



Price Pump® Co.



INSTALLATION, OPERATING AND MAINTENANCE MANUAL

1" AND 1-1/2" AIR OPERATED
DIAPHRAGM PUMPS

STANDARD ELASTOMERS

PLEASE FILL IN DATA
FROM YOUR PUMP
NAMEPLATE

Pump Model _____

Spec. No. _____

Serial No. _____

Seal No. _____

RETAIN MANUAL
FOR REFERENCE

Price Pump® Company

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Sonoma, CA 95476

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47396-4/95
IN-AOD-5

Congratulations

You are now the owner of a Price® Pump Co. Air Operated Diaphragm Pump. This pump was carefully inspected and subjected to final performance tests before releasing for shipment. In order to achieve maximum performance and reliability, please follow the simple instructions in this manual.

RECOMMENDED PRECAUTIONS

1. For satisfactory operation and safety, maximum inlet air pressure must not exceed 125 psi (8.79 kg/sq cm).
2. No modifications, additions or deletions should be made to the pump without prior approval of the factory.
3. Drain casing completely and flush with water before servicing pump handling volatile or harmful liquids.

READ CAREFULLY THE CAUTION BELOW

CAUTION:

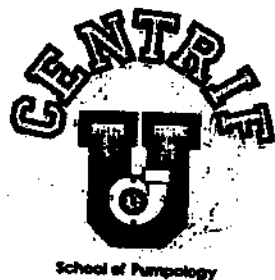
The performance of Price® pump is based upon clear, cold, fresh water with suction conditions as shown on the performance curves. If used to pump other liquids, pump performance may differ from rated performance based on the different specific gravity, temperature, viscosity, etc. of the liquid being pumped. A standard pump, however, may not be safe for pumping all types of liquids, such as toxic, volatile or chemical liquids, or liquids under extreme temperatures or pressures.

Please consult Price® Pump catalogs as well as local codes and general references to determine the appropriate pumps for your particular application. Since it is impossible for us to anticipate every application of a Price® pump, if you plan to use the pump for a non-water application, consult Price® Pump beforehand to determine whether such application may be proper or safe under the circumstances. Failure to do so could result in property damage or personal harm.



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OPERATING INSTRUCTIONS

1" & 1-1/2" AIR OPERATED DIAPHRAGM PUMPS

STANDARD ELASTOMERS

INSTALLATION

Bolt pump to a mounting pad using appropriately sized diameter bolts. Rubber vibration insulators should be used between the pump mounting feet and mounting pad to reduce pump vibrations and stresses. In permanent installations the pump should not be directly attached to rigid piping, but instead should be connected through flexible hoses or equivalent on both the suction and discharge. This should be done to reduce pipe stresses and vibrations which are characteristic of the reciprocating nature of the pump. A surge suppressor may be required on the discharge line of the pump if further reduction in vibration or a reduction of pulsation in the discharge flow is desired.

If the pump is used in a submerged application a line or hose should be attached to the pump air exhaust to prevent liquid from entering the air valve when the pump is shutdown or operating at low discharge heads. **CARE MUST BE EXERCISED WHEN SUBMERGING THE PUMP IN CORROSIVE PUMPING MEDIA.**

Suction and discharge pipe size should be at least equal to the inlet pipe diameter or larger. Larger, if highly viscous liquid is to be pumped or long lengths of pipe are used. When using suction hoses use the non-collapsing reinforced type, since this pump is capable of producing high vacuum at the suction inlet.

SOLIDS-HANDLING CAPABILITY

Price® Pump Air Operated Diaphragm Pumps will pass the following spherical solid sizes:

Model	Size
1AOD-P	1/8" Dia. (3.1 mm)
1-1/2 AOD	3/16" Dia. (4.7mm)
1 AOD-P	3/16" Dia. (4.7mm)

If the possibility exists that larger sized solids may be suspended or carried along by the pumping media, install a strainer on the suction line with smaller sized holes than the allowable solid size. This will prevent the larger solids from entering the pump and interfering with operation of the pump ball valves.

AIR SUPPLY

The inlet to the air valve is a female 1/4" NPT. The air supply line should be sized accordingly so that there is no restriction less than inlet pipe size.

NOTE: Longer air lines require larger diameters to reduce the air system pressure loss and make available required pressure and flow at the pump air inlet. It is safe to use up to 110 psig (7.73 kg/sq cm) for pumping requirements.

WARNING: DO NOT EXCEED 125 PSIG (8.79 KG/SQ CM) AIR SUPPLY PRESSURE AS COMPONENT DAMAGE OR PERSONAL INJURY MAY RESULT.

PUMP CONTROL

The pump operating conditions, flow (GPM) and discharge head (PSIG) can be controlled in the following manner:

1. Throttling the pump discharge by means of a valve on the discharge line. When the pump discharge pressure equals the air supply pressure, the pump will stop. This will not harm the pump, however, **do not exceed 125 psig (8.6 kg/sq cm) air supply pressure.** The pump may be in this mode indefinitely. By opening the discharge valve the pump will resume pumping.
2. The air pressure supply can be limited to the pump. Price® Pump recommends the installation of a Price® Pump air filter/pressure regulator for all AOD applications. A globe or gate valve can be used before the regulator for on or off control. Failure to use an air pressure regulator will cause the pump air inlet pressure and thus discharge pressure to climb to maximum air system pressure when the pump is stopped.

Minimum Air Supply Pressure

This air valve incorporates a stall-free design and will begin operating with air inlet pressures as low as 5 psig.

OPERATING INSTRUCTIONS

OPERATING INSTRUCTIONS

The pump air valve is of an oilless design; that is, no lubrication is required or recommended. A clean, dry air supply should be provided for optimum air valve operation and life. In cold weather operation, or under conditions of high pump discharge pressure and relatively high humidity, air valve freezing may occur as a result of moisture in the compressed air being released. If this occurs, anti-freeze, of the ethylene glycol type, may be used in a measuring dispenser, such as an air line lubricator at the pump air inlet. The resulting mist will keep the air valve free of ice build-up.

1. In cases where there are several air-operated diaphragm pumps being used simultaneously and freezing of the air valve occurs frequently due to excessive moisture in the compressed air system, it may be advantageous to install a desiccant type compressed air dryer in the air system to purge the air supply of unwanted moisture.

For permanent installations, an air filter and water/oil separator should be used. This is always good practice, since it insures maximum life of the air valve moving parts and seals by keeping them clean of dirt and oil residue.

Excessive oil and water in the inlet air supply will cause a varnish-like substance to form on the self-lubricated valve spool. This will eventually lead to valve spool "sticking" and result in erratic spool operation. Should this occur, the spool and housing bore may be cleaned with a commercial safety solvent.

2. When starting the pump, make sure all valving on the suction and discharge lines are open. The pump will not prime with the valving closed. Pump cavitation will occur if the suction line is restricted with foreign matter - use a suction strainer with hole size less than allowable solid size for model in question.
3. When pumping highly viscous materials, it is advisable to check the pump flow rate vs. the pump stroke rate.

PUMP MODEL	AVG. GALLONS PER STROKE*
	Standard Elastomers
1 AOD	.18 (.68L)
1 1/2 AOD	.35 (1.3L)
	Standard Elastomers
1 AOD-P	.12 (.45L)

*Actual test data with flooded suction and specific gravity of 1.0.

One pump stroke is equal to one exhaust blast. The pump should not pump faster than the material is capable of being drawn into the pump. If this occurs, cavitation will occur and damage to the pump could result in time.

4. To determine maximum pumping speed, increase air supply while pump discharge increases. When discharge flow no longer increases, throttle back air until pump discharge flow starts to fall off. This point is the optimum pumping speed achievable under those controlled by either one of the two methods previously mentioned under the PUMP CONTROL section of this manual.
5. The pump air exhaust port should be kept free from blockage. The pump should never be operated submerged without installing a line to the exhaust port and directing the same above the liquid surface. An appropriately sized hose with a 1/2" male NPT connector may be piped up to the exhaust port and directed away. The exhaust line, if required, should be kept as short as possible or pump performance could be affected. If long lengths of exhaust line are necessary, increase the internal diameter of the exhaust line to minimize pressure drop and pump performance loss. If the exhaust sound level becomes too objectionable, use the air muffler provided.

NOTE: Installing an air exhaust muffler on a submerged pump will not prevent the liquid in which the pump is submerged, from entering the air valve.

CAUTION: If a diaphragm failure occurs, the pumping media may be blown out the exhaust port. This could be hazardous if the pumping media is toxic or aggressive. It is advisable to add a line to the exhaust port and direct it safely away when pumping toxic or aggressive media.

6. Drain pump and flush after use when pumping material which can pack, settle out of liquid suspension, or solidify in time. A packed pump can cause damage to the diaphragm clamping plates and pump shaft when started after a period of interrupted use. The pump may be inverted and drained through the discharge port and flushed through the suction port.

OPERATING TEMPERATURE 1 AOD & 1 1/2 AOD-Metal Wetted Parts

The pump should not be used to pump liquids above 180°F (82°C). Degradation of the pump elastomers will develop when the temperature of the pumping media rises above 180°F (82°C). For operating temperatures above 180°F (82°C) consult factory.

OPERATING TEMPERATURE 1 AOD-P

The pump should not be used to pump liquids above 150°F (65°C). For operating temperatures above 150°F (65°C) consult factory.

OPERATING INSTRUCTIONS

TROUBLESHOOTING

1. Pump will run but will not pump.

- a. check suction line for leaks.
- b. tighten bolts or clamps on suction manifold of pumps.
- c. material too viscous to pump at high rate of flow – slow down pump by reducing air supply to pump or use larger diameter suction line.
- d. suction manifold & pump chambers misaligned – disassemble & realign.
- e. suction or discharge balls jammed open with foreign object – disassemble pump & examine.

NOTE: Optimum priming speed for these pumps is obtained when air inlet pressure is maintained between 15-20 psi, (1.0-1.4 kg/cm²) with open pump discharge.

2. Air bubbles in pump discharge

- a. check suction line and manifold bolts or clamps for leaks
- b. cracked or ruptured diaphragm

3. Intermittent pump operation and/or ice blowing from exhaust port

- a. remove obstruction from suction line
- b. valve freeze-up – install de-icer on air inlet line or suitable air dryer in compressed air line.
- c. sticky air valve – remove main spool & clean with safety solvent.

