



Price Pump® Co.



# INSTALLATION, OPERATING AND MAINTENANCE MANUAL

2" AND 3" AIR OPERATED  
DIAPHRAGM PUMPS

MODELS: 2 AOD-STTS  
2AOD-CTTS  
3AOD-CTTS  
2AOD-ATTA  
3AOD-ATTA

TEFLON FITTED

PLEASE FILL IN DATA  
FROM YOUR PUMP  
NAMEPLATE

Pump Model \_\_\_\_\_

Spec. No. \_\_\_\_\_

Serial No. \_\_\_\_\_

Seal No. \_\_\_\_\_

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RETAIN MANUAL  
FOR REFERENCE

47394-9/94  
IN-AOD-4

# 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

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### 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

## 2" & 3" AIR OPERATED DIAPHRAGM PUMPS

### TEFLON FITTED

#### 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
2 AOD	3/8" Dia. (9.5 mm)
3AOD	7/16" Dia. (11mm)

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

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

# OPERATING INSTRUCTIONS

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 valves on the suction and discharge lines are open. The pump will not prime with the valves 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* Teflon Fitted
2 AOD	.80 (3.0 l)
3 AOD	.82 (3.1 l)

\*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 of blockage. The pump should never be operated submerged without installing a line to the exhaust port and directing the same above the liquid sur-

face. An appropriately sized hose 3/4" (19 mm) for the 2" and 3" models, may be piped up to the exhaust port and directed away. The required exhaust line 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

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.

## TROUBLESHOOTING

1. **Pump will run but will not pump.**
  - a. check suction line for leaks.
  - b. tighten up 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.
  - d. suction manifold & pump chambers misaligned - disassemble & realign.
  - e. suction or discharge balls jammed open with foreign object - disassemble pump & check.

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

# OPERATING INSTRUCTIONS

2. **Air bubbles in pump discharge.**
  - a. check suction line & 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 spool & clean with safety solvent.
4. **Pump stops pumping.**
  - a. increase air supply pressure – **DO NOT exceed 125 psig (8.79 kg/cm<sup>2</sup>)** under any circumstances and check for obstruction in suction or discharge line.
  - b. spool sticking – remove 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 coming 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 up of pumping action.**
  - a. clogged air exhaust muffler – replace.
  - b. ice build up in air valve – install de-icer on air inlet line.

## PUMP DISASSEMBLY INSTRUCTIONS

Prior to disassembly of any AOD pump included herein; 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 MODELS 2AOD & 3AOD, CAST IRON – Teflon Fitted

(refer to Fig. 1, page 11)

1. Pump should be disassembled in the normal upright position. Remove cap screws (52), flatwashers (53), and hex nuts (54), from the discharge on top manifold (23). Remove manifold, ball valves (29), and ball seats (28A). 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), flat washers (53) and hex nuts (54), from the suction or lower manifold (24). Remove remaining pump 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 12 1/2" (318 mm) dia. clamps (22) from the pump chamber/air chamber connection. As you remove clamps, place an index mark across the pump chamber flange (1) and air chamber flanges (10) & (11) 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 clamping plate (4) in a table vise. Remove opposing outer diaphragm plate (4) with wrench. **Loctite #271** is used to secure outer diaphragm plates (4) to shaft (16A). Heating hex area of outer diaphragm plate with propane torch will assist removal if difficult. The light heating will degrade strength of **Loctite #271**. Then remove diaphragm (50), diaphragm (6A), backing diaphragm (48A), inner diaphragm plate (7A), and rubber bumper (8) from pump shaft (16A). Check diaphragm and rubber bumper for wear. Replace if necessary. If teflon tape (51) on pump chamber (1A) is damaged, replace. The tape ensures proper diaphragm sealing.
5. Remove shaft (16A) and remaining diaphragm (attached) 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 clamp plate and remaining parts.

# OPERATING INSTRUCTIONS

6. Disassemble air chambers (10) & (11) from air valve housing by removing five 3/8" socket flat head screws (9) from the air chamber.
7. Remove & replace shaft gasket (14) in air chamber.
8. Remove gasket (12) from the air chamber and replace if worn excessively.
9. Repeat steps 6 thru 8 for the opposing air chamber.
10. Refer to air valve disassembly instructions in another section of this manual.

## REASSEMBLY INSTRUCTIONS FOR MODELS 2AOD & 3AOD, CAST IRON – Teflon Fitted

(refer to Fig. 1, page 11)

1. Reassemble air chambers (10) & (11) to refurbished air valve housing:
  - a. The cupped side of the special shaft gaskets (14) and special pilot spool gaskets (12) must be facing toward their respective diaphragms. Installing gaskets backwards will make sealing ineffective.
  - b. Replace the composition material, air valve/air chamber gaskets (15).
  - c. Add **Loctite #242** to 3/8" socket flat head screws (9) prior to reassembly.
  - d. Position air chamber (11) onto bronze bushing protruding from air valve housing (34) and align pilot spool end cap (80) (protruding from air valve).

**NOTE:** Be careful to align the air valve/air chamber gasket (15) prior to assembly with screws. Check for proper pilot spool operation by laying valve on table and depressing extended pilot spool. Spool should move smoothly and easily (**not loose**) through gaskets.

Assemble air chamber to valve housing by installing 3/8" socket flat head screws (9) and tightening diametrically opposite to **100 inch. lb. (11 n-m)** torque. Check alignment after screws are tightened.

