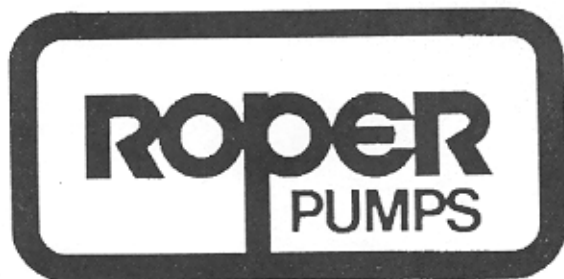


**INSTALLATION, OPERATION
AND
MAINTENANCE MANUAL
FOR
ROPER
PROGRESSING CAVITY
PUMP
MODELS
7X212 & 7X305
TYPES 1 & 3**



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TABLE OF CONTENTS

Section	Page
1.	INTRODUCTION 1
2.	SAFETY PRECAUTIONS 2
3.	PRE-OPERATION CHECKS 4
4.	PREPARATION OF FOUNDATION 5
5.	ALIGNING DRIVER AND PUMP 6
	FLEXIBLE COUPLING
	BELTS AND SHEAVES
6.	ADDITIONAL IMPORTANT WARNINGS AND INFORMATION 8
7.	INSTALLATION OF PIPES 9
8.	NPT CONNECTIONS 10
9.	INSTRUCTIONS FOR PUMP DISASSEMBLY 11
10.	INSTRUCTIONS FOR PUMP ASSEMBLY 12
11.	PUMP SECTIONAL DRAWINGS 15
12.	PARTS LIST 19
13.	PRESSURE RATINGS 23
14.	STORAGE 24
	SHORT TERM STORAGE
	LONG TERM STORAGE
15.	NAMEPLATE DATA 25
	PUMP NOMENCLATURE
16.	SHAFT SEALING 26
	PACKING
	CARE OF PACKING
	MECHANICAL SEALS
17.	BEARING LUBRICATION 28
	PREFERRED RELUBRICATION METHOD
	ALTERNATE RELUBRICATION METHOD
18.	JOINT LUBRICATION 31
19.	SPECIAL PRECAUTIONS FOR HOPPER FEED PUMPS 31
20.	CHECKING PUMP PERFORMANCE 32
21.	REPLACEMENT PARTS 33

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 crew using this pump have 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 DISASSEMBLY 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 a bar or stick.
- **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 fluoroelastomers 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 to $1\frac{1}{2}$ inches 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.

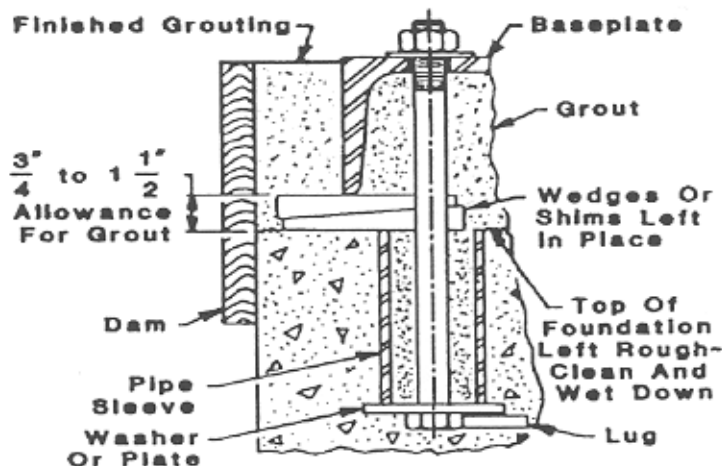


Fig. 1: Typical Baseplate Anchoring

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

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-

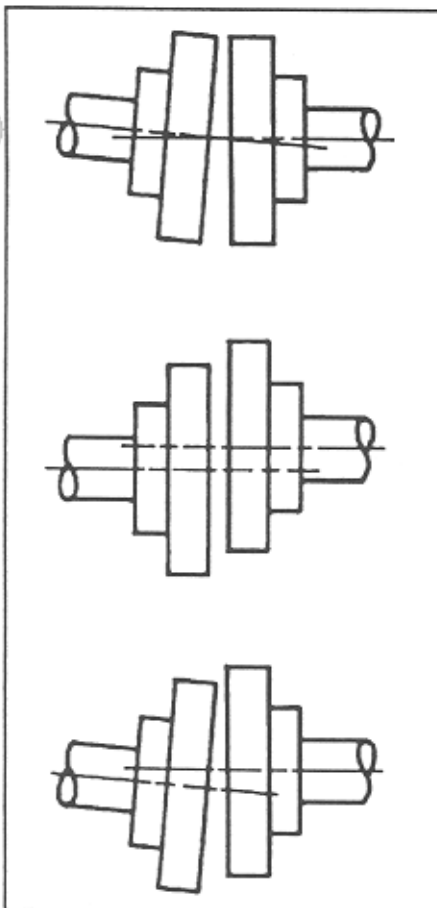


Fig. 2: Misalignments:
Top, Angular; Center, Parallel; Bottom, Both.

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:

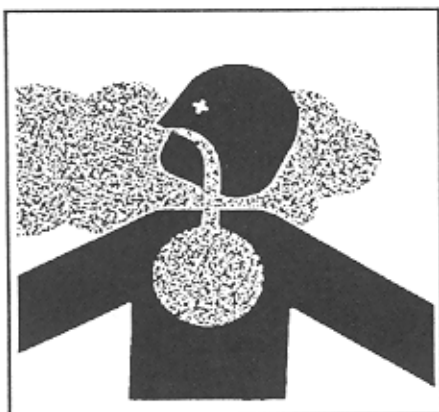
- Decide the results of spillage or leakage (all pumps or systems may fail sometime).

<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

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.



DANGER! TOXIC! Do not burn fluoroelastomers.

- 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, threaded stator connections, 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 appropriate sectional drawing in section 11.

