

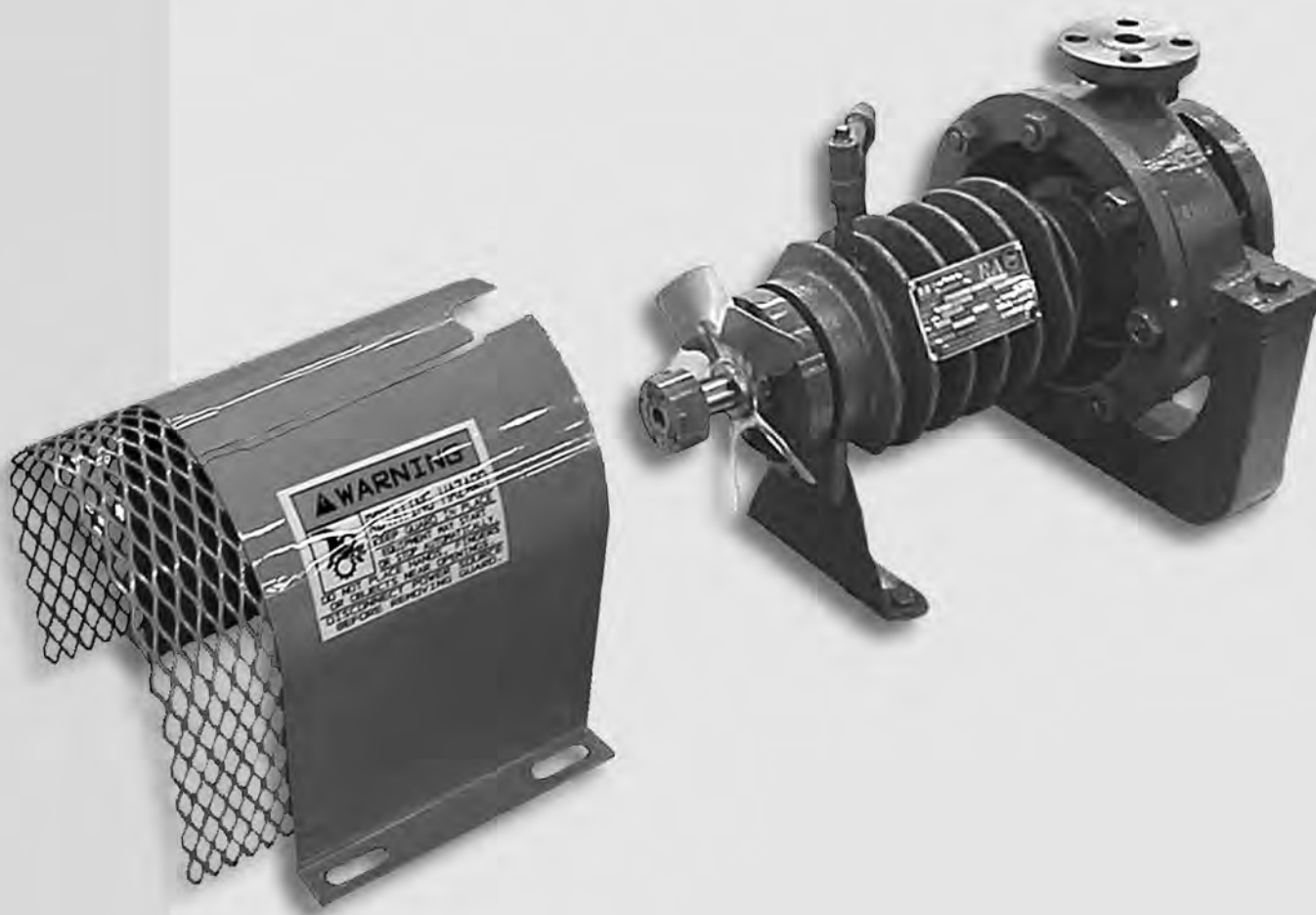
DEAN PUMP® SERIES RA

Fan Cooled Hot Oil Pumps

INSTALLATION

OPERATION

MAINTENANCE MANUAL



**DO NOT INSTALL, OPERATE, OR SERVICE THIS PUMP
BEFORE READING THE ENTIRE MANUAL**

INDEX

Product Inspection and Test	1
Warnings	1
Receiving Pump	1
Storage	1
Mechanical Design Specifications	2
Standard Materials of Construction	2
Allowable Working Pressure	2
Installation	3
Application and Reapplication	3
Pump Foundation	3
Baseplate Mounting and Alignment	3
Suction and Discharge Piping	4
Pump and Driver Alignment	4
Allowable Piping Loads	6
Small Piping Connections	6
Pump Lubrication	7
Bearings	7
Mechanical Seal	7
Starting the Pump	8
Filling	8
Operating	8
Pump Start-Up Checklist	9
Spare Parts	10
Ordering Spare Parts	10
Pump Section Views	11
Disassembly and Reassembly Procedures	13
Warnings	13
Disassembly Procedure	14
Reassembly Procedure	15

PRODUCT INSPECTION AND TEST

The Products of Dean Pump Division are subject to thorough and rigorous quality control and inspection procedures throughout the whole of the manufacturing process to assure proper operation in full conformity with established performance standards. On completion of inspection, each unit is sprayed internally with rust inhibitor (if material is subject to atmospheric corrosion), sealed

against the entrance of dirt, and tagged with a signed certificate of inspection prior to shipment. Each pump when shipped is ready to perform the service for which it was designed with minimum maintenance and expense if properly installed and operated in accordance with the instructions furnished.

WARNING

HAZARDOUS SITUATIONS MAY OCCUR UNLESS THIS EQUIPMENT IS APPLIED, INSTALLED, OPERATED, AND MAINTAINED BY THOROUGHLY QUALIFIED PERSONNEL IN STRICT ACCORDANCE WITH THE INSTRUCTION MANUAL AND ALL APPLICABLE DRAWINGS AND CODES.

Read the instruction manual completely before installing, filling, operating, or maintaining this equipment.

Obtain, read and heed the MSDS (Material Safety Data Sheet) for the fluids being handled before attempting to fill, operate or maintain this equipment. Obtain instructions from the Safety Engineer responsible for your facility before performing any work on the pumping equipment and systems.

Proper storage while not in use and proper installation and startup are essential for successful pump operation. Misuse or improper storage, installation or operation of pumps may result in serious loss or damage. Dean Pump Division is not responsible for any loss or damage resulting from causes beyond its control, and is not liable for charges for work performed or materials furnished to repair such loss or damage.

All installation, operation, and maintenance must be done by thoroughly qualified personnel in strict accordance with this manual and must comply with all local, state and Federal codes. Only Dean authorized service parts must be used in the repair of these pumps.

RECEIVING PUMP

When the pump is received from the transportation company it should be promptly inspected for damage and such damage noted on the bill of lading before it is signed. Claims for shipping damage must be filed against the carrier.

Care must be exercised in unloading and handling the pump.

STORAGE

Pumps must be properly covered and protected against moisture, dirt, and physical damage during storage prior to installation.

If prolonged storage is anticipated, do the following:

- 1) Seal the suction opening of the pump with a blind flange, gasket, and bolts.
- 2) Fill through the discharge opening of the pump with a corrosion inhibiting liquid that is also compatible with the liquid that will later be pumped. Evaluation of compatibility must include consideration of the temperature at which the system will later operate. Remove the seal vent plug while filling to assure that all air is purged from the mechanical seal cavity. When the liquid flows through the vent connection, replace the seal vent plug. If liquid does not flow from this connection, fill through this connection until all air is purged.
- 3) Continue filling through the discharge opening until the pump is completely filled.

- 4) Seal the discharge opening with a blind flange, gasket, and bolts.
- 5) Remove the barrier oil fill plug. Fill the barrier cavity with a corrosion inhibiting liquid that is compatible with the barrier liquid that will be used later for pump operation. When this liquid starts to flow out of the overflow pipe, replace the fill plug.
- 6) Remove the bearing end cover (28) and fill the center pocket of the end cover with the grease described under "PUMP LUBRICATION". Replace and secure the end cover.
- 7) Apply a heavy protective coating to all exposed machined surfaces. A rust preventive must be used to protect all steel and iron parts.
- 8) Rotate the pump shaft "by hand" each month. Wear heavy gloves when rotating the shaft, to protect your hands.

When you are ready to place the pump in service;

- 1) Remove the bearing end cover (28). Remove and discard about one half of the grease that is in the end cover. Replace and secure the end cover (see assembly instructions). Be sure to comply with all government regulations in the disposal of the grease.
- 2) Remove the barrier oil drain plug, drain and discard the storage liquid. Remove the barrier oil fill plug. Flush all remains of the storage liquid from the barrier cavity. Replace the fill and drain plugs. Use a flush liquid that is compatible with the barrier fluid to be used. Be sure to comply with all governmental regulations in disposal of the storage liquid and the flush liquid.
- 3) Remove and discard the discharge bolts, nuts, blind flange, and gasket. Remove the casing drain plug and the seal vent plug. Drain and discard the storage liquid. Remove and discard the suction bolts, blind flange, and gasket. Stand the pump up on its suction flange to allow residual liquid to drain. Flush all remains of the storage liquid from the pump. Use a flush liquid that is compatible with the pumpage, as any flush liquid remaining in the pump when it is placed in operation, will be exposed to the operating temperatures and pressures. Vapor pressure is "one" of the critical properties to be considered. Be sure to comply with all environmental regulations in disposal of the storage liquid, flush liquid, and gaskets.

WARNING:

Be sure that there is nothing remaining in the pump that could react with the liquid that will be pumped or that would have an excessive vapor pressure at the system operating temperature. For example, water residue left in the pump, when exposed to the operating temperature of the system, would create a vapor pressure in excess of the capability of the system to retain it, therefore causing an explosion that could prove fatal.

- 4) Replace the casing drain plug and the seal vent plug.

- 5) Remove the "storage" protective coating from the external surfaces of the pump.

Pumps must also be protected from moisture, dirt, and physical damage, during and after installation while the system is being completed. Pumps "stored" on their foundations must be completely checked for proper installation prior to start-up.

Care in storage and installation will preserve the built-in quality of each Dean Product.

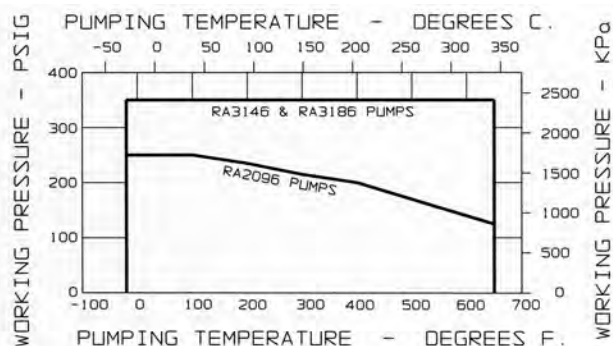
RA SERIES

FAN COOLED, HORIZONTAL, SINGLE STAGE, END SUCTION, ENCLOSED IMPELLER, CENTRIFUGAL HOT OIL PUMPS. THESE PUMPS ARE DESIGNED SPECIFICALLY FOR USE WITH HEAT TRANSFER OILS. THESE PUMPS WILL NOT WORK ON OTHER LIQUIDS.

MECHANICAL DESIGN SPECIFICATIONS

PUMP TYPE	RA2096	RA3146	RA3186
Direction of Rotation (Viewed from Coupling End)	CW	CCW	CCW
Casing Thickness, Minimum	5/16"	5/16"	5/16"
Corrosion Allowance	1/8"	1/8"	1/8"
Impeller Balance Standard Optional Extra	Single Plane Dynamic	Single Plane Dynamic	Single Plane Dynamic
Flanges ANSI Class Facing Finish	150 Flat Face 125 Ra	300 Raised Face 125 Ra	300 Raised Face 125 Ra
Suction Pressure, Maximum	100 PSIG	100 PSIG	100 PSIG
Horsepower Rating, Maximum @3500 RPM @1750 RPM @1150 RPM	35 15 10	100 40 25	250 125 75
Bearings: Thrust Bearing, Ball Type, Grease Lubricated Radial Bearing, Sleeve Type, Pumpage Lubricated	5306 2RS Double Row	7308 BG Angular Contact Pair	7311 BG Angular Contact Pair
Seal Chamber Dimensions Length (Depth) Inside Diameter (Bore Dia.) Shaft Diameter	1 5/8" 2 1/16" 1 1/8"	2 13/16" 3 1/8" 1 3/4"	3 7/8" 4 5/16" 2 1/4"
Pump Shaft Dimensions Span Between Bearings Span Between Radial Bearing Centerline and Impeller Centerline Diameter at Coupling Diameter Between Bearings Diameter at Impeller	8 11/16" 1 5/8" 7/8" 15/16" 3/4"	11 7/16" 2 5/16" 1 1/8" 1 9/16" 1 1/8"	14 5/8" 3 1/4" 1 3/8" 1 7/8" 1 1/2"
L/D*	4.3	2.1	2.8
Material Class	22 (Ductile Iron)	22 (Ductile Iron)	22 (Ductile Iron)
Maximum Working Pressure	250 PSIG @100°F	350 PSIG	350 PSIG
Pumping Temperature Minimum Maximum	-20°F @ 250 PSIG 650°F @ 125 PSIG	-20°F 650°F	-20°F 650°F
Maximum Ambient Temperature (temp. within 12" of pump)	104°F	118°F	118°F
Hydrostatic Test Pressure	430 PSIG	550 PSIG	550 PSIG

ALLOWABLE WORKING PRESSURE VS. PUMPING TEMPERATURE



THESE PUMPS ARE DESIGNED SPECIFICALLY FOR USE WITH HEAT TRANSFER OILS. THESE PUMPS WILL NOT WORK ON OTHER LIQUIDS.

