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# Operation and Maintenance Manual

## MODEL S-216-J-( ) Series
AIR-DRIVEN HYDRAULIC PUMP

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**Sprague Products**
*Division of Curtiss-Wright Flow Control Corporation*
10195 Brecksville Road
Brecksville, OH 44141 USA
Telephone: 440-838-7690 • Fax: 440-838-7513
www.cwfc.com

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## INTRODUCTION

This Handbook provides the necessary information to install, operate service and overhaul the basic hydraulic pump, model S-216-J-( ).

While other model pumps vary in some details of design from the basic pumps, the installation, operation, maintenance and many of the component parts remain the same or are similar.

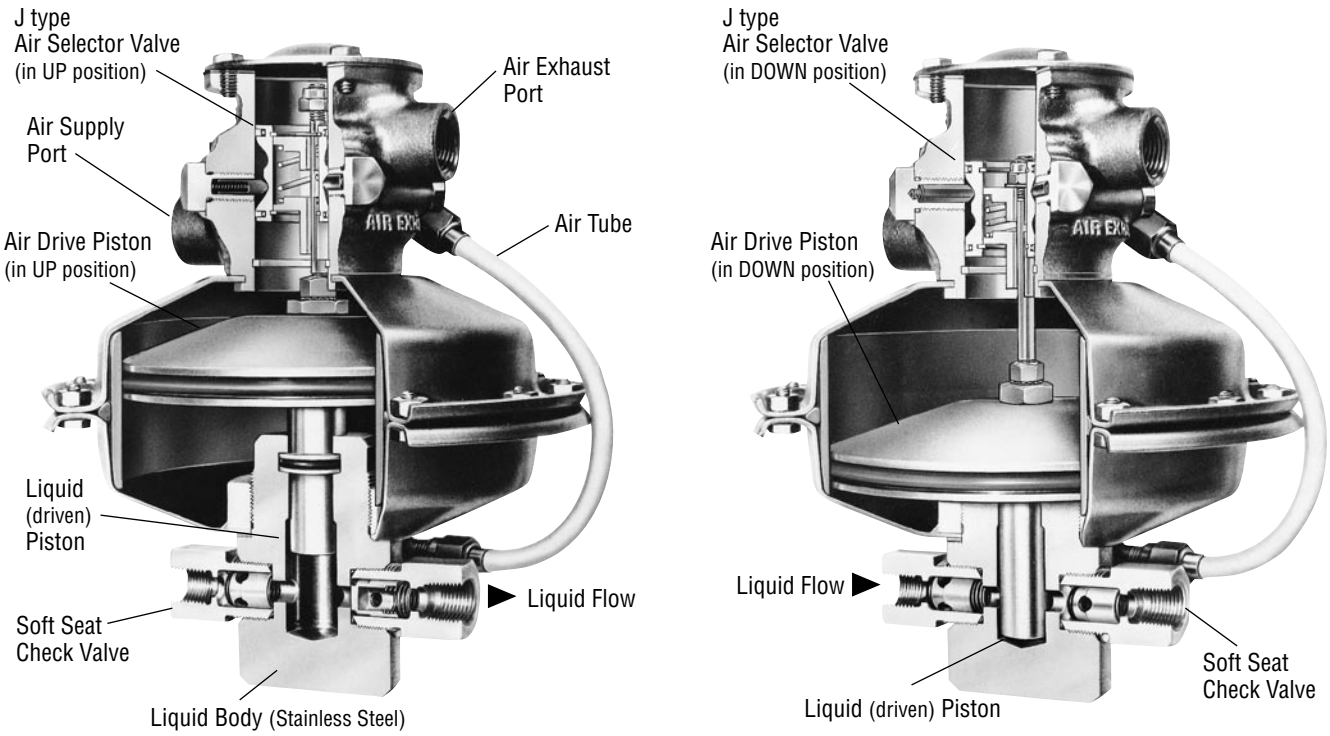
Many of the instructions contained in this Handbook are applicable to all hydraulic pump models with J type air valves.



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## HOW THE SPRAGUE AIR-DRIVEN PUMP WORKS




**S-216-J-( ) SERIES PUMP**

The Sprague Products pump develops high output pressure by applying the principle of differential areas. The pump has a large area air piston, air-driven at low pressures. This air piston drives a small area fluid piston that in turn pumps liquids at high pressures.

The fluid output pressure is determined by the ratio between the area of the air driven piston, the area of the fluid driven piston, and the applied operating air pressure.
The area relationship of the air piston to the fluid piston is referred to as the pump ratio. A nominal ratio is indicated in the dash number which follows the pump model basic number. Actual ratio may differ from nominal ratio.

**Example:** S-216-J-10 pump has an approximate ratio of 10 to 1 or 10 psi liquid pressure for each 1 psi of operating air pressure.

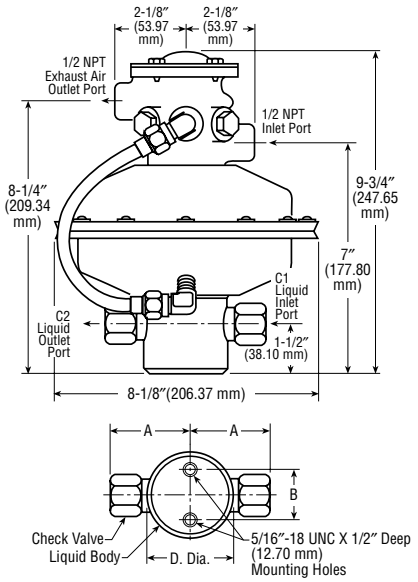
In operation, an S-216-J-10 pump using 100 psi of input air pressure will produce a maximum liquid output pressure of 1000 psi; 80 psi air will produce an output pressure of 800 psi air; 60 psi air . . . 600 psi output; and 40 psi air . . . 400 psi output.

By regulating the incoming air supply at the pressure regulator, the liquid output pressure can be adjusted through the pump's pressure range.



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| Nominal Ratio | A Inch | A mm | B Inch | B mm | C1 Inlet | C2 Outlet | D/Dia. Inch | D/Dia. mm |
|---|---|---|---|---|---|---|---|---|
| **10:1** | 2-29/32 | 73.82 | 2-7/16 | 61.90 | 3/8 NPT | 3/8 NPT | 3.1/2 | 88.86 |
| **20:1** | 2-29/32 | 73.82 | 2-7/16 | 61.90 | 3/8 NPT | 3/8 NPT | 3-1/4 | 82.51 |
| **30:1** | 2-29/32 | 73.82 | 2-7/16 | 61.90 | 3/8 NPT | 3/8 NPT | 3-1/4 | 82.51 |
| **35:1** | 2-1/4 | 57.15 | 1-1/2 | 38.10 | 3/8 NPT | 3/8 NPT | 2-1/2 | 63.47 |
| **60:1** | 2-1/4 | 57.15 | 1-1/2 | 38.10 | 3/8 NPT | 3/8 NPT | 2-1/2 | 63.47 |
| **100:1** | 2-1/4 | 57.15 | 1-1/2 | 38.10 | 3/8 NPT | 3/8 NPT | 2-1/2 | 63.47 |
| **125:1** | 2-1/4 | 57.15 | 1-1/2 | 38.10 | 3/8 NPT | 3/8 NPT | 2-1/2 | 63.47 |
| **125:1** | 2-1/4 | 57.15 | 1-1/2 | 38.10 | 1/4 NPT | 9/16-18 NBS | 2-1/2 | 63.47 |
| **150:1** | 2-1/4 | 57.15 | 1-1/2 | 38.10 | 1/4 NPT | 9/16-18 NBS | 2-1/2 | 63.47 |
| **200:1** | 2-1/4 | 57.15 | 1-1/2 | 38.10 | 1/4 NPT | 9/16-18 NBS | 2-1/2 | 63.47 |
| **300:1** | 2-1/4 | 57.15 | 1-1/2 | 38.10 | 1/4 NPT | 9/16-18 NBS | 2-1/2 | 63.47 |

| WEIGHTS (Approximate) | NOMINAL RATIO | ACTUAL WEIGHT LBS.-OZ. | ACTUAL WEIGHT KILOGRAMS | SHIPPING WEIGHT LBS.-OZ. | SHIPPING WEIGHT KILOGRAMS |
|---|---|---|---|---|---|
| | **10:1** | 16-4 | 7.4 | 19 | 8.6 |
| | **20:1, 30:1** | 14-8 | 6.6 | 17 | 7.7 |
| | **35:1, 60:1, 100:1, 125:1, 150:1, 200:1, 300:1** | 12-8 | 5.7 | 15 | 6.8 |

*Figure 1-1 Basic pump dimensions and weights*

## 1.0 INSTALLATION

1.1 The S-216 Series pumps require only bolt attachment to a base plate and plumbing connection of three lines:

a. From driving air source to pump air inlet port.

b. From fluid source to pump fluid inlet port.

c. From pump fluid outlet port to working system.

To obtain effective fluid sealing at the inlet and outlet check ports of the pump, the NPT male threads on the two fluid lines connecting to and from the pump should each be sealed with two wraps of Teflon® tape.

