Engineering

SAN/0499-82
MDC G9705

10 MWe Solar Thermal
Central Receiver Pilot Plant

SOLAR FACILITIES DESIGN INTEGRATION

PLANT MAINTENANCE/TRAINING MANUAL
(RADL ITEM 2-37)
SECTION 1 — ROTATING APPARATUS (BOOK 2 OF 3)

Revised September 1982
July 1981

WORK PERFORMED UNDER CONTRACT
DE-AC03-79SF10499

MCDONNELL DOUGLAS ASTRONAUTICS COMPANY
5301 BOLSA AVENUE
HUNTINGTON BEACH, CA 92647

U.S. Department of Energy

McDonnell Douglas Corporation | Rockwell International, Rocketdyne Division | Stearns-Roger | Solar Energy

SAN/0499-82
MDC G9705

10 MWe Solar Thermal
Central Receiver Pilot Plant
Solar Facilities Design Integration

PLANT MAINTENANCE/TRAINING MANUAL
(RADL ITEM 2-37)
SECTION 1 — ROTATING APPARATUS (BOOK 2 OF 3)

July 1981
Revised September 1982

MCDONNELL DOUGLAS ASTRONAUTICS COMPANY
5301 BOLSA AVENUE
HUNTINGTON BEACH, CA 92647

PREPARED FOR THE
U.S. DEPARTMENT OF ENERGY
SOLAR ENERGY
UNDER CONTRACT DE-AC03-79SF10499

UPDATE FOR
PLANT MAINTENANCE/TRAINING MANUAL
(RADL ITEM 2-37)
SECTION 1 - ROTATING APPARATUS

INSTRUCTIONS:

1. This update is issued to incorporate corrections and additions to the preface, table of contents, index pages of the original July 1981 document and to incorporate additional information in paragraph 1.2, Pumps. This update has resulted in the addition of several books for this section (for paragraph 1.2) due to the large volume of data. Accordingly, Section 1 has been completely revised and reprinted in its entirety. Therefore you can destroy the original July 1981 issue.

2. For information, the following items were changed in the original issue:

   - Revised index pages 1.2-3, 1.3-1, 1.4-1 and 1.5-1

3. The following new data was incorporated in paragraph 1.2, Pumps:

Book 1
- Oil Circulating Pump - Pages 1.2.1-45 thru 1.2.1-49.
- Fluid Makeup Pump - Pages 1.2.3-1 thru 1.2.3-16.
- Flash Tank Drain Pump - Pages 1.2.4-1 thru 1.2.4-36.
- Raw/Service Water Pumps - Pages 1.2.6-1 thru 1.2.6-28.
- Primary and Secondary Fire Water Pumps - Pages 1.2.7-1 thru 1.2.7-441.

Book 2
- Fire Maintenance Jockey Pump - Pages 1.2.8-1 thru 1.2.8-51.
- Demin. Water Transfer Pump - Pages 1.2.9-1 thru 1.2.9-23.
- Separator Waste Water Pump - Pages 1.2.10-1 thru 1.2.10-24.
- Oil Sump Pump - Pages 1.2.11-1 thru 1.2.11-27.
- Raw/Service Water Sump Pump - Pages 1.2.12-1 thru 1.2.12-20.
- Oil Sludge Pump - Pages 1.2.13-1 thru 1.2.13-14.

Book 3
- TSU Area Sump Pump - Pages 1.2.14-1 thru 1.2.14-13.
- Receiver Feedwater Pump - Pages 1.2.23-1 thru 1.2.23-563.
- BCS Fluid Receiver Pump - Pages 1.2.36-1 thru 1.2.36-17.

PREFACE

This document is provided by the McDonnell Douglas Astronautics Company (MDAC) in accordance with Department of Energy Contract Number DE-AC03-79SF10499, Reports and Deliverables List Item 2-37. The material presented here is intended for training and maintenance usage by Southern California Edison Operations Personnel.

Specific notes on the organization and content of the document are as follows:

1. This document is organized in major sections that reflect the top level breakdown of the Master Equipment List as defined in RADL Item 2-19. This is in contrast to the subsystem approach used in designing the plant, however, is consistent with the Southern California Edison operating plant equipment lists.

Section 1 - Rotating Apparatus
Section 2 - Stationary Apparatus
Section 3 - Electrical Apparatus
Section 4 - Valves
Section 5 - Instrumentation
Section 6 - Control and Data Systems
Section 7 - Collector System
Section 8 - Special Heliostat Instrumentation and Meteorological Measurements Equipment
Section 9 - Heating Ventilating and Air Conditioning
Section 10 - Facilities

2. Assignments to categories are made on the basis of the lowest level tag numbers. For example, maintenance information for the thermal storage extraction pump skid assembly (SA-309) is not listed in the stationary apparatus section, but broken down to the generic categories as defined by the tag number; i.e., pumps (Section 1.2), air operated stop valves (Section 4.2), pressure transmitter (Section 5.2), etc.

3. The Process Instrumentation Section (Section 5.0) is organized on the basis of sensor type as defined by the first letter of the designating tag number. It contains sensor-related information only. Signal conditioning equipment is treated in Section 6.0.

4. The information on the Collector System, which was provided by the Martin Marietta Corp. (MMC) and the major items of the Electrical Power Generation System equipment, provided by Southern California Edison is not provided herein. However, the various sections were structured for their inclusion where applicable.

Technical questions concerning this RADL Item should be directed to Mr. R. G. Riedesel at (714) 896-3357 or Mr. R. J. Perkins at (714) 896-3073.

TABLE OF CONTENTS

1.2 PUMPS (CONTINUED)

1.2.8 Fire Maintenance Jockey Pump

1.2.8.1 Identification

Tag Number	Description
P707	Jockey Pump and Controller with pressure switch tag number 1513

1.2.8.2 Description

Pump

Manufacturer:	Aurora Pump 800 Airport Road North Aurora, Illinois 60542
Part Number:	Model 935

Motor

Manufacturer:	Marathon Electric Wausau, WI 54401
Part Number:	See Aurora Pump Model 935

Controller (with pressure switch tag number PS1513)

Manufacturer:	Metron Instruments, Inc. 1051 So Platte River Drive Denver, Colorado 80223
Part Number:	Model MIDA-5-460

1.2.8.3 Vendor

McLemore Pump & Equipment Co.
4895 Joliet St.
Denver, CO 80239

1.2.8.4 Procurement Specification

Stearns-Roger Specification Number D46.8 (DOE Specification Number 40M700-14S)

1.2.8.5 Piping Connections

P707 - See Construction Package 9, Dwg No. 40P7005133155, Sht. P6-1

1.2.8.6 Operation/Maintenance

See attached Aurora Pump Manual, 932 section with motor, and controller data included.

932 SECTION
PERIPH. TURBINE JOCKEY PUMP
ELECTRIC DRIVE

TABLE OF CONTENTS
FIRE JOCKEY PUMP

AURORA PUMP
A UNIT OF GENERAL SIGNAL
800 AIRPORT ROAD · NORTH AURORA ILLINOIS · 60542

NO. OF PRINTS	
8	FOR APPROVAL
	FINAL

4 REPROS.

SALES OFFICE: McLEMORE PUMP & EQUIPMENT CO. PO # A01-105
FACTORY ORDER NUMBER: 4AO-7434
JOB: SOLAR-ONE PILOT PLANT
SERVICE: JOCKEY PUMP
ENGINEER: STEARNS-ROGER ENGINEERING CORP.
CONTRACTOR: STEARNS-ROGER ENGINEERING CORP
SOLD TO: STEARNS-ROGER ENGINEERING PO # 2001-C21700
REFERENCE: PROJECT Nº C21700

PUMP

ONE NUMBER OF UNITS | I 05 SIZE | 935 MODEL | ____ POWER SERIES | PUMP ONLY ☐
25 GPM | 289' TDH | 3600 RPM | ROTATION: RH ☒ LH ☐

BASE:
- ☐ STEEL DRIP RIM
- ☐ STEEL
- ☐ FABRICATED STEEL
- ☐ CAST IRON RING TYPE

CONSTRUCTION:
- ☒ STANDARD FITTED
- ☐ ____
- CASE CI
- IMP. BRZ
- SHAFT 416 S.S.
- SLEEVE ____
- CHAN.RING CI
- SPACER ____

COUPLING:
- ☐ STANDARD
- ☐ SPACER
- ☐ GUARD

STUFFING BOX:
- ☒ MECHANICAL SEAL
- ☒ STANDARD
- ☐ ____
- ☐ PACKING
- ☐ LANTERN RING

CONNECTIONS
- ☒ THREADED
- ☐ FLANGE
- ☐ 125 # SUCTION
- ☐ 250 # DISCHARGE
- ☐ ____

LUBRICATION
- ☐ GREASE
- ☐ OIL

MOTOR

5 HP. | 3 PHASE | 60 HERTZ | 460 VOLTS | 3600 RPM | 182T FRAME

BY: ☒ AURORA ☐ OTHERS
☒ ODP ☐ TEFC ☐ XPROOF
☐ VERTICAL ☒ HORIZONTAL ☐ PART WINDING
MARATHON MANUFACTURER

NOTE: MOTOR NOT MOUNTED AT FACTORY ON VERTICAL UNITS.

SPECIAL REQUIREMENTS

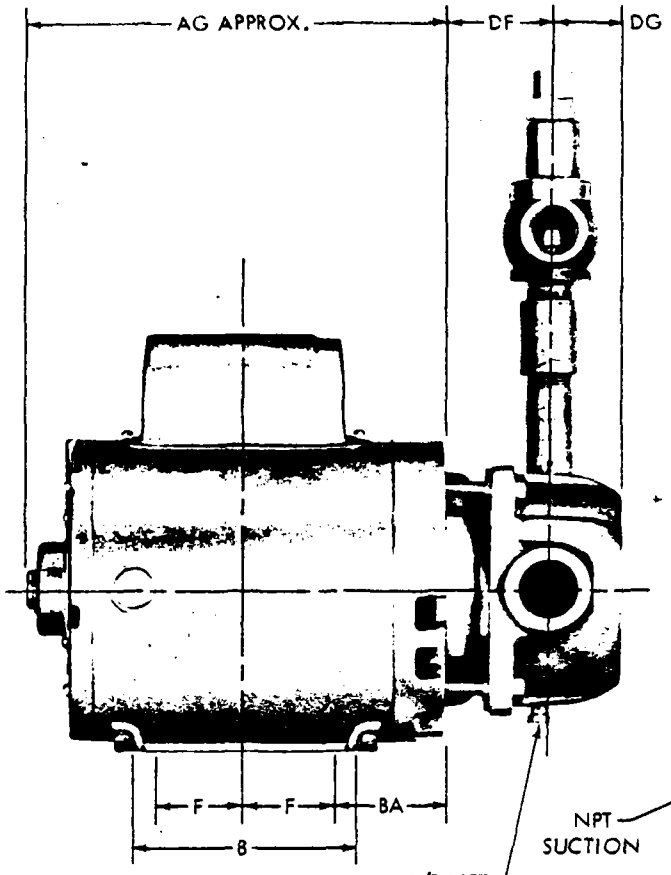
PUMP: 3/4 IN. BY-PASS W/RELIEF VALVE SET @ 340' AFTER ASSY. CERTIFIED PERFORMANCE TEST
DRIVE: ____
ELECTRICAL: METRON JOCKEY PUMP CONTROLLER PER ATTACHED SHEETS

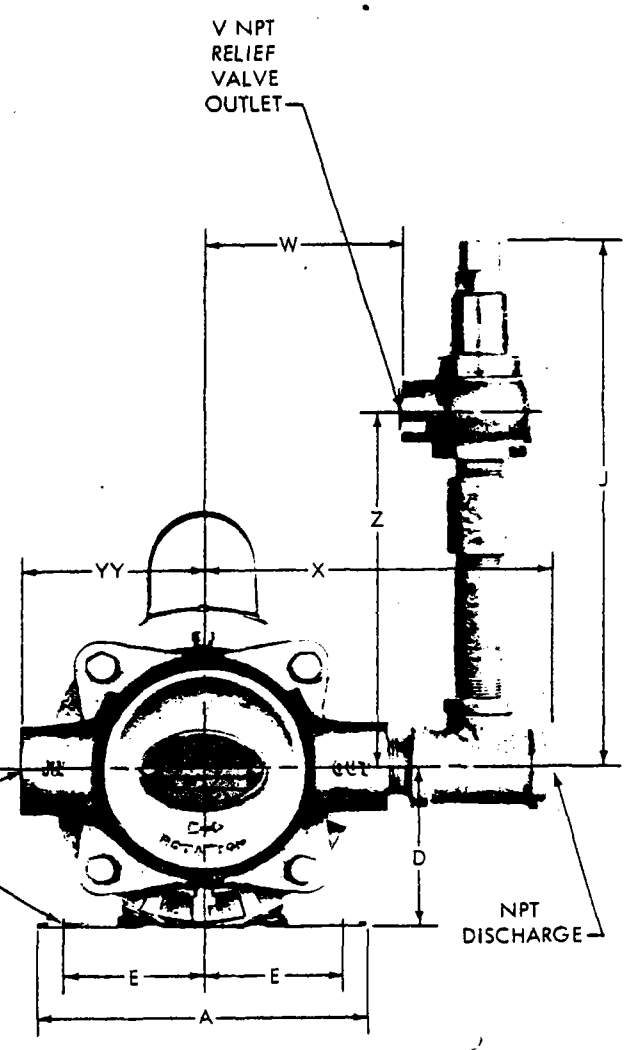
CERTIFIED PRINT: SECTION: 932 PAGE: 202 CURVE NUMBER: 33PC-11538
SPECIAL: ____ MAINTENANCE: ____
BY: WJW DC DATE: 9/4/80 OFFICE: AURORA

REVISED 12-10-80 WJW

THIS ORDER WILL NOT BE PROCESSED FOR MANUFACTURING UNTIL APPROVAL IS RECEIVED. PRINTS ARE NOT TO SCALE AND ARE CERTIFIED CORRECT ONLY FOR THIS ORDER. ALL ORDERS SUBJECT TO ACCEPTANCE AT AURORA PUMP, NORTH AURORA, ILLINOIS.

THIS ORDER CAN BE RELEASED FOR MANUFACTURING AS SHOWN: ☐ AUTHORITY: ____
RELEASE FOR MANUFACTURING PER ATTACHED CHANGE ORDER: ☐ OFFICE: ____
DATE: ____





PUMP	MODEL	934	935
	SIZE	[illegible]	105 [illegible]

NOTES:
1. ALL DIMENSIONS IN INCHES.
2. NOT FOR CONSTRUCTION PURPOSES UNLESS CERTIFIED.
3. CAPACITOR WHEN FURNISHED NORMALLY APPEARS ON TOP OF MOTOR. DIMENSIONS ARE NOT SPECIFIED AS THEY VARY WITH EACH MOTOR MANUFACTURER.
4. DIMENSIONS MAY VARY ± 1/4".

STEARNS-ROGER ENGINEERING CORP.
PROJECT NO. 621700
SOLAR-ONE PILOT PLANT
UNIT ONE
P.O. 2001

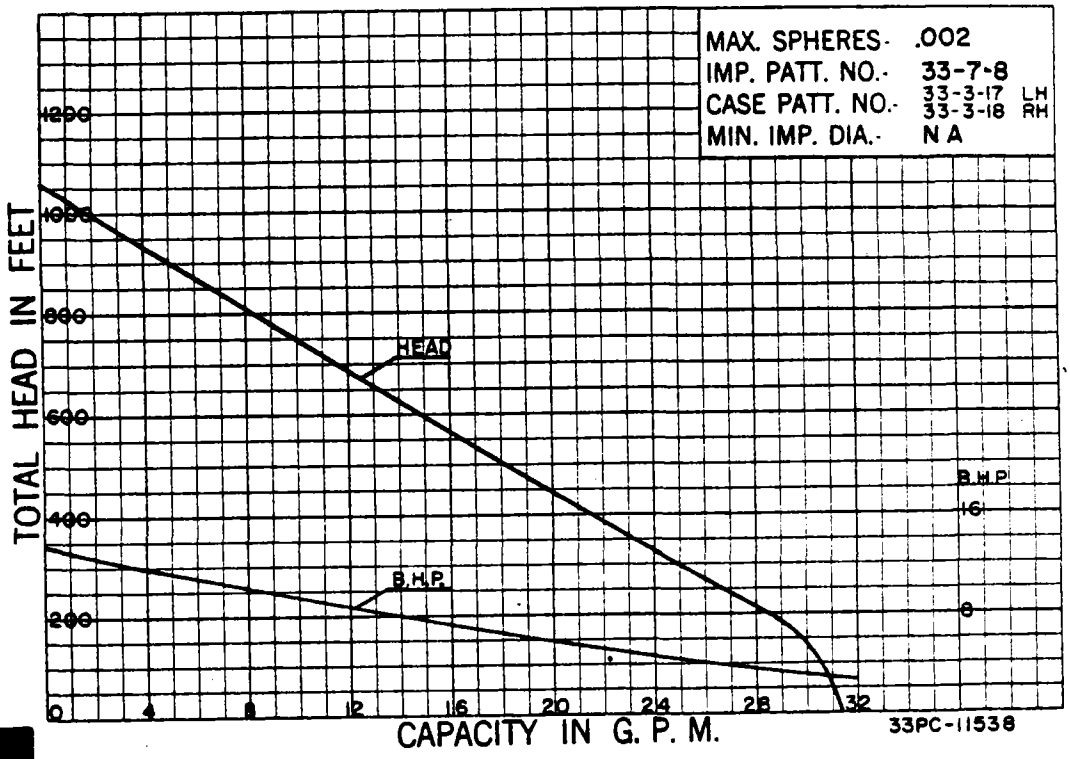
935	1/2	11-1/4	4-1/2	4-5/16	7-5/8	8-1/16
	3/4	13-3/16		4-7/16	7-7/8	10
	1-1/4	12-3/8		4-7/16	8-1/2	7-3/4

FRAME	A	B	D	E	F	H	AG	BA
56	6-3/4	4	3-1/2	2-7/16	1-1/2	11/32 SLOT	11	2-9/16
145T	7	6	3-1/2	2-3/4	2-1/2	11/32 SLOT	11	2-7/8
182T	9	6-1/2	4-1/2	3-3/4	2-1/4	13/32	11	3-5/8
184T	9	7-1/2	4-1/2	3-3/4	2-3/4	13/32	12	3-5/8

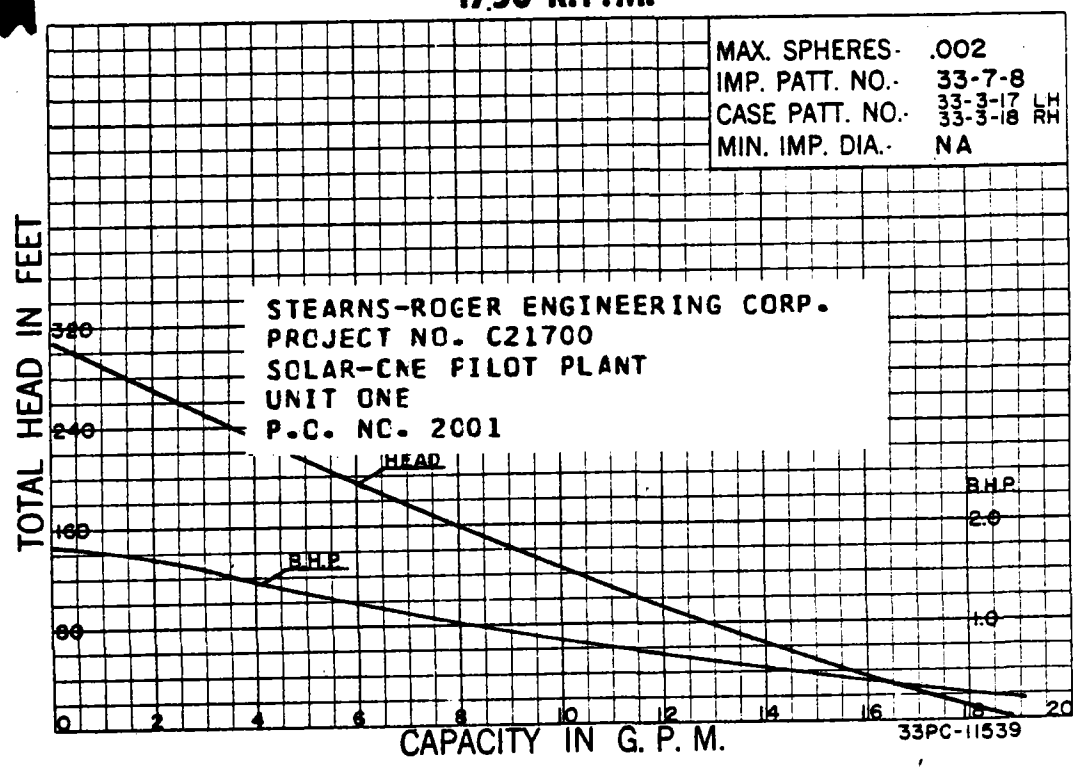
MODEL	SUCTION	DISCH.	DF	DG
934	1	1	2	1-11/16
935	2	1-1/2	2-1/4	2-1/4

AURORA PUMP
A UNIT OF GENERAL SIGNAL
800 AIRPORT ROAD · NORTH AURORA, ILLINOIS · 60542

MODEL 10 5
1½" x 2"
3500 R.P.M.



1750 R.P.M.



AURORA PUMPS
AURORA PUMP
A UNIT OF GENERAL SIGNAL CORPORATION
AURORA · ILLINOIS

AURORA® PUMPS

INSTRUCTION MANUAL

REPAIR

MODEL 134-135 (04-05 SERIES)

6

SERVICE

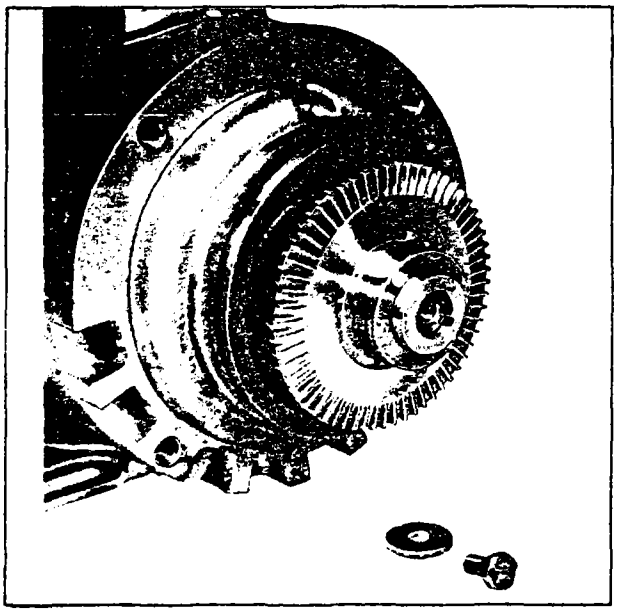
Your Aurora pump requires no maintenance other than periodic inspection and occasional cleaning. The intent of inspection is to prevent breakdown, thus obtaining optimum service life. The pump is lubricated by the liquid being pumped and therefore does not require periodic lubrication. The motor, however may require lubrication, in which case, the motor manufacturer's recommendation should be followed.

REPAIRS

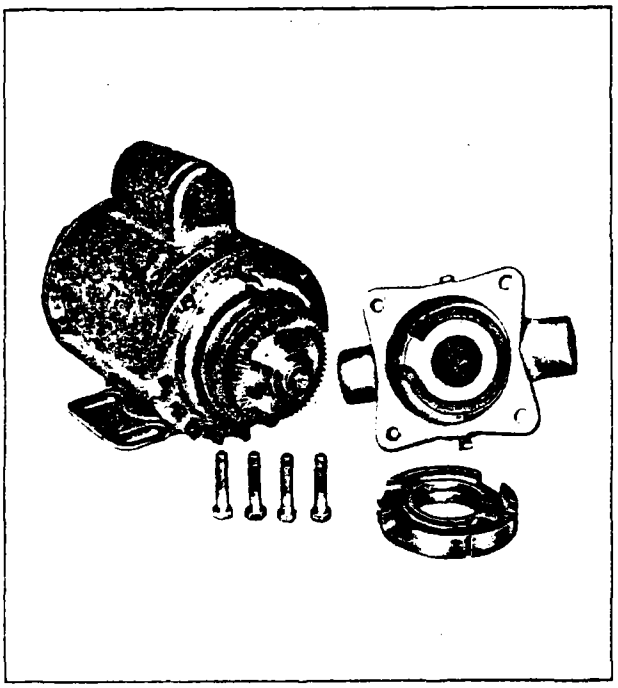
The pump may be disassembled using the illustrations and text provided. Although complete disassembly is covered, it will seldom be necessary to completely disassemble your Aurora pump.

The illustrations accompanying the disassembly instructions show the pump at various stages of disassembly. The illustrations are intended to aid in the correct identification of the parts mentioned in the text.

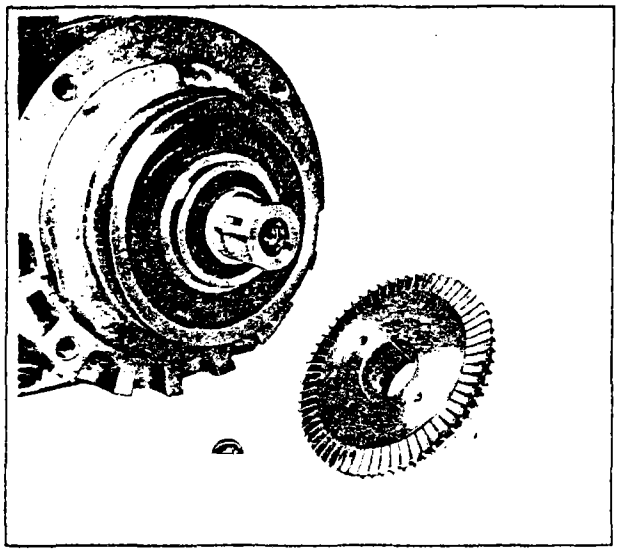
Inspect removed parts at disassembly to determine their reusability. Cracked castings should never be reused. All packing and gaskets should be replaced with new ones at reassembly simply as a matter of economy; they are much less expensive to replace routinely than to replace as the need occurs. In general it is economical to return to the manufacturer for repair only the motor and motor controller.



Impeller screw and washer removed.



Pump casing and outer ring removed.



Impeller and key removed.

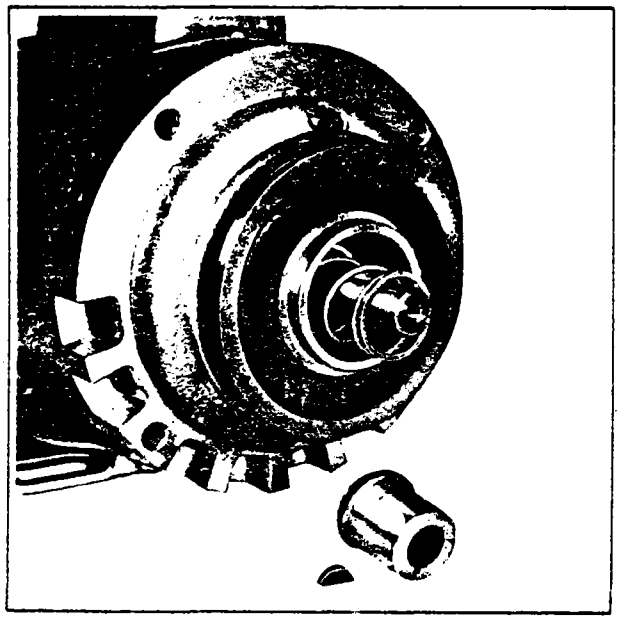
Disassembly. Disassemble only what is needed to make repairs or accomplish inspection.

Disassembling the Model 134 and 135 pumps (See Figure 3).

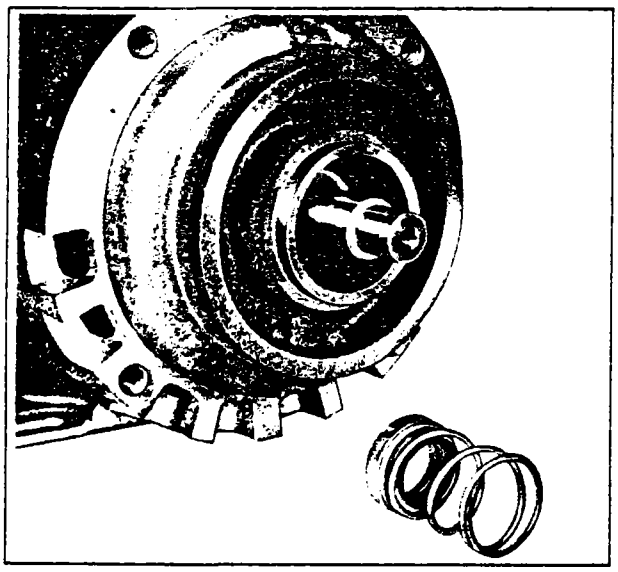
1. Remove the four screws (2) and separate the casing (6) from the motor bracket (19, 20).

2. Remove the two plugs (3), screws (4), and nameplate (5) only if replacement is necessary. Remove pin (15).

3. Remove outer ring (7).



Sleeve and key removed from shaft.



Mechanical seal and spring removed.

4. Remove screw (8) and washer (9) and remove impeller (10) with key (13) from impeller sleeve.

5. Remove impeller sleeve (12) with key (11) from shaft.

6. Carefully remove the mechanical seal (14). The stationary portion of the seal may be removed in Step 9.

CAUTION

The mechanical seal (see Figure 1) is a precision product and must be treated as such. During removal great care must be taken to avoid dropping any part of the seal. Take particular care not to scratch the lapped faces on the washer or the sealing seat. Do not put a seal back into service until the sealing faces of the washer and seat have been relapped or replaced.

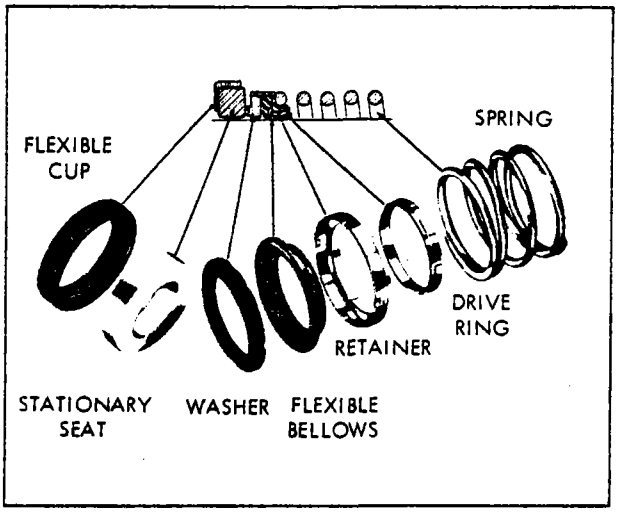


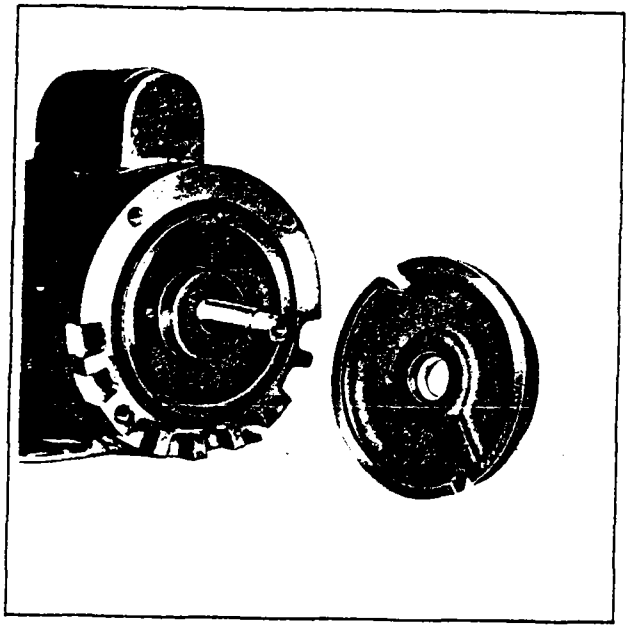
Figure 1. Mechanical Seal

7. Remove inner ring (16).

8. Gasket (17) may be removed from bracket if replacement is necessary.

9. Remove the four screws (18) (Model 135, 1-1/8 inch shaft only). Motor bracket with stationary portion of seal may now be removed by applying a steady force separating bracket and motor.

Reassembly. Clean and inspect all parts thoroughly prior to reassembly. Replace gasket. Check that all mating surfaces are free of nicks and burrs.



Bracket removed.

Inspect the impeller hub carefully for signs of excessive wear. Proceed to reassemble the pump as follows: (See Figure 3)

1. Position the motor bracket (19, 20) on the motor and secure with screws (18). Tighten screws evenly. (Screws used on 135 Series, 1-1/8 inch shaft only).

2. Attach nameplate (5) with screws (4), and replace plugs (3) if these were removed.

NOTE

The mechanical seal (14) cannot be installed as an assembly; the seal seat must be properly in place before the balance of parts can be added.

3. Thoroughly inspect the seal cavity in the motor bracket, checking for burrs or nicks which could damage the seat of the mechanical seal (14). Apply a film of liquid dishwashing detergent to the seal seat and install, taking care to seat it evenly and squarely.

NOTE

If it is not possible to insert seat with fingers, place cardboard protecting ring, furnished with seal, over lapped face of seat and press into place with a piece of tubing having end cut square. Tubing should be slightly larger than the diameter of the shaft. Remove cardboard ring after the seat has been firmly seated.

4. Apply a film of liquid dishwashing detergent to allow remaining seal parts to be pushed onto shaft. Check the proper sequence of assembly as shown in Figure 1.

5. Position gasket (17) on the motor bracket (19, 20) and gradually slip into its groove.

6. Install inner ring (16).

7. Replace shaft key (11) and impeller sleeve (12). Be sure spring of mechanical seal is properly positioned on back side of impeller sleeve.

8. Slip on impeller (10). Line up impeller keyway with key (13) so that key is not pushed out of keyway when the impeller is replaced. Secure impeller with washer (9) and screw (8).

9. Place the pin (15) and outer ring (7) in casing (6); slide casing into position over motor bracket (19, 20) being careful not to damage gasket (17).

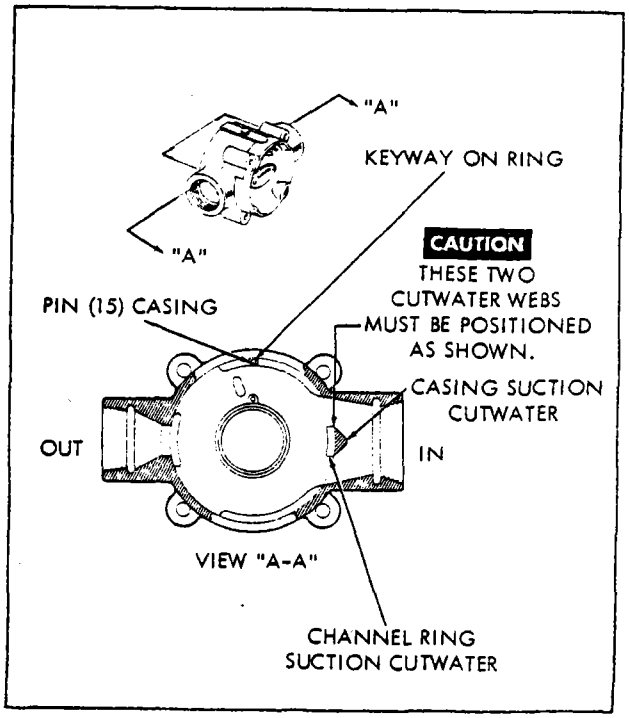


Figure 2. Model 134-135 Installing Inner and Outer Rings in Casing

Attach casing with screws (2). (See Figure 2 for proper positioning of inner and outer rings in casing.)

10. Replace pipe plug (3), and install nameplate (5) and attach with screws (4), if these were removed.

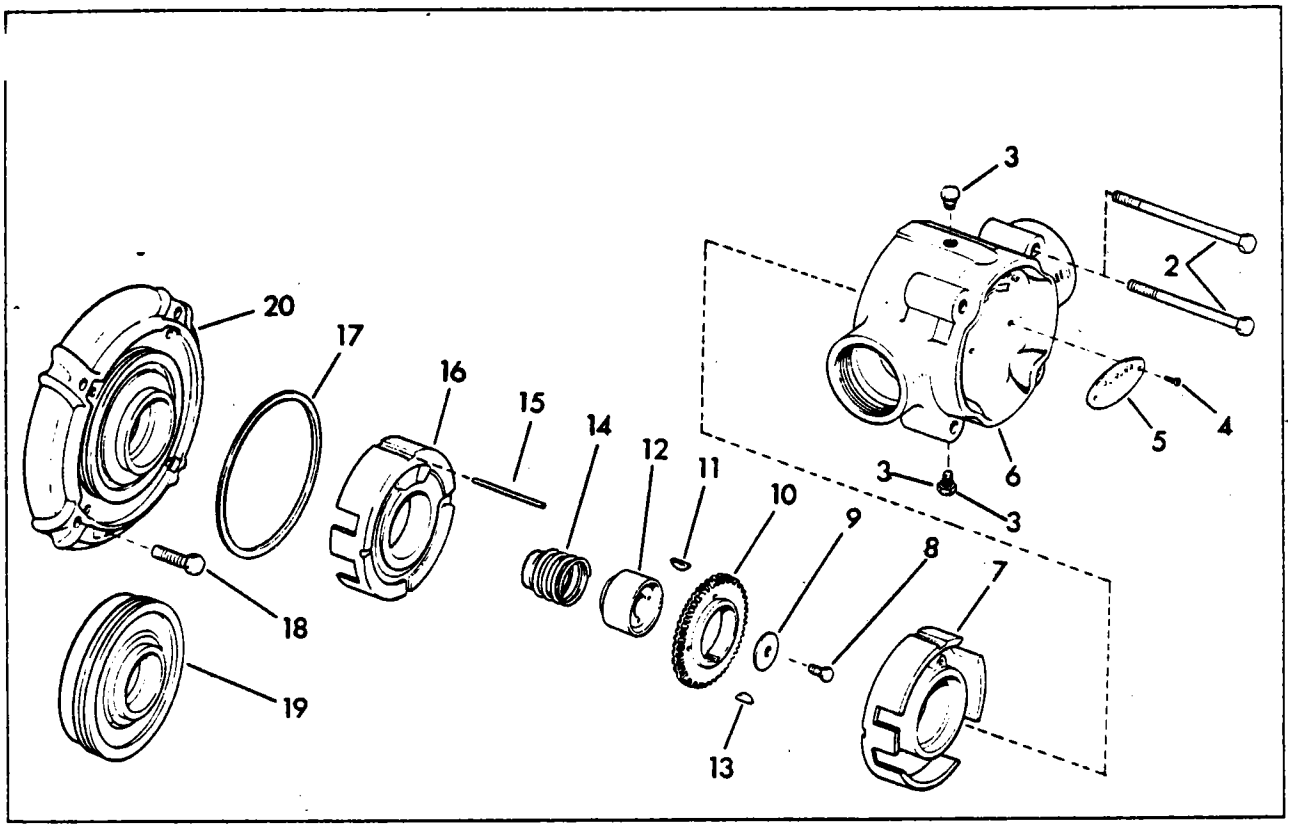


Figure 3. 134 and 135 Series Pump Exploded View

List of Parts For Model 134-135

2. Capscrew
3. Pipe Plug
4. Drive Screw
5. Nameplate
6. Casing
7. Outer Ring
8. Capscrew
9. Washer
10. Impeller
11. Key
12. Sleeve
13. Key
14. Seal
15. Pin
16. Inner Ring
17. Gasket
18. Capscrew
19. Bracket
20. Bracket

STEARNS-ROGER ENGINEERING CORP.
PROJECT NO. 621700
SOLAR-ONE PILOT PLANT
UNIT ONE
P.O. 2001

AURORA® PUMPS

INSTRUCTION MANUAL
INSTALLATION
CLOSE COUPLED PUMP

2

GENERAL. The life of your Aurora pump can be extended considerably by carefully following the installation instructions contained herein. Each step of the pump installation instructions plays a vital part in assuring long life, efficient operation, and reduced maintenance, from the initial location of the pump through prestarting directions.

UNPACKING YOUR PUMP. The crate containing your pump should be opened immediately upon receipt from the factory, and the pump generally inspected for damage and shortage of parts. Particular attention should be given to the discharge and suction nozzle threads or flanges. Any damage or shortage of parts should be reported to the carrier immediately.

CLEANING. If your pump is to be installed immediately, it will be necessary to remove the protective covers from all openings, and to clean the exposed metal parts thoroughly with a cleaning solvent to remove the preservative coating.

STORAGE. If your pump is not to be put in service immediately it should be covered and stored in a clean dry area. The protective covers and preservative should be left intact until the pump is put into service. For extended storage, the pump should be dried internally with hot air or some other suitable means, and once free of moisture, filled with a protective fluid such as light oil or kerosene. Accordingly, at time of installation, the pump will have to be completely dismantled and thoroughly cleaned.

PLANNING THE PUMP LOCATION. You probably have spent considerable time planning where your pump will be located. However you may have overlooked some factor which may affect pump operation or efficiency.

The pump should be located as close to the liquid source as possible so that the suction line can be short and direct. It should be located in a clean, open area, where it is easily accessible for inspection, disassembly and repair. Pumps installed in dark, dirty areas or in cramped locations are often neglected which can result in premature failure of both the pump and the driver.

Your pump should be located so that a hoist or crane can be used to move it without interference from piping. This factor is often overlooked in the advance planning stage.

Protect your pump against the possibility of flooding. Although water will not seriously damage the pump, the drive motor can be damaged.

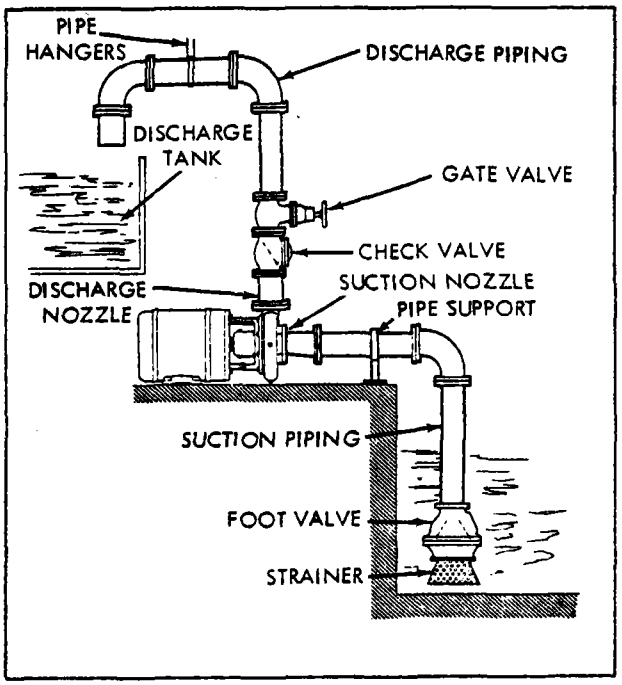


FIGURE 1. RECOMMENDED LOCATION - SHORT DIRECT SUCTION

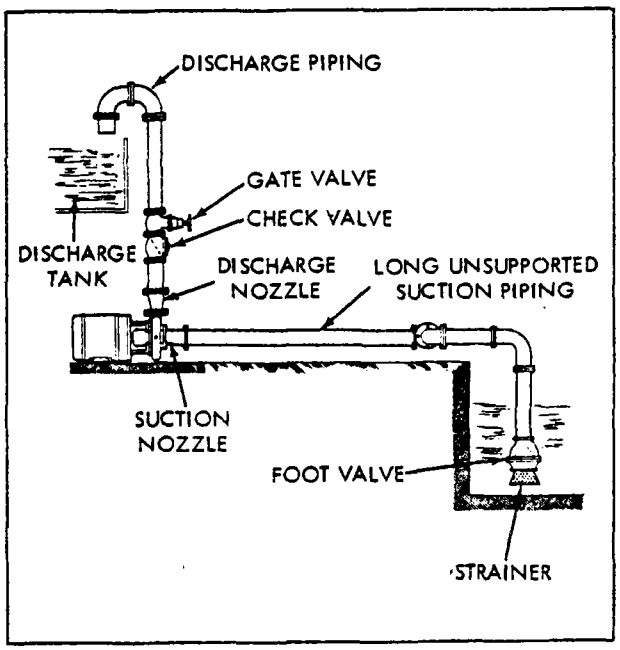


FIGURE 2. UNSATISFACTORY LOCATION - LONG INDIRECT SUCTION WITH NO SUPPORT

CLOSE COUPLED PUMP INSTALLATION

The pump should be located in an area where moisture, either from leakage through the packing or from condensation, can be adequately drained off. Moisture dripping on exposed metal or wood can cause rapid deterioration of the area. Also, wet floors produce safety hazards.

Adequate provisions should be made for electrical wiring to the pump motor. A switch and overload protection should be installed near the pump unless it is impractical. The electrical conduit should be positioned in such a way as to preclude the possibility of moisture entering the conduit or the motor and causing short circuits.

Outdoor installation will normally provide all of the above mentioned conditions. However it is advisable to provide a weather shelter for your pump.

FOUNDATION. The foundation for your pump must be sufficiently rigid to absorb any vibration and stress encountered during pump operation. A raised foundation of concrete is preferable for most floor mounted pumps. The raised foundation assures a satisfactory base, protects against flooding, simplifies moisture drainage, and facilitates keeping the area clean.

Your pump should be firmly bolted to the foundation, whether it is a raised concrete base, steelwork wall, or structural member. The mounting bolts or lag-screws should be accurately located per the applicable Aurora dimension sheet.

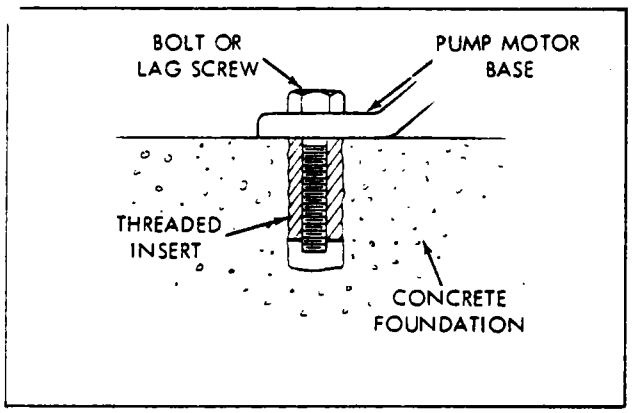


FIGURE 3. TYPICAL CLOSE COUPLED PUMP MOUNTING

Lag screws or bolts screwed into threaded inserts in the concrete are recommended for mounting close coupled pumps, rather than studs set into concrete. This permits removal of the drive motor without disturbing the pump liquid end or the piping.

If a large pump is to be mounted on steelwork or other structure, adequate support should be provided to prevent deflection of the structure which could produce excessive strain on the pump casing and piping.

SETTING THE PUMP. Check the mounting surfaces of the pump unit and the foundation to make sure they are clean and free of obstructions.

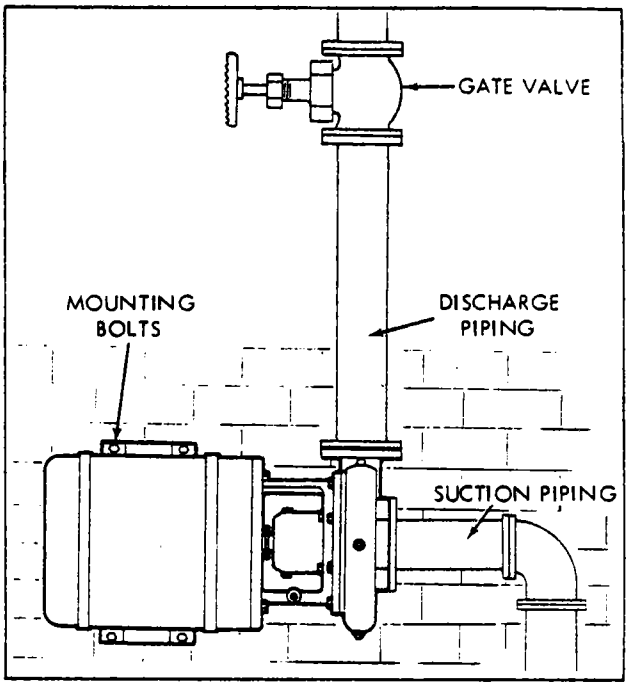


FIGURE 4. WALL MOUNTED PUMP

Set the pump on the foundation, being careful not to damage the foundation bolts or studs, if used.

Tighten the nuts or bolts finger tight.

LEVELING THE PUMP. Level the pump unit using the suction and discharge nozzles or flanges as reference points. Insertion of a short piece of pipe in the threaded nozzles will facilitate use of a spirit level to determine whether or not the pump unit is level in all directions. A spirit level also can be used on the machined faces of the suction and discharge flanges. Insert shims under the mounting feet as required until the pump is level. Firmly tighten the nuts or bolts securing the pump to the foundation.

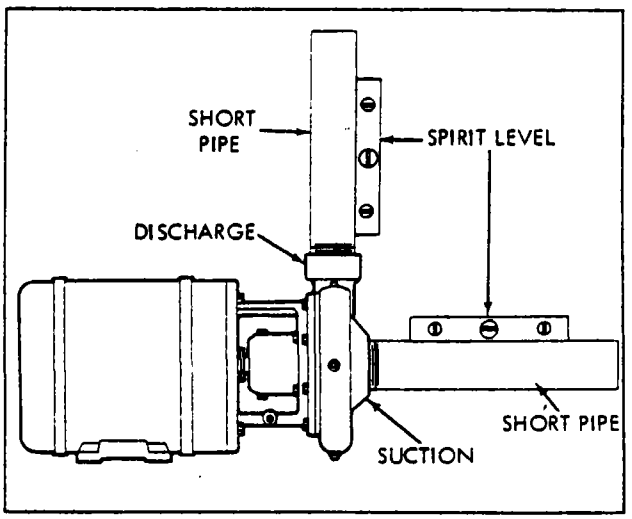


FIGURE 5. LEVELING PUMP WITH SPIRIT LEVEL AND SHORT LENGTHS OF PIPE

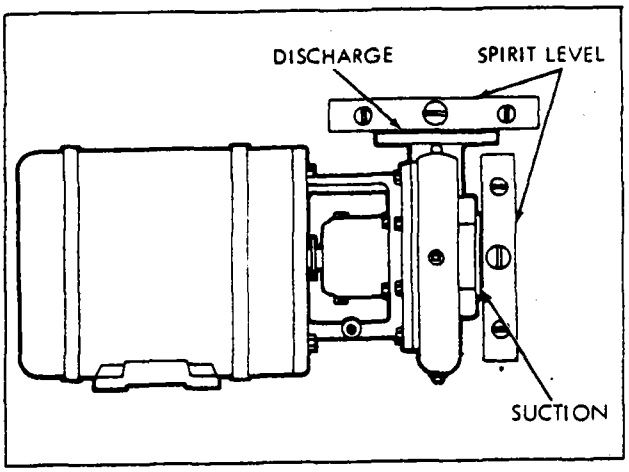


FIGURE 6. LEVELING WITH SPIRIT LEVEL ON PUMP FLANGES

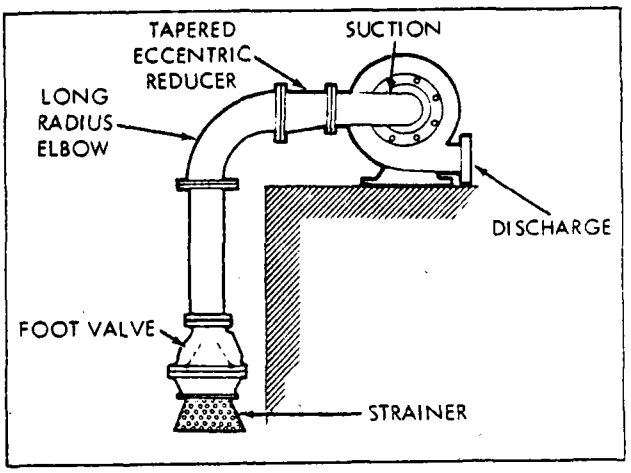


FIGURE 8. RECOMMENDED SUCTION LIFT PIPING - SHORT AND DIRECT

PIPING. Your pump unit is now ready to be piped. The piping practices you follow will directly affect the efficiency and power consumption of your pump. Pay particular attention to the seemingly insignificant details involved in piping your pump for they make the difference between a good and bad installation.

SUPPORTING THE PIPE. Both the suction and the discharge piping should be independently supported near the pump. Liberal use of pipe hangers and support blocks will prevent excessive strain on the pump casing and on the pipe joints.

SUCTION PIPING. The suction piping should be short, but no less than ten pipe diameters in length, and direct with as few elbows and fittings as possible to keep head loss, from friction, at a minimum. However, the suction pipe should provide a minimum uninterrupted length, equal to ten pipe diameters, to the pump suction flange. A horizontal suction line should have a gradual rise to the pump, and pass under any interfering piping.

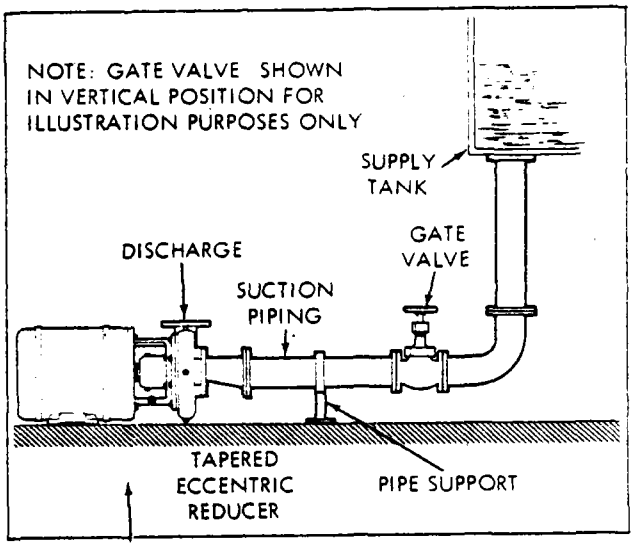


FIGURE 9. RECOMMENDED FLOODED SUCTION PIPING - SHORT AND DIRECT

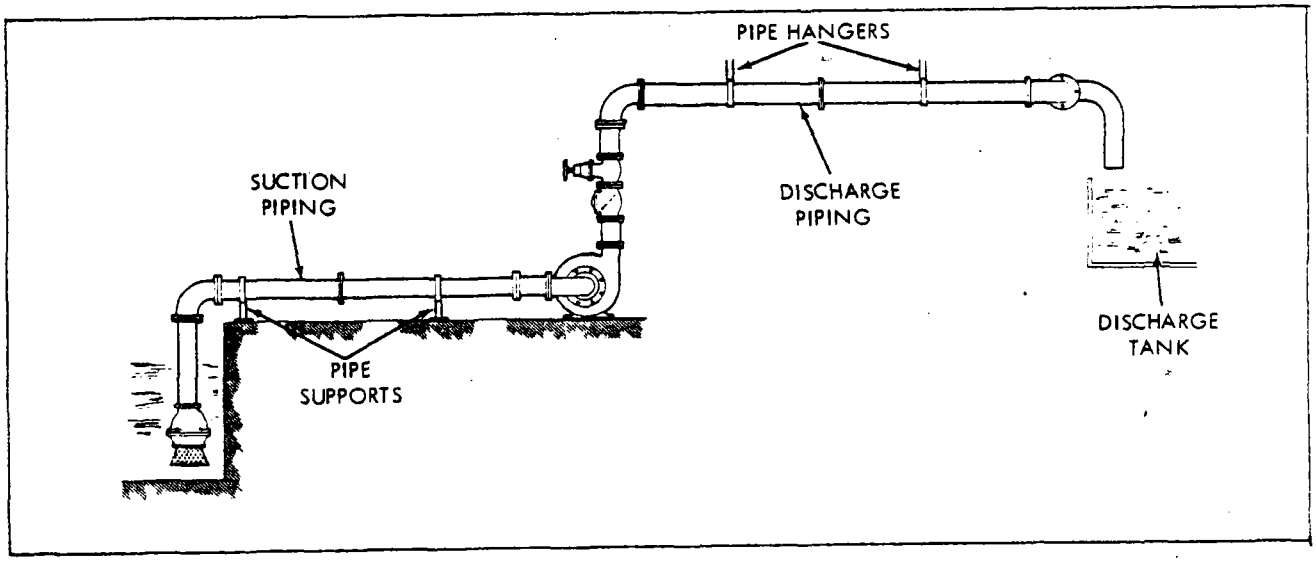


FIGURE 7. SUPPORTING PIPING

PIPE. The suction pipe diameter should be at least the same diameter as the suction nozzle on the pump, and preferably larger. Use of a smaller diameter pipe will result in loss of head due to friction. All joints must be tight to maintain prime on the pump.

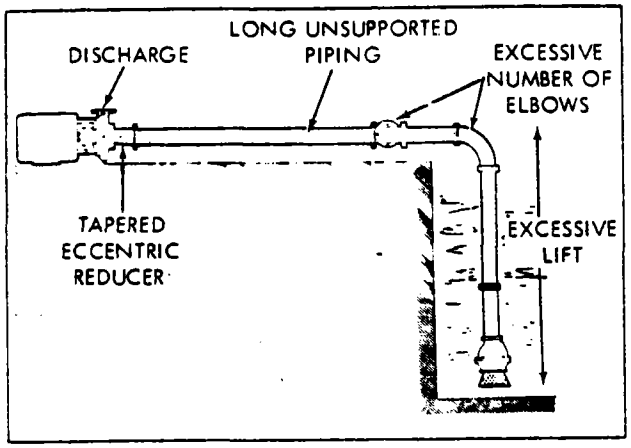


FIGURE 10. UNSATISFACTORY SUCTION LIFT PIPING - LONG AND INDIRECT WITH NO SUPPORT

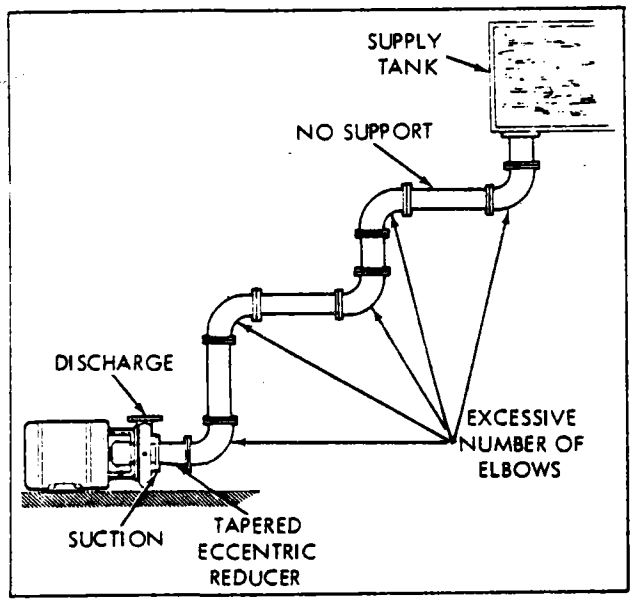


FIGURE 11. UNSATISFACTORY FLOODED SUCTION PIPING - LONG AND INDIRECT WITH NO SUPPORT

ELBOWS. Long radius elbows should be used in place of standard elbows wherever possible, because of their superior flow characteristics. For instance, head loss in a standard four inch elbow is equivalent to the head loss in a piece of pipe 11 feet long, while the head loss in a long radius elbow is approximately half as much. Elbows should not be used at the suction nozzle, but if it is unavoidable, they should be installed in a vertical position. Elbows installed in any position at the suction nozzle have a tendency to distribute the liquid unevenly in the impeller chamber, causing a reduction in capacity, and creating an undersirable thrust condition.

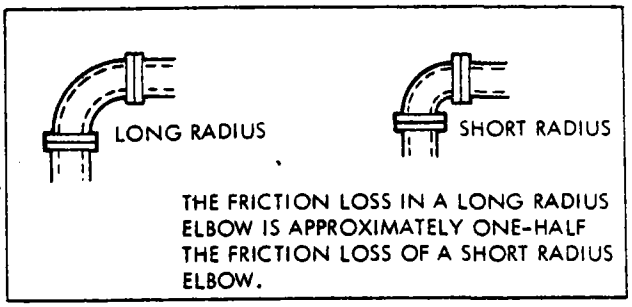


FIGURE 12. LONG VERSUS SHORT RADIUS ELBOWS

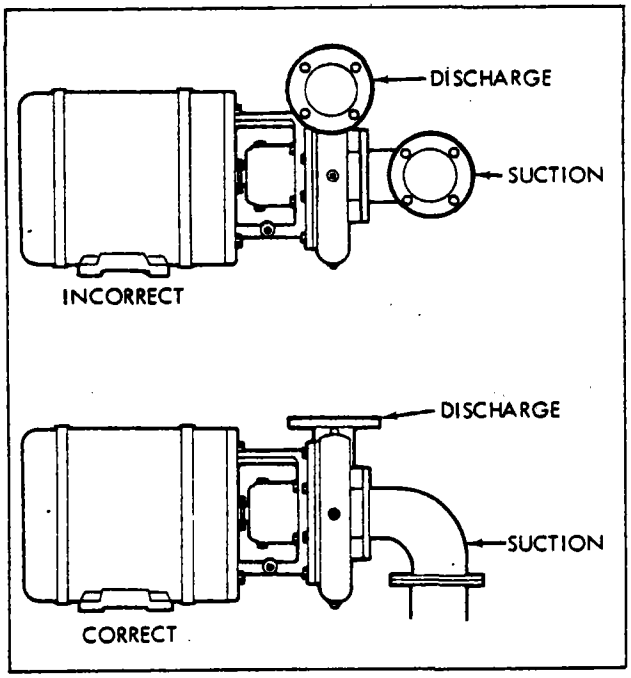


FIGURE 13. ELBOW INSTALLATION ON SUCTION NOZZLE

REDUCERS. Eccentric reducers should be installed directly at the suction nozzle, with the taper at the bottom to prevent air pockets from forming. Straight taper reducers should never be used in a horizontal suction line because of the air pocket that is formed at the leg of the reducer and the pipe.

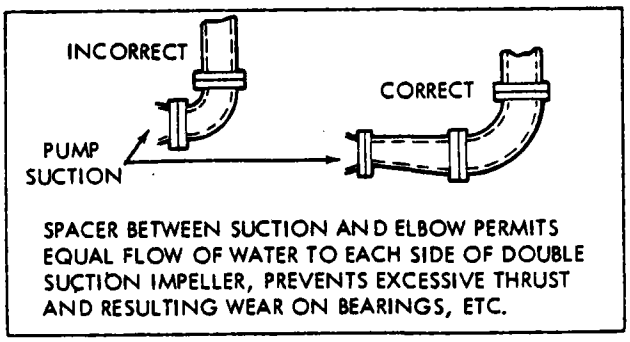
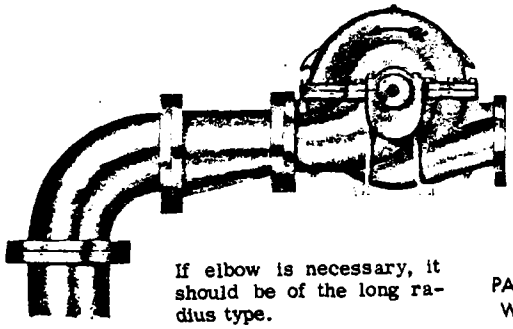


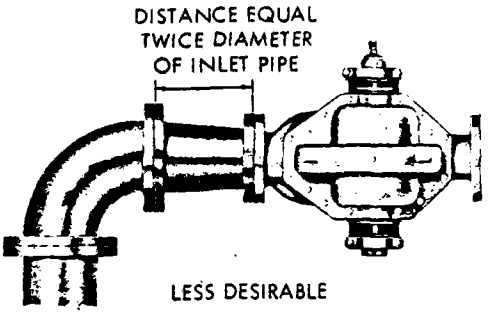
FIGURE 14. REDUCER BETWEEN ELBOW AND PUMP SUCTION NOZZLE

SPECIAL SUCTION PIPING SPECIFICATIONS FOR HORIZONTAL DOUBLE SUCTION PUMPS

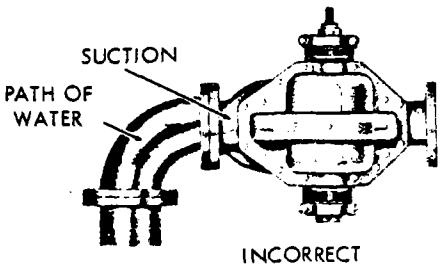


If elbow is necessary, it should be of the long radius type.

CORRECT



LESS DESIRABLE



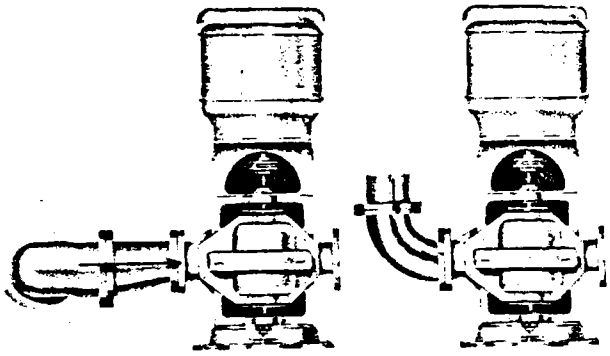
INCORRECT

Discharge piping and suction piping should be supported close to the pump flange to prevent vibration and strain on pump casing.

The suction pipe on horizontal double suction pumps, should not be installed so that there is an elbow close to the suction nozzle unless the elbow is mounted vertically. There is always an uneven flow of liquid through an elbow and when the elbow is installed at any angle other than vertical more water will enter one side of the impeller than enters the other side. This causes a reduction in capacity and efficiency and creates an axial thrust load which may over heat and possibly cause rapid wear of the thrust bearing.

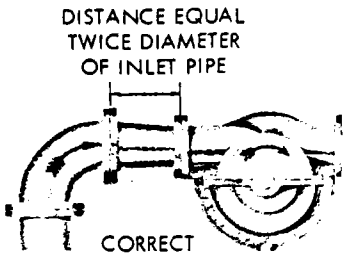
FIGURE 15

SPECIAL SUCTION PIPING SPECIFICATIONS FOR VERTICAL DOUBLE SUCTION PUMPS

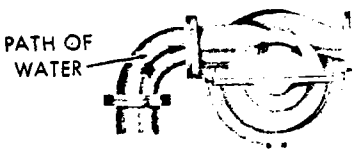


CORRECT

INCORRECT



CORRECT



LESS DESIRABLE

Suction connections for vertical mounted double suction pumps should be installed the opposite of horizontal pumps. That is, if an elbow is installed close to the suction nozzle it should only be mounted horizontally. Any angle other than horizontal will cause more water to enter one side of the impeller than enters the other side. This causes a reduction in capacity and efficiency and creates an axial thrust load which may over heat and possibly cause rapid wear of the thrust bearing.

FIGURE 16

TYPICAL PIPING FOR DOUBLE SUCTION PUMPS

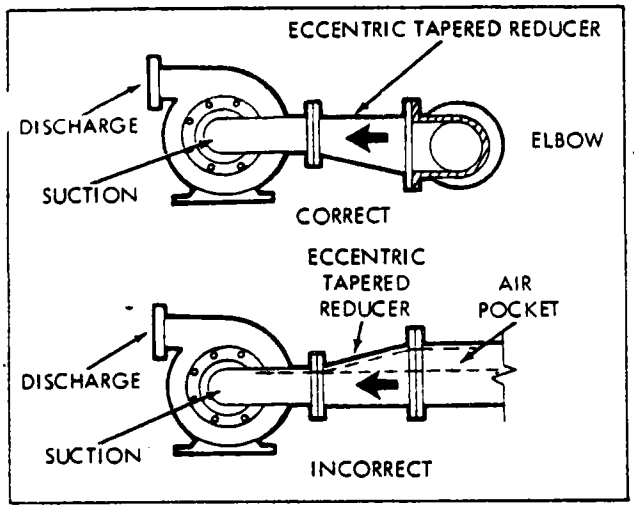


FIGURE 17. INSTALLATION OF TAPERED REDUCERS

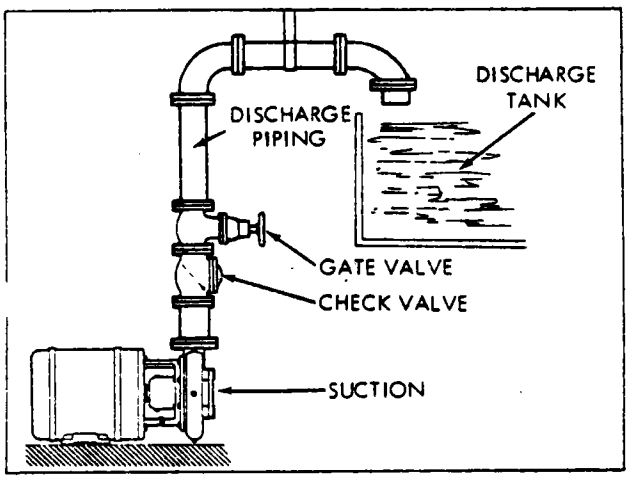


FIGURE 18. RECOMMENDED DISCHARGE PIPING - SHORT AND DIRECT

DISCHARGE PIPING. Discharge piping should also be short and direct as possible, with few elbows and fittings, to reduce head loss from friction.

PIPE. The discharge pipe diameter should be the same as, or larger than, the discharge nozzle diameter. The size of discharge pipe to be used is dependent upon the application. The recommended pipe diameter can be obtained from your nearest Aurora Pump Sales Office.

ELBOWS. Long radius elbows should be used in the discharge piping as well as in the suction piping, to prevent excessive head loss due to friction. Whenever possible, elbows should not be installed directly at the discharge nozzle as the turbulence created by the elbow will affect pressure gauge readings.

REDUCERS AND INCREASERS. An increaser should be installed at the discharge nozzle if larger diameter discharge piping is used. Straight taper increasers and/or reducers are satisfactory in discharge piping, because air pockets on the discharge side do not affect pump efficiency.

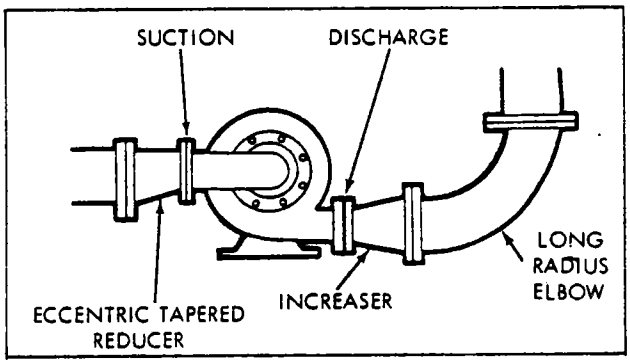


FIGURE 20. REDUCER INCREASER INSTALLATION

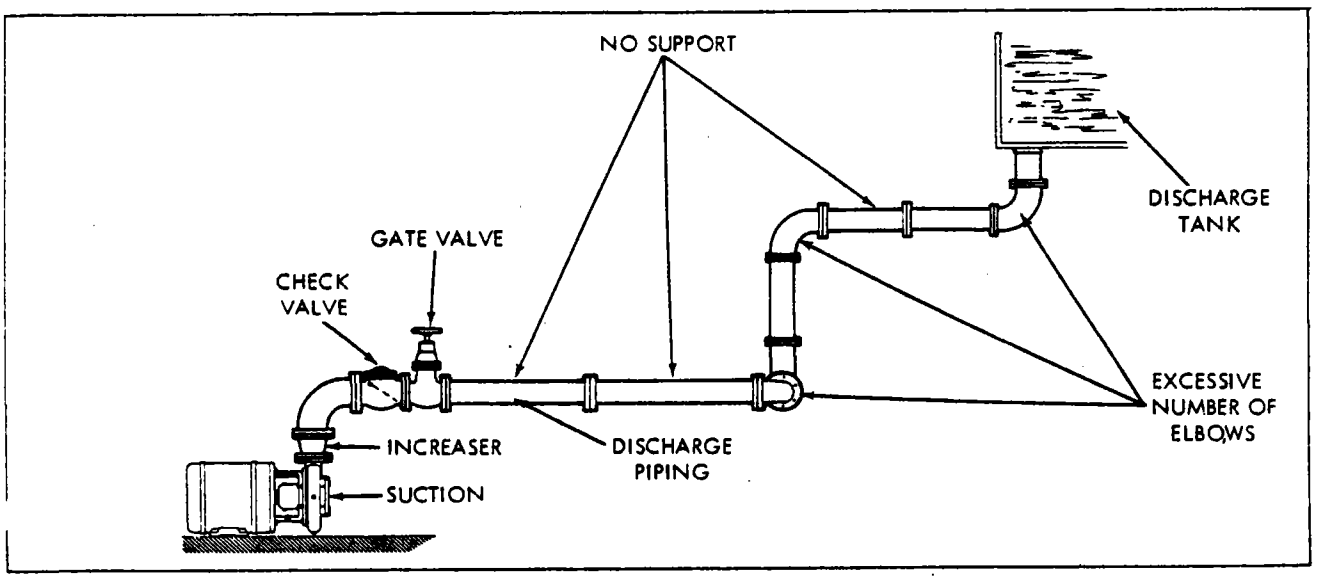


FIGURE 19. UNSATISFACTORY DISCHARGE PIPING - LONG WITH EXCESSIVE ELBOWS AND JOINTS

EXPANSION JOINTS. Expansion joints are used primarily to prevent transmission of piping strain, caused by thermal expansion and contraction, piping misalignment, pressure changes, or other causes, to the pump casing. They are also used to suppress any noise that may be transmitted through the piping. It is recommended that the flexible metal type of expansion joint be used because rubber expansion joints, while costing less, have a tendency to deteriorate, making frequent replacement necessary.

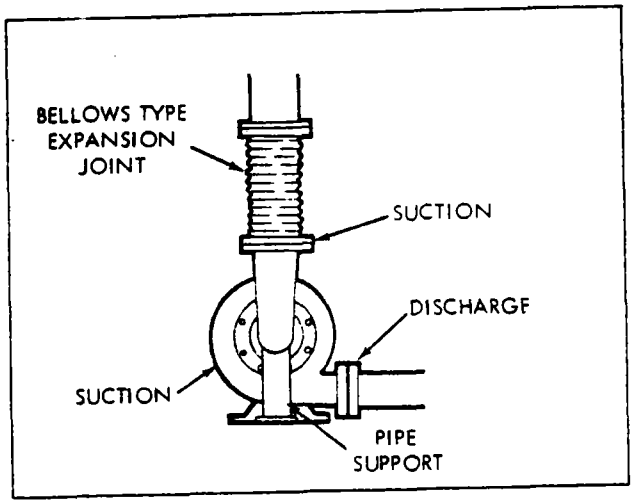


FIGURE 21. EXPANSION JOINT IN SUCTION LINE

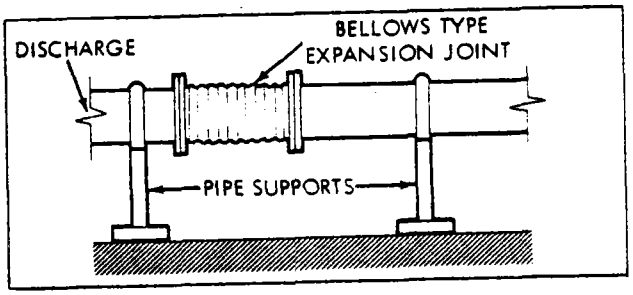


FIGURE 22. EXPANSION JOINT IN DISCHARGE PIPING

If an expansion joint must be used, an anchor or restraining device should be installed between the joint and the pump to prevent objectionable forces from being transmitted to the pump. If an anchor is not installed at this point, a force equal to the area of the expansion joint times the pressure in the pipe is developed and transmitted to the pump. This force may exceed the allowable flange loading and could result in damage to the pump or piping.

