

# CECO Dean

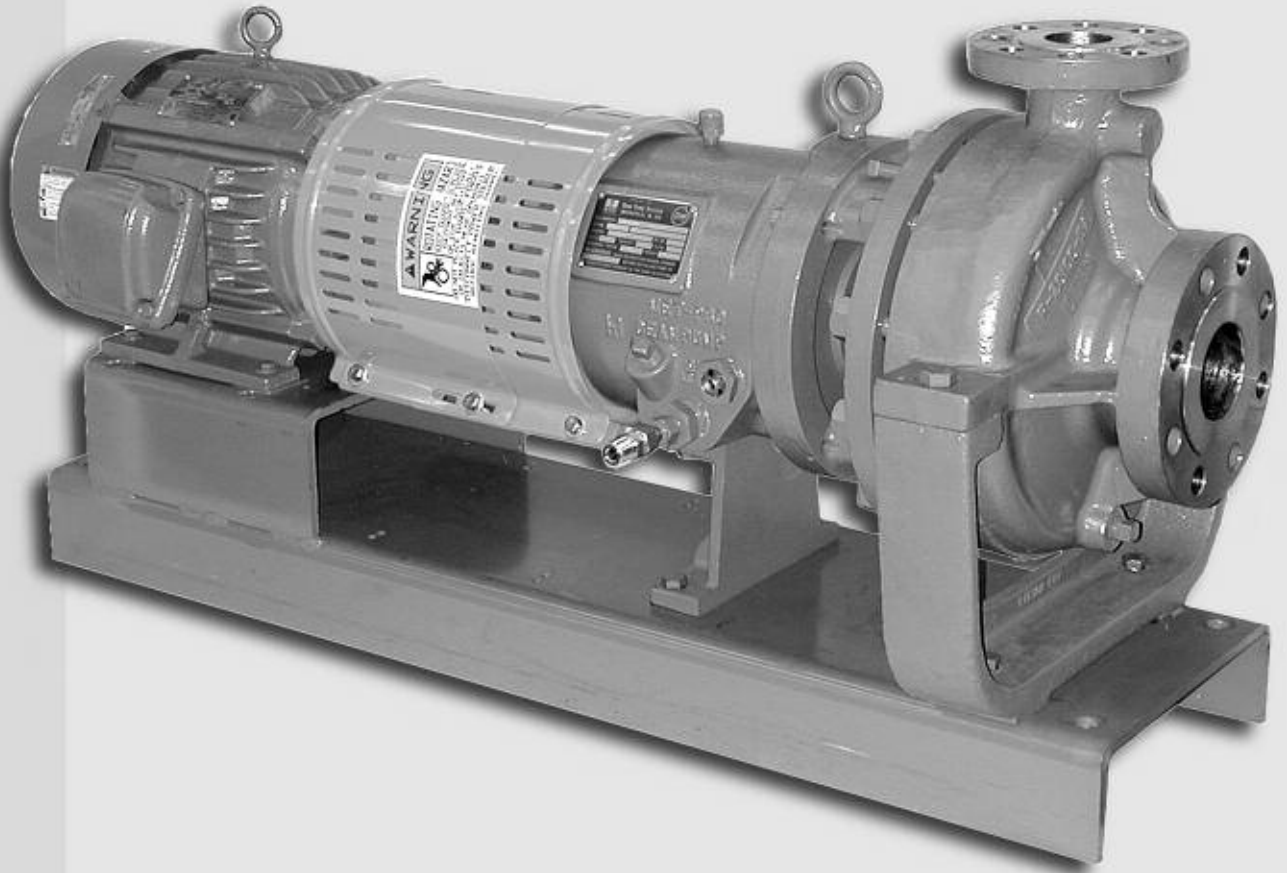
## DEAN PUMP® SERIES R4000

Horizontal Process Pumps

INSTALLATION

OPERATION

MAINTENANCE 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 oiled, 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.

## DEAN PRODUCT WARRANTY

We warrant to the purchaser from us of Dean Pump products and parts of our own manufacture (Dean Products) that the Dean Products are free under rated use and service from defects in design, material and workmanship for a period of one (1) year from the date of installation, but not to exceed eighteen (18) months from the date of shipment by us. This warranty does not cover (I) any loss or damage resulting from wear, corrosion, abrasion or deterioration due to normal use in rated service; (II) replacement of service items such as shaft packings and mechanical seals; (III) products or parts manufactured by others but furnished by us which, if defective, shall be repaired or replaced only to the extent of the original manufacturer's warranty; (IV) any loss or damage to or defects in any Dean Products resulting from the misuse or improper storage, installation, or operation thereof; or (V) any loss or damages to or defects in any Dean Products resulting from any alteration or modification thereof not expressly authorized and approved by us in writing. We shall

not be liable, directly or indirectly, under any circumstances for consequential or incidental damages, including, but not limited, to: (I) any loss of business or profits; and (II) labor, material or other charges, claims, losses or damages incurred or suffered from, in connection with or in consequence of the working upon, alteration, or repair of any defective Dean Products by persons or firms other than us. Our liability for breach of warranty hereunder is limited solely to the repair in our factory or the replacement F.O.B. our factory, as the case may be, or any Dean Products which shall have been determined by us, after notice to us and inspection by us within the warranty period, to be so defective when shipped by us. THIS WARRANTY AND THE LIABILITY SET FORTH HEREIN ARE EXCLUSIVE AND IN LIEU OF ALL OTHER LIABILITIES AND WARRANTIES, EXPRESSED OR IMPLIED, INCLUDING IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR PARTICULAR PURPOSE.

## 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 should 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, a heavy protective coating should be applied to bearings and all exposed machined surfaces. A rust preventative must be used to protect all steel or cast iron parts. Compression packing or mechanical seals should be removed and stored as well as protected separately.

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.

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## STANDARD, HORIZONTAL, SINGLE STAGE, END SUCTION, ENCLOSED IMPELLER, CENTRIFUGAL PROCESS PUMPS TYPES R4140, R4170, R4180 AND R4240

### MECHANICAL DESIGN SPECIFICATIONS

Direction of Rotation (Viewed from Coupling End) .....CCW  
 Casing Thickness, Minimum .....5/16"  
 Corrosion Allowance .....1/8"  
 Impeller — Standard .....Single Plane Balanced  
 Optional Extra .....Dynamically Balanced  
 Flanges — ASME/ANSI B16.5 Rating .....Class 300  
 Facing .....Standard Raised Face  
 Optional Extra .....Ring Type Joint  
 Finish .....125 Ra  
 Seal Chamber & Bearing Housing Jacket Pressure, Maximum .....125 psig  
 Suction Pressure, Maximum .....Max. Working Pressure Less Pump Developed Head

	R4140	R4170	R4180	R4240
Horsepower Rating — Maximum				
@ 3500 rpm	100	200	250	—
@ 1750 rpm	40	100	125	300
@ 1160 rpm	25	—	75	200
Bearings, Type Ball Bearings, Oil Lubricated Thrust Bearing (Angular Contact Pair) Radial Bearing	7309BG 6309	7311BG 6311	7312BG 6312	7317BG 6316
Approximate Oil Capacity of Bearing Housing	41 oz	36 oz	64 oz	120 oz
Seal Chamber Dimensions (Large Taper Bore)				
Length (Depth)	3"	3"	4 1/2"	4 7/8"
Inside Diameter (Bore Diameter)	3 1/2"	3 7/8"	4 1/4"	5"
Shaft Sleeve Diameter	1 3/4"	2 1/8"	2 1/4"	3"
Standard Bore (Stuffing Box) Dimensions				
Length (Depth)	3"	3"	3 7/8"	4 1/8"
Inside Diameter (Bore Diameter)	2 1/2"	2 7/8"	3 1/4"	4"
Shaft Sleeve Diameter	1 3/4"	2 1/8"	2 1/4"	3"
Lantern Gland Width	5/8"	5/8"	3/4"	1"
Lantern Gland to Open End of Stuffing Box	1 1/2"	1 1/2"	1 1/2"	2 3/8"
Packing Size, Square	3/8"	3/8"	1/2"	1/2"
Number of Rings with Lantern Ring	6	6	6	6
Spacing	3G3	3G3	3G3	3G3
Number of Rings Lantern Omitted	7	8	7	8
Pump Shaft Dimensions				
Span Between Bearings Q <sub>1</sub> to Q <sub>2</sub>	6"	5 15/16"	8 1/4"	10 3/16"
Span Between Radial Bearing Q <sub>1</sub> and Impeller Q <sub>1</sub>	8"	8 3/16"	10 3/4"	12 5/16"
Diameter at Coupling	1 1/8"	1 5/8"	1 5/8"	2 3/8"
Diameter Between Bearings	2 1/8"	2 5/8"	2 3/4"	4"
Diameter at Impeller	1 1/8"	1 1/4"	1 1/2"	2 1/4"
L <sup>3</sup> /D <sup>4</sup>				
Sleeved	101	44	78	36
Solid	55	27	26	23

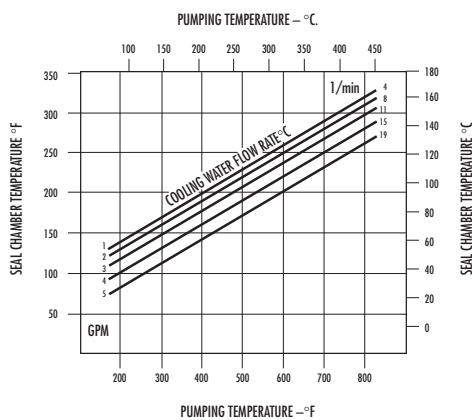
MATERIAL CLASS	MAXIMUM WORKING PRESSURE	PUMPING TEMPERATURE		HYDROSTATIC TEST PRESSURE	
		MINIMUM	MAXIMUM	R4140/R4170	R4180/R4240
40†	500 psig @ 650°F	-20°F	800°F @ 350 psig	850 psig	750 psig
50	500 psig @ 100°F	-20°F	850°F @ 305 psig	psig	psig

† Carbon Steel with Cast Iron trim. Also available with 316SS trim.

**WARNING:** Use the "Allowable Working Pressure VS. Pumping Temperature" chart (below, right) to determine the allowable working pressure at any allowable pumpage temperature for the material of construction selected.

### Seal Chamber Temperature VS. Pumping Temperature

with respect to the GPM of cooling water flowing through the cooling jacket surrounding the seal chamber.



\*GPM Flow Rate of Cooling Water Based on 70°F (21°C) Inlet Temp  
 Specifications are subject to change without notice

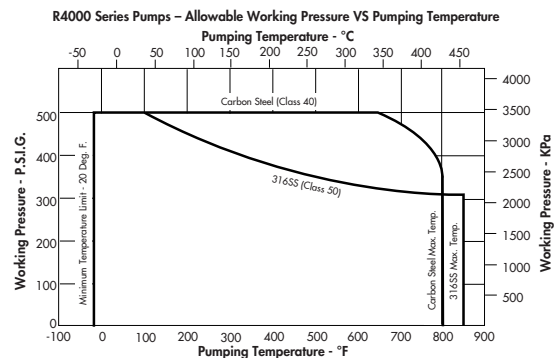
STANDARD MATERIALS OF CONSTRUCTION			
Part No.	Part Name	Carbon Steel (Cl. 40)	316SS (Cl. 50)
3	Impeller	C.I. (1)	316 (3)
*4	Impeller Key	Steel (2)	316 (8)
5	Casing	Steel (6)	316 (3)
5A	Casing Drain Plug	Steel (2)	316 (8)
5C	Casing Stud Nut	Steel (5)	
5D	Casing Stud	Steel (4)	
*6	Casing Back Cover Ring	Iron (7)	316 (3)
6A	Casing Ring	Iron (7)	316 (3)
7	Cradle Spacer	D.I. (16)	
7A	Bull's Eye Oil Level Indicator	Steel & Glass	
7G	Spacer to Bearing Housing Capscrew	Steel (2)	
9	Bearing Housing Foot	C.I. (1)	
*10	Shaft Sleeve	316 (8)	
*10K	Shaft Sleeve Key	304 (9)	
*12	Impeller Bolt (Nut on R440)	Steel (2)	316 (8)
*12A	Impeller Washer	Steel (2)	316 (8)
*12B	Impeller Lock Washer	316 (8)	
*12C	Impeller Washer Pin	304 (9)	316 (8)
13	Seal Chamber Gland	316 (8)	
	Packing Gland	Steel (6)	316 (3)
14	Gland Stud	Steel (4)	304 (9)
15	Gland Nut	Steel (5)	304 (9)
*17	Lantern Ring	C.I. (1)	316 (3)
22	Casing Back Cover	Steel (6)	316 (3)
*22A	Back Cover to Cradle Cap Screw	Steel (2)	
*25	Radial Bearing	—	
*25A	Thrust Bearing	—	
*26	Bearing Housing	C.I. (1)	
*27	Seal Ring	C.I. (1)	
*28	Bearing End Cover	C.I. (1)	
*28A	Bearing End Cover Cap Screw	Steel (2)	
*29	Pump Shaft	Steel (10)	316 (8)
*31	Thrust Bearing Lock Nut	Steel (2)	
*31A	Thrust Bearing Lock Washer	Steel (2)	
*54	Throat Bushing	C.I. (1)	316 (8)
56	Casing Foot	C.I. (1)	
*56B	Casing Foot Dowel	Steel (2)	
*75B	Retaining Ring (All Except R4240)	Steel	
*76	Labyrinth Seal—Front	Bronze & Viton †	
*76A	Labyrinth Seal—Rear	Bronze & Viton †	
77	Casing Gasket	Grafoil (11)	
*77B	End Cover Gasket	Buna (14)	
*80	Bearing Housing Vent	—	
*83	Motor Support (C Face)	C.I. (1)	
*87	Impeller Ring—Back (Optional)	Steel (2)	316 (3)
87A	Impeller Ring—Front (Optional)	Steel (2)	316 (3)
95A	Mechanical Seal Stationary	—	
95B	Mechanical Seal Rotary	—	
*109	Oil Cooler	SS Tubing with Steel Fins	

