Flow

ESL INTENSIFIER

M-310 | REV. G | JANUARY 2009

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Contents

Introduction

This manual will help you become familiar with your new Flow International equipment. Information was compiled from the most current information available at the time of publication.

Safety

A comprehensive list of safety precautions is located in your pump manual. These precautions must be reviewed and understood by operating and maintenance personnel before installing, operating or servicing the equipment. The high-pressure waterjet system is a powerful cutting tool and must always be treated with respect.

Warnings, cautions, and notes

Before operating the equipment, please thoroughly understand and adhere to all warnings, cautions, and notes that appear in this manual. These are defined as follows:

WARNING
Highlights an operating or service procedure or condition that can result in death or serious injury to personnel.

CAUTION
Highlights an operating or service procedure or condition that can lead to impaired system operation or equipment damage.

Note: Highlights an operating or service procedure or condition that is essential for efficient operation and service.

Related documents

Your equipment was shipped with several manuals. Some are shipped with every system; others are specific depending on the model of intensifier pump purchased. Other manuals than those listed may have been shipped with your system if the ESL intensifier was installed as a retrofit kit.

Every system comes with the following manual:

- M-127, Small High-Pressure Components

One of these pump and/or system manuals was shipped with the equipment:

- M-287, 7X Intensifier Pump
- M-294, 25X Intensifier Pump
- M-331, 20XW Intensifier Pump
- M-368, IFB DWJ 50iS
- M-371, IFB 50iS
- M-378, IFB DWJ 100iD
- M-380, IFB 100iD
- M-373, WMC2 50iS
- M-375, WMC2 100iD
- M-377, 30XQ Pump
- M-384, IFB StoneCrafter
- M-387, 30SA Intensifier Pump

ESL intensifier description

The ESL intensifier is available in 60,000 psi (4138 bar) and 40,000 psi (2759 bar) output water pressure ratings.

Specifications

Diameter .....7 in. (178 mm)
Length .....32 in. (809 mm)
Weight .....105 lb (48 kg)
Type of shift.....electric
Output pressures.....60K/20:1, 40K/20:1
Hydraulic oil
kinematic viscosity.....310 SSU @ 100°F (38°C)

Hydraulic oil

Oil must be ISO viscosity grade 46. The following oils are recommended, but other manufacturer's equivalents can be used.

- Mobil DTE Medium or DTE 25
- Shell Turbo T 46
- Chevron Turbine Oil GST 46
- Texaco Regal R&O 46

Operating principles

The intensifier pump consists of a hydraulic system, a high-pressure water delivery system, and a control system. Details of the control, hydraulic oil, and high-pressure water systems can be found in the following manuals:

- Intensifier pump manual or the intensifier pump chapter of an IFB or WMC system manual
- MS-2275, Ultrahigh-Pressure Pump Operating Principles

Periodic maintenance

Daily inspections and periodic maintenance will help you get the maximum life, safety, and efficiency from your FLOW equipment. Periodic maintenance is regularly scheduled preventive maintenance and includes replacing worn parts that have reached the end of their service life. It will help minimize unscheduled down time, maximize equipment use, and eliminate unsafe operating conditions.

Flow recommends that you use a maintenance and service log to record all service work. Maintenance Log MS-2258 is provided on the CD.

Note: Review all maintenance precautions and safety instructions listed in the intensifier pump manual.

Maintenance tips

- Stock enough spare parts to minimize downtime and help avoid rush part orders.
- Practice good housekeeping.
- Assign a complete set of service tools to the workstation.

Maintenance precautions

- Protect all machined and lapped mating surfaces from damage.
- Carefully work out any damage to seal surfaces, or seal damage and leaks will be a recurring problem.
- Carefully clean and blow out all parts being reassembled. Do not use paper towels.
- Do not use any substitutes for the sealants and lubricants recommended by Flow.

Torque specifications

Refer to the following table when specific torque requirements are not listed in a service procedure. Mounting bolts and machine screws shall not be torqued beyond the manufacturer's recommended limits.

High-pressure gland nuts	*U.S. (ft-lb)*	*SI (N-m)*
¼ in.	15-25	20-34
⅜ in.	35-45	47-60
9⁄16 in.	60-75	80-100

Note: Before assembly, lubricate threads of all high-pressure tubing connections with Blue Lubricant.

Troubleshooting

Intensifier weep hole identification

Water leaking from weep holes can provide clues to the condition of components, depending on the temperature and force of the water.

Included with this manual is an intensifier troubleshooting illustration that identifies the weep holes described below.

Check valve outlet body

Leakage can be caused by the following:

- Loose high-pressure connection
- Cracked or scored check valve outlet body
- Scored high-pressure tubing

Repair any problems immediately.

Main check valve body

Leakage can be caused by a loose connection and/or a cracked or scored main body, insert, or outlet body. Repair any problems immediately.

End cap

High-pressure water seal seepage is the most common cause for end cap weep hole leakage. It can be caused by a loose end cap, failure of the high-pressure seal between the cylinder and check valve main body, failure of check valve body o-rings, or a cracked or scored high-pressure water cylinder or check valve main body.

Cold water leaking from this weep hole can be caused by a damaged o-ring on the check valve body or a damaged high-pressure seal, whether or not the intensifier is running.

Check leakage quantity. If seepage is very gradually increasing, has not suddenly appeared, is no more than lukewarm, and is less than two teaspoons (0.8 oz/23 ml) per stroke, it is safe to continue to operate the pump. See *Intensifier Service Notes*.

End bell

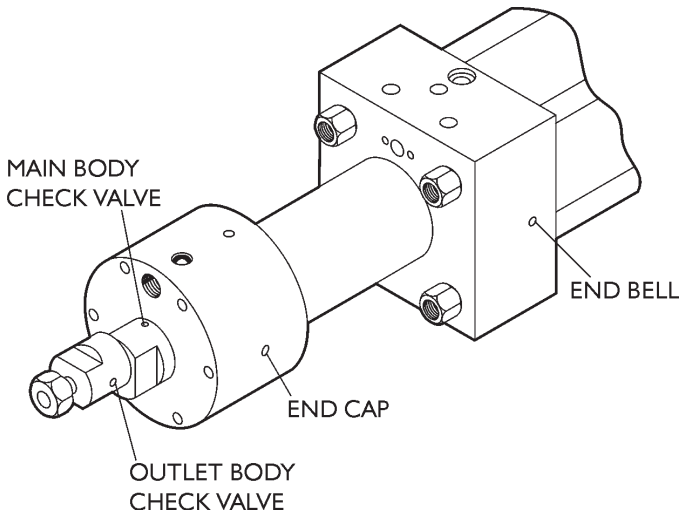
The weep hole is drilled into the void separating the hydraulic oil cylinder and the high-pressure water cylinder. Hydraulic oil leakage can be caused by:

- Failure of the end bell hydraulic oil seal and/or
- Cracked or scored end bell or plunger

Leakage is usually due to end bell oil seal damage. Normal oil seal leakage can be up to one drip per hour.

Water leakage from the end bell weep hole is usually caused by failure of the high-pressure water seal located in the end of the cylinder, but can also result from a cracked or scored high-pressure water cylinder or plunger.

Check leakage quantity. If seepage very gradually increases, has not suddenly appeared, is no more than lukewarm, and is less than two teaspoons (0.8 oz/23 ml) per stroke, it is safe to continue to operate the pump. See *Intensifier Service Notes*.



Troubleshooting guide

The troubleshooting guide will help you identify the probable cause of a system malfunction and the most effective corrective action.

Using the troubleshooting guide

The probable causes of each malfunction are listed in order from the most likely to the least likely to occur. The corrective action is a condensed summary of the service required to remedy the problem. When you encounter a system malfunction:

1. Carefully and precisely define the problem.
2. On the troubleshooting table, locate the symptom that most closely resembles your assessment of the problem.
3. Identify the most likely probable cause.
4. Follow the corrective action procedure.

If the symptoms in the chart do not correspond to your malfunction, or if the problem is not resolved or eliminated by the recommended corrective action, contact Flow Technical Service.

Troubleshooting guide

1. Intensifier strokes unevenly	
Leaky check valve (inlet or outlet) on one side only	Replace or rework the check valves as necessary. For best results, lap or replace all check valves at the same time.
Foreign particles trapped between check valve and seat	1. Remove the end cap(s). Eliminate the sources of contamination to prevent problem from recurring. 2. Examine the check valves and remove any foreign material. Relap if necessary. 3. Clean all parts and reassemble.
Worn/bent shift cable or associated parts (mechanical shift only)	1. Remove the shift cable guide. 2. Install the spare shift cable guide and recheck. Replace any worn parts.
High-pressure water plunger has separated from the oil piston	Associated with a drop in output water pressure and flow. Avoid prolonged operation under this condition—it will cause severe damage to the intensifier. Disassemble the hydraulic oil cylinder and piston and replace parts if defective.
Wrong shift/actuator pins installed	Replace with bronze shift/actuator pins (002226-1 mechanical shift; B-1702-1 electric shift).
Debris in shift circuit	Check spool movement on both the pilot and shift valves. Inspect spools for defects. Hand lap with 600 grit paper. If unable to remove defects, replace valve.
2. Intensifier knocks severely	
Low inlet water pressure to the intensifier	1. Make sure the inlet water pressure output is above the required minimum for your intensifier pump. 2. Replace filters in filtration system; make sure they are replaced in the same order they were removed.
Intensifier inlet passages clogged by debris or corrosion	1. Inspect the filtered water inlet lines. 2. Remove the end cap. Inspect and remove any foreign material clogging the inlet passages. 3. Inspect the check valve.
Sticky outlet check valve poppet	1. Remove the end cap. 2. Relap the check valve poppet and the insert; reinstall.
3. Oil leakage from end bell weep hole	
Worn end bell oil seal	Replace the end bell oil seals. Replace all oil seals at the same time.
4. Oil leaking from manifold/end bell interface	
Defective/worn o-ring seals, or loose manifold mounting screws or port plugs on valve	Retorque the manifold mounting screws, following the torque values provided in this section. If leak will not stop, replace the o-ring interface seals between the manifold and the end bells. Lap manifold if the o-ring surface is nicked.

Misaligned end bells	1. Remove intensifier from pump and place on assembly fixture. 2. Loosen tie rods and retorque. Confirm that end bells are aligned correctly.

5. Oil leaking from manifold/shift valve interface

Defective or worn o-ring seals; loose shift valve mounting screws	Retorque the shift valve mounting screws, using torque values in this manual. If leak doesn't stop, replace interface o-ring seals between manifold and shift valve.

6. Oil leaking from shift valve/pilot valve interface

Defective/worn o-rings, loose pilot valve mounting screws, or incorrect torque	Retorque pilot valve mounting screws, following the torque values in this manual. If leak won't stop, replace interface o-ring seals between pilot valve and shift valve.

7. Water leaking from end bell weep hole

Worn high-pressure water seal	Replace all high-pressure water seals and seal backup rings. Be careful not to scratch the water cylinder during seal extraction and insertion.
Fractured high-pressure water cylinder at the end bell side	Replace water cylinder and seals. Be careful not to scratch the high-pressure water cylinder during seal insertion.
Worn high-pressure water plunger	1. Inspect plunger diameter. The diametrical clearance between plunger and new backup ring must be less than 0.002 inch (0.05 mm). Replace if scratched, pitted or below tolerance. 2. Replace water seals and seal backup ring.

8. Water leaking from end cap weep hole

Worn HP water seal	Replace high-pressure water seal.
Damaged low-pressure water seal o-rings on the check valve body	Replace water seal o-rings. Do not pinch the o-ring seals when installing check valve housing.
Fractured high-pressure water cylinder	Replace cylinder and high-pressure seals. After replacement, increase pressure gradually.
Fractured check valve body	Inspect for fractures. Replace check valve body if required. Replace all water seals.
End cap incorrectly assembled to high-pressure cylinder	Remove end cap and reassemble. Replace HP water seal (if damaged).

9. Short high-pressure water seal life

Excessive clearance between seal backup ring and HP water plunger	1. Remove HP water cylinder. Replace all HP water seals (backup ring, seal, hoop, and o-ring). 2. Examine HP plunger. Replace if diameter is less than specified or if surface roughness is greater than 4 micro-inch RMS. ***Caution:*** High-pressure seal rings must be replaced whenever high-pressure seals are replaced.
Scratched HP water plunger	Deep pits or scratches in excess of 10 micro-inches will cause premature high-pressure water seal failure. Replace as necessary.

Excessively worn HP water cylinder	Examine for wear, particularly at the ends of the bore. Replace if ID is greater than specified. Replace if pitted or eroded in seal areas.
Contaminated water	Analyze water sample. Inspect water filters.

10. Water leaking from check valve weep hole

Worn or damaged outlet check valve insert and/or poppet Loose outer body adapter or outlet body	Rework or replace outlet check valve insert and poppet. Always torque fittings to the recommended torque value.

11. Fractured high-pressure water cylinder

Stress fatigue	Replace HP water cylinder. The cylinder has a limited fatigue life, and will require periodic replacement depending on the application. Premature failure is primarily attributed to scratches in the bore. Replace all water seals whenever replacing the high-pressure water cylinder. Record service intervals and work for future reference.

12. Fractured check valve body

Stress fatigue	Replace HP water cylinder. The cylinder has a limited fatigue life, and will require periodic replacement depending on the application. Premature failure is primarily attributed to scratches caused during assembly or installation. Relap or replace the check valves if the HP water cylinder is replaced.

Service procedures

The service procedures contain step-by-step instructions and illustrations to explain how to service the equipment. Service procedures cover how to replace parts during scheduled or unscheduled maintenance, and also include preventive maintenance procedures to help ensure trouble-free operation of the machinery.

