SERVICE MANUAL

4DNX, 4DX, 4SP, 4SPX SERIES PLUNGER PUMPS

CAT PUMPS®
The Pumps with Nine Lives

PUMP MODEL	FLOW		PRESSURE		RPM	TEMPERATURE		SHAFT DIA.		OIL CAPACITY	
	gpm	lpm	psi	bar	Pump	˚F	˚C	in	mm	oz	l
4DNX25GSI	2.5	9.5	3000	207	3450	140	60	3/4	19	8.5	0.25
4DNX27GSI	2.7	10.2	3000	207	3450	140	60	3/4	19	8.5	0.25
4DX03ELR	0.3	1.14	2000	138	1750	140	60	5/8	15.8	8.5	0.25
4DX10ER	1.0	3.8	2000	138	3450	140	60	5/8	15.8	8.5	0.25
4DX15ER	1.5	5.7	2000	138	3450	140	60	5/8	15.8	8.5	0.25
4DX20ER	2.0	7.6	2000	138	3450	140	60	5/8	15.8	8.5	0.25
4DX27ER	2.7	10.2	2000	138	3450	140	60	5/8	15.8	8.5	0.25
4DX30ER	3.0	11.4	2000	138	3450	140	60	5/8	15.8	8.5	0.25
4DX29GUIF	2.9	11.0	2600	179	3450	140	60	3/4	19	8.5	0.25
4SP21ELR	2.1	7.9	2000	138	1750	140	60	5/8	15.8	10.1	0.30
4SP29ELR	2.85	10.8	1200	83	1725	140	60	5/8	15.8	10.1	0.30
4SPX32G1I	3.2	12.1	3000	207	3450	140	60	1	25.4	10.1	0.30

IMPORTANT SAFETY INSTRUCTIONS

It is the responsibility of the user to read and understand all instructions, important safeguards, and safety precautions before operating or servicing any pump. Failure to do so may result in property damage, personal injury or death.

General Safety Information and Symbols

Pay special attention to the following signal words, safety alert symbols and statements:

⚠DANGER indicates a hazardous situation which, if not avoided, will result in death or serious injury.

⚠WARNING indicates a hazardous situation which, if not avoided, could result in death or serious injury.

⚠CAUTION indicates a hazardous situation which, if not avoided, could result in minor or moderate injury or property damage.

NOTICE indicates a hazardous situation which, if not avoided, could result in property damage.

⚠ Indicates a potential personal injury hazard. Obey all safety messages that follow this symbol to avoid possible injury or death.

SERVICING THE 4DNX, 4DX, 4SP and 4SPX SERIES PLUNGER PUMPS

⚠WARNING

Do not service pump or electrical equipment while energized. Electricity can cause personal injury, death or property damage.

1. Adhere to "Lock Out" and "Tag Out" procedures for electrical equipment.
2. Before commencing pump service, turn power supply off.
3. Keep water away from electrical outlets and electrical devices.
4. Electrical components must be installed by a qualified electrician to avoid risk of electrocution.

SERVICING THE VALVES

Disassembly

NOTE: All pump models require one (1) stacked valve kit to repair pump.

NOTE: Discharge and inlet valve assemblies may stay together or separate during removal. Spring retainers may also separate from the seat during removal.

1. Use a M19 hex tool to remove three (3) valve plugs (Model 4DX03ELR has [2] valve plugs).
2. Use a pick tool to remove o-ring from each valve plug.
3. Use a reverse pliers to remove stacked valve assembly from each valve chamber (See Figure 1).

NOTE: Pump series 4DX - if inlet seat or discharge seat remains in valve chamber use a M8 screw to thread into seat and pull out (See Figure 2).

4. Separate discharge valve assembly (top) from inlet valve assembly (bottom) (See Figure 3).
5. Disassemble discharge valve assembly and inspect all parts per NOTE.

NOTE: Pump series 4DNX, 4SPX and 4SP have o-ring and backup-ring, no backup-ring on pump series 4DX (See Figure 4).

6. Disassemble inlet valve assembly and inspect all parts per NOTE.

NOTE: Examine seats, valves and springs for grooves, pitting or wear and replace with a new valve kit as needed (See Figure 5).

NOTE: Examine o-rings and backup-rings for cuts or wear and replace with a new valve kit as needed (See Figure 5).

Reassembly

NOTE: New stacked valve assembly (inlet/discharge) already assembled.

7. Place new stacked valve assembly (inlet/discharge) with inlet valve down into each valve chamber.
8. Lubricate and install o-ring onto each valve plug.
9. Apply Loctite®242® to threads of each valve plug, hand thread valve plug into each valve chamber.
10. Use a M19 hex tool to torque each valve plug to 520 in lbs, 43 ft lbs or 58 Nm.

Loctite and 242 are registered trademarks of Henkel Corporation.

