25FR PLUNGER PUMP SERVICE MANUAL

SPLIT MANIFOLD PLUNGER PUMPS
25 FRAME [2530, 2537]

CAUTION: CAT PUMPS are positive displacement pumps. Therefore, a properly designed pressure RELIEF OR SAFETY VALVE MUST BE INSTALLED in the discharge piping. Failure to install such a relief mechanism could result in personal injury or damage to the pump or system. CAT PUMPS does not assume any liability or responsibility for the operation of a customer's high pressure system.

INSTALLATION AND START-UP INFORMATION

Optimum performance of the pump is dependent upon the entire fluid system and will be obtained only with the proper selection, installation of plumbing, and operation of the pump and accessories.

SPECIFICATIONS: Maximum specifications refer to individual attributes. It is **not** implied that **all maximums** can be performed **simultaneously**. If more than one maximum is considered, check with your CAT PUMPS supplier to confirm the proper performance and pump selection.

LUBRICATION: Fill crankcase with special CAT PUMP oil per pump specifications [84 oz., 2.5 L]. DO NOT RUN PUMP WITHOUT OIL IN CRANKCASE. Change initial fill after 50 hours running period. Thereafter, change oil every **3 months or 500 hour intervals. Oiler adjustment** is vertical to start feed, horizontal to stop feed, dial to adjust flow rate. Additional lubrication may be required with increased hours of operation and temperature.

PUMP ROTATION: Pump was designed for forward rotation to allow optimum lubrication of the crosshead area. Reverse rotation is acceptable if the crankcase oil level is increased slightly above center dot to assure adequate lubrication.

PULLEY SELECTION: Select size of motor pulley required to deliver the desired volume from Horsepower Requirement and Pulley Selection Chart.

MOTOR SELECTION: The motor or engine driving the pump must be of adequate horsepower to maintain full RPM when the pump is under load. Select the electric motor from the Horsepower Requirement Chart according to required pump discharge volume, maximum **pressure at the pump** and drive losses of approximately 3-5%. Consult the manufacturer of gas or diesel engine for selection of the proper engine size.

Mount the pump on a rigid, horizontal surface in a manner to permit drainage of crankcase oil. An uneven mounting surface will cause extensive damage to the pump base. To minimize piping stress, **use appropriate flexible hose to inlet and discharge ports**. Use the correct belt; make sure pulleys are aligned. Excessive belt tension may be harmful to the bearings. Hand rotate pump before starting to be certain shaft and bearings are free moving.

LOCATION: If the pump is used in extremely dirty or humid conditions, it is recommended pump be enclosed. Do not store or operate in excessively high temperature areas or without proper ventilation.

INLET CONDITIONS: Refer to complete **Inlet Condition Check-List** in this manual before starting system. DO NOT STARVE THE PUMP OR RUN DRY.

C.A.T.: Installation of a C.A.T. (Captive Acceleration Tube) is recommended in applications with stressful inlet conditions such as high temperatures, booster pump feed, long inlet lines or quick closing valves.

DISCHARGE PLUMBING: OPEN ALL VALVES BEFORE STARTING SYSTEM to avoid deadhead overpressure condition and severe damage to the pump or system.

Install a **Pulsation Dampening** device mounted directly to the discharge line. Be certain the pulsation dampener (Prrrrr-o-lator) is properly precharged for the system pressure (see individual Prrrrr-o-lator data sheet).

A **reliable Pressure Gauge** should be installed near the discharge outlet of the high pressure manifold. This is extremely important for adjusting pressure regulating devices and also for proper sizing of the nozzle or restricting orifice. The pump is rated for a maximum pressure; this is the **pressure** which would be **read at the discharge manifold of the pump**, NOT AT THE GUN OR NOZZLE.

A Pressure Regulator or Unloader Valve must be installed to prevent over pressurizing the pump in the event the discharge or downstream plumbing becomes plugged or is turned off. Severe damage to the pump will result if this condition occurs without a relief valve in the line. **CAUTION: Failure to install such a safety valve will void the warranty on the pump. Discharge regulating devices should be at minimum pressure setting at start-up.** On systems over 2000 PSI SECONDARY PROTECTION is recommended by installing a pop-off valve, safety valve or rupture disc. START SYSTEM WITH ALL VALVES OPEN OR IN THE LOW PRESSURE SETTING.

Use PTFE liquid (sparingly) or tape to connect accessories or plumbing. Exercise caution not to wrap tape beyond the last thread to avoid tape from becoming lodged in the pump or accessories. This condition will cause a malfunction of the pump or system.

