

# CECO Dean

## **SERIES RWA** Fan Cooled Hot Water Pumps

**I** NSTALLATION

**O** PERATION

**M** AINTENANCE **M** ANUAL



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

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## 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) Remove the vapor eliminator from the pipe tee into which it is mounted. Wrap and box the vapor eliminator and store it in a clean dry place.
- 2) Seal the suction opening of the pump with a blind flange, gasket, and bolts.
- 3) 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. Fill the pump until the liquid flows from the pipe tee from which the vapor eliminator was removed. Plug the top of the pipe tee with a NPT pipe plug.
- 4) Continue filling through the discharge opening until the pump is completely filled.

- 5) Seal the discharge opening with a blind flange, gasket, and bolts.
- 6) Remove the pumpage leak detection pipe from the bottom of the bearing housing. Apply pipe sealant to a  $\frac{3}{8}$ " NPT pipe plug, and tighten it into this opening. Save the pipe that was removed, so that it may be re-installed when the pump is placed into service.
- 7) Remove the gland vent plug from the top of the bearing housing and fill the gland cavity, through this opening, with a standard SAE 10 weight oil. When full, replace the  $\frac{3}{8}$ " NPT pipe plug.
- 8) 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.
- 9) Apply a heavy protective coating to all exposed machined surfaces. A rust preventive must be used to protect all steel and iron parts.
- 10) 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 plug that was installed into the pumpage leak detection connection. Drain and discard the storage liquid. Re-install the leak detection pipe. Be sure to comply with all governmental regulations in disposal of the storage liquid.
- 3) Remove and discard the discharge bolts, nuts, blind flange, and gasket. Remove the casing drain plug. Remove and discard, the NPT plug from the top connection of the pipe tee (into which the vapor eliminator mounts). 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 governmental 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.**

- 4) Replace the vapor eliminator. Place pipe sealant onto the threads of the pipe nipple, and tighten the vapor eliminator onto the top of the piping rising from the vent tee. Install the vapor exhaust tube into the connector on top of the vapor eliminator.
- 5) Replace the casing drain plug.

- 6) 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.

**RWA SERIES**

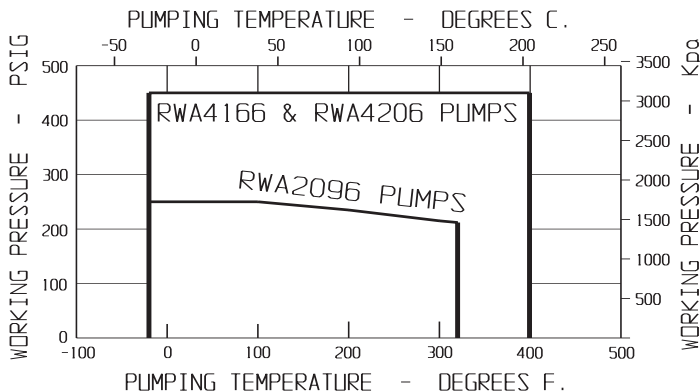
**FAN COOLED, HORIZONTAL, SINGLE STAGE, END SUCTION, ENCLOSED IMPELLER, CENTRIFUGAL, HOT WATER PUMPS. THESE PUMPS ARE DESIGNED SPECIFICALLY FOR USE WITH HOT WATER, ETHYLENE GLYCOL, PROPYLENE GLYCOL AND TRIETHYLENE GLYCOL. THESE PUMPS WILL NOT WORK ON OTHER LIQUIDS.**

**MECHANICAL DESIGN SPECIFICATIONS**

PUMP TYPE	RWA 2096	RWA 4166	RWA 4206
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	260 PSIG	260 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	5306 2RS Double Row	7308 BG Angular Contact Pair	7311 BG Angular Contact Pair
Radial Bearing, Sleeve Type, Pumpage Lubricated			
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" 2"	3 7/8" 4 5/16" 2 1/2"
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" 1 5/16" 3/4"	11 7/16" 2 5/16" 1 1/8" 1 9/16" 1 1/8"	14 5/8" 3 1/4" 1 5/8" 1 7/8" 1 1/2"
L <sup>3</sup> /D <sup>4</sup>	4.3	2.1	2.8
Material Class	(Ductile Iron)	(Ductile Iron)	(Ductile Iron)
Maximum Working Pressure	250 PSIG @100°F	450 PSIG	450 PSIG
Pumping Temperature Minimum Maximum	-20°F @ 250 PSIG 320°F @ 210 PSIG	-20°F	-20°F
Maximum Ambient Temperature (temp. within 12" of the pump)	118°F	118°F	118°F
Hydrostatic Test Pressure	430 PSIG	700 PSIG	700 PSIG

Seal chamber pressure equals pump suction pressure plus .06 x developed head.

**ALLOWABLE WORKING PRESSURE VS. PUMPING TEMPERATURE**



**STANDARD MATERIALS OF CONSTRUCTION**

Part No.	Part Name	RWA 2096 Class 22	RWA 4166 Class 22	RWA 4206 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)
*10	Shaft Sleeve	N.A.	316 S/S	316 S/S
*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 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	Teflon (11)	Teflon (11)	Teflon (11)
*77A	Sleeve Gasket	N.A.	Aflas	Aflas
*77B	Bearing End Cover Gasket	N.A.	Buna (14)	Buna (14)
*95A	Mechanical Seal Stationary	Silicon Carbide & Aflas	Silicon Carbide & Aflas	Silicon Carbide & Aflas
*95B	Mechanical Seal Rotary	S/S, Carbon, & Aflas	S/S, Carbon, & Aflas	S/S, Carbon, & Aflas
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	Aflas (13)	Aflas (13)	Aflas (13)
*370	Sleeve Set Screw	N.A.	18-8 S/S	18-8 S/S
*375	Anti-Rotation Pin	N.A.	N.A.	316 S/S

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

**MATERIAL SPECIFICATIONS (REFER TO NUMBERS IN PARENTHESES)**

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

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Teflon® is a registered Trademark of E. I. DuPont Co.

