

**INSTALLATION, OPERATION
AND
MAINTENANCE MANUAL
FOR
ROPER
PROGRESSING CAVITY
PUMP MODELS
74B065, 764065, 794065, 71B115,
724115, 744115, 76C115, 714175,
724175, 74C175, 71C335 & 72C335
TYPE 4**



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NOTE: BOLD FACE TOPICS CONTAIN IMPORTANT SAFETY INFORMATION.

1. INTRODUCTION

! IMPORTANT

THIS MANUAL MUST ACCOMPANY THE PUMP UPON ALL TRANSFERRALS. MAKE SURE THE OPERATOR OF THE EQUIPMENT HAS READ AND UNDERSTANDS THIS MANUAL BEFORE OPERATING THE PUMP OR ANY RELATED EQUIPMENT.

When properly selected, installed, operated and maintained, Roper pumps will provide long, dependable service. Remember, faulty selection and installation form the basis of more pump troubles than all other causes combined. No amount of maintenance can compensate for selection and installation mistakes. Read and understand this manual carefully before installing or operating this pump.

This pump is satisfactory for its rated conditions. Yet, its operation beyond these conditions may subject it to stresses and strains that it is not designed to withstand.

Install ample coupling or belt guards for the protection of the crew.

This manual will cover standard pumps and most spec. number pumps. Appearance may vary among pumps and construction may vary on spec. number pumps. Specification numbers are assigned to pumps with other than standard features.

If there is any question concerning the ratings, instructions or compatibility of the pump with the pumped liquid, consult a distributor or the home office of:

Roper Pump Company
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! IMPORTANT

Read the following before starting the pump! Failure to heed these warnings may result in an accident causing physical damage, serious personal injury or death!

- Read and understand all tags and installation and operating instructions.
- **WARNING!** Install proper guard(s). NEVER operate pump without guard(s) in place. Even with proper guard(s) installed, always use caution near rotating parts including the drive system for the pump.
- Know the operating conditions.
- Open all lines before starting pump.

- **WARNING! DO NOT** operate this equipment in excess of its rated capacity, pressure, speed, and temperature or other than according to the instructions contained in this manual.
- **DANGER! TOXIC! DO NOT** run the pump dry. Running dry (flow less than 10% of normal) is harmful to the pump and will cause rapid heating of the pump due to internal friction. This friction may cause the rubber element of the stator to smoke, possibly releasing toxic fumes from fluoroelastomer (FKM) stators. Devices should be installed in the suction piping to prevent dry operation of the pump. The chance of the release of toxic vapors into the system piping must be considered if FKM stators are used. Adequate provision for proper venting of the system piping must be made prior to any maintenance work, if dry operation is suspected.
- **WARNING!** Install and properly set devices into the system to prevent the chance of too much pressure, high temperature, and driver overload. The pump is not provided with these devices.
- **WARNING!** Proper measures and safeguards must be taken to avoid spillage and overflow from overfilling or putting too much pressure on any component of the system. This includes the receiver and lines.
- *These instructions cannot possibly cover every situation concerning the operation, inspection, adjustment, and test of the equipment furnished. Roper Pump Company must presume that the crew using this pump has ample knowledge and training to apply sound safety and operational practices that may not be mentioned.*

2. SAFETY PRECAUTIONS

WHEN LIQUID BEING PUMPED IS HAZARDOUS OR VOLATILE, FULL PRECAUTIONS SHOULD BE TAKEN ALWAYS. THIS INCLUDES THE RUN-IN PERIOD AND DURING DIS-ASSEMBLY AND ASSEMBLY OF PUMP.

Controls, guards, walkways, machine arrangement, crew training, etc., are all necessary factors in the creation of a safe, practical installation and are generally not a part of our services. *It is the responsibility of the contractor, installer, owner and user to add to the materials furnished by Roper to result in a safe installation and to comply with OSHA, state and local laws, and the ANSI Safety Code.*

There are many kinds of devices for pumps and systems such that if one component in a system is stopped, other equipment feeding or following it, also can be automatically stopped. Serious thought should be given to the installation of these types of devices in every pump system.

- **DO NOT** attempt to install, operate or perform maintenance on this equipment without first reading and understanding the material in this manual. Also, read and understand all tags and any other documentation accompanying the pump.
- **DO NOT** operate this equipment in excess of its rated capacity, pressure, speed or temperature or other than according to the instructions contained in this manual.
- **DO NOT** continue to operate this equipment if there is a failure of any part of the equipment or system. Correct the failure before operating the equipment.
- **DO NOT** bypass safety controls or guards. Their purpose is to protect and they must be in proper working order.
- **DO NOT** operate equipment without proper guards in place.
- **DO NOT** walk, stand, sit or lean on guards.

- **DO NOT** work on a pump while it is operating.
- **DO NOT** place hands, feet, head or any other part of your body in any pump opening while the pump can be operated.
- **DO NOT** poke or prod material in the pump with any object.
- **DO NOT** work on this equipment if there is the slightest chance of it becoming energized by accident. Lockout the energy source to the driver and disconnect the coupling before performing maintenance to the equipment.
- **DO NOT** run the pump dry. Running dry (flow less than 10% of normal) is harmful to the pump and will cause rapid heating due to internal friction. This friction also may cause the rubber element of the stator to smoke possibly releasing toxic fumes.
- **DO NOT** wear loose or dangling clothing or jewelry near the equipment. It could become caught and possibly cause serious injury.
- **DO NOT** use metallic or hard faced striking tools when the need for tapping parts into position arises. Hard faced striking tools may damage parts or they may fracture or chip and send particles flying that could cause possible injury.
- **DO NOT** allow spills to remain in the work area. Clean up spills immediately. Oils, greases and other fluids used in the equipment may create hazards if not cleaned up immediately after a spill.
- **DO NOT** spin bearings with compressed air. This is highly dangerous and can cause the bearing to fragment with explosive force possibly causing serious injury or death.
- **DO NOT** attempt to install, use or repair this equipment while under the influence of any substance that may impair physical or mental abilities. This includes, but is not limited to, alcohol and prescription and nonprescription drugs.
- **DO NOT** dispose of fluoroclastomers by burning. Toxic vapors are released by this compound upon combustion.
- **DO** completely read and understand the information contained in this manual. The operator of the equipment must be familiar with these instructions.
- **DO** always keep safety in mind.
- **DO** know the operating conditions of the equipment.
- **DO** take proper measures and precautions to avoid spillage and overflow from overfilling or putting too much pressure on any component of the system.
- **DO** identify all possible hazards and decide what controls are needed. Remember, only you understand your product and system characteristics fully. *The ultimate responsibility for the application and safety is with you.*
- **DO** install and properly set devices into the system to prevent the chance of dry operation, overpressure, excessive temperature and driver overload.
- **DO** provide guards for all exposed rotating parts, including parts of the drive system, to prevent possible injury.
- **DO** be careful when working near an operating pump. Contacting or getting caught in rotating parts could cause serious or fatal injury.

- **DO** keep equipment in good working order, especially safety devices and guards.
- **DO** always know your position about the equipment.
- **DO** wear proper clothing near the equipment. Safety glasses or goggles, and safety shoes are recommended. They will help reduce the chance of injury.
- **DO** use soft faced striking tools when the need for tapping parts into position arises. Rubber or plastic faced striking tools are recommended.
- **DO** practice good housekeeping. Clean up spills immediately. Keep the work area clean to avoid hazards. Always be sure of your footing around the equipment to avoid a possible fall and injury.
- **DO** use proper tools. Avoid *cheater* bars as they are a source for serious injury should they slip or break.

3. PRE-OPERATION CHECKS

Read and understand the instructions and recommendations contained in this manual.

Test the rotation of the driver to make sure it will operate the pump in the desired direction of rotation. Normal rotation is shown on the pump drive end. The driver rotation test must be done with the driver and pump disconnected. **DO NOT** run pump dry. Dry operation is harmful to the pump.

Before the initial startup, some fluid to be pumped should be introduced into the inlet body to insure wetting of the pumping elements. (On subsequent startups, if the pump does not discharge fluid after it has been operating for one minute, it should be reprimed.) Turn on the flush liquid to the packing, if applicable.

After starting the unit, check to see that the pump is delivering liquid. If not, stop the driver immediately and refer to the section on Checking Pump Performance. After the pump is delivering liquid, check the unit for excessive vibration, localized heating, and excessive packing leakage. Check the pressure or vacuum by installing gauges at both the inlet and discharge sides of the pump to make sure the pressure or vacuum conform to specifications.

! WARNING

If there is no pressure relief device in the system, **NEVER** block the discharge line. High pressure will occur, resulting in possible damage or breakage to the pump or system parts and possible injury to personnel. Even with a pressure relief device in the system, **DO NOT** operate the pump for more than a few seconds with the discharge line blocked. Rapid heating and possible damage will occur. Even an open discharge line does not prevent the possibility of high pressure. Discharge line length, diameter, and arrangement along with fluid viscosity and velocity also can create a high pressure situation at the pump.



WARNING! Do not overpressurize pump or system.

4. PREPARATION OF FOUNDATION

Locate the pump so that it is as low and as close to the fluid source as practical and so that piping to and from the pump will be as short and simple as practical. The pump and its driver must be accessible for inspection and maintenance. Accessibility to the unit and adequate clearance should be a major thought in any installation. The driver must be suitable for the environment (for example, open, splash proof, totally enclosed or explosion proof electric motor). If the driver is not suitable, choose a different location or obtain another driver.

For best pump-driver unit life, mount each unit on a strong, fabricated, structural steel baseplate with a proper foundation. A good foundation is of major importance to the total installation. A thick, heavy concrete foundation is best, since it is heavy enough to support the baseplate rigidly and absorb strain and shock. Locate anchor bolts for the baseplate in the foundation. Use a pipe sleeve, two to three times as large as the anchor bolts, around the anchor bolts to allow some lateral bolt movement during final positioning of the unit.

Place the unit, with the pump and driver mounted on the baseplate, on the foundation and disconnect the coupling (flexible coupling, belts and sheaves, etc.). **DO NOT** reconnect the coupling until all alignment operations are complete. Support the baseplate on rectangular metal blocks and shims or on metal wedges having a small taper. Place the support pieces close to the anchor bolts and directly under the part of the baseplate carrying the greatest weight. Space the support pieces close enough to give uniform support. Allow a gap of about $\frac{3}{4}$ inch (19 mm) to $1\frac{1}{2}$ inches (38 mm) between the foundation and baseplate for grouting. Refer to Fig. 1.

Adjust the metal supports or wedges until the shafts of the pump and driver are level. At this time, check the faces of the inlet and discharge connections of the pump for horizontal or vertical position using a level. Correct the positions, if necessary, by adjusting the supports or wedges under the baseplate as required.

For maximum rigidity and lower noise levels, grout the baseplate to the foundation. Use a good grade of nonshrink grout. When all alignments are correct (refer to section on Aligning Driver and Pump), tighten the anchor bolts evenly but not too firmly. Then grout the unit to the foundation. Completely fill the baseplate with grout. It is desirable to grout the leveling pieces, shims, or wedges in place. Fill the spaces between the anchor bolts and sleeves with grout, also. Allow the grout to dry according to the manufacturer's instructions. **DO NOT** fully tighten the anchor bolts until the grout has hardened.

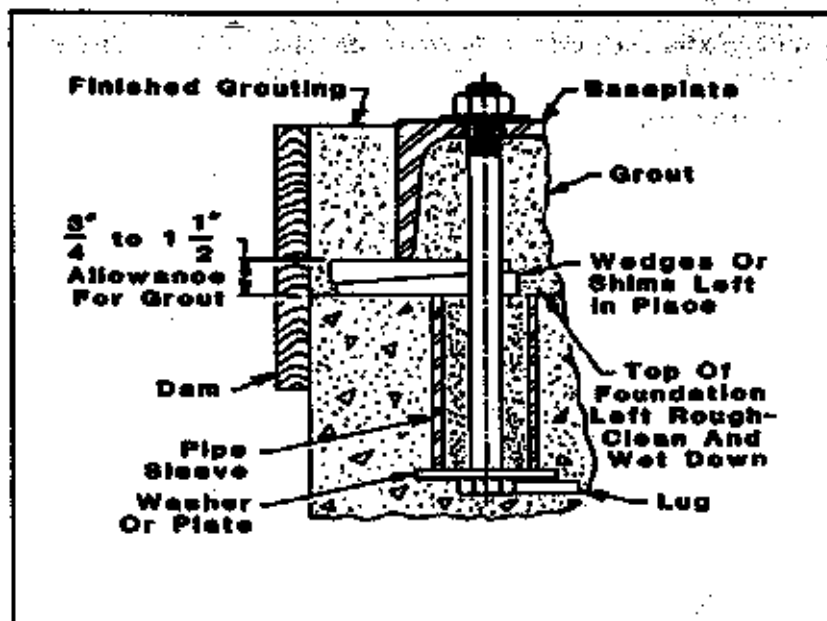


Fig. 1: Typical Baseplate Anchoring

After the grout has hardened and the anchor bolts have been properly tightened, check the unit for parallel and angular misalignment, and if necessary, take corrective measures. After the piping to the unit has been connected, check the alignment again.

- NOTE: Attempts to correct alignment in one direction may alter the alignment in the other direction. Therefore, it is necessary to check alignment in all directions after making any adjustments.