NOZZLES: A worn nozzle will result in loss of pressure. Do not adjust pressure regulating device to compensate. Replace nozzle and reset regulating device to system pressure.

PUMPED FLUIDS: Some fluids may require a **flush between operations or before storing.** For pumping fluids other than water, contact your CAT PUMPS supplier.

STORING: For extended storing or between use in cold climates, drain all pumped fluids from pump and **flush with antifreeze solution to prevent freezing and damage** to the pump. DO NOT RUN PUMP WITH FROZEN FLUID.

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Fig. 1

Fig. 2

Fig. 3

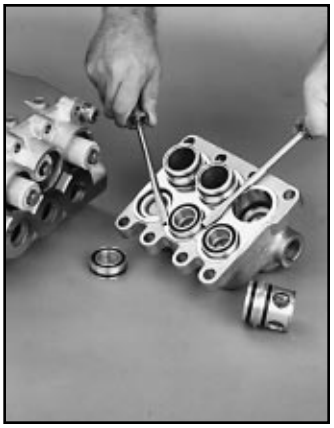


Fig. 4

SERVICING THE VALVES

Disassembly

1. To service the Valves, the Discharge Manifold must be removed. Using a M10 allen wrench remove the Socket Head Screws. (Fig. 1)
2. Support the underside of the Discharge Manifold and lightly tap the top back of the Manifold with a soft mallet. Two screwdrivers may be needed to further separate the Discharge Manifold from the Inlet Manifold. (Fig. 2)
3. Remove the Discharge Manifold and place it **crankcase side up.** (Fig. 3)
   NOTE: The Discharge Valve Assembly is secured in the upper chambers by the Discharge Valve Spacer, while the Inlet Valve Assembly is secured in the lower chambers by the Inlet Valve Adapter.
4. The Discharge Valve Spacers can remain in either the Inlet Manifold or the Discharge Manifold. (Fig. 5) To remove the Spacer from the Manifold, insert two screwdrivers on opposite sides under the machined lip on the outside of the Spacer and pry out. (Fig. 4)
5. To remove the Inlet Valve Adapter use a reverse pliers to pull out of the Manifold.
6. Both the Inlet and Discharge use the same Valve Assembly. With a flat head screwdriver, carefully pry the Valve Seat, O-Ring, Valve, Spring and Retainer from the manifold chamber. (Fig. 6 Discharge) (Fig. 7 Inlet)
   IMPORTANT: Exercise caution to avoid scoring the Manifold chamber wall.
   NOTE: This Valve Assembly does not snap together.

Reassembly

NOTE: For certain applications apply liquid gasket to the O-Ring crevices and seal surfaces. See Tech Bulletin 53 for model identification.

1. Inspect the Spring Retainer for any scale buildup or wear and place the new Spring Retainer into the valve chamber.
2. Examine the Spring for fatigue or breaks and place the new Spring into the Retainer.
3. Examine the Valve for pitting or grooves and set the new Valve onto the Spring with the **concave side down.**
4. Place the Valve Seat into the valve chamber with the **concave side down.** Then apply liquid gasket to the O-Ring and press squarely into the lip on the Spring Retainer.
   Effective with 695 mfg date, the O-Ring was moved to the back side of the Valve Seat with the O-Ring installed first, onto the lip in the manifold chamber, then the Valve Seat with the **machined O-Ring groove down.**
   Effective with 1195 mfg date, the Valve Seat was modified to a new thicker style, still with the O-Ring installed first, onto the lip in the manifold chamber, then the Valve Seat with the **machined O-Ring groove down.**
5. Examine the Valve Seat for any grooves, pitting or wear and replace. Place the new Valve Seat onto the the O-Ring with the concave side down.
6. Look for wear or damage to both the inner and outer O-Rings on the Inlet Adapter and replace.
7. Fit the O-Rings into both the outer groove and face groove of the Inlet Adapter and apply liquid gasket into the O-Ring crevice.
8. Press the Inlet Adapter into the lower Manifold chamber.
9. Remove and examine both O-Rings on the Discharge Valve Spacer for wear or cuts and replace as needed.
10. Fit the new O-Rings into the groove on the outside of the Discharge Valve Spacer. Apply liquid gasket into the O-Ring crevice and carefully press the Spacer completely into the Discharge Manifold chamber with the **smaller diameter side down.**
11. Replace Discharge Manifold over the Plunger Rods with Discharge Valve Spacers to the top and Inlet Adapters to the bottom. Tap with a soft mallet until completely seated in chambers.
12. Reinstall the Socket Head Screws and torque to specifications in chart.
    IMPORTANT: Follow the torque sequence to assure the proper alignment.

