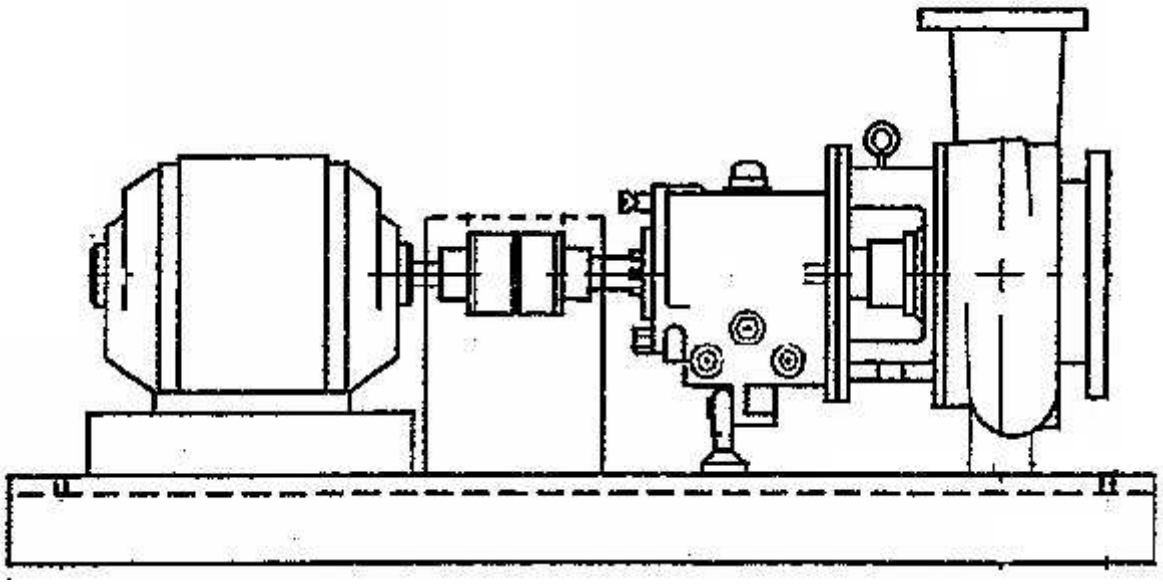
Pinnacle-Flo, Inc.

Installation, Operation, and Maintenance Manual – ANSI Series 8896

Process Pump



Customer: _____

PO#: _____

Service: _____

Equipment No.: _____

Serial No.: _____

Pinnacle-Flo, Inc.

TABLE OF CONTENT

General

Read this entire book before attempting to install, operate or repair this pump. Properly installing your pump will give you satisfactory, dependable service. We urge that you carefully read these step-by-step instructions, to eliminate any problems of installation, operation or repair.

Failure to read and comply with installation and operating instructions will void ther responsibility of the manufacturer and may also result in bodily injury as well as property damage.

This book is intended to be a permanent part of your pump installation and should be preserved in a convenient location for ready reference. If these instructions should become soiled or lost, obtain a new copy from your local representative or Pinnacle-Flo Inc. Include pump model and or serial number with your request.

Warranty

New equipment manufactured by Seller is warranted to be free from defects in material and workmanship under normal use and service for a period of one year from date of start-up or 18 months from date of shipment. Seller's obligation under this warranty being limited to repairing or replacing at its option any part found to its satisfaction to be so defective provided that such part is, upon request, returned to Seller's factory from which it was shipped, transportation prepaid. This warranty does not cover parts damaged by decomposition from chemical action or wear caused by abrasive materials, nor does it cover damage resulting from misuse, accident, neglect, or from improper operation, maintenance, installation, modification or adjustment. This warranty does not cover parts repaired outside Seller's factory without prior written approval. Seller makes no warranty as to starting equipment, electrical apparatus or other material not of its manufacture, since the same are usually covered by warranties of the respective manufactures thereof.

In the event, notwithstanding the terms of this agreement, it is determined by a court of competent jurisdiction that an express warranty has been given by Seller to Purchaser with respect to the head, capacity or other like performance characteristics of said equipment, Seller's liability for breach of the same shall be limited to accepting return of such equipment F.O.B plant of manufacture, refunding any amount paid thereon by Purchaser (less depreciation at the rate of 15% per year if Purchaser has used equipment for more than thirty (30) days) and canceling any balance still owing on the equipment.

This warranty is expressly in lieu of any other warranties, expressed or implied, and Seller specifically disclaims any implied warranty of merchantability or fitness for a particular purpose.

Instructions

I-A. Importance of Instructions

The design, material and workmanship incorporated in the construction of Pinnacle-Flo Inc. make them capable of giving long, trouble-free service. The life and satisfactory service of any mechanical unit, however, is enhanced and extended by periodic inspection and careful maintenance. This instruction manual was prepared to assist operators in understanding the construction and correct methods of installing, operating, and maintaining these pumps. Keep this instruction manual handy for reference. Further information can be obtained by contacting your local authorized distributor or the factory.

I-B. Special Warnings

Pinnacle-Flo Inc. will not be liable for any damages or delay caused by failure to comply with the provisions of this instruction manual. This pump is not to be operated at speeds, working pressures, discharge pressures, or temperatures higher than, nor used with liquids other than, stated in the original order acknowledgment without written permission of Pinnacle-Flo Inc. For pressure/temperature limitations see page 46.

I-C. Preservation and Storage

Pinnacle-Flo Inc.'s, normal shipping and storage preparation is suitable for protecting the pump during shipment in covered trucks. It also provides protection during covered storage at the job site, and for a short period between installation and start-up. If the pump is to be idle and or exposed to the element for a extended period, either before or after installation, special precautions are required. One approach is to provide special preservatives and wrapping before shipment. However, after installation the protective wrapping will have been removed. Therefore, application of preservatives after installation is considered a good practice. Information about various long term preservation and storage options available can be obtained for the driver, coupling, mechanical seal, or other equipment supplied on your order. Contact your local authorized distributor or the factory for further details.

Section II

Installation

II-A. Location

Select a location for the pumping unit (Pump, base plate, coupling and driver) which will:

(a) Be clean, well ventilated, properly drained and provided accessibility for inspection and maintenance. Outdoor installations may require protection from the elements, particularly freezing.

(b) The suction supply system must provide the pump with Net Positive Suction Head (NPSH) equal to or greater than that required by the pump at any capacity over the expected operating range. Ask your representative for assistance if you do not understand how to calculate or measure suction supply system NPSH.

II-B. Mounting and Leveling The Unit

Caution – Use qualified personnel (riggers) to lift or move unit at any time. *Never* lift unit using hooks or slings on shafts. *Never* place eyebolts in tapped holes except for removal of a part to perform service work.

When the unit is received with the pump and the driver mounted on the base plate, it should be placed on the foundation and the coupling halves disconnected. The coupling should not be reconnected until the alignment operations have been completed. The base plate should be supported on rectangular metal blocks and shims or on metal wedges having a small taper. The support pieces should be placed close to the foundation bolts (Figure 2). On large units, small jacks made of cap screws and nuts are very convenient. In each case the supports should be directly under the part of the base plate carrying the greatest weight and spaced closely enough to give uniform support. A spacing of 24 inches is suggested on medium size units. A gap of about ¾" to 1-1/2" should be allowed between the base plate and the foundation for grouting.

Adjust the metal supports or wedges until the shafts of the pump and driver are level. Check the coupling faces as well as the suction and discharge flanges of the pump for horizontal or vertical position by means of a level. Correct the positions, if necessary, by adjusting the supports or wedges under the base plate as required.

***Important* – Pumps and drivers mounted on a common base plate were accurately aligned before shipment. All base plates are flexible to some extent and, therefore must not be relied upon to maintain the factory alignment.**

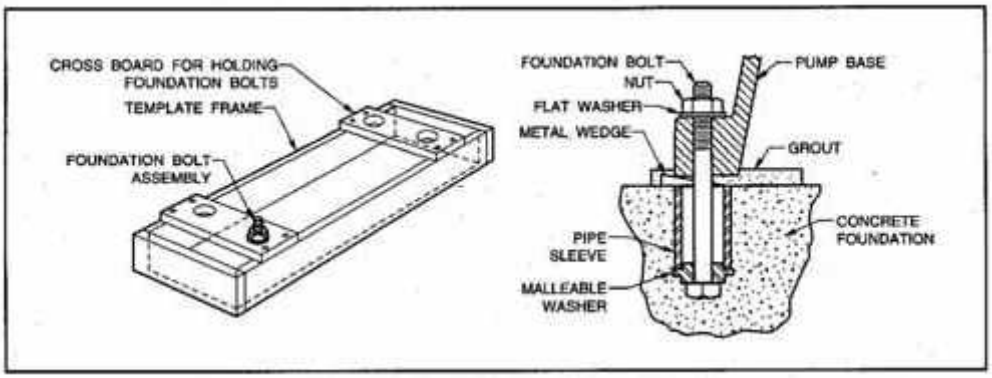


Figure 1. Foundation bolt location and anchorage

Realignment is necessary after the complete unit has been leveled on the foundation and again after the grout has set and foundation bolts have been tightened. The alignment must be checked after the unit is piped and rechecked periodically as outlined in the following paragraphs. To facilitate accurate field alignment, we do not dowel the pumps or driver on the base plates before shipment.

II-C. Alignment

Reliable, trouble free and efficient operation of a pumping unit requires correct alignment of pump and driver shafts. Misalignment may be the cause of:

(1) Noisy pump operation
(2) Vibration
(3) Premature bearing failure
(4) Excessive coupling wear

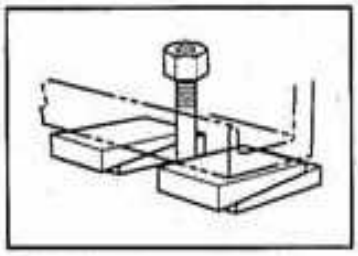


Figure 2. Adjusting wedges for mounting

Factors that may change the alignment of the pumping unit are:

(1) Settling of the foundation
(2) Springing of the base plate
(3) Piping strains
(4) Shifting of pump or driver on the base

II-D. Alignment Check

The following checking procedure applies to a pumping unit consisting of a pump, flexible coupling and driver mounted on a common base plate. Check alignment as follows:

(1) Disconnect the coupling halves.
(2) Set the coupling flange gap as required by the coupling manufacture.
(3) The preferred test for parallel and angular alignment may be made with a dial indicator mounted as shown in Figure 3. Proceed as follows:
  (a) Scribe the index lines on the coupling halves (as shown) or mark where the indicator point rests.
  (b) Set indicator dial to zero.
  (c) Slowly turn BOTH coupling halves so that index lines match, or indicator point is always on the mark.
  (d) Observe dial reading to determine whether pump or driver needs adjustment.
  (e) Acceptable parallel and angular alignment occurs when total indicator reading (complete turn) does not exceed limits specified by the coupling manufacturer.

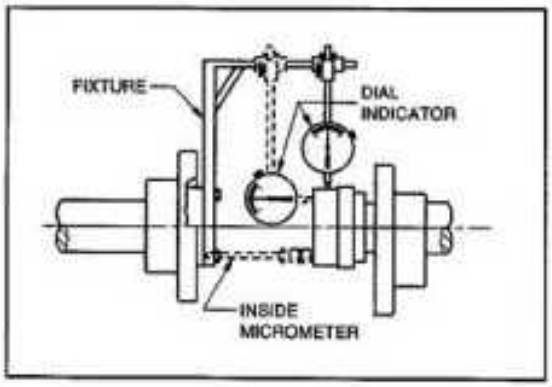


Figure 3. Testing alignment, dial indicator

(4) Test for parallel and angular alignment with a straight edge and feeler gauge as shown in Manufacturer's instructions. With coupling halves stationary, make scribes at four places 90 degrees apart. Perfect alignment occurs when a straight edge is level across the coupling halves and same gauge just enters between the halves, both conditions at all points.

When significant operating temperature differential will exist between the pump and driver (i.e. steam turbine drive with pump handling cold liquid), thermal growth will cause the hotter unit to rise. Compensate for this growth by initially setting the hotter unit 0.003 inch to 0.005 inch low. When both units are at normal operating temperature, a final check or coupling alignment must be made. Correct the alignment if necessary.

NOTE: CHECK FOR CORRECT ELECTRIC MOTOR ROTATION WHILE COUPLING HALVES ARE DISCONNECTED.

II-E. Alignment Adjustment

Sine all base plates are flexible, they may be distorted from transportation or handling. Therefore, it may be necessary to correct excessive parallel and angular misalignment by slightly shifting the leveling wedges under the base plate. Tap lightly (in or out) with a hammer. Recheck alignment after each shifting of a wedge.

(a) In some instance, for factory aligned pumping units, it may be necessary to change the shims under the pump or driver, or even relocate these factory-positioned units on the base plate. Make such changes only after it is certain that alignment cannot be obtained by shifting of the wedges.

(b) If wedges are shifted or shims changed a substantial amount to obtain proper alignment, recheck the piping alignment and level of the shafts.

NOTE: PUMP AND MOTOR SHAFTS MUST BE LEVEL, HAVE PROPER ALIGNMENT AND THE PIPING MUST MATE WITH THE PUMP FLANGES WITHOUT STRAIN. ALL THREE CONDITIONS MUST BE CORRECT TO PROVIDE PROPER PERFORMANCE AND LONG LIFE OF THE PUMPING UNIT.

