Instruction Manual

Series G, Model B
Motor-Driven Pump

For file reference, please record the following data:

Model No: _____

Serial No: _____

Installation Date: _____

Installation Location: _____

When ordering replacement parts for your LMI Pump, please include the complete Model Number and Serial Number of your unit.

LMI
MILTON ROY

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1784 B. 12/99

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WARNING

A PRESSURE RELIEF VALVE WITH A RELIEF PRESSURE OF 25 PSI (1.7 BAR) ABOVE RATED PUMP PRESSURE AND A RELIEF FLOW (BLEED) RATE ADEQUATE FOR RATED PUMP OUTPUT (PULSATING) MUST BE INSTALLED IN THE DISCHARGE LINE OF THIS PUMP.

Discharge piping should have a minimum burst pressure of 600 psi (41 Bar). Failure to provide pressure relief may result in failure modes dangerous to the system, associated piping, the pump itself and operating personnel.

1.0 Description

1.1 General

The Series G, Model "B" pumps are reciprocating, chemical dosing pumps capable of producing controlled flows up to 310 gallons per hour (1175 l/h) at pressures up to 150 psi (10 Bar) (depending on the model). These pumps feature a mechanically actuated diaphragm, which eliminates the need for contour plates, and a stroke adjustment mechanism based on the variable eccentric principle instead of the traditional lost motion design. This design substantially reduces pressure and flow pulsations contributing to an increase in the life of system components and more continuous chemical injection. It is designed for industrial service and offers an accuracy of ± 2% of 100% rated flow between 10% and 100% of its flow range.

1.2 Principle of Operation

The pump consists of two (2) major assemblies; the drive and the liquid end. Pump delivery is a function of the drive's stroke rate, liquid end size and stroke length. Stroke length can be adjusted while the pump is running or stopped by turning the stroke adjusting knob.

The drive motor transmits rotary motion to a worm gear speed reduction unit which in turn drives the variable eccentric crank. The adjustable crank imparts reciprocating motion to the diaphragm through an interposing connecting rod. The stroke length is adjusted by changing the position of the variable eccentric crank in the connecting rod assembly.

As the Liquifram™ starts back on the suction stroke, the pressure immediately drops inside the liquid end. When the liquid end pressure drops below the suction line pressure, the suction ball check is "pushed" upward and the process fluid in the suction line flows into the liquid end chamber. When the suction stroke ends, the Liquifram™ movement momentarily stops. The pressure in the liquid end equalizes with the pressure in the suction line and the suction ball check seats.

It is important that the pressure in the liquid end remain above the vapor pressure of the process fluid during the suction stroke. If the fluid pressure drops below the vapor pressure, cavitation will occur, negatively impacting the performance of the pump. If you suspect the possibility of cavitation, contact an LMI Master Distributor for assistance.

As the diaphragm starts forward on the discharge stroke the pressure immediately rises inside the liquid end. When the liquid end pressure rises above the discharge line pressure, the discharge ball check is "pushed" upward and the process fluid in the liquid end flows into the discharge line. When the discharge stroke ends, the diaphragm momentarily stops again. The pressure in the liquid end equalizes with the discharge line pressure and the discharge ball check reset. The cycle then starts again.

1.3 General Specifications

Flow Rate ..... Up to 310 GPH (1175 l/h)

Pressure ..... Up to 150 PSI (10 Bar)

Design ..... Mechanically Actuated Liquifram™

Drive ..... Variable Eccentric

Accuracy ..... ± 2% of 100% rated flow between 10% and 100% of rated flow

Adjustment ..... Lockable micrometer is adjustable from 0% to 100% while pump is running or stopped

Lubrication ..... Oil bath

Temperature ..... Ambient and Liquid: 122º F (50º C) Maximum, 14º F (-10º C) Minimum

Suction Lift ..... 8.2 ft (2.5 m) of water column maximum. 11 PSI minimum internal pressure (4 PSI Max. Vacuum)

Paint ..... Two-part epoxy, yellow RAL 1018

1.4 Product Code

Series G Pumps are available in a variety of different configurations. For a breakdown of the options included in a specific pump, compare the pump model number and product code found on the pump nameplate with the model/product code breakdown shown in Figure 1. A sample dataplate is shown in Figure 2.

Model G51 8 - 541P

Output Code(1)

G51	29 GPH @ 60 Hz	(92 l/h @ 50 Hz)	150 psi (10.0 Bar)
G52	58 GPH @ 60 Hz	(184 l/h @ 50 Hz)	150 psi (10.0 Bar)
G53	116 GPH @ 60 Hz	(366 l/h @ 50 Hz)	150 psi (10.0 Bar)
G58(2)		(457 l/h @ 50 Hz)	(10.0 Bar)
G63	155 GPH @ 60 Hz	(488 l/h @ 50 Hz)	100 psi . (7.0 Bar)
G68(2)		(610 l/h @ 50 Hz)	(7.0 Bar)
G73	310 GPH @ 60 Hz	(1000 l/h @ 50 Hz)	50 psi . (3.5 Bar)
G78(2)		(1250 l/h @ 50 Hz)	(3.5 Bar)

Motor

8	3/4 hp, 1-Phase, 60 Hz, 115/230 V, 1800 rpm, TEFC, 56C Frame
K	0.55 kW, 3-Phase, 50 Hz, 220/380 V, 1500 rpm, TEFC, F165 Flange, 80 Frame
J	3/4 hp, 3-Phase, 60 Hz, 230/460 V, 1800 rpm, TEFC, 56C Frame
H	AC Variable Speed Motor
P	DC Variable Speed Motor
N	No Motor (IEC 80 Frame, F165 Flange)
X	No Motor (56C Frame)

Liquid End No.	Head / Fittings	Connections Inch	Connections Metric
541P	Polypropylene/PVC	1/2" NPT F	
541Q	Polypropylene/PVC		DN15
542P	PVDF	1/2" NPT F	
542N	PVDF		1/2" BSP F
547P	316 SS	1/2" NPT F	
547N	316 SS	.	1/2" BSP F
548P	PVC	1/2" NPT F	
548Q	PVC		DN15
561P	Polypropylene/PVC	1" NPT F	
561Q	Polypropylene/PVC		DN25
562P	PVDF	1" NPT F	
562N	PVDF		1" BSP F
567P	316 SS	1" NPT M	
567N	316 SS		1" BSP M
568P	PVC	1" NPT F	
568Q	PVC		DN25
581P	Polypropylene/PVC	1" NPT F	
581Q	Polypropylene/PVC		DN25
582P	PVDF	1" NPT F	
582N	PVDF		1" BSP F
587P	316 SS	1" NPT M	
587N	316 SS		1" BSP M
588P	PVC	1" NPT F	
588Q	PVC		DN25

(1) Outputs are at nominal 22 psi (1.5 Bar)
(2) Available only with 50 Hz motor

Figure 1: Model/Product Code

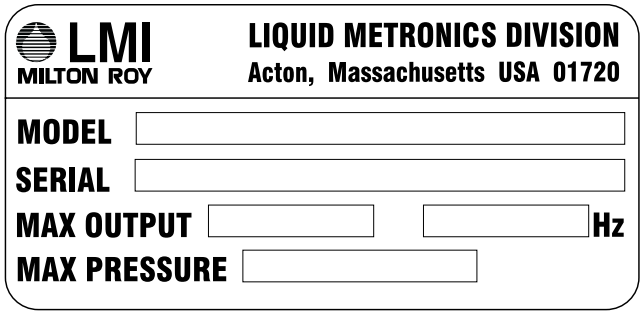

Figure 2: Sample Dataplate

2.0 Installation

2.1 Unpacking

Pumps are shipped f.o.b. factory or distributor warehouse and the title passes to the customer when the carrier signs for receipt of the pump. In the event that damages occur during shipment, it is the responsibility of the customer to notify the carrier immediately and to file a damage claim.

Carefully examine the shipping carton upon receipt from the carrier to be sure there is no obvious damage to the contents. Open the carton carefully so accessory items inside will not be damaged or lost. Examine all material and check against packing list to be sure that all items are accounted for and intact.

2.2 Safety Precautions

When installing, operating, and maintaining the Series G Pump, keep safety considerations foremost. Use proper tools, protective clothing, and eye protection when working on the equipment and install the equipment with a view toward ensuring safe operation. Follow the instructions in this manual and take additional safety measures appropriate to the liquid being pumped. *Be extremely careful in the presence of hazardous substances (e.g., corrosives, toxins, solvents, acids, caustics, flammables, etc.).*

2.3 Storage

Temporary Storage (Less than 6 Months)

It is preferable to store the material under a shelter in its original package to protect it from adverse weather conditions. In condensing atmospheres, follow the long term storage procedure.

Long Term Storage (Longer than 6 Months) Primary Considerations

The primary consideration in storage of pump equipment is to prevent corrosion of external and internal components. This corrosion is caused by natural circulation of air as temperature of the surroundings change from day to night, day to day, and from season to season. It is not practical to prevent this circulation which carries water vapor and other corrosive gasses, so it is necessary to protect internal and external surfaces from their effects to the extent possible.

When the instructions given in this section are completed, the equipment is to be stored sheltered; protected from direct exposure to weather. The prepared equipment should be covered with a plastic sheet or a tarpaulin, but in a manner which will allow air circulation and prevent capture of moisture. Equipment should be stored 12 inches or more above the ground.

Pump Drive

1. Flood the gearbox compartment with a high grade lubricating oil/rust preventative such as Mobile Oil Corporation product "Mobilarma 524." Fill the compartment completely to minimize air space and water vapor condensation. After storage, drain this material and refill the equipment with the recommended lubricant for equipment commissioning.
2. Remove drive motor and liquid end, and brush all unpainted metal surfaces with multipurpose grease (NLGI grade 2 or 3). Store these unattached.