## 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.

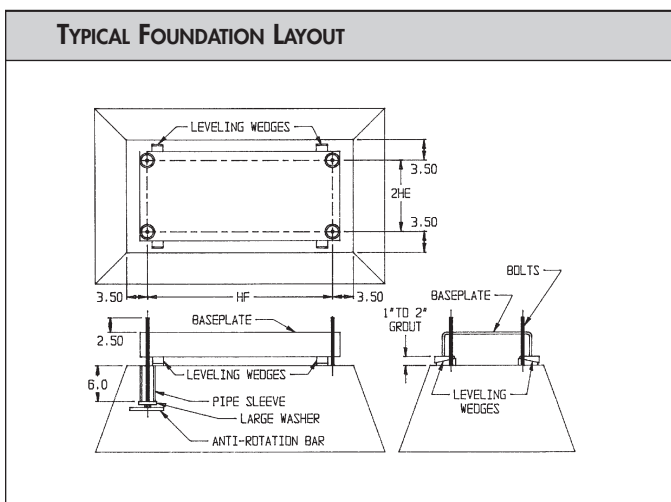
Many pumps look identical from the outside but can be made of different materials and/or be constructed differently inside. Personal injury, death, equipment damage, product (pumpage) damage, and/or product loss could occur if the incorrect pump is installed.

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.



### 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"** on page 5. The pipe flanges must line up with the pump flanges "freely".

Install a "new" bolt, of the correct size 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

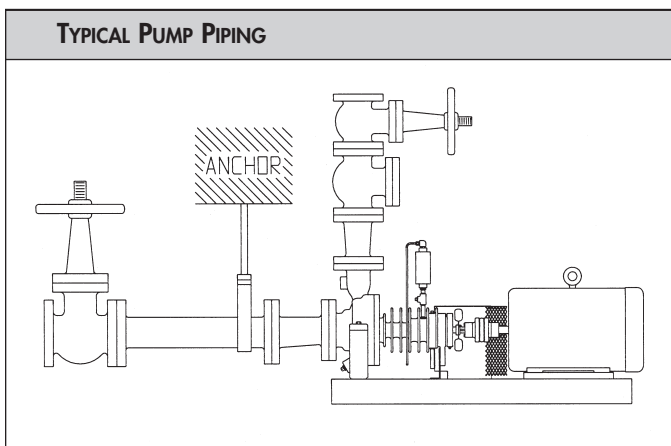
Suction and discharge nozzle sizes of Dean pumps are selected for proper performance of the pumping unit and are not intended to determine the suction and discharge pipe sizes. Pipe sizes must be determined by the user based on the system requirements.

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 7 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.

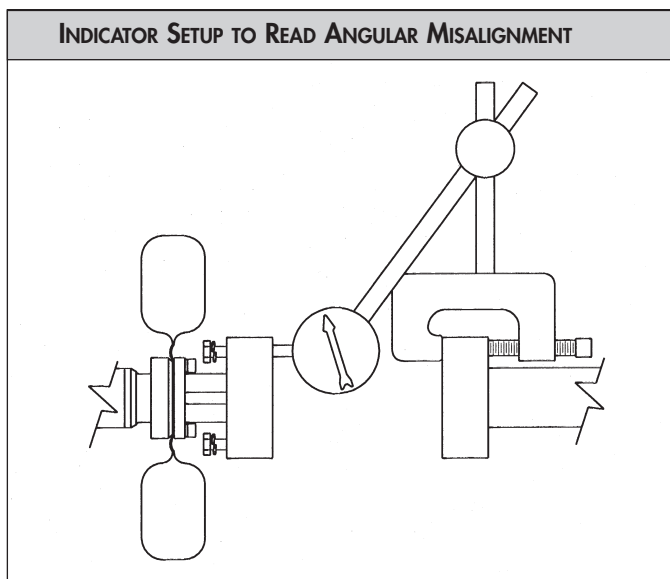
**Final alignment must always be checked and corrected at the operating temperatures of the pump and driver.**

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.

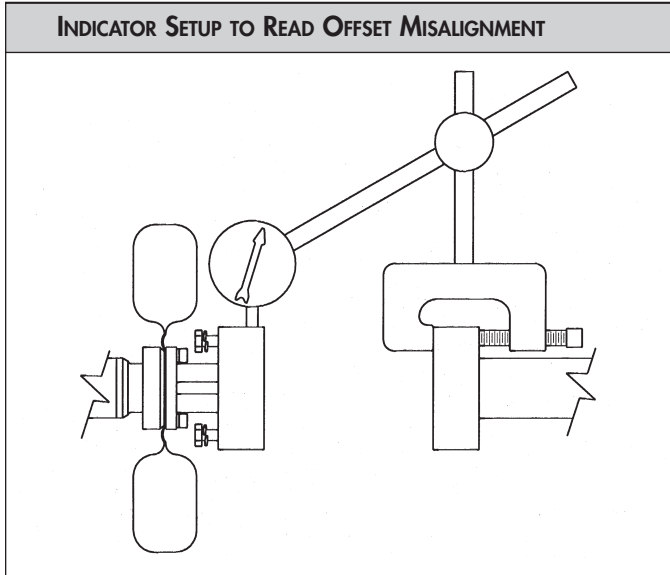
Coincident alignment of the driver and pump shaft is measured at the faces of the coupling hubs.

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.

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. 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 relevelled 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 RWA2096, RWA4166 AND RWA4206 PUMPS

## MAXIMUM FORCES ON FLANGES

### FOR SUCTION FLANGE

$$+/-F_x \leq 200 \text{ LBS./NOM.IN.} \leq 1.2W$$

$$+/-F_y \leq 130 \text{ LBS./NOM.IN.} \leq 0.6W$$

$$+/-F_z \leq 160 \text{ LBS./NOM.IN.} \leq 1.0W$$

$$F_r = (F_y^2 + F_z^2)^{1/2} \leq 2000 \text{ LBS}$$

### FOR DISCHARGE FLANGE

$$+/-F_x \leq 160 \text{ LBS./NOM.IN.} \leq 1.3W$$

$$-F_y \leq 200 \text{ LBS./NOM.IN.} \leq 1.2W$$

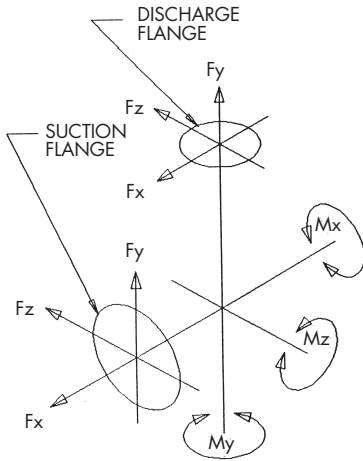
$$+F_y \leq 100 \text{ LBS./NOM.IN.} \leq 0.5W$$