***Note:*** *Tape to within one or two threads of the end of the fitting, NOT at the end.*

*DO NOT use pipe dope. DO NOT tape the driving air supply line thread connecting to the pump. No special tools are required to install the pump.*

1.2 LOCATION-For maximum performance, the pump's fluid inlet port should be level with or below the fluid reservoir or fluid source.

1.3 MOUNTING-Two mounting holes are provided on the underside of the basic model pump's fluid body for attachment to a base plate or platform. See Figure 1-1.

1.4 PLUMBING-All plumbing must be rated to 1-1/2 times maximum operating pressures.

a. Connect driving air supply line to pump air inlet port.

b. Connect fluid supply line from reservoir to pump inlet check valve.

c. Connect system fluid line to pump outlet check valve.

d. A muffler may be attached to the pump's air exhaust port.

See Figure 1-2 for:

1. Line hook up to pump.
2. Pump installation.
3. Recommended accessories.

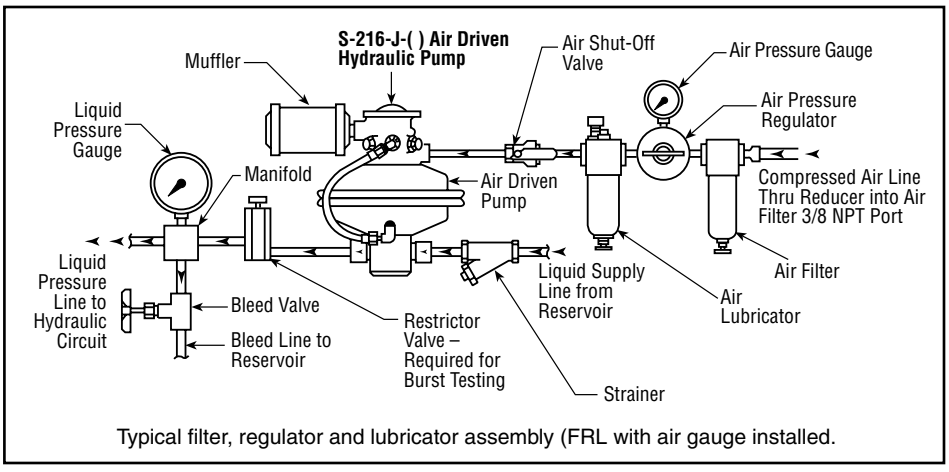



*Figure 1-2 Pump installed in typical circuit with recommended accessories which are available from Sprague Products.*

## 2.0 OPERATION

2.1 START PUMP

a. Close air shut-off valve between pump and pressure regulator.

b. Turn on driving air supply.

c. Adjust air pressure regulator at air control unit (FRL) to 25 psi (1.73 bar) starting pressure.

d. Open valve in hydraulic circuit to allow free fluid flow.

e. Slowly open the air shut-off valve to start the pump operating.

f. After pump has been primed, close valve in hydraulic circuit.

g. Check pump and air circuit for leaks in lines, fittings, etc.

h. With pump and circuit operating properly, readjust air pressure regulator until desired pump discharge pressure is reached. The hydraulic circuit is ready to operate.

**⚠ WARNING**

**Do not exceed 100 p.s.i.g. inlet air pressure.**

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2.2 STOP PUMP

a. Close air shut-off valve. Normally after driving air supply has been adjusted, the pump can be on-off controlled or reduced in pumping rate at the air shut-off valve.

b. After stopping pump, bleed off hydraulic pressure before disconnecting the hydraulic circuit.

## 3.0 MAINTENANCE

3.1 SPECIAL TOOLS – None is required to service pump. Use standard tools.

3.2 INSPECTION and MAINTENANCE –Refer to Chart 3-1 as a guide to general maintenance. Recommended inspection periods may require adjustment to comply with local conditions or as determined by experience.

3.3 TROUBLE-SHOOTING – Chart 3-2 aids in checking the pump and outlines corrective action .

To eliminate the unnecessary disassembly of the pump, probable causes of malfunction are listed in the following order:

a. Causes that can be corrected without disassembly of pump.

b. Causes that can be corrected with partial disassembly of pump.

c. Causes that require complete disassembly of pump.

The number in parenthesis following the part name corresponds to the item number on the S-216-J-( ) Illustrated Parts Breakdown (IPB), publication no. 8239.

3.4 For disassembly, inspection, repair, and reassembly of S-216-J-( ) pump, refer to Sections 4.0, 5.0, 6.0 and 7.0.

3.5 For IPB, and service and overhaul instructions of other air-driven pumps, refer to supplemental data sheets in this Handbook, Section 9.0.

## 4.0 DISASSEMBLY

4.1 The disassembly procedure describes the removal of the entire upper or “air” assembly of parts from the lower or “liquid” portion of the pump. The number in parenthesis following the part name corresponds to the item number on the S-216-J-( ) Illustrated Parts Breakdown (IPB), 8239.

When the pump is disassembled, matched parts (i.e. fluid body and fluid piston) should be kept together and handled carefully to avoid damage to lapped or honed surfaces.

To wash metal parts, use Stoddard dry cleaning solvent per Federal Specification P-D-680 or MIL-F-7024, Type II or use any quality commercial solvent that is available.

The pump disassembly and reassembly can be done with the following standard hand tools:

a. O-ring removal tool
b. Retainer ring pliers
c. Ratchet wrench with 7/16″ Dia. x 3″ extension hex socket
d. 7/16″ wrench
e. 11/16″ wrench
f. 3/4″ wrench
g. 15″ adjustable wrench

Power equipment and special tools can be used at user’s discretion.

4.2 Use bench vise to hold pump while disassembling and reassembling. Cushion vise jaws with soft aluminum plates to prevent scratching the fluid body. See Figure 4-1. Position pump in vise with tube (48) to the front of

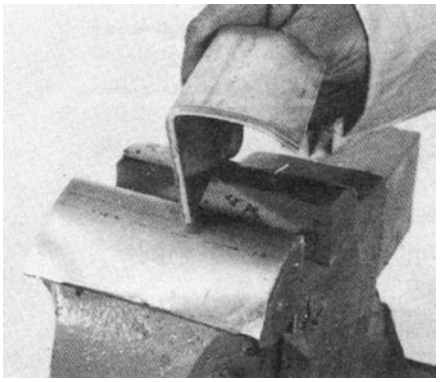


Figure 4-1 Aluminum plates in vise.

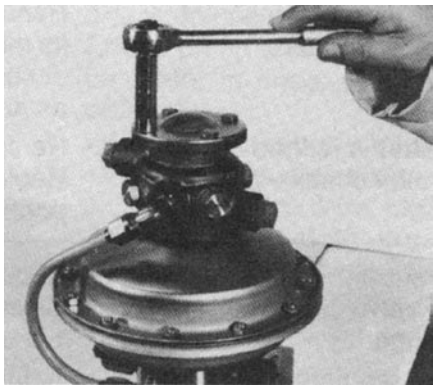


Figure 4-2 Removing air valve cover.

| ITEM | INSPECTION PERIOD | REQUIRED MAINTENANCE |
|---|---|---|
| (1) Driving Air Filter | (a) 10 hours | Check for and drain liquid accumulated in filter from condensation. |
| | (b) 50 hours | Check filter element and other components for clogging. Clean as required. |
| (2) Driving Air Lubricator (not required on JN type pumps) | (a) 10 hours | Check oil supply to fill line. Use SAE #10 or equivalent good quality oil. Check oil drip rate (2 drops per minute normal) at adjustment knob. |
| (3) Driving Air Pressure Regulator. | (a) Periodic | Check for air leaks. Repair as required. |
| (4) Driving Air Pressure Gauge | (a) 10 hours | Shutoff inlet air pressure and check for zero reading. |
| | (b) 50 hours | Calibrate against master gauge. |
| (5) Pump | (a) 10 hours | Check pump and fittings for air or fluid leakage. Repair as required. |

*Chart 3-1 Schedule of inspection and maintenance.*

**⚠ WARNING**

**Before any maintenance or repair is attempted, the compressed air line to the pump should be disconnected, and all air pressure and fluid pressure allowed to bleed from the pump.**



