

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.

|--|

Tightenin	ig torques for te	rminal board co	nnections			
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						
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  $> 1.7 \text{ x t}_{\text{E}}$ -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.

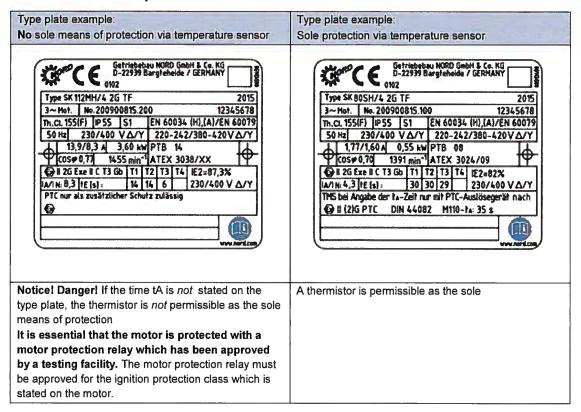
If the only protection is a PTC thermistor temperature sensor, a performance-tested, PTC tripping device certified by a designated body must be used. The PTC triggering device must be equipped with the following protection class label:



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.

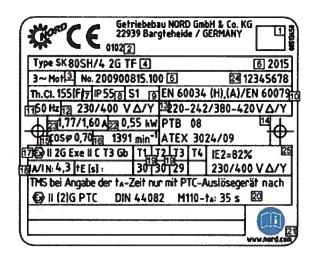
- · Only perform insulation measurements outside of an explosive atmosphere.
- Discharge the connection terminals by short circuiting them after the measurement and before returning to an explosive atmosphere.

# 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



_							
10	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	g torques for te	rminal board co	nnections	
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 tio	htening torque	S	
(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.

30 B 1091 en-3517



## 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.

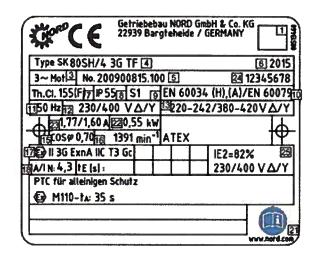
- · Only perform insulation measurements outside of an explosive atmosphere.
- Discharge the connection terminals by short circuiting them after the measurement and before returning to an explosive atmosphere.

# 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
			<del>_</del>	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	<b>€</b> x <b>&gt;</b>	II 2D Ex th IIIC T125°C Db	for category 2 (Zone 21) <sup>1)</sup>
	(€		$\langle E_{x} \rangle$	II 3D Ex to IIIB T125°C Do	for category 3 (Zone 22 – non-conducting dust) <sup>1)</sup>
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) <sup>1)</sup>

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			

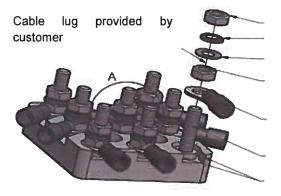
#### 3.3.3 Electrical Connection

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.

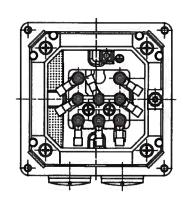
The motor must not be opened under hazardous atmospheres to connect the electrical cables or for any other work. The voltage must always be switched off and secured against being switched on again before opening the motor!

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

				Assign	ment o	f Cable G	lar	ds to M	otor Size	9			
	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 <sub>P</sub> [mm <sup>2</sup> ]		
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.



# 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.



#### 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  $\geq 8$  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.

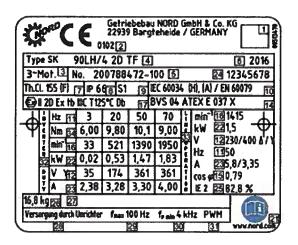


# 3.4.6 Overview of brake installation for NORD ATEX motors

		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
2	Code number of the designated facility (only for 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.

B 1091 en-3517



## 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 <a href="www.nord.com">www.nord.com</a>. We will be pleased to send you the spare parts catalogue on request.



# **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, 2009/125/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

Probaban-Pittre-Str. 1 . 22941 Bandlaba ny - Fast. =45(0)4532 289 - 0 - Fast =45(0)4532 289 - 2253 ; indeg

# **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

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/\*1 2G \*1 to SK 200\*1/\*1 2G \*1
  - 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** 

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 60079-0:2012+A11:2013 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 60079-7:2007

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** 



# **GETRIEBEBAU NORD** Member of the NORD DRIVESYSTEMS Group



Getriebebau NORD GmbH & Co. KG

Hurd-Str. 1 . 22943 Bargtahride, Ga ny , Fans. +43(0)4532 289 - 0 . Fax +49(0)4532 289 - 2253 . Info@mont.com

#### 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
  - <sup>3)</sup> 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
  - <sup>20</sup> 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:

EN 60079-0:2012+A11:2013 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 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

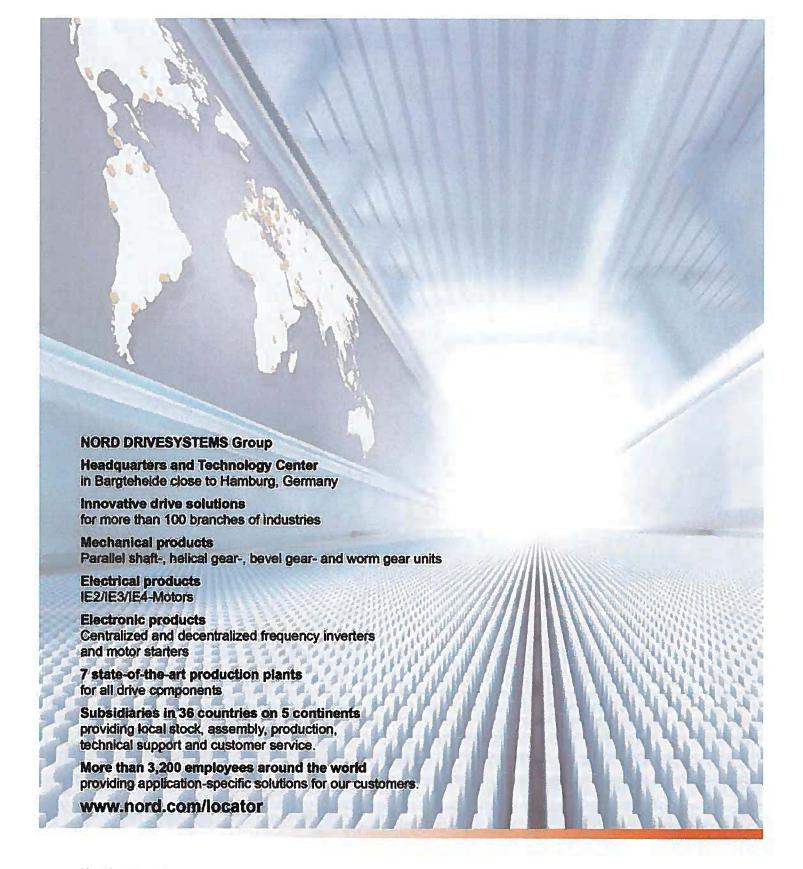
First marking was carried out in 2014.

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

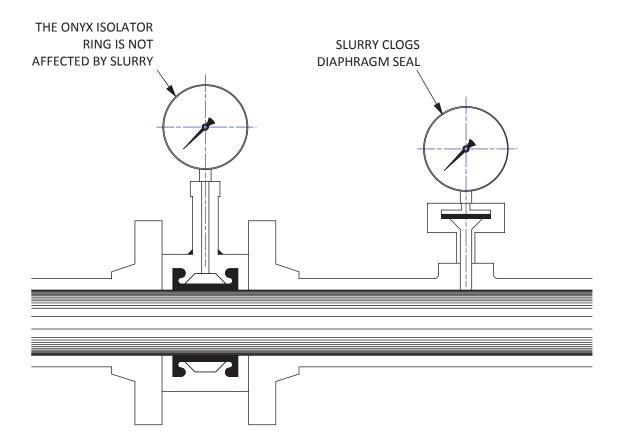
# 

### ONYX VALVE CO ISOLATOR RING

### **Installation & Maintenance**

**Operation:** (02-2010)

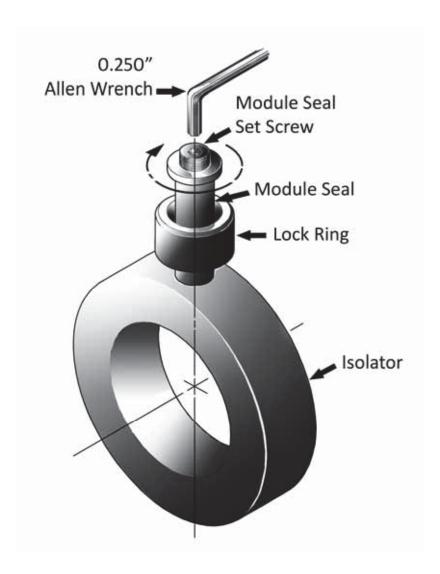
Obtaining accurate pressure readings on slurry lines is difficult because slurries, abrasives and solids clog pressure elements such as gauges, switches and transmitters.



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:

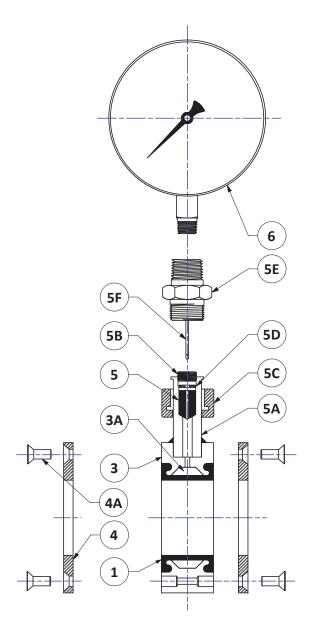
- A) It is NOT necessary to remove the Isolator Ring from the process pipe.
- B) In order to minimize fluid loss, reduce process pressure as low as possible before removing gauges or other instruments from the Isolator Ring.

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

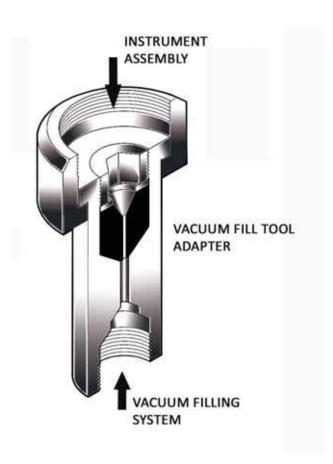
- 11. Reinstall end plates (#4).
- 12. Replace end plate screws (#4A).
- 13. Connect a separate stinger fitting (#5E), to vacuum filling system, evacuate air from the ring assembly, and refill with fresh instrument fluid. Use Onyx silicone fluid.
- 14. The Isolator Ring can now be returned to service.

### 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



10		<del> </del>	-
9			(2)
8			—————————————————————————————————————
7			-(13)
6		[ ] (74)	ᠴ
(5)—			
(4)			5
_			
3		<b>M</b>	
2			
1)	-	<u>L</u>	

NO	PART NAME	QTY	SPECIF	ICATION
1	BODY	1	WCB	CF8M
2	END CAP	1	WCB	CF8M
3	SEATS	2	RPTFE	RPTFE
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

TABLE OF CONTENTS	PAGE
General Information	2
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

### **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.

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

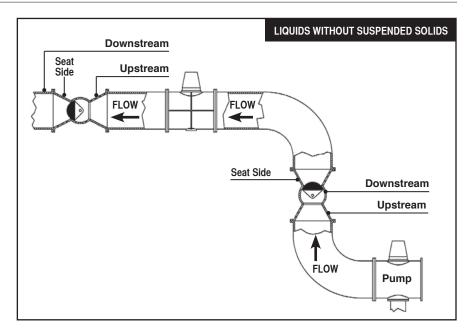
Valve may be installed with plug shaft vertical or horizontal. For vertical pipe installations, install valve with seat facing downstream.

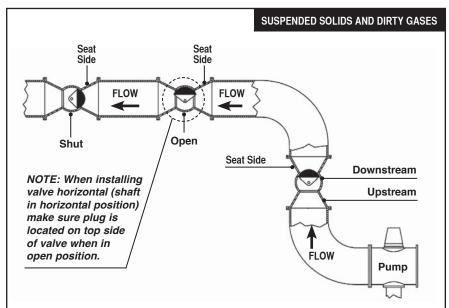
Before installation, blow out pipeline to remove all foreign materials.

### **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.





**Operation** 

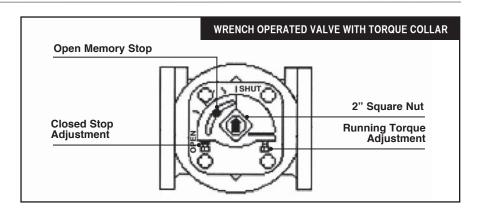
#### WRENCH OPERATED PLUG VALVES

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

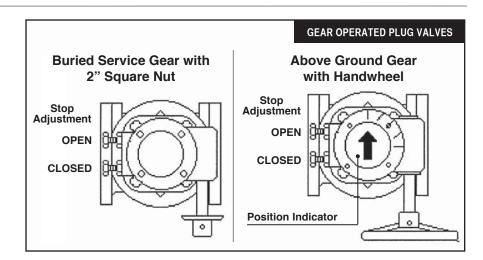
#### **GEAR OPERATED PLUG VALVES**

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.

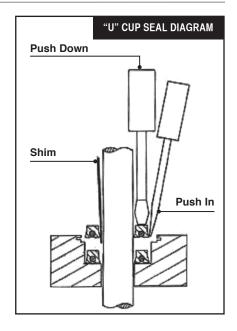
Wrench Operated Valves: Remove the star washer fastening the torque collar to the plug stem. Remove the torque collar and set aside. With the valve de-pressurized, remove the hexagonal head cap screws that hold the bonnet to the valve body.