$$+/-F_z \leq 130 \text{ LBS./NOM.IN.} \leq 1.0W$$

$$F_r = (F_x^2 + F_z^2)^{1/2} \leq 2000 \text{ LBS}$$

### WHERE

F = FORCE IN POUNDS  
 F<sub>r</sub> = RESULTANT FORCE  
 W = WEIGHT OF PUMP ONLY, IN POUNDS



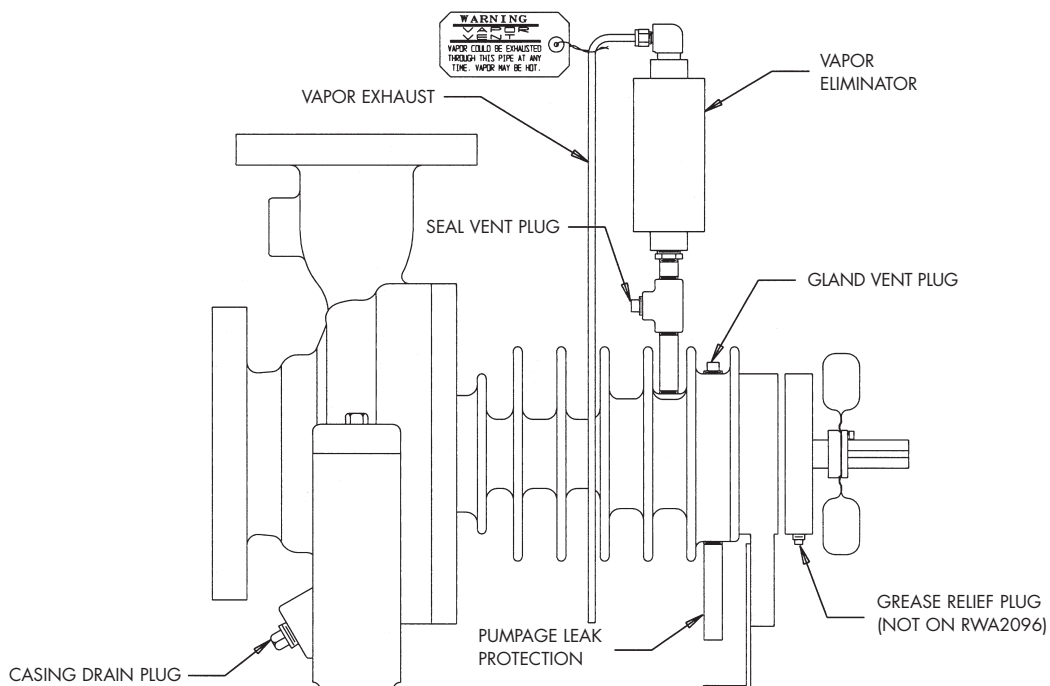
**MAXIMUM MOMENTS APPLIED TO A PUMP ON A FULLY BOLTED AND GROUTED BASEPLATE. LOADS ARE TO BE APPLIED ONLY THROUGH THE SUCTION AND DISCHARGE FLANGES.**

	Pump Size	Wt.-Lbs. Pump Only	M <sub>x</sub> lb. ft.	M <sub>y</sub> lb. ft.	M <sub>z</sub> lb. ft.
RWA2096	1X1½X6	105	278	192	91
RWA2096	1½X3X6	115	277	265	91
RWA2096	1X1½X8	125	278	132	91
RWA4166	1X3X8½	195	690	340	725
RWA4166	1½X3X8½	220	690	340	725
RWA4166	2X3X8½	245	690	340	725
RWA4166	3X4X8½	270	725	295	600
RWA4166	4X6X8½	310	785	320	600
RWA4166	1½X3X10	240	760	310	600
RWA4166	2X3X10	275	760	310	600
RWA4166	3X4X10	305	830	340	600
RWA4166	4X6X10#2	345	950	340	600
RWA4206	4X6X10#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, 5<sup>th</sup> Edition.

DATA SHEET #1198H

## SMALL PIPING CONNECTIONS FOR "RWA" PUMPS





## 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 RWA2096 uses a "sealed for life" bearing that is packed with grease by the ball bearing manufacturer.

The RWA4166 and RWA4206 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 NLGI, 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 RWA4166 pump. Two containers are required for a RWA4206 pump. Order "RA3000" Grease #2 for bearing lubrication.

### MECHANICAL SEAL

The "RWA" pumps are arranged with a mechanical face seal (95A and 95B) that was specifically selected for sealing hot water, hot solutions of ethylene glycol in water, hot solutions of propylene glycol in water, and hot solutions of triethylene glycol in water. The mechanical seal faces are lubricated by the liquid being pumped – it is therefore necessary to have liquid at the mechanical seal faces at all times. To accomplish this, the mechanical seal cavity of the pump must be vented when filling the pump with liquid (see FILLING below) to allow the seal cavity to also fill with liquid.

When operating, these liquids may vaporize at the seal faces, this vapor will be removed by the vapor eliminator mounted on the top of the pump.

#### **WARNING:**

***Vapor emitting from the vapor exhaust may be hot.***

## 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

The pump was shipped with the vapor eliminator and vapor exhaust tube not installed. Do not install these until so directed.

#### **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 the pumpage leak detection connection, this must be left open. 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 pipe cap from the top of the pipe rising from the pipe tee which also contains the seal vent plug, refer to the "Small Piping Connections" drawing on page 7. Discard the pipe cap. Allow the air to flow from this port until the pumpage starts to flow. This could take considerable time as the radial bearing clearance, through which the liquid must flow, is quite small. Several minutes is not unusual although sometimes it may vent in less than a minute. If the pump is a "RWA2096", use a funnel and fill the seal cavity through this connection with clean pumpage. Install the vapor eliminator assembly into the top of the pipe through which you were venting. Install the vapor exhaust tubing into the top of the vapor eliminator. Refer to the "Small Piping Connections" drawing on page 7.

At any time in the future, when the system is drained and the pump needs filling, follow the above procedure except remove the seal vent plug to vent the seal cavity and leave the vapor eliminator intact.

