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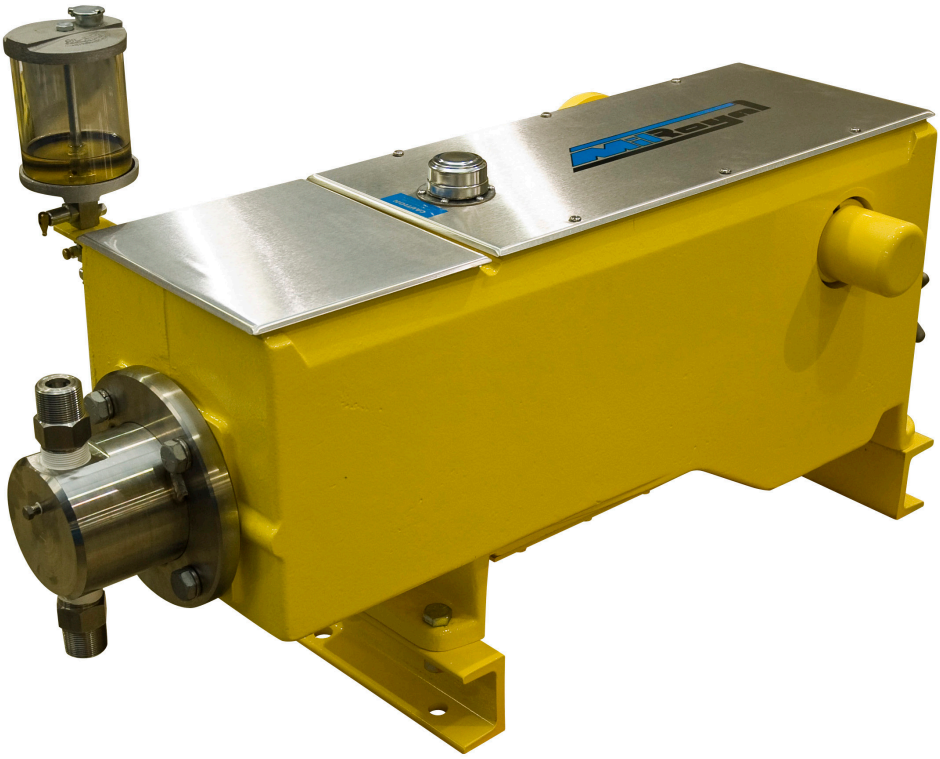

MILROYAL® C Packed Plunger Liquid End IOM Manual

Manual No : 54270
Rev. : 00
Rev. Date : 01/2016

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PRECAUTIONS

The following precautions should be taken when working with metering pumps.
Please read this section carefully prior to installation.

Protective Clothing

ALWAYS wear protective clothing, face shield, safety glasses and gloves when working on or near your metering pump. Additional precautions should be taken depending on the solution being pumped. Refer to **Safety Data Sheets** (SDS) for the solution being pumped.

Hearing Protection

It is recommended that hearing protection be used if the pump is in an environment where the time weighted average sound level (TWA) of 85 dbA is exceeded (As measured on the A scale - slow response).

Electrical Safety

- Remove power and ensure that it remains OFF while maintaining pump.
- **DO NOT FORGET TO CONNECT THE PUMP TO EARTH**.
- Electric protection of the motor (Thermal protection or by means of fuses) is to correspond to the rated current indicated on the motor data plate.

Liquid Compatibility

Verify if the materials of construction of the wetted components of your pump are recommended for the solution (chemical) to be pumped.

Pumps Water "Primed"

All pumps are tested with water at the factory. If your process solution is not approved with water, flush the **Pump Head Assembly** with an appropriate solution before introducing the process solution.

Plumbing and Electrical Connections

Always adhere to your local plumbing and electrical codes.

Line Depressurization

To reduce the risk of chemical contact during disassembly or maintenance, the suction and discharge lines should be depressurized before servicing.

Over Pressure Protection

To ensure safe operation of the system it is recommended that some type of safety / pressure-relief valve be installed to protect the piping and other system components from damage due to over-pressure.

Lifting

This manual should be used as a guide only - Follow your company's recommended lifting procedures. It is not intended to replace or take precedence over recommendations, policies and procedures judged as safe due to the local environment than what is contained herein. Use lifting equipment that is rated for the weight of the equipment to be lifted.

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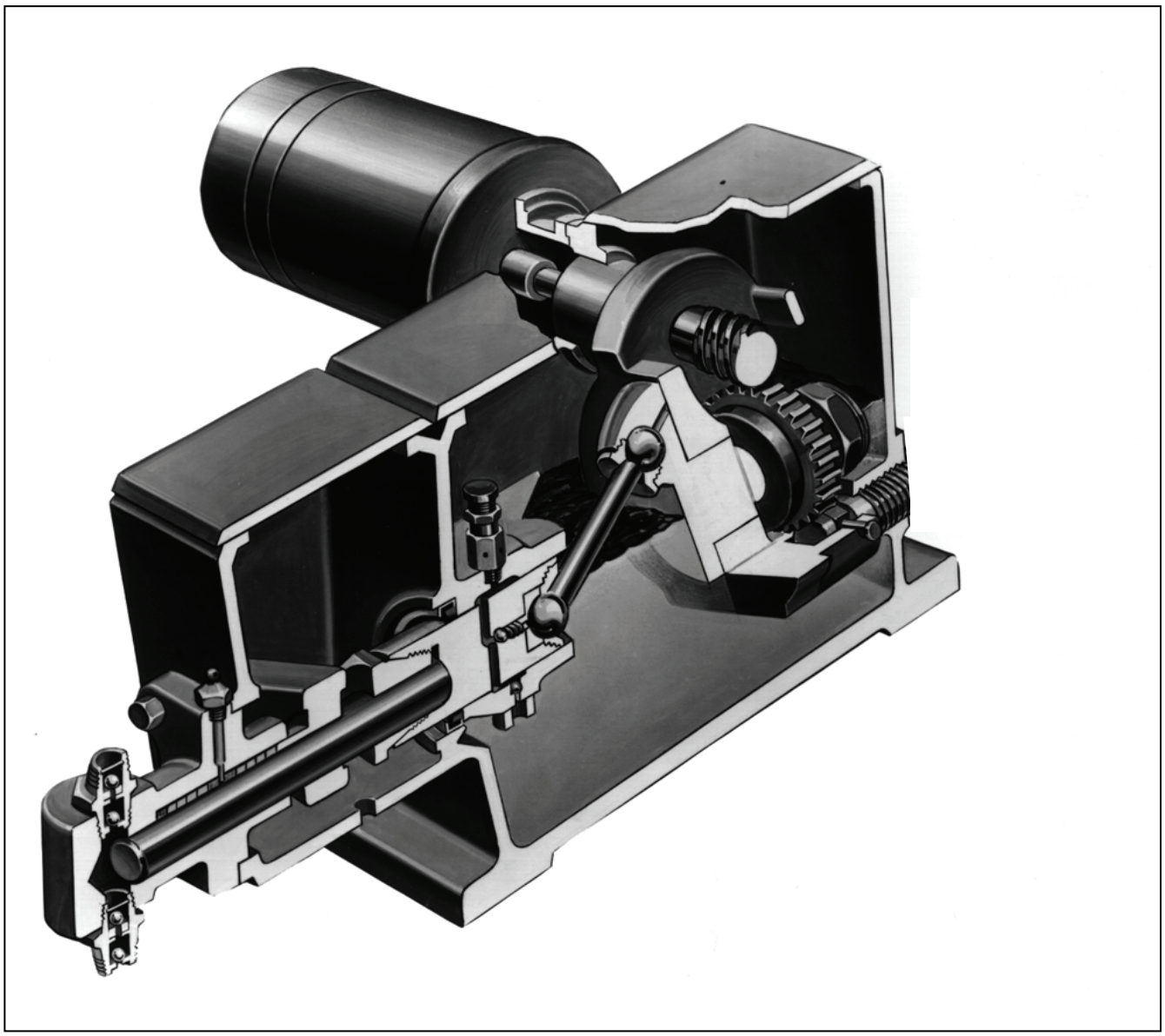


Figure 1. MILROYAL® C Metering Pump

1.1 INTRODUCTION

The MILROYAL® C is a reciprocating positive-displacement controlled-volume pump designed to move specific volumes of liquid against a positive pressure differential between the pump suction and the pump discharge. The delivered volume is controllable within one percent of setting.

The pump consists of three major components: (1) a drive unit, (2) a reciprocating plunger, and (3) a liquid end. This manual will concentrate on the various packed plunger liquid ends. Pump delivery is a function of drive speed, plunger stroke length, and plunger diameter. In addition, delivered volume for a given pump can be varied by mechanical (micrometer hand knob) or (optional) electrical or pneumatic adjustment of plunger stroke length. Pump drives may also be fitted with HPD (High Performance Diaphragm, Manual 54146) as well as several styles of packed plunger liquid ends.

1.2 PRINCIPLE OF OPERATION

The drive unit moves the pump plunger to draw liquid into the liquid end on the suction stroke and to expel the liquid on the subsequent discharge stroke. In packed plunger liquid ends, the plunger contacts the process liquid, therefore a packing lubricant may be necessary depending on the fluid being pumped. Accurate flow control is achievable only if the discharge line pressure (discharge head) is greater than the suction line pressure (suction head). For aid in determining acceptable piping performance, please refer to Milton Roy's NPSH calculator, available on line at www.miltonroy.com.

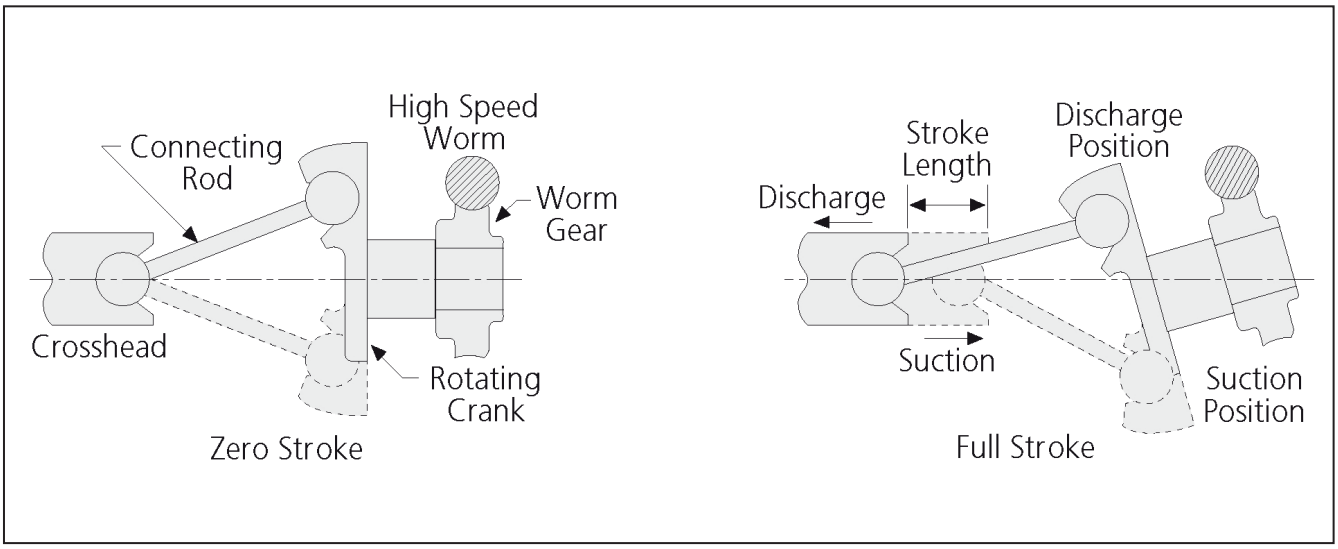


Figure 2. Capacity Adjustment

As the plunger reciprocates in the liquid end, the pumped liquid is alternately drawn into and discharged from the liquid end. Each suction (rearward) stroke of the pump plunger creates a negative pressure in the displacement chamber. The pressure of the liquid in the suction line unseats the suction ball-checks and liquid flows into the displacement chamber. On the discharge stroke, the plunger moves forward and pressurizes the liquid which unseats the discharge ball-checks to flow out the discharge port. On each suction stroke, the discharge ball-checks are seated, and on each discharge stroke, the suction ball-checks are seated (pressure in pump head is greater than suction line pressure). This mode of operation prevents back flow and ensures liquid movement from the suction port, through the liquid end, and out the discharge port.

In packed plunger liquid ends, the plunger contacts the process liquid, while diaphragm liquid ends isolate the process liquid from the pump plunger. In the latter designs, the plunger displaces hydraulic fluid which moves a diaphragm in contact with the process liquid, forcing the process liquid through the liquid end. Liquid ends are covered in separate instruction manuals.

1.3 OPTIONS

MILROYAL® C pumps manufactured during and after 1995 were given a new model code which completely defines the material and options selected. Detailed specifications for this pump are listed on the pump order acknowledgment. Compare the model code on the pump nameplate with the Model Code on page 4 to determine the pump's features.

1.4 SAFETY PRECAUTIONS

When installing, operating, and maintaining the MILROYAL® C keep safety considerations foremost. Use proper tools, protective clothing, and eye protection when working on the equipment. 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., corrosive, toxins, solvents, acids, caustics, flammables etc.).

