Sludge Transfer Pumps

A-C Pump

ITT Fluid Technology Corporation

INSTRUCTIONS

Installation
Operation
Maintenance

NSWV - PACKING
MODEL 300 PEG BASE
CENTRIFUGAL PUMPS

52 x 11732
with packing

INDEX

NOTE

The information contained in this book is intended to assist operating personnel by providing information on the characteristics of the purchased equipment.

It does not relieve the user of their responsibility of using accepted engineering practices in the installation, operation, and maintenance of this equipment.

Any further questions, contact ITT A-C Pump.
(513) 482-2500

Specific Pump Instructions
NSWV Model 300 Peg Base

INTRODUCTION

PURPOSE OF MANUAL:

This manual is furnished to acquaint you with some of the practical ways to install, operate, and maintain this pump. Read it completely before doing any work on your unit and keep it handy for future reference.

Equipment cannot operate well without proper care. To keep this unit at top efficiency, follow the recommended installation and servicing procedures outlined in this manual. The ITT A-C Pump Customer Service Department is available to expertly guide the installation of the pump for maximum operating life and minimum downtime.

ITT A-C PUMP SERVICE ORGANIZATION:

Experienced, factory-trained servicemen offer prompt, efficient service at reasonable rates. These servicemen can find and correct costly errors such as poor grouting, misalignment, pipe stresses transmitted to the pump casing, or improperly sized piping. A serviceman may be requested through your nearest ITT A-C Pump Sales Representative.

Replacement and spare parts, including special attention to your individual problems, may also be obtained through the same Sales Representative.

WARRANTY

Refer to your sales contract for coverages.

PUMP IDENTIFICATION (NAMEPLATE)

There are two identification plates on each pump.

The pump nameplate contains the following information:

- Pump Size and Type
- Model Number
- Serial Number
- Rating (flow rate in GPM, pressure in feet of head, and pump speed in RPM)
- Impeller Diameter
- Maximum Field Hydrotest Pressure
- Identification Number (User's I.D.)

The frame identification plate contains the following information:

- Frame Size
- Bearing manufacturer's numerical designation for each bearing
- Type of bearing lubrication (grease)

SAFETY INFORMATION

WARNING: Follow the "Vertical Pump Lifting Instruction Booklet" (52-328-428) attached to the pump. Failure to follow all instructions may result in serious injury, death, or property damage.

Read all warning & caution decals on the pump.

Never use motor lifting lugs or pump casing lugs to lift entire unit.

When field hydrotesting pump or system, do not exceed maximum field hydrotest pressure given on pump nameplate. Vent all air from pump and piping.

INSTALLATION

RECEIVING PUMP:

Check pump for shortages and damage immediately upon arrival. (An absolute must!) Prompt reporting to the carrier's agent, with notations made on the freight bill, will expedite satisfactory adjustment by the carrier.

Vertical pumps are normally shipped from the factory separate from their drives.

Proper alignment is very important on all vertical pumps to avoid vibration. On most vertical pumps alignment must be established during installation. ITT A-C Pump has determined that proper and correct alignment can only be made by accepted erection practices. Refer to the following paragraphs on "Foundation", "Setting Baseplate/Pedestal", "Alignment Procedure", and "Doweling".

STORAGE:

Temporary:
Temporary storage is considered one month or less. If the pump is not to be installed and operated soon after arrival, store it in a clean, dry place having slow, moderate changes in ambient temperature. Rotate the shaft periodically to coat the bearings with lubricant and to retard oxidation, corrosion, and to reduce the possibility of false brinelling of the bearings.

For complete details on temporary storage, consult Bulletin 5621-0086 in your Service Manual.

Long Term:
Storage longer than one month is considered long term storage. See Bulletin 5621-0085 in your Service Manual.

LOCATION:

The pump should be installed as near the suction supply as possible, with the shortest and most direct suction pipe practical. The total dynamic suction lift (static lift plus friction losses in suction line) should not exceed the limits for which the pump was sold.

The pump must be primed before starting. Whenever possible, the pump should be located below the fluid level to facilitate priming and assure a steady flow of liquid. This condition provides a positive suction head on the pump. It is also possible to prime the pump by pressurizing the suction vessel.

When installing the pump, consider its location in relation to the system to assure that sufficient Net Positive Suction Head (NPSH) at pump suction is provided. Available NPSH must always equal or exceed the required NPSH of the pump.

The pump should be installed with sufficient accessibility for inspection and maintenance. A clear space with ample head room should be allowed for the use of an overhead crane or hoist sufficiently strong to lift the unit.

NOTE: Allow sufficient space to be able to dismantle pump without disturbing the pump inlet and discharge piping.

Select a dry place above the floor level wherever possible. Take care to prevent pump from freezing during cold weather when not in operation . Should the possibility of freezing exist during a shut-down period, the pump should be completely drained, and all passages and pockets where liquid might collect should be blown out with compressed air.

Make sure there is a suitable power source available for the pump driver. If motor driven, electrical characteristics should be identical to those shown on motor data plate.

FOUNDATION:

The foundation must be substantial enough to absorb vibration. (Hydraulic Institute Standards recommend the foundation weight at least five (5) times the weight of the pump unit.) It must form a permanent and rigid support for the pedestal. This is important in maintaining the alignment of a flexibly coupled unit.

Foundation bolts, .25" smaller in diameter than the clearance holes in the pedestal, should be embedded in the concrete to a depth of eight (8) times the diameter of the bolt and locked with either a hook around a reinforcing bar or alternatively, a nut and washer at the bottom. The bolts should have a sleeve around them at least six (6) times the bolt diameter long and at least two (2) bolt sizes larger in I.D. If a nut and washer are used for locking, the washer should have an O.D. two (2) sizes larger than the sleeve.

The foundation should be poured to within 3/4" -1.5" of the finished height. (See Figure 1.)

Freshly poured foundations should be allowed to cure for several days before the unit is set in place and grouted.

SETTING BASEPLATE / PEDESTAL:

These units do not have a locating fit for the motor. Both parallel md angular alignment between pump shaft and motor shaft must be made.

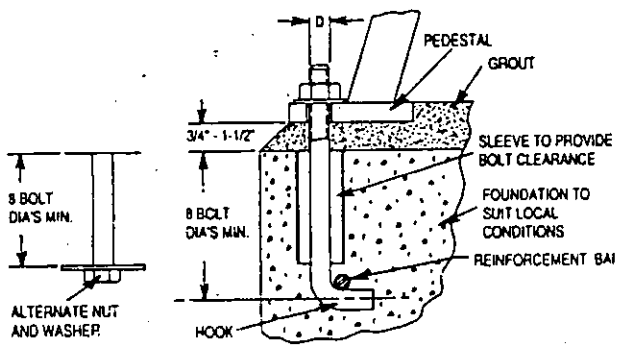


FIGURE 1 - FOUNDATION

Initial or rough alignment must be done prior to grouting of pedestal. Rough alignment is designated as .020" TIR parallel alignment and .009" TIR per inch of radius angular alignment (See "Alignment Procedure" described below).

Use blocks at anchor bolts and midway to position bottom of pedestal at finished height called for on drawings (see Figure 11) with foundation bolts extending through holes in the pedestal. Metal wedges with a small taper may be used in lieu of blocks and shims.

Level the pump by adding or removing shims between the blocks and the bottom of the pedestal. Hand tighten the nuts at first. Being very careful not to distort the pedestal, snug down the nuts with a wrench.

NOTE: A non-flexible coupling should not be connected until the alignment operation has been completed. The unmachined surfaces of the pump pedestal do not have to be level.

After foundation bolts are lightly torqued, recheck alignment requirements once more. Follow requirements outlined at the beginning of this section. Then the unit can be grouted in.

Grout compensates for the uneven foundation. Together with the pedestal it makes a very rigid interface between the pump and the foundation, distributing weight around the pedestal rim and preventing shifting.

Use an approved, non-shrinking grout such as Embeco 636 or 885 by Master Builders, Cleveland, Ohio, or equivalents.

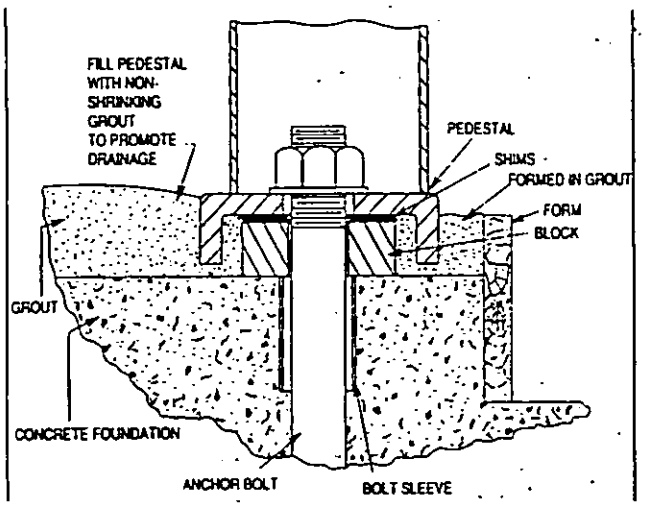


FIGURE II - GROUTING

GROUTING PROCEDURE:

1. Build a strong form around the foundation to contain the grout.

2. Soak the top of the foundation thoroughly, then remove surface water.

3. The area between pedestal and foundation should be completely filled with grout and if necessary, temporarily use air relief tubing or drill vent holes to remove trapped air. It is a good practice to fill center of pump pedestal with grout up to the sill so water cannot stand in this area.

4. After the grout has thoroughly hardened (approximately 24 hours) tighten the foundation bolts fully.

5. Approximately fourteen (14) days after the grout has been poured and 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.

ALIGNMENT PROCEDURE:

There are two forms of misalignment between the pump shaft and the driver shaft as follows:

1. Angular misalignment - shafts have axis concentric at intersection, but not parallel.

2. Parallel misalignment - shafts have axis parallel, but offset.

The necessary tools for checking alignment are: (1) a straight edge and a taper gauge or set of feeler gauges or, (2) a dial indicator with mounting magnet and extension bars.

METHOD I - Straight Edge:

Proceed with this method only if satisfied that face and outside diameters of the coupling halves are square and concentric with the coupling bores. If this condition does not exist or elastomeric couplings do not make this method convenient, use Method 2.

Check for angular alignment by inserting the taper or feeler gauges between the coupling faces at 90° intervals. The unit is in angular alignment when these four (4)

measurements are the same. (Figure IIIa.)

Check for parallel alignment by placing a straight edge across both coupling rims on all four sides. The unit is in parallel alignment when the straight edge rests evenly across both coupling rims in all four (4) positions. (Figure IIIb.)

METHOD 2 - Dial Indicators:

A dial indicator can be used to attain more accurate alignment.

Fasten the indicator to the pump half of the coupling and adjust the assembly until the indicator button is resting on the other half coupling periphery.

Set the dial to zero and chalk mark the coupling half where the button rests. (Chalk is not necessary on the elastomeric couplings that have not been disconnected.) Rotate both shafts by the same amount; i.e., all readings must be made with the button on the chalk mark.

The dial readings will indicate whether the driver has to be raised, lowered, or moved to either side. After each adjustment, recheck both parallel and angular alignments. Accurate alignment of shaft centers can be obtained with this method even where faces or outside diameters of the coupling are not square or concentric with the bores. For angular alignment, change the indicator so it bears against the face of the same coupling half and proceed similarly to above. See Figure IVa and IVb.

NOTE: Gross deviation in squareness or concentricity may cause unbalance problems and if so must be corrected.

NOTE: Permissible misalignment will vary with the type of coupling. Consult coupling manufacturer's data.

Parallel: Single element coupling
.004" TIR (4 mils)

Angular: Single element coupling
.004/Inch of Radius

Check and correct for angular misalignment before correcting parallel alignment. Final alignment should be made by moving and shimming the motor on its pedestal until the coupling hubs are within the recommended tolerances measured in total run out. All measurements should be taken with the motor bolts tightened.