4. Pump stops pumping.

- a. increase air supply pressure – **DO NOT exceed 125 psig (8.79 kg/cm²)** under any circumstances and check for obstruction in suction or discharge line.

- b. spool sticking – remove main spool & clean with safety solvent – install suitable filter on air inlet if dirt or contaminants persist.
- c. air valve ice-up – excess moisture on the muffler is an indication that significant water is present in the air supply. Depending on the degree of severity, an in line water separator or air dryer is recommended.

5. Severe pump vibration with intermittent flow.

- a. ruptured diaphragm – disassemble pump, replace diaphragm and clean air valve if necessary.
- b. mechanical failure – disassemble pump and inspect for bent shaft, etc.

6. Pumping media leaking from exhaust port.

- a. ruptured diaphragm – disassemble pump, replace diaphragm – clean air valve if necessary.

7. Varying pump discharge per stroke.

- a. remove suction manifold and check for obstructions.
- b. worn or leaky ball valves & seats – disassemble pump and replace worn parts.

8. Slowing of pumping action

- a. clogged air exhaust muffler – replace
- b. ice build up in air valve – install de-icer on air inlet line

OPERATING INSTRUCTIONS

PUMP DISASSEMBLY INSTRUCTIONS

Prior to disassembly of any AOD pump follow the "caution" below.

CAUTION: Do not attempt to perform any maintenance or repair on the air operated diaphragm pumps until the compressed air line to the pump and pump discharge line has been shut off, bled down, and disconnected. In addition, when pumps are being used to pump toxic or aggressive media the pumps should be flushed clean prior to disassembly.

DISASSEMBLY INSTRUCTIONS FOR MODEL 1AOD, CAST IRON, ALUMINUM, STAINLESS STEEL

(refer to Fig. 1, page 13)

1. Pump should be disassembled in the normal upright position. Remove cap screws (52), flatwashers (53), and hex nuts (54), from the discharge (top) manifold (23). Remove manifold, ball valves (29), and ball seats (28). Check for excessively worn seats & replace if necessary. Check ball valves for gouges and deep scratches or heavily worn or abraded areas and replace. Heavily worn balls and seats will affect pump performance.
2. Remove cap screws (52) and hardware from suction manifold (24). Remove remaining pump chamber assembly from suction manifold & place on table. Perform same inspections on balls and seats as in step #1 above. Heavily worn balls and seats will affect pump performance.
NOTE: Mark pump chambers (1) and air chambers (86) with an index line 90° across the diaphragm as well as an L and R (left and right) to distinguish the pump chambers. These marks will aid in alignment during reassembly.
3. Remove cap screws (52), flat washers (53) and hex nuts (54), from pump chamber (1) which connect pump chamber to clamp ring (87). Remove pump chambers.
4. Remove 3/8"-16 x 1 1/4" 316 SS cap screw (2) and stainless washers (3) from pump shaft (16). Disassemble outer diaphragm clamping plate (4), diaphragm (6), inner diaphragm clamping plate (7), and bumper (8). Slide shaft (16) from the air valve housing (78), with opposing diaphragm and plates attached. Check diaphragms & rubber bumpers for wear and replace, if necessary.
5. Remove remaining diaphragm and plates from shaft by putting shaft in vise between two blocks of wood or soft metal jaws and removing the 3/8" capscrew from other end of shaft.
6. Refer to Air Valve Disassembly Instructions on page 11 of this manual.

REASSEMBLY INSTRUCTIONS FOR MODEL 1AOD, CAST IRON, ALUMINUM, STAINLESS STEEL

(refer to Fig. 1, page 13)

1. Place pump shaft (16) in vise with soft metal jaws or wooden blocks between the vise jaws and shaft. Assemble new rubber bumper (8), inner diaphragm clamping plate (7), new diaphragm (6) and outer diaphragm clamping plate (4) with the diaphragm concave side facing upward. Apply Loctite #242 to 3/8"-16 x 1 1/4" 316 SS capscrew (2) and assemble to shaft with 3/8" stainless steel flat washer (3). Torque capscrew to 400 inch lbs. (45 n-m).
2. Push shaft through bore in air chamber/air valve assembly. Check for free movement of shaft, then bottom out diaphragm in air chamber. Invert assembly and assemble remaining new bumper, diaphragm (6), clamping plates & capscrew per step #1 above. Torque capscrew to 400 inch lbs. (45 n-m).
3. Place pump chamber (1) marked either L or R on table and align proper index mark on respective air chamber (86).
NOTE: Diaphragm should be depressed into air chamber being assembled at this time. Place diaphragm outer bead into groove in pump chamber. Check to make sure diaphragm bead fits evenly into groove.
4. Install and tighten the capscrews (52), washers (53), and nuts (54). After tightening, check alignment between pump chamber and air chamber.
5. Push opposing diaphragm into its respective air chamber, the diaphragm bead should sit flush in air chamber groove.
6. Place the other pump chamber (1) onto the exposed diaphragm. Using either the previously made alignment marks, or by visual inspection, align the two pump chambers (1) so their respective manifold flanges are parallel. If surfaces are not reasonably parallel, leakage at the ball seats could occur.
7. Repeat step 4 for second pump chamber.
8. Place a suction ball valve (29) and a valve seat (28) into the bottom of each pump chamber (1). Be sure the raised "O" ring contour on the valve seat is facing downward toward the suction manifold. Align the pump with the suction manifold (24) and attach with cap screws (52), washer (53) and hex nuts (54).

The discharge manifold (23) should have two ball valves (29) and two valve seats (28) placed into it. The raised "O" ring contour should be visible when the seat (28) is placed in the manifold (23). Using cap screw (52), washer (53) and hex nut (54), secure the discharge manifold (23) with ball valve and valve seats to the pump.

CAUTION: DO NOT TORQUE MANIFOLD BOLTS BEYOND 130 IN-LB (15 N-M).

OPERATING INSTRUCTIONS

DISASSEMBLY INSTRUCTIONS FOR MODEL 1AOD-P

(refer to Fig. 2, page 14)

1. Start disassembly by standing pump upright. Remove discharge manifold (23) by removing cap screws (52), hex nuts (32), and flat washers (31).
2. Remove "O" rings (47), ball cages (57), balls (29), ball seats (28), and gaskets (58) from discharge end of pump chambers (1). Check "O" ring, ball cages, balls, and ball seats. Replace any part that appears to be worn or damaged.

NOTE: It is recommended that discharge seat gasket (58) automatically be replaced.

3. Remove suction manifold (24) and mounting feet (55) by removing cap screws (56), hex nuts (32), and flat washers (31).
4. Remove "O" rings (47), ball seats (28), balls (29), and ball cages (57) from suction end of pump chambers (1). Check "O" rings, ball seats, balls, and ball cages. Replace any part that appear to be worn or damaged.
5. **NOTE:** Mark pump chambers (1) and air chambers (86) with an index line 90° across the diaphragm (6) as well as an L and R (Left and Right). These marks will aid in proper alignment during reassembly. Remove both pump chambers by removing cap screws (30), hex nuts (32), and flat washers (31).
6. While holding the hex head portion of one of the plastic outer diaphragm clamping plates (4), unscrew the other clamp plate. Either plate may come loose first. Completely remove outer clamp plate (4), diaphragm (6), inner clamp plate (7) and bumper (8). Slide shaft (16), with opposing diaphragm and plates attached, out of air valve housing (78).

Check clamping plates, diaphragms and bumpers for wear or damage. Replace if necessary.

7. Remove remaining diaphragm and plates from shaft by putting shaft in vise between two blocks of wood or soft metal jaws and unscrewing the outer clamp plate.
8. Refer to Air Valve Disassembly Instructions on page 11 of this manual.

REASSEMBLY INSTRUCTIONS FOR MODEL 1AOD-P

(Refer to Fig. 2, page 14)

1. Place pump shaft (16) in vise with soft metal jaws or wooden blocks between the vise jaws and shaft. Place new rubber bumper (8) on end of shaft. Assemble new diaphragm (6) and inner diaphragm clamping plate (7) onto 3/8" stud protruding from outer diaphragm clamping plate (4), concave side facing away from shaft. Apply Loctite #242 to

thread and screw assembly into end of shaft. **Tighten hex head portion of outer clamp to 150-200 in lbs. (17-22 nm).**

2. Push shaft through bore in air chamber/air valve assembly. Check for free movement of shaft, then bottom out diaphragm in air chamber. Invert assembly and assemble new bumper to shaft, new diaphragm, inner clamp plate to outer clamp plate and screw into end of shaft. **Tighten outer clamp plate to 150-200 in lbs (17-22 nm).**
3. Place pump chamber (1) marked either L or R on table and align proper index mark on respective air chamber (86). Diaphragm should be depressed into air chamber being assembled at this time. Place diaphragm outer bead into groove in pump chamber. If no index marks are present, visually align the air valve housing. The word "Top" appears on the outside portion of one of the large "cube-like" pump chamber sections.
4. Install and tighten the capscrews (30), washers (31), and nuts (32) securing the pump chamber to the air chamber in several steps. **Tighten cap screws and nuts in several steps to 70-80 inch lbs (8-9 nm) so as not to distort the non-metallic parts.**
5. Push opposing diaphragm into its respective air chamber groove.
6. Align and secure the other pump chamber to the air chamber following the procedure in step #5.
7. Place pump assembly on a table with the "top" of the pump chamber facing down.
8. Into each of the pump chamber openings facing-up, insert ball cage (57), ball (29), ball seat (28) and "O" ring gasket (47). Place suction manifold (24) on top of the pump assembly so that the flat surfaces of the square pads are against the "O" ring gasket (47). Align the holes in the mounting feet (55) with the holes in the suction manifold (24) and pump chambers (1). Insert the eight 3/8" x 4 3/4" cap screws with flatwashers through the mounting feet, manifold and pump chambers and secure with flatwasher (31) and hex nuts (32). **Torque capscrews and nuts to 115-125 in lbs (13-14 nm).**
9. Invert the pump so it is now resting on its feet.
10. Into the top of each pump chamber, insert new gasket (58), ball seat (28), ball (29), ball cage (57) and "O" ring gasket (47).
11. Place discharge manifold (23) on top of the pump assembly so that the flat surfaces of the square pads are against the "O" ring gaskets. Insert the eight 3/8" x 4 1/2" capscrews with flat washers through the manifold and pump chambers. Secure with flatwashers & hex nuts. **Torque capscrews and hex nuts to 115-125 in lbs (13-14 nm).**
12. Your pump is now ready to be placed back in service.