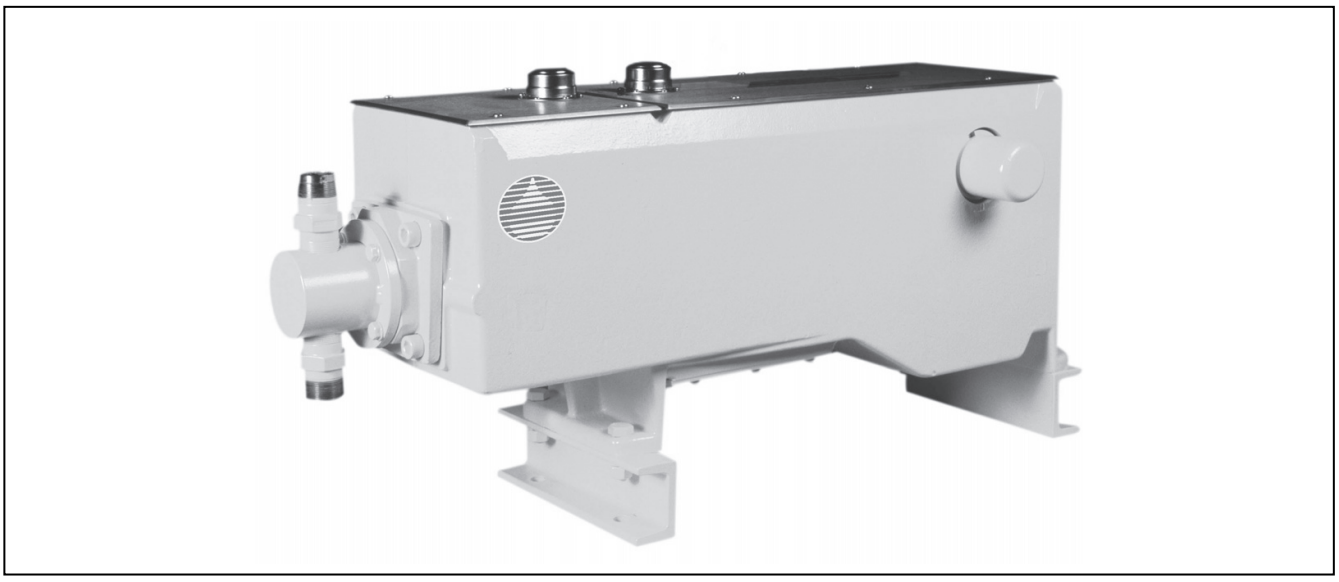
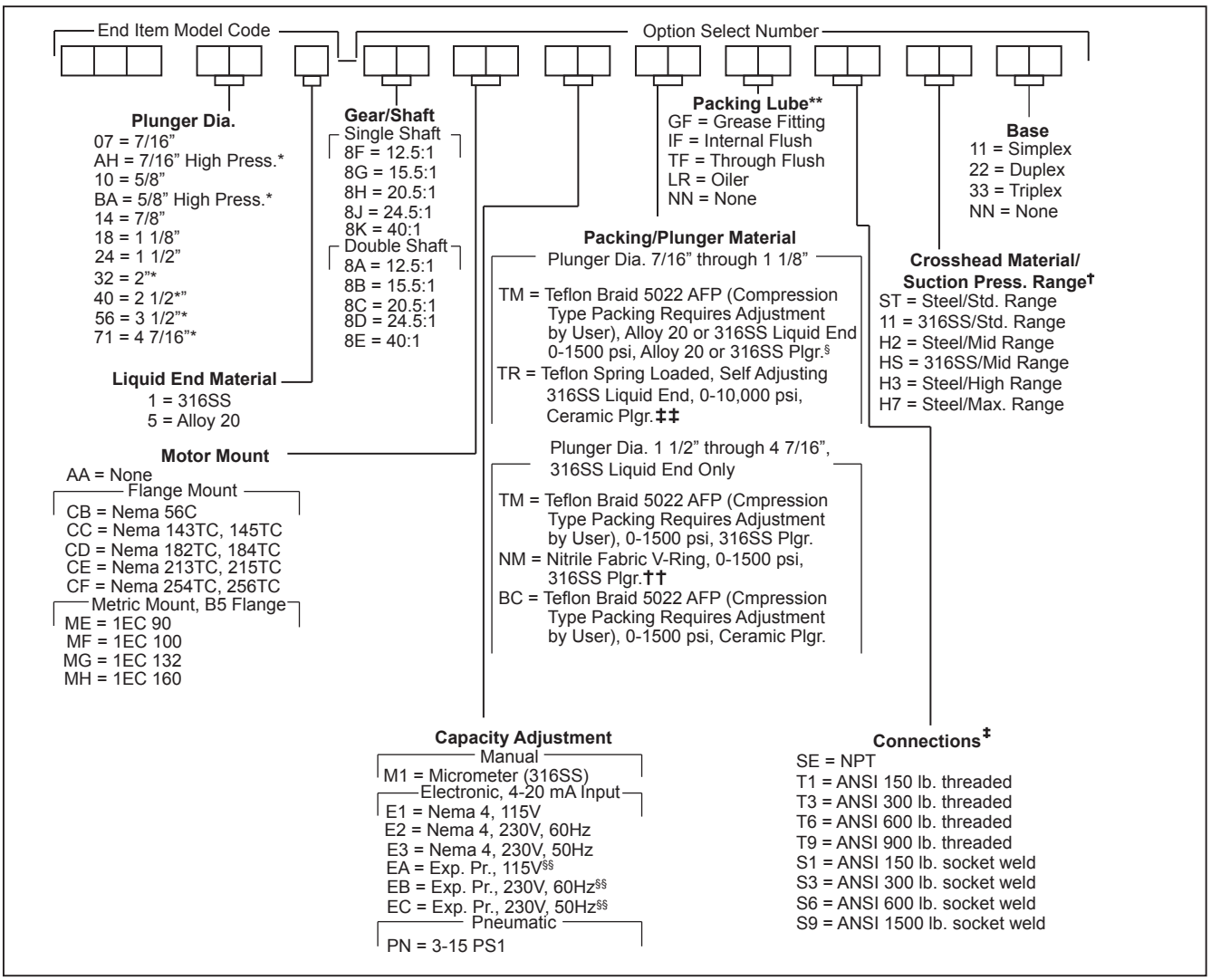


Figure 3. Packed Plunger Pump

PACKED PLUNGER LIQUID END MODEL CODE



NOTE:

* *Plunger diameter codes AH and BA are available in 316SS only and are for applications requiring pressures over 5000 psi.*

† *Refer to suction pressure table (PD3661 MILROYAL® Brochure) for suction pressure vs. range.*

‡ *Flange sizes equal the NPT connections size as noted on the liquid end drawing.*

§ *The plunger material will automatically match the liquid end material when selecting packing/plunger material code TM.*

** *Select packing lube GF with packing codes TM & NM. Contact Applications Engineering for other packing lube selection.*

†† *Packing code NM is a standard option for 316SS liquid ends with plunger diameters of 1 1/8" and larger.*

‡‡ *Packing/plunger code TR is offered on 316SS liquid ends with 5/8" or 7/16" high pressure plunger diameters.*

§§ *Explosion proof electronic actuators are certified by Factory Mutual for Class I, Division I, Groups B, C, & D; Class II, Division I, Groups E, F, & G & NEMA 4X.*

CE 0891 Ex II 2 G D FM APPROVED NRTL LISTED MET c us

SECTION 2 - INSTALLATION

2.1 UNPACKING / INSPECTION

Pumps are shipped Free on Board (FOB) factory or representative 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 crate upon receipt from the carrier to be sure there is no obvious damage to the contents. Open the crate carefully so accessory items fastened to the inside of the crate will not be damaged or lost. Examine all material inside the crate and check against the packing list to be sure that all items are accounted for and intact.

2.2 STORAGE

2.2.1 Short Term 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.

2.2.2 Long Term Storage (Longer than 6 Months)

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 gases, so it is necessary to protect internal and external surfaces from their effects to the greatest extent possible.

When the instructions given in this section are completed, the equipment is to be stored in a shelter; 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.

If equipment is to be shipped directly from Milton Roy into long term storage, contact Milton Roy to arrange for factory preparation.

2.2.3 Pump Drives and Gearboxes

Flood the gearbox compartments with a high grade Lubricating Oil/Rust Preventative such as Mobil Oil Corporation product “Mobilarma 524”. Fill the compartment(s) completely to minimize air space and water vapor condensation. After storage, drain this material and refill the equipment with the recommended running fluids and lubricants for equipment commissioning.

Remove drive motors and mounting adapters, and brush all unpainted metal surfaces with multipurpose grease (NLGI grade 2 or 3). Store these unattached.

2.2.4 Pump Liquid Ends

Flood the front compartment of the pump housing (if the model has a front compartment) with a high grade Lubricating Oil/Rust Preventative such as Mobil Oil Corporation product “Mobilarma 524”.

1. If the pump has a diaphragm style liquid end, fill the pump-housing compartment all the way to minimize airspace and water vapor condensation.
2. If the pump has a packed plunger style liquid end, holes in the chamber for gland tightening bolts will leak the oil, so fill the chamber only to the bolt centerline. Brush the remaining exposed metal parts thoroughly with general purpose grease (NLGI grade 2 or 3).

3. Most of the liquid ends themselves are constructed of inherently corrosion resistant materials and require no applied corrosion inhibitor. If they are NOT naturally resistant (test the threaded or flanged inlet and outlet connections - if they have little or no magnetic property, they are resistant) they should be flush filled with a corrosion inhibiting and non-freezing liquid which is compatible with the final pumped process chemical. Flush and fill with inhibitors such as “Mobilarma 524” or with a commercial automotive antifreeze coolant. The pump head contains one way check valves, so flush in a direction into the suction (bottom) connection, and out the discharge (top) connection.

Cap or plug all openings to capture the inhibiting fluid, and to prevent animals and insects from building nests.

2.2.5 Pneumatic, Electrical and Electronic Equipment

Motors should be prepared in the manner prescribed by their manufacturer. If information is not available, dismount and store motors as indicated in paragraph below.

For all pneumatic and electrical equipment, place packets of Vapor Phase Corrosion Inhibitor (VPCI) inside of the enclosure, then place the entire enclosure, with additional packets, inside a plastic bag, and seal the bag tightly closed. Contact Milton Roy Service Department for recommended VPCI materials.

2.3 SAFETY PRECAUTIONS

⚠ WARNING **WHEN INSTALLING, OPERATING, AND MAINTAINING THE MILROYAL® C, 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.).**

⚠ CAUTION **THE PERSONNEL RESPONSIBLE FOR INSTALLATION, OPERATION AND MAINTENANCE OF THIS EQUIPMENT MUST BECOME FULLY ACQUAINTED WITH THE CONTENTS OF THIS MANUAL.**

2.4 PUMP MOUNTING / LOCATION

Refer to the “DRIVE” manual, 53939. Support the pump firmly in a level position (shim if necessary) on a solid, vibration-free foundation, preferably with the base above floor level to protect if from washdowns and to provide easier access for service. The pump features mounting holes to accommodate anchor bolts.

Some MILROYAL® pumps are shipped with motors dismounted. After anchoring pump drive in position, install motor.

2.5 PIPING

2.5.1 General

Never connect rigid pipe to plastic liquid ends; rather, use flexible connections to both suction and discharge.

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.

Size piping to accommodate peak instantaneous flow. Because of the reciprocating motion of the pump plunger, 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 requires piping sufficient for 99 gph (33.1 L/hr.) X 3.14 or 276 gph (1044.7 L/hr.).

To minimize viscous flow losses, pipe viscous liquids with line up to four sizes larger than the pump port.

Remove burrs, sharp edges, and debris from inside piping. Blow out all pipe lines before making final connections to pump.

Provide for pipe expansion when hot liquids are to be pumped. Support piping so that pipe weight is not placed on the pump. Never spring piping to make connections.

Piping should be sloped to prevent vapor pockets, because vapor in the liquid end will cause inaccurate pump delivery.

When pumping suspended solids (such as slurries), install plugged crosses at all 90-degree line turns to permit line cleaning without dismantling piping.

2.5.2 Suction Piping

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 a hold-up tower or supply vessel on the suction line close to the pump can help ensure a flooded suction line. (Consult Milton Roy, Flow Control Division for assistance in such applications).

Avoid negative suction pressure conditions (suction lift), as such conditions adversely affect metering accuracy. If such conditions are unavoidable, contact Milton Roy Flow Control Division for recommendations.

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.

When suction piping is long, and particularly at stroke speeds above 70 strokes per minute (spm), piping size should be larger than the liquid end suction fitting to prevent pump starvation.

If long suction lines are unavoidable, install a float box (See *Figure 4*) or auxiliary feed tank (stand pipe) near the suction side of the pump. The float box may be calibrated and used to check pump capacity by measuring the time required for pumping a specific quantity of liquid from the box. In many cases, installing an accumulator or pulsation dampener at the pump suction connection will promote flooded suction even when the suction line is long. Consult Milton Roy Flow Control Division for details.

Suction piping must be absolutely airtight to ensure accurate pumping. After installation, test suction piping for leaks with air and soap solution.

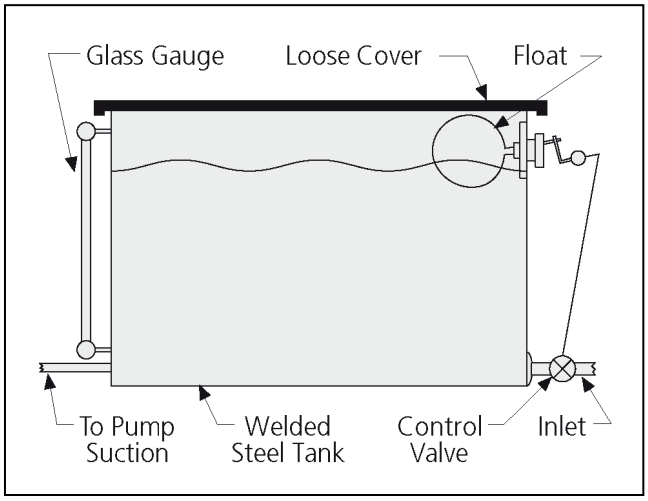


Figure 4. Float Box

2.5.3 Discharge Piping

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 maximum pressure rating shown on the pump nameplate.

The pump will not deliver a controlled flow unless the discharge line pressure is greater than the suction line pressure. Piping should be arranged to provide at least 5 psi positive pressure differential between the discharge side and the suction side. There are a number of ways to create an artificial discharge pressure, such as by installing a vented riser or a back pressure valve. (Please consult Milton Roy Flow Control Division for recommendations to increase back pressure in slurry applications.)

When pumping water-treating 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.

2.6 VENTED RISERS

A vented riser (*Figure 5*) is simply a vertical extension of the discharge pipe into an open tee. The other side of the tee goes to the process. Practically maintenance-free, this device prevents siphoning and reduces pulsations; however, a clogged or closed line may cause the riser to overflow. Therefore, substitute a pulsation dampener and back pressure valve for a vented riser when pumping hazardous liquids.

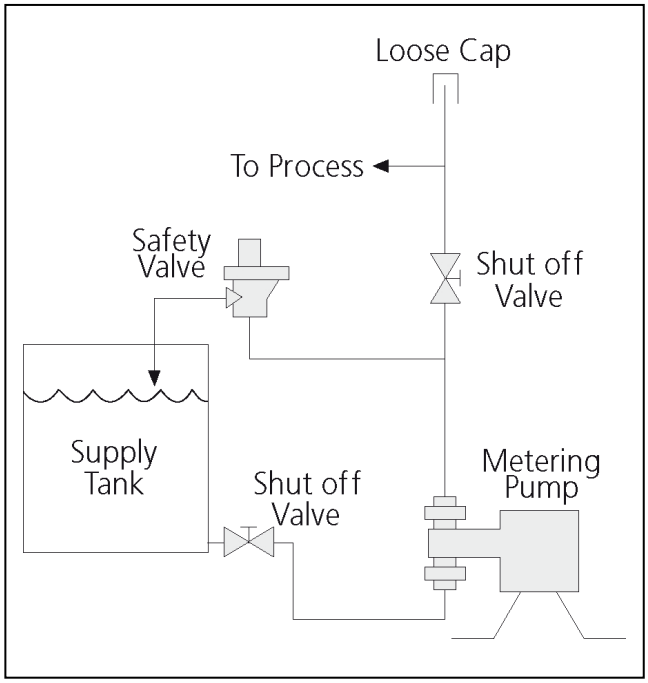


Figure 5. Vented Riser

2.7 PULSATION DAMPENERS

(Accumulators, Surge Chambers etc.)

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 performance and may reduce system costs dramatically by permitting the substitution of smaller piping. Please contact Milton Roy for further information on pulsation dampeners.

2.8 BACK PRESSURE VALVES

A Milton Roy 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).

2.9 SAFETY VALVES

Motor-driven positive displacement pumps can develop tremendous 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 a Milton Roy 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.