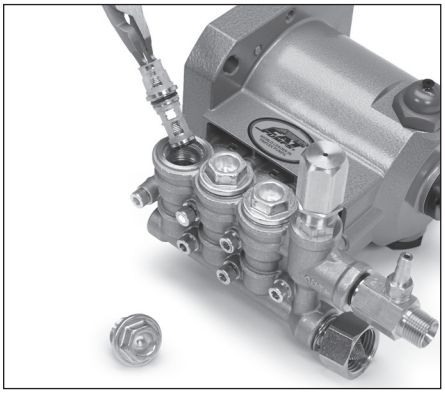


Figure 1

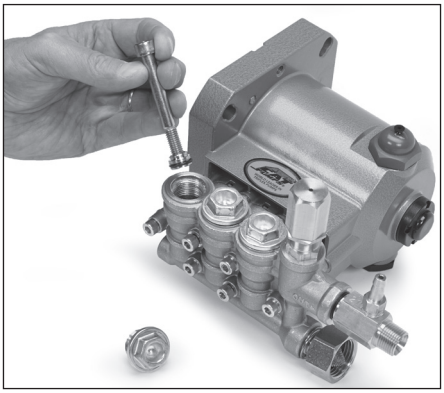


Figure 2

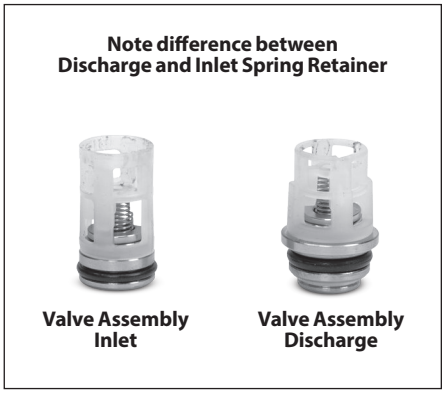


Figure 3

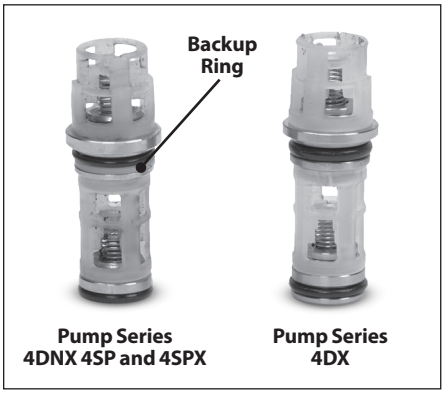


Figure 4

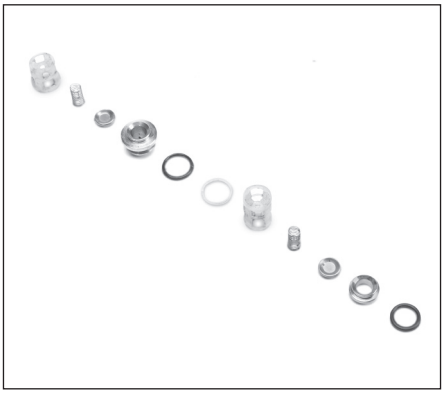


Figure 5

SERVICING THE SEALS

Disassembly

NOTE: All pump series require one (1) seal kit to repair pump.

NOTE: Manifold must be removed to service the seals.

1. Use a M5 allen wrench to remove hex socket head screws (HSH).

NOTE: Pump series 4DNX and 4DX have six (6) HSH screws.

NOTE: Pumps series 4SP and 4SPX have eight (8) HSH screws.

2. Use two (2) flat tip screwdrivers to create a separation between manifold and crankcase, then remove manifold by hand.

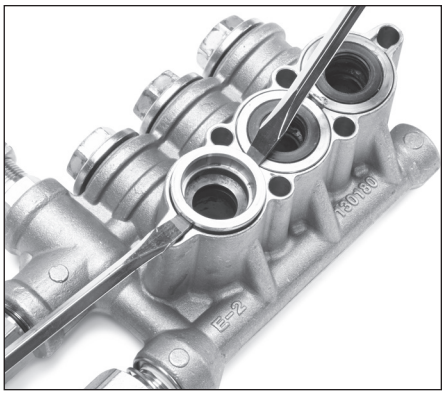


Figure 6

NOTICE

Keep the manifold head properly aligned with the ceramic plungers when removing to avoid damaging the plungers.

3. Remove low-pressure seals from either plungers or within seal cases.
4. Use two (2) flat tip screwdrivers to remove seal cases from manifold (See Figure 6).
5. Use a pick tool to remove o-ring from each seal case.
6. Remove high-pressure seal from each seal chamber (See Figure 7).

NOTE: Pump series 4SPX - remove ring support first, then high-pressure seal. Pump series 4DNX, 4DX and 4SP do not have this support ring (See Figure 8).

NOTE: Examine low-pressure seals for wear to internal surfaces, outer surfaces, and broken springs and replace with a new seal kit as needed.

NOTE: Examine seal case o-rings for cuts or deterioration and replace with a new seal kit as needed.

NOTE: Examine high-pressure seals for frayed edges or uneven wear and replace with a new seal kit as needed.

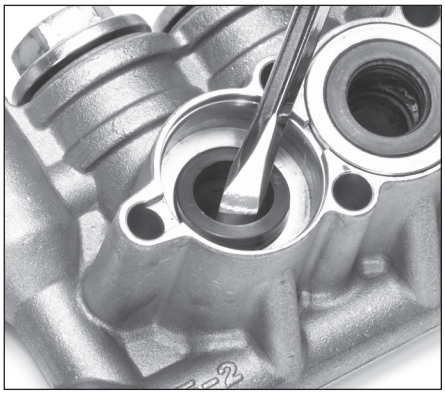


Figure 7

Reassembly

1. Place manifold on a flat surface with the crankcase side of manifold facing upwards.
2. Install high-pressure seal with open side down into each seal chamber (See Figure 9).

NOTE: Pump series 4SPX - place support ring on top of high-pressure seal.

3. Lubricate and install o-ring onto each seal case.
4. Install seal case into each seal chamber of manifold.
5. Pump Series 4DX, 4SP and 4SPX – Install low-pressure seal with spring facing down into seal case, press into place until flush with seal case.
6. Lightly lubricate ceramic plungers. Carefully slide manifold over the ceramic plungers, supporting it from the underside. Press manifold up to crankcase until flush.
7. Thread in manifold screws by hand.
8. Use a M5 allen wrench and torque in sequence as shown to 55 in lbs, 4.6 ft lbs or 6.2 Nm.

