

Z-CLASS Pump Element 3-6

L2596 Rev. G 10/13

For Date Codes Beginning with the Letter "A", "B", "C" and "D"

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**To Protect Your
Warranty, Use Only
ENERPAC Hydraulic
Oil.**

Enerpac recommends
that all kit components
be installed to assure
optimum performance of
the repaired product.

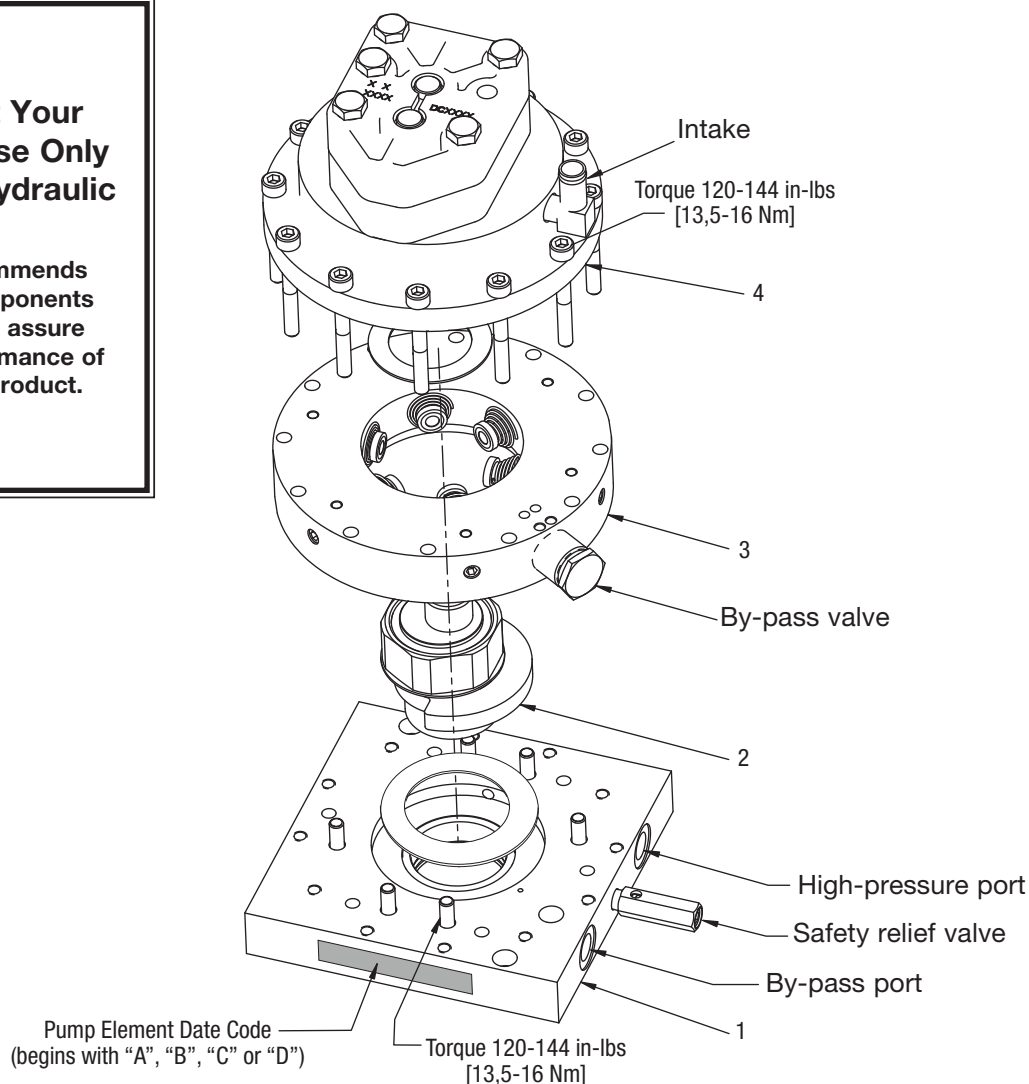


Figure 1, Pump Element Assembly (typical)

Item	Figure	Description
1	2A, 2B	Top Plate Assembly
2	3A, 3B	Eccentric Assembly
3	4	Piston Ring Assembly
4	5	Gear Pump Assembly

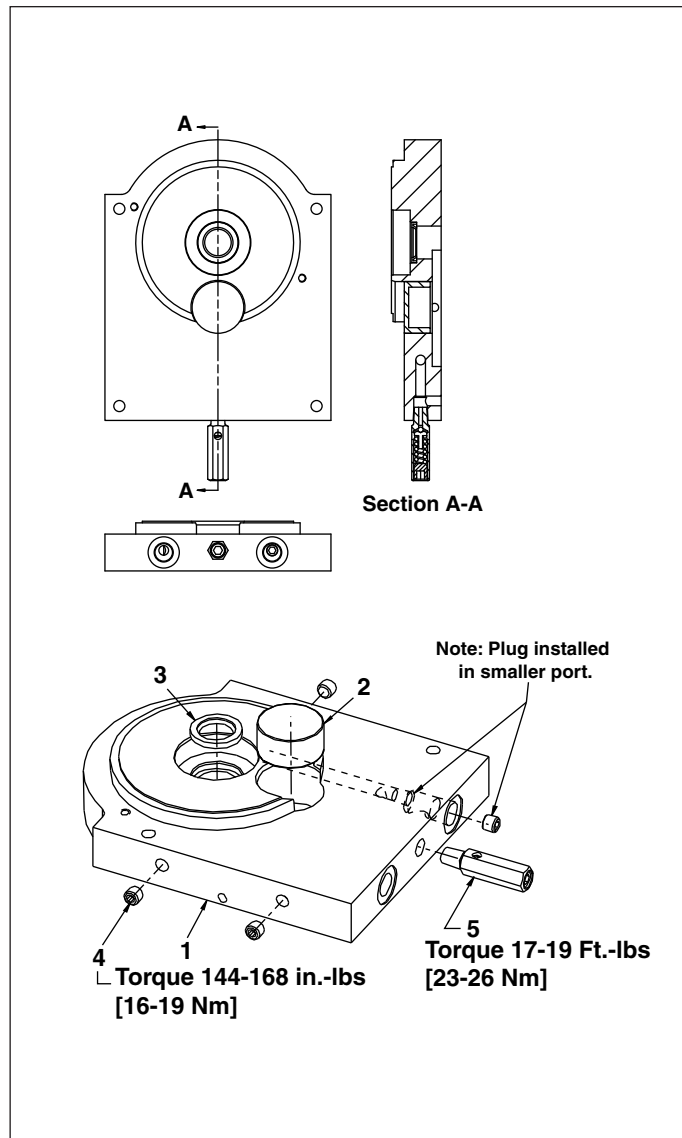


Figure 2A, Top Plate Assembly for Gear Reduction Motor (ZU Series - All Date Codes)

Repair Parts List for Figure 2A			
Item	Part Number	Qty.	Description
1	★DC8107101	1	Top Plate 3 Piston (new style)
2	★DC9240155	1	Bearing, Needle 25x32x16CL
3	★DC9041776	1	Lip Seal 17x25x4SC
4	★A1006245	4	1/16 Flush Plug
5	DA5999900SR	1	1/8 NPT Relief Valve

★ Items included in Repair Kit DC9280900SR

Item 1 Notes:

- Old style 3 piston top plate DC9223101 used on ZU Series pumps made before 05/2006 is no longer available.
- New style 3 piston top plate DC8107101 can be used as a replacement part for all ZU Series pumps.

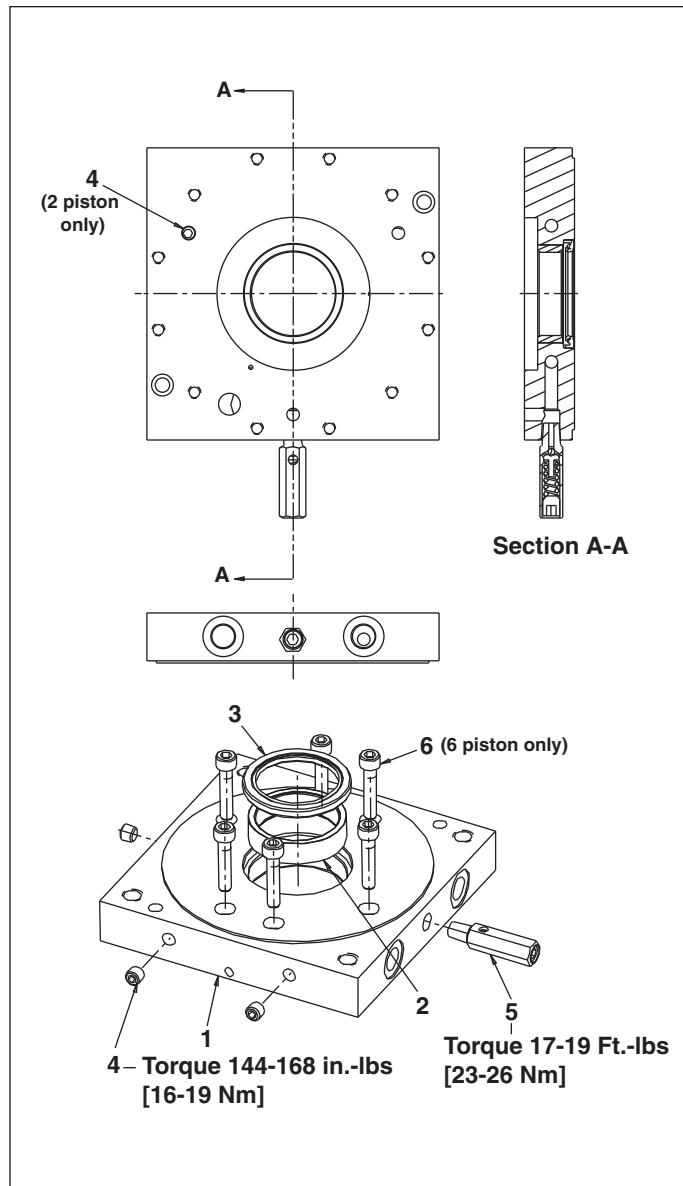


Figure 2B, Top Plate Assembly for Direct Drive Motor

Note: For ZE, ZG and ZW Series pumps with pump element date codes A, B or C, see next page.