DOWELING:

The motor or driver may, if desired, (or required in specification) be dowelled on diagonally opposite locations. This should not be done until the unit has been run for a sufficient length of time and alignment is within

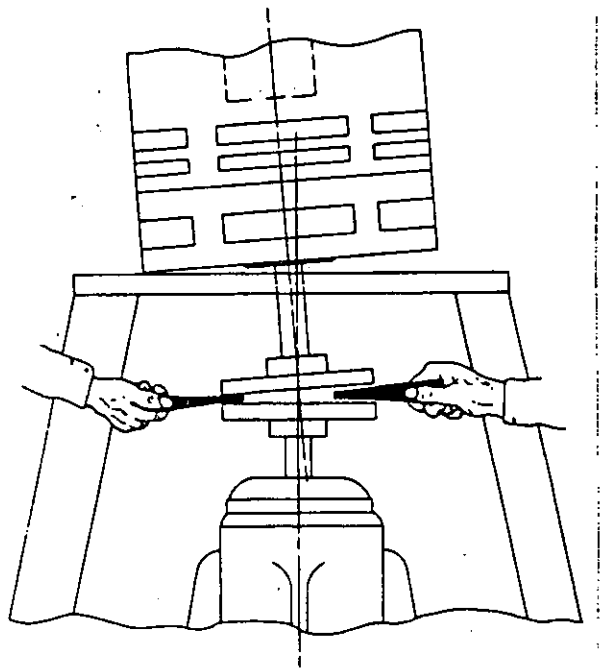


FIGURE IIIa - CHECKING ANGULAR ALIGNMENT

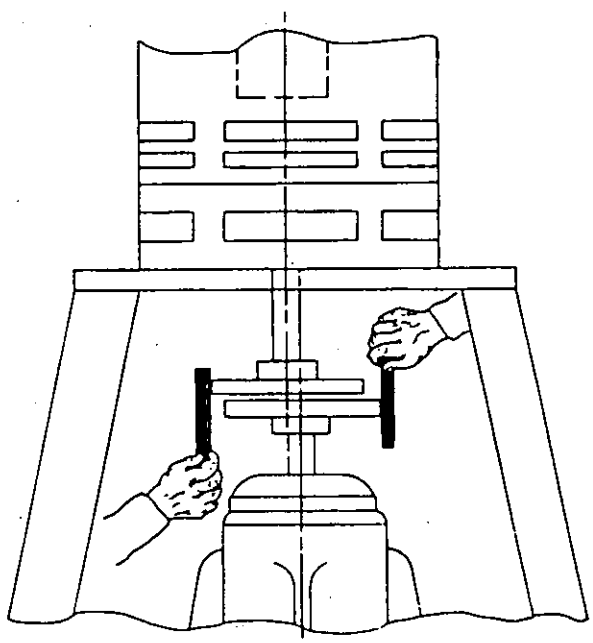


FIGURE IIIb - CHECKING PARALLEL ALIGNMENT

the TIR tolerance previously stated.

SUCTION AND DISCHARGE PIPING:

Pipe flanges should not impose any strain on the pump. This can be checked by a dial indicator. Any strain must be corrected by adjustments in the piping system.

Suction and discharge piping should be anchored, supported, and restrained near the pump to avoid strain on the pump. When using rubber expansion joint, follow the recommendations of the Technical Hand-book on Rubber Expansion Joints and Flexible Pipe Connectors, published by the Fluid Sealing Association, 2017 Walnut Street, Philadelphia, PA, 19103.

When installing the pump piping, be sure to observe the following precautions:

Piping should always be run to the pump.

Do not move pump to pipe.

Both the suction and discharge piping should be independently anchored near the pump and properly aligned so that no strain is transmitted to the pump when the flange bolts are tightened. Use pipe hangers or other supports at necessary intervals to provide support. When expansion joints are used in the piping system they must be installed beyond the piping supports closest to the pump. Tie bolts should be used with expansion joints to prevent pipe strain. Do not install expansion joints next to the pump or in any way that would cause a strain on the pump resulting from system pressure changes. It is usually advisable to increase the size of both suction and discharge pipes at the pump connections to decrease the loss of head from friction.

Install piping as straight as possible, avoiding unnecessary bends. Where necessary, use 45° or long sweep 90° fitting to decrease friction losses.

Make sure that all piping joints are air-tight.

Where flanged joints are used, assure that inside diameters match properly.

Remove burrs and sharp edges when making up joints.

Do not "spring" piping when making any connections. Provide for pipe expansion when hot fluids are to be pumped.

SUCTION PIPING:

When installing the suction piping, observe the following precautions (See Figure V).

The sizing and installation of the suction piping is extremely important. It must be selected and installed so that pressure losses are minimized and sufficient liquid will flow into the pump when started and operated. Many NPSH (Net Positive Suction Head) problems can be

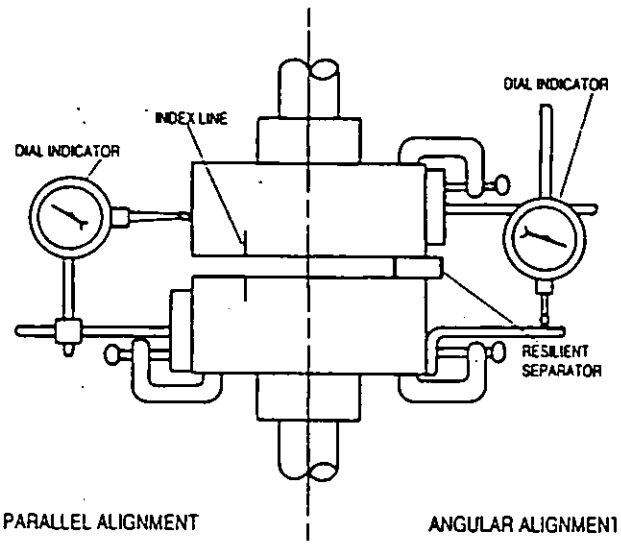
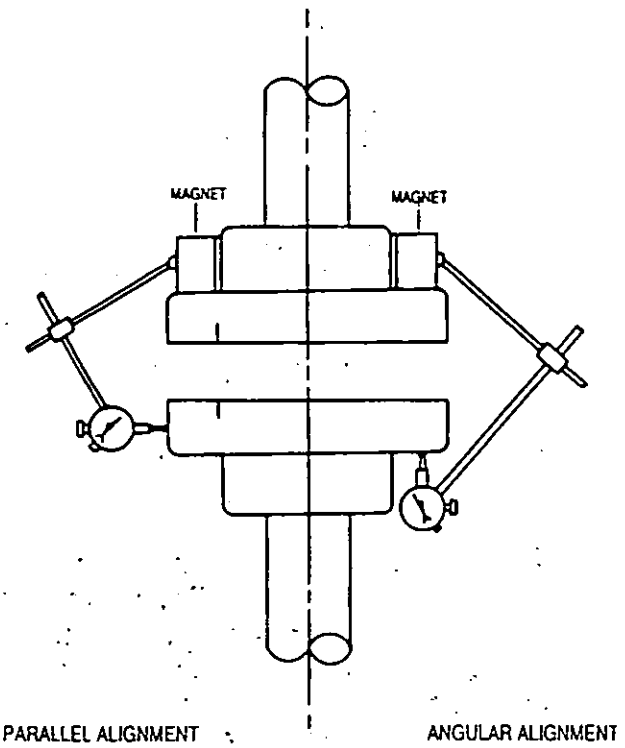


FIGURE IVa - SINGLE ELEMENT COUPLINGS



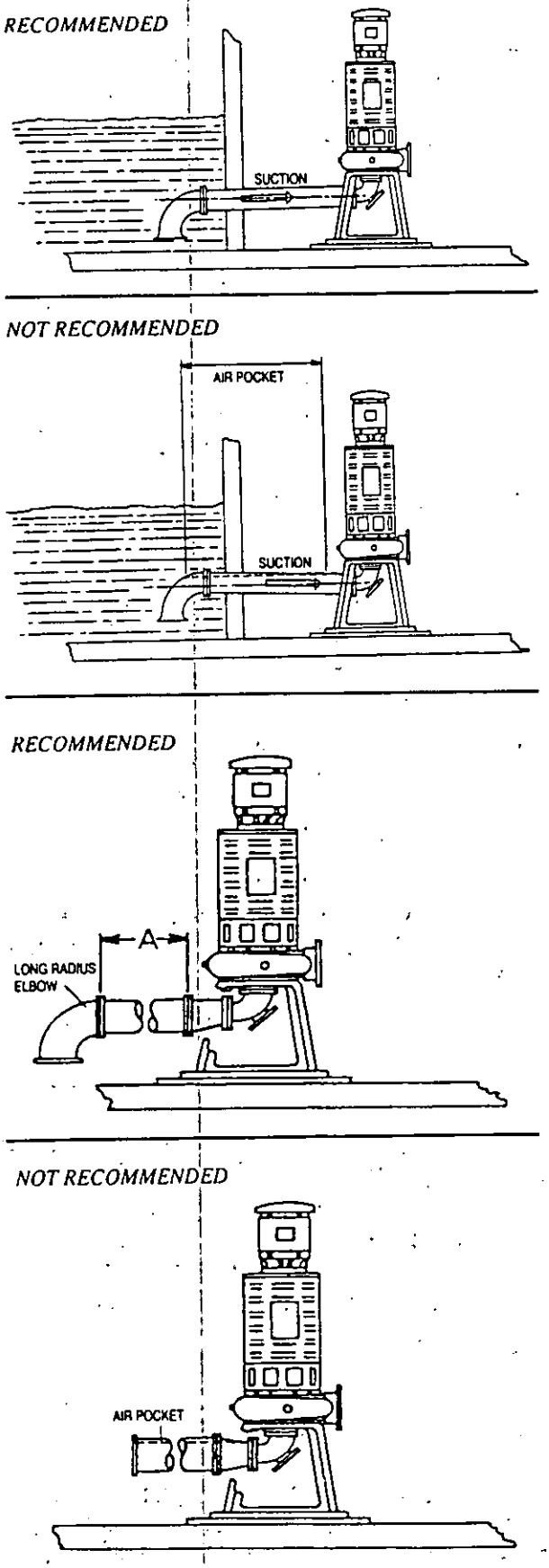


FIGURE V - SUCTION PIPING

directly attributed to improper suction piping systems.

Suction piping should be short in length, as direct as possible, and never smaller in diameter than the pump suction opening. A minimum of five (5) pipe diameters distance ("A") between any elbow or tee and the pump is required. If a long suction pipe is required, it should be one or two sizes larger than the suction opening, depending on its length.

Reducers should be limited to one pipe size reduction each to avoid excessive turbulence and noise. They should be of the conical type. Contour reducers are not recommended.

When operating on a suction lift, the suction pipe should slope upward to the pump nozzle. A horizontal suction line must have a gradual rise to the pump. Any high point in the pipe will become filled with air and thus prevent proper operation of the pump. When reducing the piping to the suction opening diameter, use an eccentric reducer with the eccentric side down to avoid air pockets.

NOTE: When operating on suction lift never use a straight taper reducer in a horizontal suction line, as it tends to form an air pocket in the top of the reducer and the pipe.

When installing valves in the suction piping, observe the following precautions:

1. If the pump is operating under static suction lift conditions, a foot valve may be installed in the suction line to avoid the necessity of priming each time the pump is started. This valve should be of the flapper type, rather than the multiple spring type, sized to avoid excessive friction in the suction line. (Under all other conditions, a check valve, if used, should be installed in the discharge line. See "Discharge Piping".)

2. When foot valves are used, or where there are other possibilities of "water hammer", close the discharge valve slowly before shutting down the pump.

3. Where two or more pumps are connected to the same suction line, install gate valves so that any pump can be isolated from the line. Gate valves should be installed on the suction side of all pumps with a positive pressure for maintenance purposes. Install gate valves with stems horizontal to avoid air pockets. Globe valves should not be used,

particularly where NPSH is critical.

4. The pump must never be throttled by the use of a valve on the suction side of the pump. Suction valves should be used only to isolate the pump for maintenance purposes, and should always be installed in positions to avoid air pockets.

Inlet bells, pipe size, and wet well (sump) dimensions should conform to the recommendations of the Hydraulic Institute Standards latest edition.

DISCHARGE PIPING:

If the discharge piping is short, the pipe diameter can be the same as the discharge opening. If the piping is long, pipe diameter should be one or two sizes larger than the discharge opening. On long horizontal runs, it is desirable to maintain as even a grade as possible. Avoid high spots, such as loops, which will collect air and throttle the system or lead to erratic pumping.

A check valve and gate valve should be installed in the discharge. The check valve, placed between pump and gate valve, protects the pump from excessive back pressure, and prevents liquid from running back through the pump in case of power failure. The gate valve is used in priming and starting, and when shutting the pump down.

PRESSURE GAUGES:

Properly sized pressure gauges should be installed in both the suction and discharge nozzles in the gauge taps which are provided. The gauges will enable the operator to easily observe the operation of the pump, and also determine if the pump is operating in conformance with the performance curve. If cavitation, vapor binding, or other unstable operation should occur, widely fluctuating discharge pressure will be noted.