STANDARD MATERIALS OF CONSTRUCTION				
Part No.	Part Name	RA2096 Class 22	RA3146 Class 22	RA3186 Class 22
3	Impeller	C.I. (1)	C.I. (1)	C.I. (1)
*4	Impeller Key	Steel (2)	Steel (2)	Steel (2)
5	Casing	D.I. (10)	D.I. (10)	D.I. (10)
5A	Casing Drain Plug	Steel (2)	Steel (2)	Steel (2)
5C	Casing Stud Nut	N.A.	Steel (5)	Steel (5)
5D	Casing Stud/Cap Screw	Steel (3) Screw	Steel (4) Stud	Steel (4) Stud
6A	Casing Ring (Only Some Sizes)	N.A.	Iron (7)	Iron (7)
9	Bearing Housing Foot	Steel (2)	Steel (2)	Steel (2)
*12	Impeller Bolt/Nut	Steel (2) Nut	Steel (2) Bolt	Steel (2) Bolt
*12A	Impeller Washer	Steel (2)	Steel (2)	Steel (2)
*13	Mechanical Seal Gland	Steel (2)	Steel (2)	Steel (2)
*25A	Shaft Bearing – Thrust – Ball	Double Row	Angular Contact Pair	Angular Contact Pair
26	Bearing Housing	D.I. (10)	D.I. (10)	D.I. (10)
*28	Bearing End Cover	C.I. (1)	Steel (2)	D.I. (9)
*29	Pump Shaft	11-13 S/S (12)	11-13 S/S (12)	11-13/316 S/S (8)
*31	Thrust Bearing Lock Nut	N.A.	Steel (2)	Steel (2)
*31A	Thrust Bearing Lock Washer	N.A.	Steel (2)	Steel (2)
56	Casing Foot	N.A.	C.I. (1)	C.I. (1)
*75	Snap Ring	N.A.	Steel (2)	N.A.
*75A	Snap Ring	Steel (2)	N.A.	N.A.
*76	Grease Seal – Front	Viton (13)	Viton (13)	Viton (13)
*76A	Grease Seal – Rear	N.A.	Buna (14)	Buna (14)
77	Casing Gasket	Grafoil (11)	Grafoil (11)	Grafoil (11)
*77B	Bearing End Cover Gasket	N.A.	Buna (14)	Buna (14)
*84	Barrier Oil Fill Plug	Steel (2)	Steel (2)	Steel (2)
*92	Barrier Oil Drain Plug	Steel (2)	Steel (2)	Steel (2)
*95A	Mechanical Seal Stationary	Silicon Carbide & Viton	Silicon Carbide & Viton	Silicon Carbide & Viton
*95B	Mechanical Seal Rotary	S/S, Carbon & Viton	S/S, Carbon & Viton	S/S, Carbon & Viton
98	Coupling Guard	Steel (2)	Steel (2)	Steel (2)
*120	Fan	Aluminum	Aluminum	Aluminum
*121	Fan Collar	N.A.	Steel (2)	Steel (2)
*122	Fan Clamp Ring	Steel (2)	Steel (2)	Steel (2)
*180	Radial Bearing Cartridge	Carbon & Steel	Carbon & Steel	Carbon & 416 S/S
*325	Seal Gland Gasket	Viton (13)	Viton (13)	Viton (13)
*365	Mechanical Seal Retainer	Steel (2)	Steel (2)	Steel (2)
*370	Seal Retainer Set Screw	Steel	Steel	Steel
*375	Anti-Rotation Pin	N.A.	N.A.	316 S/S

*Denotes parts interchangeability in all pump sizes of a given series.

- | | |
|--|--|
| (1) Cast Iron | (8) ANSI 316 S/S with ANSI 416 S/S at the sleeve bearing |
| (2) AISI 1020 | (9) Ductile Iron – ASTM A536 |
| (3) SAE Grade 5 or ASTM A449
Type 1 Steel | (10) Ductile Iron – ASTM A395 |
| (4) AISI 4140 ASTM A193-B7 Steel | (11) Grafoil® |
| (5) ASTM A194 Grade 2 Steel | (12) ANSI – 420 S/S |
| (7) Hardened Iron | (13) Viton® Elastomer |
| | (14) Buna N Rubber |

Viton® is a registered Trademark of E.I. DuPont Co.
Grafoil® is a registered Trademark of Union Carbide Corp.

INSTALLATION

Obtain MSDS data sheets for all liquids (from the manufacturers of those liquids) being used with the pump, and heed all cautions.

Always wear the appropriate protective apparel when working on or around the pumping equipment. Safety glasses with side shields, heavy work gloves (use insulated work gloves when handling hot items), steel-toed shoes, hard hat, and any other protective gear as needed for protection. One example of other gear would be breathing apparatus when working near toxic materials. Use lifting devices, manufactured expressly for the purpose of lifting, to move the pumping machinery. Do not attempt to lift the assembly or its components manually. Use only devices with lifting capabilities in excess of the weight of the unit being lifted. Inspect straps, chains, hooks, etc. for damage and lifting capability before use.

Personal injury, death, and/or equipment damage could occur if good lifting practices are not used.

APPLICATION AND REAPPLICATION

At the time of installation, the equipment received should have already been selected for the service required. You must read the paperwork for the installation and check the serial number of the pump to assure that you are installing the correct pump into the service for which it was selected.

Many pumps look identical from the outside but can be made of different materials and/or be constructed differently inside. Personal injury, death, equipment damage, product (pumpage) damage, and/or product loss could occur if the incorrect pump is installed.

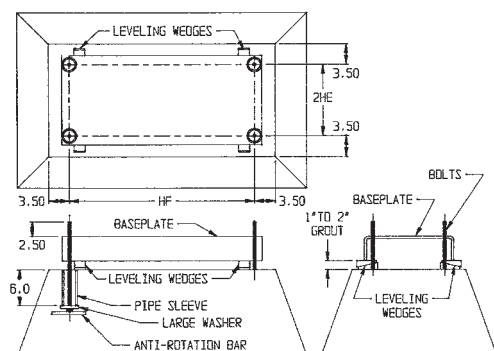
Do not transfer an existing pump to any other service conditions until you have thoroughly reviewed the pump construction, materials, sizing, sealing, pressure containing capability, head/capacity capability, and temperature capability with respect to the required service. Consult your Dean Pump sales engineer with all the service requirements and a full description of the existing pump (including the serial number), seal, and sub-systems so that we can assist you in a successful reapplication.

PUMP FOUNDATION

The pump foundation provides rigid support to the baseplate and maintains the exact alignment of the pumping unit. Baseplates are designed to rigidly support the pump and driver without vibration or distortion only when they are properly set, leveled, and secured to the foundation.

The purchaser may elect to mount the pump without grouting the baseplate. In any case the baseplate must be fully supported by the customer's mounting means to prevent vibration and distortion.

TYPICAL FOUNDATION LAYOUT



BASEPLATE MOUNTING AND ALIGNMENT

The sequence of mounting which must be observed for proper baseplate and pump mounting is:

- 1) Place baseplate, with pump and driver mounted thereon, on the pump foundation.
- 2) Use wedges under the baseplate edges, at each foundation bolt, to properly support and level the unit. Check this with a spirit level. Pull down the baseplate mounting bolt nuts tightly and recheck for level. Correct if necessary.
- 3) Align the driver to the pump. See **"Pump and Driver Alignment"** on page 5.
- 4) Grout the baseplate. **Do not grout the baseplate to the foundation until the pump and driver are correctly aligned.** Channel type baseplates are made with open ends to allow easy grouting and do not require grouting holes in the baseplate. Fabricated structural steel baseplates are provided with grouting holes. Fill the entire void under the baseplate with grout and firmly embed the baseplate edges.
- 5) Install "new" gaskets, of the correct material for the service, and the correct size per ASME B16.20, or ASME B16.21 at the suction and the discharge flanges of the pump. Use only new gaskets.

Connect the suction and discharge piping without forcing the piping into position. See **"Suction and Discharge Piping"** below. The pipe flanges must line up with the pump flanges "freely".

Install a "new" bolt, of the correct size per ASME/ANSI B16.5, and of the correct material per ASME/ANSI B16.5, in every bolt hole. Tighten all bolts evenly. Use only new uncorroded fasteners.

WARNING:

Strain caused by "forcing", improper flange bolting, and/or misalignment may cause failure of the pumping unit, flanges, piping and/or fluid (pumpage) release which could cause personal injury, death, and/or damage to this and/or other equipment.

WARNING:

Make sure that all piping is installed into its correct connection. Installation of a pipe into an incorrect location could result in an explosion and personal injury or death as well as damage to this and/or other equipment.

Install pressure relief valves in any cavities that could be subjected to pressures in excess of the allowable working pressure. Explosion, personal injury, death, and/or damage to this and/or other equipment may occur if pressure exceeds allowable.

- 6) Recheck the alignment between the driver (motor, turbine, or engine) and pump shafts. Installation of piping may have forced the pump out of alignment. If so, correct the piping to remove the distorting load, and realign the pump and driver..
- 7) The pump and driver alignment must again be checked at the operating temperature and alignment corrected under the hot condition.
- 8) After about two weeks of normal pump operation the pump and driver alignment should again be checked under the hot condition. If alignment is still correct, the driver feet may be doweled to the baseplate. If the alignment has changed, realign the unit and recheck after two weeks.

SUCTION AND DISCHARGE PIPING

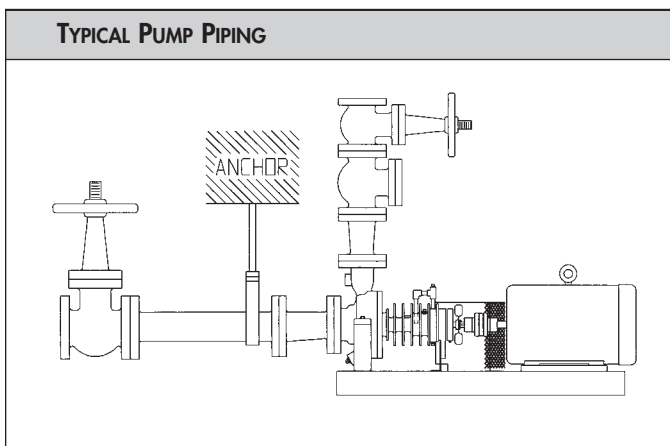
Suction and discharge nozzle sizes of Dean pumps are selected for proper performance of the pumping unit and are not intended to determine the suction and discharge pipe sizes. Pipe sizes must be determined by the user based on the system requirements.

Suction piping should have a minimum friction loss and thus should be as short and straight as possible with a pipe diameter as large as economically feasible for the flow rate handled.

Suction piping should never be smaller in diameter than the suction nozzle size. When the suction piping is larger than the suction nozzle size an eccentric reducer is required at the suction flange and must be installed with the taper located on the underside to eliminate air or vapor pockets. The section of piping attached to the suction flange of the pump should be straight for a length of eight pipe diameters or more.

Discharge piping may be the same size as, larger, or smaller than the discharge nozzle as the system flow may demand.

In new installations or rebuilt systems, dirt, pipe scale, welding slag, and general construction debris may get into the piping. It is important to prevent this material from entering the pump and damaging pump parts, bearings, mechanical seal faces, or lip seals. Bearings, mechanical seals and lip seals are especially subject to damage even by very small particles. To prevent damage, a strainer or filter installed in the suction line is recommended. Commercially available strainers or filters as recommended by their manufacturers can do an excellent job.



Suction line screens or strainers may usually be removed when, after several days of use, no dirt has been collected and the system is clean.

Remember that screens and filters in the suction line are restricting devices which reduce the net positive suction head (NPSH) available to the pump and should be considered at the time the system is designed.

PUMP AND DRIVER ALIGNMENT

Proper running life of a pump and driver unit depends on the accuracy with which the axis of the driver shaft coincides with the axis of the pump shaft when the unit is running. Although pumps and drivers are check aligned at the factory, this is only to confirm that the unit can be aligned in the field as handling during shipment and installation will cause the alignment to change. **The pump and driver alignment must always be checked and corrected before the baseplate is grouted to the foundation and again before the pump is first started.** If the baseplate mounting instructions have been carefully followed, no difficulties in making the alignment should be

experienced. **Failure to properly align the unit will result in vibration, short bearing life, and reduced mechanical seal life.**

Pumps are not constructed to be used as pipe anchors. Both suction and discharge piping must be supported independently of the pumping unit and thermal expansion joints provided to guard against expansion loads on the pump. Pipes should be anchored between the expansion joint and the pump and as closely to the pump as possible. Failure to provide proper piping support and expansion joints may impose strains on the pumping unit which will result in serious misalignment. Maximum allowable piping loads are shown on page 6 in this manual.

No allowance for thermal expansion is made for motor driven units in mounting the driver. Allowance for turbine mounting should be in accordance with the turbine manufacturer's recommendations.