PIPE ALIGNMENT. Proper piping alignment is essential before connection is made. Piping alignment should never be achieved by force, as this could produce strain on the piping and the pump casing. Proper supports should be installed for the piping to keep its weight off the pump casing.

When flange bolts are used, line up the piping first, then loosely install flange bolts. Check the piping alignment, and tighten the flange bolts until all bolts are tightened securely.

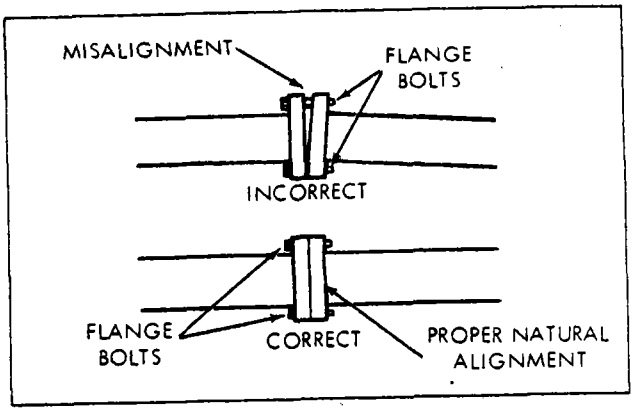


FIGURE 23. PIPE ALIGNMENT

AIR IN PIPING. One of the most common conditions affecting pump efficiency is the formation of air pockets in the suction line. The air pockets are a result of high points and improper installation of elbows, reducers, and valves in the suction piping.

For suction lift applications, lantern rings are required to prevent air from leaking into the pump through the stuffing box.

The pump seals or packings depend on the liquid being pumped for lubrication. Excessive air can prevent proper lubrication with resultant damage to them.

In suction lift applications, the suction pipe in the liquid well must be sufficiently submerged to prevent exposure of the end of the pipe when the well is at its minimum level and to prevent vortexing action (whirlpool effect) of the liquid at the suction pipe, which will draw air into the pipe. Also, care should be taken to keep the suction pipe located away from the well inlet since the incoming liquid may be carrying air bubbles. Another cause of air in the liquid is dropping of the liquid from too high a point into the well.

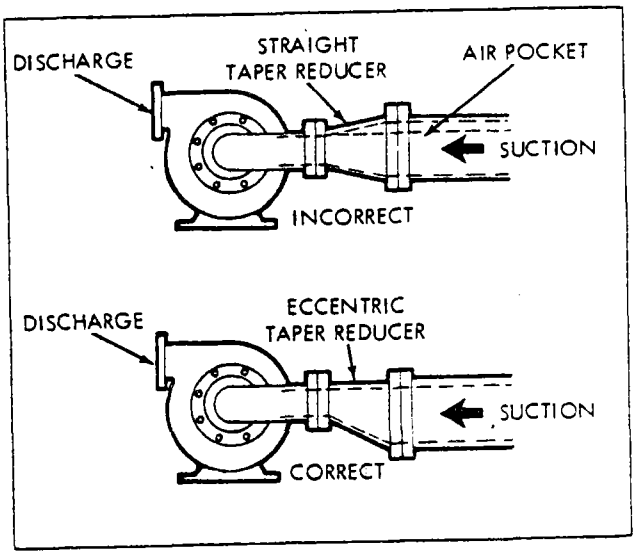


FIGURE 24. AIR POCKET IN REDUCER

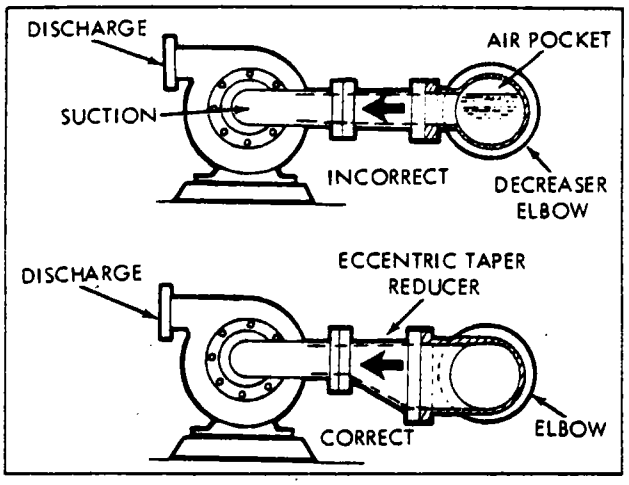


FIGURE 25. AIR POCKET IN ELBOW

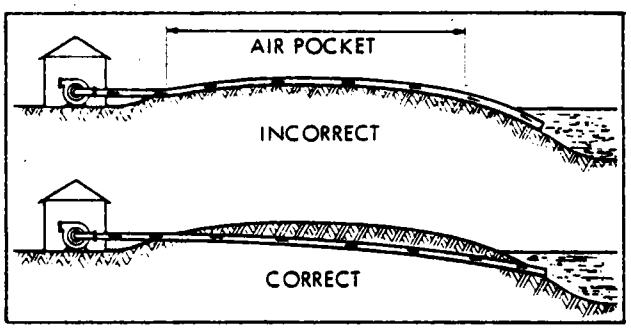


FIGURE 26. AIR POCKET IN HORIZONTAL SUCTION PIPING

VALVES. Valves are an important part of your installation, for they facilitate priming of the pump, and control the volume of the pumped liquid.

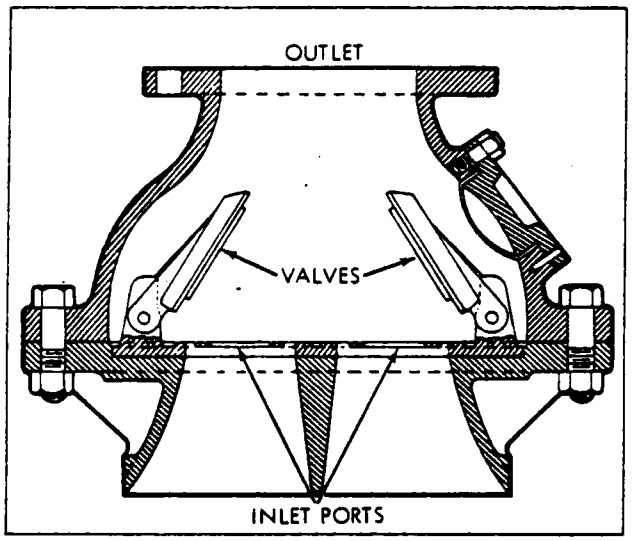


FIGURE 27. FOOT VALVE

SUCTION LIFT. In suction lift applications where the suction lift is low a foot valve can be installed, to maintain the prime on the pump. A foot valve is essentially a check valve, allowing flow in one direction only, toward the pump. When the pump is shut down, the pressure of the liquid returning to the well, causes the valve to close, retaining the liquid in the suction line.

A slow closing check valve should be installed when the static discharge head is high. A foot valve should not be used under these conditions, as failure of the driver would allow the water to rush back rapidly thus causing a heavy water hammer.

Foot valves, when used, should be of the flat type rather than multiple spring type. The valve should have a large inlet area, because the friction loss in a foot valve is high. Install check and foot valves as indicated by arrow to ensure proper installation.

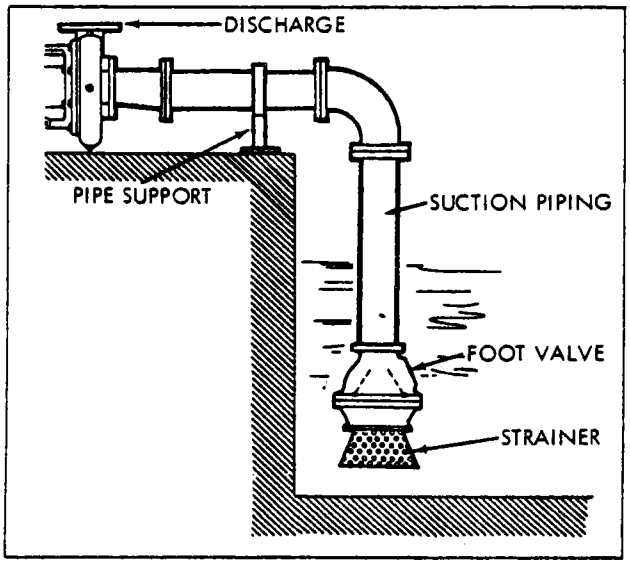


FIGURE 28. FOOT VALVE INSTALLED WITH SCREEN

FLOODED SUCTION. When the liquid source is above the pump centerline, a flooded suction condition exists, and a gate valve is required to shut off the liquid supply for pump inspection and maintenance. The gate valve should be installed with the stem in a horizontal or downward position to prevent formation of an air pocket in the valve.

DISCHARGE VALVES. The discharge piping should include a check valve and a gate valve. The check

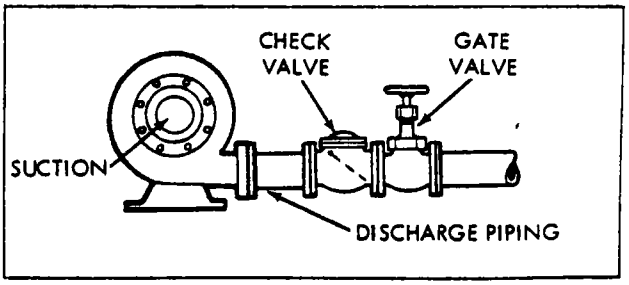


FIGURE 29. GATE VALVE AND CHECK VALVE

valve should be located between the gate valve and the pump. If an increaser is used in the discharge piping, the increaser should be installed between the pump nozzle and the check valve. The check valve protects against a reverse flow of the liquid if the driver fails.

The gate valve is used in the priming operation, as a throttling valve to control pump volume, and to shut down the pump for inspection and maintenance.

AIR VENT VALVE. Vent valves are installed at the high points in the pump casing to allow air or vapor to escape. These valves are used to release trapped air from the pump casing during priming and when pump becomes air bound.

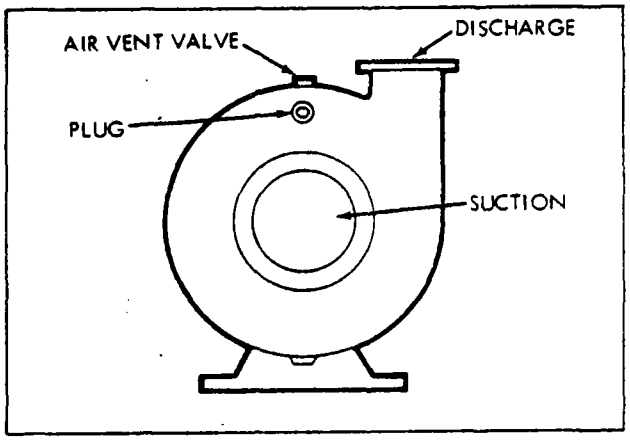


FIGURE 30. AIR VENT VALVE OR PLUG

STRAINERS AND SCREENS. It is important to remove foreign matter that can clog the pump and impair its capacity, or stop it completely. Small particles such as sand, dirt, scale from inside pipe and other extraneous materials can get into the close clearance parts of the pump and cause considerable damage to the parts.

Strainers should be selected so as to have a total area of holes equal to at least four times the suction pipe area.

In applications where sticks, twigs, leaves and other large debris are present, a larger outside screen should be placed around the suction inlet to prevent choking of the strainer. This screen should have sufficient openings so that flow velocity does not exceed two feet per second.

PRIMING THE PUMP. Your pump will not operate satisfactorily until it is primed. All air must be expelled from the suction piping and pump casing, and replaced by the liquid to be pumped. There are several methods of priming pumps. The one you select will depend on your specific requirements.

FLOODED SUCTION PRIMING. This method of priming a pump is relatively simple. The liquid source is located above the pump, and all that is necessary to prime the pump is to open the air vent

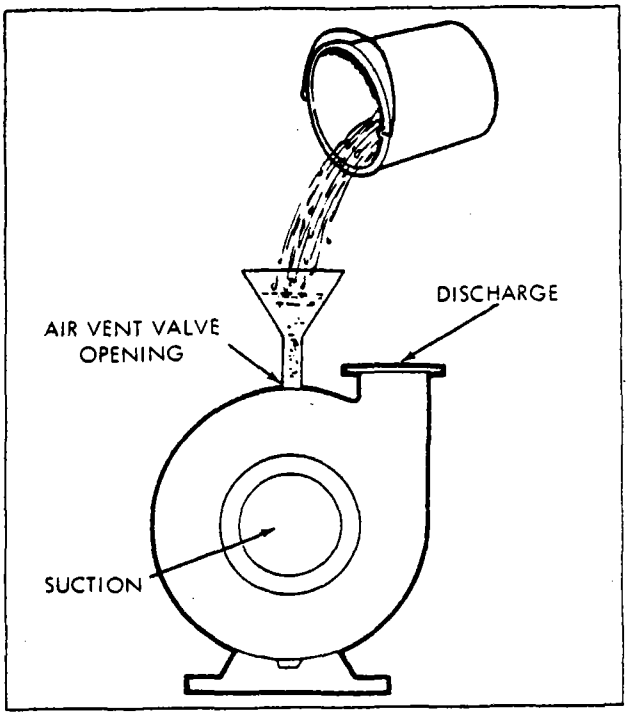


FIGURE 31. PRIMING BY HAND

valve or plug in the pump casing, and to crack the gate valve in the suction line. The suction line and pump should be filled slowly until a steady stream of liquid is observed flowing from the air vent. After your pump is operating, it is recommended that the air vent valve or plug be opened again to insure that all air has been expelled from the pump casing.

FOOT VALVE PRIMING. A foot valve can be used for priming on suction lift applications. The foot valve, located at the bottom end or foot of the suction piping, functions as a check valve which allows flow in one direction only, toward the pump.

Initial priming is accomplished by completely filling the suction piping and pump casing with the liquid to be pumped. This can be done by removing the air vent valve or plug at the top of the pump casing and inserting a pipe nipple in the orifice, with an appropriate increaser to accommodate a hose connection. A priming line can also be inserted in the discharge piping between the check valve and the pump or the priming can be done with a bucket and funnel. The important thing is to completely fill the suction pipe and pump casing with liquid.

When the pump is started, the vacuum created by pumping the priming fluid, combined with atmospheric pressure in the liquid well, forces liquid into the suction piping, thus opening the valve and keeping it open until the pump is shut down. When the pump is shut down, the liquid being pumped, reverses its flow, causing the valve to close, trapping the liquid in the suction piping and pump casing, thus maintaining a prime on the pump.

VACUUM PRIMING. Vacuum priming consists of removing air from the pump casing and suction

piping and drawing liquid into them by means of a vacuum creating device. The types of vacuum equipment range from a simple hand pump to complex central priming systems. Your specific priming requirements will govern what type of vacuum primer you use.

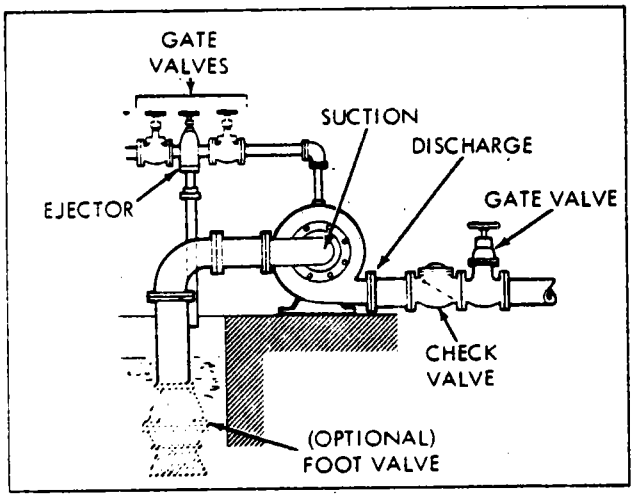


FIGURE 32. PRIMING BY EJECTOR

AIR EJECTOR. One type of vacuum primer is the air ejector. If liquid under pressure or steam is available, an ejector can be used. The ejector is connected to the air vent orifice. A stream of the ejecting medium is passed through the ejector creating a vacuum in the ejector, and drawing air from the pump casing and suction piping. When liquid flows steadily from the ejector discharge pipe, the pump is primed.

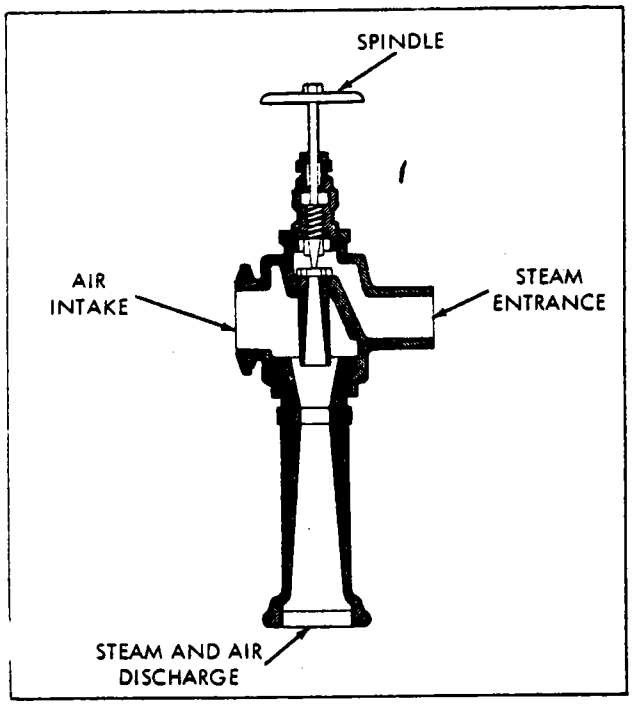


FIGURE 33. EJECTOR CUTAWAY

VACUUM PUMPS. Rotary or reciprocating pumps are frequently used as vacuum pumps. They fall into two categories, wet-vacuum and dry-vacuum. The principle of operation is essentially the same, however, the dry-vacuum pump cannot accommodate a liquid and air mixture while the wet-vacuum pump can accommodate liquid, air or a combination of both.

Vacuum pumps can be installed as part of a central priming system servicing many pumps, as an automatic priming system, or as a manually controlled independently driven pump.

The suction piping of the vacuum pump is connected to the air vent orifice on the pump to be primed. The vacuum produced by the vacuum pump removes air from the centrifugal pump suction piping and casing, and draws liquid from the liquid well into the centrifugal pump. Dry-vacuum pumps must be installed so that no liquid is taken into the air pump. Installation of a water trap, or use of a vacuum tank are recommended for dry vacuum pumps.

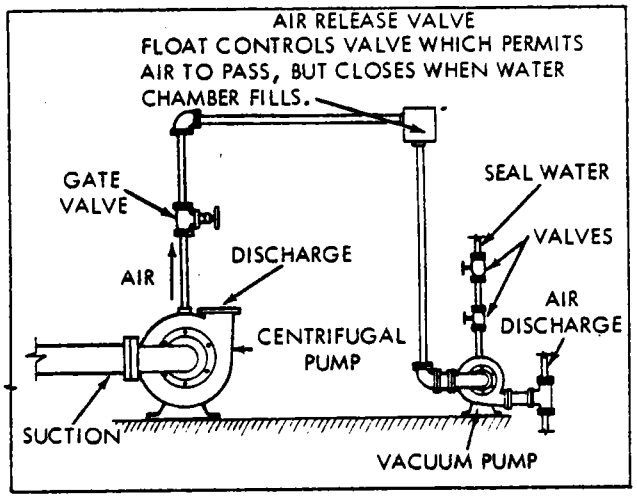


FIGURE 34. PRIMING BY VACUUM PUMP

INDUCTOR PRIMING. On suction lift applications it may be desirable to prime your pump with a priming inductor. This type of primer is comprised of a liquid nozzle and an inductor at the foot end of the suction piping. The nozzle and inductor are connected to a high pressure liquid supply such as a city water service.

The pump is primed by opening the valve in the pressure line, which allows the liquid to flow through the nozzle into the inductor. The velocity of the high pressure liquid drives the liquid into the suction piping and up to the pump, priming it.

ELECTRICAL WIRING. Normally, your pump will be supplied with an attached drive motor. The motor should be wired in accordance with the wiring diagram found on the motor name plate. Be sure the voltage, frequency, and phase of your power supply corresponds with the name plate data. It is advisable to provide a separate switch and overload protection for your pump motor to protect against power

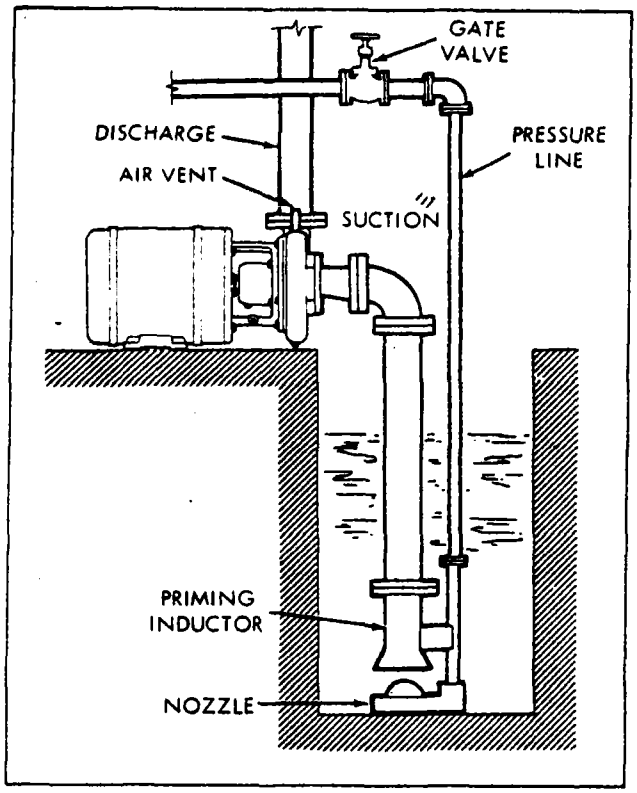


FIGURE 35. PRIMING BY INDUCTOR

failure in some other area. Conversely, if the pump motor develops electrical problems, it will be isolated from other equipment.

PRESTARTING INSTRUCTION. Before starting the pump, check the direction of rotation. Make sure that the rotation is the same as the arrow on the casing, or as otherwise indicated.

CAUTION

Do not operate the pump without liquid. Pump seals or packing depend on the liquid being pumped for lubrication.

Be sure the pump is primed and that no air exists in the suction pipe and pump casing.

Check the various valves to make sure they are open or closed as required by your specific application.

AURORA® PUMPS

INSTRUCTION MANUAL

OPERATION
TURBINE PUMP

4

TURBINE PUMP OPERATION. Turbine pumps operate under an extremely wide range of conditions. The pump you have selected exactly fits your specific requirements. Before putting your pump into operation, however, there are certain basic ground rules that have to be followed to assure maximum efficiency, long pump life, and maintenance free service.

Turbine pumps should never be started or run dry. Operating a pump dry can cause burning of the packings or seal, resulting in destruction of the packings or seals, and possible scoring of the pump shaft. To prevent the pump from being run dry, it is necessary to prime it before starting it.

A turbine pump should not be throttled, or the volume controlled on the suction side of the pump. Throttling the pump on the suction side not only reduces the capacity, but also reduces pump efficiency, and more important, can cause serious damage to pump due to cavitation. Cavitation occurs when the pressure at any point inside the pump drops below the vapor pressure of the liquid. The liquid flashes and forms vapor bubbles. These bubbles move along with the liquid into a higher pressure area, where the bubbles collapse or implode creating an area of low pressure. The implosion phenomenon is characterized by a crackling noise and sometimes by loud knocking as the vapor bubbles are collapsed. Repetition of this action causes a wearing away of the metal on the impeller and other parts of the pump, and if allowed to continue can result in serious damage to the pump.

The turbine pump capacity can be effectively controlled by use of a throttling valve in the discharge piping. If it is necessary to throttle or limit the discharge of a turbine pump, however, it may be necessary to provide relief valves and by-pass piping to accommodate the excessive pressures that may be developed within the pump and to reduce h.p. requirements.

A turbine pump should not be operated with the gate valve in the discharge line closed. Unlike centrifugal pumps, which use a minimum amount of power when the throttling valve is closed, a turbine pump requires maximum power at shut-off.

On pumps equipped with packings, there should be sufficient leakage to insure lubrication of the packing and effective cooling of the stuffing box. The packing gland should always be adjusted evenly and not too tightly. Over-tightening the packing can generate heat that will burn the packing and cause scoring of the shaft, making it necessary to replace both the shaft and the packings.

A strainer or sediment trap should be provided on the suction side of the pump to prevent introduction of abrasive particles into the turbine blades. These particles can cause excessive wear of the blade and the channel rings, making it necessary to replace either the impeller or the rings.

Adequate precautions should be taken to prevent freezing of the liquid in the pump when the pump is not in operation. If there is any possibility of freezing, the water should be drained off by removal of the plugs provided in the pump casing.

All mounting bolts and piping connections must be firmly tightened to prevent excessive vibration, leakage, and possible damage to the pump. The mounting bolts are particularly important. If they are not firmly tightened, the base plate upon which the pump is mounted may deflect, causing a misalignment of the pump and the driver.

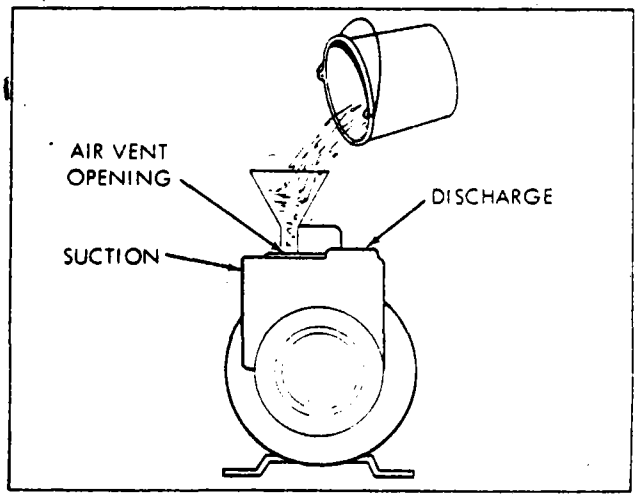


FIGURE 1. PRIMING BY HAND

STARTING THE PUMP. In order to start your pump, it is first necessary to prime it.

PRIMING THE PUMP. Your pump will not operate satisfactorily until it is primed. All air must be expelled from the suction piping and pump casing, and replaced by the liquid to be pumped. There are several methods of priming pumps. The one you select will depend on your specific requirements.

FLOODED SUCTION PRIMING. This method of priming a pump is relatively simple. The liquid source is located above the pump, and all that is necessary to prime the pump is to open the air vent

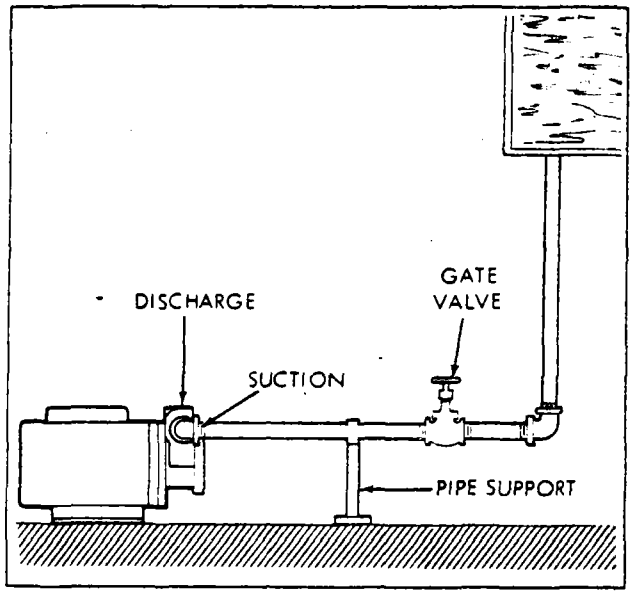


FIGURE 2. FLOODED SUCTION PRIMING

valve or plug in the pump casing, and to crack the gate valve in the suction line. The suction line and pump should be filled slowly until a steady stream of liquid is observed flowing from the air vent. After your pump is operating, it is recommended that the air vent valve or plug be opened again to insure that all air has been expelled from the pump casing.

FOOT VALVE PRIMING. A foot valve can be used for priming on suction lift applications. The foot valve located at the bottom end or foot of the suction piping, functions as a check valve which allows flow in one direction only, toward the pump.

Initial priming is accomplished by completely filling the suction piping and pump casing with the liquid to be pumped. This can be done by removing the air vent valve or plug at the top of the pump casing, and inserting a pipe nipple in the orifice with an appropriate increaser to accommodate a hose connection. A priming line can also be inserted in the discharge piping between the check valve and the pump, or the priming can be done with a bucket and funnel. The important thing is to completely fill the suction pipe and pump casing with liquid.

When the pump is started, the vacuum created by pumping the priming fluid, combined with atmospheric pressure in the liquid well, forces liquid into the suction piping, thus opening the valve and keeping it open until the pump is shut down. When the pump is shut down, the liquid being pumped reverses its flow causing the valve to close. The liquid is now trapped in the suction piping and pump casing, thus maintaining a prime on the pump.

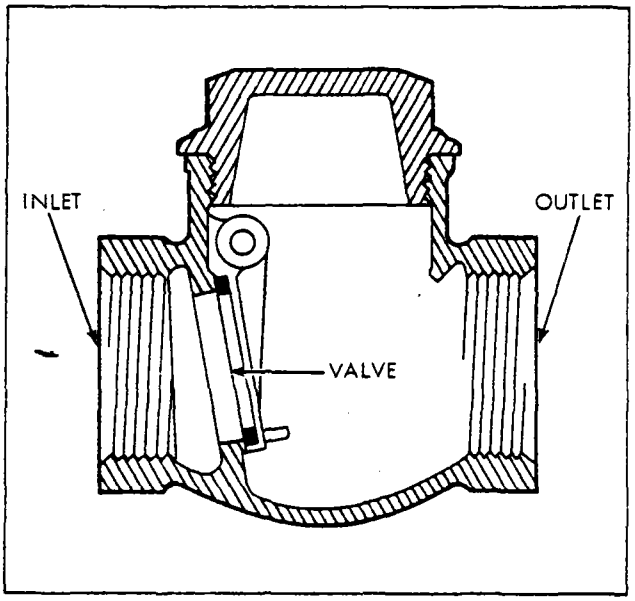


FIGURE 4. FOOT VALVE CUTAWAY VIEW

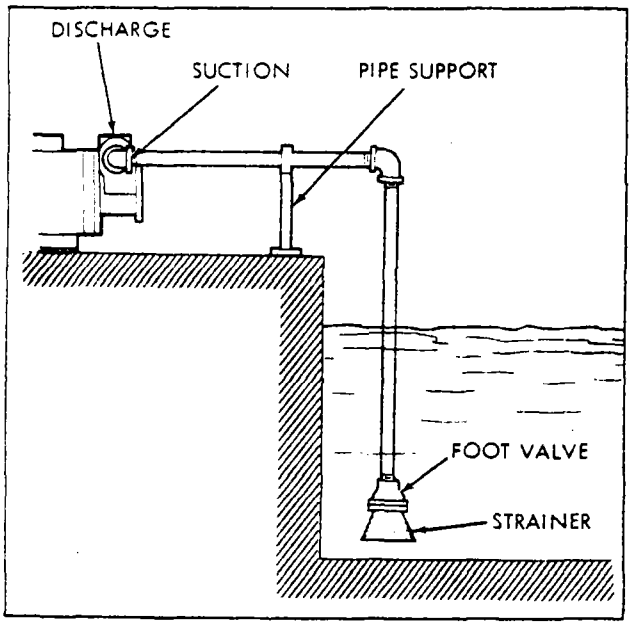


FIGURE 3. PRIMING WITH FOOT VALVE

VACUUM PRIMING. Vacuum priming consists of removing air from the pump casing and suction piping, and drawing liquid into them by means of a vacuum creating device. The types of vacuum equipment range from a simple hand pump to complex central priming systems. Your specific priming requirements will govern what type of vacuum primer you use.

AIR EJECTOR. One type of vacuum primer is the air ejector. If liquid under pressure or steam is available, an ejector can be used. The ejector is connected to the air vent orifice. A stream of the ejecting medium is passed through the ejector creating a vacuum in the ejector. This action will draw air from the pump casing and suction piping. When liquid flows steadily from the ejector discharge pipe, the pump is primed.

VACUUM PUMPS. Rotary or reciprocating pumps are frequently used as vacuum pumps. They fall into two categories, wet-vacuum and dry-vacuum.

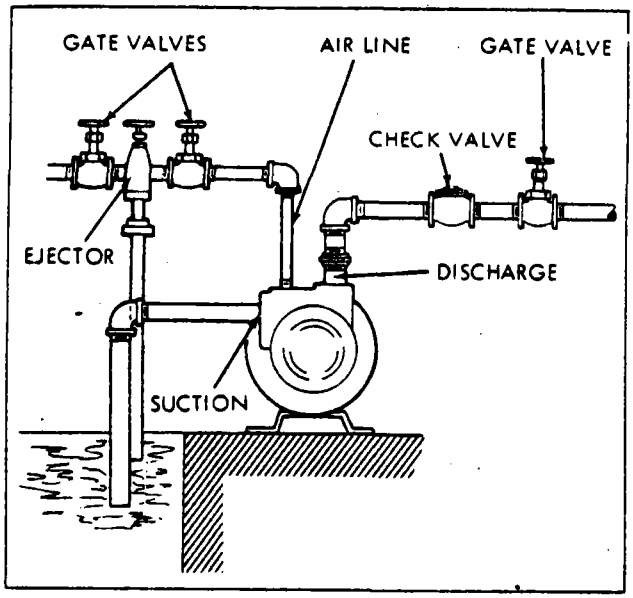


FIGURE 5. PRIMING BY EJECTOR

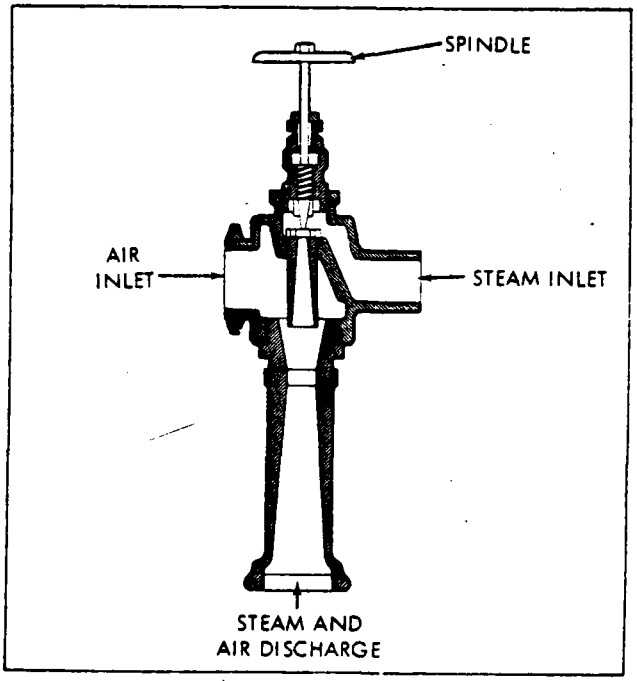


FIGURE 6. EJECTOR CUTAWAY VIEW

The principle of operation is essentially the same, however, the dry-vacuum pump cannot accommodate a liquid and air mixture, while the wet-vacuum pump can accommodate liquid, air or a combination of both.

Vacuum pumps can be installed as part of a central priming system servicing many pumps, as an automatic priming system, or as a manually controlled independently driven pump.

The suction piping of the vacuum pump is connected to the air vent orifice on the pump to be primed. The vacuum produced by the vacuum pump removes air from the turbine pump suction piping and casing, and

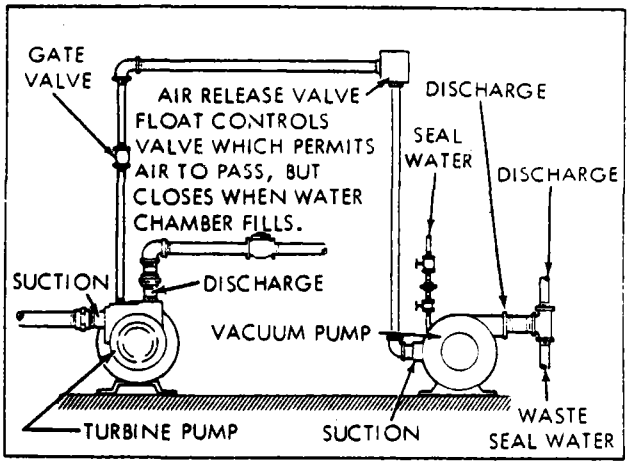


FIGURE 7. VACUUM PUMP PRIMING

draws liquid from the liquid well into the turbine pump. Dry-vacuum pumps must be installed so that no liquid is taken into the air pump. Installation of a water trap, or use of a vacuum tank are recommended for dry vacuum pumps.

INDUCTOR PRIMING. On suction lift applications it may be desirable to prime your pump with a priming inductor. This type of primer is comprised of a liquid nozzle and an inductor at the foot end of the suction piping. The nozzle and inductor are con-

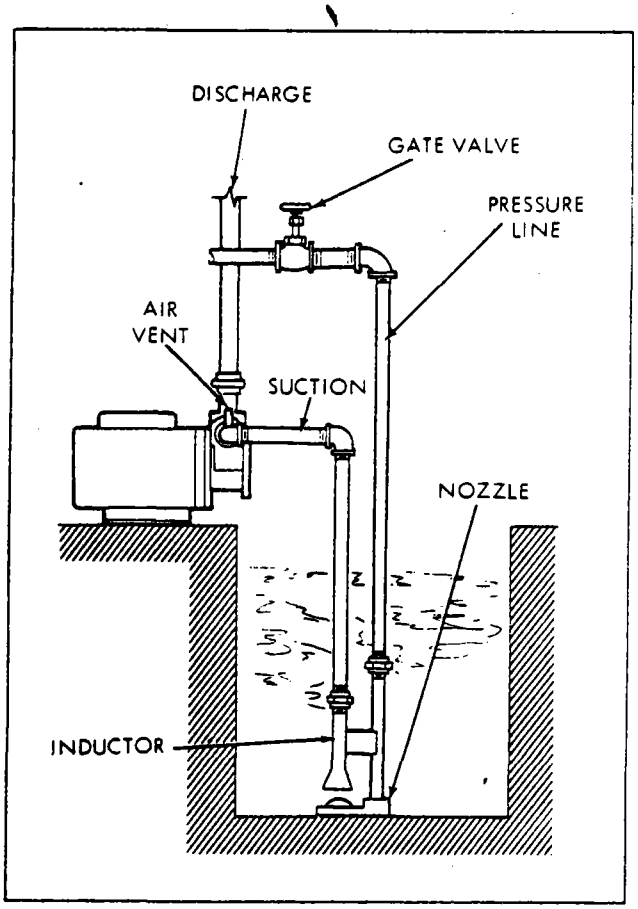


FIGURE 8. INDUCTOR PRIMING

nected to a high pressure liquid supply such as a city water service.

The pump is primed by opening the valve in the pressure line. This will allow the liquid to flow through the nozzle and into the inductor. The velocity of the high pressure liquid drives the liquid into the suction piping and to the pump, thus completing the priming operation.

POSITION OF DISCHARGE GATE VALVE WHEN STARTING. The discharge gate valve should be open when a turbine pump is started, because a turbine pump primed and operating at full speed, develops a very high internal pressure when the discharge gate valve is closed.

POSITION OF SUCTION PIPING GATE VALVE. In flooded suction applications, the gate valve is opened at the time the pump is being primed, and will remain open for starting and operation. If a flooded suction condition does not exist and a gate valve has been installed in the suction line, the operator may close the gate valve as the pump is shut off. However, the pump should not be run with the suction closed for more than a few seconds. In this manner the pump will maintain its prime for short periods of time. It is recommended that either a foot valve or a check valve be installed in the suction piping, if it is necessary for the pump to maintain its prime while it is shut down.

COOLANT VALVES. Valves in the cooling liquid line should be opened prior to the pump's being started, and will remain open while the pump is in operation.

SHUTTING DOWN THE PUMP. To shut down your pump, simply shut off the motor and close the applicable valves.

AURORA® PUMPS

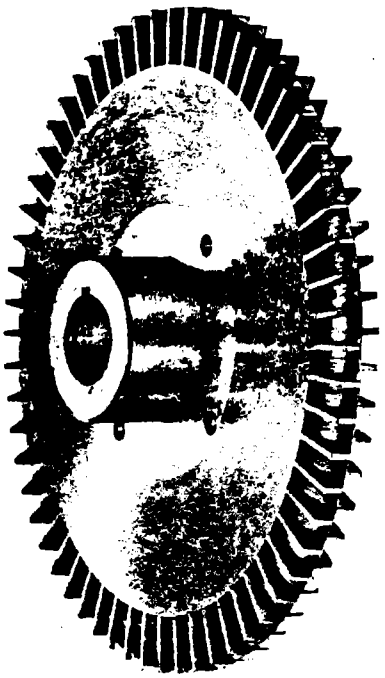
INSTRUCTION MANUAL
TROUBLESHOOTING
TURBINE PUMP

5

Your Aurora Pump has been engineered and carefully selected for your application. It should provide years of trouble-free service. However, any piece of machinery is subject to wear and occasional malfunctions.

To help you quickly isolate and rectify any malfunction the following troubleshooting chart has been prepared.

Frequent use of the chart to determine the cause of minor operating problems may prevent a major problem or possible breakdown of your pump.



STEARNS-ROGER ENGINEERING CORP.
PROJECT NO. 621700
SOLAR-ONE PILOT PLANT
UNIT ONE
P.O. 2001

TURBINE PUMP TROUBLESHOOTING

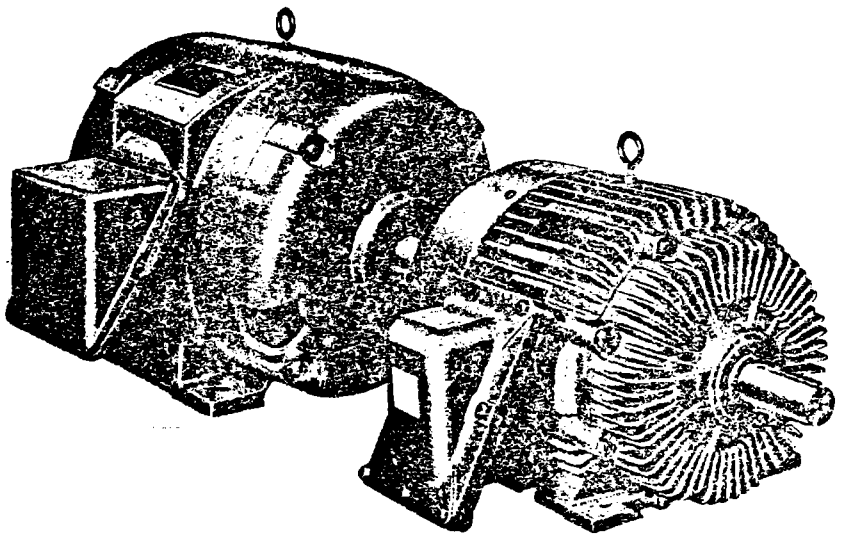
TROUBLE	PROBABLE CAUSE	REMEDY
1. Pump fails to prime or loses its prime	a. Air leaks in suction lines	a. Clean and tighten all suction connections; relocate suction inlet in liquid source.
	b. Suction strainer is clogged	b. Remove dirt, leaves or other material from strainer.
	c. Suction lift is too high	c. Re-evaluate pump requirements and correct suction conditions accordingly. Consult your local Aurora Pump Sales Office.
	d. Defective priming valve	d. Replace valve.
	e. Defective packing or seal	e. Replace packing or seal.
2. No discharge from pump	a. Pump is not properly primed	a. Reprime the pump; refer to priming troubles and remedies.
	b. Total head is too high	b. Re-evaluate head calculations; measure elevation differences between pump and liquid source, and pump and discharge point. Consult your local Aurora Pump Sales Office.
	c. Driver is not operating at rated speed	c. Check voltage of electric motor; check steam pressure of steam turbine; check engine R.P.M.'s. Refer to applicable maintenance manuals for possible troubles and corrective action.
	d. Impeller or discharge line is clogged	d. Back flush pump to clear obstruction; disassemble pump and/or piping and remove obstruction.
	e. Wrong direction of rotation	e. Check wiring against diagram on motor name plate and in controller; reverse any two power leads on a three-phase motor; replace a single phase motor.
3. Pump does not deliver rated capacity	a. Pump is not properly primed	a. See 2.a. above.
	b. Suction lift is too high	b. See 1.c. above.
	c. Excessive air in liquid	c. See 1.a. above.
	d. Air leakage through stuffing box	d. See 1.e. above.
	e. Driver is not operating at rated speed	e. See 2.c. above.
	f. Impeller is clogged	f. See 2.d. above.
	g. Channel or spacer rings are worn	g. Replace channel or spacer rings.
	h. Impeller is damaged	h. Replace impeller.
4. Insufficient pressure	a. Excessive air in liquid	a. See 3.c. above.
	b. Drive is not operating at rated speed	b. See 2.c. above.
	c. Wrong direction or rotation	c. See 2.e. above.
	d. Total head is too high	d. See 2.b. above.
	e. Channel or spacer rings are worn	e. See 3.g. above.
	f. Impeller is damaged	f. See 3.h. above.
5. Pump starts then stops pumping	a. Air leaks in suction line	a. See 1.a. above.
	b. Air pocket in suction line	b. Reprime the pump; eliminate air pocket conditions.
	c. Water seal line is plugged	c. Remove obstruction from water line.
	d. Excessive air in liquid	d. See 1.a. above.
	e. Suction lift too high	e. See 1.c. above.
	f. Defective packing or seal	f. See 1.e. above.

TURBINE PUMP TROUBLESHOOTING

TROUBLE	PROBABLE CAUSE	REMEDY
6. Excessive power consumption	a. Speed is too high	a. Internal electric motor wiring is incorrect; replace motor; refer to applicable driver maintenance manuals for possible troubles and corrective action.
	b. Wrong direction of rotation	b. See 2.e.
	c. Total head is too high	c. See 2.b.
	d. Impeller is clogged	d. See 2.d.
	e. Impeller is binding or rubbing	e. Relieve strain on casing; adjust impeller clearance.
	f. Motor shaft is bent or worn	f. Replace motor shaft.
	g. Driver and pump are misaligned	g. Realign driver with pump.
	h. Pump shaft is bent	h. Replace shaft.
	i. Channel rings are worn	i. See 3.g.
	j. Packing is incorrectly installed or too tight	j. Install packings correctly; replace if necessary.
7. Pump is noisy or has excessive vibration	a. Magnetic hum	a. Consult motor manufacturer.
	b. Motor bearings are worn	b. Replace bearings.
	c. Foreign material in impeller	c. Remove foreign material.
	d. Impeller is binding	d. See 6.e. above.
	e. Motor shaft is bent or worn	e. See 6.f. above.
	f. Driver and pump are misaligned	f. See 6.g. above.
	g. Pump shaft is bent	g. See 6.h. above.
	h. Foundation is not rigid	h. Strengthen foundation; change method of mounting pump unit.
	i. Worn pump bearings	i. Replace bearings.
	j. Impeller is damaged	j. See 3.h.
	k. Lack of lubrication in bearings	k. Lubricate bearings; replace bearings if damaged.
	l. Pump is not properly leveled	l. Check levelness of pump.
	m. Piping is not supported	m. Provide support for suction and discharge piping.
	n. Pump is cavitating	n. Re-evaluate pump application; consult local Aurora Pump Sales Office.

MARATHON® ELECTRIC

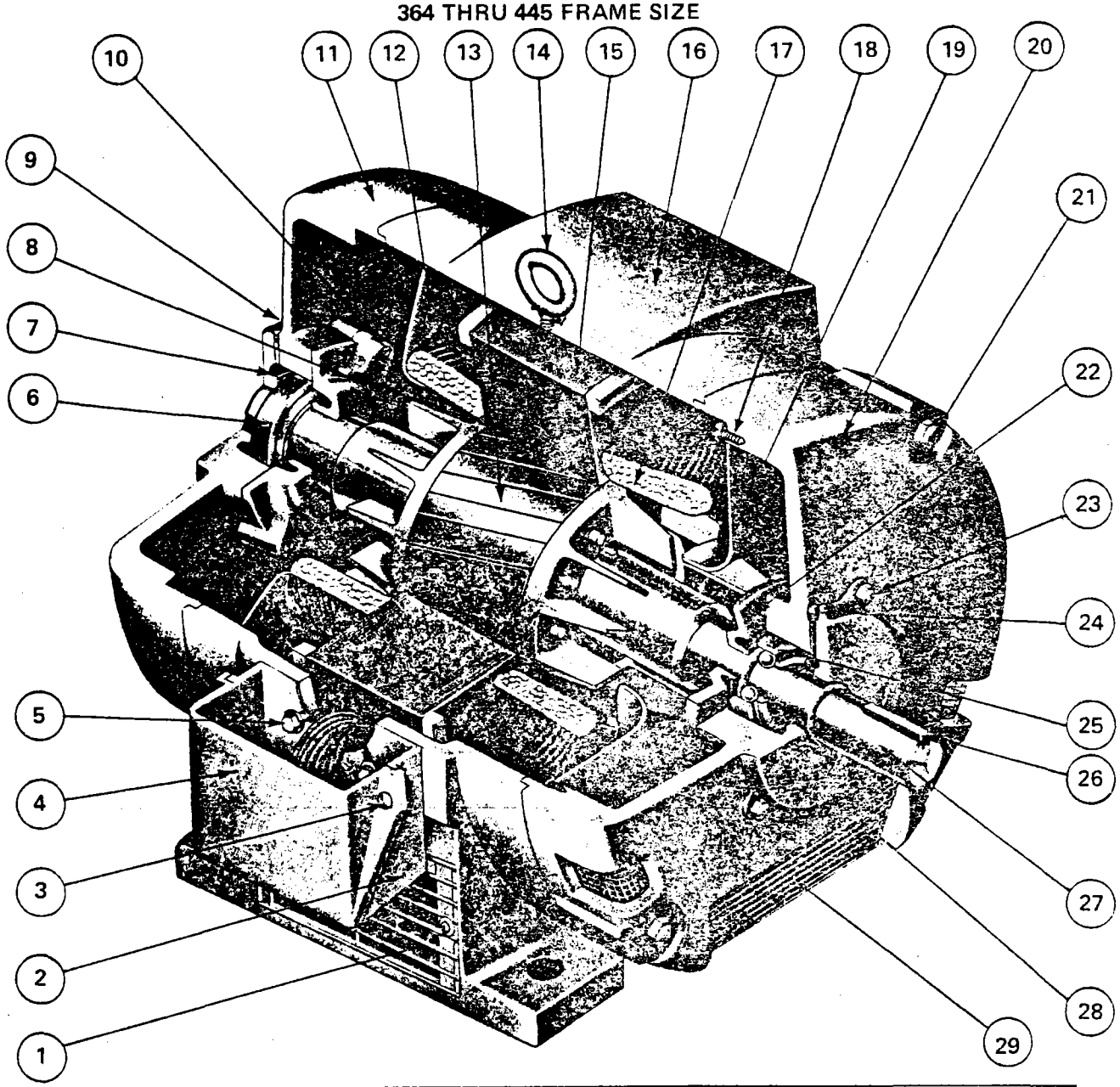
STANDARD INDUCTION MOTORS



INSTALLATION, OPERATION, AND MAINTENANCE INSTRUCTIONS

STEARNS-ROGER ENGINEERING CORP.
PROJECT NO. 621700
SOLAR-ONE PILOT PLANT
UNIT ONE
1.2.8-29 P.O. 2001

TYPICAL CUTAWAY VIEW OF A MARATHON DESIGNED, DRIPPROOF, HORIZONTAL INTEGRAL HORSEPOWER MOTOR & PARTS DESCRIPTION 364 THRU 445 FRAME SIZE



ITEM	DESCRIPTION	ITEM	DESCRIPTION	ITEM	DESCRIPTION
1.	** Frame Vent Screen	11.	Bracket O.P.E.	21.	Bracket Holding Bolt
2.	Conduit Box Bottom	12.	Baffle Plate O.P.E.	22.	Inner Bearing Cap P.E.
3.	Conduit Box Top-Holding Screw	13.	Rotor Core	23.	Inner Bearing Cap Bolt
4.	Conduit Box Top	14.	Lifting Eve Bolt	24.	Grease Plug
5.	Conduit Box Bottom-Holding Bolt	15.	Stator Core	25.	*Ball Bearing P.E.
6.	*Ball Bearing O.P.E.	16.	Frame	26.	Shaft Extention Key
7.	Pre-loading Spring	17.	Stator Winding	27.	Shaft
8.	Inner Bearing Cap O.P.E.	18.	Baffel Plate Holding Screw	28.	Drain Plug (grease)
9.	Grease Plug	19.	Baffle Plate P.E.	29.	** Bracket Screen
10.	Inner Bearing Cap Bolt	20.	Bracket P.E.		

P.E. = Pulley End

O.P.E. = Opposite Pulley End

* = Bearing Numbers are shown on motor nameplate when requesting information or parts always give complete motor description, model and serial numbers.

** = Bracket and frame screens are optional.

WARNING

These instructions must be followed to ensure safe and proper installation, operation and maintenance of the motor. They should be brought to the attention of all persons who install, operate or maintain this equipment.

GENERAL INFORMATION

Marathon Electric motors are all fully factory tested and inspected before shipment. Frequently the most likely cause of troubles may occur in either (1) shipment, (2) improperly matched power supply, or (3) failure to follow the installation precautions. These instructions are intended as a guide to eliminate these causes before they are overlooked.

ACCEPTANCE

Check carefully for any damage that may have occurred in transit. If any damage or shortage is discovered, do not accept until an appropriate notation on the freight bill is made. Any damage discovered after receipt of equipment should be immediately reported to the carrier.

WARNING

Failure to follow instructions and safe electrical procedures could result in serious injury or fatality. Disconnect all power before servicing. Install and ground per local and national codes. Consult qualified personnel with any questions or services required.

INSTALLATION

UNCRATING

After uncrating, check further that no apparent damage has been incurred in handling. See that the motor shaft and armature turn freely.

EXPOSURE

Check to determine that the motor has not been exposed to dirt, grit, or excessive moisture in either shipment (without protection) or storage before installation. Motors in storage should have shafts turned over once each month to redistribute grease in bearings.

Never start a motor which has been wet without having it thoroughly dried.

The measure of insulation resistance (see operation) is a good dampness test. Clean the motor of any dirt or grit.

SAFETY

Eyebolts or lifting lugs are intended only for lifting the motor and factory motor-mounted standard accessories. These lifting provisions should never be used when lifting or handling the motor and other equipment (i.e.) pumps, gear boxes, fans (or other d iven equipment) as a single unit.

Eyebolt lifting capacity rating is based on a lifting alignment coincident with the eyebolt centerline. Eyebolt capacity reduces as deviation from this alignment increases.

Motors should be installed, protected and fused in accordance with latest issue of National Electrical Code, NEMA Standard Publication No. MG 2 and local requirements.

Frames and accessories of motors should be grounded in accordance with National Electrical Code (NEC) Article 430. For general information on grounding refer to NEC Article 250.

Rotating parts such as pulleys, couplings, external fans, unusual shaft extensions should be permanently guarded against accidental contact with clothing or body extremities.

WARNING

Disconnect power before working on motor driven equipment. Motors with automatic thermal protectors will automatically restart when the protector cools. Do not use motors with automatic thermal protectors in applications where automatic restart will be hazardous to personnel or equipment.

WARNING

Motors with manual thermal protectors may start unexpectedly after protector trips. If manual protector trips, disconnect motor from power line. After protector cools (five minutes or more) it can be reset and power may be applied to motor.

THERMAL PROTECTOR INFORMATION

A space on nameplate will be stamped or not be stamped to indicate:

1. Motor is thermally protected
2. Motor is not thermally protected
3. Motor is with overheat protective device

For examples, refer to paragraphs below:

1. Motors equipped with built-in thermal protection have "THERMALLY PROTECTED" stamped on the nameplate. Thermal protectors open the motor circuit electrically when the motor overheats or is overloaded. The protector cannot be reset until the motor cools. If the protector is automatic, it will reset itself. If the protector is manual, press the red button to reset.
2. Motors without thermal protection have nothing stamped on nameplate about thermal protection.
3. Motors that are provided with overheat protective device that does not open the motor circuit directly, nameplate will be stamped "WITH OVERHEAT PROTECTIVE DEVICE".
   A. Motors with this type of "Overheat Protective Device" have protector leads brought out in the motor conduit box marked "P1" and "P2". These leads are intended for connection in series with the stop button of a 3-wire pilot circuit of a magnetic controller connected to a motor, as in Figure 1.
   B. The load controlled by the above "Overheat Protective Device" cannot exceed the values shown in the chart below.

AC VOLTS	VOLT–AMP RATINGS	AC VOLTS	VOLT–AMP RATINGS
120	360	208	360
240	360	480	360
600	360		

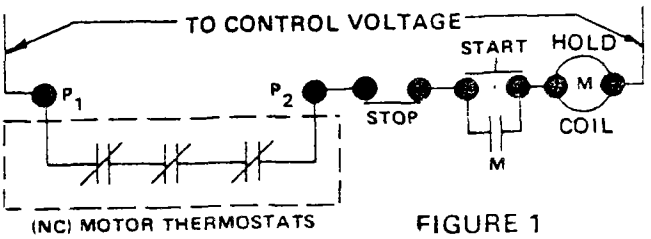
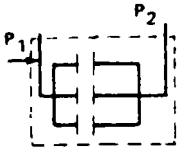


FIGURE 1



N/O MOTOR THERMOSTATS

Normally Open (N/O) Motor Thermostats are used in conjunction with controls installed by Original Equipment Manufacturers.

FIGURE 1A

LOCATION

In selecting a location for the unit, first consideration should be given to ventilation. It should be far enough from walls or other objects to permit a free passage of air.

The motor should never be placed in a room with a hazardous process, or where flammable gasses or combustible material may be present unless it is specifically designed for this type of service.

1. Dripproof motors are intended for use where atmosphere is relatively clean, dry and non-corrosive.
   a. When atmosphere is worse than above request approval of motor for use intended.
2. Totally enclosed motors may be installed where dirt, moisture and corrosion are present, or in outdoor locations.
3. Explosion proof motors are built for use in hazardous locations as indicated by Underwriters' label on motor. Consult your local governmental inspection agency for guidance.

The ambient temperature of the air surrounding the motor should not exceed 40° C or 104° F unless the motor has been especially designed for high ambient temperature applications. The free flow of air around the motor should not be obstructed.

FLOOR MOUNTING

Motors should be provided with a firm, rigid foundation, with the plane of four mounting stud pads flat within .010" for 56 to 210 frame; .015" from 250 through 680 frame. This may be accomplished by shims under the motor feet. For special isolation mounting, contact a Marathon Electric sales representative.

Before connecting motor to the load by belt drive or direct coupling, verify manually that the rotor turns freely and does not rub.

V-BELT DRIVE

1. Align sheaves carefully to avoid axial thrust on motor bearing. The drive sheave on the motor should be centered on the shaft extension.
2. When adjusting belt tension by pulling on the feet make sure the motor is secured by all mounting bolts before tightening belts.
3. Adjust belt tension to belt manufacturers recommendations.
4. Sheaves should be in accordance to NEMA Spec. MG-1 or as approved by the manufacturer for a specific application.

DIRECT CONNECTED DRIVE

Flexible or solid shaft couplings must be properly aligned for satisfactory operation. On flexible couplings, the clearance between the ends of the shafts should be in accordance with the coupling manufacturer's recommendations or NEMA standards for end play and limited travel in coupling.

ANGULAR MISALIGNMENT and RUN-OUT between direct connected shafts will cause increased bearing loads and vibration even when the connection is made by means of a flexible coupling.

To check for ANGULAR MISALIGNMENT, clamp the dial indicator to one coupling hub and place the finger or button of the indicator against the finished face of the other hub as shown in diagram 1. Set the dial at zero.

Rotate one shaft, keeping the indicator button at the reference mark on the coupling hub, and note the reading on the indicator dial at each revolution.

ANGULAR MISALIGNMENT OF THE SHAFTS MUST NOT EXCEED A TOTAL INDICATOR READING OF .002 INCH FOR EACH INCH OF DIAMETER OF THE COUPLING HUB.

After the shafts have been checked for angular misalignment and are parallel within the limits specified in the preceding paragraph, check the shaft for RUN-OUT to assure concentricity of the shafts. Clamp the indicator button on the machined diameter of the other hub as shown in diagram II. Set the dial at zero.

Rotate one shaft, keeping the indicator button at the reference mark on the hub and note the reading on the indicator dial at each revolution.

TOTAL RUN-OUT BETWEEN THE HUBS SHOULD NOT EXCEED .002 INCH.

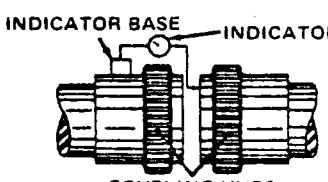


DIAGRAM 1

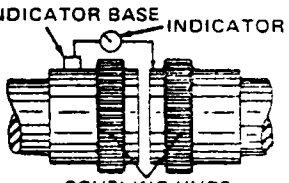


DIAGRAM 2

Rotating parts such as couplings, external fans, unusual shaft extensions should be permanently guarded against accidental contact with clothing or body extremities.

ELECTRICAL CONNECTIONS

1. All wiring, fusing, and grounding must comply with National Electrical Codes and local requirements.
2. To determine proper wiring, rotation and voltage connections, refer to the information and diagram on the nameplate, separate connection plate or decal. If the plate or decal has been removed, make inquires of the manufacturer.
3. Use the proper size of line current protection and motor controls as required by the National Electrical Code and local codes. Recommended use is 125% of full load amps as shown on the nameplate for motors with 40° C ambient and a service factor over 1.0. Recommended use is 115% of full load amps as shown on the nameplate for all other motors. Do not use protection with larger capacities than recommended. All three phase motors must have all three phases protected.

CHANGING ROTATION

1. The key must be removed from the motor shaft before starting. Keep hands and clothing away from rotating parts.
2. Before the motor is used as a power source for equipment, determine the proper rotation of the driven unit.
3. Before applying a load to the motor, determine that the motor and driven unit are in the same rotation sequence.
4. Checking rotation can be done by jogging or bumping by applying power to the motor leads for a short period of time, enough to just get motor shaft to rotate a slight amount to observe shaft rotating direction.
5. Three phase - interchange any two (2) of the line leads with the motor lead connections shown on the nameplate, separate connection plate or decal.

PART WINDING STARTING

On those motors used for part winding starting, the elapsed time on the first step should be kept as short as possible and should not exceed 5 seconds. It is recommended that this time be limited to 2 seconds.

OPERATION

BEFORE INITIAL STARTING

1. If a motor has become damp in shipment or in storage, it is advisable to measure insulation resistance of the stator winding.

$$\text{Minimum Insulation Valve in Megohms} = \frac{\text{Rated Voltage}}{1000} + 1$$

2. If insulation resistance is low, dry out the moisture in one of the following ways:
   a. Bake in oven at temperature not more than 90° C (194° F) until insulation resistance is practically constant.
   b. Enclose motor with canvas or similar covering, leaving a hole at the top for moisture to escape, and insert heating units or lamps.
   c. Pass a current at low voltage (rotor locked) through the stator winding. Increase the current gradually until the winding temperature, measured with a thermometer, reaches 90° C (194° F). Do not exceed this temperature.
3. See that voltage and frequency stamped on motor and control nameplates correspond with that of the power line.
4. Check all connections to the motor and control with the wiring diagram.
5. Be sure rotor turns freely and does not rub when disconnected from the load. Any foreign matter in the air gap should be removed.
6. Leave the motor disconnected from the load for the initial start; it is desirable to operate the motor without load for about one hour to test for any localized heating in bearings and windings. Check for proper rotation.

COLLECTOR RINGS (Wound Rotor Motors Only)

The collector rings are sometimes slushed at the factory to protect them while in stock and during shipment. The brushes have been fastened in a raised position. Before putting the motor into service, the slushing should be removed with carbon tetrachloride or some other cleaning fluid that will not attack insulation; the rings polished with fine sandpaper; and the brushes should be set down on the collector surface. Keep the rings clean and maintain their polished surfaces. Ordinarily, the rings will require only occasional wiping with a piece of canvas or non-linting cloth. Do not let dust or dirt accumulate between the collector rings.

BRUSHES (Wound Rotor Motors Only)

See that the brushes move freely in the holders and at the same time make firm, even contact with the collector rings. The pressure should be between 2 and 3 pounds per square inch of brush surface.

When installing new brushes, fit them carefully to the collector rings. Be sure that the copper pigtail conductors are securely fastened to, and make good contact with, the brushholders.

ALLOWABLE VOLTAGE AND FREQUENCY RANGE

If voltage and frequency are within the following range, motors will operate, but with somewhat different characteristics than obtained with correct nameplate values.

1. Voltage: Within 10% above or below the value stamped on the nameplate.
2. Frequency: Within 5% above or below the value stamped on the nameplate.
3. Voltage and Frequency together: Within 10% (providing frequency above is less than 5%) above or below values stamped on the nameplate.

CLEANLINESS

Keep both the interior and exterior of the motor free from dirt, water, oil and grease. Motors operating in dirty places should be periodically disassembled and thoroughly cleaned.

CONDENSATION DRAIN PLUGS

If motor is totally enclosed fan cooled or non ventilated and is equipped with automatic drain plugs, they should be free of oil, grease, paint, grit and dirt so they don't clog up.

LUBRICATION

This motor has been properly lubricated at the time of manufacture and is not necessary to lubricate at time of installation. If the motor has been in storage for a period of six months or greater, relubricate before starting.

To lubricate:

1. Stop motor
2. Wipe clean all grease fittings. (Filler and drain.)
3. Remove filler and drain plugs. A and B (See figure 2.)
4. Free drain hole of any hard grease (use piece of wire if necessary).
5. Add Grease* using a low pressure grease gun.
6. Start motor and let run for approximately 30 minutes.
7. Stop motor, wipe off any drained grease, and replace filler and drain plugs.
8. Motor is ready for operation.

* The amount of grease added is very important. Only enough grease should be added to replace the grease used by the bearing. Too much grease can be as harmful as insufficient grease. Every four years (every year in the case of severe duty) motors with open bearings should be thoroughly cleaned, washed and repacked with grease. The quantity of grease is important. The grease cavity should be filled 1/3 to 1/2 full. Too much grease is as detrimental as insufficient grease. (See figures 3, 4, 5.)

NOTE

If lubrication instructions are shown on motor, they will supersede this general instruction.

FIGURE 2

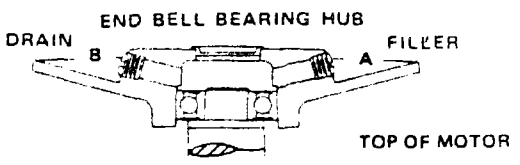


FIGURE 3

RECOMMENDED GREASES

INSULATION CLASS SHOWN ON NAMEPLATE	GREASE DESIGNATION	GREASE SUPPLIER
B	Alvania #2	Shell Oil Company or equivalent
F	Chevron SRI-2	Standard Oil of California or equivalent

FIGURE 4

RELUBRICATION PERIOD

Frame Size @ 900, 1200 & Var. Speed	Relub. Period @ Std. Conditions (8 hr./day, normal to light loading 100° F max. amb.)	Severe Conditions	Extreme Conditions
140–180	4.5 Years	18 Months	9 Months
210–280	4 Years	16 Months	8 Months
320–400	3.5 Years	14 Months	7 Months
440–508	3.0 Years	12 Months	6 Months
510	2.5 Years	11½ Months	6 Months
Frame Size @ 1800 RPM	**Std. Conditions**	**Severe Conditions**	**Extreme Conditions**
140–180	3 Years	1 Year	6 Months
210–280	2.5 Years	10½ Months	5½ Months
320–400	2.0 Years	9 Months	4½ Months
440–508	1.5 Years	8 Months	4 Months
510	1 Years	6 Months	3½ Months
All Motors over 1800 RPM	6 Months	3 Months	3 Months

For roller bearings: Divide above times by 3.

STANDARD CONDITIONS: Eight hours per day, normal or light loading, clean 100° F maximum ambient.

SEVERE CONDITIONS: Twenty-four hours per day operation, or shock loadings, vibration, or in dirt or dust at 100° to 150° F ambient.

EXTREME CONDITIONS: Heavy shock or vibration, dirt or dust at 100° to 150° F ambient.

WARNING

Disconnect power before working on motor driven equipment. Motors with automatic thermal protectors will automatically restart when the protector temperature drops sufficiently. Do not use motors with automatic thermal protectors in applications where automatic restart will be hazardous to personnel or equipment.

TROUBLES

If trouble is experienced in the operation of the motor, make sure that:

1. The bearings are in good condition and operating properly.
2. There is no mechanical obstruction to prevent rotation in the motor or in the driven load.
3. The air gap is uniform.
4. All bolts and nuts are tightened securely.
5. Proper connection to drive machine or load has been made.

In checking for electrical troubles, be sure that:

1. The line voltage and frequency correspond to the voltage and frequency stamped on the nameplate of the motor.
2. The voltage is actually available at motor terminals.
3. The fuses and other protective devices are in proper condition.
4. All connections and contacts are properly made in the circuits between the control apparatus and motor.

Never attempt to measure the temperature rise of a motor by hand. Temperature rise must be measured by thermometer, resistance, or by imbedded detector or thermocouple.

CAUTION

1. **Do not perform any maintenance or service on this motor before disconnecting the power source.**
2. **Discharge all capacitors before servicing motor.**
3. **Always keep hands and clothing away from moving parts.**
4. **Electrical repairs should be performed by trained and qualified personnel only.**
5. **Failure to follow instructions and safe electrical procedures could result in serious injury.**
6. **If safety guards are required, be sure the guards are in use.**

FIGURE 5

AMOUNT OF GREASE REQUIRED WHEN REGREASING

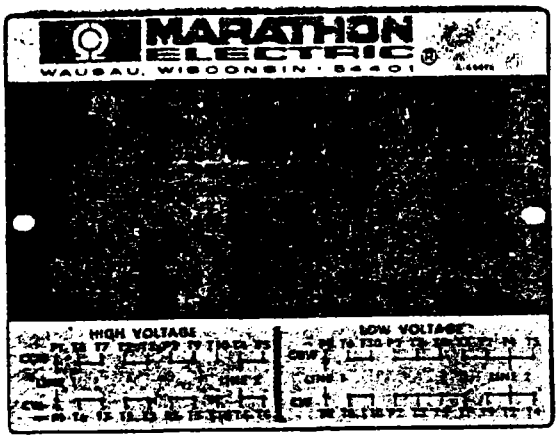
BEARING NUMBER	AMOUNT ($IN.^3$)	APPROX. EQUIV. TEASPOONS	BEARING NUMBER	AMOUNT ($IN.^3$)	APPROX. EQUIV. TEASPOONS
203	.15	.5 Tsp.	222	3.0	10.0 Tsp.
205	.27	.9 Tsp.	307	.53	1.8 Tsp.
206	.34	1.1 Tsp.	308	.66	2.2 Tsp.
207	.43	1.4 Tsp.	309	.81	2.7 Tsp.
208	.52	1.7 Tsp.	310	.97	3.2 Tsp.
209	.61	2.0 Tsp.	311	1.14	3.8 Tsp.
210	.72	2.4 Tsp.	312	1.33	4.4 Tsp.
212	.95	3.1 Tsp.	313	1.54	5.1 Tsp.
213	1.07	3.6 Tsp.	314	1.76	5.9 Tsp.
216	1.49	4.9 Tsp.	316	2.24	7.4 Tsp.
219	2.8	7.2 Tsp.	318	2.78	9.2 Tsp.

These instructions do not cover all details or variations in equipment nor provide for every possible condition to be met in connection with installation, operation or maintenance. Should additional information be desired for the purchaser's purposes, the matter should be referred to the nearest Marathon Electric Manufacturing Corp. sales office listed on the back page.

MOTOR TROUBLE SHOOTING CHART

Your motor service and any trouble shooting must be handled by qualified persons who have proper tools and equipment.

TROUBLE	CAUSE	WHAT TO DO
Motor fails to start	Blown fuses	Replace fuses with proper type and rating.
	Overload trips	Check and reset overload in starter.
	Improper power supply	Check to see that power supplied agrees with motor nameplate and load factor.
	Improper line connections	Check connections with diagram supplied with motor.
	Open circuit in winding or control switch	Indicated by humming sound when switch is closed. Check for loose wiring connections. Also see that all control contacts are closing.
	Mechanical failure	Check to see if motor and drive turn freely. Check bearings and lubrication
	Short circuited stator	Indicated by blown fuses. Motor must be rewound.
	Poor stator coil connection	Remove end bells, locate with test lamp.
	Rotor defective	Look for broken bars or end rings.
	Motor may be overloaded	Reduce load.
Motor stalls	One phase may be open	Check lines for open phase.
	Wrong application	Change type or size. Consult manufacturer.
	Overload motor	Reduce load.
	Low motor voltage	See that nameplate voltage is maintained. Check connection.
	Open Circuit	Fuses blown, check overload relay, stator and pushbuttons.
Motor runs and then dies down	Power failure	Check for loose connections to line, to fuses and to control.
Motor does not come up to speed	Not applied properly	Consult supplier for proper type.
	Voltage too low at motor terminals because of line drop.	Use higher voltage on transformer terminals or reduce load. Check connections. Check conductors for proper size.
	Starting load too high	Check that load motor is supposed to carry at start.
	Broken rotor bars or loose rotor	Look for cracks near the rings. A new rotor may be required as repairs are usually temporary.
	Open primary circuit	Locate fault with testing device and repair.
Motor takes too long to accelerate	Excess loading	Reduce load.
	Poor circuit	Check for high resistance
	Defective squirrel cage rotor	Replace with new rotor.
	Applied voltage too low	Get power company to increase power tap.
Wrong rotation	Wrong sequence of phases	Reverse connections at motor or at switchboard.
Motor overheats while running under load	Overloaded	Reduce load.
	Frame or bracket vents may be clogged with dirt and prevent proper ventilation of motor.	Open vent holes and check for a continuous stream of air from the motor.
	Motor may have one phase open	Check to make sure that all leads are well connected.
	Grounded coil	Locate and repair
	Unbalanced terminal voltage	Check for faulty leads, connections and transformers.
Motor vibrates after corrections have been made.	Motor misaligned	Realign.
	Weak support	Strengthen base
	Coupling out of balance	Balance coupling.
	Driven equipment unbalanced	Rebalance driven equipment.
	Defective ball bearing	Replace bearing.
	Bearings not in line	Line up properly.
	Balancing weights shifted	Rebalance motor.
	Polyphase motor running single phase	Check for open circuit.
	Excessive end play	Adjust bearing or add washer.
Unbalanced line current on polyphase motors during normal operation.	Unequal terminal volts	Check leads and connections.
	Single phase operation	Check for open contacts.
Scraping noise	Fan rubbing air shield	Remove interference.
	Fan striking insulation	Clear fan.
	Loose on bedplate	Tighten holding bolts.
Noisy operation	Airgap not uniform	Check and correct bracket fits or bearing.
	Rotor unbalance	Rebalance.
Hot bearings general	Bent or sprung shaft	Straighten or replace shaft.
	Excessive belt pull	Decrease belt tension.
	Pulleys too far away	Move pulley closer to motor bearing.
	Pulley diameter too small	Use larger pulleys.
	Misalignment	Correct by realignment of drive.
Hot bearings ball	Insufficient grease	Maintain proper quantity of grease in bearing.
	Deterioration of grease or lubricant contaminated	Remove old grease, wash bearings thoroughly in kerosene and replace with new grease.
	Excess lubricant	Reduce quantity of grease, bearing should not be more than ½ filled.
	Overloaded bearing	Check alignment, side and end thrust.
	Broken ball or rough races	Replace bearing, first clean housing thoroughly.