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

- (1) Cast Iron
- (2) AISI 1020
- (3) 316SS — ASTM #A744 Grade CF8M
- (4) AISI 4140, ASTM #A193-B7 Steel
- (5) ASTM #A194 Grade 2 Steel
- (6) ASTM #A216 Grade WCB Cast Steel (-20 + 800°F)
- (7) Hardened Iron
- (8) AISI—316SS
- (9) AISI—304SS
- (10) Alloy Steel —125,000 TS, 100,000 YP
- (11) Grafoil — Registered trademark of Union Carbide Corp.
- (12) Manila Paper
- (13) Fibre Sheet — Non-Asbestos Fibre
- (14) Buna N Rubber
- (15) Steel Finned, Stainless Steel Tube with Steel End Fittings
- (16) Ductile Iron — ASTM-A536 Class 65-45-12

### SEAL CHAMBER PRESSURE - R4000 SERIES PUMPS

\*\*With Impeller Balance Holes—Seal Chamber Pressure Equals Pump Suction Pressure Plus .06 x Pump Developed Pressure in PSI  
 Without Impeller Balance Holes—Seal Chamber Pressure Equals Pump Suction Pressure Plus .75 x Pump Developed Pressure in PSI  
 Pumps are normally furnished with balance holes



# 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.

## 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 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 (except for pumps with optional "C" face motor support). See "**Pump and Driver Alignment**" on page 4.
- 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) Connect the suction and discharge piping without forcing the piping into position. See "**Suction and Discharge Piping**" on page 4. The pipe flanges must line up with the pump flanges "freely".

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

### WARNING:

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

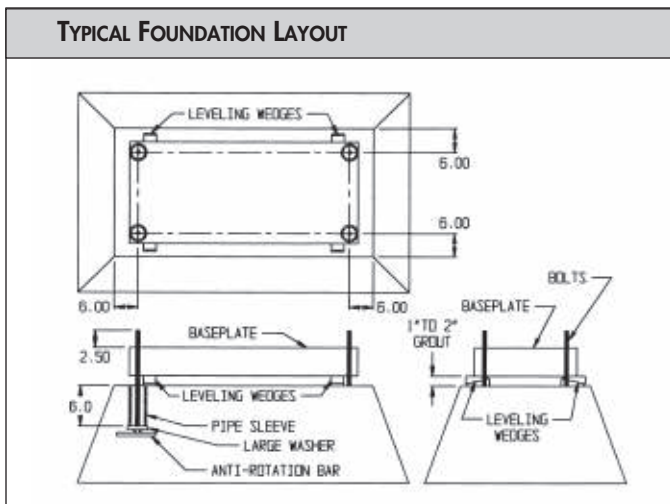
- 6) Recheck pump and driver alignment (except for pumps with optional "C" face motor support) to ensure that no distortion of the pump unit has been caused by piping strain. Correct piping if misalignment has occurred and again align pump and driver.
- 7) Connect all other (auxiliary) piping necessary for safe and successful operation of the equipment in the specific service conditions of the application. See "**Pump Cooling Requirements**" on page 6.

### 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.**

**One example of the above would be the cooling jacket around the seal chamber. If this chamber were full of water and someone would close both the inlet and outlet valves and then operate the pump at 500 degrees fahrenheit, the vapor pressure of the water, 665 PSIG, would far exceed the capacity of the jacket and possibly other parts. In this example, a relief valve must be installed between the pump and the outlet valve.**

- 8) 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.

- 9) The pump and driver alignment must again be checked (except for pumps with optional "C" face motor support) at the operating temperature and alignment corrected under the hot condition.
- 10) After about two weeks of normal pump operation the pump and driver alignment should again be checked (except for pumps with optional "C" face motor support) 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.

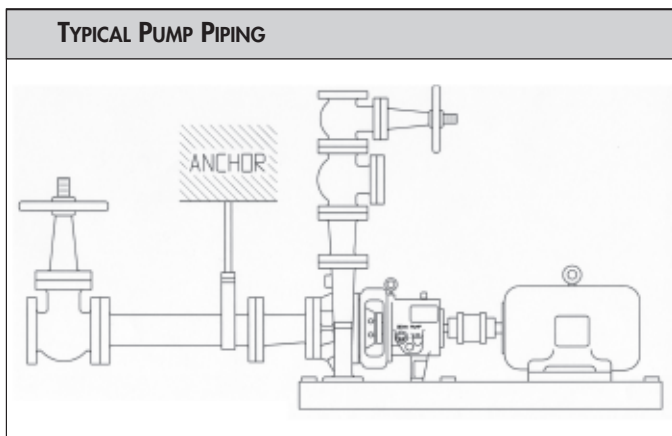
### SUCTION AND DISCHARGE PIPING

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, mechanical seal faces, or seal chamber packing. Mechanical seal parts 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. In addition, special filtering and mechanical seal flushing may be required. Consult your Dean representative. 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 restrictive 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 and handling during shipment and installation will cause the alignment to change. **The pump and driver alignment must always be checked and corrected (except for pumps with optional "C" face motor support) 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 or shaft packing 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 5 in this manual.

No allowance for thermal expansion is made for motor driven units in mounting the driver. Allowance for turbine mounting should be in accordance with the turbine manufacturer's recommendations. **Final alignment must always be checked and corrected at the operating temperatures of the pump and driver.**

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

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

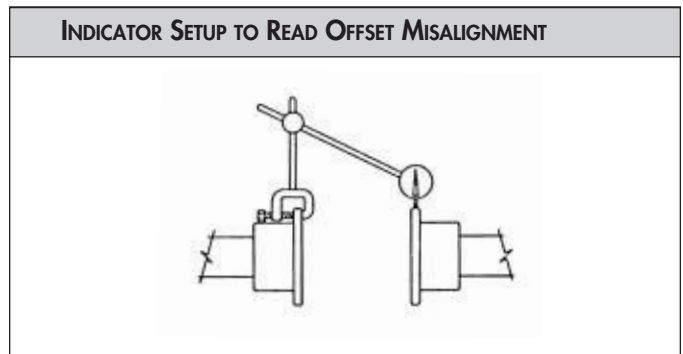
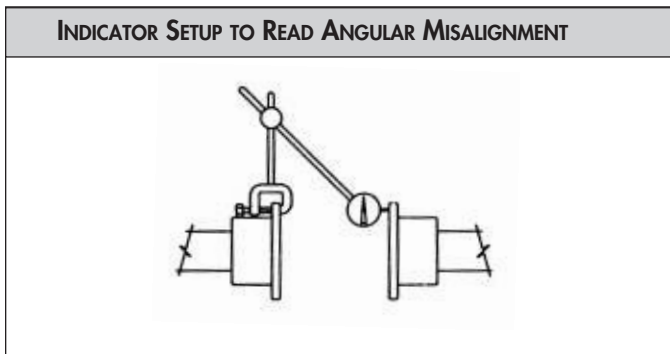
The first step is to remove the spacer from the coupling. To one of the remaining coupling hubs, firmly seated on the shaft, attach a dial indicator. Let the indicator button ride on the face of the other coupling hub and near the outside diameter. See illustration on page 5. Rotate the shaft on which the dial indicator is mounted, allowing the indicator button to move on the stationary coupling hub. The indicator dial movement will show the difference in distance between the two hubs. This indicates the amount of angular misalignment between the hubs and therefore the shaft axes. Good practice suggests alignment to within 0.002" T.I.R.

To check the offset alignment, mount the dial indicator as above except with the indicator button on an outside diameter of the stationary coupling hub. See illustration below. Rotate the shaft on which the dial indicator is mounted, allowing the indicator button to ride on the outside diameter of the stationary hub. The indicator dial movement will show the difference in the center locations of the two shafts. Good practice suggests alignment to within 0.002" T.I.R.

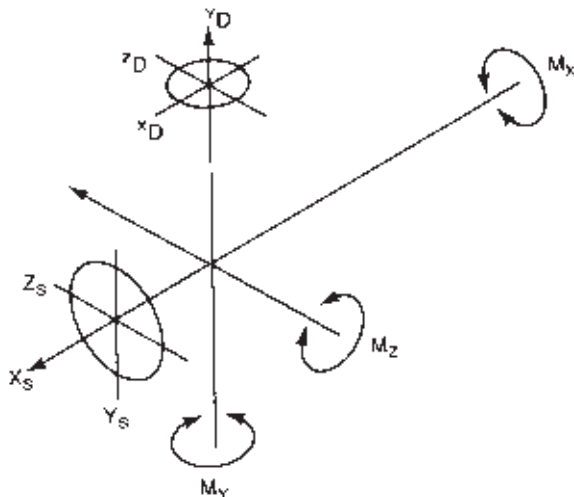
Angular and offset alignment is adjusted by placing thin metal shims under the driver mounting feet to bring the drive into exact alignment with the bolted down pump. ***If misalignment is of major proportions, the baseplate has been improperly installed on the foundation and must be leveled before proceeding with alignment.***

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

Allowable error of shaft alignment is somewhat dependent on the coupling type. ***However, the closer the running alignment, the better the running life will be.***



### ALLOWABLE PIPING LOADS R4000 SERIES PUMPS



**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.**

#### MAXIMUM FORCES ON FLANGES FOR SUCTION FLANGE

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

#### FOR DISCHARGE FLANGE

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

#### WHERE

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

Pump Size	Pump Type	Wt. Lbs. Pump Only	M <sub>x</sub> lb. ft.	M <sub>y</sub> lb. ft.	M <sub>z</sub> lb. ft.
1 x 3 x 8 1/2	R4140	210	690	340	725
1 1/2 x 3 x 8 1/2	R4140	235	690	340	725
2 x 3 x 8 1/2	R4140	260	690	340	725
3 x 4 x 8 1/2	R4140	285	725	295	600
4 x 6 x 8 1/2	R4140	325	785	320	600
1 1/2 x 3 x 10	R4140	255	760	310	600
2 x 3 x 10	R4140	290	760	310	600
3 x 4 x 10	R4140	320	830	340	600
4 x 6 x 10	R4140	360	950	340	600
1 x 2 x 11 1/2	R4140	240	850	350	600
1 1/2 x 3 x 11 1/2	R4140	275	850	350	600
2 x 3 x 11 1/2	R4140	315	870	355	600
3 x 4 x 11 1/2	R4140	345	930	335	575
4 x 6 x 11 1/2	R4140	430	980	350	760
1 1/2 x 3 x 13 1/2	R4140/4170	400	1015	365	525
2 x 3 x 13 1/2	R4140/4170	414	1015	365	525
3 x 4 x 13 1/2	R4140/4170	430	1045	375	630
4 x 6 x 10	R4180	480	2300	1850	800
6 x 8 x 12 1/2	R4180	560	2740	1490	800
2 x 4 x 15 1/2	R4180	575	2530	1375	800
3 x 4 x 15 1/2	R4180	587	2550	1385	800
4 x 6 x 15 1/2	R4180	604	2740	1490	800
6 x 8 x 15 1/2	R4240	919	3000	1615	1500
8 x 10 x 15 1/2	R4240	942	3340	1810	1500

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

## PUMP COOLING REQUIREMENTS

Pumps may be furnished with the following jackets or cooling coil:

- 1) Stuffing box
- 2) Mechanical seal gland (optional)
- 3) Casing pedestals (optional)
- 4) Bearing housing cooling coil (optional)

Cooling is recommended under the following conditions:

### STUFFING BOX COOLING

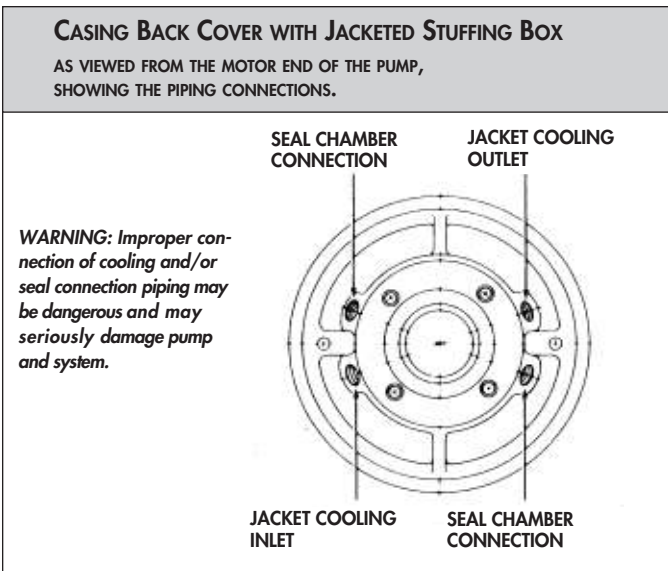
- 1) With a mechanical seal when the application requires cooling.
- 2) With a mechanical seal when pumping liquids of 0.75 specific gravity, or less, when the pumping temperature permits further cooling.
- 3) With stuffing box packing, except Grafoil, at temperatures above 250°F.