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	<ul><li>adjust or replace torque collar</li><li>remove obstruction</li><li>reduce pressure</li><li>replace plug</li></ul>
Valve will not close	broken or misadjusted torque collar     obstruction in line     excessive line pressure     elastomer damage	<ul> <li>adjust or replace torque collar</li> <li>remove obstruction</li> <li>reduce pressure</li> <li>replace plug</li> </ul>
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

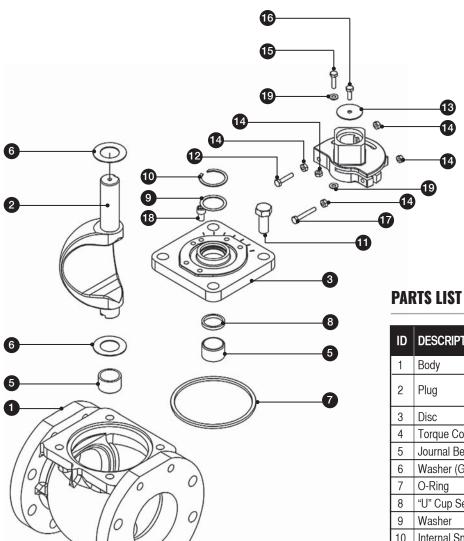
### **Gear Operated Plug Valve**

PROBLEM	CAUSE	SOLUTION
Valve will not open	<ul> <li>bent input shaft</li> <li>obstruction in line</li> <li>excessive line pressure</li> <li>elastomer damage</li> </ul>	<ul><li>replace worn shaft</li><li>remove obstruction</li><li>reduce pressure</li><li>replace plug</li></ul>
Valve will not close	<ul> <li>bent input shaft</li> <li>obstruction in line</li> <li>excessive line pressure</li> <li>elastomer damage</li> </ul>	<ul><li>replace worn shaft</li><li>remove obstruction</li><li>reduce pressure</li><li>replace plug</li></ul>
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	<ul><li>no power source</li><li>improper signal</li><li>burned out or impaired component</li></ul>	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



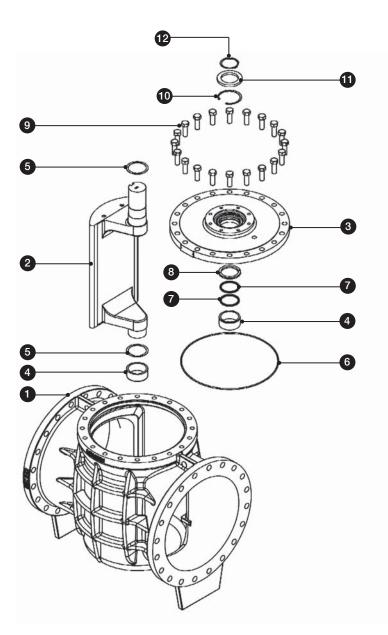
ID	DESCRIPTION	MATERIAL
1	Body	Cast Iron ASTM A-126 Class B
2	Plug	Rubber Coated Ductile Iron ASTM A-536
3	Disc	Cast Iron ASTM A-126 Class B
4	Torque Collar	Ductile Iron ASTM A-536
5	Journal Bearing	303 Stainless Steel
6	Washer (Grit Seal)	PTFE
7	O-Ring	Elas. as Spec.
8	"U" Cup Seal	Elas. as Spec
9	Washer	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

<sup>\*</sup>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.

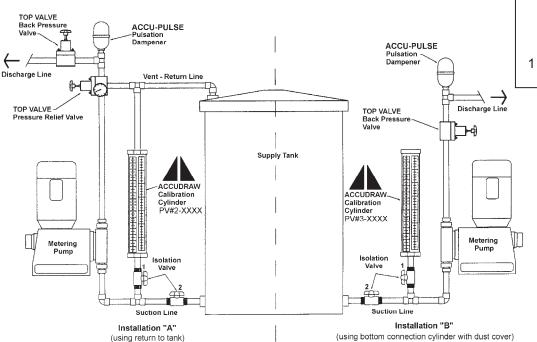
e.g. 10 USGPH in 1 minute equals 5 USGPH X 2 in 30 seconds or 2.5 USGPH X 4 in 15 seconds **Using the ml scale:** (scale is based on <u>volume</u> pumped, over any given time)

- 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

Poly

- 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, Teflon, 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**

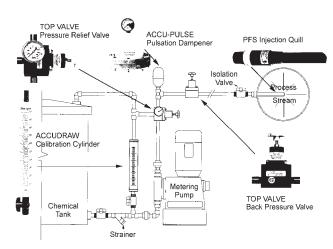
**Pulsation Dampeners** 



### 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
- PVC, CPVC, PVDF, polypropylene, stainless and Hastelloy 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 & 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.

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



# 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.

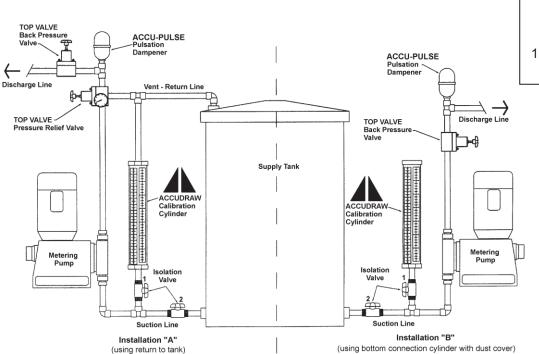
- 2. With the calibration cylinder full of the liquid to be dispensed, start the metering pump and operate at 100% output until all air is removed from both suction lines and pump head.
- 3. Shut pump "OFF".
- 4. With calibration cylinder full, close isolation Valve (#2) from supply tank, and open isolation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



Call Toll Free 1-800-776-6580 *E-Mail: primary@ primaryfluid.com*Tel: (905) 333-8743 Fax: (905) 333-8746® Registered Trade Mark of Primary Fluid Systems Inc.

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

### **ACCUDRAW** Calibration Cylinders



**PVC** Glass

Poly

- 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**

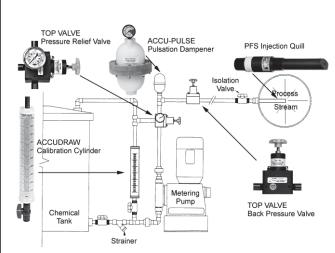
**Pulsation Dampeners** 



### 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.

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



# 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**

<b>ACCU-PULSE Unit Inform</b>	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**

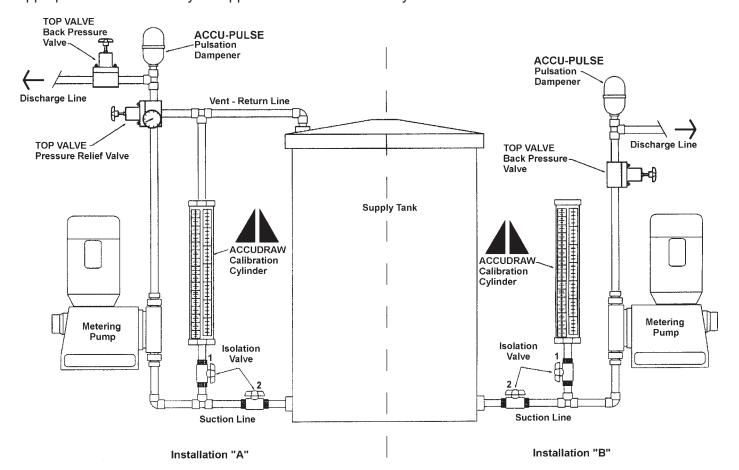
Chargeable models do not require an air line connection, the units must be charged with compressed air or nitrogen, using a hand pump, tank or compressor.

### 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

# 

# A PULSAFEEDER 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**

Information and specifications in this document are subject to change without notice.

## Copyright

Copyright © 2003 Pulsafeeder, Inc. All rights reserved.

No part of this publication may be reproduced, stored in a retrieval system or transmitted in any form or any means electronic or mechanical, including photocopying and recording for any purpose other than the purchaser's personal use without the written permission of Pulsafeeder, Inc.

## **Trademarks**

PULSAR® is a registered trademark of Pulsafeeder, Inc.

PULSAR Shadow<sup>®</sup> is a registered trademark of Pulsafeeder, Inc.

Cruise Control<sup>®</sup>, ECA<sup>®</sup>, DLC<sup>®</sup>, and DLCM<sup>®</sup> are registered trademarks of Pulsafeeder, Inc.

## **Table of Contents**

1.	I. Introduction				
	1.1	Overall Operation	1		
	1.2	Component Layout	2		
	1.3	Standard Reagent Head Assembly	3		
		Leak Detection Assembly			
	1.5	Control Assembly	5		
		Gear Ratio Assembly			
2.	EQUIF	PMENT INSPECTION	ô		
3.	STOR	AGE INSTRUCTIONS	7		
		Short Term			
	-	Long Term			
		ALLATION			
		Location			
		Piping System			
		Suction Pressure Requirements			
		Discharge Pressure Requirements			
		Automatic Control			
		Leak Detection Assembly			
		Drive Motor Installation			
	4.7.1				
	4.7.2				
	4.7.3				
5.	EQUIF	PMENT STARTUP	12		
	5.1	Oil Capacities	13		
		Eccentric Oil Fill			
		Gear Oil Fill			
		Oil Changes			
	5.4.1				
	5.4.2				
6.	STAR	TUP	15		
	6.1	Output Adjustment	15		
		Priming the Reagent Head			
		Calibration			
		Leak Detection			
7.	MAIN	TENANCE	18		
	7.1	Wet End Removal, Inspection and Reinstallation	18		
	7.1.1				
		2 Leak Detection			
		Check Valves			
	7.2.1				
	7.2.2				
	7.3	Oil Seals - General Description			
		Removal and Replacement			
		Cover Assembly			
	7.5.1				
	7.5.2				
	7.5.3		_		
	7.6	Motor			
	7.6.1				
	7.6.2				
8	RFPI	ACEMENT PARTS	27		

8.1 PULSAR Shadow® KOPkit Program	27
8.2 Ordering KOPkits or Parts	27
9. TROUBLESHOOTING CHART	28
10. APPENDIX I PIPING CALCULATIONS	30
10.1 Suction Head Requirements	30
10.2 System Backpressure	
11. APPENDIX II OIL SPECIFICATIONS	
12. APPENDIX III BOLT TORQUE TABLES	33
13. APPENDIX V PULSAFEEDER ACCESSORIES	34
13.1 Pulsation Dampeners	34
13.2 Dampener Installation	34
13.3 Pulsation Dampener Removal	36
13.4 Diaphragm Back Pressure and Pressure Relief Valves	36

## **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<sup>®</sup> 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

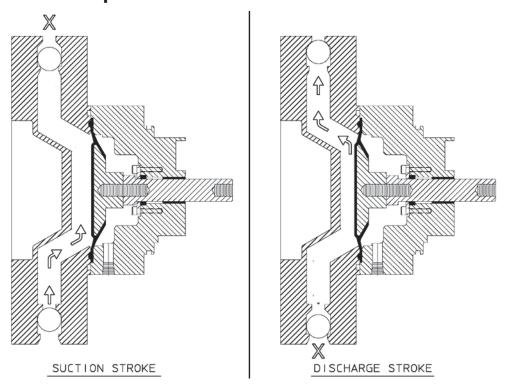


Figure 1

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

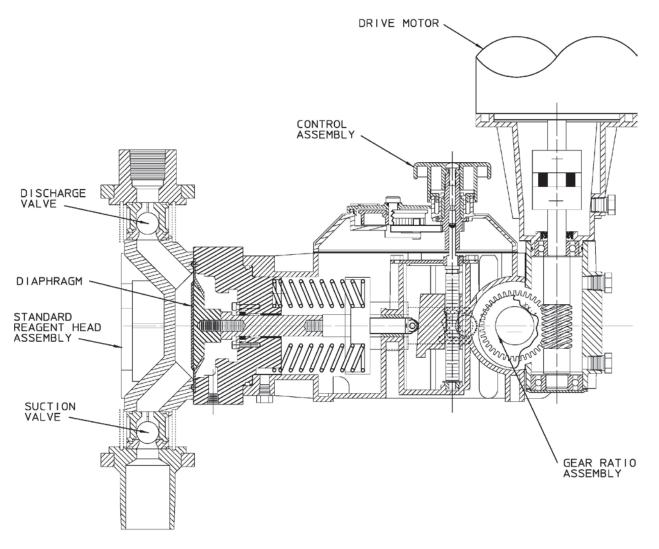


Figure 2

A typical model with manual external stroke adjustment is shown.

## 1.3 Standard Reagent Head Assembly

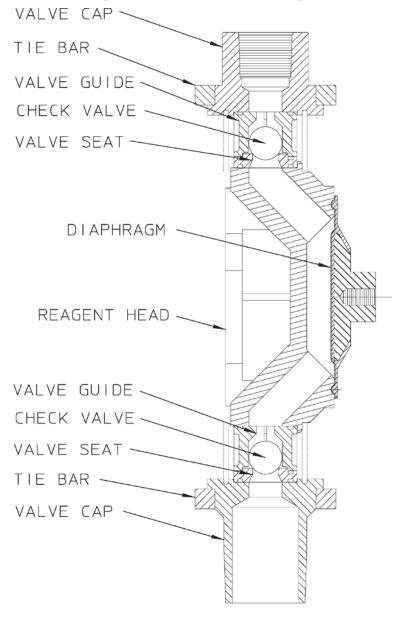


Figure 3

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

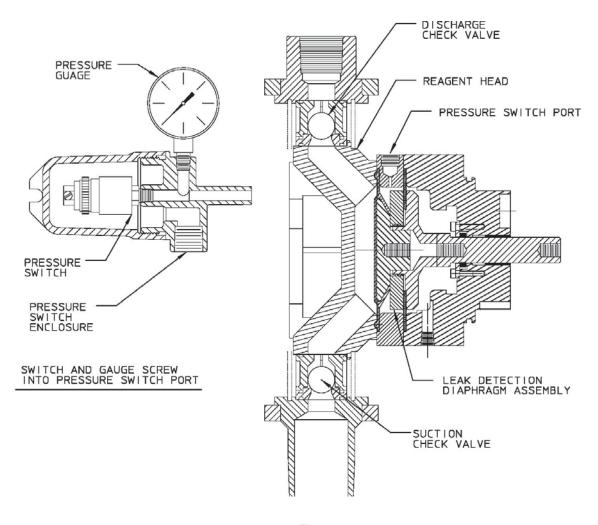


Figure 4

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

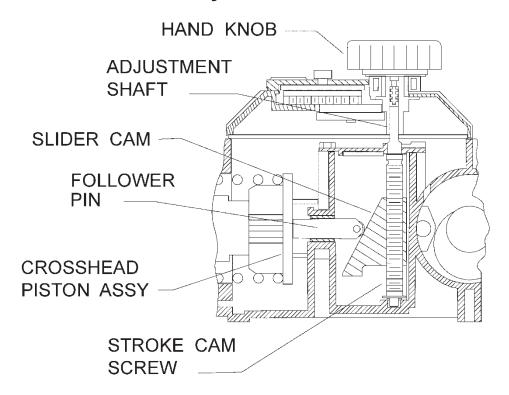


Figure 5

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

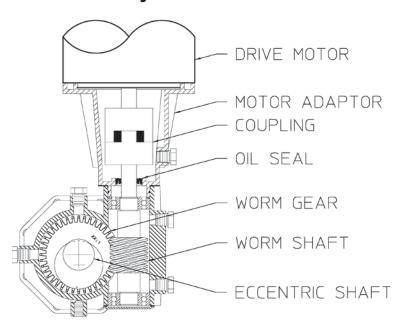
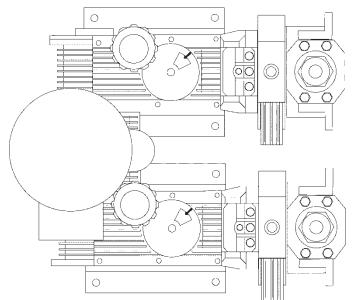


Figure 6

PULSAR Shadow<sup>®</sup> 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<sup>®</sup> 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.