Electrical Equipment

1. Motors should be prepared in the manner prescribed by their manufacturer. If information is not available, dismount and store motors as indicated in step 3 below.
2. Dismount electrical equipment (including motors) from the pump.
3. For all electrical equipment, place packets of Vapor Phase Corrosion Inhibitor (VPCI) inside the enclosure, then place the entire enclosure, with additional packets, inside a plastic bag. Seal the bag tightly closed.

2.4 Handling of Pump

To avoid damaging the pump while moving or installing a Series G Pump, follow the instructions below. Refer to Figure 3.

1. Place a sling under the motor flange.
2. Cross the two ends of the sling and close the loop.
3. Place the other end of the sling under the liquid end mounting flange.
4. Make sure the entire unit is well balanced before attempting to move the pump.

To avoid possible damage to either pump or personnel, bolt pump down as soon as it is in position.

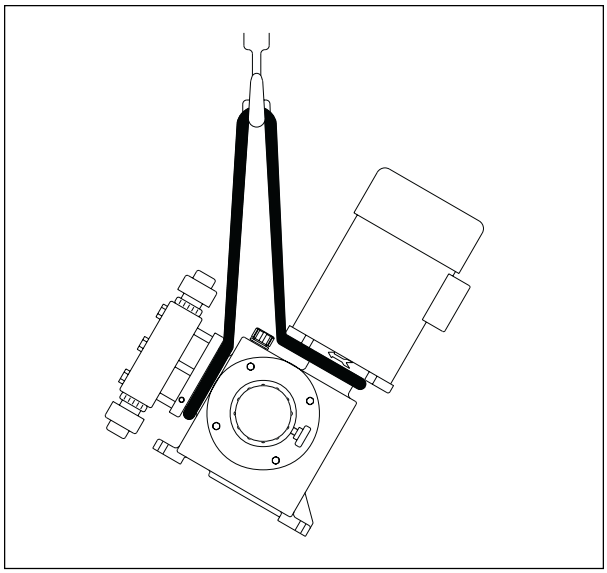

Figure 3: Handling a Series G Pump

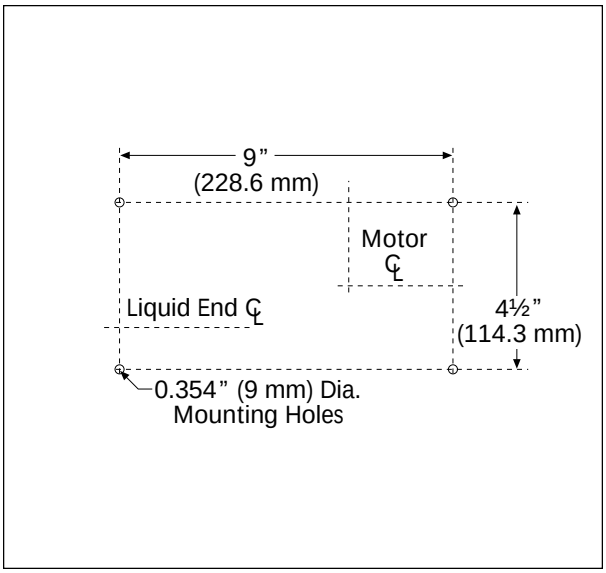

Figure 4: Mounting Hole Dimensions

2.5 Mounting

Support the pump firmly in a level position on a solid, vibration-free foundation, preferably with the base above floor level to protect the pump from wash downs and to provide easier access for service. Be sure to allow enough space around the pump for easy access during maintenance operations, pump adjustments, and/or oil filling or draining procedures.

Series G Pumps are provided with mounting holes to accommodate anchor bolts. Refer to Figure 4 for mounting hole dimensions.

Some Series G Pumps are shipped with motors dismounted. After anchoring pump in position, install motor, referring to Figure 7. **Make sure spring (360) provided with pump is installed in worm shaft prior to motor installation.**

Pumps installed outdoors should be protected by a shelter.

2.6 Piping

NPSH Considerations

Size piping to accommodate peak instantaneous flow. Because of the reciprocating motion of the pump diaphragm, pump delivery follows an approximate sine curve with a peak instantaneous flow pi (3.14) times the average flow. Therefore, piping must be designed for a flow 3.14 times the pump capacity; this means that a pump rated for 88 gallons per hour (333 l/h) requires piping sufficient for 3.14 x 88 gph, or 276 gph (1045 l/h).

To minimize viscous flow losses when handling viscous liquids, it may be necessary to use suction piping up to four times larger than the size of the suction connection on the pump. If in doubt, contact your nearest LMI Master Distibutor to determine the necessary pipe size.

General Piping Considerations

- Use extreme care in piping to plastic liquid end pumps with rigid pipe such as PVC. If excessive stresses or vibration is unavoidable, flexible connections are recommended.
- Use piping materials that will resist corrosion by the liquid being pumped. Use care in selecting materials to avoid galvanic corrosion at pump liquid end connections.
- Use piping heavy enough to withstand maximum pressures.
- Remove burrs, sharp edges, and debris from inside piping. Blow out all pipe lines before making final connections to pump.
- Because vapor in the liquid end will cause inaccurate pump delivery, piping should be sloped to prevent vapor pockets.
- When pumping suspended solids (such as slurries), install plugged crosses at all 90° line turns to permit line cleaning without dismantling piping.
- See Figure 5 for a typical recommended pump installation scheme.

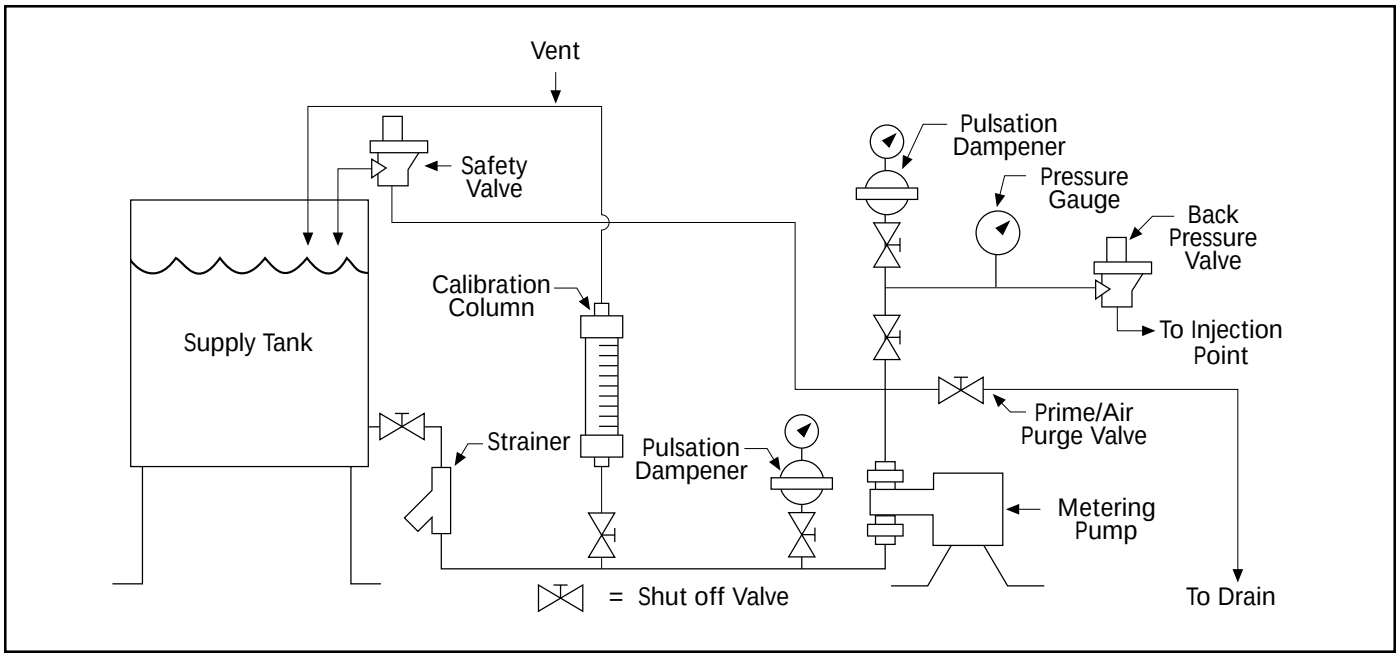

Figure 5: Typical Recommended Pump Installation Scheme

Suction Piping Considerations

- It is preferable to have the suction of the pump flooded by locating the liquid end below the lowest level of the liquid in the supply tank. Installing the supply vessel on the suction line close to the pump can help ensure a flooded suction line.
- Avoid negative suction pressure conditions (suction lift), as such conditions adversely affect metering accuracy. A lift of 8.2 ft (2.5 m) of water column is the maximum suction lift permissible.
- Series G Pumps are designed to operate with process liquid supplied at or above atmospheric pressure. Although these pumps can move liquids supplied at less than atmospheric pressure, in these negative pressure applications it is important that all connections be absolutely drip free and vacuum tight, and that a foot valve be installed at the bottom of the suction line (see Figure 6).
- When pumping a liquid near its boiling point, provide enough suction head to prevent the liquid from "flashing" into vapor when it enters the pump liquid end on the suction stroke.
- If possible use metal or plastic tubing for the suction line because tubing has a smooth inner surface and can be formed into long, sweeping bends to minimize frictional flow losses.
- A strainer should be used in the suction line to prevent foreign particles from entering the liquid end. This and any other measures which prevent debris from entering and fouling the ball-checks will give increased maintenance-free service. Check strainer frequently to prevent blockage which could lead to cavitation.
- Keep suction piping as short and straight as possible.
- Piping size should be larger than the liquid end suction fitting to prevent pump starvation.
- If long suction lines are unavoidable, install a stand pipe near the pump in the suction line.
- Suction piping must be absolutely airtight to ensure accurate pumping. After installation, test suction piping for leaks with air and soap solution.