### MECHANICAL SEAL GLAND COOLING

When the mechanical seal application requires cooling of the seal faces. This depends on the liquid pumped and the pumping temperature.

### BEARING HOUSING COOLING

At pumping temperatures below 500°F, such cooling is rarely necessary. Excessive cooling of the bearing housing may lead to early bearing failure from moisture condensation and contamination of the oil.



**WARNING—EXTREME HAZARD TO PERSONNEL:** Improper connection of cooling water piping may result in the injection of cooling water into the pump stuffing box and into the pumpage. Depending on temperature this may cause a violent steam explosion in the pump, piping, or associated equipment with extreme hazard to personnel. It may also cause serious contamination of the pumpage and heavy corrosion of pump or equipment parts.

### CASING PEDESTAL COOLING

Casing pedestal cooling is used to equalize and minimize thermal expansion of the pedestal pump supports.

### COOLING WATER PIPING

The cooling water piping depends on what cooling coil or jackets are furnished and used. Jackets to be piped in series are, Casing Pedestal Cooling, Stuffing Box Cooling, and Bearing Housing Cooling, with the cooling water to flow in that sequence. Not all of these jackets will necessarily be used. All other jackets or cooling coil should be piped in parallel with separate flow to each. The customer must provide piping and a shut-off valve on each cooling inlet. The customer must also provide the outlet piping from each jacket or cooling coil, fitted with a pressure relief valve set at a maximum of 150 PSIG, and then a flow control valve. Pipe each outlet from the valve to its own sight drain or through a suitable flow indicating device into the plant cooling water system.

In no case should the outlets be piped into the municipal water system.

### COOLING WATER FLOW RATES

**Stuffing box cooling**, when used, has flow rates related to pumping temperature. See the chart below. The lower flow rates will lead to higher cooling water temperature and promote more rapid scaling within the jacket. Higher flow rates will do no harm.

**Mechanical seal gland cooling** flow should be adjusted to about 1/2 GPM.

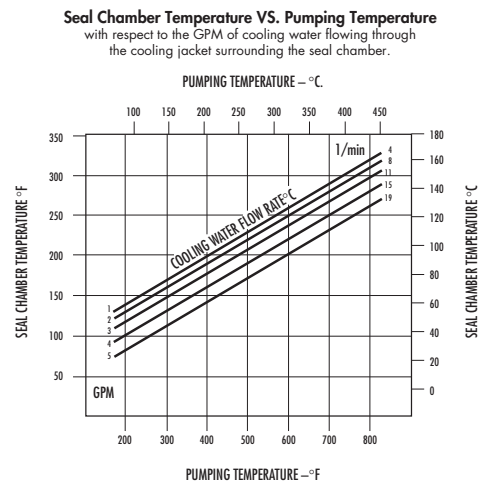
**Bearing housing cooling** flow rate, when not in series with the stuffing box cooling, should be adjusted to 1/2 GPM. This will maintain the oil temperature below 130°F at all pumping temperatures.

The pumps may be operated without bearing housing cooling if experience with the particular installation shows that the bearing temperature, without cooling, does not rise above 200°F.

As stated before, pumps operating at 500°F and lower, seldom require bearing housing cooling.

**Casing pedestal cooling** flow rates are equal to stuffing box cooling flow rates when piped in series. If piped separately, the flow need not be over 1/2 GPM.

**WARNING—EXTREME HAZARD TO PERSONNEL:** When cooling water is used to cool the stuffing box, gland, or bearing housing jackets, it is mandatory that the cooling water be allowed to flow at any time the pump is running. Closing the inlet and/or outlet valves under running conditions may result in the water in the jackets reaching high pressure which may lead to the rupture of a water jacket with extreme hazard to personnel.



\*GPM Flow Rate of Cooling Water Based on 70°F (21°C) Inlet Temp  
**Specifications are subject to change without notice**



## PIPING CONNECTIONS FOR R4000 SERIES PUMPS

Connections (1) and (3) are cooling water inlets. Connections (2) and (4) are cooling water outlets. Do not control cooling water flow with a valve on connections (1) and/or (3). Connections (3) and (4) may be reversed, if so desired.

Openings (1) and (2) are stuffing box cooling jacket connections and are covered, at the manufacturing plant, with thread protectors, for shipment.

Openings (3) and (4) are bearing housing oil cooler connections and are covered, at the manufacturing plant, with thread protectors, for shipment.

Openings (5) and (6) are connections into the center of the mechanical seal cavity (or to the lantern ring if the box is packed) and are

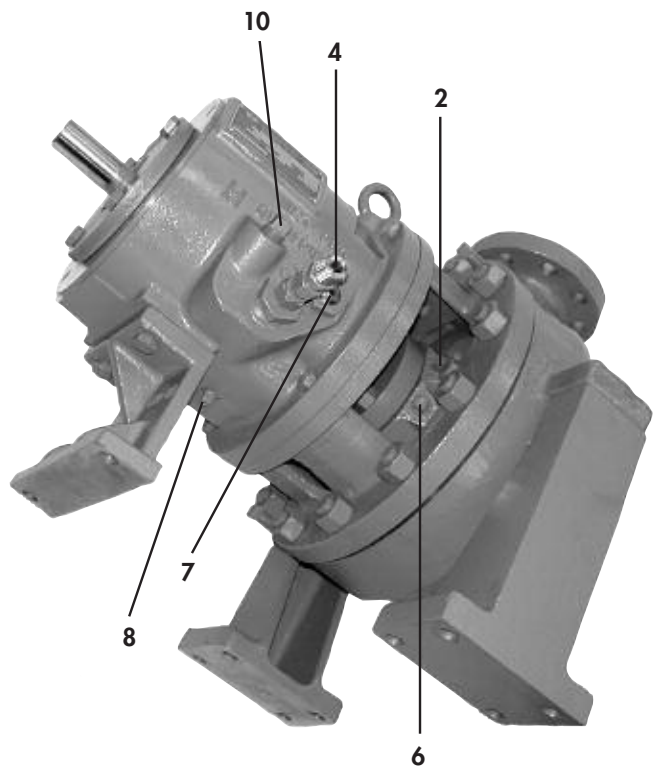
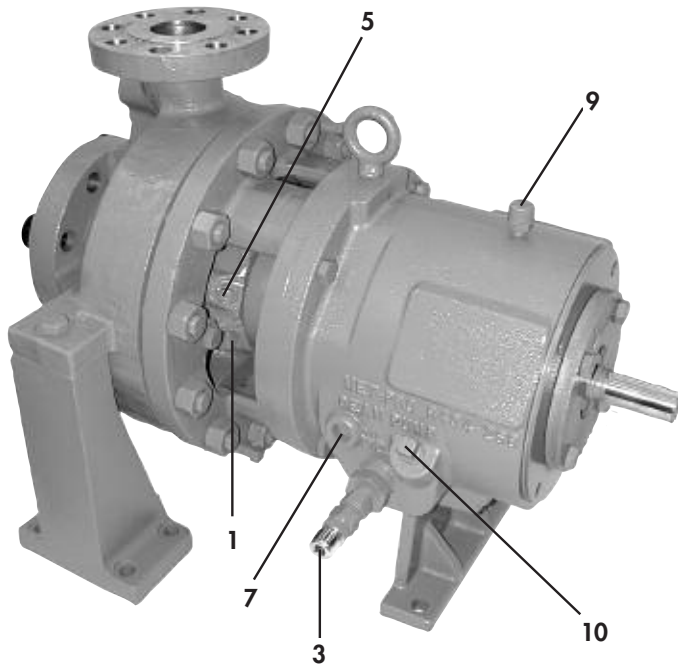
sealed with standard, metal, threaded pipe plugs at the manufacturing plant.

Connection (7) is for the "Bull's Eye" oil level indicator which is shipped installed on the side of the pump shown in the photo. There is a connection (7) on both sides of the pump. The "Bull's Eye" can be moved, in the field, if so desired, to the opposite side of the pump.

Connection (8) is the oil drain. This is plugged with a standard, metal, threaded pipe plug.

Connection (9) is the oil reservoir vent which is shipped installed.

Opening (10) is the oil fill connection. This connection is plugged with a standard, metal, threaded pipe plug. There is a connection (10) on both sides of the pump so that the oil reservoir may be conveniently filled from either side.



## PUMP LUBRICATION

Lubrication of the ball type bearings in Dean pumps is by oil contained in the sump of the bearing housing (26). The oil must be a good grade of rust and oxidation inhibited, non-foaming, industrial oil with a viscosity of approximately 500 SSU at 100°F. This will be an ISO 100 oil.

Failure to level the pump assembly when the entire unit is installed may adversely affect the oil level and reduce bearing life. Proper care should be taken to avoid this condition.

The R4000 series pumps are supplied with a "Bull's Eye" type oil level indicator, and fill openings on both sides of the bearing housing. Fill the sump through one of the NPT tapped openings on the side of the bearing housing until the oil level reaches the center of the "Bull's Eye" level indicator. The oil must be maintained at this level during operation.

If the optional automatic oiler was supplied, it was packed separately for pump shipment to avoid damage. Install the oiler into the

upper 1" NPT tapped hole (connection #7 on page 7) on either side of the bearing housing. Screw the oiler reservoir from the top of the "Bull's Eye" housing, invert it, fill it with oil, and reinstall it into the housing. Thereafter, the oil level in the bearing housing remains constant as long as there is any oil in the reservoir cup. To maintain the oil level between oil changes, refill the oil cup when the cup nears empty.

The oil should be drained and replaced at regular intervals, the intervals depending on the atmospheric conditions (dust, soot, corrosive vapors, humidity, temperature variations, etc.) prevailing at the pump installation site. The bearing housing should be flushed with a good solvent before the oil is replaced.

**Pumps are shipped from the factory without oil in the bearing housing.**

## 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.

If the pump is equipped with cooling water piping this should be turned on before filling the pump.

### FILLING

#### WARNING:

*Before filling the pump with liquid, check to see that all possible leak locations are sealed. See that the point where the pump shaft enters the pressure containing cavity is sealed. Normally this sealing is accomplished with shaft packing or a mechanical face seal. 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.*

When the source of liquid supplied to the pump is below atmospheric pressure or located below the pump, the pump must be primed prior to start up. The priming may be accomplished in any of several ways, three of which are listed.

- 1) An exhauster may be connected to the discharge piping between the pump and the discharge shut-off valve. With the discharge shut-off valve closed and the suction valve open, the air can be exhausted from the pump and piping.
- 2) With a foot valve installed in the suction piping, the pump may be filled with liquid introduced somewhere above the pump in the discharge line. The seal chamber should be vented to allow complete filling. A foot valve may create extensive losses and should be taken into consideration in calculating the available NPSH.
- 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.

When the source of liquid supplied to the pump is above atmospheric pressure or above the pump centerline, the pump may be filled by venting through a bleed off line to atmosphere or back to the pump suction source.

***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, lock-out the power to the driver (motor, turbine, engine, etc.), and remove the spacer assembly at this time. If the pump was purchased with the "C" face motor support option, the coupling will not have a spacer assembly. 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 (except for pumps with the optional "C" face motor support). Be sure that you install all the retaining devices and bolts and that they are tight. Read and comply with the coupling manufacturers 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 into place, 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 mechanical seal or compression packing. When the pump is equipped with a mechanical seal, vent the pump seal chamber through the seal connection to provide lubrication to the mechanical seal faces.***

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

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 pump at once and correct the problem.