STUFFING BOX LUBRICATION:

Contaminants in the pumped liquid must not enter the stuffing box. These contaminants may cause severe abrasion or corrosion of the shaft, or shaft sleeve, and rapid packing deterioration; they can even plug the stuffing box flushing and lubrication system. The stuffing box must be supplied at all times with a source of clean, clear liquid to flush and lubricate the packing. The most important consideration is to establish the optimum flushing pressure that will keep contaminants from the stuffing box cavity. If this pressure is too low, fluid being pumped may enter the stuffing box. If the pressure is too high, excessive packing wear may result; and extreme heat may develop in the shaft causing higher bearing temperatures. The most desirable condition, therefore, is to use a seal water pressure slightly above the maximum stuffing box pressure.

If the pump system pressure conditions vary during the day, packing adjustment becomes difficult. Consideration should be given to using a mechanical seal.

STUFFING BOX OPERATING PRESSURE:

The actual stuffing box operating pressure may be obtained by installing a pressure gauge on the box. This is done with an extra lantern ring(s) temporarily replacing the two rings of packing in the bottom of the box to obtain accurate gauge readings. Take gauge readings with the pump running under various head and capacity conditions. Then set the pressure of flushing or lubrication liquid at a value 20 psi above the maximum expected stuffing box operating pressure.

When it is not possible to make this measurement on a pump with packing you need to calculate the necessary seal water pressure.

Even under the best conditions, a properly packed stuffing box should be watched closely. If pressure conditions change slightly, there will be a resultant change in packing "seating" which should be compensated by a change in gland adjustment. Consideration should also be given to the lubrication pressure. A wide variation indicates a need to use a mechanical seal.

Standard pumps are normally packed before shipment. If the pump is installed within 60 days after shipment, the packing will be in good condition with a sufficient supply of lubrication. If the pump is stored for a longer period, it may be necessary to repack the stuffing box. In all cases, however, inspect the packing before the pump is started.

NOTE: Packing adjustment is covered under "Maintenance".

It is very unusual for sewage pumps to be able to use internal liquid lubrication (pumped liquid) to lubricate packing. Only when all of the following conditions prevail, can this be done:

1. Liquid is clean, free from sediment and chemical precipitation, and is compatible with seal materials.
2. Temperature is above 32°F and below 160°F.
3. Suction pressure is below 75 psig.
4. Liquid has lubricating qualities.
5. Liquid is non-toxic and non-volatile.

When the liquid being pumped contains solids or is otherwise not compatible with packing materials, an outside supply of seal liquid should be furnished. In general, external-injection liquid (from an outside source) is required when at least one of the following conditions prevail:

1. Liquid being pumped contains dirt, grit, or other impurities.
2. Temperature of the pumped liquid is below 32°F or above 160°F.
3. Liquid being pumped has non-lubricating properties.
4. Liquid is toxic or volatile.
5. Suction pressure is above 75 psig, vacuum, or high lift.

The standard stuffing box consists of rings of packing (see assembly section for number of rings), a lantern ring, and a gland. A shaft sleeve which extends through the box and under the gland is normally provided to protect the shaft.

A tapped hole is supplied in the stuffing box directly over the seal cage to introduce a clean, clear sealing medium. The stuffing box must, at all times, be supplied with sealing liquid at a high enough pressure to keep the box free from foreign matter, which would quickly destroy the packing and score the shaft sleeve.

Only a sufficient volume of sealing liquid to create a definite direction of flow from the stuffing box inward to the pump casing is required, but the pressure is important. Apply seal water at a rate of approximately 0.25 GPM at the proper pressure.

One recommended method to minimize error in regulating flushing water is a "Controlled Pressure System" (Figure VI). Most important is the pressure reducing valve adjusted to a value slightly exceeding the maximum stuffing box operating pressure (assuming it is reasonably constant). A flow indicating device will serve to indicate a failing of the bottom packing rings allowing leakage into the pump.

External sealing liquid should be adjusted to the point where the packing runs only slightly warm, with a very slow drip from the stuffing box. Excess pressure from an external source can be very destructive to packing. More pressure is required, however, for abrasive slurries than for clear liquids. Examination of the leakage will indicate whether to increase or decrease external pressure. If slurry is present in the leakage, increase the pressure until only clear liquid drips from the box. If the drippage is corrosive or harmful to personnel, it should be collected and piped away.

A common error is to open the external piping valve wide and then control the drippage by tightening the packing gland. Actually, a combination of both adjustments is essential to arrive at the optimum condition. The life of packing and sleeve depends on this careful control more than any other factor.

PACKING WITH GREASE LUBRICATION

Pump stuffing boxes are also suitable for grease lubrication. Several types of grease lubricators are available. When using a grease lubricator, grease pressure to the stuffing box should be as calculated, See Section B. A Z-F lubricator automatically provides sufficient pressure.

OPERATION

PRE-START CHECKS:

Before initial start of the pump, make the following inspections:

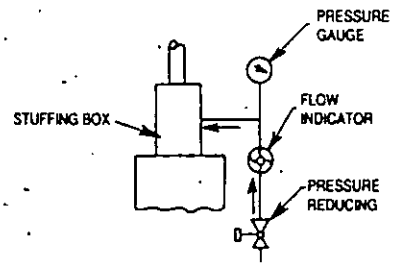


FIGURE VI
CONTROLLED PRESSURE SYSTEM FOR PACKING

1. Check alignment between pump and motor.

2. Check all connections to motor and starting device with wiring diagram. Check voltage, phase, and frequency on motor nameplate with line circuit.

3. Check suction and discharge piping and pressure gauges for proper operation.

4. Check impeller adjustment, see Section for proper adjustment.

5. Turn rotating element by hand to assure that it rotates freely.

6. Check stuffing box adjustment, lubrication, and piping.

7. Check driver lubrication.

8. Assure that pump bearings are properly lubricated.

9. Assure that coupling is properly lubricated, if required.

10. Assure that pump is full of liquid (see Priming,) and all valves are properly set and operational, with the discharge valve and the suction valve open. Purge all air from top of casing.

11. Check rotation. Be sure that the driver operates in the direction indicated by the arrow on the pump casing as serious damage can result if the pump is operated with incorrect rotation. Check rotation each time the motor leads have been disconnected.

PRIMING:

If the pump is installed with a positive head on the suction, it can be primed by opening the suction and vent valve and allowing the liquid to enter the casing.

If the pump is installed with a suction lift, priming must be done by other methods such as foot valves, ejectors, or by manually filling the casing and suction line.

NOTE: Under either condition, the pump must be completely filled with liquid before starting. The pump must not be run dry in the hope it will prime itself.

FLUSHING:

New and old system should be flushed to eliminate all foreign matter. Heavy scale, welding splatter, and wire or other large foreign matter can clog the pump impeller. This will reduce the capacity of the pump causing cavitation or excessive vibration.

FILLING:

Vents should be located at the highest point so entrained gases and air can escape. However, if the gases are flammable, toxic, or corrosive they should be vented to an appropriate place to prevent harm to personnel or other parts of the system. Pipe hangers and anchors should be checked to make sure they are properly set to take the additional weight of the pumpage.

All drains should be closed when filling the system. Filling should be done slowly so that excessive velocities do not cause rotation of the pumping element which may cause damage to the pump or its driver. The adequacy of the anchors and hangers may be checked by mounting a dial indicator off of any rigid structure not tied to the piping and setting the indicator button on the pump flange in the axial direction of the nozzle. If the indicator moves, as the filling proceeds, the anchors and supports are not adequate or set properly and should be corrected.

STARTING:

1. Close drain valves.

2. Open fully all valves in the suction and discharge lines.

3. Turn on seal water to the stuffing box. (If pumped fluid is dirty, these lines should always be left open.)

4. Prime the pump:

   NOTE: If the pump does not prime properly, or loses prime during start-up, it should be shut-down and the condition corrected before the procedure is repeated.

5. Start the pump driver.

6. When the pump is operating at full speed, check to see that the check valve has opened up. Check valve must open 5 seconds or less after start-up to

prevent damage to pump by operating at zero flow.

7. Adjust the seal water valves to produce the recommended pressure for the packed stuffing box.

OPERATIONAL CHECKLIST:

1. Driver/Pump Rotation:
   Check rotation each time the motor leads have been disconnected. Be sure that the driver operates in the direction indicated by the arrow on the pump casing. Rough operation and extreme vibration can result if the pump is operated in the wrong direction.

2. Coupling:
   Recheck coupling alignment.

3. Stuffing Box Adjustment:
   Make stuffing box packing gland and lubrication adjustments.

4. Flow:
   An accurate measurement of flow rate (volume/time) is difficult in the field. Venturi meters, flow nozzles, orifice plates, or timing the draw down in the wet well are all possible methods. Record any reading for future reference.

5. Pressure:
   Check and record both suction and discharge pressure gauge readings for future reference. Also record voltage, amperage per phase, and kilowatts if an indicating wattmeter is available.

6. Temperature:
   Check and record bearing temperatures using a thermometer. Temperature should not exceed 180°F.

7. Vibration and Sound:
   The acceptable vibration level of a centrifugal pump depends on the rigidity of the pump and the supporting structure. Recommended values for vibration can vary between .20 ips velocity to .60 ips velocity depending on the operating characteristics and the structure. Refer to the current edition of the Hydraulic Institute Standards for a complete description and charts on various pumps.

   Field sound levels are difficult to measure because of background noise from piping, valves, drivers, gears, etc. Follow recommendations in the Hydraulic Institute Standards, current edition.

SHUTDOWN:

The following steps will take care of most normal shutdowns of the pump. Make any further adjustments of process piping, valves, etc., as required. If the pump is to be removed from service for an extended period of time, "Freeze Protection".

1. Shut down the driver.

2. Close suction and discharge valves.

3. Close seal water valves. (If pumped liquid is dirty, or if inleakage is to be prevented, these lines should always be left open, except when the pump is completely drained.)

4. Open drain valves as required.

FREEZE PROTECTION:

Pumps that are shut down during freezing conditions should be protected by one of the following methods.

1. Drain the pump; remove all liquid from the casing.

2. Keep fluid moving in the pump and insulate or heat the pump to prevent freezing.

   NOTE: If heat is used to keep the pump from freezing, do not let the temperature rise above 150°F.

FIELD TESTS:

PERFORMANCE CURVE:

A typical performance curve for a specific pump can be obtained from ITT A-C Pump. This can be used in conjunction with a field test, if one is required. All ITT A-C Pump tests and curves are based on the Hydraulic Institute Standards. Any field test must be conducted according to these Standards.

Unless otherwise specifically agreed, all capacity, head, and efficiencies are based on shop tests when handling clear, cold, fresh water at a temperature not over 85°F.

To aid in calculating pump performance, the following test information and definitions are included for reference.

NOTE: Complete procedure for testing pumps is given in the Hydraulic Institute Test Standards.

GAUGE DATUM:

The datum for all gauge readings is taken as the eye of the impeller.

HEAD MEASUREMENT:

The unit for measuring head should be in feet; therefore, all pressure readings of the pumped liquid should be converted to feet. The relationship between a pressure expressed in pounds per square inch (psi) and that expressed in feet of head is:

$$\text{Head in feet} = \frac{\text{psi} \times 2.31}{\text{sg}}$$

Where sg = specific gravity of the liquid pumped
Where sg = 1.0 for water at 60°F

TOTAL HEAD:

Total head is the algebraic difference between the total suction and the total discharge heads.

1. Where suction lift exists, total head is the sum of the total discharge head and the suction lift.

2. Where positive suction head exists, the total head is the total discharge head minus the total suction head.

SUCTION LIFT:

Suction lift exists where the total suction head is negative. Total suction lift is the reading of a liquid manometer at the suction nozzle of the pump, converted to feet of liquid, and referred to the datum plus the velocity head at the point of gauge attachment.

POSITIVE SUCTION HEAD:
Suction head exists when the total suction head is positive. Total suction head is the reading of a gauge at the suction of the pump, converted to feet of liquid, and referred to datum plus the velocity head at the point of gauge attachment.

VELOCITY HEAD:

Velocity head is figured from the average velocity obtained by dividing the discharge flow (in cubic feet per second) by the actual area of the pipe cross-section (in square feet), and is determined at the point of gauge connection. It is expressed by the formula:

$$H_v = \frac{V^2}{2g}$$

Where g = the acceleration due to gravity, and is 32.17 feet per second squared at sea level and 45 degrees latitude.

V = velocity in the pipe in feet per second.