(ZA Series - Aluminum Top Plate - Date Codes A, B, C and D)			
Repair Parts List for Figure 2B (see graphic above)			
Item	Part Number	Qty.	Description
1	❖ DC8105101	1	Top Plate 2 and 3 Piston
2	❖ DC9026155	1	Bearing, Needle 40x47x12
3	❖ DC9027776	1	Oil Lip Seal 40x52x5
4	❖ A1006245	2	1/16 Flush Plug (for 3 piston)
	❖ A1006245	3	1/16 Flush Plug (for 2 & 6 piston)
5	❖ DA5999900SR	1	1/8 NPT Relief Valve
6	❖ CCA625028-1A	6	SHCS M6x1.0x30

❖ Items included in Repair Kit DC9279900SR (use for 2, 3 or 6 piston)

(ZE, ZG and ZW Series - Steel Top Plate - Date Code D only)			
Repair Parts List for Figure 2B (see graphic above)			
Item	Part Number	Qty.	Description
1	⑥ DC8350101	1	Top Plate 6 Piston (steel)
	②③ DC8351101	1	Top Plate 2 and 3 Piston (steel)
2	②③⑥ DC9026155	1	Bearing, Needle 40x47x12
3	②③⑥ DC9027776	1	Oil Lip Seal 40x52x5
4	③ A1006245	2	1/16 Flush Plug (for 3 piston)
	②⑥ A1006245	3	1/16 Flush Plug (for 2 & 6 piston)
5	②③⑥ DA5999900SR	1	1/8 NPT Relief Valve
6	⑥ CCA625028-1A	6	SHCS M6x1.0x30

② Items included in Repair Kit DC9281900SR (2 piston)

③ Items included in Repair Kit DD1121900SR (3 piston)

⑥ Items included in Repair Kit DC9278900SR (6 piston)

IMPORTANT: ZE, ZG and ZW Series pumps with pump element date code A, B or C:
New top plate and eccentric must be replaced as a set. Be sure to install ALL kit parts (see bottom of page).

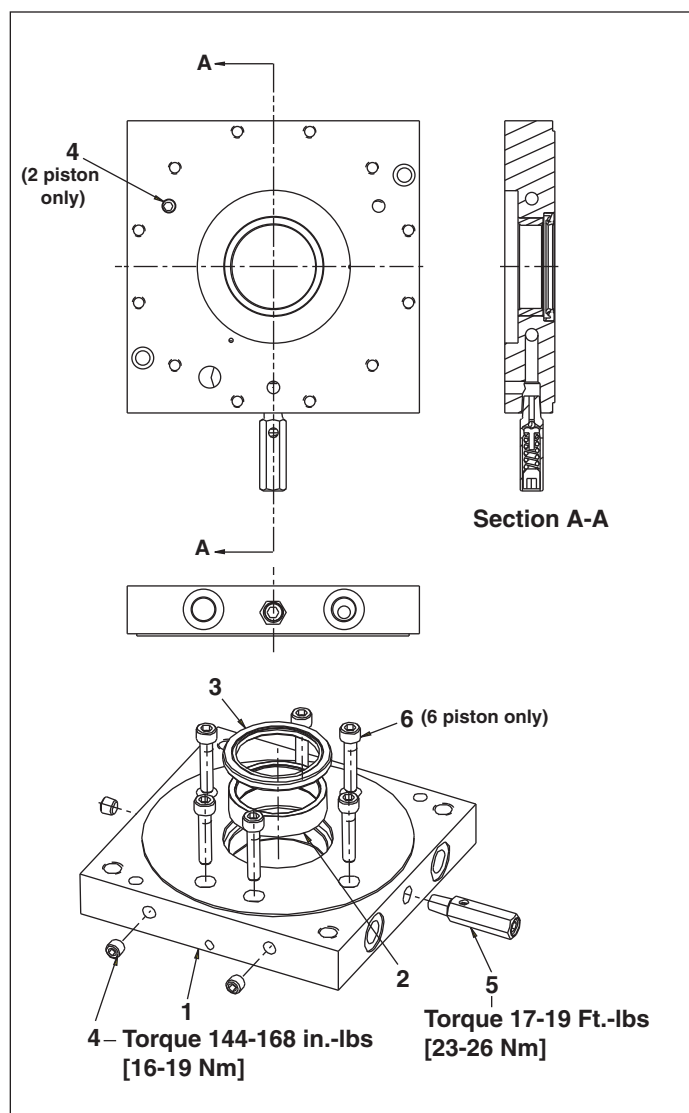


Figure 2B, Steel Top Plate Assembly for Direct Drive Motor (Replaces original aluminum top plate assembly - ZE, ZG and ZW Series - Date Codes A, B and C)

Repair Parts List for Figure 2B (see graphic above)			
Item	Part Number	Qty.	Description
1	⑥ DC8350101	1	Top Plate 6 Piston (steel)
	②② DC8351101	1	Top Plate 2 and 3 Piston (steel)
2	②②② DC9026155	1	Bearing, Needle 40x47x12
3	②②② DC9027776	1	Oil Lip Seal 40x52x5
4	③ A1006245	2	1/16 Flush Plug (for 3 piston)
	②② A1006245	3	1/16 Flush Plug (for 2 & 6 piston)
5	②②② DA5999900SR	1	1/8 NPT Relief Valve
6	③ CCA625028-1A	6	SHCS M6x1.0x30

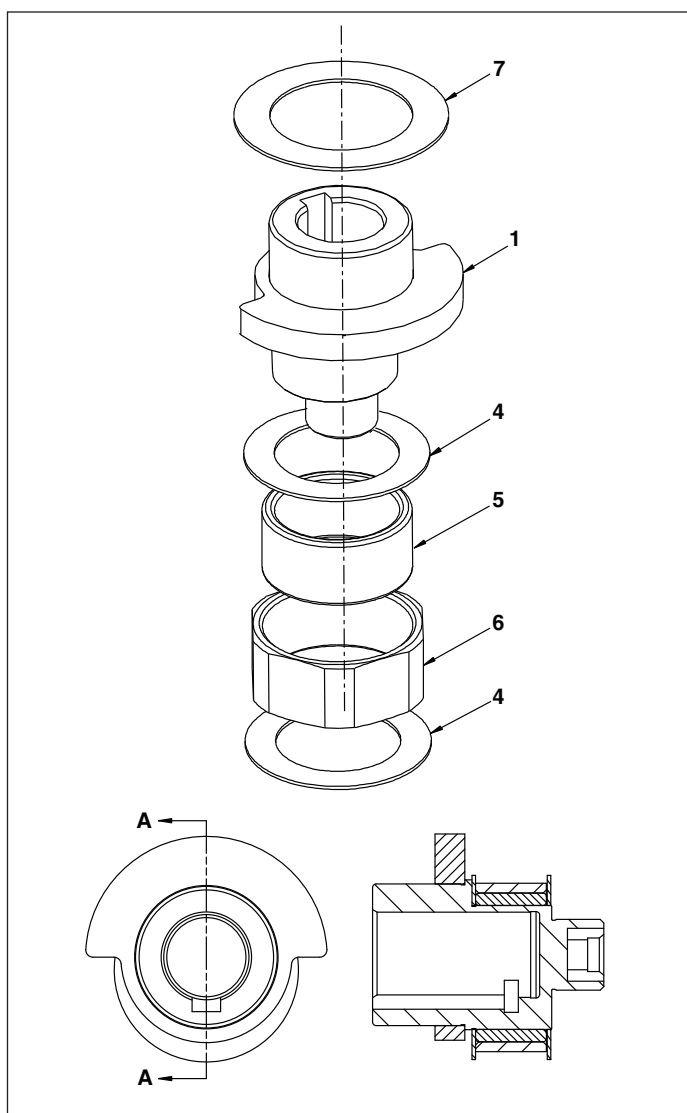


Figure 3B, Eccentric Assembly for Direct Drive Motor (Replaces original eccentric assembly - ZE, ZG and ZW Series - Date Codes A, B and C)

Repair Parts List for Figure 3B (see graphic above)			
Item	Part Number	Qty.	Description
1	②②② DC9214537	1	Eccentric, Induction
4	②②② BSS4725D	2	Ring
5	②②② DC4107155	1	Bearing, Needle 35x42x20
6	②②② DC4328350	1	Hex Cam
7	②②② DD1277108	1	Locating Washer

IMPORTANT: Locating washer (item 7) must be installed on all ZE, ZG and ZW Series pump elements that are being updated from aluminum to steel top plate assemblies. **Note:** Locating washer (item 7) is larger in diameter than rings (item 4). Be sure to install parts in correct locations.

Note: On ZE, ZG and ZW Series pump elements with date code A, B or C, the old aluminum top plate must be replaced with a new steel top plate, part number DC8350101 (6 piston) or DC8351101 (2 & 3 piston). The eccentric assembly must also be replaced when the top plate is replaced (old style eccentric assembly is not compatible with new top plate design). Repair kit required will vary, depending on pump model:

② Indicates items included in Repair Kit DD1319900SR – Use for 2 piston pump element, date codes A, B or C.

③ Indicates Items included in Repair Kit DD1320900SR – Use for 3 piston pump element, date codes A, B or C.