Discharge Piping Considerations

- Install pipe large enough to prevent excessive pressure losses on the discharge stroke of the pump. Maximum pressure at the discharge fitting on the liquid end must be kept at or below the rated pressure (maximum allowable working pressure shown on the pump dataplate).
- The pump will not deliver a controlled flow unless the discharge line pressure is 10 psi (.7 Bar) greater than the suction line pressure. There are a number of ways to create an artificial pressure, such as by installing a back pressure valve.
- When pumping water-treatment chemicals directly into boiler drums, use one liquid end assembly for each boiler drum. Discharging into a manifold having the slightest pressure difference between its several discharge connections can diminish metering accuracy as the outlet with the lowest pressure will receive more liquid than the other outlets.

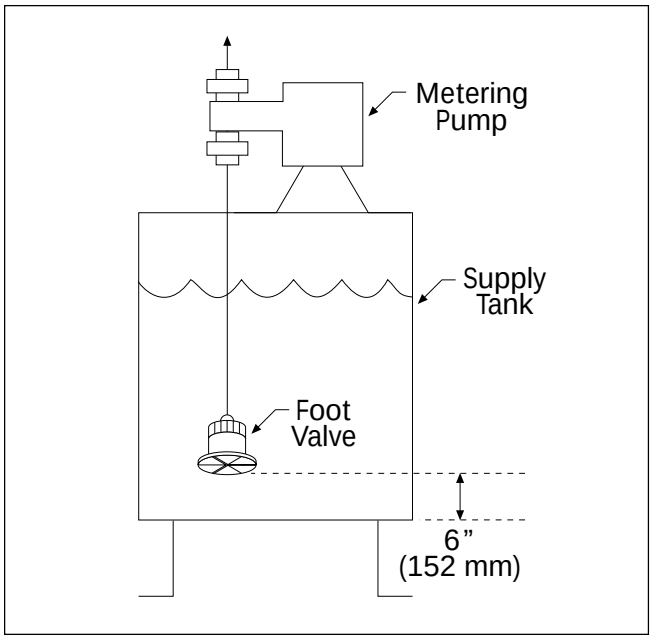

Figure 6: Suction Lift Installation

Back Pressure Valves

An LMI Back Pressure Valve should be installed in the discharge line near the pump to ensure sufficient discharge head pressure for proper pump metering action. Normally, the valve should be located near the pump; however, back pressure valves for large pumps with long and extremely small discharge lines may have to be installed near the point of discharge into the process (to minimize siphoning tendencies).

Pulsation Dampeners

An accumulator, surge chamber, surge suppressor, or pulsation dampener should be used with the back pressure valve in the discharge line to absorb the flow peaks between the pump and the back pressure valve. Without the pulsation dampener the valve mechanism will snap open and closed with the surge from each pump stroke. The pulsation dampener will allow the back pressure valve to oscillate about a partly-closed position, thus minimizing wear on the valve. Discharge line pulsation dampeners offer the further advantage of limiting the flow and pressure variations characteristic of this kind of pump. Installing a properly sized pulsation dampener will improve pump performance and may reduce system costs dramatically by permitting the substitution of smaller piping.

Safety Valves

Motor-driven positive displacement pumps can develop excessive discharge pressures long before thermal overload devices interrupt the motor electrical circuit. To prevent a blocked discharge line from causing damage to the pump, piping, or process equipment, install an LMI Safety Valve in the pump discharge line. This valve is designed and sized to handle system flow rates and pressures safely while resisting corrosion by the process liquid.

Install the safety valve in the discharge line between the pump and the nearest shut-off valve (this will prevent pump damage from accidental valve closure). Pipe the safety valve outlet back to the suction tank or to drain, but in either case ensure that the pipe end is continuously visible so safety valve leakage may be detected. LMI safety valves must be installed at top of supply tank in order to function properly (see Figure 5).

Check Valves

A check valve should be installed at the point where the discharge line enters a boiler or other high-pressure vessel. This will prevent back flow through the discharge piping and will isolate the pump discharge from system pressures (a safety consideration).

Shut-off Valves

Provide shut-off valves in both suction and discharge lines next to the pump. Locate discharge line shut-off valve downstream from the inlet connection of the safety valve. Figure 5 shows recommended valve locations.

2.7 Leak Detection

Series G, Model B pumps are equipped with a leak detection port. For ease of installation, each pump has a plastic tubing connector installed in the leak detection port (see item 448 in Figure 8). In the event of a failure of the oil seal (70 in Figure 7) or diaphragm assembly (261 in Figure 8), pump drive oil or process fluid will escape from this leakage port. During pump installation, actions should be taken to ensure that this leakage is safely collected by installing tubing between the leak detection port and an appropriate containment vessel.

2.8 Electrical Connections

Ensure that the electrical supply matches the pump motor dataplate characteristics.

Before operating the pump, check the direction of rotation of the motor to be sure it matches the direction of the arrow stamped on the motor (rotation should be clockwise when viewed from the top of the motor). If motor rotation is incorrect, refer to the motor data plate or motor manufacturer's instructions for reversing.

Operation with the wrong motor rotation will damage the pump and motor and void the warranty.

Do not forget to connect the pump to an earth ground!

Electric protection of the motor (fuses, overload meters or relays) should correspond to the rated current indicated on the motor data plate.

3.0 Operation

3.1 Initial Start-Up

Check that all mounting bolts are tight, piping is installed properly, and the discharge line is open.

Check oil drain plug for tightness. Remove the oil fill cap and fill the pump casing until level is between the markings on the oil fill cap dipstick, (approximately 3 quarts [2.8 Liters]).

The oil furnished with the pump is grade AGMA No. 5 EP with a viscosity of 1000 SSU at 100° F (218.4 cSt at 40° C). For operation in ambient temperatures below 50° F (10° C), substitute AGMA No. 2 EP with a viscosity of 400 SSU at 100° F (86.4 cSt at 40° C). Manufacturers' equivalent oils are shown below.

ABOVE 50° F (10° C)		BELOW 50° F (10° C)	
Chevron	N.L. Gear Compound 220	Chevron	N.L. Gear Compound 68
Exxon	Spartan E.P. 220	Exxon	Spartan E.P. 68
Mobil	Mobilgear 630	Mobil	Mobilgear 626
Texaco	Meropa 220	Texaco	Meropa 68
Shell	Omaha 220	Shell	Omaha 68

Before switching on power to the pump, turn the capacity adjustment knob to zero. Check that all shut-off valves in the suction and discharge lines are open before increasing the capacity adjustment from zero.

Manual Capacity Control

To adjust pump capacity, loosen the stroke locking screw located in the pump side cover. Pump capacity is adjusted by turning the micrometer type stroke adjustment knob clockwise to decrease capacity or counterclockwise to increase capacity as required. The adjustment scale is marked in percent (%) of full stroke, with calibration lines on the knob at 1% intervals. After adjusting the knob to the desired capacity setting, hand tighten the stroke locking screw to maintain the capacity setting.

Filling Pumping System

It is especially important that pump suction and discharge lines be free of entrained air. To ensure this condition, operate the pump without any discharge pressure and fill the entire pumping system with liquid before starting pressure tests. A simple method to assure priming of the pump is to install a tee and a shut-off valve at the discharge connection of the pump.

If the pump is idle for long periods, temperature changes in the process liquid may produce air in the system. To discharge the air, install a valve in the discharge line which will allow the process liquid to be pumped to exhaust when starting the pump.

Capacity Calibration

After the first 12 hours of operation, the pump may be tested and calibrated to find the exact pump capacity under specific operating conditions.

Usually, calibrating the pump at only 100, 50, and 10 percent capacity settings is enough to indicate pump performance throughout the adjustment range.

The pump can be calibrated by measuring the decrease in liquid level pumped from a calibrated vessel. This method is recommended for hazardous liquids because it eliminates operator contact with the liquid. LMI test-tube Calibration Columns are available for convenient and accurate calibration of any pump.

The pump can also be calibrated by collecting and measuring pumped liquid at the pump discharge port. It may be necessary to create discharge head at the liquid take-off point so that the pump will operate properly (see Section 2.6 for recommended ways to do this).

This method is not generally recommended as it may expose operating personnel to hazardous liquids. Furthermore, the pump may over pump dramatically and the position of the capacity adjustment knob may have little effect on measuring flow rate.

4.0 Maintenance

4.1 Spare Parts

The following spare parts should be stocked for each pump to prevent serious delays in repairs. Refer to Figures 7–14 and to the accompanying parts lists.

B40 Metallic Liquid End

(1) Diaphragm Assembly (261)

(1) Oil Seal (70)

(2) Check Valve Assemblies (425)

(See parts list)

All Other Liquid Ends

(1) Diaphragm Assembly (261)

(1) Oil Seal (70)

(2) Seat, O-Ring, Ball Set (423)

(See parts list)

Parts orders must include the following:

1. Quantity required
2. Part number
3. Part description
4. Pump serial number (found on dataplate)
5. Pump model number (found on dataplate)
6. Pump product code (found on dataplate)

Always include the serial number, model number, and product code in all correspondence regarding the unit.

4.2 Shipping Pumps for Repair

Pumps can not be accepted for repair without a Return Material Authorization. Pumps should be clearly labeled to indicate the liquid being pumped. Process liquid should be flushed from the pump liquid end and oil should be drained from the pump housing before the pump is shipped.