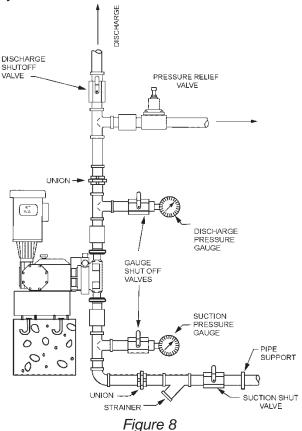
The pump must be rigidly bolted to a solid and flat foundation to minimize vibration, which can loosen connections. When the pump is bolted down, care must be taken to avoid distorting the base and affecting alignments. The pump must be level within 5O. This will assure that the eccentric and gear oils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

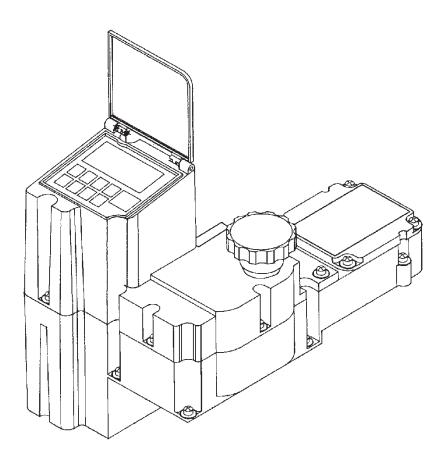
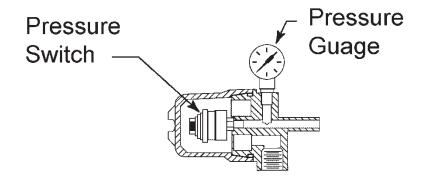


Figure 9

## 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.

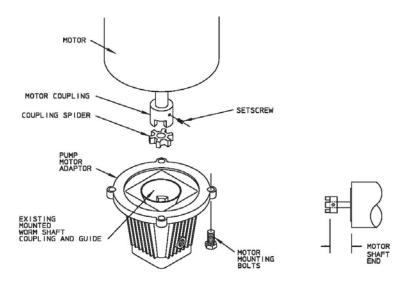


Figure 11

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<sup>®</sup> 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.

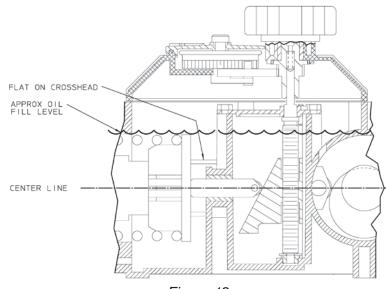


Figure 12

## 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

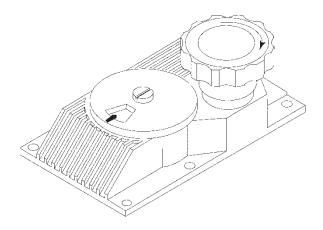


Figure 13

PULSAR Shadow<sup>®</sup> 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

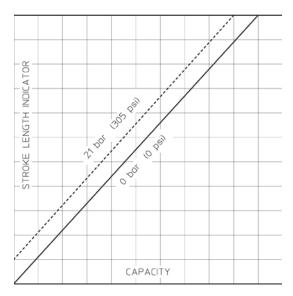


Figure 14

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

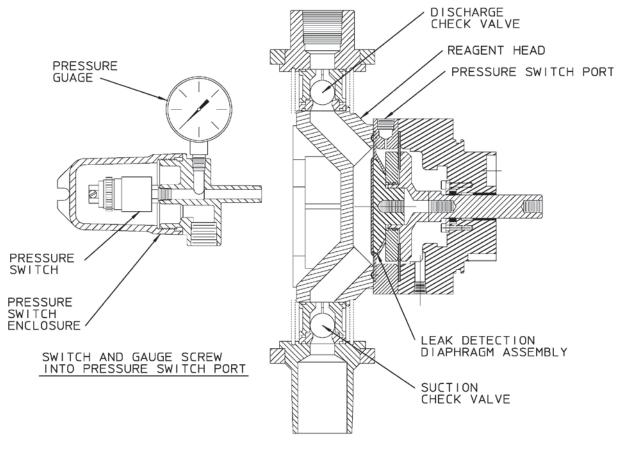


Figure 15

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

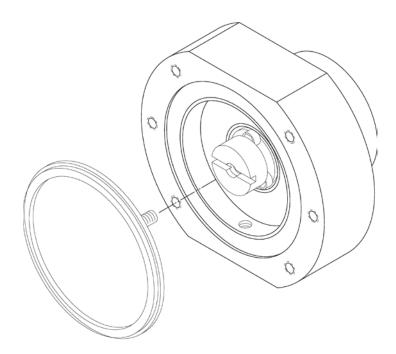


Figure 16

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.
- 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.



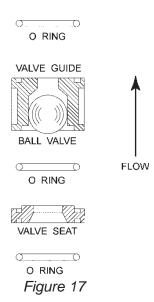
IF DISASSEMBLY OF THE HEAD IS REQUIRED, EXERCISE CAUTION DURING REMOVAL SINCE THE RETURN SPRING OF THE PISTON IS UNDER FULL LOAD. CONSULT FACTORY PRIOR TO PERFORMING THIS PROCEDURE.

#### 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.

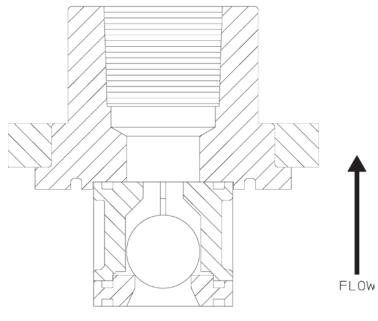


Figure 18

## 7.3 Oil Seals - General Description

The pump has four oil seals as follows:

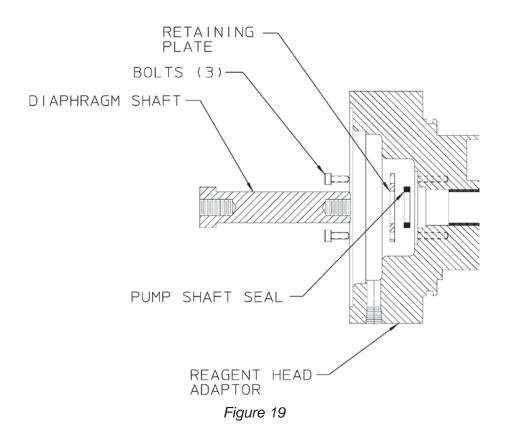
Seal	Location
Pump shaft	Inside the pump head
Motor adapter	Inside the motor adapter, below the worm shaft coupling
Gearbox oil	Inside the screwed end play adjustment cap on the side of the gearbox
Eccentric box	On the side of the gearbox where the eccentric shaft protrudes.

## 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.

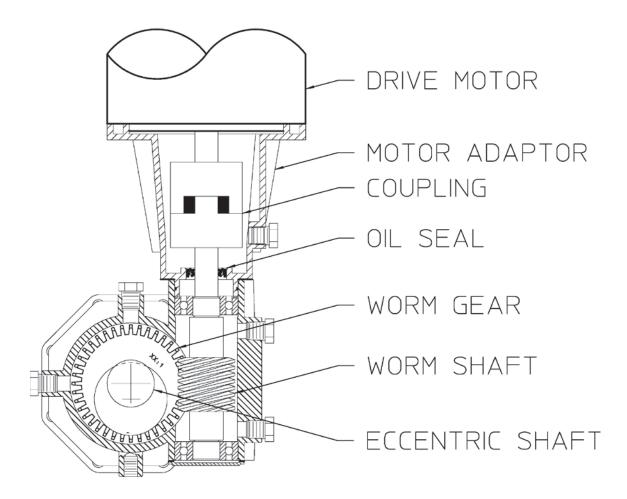


Figure 20

## 7.5 Cover Assembly

## 7.5.1 Removal and Reinstallation

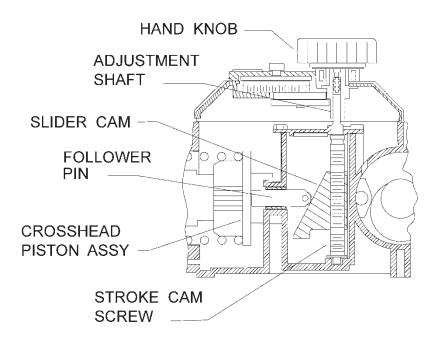


Figure 21

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<sup>®</sup> 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<sup>®</sup> pump model. Each KOPkit is vacuum-packed for extended storage. All PULSAR Shadow<sup>®</sup> 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	MEL	NCL	.AII	JRE

NPSH<sub>R</sub> Net positive suction head required, [psi, bar]

NPSH<sub>A</sub> Net positive suction head available, [psi, bar]

P<sub>A</sub> Pressure at the surface of the liquid being pumped (atmospheric or

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

P<sub>H</sub> Head pressure above (+) or below (-) the pump centerline, [psi, bar]

P<sub>V</sub> 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]

C<sub>1</sub>,C<sub>2</sub> Numeric constants used in Equations 1- 4

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

L<sub>D</sub> Length of discharge piping (actual, not equivalent), [ft, m]

P<sub>P</sub> System discharge pressure, [psig, bar(g)]

P<sub>T</sub> 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 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		Head Bolts		Tie Bars			
Head Part	Head	# Bolts and	# Bolts and Torque		#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.

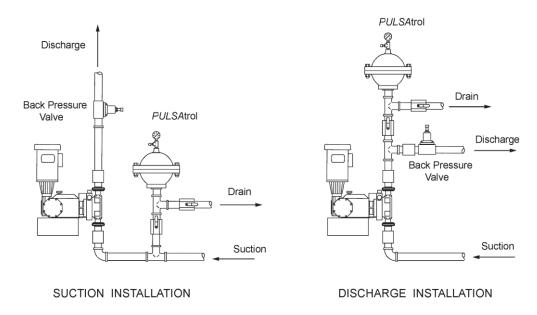


Figure 23

#### 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.

#### •

#### 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

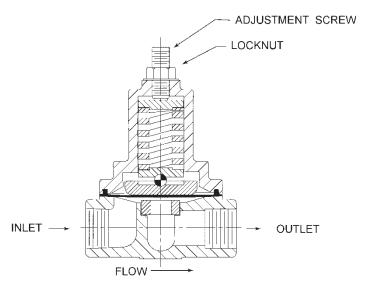
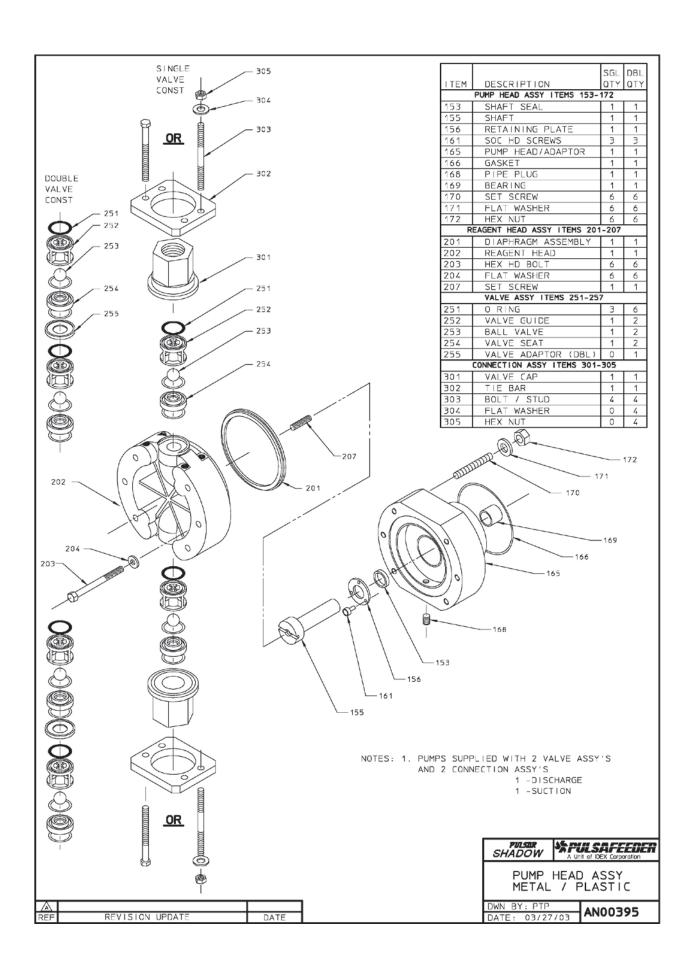


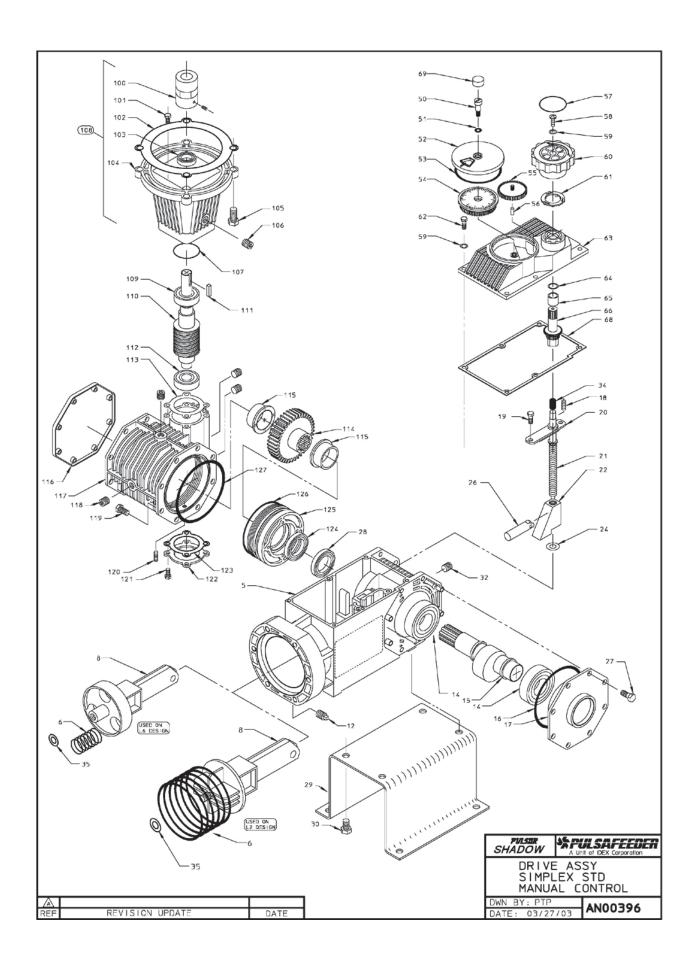
Figure 24

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.