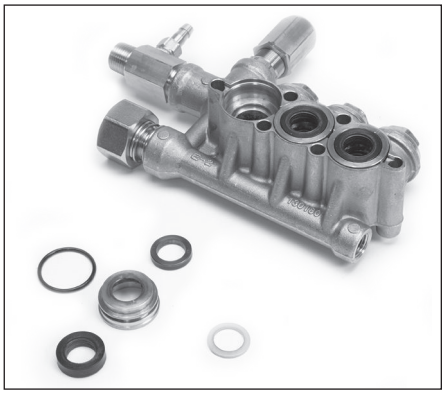
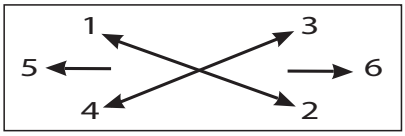


Figure 8

PUMP SERIES 4DNX AND 4DX TORQUE SEQUENCE



PUMP SERIES 4SP AND 4SPX TORQUE SEQUENCE

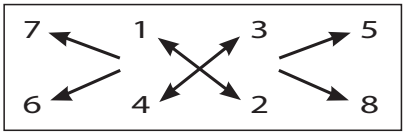


Figure 4

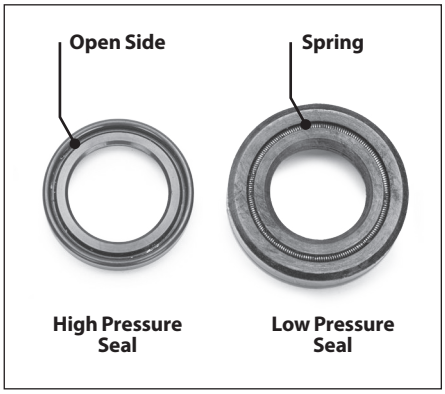


Figure 9

SERVICING THE PLUNGERS

Disassembly

NOTE: Remove manifold head as noted under **SERVICING SEALS,** Disassembly, steps 1 to 3.

NOTE: Pump series 4SP and 4SPX crankcase style is different than the 4DNX and 4DX pump series.

1. Use M10 hex tool to remove plunger retainer from each plunger rod.
2. Remove seal washer from each plunger retainer.
3. Remove ceramic plunger from each plunger rod.
4. Remove seal retainers from crankcase.

NOTE: Pump series 4SP and 4SPX seal retainer is different than the 4DNX and 4DX pump series (See Figure 10).

NOTE: Examine seal washers for cuts or deterioration and replace with a new seal kit as needed.

NOTE: Examine plunger retainer for damaged threads and replace individually as needed.

NOTE: Examine ceramic plunger for scoring, scale build-up, chips or cracks and replace individually as needed.

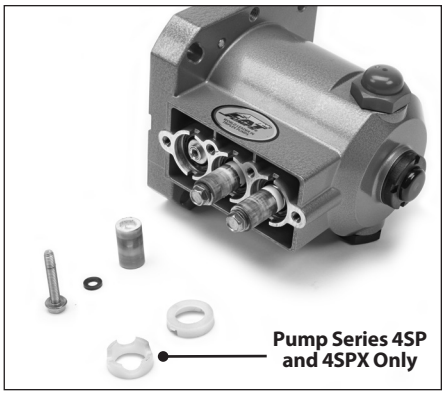


Figure 10

Reassembly

5. Install seal washer over each plunger retainer.
6. Slide plunger retainer with seal washer onto flat end of each ceramic plunger.
7. Apply Loctite®242® to exposed threaded end of each plunger retainer.
8. Install ceramic plunger with plunger retainer and seal washer over each plunger rod shoulder and thread hand tight (See Figure 11).
9. Use a M10 hex tool and torque to 55 in lbs, 4.6 ft lbs or 6.2 Nm.
10. On pump series 4DNX and 4DX, slide white seal retainer with slotted openings to the top and bottom and facing the crankcase (See Figure 12).
11. On pump series 4SP and 4SPX, slide white seal retainer with flat end facing the crankcase (See Figure 13).

