5DX PLUNGER PUMP SERVICE MANUAL

PLUNGER PUMP MODELS: 5DX30G1, 5DX35G1, 5DX40G1, 5DX50G1

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 Hydraulic oil per pump specifications. 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.**

DRIVE SELECTION: The pump shaft size is a 1" gas shaft. The engine driving the pump must be of adequate horsepower to maintain full RPM when the pump is under load. Select the horsepower requirement according to required pump discharge volume and maximum **pressure at the pump!** Consult the manufacturer of gas or diesel engine for selection of the proper engine.

MOUNT THE PUMP: All 5DX models are direct drive and do not need to be mounted to another surface. To minimize piping stress, **use appropriate flexible hose to inlet and discharge ports**. Before mounting pump to gas engine, apply PN 6106 antiseize lubricant to pump shaft. Refer to Technical Bulletin #055 for instructions on removing pump from gas engine.

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.

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

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.

All 5DX models come complete with a modular Pressure Regulating Unloader with built-in by-pass. **A Pressure Regulator or Unloader Valve must be installed on the pump 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.

When the high pressure system is left running with the trigger off, the by-pass fluid can be routed to drain or to the pump inlet. If routed to the pump inlet, the **by-pass fluid can quickly develop excessive heat and result in damage to the pump.** A THERMO VALVE installed in the by-pass line is recommended to protect the pump. An AUTO SHUT OFF ASSEMBLY may also be used.

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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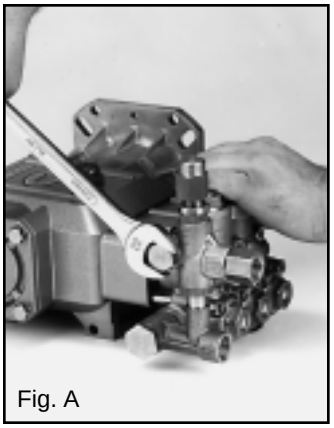


Fig. A

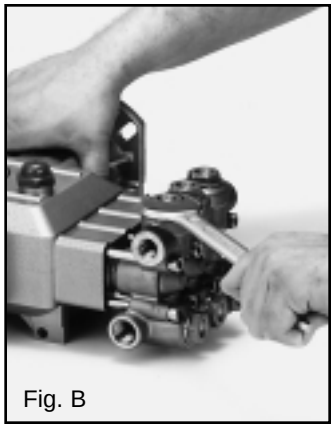
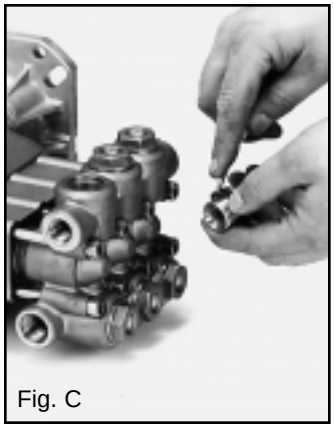


Fig. B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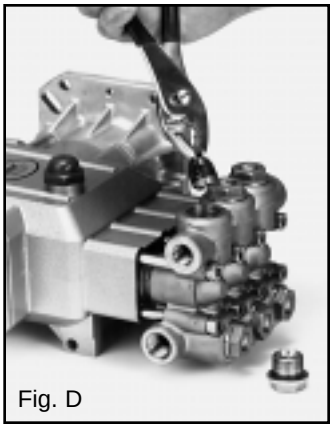


Fig. D

SERVICING THE VALVES

1. Check oil for proper level, presence of water or discoloration and replace as needed.
2. Disconnect all plumbing and use an M24 Wrench on the top unloader screw and an M27 on the bottom unloader screw to remove the unloader before servicing. (Fig. A)
3. Using an M22 hex tool, remove the top discharge and bottom inlet Valve Plugs. (Fig. B)
4. Examine the O-ring under the plug for cuts or distortion and replace if worn. Lubricate the new O-rings before installing. (Fig. C)
5. Using a pliers, grasp the Spring Retainer by the tab at the top and remove from the valve chamber. (Fig. D) Usually the valve assembly will remain together while being removed. To separate the valve assembly, insert a screw driver into the side of the Retainer and press on the back side of the Valve to begin the separation, then between the Retainer and Valve Seat to separate completely.

