SUNPUMPS SPB-SERIES
PISTON PUMP SERVICE MANUAL

Caution: Piston 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. SunPumps 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.

LUBRICATION: Fill crankcase with special 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 **three months or at 500 hour intervals.**

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.

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.

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. Optimum precharge should be calibrated at 30-50% of the operating system.

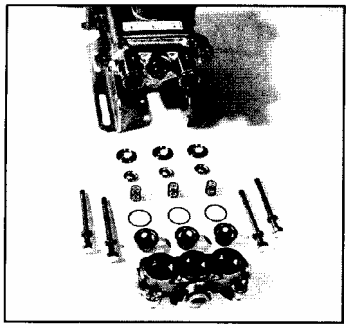
A **reliable Pressure Gauge** should be installed near the discharge outlet of the high-pressure manifold.

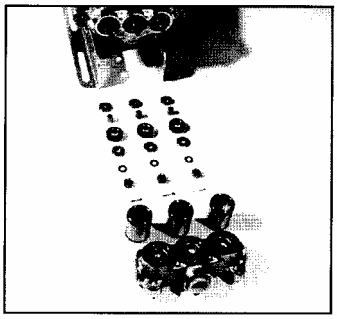
The pump is rated for a maximum pressure; this is the **pressure**, which would be **read at the discharge manifold of the pump.**

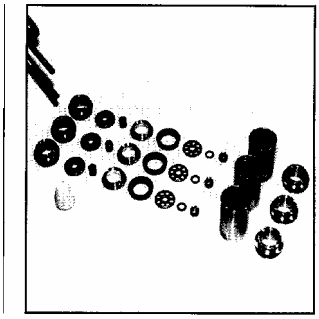
An Unloader or Relief Valve must be installed to prevent over pressurizing the pump in the event the discharge or downstream plumbing becomes plugged or is turned off. Severe damage to the pump will result if this condition occurs without a relief valve in the line. **CAUTION: Failure to install such 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.

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







SERVICING THE VALVE ASSEMBLIES

DISASSEMBLY

1. Remove the fasteners securing the discharge manifold to the crankcase of the pump.
2. Support the discharge manifold and tap from the backside with soft mallet. Gradually work free from cylinders.
3. Valve assemblies will remain in the manifold. **Pump models with the o-ring groove on the outside of the valve seat require the assistance of a Valve Seat Removal Tool to remove the valve seat.** The valve, spring and retainer will then fall out when the manifold is inverted.

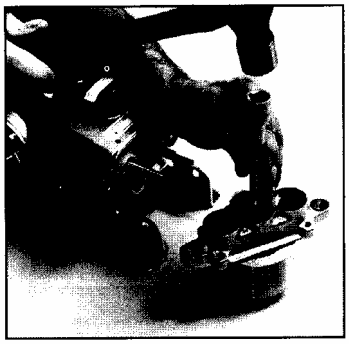
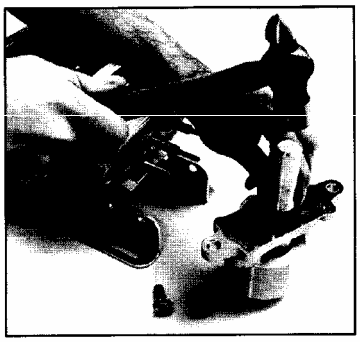
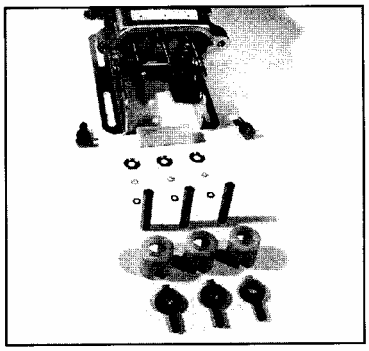
Pump models without the o-ring groove on the outside of the valve seat permit the seat, valve,
spring and retainer all to fall out when manifold is inverted.

REASSEMBLY

1. Examine Retainer for wear and replace as needed. Place Retainer in manifold chamber with nylon tab down.
2. Examine springs for fatigue and replace as needed. Insert spring into center of

retainer.