Federal law prohibits handling of equipment that is not accompanied by an OSHA Material Safety Data Sheet (MSDS). A completed MSDS must be packed in the shipping crate with any pump shipped for repair. These safety precautions will aid the troubleshooting and repair procedure and preclude serious injury to repair personnel from hazardous residue in pump liquid end. A Materials Safety Data Sheet must accompany all returns.

All inquiries or parts orders should be addressed to your local LMI Master Distributor.

4.3 Preventive Maintenance

LMI pumps are carefully designed, manufactured, assembled, and quality tested to give reliable service with minimal maintenance. However, a weekly maintenance check is recommended to visually confirm proper operation of the pump.

Drive

Initially, change gear drive oil after the first 250 hours of operation. Then change drive oil after every 4000 hours of operation or every six months, whichever comes first.

Diaphragm Assembly

The Series G diaphragm assembly should be replaced every 4000 hours of operation to avoid the possibility of failure. Refer to the instructions in the “Corrective Maintenance” section.

Oil Seal

The Series G oil seal should be replaced every 4000 hours of operation to avoid the possibility of failure. Oil seal replacement requires the removal of the diaphragm assembly, so it is recommended that the oil seal and diaphragm assembly be replaced at the same time. Refer to the instructions in the “Corrective Maintenance” section.

Check Valves

LMI recommends that check valve balls, seats, gaskets, and O-Rings be replaced on an annual basis. If highly corrosive material (acids, slurries, etc.) is being pumped, some applications may require more frequent replacement.

To determine if check valves need maintenance, disassemble the check valves following the instructions in the “Corrective Maintenance” section. Inspect the ball check and seat for chemical or physical damage. The ball should be perfectly round and free of pits, mars, or scratches. The seat should retain a sharp edge where the ball contacts for proper sealing. If the seat edge is worn or damaged, or has any pits, mars, or scratches, it should be replaced. If the ball and/or seat is excessively damaged, the replacement schedule should be shortened accordingly. If the ball and seat are both in good condition, the replacement schedule can be lengthened.

Complete instructions for replacing worn check valve parts are given in the “Corrective Maintenance” section.

4.4 Corrective Maintenance

Before carrying out any servicing operation on the metering unit or pipes, disconnect electrical power from the pump, and take the necessary steps to ensure that the harmful liquid they contain cannot escape or come into contact with personnel. Suitable protective equipment must be provided. Check that there is no pressure before proceeding with dismantling.

Cleaning Fouled Check Valves

Check valve assemblies are designed to be self cleaning and should seldom need servicing. Fouled check valves can usually be cleaned by pumping a solution of mild detergent and warm water (if compatible with liquid being pumped) for 15 minutes, followed by flushing with water.

Check Valve Replacement

Before beginning work on the valve assemblies, make sure the shut-off valves are closed and that pressure has been bled from the system. When replacing the valves, take care to systematically change their O-Rings and/or gaskets. Take care to properly assemble the valve assemblies; the ball must be placed on the sharp edge of the seat.

Check valves are supplied in two different configurations: plastic, and stainless steel. Be sure to refer to the appropriate instructional set below.

Be sure to follow instructions carefully and refer to the appropriate Figure when reassembling check valves. If check valve cartridges are installed incorrectly, one of the following will occur: (a) immediate severe damage to pump mechanism, (b) no pumping, (c) reverse pumping action (from discharge line into suction line).

Plastic Check Valves

Disassembly (Refer to Figure 9 or 11)

1. Unscrew the union nut (435). The union end (445) is held in place by the union nut and will separate easily from the other liquid end parts.
2. Unscrew the ball guide (424) from the liquid end.
3. Screw the union nut part way (one or two turns) onto the end of the ball guide that has the seat in it. Be sure the union nut is on loosely. This will allow a gap for the seat (420) to fall into as it is removed from the ball guide.
4. Sit the ball guide/union nut onto a flat surface with the union nut down. Looking into the top of the ball guide, you will see four large holes surrounding one small hole. Insert a thin, blunt instrument such as a hex head screwdriver into the small center hole until it rests on the top of the ball (422).
5. Tap screwdriver gently with a hammer until the ball and seat are released from the ball guide.

If you are disassembling unit for inspection only, be sure to use a blunt instrument and tap gently to avoid damaging the ball. If the ball and/or seat are damaged during disassembly, they will have to be replaced. If available, to avoid damage, it is advisable to use gentle air pressure (applied at end opposite the seat - 420) for ball and seat removal.

6. Carefully remove the two or three O-Rings (depending on liquid end style) from the ball guide and seat.
7. Carefully clean any parts to be reused. If any chemicals are used in the cleaning process, ensure that they are compatible with the process liquid.

Plastic Check Valves:

Reassembly

1. Fit new O-Rings into position on the ball guide and seat.

To assure a tight, leak free seal, new O-Rings should be used each time the check valves are disassembled.

2. Drop the ball into the curved inner chamber end of the ball guide.
3. Sit the ball guide on a flat surface so that the side with the ball faces upwards. Position seat on the ball guide, trapping the ball inside. When the seat is pressed into the ball guide, the beveled edge of the seat must be facing outward. The bevel should not face the inside of the check valve (refer to Figure 9 or 11). Use a flat surface such as a board to press the seat into the ball guide with firm, even pressure.

If the seat is improperly positioned, the ball will not create a tight seal and poor pumping performance will result.

4. Position the union end (445) onto the correct end of the ball guide. Refer to Figure 9 or 11, as the correct end is determined by whether the valve is intended for the suction or discharge port of the liquid end. Slip the union nut (435) over the union end and screw tightly (hand tight only) onto the ball guide.

The order of assembly of the suction and discharge check valves is different. Refer to Figure 9 or 11 for proper assembly order. If check valve cartridges are installed incorrectly, one of the following will occur: (a) immediate severe damage to pump mechanism, (b) no pumping, (c) reverse pumping action (from discharge line into suction line).

5. Screw the valve assembly into the liquid end body **(hand tight only)**. **DO NOT OVER TIGHTEN.**

B60 & B80 Liquid End Stainless Steel Check Valves

Disassembly (Refer to Figure 12)

1. Unscrew the three screws (441 & 442) and remove them and their three washers (439).
2. Remove the valve clamp (437).
3. The connection (435), seat (420), ball (422) and ball guide (424) should all now slip apart easily.
4. Remove and discard the three gaskets (419).
5. Carefully clean any parts to be reused. If any chemicals are used in the cleaning process, ensure that they are compatible with the process liquid.

B60 & B80 Liquid End Stainless Steel Check Valves

Reassembly

1. Drop the ball into the curved inner chamber end of the ball guide.
2. Place a new gasket on the rim of the ball guide, and sit the seat on top of the ball guide, trapping the ball and gasket between the seat and ball guide.

Do not reuse old gaskets (419). Even if ball and seat are not worn and do not need replacing, new gaskets must be used any time the check valves are disassembled.

3. Position the connection (435) onto the correct end of the ball guide with a gasket trapped between the two metal surfaces. Refer to Figure 12, as the correct end is determined by whether the valve is intended for the suction or discharge port of the liquid end.

The order of assembly of the suction and discharge check valves is different. Refer to Figure 12 for proper assembly order. If check valve cartridges are installed incorrectly, one of the following will occur: (a) immediate severe damage to pump mechanism, (b) no pumping, (c) reverse pumping action (from discharge line into suction line).

4. Position the check valve assembly onto the liquid end, trapping a gasket between the two metal surfaces. (Seat and pump head).
5. Slide the valve clamp (437) over the connection (435) and screw into the liquid end using the three screws (441,442) and their split washers (439). Since one screw (441) is shorter than the others, be sure that it is screwed into the appropriate hole.

B40 Liquid End Stainless Steel Check Valves:

Disassembly (Refer to Figure 10)

B40 stainless steel check valves differ from the plastic versions in that the ball seat is integral to the ball guide. The seats cannot easily be inspected for damage or wear. If you suspect that the check valve may be damaged or worn, replace the entire check valve assembly as per the instructions below.

1. Unscrew the coupling (445).
2. Unscrew the ball guide (424) from the liquid end.
3. Remove and discard the O-Rings (419).
4. Carefully clean any parts to be reused. If any chemicals are used in the cleaning process, ensure that they are compatible with the process liquid.

B40 Liquid End Stainless Steel Check Valves:

Reassembly

1. Screw the correct end of the check valve assembly into the liquid end (refer to Figure 10), trapping a new O-Ring between the liquid end and the check valve assembly.

To assure a tight, leak free seal, new O-Rings should be used each time the check valves are disassembled.

The order of assembly of the suction and discharge check valves is different. Refer to Figure 10 for proper assembly order. If check valve cartridges are installed incorrectly, one of the following will occur: (a) immediate severe damage to pump mechanism, (b) no pumping, (c) reverse pumping action (from discharge line into suction line).

2. Screw the coupling (445) onto the check valve assembly, trapping a new O-ring (419, 423) between the coupling and the check valve assembly.

Diaphragm Assembly Replacement

It is recommended that the oil seal and diaphragm assembly be replaced at the same time. The instructions given under "Replacing the Oil Seal" are complete instructions for replacing both the oil seal and the diaphragm assembly. If you plan to replace both, refer to the "Replacing the Oil Seal" instructions, and disregard the instructions below. These instructions are intended for use only if the diaphragm assembly is being replaced independent of the oil seal.

Before beginning diaphragm replacement, make sure that all shut-off valves are closed and all pressure is bled from the liquid end.

Disassembly (Refer to Figures 7 and 8)

1. Set the stroke adjusting knob to 100%.
2. Disconnect the suction and discharge piping.
3. Unscrew the six diaphragm head bolts.
4. Remove the diaphragm head assembly from the pump body.
5. Turn the motor fan by hand (remove the motor shroud if necessary) until the end of the diaphragm assembly (261) is fully forward, and unscrew the diaphragm assembly from the connecting rod (60).