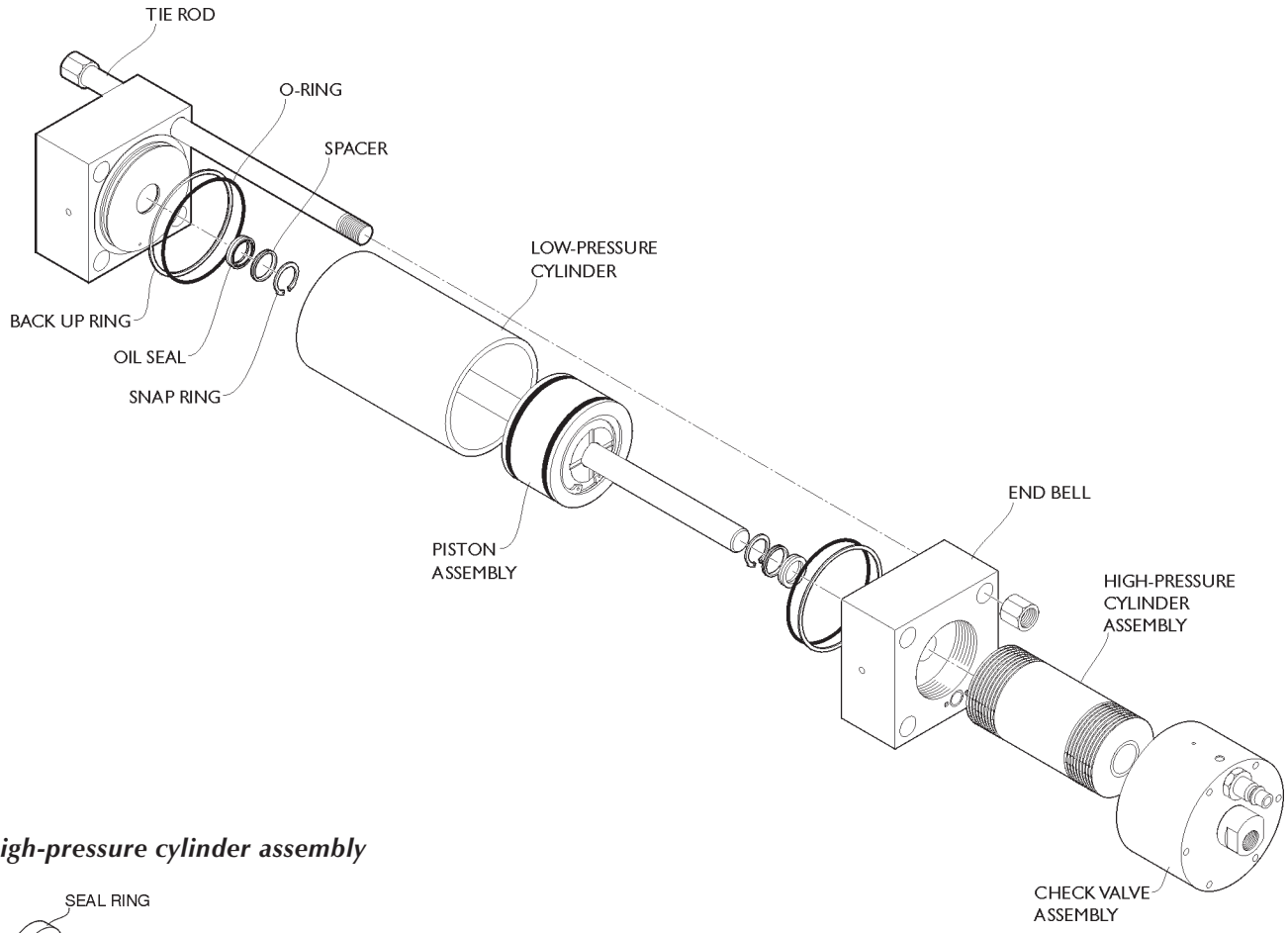
Note: Information on high-pressure components (such as swivels, filters, and tubing) is in manual M-127, Small High-Pressure Components.

Intensifier service notes

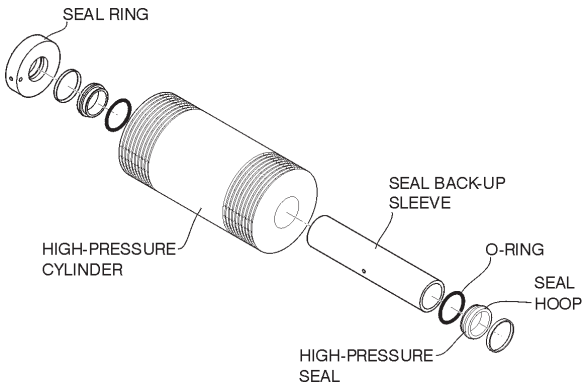
The following list was compiled from Flow customers, technicians, and operators. It can help to lower repair costs, shorten repair time, and increase component life.

- Read and understand each procedure before starting any work on the intensifier pump.
- Measure the amount of water seepage from the end cap and end bell weep hole. If less than 2 tsp (23 ml) per stroke and has not suddenly appeared or increased drastically, you do not need to immediately stop the pump and change seals. However you should schedule maintenance as soon as possible.
- Except for a complete overhaul or repairs involving the hydraulic oil cylinder, it is usually easier and quicker to work on the intensifier while it is in the cabinet (this is not recommended for dusty environments such as paper, fiberglass or plastic manufacturers).
- Immediately replace all cracked check valve parts and clean up leakage.
- All threaded high-pressure connections require a fresh, even coating of Blue Lubricant. Do not substitute another product.
- Clean all parts with a clean, non-residue solvent such as Citra-Safe or isopropyl alcohol. Use a dedicated solvent tank if possible. Contamination from other industrial parts will seriously reduce part life.
- All parts that contain high-pressure water (cylinder, check valve housing, tubing) are susceptible to stress fatigue accelerated by stress risers. Stress risers are caused by scratches, nicks or other surface disruptions. Rework damage or replace the component.
- High-pressure water seal life and the service life of other parts are related to the stress put on the parts—a function of stroke rate and water pressure. Exceeding the pump ratings can lead to increased cost and downtime.
- Keep all intensifier tools supplied with the pump in a separate locked cabinet. Substituting tools for those supplied by or available from Flow is not recommended.
- Use the intensifier assembly fixture when reassembling the hydraulic oil cylinder. Problems with manifolds and leaking o-rings are significantly reduced when the fixture is used.
- Keep the work area clean. When reassembling any intensifier, remember that clean hands, shop coat, rags, parts, tools, air, solvent, and lubricants all contribute to lower maintenance costs and reduced downtime.

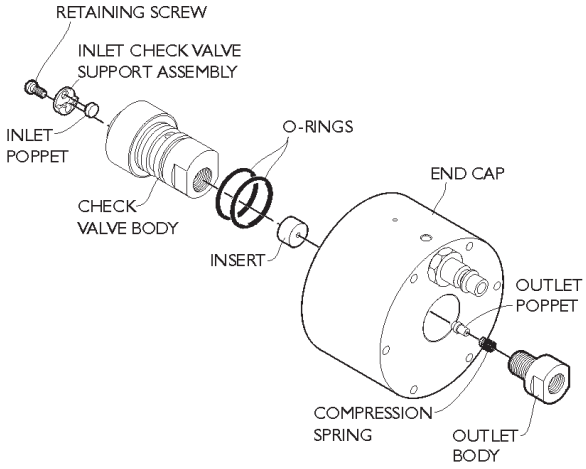
Major parts of the intensifier



High-pressure cylinder assembly



Check valve assembly



High-pressure water cylinder and seals

The intensifier requires no periodic maintenance. However, when seals leak excessively or if you find a stress fracture, repair the intensifier immediately. See *Intensifier weep hole identification*.

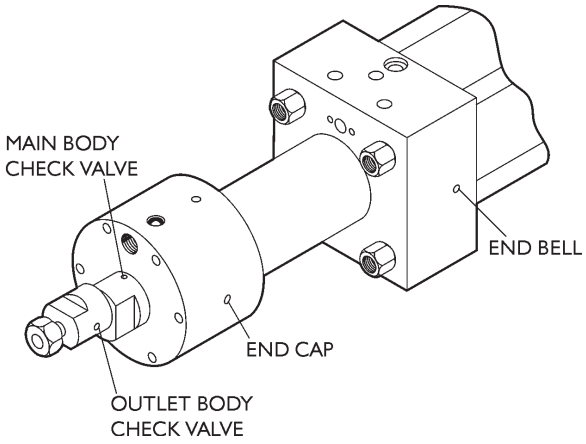
If you are servicing only the high-pressure water cylinder and related components, you can leave the intensifier mounted in the pump frame. Keep the work area clean and free of airborne fiber and dust.

Service steps

WARNING
Place the main electrical disconnect in the OFF position and bleed down all high-pressure lines. Place an *Out of Service* tag on the main electrical disconnect and lock it out. Failure to do so can cause equipment damage or injury to personnel.

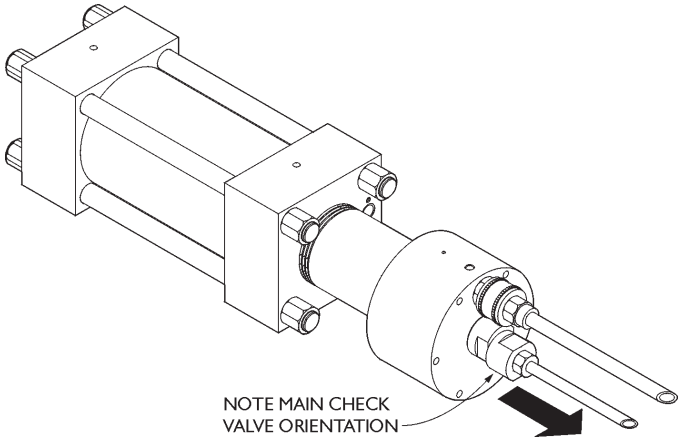
1. Shut down the system.
2. Disconnect the supply water hose at the quick-disconnect. Using two wrenches, disconnect the high-pressure water line from the check valve outlet body. Loosen the other end and move the tubing out of the way.

CAUTION
Do not bend or flex the high-pressure tubing—this can cause it to fail prematurely.



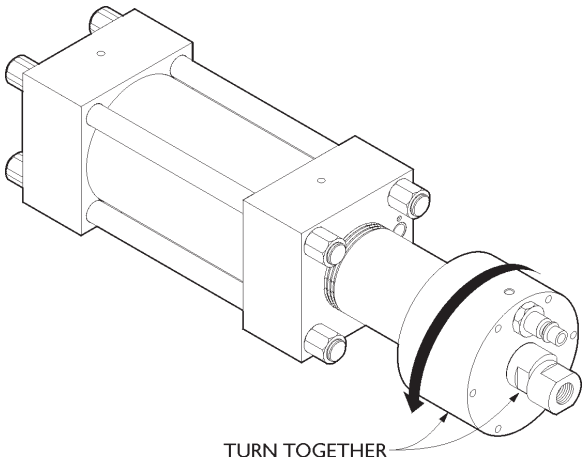
3. Note the orientation of the main check valve body, then loosen the end cap by tapping the spanner wrench with a mallet. If necessary, remove the cable guide, then hold onto the high-pressure water cylinder with a strap or girth wrench.

CAUTION
DO NOT grip the cylinder with any sharp-toothed tool. Surface scratches and gouges will lead to early part failure.



4. Unscrew the end cap from the cylinder by hand; make sure the check valve assembly and the end cap turn as an assembly.

CAUTION
If the check valve and end cap do not turn together, the check valve body o-rings can be damaged. If necessary, use a wrench.



5. Set the end cap aside. Flow recommends that you service the check valves at every regular seal replacement interval, following the procedure in *End Cap and Check Valve*.

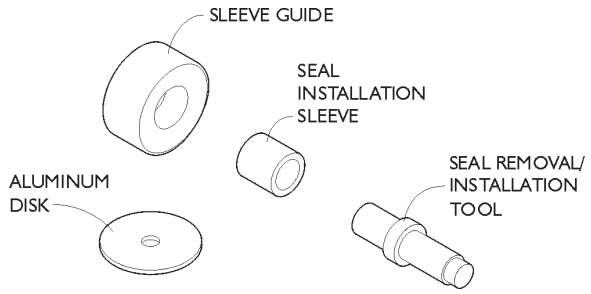
   When the check valve service is complete, continue with Step 6.

6. Loosen the high-pressure cylinder using a girth or strap wrench.

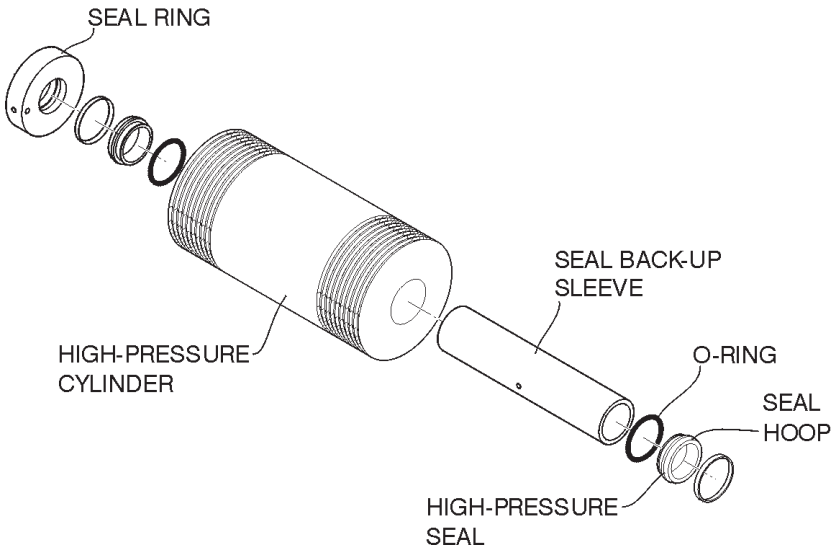
CAUTION
DO NOT grip the cylinder with any sharp-toothed tool. Surface scratches and gouges will lead to early part failure.