- 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 calculation of the available NPSH. When the pump is filled, plug the port through which you were filling. Remove the pipe cap from the top of the pipe rising from the pipe tee which also contains the seal vent plug (refer to the "Small Piping Connections" drawing on page 7). Discard the pipe cap. Allow the air to flow from this port until the pumpage starts to flow. This could take considerable time as the radial bearing clearance, through which the liquid must flow, is quite small. Several minutes is not unusual although sometimes it may vent in less than a minute. If the pump is a "RWA2096", use a funnel and fill the seal cavity through this connection with clean pumpage. Install the vapor eliminator assembly into the top of the pipe through which you were venting. Install the vapor exhaust tubing into the top of the vapor eliminator. Refer to the "Small Piping Connections" drawing on page 7.

At any time in the future, when the system is drained and the pump needs filling, follow the above procedure except remove the seal vent plug to vent the seal cavity and leave the vapor eliminator intact.

- 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 on page 8, 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 the atmosphere. When the source of the liquid is above the pump's discharge flange, the venting could be back to the suction source, instead of to the atmosphere. When all of the air has been expelled through the bleed-off, seal it. Remove the pipe cap from the top of the pipe rising from the pipe tee which also contains the seal vent plug (refer to the "Small Piping Connections" drawing on page 7). Discard the pipe cap. Allow the air to flow from this port until the pumpage starts to flow. This could take considerable time as the radial bearing clearance, through which the liquid must flow, is quite small. Several minutes is not unusual, although sometimes it may vent in less than a minute. If the pump is a "RWA2096", use a funnel and fill the seal cavity through this connection with clean pumpage. Install the vapor eliminator assembly into the top of the pipe through which you were venting. Install the vapor exhaust tubing into the top of the vapor eliminator. Refer to the "Small Piping Connections" drawing on page 7.

At any time in the future, when the system is drained and the pump needs filling, follow the above procedure except remove the seal vent plug to vent the seal cavity and leave the vapor eliminator intact.

**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 "RWA4166" or a "RWA4206", 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 page 11.

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.

If the pump is a "RWA4166" or a "RWA4206", stop the pump after about thirty minutes of operation, 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 page 11.

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 page 7.
  - 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 be sure that the pumpage leak detection connection is open for proper operation.
  - 11) 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.
  - 12) Remove the bearing grease relief plug, if the pump is a RWA4166 or a RWA4206.
  - 13) Remove all dirt, waste, tools, and construction debris from the area.
  - 14) 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.

Part #	Part Name
3	Impeller
4*	Impeller Key
5	Casing
5A	Casing Drain Plug
5C	Casing Stud Nut (RWA4166 & RWA4206)
5D	Casing Stud (RWA4166 & RWA4206) Casing Capscrew (RWA2096)
6A	Casing Ring (only some sizes)
9	Bearing Housing Foot
10*	Shaft Sleeve (RWA4166 & RWA4206)
12*	Impeller Bolt (RWA4166 & RWA4206) Impeller Nut (RWA2096)
12A*	Impeller Washer
13*	Mechanical Seal Gland
25A*	Thrust Bearing (Pair – RWA4166 & RWA4206) (Double – RWA2096)

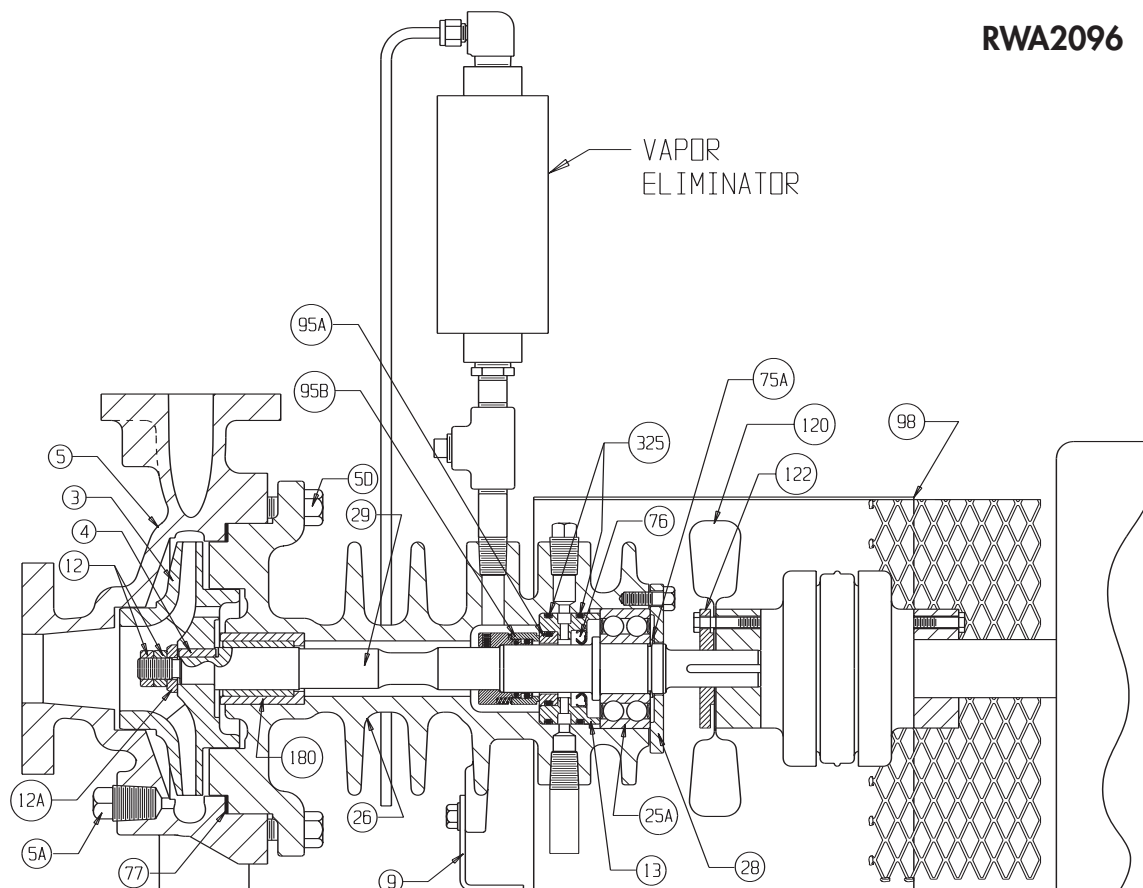
\* Denotes parts interchangeability in all pumps of the same series (i.e. RWA2096, RWA4166, or RWA4206)