FOR RENEWAL PARTS

When ordering parts for repair or spares, give description and state quantity of parts desired, together with the complete nameplate data: rating, model and serial number of the motor and all data.

Sales and Service Assistance

California

ANAHEIM
625 South Euclid Suite 15
Anaheim, CA 92802
Phone: (714) 956-7111

SAN LEANDRO
14441 Griffith Street
San Leandro, CA 94577
Phone: (415) 357-7620

Connecticut

HARTFORD
49 North Gate
Simsbury, CT 06070
Phone: (203) 658-9835

Illinois

CHICAGO
680 Greenleaf Avenue
Elk Grove Village, IL 60007
Phone: (312) 593-6500

Indiana

INDIANAPOLIS
4518 North Hillside
Indianapolis, IN 46205
Phone: (317) 253-6465
253-5354

Louisiana

NEW ORLEANS
336 N. Jefferson
Davis Parkway
New Orleans, LA 70119
Phone: (504) 482-2089

Minnesota

MINNEAPOLIS
8700 West 36th Street
Minneapolis, MN 55426
Phone: (612) 935-8424

Missouri

ST. LOUIS
1887 Cedar Mill Drive
Chesterfield, MO 63017
Phone: (312) 593-6500

New York

SYRACUSE
Room 173 Pickard Building
5858 East Molloy Road
Syracuse, NY 13211
Phone: (315) 454-0994
454-3130

Ohio

CINCINNATI
9319 Cincinnati-Columbus Rd.
West Chester, OH 45069
Phone (513) 777-7990

CLEVELAND
20800 Center Ridge Rd-Suite 400
Cleveland, OH 44116
Phone: (216) 331-2910
331-1081

Pennsylvania

ALLENTOWN
P.O. Box 2206
Allentown, PA 18001
Phone: (215) 837-1866

South Carolina

GREENVILLE
100 Executive Center Drive
Greenville, SC 29615
Phone: (803) 288-8991
288-8990

Tennesse

NASHVILLE
1040 Murfreesboro Road
Suite 207
Nashville, TN 37217
Phone: (615) 242-3321
242-3322
255-8281

Texas

DALLAS
1366 Exchange Drive
Richardson, TX 75080
Phone: (214) 699-0251

HOUSTON
4502 Mossygate Rd.
Spring, TX 77373
Phone: (713) 350-3277

Washington

SPOKANE
Electro-Power Corp.
North 104 Madelia
P.O. Box 2983
Spokane, WA 99220
Phone: (509) 535-2931

MARATHON ELECTRIC

100 E. Randolph Street
Wausau, WI 54401
Phone: (715) 675-3311

AURORA PUMP
A UNIT OF GENERAL SIGNAL
ENGINEERING DEPT.
NORTH AURORA, ILLINOIS· 60542

JOCKEY PUMP CONTROLLER

JOCKEY PUMP F.O. # 4AO-7434

JOCKEY PUMP CONTROLLER

JOCKEY PUMP FOR 5 H.P. 3600 R.P.M.

3 PHASE 60 CYCLE 460 VOLTS

0-200 # RANGE PRESSURE SWITCH

X WITH RUNNING PERIODTIMER

____ WITHOUT RUNNING PERIOD TIMER

ALARM PANEL

____ TYPE A

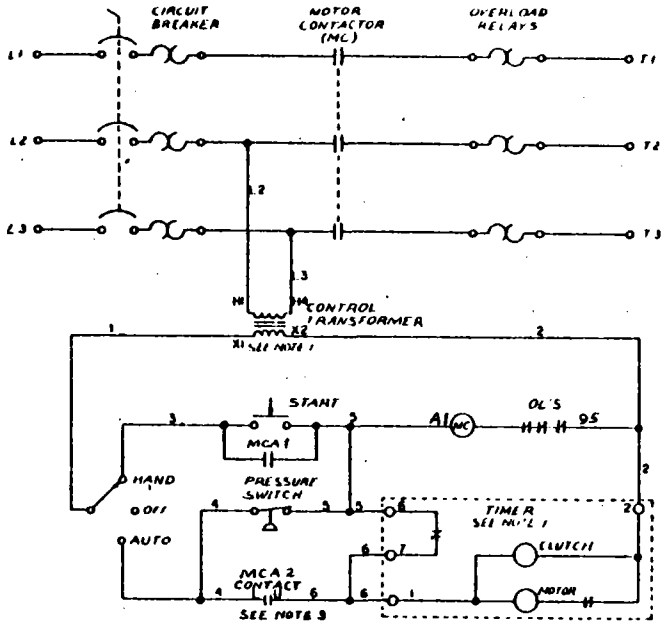
____ TYPE B

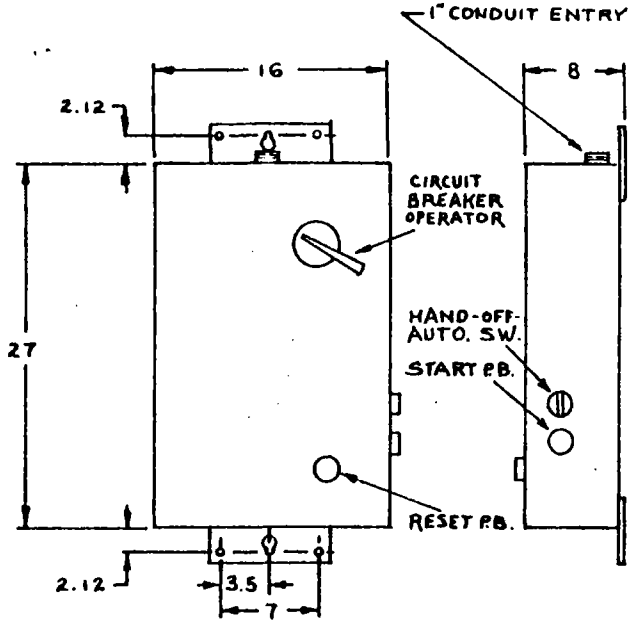
BY: WJW

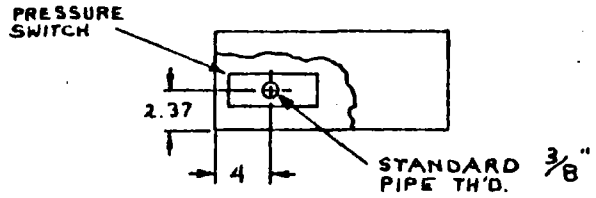
DATE: 12-10-80

STEARNS-ROGER ENGINEERING CORP.
PROJECT NO. C21700
SOLAR-ONE PILOT PLANT
UNIT ONE
P.O. NO. 2001

SP-10696B







STEARNS-ROGER ENGINEERING CORP.
PROJECT NO. 621700
SOLAR-ONE PILOT PLANT
UNIT ONE
P.O. 2001

NOTES:
1. SERIES M10A SUPPLIED WITH TIMER & TRANSFORMER
   SERIES M10B SUPPLIED WITHOUT TIMER (TRANS. OPTIONAL)
2. OUTLINE DIMENSIONS REFERENCED TO H.P. IN TABLE AT RIGHT
3. MCA1 AND MCA 2 ARE MOTOR CONTACTOR AUXILIARY CONTACTS. MCA 2 SUPPLIED WITH SERIES M10A ONLY.

CERTIFIED CORRECT DRAWING James S. Hathaway

DRAWN JSH 5 23 78	Metron	METRON INSTRUMENTS, INC.
CHECK		
APPD Rmd 5 25 78		
JOCKEY PUMP CONTROLLER, WITH CIRCUIT BREAKER, SERIES M10A	CODE IDENT NO 60031	
	SIZE C	30525A-SA
	SCALE	

1.2.8-38

JOCKEY PUMP CONTROLLER MODEL M10A-5-460

PARTS LIST

PART	REC. SPARES	PART NO.	MFGR.
Circuit Breaker		MCP03150CR	Westinghouse
Motor Contactor		A203C12T38	I-T-E
Contactor Heater	3	G30T38	I-T-E
Contactor Coil	1	G10C126	I-T-E
Run Period Timer	1	BR18A603	Eagle Signal Co.
Pressure Switch	1	DA31-2	Mercoid
Control Transformer	1	C150BTZ13	Micron

STEARNS-ROGER ENGINEERING CORP.
PROJECT NO. 621700
SOLAR-ONE PILOT PLANT
UNIT ONE
P.O. 2001

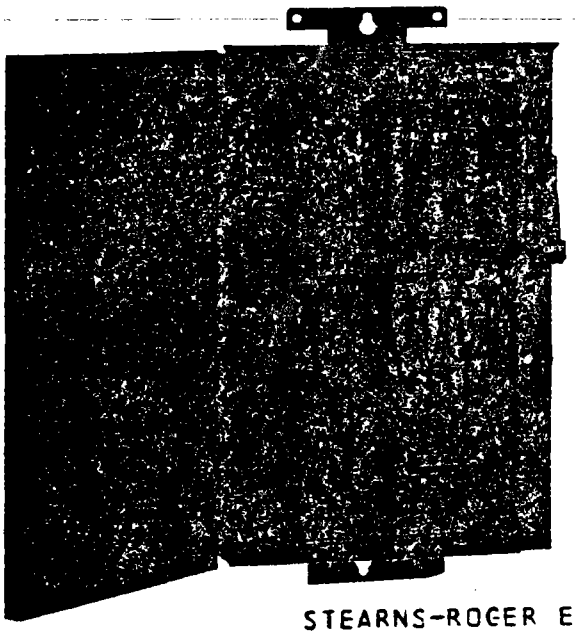
DATA SHEET M10

JOCKEY PUMP CONTROL

Jockey (or make-up) pump controllers are installed in the same water system as the main Fire Pump Controllers. Their purpose is to maintain normal water pressure which may fluctuate because of small leaks in the system. The use of this small pump for pressure maintenance eliminates unnecessary frequent starting of the main pump, which in turn reduces pump wear and overpressure conditions in the water system.

The series M10 Jockey Pump Controller includes the standard bourdon tube pressure switch with independent high and low set points for automatic starting. A fusible disconnect switch is provided with externally operable handle (circuit breaker can be supplied if required). A three position Hand - Off - Auto switch and manual start pushbutton are also included. A minimum run period timer and control transformer are standard features on series M10A. Series M10B does not have the minimum run period timer. It may be ordered with or without the control transformer. See ordering information on reverse.

All external control devices are conveniently mounted on the front of the cabinet.



FEATURES

Controller is listed by Underwriters Laboratories.

Nema 3R Weatherproof cabinet.

Mercoid bourdon tube type pressure switch with independent high and low set points.

All components are U.L. Listed and of heavy duty industrial grade.

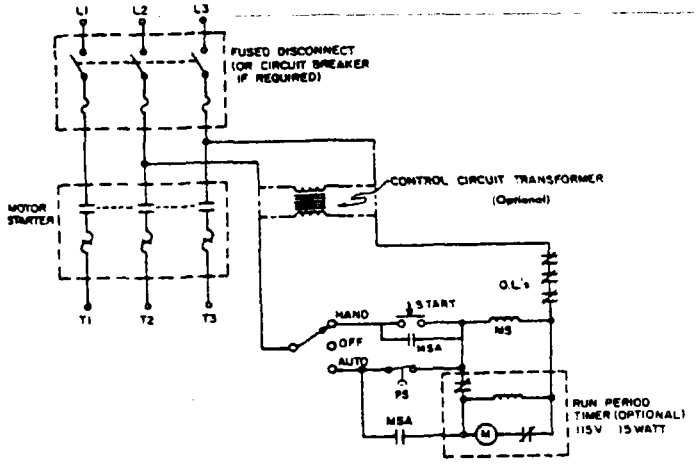
Sizes from ½ to 30 H.P., 208 to 600 volt, 3 phase, 3 wire, across the line.

STEARNS-ROGER ENGINEERING CORP.
PROJECT NO. 621700
SOLAR-ONE PILOT PLANT
UNIT ONE
P.O. 2001

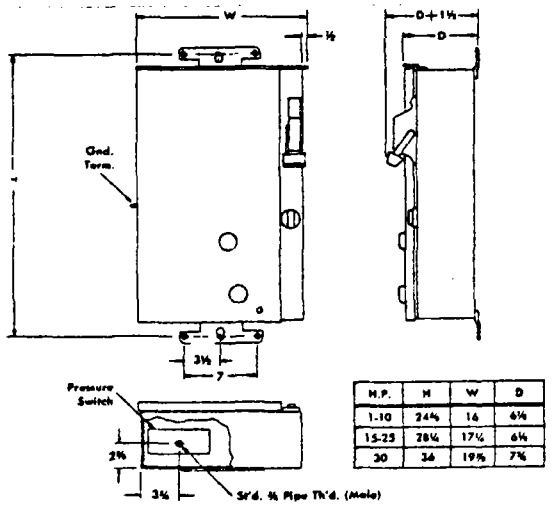
ORDERING INFORMATION

SERIES M10 JOCKEY PUMP CONTROLLERS ALL SERIES M10 CONTROLLERS HAVE MERCOID-BOURDON TUBE PRESSURE SWITCH					
MODELS M10A WITH TRANSFORMER AND RUN PERIOD TIMER			MODELS M10B WITHOUT TRANSFORMER OR RUN PERIOD TIMER		
H.P.	VOLTAGE	PRICE	H.P.	VOLTAGE	PRICE
½ thru 7½	208/575	$370.00	½ thru 7½	208/575	$310.00
10	208/230	450.00	10	208/230	390.00
10	440/575	370.00	10	440/575	315.00
15	208/575	450.00	15	208/575	390.00
20 and 25	208/230 440/575	650.00 450.00	20 and 25	208/230 440/575	590.00 390.00
			NOTE: For Model M10B Without Timer, But With Transformer, Add $32.00		

SCHEMATIC WIRING



OUTLINE DIMENSIONS



H.P.	H	W	D
1-10	24¾	16	6¼
15-25	28¼	17½	6¼
30	36	19⅝	7⅝

STEARNS-ROGER ENGINEERING CORP.
PROJECT NO. 621700
SOLAR-ONE PILOT PLANT
UNIT ONE
P.O. 2001

CUSTOM BUILT CONTROLS DIVISION OF
METRON INSTRUMENTS, INC.
1051 SOUTH PLATTE RIVER DRIVE DENVER, COLORADO 80223
1.2.8-41 PHONE 303 744-1791 TELEX 4-5729

ELECTRIC JOCKEY PUMP CONTROLLER

SERIES M10

GENERAL DESCRIPTION

Jockey (or make-up) pump controllers are installed in the same system as the main Fire Pump Controllers. Their main purpose is to maintain normal water pressure which may fluctuate slightly because of small leaks in the system. The use of this small pump in the system eliminates frequent starting of the main pump. The Jockey Pump Controller automatically starts the Jockey Pump motor when the water pressure drops below a set level.

Model 10A includes a line voltage to 115 volt control transformer and a run period timer to provide preset minimum run time. Model 10B does not include the run period timer and will stop as soon as pressure is restored.

Refer to drawing B20857 for schematic and outline drawings.

MODEL DESIGNATION

The Jockey Pump Controllers are designated as:

$$\text{M10}\underset{\text{I}}{\underline{\text{A}}} - \underset{\text{II}}{\underline{5}} - \underset{\text{III}}{\underline{460}}$$

I. A - With transformer and timer
   B - Without timer, transformer optional

II. Designates horsepower

0.5	- 1/2 hp
0.75	- 3/4 hp
1	- 1 hp
1.5	- 1-1/2 hp
2	- 2hp
3	- 3 hp
5	- 5 hp
7.5	- 7-1/2 hp
10	- 10 hp
15	- 15 hp
20	- 20 hp
25	- 25 hp
30	- 30 hp

STEARNS-ROGER ENGINEERING CORP.
PROJECT NO. 621700
SOLAR-ONE PILOT PLANT
UNIT ONE
P.O. 2001

III. Designates 3 phase voltage rating

208 - 208
240 - 240
480 - 480
600 - 600

PART II

INSTALLATION

The Jockey Pump Controller has been assembled and wired at the factory with the highest workmanship standards. All wiring and functions have been thoroughly tested to assure correct operation when properly installed. Before operating the controller, perform the Initial Installation Start-Up Procedure, Part III.

The enclosure should be well grounded according to local standards. Connection from the contactor to the motor may be done after the test procedure is completed.

After installation has been completed, perform the Initial Installation Start-Up Procedure, Part III, before operating the controller.

PART III

INITIAL INSTALLATION START-UP PROCEDURE

A. General:

All but the final functional test can be made with the motor disconnected. This will eliminate the need for starting and stopping the motor several times during the test procedure.

If the output connections from the contactor to the motor were made on initial installation, disconnect them for the first part of the Initial Installation Start-Up Procedure.

The controls and their functions are as follows:

a) Motor Disconnect Switch

The Motor Disconnect Switch is located ahead of the motor contactor and is provided with fuses according to the motor full load current. Its function is to provide short circuit protection and a disconnect means.

b) Hand-Off-Auto Selector

This switch is used to select between Automatic and Manual operation. When switched to Hand, the motor starts when the start switch is pressed. When switched to Off, the motor stops. In the Auto position, the contactor closes and starts the pump motor when the pressure drops below a preset level.

c) Start Switch

This switch is used to start the motor when in the Hand mode.

B. Initial Start-Up

1. Close disconnect switch and measure voltage at input of motor contactor. Voltage should be the same as the incoming line voltage.

2. Switch to Hand and press the start switch. Motor contactor should close. Measure voltage at output of contactor. It should be the same as the incoming line voltage.

3. Switch to Off. Motor contactor should open.

4. Switch to Auto and drop water pressure at water inlet to controller so pressure switch will close. Motor contactor should close. Allow water pressure to return to normal. If used, set run period timer for 1 minute for each 10 h.p. rating of motor, but not to exceed 7 minutes. Motor contactor should

open after this time period. If run period timer is not used, motor contactor will open as soon as water pressure returns to normal.

5. Connect output from contactor to pump motor.

6. Close circuit breaker.

7. Switch to Hand. Motor should start.

8. Switch to Off. Motor should stop.

PART IV

OPERATION OF CONTROLLER

After the installation and test procedures are completed, the controller is ready for normal operation.

The disconnect switch should be closed. Set the running period timer to 1 minute for each 10 h.p. rating of motor but not to exceed 7 minutes.

PART V

SEQUENCE OF OPERATION

A. Introduction:

The explanation of the sequence of operation will start with the assumption that the controller has been properly installed, all external connections have been made and the disconnect switch is closed.

B. Manual Operation:

To manually start the Jockey Pump Motor, the Hand-Off-Auto switch is switched to Hand and the Start switch pressed. This energizes the Motor Contactor Coil (MS) and causes the Motor Contactor contacts to close, thus starting the motor.

To manually stop the motor the Hand-Off-Auto switch is switched to Off, opening switch contacts, allowing the MS to de-energize, thus opening the Motor Contactor contacts.

C. Automatic Operation:

For automatic operation, the Hand-Off-Auto switch is switched to Auto. This places the pressure switch (PS) in series with the MS. Under normal pressure the PS contacts are open. When the water line pressure drops below a certain preset level the PS contacts close and energize the MS, thus closing the contactor contacts and starting the pump motor. Auxiliary contacts MCA also close and thru the normally closed contacts of the Run Period Timer hold the MS energized even after the water pressure has returned to normal. The MS will remain energized until the Run Period Timer times out and its contacts open. If the Run Period Timer is not used, the motor will stop as soon as the water pressure returns to normal.

STEARNS-ROGER ENGINEERING CORP.
PROJECT NO. 621700
SOLAR-ONE PILOT PLANT
UNIT ONE
P.O. 2001

JOCKEY PUMP CONTROLLER MODEL M10A-5-460

PARTS LIST

PART	REC. SPARES	PART NO.	MFGR.
Circuit Breaker		MCP03150CR	Westinghouse
Motor Contactor		A203C12T38	I-T-E
Contactor Heater	3	G30T38	I-T-E
Contactor Coil	1	G10C126	I-T-E
Run Period Timer	1	BR18A603	Eagle Signal Co.
Pressure Switch	1	DA31-2	Mercoid
Control Transformer	1	C150BTZ13	Micron

STEARNS-ROGER ENGINEERING CORP.
PROJECT NO. 621700
SOLAR-ONE PILOT PLANT
UNIT ONE
P.O. 2001

CERTIFIED PERFORMANCE TEST PROCEDURES
(Form A-60006 is used for recording data)

A. The Hydrostatic Test (see procedures) should already have been accomplished (Hydrostatic test procedures are from the Q.C. Manual. A copy is provided here).

B. The calibrated test motor is mounted with pump. In some cases the customers motor will be used. If customers motor is used, record amps, volts, P.F., & watts when possible.

C. The pump is piped into its proper test system. Proper gauge pipe must be on suction & discharge. Use the positive pressure system or one of the tanks. Suction lift should be used only when specified. (For sump pumps, sewage ejectors, etc., refer to procedures for wet pit pumps).

D. A properly sized suction & discharge gauge is selected. The gauges are then calibrated against the dead-weight testor or the calibrated master gauge. A mark of "OK" or a correction is recorded on the test sheet (Form A-60006) along with the gauge number. The gauges are then placed on the proper gauge pipe. (See gauge calibration procedures). Record on data sheet the vertical distance, in feet, between the centerlines of the suction & disch., gauge. This is the gauge distance.

E. The test form (A-60006) is completed with the following information: Pump size and type (if the pump is being tested of a construction other than a called for on the order, this must be recorded under "remarks"), impeller number, impeller diameter, impeller tips (plain or sharpened) pump serial number and F.O. number.

F. The motor information then recorded as required on the test form. If motor for order is not used, test data sheet should be noted in remarks column: Ex: motor for job - Marathon 50hp, 1750 RPM.

G. Pump rating information is taken from the order and recorded. Also, the nameplate is checked for complete and accurate information.

H. The Electrical Power Measurement equipment is recorded on data sheets. Be sure to record proper ratio of wattmeter. (See power Measurement Procedures).

I. The pump should be connected and ready to operate. If suction lift is used, the pump must be primed. If positive suction pressure is used, this will prime the test pump.

J. Start test pump, bleed air from pump and discharge manifold and calibrate flowmeter. (See instructions for "Flowmeter Calibration").

K. Set pump at duty point specified on order. Set Pressure and read flow. Record this information on the V.I.P. test data card. This card should be completely filled out. If the duty stated on the order is met, and the pump is operating smoothly, proceed with performance test. If duty is not met or pump does not seem to be operating properly, check with supervisor.

L. Return pump to shut-off setting and record the following information. Discharge gauge reading, suction gauge reading (mark if this reading is pos., (+) or negative (-), flowmeter reading, wattmeter reading and RPM. If other than a calibrated motor is used, also record volts, amps, and power factor when possible. Use RPM indicator for RPM readings when possible. (See procedures).

M. Continue taking test points at different flow settings, (approximately in increments of 10 on flowmeter) until the maximum wattmeter reading is passed and/or extreme cavitation is encountered. Minimum of 6 points is required.

N. Return pump to duty and observe operation.

O. If operation seems alright, return to shut-off setting. Always stop pump at shut-off point (except turbine type pumps) this is because the flow-meter should always be kept full of water.

P. Remove or shut-off suction & discharge gauges. Turn off power to test pump. Turn off power to positive pressure pump.

Q. Analyze test for compliance to requirements. Check with supervisor if needed. (See procedures for analyzing tests).

R. Record test in test log and place test numbers on data sheet along with date and tecnician initials. Mark test data sheet as certified test in "Remarks" column. If suction or discharge gauge pipes differ from pump suction or discharge sizes this must be recorded on test sheets.

S. Test Data Sheets must be complete with the following information:

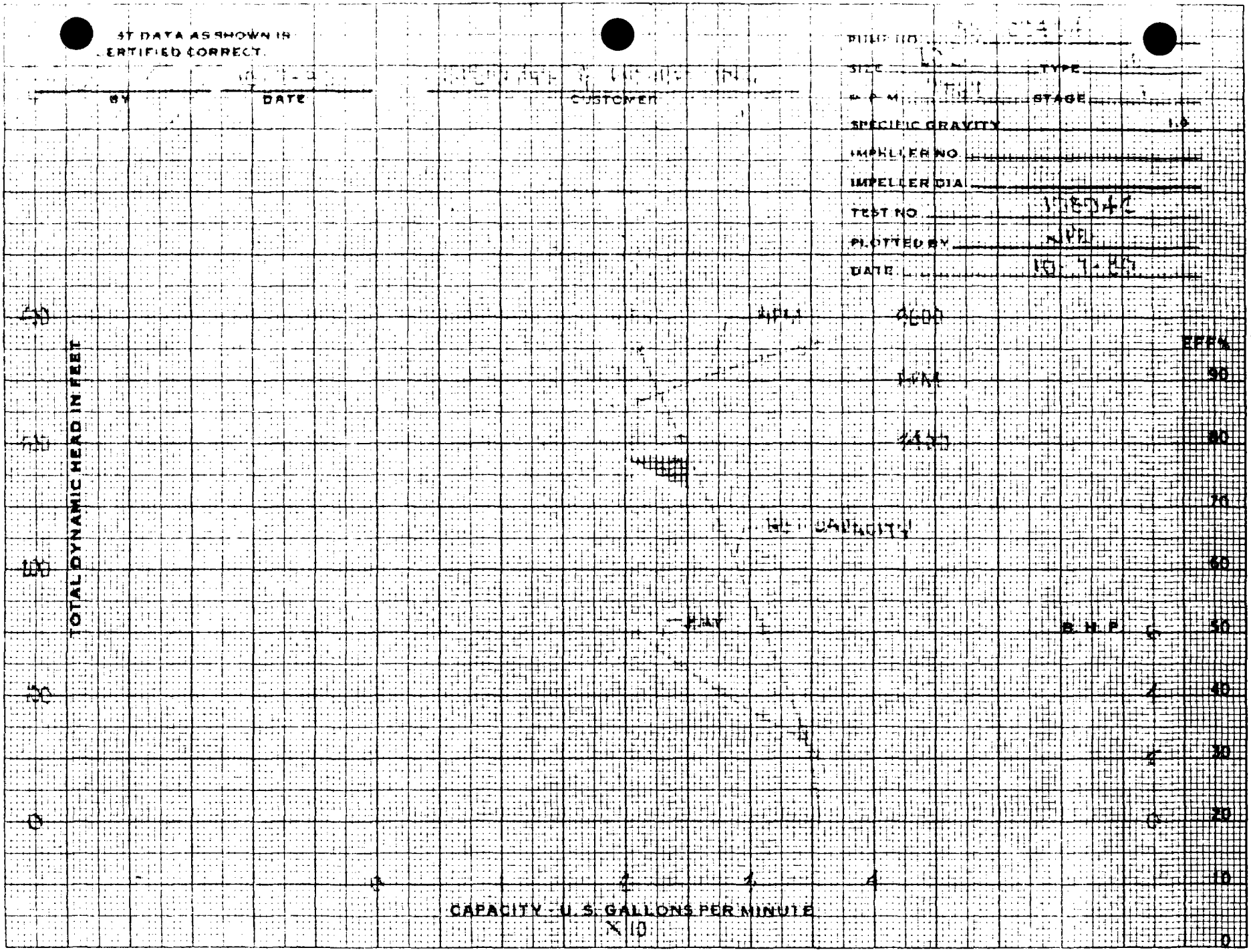
Impeller Number
Impeller Diameter
Impeller Tips
Pump Serial Number, F.O. Number, or AFD Project Number
Motor Information
Pump Rating Information (Except AFD Projects)
Wattmeter Make
Test Number, Date and Technician Initials
Suction & Discharge Gauge Pipe sizes (If different from pump)
Suction & Discharge Gauge Number (Gauge marking of "OK" or a correction value)
Barometer Reading
Remarks column should carry the type of test and any other remark as applicable.
(See procedures for the type of test)
Minimum of 6 test points with information as follows:
Discharge Pressure
Suction Pressure (marked head (+) or lift (-)
Gauge Distance (Vertical Distance between suction gauge and discharge gauge centerline. If discharge gauge is highest, number is positive (+). If suction gauge is highest, number is negative (-).
Flowmeter readings and full scale setting
Watt reading and proper ratio
RPM Readings

T. Remove equipment and pump from test set-up.

U. Tag pump, "Hold for Approval". (Tag should have date and intials by "Hydraulic".

V. If a final hydrostatic test is required, this can now be accomplished. Add date and intials to tag by "Hydro".

W. Analyze test and plot curve as required. (See procedures for analyzing test).



1.2.8-51

A-40040 REV. 2-78 K&E•

AURORA PUMP
A UNIT OF GENERAL SIGNAL

SHEET NO.

1.2.9 Demin. Water Xtr. Pump

1.2.9.1 Identification

Tag Number	Description
P710	Demin. Water Xtr. Pump

1.2.9.2 Description

Manufacturer: Worthington Group, McGraw-Edison Co..
14 Fourth Avenue
East Orange, NJ 07017

Part Number:

1.2.9.3 Vendor

Worthington

1.2.9.4 Procurement Specification

DOE Specification Number 40M700-6S, CP9

1.2.9.5 Piping Connections

DOE Dwg. No. 40P7005133155, CP9

1.2.6 Operation/Maintenance

See following Worthington Manual:

D-1011 and D-1012 Instruction for Installation, Operation, Maintenance, and List of Parts for Centrifugal Pumps

FOREWORD

Worthington products are the result of more than a century of progressive study and development. Advanced design, proper selection of materials, and precision construction reflect this wide experience. Worthington products will give trouble-free efficient operation with minimum maintenance and repair.
This instruction book will familiarize management and operating personnel with pertinent details and proper procedures for the installation, operation, and maintenance of one of these products.

INTRODUCTION

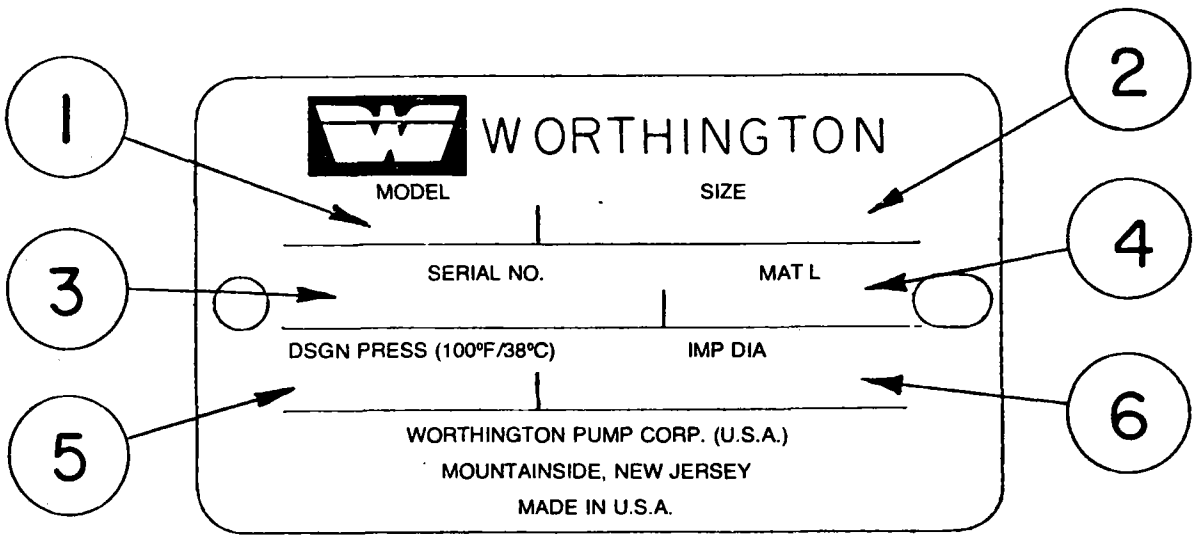
Model D-1011 and D-1012 pumps are frame mounted volute type centrifugal pumps designed to be coupled to a separate driver such as an induction motor. These pumps are available in a wide range of sizes and materials of construction that include ductile iron (stainless steel fitted) and several of alloy steels. A variety of optional features are available to fit a wide range of applications. This product line includes pumps which meet Dimensional and Performance Standards of ANSI B-73.1-1974 as well as additional inbetween and larger sizes. Model D-1011 pumps differ from D-1012 pumps in that they have convertible packed stuffing boxes while the latter (D-1012) have mechanical seal only design.

HOW TO READ PUMP NAMEPLATE

1. "MODEL" "D-1011" or "D-1012" refers to the general type of pump covered by this instruction book.
2. "SIZE" Three numbers separated by X's.

First Number	Suction connection pipe size
Second Number	Discharge connection pipe size
Third Number	Arbitrary number giving the relative size of the liquid end (not the exact imp. dia.)

3. "SERIAL NO." This number corresponds to records which will enable your Worthington representative to determine the component parts of your pump so exact duplicate parts or specific technical assistance can be provided.
4. "MATL" This block describes the major construction materials of the pump. For model D-1011 and D-1012 pumps construction materials are as follows: "duct iron"—ductile iron casing with stainless steel internal parts. "316 SS"—type 316 stainless steel. "W-20"—Worthite 20 alloy steel.
5. "DSGN PRESS (100°F/38°C)" Maximum allowable discharge pressure at or below 100°F(38°C) temperature. Maximum allowable pressure at higher temperatures are based on many factors. Contact your Worthington representative for specific limitations for your pump.
6. "IMP. DIA." Impeller Diameter. Two numbers are given. First the maximum available impeller diameter. Then the diameter of the impeller in the pump. The second number, the diameter of the impeller actually installed, is required for ordering a new impeller or a duplicate pump. The wrong diameter impeller will not operate properly and may overload either pump, motor or both.



CONTENTS

The nameplate data for your pumps can be tabulated below for future reference:

PUMP LOCATION OR SERVICE	PUMP SIZE	SERIAL NUMBER	IMP. DIA.	ELECTRIC MOTOR DATA	
				MOTOR SERIAL NO.	H.P.

WARNING

Do not operate this equipment in excess of its rated capacity, speed, pressure and temperature, nor otherwise than in accordance with the instructions contained in this Manual. This equipment (or a prototype) has been shop tested and found satisfactory for the conditions for which it was sold, but its operation in excess of these conditions will subject it to stresses and strains which it was not designed to withstand.

Failure to heed this warning may result in an accident causing personal injury.

SECTION I
INSTALLATION

INSPECTION OF EQUIPMENT

Immediately upon receipt of shipment, inspect and check the shipping manifest and report to the transportation company's local agent any damage or shortage.

Inspect the crate and wrappings before discarding. Parts or accessories are sometimes wrapped individually or fastened to the crate.

STORAGE

1. Keep unit in clean, dry location. Leave piping connection covers in place to keep dirt out of inside of pump.
2. Rotate pump shaft by hand every six months to protect bearings.
3. If pump has been stored over 3 years it is recommended that bearing frame be disassembled to clean bearings and relubricate as appropriate. D-1011 pumps with packed stuffing boxes should have packing replaced if it has been left installed in the pump during this period.
4. Storage over 6 months in tropical and marine locations — consult your Worthington representatives for recommendations.

CLEANING PRIOR TO INSTALLATION

Remove glue and dirt from suction and discharge flanges. Check motors to make sure no foreign objects have entered through fan and cooling openings. Remove any slushing compounds on exposed areas of pump shaft. Clean pump and motor nameplate.

LOCATION

Locate the pump so that:

1. It will be easy to inspect and maintain.
2. The unit is above the flood level.
3. Piping connections will be simple and direct and will provide adequate N.P.S.H. (see next paragraph) to prevent cavitation.
4. There is sufficient room to lift the motor on larger units.
5. The foundation is stable enough so that it won't shift and leave the pump hanging on the connecting piping.
6. You can read both nameplates (motor and pump).
7. There is enough free air circulation around the motor for proper cooling.

NET POSITIVE SUCTION HEAD

The NPSH required varies with every size of pump and for any given pump it varies with the capacity. The NPSH required by your unit can be obtained from the performance curves available from your Worthington representative.

To determine the NPSH available in your system refer to Fig. 1 and the following equation:

$$NPSHA_{(METERS)} = Z \pm \frac{(P-Pv)10}{Sp.Gr.} - H_f - H_e$$

$$NPSHA_{(FEET)} = Z \pm \frac{(P-Pv)2.31}{Sp.Gr.} - H_f - H_e$$

Where Z = Static head in feet (meters)
P = Pressure on surface of liquid in psia, kPa
P_v = Vapor pressure of liquid at pumping temperature in psia kPa
H_f = Suction line friction losses in feet (meters)
H_e = Entrance loss from tank to pipe in feet (meters)

Note: For boiling liquids P equals P_v and this item can be omitted from the equation.

If the available NPSH is not equal to or greater than that required by the pump, it must be increased. This is usually done by increasing the static head, Z.

FOUNDATION

It is recommended that Model D-1011 and D-1012 pumps be mounted on permanent foundations which will prevent excessive strains from piping connections and coupling misalignment. Figure 1 shows a typical installation.

Ideally pumps should be installed in horizontal position using standard steel or cast iron accessory baseplates on a permanent masonry or structural steel foundation of sufficient mass to absorb all normal vibrations. Foundation bolts should be located or embedded in the concrete by lay-out or template in relation to the suction and discharge piping. If concrete is used, foundation bolts of the specified size may be enclosed in a pipe sleeve two or three diameters larger than the bolts to compensate for minor variation in lineup.*

Channel steel bases are bolted in place. Drain rim steel bases may be grouted if desired. Cast iron bases are designed for and must be grouted.

*Refer to "Mounting & Grouting for Pumps" Worthington Bulletin 20RP-1355.

Standard accessory steel baseplates furnished with these pumps and motors 10HP(7.46KW) and under may be bolted to machine or equipment structures, either rigidly or, if flexible piping is used, with properly designed vibration isolators.

A unit mounted on steel work or structural members should be mounted over or adjacent to girders or walls so that no misalignment will occur from yielding or sagging of the structure.

Small units (10HP(7.46KW) and under) may be operated in temporary installations without permanent foundation attachments if mounted on standard channel steel or drain rim steel (but not cast iron) accessory baseplates. Under such conditions due consideration must be given to the following factors:

1. Use flexible piping connections such as hose which will not impose heavy pipe strains on pump casing but will not rupture or leak if unit shifts slightly due to vibration or external forces.
2. Connect motor with safe durable electrical connections which will not be affected by slight shifting of unit.
3. Conditions of coupling misalignment may shorten life of motor and pump thrust bearings.
4. Use grease lube for pump bearings (oil lube requires accurate leveling of pump on a permanent foundation).

Pumps with grease lube may be mounted in positions other than conventional horizontal, except that D-1011 pumps with conventional packed stuffing boxes should not be positioned in such a way as to allow normal stuffing box leakage to contaminate motor or pump frame or areas surrounding the pump. Pumps with oil lube must have bearing frames leveled in a horizontal position to insure proper bearing lubrication. If pump discharge does not point vertical it may not be possible to vent air from the casing prior to start up unless auxiliary vent connections are added.

SUCTION PIPING

Suction piping should be as short and direct as possible and free from all air leaks. Where economically practical the pipe should be one size larger than the suction opening. It should have a continuous rise or fall from the source to eliminate high spots or air pockets.

Isolation valves on suction and discharge lines are recommended to facilitate future inspection and repairs.

DISCHARGE PIPING

The discharge piping should be selected with a diameter one size larger than the discharge opening of the pump if economically practical. It is very important that the pipe be independently supported near the pump so that no strains will be transmitted to the unit. External loads caused by the pipe cause misalignment with subsequent failure of bearings and internal parts. Provisions that are made for pipe expansion on hot services also avoid placing strain on the pump.

Before securing the piping, flush the pump and piping to be sure they are clear of foreign material. Also check the flanges for both lateral and angular misalignment. Piping must be concentric and square before final bolting.

AUXILIARY PIPE CONNECTIONS

The following auxiliary piping should be connected to the unit, if required.

1. Baseplate drain (cast iron baseplates and drain rim baseplates).
2. Optional bearing cooling ring if supplied.
3. Jacketed stuffing box on D-1011 only.
4. Lantern ring connections, if required. See Section III "Maintenance" for instructions.
5. Mechanical seal connections, as indicated on the mechanical seal print.
6. Drip pan.
7. Frame drain sump.

Pipe connection sizes are shown on the elevation drawing for the unit.

MOUNTING AND ALIGNMENT

Pumps operate most reliably when carefully aligned on permanent rigid foundations. Strains which will cause wear of internal parts of the pump and excessive noise and vibration are eliminated this way.

Pump-driver combinations are aligned at the factory but must be rechecked for coupling alignment because they may be sprung in shipment or distorted by tightening of foundation bolts.

The best procedure to follow is to remove the coupling guard and check coupling alignment before tightening any foundation bolts.

If the pump is mounted on a permanent foundation, tighten the bolts now and recheck coupling alignment. Also turn the shaft by hand to assure that it turns freely.

If unit is to be grouted do it now. After the grout has been poured and

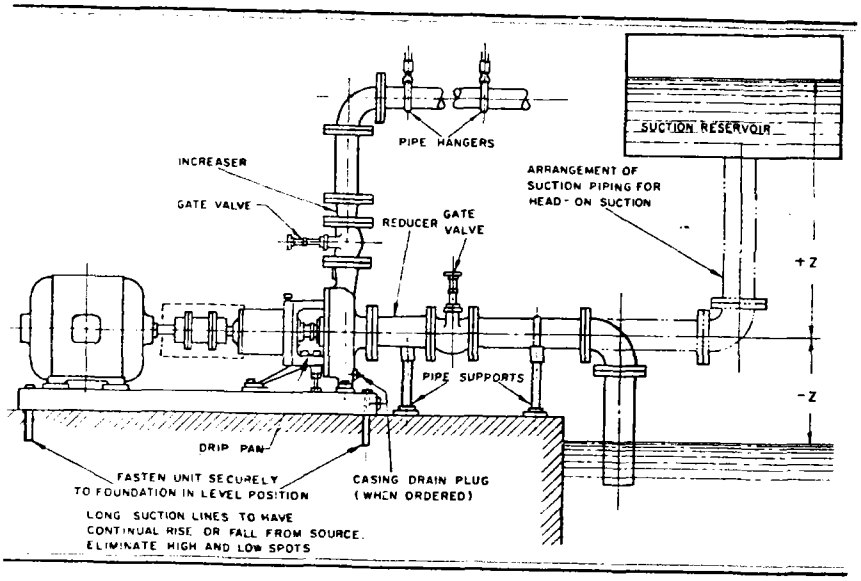


Fig. 1—Typical Piping and Installation

allowed to set for 48 hours tighten foundation bolts evenly and securely. Recheck coupling alignment. Replace coupling guard.

Pumps with oil lubrication must have oilers installed and oil added before starting. See maintenance section page 9 for procedure. Grease lubricated pumps are shipped with bearings already greased ready for up to 30 days operation prior to relubrication.

Pumps on hot service should have final coupling alignment made with the unit at its operating temperature.

SECTION II
OPERATION

DRIVER

For all driver information reference should be made to the manufacturer's instruction tag or booklet attached to the unit or crate.

On motor driven units check motor characteristics on nameplate and connect wiring in accordance with attached instruction tag. Check rotation of shaft against direction arrow on pump casing with spacer out.

PRIMING

Before starting any centrifugal pump it is absolutely necessary that both the casing and suction pipe be completely filled with liquid. This priming can be accomplished by any of the following methods.

A. When the liquid supply level is above the center line of the pump. it is primed by opening the suction and discharge valves. The inflowing liquid will displace the air and fill the suction line, pump casing, and discharge line up to the level of supply.

B. Where the pump is operating with suction lift and the suction line is equipped with a foot valve. the system is filled with liquid by filling through the discharge piping.

C. With pumps operating on a suction lift where foot valves will not operate properly. a priming chamber may be used. For detailed information on this subject refer to Worthington reprint W-350-S1A.

D. Instead of the preceding methods of filling the pump. one of a number of types of air removal apparatus may be used. depending upon the facilities available. This apparatus is required when the pump operates under a suction lift and there is no foot valve in the suction pipe. The connections are made in the top of the pipe at the pump suction opening. To prime. shut the discharge valve and do not start the driver until the pump and piping are full of water. Provision must be made to seal the stuffing box with sealing fluids to prevent in-leakage of air. See "Stuffing Boxes." page 10.

PRELIMINARY TO STARTING

Read the instruction book thoroughly before starting the unit. Make sure the following items are checked before starting.

1. Pack the stuffing box.

2. Alignment.

3. Lubricate the driver.

4. Check the direction of rotation of the driver with the coupling halves disconnected.

5. Lubricate the coupling, if required.

6. Check bearing lubrication as indicated in Section III "Maintenance." Oil lubricated pumps are shipped from the factory without oil.

7. For pumps equipped with packed boxes. the gland nuts must be loose.

8. The pump must be filled with liquid. If a priming device is used. it must be operating before the pump is started.

9. If the unit is equipped with a Jacketed Stuffing Box, Frame-Cooling Ring or an Independent Seal to the Stuffing Box. turn on the water to these items.

10. Turn on fluid to mechanical seal.

STARTING

The procedure for starting the unit will vary somewhat with each installation but the following steps will generally apply:

1. Make certain that suction and discharge valves are open. In acid service the valves should never be closed while the pump is operating since a resulting increase in liquid temperature may make the acid corrosive even to the corrosion resistant casing materials.

2. Start the driver.

3. Check to see that the pump is delivering liquid.

4. When in service for about one-half hour check for quiet operation, temperature of bearings, and stuffing box operation. After the pump reaches operating temperature shut it down. Then check the alignment and check for binding.

STOPPING

Although the procedure for stopping may vary slightly with each installation the following steps will generally apply:

1. Close the discharge valve.

2. Shut down the driver.

3. Close the suction valve.

4. Turn off water to frame-cooling ring and independent seal if so equipped.

5. Turn off cooling water to jacketed stuffing box.

6. Do not turn off the sealing fluid line to lantern ring unless the pump is to be shut down for an extended period and drained of all liquid.

7. Turn off fluid to mechanical seal if so equipped.

8. Do not tighten the gland to stop liquid leaking out, or air leaking in. unless provision is made to relieve the gland before restarting.

OPERATING DIFFICULTIES

If the recommended installation procedure has been followed, the pump should operate satisfactorily with no attention other than that necessary for the routine care of stuffing box and bearings. However, if difficulties do arise, unnecessary expenses and delay can be avoided by giving careful consideration to the following list:

1. Failure to deliver liquid

a. Pump not primed.

b. Insufficient speed. If motor driven, check voltage and current of each phase.

c. Discharge pressure required by the system is greater than that for which the pump was designed.

d. Net positive suction head insufficient.

e. Wrong direction of rotation.

f. Suction lift too high.

g. Insufficient margin between suction pressure and vapor pressure.

h. Air or vapor pocket in suction line

i. Air leaks into suction line

j. Air leaks into pump through mechanical seal, sleeve gaskets, casing gasket or pipe plugs

k. Inlet of suction pipe insufficiently submerged

l. Parallel operation of pumps unsuitable for such operation

m. Foreign matter in impeller

2. Insufficient capacity.

a. Air leaks in suction line

b. Speed too low

c. Discharge pressure required by the system is greater than that for which the pump was designed.

d. Impeller partly clogged

e. Insufficient suction head (cavitation occurring).

f. Mechanical defects — Impeller damaged

g. Foot valve too small or clogged

h. Foot valve not sufficiently submerged

i. Wrong direction of rotation

j. Vortexing

k. Pump or suction pipe not completely filled with liquid

l. Suction lift too high

m. Insufficient margin between suction pressure and vapor pressure

n. Excessive amount of air or gas in liquid

o. Air pocket in suction line

p. Air leaks through gaskets

q. Air leaks into pump through stuffing boxes

r. Inlet of suction pipe insufficiently submerged

s. Water-seal pipe plugged

t. Inducer used for wrong service

u. Inducer (where required) clogged or worn

v. Viscosity of liquid differs from that for which designed

w. Wearing ring surfaces worn

x. Impeller damaged or eroded

y. Impeller clearance too great

3. Insufficient pressure.

a. Leaks in the suction line

b. Air or vapor in the line

c. Mechanical defects (see above)

d. Wrong direction of rotation

e. Excessive amount of air or gas in liquid

f. Inducer used for wrong service

g. Inducer (where required) clogged or worn

h. Speed too low

i. Wrong direction of rotation

j. Total head of system higher than design head of pump

k. Viscosity of liquid differs from that for which designed

l. Foreign matter in impeller

m. Wearing ring surfaces worn

n. Impeller damaged or eroded

4. Pump loses prime after starting

a. Leaks in the suction line

b. Suction lift too high

c. Air or vapor in the liquid

d. Air leakage through stuffing box

e. Operating too far out on curve

f. Suction lift too high

g. Insufficient margin between suction pressure and vapor pressure

h. Excessive amount of air or gas in liquid

i. Air pocket in suction line

j. Air leaks into suction line

k. Air leaks into pump through gaskets

l. Inlet of suction pipe insufficiently submerged

m. Water-seal pipe plugged (model 1011)

n. Seal cage improperly located in stuffing box, preventing sealing fluid entering space to form the seal (model 1011 packed box only)

5. Pump overloads driver

a. Speed too high

b. Total dynamic head too low: pumping too much liquid

c. Liquid pumped is of different specific gravity and/or viscosity than that for which pump was designed

d. Oversize impeller

e. Wrong direction of rotation

f. Total head of system higher than design head of pump

g. Total head of system lower than pump design head

h. Specific gravity of liquid different from design

i. Viscosity of liquid differs from that for which designed

j. Foreign matter in impeller

k. Misalignment

l. Rotating part rubbing on stationary part

m. Bearings worn

n. Wearing ring surfaces worn

o. Packing improperly installed

p. Incorrect type of packing for operating conditions

q. Gland too tight resulting in no flow of liquid to lubricate packing

6. Pump vibrates

a. Pump or suction pipe not completely filled with liquid

b. Suction lift too high

c. Insufficient margin between suction pressure and vapor pressure

d. Foot valve too small

e. Foot valve partially clogged

f. Inlet of suction pipe insufficiently submerged

g. Inducer used for wrong service

h. Inducer (where required) clogged or worn

i. Operation at very low capacity

j. Foreign matter in impeller

k. Misalignment due to pipe strain

l. Improperly designed foundation

m. Shaft bent

n. Rotating part rubbing on stationary part internally

o. Bearings worn

p. Impeller damaged or eroded

q. Shaft running off center because of worn bearings or misalignment

r. Impeller out of balance

s. Internal misalignment due to improper repairs causing impeller or inducer to rub

t. Excessive thrust caused by a mechanical failure inside the pump

u. Excessive grease in ball bearings

v. Lack of lubrication for bearings

w. Improper installation of bearings (damage during assembly, incorrect assembly, wrong type of bearing, etc.)

x. Dirt getting into bearings

y. Rusting of bearings due to water getting into housing around shaft deflector

7. Packing has short life

a. Water-seal pipe plugged

b. Seal cage improperly located in stuffing box, preventing sealing fluid entering space to form the seal

c. Misalignment

d. Shaft bent

e. Bearings worn

f. Shaft or shaft sleeves worn or scored at the packing

g. Packing improperly installed

h. Incorrect type of packing for operating conditions

i. Shaft running off center because of worn bearings or misalignment

j. Rotor out of balance resulting in vibration

k. Gland too tight resulting in no flow of liquid to lubricate packing

l. Failure to provide cooling liquid to water-cooled stuffing boxes

m. Excessive clearance at bottom of stuffing box between shaft and casing, causing packing to be forced into pump interior

n. Dirt or grit in sealing liquid, leading to scoring of shaft or shaft sleeve

8. Stuffing box leaks excessively

a. Water-seal pipe plugged

b. Seal cage improperly located in stuffing box, preventing sealing fluid entering space to form the seal

c. Misalignment

d. Shaft bent

e. Bearings worn

f. Shaft or shaft sleeves worn or scored at the packing

g. Packing improperly installed

h. Incorrect type of packing for operating conditions

i. Shaft running off center because of worn bearings or misalignment

j. Rotor out of balance resulting in vibration

k. Gland too tight resulting in no flow of liquid to lubricate packing

l. Failure to provide cooling liquid to water-cooled stuffing boxes

m. Excessive clearance at bottom of stuffing box between shaft and casing, causing packing to be forced into pump interior

n. Dirt or grit in sealing liquid, leading to scoring of shaft or shaft sleeve

9. Mechanical seal has short life

a. Shaft bent

b. Shaft sleeve worn or scored or running off center

c. Mechanical seal improperly installed

d. Incorrect type of mechanical seal for operating conditions

e. Shaft running off center because of worn bearings or misalignment

f. Impeller out of balance resulting in vibration and shaft deflection

g. Abrasive solids in liquid pumped

h. Internal misalignment of parts preventing seal washer and seat from mating properly

i. Mechanical seal was run dry

j. Bearings worn

k. Misalignment due to pipe strain

10. Mechanical seal leaks excessively

a. Misalignment due to pipe strain

b. Shaft bent

c. Bearings worn

d. Leakage under sleeve due to gasket and O-ring failure

e. Shaft sleeve worn or scored or running off center

f. Mechanical seal improperly installed

g. Incorrect type of mechanical seal for operating conditions

h. Shaft running off center because of worn bearings or misalignment

i. Impeller out of balance resulting in vibration

j. Abrasive solids in liquid pumped

k. Internal misalignment of parts preventing seal washer and seat from mating properly

l. Mechanical seal was run dry

11. Bearings have short life

a. Internal misalignment due to pipe strain or improper foundations

b. Coupling misalignment

c. Bent or damaged shaft

d. Damaged bearing housings

e. Excessive thrust caused by a mechanical failure inside the pump

f. Excessive grease in bearings

g. Lack of lubrication for motor bearings

h. Wrong type of grease in grease lube pumps

i. Wrong type of oil in oil lube pumps

j. Improper installation of bearings (damage during assembly, incorrect assembly, wrong type of bearing, etc.)

k. Dirt getting into bearings

l. Rusting of bearings due to water getting into housing around shaft deflector

m. Improper oil level in oil lube pumps

n. Operation with too large an impeller or too high speed or specific gravity for pump

o. Excessively worn open impeller

p. Out of balance shaft or impeller

12. Pump overheats and seizes

a. Pump not primed and allowed to run dry

b. Vapor or air pockets inside of pump

c. Operation at too low capacity

d. Parallel operation of poorly matched pumps

e. Internal misalignment due to too much pipe strain, poor foundations or improper repairs

f. Internal rubbing of rotating part on stationary part

g. Worn bearings

h. Lack of lubrication

SECTION III
MAINTENANCE

BEARING LUBRICATION—GENERAL

Model D-1011 and D-1012 pumps are furnished with either of two lubrication systems, oil or grease. Oil lube pumps may be identified by the externally mounted oiler and two oil slingers attached to the pump-shaft between the bearings. Grease lube pumps do not have these slingers installed. Grease lube pumps have grease fittings installed on the line and thrust bearing ends of the bearing housing. See Repair Section IV (Bearing Frame) Page 14 for instructions on how to convert from oil lube to grease lube or from grease lube to oil lube.

OIL LUBRICATION

Oil lube pumps use an externally mounted oil lubricator (Trico oiler) shown in figure 2.

Rotating oil throwers fill the inside of the frame with oil droplets which continually coat the bearings with fresh lubricant.

No critical oil level adjustment is necessary in this oiling system.

The constant level Trico oiler maintains the oil level automatically. Only a quick glance is necessary to determine that proper lubrication is being provided.

Instructions for Filling Oil Reservoir —Unscrew the plastic bottle from the oil reservoir, then fill with the proper grade of oil and replace. Allow the oil to flow until the oil level in the bottle reaches and maintains a constant level. Make sure the bottle is in the lowest position while filling so that the correct amount of oil is poured in. It will be necessary to refill the bottle several times. Do not fill through the air vent opening in the top of the housing because too much oil may be added. This will cause the bearing to overheat. Also, oil may leak out at the annular clearance between the shaft and the bearing cover and housing.

When the level is reached and no more oil runs out of the bottle, the pump may be started. The oil in the bottle must be visible at all times. From time to time, it may be necessary to add more oil.

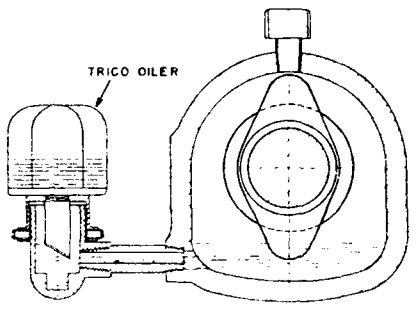


Fig. 2—Trico Oiler

Starting New Pumps — Before starting, the oil reservoirs must be filled with oil as outlined under "Instructions for Filling Oil Reservoir." Make sure that the proper grade of oil is used.

The bearings are shipped from the factory with a slushing compound which serves as a rust preventative.

Grade of Oil—Use of a high quality lubricating oil containing rust, oxidation and foam inhibitors. Such oils are often referred to as turbine and/or hydraulic oils. To select oil of the proper viscosity, the actual operating temperature of the bearings must be measured or approximated from experience.

The following chart lists the recommended viscosity for different bearing temperatures.

BearingTemp.		Viscosity		
°F	°C	SSU 100°F	CST 38°C	SAE No.
0-125	-18-52	75	16	5W
126-145	52-63	150	33	10W
146-180	63-82	300	65	20
181-200	83-93	700	152	30

*SSU is Saybolt Seconds Universal.

Oil Changes — For normal 8 hour duty, change the oil approximately every 6 months. For pumps on hot service or in a damp or corrosive atmosphere change the oil more frequently.

GREASE LUBRICATION

The bearings should be lubricated through the hydraulic grease fittings with a lime base, moisture resistant grease for bearing temperatures between 32 and 150F(0 and 66C). For temperatures in excess of 150F(66C) use a short fibre, soda base of mixed base grease. Secure the best grade of No. 2 consistency ball bearing grease for these conditions from a reputable manufacturer.

Immediately after lubrication, bearings will show a definite temperature rise and should be allowed to operate from 4 to 8 hours until the temperature stabilizes.

If the heating persists, refer to instructions on coupling and piping alignment.

The frequency of lubrication depends on the operating conditions. For normal duty, 8 hours daily, relubricate every 1000 hours of operation. Lubricate the bearings while the unit is running and **DO NOT OVERLUBRICATE.**

STUFFING BOXES—PACKED

Type of Packing—Die-molded packing is furnished on all D-1011 pumps ordered with packed stuffing boxes. Special hardened shafts or sleeves are required for certain types of packing. For special applications consult a reputable packing manufacturer or your Worthington pump representative.

Lantern Ring Connection — Stuffing boxes are equipped with a lantern ring which can be used to bleed water or other fluid to the packing. The fluid provides cooling and lubrication, and also prevents air leakage into the pump when the suction pressure is less than atmospheric. Also, when an independent source of sealing fluid is used, it is possible to flush the packing of any grit or solids handled by the pump. If required, sealing fluid can be supplied to the stuffing box lantern ring by two methods:

1. By injecting water from an independent source at a pressure approximately 5 to 10 psi (35 to 69kPa) higher than suction pressure.

2. By the use of a seal tube connected to the pump volute.

The method employed should conform with the instructions listed as follows:

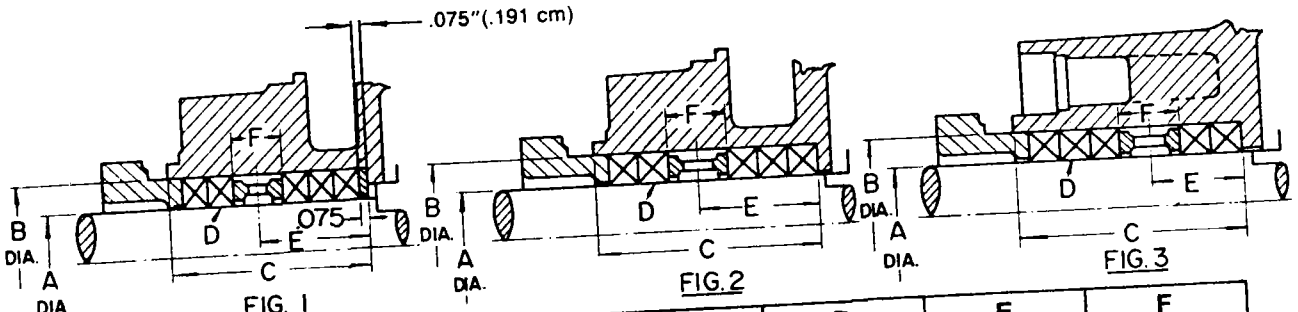
Chemical pump stuffing boxes cannot be sealed by the liquid pumped as is done on water pumps. However, sealing against inleakage of air or outleakage of liquids that are corrosive, hazardous, or costly, or that contain solids is important. Sealing is only possible if an independent source of fluid is connected to the lantern ring with a continuous and steady external pressure at all times during operation and shut-down.

The sealing fluid is sometimes water, but where water is not compatible with the liquid being pumped it cannot be used, such as with:

1. Sulfuric acid above 65 to 70%.

2. Anhydrous liquids that must be kept so.

3. Liquids that will form hydrochloric acid on contact with water.



FRAME SIZE	FIG.	A SHAFT OR SLEEVE DIA		B BOX BORE DIA		C BOX DEPTH		D PACKING SIZE		E DISTANCE TO SEAL CAGE ℄		F SEAL CAGE WIDTH	
		IN.	CM.	IN.	CM.	IN.	CM.	IN.	CM.	IN.	CM.	IN.	CM.
1	1	1.125	2.858	1.750	4.445	2.05	5.207	1/4x5/16	.64x.79	1.105	2.807	.56	1.422
2 Except 3x1-1/2x13 3x2x13	2	1.375	3.493	2.000	5.080	2.32	5.893	5/16 SQ.	.79 SQ.	1.25	3.175	.62	1.575
2 ONLY 3x1-1/2x13 3x2x13	3	1.375	3.493	2.000	5.080	2.32	5.893	5/16 SQ.	.79 SQ.	.94	2.388	.62	1.575
3 3x2x6 4x3x6 6x4x6	2	1.750	4.445	2.500	6.350	2.83	7.188	3/8 SQ.	.95 SQ.	1.50	3.810	.75	1.905
3 ALL OTHERS	3	1.750	4.445	2.500	6.350	2.83	7.188	3/8 SQ.	.95 SQ.	1.12	2.845	.75	1.905
4	3	2.125	5.398	2.875	7.303	2.83	7.188	3/8 SQ.	.95 SQ.	1.50	3.810	.75	1.905
5	3	2.750	6.985	3.750	9.525	3.78	9.601	1/2 SQ.	1.27 SQ.	1.50	3.810	1.00	2.54

Fig. 3—Stuffing Box Arrangements

Mechanical seals are usually recommended for such conditions, although in some cases, the fluid seal on a packed box can be a clean solution of a liquid that is compatible with the product. In some cases glycerine or other hydrocarbons have been used for sealing against oleum; weak caustic may be used for sealing strong caustic; steam, for materials that harden at low temperatures such as strong black liquor; and inert dry gas in exceptional cases.

This fluid should be supplied to the pump at a pressure 5 to 10 psi(35 to 69kPa) above the suction pressure or above atmospheric pressure when a negative suction pressure exists. In addition, this fluid should be left on at all times, when there is liquid in the pump, whether the pump is operating or not.

COOLING JACKET

D-1011 pumps are designed with an integral stuffing box cooling jacket. The purpose of this jacket is to provide a means for circulating cooling water around the stuffing box of pumps on hot liquid services. Such cooling is usually required on packed box pumps if liquid temperature is over 250°F(121°C).

STUFFING BOX DIMENSIONS AND ARRANGEMENT

Stuffing box dimensions and arrangement are shown in Fig. 3. The lantern ring in and out connection at the stuffing box are plugged at the factory with pipe plugs. The stuffing box is normally equipped with a lantern ring unless the order specifically calls for a different arrangement.

Packing Replacement — We recommend the use of pre-cut die-molded or mandril-cut packing. To install new packing, first remove the old packing with a suitable packing puller. Make sure that the packing to be installed is of the proper grade and the sleeve or shaft is in good condition. For packing recommendations, contact Worthington or a reputable packing manufacturer. Blue African Asbestos packing is good for most corrosive chemicals. Insert one packing ring at a time into the stuffing box by means of the gland. The split of successive packing rings should be placed 90 degrees apart. If a lantern ring is used, make sure the ring is installed in the right location. The lantern ring should be directly under the tapped opening in the stuffing box.

When installing the gland, tighten the gland nuts finger tight. Do not over tighten with a wrench.

Packing Adjustment—General — In order to assure proper packing lubrication, a leakage rate of 30 drops per minute is required. If the stuffing box leakage rate is too high, tighten each hexagon gland nut only one flat or one sixth of a turn. Wait for about ten minutes until the packing seats itself. After ten minutes, if the leakage rate is still too high, tighten the nuts another one sixth of a turn. Do not overtighten the nuts to the point where all leakage is stopped.

Operation of the pump without stuffing box leakage will cause the packing to burn up. Also, the shaft or shaft sleeve will be scored and the horsepower required to drive the pump will increase.

Packing Adjustment—Start-Up — If the glands are tightened to prevent leakage when the pump is shut down, make sure the gland nuts are loosened before the pump is started again. Many operators forget to loosen the nuts before starting. This is a common cause of packing and shaft or sleeve failure.

STUFFING BOXES—MECHANICAL SEALS

A wide variety of mechanical seals are available as options on D-1011 and D-1012 pumps. Mechanical seals by their nature require no maintenance. D-1011 and D-1012 pumps all accommodate commercially available mechanical seals most widely used in Chemical and Process service. Inside and outside seals, balanced and unbalanced, single and double are available. Auxiliary fittings such as stuffing box throat bushings, lip seals and so forth are also available. For seal recommendations refer to Worthington or a reputable seal manufacturer.

SECTION IV

REPAIR INSTRUCTIONS

The following section is divided into subsections covering several of the basic variations of D-1011 and D-1012 pumps. Because of the large number of combinations of optional features it may be necessary to refer to several subsections of this section for information needed to proceed the various repair steps for a given pump. The first paragraph of each subsection will contain identification information to help guide the user of this manual.

This section includes the following subsections:

Rotor Assembly Removal
Disassembly—All D-1011 Pumps
Disassembly—All D-1012 Pumps
Inspection and Repair of Components
Bearing Frame Repairs
Disassembly of Frame
Assembly of Frame
Conversion from grease to oil lube (and vice versa)
Assembly Procedure—All D-1011 Pumps
Assembly Procedure—All D-1012 Pumps

ROTOR ASSEMBLY REMOVAL—

Remove the spacer portion of the coupling by following the coupling manufacturer's instructions. Close the suction and discharge valves and drain the liquid from the casing. Some units are furnished with a drain plug in the casing (1). With D-1011 and D-1012 pumps the casing can be left in the line. The complete bearing frame and rotor assembly are removed from the casing as one integral unit. Disconnect all auxiliary piping. Remove cap screws which attach adapter (71) to casing (1). Jack bolt holes are provided and should be used rather than crude prying methods to separate the adapter from the casing.

Loosen the two bolts which attach the outboard frame support (53B) to the base. Adjust the inboard frame support (53A) so that the weight of the frame assembly is sustained by this support. This support is threaded for easy vertical adjustment so the rotor can be positioned to slide smoothly into or out of place. Slide out the frame assembly from the casing as one integral unit. This assembly can then be removed to the bench for dismantling.

DISASSEMBLY ALL D-1011 PUMPS

1. With casing (1) removed, use a sharp tool to pry back the locking tab of the impeller nut lockwasher (24A).
2. Using a suitable means to keep the impeller (2) from turning, remove the impeller locknut (24) or inducer (2A). Note that the inducer does not use a lockwasher.
3. Remove impeller (2) and impeller key (32) from shaft.
4. On pumps with mechanical seals remove the nuts or cap screws which attach the gland (17A) to the stuffing box cover (11) or cooling cap (11B).
5. Remove cap screws which hold the stuffing box cover (11) to the adapter (71) and separate the two.
6. At this point the mechanical seal rotor (80) if so equipped can be removed from the shaft (14) or left in place.
7. Slide the gland (17 or 17A) off the end of the shaft.
8. Pull the shaft sleeve (14) off the shaft.
9. Remove 4 cap screws which hold the bearing frame assembly to the adapter (71) and remove the frame assembly by withdrawing rearward from the adapter. See page 13 for repairs to the bearing frame assembly.
10. Adapter supports (53A and 53B) may be removed from the adapter (71) at this point if required.
11. Packing (13), gland (17), lantern ring (29), and stuffing box bushing (63) (This last item used on frame 1 pumps only) may be removed from stuffing box cover at this time.

DISASSEMBLY ALL D-1012 PUMPS

1. With casing (1) removed, use a sharp tool to pry back the locking tab of the impeller nut lockwasher (24A).
2. Using a suitable means to keep the impeller (2) from turning, remove the impeller locknut (24) or inducer (2A). Note that the inducer does not use a lockwasher.
3. Remove impeller (2) and impeller key (32) from shaft.
4. Loosen or remove mechanical seal rotor retainer from shaft sleeve. This is either a retaining ring (211) for bellows type mechanical seals or a socket set screw in a collar for chemical seals.
5. Pull the rotor (80) off the shaft (6) or shaft sleeve (14). If a shaft sleeve is relatively loose on the pump shaft the rotor and the sleeve may come off together and be separated later.
6. Remove 4 cap screws which hold the bearing frame assembly to the adapter (71) and remove the frame assembly by withdrawing rearward from the adapter. See page 13 for repairs to the bearing frame assembly.
7. Adapter supports (53A and 53B) may be removed from the adapter (71) at this point if required.

INSPECTION AND REPAIR OF COMPONENTS

With pump liquid end disassembled, clean all parts and check for worn and damaged areas. The following paragraphs apply to all D-1011 and D-1012 pumps unless they say otherwise.

Casing—Closed Impeller Type (1)

Clean and inspect gasket surfaces for damage areas that would cause leaks. Check wearing ring surfaces for excessive wear. On alloy steel pumps these surfaces are a machined part of the casing. On standard fitted pumps stainless steel wearing rings may be removed by driving out with a specially sharpened drift pin. Figure 4 gives standard wearing ring clearances for adapter and casing sides of impeller.

Casing—Open Impeller Type (1)

Clean and inspect gasket surfaces for for damaged areas that would cause

Pump Size	Wearing Ring Diametric Clearance		Pump Size	Wearing Ring Diametric Clearance	
	IN	CM		IN	CM
1½x1x6	.018-.024	.046-.061	4x3x6	.021-.027	.053-.069
1½x1x8	.018-.024	.046-.061	4x3x8	.021-.027	.053-.069
2x1x10	.018-.024	.046-.061	4x3x10	.021-.027	.053-.069
3x1½x5	.018-.024	.046-.061	4x3x13	.021-.027	.053-.069
3x1½x6	.018-.024	.046-.061	6x4x6	.021-.025	.053-.064
3x1½x8	.018-.024	.046-.061	6x4x8	.021-.025	.053-.064
3x1½x10	.018-.024	.046-.061	6x4x10	.021-.027	.053-.069
3x1½x13	.018-.024	.046-.061	6x4x11	.021-.027	.053-.069
3x2x5	.018-.024	.046-.061	6x4x13	.021-.027	.053-.069
3x2x6	.018-.024	.018-.061	8x6x11	.024-.030	.061-.076
3x2x8	.018-.024	.018-.061	8x6x13	.024-.030	.061-.076
3x2x10	.018-.024	.018-.061	8x6x13	.024-.030	.061-.076
3x2x13	.018-.024	.018-.061	10x8x13	.027-.033	.069-.084
3x3x4	.018-.024	.018-.061	10x8x15	.027-.033	.069-.084
4x3x5	.021-.027	.053-.069			

Fig. 4—Wearing Ring Clearances

leaks. Check face of wear plate (61) for excessive wear and replace if necessary. Do not remove wearplate unless it is necessary to replace it or the gasket 73J. Clearance between wearplate and impeller when pump is assembled should be .015" to .020". (.038 to .051cm.).

Impeller—Closed (2)

Check wearing ring surfaces for excess wear and gasket surfaces of impeller hub for damage. If excessively worn or eroded, the impeller must be replaced.

Impeller—Open (2)

Check front and rear vanes for excessive wear. If front vanes are worn, clearance to wearplate may be reduced by adjusting position of shaft or wearplate. If rear vanes are worn excessively, impeller must be replaced.

Stuffing Box Cover—D-1011 (11)

Clean and inspect gasket surfaces. Remove any dirt or scale from stuffing box cavity. Check cover ring for wear and excess clearance. See Figure 4. Stainless steel cover rings may be driven out by use of a hammer and drift pin. If necessary remove cooling cap (11b). Clean cooling cavities to remove excessive rust or scale. Replace O-rings (73B and 73C). Replace gland studs (83) if badly corroded.

Mechanical Seal Cover—D-1012 (11A)

Clean and inspect gasket surfaces. Remove any dirt or scale from mechanical seal cavity. Check cover ring for wear and excess clearance. See Figure 4. Stainless steel cover rings may be driven out by use of a hammer and drift pin.

Adapter (71)

Check for damage to precision surfaces that locate casing and bearing frame to preserve proper internal alignment. Check for corrosion due to leakage from stuffing box.

Mechanical Seal—All bellows type

It is not recommended that this mechanical seal be reused. A mechanical seal is like a gasket in this respect. Using an old one leaves too much chance of failure to make the gamble worthwhile, considering the usual cost of installing and removing a pump from its system.

Attempts to lap the faces of this mechanical seal are not recommended under any circumstances.

