

# *Replacing Intensifier Seals*

AUGUST 2010

# REPLACING THE INTENSIFIER SEALS

**The intensifier seals should be replaced when hydraulic or water leaks are detected from the intensifier.**

**TECH TIP:**  
There are two types of high pressure cylinders. The standard high pressure cylinders are the same at each end. The long service life cylinders have a taper at one end of the cylinder.

## REQUIRED EQUIPMENT

- Precision Lube thread lubricant (part number 25750)
- General purpose grease (such as wheel bearing grease)
- Degreaser (such as brake cleaner)
- Torque wrench, plastic mallet, and special tools (see the part lists section)
- Scotch-Brite™ pad (very fine or ultra fine) or 1000 grit emery cloth.
- Lapping film, 9 micron (part number 29524)
- Seals from the following table:
- (2) machine screws with 1/4-20 UNC thread, 2 inches long

Part (quantity per intensifier)	Intensifier Model	
	55-30, 55-50, 55-75 Dual	55-75 Single, 55-100, 55-150, 55-200

High Pressure Seal (4)	35373	35574
High Pressure Backup Ring (4)	35364	35572

The following parts are not required for every high pressure seal replacement procedure but they should be available as spares because they do require periodic replacement.

Rod Seal (2)	25954	25953
O-ring (2)	26471	26471
Backup Ring (2)	26472	26472
End Cap O-ring (2)	25947	25947

• Spare parts for the standard high pressure cylinder:

Consumable Backup Disc (part number 101912 for Models 55-30, 55-50, and 55-75 Dual)

Consumable Backup Disc (part number 101914 for Models 55-75 Single, 55-100, 55-150, and 55-200)

• Spare parts for the long service life high pressure cylinder (for Models 55-75 Single, 55-100, 55-150, and 55-200):

Centering Ring (part number 106870)

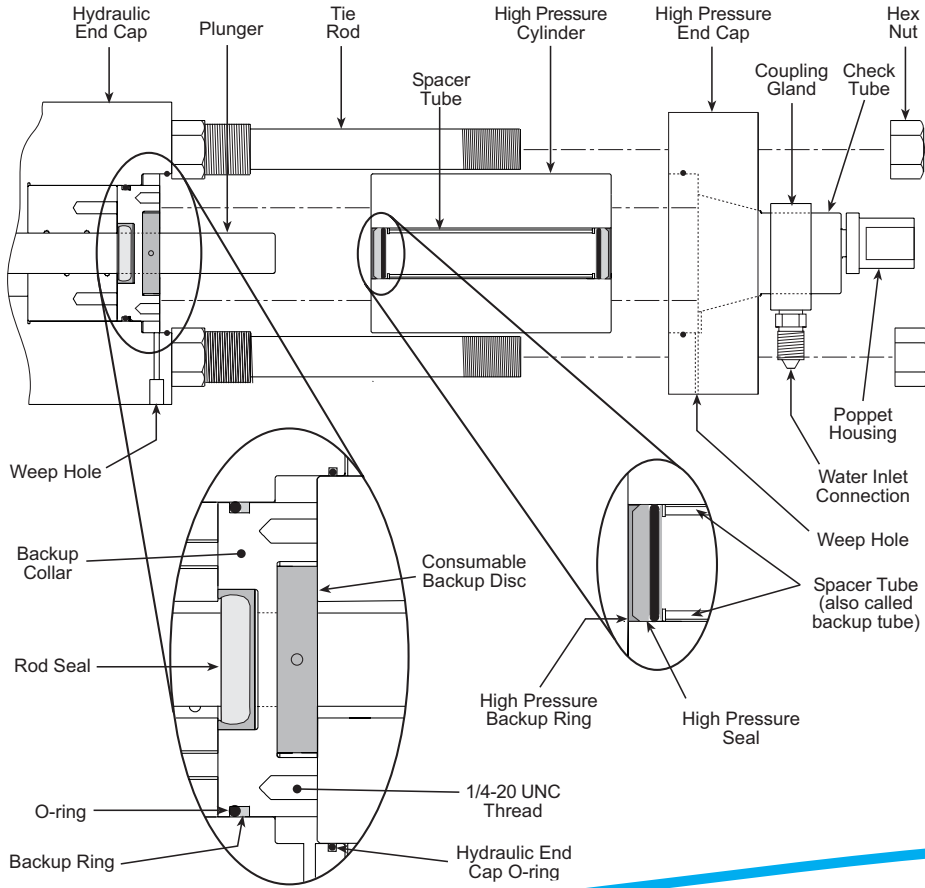
Tapered Centering Ring (part number 106872)

Mini Disk (part number 106873)