II-F. Grouting

Unless otherwise specified on the unit outline drawing, the base plate must be completely filled with grout and the leveling wedges grouted in place. The product warranty **IS VOID** if this instruction is not followed.
When the alignment is correct, the foundation bolts should be tightened evenly, but not too firmly. The unit can then be grouted to the foundation. Foundation bolts should not be fully tightened until the grout is hardened, usually about 48 hours after pouring. Installation without grout completely filling the base plate is acceptable only when recommended by specific notation on the unit outline drawing.
Grouting that completely fills a base plate is also necessary for minimum vibration levels, since a very stiff base is uneconomical and unnecessary except for portable units. Grout compensates for unevenness in the foundation and base plate and distributes the weight of the unit uniformly over the foundation. It also prevents the unit from shifting after mounting and alignment. It is essential that the pumping unit be expertly grouted by use of non-shrinking grout. The mix required varies with the type of unit to be grouted, location and amount of grout. The instructions included with the non-shrinking grout package will provide the required information for the proper mix for individual applications. Grout the unit as follows:

(a) Build a form of plywood or thick planking around the foundation to contain the grout. Support adequately to prevent deformation.

(b) Soak the top of the concrete pad thoroughly with water before grouting. Remove all surface water before pouring.

(c) Pour the grout through the holes provided I the base plate or through open ends of steel channel base plates. While pouring, tamp liberally in order to fill all cavities and prevent air pockets.

NOTE: IN POURING AND TAMPING, THE GROUT MAY TRAP AIR IN SOME PLACES. DRILL SMALL VENT HOLES THROUGH THE BASE SURFACE.

(d) After the grout has thoroughly hardened, tighten the foundation bolts and connect the piping. ***Be certain piping does not strain pump flanges.***

(e) Check the alignment after the piping is connected and the foundation bolts are tightened.

(f) Connect the coupling halves

(g) After the grout has thoroughly dried, apply an oil base paint to the exposed edges of the grout to prevent air and moisture from coming in contact with the grout.

NOTE: IT IS VERY IMPORTANT TO SUPPORT AND RESTRAIN BOTH THE SUCTION AND DISCHARGE PIPES NEAR THE PUMP TO AVOID APPLICATION OF THE FORCES AND MOMENTS TO THE PUMP CASING. FAILURE TO SUPPORT THE PIPING PROPERLY CAN CAUSE EXCESSIVE PIPE STRAIN ON THE CASING WHICH CAN AFFECT ALIGNMENT, CAUSE VIBRATION, AND PROMOTE RAPID WEAR OF SEALS AND BEARINGS. DAMAGE CAUSED BY PIPE STRAIN WILL VOID THE WARRANTY.

II-G. Suction Piping-General

The suction piping, if not installed properly, is a potential source of faulty operation. To achieve best performance, provided for the following:

(a) Avoid using elbows close to the pump suction flange. A minimum of six pipe diameters of straight pipe should always be located between the elbow and suction inlet. If elbows are used they should be long radius type.

(b) Suction pipe should be a minimum one size larger than the suction flange. Suction pipe should terminate at the suction flange of the pump through an “eccentric reducer”. Never install suction piping that is smaller in diameter than the pump suction flange.

(c) Suction throttling must never be attempted. This could cause cavitation and damage to the pump.

(d) If a strainer is installed in the suction piping, it must have a net free area of at least three (3) times the area of the suction pipe. It should be checked and cleaned periodically. The openings in the screen must be smaller than the sphere size allowed for the impeller. Contact factory for maximum sphere size.

(e) When the source of supply is feeding more than one pump, separate suction lines are recom mended.

Suction Lift Installations

(a) Suction lines, when operating under lift conditions must be kept absolutely free from air leaks.

(b) Suction piping should gradually slope upward toward the pump and all joints must be air tight.

(c) Available NPSH must be greater than the NPSH required for the pump.

(d) All piping must be cleaned before start up.

(e) A means of keeping prime on the pump (such-as) a foot valve must be provided.

Flooded Suction/Positive Head Installations

(a) The suction line must include an isolation valve to permit closing off of the source of supply so that pump inspection and maintenance can be performed. The valve should be installed a minimum of two pipe diameters from the pump suction flange.

(b) Piping should be level or slope gradually in a downward direction from the source of supply to avoid air pockets.

(c) Piping should never extend below the pump suction flange. The piping entrance at the source of supply should always be one to two sizes larger than the pump suction flange.

(d) In order to prevent eddies and vortices, the suction pipe must be adequately installed below the surface of the liquid. A minimum of three times the pipe diameter is recommended.

II-H. Discharge Piping

(a) Check and isolation valves should be installed in the discharge line. The check valve must be Placed between the pump and the isolation valve. This will protect the pump from reverse rotation and excessive back pressure. The isolation valve is used in priming, starting and when shutting down the pump. If increasers are used on the discharge side to increase the size of the discharge piping, they should be placed between the check valve and pump. When expansion joints are used, they should be placed between the check valve and the pump.

II-I. Engine Driven Units

(a) Be well ventilated. For every 10 degrees F above 60F a 1% reduction in horse power accures.

(b) Provide the engine with an efficient exhaust system so that the combustion gases discharge with a minimum of back pressure.

(c) Provide for a fuel system of adequate capacity which meets the local codes.

(d) Provide ample accessibility to service engine.

(e) Provide correct rotation to meet pumps requirement. Most are clockwise.

II-J. Electric Motor Driven Units

For electric motor drives, connect power supply to conform with national and local codes. Line voltage and wire capacity must match the ratings stamped on the motor nameplate.

(a) **Only -** when the coupling halves are disconnected, momentarily energize the motor to check that rotation is in the same direction as the arrow on the pump.

(b) If motor is three phase type, reverse rotation (if required) by interchanging any two of the three power leads. The rotation of most single phase motors are fixed.

II-K. Stuffing Box

1. **Packing:** Stuffing box packing is installed at the factory. Gland bolts nuts should be installed **Finger tight only.** Packing cannot run dry, it must be lubricated. If the pumped fluid is clean, cool fluid, it may be used through a bypass off the discharge to the lantern ring connection to lubricate the packing. If the pumped fluid is dirty or hot, it is not suitable to lubricate the packing. An external source must be utilized, unless the bypass is equipped with a proper separator, filter, and or cooling system. This must also be piped into the lantern ring connection (refer to packing recommendations shown below).
2. **Mechanical seals:** When mechanical seals are supplied, they are installed and adjusted at the factory. They **must not** run dry or come into contact with abrasives in the pumped fluid. Connect recirculation, flush, and or cooling lines as required, following instruction on the seal supplied. One the cartridge type seals installed at the factory, the centering clips are removed. Follow instructions on the seal drawing supplied.

Packing Recommendations

1. **General Service Packing** – This is an Aramid-PTEF synthetic packing. It is best suited for cold water and general service applications. It has a PH range of 0 to 12 and a maximum operating temperature of 500 degrees F. This packing is similar to Crane type 1345 or equal.
2. **Chemical and Solvent Packing** – This is a PTFE-Synthetic packing. It is used to sever in chemical and solvent applications. It has a PH range of 0 to 14 and a maximum operating temp. of 500 degrees F. This packing is similar to Crane type C1065 or equal.
3. **High Pressure and Temperature Packing –** Often called Graphoil, it is used in high pressure and temperature applications. It has a PH range of 0-14 and a maximum operating temperature of 750 degrees F.

Packing Size

The following is a list of the standard packing size for all ANSI process pump models.

Frame Size	Packing Size	Approx. Length	No. of Rings	Lantern Ring Width
ST1	**5/16 x 5/16**	**4.75”**	**5**	**7/16**
MT1	**3/8 x 3/8**	**5.75”**	**5**	**5/8**
LT1	**3/8 x 3/8**	**7.0”**	**5**	**5/8**
XLT1	**7/16 x7/16**	**8.0”**	**5**	**5/8**

Section III

Operation

III-A. Start-Up Check List

(a) **Checking shaft rotation**

1. With power off and locked out, remove spacer between coupling hubs.
2. Restore power, and momentarily energize motor to determine rotation. Motor shaft must rotate in Direction of arrow on the pump bearing frame.
3. Shut off power and lock out.
4. Check impeller clearance. Pumps assembled at the factory are set at .015 inch clearance. Do Not rely on factory setting which could be affected by piping connections, or if high temperature liquids are to be pumped, the impeller setting must be corrected. See appendix for adjustment procedure.
5. Reinstall coupling spacer. Make sure coupling hubs are secured to the shafts. Lubricate coupling as required per manufacturer's instructions. Recheck Alignment.
6. Install coupling guard.

(b) **Bearing Lubrication**

Oil lubrication: ***Pumps are not shipped from the factory with oil*****.**

1. Remove item 113A (oil fill plug) and fill frame with oil to the center of the sight glass. A high quality turbine oil with rust and oxidation inhibitors should be used.

Pure Oil Mist Lubrication: The power frame have, as standard, drilled and tapped connections for oil mist systems. The connections are located on the top of the bearing frame. Follow instructions from the manufacturer of the oil mist generator system. If you are already using flood oil lubrication, instructions for converting to oil mist are located in the Appendix.

Grease Lubrication: Pumps shipped from factory contain some grease but it is not sufficient for placing the pump into continuous service. Refer to instructions in the appendix.

Grease for Life Bearings: These bearings are greased and permanently sealed by the bearing manufacture.

See appendix for recommended lubrication schedules.

(c) **Shaft Sealing –** Refer to section II-K page 12.

Warning

Never allow pump to run dry, or operate pump without liquid in the seal chamber. Seal faces must always be lubricated. Operating a pump without liquid in the casing or seal chamber, even for a few moments, can cause seal failure, pump damage and or personal injury.

(d) Priming: A centrifugal pump must be primed before it can be operated. If run dry, damage can occur to close –clearance rotating parts and will destroy mechanical seals. If not primed properly, it will not deliver fluid. Prime in one of the following methods:

1. If system has suction pressure, slowly open the suction valve. Open air vents on pump casing and suction and discharge piping until fluid runs out. Rotate shaft a few times if possible to evacuate any trapped air in the impeller passages. Close all vent valves.

2. If the system has suction lift and there is a foot valve in the suction pipe, fill the pump casing and suction pipe with the liquid to be pumped. At the same time let any trapped air escape.

3, If the system has a suction lift but no foot valve, use a vacuum pump or ejector operated by air, steam, water, engine exhaust, etc., to evacuate the air from the pump case and suction pipe. Connect the ejector t the gauge connection at the top of the discharge nozzle, if provided.

(e) Starting the Pump: Turn the pump shaft by hand to ensure that the rotating element is free. If the rotating element rubs or binds, check for any abnormal piping strain or other loads on the pump causing misalignment. A slight drag from the mechanical seal is normal.

1. Check that the voltage and frequency on the motor nameplate match the current supply. Be sure the motor is wired for correct voltage. Check that all thermal overload relays are of the proper size and "set" for operation.

2. **Be sure the valve in the suction line is open.** Never use the suction line valve to control flow. The discharge valve should be closed or partially open. See that all pipe connections are tight. Make sure all flushing and cooling lines are open.

3, **Restore power supply and start the pump motor/driver.** When pump reaches full speed, slowly open the discharge valve.

Warning:

Do not operate the pump against a closed discharge valve for prolonged periods of time. This can cause Increased vibration levels which will affect seal and bearing life. It can also cause cavitation damage to the internal surfaces of the pump.

4. If hot liquid is pumped, control opening of discharge valve to allow pump temperature to Stabilize before reaching full capacity. Observe the operation of the pump. If excessive vibration or noise is evident, the unit should be stopped immediately and a thorough check made of the installation to determine the cause. Correct any fault before restarting the pump.

5. Listen for rubbing or binding which may have been caused by piping strains. If present, shut down the pump immediately. Investigate and correct the cause before restarting the pump.

6. Check the packing/mechanical seal for proper operation. Packing should have a leakage rate between 40 to 60 drops per minute. Never force the packing into a leakproof position since this will create excessive friction and premature damage to the packing and shaft or

shaft sleeve. If leakage is excessive, tighten the gland bolts evenly, about 1/4 turn at a time. Allow the packing to seat in its new position. Packing must be "run-in" and this could take several hours or days to achieve the desired results.
Mechanical seals are installed and adjusted at the factory. No further adjustment is required except for a short run-in period.

7. After the pump has been operating for a sufficient length of time to bring it up to operating temperature, the final alignment should be checked. Once the pump has reached operating temperature, stop the pump, lock out the power source, and immediately remove coupling guard. Disconnect coupling and check the alignment. Make any necessary adjustments. Reconnect coupling and replace coupling guard.

Warning

Never run pump without the coupling guard. Disregard of this warning can result in serious personal Injury or death.

(f) Pump Shutdown: Slowly close discharge valve and shut off power to the motor. Lock out motor Power supply to prevent accidental restart when performing inspection or routine maintenance.

Section IV

Preventive Maintenance

A planned program of routine inspection and preventive maintenance can increase the service life of your pump. Maintenance records should be kept for each pump in a data base which will be beneficial in developing long term maintenance planning. Regular check ups of the following items will help keep your pump running trouble free and keep costly downtime to a minimum.