Reassembly (Refer to Figures 7 and 8)

1. With the stroke adjusting knob at 100% and the diaphragm fully forward as in steps 1 and 5 above, screw the diaphragm assembly into the connecting rod until it reaches its natural mechanical stop.
2. Turn the motor fan by hand until the diaphragm rests properly on the diaphragm support (230). Reinstall the motor shroud if previously removed.
3. Fit the diaphragm head back into place on the pump body.
4. Torque the six diaphragm head bolts to 90 in-lb (10 Nm) in a crisscross pattern.

Replacing the Oil Seal

Before beginning oil seal replacement, make sure all shut-off valves are closed and all pressure has been bled from liquid end.

When replacing the oil seal, the diaphragm assembly must be removed first. For ease of service, it is recommended that the oil seal be replaced in conjunction with the diaphragm assembly. Therefore, the instructions below include the "Diaphragm Assembly Replacement" instructions, and can be used for both oil seal replacement and diaphragm assembly replacement.

Disassembly

Steps 2–6 below correspond to the five "Diaphragm Replacement — Disassembly" steps. (Refer to Figures 7 and 8).

1. Drain oil from the pump by unscrewing the drain plug (20) and O-Ring (19).
2. Set the stroke adjusting knob to 100%.
3. Disconnect the suction and discharge piping.
4. Unscrew the six diaphragm head bolts.
5. Remove the diaphragm head assembly from the pump body.
6. Turn the motor fan by hand (remove the shroud if necessary) until the end of the diaphragm assembly (261) is fully forward, and unscrew the diaphragm from the connecting rod (60).
7. Remove the diaphragm support ring (230).
8. Remove the retaining ring (220) from the connecting rod.
9. Slide the small oil seal clamp (210) off the connecting rod.
10. Remove the large oil seal clamp (80) by unscrewing the four slotted screws (90).
11. Pull the oil seal (70) off of the connecting rod.

Reassembly

Steps 5–8 below correspond to the four "Diaphragm Replacement — Disassembly" steps. (Refer to Figures 7, 8, and 13).

1. Install a new oil seal (70) onto the connecting rod.
2. Slide small oil seal clamp (210) onto the end of the connecting rod and secure in place with the retaining ring (220). A drive socket large enough to fit over the end of the connecting rod should be used to push the retaining ring until it snaps into place in the retaining ring groove in the connecting rod.
3. Secure the large oil seal clamp (80) over the oil seal with the four slotted screws (90).
4. Place the diaphragm support ring (230) into position making sure beveled side (for diaphragm support) is facing up (refer to Figure 8 if necessary). For B80 liquid ends, the support ring (230) has stepped diameters. Make sure that the larger diameter is installed into the metal adapter ring (225 in Figure 13).
5. With the stroke adjusting knob at 100% and the diaphragm fully forward as in steps 2 and 6 of disassembly instructions, screw the diaphragm assembly into the connecting rod until it reaches its natural mechanical stop.
6. Turn the motor fan by hand until the diaphragm rests properly on the diaphragm support ring (230). Reinstall the motor shroud if previously removed.
7. Fit the diaphragm head back into place on the pump body.
8. Torque the six diaphragm head bolts to 90 in-lb (10 Nm) in a crisscross pattern.
9. Add oil to pump, following directions given in "Initial Start-up" in Section 3.

5.0 Troubleshooting Guide

5.1 Symptoms & Remedies

Pump will not operate .....
- Low process liquid level in the tank. Add liquid.
- Worn or dirty check valves. Clean or replace.
- Blocked discharge line. Clear line.
- Frozen liquid. Thaw liquid throughout pumping system.
- Blown fuse. Replace fuse.
- Open thermal overload device in motor starter. Reset device.
- Broken wire. Locate and repair.
- Low voltage. Investigate and correct (wiring may be too light).
- Pump not primed. Allow suction line and pump head to fill with liquid before pumping against pressure. Refer to "Filling Pumping System" in Section 3.
- Capacity adjustment set at zero. Readjust capacity.

Insufficient delivery .....
- Incorrect capacity adjustment. Readjust capacity setting.
- Incorrect pump speed. Match line voltage and frequency to pump motor data plate.
- Starved suction. Increase piping size or suction head.
- Leaky suction piping. Repair piping.
- High suction lift. Rearrange equipment to decrease lift.
- Liquid near boiling. Cool liquid or increase suction head.
- Leaky safety valve in discharge line. Repair or replace safety valve.
- High liquid viscosity. Reduce viscosity (e.g., heat or dilute liquid).
- Worn or dirty check valve seats. Clean or replace.

Erratic delivery .....
- Leaky suction piping. Repair piping.
- Leaky safety valve. Repair or replace safety valve.
- Insufficient suction head. Raise suction tank level or pressurize tank.
- Liquid near boiling. Cool liquid or increase suction head.
- Worn or dirty check valves. Clean or replace.
- Clogged or dirty line strainer. Clean strainer.

Motor and pump body hot	• Normal operating temperature of both motor and pump body is frequently uncomfortable to the touch. However, neither should exceed 200° F (93° C). • Power supply does not match electrical requirement of motor. Insure proper matching of power supply and motor. • Pump is being operated at greater than rated performance. Reduce pressure or stroke speed. If this is not practical, contact service facility. • Pump improperly lubricated. Drain oil and refill with proper amount of recommended lubricant.
Pump still pumps even at zero capacity setting	• Misadjusted micrometer knob. Readjust capacity setting. • Insufficient discharge pressure. Correct condition (e.g., install a back pressure valve).
Gear noise	• Excessive backlash. Consult service facility. • Worn bearings. Consult service facility. • Wrong or insufficient lubricant. Replace or replenish lubricant.
Loud knock with each stroke	• Excessive gear set wear. Consult service facility. • Worn bearings. Consult service facility.
Noisy operation in liquid end	• Noise in check valves. Ball checks move up and down with some force. A distinct “clicking” noise is normal, especially in metal piping systems.