## PUMP START UP CHECK LIST

***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 all piping connections making certain that they are both tight and in the proper places. All piping includes seal, cooling, or heating piping.
- 4) Make sure that the baseplate has been properly installed.
- 5) Check the electrical or steam line connections to the driver.
- 6) Break the coupling by removing the coupling spacer (except for pumps with the optional "C" face motor support) 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.
- 7) Check coupling for proper alignment (except for pumps with the optional "C" face motor support). Realign if necessary.
- 8) If pump seal chamber is packed, check to be sure that gland stud nuts are pulled up only finger tight and that the gland is not cocked.
- 9) Rotate the pump shaft by hand to be sure there is no binding or rubbing within the pump or driver. Correct any difficulties at once.
- 10) Check to see that the pump is properly lubricated.
- 11) Remove all dirt, waste, tools, and construction debris from the area.
- 12) Check to see that the coupling guard is 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 or the pump parts are of special materials, spare parts stock is even more important to the user. Such spares inventory may extend from a spare mechanical seal or seal parts through complete casing back-cover-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.

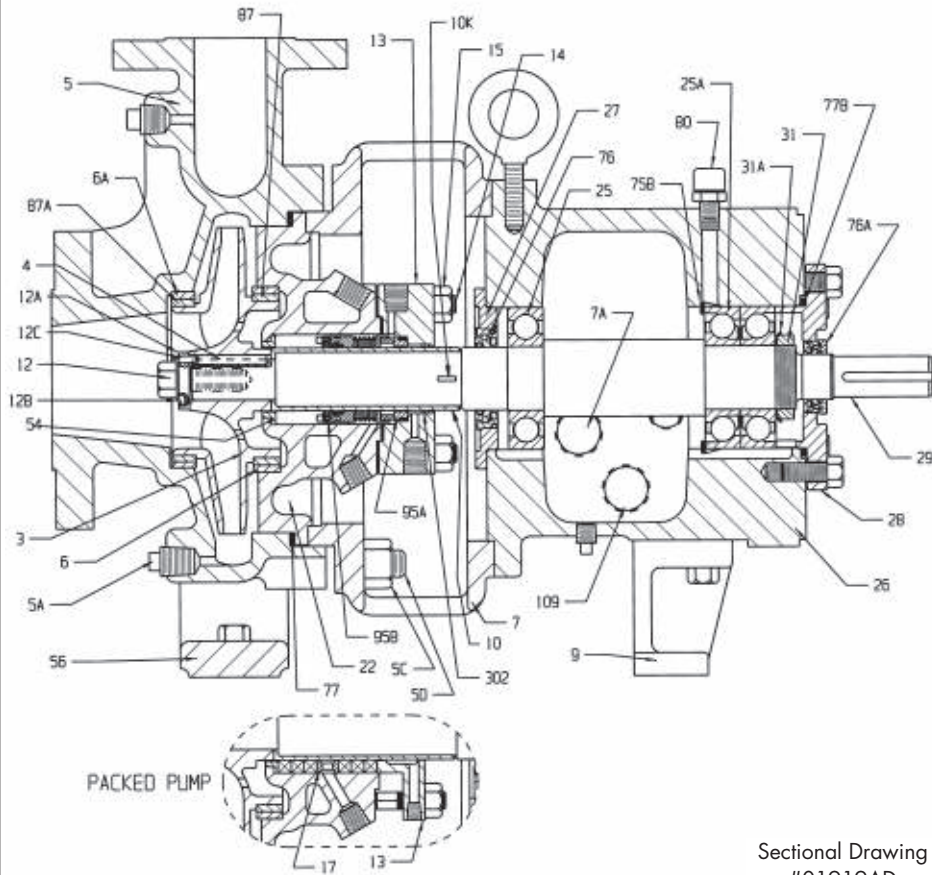
### ORDERING SPARE PARTS

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 or the top edge of the bearing housing front flange.
- 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.

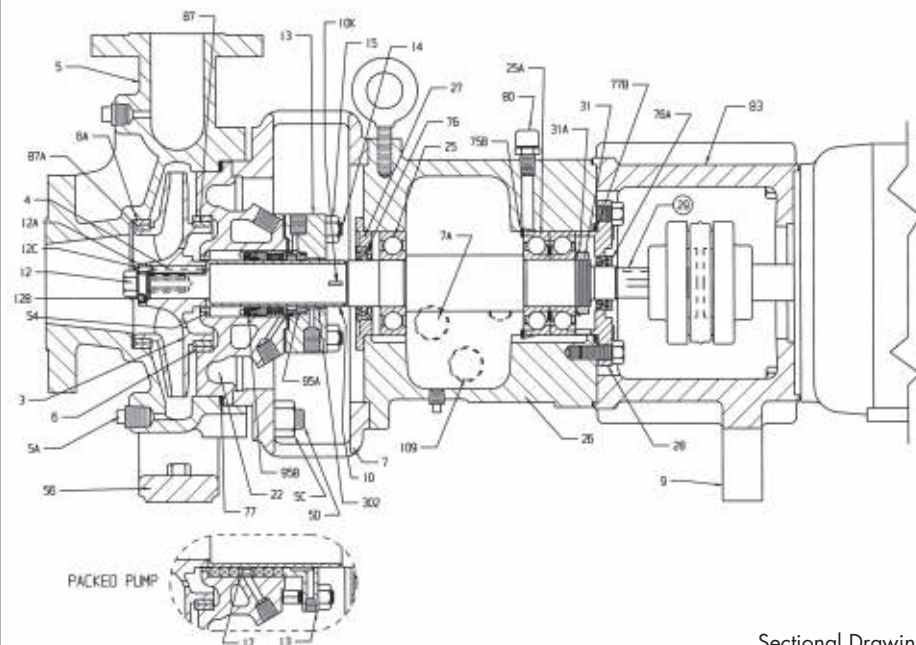
# R4140 PUMP WITH JACKETED SEAL CHAMBER AND BEARING HOUSING OIL COOLER - R4144

## PUMP WITH JACKETED SEAL CHAMBER AND BEARING HOUSING OIL COOLER - R4144



Sectional Drawing  
#01919AD

## R4140 PUMP WITH JACKETED SEAL CHAMBER AND OPTIONAL "C" FACE MOTOR SUPPORT - R4144



Sectional Drawing  
#01919AE

- R4142 Pump with jacketed seal chamber
- R4144 Pump with jacketed seal chamber and oil cooler
- R4146 Pump with large taper bore seal chamber
- R4147 Pump with jacketed seal chamber and jacketed casing
- R4148 Pump with jacketed seal chamber, jacketed casing and oil cooler

### PARTS LIST

Part No.	Part Name
3	Impeller
*4	Impeller Key
5	Casing
5A	Casing Drain Plug
5C	Casing Stud Nut
5D	Casing Stud
*6	Casing Back Cover Ring
6A	Casing Ring
7	Cradle Spacer
7A	Bull's Eye Oil Level Indicator
7G	Spacer to Bearing Housing Capscrew
9	Bearing Housing Foot
*10	Shaft Sleeve
*10K	Shaft Sleeve Key
*12	Impeller Bolt
*12A	Impeller Washer
*12B	Impeller Lock Washer
*12C	Impeller Washer Dowel Pin
13	Seal Chamber Gland
	Packing Gland
14	Gland Stud
15	Gland Nut
*17	Lantern Ring
22	Casing Back Cover
*22A	Back Cover to Cradle Cap Screw
*25	Radial Bearing
*25A	Thrust Bearing
*26	Bearing Housing
*27	Seal Ring
*28	Bearing End Cover
*28A	Bearing End Cover Cap Screw
*29	Pump Shaft
*31	Thrust Bearing Lock Nut
*31A	Thrust Bearing Lock Washer
*54	Throat Bushing
56	Casing Foot
*56B	Casing Foot Dowel
*75B	Retaining Ring
*76	Labyrinth Seal—Front
*76A	Labyrinth Seal—Rear
77	Casing Gasket
*77B	End Cover Gasket
*80	Bearing Housing Vent
83	Motor Support (Optional)
*87	Impeller Ring—Back (Optional)
87A	Impeller Ring—Front (Optional)
95A	Mechanical Seal Stationary
95B	Mechanical Seal Rotary
*109	Oil Cooler
302	Throttle Bushing

\* Denotes parts interchangeable in all pump sizes of same material of construction of R4140 pump series.

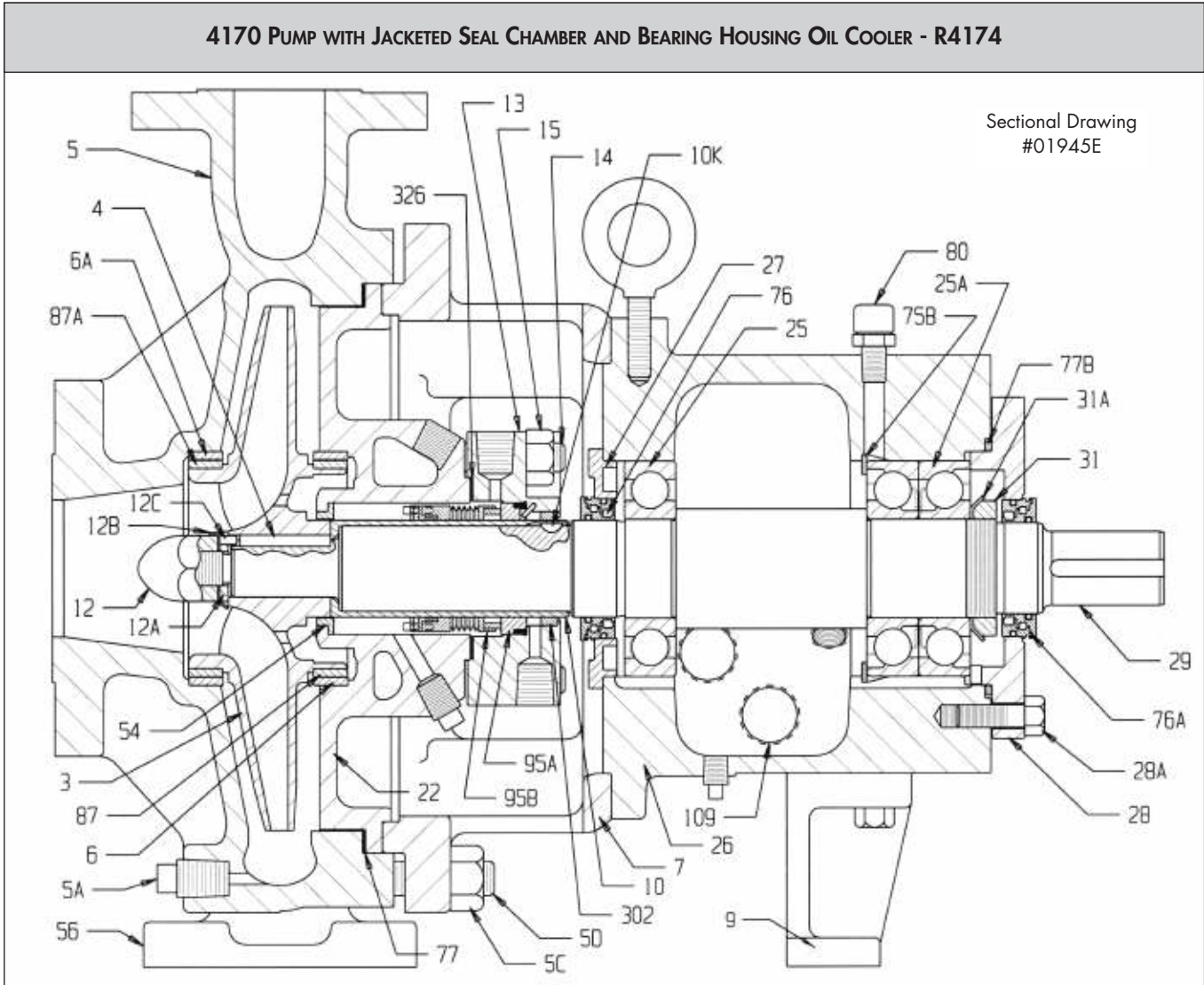
# PUMP DESIGNATION CODE FOR R4170

R4172	Pump with jacketed seal chamber	R4177	Pump with jacketed seal chamber and jacketed casing
R4174	Pump with jacketed seal chamber and oil cooler	R4178	Pump with jacketed seal chamber, jacketed casing and oil cooler
R4176	Pump with large taper bore seal chamber		

PARTS LIST					
Part No.	Part Name	Part No.	Part Name	Part No.	Part Name
3	Impeller	*12C	Impeller Washer Dowel Pin	*54	Throat Bushing
*4	Impeller Key	13	Seal Chamber Gland	56	Casing Foot
5	Casing		Packing Gland	*56B	Casing Foot Dowel
5A	Casing Drain Plug	14	Gland Stud	*75B	Retaining Ring
5C	Casing Stud Nut	15	Gland Nut	*76	Labyrinth Seal—Front
5D	Casing Stud	*17	Lantern Ring	*76A	Labyrinth Seal—Rear
*6	Casing Back Cover Ring	22	Casing Back Cover	77	Casing Gasket
6A	Casing Ring	*22A	Back Cover to Cradle Cap Screw	*77B	End Cover Gasket
7	Cradle Spacer	*25	Radial Bearing	*80	Bearing Housing Vent
7A	Bull's Eye Oil Level Indicator	*25A	Thrust Bearing	*87	Impeller Ring—Back (Optional)
7G	Spacer to Bearing Housing Capscrew	*26	Bearing Housing	87A	Impeller Ring—Front (Optional)
9	Bearing Housing Foot	*27	Seal Ring	95A	Mechanical Seal Stationary
*10	Shaft Sleeve	*28	Bearing End Cover	95B	Mechanical Seal Rotary
*10K	Shaft Sleeve Key	*28A	Bearing End Cover Cap Screw	*109	Oil Cooler
*12	Impeller Nut	*29	Pump Shaft	302	Throttle Bushing
*12A	Impeller Washer	*31	Thrust Bearing Lock Nut		
*12B	Impeller Lock Washer	*31A	Thrust Bearing Lock Washer		

\* Denotes parts interchangeable in all pump sizes of same material of construction of R4170 pump series.