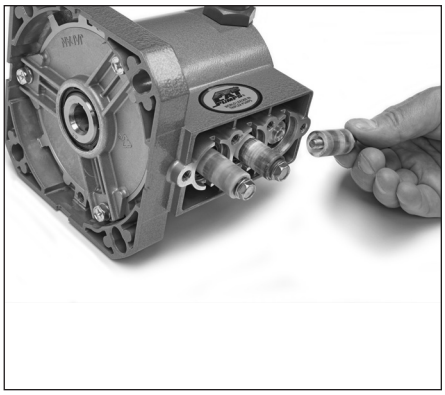


Figure 11

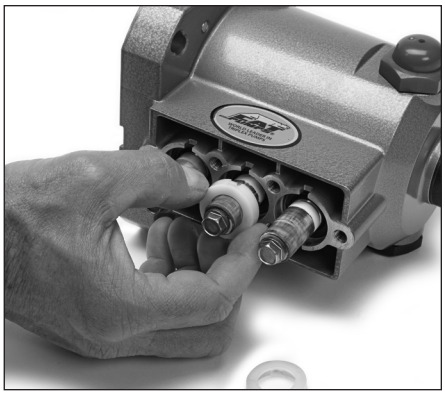


Figure 12

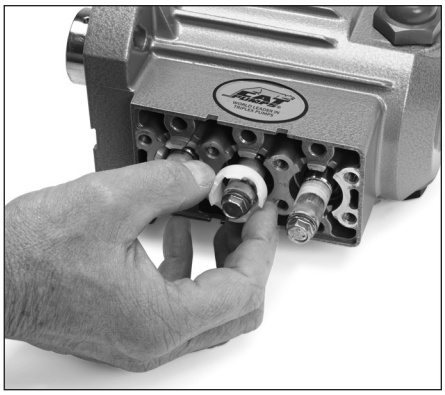


Figure 13

SERVICING THE UNLOADER OR REGULATOR

Disassembly

1. Loosen and turn locking nut towards unloader body.
2. Use a M21 hex tool or turn by hand to remove the brass adjusting cap. On pump series 4SPX, remove black nylon adjusting handle.
3. Remove spring and flat spring retainer.
4. Use a M19 hex tool to remove piston retainer.
5. Use a needle nose pliers to remove complete piston assembly (See Figure 14).
6. Use a #5 Easy Out to remove piston seat (See Figure 15).

NOTE: Pump series 4DNX, 4DX and 4SPX with a chemical injector - use a M22 hex tool to remove chemical injector from unloader/manifold body (See Figure 16).

NOTE: Pump series 4DX and 4SP without a chemical injector - use a M22 hex tool to remove discharge fitting from regulator/manifold body.

7. On pump series 4DNX and 4DX, remove spring, check valve, check valve seat and o-ring from unloader/manifold chamber.

NOTE: Examine o-rings and backup-rings for cuts or deterioration and replace with a new o-ring kit as needed.

NOTE: Examine valve end of piston assembly for wear, scoring and replace with a new repair kit as needed.

NOTE: Examine spring, check valve, check valve seat and o-ring for damage and replace with a new check valve kit as needed.

Reassembly

12. On pump series 4DNX, 4DX and 4SPX with chemical injector, lubricate and install o-ring on check valve seat. Insert with o-ring towards manifold.
13. Install check valve into check valve seat followed by spring.
14. Lubricate and install o-ring on chemical injector or discharge fitting.
15. Apply Loctite®242® to threads of chemical injector or discharge fitting.
16. Use a M22 hex tool to tighten chemical injector. Ensure hose barb faces upward.
17. Lubricate and install o-ring on seat.
18. Install seat with tapered inside diameter facing downward into unloader/regulator chamber (See Figure 17).
19. Install complete piston assembly into unloader/regulator chamber with slotted stem facing up.
20. Apply Loctite®242® to threads of piston retainer. Hand thread into unloader/regulator chamber, tighten with M19 hex tool.
21. Install flat spring retainer and then spring.
22. Thread brass adjusting cap onto piston retainer threads. On pump series 4SPX, install black nylon adjusting handle.

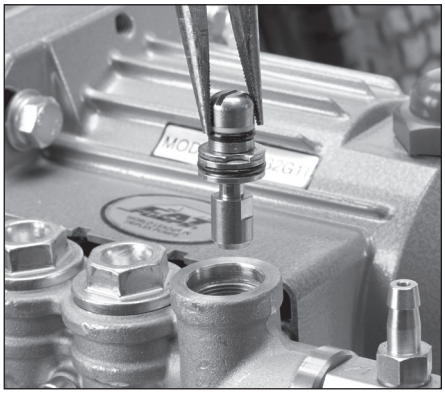


Figure 14

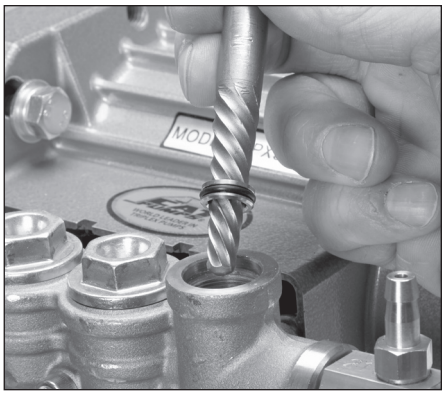


Figure 15

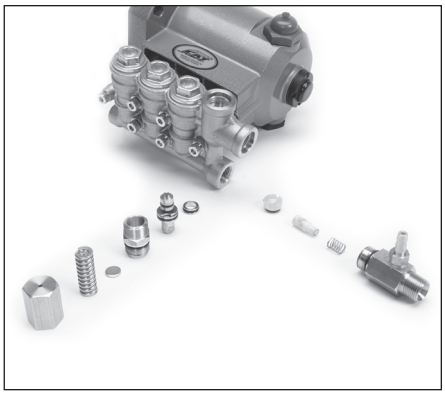


Figure 16

Unloader Valve Maintenance

Easy to Service

- No special tools required
- Repair kits are preassembled with only four (4) parts
- Simply drop in replacement components for quick service
- Repair kits are on-the-shelf stock items for 24-hour shipping



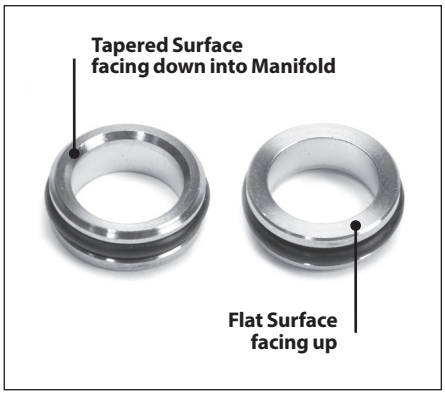


Figure 17

SERVICING THE CHEMICAL INJECTOR

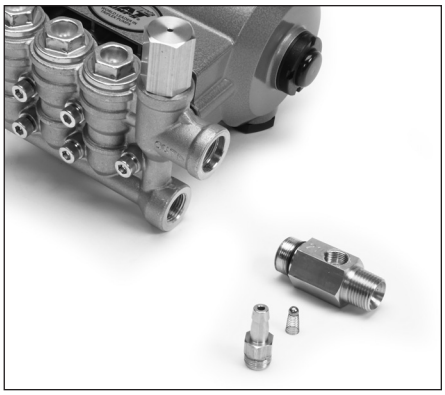


Figure 18

Disassembly

NOTE: To remove barb - do not remove chemical injector from pump.