7. Remove the cylinder by hand, *carefully* sliding it off the plunger to avoid scoring the plunger or the seal backup sleeve (located inside the cylinder).
8. Use the seal tool to remove the high-pressure seals from the cylinder. Check the seals for flaws and replace as needed.

High-pressure seal tool kit



High-pressure cylinder assembly



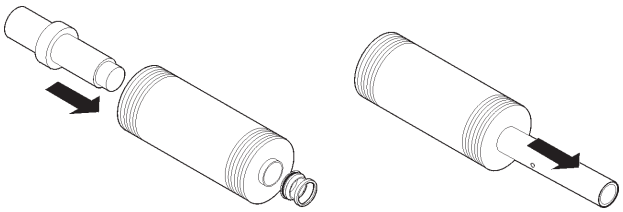
9. Remove and discard the seal ring. The seal ring is a wear item and is replaced at every seal change.
10. Clean the plunger and inspect for damage. The plunger must have a smooth surface with no scratches, pits, or other damage.

    Note: If the plunger is damaged, it must be replaced. Wrap the cylinder and end cap in a lint-free material and set aside. See *Hydraulic Oil Cylinder, Piston, Plunger and End Bell* for the replacement procedure.

    When the plunger has been replaced, continue with Step 11.

11. Clean and inspect all four components of the high-pressure seal tool kit, especially those surfaces that will contact the seal, backup sleeve, and cylinder. Smooth off any rough edges.
12. Place the high-pressure cylinder on a clean, dry shop towel. Using a mallet, tap the shouldered end of the seal installation tool into the end of the cylinder to remove the seal located in the opposite end.

    Repeat to remove the seal in the other end of the cylinder.



13. Remove the seal backup sleeve.
14. Carefully clean the high-pressure cylinder and backup sleeve.

    Note: High-pressure components must be cleaned in a non-residue solvent and allowed to air dry before reassembly.

15. Inspect all surfaces of the cylinder for damage or fatigue. Inspect the inside surface by looking through the cylinder angled toward a brightly lit white surface. If there is any damage to the interior, discard and replace the cylinder.

    CAUTION
    Do not reassemble any intensifier that has a damaged cylinder.

16. Inspect the sealing surfaces of the cylinder for roughness or damage. Minor build-up or erosion can be polished out by hand if done evenly. There must be no nicks or scratches on any sealing surface.
17. Inspect the seal backup sleeve for any signs of damage. The sleeve is a non-stressed part.

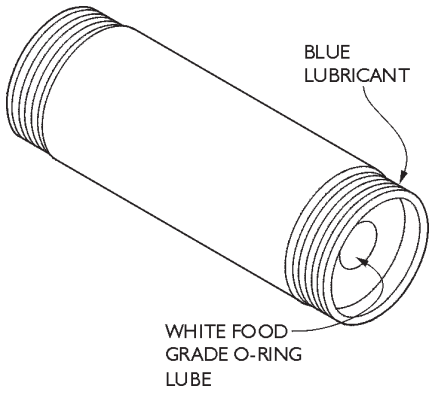
Reassembling the intensifier

The area around the intensifier must be free of surface or airborne grit. Clean hands, tools, shop coat, solvent, and work surface all contribute to reduced downtime and lower maintenance costs.

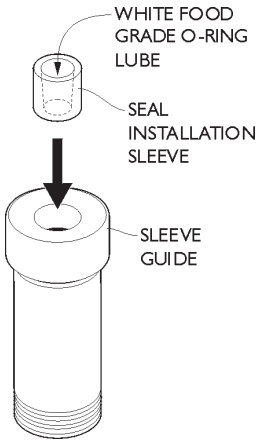
Note: Remember that when instructed to clean parts, it is necessary to first wipe all components with a rag to remove most of the Blue Lubricant (A-2185) and debris. Next, clean all components in an approved solvent and let them air dry.

18. Lubricate the inner surface of each cylinder end with white food grade o-ring lube (A-4689).
19. Apply a thin, even layer of Blue Lubricant to the threads on the cylinder and thread the sleeve guide onto the non-recessed end of the cylinder.

    Note: Threads and Blue Lubricant must not be contaminated with foreign material. If a brush is used to lubricate the threads, it must also be kept dirt-free.



20. Wipe the inner surface of the seal installation sleeve with white food grade o-ring lube and place it into the sleeve guide, small ID first. (The bore is tapered to compress the seal components during insertion.)



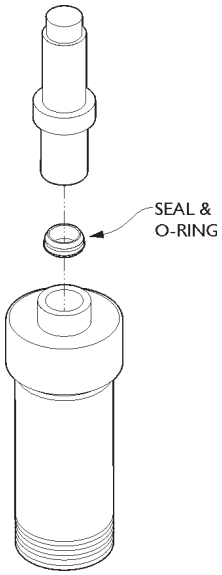
21. Lubricate the seal o-ring with white food grade o-ring lube and place it in the groove on the seal. Set the metal hoop aside.
22. Lubricate the high-pressure seal and the o-ring with white food grade o-ring lube and then place the seal (o-ring end first) into the sleeve.

    Note: Installing the metal hoop through the sleeve may reduce the hoop diameter. Reassembly is more difficult if the hoop will not remain seated in the cylinder.

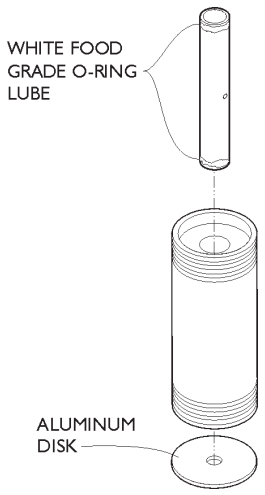
23. Insert the non-shouldered end of the tool into the sleeve and press the seal into the high-pressure cylinder.

    A slow, even movement will help keep the o-ring from rolling.

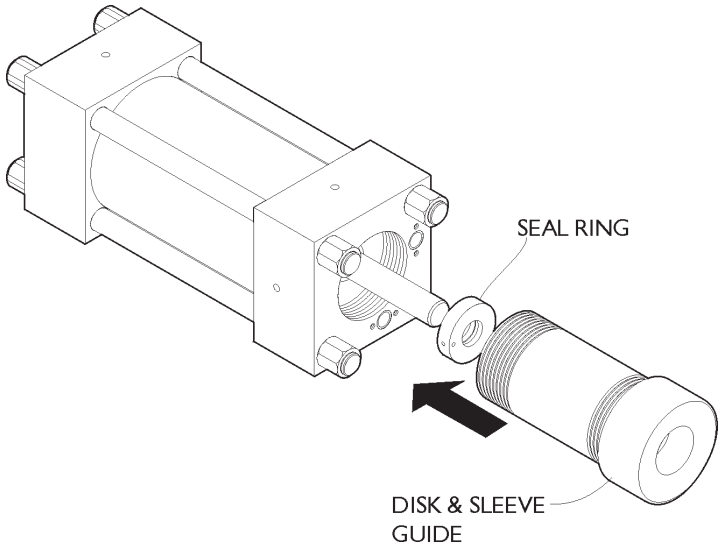
    Remove the tool, sleeve, and sleeve guide from the cylinder.



24. Lubricate inside and outside the hoop with white food grade o-ring lube. Reassemble the sleeve guide and sleeve onto the cylinder, place the hoop in the sleeve, and insert the hoop by tapping the installation tool lightly with a mallet.
25. Place the flat end of the cylinder on the aluminum disk. Lightly lubricate each end of the backup sleeve with white food grade o-ring lube; insert the sleeve into the cylinder. Take care not to damage parts or dislodge the seal and hoop.
    - Repeat Steps 21–25 to install the remaining seal assembly into the recessed end of the cylinder.



26. Place the aluminum disk on the non-recessed end of the cylinder. Thread the sleeve guide over it onto the cylinder. The disk prevents the seals, hoops, and sleeve from being dislodged while installing the cylinder.



27. Slide the new seal ring onto the plunger. It should fit tightly, but should slide along the plunger with only slight, intermittent resistance.

    Note: The seal ring is a wear item and must be replaced at every seal change.

28. Coat the plunger evenly with a thin layer of white food grade o-ring lube.
29. Coat the threads of the end bell with a thin layer of Blue Lubricant. Carefully slide the cylinder onto the plunger until it can be threaded into the end bell.

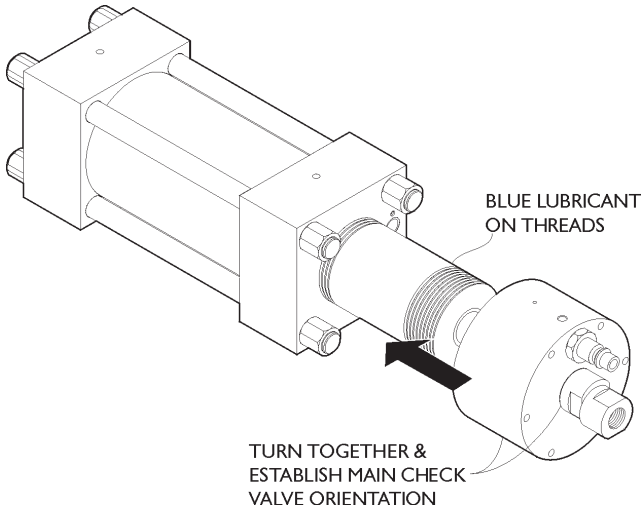
    Notes:

    - If the plunger has been fully retracted, the plunger will not contact the seal until the cylinder has been partially threaded onto the end bell. This will make installation easier.
    - Thread the cylinder on until hand tight. The cylinder should thread on easily and stop firmly. If you can turn the cylinder another ⅛ turn or more beyond full thread engagement, the hoop could be dislodged. Remove the cylinder and check for problems.
    - The high-pressure seals are fully functional at a torque value only slightly more than hand tight. Torquing the cylinder to a value greater than 120 ft-lb (88 N-m) is unnecessary and makes disassembly more difficult.
    - Never use a girth wrench for installation.

30. Tighten the cylinder using a strap wrench. The strap wrench is torque limiting—it will begin to slip after it reaches a certain torque.

CAUTION
DO NOT grip the cylinder with any sharp-toothed tool. Surface scratches and gouges will lead to early part failure.

31. Make sure the end cap check valves were inspected and lapped as required. Apply a small amount of Blue Lubricant to the check valve body shoulder face. Apply a thin coat of Blue Lubricant to the end cap threads.
32. Remove the seal guide and aluminum disk from the cylinder (as installed in Step 25). Thread the end cap onto the cylinder, making sure the check valve rotates with the end cap as an assembly.



Make sure the check valve fitting, which is drilled off center, is oriented as originally installed. Back off the end cap ½ turn if the check valve must be rotated to avoid damaging the seal and o-rings, then re-tighten. Installing the high-pressure tubing is easier if the check valve is in the original position.

33. Torque the end cap by tapping on the spanner wrench with a mallet or 8 oz. hammer. Do not exceed 100 ft-lb (75 N-m).

    Note: The high-pressure seals are fully functional at a torque value only slightly more than hand tight. Do not over tighten—torquing the end cap higher than 100 ft-lb (75 N-m) is unnecessary and makes disassembly more difficult.

34. Using two wrenches, connect the high-pressure tubing at both ends and connect the supply water hose at the quick disconnect fitting.
35. Remove tools, parts, and rags from around the pump. Make sure the covers are closed.

CAUTION
Make sure everyone near the equipment knows that you are starting it. Do not try to correct leakage problems while the pump is operating or if there is high-pressure water in the system.

36. Turn the pressure control knob fully counterclockwise to the lowest pressure setting and start the pump.
37. Operate the pump at idle oil pressure [400–700 psi (27–48 bar)] for five minutes while checking for leaks and listening for any unusual sounds.
38. Increase the pressure to 1000 psi (68 bar) and check for leaks. Increase the pressure in 500 psi increments every few minutes until the maximum rated pressure is achieved. Continue to operate the pump 7–10 minutes while checking for leaks and other problems.
39. Shut down the system and check for leaks, unsecured lines, and any unfinished work.
40. Confirm that all work is satisfactory and remove the *Out of Service* tag from the main electrical disconnect.

The pump is ready for operation. Record all maintenance work in the *Intensifier Pump Maintenance and Service Log* (MS-2258), located in your intensifier pump manual.

End cap and check valve

The check valves are located in a two-piece unit in the end cap. When the check valves need service, there will probably be one (or more) of these conditions present:

- High-pressure water temperature at the outlet fitting exceeds 120°F (49°C). This indicates excessive backflow through the outlet check valve.
- The hydraulic piston slams to the end of travel, or there is pressure pulsing in the inlet water hose. Either condition indicates excessive backflow through the inlet check valve.
- Repetitive spiking of the high-pressure water pressure. This indicates one or both of the valves may be leaking excessively.

Note: If only the check valves are being serviced, leave the intensifier in the cabinet. Be sure to keep the work area free of airborne dust and particles.