Fig. 5

Fig. 6

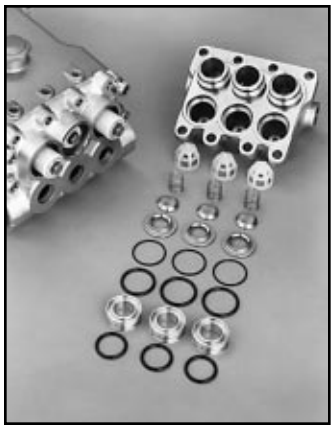


Fig. 7

Fig. 8


Fig. 9

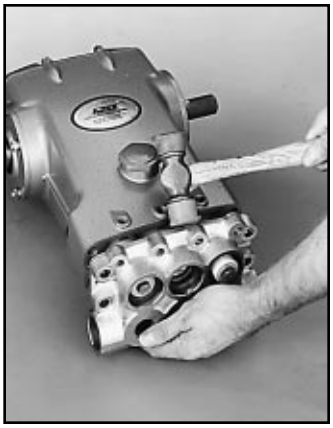


Fig. 10

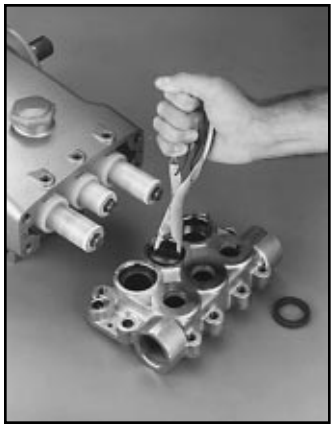


Fig. 11

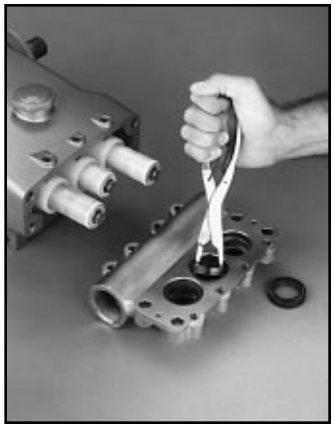


Fig. 12

SERVICING THE SEALS

Disassembly

1. Remove the Discharge Manifold as described in SERVICING THE VALVES section.
2. To service the seals the Inlet Manifold must be removed, use a M10 allen wrench to remove the 4 bolts. (Fig. 8)
3. Support the Inlet Manifold and lightly tap the top back side with a soft mallet. Remove the Inlet Manifold and place it **crankcase side down.** (Fig. 10)
4. Use a reverse pliers to remove the Hi-Pressure Seals. (Fig. 11)
5. The Lo-Pressure Seals may stay on the Plungers or in the Inlet Manifold.
6. Invert the Inlet Manifold with the **crankcase side up.**
7. Remove the Lo-Pressure Seal using a reverse pliers or slide it off the Plunger by hand. (Fig. 12)

Reassembly

NOTE: For certain applications apply liquid gasket to the O-Ring crevices and seal surfaces. See Tech Bulletin 53 for model identification.

1. Examine the Lo-Pressure Seal for wear or spring fatigue and replace. Apply liquid gasket to the outside of the new Lo-Pressure Seal and carefully press it into the Inlet Manifold chamber with the **spring down.**
2. Invert the Inlet Manifold and place the **crankcase side down.** Examine the Hi-Pressure Seal for deformity or wear and replace. Apply liquid gasket to the outside of the new Hi-Pressure Seal and carefully press it into the Inlet Manifold chamber with the **metal side down.**

SERVICING THE PLUNGERS

Disassembly

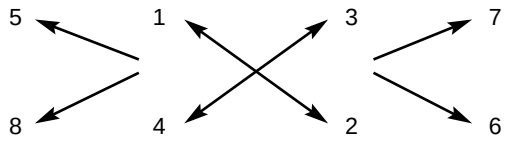
NOTE: The Ceramic Plungers and the Plunger Retainers should be examined on the same schedule as servicing the seals.