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.
9. Remove reducer coupling (44) from stator (99) using a pipe wrench.
10. Remove two retaining screws (27) from shaft collar (25) using an Allen wrench.
11. Remove shaft pin (28) by pushing pin through and out of drive shaft (24) and shaft collar (25). Slide shaft collar (25) back to packing gland (36).
12. Remove two pin washers (26) from drive shaft (24).
13. Remove cap screws (B) securing stator support cap (43) to stator support (42). Remove stator support cap (43). Place a temporary support, such as a block of wood, under inlet body (41) and remove stator support (42). Note: On 7X305 model pumps, remove support spacers (60) also.
14. Remove stator (99), rotor (98), and attached parts (connecting rod (31), connecting rod washers (32), etc.) by unscrewing stator (99) from inlet body (41) or reducer bushing (61). Either make a mark on the driving end of the rotor (98) to correspond with the face of the stator (99), or measure and record the distance the rotor (98) extends from the stator (99). This will be useful for reassembly.
15. Remove stator (99) from 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.**
16. Remove rotor band (30) from rotor (98). A punch or dowel will be useful to tap the rotor band (30) from the rotor (98) as these parts are a press fit assembly. Take care not to tap or press on the free end of the connecting rod (31) as this may cause damage to it and the rotor pin (29). Remove rotor pin (29) by pushing out of rotor (98) and remove connecting rod (31). Note: On 7X305 model pumps, remove the rotor head adapter (58), rotor band (30), and adapter pin (59) in the same manner as outlined above.
17. Remove connecting rod washers (32) from connecting rod (31).
18. Remove drive key (A) from drive shaft (24). Remove four cap screws (H), lockwashers (J), and bearing coverplate (10). Remove lip seal (19) from bearing coverplate (10).
19. Loosen nuts (E) securing packing gland (36).

20. Carefully remove drive shaft (24) and attached parts (bearings (12), spacers (14A, 14B), lockwasher (15), and locknut (16)) from bearing housing (11). A dowel may be inserted into the tubing end of the drive shaft (24) to tap upon to ease removal of the shaft assembly. Make sure the dowel fits inside of the tubing and seats against the solid part of the drive shaft (24). **DO NOT** tap or press on the tubing part of the drive shaft (24) as this may cause damage to the part. Remove shaft collar (25) from opening in bearing housing (11).
21. One tab of bearing lockwasher (15) should be found positioned into a groove of the bearing locknut (16). Locate this tab and straighten it out of the groove. Using a spanner wrench, remove bearing locknut (16). Remove bearing lockwasher (15).
22. Press bearings (12, 13) and bearing spacers (14 or 14A and 14B) from drive shaft (24). Be careful not to damage bearings or 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.**
23. Remove two nuts (E), flat washers (F), and the packing gland (36) from the packing studs (G).
24. Remove packing set (38), lantern ring (39), and packing gland washer (37) from inlet body (41). Packing hooks are commercially available to assist in removing packing. With the drive shaft (24) removed, a dowel may be inserted into the threaded end of the inlet body (41) to press against the packing gland washer (37), thereby, pushing out the packing set (38) and other parts from the inlet body (41).
25. Remove cap screws (B) securing body support cap (23 to body support (22) and remove body support cap (23). Remove inlet body (41) and bearing housing (11) from body support (22) and temporary support.
26. Remove lip seal (18) from bearing housing (11).
27. Separate the inlet body (41) from the bearing housing (11) by removing cap screws (K). Remove packing studs (G) from inlet body (41). Remove reducer bushing (61) from inlet body (41) on 7X305 model pumps.
28. 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), pin washers (26), and connecting rod washers (32) be installed each time the pump is disassembled and reassembled.

10. INSTRUCTIONS FOR PUMP ASSEMBLY

Refer to the appropriate sectional drawing in section 11.

