TITLE: Estimated Life of Power Pump Wearing Parts

1.0 Scope

The intention of this data sheet is to give **estimates only** of the life of wearing parts on power pumps. It is in no way a guarantee of component life expectancy and is a result of average lives experienced under various conditions in numerous services.

2.0 Variables Affecting Wearing Parts Life

2.1 Power End: speed, load, ambient air temperature, cleanliness of oil, frequency of oil changes, oil quality, presence of shock conditions in piping system and preventive maintenance schedule.

2.2 Fluid End: speed, pressure, pumpage temperature - corrosiveness - abrasiveness, packing lubricant, stuffing box - plunger alignment, junk rings (throat bushing, lantern ring, follower) - plunger clearances, packing adjustment, presence of shock condition in piping system and preventative maintenance schedule.

3.0 Wearing Parts - Estimated Life:

3.1 POWER END

Connecting rod bearings	2 yrs.
Wrist pin bushings	2 yrs.
End/main/pinion bearings	5 yrs.
Oil seals in wiper box	6 mos.
Oil seal on crankshaft	2 yrs.
Gaskets	2 yrs.

3.2 FLUID ENDS

Junk rings	6 mos.
Packing	3 mos.
Plungers	6 mos.
Stuffing boxes	2 yrs.
Valve bodies	6 mos.
Valve seats	1 yr.
Valve springs	1 yr.
Gaskets	Replace when removed.

Wheatley Gaso Inc (*WGI*) pumps are manufactured in accordance with the highest standards demanded by the industry. Proper maintenance and care will prolong the period of satisfactory service, and reduce costs.

These instructions were written to promote the care, operation and maintenance of your pump. When trouble arises outside the scope of this manual, contact your nearest *WGI* Distributor. If they are unable to solve your trouble, please feel free to contact our Marketing Services or Engineering Departments for assistance.

To improve our products, we must be informed of the problems and their solutions which occur in the field. We request that you send us short reports of your experiences. Include the pump model and serial numbers, operating conditions, problems, and the solution, if any.

Forward to:

Wheatley Gaso Inc.
Attn.: Marketing Services
P.O. Box 2069
Tulsa, Oklahoma 74101

Your help will be greatly appreciated!

SERVICE

WGI has an extensive network of authorized distributors who have service personnal available in case of emergency or for a major overhaul. Most of these distributors have also have parts available and can give you the necessary help in service work. We prefer that all service be handled through these distributors; however, in extreme emergencies, *WGI* can dispatch a service personnel.

- This normally will require at least 48 hours notice.

GENERAL

WGI pumps, when properly installed, given good care and regular maintenance, will operate satisfactorily for a long period of time.

The following are GENERAL PRINCIPLES that *WGI* feel should be considered to ensure trouble-free operation.

Storage

All *WGI* pumps are tested, inspected and protected against corrosion only for the period of date of shipment to immediate installation.

- If the pump is either scheduled for export shipment or will not be installed within 2 to 6 months, request copies of our "Short Term Storage Preparation for Pumps" from your nearest *WGI* distributor.

- If the pump will not be installed for more than 6 months, request copies of our "Long Term Storage Preparation of Pumps" from your nearest *WGI* distributor.

Location Of Pump

Locate the pump in a clean, accessible place, so it can be inspected at regular intervals during operation.

- Place the pump as close to the liquid supply as possible and design the suction piping as short and direct to the pump as possible.

- Provide ample head room for cranes or hoists.

Protection Of Pump Against Seepage Or Flood

If it is necessary to place the pump in a pit, provision should be made to protect the pump from water that may come into the pit from ground seepage or a flood.

Provision For Servicing Space

Whether mounted at floor level, on a foundation above floor level, or in a pit, sufficient room should be allowed for inspection & removal of normal wear parts (plungers, packings, rods, etc.) and other recommended procedures in this manual.

Leveling The Unit

Metal blocks and shims or metal wedges having a small taper should be placed close to the foundation bolts. Small jacks made of cap screws and nuts are not convenient or recommended. In either case, the supports should be directly under the areas carrying the greatest weight and spaced close enough to give uniform support with minimum deflection of the total unit.

- A gap of about 3/4" to 1" should be allowed between the base plate and the foundation for grouting.
- Adjust the metal supports or wedges until the shafts or rods of the pump are level.
- On pumps where shaft couplings are used, do not connect the coupling until all pump and driver alignment operations have been completed.
- Check the coupling faces and flanges of the pump for true horizontal and vertical position by means of a level.
- Correct the positions, if necessary, by adjusting the supports or wedges, as required.

Foundation

Pumps can be located on the floor or supporting surface, provided that the supporting installation area is sufficiently strong to support at least 150% of the total unit weight, including driver.

Pump foundations should be a reinforced concrete, mix of 1:2:4 ratio (cement, fine aggregate and course aggregate respectively), and rest on hard pan ledge or piling, at approximately 12" above the surrounding floor level. It should be entirely independent of walls or footings, building supports or floor structures. Proper concrete mixture, correct reinforcements, sufficient mass and satisfactory footing are essential to give rigid, permanent support to prevent vibration. The bearing pressures allowed on soil vary widely and depend on the underlying nature of the soil, local & company construction codes, etc. This data, available in engineering handbooks and manuals, should be carefully investigated prior to final construction.

Foundation Bolts

Locate the foundation bolts according to the complete pump unit elevation drawing.

- Set each bolt in a sleeve 2 to 3 times the bolt diameter to allow for variation in pump parts or base plates.
- The sleeves should be held rigidly yet allowing the bolts to be moved.

NOTE
Do not fill the sleeves with grout until the entire unit has been accurately aligned, supported and leveled.

- The frame or base plate when so designed should be completely filled with grout. Holes are then provided to serve as filling and vent holes.

CAUTION

Do not leave leveling pieces, shims or wedges in place if grout shrinks while hardening. If leveling screws are used, back them off after grout has hardened.

- Foundation bolts should not be finally tightened until the grout has fully hardened, usually not less than 48 hours after pouring.

PIPING

General

The design of reciprocating pump piping systems should include the evaluation of fluid pulsations since the majority of pump cavitation, high vibration, trim life, and other problems are due to high pulsation levels that are caused by the interaction of reciprocating flow with acoustical resonances in the piping. Reciprocating pump piping systems have a large number of acoustic natural frequencies that are dependent upon the lengths and diameters of the piping layout and the speed of sound in the liquid.

The piping system acoustical resonances and the resulting pulsation levels from the pump excitation can be predicted by either digital or analog simulation techniques. These techniques can be used to evaluate pulsation control devices (dampeners or accumulators) and to develop piping systems that will control pulsations and vibrations. WGI recommends that such analyses be performed in the design stage for critical pump systems, especially multiple pump or large pump systems to prevent; cavitation, high pulsations, vibrations and related failures ranging from reduced liquid end wear trim life to catastrophic power end components.

Since the design of entire piping systems in which the reciprocating pump operates is normally beyond the scope of WGI responsibility, we cannot be responsible for the accuracy and/or the recommendations of any acoustical analyses of the piping systems performed by others. In addition, many other factors such as insufficient net positive inlet head/pressure available to the pump, inadequate supports or poorly designed piping systems could cause servere damage to the pump and/or piping and are beyond our control. It is recommended that the customer consult specialists in the acoustical design of piping systems to supplement and interpret WGI information to ensure a successful installation. Any suggestions offered by WGI are strictly offered as guidelines to help point out those items that must be considered in the design and layout of reciprocating pump piping systems.

The following recommendations are based on several industry standards and WGI general experience.

- Pipe flange connections must line up naturally and must not be forced into place with flange bolts. This can either force the pump out of alignment or induce high stress loads & moments throughout the pump.

- Piping runs should be supported independently of pump to prevent any strain.

- Suction and discharge piping must be rigidly fixed in all directions and not just lightly strapped down.

NOTE

Variations in flow and pressure, changes in direction of flow, cavitation, worn plungers, leaking packing, failing pump valves, etc., all contribute to piping vibration.

- Flush, clean and blow out all piping before connecting to pump.

- Use pipe dope and tape sparingly, and only on the male thread connections.

- After the piping is installed, the pump driver and speed reducer alignment should be rechecked and corrected as required.

Suction Piping

The suction piping system should provide an available pressure that exceeds the sum of the; 1) net positive suction pressure/head required by the pump, 2) all piping system friction losses, 3) acceleration head and 4) the negative peak of the complex wave pulsation at the plungers.