Part #	Part Name
26	Bearing Housing
28*	Bearing End Cover
29*	Pump Shaft
31*	Thrust Bearing Lock Nut (Only on RWA4166 & RWA4206)
31A*	Thrust Bearing Lock Washer (Only on RWA4166 & RWA4206)
56	Casing Foot (Only on RWA4166 & RWA4206)
75*	Snap Ring (Only on RWA4166)
75A*	Snap Ring (Only on RWA2096)
76*	Grease Seal – Front
76A*	Grease Seal – Rear (Only on RWA4166 & RWA4206)
77	Casing Gasket

Part #	Part Name
77A*	Sleeve Gasket (Only on RWA4166 & RWA4206)
77B*	Bearing End Cover Gasket (Only on RWA4166 & RWA4206)
95A*	Mechanical Seal Stationary
95B*	Mechanical Seal Rotary
98	Coupling Guard
120*	Fan
121*	Fan Collar (Only on RWA4166 & RWA4206)
122*	Fan Clamp Ring
180*	Radial Bearing Cartridge
325*	Seal Gland Gasket
370*	Sleeve Set Screw (Only on RWA4166 & RWA4206)
375*	Anti-Rotation Pin (Only on RWA4206)

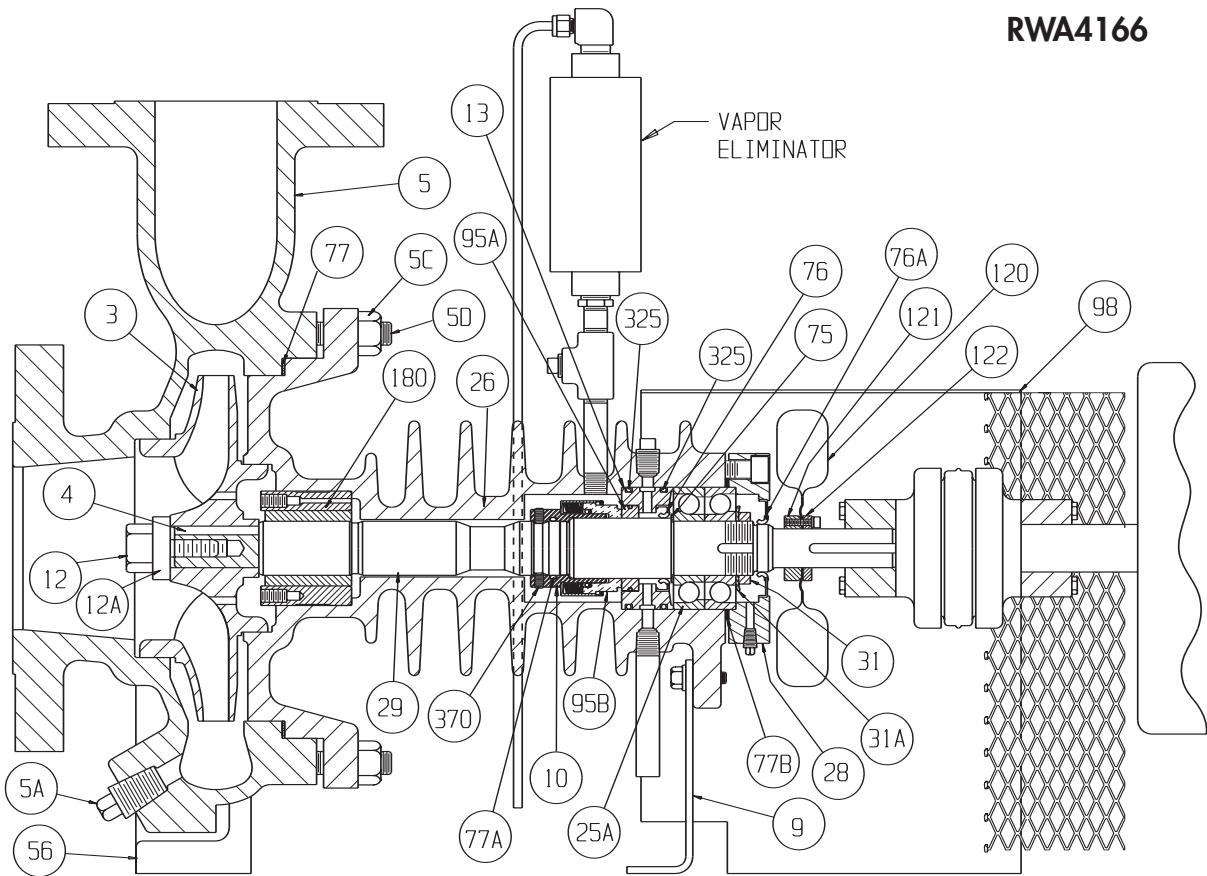
### SECTIONAL ASSEMBLY DRAWING – 01968

RWA2096



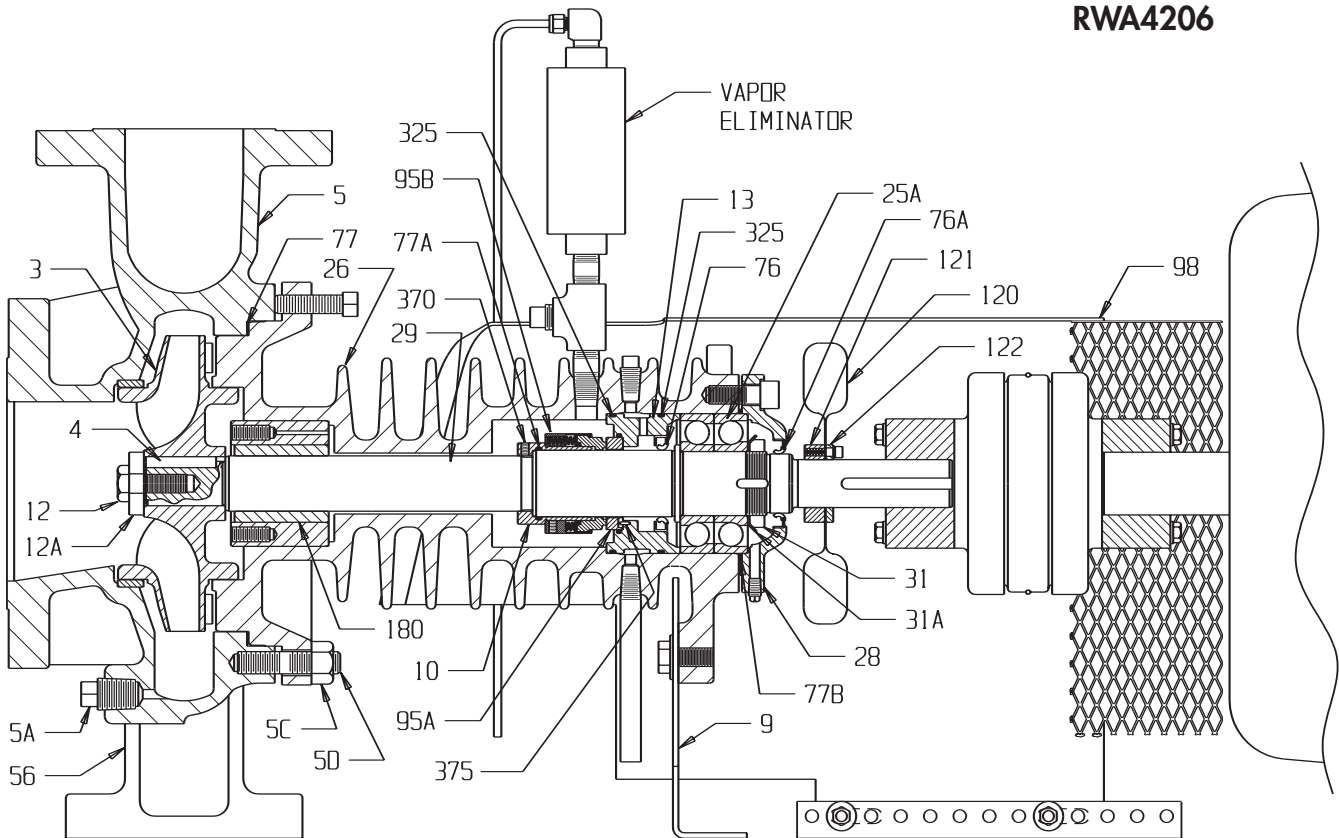
SECTIONAL ASSEMBLY DRAWING - 01964

RWA4166



SECTIONAL ASSEMBLY DRAWING - 01967

RWA4206



## DISASSEMBLY AND REASSEMBLY 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, non-toxic, 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 RWA2096, 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, 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.

- 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 RWA2096 or the casing nuts of the RWA4166 or the RWA4206, only one full turn. Then use jackscrews (two, 180° apart) through the flange of the bearing housing (26) to "break" the gasket seal. The bearing housing flange of the RWA2096 and RWA4166 pumps have tapped holes for 1/2" - 13 UNC screws, the RWA4206 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 vapor eliminator assembly (see “Small Piping Connections” on page 7). First, loosen the tubing nut at the top of the vapor eliminator and remove the vapor exhaust tube. Next, remove the vapor eliminator by breaking the pipe joint at the top connection of the pipe tee. There is no need to break any of the other piping connections.
  - k) Remove the casing capscrews (5D) of the RWA2096 or the casing nuts (5C) of the RWA4166 or the RWA4206, and using a mechanical lifting apparatus to support the weight, pull the rotating unit from the casing (5). Unscrew the two jackscrews until they are not protruding through the “casing side” of the bearing housing (26) flange.
  - l) Flush the wetted parts – now exposed – with a compatible, non-toxic, non-hazardous, stable liquid.
  - m) 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.
  - n) 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 “m” above.
  - o) 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.
- a) Remove the impeller nuts (12) of the RWA2096 or the impeller bolt (12) of the RWA4166 or the RWA4206 (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 RWA2096, 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 of 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 RWA2096, slide the fan (120) and the fan clamp ring (122) off the end of the pump shaft (29). If the pump is a RWA4166 or a RWA4206, 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 the bearing end cover gasket (77B), if the pump is a RWA4166 or RWA4206.