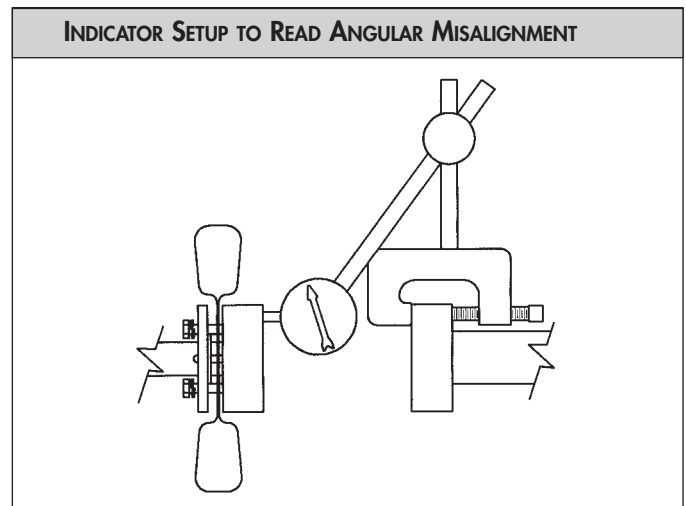
Final alignment must always be checked and corrected at the operating temperatures of the pump and driver.

Misalignment of the two shafts is of two kinds. The first of these is angular misalignment where the axis of one shaft is at an angle from the other. The other is offset alignment where the center of one shaft is offset from the center of the other shaft. These effects usually occur together so that both angular and offset misalignment are present.

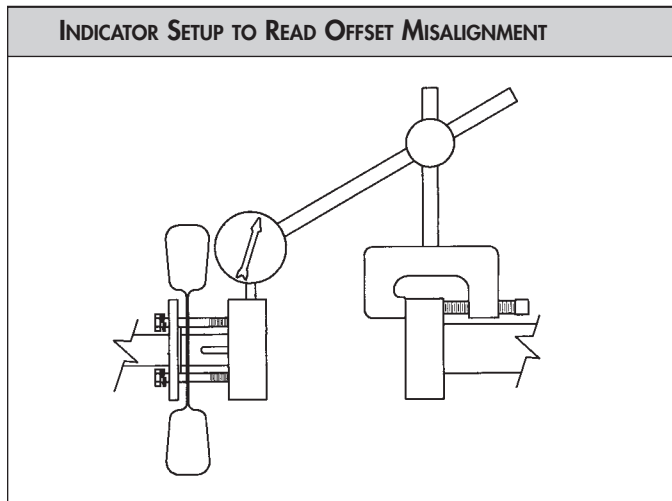
Coincident alignment of the driver and pump shaft is measured at the faces of the coupling hubs. Because of the variety of coupling types furnished at customer's request, the procedure here given is general in nature but may be applied by simple adaption to most coupling types.

The pump was shipped with the coupling spacer not installed, to allow alignment and motor rotation check. If, however, someone has installed this spacer assembly, remove it at this time. The RA2096 pumps are shipped with one of the coupling spacer flanges bolted to the pump hub to secure the cooling fan (Item #120) for shipping. Loosen the four bolts that are securing this flange and remove it.

To one of the coupling hubs, either on the motor shaft or the pump shaft, attach a dial indicator. Mount the indicator so that the indicator button rides on the face of the other coupling hub near the outside diameter of the hub. Reference the illustration "INDICATOR SETUP TO READ ANGULAR MISALIGNMENT" below. Rotate the shaft to which the dial indicator is clamped, allowing the indicator button to ride on the face of the stationary hub. The indicator dial movement will show the difference in the distance between the two hubs. This indicates the amount of angular misalignment between the hubs and therefore the shaft axes. Good practice suggest alignment to within 0.002" T.I.R. (Total Indicator Reading).



To check the offset alignment, mount the dial indicator as shown in the illustration "INDICATOR SETUP TO READ OFFSET MISALIGNMENT" below, with the indicator button on the outside diameter of the stationary hub, near the face of the hub closest to the end of the shaft. It may be necessary, on the RA2096 pumps, to slide the cooling fan (120) closer to the pump, to obtain enough clearance for the dial indicator, dependent of course upon the type of indicator used. If necessary, the fan could be removed, and replaced after the motor alignment is completed. Rotate the shaft, to which the dial indicator is clamped, allowing the indicator button to ride on the outside diameter of the stationary coupling hub. The indicator dial movement will show the difference in the center locations of the two shafts. Good practice suggest alignment to within 0.002" T.I.R.

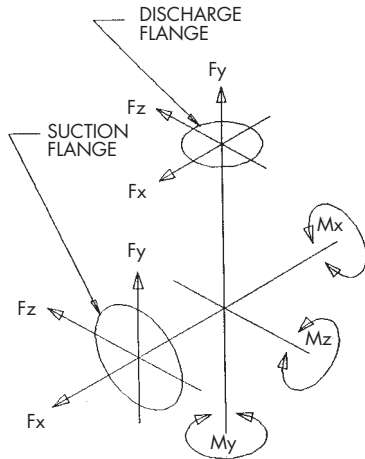


Angular and offset alignment is adjusted by moving the motor side-ways and up and down to bring the motor into exact alignment with the bolted down pump. The motor is moved up and down by adding and removing thin metal shims between the motor feet and the baseplate. ***If misalignment is of major proportions, the baseplate has been improperly installed on the foundation and must be leveled before proceeding with alignment.***

After each change, it is necessary to recheck both angular and offset alignment of the coupling. After the pump and driver are aligned, tighten all hold-down bolts and then recheck alignment.

The closer the running alignment, the longer the running life will be.

ALLOWABLE PIPING LOADS FOR RA2096, RA3146 AND RA3186 PUMPS



MAXIMUM FORCES ON FLANGES

FOR SUCTION FLANGE

$$\begin{aligned} +/F_x &\leq 200 \text{ LBS./NOM.IN.} \leq 1.2W \\ +/F_y &\leq 130 \text{ LBS./NOM.IN.} \leq 0.6W \\ +/F_z &\leq 160 \text{ LBS./NOM.IN.} \leq 1.0W \\ F_r &= (F_y^2 + F_z^2)^{1/2} \leq 2000 \text{ LBS} \end{aligned}$$

FOR DISCHARGE FLANGE

$$\begin{aligned} +/F_x &\leq 160 \text{ LBS./NOM.IN.} \leq 1.3W \\ -F_y &\leq 200 \text{ LBS./NOM.IN.} \leq 1.2W \\ +F_y &\leq 100 \text{ LBS./NOM.IN.} \leq 0.5W \\ +/F_z &\leq 130 \text{ LBS./NOM.IN.} \leq 1.0W \\ F_r &= (F_x^2 + F_z^2)^{1/2} \leq 2000 \text{ LBS} \end{aligned}$$

WHERE

F = FORCE IN POUNDS

F_r = RESULTANT FORCE

W = WEIGHT OF PUMP ONLY, IN POUNDS

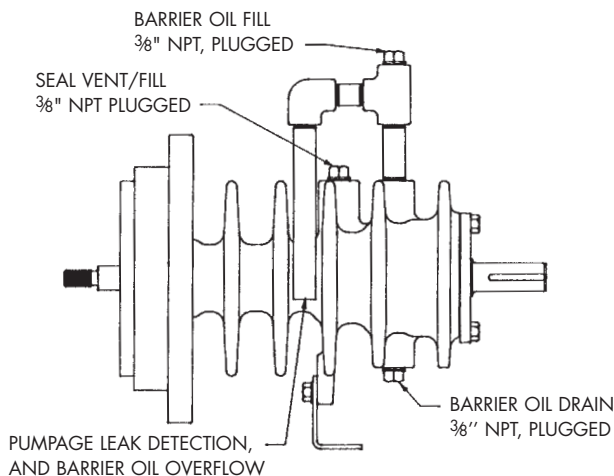
MAXIMUM MOMENTS APPLIED TO A PUMP ON A FULLY BOLTED AND GROUTED BASEPLATE. LOADS ARE TO BE APPLIED ONLY THROUGH THE SUCTION AND DISCHARGE FLANGES.

Pump Size	Wt.-Lbs. Pump Only	M_x Lb.Ft.	M_y Lb.Ft.	M_z Lb.Ft.
RA2096 1 x 1½ x 6	105	278	192	91
RA2096 1½ x 3 x 6	115	277	265	91
RA2096 1 x 1½ x 8	125	278	132	91
RA3146 1 x 3 x 8½	195	690	340	725
RA3146 1½ x 3 x 8½	220	690	340	725
RA3146 2 x 3 x 8½	245	690	340	725
RA3146 3 x 4 x 8½	270	725	295	600
RA3146 4 x 6 x 8½	310	785	320	600
RA3146 1½ x 3 x 10	240	760	310	600
RA3146 2 x 3 x 10	275	760	310	600
RA3146 3 x 4 x 10	305	830	340	600
RA3146 4 x 6 x 10 #2	345	950	340	600
RA3186 4x 6 x 10 #1	460	2300	1850	800

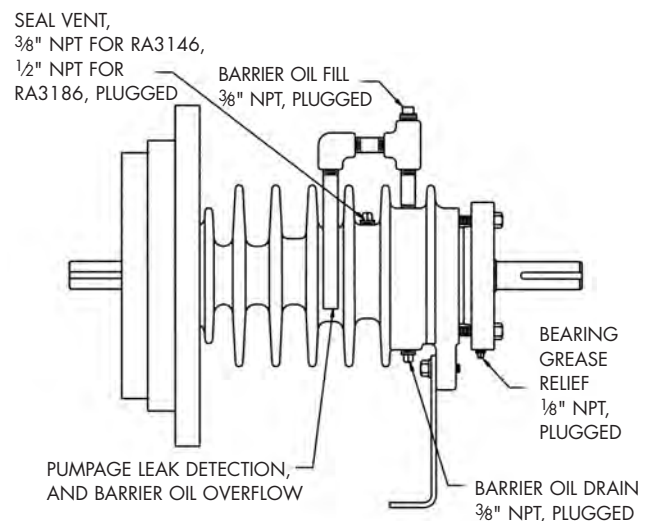
Maximum allowable forces and moments calculated from these force equations or the tabulated moment tables are those resulting in a maximum of .010 inch movement of the shaft measured at the shaft coupling when the pump is mounted on its baseplate and that baseplate is fully bolted to a properly designed foundation and is fully grouted in place. For a full discussion see API Standard 610, 5th Edition.

DATA SHEET #1198F

SMALL PIPING CONNECTIONS FOR "RA" PUMPS



RA2096



RA3146 AND RA3186

PUMP LUBRICATION

BEARINGS

The radial bearing (180) is lubricated by the liquid being pumped and therefore needs no external lubrication.

The thrust bearing(s) (25A) are grease packed "for life" and require no further lubrication until the pump is rebuilt.

The RA2096 uses a "sealed for life" bearing that is packed with grease by the ball bearing manufacturer.

The RA3146 and RA3186 have ball bearings that are hand packed as an assembly procedure when the pump is assembled. The grease is a lithium 12-hydroxystearate soap-thickened grease that has rust inhibitors and extreme pressure additives. This is a NLG1, Grade 2, similar to –

Shell Oil Company's "Alvania" Grease #EP2 or
Union Oil of California's "Unoba EP" Grease Grade 2

Grease is also available from Dean Pump in individual containers. One container is required for a RA3146 pump. Two containers are required for a RA3186 pump. Order "RA3000" Grease #2 for bearing lubrication.

MECHANICAL SEAL

The "RA" pumps are arranged with a mechanical face seal (95A and 95B) that was specifically selected for sealing the more commonly used heat transfer oils. Some of the heat transfer oils "oxidize". The manufacturer of any heat transfer oil that oxidizes will recommend that a nitrogen gas blanket be maintained on the expansion tank of the system to assure that oxygen cannot come in contact with the oil. The "RA" pumps have a cavity provided between the mechanical seal stationary (95A) and the front grease seal (76) to allow the use of a barrier fluid to keep oxygen away from the mechanical seal faces when operating with an oxidizing oil.

All "oils" will oxidize at some point depending upon the amount of air contamination and the temperature. Most "oils" will begin to oxidize at 250°F. Some "oils" will oxidize as low as 150°F. The oxidation rate doubles for every 18 to 20°F increase in temperature, so it is very important to not use a barrier fluid that has a low oxidation temperature. The user should check to see at what temperature his oil will start to oxidize.

When the oil being pumped is one that oxidizes, a barrier fluid should be used. Select a fluid to be used as the barrier fluid that is compatible with the pumpage and not detrimental to the lip seal, bearings, mechanical seal, or the bearing housing. The best fluid to use is nitrogen, but many customers prefer to use a liquid instead of a gas. Many oil companies produce a (barrier) oil that would be compatible with the oil being pumped, mechanical seal elastomers, lip seal, bearings, bearing grease, and the bearing housing. Two examples of this type of oil are Calflo AF (Petro-Canada) and Dowtherm RP (Dow Chemical). The user should check with his oil supplier for his recommendation for a non-oxidizing or low oxidizing oil to use as a barrier. Sometimes the oil being pumped can be used as the barrier fluid.

Since most of our customers are using a liquid as a barrier fluid, the pump is supplied with the barrier oil piping shown at the bottom of page 6.