NOTE
Cavitation is most often caused by the detrimental effects of pulsations in the suction piping system. Additional suction pressure/head may be required if the liquid contains dissolved gases.

- The suction piping should be direct, free of bends, and as short and direct as possible to the pump.

- All required bends or turns should be either long-radius 90^{o} or 45^{o} elbows.

- The piping should be hydrostatically tested to ensure no welds or joints are leaking.

NOTE
An air leak in the suction piping, especially where a lift is involved, will seriously affect the pump capacity.

- Adequate provisions should be made for anchoring and supporting the piping spans.

- The suction pipe diameter must be at least the same size, ideally larger, as that of the reciprocating pump suction.

- The piping should be routed without high spots and have a continual upward rise toward the pump.

- All valves in the suction piping system should have flow areas equal to or greater than the inside pipe area.

- A full-opening block valve should be conveniently located in the suction piping for isolation of the pump during servicing.

- Positive suction pressure, from gravity or booster (charge) pump, is always desirable.

- If a booster pump is necessary, it should be installed as close as possible to the liquid source. The capacity of this pump should be in excess of the reciprocating pump capacity.

CAUTION
Improper selection or location of the booster pump can result in increased pulsations and associated problems.

NOTE
Where a suction lift is involved, consult *WGI*. It is important to ensure that there are air leaks since the resulting effect is decreased pump capacity.

- Where a booster pump is used to deliver liquid to the reciprocating pump suction, the piping from the liquid source to the booster and from the booster to the pump suction should never be smaller than that of the reciprocating pump suction.

Discharge Piping

To facilitate starting, and to eliminate air, a vent or by-pass valve should be installed close to the pump discharge. To further protect the pump, a block valve and check valve should also be integrated into the piping installation.

- If the piping size is increased, it should be located between the check valve and pump.

NOTE
Piping vibration can be minimized with piping run as short and as direct as practical. When a change in direction is required, 45° long radius bends in the pipe itself or 45° long radius elbows & tees should be utilized.

- Dead ends connections must be avoided if at all possible. Hydraulic systems, using quick closing valves or similar mechanisms, must provide some means for absorbing the shock resulting from the sudden opening or closing of valves.
- Adequate provisions should be made for anchoring high pressure piping and components (eg: dampeners, etc.).

Flange Fittings

Flange fittings, unions and flexible connectors should be located close to the pump in all pipe lines, to facilitate complete pump or liquid end removal..

- Alignment must be rechecked after suction and discharge piping have been bolted to the pump, to test the effect of piping strains.

CAUTION
When handling hot or extremely cold liquids, disconnect the nozzle flanges after the unit has been in service to check the direction in which the piping expansion is acting. Correct for strain effect, as required, to obtain true flange alignment.

ACCESSORIES

Pressure Relief Valve (PRV)

The use of a discharge Pressure Relief Valve (PRV) of suitable size for the full rated capacity of the pump, set to open at a pressure above the operating discharge pressure required of the pump, is mandatory because of the safety it affords.

Full opening, pilot operated, and shear pin PRV's, or burst discs, require little or no over-pressure to develop fully open flow capacity, and are often preferable to spring loaded PRV's.

- The PRV should be installed in the pump discharge piping, as close to the pump as possible and before of any other valves.
- The outlet from the PRV will ideally be directed to the supply tank. In cases where this is not practical, and must directed back to the pump suction line, the return point should be at least 15 pipe diameters from the pump suction.
- The line size from the PRV outlet to the tank, or suction line, must be at least the same size the PRV outlet. Calculate all pressure drops in this line, based on full pump flow, when sizing the PRV. Where possible, pipe the PRV outlet so that any leakage can be observed.
- Always install a liquid-filled pressure gage, with snubber valve, ahead of the PRV so it reads the true pump pressure while relieving.

CAUTION
If the plunger size is either reduced or increased, the PRV setting must be altered accordingly.

Spring loaded type PRV's have a *set pressure* that is defined as the pressure that the valve begins to open and allow some flow to pass through to a lower pressure. As the pressure increases above the set pressure, the valve will gradually increase its through port area until it is fully open. Once this fully open position is reached, it must have sufficient capacity to relieve the full capacity of the pump to which it is installed.

Spring loaded PRV designs differ between various manufacturers and the extent of over-pressure needed to fully open the valve will vary. This range is generally 10% to 25% above the *set pressure* depending on spring design. By choosing a larger valve this increase may be reduced.

NOTE

If a spring loaded PRV has a *set pressure* that is too close to the average discharge pressure, the valve may slightly leak (crack) due to normal pump pulsations. This leakage will quickly ruin the PRV seat and this condition should be immediately corrected.

The PRV *set pressure* will vary due to the reciprocating pump type and can be reduced if a pulsation device is properly installed & operating.

Double-Acting

Type Pump	PRV Set Pressure
Duplex	Operating Pressure + 25%

Single-Acting

Type Pump	PRV Set Pressure
Simplex	Operating Pressure + 25%
Duplex	Operating Pressure + 20%
Triplex	Operating Pressure + 15%
Quintuplex	Operating Pressure + 10%

CAUTION

The PRV set pressure should never be more than 10% above the piston or plunger maximum pressure rating.

Foot Valve

When operating on a suction lift, the suction line must include a foot valve in order to keep liquid in the pipe once the pump is primed.

- The net area of the foot valve should equal or exceed the area of the suction pipe.

Strainer

To protect the pump from foreign matter, a suction strainer may be installed.

CAUTION

A clogged strainer will result in pump cavitation and serious damage.

- It should have a net area three or more times the area of the suction pipe.
- It strainer should be freely accessible for frequent inspection or cleaning to maintain a flow area exceeding the suction pipe area.
- A liquid-filled pressure gage, with snubber valve, should be installed near the pump in the suction line. If the pressure falls below the original start-up pressure, the strainer must be inspected.
- Where a suction lift is involved, either a combination pressure & vacuum or absolute pressure type gage must be used.

Pulsation Dampeners

A good suction and discharge pipe layout for conventional reciprocating pumps frequently require no devices to compensate for normal variations in velocity of flow in the piping system. However, in some piping systems, especially multiple pump installations, there can be considerable pulsations that are generated due to the system acoustical natural frequencies and pulsation devices are necessary.

- To prevent mutually enforcing pulsations in multiple pump installations, each pump should be provided with separate piping runs from the liquid source to the pump suction rather than connecting each pump to a common manifold.

- If manifolding is necessary, it should have a cross-sectional area equal to or greater than the sum of the cross-sectional areas of all the suction lines to each individual pump.

- The design or selection of the pulsation control device, dampener or accumulator, should be based on the; pump type, pump stroke & plunger size, pump speed, liquid properties, liquid pressures, ambient & liquid temperatures, and layout of the piping system.

- The pulsation device best suited to control pulsation in the piping system should be determined from analysis of the acoustical characteritics of the entire pump piping system - including all of the interconnected pump systems.

- Recommendations as to size and type of dampening devices should be obtained from the device manufacturer.

NOTE

Be sure to provide full information on the piping installation. Without complete knowledge of the piping, it is not possible to determine the size and pre-charge of dampeners. Dampening devices should be considered as a part of the piping system, rather than as a pump accessory.

- If pulsation devices are used, they should be installed as close as possible to the pump and considered as part of the piping system not as a pump accessory.

- If bladder type pulsation devices are used, that require charge pressures which are a function of the line pressure, provide access for checking & charging with nitrogen (or other similar inert gas) in accordance with the manufacturers recommendations.

NOTE

In multiple piping systems, the effectiveness of charged bladder devices can be compromised unless they are optimally tuned. Therefore, the use of acoustically tuned all-liquid filters should be considered and may be necessary for satisfactory piping system operation.

Gaskets, Pipe Dope And Pipe Tape

The gaskets, pipe dope and pipe tape used in the piping system are exposed to the same conditions of high or low temperature, pH values, etc., as the pump parts. Their careful selection is necessary to avoid joint failure.

V-Belt Drives

V-belt drives must be properly aligned and maintained. The driver and driven shafts must be parallel, and the V-belts aligned at right angles to these shafts via the sheaves. Misalignment will cause excessive belt wear and can cause the belts to turn-over in the grooves.

- Alignment can be checked by placing a straight edge evenly across the rims of both sheaves.

- If the face of the sheaves are not of equal width, the alignment can be checked by resting the straight edge across the rim of the widest sheave and measuring the distance from the straight edge to the nearest belt groove with a scale. Adjust either sheave on the shaft to equalize these dimensions.