6.0 Parts

Basic Parts

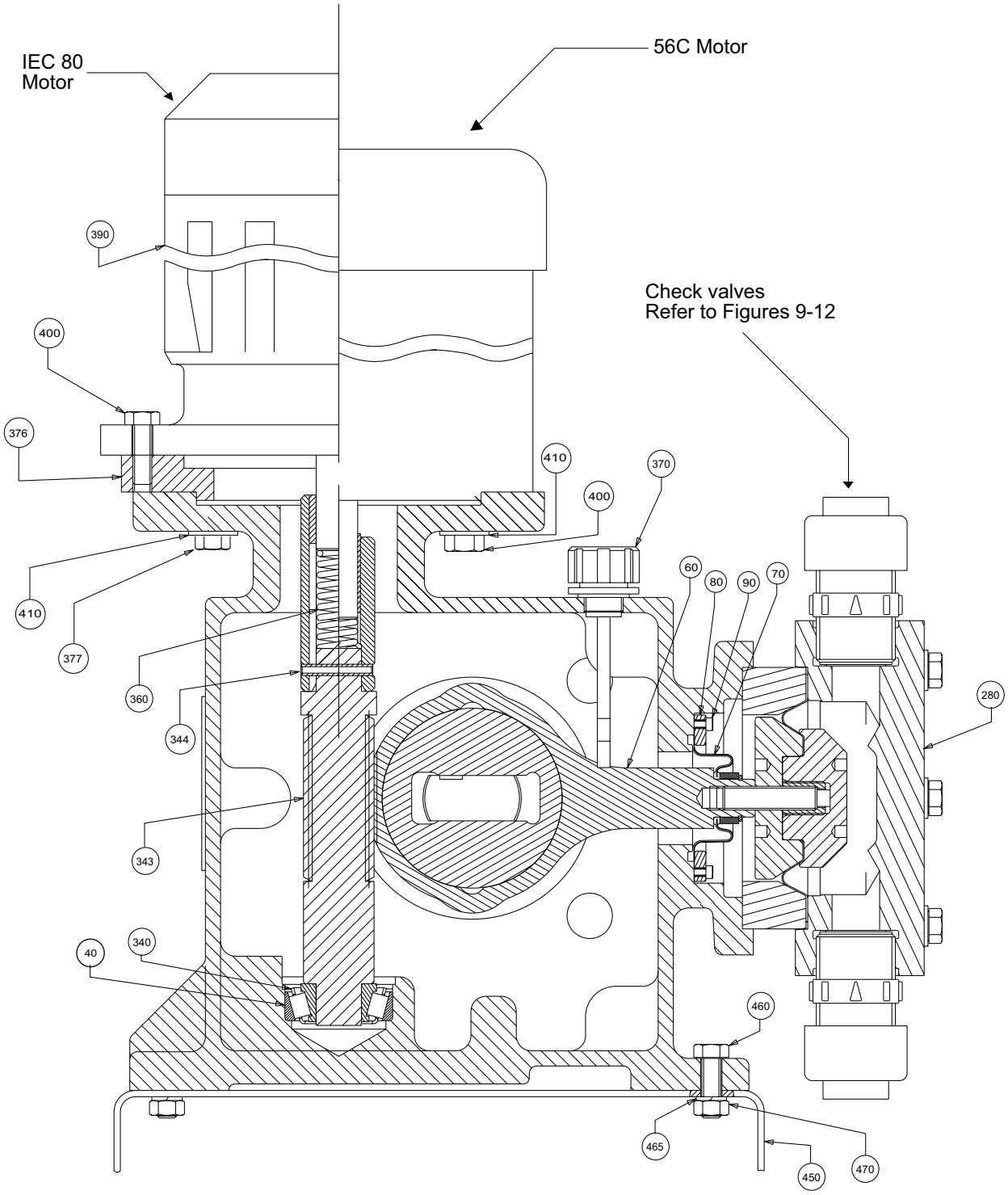

Figure 7: Series G Basic Parts — Side View

Basic Parts

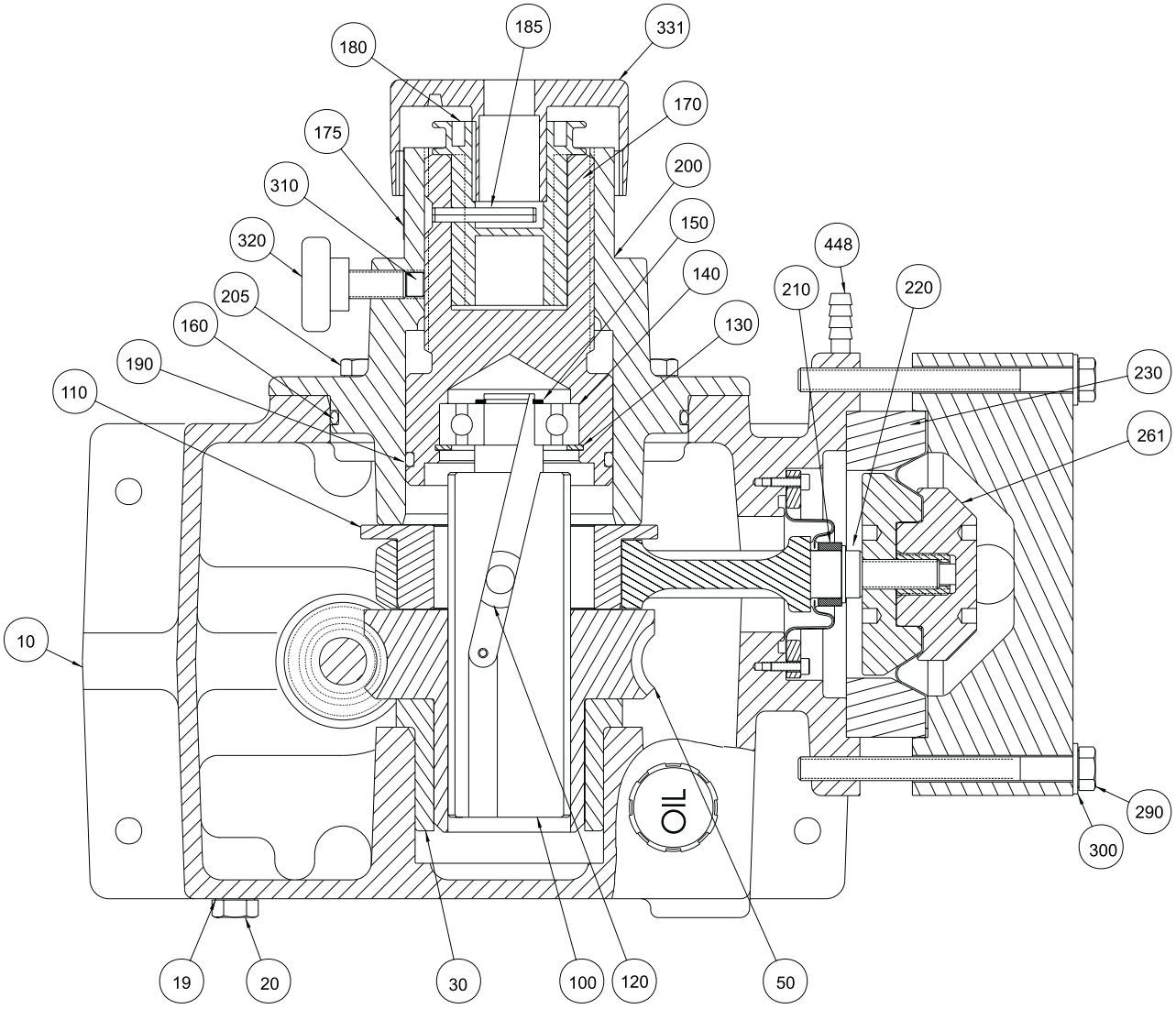

Figure 8: Series G Basic Parts — Top View

Check Valve Parts

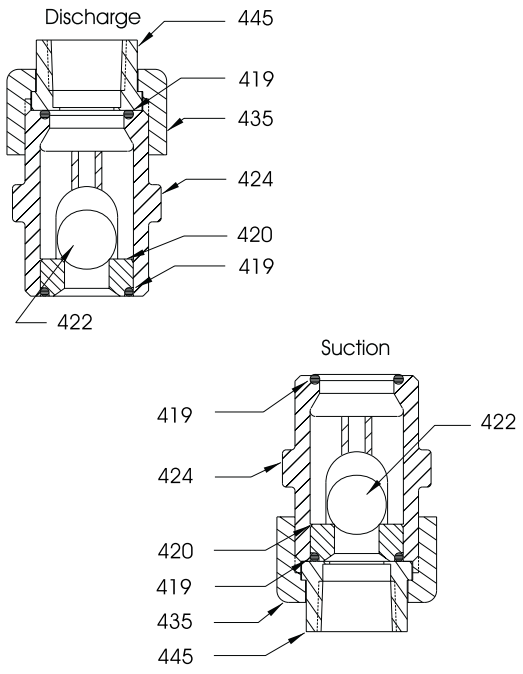

Figure 9: B40 Plastic Check Valve Parts

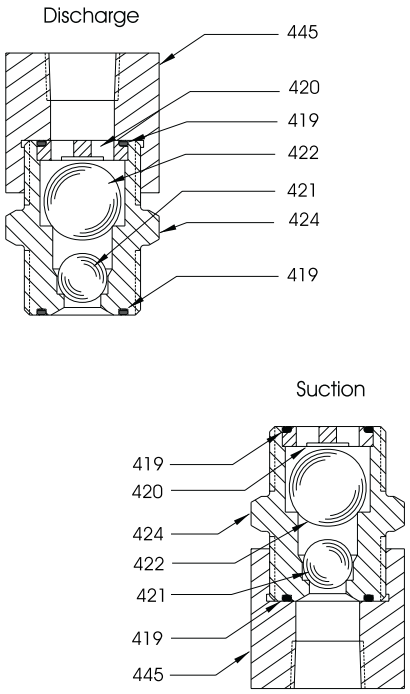

Figure 10: B40 Metallic Check Valve Parts

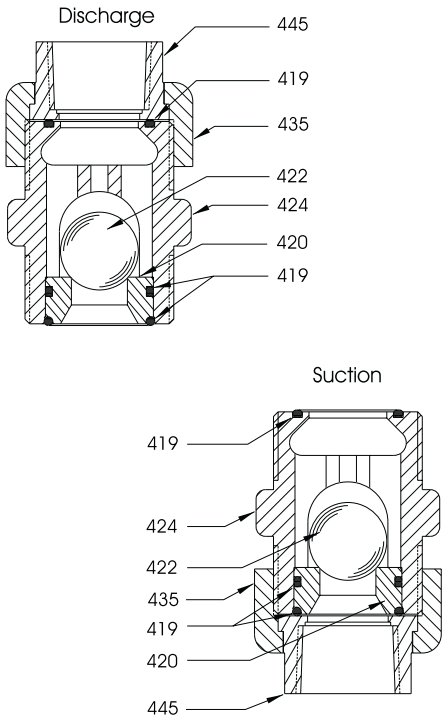

Figure 11: B60 & B80 Plastic Check Valve Parts

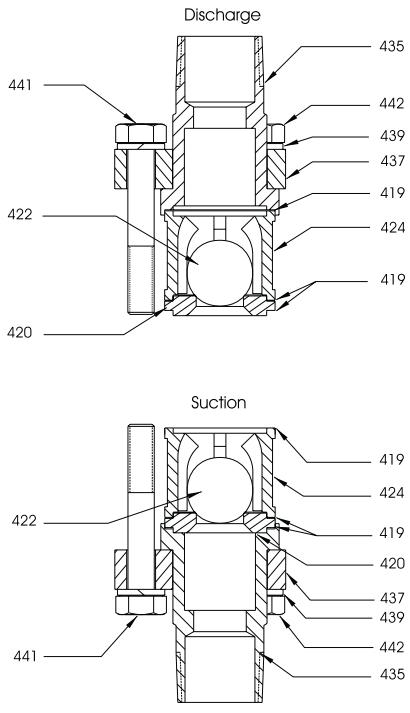

Figure 12: B60 & B80 Metallic Check Valve Parts

Basic Parts

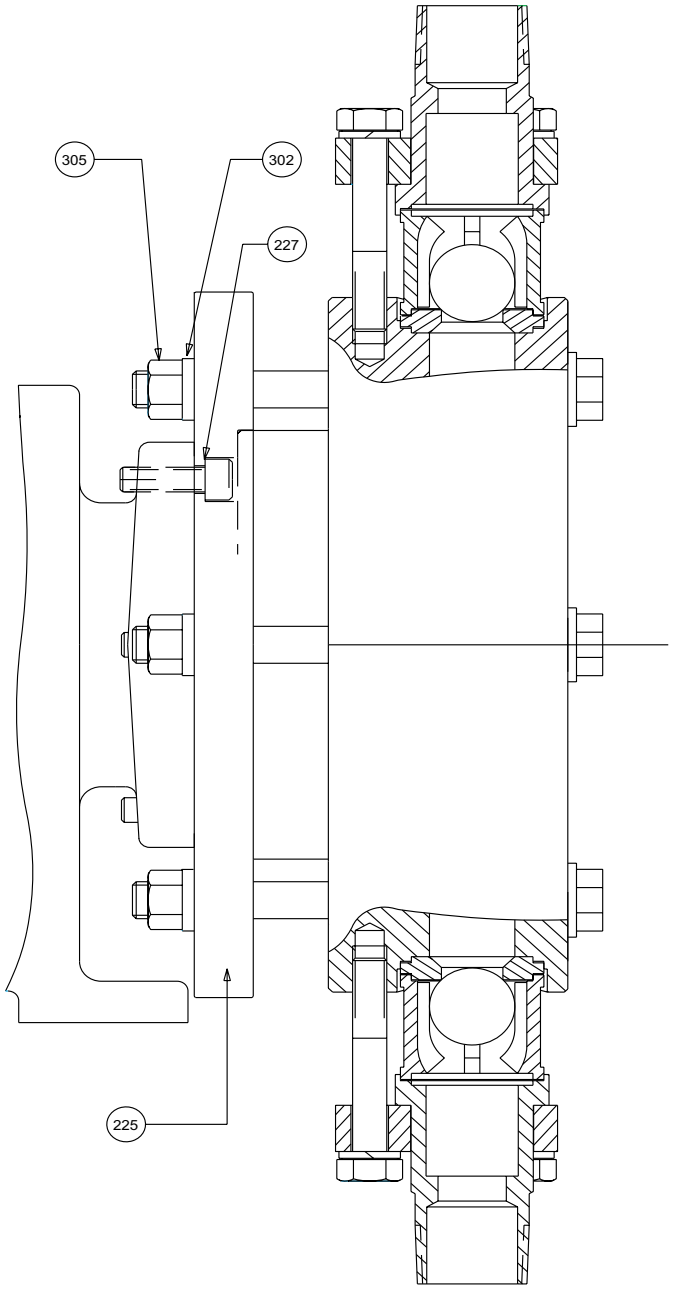

Figure 13: B80 Liquid End Adapter Parts

Basic Parts

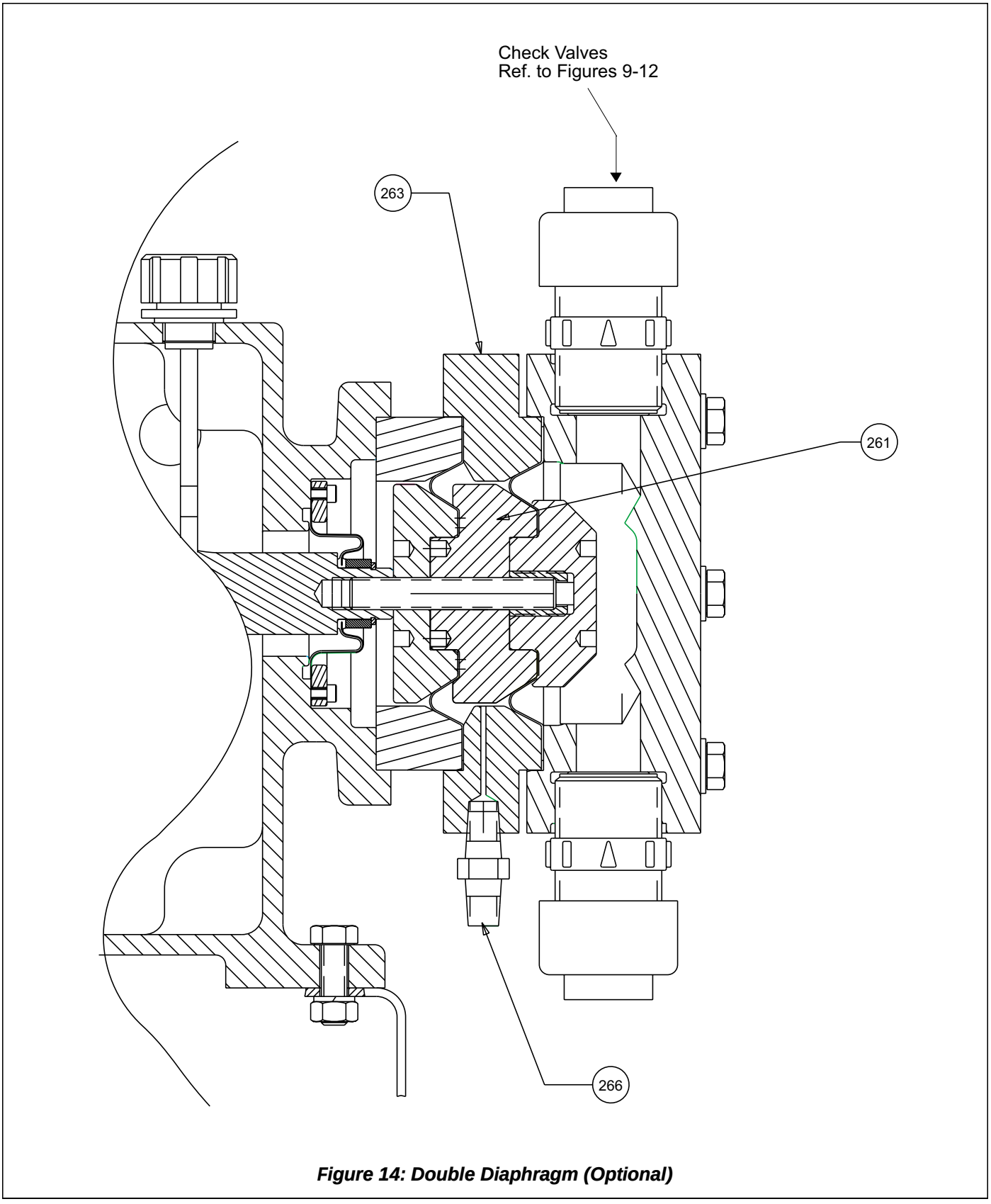

Figure 14: Double Diaphragm (Optional)

7.0 Parts Lists

7.1 **Basic Parts List** (Refer to Figure 7)

Drawing Location Reference	**Description**	**Material**	**Req.**	**Part Number**
280	Diaphragm Head (B40 Liquid End)	316 SS	1	021-0760-016
		PVC	1	60033
		Polypropylene	1	60032
		PVDF	1	60031
	Diaphragm Head (B60 Liquid End)	316 SS	1	021-0761-016
		PVC	1	60130
		Polypropylene	1	60069
		PVDF	1	60068
	Diaphragm Head (B80 Liquid End)	316 SS	1	60180
		PVC	1	60171
		Polypropylene	1	60164
		PVDF	1	60174
343 (See Note 1)	Worm Assembly (43 SPM, 56C)	—	1	60397
	Worm Assembly (36 SPM, IEC 80 Frame)	—	1	60224
	Worm Assembly (86 SPM, 56C)	—	1	60396
	Worm Assembly (72 SPM, IEC 80 Frame)	—	1	60223
