Flow

HYPLEX™ PUMP

M-354 | REV. F | MARCH 2006

Due to continuing product improvement, the information contained in this document is subject to change without notice. Flow International Corporation shall not be held liable for technical or editorial omissions made herein, nor for any incidental or consequential damage resulting from the use of this material.

ISO 9001 REGISTERED

Product registration *M-354 (Rev. F)*

This manual is one of many documents describing Flow International's products. To make future technical information more useful to our customers, we would like to hear your comments and suggested improvements to this manual. After using the manual, please complete and return this questionnaire. The Technical Publications staff will carefully review your comments. Thank you.

Complete and mail to:

Flow International Corporation
Technical Information & Publications Department
23500 64th Avenue S.
Kent, Washington 98032 USA

Return this form to receive future updates to this manual.

Manual organization

Do the tables of contents help you to easily find topics? Yes [ ] No [ ] .....

.....

.....

Is the information contained in each chapter well organized? Yes [ ] No [ ]

.....

.....

.....

.....

Is the page layout well-suited to the material being presented? Yes [ ] No [ ].....

.....

.....

.....

.....

Graphics

How do you rate the quality and quantity of photos/illustrations? Excellent [ ] Adequate [ ] Poor [ ]

.....

.....

.....

Text

Does the information in the manual adequately explain how to operate and service the equipment? .....

.....

.....

.....

If there are paragraphs or procedures you feel need clarification, please identify them by page number and add your comments .....

.....

.....

.....

.....

Is there anything you'd add or delete from the manual to make it more useful to you?.....

.....

.....

.....

Is there any information that should receive more emphasis? .....

.....

.....

.....

General comments

.....

.....

.....

Personal information

Your name ..... Title .....

Company..... Date .....

Address .....

City, State (Country), zip.....

Please indicate here if you would like a written reply. [ ]

Contents

Introduction

The information in this manual will help you become familiar with your new Flow International (FLOW) equipment. It was compiled from the most current information available at the time of publication and is intended to cover the most common configurations. Your equipment was shipped with other documents and drawings. Refer to these drawings when using the service procedures in this manual.

Safety

All operating personnel and service technicians must read and follow the comprehensive list of safety precautions in all manuals provided with your equipment before installing, operating, or servicing the equipment. This will help avoid creating unsafe conditions or equipment damage.

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, you must read, understand, and follow all warnings, cautions, and notes in this manual. They 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.

CHAPTER 1

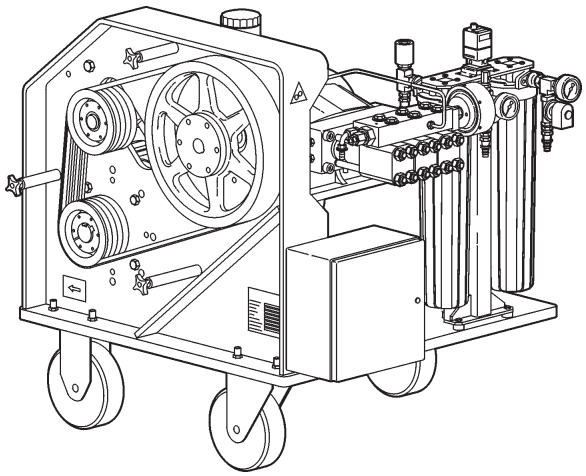
Equipment Description

The HyPlex pump is a powerful, ultrahigh-pressure waterjet cutting tool designed for minimum maintenance and reliable performance. The pump has an output water pressure rating of 55,000 psi (3792 bar).

Features

- Triplex pump
- Totally-enclosed, fan cooled (TEFC) motor
- Adjustable output pressures from 1000–55,000 psi
- UHP water system pressures are monitored by a pressure transducer and displayed in FlowCUT
- Dual filter system removes particles larger than 0.5 microns absolute
- Controlled with FlowMaster software
- FlowSense, an early warning system for critical parts
- No extra cooling water is required
- Available in 30 or 50hp motor, 60Hz or 50Hz

30/50 hp pump



Specifications

Contact FLOW Technical Service for further information. Also see the system drawings in Chapter 5.

Dimensions..... 51.25L x 53.75W x 42.5H

Oil .....SAE 30
Use SAE 40 for ambient temperatures above 90°F/32°C

Reservoir.....2.5 qt (2.6L)

Maximum stroke rate
75 hp.....1720/rpm
50 hp.....1160/rpm
30 hp.....720/rpm

Output pressure .....55,000 psi (3792 bar)

Max. pressure .....60,000 psi (4138 bar)

Filtration provided.....0.5 micron and 1 micron

Min. inlet water
75 hp.....2.5 gpm @ 60 psi
50 hp.....1.7 gpm @ 60 psi
30 hp.....1.0 gpm @ 60 psi

Max. inlet temperature .....65°F (21°C)
If plant inlet water temperature is higher, contact FLOW Technical Service

Air .....80-120 psi (5.5-8.3 bar)

Voltage .....400/50 Hz, 3ø
.....480/60 Hz 3ø
Power transformer required for any other voltages

Hydraulic oil

Use an oil that does not contain anti-wear additives. Shell Rotella (or equivalent) is recommended, but other manufacturer's equivalents can be used.

Use SAE 30 unless ambient temperature is above 90°F (32°C), then use SAE 40.

Reservoir capacity	2.5 qt (2.4 liter) Fill reservoir until oil is visible on the dipstick.
SAE designation	MS, SL, or SJ

CHAPTER 2

Safety

This chapter contains a comprehensive list of safety precautions that must be followed to ensure safe operation of the equipment. These precautions must be read and understood by everyone operating and maintaining the equipment—before they start working with the equipment. Note that OSHA and state safety agency rules must be complied with in addition to those given in this chapter and elsewhere in this manual. Applicable plant general safety precautions must also be followed.

Safety precautions

FLOW designed your high-pressure waterjet cutting system and related equipment with safety in mind. Throughout the manual, safety precautions and warnings for specific operations are highlighted. Safety precautions are also posted on the equipment. The operator and service personnel shall pay particular attention to these precautions at all times.

Operators of a high-pressure waterjet cutting system must treat the system as they would treat any high-speed cutting tool. Although the waterjet may appear harmless, it is a high-energy cutting tool capable of cutting many non-metallic materials such as composites, plastics, and wood products. Misuse of this equipment or carelessness in its application can be extremely hazardous to operating personnel. Always treat the waterjet cutting system with respect.

Warnings, cautions, and notes

Service procedures in the waterjet manuals include safety warnings, cautions, and notes that must be read, understood, and adhered to. These are specific categories of safety notices, and are defined as follows:

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

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

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

Replacement label

- Part # 006317-1
  3.75 x 6 in.
- Part # 009837-1
  1.8 x 3 in.

Safety tips

- Do not allow the waterjet stream to touch any part of your body—it will cause serious injury. Do not point the waterjet at anyone.
- During equipment maintenance, take the system out of service. The controls must be properly locked and marked with a warning sign.
- All personnel required to perform any system operating or service function must pay particular attention to all warning signs and notices posted in the plant and on the equipment.
- All protective guards, shields, and covers must be in place on the equipment at all times.
- First aid facilities shall be provided in convenient locations throughout the plant. These locations must be known by all personnel.
- Always keep the work area around the equipment clean and free of debris. Oil spillage results in slippery floors and must be cleaned up immediately.
- Any unfavorable conditions that may result in injuries shall be reported to the plant supervisor immediately.
- As a general practice, it is recommended that safety shoes, glasses, and hearing protection be worn by all personnel working around the equipment. Do not wear rings, watches, or necklaces when working around any equipment that has moving parts.

Mechanical system

- Don't start the system unless you know how to stop it.
- Never maintain, service, or clean around the equipment while it is operating.
- Do not use incorrect tools—it can cause injury or costly damage to equipment.
- Never climb on or around the equipment on makeshift devices. Use only approved catwalks, ladders, or platforms.
- Do not exceed specified pressure setting limits for pneumatic or hydraulic components. Exceeding these limits may result in serious injury to personnel or damage to the equipment.
- Shield and bundle equipment hoses and cables so they do not obstruct the operator's freedom of movement.
- Always be alert when working around the equipment.
- Clear all tools, parts, and rags from moving parts after servicing the equipment.

Electrical system

- Only properly trained personnel shall perform electrical and/or electronic troubleshooting and servicing of electrical devices.
- Always assume that power is ON in all electrical systems. Always check and lock out the main power switches before servicing the equipment. Post a sign, "Maintenance in Progress—Do Not Energize."
- Be aware that live electrical circuits are present in the control console whenever the master disconnect is on, regardless of whether the E-Stop is engaged.
- Disconnect circuit breakers and lock them in the OFF position before servicing the electrical system. If this isn't possible, have someone stand by to prevent someone from powering up the system.
- Take extra precautions when servicing the power system in a damp environment.
- Never alter or bypass protective interlocks or devices unless specifically instructed to do so, and only if all precautions are followed.
- You must give capacitors sufficient time for discharge. If this is not possible, discharging should be done manually and with care.
- Do not use jumper wires across fuses, fuse holders, or breakers.
- Make sure all tools are properly insulated for the job. Use only proper test apparatus; check regularly to make sure it is working correctly. Use caution when connecting a test probe to test points.
- All replacement wires shall conform to the manufacturer's specifications, including color coding, wire numbers, and size.
- Close the control panel doors or junction box covers after servicing.

Waterjet system

- High-pressure water can remain in the system for an extended time after shutting down the water source. Always bleed-down system pressure before servicing any part of the system.
- Do not touch weep holes with your bare hands or try to stop water by plugging the holes.
- Remember that the waterjet stream is a knife. Do not introduce anything into its path that you do not intend to cut.

- Wear a face shield when required by operating instructions.
- Do not remove protective shields from high-pressure tubing. If shields are removed for servicing, they must be replaced before starting the system.
- Torque all fittings to the manufacturer's torque specifications.
- Stepping or leaning on high-pressure tubing can break connections, causing leakage.
- Use only high-pressure fittings, valves, and tubing certified for 60,000 psi (4138 bar) when making alterations or additions to the high-pressure water system.
- Do not alter or eliminate stress relief tubing coils.
- Follow the tubing manufacturer's recommendations for high-pressure tube bending radii.
- Do not exceed specified operating pressures for high-pressure water system components.
- Do not over-torque fittings or bend swivels excessively.
- Follow the manufacturer's recommendations for servicing the equipment, and use only original manufacturer replacement parts.
- Follow the manufacturer's system startup procedure to ensure safe operation.
- Use care when lifting equipment covers during operation.

WARNING
NEVER point a waterjet cutting or cleaning tool at yourself or at any person. Do not aim any waterjet tool at anything you do not want to cut.

Protective clothing

Personnel operating hand-held, high-pressure water cutting or cleaning equipment and those working nearby should wear the protective clothing and safety devices described in this chapter.

FLOW recommends that work-site safety personnel approve all safety equipment and clothing for everyone working around waterjet equipment.

Eye protection

- Operators must wear visors and goggles to guard against spray and flying debris. A goggles and visor combination is a typical requirement for waterjet cleaning.

Head protection

- Helmets must be worn at all times by all personnel within the work area. Helmet material must withstand mechanical shock to 10 G in 8 ms without fracturing.

Hand protection

- The operator must wear gloves at all times. Leather gloves are preferred.

Foot protection

- Safety footwear with steel toe-caps at least 0.02-in. (5 mm) thick must be worn. The toe cap must cover at least 30% of the footwear length.
- For some applications, footwear must be equipped with metatarsal guards to provide instep protection.

Hearing protection

- Operators and other personnel exposed to noise levels of more than 90 dBa for more than 1 hour must wear suitable ear protection. Ear plugs and muffs are usually adequate.

Body protection

- Waterproof garments only protect the operator from spray and flying debris. They do NOT deflect direct jet impact.

Emergency medical information

Anyone who receives equipment-related injuries while operating high-pressure water equipment should be given immediate hospital attention. It is vital that medical personnel have information about this type of injury. Therefore, all waterjet operating personnel should carry a waterproof emergency medical tag or card that describes their work and the nature of injuries inherent in using waterjet cutting devices. The card illustrated below can be purchased from Flow International (P/N A-8466).

The tag or card should contain the following standard information:

MEDICAL ALERT

This card is to be carried by personnel working with high-pressure waterjet equipment. Obtain medical treatment immediately for ANY high-pressure waterjet injuries.

FLOW INTERNATIONAL CORPORATION
23500 64th Avenue South
Kent, Washington 98032 USA
(253) 850-3500

This person has been working with water jetting at pressures to 55,000 psi (379 MPa, 3793 bar, 3867 kg/cm2) with a jet velocity of 3000 fps (914 mps). This should be taken into account during diagnosis. Unusual infections with microaerophilic organisms occurring at lower temperatures have been reported. These may be gram-negative pathogens, such as those found in sewage. Bacterial swabs and blood cultures may therefore be helpful. A local poison control center should be contacted for additional treatment information.

CHAPTER 3

Maintenance & Troubleshooting

Periodic maintenance

Periodic maintenance is service to be performed on the equipment at regular intervals, designed to help minimize unscheduled production down time and premature parts failure. FLOW recommends that you keep detailed service records to help you prepare a maintenance schedule that is compatible with your application and production requirements.

General precautions

Observe the following general precautions at all times. Review the safety information in Chapter 2 before performing any maintenance or service, and pay attention to the safety messages in the maintenance and service procedures. Do not make any unauthorized changes to equipment or components.

Electrical

- Maintain all electrical components, protective guards, and shutdown devices according to approved practices.
- Make sure power cannot be applied to equipment during maintenance work. On diesel units, turn off the battery disconnect switch before beginning work.
- Before servicing, use a volt meter to make sure the system is not energized. Take extra precautions when servicing the electrical system in a damp environment.
- Never use jumper wires across fuses, fuse holders, or breakers.
- Do not use metal rulers, flashlights, pencils, or tools that have exposed conducting material.
- De-energize all equipment before connecting or disconnecting meters or test leads.
- When connecting the volt meter to terminals for measurement, use a range higher than the expected voltage.
- Replacement wires must conform to the manufacturer's specifications, including proper color coding and wire numbers.

Mechanical

- Use only high-pressure fittings, valves, and tubing certified for 60,000 psi (4138 bar) when making changes to the high-pressure water system.
- Immediately repair any leaks in fittings or connections. Torque all fittings to the manufacturer's specifications.
- When pressurizing any new, rebuilt, or recently serviced high-pressure component, clear all personnel from the immediate area until system pressure has been applied for three minutes and cycled on and off at least three times. At first startup, make sure the low pressure icon is selected. Then if no leaks or problems occur, click on the high-pressure icon and continue.
- Do not touch high-pressure leaks.
- Bleed down system pressure before servicing any part of the system. Never tighten pressurized fittings.
- Follow the manufacturer's recommendations for servicing the equipment, and use only original manufacturer replacement parts.

- Use cleaning solvents only in well-ventilated areas. Avoid prolonged breathing fumes and contact with skin or eyes.
- Inspect the entire system before operating it. Correct any fault or malfunction.

Tools

- Use only approved test equipment, and check it regularly for correct operation and calibration.
- Use the correct tools—the incorrect tool can result in injury to personnel or costly damage to the equipment.
- Clear all tools and rags from around the machine after service and before starting the equipment.
- Use only approved work platforms. Never climb on or around the equipment using makeshift devices.

Protective clothing

- Do not wear loose clothing while working around rotating parts of machinery.
- Pressurized air can drive particles into eyes and skin if handled improperly. To prevent injury, use appropriate protective equipment and clothing and exercise extreme caution.

Torque specifications

Refer to the following table when specific torque requirements are not listed in a service procedure.

CAUTION
Never torque mounting bolts and machine screws beyond the manufacturer's recommended limits.

The torque values for high-pressure water assemblies and fittings are listed in U.S. Customary System foot-pounds (ft-lb) and Systéme International (SI) Newton-meters (N-m).

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

HyPlex startup sequence after service

After initial installation, and whenever you install one of the HyPlex maintenance kits, follow this procedure when returning the equipment to service. It provides checks to make sure the pump is correctly reassembled.

- See Chapter 1 for routine operating instructions

Before starting the equipment

- Be sure you know how to stop it.
- Read the manuals, get training from an experienced operator, and review the safety precautions.
- Follow a written checklist that includes an inspection for needed or ongoing service, damaged or missing parts, leaks, and anything that could make equipment unsafe to operate.
- Make sure doors are closed and covers are in place, and call out "START-UP" to let anyone in the area know the equipment will be starting up.

WARNING
NEVER operate the pump with uncertified parts— this can cause explosive separation of parts & serious bodily injury. Contact FLOW or seek professional installation assistance.

- All operators and service personnel must review the safety precautions in Chapter 2 and in all manuals provided with this equipment before operating the equipment.

Starting the pump

1. Flush debris from all water supply hoses before connecting them to the pump.

CAUTION
Debris in the water supply line can cause extensive damage to high-pressure components. Such damage IS NOT covered by warranty.

2. Fill the pump case with a recommended oil (see the list on Page 8). The pump capacity is 2.5 qt. (2.4 L). Fill the reservoir until the oil is visible on the dipstick.

CAUTION
Never operate the pump without oil—this can cause extensive damage and IS NOT covered by warranty.

3. Make sure water lines, air lines, and drain lines are correctly connected and routed.

CAUTION
Cutting equipment and nozzles must be installed when operating the pump. Operating the pump without proper line restriction will damage high-pressure components.

4. Clear tools, parts, and rags from around the pump. Check in and around the pump for foreign objects and debris.
5. Open the inlet water valve; check all connections for leaks.

CAUTION
Operating the pump with the inlet water valve closed will cause damage.

Do not tighten any loose or leaking connections while the pump is operating or while the line is pressurized.

6. Place the main electrical disconnect in the ON position.
7. Release the E-stop button.
8. Activate FlowCUT and open a part program. Select Run Machine. The screen will display the pump on/off control. Verify that the low-pressure icon is checked.
9. If you have just installed a maintenance kit, click on Advanced | FlowSense diagnostic in the menu bar on the Run machine screen. You must enter pump hours and kit installation information or the pump will not run.
10. Run the *Temperature Input Offset Adjustment* routine; see Page 16.
11. The scaling factor (0.13) needs to be adjusted if pump pressure calibration is required. See *Calibrating the pump control system* on Page 16.
12. Open the manual relief valve on filters.
13. Click on the low-pressure icon. Check all connections for leaks.
14. Click on the high-pressure icon.
15. Turn the pump on by clicking the pump ON button. When the pump reaches 55,000 psi (3792 bar), operate the pump at this pressure for 5-10 minutes while checking for leaks. Correct as required.
16. Turn the pump off, exit FlowCUT, and press the E-stop button.