IV-A. Daily/Weekly Routine Inspection and Maintenance

(a) Observe oil level and condition through sight glass. Oil level should be visible and at the halfway point in the sight glass. Slight foaming under operation is normal. Contaminated oil should be changed immediately.
(b) Grease lubricated bearing should be re-greased at start-up and approximately every 2000 hours of Operation. Refer to Appendix, page 36, for recommended grease manufactures.
(c) Check mechanical seal chamber for leaks. Mechanical seals should not leak. Visible signs of leakage should be investigated immediately.
(d) Visually inspect pump for leaks. Inspect all tapped and plugged connections. Check for unusual Noise or vibrations. Check for high bearing temperatures.
(e) Periodically, check foundation bolts, pipe supports and pump to motor alignment.
(f) If performance deteriorates, check for blockage in pipe system, or possible worn parts.

Section V

Pinnacle-Flo Small & Medium (ST1/MT1) Power Frames

V-A. Disassembly and Reassembly Instructions

Required Tools

Torque Wrenches* (ft. lbs)	Dial Indicator
Dead Blow Hammer	Micrometer
Allen Wrenches	Snap Ring Pliers
Open End Wrenches	Feeler Gauges
Induction Bearing Heater	Drift Punch
Spanner Wrench	Hoist

Warning
Proper methods to handle pump components must always be used to avoid physical injury or damage to parts.
Lock out power supply to motor, close off suction and discharge valves. Drain liquid from casing and Flush if required. Carefully, disconnect all accessory piping, remove coupling guard and disconnect Coupling. Remove complete pump assembly or back pull out, (power frame with adapter, stuffing box, and impeller attached), by removing frame adapter to casing bolts, (Item 370). Using suitable lifting devises, place pump, or back pull out assembly, on clean work surface of adequate strength to support the weight.

ST1/MT1 Pump Frames

(a) Secure pump/back pull out assembly, to work bench.
(b) Drain oil from bearing frame by removing oil drain plug (408A). Replace drain plug and dispose of used oil in an environmentally appropriated manner.
(c) Scribe line on pump shaft at end of coupling hub and proceed to remove hub from shaft.
(d) Remove impeller (101), never apply heat to remove an impeller. The heat can cause an explosion due to trapped gas or fluid between pump shaft and impeller which could result in death or serious injury. Use impeller shaft wrench. Slide wrench over shaft and key. Turn impeller clockwise (viewed from impeller end of shaft), to raise wrench off of work bench. Abruptly, turn impeller counterclockwise to impact wrench against the workbench surface or block of wood. Remove impeller and discard impeller o-ring seal (496A)

Removal of Stuffing Box/Cover – Mechanical Seal Pumps

(e) Remove seal gland stud nuts (353). Separate seal gland (250), and slide gland towards bearing Isolator (333A).
Remove seal chamber (184), slide chamber forward and off of pump shaft.
(f) Remove mechanical seal rotary (non-cartridge type) from pump shaft sleeve by loosening set screws and sliding assembly off pump shaft sleeve.
(g) Slide shaft sleeve forward and remove from shaft (126).
(h) Slide seal gland with seal stationary seat and O-ring gasket off of pump shaft.

Removal of Stuffing Box Cover-Packed Pumps

(i) Remove packing gland studs (353) and nuts (353A).
(j) Remove stuffing box cover stud nuts (423B).
(k) Remove box cover by sliding cover forward and off of pump shaft.
(l) Remove packing rings (106) and lantern ring (105).
(m) On PMT,PLT and PXLT pump models, remove frame adapter (108) from power frames as follows:
1. Remove dowel pins (469B)
2. Remove frame to adapter bolts (370B)
3. Separate adapter from frame and discard Fiber gasket (360D).
4. ***Do Not Remove Bearing Isolator/Seal assembly from frame Adapter***

Power End Disassembly-ST1 and MT1 Models

(a) Remove cap screws (370C), loosen jam nuts (423). Tighten jack bolts (370D evenly. Bearing housing will begin to back out of frame.
(b) Slide shaft assembly, with bearing housing out of bearing frame.
(c) Remove all jack screws and nuts, item (370D) and (423).
(d) Remove and discard bearing housing O-ring (496).
(e) Using snap ring pliers, remove bearing retaining ring (361A).
(f) Remove bearing housing (134) from shaft assembly by tapping the shaft with a rubber mallet, driving the thrust bearing and shaft assembly from the bearing housing.
Do not attempt to remove the labyrinth seal, (332A) and (332A). These are one piece isolators that are not designed for field disassembly. Unless damaged, the isolator O-rings do not require service or replacement.
(g) Remove bearing lock nut (136) and lock washer (382).
(h) Using an arbor press, remove inboard and outboard bearings. Slide snap ring off shaft after bearings have been removed.
(i) Complete disassembly of bearing frame (228). Remove oil fill plug (113A), oil sight glass (408N), oil mist/grease plugs four (4) total (408H). Remove oil cooler inlet and outlet plugs (408L), and (409M). On PMT models, remove frame foot attachment bolts (370F).

Power End Disassembly-LT1 Frames

(a) Remove bearing housing bolts (370C), loosen jam nuts (423). Tighten jack bolts (370D) evenly. Bearing housing will begin to back out of frame.
(b) Slide shaft assembly with bearing housing out of bearing frame.
(c) Remove all jack screws and nuts, items (370D) and (423). Remove bearing housing O-ring (496).
(d) Remove bearing cover screws (370G) and remove cover.
(e) Remove bearing housing (134) from shaft by tapping the shaft with a rubber mallet, driving the shaft assembly from the bearing housing.
Do not attempt to remove the bearing isolators (333A and 332A). These are one piece isolators that are not designed for field disassembly. Unless damaged, the isolator O-rings do not require service or replacement.
(f) Remove bearing lock nut (136) and lock washer (382).
(g) Using an arbor press, remove inboard and outboard bearings. Remove bearing cover. ***Do not remove oil ring (248A) from shaft unless it is damaged.***

Power End Disassembly – XLT1 Frames

(a) Remove bearing frame foot bolts (370F) and remove foot (241).
(b) Remove bearing housing bolts (370C, loosen jam nuts (423). Tighten jack bolts (370D) evenly. Bearing housing will begin to back out of frame.
(c) Slide shaft assembly with bearing housing out of bearing frame.
(d) Remove all jack screws and nuts, items (370D and (423). Remove bearing housing O-ring (496).
(e) Remove bearing cover bolts (370G) and bearing cover (109C). Discard O-ring gasket (360C). ***Do not remove bearing isolators.***
(f) Using an arbor press, remove inboard bearing (168A).
(g) Remove bearing housing (134) by sliding housing over the bearing and removing housing from impeller end of shaft.
(h) Remove bearing locknut (136) and lock washer (382).
(i) Press outboard bearing (112) off shaft.

V-B. Parts Inspection

All parts must be inspected before reassembly to insure the rebuilt pump will perform properly. Each part should be examined for signs of fatigue, excessive wear and cracks. Replace any worn parts if they do not meet the following tolerance standards.

Bearing Frame and Foot – Visually inspect for cracks, roughness, rust or scale. Check machined surfaces for pitting or erosion. ***Bearing Frame*** – Inspect tapped connections for dirt, clean and chase threads as necessary. Remove all loose or foreign material. Inspect lubrication passages to be sure they are open. Inspect inboard bearing frame bores.

Shaft and Sleeve – Visually inspect, check for grooves or pitting. Check bearing fits and shaft run-out. Replace shaft and sleeve if worn, or if tolerances are outside the limits listed below.

Casing – Visually inspect for signs of wear, corrosion, or pitting. The casing should be replaced if wear exceeds 1/8" deep. Check gasket surface for signs of corrosion or irregularities.

Impeller – Visually inspect impeller vanes for wear, erosion, or corrosion damage. If vanes are worn more the 1/8" deep or if they are bent, the impeller should be replaced.

Frame Adapter – Visually inspect for cracks, warpage or corrosion damage. Replace if any of these signs appear.

Bearing Housing – Visually inspect for signs of wear or corrosion. Check for cracks and/or pits. Check tolerances as noted below. Replace if worn or out of tolerance.

Seal Chamber/Box Cover – Visually inspect for cracks, pitting, erosion or corrosion. Check face of cover for wear, scoring or grooves. Replace if worn more the 1/8" deep.

BEARING FITS
INCHES (MM)

	ST	MT	LT	TXLT
Frame Inboard I.D.	2.8346 (72.000)	3.9370 (100.000)	4.7244 (120.000)	5.5118 (140.000)
	2.8353 (72.019)	3.9379 (100.022)	4.7253 (120.022)	5.5128 (140.025)
Bearing Inboard O.D.	2.8346 (72.000)	3.9370 (100.000)	4.7244 (120.000)	5.5118 (140.000)
	2.8341 (71.987)	3.9364 (99.985)	4.7238 (119.985)	5.5111 (139.982)
Shaft Inboard O.D.	1.3875 (35.013)	1.7722 (45.013)	2.1660 (55.015)	2.5597 (65.015)
	1.3871 (35.002)	1.7718 (45.002)	2.1655 (55.002)	2.5592 (65.002)
Bearing Inboard I.D.	1.3780 (35.000)	1.7717 (45.000)	2.1654 (55.000)	2.5591 (65.000)
	1.3775 (34.988)	1.7712 (44.988)	2.1648 (54.985)	2.5585 (64.985)
Shaft Outboard O.D.	1.1815 (30.011)	1.7722 (45.013)	1.9690 (50.013)	2.5597 (65.015)
	1.1812 (30.002)	1.7718 (45.002)	1.9686 (50.002)	2.5592 (65.002)
Bearing Outboard I.D.	1.1811 (30.000)	1.7717 (45.000)	1.9685 (50.000)	2.5591 (65.000)
	1.1807 (29.990)	1.7712 (44.988)	1.9680 (49.988)	2.5585 (64.985)
Bearing Housing I.D. Outboard	2.8346 (72.000)	3.9370 (100.000)	4.3307 (110.000)	5.5118 (140.000)
	2.8353 (72.019)	3.9379 (100.022)	4.3316 (110.022)	5.5128 (140.025)
Bearing O.D. Outboard	2.8346 (72.000)	3.9370 (100.000)	4.3307 (110.000)	5.5118 (140.000)
	2.8341 (71.987)	3.9364 (99.985)	4.3301 (109.985)	5.5111 (139.982)

SHAFT RUNOUT (WITH SLEEVE) IN INCHES

	ST	MT	LT	TXLT
At Sleeve Journal	0.002	0.002	0.002	0.002
At Coupling Journal	0.002	0.002	0.002	0.002

V-C. Assembly (See Isometric View, Pages)

Rotating Element and Bearing Frame, ST1 & MT1 Frames

Bearing frame – Inspect tapped connections for dirt, clean and chase threads as necessary. Use thread sealant on all threads and fittings.

(a) Install oil fill plug (113A), oil sight glass (143), oil mist/grease plugs (408H), oil cooler inlet and outlet plugs (408L) and (408M).
(b) Attach bearing frame foot (241) with bolts (370F).

Power-End Assembly

(a) Install outboard bearing (112) on shaft. If bearings are grease lubricated install single shielded bearing with shield toward the impeller. Bearings can be pressed on the shaft with an arbor press, or if available, an induction heater can be used. Follow all instructions and recommendations of the heater manufacturer. When using a press, make sure that force is applied to the inner bearing rece only.
(b) Install bearing lock washer (382) on shaft. Place tang of lock washer in shaft keyway under bearing.
(c) Thread locknut (136) onto shaft. Tighten nut until snug, with a spanner wrench, and bend any tang of lock washer over flat on nut. Slide bearing retaining snap ring (361A) over shaft, flat side toward the bearing.
(d) Install inboard bearing (168A). If using a press, make sure force is applied on the inner race of bearing only. NOTE: If bearing is grease lubricated, it has a single shield. The bearing is installed with the shield away from the impeller.
(e) Install new O-ring (496) on bearing housing (134). Apply thin coating of oil on outside of bearing and inside of bearing housing. Lightly lubricate shaft to assist with installation of bearing isolator O-rings.
(f) Slide coupling end of pump shaft through bearing housing. Press housing evenly, ***Do not force,*** until bearing seats against shoulder in bearing housing. Support outer face of bearing isolator to prevent accidental separation of rotor from stator.
(g) Install bearing snap ring (361A) in groove in bearing housing bore.

NOTE: *Locate ends of snap ring so they do not obstruct the flow of oil through the return groove. Rotate shaft to make sure it turns freely.*

(h) Apply thin film of lubricant to outside of bearing housing (134).
(i) Apply thin film of lubricant to frame bore ID. Install shaft assembly into bearing frame (228). Rotate shaft to make sure it turns freely.
(j) Install cap screws (370C) into bearing frame (228).

(k) Install jack bolts (370D) and lock nuts (423). Hand tighten evenly.
(l) On MT1 frames, install new Fiber gasket in frame face (360D).

V-D. Assembly (See Isometric View, Pages)

Rotating Element and Frame Assembly, LT1 & XLT1

Bearing frame – Inspect tapped connections for dirt, clean and chase threads as necessary. Use thread sealant on all threads and fittings.