2.10 CHECK VALVES (*Figure 6*)

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).

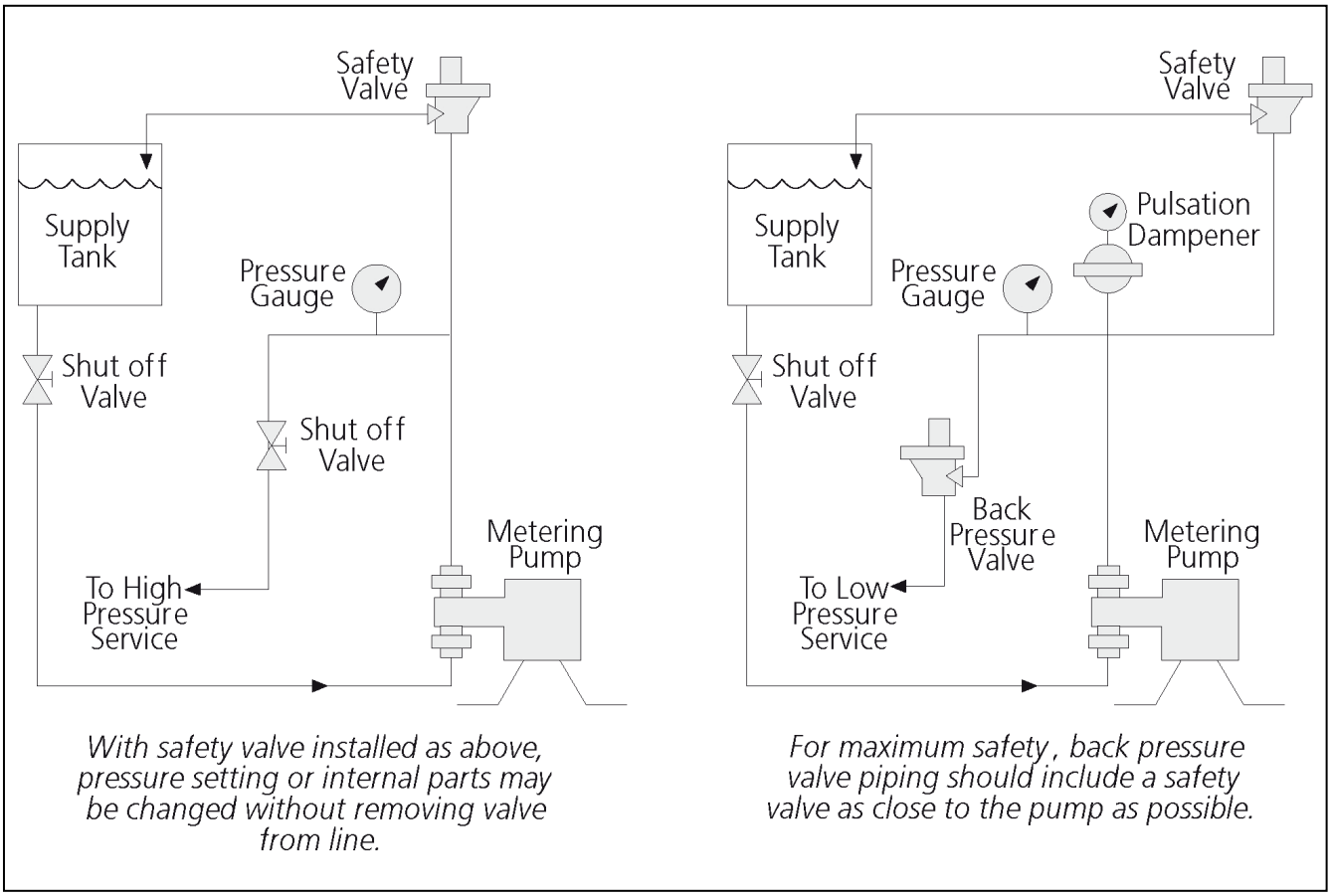


Figure 6. Recommended Valve Locations

2.11 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 6* shows recommended valve locations.

2.12 SERVICE CONNECTIONS

2.12.1 Pump Drive

Check the nameplate data on the pump drive motor and insure proper power supply is available before making any connections.

The preferred motor shaft rotation is shown by an arrow on the drive side flange of the pump. If necessary, motor can be run in the opposite direction, but connecting rod set screws (405-A) should be first checked for tightness. This added precaution will ensure that reversed directional stresses do not loosen the tension bearings. To reverse motor rotation, reverse motor lead connections.

For drives other than constant speed electric motors, refer to manufacturer's instructions and service information included with pump.

2.12.2 Stuffing Box

The stuffing box is designed to handle most clear, free flowing liquids; however, liquids with suspended solids and abrasives (e.g., certain slurry and phosphate solutions) tend to precipitate in the packing, causing abnormal wear on packing and plunger. An internal flushing connection used with a V- or Chevron-type packing will minimize this tendency and increase packing and plunger life in these applications. (For abrasive slurry applications, ball-check valve cartridges should be installed remote from pump liquid end. Contact Milton Roy for full details.)

To connect for internal flushing, remove the stuffing box grease fitting and connect the stuffing box to a source of water (or other compatible liquid) at 25 to 50 psig (172 to 345 kPa) above suction pressure. Since only a few drops per minute are necessary, small diameter tubing will suffice. Install a 1/8" or 1/4" NPT stainless steel aircraft hydraulic system check valve on the flush line right next to the stuffing box connection to keep the process liquid from backing up through the flush line if the packing should fail. A 1/8" or 1/4" (3.2 or 6.4 mm) needle valve should be included for controlling the flushing liquid flow rate. The MILROYAL® C can be fitted at the factory or in the field with a SWAGELOK® elbow and tubing to exit through the pump housing for connection to a flushing line. Contact your Milton Roy representative to order these two parts.

Through flush connections to carry hazardous or undesirable fluids from the stuffing box can be provided for by drilling and tapping the stuffing box during manufacture. In these installations, the flushing liquid is piped away from the stuffing box to a drain or other suitable disposal point. For specific instructions concerning field installation of through flushing, consult Milton Roy and provide full details of the application.

2.12.3 Drains

Provide drains convenient to the pump so that any leakage of hazardous fluids may be diverted to suitable container or area. The pump catchall area (beneath the small top cover) is provided with a hole drilled and tapped to receive piping for drainage.

2.12.4 Auxiliary (Accessory) Equipment

Service connections for auxiliary or accessory electrical equipment should be determined by referring to wiring diagrams, instruction manuals, and the data plate furnished with the equipment. Air-operated equipment should normally be supplied with two sources of air. The power elements require a standard 60 psig (414 kPa) (80-100 psig (552-690 kPa) at compressor) plant air supply (however, an 80 psig (552 kPa) supply (90- 100 psig (621-690 kPa) at compressor) is recommended to ensure maximum performance under all conditions). Instrument air should be supplied from a control instrument or from a manual air pressure regulator furnished with 30 psig (207 kPa) service.

3.1 INITIAL START-UP

Follow the start up directions in the "DRIVE" manual (53939) and those listed below.

3.2 INITIAL ADJUSTMENTS

3.2.1 Non-Adjustable Type Packing

"Non-adjustable" plunger packing (specified self-adjusting in the pump model number, Section 1, OPTIONS) is preset by internal spring pressure and is complete once the gland cap (*Figure 10*, Item 1660) is fully tightened. No adjustments possible.

3.2.2 Adjustable Type Packing

Plunger packing (adjustable braided packing **ONLY**, specified in pump model number, (Section 1, OPTIONS).

Before pumping under load, break in plunger packing as follows:

1. Release packing gland nut (1660, *Figure 10 and 11*) then retighten 1/4 turn past finger tight.
2. Inject a packing lubricant compatible with the liquid being pumped into the packing grease fitting (1625).
3. Tighten packing gland one full turn.
4. Allow packing to settle for 15 minutes; then release the packing gland and retighten 1/4 turn past finger tight.
5. Start pump. For the longest packing life run dry (no liquid being pumped) for 30 minutes, occasionally applying a few drops of light oil to the plunger where it enters the stuffing box. If this is not practical proceed to the next step.
6. Place pump in service and adjust output. If gland leaks, tighten a little at a time (1/6 turn) until leakage is minimized, waiting at least 5 minutes between adjustments to allow packing to settle. If packing temperature increases, it may be necessary to loosen gland to prevent damage to packing. If it is possible to tolerate some leakage at the gland cap, the leaking liquid will help cool and lubricate packing and plunger, greatly extending the life of each.

The first 24 hours of operation is critical to packing life. Packing adjusted too tightly will overheat and decompose rapidly, while properly adjusted packing will wear in with a good running surface. In some cases - especially at high pressures - frictional heat will expand the packing and the gland may have to be loosened during operation.

Packing types and packing replacement are discussed in Section 4.

3.2.3 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 one of two methods carried out in a given time:

1. Measure the decrease in liquid level pumped from a calibrated vessel.
2. Collect and measure pumped liquid at the pump discharge port. (It may be necessary to create discharge head at the liquid take-off point; otherwise pump will not operate properly. See Section 2 for ways to do this.)

The first method is recommended for hazardous liquids because it eliminates operator contact with the liquid.

3.3 FILLING PUMP SYSTEM

It is especially important that pump suction and discharge lines be free of entrained air. To ensure this condition, operate the pump under no discharge pressure and fill the entire pumping system with liquid before starting pressure tests.

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.

3.4 PREVENTATIVE MAINTENANCE

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

3.4.1 Packing

If an automatic oiler is used, monitor normal lubricant consumption and refill the reservoir before it becomes empty.

If other external lubricant is used, lubricate the plunger packing daily with a lubricant compatible with the liquid being pumped. Do not add any other kind of lubricant to the packing.

3.4.2 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 hot detergent solution for 15 minutes, followed by water flushing.

4.1 SPARE PARTS

The spare parts listed in Table 1 should be stocked for each pump to prevent serious delays in repairs.

Parts orders must include the following information:

1. Quantity (in this manual)
2. Part number (in this manual)
3. Part description (in this manual)
4. Pump serial number (on pump nameplate)
5. Full model number (on pump nameplate)

Always include the serial and model numbers in all correspondence regarding the unit.

Table 1: SPARE PARTS

Drawing Location Reference	Description	Qty. Req.
1640	Packing	2
1730	Plunger	1
1710	Check Valve Assemblies (three types shown *Figure 9*, includes balls and seats below)*	2
224	Seat, Upper/Lower, Detail 1	4
224	Seat, Upper, Detail 2 (includes seat and stop as an assembly)	2
225	Seat, Lower, Detail 2	2
179	Seat, Upper/Lower, Detail 3	4
180	Ball Guide, Upper/Lower, Detail 3	4
181	Retaining Ring, Detail 3	2
408	O-Ring, Detail 3	4
409	Back-up Ring, Detail 3	4
407	Ball-Checks, Details 1, 2, and 3	4

* Balls/seats can be replaced in the field. Milton Roy recommends replacing the complete check valve assembly which minimizes down time and curtails damage to the check valve.

4.2 RETURNING UNITS TO THE FACTORY

Pumps will not be accepted for repair without a Return Material Authorization, available from the Factory Repair Department. Pumps returned to the Factory for repairs should be clearly labeled to indicate the liquid being pumped. Process liquid should be flushed from liquid end before pump is shipped. These safety precautions will aid the troubleshooting and repair procedure and preclude injury to repair personnel from corrosive residue in pump liquid end. Safety Data Sheet must accompany all returns.

All inquiries or parts orders should be addressed to your local Milton Roy representative or sent to:

www.miltonroy.com

4.3 PACKING REPLACEMENT: PLUNGER SIZES 7/16" THRU 1-1/8" (*Figure 10*).

MILROYAL® C pumps manufactured during and after 1995 (new model code) contain either spring loaded nonadjustable V-ring packing or adjustable packing sets (V-ring or braided as shown in *Figures 10 and 11*). The identification is explained in the model code shown Section 1, OPTIONS.

4.3.1 Packing Replacement (Spring Loaded, Non- Adjustable Packing Type Only, *Figure 10*)

The V-Type (Chevron style) packing rings are provided as a set. The set includes the lantern ring, V-rings, seal ring, o-ring and spring. In some cases a separate kit of V-rings and other soft seal parts (not including the metal parts) may be purchased.

The liquid end must be removed from the pump to replace the packing set. Flush liquid end of process liquid. Disconnect suction and discharge lines. The hex head pipe plug (1770) in the end of the liquid end connects to the process cavity, and need not be removed (the hole connects to the packing cavity providing continuous venting).

1. Unscrew the plunger retention nut (1720) and move it away from the crosshead. Remove tubing (1760) or grease fitting from the liquid end, and the bolts fastening it to the pump housing.
2. Measure and record the length of plunger protruding from the liquid end.
3. Withdraw plunger from liquid end. Inspect plunger and the inside of the liquid end. Both areas must be free from streaks (longitudinal groves) and other irregularities. Also replace any scored or corroded plungers.
4. Clamp the liquid end in a vise and loosen the packing follower retaining nut (1660), expecting the internal spring to push the packing parts outward.

⚠ CAUTION **THE SPRING FORCE MAY SUDDENLY LOOSEN STUCK PACKING, CAUSING IT TO FLY OUT OF THE LIQUID END. (THE SAME PRECAUTION MUST BE USED DURING REINSTALLATION).**

5. Thoroughly clean the liquid end body of old packing, contamination and lubricant.
6. The metal parts: lantern ring, spring etc. may be reused if they are in good condition. The V-rings and seals are typically replaced.
7. IT IS IMPORTANT TO PACKING LIFE to soak the packing rings in the normal packing lubricant prior to installing them in the pump, in order to reduce friction and aid the break-in process. If packing grease is used, work some grease into each ring before assembly. Also coat the inside of the liquid end with the same lubricant.
8. Replace ALL packing parts as shown in *figure 10*. Proper packing compression and minimized leakage require use of the packing components as designed. Begin assembling the components one ring at a time.
9. When installing the gland cap, anti-seize lubricant must be applied to the threads. Thread the gland cap onto the liquid end and tighten it until it bottoms out against the packing follower.

NOTE:
Once the gland cap is tightened the compression on the spring loads the packing. NO OTHER ADJUSTMENT WILL BE NECESSARY. Braided packing will be covered later, and does require adjustment.

10. Coat the plunger (see paragraph 4.3.2 for ceramic plunger installation) with lubricant and insert it into the liquid end far enough that it extends from the liquid end the distance measured in step 2, plus 1/8”(3 mm.). Proceed to paragraph 4.3.3.

4.3.2 Ceramic Plunger Installation: Plunger Sizes 7/16” THRU 1-1/8” (*Figure 7, 8, and 10*)

1. Remove liquid end (1600) and place on work bench with check valves located towards the bottom.
2. Remove motor for access to worm shaft (See Manual 53939).
3. Turn worm shaft to 100% stroke (full suction).
4. Measure distance from crosshead to front of drive (1A, *Figure 7*).
5. Install packing (Paragraph 4.3.1).
6. Tighten gland cap 30 inch lbs. (Paragraph 4.3.1).
7. Subtract 1-1/2” from measurement 1A obtained above. Use this measurement to position plunger (*Figure 8*).
8. Carefully tap plunger with rubber mallet into liquid end packing ring. Set plunger with measurement taken step 7.