Schedule semi-annual inspections and checks of the foundation anchor bolts as part of a preventive maintenance program. If loose foundation bolts are found, tighten them and check the unit alignment.

Normal mounting for this pump is horizontal with the pump above the baseplate, properly grouted to a concrete foundation placed in or on solid earth. Mountings other than described

above (such as vertical mounting, wall mounting, ceiling mounting, etc.) may require that special components and precautions be used. Extra pump supports, special drivers, extra anchor bolts may be necessary in unusual mountings. If your application requires other than normal mounting, as described above, you are urged to consult Roper Pump Company for assistance in determining any special needs that may be required.

5. ALIGNING DRIVER AND PUMP

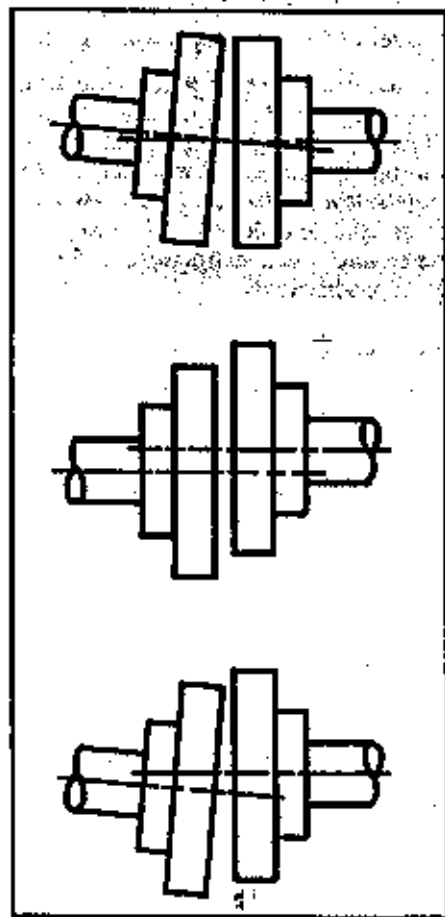


Fig. 2 Misalignments: Top, Angular; Center, Parallel; Bottom, Both.

Driver and pump units built at Roper are factory aligned before shipment. Still, the flexible coupling or belts and sheaves must be accurately realigned during and after installation. Refer to the flexible coupling or belt and sheave manufacturer's recommendations and instructions for the requirements for proper alignment. Also refer to the section on Preparation of Foundation for additional information.

FLEXIBLE COUPLING

DO NOT use a flexible coupling to compensate for misalignment of the driver and pump shafts. The purpose of the flexible coupling is to compensate for temperature changes and to permit end movement of the shafts without interference with each other while transmitting power from the driver to the pump.

The faces of the coupling halves should be spaced far enough apart so that they cannot strike each other when the driver rotor is moved hard over toward the pump. Allowance should be made for wear of the thrust bearings. The necessary tools for approximate checking of the alignment of a flexible coupling are a straight edge and a taper gauge or a set of feeler gauges.

There are two forms of misalignment between the driver shaft and the pump shaft. The first is angular misalignment, where the axes of the shafts are concentric but not parallel. The other is parallel misalignment, where the axes of the shafts are parallel but not concentric. Refer to Fig. 2.

Make the check for angular alignment by inserting the taper gauge or feeler gauges between the coupling faces and comparing the distance between the faces at four points spaced at 90° intervals around the coupling. The unit will be in angular alignment when the measurements show that the coupling faces are the same distance apart at all points.

Make the check for parallel alignment by placing a straight edge across both coupling halves at the top, bottom, and at both sides. The unit will be in parallel alignment when the straight edge rests evenly on the coupling halves at all positions. Allowance may be necessary for temperature changes and for coupling halves that do not have the same outside diameter. Take care to have the straight edge parallel to the axes of the shafts.

Correct angular and parallel misalignment by placing shims under the mounting feet of the equipment. After each change, it is necessary to recheck the align-

ment of the coupling halves. Adjustment in one direction may disturb adjustments already made in another direction.

! WARNING

Make sure there is no chance of the driver becoming energized while aligning driver and pump. Getting caught in rotating parts of the drive system may cause serious personal injury or death. **DO NOT** start or operate pump without guards in place.

BELTS AND SHEAVES

The driver and pump shafts must be parallel, and the belts at right angles to these shafts. Misalignment will cause undue belt wear, or turn-over in the grooves. *Approximate* alignment should be checked by placing a long straight edge evenly across the rims of both sheaves. If the faces of the sheaves are not of equal width, the alignment may 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 should be mounted with adequate provision for belt center distance adjustment. Provide a minus adjustment to permit belt installation without stretching and a plus allowance to provide belt take-up.

DO NOT pry, twist, or force the belts over the sheave grooves. This will damage the belts and greatly reduce the 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 center distance until proper belt tension is obtained. Adjust take-up until only a slight bow appears on the slack side of the drive when it is operating. All the belts must be pulling evenly. Belt tension should be reasonable. It is not necessary to have belts excessively tight.

! WARNING

With guard removed, visually inspect belts only. Align or adjust belts with energy source to driver locked out to prevent operation. Getting caught in rotating parts of the drive system may cause serious personal injury or death. **DO NOT** start or operate pump without guards in place.

During the first few days of operation, the belts will seat themselves in the sheave grooves. After that, the drive must be adjusted to take up the slack. Slipping belts will result in lowered capacity. Squealing or smoking belts are sometimes a clue to the slipping of belts but not always.

Keep belts clean and free from oil. Clean oily belts with a cloth dampened with soap and water. Stop drive to clean belts. **DO NOT** attempt to clean belts while the drive is operating. Never install new belts on the same drive with used belts. **DO NOT** use sheaves with chipped or worn grooves. For hazardous locations, check to see if an antistatic belt should be used. When purchasing replacement belts, the same size and type should be ordered as furnished originally.



WARNING! Do not operate without guards in place.



WARNING! Do not operate without guards in place.

6. ADDITIONAL IMPORTANT WARNINGS AND INFORMATION

- This manual cannot possibly cover every situation concerning the use, inspection, adjustment, and test of the pump furnished. Roper must presume that the crew using this pump have ample knowledge and training to apply sound safety and operating practices that may not be mentioned.
- Roper pumps are general purpose pumps for a wide range of uses; yet, they are not designed nor intended for use with every known substance. It is, therefore, not practical to include performance or maximum ratings in this manual. Roper sales brochures contain standard ratings for the type of pump involved. If you do not have ratings or performance properties for your pump, they may be obtained by contacting a Roper distributor or Roper Pump Company.
- Review this manual to figure out the proper union of the pump into the total plant or system operating programs.
- Roper does not supply, recommend or approve the systems in which its pumps are or may be used. Unless designed, built, and used properly, systems may be unsafe or dangerous. You should check and comply with all federal, state, local and other regulations and recommendations such as: NFPA, UL, OSHA, API, etc.

In particular, you must check the pumped liquid properties and take proper precautions. Among other things, consider the following:

- Decide the results of spillage or leakage (all pumps or systems may fail sometime).

<input type="checkbox"/> Explode	<input type="checkbox"/> Toxic
<input type="checkbox"/> Corrode	<input type="checkbox"/> Fire
<input type="checkbox"/> Chemical Burn	<input type="checkbox"/> High Temperature
<input type="checkbox"/> High Pressure	<input type="checkbox"/> Other

Are you using proper safeguards?

Temperature Controls
 Pressure Controls
 Leak Detectors
 Shutoff Devices
 High or Low Pressure Safeguards
 Alarm Devices

Overfill or Overflow Detection

Driver Overload Controls

Consider all possible methods and series of failure.

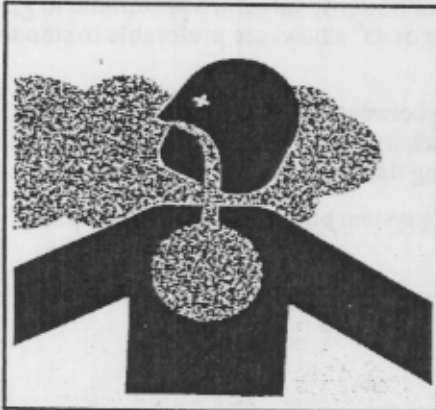
Are any other methods needed to control a hazard?

Regular scheduled inspection for the wear and tear of parts.

- Identify all possible hazards. Decide upon and install the required controls. Only you, the user, understand your product and system properties fully. The ultimate responsibility for the application and safety is with you.
- Particularly note the chance of fire and burns from flammable or hot liquid spillage from burst hoses and take proper precautions.
- Properly guard all exposed rotating parts of the drive to the pump.

- Install a pressure relieving device in the system discharge piping to protect the equipment and crew from accident due to too much pressure. READ SECTION ON PRE-OPERATION CHECKS.

! DANGER TOXIC



DANGER! TOXIC! Do not burn fluoroelastomers.

DO NOT run the pump dry. Running dry (flow less than 10% of normal) is harmful to the pump and will cause rapid heating of the pump due to internal friction. This friction may cause the rubber element of the stator to smoke, possibly releasing toxic fumes from fluoroelastomer (FKM) stators. Install devices into the system to prevent the chance of running dry. Consider ample provisions to allow for venting of the system piping should you suspect dry operation of an FKM fitted pump. **DO NOT** dispose of parts containing FKM, such as stators, o-rings, and connecting rod washers made of this material, by burning. Clearly mark FKM parts, prior to disposal, with a warning stating "DO NOT BURN" due to the danger of releasing toxic vapors.

- Spillage or overflow, from overfilling or putting too much pressure on any component of a system incorporating this pump, may result in an accident. Proper measures and precautions must be taken to avoid spillage or overflow from overfilling or putting too much pressure on any component of the system. This includes the receiver and lines.
- Roper continually updates its manuals; therefore, you should periodically request an updated copy or check that you have the latest edition.

Prior to starting pump, read sections on Preparation of Foundation; Aligning Driver and Pump; Installation of Pipes; NPT Connections; and Pre-Operation Checks. These sections may be found elsewhere in this book.

7. INSTALLATION OF PIPES

Piping must be installed and checked carefully. Allow for any expansion or contraction.

Any external force or moment (torque or twist) applied on the pump ports by the piping will cause stresses in the pump and its foundation. This may cause misalignment that could result in hot bearings, worn couplings or offensive vibration. Such forces or moments may be caused by improperly aligned piping or by thermal expansion of the piping when pumping hot or cold fluids. The piping should be supported independently. Use flexible piping connectors, and insure that they are properly anchored.

If an expansion joint is installed in the piping between the pump and the nearest point of anchor in the piping, a force equal to the area of the expansion joint (which may be considerably larger than the normal pipe size) times the pressure in the pipe will be transmitted directly to the pump. Pipe couplings that do not provide an axially rigid connection have the same effect. This reaction force can be so large that it would be impractical to design suitable components to withstand the force. If an expansion joint or nonrigid coupling is used, install a

pipe anchor between it and the pump. If properly installed, this will eliminate the offensive forces mentioned above.

The pump port size does not necessarily establish the correct pipe size. Piping must be sized and arranged to provide ample inlet pressure at the pump and to insure that the discharge pressure will be at least as low as the rated pressure of the pump. If the fluid to be pumped is viscous, or the piping long or the suction lift or static discharge head somewhat high, piping one or two sizes larger may be required. Friction losses should be carefully calculated (see Hydraulic Institute Pipe Friction Manual or similar authority for friction loss data) and compared to the pump ratings before the installation is made. Where valves are used in the piping system, gate, ball, or butterfly valves are preferable to globe or angle valves. 90° long radius elbows or 45° elbows are preferable to standard short radius elbows.

An easily removable section of piping between one to two times longer than the stator should be connected to the discharge port. This will allow the rotor and stator to be removed without removing the entire pump from the baseplate.

Thoroughly clean and flush the piping system before connecting the pump.

8. NPT CONNECTIONS

American National Standard Taper Pipe Threads (NPT) are used on pipe plugs and threaded ports of the pump. To produce a pressure tight joint, a thread sealant must be used. TFE tape is generally not recommended where cast iron is used as one or more parts of the joint. The use of TFE tape for installing cast iron fittings may cause damage to the pump or fittings.

The following is a partial list of sealants that may be used when making up joints on the pump.

For cast iron or steel joints:

- PST Pipe Sealant No. 567 - Loctite Corp.
- Rectorseal No. 5 - The Rectorseal Corp.
- Leak Lock - Highside Chemical, Inc.

For stainless steel joints:

- PST Pipe Sealant No. 567 - Loctite Corp.

Follow the sealant manufacturer's instructions when making up a joint.

- NOTE: The assembly of NPT connections, especially on stainless steel, without the use of a sealant may cause severe galling of the threads resulting in damaged parts that may require replacement.

9. INSTRUCTIONS FOR PUMP DISASSEMBLY

Refer to the sectional drawing in section 11 for assistance during the disassembly of the pump.