(a) Install oil fill plug (113A), oil sight glass (143), oil mist/grease plugs (408H), oil cooler inlet and outlet plugs (408L) and (408M).
(b) Attach bearing frame foot (241) with bolts (370F).

Rotating Element LT1 Frame

(a) If removed, install oil ring (248A) on shaft. *Oil ring is a press fit onto shaft, use proper size drive tool to prevent damage.*
(b) Install bearing cover (109C) on shaft.
(c) Install outboard bearings (112). Note: *LT1 frames use duplex angular contact bearings. Make sure bearings are mounted in the correct order,* ***BACK TO BACK****.*
(d) Install inboard bearing (168A). If using a press, make sure force is applied on the inner race of bearing only. NOTE: If bearing is grease lubricated, it has a single shield. The bearing is installed with the shield away from the impeller.
(e) Lightly lubricate bearings with oil and coat the outside of outboard bearing (112) and bearing housing bore (134). Slide bearing housing (134) onto shaft and over outboard bearing. ***Do Not Force.***
(f) Install bearing cover bolts (370G), check shaft so it turns freely. Tighten bolts to 55 In-lbs. for lubricated threads or 83 In-lbs. for dry threads.
(g) Install new O-ring for bearing housing (496).
(h) Lightly lubricate outside surface of bearing housing (134) and inside diameter of frame bearing bore (228).
(i) Install shaft and bearing assembly into bearing housing (228). Rotate shaft to see it turns freely.
(j) Install bearing cover bolts (370C), hand tighten only. Install jack bolts (370D with lock nuts (423). **Hand Tight Only.**

Rotating Element – XLT1 Frame

(a) Install outboard bearing (112) on shaft.
(b) Install bearing lock washer (382) on shaft. Place tang of lock washer in shaft keyway. Thread locknut (136) onto shaft. Tighten nut until snug and bend tang of lock washer (382) over flat on nut. If it is necessary to adjust the position of the locknut so that the tang will line up with the flat, always tighten the nut, ***Never loosen it.***
(c) Lightly lubricate bearing with oil and coat the outside of outboard bearing (112) and bearing housing bore (134). Slide bearing housing (134) onto shaft and over outboard bearing. ***Do Not Force.***
(d) Install gasket (360C), bearing cover (109C) and bolts. Check to see the shaft turns freely. Refer to Appendix page for bolt torque values.
(e) Install inboard bearing (168A). If bearing is regreaseable type, install with shield away from impeller. Lightly lubricate bearing with oil or grease as required.
(f) Install new O-ring for bearing housing (496). Lubricate outside of bearing housing and inside diameter of frame bearing bore (228) with oil.
(g) Install shaft and bearing assembly into frame (228). Rotate shaft to see if it turns freely.
(h) Install bearing cover bolts (370C), hand tighten only. Install jack bolts (370D) with lock nuts (423), hand tighten only.
(i) Install bearing frame foot (241), hand tighten bolts (370F).

Power Frame Checks and Liquid End Assembly-All Models

(a) Place power frame in the horizontal position, support frame assembly so that it does not tip over. Check shaft end play by moving shaft forward and backward by hand. Dial indicator movement should be within tolerances listed in Appendix. If values are greater, disassemble power end for inspection.
(b). Install shaft sleeve (126). Install impeller, (101) on shaft (122). Rotate shaft one full revolution, and check for shaft/sleeve run out. See tolerances listed in Appendix. Maximum allowable indicator run-out is 0.002 inches. If values are greater, disassemble power end for inspection.
(c) Attach dial indicator against face of frame. Rotate shaft by hand so that indicator sweeps the entire fit for 360 degrees. Maximum indicator run-out should be no more than 0.005 inch. If greater, disassemble and determine cause.
(d) Lightly lubricate adapter Fiber gasket (360D) and install in frame face. Install frame adapter (108) with bearing isolator seal (333A (MT1 frames only)) onto the power end assembly, align bolt holes and dowel pin holes. Install dowel pins (469B) and frame to adapter bolts (370B). See appendix for bolt torques. Tighten evenly in a crisscross manner.
(e) Attach dial indicator to shaft, place indicator against mating face of adapter. Rotate shaft 360 degrees. Total indicator run-out should not exceed 0.005 inches. With dial indicator still attached to shaft, position indicator on inside diameter of mating face. Rotate shaft again a full 360 degrees. Total indicator run-out should not exceed 0.005 inches. If greater values are measured, disassemble and determine cause before proceeding with assembly.

Packed Type Pumps

(a) Install stuffing box cover (184) with studs and nuts (370H, 423B).
(b) Mount dial indicator on end of shaft and check seal chamber cover run out. Rotate shaft a full 360 degrees. Maximum dial indicator reading should not exceed 0.005 inches on any of the following readings:
    (1) Outside diameter of the pilot fit.
    (2) Face of gasket surface.
    (3) Box cover face.
(c) Apply a light coating of anti-seize compound to area of shaft under the sleeve. Install shaft sleeve (126). Be sure sleeve is seated against shoulder of shaft.
(d) Install impeller with O-ring. Thread impeller on shaft until it seats against shaft sleeve face. Slide impeller wrench over shaft and coupling key. Tighten impeller, by raising wrench counterclockwise (viewed from impeller end) and slamming it down (clockwise) against the work bench. Repeat two or three times.
(e) Attach dial indicator to flange of frame adapter. Position indicator on tip of impeller vane. Rotate shaft 360 degrees. Check impeller run out from bane tip to vane tip. Total indicator run-out should be less than 0.005 inches.
(f) Install packing in stuffing box. Stagger each ring joint 90 degrees. Two rings should be inserted into the bottom of the box, followed by the lantern ring (105) and then three more rings of packing. Make sure lantern ring is located at the flushing connection, otherwise no flushing will occur. Install packing gland haves (107), hand tighten gland nuts evenly.

Mechanical Seal Pumps

(a) Install seal cover (184) with studs and nuts (370H, 423B).
(b) Mount dial indicator on end of shaft and check seal chamber cover run out. Rotate shaft a full 360 degrees. Maximum dial indicator reading should not exceed 0.005 inches on any of the following readings:
    (1) Outside diameter of the pilot fit.
    (2) Face of gasket surface.
    (3) Seal cover face.
(c) Install shaft sleeve. Apply a light coating of anti-seize compound to area of shaft under the sleeve. Install shaft sleeve (126). Be sure sleeve is seated against shoulder of shaft.
(d) Install impeller less O-ring. Thread impeller on shaft until it seats against shaft sleeve face. Slide impeller wrench over shaft and coupling key. Tighten impeller, by raising wrench counterclockwise (viewed from impeller end) and slamming it down (clockwise) against the work bench. Repeat two or three times.
(e) Attach dial indicator to flange of frame adapter. Position indicator on vane tip of impeller. Rotate shaft 360 degrees. Check impeller run out from vane tip to vane tip. Total indicator run-out should be less than 0.005 inches.

(f) Apply bluing solution to the shaft sleeve. Scribe a mark on the shaft sleeve at the face of the seal chamber/stuffing box cover. This will locate a reference point for the installation of the mechanical seal.
(g) Remove impeller and shaft sleeve. Remove seal chamber cover.
(h) Install mechanical seal stationary into mechanical seal gland (250). Follow seal manufacturer's instructions. Slide seal gland with stationary seal seat over shaft and position gland back towards the adapter face.
(i) Reinstall shaft sleeve. Follow the manufacturer's instructions and install the rotating seal assembly on the shaft sleeve.
(j) Install seal chamber (184) with studs and nuts (370H, 423B).
(k) Install impeller with O-ring. Thread impeller on shaft until it seats against shaft sleeve face. Slide impeller wrench over shaft and coupling key. Tighten impeller, by raising wrench counterclockwise (viewed from impeller end) and slamming it down (clockwise) against the work bench. Repeat two of three times.
(l) Install mechanical seal gland (250) with nuts (353A). Tighten nuts evenly. Check shaft to see if it can be rotated by hand. If binding or rubbing occurs, determine cause and correct before proceeding. See chart below for possible causes.

Symptoms	Causes
Excessive Shaft/Sleeve Run-out	**Sleeve Worn-Replace** **Shaft Bent/Twisted - Replace**
Excessive Bearing Frame Flange Run-out	**Shaft Bent/Twisted – Replace** **Frame Flange Warped - Replace**
Excessive Frame Adapter Run-out	**Adapter Eroded/Warped - Replace**
Excessive Impeller Vane Tip Run-out	**Vanes Broken or Worn - Replace**
Excessive Shaft End Play	**Bearing internal Clearance Too Great – Replace Bearings, Snap Ring Loose or Broken – Replace or Reseat**
Excessive Seal Chamber Run-out	**Seal Chamber Not Seated** **Seal Chamber Worn/Warped** **Seal Chamber Corroded-Eroded -Replace**

V-E. Installation – Back Pull Out Assembly – All Models

***Warning*: Proper methods to handle the back pull out assembly must always be used to avoid physical injury or damage.**

(a) Inspect casing; Clean casing fits and install gasket (351) onto seal chamber/stuffing box cover.
(b) Loosen cap screws (390C) and jacking bolts (370D). Install back pull out assembly in casing.
(c) Apply anti – seize compound to casing bolts (370). Install casing bolts hand tight. Torque casing bolt to values shown in Appendix.
(d) Check lateral movement of impeller in casing. Acceptable range is between .030 inch and .070 inch. Clearance beyond these limits indicate defective parts, improper installation or excessive pipe strain. Determine cause and correct before proceeding.
(e) Set impeller clearance as detailed in Appendix.
(f) Install any auxiliary piping or flush plans.
(g) Check shaft to see if it can be rotated by hand. If binding or rubbing occurs, determine cause and correct before proceeding.

Refill Power Frame With Oil, Or Grease Bearings As Described In The Preliminary Start Up Check List. Follow All Instructions In Start Up Check List and Proceed With Pump Start-Up.

NOTE: A high quality turbine oil with rust and oxidation inhibitors should be used. Under normal operating conditions, an oil of 300 SSU viscosity at 100 degree F should be used where pumping temperatures do not exceed 350 degree F. Fill frame with oil to the center of the sight glass through the oil fill plug (113A) located at top of power frame.

Change oil after 200 hours of operation for new bearings, then every 2000 hours or three months whichever occurs first.

Appendix - Bearing Frame Oil Capacity

Frame	Pints	Milliliters
ST1	1.0	473
MT1	2.6	1250
LT1	3.0	1420
XLT1	7.4	3500

Recommended Oil Manufacturers

Atlantic Richfield	**Duro 68**
Chevron	**Chevron Turbine Oil GST 68**
Exxon	**Teresstic 68**
Texaco, Inc.	**Regal R&O 68**
Mobil	**DTE Heavy - Medium**
Amoco Oil	**Amoco Industrial Oil 68**
Philips	**Mangus Oil 315**
Shell	**Tellus Oil 68**
Sunoco	**Sunvis 968**
Royal Purple	**Synfilm ISO VG 68 Synthetic Lube**

Grease Lubricated Bearings

NOTE: Grease lubricated ball bearing are optional on the ANSI series. These units can be identified by grease fittings located on the bearing frame (see figure b). Pumps ordered with regreaseable bearing from the factory will contain some grease, but not a sufficient amount for placing the pump into continuous service. It is necessary to completely grease the bearings as described below before placing the pump on line. Failure to do this may result in repairs not covered by the product warranty.

(a) Clean any dirt of foreign matter from the grease fittings. Remove grease relief plugs from bottom of the frame. Pump grease through the fitting and into each bearing cavity until fresh grease comes out of the relief ports. ***REGREASE BEARINGS EVERY 2000 HOURS OF OPERATION OR 3 MONTHS, WHICHEVER OCCURS FIRST.*** For pumping temperatures less than 350 degrees F, use a lithium based mineral oil grease of NLGI consistency equal to No.2 ***NEVER MIX GREASES OF DIFFERENT CONSISTENCIES OR DIFFERENT TYPES. WHEN CHANGING FROM ONE TYPE GREASE OR CONSISTENCY TO ANOTHER, ALWAYS REMOVE THE BEARINGS AND CLEAN OUT ATT THE OLD GREASE.***

Acceptable Grease Manufacturers

NGLI GRADE 2	(350 Degrees F. Max)
Mobil	Mobilux EP2
Exxon	Unirex N2
Sunoco	Multipurpose EP
SKF	LGMT 2

NGLI GRADE 3	(500 Degrees F. Max)
Exxon	Unirex 3
SKF	LGMT 3

Bearing Identification
SKF – MRC or Equal

Inboard (Radial Bearings)		
Frame	Oil	Grease
PST	207S	207SF
PMT	309S	309SF
PLT	311S	-
PXLT	313S	313SF
Outboard (Thrust Bearings/Double Row)		
Frame	Oil	Grease
PST	5306	5306F
PMT	5309	5309F
PLT	7310 Duplex	-
PXLT	5313	5313F

Impeller Clearance Adjustment

If a gradual loss in head and or capacity occurs, performance may be restored by adjusting the impeller. If performance cannot be restored by adjustment, the pump should be disassembled and impeller and casing inspected for wear. Impeller clearance is the measurement between the edge of the impeller vanes and the surface of the casing. The following table should be used as a guide for setting the impeller clearance under various operating temperatures.