2. Repeat step #1 for opposing air chamber (10). Recheck pilot spool operation.
3. Place pump shaft (16A) in vise with soft metal jaws or wooden blocks between the vise jaws. Assemble new rubber bumper (8) to shaft. Assemble inner diaphragm plate (7A), backing diaphragm (48A), diaphragm (6A), diaphragm (50), and remaining diaphragm plate (4), to shaft (16A). Diaphragms should be positioned so that "O" ring groove of diaphragm (6A) and rubber backing diaphragm will be facing the air chambers (with convex side facing upward). Tighten, but do not torque down until later on during

reassembly. **Loctite #271** is recommended on internal threads of outer diaphragm plates (4).

4. Using water (as a lubricant) on end of shaft, insert and push shaft assembly through bore in air chamber/air valve assembly. Check for free movement of shaft. Shaft must not bind. Bottom out diaphragm in air chamber. Invert assembly and place new rubber bumper, remaining diaphragms, diaphragm, diaphragm plate, etc. in same procedure as step #3 above. Put hex head of outer diaphragm clamping plate on end of shaft in table vise. Use **Loctite #271** on threads of 7. outer clamp plate (4).
5. Place wrench on hex head of opposing outer diaphragm plate at opposite end of pump shaft. Torque to **80 ft. lb. (108 n-m)**. Be sure both outer diaphragm plates are tightened to **80 ft. lb. (108 n-m)**.

**CAUTION:** Be sure inner diaphragm plates do **not** rotate while tightening. If allowed to rotate, damage to pilot spool end could result.

6. To assemble pump chambers (1A) to air chambers (10) & (11), secure diaphragm (6A) & backing diaphragm (48A) into groove of air chamber. Teflon tape (51) on pump chamber (1) must be clean and undamaged to seal effectively. Replace if necessary.

Position pump chamber previously marked with an index mark (felt pen) to match index mark on air chamber (both suction and discharge ports on pump chamber should be located on a vertical center line through the air valve assembly). If replacing a pump chamber (1A), do this roughly by eye. Assemble 12 1/2" (318 mm) dia. clamp quarters (22A) and hardware to pump chamber flange and tighten slightly. Assemble second pump chamber to opposing air chamber by first prying up diaphragm plate with large screwdrivers until diaphragm sits securely in groove cast in pump chamber and air chamber castings. 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 flange – they should be parallel to the eye.

**NOTE:** The pump may leak if these surfaces are not parallel – the pump placed on a flat surface will give a good indication of parallelism.

7. Tighten 12 1/2" (318 mm) clamps (22A) by tapping clamps with a wooden or fiber mallet while tightening the 3/8" clamp cap screws. Torque capscrews to approximately **13-20 ft lb. (17-27 n-m)**. Do not over tighten. Check alignment once again. If OK, proceed. If not, loosen clamps and realign.
8. Place a ball valve (29) and a valve seat (28A) in each pump chamber (1). Align the pump with suction manifold (24) and secure with cap screws (52), washers (53) and hex nuts (54).

# OPERATING INSTRUCTIONS

- Place a ball valve (29) and a valve seat (28A) with two "O" rings (47) into each side of the discharge manifold (23). Using capscrew (52), washer (53) and hex nut (54) secure the discharge manifold (23) with ball valve and valve seats to the pump.

## DISASSEMBLY INSTRUCTIONS FOR MODELS 2AOD & 3AOD, ALUMINUM – Teflon Fitted

(refer to Fig. 2, page 12)

- Pump should be disassembled in the normal upright position. Remove small clamp (27) from the discharge or top manifold. Remove manifold (23A), teflon "O" rings (47), ball valves (29), and ball seats (28A). Check for wear on balls and seats and damage to the teflon "O" rings. If ball has deep gouges or cuts replace it.
- Remove clamps (27) from suction or lower manifold (24A). Remove remaining pump from manifold & place on table. Perform same inspections on balls, seats, and "O" rings, as in step #1 above. Heavily worn balls, seats, and "O" rings will affect pump performance.
- Remove 12 1/2" dia. (318 mm) clamps (22A) from the pump chamber/air chamber connection. As you remove clamps, place an index mark across the pump chamber flange (1A), air chamber flange (10) with a felt pen marker. This will aid in finding the right alignment during reassembly. Remove pump chamber (1A) 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.

- Place ESNA locknut (2) on end of pump shaft in a table vise and loosen opposing ESNA locknut (2) with wrench. Remove locknut (2), outer diaphragm plate (4), diaphragm (50), diaphragm (6A), backing diaphragm (48A), inner diaphragm plate (7A), and rubber bumper (8), from pump shaft (16). Check diaphragm and rubber bumper for wear. If teflon tape (51) on pump chamber (1A) is damaged, replace. The tape ensures proper diaphragm sealing.
- Remove shaft (16A) and remaining diaphragm (attached) 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 locknut and remaining parts.
- Disassemble air chambers (10) & (11) from air valve housing by removing five 3/8" socket flat head screws (9) from the air chamber.

- Remove & replace shaft gasket (14) in air chamber.
- Remove pilot spool gasket (12) from the air chamber and replace if worn excessively.
- Repeat steps 6 thru 8 for the opposing air chamber.
- Refer to air valve disassembly instructions in another section of this manual.

## REASSEMBLY INSTRUCTIONS FOR MODELS 2AOD & 3AOD, ALUMINUM – Teflon Fitted

(refer to Fig. 2, page 12)

- Reassemble air chambers (10) & (11) to refurbished air valve housing:
  - The cupped side of the special lip seal must be facing toward their respective diaphragms. Installing seal backwards will make sealing ineffective.
  - Replace the composition material, air valve/air chamber gaskets (15).
  - Add **Loctite #242** to 3/8" socket flat head screws (9) prior to reassembly.
  - Position air chamber (11) onto bronze bushing protruding from air valve housing (33) and align pilot spool end cap (80) (protruding from air valve).