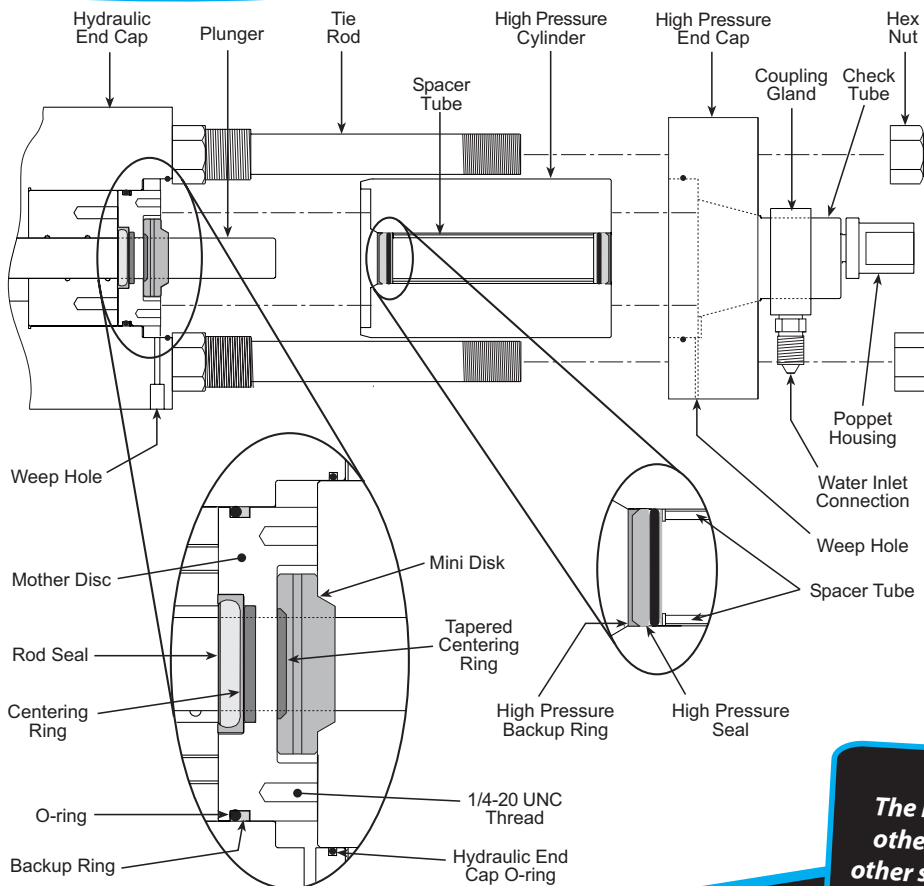
• Intensifier Seal Tool Kit part number 45319-5707 (for Models 55-30, 55-50, and 55-75 Dual)

Intensifier Seal Tool Kit part number 45319-5529 (for Models 55-75 Single, 55-100, 55-150, and 55-200)

**Component Identification**  
*Standard HP Cylinder*



**Component Identification**  
*Long Service Life HP Cylinder*



**TECH TIP:**  
*The high pressure seals wear faster than the other intensifier seals. Be sure to inspect the other seals when the intensifier is disassembled and replace any worn or damaged seals.*

# STEP 1: Prepare the Intensifier

1. Manually extend the plunger into the high pressure cylinder that is to be serviced. The proximity switch actuator will be in the up position when the plunger is extended into the high pressure cylinder.

## TECH TIP:

Extending the plunger allows the plunger to be inspected when the intensifier is disassembled. Each side of the valve has a manual actuating pin. Use a rigid tool to press one of the actuating pins to cause the intensifier piston to extend into one end of the intensifier. Pressing a directional valve actuating pin extends the plunger in the same direction as the actuating pin is pressed; pressing the activating pin on the right side of the intensifier extends the plunger into the left side of the intensifier.