1. To service the Ceramic Plungers, first remove the Seal Retainers.
2. Loosen the Plunger Retainer about three or four turns using a M14 hex tool.
3. Grasp the Ceramic Plunger and push toward the Crankcase until it separates from the Plunger Retainer.
4. Unthread the Plunger Retainer with Gasket, O-Ring, Back-up-Ring and Ceramic Plunger. Remove the Keyhole Washer and Barrier Slinger from the Plunger Rod. (Fig. 13) and (Fig. 14)

Reassembly

1. Examine the Barrier Slinger for any wear or damage and place on the Plunger Rod with the **concave side facing out.**
2. Examine the Keyhole Washer and place on the Plunger Rod with the **slot down.**
3. Examine the O-Ring and Back-up-Ring on the Plunger Retainer and replace if worn or damaged. First install the Gasket, then the O-Ring and Back-up-Ring. Lubricate the Plunger Retainer O-Ring to avoid cutting during installation.
4. If the Plunger Retainer unthreads from the stud during removal, thread the stud into the retainer.
5. Examine the Ceramic Plunger for scoring, cracks or scale and replace if needed. The Ceramic Plunger can be cleaned with a scotchbrite pad. Slide the Ceramic Plunger onto the retainer and stud assembly with the **shallower counterbore away from the retainer.** The Plunger can only be installed one direction, **shallow counterbore towards the crankcase.** Do not force into position.
6. Apply locktite 242 to the threads of the Plunger Retainer Stud and thread onto the Plunger Rod. Then torque to specifications in chart.
7. Reinstall the Seal Retainers with the **slots to the top and bottom.**
8. Rotate the Crankshaft to line up the outside Plungers. Then lightly lubricate the Plungers with oil.
9. Carefully slide the Inlet Manifold over the Ceramic Plungers and press until flush with the Crankcase.
10. Reinstall the Inlet Socket Head Screws and torque to specifications in chart.
11. The Hi-Pressure Seals may shift while installing the Inlet Manifold. Use one of the Discharge Valve Spacers to press the Seals back into position.
12. Carefully press the Discharge Manifold into the Inlet Manifold. Use a soft mallet to tap into place and reinstall the Socket Head Screws. Torque to specifications in chart.

IMPORTANT: Follow the torque sequence to assure the proper alignment.



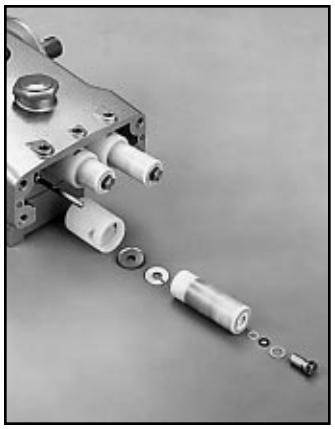


Fig. 13


Fig. 14

SERVICING THE CRANKCASE SECTION

1. While Inlet Manifold, Plungers and Seal Retainers are removed, examine crankcase seals for wear.
2. Check oil level and for evidence of water in oil.
3. Rotate Crankshaft by hand to feel for smooth bearing movement.
4. Examine Crankshaft Oil Seal externally for drying, cracking or leaking.
5. Consult factory or your local distributor if Crankcase service is required.

See Section II of the Plunger Pump Service Video for additional information.

PREVENTATIVE MAINTENANCE CHECK-LIST

Check	Daily	Weekly	50 hrs.	500 hrs.*	1500 hrs.**
Clean Filters	x				
Oil Level/Quality	x				
Oil Leaks	x				
Water Leaks	x				
Belts, Pulley		x			
Plumbing		x			
Initial Oil Change			x		
Oil Change				x	
Seal Change					x
Valve Change					x
Accessories					x

*If other than CAT PUMPS special multi-viscosity ISO68 oil is used, change cycle should be every 300 hours.

**Each system's maintenance cycle will be exclusive. If system performance decreases, check immediately. If no wear at 1500 hours, check again at 2000 hours and each 500 hours until wear is observed.

**Remember to service the regulator/unloader at each seal servicing and check all system accessories and connections before resuming operation.