HyPlex pump temperature input offset adjustment routine

This software routine will run once, when enabled, to read the temperature inputs from the three thermistors and calculate the relative value of each to the lowest among the three. These relative values are used in the calculation for continuous monitoring of the cylinder temperature when the pump is running.

When to run this adjustment routine

- Initial installation of the pump
- Every time a dynamic seal kit is installed
- When replacing a thermistor (A-13262) or thermistor cable (A-13264)
- When replacing the analog input board (A-13533) or analog input module (A-01012-10)

Procedure

1. Make sure the pump is at room temperature (the pump should not have run long enough that all three cylinders are the same temperature.
2. Follow the HyPlex startup sequence after service on Page 15.
3. Start FlowCUT and go to the Run machine screen. Enable the temperature sensor offset adjustment routine by clicking on the appropriate button in the Option Component dialog box.
4. Close the Option Component dialog box and run the pump in low-pressure mode for about 45 seconds, then stop the pump.
5. Open the Advanced Diagnostic Tools window and enable the “technical service only” section. Enter variable P457 and press Enter in the command box, then write down the value given for this variable. Repeat for variables P458 and P459, writing down the values for each.
7. Open the ICSCARD.INI file that is located in C:\FlowMaster5.0\system folder.
8. Enter the values for P457, P458, and P459 in the file under the general initialization section. If the variables already have values assigned to them, simply overwrite them.
9. Save the file. In the FlowCUT program, go back to the previous screen and open the Run Machine screen in order to make the changes effective.

Calibrating the pump control system

Pressure calibration

Whenever the pump output pressure is significantly off the commanded pressure setting, pressure controls must be calibrated.

1. Start the pump in low pressure.
2. Click on Option Component on the FlowCUT Run Machine screen. If this button is not visible, refer to the procedure in this chapter.

WARNING
Waterjet nozzle will automatically open when starting the calibration routine. The cutting head must be positioned away from any material or tooling.

3. Start the calibration routine by clicking on the appropriate button in Option Component dialog box.
4. Save the newly calculated P536 & P548 values in the icscard.ini file. See the procedure in this chapter for instructions on saving parameter values.

   Default pressure conversion scaling factors are:
   P535 = 0.23
   P536 = 0.13
   P547 = 0.00
   P548 = 0.00

Pump pressure scaling factor

Over time, the pump output pressure may need to be calibrated. The values are located in the ICSCARD.INI file; editing can be done using any text editor, such as Notepad.

The scaling factor needs to be adjusted any time pump pressure calibration is required. This would be for a new PCV poppet and seat at first installation (either new equipment or after a rebuild).

For a new PCV poppet and seat:

Pump HP	*High*	*Low*
30/50	P536 = 0.181	P548 = 0.176

Inspection & maintenance schedules

FLOW equipment has been designed for long service life. However, maximizing the life, safety, and efficiency of the equipment depends on daily inspections and regular maintenance. Periodic maintenance can take the form of regularly scheduled preventive maintenance, such as the items listed below. It also includes replacing worn parts that have reached the end of their service life. In addition, the HyPlex pump has four mandatory maintenace kits that are installed at fixed intervals. These are described beginning on the following page.

Routine daily checks

Before startup

- Inspect pump, high-pressure tubing, connections, and valves for leakage. Correct any problems before starting the pump.
- Check the oil level in the pump.
- Check the main electrical disconnect for "Out of Service" tags and check all around the equipment for indications of maintenance work in process.

After startup

- Listen for unusual sounds as the pump starts and water pressure increases. Look for leaks.

End of shift

- Clean machine work area.

Mandatory maintenance schedules

At fixed intervals for the life of the pump, you must perform a mandatory maintenance kit installation. The Service information feature in FlowCUT is factory-set to remind the operator 10 hours before the next required maintenance hour mark (these are listed below). If maintenance has not been done within 1 hour after the required hour mark, the pump will be disabled until service has been conducted and the service information record dialog box has been updated.

Maintenance periods by pump hours

Every 400 hours for a 30hp HyPlex and every 250 hours for a 50 hp HyPlex you will be installing a maintenance kit. Complete kit bills of material are in Chapter 5. Complete kit installation procedures are in Chapter 4.

Maintenance Kit Description	***P/N***	***Hourly intervals***	
		30 hp HyPlex	***50 hp HyPlex***
Dynamic Seal Kit	015606-1	400, 1200, 2000 hours and so on *unless replaced by a minor or major interval kit installation*	250, 750, 1250 hours and so on *unless replaced by a minor or major interval kit installation*
Minor Kit	712101-1	800, 2400, 4000 hours and so on *unless replaced by a major interval kit installation*	500, 1500, 2500 hours and so on *unless replaced by a major interval kit installation*
Major Kit	712101-2	1600, 3200, 4800 hours and so on	1000, 2000, 3000 hours and so on
PCV Kit	015605-1	3200, 6400, 9600 hours and so on	2000, 4000, 6000 hours and so on

Maintenance kit intervals

Kit intervals vary depending on the horsepower of the pump, and are briefly explained below. See the table on the previous page for kit part numbers.

30 hp HyPlex pump

Dynamic seal maintenance kit interval

- Every 400 hours, install the Dynamic Seal kit (unless replaced by a Minor or Major kit interval)

Minor maintenance interval

- Every 800 hours, install the Minor Maintenance kit (unless replaced by a Minor or Major kit interval)

Major maintenance interval

- Every fourth Dynamic Seal kit or 1600 hours, install the Major Maintenance kit

PCV rebuild interval

- Every 2000 hours

50 hp HyPlex pump

Dynamic seal maintenance kit interval

- Every 250 hours, install the Dynamic Seal kit (unless replaced by a Minor or Major kit interval)

Minor maintenance interval

- Every 500 hours, install the Minor Maintenance kit (unless replaced by a Minor or Major kit interval)

Major maintenance interval

- Every fourth Dynamic Seal kit or 1000 hours, install the Major Maintenance kit. This kit requires a different procedure, located in this chapter.

PCV rebuild interval

- Every 2000 hours

Other routine maintenance

In addition to installing the minor and maintenance kits at the specified intervals, you also need to do the following maintenance items at these times.

At each dynamic seal maintenance interval

- Change the crankcase oil at every dynamic seal maintenance interval OR once a year OR whenever water is noticeable in the crankcase (see *Servicing the crankcase*).

At each minor maintenance interval

- Check the drive belt.
- Check all electrical cables and connections.
- Change the water filter cartridges, or when delta P is >15 psi (1.03 bar).

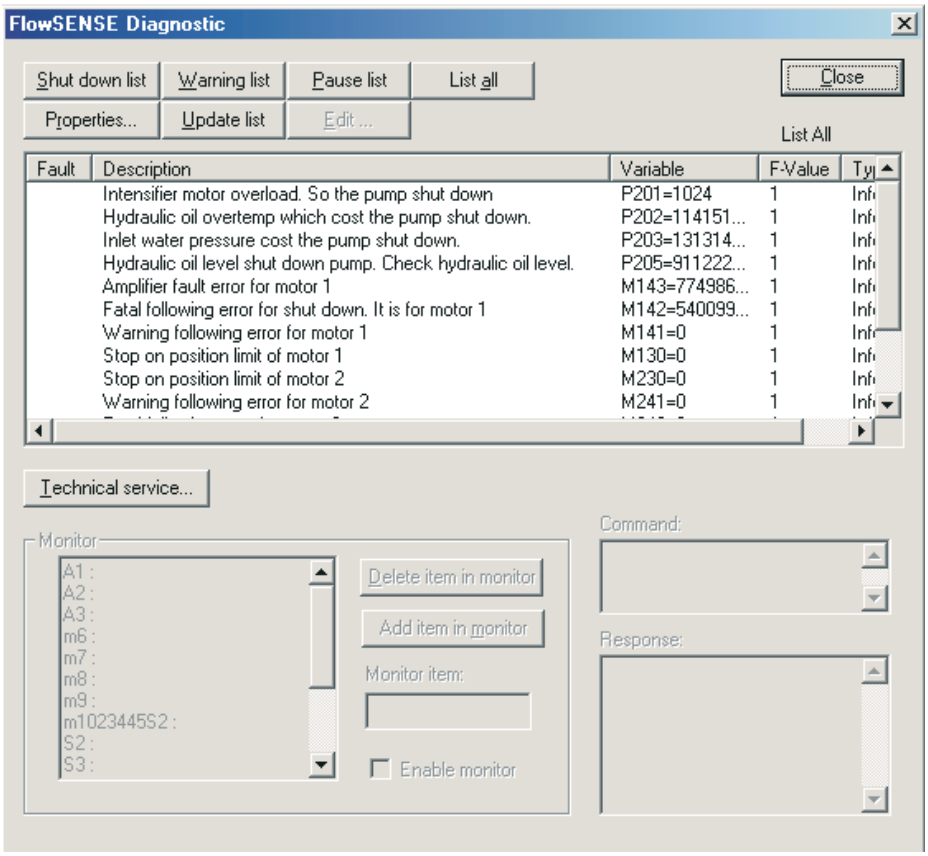
  Note: Change cartridges at an interval convenient to your Minor Maintenance schedule. Cartridge life is very dependent on inlet water quality.

Troubleshooting the HyPlex pump using FlowSense

Hyplex pumps running with a FlowMaster controller are continuously monitored by FlowSense, a diagnostic program that monitors a number of system conditions, some of which are specific to pump conditions. Sensors located on the pump enable FlowSense to alert the operator of pump conditions that will require attention. To indicate a warning, the colors of the display are inverted and will blink. If a shutdown condition exists, a dialog box will appear.

To investigate the cause for the of the fault, and how it can be corrected:

- Go to Run Machine and click on Advanced | FlowSense diagnostic in the menu bar. This screen is shown below.
- In the Flow Sense dialog box that is displayed, locate the X in the Fault column and highlight that row.
- Click on the Properties button



FlowSense diagnostic codes

Pump conditions monitored by FlowSense include both shutdown and warning conditions. These are described on the next two pages.

FlowSense shutdown codes

1. Low inlet water pressure shutdown	
• Water supply valve closed • Inlet water pressure low • Dirty water filters	Check the water supply cut off, and make sure the water supply valve (when supplied) is in the correct position. Remove and check the water filter cartridges; replace if dirty.
2. Crankcase overtemp shutdown	
Low oil level	Add oil to crank case.
Faulty oil temp thermostat	Verify pressure setting, adjust per drawing.
Problems in crankshaft/rotating group	Contact FLOW Technical Service.
3. Overpressure shutdown	
Debris in PCV poppet seat	Remove PCV and clean poppet/ seat to remove debris. Replace poppet/seat if required. **Note:** Debris in the seal can also cause an underpressure problem.
Control air pressure to PCV set too high	Remove air control pressure to PCV. **Note:** Max pressure for PCV is 40 psi (2.76 bar).
Damaged PCV piston	Repair/replace piston and/or piston seals.
Incorrect UHP transmitter calibration	Calibrate pressure transmitter.
4. Cylinder overtemp shutdown (subplate adapter)	
• Failed dynamic seal • Cracked dynamic seal carrier • Damaged plunger • Debris under or failed outlet poppet/seat in check valve assembly • Debris under or failed inlet poppet • Cracked check body • Cracked UHP cylinder	• Check pump hours, and install the appropriate required maintenance kit. • Disassemble pump and inspect all components, following the maintenance procedures in this manual. Repair or replace parts as required.
5. Motor overload shutdown	
Circuit breaker has tripped	Check for cause of tripped breaker; reset.
Motor starter relay is not closing	Check for incorrect wiring.
Tripped overload relay on motor starter	Reset relay.
Control relay is open	Locate the control relay on the wiring diagram and check for correct operation. Replace if defective.
Defective motor starter auxiliary contact	Press the contactor and testing with power applied to the coil. Replace auxiliary contact if defective.

Defective motor starter coil	Check for defects by testing with power applied to the coil. Replace coil if defective.
Start circuit is wired incorrectly	Check wiring against diagram; correct errors.
• One phase of electrical power is lost • Circuit breaker trip level set too low	Re-adjust overload to a higher setting. **Note:** Applicable only to motor starters equipped with an adjustable trip circuit breaker.
Motor starter heater coils are improperly sized for the load	Check size of all coils; replace if incorrect. Current requirements can be found in the product specifications. Do not exceed 130% of the motor's full-load current.
6. Pump health shutdown	
One of the high-pressure cylinders is no longer producing pressure	Immediate service is required (dynamic seals and/or check valves).
• Failed dynamic seal • Cracked dynamic seal carrier • Damaged plunger • Debris under or failed outlet poppet/seat in check valve assembly • Debris under or failed inlet poppet • Cracked check body • Cracked UHP cylinder	• Check pump hours, and install the appropriate required maintenance kit. • Disassemble pump and inspect all components, following the maintenance procedures in this manual. Repair or replace parts as required.

FlowSense warning codes

1. Inlet water temperature warning	
• Water inlet above 65°F (18°C) • Dynamic seal(s) may be damaged	Check inlet water temperature to make sure it is below 65°F.
2. Analog input out of range	
Thermistor cables disconnected	Make sure the cables are connected
Faulty thermistor(s)	Replace thermistors if suspected.
Wiring problem	Check for and correct any wiring mistakes
Faulty analog input module	Replace if suspected
3. Cylinder overtemp warning	
• Dynamic seal starting to fail • Cracked dynamic seal carrier • Damaged plunger • Debris under or failed outlet poppet/seat in check valve assembly • Debris under or failed inlet poppet • Cracked check body • Cracked UHP cylinder	• Check pump hours, and install the appropriate required maintenance kit. • Disassemble pump and inspect all components as per maintenance procedures in this manual. Repair/replace as required.

Troubleshooting the high-pressure components

You may experience other conditions that are not detected by FlowSense; these are explained in the troubleshooting table that begins on the next page. To supplement the table, also refer to the color troubleshooting illustration in this chapter.

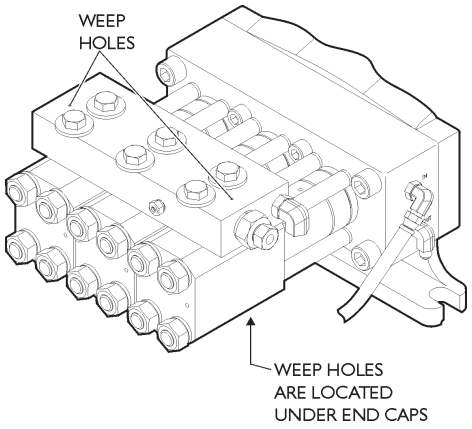
Unless otherwise specified, service procedures are located in *Installing the minor maintenance kit* or *Installing the major maintenance kit*, located in this chapter.

Additional troubleshooting tips

While FlowSense is designed to diagnose the most common conditions that require attention to the pump, the following tips have been helpful in isolating less common system malfunctions and in correcting problems quickly.

- Listen to the machine and watch it operate. Learn to recognize the normal noises, temperature, and operating conditions. This will increase your ability to notice any unusual machine behavior.
- Keep a record of all service performed on the equipment. This will provide valuable information to help you stock spare parts and schedule maintenance.

Weep holes



Weep holes provide an outlet for high-pressure water in case of seal problems, and thus can help you identify problems with the pump. Leakage can be caused by:

- a loose or leaking end cap
- failed check valve body o-rings
- cracked or scored high-pressure check valve body

Water leakage from the end cap weep hole is usually caused by failure of the check valve body o-ring or a cracked check valve body.

Troubleshooting table for the high-pressure components

If you have questions about anything on the troubleshooting table, contact FLOW Technical Service.

1. Pressure (nozzle closed) is much higher than operating pressure [greater than set pressure].	
Air pressure is set too high	• See setting of proportional valve • See Initial pump start up procedure in Chapter 3.
Nozzle/orifice damage	Replace nozzle
PCV poppet/seat excessive leakage	Replace poppet/seat
Pump requires maintenance	Check pump hours, and install the appropriate required maintenance kit. See required maintenance procedures in Chapter 3.
2. Excessive heat in end caps caused from check valves **Note:** Heat below 110°F (43°C) should be considered OK (above 110°F is painful to touch).	
Excessively worn high-pressure check valve body face	This condition will create excessive leakage, which in turn develops heat. Recommend installing the required maintenance kit. Check pump hours, and install the appropriate required maintenance kit.
3. Incomplete cutting or poor edge quality	
Water pressure is too low, which could be caused by any one of the following:	• Pump pressure set too low. Increase to recommended level • High-pressure water filters need service • Leak in high-pressure water system • Nozzle needs service • The pump needs maintenance. Check pump hours, and install the appropriate required maintenance kit.
4. Static seal is leaking	
Note: Static seal failure has the same symptoms as a fractured inlet check valve poppet.	
The end cap assembly, inlet water manifold, and high-pressure cylinder will become very hot	Replace check valve body and/or high-pressure cylinder. See procedures in Chapter 3.
5. Inlet check valve malfunction	
Note: Failure can also be caused by static seal leakage or valve body fracture. Check all components for signs of damage.	
Inlet water pressure is too low, which does not let the inlet poppet open enough to allow a full charge of water to enter the high-pressure cylinder	Check and adjust inlet water pressure if necessary. Minimum water inlet after the filters must be above 15 psi (4.1 bar).
A cracked or eroded inlet poppet will cause the pump to lose pressure by as much as 50%. If this happens, the water inlet manifold, high-pressure cylinder, and end cap will become very hot (approximately 180°F (82°C).	Check pump hours and install the appropriate required maintenance kit. **Note:** High-pressure water leakage will not be visible.
Filler tube sleeve is too short	Check overall length, and replace if required. It should be 0.670 in. (±0.002 in.).