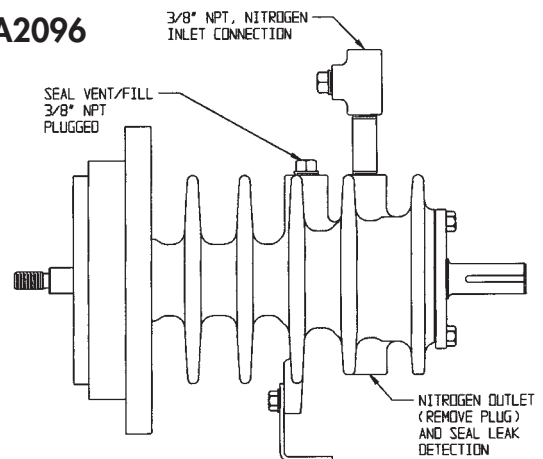
When using a liquid barrier fluid, the barrier cavity is filled through the pipe tee located directly above the cavity. Remove the 3/8" pipe plug (84) from the top of the tee (see the drawing at the bottom of page 6) and pour the barrier liquid into the tee until the liquid level is flush with the bottom of the pipe nipple that extends

horizontally out of the side of the tee. Any excess above this level will run out on to the baseplate. Rotate the shaft by hand (wear gloves for this operation) to help remove any trapped air pockets. Refill to previous level and replace the pipe plug (84).

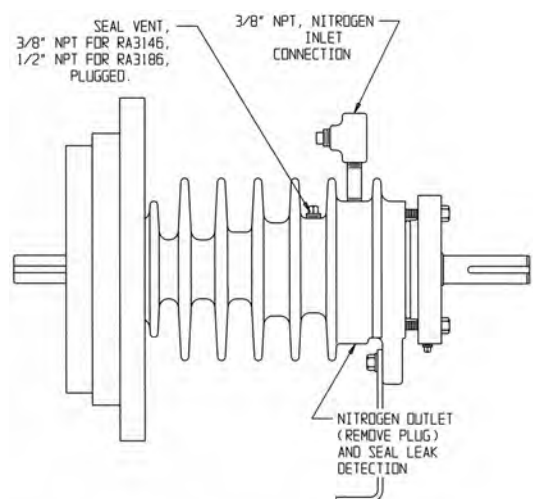
If nitrogen is to be used as the barrier fluid, the barrier piping must be modified, from that shown on page 6, to that shown below. Remove the vertical overflow pipe nipple, the 3/8" pipe elbow, and the horizontal pipe nipple connecting the pipe elbow to the pipe tee. Discard these parts. Move the pipe plug in the top of the pipe tee to the side connection of the pipe tee. Remove the 3/8" barrier oil drain plug from the bottom of the bearing housing, and discard it. Connect the nitrogen supply line to the top of the pipe tee and regulate the pressure to 1/4 P.S.I.G. maximum. The 3/8" connection at the bottom of the bearing housing will be left un-plugged to become an outlet for the nitrogen and serve as a leak detection in the event of mechanical seal failure.

PIPING MODIFICATION FOR NITROGEN BARRIER

RA2096



RA3146 AND RA3186



When pumping a heat transfer oil that does not oxidize, a barrier fluid is not needed. Modify the barrier piping as described above for the use of nitrogen except plug both of the connections in the pipe tee. A collection pan could be placed on the baseplate under this drain opening to collect any condensed vapors or leakage from the mechanical seal when the faces wear.

STARTING THE PUMP

It is important that a pump should never be subjected to thermal or pressure shock. The liquid should therefore be allowed to flow into the casing slowly. A centrifugal pump should never be started until all the parts are up to the temperature of the liquid to be pumped.

FILLING

WARNING:

Before filling the pump with liquid, check to see that all possible leak locations are sealed. See that all of the connections into the pressure containing cavity are sealed or connected to a related piping system that also has all possible leak paths sealed. Do not plug unused cavities, as this could develop dangerous pressure build-up. Use a wrench on all bolted joints to apply torque to assure that all gaskets are sealed in a tight joint. Check to see that all threaded pipe connections are also tight enough to seal the Liquid pressure that will be applied when the system is started.

WARNING:

Filling directions below refer to venting of "air" to the atmosphere, but dependent upon the physical properties of the liquid intended to be pumped, temperature, pressure, and other variables related to the system and its operational requirements, this may not be allowed by federal or local regulations, or may not be acceptable for whatever other reasons. Consult your plant or corporate safety engineer for instruction on possible required procedures for the specific liquid, operating conditions and legal requirements.

When the source of the liquid to be pumped is below atmospheric pressure or located below the pump, the filling may be accomplished in any of several ways, three of which are listed below:

- 1) An exhauster may be connected to the discharge piping between the pump and the discharge isolation valve. With the discharge isolation valve closed and the suction valve open, the air can be exhausted from the pump and the suction piping. When all the air has been removed, close the suction valve, remove the exhauster, plug the access port where the exhauster was connected, and then open the discharge valve. Remove the seal vent plug from the top of the bearing housing, refer to the drawings on page 6. Allow the air to flow from this port until the pumpage starts to flow. This could take considerable time dependent upon the viscosity of the pumpage. Fifteen to twenty minutes is not unusual, however some liquids may vent out in less than a minute. If the pump is a "RA2096" use a funnel and fill the seal cavity, through this connection with clean pumpage.
- 2) With a foot valve installed in the suction piping, the pump may be filled with pumpage introduced somewhere above the pump in the discharge piping. A foot valve may create extensive losses and therefore must be allowed for in calculating the available NPSH. When the pump is filled, plug the port through which you were filling. Remove the seal vent plug from the top of the bearing housing, refer to the drawings on page 6. Allow the air to flow from this port until the pumpage starts to flow. This could take considerable time dependent upon the viscosity of the pumpage. Fifteen to twenty minutes is not unusual, however some liquids may vent out in less than a minute. If the pump is a "RA2096", use a funnel and fill the seal cavity, through this connection with clean pumpage.
- 3) A vacuum pump (preferably a wet vacuum pump) may be used for evacuating air from the pump and piping. The vacuum pump should be connected as is the exhauster covered in No. 1 above and the procedure is the same.

When the source of the liquid to be pumped is above atmospheric pressure or above the pumps discharge flange, the pump may be filled by venting through a bleed-off line to atmosphere. When the source of the liquid is above the pumps discharge flange the venting could be back to the suction source, instead of to atmosphere. When all of the air has been expelled through the bleed-off, seal it. Remove the seal vent plug from the top of the bearing housing, refer to the drawings on page 6. Allow the air to flow from this connection until the pumpage starts to flow. This could take a considerable amount of time, dependent upon the viscosity of the pumpage. Fifteen to twenty minutes is not unusual, however some liquids may vent out in less than a minute. If the pump is a "RA2096", use a funnel to fill seal cavity, through this connection with clean pumpage.

It is most important to check the direction of rotation of the pump before allowing the pump to come up to speed. The pump was shipped with the coupling spacer not installed to allow alignment and motor rotation direction check. If, however, someone installed this spacer assembly, remove it at this time. To check rotation direction, push the starting button and instantly push the stop button. This will allow the motor to turn over a few revolutions and the direction of rotation to be observed. A direction of rotation arrow is shown on the front of the pump casing. If rotation is incorrect, change the wiring connections and recheck rotation. ***Operating the pump in reverse rotation may cause extensive damage.***

WARNING:

Lock-out the power to the driver (motor, turbine, engine, etc.) install the shaft coupling spacer. Be sure that you install all the retaining devices and bolts and that they are tight. Read and comply with the coupling manufacturer's instructions. Personal injury, death, and/or equipment damage could occur if the coupling spacer is not properly installed. Remove all debris and tools from the area near the shafts and the shaft coupling. Do this to assure that nothing is caught and thrown by the rotating parts when the pump is started. Bolt the coupling guard securely to the baseplate, checking to assure that it is not contacting any parts that will rotate when the pump is started.

OPERATING

WARNING:

Before starting the unit, see that all personnel are a safe distance away from all possible hazards, that all sub-systems are connected and operating, that all debris has been removed, that the shaft coupling guard is securely in place, and that the pump is full of liquid.

Do not operate this pump at shut-off (no flow) as an explosion may result. This can occur with any liquid, even "cold water". Personal injury, death, equipment damage, and/or loss of product (pumpage) is Likely to occur. If your system is operated where it is possible for all outlets of the discharge from the pump to be closed while the pump is still operating, a modification of the system needs to be made to assure a continual flow of pumpage through the pump. NOTE: Some people have a belief that a bypass line from the discharge side of the pump to the suction side of the pump will relieve this problem, this is "NOT TRUE"; DO NOT ATTEMPT THIS.

WARNING:

Do not operate a pump at a low flow condition, unless provision has been made to prevent dangerous heat build up within the pump casing. The liquid in the pump will heat up and this may result in high pressure in the pump in a short time. Such pressure may result in a rupture of the pressure-containing parts and cause severe hazard to personnel and/or damage to the system.

A centrifugal pump should never be run without liquid in the casing. Extensive damage may result, particularly to the bearing or the mechanical seal. Vent or fill the pump seal chamber through the seal vent connection to provide lubrication to the mechanical seal faces.

If the pump is a "RA3146" or a "RA3186", remove the bearing grease relief plug from the bottom of the bearing end cover (28). Replace the coupling guard and securely fasten it in place.

Make sure that the coupling guard is installed with the expanded metal section nearest the motor, as shown on the Sectional Assembly drawings on pages 11 and 12.

A centrifugal pump should be started with the suction valve fully open and the discharge valve opened a slight amount. Start the pump.

As soon as the pump is up to speed, the discharge valve must be opened slowly. A centrifugal pump cannot be operated with the discharge valve closed without heating up dangerously. During the first several minutes of operating watch the pump carefully for overheating, vibration, and other abnormal conditions. If trouble develops, stop the pump at once and correct the problem.

After thirty minutes of operation, stop the pump. If the pump is using a barrier fluid, check the level by removing the $\frac{3}{8}$ " pipe plug (84) from the pipe tee, and refill, if necessary, to a level flush with the bottom of the pipe nipple that extends horizontally out of the tee.

If a small amount of barrier oil has dropped from the barrier overflow pipe onto the baseplate, do not be concerned as this might occur with the initial heat expansion of the barrier liquid.

The barrier overflow pipe is also used to detect mechanical seal leakage. If, after the pump has run for a few hours at system temperature, oil starts to spill from this pipe, it is an indication of impending mechanical seal failure. The mechanical seal (95A and 95B) should be replaced before the leakage becomes excessive.

If the pump is a "RA3146" or a "RA3186", replace the grease relief plug into the bottom of the bearing end cover (28) and tighten to 7 ft. lb. Replace the coupling guard and securely fasten it in place.

Make sure that the coupling guard is installed with the expanded metal section nearest the motor, as shown on the Sectional Assembly drawings on pages 11 and 12.

Restart the pump.

PUMP START-UP CHECKLIST

These points must be checked after pump installation and before starting up the pump.

- 1) Read instruction manual thoroughly and understand it.
- 2) Review pump order head sheet for the service rating of the pump and any special features.
- 3) Check to see that the seal chamber has been vented.
- 4) Check all piping connections making certain that they are both tight and in the proper places. All piping includes the small piping described on pages 7 and 8.
- 5) Make sure that the baseplate has been properly installed.
- 6) Check to see that the motor is of the fan cooled type. A fan cooled motor is necessary for successful operation of the pump.
- 7) Check the electrical connections to the driver.
- 8) Break the coupling by removing the coupling spacer and bump the motor starting button to check motor rotation. Operating the pump in reverse rotation may cause extensive damage. If driver rotation is correct, replace the coupling spacer. If not, connect the wiring for proper rotation and recheck.
- 9) Check the coupling for proper alignment. Realign if necessary.
- 10) Check to see that the barrier fluid has been installed, if the barrier fluid is required for your operation.
- 11) Check to be sure that the pumpage leak detection connection is open for proper operation.
- 12) Rotate the pump shaft by hand to be sure that there is no binding or rubbing within the pump or driver. Wear heavy gloves to protect your hands. Correct any problems before proceeding.
- 13) Remove the bearing grease relief plug, if the pump is a RA3146 or a RA3186.
- 14) Remove all dirt, waste, tools, and construction debris from the area.
- 15) Check to see that the coupling guard is fastened securely in place.