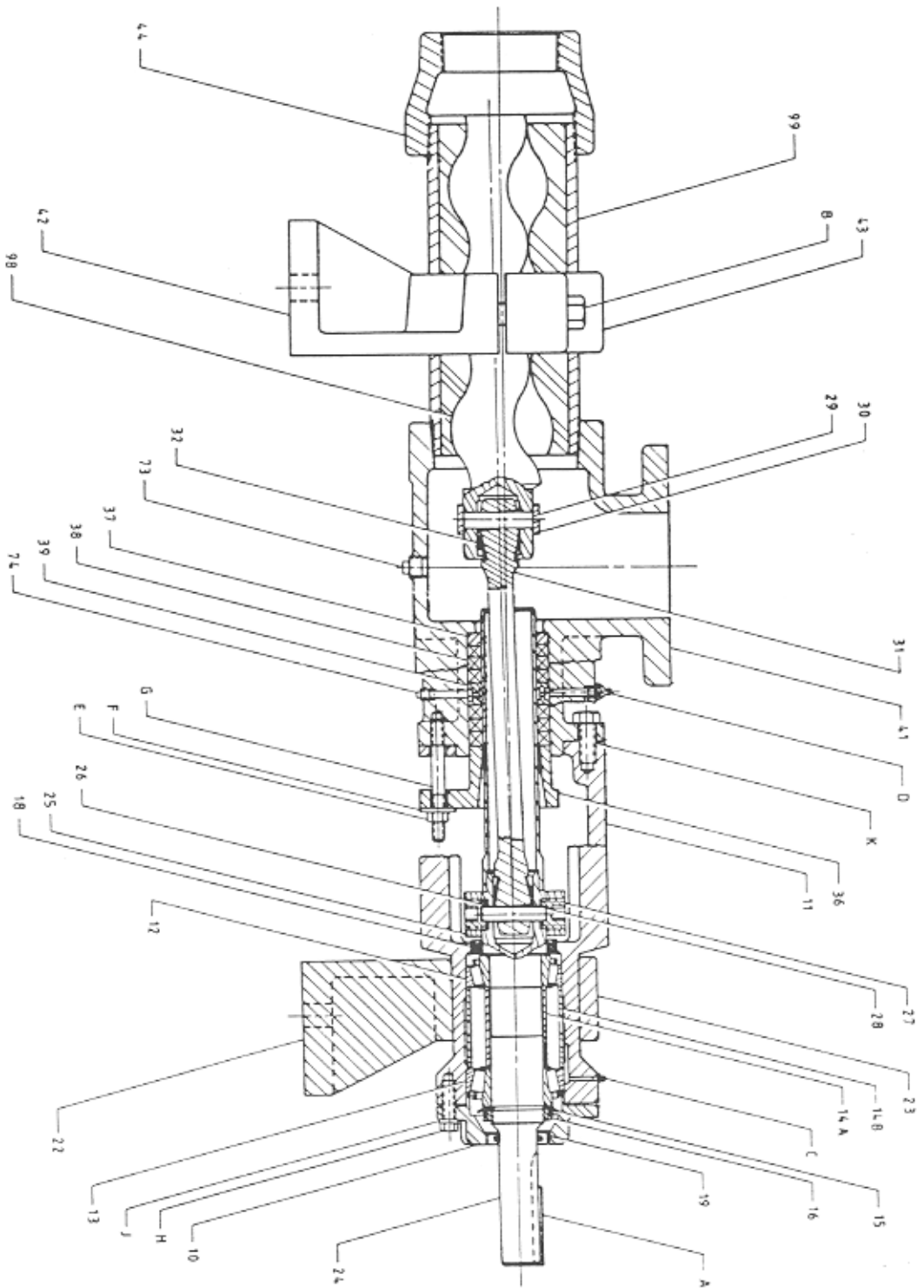
1. Read sections on Replacement Parts, Bearing Lubrication, Joint Lubrication, NPT Connections, Packing and Safety Precautions before assembling pump. Visually inspect all parts during assembly. Replace all worn or damaged parts. Although they may appear reusable, it is recommended that a new packing set (38), lip seals (18, 19), pin washers (26), and connecting rod washers (32) be installed when the pump is being reassembled.
2. For ease of assembly, stand inlet body (41) vertically on end with threaded hole.
3. Install pipe plug (73) into inlet body (41).
4. Clean bore of stuffing box in inlet body (41). Install packing gland washer (37) into inlet body (41). Install packing set (38) and lantern ring (39) into inlet body (41). Position lantern ring (39) so that it aligns with flush holes in inlet body (41).

Stagger joints of adjacent packing rings 180° apart. Refer to section on Packing for additional information.