6. Outlet check valve malfunction	
Poppet and seat failure is very similar to outlet check valve failure in an intensifier. Contact erosion is caused by excessive wear or debris lodged between poppet and seat.	This will cause the pump to lose pressure and the outlet portion of the pump will become very hot. Check pump hours, and install the appropriate required maintenance kit.
Notes: • Fatigue can fracture the outlet poppet guide or spring. By itself this won't cause noticeable problems with pump output, but it will cause the poppet and seat to wear prematurely. • Check the outlet every time the end cap is removed: insert a rod down the outlet passage through the inlet screw and gently force poppet response. The short poppet stroke, soft spring force, and crisp closure will be evident.	
7. End cap seal is leaking	
During operation, hot water coming out of the weep hole in the end cap indicates that high-pressure leakage has passed the end cap seal	Replace end cap seal or entire end cap.
	Check tie rods. Replace set of four if one has failed.
Output pressure is set too high	Lower the setting. **Note:** Cold water leaking out of the side weep hole usually indicates a damaged check valve o-ring.
8. Failure of other high-pressure components	
Replace the high-pressure cylinder if any of these situations occurs: • HP cylinder fracture at the dynamic end. Water will leak between guide and cylinder. • HP cylinder fracture at the static seal end. Water will leak back into the pump through the inlet check valve. The high-pressure cylinder, manifold, and end caps will become very hot. • HP cylinder fracture at the center of the high-pressure cylinder. Water will leak violently through the fracture.	
Replace the check valve assembly if either of these conditions occurs: • Check valve body fracture with no outward water leaks. The end cap, high-pressure cylinder, and water inlet and manifold lines will become hot to the touch. The failure indication is very similar to the inlet check valve poppet failure and static seal leakage. • Check valve body fracture, indicated by hot water leaks from the weep hole at the side of the end cap.	
End cap failure will, depending on location, produce hot water leaking from a weep hole or from one of the tie rod holes, leakage between end cap and manifold, or will cause an internal leak back into the pump. • Replace end caps and check for other forms of damage.	
Hot water leaking from the bottom weep hole could indicate a cracked check valve body. Be sure to inspect all components in the end cap.	
Excessive wear of the outlet seat can form an overhanging lip at the surface of the stepped bore. This causes an overpressure condition in the high-pressure cylinder and a loud knocking when the poppet opens.	
UHP manifold failure	During operation, you will see leakage or hot water between the manifold and one of the end caps. • Inspect o-rings and backup rings; replace as required. • Inspect manifold UHP ports for cracks. Replace manifold if required.

9. Plunger failure damage **Note:** Damage will vary depending on where it fails and how long it runs unnoticed.	
If the plunger surface is damaged, it will rapidly destroy the dynamic seal	Replace the plunger. Check pump hours, and install the appropriate required maintenance kit.
If the plunger breaks at or near the plunger collar, the unit may continue to run as long as the inlet water pressure is high enough to return the plunger on the inlet stroke	• Replace plunger. • Check pump hours, and install the appropriate required maintenance kit. • Inspect crosshead for damage. • Inspect dynamic seal carrier for damage in the backup ring area.
10. Pump does not come up to pressure (nozzle open)	
Orifice is too large	Install the correct orifice. (See orifice size chart)
Orifice(s) is damaged	Replace the orifice(s).
Plumbing or HP hoses leak	Correct leaks.
Inlet water pressure is low	Correct as needed.
High-pressure pump is leaking. Possible causes: • static seal leaking (see Item 4) • inlet check valve malfunction (see Item 5) • outlet check valve malfunction (see Item 6) • end cap seal leaking (see Item 7) • excessive PCV poppet leakage (see required maintenance kit procedures) • control pressure for PCV set too low (see required maintenance kit procedures)	Item numbers refer to the troubleshooting headings in this table. Refer to the corrective action as directed. Contact FLOW Technical Service for more information.
11. Electrical motor will not stop	
Defective E-STOP	Replace if defective
Stop circuit wired incorrectly	Check wiring against diagrams; correct errors.
12. Electric motor is excessively noisy	
Bearings are not lubricated	Electric motor bearings require periodic lubrication; follow manufacturer's recommendations. Replace bearing if necessary.
Belt and/or insert is loose or broken	Check and tighten belt. Replace if worn or broken.
Open electrical circuit phase	Make sure phases are closed. Replace if defective.
Loose mounting bolts	Tighten loose bolts.

CHAPTER 4

Service

Servicing the high-pressure pump

The step-by-step instructions and illustrations in the service procedures will help you service the equipment. There are required service procedures that must be done at specific intervals; these and other procedures for replacing parts are located in this chapter.

Service tips & notes

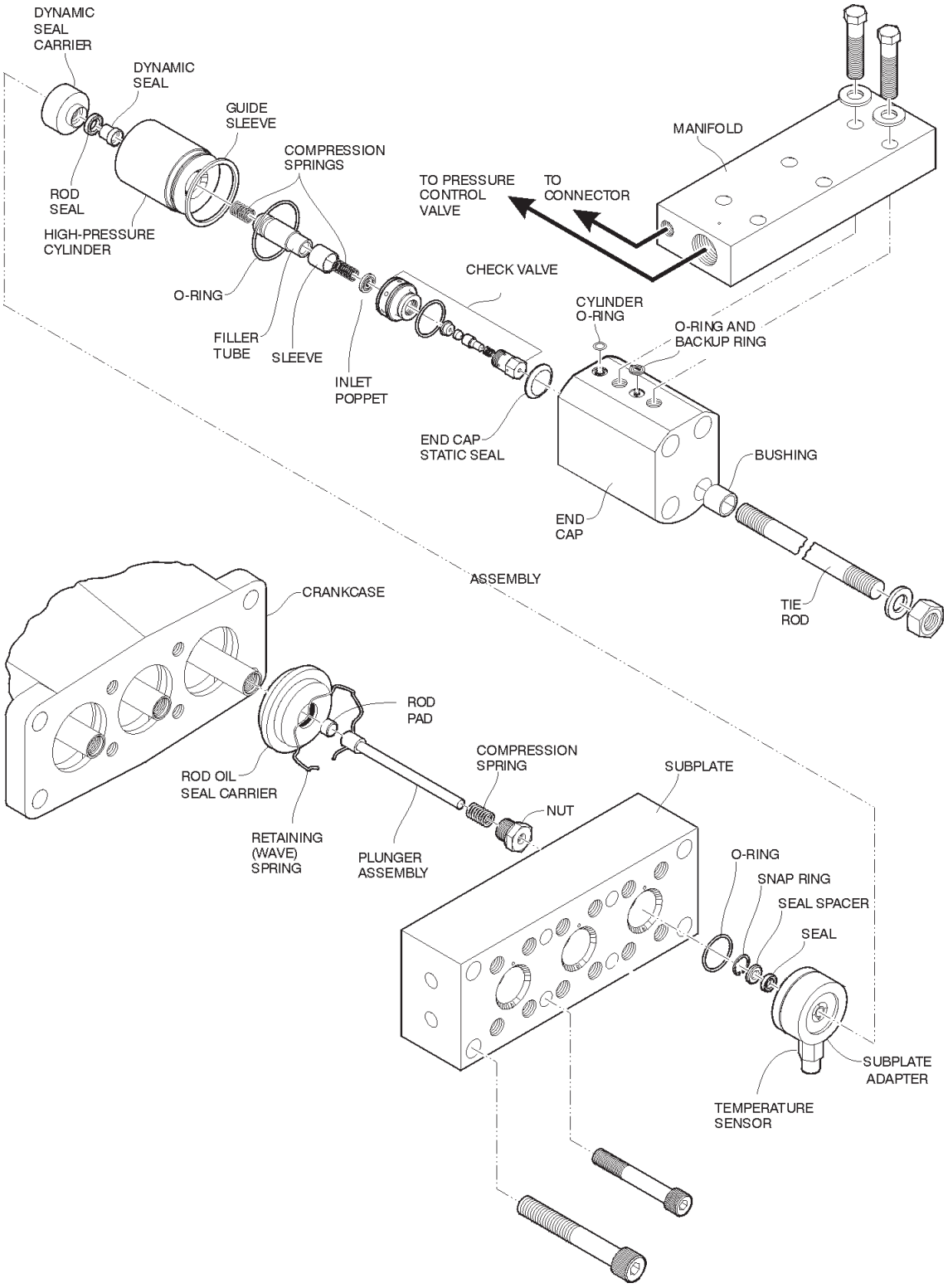
Review the safety precautions in Chapter 2 and the maintenance tips in this chapter before starting any work. If you have questions about any service, contact FLOW Technical Service.

- Inspect the equipment every day before operating it. Correct malfunctions, using the troubleshooting guide to isolate the problem and the applicable service procedure to correct it.
- Read and thoroughly understand each service procedure before starting the work.
- Maintain records of service performed. This will provide valuable information to help you restock spare parts.
- Do not use a substitute for the fluids, sealants, and lubricants recommended by FLOW. Clean off grease fittings before connecting grease gun to avoid injecting dirt-filled grease into the bearings. All threaded high-pressure connections require an even coating of Blue Lubricant (A-2185).
- Routinely check for loose bolts or wire connections.
- Handle critical parts with care and avoid scratching or denting the high-pressure water system components.
- Protect all machined and lapped mating surfaces against nicks, scratches, and burrs. Carefully work out any damage to seal wiping surfaces, or seal damage and leaks will be a recurring problem.
- Monitor water seepage from end cap weep holes. If seepage is cold (same temperature as inlet water), it is usually not necessary to change seals, but you should schedule maintenance as soon as possible. If seepage is hot, shut down the system and repair the pump. Cracked parts and leakage from the check valve MUST be repaired immediately.
- All parts that contain high-pressure water (cylinder, check valve housing, tubing) are susceptible to stress fatigue accelerated by stress risers, caused by nicks, scratches, or other surface disruptions. Rework all such damage or replace the component.
- Life expectancy of high-pressure water seals and other high-pressure parts is related to stress on the parts, and is a function of stroke rate, water pressure, and inlet water temperature. Exceeding pump ratings can lead to increased costs and downtime.

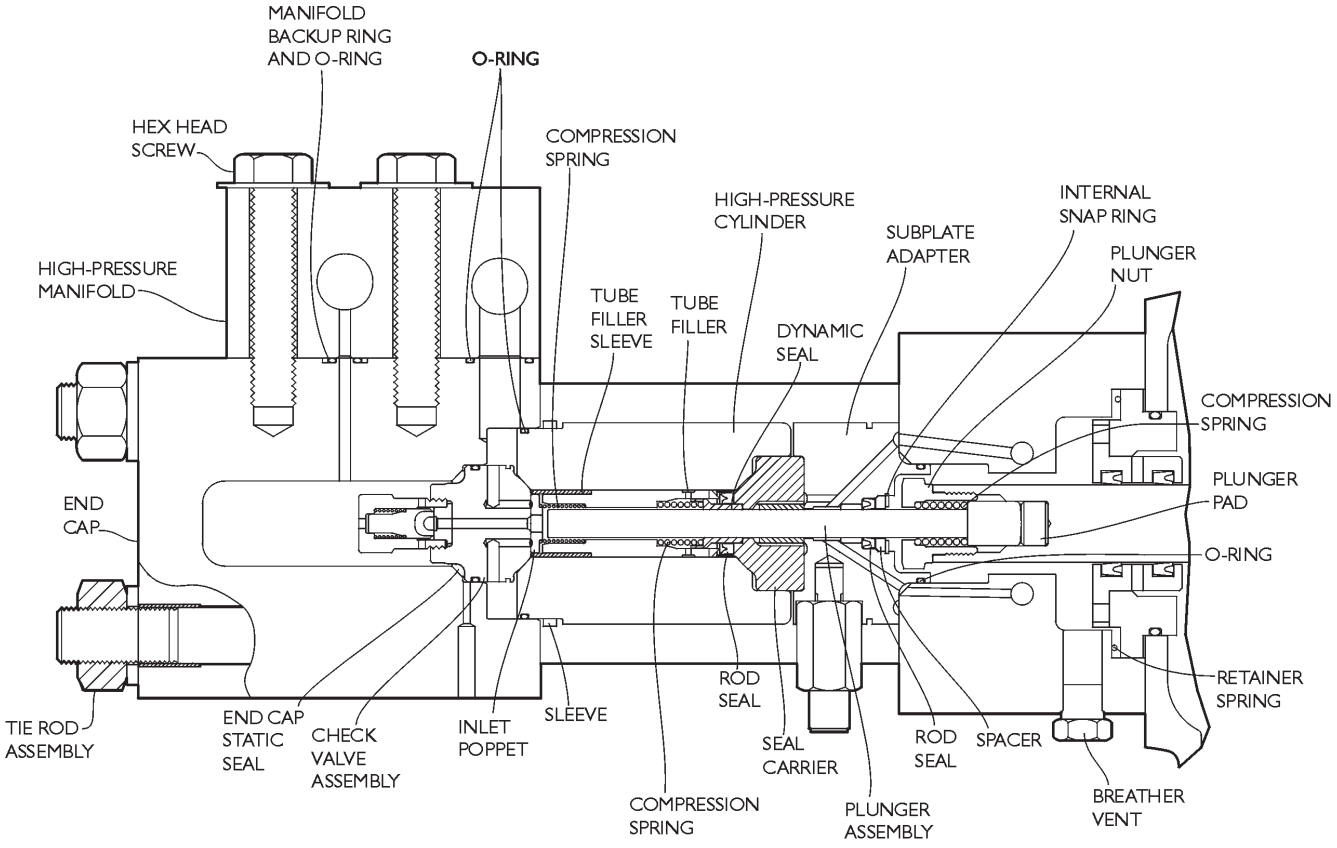
Clean environment

- Keeping components clean is critical. Make every effort to find a clean area to service the components—do not tear down parts in the same area where cleaning is taking place. Airborne dirt and abrasive have serious detrimental effects on part life.
- Carefully clean and blow out all parts being reassembled. Do not use paper towels. Do not create airborne dust.
- Clean all parts with fresh, clean solvent that does not leave a residue, such as Citra-safe or isopropyl alcohol. FLOW recommends that you set up a dedicated solvent tank for these critical parts. Contamination from other industrial parts will seriously reduce part life.

Major high-pressure components



High-pressure pump



Notes

Installing the Dynamic Seal Maintenance kit

Use this procedure when installing the dynamic seal maintenance kit on your HyPlex pump. The complete service schedule for the Dynamic Seal Maintenance kit can be found on Page 18.

Tools

- HyPlex tool kit (012068-1) which contains a plunger nut tool, spanner wrench, glass plate, tie rod driver, rebuild clamp, screw, and flat washer
- Combination wrenches (9⁄16–1¼ in.)
- ½ in. drive socket set (9⁄16–1¼ in.)
- ½ in. torque wrench (10–250 ft-lb) (**Note:** you may need two separate wrenches)
- Feeler gauge set
- Screwdriver set
- 0–1″ micrometer or dial caliper

Service notes

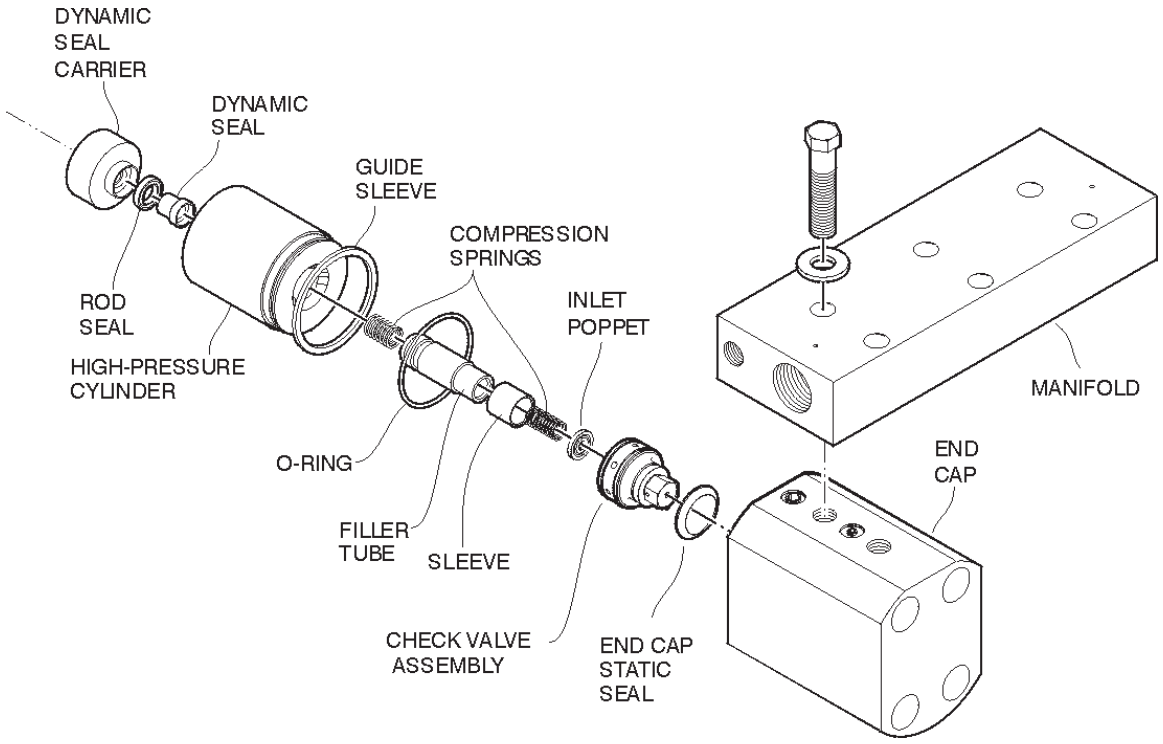
All components should be clean and free of debris prior to assembly. Keeping the work area clean is important while working on the equipment.

Read the entire procedure through before beginning service, paying particular attention to safety instructions.

CAUTION
Failure to follow these step-by-step instructions and the procedures in your service manual could result in premature failure or damage to the equipment.

Repair kit

- Dynamic Seal Maintenance kit, 015606-1



Disassembly

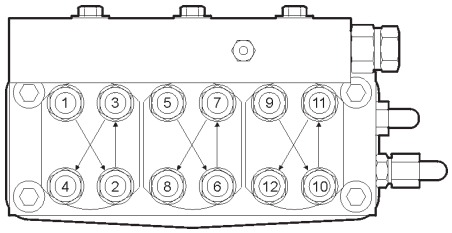
1. Push in the E-stop.

WARNING
Bleed down all high-pressure lines. Failure to do so may result in equipment damage or injury to personnel.

2. Disconnect high- and low-pressure plumbing from the high-pressure manifold and pressure control valve (PCV).
3. Remove high-pressure line to the transducer.
4. Loosen the six hex screws and remove the high-pressure manifold from the end caps. Retain o-rings and backup rings; you will need them for reassembly.