	Worm Assembly (173 SPM, 56C)	—	1	60395
	Worm Assembly (144 SPM, IEC 80 Frame)	—	1	60222
	Worm (180 SPM, IEC 80 Frame)	—	1	60221
390	Motor (3/4 hp, 1 ph, 1800 rpm, 56C)	—	1	60153
	Motor (0.55 kw, 3 ph, 1500 rpm, IEC 80)	—	1	441-0021-522
	Motor (3/4 hp, 3 ph, 1800 rpm, 56C)	—	1	041-1200-6340
400	Hex Head Screw (3/8-16 x 1) (56C Motor)	—	4	040-5001-8119
	Hex Head Screw (M10 x 25 mm) (IEC 80 motor)	—	4	435-0001-732
410	Flat Washer (3/8) (56C motor)		4	040-4000-9012
	Flat washer (M10) (IEC 80 Motor)		4	434-0005-152
377	Hex Head Screw, M10x25 (IEC 80 motor)		4	435-0001-732
40	Bearing Cup	—	1	040-9011-6050
60	Connecting Rod	—	1	60654
70	Oil Seal	Buna N	1	60048
80	Oil Seal Clamp	Aluminum	1	60034
90	Slotted Pan Head Screw, M3x10	304 SS	4	60294
340	Bearing Cone	—	1	040-9011-6040
360 See Note 2	Spring (56C)	—	1	60264
	Spring (IEC 80)	—	1	60225
370	Vent with Dip Stick	—	1	70067
450	Base	—	1	60071
460	Hex Head Screw (M8 x 35 mm)	Steel	4	435-0035-542
465	Spring Lock Washer (8 mm)	—	4	434-0009-002
470	Hex Nut (M8)	—	4	435-0000-042
376	IEC 80 Motor Adapter Ring	—	1	60199
344	Spring Pin			040-1000-5101

Note 1: Worm assembly (343) includes worm, spring (360), and bearing cone (340)

Note 2: Part number for 56C motor spring (60264) applies to two-piece worm assembly: worm and motor coupling piece joined together by a spring pin (344). If worm is previous one-piece design (no spring pin), the correct 56C motor spring part number is 60059.