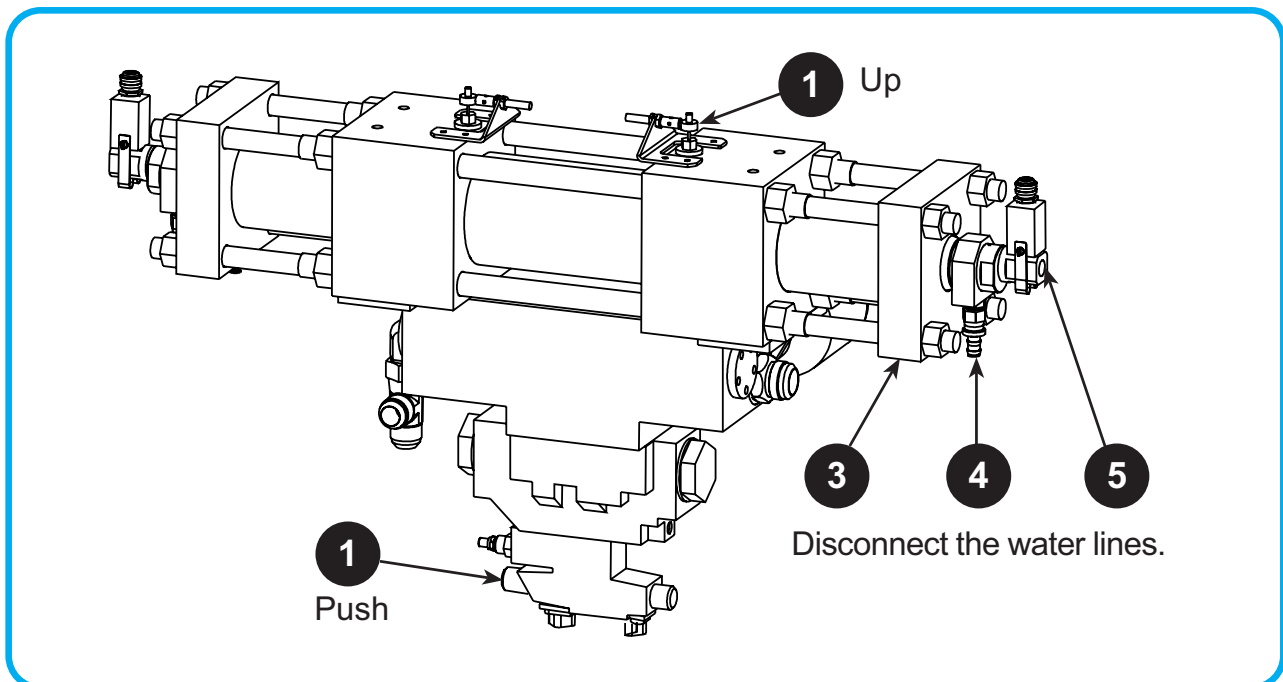
2. Bleed all water and hydraulic pressure from the system.

With the intensifier on and the pump motor running, turn on the water tool (waterjet, abrasivejet, etc.), adjust the hydraulic pressure to zero. Then turn the intensifier motor off. This should relieve any water pressure and hydraulic pressure in the system

3. Disconnect the drain tube from the weep connection on the high pressure end cap.

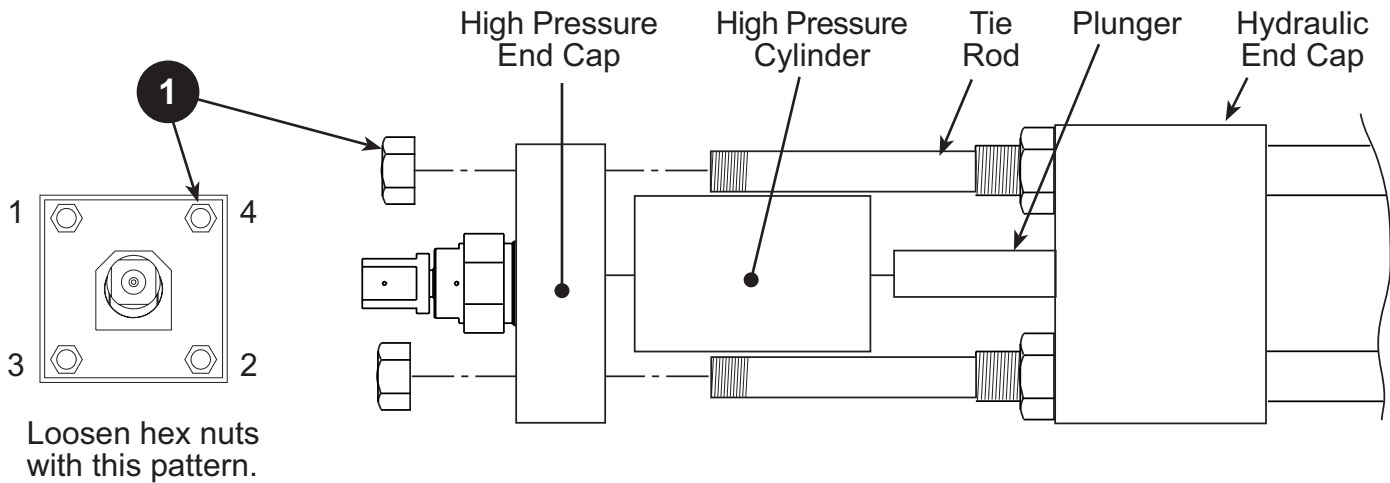
4. Disconnect the UHP water connection from the intensifier at the high pressure water manifold. Do not loosen the UHP outlet connection at the poppet housing.