3. Inspect the Valves for wear, ridges or pitting and replace as needed.
   Note: Seating side of **Flat Valves** may be lapped on flat surface using 240 grit paper. **Quiet Valves** due to their shape must be replaced. Insert valve over spring with **dimpled side up.**
   Note: **Do not mix Quiet Valve and Flat Valve Assemblies.**
4. Examine Valve Seats for wear, pitting or grooves. Lap the **Flat Valve Seats** with 240 grit paper or replace if evidence of excessive wear. **Quiet Valve Seats** must be replaced if worn. Install seats with **dishside down.**
5. Examine o-rings and back-up rings on the Valve Seat if used and replace if worn. Always lubricate o-rings for ease of installation and to avoid damage.
   Note: First install o-ring in groove on seat towards seating surface, then back-up ring.
   Note: Models without outer groove on seat require the o-ring to be placed on lip of retainer.
6. Lubricate o-rings on exposed cylinder. Exercise caution when slipping manifold over Cylinders to avoid damaging cylinder o-rings. Completely press manifold over cylinders.
7. Replace fasteners and torque per chart.
   Note: Replace all original shims if used. **When new manifold is used reshim pump.** When starting the pump, check to see that there is no cylinder motion, as this will cause premature failure of the cylinder o-rings. Center cylinder motion indicates improper shimming.

SERVICING THE PUMPING SECTION

STANDARD PISTON PUMP

DISASSEMBLY:

1. Remove the discharge manifold as described above.
2. Grasp cylinders by hand and with an up and down motion, pull cylinders from inlet manifold.
3. Remove cotterpin, nut and washer from piston rod.
4. Next remove retainer, spacer, piston-cup assembly and inlet valve.

REASSEMBLY:

1. Examine inlet valve surface for pitting, scale or grooves. Reverse valves and sand inlet side of valve using 240 grit paper for clean surface or replace if evidence of excessive wear. Slip onto rod.
2. Examine Piston seating surface and lightly sand on flat surface using 240 grit paper.

If extreme pitting or sharp edges, replace piston.

3. Examine cup for wear, cracking, tearing or separation from the piston. If worn replace and lubricate before installing on piston.
   Note cup installation: Wipe cup inserter with oil. Slip back-up ring (when used) onto piston. Push cup over inserter and square with all surfaces. Faulty cup installation causes premature cup failure. Some models use a one-piece piston assembly. The cup does not separate from the piston. Replace entire assembly. Lubricate piston assembly and slip piston-cup assembly onto piston rod with **lid facing discharge.**
4. Next replace Piston Spacer and Retainer on rod.
5. Replace washer; thread on nut and torque per chart.
   Note: Always replace with new **stainless steel cotterpin** and turn ends under.
6. Examine cylinder walls for scoring or etching which causes premature wear of cups and replace as needed.
7. Lubricate cylinder and replace o-rings and/or back-ups rings if worn or damaged. **Back-up rings go to low pressure side of the o-rings.** Carefully slip cylinder over rod ends and push into inlet manifold with **back-up ring to the discharge, stroke marking on the inside of cylinder to the crankcase.**
8. Position discharge manifold onto pump as described, replace fasteners and torque per specifications chart.

SLEEVED-TYPE PISTON MODELS

DISASSEMBLY

1. After removing the discharge manifold, slip cylinders off piston rods. It is best to leave the cylinder adapters and springs in the inlet manifold as they may score the sleeved-type pistons when removed. The V-packings will remain in the cylinders.
2. Press worn V-packings from cylinders.
3. Remove cotter pins, slotted nuts, washers and piston retainers. Pull sleeved-type pistons from each piston rod. Next slip sleeved-type spacer and inlet valve from each piston rod.
4. Lubricate and install new o-rings on cylinders and adapters.
5. Inspect inlet valve surfaces. If inlet valves are worn, lap with 240 grit paper or replace if evidence of excessive damage. If sleeved-type piston inlet surface is worn or the outer diameter is scored, replace it.