OPERATING INSTRUCTIONS

DISASSEMBLY INSTRUCTIONS FOR MODEL 1 1/2 AOD, CAST IRON

(refer to Fig. 3, page 15)

1. Pump should be disassembled in the normal upright position. Remove cap screws (52), flatwashers (53), and hex nuts (54), from the discharge (top) manifold (23). Remove manifold, ball valves (29), and ball seats (28). Check for excessively worn seats & replace if necessary. Check ball valves for gouges and deep scratches or heavily worn or abraded areas and replace. Heavily worn balls and seats will affect pump performance.
2. Remove cap screws from suction (lower) manifold (24). Remove remaining pump chamber assembly from suction manifold & place on table. Perform same inspections on balls and seats as in step #1 above. Heavily worn balls and seats will affect pump performance.
3. Remove 9 1/2" dia. (241 mm) clamps (22) from the pump chamber/air chamber connection. As you remove clamps, place an index mark across the pump chamber flange (1), air chamber flange (86) with a felt pen marker. This will aid in finding the right alignment during reassembly. Remove pump chamber (1) by lightly tapping pump chamber with a fiber or wooden mallet until it is free of the diaphragm.

CAUTION: Do not use a metal headed hammer on the pump chamber.

4. Place hex head of outer diaphragm plate (4) on end of pump shaft (16) in a table vise and loosen opposing diaphragm plate with wrench. Remove outer diaphragm plate (4), diaphragm (6), inner diaphragm plate (7), and rubber bumper (8) from pump shaft (16). Check diaphragm, rubber bumper, and "O" ring for wear and replace if necessary.
5. Remove shaft (16) and remaining diaphragm (assembly) from pump by sliding through pump shaft bore. Put free end of shaft in vise between two blocks of wood or soft metal jaws and remove diaphragm plate and remaining parts.
6. Refer to air valve disassembly instructions on page 11 of this manual.

REASSEMBLY INSTRUCTIONS FOR MODEL 1 1/2 AOD, CAST IRON

(Refer to Fig. 3, page 15)

1. Place pump shaft (16) in vise with soft metal jaws or wooden blocks between the vise jaws and shaft. Assemble new diaphragm (6) to the pump shaft using the inner diaphragm clamping plate (7), outer

diaphragm clamping plate (4), and new rubber bumper (8). The diaphragm concave side must face upward. Apply **Loctite #242** to the internal threads of the outer clamp plate (4) and assemble to shaft.

2. Insert shaft assembly through bore in air chamber/air valve assembly. Check for free movement of shaft. Shaft should not bind. Bottom out diaphragm in air chamber. Invert assembly and place remaining diaphragm, clamping plates, and new rubber bumper, as in step #1 above.
3. Place hex head of diaphragm clamping plate (4) in table vise. Place wrench on hex head of opposing diaphragm plate (4) at opposite end of pump shaft. **Torque to 35 ft. lbs., (47 n-m). Be sure both outer clamp plates are torqued to 35 ft. lbs. (47 n-m).**
4. To assemble pump chambers (1) to air chambers (86) start with either diaphragm which is fully recessed in air chamber. Place pump chamber previously marked with an index mark (felt pen) to match index marks on air chamber. If replacing a pump chamber, align roughly by eye. Assemble 9/2" (241 mm) dia. clamp halves (22) and hardware bolt (19), & Nut (21) to pump chamber flange and tighten slightly. Assemble second pump chamber to opposing air chamber by first depressing diaphragm until it sits securely in groove cast in air chamber casing. Rotate pump chamber until index marks align. Add clamp halves & hardware and tighten slightly. At this point an alignment check should be made. Place a straight edge on each pump chamber flange – they should be parallel. Place pump upright on that flat surface – the suction flange of pump chamber should lie flat.

NOTE: The pump may leak at the manifolds if these surfaces are not parallel.

5. Tighten 9 1/2" (241 mm) clamps (22) by tapping clamps with a soft metal or wooden mallet while tightening the 3/8" clamp capscrews. **Torque capscrews to approximately 150-200 inch lbs. (17-23 n-m).** Do not over tighten. Check alignment once again. If OK, proceed. If not, loosen clamps and realign.
6. Place a suction ball valve (29) and valve seat (28) into the bottom of each pump chamber (1). Be sure the raised "O" ring contour on the valve seat is facing downward toward the suction manifold. Align the pump with the suction manifold (24) and secure with cap screws (52), washers (53), and hex nuts (54).

The discharge manifold (23) should have two ball valves (29) and two valve seats (28) placed into it. The raised "O" ring contour should be visible when the seat (28) is placed in the manifold (23). Using cap screw (52), washer (53) and hex nut (54), secure the discharge manifold (23) with ball valve and valve seats to the pump. Reassembly is complete.

OPERATING INSTRUCTIONS

DISASSEMBLY INSTRUCTIONS FOR MODEL 1 1/2 AOD, ALUMINUM

(refer to Fig. 4, page 16)

1. Pump should be disassembled in the normal upright position. Remove small clamps (27) from the discharge (top) manifold (23) by removing carriage bolts (25) and hexnuts (26). Remove manifold, ball valves (29), and ball seats (28). Check for excessively worn seats & replace if necessary. Check ball valves for gouges and deep scratches or heavily worn or abraded areas and replace. Heavily worn balls and seats will affect pump performance.
2. Remove small clamp halves (27) from suction (lower) manifold (24). Remove remaining pump assembly from suction manifold & place on table. Perform same inspections on balls and seats as in step #1 above. Heavily worn balls and seats will affect pump performance.
3. Remove 9 1/2" dia. (241 mm) clamps (22) from the pump chamber/air chamber connection. As you remove clamps, place an index mark across the pump chamber flange (1), air chamber flange (86) with a felt pen marker. This will aid in finding the right alignment during reassembly. Remove pump chamber (1) by lightly tapping pump chamber with a fiber or wooden mallet until it is free of the diaphragm.

CAUTION: Do not use a metal headed hammer on the pump chamber.

4. Place ESNA locknut (2) on end of pump shaft in a table vise and loosen opposing ESNA locknut with wrench. Remove ESNA locknut (2), outer diaphragm plate (4), diaphragm (6), inner diaphragm plate (7), and rubber bumper (8) from pump shaft (16). Check diaphragm & rubber bumper for wear and replace if necessary.
5. Remove shaft and remaining diaphragm from pump by sliding through pump shaft bore. Put free end of shaft in vise between two blocks of wood or soft metal jaws and remove ESNA locknut and remaining parts.
6. Refer to air valve disassembly instructions on page 11 of this manual.

REASSEMBLY INSTRUCTIONS FOR MODEL 1 1/2 AOD, ALUMINUM

(Refer to Fig. 4, page 16)

1. Place pump shaft (16) in vise with soft metal jaws or wooden blocks between the vise jaws and shaft. Assemble new rubber bumper (8), inner diaphragm clamping plate (7), new diaphragm (6), outer diaphragm clamping plate (4), and ESNA locknut (2) to shaft. Tighten locknut but do not torque down until step #3 during reassembly.

2. Insert and push shaft assembly through bore in air chamber/air valve assembly. Check for free movement of shaft. Shaft should not bind. Bottom out diaphragm in air chamber. Invert assembly and place remaining diaphragm, clamping plates, and new rubber bumper, as in step #1 above.
3. **Torque ESNA nuts to 35 ft. lbs., (47 n-m). Be sure both ESNA nuts are torqued to 35 ft. lbs. (47 n-m).**
4. To assemble pump chambers (1) to air chambers (86) start with either diaphragm which is fully recessed in air chamber. Place pump chamber previously marked with an index mark (felt pen) to match index marks on air chamber. If replacing a pump chamber, do this roughly by eye. Assemble 9 1/2" (241 mm) dia. clamp halves (22) and hardware bolt (19), & Nut (21) to pump chamber flange and tighten slightly. Assemble second pump chamber to opposing air chamber by first depressing diaphragm until it sits securely in groove cast in air chamber casing. Rotate pump chamber until index marks align. Add clamp halves & hardware and tighten slightly. At this point an alignment check should be made. Place a straight edge on each pump chamber flange – they should be parallel. Place pump upright on flat surface – the suction flanges of pump chambers should lie flat.

NOTE: The pump may leak at the manifolds if these surfaces are not parallel.

5. Tighten 9 1/2" (241 mm) clamps (22) by tapping clamps with a soft metal or wooden mallet while tightening the 3/8" clamp capscrews. **Torque capscrews to approximately 150-200 inch lbs. (17-23 n-m).** Do not over tighten. Check alignment once again. If OK, proceed. If not, loosen clamps and realign.
6. Place valve seats (28) in counterbored holes in suction manifold (24).

NOTE: Raised "O" ring lip on valve seat must be facing downward in counterbored hole. Surfaces for valve seats should be free of nicks, dents and scratches. The rubber valve seat should protrude an even height above suction flange.

7. Place a ball valve (29) in valve seats & place assembled pump onto suction manifold. Use clamp halves (27) and hardware. To assemble pump body to manifold, gently tap clamps while assembling to insure a good seal. Make sure manifold flanges & pump chamber flanges are centered. **Tighten 3 1/2" (89 mm) dia. clamps to 20 inch lbs., (2 n-m).**
8. Repeat similar procedure for discharge manifold (23) and associated balls, seats, clamps, etc. to complete assembly.

OPERATING INSTRUCTIONS

DISASSEMBLY INSTRUCTIONS FOR MODEL 1 1/2 AOD, STAINLESS

(refer to Fig. 5, page 17)

1. Pump should be disassembled in the normal upright position. Remove small clamps (27) from the discharge (top) manifold (23) by removing carriage bolts (25) and hexnuts (26). Remove manifold, ball valves (29), and ball seats (28). Check for excessively worn seats & replace if necessary. Check ball valves for gouges and deep scratches or heavily worn or abraded areas and replace. Heavily worn balls and seats will affect pump performance.
2. Remove small clamp halves (27) from suction (lower) manifold (24). Remove remaining pump assembly from suction manifold & place on table. Perform same inspections on balls and seats as in step #1 above. Heavily worn balls and seats will affect pump performance.
3. Remove 9 1/2" dia. (241 mm) clamps (22) from the pump chamber/air chamber connection. As you remove clamps, place an index mark across the pump chamber flange (1), air chamber flange (86) with a felt pen marker. This will aid in finding the right alignment during reassembly. Remove pump chamber (1) by lightly tapping pump chamber with a fiber or wooden mallet until it is free of the diaphragm.