_				
ſ	ITEM	DESCRIPTION	QTY	
		ECCENTRIC BOX ASSY ITEMS 5 -35	$\vdash$	
	5	ECCENTRIC BOX SUB-ASSY	1	
	6	RETURN SPRING	1-3	
	8	CROSSHEAD SUB-ASSY	1	
	12	PIPE PLUG	2	
	14	BEARING ECCENTRIC	1	
ŀ	16	O RING	1	
l l	17	BEARING CAP	1	
	18	SET SCREW	1	
ļ.	19	HEX HD BOLT	2	
-	20	WEDGE COVER ADJUSTMENT SCREW	1	
	22	WEDGE	1	
l l	24	THRUST WASHER	1	
[	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	
	32	PIPE PLUG	1	
Į.	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	
İ	52	SCALE COVER	1	
[	53	GASKET	1	
ļ.	54 55	SCALE GEAR GEAR	1	
	56	DOWEL PIN	1	
ŀ	57	LABEL	1	
	58	SCREW	1	
	59	FLAT WASHER	7	
-	60	KNOB	1	
	61	CLICKER HEX HD BOLT	6	
ŀ	63	COVER	1	
ľ	64	O RING	1	
[	65	BUSHING	1	
-	66	GEAR SHAFT	1	
	68	COVER GASKET SCREW CAP	1	
ŀ	0,	GEARBOX ASSY ITEMS 100-129		
İ	100	COUPL ING	1	
[	101	HEX HD BOLT	4	
-	102	GASKET	1	
-	103	OIL SEAL MOTOR ADAPTOR	1	
ŀ	105	HEX HD BOLT	4	
ŀ	106	PIPE PLUG	1	
	107	O RING	1	
Į.	108	MOTOR ADAPTOR ASSY	1	
ŀ	109	BEARING WORM	1	
ŀ	111	KEY	1	
ŀ	112	BEARING	1	
	113	SHIM PACKAGE	1	
Į.	114	WORM GEAR	1	
ŀ	115	BEARING COVER	1	
<u> </u>	117	GEARBOX	1	
ŀ	118	PIPE PLUG	4	
İ	119	HEX HD BOLT	4	
[	120	SET SCREW	1	
Į.	121	HEX HD BOLT	4	
ŀ	122	BOTTOM COVER GASKET	1	
ŀ	123	OIL SEAL	1	
ŀ	125	GEARBOX CAP	1	
1	126	O RING	1	
[	127	O RING	1	
ŀ	128 129	NAME TAG (NOT SHOWN)	1	PULSAFEEDE
L	129	DRIVE SCREW (NOT SHOWN)	4	SHADOW A Unit of IDEX Corporation  DRIVE ASSY
				SIMPLEX STD B.O.M
<u> </u>				DWN BY: PTP ANDOROZ
REF REVISION UPDATE	- 1	DATE		DATE: 03/27/03



# PULSAR® Shadow MECHANICAL DIAPHRAGM METERING PUMP

**Bulletin: IOM-PSRM-1501** 

# SPULSAFEEDER®

Pulsafeeder, Inc.
A unit of IDEX Corporation
2883 Brighton Henrietta Town Line Road
Rochester NY 14623
+1 (585) 292-8000
www.pulsa.com

www.pulsa.com pulsa@idexcorp.com



# 



pulsa.com

#### Pulsalube #8 GS Ultra Synthetic Gear Oil

#### **SECTION 1: Identification**

Product Identifier Syncon® EP Plus Gear Oil

Other means of identification Phillips 66 Syncon® EP Plus Gear Oil 150

Phillips 66 Syncon® EP Plus Gear Oil 220 Phillips 66 Syncon® EP Plus Gear Oil 320 Phillips 66 Syncon® EP Plus Gear Oil 460 Phillips 66 Syncon® EP Plus Gear Oil 680

SDS Number LBPH778853
Relevant identified uses Gear Lubricant
Uses advised against All others

24 Hour Emergency Phone Number CHEMTREC 1-800-424-9300

CHEMTREC Mexico 01-800-681-9531

Manufacturer/Supplier SDS Information Customer Service

Phillips 66 Lubricants Phone: 800-762-0942 U.S.: 800-368-7128 or International: 1-832-765-2500

P.O. Box 4428 Email: SDS@P66.com Technical Information

Houston, TX 77210 URL: www.Phillips66.com 1-877-445-9198

#### **SECTION 2: Hazard identification**

Classified Hazards Hazards Not Otherwise Classified (HNOC)

This material is not hazardous under the criteria of the Federal OSHA Hazard PHNOC: None known Communication Standard 29CFR 1910.1200.

HHNOC: None known

#### Label Elements

No classified hazards

#### SECTION 3: Composition/information on ingredients

Chemical Name	CASRN	Concentration <sup>1</sup>
Synthetic Lubricant Base Oil	VARIOUS	98

<sup>&</sup>lt;sup>1</sup> All concentrations are percent by weight unless ingredient is a gas. Gas concentrations are in percent by volume.

#### **SECTION 4: First aid measures**

Eye Contact: If irritation or redness develops from exposure, flush eyes with clean water. If symptoms persist, seek medical attention.

**Skin Contact:** Remove contaminated shoes and clothing and cleanse affected area(s) thoroughly by washing with mild soap and water or a waterless hand cleaner. If irritation or redness develops and persists, seek medical attention.



pulsa.com

**Inhalation:** First aid is not normally required. If breathing difficulties develop, move victim away from source of exposure and into fresh air in a position comfortable for breathing. Seek immediate medical attention.

Ingestion: First aid is not normally required; however, if swallowed and symptoms develop, seek medical attention.

**Most important symptoms and effects, both acute and delayed:** Prolonged or repeated contact may dry skin and cause irritation. Inhalation of oil mists or vapors generated at elevated temperatures may cause respiratory irritation. Accidental ingestion can result in minor irritation of the digestive tract, nausea and diarrhea.

**Notes to Physician:** Acute aspirations of large amounts of oil-laden material may produce a serious aspiration pneumonia. Patients who aspirate these oils should be followed for the development of long-term sequelae. Inhalation exposure to oil mists below current workplace exposure limits is unlikely to cause pulmonary abnormalities.

#### **SECTION 5: Firefighting measures**

#### NFPA 704 Hazard Class

Health: 0 Flammability: 1 Instability: 0



- 0 (Minimal)
- 1 (Slight)
- 2 (Moderate)
- 3 (Serious)
- 4 (Severe)

**Extinguishing Media:** Dry chemical, carbon dioxide, foam, or water spray is recommended. Water or foam may cause frothing of materials heated above 212°F / 100°C. Carbon dioxide can displace oxygen. Use caution when applying carbon dioxide in confined spaces. Simultaneous use of foam and water on the same surface is to be avoided as water destroys the foam.

#### Specific hazards arising from the chemical

**Unusual Fire & Explosion Hazards:** This material may burn, but will not ignite readily. If container is not properly cooled, it can rupture in the heat of a fire.

**Hazardous Combustion Products:** Combustion may yield smoke, carbon monoxide, and other products of incomplete combustion. Oxides of sulfur, nitrogen or phosphorus may also be formed.

**Special protective actions for firefighters:** For fires beyond the initial stage, emergency responders in the immediate hazard area should wear protective clothing. When the potential chemical hazard is unknown, in enclosed or confined spaces, a self contained breathing apparatus should be worn. In addition, wear other appropriate protective equipment as conditions warrant (see Section 8).

Isolate the hazard area and deny entry to unnecessary and unprotected personnel Stop spill/release if it can be done safely. Move undamaged containers from immediate hazard area if it can be done safely Water spray may be useful in minimizing or dispersing vapors and to protect personnel. Cool equipment exposed to fire with water, if it can be done safely. Avoid spreading burning liquid with water used for cooling purposes.

See Section 9 for Flammable Properties including Flash Point and Flammable (Explosive) Limits

#### SECTION 6: Accidental release measures

**Personal precautions, protective equipment and emergency procedures:** This material may burn, but will not ignite readily. Keep all sources of ignition away from spill/release. Stay upwind and away from spill/release. Avoid direct contact with material. For large spillages, notify persons down wind of the spill/release, isolate immediate hazard area and keep unauthorized personnel out. Wear appropriate protective equipment, including respiratory protection, as conditions warrant (see Section 8). See Sections 2 and 7 for additional information on hazards and precautionary measures.

**Environmental Precautions:** Stop and contain spill/release if it can be done safely. Prevent spilled material from entering sewers, storm drains, other unauthorized drainage systems, and natural waterways. Use water sparingly to minimize environmental contamination and reduce disposal requirements. If spill occurs on water notify appropriate authorities and advise shipping of any hazard. Spills into or upon navigable waters, the contiguous zone, or adjoining shorelines that cause a sheen or discoloration on



pulsa.com

the surface of the water, may require notification of the National Response Center (phone number 800-424-8802).

**Methods and material for containment and cleaning up:** Notify relevant authorities in accordance with all applicable regulations. Immediate cleanup of any spill is recommended. Dike far ahead of spill for later recovery or disposal. Absorb spill with inert material such as sand or vermiculite, and place in suitable container for disposal. If spilled on water remove with appropriate methods (e.g. skimming, booms or absorbents). In case of soil contamination, remove contaminated soil for remediation or disposal, in accordance with local regulations.

Recommended measures are based on the most likely spillage scenarios for this material; however local conditions and regulations may influence or limit the choice of appropriate actions to be taken. See Section 13 for information on appropriate disposal.

#### **SECTION 7: Handling and storage**

**Precautions for safe handling:** Keep away from flames and hot surfaces. Wash thoroughly after handling. Use good personal hygiene practices and wear appropriate personal protective equipment (see section 8). Spills will produce very slippery surfaces. Do not enter confined spaces such as tanks or pits without following proper entry procedures such as ASTM D-4276 and 29CFR 1910.146. Do not wear contaminated clothing or shoes.

**Conditions for safe storage:** Keep container(s) tightly closed and properly labeled. Use and store this material in cool, dry, well-ventilated area away from heat and all sources of ignition. Store only in approved containers. Keep away from any incompatible material (see Section 10). Protect container(s) against physical damage.

"Empty" containers retain residue and may be dangerous. Do not pressurize, cut, weld, braze, solder, drill, grind, or expose such containers to heat, flame, sparks, or other sources of ignition. They may explode and cause injury or death. "Empty" drums should be completely drained, properly bunged, and promptly shipped to the supplier or a drum reconditioner. All containers should be disposed of in an environmentally safe manner and in accordance with governmental regulations. Before working on or in tanks which contain or have contained this material, refer to OSHA regulations, ANSI Z49.1, and other references pertaining to cleaning, repairing, welding, or other contemplated operations.

#### SECTION 8: Exposure controls/personal protection

Chemical Name	ACGIH	OSHA	Phillips 66
Synthetic Lubricant Base Oil			TWA: 5 mg/m <sup>3</sup>
			STEL: 10 mg/m <sup>3</sup>
			as Oil Mist, if Generated

Note: State, local or other agencies or advisory groups may have established more stringent limits. Consult an industrial hygienist or similar professional, or your local agencies, for further information.

**Engineering controls:** If current ventilation practices are not adequate to maintain airborne concentrations below the established exposure limits, additional engineering controls may be required.

**Eye/Face Protection:** The use of eye/face protection is not normally required; however, good industrial hygiene practice suggests the use of eye protection that meets or exceeds ANSI Z.87.1 whenever working with chemicals.

**Skin/Hand Protection:** The use of skin protection is not normally required; however, good industrial hygiene practice suggests the use of gloves or other appropriate skin protection whenever working with chemicals. Suggested protective materials: Nitrile

**Respiratory Protection:** Where there is potential for airborne exposure above the exposure limit a NIOSH certified air purifying respirator equipped with R or P95 filters may be used.

A respiratory protection program that meets or is equivalent to OSHA 29 CFR 1910.134 and ANSI Z88.2 should be followed whenever workplace conditions warrant a respirator's use. Air purifying respirators provide limited protection and cannot be used in atmospheres that exceed the maximum use concentration (as directed by regulation or the manufacturer's instructions), in oxygen deficient (less than 19.5 percent oxygen) situations, or under conditions that are immediately dangerous to life and health (IDLH).

Suggestions provided in this section for exposure control and specific types of protective equipment are based on readily



pulsa.com

available information. Users should consult with the specific manufacturer to confirm the performance of their protective equipment. Specific situations may require consultation with industrial hygiene, safety, or engineering professionals.

#### **SECTION 9: Physical and chemical properties**

**Note:** Unless otherwise stated, values are determined at 20°C (68°F) and 760 mm Hg (1 atm). Data represent typical values and are not intended to be specifications.

Appearance: Amber, Transparent Flash Point: > 469 °F / > 243 °C

Physical Form: Liquid Test Method: Cleveland Open Cup (COC), ASTM D92

Odor: Petroleum Initial Boiling Point/Range: No data

Odor Threshold: No data

Vapor Pressure: No data

pH: Not applicable Partition Coefficient (n-octanol/water) (Kow): No data

Vapor Density (air=1): >1

Upper Explosive Limits (vol % in air): No data
Lower Explosive Limits (vol % in air): No data

Decomposition Temperature: No data

Decomposition Temperature: No data

Evaporation Rate (nBuAc=1): No data Specific Gravity (water=1): 0.84 - 0.89 @ 68°F (20°C)

Particle Size: Not applicable Bulk Density: 7.0-7.3 lbs/gal

Percent Volatile: No data Viscosity: 17 - 73 cSt @ 100°C; 139 - 740 cSt @ 40°C

Flammability (solid, gas): Not applicable Pour Point: < -43 °F / < -42 °C Solubility in Water: Negligible

#### **SECTION 10: Stability and reactivity**

Reactivity: Not chemically reactive.

Chemical stability: Stable under normal ambient and anticipated conditions of use.

Possibility of hazardous reactions: Hazardous reactions not anticipated.

Conditions to avoid: Extended exposure to high temperatures can cause decomposition. Avoid all possible sources of ignition.

Incompatible materials: Avoid contact with strong oxidizing agents and strong reducing agents.

Hazardous decomposition products: Not anticipated under normal conditions of use.

#### **SECTION 11: Toxicological information**

#### **Information on Toxicological Effects**

#### Substance / Mixture

Acute Toxicity	Hazard	Additional Information	LC50/LD50 Data
Inhalation	Unlikely to be harmful		>5 mg/L (mist, estimated)
Dermal	Unlikely to be harmful		> 2 g/kg (estimated)
Oral	Unlikely to be harmful		> 5 g/kg (estimated)

Aspiration Hazard: Not expected to be an aspiration hazard.

Skin Corrosion/Irritation: Not expected to be irritating. Repeated exposure may cause skin dryness or cracking.

Serious Eye Damage/Irritation: Not expected to be irritating.



pulsa.com

**Skin Sensitization:** No information available on the mixture, however none of the components have been classified for skin sensitization (or are below the concentration threshold for classification).

Respiratory Sensitization: No information available.

**Specific Target Organ Toxicity (Single Exposure):** No information available on the mixture, however none of the components have been classified for target organ toxicity (or are below the concentration threshold for classification).