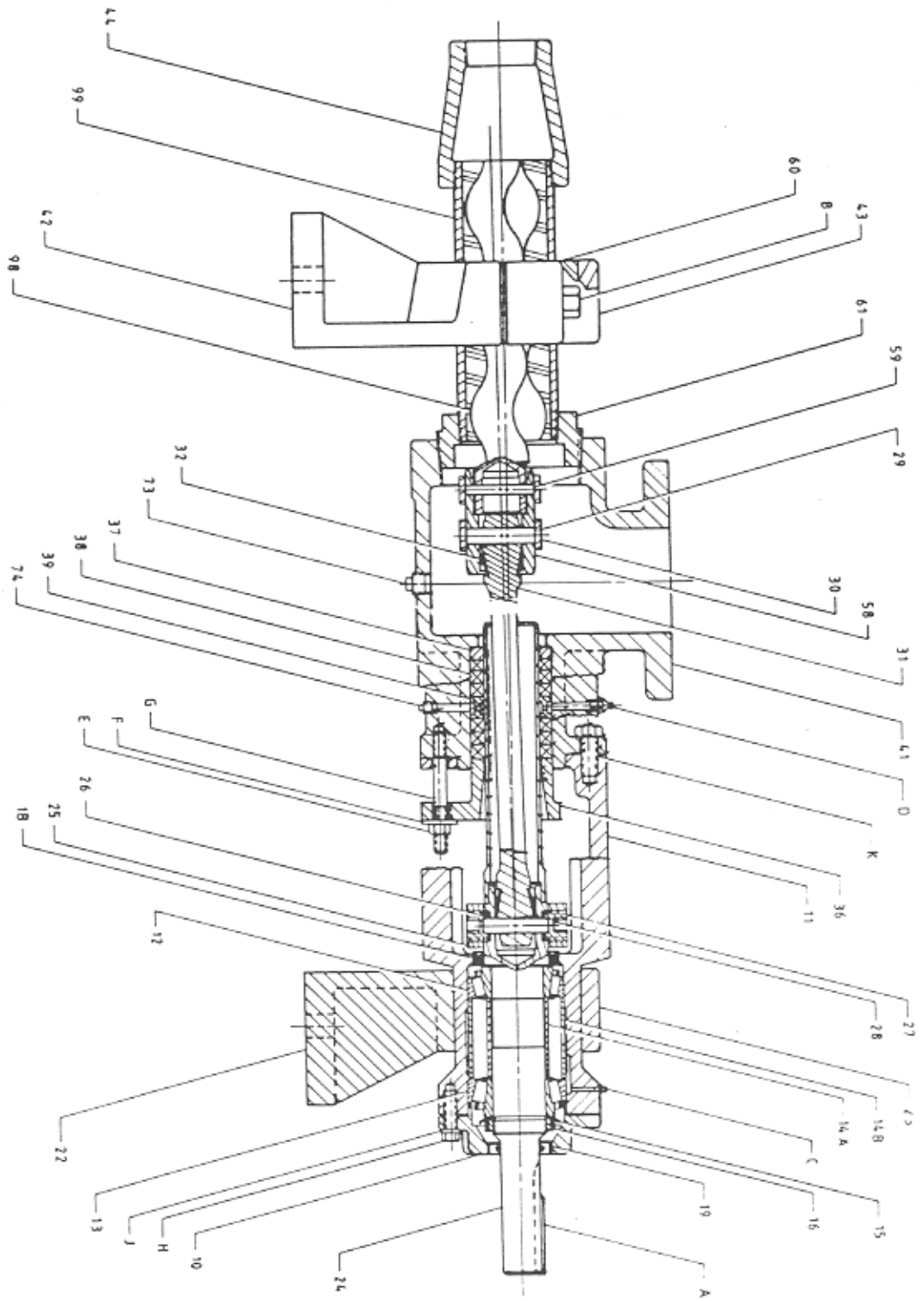
5. Install two packing studs (G) into inlet body (41). Place bearing housing (11) onto inlet body (41) and secure with cap screws (K). Place packing gland (36) over studs (G). Install two flat washers (F) and nuts (E) onto studs (G). Only tighten nuts (E) finger tight. Final tightening and packing adjustment should be done after the pump has been completely assembled and installed. Refer to section on Packing.
6. Install lip seal (18) into bearing housing (11). Lubricate bore of lip seal (18) with a light oil.
7. Place shaft collar (25) on top of packing gland (36) to allow drive shaft (24) to pass through.
8. Press bearings (12, 13) and spacers (14 or 14A and 14B) onto drive shaft (24). Be careful not to damage bearings or shaft. When pressing on bearings, use an arbor or dowel to fit inside the tubing section of the shaft to apply pressure to the solid part of the shaft. **DO NOT** press against the tubing section of the shaft as this could damage 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.**
9. Install bearing lockwasher (15) onto drive shaft (24). Install bearing locknut (16) onto drive shaft (24) using a spanner wrench to tighten the locknut (16). After tightening the locknut (16) onto the shaft (24), locate a groove in the locknut (16) that aligns with a tab on the lockwasher (15). If none are in alignment, additional tightening of the locknut (16) will be required. After aligning a groove in the locknut (16) with a tab on the lockwasher (15), bend the aligned tab of the lockwasher (15) into the groove of the locknut (16) to prevent loosening of the locknut (16).
10. Pack each bearing (12) full of grease and fill the space between the bearings (12) about one-half full of grease. Refer to section on Bearing Lubrication for additional information.
11. Lightly lubricate the bore of the packing set (38). Carefully slide the drive shaft (24) into the bearing housing (11) until the outer bearing (13) seats. Make sure shaft collar (25) is present and that drive shaft (24) passes through it. It may be necessary to lightly tap the end of the drive shaft (24) with a rubber or plastic mallet to seat the outer bearing (13). **DO NOT** use a metallic faced striking instrument.
12. Install lip seal (19) into bearing coverplate (10). Lubricate bore of lip seal (19) with a light oil.
13. Carefully install bearing coverplate (10), with lip seal (19), onto bearing housing (11) taking care not to cut or damage the lip seal (19) on the keyway of the shaft (24). Covering the keyway with a piece of tape should help prevent damage to the lip seal (19). Secure the bearing coverplate (10) using four cap screws (H) and lockwashers (J).
14. Lubricate and install two connecting rod washers (32) onto connecting rod (31).
15. Apply a generous amount of grease that is compatible with the pumped fluid to one end of the connecting rod (31). Refer to section on Joint Lubrication for additional information. Slide greased end of connecting rod (31) into head of rotor (98) until the pin holes are aligned. Install rotor pin (29) into rotor (98) and connecting rod (31). Press or tap rotor band (30) onto rotor (98). Note: On 7X305 model pumps, installation of the rotor head adapter (58), rotor band (30), and adapter pin (59) is performed in the same manner as outlined above.

16. Lubricate the inside of stator (99) and profile of 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 rotor (98) and stator (99) will be slippery and possibly difficult to hold.** Slide rotor (98) into stator (99) until mark on rotor (98) aligns with face of stator (99) or until rotor (98) extends from stator (99) the same amount as measured previously. Refer to step No. 14 in Instructions for Pump Disassembly. Immediately clean up any materials used for lubricating the parts that may have spilled.
17. Apply a generous amount of grease that is compatible with the pumped fluid to the free end of the connecting rod (31). Refer to section on Joint Lubrication for additional information.
18. At this point, the inlet body assembly should be positioned to a horizontal position and secured to prevent movement.
19. On 7X305 model pumps, refer to section on NPT Connections and install reducer bushing (61) into inlet body (41).
20. Refer to section on NPT Connections. Start threads of stator (99) into inlet body (41) or reducer bushing (61). Position free end of connecting rod (31) in the drive shaft (24) until the pin holes are aligned.
21. Install one pin washer (26) into counterbore on each side of drive shaft (24). Slide collar (25) over pin washers (26) and pin holes in shaft (24).
22. Install shaft pin (28) through collar (25), pin washers (26), drive shaft (24), and connecting rod (31). Shaft pin (28) should extend evenly from both sides of shaft pin holes.
23. Install two retaining screws (27) into collar (25), over pin washers (26), using an Allen wrench. Make sure pin washers (26) are not cocked in their counterbores in the shaft (24). Also, make sure the counterbores in the retaining screws (27) fit over the extensions of the shaft pin (28), and the pilot of the retaining screws (27) fit into the counterbores of the shaft (24). This will help insure proper sealing of the shaft pin (28).
24. Fully tighten stator (99) into inlet body (41) or reducer bushing (61) using a pipe wrench. Position the wrench close to the inlet body (41) to reduce the stresses imposed on the threads while tightening.
25. Refer to section on NPT Connections and install reducer coupling (44) onto stator (99).
26. Set assembly on body support (22) and stator support (42). Place body support cap (23) and stator support cap (43) in position and secure with cap screws (B). Tighten cap screws (B) evenly to secure support caps. *Excessive or uneven tightening of the cap screws (B) may damage or break the support caps.* Note: On 7X305 model pumps, make sure support spacers (60) are in place.
27. Install drive key (A) into drive shaft (24).
28. Read 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 pump.