TORQUE CHART

Pump Item / Pump Model	Thread	Tool Size [Part No.]	Torque in. lbs.	Torque ft. lbs.	Torque Nm
Plunger Retainer	M7	M14 Hex [25053]	90	7.2	10
Inlet Manifold Screws	M12	M10 Allen [33047]	350	28.9	40
Discharge Manifold Screws	M12	M10 Allen [33047]	350	28.9	39
Crankcase Cover/ Bearing Cover Screws	M8	M13 Hex [25324]	115	9.4	13
Connecting Rod Screws	M8	M13 Hex [25324]	130	10.8	15
Bubble Oil Gauge	M28	Oil Gauge Tool [44050]	45	3.6	5
Mounting Bolts	M12	M19 Hex	350	28.9	40

TECHNICAL BULLETIN REFERENCE CHART

No.	Subject	Models
002	Inlet Temperature vs. Inlet Pressure	All Models
003	3FR - 68FR Accessory Drive Packages	3FR - 68FR Plunger Models
024	Lubrication of Lo-Pressure Seals	All Models
036	Cylinder and Plunger Reference Chart	All Models
043	Plunger Pump LPS and HPS Servicing	All Plunger Models
053	Liquid Gasket	5FR, 7FR, 15FR, 35FR, 60FR
064	By-Pass Hose Length	All Unloaders/Regulators
076	Valve Seat Change	2530, 2537
077	Oil Drain Kit	All Models

INLET CONDITION CHECK-LIST

Review Before Start-Up

Inadequate inlet conditions can cause serious malfunctions in the best designed pump. Surprisingly, the simplest of things can cause the most severe problems or go unnoticed to the unfamiliar or untrained eye. REVIEW THIS CHECK-LIST BEFORE OPERATION OF ANY SYSTEM. Remember, no two systems are alike, so there can be no **ONE** best way to set up a system. All factors must be carefully considered.

INLET SUPPLY should be adequate to accommodate the maximum flow being delivered by the pump.

- ❏ Open inlet shut-off valve and turn on water supply to avoid starving the pump. **DO NOT RUN PUMP DRY.**
- ❏ Avoid closed loop systems especially with high temperature, ultra-high pressure or large volumes. Conditions vary with regulating/unloader valve.
- ❏ Low vapor pressure fluids, such as solvents, require a booster pump and C.A.T. (Captive Acceleration Tube) to maintain adequate inlet supply.
- ❏ Higher viscosity fluids require a positive head and a C.A.T. (Captive Acceleration Tube) to assure adequate inlet supply.
- ❏ Higher temperature fluids tend to vaporize and require positive heads and C.A.T. (Captive Acceleration Tube) to assure adequate inlet supply.
- ❏ When using an inlet supply reservoir, size it to provide adequate fluid to accommodate the maximum output of the pump, generally a minimum of 6-10 times the GPM (however, a combination of system factors can change this requirement); provide adequate baffling in the tank to eliminate air bubbles and turbulence; install diffusers on all return lines to the tank.

INLET LINE SIZE should be adequate to avoid starving the pump.

- ❏ Line size must be a minimum of one size larger than the pump inlet fitting. Avoid thick walled fittings, tees, 90 degree elbows or valves in the inlet line of the pump to reduce the risk of flow restriction and cavitation.
- ❏ The line MUST be a FLEXIBLE hose, NOT a rigid pipe, and reinforced on SUCTION systems to avoid collapsing.
- ❏ The simpler the inlet plumbing the less the potential for problems. Keep the length to a minimum, the number of elbows and joints to a minimum (ideally no elbows) and the inlet accessories to a minimum.
- ❏ Use pipe sealant to assure air-tight, positive sealing pipe joints.

INLET PRESSURE should fall within the specifications of the pump.

- ❏ Acceleration loss of fluids may be increased by high RPM, high temperatures, low vapor pressures or high viscosity and may require pressurized inlet and C.A.T. (Captive Acceleration Tube) to maintain adequate inlet supply. DO NOT USE C.A.T. (Captive Acceleration Tube) WITH SUCTION INLET.
- ❏ Optimum pump performance is obtained with +20 PSI (1.4 BAR) inlet pressure and a C.A.T. for certain applications. With adequate inlet plumbing, most pumps will perform with flooded suction. Maximum inlet pressure is flooded to 70 PSI (4.9 BAR).
- ❏ After prolonged storage, pump should be purged of air to facilitate priming. Disconnect any discharge port and allow fluid to pass through pump.

INLET ACCESSORIES are designed to protect against overpressurization, control inlet flow, contamination or temperature and provide ease of servicing.

- ❏ A shut-off valve is recommended to facilitate maintenance.
- ❏ Installation of a C.A.T. (Captive Acceleration Tube) is essential in applications with stressful conditions such as high temperatures, booster pump feed or long inlet lines. **Do not use C.A.T. with negative inlet pressure.**
- ❏ A stand pipe can be used in some applications to help maintain a positive head in the inlet line.
- ❏ Inspect and clean inlet filters on a regular schedule.
- ❏ A pressure gauge is recommended to monitor the inlet pressure and should be mounted AS CLOSE TO THE PUMP INLET as possible. **Short term, intermittent cavitation will not register on a standard gauge.**
- ❏ All accessories should be sized to avoid restricting the inlet flow.
- ❏ All accessories should be compatible with the solution being pumped to prevent premature failure or malfunction.