SPARE PARTS

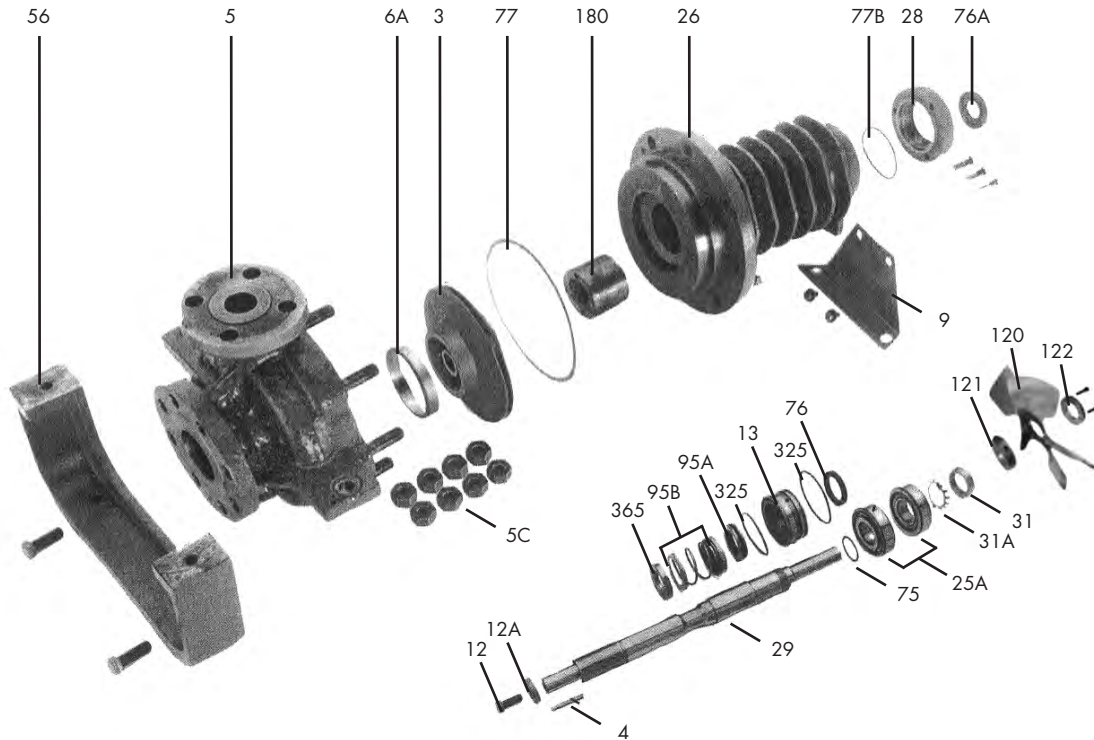
To avoid prolonged down time and facilitate rapid repair of damaged pump parts, Dean recommends that the pump user maintain a minimum stock of spare parts. If the pump service is critical, a spare parts stock is even more important to the user. Such spares inventory may extend from a spare mechanical seal through complete impeller-bearing housing assemblies prepared for immediate insertion in the pump casing. Consult your Dean representative who will assist you in selecting your spares stock.

ORDERING SPARE PARTS

Spare part orders will be handled with a minimum delay if the following information is furnished by the customer with the order:

- 1) Give the pump serial number and size. These may be found on the pump name plate. The serial number is also stamped on the suction flange of the pump.
- 2) Give the part name, part number, and material of part. These should agree with the standard parts list.
- 3) Give the quantity of each part required.
- 4) Give complete shipping instructions.

TYPE RA PUMP PARTS



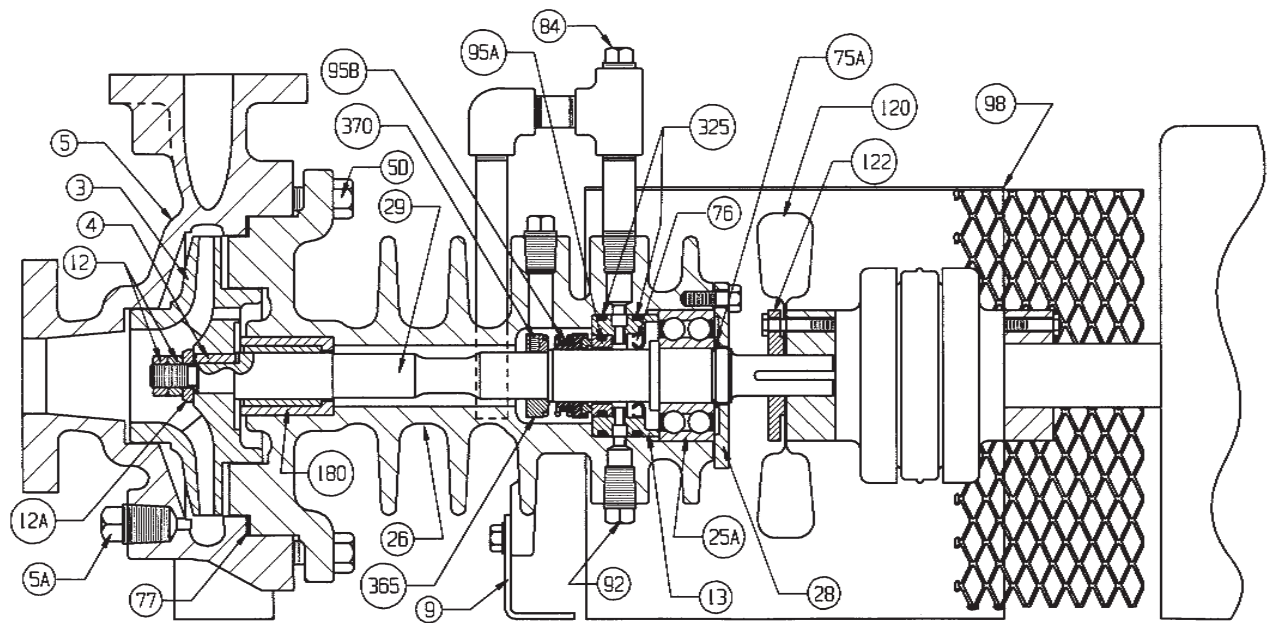
Part #	Part Name
3	Impeller
4*	Impeller Key
5	Casing
5A	Casing Drain Plug
5C	Casing Stud Nut (RA3146 & RA3186)
5D	Casing Stud (RA3146 & RA3186) Casing Capscrew (RA2096)
6A	Casing Ring (only some sizes)
9	Bearing Housing Foot
12*	Impeller Bolt (RA3146 & RA3186) Impeller Nut (RA2096)
12A*	Impeller Washer
13*	Mechanical Seal Gland
25A*	Thrust Bearing (Pair - RA3146 & RA3186) (Double - RA2096)

Part #	Part Name
26	Bearing Housing
28*	Bearing End Cover
29*	Pump Shaft
31*	Thrust Bearing Lock Nut (Only on RA3146 & RA3186)
31A*	Thrust Bearing Lock Washer (Only on RA3146 & RA3186)
56	Casing Foot (Only on RA3146 & RA3186)
75*	Snap Ring (Only on RA3146)
75A*	Snap Ring (Only on RA2096)
76*	Grease Seal - Front
76A*	Grease Seal - Rear (Only on RA3146 & RA3186)
77	Casing Gasket

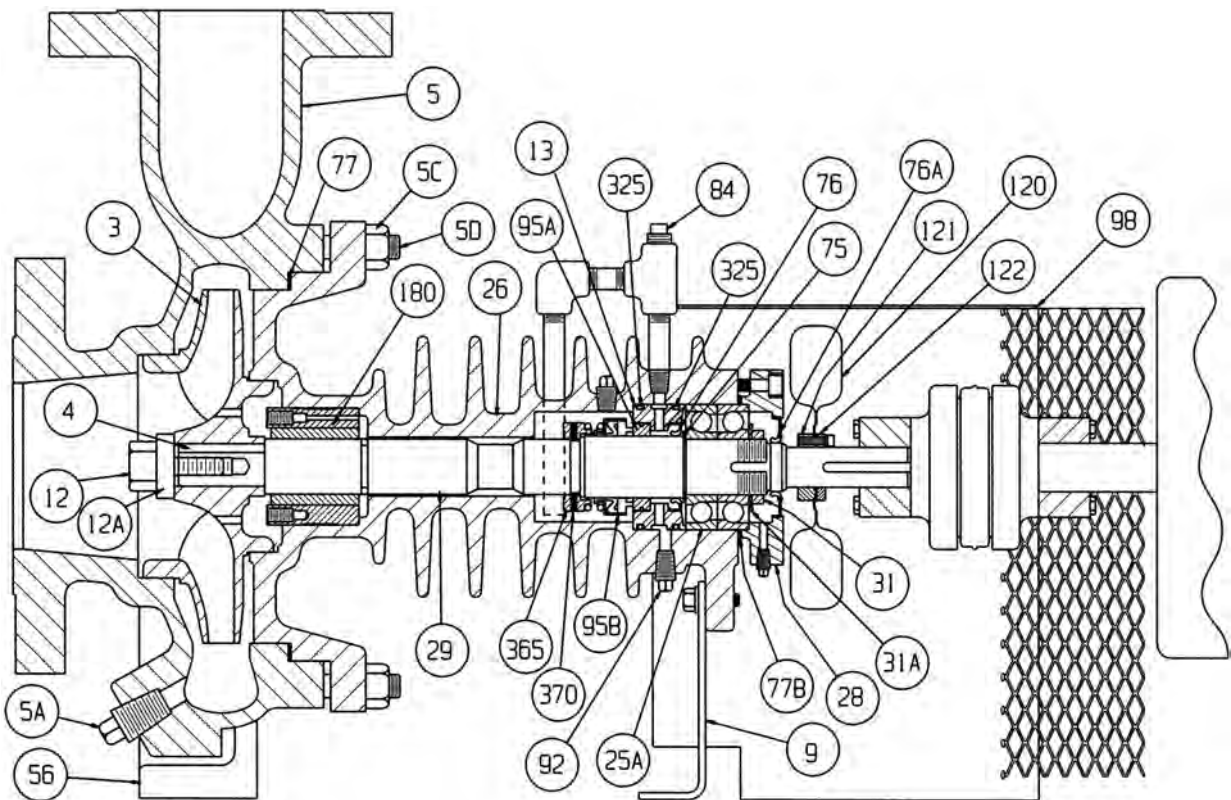
Part #	Part Name
77B*	Bearing End Cover Gasket (Only on RA3146 & RA3186)
84*	Barrier Fill Plug
92*	Barrier Drain Plug
95A*	Mechanical Seal Stationary
95B*	Mechanical Seal Rotary
98	Coupling Guard
120*	Fan
121*	Fan Collar (Only on RA3146 & RA3186)
122*	Fan Clamp Ring
180*	Radial Bearing Cartridge
325*	Seal Gland Gasket
365*	Seal Collar
370*	Collar Set Screw
375*	Anti-Rotation Pin (Only on RA3186)

* Denotes parts interchangeability in all pumps of the same series (i.e. RA2096, RA3146, or RA3186).

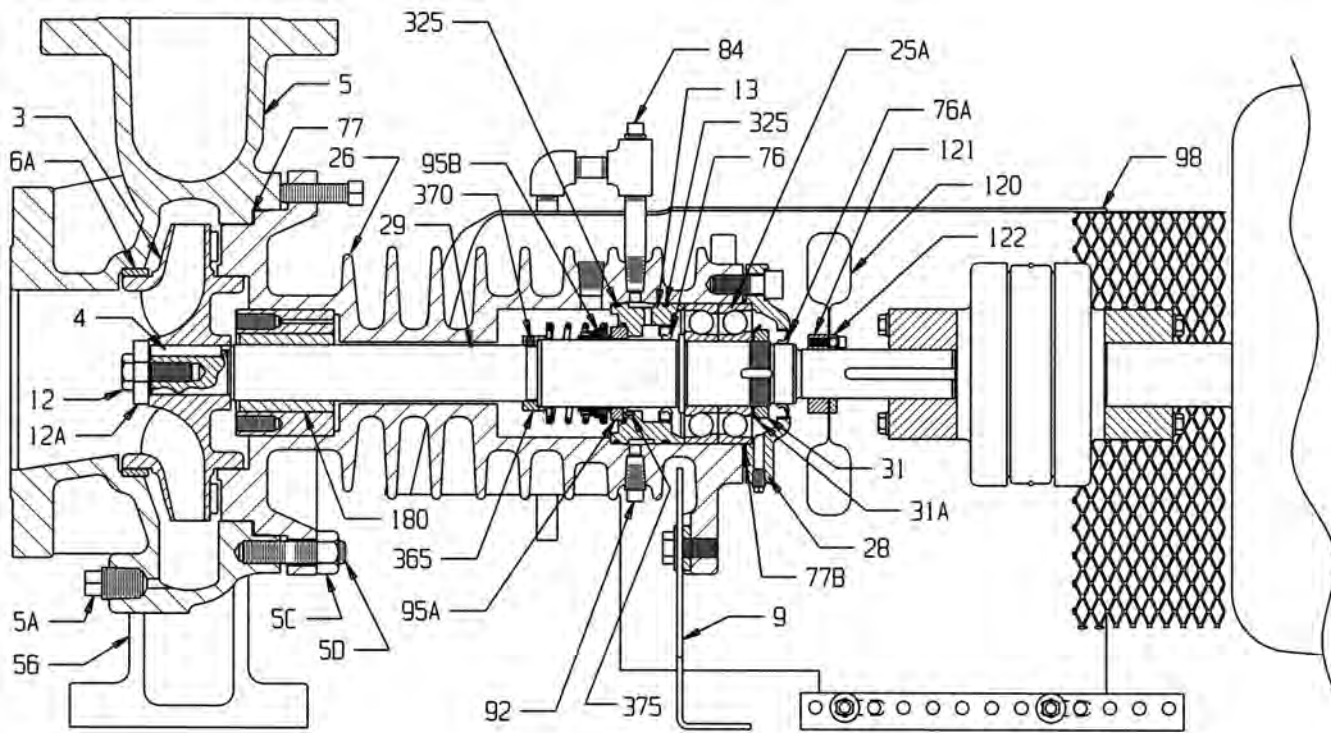
RA2096



RA3146



RA3186



DISASSEMBLY AND ASSEMBLY PROCEDURES

WARNING:

Work must be performed only by thoroughly trained and qualified personnel to assure quality repair and to reduce the possibilities of injury to personnel and/or damage to equipment. If you do not have personnel who are capable of safe quality repair of this equipment, we advise you to return the equipment to DEAN PUMP to be repaired.