Mechanical Seal — Crane Type 9 Durametallic ROTT or other Chemical type.

Mechanical seal repairs or lapping are possible but require specialized technical knowledge, skills and equipment beyond the scope of these instructions. For assistance in this area contact your Worthington pump representative or a representative of the mechanical seal manufacturer. Complete mechanical seal rotors (80) and seats (65) are available from your Worthington representative just like any other repair parts.

Shaft Sleeve (14)

Check for damage to gasket surface on impeller end and internal gasket or O-ring groove. If used with a mechanical seal, the outside surface must not be scored in the area where the seal rotor (80) bellows or sealing ring touches. If used with packing, any scoring on outside of sleeve will shorten the life of the packing by an amount that depends on how bad the scoring is.

Bearing Frame Assembly

See Section IV—Bearing Frame Repairs, which follows.

BEARING FRAME REPAIRS

The bearing frame is the assembly consisting of bearing housing (9), shaft (6), bearings (16 and 18) and other parts attached to the bearing housing. The following subsection applies to bearing frames used on all D-1011 and D-1012 pumps. There are 5 sizes of bearing frames numbered 1 thru 5 (smallest to largest). Each size is available with optional "heavy duty" features as follows:

a. back to back angular contact thrust bearings
b. cooling ring
c. special shaft materials and configurations

Bearing frames are made for either oil or grease lubrication.

DISASSEMBLY OF FRAME

1. If there is any reason to suspect a bent shaft or misalignment problem the shaft should be checked for runout with a dial indicator before disassembling the bearing frame. Maximum runout at stuffing box face is .002"(.005cm.).

2. To disassemble the bearing frame remove 4 capscrews which hold the thrust bearing cover (35) or bearing cartridge (99A) to the bearing housing (19).

3. Remove the shaft (6) and bearings (16 and 18) by driving on the impeller end of the shaft. Protect the threaded end of the shaft during this operation. In the process the deflector (40) will be pushed off the shaft. If the line bearing lip seal (47) is to be reused it is strongly recommended that there *not* be a shaft sleeve (14) left on the shaft.

4. The thrust bearing cover may be pulled off the shaft at any time. However, to remove the bearing cartridge (99A) from the shaft assembly it is necessary to remove screws which hold the bearing retaining ring (99B) to the bearing cartridge (99A). Then the cartridge may be slid

off the bearings to expose the bearing locknut.

5. If desired, the line bearing cover (35) may be removed by removing 4 cap screws.
6. Lip seals (47 and 49) are removed by driving them outward from their respective mountings using a hammer and suitable flat faced fixture.
7. The bearings may be removed from the shaft by conventional pressing or pulling methods once the bearing locknut (22) and bearing nut lockwasher (22A) are removed.
8. Bearing housing cooling ring (19A) is removed by removing the oil drain nipple and cap and then pulling the ring rearward toward the coupling end of the bearing frame. Such an operation may be difficult if there is much of a rust or scale buildup in the jacket.

ASSEMBLY

For assembly of the bearing frame the following procedure applies:

1. Install oil slingers (60) and oil ring collar (60A) on shaft if pump is oil lube. Two are used with single thrust bearing and only one with double angular contact thrust bearings.
2. Press bearings on shaft. Note that the line bearing (16) can face either way. However, the thrust bearings (18) must face in the proper direction as illustrated for both single bearing (with retaining ring (211) on coupling end) and double angular contact bearings (which mount back to back).
3. Install bearing nut lockwasher (22A) and thread on bearing locknut snug with a spanner wrench against the thrust bearing (18). Press together the tab and slot which line up.
4. Only if pump is grease lube pack each bearing with grease. Do not do this on oil lube pumps.
5. Press lip seals (47 and 49) into their respective mountings and lubricate the rubber lips of each with a small amount of grease.
6. Install bearing cartridge (99A) over thrust bearings on frames using angular contact thrust bearings. Follow this by attaching retaining ring (99B). Note that oil drain slot in retaining ring must line up in the downward position. Place O-Ring (73H) in groove on outside of cartridge (99).
7. Shaft and bearing subassembly is now installed in bearing housing (19) by inserting from coupling end and pushing thru until either retaining ring (211) or flange of cartridge (99A) contact edge of housing.
8. Install thrust bearing cover (37) on single bearing pumps making sure that ring seal (73D) is properly seated in its groove.
9. Install line bearing cover (35) making sure that gasket (73G) does not cover oil drain hole.
10. Install deflector (40).
11. Install cooling ring O-rings (73F) followed by cooling ring (19A) on bearing frames so equipped. This is followed by oil drain nipple and cap which hold cooling ring in place.
12. On oil lube pumps install lubricator.
13. On grease lube pumps install grease fittings in holes on one side of the bearing housing (19) at each end.
14. Install vent cap (45) in top hole.
15. Any remaining open holes must be plugged.

CONVERSION FROM GREASE TO OIL LUBE (and Vice-Versa)

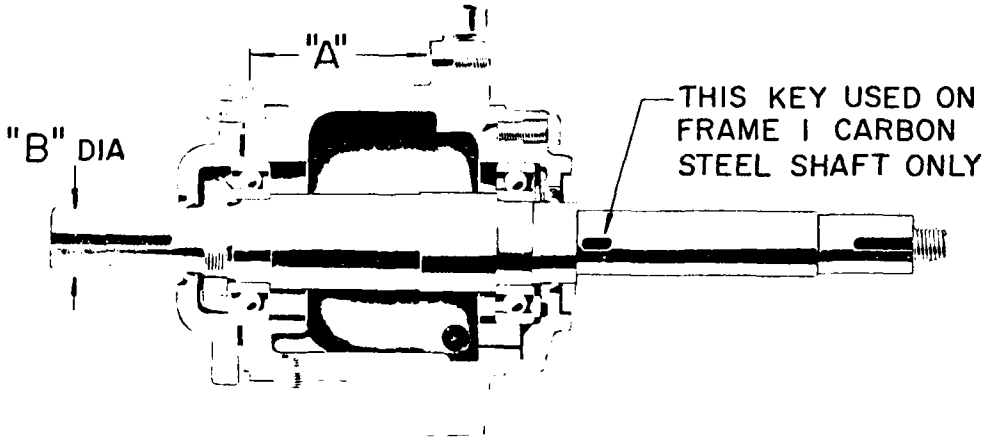
Follow steps 1, 4 and 11 thru 15 above. Procedure given above. Then follow lubrication instructions in Section III.

ASSEMBLY PROCEDURE— ALL D-1011 PUMPS

The D-1011 pump is easy to put together. The hardest part requiring the most care is installation of the mechanical seal parts on pumps equipped with mechanical seals.

1. Study the sectional diagram, and become familiar with the name of each part.
2. Make sure all of the parts are clean and ready for assembly. This means no dirt or pieces of old gasket in the joints between the frame, adapter and casing. Make sure the parts around the mechanical seals are clean. Dirt and misalignment will ruin a mechanical seal.
3. The preceding section covers assembly of bearing frame. This must be completed before assembly of the rest of the pump.
4. The easiest way to assemble the D-1011 and D-1012 pump is to set up the adapter (71) with inboard adapter support (53A) and outboard adapter support (53B) horizontally on a work surface of convenient height.
5. Install the bearing frame assembly on the adapter (71) and tighten 4 capscrews holding the two together.
6. Install the inner shaft sleeve gasket (38A) against the shaft shoulder. Don't let it be cut by the sharp edges of the keyway. On Frame 1 pumps only install shaft sleeve key (14A).
7. Install the shaft sleeve (14) on the shaft (6).
8. If pump is equipped with a mechanical seal install the seat (65) in the gland (17A) and coat the lapped face with clean oil.
9. Place the gland (17 or 17A) on the shaft against the deflector (40).
10. Cover ring (27) should be installed in stuffing box cover (11) at this point. The ring should be pressed in beveled edge first using a pressing tool which will hold the ring square with the stuffing box cover bore. Gland studs (83) and cooling cap (11B) should be installed now.
11. Install packing (13) and lantern ring (29) in stuffing box (11). Include stuffing box bushing (63) on Frame 1 pumps. Packing arrangement is shown in Fig. 3.
12. If pump is equipped with a mechanical seal, the rotor (80) should be installed on the sleeve now. Bellows type seals such as Crane Type 1 as well as chemical seals such as Crane Type 9 and Durametallic Type ROTT are positioned by set screws. Setting dimensions are given in Fig. 6.
13. Place gasket (73A) and O-Ring (73B) in place on stuffing box cover (11) for frame 1 and 2 cooling jacket series pumps. Larger cooling plate series pumps use no gasket between adapter (71) and stuffing box cover (11).

STANDARD FRAME



BEARING FRAME ASSEMBLY IDENTIFICATION

Frame	1		2		3		4		5	
	IN.	CM.	IN.	CM.	IN.	CM.	IN.	CM.	IN.	CM.
"A"	2 15/16	7.461	4 1/16	10.319	5 1/8	13.02	6 1/2	16.5	7 13/16	19.8
"B" Dia.	7/8	2.223	1	2.54	1 1/8	2.86	1 3/4	4.45	2 3/8	6.03
Standard Sleeve Dia.	1 1/8	8.858	1 3/8	3.493	1 3/4	4.45	2 1/8	5.4	2 3/4	6.99

OPTIONAL FRAME ACCESSORIES

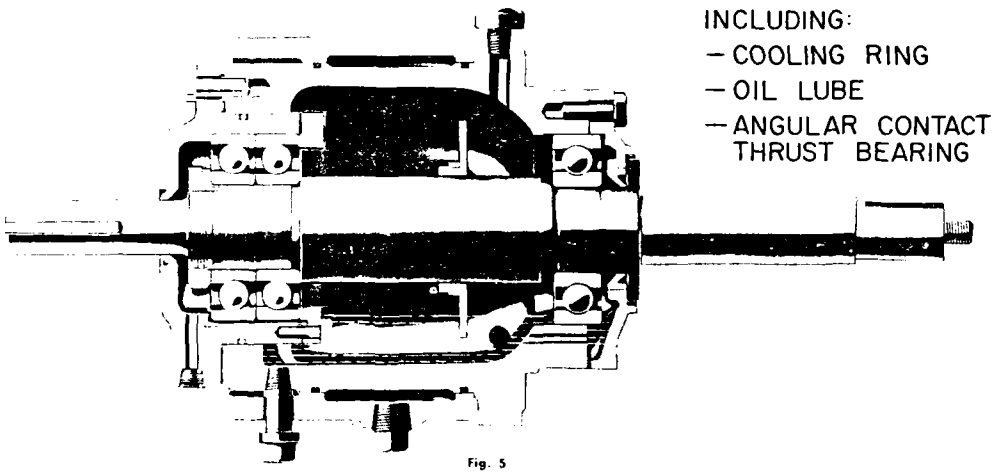


Fig. 5

14. Install stuffing box cover on adapter and install cap screws holding the two together. Some smaller size pumps use small retainer plates under these cap screws.

15. Install the impeller key (32) first twisting the shaft sleeve (14) on the shaft (6) until both keyways line up.

16. Install the shaft sleeve gasket (38).

17. Place the impeller (2) on the shaft (6) engaging the impeller key (32).

18. Put the impeller lockwasher gasket (30), impeller nut lockwasher (24A) and impeller nut gasket (28) on the end of the shaft (6) in that order. If the pump has an inducer (2A) only the impeller lockwasher gasket (30) is used.

19. Push the impeller back against the sleeve and thread the inducer (2A) or impeller locknut (24) on hand tight. If threads are damaged the locknut or inducer will not go on all the way. Before tightening the assembly check for any axial looseness of the impeller. If there is none, tighten the impeller locknut (24) or inducer (2A) using a suitable fixture to keep the shaft from turning.

20. Crimp the impeller lockwasher against one of the flats of the impeller locknut with a pair of vice-grip pliers. Do not use a hammer. No such crimping is needed with the inducer.

21. Install the casing gasket (73) on the shoulder of the stuffing box cover (11).

22 Install the casing (1) and tighten all casing cap screws.

23 Turn the pump shaft and check for any binding or rubs caused by such things as damaged or misaligned parts. Any such conditions must be corrected before the pump is run.

The pump is now ready for installation. Follow procedures given in previous sections of this book.

ASSEMBLY PROCEDURE— ALL D-1012 PUMPS

The D-1012 pump is easy to put together. The hardest part requiring the most care is installation of the mechanical seal parts on pumps equipped with mechanical seals.

1. Study the sectional diagram, and become familiar with the name of each part.

2. Make sure all of the parts are clean and ready for assembly. This means no dirt or pieces of old gasket in the joints between the frame adapter and casing. Make sure the parts around the mechanical seals are clean. Dirt and misalignment will ruin a mechanical seal.

3. See page 13 for assembly of bearing frame. This must be completed before assembly of the rest of the pump.

4. The easiest way to assemble the D-1011 and D-1012 pumps is to set up the adapter (71) with inboard adapter support (53A) and outboard adapter support (53B) horizontally on a work surface of convenient height.

5. Install the bearing frame assembly on the adapter (71) and tighten 4 capscrews holding the two together.

6. Install the inner shaft sleeve gasket (38A) against the shaft shoulder. Don't let it be cut by the sharp edges of the keyway. On Frame 1 pumps only install shaft sleeve key (14A).

7. Install the shaft sleeve (14) on the shaft (6).

8. Cover Ring (27) should be installed in mechanical seal cover (11A) at this point. The ring should be pressed in beveled edge first using a pressing tool which will hold the ring square with the stuffing box cover bore.

9. Install the seat (65) in the mechanical seal cover (11A) and coat the lapped face with clean oil. Chemical seals may have a clamped seat which is held in place by a kind of gland which is bolted to the outside of the mechanical seal cover (11A).

10. Install mechanical seal cover (11A) on adapter (71) and install cap screws holding the two together. Some smaller size pumps use small retainer plates under these cap screws.

11. The rotor (80) should be installed on the sleeve now. Bellows type seals are positioned by a retaining ring (211). Chemical seals such as Crane Type 9 and Durametallic Type ROTT are positioned by set screws. Setting dimensions are given in Fig. 6.

12. Install the impeller key (32) first twisting the shaft sleeve (14) on the shaft (6) until both keyways line up.

13. Intall the shaft sleeve gasket (38).

14. Place the impeller (2) on the shaft (6) engaging the impeller key (32).

15. Put the impeller lockwasher gasket (30), impeller nut lockwasher (24A) and impeller nut gasket (28) on the end of the shaft (6) in that order. If the pump has an inducer (2A) only the impeller lockwasher gasket (30) is used.

16. Push the impeller back against the sleeve and thread the inducer (2A) or impeller locknut (24) on hand tight. If threads are damaged the locknut or inducer will not go on all the way. Before tightening the assembly check for any axial looseness of the impeller. If there is none, tighten the impeller locknut (24) or inducer (2A) using a suitable fixture to keep the shaft from turning.

17. Crimp the impeller lockwasher against one of the flats of the impeller locknut with a pair of vise-grip pliers. Do not use a hammer. No such crimping is needed with the inducer.

18. Install the casing gasket (73) on the shoulder of the mechanical seal cover (11A).

19. Install the casing (1) and tighten all casing cap screws.

20. Turn the pump shaft and check for any binding or rubs caused by such things as damaged or misaligned parts. Any such conditions must be corrected before the pump is run.

The pump is now ready for installation. Follow procedures given in previous sections of this book.

PROCEDURE FOR SETTING OPEN VANE IMPELLER CLEARANCE

The type D-1011 and D-1012 Pumps are available with open vane impellers. In order to obtain satisfactory hydraulic performance, the axial clearance between the open vane impeller and the wear plate must be carefully set. Please refer to the open Impeller and frame assembly illustrations, and follow the step by step procedure outlined below.

SHIMMING OPEN VANE IMPELLER

A. Loosen bolts in thrust bearing cover or thrust bearing cartridge cover and pull back away from bearing housing.

B. Tap impeller nut or inducer with mallet so that shaft assembly moves towards bearing housing approximately ¼".

C. Tighten casing bolts in a diagonal pattern with wrench.

D. Tap coupling end of shaft assembly with mallet until impeller and casing wear plate make contact.

E. Tap impeller nut or inducer with mallet in small increments, checking each time for interference relief between impeller and casing wear plate.

F. When interference no longer resides, use feeler gage and measure clearance between snap ring of thrust bearing and face of bearing housing. Note: On pump assemblies with thrust bearing cartridge covers, measure clearance between cover face and bearing housing face.

G. Add .015 to measurement established with feeler gage and select shims of the total value. (Shim value = .015 + Result of Oper. No. F)

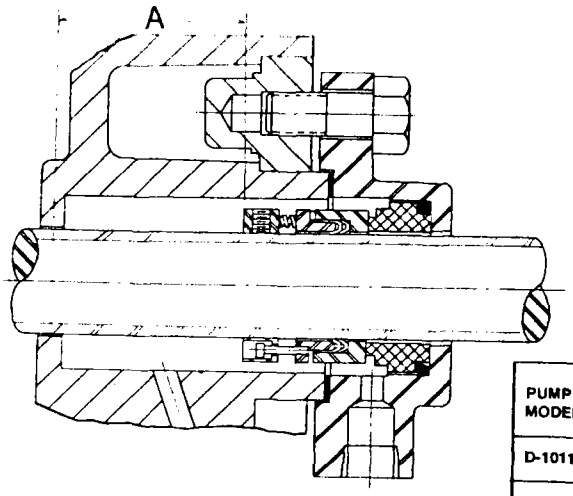
H. Assemble shims under snap ring of bearing or between thrust bearing cartridge cover face and bearing housing face.

I. Replace housing cover and tighten bolts in a diagonal pattern.

MECHANICAL SEAL SETTING DIMENSIONS

FOR CLOSED IMPELLER PUMPS ONLY

"A" Dimension on sketch shows location of seal rotor with respect to end of shaft sleeve, or shoulder on shaft when sleeveless design is used.



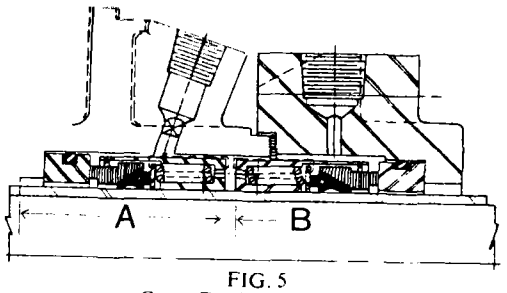
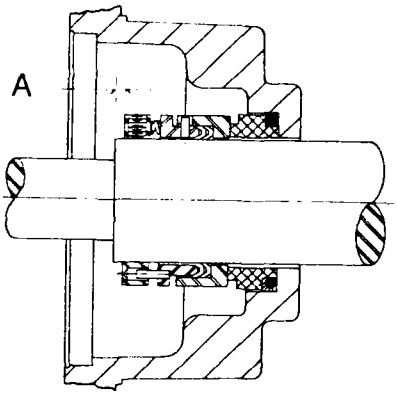


FIG. 5
Crane Double Type 9 Seal
in Convertible Stuffing Box
(D-1011, D-1021)



PUMP MODEL	FRAME SIZE	1		2*		3*		4*		5	
	TYPE OF SEAL (INTERNAL)	"A"		"A"		"A"		"A"		"A"	
		IN.	CM.	IN.	CM.	IN.	CM.	IN.	CM.	IN.	CM.
D-1011	Crane Type 1 With O-Ring Seat	0.945	2.40	1.513	3.843	1.278	3.246	1.153	2.878	1.544	3.922
D-1011	Crane Type 9 With O-Ring Seat	1.883	4.783	2.138	5.431	2.215	5.626	2.320	5.89	3.710	9 423
D-1011	Crane Type 9 With Clamped Seat	1.183	3.005	1.078	2.738	1.588	4.034	1.275	3.239	2.325	5 906
D-1011	Dura ROTT With O-Ring Seat	1.31	3.327	1.86	4.724	1.90	4.826	2.15	5.46	2.79	7.087
D-1011	Dura ROTT With Clamped Seat	0.68	1.727	0.95	2.413	1.34	3.404	1.34	3.40	2.14	5.44
D-1011	Double Crane Type 9 With O-Ring Seats	1.507 B=3/8	3.83 B=.95	1.882 B=1/4	4.780 B=.64	1.945 B 9/32	4.940 B=.71	2.32 B=0	5.89 B=0	2.482 B=5/8	6.30 B=1.59

	TYPE OF SEAL (INTERNAL)	1		2		3		4		5	
		"A"		"A"		"A"		"A"		"A"	
		IN.	CM.	IN.	CM.	IN.	CM.	IN.	CM.	IN.	CM.
	Crane Type 9 With O-Ring Seat	0.593	1.506	0.228	0.579	0.415	1.054	.500	1.270	.748	1.900
	Dura RO & ROTT With O-Ring Seat	0.0	0.0	0.0	0.0	0.10	0.25				

For Open Impeller Pumps, "A" Dimension Must Be Decreased By The Amount Of Adjusting Shims.

SECTION V
ORDERING REPAIR PARTS

ORDERING REPAIR PARTS

When ordering repair parts for the pump liquid end, please give the full nameplate data from the pump nameplate as described on Page 2 of this manual; that is:

1. Model: D-1011 or D-1012
2. Size
3. Serial Number
4. Impeller Diameter
5. Frame Size

Complete nameplate data will insure most rapid handling of your order with minimum chance of a mistake. Note that the serial number determines exactly which parts go into a pump with the exception of the impeller diameter which is therefore shown separately on the nameplate. Itemize each part required using the reference number and name of part as shown on the following pages. Be sure to state the number of parts required.

RETURNING PARTS

All materials returned to the factory must have a Return Material Authorization. Consult the nearest Worthington representative for shipping instructions and a Return Material Order Number.

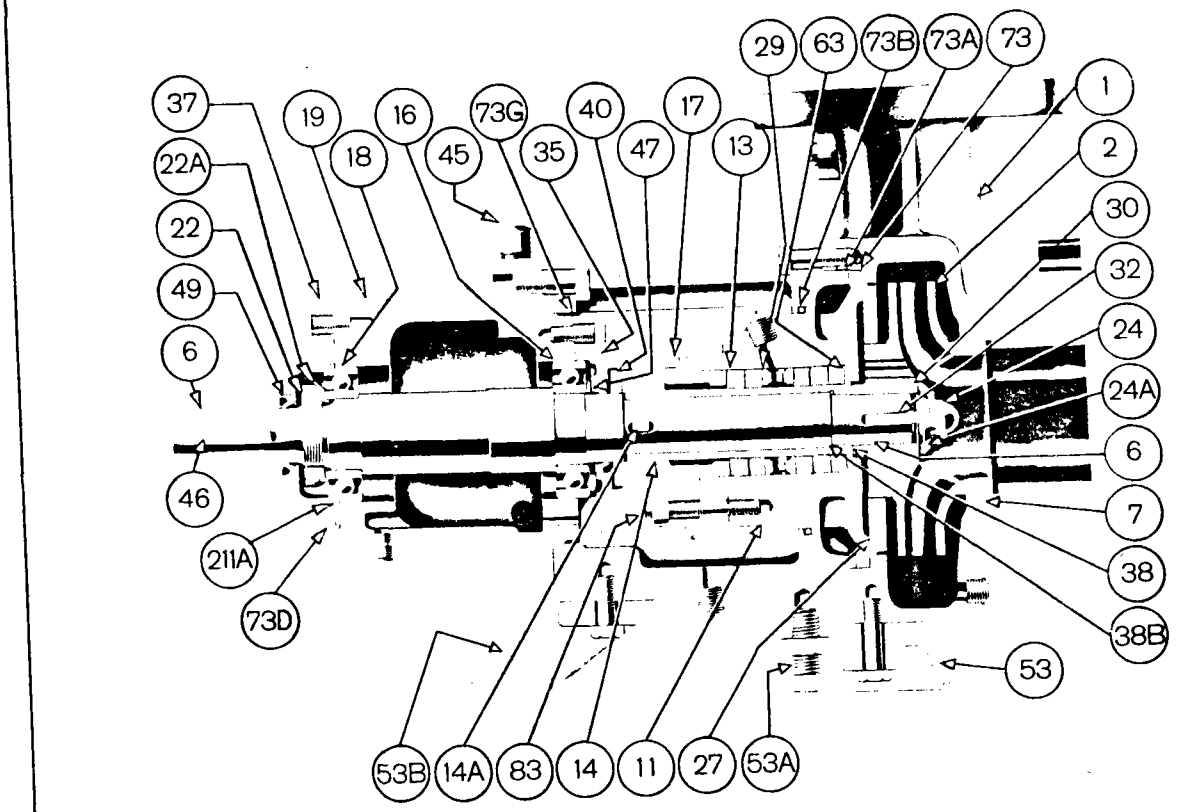
Unnecessary delays are avoided when parts or equipment are returned to the factory using the correct procedure.

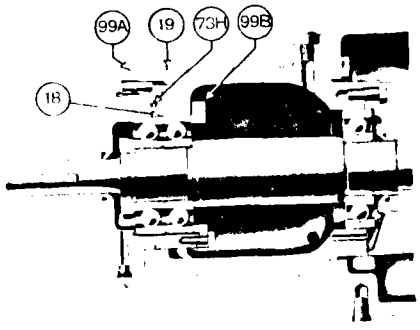
1. Contact your nearest Worthington representative, listing the material to be returned and the reasons for returning it. Make sure you give the name of the part and the part number involved and the serial number of the equipment. Give the method and date of shipment. This will notify the factory that the material is en route.

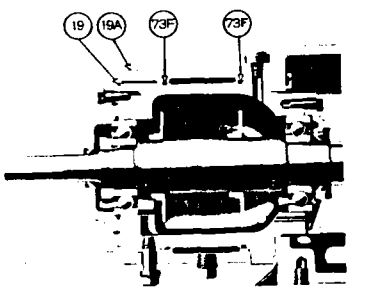
2. On receipt of the Return Material Order Number, mark or tag the material to be returned with this order number. In cases where more than one part or box is returned, print or stencil your name and the Return Material Order Number on each part or box. This will facilitate quick identification.

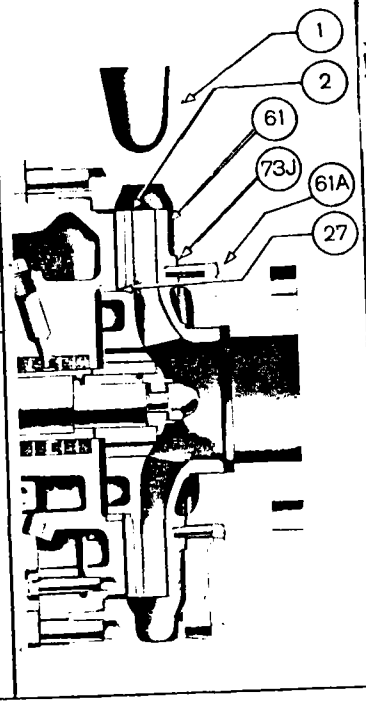
3. Articles being returned should be carefully packed to prevent damage from handling or from the exposure to weather.

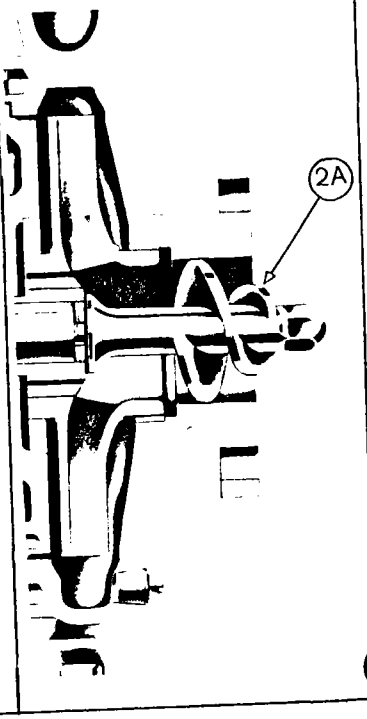
LIST OF PARTS—MODEL D-1011
FRAME 1, 2, 3 COOLING JACKET SERIES
(All Frame 1, Frame 2 except 3x1 ½x13 and 3x2x13, Frame 3 3x2x6, 4x3x6 and 6x4x6 only)

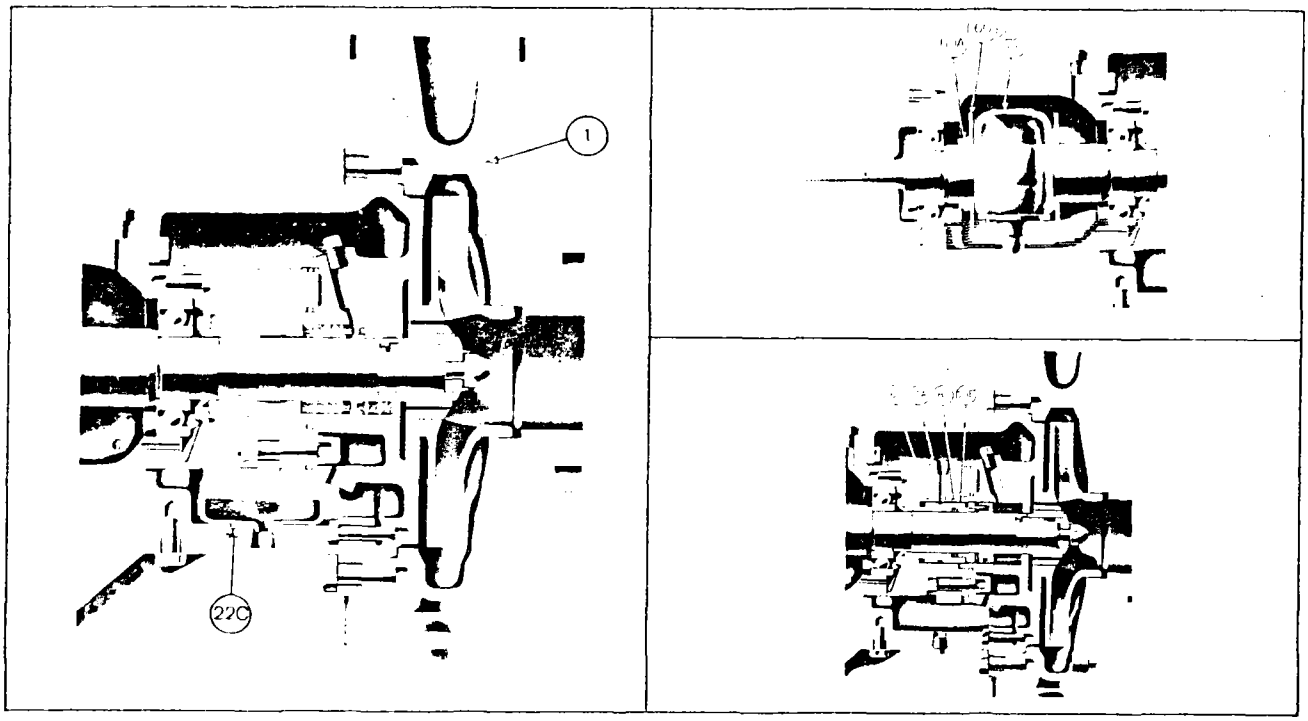










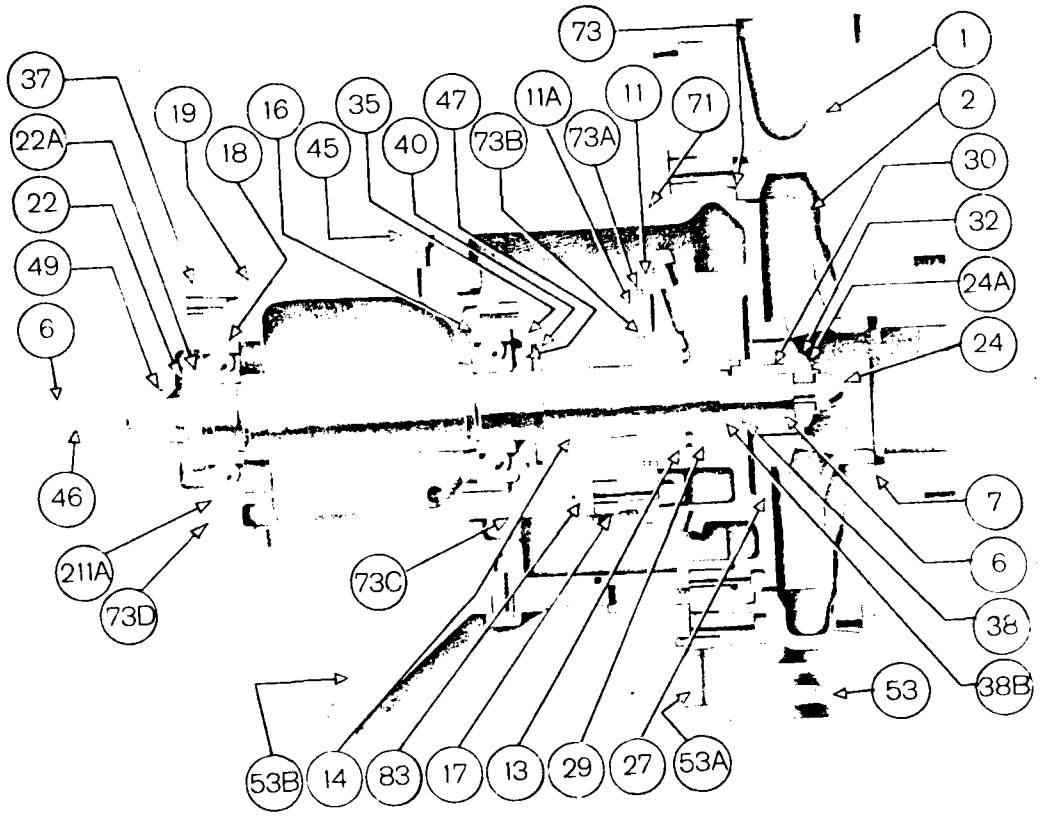


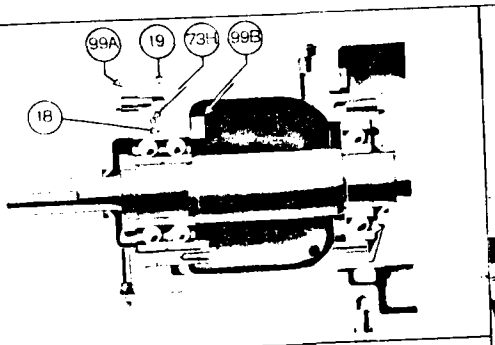
	Item No.	Name of Part
	1	Casing
x	2	Impeller
x	2A	Inducer
x	6	Shaft
x	7	Ring, Casing
	11	Cover, Stuffing Box
o	13	Packing
o	14	Sleeve, Shaft
x	14A	Key, Shaft Sleeve (Frame 1 only)
o	16	Bearing (Line)
	17	Gland, Packing
	17A	Gland, Mechanical Seal
o	18	Bearing (Thrust)
	19	Housing, Bearing
	19A	Ring, Cooling, Brg. Hsg.
x	22	Locknut, Bearing
o	22A	Lockwasher, Bearing Nut
	22C	Pan, Drip
x	24	Locknut, Impeller
x	24A	Lockwasher, Impeller Nut
x	27	Ring, Adapter and Cover
o	28	Gasket, Impeller Nut
o	29	Ring, Lantern
o	30	Gasket, Imp. Lockwasher
x	32	Key, Impeller
	35	Cover, Line Bearing
	37	Cover, Thrust Bearing
o	38B	Gasket, Sleeve (Inner) (all but Fr. 1)
x	40	Deflector
	45	Cap, Vent
x	46	Key, Coupling
o	47	Seal, Lip (Line Bearing)

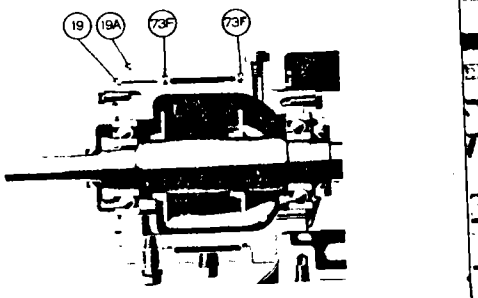
	Item No.	Name of Part
o	49	Seal, Lip (Thrust Bearing)
	53	Foot, Casing
	53A	Support, Adapter (Inboard)
	53B	Support, Adapter (Outboard)
x	60	Slinger, Oil
	60A	Collar, Oil Ring
x	61	Wear Plate
x	61A	Stud, Wearplate
o	65	Seat (Mechanical Seal)
	63	Bushing, Stuffing Box (Frame 1 Packed Box Only)
	71	Adapter
o	73	Gasket, Casing
o	73A	Gasket, Stuffing Box Cover
o	73B	Ring 'O',, Cooling Jacket
o	73D	Ring, Seal, Bearing Cover
o	73E	Gasket, Gland M.S.
o	73F	Ring 'O', Cooling Ring
o	73G	Gasket, Bearing Cover
o	73H	Ring 'O', Thrust Bearing Cart
o	73J	Gasket, Wear Plate
	77	Lubricator
o	80	Rotor, Mech. Seal
	83	Stud, Gland
	99A	Cartridge, Bearing
	99B	Ring, Bearing Retaining (Angular Cont. Bearings)
o	211	Ring, Retaining (Mech. Seal Rotor)
	211A	Ring, Retaining (an integral part of 18-Bearing (Thrust) not available separately)

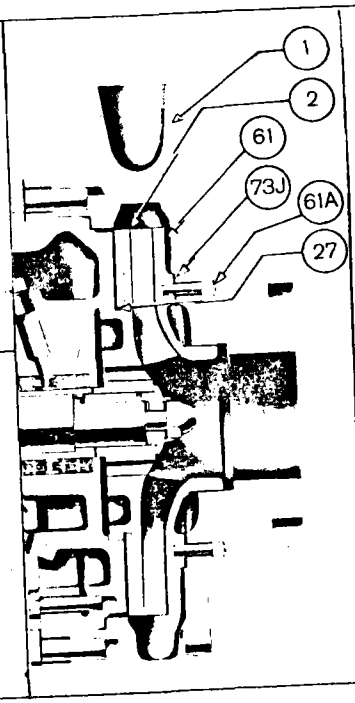
o These parts recommended as spare parts to be carried by user
x Spare parts in addition to above—export only

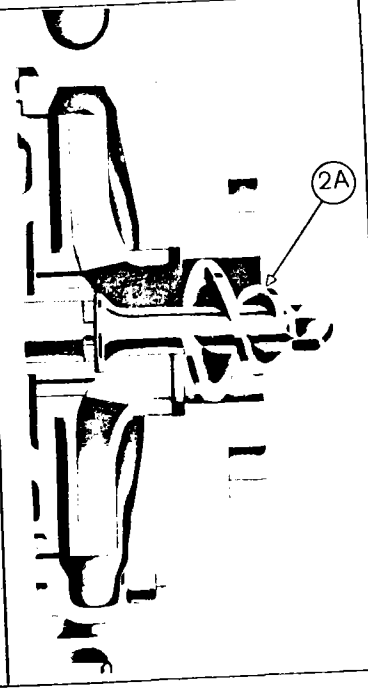
LIST OF PARTS—MODEL D-1011
FRAME 2, 3, 4, 5, COOLING CAP SERIES
(Frame 2 3x1½x13 and 3x2x13 only, Frame 3 all except 3x2x6, 4x3x6, 6x4x6
All Frame 4 and 5)

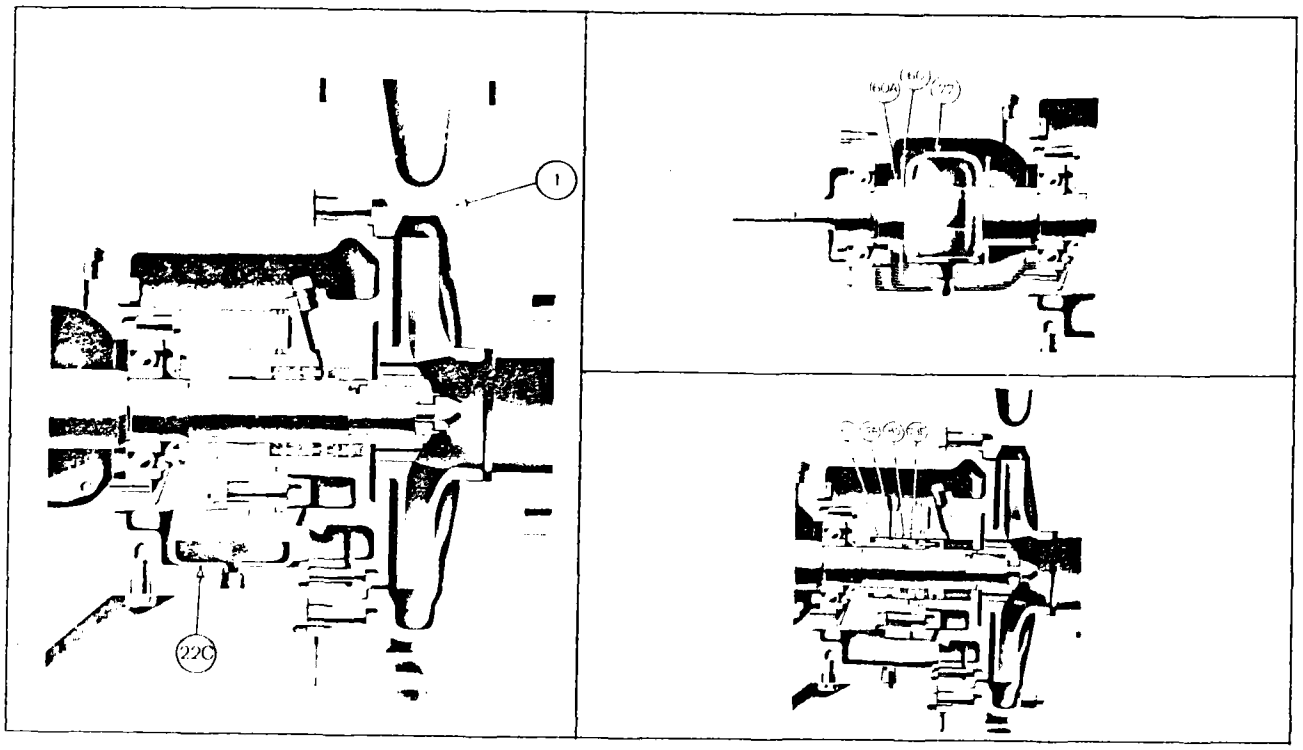










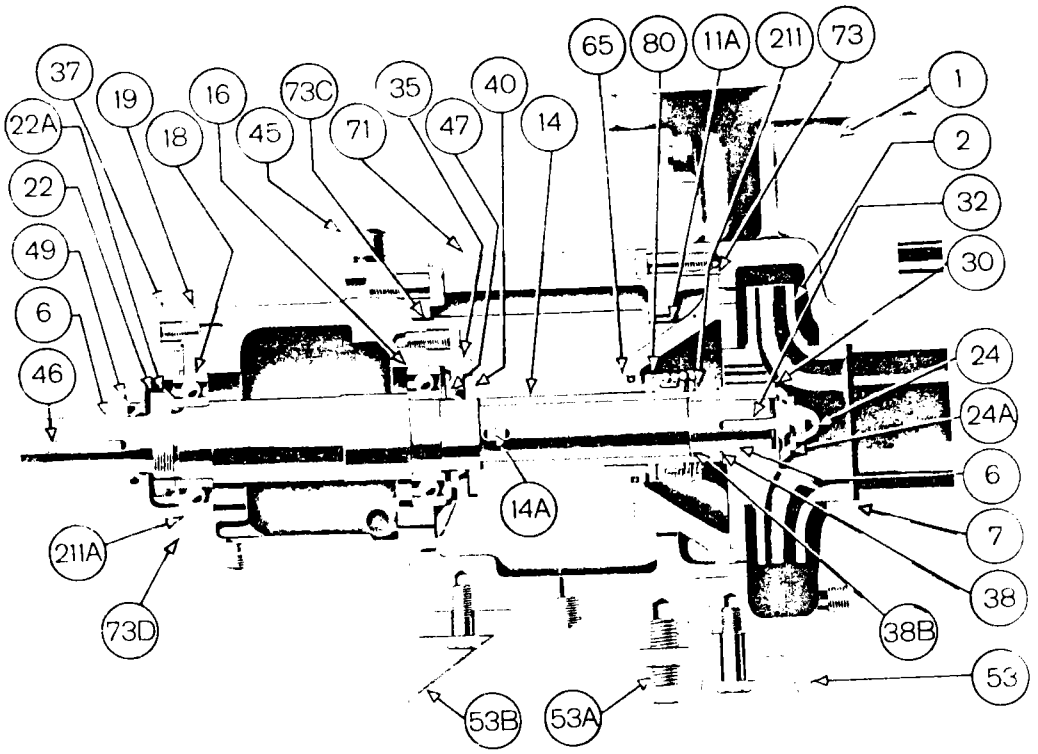


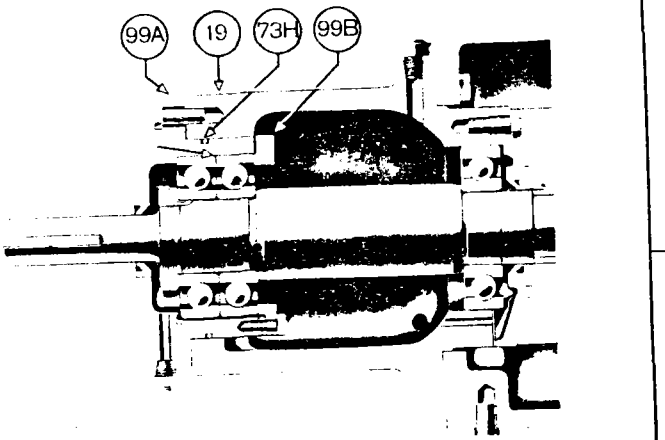
	Item No.	Name of Part
	1	Casing
x	2	Impeller
x	2A	Inducer
x	6	Shaft
x	7	Ring, Casing
	11	Cover, Stuffing Box
	11B	Cap, Cooling
o	13	Packing
o	14	Sleeve, Shaft
o	16	Bearing (Line)
	17	Gland, Packing
	17A	Gland, Mechanical Seal
o	18	Bearing (Thrust)
	19	Housing, Bearing
	19A	Ring, Cooling, Brg. Hsg.
x	22	Locknut, Bearing
o	22A	Lockwasher, Bearing Nut
	22C	Pan, Drip
x	24	Locknut, Impeller
x	24A	Lockwasher, Impeller Nut
x	27	Ring, Adapter and Cover
o	28	Gasket, Impeller Nut
o	29	Ring, Lantern
o	30	Gasket, Imp. Lockwasher
x	32	Key, Impeller
	35	Cover, Line Bearing
	37	Cover, Thrust Bearing
o	38	Gasket, Sleeve (Outer)
o	38B	Gasket, Sleeve (Inner) (all but Fr. 1)
x	40	Deflector
	45	Cap, Vent

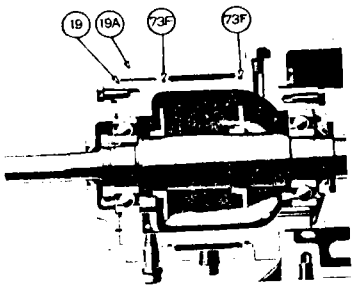
	Item No.	Name of Part
x	46	Key, Coupling
o	47	Seal, Lip (Line Bearing)
o	49	Seal, Lip (Thrust Bearing)
	53	Foot, Casing
	53A	Support, Adapter (Inboard)
	53B	Support, Adapter (Outboard)
x	60	Slinger, Oil
	60A	Collar, Oil Ring
x	61	Wear Plate
x	61A	Stud, Wearplate
o	65	Seat (Mechanical Seal)
	71	Adapter
o	73	Gasket, Casing
o	73A	Ring 'O', Cooling Cap (Outer)
o	73B	Ring 'O', Cooling Cap (Inner)
o	73D	Ring, Seal, Bearing Cover
o	73E	Gasket, Gland M.S.
o	73F	Ring 'O', Cooling Ring
o	73G	Gasket, Bearing Cover
o	73H	Ring 'O', Thrust Bearing Cart
o	73J	Gasket, Wear Plate
	77	Lubricator
o	80	Rotor, Mech. Seal
	83	Stud, Gland
	99A	Cartridge, Bearing
	99B	Ring, Bearing Retaining (Angular Cont. Bearings)
o	211	Ring, Retaining (Mech. Seal Rotor)
	211A	Ring, Retaining (an integral part of 18-Bearing (Thrust) not available separately)

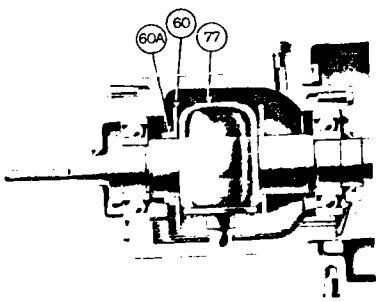
o These parts recommended as spare parts to be carried by user
x Spare parts in addition to above—export only

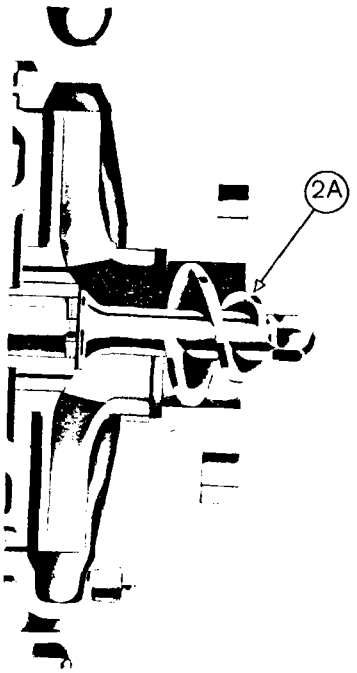
LIST OF PARTS—MODEL D-1012
ALL FRAMES 1, 2, 3, 4, 5

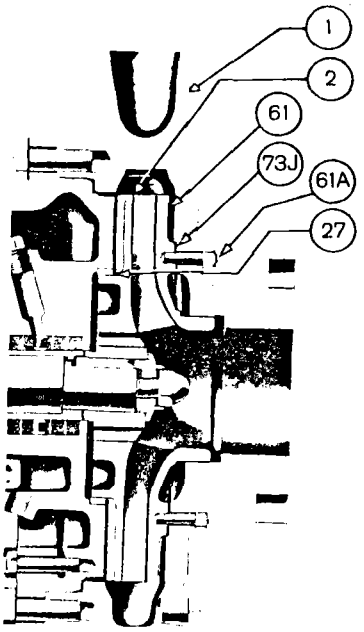












	Item No.	Name of Part
	1	Casing
x	2	Impeller
x	2A	Inducer
x	6	Shaft
x	7	Ring, Casing
	11A	Cover, Mechanical Seal
x	14	Sleeve, Shaft
x	14A	Key, Shaft Sleeve (Frame 1 only)
o	16	Bearing (Line)
o	18	Bearing (Thrust)
	19	Housing, Bearing
	19A	Ring, Cooling, Brg. Hsg.
x	22	Locknut, Bearing
o	22A	Lockwasher, Bearing Nut
x	24	Locknut, Impeller
x	24A	Lockwasher, Impeller Nut
x	27	Ring, Adapter and Cover
o	28	Gasket, Impeller Nut
o	30	Gasket, Imp. Lockwasher
x	32	Key, Impeller
	35	Cover, Line Bearing
	37	Cover, Thrust Bearing
o	38	Gasket, Sleeve (Outer)
o	38B	Gasket, Sleeve (Inner) (all but Fr. 1)
x	40	Deflector
	45	Cap, Vent
x	46	Key, Coupling

	Item No.	Name of Part
o	47	Seal, Lip (Line Bearing)
o	49	Seal, Lip (Thrust Bearing)
	53	Foot, Casing
	53A	Support, Adapter (Inboard)
	53B	Support, Adapter (Outboard)
x	60	Slinger, Oil
	60A	Collar, Oil Ring
x	61	Wear Plate
x	61A	Stud, Wearplate
o	65	Seat (Mechanical Seal)
	71	Adapter
o	73	Gasket, Casing
o	73D	Ring, Seal, Bearing Cover
o	73F	Ring 'O', Cooling Ring
o	73G	Gasket, Bearing Cover
o	73H	Ring 'O', Thrust Bearing Cart
o	73J	Gasket, Wear Plate
	77	Lubricator
o	80	Rotor, Mech. Seal
	99A	Cartridge, Bearing
	99B	Ring, Bearing Retaining (Angular Cont. Bearings)
o	211	Ring, Retaining (Mech. Seal Rotor)
	211A	Ring, Retaining (an integral part of 18-Bearing (Thrust) not available separately)

o These parts recommended as spare parts to be carried by user
x Spare parts in addition to above—export only

1.2.10 Separator Waste Water Pumps

1.2.10.1 Identification

Tag Number	Description
P711 & P712	Separator Waste Water Pumps

1.2.10.2 Description

Manufacturer:	Aurora Pumps North Aurora, Illinois 60542
Part NO:	Model 532A, 2-1/2 x 3 x 12
Spec NO:	DOE Dwg 40M7006S, CP 9
Material:	

1.2.10.3 Prescribed Service

Oil/Water Mixture

1.2.10.4 Vendor

Hambrick-Jones-Ferguson & Assoc
Tulsa, Oklahoma

1.2.10.5 Special Cautions

See Aurora Pump Manual (following)

1.2.10.6 Periodic Service

See Aurora Pump Manual (following)

1.2.10.7 Parts List

See Aurora Pump Manual (following)

1.2.10.8 Special Tools

None

1.2.10.9 Maintenance

See Aurora Pump Manual (following)

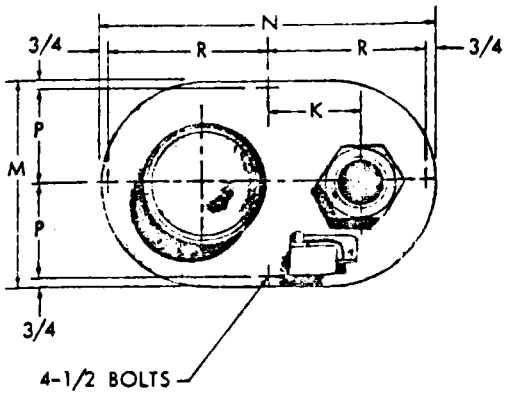
1.2.10.10 Acceptance Test

None

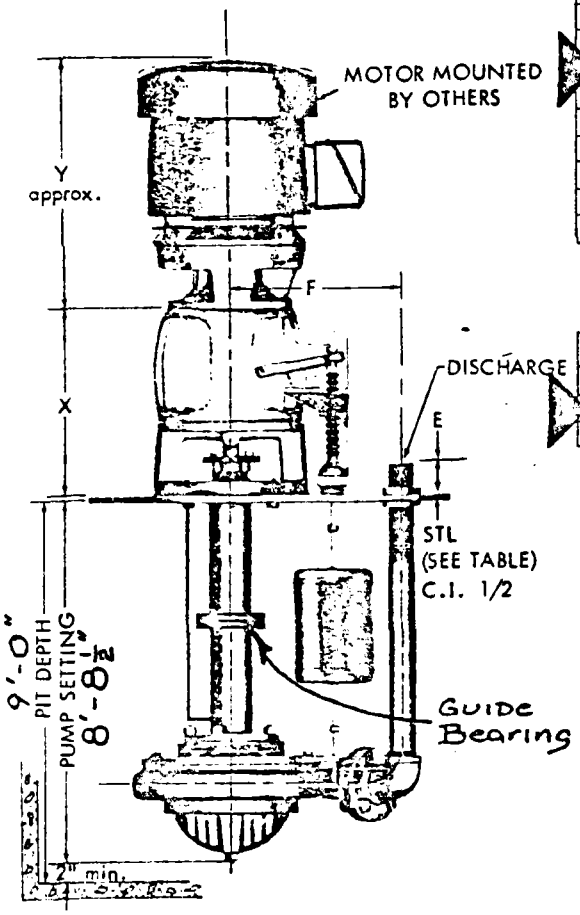
ON OVAL PLATE

DATED MARCH 1975

SUPERSEDES PAGE 251
DATED DECEMBER 1972



PUMP SIZE			E	F	K	OVAL SIZE	THK. STL.
DISCH	SUCTION	CASE BORE					
1¼	1½	7	3¼	8 3/16	5 11/16	20 X 24	¼
1¼	1½	9	3¼	9 13/16	7 7/16	20 X 24	¼
1½	2	7	3 7/16	8½	6	20 X 24	¼
1½	2	9	3 7/16	10¼	7¾	20 X 24	¼
1½	2	12	3 7/16	12 7/16	9 7/16	22 X 28	¼
2	2½	7	4 7/16	10 7/16	7 13/16	20 X 24	¼
2	2½	9	4¼	12	9	22 X 28	¼
2	2½	12	3 13/16	13 11/16	10 11/16	22 X 28	¼
2½	3	7	4 7/16	11¼	8¼	22 X 28	¼
2½	3	9	4 7/16	12 11/16	9 13/16	22 X 28	¼
2½	3	12	3 13/16	14¼	9	22 X 28	¼
3	4	9	4 7/16	13 11/16	8 7/16	22 X 28	¼
3	4	12	4 7/16	15 7/16	9 13/16	22 X 28	¼
4	4	7	4 7/16	13¾	8¼	22 X 28	¼
4	5	9A	4 7/16	14⅜	8⅞	22 X 28	¼
4	5	9B	4 7/16	15¼	9¼	22 X 28	¼
6	6	9	5¼	14¼	8¼	22 X 28	¼



OVAL	M	N	P	R
20 X 24	20	24	9¼	11¼
22 X 28	22	28	10¼	13¼

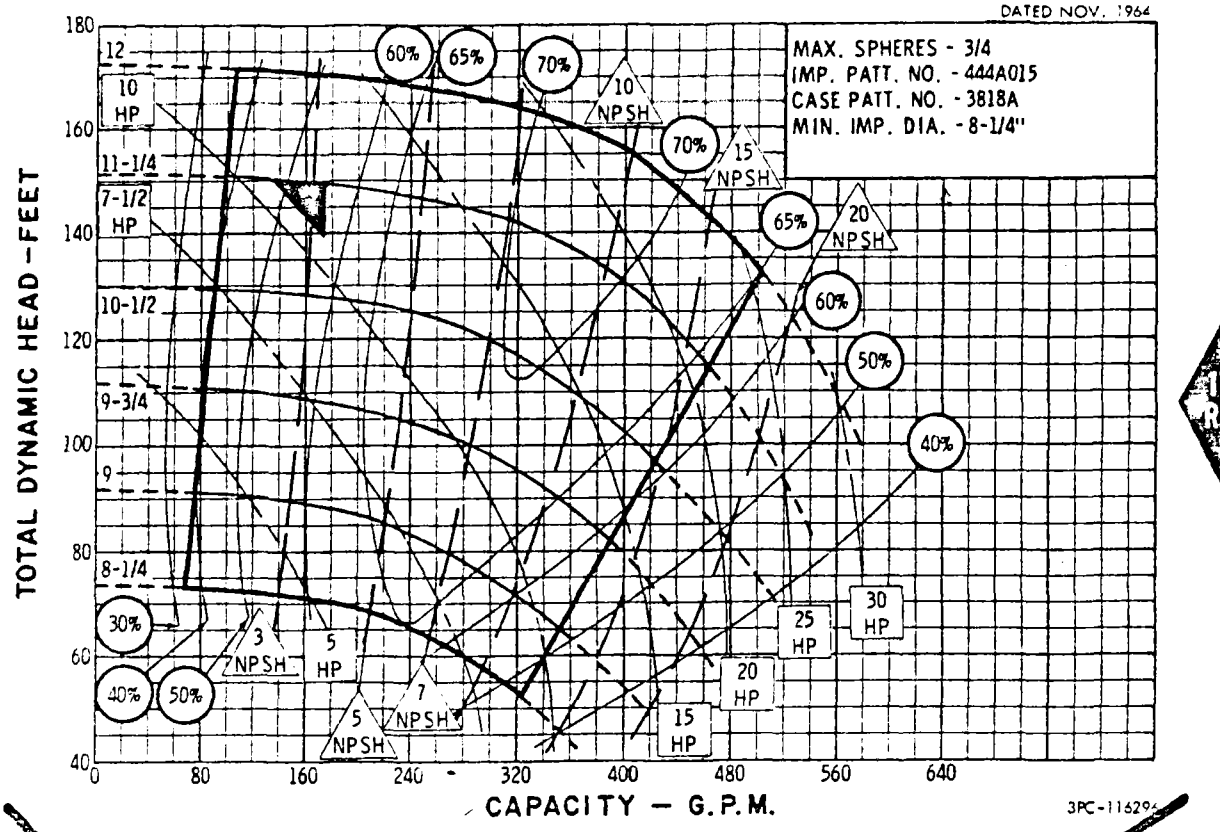
FRAME	X	Y
143HP	13⅞	11
145HP	13⅞	12
182HP	13⅞	13
184HP	13⅞	14
213HP	13⅞	16
215HP	13⅞	17
254HP	13⅞	19
256HP	13⅞	21
284HPH	15⅛	21
286HPH	15⅛	23
324HP	15⅛	24

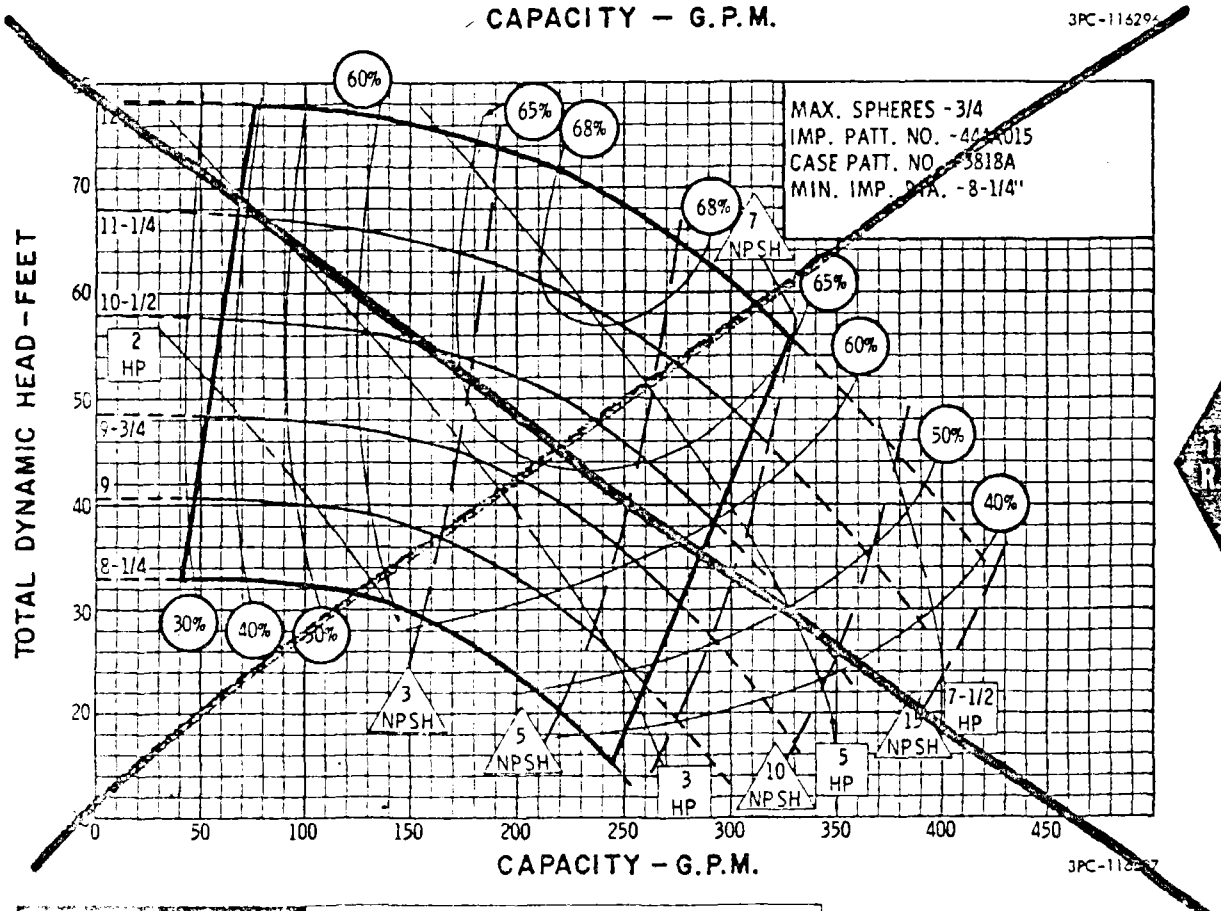
NOTES:
1. ALL DIMENSIONS IN INCHES.
2. DIMENSIONS MAY VARY ±1/8.
3. NOT FOR CONSTRUCTION PURPOSES UNLESS CERTIFIED.
4. FLOAT SWITCH FURNISHED ONLY WHEN SPECIFIED.
5. LINE SHAFT BEARING FURNISHED ON 6' 2" PUMP SETTINGS AND LONGER.
6. 22 X 28 OVALS ARE ALSO AVAILABLE WHERE 20 X 24 OVALS ARE SHOWN.

AURORA PUMP
A UNIT OF GENERAL SIGNAL
800 AIRPORT ROAD · NORTH AURORA, ILLINOIS · 60542

ENCLOSED IMPELLER

DATED DECEMBER 1971
SUPERSEDES PAGE 411
DATED NOV. 1964





AURORA PUMP
A UNIT OF GENERAL SIGNAL CORPORATION
AURORA · ILLINOIS

CURVES

INSTRUCTION MANUAL
REPAIR
MODEL 531-532 (NSB)

6

SERVICE

Your Aurora pump requires no maintenance other than periodic inspection, occasional cleaning and lubrication. The intent of inspection is to prevent breakdown, thus obtaining optimum service life. The pump bearing is grease lubricated and requires periodic lubrication as does the lower head bearing. The motor may also require lubrication, in which case, the motor manufacturer's recommendation should be followed.

LUBRICATION (BALL BEARINGS)

Regreasable bearings will require periodic lubrication and can be accomplished by using the zerk or lubrication fittings in the lower head assembly. Lubricate the bearings at regular intervals using a grease of high quality. Lithium, lithium soda or calcium base grease is recommended as lubricants for pumps operating in both wet and dry locations. Mixing of different brands of grease should be avoided due to possible chemical reactions between the brands which could damage the bearing. Accordingly, avoid grease of vegetable or animal base which can develop acids, as well as grease containing rosin, graphite, talc and other impurities. Under no circumstances should grease be reused.

Over lubrication should be avoided as it may result in overheating and possible bearing failure. Under normal application, adequate lubrication is assured if the amount of grease is maintained at 1/3 to 1/2 the capacity of the bearing and adjacent space surrounding it.

In dry locations each bearing will need lubrication at least every 4,000 hours of running time or every 6 to 12 months, whichever is more frequent. In wet locations the bearings should be lubricated at least after every 2,000 hours of running time or every 4 to 6 months, whichever is more frequent. A unit is considered to be installed in a wet location if the head assembly and motor are exposed to dripping water, to the weather, or to heavy condensation such as is found in unheated and poorly ventilated underground locations.

At times it may be necessary to clean the bearings due to accumulated dirt or deteriorated lubricants. This can be accomplished by flushing the bearing with a light oil heated to 180 to 200° F. while rotating it on a spindle. Wipe the bearing housing with a clean rag soaked in a cleaning solvent, and flush all surfaces.

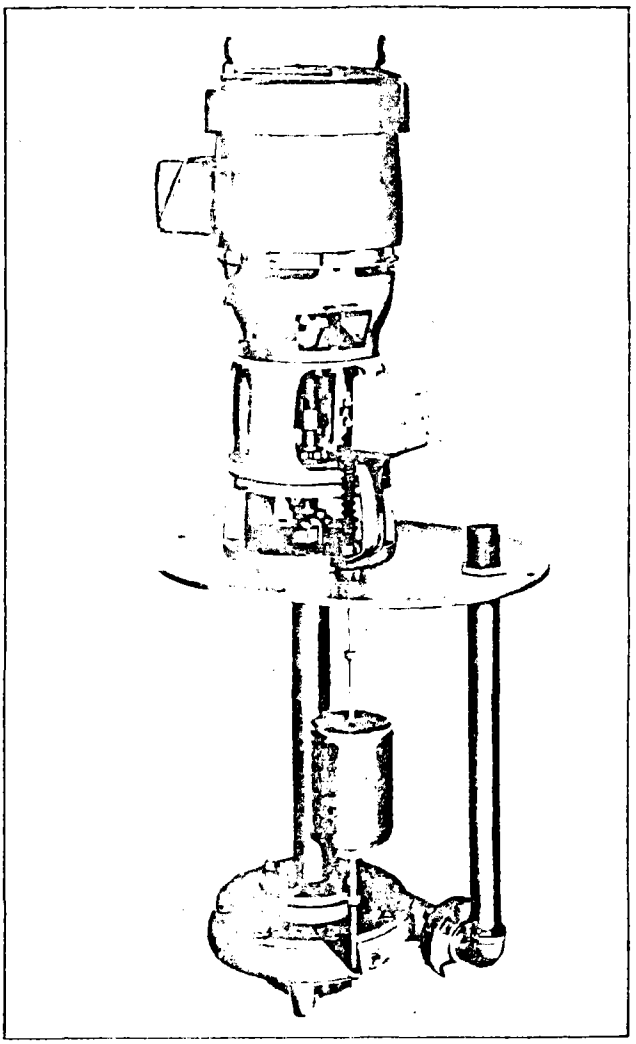
Dry bearing thoroughly before relubricating. Compressed air can be used to speed drying, but care should be taken not to let bearings rotate while being dried.

CAUTION

Use normal fire caution procedures when using any petroleum cleaner.

LUBRICATION (LINE SHAFT & PUMP BEARINGS)

Grease lubricated sleeve bearings will require frequent lubrication which can be accomplished by using the zerk fitting(s) located on the pump base. It is suggested that relubrication intervals be every 20 hours of running time. Sleeve bearings are not susceptible to over lubrication as is the case with ball bearings.



A. Complete unit assembly.

REPAIRS

The pump may be disassembled using the illustrations and text provided. Although complete disassembly is covered, it will seldom be necessary to completely disassemble your Aurora pump.

The illustrations accompanying the disassembly instructions show the pump at various stages of disassembly. The illustrations are intended to aid in the correct identification of the parts mentioned in the text.

Inspect removed parts at disassembly to determine their reusability. Pump or line shaft bearings that are scored or noticeably out of round should not be reassembled. Cracked castings should never be reused and scored or worn pump shafts should be replaced.

All packings and gaskets should be replaced with new ones at reassembly simply as a matter of economy. They are much less expensive to replace routinely than to replace singly as the need arises. In general, it is economical to return to the manufacturer for repair only the motor and motor controller.

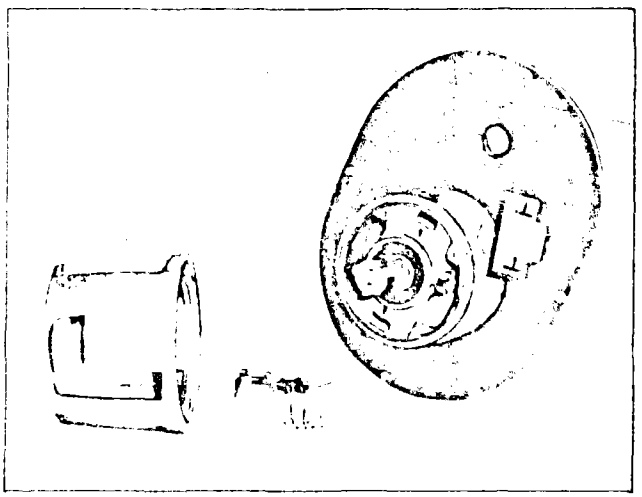
DISASSEMBLY

Disassemble only what is needed to make repairs or accomplish inspection. Proceed to disassemble the pump as follows: (Refer to figure 1.)

1. Disconnect wiring from motor control panel to motor and float switch. Take any other steps needed to prevent drive unit from being unintentionally energized during disassembly.

2. Remove the float switch. For instructions, refer to the repair notes on float switches.

3. Pump motor (52) and upper head (53) are best removed as a unit. The upper head serves to protect the motor output shaft from accidental damage. Therefore, remove capscrews (42) and lift the unit free from lower head (84) and lower half of coupling (48). If necessary, upper head (53) may be removed from motor (52) by unthreading capscrews (51) and removing nuts (50).



B. Upper head, coupling half, key and insert removed

4. Coupling half (48) is removed by loosening setscrew (47). Similarly, setscrew (44) will free upper coupling half (45). Remove coupling keys (46 and 49) and insert (43).

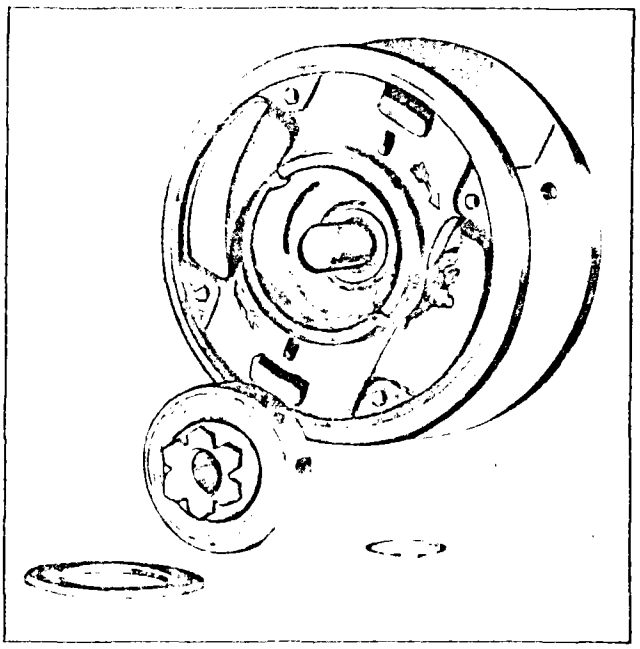
5. Remove remaining pump and connected parts from basin to continue disassembly.

NOTE

However, if ventilation piping is used, remove it before lifting off plate.

6. Locknut (55) can be unthreaded, exposing slinger (54) for removal. Then bearing collar (56) with ball bearing (58) is unthreaded from pump shaft. Retaining ring (57) must be removed from collar (56) with a pair of Truarc pliers, if bearing (58) is to be pressed off collar (56).

7. Remove grease seal (59) if necessary.

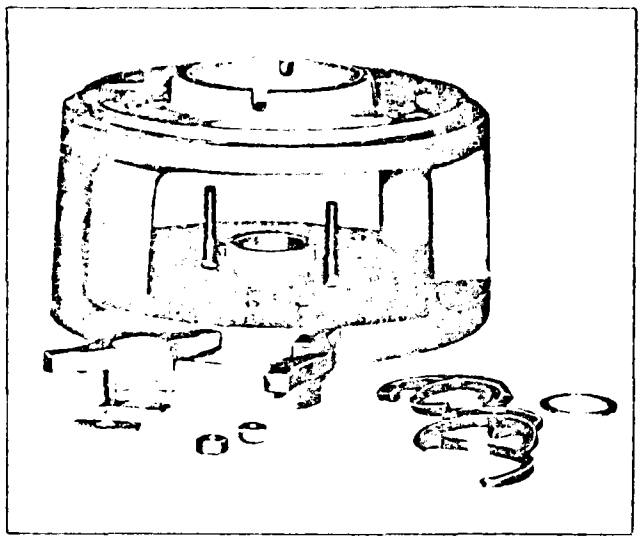


C. Slinger, bearing collar, bearing and retaining ring removed.

NOTE

Grease seal (59) should not be removed except for replacement because it's case is easily damaged. When removal is necessary, it can be tapped out of its seat in the lower head with coupling key (49) used as a driving tool.