BY-PASS TO INLET Care should be exercised when deciding the method of by-pass from control valves.

- ❏ It is recommended the by-pass be directed to a baffled reservoir tank, with at least one baffle between the by-pass line and the inlet line to the pump.
- ❏ Although not recommended, by-pass fluid may be returned to the inlet line of the pump if the system is properly designed to protect your pump. When using this method a PRESSURE REDUCING VALVE should be installed on the inlet line (**BETWEEN** THE BY-PASS CONNECTION AND THE INLET TO THE PUMP) to avoid excessive pressure to the inlet of the pump when a flow sensitive regulating device is used. It is also recommended that a THERMO VALVE be used in the by-pass line to monitor the temperature build-up in the by-pass loop to avoid premature seal failure.
- ❏ A low-pressure, flexible cloth braid (not metal braid) hose should be used from the by-pass connection to the inlet of the pump.
- ❏ Caution should be exercised not to undersize the by-pass hose diameter and length. Refer to Technical Bulletin 64 for additional information on the size and length of the by-pass line.
- ❏ Check the pressure in the by-pass line to avoid overpressurizing the inlet.
- ❏ The by-pass line should be connected to the pump inlet line at a gentle angle of 45° or less and no closer than 10 times the pump inlet port diameter e.g. 1-1/2" port size = 15" distance from pump inlet port.

HOSE FRICTION LOSS

Water* Flow Gal/Min	PRESSURE DROP IN PSI PER 100 FT OF HOSE WITH TYPICAL WATER FLOW RATES Hose Inside Diameters, Inches						
	1/4	5/16	3/8	1/2	5/8	3/4	1"
0.5	16	5	2				
1	54	20	7	2			
2	180	60	25	6	2		
3	380	120	50	13	4	2	
4		220	90	24	7	3	
5		320	130	34	10	4	
6			220	52	16	7	1
8			300	80	25	10	2
10			450	120	38	14	3
15			900	250	80	30	7
20			1600	400	121	50	12
25				650	200	76	19
30					250	96	24
40					410	162	42
50					600	235	62
60						370	93

*At a fixed flow rate with a given size hose, the pressure drop across a given hose length will be directly proportional. A 50 ft. hose will exhibit one-half the pressure drop of a 100 ft. hose. Above values shown are valid at all pressure levels.

WATER LINE PRESSURE LOSS

PRESSURE DROP IN PSI PER 100 FEET

Water GPM	Steel Pipe—Nominal Dia. 1/4	3/8	1/2	3/4	1	1 1/4	1 1/2	Brass Pipe—Nominal Dia. 1/4	3/8	1/2	3/4	1	1 1/4	1 1/2	Copper Tubing O.D. Type L 1/4	3/8	1/2	5/8	3/4	7/8
1	8.5	1.9						6.0	1.6						120	13	2.9	1.0		
2	30	7.0	2.1					20	5.6	1.8					400	45	10	3.4	1.3	
3	60	14	4.5	1.1				40	11	3.6						94	20	6.7	2.6	
5	150	36	12	2.8				100	28	9.0	2.2					230	50	17	6.1	3.0
8	330	86	28	6.7	1.9			220	62	21	5.2	1.6				500	120	40	15	6.5
10	520	130	43	10	3.0			320	90	30	7.8	2.4					180	56	22	10
15		270	90	21	6.2	1.6			190	62	16	5.0	1.5					120	44	20
25		670	240	56	16	4.2	2.0		470	150	40	12	3.8	1.7				330	110	50
40					66	17	8.0					39	11	5.0				550	200	88
60						37	17						23	11						
80						52	29						40	19						
100					210	107	48						61	28						