Service steps

WARNING
Place the main electrical disconnect in the OFF position and bleed down all high-pressure lines. Place an *Out of Service* tag on the main electrical disconnect and lock it out. Failure to do so may lead to equipment damage or injury to personnel.

1. Shut down the system.
2. Disconnect the supply water hose at the quick-disconnect fitting and use two wrenches to disconnect the high-pressure water line from the check valve outlet body. Loosen the other end of the tubing and move it out of the way.

CAUTION
Do not bend or flex the high-pressure tubing—it can cause early failure of the tubing.

3. Using two wrenches, remove the outlet body. The outlet body contains the outlet poppet and a spring.

   Note: Don't stretch or compress the spring unnecessarily—this can change the compression rate and affect poppet performance.

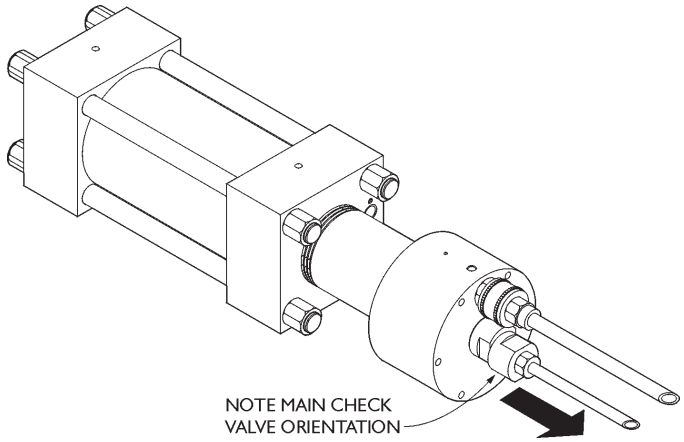
4. Remove the insert from the main body. The insert can be difficult to remove. If necessary, push the sharpened end of a small dowel or a sharp pencil into the insert bore, then pull it out.

   Note: The lapped surface is visible when the insert is in place.

   If you are only servicing the outlet check valve, go to Step 14. Otherwise set the outlet body, spring, poppet, and insert aside.

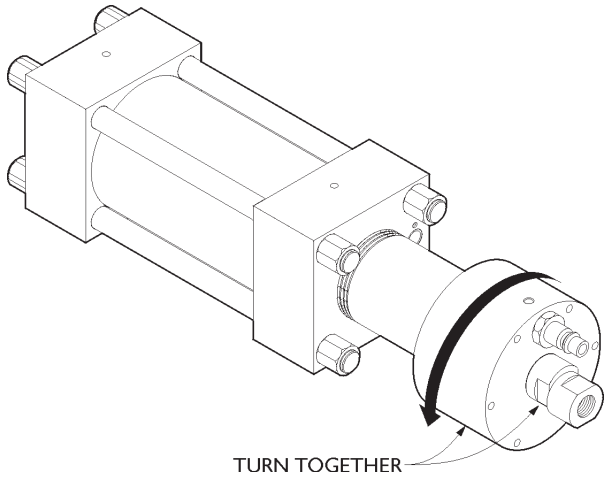
5. Note the orientation of the main check valve body, then loosen the end cap by tapping the spanner wrench with a mallet. If required, remove the cable guides, then restrain the high-pressure water cylinder with a strap or girth wrench.

CAUTION
Do NOT grip the cylinder with any sharp-toothed tool. Surface scratches and gouges will lead to early part failure.



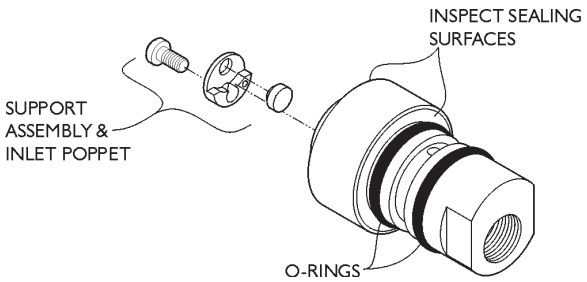
6. Unscrew the end cap from the cylinder by hand; make sure the check valve assembly and the end cap turn as an assembly.

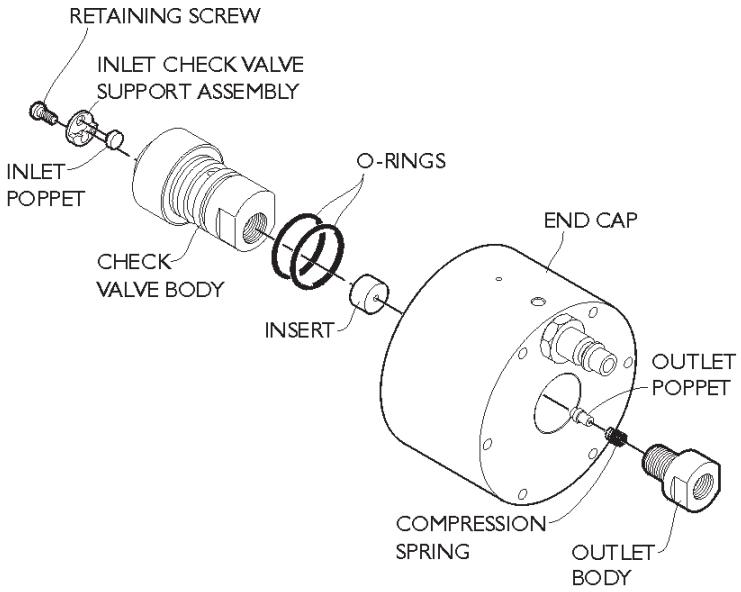
   Note: If the check valve and end cap do not turn together, the check valve body o-rings can be damaged. If necessary, use a wrench.



7. Check the corners of the wrench flats on the main body, and file off any burrs to prevent scratching the end cap bore during removal.

8. Use your thumbs to press the check valve body out through the end cap. The only resistance you should feel is when the o-rings on the main body contact the inner bore of the end cap.
9. Remove the retaining screw. Remove the support assembly and inlet poppet.
10. Clean all parts in a non-residue solvent and allow them to air dry before reassembly. Clean each part separately to prevent damaging parts.
11. Inspect the main body o-rings. If the o-rings show signs of damage, replace them and check the passages in the main body for debris.
12. Inspect the sealing surfaces on the main body for erosion, cracks, or other damage. Replace the main body if required.

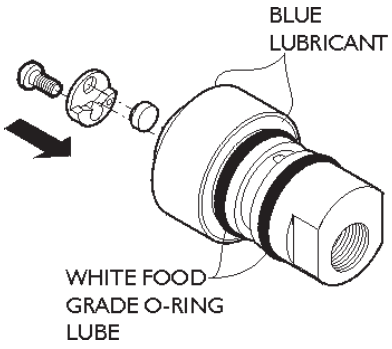




13. Inspect the support assembly and inlet poppet. Replace the support assembly if the poppet has caused extensive wear to the mating face of the support.
14. Lap the sealing surfaces on the outlet poppet, insert, check valve outlet, inlet poppet, and main body. See *Lapping the Sealing Surfaces* for the lapping procedure. Clean all newly-lapped parts with clean solvent such as isopropyl alcohol. Dry and re-inspect the parts.

    Note: Dimensions for each part are the *minimum* allowed. Parts must be discarded if they become smaller. Hand lapping, machining, machine grinding, or polishing are acceptable ways to remove surface imperfections from components before final lapping.

15. Apply Loctite #242 (A-3202) to the threads of the retainer screw.
16. Position the support assembly on the main body with the inlet poppet in place and the roll pin in its locating hole. Tighten the retainer screw to a torque valve of 40 in-lb (4.52 N-m).



17. Clean and inspect all surfaces in the end cap.

    Note: Thread damage could keep the end cap from becoming fully seated on the cylinder.

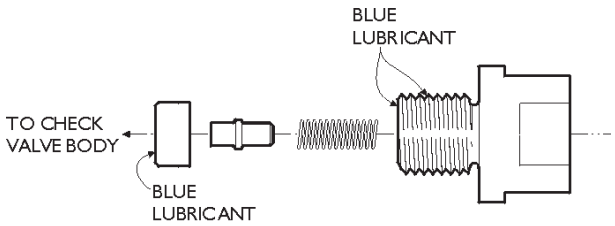
18. Lubricate the check valve body o-rings with white food grade o-ring lube.
19. Apply a thin film of Blue Lubricant on all check valve main body shoulder surfaces that contact the end cap and the high-pressure cylinder.

    Apply a thin film of Blue Lubricant to the threads of the end cap.

20. Use your thumbs to press the check valve body into the end cap.
21. Thread the end cap onto the cylinder. Make sure the check valve and end cap turn as an assembly. Orient the check valve as originally installed. If the check valve must be rotated, back off the end cap one-half turn to avoid damaging the o-rings and high-pressure seals.
22. Torque the end cap by tapping on the spanner wrench with a mallet or 8 oz. hammer. Do not over-torque.

    Note: The high-pressure seals are fully functional at a torque value only slightly more than hand tight. Torquing the end cap more than 100 ft-lb (75 N-m) is unnecessary and will make disassembly more difficult.

23. Apply a thin layer of Blue Lubricant to the radiused face of the insert and place the insert, radiused face first, into the check valve main body.



Note: The Blue Lubricant will help keep the insert from sticking in the check valve body and make it easier to remove for service.

24. Apply Blue Lubricant to the check valve outlet body face and threads. Insert the spring and poppet, small diameter (chamfered side) of poppet first, into the outlet body as shown above.

CAUTION

Stretching or compressing the spring unnecessarily will change spring compression and affect poppet performance. When held vertically, poppet shoulder must be approximately even with the face of the outlet body.

25. Thread the outlet body into the main body and tighten using two wrenches. Torque to 65 ft-lb (88 N-m).
26. Using two wrenches, connect the high-pressure tubing, then connect the supply water hose at the quick disconnect fitting.
27. Remove tools, parts, and rags from around the pump. Close the pump covers.

CAUTION
Always operate the pump with the covers closed. Do not try to correct leaks when the pump is running or when high-pressure water is in the system.

28. Turn the pressure control knob fully counterclockwise to the lowest pressure setting and start the pump.
29. Operate the pump at idle oil pressure [400–700 psi (27–48 bar)] for 5 minutes while checking for leaks and listening for any unusual sounds.
30. Increase pressure to 1000 psi (68 bar) and again check for leaks. Increase the pressure in 500 psi (34 bar) increments every few minutes until the maximum rated pressure is achieved. Continue to operate the pump 7–10 minutes while checking for leaks or any other problems.
31. Shut down the system and check for leaks, unsecured lines and any unfinished work. Record all maintenance work in the service log.

When all work is satisfactory remove the *Out of Service* tag from the main electrical disconnect. The pump is ready for operation.

Lapping the sealing surfaces

You will need check valve lapping kit B-1813-1 and a drill press. Attach a 320 grit abrasive strip to one side of the glass plate, and a 600 grit strip to the other side. The check valve components have different lapping techniques, which are described below.

Lapping the outlet poppet, insert, and check valve outlet passage

Machining allowances

If the sealing surface of any component cannot easily be restored by lapping, you can machine it flat before lapping as long as only the sealing surface is machined, the relationship of the face to the component axis is unchanged, and minimum dimensions are maintained.

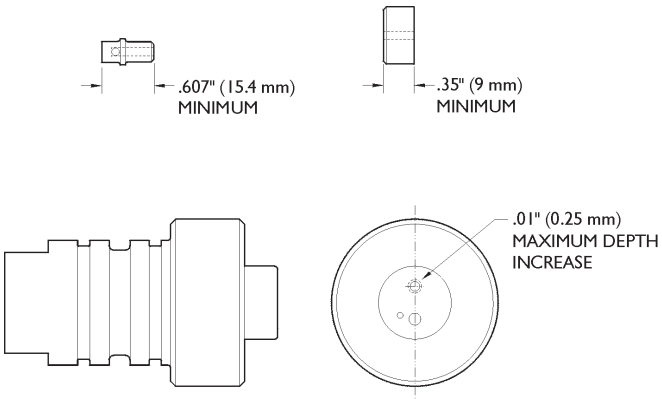
Minimum dimensions

Insert:

- Minimum thickness of 0.35 in. (8.9 mm)

Outlet poppet:

- Minimum length is 0.607 in. (15.42 mm)
- The retainer screw thread depth of the outlet poppet passage may need to be increased. This increase shall not exceed 0.01 in. (0.25 mm) at any time.



Lapping the outlet poppet

For maximum performance and life, the sealing surface must be flat and smooth with no radial grinding or lapping marks.

Because of its size and shape, hand-lapping the poppet can round the sealing surface, which causes squealing during operation. Flow recommends using a drill press to lap this part.

1. Make sure the drill chuck is square to the table and does not wobble. Secure the chamfered end of the poppet into the chuck up to the shoulder.
2. Place the glass plate on the table with the 320 grit side up. Place a few drops of water on the abrasive strip.
3. Start the drill press and lower the poppet onto the glass plate, moving the plate in a figure-8 pattern under the poppet. Lap until all surface imperfections have been removed.

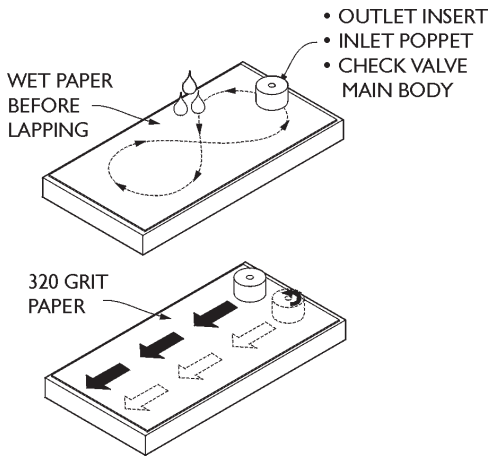
CAUTION
Do not lap outlet poppet with 600 grip abrasive. A polished sealing surface can cause the poppet to stick.