**Specific Target Organ Toxicity (Repeated Exposure):** No information available on the mixture, however none of the components have been classified for target organ toxicity (or are below the concentration threshold for classification).

**Carcinogenicity:** No information available on the mixture, however none of the components have been classified for carcinogenicity (or are below the concentration threshold for classification).

**Germ Cell Mutagenicity:** No information available on the mixture, however none of the components have been classified for germ cell mutagenicity (or are below the concentration threshold for classification).

Reproductive Toxicity: No information available on the mixture, however none of the components have been classified for reproductive toxicity (or are below the concentration threshold for classification

#### **SECTION 12: Ecological information**

#### **GHS Classification:**

#### No classified hazards

**Toxicity:** Experimental studies with rainbow trout, daphnia, and fresh water algae indicate that synthetic base oils are not expected to be harmful to aquatic organisms.

**Persistence and Degradability:** Synthetic base oils are not considered to be readily biodegradable but may be inherently biodegradable. They are expected to completely biodegrade over extended periods of time.

Bioaccumulative Potential: Not expected to bioaccumulate.

**Mobility in Soil:** Volatilization to air is not expected to be a significant fate process due to the low vapor pressure of this material. In water, this material will float and spread over the surface at a rate dependent upon viscosity. The main fate process is expected to be slow biodegradation of individual components in soil and sediment.

Other adverse effects: None anticipated.

#### SECTION 13: Disposal considerations

The generator of a waste is always responsible for making proper hazardous waste determinations and needs to consider state and local requirements in addition to federal regulations. This material, if discarded as produced, would not be a federally regulated RCRA "listed" hazardous waste and is not believed to exhibit characteristics of hazardous waste. See Sections 7 and 8 for information on handling, storage and personal protection and Section 9 for physical/chemical properties. It is possible that the material as produced contains constituents which are not required to be listed in the SDS but could affect the hazardous waste determination. Additionally, use which results in chemical or physical change of this material could subject it to regulation as a hazardous waste. This material under most intended uses would become "Used Oil" due to contamination by physical or chemical impurities. Whenever possible, Recycle used oil in accordance with applicable federal and state or local regulations. Container contents should be completely used and containers should be emptied prior to discard.

#### **SECTION 14: Transport information**

U.S. Department of Transportation (DOT)

**UN Number:** Not regulated **UN proper shipping name:** None **Transport hazard class(es):** None

Packing Group: None



pulsa.com

Environmental Hazards: This product does not meet the DOT/UN/IMDG/IMO criteria of a marine pollutant

Special precautions for user: If shipped by land in a packaging having a capacity of 3,500 gallons or more, the provisions of 49

CFR, Part 130 apply. (Contains oil)

Transport in bulk according to Annex II of MARPOL 73/78 and the IBC Code: Not applicable

#### CERCLA/SARA - Section 302 Extremely Hazardous Substances and TPQs (in pounds):

#### SECTION 15: Regulatory information

This material does not contain any chemicals subject to the reporting requirements of SARA 302 and 40 CFR 372.

#### CERCLA/SARA - Section 311/312 (Title III Hazard Categories)

Acute Health Hazard:NoChronic Health Hazard:NoFire Hazard:NoPressure Hazard:NoReactive Hazard:No

#### CERCLA/SARA - Section 313 and 40 CFR 372:

This material does not contain any chemicals subject to the reporting requirements of SARA 313 and 40 CFR 372.

#### EPA (CERCLA) Reportable Quantity (in pounds):

This material does not contain any chemicals with CERCLA Reportable Quantities.

#### **California Proposition 65:**

This material does not contain any chemicals which are known to the State of California to cause cancer, birth defects or other reproductive harm at concentrations that trigger the warning requirements of California Proposition 65.

#### **International Hazard Classification**

#### Canada:

This product has been classified in accordance with the hazard criteria of the Hazardous Products Regulations (SOR/2015-17) and the SDS contains all the information required by the Regulations.

#### **International Inventories**

All components are either listed on the US TSCA Inventory, or are not regulated under TSCA.

All components are either on the DSL, or are exempt from DSL listing requirements.

#### U.S. Export Control Classification Number: EAR99

#### **SECTION 16: Other information**

Issue Date:	Previous Issue Date:	SDS Number	Status:
22-Jun-2016	12-Apr-2016	LBPH778853	FINAL

#### **Revised Sections or Basis for Revision:**

New SDS

#### **Guide to Abbreviations:**

ACGIH = American Conference of Governmental Industrial Hygienists; CASRN = Chemical Abstracts Service Registry Number; CEILING = Ceiling Limit (15 minutes); CERCLA = The Comprehensive Environmental Response, Compensation, and Liability Act; EPA = Environmental Protection Agency; GHS = Globally Harmonized System; IARC = International Agency for Research on Cancer; INSHT = National Institute for Health and Safety at Work; IOPC = International Oil Pollution Compensation; LEL = Lower Explosive Limit; NE = Not Established; NFPA = National Fire Protection Association; NTP = National Toxicology Program; OSHA = Occupational Safety and Health Administration; PEL = Permissible Exposure



pulsa.com

Limit (OSHA); SARA = Superfund Amendments and Reauthorization Act; STEL = Short Term Exposure Limit (15 minutes); TLV = Threshold Limit Value (ACGIH); TWA = Time Weighted Average (8 hours); UEL = Upper Explosive Limit; WHMIS = Worker Hazardous Materials Information System (Canada)

#### Disclaimer of Expressed and implied Warranties:

The information presented in this Safety Data Sheet is based on data believed to be accurate as of the date this Safety Data Sheet was prepared. HOWEVER, NO WARRANTY OF MERCHANTABILITY, FITNESS FOR ANY PARTICULAR PURPOSE, OR ANY OTHER WARRANTY IS EXPRESSED OR IS TO BE IMPLIED REGARDING THE ACCURACY OR COMPLETENESS OF THE INFORMATION PROVIDED ABOVE, THE RESULTS TO BE OBTAINED FROM THE USE OF THIS INFORMATION OR THE PRODUCT, THE SAFETY OF THIS PRODUCT, OR THE HAZARDS RELATED TO ITS USE. No responsibility is assumed for any damage or injury resulting from abnormal use or from any failure to adhere to recommended practices. The information provided above, and the product, are furnished on the condition that the person receiving them shall make their own determination as to the suitability of the product for their particular purpose and on the condition that they assume the risk of their use. In addition, no authorization is given nor implied to practice any patented invention without a license.

Revision Date: 22-Jun-2016

# 



pulsa.com

#### PULSALube Premium 9M Eccentric & Gear Oil

#### **SECTION 1**

#### PRODUCT AND COMPANY IDENTIFICATION

**PRODUCT** 

Product Name: MOBIL 600 W SUPER CYLINDER OIL

**Product Description:** Base Oil and Additives **Product Code:** 20156050D010, 601211-80

Intended Use: Cylinder oil

**COMPANY IDENTIFICATION** 

Supplier: East Coast Lubes Pty Ltd (Queensland and Northern Territory)

A.B.N. 37 117 203 611 Cnr North and Mort Streets

Toowoomba, Queensland 4350 Australia

 24 Hour Emergency Telephone
 1300 131 001

 Supplier General Contact
 1800 069 019

Supplier: Southern Cross Lubes (Victoria and Tasmania)

58-66 Ajax Road

Altona, Victoria 3018, Australia

24 Hour Emergency Telephone

1300 131 001

Product Technical Information Supplier General Contact

1300 466 245 1300 552 861

Supplier: Perkal Pty Ltd Trading as Statewide Oil (Western Australia)

A.B.N. 43 009 283 363

14 Beete Street

Welshpool, Western Australia 6106 Australia

24 Hour Emergency Telephone

(8:00am to 4:30pm Mon to Fri) 1300 919 904

**Product Technical Information** 

**Supplier General Contact** (08) 9350 6777 (08) 9350 6777

Supplier: Perkal Pty Ltd Trading as Statewide Oil (South Australia)

A.B.N. 43 009 283 363

6-10 Streiff Rd

Wingfield, South Australia 5013 Australia

24 Hour Emergency Telephone Product Technical Information

(8:00am to 4:30pm Mon to Fri) 1300 919 904

Product Technical Information Supplier General Contact

(08) 8359 8995 (08) 8359 8995

#### **HAZARDS IDENTIFICATION**

**SECTION 2** 



pulsa.com

-----

This material is not hazardous according to regulatory guidelines (see (M)SDS Section 15).

#### Other hazard information:

#### **Physical / Chemical Hazards:**

No significant hazards.

#### **Health Hazards:**

Excessive exposure may result in eye, skin, or respiratory irritation.

#### **Environmental Hazards:**

No significant hazards.

**NOTE:** This material should not be used for any other purpose than the intended use in Section 1 without expert advice. Health studies have shown that chemical exposure may cause potential human health risks which may vary from person to person.

#### **SECTION 3**

#### COMPOSITION / INFORMATION ON INGREDIENTS

This material is defined as a mixture.

#### No Reportable Hazardous Substance(s) or Complex Substance(s).

Other ingredients determined not to be hazardous up to 100%.

#### **SECTION 4**

#### **FIRST AID MEASURES**

#### **INHALATION**

Remove from further exposure. For those providing assistance, avoid exposure to yourself or others. Use adequate respiratory protection. If respiratory irritation, dizziness, nausea, or unconsciousness occurs, seek immediate medical assistance. If breathing has stopped, assist ventilation with a mechanical device or use mouth-to-mouth resuscitation.

#### SKIN CONTACT

Wash contact areas with soap and water.

#### **EYE CONTACT**

Flush thoroughly with water. If irritation occurs, get medical assistance.

#### **INGESTION**

First aid is normally not required. Seek medical attention if discomfort occurs.

#### **NOTE TO PHYSICIAN**

None

#### **SECTION 5**

#### **FIRE FIGHTING MEASURES**



pulsa.com

#### **EXTINGUISHING MEDIA**

**Appropriate Extinguishing Media:** Use water fog, foam, dry chemical or carbon dioxide (CO2) to extinguish flames.

Inappropriate Extinguishing Media: Straight streams of water

#### **FIRE FIGHTING**

**Fire Fighting Instructions:** Evacuate area. Prevent run-off from fire control or dilution from entering streams, sewers or drinking water supply. Fire-fighters should use standard protective equipment and in enclosed spaces, self-contained breathing apparatus (SCBA). Use water spray to cool fire exposed surfaces and to protect personnel.

**Hazardous Combustion Products:** Aldehydes, Incomplete combustion products, Oxides of carbon, Smoke, Fume, Sulphur oxides

#### FLAMMABILITY PROPERTIES

Flash Point [Method]: >282°C (540°F) [ASTM D-92]

Flammable Limits (Approximate volume % in air): LEL: 0.9 UEL: 7.0

**Autoignition Temperature: N/D** 

#### **SECTION 6**

#### **ACCIDENTAL RELEASE MEASURES**

#### NOTIFICATION PROCEDURES

In the event of a spill or accidental release, notify relevant authorities in accordance with all applicable regulations.

#### **PROTECTIVE MEASURES**

Avoid contact with spilled material. See Section 5 for fire fighting information. See the Hazard Identification Section for Significant Hazards. See Section 4 for First Aid Advice. See Section 8 for advice on the minimum requirements for personal protective equipment. Additional protective measures may be necessary, depending on the specific circumstances and/or the expert judgment of the emergency responders.

For emergency responders: Respiratory protection: respiratory protection will be necessary only in special cases, e.g., formation of mists. Half-face or full-face respirator with filter(s) for dust/organic vapor or Self Contained Breathing Apparatus (SCBA) can be used depending on the size of spill and potential level of exposure. If the exposure cannot be completely characterized or an oxygen deficient atmosphere is possible or anticipated, SCBA is recommended. Work gloves that are resistant to hydrocarbons are recommended. Gloves made of polyvinyl acetate (PVA) are not water-resistant and are not suitable for emergency use. Chemical goggles are recommended if splashes or contact with eyes is possible. Small spills: normal antistatic work clothes are usually adequate. Large spills: full body suit of chemical resistant, antistatic material is recommended.

#### SPILL MANAGEMENT

Land Spill: Stop leak if you can do so without risk. Recover by pumping or with suitable absorbent.

**Water Spill:** Stop leak if you can do so without risk. Confine the spill immediately with booms. Warn other shipping. Remove from the surface by skimming or with suitable absorbents. Seek the advice of a specialist before using dispersants.



pulsa.com

Water spill and land spill recommendations are based on the most likely spill scenario for this material; however, geographic conditions, wind, temperature, (and in the case of a water spill) wave and current direction and speed may greatly influence the appropriate action to be taken. For this reason, local experts should be consulted. Note: Local regulations may prescribe or limit action to be taken.

#### **ENVIRONMENTAL PRECAUTIONS**

Large Spills: Dyke far ahead of liquid spill for later recovery and disposal. Prevent entry into waterways, sewers, basements or confined areas.

#### **SECTION 7**

#### HANDLING AND STORAGE

#### **HANDLING**

Prevent small spills and leakage to avoid slip hazard. Material can accumulate static charges which may cause an electrical spark (ignition source). When the material is handled in bulk, an electrical spark could ignite any flammable vapors from liquids or residues that may be present (e.g., during switch-loading operations). Use proper bonding and/or earthing procedures. However, bonding and earthing may not eliminate the hazard from static accumulation. Consult local applicable standards for guidance. Additional references include American Petroleum Institute 2003 (Protection Against Ignitions Arising out of Static, Lightning and Stray Currents) or National Fire Protection Agency 77 (Recommended Practice on Static Electricity) or CENELEC CLC/TR 50404 (Electrostatics - Code of practice for the avoidance of hazards due to static electricity).

**Static Accumulator:** This material is a static accumulator.

#### **STORAGE**

The type of container used to store the material may affect static accumulation and dissipation. Do not store in open or unlabelled containers. Keep away from incompatible materials.

Material is defined under the National Standard [NOHSC:1015] Storage and Handling of Workplace Dangerous Goods.

#### **SECTION 8**

#### **EXPOSURE CONTROLS / PERSONAL PROTECTION**

#### Exposure limits/standards for materials that can be formed when handling this product:

NOTE: Limits/standards shown for guidance only. Follow applicable regulations.

#### **Biological limits**

No biological limits allocated.

#### **ENGINEERING CONTROLS**

The level of protection and types of controls necessary will vary depending upon potential exposure conditions. Control measures to consider:

No special requirements under ordinary conditions of use and with adequate ventilation.

#### PERSONAL PROTECTION

Personal protective equipment selections vary based on potential exposure conditions such as applications,



pulsa.com

handling practices, concentration and ventilation. Information on the selection of protective equipment for use with this material, as provided below, is based upon intended, normal usage.

**Respiratory Protection:** If engineering controls do not maintain airborne contaminant concentrations at a level which is adequate to protect worker health, an approved respirator may be appropriate. Respirator selection, use, and maintenance must be in accordance with regulatory requirements, if applicable. Types of respirators to be considered for this material include:

Particulate

No special requirements under ordinary conditions of use and with adequate ventilation.