8. Remove nuts (66) and clamps (67) from studs (69) and slide gland (68) off shaft (61). Remove packing (70) and packing ring (71).



D. Nuts, clamps, gland halves, packing and packing ring removed from lower head.

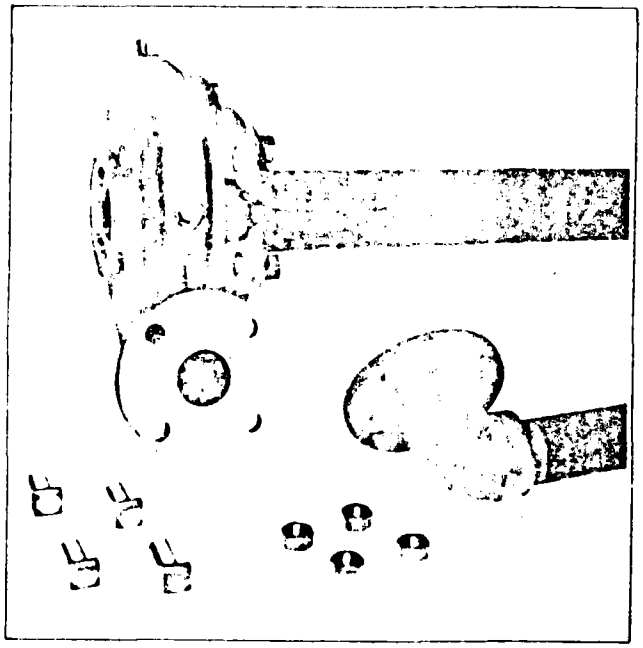
NOTE

This stuffing box arrangement is Option #3. For other options, refer to figure 1.

9. Remove oiler (73) if used and pipe plug (63). Also disconnect any lubrication line used to lubricate line shaft bearings or piping for pressurized support column water supply.

10. Unscrew capscrews (80 and 81) to remove lower head (84). Remove gasket (85).

11. Remove upper locknut (77) from discharge piping (78). Then plate can be lifted off.



E. Nuts, capscrews and gasket removed to free discharge piping

Remove gasket (23). Remove screws (83) and nameplate (82) only if replacement is necessary.

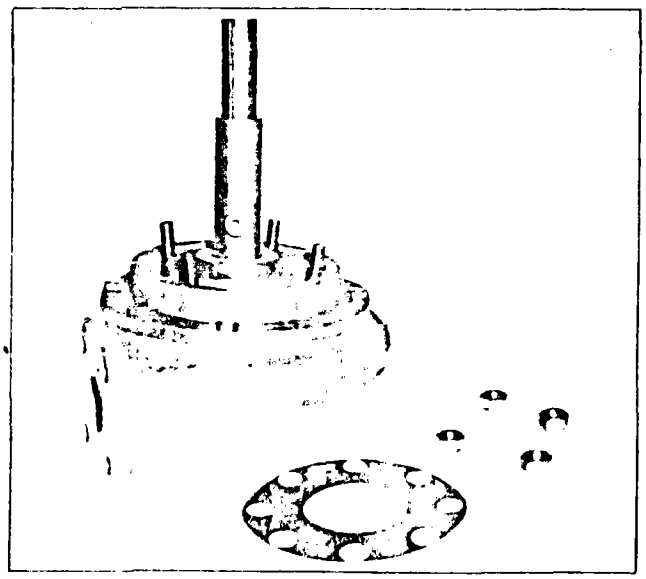
12. Successive lengths of piping and shafting are disassembled as follows:

a. If a line shaft bearing is lubricated through a lubrication line, detach the line and elbow from pipe nipple in upper support section and then remove nipple.

b. Unscrew capscrews (39) and nuts (38) to lift top support pipe section and expose shaft coupling (60). Use a wrench to hold shaft (61) and a second wrench to unscrew coupling (60). Remove gasket (23).

c. Remove pipe plug (25) if used, then slide line shaft bearing (41) off shaft.

d. For additional lengths of discharge pipe (78) use a large pipe wrench to hold discharge pipe and a second wrench to unscrew coupling (79).



F. Nuts, support piping and gasket removed from cover.

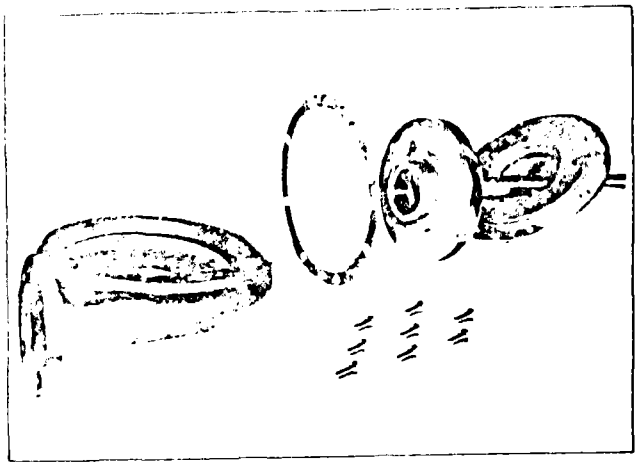
CAUTION

To protect a bearing that can be reused, tape the threaded section of the shaft end before removing bearing.

13. Discharge piping (78) and flanged elbow (76) can be removed from casing (8) by unthreading capscrews (5) and nuts (6). Remove gasket (9).

14. To lift off remaining support piping (40) unscrew nuts (20). Then remove gasket (23) and slide bolts (21) out.

15. Unthread capscrews (7) to remove cover (22) and gasket (10) exposing impeller.



G. Capscrews, cover, casing and gasket removed to reveal impeller.

16. Lift remaining shafting (61), impeller (15) and pump bearing (26) from casing (8). Remove pipe plug (25) from bearing (26), then slide bearing off end of the shaft, using the afore mentioned caution.

17. Unscrew impeller capscrew (13), remove gasket (14), impeller (15) and impeller key (16).

18. Case rings (11 and 24) are pressed into their housings with an interference fit and must be removed with a puller. New ring(s) should be used for reassembly since it is likely that during removal this fit will be lost.

19. Impeller wearing rings (optional - (18 and 19)) are pressed on and must be cut off if replacement is necessary. If they are turned off in a lathe, take care not to cut into the impeller.

20. To remove strainer (3) unscrew capscrews (1) and washers (2). For smaller size pumps unscrew strainer (3) and nipple (4) from casing (8).

REASSEMBLY

Reassembly will generally be in reverse order of disassembly. If disassembly was not complete, use only those steps related to your particular repair program.

1. Slide pump bearing (26) onto pump end of shafting (61) using the last caution mentioned in disassembly with the flanged end of bearing toward the bottom end of shaft. If bearing is not to be lubricated through a lubrication line, place pipe plug (25) in tapped hole in bearing.

2. Slide pump shaft (61) into pump end of support piping (40). Position pump bearing against pump flange of support piping. If bearing is to be lubricated through a lubrication line, align tapped opening in the bearing with vent opening in the support pipe, and install an 1/8 inch pipe nipple to maintain the alignment.

3. Press case rings (11 and 24) in casing (8) and cover (22). Rings should not be hammered into place. Use a press, or clamp the parts in a bench vise, using wooden blocks to protect the rings. It may be necessary to pin or dowel the rings after assembly if the insert or casing has had rings replaced before, since each reassembly can stretch or tear metal and thereby loosen the fits. If the facilities are available, it is good practice to take a very light finish cut or to ream the inside diameter of the casing rings after pressing to restore roundness. When rings are pressed, they may get squeezed out of shape.

4. Replace wear ring(s) (optional - (18 and 19)) on impeller, using the same care as for the case wear ring(s). If the rings are to be trued on a lathe, do not clamp the impeller so tightly that it is permanently distorted.

5. Slide cover (22) onto shaft (61). Place impeller key (16) in shaft and replace impeller (15) on shaft. Secure impeller with impeller capscrew (13) and gasket (14).

6. Position gasket (10) on cover (22) and bolt to casing (8) with capscrews (7).

7. Place bolts (21) in slot in cover (22) and hold them in place with gasket (23). With discharge outlet aligned with vent opening in support pipe, bolt cover to flanged support pipe (40) with nuts (20).

8. Bolt discharge flanged elbow (76), with gasket (9) in place, to casing with capscrews (5) and nuts (6). Lengths of discharge pipe (78) may now be replaced in flanged elbow (76).

NOTE

If pump bearing is to be lubricated through a lubrication line, assemble the required elbow and tubing on previously installed nipple. If support column is to be pressurized with a flow of fresh water, connect the required 3/4 inch pipe nipple, elbow and pipe to support piping, and ascertain that other vent openings are plugged.

9. Successive lengths of piping and shafting are assembled as follows: (Pumps designed for pump settings* deeper than 6 feet, 2 inches are provided with multiple part discharge and support piping and with line shaft bearings at each support piping joint.)

a. Slide a line shaft bearing (41) down pump shaft, with tapped opening toward upper end until it seats against the flange of the previously assembled section of support piping (40).

b. To add successive lengths of pump shafting, thread shaft coupling (60) onto threaded end of one shaft (61). Start second piece of shafting into opposite end of coupling. Tighten both shafts evenly into coupling with pipe wrenches being careful not to score shafting excessively. There should be an even amount of shaft threads showing on either side of the coupling after tightening.

c. If line shaft bearing is to be lubricated through a lubrication line, turn bearing as required to align tapped opening with lubricant piping. Position support pipe gasket (23) against support pipe flange, and lower the next section of support piping into place. Turn it to align vent opening with tapped opening in line shaft bearing, and secure it by installing bolts (39) and nuts (38). Install any 1/8 inch pipe nipple in tapped opening of line bearing if required, and connect it to previously assembled lubrication piping.

d. If necessary, screw a discharge pipe coupling (79) onto threaded end of previously assembled section of discharge piping, and thread the next section of piping into coupling. Tighten with a pipe wrench, using a second wrench to hold the previously assembled section.

*"Pump Setting" is the distance from bottom of strainer (3) to bottom of lower head (84). This measurement is normally 4 inches less than "Pit Depth," the distance from bottom of basin to top face of basin.

10. Place locknut (77) on discharge pipe (78) and thread down approximately 1 inch.

11. Lower pump support plate over support piping (40) and discharge piping (78). Position gasket (23) on support pipe flange, gasket (85) on lower head and slide lower head (84) into place.

NOTE

Install float control at this time if liquid end is not accessible when ejector is lowered into basin.

12. Lift pump support plate into position against lower head (84) and install capscrews (80 and 81). Place locknut (77) on discharge pipe (78) and tighten locknuts above and below the plate to secure discharge piping in place. Replace strainer (3) with either washers (2) and capscrews (1) or nipple (4). If pipe plugs (12) were removed, replace in casing (8). Pump support plate and pump assembly may now be lowered into place on basin cover and can be bolted down.

13. Install pump shaft packing ring (71) and packing (70) around shaft in lower head. Assemble packing gland halves (68) on gland studs (69) and secure with gland clamps (67) and nuts (66). Do not tighten nuts more than finger tight unless pump support piping is to be pressurized with fresh water.

14. Seat grease seal (59) with sealing edge upward in its seat in lower head.

NOTE

Cover threads of pump shaft temporarily with a tape or some other means before sliding on grease seal to prevent threads from damaging seal.

15. Press ball bearing (58) onto bearing collar (56) with ball bearing seal facing flange on collar, and secure bearing on collar by installing retaining ring (57).

16. Thread bearing collar onto pump shaft with bearing surface downward. Turn collar clockwise until bearing seats in lower head, then turn it an additional one-half turn. This will raise shaft and impeller approximately 1/64 inch off suction cover, providing the correct clearance for efficient pump operation.

17. Hold bearing collar (56) and install locknut (55) against collar. Ascertain that pump shaft turns freely by hand. Press rubber slinger (54) into place on bearing collar.

NOTE

Connect pressurization or lubrication piping at this time by using opening provided in pump support plate. For pressurization piping, a 3/4 inch line to water supply is connected to tapped opening in lower head. For lubrication piping, line is connected to lubrication device. If no lubrication line is required and there are line shaft bearings, install oiler (73) and pipe plug (63) in openings provided in lower head.

18. Install coupling half (48) and key (49) on upper end of pump shaft, and tighten coupling setscrew (47) temporarily to prevent its slipping down shaft.

19. Position coupling insert (43) in lower half of coupling and secure upper coupling half (45) with its key (46) on motor output shaft. Align bottom end of key with key slot in the end surface of motor shaft, and secure by tightening setscrew (44).

20. If upper head (53) was removed from motor (52) replace with capscrews (51) and nuts (50). Lower motor (52) and upper head (53) carefully into position on lower head while engaging coupling halves with coupling insert. Bolt assembly to lower head with capscrews (42).

21. Loosen setscrew (47) in lower coupling half (48) and slide coupling half and key (49) upward until they engage coupling insert (43) with proper clearance as shown in Section 2, Item 4 of this Instruction Manual.

22. If nameplate (82) was removed replace at this time with screws (83).

NOTE

Install float switch at this time. For instructions refer to the repair notes on float switches.

23. Connect wiring from motor control panel to motor and float switch, following exactly the instructions provided by their respective manufacturers. Also connect solenoid valve or oiler at this time if used, using diagrams provided. All wiring must comply with applicable electrical code requirements for type of duty pump is to perform.

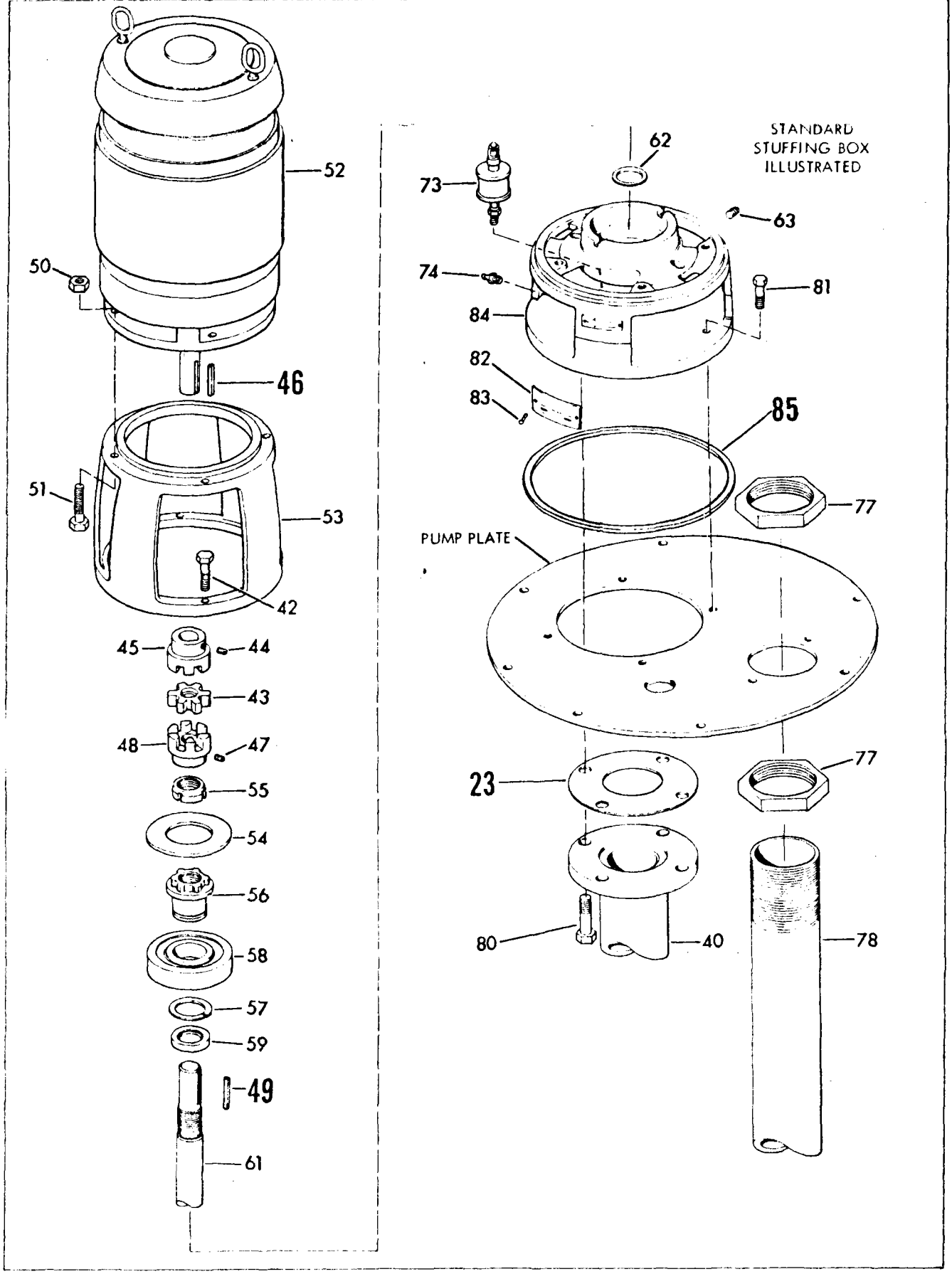
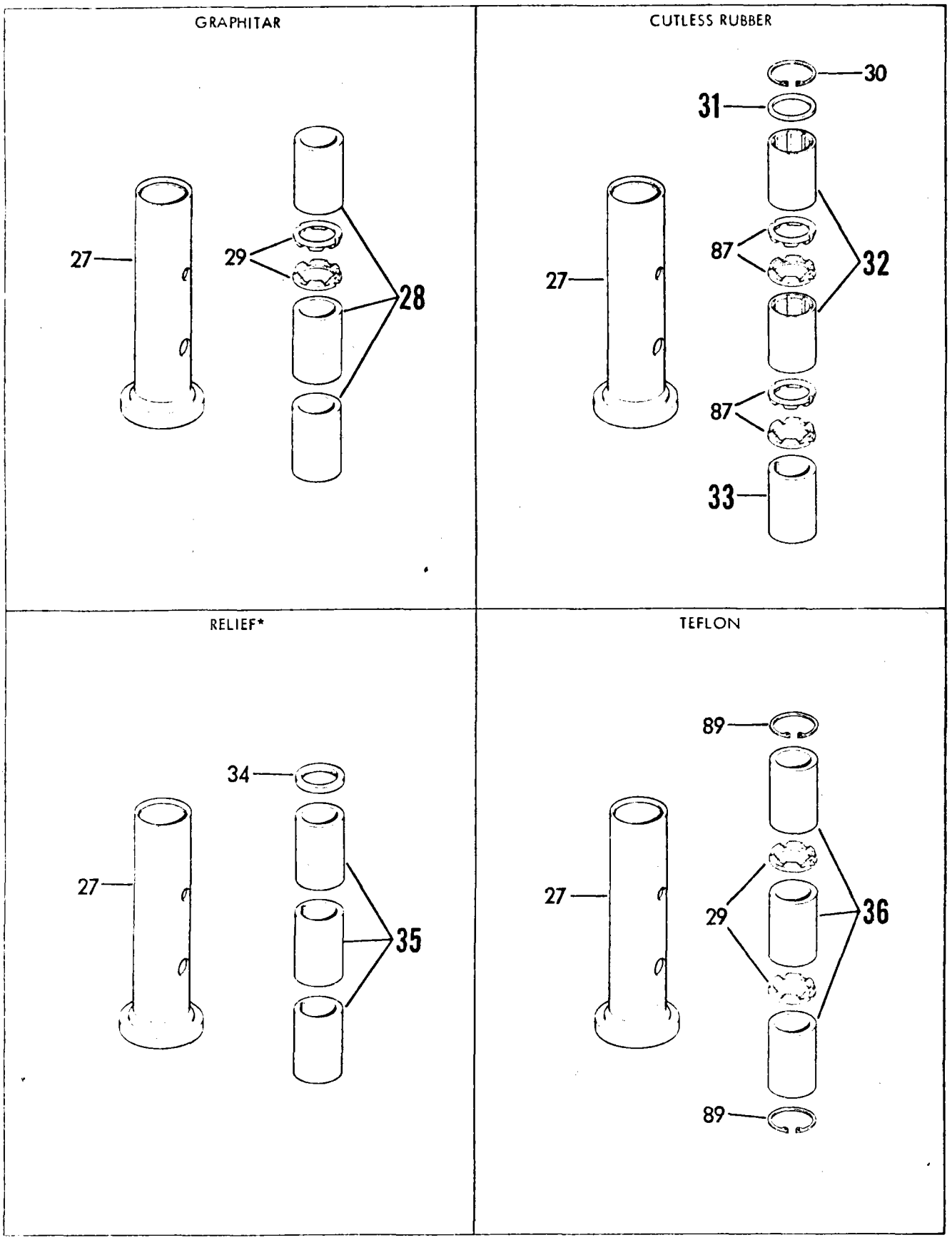


Figure 1. Model 531-532 Exploded View (Sheet 1 of 4)

OPTIONAL RELIEF HOUSING



*Standard for pump settings over 10 feet.

Figure 1. Model 531-532 Exploded View (Sheet 3 of 4)

OPTIONAL SPOOL HOUSING

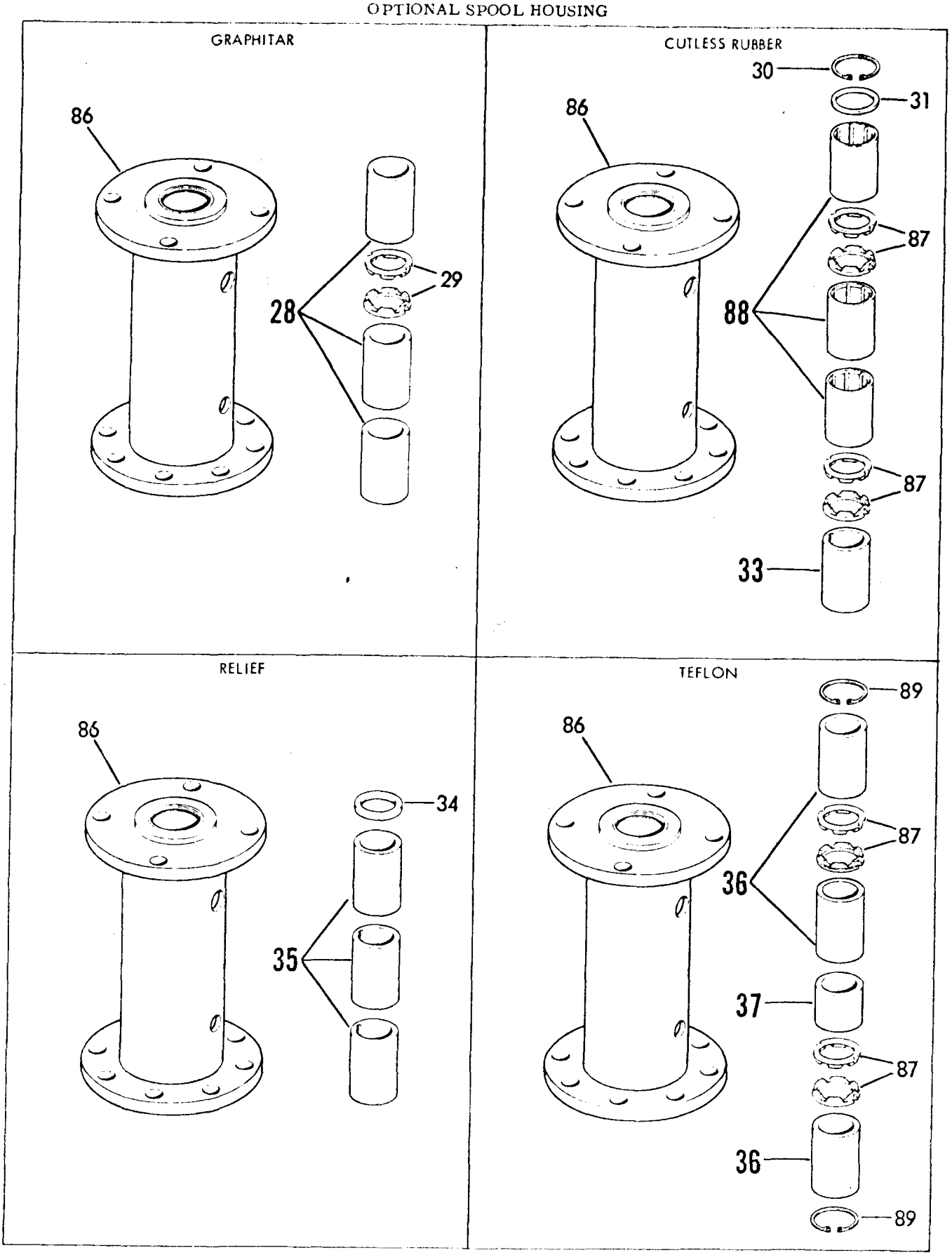


Figure 1. Model 531-532 Exploded View (Sheet 4 of 4)

Model 531-532 List of Parts (See Figures 1 & 2)

1. Capscrew
2. Washer
3. Strainer
4. Nipple
5. Capscrew
6. Nut
7. Capscrew
8. Casing
9. Gasket
10. Gasket
11. Case ring
12. Plug, pipe
13. Impeller capscrew
14. Gasket
15. Impeller
16. Impeller key
18. Impeller ring (opt)
19. Impeller ring (opt)
20. Nut
21. Bolt
22. Cover
23. Gasket
24. Case ring
25. Float rod guide
26. Pump bearing
27. Bearing housing (opt)
28. Bushing (opt)
29. Lantern ring (opt)
30. Snap ring (opt)
31. Retainer ring (opt)
32. Bushing (opt)
33. Bushing (opt)
34. Seal (opt)
35. Bushing (opt)
36. Bushing (opt)
37. Bushing (opt)
38. Nut
39. Capscrew
40. Support pipe
41. Bearing
42. Capscrew
43. Insert
44. Setscrew
45. Coupling half
46. Key
47. Setscrew
48. Coupling half
49. Key
50. Nut
51. Capscrew
52. Motor
53. Upper head
54. Slinger
55. Locknut
56. Bearing collar
57. Retaining ring
58. Bearing
59. Seal
60. Coupling, shaft
61. Shaft
62. Slinger
63. Plug, pipe
64. Seal (opt)
65. Fitting
66. Nut (opt)
67. Clamp (opt)
68. Gland (opt)
69. Stud (opt)
70. Packing (opt)
71. Packing ring (opt)
72. Lantern ring (opt)
73. Oiler (opt)
74. Fitting (opt)
75. Street elbow
76. Flanged elbow
77. Locknut
78. Discharge pipe
79. Coupling, pipe
80. Capscrew
81. Capscrew
82. Nameplate
83. Screw
84. Lower head
85. Gasket
86. Spool bearing housing (opt)
87. Lantern ring (opt)
88. Bushing (opt)
90. Grease fitting
91. Elbow
92. Coupling
93. Close nipple
94. Nipple
95. Comp. fitting
96. Comp. fitting
97. Nylon tube

NOTE

WHEN ORDERING SPARE PARTS ALWAYS INCLUDE THE PUMP TYPE, SIZE, SERIAL NUMBER, AND THE PIECE NUMBER FROM THE EXPLODED VIEW IN THIS MANUAL.

ORDER ALL PARTS FROM YOUR LOCAL AUTHORIZED DISTRIBUTOR, FACTORY BRANCH SALES OFFICE OR THE FACTORY AT NORTH AURORA, ILLINOIS.

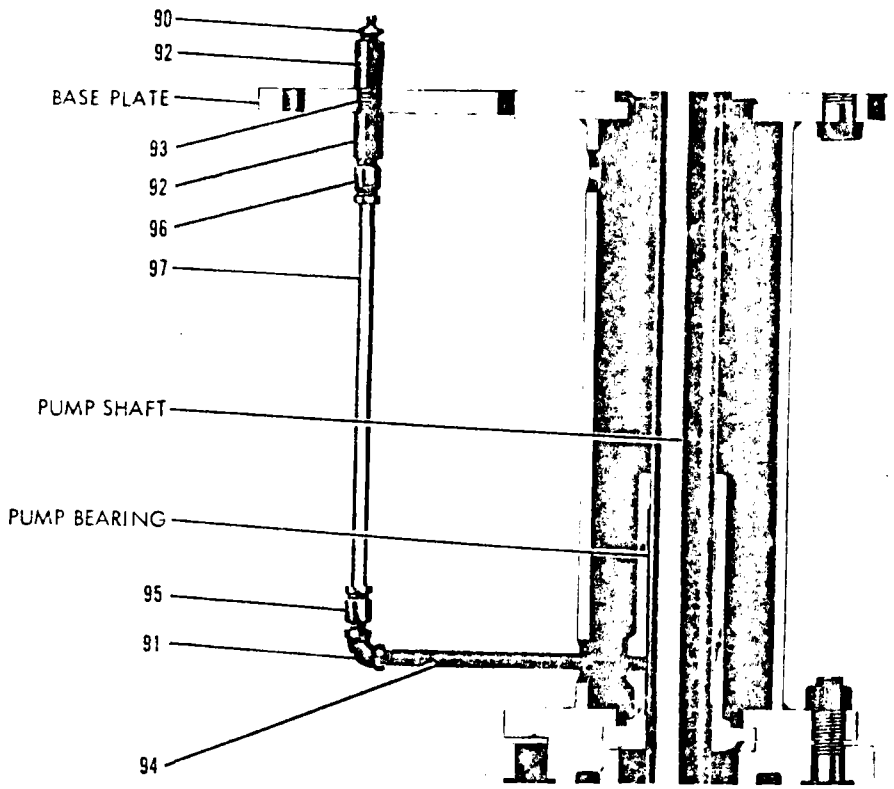


Figure 2.

AURORA® PUMPS

INSTRUCTION MANUAL
INSTALLATION
VERTICAL WET PIT PUMP

2

GENERAL. The life of your Aurora Pump can be extended considerably by carefully following the installation instructions contained herein. Each step of the pump installation instructions plays a vital part in assuring long life, efficient operation and reduced maintenance, from the initial location of the pump through starting directions.

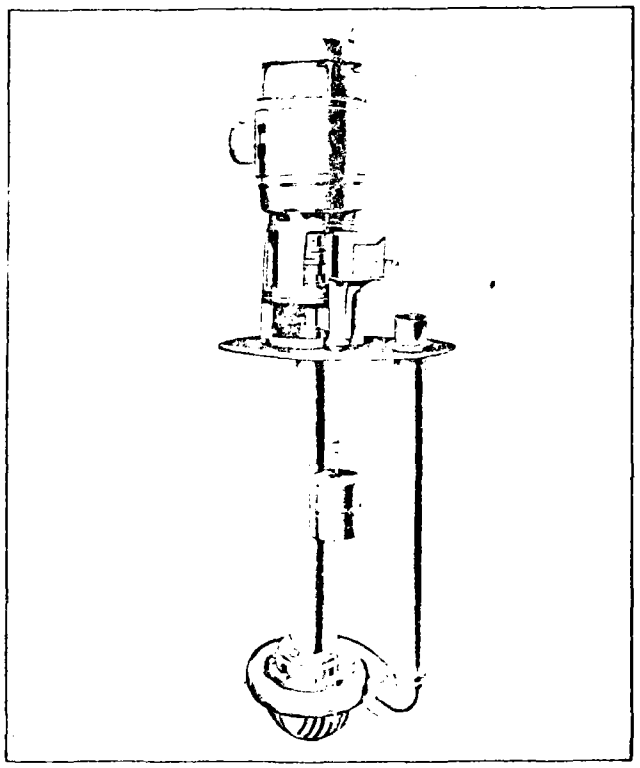


FIGURE 1. TYPICAL SUMP PUMP UNIT

UNPACKING YOUR PUMP. The crates containing your pump should be opened immediately upon receipt from the factory and the pump generally inspected for damage and shortage of parts. Look particularly for such damage as bent lengths of shafting, piping, damaged electrical components, and castings. Particular attention should be given to the discharge and suction nozzle threads or flanges. Any damage or shortage of parts should be reported to the carrier immediately.

CLEANING. If the pump is to be installed immediately, it will be necessary to clean the exposed metal parts thoroughly with white gasoline or other suitable solvent to remove the preservative coating, and to remove the protective covers from all openings. Cleaning of the pump should not be accomplished

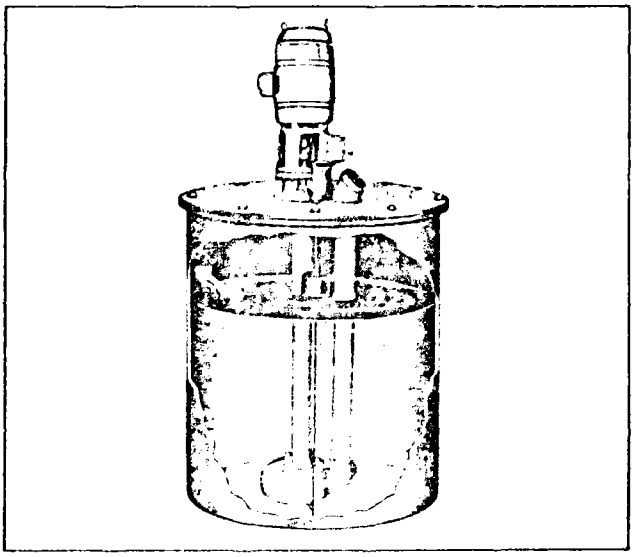


FIGURE 2. TYPICAL SEWAGE EJECTOR IN A BASIN

until the basin and the outlet connections are completed and ready for the pump.

PLANNING THE PUMP LOCATION. It is important to know that your pump has been manufactured to your specific application, therefore you know where the pump will be located, where the outlet piping will run, and other pertinent data. However, you may have overlooked a factor which may affect your pump's operation, installation, or efficiency.

A hoist capable of lifting the assembled pump should be available to lower the pump into the basin. This will require head room that is at least equal to the depth of the basin plus approximately 3 feet. Considerable time and labor can be saved by preassembling the pump. Also, although the pump can be installed in a flooded pit, it is desirable to empty the basin if at all possible.

Adequate provisions should be made for electrical wiring to the pump motor and other electrical accessories included with your pump. Overload protection should be provided in the pump circuit. Precautions should be taken when the pump is installed to preclude the possibility of moisture entering the conduit or the motor and causing short circuits and grounding.

On applications where an extremely long driveshaft is required, it is advisable to use tie rods or some other means of supporting the pump unit in the basin.

OUTLET PIPING. The outlet piping should be short and direct as possible with a minimum of elbows and fittings, to reduce head loss from friction. The outlet piping should be supported as close to the pump as possible, using either pipe hangers or supports. The outlet pipe diameter should be the same as or larger than the discharge pipe diameter. A flanged connection should be provided at the pump discharge pipe to simplify pump removal. An increaser if used, should be installed as close as possible to the discharge pipe. Straight taper increases are satisfactory in discharge applications.

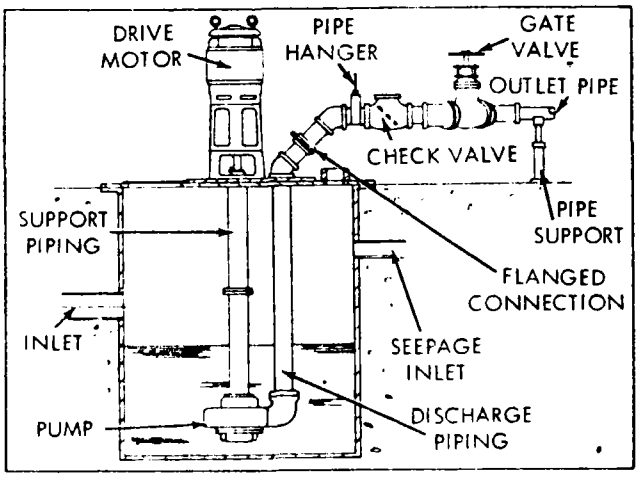


FIGURE 3. TYPICAL OUTLET PIPING

Piping should line up naturally when connected. Forcing pipes into line by using flange bolts can produce strain on the piping and on the shafting of the pump. Flange bolts when used, should be loosely installed, and the pipe alignment checked. When the alignment is satisfactory, tighten the flange bolts alternately until all are firmly secured.

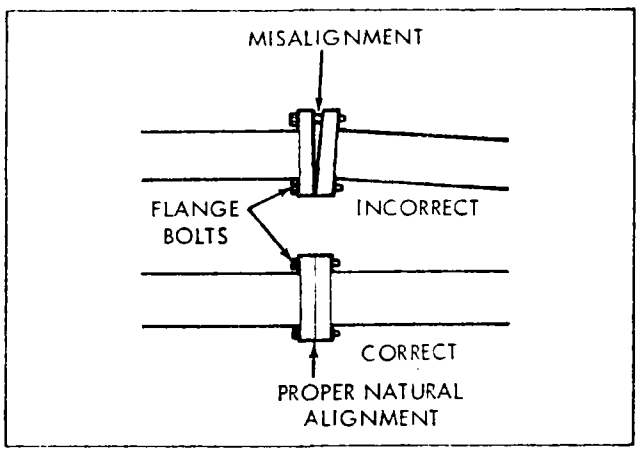


FIGURE 4. PIPE ALIGNMENT

The outlet piping should include a horizontal check valve and a gate valve. The check valve should be located between the gate valve and the pump discharge piping. The check valve protects against a reverse flow of the liquid if the driver fails. The gate valve provides a means of throttling the pump's discharge. The gate valve should be nearly closed when starting the pump, because a centrifugal pump requires much less power with the gate valve closed than it does with the gate valve open. The gate valve also is closed when the pump is shut down for repairs or inspection.

MOUNTING THE PUMP. There are several methods of mounting vertical pumps to the foundations. The method of mounting that you choose will be based on your specific requirements.

CURB RINGS AND SOLE PLATES. In some applications, it may be desirable to use a curb ring for mounting your pump.

A curb ring can be either rectangular or circular. The curb ring should have sufficient clearance at the inside diameter to allow passage of all sections of the pump located below the support plate.

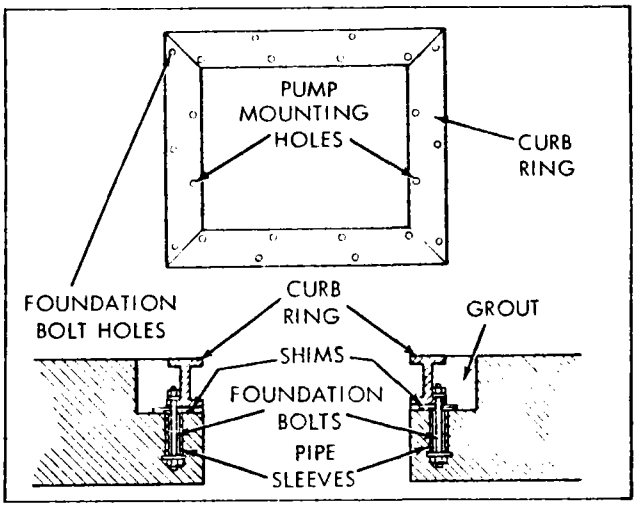


FIGURE 5. INSTALLATION OF RECTANGULAR CURB RING

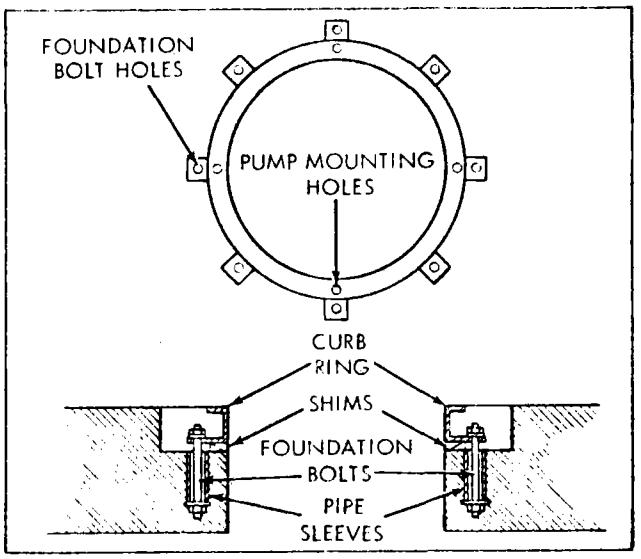


FIGURE 6. INSTALLATION OF CIRCULAR CURB RING

FOUNDATION. The foundation for your pump should be heavy enough to withstand any vibration or stress encountered during pump operation.

The mounting bolts or studs for the curb ring should be imbedded in concrete and accurately located per the applicable Aurora dimension sheet. Foundation bolts should be inclosed by a sleeve two to four diameters larger than the bolt to allow movement for proper alignment with the curb ring.

LEVELING THE CURB RING. The curb ring should be set in place and leveled with shims. The mounting face of the curb ring is machined to an even flat surface and can be easily leveled with a spirit level. When the curb ring is leveled the foundation bolts should be tightened, but not too firmly. Waste material should be stuffed into the sleeves around the foundation bolts, to prevent grout from filling the sleeves during grouting.

GROUTING THE INSTALLATION. Grouting the curb ring prevents lateral movement of the ring and improves the vibration absorbing characteristics of the foundation. A wooden dam should be constructed around the sole plate to contain the grout while it is being poured. When a curb ring is to be used above the floor line it is necessary to construct a dam around the outside diameter of the ring to contain the grout. The entire area around the outside diameter of a curb ring should be filled, with a non-shrinkable grout. The grout should be puddled frequently to remove any air bubbles from it.

The leveling shims should be grouted in place. Allow time for the grout to set, usually from 42 to 72 hours after pouring, before proceeding with the installation. After the grout has set, the curb ring levelness should again be checked and the foundation bolts firmly tightened down.

BASIN COVERS. Basin covers may be set in concrete either with or without a curb ring or they may be bolted to the top flange of a cast iron or steel basin. The pump may be mounted directly to the basin cover on installations where the cover is not too large. On installations where the basin cover is large, the pump normally is mounted on an oval pump plate which permits removal of the pump from the basin without removing the entire basin cover.

PREPARING TO INSTALL THE PUMP. Your wet pit pump is usually shipped in more than one crate. The pump is shipped completely assembled along with accessory equipment such as float controls, motor controllers and high water alarms in one crate and the pump motor in another. An exception to this is when the length of the pump or the method of transportation makes it necessary to ship in more than two crates.

The pump and motor should be uncrated at this time. All wrapping materials should be checked for small parts that were shipped separately. Adequate support should be provided at intervals along the length of the pump as the crate is removed.

If your installation requires a basin cover, the cover should be lowered on to the basin properly orientated to the outlet connections and securely bolted in place.

INSTALLING THE PUMP. If the pump cannot be lowered into the basin as a complete unit, it is necessary to assemble it by stages. To do this, the liquid end assembly must first be lowered into the basin before the rest of the pump can be assembled. A rope sling should be secured about the pump casing and the liquid end assembly carefully lowered into the basin while guiding the lengths of support piping through the basin cover opening. The liquid end assembly should be lowered far enough to bring the top of the support pipe within a foot or so of the top of the base plate. Additional sections of piping and shafting should be assembled as follows:

a. Slide a line shaft bearing down the pump shaft with the tapped opening toward the upper end, until it seats against the flange of the first section of support piping.

b. Thread a shaft coupling onto the threaded end of one shaft until the shaft is visible through the small hole drilled through the middle of the coupling. Thread the next length of shafting into the coupling.

NOTE

Do not use pipe wrenches on the shafting; it is not necessary to firmly tighten the shafts in their couplings because the torque of the pump motor will tighten them during operations.

c. If the line shaft bearing is to be lubricated through a oil or grease line, locate the bearing as required to align the tapped opening with the lubricant piping. Install a support pipe gasket against the pipe flange, and lower the next section of support piping into place. Align the vent openings with the tapped opening in the line shaft bearing, and bolt the support pipe together. If required, install a 1/8" nipple in the tap opening of the line bearing and connect it to the lubrication piping.

d. If necessary, assemble a discharge pipe coupling onto the threaded end of the previous section of discharge piping and thread the next section of piping into the coupling. Tighten the discharge piping with a pipe wrench. Each subsequent section of shafting support piping and discharge piping should be installed in this manner. As each successive section of piping and shafting is installed, the pump should be lowered by stages into the basin.

e. At the same time that the additional lengths of piping and shafting are being assembled, the additional sections of float control rod should be assembled. This is accomplished by installing successive lengths onto the threaded rod couplings. The lower float stop should be assembled to the rod with the flat side downward at the required distance from the liquid end. The float should be slipped onto the rod, and the upper float stop, flat side up, installed at the required distance from the bottom of the rod.

f. In a like manner, install lubrication piping and pressurization lines as required by your application.

After all of the piping has been assembled, a locknut should be installed on the upper end of the discharge

pipe and the pump oval plate lowered into position. Position the gaskets on the support pipe flange, and slide the lower head into place. The lower head should be positioned so that access to the grease fitting will not be obstructed by the discharge, lubrication, or pressurization piping, or the float control. Bolt the lower head to the pump oval plate. Assemble the remaining locknut over the upper end of the discharge pipe. Carefully align and position the discharge pipe and tighten down the locknut on either side of the pump oval plate. It is essential that no strain be placed on either the discharge piping or the pump casing. Therefore it is necessary that alignment of the discharge piping should be done with great care. Any strain on the discharge piping may force the support pipe and shafting out of line and result in overloading the pump motor.

Assemble the float control mechanism to the pump oval plate and align the switch arm with the end of the float rod. Set the upper end lower float rod stops approximately 3/4" above and below the arm.

Assemble one-half of the flexible coupling with its key to the motor driveshaft. There is a clearance between the top of the pump shaft and the end face of the motor driveshaft when the motor is installed. Accordingly, the coupling halves must be secured to the motor shaft above the recess surfaces of the lower coupling half. Place the coupling insert in the lower coupling half on the pump shaft, and lower the motor into place engaging the upper coupling half with the lower half and the coupling insert. Locate the motor as required for the most convenient connections of the electrical leads and bolt it in place. Adjust the lower coupling half until the ends of the dogs in the lower half are approximately 1/8" from the recessed surface of the upper half.

The pump motor, upper head, and lower head have register fits which combined with accurate location of the pump base plate, make it unnecessary to align the flexible coupling at installation of the pump.

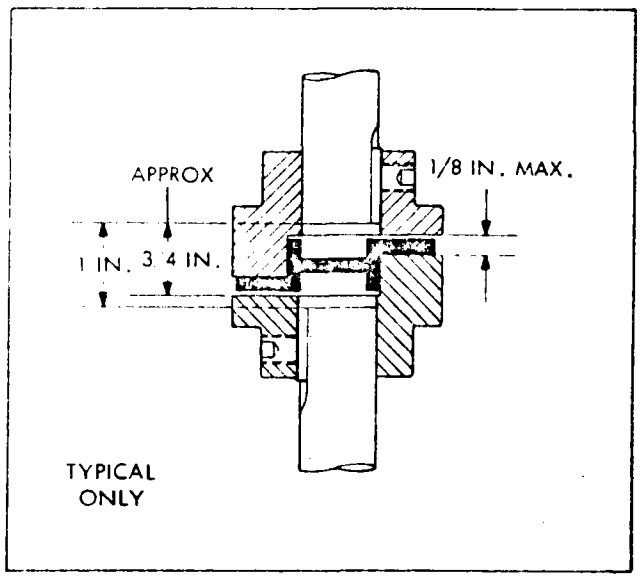


FIGURE 7. INSTALLING FLEXIBLE COUPLING

Connect the outlet piping to the pump discharge piping. For above ground discharge, two 45° elbows and flange connection are satisfactory. Check the outlet piping to make sure it is properly supported and lines up correctly before connecting it to the discharge of the pump. Misalignment of the piping can impose unnecessary loads on the discharge elbow and can cause distortion and strain of the support piping and shafting of the pump which can result in vibration, uneven bearing wear, or damage to the pump.

Connect the electrical wiring to the pump motor, the motor controller, float control and any other electrical accessories that were provided with your pump. Wiring instruction provided with the components should be followed exactly.

Connect flushing or pressurization water lines if required. Connect any vent piping to the basin cover.

Refer to the applicable maintenance manual for lubrication of liquid end bearings, head bearings, and intermediate shaft bearings.

PRESTARTING INSTRUCTION. Close the gate valve in the outlet piping. Rotate the pump shaft by hand to see that it turns freely without binding. Fill the basin to a depth at least sufficient to raise the float off the lower float stop and to cover the pump casing. Activate the float control arm and, as the pump motor starts, check the direction of rotation. The correct rotation is shown by the arrow on the lower head. As the pump motor approaches full speed open the outlet piping gate valve slowly.

Measure the effective discharge head by inserting a pressure gauge in any convenient place in the discharge head piping near the pump discharge outlet. The pounds per square inch (P.S.I.) reading can be converted to feet or head by multiplying by 2.31 and adding the height of the gauge above the basin liquid level as measured in feet. The result should be within 10% of the name plate head feet reading. Any wide variation from the head feet reading, can cause early failure of pump bearings, and should be corrected immediately. Refer to the applicable trouble shooting chart for your pump.

After several minutes of operation, the pump should be operating a quiet, vibrationless speed and neither the head bearing nor the motor casing should be exceedingly warm to the touch.

Shut down the pump and make sure that all bolts securing the pump, the pump oval plate and the basin cover are firmly tightened down.

INSTRUCTION MANUAL
OPERATION
CENTRIFUGAL PUMP

4

CENTRIFUGAL PUMP OPERATION. Centrifugal pumps operate under a wide range of conditions. The pump you have selected exactly fits your specific requirements. Before putting your pump into operation however, there are certain basic ground rules that have to be followed to assure maximum efficiency, long pump life, and maintenance free service.

Centrifugal pumps should never be started or run dry. Operating a pump dry can cause burning of the packings or seal, resulting in distruction of the packings or seals, and possible scoring of the pump shaft. To prevent the pump from being run dry, the pump should be primed before starting it.

A centrifugal pump should not be throttled, or the volume controlled on the suction side of the pump. Throttling the pump on the suction side, not only reduces the capacity, but also reduces pump efficiency, and more important, can cause serious damage to the pump due to cavitation. Cavitation occurs when the pressure at any point inside the pump drops below the vapor pressure of the liquid. The liquid flashes and forms vapor bubbles. These bubbles move along with the liquid into a higher pressure area, where the bubbles collapse or implode creating an area of low pressure. The implosion phenomenon is characterized by a crackling noise and sometimes by loud knocking as the vapor bubbles are collapsed. Repetition of this action causes a wearing away of the metal on the impeller and other parts of the pump, and if allowed to continue can result in serious damage to the pump.

Pump capacity can be effectively controlled by use of a throttling valve in the discharge piping. Most centrifugal pumps can be operated for brief periods of time with the throttling valve closed without building up excessive pressure or overloading the drive unit. In fact, a centrifugal pump operating against a closed discharge line at its rated capacity, actually requires less power to operate than it does when the throttling valve is open.

The pump should never be started with the throttling valve completely closed however because a condition of water hammer could exist. The condition of water hammer is caused by an increase in pressure due to changes in velocity of the liquid flowing through the pipe line. When the velocity is changed by closing a valve or by some other means, the magnitude of the pressure produced is frequently much greater than the static pressure on the line, and may cause rupture or damage to the pump, piping, or fittings. Water hammer may be controlled by regulating valve closure, or the use of relief valves and slow closing check valves.

On pumps equipped with packings, there should be sufficient leakage from the packing to insure lubrication of the packing and effective cooling of the stuffing box. The packing glands should always be adjusted evenly and not too tightly. Over tightening the packing can generate heat which will burn the packing and cause scoring of the shaft, making it necessary to replace both the shaft and the packings.

Adequate precautions should be taken to prevent freezing of liquid in the pump when the pump is not in operation. If there is any possibility of freezing, the water should be drained off by removal of the plugs provided in the pump casing.

All mounting bolts and piping connections must be firmly tightened to prevent excessive vibration, leakage, and possible damage to the pump. The mounting bolts are particularly important. If they are not firmly tightened, the base plate upon which the pump is mounted may deflect, causing a misalignment of the pump and the driver.

STARTING THE PUMP. In order to start your pump, it will first be necessary to prime it.

PRIMING THE PUMP. Your pump will not operate satisfactorily until it is primed. All air must be

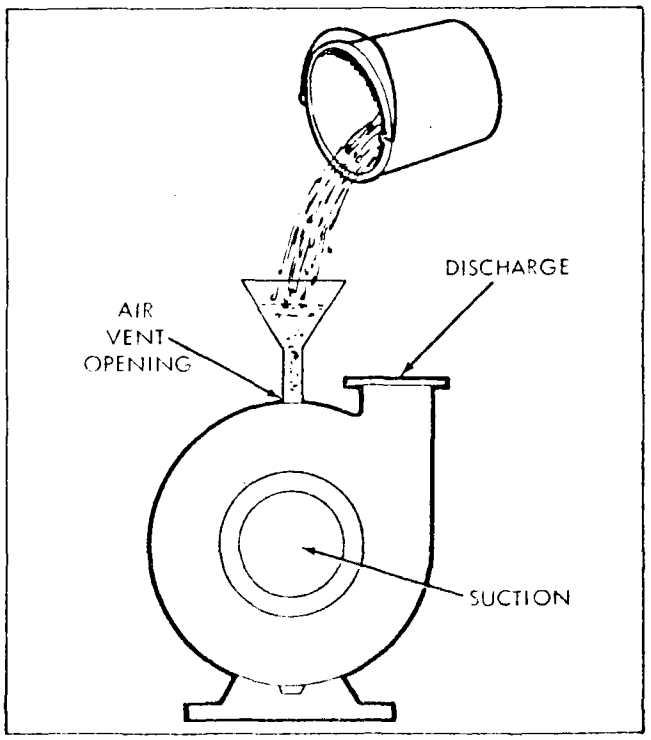


FIGURE 1. PRIMING BY HAND

expelled from the suction piping and pump casing, and replaced by the liquid to be pumped. There are several methods of priming pumps. The one you select will depend on your specific requirements.

FLOODED SUCTION PRIMING. This method of priming a pump is relatively simple. The liquid source is located above the pump, and all that is necessary to prime the pump is to open the air vent valve or plug in the pump casing, and to crack the gate valve in the suction line. The suction line and pump should be filled slowly until a steady stream of liquid is observed flowing from the air vent. After your pump is operating, it is recommended that the air vent valve or plug be opened again to insure that all air has been expelled from the pump casing.

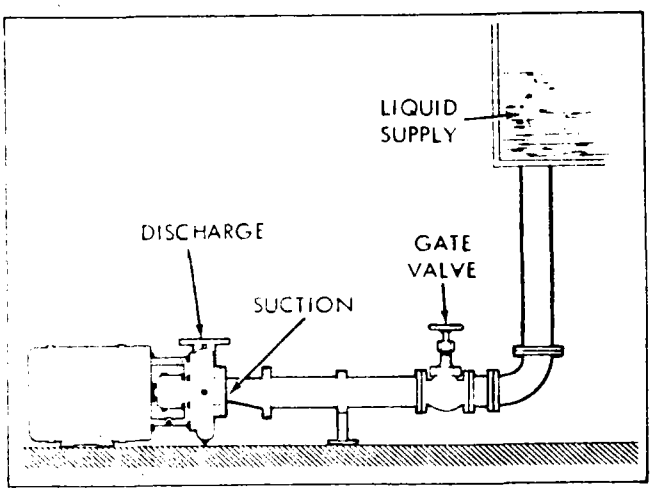


FIGURE 2. FLOODED SUCTION PRIMING

FOOT VALVE PRIMING. A foot valve can be used for priming on suction lift applications. The foot valve located at the bottom end or foot of the suction

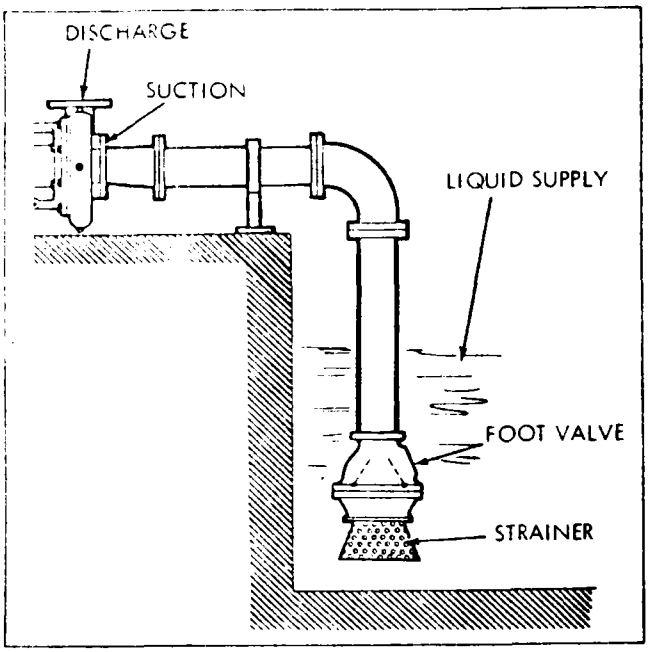


FIGURE 3. PRIMING WITH A FOOT VALVE

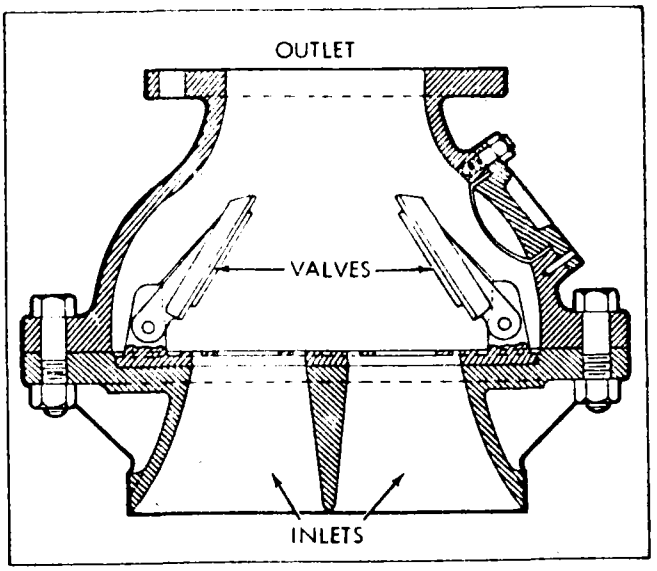


FIGURE 4. FOOT VALVE CUTAWAY

piping, functions as a check valve which allows flow in one direction only, toward the pump.

Initial priming is accomplished by completely filling the suction piping and pump casing with the liquid to be pumped. This can be done by removing the air vent valve or plug at the top of the pump casing, and inserting a pipe nipple in the orifice with an appropriate increaser to accommodate a hose connection. A priming line can also be inserted in the discharge piping between the check valve and the pump, or the priming can be done with a bucket and funnel. The important thing is to completely fill the suction pipe and pump casing with liquid.

When the pump is started, the vacuum created by pumping the priming fluid, combined with atmospheric pressure in the liquid well, forces liquid into the suction piping, thus opening the valve and keeping it open until the pump is shut down. When the pump is shut down, the liquid being pumped reverses its flow causing the valve to close. The liquid is now trapped in the suction piping and pump casing, thus maintaining a prime on the pump.

VACUUM PRIMING. Vacuum priming consists of removing air from the pump casing and suction piping, and drawing liquid into them by means of a vacuum creating device. The types of vacuum equipment range from a simple hand pump to complex central priming systems. Your specific priming requirements will govern what type of vacuum primer you use.

AIR EJECTOR. One type of vacuum primer is the air ejector. If liquid under pressure, or steam is available, an ejector can be used. The ejector is connected to the air vent orifice. A stream of the ejecting medium is passed through the ejector creating a vacuum in the ejector, and drawing air from the pump casing and suction piping. When liquid flows steadily from the ejector discharge pipe, the pump is primed.

inductor. This type of primer is comprised of a liquid nozzle and an inductor at the foot end of the suction piping. The nozzle and inductor are connected to a high pressure liquid supply such as a city water service.

The pump is primed by opening the valve in the pressure line. This will allow the liquid to flow through the nozzle and into the inductor. The velocity of the high pressure liquid drives the liquid into the suction piping and up to the pump, thus completing the priming operation.

POSITION OF DISCHARGE GATE VALVE WHEN STARTING. The discharge gate valve should partially be closed when a high or medium head centrifugal pump is started, because this type of pump requires much less power with the gate valve closed, than when it is operated at rated capacity and head with the discharge gate valve open. As soon as the pump is up to operating speed, the discharge gate valve should be opened to the desired position.

POSITION OF SUCTION PIPING GATE VALVE. In flooded suction applications, the gate valve is opened at the time the pump is being primed, and will remain open for starting and operation.

COOLANT VALVES. Valves in the cooling liquid line should be opened prior to the pump's being started, and will remain open while the pump is in operation, unless it is desirable to check the rate of leakage from the stuffing box.

SHUTTING DOWN THE PUMP. To shut down your pump, simply close the discharge gate valve and shut down the motor. If it is necessary for the pump to maintain its prime while it is shut down, it is advisable to install either a foot valve or a check valve in the suction piping.

AURORA PUMPS

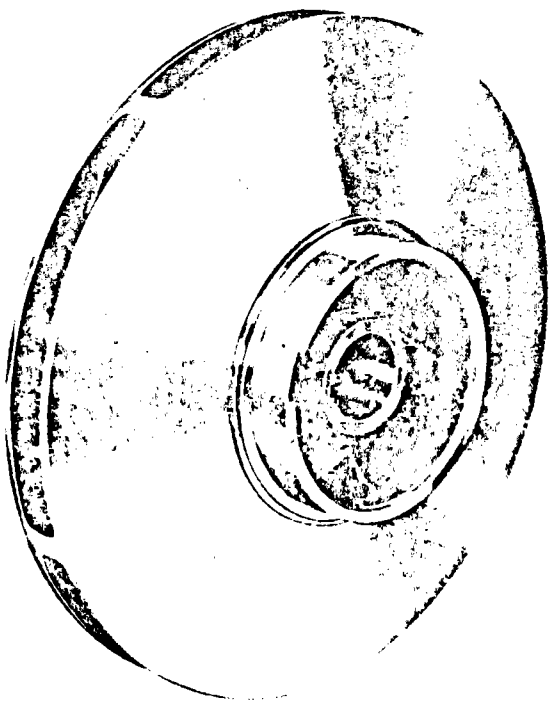
INSTRUCTION MANUAL
TROUBLESHOOTING CENTRIFUGAL PUMP

5

Your Aurora Pump has been engineered and carefully selected for your application. It should provide years of trouble-free service. However, any piece of machinery is subject to wear and occasional malfunctions.

To help you quickly isolate and rectify any malfunction the following troubleshooting chart has been prepared.

Frequent use of the chart to determine the cause of minor operating problems may prevent a major problem or possible breakdown of your pump.



TROUBLE	PROBABLE CAUSE	REMEDY
1. Pump fails to prime or loses its prime	a. Air leaks in suction lines	a. Clean and tighten all suction connections; relocate suction inlet in liquid source
	b. Suction strainer is clogged	b. Remove dirt, leaves or other material from strainer.
	c. Suction lift is too high	c. Re-evaluate pump requirements and correct suction conditions accordingly. Consult your local Aurora Pump Sales Office.
	d. Defective priming valve	d. Replace valve.
	e. Defective packing or seal	e. Replace packing or seal.
2. No discharge from pump	a. Pump is not properly primed	a. Reprime the pump; refer to priming troubles and remedies.
	b. Total head is too high	b. Re-evaluate head calculations; measure elevation differences between pump and liquid source, and pump and discharge point. Consult your local Aurora Pump Sales Office.
	c. Driver is not operating at rated speed	c. Check voltage of electric motor; check steam pressure of steam turbine; check engine R.P.M.'s. Refer to applicable maintenance manuals for possible troubles and corrective action.
	d. Impeller or discharge line is clogged	d. Back flush pump to clear obstruction; disassemble pump and/or piping and remove obstruction.
	e. Wrong direction of rotation	e. Check wiring against diagram on motor name plate and in controller; reverse any two power leads on a three-phase motor; replace a single phase motor.
	f. Pump is vapor bound	f. Provide additional pressure on liquid being pumped by elevating liquid source or pressurizing the supply tank.
3. Pump does not deliver rated capacity	a. Pump is not properly primed	a. See 2.a. above.
	b. Suction lift is too high	b. See 1.c. above.
	c. Excessive air in liquid	c. See 1.a. above.
	d. Air leakage through stuffing box	d. See 1.e. above.
	e. Driver is not operating at rated speed	e. See 2.c. above.
	f. Impeller is clogged	f. See 2.d. above.
	g. Wearing rings are worn	g. Replace wearing rings.
	h. Impeller is damaged	h. Replace impeller.
	i. Pump is vapor bound	i. See 2.f. above.
4. Insufficient pressure	a. Excessive air in liquid	a. See 3.c. above.
	b. Drive is not operating at rated speed	b. See 2.c. above.
	c. Wrong direction or rotation	c. See 2.e. above.
	d. Total head is too high	d. See 2.b. above.
	e. Wearing rings are worn	e. See 3.g. above.
	f. Impeller is damaged	f. See 3.h. above.
	g. Casing gasket is defective allowing internal leakage	g. Replace casing gasket.
	h. Liquid is vaporizing	h. See 2.f. above.

TROUBLE	PROBABLE CAUSE	REMEDY
5. Pump starts then stops pumping	a. Air leaks in suction line	a. See 1.a. above.
	b. Air pocket in suction line	b. Reprime the pump; eliminate air pocket conditions.
	c. Water seal line is plugged	c. Remove obstruction from water line.
	d. Excessive air in liquid	d. See 1.a. above.
	e. Suction lift too high	e. See 1.c. above.
	f. Defective packing or seal	f. See 1.e. above.
	g. Pump is vapor bound	g. See 2.f. above.
6. Excessive power consumption	a. Speed is too high	a. Internal electric motor wiring is incorrect; replace motor; refer to applicable driver maintenance manuals for possible troubles and corrective action.
	b. Wrong direction of rotation	b. See 2.e. above.
	c. Total head is too high	c. See 2.b. above.
	d. Total head is too low	d. Re-evaluate head conditions; correct as required. Consult your local Aurora Pump Sales Office.
	e. Impeller is clogged	e. See 2.d. above.
	f. Impeller is binding	f. Relieve strain on casing; adjust impeller clearance.
	g. Motor shaft is bent or worn	g. Replace motor shaft.
	h. Driver and pump are misaligned	h. Realign driver with pump.
	i. Power frame shaft is bent	i. Replace shaft.
	j. Wearing rings are worn	j. See 3.g. above.
	k. Packing is incorrectly installed	k. Install packings correctly; replace if necessary.
7. Pump is noisy or has excessive vibration	a. Magnetic hum	a. Consult motor manufacturer.
	b. Motor bearings are worn	b. Replace bearings.
	c. Foreign material in impeller	c. Remove foreign material.
	d. Impeller is binding	d. See 6.f. above.
	e. Motor shaft is bent or worn	e. See 6.g. above.
	f. Driver and pump are misaligned	f. See 6.h. above.
	g. Power frame shaft is bent	g. See 6.i. above.
	h. Foundation is not rigid	h. Strengthen foundation; change method of mounting pump unit.
	i. Worn bearing in power frame	i. Replace bearing.
	j. Impeller is damaged	j. See 3.h. above.
	k. Lack of lubrication in power frame	k. Lubricate power frame bearings; replace bearings if damaged.
	l. Pump is not properly leveled	l. Check levelness of pump.
	m. Piping is not supported	m. Provide support for suction and discharge piping.
	n. Pump is cavitating	n. Re-evaluate pump application; consult local Aurora Pump Sales Office.

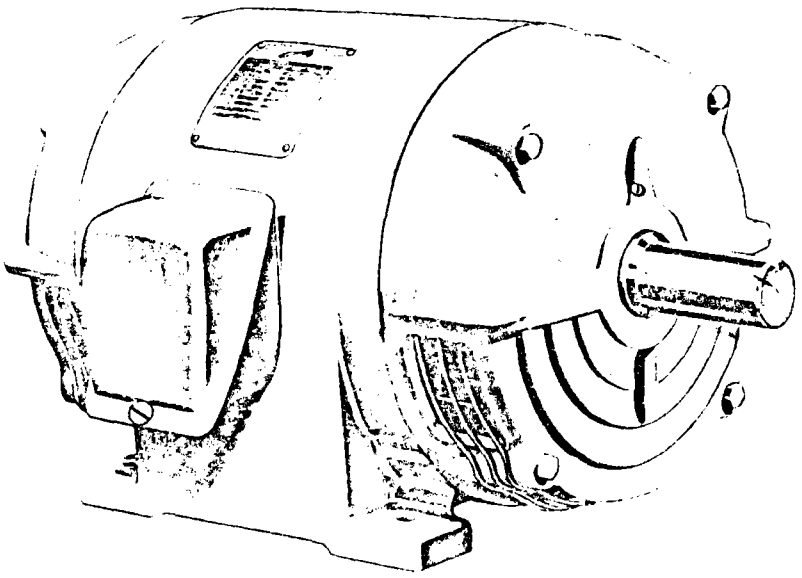
AURORA® PUMPS

INSTRUCTION MANUAL
TROUBLESHOOTING ELECTRIC MOTOR

5

The following troubleshooting chart is furnished to you as part of Aurora Pump's continuing efforts to provide total service to their customers.

The troubles or symptoms, their probable causes and the suggested remedies contained in this trouble-shooting chart will aid you in quickly determining and correcting most problems as they occur. It is not the intent of Aurora Pump to replace the recommendations of the motor manufacturer as to operation and maintenance. Rather, this chart is offered as a supplement to such data. Any specific questions or problems regarding your motor should be directed to the manufacturer of the motor. Be sure to supply the relevant data from the motor nameplate when inquiring about motor service or maintenance.



SYMPTOM	PROBABLE CAUSE	SUGGESTED REMEDY
Motor does not start	1. Break in power supply circuit -- a. Blown or defective primary fuses or opened circuit-breakers b. Blown or defective secondary fuses or opened circuit-breakers 2. Open control circuit -- a. Overload trips are open b. Defective holding coil in magnetic switch c. Loose or poor connections in control circuit 3. Magnetic switch closes a. Poor switch contact b. Open circuit in control panel c. Open circuits in lead to motor d. Leads improperly connected	1. Close break in circuit -- a. Check voltage across all phases above the disconnect switch. Replace fuses or reset circuit-breakers as necessary. b. Check voltage across all phases below disconnect switch (with disconnect switch closed). Replace fuses or reset circuit-breakers as necessary. 2. Complete the control circuit -- a. Push reset button. b. Push start button and allow sufficient time for operation of time delay, if used, then check voltage across magnetic holding coil. If correct voltage is measured, coil is defective. If no voltage is measured, control circuit is open. c. Make visual inspection of all connections and re-tighten as necessary. 3. Check switch operation a. Open manual disconnect switch, close magnetic switch by hand and examine contactors and springs. b. Check voltage at T1-T2-T3. c. Check voltage at leads to outlet box. d. Check lead numbers and connections.
Motor fails to come up to speed	1. Low or incorrect voltage 2. Incorrect connection at motor 3. Overload - Mechanical 4. Overload - Hydraulic	1. Check voltage T1-T2-T3 in control panel and at motor leads in outlet box. 2. Check for proper lead connections at motor, compare with connection diagram on motor. 3. Check impeller setting. Check for locked or tight shaft. 4. Check impeller setting. Check GPM against pump capacity and head.
Motor runs hot	1. Inadequate ventilation 2. Overload 3. Unbalanced supply voltage	1. Assure adequate supply of fresh air. Check air blast through motor by feeling air discharge at bottom of motor. 2. Check load with ammeter. 3. Check supply voltage with voltmeter.
Motor vibrates	1. Headshaft misaligned 2. Worn shaft bearings or bent shaft 3. Hydraulic disturbance in discharge piping 4. Unbalanced rotor assembly 5. Motor not mounted securely	1. Remove top drive coupling and check alignment of motor to pump. 2. Disconnect motor from pump and run motor only to determine source of vibration. 3. Check isolation joint in discharge piping near pump head. 4. Balance rotor. 5. Secure properly and check alignment.
Motor noisy	1. Worn thrust bearing 2. Electrical noise	1. Remove dust cover, rotate rotor by hand and make visual examination of balls and races. (Bearing noise is usually accompanied by high frequency vibration.) 2. Most motors are electrically noisy during the starting period. The noise should diminish as the motor reaches full speed.
Incorrect rotation	1. Incorrect connections	1. Refer to connection diagram and re-connect according to instructions.