Impeller Clearance at for Various Service Temperatures (Inches)				
Pumping Temperature	**8896 Pump Frame Size**			
	ST1	**MT1/LT1**	**Low Flow**	**XLT1**
-20 to 200 F	0.005”	0.008”	0.018”	0.015
200 to 250 F	0.006”	0.009”	0.019”	0.016
250 to 300 F	0.007”	0.010”	0.020”	0.017”
300 to 350 F	0.009”	0.012”	0.022”	0.019”
350 to 400 F	0.010”	0.013”	0.023”	0.020”
400 to 450 F	0.011”	0.014”	0.024”	0.021”
450 to 500 F	0.012”	0.015”	0.025”	0.022”

Feeler Gauge Adjustment of impeller Clearance

(a) Lock out Power Supply to Motor.

(b) Remove coupling guard. Loosen jack bolts (370D) and jam nuts (423). Tighten bearing housing bolts (370C) evenly, while slowly rotating the shaft until the impeller just start to rub on the casing. Using a feeler gauge, set the gap between the three housing bolts (370C) and the bearing housing. Set the gap according to the table as required. *See figure* D on page 29.

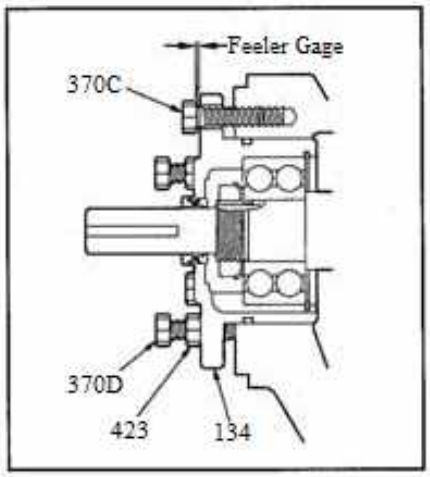


Figure D.

(c) Tighten jacking bolts (370D) evenly, until bearing housing back out and contacts the bearing housing bolts (370C). Tighten jam nuts (423) evenly. Rotate shaft to make sure that it turns freely.
(d) Reinstall coupling guard.

Dial Indicator Adjustment of Impeller Clearance

(a) Lock out Power Supply to Motor.
(b) Remove coupling guard and coupling.
(c) Place a dial indicator with a magnetic mounting base on the surface of the pump baseplate. Position indicator against face of pump shaft. *See figure* E.

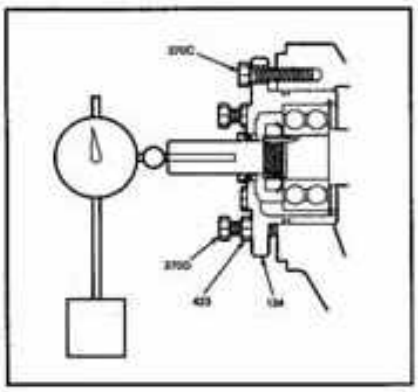


Figure E.

(d) Loosen jacking bolts (370D) and jam nuts (423).
(c) Tighten bearing housing bolts (370C) evenly, while slowly rotating the shaft until the impeller just starts to rub on the casing. Set dial indicator to zero.
(f) Tighten the jacking bolts (370D) evenly, until they contact the bearing frame. Continue to tighten the jacking bolts evenly, about one flat at a time, drawing the bearing housing away from the frame until the dial indicator shows the proper clearance, from .015 inch to .025 inch.
(g) Tighten bearing housing blots (370C evenly, then tighten jacking bolts (370D) evenly. Make sure dial indicator reading does not move from the proper setting. Rotate shaft to make sure it turns freely.
(h) Reinstall coupling and coupling guard.

Assembly Checks Shaft end Play

Frame	Double Row
PST	**.0011 IN. (.028mm)** **.0019 IN. (.047mm)**
PMT	**.0013 IN. (.033mm)** **.0021 IN. (.054mm)**
PLT	**.0010 IN. (.026mm) Duplex** **.0015 IN. (.038mm) Duplex**
PXLT	**.0014 IN. (.036mm)** **.0023 IN. (.058mm)**

Bolt Torque Values

Bolt Torque, Ft.-Lbs. (except where noted)					
		DI Casing		Alloy Casing	
	Frame	Dry	Lubed	Dry	Lube
Casing Bolts (370)	8” ST1	30	20	54	35
	6” ST1	59	39	107	71
	MT1				
	LT1				
	XLT1				
	XLT1 17	170	113	212	141
Frame-Adapter (370)	All	Dry – 30 in. lbs. Lubed – 20 in. lbs.			
Bearing Clamp Ring (236A)	LT1	Dry – 83 in. lbs. Lubed – 55 in. lbs.			
Bearing End Cover (370G)	XLT1 XLT1-17	Dry – 12 in. lbs. Lubed – 9 in. lbs.			

Bearing Locknut Torque Values

Maximum Bearing Locknut Torque, Ft.-lbs.			
Frame	Bearing Size	Locknut Size	Max Torque
ST1	5306/C	N-06	20
MT1	5309/C	N-09	50
LT1	7310BECBM	N-10	70
XLT1	5313/C	N-13	140

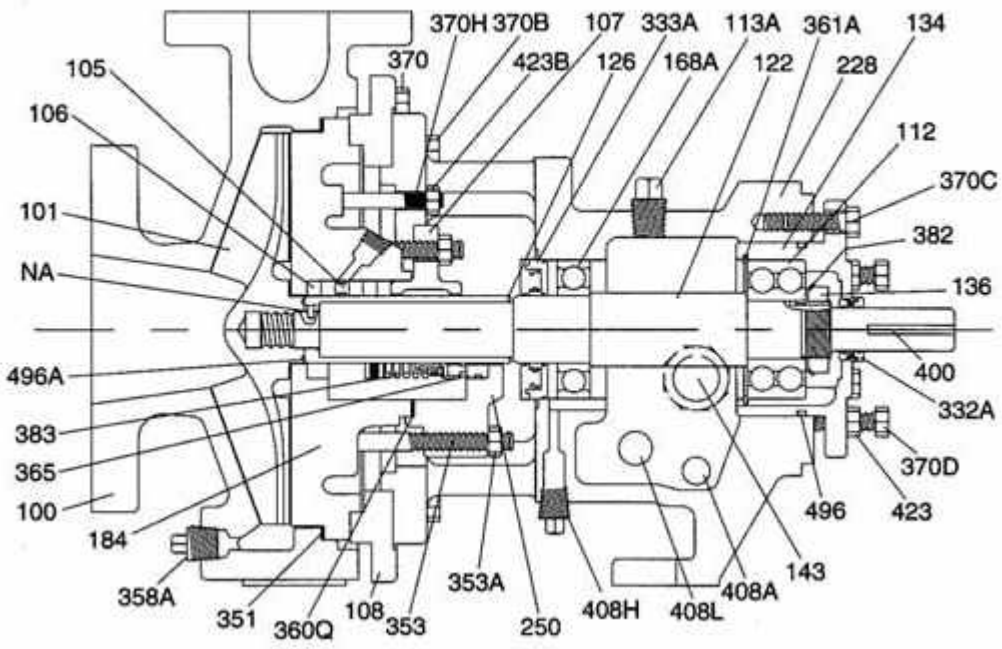
Pinnacle-Flo, Inc.

Parts List with Materials of Construction

			MATERIAL								
ITEM #	QTY	Description	CS 316SS	All 316SS	CD4MCu	Alloy 20	Monel	Nickel	Hsst B	Hast C	TI
100	1	Casing	D.I.	316SS	CD4	Alloy	Monel	Nickel	Has B	Has C	TI
370		Bolt Casing	Steel	STAINLESS STEEL							
368A	1	Plug Casing Drain	Steel	SS	Alloy 20	Alloy 20	Monel	Nickel	Has B	Has C	TI
101	1	Impeller	316 SS	316 SS	CD 4	Alloy 20	Monel	Nickel	Has B	Has C	TI
122	1	Shaft	4140 Steel		316 SS	316 SS					
184	1	Cover, Stuffing Box	CS	316 SS	CD4	Alloy 20	Monel	Nickel	Has B	Has C	TI
370H	2	Box Cover Adpt. Studs	Steel	STAINLESS STEEL							
423B	2	Nut Cover Adpt. Studs	Steel	STAINLESS STEEL							
106	5	Packing	ARAMID – PTFE SYNTHETIC								
126	1	Shaft Sleeve	316 SS		316 SS	Alloy 20	Monel	Nickel	Has B	Has C	TI
168A	1	Bearing Inboard	STEEL – SIGNLE ROW BALL								
250	1	Mech. Seal Gland	316 SS	316 SS	316 SS	Alloy 20	Monel	Nickel	Hss B	Has C	TI
107	1	Packing Gland	Steel	316 SS	316 SS	Alloy 20	Monel	Nickel	Has B	Has C	TI
353	4	Gland Studs	Steel	STAINLESS STEEL							
353A	4	Gland Stud Nuts	Steel	STAINLESS STEEL							
112	1	Bearing Outboard	STEEL – DOUBLE ROW BALL								
228	1	Frame	CARBON STEEL								
241	1	Frame Foot	CAST IRON								
408H	4	Plug, Frame Lub. Port	STEEL								
408L	1	Plug, Oil Cooler Inlet	STEEL								
408A	1	Plug, Frame Drain	STEEL								
370F	2	Bolt, Frame Foot	STEEL								
529	2	Washer, Frame Foot	STEEL								
408M	1	Plug Oil Cooler Outlet	STEEL								
113A	1	Plug Oil Fill	STEEL								
136	1	Bearing Locknut	STEEL								
105	1	Lantern Ring	TEFLON								
134	1	Outboard Brg. Housing	CARBON STEEL								
370C	3**	Bearing Housing Bolt	STEEL								
370D	3**	Bearing Hsg Jack Bolt	STEEL								
423	3	Jam Nut	STEEL								
408H	2	PXLT Brg. Hsg. Lub. Plug	STEEL								
361A	1	Bearing Snap Ring	STEEL								
109C	1	Outboard Brg Cover	Carbon Steel								
370G	6	Bearing Cover Bolts	STEEL								
360C	1	PXLT Gasket Brg. Cover	VEGETABLE FIBER								
496A	1	Impeller O-Ring	PTFE								
400	1	Coupling Key	STEEL								
248A	1	Oil Ring – PLT Frame Only	STEEL								
365	1	Mech. Seal Stationary Seat	VARIES								
382	1	Bearing Lock Washer	STEEL								
106	1	Adapter	STEEL/CARBON STEEL								
370B	4	Frame Adapter Bolts	STEEL								
469B	2	Dowel Pin, Frame Adpt	STEEL								
351	1	Case Gasket	ARAMIED FIBER WITH EPDM BINDER								
360Q	1	Gland Gasket	VARIES								
360D	1	Adapter Gasket	VEGETABLE FIBER								
496	1	Brg. Hsg. O-ring	BUNA								
383	1	Mech. Seal Rotating Element	VARIES								
333A	1	Inboard Bearing Isolator	BRASS								
332A	1	Outboard Bearing Isolator	BRASS								
143	1	Oil Sight Glass	STEEL & GLASS								
*Packing Gland Has 2 Studs & Nutss			**4 on PXLT Frames			Subject to change without notice.					

Pinnacle-Flo, Inc.