VOLUME MEASUREMENT:

The method of volume measurement should be made by some accurate and accepted method and converted to gallons per minute. For easy reference, refer to the following:

1. The standard U.S. gallon contains 231 cubic inches.

2. One cubic foot equals 7.4805 gallons.

3. The specific weight of water at a temperature of 60°F shall be taken as 62.34 pounds per cubic foot.

HORSEPOWER:

1. The formula for horsepower required at the pump shaft is:

$$\text{Bhp} = \frac{\text{Total head} \times \text{GPM} \times \text{specific gravity}}{3960 \times \text{Pump Eff.}}$$

2. The true motor brake horsepower, once the efficiency is determined from dynamometer tests, can also be calculated from the following formula:

$$\text{Bhp} = \frac{\text{kw input} \times \text{Eff.}}{0.746}$$

Where Bhp = Brake horsepower delivered
kw input = Real input power (kw)
Eff. = Motor efficiency

PUMP EFFICIENCY:

Pump efficiency can be calculated by the formula:

Pump eff. = $\frac{\text{Total head x GPM x specific gravity}}{3960 \times \text{Bhp}}$

MAINTENANCE

GENERAL MAINTENANCE & PERIODIC INSPECTION:

Operating conditions vary so widely that to recommend one schedule of preventative maintenance for all centrifugal pumps is not possible. Yet, some sort of regular inspection must be planned and followed. We suggest a permanent record be kept of the periodic inspections and maintenance performed on your pump. This recognition of maintenance procedure will keep your pump in good working conditions, and prevent costly breakdowns.

One of the best rules to follow in the proper maintenance of your centrifugal pump is to keep a record of actual operating hours. Then, after a predetermined period of operation has elapsed. The pump should be given a thorough inspection. The length of this operating period will vary with different applications, and can only be determined from experience. New equipment, however, should be examined after a relatively short period of operation. The next inspection period can be lengthened somewhat. This system can be followed until a maximum period of operation is reached which should be considered the operating schedule between inspections. See Maintenance Time.

MAINTENANCE OF FLOOD DAMAGED PUMPS:

The servicing of centrifugal pumps after a flooded condition is a comparatively simple matter under normal conditions.

Bearings are a primary concern on pumping units. First, dismantle the frame, clean and inspect the bearings for any rusted or badly worn surfaces. If bearings are free from rust and wear, reassemble and relubricate them with one of the recommended bearing lubricants. Depending on the length of time the pump has remained in the flooded area, it is unlikely that bearing replacement is necessary; however, in the event that rust or worn surfaces appear, it may be necessary to replace the bearings.

Next, inspect the stuffing box, and clean out any foreign matter that might clog the box. Packing that appears to be worn, or no longer regulates leakage properly should be replaced.

Couplings should be dismantled and thoroughly cleaned. Lubricate the coupling with one of the coupling manufacturer's recommended lubricants where required.

Any pump that is properly sealed at all joints and connected to both the suction and discharge should exclude outside liquid. Therefore, it should not be necessary to go beyond the bearings, stuffing box, and coupling when servicing the pump after flood damage.

LUBRICATION:

BEARING LUBRICATION - GREASE:

Grease lubricated ball bearings are packed with grease at the factory and ordinarily will require no attention before starting, provided the pump has been stored in a clean, dry place prior to its first operation. The bearings should be watched the first hour or so after the pump has been started to see that they are operating properly.

In greasing anti-friction bearings the use of high pressure equipment is not only unnecessary, but is actually undesirable unless used with great care. High pressure may damage the bearings or seals, cause unnecessary loss of grease, create a danger of overheating due to over greasing, and produce unsightly conditions around the bearing. EXCESS GREASE IS THE MOST COMMON CAUSE OF OVERHEATING. Adequate lubrication is assured if the level of grease is maintained at about 1/2 the capacity of the bearing and bearing housing space. Any greater amount will, as a rule, be discharged by the seal or vent and be wasted.

The importance of proper lubrication cannot be over emphasized. Lubrication frequency depends upon the speed, size and type of bearing, and operating temperature or environmental conditions. Generally, the smaller the bearing and faster the speed, the more frequent the interval for re-lubrication with grease. It is recommended that a certain amount of grease be added at intervals of three to six months to replace the small quantity of grease lost between grease flushing intervals. For average bearing housing designs, one (1) ounce of grease will be sufficient at these intervals. For larger or smaller bearing housings this amount may have to be adjusted.

Unfortunately, there is not a grease available which will not harden over time and become less suitable for its purpose due to oxidation. Therefore, it is good practice

to remove all the old grease about once a year and thoroughly clean the bearings. This should be done during major overhauls. After gaining experience with each individual pump and its operating characteristics, the re-lubrication and flushing intervals may be adjusted accordingly. Keep good records and add grease at regular intervals. Then adjustments can be made after the first overhaul, if necessary.

A lithium based NLGI-2 grade grease should be used for lubricating bearings where the ambient temperature is above -20°F. Grease lubricated bearings are packed at the factory with Mobilux EP No. 2 grease. Other recommended greases are Texaco Multifak EP-2 and Shell Alvania EP-2.

Greases made from animal or vegetable oils are not recommended due to the danger of deterioration and forming of acid. Do not use graphite.

REFILLING GREASE AFTER CLEANING:

When cleaning bearings during a major over-haul, use a bearing cleaning solvent, industrial cleaning solvent, or kerosene. In case of badly oxidized grease, soak bearings in hot, light oil (200° to 240°F). Do not use gasoline. Use lint free cloths. Do not use waste rags.

Hand pack clean bearings (not the housing) completely full with fresh grease while the pump is disassembled. Add additional grease to the bearing housing. The resulting total level of grease should be about 1/2 the capacity of the bearing and bearing housing space. On vertical pumps place some grease on the frame ledge above the inboard (lower) bearing. Remove the vent plug to allow any excess grease to be expelled during the first 24 hours of operation. Then replace all vent plugs.

PERIODIC ADDITION OF GREASE:

Grease lubricated ball bearings are packed with grease at the factory. Store the pump in a clean, dry place prior to its first operation.

If one is uncertain about the amount of grease in a bearing at re-lubrication intervals, the safe rule is to add grease slowly (one ounce at a time) as the bearing operates (if this is safe). Remember, a ball or roller bearing in most applications is assured of adequate lubrication if the level of grease is maintained at about 1/2 the capacity of the bearing and bearing housing space: Any greater amount will, as a rule, be discharged by the seals or vent and be wasted. EXCESS GREASE IS THE MOST COMMON CAUSE OF OVERHEATING OF THE BEARINGS. Remove vent plugs for the first 24 hours of operation after regreasing.

BEARING TEMPERATURE:

Normally the maximum desirable operating temperature for ball bearings is 180°F as measured on the bearing housing. Special designs may have higher limits. Should the temperature of the bearing frame rise above the limit, the pump should be shut down to determine the cause. A bearing frame which feels hot to the touch of the hand is not necessarily running hot. Check with an accurate temperature measuring device to be sure.

COUPLINGS:

Flexible couplings (Wood's or Falk Torus coupling for instance) provide smooth transmission of power. There is no rubbing action of metal against rubber to cause wear. Couplings are not affected by abrasive, dirt, or moisture. This eliminates need for lubrication or maintenance, and provides clean and quite performance.

Grid or gear tooth couplings (Falk Grid Steelflex or Falk Crowned Tooth coupling for instance) must be initially lubricated with Falk Long Term Grease (LTG) and do not require relubrication for up to three years. If couplings leak grease, are exposed to extreme temperatures, or excessive moisture, more frequent lubrication may be required.

Use coupling manufacturer's recommended grease to provide trouble free performance.

If other type of couplings are used, follow maintenance instructions of coupling manufacturer.

SEAL INFORMATION:

All pumps are packed before shipment unless otherwise requested. All packing used are the highest grade material. Before pump is put into operation check the condition of the packing. If pump is installed within sixty (60) days after shipment the packing will be in good condition with a sufficient supply of lubrication. If pump is stored for a longer period it may he necessary to repack the stuffing box. In all cases, however, we recommend an inspection of the packing before pump is started.

The standard sewage pump packing is made from acrylic

yarn impregnated with TFE and has reinforced corners.

A well lubricated packing reduces stuffing box resistance and prevents excessive wear on the shaft or shaft sleeve. Many brands of packing on the market have the desired qualities. For specific recommendations, consult the factory.

When a pump is first started it is advisable to have the packing slightly loose without causing an air leak. As the pump runs in. gradually tighten the gland bolts evenly. The gland should never be drawn to the point where packing is compressed too tight and no leakage occurs. This will cause the packing to burn, score the shaft or shaft sleeve, and prevent liquid from circulating through the stuffing box cooling the packing. The stuffing box is improperly packed or adjusted if friction in the box prevents turning the rotating element by hand. A properly operated stuffing box should run lukewarm with as low drip of sealing liquid. After the pump has been in operation for some time, and the packing has been completely run-in, drippage from the stuffing box should be at least 40 to 60 drops per minute. This will indicate proper packing and shaft sleeve lubrication and cooling.

NOTE: Eccentric operation of the shaft or sleeve through the packing could result in excess leakage that cannot be compensated for. Correction of this defect is very important.

Packing should be checked frequently and replaced as service indicates. Six months might be a reasonable expected life, depending on operating conditions. It is impossible to give any exact predictions. A packing tool may be used to remove all old packing from the stuffing box. Never reuse old and lifeless packing or merely add some new rings. Make sure the stuffing box is thoroughly cleaned before new packing is installed. Also check the condition of the shaft or sleeve for possible scoring or eccentricity, make replacements where necessary.

New packing should be placed carefully into the stuffing box. If molded rings are used, the rings should be opened sideways and the joints pushed into the stuffing box first. The rings are installed one at a time, each ring seated firmly and the joints staggered at about a 90° angle from each preceding joint so they are not in line. The joints should be kept at about 90° from each preceding joint.

If coil packing is used, cut one ring to accurate size with either a butt or mitered joint. An accurately cut butt joint is superior to a poor fitting mitered joint. Fit the ring over the shaft to assure proper length. Then remove and cut all other rings to the first sample. When the rings are placed around the shaft a tight joint should be formed. Place the first ring in the bottom of the stuffing box. Then install each succeeding ring, staggering the joints as described above, making sure each ring is firmly seated.

Make sure the lantern ring (seal cage) is properly located in the stuffing box under the sealing water inlet. The function of the lantern ring is to establish a liquid seal around the shaft, prevent leakage of air through the stuffing box and lubricate the packing. If it is not properly located it serves no purpose.

CLEANING WITHOUT DISMANTLING PUMP:

The ITT A-C Pump suction elbow is also equipped with a hand hole with removable cover and a pipe tap for injecting high pressure clean out water into the pump. This high pressure water (up to 80 psi maximum) can be injected to flush out any matter clogging the impeller or water passages. The water should be applied only with the suction valve closed.

Other cleaning methods include running an auger into the pump through the clean out hole in the suction elbow or through the casing hand hole. This should free any clogging in the impeller eye.

If the pump cannot be freed of clogging after the above methods have been tried, dismantle the unit as described.

CAUTION: Do not open hand hole cover unless driver has been locked out and pump drained of fluid. Failure to follow these instructions may result in serious injury, death, or property damage.

MAINTENANCE TIME TABLE:

EVERY MONTH	Check bearing temperature with a thermometer, not by hand. If bearings are running hot (over 180°), it may be the result of too much lubricant. If changing the lubricant does not correct the condition, disassemble and inspect the bearings.
EVERY 3 MONTHS	Check grease lubricated bearings for saponification. This condition is usually incurred by the infiltration of water or other fluid past the bearing shaft seals and can be noticed immediately upon inspection, since it give the grease a whitish color. Wash out the bearings with a clean industrial solvent and replace the grease with the proper type as recommended.
EVERY 6 MONTHS	Check the packing and replace if necessary. Use the grade recommended. Be sure the lantern ring is centered in the stuffing box at the entrance of the stuffing box piping connection. Check shaft or shaft sleeve for scoring. Scoring accelerates packing wear. Check alignment of pump and motor. If misalignment recurs frequently, inspect the entire piping system. Unbolt piping at suction and discharge flanges to see if it springs away, thereby indicating strain on the casing. Inspect all piping supports for soundness and effective support of load.
EVERY YEAR	Remove the rotating element. Inspect thoroughly for wear, and order replacement parts if necessary. Check wearing clearances -clearance between impeller inlet and suction cover or between impeller wear ring and suction wear plate. Remove any deposit or scaling. Clean out stuffing box piping. Measure total dynamic suction and discharge head as a test of system piping. Record the figures and compare them with the figures of the last test. This is important, especially where the fluid being pumped tends to form a deposit on internal surfaces. Inspect foot valves and check valves, especially the check valve which safeguards against water hammer when the pump stops. A faulty foot or check valve will reflect also in poor performance of the pump while in operation.

NOTE: The above time table is based on the assumption that after start-up, the unit had been regularly monitored and such a schedule was found to be consistent with operation, as shown by stable readings. Extreme or unusual applications or conditions should be taken into consideration and may require shorter maintenance intervals.