- The driver (motor, engine, etc...) should be mounted with adequate provision for belt center distance adjustment. Provide a minus adjustment allowance for belt installation without stretching and a plus adjustment allowance for belt take-up & wear.

CAUTION

Do not pry, twist, or force the belts over the sheave grooves. This will damage the belts and greatly reduce belt life. Shorten the drive by moving the driver enough to permit fitting the belts in the proper grooves.

- When the belts are in place, increase the centers until proper belt tension is obtained. See the normal tension for the slack side of the belt.

NOTE

During the first few days of operation, the belts will seat themselves in the grooves, and must be retightened.

- Keep belts clean and free from oil. Clean oily belts with a cloth dampened with soap and water. There should be free air circulation around the drive to prevent excessive heat that reduces belt life.

CAUTION

Never install *new* belts on the same drive with used belts. Do not use sheaves with chipped or worn grooves.

CAUTION

For hazardous locations static conducting belts should be used.

- Consult V-belt manufacturer's tables and data for recommended V-belt cross-sections and belt length.

- When purchasing replacement V-belts, the same size and type should be ordered as originally furnished.

- Slipping belts will result in lower capacity. Check pump speed with a tachometer. It should equal driver speed multiplied by driver sheave pitch diameter divided by pump sheave pitch diameter. Squealing or smoking belts are often the clue to slipping belts, but not always.

GENERAL

The following maintenance instructions for this pump are intended to serve as an initial guideline only based on average usage and mean operating conditions.
Additional checklist items or inspection interval changes should be recorded in the individual pump service logs. Also, some components may even be scheduled for replacement at predefined intervals to prevent their more expensive emergency replacement.

LUBRICATION OIL

The power end lubricant/oil for this *WGI* model will vary based on the ambient operating temperatures and is specified as shown.
If possible, inspect the oil level & color daily.

- Ambient = -15°F to 31°F (-26 °C to 0°C)

Viscosity Grade	Kinematic Viscosity
AGMA EP 3	95.0 cSt @ 40°C
ISO 100	11.0 cSt @ 100°C

- Ambient = 32°F to 125°F (0°C to 52°C)

Viscosity Grade	Kinematic Viscosity
AGMA EP 4	142.0 cSt @ 40°C
ISO 150	14.4 cSt @ 100°C

- Ambient = 126°F & Up (52°C & Up)

Viscosity Grade	Kinematic Viscosity
AGMA EP 5	209.0 cSt @ 40°F
ISO 220	18.8 cSt @ 100°F

NOTE
The prefix EP denotes *extreme pressure* additives, either active or passive, that inhibit welding, scuffing and tearing at metal contact interfaces.

Numerous factors effect and determine regular and chance oil change intervals. The most frequent is contamination, either due to operating or environmental conditions. When contamination occurs, drain the oil immediately, thoroughly flush & clean the entire power end with kerosene, and refill the crankcase.

- **Water** *from oil seal, wiper seal, breather cap or gasket leakage.*
- **Solids** *from initial break-in as a result of first use as a new or rebuilt power end.*
- **Dust, Sand or Dirt** *from air-borne sources through the shaft and wiper seals or breather cap.*
- **Corrosives** *from pumpage liquid, vapor or gases through the wiper box seals, crankshaft seals or breather cap.*

INSPECTION INTERVALS

DAILY or Every 24 Hours of Operation

- Normal power end and liquid end operating conditions ~ *temperatures, quiet and smooth operation*
- Crankcase, packing lubricator and, if applicable, gear reducer ~ *oil levels*
- Power end and fluid end gaskets ~ *leakage*
- Packing and gland nuts snug ~ *excessive leakage or unsuitable materials*

CAUTION
Always perform all inspections/checks of components in the cradle area (gland nuts, wiper box bolts, etc.) with pump off and driver disabled.

- Cradle area ~ *clean and properly draining*
- V-belts ~ *squeeling or slipping* or drive couplings ~ *oil or grease leakage*
- Liquid end operating pressures ~ *not above specified nameplate values*

- All fasteners torques ~ *secure & proper*, especially power end to liquid end & bearing housings ~ *leakage or movement*

CAUTION
Always perform all fastener torque checks with pump off and driver disabled.

NOTE
Pumps with power end pressure lubrication to be above 25 psig at normal operating temperature.

- Packing lubricator pumps ~ *all functioning, delivering proper drip rate*

WEEKLY or Every 170 Hours of Operation

- Crankcase and gear reducer lubrication ~ solids and/or liquids contamination. Sample oil from drain connection(s) while the pump is running

NOTE
If the pump is either new or has received a major over-haul (replaced; shell bearings, wrist pins & bushings, center main bearings, end main bearings, etc.) the oil should be changed at this interval. Prior to adding new oil, the crankcase cover should be removed and all interior surfaces wiped clean. Check all connecting rod bolt torques and clean the oil filter before replacing the crankcase cover.

- All strainers, foot valves and any other suction line piping components ~ *free of restrictions and in proper working order*

- V-belt ~ *tension* and drive coupling ~ *bolts & joint secure*

- Plungers and pony rod ~ *connections tight*

MONTHLY or Every 750 Hours of Operation

- Crankcase breather screen (clear and free of debris).

- Lubricator lines and connections ~ *leaks and crimps*

QUARTERLY or Every 2250 Hours of Operation

- Power end ~ *change oil*

- Oil filter element ~ *clean in kerosene or replace*

- Crankshaft oil seals ~ *leakage, free of paint, cracked or weather checked, excessive heat*

SEMI-ANNUALLY or Every 4500 Hours of Operation

- Drive couplings ~ *lubricate and, if applicable, check seals & bolt torque's*

- Valve disc/body and seat sealing surfaces ~ *excessive wear, pitting, wire drawing and solids imbedding*

- Valves springs ~ *broken, compressed or worn*

- Plungers and, if applicable, pony rods ~ *scored, worn or damaged*

- Wiper box seals/packing to include wiper box o-rings ~ *leakage either from or into power end crankcase*

- V-belts ~ *excessive wear or cracking*

ANNUALLY or Every 9000 Hours of Operation

Schedule disassembly & inspection of complete pump, concentrating especially on:

- Crankshaft Pin ~ *surface finish & within dimensional size*
- Crankshaft end main & center main bearings ~ *pitting, scoring, or rust*
- Wrist pins & wrist pin bushings ~ *wear, scoring, heat marks or dimensional size*
- Power end pressure lube pump ~ *internal moving parts wear, or shimming*
- Plungers and pony rods ~ *finish, scoring, dings or dimensional size*
- Wiper Box Seals and O-rings ~ *leakage, wear, or damage*
- Stuffing box packing ~ *leakage, wear, or damage*
- Stuffing box spring, if applicable ~ *wear or breakage*
- Stuffing box metal/non-metallic trim (throat bushing, follower, adapters, etc.) ~ *wear, corrosion or erosion*
- Valve insert, if applicable ~ *wear or damage*
- Valve body & seat ~ *sealing bevel wear or damage*
- Liquid end gaskets & seals ~ *leakage, tears, wear or damage*

LIQUID END

Refer to Liquid End parts list drawing ***B115948*** *for the referenced item descriptions and their locations.*

Discharge Valves ~ Wing-Guided

Removal

The discharge valves are each located just under the valve cover in the common discharge manifold of the liquid end body.

- Remove all the nuts from the studs followed by the lifting up & sliding off of the valve cover over the studs.

NOTE:
Inspect the valve cover O-ring at this time for damage (unraveling, rips, tears, pinching, etc.) and replace of required.

- Next remove the valve retainer by loosening & unthreading it from the seat and removing it from the chamber.

- Next remove the spring, followed by the body itself.

NOTE:
Replacement of the retainer, spring, or body can be accomplished without removing the seat. When removing the discharge valve seat for replacement, be careful not to damage the liquid end tapered deck seating surface.

- If pulling of the seat is required at this time, position the puller head into and through the seat, followed centering the threaded puller stud through the hydraulic cylinder & top puller plate.

- Thread on and hand tighten the puller nut.

- Apply hydraulic cylinder pressure until the seat is broken loose and can be removed.

NOTE
Inspect the liquid end seat taper for wear or damage. Gage the taper with the seat plug to ensure the stand-off is still within specified limits.

Installation

NOTE
Taper surfaces must be **Clean and Dry!** Use solvent or diesel fuel to flush clean, then wipe dry with a clean lint-free cloth before installing each seat.