When it is necessary to open the pump and/or the pumping system the fluid will be exposed to the atmosphere and personnel in the area. For the safety of all involved, the risk of exposure of personnel to the hazards of the pumpage can be reduced by flushing the entire system with a compatible, nontoxic, non-hazardous, stable fluid before opening the pump or the system. In all cases, where the system is flushed or not, use the utmost care around the pumpage and the pumping system.

Always wear the appropriate protective apparel when working on or around the pumping equipment. Safety glasses with side shields, heavy work gloves (use insulated work gloves when handling hot items), steel-toed shoes, hard hat, and any other protective gear as needed for protection. One example of other gear would be breathing apparatus when working near toxic materials.

Use only top quality tools.

- a) Stop the pump. Turn off the power supply (electricity) to the pump driver (motor) and lock the switching device so that it can not be restarted. Tag the switching device so that no one will attempt to restart the unit.
- b) Close the suction and discharge valves completely to isolate the pump from the system. Lock the valves in the closed position and tag them so that no one will attempt to open them.
- c) Turn off, lock out, and tag all sub-systems and auxiliary equipment and auxiliary supply lines to isolate the pumping unit from any and all power, energy, and/or fluids.

WARNING:

Do not attempt to perform any work on the unit until you are confident that the pump and its contents have been stabilized at ambient temperature, and atmospheric pressure.

Put on protective wear to protect human tissue from attack by the fluids contained in the pump and any sub-systems, and from any vapors or fumes that could possibly be released from these fluids. This could mean breathing apparatus, face shields, heavy long sleeve rubber gloves, rubber apron, hood, and possibly more, dependent, of course, on the properties of the fluids involved and the installed drain and vent piping arrangement. Personal injury and/or death can occur if adequate precautions are not taken with regard to the fluid, the installation and the possibilities of the release of fluid, vapors, and/or fumes.

- d) Remove the coupling guard. Remove the coupling spacer. Be careful to not bend the blades of the fan (120). If the pump is a RA2096, the removal of the spacer will also loosen the fan (120) from the face of the coupling hub.
- e) Drain all the fluids from all the auxiliary sub-systems (lubrication, cooling, heating, seal barrier, etc.) that are connected to the pump. Drain each fluid into a separate container. Use caution required for each fluid after reading the MSDS (Material Safety Data Sheet) for each.
- f) Flush each sub-system with a compatible, non-toxic, non-hazardous, stable liquid. Drain into individual containers for each fluid. Disconnect and remove all auxiliary piping.

- g) Carefully bleed off any pressure remaining in the pump. Pressure remaining in the pump will be dependent upon the pressure in the system when the pump was stopped; the quality, type, and condition of the isolation valves; the thermal expansion values of the fluid and the pump material; and the change in the vapor pressure of the fluid between the temperature at the time the isolation valves were closed and the ambient temperature. Bleeding must be through a valved drain line piped to a closed container mounted lower than the pump. The container must be arranged with a relief passage to some point where pressure and fumes will not be harmful to personnel. The container must also have a Level device so that determination can be made that sufficient fluid has been drained to empty the pump cavity and the volume of fluid that was contained in the run of suction and discharge pipe between the isolation valves and the pump. After the initial rush of fluid from the pump relieves the pressure, the drain valve can be opened further to speed the draining operation. When fluid quits running into the drain tank, gauge the volume to see if it is sufficient to have fully drained the contents of the pump and the suction and discharge pipes between the isolation valves.

If the system was constructed without any drain connections, it will be necessary to consult the designers of the system for safe draining procedures.

- h) Now drain any small piping, that contains the fluid pumped, from all low points into the same container used to drain the pump. Do not drain any other fluids (different than the pumpage) into this container as they may not be compatible. Personal injury, death, and/or equipment damage could occur.

WARNING:

Even though it might appear that the cavity being drained has completely drained, be extremely careful about opening the system and/or opening the pump. If something solid in the pumpage moves to the vicinity of the drain connection, it could seal-off the drain and maintain pressure in the cavity thought to have been drained. It is also possible that the isolation valves are not sealing and therefore allowing liquid to flow from the system into the pump. Personal injury, death and/or equipment damage may occur if great caution is not exercised.

- i) Remove the bolt(s) that retain the bearing housing foot (9) to the baseplate. Because of the above possibility, when you loosen the gasketed joint at the back of the casing (5), loosen the casing capscrews (5D) of the RA2096 or the casing nuts of the RA3146 or the RA3186, only one full turn. Then use jack-screws (two, 180° apart) through the flange of the bearing housing (26) to "break" the gasket seal. The bearing housing flange of the RA2096 and RA3146 pumps have tapped holes for 1/2"-13 UNC screws, the RA3186 has 5/8"-11 UNC. If fluid and/or pressure remains in the pump, it will spray out now. Use extreme caution, wearing protective gear, to avoid injury. Do not proceed with disassembly until leakage ceases completely. If leakage does not cease, the isolation valves may not be sealing. Note that if the pump was purchased without a drain, the pump will contain fluid which will flow out at the time the nuts or capscrews are loosened and the gasket seal is "broken".

WARNING:

When you open the pump, the fluid will be exposed to the atmosphere and personnel in the area. For the safety of all involved, the risk of exposure can be reduced by flushing the cavity that was just drained with a compatible, non-toxic, non-hazardous, stable liquid, before disassembling the pump.

- j) Remove the casing capscrews (5D) of the RA2096 or the casing nuts (5C) of the RA3146 or the RA3186, and using mechanical lifting apparatus to support the weight, pull the rotating unit from the casing (5). Un-screw the two jack-screws until they are not protruding through the "casing side" of the bearing housing (26) flange.
- k) Flush the wetted parts, now exposed, with a compatible, non-toxic, non-hazardous, stable liquid.
- l) Remove the gasket from the face of the casing (5) or the bearing housing (26) dependent on which one the gasket may have adhered to. The type of gasket and material of construction will vary with service requirements. Attack by prying and then, if necessary, layering off the old gasket with a sharp scraper, attempting to remove it in the largest possible pieces. Wear heavy Leather, long sleeve work gloves when using the scraper. Wet the gasket before and during the scraping operation to reduce the possibility of fibers becoming airborne. Wear a respirator during this operation and until all debris has been disposed of in a plastic bag. Remove all of the gasket material down to clean metal surfaces on both parts that contacted the gasket. Use care to not damage the metal faces. Place all of the gasket residue in a plastic bag, seal the bag and dispose.
- m) Inspect the inside of the casing (5) for any signs of wear, corrosion or any other damage. If the casing needs to be removed, remove the bolts from the suction and discharge flanges. Remove the bolts that hold the casing feet to the baseplate. The casing can now be removed. Remove the suction and discharge flange gaskets using the procedure as in paragraph "l" above.
- n) The rotating assembly of the pump can now be moved to a more convenient location for further disassembly. Use mechanical lifting equipment to move assemblies and components.

DISASSEMBLY PROCEDURE

To further dismantle the pump, perform the following steps in the sequence shown:

WARNING:

Use only high quality tools.

Obtain MSDS data sheets for all liquids (from the manufacturers of those liquids) being used with the pump, and heed all cautions.

Flush parts as disassembled to remove hazardous residue from the pumpage and/or sub-system fluids.

Wear protective equipment as advised at the beginning of this section.

Use mechanical lifting equipment to lift assemblies and components.

Do not apply heat to parts to assist in disassembly. Explosion could occur causing personal injury, death, and/or damage to equipment.

Do not attempt to drill, saw or otherwise cut parts to remove them. Explosion and/or fuming could occur causing personal injury, death, and/or equipment damage.

Do not hammer on any parts. Personal injury and/or damage to equipment may occur.

- a) Remove the impeller nuts (12) of the RA2096 or the impeller bolt (12) of the RA3146 or the RA3186 (all have right hand threads) while holding the pump shaft (29) against rotation with a wrench on the flats of the coupling hub. When loosening the impeller nuts (12) of the RA2096, be sure to loosen the

outer nut and remove it, before loosening the nut that is closest to the impeller (3). Remove the impeller retaining washer (12A). Slide the impeller (3) off the shaft (29). Remove the impeller key (4) from the shaft (29).

- b) Remove the coupling hub from the pump shaft (29) by loosening the set screws and using a gear puller to pull the hub from the shaft. Do not hammer on the coupling hub or the shaft. Remove the coupling key. Be careful to not bend the blades of the fan (120).
- c) Remove the fan (120) from the pump shaft (29). If the pump is a RA2096, slide the fan (120) and the fan clamp ring (122) off of the end of the pump shaft (29). If the pump is a RA3146 or a RA3186, loosen the radially positioned securing screw in the side of the fan collar (121) and slide the fan (120), fan collar (121), fan clamp ring (122) assembly off the end of the pump shaft (29). If this assembly resists removal, loosen the two axially positioned screws that hold these parts together.

WARNING: Wear gloves when removing the fan (120) to protect your hands as the fan is made of thin metal and could cut you.

- d) Remove the bearing end cover (28) from the bearing housing. Remove bearing end cover gasket (77B) if pump is a RA3146 or RA3186.
- e) Press the grease seal (76A) from the bearing end cover (28), if the pump is an RA3146 or a RA3186.
- f) Pull the pump shaft (29) from the bearing housing (26), using care to keep the shaft in line with the bearing housing so as not to damage any parts. Wear heavy work gloves. Compression of the mechanical seal spring will be detected during this operation.
- g) Remove the set screws (370) from the mechanical seal collar (365) and then slide it from the shaft (29). Slide the mechanical seal rotary (95B) from the shaft (29). It may take a considerable amount of force to remove the rotary (95B) as the elastomeric shaft sealing element may grip the shaft quite tightly.
- h) Remove the mechanical seal gland (13) from the shaft. Remove the seal gland gaskets (325) from the seal gland (13). Remove the mechanical seal stationary (95A) from the mechanical seal gland (13). If the pump is a RA3186, remove the "mechanical seal stationary O ring" from the inside of the mechanical seal gland (13).
- i) Remove the grease seal (76) from the seal gland (13). This can be removed by inserting a screw driver or a small drive pin punch into the open side of the seal and driving it out of the seal gland.
- j) If the pump is a RA2096, remove the snap ring (75A) from the pump shaft (29). If the pump is a RA3146 or a RA3186, bend the tab of the bearing lock washer (31A) out of the slot in the bearing lock nut (31). Remove the bearing lock nut and the bearing lock washer from the pump shaft (29). Press the thrust bearing(s) (25A) from the pump shaft. Exercise care to push only on the inner race of the bearings. Do not press on the shaft snap ring (75) of the RA3146. Do not hammer on the bearing(s) or the shaft in any manner as this may result in damage to the shaft. Remove the snap ring (75) from the pump shaft of the RA3146, only if it is damaged.
- k) Press or drive the bearing cartridge (180) from the bearing housing (26).
 - 1) RA2096 procedure:
Use a 1 1/4" diameter bar, 12" long, cut square on the ends. Insert the bar into the coupling end of the bearing housing (26) until it stops against the bearing cartridge

(180). Use a hydraulic press to press the bearing cartridge (180) from the bearing housing (26).

2) RA3146 procedure:

The bearing cartridge (180) has two $\frac{3}{8}$ "-16 UNC tapped holes that are accessible from the impeller end of the bearing housing. Securely bolt a $\frac{1}{2}$ " Class 300 flange to the cartridge, using washers on the bolts. Use a 14" long piece of 1" pipe ($1\frac{5}{16}$ " outside diameter), cut square on the ends, to reach down through the bearing housing (26) to press the bearing cartridge out.

3) RA3186 procedure:

The bearing cartridge (180) has two $\frac{1}{2}$ "-13 UNC tapped holes that are accessible from the impeller end of the bearing housing. Securely bolt a 1" Class 300 flange to the cartridge, using washers on the bolts. Use a 22" long piece of $1\frac{1}{4}$ " pipe ($1\frac{5}{8}$ " outside diameter), cut square on the ends, to reach down through the bearing housing (26) to press the bearing cartridge out.

l) Remove the seal vent plug from the top of the bearing housing (26) and discard it. The RA2096 and RA3146 pumps have a $\frac{3}{8}$ " plug and the RA3186 pumps have a $\frac{1}{2}$ " plug. Refer to the drawings on page 6.

m) If there is any reason to remove the bearing housing foot (9), it is secured by two bolts and located by a dowel pin.

REASSEMBLY PROCEDURE

WARNING:

Use only high quality tools.

Wear protective equipment as advised at the beginning of this section.

Use mechanical lifting equipment to lift assemblies and components.

Do not hammer on any parts. Personal injury and/or damage to equipment may occur.

Do not attempt to manufacture parts or modify Dean Pump parts in any manner. Death, personal injury, and/or damage to equipment may occur.

Replace all gaskets, seals, bearings, and lubricants. Replace all parts that have worn, corroded, eroded, or otherwise deteriorated.

Use only Dean Pump Division of Met-Pro Corporation parts.