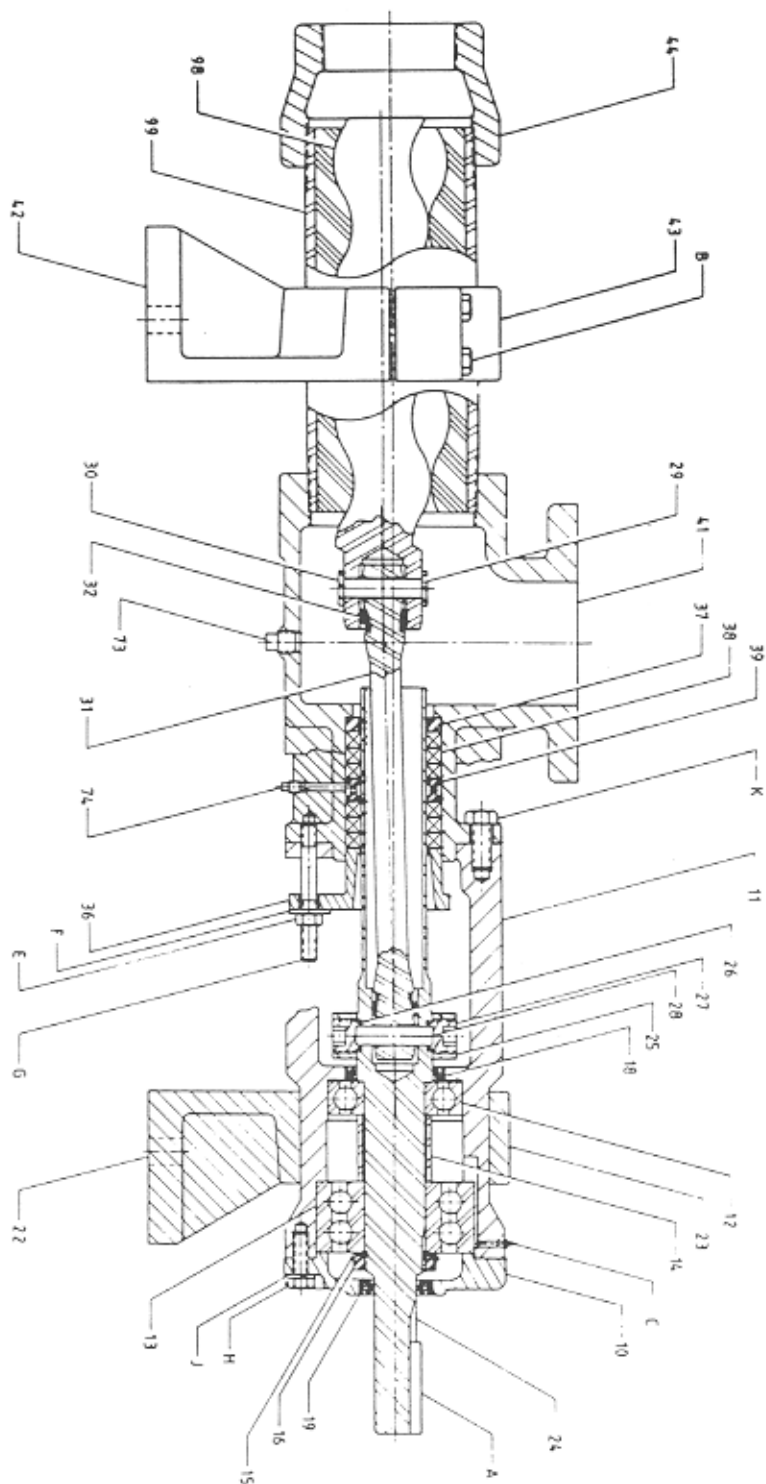
11. PUMP
SECTIONAL
DRAWINGS



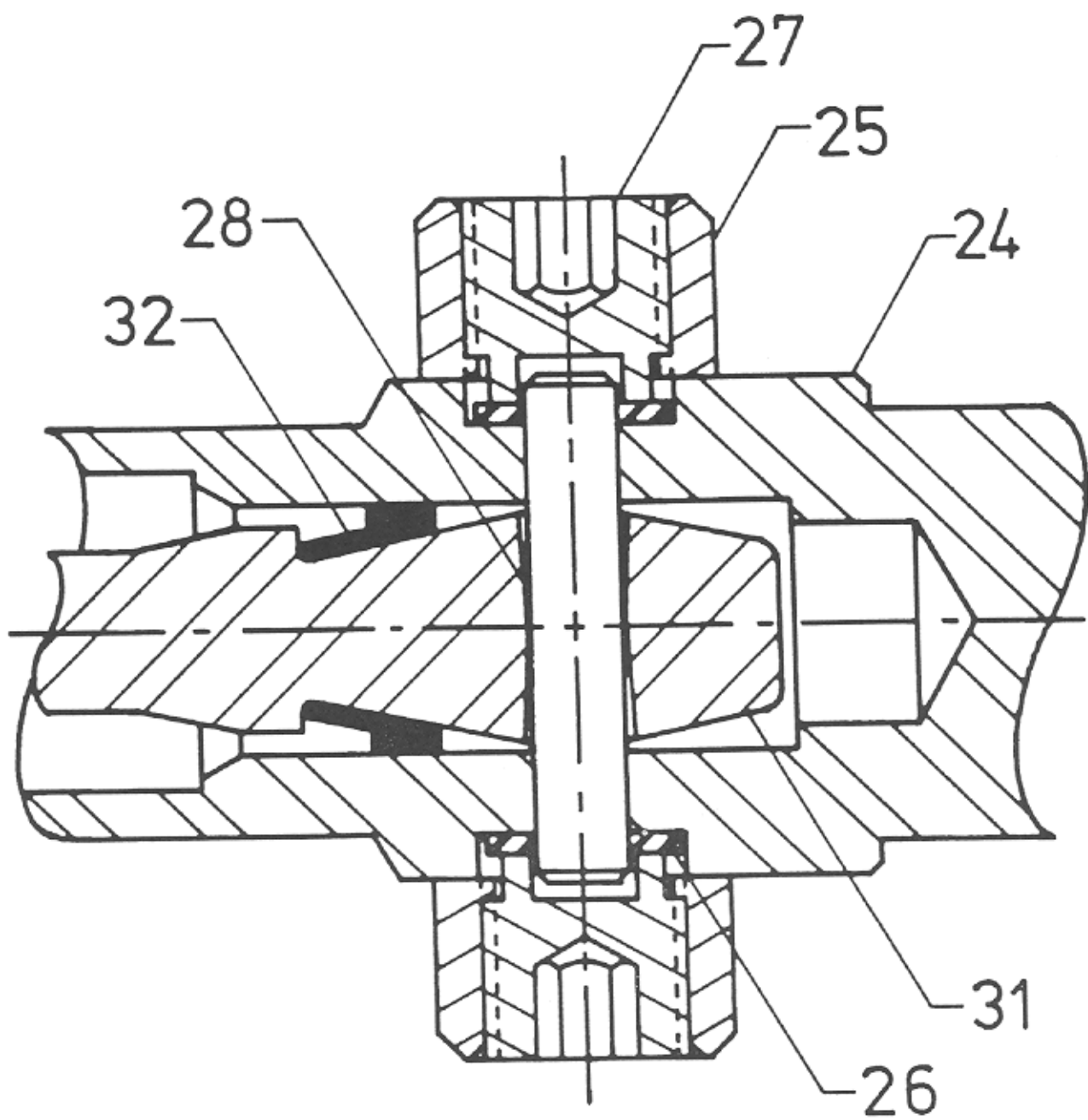
7X212 Type 3



7X305 Type 3



7X212 Type 1



12. PARTS LIST

Key No.	Description	Qty	Pump	Iron/Steel	Stainless	
10	Bearing coverplate	1	Type 3	P92-35		
			Type 1	P92-4		
11	Bearing housing	1	Type 3	P96-26		
			Type 1	P96-2		
12	Bearing, inner	1	Type 3	G94-13		
			Type 1	G40-177		
13	Bearing, outer	1	Type 3	G94-13		
			Type 1	G40-174		
14	Bearing spacer	1	Type 1	D101-8		
14A	Bearing spacer (inner)	1	Type 3	D101-108		
14B	Bearing spacer (outer)	1	Type 3	D101-109		
15	Bearing lockwasher	1	ALL	G33-26		
16	Bearing locknut	1	ALL	G33-25		
18 *	Lip seal, inner	1	ALL	G17-96		
19 *	Lip seal, outer	1	ALL	D83-8		
22	Body support	1	Type 3	P94-55		
			Type 1	P94-8		
23	Body support cap	1	Type 3	P95-55		
			Type 1	P95-8		
24	Drive shaft	1	ALL	D98-27	D98-32	
25	Shaft collar	1	ALL	D104-4		
26 *	Pin washer	2	ALL		D100-4	
27 *	Retaining screw	2	ALL	G91-12	G91-4	
28 *	Pin, shaft	1	ALL	D99-7	D99-19	
29 *	Pin, rotor	1	ALL	D99-7	D99-19	
30	Rotor band	1	7X212		D101-7	
		2	7X305		D101-7	
31 *	Connecting rod	1	ALL	D97-4	D97-10	
32 *	Connecting rod washer	2				
	(NBR)		ALL	G90-4		
	(FKM)		ALL	G90-10		
36	Packing gland	1	ALL	CP91-4-24	CP91-4-25	
37	Packing gland washer	1	ALL	D102-4	D102-10	
38 *	Packing set (synthetic)	1	ALL	N43-59		
39	Lantern ring (TFE)	1	ALL	D103-4		
41	Inlet body	1	ALL	P90-4	CP90-4	
42	Stator support	1-2	ALL	P94-7		
43	Stator support cap	1-2	ALL	P95-7		