CAUTION
Never drive the complete assembled valve into position. Install each component separately, beginning with of the seat.

- Drive the seat firmly into the liquid end, followed by installation of the body, spring and retainer.

- Torque the retainer to 35 ft-lbs.

Suction Valve Removal & Installation

Removal

Access to any portion of the suction valve assembly requires the removal the complete discharge assembly first.

- Rotate the pump until is in its full back position and stop rotation after beginning plunger forward stroking.

- Remove the discharge valve assembly before proceding further.

- Next remove the retainer by loosening & unthreading it from the seat and removing it from the chamber.

must be changed when excessive leakage occurs.

NOTE
Removal of the stuffing box, with the packing & plunger, is recommended whenever packing rings need to be replaced.

- Loosen the gland nut and remove the plunger from the stuffing box.
- Remove the complete packing set (top adapters, V-rings, bottom adapter, spring & bushing), follower and bushing. Inspect all these items, except the V-rings, for excessive wear or damage and replace if

nut loose until stuffing box is bolted into position and the plunger is made up tight to the pony rod.

NOTE
The threaded joints between pony rod-to-crosshead and plunger-to-pony rod must be as tight as possible with a 12" pipe wrench.

- Tighten the gland nut fully into the stuffing box.

NOTE
During priming of the pump the plungers must be manually lubricated until the full back-plunger drip lubrication rate is seen

- Next remove the spring, followed by the body itself.

NOTE:
Replacement of the retainer, spring, or body can be accomplished without removing the seat. When removing the suction valve seat for replacement, be careful not to damage the liquid end tapered deck seating surface.

- If pulling of the seat is required at this time, position the puller head into and through the seat, followed centering the threaded puller stud through the hydraulic cylinder & top puller plate.
- Thread on and hand tighten the puller nut.
- Apply hydraulic cylinder pressure until the seat is broken loose and can be removed.

NOTE
Inspect the liquid end seat taper for wear or damage. Gage the taper with the seat plug to ensure the stand-off is still within specified limits.

Installation

NOTE
Taper surfaces must be **Clean and Dry!** Use solvent or diesel fuel to flush clean, then wipe dry with a clean lint-free cloth before installing each seat.

CAUTION
Never drive the complete assembled valve into position. Install each component separately, beginning with of the seat. Drive it firmly into the liquid end, followed by installation of the body, spring and retainer.

- Drive the seat firmly into the liquid end, followed by installation of the body, spring and retainer.
- Torque the retainer to 35 ft-lbs.

Plungers
This pump is equipped with two-piece type plungers, separate plunger & pony rod, that can only be removed through the cradle area.

Removal
Rotate the pump crankshaft until the threaded joint between the plunger and pony rod is centered in the cradle.

NOTE
Use a pipe or chain wrench only in knurled surface areas and always handle the plunger carefully. Any nicks in the main body of the plunger or pony rod will cause prompt & frequent packing or oil seal failure.

- Unscrew plunger from the pony rod and push it forward into the stuffing box.
- Remove the baffle disc from the pony rod only if the pony rod is to be removed.
- Unscrew the pony rod from the crosshead and remove it through the cradle area.
- Unbolt and remove all the stuffing box clamp ring bolts and remove the clamp ring from the cradle.

NOTE
Each clamp ring contains two threaded holes for jack-bolt removal. Each bolt/cap screw should be at least 8" long and with at least 6-1/2" of full 5/8"-11 UNC thread.

- Pull and remove the complete stuffing box, with plunger still installed, from the cradle.

NOTE
Inspect the stuffing box O-ring at this time for damage (unraveling, rips, tears, pinching, etc.) and replace of required.

POWER END

Refer to Power End parts list drawing ***2-14091*** *for the referenced item descriptions and their locations.*

Crankshaft

The crankshaft is typically removed through the drive extentsion side bearing housing opening, ***see FIG. 1***.

- Remove the connecting rod cap and push the remainder of the connecting rod assembly forward all the way.
- Remove the crankshaft bearing housings by removing all cap screws.
- Using two of the housing cap screws as jack screws, retract the bearing housings by threading through the bearing housing flange against the pump frame.

CAUTION
The crankshaft should then be free for well supported removal through either bearing housing opening.

End Main Bearings

- Adjustment of the crankshaft end bearing end-play accomplished by using varying quantities & thicknesses of bearing gaskets (1/32", 1/64", and .005" ~ see **Fig. 1**).
- The correct end-play is reached only when the bearing housing cap screws are evenly torqued. The measured end-play must be within the following range:

HP600	0.008"/0.010"

- To remove the bearings, the crankshaft must be removed first. The *old* bearings may be pulled from the crankshaft and the outer race from the bearing housing by use of a bearing puller, ***see Fig. 2 & Fig. 3***.
- Expand bearing inner race (cone) onto the crankshaft by heating it in hot oil at 300/350^{o} F.
- Drop or slide the bearing over the shaft journal, then seat and hold it into position using a pipe sleeve or asbestos gloves.
- Install the outer race/cup into the bearing housing by hydraulic press, fitting it in until bottomed out.

CAUTION
Check the outer race to see that there is no slippage in the bearing housing. If slippage or rotation is present, the bearing housing should be replaced. Races must solidly abut the adjacent shaft or housing shoulder.
Never use a direct flame on races or rollers as uneven heating will cause distortion.

- Crankshaft Journal Diameter:

End Main Bearing	6.8795"/6.8770"

Center Main Bearings

This pump has cylindrical roller anti-friction center main bearings. They do not require adjustment.

- To remove the center cylindrical roller bearings, first remove the crankshaft. The *outer race* for these bearings, which include the cage & rollers, are tap fit into the power frame and each are retained by four flat washers and bolts.
- Removal direction is out toward the bearing housing bore. The *inner race* is expansion fit onto the crankshaft.

NOTE
Careful oxy-acetalyne torch heating or cutting for removal is customary.

- Heat the new *inner race* in hot oil from 300° F to 350° F and slide each to the crank stop shoulder.

- Crankshaft Journal Diameter:

  Center Main Bearing 13.0074"/13.0064"

Shell Bearings

The connecting rod shell bearings are precision split-flanged shim-adjustable type.

- Measure the total diameter clearance between the crank pin & shell bearing using "plastigage".

- Remove shims from both sides until a total oil clearance of 0.006" is reached.

NOTE
Properly torque the connecting rod bolts prior to each measurement.

- Undersized shell bearings also available for crank pins that have been ground undersize:

SHELL BEARING	PART NUMBER	CRANK PIN DIA.
1/32" Undersize	001-017594-999	5.469"/5.468"
1/16" Undersize	001-017593-999	5.438"/5.437"
1/8" Undersize	001-021070-999	5.375"/5.374"

Connecting Rod & Crosshead Assembly

This assembly is removed through the crankcase end of the pump, ***see Fig. 4***.

- Remove of the plungers & pony rod, crankshaft, and bearing housings.

- Pull the connecting rod & crosshead assembly out through the back of the pump.

NOTE
The punch marks/dots on each rod & cap identify the position in which the rod assembly is used. They are typically numbered beginning from the crank drive extension side.

- Reassemble each cap to the appropriate rod immediately after assembly removal.

NOTE
The rod & cap are matched and are also number punch identify proper matching.

Wrist Pin

The wrist pin is made from precision ground, case hardened, bearing quality carbon steel. It is press-fit into the crosshead and includes a woodruff key to prevent its rotation.

Wrist Pin Bushing

This bushing is recommended for all normal suction head conditions, ***see Fig. 4***.

CAUTION
Before attempting to remove the bushing, remove the roll pin located in the gun drill bore of the connecting rod.

- Before replacing this bushing, dimensionally check the connecting rod bore.

- Press-fit the bushing into the connecting rod, check and (if needed) hone to size.

- Reinstall the roll pin to a position the same as the internal oil groove and below the bore diameter.

Crankshaft Pressure Lubrication System

The pressure lubrication for this model is provided by an integral positive-displacement rotary-vane pump driven, driven by the reciprocating pump crankshaft, ***see Fig. 5***. Its vane pump shaft is slotted and coupled to the crankshaft by a precision press-fit oil pump pin. The lubrication pump is mounted inside the lube side bearing housing. Also located on the bearing housing is the oil pressure relief valve assembly and oil pressure switch-gage.

