction Head Requirements

All reciprocating metering pumps require a net positive suction head (NPSHR). The NPSHR for PULSAR Shadow® pumps is 5 psi (0.35 bar). The NPSHR is defined as the pressure required above the absolute vapor pressure of the process fluid at the pumping temperature. This pressure is required at the suction port of the pump throughout the entire pump stroking cycle in order to prevent cavitation of the process fluid within the reagent head. Satisfying the NPSHR is required to assure metering accuracy.

The net positive suction head available (NPSHA) must be greater than the NPSHR. The NPSHA of any given system is calculated as follows:

Equation 1. For fluid viscosity below 50 centipoise.

$$NPSH_A = P_A \pm P_H - P_V - \left(\frac{L_s RGQ}{C_t d^2}\right)$$

Equation 2. For fluid viscosity at or above 50 centipoise.

$$NPSH_{A} = P_{A} \pm P_{H} - P_{V} - \sqrt{\left(\frac{L_{S}RGQ}{C_{1}d^{2}}\right)^{2} + \left(\frac{L_{S}\mu Q}{C_{2}d^{4}}\right)^{2}}$$

The <u>variables</u> used in Equations 1 through 4 must be in the units shown in the table below for the <u>constants</u> listed below to be used correctly.

Variable	Units Set				
Variable	English	Metric			
NPSH	psi	bar			
P_A	psia	bar(a)			
P_H	psi	bar			
P_V	psia	bar(a)			
L_S	feet	meters			
R	strokes/min	strokes/min			
G	no units	no units			
Q	gallons/hr	liters/hr			
d	inches	millimeters			
μ	centipoise	centipoise			
L_D	feet	Meters			
P_T	psi	bar			
P_{P}	psi	bar			
V_P	feet/sec	meters/sec			
C_1	24,600	640			
C_2	45,700	1.84			

Note: If piping sizes vary throughout the suction line, different additive values may be used for the pressure losses attributed to the liquid's acceleration and deceleration. Use the last term of Equation 1 or 2 as many times as needed in the equation to adjust for different lengths of different pipe diameters in the suction line. (Everything but the pipe length and diameter will stay the same in the equation.)

10.2 System Backpressure

The system backpressure must exceed the suction pressure by at least 5 psi (0.35 bar) in order to prevent flowthrough, however it must not exceed the rated discharge pressure of the pump. Flowthrough can be defined as the process liquid flowing from a higher pressure to a lower pressure (downhill pumping), which results in a flow output greater than the pumps calibrated capacity, failure and undesired flow at pump shutdown. If the system backpressure is not at least 5 psi (0.35 bar) greater than the suction pressure, a backpressure valve must be installed in the discharge piping. To calculate the total system backpressure use Equation 3 or 4.

Equation 3. For fluid viscosity below 50 centipoise.

$$P_T = \left(\frac{L_D RGQ}{C_I d^2}\right) + P_P \pm P_H$$

Equation 4. For fluid viscosity at or above 50 centipoise.

$$P_T = \sqrt{\left(\frac{L_D RGQ}{C_1 d^2}\right)^2 + \left(\frac{L_D \mu Q}{C_2 d^4}\right)^2} + P_P \pm P_H$$

NO		101	A T	
	$\mathbf{w} = \mathbf{r}$	u (. i	Δ	JRE

NPSH_R Net positive suction head required, [psi, bar]
NPSH_A Net positive suction head available, [psi, bar]

P_A Pressure at the surface of the liquid being pumped (atmospheric or

supply tank blanket pressure) [psia, bar(a)]

P_H Head pressure above (+) or below (-) the pump centerline, [psi, bar]

P_V Absolute vapor pressure at pumping temperature of the process liquid at

pump inlet, [psia, bar(a)]

Length of suction piping (actual, not equivalent), [ft, m]

R Pump stroking rate, strokes/min [spm]

G Specific gravity of process liquid, [unitless]

Q Pump average flow rate, [gph, lph]
d Internal pipe diameter, [inches, mm]

C₁,C₂ Numeric constants used in Equations 1- 4

μ Viscosity of process liquid at pumping temperature, centipoise [cp]

L_D Length of discharge piping (actual, not equivalent), [ft, m]