⑥ Indicates Items included in Repair Kit DD1321900SR – Use for 6 piston pump element, date codes A, B or C.

Discard all old top plate parts (items 1-6 of fig. 2B) and all old eccentric parts (items 1, 4, 5 and 6 of fig. 3B). Replace with new kit parts.

IMPORTANT: Failure to install all kit parts will result in permanent damage to pump. Such damage is not covered under warranty.

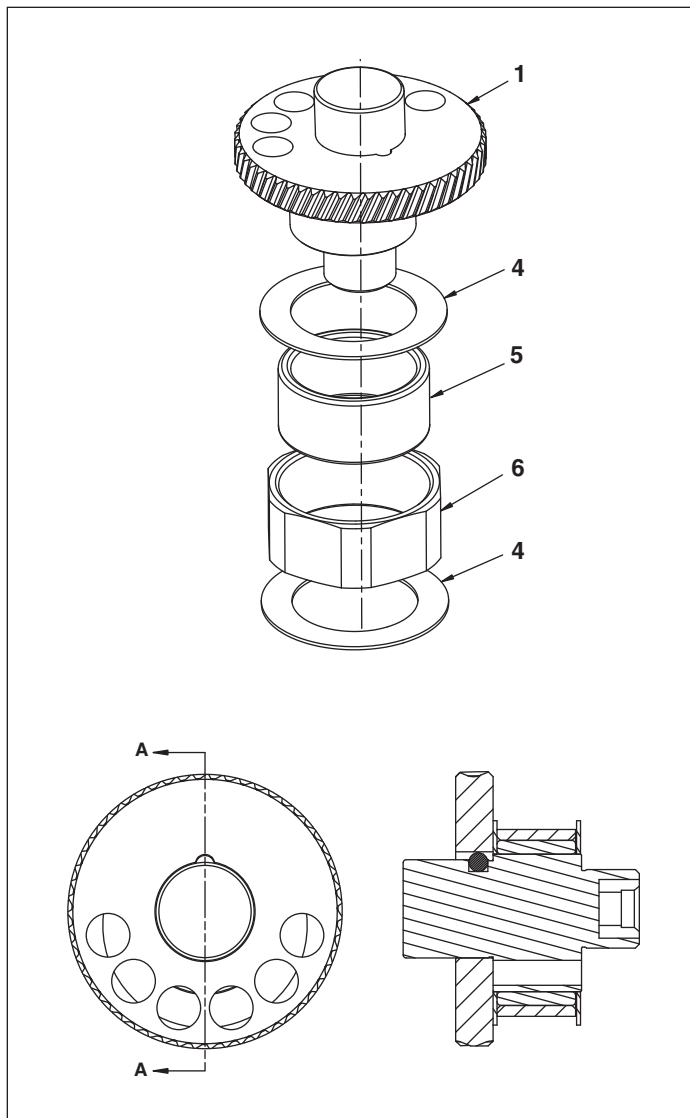


Figure 3A, Eccentric Assembly for Gear Reduction Motor (ZU Series - All Date Codes)

Repair Parts List for Figure 3A (see graphic above)			
Item	Part Number	Qty.	Description
1	★ (not sold separately)	1	Eccentric, Universal
4	★ BSS4725D	2	Ring
5	★ DC4107155	1	Bearing, Needle 35 x 42 x 20
6	★ DC4328350	1	Hex Cam

★ Items available as part of Eccentric Assembly kit DC9238900SR.

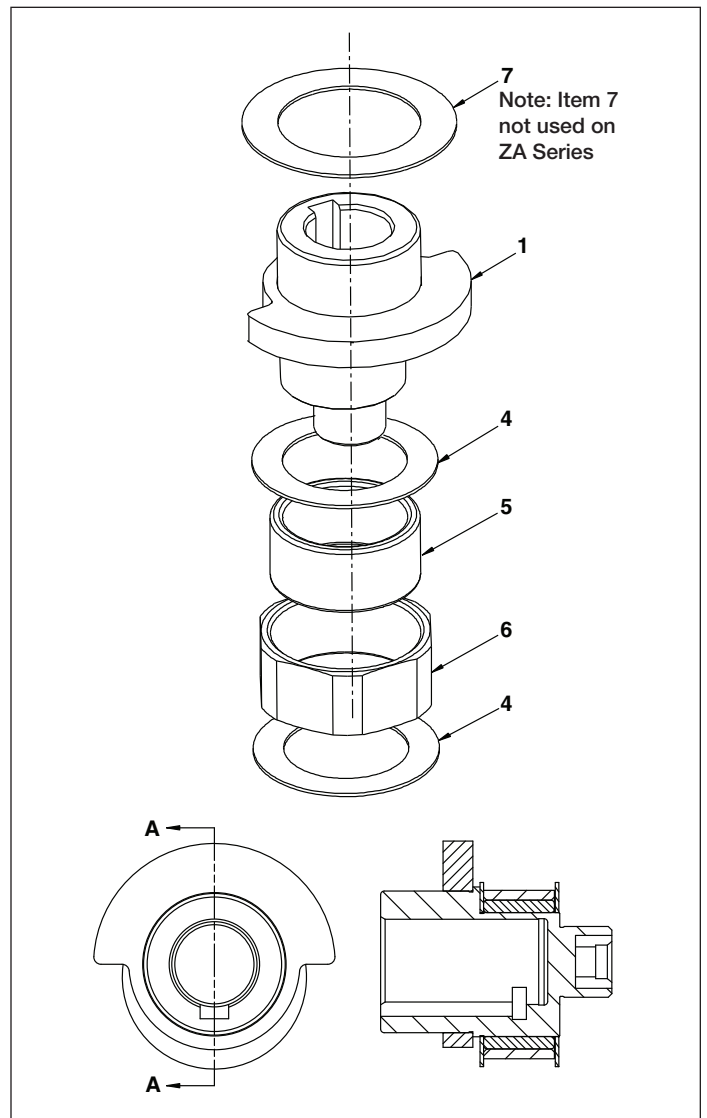


Figure 3B, Eccentric Assembly for Direct Drive (ZE, ZG and ZW Series - Date Code D Only) (ZA Series - All Date Codes)

Repair Parts List for Figure 3B (see graphic above)			
Item	Part Number	Qty.	Description
1	★ DC9214537	1	Eccentric, Induction
4	★ BSS4725D	2	Ring
5	★ DC4107155	1	Bearing, Needle 35 x 42 x 20
6	★ DC4328350	1	Hex Cam
7	★ DD1277108	1	Locating Washer (used on ZE, ZG and ZW only)

★ Items available as part of Eccentric Assembly kit DC9215900SR.

Note: Locating washer (item 7) is used on all ZE, ZG and ZW pumps with date code D. Locating washer (item 7) is NOT USED on ZA Series pump elements.

Note: Locating washer (item 7) is larger in diameter than rings (item 4). Be sure to install parts in proper locations.

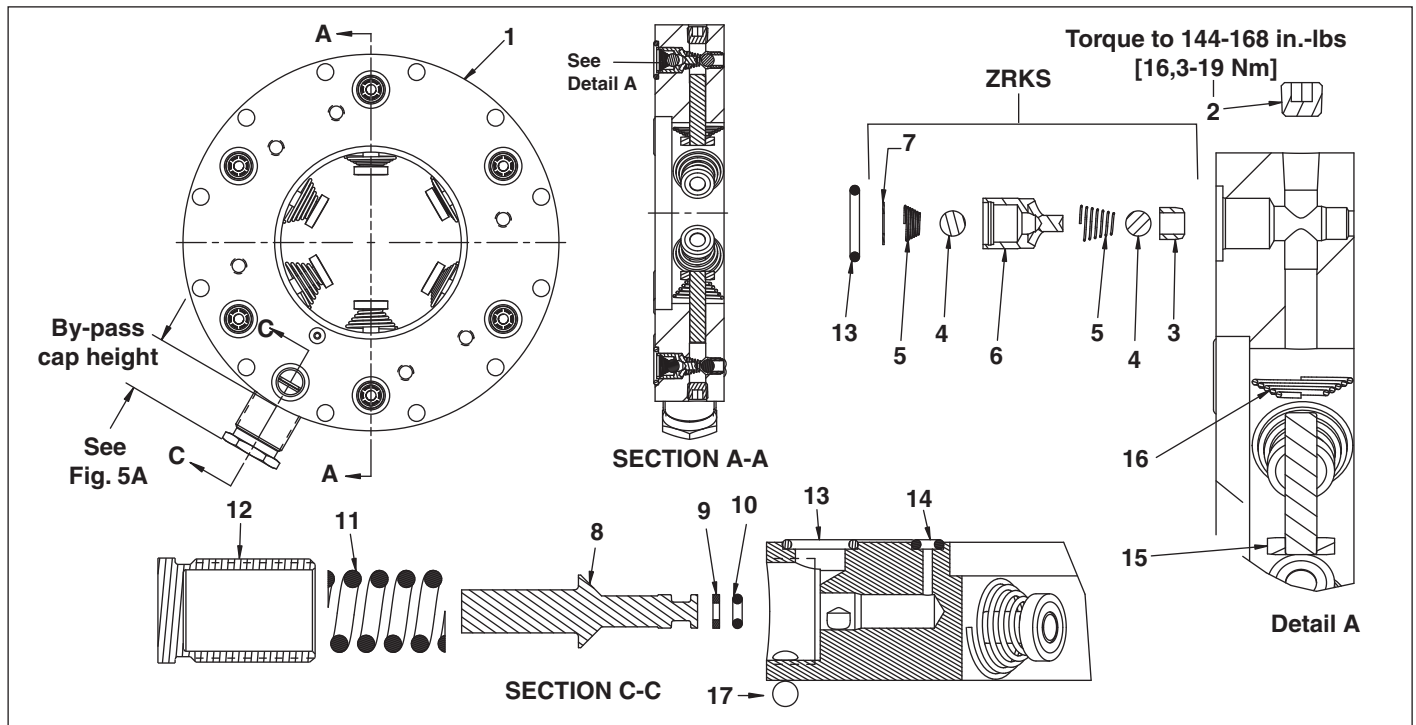


Figure 4, Piston Ring Assembly (6 Piston Shown)