44	Reducer coupling	1	7X212	P93-4	CP93-4	
			7X305	P93-3	CP93-3	
* Recommended spare parts	58 *	Rotor head adapter	1	7X305	D101-26	D101-23
	59 *	Pin, adapter	1	7X305	D99-40	D99-38
	60	Support spacer	2	7X305	D101-24	
	61	Reducer bushing	1	7X305	P67-4	G61-374

Key No.	Description	Qty	Pump	Steel	Stainless
73	Pipe plug, 1/2 NPT	3	ALL	G56-58	G56-46
74	Pipe plug, 1/8 NPT	1	ALL	G56-45	G56-53
98 *	Rotor	1			
	Std plated		71212	D96-10	D96-27
			72212	D96-11	D96-28
			73212	D96-12	D96-29
			71305	D96-7	D96-24
			72305	D96-8	D96-25
			73305	D96-9	D96-26
			74305	D96-782	D96-795
	Std unplated		71212	D96-410	D96-427
			72212	D96-411	D96-428
			73212	D96-412	D96-429
			71305	D96-407	D96-424
			72305	D96-408	D96-425
			73305	D96-409	D96-426
	Single u/s plated		71212	D96-110	D96-127
			72212	D96-111	D96-128
			73212	D96-112	D96-129
			71305	D96-107	D96-124
			72305	D96-108	D96-125
			73305	D96-109	D96-126
	Single u/s unplated		71212	D96-510	D96-527
			72212	D96-511	D96-528
			73212	D96-512	D96-529
			71305	D96-507	D96-524
			72305	D96-508	D96-525
			73305	D96-509	D96-526
99 *	Stator	1			
	(L) Buna n		71212	D95-73	D95-85
	70 Dur		72212	D95-77	D95-89
	(NBR)		73212	D95-81	D95-93
			71305	D95-49	D95-61
			72305	D95-53	D95-65
			73305	D95-57	D95-69
			74305	D95-607	D95-771
	(M) Natural rubber		71212	D95-74	D95-86
	50 Durometer		72212	D95-78	D95-90
	(NR)		73212	D95-82	D95-94
			71305	D95-50	D95-62
			72305	D95-54	D95-66
			73305	D95-58	D95-70
			74305	D95-608	D95-775