   If the Valve assembly separates during removal, remove the Spring and Valve with a needle nose pliers. Then with a reverse pliers, remove the Valve Seat from the valve chamber.
6. Next remove the Valve Seat O-ring, which usually stays at the bottom of the valve chamber. Exercise caution to avoid damage to the valve chamber walls.
7. Examine all valve parts for pitting, gouges or general wear and replace with preassembled Valve Assembly in the service kit which contains Spring Retainers, Springs, Valves, Valve Seats and O-rings (Fig. E) NOTE: Inlet and Discharge Valve Assemblies are interchangeable. **Two Valve Kits** are needed for a complete valve change.
8. With a pliers grasp the new Valve Assembly by the tab at the top, immerse in oil and push into the valve chamber. Be certain the valve assembly is completely seated in the valve chamber.
9. Apply Loctite 242 to the threads of the Valve Plugs, thread into the manifold port and torque per chart.

SERVICING THE PUMPING SECTION

1. Using an M6 Allen Tool remove the eight socket head bolts from the face of the manifold head. (Fig. F)
2. Insert a flat head screwdriver between the crankcase and manifold head and gently apply light pressure to the head to assist in separation. (Fig. G)
3. Then supporting the manifold from the underside, work the manifold head from the plungers. (Fig. H) CAUTION: Keep the manifold head properly aligned with the ceramic plungers when removing to avoid damage to either the plungers or seals.
4. Examine the Ceramic Plungers for cracks or scoring and refer to SERVICING THE PLUNGERS if replacement is needed.

Reassembly

1. Generally the Ceramic Plungers do not need to be replaced. They can be cleaned with a non-abrasive cleaner to remove any foreign build-up.
2. Turn the shaft by hand to line up the plungers so the end plungers are parallel.
3. Lightly lubricate the plungers and carefully slide the Manifold Head onto the Ceramic Plungers, supporting it from the underside to avoid damage to the plungers or seals. Press the Manifold Head into the Crankcase until flush.
4. Replace the eight Hex Socket Head Bolts and torque per chart.

SERVICING THE PLUNGERS

Disassembly

1. Remove the Manifold Head as described in SERVICING THE PUMPING SECTION.
2. First remove the Seal Retainers from each Plunger Rod.
3. Using an M10 hex tool, loosen the Plunger Retainer Stud from the Plunger Rod.
4. Next remove the Ceramic Plunger, Sealing Gasket and Barrier Slinger from the Plunger Retainer Stud. (Fig. K) NOTE: Refer to Tech Bulletin 071 (old 4HP Plunger Rod Change) for additional information on Ceramic Plungers.