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| TROUBLE | PROBABLE CAUSE | CORRECTION |
|---|---|---|
| (1a) PUMP IS NOT DELIVERING FLUID (pump running) | (a) Reservoir fluid supply is low. | Add fluid as required. |
| | (b) Fluid supply line to pump inlet check valve is clogged. | Remove and clean line. Check reservoir, its inlet filter and outlet for accumulation of foreign matter. Clean as required. |
| | (c) Foreign matter is lodged in pump inlet and outlet check valves (22 and 31). | Remove and clean check valves. Replace o-rings (24 and 32) on poppets (23 and 33). |
| (1b) PUMP IS NOT DELIVERING FLUID (pump not running) | (d) Driving air supply is disconnected, air shut-off valve closed or air filter clogged. | Reconnect line. Open valve. Clean air filter. |
| | (e) Air pressure regulator not adjusted. | Adjust regulator. |
| | (f) Air shuttle valve (4A) is sticking. | Remove and clean air valve and housing assembly and its shuttle valve components.<br>Adjust air lubricator. |
| | (g) Connecting rod (37) is improperly adjusted or bent (may occur after pump overhaul). | Readjust rod and nut (44). Refer to paragraph 7.19 and Figure 7-14.<br>Straighten or replace rod. |
| | (h) Spring (4E) in shuttle valve is broken. | Replace spring. |
| (2) PRESSURE DROP OR PUMP FAILS TO BUILD-UP DISCHARGE FLOW (pressure) | (a) Leakage or blockage at inlet or outlet check valves (22 or 31). Damaged or worn o-rings. | Remove and clean check valves. Look for foreign matter lodged in seating areas.<br>Replace damaged or worn o-rings. |
| | (b) Fluid found in lower housing (19), damaged seals in sealing groove of fluid body. | Replace o-rings (17 or 29), packing retainers (18), and back-up rings (18A or 30A). |
| | (c) Damaged o-ring (15) in outer groove of air piston (14) or scratched or scored cylinder (13). Either or both allow air pressure to escape to exhaust port. | Replace o-ring. Inspect cylinder for scores or scratches. If marred, replace cylinder. |
| (3) HYDRAULIC FLUID IN EXHAUST AIR | (a) Damaged seals in fluid body (21) or fluid piston (16 or 28) scored. | Replace o-ring (17 or 29) and retainers (18 or 30). Inspect fluid piston for score marks; polish as required. Replace pistons and fluid body if in-service-wear allowance exceeded. |
| (4) AIR LEAK IN COVER OF AIR VALVE & HOUSING ASSY. | (a) Cover (1) loose. Cracked or damaged o-ring. | Tighten cover bolts (3) or replace o-rings. |
| (5) AIR IN SYSTEM | (a) Air leak in suction line from reservoir to pump or at pump inlet check valve. | Tighten line fittings; use Teflon® tape to seal fittings. |
| | (b) Reservoir fluid level below reservoir suction outlet. | Check reservoir fluid level; refill as required. |

*Chart 3-2 Troubleshooting pump operation.*

4.3 Unscrew the four cap screws (3) to remove the air valve cover (1) and its 0-ring (2). See Figure 4-2.

4.4 Remove tube assembly (48) by removing the two fittings from the two 90° elbows on the upper and lower housing. See Figure 4-3. Do not remove elbows. Apply air hose and air pressure to lower 90° elbow to raise air piston (14) and shuttle (4A) to upper position. See Figure 4-4.

4.5 Use 7/16" wrench to remove self-locking nut (44) from connecting rod (37). See Figure 4-5.

4.6 Use 7/16 socket on ratchet wrench to remove the twelve cap screws (45) and nuts (46) that attach the upper housing (19). See Figure 4-6. Lift and remove the upper housing assembly. Remove stop sleeve (4) from connecting rod.

4.7 If the shuttle assembly in the upper housing needs removal and disassembly, proceed as follows:

4.7.1 Use 11/16" wrench and remove the four sets of detent bolts (6), springs (7), and pins (9) from the air valve body (5A). See Figure 4-7.

4.7.2 From inside the upper housing, push upward on shuttle stop (4F) to remove the shuttle assembly. See Figure 4-8.

4.7.3 Using retainer ring pliers, remove the snap ring (4g) to release the (4), spring (4E), and guide sleeve (4) from the shuttle (4A). See Figure 4.9.

4.8 Remove the cylinder (13) and its o-ring (15) from the lower housing (19). See Figure 4-10.

4.9 Remove rod, air piston (14) and fluid piston (16 or 27) from the fluid body (21). See Figure 4-11.

4.10 Disassemble shifting nut (40), lock washer (39), plain nut (38) and connecting rod from air piston (14). See Figure 4-12. Unscrew air piston from fluid piston (16). Remove the o-ring (15) from the air piston.

**Note:** *Disassembly is not necessary unless one of the components is damaged.*



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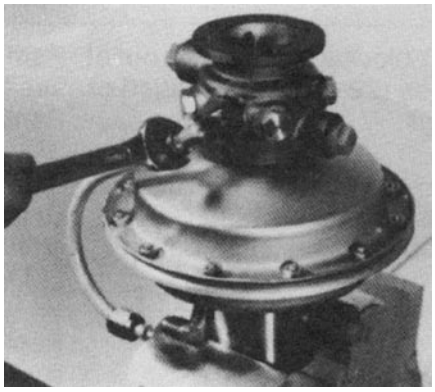


*Figure 4-3 Removing tube assembly.*

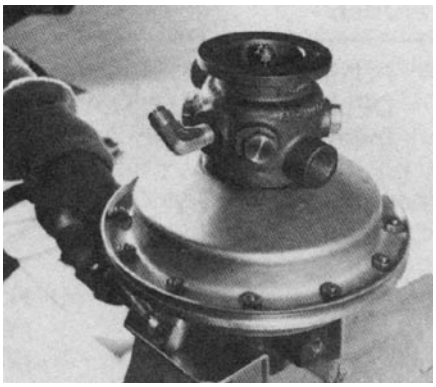


*Figure 4-4 Applying air pressure to raise air piston and rod.*

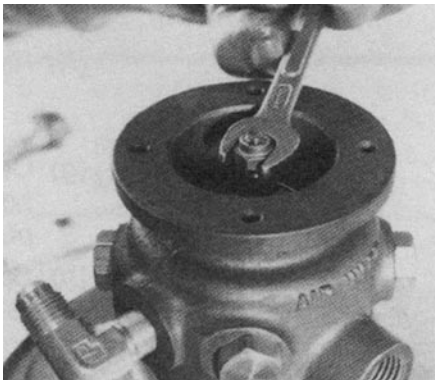


*Figure 4-5 Removing self-locking nut from connecting rod.*



*Figure 4-6 Removing housing screws and nuts.*

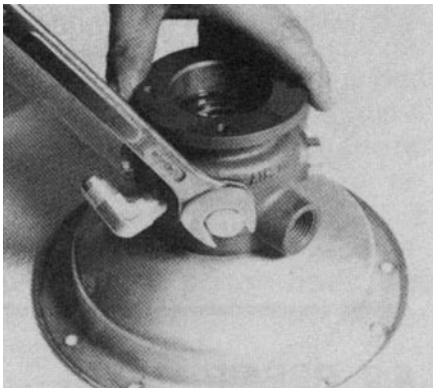


*Figure 4-7 Removing detent bolt, spring and pin.*

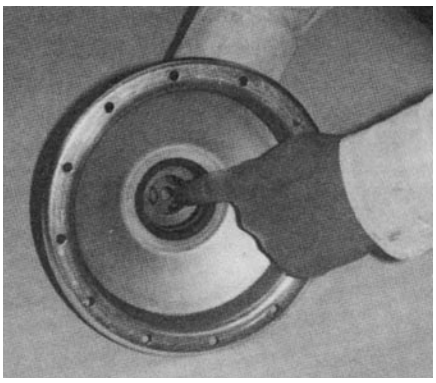


*Figure 4-8 Pressing shuttle out of upper housing.*

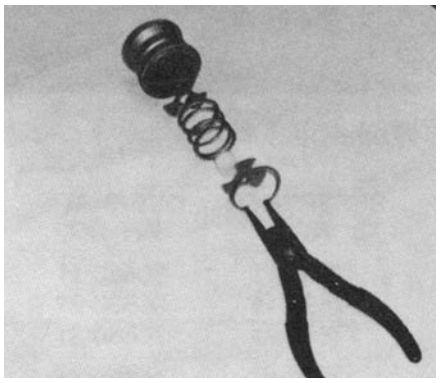


*Figure 4-9 Removing shuttle assembly components.*

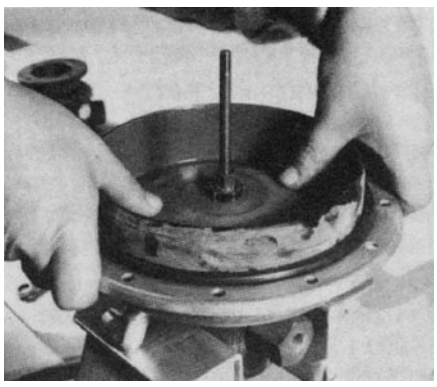


*Figure 4-10 Removing cylinder from lower hous-*

4.11 Using o-ring removal tool, carefully remove the two Teflon® retainers (18) and o-ring (17) from the seal groove in the fluid body (21). See Figure 4-13. Discard the old retainers and o-ring.

4.12 Using adjustable wrench, remove the inlet check valve assembly (22-25) from the fluid body port. See Figure 4-14. Remove o-ring (26) or gasket (35) from port. Note sequence of parts removal and the position of poppet (33) relative to the check valve body (31). Wipe surplus fluid from inside port.

4.13 Using adjustable wrench, remove outlet check valve assembly (22-25) from the fluid body port. Remove o-ring (26) or seat (36) from port. Note sequence of parts removal and position of poppet (33) from the check valve body (31). Wipe surplus fluid from port.

4.14 Check for leakage at gasket (20) junction between the lower housing (19) and the fluid body (21). Unless there is evidence of leakage at gasket (20), DO NOT remove the lower housing from the fluid body.