The lubrication pump pulls oil from the bottom of the crank case, through the 25 micron filter located in the power end crankcase, into the suction chamber, across the lubrication pump vanes, and into the crankshaft gun drilling. The oil pressure relief valve by-passes all excess flow back into the crank case area.

Since the oil pump is driven directly by the crankshaft, the oil pressure will vary with the speed of the reciprocating pump , the lubricant type and ambient & operating temperature. The normal operating pressure is from 25 to 40 psig, with an absolute minimum 15 psig.

NOTE
When the reciprocating pump is first started, the pressure may be as high as 70 to 90 psig.

CAUTION
Do not attempt to change the pressure, unless it is too low, until after the pump has reached a steady operating temperature at normal conditions.

In the event of lossed oil pressure;

- Check the oil filter ~ *ensure it is clean and not restricted*
- Inspect the oil pump by removing the lubrication pump cover cap screws & cover. Slide the pump from the bearing housing ~ *inspect the pump vanes, idler gear & vane spring for wear or damage and replace if required*

NOTE
The vane spring is also serves as a reversing lock and should allow the oil pump to be rotating in either direction.

- Measure the lube side bearing housing bore, for both the lube pump gear & shaft.
- Reinstall the oil pump and measure from its outer face to the bottom of the shim gasket face in the bearing housing. Add or remove enough shims to result in a clearance, between the oil pump face and oil pump cover, of 0.001" to 0.002".
- Replace the cap screws and torque each to 15 ft-lbs.

Wiper Box Assembly

Component Removal & Installation

In order replace the gland nut oil seal, the plunger & pony rod connection must be loosened & separated.

- Unthread & remove the gland nut, drive out the old oil seal and tap in the new oil seal with the lip of the seal facing toward the liquid end/stuffing box, ***see Fig. 6***.

In order to replace the wiper box seal, removal of the pony rod is required. Remove the baffle disc, loosen & separate the pony rod from the crosshead, and remove the pony rod.

- Remove the follower, followed by the old seal.
- Clean the wiper box bore and install the new seal, with the black seal lip toward the crosshead, after liberally lubricating with it oil.

- Reinstall the follower, fully screw the gland nut onto the wiper box and tighten the nut with the special wrench provided with the pump.

- Liberally oil the pony rod before carefully sliding it through both seals.

CAUTION
Take care not to reverse roll the lip on the gland nut oil seal during reassembling.

NOTE
Worn, pitted, or scored pony rods must be replaced to avoid damaging the new seals and to retain and protect the crankcase lubricant during pump operation.

- After screwing the pony rod into the crosshead, apply as much load as possible using a 12" or 16" pipe wrench.

CAUTION
DO NOT use a cheater bar/extension tube. This will apply too much torque to the threaded connection.

- Install and position the baffle disc onto the knurled portion of the pony rod at this time.

- After screwing the plunger into the pony rod, apply as much load as possible using a 12" or 16" pipe wrench.

CAUTION
DO NOT use a cheater bar/extension tube. This will apply too much torque to the threaded connection.

CRITICAL DIMENSIONS & TOLERANCES

All of the following dimensions are in inches!

Crankshaft	
Drive End Dia.	5.500/5.499
Center Roller Bearing Dia.	13.0074/13.0060
End Taper Bearing Dia.	6.8795/6.8770
Oil Seal Dia.	5.627/5.623
Pin Dia.	5.500/5.499
Pin Width	5.001/5.005
Pin Fillet Radius	0.344
Lube Pump Extension Dia.	1.748/1.747
Crosshead	
Outside Dia.	8.744/8.741
Wrist Pin Dia.	3.248/3.249
OVEN	3.256
Connecting Rod	
Shell Bearing Bore	6.128/6.129
Wrist Pin Bore	3.875/3.876
Wrist Pin	
Outside Dia.	3.2505/3.2500
FREEZER	3.249
Wrist Pin Bushing	
Outside Dia.	3.8785/3.8775
Inside Dia. (before press-fit)	3.248/3.249
Inside Dia. (after press-fit)	3.253/3.255
Pony Rod	
Outside Dia.	2.257/2.253
Power End Wiper Box	
Seal Bore Dia.	2.998/3.002
Seal Bore Depth	1.245/1.255
Power Frame	
Bearing Housing Bore	14.500/14.502
Center Main Bearing Bore	17.245/17.246
Crosshead Bore	8.750/8.755
Stuffing Box	
Inside Bore Dia.	3.000/3.002
Outside Dia. (for Retainer)	4.750/4.752
Power Frame-to-Fluid End Adapters ~ All	
Outside Dia. (to Power Frame)	7.998/8.000
Inside Dia. (to Stuffing Box)	4.754/4.756

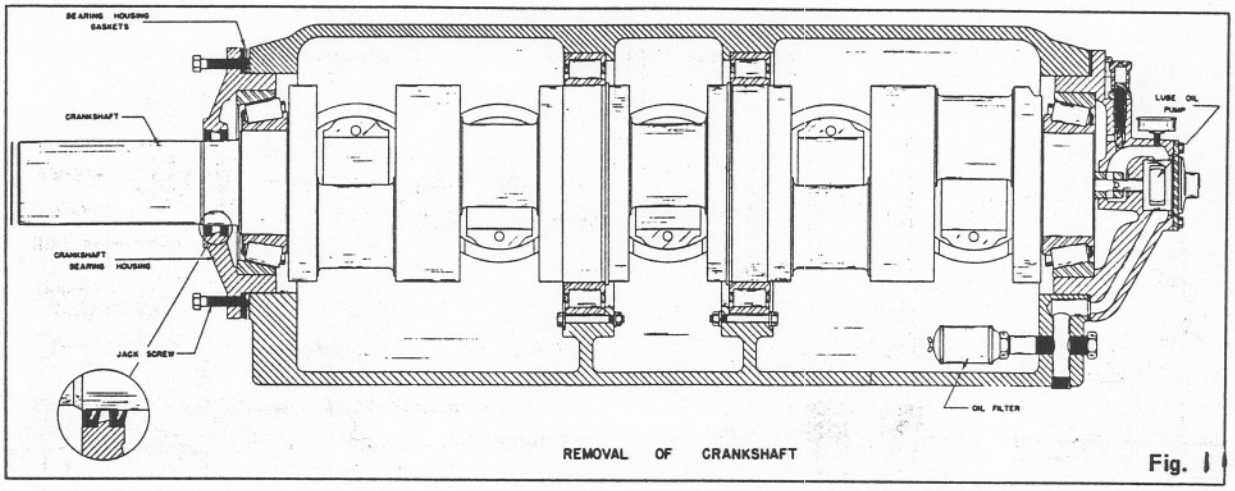
FASTENER TORQUES

Refer to Liquid End parts list drawing ***B115948*** *for the following ITEM NO.'s and locations.*

ITEM NO.	TORQUE ft - lbs	PART DESCRIPTION
615	600	Cap Screw, Adapter to P.F.
618	70	Cap Screw, Adapter to L.E.
632	900	Nut, Valve Cover
700	400	Cap Screw, Clamp Ring

Refer to Power End parts list drawing ***2-14091*** *for the following ITEM NO.'s and locations.*

ITEM NO.	TORQUE ft - lbs	PART DESCRIPTION
050	20	Cap Screw, Crankcase Cover
077	20	Cap Screw, Pin Cover
129	20	Cap Screw, Center Bearing
154	200	Cap Screw, Bearing Housing
204	260	Castle Nut, Connecting Rod
218	20	Cap Screw, Wiper Box
239	15	Cap Screw, Lube Pump



