SERIES M

INSTALLATION
OPERATION
MAINTENANCE
INSTRUCTION

BULLETIN No. SERIES M

PULSAFEEDER®
A Unit of IDEX Corporation

Manufacturers of Quality Pumps,
Controls and Systems

ENGINEERED PUMP OPERATIONS
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MAINTENANCE

INTRODUCTION

GENERAL DESCRIPTION

SERIES M 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.

PRINCIPLES OF OPERATION

I OVERALL OPERATION

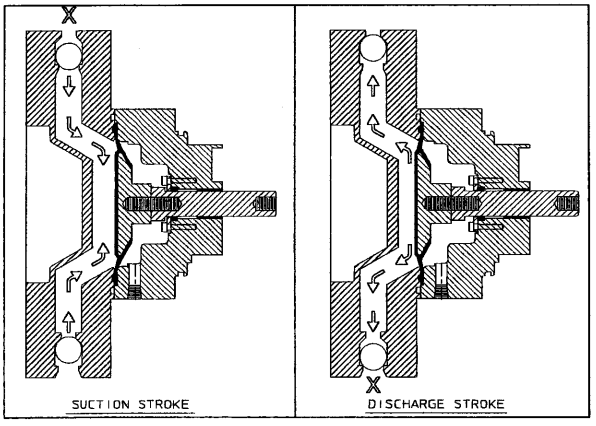


Figure 1

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.

II COMPONENT OPERATION

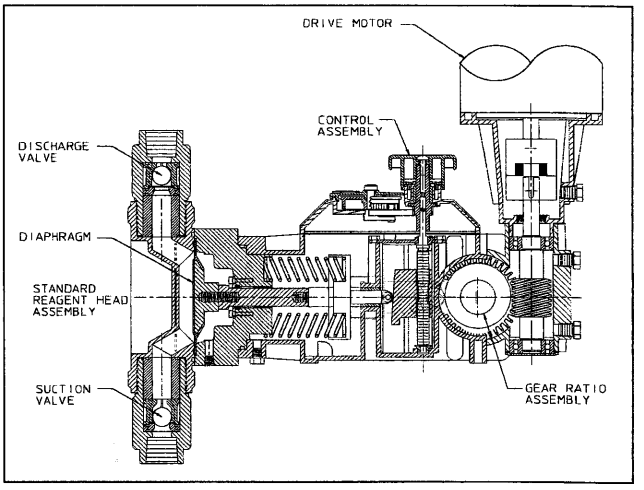
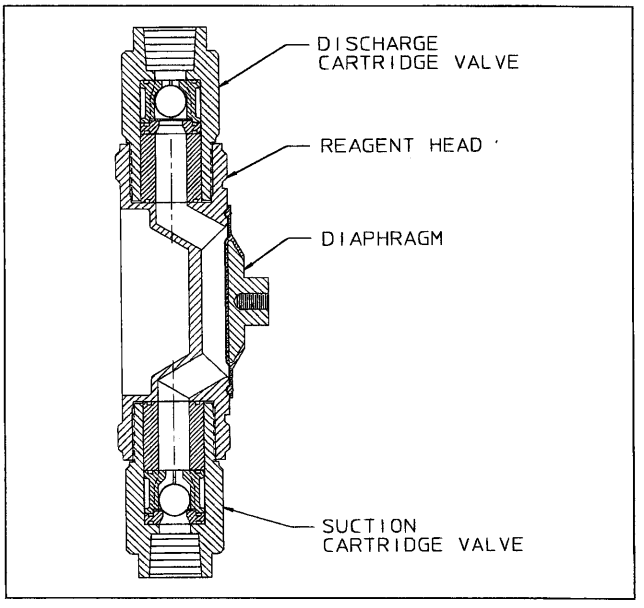


Figure 2

A typical model with manual external stroke adjustment is shown.



A) Standard Reagent Head Assembly

Figure 3

The typical reagent head assembly consists of reagent head, diaphragm, and suction and discharge cartridge check valves. This assembly is the only part of the pump to contact the process liquid; consequently, maintenance is critical to pump performance.

B) LDA, Leak Detection Assembly

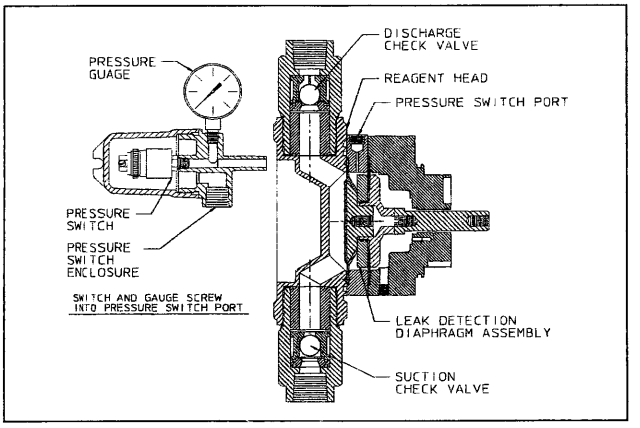


Figure 4

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

C) Control Assembly

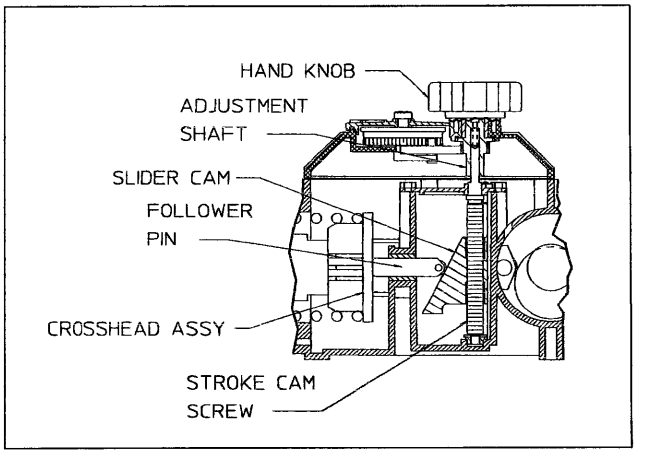


Figure 5

SERIES M 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 slider cam to position the follower pin as to limit rearward travel of the diaphragm.

D) Gear Ratio Assembly

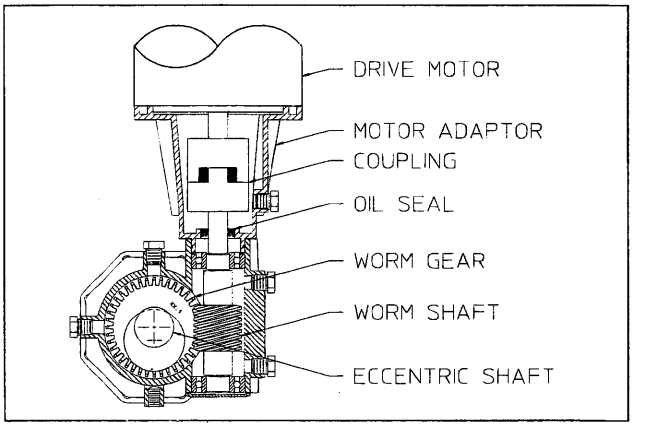


Figure 6

SERIES M 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.

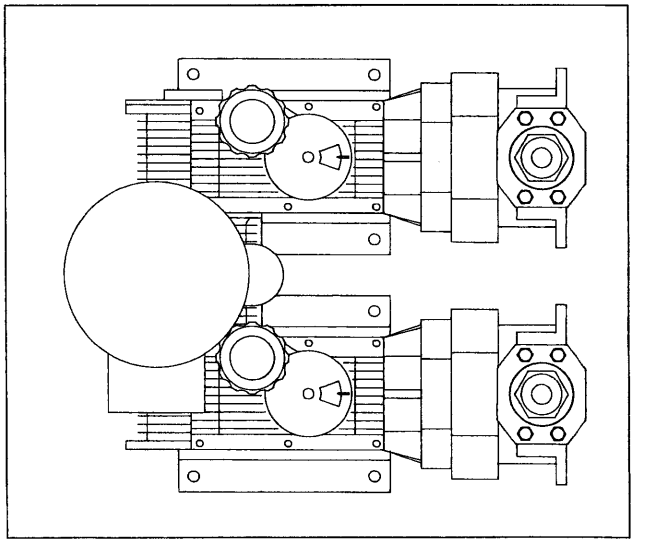


Figure 7

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 gear box assembly (the driver pump) and the pump without a gear box is called the driven pump. Each pump is mounted on its respective 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.

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 or distributor of SERIES M pumps.**

STORAGE INSTRUCTIONS

I SHORT TERM

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

A) Store the pump indoors at room temperature in a dry environment.

B) 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.

C) 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" on page 8.

D) Prior to startup, perform a complete inspection and then start up in accordance with instructions in this manual.

II 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 such items which 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 this 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.

INSTALLATION

I LOCATION

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

SERIES M 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 0° C (32° 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 5°. This will assure that the eccentric and gear oils are maintained at the proper levels and that the check valves can operate properly.

II PIPING SYSTEM

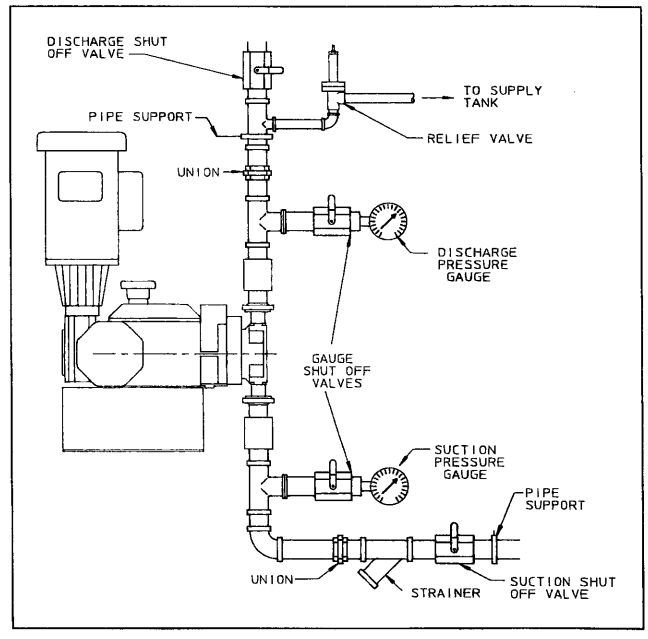


Figure 8

All piping systems should include:

1. A separate system relief valve to protect piping and process equipment, including the pump, from excess process pressures. ***An external relief valve is required!!**

2. 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.

3. 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.

4. 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.

III SUCTION PRESSURE REQUIREMENTS

Although SERIES M 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.

IV DISCHARGE PRESSURE REQUIREMENTS

All SERIES M 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 (syphoning) 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.

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

V AUTOMATIC CONTROL

Pumps equipped with the MLC electronic stroke length controller are provided with separate instructions. Refer to MLC Installation, Operation and Maintenance Manual (PMP-MLC-IOM). Perform all MLC installation procedures prior to pump startup.

VI LDA, LEAK DETECTION ASSEMBLY

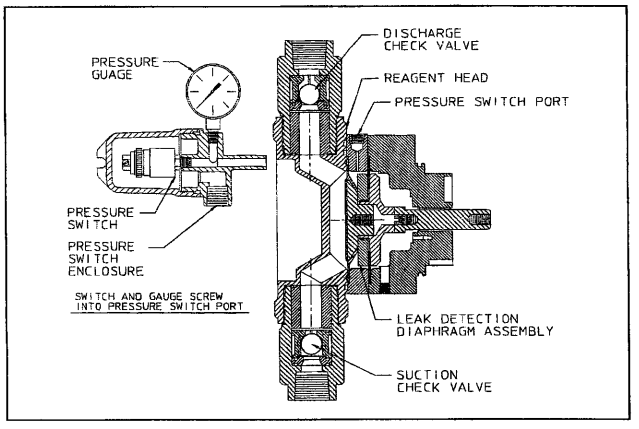


Figure 9

If purchasing an optional pressure switch, install electrical wiring and conduit in accordance with local electrical codes. The switch is rated as follows:

30 VDC or **125 VAC**
1 Ampere Resistive

The switch is the SPDT (single pole, double throw) type and can therefore be connected to either open or to close upon an increase of pressure within the LDA.

Normally Open (NO) N
Normally Closed (NC) C
Common Unmarked, between NO and NC terminals.

EQUIPMENT STARTUP

I LUBRICATION

CAUTION

SERIES M pumps use two separate oils: Pulsalube 9M oil for the eccentric box and Pulsalube 8G, gear oil for the gearbox. Confusion between the two reduce performance of the pump.

A) Oil Capacities

Pulsalube 9M 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 SERIES M pumps to specified levels are:

Eccentric Oil No. 9M

- Eccentric box - 950 ml (1 quart)

Gear Oil No. 8G

- .18 kwatt Gearbox - 150 ml (0.16 quart) (Model L2, M2)
- .55 kwatt Gearbox - 200 ml (0.21 quart) (Model L6, M6)

B) Eccentric Oil Fill

Fill the eccentric box with oil by removing the manual cover assembly or MLC if so equipped. Fill with the proper oil (Pulsalube 9M) to the centerline of the crosshead assembly or slightly above (oil level should not go above the flat on the crosshead). Replace the cover or MLC. Take care not to disturb the stroke length setting when reinstallaing.