RESISTANCE OF VALVES AND FITTINGS

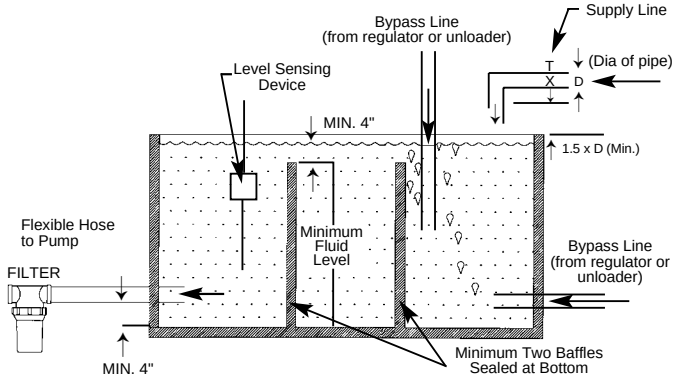
Nominal Pipe Size Inches	Inside Diameter Inches	Equivalent Length of Standard Pipe in Feet: Gate Valve	Globe Valve	Angle Valve	45° Elbow	90° Elbow	180° Close Ret	Tee Thru Run	Tee Thru Branch
1/2	0.622	0.41	18.5	9.3	0.78	1.67	3.71	0.93	3.33
3/4	0.824	0.54	24.5	12.3	1.03	2.21	4.90	1.23	4.41
1	1.049	0.69	31.2	15.6	1.31	2.81	6.25	1.56	5.62
1 1/4	1.380	0.90	41.0	20.5	1.73	3.70	8.22	2.06	7.40
1 1/2	1.610	1.05	48.0	24.0	2.15	4.31	9.59	2.40	8.63
2	2.067	1.35	61.5	30.8	2.59	5.55	12.30	3.08	11.60
2 1/2	2.469	1.62	73.5	36.8	3.09	6.61	14.70	3.68	13.20
3	3.068	2.01	91.5	45.8	3.84	8.23	18.20	4.57	16.40
4	4.026	2.64	120.0	60.0	5.03	10.80	23.90	6.00	21.60

Arriving at a total line pressure loss, consideration should then be given to pressure loss created by valves, fittings and elevation of lines.

If a sufficient number of valves and fittings are incorporated in the system to materially affect the total line loss, add to the total line length, the equivalent length of line of each valve or fitting.

TYPICAL RESERVOIR TANK

RECOMMENDED 6 TO 10 TIMES SYSTEM CAPACITY



Handy Formulas to Help You

Q. **How can I find the RPM needed to get specific GPM (Gallons Per Minute) I want?**

A. Desired RPM = Desired GPM x $\frac{\text{Rated RPM}}{\text{Rated GPM}}$

Q. **I have to run my pump at a certain RPM. How do I figure the GPM I'll get?**

A. Desired GPM = Desired RPM x $\frac{\text{Rated GPM}}{\text{Rated RPM}}$

Q. **Is there a simple way to find the approximate horsepower I'll need to run the pump?**

A. Electric Brake Horsepower Required = $\frac{\text{GPM x PSI}}{1460}$ (Standard 85% Mech. Efficiency)

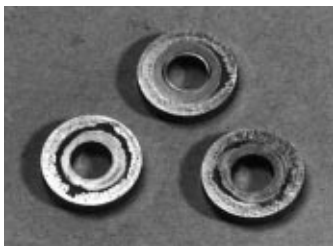
Q. **What size motor pulley should I use?**

A. Pump Pulley (Outer Diameter) x $\frac{\text{Pump RPM}}{\text{Motor/Engine RPM}}$ (Consult Engine Mfr.)

Q. **How do I calculate the torque for my hydraulic drive system?**

A. Torque (ft. lbs.) = 3.6 $\left(\frac{\text{GPM x PSI}}{\text{RPM}}\right)$

Avoid Cavitation Damage



One or several of the conditions shown in the chart below may contribute to cavitation in a system resulting in premature wear, system downtime and unnecessary operating costs.

CONDITION	SOLUTION
Inadequate inlet line size	• Increase line size to the inlet port or one size larger
Water hammering fluid acceleration/ deacceleration	• Install C.A.T. Tube • Move pump closer to fluid supply
Rigid Inlet Plumbing	• Use flexible wire reinforced hose to absorb pulsation and pressure spikes
Excessive Elbows in Inlet Plumbing	• Keep elbows to a minimum and less than 90°
Excessive Fluid Temperature	• Use Thermo Valve in bypass line • Do not exceed pump temperature specifications • Substitute closed loop with baffled holding tank • Adequately size tank for frequent or high volume bypass • **Pressure feed high temperature fluids** • Properly ventilate cabinets and rooms
Air Leaks in Plumbing	• Check all connections • Use Teflon tape
Agitation in Supply Tank	• Size tank according to pump output — **Minimum 6-10 times system GPM** • Baffle tank to purge air from fluid and separate inlet from discharge
High Viscosity Fluids	• Verify viscosity against pump specifications before operation • Elevate fluid temperature enough to reduce viscosity • Lower RPM of pump • Pressure feed pump • Increase inlet line size
Clogged Filters	• Perform regular maintenance or use clean filters to monitor build up • Use adequate mesh size for fluid and pump specifications