## 4170 PUMP WITH JACKETED SEAL CHAMBER AND BEARING HOUSING OIL COOLER - R4174



## PUMP DESIGNATION CODE FOR R4180

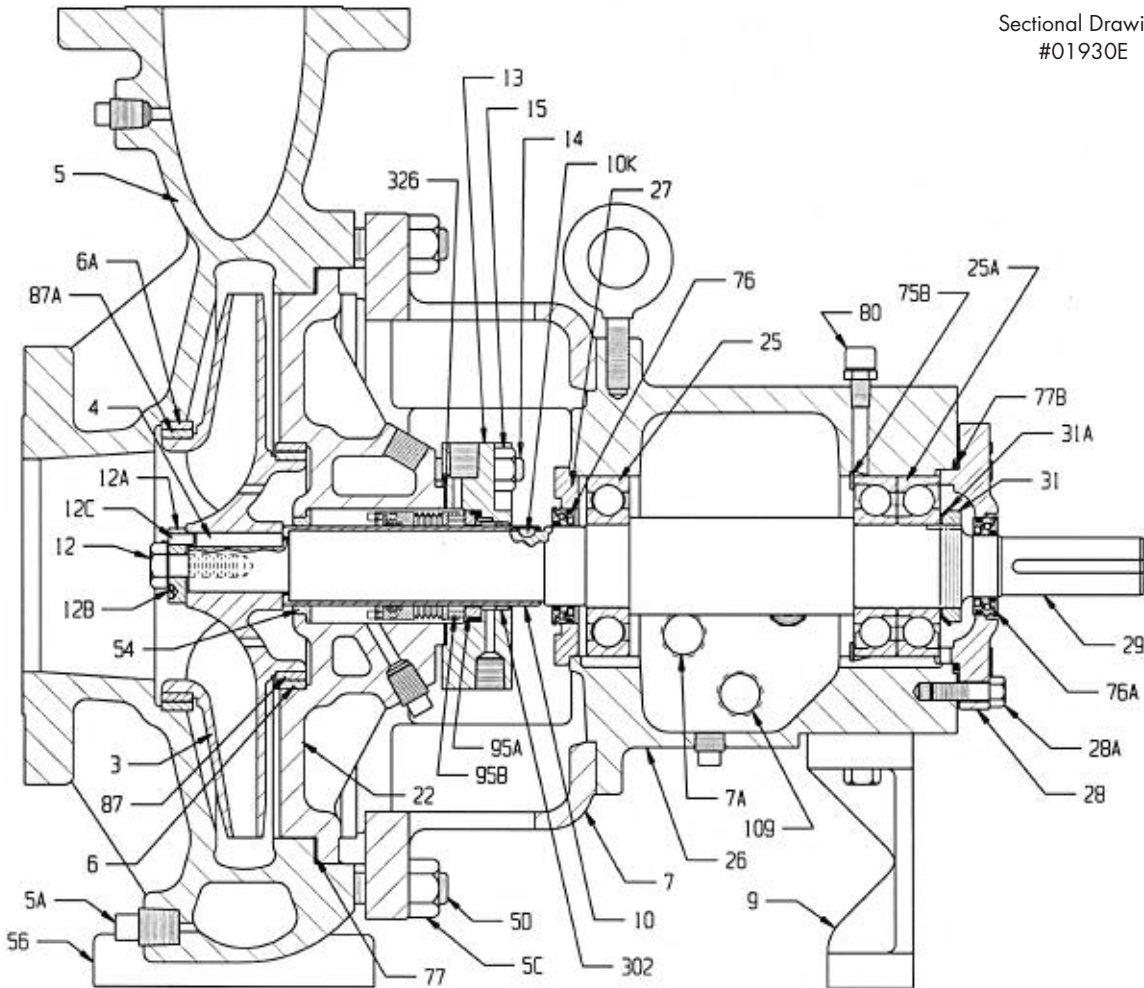
R4182	Pump with jacketed seal chamber	R4187	Pump with jacketed seal chamber and jacketed casing
R4184	Pump with jacketed seal chamber and oil cooler	R4188	Pump with jacketed seal chamber, jacketed casing and oil cooler
R4186	Pump with large taper bore seal chamber		

PARTS LIST					
Part No.	Part Name	Part No.	Part Name	Part No.	Part Name
3	Impeller	*12C	Impeller Washer Dowel Pin	*54	Throat Bushing
*4	Impeller Key	13	Seal Chamber Gland	56	Casing Foot
5	Casing		Packing Gland	*56B	Casing Foot Dowel
5A	Casing Drain Plug	14	Gland Stud	*75B	Retaining Ring
5C	Casing Stud Nut	15	Gland Nut	*76	Labyrinth Seal—Front
5D	Casing Stud	*17	Lantern Ring	*76A	Labyrinth Seal—Rear
*6	Casing Back Cover Ring	22	Casing Back Cover	77	Casing Gasket
6A	Casing Ring	*22A	Back Cover to Cradle Cap Screw	*77B	End Cover Gasket
7	Cradle Spacer	*25	Radial Bearing	*80	Bearing Housing Vent
7A	Bull's Eye Oil Level Indicator	*25A	Thrust Bearing	*87	Impeller Ring—Back (Optional)
7G	Spacer to Bearing Housing Capscrew	*26	Bearing Housing	87A	Impeller Ring—Front (Optional)
9	Bearing Housing Foot	*27	Seal Ring	95A	Mechanical Seal Stationary
*10	Shaft Sleeve	*28	Bearing End Cover	95B	Mechanical Seal Rotary
*10K	Shaft Sleeve Key	*28A	Bearing End Cover Cap Screw	*109	Oil Cooler
*12	Impeller Nut	*29	Pump Shaft	302	Throttle Bushing
*12A	Impeller Washer	*31	Thrust Bearing Lock Nut		
*12B	Impeller Lock Washer	*31A	Thrust Bearing Lock Washer		

\* Denotes parts interchangeable in all pump sizes of same material of construction of R4180 pump series.

### 4180 PUMP WITH JACKETED SEAL CHAMBER AND BEARING HOUSING OIL COOLER - R4184

Sectional Drawing  
#01930E



## PUMP DESIGNATION CODE FOR R4240

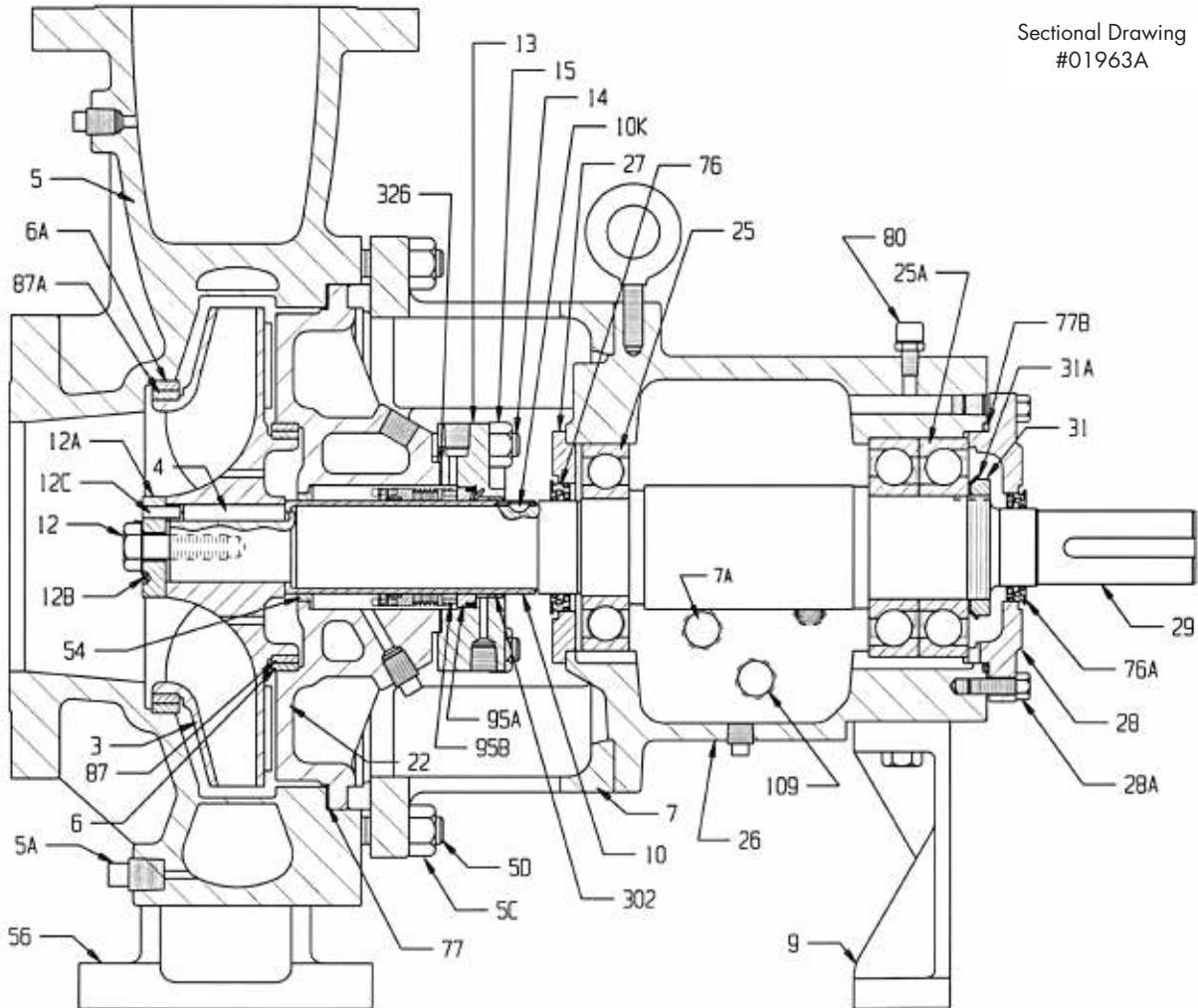
R4242	Pump with jacketed seal chamber	R4247	Pump with jacketed seal chamber and jacketed casing
R4244	Pump with jacketed seal chamber and oil cooler	R4248	Pump with jacketed seal chamber, jacketed casing and oil cooler
R4246	Pump with large taper bore seal chamber		

PARTS LIST					
Part No.	Part Name	Part No.	Part Name	Part No.	Part Name
3	Impeller	*12C	Impeller Washer Dowel Pin	*54	Throat Bushing
*4	Impeller Key	13	Seal Chamber Gland	56	Casing Foot
5	Casing		Packing Gland	*56B	Casing Foot Dowel
5A	Casing Drain Plug	14	Gland Stud	*76	Labyrinth Seal—Front
5C	Casing Stud Nut	15	Gland Nut	*76A	Labyrinth Seal—Rear
5D	Casing Stud	*17	Lantern Ring	77	Casing Gasket
*6	Casing Back Cover Ring	22	Casing Back Cover	*77B	End Cover Gasket
6A	Casing Ring	*22A	Back Cover to Cradle Cap Screw	*80	Bearing Housing Vent
7	Cradle Spacer	*25	Radial Bearing	*87	Impeller Ring—Back (Optional)
7A	Bull's Eye Oil Level Indicator	*25A	Thrust Bearing	87A	Impeller Ring—Front (Optional)
7G	Spacer to Bearing Housing Capscrew	*26	Bearing Housing	95A	Mechanical Seal Stationary
9	Bearing Housing Foot	*27	Seal Ring	95B	Mechanical Seal Rotary
*10	Shaft Sleeve	*28	Bearing End Cover	*109	Oil Cooler
*10K	Shaft Sleeve Key	*28A	Bearing End Cover Cap Screw	302	Throttle Bushing
*12	Impeller Nut	*29	Pump Shaft		
*12A	Impeller Washer	*31	Thrust Bearing Lock Nut		
*12B	Impeller Lock Washer	*31A	Thrust Bearing Lock Washer		

\* Denotes parts interchangeable in all pump sizes of same material of construction of R4240 pump series.