**NOTE:** Be careful to align the air valve/air chamber gasket (15) prior to assembly with screws. Check for proper pilot spool operation by laying valve on table and depressing extended pilot spool. Spool should move smoothly and easily (**not loose**) through gaskets.

Assemble air chamber to valve housing by installing 3/8" socket flat head screws (9) and tightening diametrically opposite to **100 inch lb. (11 n-m) torque**. Check alignment after screws are tightened.

- Repeat step #1 for opposing air chamber. Recheck pilot spool operation.
- Place pump shaft (16A) in vise with soft metal jaws or wooden blocks between the vise jaws. Assemble new rubber bumper (8) to shaft. Assemble diaphragm (50), diaphragm (6A), and backing diaphragm (48A), to pump shaft using the diaphragm plates (4) and (7A) and rubber bumper (8). Diaphragms should be positioned so that "O" ring groove of diaphragm (6A) and rubber backing diaphragm will be facing the air chambers. Lightly tighten outer diaphragm plate (4) to shaft. Diaphragm should be next to outer diaphragm plate (4). Radius on edge of inner diaphragm plate (7A) should face diaphragm. **Loctite #271** is recommended on threads of outer diaphragm plates (4).

# OPERATING INSTRUCTIONS

4. Using water (as a lubricant) on free end of shaft, insert and push shaft assembly through bore in air chamber/air valve assembly. Check for free movement of shaft. Shaft must not bind. Bottom out diaphragm in air chamber. Invert assembly and place new rubber bumper, remaining diaphragms, diaphragm, diaphragm plates, etc. in same procedure as step #3 above. Put hex head of outer diaphragm clamping plate on end of shaft in table vise. Use **Loctite #271** on threads of outer clamp plate (4).

5. Place wrench on opposing lock nut (2) at opposite end of pump shaft. Torque to **80 ft. lb. (108 n-m)**. Be sure both outer diaphragm plates are tightened to **80 ft. lb. (108 n-m)**.

**CAUTION:** Be sure inner clamp plates do **not** rotate while tightening. If allowed to rotate, damage to pilot spool end caps could result.

6. To assemble pump chambers (1A) to air chambers (10) & (11), secure diaphragm (6A) & backing diaphragm (48A) in groove of air chamber casting. Teflon tape (51) on pump chamber (1) must be clean and undamaged to seal effectively. Replace if necessary. Place pump chamber previously marked with an index mark (felt pen) to match index mark on air chamber (both suction and discharge ports on pump chamber should be located on a vertical center line through the air valve assembly). If replacing a pump chamber (1A), do this roughly by eye. Assemble 12 1/2" (318 mm) dia. clamp quarters (22A) and hardware to pump chamber flange and tighten slightly. Assemble second pump chamber to opposing air chamber by first prying up diaphragm plate with large screwdrivers until diaphragm sits securely in groove cast in pump chamber and air chamber castings. 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 flange – they should be parallel to the eye.

**NOTE:** The pump may leak if these surfaces are not parallel – the pump placed on a flat surface will give a good indication of parallelism.

7. Tighten 12 1/2" (318 mm) clamps (22A) by tapping clamps with a wooden or fiber mallet while tightening the 3/8" clamp cap screws. Torque cap screws to approximately **13-20 ft lb. (17-27 n-m)**. Do not over tighten. Check alignment once again. If ok, proceed. If not loosen clamps and realign.

8. Place valve seats (28A) with flat surface downward into seat ports in suction manifold (24A). Then place "O" rings (47) on top of valve seats (28A).

**NOTE:** If existing "O" ring (47) is cut or badly scratched, it should be replaced. Otherwise, the "O" ring should be reversed from its previous installation (install used "O" ring flat side down).

9. Place ball valves (29) in valve seats & assemble pump to manifold and fasten using 3 1/2" dia. clamp halves (27) and attaching hardware (25) & (26). Gently tap clamps while assembling to insure a good seal. Flanges should match evenly before clamps are tightened. Tighten 3 1/2" dia. clamps to **50 inch lbs. (6 n-m)**.

10. Repeat step #8 for discharge manifold (23) and associated balls, seats, clamps, etc. to complete assembly.

## DISASSEMBLY INSTRUCTIONS FOR MODEL 2AOD, STAINLESS – Teflon Fitted

(refer to Fig. 3, page 13)

1. Pump should be disassembled in the normal upright position. Remove small clamp (27) from the discharge or top manifold (23). Remove manifold, ball valves (29), and ball seats (28A). Check for excessively worn seats & replace if necessary. Check ball valves for gouges and deep scratches or heavily worn or abraded areas and replace as needed. Heavily worn balls and seats will affect pump performance.

2. Remove clamps (27) from suction or lower manifold (24A). Remove remaining pump 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 12 1/2" dia. (318 mm) clamps (22A) from the pump chamber/air chamber connection. As you remove clamps, place an index mark across the pump chamber flange (1A) & air chamber flange (10) with a felt pen marker. This will aid in finding the right alignment during reassembly. Remove pump chamber (1A) 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 one cast outer diaphragm plate (4) hex portion in a table vise. Remove opposing outer diaphragm plate (4) with wrench. **Loctite #271** is used to secure outer diaphragm plated (4) to shaft (16A). Heating hex area of outer diaphragm plate with propane torch will assist removal if difficult. The light heating will degrade strength of **Loctite #271**. Then remove diaphragm (50), diaphragm (6A), backing diaphragm (48A), inner diaphragm plate (7A), and rubber bumper (8), from pump shaft (16A). Check diaphragm and rubber bumper for wear. Replace if necessary. If teflon tape (51) on pump chamber (1A) is damaged, replace. The tape ensures proper diaphragm sealing.