1. Read sections on Safety Precautions and Additional Important Warnings and Information before starting to disassemble pump. While disassembling pump, always inspect disassembled parts and adjacent parts to see if further disassembly is needed. Replace worn or damaged parts as required. Read section on Replacement Parts.
2. It is recommended that the pump be operated with clean water, or other nonhazardous clean fluid, to flush out the pump and insure that the rotor and stator are not dry.
3. Turn off pump and lockout energy source to driver. **DO NOT** proceed further with disassembly of the pump if there is the slightest possibility that the driver may be started.
4. If used, turn off and disconnect water flush to packing.
5. Close inlet and discharge valves.
6. Remove guard and disconnect coupling of driver and pump.
7. Drain inlet and discharge lines. Disconnect lines from pump inlet and discharge.
8. Remove pipe plug (73) from inlet body (41) and drain inlet body. If oil lubrication of the bearings is used, drain the oil from the bearing housing.
9. Remove body coverplates (20) and gaskets (21) by removing cap screws (S) and lockwashers (T).
10. Remove two nuts (E), flat washers (F), and the packing gland (36) from the packing studs (G).
11. Remove packing set (38) and lantern ring (39) from inlet body (41). Packing hooks are commercially available to assist in removing packing.
 Note: On multiple stage pumps, or when removing stator (99), rotor (98) or rotor gear joint assembly, skip step 12 and resume disassembly with steps 13 and 14A.
12. Remove discharge flange (45) and gasket (79) by removing cap screws (AB) and lockwashers (AC) from clamp ring (93B). Remove retaining ring (91) and clamp ring (93B) from stator (99).
13. Remove cap screws (B) securing stator support cap (43). Remove stator support cap (43) from stator support (42).
14. Remove cap screws (N) and lockwashers (R) securing clamp ring (93A) to inlet body (41) or body spool (94). Pull stator (99) off of rotor (98). A twisting motion, similar to unthreading the parts, may help ease stator (99) removal. Note that any fluid trapped in the cavities formed by the rotor and stator will spill from these parts during disassembly. Full precautions should be taken to avoid any hazards. Remove stator gasket (79). Remove stator retaining ring (91) and clamp ring (93A) from stator (99). Skip to step 15 if you remove the rotor (98) and stator (99) with this step.
- 14A. Use a winch type device securely anchored directly opposite to the stator end. Attach cable end to the discharge flange (45) to pull stator (99) off of rotor (98). Note that any fluid trapped in the cavities formed by the rotor and stator will spill from these parts during disassembly. Full precautions should be taken to avoid any hazards. **DO NOT** exceed the rated limits of the winch type device in removing the stator. Perform step 12 of the disassembly at this time.

15. Inspect the rotor (98) and stator (99) for damage and wear.
16. Remove the plugs (AF) from the stub shaft (57) and the drive shaft (24). Remove set screw (AA) from the drive shaft (24). Remove six socket head cap screws (M) from the stub shaft (57). Remove the stub shaft (57). Two threaded holes are provided for jacking the stub shaft (57) off of the drive shaft (24). Remove and inspect the o-ring (63) from the stub shaft (57).
17. Remove the primary thrust plate (52) from the drive shaft (24) and remove the two joint keys (54). Remove locknut (35) from end of connecting rod (31). Remove ring gear (51), hub gear (50), secondary thrust plate (53), connecting rod washer (32) and joint seal (33).
18. Pull the rotor/connecting rod assembly from the pump. Remove the plug (AE) from the coupling housing (55). Remove the socket head cap screws (U) from the retaining ring (56) and remove the retaining ring (56) and o-ring (64). Remove joint keys (54) and primary thrust plate (52) from the rotor (98). Slide coupling housing (55) off of hub gear/connecting rod assembly. Slide ring gear (51) off of hub gear (50).
19. Clamp connecting rod in a vise or hold with a pipe wrench and remove the locknut (35). Remove hub gear (50), secondary thrust plate (53), connecting rod washer (32) and joint seal (33) from the connecting rod (31).
20. Remove six cap screws (H) and lockwashers (J) securing the bearing coverplate (10) to the bearing housing (11). Remove the bearing coverplate (10) with the lip seal (19) and o-ring (17). Remove the lip seal (19) and o-ring (17) from the bearing coverplate (10).
21. Pull the drive shaft/bearing assembly out of the bearing housing (11), taking steps to support the weight of the assembly as the bearings clear the housing. Remove lip seal (18) from bearing housing (11).
22. Remove flinger (40) from drive shaft (24). Remove set screw (X) from the bearing locknut (16). Using a suitable spanner wrench or a soft punch and hammer, remove the locknut (16) from the drive shaft (24).
23. Press outer bearing (13), bearing spacers (14A and 14B) and inner bearing (12) from the drive shaft (24). Be careful not to damage the bearings or shaft. Press against the inner race of the bearings to avoid bearing damage. **DO NOT** press on the tubing section of the drive shaft (24) as this may damage the shaft. **DO NOT** spin bearings with compressed air. This is highly dangerous and can cause the bearings to fragment with explosive force, thereby, possibly causing serious injury or death.
25. In most cases, this is as far as disassembly should normally be performed. However, in some cases, the inlet body (41) may need to be removed from the bearing housing (11). To remove the inlet body (41) from the bearing housing (11), remove the cap screws (K) and lockwashers (L) securing these parts together. The clamp ring (92), retaining ring (90) and packing studs (G) may be removed from the inlet body (41).
26. On model 7XC335 units there is a body spool (94) connected to the inlet housing (41). While removal is usually not necessary, this part may be removed by removing the cap screws (N) and lockwashers (R) securing the body spool (94) and inlet body (41) together. There is a gasket (79) between these parts.
27. Visually inspect all parts. Replace all worn or damaged parts before reassembling pump. It is recommended that a new packing set (38), lip seals (18, 19), o-rings (17, 63, and 64), gaskets (21 and 79) and joint seals (33) be installed each time the pump is disassembled and reassembled.

10. INSTRUCTIONS FOR PUMP ASSEMBLY

Refer to the sectional drawing in section 11 for assistance during the assembly of the pump.

1. Read the sections on Replacement Parts, Bearing Lubrication, Joint Lubrication, NPT Connections, Packing and Safety Precautions before starting to assemble the pump. Visually inspect all parts during the assembly. Replace all worn or damaged parts. Although they may appear reusable, it is recommended that a new packing set (38), lip seals (18, 19), o-rings (17, 63 and 64), gaskets (21 and 79) and joint seals (33) be installed when the pump is being reassembled.
2. Cleanliness is important during the assembly of the pump. To help avoid premature failures, the bearings, bearing spacers, lip seals and gear joint components should be kept clean and handled with care. Refer to the Torque Guidelines Chart below, for the proper torque requirements for all threaded fasteners.

TORQUE GUIDELINES CHART					
Carbon Steel Fasteners			Stainless Steel Fasteners		
Size	Maximum Torque		Size	Maximum Torque	
5/16 - 18	10 lb-ft	13.5 Nm	#10-24	23 lb-in.	2.6 Nm
3/8 - 16	22 lb-ft	29 Nm	1/4 - 20	75 lb-in.	8.5 Nm
1/2 - 13	43 lb-ft	59 Nm	5/16 - 18	10 lb-ft	13.5 Nm
5/8 - 11	86 lb-ft	116 Nm	3/8 - 16	20 lb-ft	27 Nm
3/4 - 10	152 lb-ft	206 Nm	1/2 - 13	43 lb-ft	58 Nm
Maximum Connecting Rod Nut Torque: 85 lb-ft (115 Newton meters)					

3. Slide the clamp ring (92) onto the inlet body (41) and install the retaining ring (90). Install the packing studs (G) into the inlet body (41). Secure the inlet body (41) to the bearing housing (11) with cap screws (K) and lockwashers (L). Make sure the inlet body flange is rotated into the correct position before tightening the cap screws (K).
4. On 7XC335 pumps, place a gasket (79) into the large diameter of the inlet body (41) and assemble the body spool (94) to the inlet body (41) with cap screws (N) and lockwashers (R).
5. Install the inner lip seal (18) into the bearing housing (11). The lip of the seal should be facing outward toward the inlet body (41) with the spring visible. Lubricate the bore of the inner lip seal (18) with a light oil. Clean the bore of the stuffing box in the inlet body (41). Refer to the section on Shaft Sealing and install the packing set (38) and lantern ring (39) into the inlet body (41). DO NOT tamp down or compress the packing set (38) at this time.
6. Refer to the section on Bearing Lubrication. Refer to the pump sectional drawing in section 11 for the proper bearing orientation and press the outer bearing (13) onto drive shaft. DO NOT press directly on the drive shaft (24) as it may damage the part. A steel plate of suitable size (9 inches

- (230 mm) square by $\frac{3}{4}$ inch (20 mm) thick) may be placed on the large end of the drive shaft (24) to use in pressing on the bearings. Be careful not to damage the bearings or the shaft. Press against the inner race of the bearings to avoid bearing damage. **DO NOT spin bearings with compressed air. This is highly dangerous and can cause the bearings to fragment with explosive force, thereby, possibly causing serious injury or death.** Coat the bearing with a proper lubricant and insure that the lubricant reaches all surfaces of the bearing.
7. Position the inner bearing spacer (14A) and the outer bearing spacer (14B) onto the drive shaft (24). If grease is used as a bearing lubricant, fill the area between the bearing spacers (14A and 14B) half full of lubricant. **DO NOT** fill the area between the bearings completely full of lubricant. This may be done after assembling the inner bearing (12) to the shaft, through the holes in the outer bearing spacer (14B). However, you **MUST BE SURE** that lubricant is supplied to the bearings before inserting the bearing/shaft assembly into the bearing housing (11).
 8. Refer to the pump sectional drawing in section 11 for the proper bearing orientation and press the inner bearing (12) onto the drive shaft (24). The bearing spacers (14A and 14B) will properly locate the inner bearing (12).
 9. Install the bearing locknut (16) onto the drive shaft (24) and tighten until it rests against the inner race of the inner bearing (12). Install the brass tip set screw (X) into the bearing locknut (16) and tighten.
 10. Position the flinger (40) into the opening of the bearing housing (11) and install the drive shaft/bearing assembly into the bearing housing (11). Be careful to avoid damage to the inner lip seal (18). Position the flinger (40) onto the drive shaft (24) as the shaft (24) passes through the opening in the bearing housing (11).
 11. Install the outer lip seal (19) into the bearing coverplate (10). The lip of the seal should be facing inward toward the inlet body (41). Lubricate the bore of the outer lip seal (19) with a light oil. Place the o-ring (17) onto the bearing coverplate (10) and secure the bearing coverplate (10) to the bearing housing (11) using cap screws (H) and lockwashers (J). **Make sure that the small slot on the bearing coverplate (10) lip aligns with the slot in the bottom of the bearing housing (11) bore.** Be careful to avoid damage to the outer lip seal (19) and o-ring (17). The cap screws (H) should be tightened evenly and care should be taken to insure the o-ring (17) seats properly in the step in the bearing housing (11). When the bearing coverplate (10) is fully assembled to the bearing housing (11) a small gap of approximately $\frac{1}{32}$ inch (.75 mm) will exist between the bearing coverplate (10) and bearing housing (11).
 12. Slide the retaining plate (56) over the rotor (98) profile to the rotor head. The side of the retaining plate (56) with the smaller diameter holes should be facing the rotor head. On some models where the retaining plate (56) is two pieces, this step may be eliminated.
 13. Slide the stator clamp rings (93A and 93B) on both ends of the stator (99) and install the retaining rings (91) to secure the clamp rings (93A and 93B) into position.
 14. Lubricate the inside of the stator (99) and the profile of the rotor (98) with glycerine, waterless hand cleaner or very soapy water. Grease or oil is not recommended and should not be used for this purpose. Proceed with caution as both the rotor (98) and the stator (99) will be slippery and possibly difficult to hold. Slide the rotor (98) into the stator (99) until the rotor head end of the rotor (98) extends the specified distance from the end of the stator (99). See the Rotor Length Extension Chart. Make sure the rotor (98) is inserted into the proper end of the stator (99).

with the clamp ring (93A) used for the stator/inlet body or stator/body spool connection. Immediately clean up any materials used for lubricating the parts that may have spilled. Turning the rotor (98) counterclockwise while inserting it into the stator (99) may help ease the assembly.