For high airborne concentrations, use an approved supplied-air respirator, operated in positive pressure mode. Supplied air respirators with an escape bottle may be appropriate when oxygen levels are inadequate, gas/vapour warning properties are poor, or if air purifying filter capacity/rating may be exceeded.

**Hand Protection:** Any specific glove information provided is based on published literature and glove manufacturer data. Glove suitability and breakthrough time will differ depending on the specific use conditions. Contact the glove manufacturer for specific advice on glove selection and breakthrough times for your use conditions. Inspect and replace worn or damaged gloves. The types of gloves to be considered for this material include:

Nitrile, Viton

No protection is ordinarily required under normal conditions of use.

Eye Protection: If contact is likely, safety glasses with side shields are recommended.

**Skin and Body Protection:** Any specific clothing information provided is based on published literature or manufacturer data. The types of clothing to be considered for this material include:

No skin protection is ordinarily required under normal conditions of use. In accordance with good industrial hygiene practices, precautions should be taken to avoid skin contact.

**Specific Hygiene Measures:** Always observe good personal hygiene measures, such as washing after handling the material and before eating, drinking, and/or smoking. Routinely wash work clothing and protective equipment to remove contaminants. Discard contaminated clothing and footwear that cannot be cleaned. Practise good housekeeping.

#### **ENVIRONMENTAL CONTROLS**

Comply with applicable environmental regulations limiting discharge to air, water and soil. Protect the environment by applying appropriate control measures to prevent or limit emissions.

#### **SECTION 9**

#### PHYSICAL AND CHEMICAL PROPERTIES

Note: Physical and chemical properties are provided for safety, health and environmental considerations only and may not fully represent product specifications. Contact the Supplier for additional information.

#### **GENERAL INFORMATION**

Physical State: Liquid

Colour: Brown

Odour: Characteristic
Odour Threshold: N/D

#### IMPORTANT HEALTH, SAFETY, AND ENVIRONMENTAL INFORMATION



#### pulsa.com

Relative Density (at 15 °C): 0.907 Flammability (Solid, Gas): N/A

Flash Point [Method]: >282°C (540°F) [ASTM D-92]

Flammable Limits (Approximate volume % in air): LEL: 0.9 UEL: 7.0

**Autoignition Temperature: N/D** 

**Boiling Point / Range:** > 316°C (600°F) **Decomposition Temperature:** N/D **Vapour Density (Air = 1):** > 2 at 101 kPa

Vapour Pressure: < 0.013 kPa (0.1 mm Hg) at 20 °C

Evaporation Rate (n-butyl acetate = 1): N/D

pH: N/A

Log Pow (n-Octanol/Water Partition Coefficient): > 3.5

Solubility in Water: Negligible

Viscosity: 460 cSt (460 mm2/sec) at 40 °C | 30.5 cSt (30.5 mm2/sec) at 100 °C

Oxidizing Properties: See Hazards Identification Section.

#### OTHER INFORMATION

Freezing Point: N/D
Melting Point: N/A
Pour Point: -6°C (21°F)

DMSO Extract (mineral oil only), IP-346: < 3 %wt

#### SECTION 10 STABILITY AND REACTIVITY

STABILITY: Material is stable under normal conditions.

**CONDITIONS TO AVOID:** Excessive heat. High energy sources of ignition.

**INCOMPATIBLE MATERIALS:** Strong oxidisers

HAZARDOUS DECOMPOSITION PRODUCTS: Material does not decompose at ambient temperatures.

POSSIBILITY OF HAZARDOUS REACTIONS: Hazardous polymerization will not occur.

#### SECTION 11 TOXICOLOGICAL INFORMATION

#### INFORMATION ON TOXICOLOGICAL EFFECTS

Hazard Class	Conclusion / Remarks
Inhalation	
Acute Toxicity: No end point data for material.	Minimally Toxic. Based on assessment of the components.
Irritation: No end point data for material.	Negligible hazard at ambient/normal handling temperatures.
Ingestion	
Acute Toxicity: No end point data for material.	Minimally Toxic. Based on assessment of the components.
Skin	
Acute Toxicity: No end point data for material.	Minimally Toxic. Based on assessment of the components.
Skin Corrosion/Irritation: No end point data	Negligible irritation to skin at ambient temperatures. Based on



pulsa.com

for material.	assessment of the components.
Eye	
Serious Eye Damage/Irritation: No end point data for material.	May cause mild, short-lasting discomfort to eyes. Based on assessment of the components.
Sensitisation	
Respiratory Sensitization: No end point data for material.	Not expected to be a respiratory sensitizer.
Skin Sensitization: No end point data for material.	Not expected to be a skin sensitizer. Based on assessment of the components.
Aspiration: Data available.	Not expected to be an aspiration hazard. Based on physico- chemical properties of the material.
<b>Germ Cell Mutagenicity:</b> No end point data for material.	Not expected to be a germ cell mutagen. Based on assessment of the components.
Carcinogenicity: No end point data for material.	Not expected to cause cancer. Based on assessment of the components.
Reproductive Toxicity: No end point data for material.	Not expected to be a reproductive toxicant. Based on assessment of the components.
Lactation: No end point data for material.	Not expected to cause harm to breast-fed children.
Specific Target Organ Toxicity (STOT)	
Single Exposure: No end point data for material.	Not expected to cause organ damage from a single exposure.
Repeated Exposure: No end point data for material.	Not expected to cause organ damage from prolonged or repeated exposure. Based on assessment of the components.

#### **OTHER INFORMATION**

#### Contains:

Base oil severely refined: Not carcinogenic in animal studies. Representative material passes IP-346, Modified Ames test, and/or other screening tests. Dermal and inhalation studies showed minimal effects; lung non-specific infiltration of immune cells, oil deposition and minimal granuloma formation. Not sensitising in test animals.

#### IARC Classification:

The following ingredients are cited on the lists below:

Chemical Name	CAS Number	List Citations	
SOLVENT DEASPHALTED	64741-95-3	1	
RESIDUAL OIL			

--REGULATORY LISTS SEARCHED--

1 = IARC 1 2 = IARC 2A 3 = IARC 2B

The information given is based on data available for the material, the components of the material, and similar materials.

#### ECOTOXICITY

Material -- Not expected to be harmful to aquatic organisms.

#### **MOBILITY**



pulsa.com

Base oil component -- Low solubility and floats and is expected to migrate from water to the land. Expected to partition to sediment and wastewater solids.

#### PERSISTENCE AND DEGRADABILITY

#### **Biodegradation:**

Base oil component -- Expected to be inherently biodegradable

#### **BIOACCUMULATION POTENTIAL**

Base oil component -- Has the potential to bioaccumulate, however metabolism or physical properties may reduce the bioconcentration or limit bioavailability.

#### **SECTION 13**

#### **DISPOSAL CONSIDERATIONS**

Disposal recommendations based on material as supplied. Disposal must be in accordance with current applicable laws and regulations, and material characteristics at time of disposal.

#### **DISPOSAL RECOMMENDATIONS**

Product is suitable for burning in an enclosed controlled burner for fuel value or disposal by supervised incineration at very high temperatures to prevent formation of undesirable combustion products. Protect the environment. Dispose of used oil at designated sites. Minimize skin contact. Do not mix used oils with solvents, brake fluids or coolants.

**Empty Container Warning** Empty Container Warning (where applicable): Empty containers may contain residue and can be dangerous. Do not attempt to refill or clean containers without proper instructions. Empty drums should be completely drained and safely stored until appropriately reconditioned or disposed. Empty containers should be taken for recycling, recovery, or disposal through suitably qualified or licensed contractor and in accordance with governmental regulations. DO NOT PRESSURISE, CUT, WELD, BRAZE, SOLDER, DRILL, GRIND, OR EXPOSE SUCH CONTAINERS TO HEAT, FLAME, SPARKS, STATIC ELECTRICITY, OR OTHER SOURCES OF IGNITION. THEY MAY EXPLODE AND CAUSE INJURY OR DEATH.

#### SECTION 14 TRANSPORT INFORMATION

LAND (ADG): Not Regulated for Land Transport

SEA (IMDG): Not Regulated for Sea Transport according to IMDG-Code

Marine Pollutant: No

AIR (IATA): Not Regulated for Air Transport

#### **SECTION 15**

#### **REGULATORY INFORMATION**

This material is not considered hazardous according to Australia Model Work Health and Safety Regulations.

Product is not regulated according to Australian Dangerous Goods Code.



pulsa.com

No Poison Schedule number allocated by the Standard for the Uniform Scheduling of Medicines and Poisons (SUSMP) established under the Therapeutic Goods Act.

AS1940 COMBUSTIBLE CLASS: C2

#### REGULATORY STATUS AND APPLICABLE LAWS AND REGULATIONS

Listed or exempt from listing/notification on the following chemical inventories: AICS, DSL, ENCS, IECSC, KECI, PICCS, TSCA

#### **SECTION 16**

#### OTHER INFORMATION

#### **KEY TO ABBREVIATIONS AND ACRONYMS:**

N/D = Not determined, N/A = Not applicable, STEL = Short-Term Exposure Limit, TWA = Time-Weighted Average

#### THIS SAFETY DATA SHEET CONTAINS THE FOLLOWING REVISIONS:

Perkal Pty Ltd Trading as Roto Oil (South Australia): Section 01: Supplier Mailing Address information was deleted. Perkal Pty Ltd Trading as Statewide Oil (South Australia): Section 01: Supplier Mailing Address information was added. Perkal Pty Ltd Trading as Statewide Oil (Western Australia): Section 01: Supplier Mailing Address information was modified.

Section 01: Company Contact Methods information was modified.

Section 01: Product Code information was modified.

Section 11: Tox List Cited Table information was added.

Southern Cross Lubes (Victoria and Tasmania): Section 01: Supplier Mailing Address information was modified.

The information and recommendations contained herein are, to the best of ExxonMobil's knowledge and belief, accurate and reliable as of the date issued. You can contact ExxonMobil to insure that this document is the most current available from ExxonMobil. The information and recommendations are offered for the user's consideration and examination. It is the user's responsibility to satisfy itself that the product is suitable for the intended use. If buyer repackages this product, it is the user's responsibility to insure proper health, safety and other necessary information is included with and/or on the container. Appropriate warnings and safe-handling procedures should be provided to handlers and users. Alteration of this document is strictly prohibited. Except to the extent required by law, republication or retransmission of this document, in whole or in part, is not permitted. The term, "ExxonMobil" is used for convenience, and may include any one or more of ExxonMobil Chemical Company, Exxon Mobil Corporation, or any affiliates in which they directly of indirectly hold any interest.

DGN: 2007389DAU (547803) Revision Date: 26 Jul 2017

\_\_\_\_\_\_

Prepared by: Exxon Mobil Corporation

EMBSI. Clinton NJ US

# 



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

SCHUTTE & KOERTING
FIGURE 264, EDUCTOR

# 



#### **Water Jet Eductors**

#### Introduction

The Water Jet Eductor is a type of ejector which utilizes the kinetic energy of a pressurized liquid to entrain another liquid, mix the two, and discharge the mixture against a counter pressure. Ejectors of this type are used throughout industry for pumping and mixing operations.

#### **Application**

Water jet eductors have numerous uses in the plant such as lifting, pumping, mixing and agitation of liquids, granular solids and slurries. Some specific applications are: draining flooded areas, emptying tanks and sumps, pumping and mixing operations in oil treating systems, dewatering sand and coal barges, introducing anti-knock agents and coloring additives into gasoline, continuous blending, acidifying, causticizing of oils, producing emulsions, pumping food products, pumping sand and filter clay, tank mixing, and various proportioning operations. As an example of eductor performance in a typical use, a jet eductor measuring 8½" in length will empty a 500 gallon water tank in less than half an hour, using water at 60 psig, as the sole source of motive power.

#### **Features**

**Self Priming** Eductors require no priming and can be used for either continuous or intermittent operation.

**Simple and Reliable** Since the basic eductor has no moving parts to wear or break, only periodic inspection is required.

Corrosion and Erosion Resistant Because they can be made from most materials, or coated with corrosion resistant materials, eductors can be made resistant to the corrosive effects of the liquids handled and the environment.

**Automatic Control** Units can be adapted for automatic operation by means of a regulating spindle or a snap valve and float arrangement.

**Non-Electrical** Eductors can be used in hazardous locations where electrically operated alternatives would require expensive explosion-proofing.

**Easy to Install** Either threaded or flanged connections are available. Units are compact, relatively light and can be adapted to a variety of piping configurations.

**Low Cost** Water eductors are inexpensive in relation to the work they do.

#### Construction

Water Jet Eductors consist of only three basic components: a converging nozzle, a diffuser (or venturi) and a body to hold these parts in their proper relative positions and provide a suction chamber.







Converging Nozzle

Diffuser (or Venturi)

Body - holds diffuser and nozzle in position

Jet ejectors can be made from most workable materials, such as: cast iron, bronze, stainless steel, aluminum, polyvinyl chloride, polyester fiberglass, Phenolic Fiberglass Reinforced Plastic (FRP), Teflon<sup>2</sup> and Hastelloy<sup>3</sup>.

A variety of types and sizes are available as noted on the following pages. Certain variables such as pressure, temperature, viscosity, density, operating conditions of suction and discharge fluids, and desired results must be considered in determining the type of eductor best suited to your needs. S&K engineers will work with you to select the proper eductor for your application.

Request Performance Data Supplement 2M for operating characteristics of water jet eductors.

Index	
Description	Page
Fig. 264 Water Jet Eductor	2
Fig. 266 Water Jet Eductor	2
Fig. 264 PVC and Kynar Water Jet Eductor	3
Fig. 2645 Automatic Eductor	4
Fig. 265 Liquid Jet Eductor	5
Fig. 242 Condensate and Mixing Eductor	6
Fig. 258 Tank Mixing Eductor	7
Fig. 268 Tank Mixing Eductor	7
Fig. 254 Hopper-Equipped Eductor	9
Fig. 267 Hopper-Equipped Eductor	9
Fig. 227 Hopper-Equipped Eductor	9
Fig. 224 Water Jet Sand and Mud Eductor	10
Fig. 235 Annular Multi-Nozzle Water Jet Eductor	11
Fig. 222 Portable Eductor	12
Fig. 212 Corrosion Resistant Eductor	12
Typical Applications of S&K Water Jet Eductors	12



#### Fig. 264 and Fig. 266 Water Jet Eductors

S&K Fig. 264 and Fig. 266 Water Jet Eductors are designed for liquid pumping and mixing operations and for the handling of some solids where requirements do not necessitate capacities greater than those obtained with sizes up to and including 6". They are considered the standard eductors within this size range. Typical applications begin on page 12.

In operation, pressure liquid enters the eductor through the pressure nozzle and produces a high velocity jet. This jet action creates a vacuum in the line which causes the suction liquid to flow up into the body of the eductor where it is entrained by the

pressure liquid. Both liquids are thoroughly mixed in the throat of the eductor and are discharged against back pressure. The streamlined body with no pockets permits the pressure liquid to move straight through the eductor and reduces the possibility of solids in the suction material collecting and clogging. In addition, pressure drop in the suction chamber is held to a minimum.