Repair Parts List for Figure 4 (Note: part quantities will vary - quantities for 6 piston shown)

Item	Part Number	Qty.	Description	Item	Part Number	Qty.	Description
1	DC9294101	1	Piston Ring 2 Piston	9	★ B1006564	1	B/U Washer
	DC9221101	1	Piston Ring 3 Piston	10	★ B1006803	1	O-ring, 0.25" O.D.
	DC9216101	1	Piston Ring 6 Piston	11	※ DC394110	1	Spring
2	A1006245	6	1/16 Flush Plug	12	※ (See Figure 5A)	1	Bypass End Cap
3	† BSS5358D	6	Seat, Piston Inlet	13	★ B1013203	7	O-ring, Viton, 0.56" O.D.
4	† B1005016	12	3/16" Diameter Ball	14	★ B1005203	1	O-ring, Viton
5	† BSS5809D	12	Spring	15	DC9244920	6	Piston Assembly
6	† BSS5357D	6	Seat, Piston Outlet	16	BSS5509D	6	Spring
7	† BSS5356D	6	Retaining Ring	17	★ DC9293016	2	Ball Nylon 3/16"
8	DC9292051	1	Piston Bypass				

† Items included in and available only as a part of Piston Check Kit ZRKS. Each kit includes three sets of components. **Order two kits for six piston pumps.**

★ Items included in and available only as a part of Seal Kit ZRK.

※ Models built before October 2008: order a new bypass end cap when replacing spring. See Figure 5A for part numbers.

Notes: See Figure 4A for seat tool drawing. See Figure 5A for bypass cap height and piston ring assembly part number.

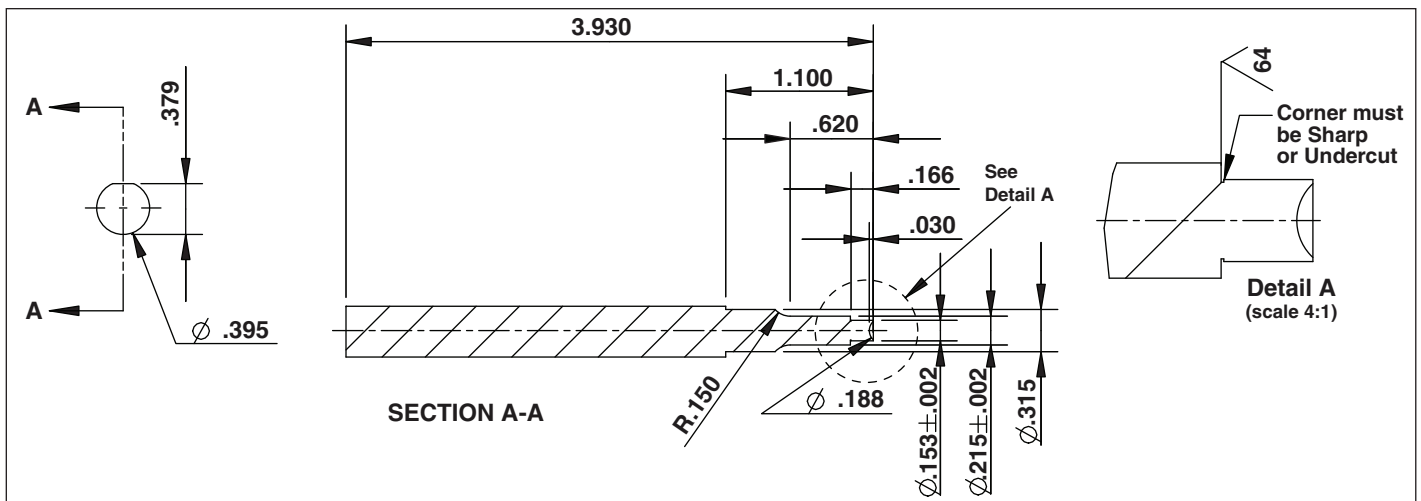


Figure 4A

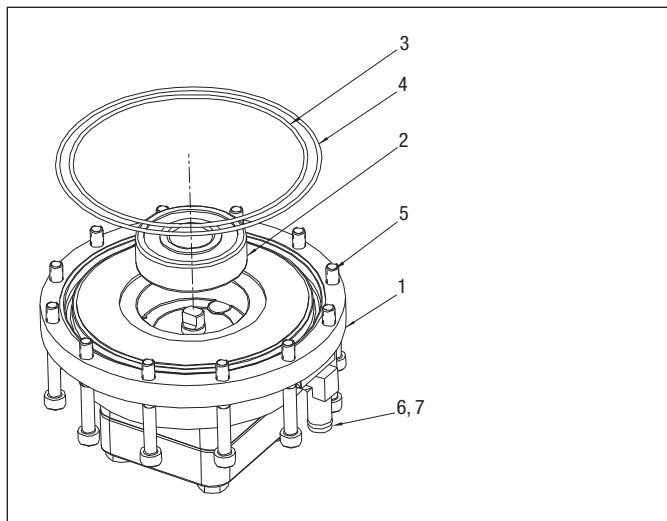


Figure 5, Gear Pump Assembly

Repair Parts List for Figure 5

Item	Part Number	Qty.	Description
1		1	Gear Pump
2	† DC9219155	1	Bearing Ball 20x52x15
3	★† B1400503	1	O-ring
4	★† B1402503	1	O-ring
5	CCA633028-1A	12	SHCS M6x1.0x50 (6 piston only)
6	✚ DC9638101	1	Intake Spacer
7	DC9642097	1	Intake Elbow

★ Items included in and available only as a part of Seal Kit ZRK.

† Items included in complete gear pump replacement kit.

See chart in Figure 5A.

✚ Intake spacer used only on pump elements with date codes "A" and "B".

Key to Figure 5A - By-Pass End Cap Height:

◆ Use bypass end cap DC9208020 (Figure 4, Item 12).

* Use bypass end cap DC8373020 (Figure 4, Item 12).

▲ Use bypass end cap DC8374020 (Figure 4, Item 12).

Figure 5A Specifications, Settings and Repair Kits

Pump Model	Pump Element Replacement Kit	Gear Pump Replacement Kit	Piston Ring Replacement Kit	By-Pass Setting (PSI)	By-Pass End Cap Height	Relief Valve Setting (PSI)
ZA4xxxxx	DC9705900SR 10KPSI	DC9298920SR	DC9222900SR	1425 - 1475	0.94" (23.9 mm) ◆	10300 - 10800
ZA4xxxTx-E	DC9706900SR 11.6KPSI	DC9298920SR	DC9222900SR	1425 - 1475	0.94" (23.9 mm) ◆	11700 - 12000
ZA4xxxTx-Q	DC9705900SR 10KPSI	DC9298920SR	DC9222900SR	1425 - 1475	0.94" (23.9 mm) ◆	10300 - 10800
ZE3xxxxx	DC9700900SR 10KPSI	DC9299920SR	DD1106900SR	825 - 875	0.99" (25.1 mm) ▲	10300 - 10800
ZE3xxxxx Single Stage	DC9703900SR 10KPSI	DC9296920SR	DC9282900SR	Not Applicable	0.99" (25.1 mm) ◆	10300 - 10800
ZE3xxxxx-E	DD1505900SR 11.6KPSI	DC9299920SR	DD1106900SR	825-875	0.99" (25.1 mm) ◆	11700 - 12000
ZE4xxxxx	DC9704900SR 10KPSI	DC9300920SR	DD1103900SR	1225 - 1275	0.95" (24.1 mm) *	10300 - 10800
ZE4xxxxx Single Stage	DC9709900SR 10KPSI	DC9296920SR	DC9222900SR	Not Applicable	0.99" (25.1 mm) ◆	10300 - 10800
ZE4xxxxx-E	DD1506900SR 11.6KPSI	DC9300920SR	DD1103900SR	1225 - 1275	0.95" (24.1 mm) *	11700 - 12000
ZE5xxxxx	DC9710900SR 10KPSI	DC9301920SR	DD1101900SR	1100 - 1150	0.96" (24.4 mm) *	10300 - 10800
ZE5xxxxx-E	DD1507900SR 11.6KPSI	DC9301920SR	DD1101900SR	1100 - 1150	0.96" (24.4 mm) *	11700 - 12000
ZE5xxxxx Single Stage	DC9713900SR 10KPSI	DC9296920SR	DC9217900SR	Not Applicable	0.99" (25.1 mm) *	10300 - 10800
ZE6xxxxx	DC9715900SR 10KPSI	DC9299920SR	DC9217900SR	2400 - 2450	0.85" (21.6 mm) ◆	10300 - 10800
ZE6xxxxx Single Stage	DC9713900SR 10KPSI	DC9296920SR	DC9217900SR	Not Applicable	0.99" (25.1 mm) *	10300 - 10800
ZG5xxxxx	DD1123900SR 10KPSI	DC9298920SR	DC9222900SR	1600-1650	0.92" (23.4 mm) ◆	10300 - 10800
ZG5xxxxx-B	DC8143900SR 10KPSI	DC9296920SR	DC9222900SR	1600-1650	0.92" (23.4 mm) ◆	10300 - 10800
ZG6xxxxx	DC9715900SR 10KPSI	DC9299920SR	DC9217900SR	2400 - 2450	0.85" (21.6 mm) ◆	10300 - 10800
ZU4xxxxx	DC9707900SR 10KPSI	DC9299920SR	DD1103900SR	1050 - 1100	0.96" (24.4 mm) *	10300 - 10800
ZU4xxxTx-E	DC9708900SR 11.6KPSI	DC9299920SR	DD1103900SR	1050 - 1100	0.96" (24.4 mm) *	11700 - 12000
ZU4xxxTx-Q	DC9707900SR 10KPSI	DC9299920SR	DD1103900SR	1050 - 1100	0.96" (24.4 mm) *	10300 - 10800
ZW3xxxxx	DD1491900SR 5KPSI	DC9296920SR	DD1492900SR	1400 - 1450	0.93" (23.6 mm) ▲	5300 - 5600
ZW4xxxxx	DC9717900SR 5KPSI	DC9298920SR	DD1103900SR	1100 - 1150	0.96" (24.4 mm) *	5300 - 5600
ZW4xxxxx Single Stage	DC9718900SR 5KPSI	DC9296920SR	DC9222900SR	Not Applicable	0.99" (25.1 mm) ◆	5300 - 5600
ZW5xxxxx	DC9714900SR 5KPSI	DC9300920SR	DD1101900SR	1025 - 1075	0.99" (25.1 mm) *	5300 - 5600
ZW5xxxxx Single Stage	DC9719900SR 5KPSI	DC9296920SR	DC9217900SR	Not Applicable	0.99" (25.1 mm) ◆	5300 - 5600