* Recommended spare parts

Key No.	Description	Qty	Pump	Steel	Stainless
99 *	Stator	1			
	EPDM		71212	D95-75	D95-87
	70 Durometer (EPR)		72212	D95-79	D95-91
			73212	D95-83	D95-95
			71305	D95-51	D95-63
			72305	D95-55	D95-67
			73305	D95-59	D95-71
			74305	D95-609	D95-779
	(V) Fluoroelastomer		71212	D95-76	D95-88
	70 Durometer (FKM)		72212	D95-80	D95-92
			73212	D95-84	D95-96
			71305	D95-52	D95-64
			72305	D95-56	D95-68
			73305	D95-60	D95-72
			74305	D95-677	D95-637

Key No.	Description	Qty	Pump	Part No.	Size
A	Key, drive	1	ALL	D30-27	3/8 sq x 3
B	Screw, hex head	8-12	ALL	G50-050325	1/2-13 x 3-1/4
C	Lube fitting, drive	1	ALL	G63-1	3/16 drive
D	Lube fitting, threaded	1	ALL	G63-2	1/8 NPT
E	Nut, hex	2	ALL	G73-050	1/2-13
F	Washer, flat	2	ALL	G8-337	1/2
G	Stud	2	ALL	D22-217	1/2-13 x 4-1/2
H	Screw, hex head	4	ALL	G50-050150	1/2-13 x 1-1/2
J	Lockwasher	4	ALL	G8-340	1/2
K	Screw, hex head	4	ALL	G50-062150	5/8-11 x 1-1/2
IOM	Instruction manual	1	ALL	G12-177	

* Recommended spare parts

SERVICE NOTES

Roper Pump Company continually updates its instruction books; therefore, you should periodically request an updated book or check that you have the latest edition.

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).