9. Bolt up liquid end to front of drive (*Figure 10*).

NOTE:
No side loading should be put on plunger. If diameters do not line up check all locating diameters for obstructions.

10. Move crosshead to meet plunger by turning worm gear. Complete install of liquid end (Paragraph 4.3.3).
11. On start-up set stroke control knob to 40% of stroke. Bring pressure up slow during break-in, normally six hours.

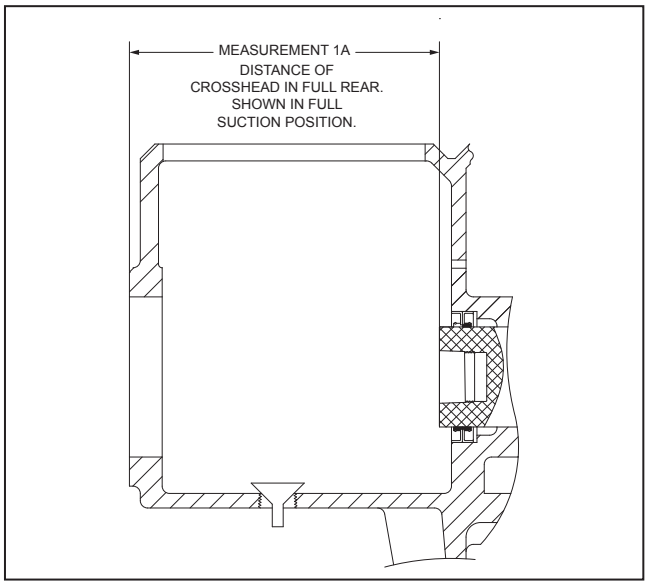


Figure 7. Measurement From Crosshead to Front of Drive.

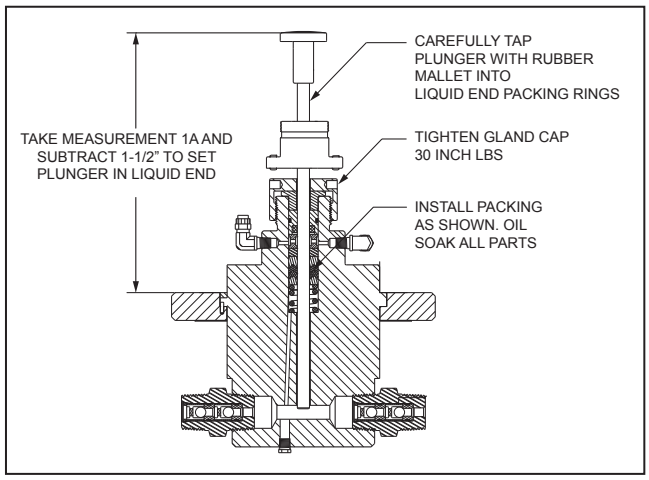


Figure 8. Liquid End Assembly Position

4.3.3 Liquid End Installation (*Figure 10*)

1. Install liquid end to pump casing, guiding the plunger adapter into the crosshead. Tighten the plunger retainer nut (1720) by hand until it seals the plunger button snugly in the crosshead. Back OFF adapter approximately 1/8" turn. Tighten set screws. The plunger should "FLOAT" radially and axially approximately 1/64".
2. Install and tighten bolts to hold liquid end to pump housing.
3. Install the tubing as provided.

4.3.4 Packing Drip Lubrication System (Option) *Figure 10*

This system as shown in *figure 10* is designed to extend packing life. It is gravity fed and requires air purging during start-up. Initial monitoring and adjustment of the sight glass drip control valve (1840) is required. Rectorial oil is preferred by packing manufacturer, however, steam cylinder oil or light gear oil may be used.

Filling the liquid end and tubing lines of the drip lubrication system is necessary.

1. Disconnect the tubing fitting just below the drip valve in order to fill and purge the tubing and liquid end until all air is removed. This will eliminate running the packing dry during start-up, extending packing life.
2. Fill the liquid end and tubing using a syringe. The overflow tube (1760) near the gland nut will allow the air and lubricant to escape as the syringe fills the cavities.
3. Reconnect the tubing fitting below the drip valve once the air has been removed from the lines.
4. Add lubricant to the Oiler and open the ON/OFF valve (1870) immediately beneath the oiler. The adjustment of the drip is not controlled by this valve.

5. Adjust the thumb knob on the sight glass drip oiler and observe the drops per minute. A normal starting point for the drip rate is 4 to 10 drops per minute. Once the pump is running, the lubricant may appear with some process liquid at the overflow tube or enter the process. Therefore the oiler drip rate may not be equal to the overflow tube drip rate.
6. The sight glass in the drip oiler SHOULD NOT be full of oil. This would indicate too high a flow rate or a blocked line. The sight glass is intended to show the drip rate, and is not to be filled. A drip rate of 4 to 10 drops per minute is usually satisfactory as long as the sight glass does not fill with oil.

4.3.5 Packing Replacement, Adjustable Packing Type Only (*Figure 10*).

Liquid End removal is similar to the method used on the Spring loaded packing configuration. Adjustable style packing does not have the compression spring. Also the spacer and rings (1640, 1642, 1644) are different from those in the spring loaded type packing.

1. Withdraw plunger from liquid end. Inspect plunger for surface anomalies and replace scored or corroded plunger. Withdraw the packing follower (1650) from liquid end. Remove packing, lantern ring and spacer. Thoroughly clean liquid end of old packing and grease.
2. Thoroughly coat each piece of new packing with lubricant compatible with the liquid being pumped.
3. Insert spacer (1642) first into stuffing box, followed by each new packing ring, one section at a time. Tamp each piece of packing firmly in place before adding the next piece. When installing split or seamed packing, stagger stuffing splits so they do not from a line allowing leakage. Locate lantern ring under the lubrication fitting (lantern ring will move as packing sets under adjustment). Fill stuffing box with packing to within 1/4" of the end to allow installation of gland follower and packing gland cap (1650 & 1660).
4. Coat plunger with lubricant and insert into liquid end.
5. Reattach the liquid end as shown under the "Liquid End Installation" paragraph 4.3.3, section steps 1 thorough 3.
6. Install grease fitting.
7. Follow "Initial Adjustments" paragraph 4.3.6, after re-assembly of the liquid end.

4.3.6 Initial Adjustments: Adjustable 7/16"- 1-1/8" Packing ONLY (See *Figure 10* And Product Code For Identification).

Before pumping under load, break in plunger packing as follows: release gland cap (1660) then retighten one-quarter turn past finger tight. Tighten the gland cap until moderate resistance is felt. After 15 minutes, release then retighten again until moderate resistance is felt.

1. Inject a packing lubricant compatible with the liquid being pumped into the packing grease fitting (1625).
2. When adding grease to the packing grease fitting, stop the filling process once noticeable resistance on the grease gun handle is felt. Over-pressurizing the packing causes deformation of the packing and early failure.
3. Start pump.

4. Place pump in service and adjust output. If gland leaks, tighten a little at a time (1/6 turn) until leakage is minimized, waiting at least 5 minutes between adjustments to allow packing to settle.
5. If packing temperature increases, it may be necessary to loosen gland to prevent damage to packing.
6. If it is possible to tolerate some leakage at the gland cap, the leaking liquid will help cool and lubricate packing and plunger, greatly extending the life of each. The first 24 hours of operation is critical to packing life. Packing adjusted too tightly will overheat and decompose rapidly, while properly adjusted packing will wear in with a good running surface. In some cases-especially at high pressures-frictional heat will expand the packing and the gland may have to be loosened during operation.

4.3.7 Packing Lubricant (If Equipped With Drip Oiler See Previous Instructions)

If equipped with a grease fitting lubricate the plunger packing daily with a lubricant compatible with the liquid being pumped. Do not add any other kind of lubricant to the packing. Do not over pressurize with grease gun.

4.3.8 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 hot detergent solution for 15 minutes, followed by water flushing. See paragraph 4.5.1 for check valve replacement. Balls and seats can be replaced in the field. Milton Roy recommends replacing the complete check valve assembly which minimizes down time and curtails damage to the check valve.

4.4 PACKING REPLACEMENT: PLUNGER SIZES 1-1/2" AND LARGER (ADJUSTABLE V-RING OR BRAIDED PACKING, *FIGURES 10 AND 11.*)

The following two types of packing are used with the 1- 1/2" and larger plunger sizes:

1. Automatic, Self-Sealing V- or Chevron-Type.
2. Compression-Type.

The packing originally furnished with the pump was selected as the best type for the application, and it must not be replaced by the other type of packing without first consulting Milton Roy.

The V or Chevron shape of automatic packing seals by expanding with the plunger discharge stroke. On the suction stroke it relaxes to ease the load on the drive mechanism. Except under extreme pressure conditions, automatic packing need never be more than finger tight.

Compression-type packing have square or round cross-sections. Composed of various materials and suited to a particular group of chemicals, these packing must be compressed in the stuffing box to be effective. However, packing compressed too tightly may overheat and disintegrate rapidly and may also score stainless steel plungers.

4.4.1 Packing Replacement (*Figures 10 and 11*)

1. Disconnect suction and discharge lines.
2. For 1-1/2 inch plunger remove two socket set screws (1740, *Figure 10*) and remove plunger adapter (1720). For 2 inch and above plungers turn to loosen plunger adapter (1720, *Figure 11*).
3. For 1-1/2 inch plunger remove gland cap (1660, *Figure 10*) and move it toward crosshead. For 2 inch and 2-1/2 inch plunger unbolt yoke gland cap (1660, *Figure 11*) and move it toward crosshead. Unscrew gland cap (1660, screwed gland cap design only for 3-1/2 and 4-7/16 inch plunger).

4. For 1-1/2 inch plunger remove bolts (1700, *Figure 10*) fastening liquid end to drive. For 2 inch and 2- 1/2 inch plunger remove bolts (898, *Figure 11*) and remove liquid end from adapter (900, *Figure 11*). For 3-1/2 and 4-7/16 inch plunger remove bolts (1700, *Figure 11*) and remove liquid end.
5. Measure and record the length of plunger protruding from the liquid end.
6. Withdraw plunger from liquid end. Inspect plunger for surface anomalies and replace scored or corroded plunger. Withdraw gland follower (1650, *Figure 11*) from stuffing box (screwed gland cap design only). Remove packing and lantern ring from stuffing box. Thoroughly clean stuffing box of old packing and grease.
7. Thoroughly coat each piece of new packing with lubricant compatible with the liquid being pumped.
8. Place new packing in stuffing box one section at a time. Tamp each piece of packing firmly in place before adding the next piece. When installing split or seamed packing, stagger stuffing splits so they do not from a line allowing leakage. Locate lantern ring under the lubrication fitting (lantern ring will move as packing sets under adjustment). Fill stuffing box with packing to within 1/4" of the end to allow installation of gland follower and packing gland cap (1660).
9. Insert plunger in liquid end far enough that it extends from the liquid end the distance measured in step 1 plus 1/8". Install gland follower in stuffing box.
10. Install liquid end to pump casing, guiding plunger through gland cap. Seat plunger in plunger adapter and gently force liquid end to its mounting place (plunger must bottom in adapter simultaneously); this operation is necessary to insure seating plunger in plunger adapter.
11. Install and tighten bolts to hold liquid end to mounting face.
12. See liquid end install.
13. Install gland cap to stuffing box. Install grease fitting.
14. Break in packing as instructed in Section 3.

4.5 CHECK VALVE DISASSEMBLY

The pump may be dismantled for parts replacement through the following procedures. (Numbers in parentheses are part identifiers from figures in this manual or manual 53939, MILROYAL® C Drive Manual.)

4.5.1 Check Valves

4.5.1.1 Plungers 1-1/8" and smaller check valves (replacement of balls and seats) refer to *figure 9*, detail 1, detail 3, and *figure 10*.

1. Unscrew and remove check valve assembly (1710) from liquid end (1600).
2. Screw upper check valve body into a pipe coupling. Invert assembly and place coupling on work surface.
3. Using an arbor press or a mallet and a brass rod just large enough to cover the exposed (lower) seat, press the cartridge parts out of the cartridge body (221).
4. Remove limit pins (292) from seats if equipped.

4.5.1.2 Plungers 1-1/2" and larger check valves (replacement of balls and seats) refer to *Figure 9*, detail 2, *Figures 10, and 11*.

1. Unscrew and remove check valve assembly (1710) from liquid end (1610).
2. Drift out limit pin (1718) at top of check valve. Remove upper ball-check (1717) from check valve.
3. Screw upper check valve body into a pipe coupling. Invert assembly and place coupling on work surface.
4. Using an arbor press or a mallet and a brass rod just large enough to cover the exposed (lower) seat, press the check valve parts out of the check valve body (1712).

When Required Remove Liquid End As Follows (*Figures 10 and 11*):

1. Disconnect motor power supply.
2. Remove covers (6085 and 6083, Manual 53939). Drain oil from pump casing.
3. Unbolt and remove gland cap (1660, *figure 10*); unscrew gland (1660, *Figure 11*). Use face spanner wrench (8030) to remove gland cap (1660, *Figure 11*) for 3-1/2 inch and 4-7/16 inch diameter plungers.
4. Remove two socket set screws (1740, *Figure 10*) and loosen plunger adapter (1720, *Figure 10*). Turn to loosen plunger adapter (1720, *Figure 11*).
5. Remove liquid end from pump drive. (Step 1 of "Packing Replacement").