CAUTION: Do not use a metal headed hammer on the pump chamber.

4. Place hex head of outer diaphragm plate (4) on end of pump shaft (16) in a table vise, loosen opposing diaphragm plate with wrench. Remove outer diaphragm plate (4), diaphragm (6), inner diaphragm plate (7), and rubber bumper (8) from pump shaft (16). Check diaphragm & rubber bumper for wear and replace if necessary.
5. Remove shaft and remaining diaphragm from pump by sliding through pump shaft bore. Put free end of shaft in vise between two blocks of wood or soft metal jaws and remove diaphragm plate and remaining parts.
6. Refer to air valve disassembly instructions on page 11 of this manual.

REASSEMBLY INSTRUCTIONS FOR MODEL 1 1/2 AOD, STAINLESS

(Refer to Fig. 5, page 17)

1. Place pump shaft (16) in vise with soft metal jaws or wooden blocks between the vise jaws and shaft. Assemble new diaphragm (6), inner diaphragm clamping plate (7), outer diaphragm clamping plate (4), and new rubber bumper (8) with the diaphragm concave side facing upward. Tighten clamp plate but do not torque down until step #3 during reassembly. Apply

Loctite #242 to the internal threads of the outer clamp plate (4) and assemble to shaft.

2. Insert and push shaft assembly through bore in air chamber/air valve assembly. Check for free movement of shaft. Shaft should not bind. Bottom out diaphragm in air chamber. Invert assembly and place remaining diaphragm, clamping plates, and new rubber bumper, as in step #1 above.
3. Place hex head of diaphragm clamping plate (4) in table vise. Place wrench on hex head of opposing diaphragm plate (4) at opposite end of pump shaft. **Torque to 35 ft. lbs., (47 n-m). Be sure both outer clamp plates are torqued to 35 ft. lbs. (47 n-m).**
4. To assemble pump chambers (1) to air chambers (86) start with either diaphragm which is fully recessed in air chambers. Place pump chamber previously marked with an index marking (felt pen) to match index marks on air chamber. If replacing a pump chamber, do this roughly by eye. Assemble 9 1/2" (241 mm) dia. clamp halves (22) and hardware bolt (19), & Nut (21) to pump chamber flange and tighten slightly. Assemble second pump chamber to opposing air chamber by first depressing diaphragm until it sits securely in groove cast in air chamber casing. Rotate pump chamber until index marks align. Add clamp halves & hardware and tighten slightly. At this point an alignment check should be made. Place a straight edge on each pump chamber flange – they should be parallel. Place pump upright on flat surface – the suction flange of pump chamber should lie flat.

NOTE: The pump may leak at the manifolds if these surfaces are not parallel.

5. Tighten 9 1/2" (241 mm) clamps (22) by tapping clamps with a soft metal or wooden mallet while tightening the 3/8" clamp capscrews. **Torque capscrews to approximately 150-200 inch lbs. (17-23 n-m).** Do not over tighten. Check alignment once again. If OK, proceed. If not, loosen clamps and realign.
6. Place valve seats (28) in counterbored holes in suction manifold (24).

NOTE: Raised "O" ring lip on valve seat must be facing downward in counterbored hole. Surfaces for valve seats should be free of nicks, dents and scratches. The rubber valve seat should protrude an even height above suction flange.

7. Place a ball valve (29) in valve seats & place assembled pump onto suction manifold. Use clamp halves (27) and hardware. To assemble pump body to manifold, gently tap clamps while assembling to insure a good seal. Make sure manifold flanges & pump chamber flanges are centered. **Tighten 3 1/2" (89 mm) dia. clamps to 20 inch lbs., (2 n-m).**
8. Repeat similar procedure for discharge manifold (23) and associated balls, seats, clamps, etc. to complete assembly.

OPERATING INSTRUCTIONS

AIR VALVE DISASSEMBLY INSTRUCTIONS

Removal of Air Chambers

(Refer to appropriate pump exploded view)

1. Remove the five hex nuts (62), lockwashers (61), special flat washers (17) and flat head socket screws (9) which retain one of the air chambers (86) to the air valve housing (key no. 78 of Fig. 6, page 18). Repeat this step for the opposite air chamber.
2. Loosen the connection between the long flathead screw (66) and short flat head screw (91) at coupling nut (85) by turning both (66) and (91) counter clockwise using two Allen wrenches. Loosen lock-nut (84) from coupling nut (85), and remove both from long flat head screw (66).
3. Set aside gaskets (15) and, if used, air chamber clamping rings (87). Plastic pumps are bolted while metallic pumps use clamping rings. Remove seals (12) and (14) from both air chambers (86). Replace these items during reassembly.

AIR VALVE DISASSEMBLY INSTRUCTIONS

Air Valve Body Disassembly

(Refer to Fig. 6 page 18)

1. Remove spool housing end caps (36), gaskets (37) and cap screws (35) from spool housing (68).
2. Remove main spool (39) and examine spool, piston rings (45) and ring expanders (46) for wear. Replace piston ring set & spool if deeply scratched, chipped or worn. New spools will be interchangeable with old. If main spool bore in spool housing has become corroded, excessively pitted, or deeply scratched replace spool housing (68).
3. Remove muffler (44) from air valve housing (78) and check inside for dirt and debris. If muffler is clogged it will affect pump performance. Replace if necessary.
4. Remove spool housing (68) and gasket (65) by removing the four socket head cap screws (95) and lockwashers (90). Check gasket for any degradation and replace if required.
5. Check Oilite bronze sleeve bushings (43) in valve housing (78). If worn they can be removed by carefully pressing out. Replace as necessary.
6. Remove the pilot spool (82) from the air valve by pulling out at one end. Remove the piston ring assemblies (83) from each end of the pilot spool. Examine for wear and replace as necessary.
7. Your air valve assembly is now completely disassembled and ready for reassembly.

OPERATING INSTRUCTIONS

AIR VALVE BODY REASSEMBLY INSTRUCTIONS

(Refer to Fig. 6, page 18 and appropriate pump exploded view.)

CAUTION: Care must be taken at this stage of reassembly to ensure cleanliness. A dirty valve will stick and work improperly. Keep area free of dirt, oil, and metal chips.

1. Clean all metal parts with good grade safety solvent prior to reassembly.
2. Press shaft bushings (43) into air valve housing (78), making sure they are properly aligned with the bore in the valve housing. Press bushings in to 0.165" above the flush position.
3. Install new piston ring assemblies (83) on pilot spool (82). Push pilot spool with piston rings into bore of air valve. Take care to position splits in piston rings to 3 o'clock or 9 o'clock position in bore.
4. Inspect spool (39) for scratches, scoring, chips, and wear. If severe grooving or marking is evident, replace spool. To ensure maximum performance the spool should not be excessively worn, although the pump will still run satisfactorily.
5. Insert piston ring seals (45) and expander rings (46) prior to reassembly. Replace with new if required.

NOTE: Upon reassembly of piston ring seals (45) and expander rings (46) the opening in the expander ring and the split in the piston ring should be assembled 180° apart. Also, upon reassembling the spool to the spool housing bore, rotate piston ring seals in their grooves until the split in the seal is at the valve housing 3 or 9 o'clock position. This prevents the split from covering valve housing ports during reassembly. This also eliminates the tendency to hang up on a port. Do not install main spool in a centered position or pump may not start.

6. Install spool housing cap gaskets (37) with existing end caps (36) and 1/4" - 20 Allen head screws (35) at both ends of spool housing.
7. Position new gasket (65), and spool housing assembly onto valve housing and secure with four Allen head screws (95), and lockwashers (91). **Torque screws (95) to 7 ft-lbs. (9.5 n-m).**
8. Check muffler (44) to make sure that it is clean and free of debris. If it cannot be cleaned, replace with new. Install muffler in air valve housing. Do not overtighten. One quarter turn past hand tight should be sufficient.

AIR CHAMBER REASSEMBLY TO AIR VALVE BODY

(Refer to Fig. 6, page 18 and appropriate pump exploded view)

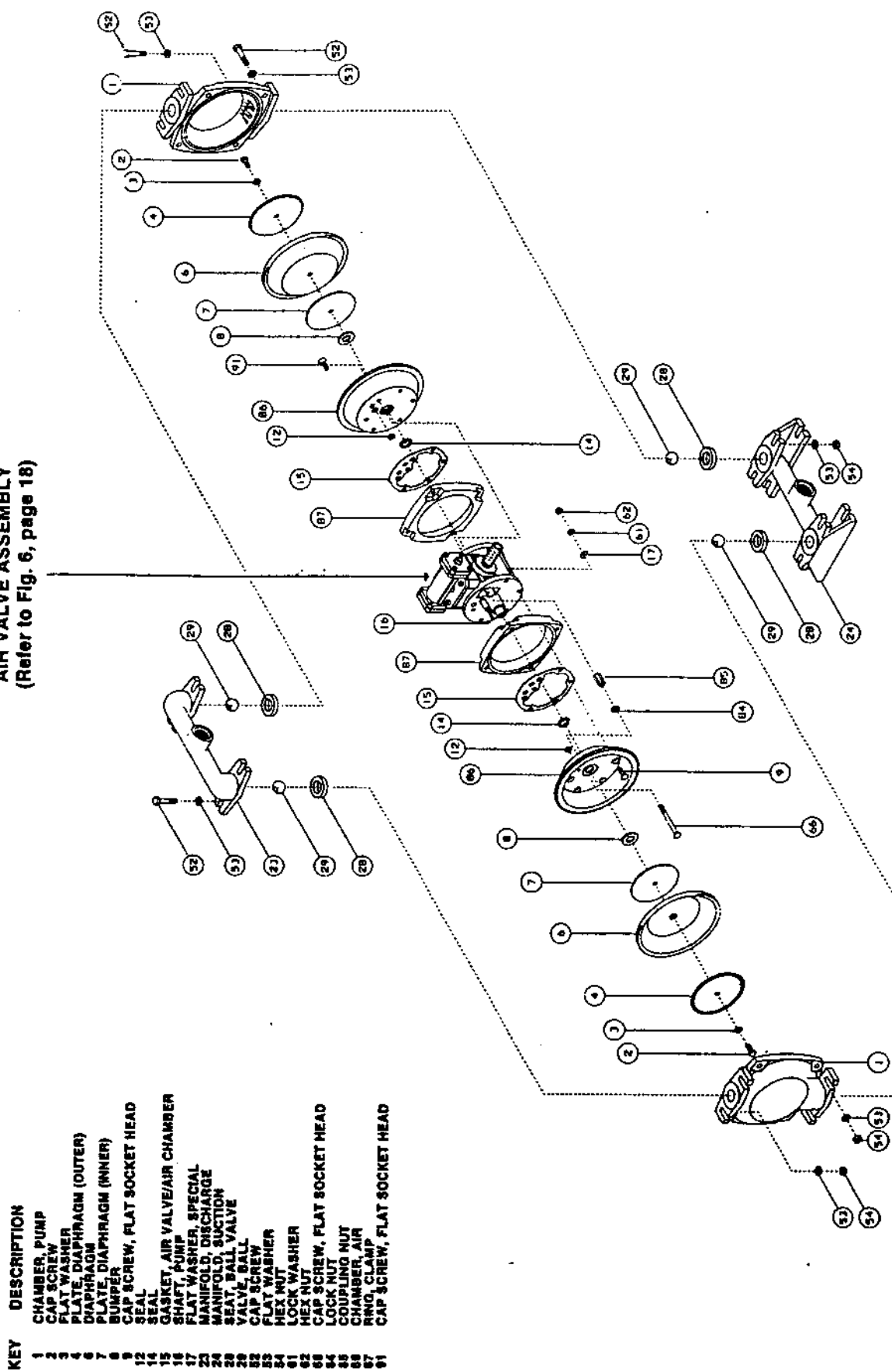
1. Install new seals (12) and (14) in both air chambers. **Important!** The lips of seal (12) must face away from the air valve housing and the lips of seal (14) must face inwards towards the center of the air valve housing.
2. Align gasket (15) with air valve housing (78) and attach air chamber (86) using five flathead screws (9), special flatwashers (17), lockwashers (61) and hex nuts (62).