7.1 Basic Parts List - Continued (Refer to Figures 8 & 14)

Drawing Location Reference	Description	Material	Qty. Req.	Part Number
261	Diaphragm Assembly (B40 Liquid End)	316 SS	1	305-0976-120
		PVC	1	60150
		Polypropylene	1	305-0976-110
		PVDF	1	305-0976-130
	Diaphragm Assembly (B60 Liquid End)	316 SS	1	305-0976-320
		PVC	1	60151
		Polypropylene	1	305-0976-090
		PVDF	1	305-0976-230
	Diaphragm Assembly (B80 Liquid End)	316 SS	1	60228
		PVC	1	60226
		Polypropylene	1	60227
		PVDF	1	60229
	Double Diaphragm Assembly (B40 Liquid End) (Includes Items 263 and 266)	316 SS	1	60273
		PVC	1	60274
		Polypropylene	1	60275
		PVDF	1	60276
	Double Diaphragm Assembly (B60 Liquid End) (Includes Items 263 and 266)	316 SS	1	60277
		PVC	1	60278
		Polypropylene	1	60279
		PVDF	1	60280
	Double Diaphragm Assembly (B80 Liquid End) (Includes Items 263 and 266)	316 SS	1	60269
		PVC	1	60270
		Polypropylene	1	60271
		PVDF	1	60272
19	Drain Gasket	Buna N	1	040-8006-8031
290	Hex Head Screw (M8 x 90 mm) (B40 Liquid End)	304 SS	6	435-0035-655
	Hex Head Screw (M8 x 110 mm) (B60 Liquid End)	304 SS	6	435-0001-655
	Hex Head Screw (M12 x 130 mm) (B80 Liquid End)	304 SS	6	435-0036-035
	Hex Head Screw (M8 x 110 mm) (B40 Double Diaphragm)	304 SS	6	435-0001-655
	Hex Head Screw (M8 x 130 mm) (B60 Double Diaphragm)	304 SS	6	60206
	Hex Head Screw (M12 x 160 mm) (B80 Double Diaphragm)	304 SS	6	435-0036-065
300	Flat Washer (M8) (B40 and B60 Liquid End)	304 SS	6	434-0005-085
	Flat Washer (M12) (B80 Liquid End)	304 SS	6	434-0055-073
10	Drive Housing	—	1	60001
50	Gear (36/43 SPM)	—	1	60011
	Gear (72/86 SPM)	—	1	60009
	Gear (144/173 SPM)	—	1	60007
	Gear (180 SPM)	—	1	60050
20	Drain Plug (3/8-19 BPS)	—	1	60086
30	Thrust Flange Bearing	Bronze	1	60014
100	Sliding Crank	Steel	1	60002
110	Eccentric	Steel	1	60003
120	Shoe	Steel	1	60052
130	Retaining Ring	—	1	60064

7.1 **Basic Parts List - Continued** (refer to Figures 8, 13, and 14)

140	Single Row Bearing	—	1	60057
150	Retaining Ring	—	1	040-4010-7231
160	O-Ring (2-230)	Buna N	1	040-8009-5171
170	Stroke Adjustment Screw	—	1	60442
175	Stroke Scale	—	1	025-3004-6062
180	Stroke Adjustment Screw Insert	—	1	70011
185	Self Locking Spring Pin (3/16 x 1 3/8)	—	1	040-1002-1143
190	O-Ring (2-246)	Buna N	1	040-8009-5371
200	Cover	—	1	60443
205	Hex Head Screw (M8 x 16 mm)	—	4	435-0001-622
210	Oil Seal Clamp	Aluminum	1	60043
220	Retaining Ring	—	1	040-4013-3060
230	Diaphragm Support (B40 Liquid End)	—	1	60035
	Diaphragm Support (B60 Liquid End)	—	1	60070
	Diaphragm Support (B80 Liquid End)	—	1	60159
310	Ball 5/16	Nylon	1	60152
320	Stroke Locking Knob	—	1	60398
331	Stroke Adjusting Knob	—	1	60296
448	Tubing Connector (1/4)	—	1	402-0479-028
--	Gear Oil (AGMA 5 EP)-1 Quart can	—	3	407-0152-010
263	Intermediate Ring (Not sold seperately. See double diaphragm assembly 261).	PVC	1	
266	Hex Nipple 1/4 NPT connection (Included in double diaphragm assembly 261).	316SS	1	60208
305	M12 Hex Nut	304SS	6	4350000085
302	M12 Lockwasher	316SS	6	4340009095
227	Socket Head Screw, M8 x 25mm	Steel	6	4350003473
225	Adapter Ring	Aluminum	1	60165

7.2 Check Valve Parts List (refer to Figures 9 through 12)

Drawing Location Reference	Description	Liquid End Material	Qty. PUMP	Part Number	
				Liquid End	Liquid End
424	Ball Guide	316 SS	2	See Note 2	029-2005-2016
		PVC	2	003-0155-071	003-0106-071
		Polypropylene	2	003-0155-070	003-0106-070
		PVDF	2	003-0155-078	003-0106-078
425	Check Valve Assembly (See Note 1)	316 SS	2	305-0876-602	305-0583-022
		PVC	2	305-0870-007	305-0629-007
		Polypropylene	2	305-0870-009	305-0629-009
		PVDF	2	305-0870-008	305-0629-008
435	Union Nut	PP,PVC,PVDF	2	432-0236-038	432-0236-058
	Connection (1" NPT Male)	316 SS	2	—	045-0128-116
	Connection (1" BSP Male)	316 SS	2	—	045-0128-016
437	Valve Clamp, Steel	All	2	—	004-0215-010
439	Split Washer (M10) 304 SS	All	6	—	434-0009-015
441	Hex Head Screw (M10 x 65 mm) 304 SS	All	2	—	435-0035-765
442	Hex Head Screw (M10 x 75 mm) 304 SS	All	4	—	435-0035-785
445	Union End (½" NPT Female)	PP, PVC	2	60117	—
	Union End (1" NPT)	PP, PVC	2	—	60132
	Union End (Metric Socket 15 x 20)	PP, PVC	2	432-0350-028	—
	Union End (Metric Socket 25 x 32)	PP, PVC	2	—	432-0350-008
	Union End (½" NPT)	PVDF	2	60119	—
	Union End (½" BSP)	PVDF	2	60146	—
	Union End (1" NPT)	PVDF	2	—	60133
	Union End (1" BSP)	PVDF	2	—	60147
	Coupling (1" BSP x ½" NPT)	316 SS	2	60135	—
	Coupling (1" BSP x ½" BSP)	316 SS	2	045-0420-016	—
420	Seat Not sold seperately, obtainable through purchase of seat,ball set (423).				
423	Seat, Seal, Ball -- Set	316SS	2	See note 2	305-0436-322
		Polypropylene	2	305-0879-500	305-0629-500
		PVC	2	305- 0879-500	305-0629-500
		PVDF	2	305-0879-700	305-0629-700
422	Ball Not sold seperately, obtainable through purchase of seat,seal,ball set (423).				
419	Seal (See note 3) Not sold seperately. obtainable through purchase of seat,seal,ball set (423).				

Note 1: Item 425 (Check Valve Assembly) Consists of Items 424 (Ball Guide), 420 (Seat), 422 (Ball), and 419 (Seal)

Note 2: B40 stainless check valve does not contain a removable ball seat (seat is integral to ball guide). Ball guide, ball and seal are not sold seperately. Replacement requires purchase of the complete check valve assembly (part # 305-0876-602).

Note 3: Seal is a PTFE gasket for the B60 and B80 stainless steel check valves. For all others, the seal is an O-Ring.

8.0 Statement of Limited Warranty

LMI TERMS AND CONDITIONS OF SALE:

1. Seller warrants that the equipment delivered by it to the Buyer is in accordance with the Seller's published specifications and is of the kind and of the description contained in seller's invoice.

THIS WARRANTY IS IN LIEU OF AND TO THE EXCEPTION OF ALL OTHER WARRANTIES, EXPRESS OR IMPLIED, INCLUDING BUT NOT BY WAY OF LIMITATION, WARRANTIES OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE. DISTRIBUTOR IS NOT AUTHORIZED TO BIND THE COMPANY FOR ANY OTHER WARRANTY. THE FOREGOING STATES THE COMPANY'S ENTIRE AND EXCLUSIVE LIABILITY, AND DISTRIBUTOR AGREES TO HOLD THE COMPANY HARMLESS FROM AN IMPROPER APPLICATION OF PRODUCTS.

2. Seller's liability for breach of the foregoing warranty is expressly limited to the repair or, at Seller's option, replacement of such equipment FOB factory, or Acton, MA. Such obligation to repair or replace such equipment shall terminate 24 months after the delivery to such equipment to the Buyer. In no event shall the Seller be liable for any consequential damages resulting from any breach of warranty.

The Company warrants the Products in accordance with the statement of warranty policy included herein except that pump Product series designated as "A," "B," "C," "E," "G" and "P" and Liquitron™ series of product shall be warranted for a period of two (2) years from the date of delivery from Company; and except replacement elastomeric expendable parts and probes which are not covered by any warranty either express or implied.

If the Buyer claims that the warranty contained herein has been breached, it shall immediately notify the Seller of such claimed breach in writing at Seller's address contained herein. The Buyer shall render necessary assistance to Seller, and it shall furnish adequate means for operating and testing such equipment.

The SOLE PURPOSE of the foregoing stipulated exclusive remedy shall be to provide to the Buyer free repair or at Seller's option replacement of non-conforming equipment in the manner provided herein. This EXCLUSIVE REMEDY shall not be deemed to have failed of its essential purpose so long as the Seller is willing and able to repair or at its option replace non-conforming equipment in the prescribed manner.

3. Seller shall not be liable for any loss or damage for delays in delivery or compliance with any warranty provision contained herein due to acts of God, acts of civil or military authorities, fires, floods, wars, riots, labor strikes or actions, accidents or delays in transportation or any other cause beyond the Seller's control.

4. All Shipments by Company to Distributor shall be made F.O.B. Factory, Ivyland, Pennsylvania 18974, U.S.A. unless special arrangements are agreed to by both Company and Distributor.

5. The within terms and conditions constitute the entire agreement of the Buyer and Seller. Such terms and conditions may not be modified, altered or amended except by a writing signed by both parties. Such terms and conditions shall be binding upon the parties hereto, their successors and assigns. In the event that any term or condition shall be held to be invalid or unenforceable, all other terms shall remain in full force and effect. Such terms and conditions shall be governed and construed in accordance with the laws of the Commonwealth of Massachusetts.

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