# OPERATING INSTRUCTIONS

5. Remove shaft (16A) and remaining diaphragm (attached) from pump by sliding through pump shaft bore. Put free end of shaft in vise between two blocks of work or soft metal jaws and remove outer diaphragm plate (4) and remaining parts.
6. Disassemble air chambers (10) & (11) from air valve housing by removing five 3/8" socket flat head screws (9) from the air chamber.
7. Remove & replace shaft gasket (14) in air chamber.
8. Remove pilot spool gasket (12) from the air chamber and replace if worn excessively.
9. Repeat steps 6 thru 8 for the opposing air chamber.
10. Refer to air valve disassembly instructions in another section of this manual.

## REASSEMBLY INSTRUCTIONS FOR MODEL 2AOD STAINLESS- Teflon Fitted

(refer to Fig. 3, page 13)

1. Reassemble air chambers (10) & (11) to refurbished air valve housing:
  - a. The cupped side of the special shaft gaskets (14) and pilot spool gaskets (12) must be facing toward their respective diaphragms. Installing gaskets backwards will make sealing ineffective.
  - b. Replace the composition material, air valve/air chamber gaskets (15).
  - c. Add **Loctite #242** to 3/8" socket flat head screws (9) prior to reassembly.
  - d. Locate air chamber (11) onto bronze bushing protruding from air valve housing (34) and align pilot spool (80) (protruding from air valve).

**NOTE:** Be careful to align the air valve/air chamber gasket (15) prior to assembly with screws. Check for proper pilot spool operation by laying valve on table and depressing extended pilot spool. Spool should move smoothly and easily (**not loose**) through gaskets.

Assemble air chamber to valve housing by installing 3/8" socket flat head screws (9) and tightening diametrically opposite to **100 inch. lb. (11 n-m)** torque. Check alignment after screws are tightened.

2. Repeat step #1 for opposing air chamber (10). Recheck pilot spool operation.
3. Place pump shaft (16A) in vise with soft metal jaws or wooden blocks between the vise jaws. Assemble new rubber bumper (8) to shaft. Assemble inner diaphragm plate (7A), backing diaphragm (48A),

diaphragm (6A), diaphragm (50), and outer diaphragm plates (4), to shaft (16A). Diaphragms should be positioned so that "O" ring groove of diaphragm (6A) and rubber backing diaphragm will be facing the air chambers (with convex side facing upward). Tighten, but do not torque down until later on during reassembly. **Loctite #271** is recommended on internal threads of outer diaphragm plates (4).

4. Using water (as a lubricant) on end of shaft, insert and push shaft assembly through bore in air chamber/air valve assembly. Check for free movement of shaft, shaft must not bind. Bottom out diaphragm in air chamber. Invert assembly and place new rubber bumper, remaining diaphragms, diaphragm, diaphragm plate, etc. in same procedure as step #3 above. Put hex head of outer diaphragm clamping plate on end of shaft in table vise. Use **Loctite #271** on threads of outer clamp plate (4).
5. Place wrench on hex head of opposing outer diaphragm plate at opposite end of pump shaft. Torque to **80 ft. lb. (108 n-m)**. Be sure both outer diaphragm plates are tightened to **80 ft. lb. (108 n-m)**.

**CAUTION:** Be sure inner diaphragm plates do not rotate while tightening. If allowed to rotate, damage to pilot spool end caps could result.

6. To assemble pump chambers (1A) to air chambers (10) & (11), secure diaphragm (6A), & backing diaphragm (48A) into groove of air chamber casting. Teflon tape (51) on pump chamber (1) must be clean and undamaged to seal effectively. Replace if necessary. Position pump chamber previously marked with an index mark (felt pen) to match index mark on air chamber (both suction and discharge ports on pump chamber should be located on a vertical center line through the air valve assembly). If replacing a pump chamber (1A), do this roughly by eye. Assemble 12 1/2" (318 mm) dia. clamp quarters (22A) and hardware to pump chamber flange and tighten slightly. Assemble second pump chamber to opposing air chamber by first prying up diaphragm plate with large screwdrivers until diaphragm sits securely in groove cast in pump chamber and air chamber castings. 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 flange – they should be parallel to the eye.

**NOTE:** The pump may leak if these surfaces are not parallel – the pump placed on a flat surface will give a good indication of parallelism.

7. Tighten 12 1/2" (318 mm) clamps (22A) by tapping clamps with a wooden or fiber mallet while tightening the 3/8" clamp capscrews. Torque capscrews to approximately **13-20 ft lb. (17-27 n-m)**. Do not over tighten. Check alignment once again. If OK, proceed. If not, loosen clamps and realign.

# OPERATING INSTRUCTIONS

- Place a ball valve (29) and a valve seat (28A) in each pump chamber (1). Align the pump with suction manifold (24) and secure with cap screws (52), washers (53), and hex nuts (54).
- Place ball valves (29) in valve seats & assemble pump to manifold using 3 1/2" dia. clamp halves (27) and attaching hardware. Gently tap clamps while assembling to insure a good seal. Make sure manifold flanges & pump chamber flanges are centered. Tighten 4 1/2" (114 mm) dia. clamps to **50 inch lb. (5 n-m)**.
- Repeat step #8 for discharge manifold (23A) and associated balls, seats, clamps, etc. to complete assembly.

## AIR VALVE DISASSEMBLY INSTRUCTIONS

(refer to Fig. 4, page 14)

- Remove pilot spool assembly (88) and check O.D. of phenolic (82) for wear. Replace phenolic if deeply scratched, chipped or worn.