1.0 FIRST STAGE, LOW PRESSURE - HIGH FLOW

1st stage = low pressure – high flow

- By-pass valve is closed.
- All low-pressure gear pump flow is routed through the high-pressure pistons inlet and outlet checks, (up to six sets) and then out the pressure port.

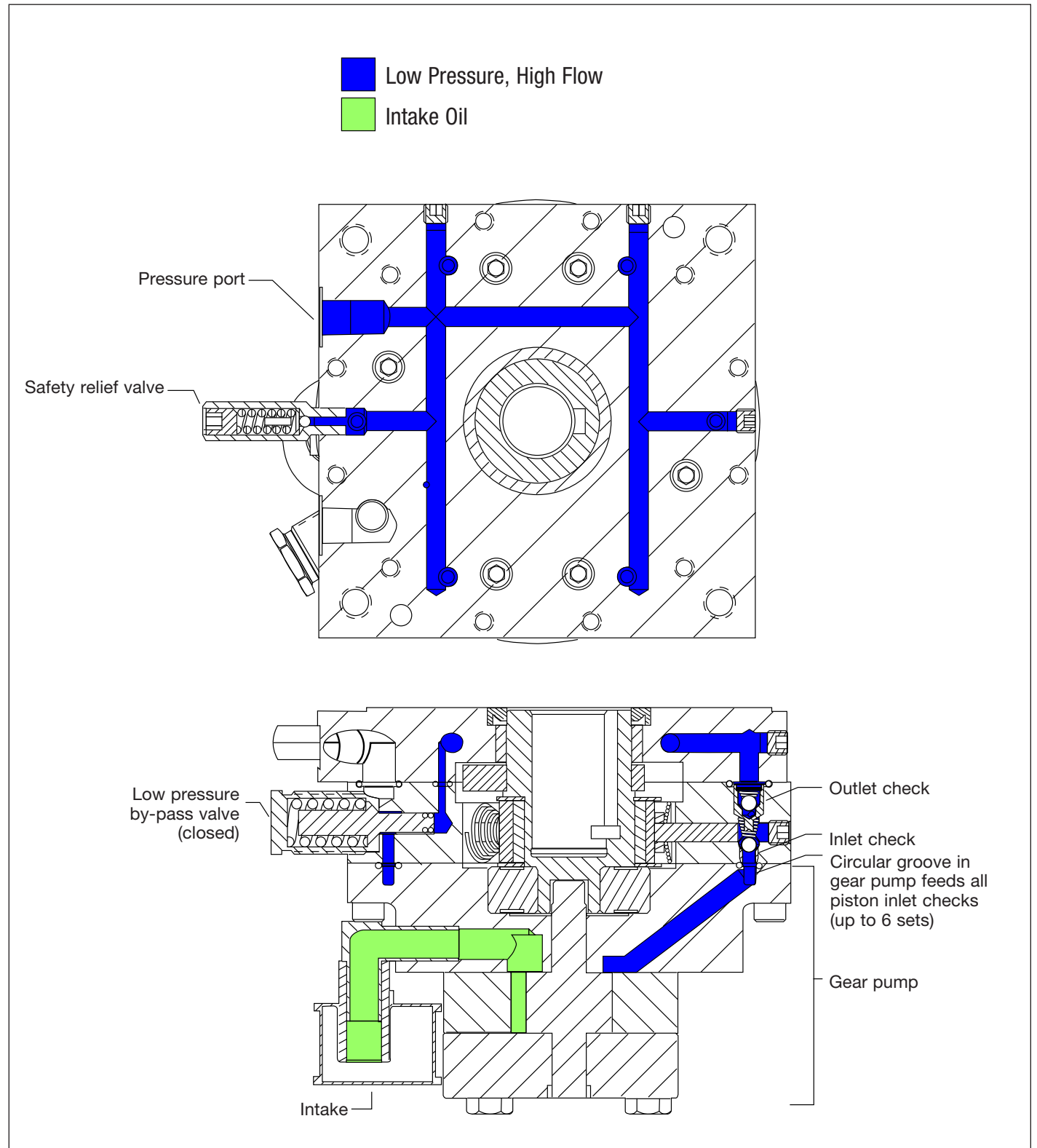


Figure 6

2.0 SECOND STAGE, HIGH PRESSURE - LOW FLOW

2nd stage = high pressure – low flow

- By-pass opens at pre-set pressure.
- Low pressure, gear pump flow, supercharges high pressure pistons. Remaining gear pump oil returns to tank via the by-pass valve.
- Eccentric driven piston reciprocates to build high pressure.

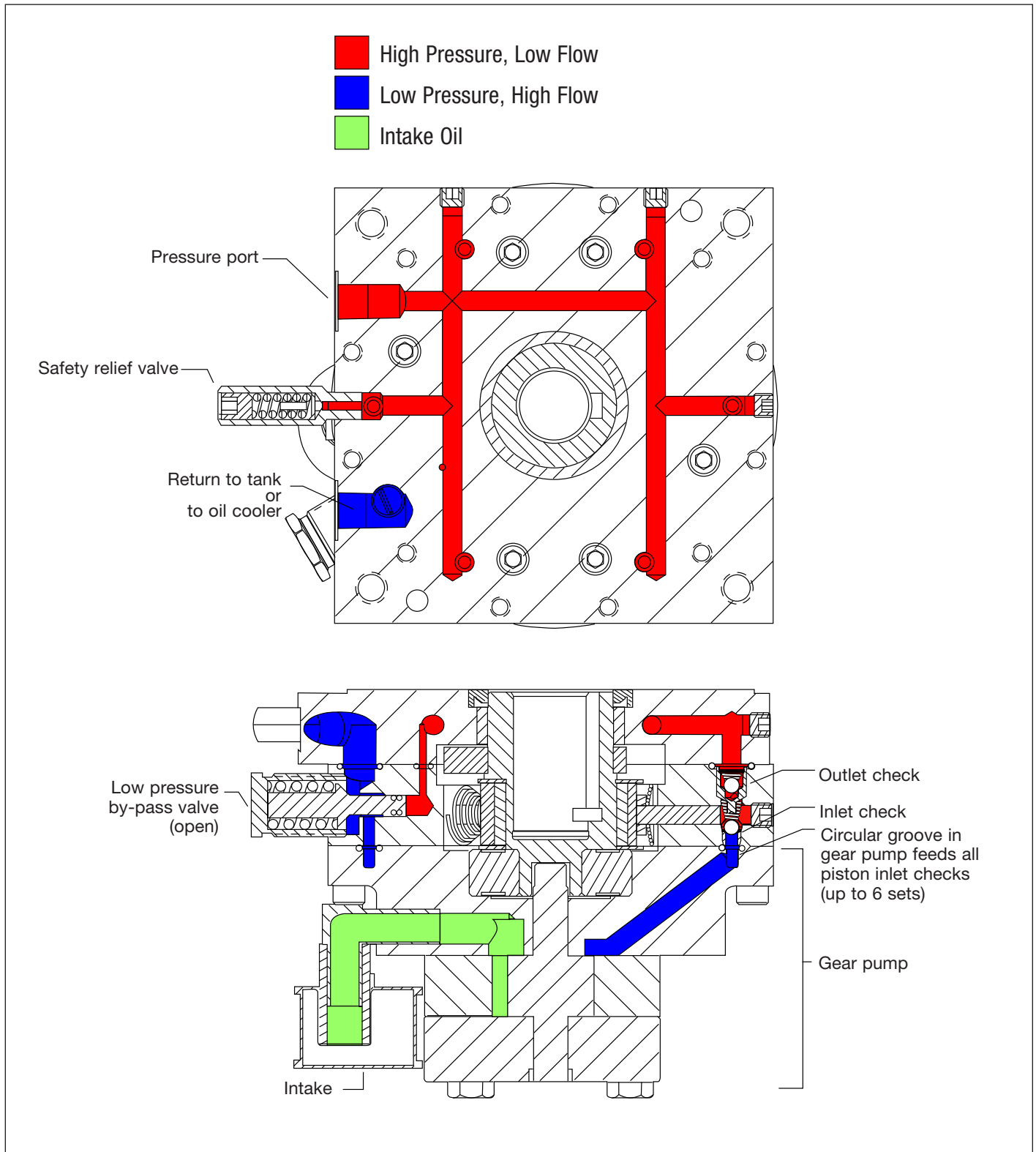


Figure 7

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SERVICE INSTRUCTIONS: These Service instructions are intended to be used by qualified personnel at Authorized Enerpac Service Centers. Users of Enerpac equipment should see the pump Instruction Sheet for installation, operation, and maintenance information.