Lapping the outlet insert

The outlet insert can be lapped by hand.

1. Lap the insert on the wetted 320 grit side of the plate in a figure-8 pattern until all surface imperfections have been removed.
2. Turn the plate over and lap the insert on the 600 grit side until the insert is evenly polished.
3. Using the wetted 320 grit side of the plate, draw the body along the full length of the abrasive strip once, then rotate it 90° and repeat the score.

This final scoring process will help avoid poppet sticking.



Lapping the inlet poppet and main body

Machining allowances

If the sealing surface of any component cannot easily be restored by lapping, you can machine it flat before lapping as long as: only the sealing surface is machined, the relationship of the face to the component axis is unchanged, and minimum dimensions are maintained (see below).

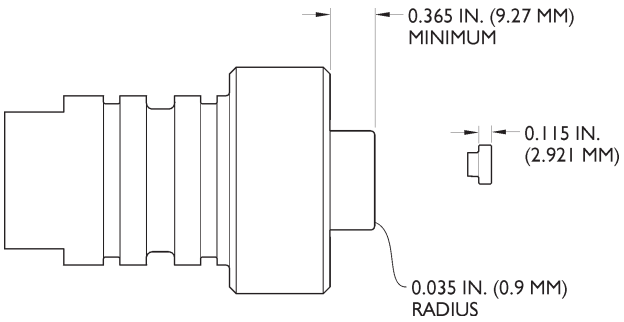
Minimum dimensions

Inlet poppet face:

- Minimun height of 0.365 in. (9.27mm) on the shoulder and radius of 0.035 in. (0.9 mm)

Inlet poppet:

- Minimum thickness of 0.115 in. (3.05 mm)



Lapping the inlet poppet

The inlet poppet can be lapped by hand.

1. Lap the poppet on the wetted 320 grit side of the plate in a figure-8 pattern until all surface imperfections have been removed.
2. Turn the plate over and lap on the 600 grit side until the poppet is evenly polished.
3. Using the wetted 320 grit side of the plate, draw the body along the full length of the abrasive strip once, then rotate it 90° and repeat the score.

This final scoring process will help avoid poppet sticking.

Lapping the check valve main body

Because of its size, the main body can be lapped by hand, keeping any rounding of the sealing face outside the area where the inlet poppet sits.

1. Lap the body on the wetted 320 grit side of the plate in a figure-8 pattern until all surface imperfections have been removed.
2. Turn the plate over and lap on the 600 grit side until the body is evenly polished.
3. Using the wetted 320 grit side of the plate, draw the body along the full length of the abrasive strip once, then rotate it 90° and repeat the score.

This final scoring process will help avoid poppet sticking.

Hydraulic oil cylinder, piston, plunger, and end bell

The double-acting hydraulic oil cylinder is located between two high-pressure water cylinders. When the cylinder and end bells require service, one or more of the following conditions will be present:

- Excessive oil leakage from the end bell weep hole or the joint between cylinder and end bell (more than one drop every 30 seconds).
- Worn piston seals, allowing excessive oil flow around the piston.
- A jammed piston or detached plunger.

All service must be performed in a clean, well-lit area. The intensifier must be removed from the pump and disassembled on a workbench. An experienced technician using the correct tools and procedures can complete the procedure in 2½–3 hours.

Tools required

You will need the intensifier assembly fixture (C-2217-1) for this procedure. The fixture is used during reassembly to align the end bells square with each other and minimize the chance of o-ring damage as the cylinder is being drawn onto the end bells. Misaligned end bells can cause the oil manifold to leak or even break.

Service steps

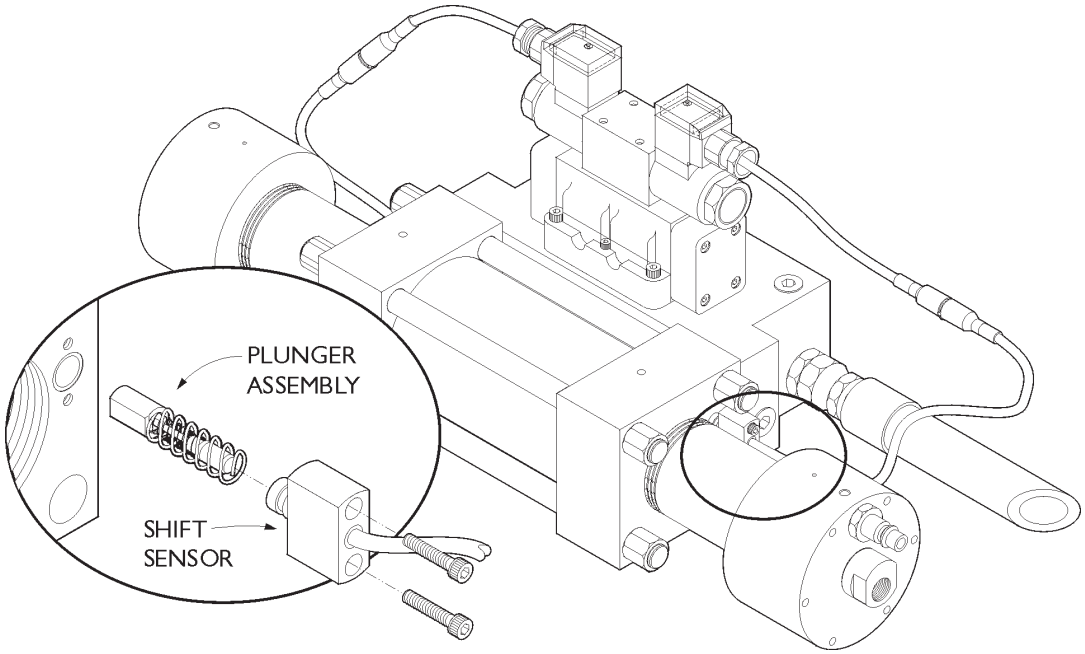
WARNING
Place the main electrical disconnect in the OFF position and bleed down all high-pressure lines. Place an *Out of Service* tag on the main electrical disconnect and lock it out. Failure to do so may result in equipment damage or injury to personnel.

1. Shut down the system.
2. Disconnect the supply water hoses at the quick-disconnect fittings. Using two wrenches, disconnect the high-pressure water lines from the check valve outlet bodies. Loosen the other ends of the tubing and move them out of the way.

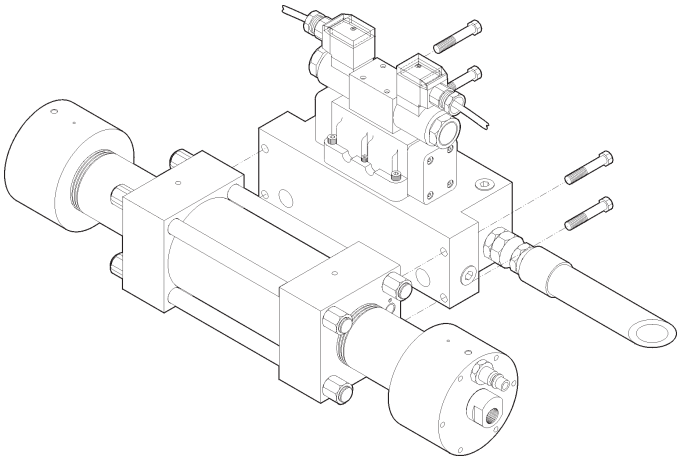
CAUTION
Do not bend or flex the high-pressure tubing. Such stress may cause early failure of the tubing.

3. Remove the high-pressure cylinders and end caps as described in *High-pressure water cylinder and seals*.
4. **Manual shift.** Remove the shift cables and actuating pins from the intensifier and set aside. Remove the shift pins using the shift pin tool (002228-1).

   Electric shift. Remove the shift sensors. Use the shift pin tool to remove the shift pins.

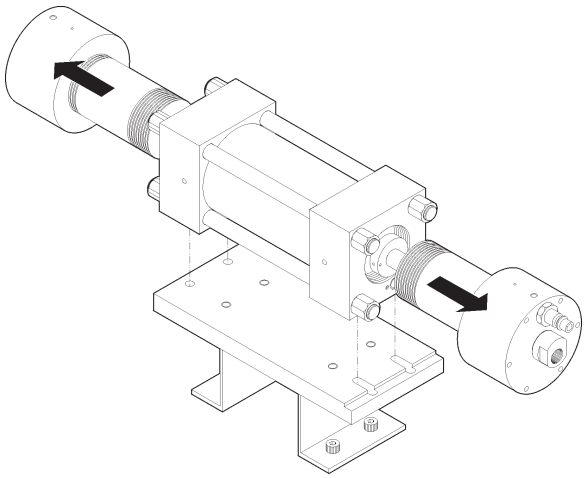


5. Loosen the screws that hold the intensifier to the manifold; remove the intensifier. Drain oil from the intensifier ports.

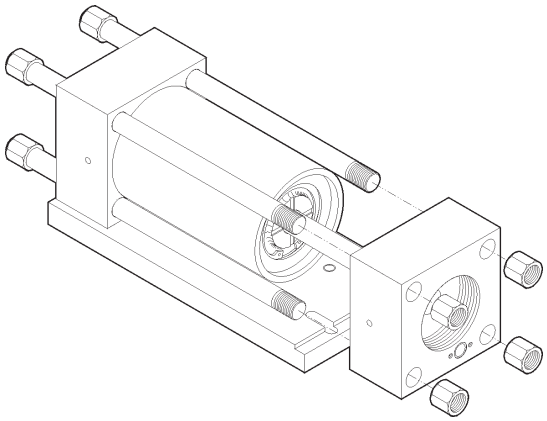


6. Mount the intensifier assembly fixture to the workbench. Place the intensifier on the fixture with the manifold surface facing down, and secure the intensifier to the fixture.

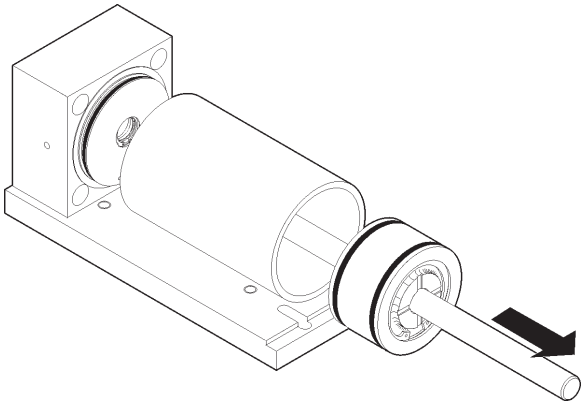
WARNING
Failure to properly mount intensifier assembly fixture or secure intensifier to the assembly fixture may allow the parts to unexpectedly tip and fall, causing serious bodily injury.



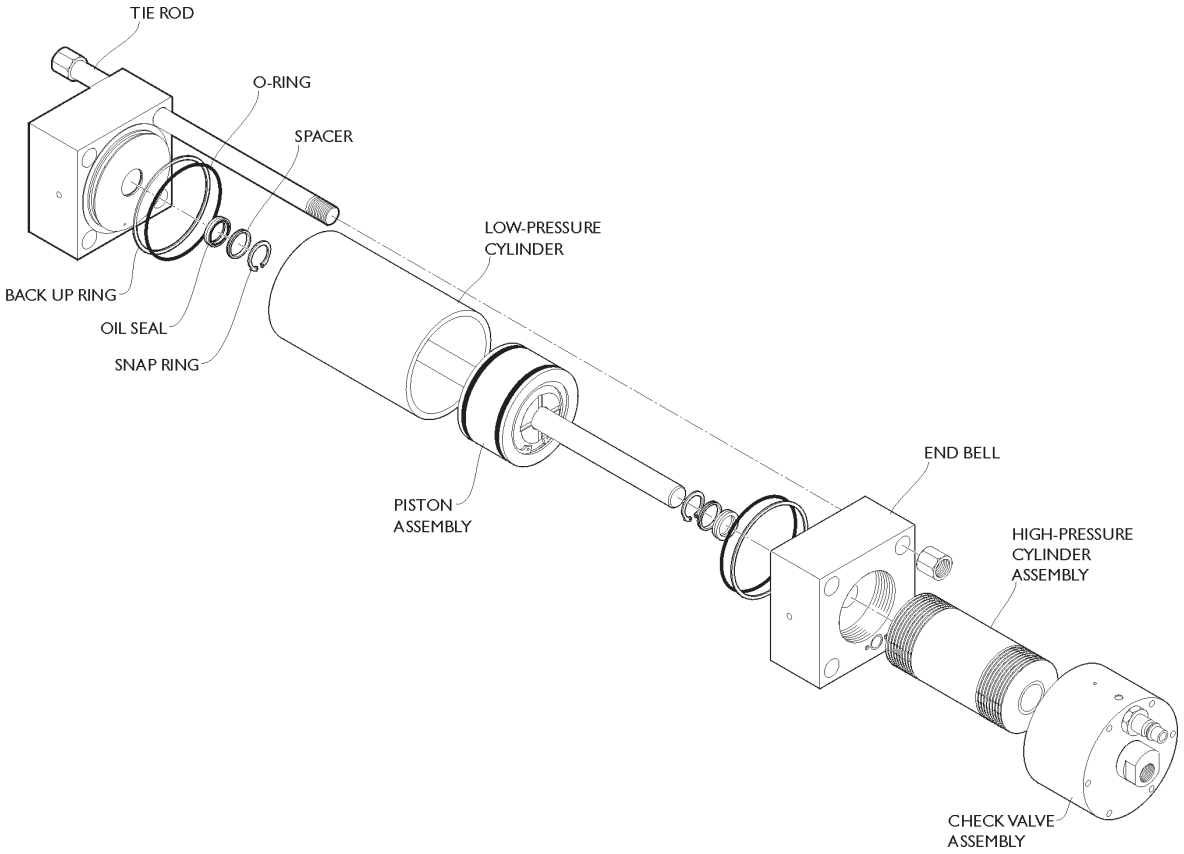
7. Remove the torque from the cylinder tie rods using two wrenches in a figure-8 pattern. Do not use a torque wrench. Remove nuts and tie rods.
8. Remove the cap screws that hold one end bell to the intensifier assembly fixture. Using a mallet, tap the end bell free of the low-pressure cylinder. Remove the end bell and set it aside.