REMOVAL OF CRANKSHAFT

Fig. 1

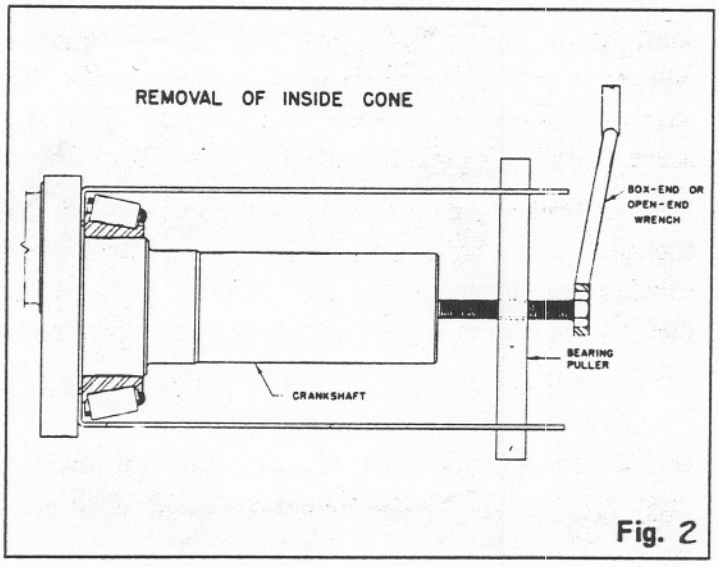
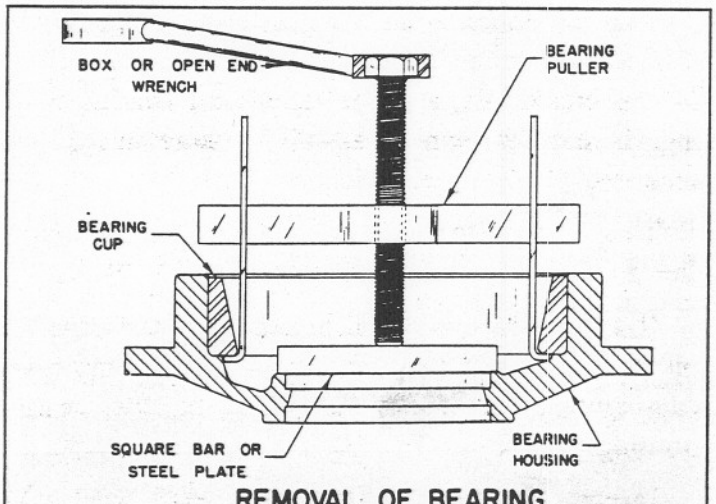
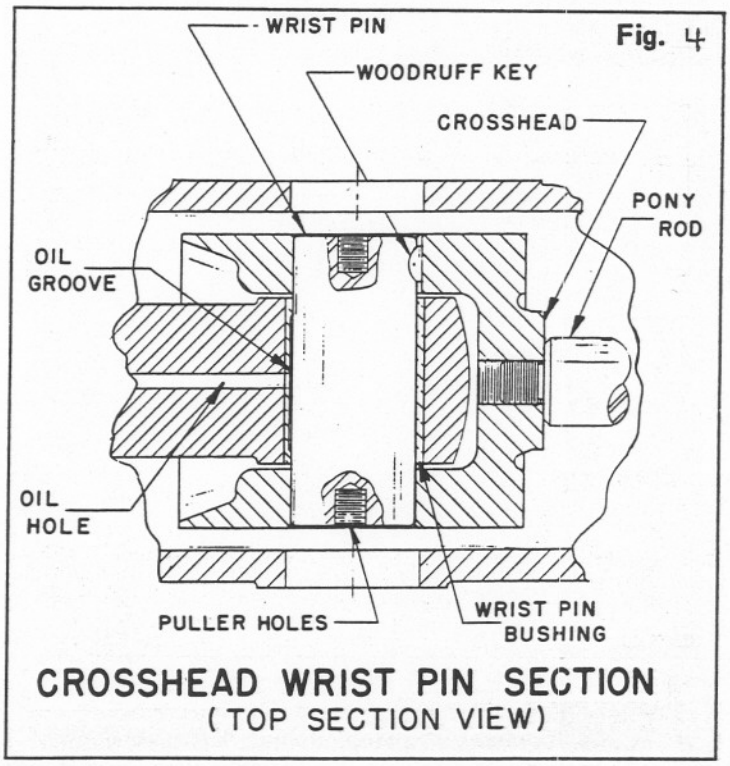


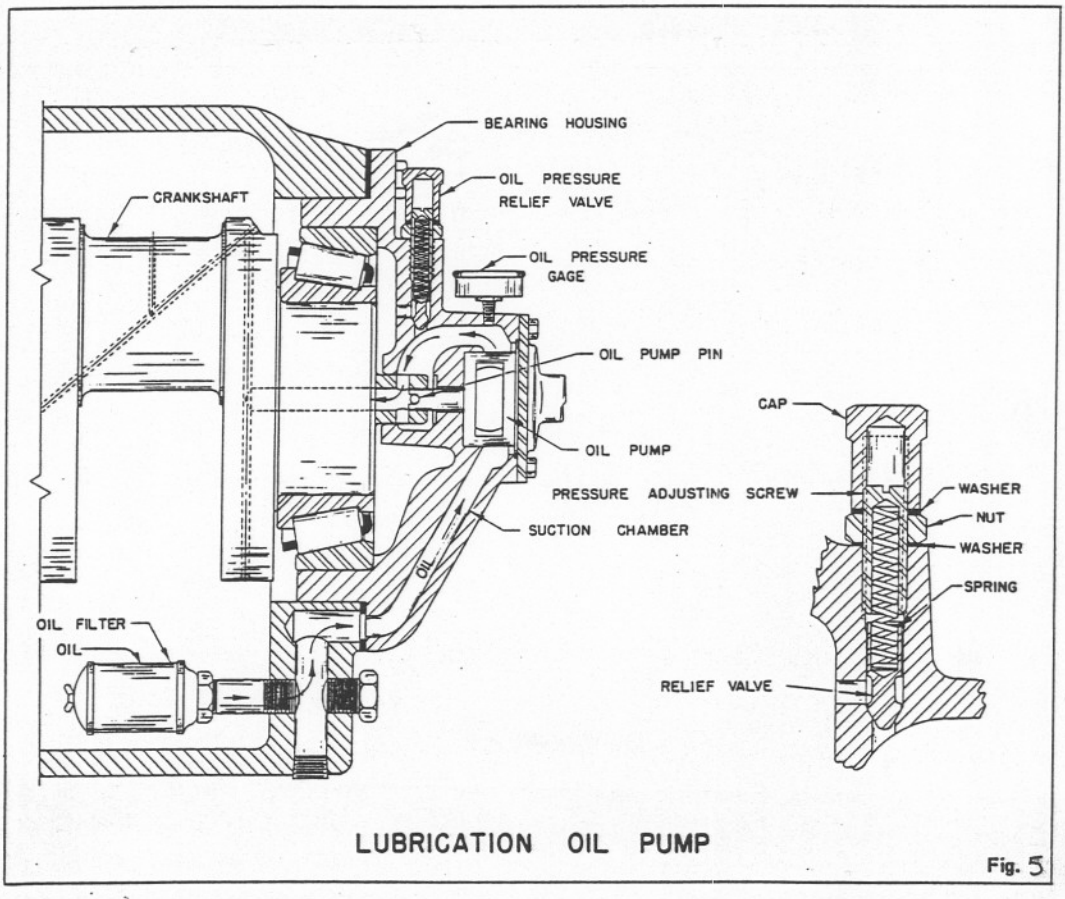
Fig. 2



REMOVAL OF BEARING CUP FROM HOUSING

Fig. 3


WRIST PIN
Fig. 4
WOODRUFF KEY
CROSSHEAD
PONY ROD
OIL GROOVE
OIL HOLE
PULLER HOLES
WRIST PIN BUSHING
CROSSHEAD WRIST PIN SECTION
(TOP SECTION VIEW)


BEARING HOUSING
OIL PRESSURE RELIEF VALVE
CRANKSHAFT
OIL PRESSURE GAGE
OIL PUMP PIN
CAP
OIL PUMP
PRESSURE ADJUSTING SCREW
WASHER
NUT
WASHER
SUCTION CHAMBER
SPRING
OIL
OIL FILTER
OIL
RELIEF VALVE
LUBRICATION OIL PUMP
Fig. 5