5. Disconnect the water supply tubing from the water inlet connection on the high pressure end cap.



## STEP 2: Disassemble the End of the Intensifier

**Disassemble the end of the intensifier and place the components on a workbench.**



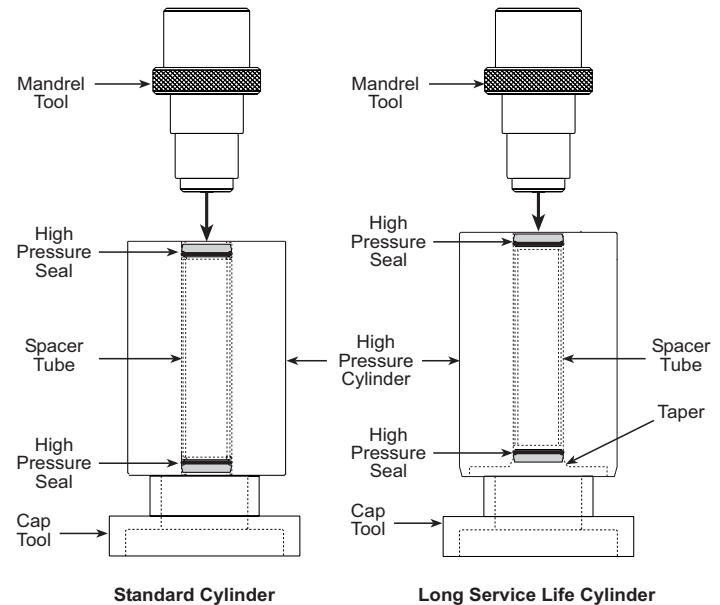
- 1. Loosen each hex nut 1/4 turn, use a pattern shown in the figure to relieve the tension on the end cap.**
  - 2. Remove the hex nuts securing the high pressure end cap.**
  - 3. Remove the high pressure end cap and high pressure cylinder. Some effort is needed to pull the high pressure cylinder off the plunger. Place the high pressure cylinder on a workbench.**
- Usually the high pressure cylinder comes off at the same time. Support the high pressure cylinder while removing it from the hydraulic end cap, it can fall free and damage the plunger. Use a plastic mallet to separate the end cap from the high pressure cylinder if needed.**

## STEP 3: Remove the High Pressure Seals

Remove the high pressure seals, backup rings, and spacer tube from the high pressure cylinder.

**TECH TIP:** There are two types of high pressure cylinders, the standard design and the long service life design.

1. Place the high pressure cylinder on the cap tool. Ensure the cylinder is centered on the cap tool so the inside diameter of the cylinder is not blocked.
2. Insert the mandrel tool into the high pressure cylinder and press down (tap with a plastic mallet if necessary). The spacer tube pushes the high pressure seal and backup ring out the bottom of the cylinder.
3. Turn the high pressure cylinder over and use the mandrel tool to push the spacer tube which pushes the second high pressure seal and backup ring out the bottom of the cylinder.
4. Remove the spacer tube from the high pressure cylinder.
5. Discard the high pressure seals and backup rings.



## Step 4: Clean the Parts

Clean the high pressure cylinder parts and inspect for damage. Replace damaged parts as needed.

1. Clean the high pressure cylinder with degreaser. Dry the cylinder.
2. Clean both ends of the high pressure cylinder with a Scotch-Brite pad.
3. Clean the inside edge of the high pressure cylinder bore (see Fig. 1) with a Scotch-Brite pad. By rolling the HP cylinder on a flat surface while holding the Scotch-Brite pad in the I.D. making radial lines. Inspect the area for wear or damage. You only need to clean the portion of the bore where the high pressure seals reside. Inspect the area for unusual wear (use your experience to determine if wear is unusual or normal).
4. Check the face of the check tube and the face of the high pressure cylinder (see Fig. 2) where they contact each other for wear. Clean these faces if needed.
5. Rinse all of the parts with water and dry completely.



Fig. 1



Fig. 2

# STEP 5: Inspect the Parts

## 1. Inspect the plunger for wear.

Use your fingernail to detect fine scratches or buildup on the plunger, pull your fingernail across the plunger. If scratches are detected, use 9 micron lapping film to remove any roughness.

## 2. For the standard HIGH PRESSURE CYLINDER only:

Inspect the consumable backup disc.

A. Remove the consumable backup disc from the hydraulic end cap. Clean the disc thoroughly with solvent and a Scotch-Brite pad.

B. Replace the consumable disc if it is chipped or cracked at the inner perimeter where the disc rests against the plunger.