NOTE: For any model which uses air chamber clamp rings (87) make certain to place the clamp rings (87) in position before attaching air chambers to the air valve body. The beveled edge of the clamp ring should face towards the air chamber.

3. Thread long flat head screw (66) through the appropriate hole in the opposite air chamber (86) and gasket (15), which lines up with the hole left blank in step 2 when this air chamber was installed. Thread locknut (84) and coupling nut (85) onto long flathead screw (66). Lock coupling nut in place with locknut.
4. Install second air chamber (86) with gasket (15) and long flathead screw with locknut and coupling nut onto air valve (78). Attach air chamber to air valve using five flathead screws (9), special flat washers (17), lockwashers (61) and hex nuts (62).
5. Install short flat head screw (35) in blank hole in first air chamber, then engage coupling nut. Tighten flat head screws (66) and (35) using two Allen wrenches. **Torque all air chamber to air valve hardware to 7 ft.-lbs. (9.5 n-m).**
6. Your air valve assembly is now completely refurbished and ready for further pump assembly.

MODEL 1A0D - ALUMINUM, CAST IRON & STAINLESS STEEL

AIR VALVE ASSEMBLY
(Refer to Fig. 6, page 18)

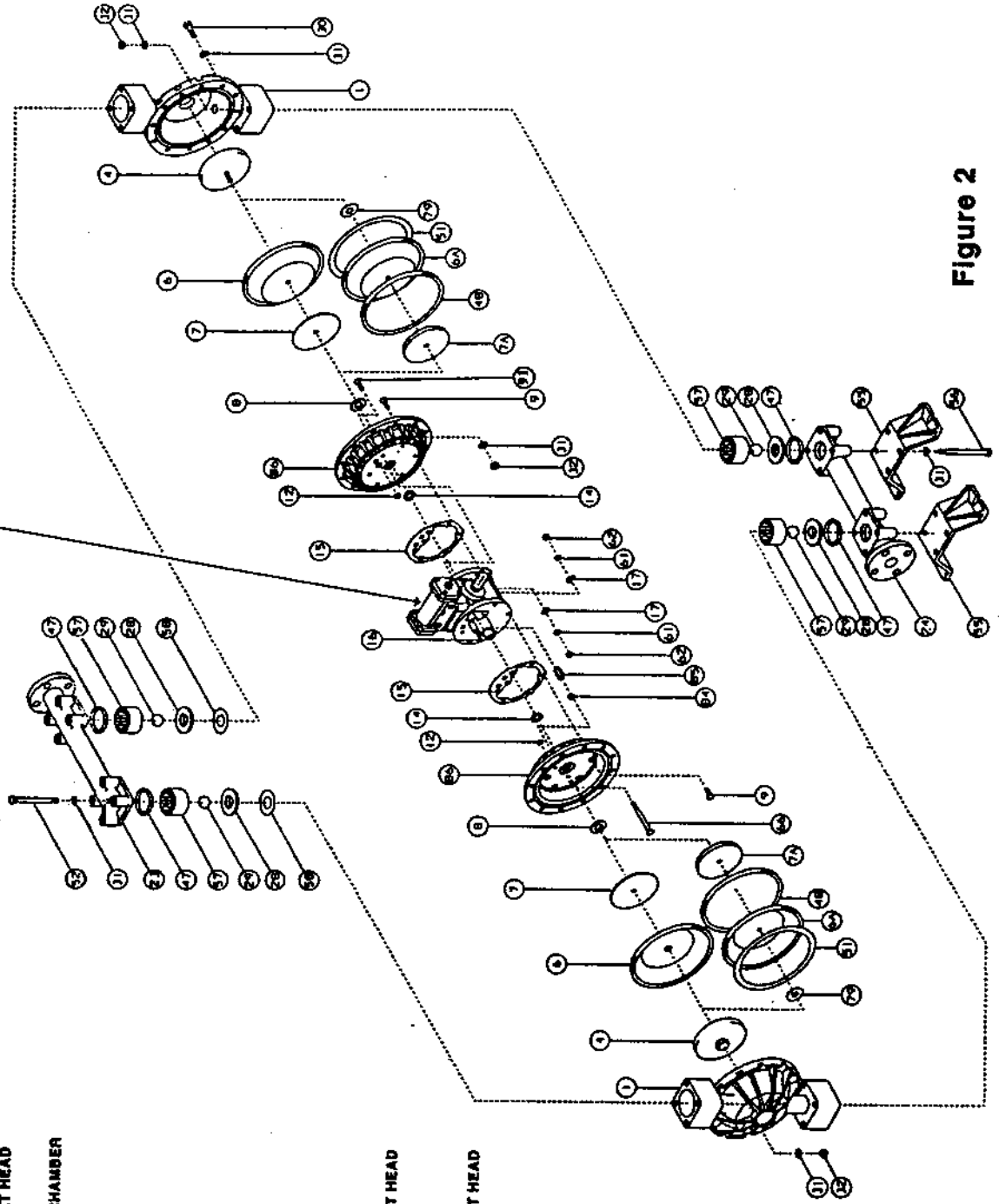


KEY	DESCRIPTION
1	CHAMBER, PUMP
2	CAP SCREW
3	FLAT WASHER
4	PLATE, DIAPHRAGM (OUTER)
5	DIAPHRAGM
6	PLATE, DIAPHRAGM (INNER)
7	BUMPER
8	CAP SCREW, FLAT SOCKET HEAD
9	SEAL
10	SEAL
11	GASKET, AIR VALVE/AIR CHAMBER
12	SHAFT, PUMP
13	FLAT WASHER, SPECIAL
14	MANIFOLD, DISCHARGE
15	MANIFOLD, SUCTION
16	SEAT, BALL VALVE
17	VALVE BALL
18	CAP SCREW
19	FLAT WASHER
20	LOCK NUT
21	HEX NUT
22	CAP SCREW, FLAT SOCKET HEAD
23	LOCK NUT
24	COUPLING NUT
25	CHAMBER, AIR
26	RING, CLAMP
27	CAP SCREW, FLAT SOCKET HEAD
28	CLAMP
29	CLAMP
30	CLAMP
31	CLAMP
32	CLAMP
33	CLAMP
34	CLAMP
35	CLAMP
36	CLAMP
37	CLAMP
38	CLAMP
39	CLAMP
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81	CLAMP
82	CLAMP
83	CLAMP
84	CLAMP
85	CLAMP
86	CLAMP
87	CLAMP
88	CLAMP
89	CLAMP
90	CLAMP
91	CLAMP

Figure 1

MODEL 1AOD - P

AIR VALVE ASSEMBLY (Refer to Fig. 6, page 18)



KEY	DESCRIPTION
1	CHAMBER, PUMP
4	PLATE, DIAPHRAGM (OUTER)
6	DIAPHRAGM
7	PLATE, DIAPHRAGM (INNER)
8	BUMPER
9	CAP SCREW, FLAT SOCKET HEAD
12	SEAL
14	GASKET
15	GASKET, AIR VALVE/AIR CHAMBER
16	SHAFT, PUMP
17	FLAT WASHER, SPECIAL
23	MANIFOLD, DISCHARGE
24	MANIFOLD, SUCTION
28	SEAT, BALL VALVE
28	VALVE, BALL
30	CAP SCREW
31	FLAT WASHER
32	HEX NUT
47	"O" RING
48	"O" RING, DIAPHRAGM
51	TAPE, TEFLON
52	CAP SCREW
55	FOOT, MOUNTING
56	CAP SCREW
57	CAGE, BALL VALVE
58	GASKET
61	LOCKWASHER
62	HEX NUT
66	CAP SCREW, FLAT SOCKET HEAD
78	GASKET
84	LOCK NUT
85	COUPLING NUT
86	CHAMBER, AIR
91	CAP SCREW, FLAT SOCKET HEAD