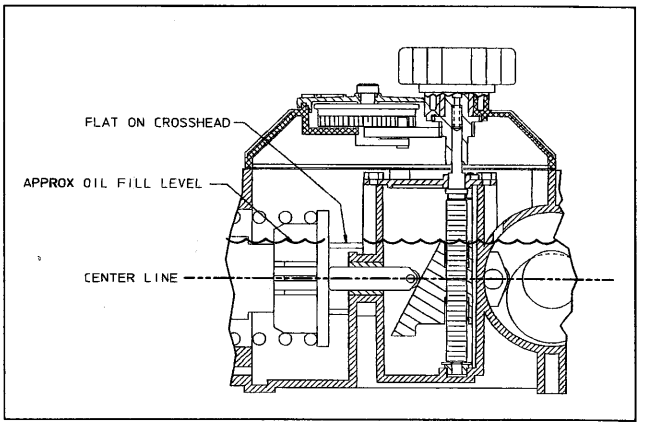


Figure 10

C) 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. Do not add oil through the port on the side of the motor adapter. This port is for motor drive coupling access only.

***Note: Gear oil is filled at the factory and the gearbox is shipped full.**

D) Oil Changes

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

1. Normal service: clean/dry atmosphere, an ambient operating temperature of 0° C to 40° C (32° F to 104° F) and up to 2,000 annual operating hours.

2. Severe Service: humid atmosphere, an ambient operating temperature below 0° C (32° F) or above 40° C (104° F), and over 2,000 annual operating hours.

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. Drain the oil by removing the drain plug on the bottom of the eccentric box.
4. Replace the drain plug.
5. Fill the eccentric box with Pulsalube 9M oil as described under "Eccentric Oil Fill".

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.

II STARTUP

A) Output Adjustment

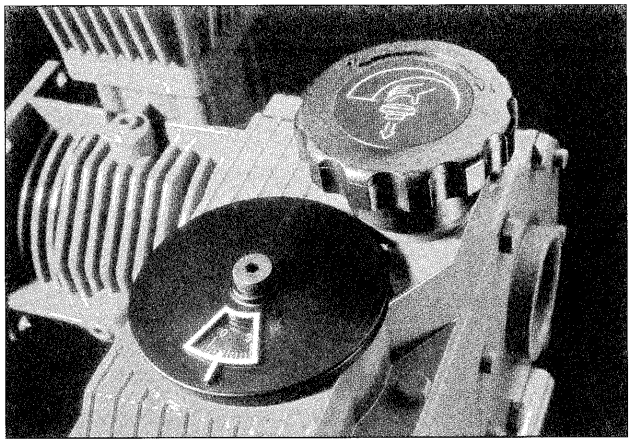


Figure 11

All SERIES M 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 an MLC stroke length controller.

B) 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. **See Maintenance Section On Check Valves.** Remove the discharge valve assembly. Fill the head through the discharge valve port with process (or compatible) liquid, 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.

C) Calibration

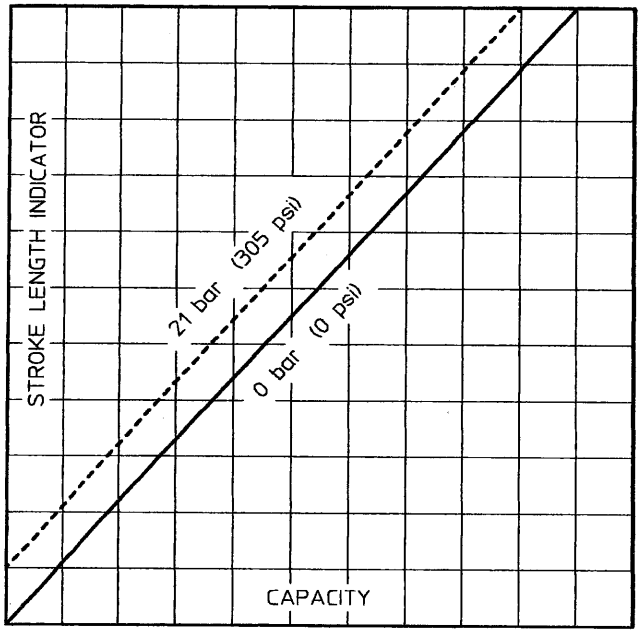


Figure 12

All metering pumps must be calibrated in order to accurately specify stroke length settings for required flow rates. For pumps provided with MLC electronic stoke length control, refer to separate MLC instructions in Bulletin PMP-MLC-IOM.

A typical calibration chart is shown in Figure 12. 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 corresponding decrease in output flow. Pumps are rated at a certian flow for it's 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.

D) LEAK DETECTION

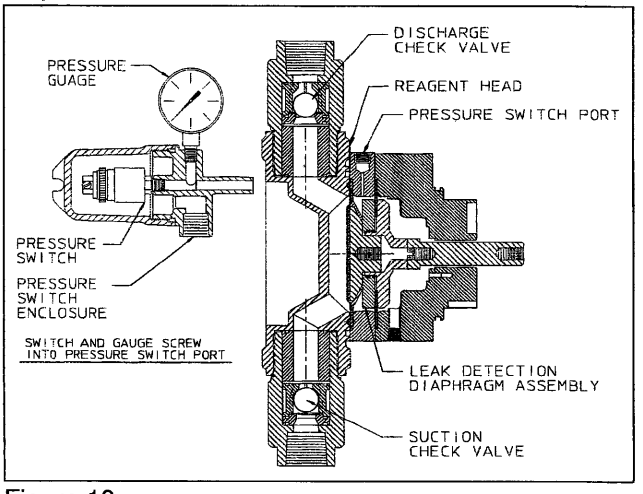


Figure 13

1. Follow the same priming procedure for a standard reagent head steps 1-5.

2. If the optional pressure switch has been supplied, apply power to the alarm circuit.

MAINTENANCE

CAUTION

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 appropriate.

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.

SERIES M 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.

I WET END REMOVAL , INSPECTION, AND REINSTALLATION

CAUTION

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.

A) Standard Diaphragm

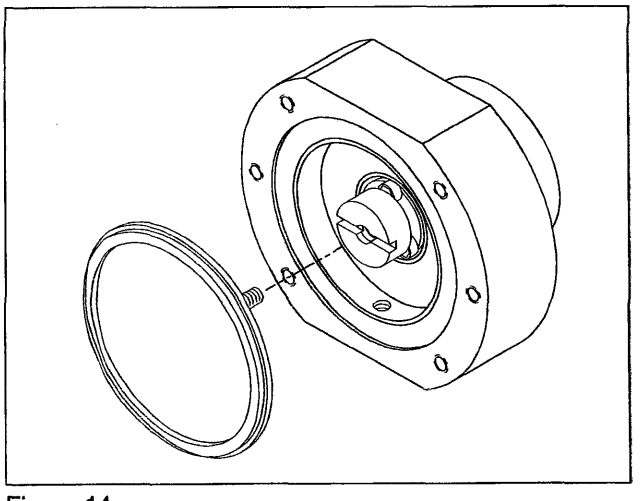


Figure 14

SERIES M 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 under "Caution" to prevent environmental and personnel exposure to hazardous materials.
4. Close the inlet and outlet shutoff valves.
5. Disconnect piping to the reagent head and drain any process liquid, following material safety precautions described.
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 by the check valves into a suitable container, continuing to follow safety precautions as appropriate.
9. Remove the final bolt and rinse or clean the reagent head with an appropriate material.
10. Remove the diaphragm by turning counter-clockwise and inspect the diaphragm. The diaphragm must be replaced if it 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. Then lubricate the elastomer 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 OLube).

    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.
12. Install the reagent head bolts and tighten in an alternating pattern to ensure an even seating force. Torque to the values recommended in *Appendix III.*
13. Reprime the pump per the procedure outlined under "Priming the Reagent Head".

B) Leak Detection

1. Follow the same procedures as described for the standard diaphragm, steps 1-13.

Note: It is not neccessary to remove or replace the LDA secondary (rear) diaphragm unless you find it damaged in any way.

Caution

If disassembly of the head is required, exercise caution during removal since the return spring of the piston is under full load.

II CHECK VALVES

A) 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.

B) Plastic Construction Removal, Inspecton, and Reinstallation

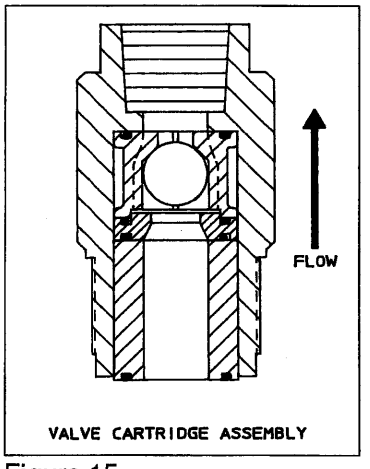


Figure 15

*Note: Plastic construction valving is of the cartridge design and is intended to be replaced as an assembly.

1. Disconnect the power source to the drive motor.
2. Relieve all pressure from the piping system.
3. Take all precautions described under "Caution" to prevent environmental and personnel exposure to hazardous materials.
4. Close the inlet and outlet shutoff valves.
5. Disconnect the suction line at the installed union and the suction port.
6. Loosen and remove the suction valve cartridge slowly to drain any liquid from the reagent head cavity.
7. Disconnect the discharge line at the installed union and the discharge port.
8. Loosen and remove the discharge valve cartridge slowly to drain any trapped liquid.
9. Reinstall both new valve assemblies, taking care to ensure that they are in the correct ports. It is not neccessary to coat the threads of the cartridge vale with a pipe sealant. Refer to Figure 15.
10. Reinstall both suction and discharge piping.

C) Metal Construction Removal, Inspection, and Reinstallation

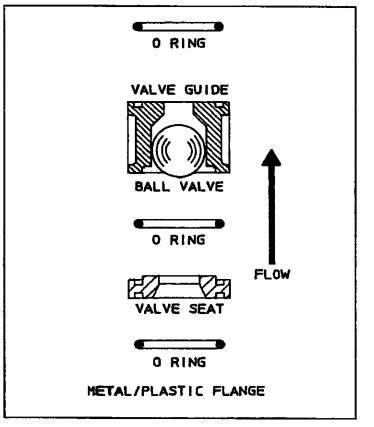


Figure 16

1. Disconnect the power source to the drive motor.
2. Relieve all pressure from the piping system.
3. Take all precautions described under "Caution" 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.

10. Reassemble both valves using new parts as required. Sealing "O"-rings should always be replaced.

11. Reinstall both valve assemblies, taking care to ensure that they are correctly oriented with balls above seats and the seat with the right angle knife edge up (chamfered edge down). Refer to Figure 16.

12. Tighten the tiebar bolts evenly, making sure the valve assemblies are assembled squarely. Refer to Appendix III for torque values.

Note: For best results, always loosen the unions or flanges on either side of the system piping prior to retightening of the check valve assemblies. Retighten the unions or flanges after the check valves are securely tightened into position.

13. Check for leaks and retighten tiebar bolts as necessary.

III OIL SEALS

A) General Description

The pump has four oil seals as follows:

1. The pump shaft seal • inside the pump head
2. The motor adapter seal • inside the motor adapter, below the worm shaft coupling
3. The gearbox oil seal • inside the screwed end play adjustment cap on the side of the gearbox
4. The eccentric box seal • in the side of the gearbox where the eccentric shaft protrudes.

B) Removal and Replacement

1. To replace the pump shaft seal, first remove the reagent head assembly. Then remove the diaphragm. Remove the pumpshaft by unscrewing counter-clockwise. Take care not to allow any shims to drop into the eccentric box when removing the shaft. The shaft is loctited to the crosshead assembly. Remove three (3) socket head screws and seal retainer plate. Seal can now be removed. DO NOT reuse damaged pump shaft or polish old one too smooth. A shaft too smooth will weep oil over time when running.

   Reinstall by reversing the disassembly procedure. Lubricate the i.d. of the seal liberally with silicone grease (ex. Parker Super Olube). Refill the eccentric box with Pulsalube Oil 9M per "Lubrication Section".

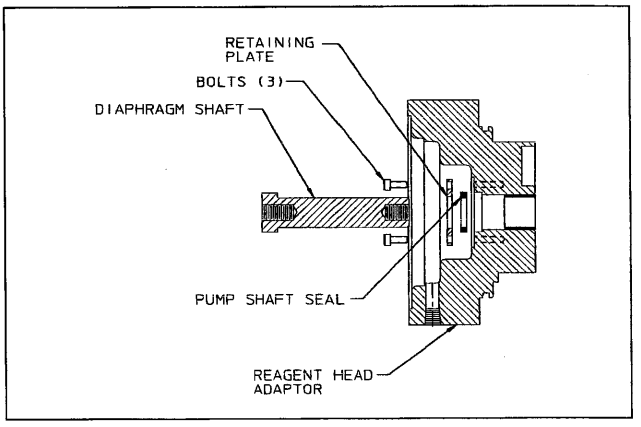


Figure 17

2. To replace the motor adapter seal, first remove the motor per "Motor Removal and Reinstallation". Loosen the coupling setscrew through the access plug 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 loose 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. Refer to Figure 19.

3. To replace the gearbox oil seal, first drain the gearbox per "Lubrication". 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".

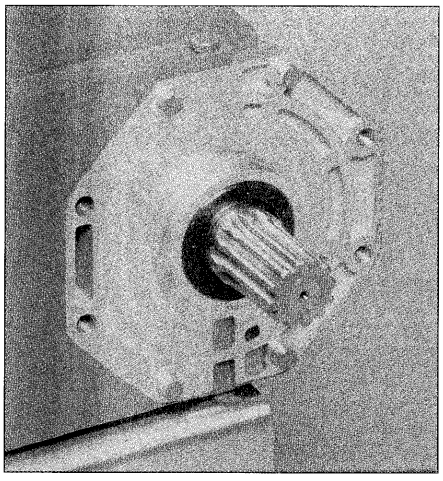


Figure 18

4. 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 into position. Reinstall by reversing the disassembly procedure. Refill the gearbox with Pulsalube 8G gear oil per "Lubrication" .