1.2.11 Oil Sump Pump

1.2.11.1 Identification

Tag Number	Description
P714	Oil Sump Pump

1.2.11.2 Description

Manufacturer:	Gorman-Rupp Co. Mansfield, Ohio
Part no:	Model 81 1/4 A-X 1/2
Spec no:	DOE Dwg. 40M7006S, CP 9
Material:	

1.2.11.3 Prescribed Service

Oil

1.2.11.4 Vendor

Gorman-Rupp Company

1.2.11.5 Special Cautions

See Gorman-Rupp Manual (following)

1.2.11.6 Period Service

See Gorman-Rupp Manual (following)

1.2.11.7 Parts List

See Gorman-Rupp Manual (following)

1.2.11.8 Special Tools

None

1.2.11.9 Maintenance

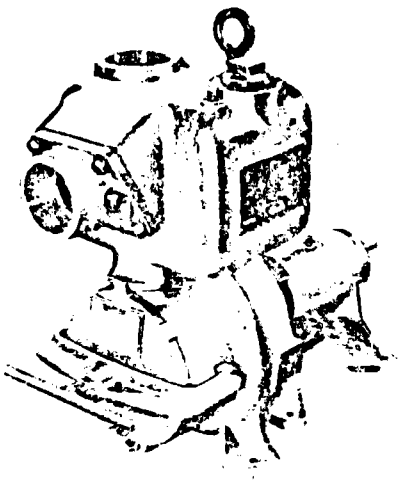
See Gorman-Rupp Manual (following)

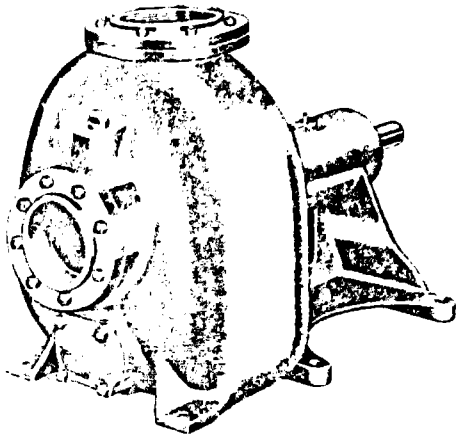
1.2.11.10 Acceptance Test

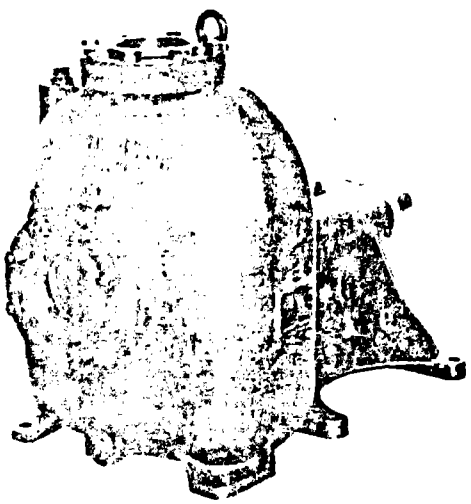
None

GORMAN-RUPP SELF-PRIMING LECTRIC-MOTOR-DRIVEN, POWER-TAKE-OFF DRIVEN, AND PEDESTAL-MOUNTED CENTRIFUGAL PUMPS

Includes Pumps in Model 10, 30, 80, 90, O, and T Series







GORMAN-RUPP

THE GORMAN-RUPP COMPANY • MANSFIELD, OHIO

GORMAN-RUPP OF CANADA LIMITED • ST. THOMAS, ONTARIO, CANADA

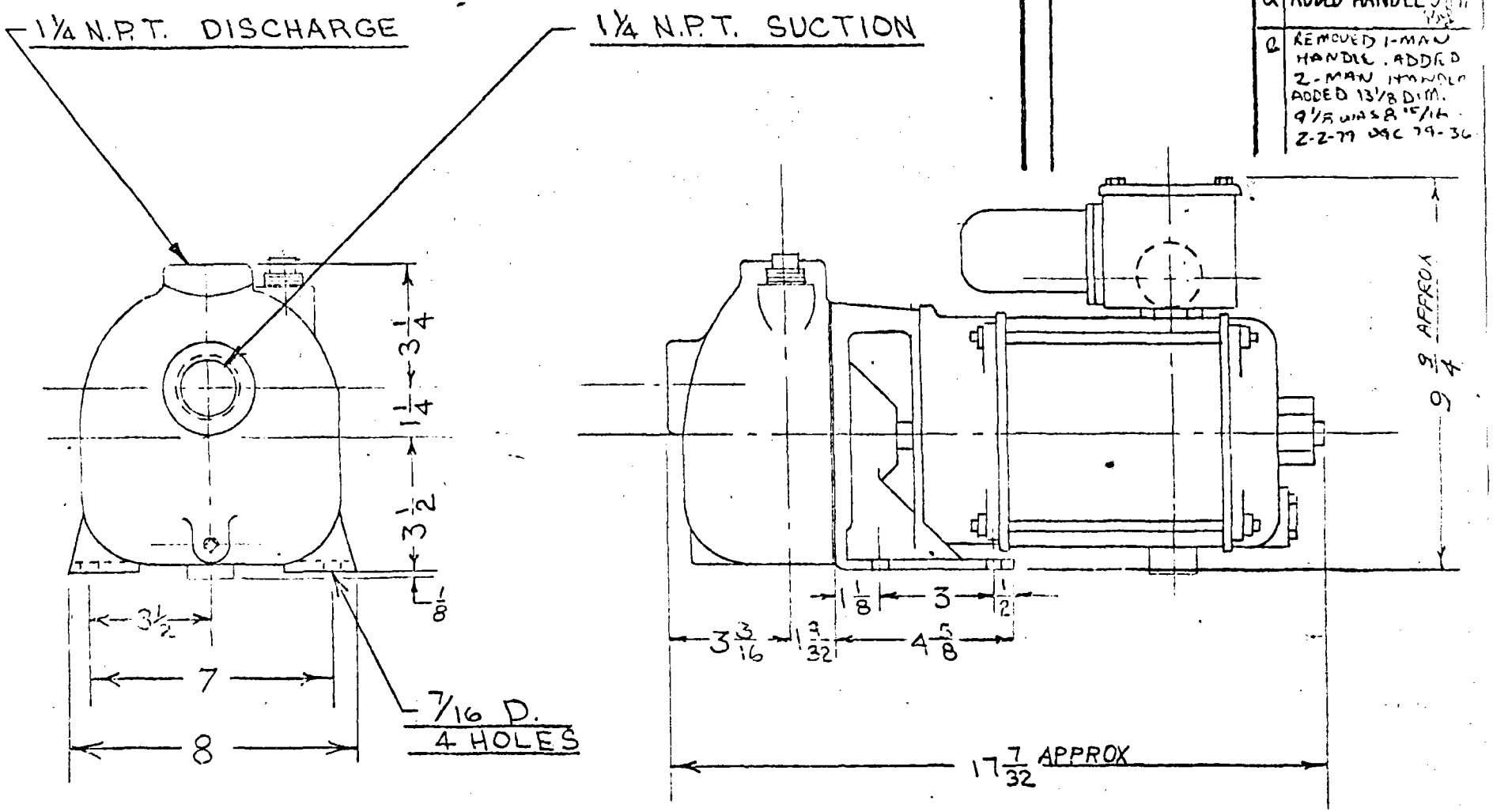
1.2.11-2
February 1968

P	C	REMOVED TWO-MAN HANDLE MA 10-15-79

6786

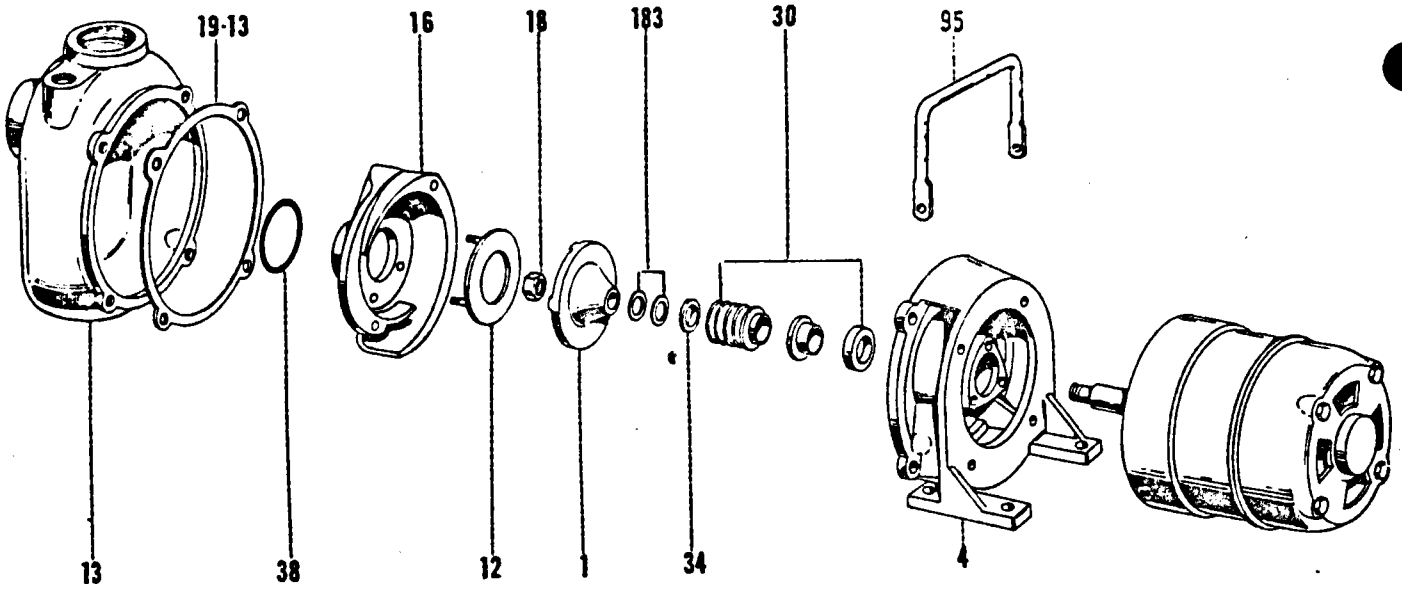
REVISIONS

A	ADDED HANDLE STUD
B	REMOVED 1-MAN HANDLE. ADDED 2-MAN HANDLE. ADDED 13/8 DIM. 9 1/8 UNS-B 5/16 - 2-2-79 DAC 79-36



1.2.11-3

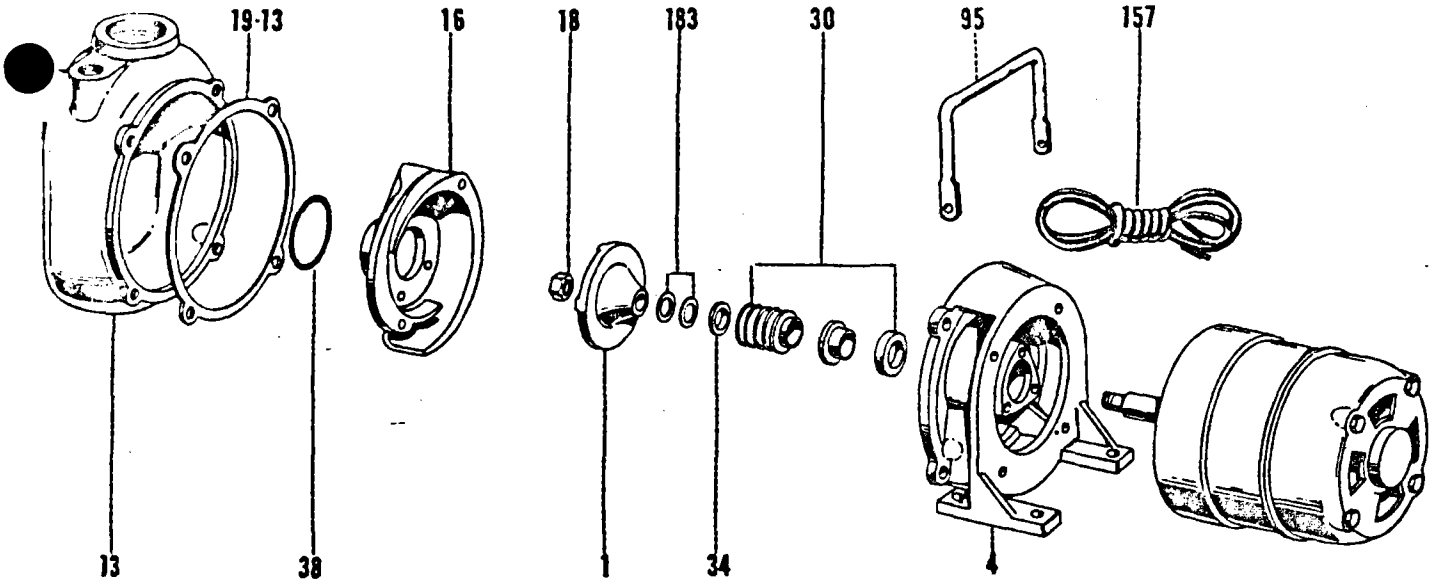
THE GORMAN-RUPP CO.	DWN. BY JKE	MODEL 81¼A-X½ OR X⅓
MANSFIELD, OHIO	DATE 9-3-58	
	REV. 10-12-71	OUTLINE A-6786



EXPLODED VIEW

IDENT. NO.	PART NAME	COMMON PART NUMBER	INDIVIDUAL PART NUMBER FOR THESE MODELS			
			81¼A3-E1/3 81¼A3-E½	81¼A3-X1/3 81¼A3-X½	81½D3-E½ 81½D3-E3/4 81½D3-E1	81½D3-X½ 81½D3-X3/4 81½D3-X1
1	IMPELLER		6030	6030	6479	6479
4	INTERMEDIATE BRACKET		5711	5711	6103-B	6103-B
12	WEAR PLATE		7181	7181		
13	HOUSING		5709	5709	6477	6477
16	VANE PLATE		5708	5708	6478	6478
18	JAM NUT	DC-07-S	DC-07-S	DC-07-S	DC-07-S	DC-07-S
19-13	GASKET		5709-G	5709-GA	6103-G	6103-GA
30	SEAL COMPLETE	S-765	S-765	S-765	S-765	S-765
34	SEAL WASHER	6087	6087	6087	6087	6087
38	"O" RING		S-461	S-461	S-300	S-300
95	CARRING HANDLE	549-B	549-B	549-B	549-B	549-B
110	STRAINER		11194		11194-A	
183	IMPELLER ADJ. SHIMS	5889	5889	5889	5889	5889

SM-40-80



EXPLODED VIEW

IDENT. NO.	PART NAME	COMMON PART NUMBER	INDIVIDUAL PART NUMBER FOR THESE MODELS	
			81¼A6-E 1/3	81¼A6-X 1/3
1	IMPELLER	**6030**	6030	6030
4	INTERMEDIATE	**5711**	5711	5711
13	HOUSING	**5709**	5709	5709
16	VANE PLATE	**5708-A**	5708-A	5708-A
18	JAM NUT	**AT-07-S**	AT-07-S	AT-07-S
19-13	GASKET	**5709-G**	5709-G	5709-G
30	SEAL ASSY.	**S-765**	S-765	S-765
34	SEAL WASHER	**6087**	6087	6087
38	"O" RING	**S-461**	S-461	S-461
95	CARRYING HANDLE	**549-B**	549-B	549-B
157	CORD ASSY.		4843	
183	IMPELLER SHIMS	**5889**	5889	5889

SM-50-80

CONTENTS

Your Gorman-Rupp Pump

1. GENERAL

These instructions provide general information for users of Gorman-Rupp self-priming electric motor-driven, power-take-off driven (PTO), and pedestal mounted centrifugal pumps. The instructions cover inspection, installation, operation and maintenance. Due to the numerous pump variations and applications, it is impossible to cover every detail of every application; however, the Gorman-Rupp Company, upon request, will gladly provide any specific information not included in this manual. When requesting information or ordering parts, please provide the complete pump model number, serial number, and any pertinent details concerning the pump application. Address requests to:

The Gorman-Rupp Company
P. O. Box 1217
Mansfield, Ohio 44902

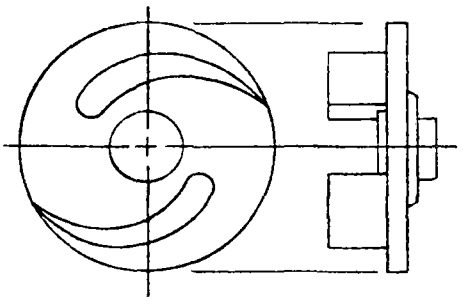
2. DESCRIPTION

a. General. This manual covers Gorman-Rupp electric motor-driven, power-take-off driven and pedestal mounted self-priming, centrifugal pumps in the Model 10, 30, 80, 90, O and T series. Once a self-priming pump is filled with liquid, it will continue to reprime each time it is started without the use of auxiliary priming devices. Pumps are constructed with open or enclosed type impellers depending on their application (see Figure 1). Pumps in the O Series use enclosed impellers; all other pumps covered in this manual use the open type impeller. Open impellers are used in pumps designed for medium heads and liquids which contain entrained solids. Closed impellers are primarily used in pumps designed for pumping clean liquids at high heads and high discharge pressures.

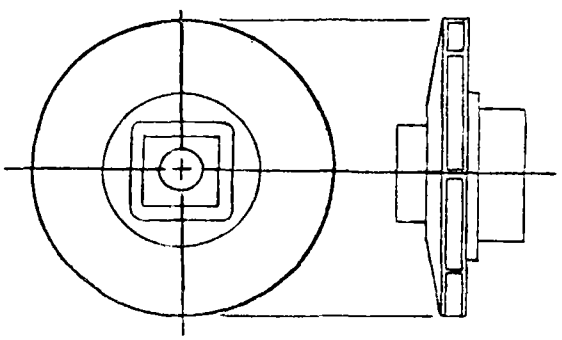
b. Drive. Gorman-Rupp pumps are driven by either close coupling or flexible coupling to a power source, through a power-take-off (PTO) or through a V-belt drive. In the close coupling method, the pump impeller is mounted either directly on the motor shaft or on an adapter shaft which is directly coupled to the motor shaft. The flexible coupling method couples the pump shaft to a separate motor shaft through an external coupling device. The flexible coupling method is used exclusively on fixed installations and pedestal mounted pumps. The power-take-off method uses a gear box and a universal assembly to couple the pump to a tractor or other suitable driving equipment. The V-belt drive system uses either a single V-belt or a matched set of belts to transfer rotational power from the power source to the pump.

c. Seals

(1) General. The shaft seals used in Gorman-Rupp pumps are classified as mechanical type seals and stuffing box seals (see Figure 2). Mechanical seals obtain sealing action by mechanical contact between the polished surfaces of a rotating element and a stationary element. Stuffing box



OPEN IMPELLER



ENCLOSED IMPELLER

Figure 1. Types of impellers.

type seals obtain sealing action by stuffing a cavity, called a stuffing box, with a packing material. The packing material is compressed snugly by a packing gland to seal the area between the pump shaft and the housing.

(2) Mechanical Seals

(a) The Gorman-Rupp grease-lubricated mechanical seal has two separate sets of seal elements for positive sealing at both ends. The seal is automatically lubricated by a spring-loaded grease cup mounted on the seal plate of the pump.

(b) The John Crane self-lubricated mechanical seal has a single set of sealing elements and is normally used in pumps designed to handle volatile liquids. The seal obtains its lubrication from the material of the sealing elements.

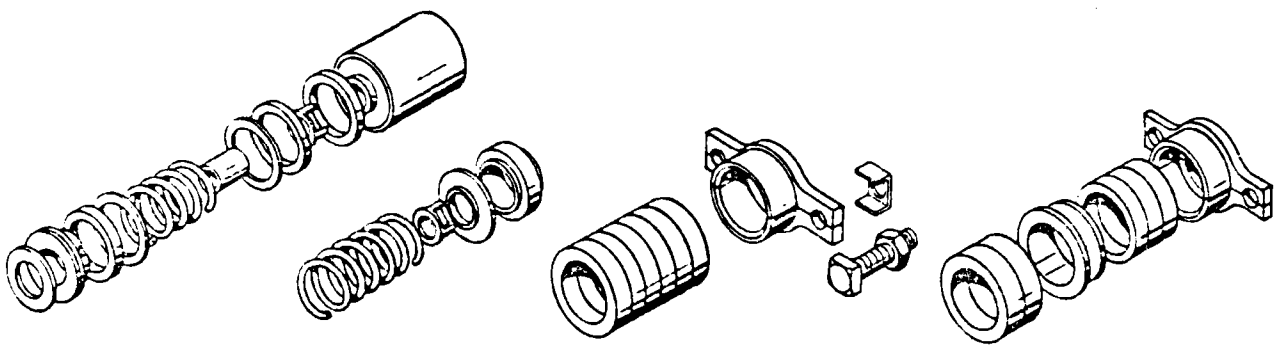
(c) The oil-lubricated mechanical seal is similar to the self-lubricated seal except that the oil-lubricated seal is manufactured by Gorman-Rupp and uses carboloy sealing faces.

(3) Stuffing Box Seals

(a) The solid packed stuffing box uses a single set of packings which are partially lubricated by allowing a slight leakage from the pump to saturate the packing material. In addition, the packings may be grease-lubricated or oil-lubricated.

(b) The packing and lantern ring stuffing box uses two sets of packings separated by a lantern ring. The lantern ring guides liquid from the pump around the shaft to seal off air leakage and lubricate the packings. In addition, the packings may be grease- or oil-lubricated.

(c) In both types of stuffing box seals, a packing gland compresses the packings in the pump. The packing gland can be adjusted to control the amount of leakage from the pump (see paragraph 17). This adjustment is critical. If the gland is too tight, excessive wear of the packing and shaft sleeve will result. If the gland is too loose, excessive leakage will limit the pumping efficiency.



(GORMAN-RUPP) GREASE-LUBRICATED MECHANICAL SHAFT SEAL

(JOHN CRANE) SELF-LUBRICATED MECHANICAL SEAL

SOLID PACKED STUFFING BOX

PACKING & LANTERN RING STUFFING BOX

Figure 2. Seals used in Gorman-Rupp pumps.

Inspecting a New Pump

3. GENERAL

All pumps are inspected and tested before shipment. However, since damage will sometimes occur during shipment, give the pump a good visual inspection before putting it into service. In addition, gaskets have a tendency to dry out and shrink after testing and should be tightened before operating the pump.

4. INSPECTION PROCEDURE

a. Visually inspect the pump for damage which may have occurred during shipment.

b. Read all tags on the pump and perform the duties indicated.

c. On pumps with oil-lubricated bearings and seals, replace the shipping plugs with the vented plugs (shipped separately).

d. Check the pump for loose bolts, nuts, and other attaching hardware; tighten all loose attaching parts.

CAUTION

On pumps with suffing-box type seals, do not tighten the packing gland before operation. If the seal leaks after the pump is put into operation, refer to paragraph 20c and tighten the gland.

e. Rotate the pump through several revolutions by hand to assure that the motor and impeller rotate freely. Close-coupled pumps with electric motors can usually be turned by rotating the blades of the cooling fan. If the pump has a removable end plate, it can be turned by removing the end plate and rotating the impeller.

f. On pumps with electric motors, check the motor size and voltage requirements before installation to assure that proper power and wiring will be available at the operating site.

g. Refer to paragraph 17 and check for proper lubrication of the pump.

Installing the Pump

5. GENERAL

This section provides a general outline of installation practices which will provide the most efficient and trouble-free pump operation. In practical installations it may not always be possible to follow all of these practices. In such cases, let good judgment and experience be the guide. Practices which are particularly harmful to personnel or equipment are indicated by WARNINGS and CAUTIONS respectively.

NOTE

Abnormal operating conditions often require special procedures or equipment to prevent pump damage. Consult the Gorman-Rupp Company when abnormal conditions are encountered.

6. LOCATION

Locate the pump in an accessible place as close as possible to the liquid source. Keep the suction lift as low as practical. Select a site which is reasonably level to assure proper pump operation. If necessary to compensate for unlevel terrain, set the pump on a support strong enough to support its weight when filled with liquid and secure enough to minimize vibration. If the pump is power-take-off driven, allow enough room for parking the tractor or driving equipment. For pumps with electric

motors, make sure that the correct power is available at the site for operating the pump. If a PTO driven pump is to be engine driven and operated in an enclosed area, pipe engine exhaust gasses to the outside and provide adequate ventilation.

WARNING

Do not operate engine-driven PTO pumps in an enclosed area unless the exhaust gasses are piped to the outside and adequate ventilation is provided. Exhaust fumes contain carbon monoxide, a deadly poisonous gas.

7. SUCTION AND DISCHARGE LINE

a. General Considerations

(1) When installing the suction and discharge lines, try to keep the lines as straight as possible to keep friction losses at a minimum. Fittings in pipe lines increase friction losses considerably. For example, a 90° elbow in a 6-inch line presents about the same friction loss as 15 feet of straight pipe. When necessary to use elbows, use the long-radius type to minimize friction loss. Use only gate-type valves in the lines since this type presents the least friction loss.

(2) When connecting pipe lines to the pump, the connecting flange must be aligned exactly with the pump port. Never pull a line into place by tightening the flange bolts. Lines must be independently supported near the pump to avoid strain on the pump which could result in serious vibration, decreased bearing life, and increased wear of the shaft sleeve and seal. Hose-type lines should also be supported to relieve the weight of the liquid. Supports must be strong enough to secure the line when it is under pressure and filled with liquid.

(3) Most pumps are drilled and tapped for installation of discharge pressure and vacuum suction gages. If it is desired to install these gages and the pump is not tapped, drill and tap the suction and discharge lines close to the pump before installing the lines.

(4) Figure 3 shows two pump installations. Figure 3A illustrates a poorly-installed pump and 3B illustrates a properly-installed pump.

b. Suction Line

(1) The suction line may be either pipe or hose. If hose is used, it must be the rigid-walled, reinforced type to prevent collapsing under suction.

(2) The suction line must be as short and straight as possible and free of air pockets. When operating on a suction lift, the line must always slope from the liquid source up toward the pump. If the line slopes down at any place in the suction run, air pockets will be created which could prevent pump priming. If it is necessary to use reducers in the suction line, use eccentric reducers to avoid the creation of air pockets. Normally, valves are not installed in the suction line; however, if a particular application requires the use of a valve, install it with the valve stem down or to either side to eliminate an air pocket in the stem.

(3) To avoid clogging or damage to the pump, install a strainer on the end of the suction line. The strainer should have an opening of at least three to four times the diameter of the suction line. During operation it is normally necessary to clean the strainer periodically depending on the amount of solids in the liquid. Secure the end of the suction line in the liquid to prevent it from drawing itself to the bottom of the sump.

(4) Carefully seal all connections in the suction line with pipe dope to provide an air-tight seal. Even a slight leak will reduce pumping efficiency under any conditions and especially when operating with a high suction lift.

(5) After installation of the suction line, inspect it carefully for potential leaks.

c. Discharge Line

(1) The discharge line may be either pipe or hose.

(2) If a throttling valve is desired to control the liquid flow, install it in the discharge line. Use a gate-type valve which is as large as the largest pipe in the line in order to minimize friction losses. Never install a throttling valve in the suction line.

(3) On high discharge heads, install a gate valve and a check valve in the discharge

line near the pump. When the pump is stopped, the check valve protects the pump from excessive shock pressure and reverse rotation caused by backward flow of the liquid down the discharge line. It is not necessary to use a check valve on low discharge head applications.

(4) If the height of the discharge line of the pump exceeds one half of the rated pump head (see applicable pump specification sheet), difficulty may be encountered when the pump is repriming. To allow the pump to reprime, install a 1 to 1-1. 4-inch bypass line between the check valve and the pump, as shown in Figure 4. Install a shut-off valve in the line and direct the bypass flow to the sump. When repriming, open the valve in the bypass line so the pump will not have to prime against the weight of the liquid in the discharge line. When the pump is primed and

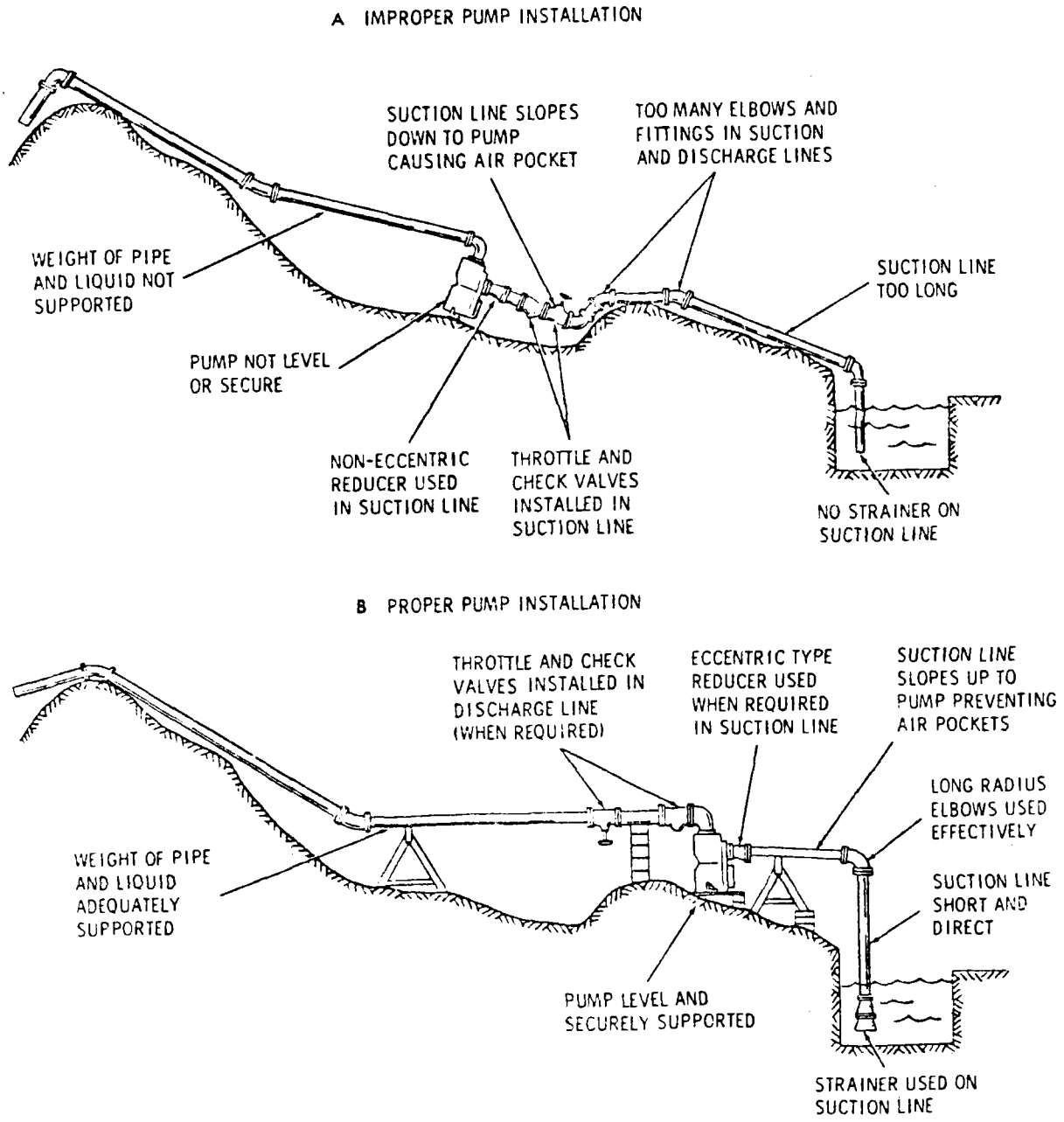


Figure 3. Examples of proper and improper pump installation.

liquid is flowing steadily from the bypass line, close the bypass valve to direct all of the pumped liquid into the discharge line.

(5) Do not terminate the discharge line at a level which is lower than that of the fluid being pumped unless a flow restricter is used in the line. If a flow restricter is not used, a syphoning action could result, causing damage to the pump.

8. SUMP PUMPING CONSIDERATIONS

a. Liquid inflow into a sump should never discharge near the suction inlet of the pump. The flow from the fill pipe carries air down into the sump. Air will reduce pumping efficiency if it enters the suction line. If it is necessary to have the fill pipe and the suction inlet close together, install a baffle in the sump around the spill area to allow entrained air to escape before the liquid is drawn into the suction line (see Figure 5).

b. When two suction lines are used in one sump, install the inlets at least three feet apart. If the suction inlets are too close together, the flow paths may interact reducing the efficiency of one or both pumps (see Figure 6).

9. PEDESTAL MOUNTED PUMPS

a. General

(1) The alignment of a pedestal mounted pump and its power source is of extreme importance for trouble-free mechanical operation. In either flexible coupling driven or V-belt driven systems, the driver and pump must be mounted so that the driver and pump shafts are aligned and parallel to each other. If the driver was mounted at Gorman-Rupp, the unit was in alignment before it was shipped. Since alignment can be lost during shipment, it should be checked and realigned, if necessary.

(2) Before checking alignment, tighten down the foundation bolts. Check to make sure that the pump casing feet, bearing housing feet, and the driver mounting bolts are tightly secured.

b. Gap and Angular Alignment of Coupling-Driven Pumps

(1) To check the angular misalignment of spider insert type couplings, use calipers to measure the dimension at four places on the circumference of the outer ends of the coupling hub at 90-degree intervals. The normal gap between coupling hubs is indicated in Figure 7. The coupling is in alignment when the coupling hubs are the same distance apart at all points. Adjustments may be made by loosening the hold-down bolts and shifting the driver and pump or shimming as required.

(2) To check the angular misalignment of couplings other than the spider insert type, insert a feeler gage or taper gage

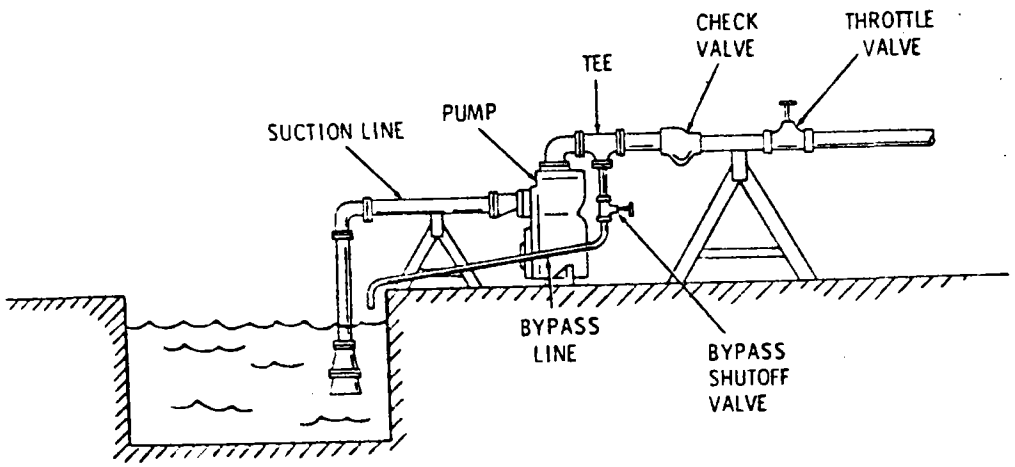


Figure 4. Installation of bypass line for high discharge heads.

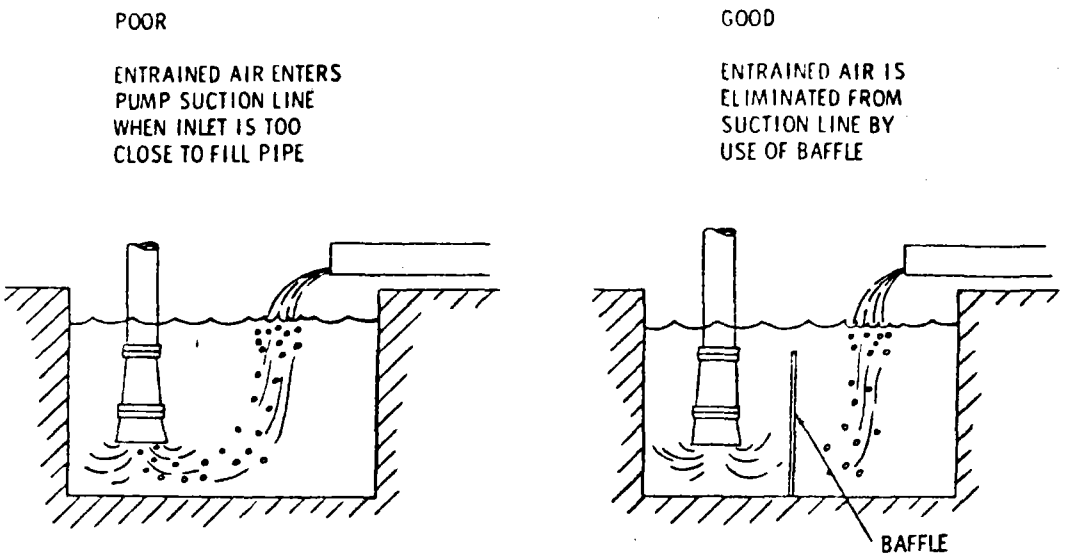


Figure 5. Eliminating entrained air caused by a fill pipe.

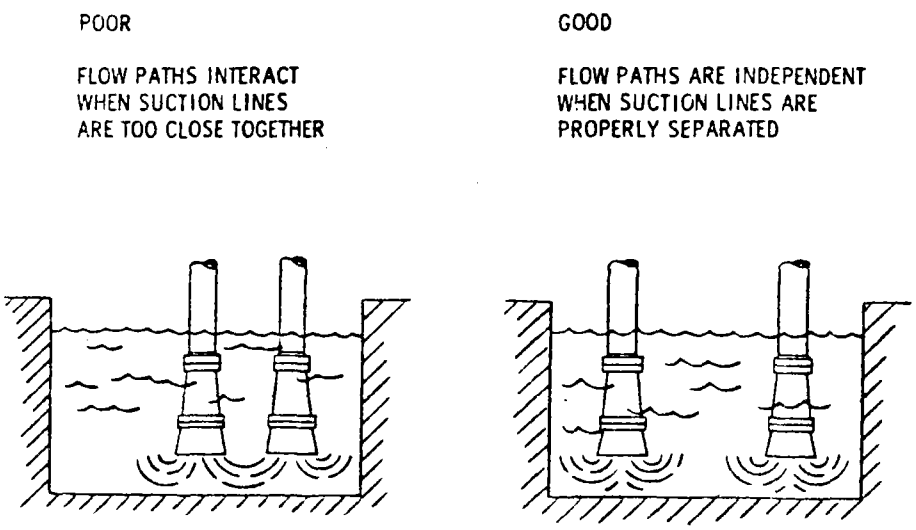


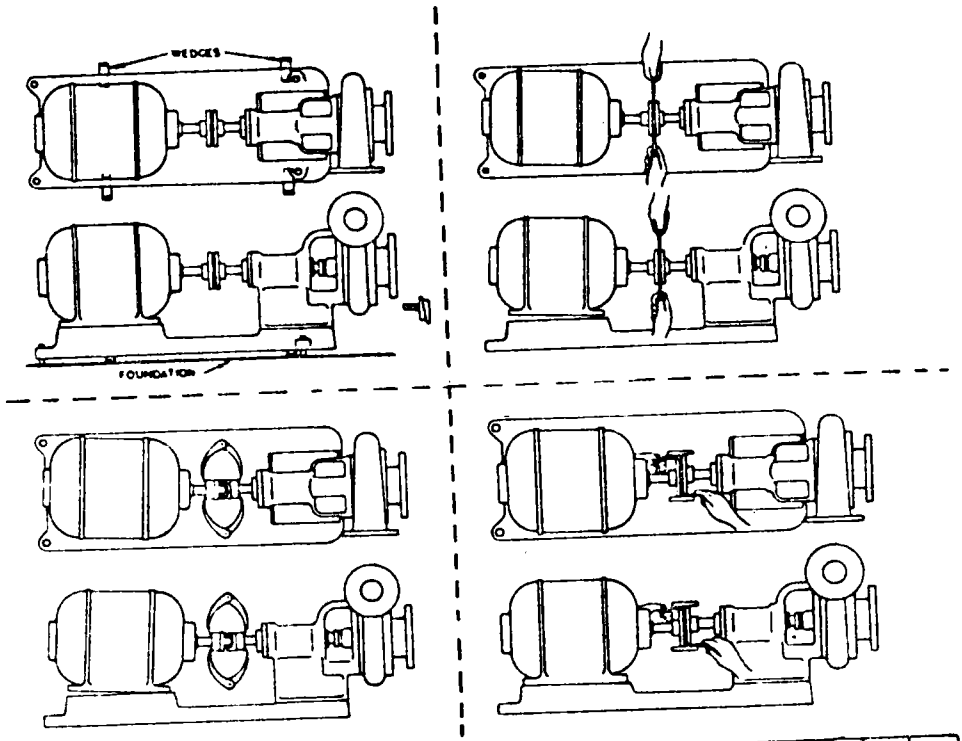
Figure 6. Using two pumps in the same sump.

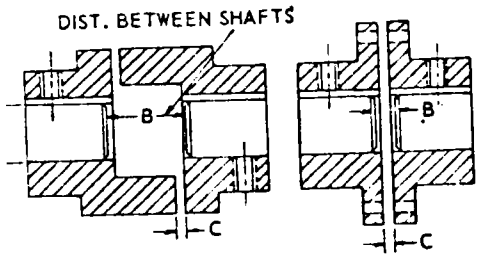
between the coupling halves at four points on the circumference of the coupling at 90-degree intervals. The normal gap between coupling hubs is given in Figure 7. The coupling is in alignment when measurements show the same distance between coupling hubs at all points. Chain type couplings will allow the chain to be free and not binding when in alignment. Adjustments may be made by loosening the hold-down bolts and shifting the position of the driver and pump or by shimming as required.

c. Parallel Alignment of Coupling-Driven Pumps. Check parallel alignment by laying a straightedge across both coupling rims at the top, bottom and sides. The coupling is in horizontal parallel alignment when the straightedge rests evenly on both halves of the coupling. Use a feeler gage between the coupling and straightedge to measure the amount of misalignment. Add shims under the driver or pump mounting feet as required to correct misalignment.

CAUTION

Adjusting the alignment in one direction may alter the alignment in another direction. Check each procedure after making any alignment alterations.



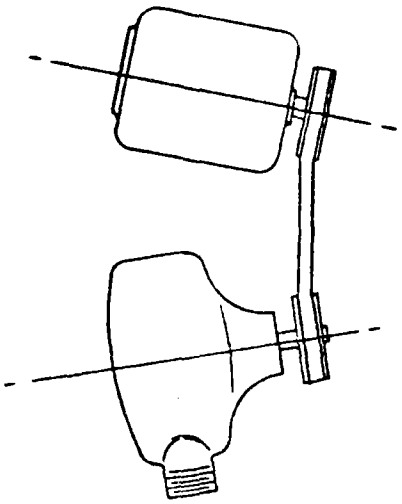


COUPLING TABLE

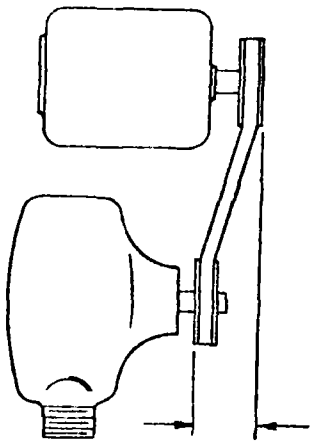
MFG. NO.	MAKE	GR. NO.	MAX BORE A	SHAFT SPACE B	GAP C
L-095	Lovejoy	S-65	1⅛	½	3/32
L-100	"	S-40	1⅜	⅝	1/8
L-150	"	S-43	1⅞	1	1/8
D-4016-A	Diamond	S-41	1⅜	9/32	9/32
D-5016-A	"	S-42	1¾	⅜	⅜
D-6018-A	"	S-66	2⅜	11/16	11/16
D-3322-C	"	S-67	3	11/16	11/16
G-100	Gerbing	S-826	¾"	5/16	5/16
G-300	"	S-1013	1	5/16	5/16
8-F	Falk	S-573	2⅜	⅛	⅛
12-F	"	S-579	3½	3/16	3/16

Figure 7. Checking alignment of flexible couplings.

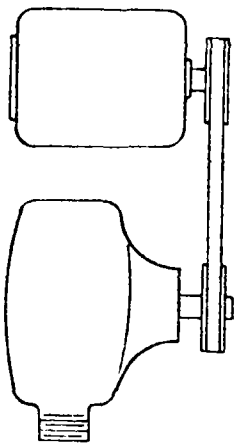
d. Alignment of V-belt Driven Pumps. To prevent excessive V-belt wear and excessive power loss, it is very important that the drive shafts of the power unit and the pump unit are parallel and that the pulleys are properly aligned. Refer to Figure 8. Use a straightedge along the sides of the pulleys to assure that the drive pulleys of the V-belt system are properly aligned. For drive systems that employ two or more belts, make sure that the belts are a matched set. Unmatched belts will result in rapid belt wear. Provisions must be made to permit belt tension adjustment. Tighten the belts in accordance with the belt manufacturer's instructions. Loose belts will result in slippage. Too tight belts will result in excessive power losses and possibly premature bearing failure. Select pulleys that will provide the proper speed ratio. Overspeeding the pump may damage the pump and the power source.



A. MISALIGNED - SHAFTS NOT PARALLEL



B. MISALIGNED - PULLEYS NOT IN LINE



C. PROPERLY ALIGNED - SHAFTS PARALLEL AND PULLEYS IN LINE

Figure 8. Alignment of V-belt driven pumps.

10. PUMPS WITH POWER-TAKE-OFF DRIVES

It is important that the universal assembly for power-take-off pumps be aligned as closely as possible as shown in Figure 9. Misalignment of more than 15 degrees will cause excessive vibration and rapid wear. Misalignment can be corrected by changing the height of the pump with respect to the driving equipment by the proper use of supporting blocks. It is especially important that the pump be securely supported when using power-take-off drive.

11. PUMPS WITH ELECTRIC MOTOR DRIVE

Check the pump specification sheet or motor nameplate to determine the correct operating power. If it is necessary to install wiring to the operating site, take into account any additional electrical requirements at the installation in addition to the power requirements of the pump and install adequate wiring and circuit breakers in accordance with local codes. Install a ground wire on the pump and attach it to a suitable ground point such as a metal rod driven into the earth.

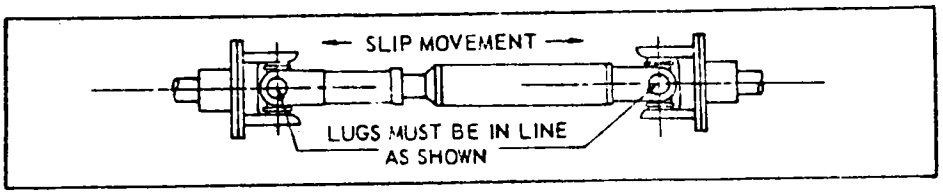
WARNING

Never operate an electric motor-driven pump without a ground. Serious injury or death by electrocution could result.

12. PUMP ROTATION

a. After installation of pumps driven by a three-phase electric motor, momentarily start the pump and check the direction of rotation. If the shaft, coupling, or V-belt is not visible, rotation can usually be determined by observing

UNIVERSAL JOINT ALIGNMENT (PTO Pumps)



Assembly of the drive shaft is very important. The universal shaft lugs must be in line as shown.

IMPROPER INSTALLATION

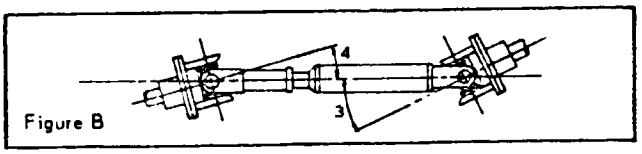


Figure B

In figure B, the tractor and pump drive shafts are not parallel. Angles 3 and 4 are not equal. Rapid wear results.

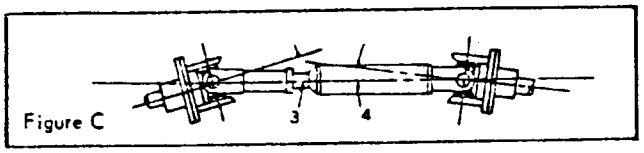


Figure C

In figure C, angles 3 and 4 are not equal. Rapid wear results.

PROPER INSTALLATION

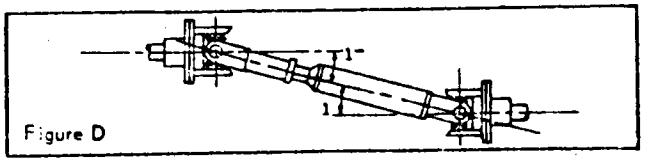


Figure D

In figure D, the angles 1 are equal, shafts are parallel. Long life.

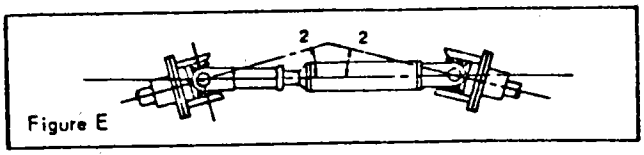


Figure E

In figure E, angles 2 are equal Low vibration. Long life.

Figure 9. Alignment of universal assembly.

the motor cooling fan or, if the pump has a removable end plate, by observing the impeller. The correct pump rotation is indicated by an arrow on the pump casting. If the rotation is incorrect, interchange any two of the three-phase wires on three-phase pumps to change the direction.

b. On pumps with power-take-off drive, check to make sure that the driving equipment will rotate the pump impeller in the correct direction before connecting the universal assembly.

CAUTION

Never operate a pump in the reverse direction. In many pumps the impeller could unscrew from the shaft and cause serious damage to the pump.

How to Operate the Pump

13. PREPARATION FOR STARTING

a. Make sure that the pump is properly installed.

b. Refer to paragraph 17 and check that the pump is properly lubricated.

c. The pump volute must be filled with liquid if the pump is being put into service for the first time, if the pump has been drained after the last period of operation, or if the pump has not been used for a considerable length of time and the liquid in the volute has evaporated. To fill the pump, open the volute fill cover or plug at the top of the pump casing and add clean liquid until the pump is full. In below-freezing conditions, use warm liquid to fill the pump and rotate the pump by hand to assure that the impeller is not frozen. Replace the volute fill cover or plug.

CAUTION

Never operate a self-priming pump unless the volute is filled with liquid. The pump will not prime when dry. Extended operation of a dry pump will destroy the seal assembly.

d. If the pump uses a Gorman-Rupp grease-lubricated mechanical seal, release the cross arm on the grease cup in order to provide lubrication for the seal (see paragraph 20b).

14. STARTING

a. Normal Discharge Heads. Starting procedures will vary slightly depending on the pump application and the type of drive used with the pump. Open any valves in the discharge line and start the drive unit. Once started, operate the pump at its maximum governed speed until it primes. Priming can be observed by a pressure indication on the discharge pressure gage or by a noticeable decrease in pump speed. Depending on pumping conditions, the pump may not prime immediately since it is necessary to fill the suction line with liquid. If after a reasonable time the pump fails to prime, stop the pump and check the suction line carefully for leaks. After the pump has primed, reduce the pumping speed or close the throttling valve in the discharge line slightly in order to fill the discharge line slowly and avoid excessive shock pressure which could damage pipe ends, gaskets, sprinkler heads, and any other fixtures connected to the line. When the discharge line has filled, adjust the pump speed and throttling valve for the required discharge pressure and flow rate.

b. High Discharge Heads. If the discharge head in a pump application exceeds one-half of the rated pump head, a bypass line must be installed to enable the pump to reprime after it is stopped (see paragraph 7c(4)). The priming operation is essentially the same as with normal discharge heads except that the throttling valve in the discharge line is closed and the bypass shutoff valve is open during priming. Once the pump has primed, open the throttling valve and close the bypass valve.

c. Electric Motor-Driven Pumps. Electric motor-driven pumps are started by applying power to the pump by setting the circuit breaker in the line to the ON position. Before operating an electric motor pump, be sure that it is

properly grounded and that it will rotate in the correct direction (see paragraphs 11 and 12).

d. PTO-Driven Pumps. When using a power-take-off from a tractor or other similar driving unit, follow the unit manufacturer's instructions for operating the unit. Be sure that the unit will rotate the pump in the correct direction.

15. OPERATING CHECKS

a. In order to insure that the pump is operating properly it should be checked when first started and periodically thereafter to prevent minor problems from becoming major repair jobs.

b. Check for any unusual noises or excessive vibration. Vibration will usually result when the pump or the suction and discharge lines are not adequately secured.

c. Check all pump connections, the discharge line, and the pump shaft seal for evidence of leakage. On pumps with stuffing box-type seals a very slight leakage is normal and desirable. However, a steady leak should be investigated further (see paragraph 20c).

d. Check the pump for overheating. The pump could overheat if the throttle valve in the discharge line is closed. The pump should not be operated against a closed throttle valve for long periods of time. Although no serious harm is normally done to the pump, the rotating impeller can churn the liquid and generate heat, causing the liquid to boil and resulting in a vapor-locked condition. If this occurs, stop the pump and allow it to cool before removing the volute fill plate or plug. Refill the volute with cold liquid.

e. Check the suction strainer and clean it if necessary from time to time during operation or if the pump flow rate begins to decrease. Even though a strainer is used, small diameter metal solids may pass through it and cause damage to the pump. Be especially alert for unusual sounds when pumping liquids containing solids of this nature.

16. STOPPING

a. Reduce the pump speed (if possible) and stop the pump.

b. In below-freezing conditions, remove the volute drain plug and drain the pump to avoid damage from freezing. After draining the volute, operate the pump for approximately one minute. This will remove any remaining liquid that could freeze the impeller to the wear plate or wear ring.

c. If the pump has been pumping corrosive liquids or liquids containing a considerable amount of solids, open the drain plug and drain and flush out the pump thoroughly with clean water. Sometimes large solids can plug the drain port, preventing the pump from completely draining. To prevent this, operate the pump at a slow speed while it is draining, or remove the end plate and flush out remaining solids with a hose.

Keeping the Pump Running

17. GENERAL

This section provides maintenance information for the lubrication, routine adjustments, and checks to determine potential trouble. The objective of this maintenance is to prevent trouble from developing and to detect potential failures before they actually occur.

18. MOTORS

A large variety of motors are used to drive Gorman-Rupp pumps. Refer to the specific manual or specification sheet for maintenance information for the motor used with a particular pump.

19. BEARINGS

a. General. The life of any bearing depends upon the care it is given. Most pumps use bearings which are grease lubricated when the pump is assembled and normally require no further lubrication until the pump is overhauled. On close-coupled pumps which have the impeller mounted directly on the motor shaft no pump bearings are used. Pedestal mounted or power-take-off driven pumps usually have

bearings in a bearing housing which require either grease or oil lubrication. It is important that the proper grade of lubricant be used and that it is kept free of dirt, moisture, and other foreign material.

b. Lubrication

(1) Under normal operating conditions, grease-lubricated bearings have sufficient grease installed in the bearing housing for 5,000 hours of operation. Do not add grease sooner than required. Overgreasing will cause excessive preloading and overheating which will shorten the bearing life. When lubrication is required, use a good grade of number "0" pressure gun grease and fill the bearing cavity a maximum of 1/3 full or enough grease to bring the level to just below the shaft. Do not overfill the housing.

(2) Under normal operating conditions, oil-lubricated bearings should be drained and refilled yearly; however, the oil level should be checked regularly. Do not oil sooner than required. Over-oiling will cause excessive preloading and overheating which will shorten the bearing life. When lubrication is required, use a good grade SAE No. 30 motor oil. Fill the bearing housing through the plug on the top of the housing nearest to the engine (see Figure 10). Add oil until the level can just be seen through the oil level sight gage. Do not overfill the housing. Make sure that the vented fill plug installed in the housing is not clogged with dirt.

c. Bearing Temperature

(1) All bearings operate at some temperature above that of the surrounding air due to heat generated by rolling and drag friction. Ball bearings can be operated safely at temperatures up to at least 180° F. However, temperatures up to 160° F are generally considered to be normal.

(2) Do not attempt to check the temperature of the bearing by hand. This is not an accurate check. Bearing temperatures can be measured accurately by placing a contact-type thermometer against the frame or bearing housing. A stable temperature is an indication of normal operation. This temperature should be recorded in a convenient place for future reference.

(3) A sudden increase in temperature is an indication of an impending failure and should be investigated. On grease-lubricated pumps add one shot of grease to the bearing housing. If this does not immediately reduce the temperature, do not add more grease since the bearing could be overlubricated. On oil-lubricated bearings, check to see that the oil is of the proper viscosity and that the oil level is neither too high nor too low. Bearing overheating can also be caused by unnecessary loads such as coupling misalignment, excessive vibration, or operating the pump against a closed discharge valve.

(4) Occasionally, when pumps are first started, the bearings seem to run extremely hot. This high temperature is frequently caused by grease or oil seals which are not completely seated and not by the bearings. As soon as the seals have seated, the temperature will drop to a normal level.

20. SEALS

a. Oil-Lubricated Mechanical Seal. The oil level in an oil-lubricated mechanical seal should be checked frequently. The cavity may become diluted with the liquid being pumped after two to three months of operation. When the oil becomes approximately 50 percent diluted or appears milky in color, drain the seal cavity and refill using SAE No. 30 motor oil (see Figure 10). Fill the seal cavity only until the oil level can be seen in the fill hole. Do not overfill the cavity. Make sure that vented fill plug on top of the housing is not clogged with dirt. Use only non-detergent oil in seal cavities.

b. Gorman-Rupp Grease-Lubricated Mechanical Seals. The grease-lubricated mechanical seal applies grease to the seal from a spring-loaded grease cup. When the plunger bottoms on the grease cup cap, the grease cup must be refilled (see Figure 11). Use only a good, soft grade of No. 2 pressure gun grease. Do not use a hard grease since it will not flow into the seal and seal failure may result. To fill the grease cup, turn the cross arm clockwise to raise the plunger and compress the spring. While in this position, the cup can be filled using a grease gun at the grease fitting on the top of the plunger. Fill the cup until grease comes out of the relief hole. The grease cup can also be filled by hand by removing the cap. During pump operation, turn the cross arm counterclockwise until it is at the top of the threaded plunger in order to apply spring pres-

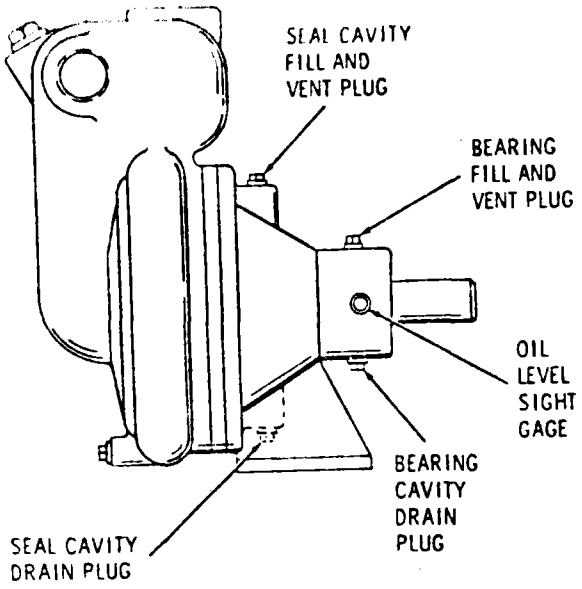


Figure 10. Fill and drain plugs for oil-lubricated bearings and seals.

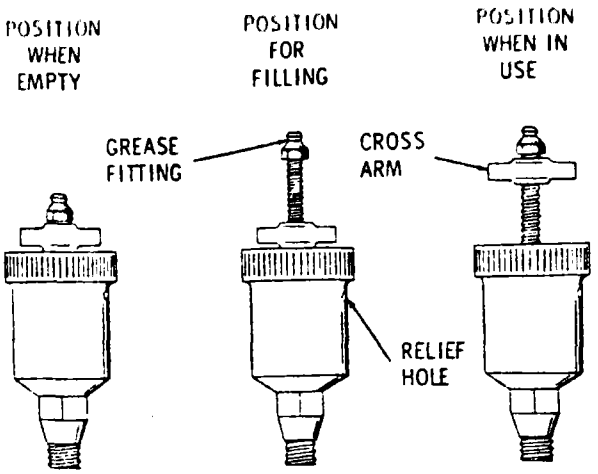


Figure 11. Automatic lubricating grease cup.

sure to the grease to automatically lubricate the seal.

c. Stuffing Box Seals

(1) Lubrication. Some stuffing box seals are lubricated by a spring-loaded grease cup in the same manner as the grease-lubricated seal. Refer to paragraph 20b for lubrication instructions.

(2) Leakage Adjustment. Excessive leakage may occur from a stuffing box seal if the packing gland is not properly secured. To adjust the gland, slightly loosen the nuts that secure the packing gland and then retighten them finger tight only. Start the pump and tighten evenly while the pump is pumping liquid. Do not tighten the gland so much that all leakage from the seal stops. A slight leakage from the seal is necessary for proper lubrication. After the gland is adjusted, the pump shaft should rotate freely by hand. If the shaft does not rotate easily, the gland is too tight. If the seal leakage cannot be controlled by adjusting the packing gland, the packings must be replaced (see paragraph 26).

d. Air Leakage Test. The pump seal and gasket can be tested for air leaks using a vacuum gage. Install a pipe plug, which has been drilled and tapped for a 1/4-inch pipe thread, in the suction coupling of the pump, using pipe dope on the threads. Install a vacuum gage in the plug. Make sure that the pump is filled with liquid and start the pump. When at operating speed, the pump should pull a vacuum of 20 inches or more to indicate that there are no air leaks in the seal or gaskets. Shut off the pump and observe whether the vacuum remains at the maximum developed by the pump. If the vacuum falls off rapidly, an air leak exists. Be sure that the leakage is not from the pipe plug or vacuum gage connection.

21. POWER-TAKE-OFF GEARBOX

Under normal operating conditions, the oil in the PTO gearbox should be drained and refilled yearly. Check the oil level regularly. When lubrication is required, remove the vented fill plug at the top of the housing and fill to the proper level using SAE No. 90 oil. Do not overfill the gearbox housing. The proper level is indicated on the tag on the gearbox housing. Make sure that the vented fill plug is not clogged with dirt.

Overhauling the Pump

22. GENERAL

The construction of the pumps differs considerably depending on the model number and model series. A typical exploded view of a self-priming pump is included in Figure 12 to assist in disassembly and reassembly. When overhauling a pump, disassembly is normally required only to the extent necessary to inspect the impeller, impeller shaft, wear plate (if used), bearings (if used), and the seal assembly. After disassembly, clean all metallic parts in a cleaning solvent and inspect for excessive wear, cracks, breaks, damaged threads, and other damage. Replace all parts that are worn excessively or are otherwise damaged. Give particular attention, as applicable, to the items covered in the following paragraphs.

23. GASKETS AND O-RINGS

a. Whenever a pump is overhauled, all gaskets should be replaced. However, if old gaskets must be reused, soak them in water to prevent them from drying out and shrinking.

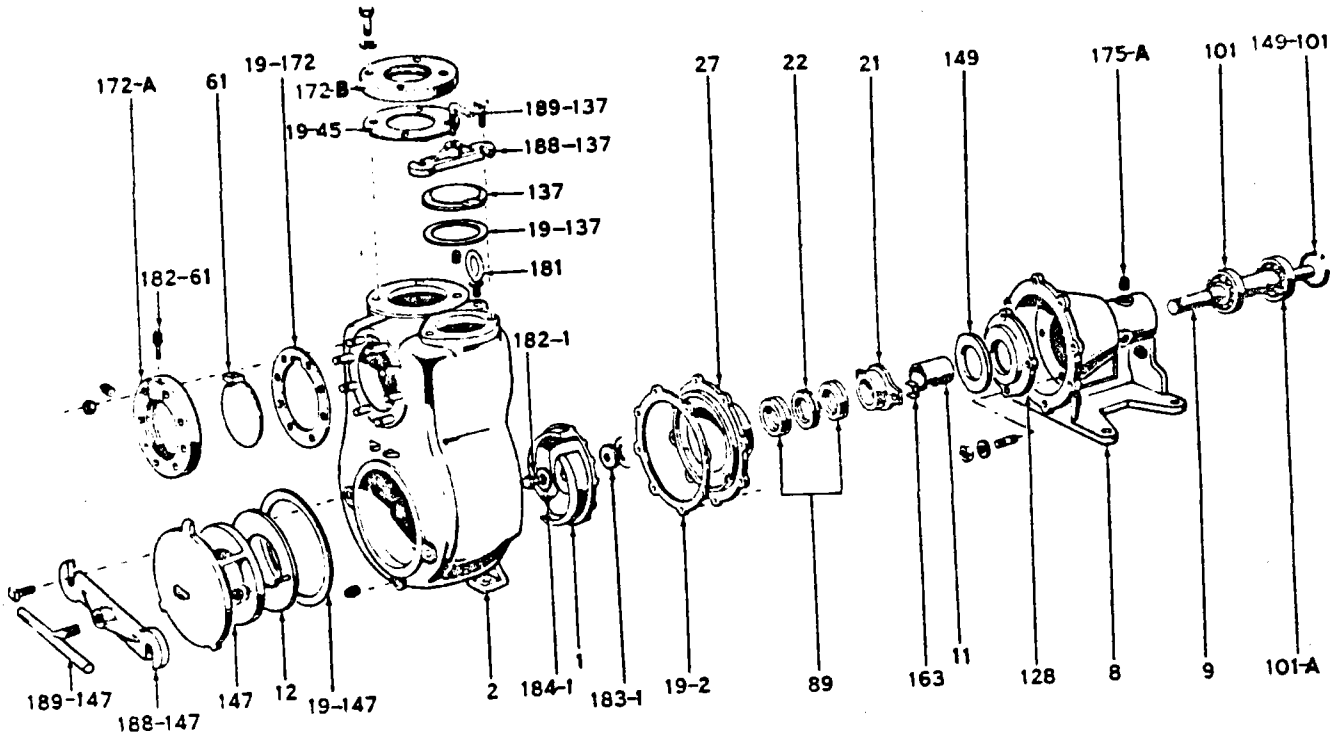
b. Inspect all O-rings carefully; replace any that are damaged.

24. IMPELLERS, WEAR PLATES OR RINGS, AND CLEARANCES

a. Impeller Removal. Impellers used on Gorman-Rupp pumps are either screwed onto threaded shafts or keyed to the shaft and secured with a nut. To remove threaded impellers, place a block of wood against the end of a vane and strike sharply with a hammer. The impeller will unscrew in the same direction as the pump runs. To remove keyed impellers, remove the nut and use a suitable puller. Use care when removing the impeller from a pump having a mechanical seal since the spring load of the seal may cause the impeller to fly off the shaft when it is being removed.

b. Open Impellers. Open impeller type pumps usually have a wear plate in front of the impeller vanes to minimize internal pump leakage (see Figure 13). This wear plate normally receives most of the wear. Pump efficiency will decrease considerably when the clearance between the wear plate and the impeller exceeds that given in Figure 13. Normally shims can be added to bring the clearance within limits. Add shims until rubbing just starts to occur when the impeller and cover or end plate are secured in place. Then remove enough shims to back the impeller away from the wear plate or cover a distance of 0.015 inch. Install the cover and rotate the pump by hand to make sure that the impeller is not binding or scraping. Minor nicks on the edges of the impeller vanes can be removed by refinishing with a stone. If the impeller and wear plate are worn excessively, they must be replaced. After replacement of the impeller, wear plate, or impeller shaft, select shims to obtain the proper clearance between the back of the impeller and the pump casing. If the impeller scrapes when the cover is installed, add another gasket of sufficient thickness between the cover and the pump casing.

c. Enclosed Impellers. Enclosed impeller type pumps use wearing rings to keep internal pump



Ident. No.	Part Name	Ident. No.	Part Name
1	Impeller	128	Bearing cap
2	Volute	137	Cover plate
8	Pedestal	147	End plate
9	Shaft	149	Slinger ring
11	Sleeve	149-101	Retaining ring
12	Wear plate	163	Clip
19-2	Gasket	172-A	Suction flange
19-45	Gasket	172-B	Discharge flange
19-137	Gasket	175-A	Vented plug
19-147	Gasket	181	Eye bolt
19-172	Gasket	182-1	Impeller screw
21	Gland	182-61	Check valve pin
22	Lantern ring	183-1	Impeller shims
27	Seal plate	184-1	Impeller washer
61	Flap valve	188-137	Clamp bar
89	Packing	188-147	Clamp bar
101	Bearing	189-137	Clamp bar screw
101-A	Bearing	189-147	Clamp bar screw

Figure 12. Typical exploded view of a self-priming pump.

leakage at a minimum (see Figure 13). When the clearance between the wearing rings and the impeller exceeds the limits shown in Figure 13 the impeller and wearing rings must be replaced. In enclosed impeller pumps, add shims behind the impeller to center the impeller in the volute; that is, to obtain equal clearance between the front of the impeller and the cover and between the back of the impeller and the pump casing. After installation of the cover, rotate the pump by hand to make sure that the impeller is not binding or scraping.

25. BEARINGS

a. After removing the bearings and the shaft from the pump housing, clean them thoroughly by washing in cleaning solvent. Dry the bearings with filtered compressed air and coat them with a light oil.

CAUTION

Bearings must be kept free of all dirt and foreign material. Dirt or foreign matter will greatly shorten bearing life. Do not spin dry bearings. This may scratch the balls or races and cause premature bearing failure.

b. Bearings are a light press fit on the impeller shaft and a snug push fit in the housing. If the shaft is worn so that the bearing slips on and off easily, the shaft must be replaced. The housing must be replaced if the bearings do not fit snugly.

c. When installing bearings on the shaft, never press or hit against the outer race, balls, or ball cage. Press only on the inner race. When installing bearings in the housing, press against the outer race.

d. After reassembly, lubricate the bearing housing in accordance with paragraph 19.

26. STUFFING BOX SEALS

a. The packings in stuffing box seals should be replaced at each overhaul or when excessive leakage occurs which cannot be stopped by adjustment. In some pumps the packings can be replaced without requiring complete disassembly of the pump. In these pumps, the packing

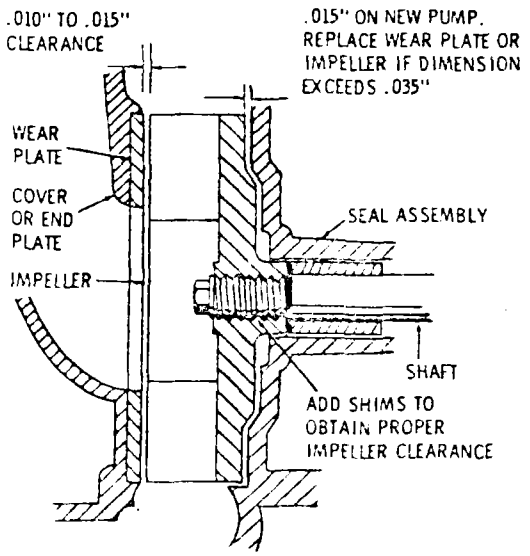


Figure 13A. Impeller clearances. (Open impeller)

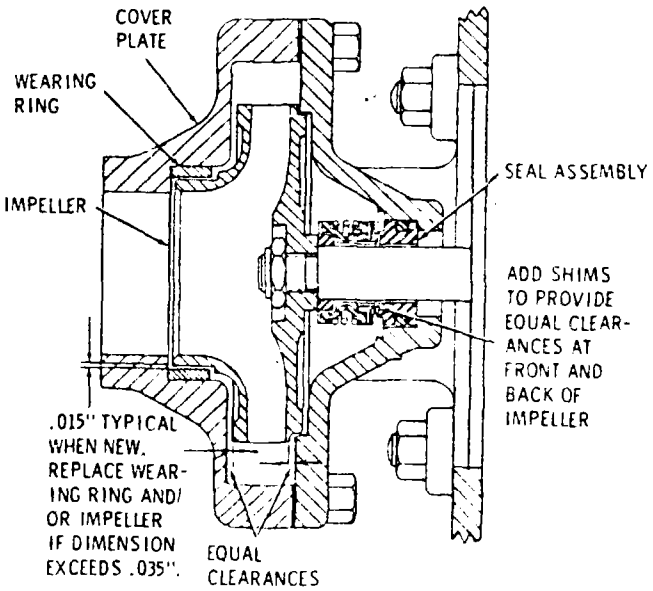


Figure 13B. Impeller clearances. (Enclosed impeller)

can be removed after the gland has been removed by using a stiff piece of wire with a hook on the end.

b. After removing the packings, clean out the stuffing box thoroughly. Dip the new packings in oil before installation. On seals with a lantern ring, install enough packing rings so that the lantern ring will be in line with the seal connection when packings are compressed (see Figure 14). Install the lantern ring and add enough packing rings to fill the remainder of the stuffing box. On seals without a lantern ring, install enough packings to fill the stuffing box. When installing packing rings, rotate each successive layer by 90 degrees to prevent a leakage path through the joints.

c. Install the packing gland and draw up the nuts evenly until they are snug. Back off the nuts and retighten them finger tight only. The gland must be adjusted while the pump is in operation as described in paragraph 20c.

27. GORMAN-RUPP GREASE-LUBRICATED MECHANICAL SEALS

a. Before removing the seal from the pump, tighten the cross arm on the grease cup against the cover. This will prevent unused grease from squirting out of the cup when the seal is removed.

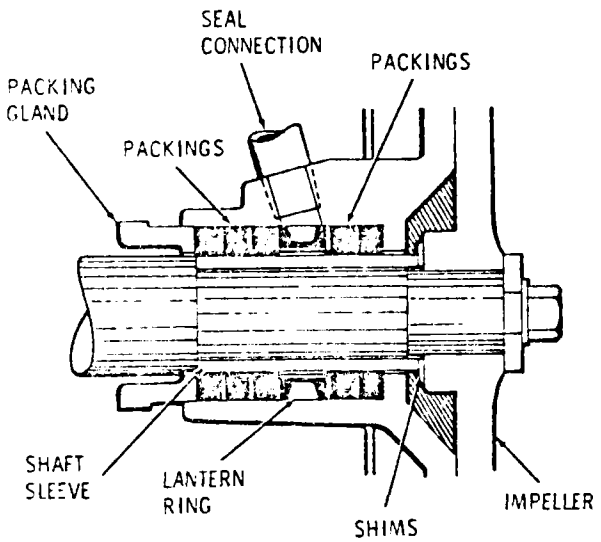


Figure 14. Cross section of a typical stuffing box seal.

b. After removing the seal from the pump, clean metallic parts by washing in cleaning solvent, and dry thoroughly. Inspect the mating surfaces of the seal for wear, scoring, grooves, and any other damage which could cause leakage. If any of the seal parts are worn, replace the entire seal. Never mix new and old parts of the seal. Inspect the seal liner in the seal housing of the seal plate and replace it if it is worn or grooved.

c. When installing the seal, take care to keep the seal parts free from dirt or foreign matter. Install the seal as shown in Figure 15.

CAUTION

Improper seal installation, marred mating surfaces, or dirt will cause the seal to leak when the pump is returned to service.

d. After installation of the seal, refer to paragraph 20 and make sure that the grease cup is filled with the proper lubricant.

28. SELF-LUBRICATED AND OIL-LUBRICATED SEALS

a. After removing the seal from the pump, clean it by washing metallic parts in cleaning solvent, and dry thoroughly. Inspect the mating surfaces of the seal for wear, scoring, grooves, or any other damage which could cause leakage. If any of the seal parts are worn, replace the entire seal. Never mix new and old parts of a seal. Inspect the impeller shaft or shaft sleeve (when used) for nicks, scratches, scoring, or other damage. Replace a damaged shaft or shaft sleeve.

b. When installing the seal, take care to keep the seal parts free from dirt and other foreign material. Install the seal in the pump as shown in Figure 16 or 17.

CAUTION

Improper seal installation, marred mating surfaces, or dirt will cause the seal to leak when the pump is returned to service.

c. After installation of an oil-lubricated seal, refill the seal housing with the proper lubricant as described in paragraph 20b.