Fig. E

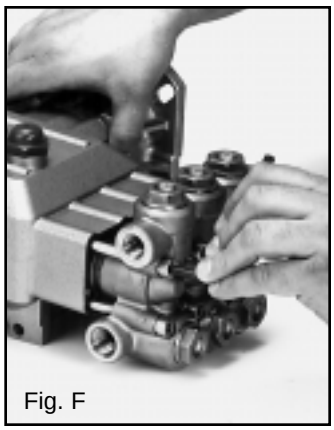


Fig. F

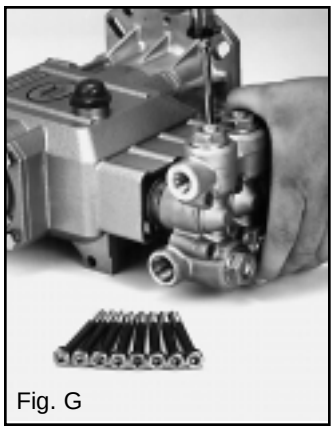


Fig. G

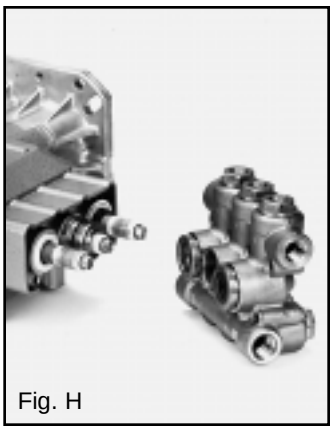


Fig. H

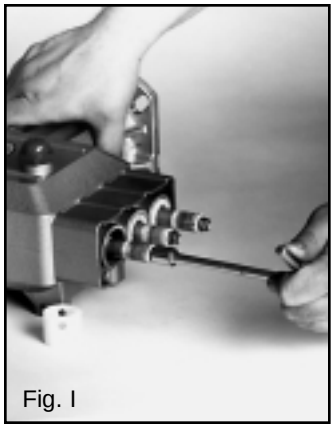


Fig. I

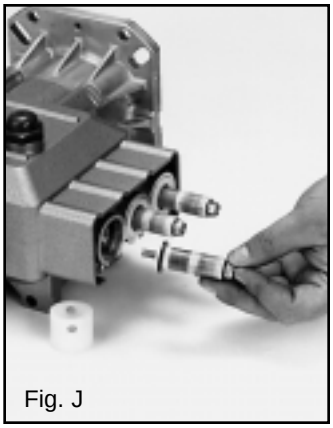


Fig. J

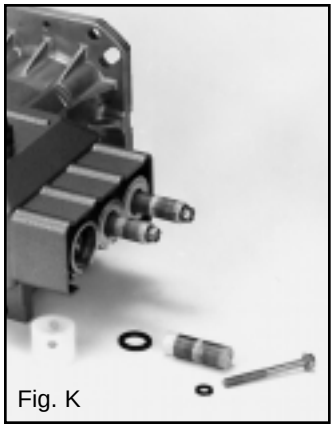


Fig. K

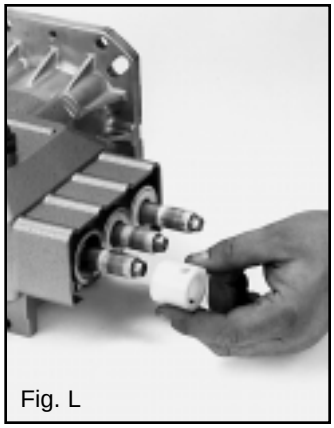


Fig. L

Reassembly

1. Visually inspect the Crankcase Oil Seal for deterioration or leaks and contact the factory for assistance with replacement. This Oil Seal seldom needs replacement. If frequent deterioration is observed,shorten the time between servicing the seals. DO NOT RUN THE PUMP WITH WORN SEALS.
2. Examine the Sealing Gasket and replace if cut or worn. Then install the new Sealing Gasket onto the Plunger Retainer Stud.
3. Examine the Ceramic Plungers for scoring or cracks and replace if worn or damaged. NOTE: **The Ceramic Plunger can be installed in either direction.** Slide the Ceramic Plunger onto the Plunger Retainer Stud.
4. Then examine the Barrier Slinger for cuts or wear and replace as needed. Install the Barrier Slinger onto the Ceramic Plunger and press to the back of the plunger.
5. Apply Loctite 242 to the exposed threads and thread the Plunger Retainer Stud with Ceramic Plunger into the Plunger Rod. Torque per chart.
6. Install the Seal Retainers onto the exposed Ceramic Plungers with the holes to the top and bottom and forward (Fig. L) and press into the Crankcase. (Fig. M)
7. Proceed with SERVICING THE SEALS AND V-PACKINGS or remount the Manifold Head.

SERVICING THE SEALS AND V-PACKINGS

Disassembly

1. Remove the Manifold Head as described in SERVICING THE PUMPING SECTION. NOTE: The Seal Case may stay in the manifold or on the ceramic plunger
2. With the **crankcase side of the Manifold Head up,** use a reverse pliers to remove the Lo-Pressure Seal from the Seal Case. (Fig. N)
3. Next using the reverse pliers, remove the Seal Case from the manifold chamber. (Fig. O) NOTE: Insert the pliers into the second lip to avoid damage to the Seal Case.
4. Next remove the O-ring from the outer groove on the Seal Case. Carefully insert a small screw driver under the O-ring and roll the O-ring off the Seal Case. (Fig. P)
5. The V-Packings and Male Adapter can be easily removed from the manifold chamber by hand or with a reverse pliers. (Fig. Q)

Reassembly

1. Examine the manifold chamber walls for any scale build up or damage. Then lubricate the chamber walls.
2. Insert the Male Adapter with **notches down and the "V" side up** and by hand, press completely into the manifold chamber.
3. Lubricate the V-Packings and install by hand into the manifold chamber with the **grooved side down.** (Fig. R)
4. Lubricate the new Seal Case O-ring before installing and insert the Seal Case into the manifold chamber.
5. Examine the Lo-Pressure Seals for wear or broken spring and replace as needed.
6. Install the Lo-Pressure Seal into the Seal Case with the **garter spring down.**
7. Next install the Seal Retainer over the Ceramic Plungers with the holes to the top and bottom and forward.
8. Replace the Manifold Head onto the drive end as described under SERVICING THE PUMPING SECTION and torque per chart.