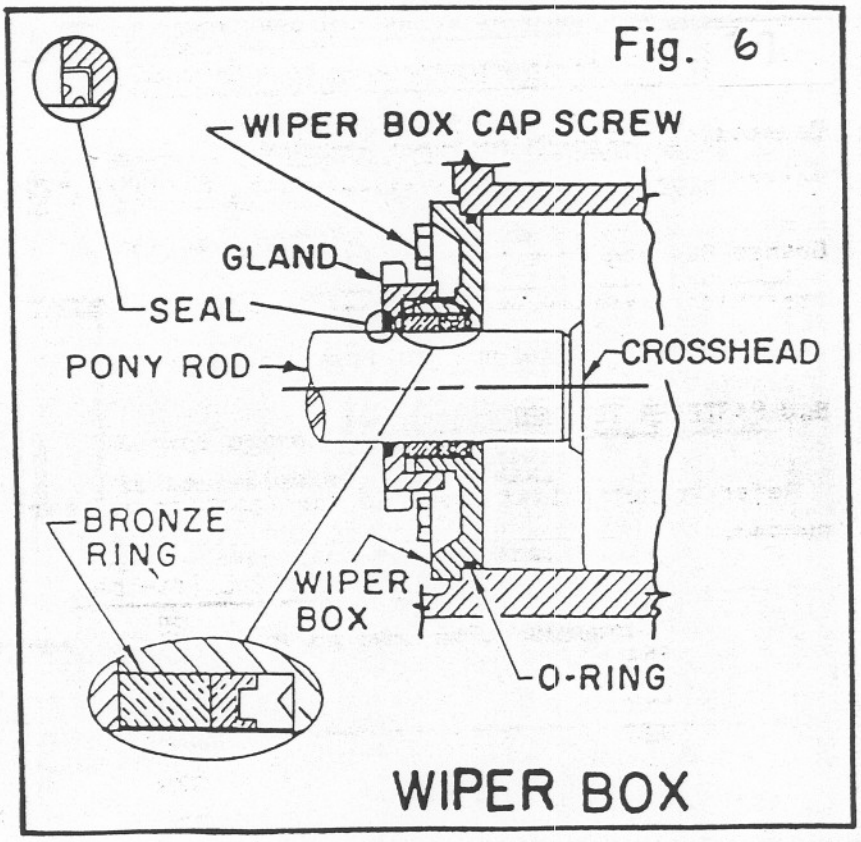
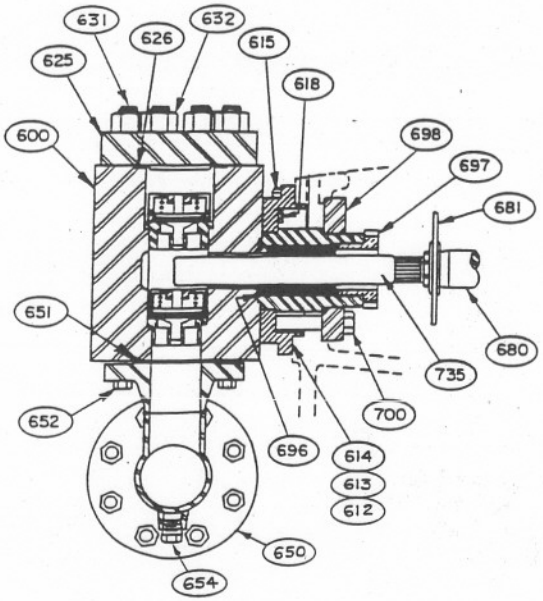
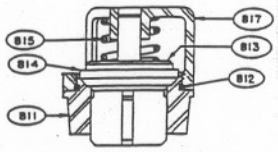


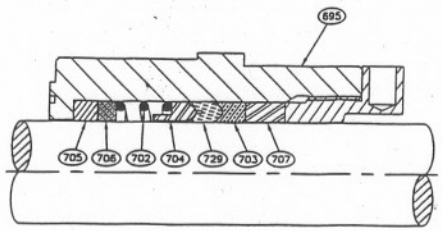
Fig. 6
WIPER BOX CAP SCREW
GLAND
SEAL
PONY ROD
CROSSHEAD
BRONZE RING
WIPER BOX
O-RING
WIPER BOX

MODEL HP600H
Liquid End Parts List

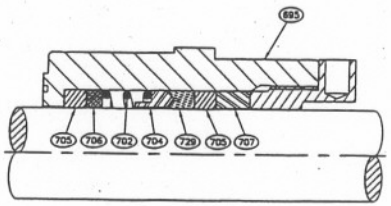




ABRASION RESISTANT VALVE



"SSF-4" PACKING SET
1 "SSF" PACKING RING



"ASF-4" PACKING SET
1 "ASF" PACKING RING

ITEM NO.	PART NUMBER	UNIT QTY.	PART DESCRIPTION
600	AAC-030849-XDJ	1	Liquid End, Flanged
612	002-011576-351	2	Adapter, Intermediate
613	002-008568-351	2	Adapter, End
614	002-011575-231	1	Adapter, Center
615	100-100200-287	12	Cap Screw
* 616	ABA-028144-402	2	Alignment Pin, PF-FE
618	105-012314-287	20	Cap Screw
625	AAC-030871-XDJ	5	Valve Cover
626	110-000245-200	5	O-Ring
631	102-114514-287	40	Stud
632	133-114007-287	40	Nut
650	AAC-030850-220	1	Suction Manifold, Steel
651	204-000034-214	5	Gasket
652	100-034134-278	40	Cap Screw
654	170-034002-278	5	Pipe Plug
680	001-008315-402	5	Pony Rod
681	001-021313-201	5	Baffle Disc
* 685	AAB-115716-405	1	Nameplate, Pump
* 686	126-006516-405	4	Drive Screw
* 693	AAB-030420-274	1	Spanner Wrench, Gland Nut
695	AAC-030872-XDJ	5	Stuffing Box
696	110-000233-200	5	O-Ring
697	ADB-030873-999	5	Gland Nut
698	AAB-008569-278	5	Clamp Ring, Stuffing Box
700	100-078612-999	40	Cap Screw
706	GHC-103259-278	5	Bushing, 316 SS
707	LXC-103259-278	5	Follower, 316 SS

"SSF-4" Packing ***(1 "SSF" Pkg Ring & 316 SS Spring)***

	ABC-115892-999	**5**	**COMPLETE Packing Set**
EACH	*PACKING SET CONSISTS OF THE FOLLOWING ITEMS:*		
702	AAC-115892-008	1	Spring, 316 SS
703	AAC-115892-005	1	Top Adapter, PEEK
704	AAC-115892-003	1	Bottom Adapter, 316 SS
705	AAC-115892-001	1	Bushing, PEEK
729	AAC-115892-004	1	Packing Ring, "SSF"

"ASF-4" Packing ***(1 "ASF" Pkg Ring & 316 SS Spring)***

	ABC-116006-999	**5**	**COMPLETE Packing Set**
EACH	*PACKING SET CONSISTS OF THE FOLLOWING ITEMS:*		
702	AAC-116006-007	1	Spring, 316 SS
704	AAC-116006-003	1	Bottom Adapter, 316 SS
705	AAC-116006-001	2	Bushing, PEEK
729	AAC-116006-004	1	Packing Ring, "ASF"

PLUNGERS ~ *2-1/8"*

735	002-013018-XXX	5	Hard Coated w/316 SS Base: COLMONOY #6 = E09 TUN/S157 = E26
735	002-025984-E24	5	Ceramic Coated w/316 SS Base

REVISION DATE: 06-12-97

ITEM NO.	PART NUMBER	UNIT QTY.	PART DESCRIPTION

ABRASION RESISTANT ("AR") Stn. Stl. VALVES

Discharge Valves

840	001-028329-999	5	**"AR" Ass'y with Insert**
	EACH ASSEMBLY CONSISTS OF THE FOLLOWING ITEMS:		
811	001-028329-001	1	Seat, 17-4PH SS
812	001-027952-008	1	O-Ring, 90 Durometer
813	001-027952-004	1	Body w/Insert Groove, 17-4PH SS
814	001-027952-003	1	Insert
815	001-027952-005	1	Spring
817	001-027952-006	1	Retainer, 316 SS
840	998-HP600H-010	5	**"AR" Ass'y Metal-to-Metal**
	EACH ASSEMBLY CONSISTS OF THE FOLLOWING ITEMS:		
811	001-028329-010	1	Seat, Nitronic 60 SS w/Molyguard
812	001-027952-008	1	O-Ring, 90 Durameter
813	001-027952-007	1	Body w/o Insert Groove, 316 SS
815	001-027952-005	1	Spring
817	001-027952-006	1	Retainer, 316 SS
840	998-HP600H-012	5	**"AR" Ass'y Metal-to-Metal**
	EACH ASSEMBLY CONSISTS OF THE FOLLOWING ITEMS:		
811	001-028329-009	1	Seat, 316L SS
812	001-027952-008	1	O-Ring, 90 Durameter
813	001-027952-007	1	Body w/o Insert Groove, 316 SS
815	001-027952-005	1	Spring
817	001-027952-006	1	Retainer, 316 SS