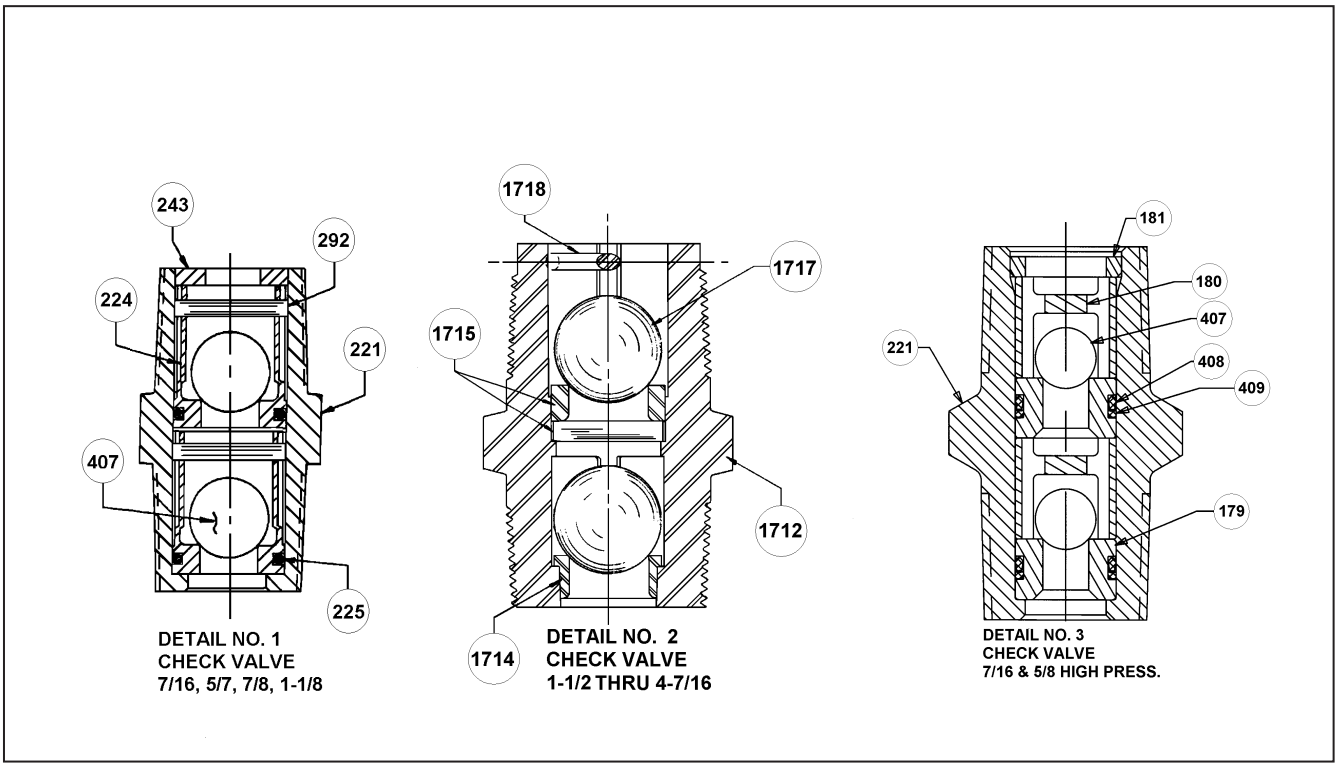


Figure 9. Check Valve Parts

4.6 CHECK VALVE REASSEMBLY

4.6.1 Check Valves

4.6.1.1 Plungers 1-1/8" and smaller check valves (*Figure 9*, Detail 1 and *Figure 10*).

NOTE:

High pressure check valves use a separate seat, with 'O'-rings and backup rings, and separate machined ball guides. Re-assemble these check valves (Figure 9 Detail 3) with new 'O'-rings and backup rings using "O'-ring lubricant. (The backup ring goes under the 'O'-ring)

1. Install O-rings (225) in grooves in each seat (224). Make sure the ends of split rings overlap in the seat grooves.
2. Place a ball-check (407) in one seat.
3. Install limit pin (292) in seat with ball-check. This assembly will be the lower seat assembly.
4. Coat seat O-rings with TEFLON® spray or other lubricant. Position lower seat assembly in the top of the check valve body (221) with the limit pin at top. Press lower seat assembly into check valve body till it is flush with top of valve body.
5. Place a ball-check in the remaining seat and install the limit pin in this seat.
6. Position second (upper) seat assembly in top of check valve body with limit pin at top and press this upper seat assembly into check valve body (forcing lower seat further down under it) until it is flush with top of valve body.
7. Place a piece of bar stock equal to the inside diameter of the check valve body on top of the upper seat. Press bar stock to drive both seats down into the check valve body until lower seat bottoms in valve body counter bore. (Top seat will be recessed slightly from top of valve).

4.6.1.2 Plungers 1-1/2" and larger check valves (Figure 9, Detail 2, Figures 10, and 11).

1. Insert shouldered (lower) seat (1714) into bottom of check valve (1712).
2. Drive seat into valve taper with a brass rod and hammer.

⚠ CAUTION **OMIT STEP 3 WHEN INSTALLING TUNGSTEN CARBIDE SEATS AS THEY MAY SHATTER OR CHIP FROM THE SHOCK.**

3. Place a few drops of light machine oil on the seat and place a hardened ball on the seat. Set the check valve on a solid flat surface and lightly tap the ball against the seat with one blow of a hammer on a brass rod. This will break the sharp edge of the seat without beveling it, thus preserving proper seating of the ball.

⚠ CAUTION **DO NOT TAP HARDENED BALLS ON TUNGSTEN CARBIDE SEATS OR SEATS MAY SHATTER OR CHIP.**

4. Place a new ball on the bottom seat. Repeat steps 2 and 3 for the top seat. Place a new ball on top seat and press in limit pin (1718).
5. Install check valve assembly in liquid end (1600).

SECTION 5 - TROUBLESHOOTING GUIDE

SYMPTOMS	REMEDIES
Pump will not operate.	• Liquid level is low. Add liquid.
	• Blocked discharge line. Clear line.
	• Liquid is frozen. Thaw liquid through pumping system.
	• Fuse is blown. Replace fuse.
	• Open thermal overload device in 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.
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 packing. Adjust or replace packing.
	• 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 packing. Adjust or replace packing.
	• 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 valve seats. Clean or replace.
	• Clogged or dirty line strainer. Clean strainer.

SYMPTOMS	REMEDIES
Motor overheating.	• Totally enclosed and explosion proof motors run hotter than open motors.
	• Wrong or insufficient gear case lubricant. Check oil level and type. Replace questionable lubricant.
	• Tight or dry packing. Adjust and lubricate packing.
	• Operation beyond rated capacity. Constrain operation to specifications.
	• Incorrect power supply. Match line voltage and frequency to pump motor data plate.
	• Misalignment. Check alignment of moving parts.
	• Over-tightened bearing adjuster. Remove and properly reinstall bearing adjuster.

6.1 GENERAL

1. This section gives information regarding replaceable components.

6.2 ILLUSTRATED PARTS LIST

1. Figure and Item Number Column
   a) The item numbers shown in the detailed parts list correspond to the item numbers appearing on the exploded view illustration. To find an unknown part number, locate the part on the illustration and note the item number. Look for the item number on the detailed parts list. The part number is on the same line. A dash (-) precedes non-illustrated item numbers.
2. Description Column
   a) The name of the item is in the description column.
3. Part Number Column
   a) The supplier's part number is listed in the part number column.
4. Material/SPM Column
   a) The material used to manufacture the part is listed in the material/SPM column.
   b) The strokes per minute is listed for all worm and shaft assemblies in the material/SPM column.
5. Quantity Column
   a) The numbers appearing in the quantity column are the total quantity of the listed part required in its immediate assembly.

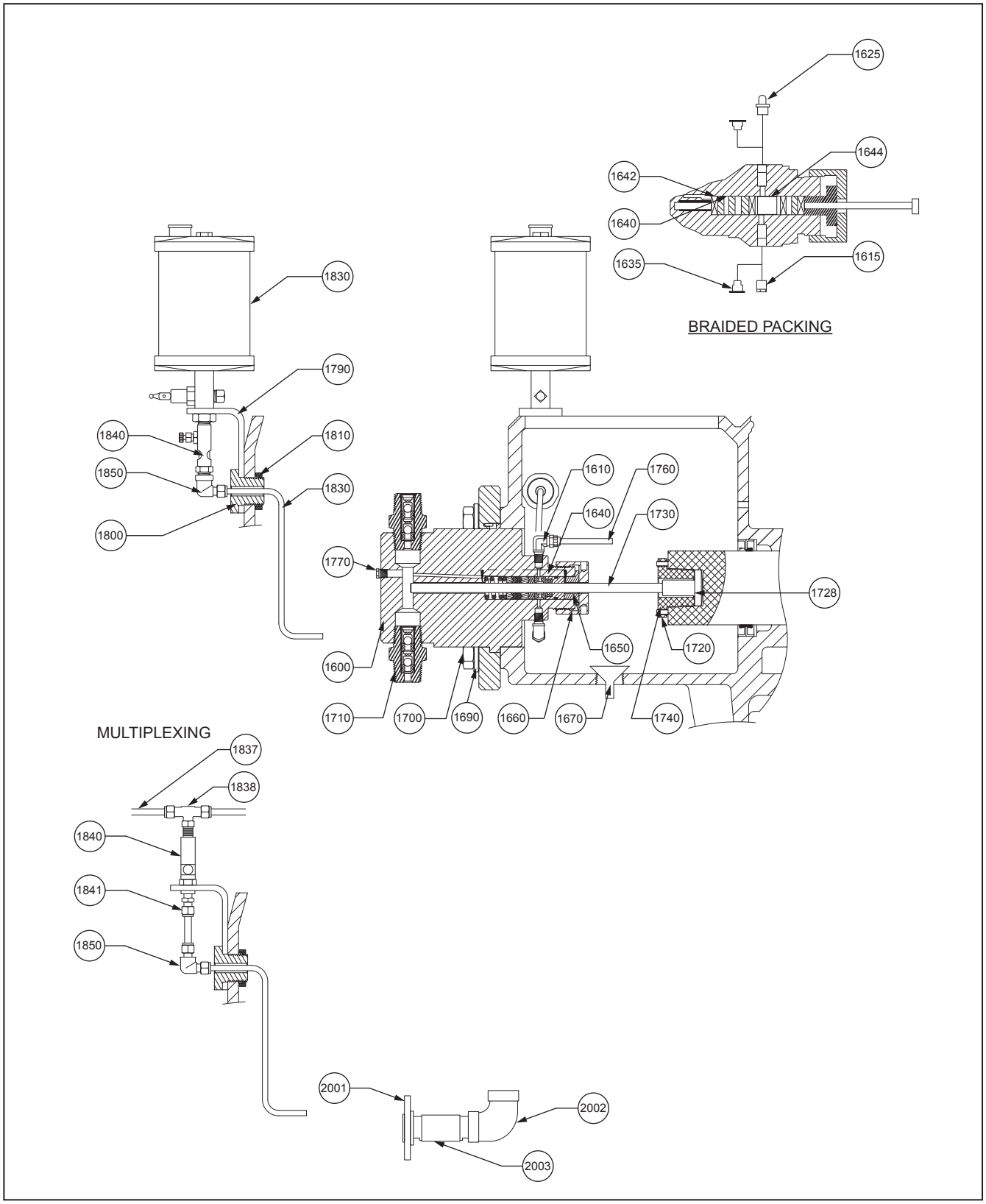


Figure 10. High Pressure “Bar Stock” Liquid End Assembly (Plungers 7/16” thru 1-1/2”) Manufactured After 1995. (DWG 102-2285-000)

6.3 PARTS LIST - 7/16” PLUNGER - HIGH PRESSURE “BAR STOCK” LIQUID END ASSEMBLY MANUFACTURED AFTER 1995.

PACKING/PLUNGER MATERIAL	CODE	PACKING/PLUNGER MATERIAL	CODE
316SS or Alloy 20 Liquid End, 0-1500 psig, Teflon Braid 5022 AFP, Alloy 20 or 316SS Plgr.	TM	316SS Liquid End, 0-10,000 PSIG, Ceramic Plgr. Teflon spring loaded, self adjusting.	TR

ITEM No.	DESCRIPTION	PART NO. (7/16”, 0-5000 psig, 316SS) Code 07	PART NO. (7/16”, 0-5000 psig, Alloy 20) Code 07	PART NO. (7/16”, over 5000 psig, 316SS) Code AH	PACKING/ PLUNGER MATERIAL	QTY
1600	LIQUID END WELD ASSY, 316SS	20149		20149		1
	LIQUID END WELD ASSY, CA-20		20752			1
1650	FOLLOWER, 316SS	2440008016		2440008016		1
	FOLLOWER, CA-20		2440008028			1
1660	GLAND CAP, 316SS	2080025016		2080025016		1
	GLAND CAP, CA-20		2080025028			1
1670	FUNNEL	4070124000	4070124000	4070124000		1
1690	WASHER, SPRING LOCK	4040045022	4040045022	4040045022		4
1700	SCREW, HEX HEAD	4050022161	4050022161	4050022161		4
1710	CHECK VALVE CARTRIDGE 316SS	2210207002				2
	CHECK VALVE CARTRIDGE AL-20		2210207003			2
	CHECK ASSY, 3/4 NPT, 3/8 BALL			2210878000		2
1720	PLUNGER RETENTION NUT	2720127006	2720127006	2720127006		1
1740	SCREW, SOCKET SET	4050043071	4050043071	4050043071		2
6085	COVER ASSEMBLY, CATCHALL	2810296002	2810296002	2810296002		1
6090	SCREW, PAN HEAD, 1/4-20X3/4	4050213072	4050213072	4050213072		6
8002	MOTOR ROTATION ARROW	4120007010	4120007010	4120007010		2
8004	DECAL, CAPACITY ADJ LOCK	2530022000	2530022000	2530022000		1
8005	STICKER, CAUTION	2530006099	2530006099	2530006099		1
1615, 1770	PLUG, 1/8 NPT HEX HEAD	4020012013				2

- Parts Not Illustrated

Parts Continued Next Page

ITEM No.	DESCRIPTION	PART NO. (7/16", 0-5000 psig, 316SS) Code 07	PART NO. (7/16", 0-5000 psig, Alloy 20) Code 07	PART NO. (7/16", over 5000 psig, 316SS) Code AH	PACKING/ PLUNGER MATERIAL	QTY
STANDARD BRAIDED PACKING PARTS						
1625	FITTING, GREASE, LEAKPROOF	4070013000				1
OILER (OPTIONAL)						
1610	ELBOW, MALE 1/4T X 1/8 NPT 316SS	A1-0012	A1-0012	A1-0012		2
1760	TUBING, 1/4 X 0.035 WALL 316SS	4020141003	4020141003	4020141003		5 IN.
1790	BRACKET, OILING SYSTEM	1791534006	1791534006	1791534006		1
1800	NUT, RETAINING	1791535006	1791535006	1791535006		1
1810	NUT, TRU-SEAL, 1-11.5 NPT	4080033061	4080033061	4080033061		1
1830	RESERVOIR, OIL-RITE	4070346000	4070346000	4070346000		1
1840	VALVE SIGHT FEED, OIL-RITE	4070347000	4070347000	4070347000		1
1850	ELBOW, FEMALE, 1/4T X 1/8 NPT	4020604040	4020604040	4020604040		1
1860	TUBING 1/4 X 0.035 WALL 316SS	C7-0027	C7-0027	C7-0027		18 IN
1870	PLUG, 1/4 NPT SQ. HEAD	4020009111	4020009111	4020009111		1
PACKING AND PLUNGER						
1640	7/16 X 1-1/16 BRAIDED RING SET	4080156011			TM	1
1730	PLUNGER ASSEMBLY 7/16 316SS	20154			TM	1
1642	PACKING SPACER 7/16 PLGR 316SS	2070018699			TM	4
1644	LANTERN RING 7/16 PLGR 316SS	2060006616			TM	1

- Parts Not Illustrated

Parts Continued Next Page

ITEM No.	DESCRIPTION	PART NO. (7/16", 0-5000 psig, 316SS) Code 07	PART NO. (7/16", 0-5000 psig, Alloy 20) Code 07	PART NO. (7/16", over 5000 psig, 316SS) Code AH	PACKING/ PLUNGER MATERIAL	QTY
PACKING AND PLUNGER						
1640	7/16 X 1-1/16 BRAIDED RING SET		4080156011		TM	7
1730	PLUNGER ASSEMBLY 7/16 CA-20		41137		TM	1
1642	PACKING SPACER 7/16 PLGR CA-20		2070018628		TM	4
1644	LANTERN RING 7/16 PLGR CA-20		2060006628		TM	1
1640	SPRING LOAD PACK 7/16 TEFLON			4080153010	TR	1
1652	FOLLOWER INSERT 7/16			22160	TR	1
1730	PLUNGER ASSEMBLY, 7/16 CERAMIC, (USED AFTER 2004)			41137	TR	1
1730	PLUNGER ASSEMBLY, 7/16 CARBIDE, (USED AS STANDARD PART THROUGH 2004)			20732	TR	1