### TECH TIP:

If the consumable backup disc is to be reused, install it so the side of the disc that had been facing the high pressure cylinder now faces the hydraulic end cap. This promotes even wear.

C. Determine if the consumable backup disc requires replacement. Slide the consumable backup disc onto the plunger, it should slide freely. Check if the consumable backup disc can wobble on the plunger (slide a new consumable backup disc on the plunger to compare the amount of wobble). Replace the consumable backup disc if wear is excessive.

## 2. For the LONG SERVICE LIFE HIGH PRESSURE CYLINDER only:

Inspect the mini disc.

A. If a nick or gap is visible between the mini disk and the plunger replace the mini disk

3. Inspect inside the hydraulic end cap. A small amount of hydraulic fluid in this area is normal, if hydraulic leakage is excessive the rod seal must be replaced (experience teaches you when the amount of hydraulic fluid is excessive).

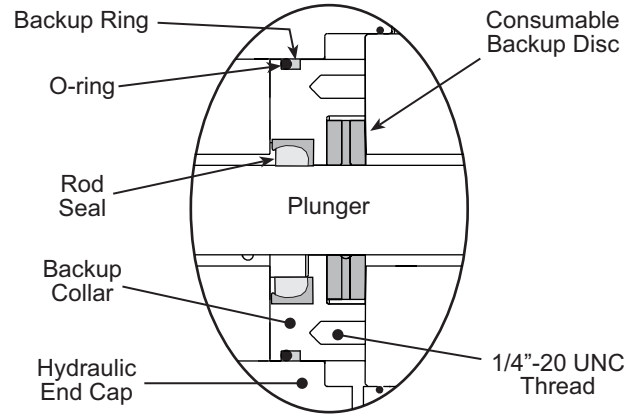
- If the high pressure seal service life is reduced from normal, perform **Replace the Rod Seal** to replace the rod seal.
- If you suspect the rod seal is leaking, perform **Replace the Rod Seal** to replace the rod seal.
- If leakage is not excessive, go to **Install New High Pressure Seals**.

# STEP 6: Replace the Rod Seal

There are two procedures to replace the rod seal.

- For Models with STANDARD HIGH PRESSURE CYLINDERS
- For Models with LONG SERVICE LIFE HIGH PRESSURE CYLINDERS

## For Models with STANDARD HIGH PRESSURE CYLINDERS



**Rod Seal Components**

### 1. Remove the backup collar.

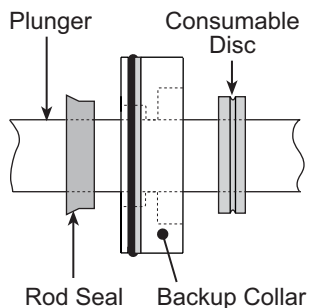
Thread two machine screws into the holes in the backup ring. Use the machine screws to pull the backup ring out; apply even pressure to the screws to pull the backup ring out. Remove the machine screws when done.

### 2. Remove and discard the rod seal.

### 3. Inspect the O-ring and backup ring on the backup collar, replace them if damaged or worn.

### 4. Clean the backup ring.

### 5. Insert the new rod seal over the plunger with the lip facing the center of the intensifier.



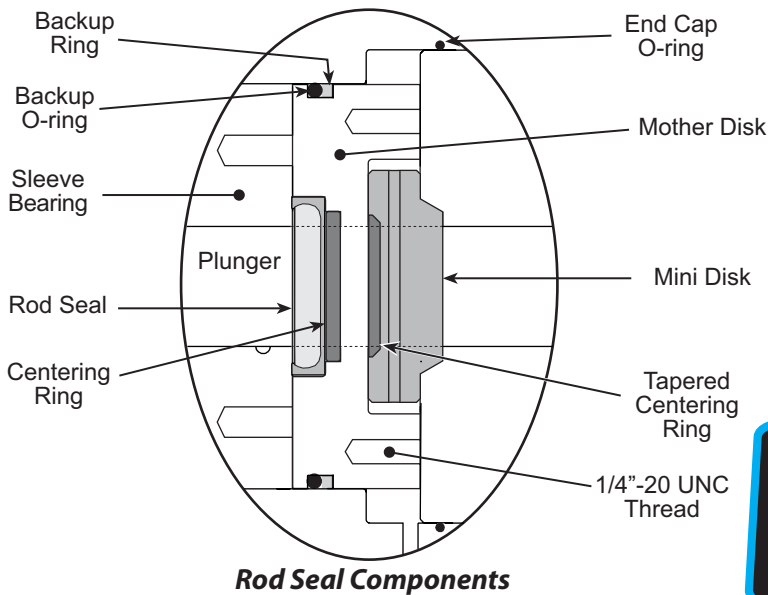
6. Slide the backup ring over the plunger and rod seal. Push the backup ring into the hydraulic end cap (this requires considerable effort). The rod seal will seat into the backup ring.