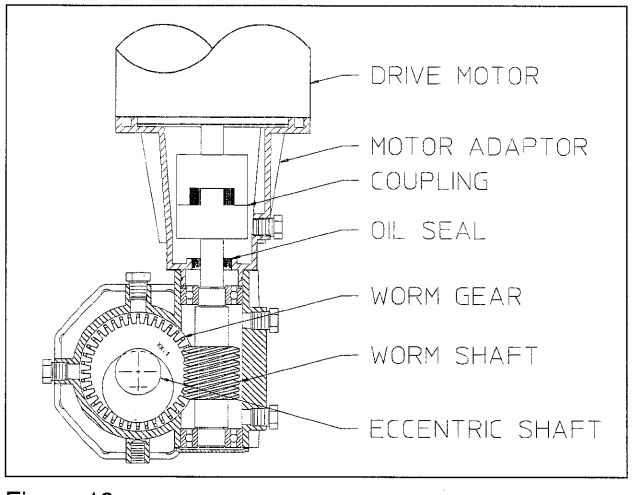


Figure 19

IV COVER ASSEMBLY

A) Removal and Reinstallation

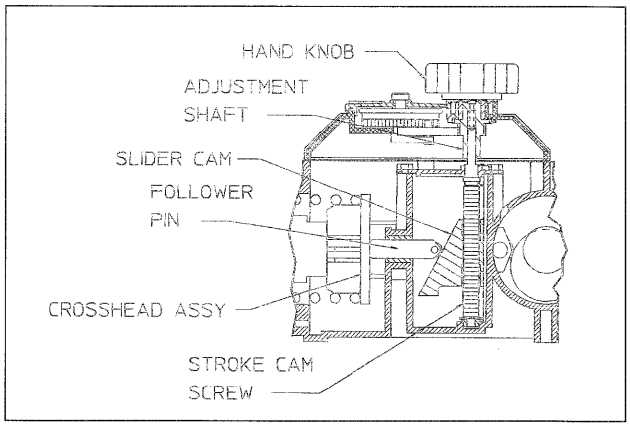


Figure 20

Note: 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.

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.

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. 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.

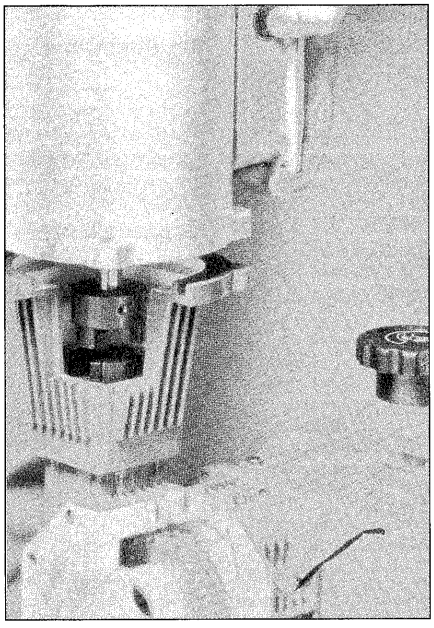


Figure 21

V MOTOR

A) Removal and Reinstallation

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 loose the shaft key.

5. Install the coupling half on the shaft of the replacement motor, ensuring that the shaft key is in place. Align the end of the shaft flush with the inner surface of the coupling and tighten the setscrew.

6. Reinstall the motor by reversing steps (3) through (1) above.

*Note: Motor rotation may be wired for CW or CCW rotation.

VI REPLACEMENT PARTS

A) SERIES M KOPkit Program

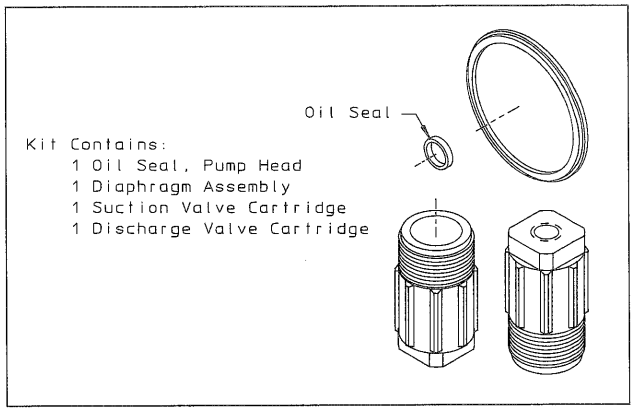


Figure 22

SERIES M KOPkits contain all replacement parts normally used in a preventative maintenance program. (Pulsalube 9M eccentric oil and Pulsalube 8G gear oils are also available separately for preventative maintenance programs. See "Equipment Startup"). There is a specific KOPkit for every SERIES M pump model. Each KOPkit is vacuum-packed for extended storage. All SERIES M 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 by a Pulsafeeder representative.

B) 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.

- Part number and description from the SERIES M parts list. Include the three-character suffix. (Note: SERIES M part numbers begin either with the letters "NP", or the letter "W", e.g., NP170001-TNR or W210221-001.)

TROUBLESHOOTING CHART

Difficulty	Probable Cause	Remedy
Pump does not start	1. Coupling disconnected	Connect coupling
	2. Faulty power source	Check power source
	3. Blown fuse, circuit breaker	Replace — eliminate overload
	4. Broken wire	Locate and repair
	5. Wired improperly	Check diagram
	6. Pipe line blockage	Open valves
No delivery	1. Motor not running	Check power source. Check wiring diagram.
	2. Supply tank empty	Fill tank
	3. Lines clogged	Clean and flush
	4. Closed line valves	Open valves
	5. Ball check valves held open with solids	Clean — inspect
	6. Vapor lock, cavitation	Increase suction pressure
	7. Prime lost	Reprime, check for leak
	8. Strainer clogged	Remove and clean. Replace screen if necessary
Low delivery	1. Motor speed too low	Check voltages, frequency, wiring, and Terminal connections. Check nameplate vs. Specifications.
	2. Check valves worn or dirty	Clean, replace if damaged
	3. Calibration system error	Evaluate and correct
	4. Product viscosity too high	Lower viscosity by increasing product temperature. Increase pump and/or piping size
	5. Product cavitating	Increase suction pressure. Cool product as necessary
Delivery gradually drops	1. Check valve leakage	Clean, replace if damaged
	2. Leak in suction line	Locate and correct
	3. Strainer fouled	Clean or replace screen
	4. Product change	Check viscosity
	5. Supply tank vent plugged	Unplug vent
Delivery erratic	1. Leak in suction line	Locate and correct
	2. Product cavitating	Increase suction pressure
	3. Entrained air or gas in product	Consult factory for suggested venting
	4. Motor speed erratic	Check voltage and frequency
	5. Fouled check valves	Clean, replace if necessary

TROUBLESHOOTING CHART (continued)

Difficulty	Probable Cause	Remedy
Delivery higher than rated	1. Suction pressure higher than discharge pressure	Install backpressure valve or consult factory for piping recommendations
	2. Discharge piping too small	Increase pipe size — install Pulsation dampener at pump in discharge line
	3. Backpressure valve set too low	Increase setting
	4. Backpressure valve leaks	Repair, clean, or replace
Pump loses oil	1. Diaphragm ruptured	Replace
	2. Leaky seal	Replace
	3. Cover gasket leaks	Replace or retighten
	4. Pump head gasket leaks	Replace - tighten pump head bolts Apply sealing compound
Noisy gearing, knocking	1. Discharge pressure too high	Reduce pressure
	2. Water hammer	Install Pulsation dampener
	3. Stroke length at partial setting	Nondestructive knocking is characteristic of lost motion pumps
	4. No oil in gearbox	Replace oil
Piping noisy	1. Pipe size too small	Increase size of piping — install Pulsation dampener
	2. Pipe runs too long	Install Pulsation dampener in line
	3. Surge chambers flooded	Replace with air or inert gas. If a Pulsation dampener is installed, replace diaphragm and recharge
	4. No surge chambers used	Install Pulsation dampeners
Motor overheats	1. Pump overloaded	Check operating conditions against pump design
	2. High or low voltage	Check power source
	3. Loose wire	Trace and correct

APPENDIX I PIPING CALCULATIONS

SUCTION HEAD REQUIREMENTS

All reciprocating metering pumps require a net positive suction head (NPSHR). The NPSHR for SERIES M 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.*

$$NPSH_A = P_A \pm P_H - P_V - \left(\frac{L_S R G Q}{C_1 d^2}\right)$$

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

$$NPSH_A = P_A \pm P_H - P_V - \sqrt{\left(\frac{L_S R G Q}{C_1 d^2}\right)^2 + \left(\frac{L_S \mu Q}{C_2 d^4}\right)^2}$$

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

Variable	Units Set	
	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	unitless	unitless
Q	gallons/hr	liters/hr
d	inches	millimeters
μ	centipoise	centipoise
L_D	feet	meters
P_T	psi	bar
P_P	psi	bar
Constant C_1	24,600	640
Constant 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.)*

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 system's total backpressure use Equation 3 or 4.

Equation 3. *For fluid viscosity below 50 centipoise.*

$$P_T = \frac{L_D R G Q}{C_1 d^2} + P_P \pm P_H$$

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

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

NOMENCLATURE

NPSHR =Net positive suction head required, [psi, bar]

NPSHA =Net positive suction head available, [psi, bar]

P_A *= Pressure at the surface of the liquid being pumped (atmospheric or supply tank blanket pressure) [psia, bar(a)]*

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

P_V *= Absolute vapor pressure at pumping temperature of the process liquid at pump inlet, [psia, bar(a)]*

L_S *= 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_1, C_2 *= Numeric constants used in Equations 1- 4*

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

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

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

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

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 degrees F = 2241

Viscosity (ASTM D 2161) SSU @ 210 degrees F = 225

Viscosity Index (ASTM D 2270) = 167

Pour Point (ASTM D 97) Degrees F© = -40(-40)

Flash Point, COC (ASTM D 92) Degrees F© = 490(254)

Timken OK Load (ASTM D 2782) Lb(kg) = 100+(45+)

Four Ball EP Test (ASTM D 2783)
Weld Point kg = 250
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 = Pulsalube 8G (amber)

PULSAlube 9M

AGMA Number = 7

ISO Viscosity Grade = 460

API Gravity = 28.7

Viscosity (ASTM D 2161) SSU @ 100 degrees F = 2000

Viscosity (ASTM D 2161) SSU @ 210 degrees F = 141

Viscosity Index (ASTM D 2270) = 159

Pour Point (ASTM D 67) Degrees F© = -10

Flash Point, COC (ASTM D 92) Degrees F© = 560

Timken OK Load (ASTM D 2782) Lb(kg) = 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 = Pulsalube 9M (amber)

APPENDIX III BOLT TORQUE RECOMMENDATIONS

PULSAR—Liquid End Bolt Torque Requirements

Metal Construction

Reagent Head Part #	Head Size	Head Bolts			Tie Bars		
			Torque			Torque	
		# Bolts and Size	N-m	Ft-Lbs	# Bolts and Size	N-m	Ft-Lbs
NP 160001	A	(6) M10 * 1.5	39	29	(4) M8 * 1.25	8	6
NP 160002	B	(6) M12 * 1.75	68	50	(4) M8 * 1.25	8	6
NP 160003	C	(6) M10 * 1.5	39	29	(4) M8 * 1.25	8	6
NP 160004	D	(6) M8 * 1.25	20	15	(4) M8 * 1.25	8	6

Plastic Construction

Reagent Head Part #	Head Size	Head Bolts			Tie Bars		
			Torque			Torque	
		# Bolts and Size	N-m	In.-Lbs	# Bolts and Size	N-cm	In.-Lbs
NP 160012	A	(6) M10 * 1.5	850	29	(4) M8 * 1.25	250	22
NP 160014	B	(6) M12 * 1.75	850	50	(4) M8 * 1.25	250	22
NP 160011	C	(6) M10 * 1.5	850	29	(4) M8 * 1.25	250	22
NP 160013	D	(6) M8 * 1.25	850	15	(4) M8 * 1.25	250	22

APPENDIX IV PULSAFEEDER ACCESSORIES

PRESSURE RELIEF VALVES

Pulsafeeder diaphragm relief valves are designed to protect chemical feed systems from over pressure damage, that may be caused by defective equipment in the line or a blockage in the discharge line. Field adjust the pressure relief valve to operate when the discharge pressure exceeds operating pressure by 10-15%.

DIAPHRAGM BACKPRESSURE VALVE

The Pulsafeeder diaphragm backpressure valve creates constant backpressure. A TFE diaphragm, offering maximum chemical protection and service life, seals spring and bonnet from product. This diaphragm seals directly on a replaceable seat.

Be sure to install with fluid flow in direction of arrow on valve body. If arrow is missing from plastic valve body, install with flow exiting out center hole of valve body.