■ REQUIRED TOOLS AND TEST EQUIPMENT:

- ✓ Hydraulic hand pump capable of 10,000 psi
- ✓ Test bench with sump, ammeter, V152 valve, flow meter, and test cylinder
- ✓ High pressure gauge (0-15,000 psi)
- ✓ High pressure hose (10,000 psi working pressure rating)
- ✓ Torque wrench (torque rating)
- ✓ Magnet to remove check balls
- ✓ O-ring pick
- ✓ Flat bottom punch 5/32"

- ✓ Flat bottom punch 11/64"
- ✓ White Assembly grease
- ✓ Allen wrench 5 mm
- ✓ Enerpac Hydraulic Oil
- ✓ VM2, 3 way, 2 position, directional control valve
- ✓ Hydraulic press
- ✓ Seat assembly tool #DC9505816 (drawing available from Enerpac)
- ✓ Retaining Ring Tool #AT0229 (drawing available from Enerpac)

1.0 TROUBLESHOOTING

Problem	Possible Cause	Action
Motor current draw is excessive or trips circuit breaker.	a) Low voltage at pump. b) Defective motor. c) Bypass valve malfunction. d) Damaged or worn gear pump. e) Power cord damaged or wiring incorrect.	a) Check voltage at pump while pump is at operating pressure. If below 90% of rated line voltage replace extension cord with heavier gauge and/or move to another electric circuit. b) Remove the motor. Test and replace if necessary. c) Inspect, test, and adjust the bypass valve. Replace or rebuild if required. d) Remove and inspect the gear pump. Replace if necessary. e) Replace or repair as necessary.
Pump runs and delivers flow, but will not build pressure.	a) Defective or misadjusted external relief valve. b) Oil leaks from one or more components within the reservoir. c) Valve malfunction or improper adjustment. d) Bypass valve worn.	a) Inspect the relief valve. Reset or replace if required. b) Perform the back-pressure test. c) Adjust or repair. d) Remove and inspect the bypass valve. Rebuild or replace if necessary.
Low or no flow at 0 psi.	a) Motor rotation reversed (3-phase only). b) Bypass valve is malfunctioning. c) Pump component parts are leaking. d) Oil intake screen is clogged with debris. e) Gear pump malfunction. f) Direction valve malfunction or improper adjustment.	a) Reverse 2 of 3 motor wire connections. b) Remove and inspect the bypass valve. Rebuild or replace if necessary. c) Perform the backpressure test to isolate leaks. d) Remove the pump from the reservoir and inspect the intake screen. Flush components of contamination. Replace damaged components and hydraulic oil. e) Disassemble the pump and inspect the gear pump. Replace if necessary. f) Adjust or repair.
Pump fails to maintain pressure.	a) Defective directional valve. b) Defective final outlet check. c) Oil leaks from one or more components within the pump assembly or valve assembly.	a) Repair or replace. b) Repair or replace. c) Remove the pump from the reservoir and perform the back-pressure test outlined in test procedure.



IMPORTANT: To avoid unnecessary service, the pump should be tested prior to any service work. Please refer to Test Procedures and Troubleshooting sections.

These service instructions only cover the basic pump portion of the entire pump assembly and are not all-inclusive. Certain assumptions are made throughout the document, that the technician is capable of identifying worn parts and has the proper equipment to perform the required repairs and tests.

For information regarding the rest of the pump assembly, please refer to the repair parts sheet for your specific unit.

2.0 DISASSEMBLY

2.1 Disassemble Hydraulic Pump Assembly

1. Be sure pump is disconnected from power source before disassembling.
2. Remove pump from the cover plate.
3. Remove the intake filter by pulling on the end closest to the pump. Be careful not to pull on the mesh screen or it may be damaged.
4. If the pump is a 6-piston pump (note the number of flush plugs in the piston ring) you will first need to remove the 6 screws (Fig. 2b, item 6) that are on the top of the pump with a 5 mm Allen wrench.
5. Now remove the 12 screws (Fig. 5, item 5) on the bottom of the pump using a 5 mm Allen wrench.
6. Pull up on the gear pump assembly (Fig. 1, item 4) to remove it from the piston ring. Check the condition of the two O-rings that are between the gear pump and the piston ring.
7. Remove the top ring (Fig. 3, item 4).
8. Pull up on the piston ring assembly (Fig. 1, item 3) to remove it from the pump. Note: The hex cam may come off with the assembly. This will hold the pistons in if you do not need to service them
9. Remove the eccentric assembly (Fig. 1, item 2) from the top plate. Check for signs of wear on the eccentric. If there is material missing from the bearing areas the eccentric assembly needs to be replaced. Also check the ID of the hex cam for wear.
10. If present, remove locating washer (Fig. 3B, item 7).

2.2 Disassemble Piston Ring Assembly (Refer to Figure 4.)

1. Remove the hex cam (Fig. 3, item 6) from the piston ring assembly (Fig. 1, item 3). Note: Be careful, since the pistons are spring loaded and they may come out abruptly.
2. Remove pistons (item 15) and spring (item 16).
3. Disassemble the bypass valve by removing the bypass end cap (item 12) with a 13/16 inch [21 mm] wrench. Once the bypass end cap is removed pull out the spring (item 11) and piston (item 8).
Note: If piston cannot be removed with fingers try using pliers (use soft jaws so the piston does not get damaged).
4. Check to make sure that the back-up (item 9) and O-ring (item 10) on the bypass piston (item 8) are both in good condition.
5. Before the check valves are disassembled there are some checks that should be done to determine if the check valves are bad.

This is quick way to verify the integrity of your check valves.

The piston ring assembly (Fig. 1, item 3) should still have oil on it from the disassembly. If the piston ring is dry you should insert oil into the piston bores before putting the piston into the bore. With the piston ring assembly (Fig. 1, item 3) in your hands, install one piston (item 15) and spring (item 16) into a

piston bore. While covering the outlet O-ring (item 13) with your thumb slowly push the piston (item 15) into the bore. Watch the intake seat (item 3) to see if oil and air are bubbling out. If the intake seat is good you will not notice anything coming out of the intake seat (item 3) and you will have a high pressure trying to push your thumb off of the outlet o-ring.

To check the outlet seat (item 6), cover up the inlet seat (item 3) with your thumb. Slowly push the piston (item 15) into the piston bore, the outlet seat (item 6) may spray oil so take care to point it away from you. Once the piston is pushed all the way in let go of the piston. Watch the outlet seat (item 6) to see if oil and air are bubbling around the ball (item 4). If the outlet seat is working correctly there should be no oil/air movement around the outlet ball and the intake seat should create a strong vacuum on your thumb.

This is the more detailed way to verify the integrity of your check valves and should only be performed by an experienced technician. These operations are time consuming and difficult and should be performed only if absolutely necessary.

Remove all the pistons from the piston ring. Remove the eccentric assembly from the top plate. Install the piston ring onto the top plate with 12, M6x1.0x35, bolts (Enerpac P/N CCA627028-1A). Torque the bolts to 120-144 in-lbs (13.5-16 Nm). If this is a 6 piston pump turn the pump over and reinstall the 6 bolts (Fig. 2, item 6) into the top plate at 120-144 in-lbs (13.5-16 Nm). Run a back pressure test up to 5,000 psi and watch to see if any oil comes out of the piston bores. This will show if you have any bad outlet checks that need to be replaced.

The check for the inlet seats is complicated and should be avoided. The eccentric assembly (Fig. 1, item 3) needs to be installed in the top plate assembly (Fig. 1, item 1). All of the pistons (item 15) need to be installed in the piston ring (item 1). Install the piston ring assembly (Fig. 1, item 2) onto the top plate with 12, M6x1.0x35, bolts (Enerpac P/N CCA627028-1A). Leave the gear pump assembly (Fig. 1, item 4) off so that the intake seats are visible. Torque the bolts to 120-144 in-lbs (13.5-16 Nm). If this is a 6 piston pump turn the pump over and reinstall the 6 bolts (Fig. 2, item 6) into the top plate at 120-144 in-lbs (13.5-16 Nm). The plug on the outside of the piston ring needs to be removed with a 5/32nd [4 mm] Allen wrench. A 1/16th NPT fitting needs to be installed in the port and hooked to a hand pump, Enerpac P/N CK911032 can be used in conjunction with a 10,000 psi hose. Turn the eccentric so that the piston that is going to be tested is in the bore as deep as possible. The outlet from the pump assembly needs to be plugged. Back pressure into the port at 5000 psi and check to see if oil comes out of the inlet check. This process needs to be repeated for all of the pistons. When the testing is done for one of the ports the plug needs to be reinstalled at 144-168 in-lbs [16.3-19 Nm].

If a check valve is damaged it can be replaced.

Check Valve Removal

1. Set piston ring assembly in a bench press with the o-ring grooves on the bottom. Make sure that there is clearance in the bench vice support for the check valve to be pushed out.
2. Insert a punch that is 5/32nd (4 mm) or smaller into the intake hole. The punch should go through the intake seat and rest on the check ball. Push on the punch with a maximum of 2000 lbs [907 kg]. This will push the outlet check assembly out in one piece and will push out the ball and spring for the inlet check valve.
3. Instead of removing the intake seats the damaged seats can be reworked using methods such as a ball hone.
4. Remove the inlet seat (Fig. 4, item 3) by using a 11/64" flat bottom punch. This operation can damage the piston ring if the punch is not the correct diameter. Place the punch on the inlet seat and apply a maximum of 2000 lbs [907 kg] with a bench press to drive the punch down.