The pilot spool assembly can be disassembled by unscrewing the end caps (80) from the tie rod (81). Use heat from a propane torch to break down the loctite on the screw threads.

Apply #242 blue loctite on reassembly.

If bore for pilot spool has become corroded, excessively pitted, or deeply scratched, replace air valve housing (34).

- Remove main spool end caps (36), gaskets (37), and capscrews (35), from valve housing (34).
- Remove main spool (39) and examine spool and piston ring sets (38) for wear. Replace piston ring sets & 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.
- Replace oilite bronze sleeve bushings (43) in valve housing shaft bore if worn excessively. Bushings can be removed by pressing out using a hydraulic press - care must be taken to avoid cracking the valve housing. Each bushing should protrude **0.135/0.125 inches (3.429/3.175 mm)** from the shaft bore. Maintain these dimensions to prevent internal air leaks.

## AIR VALVE REASSEMBLY INSTRUCTIONS

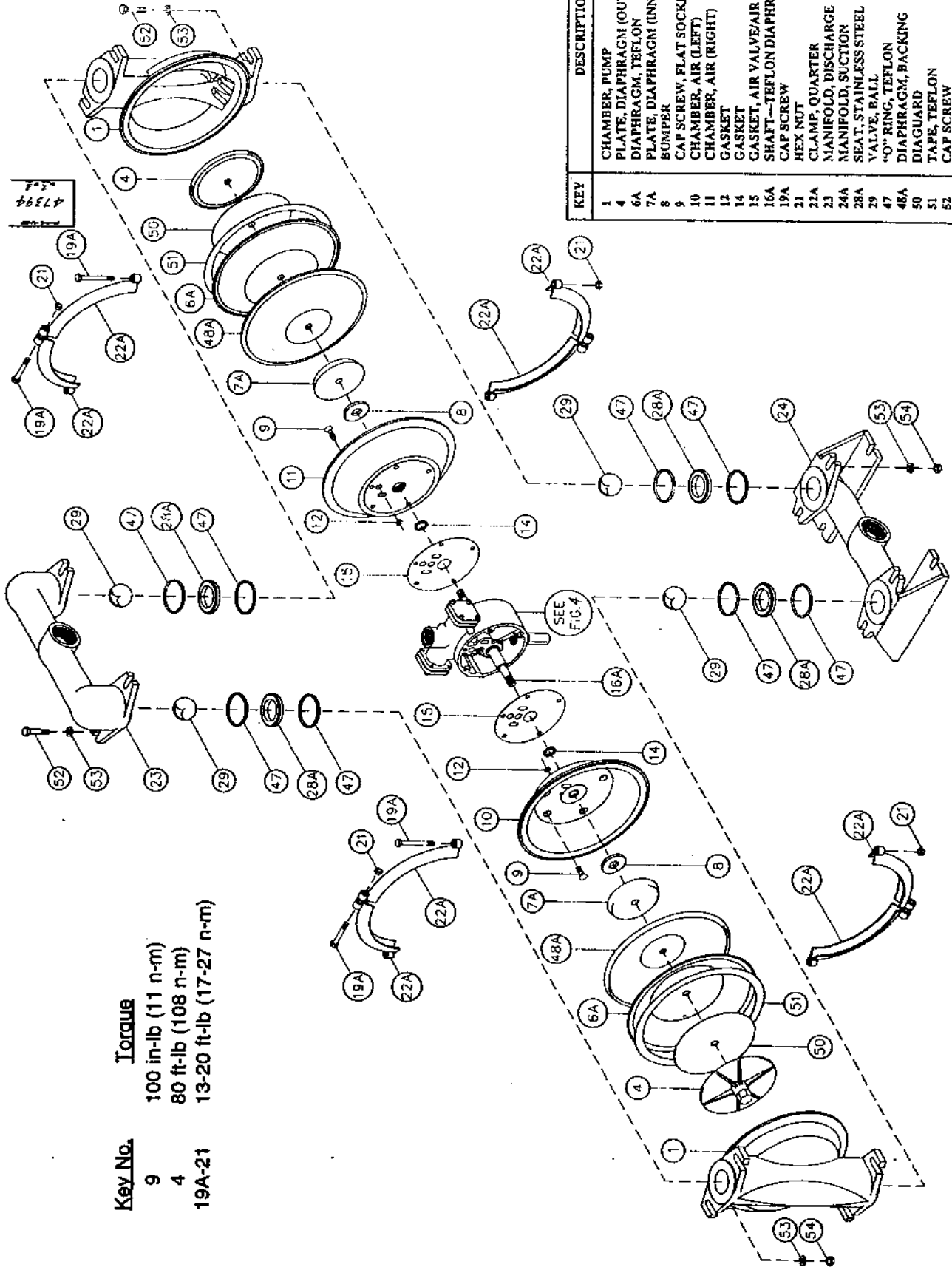
(refer to Fig. 4, page 14)

**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.

- Clean all parts with good grade safety solvent prior to reassembly. Place reconditioned valve housing (34) on a clean work bench.
- Install pilot spool assembly (88) in air valve housing.
- Inspect main spool (39) for scratches, chips, marks, etc. If severe grooving or marking is evident, replace spool. To ensure maximum performance spool should not be excessively worn, although pump will run with worn spools.
- Remove piston ring and expander ring sets (38) from main spool. Replace with new.