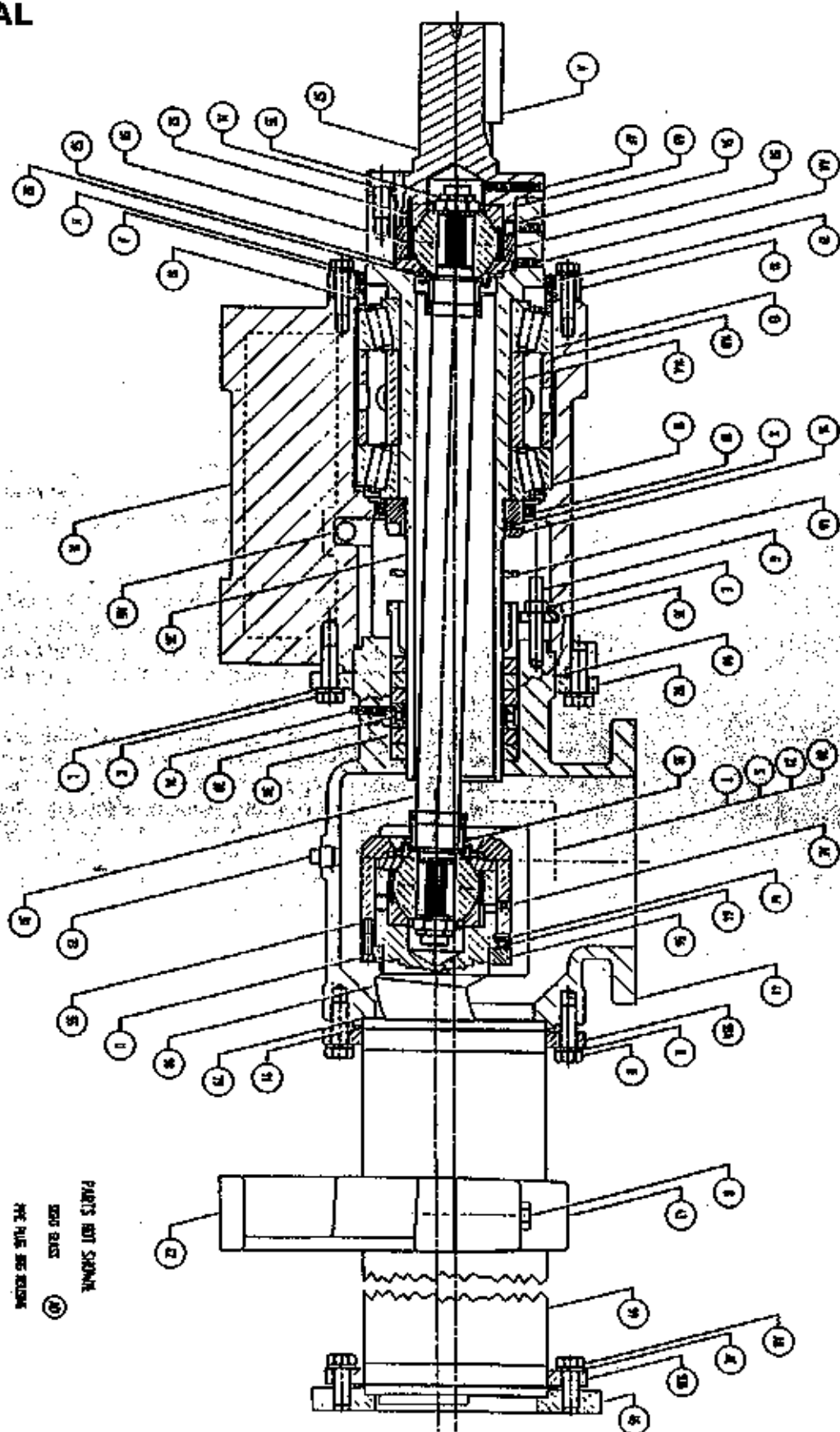
ROTOR LENGTH EXTENSION CHART		
PUMP MODEL	INCHES	MILLIMETERS
74B065	6.84	174
764065	6.84	174
794065	6.84	174
71B115	6.84	174
724115	6.84	174
744115	6.84	174
76C115	6.84	174
714175	7.00	178
724175	7.00	178
74C175	7.00	178
71C335	7.19	183
72C335	7.19	183

15. Insert the primary thrust plate (52) into the rotor head. Make sure the dished side of the primary thrust plate (52) is facing outward. Make sure the rotor (98) and primary thrust plate (52) surfaces are flush to insure proper assembly and pump operation. Position the o-ring (64) onto the rotor head.
16. Place the connecting rod seal (33) onto one end of the connecting rod (31). The seal must be positioned so that the flat face of the seal neck fits into the connecting rod ring on the connecting rod. Refer to the sectional drawing in section 11 for the connecting rod seal (33) positioning. Apply a coating of the proper joint lubricant to the inside surfaces of the connecting rod seal (33).
17. Lubricate the connecting rod washer (32) and slide it onto the connecting rod (31) so that the flat face and radius of the connecting rod washer (31) is against the connecting rod seal (33).
18. Lubricate the dished side of the secondary thrust plate (53) and position the thrust plate against the connecting rod seal (33). Make sure the lip on the outside diameter of the connecting rod seal (33) fits onto the step on the back side of the secondary thrust plate (53).

19. Lubricate the splines on the inside of the hub gear (50) and install hub gear (50) onto the connecting rod (31). Make sure that the counterbored end (the end without any splines) of the hub gear (50) goes onto the connecting rod (31) first. The hub gear (50) should slide freely onto the splines of the connecting rod (31). Secure the hub gear (50) in place with the connecting rod nut (35). Liberally apply lubricant to all surfaces of the hub gear (50).
20. Apply lubricant to the teeth of the ring gear (51) and slide the ring gear (51) onto the hub gear (50). Make sure the slots in the ring gear (51) face the end of the connecting rod (31) with the connecting rod nut (35).
21. Insure that all surfaces of the joint assembly are coated with lubricant, including the dished surface of the primary thrust plate (52) installed in the rotor (98). Fill the recessed area in the rotor head with lubricant.
22. Slide the coupling housing (55) over the connecting rod (31) and joint assembly, being careful to seat the outside diameter of the connecting rod seal (33) in the end of the coupling housing (55). Place two joint keys (54) into the slots in the ring gear (51).
23. Align the joint keys (54) in the ring gear (51) with the slots in the rotor head. Slide the joint/coupling housing assembly onto the rotor (98) making sure the joint keys (54) are properly engaged in the rotor (98) and ring gear (51). The small hole in the rotor head should be aligned with the first threaded hole on the outside of the coupling housing (55). Assemble set screw (W) into the threaded hole until light contact is made with the hole in the rotor (98).
24. Position the o-ring (64) into the step in the coupling housing (55). align the holes in the retaining plate (56) with the holes in the coupling housing (55) and secure with socket cap screws (U). Tighten the cap screws (U) evenly and insure the o-ring (64) remains in place. When assembled, there may be a small gap of a few thousandths of an inch between the retaining plate (56) and coupling housing (55). Excess lubricant in the joint assembly will be purged from the vent hole while the retaining plate (56) is being secured to the coupling housing (55). Tighten the setscrew (W) into the rotor head. Move the free end of the connecting rod (31) in a circular motion to insure that the joint is free and not binding. This will help purge excess lubricant from the assembly. Install the pipe plug (AE) in the second hole of the coupling housing (55).
25. Place a gasket (79) into the recess in the end of the inlet body (41) or, on 7XC335 models, the body spool (94). Move the rotor/stator/connecting rod assembly into position and insert the connecting rod (31) through the inlet body (41) and drive shaft (24). Align the stator (99) with the bore of the inlet body (41) or body spool (94), checking to insure the gasket (79) remains in place. Start the cap screws (N), with lockwashers (R), to secure the clamp ring (93A) to the inlet body (41) or body spool (94). **DO NOT** tighten these cap screws (N). For proper assembly of the shaft end joint assembly, the end of the connecting rod (31) should extend past the end of the drive shaft (24) by approximately $2\frac{1}{8}$ inches (111 mm). Reposition the rotor/stator assembly in or out of the inlet body (41) or body spool (94) to obtain this dimension.
26. Place the connecting rod seal (33) onto the end of the connecting rod (31). The seal must be positioned so that the flat face of the seal neck fits into the connecting rod ring on the connecting rod. Refer to the sectional drawing in section 11 for the connecting rod seal (33) positioning. Apply a coating of the proper joint lubricant to the inside surfaces of the connecting rod seal (33).

27. Lubricate the connecting rod washer (32) and slide it onto the connecting rod (31) so that the flat face and radius of the connecting rod washer (31) is against the connecting rod seal (33).
28. Lubricate the dished side of the secondary thrust plate (53) and position the thrust plate against the connecting rod seal (33). Make sure the lip on the outside diameter of the connecting rod seal (33) fits onto the step on the back side of the secondary thrust plate (53).
29. Lubricate the splines on the inside of the hub gear (50) and install hub gear (50) onto the connecting rod (31). Make sure that the counterbored end (the end without any splines) of the hub gear (50) goes onto the connecting rod (31) first. The hub gear (50) should slide freely onto the splines of the connecting rod (31). Secure the hub gear (50) in place with the connecting rod nut (35). While tightening the connecting rod nut (35), prevent the connecting rod (31) from turning by carefully holding the connecting rod (31) with a pipe wrench through the body coverplate openings in the inlet body (41). Liberally apply lubricant to all surfaces of the hub gear (50).
30. Apply lubricant to the teeth of the ring gear (51) and slide the ring gear (51) onto the hub gear (50) and into the drive shaft (24). Make sure the slots in the ring gear (51) face outward.
31. Place two joint keys (54) into the slots in the ring gear (51). A small amount of lubricant may be used to help hold the joint keys (54) in position. The face of the ring gear (51) should be approximately flush with the end of the drive shaft (24) at this point.
32. Place the primary thrust plate (52) into the stub shaft (57) aligning the slot on the outside diameter of the primary thrust plate (52) with the pin in the stub shaft (57). When the thrust plate is properly seated, the faces of the thrust plate and stub shaft should be approximately flush. Lubricate the dished surface of the primary thrust plate (52) and fill the recess in the stub shaft (57) with lubricant.
33. Place the o-ring (63) in the groove of the stub shaft (57). Align the slots in the stub shaft (57) with the joint keys (54) in the ring gear (51) and insert the stub shaft (57) into the drive shaft assembly. If the threaded holes in the drive shaft (24) do not align with the holes in the stub shaft (57), a strap wrench or pipe wrench may be used to turn the drive shaft slightly. Secure the stub shaft (57) to the drive shaft (24) with cap screws (M). Tighten the cap screws (M) evenly until the stub shaft is tight against the face of the drive shaft (24). Excess lubricant in the joint assembly will be purged from the holes in the drive shaft (24) and stub shaft (57). Install pipe plugs (AF) into the drive shaft (24) and stub shaft (57). Install set screw (AA) into the threaded hole in the drive shaft (24) nearest the bearing housing (11).
34. Tighten cap screws (N) securing the clamp ring (93A) to the inlet body (41) or body spool (94).
35. Place stator support cap(s) (43) over stator (99) and secure to stator support(s) (42) with cap screws (B). Place stator gasket (79) into recess of discharge flange (45) and position discharge flange (45) onto stator (99). Secure clamp ring (93B) to discharge flange (45) using cap screws (AB) and lockwashers (AC).
36. Install body coverplates (20) and body coverplate gaskets (21) onto the inlet body (41) using cap screws (S) and lockwashers (T). Install pipe plug (73) into inlet body (41).
40. Read the sections on Additional Important Warnings and Information, NPT Connections, Installation of Pipes, Safety Precautions, Pre-Operation Checks, Packing, and Aligning Driver and Pump before installing and operating the pump.

11. PUMP SECTIONAL DRAWING



12. PARTS LIST

Key No.	Description	Qty	Pump	Iron/Steel	Stainless
10	Bearing coverplate	1	ALL	P92-36-33	
11	Bearing housing	1	ALL	P96-29-33	
12	Inner bearing	1	ALL	G94-14	
13	Outer bearing	1	ALL	G94-14	
14A	Bearing spacer, inner	1	ALL	D101-112	
14B	Bearing spacer, outer	1	ALL	D101-117	
16	Bearing locknut	1	ALL	D14-82	
17*	O-ring, bearing cplt	1	ALL	G68-106	
18*	Lip seal, inner	1	ALL	G17-182	
19*	Lip seal, outer	1	ALL	G17-183	
20	Body coverplate	2	ALL	P99-13	CP99-13
21*	Gasket, body cplt	2	ALL	G90-90	
24	Drive shaft	1	ALL	D98-238	D98-239
31	Connecting rod	1	ALL except 7XC335	N93-14	N93-15
			7XC335	N93-16	N93-17
32	Connecting rod washer	2	ALL	D8-463	
33*	Connecting rod seal	2	ALL	G90-88	
35	Connecting rod nut	2	ALL	G43-86	
36	Packing gland half	2	ALL		CP91-C45-25
38*	Packing set	1	ALL	N43-150	
39*	Lantern ring	1	ALL	D103-31	
40	Flinger	1	ALL	D38-44	
41	Inlet body	1	7XX065, 7XX115	P90-75-33	CP90-75-32
			7XX175, 7XC335	P90-76-33	CP90-76-32
42	Stator support	1-3	7XX065, 7XX115	P94-58-33	
			7XX175, 7XC335	P94-59-33	
43	Stator support cap	1-3	7XX065, 7XX115	P95-58-26	
			7XX175, 7XC335	P95-59-33	
45	Discharge flange	1	764065, 794065	G97-103	G97-104
			76C115	G97-103	G97-104
			74B065, 71B115	G97-101	G97-102
			724115	G97-101	G97-102
			744115	G97-105	G97-106
			714175, 724175	G97-99	G97-100
			74C175, 71C335	G97-99	G97-100
			71C335	G97-99	G97-100
50	Hub gear	2	ALL	D109-3	
51	Ring gear	2	ALL	D110-3	
52	Primary thrust plate	2	ALL	D111-7	
53	Secondary thrust plate	2	ALL	D111-8	
54	Joint key	4	ALL	D30-208	
55	Coupling housing	1	ALL	D107-22	D107-23
56	Retaining plate	1	7XX065, 7XX115	D108-22	D108-23
			7XX175, 7XC335	D108-24	D108-25