CAUTION
Follow the procedure in Step 5 when removing the 12 hex nuts. Removing them incorrectly will overload the tie rods and cause damage.

5. Loosen the 12 hex nuts in a crisscross pattern a few degrees at a time until all nuts are loose. Remove nuts and washers only after all 12 nuts have been loosened.



For each of the three high-pressure cylinders

6. Slowly pull the end cap back about 2 in. (51 mm). Use two small pry bars in the groove between the high-pressure cylinder and the end cap to separate them, being very careful not to damage the plastic guide. Retain any springs that separate from the assembly.
7. Remove the end cap, high-pressure cylinder, inlet poppet, springs, filler tube, and sleeve. Separate the spring from the inlet poppet.
8. If the dynamic seal carrier does not separate from the high-pressure cylinder, clamp the seal carrier into a soft-jawed vise and gently work the cylinder from side to side until they separate.
9. Slide the dynamic seal carrier off the plunger if it did not come off with the high-pressure cylinder. Remove and discard the dynamic seal and rod seal.

CAUTION
Use care when removing the dynamic seal and rod seal. Do not scratch or nick the seal carrier bores.

10. Place the end cap vertically on a work bench with the check valve end up.
11. Remove the check valve assembly from the end caps by using two pry bars in the circumferential groove in the OD of the check valve body. Take care not to damage the body or end cap.

Lap inlet face of check valve body and inlet poppet

12. Use the glass lapping plate from the tool kit and lapping paper from the repair kit.
13. Lightly wet the paper with water. Place the inlet face of the check valve body against the lapping paper. With a light downward pressure, lap the body in a figure 8 pattern.

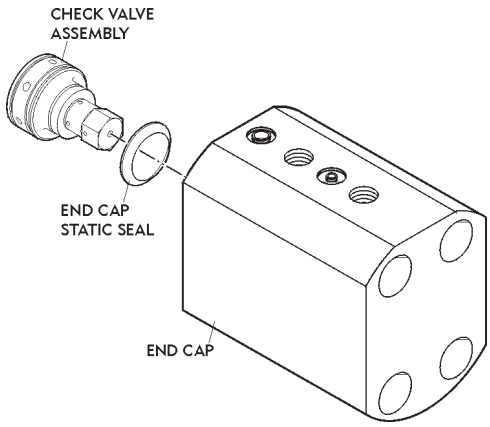
CAUTION
Be very careful not to rock the check valve body while lapping the surface—flatness is very critical.

After 10-12 laps, rotate the check valve body 45° and continue lapping until the surface has a smooth matte finish free of any deep scratches or signs of deformation from the inlet poppet. Re-wet the paper as needed. Lap the inlet check valve poppet using this same method.

14. Thoroughly clean the check valve body openings and inlet poppet to remove particles from the lapping procedure.

Reassembly

Assemble the end cap

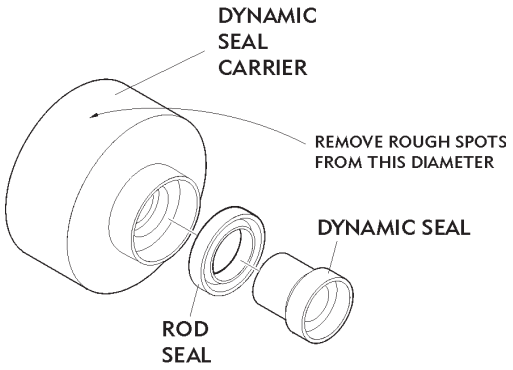


1. Lightly lubricate the o-ring with o-ring lube and install into the groove on the check valve body.
2. Verify the end cap static seal is on the outlet end of the check valve body.
3. With the outlet cage facing the end cap, insert the check valve body into the end cap.

Repeat Steps 1–3 for the remaining end caps.

Assemble and install the dynamic seal carrier

1. Using the lapping paper used on the check valves, smooth any rough spots from the outside diameter of the dynamic seal carrier.



2. Inspect the dynamic seal carrier for cleanliness and erosion damage. Erosion damage at the innermost corner will cause seal life to be reduced. Make sure the guide bearing is in good condition. (The presence of cracked or loose pieces is reason for replacement.) Replace the dynamic seal carrier if necessary. Clean as necessary.
3. Install the rod seal as shown in Step 1, with the v-shape facing up, into the dynamic seal carrier.
4. Install the dynamic seal into the inner diameter of the rod seal, making sure the rod seal is fully seated into the dynamic seal carrier bore.

   Note: Make sure the plungers are clean and free of any damage or scratches before installing the seal carriers. Also make sure that the subplate adapter/seal carrier interface is clean and free of debris.

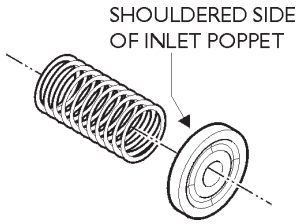
5. Slide the dynamic seal carrier into the plungers until seated against the register of the subplate adapter.

Install the high-pressure cylinder

CAUTION
Take care not to pinch the o-ring with the guide sleeve while installing the high-pressure cylinder.

1. Using the lapping paper used on the check valves, smooth any rough spots from the 1.5-in. inner diameter of the cylinder. Clean thoroughly to remove abrasive debris.
2. Apply Blue Lubricant to the 1.5-in. diameter of the dynamic seal carrier and to the inner diameter of the high-pressure cylinder.
3. Place the plastic guide sleeve on the high-pressure cylinder.
4. Lubricate the o-ring with o-ring lube and place it in the groove of the high-pressure cylinder.
5. Place the high-pressure cylinder in position on the tie rods, and slide the cylinder back to make contact with the dynamic seal carrier.
6. Make sure the guide sleeve is positioned correctly on the cylinder and is not pinching the o-ring.

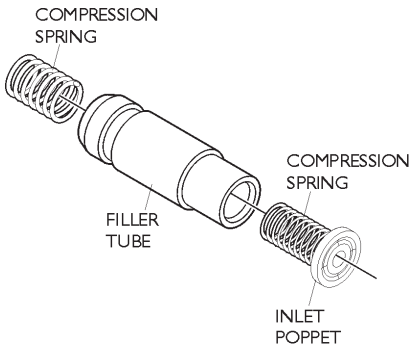
Assemble the inlet poppet



1. Place the inlet poppet spring over the shouldered side of the inlet poppet.
2. Apply pressure to the spring and rotate counterclockwise until it snaps into place. Make sure the spring is firmly attached.

Repeat for remaining inlet poppets.

Assemble the filler tube



1. Place the dynamic seal compression spring into the tapered end of the filler tube.
2. Insert the filler tube, spring end first, into the high-pressure cylinder, being sure to engage the spring into the dynamic seal.

Repeat for remaining filler tubes.

3. Insert the inlet poppet assembly into the filler tube, spring end first.
4. Measure the overall length of the filler tube sleeve. It should be 0.670 in. (+/- 0.002 in.).
5. Partially install the filler tube sleeve so that it surrounds the inlet poppet and spring.

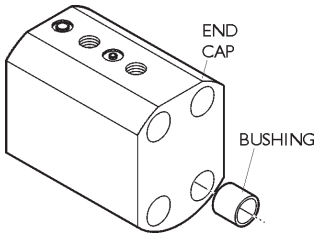
Repeat for the remaining filler tube sleeves.

Note: The filler tube sleeve helps align the poppet with the check valve body and prevents pinching of the poppet between the check valve and the filler tube during assembly.

Install the end cap

CAUTION
It is important that you do not let the end cap spring back while installing. If it does, the inlet poppet can be pinched, causing damage.

1. Make sure all eight of the end cap split bearings (bushings) are in position.



2. Align the end cap so it will slide over the tie rods.
3. Carefully slide the end cap back until the check valve makes contact with the inlet poppet.
4. Continue sliding the end cap back until it seats over the o-ring on the high-pressure cylinder.
5. Temporarily install one of the hex nuts, hand tight, to prevent the end cap from springing back.
6. Install the other two end caps before continuing.

CAUTION
Make sure all the split bearings are completely seated in the end cap. Not doing so will cause premature torque while torquing the end caps.

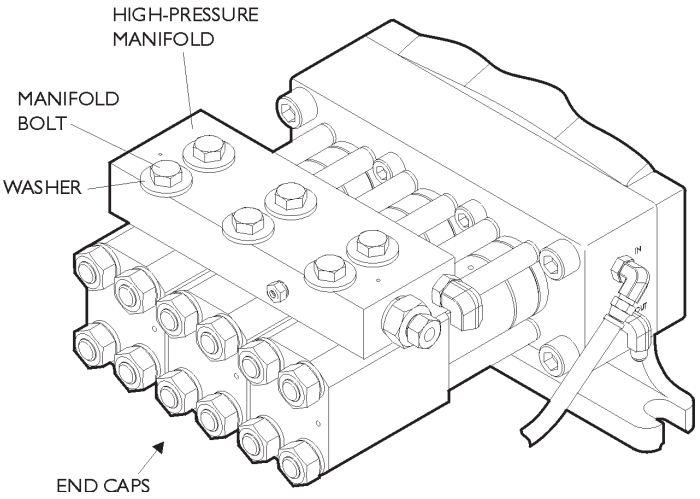
7. Apply anti-seize compound to both sides of the washers and to the threads of the tie rods.

8. Install washers and hex nuts hand tight. Do not torque the tie rod hex nuts at this time.

   Note: If dragging or stiffness occurs while installing the hex nuts, determine the cause and eliminate it.

9. Remove the temporarily installed hex nuts. Apply anti-seize to both sides of the washers and threads, then reinstall the nuts.

Install the high-pressure manifold



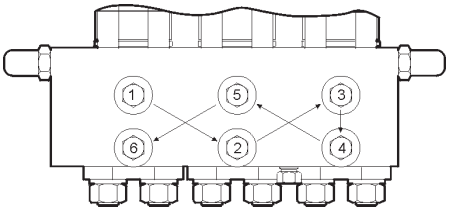
1. Place the high-pressure manifold over the three end caps, aligning the through holes with the threaded holes in the end caps.
2. Lightly apply anti-seize compound to the manifold bolts and both sides of the washers.
3. Secure the manifold with hex head bolts tightened hand tight. DO NOT torque bolts at this time.

Torque manifold & tie rods

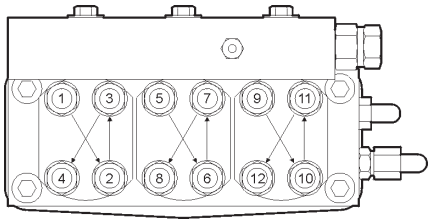
Before following the torque procedure, it is critical to check the alignment of the high-pressure cylinder and the subplate adapter. Check the gap between the high-pressure cylinder and the subplate adapter at the 12:00 and 6:00 positions. The gap must be within 0.015 in. differential.

Note: It may be necessary to compensate prior to applying the required torque.

1. Preload the manifold bolts 10 ft-lb (14 N-m), using the torque sequence diagram shown here.



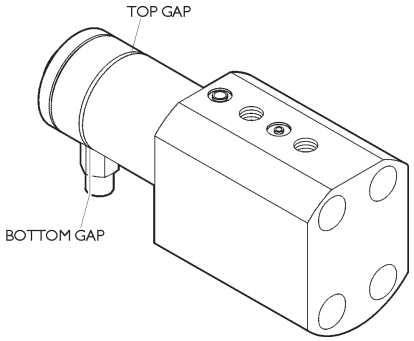
2. Evenly tighten the tie rod nuts approximately 60°, one at a time, to 165 ft-lb (224 N-m), following the sequence shown below.



   Note: Occasionally rotate the sheave while applying torque. If friction is detected, there may be a problem developing. You may need to disassemble and start over again.

3. Torque the manifold bolts to 70 ft-lb (95 N-m) following the torque sequence in the manifold diagram in Step 1.

Check alignment



Check the gap between the high-pressure cylinder and subplate adapter, at the 12:00 and 6:00 positions. The gap must be within 0.015 in. differential.

Note: If the gap is greater than 0.015 in. differential, disassemble and reassemble, compensating for the difference.

Completing the kit installation

1. Remove the oil temperature sensor from the crankcase drain and completely drain the oil.
2. Reinstall the oil temperature sensor and fill the crankcase with oil. Recommended oils are listed in Chapter 1.

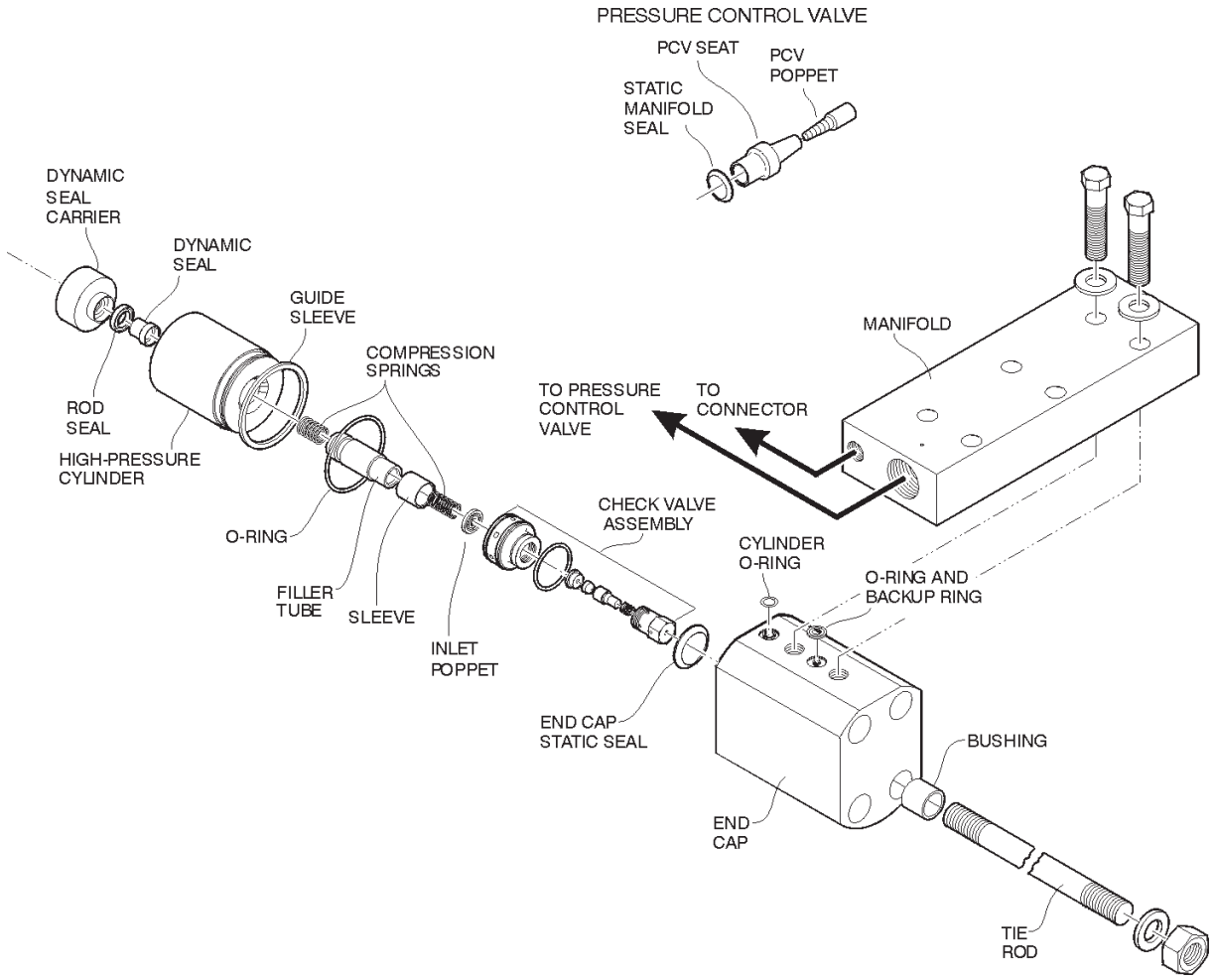
Returning the pump to service

Follow the start-up procedure on Page 31 before returning the HyPlex pump to service.

Be sure to enter pump hours and kit completion in the Advanced | FlowSense diagnostic screen, or the pump will not run.

Installing the Minor Maintenance kit

This service is performed at specified intervals for the life of the equipment. The complete service schedule for the minor maintenance kit (and the major maintenance kit) is described on Page 18.



Tool and repair kits

- HyPlex Tool Kit 012068-1 (contains a plunger nut tool, spanner wrench, glass plate, tie rod driver, rebuild clamp, screw, flat washer)
- Combination wrenches (9⁄16–1¼ in.)
- ½ in. drive socket set (9⁄16–1¼ in.)
- ½ in. torque wrench (10–300 ft-lb) (Note: you may need two wrenches)
- Feeler gauge set
- Screwdriver set
- Snap-ring pliers
- Minor maintenance repair kit, 712101-1
- Drawings 012306 and 014037

Service notes

All components should be clean and free of debris prior to assembly. Keeping the work area clean is important while working on the equipment.

Read the entire procedure through before beginning service, paying particular attention to safety instructions.

CAUTION
Failure to follow these step-by step instructions could cause premature parts failure and/or damage to the equipment.

Disassembly

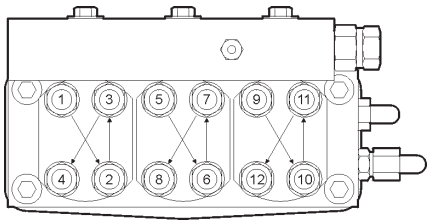
1. Push in the E-stop.

WARNING
Bleed down all high-pressure lines. Failure to do so may result in equipment damage or injury to personnel.

2. Disconnect high- and low-pressure plumbing from the high-pressure manifold and pressure control valve (PCV).
3. Remove high-pressure line to the transducer. Remove PCV from manifold.
4. Loosen the 6 hex screws and remove the high-pressure manifold from the end caps. Retain the o-rings and backup rings; you will need them for reassembly.

CAUTION
Follow the procedure in Step 5 when removing the 12 hex nuts. Removing them incorrectly will overload the tie rods and cause damage.

5. Loosen the 12 hex nuts in a crisscross pattern a few degrees at a time until all nuts are loose. Remove nuts and washers only after all 12 nuts have been loosened.