Suction Valves

840	001-028328-999	5	**"AR" Ass'y w/Insert**
	EACH ASSEMBLY CONSISTS OF THE FOLLOWING ITEMS:		
811	001-028328-001	1	Seat, 17-4PH SS
812	001-027952-008	1	O-Ring, 90 Durometer
813	001-027952-004	1	Body w/Insert Groove, 17-4PH SS
814	001-027952-003	1	Insert
815	001-027952-005	1	Spring
817	001-027952-006	1	Retainer, 316 SS
840	998-HP600H-020	5	**"AR" Ass'y Metal-to-Metal**
	EACH ASSEMBLY CONSISTS OF THE FOLLOWING ITEMS:		
811	001-028328-010	1	Seat, Nitronic 60 SS w/Molyguard
812	001-027952-008	1	O-Ring, 90 Durometer
813	001-027952-007	1	Body w/o Insert Groove, 316 SS
815	001-027952-005	1	Spring
817	001-027952-006	1	Retainer, 316 SS
840	998-HP600H-022	5	**"AR" Ass'y Metal-to-Metal**
	EACH ASSEMBLY CONSISTS OF THE FOLLOWING ITEMS:		
811	001-028328-009	1	Seat, 316L
812	001-027952-008	1	O-Ring, 90 Durometer
813	001-027952-007	1	Body w/o Insert Groove, 316 SS
815	001-027952-005	1	Spring
817	001-027952-006	1	Retainer, 316 SS

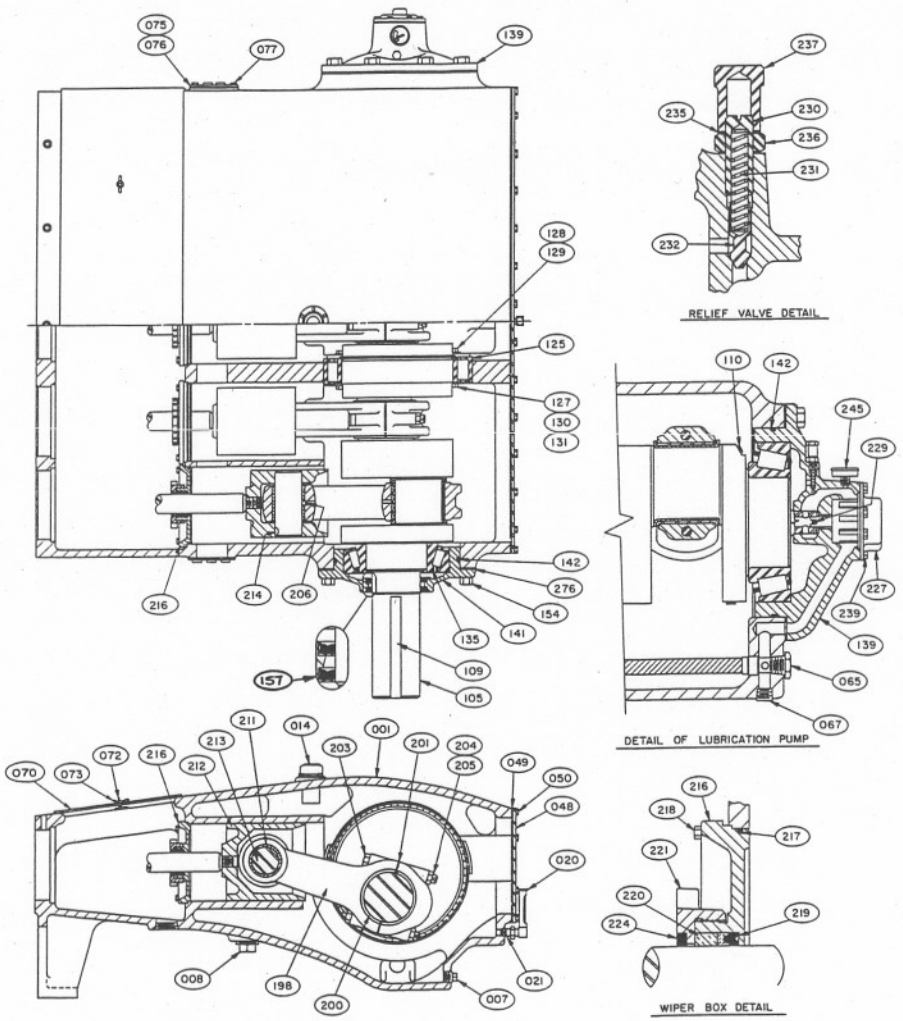
*** - NOT SHOWN ON DRAWING**

NOTE: When Ordering Parts, give:

1. Pump Serial Number
2. Pump Model Number
3. Item Number
4. Part Number
5. Part Description
6. Unit Quantity
7. Trim Size
8. Material

B115948 REV. F

MODEL HP600
Power End Parts List



ITEM NO.	PART NUMBER	QTY. REQ'D	PART DESCRIPTION
001	008-013827-350	1	Power Frame
007	170-100005-353	1	Pipe Plug
008	170-200004-353	2	Pipe Plug
* 012	001-017726-237	1	Gland Plug
* 013	110-000212-201	1	O-Ring
014	001-011094-999	1	Breather
020	001-011093-999	1	Sight Gage
021	157-100112-220	1	Pipe Nipple
048	002-011084-231	1	Cover
049	002-011128-204	1	Gasket
050	100-038058-290	24	Cap Screw
065	002-016950-220	1	Oil Filter
* 066	170-114002-220	1	Pipe Plug
067	170-100003-220	1	Pipe Plug
070	002-011098-231	1	Cover
072	104-038100-286	2	Stud
073	187-038016-286	2	Wing Nut
075	001-013752-280	2	Pin Cover
076	001-007854-204	2	Gasket
077	100-038012-290	6	Cap Screw
105	008-013734-351	1	Crankshaft
109	146-114934-236	1	Key
110	170-014003-220	5	Pipe Plug
125	121-130172-999	2	Center Bearing Set
127	155-012138-220	8	Washer
128	154-038068-220	8	Washer
129	100-038400-273	8	Cap Screw
130	155-038100-220	8	Washer
131	133-038016-243	8	Nut
135	120-687122-999	2	End Bearing Set
139	008-007315-350	1	Bearing Housing, Lube Side
141	004-006463-350	1	Bearing Housing, Shaft Side
142	110-000280-201	2	O-Ring
154	100-078134-290	16	Cap Screw
157	145-558700-999	2	Oil Seal
198	004-007237-225	5	Connecting Rod
200	001-006570-999	5	Shell Bearing
201	001-007242-999	10	Shim Set
203	001-006708-270	10	Bolt
204	001-028582-003	10	Nut, Castle
205	148-532200-220	10	Cotter Pin
206	149-038034-406	5	Roll Pin
211	002-011724-302	5	Bushing
212	002-006320-350	5	Crosshead

ITEM NO.	PART NUMBER	QTY. REQ'D	PART DESCRIPTION
213	001-006572-236	5	Wrist Pin
214	216-014078-220	5	Key
216	004-013738-350	5	Wiper Box
217	110-000267-201	5	O-Ring
218	100-038114-273	20	Cap Screw
219	001-023800-999	5	Seal
220	001-023925-302	5	Follower
221	002-013742-350	5	Gland Nut
224	145-214301-999	5	Oil Seal
227	001-012157-999	1	Lube Pump, *Tuthill*
* 228	227-014018-405	1	Pipe Bushing
* 228	469-080202-305	1	Adapter
229	001-014240-220	1	Pin
230	001-014242-271	1	Adjusting Screw
231	001-014241-363	1	Spring
232	001-014244-278	1	Valve Body
235	001-014251-206	2	Washer
236	130-078014-243	1	Jam Nut
237	001-014243-271	1	Cap
239	100-516100-290	6	Cap Screw
245	AAA-030205-999	1	Switch-Gage
* 263	AAB-115716-405	1	Nameplate, Pump
* 264	126-006516-405	8	Drive Screw
276	998-836000-009	1	Shim Kit

PARTS & KITS ~ *OPTIONAL*

ITEM NO.	PART NUMBER	QTY. REQ'D	PART DESCRIPTION
0279	998-836500-015	5	Connecting Rod Kit (ITEMS: 198, 203, 204, 205, 206 and 211)
9050	998-836000-010	1	Gasket Kit (ITEMS: 049, 076, 142, 157, 217, 224 and 276)

*** NOT SHOWN ON DRAWING**

NOTE: When ordering parts, give:

1. Pump Model Number
2. Pump Serial Number
3. Item Number
4. Part Description
5. Part Number
6. Quantity Required

REVISION DATE: OCTOBER 31, 1996

2-014091 REV. C