- Parts Not Illustrated

Parts Continued Next Page

6.4 PARTS LIST - 5/8” PLUNGER - HIGH PRESSURE “BAR STOCK” LIQUID END ASSEMBLY MANUFACTURED AFTER 1995.

PACKING/PLUNGER MATERIAL	CODE	PACKING/PLUNGER MATERIAL	CODE
316SS or Alloy 20 Liquid End, 0-1500 psig, Teflon Braid 5022 AFP, Alloy 20 or 316SS Plgr..	TM	316SS Liquid End, 0-10,000 PSIG, Ceramic Plgr. Teflon spring loaded, self adjusting.	TR

ITEM No.	DESCRIPTION	PART NO. (5/8”, 0-5000 psig, 316SS) Code 10	PART NO. (5/8”, 0-5000 psig, Alloy 20) Code 10	PART NO. (5/8”, over 5000 psig, 316SS) Code BA	PACKING/ PLUNGER MATERIAL	QTY
1600	LIQUID END ASSY, 316SS	20150		20150		1
	LIQUID END ASSY, CA-20		20171			1
1650	FOLLOWER, 316SS	2440008116	2440008116	2440008116		1
1660	GLAND CAP, 316SS	2080025016		2080025016		1
	GLAND CAP, CA-20		2080025028			1
1670	FUNNEL	4070124000	4070124000	4070124000		1
1690	WASHER, SPRING LOCK	4040045022	4040045022	4040045022		4
1700	SCREW, HEX HEAD	4050022161	4050022161	4050022161		4
1710	CHECK VALVE CARTRIDGE 316SS	2210207002				2
	CHECK VALVE CARTRIDGE AL-20		2210207003			2
	CHECK ASSY, 3/4 NPT, 3/8 BALL			2210878000		2
1720	PLUNGER RETENTION NUT	2720127106	2720127106	2720127106		1
1740	SCREW, SOCKET SET	4050043071	4050043071	4050043071		2
6085	COVER ASSEMBLY, CATCHALL	2810296002	2810296002	2810296002		1
6090	SCREW, PAN HEAD, 1/4-20X3/4	4050213072	4050213072	4050213072		6
8002	MOTOR ROTATION ARROW	4120007010	4120007010	4120007010		2
8004	DECAL, CAPACITY ADJ LOCK	2530022000	2530022000	2530022000		1
8005	STICKER, CAUTION	2530006099	2530006099	2530006099		1
8010	OIL, GEAR, AGMA 7, 5 GAL	4070122030	4070122030	4070122030		2
8010	OIL, GEAR, AGMA 7, 2.5 GAL	4070122020	4070122020	4070122020		1
1650, 1770	PLUG, 1/8 NPT HEX HEAD	4020012013	4020012013	4020012013		2

- Parts Not Illustrated

Parts Continued Next Page

ITEM No.	DESCRIPTION	PART NO. (5/8", 0-5000 psig, 316SS) Code 10	PART NO. (5/8", 0-5000 psig, Alloy 20) Code 10	PART NO. (5/8", over 5000 psig, 316SS) Code BA	PACKING/ PLUNGER MATERIAL	QTY
STANDARD BRAIDED PACKING PARTS						
1625	FITTING, GREASE, LEAKPROOF	4070013000	4070013000	4070013000		1
OILER (OPTIONAL)						
1610	ELBOW, MALE 1/4T X 1/8 NPT 316SS	A1-0012	A1-0012	A1-0012		2
1760	TUBING, 1/4 X 0.035 WALL 316SS	C7-0027	C7-0027	C7-0027		5 IN.
1790	BRACKET, OILING SYSTEM	1791534006	1791534006	1791534006		1
1800	NUT, RETAINING	1791535006	1791535006	1791535006		1
1810	NUT, TRU-SEAL, 1-11.5 NPT	4080033061	4080033061	4080033061		1
1830	RESERVOIR, OIL-RITE	4070346000	4070346000	4070346000		1
1840	VALVE SIGHT FEED, OIL-RITE	4070347000	4070347000	4070347000		1
1850	ELBOW, MALE, 1/4T X 1/8 NPT	A1-0012	A1-0012	A1-0012		2
	ELBOW, FEMALE, 1/4T X 1/8 NPT	4020604040	4020604040	4020604040		1
1860	TUBING 1/4 X 0.035 WALL 316SS	C7-0027	C7-0027	C7-0027		18 IN
1870	PLUG, 1/4 NPT SQ. HEAD	4020009111	4020009111	4020009111		1
PACKING AND PLUNGER						
1640	5/8 X 1-1/4 BRAIDED RING SET	4080156021			TM	1
1730	PLUNGER ASSEMBLY 5/8 316SS	20155			TM	1
1642	PACKING SPACER 5/8 PLGR 316SS	2070018399			TM	4
1644	LANTERN RING 5/86 PLGR 316SS	2060006316			TM	1
1640	5/8 X 1-1/4 BRAIDED RING SET		4080156021		TM	1
1730	PLUNGER ASSEMBLY 5/8 CA-20		20159		TM	1
1642	PACKING SPACER 5/8 PLGR CA-20		2070018328		TM	4
1644	LANTERN RING 5/8 PLGR CA-20		2060006328		TM	1

- Parts Not Illustrated

Parts Continued Next Page

ITEM No.	DESCRIPTION	PART NO. (5/8", 0-5000 psig, 316SS) Code 10	PART NO. (5/8", 0-5000 psig, Alloy 20) Code 10	PART NO. (5/8", over 5000 psig, 316SS) Code BA	PACKING/ PLUNGER MATERIAL	QTY
PACKING AND PLUNGER						
1640	SPRING LOAD PACK 5/8 TEFLON			4080148010	TR	1
1652	FOLLOWER INSERT 5/8			22157	TR	1
1730	PLUNGER ASSEMBLY, 5/8 CARBIDE, (USED AS STANDARD PART THROUGH 2004)			2120168100	TR	1
1730	PLUNGER ASSEMBLY, 5/8 CERAMIC, (USED AFTER 2004)			40910	TR	1
-	RETENTION BUTTON, (USED AS STANDARD PART THROUGH 2004)			2720131042	TR	1
-	SPRING PIN, (USED AS STANDARD PART THROUGH 2004)			4010003061	TR	1

- Parts Not Illustrated

Parts Continued Next Page

6.5 PARTS LIST - 7/8" PLUNGER - HIGH PRESSURE "BAR STOCK" LIQUID END ASSEMBLY MANUFACTURED AFTER 1995.

PACKING/PLUNGER MATERIAL	CODE	PACKING/PLUNGER MATERIAL	CODE
316SS or Alloy 20 Liquid End, 0-1500 psig, Teflon Braid 5022 AFP, Alloy 20 or 316SS Plgr.	TM	316SS Liquid End, 0-10,000 PSIG, Ceramic Plgr. Teflon spring loaded, self adjusting.	TR

ITEM No.	DESCRIPTION	PART NO. (5/8", 0-5000 psig, 316SS) Code 10	PART NO. (5/8", 0-5000 psig, Alloy 20) Code 10	PACKING/ PLUNGER MATERIAL	QTY
1600	LIQUID END ASSEMBLY, 316SS	20151			1
	LIQUID END ASSEMBLY, CA-20		20171		1
1660	GLAND CAP, 316SS	2080025116			1
	GLAND CAP, CA-20		2080025128		1
1670	FUNNEL	4070124000	4070124000		1
1690	WASHER, SPRING LOCK	4040045022	4040045022		4
1700	SCREW, HEX HEAD	4050022161	4050022161		4
1710	CHECK VALVE, 316SS	2210263002			1
	CHECK VALVE CA-20		2210263003		1
1720	PLUNGER RETENTION NUT	2720127206	2720127206		1
1740	SCREW, SOCKET SET	4050043071	4050043071		2
6085	COVER ASSEMBLY, CATCHALL	2810296002	2810296002		1
6090	SCREW, PAN HEAD, 1/4-20X3/4	4050213072	4050213072		6
8002	MOTOR ROTATION ARROW	4120007010	4120007010		2
8004	DECAL, CAPACITY ADJ LOCK	2530022000	2530022000		1
8005	STICKER, CAUTION	2530006099	2530006099		1
8010	OIL, GEAR, AGMA 7, 5 GAL	4070122030	4070122030		2
	OIL, GEAR, AGMA 7, 2.5 GAL	4070122020	4070122020		1
1650, 1770	PLUG, 1/8 NPT HEX HEAD	4020012013	4020012013		2
STANDARD BRAIDED PACKING PARTS					
1625	FITTING, GREASE, LEAKPROOF	4070013000	4070013000		1

- Parts Not Illustrated

Parts Continued Next Page

ITEM No.	DESCRIPTION	PART NO. (5/8", 0-5000 psig, 316SS) Code 10	PART NO. (5/8", 0-5000 psig, Alloy 20) Code 10	PACKING/ PLUNGER MATERIAL	QTY
OILER (OPTIONAL, USE WITH PACKING/PLUNGER MATERIAL CODE TR ONLY RECOMMENDED)					
1610	ELBOW, MALE 1/4T X 1/8 NPT 316SS	A1-0012	A1-0012		2
1760	TUBING, 1/4 X 0.035 WALL 316SS	C7-0027	C7-0027		5 IN.
1790	BRACKET, OILING SYSTEM	1791534006	1791534006		1
1800	NUT, RETAINING	1791535006	1791535006		1
1810	NUT, TRU-SEAL, 1-11.5 NPT	4080033061	4080033061		1
1830	RESERVOIR, OIL-RITE	4070346000	4070346000		1
1840	VALVE SIGHT FEED, OIL-RITE	4070347000	4070347000		1
1850	ELBOW, MALE, 1/4T X 1/8 NPT	A1-0012	A1-0012		2
	ELBOW, FEMALE, 1/4T X 1/8 NPT	4020604040	4020604040		1
1860	TUBING 1/4 X 0.035 WALL 316SS	C7-0027	C7-0027		18 IN.
1870	PLUG, 1/4 NPT SQ. HEAD	4020009111	4020009111		1
PACKING AND PLUNGER					
1640	7/8 X 1-1/2 BRAIDED 8 RING SET	4080156031		TM	1
1642	PACKING SPACER 7/8 PLGR 316SS	2070018499		TM	4
1644	LANTERN RING 7/8 PLGR 316SS	2060006416		TM	1
1650	FOLLOWER 7/8 PLGR 316SS	2440008616		TM	1
1730	PLUNGER ASSEMBLY 7/8 316SS	20156		TM	1
1640	7/8 X 1-1/2 BRAIDED 8 RING SET		4080156031	TM	1
1642	PACKING SPACER 7/8 PLGR CA-20		2070018428	TM	4
1644	LANTERN RING 7/8 PLGR CA-20		2060006428	TM	1
1650	FOLLOWER 7/8 PLGR 316SS		2440008216	TM	1
1730	PLUNGER ASSEMBLY 7/8 CA-20		20160	TM	1
1640	SPRING LOAD PACK 7/8 TEFLON	4080152030		TR	1
1650	FOLLOWER, 7/8 PLUNGER, 316SS	2440008116		TR	1
1652	FOLLOWER, INSERT 7/8	22158		TR	1
1730	PLUNGER ASSEMBLY, 7/8 CARBIDE, (USED AS STANDARD PART THROUGH 2004)	20169		TR	1
	PLUNGER ASSEMBLY, 7/8 CERAMIC, (USED AFTER 2004)	41136		TR	1

- Parts Not Illustrated

Parts Continued Next Page

6.6 PARTS LIST - 1-1/8” PLUNGER - HIGH PRESSURE “BAR STOCK” LIQUID END ASSEMBLY MANUFACTURED AFTER 1995.

PACKING/PLUNGER MATERIAL	CODE	PACKING/PLUNGER MATERIAL	CODE
316SS or Alloy 20 Liquid End, 0-1500 psig, Teflon Braid 5022 AFP, Alloy 20 or 316SS Plgr.	TM	316SS Liquid End, 0-10,000 PSIG, Ceramic Plgr. Teflon spring loaded, self adjusting.	TR

ITEM No.	DESCRIPTION	PART NO. (1 1/8”, psig, 316SS) Code 18	PART NO. (1 1/8” psig, Alloy 20 Code 18	PACKING/ PLUNGER MATERIAL	QTY
1600	LIQUID END ASSEMBLY, 316SS	20152			1
	LIQUID END ASSEMBLY, CA-20		20173		1
1660	GLAND CAP, 316SS	2080025116			1
	GLAND CAP, CA-20		2080025128		1
1670	FUNNEL	4070124000	4070124000		1
1690	WASHER, SPRING LOCK	4040045022	4040045022		4
1700	SCREW, HEX HEAD	4050022161	4050022161		4
1710	CHECK VALVE, 316SS	2210263002			1
	CHECK VALVE CA-20		2210263003		1
1720	PLUNGER RETENTION NUT	22083	22083		1
1740	SCREW, SOCKET SET	4050043071	4050043071		2
6085	COVER ASSEMBLY, CATCHALL	2810296002	2810296002		1
6090	SCREW, PAN HEAD, 1/4-20X3/4	4050213072	4050213072		6
8002	MOTOR ROTATION ARROW	4120007010	4120007010		2
8004	DECAL, CAPACITY ADJ LOCK	2530022000	2530022000		1
8005	STICKER, CAUTION	2530006099	2530006099		1
1650, 1770	PLUG, 1/8 NPT HEX HEAD	4020012013	4020012013		2
STANDARD BRAIDED PACKING PARTS					
1625	FITTING, GREASE, LEAKPROOF	4070013000	4070013000		1