For each of the three high-pressure cylinders

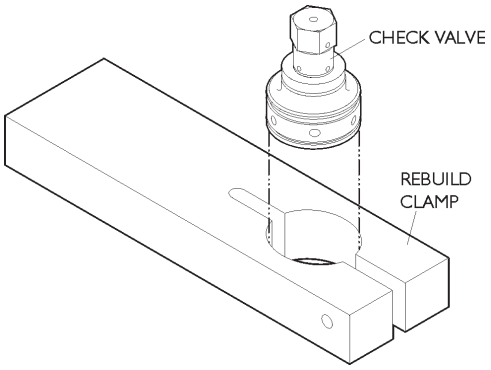
6. Slowly pull the end cap back about 2 in. (51 mm). Use two small pry bars in the groove between the high-pressure cylinder and the end cap to separate them, being very careful not to damage the plastic guide.

   Note: Springs at either end of the cylinder have a tendency to fall out when the components are separated. Retain the springs.

7. Remove the end cap, high-pressure cylinder, inlet poppet, springs, filler tube, and sleeve. Discard the inlet poppet and spring.
8. If the dynamic seal carrier does not separate from the high-pressure cylinder, clamp the seal carrier into a soft-jawed vise and gently work the cylinder from side to side until they separate.
9. Slide the dynamic seal carrier off the plunger if it did not come out with the cylinder. Remove and discard dynamic seal and rod seal.

CAUTION
Use care when removing dynamic seal and rod seal. Do not scratch or nick seal carrier bores.

10. Place the end cap vertically on a work bench, with the check valve end up.
11. Remove the check valve assembly from the end caps by using two pry bars in the circumferential groove in the OD of the check valve body. Take care not to damage the body or the end cap.
12. Place the check valve body in the rebuild clamp and loosen the outlet cage.



Note: The rebuild clamp in the Hyplex tool kit is the preferred method of securing the check valve while applying torque to the outlet cage. If the clamp is unavailable, use a soft jawed vise.

13. Remove and discard the outlet poppet, outlet poppet spring, and outlet poppet seat.

Lap inlet face of check valve body

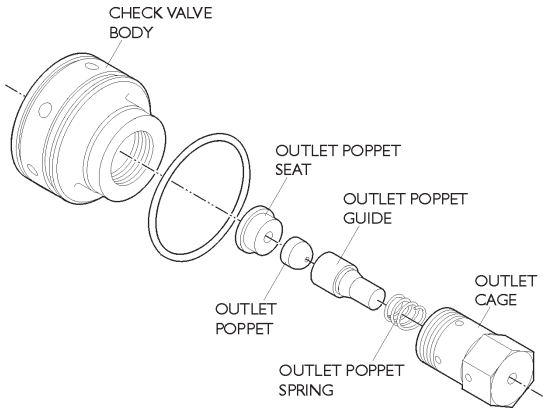
14. Use the glass lapping plate from the tool kit and lapping paper from the repair kit. Lightly wet the paper with water.
15. Place the check valve body with the inlet face against the lapping paper. With a light downward pressure, lap the body in a figure 8 pattern.

    CAUTION
    Be very careful not to rock the check valve body while lapping the surface—flatness is very critical.

    After 10-12 laps, rotate the check valve body 45° and continue lapping until the surface has a smooth matte finish free of any deep scratches or signs of deformation from the inlet poppet. Re-wet the paper as needed.

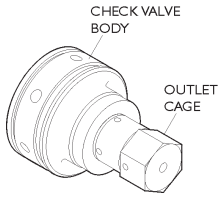
16. Thoroughly clean the check valve body openings to remove particles caused by the lapping procedure.

Reassembly

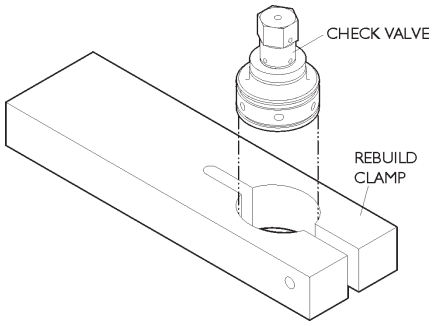


Assemble the check valve

1. Insert the outlet poppet into the outlet poppet guide. Orient as shown above, with the radiused end of the poppet entering first. The counterbore in the poppet should be visible after installation.
2. Place the outlet poppet spring onto the guide. The spring should be loose on the guide.
3. Place the assembly into the outlet cage along with the outlet poppet seat.
4. Hold the outlet cage assembly (threaded end of the outlet cage facing up), so that the installed components will not fall out. Lightly apply Blue Lubricant to the threads of the outlet cage.
5. Carefully thread the check valve body onto the outlet cage assembly.



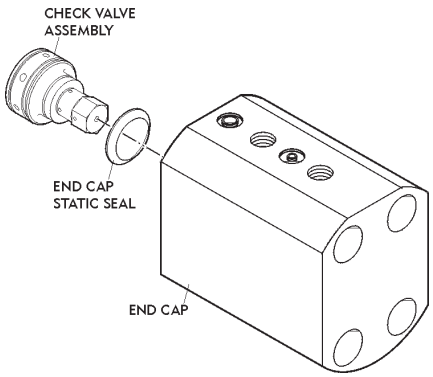
6. Secure the rebuild clamp in a vise.
7. Secure the check valve body in the rebuild clamp with the inlet face downward. Torque the outlet cage to 20 ft-lb (27 N-m).



Repeat Steps 1–7 for the remaining check valves.

Assemble the end cap

1. Lightly lubricate the o-ring with o-ring lube and install into the groove on the check valve body.



2. Place the static seal on the outlet end of the check valve body.

   Note: Apply a small amount of Blue Lubricant between the static and the check body to hold the static seal as installation.

3. With the outlet cage facing the end cap, insesrt the check valve body into the end cap.

Repeat Steps 1–3 for the remaining end caps.

Check plunger torque

1. Remove the subplate adapter.
2. Carefully slide the plunger nut tool (in the HyPlex tool kit) over the plunger. With a torque wrench and plunger nut tool, check plunger nut torque. Torque should be 20 ft-lb (27 N-m).
3. Rotate the sheave to fully extend the next plunger to be checked.

Repeat Steps 1–3 for the other plungers. When finished, wipe off dirt or grease from all three plungers.

4. Reinstall the subplate adapters.

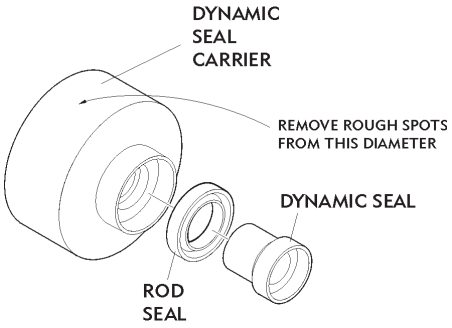
Check tie rod torque

You will need the tie rod driver (in the HyPlex tool kit) and a ½-20 bolt for this procedure. Making sure the tie rods have the correct torque will help ensure proper torque of the high-pressure assembly.

CAUTION
Make sure the tie rod driver is threaded down completely, then back it off a turn before tightening the ½-20 bolt. Otherwise you will damage the tie rod threads.

1. Attach the tie rod driver to the end of the tie rod.
2. Tighten the ½-20 bolt, being careful not to damage the threads. Torque to 80 ft-lb (109 N-m).

Check torque for the other tie rods.



Assemble and install the dynamic seal carrier

1. Using the lapping paper used on the check valves, smooth any rough spots from the outside diameter of the seal carrier.
2. Inspect the dynamic seal carrier for cleanliness and erosion damage. Erosion damage at the innermost corner will cause seal life to be reduced. Make sure the guide bearing is in good condition. (The presence of cracked or loose pieces are reason for replacement). Replace the dynamic seal carrier if necessary. Clean as necessary.
3. Install the rod seal as shown, with the v-shape facing up, into the dynamic seal carrier.
4. Install the dynamic seal into the inner diameter of the rod seal, making sure the dynamic seal is fully seated against the dynamic seal carrier.

   Note: Make sure the plungers are clean and free of any damage or scratches before installing the dynamic seal carriers. The subplate adapter/seal carrier interface must be clean and free of debris.

5. Slide the dynamic seal carrier into the plungers until seated against the register of the subplate adapter.

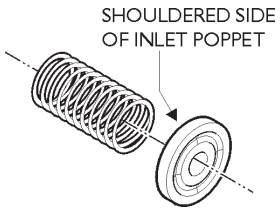
Install the high-pressure cylinder

CAUTION
Take care not to pinch the o-ring with the guide sleeve while installing the high-pressure cylinder.

1. Using the lapping paper used on the check valves, smooth any rough spots from the 1½-in. inner diameter of the cylinder. Clean thoroughly to remove any abrasive debris.

2. Apply Blue Lubricant to the 1½-in. diameter of the dynamic seal carrier and to the 1½-in. inner diameter of the high-pressure cylinder.
3. Place the plastic guide sleeve on the high-pressure cylinder.
4. Lubricate the o-ring with o-ring lube and place in the groove of the high-pressure cylinder.
5. Place the high-pressure cylinder in position on the tie rods.
6. Slide the high-pressure cylinder back to make contact with the dynamic seal carrier.
7. Make sure the tie rod guide sleeve is positioned correctly on the cylinder and is not pinching the o-ring.

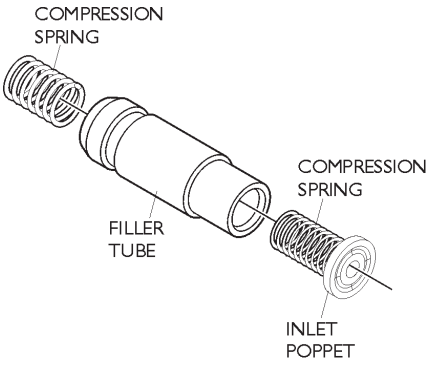
Assemble the inlet poppet



1. Place the inlet poppet spring over the shouldered side of the inlet poppet.
2. Apply pressure to the spring and rotate counterclockwise until it snaps into place. Be sure the spring is firmly attached.

Repeat for remaining inlet poppets.

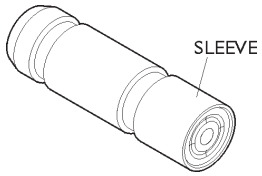
Assemble the filler tube



1. Place the dynamic seal compression spring into the tapered end of the filler tube.
2. Insert the filler tube, spring end first, into the high-pressure cylinder, making sure to engage the spring into the dynamic seal.

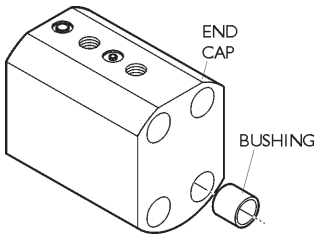
Repeat for the remaining filler tubes.

3. Insert the inlet poppet assembly into the filler tube, spring end first.
4. Partially install the filler tube sleeve so that it surrounds the inlet poppet and spring.



Note: The filler tube sleeve helps align the poppet with the check valve body and prevents pinching of the poppet between the check valve and filler tube during assembly.

Install the end cap



CAUTION
It is important that you do not let the end cap spring back while installing. If it does, the inlet poppet can be pinched, causing damage.

1. Make sure all eightof the end cap split bearings (bushings) are in position.
2. Align the end cap so it will slide over the tie rods, then carefully slide the end cap back until the check valve makes contact with the inlet poppet.

3. Continue sliding the end cap back until it seats over the o-ring on the high-pressure cylinder.
4. Temporarily install one of the hex nuts, hand tight, to prevent the end cap from springing back.
5. Follow Steps 1–4 to install the other two end caps in the same way, then continue with Step 6.

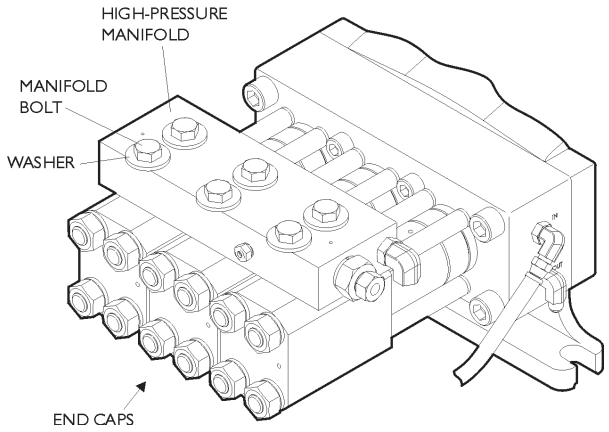
CAUTION
Make sure all the split bearings are completely seated in the end cap. Not doing so will cause premature torque while torquing the end caps.

6. Apply anti-seize compound to both sides of the washers and to the threads of the tie rods.
7. Install washers and hex nuts hand tight. **Do not torque** the hex nuts at this time.

   Note: If dragging or stiffness occurs while installing the hex nuts, determine the cause and eliminate it.

8. Remove the temporarily installed hex nuts. Apply antiseize to both sides of the washers and threads, then reinstall the nuts.

High-pressure manifold installation



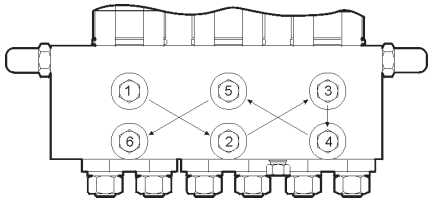
1. Place the high-pressure manifold over the three end caps, aligning the through holes with the threaded holes in the end caps.
2. Apply anti-seize compound to the manifold bolts and both sides of the washers.
3. Secure the manifold with hex head bolts tightened hand tight. DO NOT torque bolts at this time.

Torque manifold and tie rods

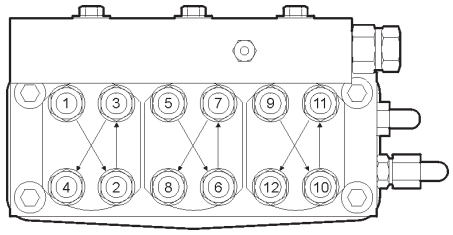
Before following the torque procedure, it is critical to check the alignment of the high-pressure cylinder and the subplate adapter. Check the gap between the high-pressure cylinder and subplate adapter at the 12:00 and 6:00 positions. The gap must be within 0.015 in. differential. See illustration on Page 43.

Note: It may be necessary to compensate prior to applying the required torque.

1. Preload manifold bolts 10 ft-lb (14 n-m) following the torque sequence shown here.



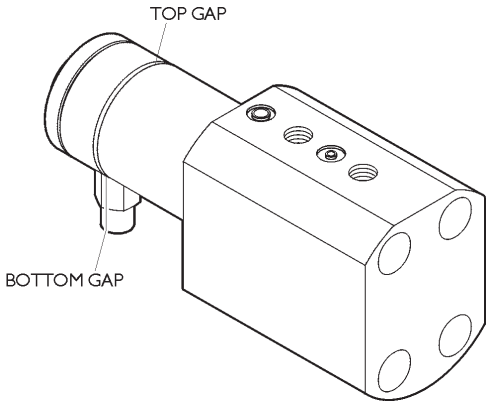
2. Evenly tighten the tie rod nuts approximately 60°, one at a time, to 165 ft-lb (224 N-m), following the sequence shown here.



Note: Occasionally rotate the sheave while applying torque. If you detect any friction, there may be an problem developing. You may need to disassemble and start over again.

3. Torque manifold bolts to 70 ft-lb (95 N-m) following the torque sequence shown in Step 1 of this torque procedure.

Check alignment



Check the gap between the high-pressure cylinder and subplate adapter, at the 12:00 and the 6:00 positions. The gap must be within 0.015 in. differential.

Note: If the gap is greater than 0.015 in. differential, disassemble and reassemble, compensating for the difference.

PCV assembly

1. Install the new poppet and seat in the PCV.
2. Install the PCV into the high-pressure manifold. Torque to 190 ft-lb (258 N-m).

Completing the kit installation

1. Remove the oil temperature sensor from the crankcase drain and completely drain the oil.
2. Reinstall the oil temperature sensor and fill the crankcase with oil. Recommended oils are listed in Chapter 1.

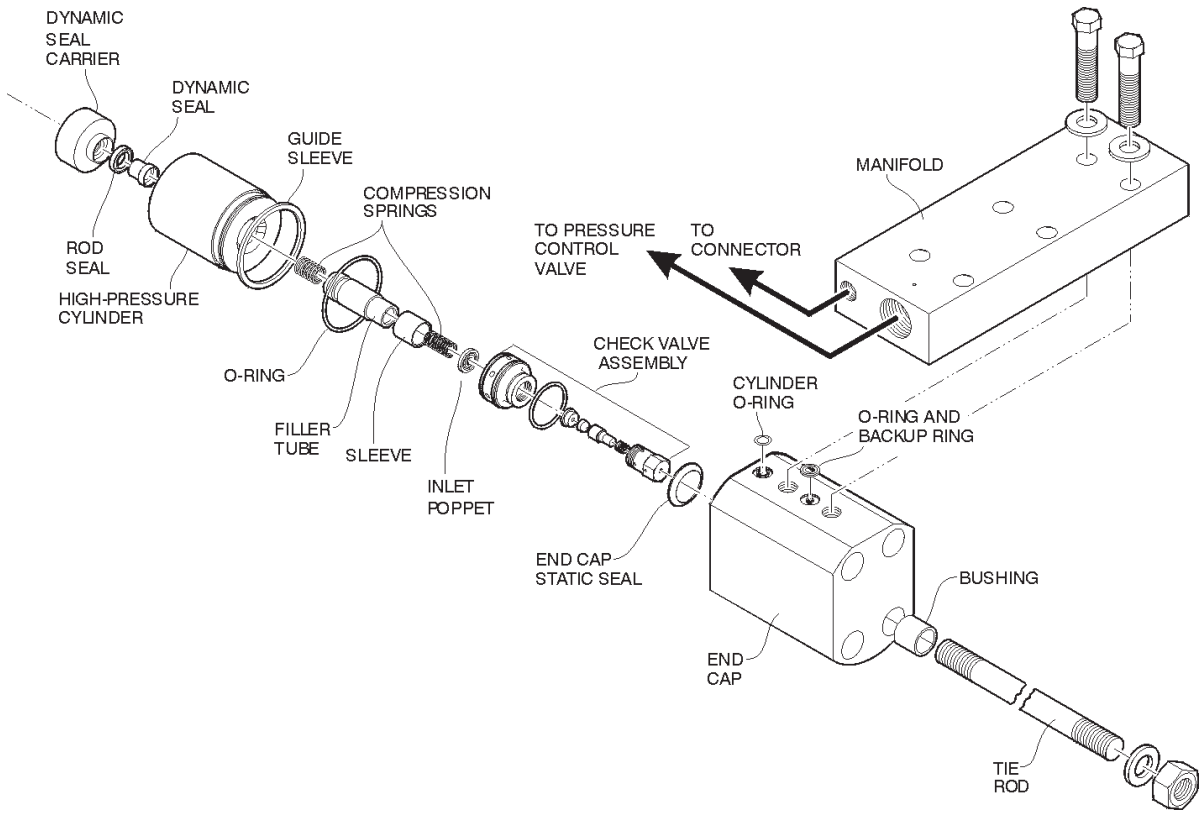
Returning the pump to service

Follow the start-up procedure on Page 31 before returning the HyPlex pump to service.