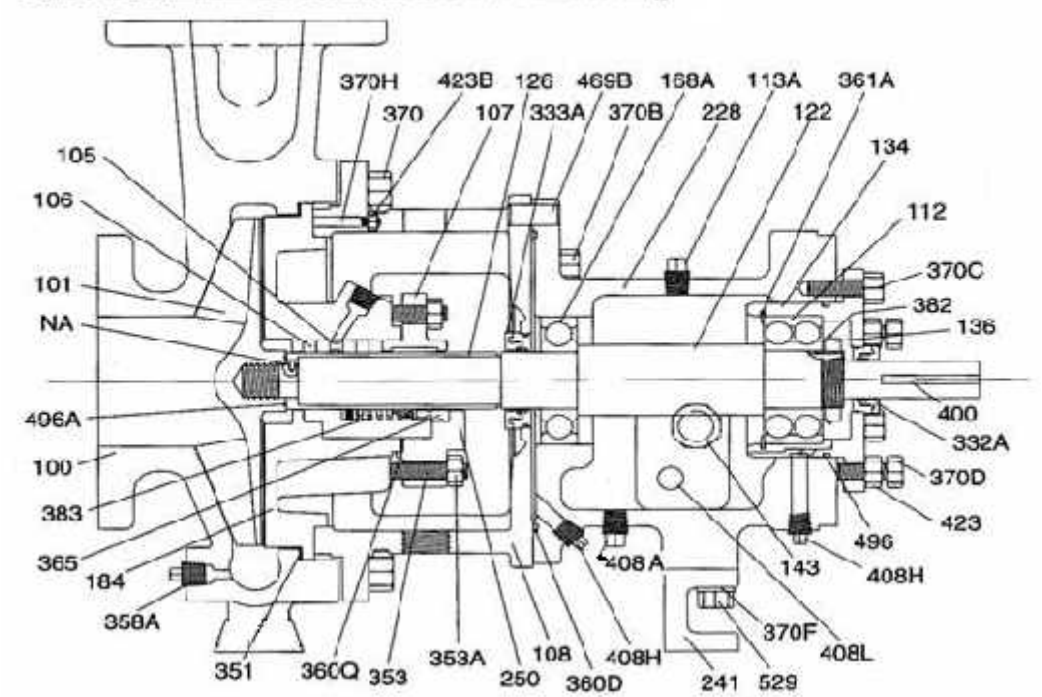
PST FRAME Cross Sectional Drawing



Item #	QTY	Description		Item #	QTY	Description
100	1	Casing		136	1	Locknut, Bearing
370	-	Casing Bolts		105	1	Ring, Lantern
358A	1	Case Drain Plug		134	1	Housing, Bearing Outboard
101	1	Impeller		370C	3	Bolt, Bearing Housing
122	1	Shaft		370D	3	Jack Bolt, Bearing Housing
184	1	Cover/Stuffing Box		423	3	Jam Nut, Brg. Hsg. Jack Bolt
370H	2	Adapter Studs		361A	1	Snap Ring, Bearing
423B	2	Adapter Stud Nuts		496A	1	O-Ring, Impeller
106	5	Packing		400	1	Key, Coupling
126	1	Shaft Sleeve		365	1	Seal, Mechanical Stationary
168A	1	Bearing Inboard		382	1	Bearing Lock Washer
250	1	Gland Mech. Seal		106	1	Adapter 8” Pump Only
107	1	Gland Packing		370B	4	Bolt, Frame / Adapter
353	4*	Gland Studs		351	1	Gasket, Case
353A	4*	Gland Stud Nuts		360Q	1	Gasket, Gland Mech. Seal
112	1	Bearing Outboard		496	1	Gasket, Housing Frame
228	1	Frame		383	1	Seal, Mechanical Rotating Element
408H	4	Plug, Frame Lub. Port		333A	1	Isolator Bearing Inboard
408L	1	Plug, Oil Cooler Inlet		332A	1	Isolator Bearing Outboard
408A	1	Plug, Frame Drain		143	1	Oil Sight Glass
113A	1	Plug, Oil Fill				
* Packing Gland has 2 studs and nuts						

Pinnacle-Flo, Inc.

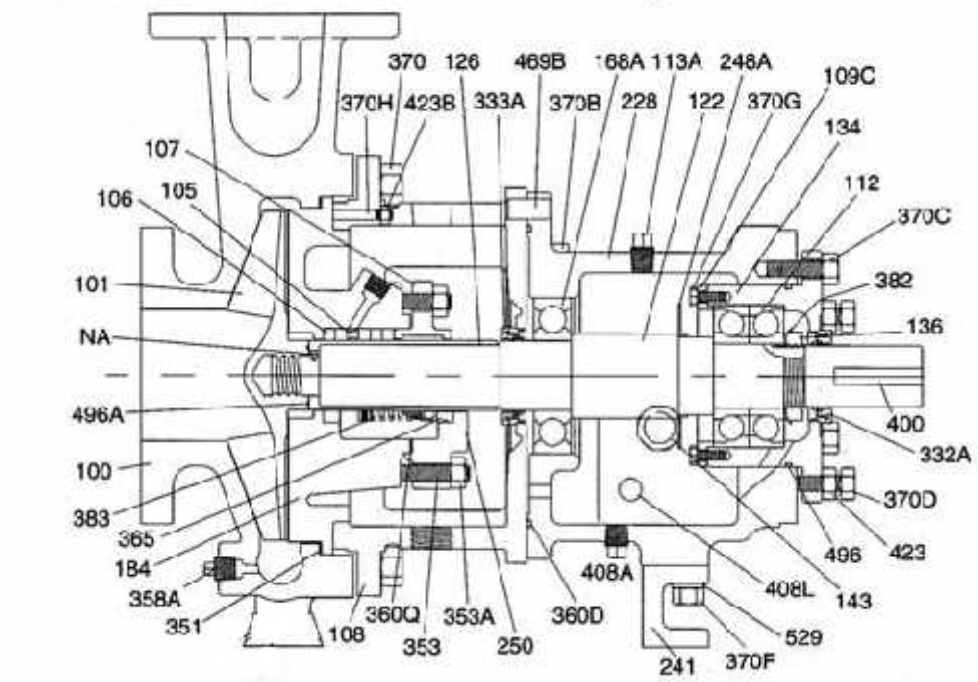
PMT FRAME Cross Sectional Drawing



Item #	QTY	Description		Item #	QTY	Description
100	1	Casing		113A	1	Plug, Oil Fill
370	-	Bolt, Casing		136	1	Locknut, Bearing
358A	1	Plug, Casing Drain		105`	1	Ring, Lantern
101	1	Impeller		134	1	Housing, Bearing
122	1	Shaft		370C	3	Bolts, Bearing Housing
184	1	Cover, Stuffing Box		370D	3	Jack Bolts, Bearing Housing
370H	2	Adapter Studs / Cover		423	3	Jam Nuts, Brg. Hsg. Jack Bolts
423B	2	Nut, Adapter Studs / Cover		361A	1	Snap Ring, Bearing
106	5	Packing		496A	1	O-ring Impeller
126	1	Shaft Sleeve		400	1	Key, Coupling
168A	1	Bearing Inboard		365	1	Seal Mechanical Stationary
250	1	Gland, Mechanical Seal		382	1	Lock washer Bearing
107	1	Gland, Packing		108	1	Adapter Frame
353	4*	Studs / Gland		370B	4	Bolts Frame Adapter
353A	4*	Nut, Gland Stud		469B	2	Dowel Pin / Frame Adapter
112	1	Bearing Outboard		351	1	Gasket / Casing
228	1	Frame		360Q	1	Gasket / Gland
241	1	Foot / Frame		360D	1	Gasket / Frame Adapter
408H	4	Plug Frame Lub. Ports		496	1	O-Ring Bearing Housing
408L	1	Plug Oil Cooler Inlet		383	1	Mechanical Seal Rotating Element
408A	1	Plug Frame Drain		333A	1	Isolator, Bearing Inboard
529	2	Bolt, Frame Foot		332A	1	Isolator, Bearing Outboard
370F	2	Washer, Frame Foot		143	1	Oil Sight Glass
•	• Packing Gland uses only 2 Studs and Nuts					

Pinnacle-Flo, Inc.

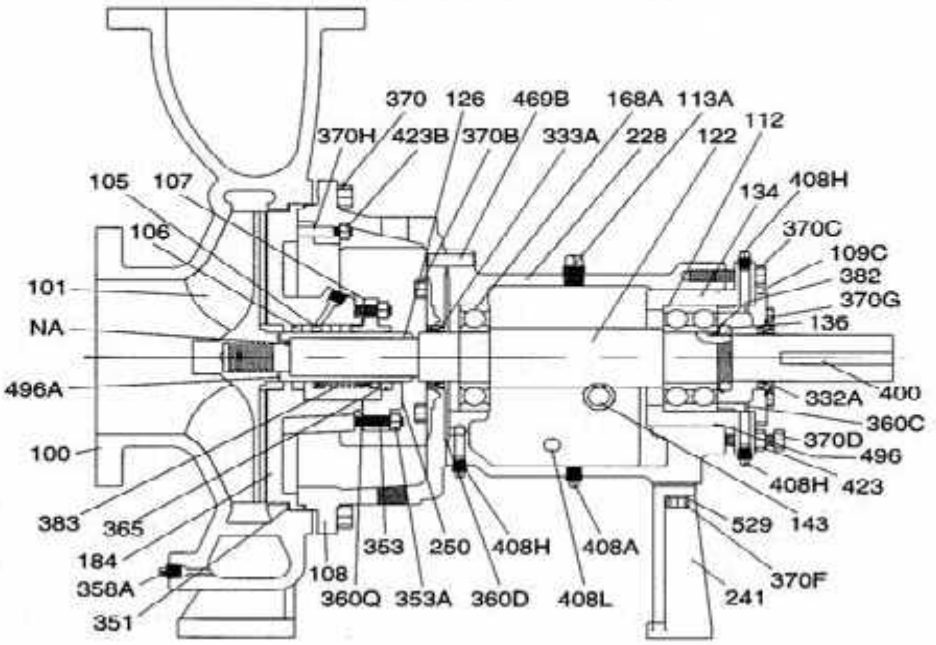
PLT FRAME Cross Sectional Drawing



Item #	QTY	Description		Item #	QTY	Description
100	1	Casing		113A	1	Plug, Oil Fill
370	-	Bolt, Casing		136	1	Locknut, Bearing
358A	1	Plug, Casing Drain		105`	1	Ring, Lantern
101	1	Impeller		134	1	Housing, Bearing
122	1	Shaft		370C	3	Bolts, Bearing Housing
184	1	Cover, Stuffing Box		370D	3	Jack Bolts, Bearing Housing
370H	2	Adapter Studs / Cover		423	3	Jam Nuts, Brg. Hsg. Jack Bolts
423B	2	Nut, Adapter Studs / Cover		361A	1	Snap Ring, Bearing
106	5	Packing		496A	1	O-ring Impeller
126	1	Shaft Sleeve		400	1	Key, Coupling
168A	1	Bearing Inboard		365	1	Seal Mechanical Stationary
250	1	Gland, Mechanical Seal		382	1	Lock washer Bearing
107	1	Gland, Packing		108	1	Adapter Frame
353	4*	Studs / Gland		370B	4	Bolts Frame Adapter
353A	4*	Nut, Gland Stud		469B	2	Dowel Pin / Frame Adapter
112	1	Bearing Outboard		351	1	Gasket / Casing
228	1	Frame		360Q	1	Gasket / Gland
241	1	Foot / Frame		360D	1	Gasket / Frame Adapter
408H	4	Plug Frame Lub. Ports		496	1	O-Ring Bearing Housing
408L	1	Plug Oil Cooler Inlet		383	1	Mechanical Seal Rotating Element
408A	1	Plug Frame Drain		333A	1	Isolator, Bearing Inboard
370F	2	Bolt, Frame Foot		332A	1	Isolator, Bearing Outboard
529	2	Washer, Frame Foot		143	1	Oil Sight Glass
248A	1	Ring, Oil		109C	1	Cover, Bearing Outboard

- Packing Gland uses only 2 Studs and Nuts

PXLT FRAME Cross Sectional Drawing

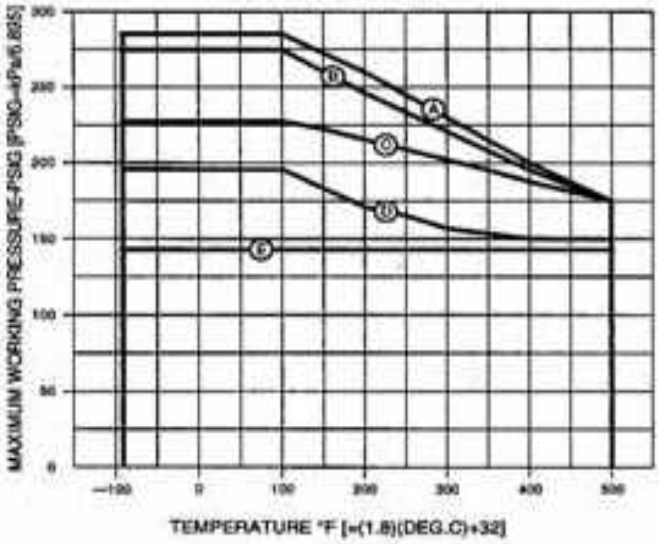


Item #	QTY	Description		Item #	QTY	Description
100	1	Casing		113A	1	Plug, Oil Fill
370	-	Bolt, Casing		370G	6	Bolt, Bearing Cover
358A	1	Plug, Casing Drain		105`	1	Ring, Lantern
101	1	Impeller		134	1	Housing, Bearing
122	1	Shaft		370C	3	Bolts, Bearing Housing
184	1	Cover, Stuffing Box		370D	3	Jack Bolts, Bearing Housing
370H	2	Adapter Studs / Cover		423	3	Jam Nuts, Brg. Hsg. Jack Bolts
423B	2	Nut, Adapter Studs / Cover		361A	1	Snap Ring, Bearing
106	5	Packing		496A	1	O-ring Impeller
126	1	Shaft Sleeve		400	1	Key, Coupling
168A	1	Bearing Inboard		365	1	Seal Mechanical Stationary
250	1	Gland, Mechanical Seal		382	1	Lock washer Bearing
107	1	Gland, Packing		108	1	Adapter Frame
353	4*	Studs / Gland		370B	4	Bolts Frame Adapter
353A	4*	Nut, Gland Stud		469B	2	Dowel Pin / Frame Adapter
112	1	Bearing Outboard		351	1	Gasket / Casing
228	1	Frame		360Q	1	Gasket / Gland
241	1	Foot / Frame		360D	1	Gasket / Frame Adapter
408H	4	Plug Frame Lub. Ports		496	1	O-Ring Bearing Housing
408L	1	Plug Oil Cooler Inlet		383	1	Mechanical Seal Rotating Element
408A	1	Plug Frame Drain		333A	1	Isolator, Bearing Inboard
370F	2	Bolt, Frame Foot		332A	1	Isolator, Bearing Outboard
529	2	Washer, Frame Foot		143	1	Oil Sight Glass
360C	1	Gasket, Bearing Cover				
136	1	Locknut, Bearing		109C	1	Cover, Bearing Outboard
•	• Packing Gland uses only 2 Studs and Nuts					