Accompanying Bulletin 2M Supplement Performance Data provides performance information.

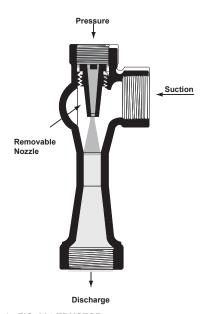


Fig 1. FIG. 264 EDUCTOR

Eductors of this type have streamlined bodies with threaded pipe connections. They are made in sizes ranging from 1/2" to 3" and are stocked in these sizes in ductile iron and bronze and Fig. 316 stainless steel. They are stocked in sizes from 1/2", 2", and 3" in PVC. Other materials are available on order.

2 1/2

4

100

180

125

125

125

125



Fig. 2. FIG. 264 EDUCTOR

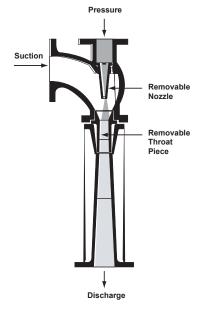


Fig. 3. FIG. 266 EDUCTOR.

These eductors are similar to Fig. 264 Eductors except that they have flanged connections and removable throat bushings along with removable nozzles. They are supplied in cast iron, bronzemounted in 4" and 6" sizes. Other materials can be supplied on special order.

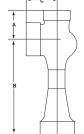


Fig. 264

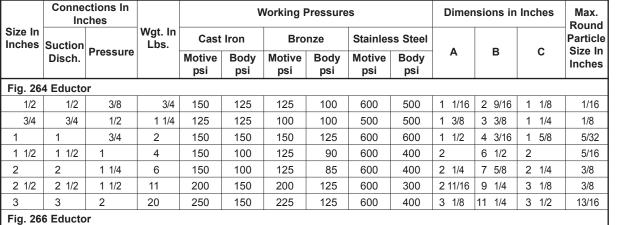


Table 1. Sizes and Dimensions, Fig. 264 and Fig. 266 Water Jet Eductors

Fig. 266

2

6

6

4 3/8

19 1/4

6 1/16 28 3/8

7 13/16

1 1/8

9 1/8



### Fig. 264 PVC and Kynar Water Jet Eductors

Fig. 264 PVC and Kynar Eductors offer resistance to many corrosive media. PVC Eductors are not recommended, however, for acetone, ketones, ether, esters, aromatic hydrocarbons or chlorinated hydrocarbons. A table of recommended uses is available on request. Maximum temperature rating is 150°F. Kynar Eductors will handle PVC applications including those mentioned above. Kynar's temperature limitation is 250°F. Pressure ratings are given in Table 2.

Fig. 264 PVC and Kynar Eductors operate on the same principle as do all other S&K Eductors. Performance characteristics with water are shown in Bulletin 2M Supplement Technical Data. For performance with other liquids, contact S&K.

Nozzles and diffusers are not removable on these eductors. Sizes 1" and smaller are of molded construction.

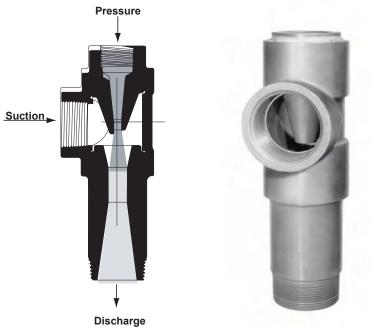


Fig. 4. FIG. 264 PVC EDUCTOR.
Sizes from 1 1/2" up are designed as shown here and in Fig. 5. On these sizes, the pressure and suction connections are female and the discharge connection is male. All connections are threaded.

Fig. 5. FIG. 264 PVC EDUCTOR.

Table 2. Sizes, Dimensions, and Particle Size Data, Fig. 264 Water Jet Eductor

Size in		ctions in thes		Dimens	sions in	Inches	Working Pressure	Max. Round Particle Sizes	
Inches	Suction Disch.	Pressure	Wgt. In Lbs.	Α	В	С	(psig) at 75°F	(in inches) Eductors will Handle	
1/2s	1/2s	3/8s	1/2	1 7/16	3 1/4	1 7/16	325	1/16	
1/2	1/2	3/8	1/2	1 7/16	3 1/4	1 7/16	325	1/16	
3/4	3/4	1/2	1/2	1 11/16	3 1/2	1 11/16	275	1/8	
1	1	3/4	1/2	1 7/8	3 11/16	1 7/8	250	5/32	
1 1/2	1 1/2	1	1 1/2	2 9/16	5 11/32	2 1/16	200	5/16	
2	2	1 1/4	2 1/2	3 1/32	6 21/32	2 5/32	185	3/8	
3	3	2	6 3/4	4 1/8	9 1/2	3 7/8	165	13/16	

s = denotes smaller internals.

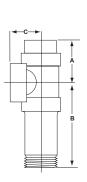




Fig. 6. FIG. 264 KYNAR EDUCTOR.

1/2" to 1" Design. Sizes 1/2", 3/4", and 1" look like this. All connections are female and are



#### Fig. 2645 Automatic Eductor

Fig. 2645 Automatic Water Jet Eductors are used to pump out sumps (pits, tanks, etc.) where liquid accumulates slowly but must be evacuated when it reaches a predetermined level.

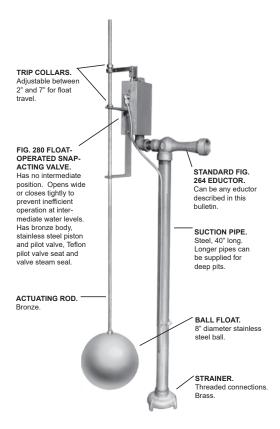
As the liquid in the sump (basin, tank, cellar, bilge, etc.) accumulates, it raises the ball float until the upward action of the float opens the snap-acting valve, admitting motive fluid into the pressure connection of the eductor.

The jet action of the motive fluid creates a vacuum in the eductor and entrains the suction fluid, discharging both

fluids under pressure. As the suction fluid is thus pumped out, the sump level drops to a point where the snapacting valve shuts off. No further pumping action takes place until the sump again fills to the operating level.

Operation of the Fig. 2645 Eductor is completely automatic. It is self-operated, requires no electrical connections or any external power other than the motive fluid. The snap-acting valve and ball float are the only moving parts. The full assembly is so compact it can be installed in tanks as small as 13 1/2" diameter.

For performance information, see accompanying Bulletin 2M Supplement Performance Data.



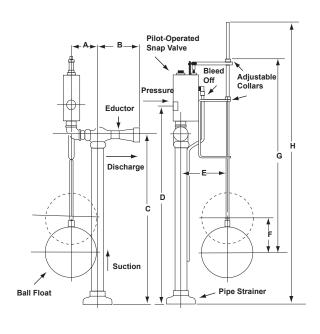


Table 3. Sizes and Dimensions, Fig. 2645 Automatic Eductor

Eductor	Connection	s In Inches N.P.T.	Wgt. In		ng Pressure Bronze)	Dimensions in Inches							
Size In Inches	SucDisch.	Pressure (Snap-Valve)	Lbs.	Motive* (psig)	Body (psig)	Α	В	С	D	E	F	G	Н
3/4	3/4	1	24	100	100	3 11/16	3 3/8	41	44 7/8	7 5/6	5 3/8	47 1/8	60
1	1	1	26	150	125	4 5/16	4 3/16	41	44 7/8	7 5/6	5 3/8	47 1/8	60
1 1/2	1 1/2	1	32	125	90	4 1/8	6 1/2	41	44 7/8	7 5/6	5 3/8	47 1/8	60
2	2	2	43	125	85	6 1/4	7 5/8	38 3/8	43 15/16	7 7/16	5 3/8	47 1/8	60
2 1/2	2 1/2	2	65	200	125	6 11/16	9 1/4	38 3/8	43 15/16	7 7/16	5 3/8	47 1/8	60
3	3	2	81	200	125	6 3/8	11 1/4	38 3/8	43 15/16	7 7/16	5 3/8	47 1/8	60

<sup>\*</sup>Minimum motive pressure for all Fig. 2645 Eductors: 40 psig



#### Fig. 265 Liquid Jet Eductor

Fig. 265 Liquid Jet Eductor is similar in design to the Fig. 264 Water Jet Eductor and is made for liquid pumping and mixing operations and for handling some solids where requirements do not necessitate capacities greater than those obtained with sizes up to and including 3". Typical applications begin on page 12.

The Fig. 265 Liquid Jet Eductor provides higher discharge pressures and higher suction flow capacities than other standard eductors.

In operation, pressure liquid enters the eductor through the pressure nozzle and produces a high velocity jet. This jet action creates a vacuum in the line which causes the suction liquid to flow up into the body of the eductor where it is entrained by the pressure liquid. Both liquids are thoroughly mixed in the throat of the eductor and are discharged against back pressure. The streamlined body with no pockets permits the pressure liquid to move straight through the eductor and reduces the possibility of solids in the suction material collecting and clogging. In addition, pressure drop in the suction chamber is held to a minimum.

Accompanying Bulletin 2M Supplement Performance Data provides performance information.

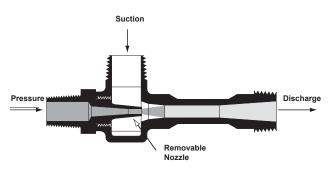


Fig 8. FIG. 265 LIQUID JET EDUCTOR

Eductors of this type have streamlined investment cast bodies with threaded NPT male pipe connections. They are made in sizes ranging from 3/4" to 3" and are stocked in these sizes in Fig. 316 stainless steel. Other materials are available on order



Fig. 9. FIG. 265 EDUCTOR.

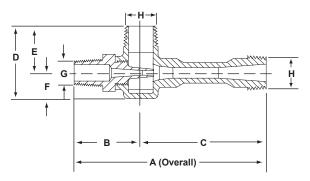


Table 265. Sizes and Dimensions, Fig. 265 Liquid Jet Eductor

Size (In	Wgt.	Dimensions							Connections	
Inches)	J	Α	В	С	D	E	F	G	н	
3/4	1	5 7/8	2	3 7/8	2 1/4	1 1/2	3/4	3/8	3/4	
1	2	7 1/8	2 1/4	4 7/8	2 3/4	1 3/4	1	1/2	1	
1 1/2	4	11	2 3/4	8 1/4	3 21/32	2 1/2	1 5/16	1	1 1/2	
2	8	14 3/8	3 1/8	11 1/4	5	2 7/8	2 1/8	1 1/4	2	
3	30	23 7/8	4	19 7/8	8	5	3	2	3	



#### Fig. 242 Condensate and Mixing Eductor

Fig. 242 Water Jet Eductors are designed to mix two liquids intimately in various proportions in operations where the pressure liquid is the greater proportion of the mixture. Typical applications include: removal of condensate; mixing gasoline with acid; blending and proportioning chemical solutions; and diluting acids and alkali.

In operation, the pressure liquid issues from the nozzle at high velocity and entrains the suction liquid. The extreme turbulence in the throat of the eductor mixes the two liquids, blending and emulsifying thoroughly and completely. Colloidal suspensions can also be produced.

Entrainment ratio is dependent upon the eductor design. Close regulation within the design limits is usually obtained by a valve in the suction liquid line.

The pressure drop between the pressure liquid and the discharge should be at least 10 psi to give adequate mixing, and the difference between the discharge pressure and the suction pressure should not exceed 75% of the difference between the operating pressure and the suction pressure.

When used for removal of condensate, the eductor should be installed three feet below the condensate level at the drain of the condenser. For performance information, see Technical Data Supplement to Bulletin 2M.



Fig. 10. FIG. 242 EDUCTOR.

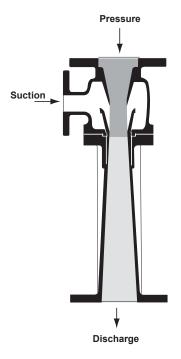
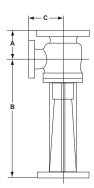


Fig. 11. FIG. 242 EDUCTOR.
The 242 is the flanged type Condensate and Mixing Eductor. This style, too, is made in bronze or cast iron, bronze mounted, but can be supplied in other materials. Nozzles and throat bushings are removable.

Table 4. Sizes and Dimensions, Fig. 242 Condensate and Mixing Eductor

		nection in Ir	nches	Dimen	Weight		
Size No.	Pressure	Suction*	Discharge	Α	В	С	in Lbs.
2	2	1 - 2	2	4 3/4	11 3/4	3 3/4	50
2 1/2	2 1/2	1 1/4 - 2 1/2	2 1/2	3 1/2	15 1/4	4	60
3	3	2 - 3	3	4	17 15/16	4 5/8	70
4	4	2 - 4	4	5 9/16	20 3/8	5 1/2	80
6	6	3 - 6	6	6 1/4	29	6	270
8	8	4 - 8	8	14 1/16	35 1/2	7 13/16	450

\*Note: Suction connection may vary to suit conditions.





## Fig. 258 and Fig. 268 Tank Mixing Eductors

Fig. 258 and Fig. 268 Tank Mixing Eductors are used to agitate liquid, dissolve powdered solids in liquid, and to mix two or more liquids intimately within a tank or other vessel without the use of baffles or moving parts inside the tank. These units take the place of mechanical agitators.

The 268 is used in preference to the 258 in operations where it is desirable to start mixing from a shallow level or where uniform local agitation is required over large, shallow tank area. Typical applications of each are shown in the application section beginning on page 12.

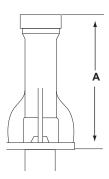
Fig. 258 and 268 Eductors are operated by a flow of pressure liquid through the nozzle. As shown in the sectional drawings, the motive liquid entrains suction liquid, the two are mixed intimately in the venturi, and the mixture is discharged into the tank. Pressure liquid can be taken from the tank by means of a pump or it can be a new liquid. Standard, stock units are designed to entrain 3 gallons of suction fluid for each gallon of motive fluid. (Special designs of the 258 Eductor can be made to give 1 to 1 ratio.)

Normally, the tank is filled by means of the eductors. Mixing occurs as soon as the level of liquid in the tank covers the suction of the eductor. In addition to the mixing obtained between suction and motive fluids in the eductor, the jet action of the discharge from the eductor serves to agitate the tank and prevents stratification.

If a drawing or sketch of the mixing tank is furnished, S&K will recommend and quote on the proper type of distribution system.

Performance information is given in accompanying Performance Data, Bulletin 2M Supplement. Similar units using steam as motive fluid for heating, circulating and mixing are described in Bulletin 3A as "Fig. 314" units.