* Recommended spare parts

Key No.	Description	Qty	Pump	Iron/Steel	Stainless
57	Stub shaft	1	ALL	N90-15	
63*	O-ring, stub shaft	1	ALL	G68-10	
64*	O-ring, rotor	1	ALL	G69-134	
73	Pipe plug, drain	1	ALL	G56-15	G56-77
74	Pipe plug, pkg lube	4	ALL	G56-45	G56-53
77	Pipe plug, brg hsg	1	ALL	G56-14	
79*	Stator gasket	2	7XX065, 7XX115 7XX175, 7XC335	G90-84 G90-86	
90	Retaining ring, body	1	ALL	G41-243	
91	Retaining ring, stator	2	7XX065, 7XX115 7XX175, 7XC335	G41-242 G41-244	
92	Clamp ring, body	1	ALL	D101-114	
93A	Clamp ring, stator/body	1	7XX065, 7XX115 7XX175, 7XC335	D101-113 D101-115	
93B	Clamp ring, discharge	1	764065, 794065 744115 74B065, 71B115 724115 744115 714175, 724175 74C175, 71C335 72C335	D101-119 D101-119 D101-113 D101-113 D101-118 D101-115 D101-115 D101-115	
94	Body spool	1	7XC335	P90-77-33	CP90-77-32
98*	Rotor	1			
	Std plated		74B065 764065 794065 71B115 724115 744115 76C115 714175 724175 74C175 71C335 72C335	D96-1060 D96-1019 D96-1061 D96-1022 D96-1023 D96-1064 D96-1065 D96-1025 D96-1026 D96-1066 D96-1525 D96-1526	D96-1069 D96-1049 D96-1070 D96-1052 D96-1053 D96-1071 D96-1072 D96-1055 D96-1056 D96-1073 D96-1067 D96-1068
99*	Stator	1			
	(L) Buna n		74B065	D95-753	
	70 Durometer (NBR)		764065 794065 71B115 724115 744115 76C115	D95-756 D95-1159 D95-759 D95-762 D95-765 D95-1164	

* Recommended
spare parts

Key No.	Description	Qty	Pump	Steel
99*	Stator	1		
			714175	D95-1026
			724175	D95-1030
			74C175	D95-1034
			71C335	D95-1038
			72C335	D95-1042
	(M) Natural rubber		74B065	D95-754
	55 Durometer		764065	D95-757
	(NR)		794065	D95-1160
			71B115	D95-760
			724115	D95-763
			744115	D95-766
			76C115	D95-1165
			714175	D95-1027
			724175	D95-1031
			74C175	D95-1035
			71C335	D95-1039
			72C335	D95-1043
	(C) EPDM		74B065	D95-755
	70 Durometer		764065	D95-758
	(EPR)		794065	D95-1161
			71B115	D95-761
			724115	D95-764
			744115	D95-767
			76C115	D95-1166
			714175	D95-1028
			724175	D95-1032
			74C175	D95-1036
			71C335	D95-1040
			72C335	D95-1044

* Recommended spare parts

Hardware List

Key No.	Description	Qty	Pump	Part No.	Size
A	Drive key	1	ALL	D30-207	7/8 square x 4
B	Screw, hex head	2-6	ALL	G50-075450	3/4 - 10 x 4 1/2
E	Nut, hex	2	ALL	G44-38	5/8 - 11
G	Stud	2	ALL	D22-332	5/8 - 11 x 4
H	Screw, hex head	6	ALL	G50-062225	5/8 - 11 x 2 1/4
J	Lockwasher	6	ALL	G8-355	5/8
K	Screw, hex head	6	ALL	G50-075225	3/4 - 10 x 2 1/4
L	Lockwasher	6	ALL	G8-341	3/4
M	Screw, soc head	6	ALL	G45-075150	3/4 - 10 x 1 1/2
N	Screw, hex head	6	7XX065	G50-075225	3/4 - 10 x 2 1/4
			7XX115	G50-075225	3/4 - 10 x 2 1/4
			7XX175	G50-075250	3/4 - 10 x 2 1/2
			7XC335	G50-075250	3/4 - 10 x 2 1/2
R	Lockwasher	6	ALL	G8-341	3/4
S	Screw, hex head	16	ALL	G50-050125	1/2 - 13 x 1 1/2
T	Lockwasher	16	ALL	G8-340	1/2
U	Screw, soc head	8	ALL	G45-037100	3/8 - 16 x 1
W	Set screw	1	ALL	G62-144	3/8 - 16 x 3/4
X	Set screw, brass tip	1	ALL	G62-145	5/16 - 18 x 3/8
AA	Set screw	1	ALL	G62-143	3/8 - 16 x 1
AB	Screw, hex head	6-12	ALL	G50-075200	3/4 - 10 x 2
AC	Lockwasher	6-12	ALL	G8-341	3/4
AD	Sight glass	2	ALL	G36-4	1/2 NPT
AE	Pipe plug	2	ALL	G56-78	1/8 NPT
AF	Pipe plug	2	ALL	G56-78	1/8 NPT
AG	Pipe plug, plastic	2	ALL	G57-35	3/4 NPT
IOM	Instruction manual	1	ALL	G12-222	

Roper Pump Company assumes no responsibility for parts other than those supplied by Roper. The use of substitutes may result in poor performance or in an accident causing physical damage or injury to personnel.

13. PRESSURE RATINGS

Fig. 3 shows the maximum allowable differential pressure (the amount of pressure difference between the inlet and discharge of the pump) for several durometer stators and stages of pump. These values are maximum allowables and are not recommended for every application. Abrasive fluids should not be pumped at these maximum values due to the shortened life of the rotor and stator that will occur. Refer to Roper's progressing cavity pump technical literature for added information on suggested pressure limits for pumping abrasive products.

Seventy (70) durometer (Shore A scale) stators include buna n (code L), EPDM (code C) and fluoroelastomer (code V). Fifty five (55) durometer stators include natural rubber (code M) and a special soft durometer buna n (code L1).

Figs. 4 and 5 show the maximum non-shock pressure rating of the pump inlet

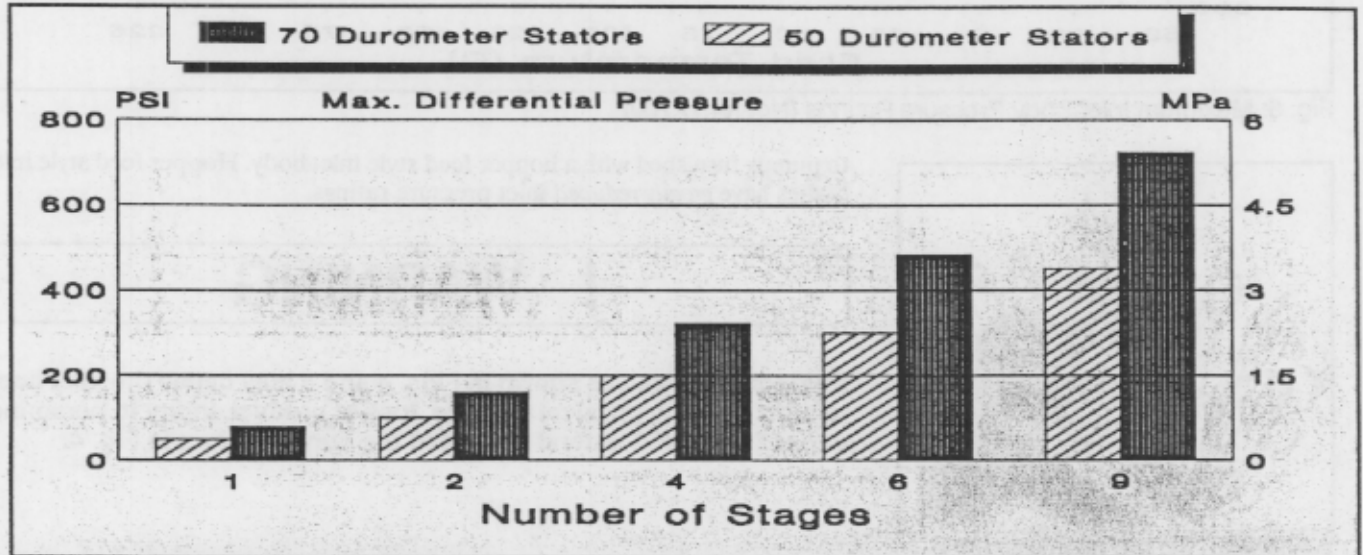


Fig. 3: Maximum Differential Pressure

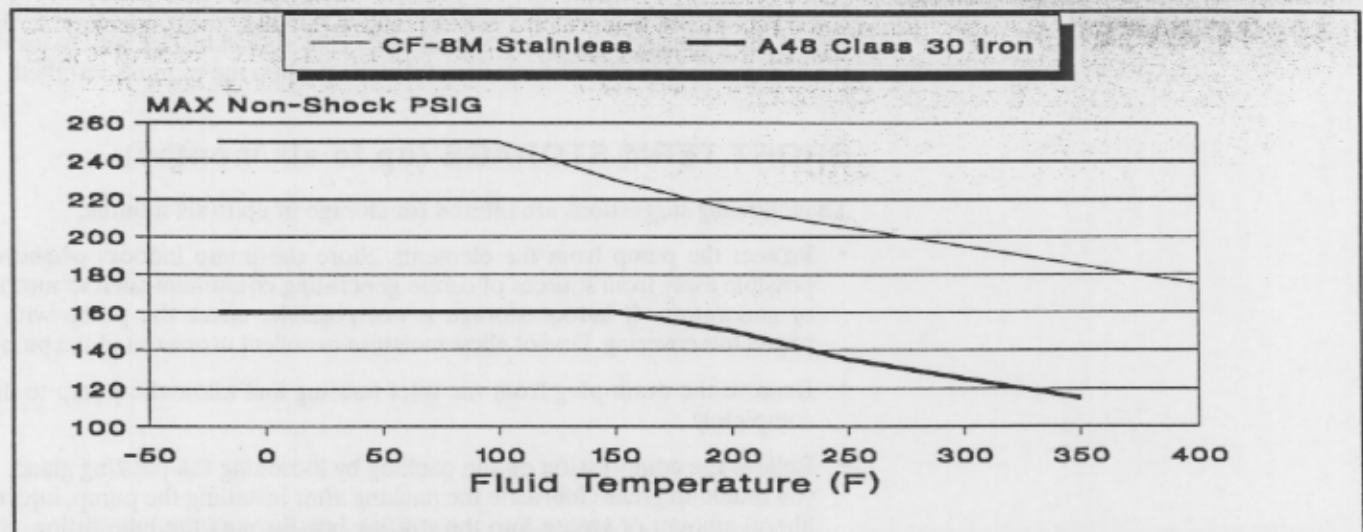


Fig. 4: Max. Inlet Body Pressure Ratings (Not for 7X700)

body against temperature. Despite the number of stages of the pump or the direction of rotation, the values shown in Figs. 4 and 5 must not be exceeded on the inlet body of the pump. The values shown in Figs. 4 and 5 DO NOT apply

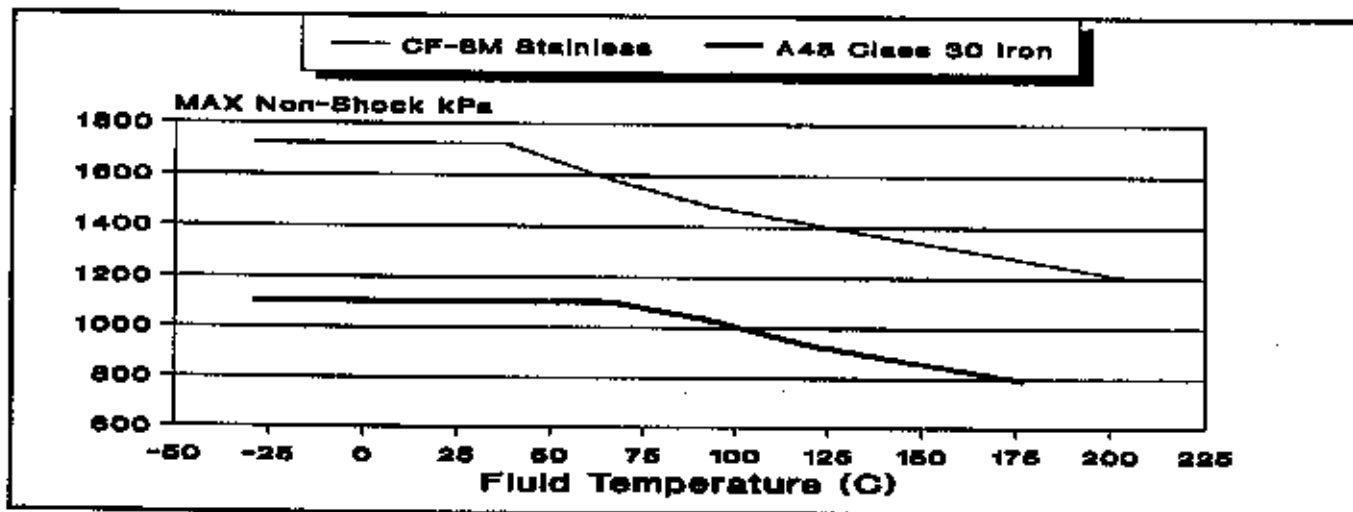
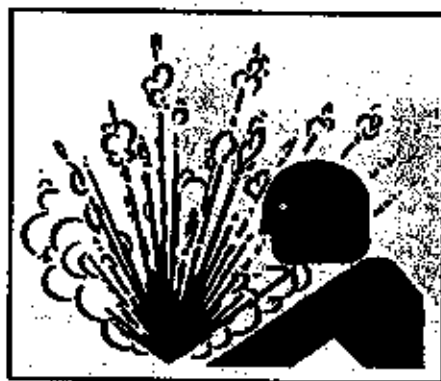


Fig. 6: Maximum Inlet Body Pressure Ratings (Not for 7X700)



WARNING! Do not overpressurize pump or system.