PULSATION DAMPENER INSTALLATION, OPERATION, AND REMOVAL INSTRUCTIONS

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

INSTALLATION

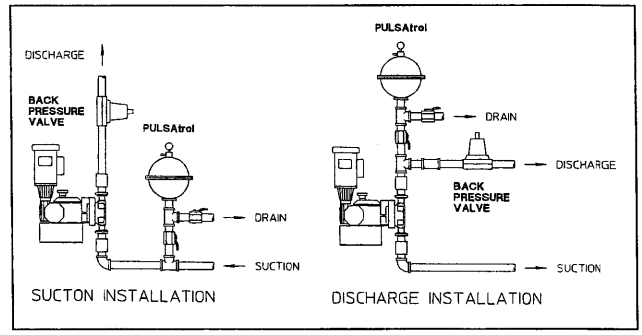


Figure 23

On both discharge and suction lines, it is desirable to mount the Pulsation dampener as close to the pump connection as possible. It will function in any position (horizontal, vertical, or any angle) but a vertical position is recommended to allow drainage prior to maintenance. 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 near the Pulsation dampener to assure proper operation.

OPERATION
(Pre-charging the Pulsation dampener)

A) Discharge Installation

The Pulsation dampener may be pre-charged with air or nitrogen. When properly pre-charged 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 pre-charging.

Use the pre-charge pressure as determined below. 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.

PROCEDURE

Pre-Charge Procedure for Discharge Installation

1. Calculate the pre-charge pressure

   Mean Line Pressure (PSIG)
   + Atmospheric Pressure
   Absolute Pressure (PSIA)
   x Pre-charge Percentage (80% Max.)
   Pressure Absolute
   – Atmospheric Pressure
   Pre-charge Pressure (PSIG)

   = Pre-charge Pressure

2. Isolate the Pulsation dampener from the line.
3. Carefully drain off the process fluid by opening a drain valve (see recommend piping arrangement).
4. Apply pre-charge pressure (additional liquid may drain as the diaphragm moves).
5. Close the drain valve.
6. Place the Pulsation dampener in the stream.

B) Suction Installation (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.

PROCEDURE

Pre-Charge Procedure for Suction Installation

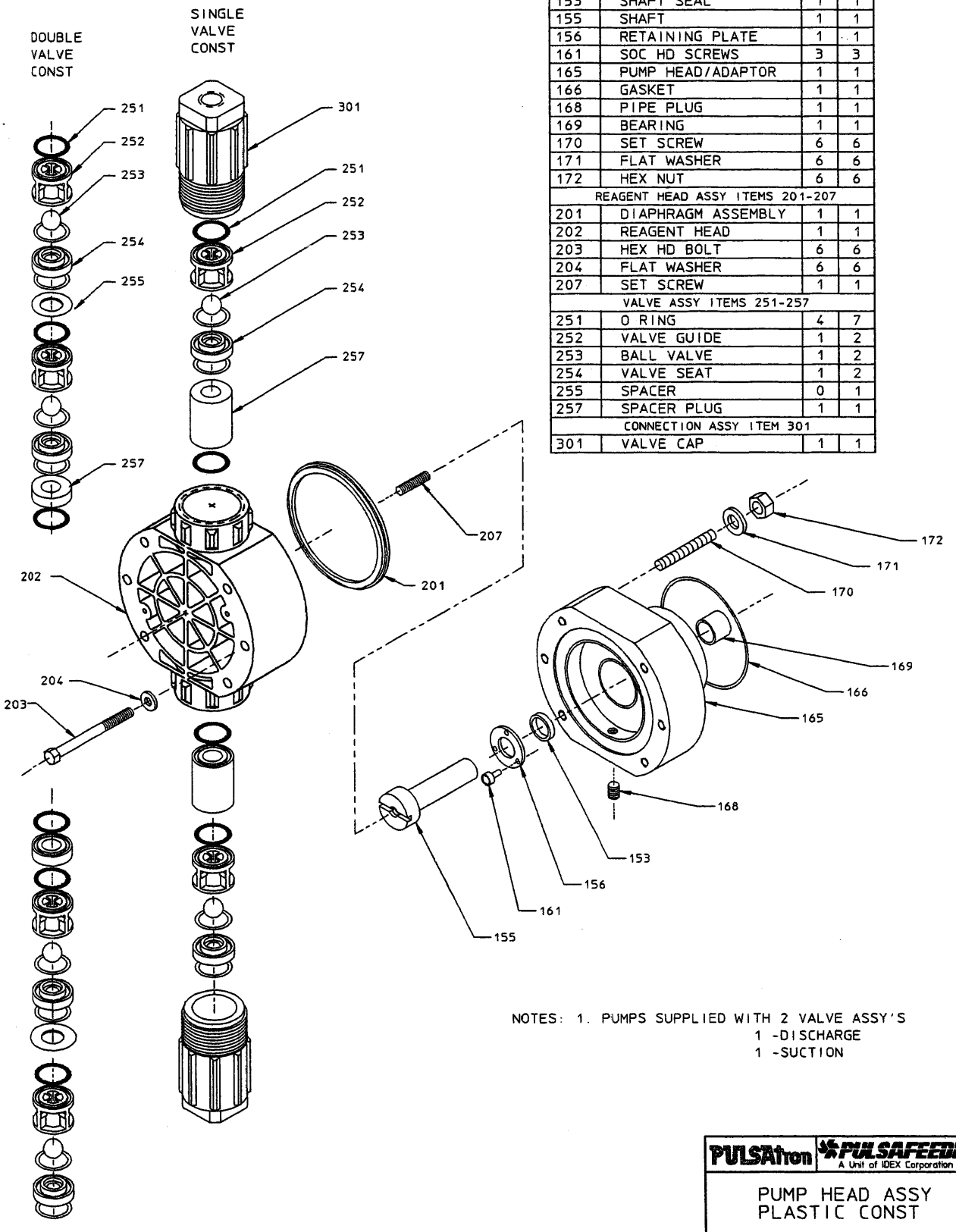
1. Isolate the Pulsation dampener from the line.
2. Carefully drain off any process fluid by opening a drain valve (see recommended piping arrangement, attached).
3. Apply 5-10 psi pre-charge pressure (additional liquid may drain as diaphragm moves).
4. Close the drain valve.
5. Bleed off all pressure 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 the Pulsation dampener functions, the needle will go from pressure to vacuum.

C) Suction Installation (Suction Lift)

1. Follow the reagent head priming procedures for a suction lift condition found on page 9, Steps 3-5.
2. Now charge the Pulsation dampener following the procedures for a flooded suction installation found in the above Section B.

REMOVAL

When removing or disassembling Pulsation dampeners, 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.



ITEM	DESCRIPTION	SGL QTY	DBL QTY
	PUMP HEAD ASSY ITEMS 153-172		
153	SHAFT SEAL	1	1
155	SHAFT	1	1
156	RETAINING PLATE	1	1
161	SOC HD SCREWS	3	3
165	PUMP HEAD/ADAPTOR	1	1
166	GASKET	1	1
168	PIPE PLUG	1	1
169	BEARING	1	1
170	SET SCREW	6	6
171	FLAT WASHER	6	6
172	HEX NUT	6	6
	REAGENT HEAD ASSY ITEMS 201-207		
201	DIAPHRAGM ASSEMBLY	1	1
202	REAGENT HEAD	1	1
203	HEX HD BOLT	6	6
204	FLAT WASHER	6	6
207	SET SCREW	1	1
	VALVE ASSY ITEMS 251-257		
251	O RING	4	7
252	VALVE GUIDE	1	2
253	BALL VALVE	1	2
254	VALVE SEAT	1	2
255	SPACER	0	1
257	SPACER PLUG	1	1
	CONNECTION ASSY ITEM 301		
301	VALVE CAP	1	1

NOTES: 1. PUMPS SUPPLIED WITH 2 VALVE ASSY'S
1 -DISCHARGE
1 -SUCTION

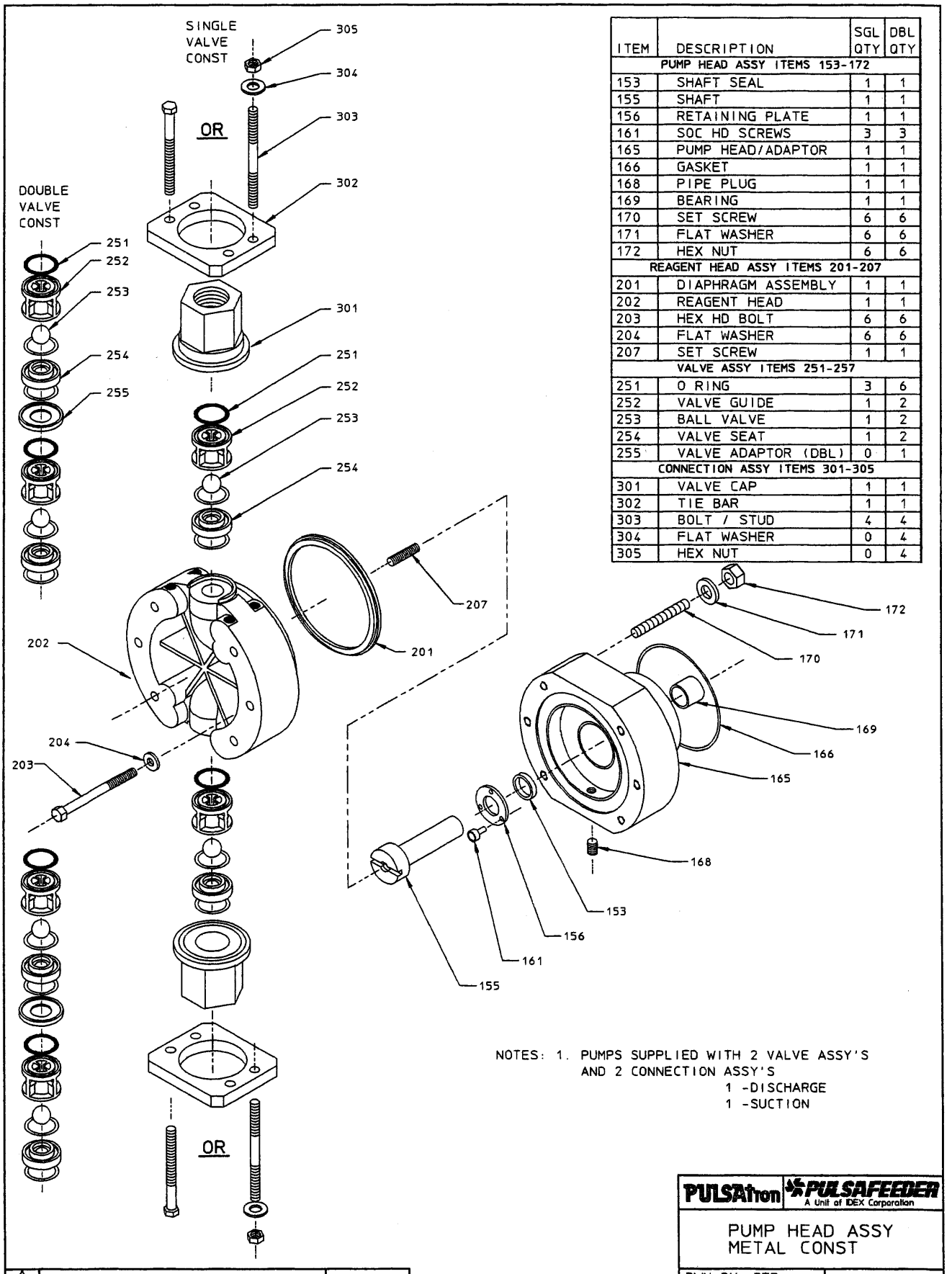
REF	REVISION UPDATE	DATE
A		

PULSAtron | PULSAFEEDER A Unit of IDEX Corporation

PUMP HEAD ASSY
PLASTIC CONST

DWN BY: PTP
DATE: 05/15/97

AN00167



ITEM	DESCRIPTION	SGL QTY	DBL QTY
	PUMP HEAD ASSY ITEMS 153-172		
153	SHAFT SEAL	1	1
155	SHAFT	1	1
156	RETAINING PLATE	1	1
161	SOC HD SCREWS	3	3
165	PUMP HEAD/ADAPTOR	1	1
166	GASKET	1	1
168	PIPE PLUG	1	1
169	BEARING	1	1
170	SET SCREW	6	6
171	FLAT WASHER	6	6
172	HEX NUT	6	6
	REAGENT HEAD ASSY ITEMS 201-207		
201	DIAPHRAGM ASSEMBLY	1	1
202	REAGENT HEAD	1	1
203	HEX HD BOLT	6	6
204	FLAT WASHER	6	6
207	SET SCREW	1	1
	VALVE ASSY ITEMS 251-257		
251	O RING	3	6
252	VALVE GUIDE	1	2
253	BALL VALVE	1	2
254	VALVE SEAT	1	2
255	VALVE ADAPTOR (DBL)	0	1
	CONNECTION ASSY ITEMS 301-305		
301	VALVE CAP	1	1
302	TIE BAR	1	1
303	BOLT / STUD	4	4
304	FLAT WASHER	0	4
305	HEX NUT	0	4