To reassemble the pump, perform the following steps:

- Clean all parts, thoroughly inspect them, and replace where necessary. If the pump shaft (29) has two lip contact wear patterns (lip seal contact area) under the lip seal (76), replace the shaft. If the shaft is scored under the bearing (180), replace the shaft.
- Install a new seal vent plug into the top of the bearing housing (26), but do not apply any pipe sealant, and do not tighten the plug. The plug will need to be removed again later, for venting, when the pump is installed into the system. Refer to the drawings on page 6.
- Press a new bearing cartridge (180) into the bearing housing (26) until it seats firmly against the shoulder in the bearing housing. On the RA2096, install with the exposed carbon bearing face facing outward (see sectional assembly drawing). On the RA3146 and RA3186, install with the two tapped holes facing outward and the $\frac{1}{8}$ " diameter "through hole" positioned at the top of the bearing housing (see sectional assembly drawing). Use a press and a pad over the end of the bearing cartridge (180). Do not hammer on the bearing

cartridge; the bearing could be broken. If a press is not available, the bearing cartridge could be pulled into the bearing housing by using a piece of threaded rod through the bearing housing with a large washer and a nut on each end.

d) If the pump is a RA3146, install the snap ring (75) onto the pump shaft (29) insuring that it is securely into the snap ring groove.

e) If you are reinstalling a previously used pump shaft (29), inspect the shaft for wear under the grease seal(s) as directed in paragraphs h) and r) below. Press the thrust bearing(s) (25A) onto the pump shaft (29).

1) RA2096 procedure:

Press the thrust bearing (25A) onto the pump shaft (29) and firmly against the shaft shoulder. Do not hammer on the bearing or shaft in any manner as this will cause damage.

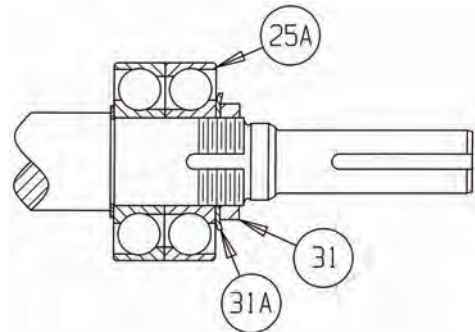
2) RA3146 procedure:

Press the thrust bearings (25A) onto the pump shaft (29) and firmly against the snap ring (75). The thrust bearings are angular-contact type, ground specifically for duplex mounting and must be assembled back-to-back (see the illustration below). Note the direction that the races of the bearing are mounted. Do not hammer on the bearings or shaft in any manner as this will cause damage.

3) RA3186 procedure:

Press the thrust bearings (25A) onto the pump shaft (29) and firmly against the shaft shoulder. The thrust bearings are angular-contact type, ground specifically for duplex mounting and must be assembled back-to-back (see the illustration below). Note the direction that the races of the bearing are mounted. Do not hammer on the bearings or shaft in any manner as this will cause damage.

THRUST BEARING POSITION - RA3146 AND RA3186



f) Secure the thrust bearing(s) (25A) to the pump shaft (29).

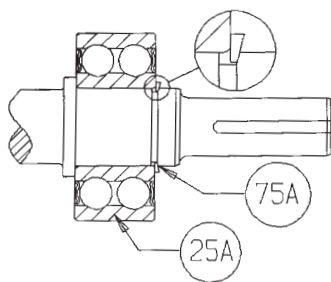
1) RA2096 procedure:

Install the bearing retaining snap ring (75A) with tapered side away from the bearing (see illustration on page 16).

2) RA3146 and RA3186 procedure:

Install a new bearing lock nut washer (31A). Install the bearing lock nut (31). Bend a tab of the bearing lock nut washer (31A) into an aligned slot of the bearing lock nut (31).

SNAP RING ORIENTATION - RA2096



g) Thrust bearing lubrication.

1) RA2096 procedure:

The thrust bearing (25A) of the RA2096 is already packed with grease and is sealed for life.

2) RA3146 and RA3186 procedure:

Pack the thrust bearings (25A) with grease.

The RA3146 requires 2.9 cubic inches of grease.

The RA3186 requires 6.8 cubic inches of grease.

Attempt to force all of the grease into the bearings. The grease must be a lithium 12-hydroxystearate soap thickened grease that has rust inhibitors and extreme pressure additives and must be a NLG1, Grade 2, similar to

Shell Oil Company's "Alvania" Grease #EP2 or

Union Oil of California's "UNOBA #EP" Grease Grade 2

Grease is also available from Dean Pump in individual containers, Order RA3000 Grease #2 for bearing lubrication. One container is required for each RA3146 pump. Two containers are required for each RA3186 pump.

h) Press a new grease seal (76) into the mechanical seal gland (13). Remove and discard the garter spring from a new grease seal (76). Install with the lip pointing towards the impeller end of the pump as shown in the pump sectional assembly drawing.

Inspect the shaft (29) when installing a used shaft (if the shaft has been used before): determine if there is one or two grease seal lip contact wear patterns (grease seal lip contact area). If two contact areas are present, the pump shaft needs replacing. If one contact area is present, stop pressing on the seal when the outside face of the seal is $\frac{1}{16}$ " above the face of the mechanical seal gland (13). If the pump shaft (29) is new, press the seal into the mechanical seal gland (13) until it is flush with the face of the mechanical seal gland.

i) Install new seal gland gaskets (325) into the mechanical seal gland (13). Lubricate the gaskets before installing, with an oil that is compatible with the liquid to be pumped, or with the pumped liquid itself.

j) Install a new mechanical seal stationary seat (95A) into the mechanical seal gland (13). If the pump is a RA2096 or a RA3146, be sure that there is an "O" ring installed in the groove in the outside diameter of the mechanical seal stationary seat (95A). If the pump is a RA3186, install the stationary seat "O" ring (the "O" ring is furnished with the mechanical seal stationary seat) into the groove in the bore of the mechanical seal gland (13). Install the mechanical seal stationary seat (95A) with the polished face away from the lip seal (76). Lubricate the "O" ring before installing the mechanical seal stationary seat (95A) into the seal gland (13). An oil compatible

with the liquid to be pumped, or the pumped liquid itself, should be used as a lubricant for the "O" ring.

k) Lubricate the area of the shaft over which the lip seal will slide, then carefully slide the mechanical seal gland (13) assembly over the shaft, so as not to damage the lip seal (76) nor the mechanical seal stationary seat (95A). Push the mechanical seal gland snugly against the thrust bearing (25A).

l) Lubricate the area of the shaft over which the mechanical seal rotary (95B) will slide. Carefully slide the mechanical seal rotary (95B) over the shaft (29) until it contacts the mechanical seal stationary (95A). **Do not damage the seal on any of the shaft shoulders.**

m) Slide the mechanical seal collar (365) carefully over the shaft (29) until it is firmly against the shaft shoulder and compressing the spring of the mechanical seal rotary (95B). Tighten the set screws while holding the seal collar (365) firmly against the shaft shoulder.

n) Lubricate the bore in the back of the bearing housing (26) so that the seal gland gaskets (325) will slide in without damage. Carefully slide the shaft assembly (29) into the bearing housing (26) from the bearing end cover end. Do not strike the carbon bearing (180) with the end of the pump shaft (29). Guide the mechanical seal gland (13) and the thrust bearings (25A) into the bearing housing (26) as the shaft assembly (29) is installed.

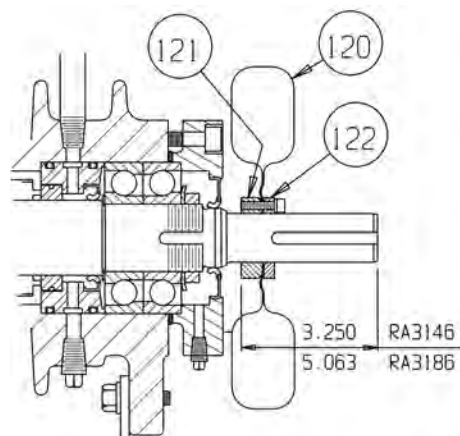
p) If the pump is a RA2096 go to step w.

q) Install a new end cover gasket (77B) over the thrust bearing (25A) and against the bearing housing (26).

r) Remove the garter spring from a new lip seal (76A) and discard it. Press the lip seal into the bearing end cover (28), from the bearing side, and up against the shoulder at the opposite side, when a new shaft is being used. If the pump shaft is not new, stop pressing on the lip seal $\frac{1}{16}$ " before it reaches the shoulder of the end cover, placing the sealing lip at a new location on the pump shaft (29).

s) Lubricate the pump shaft (29) at the diameter where the lip seal (76A) contacts. Apply any remaining grease from packing the thrust bearings (25A) around the exposed face of the bearings (25A). Place the end cover (28) carefully over the pump shaft (29) and the thrust bearing (25A), with the plugged hole towards the baseplate. Bolt the end cover (28) securely to the bearing housing (26). Torque the end cover bolts to 20 lb.ft. on the RA3146 and to 35 lb. ft. on the RA3186.

RA3146 AND RA3186 FAN LOCATIONS



- t) Mark (pencil or light scribe) a line on the pump shaft (29), $3\frac{1}{4}$ " for the RA3146 and $5\frac{1}{16}$ " for the RA3186, from the coupling end. Place the fan collar (121), grooved face first, onto the pump shaft and up to the "mark". Refer to the drawing on bottom of page 16. Tighten the fan collar locking screw tightly.

Place the fan (120), with the concave side of the blades towards the pump, over the end of the pump shaft (29) and up against the fan collar (121). The concave side of the fan blade was indicated with a label "PUMP SIDE" at the time it was shipped from the factory. Rotate the fan until the holes in the fan align with the tapped holes in the fan collar.

Place the fan clamp ring (122) over the end of the pump shaft (29) and up against the fan (120). Align the holes in the fan clamp ring with the holes in the fan and the holes in the fan collar (121).

Insert the two socket head bolts, with lock washers, through the fan clamp ring (122) and the fan (120), into the tapped holes of the fan collar (121) and tighten them securely.

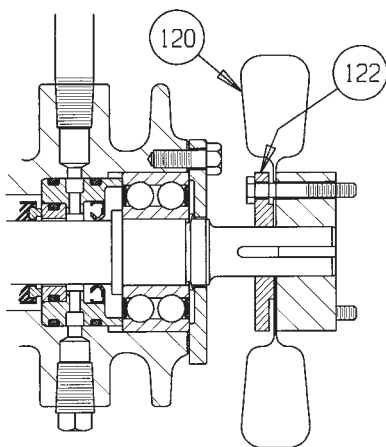
- u) Insert the coupling bolts through the lockwashers and the pump coupling hub. Place the hub onto the pump shaft (29), positioning the outer face of the hub flush with the end of the pump shaft. Install the coupling key and tighten the hub set screw(s).
- v) Go to step z).
- w) Place the end cover (28) carefully over the pump shaft (29) and bolt it securely into position against the bearing housing (26). Torque the end cover bolts to 11 lb.ft.
- x) Insert the four coupling bolts through the lockwashers and the fan clamp ring (122) from the side opposite of the raised face. The clamp ring is made to fit three different sizes of couplings, so you must insert the bolts into the holes that match the coupling hub that you are using. Slide the clamp ring onto the pump shaft (29) with the raised face facing the motor.

Place the fan (120), with the concave side of the blades towards the pump, over the end of the pump shaft, onto the coupling bolts and up against the clamp ring. Refer to the drawing below. The concave side of the fan blade was indicated with a label "PUMP

the key flush with the end of the pump shaft and the face of the hub. Tighten the hub set screw(s).

- z) Place the impeller key (4) into the keyway of the pump shaft (29). Carefully slide the impeller (3) onto the pump shaft (29).
- 1) If the pump is a RA2096, slide the impeller washer (12A) over the pump shaft (29) and against the impeller (3). Thread one of the impeller nuts (12) onto the pump shaft (29) and tighten it to a torque of 40 lb.ft. Thread the second impeller nut (12) onto the end of the pump shaft (29) and tighten it to a torque of 40 lb.ft. Hold the pump shaft (29), against the tightening torque, by placing a wrench on the flats of the coupling hub. Be careful to not bend the blades of the fan (120).
 - 2) If the pump is a RA3146 or a RA3186, Place the impeller washer (12A) on to the impeller bolt (12) and thread the impeller bolt (12) into the end of the pump shaft (29). Tighten the impeller bolt to a torque of 60 lb. ft. for the RA3146 and 100 lb. ft. for the RA3186. Hold the pump shaft, against the tightening torque, by placing a wrench on the flats of the coupling hub. Be careful to not bend the blades of the fan (120).
- aa) If the pump has a casing ring (6A), press it into the casing (5).
- ab) Carefully insert the bearing housing (26) assembly into the casing with a new casing gasket (77). Assure that the bearing housing (26) assembly is fully into the casing (5) and that the bearing housing foot (9) is in full contact with the baseplate. Tighten the casing capscrews (5D) or the casing stud nuts (5C) slowly and evenly so that the casing gasket will compress evenly. Torque the casing capscrews (5D) of the RA2096 pumps to 50 lb. ft. Torque the casing stud nuts (5C) of the RA3146 and RA3186 pumps to 105 lb. ft. if the studs are $\frac{3}{4}$ " and to 165 lb. ft. if the studs are $\frac{7}{8}$ ".
- ac) Rotate the pump shaft (29) by hand to check for interference. Wear heavy gloves when rotating the shaft, to protect your hands. Correct if any rubbing is detected.
- ad) If the casing (5) was removed from the baseplate, reattach it with bolts through the casing feet to the baseplate. Reattach the suction and discharge flanges, installing new gaskets.
- ae) Bolt the bearing housing foot to the baseplate. Rotate the pump shaft (29) again by hand to check for rubbing. Wear heavy gloves when rotating the shaft, to protect your hands. Correct if any rubbing is detected.
- af) Realign the pump and driver per instructions under "PUMP AND DRIVER ALIGNMENT".
- ag) Follow the instructions under "PUMP LUBRICATION", "STARTING THE PUMP", and "PUMP START UP CHECKLIST".