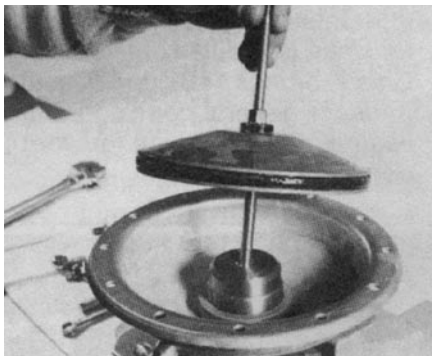


*Figure 4-11 Removing air piston and fluid piston from fluid body and lower housing.*

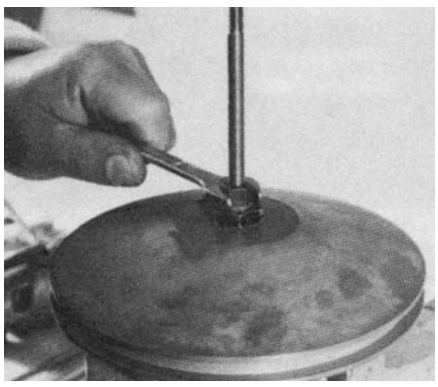


*Figure 4-12 Disassembling air piston compo-*



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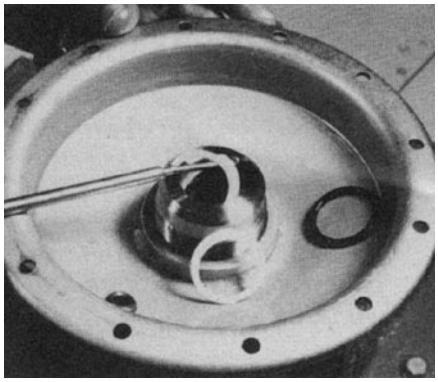


*Figure 4-13 Removing retainers and 0-ring from fluid body.*

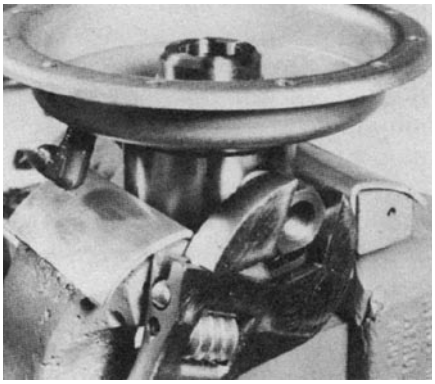


*Figure 4-14 Removing check valves from fluid body.*

## 5.0 INSPECTION

5.1 Wash all metal parts in solvent. Dry parts thoroughly with air or with lint-free cloth. Remove hardened sediment with a soft bristle brush. Do not scrape parts with a metal tool.

5.2 Under a light, and preferably under magnification, visually inspect parts for cracks, pitting, scoring, corrosion or galling.

5.3 Inspect all threaded parts for chipped, crossed or stripped threads.

5.4 Inspect and measure the free (relaxed) length of springs:

a. Detent springs (8), 7/8 inches (22.23 mm);

b. Check valve springs (25), 3/4 inches (19.05 mm);

c. Check valve springs (34), 11/16 inches (17.45 mm);

d. Shuttle spring (4E), 1 5/16 inches (33.5 mm).

5.5 Roll springs over a flat surface to check for wobble.

5.6 Check tube assembly (48) for kinks, breaks or defective tube flares.

5.7 Check outside diameter (OD) of fluid piston (16 or 27) and the inside diameter (ID) of the fluid body (21) to determine wear clearance between the two parts. See Table 5-1. Remember that the operating efficiency of the pump depends on maintaining the close tolerance dimension between the piston and the body. **Note:** *When checking the ID of the fluid body and the OD of the piston, check at several points around and up and down the bore of the body and the circumference of the piston.*

| PUMP RATIO AND DASH NO. | | ALLOWABLE MAX. CLEARANCE INCH | MM |
|---|---|---|---|
| 10:1 | - 10 | 0.010 | 0.254 |
| 20:1 | -20 | 0.008 | 0.203 |
| 30:1 | -30 | 0.007 | 0.178 |
| 35:1 | -35 | 0.005 | 0.127 |
| 60:1 | -60 | 0.005 | 0.127 |
| 100:1 | -100 | 0.004 | 0.102 |
| 125:1 | -125 | 0.004 | 0.102 |
| 150:1 | -150 | 0.003 | 0.076 |
| 200:1 | -200 | 0.002 | 0.051 |
| 300:1 | -300 | 0.001 | 0.025 |

*Table 5-1 In-service wear limits, fluid piston to fluid body.*

5.8 Check for smooth movement of shuttle assembly within air valve body. Check contacting surfaces of shuttle and bore of body for dirt, scratches or galling. Check rings (4C) on shuttle for wear, particularly at the tips. Check o-rings (4B) under seal rings for general condition and inspect detent pins (9) for worn condition.

5.9 Inspect inlet and outlet check valve seating surfaces in the fluid body (21) for nicks, burrs or excessive wear. Inspect valve bodies, poppets, springs and seats for nicks, burrs, excessive wear or rust.

## 6.0 REPAIR AND REPLACEMENT

6.1 Polish metal parts to remove minute imperfections, minor scratches or scoring. Use wet-or-dry paper grit #600.

6.2 Check fluid piston (16 or 27) and fluid body (21). If there is any evidence of galling, replace both piston and body. Carefully polish piston to remove minor scratches or nicks. Use grit #600. Polish fluid body bore with hone to remove minor imperfections. Use a very fine polishing stone. Recheck for wear clearances as described in paragraph 5.7 and Table 5-1. If imperfections cannot be easily removed, replace piston and body as a matched set. **Note:** *The replacement piston-body set also includes the lower housing and gasket.*

6.3 Check air valve and upper housing assembly. Polish out minor imperfections as described in paragraph 6.2. Keep polishing and honing to an absolute minimum to prevent an increase in wear clearance and resulting loss of air. If imperfections cannot be easily removed, replace the entire air valve and upper housing assembly.

6.4 Clean all repaired parts in solvent as described in paragraph 5.1.

6.5 Replace all metal parts that fail to pass inspection or are damaged or worn beyond simple repair.

6.6 Replace all o-rings, packing retainers, gaskets, springs and detent pins at each pump overhaul. Overhaul kits from Sprague Products conveniently contain all necessary parts to properly overhaul or service the pump. See Figure 6-1.

| PUMP MODEL NO. | REFERENCE NO. | OVERHAUL KIT |
|---|---|---|
| S-216-J-10 | 79293-11 | 90680-11 |
| S-216-J-20 | 77894-11 | 90680-21 |
| S-216-J-30 | 77894-21 | 90680-31 |
| S-216-J-35 | 77895-81 | 90680-41 |
| S-216-J-60 | 77895-11 | 90680-51 |
| S-216-J-100 | 77895-21 | 90680-61 |
| S-216-J-125 | 77895-61 | 90680-01 |
| S-216-J-125 | 77895-61001 | 90680-01001 |
| S-216-J-150 | 77895-31001 | 90680-71001 |
| S-216-J-200 | 77895-41001 | 90680-81001 |
| S-216-J-300 | 77895-51001 | 90680-91001 |

*Figure 6-1 Overhaul Kits.*

These listed kits contain nitrile seals. Kits can also be ordered with neoprene, viton, and EPR seal material. Refer to catalog SCC-0693 for kit descriptions and specific ordering information.



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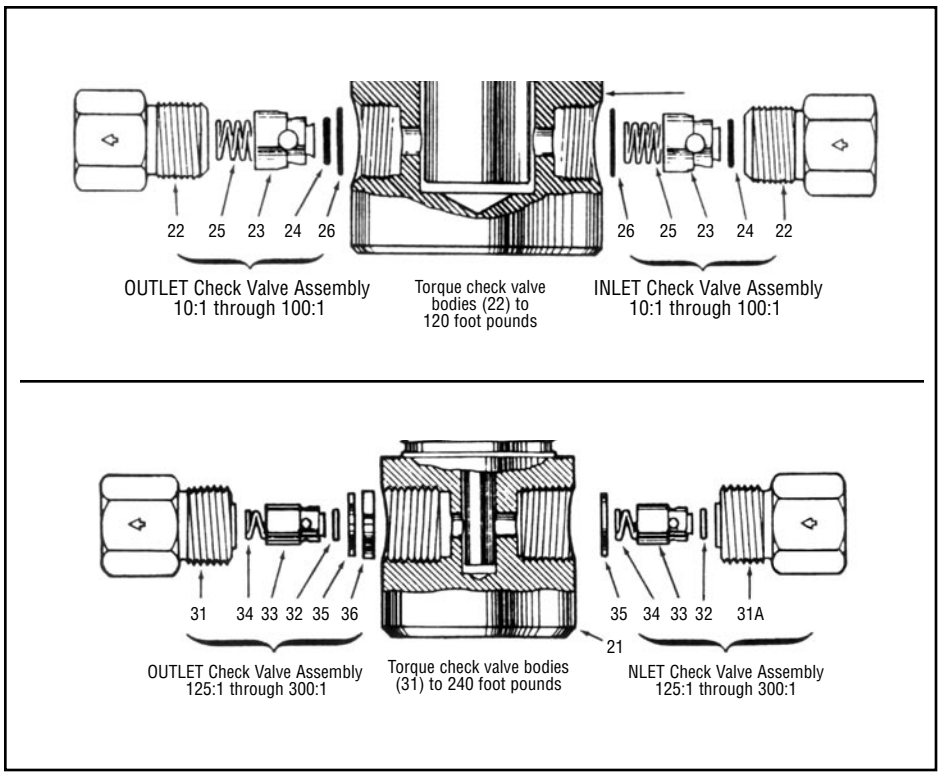