NOTE: Remove chemical hose from barb.

1. Use a M12 hex tool to remove barb.
2. Use a pick tool to remove o-ring from within barb.
3. Remove ball and spring from chemical injector body.
4. Use a M22 hex tool to remove chemical injector from unloader/manifold body (See Figure 18).
5. Use a flat tip screwdriver to remove orifice from chemical injector body.

NOTE: Examine barb and orifice for wear and damage and replace individually as needed.

NOTE: Examine spring, ball and o-ring for damage and replace with a new repair kit.

Reassembly

6. Apply Loctite® 263™ to threads of orifice.
7. Thread in orifice to chemical injector body. Torque to 53 in lbs, 4.4 ft lbs or 6 Nm.
8. Install spring with large diameter side down into barb hole.
9. Install ball onto spring.
10. Lubricate and install o-ring into inside threaded end of barb.
11. Apply Loctite®242® to threaded end of barb.
12. Hand thread barb into body of chemical injector.
13. Use a M12 hex tool to tighten barb.
14. Ensure check valve seat w/o-ring, check valve and spring are installed in unloader/manifold chamber.
15. Lubricate and install o-ring onto chemical injector.
16. Apply Loctite® 242® to threads of chemical injector.
17. Hand thread chemical injector into unloader/manifold chamber.
18. Tighten with M22 hex tool.

INSPECTION OF CRANKCASE COMPONENTS

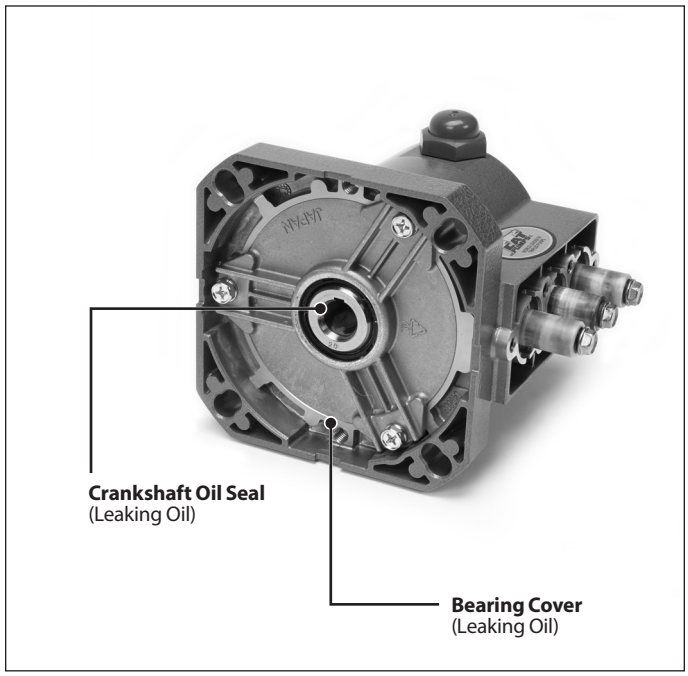


Figure 19

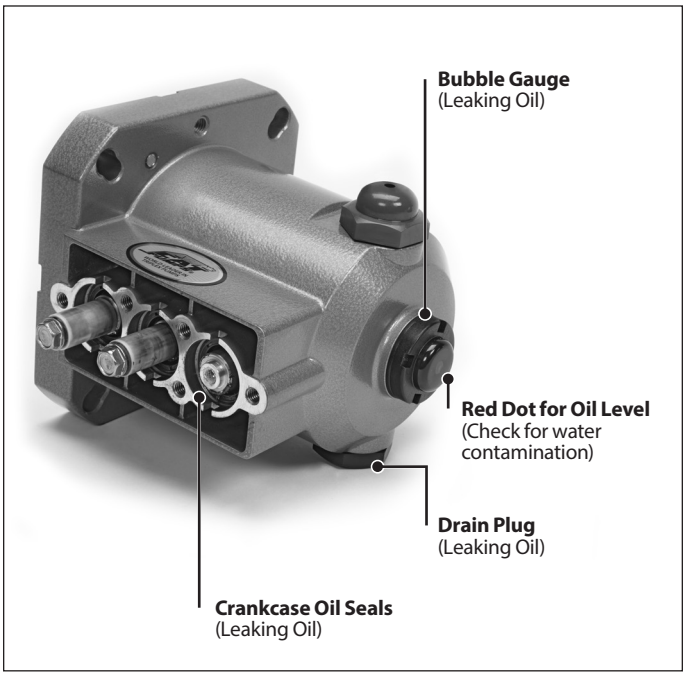


Figure 20

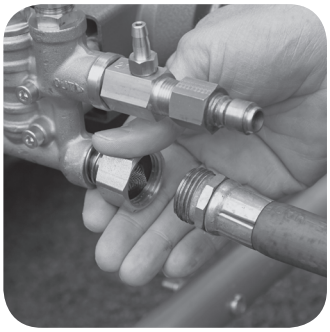
Contact Cat Pumps or local distributor for servicing crankcase.

During long term or season storage of three months or longer, the residual fluid left in the pump can cause corrosion, sticking valves and mineral deposits. For equipment stored where the temperatures drop below freezing the pump can be damaged from water freezing in the manifold. Using Cat Pumps specially formulated Pump Protector (Part # 6108, 12 oz bottle) will help prevent any damage during storage.