### 7. Install the consumable backup disc.

**TECH TIP:**  
The high pressure cylinder will seat the rod seal into the backup ring when the high pressure end cap is tightened.



**For Models with LONG SERVICE LIFE HIGH PRESSURE CYLINDERS**



**TECH TIP:**  
A small amount of hydraulic fluid will drain from the hydraulic end cap when the mother disk is removed. Place a rag below the hydraulic end cap to collect any hydraulic fluid.

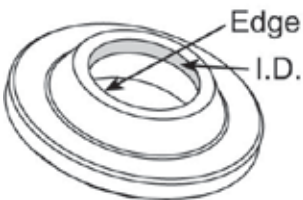
**1. Remove the mother disk from the hydraulic end cap. The mother disk can be removed by hand.**

**Thread two machine screws into the mother disk. Pull the two screws out evenly to remove the mother disk and mini disk from the hydraulic end cap. Remove the machine screws when done.**

**2. Separate the mini disk, rod seal, centering ring and tapered centering ring from the mother disk. Discard the rod seal**

**3. Clean the mother disk, mini disk, and centering rings. Inspect the mother disk O-ring and backup ring for damage. Ensure that the mini disk weep groove and weep holes are clean of any debris. Use compressed air to blow debris from the holes.**

**4. Inspect the mini disk. The inside diameter (I.D.) of the cone side of the mini disk should appear evenly polished and be smooth to the touch (an uneven polished area indicates worn centering rings).**



**The corner between the face of the cone and the inside diameter should be square and sharp. Use your fingernail along the edge. If you catch your fingernail on this edge, it is an indication of a bur, crack or chip; a bur can be removed otherwise replace the mini disk.**

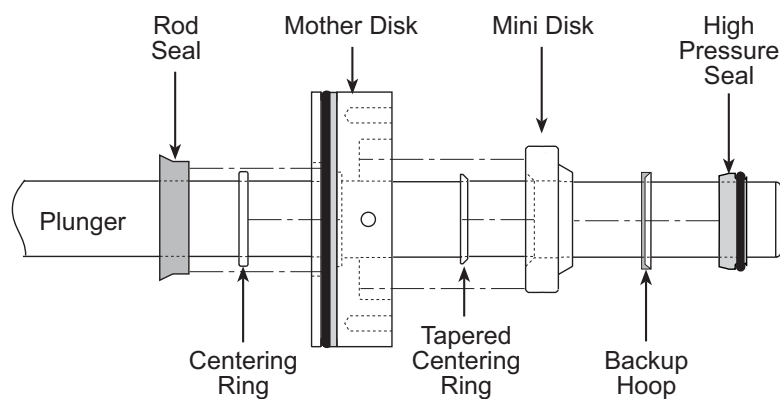
**5. Clean the plunger.**

6. Apply a light coat of hydraulic fluid to the rod seal and slide it on to the plunger with the lip facing the bearing sleeve.

**TECH TIP:**  
The high pressure cylinder will seat the rod seal into the mother disk when the high pressure end cap is tightened.

7. Install the mother disk and mini disk. The centering rings are a slip fit and you will notice drag when they are installed on the plunger. If no drag is detected, replace the centering rings.

Install the centering ring into the mother disk then place the mother disk onto the plunger. Slide the tapered centering ring onto the plunger until it contacts the mother disk. Slide the mini disk onto the plunger until it captures the tapered centering ring



8. Slide a backup hoop and high pressure seal onto the plunger. Ensure the taper on the backup hoop faces the high pressure seal.

**TECH TIP:**  
Failure to install the centering rings correctly will severely reduce the life of the high pressure seal.

# STEP 7: Install New High Pressure Seals

Install new high pressure seals and new backup rings.

**TECH TIP:** For the long service life high pressure cylinder install a high pressure seal and backup ring into one end of the cylinder. The long service life cylinder has a taper at one end of the cylinder, install the high pressure seal into the other end of the cylinder.

1. Stand the high pressure cylinder upright. Place the cap tool on top of the cylinder making sure it rests flush (the cap tool can freely rotate on the cylinder if properly seated).

The insertion sleeve has an inward taper to compress the seal as it is pressed through. Slide the insertion sleeve into the cap tool, larger diameter upward.

2. Apply a light coat of high pressure lubricant to the new high pressure seal and install it onto the mandrel tool (O-ring toward the cylinder).