Be sure to enter pump hours and kit completion in the Advanced | FlowSense diagnostic screen, or the pump will not run.

Installing the Major Maintenance kit

Use this procedure when installing the Major Maintenance kit on your HyPlex pump. This service is performed at every fourth required maintenance interval for the life of the equipment. The complete service schedule for the major maintenance kit (and the minor maintenance kit) is described on Page 18.



Tools

- HyPlex Tool Kit 012068-1 (contains a plunger nut tool, spanner wrench, glass plate, tie rod driver, rebuild clamp, screw, flat washer)
- Combination wrenches (9⁄16–1¼ in.)
- ½ in. drive socket set (9⁄16–1¼ in.)
- ½ in. torque wrench (10–300 ft-lb) (Note: you may need two wrenches)
- Feeler gauge set
- Screwdriver set
- Snap-ring pliers

Repair kit

- Major maintenance repair kit, 712101-2
- Drawings 012306 and 014037

Service notes

All components should be clean and free of debris prior to assembly. Keeping the work area clean is important while working on the equipment.

Read the entire procedure through before beginning service, paying particular attention to safety instructions.

CAUTION
Failure to follow these step-by step instructions could cause premature parts failure or damage to the equipment.

Disassembly

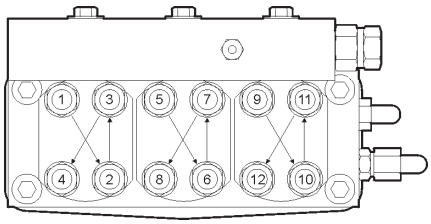
1. Push in the E-stop.

WARNING
Bleed down all high-pressure lines. Failure to do so may result in equipment damage or injury to personnel.

2. Disconnect low-pressure plumbing from the high-pressure manifold and pressure control valve (PCV).
3. Remove the ⅜-in. high-pressure fitting from the manifold, leaving the 1¼-in. high-pressure adapter in place.
4. Remove the high-pressure line to the transducer. Remove PCV from manifold.
5. Loosen the 6 hex screws and remove the high-pressure manifold from the end caps. O-rings and backup rings will be replaced with new parts.

CAUTION
Follow the procedure in Step 6 when removing the 12 hex nuts. Removing them incorrectly will overload the tie rods and cause damage.

6. Loosen the 12 hex nuts in a crisscross pattern a few degrees at a time until all nuts are loose (see illustration below). Remove nuts and washers only after all 12 nuts have been loosened.

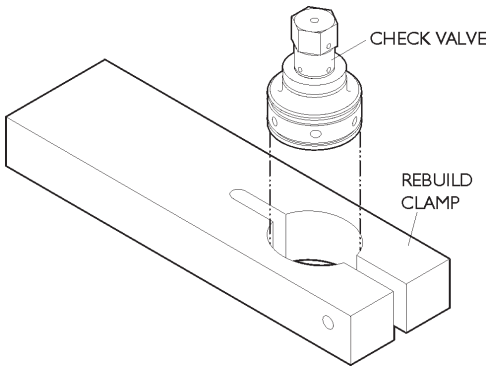


For each of the three high-pressure cylinders

7. Slowly pull the end cap back about 2 in. (51 mm), being careful not to dislodge the spring.

   Note: The spring between the dynamic seal and filler tube can fall out if the high-pressure cylinder is pulled too far away from the sub-plate adapter.
8. Use two small pry bars in the groove between the high-pressure cylinder and the end cap to separate them, being very careful not to damage the plastic guide. Retain the spring.
9. Remove the end cap, high-pressure cylinder, inlet poppet, springs, filler tube, and sleeve.
10. Separate the spring from the inlet poppet. Separate the guide sleeve from the high-pressure cylinder. Keep the spring and discard the inlet poppet, high-pressure cylinder, and guide sleeve.
11. If the dynamic seal carrier did not slide off with the cylinder, remove it now. If the dynamic seal carrier remains secure in the high-pressure cylinder, remove the cylinder contents and discard the dynamic seal carrier and the cylinder.
12. Remove the subplate adapter. Remove the snap ring from the subplate adapter using snap ring pliers. Remove the spacer and seal. Remove the o-ring on the outer diameter. Discard the seal, snap ring, and o-ring. Keep the spacer for reuse.
13. Place the end cap vertically on a work bench, with the check valve end up.
14. Remove the check valve assembly from the end cap: use two pry bars in the circumferential groove in the OD of the check valve body, prying gently on the body. Be careful not to damage the end cap.
15. Discard the end cap static seal, o-rings and back-up ring from the end caps.
16. Place the check valve body in the rebuild clamp. Loosen the outlet cage.

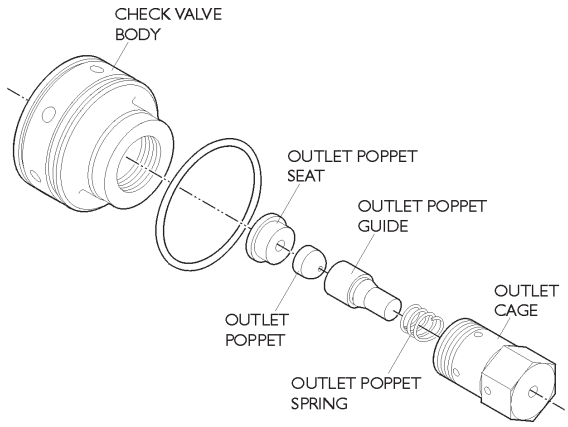
    Note: the rebuild clamp in the HyPlex tool kit is the preferred method of securing the check valve while applying torque to the outlet cage. If the clamp is unavailable, use a soft-jawed vise.



17. Remove the outlet poppet, outlet poppet spring, and outlet poppet seat from the outlet cage. Retain the cage and discard the rest.

Reassembly

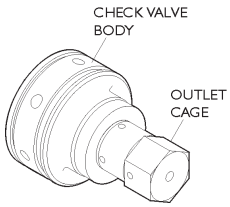
Assemble the check valve



1. Insert the outlet poppet into the outlet poppet guide.

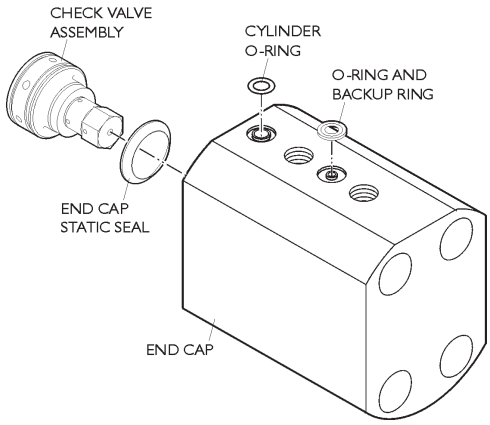
   Note: Install outlet poppet into the guide as shown, with the radiused end of the poppet going in first. The counterbore in the poppet should be visible after installation.

2. Place the outlet poppet spring around the guide. The spring should be loose on the guide.
3. Place the assembly into the outlet cage along with the outlet poppet seat.
4. Hold the outlet cage assembly upright (threaded end of the outlet cage facing up) so that the installed components will not fall out. Lightly apply Blue Lubricant to the threads of the outlet cage.
5. Carefully thread the new check valve body onto the outlet cage assembly.



6. Secure the rebuild clamp in a vise.
7. Secure the check valve body in the rebuild clamp with the inlet face downward (see illustration on previous page). Torque the outlet cage to 30 ft-lb (41 N-m).

Repeat Steps 1-7 for the remaining check valves.



Assemble the end cap

1. Lightly lubricate the o-ring seal with o-ring lube; install into the groove on the check valve body.
2. Place the end cap static seal on the outlet end of the check valve body.

   Note: Apply a small amount of Blue Lubricant between the end cap static seal and the check body to hold the seal during installation.

3. With the outlet cage facing the end cap, insert the check valve body into the end cap.
4. Install two o-rings and one back-up ring where the manifold mates to the end cap.

Repeat Steps 1-4 for the remaining end caps.

Check plunger torque

1. Carefully slide the plunger nut tool (in the HyPlex tool kit) over the plunger. With a torque wrench and plunger nut tool, check plunger nut torque. Torque to 20 ft-lb (27 N-m).
2. Rotate the sheave to fully extend the next plunger to be checked.

Repeat Steps 1–2 for the other plungers. When finished, wipe off any dirt or grease from all plungers.

Check tie rod torque

You will need the tie rod driver (in the Hyplex tool kit) and a ½-20 bolt for this procedure. Making sure tie rods are correctly torqued will help ensure proper torque of the entire high-pressure assembly.

CAUTION
Make sure the tie rod driver is threaded down completely, then back it off a turn before tightening the ½-20 bolt. Not doing so will damage the tie rod threads.

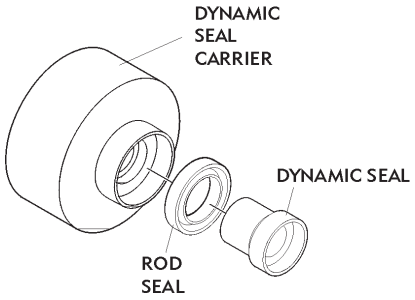
1. Attach the tie rod driver tool to the end of the tie rod and tighten the ½-20 bolt, being careful not to damage the threads. Torque to 80 ft-lb (109 N-m).
2. Check the remaining tie rods.

Assemble the subplate adapter

1. With the split face down, install the rod seal in the counterbore of the subplate adapter.
2. Place the spacer in the counterbore with the chamfered side down (toward the newly installed seal). Secure with the snap ring.
3. Lubricate and install the o-ring onto the adapter, and slide it over the plunger until it engages the counterbore of the subplate.

Repeat Steps 1–3 for the remaining subplate adapters.

Assemble and install the dynamic seal carrier



1. Install the rod seal as shown, v-shape facing up, into the seal carrier.
2. Install the dynamic seal into the inner diameter of the rod seal.
3. Make sure the plungers are clean and free of any damage or scratches, then slide the dynamic seal carrier into the plungers until seated against the register of the subplate adapter.

Repeat Steps 1–3 for the remaining dynamic seal carriers.

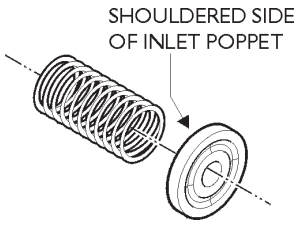
Install the high-pressure cylinder

CAUTION
Be careful not to pinch the o-ring with the guide sleeve while installing the high-pressure cylinder.

1. Place the plastic guide sleeve on the high-pressure cylinder.
2. Lubricate the o-ring with o-ring lube and place it in the groove of the high-pressure cylinder.
3. Lightly apply Blue Lubricant to the 1½-in. outside diameter of the dynamic seal carrier and the 1½-in. inner diameter of the high-pressure cylinder.
4. Place the high-pressure cylinder in position on the tie rods, and slide the cylinder back to make contact with the dynamic seal carrier. Make sure the tie rod guide sleeve is positioned correctly on the high-pressure cylinder and is not pinching the o-ring.

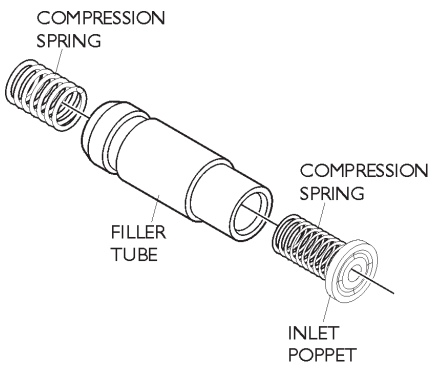
Repeat for the remaining high-pressure cylinders.

Assemble the inlet poppet



1. Place the inlet poppet spring over the shouldered side of the inlet poppet.
2. Apply pressure to the spring and rotate counterclockwise until it snaps into place. Be sure the spring is firmly attached.

Repeat for the remaining inlet poppets.

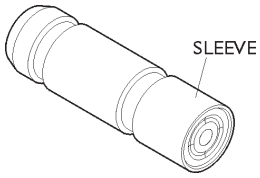


Assemble the filler tube

1. Place the dynamic seal compression spring into the tapered end of the filler tube.
2. Insert the filler tube, spring end first, into the high-pressure cylinder, being sure to engage the spring into the dynamic seal.

Repeat for the remaining filler tubes.

3. Insert inlet poppet assembly into the filler tube, spring end first.
4. Partially install the filler tube sleeve so that it surrounds the inlet poppet and spring.



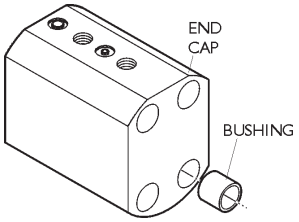
Repeat for the remaining filler tube assemblies.

Note: The filler tube sleeve helps align the poppet with the check valve body and prevents pinching of the poppet between the check valve and the filler tube during assembly.

Install the end cap

CAUTION
It is important that you do not let the end cap spring back while installing. If it does, the inlet poppet can be pinched, causing damage.

1. Make sure all eight of the end cap split bearings (bushings) are installed in the end cap.



2. Align the end cap so it will slide over the tie rods.
3. Carefully slide the end cap back until the check valve makes contact with the inlet poppet.
4. Continue sliding the end cap back until it seats over the o-ring on the high-pressure cylinder.
5. Temporarily install one of the hex nuts, hand tight, to prevent the end cap from springing back.
6. Install the other two end caps before continuing.

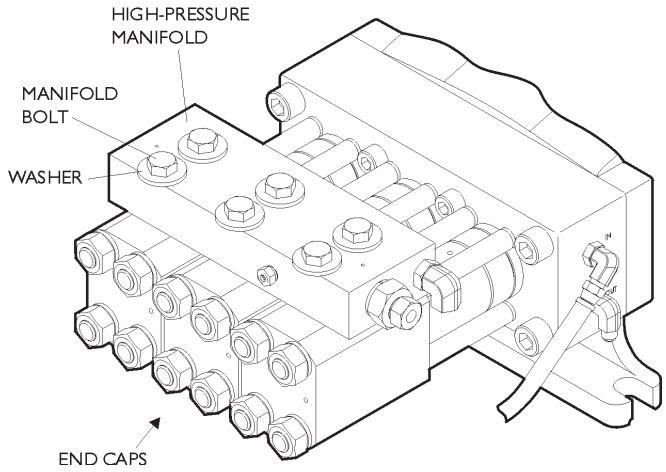
CAUTION
Make sure all the split bearings (bushings) are completely seated in the end cap. Not doing so will cause premature torque while torquing the end caps.

7. Lightly apply anti-seize compound to both sides of the washers and to the threads of the tie rods.
8. Install washers and hex nuts hand tight. **Do not torque** the tie rod hex nuts at this time.

   Note: If dragging or stiffness occur while installing the hex nuts, determine the cause and eliminate it.

9. Remove the temporarily installed hex nuts. Apply anti-seize to both sides of the washers and threads, then reinstall the nuts.

Install the high-pressure manifold



1. Place the high-pressure manifold over the three end caps, aligning the through holes with the threaded holes in the end caps.
2. Apply anti-seize compound to the manifold bolts and both sides of the washers.
3. Secure the manifold with hex head bolts tightened hand tight. **Do not torque** bolts at this time.

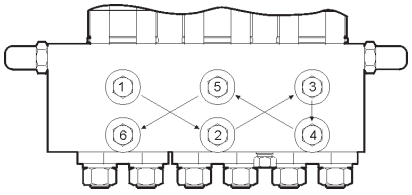
Torque manifold and tie rod bolts

Refer to drawing 012306.

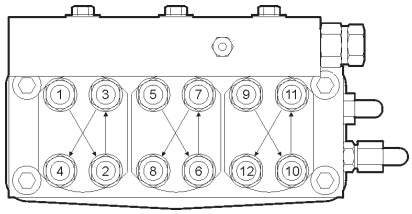
Before following the torque procedure, it is critical to check the alignment of the high-pressure cylinder and the subplate adapter. Check the gap between the high-pressure cylinder and the subplate adapter at the 12:00 and 6:00 positions. The gap must be within 0.015 in. differential.

Note: It may be necessary to compensate prior to applying the required torque.

1. Preload the manifold bolts 10 ft-lb (14 N-m), following the torque sequence shown below.



2. Evenly tighten the tie rod nuts approximately 60°, one at a time, to 165 ft-lb (224 N-m), following the sequence shown below.



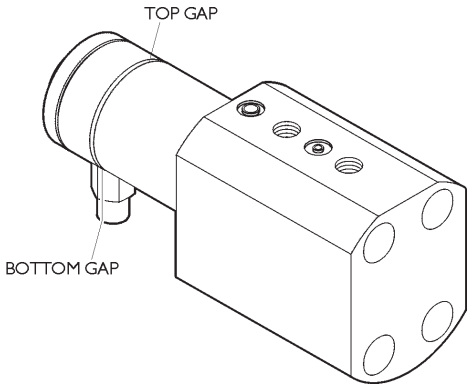
Note: Occasionally rotate the sheave while applying torque. If friction is detected, there may be a problem developing. You may need to disassemble and start over again.

3. Torque manifold bolts to 70 ft-lb (95 N-m) following the torque sequence in Step 1 above.

Check alignment

Check the gap between the high-pressure cylinder and subplate adapter, at the 12:00 and the 6:00 position. The gap must be within 0.015 in. differential.

Note: If the gap is greater than a 0.015 in. differential, disassemble and reassemble, compensating for the difference.



Assemble the PCV

1. Match pump hours with PCV maintenance requirements. Conduct PCV maintenance as described in this chapter if necessary.
2. Install the new poppet, seat, and static seal in the PCV.
3. Install the PCV into the manifold. Torque to 190 ft-lb (258 N-m).