*Figure 7-2 Inlet and outlet check valves, sequence of assembly.*

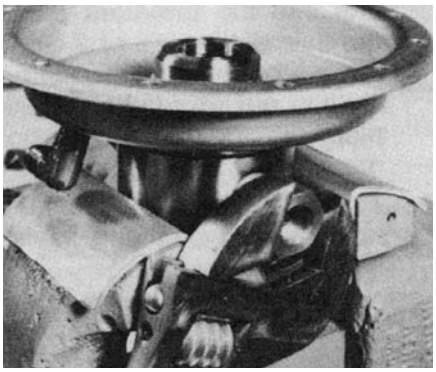


*Figure 7-1 Installing check valves.*



*Figure 7-3 Connecting rod with lock washer and shifting nut, ready to be screwed into fluid piston.*

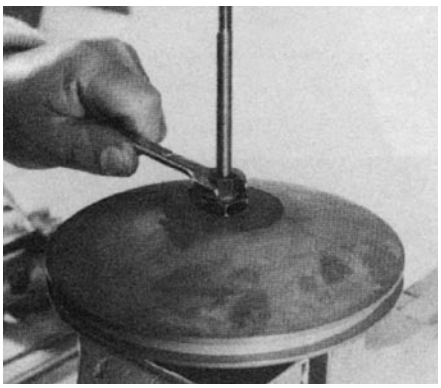


*Figure 7-4 Tightening shifting nut to secure connecting rod into fluid piston.*

## 7.0 REASSEMBLY

Before reassembling pump, wash metallic parts thoroughly in solvent and dry. Lubricate o-rings and threads with Vaseline, hydraulic oil or petrolatum per Federal Specification VV-P-236 or with lubricant compatible with special seal compounds.

7.1 Position fluid body (21) and lower housing (19) in vise. **Note:** *Insert soft aluminum plates in vise jaws to cushion grip against fluid body. Refer to paragraph 4-2.*

7.2 Reassemble and install inlet and outlet check valves into fluid body (21). See Figure 7-1. Note order of assembly and position of poppets (23 and 33) by referring to Figure 7-2. Note torque instructions in illustrations. DO NOT over-torque valve bodies (22 or 31) and be careful to avoid crossing threads when installing check valve bodies. On completion, remove from vise.

7.3 Position fluid piston (16 or 21) in vise. Use aluminum plates in vise jaws. Screw air piston (14) fully onto fluid piston. Screw nut (38) firmly with 3/4" wrench onto the threaded end of the fluid piston. Install o-ring (15) into groove in air piston (14).

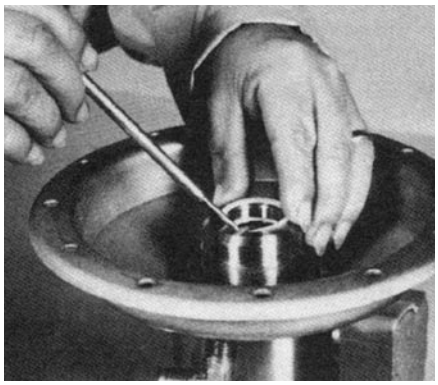


*Figure 7-5 Installing seals in fluid body.*

7.4 Screw shifting nut (40) all the way up the long length (one-inch) of threads on the connecting rod (37) with beveled end of nut toward center of rod.

7.5 Insert lockwasher (39) under shifting nut (40) and hold washer next to under side of shifting nut (40). See Figure 7-3. Screw connecting rod (37) end into the threaded end of the fluid piston (16 or 27) until the rod bottoms solidly. Torque shifting nut (40) tightly against plain nut (38) to secure connecting rod. See Figure 7-4.

7.6 Place fluid body (21) and lower housing assembly (19) in vise.

7.7 Install new seals in sealing groove in the bore of the fluid body (21), (see Figure 7-5) in the following sequence relative to pump ratio:

a. 10:1, 20:1 and 30:1 pumps: packing retainer (18)- bottom, o-ring (17)–middle, and packing retainer (18)–top;

b. 35:1 thru 300:1 pumps: back-up ring (18A) on top, o-ring (17) in middle, and packing retainer (18) on bottom of sealing groove.



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7.8 Carefully insert assembled fluid piston (16 or 27) and air piston (14) assembly into bore of fluid body to avoid scratching surfaces. See Figure 7-6. **Note:** *Before assembly, lubricate bore and seals of fluid body and fluid piston.*

7.9 Press down and rotate piston (14) until it bottoms on the top side of the fluid body (21).

7.10 Lubricate inside wall of cylinder (13) and o-ring (15) in groove of air piston with Vaseline. Press cylinder into position between air piston and lower housing (19). Position second o-ring (15) around outside of cylinder and in contact with flange of lower housing. See Figure 7-7.

7.11 Place stop sleeve over connecting rod and screw nut (44) onto the first several threads of the connecting rod.

7.12 Gripping connecting rod (37) and the underside of nut (44), pull rod upward so that the air piston (14) and fluid piston (16 or 27) are in the up position. Remove nut (44) from rod.

7.13 Reassemble shuttle assembly and install with "Top" up into air valve and upper body assembly. See Figure 7-8. Press shuttle down evenly and slowly. Move shuttle up and down several times to assure smooth movement.

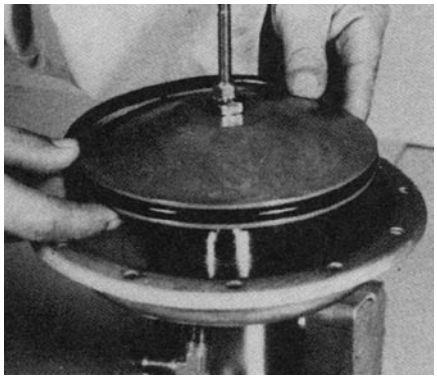


*Figure 7-6 Inserting air piston and fluid piston assembly into fluid body.*

7.14 Install air valve and upper housing assembly onto fluid body and lower housing assembly. Be sure the two elbow fittings for the tube assembly (48) are aligned with each other for later assembly. See Figure 7-9.

7.15 Install and loosely tighten the cap screws (45) and nuts (46) around the housing flanges. Tighten evenly in clockwise opposite positions: 12, 6, 3, 9, etc. Uneven tightening will cause binding between cylinder (13) and air piston (14). **Note:** *Connecting rod should be centered in the air valve shuttle assembly center hole if bolts are tightened evenly.*

7.16 Install the four sets of detent pins (9), springs (8), o-ring packings (7) and bolts (6) into the four threaded ports in valve body (5). Detent pins should engage in lower groove of the shuttle (4A).

7.17 Apply air pressure to elbow fitting (47) in the lower housings to move the piston to the up position. See Figure 7-11.



*Figure 7-7 Pressing cylinder into lower housing.*

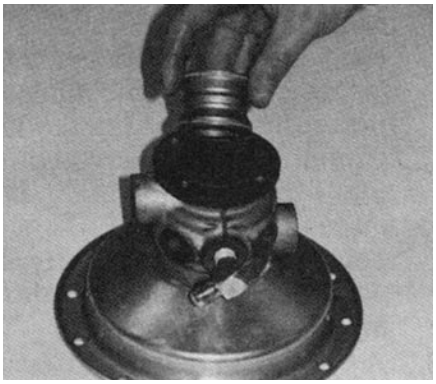


*Figure 7-8 Inserting J type shuttle assembly into air valve body.*

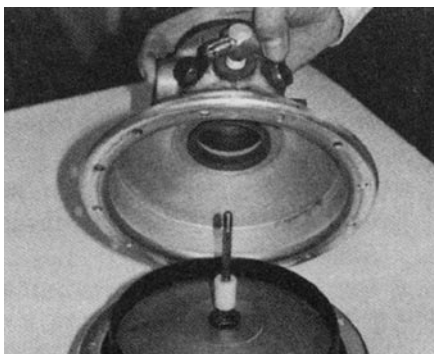


*Figure 7-9 Air valve and upper housing assembly ready for attachment to lower housing assembly.*

7.18 Install self-locking nut (44) on upper threaded end of connecting rod (37). See Figure 7-12. Referring to Figure 7-13 and paragraph 7.5, if no lower threads of connecting rod show above shifting nut (40), then install self-locking nut (44) with at least one upper thread of connecting rod exposed beyond the self-locking nut. Correspondingly, if one or two lower threads of connecting rod are exposed beyond the shifting nut, then install self-locking nut with a like number of connecting rod upper threads exposed beyond the lock nut.