Note: With this procedure both seats will likely be damaged and will need to be replaced.

2.3 Disassemble Gear Pump

Note: Only disassemble the gear pump as a last resort, after all other options have been tried. Contamination and damage to the internal parts of the gear pump can cause the pump to fail. Parts are not sold separately for the gear pump. If the pump is damaged, the complete assembly has to be changed.

1. Remove the 5 hex screws with a 1/2 inch [13 mm] socket. It is recommended that the gear pump be taken apart while the rest of the pump is assembled so there is a way to secure it.
2. Remove the end plate from the gear pump. Check for signs of wear or contamination.
3. The gears can be removed from the gear pump to check for wear but note the orientation of the gears for re-assembly.

3.0 ASSEMBLY

3.1 Assemble Gear Pump

1. Insert drive gear and driver gear into gear pump assembly, make sure tang drive is protruding in the middle of the bearing.
2. Position the top gear pump housing and secure with 5 hex cap screws at 13 ft-lbs. Tighten in an alternating sequence.
3. Install oil in the O-ring grooves on the bottom of the gear pump to help hold the O-rings in place. Place the two O-rings (Fig. 5, item 3, 4) into the grooves.

3.2 Assemble Piston Ring Assembly

1. Insert inlet seat (Fig. 4, item 3) into piston ring assembly (Fig. 4, item 1) by using tool DC9505816 and a hydraulic press. Use a maximum force of 1500 pounds—**WARNING: if this force is exceeded the piston ring will be damaged.**
2. Place check ball (Fig. 4, item 4) onto inlet seat (Fig. 4, item 3) and apply a maximum of 1500 lbs. of force by using tool DC9505816 and a hydraulic press to coin the seat.
3. Next insert spring (Fig. 4, item 5) on top of ball (Fig. 4, item 4). Make sure the small end of the spring rests on the ball. (See Fig. 4.)
4. Place upper check valve (Fig. 4, item 6) into piston ring (Fig. 4, item 1).

5. Place check ball (Fig. 4, item 4) on outlet seat (Fig. 4, item 6) and apply 1500 lbs. of force by using tool DC9505816 and a hydraulic press. Note: This will install and coin the outlet seat in one operation.
6. Place spring (Fig. 4, item 5) on outlet check ball (Fig. 4, item 4). Make sure the small end of the spring rests on the ball. (See Fig. 4). Repeat this 2, 3 or 6 times as required.
7. The retaining ring (Fig. 4, Item 7) is slightly convex and should be installed with the concave side on top. Carefully compress the spring with the retaining ring making sure to keep the spring in the upper check. Press the retaining ring in with the retaining ring tool. The retaining ring tool will set the depth of the retaining ring. If the retaining ring is installed too deep or at angle it may need to be lightly pried out to make it even. When installed properly the retaining ring should rotate in the outlet check.
8. Place back-up washer (Fig. 4, item 9) onto the by-pass piston (Fig. 4, item 8). Next install the O-ring (Fig. 4, item 10) onto the bypass piston. This order is critical to the operation of the bypass, see Figure 4 for reference. Make sure the back-up washer is tightly wrapped around the piston so that it does not get damaged when installing it in the piston ring.
9. Lube the o-ring and backup, then carefully insert by-pass piston (Fig. 4, item 8) with back-up washer and O-ring into by-pass hole in piston ring assembly. Place spring (Fig. 4, item 11) over the by-pass piston. Next thread by-pass end cap (Fig. 4, item 12) into the piston ring. Install by-pass end cap to the depth specified in the Test Specification Table (see page 11).
10. Insert piston (Fig. 4, item 15) assembly into narrow end of piston spring (Fig. 4, item 16).
11. Insert piston (Fig. 4, item 15) and spring into piston ring (Fig. 4, item 1). Repeat this 2, 3 or 6 times as required.
12. Install O-rings (Fig. 4, item 13) into piston ring outlet holes. Repeat this 3, 4 or 7 times as required.
13. Place small O-ring (Fig. 4, item 14) into by-pass pilot hole.
14. Place two nylon balls (Fig. 4, item 17) into piston ring assembly.

3.3 Assemble Hydraulic Pump Assembly

1. Place fully assembled top plate assembly on table with shaft seal on the bottom.
2. If used, place locating washer (Fig 3B, item 7) into recessed area of top plate (Fig. 1, item 1). Align center hole with bore.

IMPORTANT:

Locating Washer (Fig. 3B, item 7) must be installed on:

- ZE, ZG and ZW pump elements with date code D.
- ZE, ZG and ZW Series pump elements (date code A, B or C) that are being updated from the original aluminum top plate to the new steel top plate.

DO NOT install Locating Washer (Fig. 3B, item 7) on:

- ZA Series pump elements (all date codes).
 - ZE, ZG and ZW Series pump elements (date code A, B or C) with the original aluminum top plate that are NOT being updated to the new steel top plate.
3. Carefully insert eccentric (Fig. 3, item 1) into the top plate (Fig. 1, item 1). On direct drive units place oil on eccentric shaft to ease insertion through shaft seal.

TEST SPECIFICATION TABLE

Pump Element Number	By-pass Pressure at Max. Amp PSI [Bar]	Internal Safety Relief Valve PSI [Bar]	1st Stage Flow in³/rev [mL/rev]	2nd Stage Flow in³/rev [mL/rev]	By-pass Cap Height in [mm]
DC8143900	1625 [112]	10,300 [710] - 10,800 [745]	0.11 [1.8]	0.07 [1.15]	.92 [23.4]
DC9700900	850 [58.6]	10,300 [710] - 10,800 [745]	0.252 [4.13]	0.023 [0.38]	.99 [25.1]
DC9703900	(Not Applicable)	10,300 [710] - 10,800 [745]	0.023 [0.38]	0.023 [0.38]	.99 [25.1]
DC9704900	1250 [86.2]	10,300 [710] - 10,800 [745]	0.37 [6.06]	0.035 [0.57]	.95 [24.1]
DC9705900	1450 [100]	10,300 [710] - 10,800 [745]	0.192 [3.15]	0.035 [0.57]	.94 [23.9]
DC9706900	1450 [100]	11,700 [807] - 12,000 [827]	0.192 [3.15]	0.035 [0.57]	.94 [23.9]
DC9707900	1075 [74.1]	10,300 [710] - 10,800 [745]	0.252 [4.13]	0.035 [0.57]	.96 [24.4]
DC9708900	1075 [74.1]	11,700 [807] - 12,000 [827]	0.252 [4.13]	0.035 [0.57]	.96 [24.4]
DC9709900	(Not Applicable)	10,300 [710] - 10,800 [745]	0.035 [0.57]	0.035 [0.57]	.99 [25.1]
DC9710900	1125 [77.6]	10,300 [710] - 10,800 [745]	0.479 [7.85]	0.07 [1.15]	.96 [24.4]
DC9713900	(Not Applicable)	10,300 [710] - 10,800 [745]	0.07 [1.15]	0.07 [1.15]	.99 [25.1]
DC9714900	1050 [72.4]	5300 [365] - 5600 [386]	0.37 [6.06]	0.07 [1.15]	.99 [25.1]
DC9715900	2425 [167.2]	10,300 [710] - 10,800 [745]	0.252 [4.13]	0.07 [1.15]	.85 [21.6]
DC9717900	1125 [77.6]	5300 [365] - 5600 [386]	0.192 [3.15]	0.035 [0.57]	.96 [24.4]
DC9718900	(Not Applicable)	5300 [365] - 5600 [386]	0.035 [0.57]	0.035 [0.57]	.99 [25.1]
DC9719900	(Not Applicable)	5300 [365] - 5600 [386]	0.07 [1.15]	0.07 [1.15]	.99 [25.1]
DD1123900	1625 [112]	10,300 [710] - 10,800 [745]	0.192 [3.15]	0.07 [1.15]	.92 [23.4]
DD1491900	1425 [98.3]	5300 [365] - 5600 [386]	0.11 [1.80]	0.023 [0.38]	.93 [23.6]
DD1505900	850 [58.6]	11,700 [807] - 12,000 [827]	0.252 [4.13]	0.023 [0.38]	.99 [25.1]
DD1506900	1250 [86.2]	11,700 [807] - 12,000 [827]	0.37 [6.06]	0.035 [0.57]	.95 [24.1]
DD1507900	1125 [77.6]	11,700 [807] - 12,000 [827]	0.479 [7.85]	0.07 [1.15]	.96 [24.4]

NOTE: the pump element number is stamped into the top plate.

- Install one ring (Fig. 3 Item 4) onto eccentric.
- Install needle bearing (Fig. 3 Item 5) onto eccentric.
- Insert hex cam (Fig. 3, Item 6) into piston ring assembly so that it is centered and in contact with all piston heads. Make sure the piston heads rest on a flat section of the hex cam.
- Install piston ring assembly with the o-rings on the bottom onto the top plate assembly being careful to slide hex cam over eccentric bearing. The by-pass end cap needs to be oriented over the by-pass port in top plate (note the orientation of the bypass on Figure 1).
- Place ring (Fig. 3, Item 4) onto eccentric assembly. The hex cam may need to be pushed down so the ring is flush with the top of the eccentric.
- Place the gear pump assembly onto the eccentric assembly. The gear pump may need to be rotated to fully engage the shaft. Use caution to make sure the O-rings do not fall off the gear pump during this operation. Once the gear pump is in contact with piston ring rotate the gear pump until the inlet filter is directly above the relief valve (Fig. 2, item 5).
Note: Do not force the gear assembly onto the eccentric assembly. If it requires a lot of force, check for misalignment or damage.
- Install the 12 gear pump mounting capscrews and torque to 120-144 in-lbs. of torque using a crossing pattern.
- On 6 piston pumps turn pump over and install 6 capscrews (Fig. 2, item 6), tighten in an alternating sequence to a 120-144 in-lbs. of torque.