ANSI PROCESS PUMPS ENGINEERING DATA

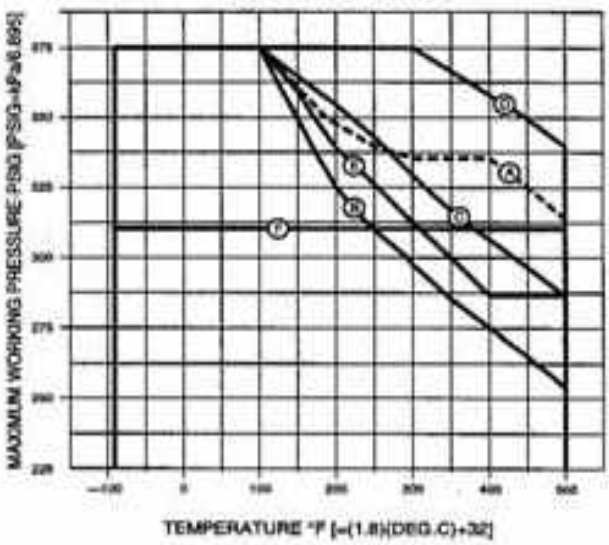
PRESSURE / TEMPERATURE RATINGS

150 LB. FLANGES



CURVE	MATERIAL
A	DUCT. IRON
A	CAST STEEL
A	CD4MCu
A	HAST. B
A	HAST. C
A	TITANIUM
B	316 S.S.
B	317 S.S.
C	ALLOY 20
D	MONEL
E	NICKEL

300 LB. FLANGES

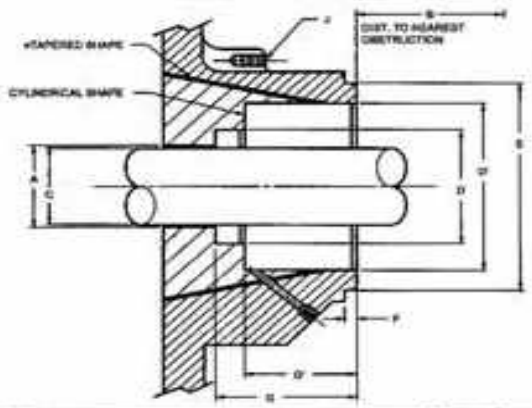


CURVE	MATERIAL
A	DUCT. IRON
A	CAST STEEL
A	316 S.S
A	317 S.S
A	ALLOY 20
A	HAST. B
B	HAST. C
B	CD4MCu
C	TITANIUM
D	MONEL
E	NICKEL

CONTACT FACTORY FOR SUCTION PRESSURES OVER 160 PSIG.

Engineering Data

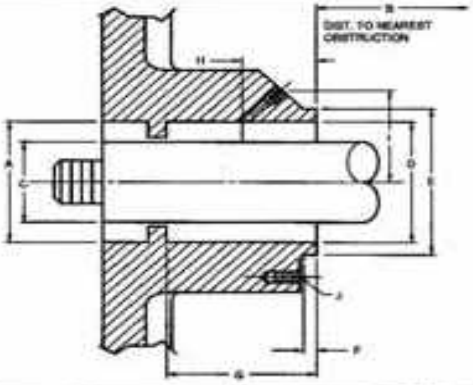
ANSI Seal Chamber Cover Large/Taper Bore



PUMP SIZE	BOX COVER									J			BOX CVR NPT	GLAND NPT
										STUDS		BOLT HOLE CIR.		
	A	B	C	D	D'	E	F	G	G'	SIZE	NO.			
ST	1.400 1.405	2.19	1.373 1.375	1.999 2.003	2.88	3.594 3.597	.19	2.12	1.69	.375	4	4.50	.25	.25
MT	1.770 1.780	2.81	1.748 1.750	2.499 2.503	3.50	4.337 4.340	.25	2.62	2.12	.500	4	5.50	.38	.50
LT	2.145 2.155	2.81	2.123 2.125	2.874 2.878	3.88	4.708 4.711	.25	2.62	2.12	.500	4	6.00	.38	.50
XLT	2.520 2.530	2.85	2.498 2.500	3.374 3.378	4.50	5.447 5.450	.25	3.00	2.50	.625	4	6.75	.38	.50

*TABLE DIMENSIONS: A, D, G AND G' ARE NOT APPLICABLE TO THE TAPERED DESIGN.

Standard Stuffing Box Center



PUMP SIZE	BOX COVER									J			BOX CVR NPT	GLAND NPT
										STUDS		BOLT HOLE CIR.		
	A	B	C	D	E	F	G	H	I	SIZE	NO.			
ST	1.400 1.405	2.19	1.373 1.375	1.999 2.003	2.392 2.395	.19	2.12	.97	1.81	.375	4	3.25	.25	.25
MT	1.770 1.780	2.81	1.748 1.750	2.499 2.503	3.017 3.020	.25	2.62	1.56	2.50	.500	4	4.12	.38	.50
LT	2.145 2.155	2.81	2.123 2.125	2.874 2.878	3.517 3.520	.25	2.62	1.56	2.63	.500	4	4.50	.38	.50
XLT	2.520 2.530	2.85	2.498 2.500	3.374 3.378	4.371 4.374	.25	3.00	1.81	3.50	.625	4	5.38	.38	.50

ORDERING SPARE PARTS

To insure against possible long and costly downtime periods, especially on critical services, it is advisable to have spare parts on hand.

1. **For critical services:** It is recommended that a "back pull-out assembly" be kept on hand. This is a group of assembled parts which includes all parts except the casing and the coupling.
   (a). If pump is equipped with mechanical seal, the following parts should be on hand:
      (1) Stuffing box packing.
      (2) Stuffing box gland.
2. An alternative, though not as desirable as that stated above, can be used on noncritical services. This involves having on hand parts that are most likely to wear and can be used as needed. See list below for these recommended spares.

Recommended Spare Parts

Shaft	Item 122	Bearing Housing Snap Ring	Item 361A
Shaft Sleeve	Item 126	Bearing Lock Washer	Item 382
Outboard Bearing	Item 112	Bearing Lock Nut	Item 136
Inboard Bearing	Item 168A	Impeller	Item 101
Case Gasket	Item 351	Impeller O-Ring	Item 496A
Frame/Adapter Gasket	Item 360	Lantern Ring (packed box)	Item 105
Bearing Housing O-ring	Item 496	Bearing Cover Gasket (TXLT only)	Item 360C

Instructions for Ordering Spare Parts

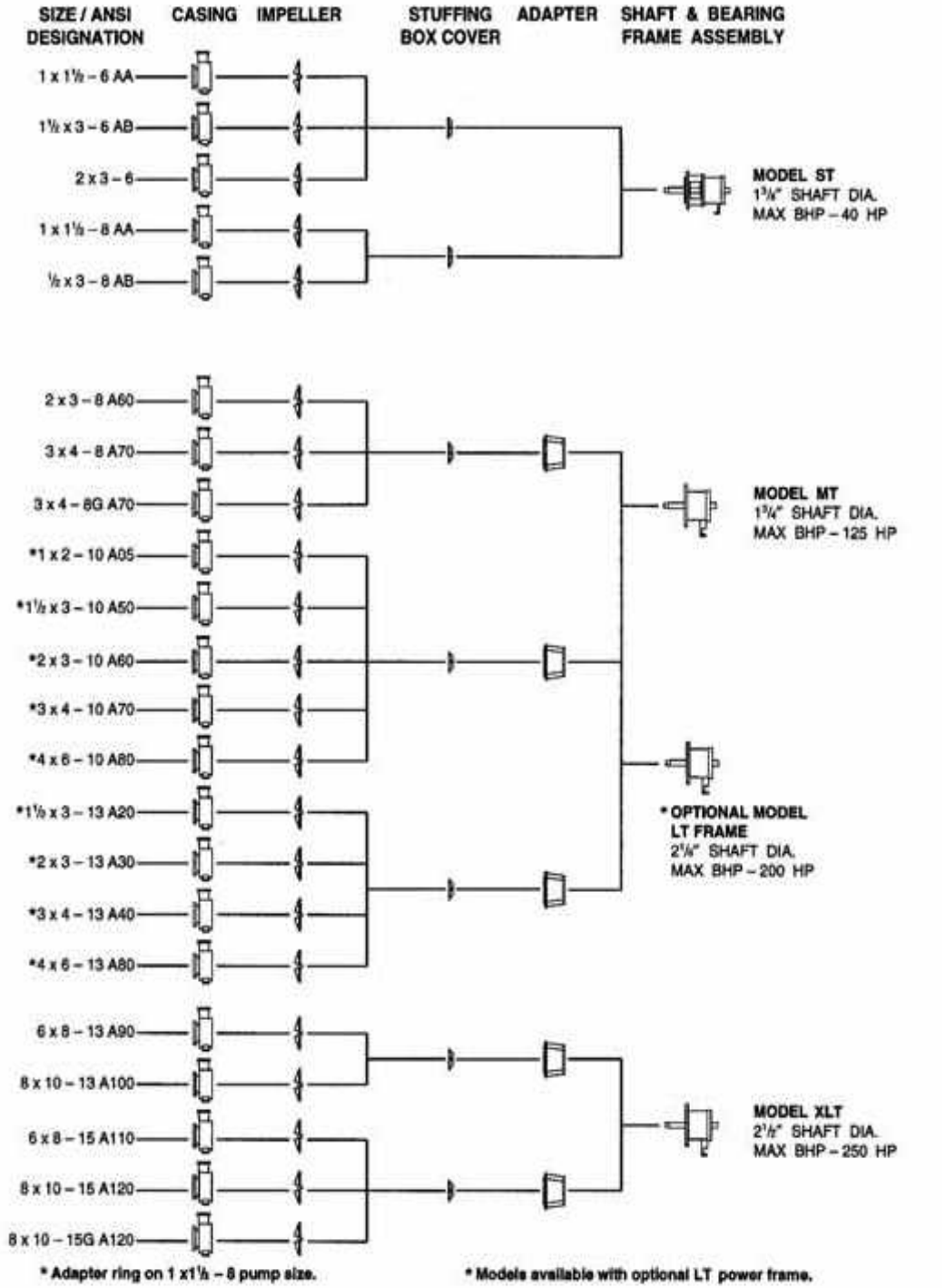
Repair orders will be handled with a minimum of delay. Contact your local authorized representative and provide the following:

1. Give model number, size of pump, and serial number. These can be obtained from the nameplate on the pump.
2. Write plainly the name, part number, and material of each part required. These names and numbers should agree with those on the sectional drawing on pages **33, 34, 35 and 36.**
3. Give the number (quantity) of parts required.
4. Give complete shipping instructions.

NOTICE:

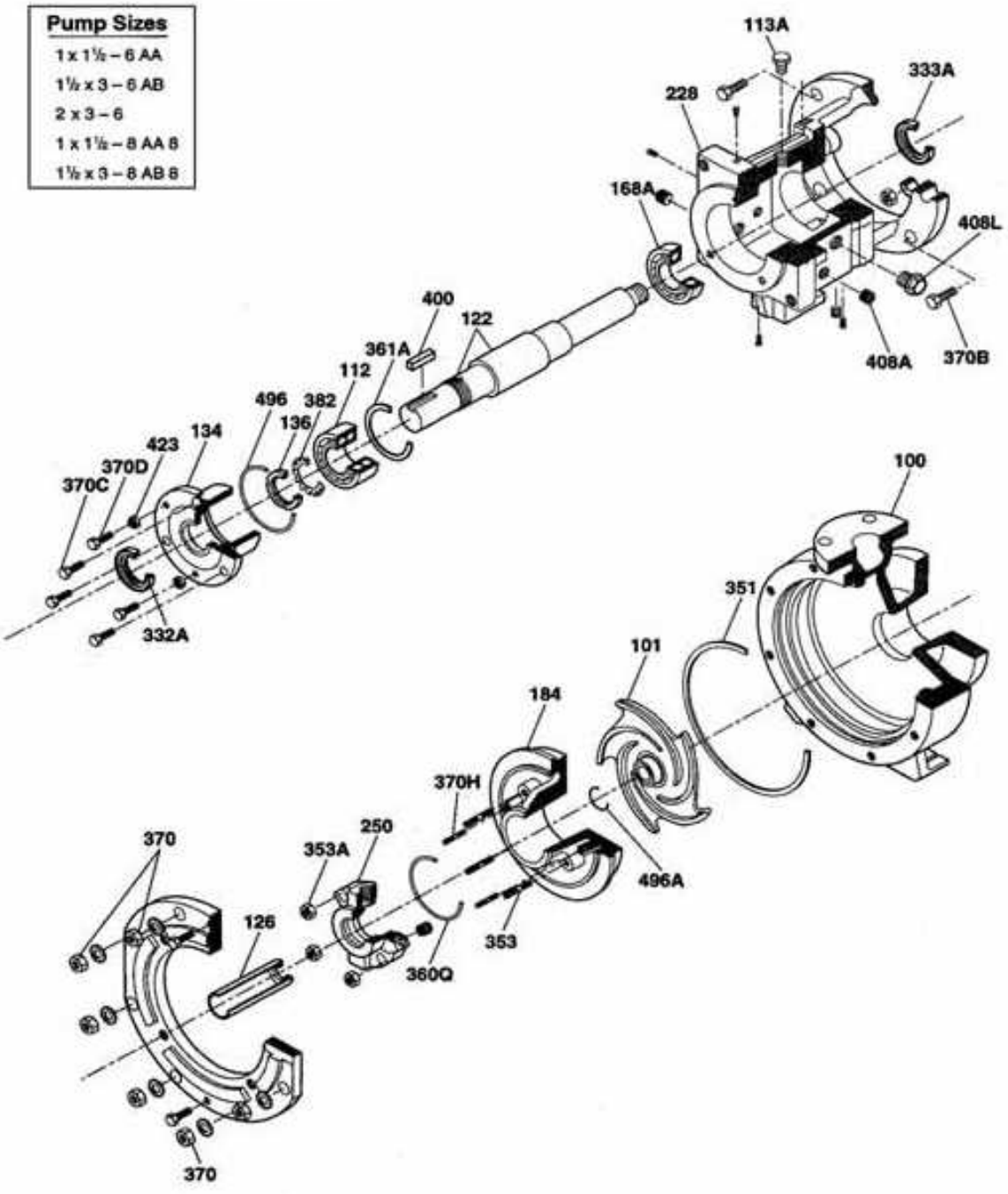
Materials of construction, specifications, dimensions, design features and application information, where shown in this bulletin, are subject to change without notice by **Pinnacle-Flo Inc.**