*Figure 7-10 Bolting upper and lower housings together.*

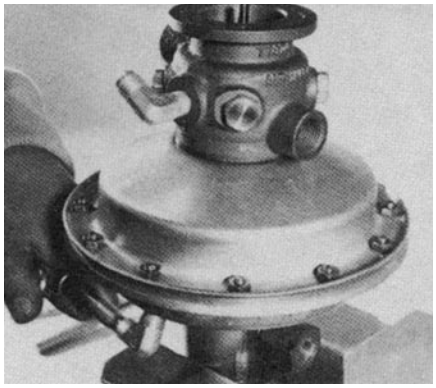


*Figure 7-11 Using air pressure to raise shuttle assembly.*

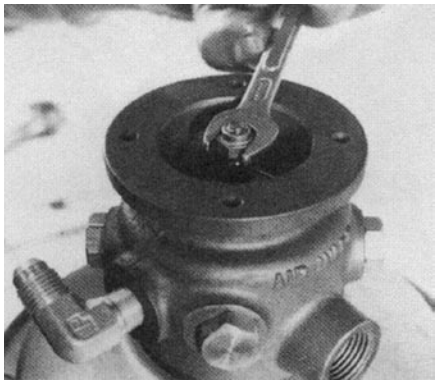


*Figure 7-12 Installing self-locking nut on connecting rod.*



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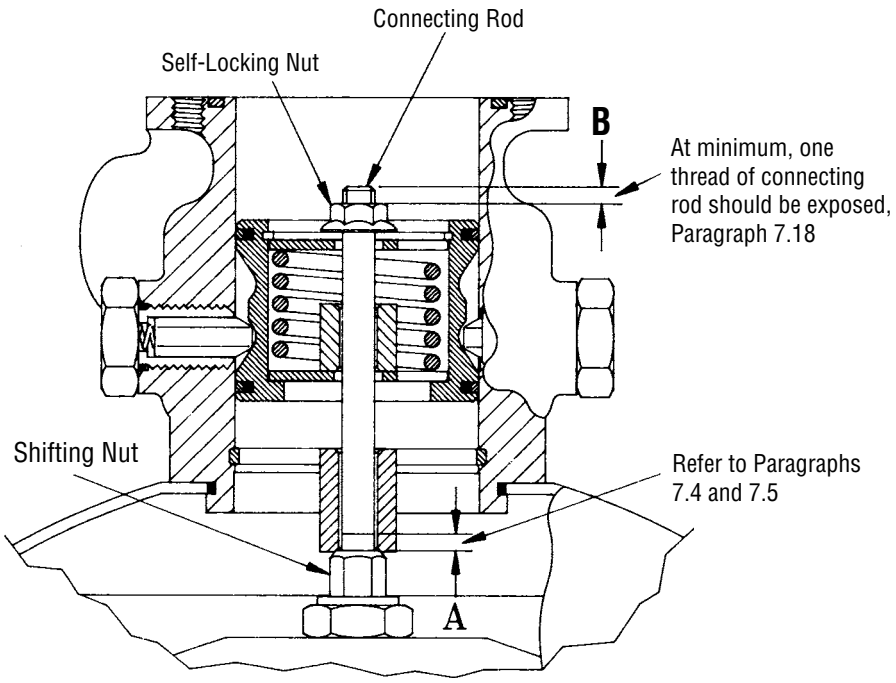
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7.19 Check for smooth movement up and down of shuttle. Using shop air (approx. 10 psi), inject air to elbow in lower housing (19) to raise shuttle to up position. Manually push down on the shuttle. Repeat this up and down movement several times to determine smoothness of movement. Movement should be smooth; if not, air piston (14) is binding against cylinder wall (13). Binding is caused by uneven tightening of the 12 screws (45) and nuts (46) at the housing flange. Retighten screws evenly per paragraph 7.15.

7.20 With pump movement assured, install new o-ring (2), cover (1) and four screws (3) to close the air valve portion of the pump.

7.21 Reinstall tube assembly (48) to the elbows in the upper and lower housings.

7.22 For final check of movement, inject air pressure to air inlet port. Movement of assembled shuttle, air piston and fluid piston should be smooth and regular.




For proper stroke adjustment, the number of exposed threads at B should equal the number of exposed threads at A (one thread minimum).

*Figure 7-14 J air valve strobe adjustment.*

## 8.0 TEST

8.1 Install pump into a typical circuit. See Figure 1-2. Operate pump in accordance with Section 2.0, Operation.

8.2 Conduct tests operating pump at different driving air pressures. Close fluid shut-off valve in pump discharge line to permit pump to build up its maximum pressure output. At this point the pump will slow to a stop, indicating a pressure balance has been reached between fluid pressure and driving air pressure. The pump will automatically restart when pressure imbalance occurs.

8.3 Compute ratio of fluid maximum output pressure to driving air input pressure. Compare pump dash number to pump's rated fluid output pressure. Refer to Table 8-1.

| PUMP MODEL DASH NO. | INPUT OPERATING AIR PRESSURE PSI | BAR | OUTPUT FLUID PRESSURE PSI | BAR |
|---|---|---|---|---|
| -10 | 40<br>100 | 2.72<br>6.80 | 400<br>1,000 | 27<br>69 |
| -20 | 40<br>100 | 2.72<br>6.80 | 720<br>1,850 | 50<br>128 |
| -30 | 40<br>100 | 2.72<br>6.80 | 1,240<br>3,100 | 84<br>214 |
| -35 | 40<br>100 | 2.72<br>6.80 | 1,850<br>4,600 | 126<br>317 |
| -60 | 40<br>100 | 2.72<br>6.80 | 2,350<br>6,100 | 160<br>420 |
| -100* | 40<br>100 | 2.72<br>6.80 | 3,500<br>8,800 | 238<br>607 |
| -125 | 40<br>100 | 2.72<br>6.80 | 5,000<br>12,500 | 345<br>862 |
| -150 | 40<br>100 | 2.72<br>6.80 | 6,200<br>16,000 | 422<br>1,103 |
| -200 | 40<br>100 | 2.72<br>6.80 | 9,500<br>23,750 | 646<br>1,637 |
| -300 | 40<br>100 | 2.72<br>6.80 | 14,000<br>33,500 | 953<br>2,310 |

*Table 8-1 Rated air input pressures to fluid output pressures.* **Except model S-216-S-100*

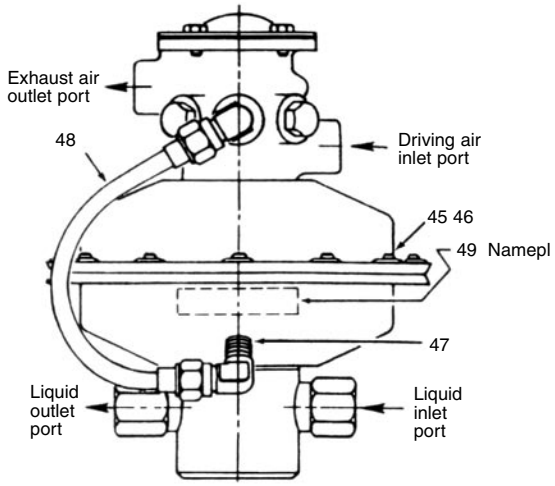


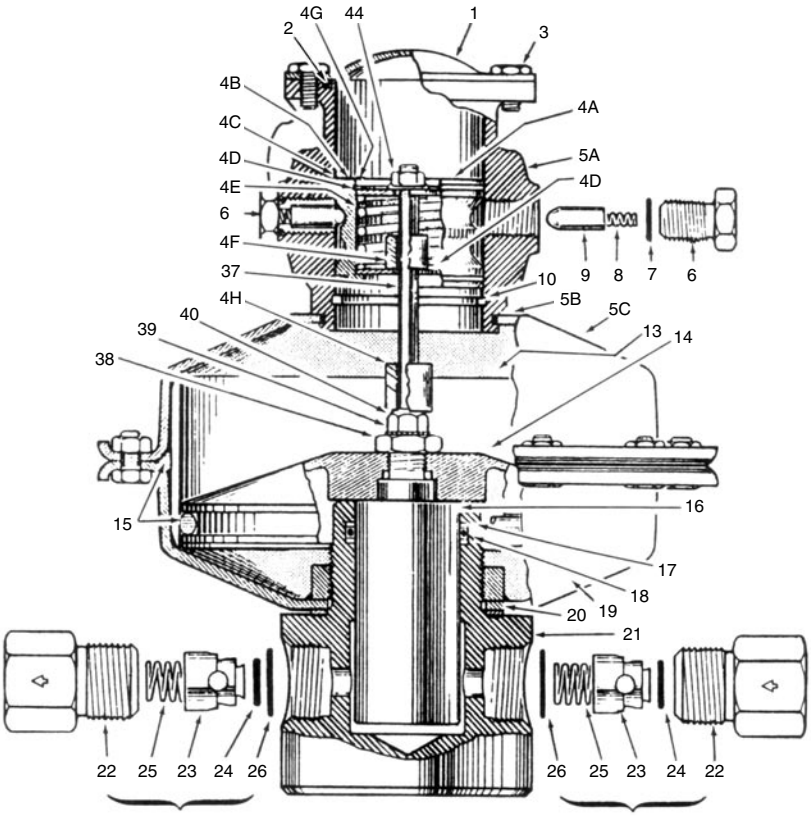
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## 8.0 IPB AND SUPPLMENTAL DATA

8239 Illustrated Parts Breakdown (IPB) enclosed to provide additional data on the S-216-J-() basic pump. Other pump data may be included as required.