- e) Press the grease seal (76A) from the bearing end cover (28), if the pump is a RWA4166 or a RWA4206.
- 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 springs will be detected during this operation.
- g) Remove the mechanical seal rotary (95B) from the pump shaft (29).
  - 1) If the pump is a RWA2096, loosen the set screws that hold the mechanical seal rotary (95B) to the shaft, at least two full turns each. Use gloves to protect your hands and 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 “O” ring, between the rotary and the shaft (29) may be tight.
  - 2) If the pump is a RWA4166 or a RWA4206, loosen the set screws (370), in the shaft sleeve (10), at least two full revolutions each. Use gloves to protect your hands and slide the shaft sleeve (10) and the mechanical seal rotary (95B), as an assembly, from the pump shaft (29). It may take a considerable amount of force to remove these parts as the sleeve gasket (77A) is a “O” ring and may be tight on the shaft (29). Loosen the set screws, that hold the mechanical seal rotary (95B) to the sleeve (10), at least two full revolutions each. Slide the seal rotary (95B) from the sleeve (10). It may take a considerable amount of force to remove the rotary (95B) as the “O” ring between the rotary and the sleeve (10) may be tight.
- 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).

**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.***

If the pump is a RWA4206, remove the “mechanical seal stationary O ring” from the inside of the mechanical seal gland (13) and inspect the anti-rotation pin (375). If the pin needs to be replaced, pull it from the gland with a pair of pliers.

- i) Remove the grease seal (76) from the seal gland (13). This can be removed by inserting 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 RWA2096, remove the snap ring (75A) from the pump shaft (29). If the pump is a RWA4166 or a RWA4206, 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 RWA4166. 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 RWA4166, only if it is damaged.
- k) Press or drive the bearing cartridge (180) from the bearing housing (26).
  - 1) RWA2096 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) RWA4166 procedure:
 

The bearing cartridge (180) has two 3/8" - 16 UNC tapped holes that are acceptable from the impeller end of the bearing housing. Securely bolt a 1/2" Class 300 flange to the cartridge, using washers on the bolts. Use a 14" long piece of 1" pipe (1 5/16" outside diameter), cut square on the ends, to reach down through the bearing housing (26) to press the bearing cartridge out.
  - 3) RWA4206 procedure:
 

The bearing cartridge (180) has two 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 1/4" pipe (1 5/8" outside diameter), cut square on the ends, to reach down through the bearing housing (26) to press the bearing cartridge out.
- l) 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.*