Modular Interchangeability Chart

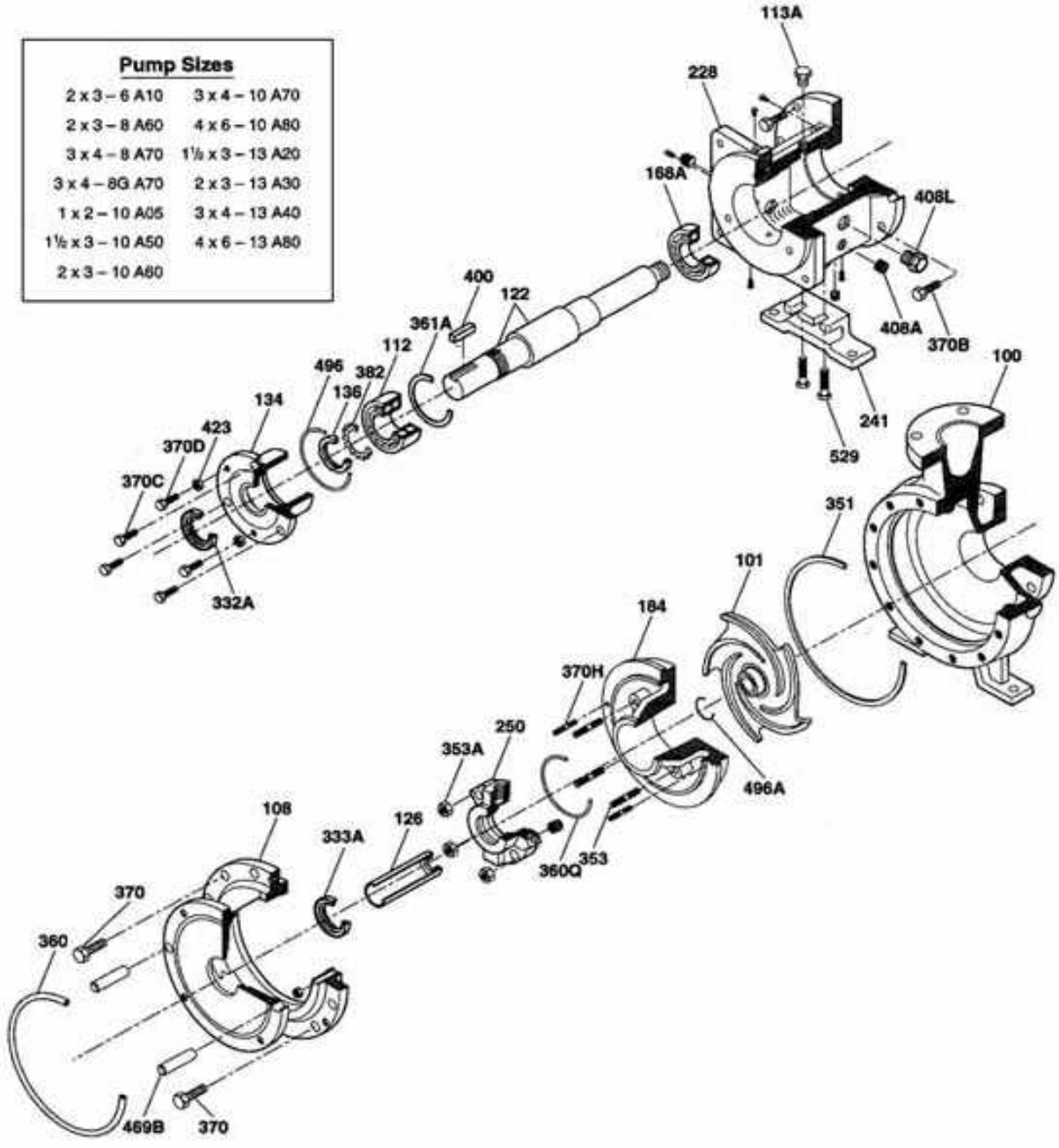


Pinnacle-Flo, Inc.

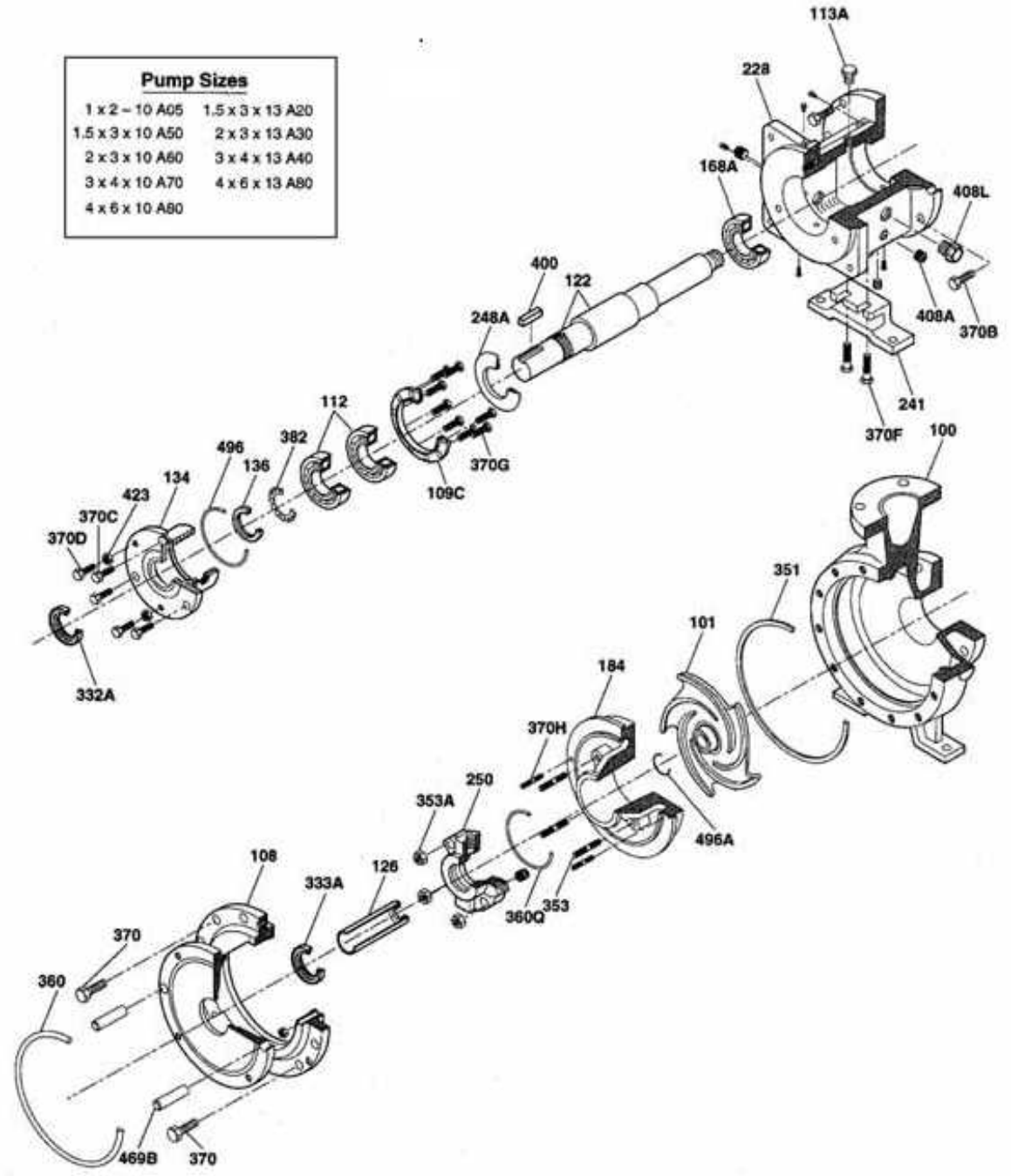
PST Exploded Isometric View



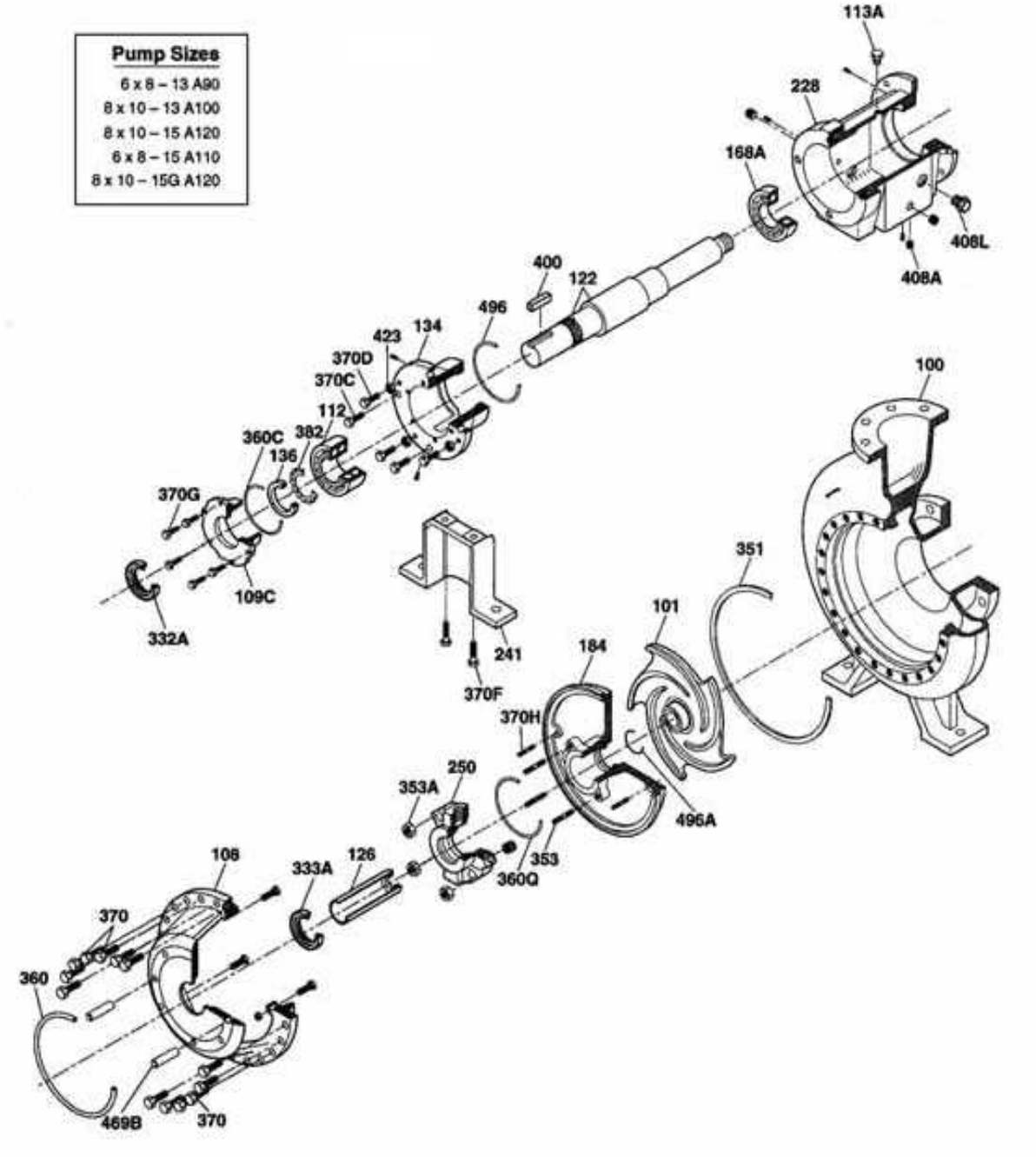
PMT Exploded Isometric View



PLT Exploded Isometric View



PXLT Exploded Isometric View



Notes