**NOTE:** Upon reassembly of piston ring and expander ring sets (38) the opening in the expander ring and the split in the piston ring should be assembled 180° apart. Also, upon reassembling the main spool into the spool housing bore, rotate piston ring sets in their grooves until the split in the ring is at the valve housing 3 or 9 o'clock position. If this is done the split will not pass over any valve housing ports during reassembly, and will not have the tendency to hang up on a port. Be sure **not** to install main spool in a centered position or pump will not start.

- Install new spool cap gaskets (37) with existing end caps (36) & 1/4" - 20 Allen head screws (35) at both ends of spool bore in spool housing.
- Clean muffler (44) with safety solvent and blow dry with compressed air. If unable to clean, replace muffler.

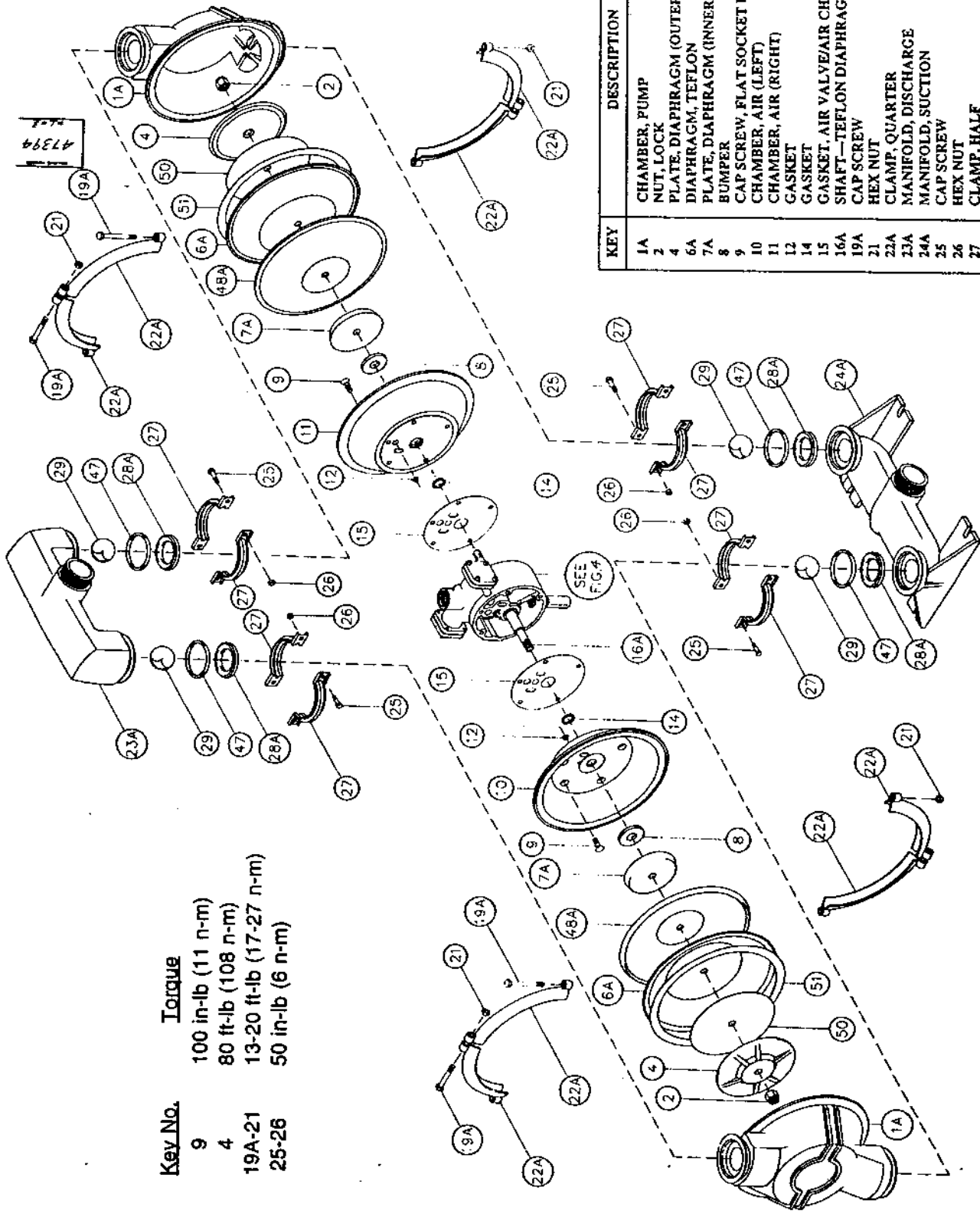


KEY	DESCRIPTION
1	CHAMBER, PUMP
4	PLATE, DIAPHRAGM (OUTER)
6A	DIAPHRAGM, TEFLON
7A	PLATE, DIAPHRAGM (INNER) TEFLON ELAS.
8	BUMPER
9	CAP SCREW, FLAT SOCKET HEAD
10	CHAMBER, AIR (LEFT)
11	CHAMBER, AIR (RIGHT)
12	GASKET
14	GASKET
15	GASKET, AIR VALVE/AIR CHAMBER
16A	SHAFT--TEFLON DIAPHRAGM
19A	CAP SCREW
21	HEX NUT
22A	CLAMP, QUARTER
23	MANIFOLD, DISCHARGE
24A	MANIFOLD, SUCTION
28A	SEAT, STAINLESS STEEL
29	VALVE, BALL
47	"O" RING, TEFLON
48A	DIAPHRAGM, BACKING
50	DIAPHRAGM
51	TAPE, TEFLON
52	CAP SCREW
53	FLAT WASHER
54	HEX NUT