P_P System discharge pressure, [psig, bar(g)]

P_T Pump discharge pressure at the discharge port, [psig, bar(g)]

11. APPENDIX II **Oil Specifications**

PULSAlube #8G

AGMA Number	7 EP
ISO Viscosity Grade	460
API Gravity (ASTM D 287)	34.1
Viscosity (ASTM D 2161) SSU @ 100°F	2241
Viscosity (ASTM D 2161) SSU @ 210°F	225
Viscosity Index (ASTM D 2270)	167
Pour Point (ASTM D 97) °F8	-40(-40)
Flash Point, COC (ASTM D 92) °F8	490(254)
Timken OK Load (ASTM D 2782) Lb(kg)	100+(45+)
Four Pall ED Toot (ACTM D 2702)	

Four Ball EP Test (ASTM D 2783)

250 Weld Point kg Load Wear Index 47 Rust Test (ASTM D 665A&B) **Pass** Oxidation Test (ASTM D 2893) **Pass** Demulsibility Test (ASTM D 2711) Pass Foam Test (ASTM D 892) Pass Copper Corrosion (ASTM D 130) 1-A Color Amber

PULSAlube 9M

7
460
28.7
2000
141
159
-10
560
100+(45+)

Four Ball EP Test (ASTM D 2783)

Weld Point kg 255 Load Wear Index 44 Rust Test (ASTM D 665A&B **Pass** Oxidation Test (ASTM D 2893) **Pass** Demulsibility Test (ASTM D 2711) **Pass** Foam Test (ASTM D 892) **Pass** Copper Corrosion (ASTM D 130) 1-A Color Amber

12. APPENDIX III Bolt Torque Tables

PULSAR – Liquid End Bolt Torque Requirements

Metal Construction

Reagent		Hea	d Bolts		Tie	e Bars		
Head Part Head		# Bolts and	Torque		#Bolts and	Torque		
Number	Size	Size	N m	ft-lb	Size	N m	ft-lb	
NP160001	Α	(6) M10*1.5	39	45	(4) M8*1.25	8	6	
NP160002	В	(6) M12*1.75	68	50	(4) M8*1.25	8	6	
NP160003	С	(6) M10*1.5	39	29	(4) M8*1.25	8	6	
NP160004	D	(6) M8*1.25	20	15	(4) M8*1.25	8	6	

Plastic Construction

Reagent		Hea	d Bolts		Tie	Bars		
Head Part	# Balta and IUI UUG #B/		#Bolts and	Torque				
Number	Size	Size	N m	in-lb	Size	N m	in-lb	
NP160012	Α	(6) M10*1.5	850	75	(4) M8*1.25	250	22	
NP160014	В	(6) M12*1.75	850	75	(4) M8*1.25	250	22	
NP160011	С	(6) M10*1.5	850	75	(4) M8*1.25	250	22	
NP160013	D	(6) M8*1.25	850	75	(4) M8*1.25	250	22	

13. Appendix V Pulsafeeder Accessories

13.1 Pulsation Dampeners

The PULSAtrol pulsation dampener is a pneumatically charged diaphragm-type chamber that intermittently stores energy. Used on the inlet, it can improve NPSHa (Net Positive Suction Head available) characteristics of the suction piping system. On the discharge line it will reduce peak pressures and pulsating flow variations.

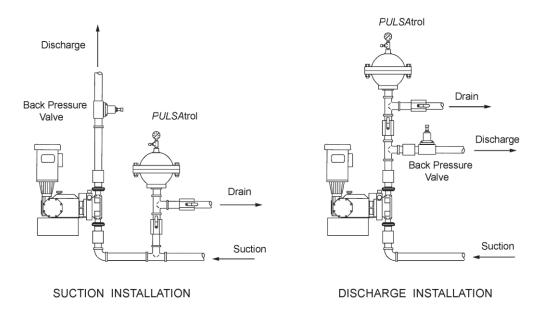


Figure 23

13.2 Dampener Installation

On both discharge and suction lines, it is desirable to mount the pulsation dampener as close to the pump connection as possible. It can be mounted in any position: horizontally, vertically, or at any angle. Vertical orientation places the process connection at the bottom, facilitating draining of the unit for maintenance or repair. A shutoff valve should always be used between the piping system and pulsation dampener. If the discharge line is open to atmospheric pressure, a backpressure valve should also be incorporated in the system beyond the pulsation dampener to assure proper operation. Pulsation dampeners do require regular maintenance and inspection. Charge pressure should be checked every 2-4 months and renewed as needed. Temperature, pressure, and other variables will affect charge life and diaphragm/bladder life.