**TECH TIP:** Do not block the air hole in the mandrel.

3. Use the mandrel to press the high pressure seal through the insertion sleeve and into the end of the high pressure cylinder. When the mandrel tool bottoms out the seal is in the proper position.

4. Twist the mandrel while removing it from the sleeve. If it is pulled directly out, it might pull the seal out. Remove the insertion sleeve from the cap tool and verify the seal is squarely seated within the cylinder bore.

**TECH TIP:** The inside of the backup ring is tapered. The taper in the backup ring mates with the tapered end of the high pressure seal.

5. Align the backup ring and mandrel tool in the cap tool.

6. Use a plastic mallet to lightly tap the end of the mandrel to press the backup ring onto the high pressure seal.

7. Turn the cylinder over and install the spacer tube.

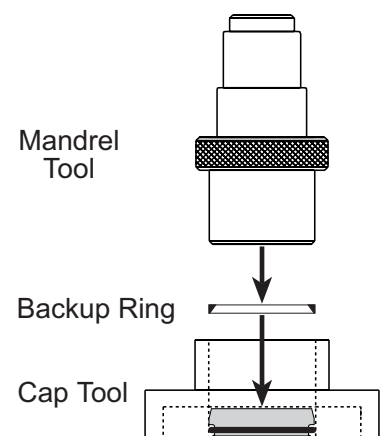
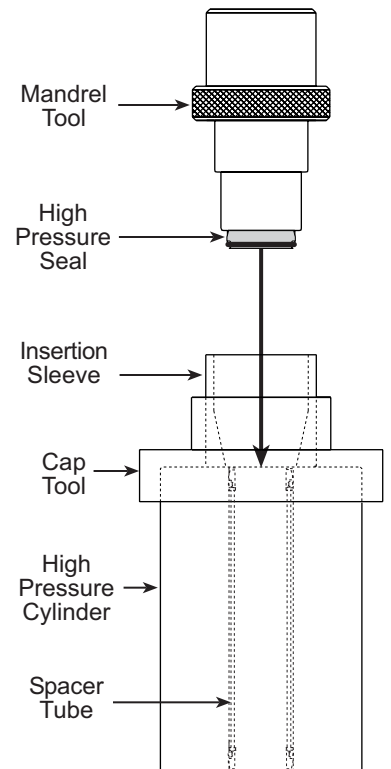
8. Standard high pressure cylinders are the same at each end. The long service life cylinders have a taper at one end of the cylinder.

**For Models with STANDARD CYLINDERS**

Repeat Steps 1 through 6. Use a plastic mallet to lightly tap the end of the mandrel to press the backup ring onto the high pressure seal.

**For Models with LONG SERVICE LIFE CYLINDERS**

The second high pressure seal and backup ring were positioned on the plunger in Replace the Rod Seal. Proceed to Assemble the Intensifier.



## STEP 8: Assemble the Intensifier

**TECH TIP:** The high pressure end cap has a low pressure water connection and a weep hole drain connection. Ensure to align the high pressure end cap so the connections will align with their mating connections.

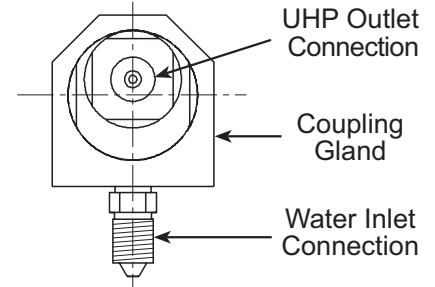
### 1. Install the high pressure cylinder.

**Note:** For the long service life high pressure cylinder slide the side of the cylinder with the taper onto the plunger first. Considerable effort is required to push the high pressure cylinder over the plunger. Slide the high pressure cylinder over the plunger and into the hydraulic end cap. Sliding the high pressure cylinder onto the plunger can cause a high pressure seal to be pushed out of the cylinder, ensure the seal stays inside the cylinder. Install the high pressure end cap.

### 2. Place the check tube in the high pressure end cap then slide the high pressure end cap onto the tie rods. Considerable effort is required to push the high pressure end cap onto the high pressure cylinder

**TECH TIP:** Notice that the poppet housing connected to the check tube is off-center. When properly aligned the UHP outlet connection is above the center line.

### 3. Rotate the check tube to align the low pressure water inlet connection and UHP outlet connection with the fixed tubing. Ensure water inlet connection is pointing straight down; this aligns both connections.