Figure 2

MODEL 1 1/2 AOD - CAST IRON

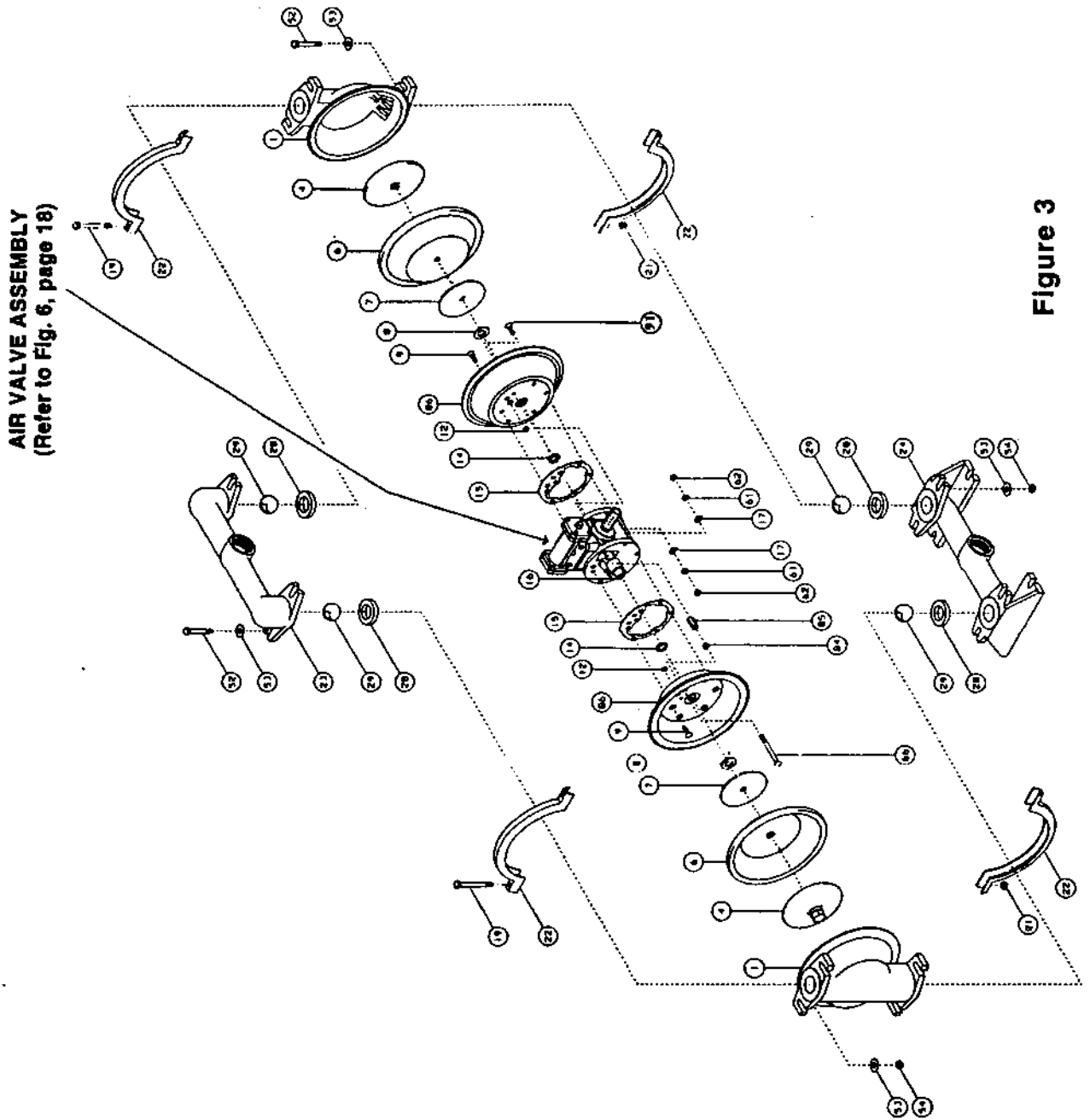
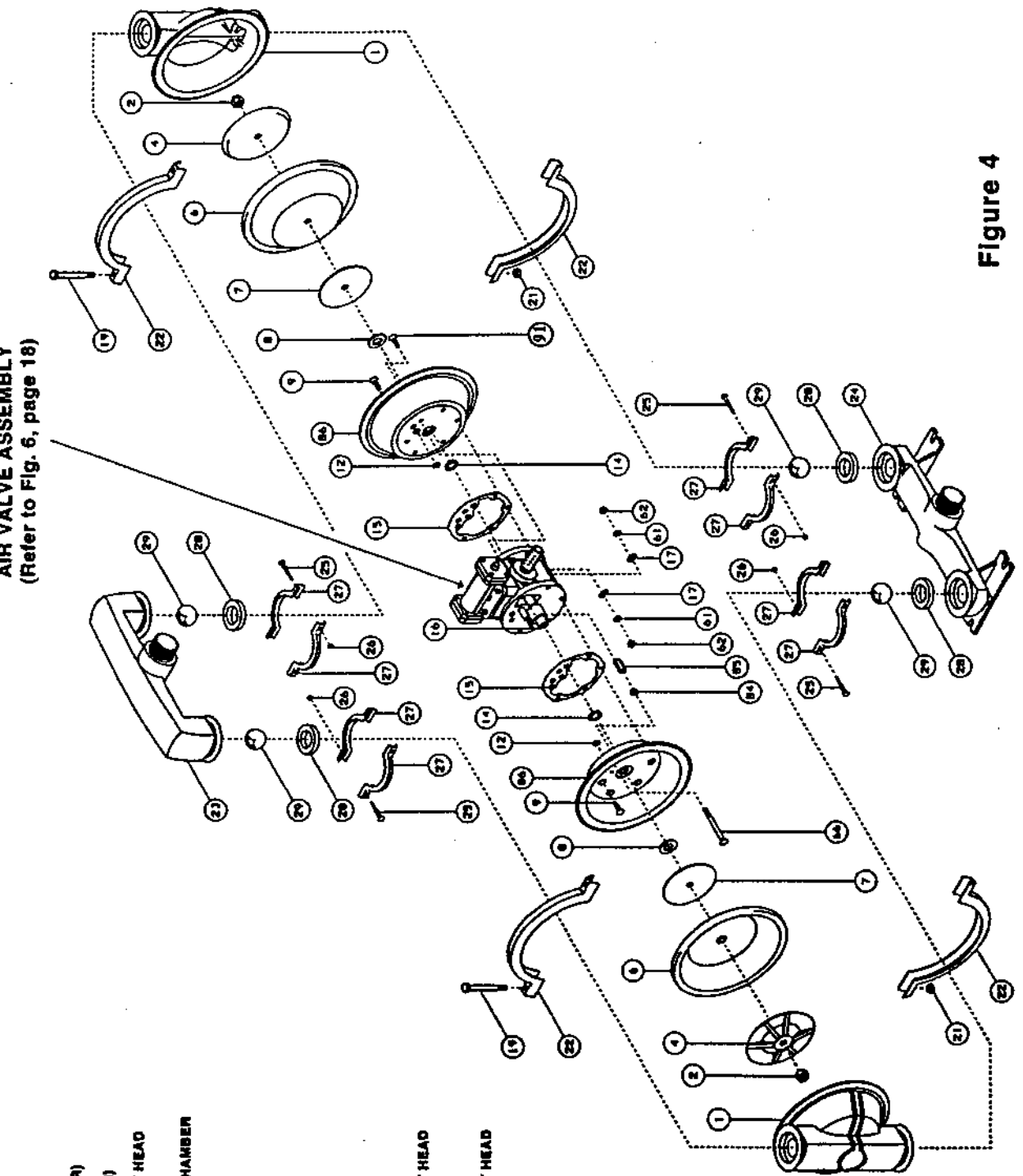


Figure 3

KEY	DESCRIPTION
1	CHAMBER, PUMP
4	PLATE, DIAPHRAGM (OUTER)
6	DIAPHRAGM
7	PLATE, DIAPHRAGM (INNER)
8	BUMPER
9	CAP SCREW, FLAT SOCKET HEAD
12	SEAL
14	SEAL
15	GASKET, AIR VALVE/ AIR CHAMBER
16	SHAFT, PUMP
17	FLAT WASHER, SPECIAL
19	CAP SCREW
21	HEX NUT
22	CLAMP, HALF
23	MANIFOLD, DISCHARGE
34	MANIFOLD, SUCTION
25	CARRIAGE BOLT
26	BEAT, BALL VALVE
29	VALVE, BALL
32	CAP SCREW
33	FLAT WASHER
34	HEX NUT
35	LOCKWASHER
36	HEX NUT
37	CAP SCREW, FLAT SOCKET HEAD
38	LOCK NUT
39	COUPLING NUT
40	CHAMBER, AIR
41	CAP SCREW, FLAT SOCKET HEAD

MODEL 1 1/2AOD - ALUMINUM

AIR VALVE ASSEMBLY (Refer to Fig. 6, page 18)