TROUBLE SHOOTING

Between regular maintenance inspections, be alert for signs of motor or pump trouble. Common symptoms are listed below. Correct any trouble immediately and AVOID COSTLY REPAIR AND SHUTDOWN.

SYMPTOMS	CURES
No Liquid Delivered	
1. Lack of prime.	Fill pump and suction pipe completely with liquid.
2. Loss of prime.	Check for leaks in suction pipe joints and fittings; vent casing to remove accumulated air.
3. Suction lift too high.	If no obstruction at inlet, check for pipe friction losses. However, static lift may be too great. Measure with mercury column or vacuum gauge while pump operates. If static lift is too high, liquid to be pumped must be raised or pump lowered.
4. Discharge system head too high	Check pipe friction losses. Larger discharge piping may correct condition. Check that valves are wide open.
5. Speed too low.	Check whether motor is directly across-the-line and receiving full voltage. Or frequency may be too low; motor may have an open phase.
6. Wrong direction of rotation.	Check motor rotation with directional arrow on pump casing.
7. Impeller completely plugged.	Dismantle pump or use hand hole cover to clean impeller.
Not Enough Liquid Delivered	
8. Air leaks in suction piping.	If liquid pumped is water or other non-explosive, and explosive gas or dust is not present, test flanges for leakage with flame or match. For such liquids as gasoline, suction line can be tested by shutting off or plugging inlet and putting line under pressure. A gauge will indicate a leak with a drop of pressure.
9. Air leaks in stuffing box.	Increase seal lubricant pressure to above atmosphere.
10. Speed too low.	See item 5.
11. Discharge system head too high.	See item 4.
12. Suction lift too high.	See item 3.
13. Impeller partially plugged.	See item 7.
14. Cavitation; insufficient NPSH (depending on Installation.)	a. Increase positive suction head on pump by lowering pump or increasing suction pipe size. b. Sub-cool suction piping at inlet to lower entering liquid temperature. c. Pressurize suction vessel.
15. Defective Impeller.	Inspect impeller. Replace if damaged or vane sections badly eroded.

SYMPTOMS	CURES
16. Defective Packing.	Replace packing and sleeves if badly worn.
17. Foot valve too small or partially obstructed.	Area through ports of valve should be at least as large as area of suction pipe - preferably 1-1/2 times. If strainer is used, net clear area should be 3 to 4 times area of suction pipe.
18. Suction inlet not immersed deep enough.	If inlet cannot be lowered, or if eddies through which air is sucked persist when it is lowered, chain a board to suction pipe. It will be drawn into eddies, smothering the vortex.
19. Wrong direction of rotation.	Symptoms are an overloaded drive and about 1/3 rated capacity from pump. Compare rotation of motor with directional arrow on pump casing. Also, impeller may be incorrect rotation for pump supplied.
20. Too small impeller diameter (probable cause if none of above.)	Check with factory to see if a larger impeller can be used; otherwise, cut pipe losses or increase speed - or both, as needed. But be careful not to seriously overload drive.
	Not Enough Pressure
21. Speed too low.	See item 5.
22. Air leaks in suction piping.	See item 8.
23. Mechanical defects.	See items 1 5 ,1 6, and 1 7 .
24. Obstruction in liquid passages.	Dismantle pump and inspect passages of impeller and casing. Remove obstruction .
25. Air or gases in liquid. (Test in laboratory, reducing pressure on liquid to pressure in suction line. Watch for bubble formation.)	May be possible to over rate pump to point where it will provide adequate pressure despite condition. Better to provide gas separation chamber on suction line near pump, and periodically exhaust accumulated gas. See item 14.
26. Too small impeller diameter. (Probable cause if none of above.)	See item 20.
	Pump Operates For Short Time, Then Stops
27. Incomplete priming.	Free pump, piping and valves of all air. If high points in suction line prevent this, they need correcting.
28. Suction lift too high.	See item 3.
29. Air leaks in suction piping.	See item 8.
30. Air leaks in stuffing box.	See item 9.
31. Air or gases in liquid.	See item 25.

PUMP TAKES TOO MUCH POWER	
SYMPTOMS	CURES
32. Head lower than rating; thereby pumping too much liquid.	Machine impeller's O.D. to size advised by factory.
33. Cavitation.	See item 14.
34. Mechanical defects.	See items 15, 16, and 17.
35. Suction inlet not immersed enough.	See item 18.
36. Liquid heavier (in either viscosity or specific gravity) than allowed for.	Use larger driver. Consult factory for recommended size. Test liquid for viscosity and specific gravity.
37. Wrong direction of rotation.	See item 6.
38. Stuffing box too tight. (Packing)	Release gland pressure. Tighten reasonably. If sealing liquid does not flow while pump operates, replace packing. If packing is wearing too quickly, replace scored shaft sleeves and keep liquid seeping for lubrication.
39. Casing distorted by excessive strains from suction or discharge piping.	Examine pump for friction between impeller and casing. Replace damaged parts. Check for pipe strain.
40. Shaft bent due to damage - through shipment, operation, or overhaul.	Check deflection of rotor by turning on bearing journals. Total indicator run-out should not exceed 0.002 on shaft and 0.004 inch on impeller wearing surface.
41. Mechanical failure of critical pump parts.	Check bearings and impeller for damage. Any irregularity in these parts will cause a drag on shaft.
42. Misalignment.	Realign pump and driver.
43. Speed may be too high (brake hp of pump varies as the cube of the speed; therefore, any increase in speed means considerable increase in power demand) .	Check voltage on motor.
44. Electrical defects.	The voltage and frequency of the electrical current may be lower than that for which motor was built; or there may be defects in motor. The motor may not be ventilated properly due to a poor location.
45. Mechanical defects in turbine, engine, or other type of drive exclusive of motor.	If trouble cannot be located, consult factory.

SERVICING

GENERAL MAINTENANCE NOTES:

When assembling and disassembling the pump frame, it is easier to work in the vertical position. Place the pump frame, minus the impeller, on a flat table or support with a hole in the center for the shaft to pass through. Use a hoist to handle larger pumps. If the pump bearings or seals are to be removed, it is recommended they be replaced rather than reusing old parts. If they fail in service as a result of damage sustained during disassembly, the cost of replacing them again will be much greater than the cost of new parts in the first place.

DISASSEMBLY:

WET END:

a. Close the discharge and suction valves.

b. Lock out power to the driver.

c. Disconnect the power source from the driver, following proper safety precautions.

d. Turn off packing liquid supply and disconnect all piping to stuffing box (2-036-0).

e. Open drain plugs and drain casing

f. Disconnect driver from pump.

g. Remove screws that secure coupling guard (0-291-0) and remove guard.

h. Disconnect the coupling.

i. Remove screws (7-904-1) that secure the motor to the upper part of the pedestal (0-207-8) and remove the motor using lifting devices provided on motor. (See "SAFETY INFORMATION".) Set motor aside and secure motor to prevent it from tipping, or being damaged.

j. Remove screws (0-904-7) that secure the upper part of the pedestal (0-207-8) to the frame (5-083-0). Remove screws and pins that secure the upper part of the pedestal to the lower and remove upper part.

k. Remove screws (0-904-9) that secure the rotating element to the casing and pull the entire rotating element from the casing. The casing may be left connected to the piping unless it or the suction cover (2-091-0) are to be replaced or repaired. Remove casing joint gasket (2-123-9).

l. Impeller Removal: Unlock and remove the impeller nut set screw (4-904-0) and impeller nut (4-023-0). The nut has right hand threads for both clockwise and counterclockwise directions of impeller rotation. The impeller nut set screw has been locked in place with a retaining compound. Application of heat from a small propane torch may be necessary to remove the set screw.

m. Remove impeller (4-002-0) and impeller key (0-9 11-3) from the tapered shaft. Wedges may be used to remove impeller, but they should be placed directly behind the vanes to avoid damaging the impeller. Impeller can also be removed by using a simple puller.

n. If the impeller is equipped with a wear ring (4-004-0) and if the wear ring is to be replaced, pry it off using a screwdriver or small pry bar. The wear ring is held in place using a retaining compound, so the application of heat from a small propane torch will be helpful.

o. Suction cover is equipped with a wear plate (2-046-0) and if the wear plate is to be replaced, drive the wear plate out using a soft metal punch approaching from the suction side. The wear plate is held in place with a retaining compound, so the application of heat from a small propane torch will be helpful.

p. Loosen packing gland (6-014-0).

q. Remove the two screws (0-904-0) that secure stuffing box cover (2-036-0) to frame (5-083-0). Remove the stuffing box cover.

r. Dismantle the stuffing box cover by removing gland (6-014-0), packing (6-924-0), lantern ring (6-013-0), and packing base ring (6-152-0).

s. Remove set screw (0-902-0) from sleeve (1-009-0) and slide the shaft sleeve off the shaft (5-007-0).

t. Remove o-ring (1-914-0) from the shaft (5-007-0)

FRAME:

Remove the pump half coupling and coupling key if these parts have been left on the shaft.

a. Remove the deflectors (5-024-3) and (5-024-4) from both ends of the frame.

b. Remove the four cap screws (0-904-4) securing the outboard bearing housing (5-025-0) to the frame.

c. Pull out the adjusting shims (5-942-0).

NOTE: Do not discard shims. They will be needed to re-adjust clearance when the pump is re-assembled. Two of the screws removed in Step b can be used as jacking screws on most frames.

d. Pull the complete shaft and bearing assembly out of the outboard end of the frame.

e. Press the bearing cover (5-018-3) out of the inboard end of the frame (5-083-0).

f. Press out the inboard bearing seal (5-177-3).

g. Remove the bearing housing snap ring (5-068-4) and grease retainer (5-299-4) from the outboard bearing housing.

h. Remove the bearing housing from the outboard end of the shaft.

i. Press out the outboard bearing seal (5-177-4) from the outboard bearing housing.

j. Bend the locking tabs on the bearing lock washer (5-517-0) out of the slots on the bearing locknut, and remove the lock nut (5-516-0) using either a spanner wrench or a drift pin and hammer.

k. Remove the outboard bearing (5-026-4) from the shaft. **NOTE:** When removing bearings, do not apply pressure to the outer race. Apply pressure to the inner race only. This will avoid any possible damage to the bearings.

l. Remove grease retainer (5-299-4) and bearing housing snap ring (5-068-4) from shaft.

m. Remove the inboard bearing (5-038-3) from the shaft (5-007-0) following the caution note in Step k.

PART INSPECTION:

When the pump is dismantled for any reason, we recommend that all parts be inspected for wear or damage. Check the following—replace parts when necessary .

1. CASING:
All machined surfaces should be cleaned. Remove rust, burrs, or raised surfaces from the main casing joint. Check for evidence of extreme wear or corrosion, especially at threaded taps and gasket joints.

2. SUCTION COVER:
Check and clean machined surfaces and gasket joint. Inspect for wear. Check suction wear plate.

3. STUFFING BOX COVER:
Check and clean machined surfaces and gasket joint. Make sure stuffing box cavity is clean. Inspect and clean seal water inlet.

4. STUFFING BOX PARTS:
Inspect gland and lantern ring. Replace packing.

5. IMPELLER:
Check impeller vanes, impeller bore, and keyway for signs of wear, breakage, or corrosion. Inspect impeller hub and impeller back vanes on rear of impeller. (Some impellers do not have back vanes.) Check impeller wear ring or inlet face for wear.

6. SHAFT SLEEVE:
Inspect the shaft sleeve for nicks, burrs, grooves, or other damage. Repair if possible; if not, replace. If the shaft sleeve for packing is grooved or worn in excess of 3/64" on the diameter, replace.

7. SHAFT:
Check bearing and impeller fits, lip seal surfaces, and keyways for signs of wear, breakage, corrosion, nicks, or burrs. Repair these surfaces if damaged or replace shaft. Check to see if shaft is straight. Shaft must be within .002 TIR straightness.

8. BEARINGS:
Clean bearings using an approved bearing cleaning solvent, or other non-flammable industrial solvent.

Inspect the bearings, replacing them if they are noisy or rough when rotated, or if there are signs of wear or pitting in the bearing raceways. **WARNING**: Under no condition should a combustible solvent such as gasoline be used to clean bearings or any other part of the pump. The use of such Solvents could lead to fire or explosion. Failure to follow all instructions may result in serious injury, death, or property damage.

9. GREASE SEALS:
   Replace.

10. FRAME:
    Check machined bores for evidence of corrosion or wear. Clean old grease from frame interior.

ASSEMBLY:

Pump and frame parts are re-assembled in the reverse order of dismantling, with special notes as outlined below. Follow all installation precautions covered in this manual. Always replace all old gaskets, o-rings, and packing. We also recommend replacing bearings if they have been removed from the shaft, and lip seals whenever new bearings are installed.