9. Remove the low-pressure cylinder from the other end bell. The piston and plungers can stay with the cylinder.



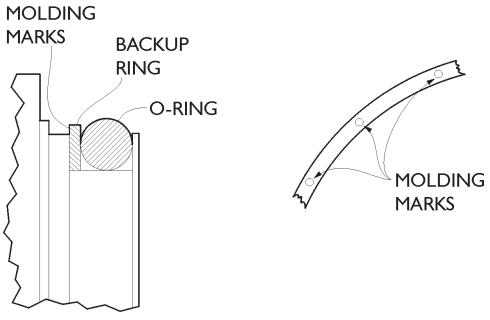
10. Drive the piston and plungers from the cylinder with a soft mallet. Set the parts aside.



Inspect the parts

11. Inspect the low-pressure hydraulic cylinder, end bells, and related parts.
12. Remove the snap ring, spacer, and seal from the end bell, but do not use a sharp tool—it will damage the parts. Remove the o-ring and back up ring from the end bell.

    Repeat step for the other end bell.
13. Clean and inspect the end bells, seal spacers, and snap rings.
    - Check the end bells for damaged threads, damaged or out-of-round shift pin hole, and damage to the sealing surfaces and grooves.
    - Seal spacers must not be warped or nicked.
    - Snap rings must not be bent and must have the appropriate tension.
14. Apply clean hydraulic oil or Parker Super O-Ring Lube (200006) to a new oil seal and install it in an end bell with the spring insert visible. Place the spacer on top of the seal and install the snap ring.
15. Lay the end bell flat. Apply clean hydraulic oil or Parker Super O-Ring Lube to the new backup ring. Locate the molding marks and install the backup ring with the molding marks facing the end bell.

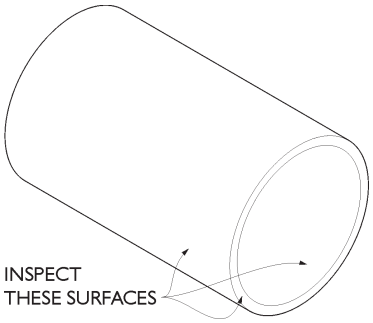


    Lubricate the new o-ring and place it in the groove on top of the backup ring. The o-ring must be outside the backup ring, facing the low-pressure cylinder.
    - Repeat Steps 14 and 15 for the other end bell, then set the end bells aside and cover with a lint-free cloth.

16. Clean all surfaces of the low-pressure cylinder and inspect for any signs of damage or fatigue.

WARNING
Do not reassemble the intensifier with a cylinder that has a damaged inner surface.

Inspect the inner diameter by looking through the cylinder angled toward a brightly lit white surface. If you see any damage, discard the cylinder.



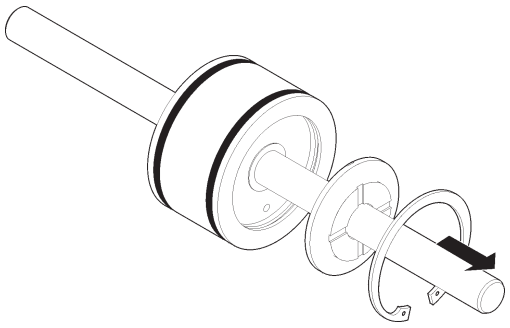
17. Inspect the sealing surfaces for roughness or damage. There can be no nicks or scratches on these surfaces. If the cylinder is free from damage, set it aside and cover with a lint-free cloth.

CAUTION
Sharp burrs on the beveled edge of the cylinder ID can damage the end bell o-ring and backup ring during reassembly. Such damage can lead to immediate seal failure and excessive hydraulic oil loss.

18. Inspect the piston and plunger for damage.
    - If the piston or plunger need to be replaced, or the plunger has excessive lateral movement with respect to the piston biscuit (more than 1/8 in. off center line), disassemble the piston and plunger.
      - Continue with Step 19
    - If there is no noticeable damage, apply clean hydraulic oil or Parker Super O-Ring Lube (200006) to the head of the plunger, turn the plunger into the counterbore in the piston biscuit, using a soft mallet if needed. Make sure the T-seals do not get nicked or rolled.
      - Proceed to Step 29, *Reassembling the intensifier*

19. Remove the snap ring and retainer.

    Note: Blow air down between the plunger and the retainer bore to loosen the retainer.



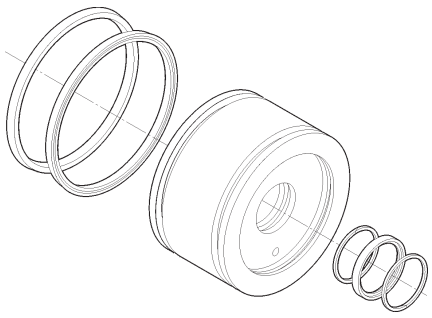
20. Remove the plunger by hand.
    - Repeat Steps 19 and 20 for the other plunger. Set the plungers aside.

21. Clean the piston assembly, removing oil, dirt and burrs from all surfaces.

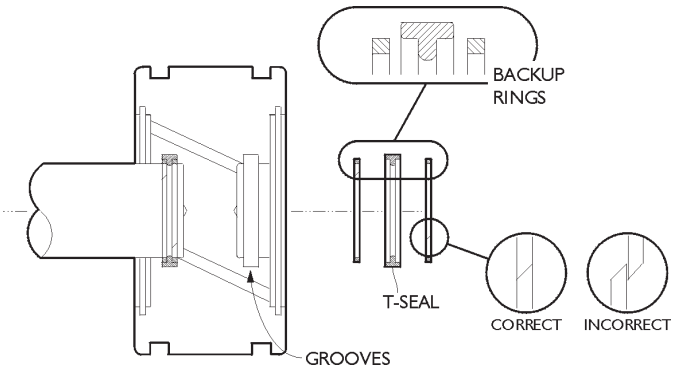
CAUTION
Inspect the plungers carefully. Scratches, pits or nicks will cause premature high-pressure seal failure.

Plungers cannot be reworked—they must be replaced.

a. Lubricate the T-seals and backup rings with Parker Super O-Ring Lube (200006).
b. Place two backup rings and one T-seal in each piston groove. The T-seal must be in the middle of the two backup rings.



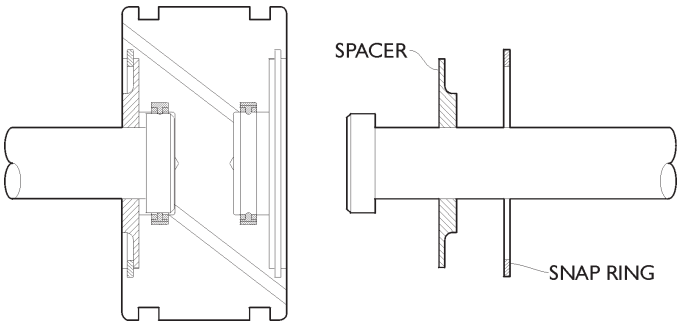
Note: Stagger the joints on the backup rings as shown to ensure correct installation (see illustration at top of Page 30).



22. Apply clean hydraulic oil or Parker Super O-Ring Lube (200006) to the head of the plunger. Turn the plunger into the counter bore in the piston biscuit, using a soft mallet if needed.

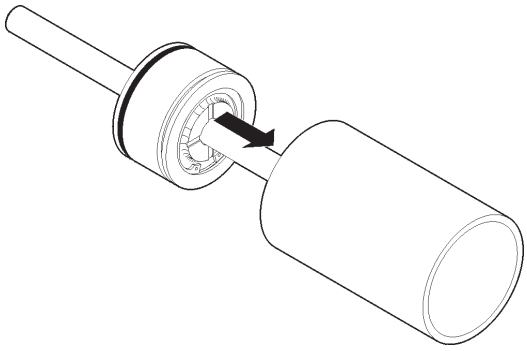
    Make sure the T-seals do not get nicked or rolled.

23. Slide the spacer over the plunger with the large end facing in as shown below. Install the snap ring into the groove.



- Repeat Steps 22 and 23 for the other plunger.

24. Apply clean hydraulic oil or Parker Super O-Ring Lube (200006) to one seal and the inside of the low-pressure cylinder. Install the seal onto the piston with the flared (o-ring) face toward the outside of the piston.
25. Slide the piston and plunger assembly containing one seal into the cylinder oriented so that the empty groove enters the cylinder first.

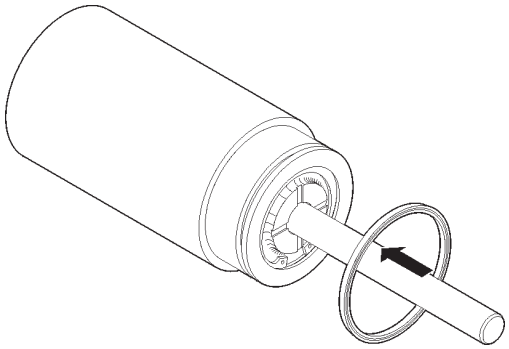


CAUTION
The seal is going into the cylinder against the flare. Take care as the seal enters the cylinder—it is compressed at this point and can be easily damaged by rough handling.

26. Slide the piston into the cylinder until the empty seal groove on the piston appears out of the other end of the cylinder.

    Note: If the seal starts to come out the end of the cylinder, do not force it back in against the flare. Instead, push the whole piston assembly through and start again, this time stopping before the seal appears.

27. Apply clean hydraulic oil or Parker Super O-Ring Lube to the seal and install it in the groove oriented with the flared o-ring face toward the outside of the piston.



28. Slide the piston and plunger back into the cylinder.

    Note: Centering the piston on the plunger will make reassembly easier.

    CAUTION
    The seal is going into the cylinder against the flare. Take care as the seal enters the cylinder—it is compressed at this point, and can be easily damaged by rough handling.

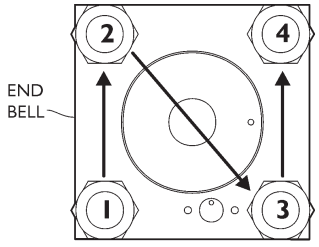
    Set the cylinder containing the piston and plunger assembly aside.

Reassembling the intensifier

29. Mount an end bell to the assembly fixture using the cap screws provided. Tighten the cap screws finger tight. The backup ring and o-ring were lubricated and installed in Step 15.
30. Apply clean hydraulic oil or Parker Super O-Ring Lube (200006) to both plungers. Determine the appropriate orientation of the label affixed to the cylinder and install the cylinder by inserting the plunger into the end bell.
31. Mount the remaining end bell to the other plunger. Secure to the assembly fixture with the cap screws finger tight.
32. Install tie rods, apply Blue Lubricant to the tie rod threads. Thread on the elastic stop nuts.
33. Draw the cylinder carefully onto the end bells by tightening the nuts evenly in a figure-8 pattern (see below). Be careful not to nick seals and backup rings.

    Notes:

    - Seal or backup ring debris must not appear at the cylinder/end bell interface. Check for any problems before continuing.
    - Torque all nuts evenly to 20 ft-lb (27 N-m) so all parts are seated.



TORQUE TIE RODS
IN FIGURE 8 PATTERN

34. Four cap screws were previously threaded into the end bells through the intensifier assembly fixture. Torque all four cap screws to 35 ft-lb (47 N-m), then back off the two in the slotted holes until they are ⅛–¼ turn tighter than finger tight.

    The bolts must hold the end bells tight against the fixture to prevent any misalignment, but they must not interfere with tightening the tie rod nuts.

35. Using a figure-8 pattern, torque all eight tie rod nuts to 40 ft-lb (54 N-m), then 60 ft-lb (81 N-m), then 80 ft-lb (108 N-m), then 100 ft-lb (68 N-m), then 120-lb (162 N-m).

    Note: These torque specifications are for 'wet' or lubricated tie rod nuts.

36. Install the high-pressure water cylinders and end caps. See *High-pressure water cylinder and seals*.
37. Remove the intensifier from the assembly fixture.
38. Lubricate the manifold o-rings and place them in the end bells.
39. Place the intensifier back into the cabinet and secure it with the original cap screws. Tighten the cap screws to 35 ft-lb (47 N-m).
40. **Manual shift.** Install the shift pins and the shift cables.
    Electric shift. Install the shift pins and the shift sensors.

    For more information see *Shift cable and pilot valve* in Chapter 4 of the pump manual.

41. Attach the high-pressure tubing at both ends, then torque the gland nuts. Attach the water supply lines at the quick-disconnect fittings.
42. Check for incomplete work and remove tools, parts, and rags. Start the pump and operate at idle oil pressure for 10-15 minutes with a single jet open. This allows the intensifier pump unit to stroke gently.
43. Slowly increase pressure to the rated output while checking for leaks, then stop the pump and inspect for any leakage. Correct any problems as required.