STEPS TO STORE AND PROTECT YOUR PUMP



1. Turn engine/motor to Off position.



2. Disconnect all hoses.



3. Unscrew blue valve from bottle and remove white internal seal.



4. Thread blue valve back onto bottle.



5. Remove black protective cap to expose male garden hose thread and internal check valve.



6. Screw bottle into garden hose fitting on inlet of pump.



7. Squeeze bottle to inject pump protector fluid into pump.



8. **Gas Pressure Washers** Pull starter cord until pump protector fluid is discharged from pump outlet. (DO NOT START ENGINE).



9. **Electric Pressure Washers** Briefly turn pressure washer on until pump protector fluid is discharged from pump outlet, then turn unit Off.



10. Remove bottle from garden hose fitting. Store or dispose of bottle properly.

PREVENTIVE MAINTENANCE SCHEDULE

Many application factors determine proper pump maintenance intervals. Variation in duty cycle, operating performance, fluid temperature, fluid type, inlet conditions and application environment can affect maintenance schedules. **Every application should be evaluated and serviced based on its own requirements.** The following checklist is intended as a reference guide only.

Check	Daily		Weekly	50 Hrs.	1500 Hrs.	3000 Hrs.
Filters	•	or	•			
Oil Level/Quality	•	or	•	①		
Water Leaks	•	or	•			
Oil Leaks	•					
Plumbing			•			
Belts, Pulley			•			
Accessories					•	
Seals					②	
Valves						③

Water leaks or loss of system performance can be an indicator of seal wear. Seal wear has many causes, including contaminated liquid or high-temperature/run dry operation. If the low-pressure seals show wear, the high-pressure seals most likely are in a similar condition. It is a good practice to replace both low and high pressure seals and inspect plungers when leaks are present.

① Cat Pumps recommends using our custom-blend premium grade hydraulic oil formulated to meet Cat Pumps specifications. For best results, perform an initial oil change after the first 50 hours of operation and every 500 hours thereafter. If other oil is used, oil change should be performed every 300 hours of operation.

② Every system operates under different conditions. Past performance and maintenance history are the best indicators of future performance. **If system performance degrades or changes, check seals and valves immediately. Service as required to restore system performance.** Depending upon operating conditions, maintenance intervals for seals kits range between 1,500 and 8,000 hours.

③ Pump valves typically require changing every other seal change. Depending upon operating conditions, maintenance intervals for valve kits range between 3,000 and 16,000 hours.

⚠DANGER

A. FLAMMABLE OR EXPLOSIVE LIQUID HAZARD

Do not operate pump with flammable or explosive liquids unless extraordinary safety precautions are observed. Leaks of flammable or explosive liquids, if exposed to elevated temperatures, static electricity, sparks or other hazards, will result in flame or possible explosion, causing serious personal injury, death or property damage.

1. Before operating pump with flammable or explosive liquids, ensure proper maintenance has been performed.
2. Do not operate pump with flammable or explosive liquids if leaks are detected.
3. Only pump flammable or explosive liquids that are compatible with pump component materials.
4. Do not operate pump with flammable or explosive liquids without safeguards or safety systems to detect leaks, elevated temperatures, spark prevention or any other hazards defined by the NFPA systems.
5. Do not remove Flammable Liquids Product Suitability Hang Tag to assure proper safety.
6. Follow ATEX guidelines for potentially explosive atmospheres.

⚠WARNING

A. ELECTRICAL SHOCK HAZARD

Do not service pump or electrical equipment while energized. Electricity can cause personal injury, death or property damage.

1. Adhere to "Lock Out" and "Tag Out" procedures for electrical equipment.
2. Before commencing pump service, turn power supply off.
3. Keep water away from electrical outlets and electrical devices.
4. Electrical components must be installed by a qualified electrician to avoid risk of electrocution.

B. ROTATING PARTS HAZARD

Do not service pump while energized. Moving, rotating or reciprocating parts can crush and cut, causing personal injury, death or property damage.

1. Adhere to "Lock Out" and "Tag Out" procedures for electrical equipment.
2. Before commencing pump service, turn power supply off, turn water supply off, squeeze trigger on gun to relieve system pressure.
3. For mobile equipment, be sure engines and hydraulics are turned off and secured to avoid accidental start.
4. Do not operate with safety guards removed.
5. Always use safety guards on all belt drives, couplings and shafts.

C. HOT SURFACE HAZARD

Do not touch pump, accessories or drive system while operating and until cool down is complete. Touching hot surface areas of the pump, accessories or drive system can cause severe burns or personal injury.

D. SKIN PUNCTURE HAZARD

Do not allow spray to contact any part of the body or animals. Pumped liquids under high pressure can pierce skin and underlying tissue or can deflect debris leading to serious personal injury or death.

1. Relieve all line pressure in the inlet line to the pump and discharge line from the pump before performing any maintenance on the pump.
2. When high pressure gun is not in use, set safety trigger lock (safety latch) to avoid accidental high pressure operation and personal injury or property damage.
3. Do not check for leaks with hand. Use a piece of cardboard to check for leaks.
4. Review cleaning procedures to minimize heavy back blasting.
5. Wear adequate safety equipment and clothing when operating high pressure sprayer.
   Never use high pressure spray with bare feet or exposed skin, and always wear safety glasses.

E. PUMPING LIQUIDS HAZARD

Do not operate pump with hot water, chemicals, or other hazardous liquids unless extraordinary safety precautions are observed. Pumping hot water, chemicals, or other hazardous liquids can expose personnel to serious injury.