NOTES: 1. PUMPS SUPPLIED WITH 2 VALVE ASSY'S AND 2 CONNECTION ASSY'S
1 -DISCHARGE
1 -SUCTION

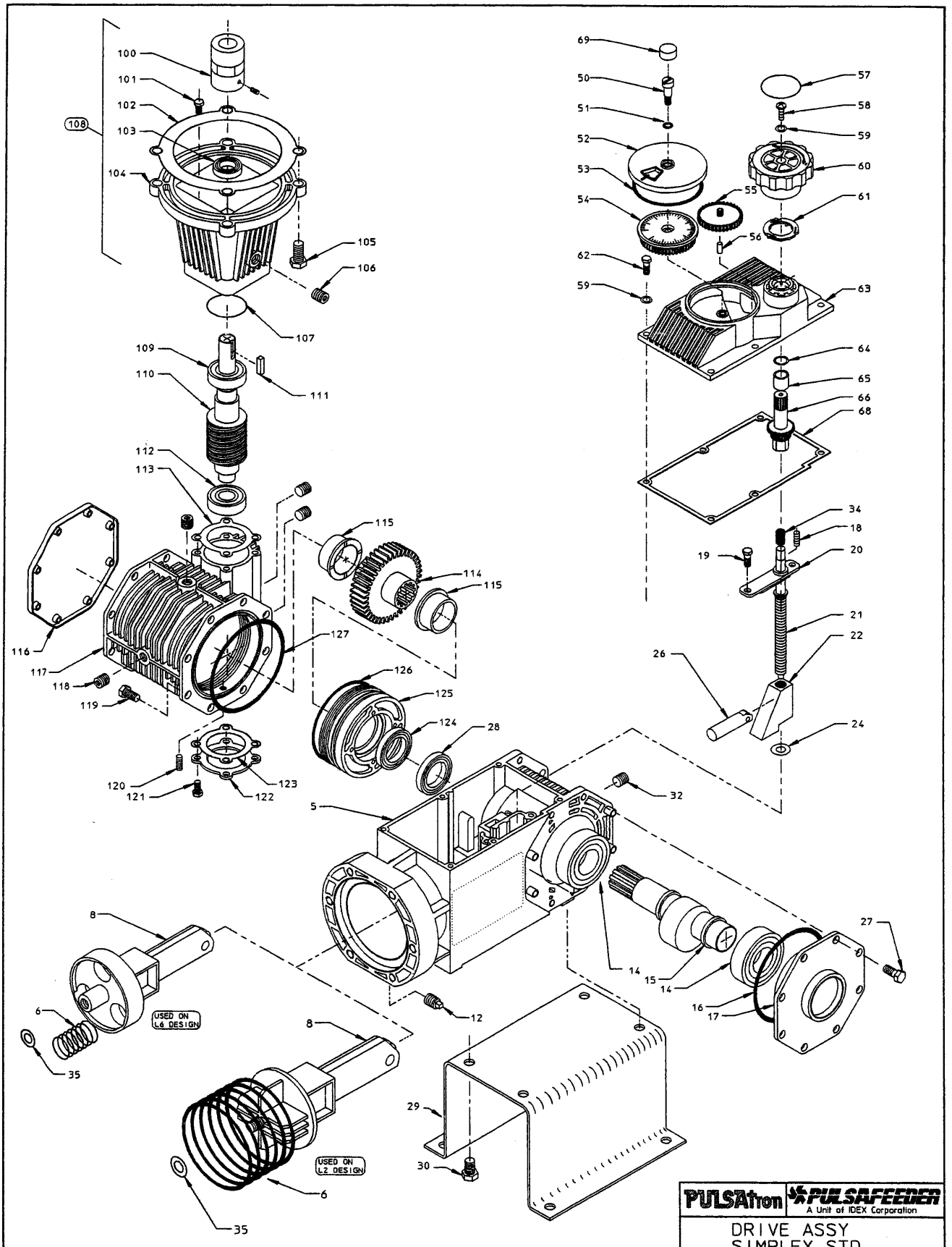
REF	REVISION UPDATE	DATE
A		

PULSAtron | PULSAFEEDER A Unit of IDEX Corporation

PUMP HEAD ASSY
METAL CONST

DWN BY: PTP
DATE: 05/15/97

AN00168



REF	REVISION UPDATE	DATE
A		

PULSAtron | PULSAFEEDER A Unit of IDEX Corporation

DRIVE ASSY
SIMPLEX STD
MANUAL CONTROL

DWN BY: PTP
DATE: 05/15/97

AN00169

ITEM	DESCRIPTION	QTY
	ECCENTRIC BOX ASSY ITEMS 5 -35	
5	ECCENTRIC BOX SUB-ASSY	1
6	RETURN SPRING	1
8	CROSSHEAD SUB-ASSY	1
12	PIPE PLUG	1
14	BEARING	2
15	ECCENTRIC	1
16	O RING	1
17	BEARING CAP	1
18	SET SCREW	1
19	HEX HD BOLT	2
20	WEDGE COVER	1
21	ADJUSTMENT SCREW	1
22	WEDGE	1
24	THRUST WASHER	1
26	FOLLOWER SUB-ASSY	1
27	HEX HD BOLT	4
28	OIL SEAL	1
29	BASE	1
30	HEX HD BOLT	4
31	TOLERANCE RING (NOT SHOWN)	2
32	PIPE PLUG	1
34	SPRING	1
35	SPACER SHIM	0-2
	MANUAL CONTROL ASSY ITEMS 50-69	
50	SHOULDER SCREW	1
51	O RING	1
52	SCALE COVER	1
53	GASKET	1
54	SCALE GEAR	1
55	GEAR	1
56	DOWEL PIN	1
57	LABEL	1
58	SCREW	1
59	FLAT WASHER	7
60	KNOB	1
61	CLICKER	1
62	HEX HD BOLT	6
63	COVER	1
64	O RING	1
65	BUSHING	1
66	GEAR SHAFT	1
68	COVER GASKET	1
69	SCREW CAP	1
	GEARBOX ASSY ITEMS 100-129	
100	COUPLING	1
101	HEX HD BOLT	4
102	GASKET	1
103	OIL SEAL	1
104	MOTOR ADAPTOR	1
105	HEX HD BOLT	4
106	PIPE PLUG	2
107	O RING	1
108	MOTOR ADAPTOR ASSY	1
109	BEARING	1
110	WORM	1
111	KEY	1
112	BEARING	1
113	SHIM PACKAGE	1
114	WORM GEAR	1
115	BEARING	2
116	COVER	1
117	GEARBOX	1
118	PIPE PLUG	4
119	HEX HD BOLT	4
120	SET SCREW	1
121	HEX HD BOLT	4
122	BOTTOM COVER	1
123	GASKET	1
124	OIL SEAL	1
125	GEARBOX CAP	1
126	O RING	1
127	O RING	1
128	NAME TAG (NOT SHOWN)	1
129	DRIVE SCREW (NOT SHOWN)	4

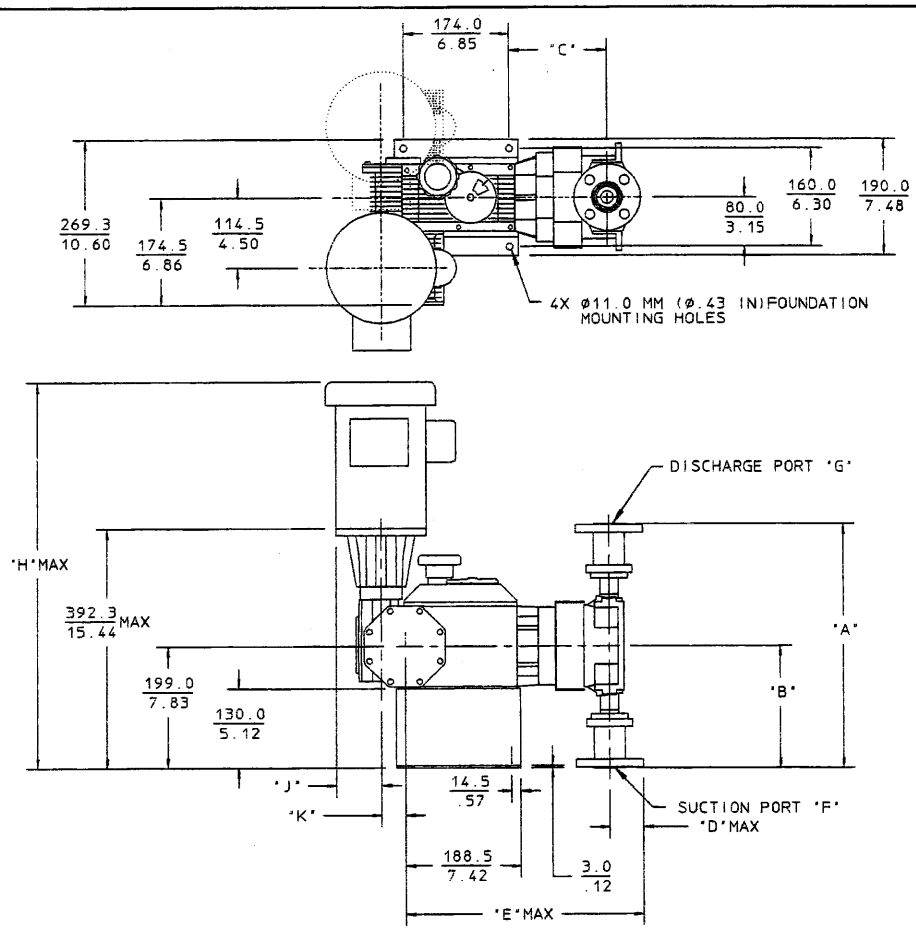
REF	REVISION UPDATE	DATE
A		

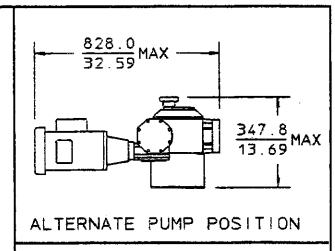
PULSAtron | PULSAFEEDER A Unit of IDEX Corporation

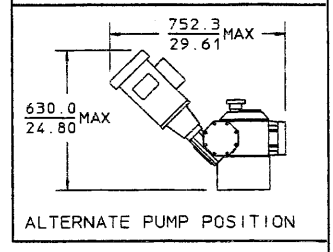
DRIVE ASSY
SIMPLEX STD
B.O.M

DWN BY: PTP
DATE: 05/15/97

AN00170







PUMP MODEL POSITIONS 3 AND 4	MM / INCHES "A"	"B"	"C"	"D"	"E"	SUCTION PORT SIZE "F"	DISCHARGE PORT SIZE "G"
F7,F8,F9,G1,G2,E2,E3	356.0	178.0	145.3	47.5	366.9	15-40	15-40
D7,D8,D9,E1	14.02	7.01	5.72	1.87	14.44		
R6,R7,R8,R9,S1	380.0	190.0	148.0	47.5	369.7	15-40	15-40
M9,N1,N2,N3,N4	14.96	7.48	5.83	1.87	14.55		
N5	380.0	190.0	148.0	52.5	373.8	20-40	20-40
	14.96	7.48	5.83	2.06	14.71		
E4,G3,G4,G5,G6,G7	380.0	190.0	148.0	47.5	369.5	15-40	15-40
G8,G9,H1,H2	14.96	7.48	5.83	1.87	14.55		
E5,E6,E7,E8,E9,F1,F2,F3,F4,F5							
H3,F6	380.0	190.0	148.0	52.5	374.5	20-40	20-40
	14.96	7.48	5.83	2.06	14.74		
S2,S3,S7,N6,N7,N8,P3	400.0	200.0	159.5	47.5	381.0	15-40	15-40
	15.75	7.88	6.28	1.87	15.00		
S4,S3,S6,S8,S9,N9,P1,P2,P4,P5,	400.0	200.0	159.5	52.5	386.0	20-40	20-40
P6	15.75	7.88	6.28	2.06	15.20		
T1,T2,P7,P8	400.0	200.0	159.5	57.5	391.0	25-40	25-40
	15.75	7.88	6.28	2.26	15.39		
T3,P9	422.0	211.0	159.5	52.5	386.0	20-40	20-40
	16.62	8.31	6.28	2.06	15.20		
T4,R1,R2	422.0	211.0	159.5	57.5	391.0	25-40	25-40
	16.62	8.31	6.28	2.26	15.39		
T5,T6,T7,R3,R4,R5	422.0	211.0	159.5	75.0	398.8	40-40	25-40
	16.62	8.31	6.28	2.95	15.70		

MOTOR FRAME INFO	MAX "H"	"J"
56C FR	727.2	73.5
	28.6	2.89
63 FR	SEE	45.0
	NOTE3	1.77
71 FR	SEE	52.5
	NOTE3	2.07
80 FR	SEE	60.0
	NOTE3	2.36
143TCFR	749.4	73.5
	29.5	2.89
182C FR	816.2	73.5
184C FR	32.1	2.89

NOTES:
1. TO USE THE CHART, YOU MUST FIND POSITIONS 3 AND 4 FROM PUMP MODEL SELECTION CODE.
   X X _ _ X X X X X - X X X X X
2. DIMENSION "K" VARIES BASED ON PUMP MODEL POSITIONS 1 AND 2 -
   _ _ X X X X X X X - X X X X X
   L2 OR M2 = 38.25 MM / 1.50 IN
   L6 OR M6 = 56.00 MM / 2.20 IN
3. CONSULT FACTORY
4. DIMS A & B ARE NOT EFFECTED BY PRESSURE RATING OF FLANGE.
5. FLANGE SELECTIONS SHOWN ARE FOR MAX RATED PRESSURE OF PUMP.