DIAGNOSIS AND MAINTENANCE

PROBLEM	PROBABLE CAUSE	SOLUTION
• Low Pressure	• Worn nozzle	• Replace nozzle of proper size.
	• Belt slippage	• Tighten or replace; use correct belt.
	• Air leak in inlet plumbing	• Use PTFE liquid or tape.
	• Pressure gauge inoperative or not registering accurately	• Check pressure with new gauge and replace as needed.
	• Relief valve stuck partially plugged or improperly adjusted	• Clean and reset relief valve to system pressure and correct by-pass. Check supply tank for contamination.
	• Worn seat or valves	• Clean or replace with valve kit.
	• Inlet suction strainer clogged or improperly sized	• Use adequate size for inlet pump connection and fluid being pumped. Clean frequently.
	• Worn seals. Abrasives in pumped fluid, severe cavitation; inadequate water supply, stressful inlet conditions	• Install and maintain proper filter, check line size and flow available to pump. Install a C.A.T. (Captive Acceleration Tube).
	• Fouled or dirty inlet or discharge valves	• Clean inlet and discharge valve assemblies.
	• Worn inlet or discharge valves	• Replace with valve kit.
	• Leaky discharge hose	• Replace hose. Check connections.
• Pulsation, pump runs extremely rough, pressure low	• Faulty Pulsation Dampener	• Check precharge (should be 30-50%) of system pressure or replace as needed.
	• Restricted inlet or air entering inlet plumbing	• Check filters and clean as needed. Check fittings and use PTFE liquid or tape for airtight connection.
	• Stuck inlet or discharge valve	• Clean or replace valve. Check supply tank for contamination.
• Water leakage from under the manifold *Slight leakage	• Worn or damaged Lo-Pressure Seals	• Replace with seal kit, check inlet pressure and use inlet pressure regulator in inlet line.
	• Worn O-Ring on plunger retainer	
• Oil leak between crankcase and pumping section	• Worn crankcase oil seals	• Replace crankcase oil seals and change crankcase oil.
• Oil leaking in the area of crankshaft	• Worn crankshaft seal	• Replace damaged seals.
	• Bad bearing	• Replace bearing.
• Excessive play in the end of the crankshaft	• Worn bearing	• Replace bearing and check proper belt tension.
• Water in crankcase	• Humid air condensing inside of the crankcase	• Change oil every 3 months or 500 hour intervals using special CAT PUMP Premium Grade Oil, PN 6100 (Case) 6107 (Bottle), (other approved oil every month or 200 hours).
	• Leaking of crankcase seals or seals installed backward	• Replace seals. Follow proper installation procedure. Contact CAT PUMPS supplier for crankcase servicing.
• Oil leaking at the rear portion of the crankcase	• Damaged or improperly installed oil gauge,	• Replace oil gauge.
	• Damaged or worn crankcase cover O-Ring, or drain plug O-Ring	• Replace O-Ring.
• Loud knocking noise in pump	• Pulley loose on crankshaft	• Check key and tighten set screw.
	• Worn bearing, connecting rod or crankshaft	• Consult CAT PUMPS supplier for crankcase servicing.
	• Stressful inlet conditions, cavitation	• Install C.A.T. (Captive Acceleration Tube).
• Frequent or premature failure of the packing	• Scored plungers	• Replace plungers.
	• Excessive inlet pressure	• Reduce inlet pressure to specifications.
	• Abrasive material in the fluid being pumped	• Install proper filtration on pump inlet plumbing.
	• Excessive pressure and/or temperature of fluid being pumped	• Check pressures and fluid inlet temperatures. Be sure they are within specified range.
	• Running pump dry	• DO NOT RUN PUMP WITHOUT WATER.
	• Cavitating the pump	• Check inlet conditions.
• Strong surging at the inlet and low pressure on the discharge side	• Foreign particles in the inlet or discharge valve or worn inlet and/or discharge valves	• Check for smooth surfaces on inlet and discharge valve seats. Replace with kit if pitted or worn.
		• Check supply tank for contamination. Install and regularly clean filter. Do not pump abrasive fluids.