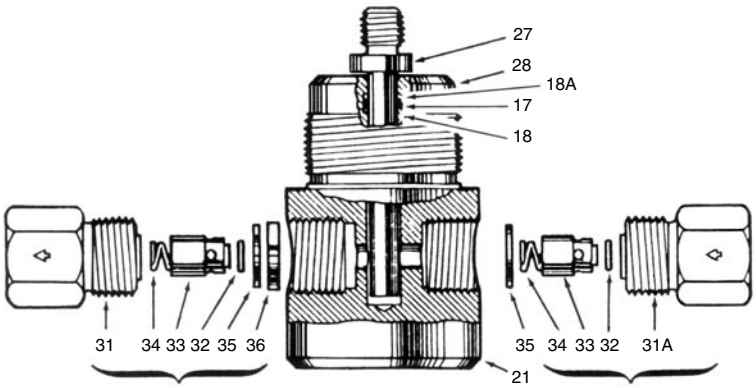



OUTLET Check Valve Assembly
10:1 through 100:1

INLET Check Valve Assembly
10:1 through 100:1

*With liquid body/piston seals for 10:1 to 30:1 ratio pumps.*




OUTLET Check Valve Assembly
125:1 through 300:1

NLET Check Valve Assembly
125:1 through 300:1

*With liquid body/piston seals for 35:1 to 300:1 ratio pumps.*

## OVERHAUL KIT

The Overhaul Kit contains replacement parts including Inlet and Outlet Check Valve O-rings and Springs; Detent Springs, Pins and O-rings; Shuttle Valve Rings and O-rings as well as other O-rings, Retainers, and Connecting Self-Locking Nut and Washer.

The kits listed below apply only to standard pumps with elastomeric type seals. Standard kit seals are nitrile. Optional kits with neoprene, Viton® and EPR seals are available. In the kit numbers listed below, the two digits after the dash indicate the choice of optional seal materials. The first of those digits indicates the pump ratio while the second indicates the seal materials.

00000-X X = pump ratio
00000-X1 1 = nitrile seals
00000-X3 3 = Viton® seals
00000-X4 4 = EPR seals

Ordering Example: An Overhaul Kit with neoprene seals is needed for an S-216-J-30. The standard kit is 90680-31 with the 3 indicating a 30 ratio pump and the 1 indicating nitrile seals. Change the last digit from 1 to 2 to indicate neoprene seals. The new number for the Overhaul Kit is 90680-32.

| Pump Model Number | Reference Number | Overhaul Kit Number |
|---|---|---|
| S-216-J-10 | 79293-11 | 90680-11 |
| S-216-J-20 | 77894-11 | 90680-21 |
| S-216-J-30 | 77894-21 | 90680-31 |
| S-216-J-35 | 77895-81 | 90680-41 |
| S-216-J-60 | 77895-11 | 90680-51 |
| S-216-J-100 | 77895-21 | 90680-61 |
| S-216-J-125 | 77895-61 | 90680-01 |
| S-216-J-125 | 77895-61001 | 90680-01001 |
| S-216-J-150 | 77895-31001 | 90680-71001 |
| S-216-J-200 | 77895-41001 | 90680-81 |
| S-216-J-300 | 77895-51001 | 90680-91 |

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| Item No | Model Number | Part Name | Pump Ratio Dash Number | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | -10 | -20 | -30 | -35 | -60 | -100 | -125 | -150 | -200 | -300 |
| | S-216-J-10 | Pump Assy., 10:1 Ratio (79293-11) | • | | | | | | | | | |
| | S-216-J-20 | Pump Assy., 20:1 Ratio (77894-11) | | • | | | | | | | | |
| | S-216-J-30 | Pump Assy., 30:1 Ratio (77894-21) | | | • | | | | | | | |
| | S-216-J-35 | Pump Assy., 35:1 Ratio (77895-81) | | | | • | | | | | | |
| | S-216-J-60 | Pump Assy., 60:1 Ratio (77895-11) | | | | | • | | | | | |
| | S-216-J-100 | Pump Assy., 100:1 Ratio (77895-21) | | | | | | • | | | | |
| | S-216-J-125 | Pump Assy., 125:1 Ratio (77895-61) | | | | | | | • | | | |
| | S-216-J-125 | Pump Assy., 125:1 Ratio (77895-61001) | | | | | | | • | | | |
| | S-216-J-150 | Pump Assy., 150:1 Ratio (77895-31001) | | | | | | | | • | | |
| | S-216-J-200 | Pump Assy., 200:1 Ratio (77895-41001) | | | | | | | | | • | |
| | S-216-J-300 | Pump Assy., 300:1 Ratio (77895-51001) | | | | | | | | | | • |
| | **Part No.** | | | | | | | | | | | |
| 1 | S-216-17-1 | Cover air valve | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 2 | 91417-138 | O-ring | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 3 | MS90725-3 | Screw cap, 1/4-20 X 1/2 long | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 |
| 4 | 90535-1 | Air valve and housing assembly | | | | | | | | | | |
| — | 90654-1 | Shuttle Assembly (See Note 1) | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 4A | 90522 | Shuttle | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 4B | 91417-029 | O-ring | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 |
| 4C | 90524 | Ring | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 |
| 4D | 92247 | Flange | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 |
| 4E | 90600 | Spring | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 4F | 92249 | Guide sleeve | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 4G | 90685 | Snap ring | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 4H | 92248 | Stop sleeve | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| — | 90651-1 | Body and housing assembly (See Note 1) | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 5A | 78216-1 | Body (See Note 2) | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 5B | 91417-023 | Gasket (See Note 2) | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 5C | S-216-19 | Upper housing (See Note 2) | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 6 | 78238 | Detent bolt | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 |
| 7 | 79552-5 | Detent O-ring | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 |
| 8 | S-216-24 | Detent spring | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 |
| 9 | 82871 | Detent pin | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 |
| 10 | S-216-56 | Stop | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 13 | S-216-13 | Cylinder | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 14 | S-216-4 | Air piston | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 15 | 79550-60 | O-ring, 70 shore | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 |
| 16 | S-216-61-10SS | Liquid piston | 1 | | | | | | | | | |
| 17 | 79551-3-1* | O-ring, 90 shore, nitrile | 1 | | | | | | | | | |
| 18 | MS28783-3 | Packing retainer, Teflon® | 2 | | | | | | | | | |
| — | 89801-10 | Body and housing assembly (See Note 3) | 1 | | | | | | | | | |
| 19 | 89800 | Lower housing | 1 | | | | | | | | | |
| 20 | S-216-20-1 | Gasket | 1 | | | | | | | | | |
| 21 | 89775 | Liquid body | 1 | | | | | | | | | |
| 16 | S-216-10-20 | Liquid piston | | 1 | | | | | | | | |
| 17 | 79550-25-1* | O-ring, 90 shore, nitrile | | 1 | | | | | | | | |
| 18 | MS28782-25 | Packing retainer, Teflon | | 2 | | | | | | | | |
| — | 89801-20 | Body and housing assembly (See Note 3) | | 1 | | | | | | | | |
| 19 | 89793 | Lower housing | | 1 | | | | | | | | |
| 20 | S-216-20 | Gasket | | 1 | | | | | | | | |
| 21 | 77893 | Liquid body | | 1 | | | | | | | | |
| 16 | S-216-10-30 | Liquid piston | | | 1 | | | | | | | |
| 17 | 79550-20-1* | O-ring, 90 shore, nitrile | | | 1 | | | | | | | |
| 18 | MS28782-20 | Packing retainer, Teflon | | | 2 | | | | | | | |
| — | 89801-30 | Body and housing assembly (See Note 3) | | | 1 | | | | | | | |
| 19 | 89793 | Lower housing | | | 1 | | | | | | | |
| 20 | S-216-20 | Gasket | | | 1 | | | | | | | |

*Seal Materials: Neoprene, Viton and EPR.