4.0 TEST PROCEDURE

4.1 Back Pressure Test

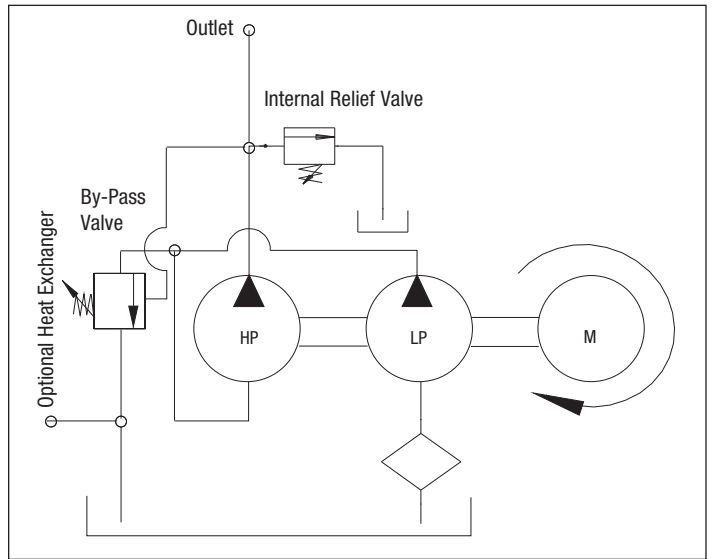
- Remove the existing valve from the pump and install a VM-2 valve in its place (NOTE: this is required due to the presence of an internal check valve in most other valve models).
- Remove the pump assembly from the reservoir and place it on a test bench, lying on its side so the bottom of the pump can easily be observed.
- Connect a 0-10,000 psi hand pump with a 0-15,000 psi pressure gauge to the VM-2 outlet. Fully close the VM-2 valve.
- Operate the hand pump to pressurize the pump to 85% of its maximum rated pressure while observing for any system leakage. Verify the pressure remains steady.
- If the pump safety relief opens before reaching 85% of maximum rated pressure, adjust the relief setpoint per 4.3 Safety Relief Valve Test.
- If the pressure fails to hold steady at 85% of maximum rated pressure, locate, isolate and correct the source of any system leakage.
- Release the system pressure and remove the hand pump, pressure gauge and VM-2 valve. Replace the original valve and restore the pump to its original condition.

4.2 Bypass Valve Test

1. Remove the pump assembly from the reservoir and place it on a test bench, lying on its side so the bottom of the pump can be easily observed.
2. Measure the bypass cap height shown in Figure 4. This dimension should closely match the value shown in the Test Specification Table.
3. Replace the pump assembly into a test bench sump or the pump reservoir.
4. Attach a V-152 relief valve to advance port of the valve on the pump. Install a 0-15,000 psi pressure gauge onto the extra V-152 port and a low restriction return hose to the bottom (tank port) of the V-152. Route the return hose back to the sump or reservoir.
5. Plug pump into an electrical power supply.
6. Place the pump valve in the advance position and fully open the V-152 valve (turning its handle counter-clockwise).
7. Start the pump motor.
8. Monitor the pump pressure and amperage while slowly closing the V-152 valve by turning its handle clockwise. The bypass valve should be set so that the maximum current draw at bypass pressure is the same or slightly below the current draw at the maximum rated pressure of the pump.
9. If an ammeter is not available, check the Test Specification Table for the approximate pressure setting of the bypass valve.
10. If the maximum current draw at bypass pressure exceeds that of maximum pressure, or if the bypass pressure is more than 200 psi off, adjust the bypass setting. Unplug the pump from its power supply, lift the pump assembly from the sump or reservoir and turn the bypass cap (Fig. 4, Item 12) (clockwise to increase the setpoint, counterclockwise to decrease). Repeat steps 5 through 10 until the proper bypass setting is reached.
11. Stop the pump motor and unplug the pump from its power supply. Remove the V-152 valve and pressure gauge and restore the pump to its original condition.

4.3 Safety Relief Valve Test

1. Remove the existing valve from the pump and install a VM-2 valve in its place (NOTE: this is required due to the presence of an internal check valve in most other valve models).
2. Remove the pump assembly from the reservoir and place it on a test bench, lying on its side so the bottom of the pump can easily be observed.
3. Connect a 0-10,000 psi hand pump with a 0-15,000 psi pressure gauge to the VM-2 outlet. Fully close the VM-2 valve.
4. Operate the hand pump and monitor the pressure gauge. Note the pressure at which the pump safety valve begins to relieve at.
5. If this value is outside the limits listed for the appropriate model in the Test Specification Table, adjust the setpoint by inserting a 5mm Allen wrench into the end of the relief valve and turning the adjustment screw (clockwise to increase the setpoint, counterclockwise to decrease). Repeat steps 4 and 5 until the proper setting is reached.
6. Release the system pressure and remove the hand pump and pressure gauge.



7. Replace the pump assembly into a test bench sump or the pump reservoir.
8. Attach a V-152 relief valve to advance port of the valve on the pump. Install the pressure gauge onto the extra V-152 port and a low restriction return hose to the bottom (tank port) of the V-152. Route the return hose back to the sump or reservoir.
9. Fully close the VM-2 valve and fully open the V-152 valve (turning its handle counter-clockwise).
10. Plug pump into an electrical power supply.
11. Start the pump motor.
12. Verify the safety valve relief setting by slowly closing the V-152 valve (turning its handle clockwise) and monitoring the system pressure.
13. If this value is outside the limits listed for the appropriate model in the Test Specification Table, repeat steps 2 through 12 until the proper setting is reached.
14. Stop the pump motor and unplug the pump from its power supply. Remove the V-152 valve, pressure gauge and VM-2 valve and restore the pump to its original condition.

5.0 FLOW TEST PROCEDURE

FLOW METER METHOD (requires test bench)

5.1 Low Pressure Flow Measurement

1. Connect an unrestricted hose from the advance port of the pump valve to the test bench flow meter supply. Route the flow meter return hose back to the return port of the pump valve (for 4 way valves) or the reservoir (for 3 way valves).
2. Plug the pump into an electrical power supply.
3. Start the motor and operate the pump in the advance mode for 30 seconds.
4. Check Test Specification Table. If pump does not meet 1st stage flow rating see Section 1.0 Troubleshooting.
5. Stop the pump motor and unplug the pump from its electrical power supply.
6. Disconnect the flow meter hoses from the pump and return the pump to its original condition.

5.2 High Pressure Flow Measurement

1. Attach a V-152 relief valve to advance port of the valve on the pump. Install a 0-15,000 psi pressure gauge onto the extra V-152 port and a low restriction return hose to the bottom (tank port) of the V-152.
2. Connect the hose from the V-152 valve to the test bench flow meter supply. Route the flow meter return hose back to the return port of the pump valve (for 4 way valves) or the reservoir (for 3 way valves).
3. Fully open the V-152 valve (turning its handle counter-clockwise).
4. Plug the pump into an electrical power supply.
5. Start the motor and operate the pump in the advance mode.
6. Monitor the system pressure and slowly close the V-152 valve by turning its handle clockwise until 85% of maximum pressure is reached.
7. Check Test Specification Table. If pump did not meet 2nd stage flow ratings see Section 1.0 Troubleshooting.
8. Stop the pump motor and unplug the pump from its electrical power supply.
9. Disconnect the flow meter hoses from the pump.
10. Remove the V-152 valve and pressure gauge and restore the pump to its original condition.

BEAKER METHOD

5.3 Low Pressure Flow Measurement

1. Verify sufficient oil exists inside the pump reservoir to complete this test.
2. Connect an unrestricted hose from the advance port of the pump valve to a graduated cylinder or beaker (ensure the container contains sufficient volume to complete the test – also take care that the initial flow oil flow surge will not tip it over or cause the hose to jump outside).
3. Plug the pump into an electrical power supply.
4. Start the motor and operate the pump in the advance position for 30 seconds.
5. Stop the pump motor and unplug the pump from its electrical power supply.
6. Calculate the flow rate by dividing the amount of oil collected in the cylinder or beaker and dividing by 30 seconds (0.5 minutes).
7. Check Test Specification Table. If pump does not meet 1st stage flow rating see Section 1.0 Troubleshooting.
8. Disconnect the hose from the pump and return the pump to its original condition.

5.4 High Pressure Flow Measurement

1. Verify sufficient oil exists inside the pump reservoir to complete this test.
2. Attach a V-152 relief valve to advance port of the valve on the pump. Install a 0-15,000 psi pressure gauge onto the extra V-152 port and a low restriction return hose to the bottom (tank port) of the V-152.
3. Route the hose from the V-152 valve to an oil sump and prepare a graduated cylinder or beaker (ensure the container contains sufficient volume to complete the test)
4. Fully open the V-152 valve (turning its handle counter-clockwise).
5. Plug the pump into an electrical power supply.
6. Start the motor and operate the pump in the advance position.
7. Monitor the system pressure and slowly close the V-152 valve by turning its handle clockwise until 85% of maximum pressure is reached.
8. Shift the return oil hose from the sump to the graduated cylinder or beaker and continue running the pump in the advance position for 30 seconds.
9. Stop the pump motor and unplug the pump from its electrical power supply.
10. Calculate the flow rate the dividing the amount of oil collected in the cylinder or beaker and dividing by 30 seconds (0.5 minutes).
11. Check Test Specification Table. If pump does not meet 2nd stage flow rating see Section 1.0 Troubleshooting.
12. Remove the V-152 valve, pressure gauge and hose and restore the pump to its original condition.