THE DIAPHRAGM/BLADDER IN A PULSATION DAMPENER IS A WEARABLE ITEM THAT WILL NEED PERIODIC INSPECTION AND REPLACEMENT.

A) Discharge Setup

The pulsation dampener may be precharged with air or nitrogen. When properly precharged the diaphragm is positioned against the bottom liquid chamber. It is therefore necessary to drain all liquid below the diaphragm and vent to atmospheric pressure when precharging.

Use the precharge pressure as determined from the pulsation dampener selection and sizing procedure (Catalog No. 211). This can vary from 50 to 80% of mean line pressure in accordance with fluctuation level selected. The pulsation dampener is now ready for service and the diaphragm will move to a neutral position as liquid enters the chamber.

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Use the following to complete a Pre Charge Procedure for Discharge Installation

- 1. Calculate the precharge pressure
 - a. Mean Line Pressure (PSIG) + Atmospheric Pressure = Absolute Pressure (PSIA)
 - b. Absolute Pressure (PSIA) x Precharge Percentage (80% max) = Pressure Absolute
 - c. Pressure Absolute Atmospheric Pressure = Precharge Pressure (PSIG)
- 2. Isolate the pulsation dampener from the process line.
- 3. Carefully drain off process fluid by opening a drain valve (see recommend piping arrangement).
- 4. Apply precharge pressure (additional liquid may drain as diaphragm moves).
- 5. Close drain valve.
- 6. Place the pulsation dampener in the process stream.

B) Suction Setup (Flooded Suction)

Charge the pulsation dampener with adequate pressure to overcome the static suction head. Start up the pump. Depress the stem on the charge valve, but only during discharge strokes of the pump, until the gauge indicates pressure pulses. The diaphragm has now centered allowing the pulsation dampener to accumulate liquid while the pump is discharging. If too much air becomes released and the gauge will not indicate pressure pulses, recharge the pulsation dampener and repeat the procedure.



Use the following to complete a Pre Charge Procedure for Suction Installation

- 1. Isolate accumulator from line.
- 2. Carefully drain off process fluid by opening a drain valve
- 3. Apply 5-10 psi precharge pressure (additional liquid may drain as diaphragm moves).
- 4. Close drain valve.
- 5. Bleed off all pressure on the pulsation dampener.
- 6. Open the valve to put pulsation dampener in stream.
- 7. Push in on the stem of the charging valve during the discharge stroke of the pump and release during the suction stroke.
- 8. Continue this for about 10 times and observe the compound gauge. As accumulator functions, the needle will go from pressure to vacuum.

13.3 Pulsation Dampener Removal

When removing or disassembling a pulsation dampener, drain all piping and remove all air and process pressure. Assume that the diaphragm is broken and the chamber is flooded under pressure since the pressure gauge could be damaged. Separate chambers with caution in a direction away from the body.



MBER THAT THE PULSATION DAMPENER HOUSING WILL RETAIN SOME AMOUNT OF PROCESS FLUID, AND HANDLE ACCORDINGLY.