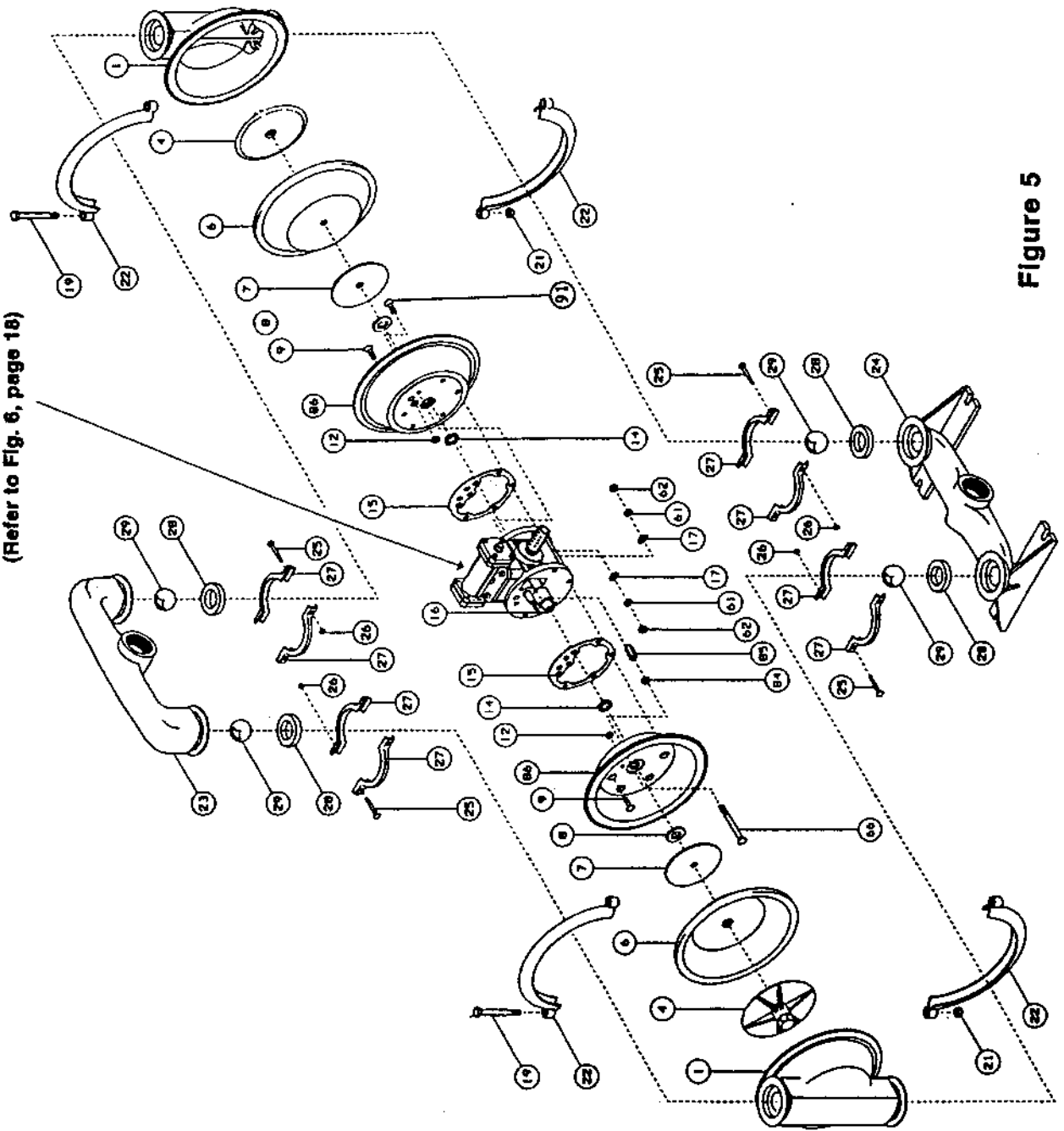
KEY

- | | |
|----|--------------------------------|
| 1 | CHAMBER, PUMP |
| 2 | NUT, LOCK |
| 4 | PLATE, DIAPHRAGM (OUTER) |
| 6 | DIAPHRAGM |
| 7 | PLATE, DIAPHRAGM (INNER) |
| 8 | BUNIPER |
| 9 | CAP SCREW, FLAT SOCKET HEAD |
| 12 | SEAL |
| 14 | GASKET, AIR VALVE/ AIR CHAMBER |
| 15 | SHAFT, PUMP |
| 16 | FLAT WASHER, SPECIAL |
| 17 | CAP SCREW |
| 18 | HEX NUT |
| 21 | CLAMP, HALF 9/16" |
| 22 | MANIFOLD, DISCHARGE |
| 23 | MANIFOLD, SUCTION |
| 24 | CARRIAGE BOLT |
| 25 | HEX NUT |
| 26 | CLAMP, HALF 3/4" |
| 27 | SEAT, BALL VALVE |
| 28 | VALVE, BALL |
| 29 | LOCKWASHER |
| 31 | HEX NUT |
| 32 | CAP SCREW, FLAT SOCKET HEAD |
| 33 | LOCK NUT |
| 34 | COUPLING NUT |
| 35 | CHAMBER, AIR |
| 36 | CAP SCREW, FLAT SOCKET HEAD |
| 91 | |

Figure 4

MODEL 1 1/2AOD - STAINLESS

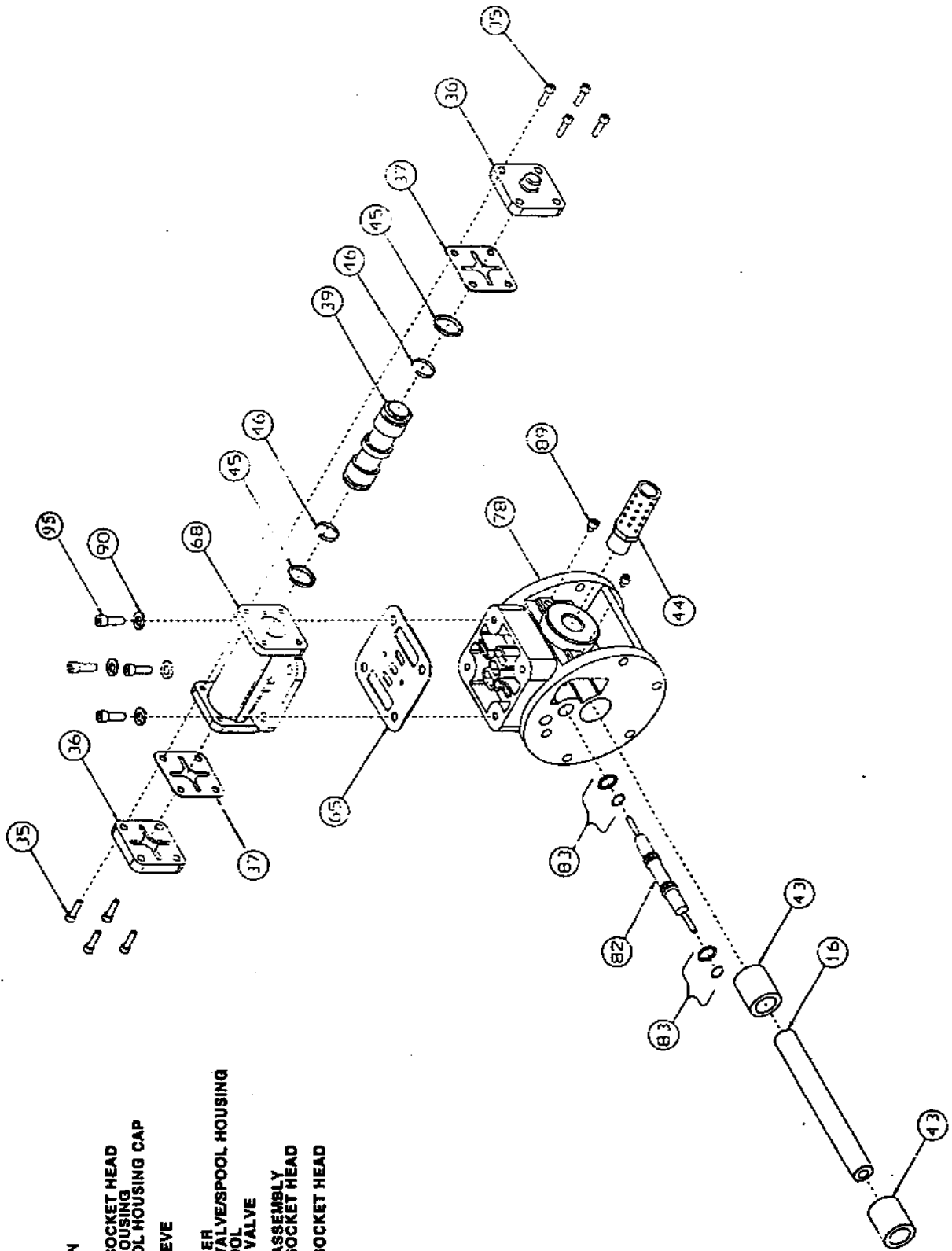
AIR VALVE ASSEMBLY (Refer to Fig. 6, page 18)



KEY	DESCRIPTION
1	CHAMBER, PUMP
4	PLATE, DIAPHRAGM (OUTER)
6	DIAPHRAGM
7	PLATE, DIAPHRAGM (INNER)
8	BUMPER
9	CAP SCREW, FLAT SOCKET HEAD
12	SEAL
14	SEAL
18	GASKET, AIR VALVE/AIR CHAMBER
16	SHAFT, PUMP
17	FLAT WASHER, SPECIAL
18	CAP SCREW
21	HEX NUT
22	CLAMP, HALF 9/16"
23	MANIFOLD, DISCHARGE
24	MANIFOLD, SUCTION
25	CARRIAGE BOLT
26	HEX NUT
27	CLAMP, HALF 3/4"
28	SEAT, BALL VALVE
29	VALVE, BALL
31	LOCK WASHER
32	HEX NUT
36	CAP SCREW, FLAT SOCKET HEAD
44	LOCK NUT
45	COUPLING NUT
46	CHAMBER, AIR
48	CAP SCREW, FLAT SOCKET HEAD
51	

Figure 5

MODELS 1 & 1 1/2 AOD - AIR VALVE



KEY	DESCRIPTION
16	SHAFT
35	CAP SCREW, SOCKET HEAD
36	CAP, SPOOL HOUSING
37	GASKET, SPOOL HOUSING CAP
39	SPOOL
43	BUSHING, SLEEVE
44	MUFFLER
45	RING, PISTON
46	RING, EXPANDER
65	GASKET, AIR VALVE/SPOOL HOUSING
68	HOUSING, SPOOL
78	HOUSING, AIR VALVE
82	SPOOL PILOT
83	PISTON RING ASSEMBLY
89	CAP SCREW, SOCKET HEAD
90	LOCKWASHER
95	CAP SCREW, SOCKET HEAD

Figure 6

AOD® PUMP WARNINGS

- A Static charge buildup could occur in a plastic pump or an electrically insulated metal pump.
- Any contaminants in the air supply will be exhausted out the muffler to the atmosphere.
- All piping connections to the pump should be flexible.
- The chemical compatibility of the pump materials of construction with the fluids being pumped must be checked before use.
- AOD® pumps are not to be used for sanitary food applications.
- Submerged AOD® pumps should have their exhaust pipes away from the liquid level. A submerged pump may leak some air from gasketed joints. Do not submerge pumps in corrosive media.
- A pump which has stopped due to air valve icing will restart by itself when ice melts.
- Use only original factory replacement parts.
- Before start-up re-torque all external fasteners to the torque values listed in the I&O manual supplied with the pump.
- Pump temperature limits must be observed: Polypro pump - 150 deg F max. (65 deg. C)
Metal pump - 180 deg F max. (82 deg. C)
- Do not exceed 125 psi (8.79 bar) air inlet pressure as component damage or personal injury may result.
- AOD® pumps must only be operated by oil free, clean, dry compressed air.
- Shut off, bleed down and disconnect the compressed air supply before doing any maintenance or repair to the pump.
- The pump should be flushed before disassembly. The pump should be inverted (outlet at bottom) to drain properly.
- A diaphragm failure could:
 - a. cause the system to which the pump is connected to be pressurized up the the compressed air supply pressure and mix air with the fluid being pumped.
 - b. Cause the fluid being pumped to be sprayed out through the exhaust muffler.
- AOD® pumps are not suitable for use with 1,1,1-trichloroethane, methylene chloride or other materials containing halogenated hydrocarbons. Aluminum wetted parts can react with these solvents and explode. Consult solvent suppliers for compatibility with aluminum before installation.
- For 1-1/2", 2" and 3" AOD® pumps- CAUTION – unit weight may exceed 65lbs. (30 kg).