14. STORAGE

to pumps furnished with a hopper feed style inlet body. Hopper feed style inlet bodies have *greatly reduced* inlet pressure ratings.

! WARNING

Exceeding the values shown in Figs. 4 and 5 may cause the inlet body to burst causing physical damage, loss of product, injury to personnel or death. **DO NOT** extend or exceed the curves shown in Fig. 4.

If you do not intend to install this Roper pump within the time frame specified below, the following suggestions are offered. They should be followed to insure the best possible chances of a successful startup when the pump is installed.

SHORT TERM STORAGE (up to six months):

The following suggestions are offered for storage of up to six months:

- Protect the pump from the elements. Store the pump indoors whenever possible away from sources of ozone generating equipment such as motors or generators. If indoor storage is not possible, cover the pump with a protective covering. Do not allow moisture to collect in or around the pump.
- Remove the drain plug from the inlet housing and allow the pump to dry completely.
- Relieve the compression on the packing by loosening the packing gland. If you intend to grease lubricate the packing after installing the pump, inject a liberal amount of grease into the stuffing box through the lube fitting. If a water flush is to be used, do not inject grease into the stuffing box. Instead, place a small amount of light oil into the stuffing box.
- Read and understand this manual thoroughly before installing or starting pump.

LONG TERM STORAGE (over six months):

If the pump is to be in storage for over six months, follow both the suggestions above for short term storage and the following suggestions:

- If applicable, remove the drive belts from belt driven units or disconnect the coupling on direct connected units.
- Apply a rust inhibitor to the pump. **DO NOT** allow petroleum based inhibitors to contact EPDM or natural rubber (code C or M) stators.
- Approximately every two weeks, rotate the drive shaft of the pump manually for several revolutions. This will help avoid a *set* condition between the rotor and stator making startup easier. This also will help avoid deformation of the stator profile that may cause excessive vibration. If the pump must be left unattended for over six months, the stator should be removed to prevent *set*.

If other equipment included with the pump, such as drivers, seals, flow monitors, etc., is to be stored also, refer to the respective manufacturer's recommendations for storage.

15. NAMEPLATE DATA

Roper identifies each pump manufactured, by a metal nameplate attached to the pump. This nameplate describes how the pump was built at our factory. Copy the nameplate data from your pump, in the area provided below. Use this for ready reference when ordering repair parts or when consulting with a Roper distributor or Roper Pump Company about this pump.

FIGURE: _____

SPEC: _____

SERIAL: _____

TYPE: _____

PUMP NOMENCLATURE

Example: 724115 GHL Spec XXX Type 4 Serial ZZZ

1. The FIGURE number is a five or six digit number followed by a three letter material code.
 - The first number (7 in the example) shows the progressing cavity pump series.
 - The second number (2) shows the number of stages of pumping elements.
 - The third number (4) shows the drive size or configuration.
 - The fourth, fifth, and sixth numbers show the approximate theoretical displacement in U.S. gallons per 100 revolutions:

4th, 5th, 6th number	065	115	175	335
Gallons per 100 revolutions	65	115	175	335
Liters per 100 revolutions	246	435	662	1268

- The three letters show the materials of construction. The first letter (G) shows the pump body. The second letter (H) shows the internals. And the third letter (L) shows the stator elastomer:

Item	Letter	Material
Pump Body	G	A48 Class 30 cast iron
	N	CF-8M stainless steel
Internals	H	Alloy steel, hard chrome plated rotor and shaft
	N	316 stainless, hard chrome plated rotor and shaft
Stator	C	EPDM (EPR)
	L	Buna N (NBR)
	M	Soft natural (NR)
	V	Fluoroelastomer (FKM)

- NOTE:** The preceding description of the figure number is to help in identifying your Roper progressing cavity pump only. **DO NOT** attempt to obtain any ratings or performance from the figure number. **DO NOT** use the explanation of the figure number to construct a pump, *not all combinations are possible*. For aid in pump selection, consult a Roper distributor or Roper Pump Company.

- Occasionally, special pumps or configurations are required that are unique for a particular application. These modifications are clarified by a SPECification number. Identification of any items different from a standard pump can be made by consulting a Roper distributor or Roper Pump Company.
- The TYPE number is a number used by Roper for in-house identification of construction and hydraulics. Always include the type number in any references to the pump.
- The SERIAL number is a unique number assigned to each pump built by Roper.

In any communication concerning this pump, always be sure to include the Figure, Spec, Serial, and Type numbers so proper identification of the pump can be assured.

16. SHAFT SEALING

PACKING

The standard shaft sealing method used on this pump is die formed ring packing with a lantern ring. Tapped holes on each side of the inlet body provide access to the lantern ring for either water flushing or grease lubrication. A water flush or lubrication of the packing is necessary for proper operation and will help prolong the life of the packing and shaft.

Water flush when the fluid to be pumped is abrasive or the pump operates with negative inlet pressure (suction lift). Clean water should be supplied to the stuffing box at a rate of $\frac{1}{4}$ to $\frac{1}{2}$ gallon per hour (1 to 2 liters per hour). The pressure of the flushing water should be approximately 10 to 15 PSI (70 to 100 kPa) higher than the pressure of the fluid in the inlet body.

- Note: On applications where clean water is not available or where it is incompatible with the fluid being pumped, other clean, nonhazardous liquids may be used for flushing the packing.

If the packing is to be grease lubricated, a good grade of bearing grease should generally be used. Should bearing grease be unacceptable or incompatible with the fluid being pumped, another paste type lubricant may be used. Lubrication of the packing should be performed with the pump stopped and not operating. Before daily start-up, if applicable, is a good time. **DO NOT** lubricate or adjust the packing with the pump operating. To lubricate the packing, stop the pump and carefully clean the lube fitting and pipe plug of any contaminants. After removing the pipe plug from the side of the inlet body, lubricant may be injected into the stuffing box through the lube fitting on the other side of the inlet body. Inject clean, fresh unused lubricant until it is seen coming out of the unplugged hole. Clean up any excess lubricant and the lube fitting. Replace the pipe plug. This procedure should be performed daily, prior to start-up. In certain applications, more frequent lubrication of the packing may be necessary. Experience will provide a guide to how frequently the packing should be lubricated. Applying lubricant often will help extend the life of the packing and shaft.

WHERE LIQUID BEING HANDLED IS HAZARDOUS OR VOLATILE, FULL PRECAUTIONS SHOULD BE TAKEN ALWAYS, INCLUDING THE RUN-IN PERIOD.

CARE OF PACKING

Packing hooks are commercially available to help in removing packing rings from the stuffing box. It is generally not recommended to reuse old packing rings. When installing packing, use formed packing rings. **DO NOT** use a one piece spiral wrap of packing. Before installing packing, carefully clean the stuffing box and shaft.

Packing rings should be installed one ring at a time, with the joints of adjacent rings staggered approximately 180° . Each ring should be seated firmly before the next ring is installed. **DO NOT** forget to install the lantern ring. The lantern ring should be approximately aligned with the flush/lube holes in the stuffing box.

The packing gland nuts should first be evenly tightened with a wrench to seat the packing firmly in the stuffing box and against the shaft, and then backed off until finger-tight. Connect the flush or lubricate the packing, depending upon the method used. After the pump is started, visually examine the stuffing box for excessive leakage. If the packing leakage exceeds ten drops per minute, stop the pump and adjust the gland nuts. Gland nuts should be adjusted evenly in $\frac{1}{8}$ to $\frac{1}{4}$ turn (1 to 2 flats on the nut) increments. Start the pump and allow it to operate for several minutes. Again, visually examine the stuffing box for excessive leakage. Repeat the above procedure until stuffing box leakage is between five to ten drops per minute. **DO NOT** work on a pump while it is operating.

DO NOT over-tighten the packing. Slight leakage is a necessary requirement for proper packing operation. Leakage of five to ten drops per minute, when the pump is operating, is desirable, as it will preserve the packing and avoid scoring of the shaft. Over-tight packing may score shafts, increase torque requirements of the pump, damage couplings and drivers and generate excessive heat.

Packing glands should be adjusted whenever leakage exceeds ten drops per minute. The condition of the packing should be checked at regular intervals, the frequency depending on the type of service. Experience will dictate how frequently the inspections should be made.

MECHANICAL SEALS

Certain applications may not permit the necessary leakage required for the proper operation of packing. These applications may require the use of an end face type of mechanical seal. Various types of mechanical seals may be available to fit most pumps. Due to the various seal types and styles available, the seal manufacturer's instructions for installation and setting should be followed.

- **NOTE:** Not all seals will fit or function in all pumps. Modification to either or both the pump or seal may be required, or it may be necessary to change to a different type of seal. Consult with both the pump and seal manufacturers if a change in shaft sealing method appears necessary.

17. BEARING LUBRICATION

The pump bearings are tapered roller bearings and are grease lubricated at the factory during assembly. In a new or relubricated pump, the bearings may run warmer than normal for a few hours before the temperature levels to normal operating temperature. This is a normal condition of bearings freshly lubricated and is no cause for alarm. Higher than normal bearing temperature, occurring for several days after relubricating the bearings, may suggest a problem. This problem could be too much lubricant, a contaminated bearing, or it could possibly suggest a bearing about to fail. Should bearing temperatures run higher than normal for several days, the shaft-bearing assembly should be removed from the pump and inspected.

GREASE LUBRICATION:

Under normal operating conditions, the bearings should not need additional lubrication or relubrication for the first 3500 hours of operation. Shorten the lubrication intervals when the pump operates in dusty or moist environments.

A premium quality of NLGI grade 2 EP (extreme pressure) grease, suitable for the operating temperatures encountered, should be used. Pumps are lubricated at the factory with Mobil's Mobilux EP2 grease.

CAUTION! DO NOT mix different brands or grades of lubricants for the same application.

It is generally recommended that the bearing seals be replaced each time the pump is relubricated. Add a few drops of oil to the bore of the bearing seals before reassembling.

Preferred relubrication method:

When relubricating the bearings, the shaft/bearing assembly should be removed from the pump and cleaned of old lubricant. Carefully inspect the bearings for signs of wear or contamination and replace them if necessary. **DO NOT** contaminate the bearings while they are out of the pump. Pack each bearing full of grease and fill the space between the bearings about half full. **DO NOT** fill the space between the bearings completely full of grease.

Alternative relubrication method:

The following alternative relubrication method is provided as a convenience for installations where the pump location creates difficulty in using the preferred relubrication method. However, bearing life may be reduced as any existing contaminants are not removed.

Thoroughly clean the area around one of the upper pipe plugs on the bearing housing and replace the plug with a lube fitting. Inject approximately 1 to 1½ ounces (30 to 45 cm³) of grease into the bearing area through the lube fitting. Clean any excess grease from around the fitting to avoid attracting dirt and contaminants. Remove the lube fitting and replace the pipe plug. **DO NOT** leave the lube fitting in the bearing housing.

Every second or third relubrication of the pump should be performed using the preferred relubrication method. This will allow proper cleaning and inspection of the parts.

OIL LUBRICATION:

The pump bearings may be lubricated with oil if desired. A premium quality of solvent refined, high viscosity index, petroleum oil containing corrosion and oxidation inhibitors and extreme pressure (EP) additive (35 lb (15.8 kg) "OK" Timken load) should be used. The oil used should have a viscosity index of 80 as a minimum, and under normal ambient temperature conditions, an ISO/ASTM viscosity grade of 220 or SAE 90. In the case of low ambient temperature an ISO/ASTM viscosity grade of 100 or SAE 80 may be desirable, while high ambient temperatures may require an ISO/ASTM viscosity grade of 460 or SAE 140.

CAUTION! DO NOT mix different brands or grades of lubricants for the same application.

If the pump is converted to oil lubrication, the oil should be changed after the first month or 100 hours, whichever comes first. Thereafter, as a general guideline under normal operating conditions, the bearings should not need additional lubrication or relubrication for the first 1000 hours or 6 months, whichever comes first, of operation. Shorten the lubrication intervals when the pump operates in dusty or moist environments. Examination of the oil during relubrication will help in establishing the proper bearing maintenance and lubrication intervals for each particular application.

It is generally recommended that the bearing seals be replaced every other time the pump is relubricated. Add a few drops of oil to the bore of the bearing seals before reassembling.

Refer to Fig. 6 on page 32 for identification of the threaded bearing housing holes. For oil lubrication, the drive shaft/bearing assembly must be removed from the pump and cleaned of all grease lubricant. The inside surfaces of the bearing housing should be inspected and cleaned also. Install a vent plug into one of the upper tapped holes, labeled **FILL** in Fig. 6, on the bearing housing. Oil may be added after reassembling the pump. With the pump not operating, the oil level should be centered in the sight glasses located in the middle tapped holes, labeled **LEVEL** in Fig. 6, on the bearing housing. The lower tapped holes should be plugged and are used to drain the oil from the bearing housing.