SERVICING THE CRANKCASE SECTION

1. While 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 evidenced.

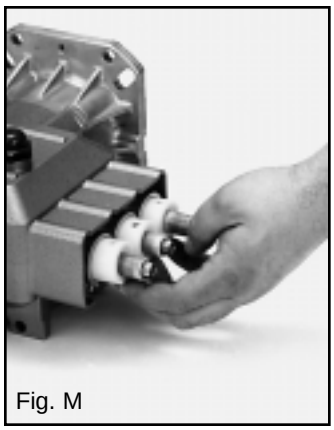


Fig. M


Fig. N


Fig. 0


Fig. P

Fig. Q

Fig. R

PREVENTATIVE MAINTENANCE CHECK-LIST

Check	Daily	Weekly	50 hrs.	500 hrs.*	1500 hrs.**	3000 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. Valves typically every other seal change.
**Remember to service the regulator/unloader at each seal servicing and check all system accessories and connections before resuming operation.

TORQUE CHART

Pump Item	Thread	Tool Size [Part No.]	Torque in.lbs.	ft.lbs.	Nm
Plunger Retainer	M6	M10 Hex [25082]	55	4.4	6
Flow-Thru Screws					
Inlet	—	1/2" Hex	360	30	40
Discharge	—	3/8" Hex	360	30	40
Manifold Head Bolts	M8	M6 Allen [30941]	115	9.4	13
Valve Plugs	M22	M24 Hex [44046]	870	72.3	100
Crankcase Cover Screws	M6	M10 Hex [25082]	50	4.0	6
Bearing Cover Screws	M8	M13 Hex [25324]	115	9.4	13
Bubble Oil Gauge	M28	Oil Gauge Tool [44050]	45	3.6	5

TECHNICAL BULLETIN REFERENCE CHART

No.	Subject	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
055	Removing Pumps from Gas or Electric Motor	2SF, 2SFX, 2X, 4SF, 4HP, 5DX
060	Baffle Assembly	8100
071	4HP Plunger Rod Change	4HP
074	Piston and Plunger Pump Torque Chart	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.
- ❑ Higher temperature fluids tend to vaporize and require positive heads.
- ❑ 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 a pressurized inlet to maintain adequate inlet supply.
- ❑ Optimum pump performance is obtained with +20 PSI (1.4 BAR) inlet pressure. With adequate inlet plumbing, most pumps will perform with flooded suction. Maximum inlet pressure is 75 PSI (4 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 over pressurization, control inlet flow, contamination or temperature and provide ease of servicing.

- ❑ A shut-off valve is recommended to facilitate maintenance.
- ❑ 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

- ❑ The standard 5DX pump comes with a Regulating Unloader. This Regulating Unloader has a **built-in by-pass channel** which routes fluid back to the inlet during the by-pass mode. No additional plumbing is required.
- ❑ It is critical that a Thermo Valve be installed to protect the pump during prolonged by-pass. The Thermo Valve may be installed on the opposite side of the Manifold Head or by replacing the Flow-Thru Screw with the Flow-Thru Direct Mount Thermo Valve [PN 33920].

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						

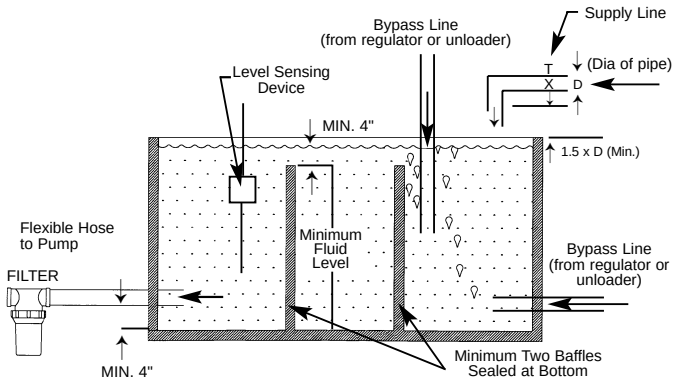
RESISTANCE OF VALVES AND FITTINGS

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)

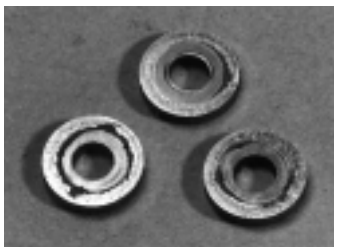
Q. **What size motor pulley should I use?**

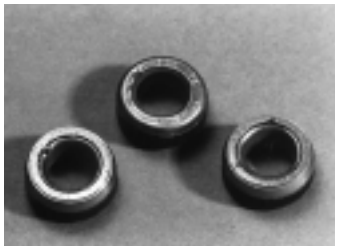
A. Pump Pulley (Outer Diameter) x $\frac{\text{Pump RPM}}{\text{Motor/Engine RPM}}$ (Consult Engine Mfr.)