AOD® sound level at a distance of 1 meter with an air inlet pressure of 35 psig.

Pump size Inches	Pump Material	Sound Pressure Level		Sound Power Level db (A)
		RMS db (A)	Peak db (C)	
1/2	Polypro	87	104	97
1	Polypro	89	105	99
1	Metal	95	110	105
1-1/2	Metal	90	109	100
2	Metal	98	108	108
3	Metal	97	108	103



GENERAL TERMS OF SALE FOR PRODUCTS

Effective: January 1, 1999

1. GENERAL

A. Seller's price is based on these sales terms and conditions. This contract shall represent the final, complete and exclusive statement of the agreement between the parties and may not be modified, supplemented, explained or waived by parol evidence, any Terms and Conditions contained in Buyer's purchase order or request for quotation, any course of dealings between the parties, Seller's performance or delivery, or in any other way. The Terms and Conditions of this contract may only be modified or waived in a written document signed by an Officer of Seller. These terms are intended to cover all activity of Seller and Buyer hereunder, including sales and use of products, parts and work and all related matters (references to products include parts and references to work include construction, installation and start-up). Any reference by Seller to Buyer's specifications and similar requirements are only to describe the products and work covered hereby and no warranties or other terms therein shall have any force of effect. Any information provided by Seller, including but not limited to suggestions as to specific equipment does not imply any guarantee of specific suitability and/or material compatibility in a particular application since many factors outside the control of Seller may affect the suitability of products in a particular application. Catalogs, circulars and similar pamphlets of the Seller are issued for general information purposes only and shall not be deemed to modify the provisions hereof.

B. The agreement formed hereby and the language herein shall be construed and enforced under the Uniform Commercial Code as in effect in the State of California on the date hereof.

2. TAXES

Any sales, use or other similar type taxes imposed on this sale or on this transaction are not included in the price. Such taxes shall be billed separately to the Buyer. Seller will accept a valid exemption certificate from the Buyer if applicable; however, if an exemption certificate previously accepted is not recognized by the governmental taxing authority involved and the Seller is required to pay the tax covered by such exemption certificate. Buyer agrees to promptly reimburse Seller for the taxes paid.

3. PERFORMANCE, INSPECTION AND ACCEPTANCE

A. Unless Seller specifically assumes installation, construction or start-up responsibility, all products shall be finally inspected and accepted within thirty (30) days after arrival at point of delivery. Products not covered by the foregoing and all work shall be finally inspected and accepted within thirty (30) days after completion of the applicable work by Seller. All claims whatsoever by Buyer (including claims for shortages) excepting only those provided for under the WARRANTY AND LIMITATION OF LIABILITY and PATENTS Clauses hereof must be asserted in writing by Buyer within said thirty (30) day period or they are waived. If this contract involves partial performance, all such claims must be asserted within said thirty- (30) day period for each partial performance. There shall be no revocation of acceptance. Rejection may be only for defects substantial to the value of products or work and Buyer's remedy for lesser defects shall be those provided for under the WARRANTY AND LIMITATION OF LIABILITY Clause.

B. Seller shall not be responsible for non-performance or for delays in performance occasioned by any causes beyond Seller's reasonable control, including, but not limited to, labor difficulties, delays of vendors or carriers, fires, governmental actions, or shortages of material, components, labor, or manufacturing facilities. Any delays so occasioned shall affect a corresponding extension of Seller's performance dates, which are, in any event, understood to be approximate. In no event shall Buyer be entitled to incidental or consequential damages for late performance or for a failure to perform. Seller reserves the right to make partial shipments and to ship products, parts or work which may be completed prior to the scheduled performance date.

C. In the event that Seller has agreed to mount motors, turbines, gears, or other products which are not manufactured by Seller and which are not an integral part of Seller's manufactured product, and a delay in the delivery of such products to Seller occurs that will cause a delay in Seller's performance date, Seller reserves the right to ship its product upon completion of manufacture and to refund an equitable portion of the amount originally included in the purchase price for mounting without incurring liability for non-performance.

D. Seller reserves to itself the right to change its specifications, drawings and standards if such changes will not impair the performance of its products, and parts, and further that such products, and parts, will meet any of Buyer's specifications and other specific product requirements which are a part of this agreement.

E. The manufacture and inspection of products and parts shall be to Seller's Engineering and Quality Assurance standards plus such other inspections, tests of documentation as are specifically agreed to by Seller. Requirements for any additional inspection, tests, documentation, or Buyer witness of manufacture, test, and/or inspection shall be subject to additional charges.

4. TITLE AND RISK OF LOSS

Title and risk of loss shall pass to buyer upon delivery of products at the designated Ex Works place (Incoterms 1990) unless other wise agreed by the parties.

5. EROSION AND CORROSION

It is specifically understood that products and parts sold hereunder are not warranted for operation with erosive or corrosive fluids. No product or part shall be deemed to be defective by reason of failure to resist erosive or corrosive action of any fluid and Buyer shall have no claim whatsoever against Seller therefore.

6. WARRANTY AND LIMITATION OF LIABILITY.

A. Seller warrants only that its product and parts, when shipped, will be free from defects in materials and workmanship. With respect to products and parts not manufactured by Seller, Seller's only obligation shall be to assign to Buyer, to the extent possible, whatever warranty Seller requires from the manufacturer. All claims for defective products or parts under this warranty must be made in writing immediately upon discovery and, in any event, within one (1) year after initial start-up or eighteen (18) months after shipment, whichever first occurs, and all claims for defective work must be made in writing immediately upon discovery and in any event, within one (1) year of completion thereof by Seller.

Defective items must be held for Seller's inspection and returned to the original f.o.b. point upon request.

THE FOREGOING IS EXPRESSLY IN LIEU OF ALL OTHER WARRANTIES WHATSOEVER, EXPRESS, IMPLIED AND STATUTORY, INCLUDING WITHOUT LIMITATION, THE IMPLIED, WARRANTIES OF MERCHANTABILITY AND FITNESS.

B. ANY PRODUCT (S) SOLD HEREUNDER WHICH IS NOT MANUFACTURED BY SELLER IS NOT WARRANTED BY SELLER and shall be covered only by the express warranty, if any, of the manufacturer thereof.

C. Upon Buyer's submission of a claim as provided above and its substantiation, Seller shall at its option either (i) repair or replace its product, part or work at the original place of delivery, or (ii) refund an equitable portion of the purchase price.

D. THE FOREGOING IS SELLER'S ONLY OBLIGATION AND BUYER'S EXCLUSIVE REMEDY FOR BREACH OF WARRANTY AND, EXCEPT FOR GROSS NEGLIGENCE, WILLFUL MISCONDUCT, AND REMEDIES PERMITTED UNDER THE PERFORMANCE, INSPECTION AND ACCEPTANCE AND THE PATENTS CLAUSES HEREOF, THE FOREGOING IS BUYER EXCLUSIVE REMEDY AGAINST SELLER FOR ALL CLAIMS ARISING HEREUNDER OR RELATING HERETO WHETHER SUCH CLAIMS ARE BASED ON BREACH OF CONTRACT, TORT (INCLUDING NEGLIGENCE) OR OTHER THEORIES. BUYER'S FAILURE TO SUBMIT A CLAIM AS PROVIDED ABOVE SHALL SPECIFICALLY WAIVE ALL CLAIMS FOR DAMAGES OR OTHER RELIEF, INCLUDING BUT NOT LIMITED TO CLAIMS BASED ON LATENT DEFECTS. IN NO EVENT SHALL BUYER BE ENTITLED TO INDIRECT, SPECIAL, INCIDENTAL OR CONSEQUENTIAL DAMAGES, NOR FOR DAMAGES FOR LOSS OF USE, LOST PROFITS OR REVENUE, INTEREST, LOST GOODWILL, WORK OR PRODUCTION STOPPAGE, IMPAIRMENT OF OTHER GOODS, INCREASED EXPENSES OF OPERATION, OR THE COST OF PURCHASING REPLACEMENT POWER OR OTHER SERVICES BECAUSE OF SERVICE INTERRUPTIONS. FURTHERMORE, IN NO EVENT SHALL SELLER'S TOTAL LIABILITY FOR DAMAGES OF BUYER EXCEED THE PURCHASE PRICE OF THE PRODUCTS OR PARTS MANUFACTURED BY SELLER AND UPON WHICH SUCH LIABILITY IS BASED. ANY ACTION ARISING HEREUNDER RELATED HERETO, WHETHER BASED ON BREACH OF CONTRACT, TORT (INCLUDING NEGLIGENCE) OR OTHER THEORIES, MUST BE COMMENCED WITHIN ONE (1) YEAR AFTER THE CAUSE OF ACTION ACCRUES OR IT SHALL BE BARRED.

7. PURCHASER'S REPRESENTATIONS & WARRANTIES

Purchaser represents and warrants that the product(s) covered by this contract shall not be used in or in connection with a nuclear facility or application. The parties agree that this representation and warranty is material and is being relied on by seller. This provision may be modified in a separate writing signed by an officer of PPC.

8. PATENTS

Seller agrees to assume the defense of any suit for infringement of any patents brought against Buyer to the extent of such suit charges infringement of an apparatus or product claim by Seller's product in and of itself, provided (i) said product is built entirely to Seller's design, (ii) Buyer notifies Seller in writing of the filing of such suit within ten (10) days after the service of process thereof, and (iii) Seller is given complete control of the defense of such suit, including the right to defend, settle and make changes in the product for the purpose of avoiding infringement of any process or method claims, unless infringement of such claims is the result of following specific instruction furnished by Seller.

9. EXTENT OF SUPPLY

Only products as listed in Seller's proposal are included in this agreement. It must not be assumed that Seller has included anything beyond same.

10. MANUFACTURING SOURCES

To maintain delivery schedules, Seller reserves the right to have all or any part of the Buyer's order manufactured at any of Seller's or its licensees' plants on a world-wide basis.

11. TERMS OF PAYMENT

Net 30 days from date of invoice.