REF	REVISION UPDATE	DATE
A		

ALL DIMENSIONS ARE MM/INCHES

MECHANICAL SERIES M

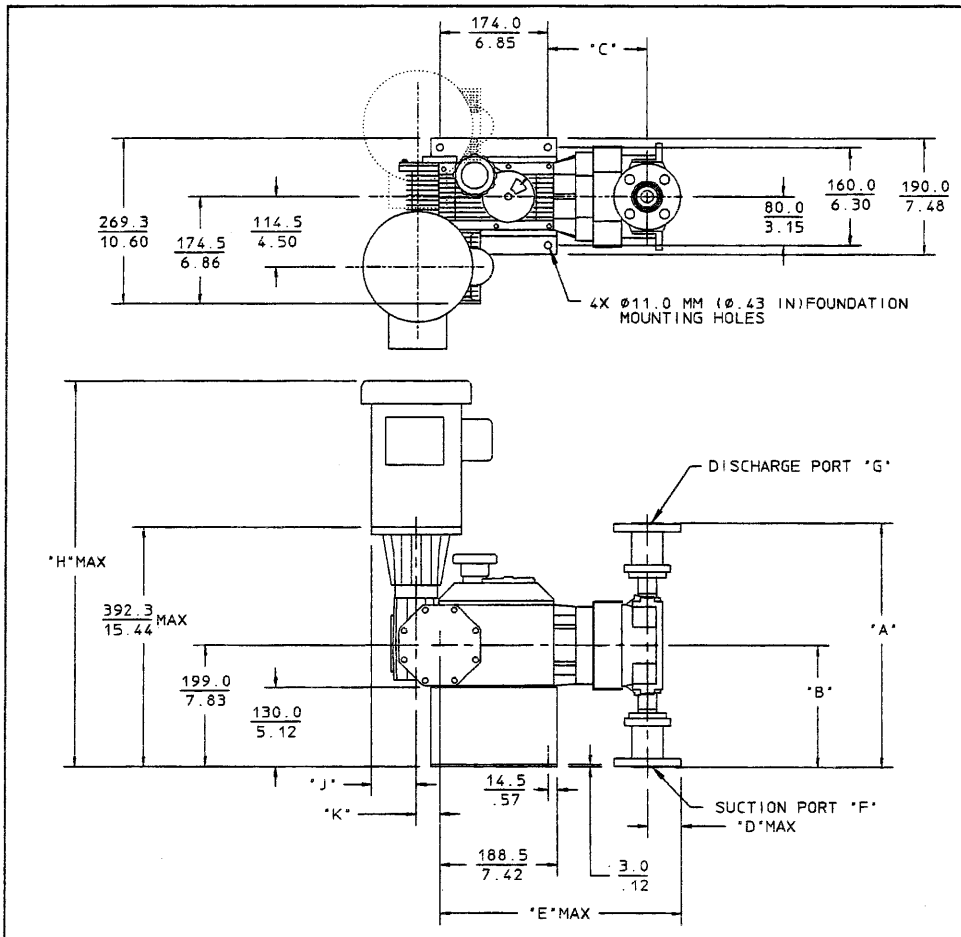
PULSAFEEDER A Unit of IDEX Corporation

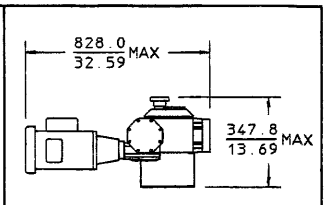
DIMENSIONAL DWG
L2,L6 / M2,M6
EXT/MAN CONTROL DIN FLG
PLASTIC CONST 50/60 Hz

DWN BY: PTP

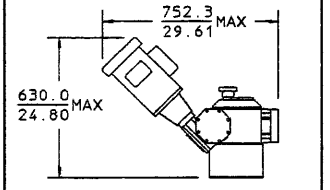
DATE: 01/02/98

20742-000





ALTERNATE PUMP POSITION



ALTERNATE PUMP POSITION

PUMP MODEL POSITIONS 3 AND 4	MM / INCHES "A"	"B"	"C"	"D"	"E"	SUCTION PORT SIZE "F"	DISCHARGE PORT SIZE "G"
C1,C2,C3,C4,C5	356.0	178.0	145.3	47.5	366.9	15-40	15-40
A1,A2,A3,A4,A5,A6	14.02	7.01	5.72	1.87	14.44		
K7,K8,K9,L1	380.0	190.0	148.0	47.5	369.7	15-40	15-40
W1,W2,W3,W4,W5	14.96	7.48	5.83	1.87	14.55		
L2,W6	380.0	190.0	148.0	52.5	373.8	20-40	20-40
	14.96	7.48	5.83	2.06	14.71		
A7,C6,C7,C8,C9,D1,D3,	380.0	190.0	148.0	47.5	369.5	15-40	15-40
D4,D5,L3,A8,A9,	14.96	7.48	5.83	1.87	14.55		
B1,B2,B3,B4,B5,B6,B7,							
D6,B8,B9	380.0	190.0	148.0	52.5	374.5	20-40	20-40
	14.96	7.48	5.83	2.06	14.74		
L3,L4,W7,W8,J4	400.0	200.0	159.5	47.5	381.0	15-40	15-40
	15.75	7.88	6.28	1.87	15.00		
L5,L6,L7,L8,L9,M1,W9,J1,J2,J3,	400.0	200.0	159.5	52.5	386.0	20-40	20-40
J5,J6,J7	15.75	7.88	6.28	2.06	15.20		
M2,M3,J8,J9	400.0	200.0	159.5	57.5	391.0	25-40	25-40
	15.75	7.88	6.28	2.26	15.39		
M4,K1	422.0	211.0	159.5	52.5	386.0	20-40	20-40
	16.62	8.31	6.28	2.06	15.20		
M5,K2,K3	422.0	211.0	159.5	57.5	391.0	25-40	25-40
	16.62	8.31	6.28	2.26	15.39		
M6,M7,M8,K4,K5,K6	422.0	211.0	159.5	75.0	398.8	40-40	25-40
	16.62	8.31	6.28	2.95	15.70		

MOTOR FRAME INFO	MAX "H"	"J"
56C FR	727.2	73.5
	28.6	2.89
63 FR	SEE NOTE3	45.0
		1.77
71 FR	SEE NOTE3	52.5
		2.07
80 FR	SEE NOTE3	60.0
		2.36
143TCFR	749.4	73.5
	29.5	2.89
182C FR	816.2	73.5
184C FR	32.1	2.89

NOTES:
1. TO USE THE CHART, YOU MUST FIND POSITIONS 3 AND 4 FROM PUMP MODEL SELECTION CODE.
   X X _ _ X X X X X - X X X X X
2. DIMENSION "K" VARIES BASED ON PUMP MODEL POSITIONS 1 AND 2 -
   _ _ X X X X X X X - X X X X X
   L2 OR M2 = 38.25 MM / 1.50 IN
   L6 OR M6 = 56.00 MM / 2.20 IN
3. CONSULT FACTORY
4. DIMS A & B ARE NOT EFFECTED BY PRESSURE RATING OF FLANGE.
5. FLANGE SELECTIONS SHOWN ARE FOR MAX RATED PRESSURE OF PUMP.

REF	REVISION UPDATE	DATE
⚠		

ALL DIMENSIONS ARE MM/INCHES

MECHANICAL SERIES M

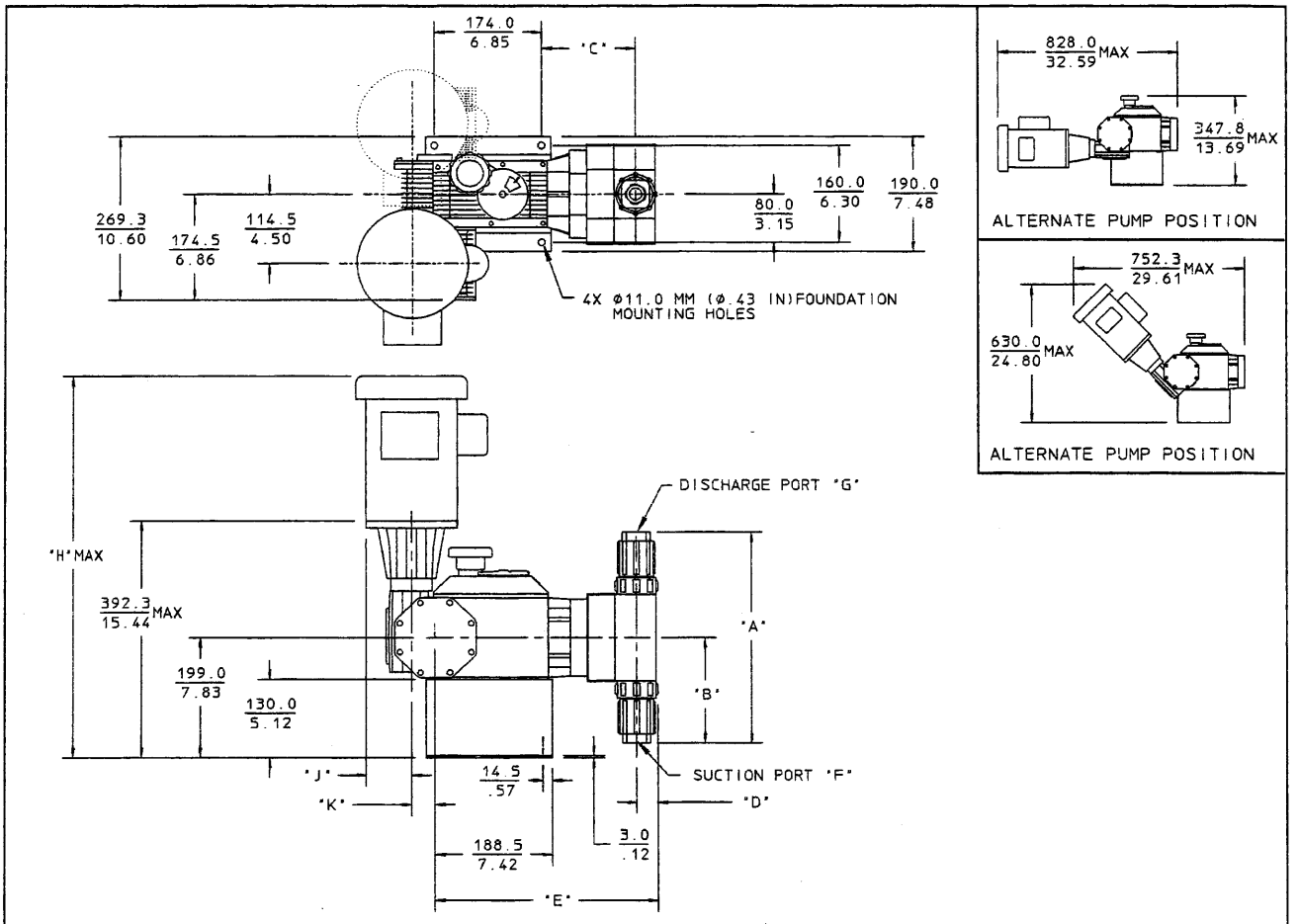
PULSAFEEDER A Unit of IDEX Corporation

DIMENSIONAL DWG
L2,L6 / M2,M6
EXT/MAN CONTROL DIN FLG
METAL CONST 50/60 Hz

DWN BY: PTP

DATE: 01/02/98

20743-000



PUMP MODEL POSITIONS 3 AND 4	MM / INCHES "A"	"B"	"C"	"D"	"E"	SUCTION PORT SIZE "F"	DISCHARGE PORT SIZE "G"
F7,F8,F9, D7,D8,D9,E1	263.0 10.35	131.5 5.18	145.3 5.72	25.0 .98	344.3 13.56	.25 FEM NPT/BSPT	.25 FEM NPT/BSPT
G1,G2,E2,E3	263.0 10.35	131.5 5.18	145.3 5.72	25.0 .98	344.3 13.56	.50 FEM NPT/BSPT	.50 FEM NPT/BSPT
E4	350.0 13.78	175.0 6.89	153.0 6.02	35.0 1.38	362.0 14.25	.25 FEM NPT/BSPT	.25 FEM NPT/BSPT
R6,R7,R8,R9,S1,G3,G4,G5,G6,G7, G8,G9,H1,H2,S2,S3,S7,M9,N1,N2, N3,N4,E5,E6,E7,E8,E9,F1,F2,F3, F4,F5,N6,N7,N8,P3,	350.0 13.78	175.0 6.89	153.0 6.02	35.0 1.38	362.0 14.25	.50 FEM NPT/BSPT	.50 FEM NPT/BSPT
H3,S4,S5,S6,S8,S9,F6,N9,P1,P2, P4,P5,P6	350.0 13.78	175.0 6.89	153.0 6.02	35.0 1.38	362.0 14.25	.75 FEM NPT/BSPT	.75 FEM NPT/BSPT
T1,T2,P7,P8	350.0 13.78	175.0 6.89	153.0 6.02	35.0 1.38	362.0 14.25	1.0 FEM NPT/BSPT	1.0 FEM NPT/BSPT
T3,P9	390.0 15.35	195.0 7.68	153.0 6.02	35.0 1.38	362.0 14.25	.75 FEM NPT/BSPT	.75 FEM NPT/BSPT
T4,R1,R2	390.0 15.35	195.0 7.68	153.0 6.02	35.0 1.38	362.0 14.25	1.0 FEM NPT/BSPT	1.0 FEM NPT/BSPT
T5,T6,T7,R3,R4,R5	390.0 15.35	195.0 7.68	153.0 6.02	35.0 1.38	362.0 14.25	1.5 MALE NPT/BSPT	1.0 FEM NPT/BSPT

MOTOR FRAME INFO	MAX "H"	"J"
56C FR	727.2 28.6	73.5 2.89
63 FR	SEE NOTE3	45.0 1.77
71 FR	SEE NOTE3	52.5 2.07
80 FR	SEE NOTE3	60.0 2.36
143TCFR	749.4 29.5	73.5 2.89
182C FR 184C FR	816.2 32.1	73.5 2.89