13.4 Diaphragm Back Pressure and Pressure Relief Valves

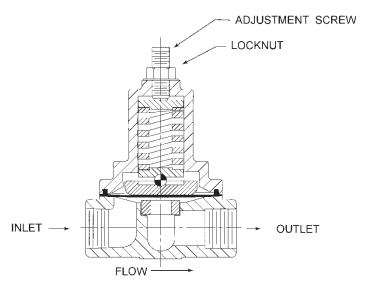
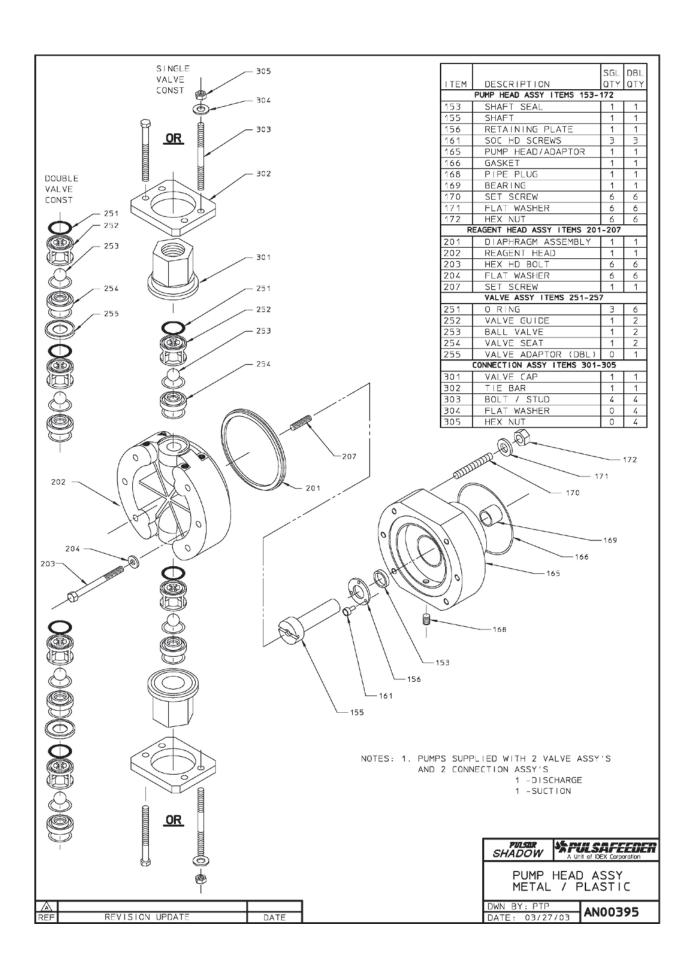


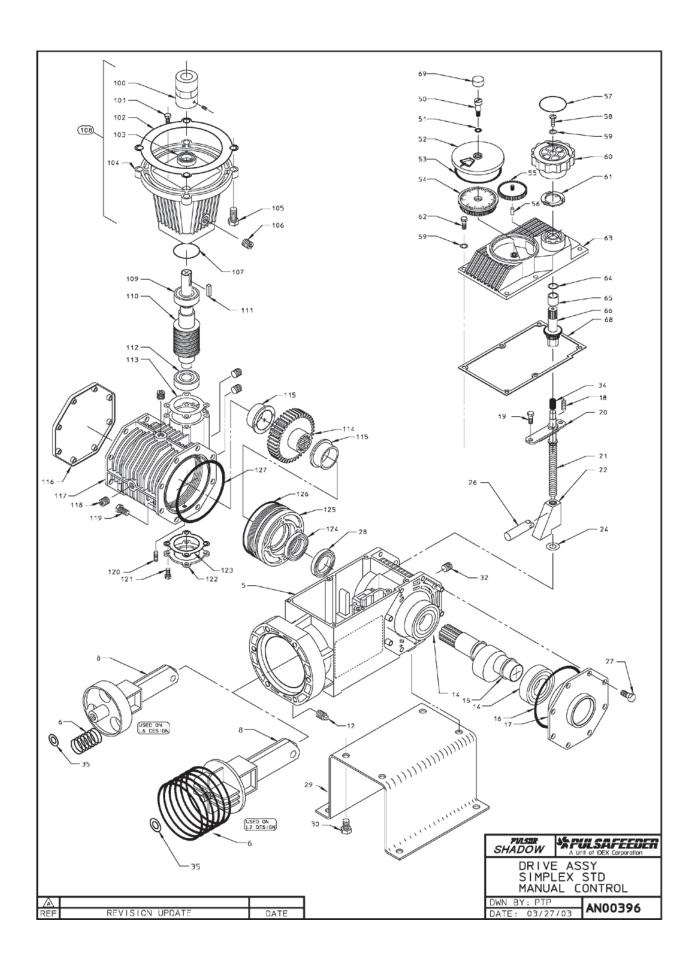
Figure 24

A diaphragm backpressure valve creates a constant system backpressure upstream of the valve. A TFE diaphragm, offering maximum chemical protection and service life, seals the spring and bonnet from the product. This diaphragm seals directly on a replaceable seat. In most systems, the setting of the backpressure valve will determine the overall system backpressure seen by the metering pump.