Table 5. Sizes and Dimensions, Fig. 258 Tank Mixing Eductor

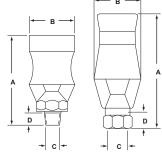


Size in	Connections in Inch		Wgt. in	Dimensions in Inches		
Inches	Disch.	Pressure	Lbs.	Α		
1/2	1	1/2	2	5 1/2		
3/4	1 1/2	3/4	6	8 1/2		
1	2	1	22 1/2	12 5/16		
1 1/4	2 1/2	1 1/4	29	11 1/8		
1 1/2	3	1 1/2	36 1/2	15 7/8		
2	4*	2	78	19 5/8		
3	6*	3		28 13/16		
4	†	4*	ON	t		
5	†	5*	APPL.	t		
6	†	6*		†		

<sup>\*</sup>Flanged Connection

Note: A discharge flange is not supplied on large fabricated units unless required by the application.

(See Fig. 16 for dimensions of Fig. 268 Eductor).



Sizes 3/8, 3/4 Sizes 1 1/2, 2, 3

Table 5-A. Sizes and Dimensions, Fig. 268 Tank Mixing Eductor

Size in Inches	A	В	С	D	Wgt. in Lbs.
3/8	3 3/4	1 3/4	3/8	7/16	3/4
3/4	5 1/4	2 3/8	3/4	9/16	2 1/2
1 1/2	8 13/16	4 1/16	1 1/2	13/16	6 1/4
2	12 1/4	5 13/16	2	45/64	22
3	17	8 1/8	3	15/16	48

<sup>†</sup> Varies with performance and application



#### Fig. 258 and Fig. 268 Tank Mixing Eductors



Fig. 12. FIG. 258 TANK MIXING EDUCTOR.

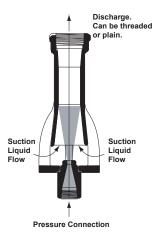


Fig. 13. FIG. 258 TANK MIXING EDUCTOR.

Standard units are made in cast iron and bronze but can be made in many other materials on special order. Large sizes can be fabricated instead of cast.



Fig. 14. FIG. 268 TANK MIXING EDUCTOR. 3/8" and 3/4" sizes.

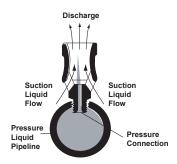


Fig. 15. FIG. 268 TANK MIXING EDUCTOR.

This design is used for 3/8" (3 3/4" overall length and 1 3/4" overall width), and 3/4" (5 1/4" overall length and 2 3/8" overall width) pressure connection sizes. It is threaded directly into threads tapped into the 1 1/2" diameter or larger pressure liquid pipeline. It is cast in one piece and is stocked in cast iron, bronze and 316 stainless steel. Other materials can be supplied on special order.



Fig. 17. FIG. 268 TANK MIXING EDUCTOR. 1 1/2" size and over.

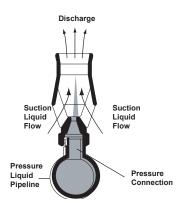


Fig. 16. FIG. 268 TANK MIXING EDUCTOR.

This design is used for 1 1/2" (8 7/8" overall length x 4 1/8" overall width), 2" (12 1/4" overall length x 5 7/8" overall width) and 3" (17" overall length x 8 1/8" overall width) pressure connection sizes. All are cast in one piece and have female thread connections for installation on nipples welded into the pressure liquid piping. The 1 1/2" and 2" sizes are stocked in cast iron, bronze, and 316 stainless steel. The 3" size is stocked in cast iron and stainless steel only. Other materials can be supplied on special



#### Fig. 254 and Fig. 267 and Fig. 227 Hopper-Equipped Eductors

Fig. 254 and Fig. 267 Hopper-Type Eductors are made for handling slurries or dry solids in granular form and are used extensively for ejecting sludges from tank bottoms, for pumping sand from filter beds

REGULATING VALVE. Controls by-passed wash-down liquid to provide smooth flow down hopper sides and prevent the excess agilation and splashing.

BY-PASS
FROM
PRESSURE
Liquid by-passed from the raise handled can be fine powders, galaries, diffiling muds, semi-solids such as crushable foodstuffs.

BY-PASS
BY-PASS
FROM
PRESSURE
Liquid by-passed from the raise handled can be fine powders, galaries, diffiling muds, semi-solids such as crushable foodstuffs.

BY-PASS
BY-PASS
BY-PASS
BY-PASS
BY-PASS
BY-PASS
BY-PASS
BY-PASS
BY-PASS
BY-PASS
BY-PASS
BY-PASS
BY-PASS
BY-PASS
BY-PASS
BY-PASS
BY-PASS
BY-PASS
BY-PASS
BY-PASS
BY-PASS
BY-PASS
BY-PASS
BY-PASS
BY-PASS
BY-PASS
BY-PASS
BY-PASS
BY-PASS
BY-PASS
BY-PASS
BY-PASS
BY-PASS
BY-PASS
BY-PASS
BY-PASS
BY-PASS
BY-PASS
BY-PASS
BY-PASS
BY-PASS
BY-PASS
BY-PASS
BY-PASS
BY-PASS
BY-PASS
BY-PASS
BY-PASS
BY-PASS
BY-PASS
BY-PASS
BY-PASS
BY-PASS
BY-PASS
BY-PASS
BY-PASS
BY-PASS
BY-PASS
BY-PASS
BY-PASS
BY-PASS
BY-PASS
BY-PASS
BY-PASS
BY-PASS
BY-PASS
BY-PASS
BY-PASS
BY-PASS
BY-PASS
BY-PASS
BY-PASS
BY-PASS
BY-PASS
BY-PASS
BY-PASS
BY-PASS
BY-PASS
BY-PASS
BY-PASS
BY-PASS
BY-PASS
BY-PASS
BY-PASS
BY-PASS
BY-PASS
BY-PASS
BY-PASS
BY-PASS
BY-PASS
BY-PASS
BY-PASS
BY-PASS
BY-PASS
BY-PASS
BY-PASS
BY-PASS
BY-PASS
BY-PASS
BY-PASS
BY-PASS
BY-PASS
BY-PASS
BY-PASS
BY-PASS
BY-PASS
BY-PASS
BY-PASS
BY-PASS
BY-PASS
BY-PASS
BY-PASS
BY-PASS
BY-PASS
BY-PASS
BY-PASS
BY-PASS
BY-PASS
BY-PASS
BY-PASS
BY-PASS
BY-PASS
BY-PASS
BY-PASS
BY-PASS
BY-PASS
BY-PASS
BY-PASS
BY-PASS
BY-PASS
BY-PASS
BY-PASS
BY-PASS
BY-PASS
BY-PASS
BY-PASS
BY-PASS
BY-PASS
BY-PASS
BY-PASS
BY-PASS
BY-PASS
BY-PASS
BY-PASS
BY-PASS
BY-PASS
BY-PASS
BY-PASS
BY-PASS
BY-PASS
BY-PASS
BY-PASS
BY-PASS
BY-PASS
BY-PASS
BY-PASS
BY-PASS
BY-PASS
BY-PASS
BY-PASS
BY-PASS
BY-PASS
BY-PASS
BY-PASS
BY-PASS
BY-PASS
BY-PASS
BY-PASS
BY-PASS
BY-PASS
BY-PASS
BY-PASS
BY-PASS
BY-PASS
BY-PASS
BY-PASS
BY-PASS
BY-PASS
BY-PASS
BY-PASS
BY-PASS
BY-PASS
BY-PASS
BY-PASS
BY-PASS
BY-PASS
BY-PASS
BY-PASS
BY-PASS
BY-PASS
BY-PASS
BY-PASS
BY-PASS
BY-PASS
BY-PASS
BY-PASS
BY-PASS
BY-PASS
BY-PAS

Fig. 18. FIG. 254 HOPPER-EQUIPPED EDUCTOR.

Standard units are made in cast iron and have hardened steel nozzles and throat bushings. Special materials are also available on special order. Both nozzles and throat pieces are removable and pressure and discharge connections can be fitted for hose where maximum portability is desired. Handles and supporting feet are optional.

and for washing and conveying granular materials. Typical materials handled include: borax, charcoal, diatomaceous earth, lime, mash, fly ash, rosin, rock and granulated salt, sand, dry sawdust, light soda ash, dry sodium nitrate, powdered sulphur, wheat and many others.

A typical application of Fig. 254 Eductor is shown in the application section of this bulletin, beginning on page 12. the material from adhering to the sides of the hopper and keep it moving down into the eductor. Pressure water, passing through the eductor nozzle, entrains the sand, sludge or other materials and discharges into the piping system.



Fig. 19. FIG. 267 HOPPER-EQUIPPED EDUCTOR.

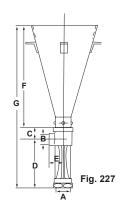
This economical unit is available from stock with body and nozzle in cast iron, bronze, 316 stainless steel, Kynar and PVC. Hoppers are stocked in Type 304 stainless steel (1, 1 1/2 & 2" sizes) and are also available in galvanized steel, brass, aluminum and PVC.

Table 6. Sizes and Dimensions, Fig. 254(1) and Fig. 267(2) Hopper-Equipped Eductors

				, 5	- ( - /			
Size in	Connectio	n (Inches)	Dimension (Inches)					
Inches	Disch.	Press.	Α	В	С	D		
FIG. 254(1)								
1 1/2	1 1/2	1 1/2	13 1/4	11 1/2	18	15 1/4		
2	2	2	14 1/2	13 3/4	21	17 3/4		
3	3	2 1/2	17 3/4	17 1/2	23 3/8	19 3/4		
4	4	4	19 5/8	24 3/16	27	22 1/2		
6	6	6	28 1/16	36 7/16	38	28 5/16		
FIG. 267	7(2)							
1	1	3/4	1 1/2	4 3/16	24	42		
1 1/2	1 1/2	1	2	6 1/2	24	41 1/2		
2	2	1 1/4	2 1/4	7 5/8	24	41		
2 1/2	2 1/2	1 1/2	2 11/16	9 1/4	24	41 1/4		
3	3	2	3 1/8	11 1/4	24	40 3/4		

# Fig. 227 Hopper-Equipped Eductor

Furnished with a stainless steel funnel, the eductor can be made of any machinable material. Bronze units up to and including 3" and cast iron units up to and including 4" sizes are available from stock. Prices, delivery or a sectional outline drawing 67-XS-081-J will be furnished on request. Stainless steel funnels are stocked in 1-1/4", 1-1/2" and 2" sizes.



D D D

Fig. 254(1)

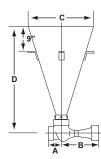


Fig. 267(2)

Table 227. Sizes and Dimensions of Fig. 227 Hopper-Equipped Eductor

Dimensions in Inches						Wgt.	
Α	В	С	D	Е	F	G	(Lbs)
1 1/4	3/4	1 9/16	6 7/16	1 13/16	39 5/8	47 5/8	31
1 1/2	3/4	2	8 13/16	2	39 1/4	50	36
2	1	2 1/2	9 1/8	2 1/4	38 1/2	49 7/8	45
2 1/2	1 1/4	2 3/4	11 1/4	2 3/8	37 7/8	51 7/8	51
3	1 1/2	3 1/16	13 5/16	2 3/4	37	53 3/8	58
4	2	3 5/8	17 1/16	3 3/16	35 1/2	56 3/16	70

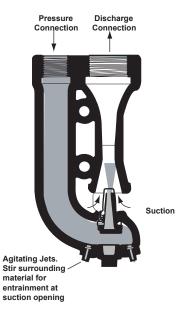


### Fig. 224 Water Jet Sand and Mud Eductor

Fig. 224 Water Jet Sand and Mud Eductors are used in pumping out wells, pits, tanks, or sumps where there is an accumulation of sand, mud, or other material not easily handled by the standard eductor. They are ideal for handling the heavy sludge residue from refining operations. A typical application of a Fig. 224 Eductor is shown in the application section beginning on page 12.

These eductors have an open suction and are designed to be submerged in the material being handled. The pressure liquid, passing through the nozzle, produces a high velocity jet which entrains the sludge or mud. This mixture is then discharged through a vertical pipe or hose. For performance information, see Bulletin 2M Supplement.

Similar units which use steam as the motive power are described in Bulletin 2A under "Fig. 225 Syphons".





Standard units are made of cast iron with bronze pressure nozzles. Other corrosion-resistant materials are available on special order.

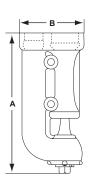


Fig. 21. FIG. 224 EDUCTOR.

Table 7. Sizes and Dimensions, Fig. 224 Sand and Mud Eductor

Size in	Connection	ons in Inches	Wgt in	Dimensions in Inches			
Inches	Disch.	Pressure	Lbs.	Α	В		
1 1/2	1 1/2	1	8	9 3/8	4 5/8		
2 1/2	2 1/2	2	42	16 3/4	7 7/8		
3	3	2 1/2	87	21 7/8	10 1/4		
4	4	3	130	25 1/2	11		
5*	5	4	-	30 1/4	17 3/8		
6*	6	4	-	35 5/16	18		

<sup>\*</sup>Flanged Connections.





### Fig. 235 Annular Multi-Nozzle Water Jet Eductor

Fig. 235 Annular Multi-Nozzle Water Jet Eductors are designed to handle solids and semi-solids. They operate at highest efficiency in large sizes and at low discharge heads. Because these eductors have high air handling capacities, they are particularly well suited for priming large pumps such as dredging pumps which frequently encounter air pockets.

Nozzles on the periphery of the throat introduce the pressure water. The pressure water creates a vacuum which draws in and entrains the material being handled and all flow discharges through the discharge connection. All suction flow is in a straight line through the eductor. For performance information, see Bulletin 2M Supplement.

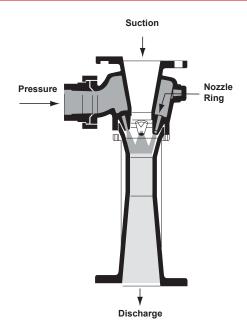


Fig. 22. FIG. 235 ANNULAR MULTI-NOZZLE WATER JET EDUCTOR.

These eductors are made to order from any workable material. Sizes from 1 1/2" to 6" are cast with flanged suction, discharge and pressure connections, except 2" size which has sil-brazed pressure connection. Sizes above 6" (to 28" and up) are generally fabricated.

Table 8. Sizes and Dimensions, Fig. 235 Annular Multi-Nozzle Water Jet Eductor

Size in Inches	Connections in Inches		Wgt.	Dimensions in Inches			
	Suction Disch.	Pressure	In Lbs.	Α	В	С	
1 1/2	1 1/2	1	16	2 7/8	8 7/16	3 3/8	
2	2	1 1/4	22	3 1/8	11 7/8	3 3/4	
2 1/2	2 1/2	1 1/2	27	3 1/4	12 5/16	4	
4	4	2 1/2	65	4 1/8	18 11/16	5 1/8	
5	5	3	100	4 5/8	24 7/16	6	
6	6	4	150	5 1/4	30	7 1/4	

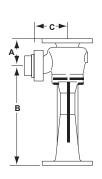




Fig. 23. FIG. 235 EDUCTOR. (2" size with sil-brazed connection).