NOTES: 1. TO USE THE CHART, YOU MUST FIND POSITIONS 3 AND 4 FROM PUMP MODEL SELECTION CODE.
X X _ _ X X X X X - X X X X X

2. DIMENSION "K" VARIES BASED ON PUMP MODEL POSITIONS 1 AND 2 -
_ _ X X X X X X - X X X X X
L2 OR M2 = 38.25 MM / 1.50 IN
L6 OR M6 = 56.00 MM / 2.20 IN

3. CONSULT FACTORY

REF	REVISION UPDATE	DATE
A		

ALL DIMENSIONS ARE MM/INCHES

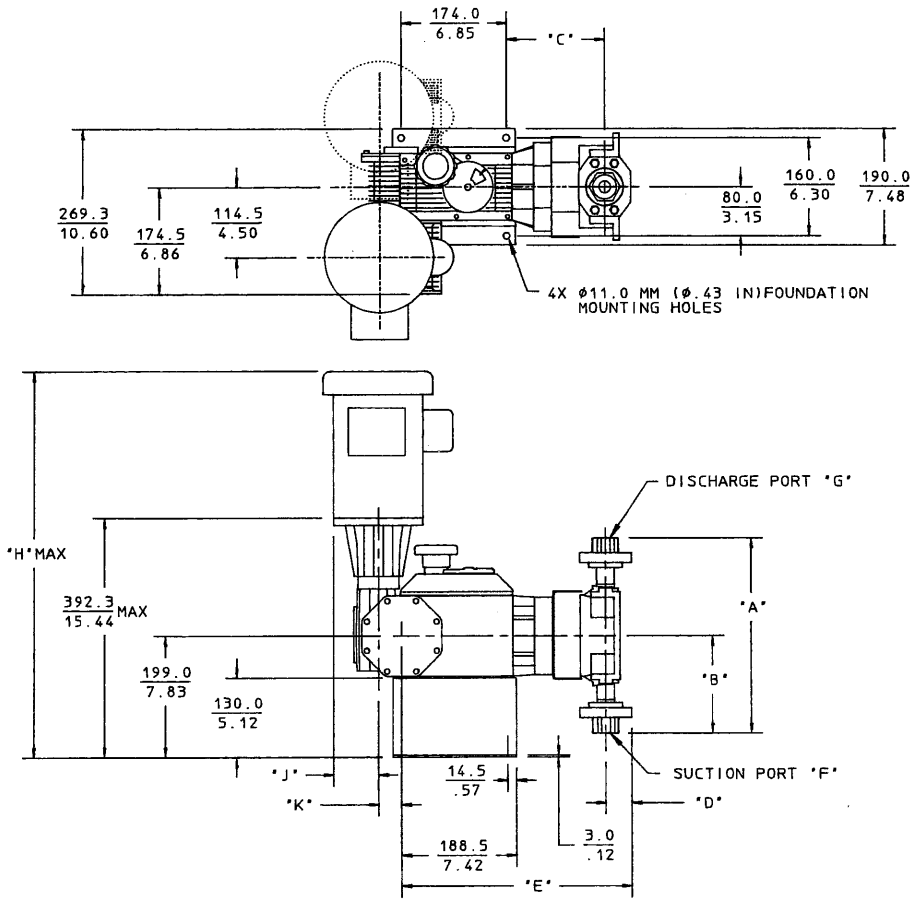
MECHANICAL SERIES M

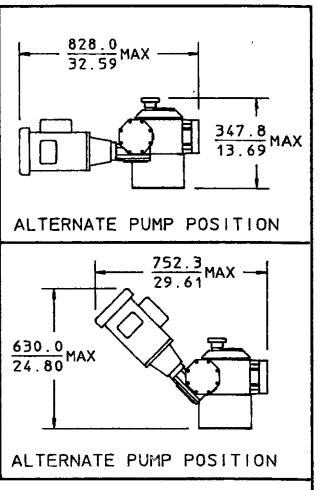
PULSAFEEDER A Unit of IDEX Corporation

DIMENSIONAL DWG
L2,L6 / M2,M6
EXT/MAN CONTROL
PLASTIC CONST 50/60 Hz

DWN BY: PTP
DATE: 05/05/97

20274-000





PUMP MODEL POSITIONS 3 AND 4	MM / INCHES 'A'	'B'	'C'	'D'	'E'	SUCTION PORT SIZE 'F'	DISCHARGE PORT SIZE 'G'
C1,C2,C3, A1,A2,A3,A4	232.0 9.13	116.0 4.56	145.3 5.72	28.0 1.10	347.3 13.67	.25 FEM NPT/BSPT	.25 FEM NPT/BSPT
C4,C5,A5,A6	232.0 9.13	116.0 4.56	145.3 5.72	28.0 1.10	347.3 13.67	.50 FEM NPT/BSPT	.50 FEM NPT/BSPT
A7	300.0 11.81	150.0 5.90	148.0 5.83	37.5 1.47	359.5 14.15	.25 FEM NPT/BSPT	.25 FEM NPT/BSPT
K7,K8,K9,L1,C6,C7,C8,C9,D1,D3, D4,D5,L3,W1,W2,W3,W4,W5,A8,A9, B1,B2,B3,B4,B5,B6,B7,	300.0 11.81	150.0 5.90	148.0 5.83	37.5 1.47	359.5 14.15	.50 FEM NPT/BSPT	.50 FEM NPT/BSPT
L2,D6,W6,B8,B9	300.0 11.81	150.0 5.90	148.0 5.83	37.5 1.47	359.5 14.15	.75 FEM NPT/BSPT	.75 FEM NPT/BSPT
L3,L4,W7,W8,J4	320.0 12.60	160.0 6.30	159.5 6.28	42.5 1.67	376.0 14.80	.50 FEM NPT/BSPT	.50 FEM NPT/BSPT
L5,L6,L7,L8,L9,M1,W9,J1,J2,J3, J5,J6,J7	320.0 12.60	160.0 6.30	159.5 6.28	42.5 1.67	376.0 14.80	.75 FEM NPT/BSPT	.75 FEM NPT/BSPT
M2,M3,J8,J9	320.0 12.60	160.0 6.30	159.5 6.28	42.5 1.67	376.0 14.80	1.0 FEM NPT/BSPT	1.0 FEM NPT/BSPT
M4,K1	362.0 14.25	181.0 7.12	159.5 6.28	42.5 1.67	376.0 14.80	.75 FEM NPT/BSPT	.75 FEM NPT/BSPT
M5,K2,K3	362.0 14.25	181.0 7.12	159.5 6.28	42.5 1.67	376.0 14.80	1.0 FEM NPT/BSPT	1.0 FEM NPT/BSPT
M6,M7,M8,K4,K5,K6	387.0 15.24	206.0 7.62	159.5 6.28	42.5 1.67	376.0 14.80	1.5 MALE NPT/BSPT	1.0 FEM NPT/BSPT

MOTOR FRAME INFO	MAX "H"	"J"
56C FR	727.2 28.6	73.5 2.89
63 FR	SEE NOTE3	45.0 1.77
71 FR	SEE NOTE3	52.5 2.07
80 FR	SEE NOTE3	60.0 2.36
143TCFR	749.4 29.5	73.5 2.89
182C FR 184C FR	816.2 32.1	73.5 2.89

NOTES: 1. TO USE THE CHART, YOU MUST FIND POSITIONS 3 AND 4 FROM PUMP MODEL SELECTION CODE.
X X _ _ X X X X X - X X X X X

2. DIMENSION "K" VARIES BASED ON PUMP MODEL POSITIONS 1 AND 2 -
_ _ X X X X X X - X X X X
L2 OR M2 = 38.25 MM / 1.50 IN
L6 OR M6 = 56.00 MM / 2.20 IN

3. CONSULT FACTORY

REF	REVISION UPDATE	DATE
A		

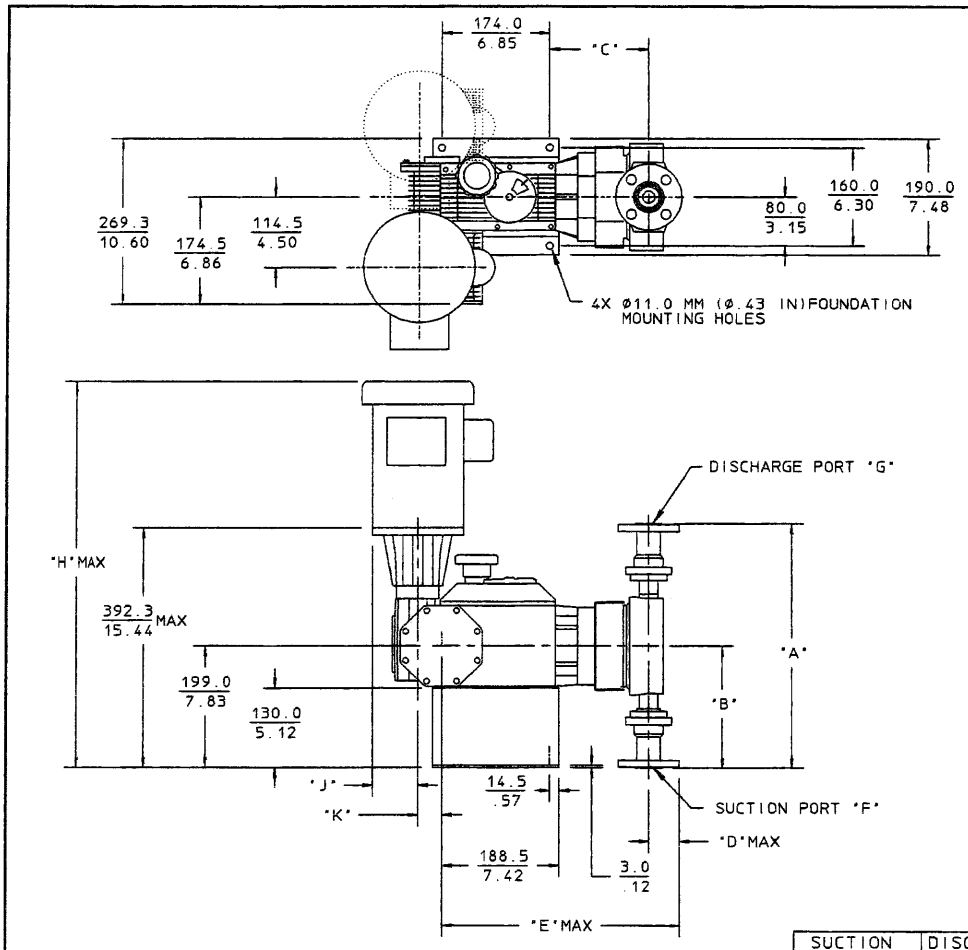
ALL DIMENSIONS ARE MM/INCHES

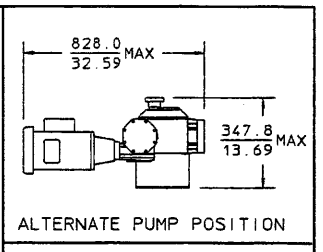
MECHANICAL SERIES M — PULSAFEEDER, A Unit of IDEX Corporation

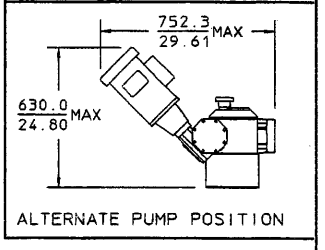
DIMENSIONAL DWG
L2,L6 / M2,M6
EXT/MAN CONTROL
METAL CONST 50/60 Hz

DWN BY: PTP
DATE: 05/05/97

20275-000







PUMP MODEL POSITIONS 3 AND 4	MM / INCHES "A"	"B"	"C"	"D"	"E"	SUCTION PORT SIZE "F"	DISCHARGE PORT SIZE "G"
F7,F8,F9,G1,G2,E2,E3	356.0	178.0	145.3	47.5	366.9	.50-300#	.50-300#
D7,D8,D9,E1	14.02	7.01	5.72	1.88	14.44		
R6,R7,R8,R9,S1,	380.0	190.0	148.0	47.5	369.7	.50-300#	.50-300#
M9,N1,N2,N3,N4,	14.96	7.48	5.83	1.88	14.55		
N5	380.0	190.0	148.0	58.7	380.0	.75-300#	.75-300#
	14.96	7.48	5.83	2.31	14.96		
E4,G3,G4,G5,G6,G7,	380.0	190.0	148.0	44.5	366.5	.50-150#	.50-150#
G8,G9,H1,H2,	14.96	7.48	5.83	1.75	14.43		
E5,E6,E7,E8,E9,F1,F2,F3,F4,F5							
H3,F6	380.0	190.0	148.0	49.3	371.3	.75-150#	.75-150#
	14.96	7.48	5.83	1.97	14.62		
S2,S3,S7,N6,N7,N8,P3	400.0	200.0	159.5	44.5	378.0	.50-150#	.50-150#
	15.75	7.88	6.28	1.75	14.88		
S4,S5,S6,S8,S9,N9,P1,P2,P4,P5,	400.0	200.0	159.5	49.3	382.8	.75-150#	.75-150#
P6	15.75	7.88	6.28	1.97	15.07		
T1,T2,P7,P8	400.0	200.0	159.5	53.8	387.3	1.0-150#	1.0-150#
	15.75	7.88	6.28	2.12	15.25		
T3,P9	422.0	211.0	159.5	49.3	382.8	.75-150#	.75-150#
	16.62	8.31	6.28	1.94	15.07		
T4,R1,R2	422.0	211.0	159.5	53.8	387.3	1.0-150#	1.0-150#
	16.62	8.31	6.28	2.12	15.25		
T5,T6,T7,R3,R4,R5	422.0	211.0	159.5	63.5	387.3	1.5-150#	1.0-150#
	16.62	8.31	6.28	2.50	15.25		

MOTOR FRAME INFO	MAX "H"	"J"
56C FR	727.2	73.5
	28.6	2.89
63 FR	SEE	45.0
	NOTE3	1.77
71 FR	SEE	52.5
	NOTE3	2.07
80 FR	SEE	60.0
	NOTE3	2.36
143TCFR	749.4	73.5
	29.5	2.89
182C FR	816.2	73.5
184C FR	32.1	2.89

NOTES:
1. TO USE THE CHART, YOU MUST FIND POSITIONS 3 AND 4 FROM PUMP MODEL SELECTION CODE.
   X X _ _ X X X X X - X X X X X
2. DIMENSION "K"
   VARIES BASED ON PUMP MODEL POSITIONS 1 AND 2 -
   _ _ X X X X X X - X X X X X
   L2 OR M2 = 38.25 MM / 1.50 IN
   L6 OR M6 = 56.00 MM / 2.20 IN
3. CONSULT FACTORY
4. DIMS A & B ARE NOT EFFECTED BY PRESSURE RATING OF FLANGE.
5. FLANGE SELECTIONS SHOWN ARE FOR MAX RATED PRESSURE OF PUMP.