RA2096



SIDE" at the time it was shipped from the factory.

- y) Place the coupling hub over the end of the pump shaft (29) and onto the coupling bolts, until the face of the hub is flush with the end of the pump shaft. Install the coupling key, with the end of

CUSTOMER'S PLANT MAINTENANCE RECORD

Dean Pump Serial Number _____

Plant Property Number _____

Service _____

Location _____

Capacity _____ ; T.D.H. _____ ; Imp. Dia. _____ ; Temp. _____ ; RPM _____

Spare Parts in Plant Stock Room _____

Interchangeable with Dean Serial Numbers _____

NOTES

NOTES

A Met-Pro Fluid Handling Technologies Business
Combining the Resources of **Dean Pump, Fibroc & Sethco**

6040 Guion Road • Indianapolis, IN 46254

(317) 293-2930 • FAX: (317) 297-7028

E-mail: info@deanpump.com • Web Site: www.deanpump.com

READ WARNINGS

**HAZARDOUS SITUATIONS MAY OCCUR UNLESS THIS EQUIPMENT IS APPLIED, INSTALLED, OPERATED, AND MAINTAINED BY THOROUGHLY QUALIFIED PERSONNEL
IN STRICT ACCORDANCE WITH THE INSTRUCTION MANUAL AND ALL APPLICABLE DRAWINGS AND CODES.**

Read the instruction manual completely, before installing, filling, operating, or maintaining this equipment.

Obtain, read, and heed the MSDS (Material Safety Data Sheet) for the fluids being handled before attempting to fill, operate or maintain this equipment.

Obtain instructions from the Safety Engineer responsible for your facility before performing any work on the pumping equipment and systems.

APPLICATION AND REAPPLICATION - At the time of installation, the equipment received should have already been selected for the service required. You must read the paperwork for the installation and check serial number of the pump to assure that you are installing the correct pump into the service for which it was selected.

Many pumps look identical from the outside but can be made of different materials and/or be constructed differently inside. Personal injury, death, equipment damage, product (pumpage) damage, and/or product loss could occur if the incorrect pump is installed.

Do not transfer an existing pump to any other service conditions until you have thoroughly reviewed the pump construction, materials, sizing, sealing, pressure containing capability, head/capacity capability, and temperature capability with respect to the required service. Consult your DEAN PUMP sales engineer with all the service requirements and a full description of the existing pump (including the serial number), seal, and sub-systems so that we can assist you in a successful reapplication.

INSTALLATION - Always wear the appropriate protective apparel when working on or around the pumping equipment. Safety glasses with side shields, heavy work gloves (use insulated work gloves when handling hot items), steel toed shoes, hard hat, and any other protective gear as needed for protection. One example of other gear would be breathing apparatus when working near toxic materials.

Use lifting devices, manufactured expressly for the purpose of lifting, to move the pumping machinery. Do not attempt to lift the assembly or its components manually. Use only devices with lifting capabilities in excess of the weight of the unit being lifted. Inspect straps, chains, hooks, etc. for damage and lifting capability before use. Lift only at the center of gravity.

Personal injury, death, and/or equipment damage could occur if good lifting practices are not used.

Install the equipment on a properly designed and built foundation. Assure that the driver (motor, turbine, or engine) shaft is properly aligned to the pump shaft.

Connect the suction and discharge piping without forcing the piping into position. The pipe flanges must line up with the pump flanges "freely". Strain caused by "forcing" and/or misalignment may cause failure of the pumping unit, flanges, and/or the piping resulting in fluid (pumpage) release. This could cause personal injury, death and/or damage to this and/or other equipment.

Install a "new" bolt, of the correct size per ASME/ANSI B16.5 and the correct material per ASME/ANSI B16.5, in every bolt hole. Tighten all bolts evenly. Use only new uncorroded fasteners.

Improper flange bolting may cause failure of the pumping unit, flanges, piping, and/or fluid (pumpage) release which could cause personal injury, death, and/or damage to this and/or other equipment.

Connect all other (auxiliary) piping necessary for safe and successful operation of the equipment in the specific service conditions of the application. Make sure that all piping is installed into its correct connection. Installation of a pipe into an incorrect location could result in an explosion and personal injury or death as well as damage to this and/or other equipment.

Install pressure relief valves in any cavities that could be subjected to pressures in excess of the allowable working pressure of that cavity. Explosion, personal injury, death, and/or damage to this and/or other equipment may occur if pressure exceeds allowable.

Recheck the alignment between the driver (motor, turbine, or engine) and pump shafts. Installation of piping may have forced the pump out of alignment. If so, correct the piping to remove the distorting load.

Check to be certain that the shaft coupling spacer is not installed, and then gently bump the motor starter to check the rotational direction of the motor. If this is not in the direction of rotation required for the pump, make the necessary corrections.

Lock-out the power to the driver (motor, turbine, engine, etc.)

Install the shaft coupling spacer. Be sure that you install all the retaining devices and bolts and that they are tight. Read and comply with the coupling manufacturer's instructions. Personal injury, death, and/or equipment damage could occur if the coupling spacer is not properly installed. Remove all debris and tools from the area near the shafts and the shaft coupling. Do this to assure that nothing is caught and thrown by the rotating parts when the pump is started. Bolt the coupling guard securely to the baseplate, checking to assure that it is not contacting any parts that will rotate when the pump is started.

FILLING - Before filling the pump with liquid, check to see that all possible leak locations are sealed. See that all of the connections into the pressure containing cavity are sealed or connected to a related piping system that also has all possible leak paths sealed. Do not plug unused jacket cavities, as this could develop dangerous pressure build-up. Use a wrench on all bolted joints to apply torque to assure that all gaskets are sealed in a tight joint. Check to see that all threaded pipe connections are also tight enough to seal the liquid pressure that will be applied when the system is started.

OPERATING - Before starting the unit, see that all personnel are a safe distance away from all possible hazards, that all sub-systems are connected and operating, that all debris has been removed, that the shaft coupling guard is securely in place, and that the pump is full of liquid.

Do not operate this pump at shut-off (no flow) as an explosion may result. This can occur with any liquid, even "cold water". Personal injury, death, equipment damage, and/or loss of product (pumpage) is likely to occur. If your system is operated where it is possible for all outlets for the discharge from the pump to be closed while the pump is still operating, a modification of the system needs to be made to assure a continual flow of pumpage through the pump. Note that some people have a belief that a bypass line from the discharge side of the pump to the suction side of the pump will relieve this problem, this is "NOT TRUE"; DO NOT ATTEMPT THIS.

MAINTENANCE, DISASSEMBLY AND REPAIR - Work must be performed only by thoroughly trained and qualified personnel to assure quality repair and to reduce the possibilities of injury to personnel and/or damage to equipment. If you do not have personnel who are capable of safe quality repair of this equipment, we advise you to return the equipment to DEAN PUMP to be repaired.

When it is necessary to open the pump and/or the pumping system, the fluid will be exposed to the atmosphere and personnel in the area. For the safety of all involved, the risk of exposure of personnel to the hazards of the pumpage can be reduced by flushing the entire system with a compatible non-toxic, non-hazardous, stable liquid before opening the pump or the system. In all cases, where the system is flushed or not, use the utmost care around the pumpage and the pumping system.

Always wear the appropriate protective apparel when working on or around the pumping equipment. Safety glasses with side shields, heavy work gloves (use insulated work gloves when handling hot items), steel-toed shoes, hard hat, and any other protective gear as needed for protection. One example of other gear would be breathing apparatus when working near toxic materials.

Use only top quality tools.

Stop the pump. Turn off the power supply (electricity, steam, etc.) to the pump driver (motor, turbine, engine, etc.) and lock the switching device so that it cannot be restarted. Tag the switching device so that no one will attempt to restart the unit.

Close the suction and discharge valves completely to isolate the pump from the system. Lock the valves in the closed position and tag them so that no one will attempt to open them.

Turn off, lock out, and tag all sub-systems and auxiliary equipment and auxiliary supply lines to isolate the pumping unit from any and all power, energy, and/or fluids.

Do not attempt to perform any work on the unit until you are confident that the pump and its contents have been stabilized at ambient temperature, and atmospheric pressure.

Put on protective wear to protect human tissue from attack by the fluids contained in the pump and any sub-systems, and from any vapors or fumes that could possibly be released from these fluids. This could mean breathing apparatus, face shields, heavy long sleeve rubber gloves, rubber apron, hood, and possibly more, dependent of course on the properties of the fluids involved and the installed drain and vent piping arrangement. Personal injury and/or death can occur if adequate precautions are not taken with regard to the fluid, the installation, and the possibilities of the release of fluid, vapors, and/or fumes.

Remove the coupling guard. Remove the coupling spacer.

Drain all the fluids from the auxiliary sub-systems (lubrication, cooling, heating, seal barrier, etc.) that are connected to the pump. Drain each fluid into a separate container. Use caution required for each fluid after reading the MSDS (Material Safety Data Sheet) for each.

Flush each sub-system with a compatible, non-toxic, non-hazardous, stable liquid. Drain into individual containers for each fluid. Disconnect and remove all auxiliary piping.

Carefully bleed off any pressure remaining in the pump. Pressure remaining in the pump will be dependent upon the pressure in the system when the pump was stopped; the quality, type, and condition of the isolation valves; the thermal expansion valves of the fluid and the pump material; and the change in the vapor pressure of the fluid between the temperature at the time the isolation valves were closed and the ambient temperature. Bleeding must be through a valved drain line piped to a closed container mounted lower than the pump. The container must be arranged with a relief passage to some point where pressure and fumes will not be harmful to personnel. The container must also have a level device so that determination can be made that sufficient fluid has been drained to empty the pump cavity and the volume of fluid that was contained in the run of suction and discharge pipe between the isolation valves and the pump. After the initial rush of fluid from the pump relieves the pressure, the drain valve can be opened further to speed the draining operation. When fluid quits running into the drain tank, gauge the volume to see if it is sufficient to have fully drained the contents of the pump and the suction and discharge pipes between the isolation valves.

If the system was constructed without any drain connections, it will be necessary to consult the designers of the system for safe draining procedures.

Now drain any small piping, that contains the fluid pumped, from all low points, into the same container used to drain the pump. Do not drain any other fluids (different than the pumpage) into this container as they may not be compatible. Personal injury, death, and/or equipment damage could occur.

Even though it might appear that, the cavity being drained has completely drained, be extremely careful about opening the system and/or opening the pump. If something solid in the pumpage moves to the vicinity of the drain connection, it could seal-off the drain and maintain pressure in the cavity thought to have been drained. It is also possible that the isolation valves are not sealing and therefore allowing liquid to flow from the system into the pump. Personal injury, death, and/or equipment damage may occur if intense caution is not exercised.

Because of the above possibility, when you loosen the gasketed joint at the back of the casing (5), loosen the bolts or nuts only one full turn, and then use jack screws to break the gasket seal. If fluid and/or pressure remains in the pump, it will spray out now. Use extreme caution, wearing protective gear, to avoid injury. Do not proceed with disassembly until leakage ceases completely. If leakage does not cease, the isolation valves may not be sealing. Note that if the pump was purchased with out a drain, the pump will contain fluid which will flow out at the time the bolts are loosened and the gasket seal is broken.

When you open the pump, the fluid will be exposed to the atmosphere and personnel in the area. For the safety of all involved, the risk of exposure can be reduced by flushing the cavity that was just drained, with a compatible non-toxic, non-hazardous, stable liquid, before disassembling the pump.

Remove the casing bolts or nuts and using mechanical lifting apparatus to support the weight, pull the rotating unit from the casing.

Flush the wetted parts now exposed with compatible, non-toxic, non-hazardous, stable liquid.

Remove the gasket from the face of the casing (5) or the bearing housing (26) dependent on which one the gasket may have adhered to. The type of gasket and material of construction will vary with service requirements. Attack by prying and then, if necessary, layering off the old gasket with a sharp scraper, attempting to remove it in the largest possible pieces. Wear heavy leather, long sleeve work gloves when using the scraper. Wet the gasket before and during the scraping operation to reduce the possibility of fibers becoming airborne. Wear a respirator during this operation and until all debris has been disposed of in a plastic bag. Remove all of the gasket material down to clean metal surfaces on both parts that contacted the gasket. Place all of the gasket residue in a plastic bag, seal the bag and dispose of it in compliance with all government requirements.

The rotating assembly of the pump can now be moved to a more convenient location for further disassembly. Use only high quality tools. Flush parts as disassembled to removed hazardous residue from the pumpage and/or sub-system fluids.

Wear protective equipment as advised at the beginning of these warnings.

Use mechanical lifting equipment to lift assemblies and components.

Do not apply heat to parts to assist in disassembly. Explosion could occur causing personal injury, death, and/or damage to equipment.

Do not attempt to drill, saw, or otherwise cut parts to remove them. Explosion and/or fuming could occur causing personal injury, death, and/or equipment damage.

Do not hammer on any parts. Personal injury and/or damage to equipment may occur.

Do not attempt to manufacture parts or modify Dean Pump parts in any manner. Death, personal injury, and/or damage to equipment may occur.

One example of the above would be overboring the seal chamber, which removes metal that is required to contain fluids. Removal of this metal reduces the pressure containing capability of the part, and may create a leak path through the part.

Replace all gaskets, seals, bearings, and lubricants. Replace all parts that have worn, corroded, eroded, or otherwise deteriorated.

Use only Dean Pump Division of MetPro Corporation parts.