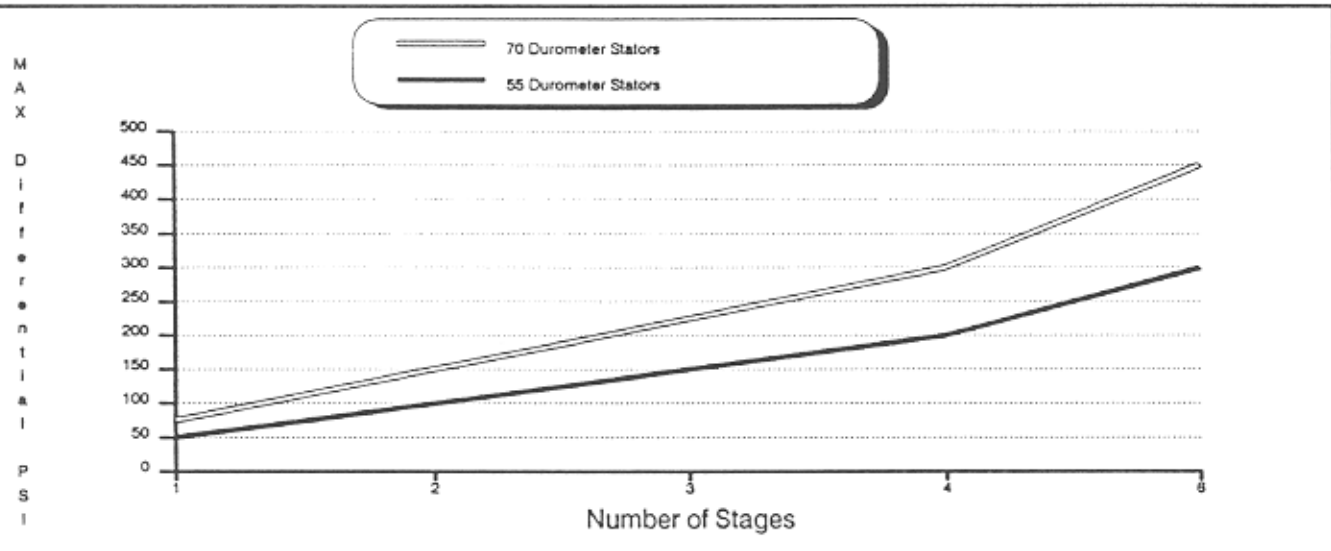


Fig. 3: Maximum Differential Pressure

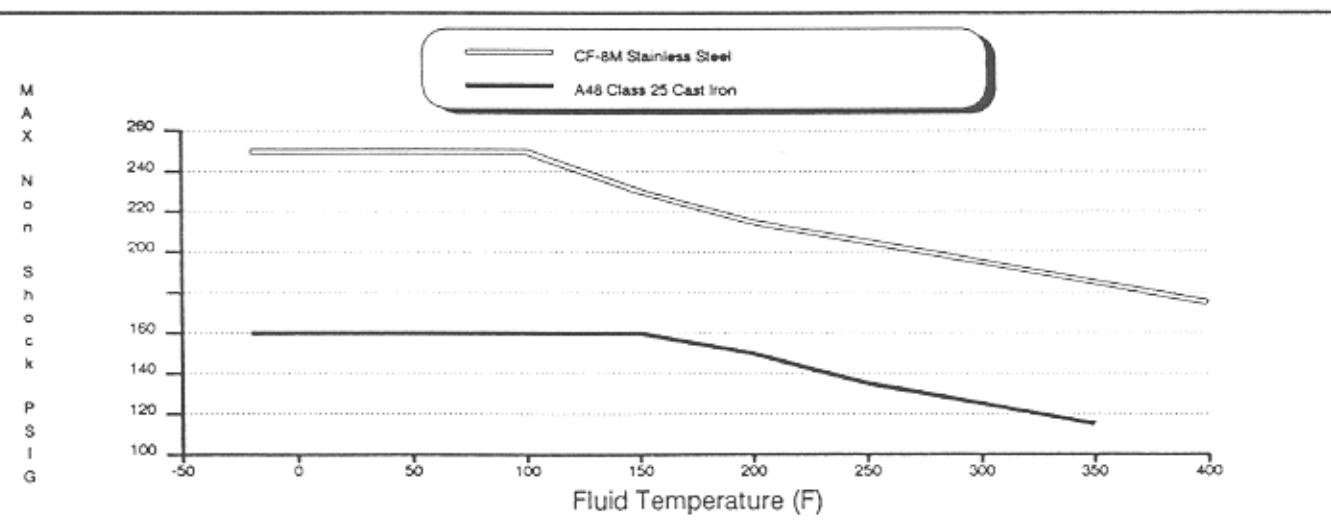


Fig. 4: Maximum Inlet Body Pressure Ratings (Not for 7X700)

Fig. 4 shows the maximum non-shock pressure rating of the pump inlet body against temperature. Despite the number of stages of the pump or the direction

of rotation, the values shown in Fig. 4 must not be exceeded on the inlet body of the pump.



WARNING! Do not overpressurize pump or system.

! WARNING

Exceeding the values shown in Fig. 4 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.

14. STORAGE

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: 73212 GHM Spec XXX Type 1 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 (3) shows the number of stages of pumping elements.
 - The third number (2) shows the drive size or configuration.
 - 2- Standard drive, pin joint construction.
 - 3- One drive size larger than standard drive, pin joint construction.
 - 4- Standard drive, gear joint construction.
 - 5- Solid shaft, pin joint construction.
 - 6- Two drive sizes larger than standard drive, pin joint construction.
 - 7- Hopper feed, pin joint construction.

- The fourth, fifth, and (where appropriate) sixth numbers show the approximate theoretical displacement in U.S. gallons per 100 revolutions:

4th, 5th, 6th	006	025	01	02	05	12	19	22	28	36	44	65	115
Gal/100 rev	.06	.25	1	2	5	12	19	22	28	36	44	65	115

- 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 (M) shows the stator elastomer:

Item	Letter	Material
Pump Body	G	A48 Class 25 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)
*On figure 7X700 hopper feed pumps, hopper is (G) carbon steel or (N) 304 stainless steel.		

- 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.
2. 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.
 3. 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.
 4. 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. The pressure of the flushing water should be approximately 10 to 15 PSI 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 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 $\frac{1}{3}$ 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 antifriction bearings, either ball bearings or tapered roller bearings, and are grease lubricated. The bearings, installed in pumps, are lubricated at the factory. Under normal operating conditions, they should not need additional lubrication or relubrication for the first 10,000 hours of operation. Shorten the lubrication intervals when the pump operates in dusty or moist environments.

A good grade 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.

It is 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 one-half full.

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. But, bearing life may be reduced as any existing contaminants are not removed. Thoroughly clean the lube fitting found in the bearing area of the inlet body. Inject approximately one to one and one-half ounces of grease into the bearing area through the lube fitting. Clean any excess grease from around the fitting to avoid attracting dirt and contaminants.

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.

- **NOTE:** 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 relubricated as outlined in the preferred relubrication method.

! 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 below. These classifications are related with many causes, some of which are outlined as follows also.

PROBLEM	POSSIBLE CAUSES
OVERHEATING	Bearing contamination
	Excessive lubrication
	Inadequate lubrication
	Housing distortion
	Cage wear
VIBRATION	Bearing contamination
	Fatigued bearing elements
	Race misalignment
	Shaft out-of-round
	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
	Lubricant churning

18. JOINT LUBRICATION

This pump is provided with two universal joints that allow the rotor to rotate through an eccentric path necessary to the proper functioning of the pump. The joints may be of a pin type or crowned gear type depending upon the model of the pump. Proper lubrication of the joints is important and will help extend the service life of the joint components.

When assembling the pump, make sure that all components of the joint are coated with lubricant. Also, fill the spaces between joint components full of lubricant. This is particularly important because joint lubrication can be performed only when the pump is disassembled and the lubricant must perform its job until the next time maintenance is performed on the pump.

In pin joint pumps, use a grease that is compatible with the fluid being pumped and that will not react with the fluid. In gear joint pumps, a good grade of EP (extreme pressure) grease containing molybdenum disulfide additives should be used.

19. SPECIAL PRECAUTIONS FOR HOPPER FEED PUMPS

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 a bar or stick.
- **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.*



WARNING! Lock out power before opening hopper body.

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.

SERVICE NOTES

9

Roper continually updates its manuals; therefore, you should periodically request an updated copy or check that you have the latest edition. Additional copies may be obtained, free of charge, by contacting a distributor or the home office of:

Roper Pump Company
P.O. Box 269
Commerce, Georgia 30529

Telephone: (404) 335-5551
TeleFAX: (404) 335-5505

Your Roper Distributor is:

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 charges 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 supercede this limited warranty. Please consult factory for these products). The Buyer hereby acknowledges and agrees, though free from defects in material and workmanship at the time of shipment, that the useful life of goods manufactured by Seller will vary depending upon the Buyer's frequency of use, application, and other factors, with regard to such goods. In that respect, notwithstanding any other provision to the contrary in the Agreement, these Terms and Conditions, or the Order Acknowledgement, the Seller specifically does not warrant the useful life of any product. 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, (e) 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, (i) Seller's aggregate liability arising from or relating to this Order Acknowledgement or 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. Disclosures 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 no 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.