FRAME:

a. Place the bearing housing snap ring (5-068-4) and the bearing grease retainer (5-299-4), in that order, on the outboard end of the pump shaft. The grease retainer has an offset surface near the inside diameter which must face away from the bearing. The flat side of the snap ring faces toward the coupling end of the shaft. THESE PARTS ARE PLACED ON THE SHAFT TO BE USED IN A LATER ASSEMBLY STEP.

b. Heat the inboard (5-038-3) and outboard (5-026-4) bearings to 225°F using a clean oil bath or a dry oven. **WARNING**: Use insulated gloves when handling hot hearings. Failure to follow all instructions may result in serious injury death or property damage.

   The inboard bearing is a single row bearing and fits on the impeller side of the shaft. The outboard bearing is a double row angular contact bearing and fits onto the coupling side of the shaft.

   Slide both bearings onto their respective bearing fits on shaft (5-007-0), being sure the bearings press firmly against the bearing fit shoulder.

   Install the bearing lock washer (5-517-0) on the coupling end of the shaft, with the locking tabs facing away from the bearing. There is a tab on the I.D. of the lock washer. This tab must fit into the groove in the pump shaft.

   Install the bearing locknut (5-516-0) with the beveled edge facing the bearing. Tighten the locknut using either a spanner wrench or a drift pin and hammer. Tapping the spanner wrench with a hammer will insure the nut is tight. Be sure the nut comes to rest in a position where a slot on the nut lines up with a tab on the lock washer. Bend one of the lock washer tabs into a matching slot on the bearing locknut.

c. Thoroughly pack both bearings with an approved lubricant. Note that the space between the bearing and bearing lip seal should be no more than one-half to one-third full of grease to prevent overheating.

d. Press the outboard bearing seal (5-177-4) into the outboard bearing housing. **Note**: Use proper tool for assembly so lip seal does not cock. The bearing seal must be positioned with the lip facing outward. The bearing seal is positioned in this fashion to exclude contaminants. Some grease leakage may occur. Pre-lubricate lip seal with a thin film of grease.

e. Slide the outboard bearing housing (5-025-0) over the shaft and outboard bearing. Place the bearing grease retainer (5-299-4) against the outer race of the outboard bearing and place the snap ring (5-068-4) into the snap ring groove in the outboard bearing housing. Be sure the snap ring is firmly seated in the groove by tapping it with a soft steel punch. The bevel on the snap ring must face away from the outboard bearing.

f. Press the inboard bearing seal (5-177-3) into the inboard bearing cover (5-018-3) with the lip pointing away from the bearing. Press the bearing cover into the inboard end of the frame. The bearing seal is positioned in this fashion to exclude contaminants. Some grease leakage may occur. Pre-lubricate lip seal with a thin film of grease.

g. Slide the shaft assembly, impeller end first, into the outboard end of the frame. This may be best performed vertically. Be careful so the inboard bearing seal does not get damaged.

h. Assemble bolts to hold bearing housing to the frame . Do not tighten the bolts fully until the rotating element is placed into the casing and the impeller clearance is adjusted.

i. Assemble deflectors (5-024-3) and (5-024-4) on both ends of frame.

j. Insert coupling key onto shaft.

WET END:

a. Insert packing base ring (6-152-0), two rings of packing (6-924-0), lantern ring (6-013-0), and the three additional rings of packing in stuffing box using shaft sleeve (1-009-0) as a guide. Remove shaft sleeve from stuffing box. Make sure lantern ring lines up with stuffing box lubrication hole. The last ring of packing may not fit into the stuffing box until the packing gets compressed in service.

b. Install the o-ring (1-914-0) in the shaft o-ring groove.

c. Slide shaft sleeve (1-009-0) over shaft (5-007-0). Position the set screw hole in the shaft sleeve directly over the dimple in the pump shaft. Place the set screw through the sleeve and into the pump shaft using a retaining compound, such as Loctite 271, to lock set screw. Do not over tighten set screw.

d. Place stuffing box cover (2-036-0) onto frame (5-083-0) and secure with two bolts. This may best be performed vertically.

e. Slide packing gland (6-014-0) into position. Tighten gland nuts until "finger tight". Two nuts are provided on each side for locking purposes.

f. If Wear plate is to be replaced, apply retaining compound, such as Loctite 222, to wear plate (2-046-0) and press it into the suction cover (2-091-0). Be sure wear plate seats firmly against machined surface. Chamfered edge must face down.

g. If wear ring is to be replaced, apply retaining compound, such as Loctite 222, to wear ring (4-004-0) and press it in place on the impeller (4-002-0). Be sure wear ring seats firmly against machined surface.

h. Place the impeller key in the shaft keyway and slide impeller on shaft taper.

i. Assemble impeller nut and tighten per instructions. It is very important that the impeller nut be tightened and the locking set screw installed exactly per the instructions. **CAUTION:** DOG POINT OF SET SCREW MUST SEAT IN DRILLED HOLE. IF THIS IS NOT DONE, IMPELLER NUT CAN LOOSEN. FAILURE TO DO SO MAY RESULT IN EQUIPMENT AND/OR PROPERTY DAMAGE. DO NOT OVER TIGHTEN SET SCREW.

j. Place a new casing joint gasket (2-123-9) onto the gasket surface of the stuffing box using a thin film of grease around the gasket.

k. Reassemble the complete rotating element of the pump into the casing. Be careful not to pinch gasket (2-123-9). Insert bolts and washer which secures frame to casing. **NOTE:** When preforming this step, be sure the bearing housing bolts installed in step h of the frame assembly are loose, and remain loose during assembly. Failure to do so may result in damage to the pump bearing housing. Pull the casing bolts down evenly finger tight, making sure frame is not "cocked" in casing. Then start "snugging" bolts. Do not completely tighten each bolt before tightening the next. It is recommended the first bolt be turned 1/2 turn, then tighten the bolt 180° opposite the first, not move to two bolts at the 90° and 270° points and tighten 1/2 turn. Follow this alternating procedure until all bolts are tightened.

l. Check impeller clearance. Adjust the number of shims (5-942-0) to obtain the proper axial clearance between the impeller (4-002-0) and wear plate (2-046-0) indicated in Appendix "A" ("Casing and Impeller Data".

m. Install upper part of pedestal and secure with bolts, nuts, and pins.

n. Replace motor and align pump per "Alignment Procedure".

o. Reconnect power source. Check for proper rotation of motor.

p. Reconnect coupling between pump and driver - recheck alignment.

q. Install coupling guard and secure with screws.

r. Connect the piping to the piping to the stuffing box and turn on sealing liquid.

s. Open valves. Be sure unit is primed before starting.

ADJUSTMENTS:

WEAR RING/PLATE:

The normal operating clearance between the impeller (4-002-0) and wear plate (2-046-0) is found in, ("Casing & Impeller Data").

Wear will eventually increase this clearance, causing pump efficiency to decrease. The rate of wear depends upon the amount of impurities in the pumped liquid, its corrosive effect, and the materials of construction of the impeller and suction cover.

If impeller is equipped with wear ring and suction cover with wear plate, they provide an economically renewable leakage joint between the impeller and suction cover. Both rings are also hardened to withstand abrasive.

IMPELLER CLEARANCE:

Clearance adjustment is required when the operating clearance exceeds twice the clearance specified.

Clearance must be changed by adding or removing shims (5-942-0) at the machined fit between the frame (5-083-0) and outboard bearing housing (5-025-0). The semi-circular shims (5-942-0) are color-coded for ease of identification.

Colors and corresponding thicknesses are as follows:

Blue.005" Pink.015" Clear.030"

To adjust clearance: Remove two cap screws (0-904-4) and place them into the jacking holes. Loosen remaining cap screws. Using the jack screws, open the clearance between the frame and housing. Remove all shims (5-942-0) then re-tighten cap screws until impeller touches the wear plate (2-046-0). Use a feeler gauge or the shims themselves to measure the gap between the outboard bearing cartridge and frame. This gap plus the required running clearance yields the required total thickness of shims.

Remove two cap screws and place them into the jacking holes. Loosen remaining cap screws. Using the jack screws, open the clearance between the frame and housing. This will allow installation of the shims. Reinstall all cap screws and tighten evenly. THE EXACT SAME NUMBER OF SHIMS MUST BE USED IN BOTH SHIM PACKS. Shims should be installed so that jack screw holes are clear of the shim pack.

CASING DESIGN DATA (CAST IRON ONLY) - Dimensions In Inches

Pump Size	Frame Group	Flange ANSI Std. F.F.	Gauge Taps Suct. lbs	Gauge Taps Disch. Std.	Gauge Taps Disch. Max	Min Thickness (In.)	Bolts No.	Bolts Size	Press (psi) With C.I. Casing Working	Press (psi) With C.I. Casing Hydrostatic
4x4x10 SC						7/16				
4x4x10 LC						7/16				
4x4x12 LC	F7-M3	125	1/4	3/4	1-1/2	1/2	8	5/8	75	115
5x5x12						1/2				
6x6x12 SC						1/2				
6x6x12 LC	F7-K2	125	1/4	3/4	1-1/2	1/2	8	5/8	75	115
6x4x14 LC									100	150
6x4x14 CV									100	150
6x6x14	F7-D3	125	1/4	3/4	1-1/2	9/16	8	3/4	100	150
8x8x14									50	75
5x5x17 *(1)*									130	195
6x6x17 *(1)*									110	165
8x8x17 SC	F7-B4	125	1/4	1	2	5/8	8	3/4	75	115
8x8x17 LC									75	115
8x8x21									75	115
10x10x21 SC									75	115
10x10x21 LC	F7-C4	125	1/4	1	2	3/4	16	7/8	75	115
12x12x21									50	75

(1) Duron Metal Casing Furinished as Standard on These Sizes

IMPELLER DESIGN DATA - Dimensions In Inches

Pump Size	Frame Group	Diameter Max.	Diameter Min Recommended	No Of Vanes	Back Vane *(1)*	Max. Sphere No.	Inlet Dia	Inlet Area (Sq. In.)	Inlet Vel. Ft./sec./ 100 GPM	Recommended Operating Clearance
4x4x10 SC		9 3/4	7		BV	2-7/16	2 7/8	6.5	4.95	
4x4x10 LC		9 7/8	7		NBV	3	4	12.6	2.55	
4x4x12 LC	F7-M3	11-15/16	9	2	NBV	3-7/16	4	12.6	3.55	.015
5x5x12		11-15/16	8		BV	3-1/4	5	19.6	1.65	
6x6x12 SC		11-15/1	8		BV	3-1/4	5	19.6	1.65	
6x6x12 LC	F7-K2	11-15/16	9	2	BV	3-5/8	6	28.2	1.14	.015
6x4x14 LC			10			3	5	19.6	1.65	
6x4x14 CV			10			3	5	19.6	1.65	
6x6x14	F7-D3	14	11	2	BV	3-7/16	6	28.2	1.14	.015
8x8x14			11			4-1/16	8	45.7	0.70	
5x5x17			12			4-3/16	5	19.6	1.65	
6x6x17			12			4-1/16	6	28.2	1.14	
8x8x17 SC	F7-B4	17	14	2	BV	4	8	50.3	.064	.015
8x8x17 LC			14			5	8	50.3	.064	
8x8x21						5-1/16	8	50.3	.064	
10x10x21 SC						5-1/16	8	50.3	.064	
10x10x21 LC	F7-C4	21	16	2	BV	6-1/16	10	78.5	.041	.020
12x12x21						6-1/16	12	113.0	0.29	

(1) BV - Back Vanes; NBV - No Back Vanes

PACKED STUFFING BOX DATA - Dimensions In Inches

Pump Size	Frame Group	Length	Bore	Sleeve Diameter	Packing		Lantern Ring (Seal Cage) Width	Connection to Seal Cage (NPT)
					No. of Rings	Size		
4x4x10 SC 4x4x10 LC 4x4x12 LC 5x5x12 6x6x12 SC	F7-M3	2-21/32	3-1/8	2-3/8	5	3/8	1/2	1/4
6x6x12 LC	F7-K2	2-15/16	4-1/4	3-1/2	5	3/8	5/8	1/4
6x4x14 LC 6x4x14 CV 6x6x14 8x8x14	F7-D3	3-13/16	4-1/2	3-1/2	5	1/2	1	1/2
5x5x17 (1) 6x6x17 (1) 8x8x17 SC 8x8x17 LC	F7-B4	3-13/16	4-1/2	3-1/2	5	1/2	1	1/2
8x8x21 10x10x21 SC 10x10x21 LC 12x12x21	F7-C4	5-13/32	6-3/4	5-1/4	5	3/4	1-1/4	1/2

DOUBLE MECHANICAL SEAL STUFFING BOX - Dimensions In Inches

Pump Size	Frame Group	Length	Stationary Seat Bore	Sleeve Diameter	Double Mechanical Seal (Std)			Seal Water Connection	
					Size	Type	Code(1)	IN	Out
4x4x10 SC 4x4x10 LC 4x4x12 LC 5x5x12 6x6x12 SC	F7-M3	2-21/32	3-1/8	2-3/8	5	Type 21	$BF_{50}171$	1/4	1/4
6x6x12 LC	F7-K2	2-15/16	4-1/4	3-1/2	5	Type 21	$BF_{50}171$	1/4	1/4
6x4x14 LC 6x4x14 CV 6x6x14 8x8x14	F7-D3	3-13/16	4-1/2	3-1/2	5	Type 21	$BF_{50}171$	1/2	1/4
5x5x17 6x6x17 8x8x17 SC 8x8x17 LC	F7-B4	3-13/16	4-1/2	3-1/2	5	Type 21	$BF_{50}171$	1/2	1/4
8x8x21 10x10x21 SC 10x10x21 LC 12x12x21	F7-C4	5-11/32	6	5	5	Type 21	$BF_{50}171$	1/2	1/4

(1) Seal Code: B - Buna N Bellows; F50 - Carbon rotating Seal ring,
I - Stainless Steel Metal Parts; 7 - Ni-Resist Sationary Seal ring,
-I - Stainless Steel Springs

SEAL LUBRICATION PRESSURE:

Packing must be lubricated with a clear particle free (50 microns maximum) liquid at a pressure sufficient to overcome the stuffing box pressure.