When all work is satisfactory, remove the *Out of Service* tag from the main electrical disconnect. The pump is ready for operation.

Parts list information

The parts list section is provided to assist the user in ordering replacement parts. Whenever possible, the parts list for complicated assemblies includes exploded view illustrations, which can help the user see how it is assembled.

Items that are available from local sources are usually excluded from the parts lists. These include electrical cable, electrical conduit fittings, hoses and hose fittings, brass fittings, copper tubing, and fasteners.

Ordering parts

Refer to manual MS-2266, Customer Support.

Customer Service

Customer Service personnel are located at Flow's headquarters in Kent, Washington, USA. They provide parts availability and price information, and are available by phone, mail, and fax between 6:30 a.m. and 5:30 p.m. Pacific time, Monday through Friday. Refer to manual MS-2266 for complete information.

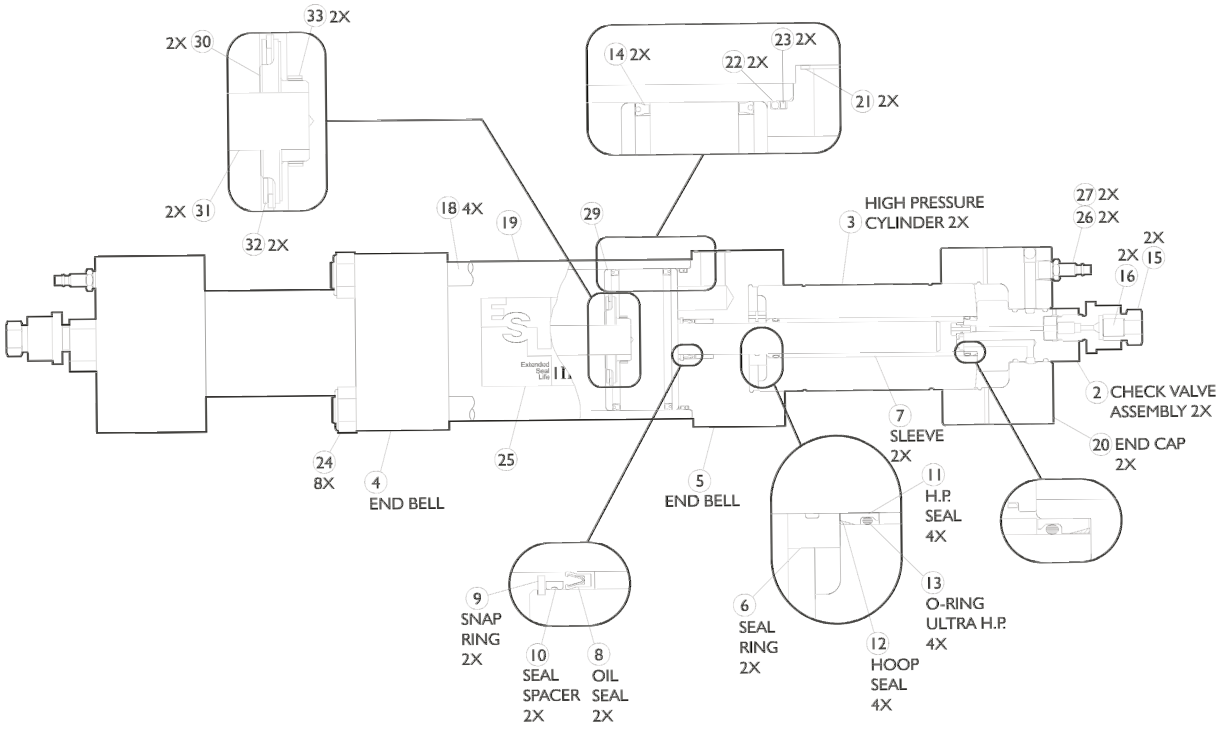
Technical Service

Technical Service personnel are available to answer questions about installation, training, and equipment service during normal business hours between 8:00 a.m. and 5:00 p.m Pacific Time., Monday through Friday. During non-business hours, an answering service will take messages. In an emergency, a service engineer will contact you as soon as possible.

A service engineer can be made available for on-site technical assistance during installation, service, and training. Contact Flow Technical Service for more information.

Top assemblies

010558-3 (Rev. O)
60K intensifier assembly



Item	Part #	Qty	Description
3	007038-3	2	Cylinder end
4	007303-2	1	End bell assembly
5	007303-1	1	End bell assembly
6	B-1465-1	2	Seal ring
7	B-1002-2	2	Seal backup sleeve
8	A-11275	2	Rod seal
9	A-0264-112	2	Snap ring
10	010276-1	2	Oil seal spacer
11	004406-1	4	High-pressure seal
12	004407-1	4	Hoop seal
13	B-8075-119	4	Ultra HP o-ring
14	A-1001	2	Poly pak seal
15	A-2838	2	High-pressure gland
16	A-2839	2	High-pressure collar
17	A-4689	AR	Food grade grease
18	B-1000-2	4	Tie rod
19	C-1000-1	1	Low-pressure cylinder
20	321276	2	End cap
21	A-00633-023	2	O-ring
22	A-0275-240	2	O-ring
23	A-00250-240	2	Backup ring

Item	Part #	Qty	Description
24	A-1000	8	Hex nut
25	010640-1	1	Label
26	004345-1	2	Quick coupling nipple
27	A-0274-6	2	O-ring
28	A-2185-2	AR	High friction lubricant*
29	007026-1	1	Piston biscuit
30	007029-1	2	Biscuit spacer
31	010253-1	2	Plunger assembly
32	A-0270-300	2	Snap ring
33	A-00251-18	2	Rod T-seal
38	004383-3	2	Check valve body
39	004380-1	2	Retaining screw
40	004382-1	2	Intensifier insert
41	005917-1	2	Outlet poppet
42	010564-1	2	Inlet support
43	A-0275-125	4	O-ring
44	A-1606	2	Compression spring
45	C-1313-1	2	OUtlet body
46	015384-1	2	Inlet poppet
47	A-2185	AR	Blue Lubricant*
48	A-3202	AR	Loctite*

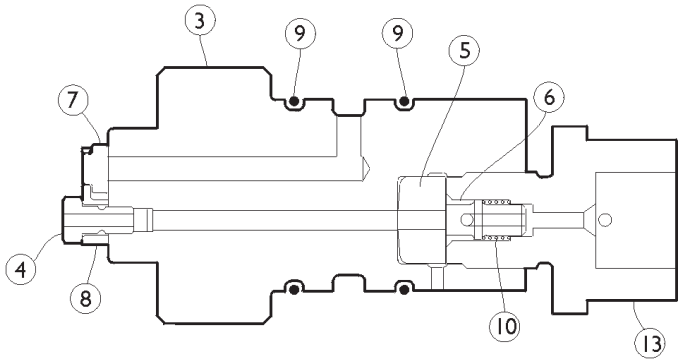
* not shown

007000-2 (Rev. Z)
40K intensifier assembly

Item	Qty	Part #	Description
4	2	007038-2	Cylinder end
6	1	007304-2	End bell
8	1	007304-1	End bell
10	2	B-1465-2	Seal ring
12	2	B-6313-2	Seal backup sleeve
14	2	A-14469	Rod seal
16	2	A-0264-131	Snap ring
18	2	013461-1	Oil seal spacer
20	4	C-5282-1	High-pressure seal
22	4	001194-1	Hoop seal
24	4	B-8075-122	Ultra HP o-ring
26	1	007201-1	Piston biscuit
28	2	006881-1	Biscuit spacer
30	2	013458-1	Plunger assembly
32	2	A-0270-300	Snap ring
33	2	A-00251-22	Rod T-seal
36	2	A-1001	Poly pak seal
37	2	A-2838	High-pressure gland
38	2	A-2839	High-pressure collar
39	AR	A-4689	Food grade grease
40	4	B-1000-2	Tie rod
41	1	C-1000-1	Low-pressure cylinder
42	2	321276	End cap
43	2	A-0063-023	O-ring
44	2	A-0275-240	O-ring
45	2	A-00250-240	Back-up ring
46	8	A-1000	Hex nut
47	1	010640-1	Label
48	2	004345-1	Quick coupling nipple
49	2	A-0274-6	O-ring
50	AR	A-2185-2	High-friction lubricant
52	2	004383-2	Check valve body
53	2	004380-1	Retaining screw
54	2	004382-1	Insert
55	2	005917-1	Outlet poppet
56	4	A-0275-125	O-ring
57	2	A-1606	Compression spring
58	2	C-1313-1	Outlet body
59	2	010564-1	Inlet support
60	2	015384-1	Inlet poppet
101	AR	A-2185	Blue Lubricant
102	AR	A-3202	Loctite

Sub-assemblies

010559-X (Rev. G)
Check valve assembly

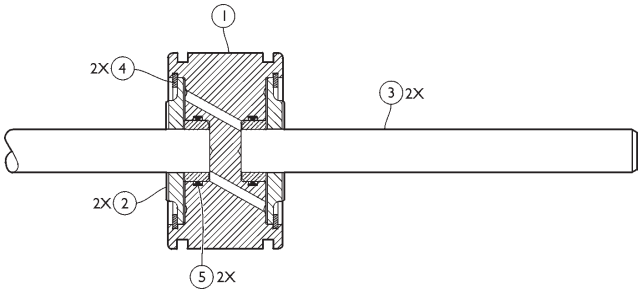


Item	Part #	Qty	Description
2	004383-2	1	Check valve body (-2 only)
3	004383-3	1	Check valve body (-3 only)
4	004380-1	1	Inlet retaining screw
5	004382-1	1	Insert
6	005917-1	1	Outlet poppet
7	015384-1	1	Inlet poppet
8	010564-1	1	Support assembly
9	A-0275-125	2	O-ring
10	A-1606	1	Compression spring
11	A-2185	AR	Blue Lubricant *
12	A-3202	AR	Loctite #242 *
13	C-1313-1	1	Outlet body

** not shown*

010559-2 40,000 psi valve
010559-3 60,000 psi valve

010561-1 (Rev. D)
60K piston assembly

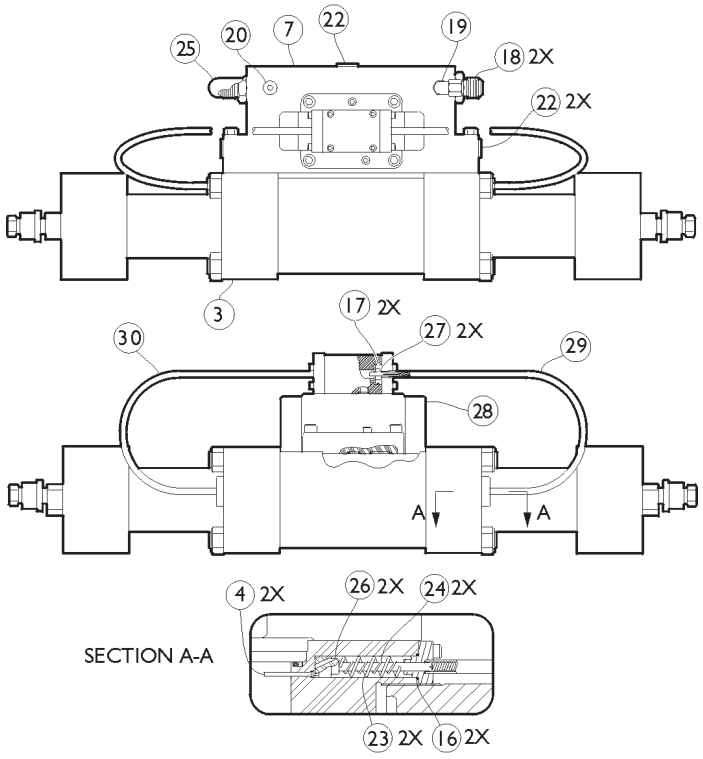


Item	Part #	Qty	Description
1	007026-1	1	Piston biscuit
2	007029-1	2	Biscuit spacer
3	010253-1	2	Ceramic plunger assy
4	A-0270-300	2	Snap ring
5	A-00251-18	2	T-seal

013763-1 (Rev. A)
40K piston assembly

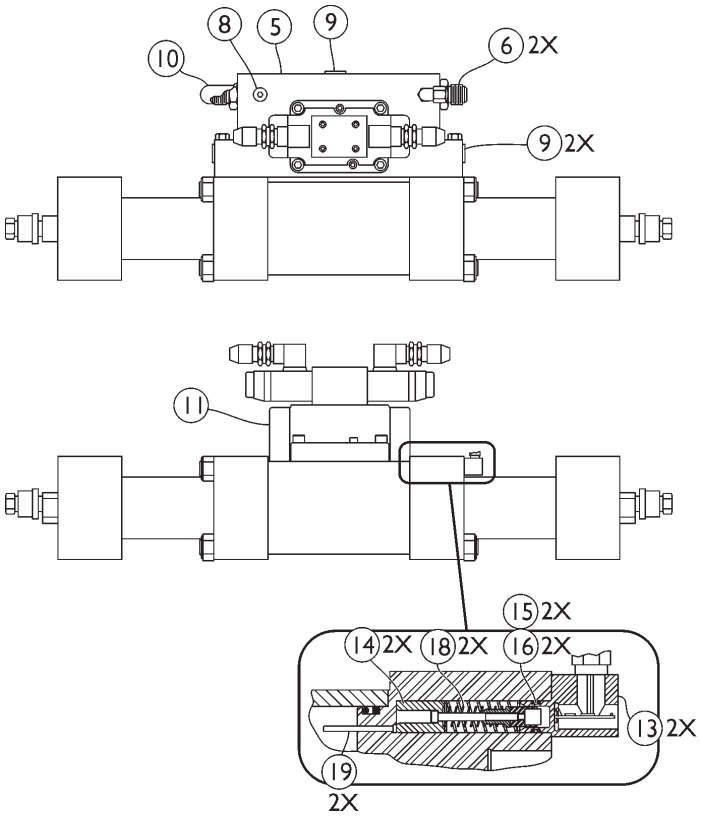
Item	Part #	Qty	Description
1	007201-1	1	Piston biscuit
2	006881-1	2	Biscuit spacer
3	013458-1	2	Ceramic plunger assy
4	A-0270-300	2	Snap ring
5	A-00251-22	2	T-seal