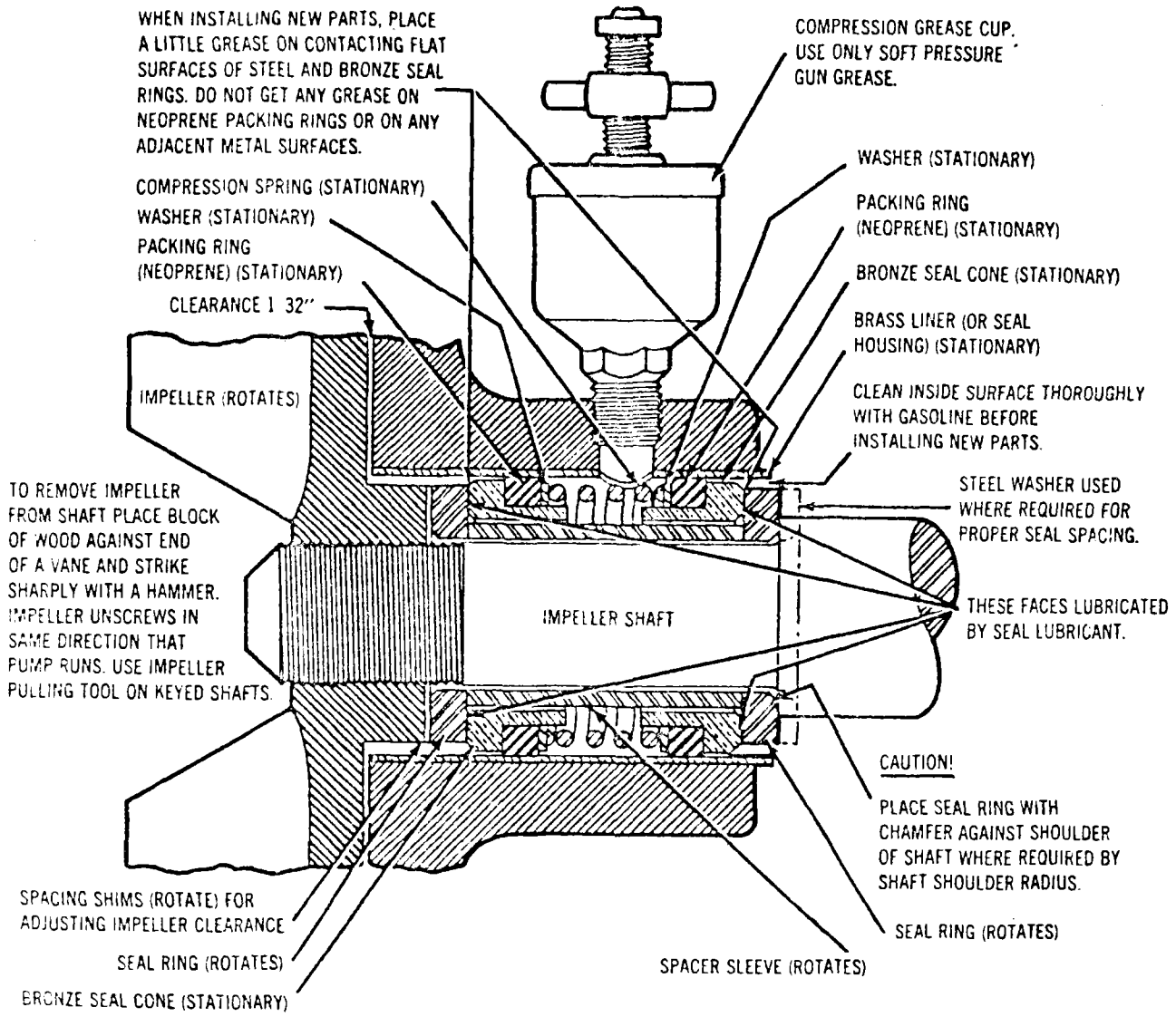


Figure 15. Installation of a typical grease-lubricated mechanical seal.

Trouble Shooting

29. GENERAL

This section provides general information useful in diagnosing and correcting unsatisfactory operation or failure of the centrifugal pump. Each trouble symptom stated is followed by a list of probable causes of the trouble. The possible remedy recommended is described opposite the probable cause.

30. PUMP FAILS TO PRIME

Probable Cause	Possible Remedy
Air leak in suction line	Correct leak.
Suction strainer clogged	Clean suction strainer.
Lining of suction hose collapsed	Replace suction hose.
Foreign matter in suction foot valve (if used) or discharge check valve	Clean valves.
Faulty seal or pump gasket	Check pump vacuum (par. 20d).
Suction lift or discharge head too high	Check installation (par. 7).

31. PUMP STOPS OR FAILS TO DELIVER RATED FLOW OR PRESSURE

Probable Cause	Possible Remedy
Air leak in suction line	Correct leak (par. 7).
Suction strainer plugged	Clean suction strainer.
Suction intake not fully submerged or sump too small	Submerge suction intake and check installation (par. 8).
Lining of suction hose collapsed	Replace suction hose.
Faulty seal or pump gasket	Check pump vacuum (par. 20d).
Impeller clogged	Remove pump end plate (if used) and free impeller or disassemble pump and repair.
Impeller and or wearing rings or wear plate badly worn or broken	Readjust impeller or replace impeller and wear plate or wearing rings (par. 24).
Driven speed too low	Check driving equipment or power source of electric motor pumps.
Suction lift or discharge head too high	Check installation (par. 7).
Wrong pump rotation	Check pump rotation (par. 12).

32. PUMP REQUIRES TOO MUCH POWER

Probable Cause	Possible Remedy
Pump speed too high	Check driving equipment.
Liquid specific gravity too high	Check pump application on pump specification sheet.
Misaligned universal assembly (PTO pumps only)	Check installation (par. 10).
Misaligned coupling (pedestal mounted pumps only)	Check alignment (par. 9).
Stuffing box seal adjusted too tight	Readjust stuffing box (par. 20c).

33. BEARINGS RUN TOO HOT

Probable Cause	Possible Remedy
Improper bearing lubrication	Check for proper type and level of bearing lubricant (par. 19).
Misaligned universal assembly (PTO pumps only)	Check installation (par. 10).
Misaligned coupling (pedestal mounted pumps only)	Check alignment (par. 9).
Suction and discharge lines not supported, causing strain on pump	Check installation (par. 7).
Bearings worn	Overhaul pump (par. 22).

34. PUMP NOISY

Probable Cause	Possible Remedy
Cavitation	Check installation for air leaks in suction line (par. 7).
Impeller shaft bent	Overhaul pump (par. 22).
Rotating parts binding, broken, or loose	Overhaul pump (par. 22).
Bearings worn	Overhaul pump (par. 22).
Misaligned universal assembly (PTO pumps only)	Check installation (par. 10).
Misaligned coupling (pedestal mounted pumps only)	Check alignment (par. 9).

WARRANTY

Pumping units manufactured by The Gorman-Rupp Company, Mansfield, Ohio are guaranteed to be free from defects in material and workmanship for one year from date of shipment from factory in Mansfield, Ohio. The obligation under this Warranty, statutory or otherwise, is limited to replacement or repair at Mansfield, Ohio factory or at a point designated by Gorman-Rupp, of such part as shall appear to us, upon inspection at such point, to have been defective in material or workmanship.

This Warranty does not obligate The Gorman-Rupp Company to bear the cost of labor or transportation charges in connection with replacement or repair of defective parts; nor shall it apply to a pump upon which repairs or alterations have been made unless authorized by Gorman-Rupp.

No warranty is made in respect to engines, motors or trade accessories, such being subject to warranties of their respective manufacturers.

In Submersible Pumps, pump and motor are integral and Submersibles are warranted as a unit. Since motor is subject to an important degree upon quality and performance of electrical controls, unit warranty is valid only when controls have been specified and provided by Gorman-Rupp.

No express implied or statutory warranty, other than herein set forth is made or authorized to be made by Gorman-Rupp.

In no event shall The Gorman-Rupp Company be liable for consequential damages or contingent liabilities arising out of the failure of any Gorman-Rupp pump or parts thereof to operate properly.

THE GORMAN-RUPP COMPANY

Mansfield, Ohio

1.2.12 Raw/Service Water Sump Pump

1.2.12.1 Identification

Tag Number	Description
P-715	Submersible sump pump

1.2.12.2 Description

Pump

Manufacturer:	Essco Los Angeles, CA
Part No:	Model VSS-3A

Motor

Manufacturer:	Reliance Electric Cleveland, OH
Frame:	140TY

1.2.12.3 Prescribed Service

1.2.12.4 Vendor

Essco

1.2.12.5 Procurement Specification

DOE Spec 40M70065, CP9

1.2.12.6 Piping Connections

DOE Drawing No. 40P7005133155, CP9

1.2.12.7 Operation/Maintenance

See following Essco Submersible Sewage Pumps and Reliance Electric Duty Master A-C Motors instructions.

ESSCO

SUBMERSIBLE SEWAGE PUMPS - TYPE VSS

ENGINEERS SALES-SERVICE CO., INC. 4935 TELEGRAPH ROAD • LOS ANGELES, CALIFORNIA 90022
(213) 261-2181 P.O. BOX 7036

Features

Pump: Cast iron volute with smooth waterway to insure maximum sewage handling efficiency. Suction plate with integral legs elevates pump to permit flow into impeller. Tongue-in-groove construction insures perfect alignment of rotating element.

Impeller: Fully non-clog balanced design of cast iron construction.

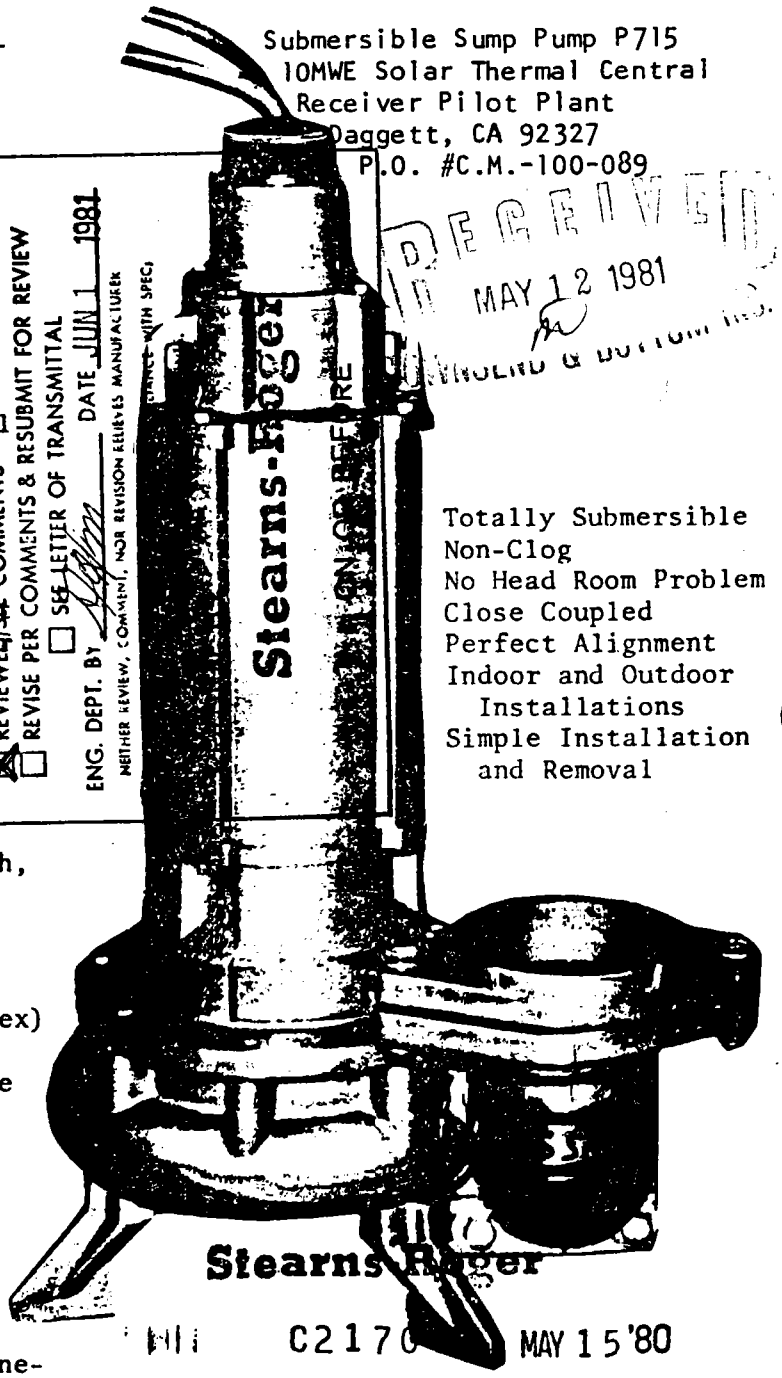
Motor: Is air-filled with special oil-filled chamber protected by two mechanical shaft seals. If outer seal should fail, the inner seal safeguards the motor while moisture enters this chamber. A moisture sensing probe is furnished to warn of impending seal failure. This moisture detection alarm system, when furnished, must be operable in order to validate the motor warranty. Built-in thermal sensors are standard. Motors are Class I, Group D, U.L. approved for complete submergence.

Controls: Standard and special control panels are available operated by any of the following pilot devices: float switch, electrode or ESSCO bubble control.

Suggested Specifications for Architects and Engineers: Furnish and install as shown on plans a Type VSS single (or duplex) submersible non-clog sewage ejector unit as manufactured by Engineers Sales-Service Co., Inc., Model No. 3A, each to deliver a minimum of 39½ GPM at 23 ft. TDH. Driven by 1½ HP, 1750 RPM, 230/3/60 submersible motor. ~~All cast iron, shall~~ meet the requirements of ASTM-A48-64, Class 30.

460 V Specified

Motor: Motor case and end brackets shall be cast iron. The motor shaft shall be one-piece 416 stainless steel through both bearings with proper length to connect directly to pump impeller. Motor shall contain Class B insulation with Class F materials rated for continuous duty in 40° C liquid. Motor shall be sized so the nameplate horsepower is the actual continuous brake horsepower output without considering motor service factor. Motors shall be explosion-proof containing underwriter's approved label.



Submersible Sump Pump P715
10MWE Solar Thermal Central
Receiver Pilot Plant
Daggett, CA 92327
P.O. #C.M.-100-089

Totally Submersible
Non-Clog
No Head Room Problem
Close Coupled
Perfect Alignment
Indoor and Outdoor
Installations
Simple Installation
and Removal

REVIEWED NO COMMENTS
REVISE PER COMMENTS & RESUBMIT FOR REVIEW
REVIEWED SEE COMMENTS
SEE LETTER OF TRANSMITTAL
ENG. DEPT. BY
DATE JUN 1 1981
NEITHER REVIEW, COMMENT, NOR REVISION RELIEVES MANUFACTURER

RECEIVED
MAY 12 1981

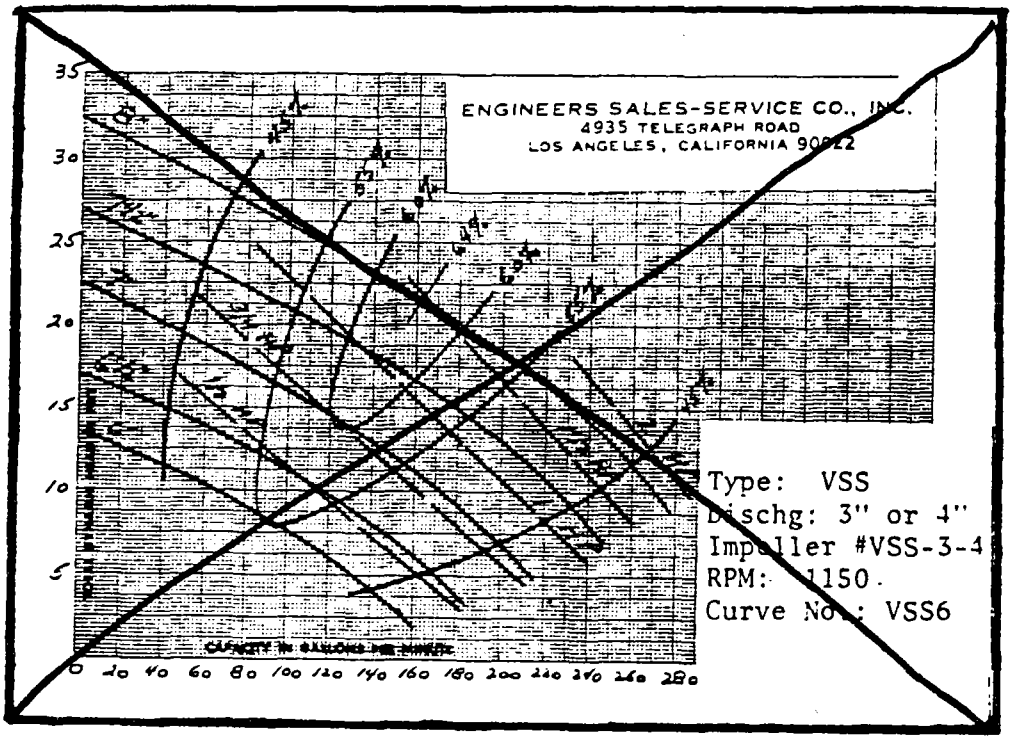
C2170 MAY 15'80

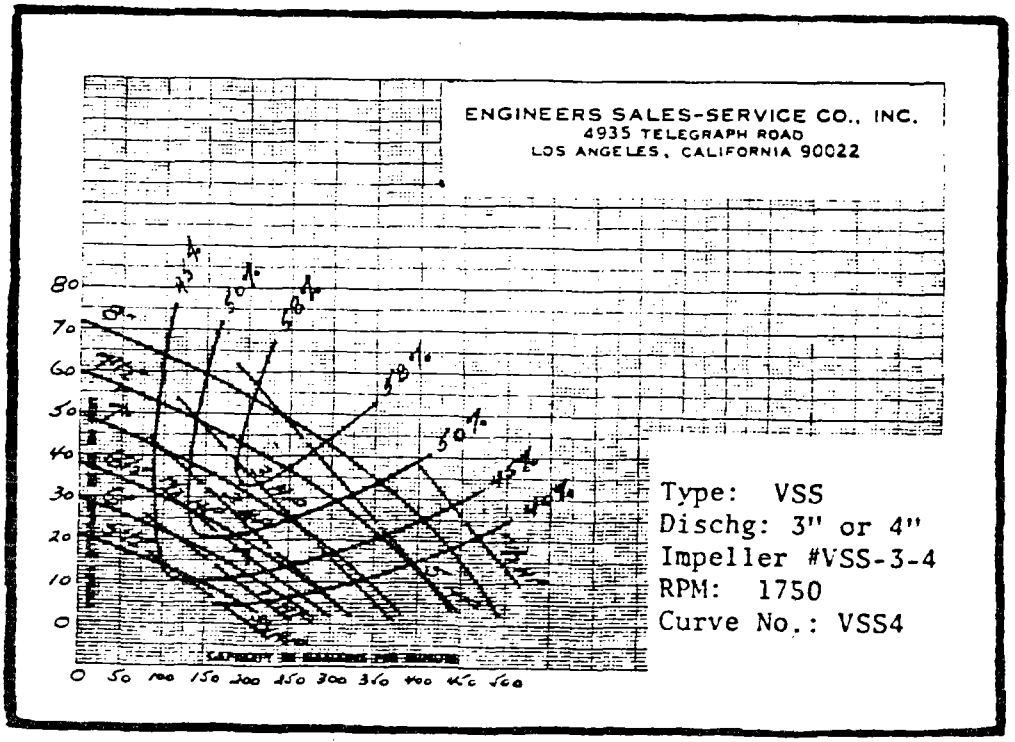
S-R No. CP-9 File No. 332

10MWE Solar Thermal Central
Receiver Pilot Plant
Daggett, CA 92327
P.O. #C.M.-100-089

Type VSS Submersible Sewage Pumps
Performance Curve VSS-3-4
Bulletin E-70

ESSCO
ENGINEERS SALES-SERVICE CO., INC. 4935 TELEGRAPH ROAD • LOS ANGELES, CALIFORNIA 90022
(213) 261-2181
P.O. BOX 7036





ESSCO

Submersible Sump Pump P715
10MWE Solar Thermal Central
Receiver Pilot Plant
Daggett, CA 92327
P.O. #C.M.-100-089

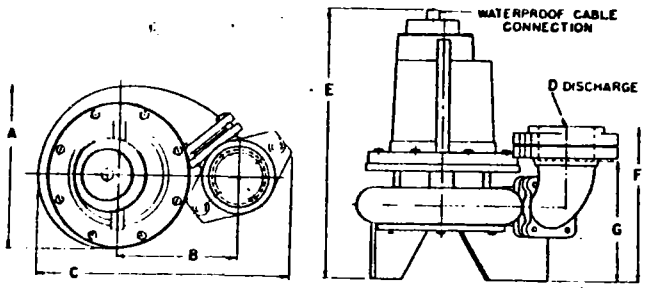
ENGINEERS SALES-SERVICE CO., INC. 4935 TELEGRAPH ROAD • LOS ANGELES, CALIFORNIA 90022
(213) 261-2181
P O BOX 703(

VSS-4 VSS-3 SEWAGE EJECTORS
CROSS SECTION & PARTS LIST

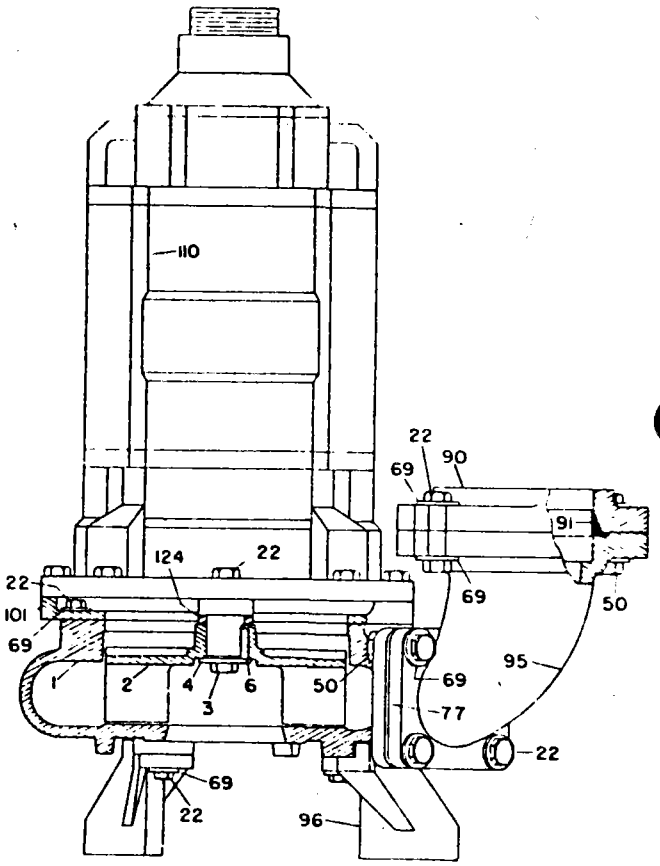
PARTS LIST

1	Pump casing	69	Plate washers
2	Impeller	69	Stand washers
3	Impeller cap screw	69	Elbow washers
4	Impeller washer	69	Flange washers
6	Impeller key	77	Casing elbow gasket
22	Motor cap screws	90	Discharge flange
22	Plate cap screws	91	Discharge pipe gasket
22	Stand cap screws	95	Casing elbow
22	Elbow cap screws	96	Stand legs
22	Flange cap screws	101	Motor adaptor plate
50	Elbow nuts	110	Motor
50	Flange nuts	124	Impeller hub spacer

Spare parts available
from local stock.



FRAME NO.	A	B	C	D	E	F	G
VSS-2P	11	6-1/4	13-1/4	2	14-1/2	11-5/8	-
VSS-3P	11	6-1/4	13-1/4	3	14-1/2	12-1/8	-
VSS-3A	13-1/4	9-3/4	20-1/2	3	33-5/8	12-3/4	10-1/2
VSS-4A	13-1/4	9-3/4	20-1/2	4	33-5/8	12-7/8	10-3/8
VSS-4C	16-3/4	12-3/4	24-3/4	4	43-1/8	15-3/8	12-7/8
VSS-5C	16-3/4	12-3/4	25-3/8	5	43-1/8	15-3/8	12-7/8
VSS-6C	16-3/4	12-3/4	25-3/8	6	43-1/8	15-1/2	12-7/8
VSS-4E	17-1/8	12-3/4	25-1/2	4	48-3/4	15-3/8	12-7/8
VSS-5E	17-1/8	12-3/4	25-1/2	5	48-3/4	15-3/8	12-7/8
VSS-6E	17-1/8	12-3/4	25-1/2	6	48-3/4	15-1/2	12-7/8



DISCHARGE SIZES:

VSS-3P (3" std.) also available with 2" discharge (specify VSS-2P)
VSS-4A (4" std.) also available with 3" discharge (specify VSS-3A)
VSS-4C (4" std.) also available with 5" discharge (specify VSS-5C)
VSS-5C (5" std.) also available with 6" discharge (specify VSS-6C)
VSS-4E (4" std.) also available with 5" discharge (specify VSS-5E)
VSS-5E (5" std.) also available with 6" discharge (specify VSS-6E)

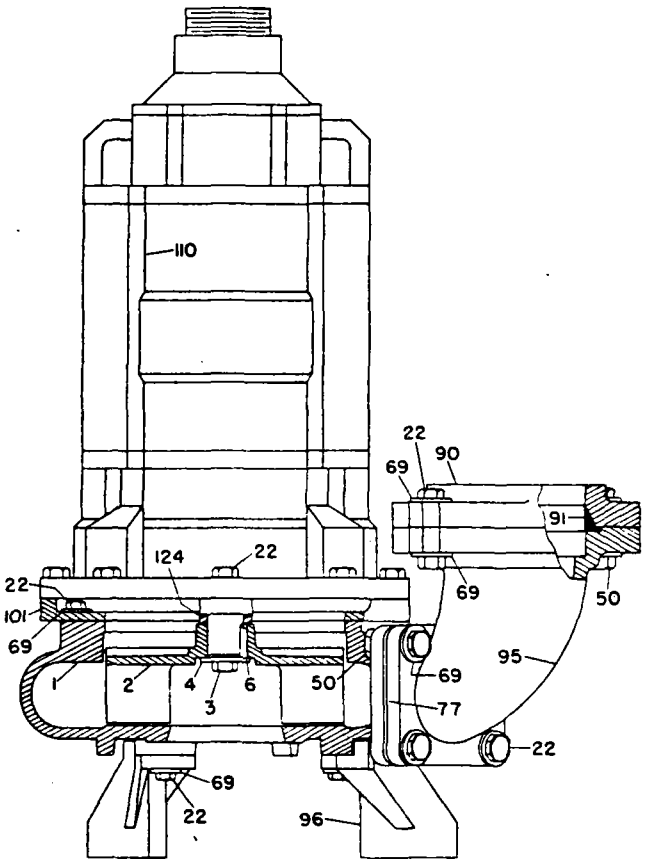
ESSCO

ENGINEERS SALES-SERVICE CO., INC. 4935 TELEGRAPH ROAD • LOS ANGELES, CALIFORNIA 90022

(213) 261-2181 P.O. BOX 7036

ESSCO VSS-4 VSS-3 SEWAGE EJECTORS CROSS SECTION & PARTS LIST

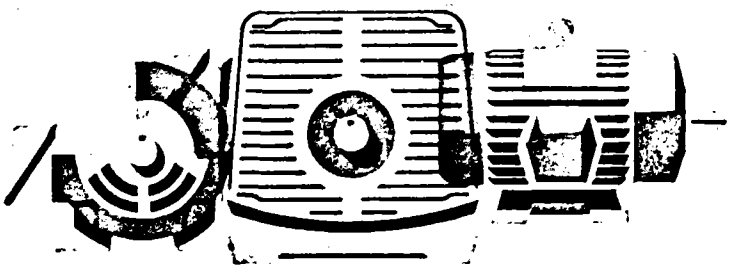
Submersible Sump Pump P715
10MWE Solar Thermal Central
Receiver Pilot Plant
Daggett, CA 92327
P.O. #C.M.-100-089



PARTS LIST

1	Pump casing	69	Plate washers
2	Impeller	69	Stand washers
3	Impeller cap screw	69	Elbow washers
4	Impeller washer	69	Flange washers
6	Impeller key	77	Casing elbow gasket
22	Motor cap screws	90	Discharge flange
22	Plate cap screws	91	Discharge pipe gasket
22	Stand cap screws	95	Casing elbow
22	Elbow cap screws	96	Stand legs
22	Flange cap screws	101	Motor adaptor plate
50	Elbow nuts	110	Motor
50	Flange nuts	124	Impeller hub spacer

Spare parts available from local stock.



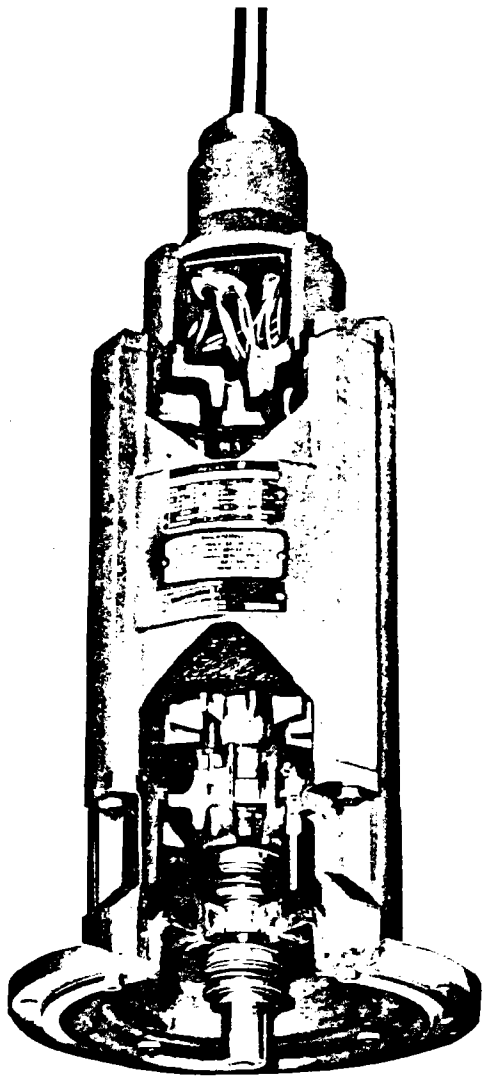
RELIANCE
DUTY MASTER
A-C MOTORS

Submersible Sewage Pump Motors

U L Listed for Use in Class I Group D Hazardous Locations in Air or Submersible in Water and Sewage

- **1/2 - 125 HP Polyphase**
- **3/4 - 5 HP Single Phase**

Submersible Sump Pump P715
10MWE Solar Thermal Central
Receiver Pilot Plant
Daggett, CA 92327
P.O. #C.M.-100-089



- **Moisture Detector and Thermal Protection Standard**
- **UL Listed Explosion-Proof for Hazardous Wet Pit Locations**

Facts About Wet Well Applications

Available only to pump OEMs. Reliance Electric Duty Master submersible AC motors bring safety and reliability to submersible sewage wet well motor applications.

Sewage wet wells are known to routinely contain explosive gases and vapors. (For a complete listing see Water Pollution Control Federation Manual of Practice No. 1, Safety and Wastewater Works, pages 44 & 45, 1975 edition.)

Such locations are defined by the National Electric Code as Class I; Division I, Hazardous Locations. Section 501-8 (a) of the NEC requires that motors be designed for the location e.g. explosion proof.

The U.S. Department of Labor (OSHA) has classified all wet wells which handle wastewater containing organic matter as Class I, Division I, Hazardous Locations.

For a listing of explosions occurring in wastewater collection system locations, see appendix b, NFPA bulletin No. 328, 1975 edition.

Reliance submersible motors are UL listed for Class I, Group D, in air or submersible in water or sewage duty. Motors 1 HP and larger include thermal devices as standard as required by Underwriters Laboratory. For motors less than 1 HP, labeled Class I, Group D, a cautionary nameplate will be supplied and is suitable only on applications where vapor or gas ignition temperatures are 280°C. or above.

Reliance Electric stocks common ratings through 40 HP continuous duty submerged in liquid, 15 minutes duty in air at nameplate horsepower, and continuous duty in air at a reduced load. Other designs through 125 HP and special continuous in air ratings are also available.

Application of this motor product for continuous in-gases operation must be done in compliance with Reliance bulletin B-3629-7.

The thermostats are automatic reset for use in normally closed circuit where the thermostat is connected in series with the holding coil of the magnetic starter. When excessive heat occurs, it causes the thermostat to open the circuit of the holding coil of the magnetic starter stopping the motor.

Use of the thermostats is required and limited to control circuits in which the maximum current does not exceed the following values:

Volts	Amps	Inrush Amps
110-220	3.0	30.0
220-240	1.5	15.0
440-490	0.75	7.5
550-600	0.6	6.0

The complete line of Duty Master Submersible Pump Motors includes single phase motors from 3/4 to 5 HP and polyphase motors in 1/2 to 125 HP ratings. Single phase motors have control panels which include auxiliary starting capacitors and connection terminal strip. All stock motors are dual voltage with reconnectable leads.

Motor listing by Underwriters Laboratories requires that any servicing of this product be done at a UL listed/Reliance approved service center.

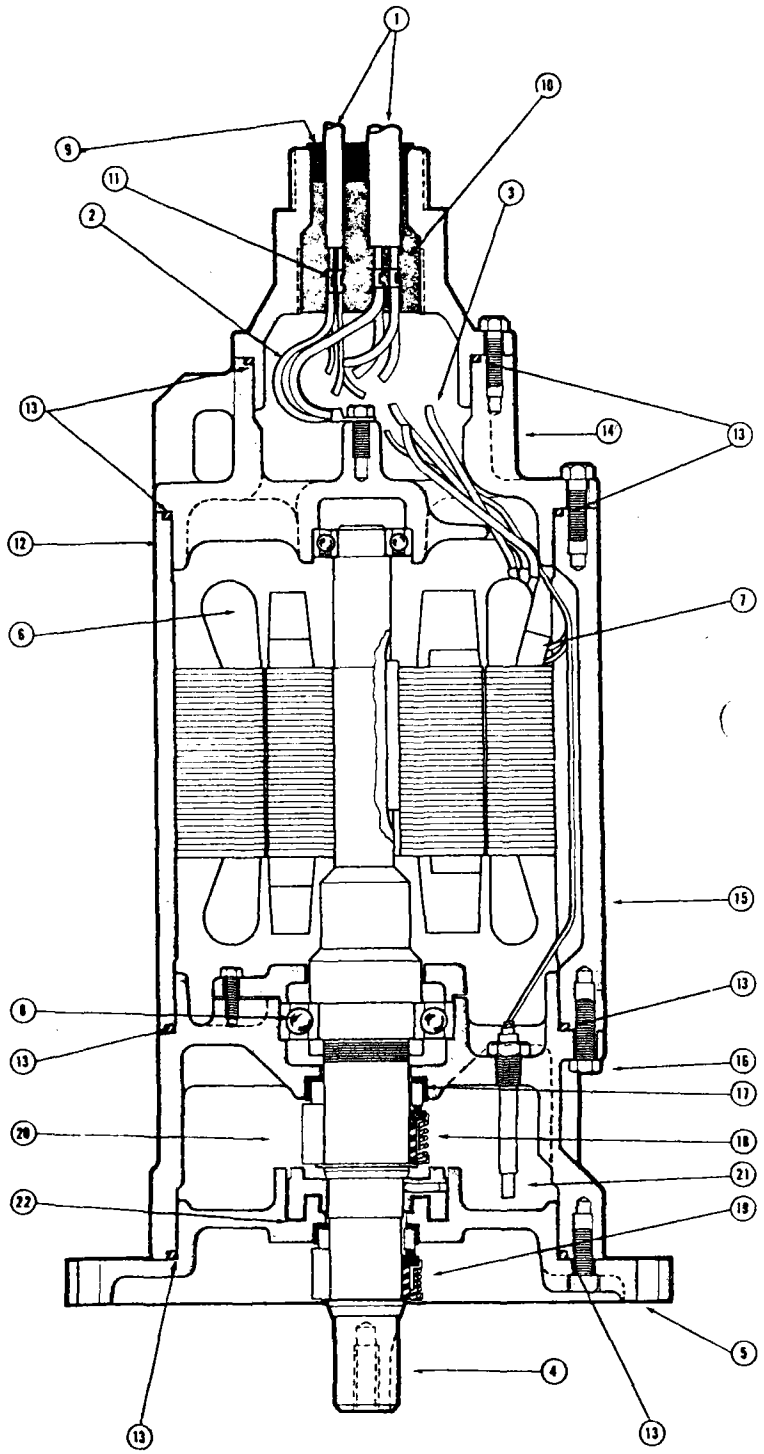
Standard NEMA Design B torque electrical designs are used throughout. Bearings are pre-lubricated at the factory and designed for a minimum B-10 life of 15,000 hours at design loads. A locked shaft extension bearing prevents shaft movement and takes thrust loads in stride.

Reliability is assured by complete pressure-proof design, plus a warning system. Corrosion-resistant cast iron end shields and frames are complemented with stainless steel hardware and shafts. Extra-long rabbet fits are protected with "O" ring seals, assuring a moisture-proof barrier against abrasive fluids. All leads are epoxy sealed. Two seals provide double protection for electrical parts. If the outer seal fails, the inner seal safeguards the motor while water enters the oil filled chamber. A moisture sensing probe detects the influx of water and warns of impending failure. The signal can be used to shut down the motor or simply to signal the need for preventative maintenance. Motors are rated thermally to NEMA MG1-12-42. Thermal protection is standard. Insulation is a special compatible Class B rated system with Class F components for long life. Special insulation systems, or seals, or "O" rings are available for high ambient applications.

Easy Installation — Motor is supplied with thirty feet of multi-conductor, power cable and control cable (1), with ground wire (2) as standard. Large chamber (3) speeds cable connection. Leads are reconnectable for dual voltage. Close coupling to pump eliminates alignment problems. Impeller mounts on motor stainless steel shaft (4), which also serves as pump shaft. Pump and motor assembly can be lowered into position as a single, compact unit. Special universal mounting flange (5) fits most standard pumps; modifications available for one size smaller flange. Small overall motor dimensions, through use of NEMA-T frame electrics, reduce space requirements.

Long lasting internal components — Special Class B insulation system (6) with Class F materials rated for continuous duty in 40°C. liquids. Thermal protection (7) standard on all motors. Conservatively rated locked antifriction bearings (8) for thrust loads.

Complete environmental protection - Buna-N grommets (9), epoxy sealed leads (10), and butt spliced connectors (11) keep liquids from entering the top of the motor. All mating frame fits (12) have rabbet joints with a large overlap, as well as O-ring seals (13). End brackets (14) and frame (15) are corrosion-resistant cast iron. Smooth frame design unobstructed by ribs eliminates clogging of frame and makes cleaning easy. Hardware (16) is stainless steel. Motor is designed for use in Class I Group D Hazardous Locations. Rubbing Faces (17) are carbon and ceramic for corrosion resistance. Inner (18) and outer seals (19) provide complete protection for motor internals. Both seals have stainless steel and Buna-N components. Sealed oil filled chamber (20) permits maximum combined depth and internal pump pressures of 200 p.s.i. Two moisture sensing probes (21) warns of impending seal failure. The labyrinth slinger (22) provides Class I Group D enclosure and acts as a protective slinger for inner seal.



SAMPLE SPECIFICATION
Submersible Sewage Pump Motors

Each submersible sewage pump shall be driven by a completely sealed electric submersible motor of _____ horsepower, _____ RPM, for operation on _____ volts, _____ phase _____ Hertz power. The motor nameplate horsepower rating shall not be exceeded by the brake horsepower requirements of the pump for the specified head and GPM conditions.

The submersible pump motor shall be designed for a Class 1 Group D, Division I hazardous location as defined by the National Electric Code. The unit shall be listed with Underwriters Laboratories as Class 1, Group D, Division I, explosion-proof, for installation in water or sewage. All electrical parts shall be housed in an air-filled cast iron, water-tight enclosure. The enclosure shall be sealed by the use of "O" rings and shall have rabbet joints with a large overlap. Cable leads shall be epoxy sealed. The motor shaft shall be stainless steel, impervious to the liquid and waste materials being handled. All external hardware including the motor nameplate shall also be made of stainless steel.

Tandem seals, one inside an oil chamber and one outside, shall provide double protection for the electrical parts. Two moisture sensing probes shall be used to detect any influx of conductive liquid past the outer seal and provide ample warning of first seal failure.

Bearings shall be prelubricated at the factory and designed for B10 life of 15,000 hours. Shaft extension bearings shall be locked to prevent shaft movement and to take high thrust loads.

Motor winding shall have a special Class B insulation system with Class F materials for extended motor life. Automatic reset, normally closed thermal overloads shall be installed in adjacent phases of the motor winding to provide the over-heating protection.

Lifting eyes shall be cast into the motor housing and shall be of adequate strength to lift the entire pump motor assembly.

RELIANCE ELECTRIC
SUBMERSIBLE MOTOR
FIVE YEAR WARRANTY

1. Reliance• Duty Master• Tandem Seal Submersible Motor is warranted for a period of five years from date of shipment to the Original Buyer, to be free from defects in material and workmanship and to conform to any applicable drawings and specifications approved by Reliance Electric.
2. The five year warranty is prorated as shown below:
   Parts will be replaced within the time period noted and Buyer will be invoiced at the percentage rate noted with price in effect at time of shipment.*

Months from date of shipment to Original Buyer			
0-18	19-31	32-45	46-60
0%	25%	50%	75%

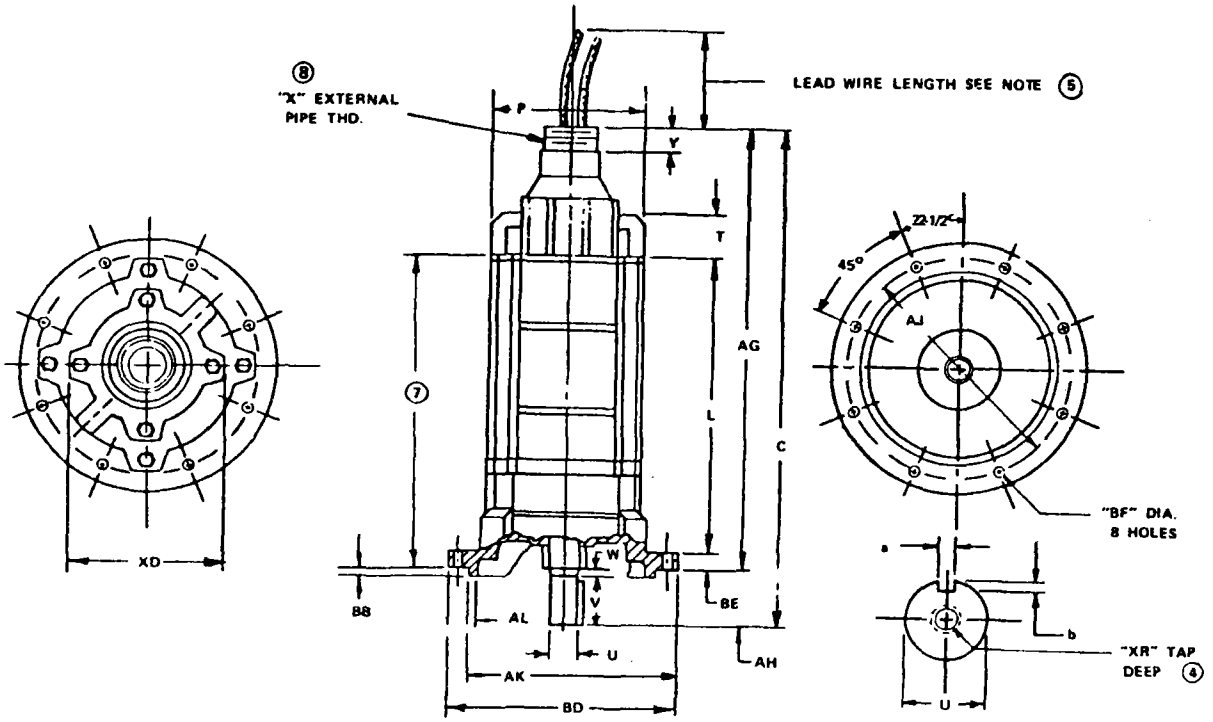
3. If within this period Reliance Electric receives from the Original Buyer written notice of any alleged defect in any such apparatus and, if the apparatus is found not to be in conformity with this warranty (the Buyer having provided Reliance a reasonable opportunity to perform any appropriate test thereon) Reliance will, at its option and expense, either repair the same or supply a replacement therefore.
4. Reliance Electric, under either option, shall have the right to require the Original Buyer to deliver the apparatus for this purpose to a designated service center and the Original Buyer shall pay all charges for inbound and outbound transportation. Reliance shall pay only the direct and actual cost of apparatus repair or replacement as provided above.
5. *Labor charges for in-warranty repairs performed by Reliance Electric or its designated Service Center shall be assumed by Reliance if the repair is completed within 18 months from date of shipment to Original Buyer.
6. On repaired motors, the warranty period shall be the residual of the Original motor supplied.
7. The Duty Master Tandem Seal Submersible Motor has a double seal with a moisture detection system. The warranty, as applied, shall cover cost of replacement of the outer seal. In the event of failure of the inner seal and the moisture detection system is connected, Reliance shall be responsible for the cost of replacement of the outer seal only. All other labor and material cost shall be borne by the user.

IN THE EVENT THE MOISTURE DETECTION SYSTEM IS NOT CONNECTED, THE WARRANTY IS VOID.

8. Motors destined for long term storage shall be stored in accordance to Reliance Electric suggested Service Bulletins. Any damage to the motor due to improper storage shall void this warranty.
9. RELIANCE ELECTRIC'S LIABILITY UNDER THIS WARRANTY OR ANY OTHER WARRANTY WHETHER EXPRESSED OR IMPLIED IN LAW OR FACT SHALL BE LIMITED TO THE REPAIR OR REPLACEMENT OF DEFECTIVE MATERIAL AND WORKMANSHIP AND IN NO EVENT SHALL IT BE LIABLE FOR CONSEQUENTIAL OR INDIRECT DAMAGES.

TYPICAL DIMENSIONS

SQUIRREL-CAGE INDUCTION
ENCLOSURE: TOTALLY ENCLOSED
SUBMERSIBLE
FRAMES 140TY THRU 250TY & 360TY



DIMENSIONS ARE IN INCHES

FRAME	C	L	P	T	U (3)	V	W	AG	AH	AJ	AK (6)	AL (2)
140TY	25.44	15.38	8.00	2.25	.8750	1.25	.31	23.88	1.56	10.00	(11)	9.125
180TY	26.66	16.50	9.62	2.25	1.2500	2.00	.28	24.38	2.28	11.50	(11)	10.625
210TY	31.69	21.12	11.50	2.25	1.4380	2.00	.25	30.12	1.56	14.12	13.125	12.00
250TY	38.53	24.12	12.75	3.50	1.750	3.31	.25	35.50	3.03	16.00	15.000	14.00
360TY	49.81	31.25	18.38	4.25	2.4997	3.19	2.12	43.25	6.56	18.75	17.500	15.25

FRAME	BD (2)	BE	BF	XR (4)	XT	LEAD CONNECTION			BB	KEYWAY		WEIGHT
						X (8)	Y	XD		a	b	
140TY	11.062	.75	.44	3/8-16	(9)	2-1/2-8	1.25	5.50	.12	.187	.09	160
180TY	12.375	.75	.56	1/2-13	(9)	1-2/2-8	1.25	6.75	.12	.250	.12	200
210TY	15.250	.75	.56	5/8-11	(9)	2-1/2-8	1.25	7.75	.25	.375	.19	315
250TY	17.000	1.00	.69	5/8-11	(9)	2-1/2-8	1.25	7.75	.25	.375	.19	750
360TY	20.25	1.12	.69	(10)	1-1/2-12	3 - 8	1.25	10.88	.25	.50	3.00	1500

DIMENSIONS ARE SUBJECT TO CHANGE WITHOUT NOTICE

This bulletin is not intended to provide operational instructions. Appropriate Reliance Electric instruction manuals and warning tags attached to the apparatus should be read prior to installation, operation and/or maintenance of equipment.

RELIANCE ELECTRIC

General Offices, 24701 Euclid Avenue, Cleveland, Ohio 44117

Bulletin B-2550-5

Area 700 (PSS)

RAW/SERVICE WATER PUMP BLDG. SUBMERSIBLE SUMP PUMP (P-715)

1. One (1) Raw/Service Water Pump Bldg. Submersible Sump Pump and Drive in accordance with Engineering Standard No. JD40.4.16 and to these specifcations and design data sheets.

   a. One (1) Submersible Sump Pump and accessories including

   b. One (1) 1/2 horsepower, watertight 460 volt, three phase, 60 hertz electric drive motor, as specified in the Stearns-Roger Motor Data Sheets, 8 pages, Standard No. JF16.02.02-1.

   c. Miscellaneous fittings, valves and instrumentation including self-contained level switches and motor controller.

   d. Assorted spare parts for two (2) years operation boxed separately.

2. The unit will be shipped with the pump and motor assemled and coupled ready for submersion.

3. The spare parts will not be installed by the Contractor and will remain in the custody of the Construction Manager.

4. The pump nameplate shall include; Model, Serial No., Total Head, capacity, speed.

BID

DIVISION USAGE					
A-E	P	PP	SH	EI	SP
	X				

Stearns-Roger
INCORPORATED
ENGINEERING STANDARD

STANDARD NUMBER
JD40.4.16-1

APPROVALS
Des. Sect. BCK
Sect. Supv.
Dir.

DESIGN DATA SHEET
VERTICAL SUMP PUMPS

PAGE 1 OF 2

ISSUED 4/8/75
REVISED 3/12/79

1	Job No. C-21700	Customer MDAC	
2	Project Solar One	By SDM	Date 4/24/80
3	Equipment Nomenclature P-715 Raw/Service Water Sump Pump		
4	Number of Pumps 1	Driver by Vendor ☒ Yes ☐ No	
5			
	CONDITIONS OF SERVICE (EACH)		
7	Fluid Pumped		Waste Water
8	Flow, Normal/Design	USGPM	55 / 56.5
9	Design Temperature	°F	60 F
10	Discharge Pressure, Design	PSIG	9.7
11	Specific Gravity at Design Temp. (Ref 60°F)		1
12	Required Total Developed Head, Design	Ft.	22.43
13	Barometric Pressure	PSIA	14
14	Viscosity at Design Temp.	Cp	1.22
15	Installation Indoors or Outdoors		indoors
16	Length(Base of Motor Support Plate to Bottom of Strainer)	Ft.-In.	
17	Sump Depth	Ft.-In.	1'-0"
18	Minimum Liquid Level (ref. floor level)	Ft.-In.	
19	Solids in Suspension:		
20	Special Requirements:		
21			
22	Submersible type pump		
23			
24			
25			
26			
27			
	CONSTRUCTION REQUIREMENTS		
29			
30	Drive Arrangement ☒ Direct ☐ V-Belt ☐ Other		
31	Mounting Plate: ☐ Yes ☐ No Dimensions:		
32	Impeller Type ☐ Open or ☒ Semi-Open		
33	Steady Bearing Lubrication ☐ Grease ☐ Water ☐ Pumped Fluid ☐ Vendor Option		
34	Column Pipe: Material		
35	Strainer ☒ Yes ☐ No Material		
36	Discharge Pipe* ☐ Threaded ☒ Flanged ☐ Coated Diameter: 1-1/2" Sch 80		
37	(If flanged, in accordance with ANSI B16.5) Class: 150		
38	Level Control ☐ Yes ☐ No Alternator NA ☐ Yes ☐ No		
39	Wet Pit Type ☒ Dry Pit Type ☐		
40	Vapor Tight Arrangement ☐ Yes ☒ No		
41	Motor Shaft Type ☐ Vertical Hollow Shaft ☐ Vertical Solid Shaft		
42	Motor Enclosure (Specify, Watertight, Class I, Division II, Group D		
43	Discharge Pipe is not supplied by pump supplier		
44			
45	Factory Tests Certified Curves ☒ Yes ☐ No		
46	Performance ☐ None ☒ Non-Witnessed ☐ Witnessed		
47	Hydrostatic ☐ None ☒ Non-Witnessed ☐ Witnessed		
48	Remarks:		
49	B-10 Bearing Life 17500 hrs.		
50			
51			

Suction strainer specified

DIVISION USAGE						Stearns-Roger INCORPORATED ENGINEERING STANDARD	STANDARD NUMBER JD40.4.16-1
NSM	P	PP	SM	FI	SP		
	X						
APPROVALS						DESIGN DATA SHEET VERTICAL SUMP PUMPS TO BE COMPLETED BY MANUFACTURER	PAGE 2 OF 2
							ISSUED 4/8/75 REVISED 3/12/79

1	Job No. C-21700			Customer NDAC			
2	Project Solar One			Manufacturer SDM			
3	Equipment Nomenclature P-715 Raw/Service Water Sump Pump						
	PART	MATERIAL	ASTM NO.		PART	MATERIAL	ASTM NO.
4	Casing	Cast Iron	A48-74	11	Strainer	N/A	
5	Impeller	Cast Iron	A48-74	12	Bearings	N/A	
6	Shaft	416 SS	Unknown	13	Discharge Pipe	N/A	
7	Mounting Plate	N/A		14	Column Pipe	N/A	
8				15			
9				16			
10				17			

	GENERAL DESCRIPTION AND CONSTRUCTION		PERFORMANCE
18	Size 3"	57	Performance Curve No. VSS-3-4
19	Mfr. Catalog No. VSS-3A	58	Pump Efficiency %
20	Type Submersible	59	Design 39
21	Casing, Max. Hydro. PSIG 1½ x dis. press	60	Runout
22	Impeller Semi-open	61	Pump Speed, RPM 1750
23	Type VSS	62	Brake Horsepower
24	Diameter Rig, Inches Approx. 6"	63	Design Point
25	Diameter, Max./Min. Inches 8" / 5.5"	64	Runout
26	Shaft, Diameter, Inches .875	65	Max. at any Point
27	Discharge Pipe, Dia., In/Sched 3" / 40	66	Minimum Recommended Flow, GPM 25
28	Oiler Assembly (if required) N/A	67	Min. Recommended Submergence, Ft. 1.5
29	Tank Solenoid/Voltage Reqd. N/A /	68	WK^2 (Wet), Lb-Ft^2
30	Tank Capacity N/A	69	
31	Coupling Size, Inches N/A	70	
32	Manufacturer/Model N/A	71	Recommended Spare Parts:
33	Mounting Plate N/A	72	Shaft seal
34	Dimensions N/A	73	Impeller
35	Strainer, Openings, Inches N/A	74	
36	Type N/A	75	
37	Outline and Dim. Dwg. No. N/A	76	
38	Assembled Weight (less driver), Lbs. 200	77	Accessories:
39	Level Control Type N/A	78	None
40	Manufacturer/Model N/A	79	
41	Alternator Control Type N/A	80	
42	Manufacturer/Model N/A	81	
43		82	
44		83	
45		84	
46		85	
47		86	
48		87	
49		88	
50		89	
51		90	
52		91	
53		92	
54		93	
55		94	
56		95	

DIVISION USAGE					
M	P	PP	SH	FI	SP
	X				

Stearns-Roger INCORPORATED
ENGINEERING STANDARD

STANDARD NUMBER
JF16.02.02-1

APPROVALS
Des. Sec.
Sect. Supv.
Div.

MOTOR DATA SHEETS

ISSUED 7/7/76
REVISED 3/27/79

NAME OF BIDDER

1. GENERAL	No. 1	No. 2	No. 3
*A. Application	Raw Water Pump Bldg. Submersible Sump Pump		
*B. Location (outdoors/indoors)	Indoors		
*C. Quantity	1		
**D. Manufacturer	ESSCO		
***E. Frame size	140 TY		
***F. Motor Type			
a. Horizontal	☐	☐	☐
b. Vertical, solid shaft	☒	☐	☐
c. Vertical, hollow shaft	☐	☐	☐
d. Squirrel cage	☐	☐	☐
e. Wound rotor	☐	☐	☐
f. Synchronous	☐	☐	☐
g. Capacitor start	☐	☐	☐
h. Split phase	☐	☐	☐
i. Shaded pole	☐	☐	☐
j. Repulsion start	☐	☐	☐
k. Repulsion induction	☐	☐	☐
l. DC	☐	☐	☐
m. Other	Submersible		

*Denotes items to be completed by Buyer.
**Denotes items to be completed by each Bidder.
***Denotes items to be completed by successful Bidder either at time of bid or submitted with first drawing transmittal.

FORM 02 224 REV 11-76

NAME OF BIDDER _____

2. PERFORMANCE	No. 1	No. 2	No. 3
**A. Rated output, horsepower	1		
**B. Load brake horsepower			
**C. Service factor	1.0		
*D. Rated voltage, volts	460		
**E. Field voltage, dc volts			
*F. Phase	3		
*G. Frequency, hertz	60		
**H. Rated Speed, rpm			
a. Synchronous	1750		
b. Actual full load	1735		
c. Base speed - DC			
*I. Minimum motor starting voltage, percent of rated	90		
**J. Full load current, amperes	2.5		
**K. Field current at base speed, dc amperes			
**L. Locked rotor current at rated voltage, amperes	11.9		
**M. Starting torque at rated voltage, percent of full load torque	292		

BID

*Denotes items to be completed by Buyer.
**Denotes items to be completed by each Bidder.
***Denotes items to be completed by successful Bidder either at time of bid or submitted with first drawing transmittal.

FORM 02 224 REV 11-76

NAME OF BIDDER _____

		No. 1	No. 2	No. 3
**N.	Breakdown torque at rated voltage, percent of full load torque	1400/353		
***O.	Accelerating time at starting voltage specified above, seconds	N/A		
***P.	Successive starting limitations			
***Q.	"Safe" locked rotor time "cold" at rated voltage, seconds	N/A		
***R.	"Safe" locked rotor time "hot" at rated voltage, seconds	N/A		
**S.	Efficiency, Percent			
	a. Service factor load	1.0		
	b. Full load	54.5		
	c. 75 percent load	51.3		
	d. 50 percent load	44.3		
**T.	Power Factor			
	a. Service factor load	NA		
	b. Full load	NA		
	c. 75 percent load	NA		
	d. 50 percent load	NA		

*Denotes items to be completed by Buyer.
**Denotes items to be completed by each Bidder.
***Denotes items to be completed by successful Bidder either at time of bid or submitted with first drawing transmittal.

FORM 02 27 AV 11.76

NAME OF BIDDER _____

	No. 1	No. 2	No. 3
**U. Losses, kW			
a. Service factor load	NA		
b. Full load	NA		
c. 75 percent load	NA		
d. 50 percent load	NA		
V. WK^2, $lb\text{-}ft^2$			
**a. Of load			
**b. Of motor			
**c. Load capability of motor			
3. CONSTRUCTION			
*A. Enclosure			
a. Open Dripproof	☐	☐	☐
b. TEFC	☐	☐	☐
c. TENV	☐	☐	☐
d. Dust-ignition proof	☐	☐	☐
e. Weather-protected	☐I ☐II	☐I ☐II	☐I ☐II
f. Other	Submersible		

BID

*Denotes items to be completed by Buyer.
**Denotes items to be completed by each Bidder.
***Denotes items to be completed by successful Bidder either at time of bid or submitted with first drawing transmittal.

NAME OF BIDDER _____

		No. 1	No. 2	No. 3
**B.	Bearings			
	a. Antifriction	☐	☐	☐
	b. Split-sleeve	☐	☐	☐
	c. Other			
	d. Type lubrication	Grease		
	e. Minimum AFBMA ~~(X-10X)~~ B-10 antifriction bearing life rating (belt or chain drive motors only), hours	15,000		
**C.	Insulation			
	a. Class	B		
	b. Maximum design total temperature rating for insulation, degrees C	N/A		
	c. Maximum service ambient temperature, degrees C	40°		
	d. Temperature rise (by resistance) at service elevation and at service factor rating, degrees C			
	e. Total hot-spot temperature at service factor rating, degrees C			
**D.	NEMA Code letter (If applicable)	L		

*Denotes items to be completed by Buyer.
**Denotes items to be completed by each Bidder.
***Denotes items to be completed by successful Bidder either at time of bid or submitted with first drawing transmittal.

FORM 01 224 REV 11-78

NAME OF BIDDER _____

	No. 1	No. 2	No. 3
**E. NEMA Design letter (If applicable)	B		
***F. Net weight, pounds approx.	125		
***G. Dimensions, inches			
a. Length			
b. Width	11" dia.		
c. Height	24"		
**H. Rotor bar and end ring. material (4kV and above)			

4. ACCESSORIES

**A. Baseplate	☐	☐	☐
**B. Soleplate	☐	☐	☐
**C. Space heater	☐	☐	☐
**D. Space heater demand, watts			
*E. Stator thermocouples or RTD's	☐	☐	☐
*F. Stator thermostatic-type protection	☐	☐	☐
*G. Bearing thermocouples or thermostats	☐	☐	☐
*H. Bearing oil sump heaters	☐	☐	☐

BID

*Denotes items to be completed by Buyer.
**Denotes items to be completed by each Bidder.
***Denotes items to be completed by successful Bidder either at time of bid or submitted with first drawing transmittal.

NAME OF BIDDER _____

	No. 1	No. 2	No.3
*I. Differential protection current transformers	☐	☐	☐
*J. Surge capacitor	☐	☐	☐
*K. Motor controller by motor supplier	☒ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No
**5. DRIVE COMPATIBILITY			
**A. Gear	☐	☐	☐
**B. Belt	☐	☐	☐
**C. Chain	☐	☐	☐
**D. Direct coupled	☒	☐	☐
*E. Half coupling to be pressed on by motor supplier	☒ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No
*F. Sheave to be pressed on by motor supplier	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No
***6. TERMINAL BOXES AND GROUND CONNECTORS			
A. Terminal boxes (inside dimensions), inches			
a. Height	_____	_____	_____
b. Width	_____	_____	_____
c. Depth	_____	_____	_____
B. Ground connector size, AWG	_____	_____	_____

*Denotes items to be completed by Buyer.
**Denotes items to be completed by each Bidder.
***Denotes items to be completed by successful Bidder either at time of bid or submitted with first drawing transmittal.

FORM 02 224 REV 11-78

NAME OF BIDDER _____

**7. OTHER INFORMATION

(Special Starting, Etc.)

*8. ACCEPTABLE MANUFACTURERS

NA

BID

*Denotes items to be completed by Buyer.
**Denotes items to be completed by each Bidder.
***Denotes items to be completed by successful Bidder either at time of bid or submitted with first drawing transmittal.

FORM 02 224 REV 11-76

1.2.13 Oil Sludge Pump

1.2.13.1 Identification

Tag Number	Description
P716	Oil sludge pump

1.2.13.2 Description

Manufacturer:	Gorman-Rupp Co. Mansfield, Ohio
Part No:	Model 2D-X 3/4
Spec No.:	DOE Dwg No 40M7006S, CP9
Material:	

1.2.13.3 Prescribed Service

Oil/sludge

1.2.13.4 Vendor

Gorman-Rupp Co

1.2.13.5 Special Cautions

See Gorman-Rupp Co manual (following)

1.2.13.6 Periodic Service

See Gorman-Rupp Co manual (following)

1.2.13.7 Parts List

See Gorman-Rupp Co Manual (following)

1.2.13.8 Special Tools

None

1.2.13.9 Maintenance

See Gorman-Rupp Co manual (following)

1.2.13.10 Acceptance Test

None

INSTALLATION OPERATION AND MAINTENANCE MANUAL

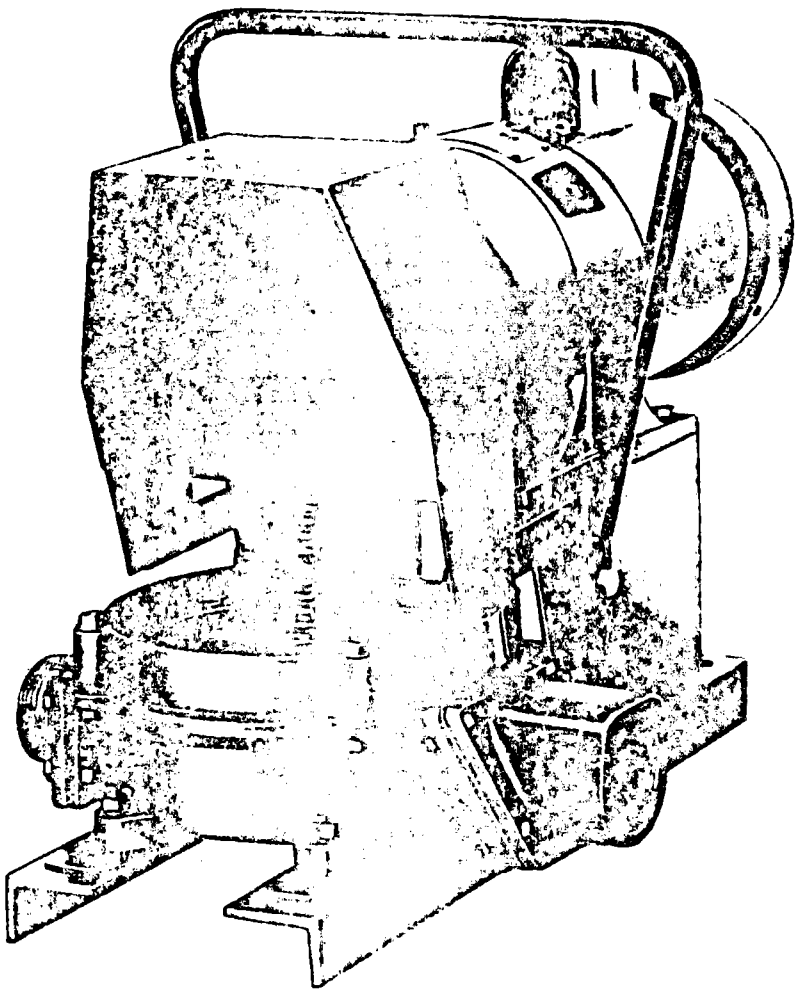
Form No. RP-00459
Replaces Form No. 0-DR-22

For

GORMAN-RUPP

Diaphragm

PUMP

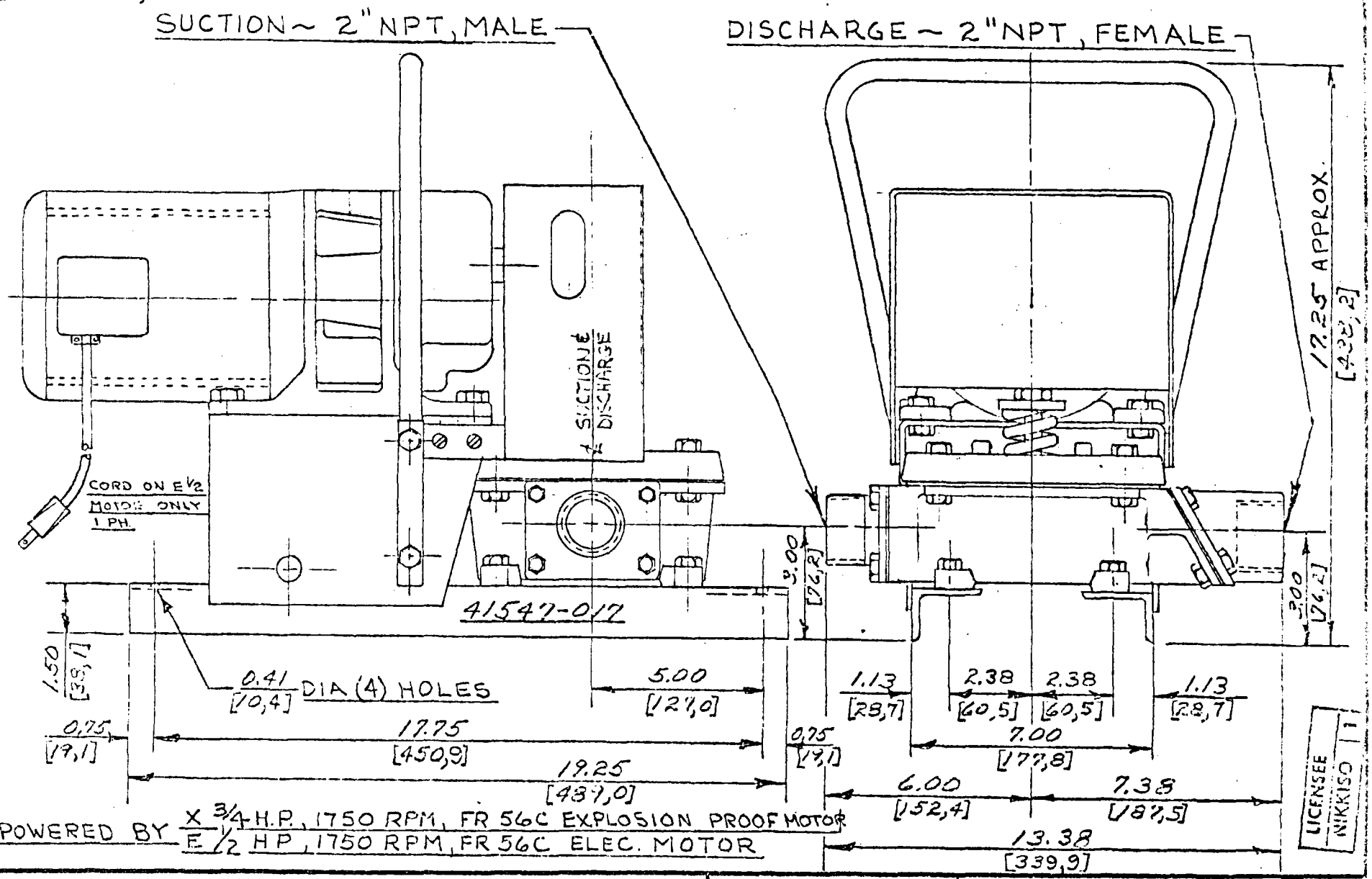


JANUARY 4, 1979

THE GORMAN-RUPP COMPANY • MANSFIELD, OHIO
GORMAN-RUPP OF CANADA LIMITED • ST. THOMAS, ONTARIO, CANADA
Printed in U.S.A.

DIMENSIONS
INCHES
[MILLIMETERS]

A-14466



POWERED BY X 3/4 H.P., 1750 RPM, FR 56C EXPLOSION PROOF MOTOR
E 1/2 HP, 1750 RPM, FR 56C ELEC. MOTOR

THE GORMAN-RUPP CO.

MANSFIELD, OHIO

DWN. BY	JLS
DATE	1-13-70
REV.	9-24-73

MODEL 20-E 1/2 / 20-X 3/4

OUTLINE A-14466

1/4

1.2.13-3

The following methods have been employed in this manual to alert maintenance personnel to procedures which require special attention, to those which could damage equipment, and to those which could be dangerous to personnel.

NOTE

Instructions to aid in installation, operation, or maintenance or which clarify a procedure.

CAUTION

Instructions which must be followed to avoid causing damage to the product or other equipment incidental to the installation. These describe the procedure required and the damage which could result from failure to follow the procedure.

WARNING

Instructions which must be followed to avoid causing injury or death to personnel. These describe the procedure required and the injury which could result from failure to follow the procedure.

INSTALLATION

Place the diaphragm pump as close to the liquid as possible. Use pipe dope on all hose or pipe connections. Make sure the strainer that is provided for the suction hose is below the surface of the liquid being pumped.

Suction Hose:

The maximum pump performance is realized at lifts of 5 feet or less. Use the shortest possible length of suction hose, hose of 20 feet or longer will reduce the capacity of the pump.

Solids Handling:

A strainer is furnished for use over the end of the suction hose to prevent sucking large unbreakable solids, such as rocks and cans up into the pump.

OPERATION

To start the pump, follow the preceeding instructions in setting up the unit.

Priming:

The pump will prime up to 15 feet static suction lift with the pump pot dry. With liquid in the pump pot, the pump will prime up to 20 feet on water.

Maximum Discharge Head:

These pumps are designed to operate at a static discharge head of 20 feet.

a. Size of discharge hose – The discharge hose should ALWAYS be the same size as the discharge fitting of the pump.

Trouble Shooting:

If pump fails to prime, check the following:

a. Suction lift in excess of 15 feet without liquid having been added to the pump pot: 20 feet maximum lift with water.

b. Valves not seating properly. This could be caused by:
   1. Foreign material under valve.
   2. Worn or damaged valves.

c. Too high a static discharge head.

d. Leaky suction hose or leaky connections.

e. Obstruction in suction line – check suction hose or strainer to see that they are free and not clogged.

f. Cracked or broken diaphragm.

g. Diaphragm not securely tightened.

Draining of Pump:

Be sure to drain the water from the pump and the hose during freezing weather when the pump is not in operation.

MAINTENANCE

Use the following lubrication schedule with No. SAE 90 Multi-Purpose Gear Lube:

a. Gear head reducer change oil approximately every 2000 hours of operation.

Grease the following with a pressure gun:

a. Plunger rod bearings upper and lower, every 50 hours of operation.

Maintenance of Electric Motors:

The diaphragm pump is close coupled to an electric motor, either 115/230 volt single or three phase, 1/2 H.P. open drip-proof, or, 115/230 volt single or three phase, 3/4 H.P. explosion proof.

The bearing housing is furnished with a grease fitting hole and a grease relief hole, both of which are pipe tapped standard 1/8" for easy use of standard fittings. Each hole is effectively plugged with a slotted-head pipe plug so that dirt is sealed out and grease is sealed in. Under normal conditions it may be many years before the motor needs to be re-greased.

A stainless steel nameplate is conveniently located on the conduit box side of the motor and is easy to read, giving necessary data including wiring diagram.

Use adequate sized wire for motor cord as too small a wire will cause motor to run slowly and overheat. Pick amperes rating from nameplate for the voltage available and choose wire size from the table on Page 2.

1/2 H.P. motors require the following amps: 115V 1 phase 8 4 amps, 230V 1 phase 4.2 amps, 230V 3 phase 2.3 amps, and 460V 3 phase 1.15 amps.

3/4 H.P motors require the following amps: 115V 1 phase 10.8 amps, 230V 1 phase 5.4 amps, 230V 3 phase 3.44 amps, and 460V 3 phase 1.72 amps.

Repair and Replacement Instructions:

The assembly of the Gorman-Rupp 2D-E1/2 or 2D-X3/4 diaphragm pump is simple and can be followed very well by referring to the exploded drawing on Page 8.

Most of the assembly and disassembly is obvious. However, if for some reason the plunger rod assembly is disassembled, caution must be taken to adjust the plunger rod spring tension and operating height by measuring the distance from the lower surface of the upper diaphragm plate and the upper surface of the plunger rod spring adjusting nut.

Proper spacing is $5\ \frac{11}{16}\ \pm\ 1/32$ (See Figure 1).

Correct Rotation:

Correct rotation should be CCW facing output shaft of gear head reducer.

WARNING

Do not use open drip-proof or TEFC motors in explosive atmospheres or when pumping volatile liquids.