**Key No.**  
 9  
 4  
 19A-21

**Torque**  
 100 in-lb (11 n-m)  
 80 ft-lb (108 n-m)  
 13-20 ft-lb (17-27 n-m)

Figure 1



**Key No.**

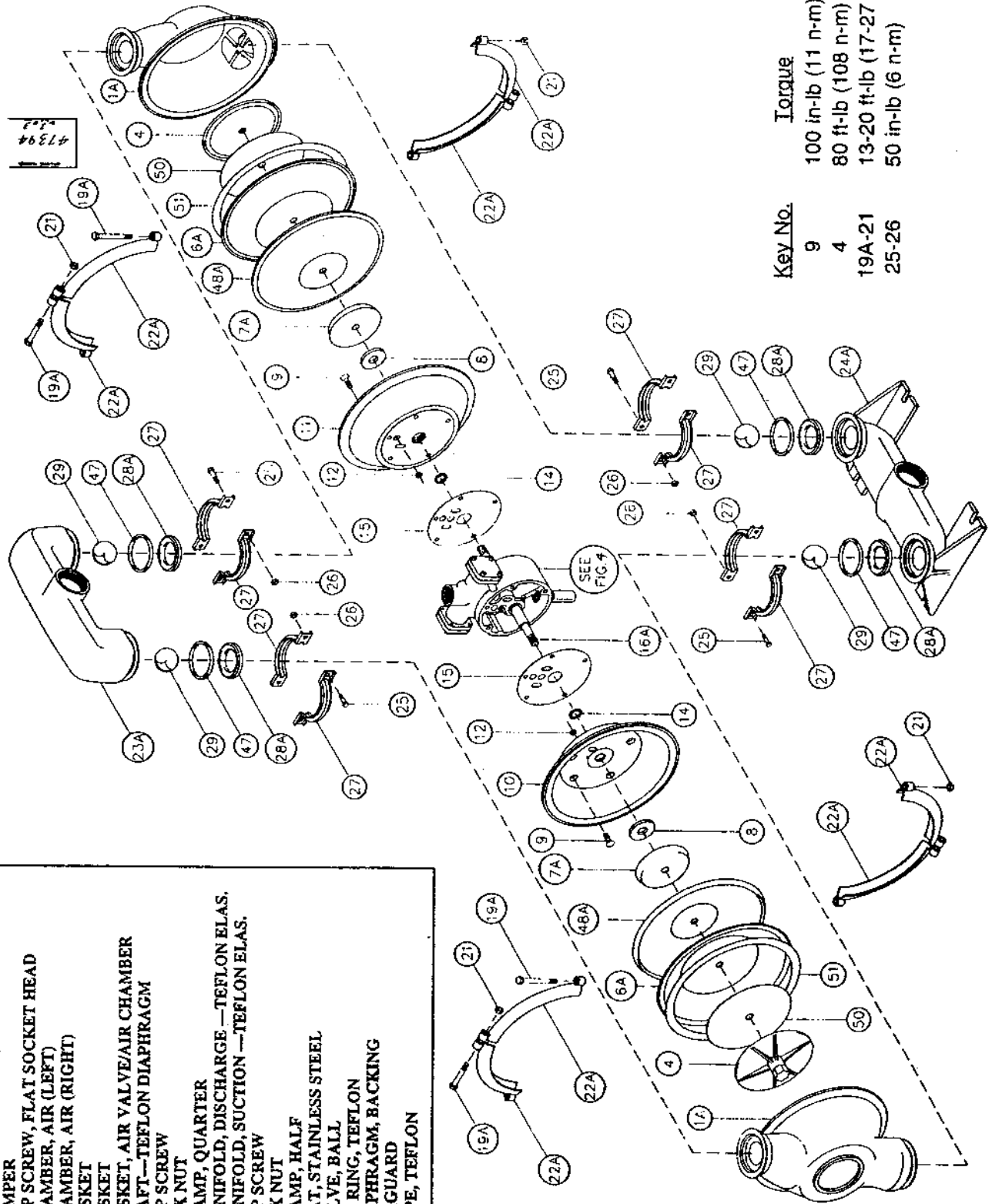
- 9 100 in-lb (11 n-m)
- 4 80 ft-lb (108 n-m)
- 19A-21 13-20 ft-lb (17-27 n-m)
- 25-26 50 in-lb (6 n-m)

**Torque**

KEY	DESCRIPTION
1A	CHAMBER, PUMP
2	NUT, LOCK
4	PLATE, DIAPHRAGM (OUTER)
6A	DIAPHRAGM, TEFLON
7A	PLATE, DIAPHRAGM (INNER) TEFLON ELAS.
8	BUMPER
9	CAP SCREW, FLAT SOCKET HEAD
10	CHAMBER, AIR (LEFT)
11	CHAMBER, AIR (RIGHT)
12	GASKET
14	GASKET, AIR VALVE/AIR CHAMBER
15	SHAFT—TEFLON DIAPHRAGM
16A	CLAMP, QUARTER
19A	MANIFOLD, DISCHARGE
21	MANIFOLD, SUCTION
22A	CAP SCREW
23A	HEX NUT
24A	CLAMP, HALF
25	SEAT, STAINLESS STEEL
26	VALVE, BALL
27	"O" RING, TEFLON
28A	DIAPHRAGM, BACKING
29	DIAPHRAGM, TAPE, TEFLON
47	DIAPHRAGM, TAPE, TEFLON
48A	DIAPHRAGM, TAPE, TEFLON
50	DIAPHRAGM, TAPE, TEFLON
51	DIAPHRAGM, TAPE, TEFLON