- Parts Not Illustrated

Parts Continued Next Page

ITEM No.	DESCRIPTION	PART NO. (1 1/8", psig, 316SS) Code 18	PART NO. (1 1/8" psig, Alloy 20 Code 18	PACKING/ PLUNGER MATERIAL	QTY
OILER (OPTIONAL, USE WITH PACKING/PLUNGER MATERIAL CODE TR ONLY RECOMMENDED)					
1610	ELBOW, MALE 1/4T X 1/8 NPT 316SS	A1-0012	A1-0012		2
1760	TUBING, 1/4 X 0.035 WALL 316SS	C7-0027	C7-0027		5 IN.
1790	BRACKET, OILING SYSTEM	1791534006	1791534006		1
1800	NUT, RETAINING	1791535006	1791535006		1
1810	NUT, TRU-SEAL, 1-11.5 NPT	4080033061	4080033061		1
1830	RESERVOIR, OIL-RITE	4070346000	4070346000		1
1840	VALVE SIGHT FEED, OIL-RITE	4070347000	4070347000		1
1850	ELBOW, MALE, 1/4T X 1/8 NPT	A1-0012	A1-0012		2
	ELBOW, FEMALE, 1/4T X 1/8 NPT	C7-0027	C7-0027		1
1860	TUBING 1/4 X 0.035 WALL 316SS	4020141003	4020141003		18 IN
1870	PLUG, 1/4 NPT SQ. HEAD	4020009111	4020009111		1
PACKING AND PLUNGER					
1640	1 1/8 X 1-3/4 BRAIDED 8 RING SET	4080156041		TM	1
1642	PACKING SPACER 1 1/8 PLGR 316SS	2070018599		TM	4
1644	LANTERN RING 1 1/8 PLGR 316SS	2060006516		TM	1
1650	FOLLOWER 1 1/8 PLGR 316SS	2440008516		TM	1
1730	PLUNGER ASSEMBLY 1 1/8 316SS	20157		TM	1
1640	1 1/8 X 1-3/4 BRAIDED 8 RING SET		4080156041	TM	1
1642	PACKING SPACER 1 1/8 PLGR CA-20		2070018528	TM	4
1644	LANTERN RING 1 1/8 PLGR CA-20		2060006528	TM	1
1650	FOLLOWER 1 1/8 PLGR 316SS		2240008516	TM	1
1730	PLUNGER ASSEMBLY 1 1/8 CA-20		20161	TM	1
1640	SPRING LOAD PACK 1 1/8 TEFLON	4080155010		TR	1
1650	FOLLOWER, 1 1/8 PLUNGER, 316SS	2240008514		TR	1
1652	FOLLOWER, INSERT 1 1/8	22159		TR	1
1730	PLUNGER ASSEMBLY, 1 1/8 CARBIDE,(USED AS STANDARD PART THROUGH 2004)	20157		TR	1
	PLUNGER ASSEMBLY, 1 1/8 CERAMIC, (USED AFTER 2004)	41138		TR	1

- Parts Not Illustrated

Parts Continued Next Page

6.7 PARTS LIST - PLUNGER 1-1/2” HIGH PRESSURE “BAR STOCK” LIQUID END ASSEMBLY MANUFACTURED AFTER 1995.

PACKING/PLUNGER MATERIAL	CODE	PACKING/PLUNGER MATERIAL	CODE
316SS Liquid End, 0-1500 psig, Teflon Braid 5022 AFP, 316SS Plgr.	TM	316SS Liquid End, 0-1500 psig, Teflon Braid 5022 AFP, Ceramic Plgr.	BC
316SS Liquid End, 0-1500 psig, Nitrile Fabric, 316SS Plgr.	NM		

ITEM No.	DESCRIPTION	PART NO. (1 1/2”, psig, 316SS) Code 24	PACKING/ PLUNGER MATERIAL	QTY
1600	LIQUID END ASSEMBLY, 316SS	2210338516		1
1660	GLAND CAP, 316SS	2080012016		1
1650	FOLLOWER 316SS	2440006016		1
1670	FUNNEL	4070124000		1
1690	WASHER, SPRING LOCK	4040045022		4
1700	SCREW, HEX HEAD	4050033164		4
1710	CHECK VALVE ASSY, 316SS	2210060002		1
1720	PLUNGER ADAPTER	2720026606		1
1740	SCREW, SOCKET SET	4050043071		2
6085	COVER ASSEMBLY, CATCHALL	2810296002		1
6090	SCREW, PAN HEAD, 1/4-20X3/	4050213072		6
8002	MOTOR ROTATION ARROW	4120007010		2
8004	DECAL, CAPACITY ADJ LOCK	2530022000		1
8005	STICKER, CAUTION	2530006099		1
1650, 1770	PLUG, 1/8 NPT HEX HEAD	4020012013		2
STANDARD BRAIDED PACKING PARTS				
1625	FITTING, GREASE, LEAKPROOF	4070013000		1

- Parts Not Illustrated

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ITEM No.	DESCRIPTION	PART NO. (1 1/2", psig, 316SS) Code 24	PACKING/ PLUNGER MATERIAL	QTY
OILER (OPTIONAL, USE WITH PACKING/PLUNGER MATERIAL CODE TR ONLY RECOMMENDED)				
1610	ELBOW, MALE 1/4T X 1/8 NPT 316SS	A1-0012		2
1760	TUBING, 1/4 X 0.035 WALL 316SS	C7-0027		5 IN.
1790	BRACKET, OILING SYSTEM	1791534006		1
1800	NUT, RETAINING	1791535006		1
1810	NUT, TRU-SEAL, 1-11.5 NPT	4080033061		1
1830	RESERVOIR, OIL-RITE	4070346000		1
1840	VALVE SIGHT FEED, OIL-RITE	4070347000		1
1850	ELBOW, MALE, 1/4T X 1/8 NPT	A1-0012		2
	ELBOW, FEMALE, 1/4T X 1/8 NPT	4020604040		1
1860	TUBING 1/4 X 0.035 WALL 316SS	4020141003		18 IN
1870	PLUG, 1/4 NPT SQ. HEAD	4020009111		1
PACKING AND PLUNGER				
1640	1 1/2 X 1-3/4 BRAIDED 8 RING SET	4083001244	TM	1
1642	NECK RING 316SS	2070001616	TM	1
1644	LANTERN RING 316SS	2060001716	TM	2
1730	PLUNGER ASSEMBLY 1 1/2 316SS	2120020616	TM	1
1640	1 1/2 X 2-1/4 X 3 PACKING 8048	4080085251	NM	1
1642	NECK RING 316SS	2070001616	NM	1
1644	LANTERN RING 316SS	2060001716	NM	2
1730	PLUNGER ASSEMBLY 1 1/2 316SS	2120020616	NM	1
1640	PACKING 5022 1 1/2 8 RING SET	4083001244	BC	1
1642	NECK RING 316SS	2070001616	BC	1
1644	LANTERN RING 316SS	2060001716	BC	2
1730	PLUNGER ASSEMBLY, 1 1/2 CERAMIC, (USED AFTER 2004)	2120020693	BC	1

- Parts Not Illustrated

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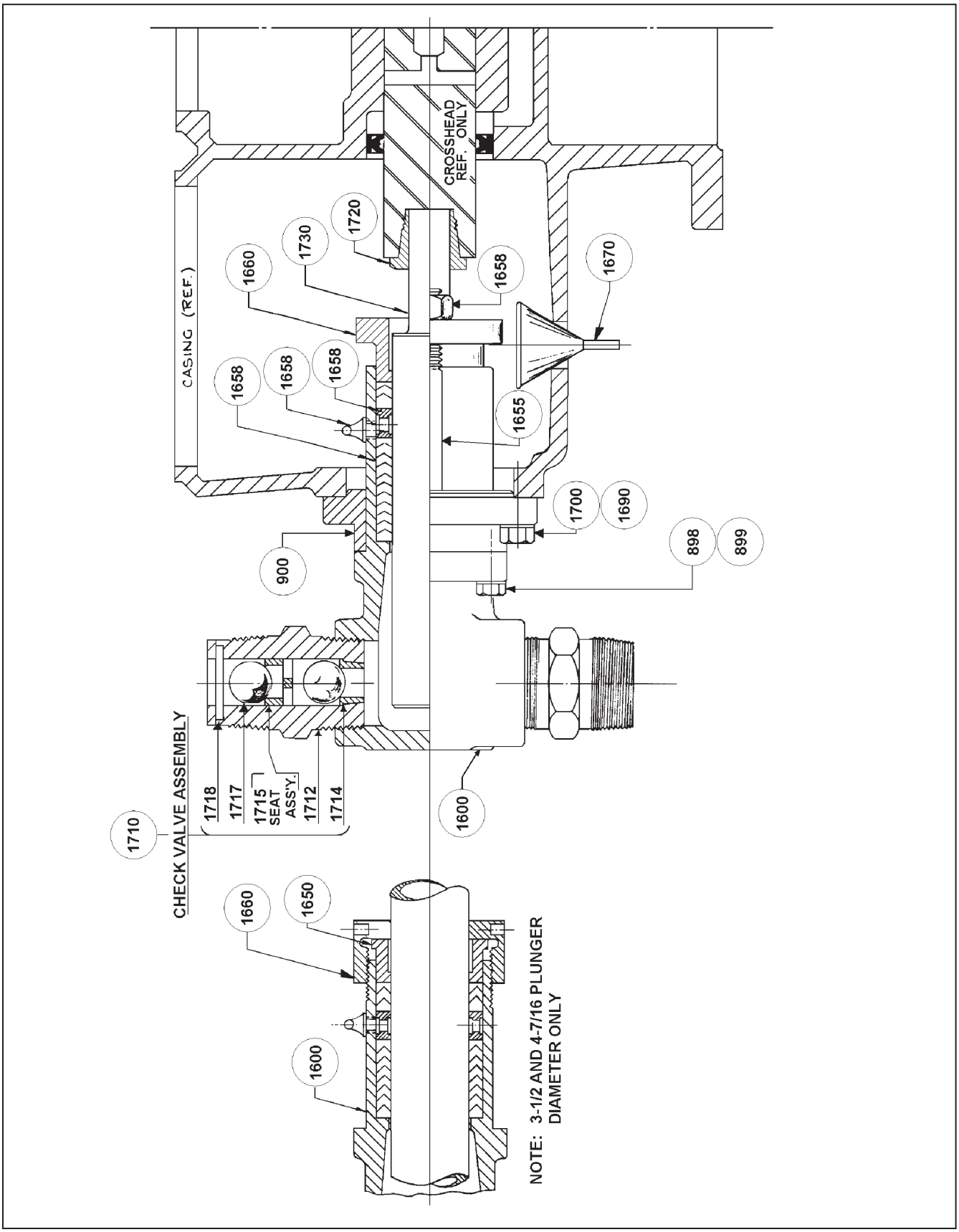

Figure 11. Liquid End Assembly (Plungers 2” THRU 4-7/16”) For All Dates Of Manufacture. Cast Body Design. (DWG 102-2285-0007)

6.8 PARTS LIST - PLUNGERS 2” AND 2-1/2” - FOR ALL DATES OF MANUFACTURE, CAST BODY DESIGN.

PACKING/PLUNGER MATERIAL	CODE	PACKING/PLUNGER MATERIAL	CODE
316SS Liquid End, 0-1500 psig, Teflon Braid 5022 AFP, 316SS Plgr.	TM	316SS Liquid End, 0-1500 psig, Teflon Braid 5022 AFP, Ceramic Plgr.	BC
316SS Liquid End, 0-1500 psig, Nitrile Fabric and 316SS Plgr.	NM		

ITEM No.	DESCRIPTION	PART NO. (5/8”, 0-5000 psig, 316SS) Code 10	PART NO. (5/8”, 0-5000 psig, Alloy 20) Code 10	PACKING/ PLUNGER MATERIAL	QTY
898	HEX HD SCR 1/2-13 X 1-1/2 STL	4050020144			4
	HEX HD SCR 5/8-11 X 1-1/2 GR5		4050021148		4
899	SPRING LOCK WASHER 1/2 18.8SS	4040043022			4
	SPRING LOCK WASHER 5/8 18.8SS		4040044022		4
900	LIQUID END ADAPTER	2720038001	2720038101		1
1600	LIQUID END, 316SS	2210055116	2210057116		1
1655	STUD	2320006106	2320006106		2
1658	HEX NUT 5/8-11 GR8	4050069019	4050069019		2
1660	GLAND CAP 316SS	2080005116	2080006016		1
1670	FUNNEL	4070124000	4070124000		1
1690	WASHER, SPRING LOCK, 3/4 18.8SS	4040045022	4040045022		4
1700	SCREW, HEX HEAD, 3/4-10 X 2 STL	4050033164	4050033164		4
1710	CHECK VALVE ASSY 1-1/2, 316SS	2210060002	2210062002		2
6085	CATCHALL COVER ASSEMBLY	2810296002	2810296002		1
6090	SCREW, PAN HEAD, 1/4-20X3/4	4050213072	4050213072		6
8002	MOTOR ROTATION ARROW	4120007010	4120007010		2
8004	DECAL, CAPACITY ADJ LOCK	2530022000	2530022000		1
8005	STICKER, CAUTION	2530006099	2530006099		1
1650, 1770	PLUG, 1/8 NPT HEX HEAD	4020012013	4020012013		2
STANDARD BRAIDED PACKING PARTS					
1625	FITTING, GREASE, LEAKPROOF	4070013000	4070013000		1

- Parts Not Illustrated

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ITEM No.	DESCRIPTION	PART NO. (5/8", 0-5000 psig, 316SS) Code 10	PART NO. (5/8", 0-5000 psig, Alloy 20) Code 10	PACKING/ PLUNGER MATERIAL	QTY
OILER (OPTIONAL)					
1610	ELBOW, MALE 1/4T X 1/8 NPT 316SS	A1-0012	A1-0012		2
1760	TUBING, 1/4 X 0.035 WALL 316SS	C7-0027	C7-0027		5 IN.
1790	BRACKET, OILING SYSTEM	1791534006	1791534006		1
1800	NUT, RETAINING	1791535006	1791535006		1
1810	NUT, TRU-SEAL, 1-11.5 NPT	4080033061	4080033061		1
1830	RESERVOIR, OIL-RITE	4070346000	4070346000		1
1840	VALVE SIGHT FEED, OIL-RITE	4070347000	4070347000		1
1850	ELBOW, MALE, 1/4T X 1/8 NPT	A1-0012	A1-0012		2
	ELBOW, FEMALE, 1/4T X 1/8 NPT	4020604040	4020604040		1
1860	TUBING 1/4 X 0.035 WALL 316SS	C7-0027	C7-0027		18 IN
1870	PLUG, 1/4 NPT SQ. HEAD	4020009111	4020009111		1
PACKING AND PLUNGER					
1640	PACKING 5022	4083001254	4083001264	TM	1
1641	LANTERN RING 316SS	2060002016	2060003016	TM	1
1720	PLUNGER ADAPTER, 5/8" HOLE	2720026306	2720026306	TM	1
1730	PLUNGER ASSEMBLY, 316SS	2120021116	2120021216	TM	1
1640	PACKING 8048 2 X 2-3/4 X 2-7/8	4080085281		NM	1
	PACKING 8048 2-1/2 X 3-1/4 X 2-15/16		4080085331	NM	1
1641	LANTERN RING 316SS	2060002016	2060003016	NM	1
1720	PLUNGER ADAPTER, 5/8" HOLE	2720026306	2720026306	NM	1
1730	PLUNGER ASSEMBLY, 346SS	2120021116	2120021216	NM	1
1640	PACKING 5022	4083001254	4083001264	BC	1
1641	LANTERN RING 316SS	2060002016	2060003016	BC	1
1720	PLUNGER ADAPTER 1-1/2" HOLE	2720026606	2720026606	BC	1
1730	PLUNGER ASSEMBLY, CERAMIC,	2120025193	2120025493	BC	1

- Parts Not Illustrated

Parts Continued Next Page

6.9 PARTS LIST - PLUNGERS 3-1/2” AND 4-7/16” - FOR ALL DATES OF MANUFACTURE, CAST BODY.

PACKING/PLUNGER MATERIAL	CODE	PACKING/PLUNGER MATERIAL	CODE
316SS Liquid End, 0-1500 psig, Teflon Braid 5022 AFP, 316SS Plgr.	TM	316SS Liquid End, 0-1500 psig, Teflon Braid 5022 AFP, Ceramic Plgr.	BC
316SS Liquid End, 0-1500 psig, Nitrile Fabric 316SS Plgr.	NM		