Completing the kit installation

1. Remove the oil temperature sensor from the crankcase drain and completely drain the oil.
2. Reinstall the oil temperature sensor and fill the crankcase with the recommended oil listed in Chapter 1.

Returning the pump to service

Follow the start-up procedure on Page 31 before returning the HyPlex pump to service.

Be sure to enter pump hours and kit completion in the Advanced | FlowSense diagnostic screen, or the pump will not run.

Notes

Installing the Pressure Control Valve (PCV) maintenance kit

Use this procedure when installing the HyPlex pressure control valve maintenance kit. The complete service schedule for the PCV is described on Page 18.

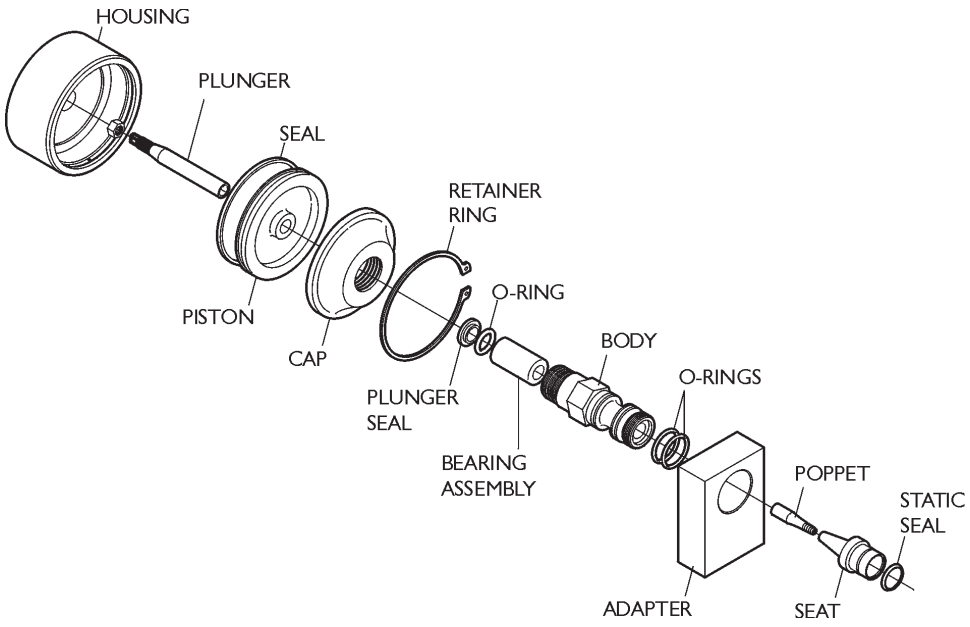
Every other time you install a Major Maintenance kit, you should also install the PCV Maintenance kit. The poppet, seat, and static seal described in this procedure are included in the Major Maintenance kit.

Tools

- HyPlex tool kit (012068-1) which contains a plunger nut tool, spanner wrench, glass plate, tie rod driver, rebuild clamp, screw, and flat wa sher.
- Combination wrenches (7/16 to 1¼ in)
- ½ in. torque wrench (10-300 ft-lb)
- (Note: you may need two separate wrenches)
- Snap ring pliers
- Screwdriver set
- Soft-jawed vise

Maintenance kit

- PCV maintenance kit, 015605-1



Disassembly

The poppet, seat, seal ring, bearing, plunger, piston seal, plunger seal, and o-rings are replaced in this procedure.

1. Shut down the system.

WARNING
Place the main electrical disconnect OFF 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.

2. Reduce air pressure to 0 psi and remove the air and drain lines from the PCV.
3. Remove the PCV from the manifold.
4. Remove the poppet, seat, and seal ring from the PCV body.
5. Remove the adapter from the PCV body and discard the o-rings.
6. Use a spanner wrench to remove the actuator from the PCV body.
7. Push the plunger free from the bearing.
8. Push the bearing from the bore of the PCV body. Remove the plunger seal and o-ring.
9. Remove the retainer ring from the actuator assembly and expose the piston.
10. Remove the piston, then remove the plunger from the piston.
11. Remove the U-packing seal from the piston.

Re-assembly

1. Install new U-packing seal on the piston.
2. Reassemble new plunger and piston with new nylock nut. Hold plunger in a soft-jawed vise. Be careful not to damage plunger surface. Tighten to 180 in-lb (refer to drawing 013002).
3. Lightly grease housing bore and piston seal, then reinstall piston/plunger assembly into actuator housing.
4. Reinstall cap onto housing.
5. Align slot in cap with the dowel pin in housing and secure with retaining ring.
6. Inspect the other non-wear components for any signs of deterioration; repair or replace as necessary.
7. Push the bearing into the PCV body bore. Install the o-ring onto the plunger seal and install into body.
8. Secure the PCV body vertically in a soft-jawed vise. Thread the cap onto the PCV body and secure it using a spanner wrench.
9. Clean any debris that remains in the high-pressure port of the manifold.
10. Make sure the static seal ring is installed on the seat and install the poppet into the seat. This will keep these parts together so they won't be separated when installing the PCV onto the manifold.

    Note: Do not press the poppet into the seat.

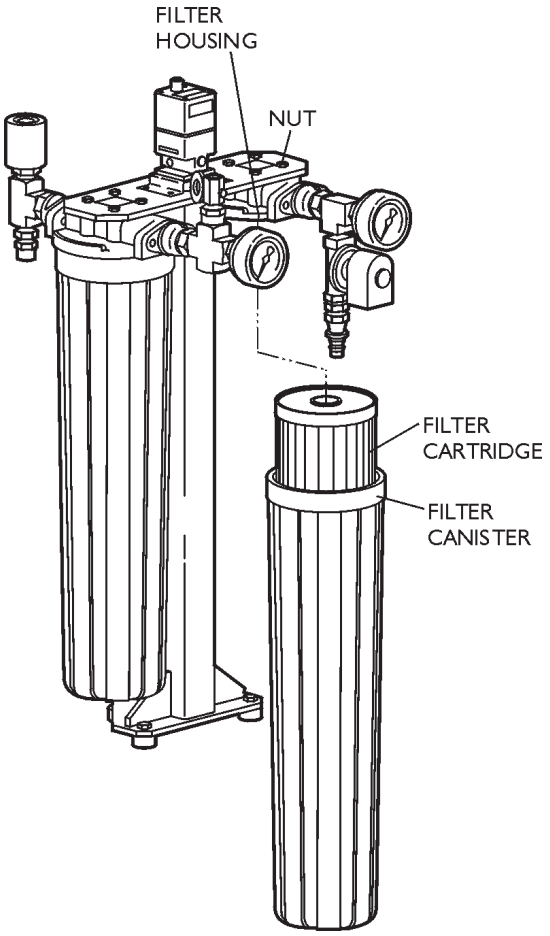
11. Place new o-rings on the PCV body and install the adapter.
12. Place poppet and seat assembly into the end of the PCV body, then thread this assembly into the high-pressure manifold. Tighten to 190 ft-lb (refer to drawing 012306 in your service manual).
13. Reconnect the air supply and drain lines.

Follow the start-up procedure on Page 31 before returning the equipment to service.

Changing the filter elements

Change the filter elements if the pressure differential between the inlet and outlet (shown on the pressure gauges) exceeds 30 psi (2.1 bar) or if pressure to the manifold is less than 15 psi (1.03 bar).

Note: Check filter pressure gauges only when pump is running at full speed and operating at standard output pressures. When the pump is slow or stopped, the pressures will be nearly equal, even with a dirty filter.



Service steps

1. Shut down the system.
2. Close the water inlet valve.
3. While supporting the filter housing, remove the filter canister using a strap wrench.
4. Remove the filter from the canister and discard.

CAUTION
Using dirty or incorrect filter elements can shorten pump life.

5. Inspect the contents of the canister.

   Notes:

   - This inspection can provide early warning of a change in inlet water quality—important, since filter life is directly related to the quality of the inlet water.
   - Filters do not have to be changed all at once; you can change one at a time.

6. Install new filter cartridge.
7. Reassemble the filter canister to the filter housing using a strap wrench.
8. Open the water inlet valve and check carefully for leaks.

CAUTION
You must open the water inlet valve before starting the pump—failure to do so could severely damage the pump.

9. Remove air for the system using the breather vents on the filter housing.
10. Enter the date and/or hours of operation from the hour meter into the service log.

Make a final inspection to remove tools, parts, and rags from the equipment before startup.

Servicing the pressure control valve (PCV)

The PCV will require service when troubleshooting reveals poor valve performance, or if it is time to install a major maintenance kit. The service involves replacing the poppet, seat, and static seal.

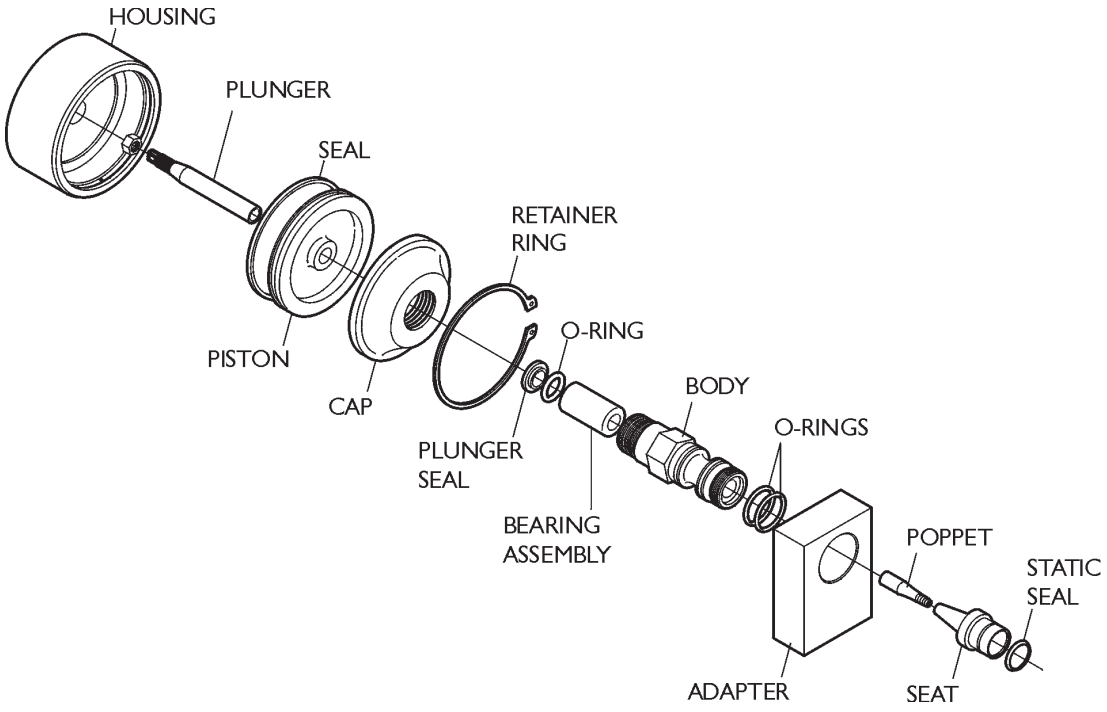
Refer to engineering drawings for parts identification, torque, and lubrication instructions.

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 result in equipment damage or injury to personnel.

1. Shut down the system.
2. Remove the valve from the manifold.
3. Remove the static seal from the seat.
4. Remove the poppet and seat; discard.
5. Install a new poppet into the seat.
6. Reinstall the static cap seal onto the seat.
7. Install poppet and seat assembly into the valve as shown on the drawing.
8. At pump restart:
   - Close nozzle.
   - Click on the low-pressure icon. Start pump and check for leaks.
   - Start power unit. Click on the high-pressure icon.
   - Open nozzle and verify operation. Typically the output pressure will drop slightly when the nozzle is open (assuming the pump is in good condition).
   - Cycle the nozzle on and off 5–10 times and verify operation. If output pressure is OK, the unit is ready for use. If there is more than a 5000 psi difference between nozzle closed and nozzle open, see the troubleshooting guide.

Note: A high-pitched noise during operation might be heard on some valves. This is normal and is no cause for concern.



Servicing the check valve

This procedure is intended to be used only if service is required outside of the preventive maintenance schedule. It is important that you continue to maintain the pump according to the procedures specified in the mandatory maintenance procedures.

- See the interval listing on Page 18, and refer to drawing 012306.

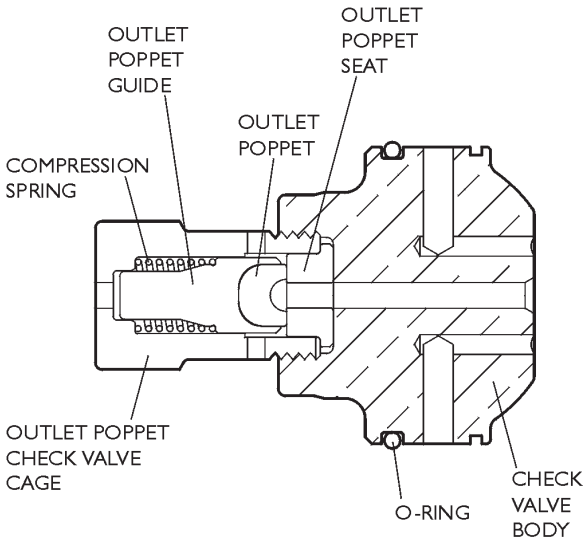
In the event of premature failure, you will need to integrate check valve repair with the preventive maintenance described in this manual. FLOW suggests the following strategy.

Premature failure close to the scheduled time

- If the check valve fails within 50 or so hours of a scheduled service, go ahead and do the complete service procedure.
- Record the actual hour meter reading when you install the maintenance kit—the next scheduled maintenance should take place at the specified number of hours from this reading.
- For example, suppose you have a 50 hp pump. The minor maintenance interval is every 500 hours. The check valve fails at 450 hours, 50 hours short of a scheduled maintenance period. You should install the Minor Maintenance kit, but the next scheduled maintenance (Dynamic Seal maintenance) would take place at 700 hours, not 750 hours.

Premature failure midway between scheduled service

- If the check valve fails somewhere midway between two scheduled service periods (for example, a check valve on a 50 hp pump that fails 150 hours since the last service), use the check valve procedure to repair *only the part(s) that failed.* Do not complete the entire procedure at this time. Continue to operate the equipment, and perform the entire required service procedure at the next scheduled time.



Service procedure

Refer to *Installing the minor maintenance kit* for the complete service procedure.

Replacing the dynamic seal and plunger

Use this procedure if service is required outside of the preventive maintenance schedule. It is important that you continue to maintain the pump according to the procedures specified in the required maintenance kit instructions.

Remember, different horsepower pumps have different maintenance intervals. See the interval listing on Page 32, and refer to drawings 012306 and 014037.

In the event of premature failure, you will need to integrate check valve repair with the preventive maintenance described in this manual. FLOW suggests the following strategy.

Premature failure close to the scheduled time

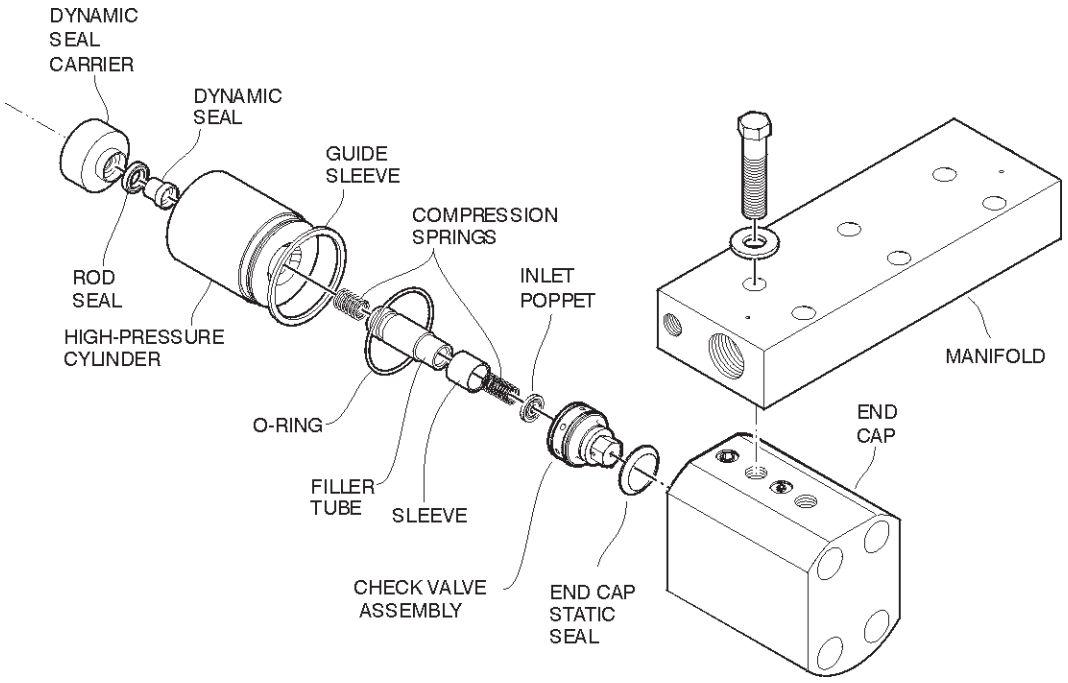
- If the check valve fails within 50 or so hours of a scheduled service, go ahead and do the complete service procedure. Record the actual hour meter reading when you install the maintenance kit—the next scheduled maintenance should take place at the specified number of hours from this reading.
- For example, suppose you have a 50 hp pump. The Dynamic Seal maintenance interval is every 250 hours. The dynamic seal fails at 2000 hours, 50 hours short of a scheduled maintenance period. Install the Dynamic Seal maintenance kit, but the next scheduled maintenance would take place at 450 hours, not 500 hours.

Premature failure midway between scheduled service

- If the check valve fails somewhere midway between two scheduled service periods (for example, a dynamic seal on a 50 hp pump that fails at 150 hours since last service), use the procedure to repair only the part(s) that failed. *Do not complete the entire procedure at this time*. Continue to operate the equipment, and perform the entire required service procedure at the next scheduled time.

Tools

- You will need plunger nut installation tool 011153-1

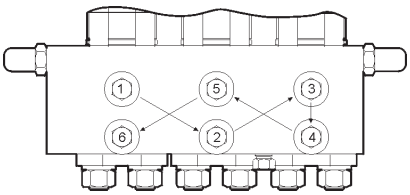


Service steps

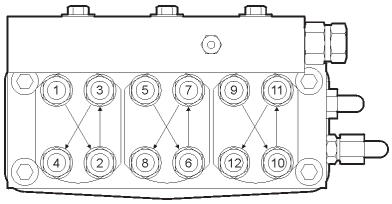
1. Push in the E-stop.