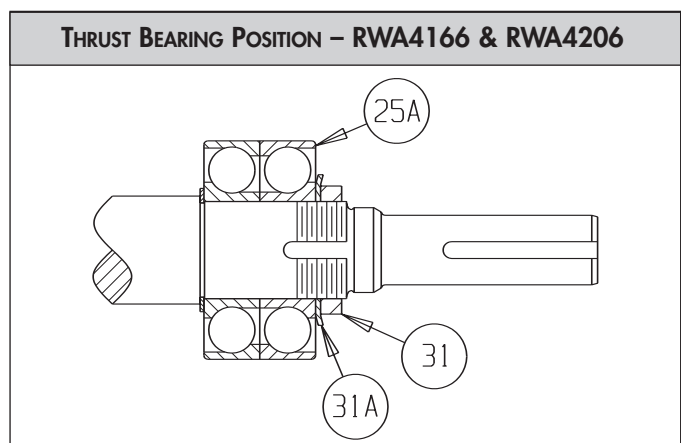
To reassemble the pump, perform the following steps:

- a) 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.
- b) Press a new bearing cartridge (180) into the bearing housing (26) until it seats firmly against the shoulder in the bearing housing. On the RWA2096 pump, install with the exposed carbon bearing face facing outward (see the sectional assembly drawing). On the RWA4166 and RWA4206 pumps, install with the two tapped holes facing outward and the 1/8" diameter “through hole” positioned at the top of the bearing housing (see the sectional assembly drawing). Use a press and a pad over the end of the bearing cartridge. 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.
- c) If the pump is a RWA4166, install the snap ring (75) into the pump shaft (29), insuring that it is securely into the snap ring groove.
- d) If you are reinstalling a previously used pump shaft (29), inspect it for wear under the grease seal(s) as directed in paragraphs g) and p) below. Also remove any scratches or burrs. Press the thrust bearing(s) (25A) onto the pump shaft (29).
  - 1) RWA2096 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) RWA4166 procedure:
 

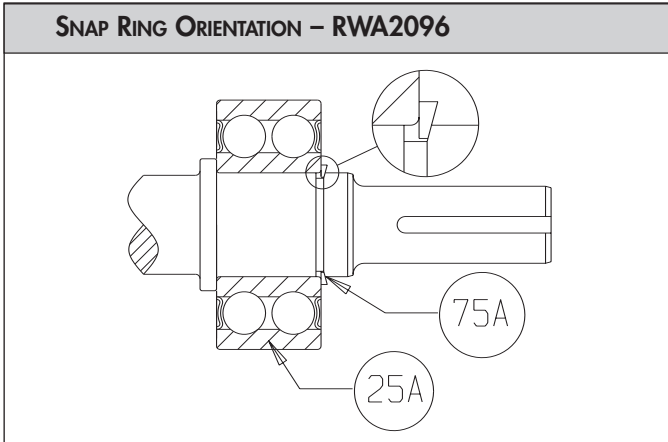
Press the thrust bearings (25A) onto the pump shaft (29) and firmly against the snap ring (75). The thrust bearings are angular-contact type, ground specifically for duplex mounting and must be assembled back-to-back (see the illustration below). Note the direction that the races of the bearing are mounted. Do not hammer on the bearings or shaft in any manner as this will cause damage.
  - 3) RWA4206 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.





- e) Secure the thrust bearing(s) (25A) to the pump shaft (29).
- 1) RWA2096 procedure:  
Install the bearing retaining snap ring (75A) with the tapered side away from the bearing (see the illustration below).
  - 2) RWA4166 and RWA4206 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).



- f) Thrust bearing lubrication:
- 1) RWA2096 procedure:  
The thrust bearing (25A) of the RWA2096 is already packed with grease and is sealed for life.
  - 2) RWA4166 and RWA4206 procedure:  
Pack the thrust bearings (25A) with grease.  
The RWA4166 requires 2.9 cubic inches of grease.  
The RWA4206 requires 6.8 cubic inches of grease.  
Attempt to force all of the grease into the bearings. The grease must be a lithium 12-hydroxysterate soap thickened grease that has rust inhibitors and extreme pressure additives and must be a NGL1, Grade 2, similar to:  
  
Shell Oil Company's "Alvania" Grease #EP  
or  
Union Oil of California's "UNOBA #2" 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 RWA4166 pump. Two containers are required for each RWA4206 pump.

- g) Press a new grease seal (76) into the mechanical seal gland (13). Remove and discard the garder 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.

If the pump is a RWA4206, and if the anti-rotation pin (375) was removed, press a new anti-rotation pin into the seal gland (13). The pin must be installed so that it protrudes from  $\frac{3}{32}$ " to  $\frac{1}{8}$ " from the face of the gland.

- h) Install new seal gland gaskets (325) into the mechanical seal gland (13). Lubricate the gaskets before installing, with a Rubber Lubricant Emulsion (temporary lubricating agent). One such product is "P-80", which is available from International Products Corp.
- i) Install a new mechanical seal stationary seat (95A) into the mechanical seal gland (13). If the pump is a RWA2096 or a RWA4166, 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 RWA4206, 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 into the groove in the bore of the mechanical seal gland (13). Install the mechanical seal stationary seat (95A) into the seal gland (13). Use the same Rubber Lubricant Emulsion used in h) above.  
  
If the pump is a RWA4206, align the slot in the seal stationary seat (95A) with the anti-rotation pin (375) in the seal gland (13) as you are installing the stationary seat.
- j) Lubricate the lip of the lip seal (76) and the area of the pump shaft (29) on which the lip seal will operate. Use the same grease that was used to pack the bearings (25A). Carefully slide the mechanical seal gland (13) assembly over the pump shaft, so as not to damage the lip seal nor the mechanical seal stationary (95A). Push the mechanical seal gland snugly against the thrust bearing (25A).
- k) If the pump is a RWA2096, go to step l). If the pump is a RWA4166 or a RWA4206, lubricate the area of the shaft sleeve (10), onto which the mechanical seal rotary (95B) mounts, with the same Rubber Lubricant Emulsion used in h) above. Carefully slide the mechanical seal rotary onto the sleeve and firmly against the shoulder of the sleeve. Tighten the set screws of the mechanical seal rotary onto the shaft sleeve. Lubricate a new shaft sleeve gasket (O ring) (77A) with the same lubricant, and install it into the sleeve.
- l) Clean any grease from the pump shaft (29) that is there from the seal gland (13) installation of step j).

- 1) RWA2096 procedure:  
Lubricate the inside of the mechanical seal rotary (95B) and the area of the pump shaft (29) over which the rotary will slide. Use the same Rubber Lubricant Emulsion as in step h) above.