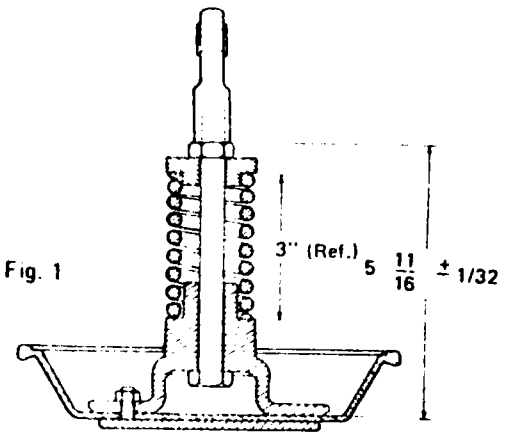


Fig. 1

CORRECT WIRE SIZE TABLE of Rubber Insulated Copper Wire on 32, 110, 220 Volt Line

FULL LOAD MOTOR AMPERES	DISTANCE FROM MOTOR TO METER IN FEET 50 FEET																			
	50 Feet			110 Feet			150 Feet			200 Feet			300 Feet			400 Feet			600 Feet	
	32	110	220	32	110	220	32	110	220	32	110	220	32	110	220	32	110	220	32	110	220
2 Amps	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	12	14	14	12	14	14
3 Amps	14	14	14	14	14	14	14	14	14	14	14	14	12	14	14	10	14	14	10	14	14
4 Amps	14	14	14	14	14	14	14	14	14	12	14	14	10	14	14	10	14	14	8	14	14
5 Amps	14	14	14	14	14	14	12	14	14	12	14	14	10	14	14	8	14	14	8	12	14
6 Amps	14	14	14	14	14	14	12	14	14	10	14	14	8	14	14	8	12	14	6	12	14
7 Amps	14	14	14	12	14	14	10	14	14	10	14	14	8	14	14	6	12	14	6	10	14
8 Amps	14	14	14	12	14	14	10	14	14	10	14	14	8	12	14	6	12	14	6	10	14
9 Amps	14	14	14	12	14	14	10	14	14	8	14	14	6	12	14	6	10	14	4	10	12
10 Amps	14	14	14	12	14	14	10	14	14	8	14	14	6	12	14	6	10	14	4	10	12
12 Amps	14	14	14	10	14	14	8	14	14	8	12	14	6	10	14	4	10	12	4	8	12
15 Amps	12	14	14	10	14	14	8	12	14	6	12	14	4	10	12	4	8	12	2	8	10
20 Amps	12	12	12	8	12	12	6	12	12	6	10	12	4	8	12	2	8	10	2	6	10
25 Amps	10	10	10	8	10	10	6	10	10	4	10	10	2	8	10	2	6	10	1	6	8
30 Amps	8	8	8	6	8	8	4	8	8	4	8	8	2	6	8	1	6	8	0	4	8
35 Amps	8	8	8	6	8	8	4	8	8	2	8	8	1	6	8	0	6	8	0	4	8

Above table is based upon 5 per cent line drop and is in accord with the regulations of the National Board of Fire Underwriters on the Allowable Current Capacities of Rubber Insulated Copper Wire. For greater distances than shown in the above table, the matter of selecting the proper size wire becomes an engineering problem.

Fig. 2

INSTALLATION INSTRUCTIONS
MODEL 8Z123-B SPEED REDUCER

DESCRIPTION

The Model 8Z123-B Speed Reducer (shown in figure 1) is an in-line drive for general purpose application. The speed reducer incorporates heavy duty, helical steel gears, tapered roller bearings, and lip-type oil seals in a cast iron housing. The speed reducer is built for direct drive from a 1/2 horsepower, NEMA 56C face, 1725 rpm motor (purchased separately). Specifications are listed in Table 1.

Table 1. Specifications, Model 8Z123-B Speed Reducer

Input speed	1725 rpm (maximum)
Input shaft diameter	5/8 inch (nominal)
Output speed at maximum input speed	60 rpm
Reduction ratio	29:1
Torque at 1/2 horsepower input	478 inch-pounds
Maximum overhung load	660 pounds
Thrust capacity	295 pounds

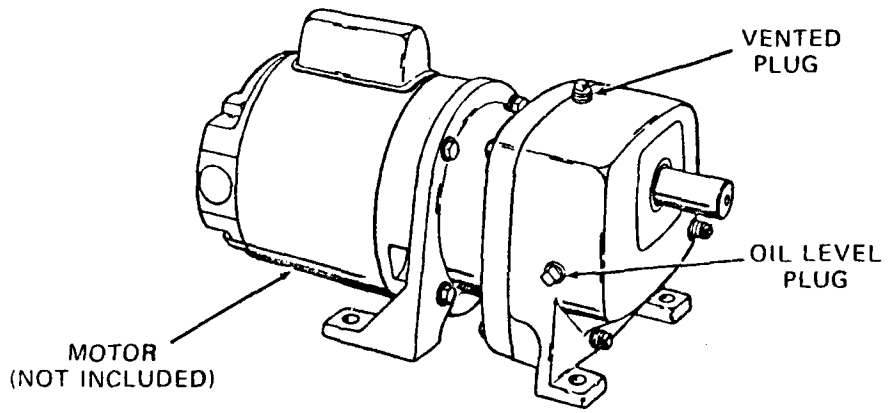


Figure 1. Speed Reducer, Model 8Z123-B

GENERAL SAFETY INFORMATION

WARNING

Install and operate the electric motor in accordance with the National Electrical Code and local codes. Ground the motor before applying line potential. Failure to comply can result in serious injury or death.

The electrical power applied to the motor is high enough to cause injury or death. Take care to prevent contact with electrical circuits while performing maintenance, troubleshooting, and repair. Disconnect power before connecting, disconnecting, or servicing the electric motor or speed reducer. Check to ensure that circuits are dead before making contact with current-carrying parts.

a. Follow all local electrical and safety codes, as well as the National Electrical Code (NEC) and the Occupational Safety and Health Act (OSHA).

b. Motor (not included with this unit) must be securely and adequately grounded. This can be accomplished by wiring with a grounded, metal-clad raceway system, by using a separate ground wire connected to the bare metal of the motor frame, or other means as specified in national or local codes.

c. Always disconnect power source before working on or near a motor or its connected load. If the power disconnect point is out of sight, lock it in the open position and tag to prevent unexpected application of power.

d. All moving parts should be guarded.

e. Be careful when touching the exterior of an operating motor. It may be hot enough to be painful or cause injury. This condition is normal if operated at rated load and voltage since modern motors are built to operate at higher temperatures.

f. Protect the power cable from coming in contact with sharp objects.

g. Do not kink power cable. Do not allow the cable to come in contact with oil, grease, hot surfaces, or chemicals.

h. Make certain that the power source conforms to the requirements of your equipment.

i. Wiping or cleaning rags and other flammable waste materials must be placed in a tightly closed metal container and disposed of later in the proper fashion.

j. When cleaning electrical or electronic equipment, always use an approved cleaning agent such as dry cleaning solvent.

INSTALLATION

a. Check that the motor size, speed, horsepower, and shaft size correspond to those of the speed reducer as listed in Table 1. The motor must have a NEMA 56C face to mate with the speed reducer. Check that the electric power available is in conformance with the motor specifications.

b. Remove the shipping plug from the top of the gear housing cover, and install the vented plug as shown in figure 2.

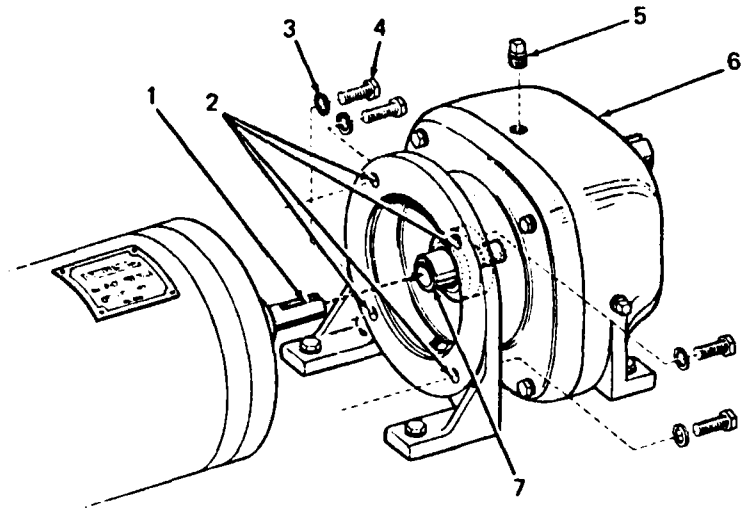
c. Wipe off motor shaft with a clean cloth. Remove burrs and nicks from the shaft surfaces and the edge of the motor shaft keyway. Wipe the shaft with light oil.

d. Refer to figure 2 and align the motor shaft (1) with the key in the speed reducer shaft sleeve (7). The key is an integral part of the shaft sleeve. Do not use any keys supplied with the motor.

e. Push the motor shaft into the shaft sleeve, and align mounting holes (2) in the speed reducer with the corresponding holes in the motor. Secure the speed reducer to the motor with four lockwashers (3) and cap screws (4) supplied with the speed reducer. Start the two upper screws, but do not tighten. Install the two lower screws and tighten finger tight. Tighten the upper two screws, then retighten all four screws evenly and alternately around the mounting flange.

f. Rotate the motor shaft by hand. If it does not rotate freely, loosen the mounting screws and recheck alignment.

g. Install the assembled motor and speed reducer on a suitable base or support. Mounting dimensions are shown in figure 3.



1. Motor shaft
2. Mounting holes
3. Lockwashers
4. Cap screws
5. Vented plug
6. Gear housing cover
7. Shaft sleeve

Figure 2. Assembling Motor and Speed Reducer

h. Disconnect and lock out the power. Tag the controls to prevent accidental starting during installation. Connect the motor to the power source in accordance with the manufacturer's instructions.

i. Start the motor momentarily, and shut it off. The motor shaft must coast freely to a stop to indicate that there is no binding.

j. If any sections of the motor shaft or speed reducer shaft are exposed, fabricate a guard from sheet metal or expanded steel mesh to prevent accidental contact with moving parts. Exposed rotating parts must be protected in accordance with OSHA requirements.

MAINTENANCE

WARNING

The electrical power applied to the motor is high enough to cause injury or death. Take care to prevent contact with electrical circuits while performing maintenance, troubleshooting, and repair. Disconnect power before connecting, disconnecting, or servicing the motor or speed reducer. Check to ensure that circuits are dead before making contact with current-carrying parts.

a. Properly selected and installed electric motors are capable of operating for long periods with minimal maintenance. Periodically clean dirt accumulations from open-type motors, especially in and around vent openings, preferably by vacuuming (avoids imbedding dirt in windings). At the same time, check that electrical connections are tight.

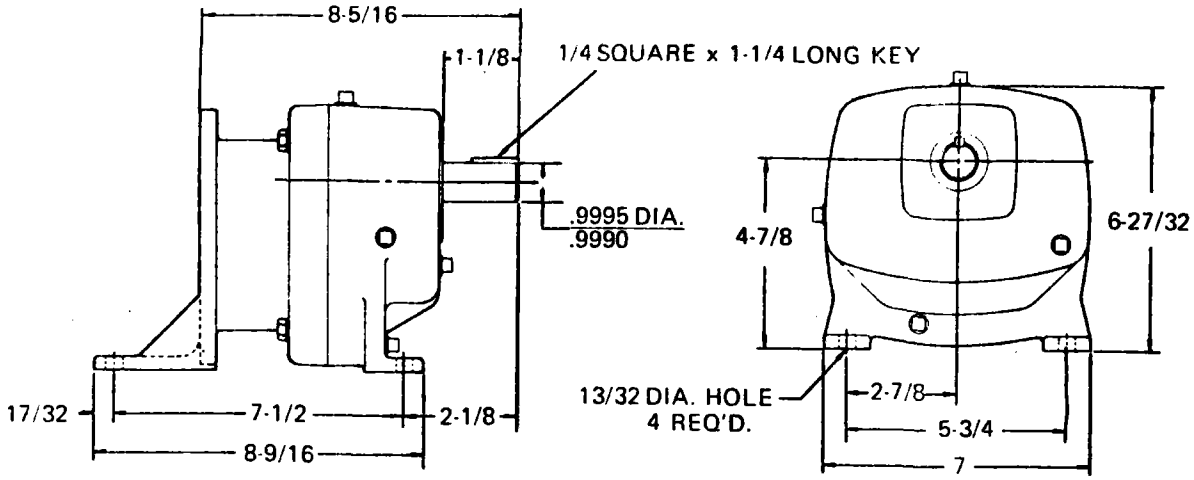


Figure 3. Speed Reducer Mounting Dimensions

b. The speed reducer was filled with oil at the factory to operate with 50° to 125°F ambient temperature. After 2000 hours of operation, drain and refill with AGMA No. 4 gear oil. If AGMA No. 4 gear oil is not available, use multi-purpose gear oil SAE 90 for ambient temperatures from +40° to +120°F. For temperatures below +40°F, use SAE 80 multi-purpose gear oil.

TROUBLESHOOTING

Refer to Table 2 for a troubleshooting chart applicable to the speed reducer. Refer servicing and troubleshooting of the motor to a qualified electrician.

Table 2. Troubleshooting Chart

Trouble	Possible Cause	Probable Remedy
UNIT FAILS TO OPERATE	Blown fuse or open circuit breaker.	Replace fuse or reset circuit breaker.
	No power.	Contact power company.
	Defective motor.	Repair or replace.
MOTOR RUNS, BUT NO OUTPUT	Defective gear(s).	Check and replace if necessary.
INTERMITTENT ROTATION OF OUTPUT SHAFT	Damaged speed reducer assembly possibly caused by shock load.	Replace gear and, if possible, avoid shock load.
EXCESSIVE NOISE	Bearings worn.	Replace bearings.
	Belt too tight.	Adjust tension.
	Overhung load exceeds rating and causes bearing wear.	Correct load and/or replace bearing.

REPLACEMENT PARTS

Please provide the following information when ordering replacement parts for your speed reducer:

Model number
Serial number (if any)
Part description

Order parts from:

Dayton Electric Mfg. Co.
CUSTOMER SERVICE DEPT.
5959 W. Howard St.
Chicago, Illinois 60648

LIMITED WARRANTY

Dayton Speed Reducers are warranted by Dayton Electric Mfg. Co. (Dayton) to the original user against defects in workmanship or materials under normal use (rental use excluded), for one year after date of purchase. Any part which is determined to be defective in material or workmanship and returned to an authorized service location, as Dayton designates, shipping costs prepaid, will be repaired or replaced at Dayton's option. For warranty claim procedures, see "Prompt Disposition" below. This warranty gives purchasers specific legal rights, and purchasers may also have other rights which vary from state to state.

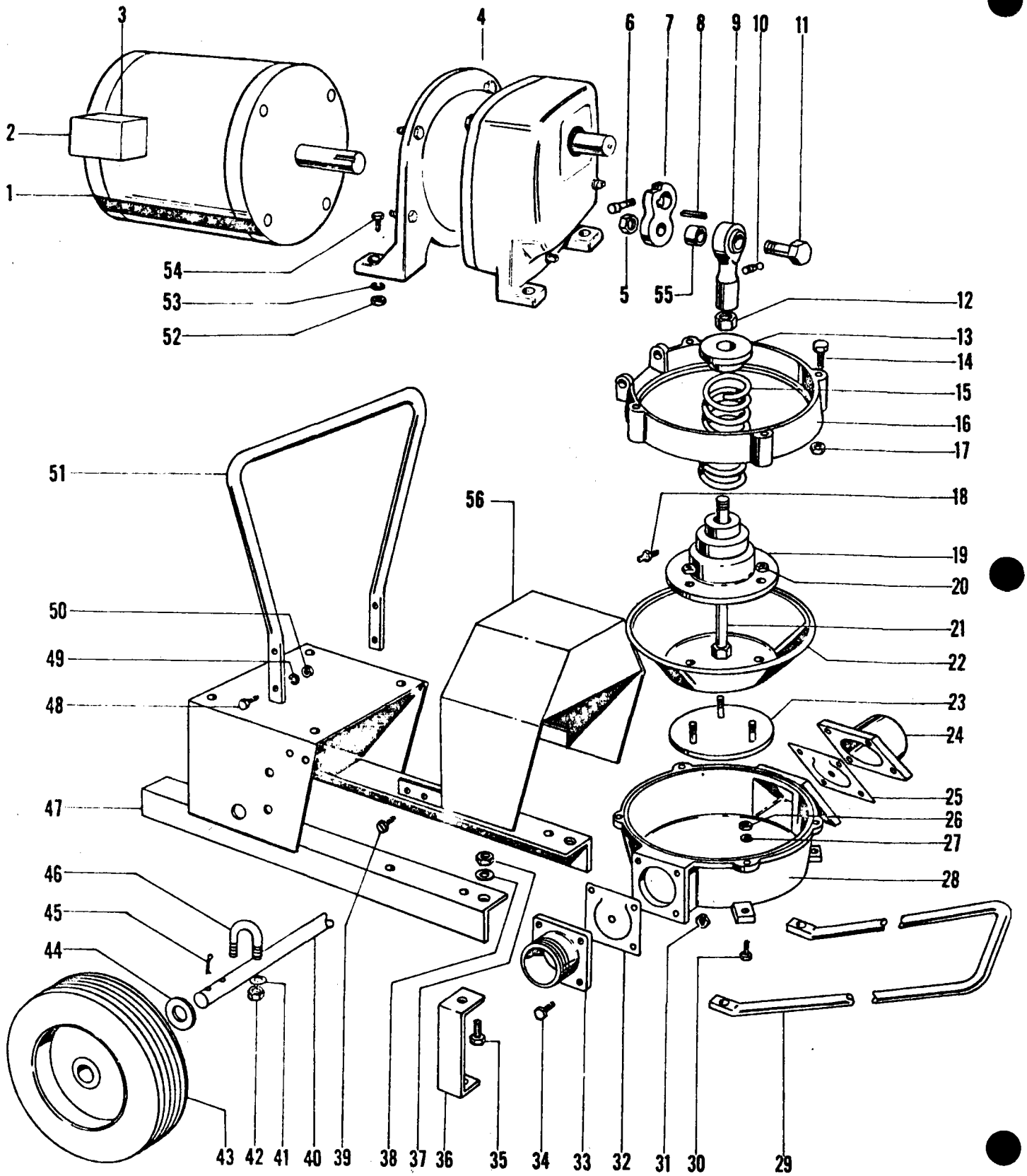
WARRANTY DISCLAIMER. Dayton has made a diligent effort to illustrate and describe the products in this literature accurately; however, such illustrations and descriptions are for the sole purpose of identification, and do not express or imply a warranty that the products are merchantable, or fit for a particular purpose, or that the products will necessarily conform to the illustrations or descriptions.

Except as provided below, no warranty or affirmation of fact, express or implied, other than as stated in "LIMITED WARRANTY" above is made or authorized by Dayton, and Dayton's liability in all events is limited to the purchase price paid.

Certain aspects of disclaimers are not applicable to consumer products; e.g., (a) some states do not allow the exclusion or limitation of incidental or consequential damages, so the above limitation or exclusion may not apply to you; (b) also, some states do not allow limitations on how long an implied warranty lasts, consequently the above limitation may not apply to you; and (c) by law, during the period of this Limited Warranty, any implied warranties of merchantability or fitness for a particular purpose applicable to consumer products purchased by consumers, may not be excluded or otherwise disclaimed.

PROMPT DISPOSITION. Dayton will make a good faith effort for prompt correction or other adjustment with respect to any product which proves to be defective within warranty. For any product believed to be defective within warranty, first write or call dealer from whom product was purchased. Dealer will give additional directions. If unable to resolve satisfactorily, write to Dayton at address below, giving dealer's name, address, date and number of dealer's invoice, and describing the nature of the defect. If product was damaged in transit to you, file claim with carrier.

DAYTON ELECTRIC MFG. CO., 5959 W. HOWARD STREET, CHICAGO, ILLINOIS 60648


1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37
38
39
40
41
42
43
44
45
46
47
48
49
50
51
52
53
54
55
56

MODELS 2D-E1/2 & 2D-X3/4

IDENTIFICATION NUMBER	PART NAME	MODEL 2D-E1/2	COMMON PART NUMBER	MODEL 2D-X3/4
1	1 Phase Electric Motor – 1/2 H.P.	28211-050		
1	3 Phase Electric Motor – 1/2 H.P. Explosion Proof	28211-540		28272-340
1	1 Phase Electric Motor – 3/4 H.P.			28272-740
1	3 Phase Electric Motor – 3/4 H.P.		27144-103	
2	Conduit Box		THA-1206	
3	Nipple, Heavy Wall		24572-003	
4	Gearhead Reducer		AT-08	
5	Jam Nut 1/2 - 13		BD-0504	
6	Socket Hd. Capscrew 5/16 - 18 X 1		38555-505	
7	Eccentric		N-0403	
8	Key		23924-005	
9	Rod End		26711-103	
10	Lube Fitting		B-0808	
11	Hex Hd. Capscrew		AT-08-S	
12	Jam Nut 1/2 - 20		31513-001	
13	Spring Ctr. Washer		B-0508	
14	Hex Hd. Capscrew		38571-603	
15	Spring (Plunger Rod)		26812-702	
16	Retainer Ring		D-05	
17	Hex Nut		S-186	
18	Lube Fitting		38583-003	
19	Diaphragm Plate (Upper)		D-04	
20	Hex Nut		46181-003	
21	Plunger Rod		26812-711	
22	Diaphragm		42111-314	
23	Diaphragm Plate (Lower)		26812-707	
24	Discharge Flange		26812-708	
25	Discharge Valve		D-05	
26	Hex Nut		J-05	
27	Lockwasher		26812-706	
28	Pump Body		5438-B	
29	Draw Bar		B-0506	
30	Hex Hd. Capscrew		D-05	
31	Hex Nut		26812-705	
32	Suction Valve		26812-704	
33	Suction Flange		B-0505	
34	Hex Hd. Capscrew		B-0606	
35	Hex Hd. Capscrew		34312-009	
36	Front Stand		D-06	
37	Hex Nut		J-06	
38	Lockwasher		21281-472	
39	Hex Hd. Tap Screw		4607-T	
40	Axle		J-06	
41	Lockwasher		D-06	
42	Hex Nut		S-752	
43	Wheel 2.75 X 10		5382	
44	Washer		M-0306	
45	Cotter Pin		5495	
46	"U" Bolt		41547-017	
47	Base		B-0603-1/2	
48	Hex Hd. Capscrew		J-06	
49	Lockwasher		D-06	
50	Hex Nut		44724-007	
51	Handle		D-06	
52	Hex Nut		J-06	
53	Lockwasher		B-0604	
54	Hex Hd. Capscrew		31143-003	
55	Spacer		42381-024	
56	Guard		9026	
	Strainer (not shown)			

WARRANTY

Pumping units manufactured by The Gorman-Rupp Company, Mansfield, Ohio are guaranteed to be free from defects in material and workmanship for one year from date of shipment from factory in Mansfield, Ohio. The obligation under this Warranty, statutory or otherwise, is limited to replacement or repair at Mansfield, Ohio factory or at a point designated by Gorman-Rupp, of such part as shall appear to us, upon inspection at such point, to have been defective in material or workmanship.

This Warranty does not obligate The Gorman-Rupp Company to bear the cost of labor or transportation charges in connection with replacement or repair of defective parts; nor shall it apply to a pump upon which repairs or alterations have been made unless authorized by Gorman-Rupp.

No warranty is made in respect to engines, motors, or trade accessories, such being subject to warranties of their respective manufacturers.

In Submersible Pumps, pump and motor are integral and Submersibles are warranted as a unit. Since motor is subject to an important degree upon quality and performance of electrical controls, unit warranty is valid only when controls have been specified and provided by Gorman-Rupp.

No express implied or statutory warranty, other than herein set forth is made or authorized to be made by Gorman-Rupp.

In no event shall The Gorman-Rupp Company be liable for consequential damages or contingent liabilities arising out of the failure of any Gorman-Rupp pump or parts thereof to operate properly.

THE GORMAN-RUPP COMPANY
Mansfield, Ohio

NOTE: In Canada, all above references to "The Gorman-Rupp Company, Mansfield, Ohio" is understood to mean "Gorman-Rupp of Canada Limited, St. Thomas, Ontario."

THE GORMAN-RUPP COMPANY • MANSFIELD, OHIO
GORMAN-RUPP OF CANADA LIMITED • ST. THOMAS, ONTARIO, CANADA Printed in U.S.A.

1.2.14 TSU Area Sump Pump

1.2.14.1 Identification

Tag Number	Description
P-717	Sump pump

1.2.14.2 Description

Pump

Manufacturer:	Aurora Pump North Aurora, IL
Part No.:	Model 531A

Motor

Manufacturer:	Marathon
Frame:	145HP

1.2.14.3 Prescribed Service

Waste Water

1.2.14.4 Vendor

Aurora

1.2.14.5 Procurement Specification

DOE Spec 40M70065, CP9

1.2.14.6 Piping Connections

DOE Drawing No. 40P7005133248

1.2.14.7 Operation/Maintenance

See following Aurora Pump Instruction Manual Repair Manual 531-532 (NSB)

AURORA PUMP
A UNIT OF GENERAL SIGNAL
800 AIRPORT ROAD · NORTH AURORA, ILLINOIS · 60542

NO. OF PRINTS	
10	FOR APPROVAL
	FINAL

SALES OFFICE: AURORA PUMP - LOS ANGELES PO# LA1-343A3
FACTORY ORDER NUMBER: 401-4625
JOB: S.C.E. 10 MW SOLAR PILOT PLANT
SERVICE: SUMP PUMP
ENGINEER:
CONTRACTOR:
SOLD TO: THE WALDINGER CORP. PO# CM0100089
REFERENCE: PROJECT C21700 P717 TSU

PUMP

ONE NUMBER OF UNITS 1½ x 2 x 7 SIZE 531A MODEL 6'-0" PIT DEPTH
50 GPM 30' HEAD 1750 RPM ☐ DUPLEX ☒ SIMPLEX

STUFFING BOX:
☒ SLINGER
☐ PACKING
☐ LANTERN RING

PUMP BEARING:
☒ STANDARD
☐ CUTLESS RUBBER
☐ RELIEF
☐ GRAPHITAR
☐ GLASS/TEFLON

INTERMEDIATE BEARING:
☐ STANDARD
☐ CUTLESS RUBBER
☐ RELIEF
☐ GRAPHITAR
☐ GLASS/TEFLON

LUBRICATION:
☒ GREASE
☐ FLUSH
☐ PRESSURIZED

CONSTRUCTION:
☒ STANDARD FITTED
☐ BRONZE FITTED
☐ ALL BRONZE
☐ ALL IRON

COUPLING:
☒ STANDARD
☐ GUARD
☐ _____

BASE PLATE:
☐ _____
☒ 20x24 OVAL
☐ 22x28 OVAL

CONTROLS:
☒ SQ-D9036 DR1-SZ FLOAT SWITCH
☐ _____ ALTERNATOR
☐ _____ HIGH WATER ALARM

MOTOR

2 HP. 3 PHASE 60 HERTZ 230/460* VOLTS 1750 RPM 145 HP FRAME

BY: ☒ AURORA ☐ OTHERS
☐ ODP ☐ TEFC ☒ XPROOF
☒ VERTICAL
MARATHON MANUFACTURER

NOTE: MOTOR NOT MOUNTED AT FACTORY.

SPECIAL REQUIREMENTS

PUMP: STAINLESS STEEL SHAFTING ; 2" 150# DISCH. FLANGE
CERTIFIED PERFORMANCE TEST
DRIVE: MOTOR DATA TO FOLLOW RELEASE OF ORDER
* SUITABLE FOR 460 VOLTS
ELECTRICAL:

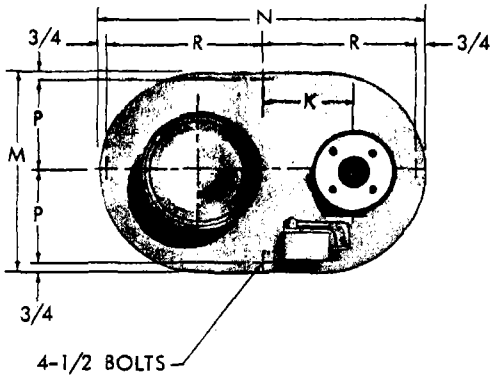
RECEIVED SEP 10 1981

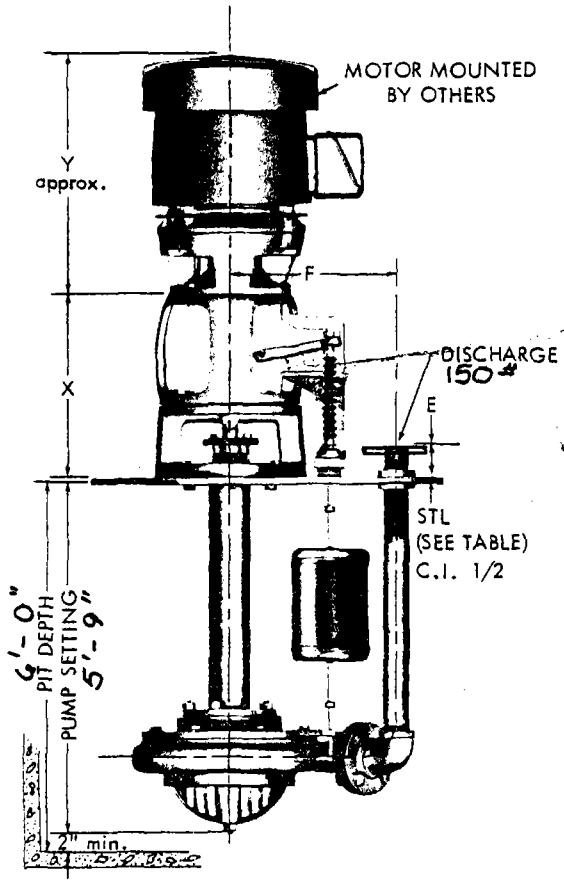
CERTIFIED PRINT:
SECTION: 530 PAGE: 9861 CURVE NUMBER: 3PC-116276
SPECIAL: MAINTENANCE: 7-27-81
BY: WJW QC DATE: 4/13/81 OFFICE: AURORA

THIS ORDER WILL NOT BE PROCESSED FOR MANUFACTURING UNTIL APPROVAL IS RECEIVED. PRINTS ARE NOT TO SCALE AND ARE CERTIFIED CORRECT ONLY FOR THIS ORDER. ALL ORDERS SUBJECT TO ACCEPTANCE AT AURORA PUMP, NORTH AURORA, ILLINOIS.

THIS ORDER CAN BE RELEASED FOR MANUFACTURING AS SHOWN: ☐
RELEASE FOR MANUFACTURING PER ATTACHED CHANGE ORDER: ☐
AUTHORITY:
OFFICE:
DATE:

AURORA MODEL 531 PUMP
ON OVAL PLATE





PUMP SIZE			E	F	K	OVAL SIZE	THK. STL.
DISCH	SUCTION	CASE BORE					
1¼	1½	7	3½	8 1/16	5 11/16	20 X 24	⅜
1¼	1½	9	3½	9 15/16	7 7/16	20 X 24	⅜
1½	2	7	3 7/16	8½	6	20 X 24	⅜
1½	2	9	3 7/16	10¼	7¾	20 X 24	⅜
1½	2	12	3 5/16	12 1/16	9 1/16	22 X 28	½
2	2½	7	4 1/16	10 5/16	7 13/16	20 X 24	⅜
2	2½	9	4½	12	9	22 X 28	½
2	2½	12	3 15/16	13 11/16	10 11/16	22 X 28	½
2½	3	7	4 3/16	11¼	8¼	22 X 28	½
2½	3	9	4 3/16	12 15/16	9 13/16	22 X 28	½
2½	3	12	3 15/16	14½	9	22 X 28	½
3	4	9	4 5/16	13 13/16	8 5/16	22 X 28	½
3	4	12	4 5/16	15 5/16	9 13/16	22 X 28	½
4	4	7	4 5/16	13¾	8⅛	22 X 28	½
4	5	9A	4 5/16	14¾	8⅛	22 X 28	½
4	5	9B	4 5/16	15¼	9¼	22 X 28	½
6	6	9	5¼	14¼	8¼	22 X 28	½

OVAL	M	N	P	R
20 X 24	20	24	9¼	11¼

FRAME	X	Y
143HP	13⅞	11
145HP	13⅞	12
182HP	13⅞	13
184HP	13⅞	14
213HP	13⅞	16
215HP	13⅞	17
254HP	13⅞	19
256HP	13⅞	21
284HPH	15⅝	21
286HPH	15⅝	23
324HP	15⅝	24

NOTES:
1. ALL DIMENSIONS IN INCHES.
2. DIMENSIONS MAY VARY ±1/8.
3. NOT FOR CONSTRUCTION PURPOSES UNLESS CERTIFIED.
4. FLOAT SWITCH FURNISHED ONLY WHEN SPECIFIED.
5. LINE SHAFT BEARING FURNISHED ON 6' 2" PUMP SETTINGS AND LONGER.
6. 22 X 28 OVALS ARE ALSO AVAILABLE WHERE 20 X 24 OVALS ARE SHOWN.

AURORA PUMPS
AURORA PUMP
A UNIT OF GENERAL SIGNAL
800 AIRPORT ROAD · NORTH AURORA, ILLINOIS · 60542

AURORA® PUMPS

INSTRUCTION MANUAL
REPAIR
MODEL 531-532 (NSB)

6

SERVICE

Your Aurora pump requires no maintenance other than periodic inspection, occasional cleaning and lubrication. The intent of inspection is to prevent breakdown, thus obtaining optimum service life. The pump bearing is grease lubricated and requires periodic lubrication as does the lower head bearing. The motor may also require lubrication, in which case, the motor manufacturer's recommendation should be followed.

LUBRICATION (BALL BEARINGS)

Regreasable bearings will require periodic lubrication and can be accomplished by using the zerk or lubrication fittings in the lower head assembly. Lubricate the bearings at regular intervals using a grease of high quality. Lithium, lithium soda or calcium base grease is recommended as lubricants for pumps operating in both wet and dry locations. Mixing of different brands of grease should be avoided due to possible chemical reactions between the brands which could damage the bearing. Accordingly, avoid grease of vegetable or animal base which can develop acids, as well as grease containing rosin, graphite, talc and other impurities. Under no circumstances should grease be reused.

Over lubrication should be avoided as it may result in overheating and possible bearing failure. Under normal application, adequate lubrication is assured if the amount of grease is maintained at 1/3 to 1/2 the capacity of the bearing and adjacent space surrounding it.

In dry locations each bearing will need lubrication at least every 4,000 hours of running time or every 6 to 12 months, whichever is more frequent. In wet locations the bearings should be lubricated at least after every 2,000 hours of running time or every 4 to 6 months, whichever is more frequent. A unit is considered to be installed in a wet location if the head assembly and motor are exposed to dripping water, to the weather, or to heavy condensation such as is found in unheated and poorly ventilated underground locations.

At times it may be necessary to clean the bearings due to accumulated dirt or deteriorated lubricants. This can be accomplished by flushing the bearing with a light oil heated to 180 to 200° F. while rotating it on a spindle. Wipe the bearing housing with a clean rag soaked in a cleaning solvent, and flush all surfaces.

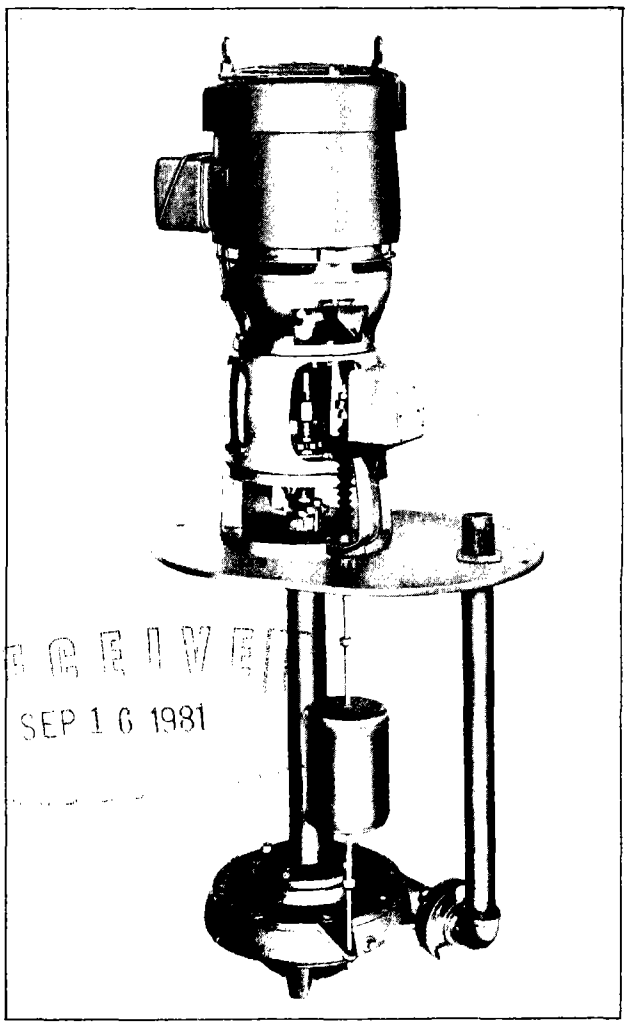
Dry bearing thoroughly before relubricating. Compressed air can be used to speed drying, but care should be taken not to let bearings rotate while being dried.

CAUTION

Use normal fire caution procedures when using any petroleum cleaner.

LUBRICATION (LINE SHAFT & PUMP BEARINGS)

Grease lubricated sleeve bearings will require frequent lubrication which can be accomplished by using the zerk fitting(s) located on the pump base. It is suggested that relubrication intervals be every 20 hours of running time. Sleeve bearings are not susceptible to over lubrication as is the case with ball bearings.



A. Complete unit assembly.

REPAIRS

The pump may be disassembled using the illustrations and text provided. Although complete disassembly is covered, it will seldom be necessary to completely disassemble your Aurora pump.

The illustrations accompanying the disassembly instructions show the pump at various stages of disassembly. The illustrations are intended to aid in the correct identification of the parts mentioned in the text.

Inspect removed parts at disassembly to determine their reusability. Pump or line shaft bearings that are scored or noticeably out of round should not be reassembled. Cracked castings should never be reused and scored or worn pump shafts should be replaced.

All packings and gaskets should be replaced with new ones at reassembly simply as a matter of economy. They are much less expensive to replace routinely than to replace singly as the need arises. In general, it is economical to return to the manufacturer for repair only the motor and motor controller.

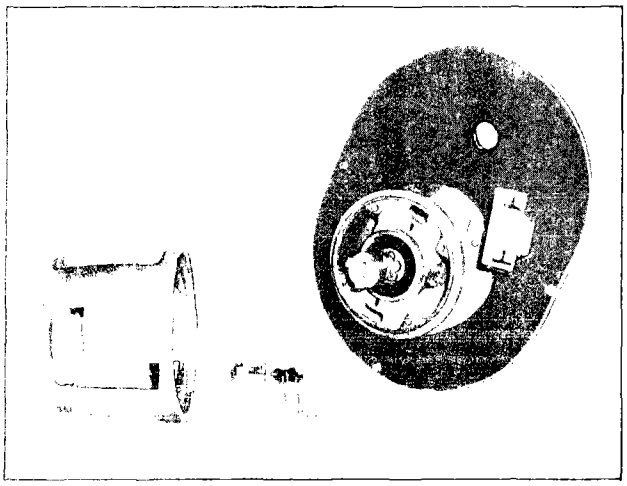
DISASSEMBLY

Disassemble only what is needed to make repairs or accomplish inspection. Proceed to disassemble the pump as follows: (Refer to figure 1.)

1. Disconnect wiring from motor control panel to motor and float switch. Take any other steps needed to prevent drive unit from being unintentionally energized during disassembly.

2. Remove the float switch. For instructions, refer to the repair notes on float switches.

3. Pump motor (52) and upper head (53) are best removed as a unit. The upper head serves to protect the motor output shaft from accidental damage. Therefore, remove capscrews (42) and lift the unit free from lower head (84) and lower half of coupling (48). If necessary, upper head (53) may be removed from motor (52) by unthreading capscrews (51) and removing nuts (50).



B. Upper head, coupling half, key and insert removed.

4. Coupling half (48) is removed by loosening setscrew (47). Similarly, setscrew (44) will free upper coupling half (45). Remove coupling keys (46 and 49) and insert (43).

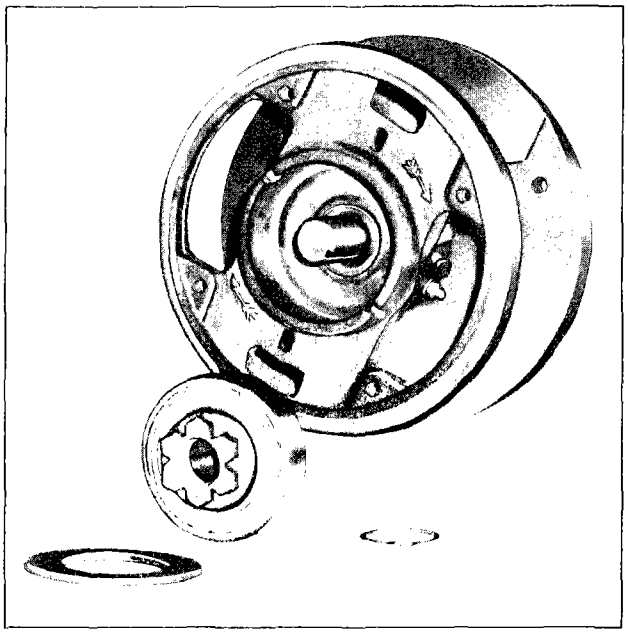
5. Remove remaining pump and connected parts from basin to continue disassembly.

NOTE

However, if ventilation piping is used, remove it before lifting off plate.

6. Locknut (55) can be unthreaded, exposing slinger (54) for removal. Then bearing collar (56) with ball bearing (58) is unthreaded from pump shaft. Retaining ring (57) must be removed from collar (56) with a pair of Truarc pliers, if bearing (58) is to be pressed off collar (56).

7. Remove grease seal (59) if necessary.

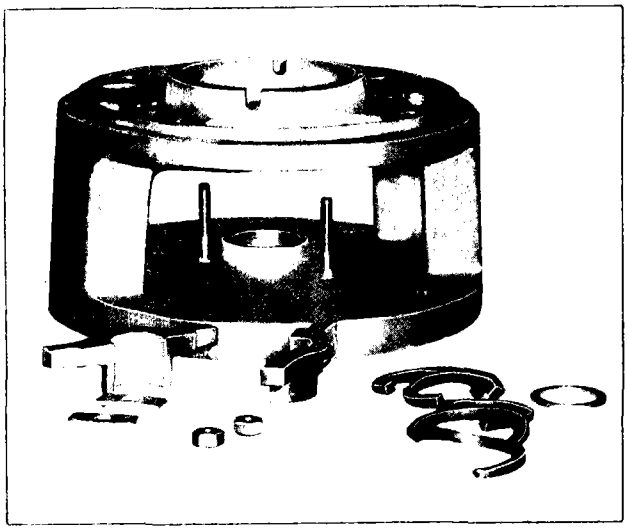


C. Slinger, bearing collar, bearing and retaining ring removed.

NOTE

Grease seal (59) should not be removed except for replacement because it's case is easily damaged. When removal is necessary, it can be tapped out of its seat in the lower head with coupling key (49) used as a driving tool.

8. Remove nuts (66) and clamps (67) from studs (69) and slide gland (68) off shaft (61). Remove packing (70) and packing ring (71).



D. Nuts, clamps, gland halves, packing and packing ring removed from lower head.

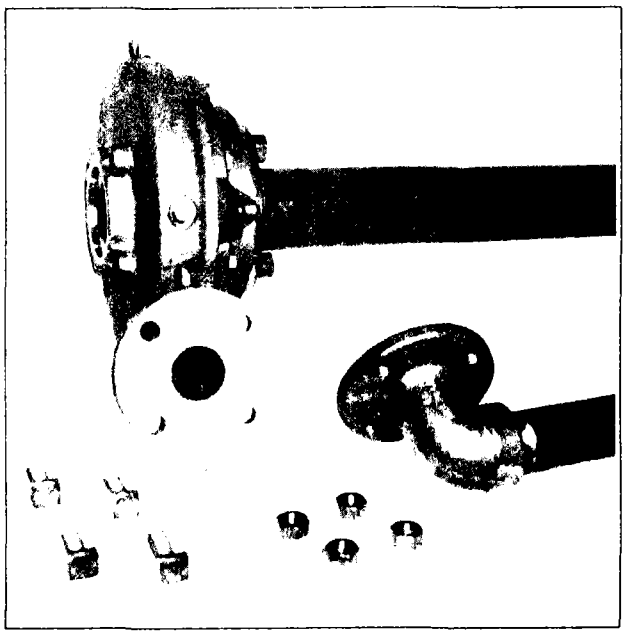
NOTE

This stuffing box arrangement is Option #3. For other options, refer to figure 1.

9. Remove oiler (73) if used and pipe plug (63). Also disconnect any lubrication line used to lubricate line shaft bearings or piping for pressurized support column water supply.

10. Unscrew capscrews (80 and 81) to remove lower head (84). Remove gasket (85).

11. Remove upper locknut (77) from discharge piping (78). Then plate can be lifted off.



E. Nuts, capscrews and gasket removed to free discharge piping.

Remove gasket (23). Remove screws (83) and nameplate (82) only if replacement is necessary.

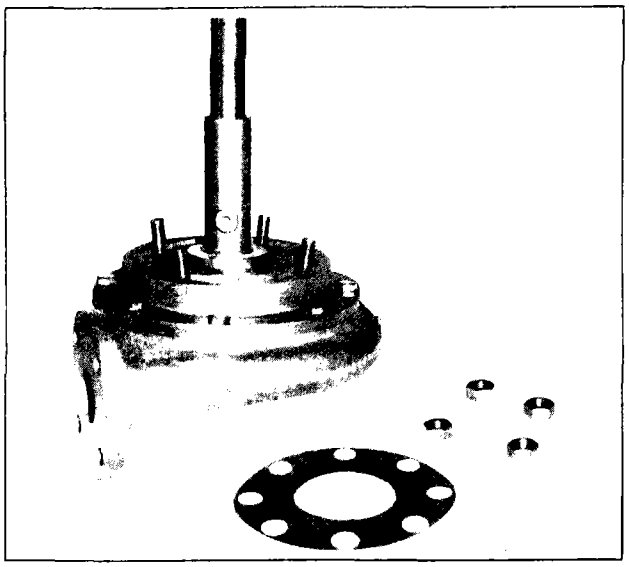
12. Successive lengths of piping and shafting are disassembled as follows:

a. If a line shaft bearing is lubricated through a lubrication line, detach the line and elbow from pipe nipple in upper support section and then remove nipple.

b. Unscrew capscrews (39) and nuts (38) to lift top support pipe section and expose shaft coupling (60). Use a wrench to hold shaft (61) and a second wrench to unscrew coupling (60). Remove gasket (23).

c. Remove pipe plug (25) if used, then slide line shaft bearing (41) off shaft.

d. For additional lengths of discharge pipe (78) use a large pipe wrench to hold discharge pipe and a second wrench to unscrew coupling (79).



F. Nuts, support piping and gasket removed from cover.

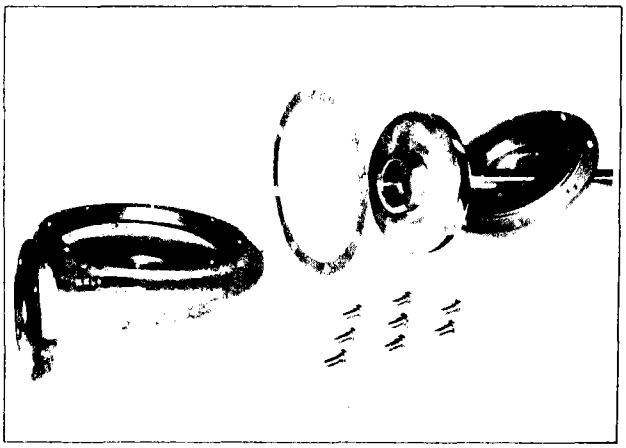
CAUTION

To protect a bearing that can be reused, tape the threaded section of the shaft end before removing bearing.

13. Discharge piping (78) and flanged elbow (76) can be removed from casing (8) by unthreading capscrews (5) and nuts (6). Remove gasket (9).

14. To lift off remaining support piping (40) unscrew nuts (20). Then remove gasket (23) and slide bolts (21) out.

15. Unthread capscrews (7) to remove cover (22) and gasket (10) exposing impeller.



6. Capscrews, cover, casing and gasket removed to reveal impeller.

16. Lift remaining shafting (61), impeller (15) and pump bearing (26) from casing (8). Remove pipe plug (25) from bearing (26), then slide bearing off end of the shaft, using the afore mentioned caution.

17. Unscrew impeller capscrew (13), remove gasket (14), impeller (15) and impeller key (16).

18. Case rings (11 and 24) are pressed into their housings with an interference fit and must be removed with a puller. New ring(s) should be used for reassembly since it is likely that during removal this fit will be lost.

19. Impeller wearing rings (optional - (18 and 19)) are pressed on and must be cut off if replacement is necessary. If they are turned off in a lathe, take care not to cut into the impeller.

20. To remove strainer (3) unscrew capscrews (1) and washers (2). For smaller size pumps unscrew strainer (3) and nipple (4) from casing (8).

REASSEMBLY

Reassembly will generally be in reverse order of disassembly. If disassembly was not complete, use only those steps related to your particular repair program.

1. Slide pump bearing (26) onto pump end of shafting (61) using the last caution mentioned in disassembly with the flanged end of bearing toward the bottom end of shaft. If bearing is not to be lubricated through a lubrication line, place pipe plug (25) in tapped hole in bearing.

2. Slide pump shaft (61) into pump end of support piping (40). Position pump bearing against pump flange of support piping. If bearing is to be lubricated through a lubrication line, align tapped opening in the bearing with vent opening in the support pipe, and install an 1/8 inch pipe nipple to maintain the alignment.

3. Press case rings (11 and 24) in casing (8) and cover (22). Rings should not be hammered into place. Use a press, or clamp the parts in a bench vise, using wooden blocks to protect the rings. It may be necessary to pin or dowel the rings after assembly if the insert or casing has had rings replaced before, since each reassembly can stretch or tear metal and thereby loosen the fits. If the facilities are available, it is good practice to take a very light finish cut or to ream the inside diameter of the casing rings after pressing to restore roundness. When rings are pressed, they may get squeezed out of shape.

4. Replace wear ring(s) (optional - (18 and 19)) on impeller, using the same care as for the case wear ring(s). If the rings are to be trued on a lathe, do not clamp the impeller so tightly that it is permanently distorted.

5. Slide cover (22) onto shaft (61). Place impeller key (16) in shaft and replace impeller (15) on shaft. Secure impeller with impeller capscrew (13) and gasket (14).

6. Position gasket (10) on cover (22) and bolt to casing (8) with capscrews (7).

7. Place bolts (21) in slot in cover (22) and hold them in place with gasket (23). With discharge outlet aligned with vent opening in support pipe, bolt cover to flanged support pipe (40) with nuts (20).

8. Bolt discharge flanged elbow (76), with gasket (9) in place, to casing with capscrews (5) and nuts (6). Lengths of discharge pipe (78) may now be replaced in flanged elbow (76).

NOTE

If pump bearing is to be lubricated through a lubrication line, assemble the required elbow and tubing on previously installed nipple. If support column is to be pressurized with a flow of fresh water, connect the required 3/4 inch pipe nipple, elbow and pipe to support piping, and ascertain that other vent openings are plugged.

9. Successive lengths of piping and shafting are assembled as follows: (Pumps designed for pump settings* deeper than 6 feet, 2 inches are provided with multiple part discharge and support piping and with line shaft bearings at each support piping joint.)

a. Slide a line shaft bearing (41) down pump shaft, with tapped opening toward upper end until it seats against the flange of the previously assembled section of support piping (40).

b. To add successive lengths of pump shafting, thread shaft coupling (60) onto threaded end of one shaft (61). Start second piece of shafting into opposite end of coupling. Tighten both shafts evenly into coupling with pipe wrenches being careful not to score shafting excessively. There should be an even amount of shaft threads showing on either side of the coupling after tightening.

c. If line shaft bearing is to be lubricated through a lubrication line, turn bearing as required to align tapped opening with lubricant piping. Position support pipe gasket (23) against support pipe flange, and lower the next section of support piping into place. Turn it to align vent opening with tapped opening in line shaft bearing, and secure it by installing bolts (39) and nuts (38). Install any 1/8 inch pipe nipple in tapped opening of line bearing if required, and connect it to previously assembled lubrication piping.

d. If necessary, screw a discharge pipe coupling (79) onto threaded end of previously assembled section of discharge piping, and thread the next section of piping into coupling. Tighten with a pipe wrench, using a second wrench to hold the previously assembled section.

*"Pump Setting" is the distance from bottom of strainer (3) to bottom of lower head (84). This measurement is normally 4 inches less than "Pit Depth," the distance from bottom of basin to top face of basin.

10. Place locknut (77) on discharge pipe (78) and thread down approximately 1 inch.

11. Lower pump support plate over support piping (40) and discharge piping (78). Position gasket (23) on support pipe flange, gasket (85) on lower head and slide lower head (84) into place.

NOTE

Install float control at this time if liquid end is not accessible when ejector is lowered into basin.

12. Lift pump support plate into position against lower head (84) and install capscrews (80 and 81). Place locknut (77) on discharge pipe (78) and tighten locknuts above and below the plate to secure discharge piping in place. Replace strainer (3) with either washers (2) and capscrews (1) or nipple (4). If pipe plugs (12) were removed, replace in casing (8). Pump support plate and pump assembly may now be lowered into place on basin cover and can be bolted down.

13. Install pump shaft packing ring (71) and packing (70) around shaft in lower head. Assemble packing gland halves (68) on gland studs (69) and secure with gland clamps (67) and nuts (66). Do not tighten nuts more than finger tight unless pump support piping is to be pressurized with fresh water.

14. Seat grease seal (59) with sealing edge upward in its seat in lower head.

NOTE

Cover threads of pump shaft temporarily with a tape or some other means before sliding on grease seal to prevent threads from damaging seal.

15. Press ball bearing (58) onto bearing collar (56) with ball bearing seal facing flange on collar, and secure bearing on collar by installing retaining ring (57).

16. Thread bearing collar onto pump shaft with bearing surface downward. Turn collar clockwise until bearing seats in lower head, then turn it an additional one-half turn. This will raise shaft and impeller approximately 1/64 inch off suction cover, providing the correct clearance for efficient pump operation.

17. Hold bearing collar (56) and install locknut (55) against collar. Ascertain that pump shaft turns freely by hand. Press rubber slinger (54) into place on bearing collar.

NOTE

Connect pressurization or lubrication piping at this time by using opening provided in pump support plate. For pressurization piping, a 3/4 inch line to water supply is connected to tapped opening in lower head. For lubrication piping, line is connected to lubrication device. If no lubrication line is required and there are line shaft bearings, install oiler (73) and pipe plug (63) in openings provided in lower head.

18. Install coupling half (48) and key (49) on upper end of pump shaft, and tighten coupling setscrew (47) temporarily to prevent its slipping down shaft.

19. Position coupling insert (43) in lower half of coupling and secure upper coupling half (45) with its key (46) on motor output shaft. Align bottom end of key with key slot in the end surface of motor shaft, and secure by tightening setscrew (44).

20. If upper head (53) was removed from motor (52) replace with capscrews (51) and nuts (50). Lower motor (52) and upper head (53) carefully into position on lower head while engaging coupling halves with coupling insert. Bolt assembly to lower head with capscrews (42).

21. Loosen setscrew (47) in lower coupling half (48) and slide coupling half and key (49) upward until they engage coupling insert (43) with proper clearance as shown in Section 2, Item 4 of this Instruction Manual.

22. If nameplate (82) was removed replace at this time with screws (83).

NOTE

Install float switch at this time. For instructions refer to the repair notes on float switches.

23. Connect wiring from motor control panel to motor and float switch, following exactly the instructions provided by their respective manufacturers. Also connect solenoid valve or oiler at this time if used, using diagrams provided. All wiring must comply with applicable electrical code requirements for type of duty pump is to perform.

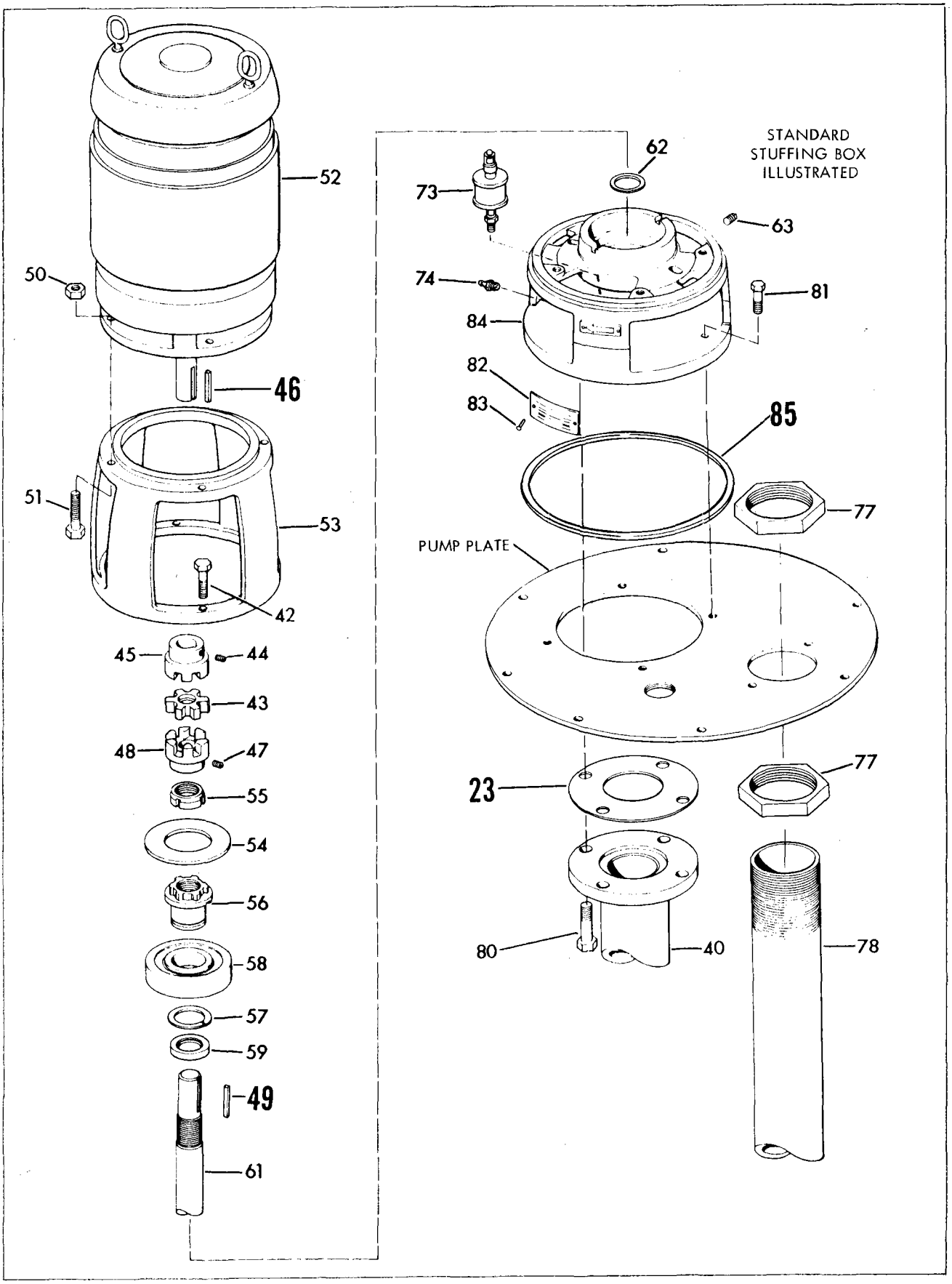
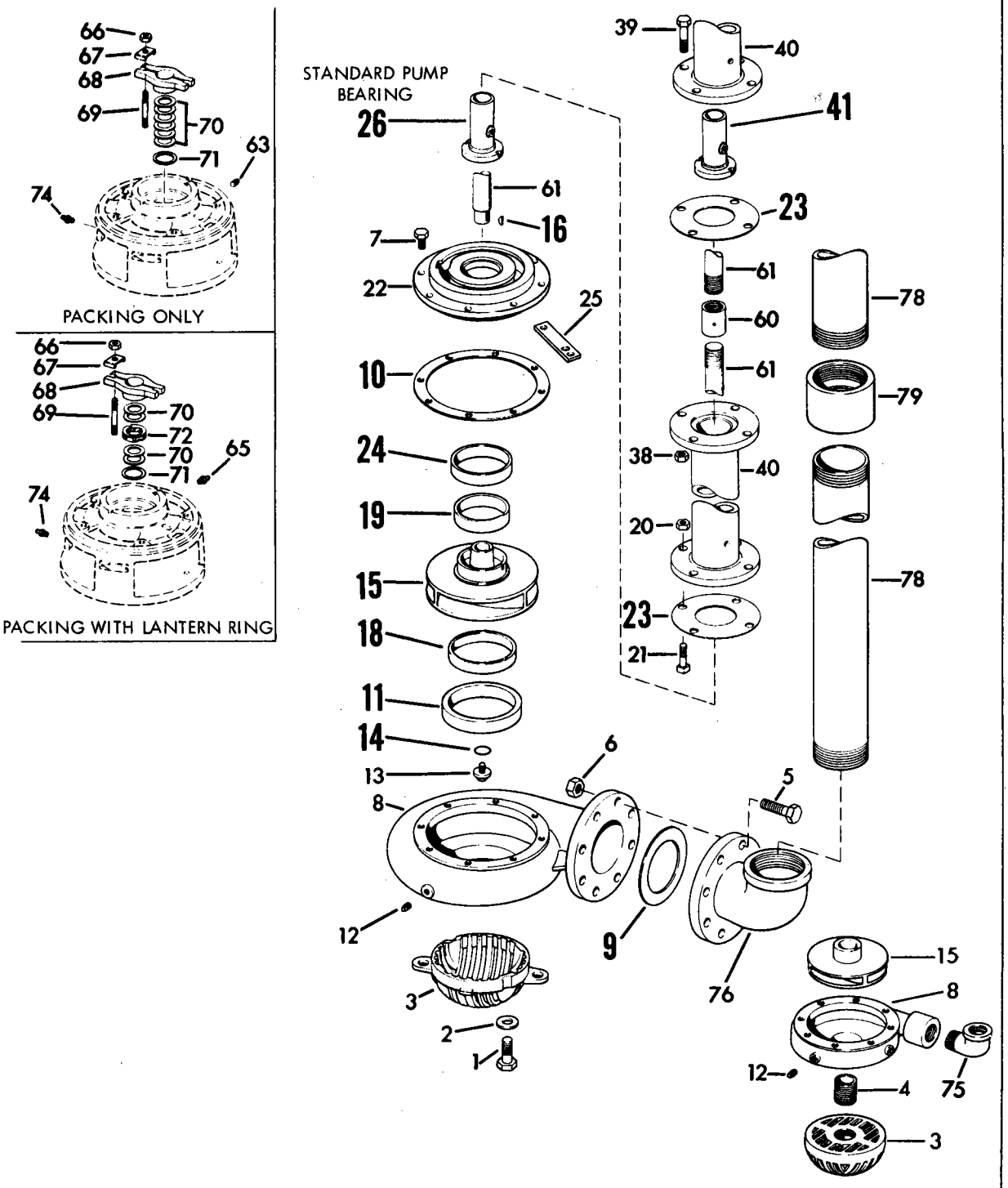


Figure 1. Model 531-532 Exploded View (Sheet 1 of 4)



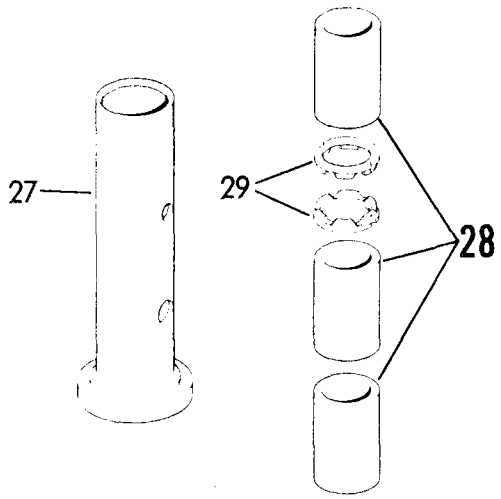
NOTE: Recommended spare parts shown in bold face type.

Figure 1. Model 531-532 Exploded View (Sheet 2 of 4)

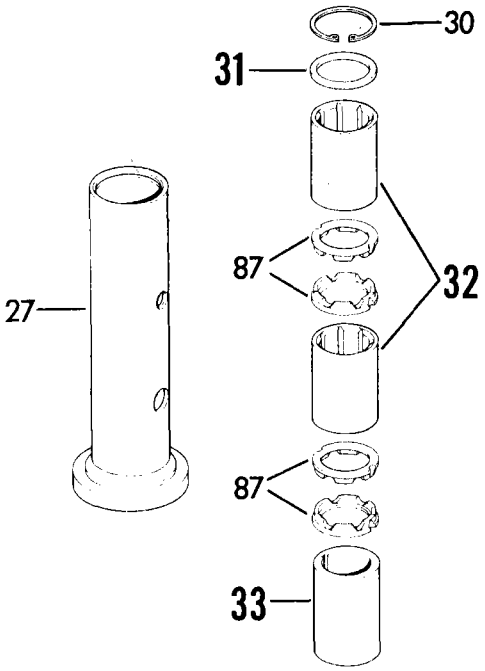
MODEL 531-532

OPTIONAL RELIEF HOUSING

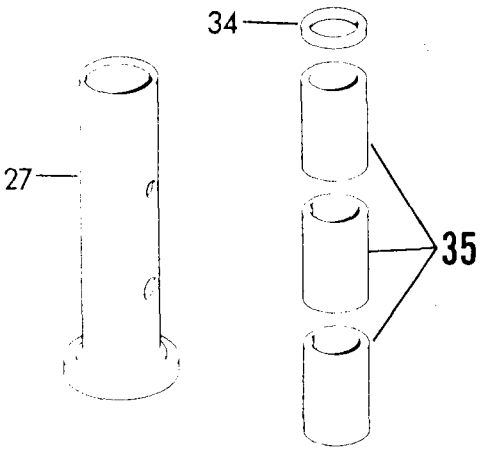
GRAPHITAR



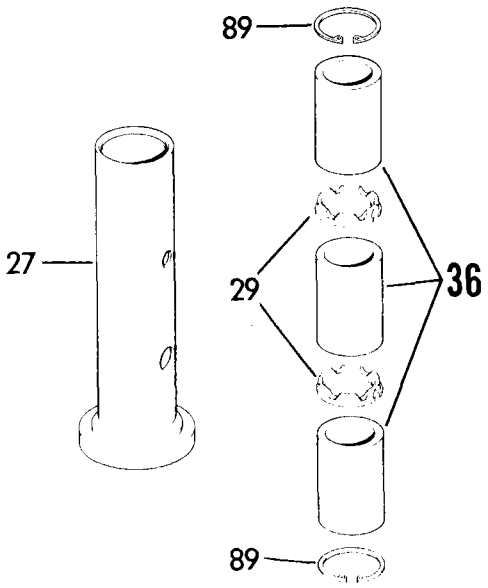
CUTLESS RUBBER



RELIEF*



TEFLON



*Standard for pump settings over 10 feet.

Figure 1. Model 531-532 Exploded View (Sheet 3 of 4)

OPTIONAL SPOOL HOUSING

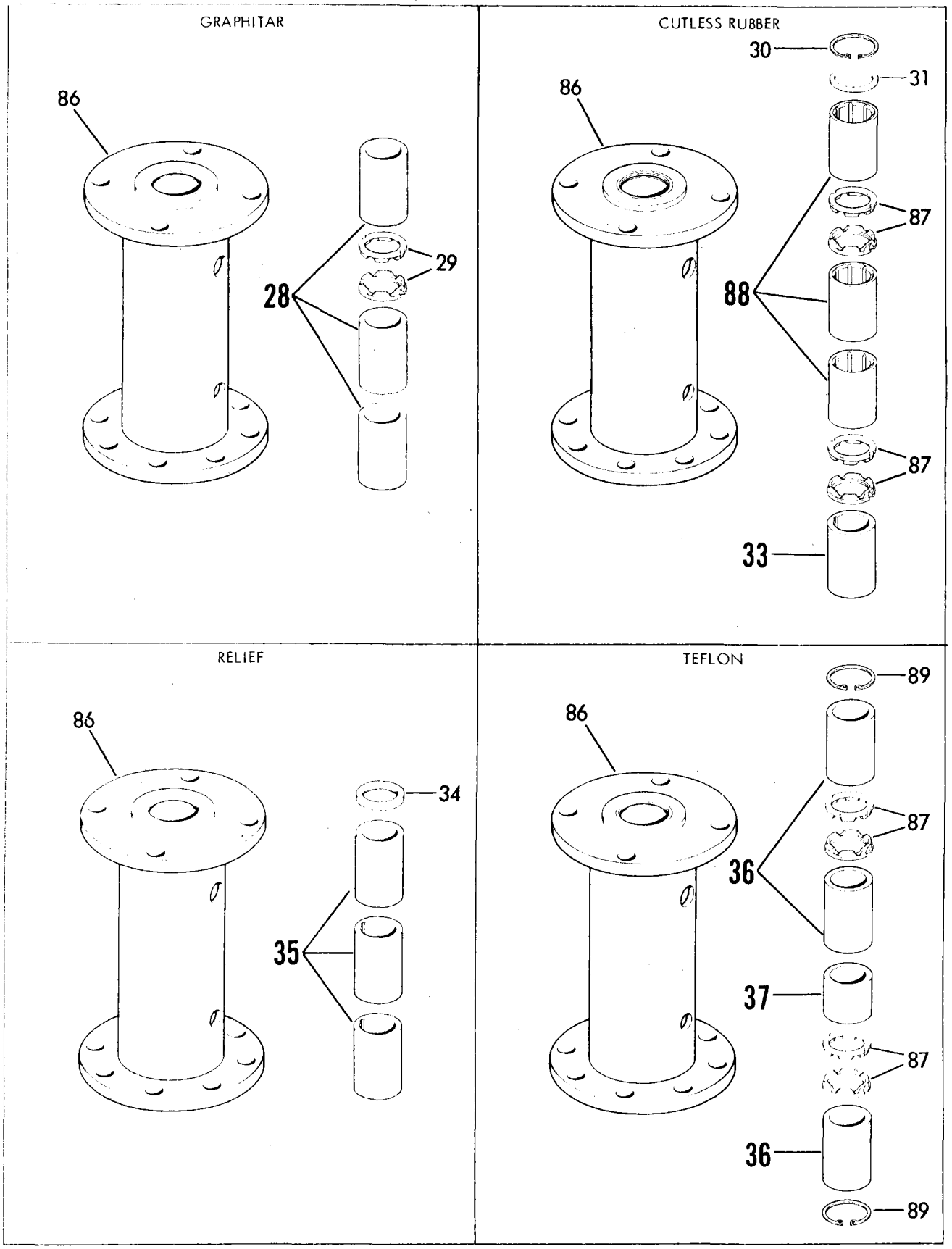


Figure 1. Model 531-532 Exploded View (Sheet 4 of 4)

Model 531-532 List of Parts (See Figures 1 & 2)

1. Capscrew
2. Washer
3. Strainer
4. Nipple
5. Capscrew
6. Nut
7. Capscrew
8. Casing
9. Gasket
10. Gasket
11. Case ring
12. Plug, pipe
13. Impeller capscrew
14. Gasket
15. Impeller
16. Impeller key
18. Impeller ring (opt)
19. Impeller ring (opt)
20. Nut
21. Bolt
22. Cover
23. Gasket
24. Case ring
25. Float rod guide
26. Pump bearing
27. Bearing housing (opt)
28. Bushing (opt)
29. Lantern ring (opt)
30. Snap ring (opt)
31. Retainer ring (opt)
32. Bushing (opt)
33. Bushing (opt)
34. Seal (opt)
35. Bushing (opt)
36. Bushing (opt)
37. Bushing (opt)
38. Nut
39. Capscrew
40. Support pipe
41. Bearing
42. Capscrew
43. Insert
44. Setscrew
45. Coupling half
46. Key
47. Setscrew
48. Coupling half
49. Key
50. Nut
51. Capscrew
52. Motor
53. Upper head
54. Slinger
55. Locknut
56. Bearing collar
57. Retaining ring
58. Bearing
59. Seal
60. Coupling, shaft
61. Shaft
62. Slinger
63. Plug, pipe
64. Seal (opt)
65. Fitting
66. Nut (opt)
67. Clamp (opt)
68. Gland (opt)
69. Stud (opt)
70. Packing (opt)
71. Packing ring (opt)
72. Lantern ring (opt)
73. Oiler (opt)
74. Fitting (opt)
75. Street elbow
76. Flanged elbow
77. Locknut
78. Discharge pipe
79. Coupling, pipe
80. Capscrew
81. Capscrew
82. Nameplate
83. Screw
84. Lower head
85. Gasket
86. Spool bearing housing (opt)
87. Lantern ring (opt)
88. Bushing (opt)
90. Grease fitting
91. Elbow
92. Coupling
93. Close nipple
94. Nipple
95. Comp. fitting
96. Comp. fitting
97. Nylon tube

NOTE

WHEN ORDERING SPARE PARTS ALWAYS INCLUDE THE PUMP TYPE, SIZE, SERIAL NUMBER, AND THE PIECE NUMBER FROM THE EXPLODED VIEW IN THIS MANUAL.

ORDER ALL PARTS FROM YOUR LOCAL AUTHORIZED DISTRIBUTOR, FACTORY BRANCH SALES OFFICE OR THE FACTORY AT NORTH AURORA, ILLINOIS.

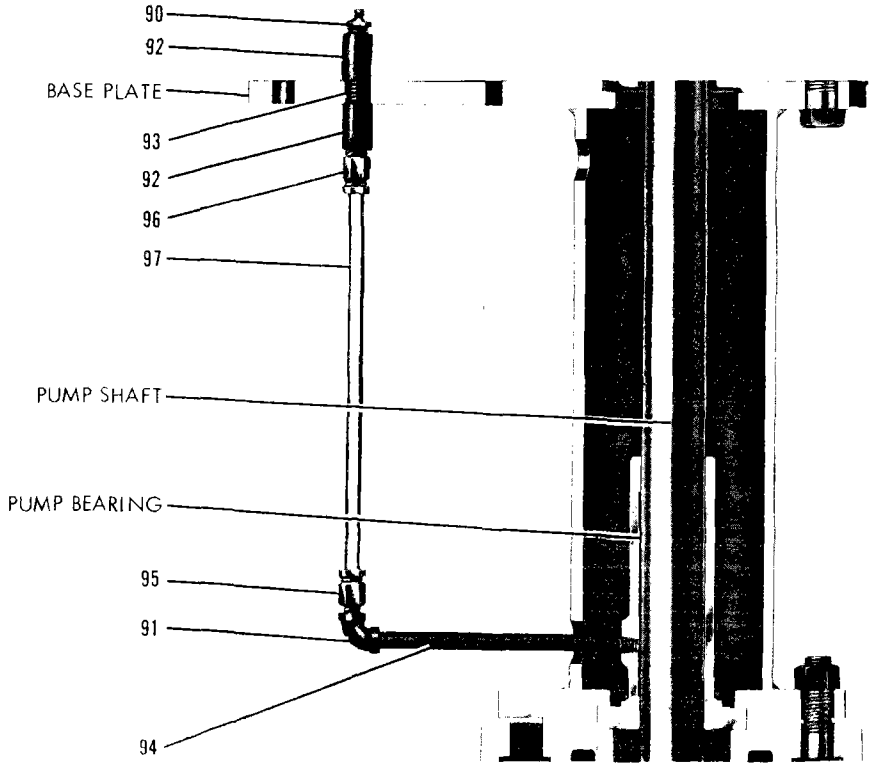


Figure 2. 1.2.14-13