### 4240 PUMP WITH JACKETED SEAL CHAMBER AND BEARING HOUSING OIL COOLER - R4244

Sectional Drawing  
#01963A





## DISASSEMBLY AND ASSEMBLY PROCEDURES

### **WARNING:**

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

*When it is necessary to open the pump and/or the pumping system the fluid will be exposed to the atmosphere and personnel in the area. For the safety of all involved, the risk of exposure of personnel to the hazards of the pumpage can be reduced by flushing the entire system with a compatible, nontoxic, non-hazardous, stable 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.*

- a) 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 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(s).
- e) If the pump and driver are independently mounted to a common baseplate (not connected to each other with a motor support (83)), remove the spacer section of the coupling. Remove the two bolts that fasten the bearing housing foot (9) to the baseplate. Go to step (j).
- f) If the pump and driver (motor or turbine) are connected together by a "C" faced motor support (83), disconnect the power supply from the driver. Place wood block and wedges, under the rear feet of motor sizes 143TC through 215TC, or under the motor support (83) of motors sizes 254TC through 365TC. These blocks are to be positioned so as to support the weight of the motor and the motor support (83) when they are separated

from the pump. Hook a lifting hoist to the lifting eye(s) of the motor and take the slack out of the cable or chain. Make sure that all of the components of the lifting apparatus are capable of lifting the weight.

- g) For units with motor sizes 143TC through 215TC, remove the two bolts that fasten the motor support (83) to the baseplate. For units with motor sizes 254TC through 365C, remove the two bolts that fasten the rear feet of the motor to the baseplate.
  - h) Remove the four bolts that fasten the motor support (83) to the back of the pump. Be careful to support the weight of the motor and motor support (83) as you are removing these bolts. Carefully move the motor and motor support (83) assembly horizontally and axially away from the pump, guiding the assembly to clear the pump coupling hub.
  - i) Remove the coupling elastomer from the coupling hub. The elastomer may be in either the pump hub or the motor hub.
  - j) Drain all the fluids from all the auxiliary sub-systems (lubrication, cooling, heating, seal barrier, etc.) that are connected to the pump. Drain each fluid into a separate container. Use caution required for each fluid after reading the MSDS (Material Safety Data Sheet) for each.
  - k) Flush each sub-system with a compatible, non-toxic, non-hazardous, stable liquid. Drain into individual containers for each fluid. Disconnect and remove all auxiliary piping.
  - l) 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, gage 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.
- m) 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.**

- n) Because of the above possibility, when you loosen the gasketed joint at the back of the casing (5), loosen the casing nuts (5C) only one full turn, and then use the jack screws in the flange of the cradle spacer (7) 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 without a drain, the pump will contain fluid which will flow out at the time the nuts 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.**

- o) Remove the casing nuts (5C) and using a mechanical lifting apparatus to support the weight, pull the rotating unit from the casing (5).
- p) Flush the wetted parts, now exposed, with a compatible, non-toxic, non-hazardous, stable liquid.
- q) Remove the gasket from the face of the casing (5) or the casing back cover (22) 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. Be careful to not scar the gasket contact surfaces of the casing or the casing back cover. 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.
- r) The rotating assembly of the pump can now be moved to a more convenient location for further disassembly. Use mechanical lifting equipment to move assemblies and components.

**DISASSEMBLY PROCEDURE**

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

**WARNING:**

**Use only high quality tools.**

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

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

**Use mechanical lifting equipment to lift assemblies and components.**

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

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

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

- a) Remove gland stud nuts (15) and slide gland (13) away from seal chamber.
- b) Remove packing from stuffing box if pump is packed. Use packing extractor.
- c) Turn down the lip of the lockwasher (12B) which is turned up against one flat of the impeller bolt (12) of the R4140, R4180, and R4240 series pumps, or against the nut of the R4170 series. Remove impeller bolt (12) (right hand thread) of the R4140, R4180, and R4240 series pumps or the impeller nut (12) (left hand thread) of the R4170 series pumps. Remove impeller bolt lockwasher (12B) and the impeller retaining washer (12A). Discard the lockwasher (12B). The impeller (3) may now be removed from the shaft (29). Remove the impeller key (4) from the shaft (29).
- d) Remove the two capscrews securing the casing back cover (22) to the cradle spacer (7) and lift out the casing back cover. Do not remove the gland studs (14) from the casing back cover (22). If the gland studs (14) are damaged, or it is deemed necessary for any other reason to remove the gland studs (14), contact Dean Pump.
- e) If the pump is equipped with a mechanical seal, loosen the set screws that retain the seal and remove the mechanical seal rotary (95B). Remove the mechanical seal stationary (95A) and gland(13). Remove the mechanical seal stationary (95A) from the gland (13).
- f) If you desire to do so, you can remove the cradle spacer (7) from the bearing housing (26) by removing the four capscrews that hold these two pieces together. Normally there is no reason to remove the spacer cradle (7).
- g) Remove the shaft sleeve (10) and shaft sleeve key (10K) from the shaft.
- h) Remove pump half of coupling from shaft (29).
- i) Remove the bearing housing oil cooler (109) before attempting to remove the pump shaft (29). Remove the 1/2" tube x 1/2" male pipe thread fitting from one end of the oiler cooler (109). Remove the tubing nut and tubing ferrule from the 1/2" tube x 1" male pipe thread fitting that is in the bearing housing (26) on the same side that you removed the first fitting. Unscrew the 1/2" tube x 1" male pipe thread fitting that is on the opposite side of the bearing housing (26) from the bearing housing and pull the oil cooler (109) out through the 1" NPT opening.
- j) Remove the bearing end cover (28) and end cover gasket (77B) from the bearing housing (26). Remove the gasket (77B) from the end cover (28).
- k) Push the pump shaft (29) towards the rear of bearing housing (26) until the thrust bearings are out of the back end of the bearing housing. If the pump is of the R4140, R4170, or R4180 series, lift the shaft (29) and reach in, with snap-ring pliers, to remove the snap-ring (75B) from the bearing housing (26). Remove the pump shaft and bearing assembly from the rear of the bearing housing.
- l) Bend the tab of the lock nut washer (31A) out of the slot in the bearing lock nut (31). Remove bearing lock nut (31) and lock nut washer (31A) from the pump shaft (29). Use a hydraulic press to remove the bearings (25 and 25A) from the shaft. **Hammering bearings in any way, may result in serious damage to the pump shaft.** Remove snap ring (75B) from the pump shaft.

- m) Press seal ring (27), labyrinth seal (76) assembly from bearing housing (26).
  - n) Press the front labyrinth seal (76) from seal ring (27).
  - o) Press rear labyrinth seal (76A) from bearing end cover (28).
  - p) If necessary, remove the casing ring (6A) by prying it out of the casing (5). If the ring is tack-welded into the casing, grind the weld from between the ring and the casing before prying out the ring.
  - q) If necessary, remove the casing back cover ring (6) by prying it out of the casing back cover (22). If the ring is tack-welded into the casing back cover, grind the weld from between the ring and the casing back cover before prying out the ring.
  - r) If necessary, press the throat bushing (54) out of the casing back cover (22), using care to not damage the gland studs (14) nor the casing back cover (22).
  - s) If so desired, the bearing housing foot (9) can be removed from the bottom of the bearing housing (26).
  - t) Clean and inspect all parts.
- g) If the bearing housing vent (80) was removed, install a new vent (80), without thread sealant, into the top of the bearing housing (26). Tighten to 20 ft. lb.
  - h) Install new "O" rings onto the O.D. and into the I.D. of both the labyrinth seals (76 and 76A). Lubricate the "O" rings on the O.D. of both labyrinths.
  - i) Press the front labyrinth seal (76) into the seal ring (27).
  - j) Press the rear labyrinth seal (76A) into the bearing end cover (28). The "expulsion port" (the slot in the O.D.) of the labyrinth (76A) must be positioned at the bottom of the end cover. This will be inline with the machined "oil return" slot in the end cover (28).
  - k) Press the bearings (25 and 25A) onto the pump shaft (29). Press only on the inner races of the bearings. Do not press on the outer races. The thrust bearing is a matched pair of angular contact bearings and must be assembled "back to back". See the illustration on page 18. If the pump is of series R4140, R4170, or R4180, place the snap ring (75B) over the shaft before pressing on the last bearing(s).
  - l) Place a new bearing lock washer (31A) onto the pump shaft (29). Tighten the bearing lock nut (31) against the lock washer (31A), while holding the shaft (29) against rotation with a hook spanner in the keyway at the coupling end of the shaft. Another way to keep the shaft from turning is to place the coupling hub and key onto the shaft and hold the hub with a wrench. Tighten the nut to the torque value below:
    - 75 ft. lb. on the R4140 series
    - 90 ft. lb. on the R4170 series
    - 100 ft. lb. on the R4180 series
    - 130 ft. lb. on the R4240 series
 Bend one of the tabs of the lockwasher (31A) into the corresponding slot in the locknut (31).

## 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. One example of the above would be overboring the stuffing box or 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. If the part separates two different fluids, mixing of the fluids could cause an explosion. Water leakage into a heat transfer liquid is one example of an explosive possibility.*

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

*Use only Dean Pump parts.*

To reassemble the pump, perform the following steps:

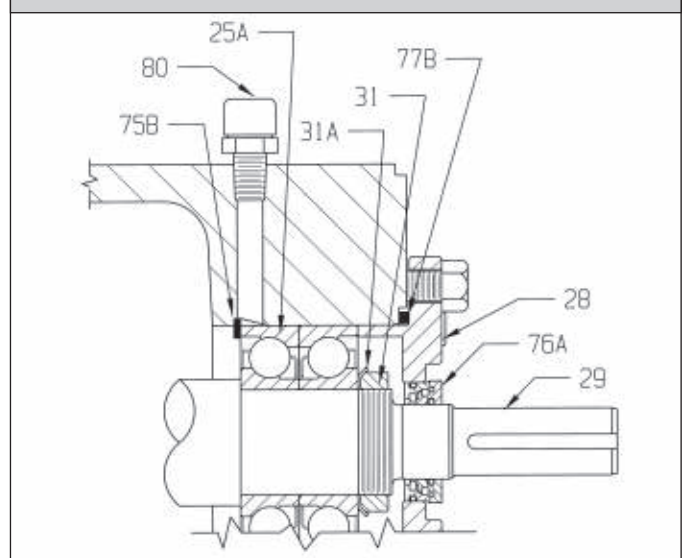
- a) Clean all parts thoroughly.
  - b) If needed, press a new throat bushing (54) carefully into the casing backcover (22).
  - c) If needed, press a new casing backcover ring (6) into the casing backcover (22).
  - d) If needed, press a new casing ring (6A) into the casing (5).
  - e) If the bearing housing foot (9) was removed, bolt it back to the bearing housing (26). Be sure that the dowel pins are in place between the foot (9) and the housing (26). Tighten the capscrews to 50 ft. lb for series R4140 and R4170 pumps. Tighten the capscrews to 80 ft. lb. for series R4180 and R4240 pumps.
  - f) If the bull's eye sight glass was removed, apply pipe sealant to the threads of a new bull's eye sight glass and tighten it into the side of the bearing housing (26). Torque to 50 ft. lb.
  - m) Lubricate the O.D. of the bearings (25 and 25A) and the bores of the bearing housing (26). Slide the shaft (29) bearing (25 and 25A) assembly into the rear of the bearing housing (26). If the pump is of the R4140, R4170, or R4180 series, after the radial bearing (25) has passed through the rear bore of the housing, reach into the opening, with snap ring pliers, and place the retaining ring (75B) into the rear bore of the housing. Install the retaining ring with the opening in the ring at the bottom of the housing so that it is centered with the oil return groove in the housing. The ring does not have to be in its groove as the bearing housing is machined with a long chamfer that allows the thrust bearing (25A) to push the ring into its groove as the shaft assembly is pushed into the bearing housing. The shaft assembly may now be fully inserted until the thrust bearing (25A) is firmly against the retaining ring (75B), and the retaining ring is firmly in its groove.
- If the pump is of the R4240 series, fully insert the shaft assembly into the bearing housing until the thrust bearing (25A) is firmly against the shoulder in the rear bore of the bearing housing.
- n) Lubricate the end cover gasket (77B), which is an "O" ring. Place the end cover gasket (77B) onto the end cover (28). Lubricate the I.D. of the rear labyrinth seal (76A), which is in the end cover (28). Lubricate the area of the pump shaft (29), just behind the thrust bearing (25A), where the rear labyrinth seal (76A) will be mounted. Slide the bearing end cover (28), labyrinth seal (76A) assembly carefully over the end of the pump shaft (29). Be careful that the "O" ring in the I.D. of the labyrinth seal (76A) does not contact the keyway of the shaft (29) and become dam-

aged. Placing a piece of plastic electrical tape over the keyway, before this assembly operation, will give a measure of protection. Rotate the end cover (28) so that the machined "oil return slot" is towards the bottom of the bearing housing (26). Seat the end cover fully into the bearing housing and tighten the end cover bolts to 20 ft. lb.