To relubricate the pump remove a pipe plug from one of the lower threaded holes on the bearing housing. This will allow the oil in the bearing housing to drain. Flush the bearing area with new, clean oil by applying the oil through one of the upper threaded holes on the bearing housing. This will help remove any contaminants in the bearing housing. Let the oil drain thoroughly. Replace the pipe plug in the lower threaded bearing housing hole and replenish the oil

supply in the bearing housing. Be sure to use only clean, unused oil for lubricating the bearings.

GENERAL BEARING INFORMATION:

Since mounting and installing the bearings have such important effects on bearing performance, durability and reliability, it must be cautioned that more bearings are damaged or abused in this early stage of their life than wear out under the conditions for which they were designed. Proper tools, fixtures and practices are a must for roller bearing applications. Nicks, dents, scores, scratches, corrosion and dirt must be avoided if reliability, long life and smooth running are to be expected.

To ease the assembly of a bearing onto a shaft, it may become necessary to expand the inner race by heating. This should be done in clean oil or in a temperature controlled furnace at a temperature between 200°F and 250°F (93°C and 121°C). **DO NOT** heat the bearing directly, use only indirect heat. **DO NOT** exceed 250°F (121°C) as overheating will tend to reduce the hardness of the bearing parts.

! WARNING

DO NOT spin bearings with compressed air. This is highly dangerous and will cause the bearing to spin at dangerously high speed. This can cause the bearing to fragment with explosive force possibly causing serious personal injury or death.

To insure that antifriction bearings can get long life and that they perform without offensive noise, temperature rise or shaft excursions, the following precautions are recommended:

- Handle bearings with care.
- Work with clean tools, clean dry hands, and in clean surroundings.
- **DO NOT** wash or wipe new bearings prior to installation.
- Place unwrapped bearings on clean paper and keep them similarly covered, if they are not in the original container.
- **DO NOT** use wooden mallets, brittle or chipped tools, or dirty fixtures and tools in mounting bearings.
- **DO NOT** spin uncleaned bearings. **NEVER** spin any bearing with compressed air.
- **DO NOT** scratch or nick bearings.
- Insure that races are started onto shafts and into housings evenly to prevent cocking.
- Inspect shafts and housings before mounting bearings.
- When removing bearings, clean the housings, covers and shafts before exposing the bearings. All dirt can be considered an abrasive; dangerous to the reuse of any bearing.
- Treat used bearings, which may be reused, as new ones.
- Protect dismantled bearings from dirt and moisture. Wrap bearings in clean, oil-proof paper when not in use.

- In assembling bearings onto shafts, **NEVER** strike the outer race, or press on it to force the inner race. Apply the pressure to the inner race only. In disassembling, follow the same precautions.

The general classifications of failures usually requiring bearing removal are listed in the table that follows. These classifications are related with many causes, some of which are outlined also.

PROBLEM	POSSIBLE CAUSES
OVERHEATING	Bearing contamination
	Excessive lubrication
	Inadequate lubrication
	Housing distortion
	Blocked oil passages
	Oil foaming
	Cage wear
VIBRATION	Bearing contamination
	Fatigued bearing elements
	Race misalignment
	Shaft out-of-round
	Cage wear
	Flats on bearing elements
NOISE	Inadequate lubrication
	Bearing contamination
	Brinelling due to handling abuse
	Loss of bearing clearance
	Bearing slipping on shaft
BINDING	Lubricant breakdown
	Bearing contamination
	Thermal expansion
	Race misalignment
	Cage failure
LUBRICANT LEAKAGE	Excessive lubrication
	Seal wear or failure
	Lubricant deteriorating due to high temperature
	Clogged oil vent plug
	Lubricant churning

The bearing housing is cast in a single piece of aluminum alloy. The bearing housing is designed to be used with the Roper Pump Company bearing housing. The bearing housing is designed to be used with the Roper Pump Company bearing housing. The bearing housing is designed to be used with the Roper Pump Company bearing housing.

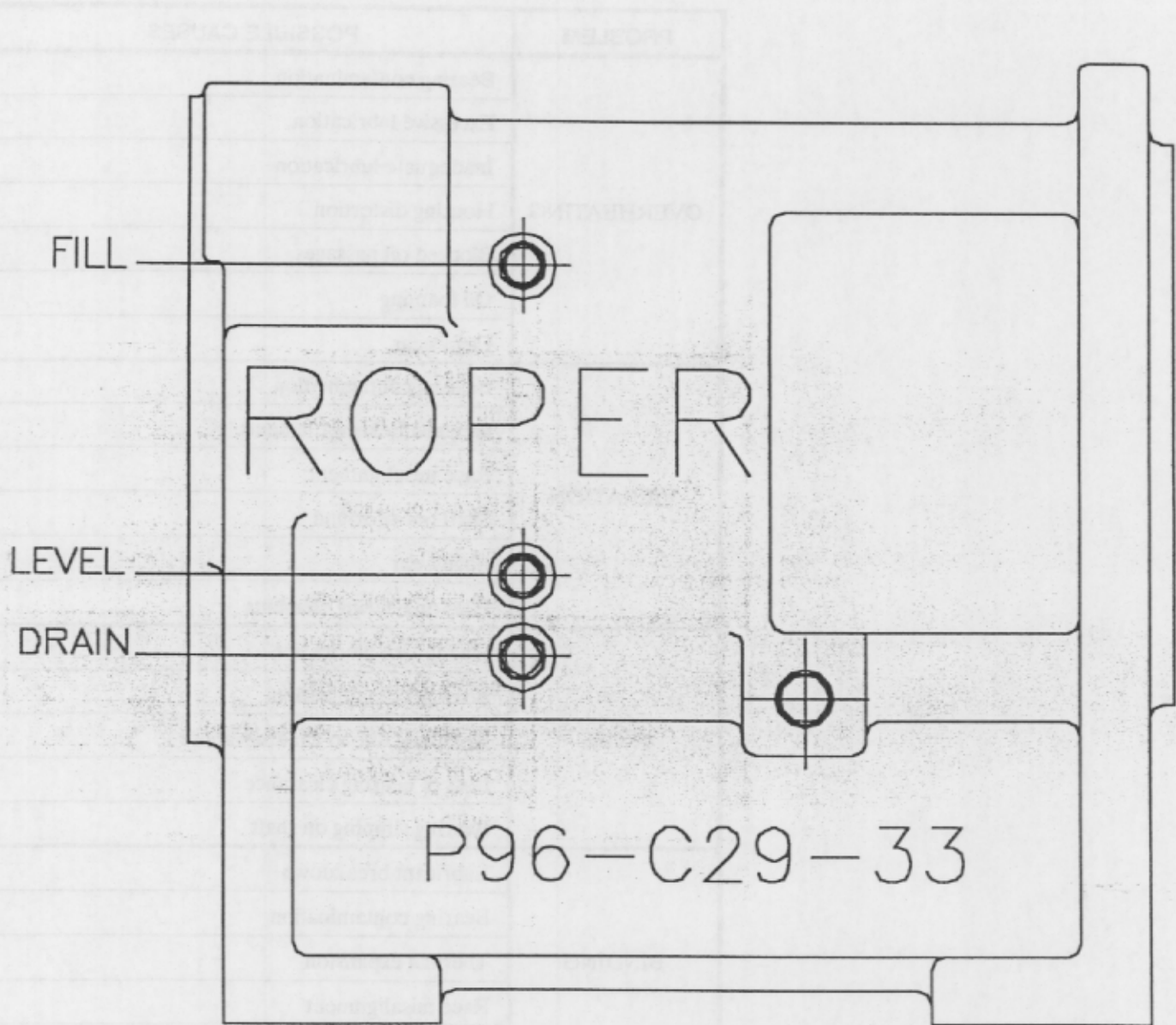


Fig. 6: Bearing Housing Threaded Holes

18. JOINT LUBRICATION

This pump is provided with two crowned gear type universal joints that allow the rotor to rotate through an eccentric path necessary to the proper functioning of the pump. Proper joint lubrication is particularly important because it can be performed only when the pump is disassembled. The lubricant must perform its job until the next time maintenance is performed on the pump.

Both of the joints should be packed with lubricant during pump assembly. **DO NOT** use lubrication fittings to lubricate the joints after assembly. The pipe plugs (AE and AF) in the stub shaft, drive shaft and coupling housing **MUST BE REMOVED** during the assembly of the joints to allow excess lubricant to vent from the joints. Damage to the joint seals and, subsequently, the joint assemblies may occur if these precautions are not followed.

A premium quality of NLGI grade 2 EP (extreme pressure) grease containing molybdenum disulfide additives should be used.

CAUTION! DO NOT mix different brands or grades of lubricants for the same application.

19. SPECIAL PRECAUTIONS FOR HOPPER FEED PUMPS



WARNING! Lock out power before opening hopper body.

To avoid unsafe conditions, install hopper feed pumps with the following minimum provisions besides the other directions contained in this manual:

- **DO NOT** operate hopper feed pumps unless the hopper body and inlet piping completely enclose the auger elements. Make sure all guards are in place. If the hopper body is opened for any reason, lock out the driver so that it cannot be restarted by anyone unless the hopper body is closed and all guards are in place.
- If an open hopper body is a condition of use, the entire pump is then to be guarded by a railing or fence. Post warning signs in the area.
- Feed openings for manual or mechanical equipment must be built so that a grating covers the hopper body opening. If the material is such that a grating cannot be used, then the exposed hopper body opening must be guarded by a railing or fence. Post warning signs in the area.
- **DO NOT** walk on hopper gratings or power transmission guards.
- **DO NOT** poke or prod material in the hopper body with any object.
- **DO NOT** place hands, feet, head, or any other part of the body in any hopper opening.
- Controls, guards, walkways, machinery arrangement, crew training, etc., are all necessary factors in the creation of a safe, practical installation. These items are generally not a part of our services. *It is the responsibility of the contractor, installer, owner, and user to add to the materials furnished by Roper to result in a safe installation and to comply with OSHA, state and local laws, and the ANSI Safety Code.*

20. CHECKING PUMP PERFORMANCE

A summary of the causes of common malfunctions.

PROBLEM	POSSIBLE CAUSES
NO LIQUID DELIVERED	Pump rotating in wrong direction.
	Inlet lift too high. Check this with gauge at pump inlet.
	Clogged inlet line.
	Inlet pipe not submerged.
	Air leaks in inlet line.
	Faulty pressure relief device in system.
	Pump worn.
RAPID WEAR	Excessive pressure.
	Pump runs dry.
	Incompatibility of liquid and pump materials.
	Pipe strain on pump. See Installation of Pipes.
	Excessive abrasives in liquid.
EXCESSIVE NOISE	Starved pump.
	Air leaks in inlet line.
	Air or gases in liquid.
	Pump speed too high.
	Improper mounting. Check alignment thoroughly. See Aligning Driver and Pump and Preparation of Foundation.
PUMP TAKES TOO MUCH POWER	Speed too high.
	Liquid more viscous than previously anticipated.
	Operating pressure higher than specified. Check this with gauge at pump discharge.
	Discharge line obstructed.
	Mechanical defect, such as bent shaft.
	Packing too tight.
	Pipe strain on pump. See Installation of Pipes.
	Incompatibility of liquid and pump material causing stator swell.
	Pressure relief device in system not operating properly.
INSUFFICIENT LIQUID DELIVERED	Air leaks in inlet line.
	Air leaks through packing or mechanical seal.
	Speed too slow.
	Excessive lift at inlet. Check this with gauge at pump inlet.
	Viscosity of liquid too high for size and length of inlet pipe.
	Foot valve, if used, too small, stuck or not working properly.
	Foot valve or end of inlet pipe not immersed deeply enough in liquid.
	Pump damaged by misalignment or foreign matter.
	Excessive clearance in pump caused by wear or corrosion.
	Faulty pressure relief device in system.

TERMS & CONDITIONS AND LIMITED WARRANTY

This agreement (this "Agreement"), consisting of these Terms and Conditions, and the associated Order Acknowledgement is binding upon Roper Pump Company, hereinafter "SELLER," and the customer, hereinafter "BUYER." By placing an order for a product with the Seller, the Buyer agrees to these Terms and Conditions of sale and acknowledges that the person placing the order has the authority to enter into the Order Acknowledgement on Buyer's behalf.

LEGAL EFFECT: Except as expressly otherwise agreed to in writing by an authorized representative of Seller, the following terms and conditions shall apply to and form a part of any Order Acknowledgement. Seller may suspend its performance of any Order Acknowledgement if Buyer defaults in the performance of its duties under the Order Acknowledgement or under any other agreement between the Buyer and Seller.

ACCEPTANCE: The sale of goods and services is expressly conditional on Buyer's acceptance of Seller's terms and conditions as stated herein. Provided that Seller's terms and conditions have not been previously accepted by Buyer, Buyer's receipt of goods or services shipped under this Agreement constitutes acceptance of these terms and conditions. No additional, different or conflicting provisions proposed by Buyer are acceptable to Seller and are hereby specifically rejected, Seller being unwilling to sell goods on any terms conflicting with, limiting or modifying the terms hereof. Buyer shall not sell, transfer or otherwise provide any goods to another for resale without the prior, written authorization of Seller. Seller reserves the right to sell and to authorize other entities to sell such goods through all means and channels of distribution and in competition with Buyer. Buyer acknowledges that it has no authority to bind or contract in the name or for the account of Seller, to create any liability against Seller or to exert any direction or control over Seller's personnel.