ITEM No.	DESCRIPTION	PART NO. (3-1/2”) Code 56	PART NO. (4-7/16”)Code 71	PACKING/ PLUNGER MATERIAL	QTY
1600	LIQUID END	2210059116	2210270016		1
1650	PACKING FOLLOWER, 316SS	2440002016	2440007016		1
1660	GLAND CAP 316SS	2080013016	7008A067116		1
1670	FUNNEL	2490051000			1
1690	WASHER, SPRING LOCK, 3/4 18.8SS	4040045022	4040045022		4
1700	SCREW, HEX HEAD, 3/4-10 X 2 STL	4050022161	4050022161		4
1710	CHECK VALVE ASSY 3-1/2, 316SS	2210064002	2210064002		2
6085	CATCHALL COVER ASSEMBLY	2810296002	2810296002		1
6090	SCREW, PAN HEAD, 1/4-20X3/4	4050213072	4050213072		6
8002	MOTOR ROTATION ARROW	4120007010	4120007010		2
8004	DECAL, CAPACITY ADJ LOCK	2530022000	2530022000		1
8005	STICKER, CAUTION	2530006099	2530006099		1
8030	FACE SPANNER, SIZE 484		4130002130		1
1650, 1770	PLUG, 1/8 NPT HEX HEAD	4020012013	4020012013		2
STANDARD BRAIDED PACKING PARTS					
1625	FITTING, GREASE, LEAKPROOF	4070001000	4070001000		1

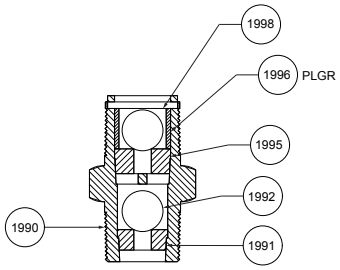
- Parts Not Illustrated

Parts Continued Next Page

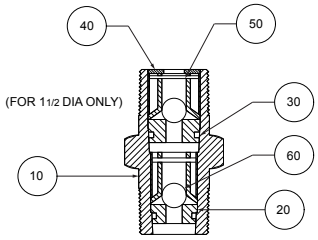
ITEM No.	DESCRIPTION	PART NO. (3-1/2") Code 56	PART NO. (4-7/16")Code 71	PACKING/ PLUNGER MATERIAL	QTY
OILER (OPTIONAL)					
1610	ELBOW, MALE 1/4T X 1/8 NPT 316SS	A1-0012	A1-0012		2
1760	TUBING, 1/4 X 0.035 WALL 316SS	C7-0027	C7-0027		5 IN.
1790	BRACKET, OILING SYSTEM	1791534006	1791534006		1
1800	NUT, RETAINING	1791535006	1791535006		1
1810	NUT, TRU-SEAL, 1-11.5 NPT	4080033061	4080033061		1
1830	RESERVOIR, OIL-RITE	4070346000	4070346000		1
1840	VALVE SIGHT FEED, OIL-RITE	4070347000	4070347000		1
1850	ELBOW, MALE, 1/4T X 1/8 NPT	A1-0012	A1-0012		2
	ELBOW, FEMALE, 1/4T X 1/8 NPT	4020604040	4020604040		1
1860	TUBING 1/4 X 0.035 WALL 316SS	C7-0027	C7-0027		18 IN.
1870	PLUG, 1/4 NPT SQ. HEAD	4020009111	4020009111		1
PACKING AND PLUNGER					
1640	PACKING 5022 3-1/2 SET	4083001284	4083007328	TM	1
1644	LANTERN RING 316SS	2060004016	2060005016	TM	1
1720	PLUNGER ADAPTER 5/8	2720026606	2720026506	TM	1
1730	PLUNGER ASSEMBLY 316SS	2120021316	2120066016	TM	1
1640	PACKING, 3 1/2 X 4-1/4 X 3-11/16, NITRILE	4080085351		NM	1
	PACKING, 4-7/16 X 5-5/16 X 2-1/2, NITRILE		4080085371	NM	1
1644	LANTERN RING 316SS	2060004016	2060005016	NM	1
1730	PLUNGER ADAPTER 5/8	2720026306		NM	1
1730	PLUNGER ASSEMBLY 316SS	2120021316	2120066016	NM	1
1640	PACKING 5022 1-1/2 8 RING SET	4083001284	4083007328	BC	1
1644	LANTERN RING 316SS	2060004016	2060005016	BC	1
1720	PLUNGER ADAPTER 1-1/8"	2720026606	2720026506	BC	1
1730	PLUNGER ASSEMBLY, 3-1/2 CERAMIC,	2120025393	2120025593	BC	1

- Parts Not Illustrated

Parts Continued Next Page



Detail No. 1
Check Valve
1 1/2" PLGR.



Detail No. 2
Check Valve
5/8", 7/8" and 1/8" Plgr.

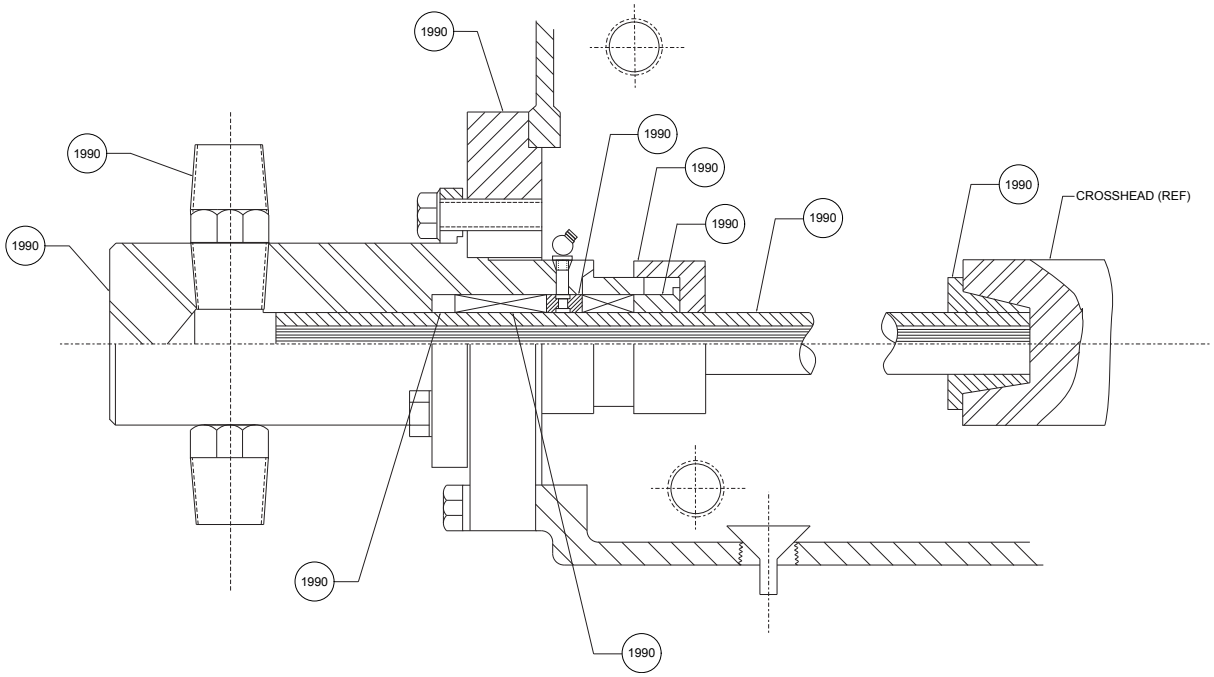


Figure 12. Liquid End Assembly (Plungers 7/16" THRU 1-1/2) Manufactured before 1996. Design Uses Adapter Plate (Item, 900)

6.10 PARTS LIST - (PLUNGERS 7/16” THRU 1-1/2”) MANUFACTURED BEFORE 1996. DESIGN USES ADAPTER PLATE (ITEM 900).

6.10.1 PLUNGERS 7/16” AND 5/8”

ITEM No.	DESCRIPTION	PART NO. (7/16” PLUNGER)	PART NO. (5/8” PLUNGER)	MATERIAL	QTY
1644	LANTERN RING (2 PIECE SET ONLY)	2060001216	2060001316	316SS	2
		2060001228	2060001328	ALLOY 20	2
1642	NECK RING	2070001216	2070001316	316SS	1
		2070001228	2070001328	ALLOY 20	1
1660	GLAND CAP	2080010016	2080010016	316SS	1
		2080010028	2080010028	ALLOY 20	1
1730	PLUNGER ASSEMBLY	2120020017		17-4 SS	1
			USE 2120020193	316SS	
		2120020028	USE 2120020193	ALLOY 20	1
			2120020193	CERAMIC	1
1600	LIQUID END (DISPL. CHAMBER)	2210338216	2210338216	316SS	1
				ALLOY 20	1
1710	CHECK VALVE ASSY	2210207002	2210207002	316SS	2
		2210207003	2210207003	ALLOY 20	2
1712	CHECK VALVE BODY	2210716016	2210716016	316SS	1
		2210716028	2210716028	ALLOY 20	1
30	SEAT	2240025016	2240025016	316SS	4
		2240025028	2240025028	ALLOY 20	4
20	O-RING 7/16 X 3/32 TEFLON	2250032175	2250032175	TEFLON	4
40	RING INSERT	2430049316	2430049316	316SS	1
		2430049328	2430049328	ALLOY 20	1
1650	GLAND FOLLOWER	2440004216	2440004316	316SS	1
		2440004228	2440004328	ALLOY 20	1
900	ADAPTER, LIQUID END	2720037301	2720037301	STEEL	1
1720	PLUNGER ADAPTER	2720026206	2720026306	STEEL	1
1718	LIMIT PIN 3/16 X 1-11/16 316SS	2920010216	2920010216	316SS	4
		2920010228	2920010228	ALLOY 20	4
60	BALL, 3/8	4070014112	4070014112	316SS	4
		4070014113	4070014113	ALLOY 20	4
1658	PACKING, 7/16” X 1-1/8” X 3-1/32”	4080085061		8048	1
	5/8” X 1-1/8” X 3-7/32”		4080085091	8048	1
	7/16” X 1-1/8” X 11/32”	4083001224		5022 Teflon	1
	5/8” X 1-1/8” X 2”		4083001064	5022 Teflon	1
	7/16” X 1-1/8” X 3”	40116		8764 Teflon	1
	5/8” X 1-1/8” X 3”		40117	8764 Teflon	1

6.10.2 PLUNGERS 7/8” AND 1-1/8”

ITEM No.	DESCRIPTION	PART NO. (7/8” PLUNGER)	PART NO. (1-1/8” PLUNGER)	MATERIAL	QTY
1644	LANTERN RING (2 PIECE SET ONLY)	2060001416	2060001516	316SS	2
		2060001428			1
			2060001528	ALLOY 20	1
1642	NECK RING	2070001416	2070001516	316SS	1
		2070001428	2070001528	ALLOY 20	1
1660	GLAND CAP	2080011016	2080011016	316SS	1
		2080011028	2080011028	ALLOY 20	1
1730	PLUNGER ASSEMBLY	USE 2120020293	USE 2120020393	316 SS	1
		USE 2120020293	USE 2120020393	ALLOY 20	1
			2120020393	CERAMIC	1
1600	LIQUID END (DISPL. CHAMBER)	2210338316	2210338416	316SS	1
		2210338328	2210338428	ALLOY 20	1
1710	CHECK VALVE ASSY	2210263002	2210263002	316SS	2
		2210263003	2210263003	ALLOY 20	2
1712	CHECK VALVE BODY	2210717016	2210717016	316SS	1
		2210717028	2210717028	ALLOY 20	1
30	SEAT	2240029016	2240029016	316SS	4
		2240029028	2240029028	ALLOY 20	4
20	SEAL 0.915 ID X 1.197OD X 0.141 THK	2250043075	2250043075	TEFLON	4
40	RING INSERT	2430049216	2430049216	316SS	1
		2430049228	2430049228	ALLOY 20	1
1650	GLAND FOLLOWER	2440005116	2440005216	316SS	1
		2440005126	2440005228	ALLOY 20	1
900	ADAPTER, LIQUID END	2720038001	2720038001	STEEL	1
1720	PLUNGER ADAPTER	2720026406	2720026506	STEEL	1
1718	LIMIT PIN 3/16 X 1-11/16 316SS	2920016016	2920016016	316SS	4
		2920016028	2920016028	ALLOY 20	4
60	BALL, 7/8	4070014212	4070014212	316SS	4
		4070014213	4070014213	ALLOY 20	4
1658	PACKING, 7/8” X 1-1/8” X 3-3/16”	4080085151		8048	1
	1-1/8” X 1-5/8” X 3-1/8”		4080085531	8048	1
	7/8”ID X 1-3/8” OD	4083001074		5022 Teflon	1
	1-1/8”		4083001094	5022 Teflon	1
	7/8” X 1-3/8” X 3”	40118		8764 Teflon	1
	1-1/8” X 1-5/8” X 3”		40119	8764 Teflon	1

6.10.3 PLUNGERS 1-1/2”

ITEM NO.	DESCRIPTION	PART NO. (1-1/2” PLUNGER)	MATERIAL	QTY
1900	BALL GUIDE	2030017016	316SS	1
		2030017028	ALLOY 20	1
1644	LANTERN RING (2 PIECE SET ONLY)	2060001716	316SS	2
		2060001728	ALLOY 20	2
1642	NECK RING	2070001616	316SS	1
		2070001628	ALLOY 20	1
1660	GLAND CAP	2080012016	316SS	1
		2080012026	ALLOY 20	1
1730	PLUNGER ASSEMBLY	2120020616	316 SS	1
		USE 2120020693	ALLOY 20	1
		2120020693	CERAMIC	1
1600	LIQUID END (DISPL. CHAMBER)	2210338516	316SS	1
		2210338526	ALLOY 20	1
1710	CHECK VALVE ASSY	2210712002	316SS	2
		2210712003	ALLOY 20	2
1712	CHECK VALVE BODY	2210061016	316SS	1
		2210061029	ALLOY 20	1
1715	UPPER SEAT	2240018016	316SS	1
		2240018028	ALLOY 20	1
1714	LOWER SEAT	2240008016	316SS	4
		2240008028	ALLOY 20	4
1650	GLAND FOLLOWER	2440006016	316SS	1
		2440006026	ALLOY 20	1
900	ADAPTER, LIQUID END	2720038001	STEEL	1
1720	PLUNGER ADAPTER	2720026606	STEEL	1
1718	LIMIT PIN 3/16 X 1-11/16 316SS	2920012116	316SS	2
		2920012128	ALLOY 20	2
1717	BALL, 1-1/8	4070014242	316SS	4
		4070014243	ALLOY 20	4
1658	PACKING, 7/8” X 1-1/8” X 3-3/16”		8048	1
	7/8”ID X 1-3/8” OD		5022 Teflon	1
	7/8” X 1-3/8” X 3”		8764 Teflon	1

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