- o) Re-install the bearing housing oil cooler (109) into the bearing housing (26). Install the oil cooler (109) into the open 1" NPT connection and carefully guide the end of the tubing through the tubing connector on the opposite side of the bearing housing (26). Apply pipe sealant to the 1" male pipe threads, and tighten the 1" tube connector into the bearing housing (26) with a torque of 50 ft. lb. The ferrules used in these tube connectors are plastic, to enable disassembly and re-assembly without damaging the cooling tube. When tightening these connectors, tighten to only 5 ft. lb.
- p) Lubricate the I.D. of the front labyrinth seal (76), which is in the seal ring (27). Lubricate the area of the pump shaft (29), just in front of the radial bearing (25), where the front labyrinth seal (76) will be mounted. Slide the seal ring (27), labyrinth seal (76) assembly carefully over the end of the pump shaft (29). Be careful that the "O" ring in the I.D. of the labyrinth seal (76) does not contact the keyways of the shaft (29) and become damaged. Press the seal ring (27), labyrinth seal (76) assembly into the front of the bearing housing (26). The "expulsion port" (the slot in the O.D.) of the labyrinth (76) must be positioned so that it is towards the bottom of the bearing housing (26)
- q) Dean pumps are made with a lapped metal-to-metal joint between the shaft sleeve (10) hook and the locating shoulder on the shaft (29) to prevent liquid leakage under the shaft sleeve. The following instructions should be carefully observed when the shaft is reassembled to the shaft:
  1. Apply a small amount of 280 grit lapping compound (similar to automobile valve grinding compound) to the inside shoulder of the shaft sleeve hook.
  2. Slide the shaft sleeve (10) onto the shaft. Do not install the shaft sleeve key (10K).
  3. Rotate the shaft sleeve repeatedly by hand in its place on the shaft until the markings on both shaft and sleeve hook show that complete metal-to-metal contact has been made.
  4. Remove the shaft sleeve and flush all lapping compound from the sleeve and shaft. Reassemble the shaft sleeve on the shaft with the shaft sleeve key (10K) in place.
- r) Assemble the cradle spacer (7) to the bearing housing (26). Tighten bolts to 50 ft. lb.
- s) If the pump stuffing box is to be packed, slide the packing gland (13) over the shaft sleeve and back against the front labyrinth seal (76).
- t) If the pump is equipped with a mechanical seal, assemble the seal parts on the shaft sleeve at this time. See separate mechanical seal installation instructions.
- u) Slide the casing back cover (22) carefully into place and secure it to the cradle spacer with the two capscrews. Be especially careful not to damage mechanical seal parts. Tighten bolts to 30 ft. lb.
- v) Place the impeller key (4) into the shaft (29) keyway and slide the impeller (3) into position on the shaft (29).

If the pump is of series R4140, R4180, or R4240, drive the impeller lockwasher dowel (12C) into the impeller washer (12A) until it is flush with the side of the washer that has a blind

## BACK-TO-BACK THRUST BEARINGS



hole. Place the impeller bolt (12) through the impeller lock washer (12B) and then the impeller washer (12A) so that the protruding part of the impeller lock washer dowel (12C) is away from the head of the impeller bolt (12). Screw the impeller bolt (12) into the shaft (29) while guiding the protruding impeller lock washer dowel (12C) into the keyways of the impeller (3) and the shaft (29).

Tighten the impeller bolt (12) to the torque value below:

60 ft. lb. on the R4140 series

100 ft. lb. on the R4180 series

150 ft. lb. on the R4240 series

Use a drive pin punch to bend the edge of the impeller lock washer (12B) into the blind hole in the impeller washer (12A). Use a chisel to bend the side of the impeller lock washer (12B) up against a flat of the impeller bolt (12) approximately 90° from the blind hole.

If the pump is of series R4170, drive the impeller lockwasher dowel (12C) into the impeller washer (12A) until it is flush with one side of the washer. Place the impeller washer (12A) over the threaded end of the shaft (29), guiding the protruding impeller lock washer dowel (12C) into the keyways of the impeller (3) and the shaft (29). Place the impeller lock washer (12B) over the threaded end of the pump shaft (29). Screw the impeller nut (left hand thread) onto the end of the pump shaft (29) and tighten it to 120 ft. lb. Use a drive pin punch to bend the edge of the impeller lock washer (12B) over the flat on the side of the impeller washer (12A). Use a chisel to bend the side of the impeller lock washer (12B) up against a flat of the impeller nut (12), approximately 90° from the flat on the side of the impeller washer (12A).

- w) Replace the coupling key into the keyway at the coupling end of the pump shaft (29).
- x) If the pump and driver are independently mounted to a common baseplate, place the pump coupling hub (including the four axial bolts) onto the pump shaft (29), flush with the end of the pump shaft, and tighten the set screws. Go to step z).
- y) If the pump and driver are connected by a "C" faced motor support, place the pump coupling hub onto the pump shaft (29), to the location noted below, and tighten the set screws.

For use with motor sizes 143TC and 145TC, place pump hub to overhang pump shaft by 1/16".

For use with motor sizes 182TC and 184TC, place pump hub so that the pump shaft protrudes 3/16".

For use with motor sizes 213TC and 215TC, place pump hub to overhang pump shaft by 5/16".

For use with motor sizes 254TC and 256TC, place pump hub flush with the end of the pump shaft.

For use with motor sizes 284TSC and 286TSC, place pump hub to overhang pump shaft by 3/16".

For use with motor sizes 324TSC, 326TSC, 364TSC and 365TSC, place pump hub flush with the end of the pump shaft.

- z) If the pump shaft is to be sealed with packing, do so now. See "Installation and Maintenance of Shaft Compression Packing" section of this manual.
- aa) Rotate the pump shaft by hand to be sure there is no internal rubbing or binding.
- ab) The partial assembly can now be taken to the assembly site. Use proper lifting equipment and methods.
- ac) Place a new casing gasket (77) into the casing (5). Unscrew the two casing jacket bolts in the flange of the cradle spacer (7) until neither protrudes from the flange towards the casing. Inspect the face of the casing, where the jack screws made contact during disassembly, and carefully remove any burrs with a file.
- ad) Using a hoist to lift and position the partial pump assembly, install it into the pump casing (5). Be careful to align the assembly with the casing so that the impeller (3) slides freely into the close clearance of the casing ring (6A). Screw the casing stud nuts (5C) by hand onto the casing studs (5D) but do not tighten them yet.
- ae) If the pump and driver are independently mounted to a common baseplate, go to step ap).
- af) If the pump and driver are connected by a "C" faced motor support (83), place wood blocks and wedges under the bearing housing (26) to support the pump.
- ag) Place the motor coupling hub onto the motor shaft to the location noted below, and tighten the set screws.

On motor sizes 143TC and 145TC, place motor hub flush with the end of the motor shaft.

On motor sizes 182TC and 184TC, place motor hub so that the motor shaft protrudes 1/4".

On motor sizes 213TC and 215TC, place motor hub to overhang motor shaft by 5/16".

On motor sizes 254TC and 256TC, place motor hub flush with the end of the motor shaft.

On motor sizes 284TSC and 286TSC, place motor hub to overhang motor shaft by 3/16".

On motor sizes 324TSC, 326TSC, 364TSC and 365TSC, place motor hub flush with the end of the motor shaft.

- ah) On motor sizes 143TC, 145TC, 182TC and 184TC, bolt the spacer section to the motor hub.
- ai) Place the coupling elastomer into the pump coupling hub.
- aj) Lift the motor and motor support (83) assembly with a hoist, and position it so that the motor support pilots onto the end of the bearing housing (26) and so that the motor end of the coupling engages the coupling elastomer that is retained in the pump hub of the coupling. It may now be necessary to rotate the motor shaft slightly to allow the coupling components to engage. Install the bolts that retain the motor support (83) to the bearing housing (26). Hand tighten the bolts.
- ak) Remove all blocks and wedges while maintaining support with a hoist. Gently and carefully lower the hoist enough to allow the weight to seat the supporting feet onto the baseplate. When the support feet make full contact with the base, lightly tighten the casing stud nuts (5C) and the bolts that retain the motor support (83) to the bearing housing (26).
- al) Tighten the casing stud nuts (5C) evenly to 105 ft. lb.
- am) Tighten the motor support (83) to bearing housing (26) bolts to 65 ft. lb.
- an) Bolt the pump assembly to the baseplate, at the motor support foot (9) for motor sizes 143TC through 215TC, or at the rear two feet of the motor for motor frames 254TC through 365TSC.
- ao) Rotate the pump shaft by hand to check for rubbing or binding. Go to step at).
- ap) Gently allow the hoist to lower the pump assembly until the weight of the unit seats the bearing housing foot (9) firmly against the base plate. Tighten the casing stud nuts (5C) evenly to 105 ft. lb for 3/4" studs and 165 ft. lb. for 7/8" studs.
- aq) Bolt the bearing housing foot (9) to the baseplate. Tighten the cap screws to 50 ft. lb. for series R4140 and R4170 pumps. Tighten the cap screws to 80 ft. lb. for series R4180 and R4240 pumps.
- ar) Rotate the pump shaft by hand to check for rubbing or binding.
- as) Align the pump and driver shafts. See "Pump and Driver Alignment". Reinstall the coupling spacer.
- at) Reinstall the coupling guard(s).
- au) Lubricate the pump according to the "Pump Lubrication" instructions.
- av) Reinstall any auxiliary piping and drain plugs that were removed during disassembly.
- aw) Remove tools, old parts and debris from the area around the pump.
- ax) Follow "Starting the Pump" instructions to restart the pump.

## INSTALLATION AND MAINTENANCE OF SHAFT COMPRESSION PACKING

The proper installation and maintenance of packing to seal a pump shaft is not difficult, but must be properly done to provide good packing and pump shaft sleeve life. Most packing must be allowed to leak. This leakage is the only lubrication for the packing and additionally provides cooling to remove part of the frictional heat built up between the shaft sleeve and the packing. Failure to allow sufficient leakage will result in short packing and shaft sleeve life and increased power consumption of the pumping unit. It is entirely possible to stall a centrifugal pump by clamping the packing gland down.

Most Dean pumps are shipped from the factory without packing in the stuffing box. Die molded packing specified for the service is shipped with the pump in a separately labeled carton. The pump stuffing box must be properly packed before the pump is put into service.

The stuffing box may be packed either with or without a lantern ring (also known as a seal cage or lantern gland) as the service of the pump dictates. When the pump suction pressure is above 100 psig a lantern ring is not recommended.

### PURPOSE OF LANTERN RING

Lantern rings are made of Teflon or suitable metal as the service demands. They are of split construction and may be easily installed or removed without disassembling the pump. A lantern ring is used in the stuffing box with packing for these reasons:

- 1) To permit the introduction of a sealing liquid into the stuffing box to prevent leakage of air into the pump through the packing when the pump suction pressure is less than atmospheric pressure. The sealing liquid may be from an internal seal connection or from an external source.
- 2) To permit introduction of grease, oil, or other suitable lubricant to the packing to provide lubrication or cooling

### INTERNAL SEAL CONNECTION TO THE LANTERN RING

An internal seal connection is used to inject pumpage from the pump casing into the lantern ring through the lantern ring connection of the stuffing box to seal the pump against air leakage as noted above. It can be used only when the pumped liquid is clean and non-abrasive.