REASSEMBLY

1. First install inlet valve then sleeved-type piston onto piston rod with the **lapped end toward the inlet valve.**
2. Next install the sleeved-type spacer.
3. Then install new V-packings in the cylinder in the following order:
   a. Install all parts in one cylinder, and then move to the next cylinder.
   b. Rotate crankshaft to extend one piston rod completely forward.
   c. Lubricate V-packings and cylinder I.D. and place **O-ring end of cylinder on work surface.**
   d. Install into cylinder Female Packing Spacer, black Female Adapter, V-packings, nylon Male Adapter and **Male Packing Spacer with "V" side down.**
   e. Install spring in outer end of cylinder and slip cylinder assembly over piston rod end. Press cylinder into manifold chamber. The spring in the cylinder will be in

your palm as the cylinder assembly is installed. Use the spring to hold parts in cylinder as it is slid over piston rod.

4. Remove spring from cylinder, install retainer, conical washer, slotted nut and torque per chart.
5. Install new cotter pin and bend ends back.
6. Replace spring in cylinder.
7. Lubricate inlet and discharge ends of adapter and install back-up rings first, then o-rings onto adapter. Lubricate O.D. of **small diameter inlet end** of adapter and press into cylinder.
8. Rotate crankshaft to extend new piston rod. Proceed as above with second and third cylinders. Proceed with standard Piston Pump Servicing.

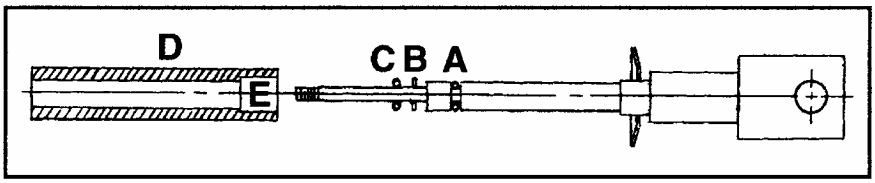
SERVICING SLEEVES AND SEALS

DISASSEMBLY

1. Remove discharge manifold and piston assemblies as described.
2. Remove inlet manifold containing seals.
3. Grasp sleeves and with a pulling and twisting motion remove the sleeve from the piston rod.
   Note: Grasp sleeve with pliers only if replacing worn sleeves, as the procedure will mar the sleeves.
4. Next remove seal retainer.
5. Remove and examine o-rings and/or back-up rings on piston rod for wear and replace as needed.

REASSEMBLY

1. Visually inspect that Barrier-Slinger is in position.
2. Lubricate new o-rings and/or back-up rings and slip onto piston rod. Install the first o-ring (A) in the groove on the piston rod. Next position back-up ring (B) against the stepped shoulder. Then install the second o-ring (C). Exercise caution as you slip the o-ring over the thread end of the piston rod.



3. Examine sleeves for scoring or etching and replace. **Immerse sleeves** (D) **in oil and carefully twist and push sleeve onto rod with machined counter bore end first** (E).
4. Next install seal retainers. If wicks are used, replace wicks, thoroughly saturate with oil, place in seal retainer and install retainer.
5. Place inlet manifold on pair of clearance blocks with **crankcase side down** and drive out old seals.
6. Invert inlet manifold with **crankcase side up** and install new seals. Lubricate O.D. of seal and install Prrrrm-A-Lube seal with **garter spring down.** If using blue dot seal, install **blue dot** seal facing up.
7. Slip lubricated seal inserters onto piston rod ends, position inlet manifold onto pump and remove seal inserters. Some models secure inlet manifold to crankcase. Replace fasteners and torque per specification chart.
8. Reassemble piston assemblies and discharge manifold as described.

9. Replace original quantity of shims on each stud before replacing discharge manifold.

SERVICING CRANKCASE SECTION

1. While inlet manifold sleeves and seal retainers are removed, examine crankcase seals for wear.
2. Check oil for proper level and for evidence of water in oil or other contaminants.
3. Rotate crankshaft by hand to feel for smooth bearing movement.
4. Examine crankshaft oil seal externally for drying, cracking or leaking.
5. Consult SunPumps if crankcase service is required.