**Figure 2**

KEY	DESCRIPTION
1A	CHAMBER, PUMP
4	PLATE, DIAPHRAGM (OUTER)
6A	DIAPHRAGM, TEFLON
7A	PLATE, DIAPHRAGM (INNER) TEFLON ELAS.
8	BUMPER
9	CAP SCREW, FLAT SOCKET HEAD
10	CHAMBER, AIR (LEFT)
11	CHAMBER, AIR (RIGHT)
12	GASKET
14	GASKET, AIR VALVE/AIR CHAMBER
15	SHAFT--TEFLON DIAPHRAGM
16A	CAP SCREW
19A	HEX NUT
21	CLAMP, QUARTER
22A	MANIFOLD, DISCHARGE --TEFLON ELAS.
23A	MANIFOLD, SUCTION --TEFLON ELAS.
24A	CAP SCREW
25	HEX NUT
26	CLAMP, HALF
27	SEAT, STAINLESS STEEL
28A	VALVE, BALL
29	"O" RING, TEFLON
47	DIAPHRAGM, BACKING
48A	DIAPHRAGM
50	DIAPHRAGM
51	TAPE, TEFLON



Key No. Torque  
 9 100 in-lb (11 n-m)  
 4 80 ft-lb (108 n-m)  
 19A-21 13-20 ft-lb (17-27 n-m)  
 25-26 50 in-lb (6 n-m)

Figure 3

KEY	DESCRIPTION
34	AIR VALVE HOUSING ASSEMBLY
35	CAP SCREW, SOCKET HEAD
36	CAP, SPOOL
37	GASKET
38	PISTON RING SET
39	SPOOL, AIR VALVE
43	BEARING, SLEEVE
44	MUFFLER
80	END CAP
81	TIE ROD
82	SPOOL, PHENOLIC
88	TWIN SPOOL ASSEMBLY

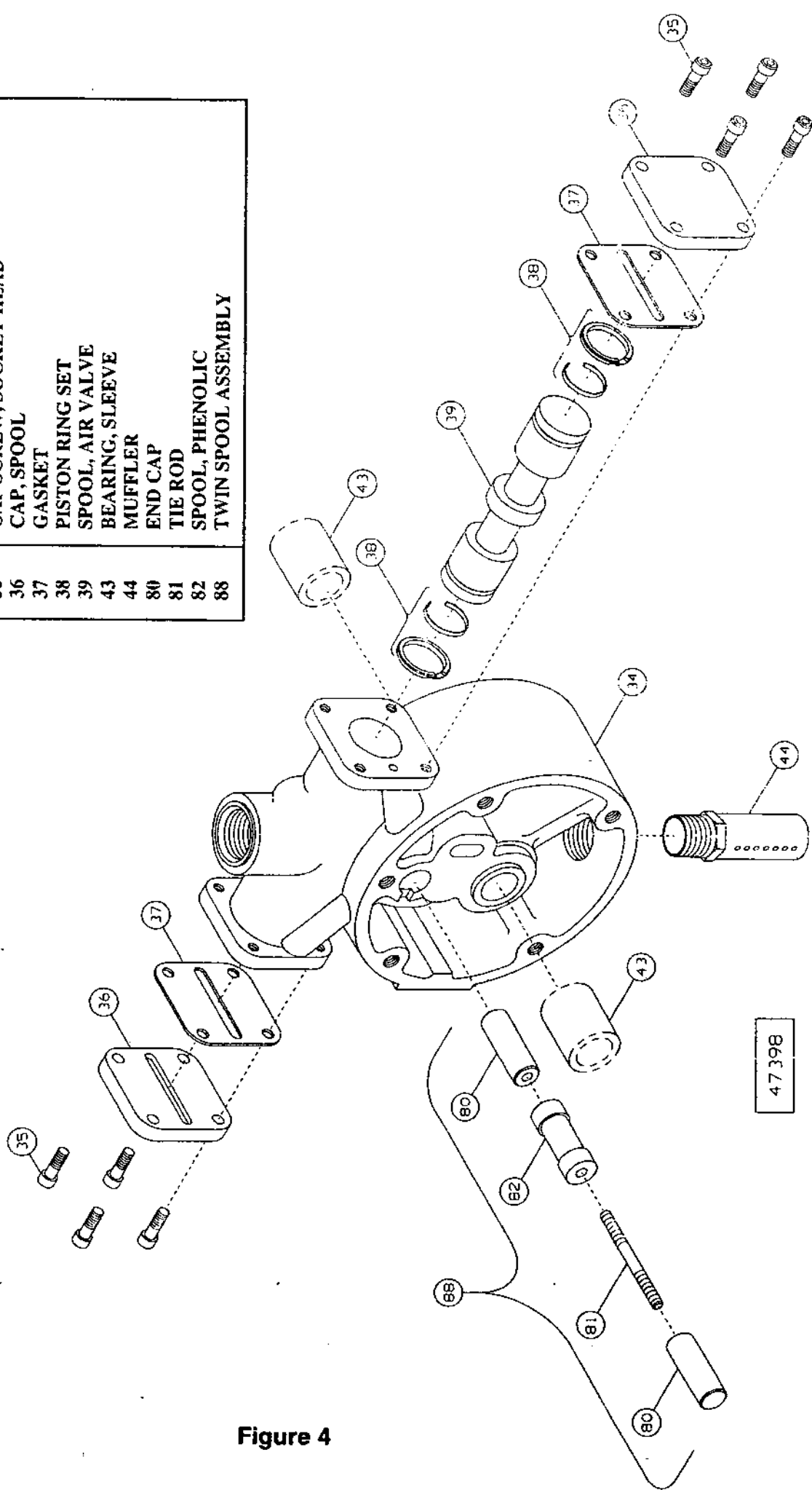


Figure 4

# 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)	
½	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 with 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 in impairing 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 products(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.