Carefully slide the mechanical seal rotary (95B) over the pump shaft (29) until it contacts the mechanical seal stationary (95A). Do not damage the seal on any of the shaft shoulders. Use a 9" to 11" piece of 1" PVC, schedule 40 pipe, with its ends cut square, to push against the seal rotary (95B). This will allow you to push the rotary (compressing the springs of the mechanical seal rotary (95B)) firmly against the shoulder of the pump shaft. Hold the rotary against the shaft shoulder and tighten the set screws that are in the mechanical seal rotary (95B) against the pump shaft.

2) RWA4166 procedure:

Lubricate the inside of the shaft sleeve (10) and the pump shaft (29), from the impeller (3) fit to the mechanical seal gland (13). Use the same Rubber Lubricant Emulsion as in step h) on page 15.

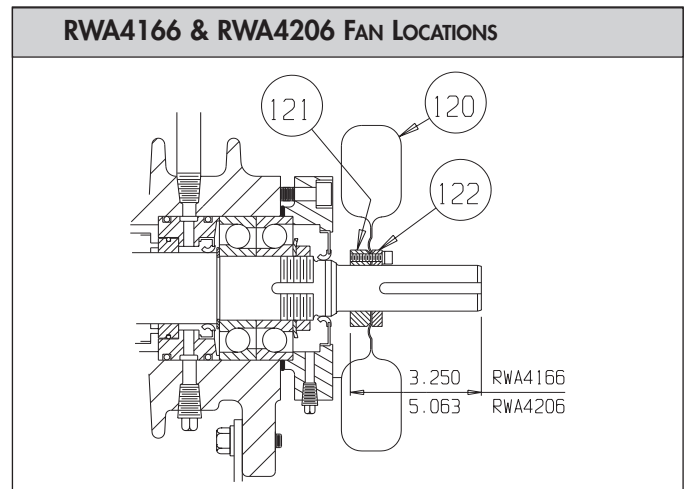
Carefully hold the shaft sleeve (10) centered with the pump shaft (29), and slide it over the shaft, and into position. Use an 11" to 13" piece of 1 1/2" PVC, schedule 40 pipe, with its ends cut square, to push against the end of the shaft sleeve. This will allow you to push the sleeve (compressing the springs of the mechanical seal rotary (95B)) against the shoulder of the pump shaft. Hold the sleeve tightly against the shoulder and tighten the four sleeve set screws (370) against the pump shaft.

3) RWA4206 procedure:

Lubricate the inside of the shaft sleeve (10) and the area of the pump shaft (29) over which the sleeve will slide. Use the same Rubber Lubricant Emulsion as in step h) on page 15.

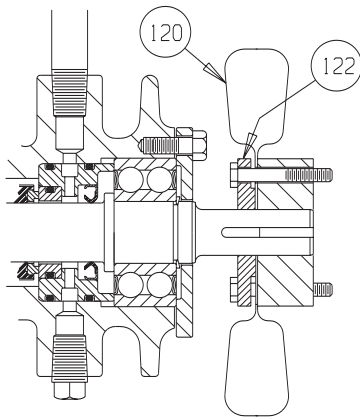
Carefully slide the shaft sleeve (10) over the pump shaft (29) and into position. Use an 13" to 15" piece of 2" PVC, schedule 40 pipe, with its ends cut square, to push against the end of the sleeve. This will allow you to push the sleeve (compressing the springs of the mechanical seal rotary (95B)) against the shoulder of the pump shaft. Hold the sleeve tightly against the shoulder and tighten the four sleeve set screws (370) against the pump shaft.

- m) Use the same Rubber Lubricant Emulsion as used in step h) on page 15. Lubricate the seal gland gaskets (325) and the bore in the back of the bearing housing (26), so that the seal gland gaskets 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.
- n) If the pump is a RWA2096, go to step u)
- o) Install a new end cover gasket (77B) over the thrust bearing (25A) and against the bearing housing (26).
- p) 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 1/16" before it reaches the shoulder of the end cover, placing the sealing lip at a new location on the pump shaft (29).
- q) 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 RWA4166 and to 35 lb. ft. on the RWA4206.



- r) Mark (pencil or light scribe) a line on the pump shaft (29), 3 1/4" for the RWA4166 and 5 1/16" for the RWA4206, 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 above. 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.
- s) 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 with the end of the key flush with the end of the pump shaft and the face of the hub. Tighten the hub set screw(s).
- t) Go to step x).
- u) 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.
- v) 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 on page 17. The concave side of the fan blade was indicated with a label "PUMP SIDE" at the time it was shipped from the factory.

## RWA2096 FAN MOUNTING



- w) 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 the key flush with the end of the pump shaft and the face of the hub. Tighten the hub set screw(s).
- x) 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 RWA2096:

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 and tighten it to a torque of 40 lb. ft. Hold the pump shaft against the tightening torque, by placing a wrench on the flats of the coupling hub. Be careful not to bend the blades of the fan (120).
  - 2) If the pump is a RWA4166 or a RWA4206:

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 RWA4166 and 100 lb. ft. for the RWA4206. Hold the pump shaft against the tightening torque by placing a wrench on the flats of the coupling hub. Be careful not to bend the blades of the fan (120).
- y) If the pump has a casing ring (6A), press it into the casing (5).
- z) 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 cap screws (5D) or the casing stud nuts (5C) slowly and evenly so that the casing gasket will compress evenly. Torque the casing cap screws (5D) of the RWA2096 pumps to 50 lb. ft. Torque the casing stud nuts (5C) of the RWA4166 and RWA4206 pumps to 105 lb. ft. if the studs are  $\frac{3}{4}$ " and to 165 lb. ft. if the studs are  $\frac{7}{8}$ ".
- aa) 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.
- ab) 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.
- ac) 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.

- ad) Realign the pump and driver per instructions under "PUMP AND DRIVER ALIGNMENT"
- ae) Follow the instructions under "PUMP LUBRICATION", "STARTING THE PUMP", AND "PUMP START UP CHECKLIST".
- af) Replace the vapor eliminator into the top of the pipe tee after filling the pump and venting the seal chamber. Reinstall the vapor exhaust tube.

**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 \_\_\_\_\_

\_\_\_\_\_

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\_\_\_\_\_

\_\_\_\_\_

# CECO Dean

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## 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 it's 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.

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.

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 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 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.