This can best be performed by using a filtered pressurized seal water system providing up to 1/4 GPM flow to the packing.

If seal water supply is from an external; source, pressure requirements can be estimated as follows:

-Pumps with impeller back vanes:

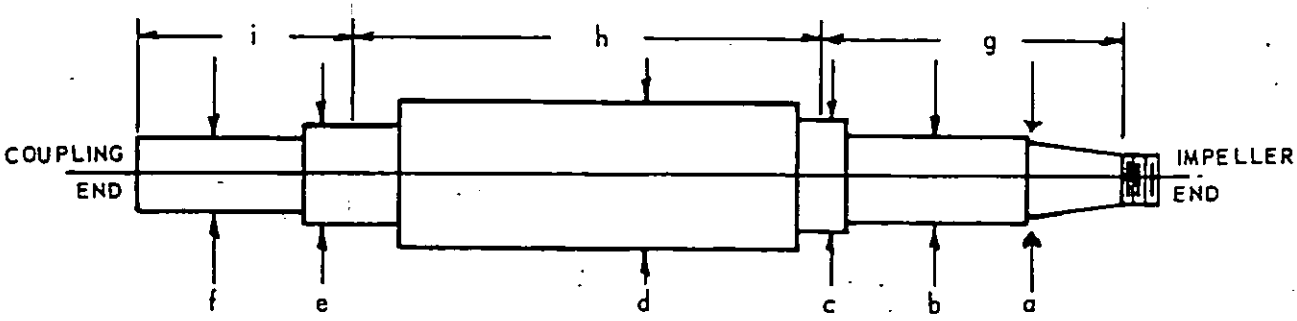
$$\text{Seal Water Pressure} = \{.5\ [\text{maximum total developed head (ft.)} + \text{suction head (ft:)}] \times \frac{1\ \text{psi}}{2.31\ \text{ft.}} \} + 20\ \text{psi}$$

Model 100-200-300 PUMPS
Shaft and Bearing Data - Dimension in Inches
Mechanical Seal

Each pump performance curve shows the correct bearing frame. The bearings selected for these bearing frames provide satisfactory service for the range of performance shown on the performance curve. The bearings are sized for 20,000 hours or 2 years minimum life (ANSI B10) based on continuous duty (24 hours per day) when operating at 50% of the best efficiency point (BEP) capacity. Computer generated bearing life, and shaft analyses are available from the factory at nominal cost.

Identifying Data	F7-M3	F7-K2	F7-D3	F7-B4	F7-C4
SHAFT DIMENSIONS					
Under Impeller (a) (1)	1 3/8	1 61/64	1 61/64	2 1/8	3
Under Shaft Sleeve (b)	1 3/4	2 1/2	2 3/4	3	4 1/2
At Inboard Bearing (c) (Nom.)	2 5/32	2 9/16	2 49/64	3 11/32	4 23/32
Between Bearings (d)	2 3/8	2 3/4	2 15/16	3 11/16	5 3/8
At Outboard Bearing (e) (Nom.)	1 49/64	1 49/64	2 23/64	2 61/64	4 21/64
At Coupling (f)	1 1/4	1 1/4	1 3/4	2 3/8	2 7/8
Impeller Nut (Size - Threads/Inch)	3/4 - 10	1 - 8	1 - 8	1 1/4 - 7	1 1/2 - 6
SHAFT LENGTHS					
Impeller End of Shaft to Centerline of inboard Bearing (g)	8 23/32	9 23/32	10 3/4	12 11/32	16 5/16
Between Centerline Bearings (h)	7 11/32	7 3/8	10	12 25/32	21 1/8
Centerline of Outboard Bearing to Coupling End (i)	4 9/16	4 5/8	7 1/2	7 3/4	9 13/16
Coupling Fit	4 11/16				
BEARINGS					
Inboard(1)	U-1311B	U-1213B	U-1314B	U-1317B	U-1224B
Outboard	5309	5309	5312	5315	5222
KEYWAY AT IMPELLER					
Width	1/4	3/8	3/8	1/2	3/4
Depth	1/8	3/16	3/16	1/4	3/8
Length	1 1/2	1 3/8	2 5/8	3 1/4	3 1/2
KEYWAY AT COUPLING					
Width	1/4	1/4	3/8	3/8	3/4
Depth	1/8	1/8	3/16	5/16	3/8
Length	2 1/4	2 1/4	4	4 1/4	5 7/8

(1) Impeller End is Tapered.



PUMP WEIGHTS

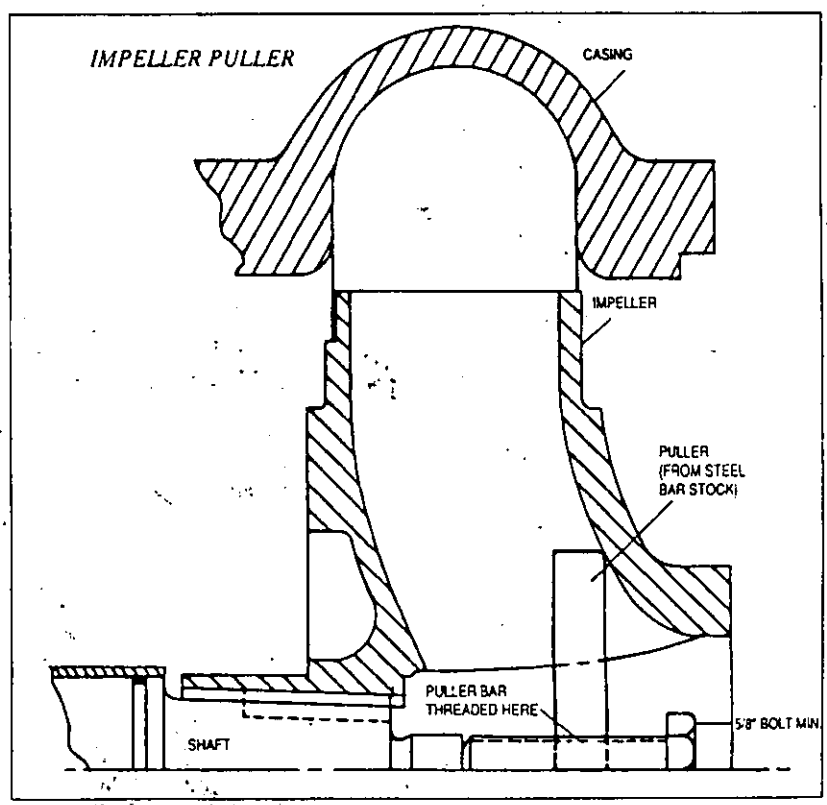
Pump Size	Frame Group	Weight (Pump, Pedestal & Guard)
4x4x10 SC	F7-M3	900#
4x4x10 LC		900#
4x4x12 LC		1200#
5x5x12		1240#
6x6x12 SC		1250#
6x6x12 LC	F7-K2	1290#
6x6x14 LC	F7-D3	1550#
6x4x14 CV		1550#
6x6x14		1700#
8x8x14		2060#
5x5x17	F7-B4	1770#
6x6x17		1870#
8x8x17 SC		2080#
8x8x17 LC		2150#
8x8x21	F7-C4	3800#
10x10x21 SC		4090#
10x10x21 LC		4140#
12x12x21		4350#

APPENDIX "B"

TOOLS

To disassemble and assemble pump, use conventional tools.

As an aid in removing the impeller from the tapered shaft fit, a simple puller, such as the one shown at the right, can be made and used.

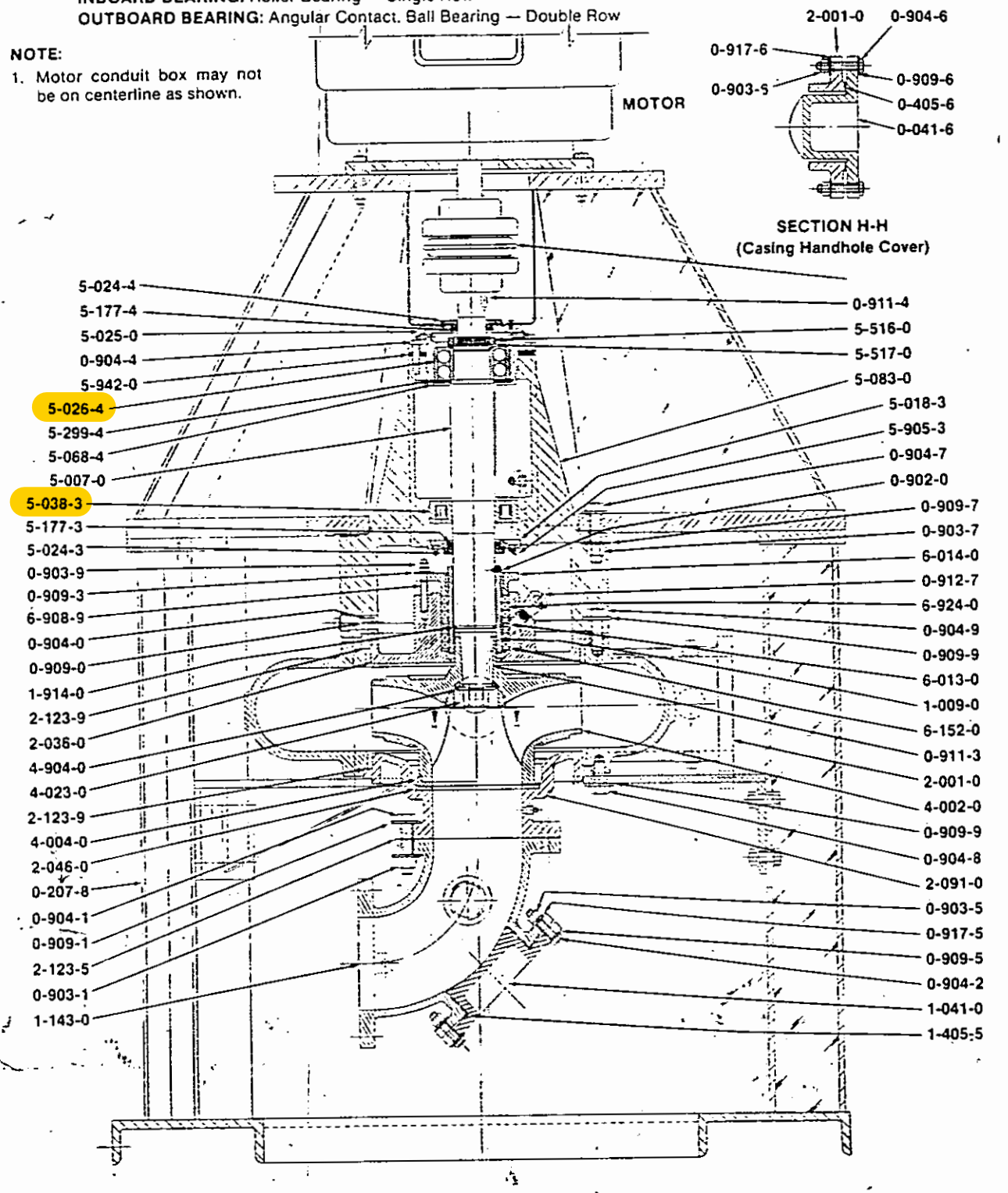


ITT A-C Pump
A unit of ITT Corporation

SPECIAL PURPOSE PUMPS
For Wastewater with Soft Solids — Type NSWV
Vertical Direct-Coupled Pumps — Model 300 PEG
Typical — Parts and Materials — Packing

FRAMES: F7-M3, F7-K2, F7-D3, F7-B4 and F7-C4
INBOARD BEARING: Roller Bearing — Single Row
OUTBOARD BEARING: Angular Contact, Ball Bearing — Double Row

NOTE:
1. Motor conduit box may not be on centerline as shown.