> **WARNING**
> **Bleed down all high-pressure lines. Failure to do so may result in equipment damage or injury to personnel.**

2. Disconnect all high- and low-pressure plumbing from the high-pressure manifold and pressure control valve (PCV).
3. Loosen the six hex screws in the sequence shown below; remove the high-pressure manifold from the end caps.



4. Loosen the 12 hex nuts in the crisscross pattern shown below, loosening only a few degrees at a time. Repeat the pattern until all nuts are loose; then remove nuts and washers. Do not fully loosen and remove any nuts until all are loose.



For each of the three cylinders

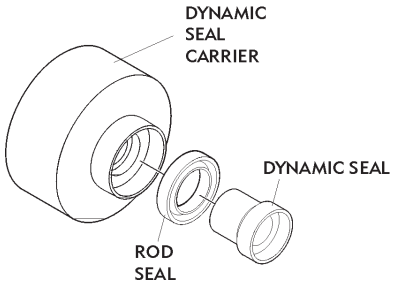
5. Slowly pull the end cap back about 2 in. (51 mm). Use two small pry bars in the groove between the high-pressure cylinder and the end cap to separate them, being very careful not to damage the plastic guide. Retain any springs that separate from the assembly.
6. Remove end cap, high-pressure cylinder, inlet poppet, springs, filler tube, and sleeve. Separate the spring from the inlet poppet.
7. Slide the seal carrier off the plunger if it did not come off with the high-pressure cylinder. Remove and discard the dynamic seal and rod seal.
8. Inspect the seal carrier and plunger for damage. Keep and reuse the seal carrier if undamaged. The plunger should not touch the bore of the seal carrier.
   - If there are contact marks on either component, replace both components.
   - If both components are OK, skip to reassembly Step 3.
9. Remove the adapter.

   Note: If the plunger is damaged, replace the rod seal in the subplate adapter. Remove the snap ring with snap ring pliers. Discard the lip seal. Keep the snap ring and spacer for reuse.

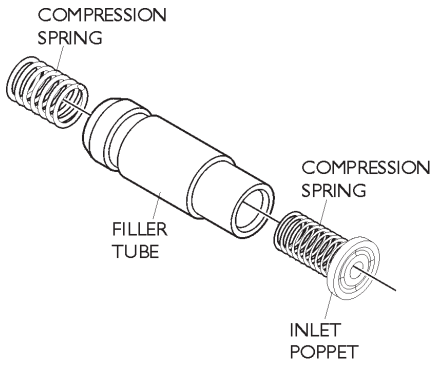
10. Rotate the crankshaft to place the damaged plunger in its fully extended position. Using the plunger nut tool, remove and retain the plunger nut and spring. Slide the plunger assembly from the crosshead bore and discard.

Reassembly

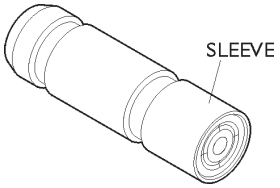
1. With the crosshead in its fully extended position, place spring into the counterbore of the plunger nut. Slip the nut and spring over the new plunger, engage the threads of the crosshead, and tighten to 20 ft-lb (27 N-m) using the plunger nut tool.
2. With the split face down, install the seal in the counterbore of the subplate adapter. Place the spacer in the counterbord with the chamfered side down (toward the newly installed seal). Secure with the snap ring.
3. Lubricate and install the o-ring onto the adapter, and slide over the plunger until it engages the counterbore of the subplate.
4. Inspect the dynamic seal carrier for cleanliness and make sure the guide bearing is in good condition. Install the rod seal and dynamic seal. Slide the seal carrier on the plungers until seated against the register of the adapter.



5. Place the high-pressure cylinder in position on the tie rods, and slide the cylinder back to make contact with the dynamic seal carrier. Make sure the tie rod guide sleeve is positioned correctly on the high-pressure cylinder and is not pinching the o-ring.
6. Place the dynamic seal compression spring into the tapered end of the filler tube.

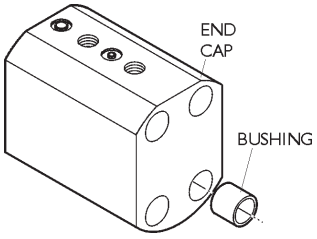


7. Insert the filler tube, spring end first, into the high-pressure cylinder, making sure to engage the spring into the dynamic seal.
8. Insert inlet poppet assembly into the filler tube, spring end first.
9. Partially install the filler tube sleeve so that it surrounds the inlet poppet and spring.



Note: The filler tube sleeve helps align the poppet with the check valve body and prevents pinching of the poppet between the check valve and the filler tube during assembly.

10. Make sure the end cap split bearings (bushings) are in position.



11. Align the end cap so it will slide over the tie rods. Carefully slide the end cap back until the check valve makes contact with the inlet poppet. Continue sliding the end cap back until it seats over the o-ring on the high-pressure cylinder.
12. Temporarily install one of the hex nuts, hand tight, to prevent the end cap from springing back.

Install the other two end caps before continuing.

CAUTION
Make sure all the split bearings are completely seated in the end cap. Not doing so will cause premature torque while torquing the end caps.

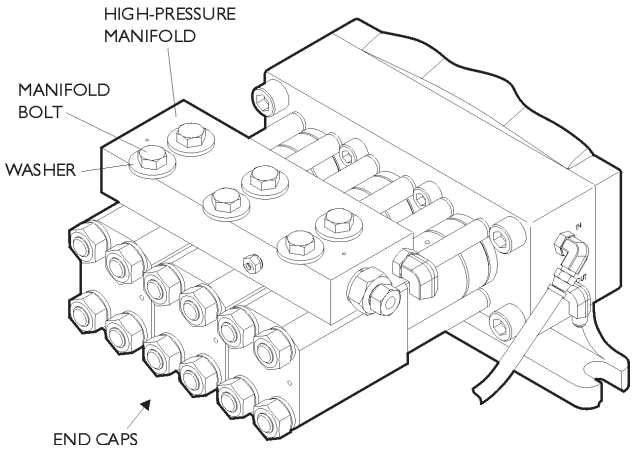
13. Lightly apply anti-seize compound to both sides of the washers and to the threads of the tie rods.
14. Install washers and hex nuts hand tight. **Do not torque** the tie rod hex nuts at this time.

    Note: If dragging or stiffness occur while installing the hex nuts, determine the cause and eliminate it.

15. Remove the temporarily installed hex nuts. Apply anti-seize to both sides of the washers and threads, then reinstall the nuts.

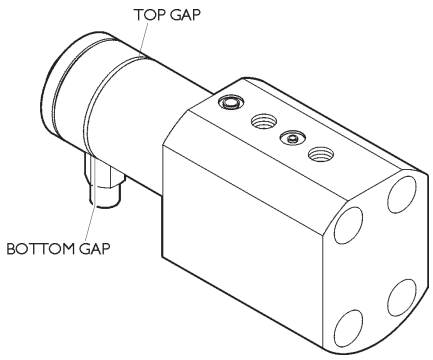
Repeat for the other end caps. All three end caps must be in place before proceeding.

16. Place the high-pressure manifold over the three end caps, aligning the through holes with the threaded holes in the end caps.
17. Apply anti-seize compound to the manifold bolts and both sides of the washers. Install washers and olts and tighten hand tight. **Do not torque** bolts at this time.



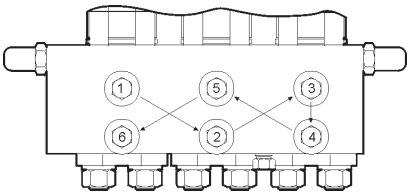
Torque manifold and tie rods

Before following the torque procedure, it is critical to check the alignment of the high-pressure cylinder and the subplate adapter. Check the gap between the high-pressure cylinder and subplate adapter at the 12:00 and 6:00 positions. The gap must be within 0.015 in. differential.

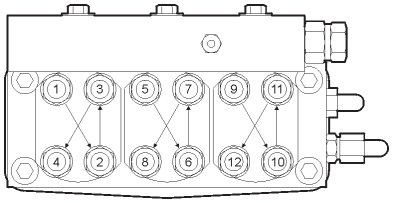


Note: It may be necessary to compensate prior to applying the required torque.

18. Preload manifold bolts 10 ft-lb (14 n-m) following the torque sequence shown here.



19. Evenly tighten the tie rod nuts approximately 60°, one at a time, to 165 ft-lb (224 N-m), following the sequence shown here.



Note: Occasionally rotate the sheave while applying torque. If you detect any friction, there may be an problem developing. You may need to disassemble and start over again.

20. Torque manifold bolts to 70 ft-lb (95 N-m) following the torque sequence shown for Step 1 of this torque procedure.
21. Connect the low- and high-pressure plumbing.

Follow the start-up procedure in Chapter 3 before returning the equipment to service.

Tensioning and aligning the belt drive

Service the sheaves and belt during scheduled preventive maintenance or if the sheaves or belt fail.

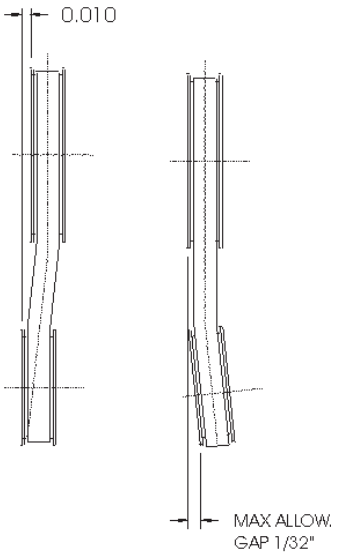
For optimum belt performance, the V-belt drive must be tensioned and aligned properly. Follow these general rules when tensioning a drive:

- The ideal tension for the belt drive is the lowest tension at which the belt will not slip under the highest load condition.
- Check tension on a new drive frequently during the first day of operation and periodically thereafter.
- Excessive tension shortens belt and bearing life.
- Keep the belt and sheaves free from oil, grease, cutting lubricants, or belt dressing—any of these can cause the belt to slip.
- If a V-belt slips, tighten it.

Servicing the belt

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 result in equipment damage or injury to personnel.

1. Shut down the system.
2. Remove the belt guard.
3. Loosen both 3/8-16 hex nuts on the spring assembly. This allows the sheave to rotate so you can remove the belt.
4. Install the new belt.
5. Apply antiseize to the ⅜-16 bolt and start tightening the ⅜-16 nuts. Tighten the nuts to the correct measurement; see the table below and refer to drawing 012240.



BELT ALIGNMENT

	Dimension A	*Belt tension*
30 hp 60 Hz	7 in. (177.8 mm)	176 lb (782 N)
30 hp 50Hz	7.5 in. (190.5 mm)	194 lb (862 N)
50 hp 60Hz	7.5 in. (190.5 mm)	219 lb (974 N)
50 hp 50 Hz	7 in. (177.8 mm)	155 lb (689 N)

6. Reinstall the belt guard.

Remove the "Out of Service" tag from the main electrical disconnect and make final inspection to remove tools, parts, and rags from the equipment. The pump is ready for operation.

Servicing the crankcase

Lubricating the pump

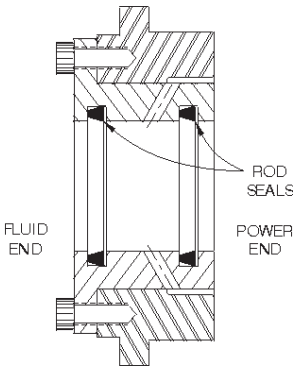
Fill the crankcase with SAE 30 crankcase oil. Allow about 3 qt (2.8 L) total—the crankcase holds about 2 qt (1.9 L); hoses and filter housing will require additional oil.

Maintain oil level between the high and low level marks on a bayonet oil gauge inserted through the crankcase cover.

- Check oil levels regularly
- Change the oil every Dynamic Seal kit interval (see Chapter 3)
- Change oil immediately if water droplets are found on the bayonet gauge

Replacing piston rod seals

The rod seal assembly contains two oil seals, oriented as shown. To access these seals, the subplate must be removed.



Assemble new seals into the housing. Use an assembly thimble (015624-1) on the end of the crosshead rod; this will expand the sealing edge as the housing slides back into the retainer. Use care to ensure that the seals (A-20295-1 and A-12500) are oriented correctly.

Crankcase replacement parts

Item	Part #	Qty.	Description
16	A-12495	3	Retainer spring
17	015445-1	3	Seal carrier
18	A-20295-1	3	Wiper seal
19	A-12500	6	U-cup
24	A-12501	1	Crankcase
25	A-12502	1	Gasket
27	A-12503	1	Lid
29	A-12504	1	O-ring
30	A-12505	1	Oil level gauge
31	A-12506	2	Cone bearing
31a	A-12507	2	U-cup bearing
32	A-12508	6	Shim gasket, green
32a	A-12509	4	Shim gasket, pink
33	A-12510	1	Bearing cap, open
34	A-12511	12	Seal washer
37	A-12512	1	Oil seal
38	A-12513	1	Crankshaft
39	A-12514	1	Bearing cap, closed
55	A-12515	1	Drain plug

Notes

CHAPTER 5

Engineering Drawings

The following drawings are provided with this manual. Please note that drawings are provided for reference only. Drawings and part numbers can become obsolete as a part of FLOW's ongoing product improvement. If part numbers are replaced by new numbers, FLOW Customer Service will inform you when you order new parts.

30/50 hp HyPlex

012240-X	30/50 hp HyPlex Pump
012306-1	High-pressure assembly
012399-X	Skid assembly
013002-1	Pressure control valve (PCV) for 30/50 hp pumps
014032-1	Water filter assembly
713649-X	30/50 hp HyPlex with cover (used with Modular WMC)

Electrical

Elementary electrical drawings are located in the system manual.

014051	Electrical enclosure

Kits

30 & 50 hp kits

712101-1	Minor maintenance kit
712101-2	Major maintenance kit
015605-1	PCV maintenance kit
015606-1	Dynamic seal maintenance kit

Maintenance kits

015605-1 Rev B
PCV Maintenance kit

#	Qty	P/N	Description
1	1	012906-1	Bearing assembly
2	1	013006-1	Plunger
3	1	013033-1	Plunger seal
4	1	A-0275-206	O-ring
5	1	A-0275-119	O-ring
6	1	A-0275-120	O-ring
7	1	A-00167-42	U-packing seal
8	1	A-0308-8	Nut
9	1	A-4689	Food-grade grease
10	1	SB-0177	HyPlex PCV Kit bulletin
11	1	013002-DWG	PCV drawing

015606-1 Rev B
Dynamic Seal Maintenance kit

#	Qty	P/N	Description
1	3	011051-1	Dynamic seal
2	3	A-00621-33	Rod seal
3	1	A-1903	Grinding paper
4	1	SB-0176	Dynamic Seal Maintenance Kit service bulletin
5	1	012306-DWG	High-pressure assembly drawing
6	2	A-20386-1	Anti-seize lubricant

712101-1 Rev. C
Minor maintenance kit
30/50 hp pump

#	Qty	P/N	Description
1	3	011051-1	Dynamic seal
2	3	A-00621-33	Rod seal
3	3	011042-1	Inlet poppet
4	3	011040-1	Outlet poppet guide
5	3	011039-1	Outlet poppet
6	3	011041-1	Outlet poppet seat
7	1	013032-1	PCV poppet
8	1	013031-1	PCV seat
9	1	006765-1	Static manifold seal
10	3	A-0275-033	O-ring
11	3	A-0275-025	O-ring
12	1	A-1903	320 grit paper
13	1	A-4689	Food-grade grease
14	1	SB-0168	Minor Maintenance SB
15	3	A-9223	Compression spring
16	3	A-12219	Spring
17	3	011350-1	Filler tube sleeve
18	2	A-20386-1	Anti-seize lubricant
19	1	012306-DWG	HP assembly drawing

712101-2 Rev. F
Major maintenance kit
30/50 hp pump

#	Qty	P/N	Description
1	3	011051-1	Dynamic seal
2	3	A-00621-33	Rod seal
3	3	011042-1	Inlet poppet
4	3	011040-1	Outlet poppet guide
5	3	011039-1	Outlet poppet
6	3	011041-1	Outlet poppet seat
7	1	013032-1	PCV poppet
8	1	013031-1	PCV seat
9	1	006765-1	Static manifold seal
10	3	A-0275-033	O-ring
11	6	A-0275-025	O-ring
12	3	013933-1	Seal carrier
13	3	011043-1	Static end cap seal
14	3	013932-1	High-pressure cylinder
15	3	013383-1	Check valve body
16	3	011350-1	Sleeve
20	3	A-00720-31	Rod seal
21	3	A-9223	Compression spring
27	3	A-0290-010	O-ring
28	3	A-0275-015	O-ring
29	3	006760-1	Manifold backup ring
30	3	014172-1	Tie rod spacer
31	1	A-4689	Food-grade grease
32	1	SB-0170	Major Maintenance SB
33	2	A-20386-1	Anti-seize lubricant
34	1	012306-DWG	HP assembly drawing
35	3	A-12219	Compression spring
36	3	A-0265-062	Internal snap ring

Tool kit

012068-1 Rev. F
HyPlex/Diesel Eagle

#	Qty	Part #	Description
1	1	011153-1	Plunger nut tool
2	1	200691-03	Spanner wrench
3	1	A-1904	Glass plate
4	1	011154-1	Tie rod driver
5	1	012324-1	Rebuild clamp (for check valve body)
6	1	A-0028-32	Screw
7	1	A-0407-6	Flat washer
8	1	A-8466	Medical alert card
9	1	A-2185	Blue Lubricant
10	1	014613-1	HyPlex maintenance video

Recommended spares

These parts are not contained in a spares kit, but FLOW recommends that you keep them on hand.

Water filters

A-00562-1	0.45 micron filter
A-00562-2	1 micron filter

PCV parts

For 30/50 hp units only

013032-1	Poppet
013031-1	Seat
006765-1	Static manifold seal

Engine filters

A-13038	Engine oil filter
A-12800	Compressor air cleaner kit
A-12983	Filter element, 1.75 x 8 in.
A-13036	Fuel/water separator element
A-13035	Engine air filter element
A-13037	Engine air filter element
A-13052	Fuel filter