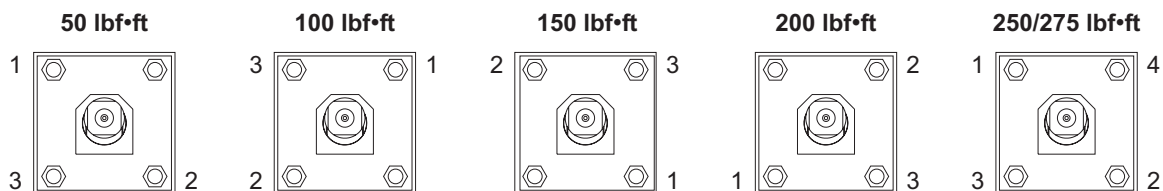


### 4. Lubricate the tie rod threads with general purpose grease. Also lubricate the face of the cap screw that contacts the high pressure end cap.

**TECH TIP:** Notice that the hex nuts have markings on one side. These markings must face outward when the hex nuts are installed. Thread the hex nuts onto the tie rods and lightly tighten the nuts.

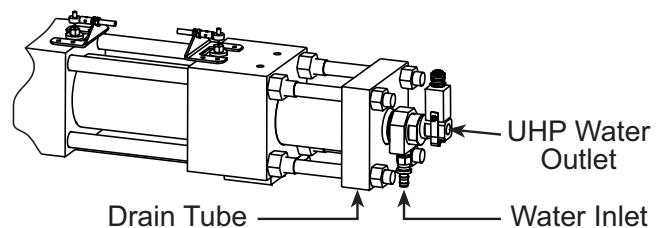
### 5. Tighten the hex nuts in increments using the pattern shown in the following figure to apply pressure evenly.

**TECH TIP:** Measure the distance between the hydraulic end cap and the high pressure end cap in several places to ensure the measurement is the same; this indicates the high pressure end cap is properly installed.



• Initially torque the hex nuts to 50 lbf·ft (68 N·m), then torque the hex nuts in increments of 50 lbf·ft (68 N·m) until 275 lbf·ft (373 N·m) is reached (repeat the last torque sequence to achieve 275 lbf·ft). Double check the final torque.

### 6. Connect the water supply tubing to the water inlet connection on the coupling gland. Connect the UHP tubing to the outlet connection in the poppet body. Do not connect the drain tube at this time.



## **STEP 9: Check Your Work**

***Inspect the assembly and verify that all parts are accounted for and all connections are properly tightened.***

***TECH TIP: Monitor the water drain connection on the bottom of the high pressure end cap for leakage when verifying proper operation.***

- 1. Start the intensifier pump.***
- 2. Turn on a water tool to allow water flow.***
- 3. Run the intensifier pump at low pressure for a couple of minutes to prime the intensifier and ensure the intensifier is cycling properly.***
- 4. Slowly increase the output pressure to 55,000 psi (3800 bar).***
- 5. Verify proper operation with no water or hydraulic leakage.***
- 6. Turn off the waterjet to dead head the system.***

***See Dead Heading the Intensifier for information about how to dead head the intensifier with the plunger in the desired high pressure cylinder.***

***Turn the waterjet on and off several times. Ensure that the high pressure cylinder you are checking is at its maximum pressure. Verify that there is no water or hydraulic leakage at the water drain tube connection.***

- 7. Shut down the intensifier pump.***
- 8. Connect the drain tube to the weep connection on the bottom of the high pressure end cap.***

# Dead Heading the Intensifier

*Dead heading the intensifier is when you stop all water flow through the intensifier by turning off all water tools (i.e. waterjets and abrasivejets). With no ultra high pressure (UHP) water flow, the intensifier stops at its highest pressure. This is useful when checking for leaks in the system.*

*It is important to know which components are under pressure when checking for leaks.*

- An intensifier has one high pressure cylinder at high pressure and the other high pressure cylinder is at low pressure, The pressure changes when the intensifier cycles.*
- The UHP pressure is bled off the system when the intensifier pump is shut down. This requires the bleed down valve to be functioning properly.*
- The UHP tubing from the intensifier to the water tools is always under pressure until the intensifier pump is turned off (this includes the attenuator).*

## *How to dead head the intensifier*

*You need to know how to detect when the high pressure cylinder you are checking is at its highest pressure. To detect the pressurized cylinder, observe both proximity switches when you dead head the intensifier. For example; if the left proximity switch goes up, then down and the right proximity switch remains down; the right high pressure cylinder is under pressure (and vice versa).*

*Dead heading the high pressure cylinder that you want to check is a hit and miss proposition. It might take several attempts to dead head the intensifier to get the proper high pressure cylinder under pressure.*

**TECH TIP:** *To shut off the waterjet, use the switch on the control console of the motion control system. Do not use the manual shut off valve located on the z-axis assembly.*

*It may take two people to dead head the intensifier; one to monitor the intensifier proximity switches and one to shut off the waterjet. Working with an assistant will establish the timing needed to shut off the waterjet and dead head the desired cylinder.*