REF	REVISION UPDATE	DATE
A		

ALL DIMENSIONS ARE MM/INCHES

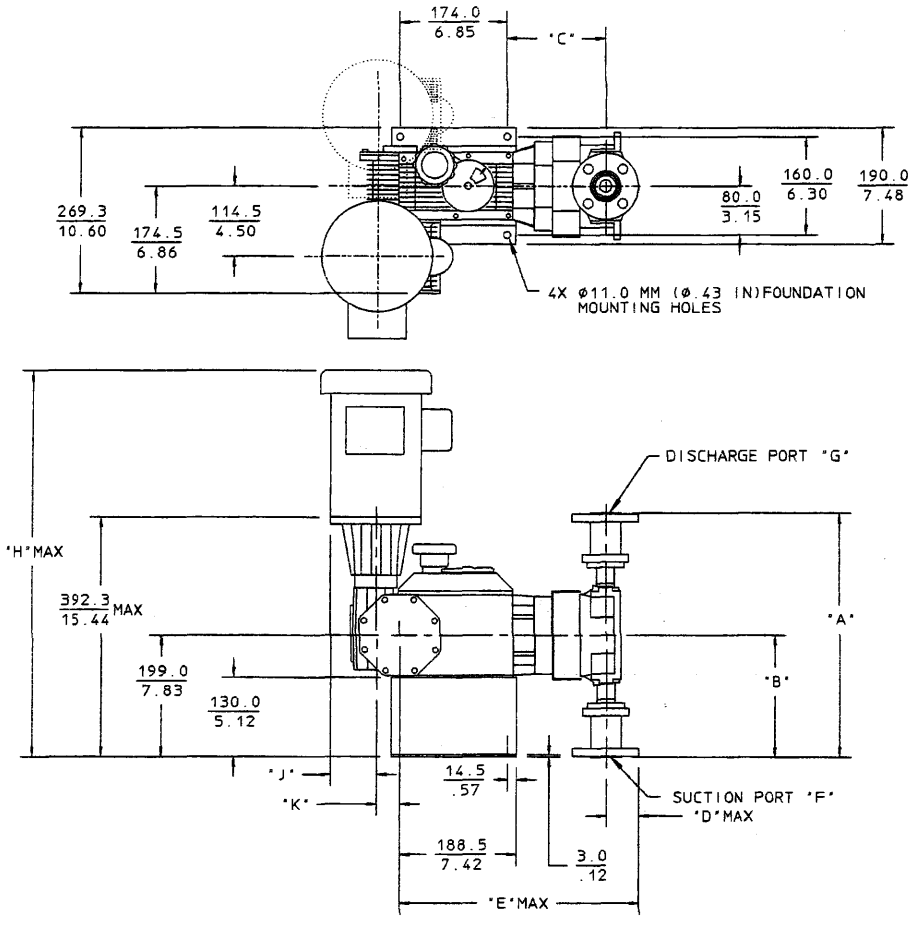
MECHANICAL SERIES M

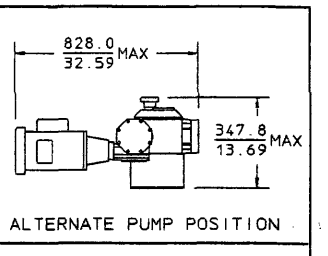
PULSAFEEDER
A Unit of IDEX Corporation

DIMENSIONAL DWG
L2,L6 / M2,M6
EXT/MAN CONTROL ANSI FLG
PLASTIC CONST 50/60 Hz

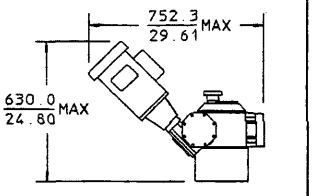
DWN BY: PTP
DATE: 05/05/97

20276-000





ALTERNATE PUMP POSITION



ALTERNATE PUMP POSITION

PUMP MODEL POSITIONS 3 AND 4	MM / INCHES "A"	"B"	"C"	"D"	"E"	SUCTION PORT SIZE "F"	DISCHARGE PORT SIZE "G"
C1,C2,C3,C4,C5	356.0	178.0	145.3	47.5	366.9	.50-300#	.50-300#
A1,A2,A3,A4,A5,A6	14.02	7.01	5.72	1.88	14.44		
K7,K8,K9,L1	380.0	190.0	148.0	47.5	369.7	.50-300#	.50-300#
W1,W2,W3,W4,W5	14.96	7.48	5.83	1.88	14.55		
L2,W6	380.0	190.0	148.0	58.7	380.0	.75-300#	.75-300#
	14.96	7.48	5.83	2.31	14.96		
A7,C6,C7,C8,C9,D1,D3,	380.0	190.0	148.0	44.5	366.5	.50-150#	.50-150#
D4,D5,L3,A8,A9,	14.96	7.48	5.83	1.75	14.43		
B1,B2,B3,B4,B5,B6,B7,							
D6,B8,B9	380.0	190.0	148.0	49.3	371.3	.75-150#	.75-150#
	14.96	7.48	5.83	1.97	14.62		
L3,L4,W7,W8,J4	400.0	200.0	159.5	44.5	378.0	.50-150#	.50-150#
	15.75	7.88	6.28	1.75	14.88		
L5,L6,L7,L8,L9,M1,W9,J1,J2,J3,	400.0	200.0	159.5	49.3	382.8	.75-150#	.75-150#
J5,J6,J7	15.75	7.88	6.28	1.97	15.07		
M2,M3,J8,J9	400.0	200.0	159.5	53.8	387.3	1.0-150#	1.0-150#
	15.75	7.88	6.28	2.12	15.25		
M4,K1	422.0	211.0	159.5	49.3	382.8	.75-150#	.75-150#
	16.62	8.31	6.28	1.94	15.07		
M5,K2,K3	422.0	211.0	159.5	53.8	387.3	1.0-150#	1.0-150#
	16.62	8.31	6.28	2.12	15.25		
M6,M7,M8,K4,K5,K6	422.0	211.0	159.5	63.5	387.3	1.5-150#	1.0-150#
	16.62	8.31	6.28	2.50	15.25		

MOTOR FRAME INFO	MAX "H"	"J"
56C FR	727.2	73.5
	28.6	2.89
63 FR	SEE	45.0
	NOTE3	1.77
71 FR	SEE	52.5
	NOTE3	2.07
80 FR	SEE	60.0
	NOTE3	2.36
143TCFR	749.4	73.5
	29.5	2.89
182C FR	816.2	73.5
184C FR	32.1	2.89

NOTES:
1. TO USE THE CHART, YOU MUST FIND POSITIONS 3 AND 4 FROM PUMP MODEL SELECTION CODE.
   X X - X X X X X - X X X X X
2. DIMENSION "K" VARIES BASED ON PUMP MODEL POSITIONS 1 AND 2 -
   X X X X X X X - X X X X X
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3. CONSULT FACTORY
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5. FLANGE SELECTIONS SHOWN ARE FOR MAX RATED PRESSURE OF PUMP.

REF	REVISION UPDATE	DATE
A		

ALL DIMENSIONS ARE MM/INCHES

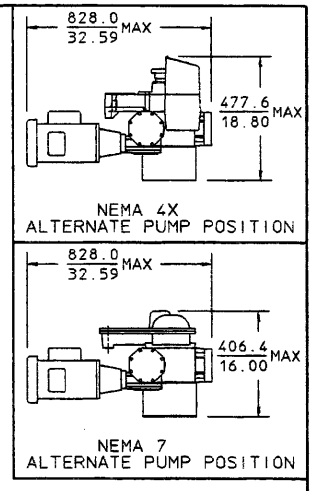
MECHANICAL SERIES M

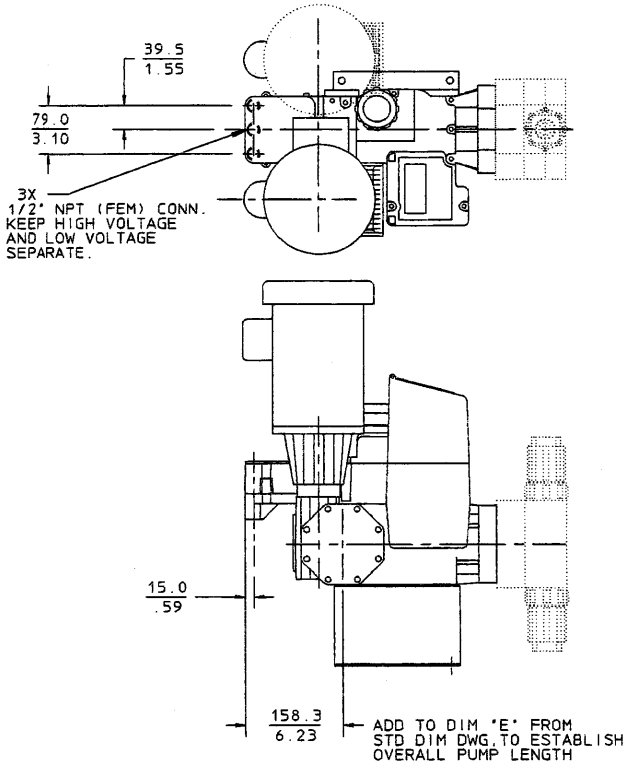
PULSAFEEDER
A Unit of IDEX Corporation

DIMENSIONAL DWG FLG
L2,L6 / M2,M6
EXT/MAN CONTROL ANSI FLG
METAL CONST 50/60 Hz

DWN BY: PTP
DATE: 05/05/97

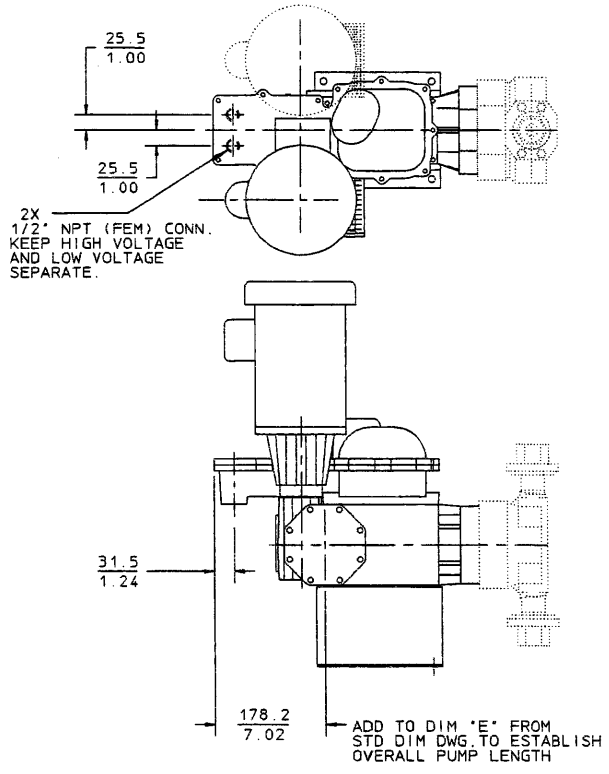
20277-000





NEMA 4X DLC CONTROL OPTION:

PLASTIC CONSTRUCTION SHOWN



NEMA 7 DLC CONTROL OPTION:

METAL CONSTRUCTION SHOWN

REF	REVISION UPDATE	DATE
A		

ALL DIMENSIONS ARE MM/INCHES

MECHANICAL SERIES M

PULSAFEEDER
A Unit of IDEX Corporation

DIMENSIONAL DWG L2/L6
L2,L6 / M2,M6
N4 & N7 DLC CTRL

DWN BY: PTP
DATE: 01/02/98

20278-001

MAINTENANCE LOG

Pump Model _____ Serial # _____

Gear Ratio _____ Maximum Flow _____

Piston Diameter _____ Maximum Pressure _____

KOPKit _____

All the above information can be obtained from the pump nameplate. Refer to the Pump Specification Data Sheet for additional information.

Date	Serviced By	Maintenance Performed

PULSAFEEDER®

A Unit of IDEX Corporation