010639-X (Rev. H)
Manifold assembly, mechanical shift



Item	Part #	Qty	Description
3	010558-30	1	Intensifier assembly
4	002226-1	2	Actuator pin
7	013403-1	1	Manifold
16	A-0275-014	2	O-ring
17	A-0275-019	2	O-ring
18	A-0636-23	2	Connector
19	A-0638-3	1	Elbow
20	A-0641-6	1	Plug
22	A-0641-7	3	Plug
23	A-1012	2	Spring
24	A-1713	2	Compression spring
26	B-1007-1	2	Actuating plunger
27	B-1611-1	2	Shift pin
28	A-11215	1	Shift valve/pilot valve assy (C-2743-1, shift valve & 006869-1, pilot valve)
29	C-5461	1	Cable guide assembly, RH
30	C-5462	1	Cable guide assembly, LH

010583-3 (Rev. P)
Manifold assembly, electric shift



Item	Part #	Qty	Description
1	010558-30	1	Intensifier assembly
5	013403-1	1	Manifold
6	A-0636-23	2	Connector
8	A-0641-6	1	Plug
9	A-0641-7	3	Plug
11	A-18862	1	Shift valve
13	011275-1	2	Sensor assembly
14	B-8346-1	2	Actuator assembly
15	A-0276-012	2	Backup ring
16	A-0275-012	2	O-ring
17	A-0102-16	4	Screw
18	A-2409	2	Compression spring
19	B-1702-1	2	Firing pin

Kits

Check valve kits

The kits listed below are used on all check valves, regardless of the intensification ratio.

B-1813-1 (Rev. F)
Check valve lapping kit

Item	Part #	Qty	Description
1	A-1904	1	Glass plate
2	A-1903	3	320 grit grinding paper
3	A-1902	3	600 grit grinding paper

015866-1 (Rev. A)
Check valve repair kit

Item	Part #	Qty	Description
1	A-1606	1	Compression spring
2	A-0275-125	2	O-ring
3	005917-1	1	Outlet poppet
4	004382-1	1	Insert
5	004380-1	1	Retaining screw
6	015384-1	1	Inlet poppet
7	010564-1	1	Support assembly
8	013463-1	1	Packaging

Tool kits

These parts are available only as kits. They are not sold individually.

B-2292-1 (Rev. A)
40K high-pressure seal tool kit

Part #	Qty	Description
B-1866-2	1	Plunger seal tool
B-1867-1	1	Seal sleeve guide tool
B-1868-2	1	Seal sleeve tool
B-2484-1	1	Seal disc tool

B-2291-1 (Rev. A)
60K high-pressure seal tool kit

Part #	Qty	Description
B-2484-1	1	Aluminum disc
B-1868-1	1	Sleeve installation tool
B-1867-1	1	Sleeve guide
B-1866-1	1	Seal installation tool

High-pressure seal kits

These parts are available only in these kits. They are not sold separately.

001197-1 (Rev. D)
40K high-pressure seal kit

Item	Part #	Qty	Description
1	A-4689	AR	White food grade o-ring lube
4	B-1465-2	2	Seal ring
5	B-8075-122	4	O-ring
6	C-5282-1	4	High-pressure seal
7	001194-1	4	Seal hoop
8	A-6283-1	1	Packaging
9	A-6283-2	1	Bubble pack

001198-1 (Rev. H)
60K high-pressure seal kit

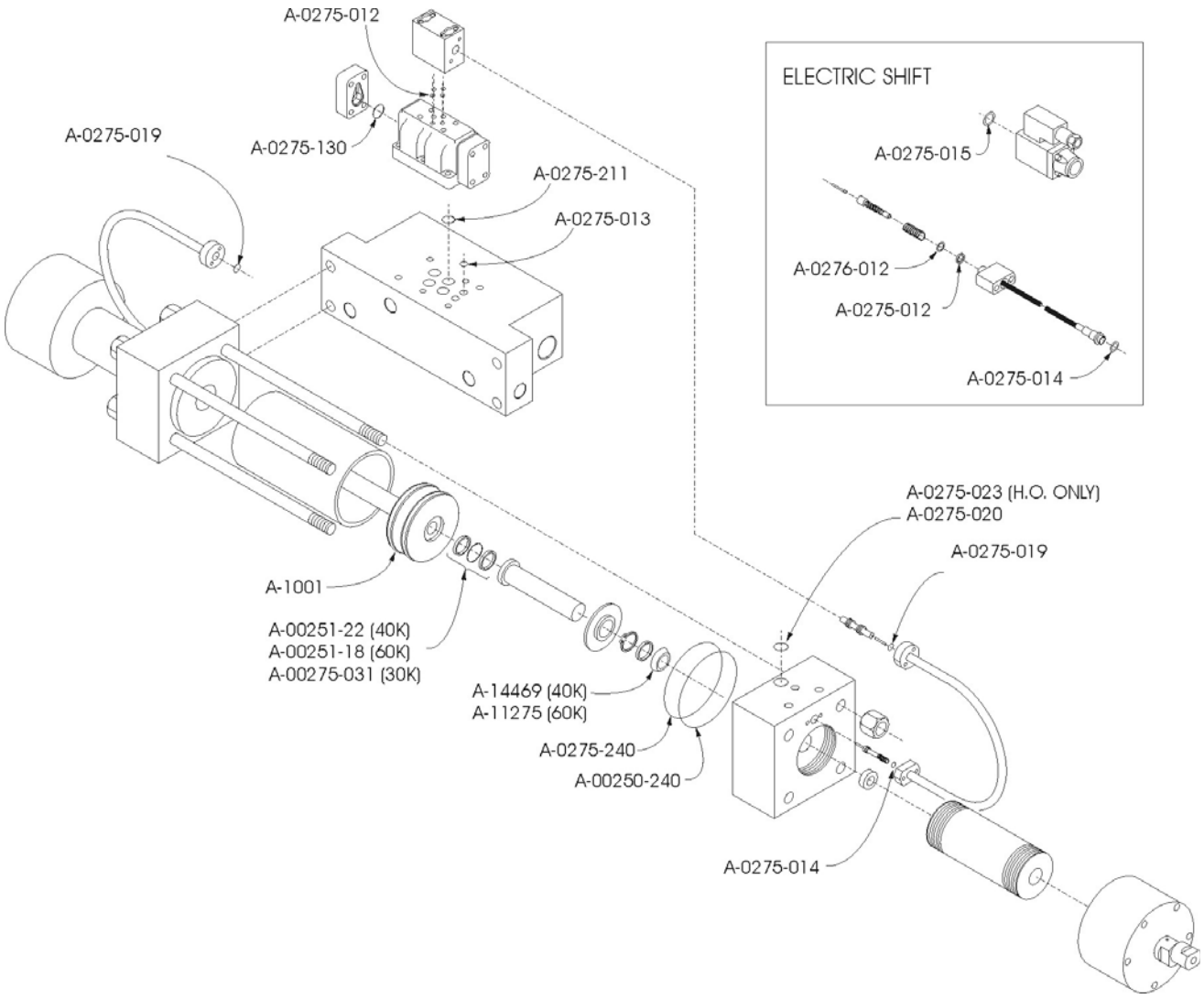
Item	Part #	Qty	Description
1	A-4689	AR	White food grade o-ring lube
4	B-1465-1	2	Seal ring
5	B-8075-119	4	O-ring
6	004406-1	4	High-pressure seal
7	004407-1	4	Seal hoop
8	A-6283-1	1	Packaging
9	A-6283-2	1	Bubble pack

Low-pressure seal kits

010641-1 (Rev. D)
60K low-pressure seal kit

Part #	Qty	Description
A-0275-130	2	O-ring
A-00250-240	2	Polymite backup ring
A-0276-012	2	Backup ring
A-0275-013	2	O-ring
A-0275-240	2	O-ring
A-0275-211	4	O-ring
A-11275	2	Rod seal
A-0275-019	2	O-ring

Part #	Qty	Description
A-0275-015	2	O-ring
A-0275-014	2	O-ring
A-0275-012	6	O-ring
A-1001	2	Poly pak seal
A-00633-023	2	O-ring
A-00251-18	2	Rod T-seal
A-20257-1	1	Rexroth o-ring kit



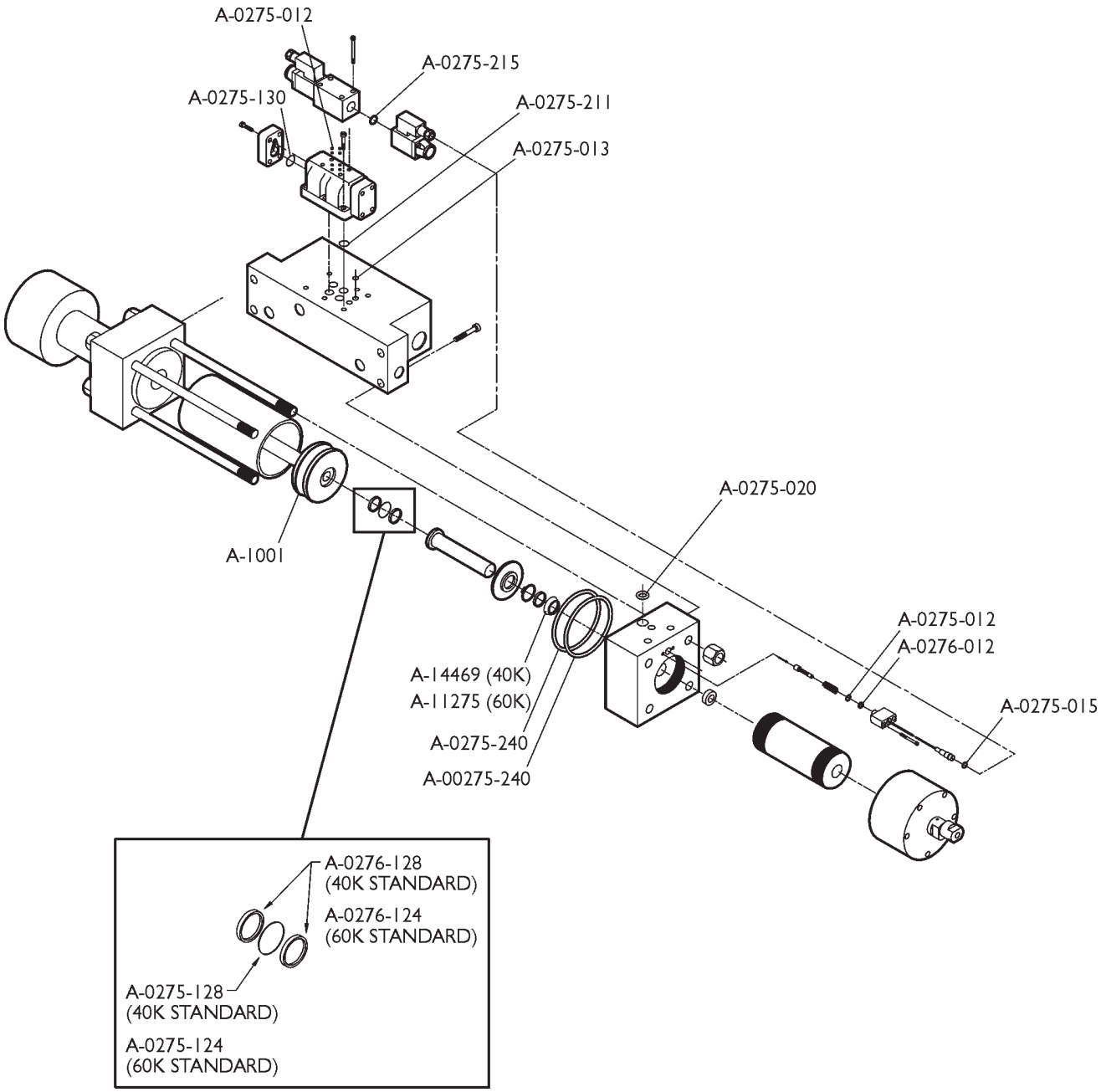
Electric shift low-pressure kits

014314-1 (Rev. B)
40K low-pressure seal kit

See illustration on following page.

Part #	Qty	Description
A-00250-240	2	Polymite backup ring
A-00251-22	2	Rod T-seal
A-00633-023	2	O-ring
A-0275-011	4	O-ring
A-0275-012	6	O-ring
A-0275-013	2	O-ring
A-0275-014	2	O-ring
A-0275-015	2	O-ring
A-0275-019	2	O-ring
A-0275-020	3	O-ring
A-0275-128	2	O-ring
A-0275-130	2	O-ring
A-0275-211	4	O-ring
A-0275-240	2	O-ring
A-0276-012	2	Backup ring
A-0276-128	4	Backup ring
A-1001	2	Polypak seal
A-14469	2	Poly seal
A-20257-1	1	O-ring kit, Rexroth valve

Electric shift low-pressure seal kit



Notes