1. Provide guards or shields around equipment to protect personnel.
2. Wear mask, goggles or eye protection while operating high pressure equipment.
3. Obtain a Material Safety Data Sheet (MSDS) or Safety Data Sheet (SDS) and take appropriate safety measures for the liquid being handled.

F. OVER PRESSURIZATION HAZARD

Do not operate high pressure pumping system unless extraordinary safety precautions are observed. A high pressure pumping system can deadhead or over pressurize causing serious personal injury and property damage.

1. All high pressure systems require a primary pressure regulating device (i.e., regulator or unloader) and a secondary pressure safety relief device (i.e., pop-off valve, safety valve, rupture disc) to assure proper pressure setting and overpressure protection.
2. All high pressure systems require a pressure gauge to monitor pressure settings and avoid overpressure of equipment or personal harm.
3. Install primary pressure relief device on the discharge side of the pump.
4. Install secondary pressure relief device between the primary device and pump.
5. Install pressure gauge onto the discharge manifold or in the discharge line near the manifold.
6. Open all valves on discharge side of plumbing before operation.

G. OXYGEN HAZARD

Do not charge Prrrrr-O-Lators (Pulsation Dampeners) with Oxygen. Oxygen may cause an explosion causing personal injury, death or property damage.

1. Use Nitrogen only when charging pulsation dampeners, DO NOT USE OXYGEN.
2. Use proper charging tools to charge pulsation dampeners.
3. Charge pulsation dampener within specifications stated on data sheet to assure proper pulsation dampening and prevent failure of bladder.

H. FALL HAZARD

Do not operate pressure washer while standing on slippery or unstable surface unless extraordinary safety precautions are observed. Pressure washing may create slippery surface on which a person may slip and fall causing personal injury or death.

1. Wear suitable footwear to maintain a good grip on wet surfaces.
2. Do not stand on ladders or scaffolding.
3. Do not over reach or stand on unstable supports.
4. Keep good footing and balance and hold gun with both hands to control kick back.

⚠ CAUTION

A. IMPROPER USE OF FITTINGS HAZARD

Do not operate the pump with improperly connected, sized, worn or loose fittings, pipes or hoses. Operating the pump under these conditions could result in personal injury and property damage.

1. Ensure all fittings, pipes and hoses are properly rated for the maximum pressure rating and flow of the pump.
2. Check all fittings and pipes for cracks or damaged threads.
3. Check all hoses for cuts, wear, leaks, kinks or collapse before each use.
4. Ensure all connections are tight and secure.
5. Use PTFE thread tape or pipe thread sealant (sparingly) to reconnect plumbing. Do not wrap tape beyond the last thread, this will prevent tape from becoming lodged in the pump or accessories.
6. Apply proper sealants to assure secure fit or easy disassembly when servicing.

B. FROZEN LIQUID HAZARD

Do not operate the pump with frozen liquid. Operating the pump under this condition could over pressurize and jettison the manifold from the crankcase causing personal injury and property damage.

1. Store pump or pumping system in an environmentally controlled room protected from freezing temperatures.
2. Follow procedures in TECH BULLETIN 083 to winterize pump.

C. CLEANING PUMP HAZARD

Do not use solvents that are flammable and toxic to clean or degrease equipment. Use of these solvents could result in personal injury and property damage.

1. Follow safety instructions as found in MSDS or SDS or on packaging of each liquid.
2. Clean equipment in a well ventilated area.
3. Disposal of solvents to be in accordance with local, state and federal regulations.

D. OPERATING BEYOND SPECIFICATIONS HAZARD

Do not operate the pump outside the specifications of individual pump data sheet or service manual. Operating the pump under these conditions could result in personal injury and property damage.

1. Do not operate the pump faster than the maximum recommended rpm.
2. Do not operate the pump at pressures higher than the maximum recommended pressure.
3. Do not operate the pump at temperatures higher than the maximum recommended temperatures.
4. Do not use accessories that are not compatible or rated for the pump.

E. LIFTING DEVICE HAZARD

Do not lift pump with unsuitable lifting devices. Use of unsuitable lifting devices may cause pump to fall resulting in personal injury, damage to pump and/or pump with drive/base plate.

1. Lifting eyes installed on the pump must be used only to lift the pump.
2. Special lifting eyes should be installed on the base for lifting the pumping system (i.e. base, drive and accessories)
3. If slings or chains are used for lifting, they must be safely and securely attached to properly balance the weight of the unit.
4. Inspect slings and chains prior to use and replace worn and damaged slings and chains.

NOTICE

A. OIL HAZARD

Use only genuine Cat Pumps custom-blend, premium grade, petroleum-based hydraulic oil. Use of other oil may not provide proper lubrication of drive-end components and may result in damage to the crankcase of the pump.

1. Cat Pumps custom-blend oil is available worldwide in 21 oz. bottles, cases, or 5 gallon twin packs. Use of other oils may void the warranty.
2. Fill pump crankcase to specific capacity indicated on data sheet or service manual prior to startup.

B. ROTATION OF PUMP HAZARD

Do not rotate pump crankshaft in reverse direction. Rotation of pump crankshaft in reverse direction may not provide proper lubrication and may result in damage to the drive-end components.

1. Forward rotation is the top of the crankshaft turning towards the manifold head of the pump.
2. Ensure oil is filled to the center red dot on sight gauge for forward rotation.
3. Ensure oil is filled to slightly above center red dot on sight gauge for reverse rotation.

C. BELT TENSION HAZARD

Do not operate pump with excessive belt tension. Excessive belt tension may damage the pumps bearings or reduce horsepower.