PREVENTATIVE MAINTENANCE CHECK-LIST					
Check hrs	**Daily**	**Weekly**	**50 hrs**	**500 hrs**	**1500**
Clean Filters	X				
Oil Level/Quality	X				
Oil Leaks	X				
Water Leaks	X				
Belt, Pulleys		X			
Plumbing		X			
Initial Oil Change			X		
Oil Change				X	
Seal Change					X
Valve Change					X
Accessories					X
If other than CAT PUMP Oil 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.					

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 BEOFRE 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 cavitating pump.

DO NOT RUN PUMP DRY Starting a pump dry will damage the piston cups immediately. If there is a possibility of the pump ever running dry, low water level controls should be used.

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 combinations 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.

After prolonged storage, pump should be purged of air to facilitate priming.

Disconnect any discharge port and allow fluid to pass through pump.

HOSE FRICTION LOSS

Pressure drop in PSI per 100 ft of hose

Water with typical water flow rates.

Flow Hose Inside Diameters, Inches

Gal/Min.	**¼**	**5/16**	**3/8**	**½**	**5/8**	**¾**	**1”**
0.5	16	5	2				
1.0	54	20	7	2			
2.0	180	60	25	6	2		
3.0	380	120	50	13	4	2	
4.0		220	90	24	7	3	
5.0		320	130	34	10	4	
6.0			220	52	16	7	1
8.0			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 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 Type L	Steel Pipe-Nominal Dia.							Brass Pipe-Nominal Dia							Copper Tubing O.D.				
GPM	¼	3/8	½	¾	1	1 ¼	1 ½	¼	3/8	½	¾	1	1 ¼	1 ½	¼	3/8	½	5/8	¾
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	Equivalent Length of Standard Pipe in Feet								
Pipe	Inside						180	Tee	Tee
Size Thru	Diameter	Gate	Globe	Angle	45	90	Close	Thru	
Inches Branch	Inches	Valve	Valve	Valve	Elbow	Elbow	Ret	Run	
½ 3.33	0.622	0.41	18.5	9.3	0.78	1.67	3.71	0.93	
¾ 4.41	0.824	0.54	24.5	12.3	1.03	2.21	4.90	1.23	
1 5.62	1.049	0.69	31.2	15.6	1.31	2.81	6.25	1.56	
1 ¼ 7.40	1.380	0.90	41.0	20.5	1.73	3.70	8.22	2.06	
1 ½ 8.63	1.610	1.05	48.0	24.0	2.15	4.31	9.59	2.40	
2 11.60	2.067	1.35	61.5	30.8	2.59	5.55	12.30	3.08	
2 ½ 13.20	2.469	1.62	73.5	36.8	3.09	6.61	14.70	3.68	
3 16.40	3.068	2.01	91.5	45.8	3.84	8.23	18.20	4.57	
4 21.60	4.026	2.64	120.0	60.0	5.03	10.80	23.90	6.00	
Arriving at a total line pressure loss, consideration should then be given to pressure loss created by values, fittings and elevation of lines.									
If a sufficient number of values 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 value or fitting.									