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.
	• Air leak in inlet plumbing	• Use PTFE liquid or tape on all connections.
	• 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. Service valve on seal replacement schedule.
	• Worn seat or valves	• Replace with valve kit. Use covered reservoir. Do not pump abrasive fluids.
	• Inlet filter clogged or improperly sized	• Initiate a more frequent service cycle. Check supply tank for contamination.
	• Worn seals. Abrasives in pumped fluid.	• Replace with Seal Kit. Install and maintain proper filter.
	• Severe cavitation; inadequate water supply, stressful inlet conditions	• Check line size, use reinforced flexible hose at pump inlet and eliminate elbows. • Increase line size. Clean filter. Check water temperature. Install Thermo Valve in by-pass.
	• Fouled or dirty inlet or discharge valves	• Clean inlet and discharge valves and replace with kit as needed.
	• Leaky discharge hose	• Replace hose. Check connections.
• Pulsation, pump runs extremely rough, pressure low	• Restricted inlet or air entering inlet plumbing	• Clean filters as needed. Check fittings and use PTFE liquid or tape for airtight connection. Check line size and flow to pump.
	• Stuck inlet or discharge valve	• Clean or replace Valve Kit. Check supply tank for contamination.
	• Worn Hi-Pressure Seals	• Repace with Seal Kit. Initiate more frequent service cycle.
	• Foreign particles in the inlet or discharge valve	• Check for smooth surfaces on inlet and discharge valve seats. Replace with kit.
	• Worn or pitted inlet and/or discharge valves	• Check supply tank for contamination. Install and regularly clean filter. Do not pump abrasive fluids.
• Water leakage from under the manifold *Slight leakage	• Worn V-Packings and Lo-Pressure Seals	• Replace with Seal Kit, check inlet pressure and temperature. Use Thermo Valve in by-pass line; inlet regulator in inlet line.
	• Worn adapter	• Examine adapter when servicing Seals and replace as needed. • Initiate more frequent service cycle.
• Frequent or premature failure of seals and packings	• Excessive heat from prolonged by-pass	• Install Thermo Valve. Replace seals with kit.
	• Abrasive in fluid	• Install inlet filter.
	• Scored plungers	• Replace plungers. Review fluid specifications.
	• Excessive inlet pressure	• Install pressure reducing valve.
	• Running pump dry	• Check inlet fluid supply line for adequate size. Clean filters.
• Oil leak between crankcase and pumping section	• Worn crankcase oil seals	• Check and replace crankcase oil seals when doing seal servicing.
• Oil leaking around crankshaft	• Worn crankshaft oil seal	• Replace damaged oil seals.
	• Bad bearing	• Replace bearing.
• Excessive play in the end of the crankshaft	• Worn bearing	• Replace bearing.
• Water in crankcase	• Humid air condensing into water inside of the crankcase	• Change oil every 3 months or 500 hour intervals using special CAT PUMP Premium Grade Oil, (case PN 6100 or bottle PN 6107), other approved oil every month or 300 hours.
	• Continued operation with worn seals and packings	• Initiate more frequent service cycle. Change oil.
	• Crankcase oil seals leaking or seals installed backward	• Replace seals. Follow proper installation procedure. Contact Cat Pumps supplier for crankcase servicing.
• Loud knocking noise from pump	• Worn bearing, connecting rod or crankshaft	• Consult Cat Pumps supplier for crankcase servicing.
	• Stressful inlet conditions	• Increase line size, use flexible hose to pump inlet, install properly sized baffled supply tank.
• Frequent or premature failure of the packings	• Scored plungers	• Replace plungers.
	• Over pressure to inlet manifold	• Reduce inlet pressure per specifications.
	• Abrasive material in the fluid being pumped	• Install proper filtration at pump inlet.
	• Excessive pressure and/or temperature of fluid being pumped	• Check pressure and inlet fluid temperature. Be sure they are within specified range. Install Thermo Valve in by-pass line.
	• Running pump dry	• DO NOT RUN PUMP WITHOUT WATER.