1. Rotate pump crankshaft before starting to ensure shaft and bearings are moving freely.
2. Ensure pulleys are properly sized.
3. Periodically replace belts to assure full horsepower transmission.
4. Ensure center distance dimensions between pulleys is correct.

D. BY-PASS OPERATION HAZARD

Do not operate the pump in by-pass for extended lengths of time. Operating the pump under this condition can quickly cause heat build-up resulting in damage to the pump.

1. Route by-pass line to supply reservoir to dissipate heated by-pass liquid into a large reservoir of cool water to reduce excessive temperature build-up.
2. Route by-pass line to inlet of pump using a thermo valve in the by-pass line or auto shut-off assembly that will sense temperature rise and either by-pass or shut down system before damage occurs.

E. DRY OPERATION HAZARD

Do not operate the pump without water or liquid. Operating pump under these conditions could result in damage to the pump.

1. Open all valves on inlet side of pump before starting operation to prevent starving the pump.
2. Do not exceed inlet suction pressure limit specified in pump data sheet.
3. Ensure inlet feed exceeds the maximum flow being delivered by the pump.
4. Ensure all fittings, pipes and hoses are properly sized for the pump to avoid restricted flow.
5. Review and implement all other recommendations appropriate for your system from the Inlet Condition Check-List.

DIAGNOSIS AND MAINTENANCE

One of the most important steps in a high pressure system is to establish a regular maintenance program. This will vary slightly with each system and is determined by various elements such as the duty cycle, the liquid being pumped, the actual specifications vs rated specifications of the pump, the ambient conditions, the inlet conditions and the accessories in the system. A careful review of the necessary inlet conditions and protection devices required before the system is installed will eliminate many potential problems. Cat Pumps are very easy pumps to service and require far less frequent service than most pumps. Typically, only common tools are required, making in-field service convenient, however, there are a few custom tools, special to certain models, that do simplify the process. This service manual is designed to assist you with the disassembly and reassembly of your pump. The following guide will assist in determining the cause and remedy to various operating conditions. You can also review our **FAQ** or **SERVICE** sections on our **WEB SITE** for more facts or contact Cat Pumps directly.

PROBLEM	PROBABLE CAUSE	SOLUTION
Low pressure	• Worn nozzle.	• Replace with proper size nozzle.
	• Air leak in inlet plumbing.	• Tighten fittings and hoses. Use PTFE liquid or tape.
	• Pressure gauge inoperative or not registering accurately.	• Check with new gauge. Replace worn or damaged gauge.
	• Relief valve stuck, partially plugged or improperly adjusted.	• Clean/adjust relief valve. Replace worn seats/valves and o-rings.
	• Inlet suction strainer (filter) clogged or improperly sized.	• Clean filter. Use adequate size filter. Check more frequently.
	• Abrasives in pumped liquid.	• Install proper filter.
	• Leaky discharge hose.	• Replace discharge hose with proper rating for system.
	• Inadequate liquid supply.	• Pressurize inlet.
	• Severe cavitation.	• Check inlet conditions.
	• Worn seals.	• Install new seal kit. Increase frequency of service.
	• Worn or dirty inlet/discharge valves.	• Clean inlet/discharge valves or install new valve kit.
Pulsation	• Foreign material trapped in inlet/discharge valves.	• Clean inlet/discharge valves or install new valve kit.
Water leak		
• Under the manifold	• Worn High-Pressure or Lo-Pressure Seals.	• Install new seal kit. Increase frequency of service.
• Into the crankcase	• Humid air condensing into water inside the crankcase.	• Install new oil cap protector. Change oil every 3 months or 500 hours.
	• Excessive wear to High-Pressure and Lo-Pressure seals.	• Install new seal kit. Increase frequency of service.
Knocking noise		
• Inlet supply	• Inadequate inlet liquid supply.	• Check liquid supply. Increase line size or pressurize.
• Bearing	• Broken or worn bearing.	• Replace bearing.
Oil leak		
• Crankcase oil seal	• Worn crankcase oil seal.	• Replace crankcase oil seal.
• Crankshaft oil seal and o-ring	• Worn crankshaft oil seal or o-ring on bearing cover.	• Remove bearing cover and replace o-ring and/or oil seal.
• Drain plug	• Loose drain plug or worn drain plug o-ring.	• Tighten drain plug or replace o-ring.
• Bubble gauge	• Loose bubble gauge or worn bubble gauge gasket.	• Tighten bubble gauge or replace gasket.
• Bearing cover	• Loose bearing cover or worn bearing cover o-ring.	• Tighten bearing cover or replace o-ring.
• Filler cap	• Loose filler cap or excessive oil in crankcase.	• Tighten filler cap. Fill crankcase to specified capacity.
Pump runs extremely rough		
• Inlet conditions	• Restricted inlet or air entering the inlet plumbing	• Correct inlet size plumbing. Check for air tight seal.
• Pump valves	• Stuck inlet/discharge valves.	• Clean out foreign material or install new valve kit.
• Pump seals	• Leaking High-Pressure or Lo-Pressure seals.	• Install new seal kit. Increase frequency of service.
Premature seal failure	• Scored plunger.	• Replace plunger.
	• Over pressure to inlet manifold.	• Reduce inlet pressure per specifications.
	• Abrasive material in the liquid being pumped.	• Install proper filtration at pump inlet and clean regularly.
	• Excessive pressure and/or temperature of pumped liquid.	• Check pressure and inlet liquid temperature.
	• Running pump dry.	• DO NOT RUN PUMP WITHOUT LIQUID.
	• Starving pump of adequate liquid.	• Increase hose one size larger than inlet port size or pressurize.
	• Eroded manifold.	• Replace manifold. Check liquid compatibility.

The Pumps with Nine Lives

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