A diaphragm pressure relief valve protects system components from excessive pressure within the system. The valve is normally set to some value slightly above normal process pressure. If this pressure setting is exceeded, the pressure relief valve will open to control and limit system pressure. The outlet port of the pressure relief valve should be carefully directed back to the supply tank or to some other safe point. The use of a pressure relief valve is especially important in systems utilizing mechanical diaphragm pumps, as these pumps have no internal bypass or relief capability.

Be sure to install either type of valve with fluid flow in direction of arrow on valve body or label.





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ſ	ITEM	DESCRIPTION	CTY	
		ECCENTRIC BOX ASSY ITEMS 5 -35		
	5	ECCENTRIC BOX SUB-ASSY	1	
	6	RETURN SPRING	1-3	
	8	CROSSHEAD SUB-ASSY	1	
	12	PIPE PLUG BEARING	2	
 	15	ECCENTRIC	1	
ŀ	16	O RING	1	
l l	17	BEARING CAP	1	
[18	SET SCREW	1	
	19	HEX HD BOLT	2	
	20	WEDGE COVER ADJUSTMENT SCREW	1	
	22	WEDGE	1	
[24	THRUST WASHER	1	
ļ.	26	FOLLOWER SUB-ASSY	1	
	27	HEX HD BOLT	4	
	28 29	OIL SEAL BASE	1	
	30	HEX HD BOLT	4	
	31	TOLERANCE RING (NOT SHOWN)	2	
1	32	PIPE PLUG	1	
ļ.	34	SPRING	1	
ŀ	35	SPACER SHIM MANUAL CONTROL ASSY ITEMS 50-69	0-2	
ŀ	50	SHOULDER SCREW	1	
ŀ	51	O RING	1	
	52	SCALE COVER	1	
[53	GASKET	1	
ŀ	54 55	SCALE GEAR GEAR	1	
ŀ	56	DOWEL PIN	1	
ŀ	57	LABEL	1	
	58	SCREW	1	
	59	FLAT WASHER	7	
-	60	KNOB CLICKER	1	
-	62	HEX HD BOLT	6	
ļ l	63	COVER	1	
	64	0 RING	1	
	65	BUSHING	1	
	66	GEAR SHAFT COVER GASKET	1	
 	69	SCREW CAP	1	
į.		GEARBOX ASSY ITEMS 100-129		
	100	COUPLING	1	
	101	HEX HD BOLT	4	
-	102	GASKET OIL SEAL	1	
	104	MOTOR ADAPTOR	1	
ŀ	105	HEX HD BOLT	4	
1	106	PIPE PLUG	1	
Į.	107	O RING	1	
ŀ	108	MOTOR ADAPTOR ASSY	1	
ŀ	110	BEARING WORM	1	
ŀ	111	KEY	1	
1	112	BEARING	1	
[113	SHIM PACKAGE	1	
ŀ	114	WORM GEAR	1	
ŀ	115	BEARING COVER	1	
	117	GEARBOX	1	
ŀ	118	PIPE PLUG	4	
1	119	HEX HD BOLT	4	
[120	SET SCREW	1	
ŀ	121	HEX HD BOLT	4	
ŀ	122	BOTTOM COVER GASKET	1	
ŀ	124	OIL SEAL	1	
į.	125	GEARBOX CAP	1	
[126	O RING	1	
ļ.	127	O RING	1	115
ŀ	128 129	NAME TAG (NOT SHOWN) DRIVE SCREW (NOT SHOWN)	4	SHADOW SPULSAFEEDE
·	127	SATTE SCREEN TROT SHOWN	4	DRIVE ASSY
				SIMPLEX STD B.O.M
<u> </u>				DWN BY: PTP AN00397
REF REVISION UPDATE		DATE		DATE: 03/27/03 ANUU39/



PULSAR® Shadow MECHANICAL DIAPHRAGM METERING PUMP

Bulletin: IOM-PSRM-1501

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