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| Item No | Model Number | Part Name | Pump Ratio Dash Number | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | -10 | -20 | -30 | -35 | -60 | -100 | -125 | -150 | -200 | -300 |
| 16 | S-216-10-35 | Liquid piston | | | | 1 | | | | | | |
| 17 | 79550-17-1* | O-ring, 90 shore, nitrile | | | | 1 | | | | | | |
| 18 | MS28782-17 | Packing retainer, Teflon | | | | 1 | | | | | | |
| 18A | 90098-35 | Back-up ring | | | | 1 | | | | | | |
| — | 89801-35 | Body and housing assembly (See Note 3) | | | | 1 | | | | | | |
| 19 | 89793 | Lower housing | | | | 1 | | | | | | |
| 20 | S-216-20 | Gasket | | | | 1 | | | | | | |
| 21 | 77888 | Liquid body | | | | 1 | | | | | | |
| — | 89803-60-1 | Piston, body and housing assembly (See Note 4) | | | | | 1 | | | | | |
| 19 | 89793 | Lower housing | | | | | 1 | | | | | |
| 20 | S-216-20 | Gasket (See Note 4) | | | | | 1 | | | | | |
| — | 77890-11 | Piston and body assembly | | | | | 1 | | | | | |
| 16 | S-216-10-60 | Liquid piston (See Note 4) | | | | | 1 | | | | | |
| 21 | 77888-1 | Liquid body (See Note 4) | | | | | 1 | | | | | |
| 17 | 79550-14-1* | O-ring, 90 shore, nitrile | | | | | 1 | | | | | |
| 18 | MS28782-14 | Packing retainer, Teflon | | | | | 1 | | | | | |
| 18A | 90098-60 | Back-up ring | | | | | 1 | | | | | |
| — | 89803-100-1 | Piston, body and housing assembly (See Note 4) | | | | | | 1 | | | | |
| 19 | 89793 | Lower housing | | | | | | 1 | | | | |
| 20 | S-216-20 | Gasket (See Note 4) | | | | | | 1 | | | | |
| — | 77890-21 | Piston and body assembly | | | | | | 1 | | | | |
| 16 | S-216-11-100 | Liquid piston (See Note 4) | | | | | | 1 | | | | |
| 21 | 77888-2 | Liquid body (See Note 4) | | | | | | 1 | | | | |
| 17 | 79550-12-1* | O-ring, 90 shore, nitrile | | | | | | 1 | | | | |
| 18 | MS28782-12 | Packing retainer, Teflon | | | | | | 1 | | | | |
| 18A | 90098-100 | Back-up ring | | | | | | | | | | |
| — | 89803-125-1 | Piston, body and housing assembly (See Note 4) | | | | | | | 1 | | | |
| 19 | 89793 | Lower housing | | | | | | | 1 | | | |
| 20 | S-216-20 | Gasket (See Note 4) | | | | | | | 1 | | | |
| — | 77890-61 | Piston and body assembly | | | | | | | 1 | | | |
| 16 | S-216-11-125 | Liquid piston | | | | | | | 1 | | | |
| 21 | 77889-2 | Liquid body | | | | | | | 1 | | | |
| 17 | 79550-11-1* | O-ring, 90 shore, nitrile | | | | | | | 1 | | | |
| 18A | 90098-125 | Back-up ring | | | | | | | 2 | | | |
| — | 89803-150-1 | Piston, body and housing assembly (See Note 4) | | | | | | | | 1 | | |
| 19 | 89793 | Lower housing | | | | | | | | 1 | | |
| 20 | S-216-20 | Gasket (See Note 4) | | | | | | | | 1 | | |
| — | 77890-31 | Piston and body assembly | | | | | | | | 1 | | |
| 16 | S-216-11-150 | Liquid piston | | | | | | | | 1 | | |
| 21 | 77889-3 | Liquid body ) | | | | | | | | 1 | | |
| 17 | 79550-10-1* | O-ring, 90 shore, nitrile | | | | | | | | 1 | | |
| 18A | 90098-150 | Back-up ring | | | | | | | | 2 | | |
| — | 82650-21 | Valve assembly, outlet (3/8 NPT thread) | 1 | 1 | 1 | 1 | 1 | 1 | | | | |
| — | 82651-21 | Valve assembly, inlet (3/8 NPT thread) (See Note 7 | 1 | 1 | 1 | 1 | 1 | 1 | | | | |
| 22 | 88906 | Check valve body (See Note 7) | 1 | 1 | 1 | 1 | 1 | 1 | | | | |
| — | 79420-3 | Poppet assembly (See Note 7) | 1 | 1 | 1 | 1 | 1 | 1 | | | | |
| 23 | 79420-1 | Poppet (See Note 7) | 1 | 1 | 1 | 1 | 1 | 1 | | | | |
| 24 | 79550-8-1* | Packing O-ring, 90 shore, nitrile (See Note 7) | 1 | 1 | 1 | 1 | 1 | 1 | | | | |
| 25 | S-216-23 | Spring (See Note 7) | 1 | 1 | 1 | 1 | 1 | 1 | | | | |
| 26 | 91417-019 | O-ring, 70 shore, nitrile | 1 | 1 | 1 | 1 | 1 | 1 | | | | |
| — | 89803-200-1 | Piston, body and housing assembly (See Note 4) | | | | | | | | | 1 | |
| 19 | 89793 | Lower housing | | | | | | | | | 1 | |
| 20 | S-216-20 | Gasket | | | | | | | | | 1 | |
| — | 77890-41 | Piston and body assembly | | | | | | | | | 1 | |
| 27 | S-216-11-200 | Liquid piston | | | | | | | | | 1 | |
| 28 | 77889 | Liquid body | | | | | | | | | 1 | |
| 17 | 79550-8-1* | O-ring, 90 shore, nitrile | | | | | | | | | 1 | |
| 18 | MS28782-8 | Packing retainer, Teflon | | | | | | | | | 1 | |
| 18A | 90098-200 | Back-up | | | | | | | | | | |

*Seal Materials: Neoprene, Viton and EPR.



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| Item No | Model Number | Part Name | Pump Ratio Dash Number | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | -10 | -20 | -30 | -35 | -60 | -100 | -125 | -150 | -200 | -300 |
| — | 89803-300-1 | Piston, body and housing assembly (See Note 4) | | | | | | | | | | 1 |
| 19 | 89793 | Lower housing | | | | | | | | | | 1 |
| 20 | S-216-20 | Gasket | | | | | | | | | | 1 |
| — | 77890-51 | Piston and body assembly | | | | | | | | | | 1 |
| 27 | S-216-11-300 | Liquid piston | | | | | | | | | | 1 |
| 28 | 77889-1 | Liquid body | | | | | | | | | | 1 |
| 17 | 91417-011-1* | O-ring, 90 shore, nitrile | | | | | | | | | | 1 |
| 18 | MS28782-6 | Packing retainer, Teflon | | | | | | | | | | 1 |
| 18A | 90098-300 | Back-up ring | | | | | | | | | | 1 |
| — | 82648-11 | Valve assembly, outlet (9/16 NBS thread) | | | | | | | 1 | 1 | 1 | 1 |
| — | 82649-11 | Valve assembly, inlet (1/4 NPT thread) | | | | | | | 1 | 1 | 1 | 1 |
| 31 | 89298-1 | Outlet Check valve body (See Note 7) | | | | | | | 1 | 1 | 1 | 1 |
| 31A | 89298 | Inlet Check valve body (See Note 7) | | | | | | | 1 | 1 | 1 | 1 |
| 32 | 79550-5-1* | Packing O-ring, 90 shore, nitrile (See Note 7) | | | | | | | 1 | 1 | 1 | 1 |
| 33 | 89297 | Poppet (See Note 7) | | | | | | | 1 | 1 | 1 | 1 |
| 34 | S-216-63 | Spring (See Note 7) | | | | | | | 1 | 1 | 1 | 1 |
| 35 | S-216-28-10 | Inlet check valve gasket (See Note 7) | | | | | | | 1 | 1 | 1 | 1 |
| — | S-216-28-8 | Outlet check valve gasket (See Note 7) | | | | | | | 1 | 1 | 1 | 1 |
| 36 | S-216-27-4 | Outlet check valve seat only (See Note 7) | | | | | | | 1 | 1 | 1 | 1 |
| 37 | 90523 | Connecting rod | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 38 | 93776-1 | Plain nut, 1/2-20 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 39 | MS35335-33 | Washer/Lock, external tooth, 1/4 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 40 | 78259 | Shifting nut | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 44 | 90686 | Self-locking nut, 1/4-28 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 45 | MS90725-3 | Screw cap, 1/4-20 X 1/2 long | 12 | 12 | 12 | 12 | 12 | 12 | 12 | 12 | 12 | 12 |
| 46 | MS51967-2 | Plain nut, 1/4-20 | 12 | 12 | 12 | 12 | 12 | 12 | 12 | 12 | 12 | 12 |
| 47 | 93594 | Elbow, 90° | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 |
| 48 | 88501 | Tube assembly | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 49 | 80063-2 | Nameplate | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |

## Notes

1. 90654-1 shuttle assembly and 90651-1 body and housing assembly may be purchased as an assembled set.
2. 90651-1 body and housing assembly, consisting of body (5A), gasket (5B) and upper housing (5C), is available only as an assembled set.
3. -10 through -35 pumps: lower housing (19), gasket (20) and liquid body (21) are available only as an assembled set.
4. -60 through -300 pumps: liquid body (21), liquid piston (16), O-ring (17), retainers (18), back-up rings (18A and 30A), lower housing (19) and gasket (20) are available only as an assembled set. O-rings, retainers and back-up rings can be ordered separately.
5. Each liquid body and lower housing assembly (See Notes 3 and 4) is provided with an accurately located port (hole) for tube assembly (48) and elbow (47).
6. Seal materials listed in the Parts List are nitrile. Neoprene, Viton and EPR seals are available. Specify seal materials when ordering.
7. Detail parts are identified in the inlet and outlet check valve assemblies.



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*Division of Curtiss-Wright Flow Control Corporation*

10195 Brecksville Road
Brecksville, OH 44141 USA
Telephone: 440-838-7690 • Fax: 440-838-7513
www.cwfc.com

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