CHANGES: This Agreement and the associated Order Acknowledgement constitutes the entire agreement between Seller and Buyer with respect to the subject matter thereof, and supersedes all prior oral or written agreements. This Agreement and the associated Order Acknowledgement may not be amended or modified, except by a further written agreement signed by an authorized representative of Seller. Seller reserves the right to make reasonable changes to an Order Acknowledgement, including changes as to packaging, testing, specifications, designs and delivery schedules. The terms and conditions of any purchase order or other instrument issued by Buyer or its agent in connection with this Agreement and the associated Order Acknowledgement or any goods sold thereunder that is in addition to or inconsistent with the terms and conditions of this Agreement or the associated Order Acknowledgement are null and void and shall not be binding on Seller. Buyer's changes made after formation of this Agreement that affect the schedule or requirements for services or otherwise affect the scope of this Agreement shall be submitted in writing by Buyer and shall become binding only if approved in writing by Seller's cognizant representative. All changes and delays resulting from such changes shall be solely determined by Seller and shall be binding upon Buyer.

TERMINATION, SUSPENSION, AND CANCELED ORDERS: Provided that Seller receives adequate written notice from Buyer, Buyer may terminate or suspend performance at Buyer's convenience subject to all reasonable charges, which charges shall be solely determined by Seller. Buyer cannot cancel or alter Orders without the Seller's written consent. If Seller grants such consent, Buyer will reimburse Seller for all of Seller's losses and expense caused by such cancellation or alteration, including without limitation all of Seller's additional costs caused by changes in design or specifications, or by product revisions, and all incidental and consequential damages incurred by Seller as a result of such cancellation or alteration. No goods may be returned to Seller except with Seller's written consent. Title in a returned good will pass when Seller takes possession of the returned goods.

CREDIT: The amount of credit offered by Seller to Buyer is contingent upon Seller's opinion of Buyer's capacity, ability, and willingness to promptly pay for goods and services received under the terms of this Agreement. Provided that, in Seller's opinion, there is a material adverse change in Buyer's financial condition and/or Buyer has not, within the agreed time, fully paid for goods and services previously supplied under this and/or another Agreement(s) with Seller, Seller reserves the right to revoke Buyer's credit and/or suspend performance on this and/or other orders for goods and services.

PAYMENTS: Standard terms for customers who qualify for credit net 30. A monthly service charge of 1.5% may be charged on amounts owed by Buyer to Seller that have not been paid within by the due date, subject to the maximum amount permitted by law.

TAXES: Buyer assumes exclusive liability for any and all taxes, tariffs, fees, duties, withholdings or like charges, whether domestic or foreign, now imposed or hereafter becoming effective ("Taxes") related to the goods and its purchases from Seller, including without limitation, federal, provincial, state and local taxes, value-added taxes, goods and services taxes, stamp, documentary, excise or property taxes, duties and other governmental charges.

TITLE AND LIEN RIGHTS: The equipment will remain personal property, regardless of how it is installed or affixed to any realty or structure. After delivery to Buyer, Seller will have all such rights, including security interests and liens, in the equipment as lawfully may be conferred upon Seller by contract under any applicable provision of law. Buyer agrees to cooperate fully with Seller in the filing of any financing statements, including Uniform Commercial Code (UCC) filings or other documents necessary to perfect such interests and liens. If Buyer defaults in its obligations under the Order Acknowledgement before the price (including any notes given therefore) of the equipment has been fully paid in cash, Seller may take any and all actions permitted by law to protect its interests including, where permissible, repossession of such equipment.

SHIPMENTS: All sales are Ex-Works Factory (as such term is defined by the International Chamber of Commerce as of the date hereof). Shipping contracts made by Seller shall be to Buyer's account. All claims for loss or damage after risk of loss has passed to Buyer shall be filed by Buyer with the carrier. Buyer shall be liable to Seller for the full price of the goods, irrespective of loss or damage in transit. Seller shall not be required to provide freight cost receipts to Buyer at the time of invoice. Buyer shall bear all risk and expense for delivery of goods, including without limitation, shipping, loading, unloading, storage, freight, and insurance. Goods may be shipped to Buyer in whole or in part. Title to goods shall pass to Buyer when delivered to the carrier or the Buyer, whichever occurs first, even if the goods are shipped freight prepaid. Among other things, a signed delivery receipt or bill of lading will constitute proof of delivery. The choice of carrier is made solely at the discretion of Seller, and Seller makes no representation as to the acceptability of a particular carrier. Except when Seller expressly agrees in writing, Seller does not guarantee shipment or delivery by a certain date or time, although Seller will strive to deliver goods by the date that it may communicate to Buyer. Seller shall not be liable to Buyer, or any other person, for any loss or damage of any kind which results from delay in shipment, delivery, or failure to give notice of delay, whether or not such delay was caused by Seller or otherwise. Seller reserves the right to backorder any goods and to ship from backorder in such order as Seller determines.

LIMITED WARRANTY: Seller warrants, to its original Buyer, that goods manufactured by Seller are free from defects in material and workmanship for 12 months from date of shipment (except for specified products with warranties that supersede this limited warranty. Please consult factory for these products). If a failure to conform to specifications or a defect in materials or workmanship is discovered within this period, Seller must promptly be notified in writing within thirty (30) days, which notification, in any event must be received no later than 12 months from the date of shipment. Within a reasonable time after such notification, Seller will correct any failure to conform to specifications or any defect in materials or workmanship, or in lieu of such repair, and at its sole option, shall replace the equipment. THE ABOVE ARE THE BUYER'S EXCLUSIVE REMEDIES FOR BREACH OF WARRANTY. Seller does not warrant: (a) defects caused by failure to provide suitable installation environment for the product, (b) damage caused by use of the product for purposes other than those for which it was purchased, (c) damage caused by disasters such as fire, flood, wind, and lightning, (d) damage caused by unauthorized attachments, or

modification, (a) any other abuse or misuse by the Buyer, including improper installation; or (f) goods which have been damaged or altered by Buyer or its customers.

Each good sold by Seller to Buyer shall be deemed to be without defect and in conformity with its specifications and the terms of this Agreement and the associated Order Acknowledgement even though reasonable variances may exist. As a result, Seller cannot and does not guarantee that goods sold hereunder, whether in whole or in part, will exactly match in specification or otherwise, and Buyer acknowledges that reasonable variance is permissible. Additionally, Seller shall have no liability if a good does not conform to any applicable state, county or local ordinance, as the conformity of a good to each state, county and local ordinance is the sole responsibility of the Buyer. Seller reserves the right to change its goods and the components of its goods without prior notice to Buyer, although in circumstances where an order from Buyer has been accepted by Seller, Seller will use commercially reasonable efforts to ensure that such change will not affect performance of the good in a materially adverse manner.

EXCEPT AS SET FORTH ABOVE AND TO THE MAXIMUM EXTENT PERMITTED BY LAW, SELLER MAKES NO OTHER WARRANTIES FOR A PRODUCT OR UNDER THIS AGREEMENT OR ANY ORDER ACKNOWLEDGEMENT AND HEREBY DISCLAIMS ALL OTHER WARRANTIES, EXPRESS OR IMPLIED, INCLUDING BUT NOT LIMITED TO THE WARRANTY OF FITNESS FOR A PARTICULAR PURPOSE OR USE, AND INCLUDING THE WARRANTY OF MERCHANTABILITY, IN NO CASE SHALL SELLER BE LIABLE FOR ANY SPECIAL, INCIDENTAL, OR CONSEQUENTIAL DAMAGES BASED UPON ANY LEGAL THEORY, INCLUDING BUT NOT LIMITED TO LOSS OF PROFITS, LOSS OF SAVINGS OR REVENUE, LOSS OF USE OF THE PRODUCT OR ANY ASSOCIATED EQUIPMENT, COST OF CAPITAL, COST OF ANY SUBSTITUTE EQUIPMENT, FACILITIES OR SERVICES, DOWNTIME, THE CLAIMS OF THIRD PARTIES INCLUDING CUSTOMERS, INJURY TO PROPERTY AND, UNLESS PRECLUDED UNDER APPLICABLE STATE LAW, BODILY AND PERSONAL INJURY.

INDEMNITY; LIABILITY LIMITATION: Buyer hereby agrees to indemnify, reimburse in full, defend and hold harmless Seller, its subsidiaries, affiliates, officers, directors, personnel and agents from and against any and all liability, claims, suits, actions, losses, costs or expenses including (without limitation) reasonable attorneys' fees relating to or arising out of any claim or demand (a) for any Taxes or related penalties and interest, (b) due to Buyer's breach of the Order Acknowledgement; (c) that Buyer's customers or a third party may make against Seller based upon or arising from damage due to the acts and/or omissions of Buyer or due to the installation of the goods; (d) for infringement or misappropriation of a third party's intellectual property rights based upon Seller's incorporation of any designs, formulas or specifications in any goods where such designs, formulas or specifications have been specifically ordered or requested by Buyer. To the maximum extent allowable under applicable law and excluding those liabilities that by law Seller cannot limit or disclaim, (f) Seller's aggregate liability arising from or relating to this Order Acknowledgement of goods, regardless of the cause of action asserted, is limited to the amount paid by Buyer to Seller for the applicable goods and (ii) Seller shall not be liable for any special, incidental, consequential, indirect, or punitive damages, including without limitation, lost revenues, loss of use of the goods, loss resulting from improper storage, processing, padding/cushion, delay in delivery or shipment or errors in shipment or labeling, loss of data, or the cost of any substitute goods or related equipment, even if Seller has been advised of the possibility of such damages.

EXPORT RESTRICTIONS: Buyer shall not export or re-export goods in violation of any applicable laws or regulations of the United States or the country in which Buyer obtained them.

CONFIDENTIAL INFORMATION. During the term of this Agreement and the associated Order Acknowledgement and for the longer of (a) three (3) years following its termination and (b) for such Confidential Information of Seller that is a Trade Secret of Seller as defined by applicable law, for the life of such Seller Trade Secret, Buyer agrees to receive and hold Confidential Information of Seller in trust and in strictest confidence and shall not use, reproduce, distribute, disclose or otherwise

disseminate any Confidential Information except as necessary to perform its obligations hereunder. Disclosure of the Confidential Information may be made only to Buyer's employees and agents who have a specific need to know and are subject to confidentiality restrictions at least as restrictive as those contained herein. "Confidential Information" means confidential information relating to the business, products and services of Seller which is or has been disclosed to Buyer, and which has value to Seller and is not generally known to Seller's competitors, including (without limitation), information regarding the specifications provided to Buyer by Seller and Seller's product plans, designs, costs, prices, finances, marketing plans, business opportunities, personnel, R&D activities and know-how.

CONTROLLING LAW: This Agreement and the associated Order Acknowledgement entered into hereunder shall be governed and construed in accordance with the laws of the State of Georgia and of the United States of America without reference to any conflicts of law principles; the parties submit themselves to the jurisdiction of the federal and state courts located in Jackson County, Georgia, which shall have exclusive jurisdiction of any disputes arising hereunder, and the parties waive any objection to venue therein. The United Nations Convention on Contracts for the International Sale of Goods, the Uniform Law on the Formation of Contracts for the International Sale of Goods, and any applicable International discovery and service of process conventions shall not be applicable. In the event legal action is undertaken by Seller to collect any amounts due to Seller by Buyer hereunder and if Seller prevails in such action, then Buyer shall reimburse Seller for its reasonable attorney fees and costs incurred in conjunction with such action, which amount shall not exceed the maximum amount allowed by law of the forum in which such action is brought.

ASSIGNMENT: Neither this Agreement nor any associated Order Acknowledgement may be assigned by the Buyer, or its contents publicized by the Buyer, without the written consent of Seller. Seller shall have the right to assign, transfer or sublicense all or any part of this Agreement or any associated Order Acknowledgement to another at any time and without the consent of Buyer.

MISCELLANEOUS: The various provisions of this Agreement and any associated Order Acknowledgement are severable, and any determination of invalidity or unenforceability of any one provision hereof shall not bearing on the continuing force and effect of the remaining provisions hereof. This Agreement and any associated Order Acknowledgement and the terms and conditions contained herein constitute the entire understanding of the parties with respect to the purchase and sale of the goods, and any prior agreements, with respect thereto, whether written or oral, are superseded hereby. This Agreement and any associated Order Acknowledgement shall be binding on the parties and their respective successors and any permitted assigns.

ELECTRONIC DATA INTERCHANGE. The parties may execute a Order Acknowledgement by transmitting and receiving the data contained in the Order Acknowledgement electronically rather than in paper form. To provide the legal validity and enforceability of such Order Acknowledgement, the parties further agree that the data transmitted herein will be considered "in writing" and to have been "signed." The parties agree not to contest the validity or enforceability of a Order Acknowledgement because of the electronic origination, transmission, storage or handling of such Order Acknowledgement. Any computer printout of the data contained in the Order Acknowledgement will be considered an "original" when maintained in the ordinary course of business and will be admissible as between the parties to the same extent and under the same conditions as other business records maintained in documentary form. The parties agree to properly use those security procedures which are reasonably sufficient to ensure that a transmission of the data contained in a Order Acknowledgement is authorized and to protect its business records and data from improper sources.