DIAGNOSIS AND MAINTENANCE

PROBLEM	PROBABLE CAUSE	SOLUTION
Pulsation	*Faulty Pulsation Dampener	Check pre-charge. If low, recharge or install a new one.
Low Pressure	*Belt slippage	Tighten or replace. Use correct type/length.
	*Air leak in inlet plumbing	Disassemble, reseal and reassemble
	*Pressure gauge inoperative or not registering accurately	Check with new gauge; replace worn or damaged gauge.
	*Relief valve stuck, partially plugged or improperly adjusted; valve seat worn	Clean and adjust relief valve; check for worn or dirty valve seats. Repair with Valve Kit.
	*Inlet suction strainer clogged or improper size	Clean. Use adequate size. Check frequently
	*Worn Piston Assy. Abrasives in pumped fluid or severe cavitation. Inadequate water supply	Install proper filter. Suction at inlet manifold must be limited to lifting less than 20' of water or –8.5 PSI vacuum.
	*Fouled or dirty inlet or discharge valves	Clean inlet and discharge valve assemblies
	*Worn inlet or discharge valves	Replace worn valves, valve seats.
	*Leaky discharge hose	Replace discharge hose and check for air tight connections.
	* Worn nozzle	Replace nozzle to proper size
Pump runs extremely rough, pressure very low	*Restricted inlet or air entering the inlet plumbing	Proper size inlet plumbing; check for air tight seal.
	*Damaged cup or stuck inlet or discharge valve	Replace worn cups or valves; clean out foreign material.
	*Worn inlet seals allowing air into system or leaking fluid	Install new inlet manifold seals and possibly sleeves.
	*Stressful inlet condition	Pressurize inlet
Cylinder o-ring blown next to discharge manifold	*Pressure in excess of rated PSI or distorted manifold from freezing damage	Check for plugged nozzle, closed valves or improperly adjusted by-pass valve and replace defective manifold or o-ring. PROTECT FROM FREEZING.
Leakage at the cylinder o-rings at the discharge manifold and black powdery substance in the area of the o-ring.	*Loose cylinders. Cylinder motion caused by improper shimming of the discharge manifold.	Remove spacer shims on manifold studs. Do not remove too many shims or the ears of the manifold will be bowed when the manifold is retightened, causing looseness in the center of the cylinder.
Water leakage from under the inlet manifold	*Worn inlet manifold seals. Leaking sleeve o-ring.	Install new o-rings as required. Replace scored sleeves.
Oil leak between crankcase and pumping section	*Worn crankcase piston rod seals.	Replace crankcase piston rod seals.
	*Excess oil from wicks	Reduce quantity of oil per oiling.
Oil leaking in the area of crankshaft	*Worn crankshaft seal or improperly installed oil seal retaining package	Remove oil seal retainer and replace damaged gasket and/or seals
	*Bad bearing	Replace bearing
Excessive play in the end of the crankshaft pulley	*Worn main ball bearing from excessive tension on the drive belt	Replace bearing. Properly tension belt. Use correct type and length.
Water in crankcase	*May be caused by humid air condensing into water inside the crankcase	Change oil every 3 months or 500 hour intervals using special CAT PUMP non detergent HYDRAULIC OIL
	*Leakage of manifold inlet seals and/or piston rod sleeve o-ring	Replace seals, sleeves and o-rings
Oil leaking from side of crankcase	*Worn crankshaft seals	Replace seals
Oil leaking at the rear portion of the crankcase	*Damaged or improperly installed oil gauge or worn crankcase rear cover	Replace oil gauge, cover o-ring, or drain plug o-ring as needed.

	o-ring, or drain plug o-ring	
Oil leakage from drain plug	*Loose drain plug or worn drain plug o-ring	Tighten drain plug or replace o-ring
Loud knocking noise in the pump	*Pulley loose on crankshaft *Broken or worn bearing	Check key and tighten set screw Replace bearing Check alignment and belt position
Frequent or premature failure of the inlet manifold seals	*Scored rods or sleeves *Over pressure to inlet manifold *Stressful inlet conditions	Replace rods and sleeves Reduce inlet pressure Pressurize inlet
Short cup life	*Abrasive material in fluid being pumped *Excessive pressure and/or temperature of fluid being pumped *Running pump dry *Front edge of piston sharp. *Chrome plating of cylinders damaged causing excessive wear of cups. May be caused by pumping acid solution *Short life on cups on cylinders	Install proper filtration on pump inlet plumbing Check discharge pressure, fluid temperature, or control valve by-pass. **Do not run pump without water.** Replace with new piston. Install new cups and cylinders Stressful 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 mating surfaces or inlet inlet valves and discharge valve sealts. F.V. and inlet valves may be lapped on a very fine oil stone; **Q.V. parts must be replaced.**