TECHNICAL NOTE:

The Model 300 PEG Base was developed by ITT A-C Pump for application to conditions of operation that include rotating speeds that may excite vibration levels above hydraulic institute limits. Using the Model 300 PEG Construction assures that resonant frequency vibrations from the pump and motor will not occur. The need for this design is a function of the size of pump, operating speed range, and the weight of the motor.

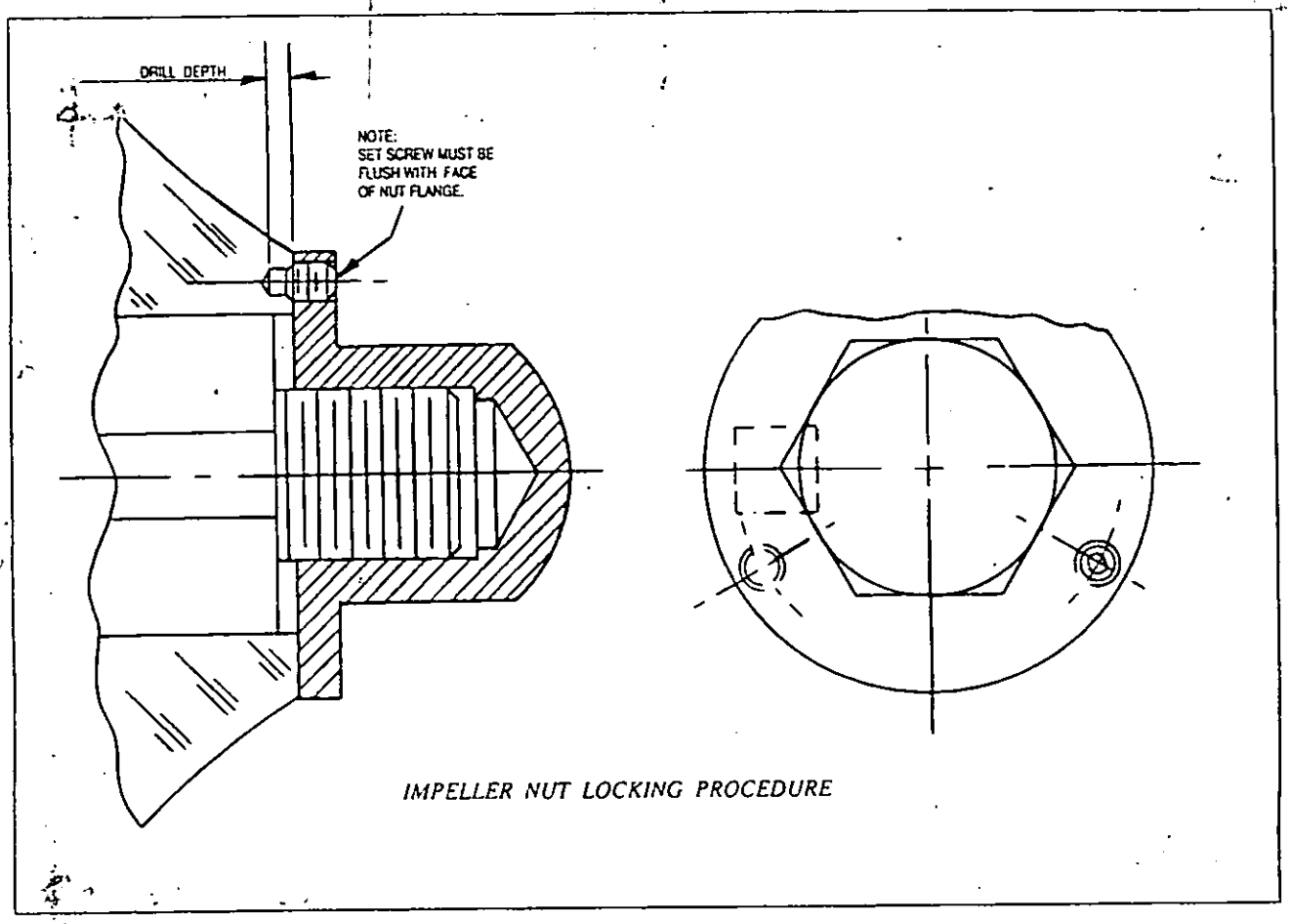
Request a factory check on all variable speed applications.

Catalog Number	Part Name	Material Options	
		II All Cast Iron ①	Optional
0-031-0	Coupling, Shaft	Flexible — ITT A-C Choice	
0-041-6	Cover Handhole (Casing)	Cast Iron — Class 30	
0-207-8	Pedestal PEG — Assembly	Fabricated Steel	
0-405-6	* Gasket, Handhole (Casing)	Rubber	
0-902-0	Screw, Set (Sleeve)	Steel	
0-903-1	Nut, Suction Elbow	Steel	
0-903-5	Nut, Handhole (Suction Elbow)	Steel	
0-903-6	Nut, Handhole (Casing)	Steel	
0-903-7	Nut, PEG Frame Support	Steel	
0-903-9	Nut, Gland Adjusting	Steel	
0-904-0	Screw, Stuff. Box Cover	Steel	
0-904-1	Screw, Suction Elbow	Steel	
0-904-2	Screw, Handhole (Suction Elbow)	Steel	
0-904-4	Screw, Bearing Housing	Steel	
0-904-6	Screw, Handhole (Casing)	Steel	
0-904-7	Screw, PEG — Frame Support	Steel	
0-904-8	Screw, Pedestal	Steel	
0-904-9	Screw, Casing to Frame	Steel	
0-909-0	Washer, Stuff. Box Cover Screw	Steel	
0-909-1	Washer, Suction Elbow	Steel	
0-909-3	Washer, Gland	Steel	
0-909-5	Washer, Handhole (Suct. Elbow)	Steel	
0-909-6	Washer, Handhole (Casing)	Steel	
0-909-7	Washer, PEG Frame Support	Steel	
0-909-9	Washer, Casing Screw	Steel	
0-911-3	Key, Impeller	Steel	
0-911-4	Key, Coupling	Steel	
0-912-7	Elbow, Flush	Steel	
0-917-5	Washer, Lock, Handhole (Suct. Elbow)	Steel	
0-917-6	Washer, Lock, Handhole (Casing)	Steel	
1-009-0	* Sleeve, Shaft	420 Hard. Stn. Stl. (500 BHN)	
1-041-0	* Cover, Handhole (Suction Elbow)	Cast Iron — Class 30	
1-143-0	* Elbow, Suction	Cast Iron — Class 30	
1-405-5	* Gasket, Handhole (Suct. Elbow)	Rubber	
1-914-0	* O-Ring, Shaft	Synthetic Rubber	
2-001-0	Casing ②	Cast Iron — Class 30	
2-036-0	Cover, Stuff Box	Cast Iron — Class 30	
2-046-0	Plate, Wear (Suction Cover) ③	~~AISI 410 S.S.~~	Stainless Steel 420
2-091-0	Cover, Suction	Cast Iron — Class 30	
2-123-5	* Gasket, Suction Elbow	Sheet Packing	
2-123-9	* Gasket, Casing Joint	Sheet Packing	
4-002-0	* Impeller, Enclosed ④	~~Cast Iron — Class 25~~	1.5% NI-Cast Iron
4-004-0	* Ring, Wear (Impeller) ③	~~Optional~~	Stainless Steel 410
4-023-0	* Nut, Impeller	18-8 S.S.	
4-904-0	* Screw, Set (Impeller Nut)	18-8 S.S.	
5-007-0	Shaft — Tapered (Imp. End)	AISI 1045 Steel	
5-018-3	* Cover, Bearing (Inboard)	Cast Iron — Class 30	
5-024-3	Deflector (Inboard)	Synthetic Rubber	
5-024-4	Deflector (Outboard)	Synthetic Rubber	
5-025-0	Housing, Bearing (Outboard)	Cast Iron — Class 30	
5-026-4	* Bearing, Ball (Outboard)	SKF or Equal	
5-038-3	* Bearing, Roller (Inboard)	Rollway or Equal	
5-068-4	Ring, Snap (Bearing Housing)	Steel	
5-083-0	Frame	Cast Iron — Class 30	
5-177-3	* Seal, Bearing (Inboard)	Garlock or Equal	
5-177-4	* Seal, Bearing (Outboard)	Garlock or Equal	
5-299-4	* Retainer, Grease (Outboard)	Steel	
5-516-0	Nut, Lock (Bearing)	Steel	
5-517-0	Washer, Lock (Bearing)	Steel	
5-942-0	* Shims, Adjusting	Plastic	
6-013-0	Ring, Lantern	Teflon	
6-014-0	Gland, Packing	Bronze	
6-152-0	Ring, Packing Base	Steel	
6-908-9	Stud, Gland	Stainless Steel	
6-924-0	* Ring, Packing (Set)	~~Graphited Yarn — Non Asbestos~~	John Crane #K-1730

① Cast Iron: ASTM A-48
② Ductile Iron standard on 5x5x17 & 6x6x17.
* Recommended spare parts.

③ Wear Ring Hardness: 300 BHN — 325 BHN (CP5.4a Pg. 233)
Wear Plate Hardness: 435 BHN — 500 BHN (CP5.4a Pg. 233)
④ Ductile Iron standard on F7-D & F7-B frame impellers.

ENG. DATA



IMPELLER NUT LOCKING PROCEDURE

Set Screw	Drill Size	Drill Depth
10 - 24	9/64 (.1406)	.156
.25-20	#10 (.1935)	.187
.312-18	17/64 (2.66)	.218
.375-16	21/64 (.328)	.250
.5 - 13	(.413)	.312

INSTRUCTIONS:

1. Assemble impeller on shaft and mark position of key on impeller.
2. Assemble impeller nut and tighten to 90 ft. - lbs.
3. Select a screw hole away from the key, use drill size listed above (to pass through tapped hole) and drill hole in impeller as specified.
4. Apply Loctite #271 to set screw and assemble set screw into drilled hole and tighten to 10 ft.-lbs. Set screw must be flush with face of flange on the nut.
5. To remove set screw, apply propane torch to set screw until able to remove with wrench.

APPENDIX C

RECOMMENDED SPARE PARTS LIST AND PARTS ORDERING INSTRUCTIONS

QTY	CATALOG CODE	DESCRIPTION
1	1-009-0	Shaft Sleeve
2	1-914-0	O-Ring, Shaft
2	2-123-9	Gasket (Suction Cover)
2	2-123-9	Gasket (Stuffing Box Cover)
2	0-405-6	Gasket (Hand hole Cover)
1	4-002-0	Impeller (Enclosed)
1	4-023-0	Impeller Nut
2	4-904-0	Impeller Locking Set Screw
1	5-038-3	Roller Bearing (Inboard)
1	5-026-4	Ball Bearing (Outboard)
1	5-068-4	Ring, Snap (Bearing Housing)
1	5-177-3	Seal, Bearing (Inboard)
1	5-177-4	Seal, Bearing (Outboard)
1	5-299-4	Retainer, Grease (Outboard)
1	5-942-0	Shims, Adjusting
1	6-924-0	Packing (Set)

INSTRUCTIONS FOR ORDERING PARTS

Then ordering parts for NSWV pumps, be sure to furnish the following information to the ITT A-C Pump stocking distributor in your area:

Serial Number
Pump Size & Type
Pump Model Number
Description of Part
Catalog Code
Quantity Required
Definite Billing and Shipping Instructions
Date Required

Parts should be ordered as far in advance of their need as possible, since circumstances beyond the control of the company may reduce existing stocks. All parts are not carried in stock. Some are made for each order. Recommended spare parts to be carried on hand are included in the paragraph above and should be given definite consideration. It replacement parts required are to be made of different materials than originally specified, give exact requirements and the reason for changing. Special care in furnishing the above information with the original order for parts will facilitate shipment.