***The pumped liquid introduced through the internal seal connection to the lantern ring will not seal the pump against air leakage through the packing when the pump is idle or on stand-by service.***

### EXTERNAL SEAL CONNECTION TO THE LANTERN RING

The sealing liquid introduced to the lantern ring may be from a source external to the pump. It must be introduced at a pressure

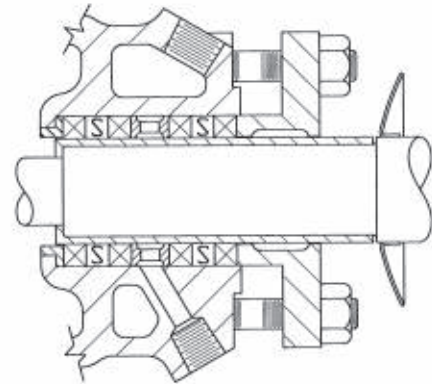
above seal chamber pressure and must be non-corrosive, non-abrasive and 150°F or less in temperature. The connection is made to the lantern ring connections on the pump stuffing box.

The lantern ring connection on the pump stuffing box is also used to introduce grease, oil, or other suitable lubricants to the lantern ring.

### LANTERN RING NOT USED

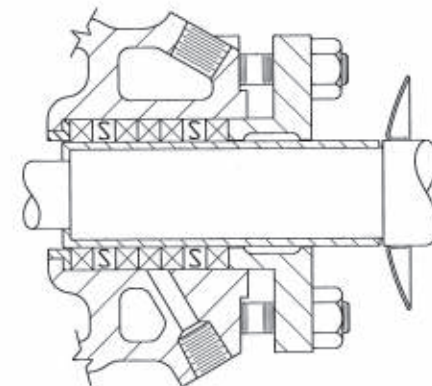
When the pump suction pressure is above atmospheric pressure or the stuffing box is pressure sealed (no impeller balance holes) and neither internal nor external liquid or lubricant is required to the packing, the lantern ring is not used and the seal chamber is packed full with rings of packing.

#### PACKED STUFFING BOX WITH LANTERN RING



S = When soft packing rings are furnished in a set with metallic rings, install the soft rings in the locations marked "S".

#### PACKED STUFFING BOX WITHOUT LANTERN RING



## PACKING INSTALLATION

These instructions apply to the conventional woven, braided, folded, and wrapped packings. Packings of multifilament Teflon, braided carbon filament, compressed carbon sheet, and other special types or materials may require special installation techniques.

The way in which the packing is installed in the stuffing box is important to the good service life of the packing and the shaft sleeve. Incorrect installation will lead to excessive leakage and may cause higher power requirements.

The use of a packing tamper (split bushing) is recommended to properly seat the packing rings. Such a tool is easily made from wood or metal in the form of a hollow cylinder. The inside diameter must be slightly larger than the shaft sleeve and the outside slightly smaller than the stuffing box bore. Split the piece lengthwise to allow insertion in the stuffing box. More than one length of packing tamper may be necessary. Suit the lengths to the particular pump.

Packing rings furnished by Dean Pump Division are diemolded to fit the stuffing box. To place a ring on the shaft sleeve, open the ring at the split at a right angle to the plane of the ring. This will best retain the molded form and avoid distortion. Successive rings should be installed with the joints at 90° intervals.

Foil wrapped packings must be installed with the foil laps running in the direction of shaft sleeve rotation on the inside of the ring. Metallic packing should be lubricated, on the wearing face only, with a dry graphite lubricant before insertion.

Foil wrapped packing sets are furnished with soft rings of packing which are placed between the hard metallic rings in the locations shown in the diagrams. These rings help to furnish lubrication during the run-in period. Being soft, they are more sensitive to compression loads and care must be taken during the adjustment period.

Follow these steps:

- 1) With the packing gland slid back towards the bearing housing, or removed if it is a two piece gland, place a ring of packing on the shaft sleeve and enter it carefully into the stuffing box. Insert the halves of the packing tamper and push the packing ring to the bottom of the stuffing box. Slide the packing gland up against the end of the packing tamper with the gland studs indexed in the gland holes, put on the gland stud nuts and tighten them firmly and evenly to seat the packing ring.
- 2) Back off the gland, remove the packing tamper, and insert a second ring of packing, staggering the ring joint 90° from that in the first ring. Repeat the seating procedure above.
- 3) If a lantern ring is to be used, check the pump specifications to determine its position in relation to the number of rings between

the bottom of the seal chamber and the lantern ring. Insert packing rings as above until the lantern ring position is reached and then install the lantern ring.

- 4) If no lantern ring is to be used, or after the lantern ring is put in place, continue to add packing rings, one at a time, staggering joints at 90° intervals, until the stuffing box is nearly full.
- 5) Put the packing gland in place and pull up the gland stud nuts firmly. Back the gland stud nuts off to finger tightness.
- 6) Rotate the pump shaft by hand to be sure it is not locked.
- 7) **Final adjustment of the packing compression must be made with the pump running.** Start and stop the pump several times to begin the running-in period. Allow sufficient leakage to assume good lubrication during the adjustment. Pull up the gland stud nuts 1/8 turn at a time. Allow a running in period between adjustments. Continue adjustment until the desired leakage control is reached. The minimum leakage rate depends on a number of things: liquid pumped, packing used, temperature, stuffing box pressure, and the condition of the pump. In any case, some leakage is necessary to both lubricate and cool the packing. Minimum rates may vary from a few drops per minute to as much as 1/2 pint per minute.
- 8) As the packing wears in service, the gland should be readjusted to maintain the minimum leakage.
- 9) After the gland has been taken up to full travel, an additional ring of packing may be placed in the stuffing box. When the gland has again been taken up to full travel the stuffing box should be repacked completely.

## USUAL CAUSES OF PACKING FAILURE AND EXCESSIVE STUFFING BOX LEAKAGE

- 1) Packing has not been installed properly.
- 2) Packing used is not suitable for the temperature and pressure involved or may be subject to attack by liquid handled.
- 3) Inner rings are not thoroughly seated in the stuffing box so that outer rings are carrying all the load.
- 4) Dirt and foreign particles in stuffing box are causing rapid scoring of shaft sleeve.
- 5) Stuffing box cooling water not turned on.
- 6) Packing gland pulled up too tight.

When ordering additional packing sets, always refer to packing set number and to pump serial number.

## INSTALLATION OF STANDARD MECHANICAL SEALS

Clean, careful, and correct installation of the mechanical seal is essential to successful mechanical seal operation. Cleanliness and accuracy of setting cannot be overemphasized.

For instructions on the pump disassembly and assembly, see above.

A correct mechanical seal drawing is furnished with each pump and the mechanical seal setting dimension is given on this drawing.

Use the setting for the specific pump type in which the installation is being made.

The pump is first assembled according to the applicable assembly instructions through the step of casing back cover installation.

The mechanical seal rotary unit must be properly located in relation to the face of the pump seal chamber in order to establish the proper seal spring tension and resultant proper force on the seal faces. An error in setting of more than several thousandths may well cause seal failure by excessive or insufficient seal face pressure.

## INSTALLATION OF SINGLE INSIDE SEALS

To make the seal installation, with the pump partially assembled as noted above, scribe a mark on the shaft sleeve (10) exactly in line with the face of the pump seal chamber (Note 1). The impeller (3), and casing back cover (22) are now removed from the pump. If the mark causes roughness on the shaft sleeve remove the burr carefully

with crocus cloth. Any roughness on the shaft sleeve may damage the mechanical seal shaft packing when the seal is assembled.

Referring to the mechanical seal drawing, determine the proper "D" dimension for the seal and pump type. Measure carefully from the mark which you have made on the shaft sleeve and make a new mark on the shaft sleeve, towards the pump end, exactly to this dimension.

**NOTE**—Pumps using a single inside balanced seal (except metal bellows) are furnished with a short shaft sleeve. The mark is made on the shaft because the sleeve does not extend to this point. The second mark (setting mark) is made on the shaft sleeve and measured from the mark on the shaft.

If the mechanical seal insert (315) is of the clamped-in style, put the mechanical seal gland (300) on the pump shaft and slide it back towards the bearing housing (26). Put the gland gasket (325), the gland insert (315) and the seat gasket (326) on the shaft. Make sure that the lapped face of the seal insert is towards the seal chamber.

Flexibly mounted inserts are of two types, depending on the service of the pump. The insert may be of rectangular cross section grooved for an "O" ring or it may be of L-shaped cross-section used with a Teflon or Grafoil seat ring. Flexibly mounted inserts (315) frequently utilize a seat locking pin (375) pressed into the gland (300) to keep the insert from rotating. Check the condition of the pin (375) in the gland (300). If it needs replacing, pull the old pin out and press a new pin (375) in. Press the pin (375) into the gland (300) to the point where there is 1/32" of clearance between it and the bottom of the mating notch in the insert (315). Check this by installing the insert (315) into the gland (300) with out the seat ring (328). After checking the clearance, remove the insert (315) from the gland (300).

To position the "O" ring mounted insert, place the "O" ring (328) into the groove of the insert (315). Lubricate the "O" ring (328) and the inside of the mechanical seal gland (300). Slide the insert (315) into the seal gland (300) being careful not to damage the "O" ring (328). Make sure that the lapped face of the insert (315) faces toward the seal chamber and that the pin (375) enters the notch in the insert (315). Also be sure that the pin (375) does not touch the bottom of the notch in the insert (315).

To install the Teflon or Grafoil mounted insert, place the seat ring (328) carefully on to the insert (315). The seat ring (328) is chamfered on the outside diameter on one end, it is necessary to have this chamfer facing away from the insert (315). Lubricate the outside diameter of the seat ring (328) and the inside of the mechanical seal gland (300), if the seat ring (328) is Grafoil, use a round dowel (or similar object) and carefully smooth the chamfered edge. Carefully slide the insert (315), seat ring (328) assembly into position into the seal gland (300). Make sure that the pin (375) enters the notch in the insert (315). Also be sure that the pin (375) does not touch the bottom of the notch in the insert (315).

Put the mechanical seal gland (300) and insert (315) on the shaft (29) and slide it back towards the bearing housing (26). Be careful not to damage the insert or its mounting. Put the gland gasket (324) over the shaft and into the gland. Slide the seal rotary unit assembly carefully onto the shaft sleeve being particularly careful not to damage the seal shaft packing (345). Be sure that the shaft sleeve hook is firmly against the shoulder on the shaft. Set the rotary unit carefully to the setting mark you have made on the shaft sleeve and lock it tightly in place with the set screws. Recheck the setting. Slide the pump casing back cover (22) carefully into place, secure it with the two capscrews and then guide the seal gland insert and gaskets together with the gland carefully into position. Reassemble the pump.

Now tighten the gland stud nuts carefully and evenly to avoid cocking the gland, making sure that the gland insert and gaskets are in place. Tighten the gland stud nuts (15) evenly to; 20 Ft.Lb. for 1/2" studs, 40 Ft.Lb. for 5/8" studs, 65 Ft.Lb. for 3/4" studs, or 75 Ft.Lb. for 7/8" studs.

Before starting the pump, bleed the air from the seal chamber. The seal chamber must be full of liquid or the seal faces may be damaged by lack of lubrication when the pump is started.

Occasionally a seal may leak very slightly when the pump is first started. If the leakage continues more than a few minutes the pump should be shut down and the seal removed to discover the cause.

#### **INSTALLATION OF SINGLE OUTSIDE UNBALANCED SEALS**

If the seal rotary unit is scribed with a setting mark, the shaft marking procedure outlined below may be omitted.

The setting mark can be found on the outer shell of the rotary unit running circumferentially between the four round holes in the shell. Visible through each hole is the edge of the metal disc against which the seal springs bear. To set the seal with the proper spring pressure, first assemble the pump as noted below with the seal rotary unit slid back towards the bearing housing (26) and left loose until the entire bearing housing-impeller assembly is bolted in place in the pump casing. Then slide the seal rotary unit into place against the stationary insert and compress the springs until the metal disc visible through the holes is aligned with the setting mark scribed on the shell. Tighten the set screws and check through each hole to determine that the seal rotary unit is correctly compressed and not cocked.

If the seal rotary unit is not marked with a setting line, a setting mark must be made on the shaft sleeve. To make the seal installation, with the pump partially assembled as noted above, scribe a mark on the shaft sleeve (10) exactly in line with the face of the pump seal chamber. The impeller (3), and casing back cover (22) are now removed from the pump. If the mark causes roughness on the shaft sleeve remove the burr carefully with crocus cloth. Any roughness on the shaft sleeve may damage the mechanical seal shaft packing when the seal is assembled.

Referring to the mechanical seal drawing, determine the proper "D" dimension for the seal and pump type. Measure carefully from the mark which you have made on the shaft sleeve and make a new mark on the shaft sleeve, towards the bearing housing, exactly to this dimension. Remove the burr if necessary. This mark is the seal setting mark.

Put the mechanical, seal rotary unit on the shaft and slide it back towards the bearing housing (26). Assemble the seat gasket (326), the mechanical seal insert (315), and gland gasket (325) to the face of the seal chamber and, placing the gland (300) in position, pull down the gland stud nuts (15) evenly to; 20 Ft.Lb. for 1/2" studs, 40 Ft.Lb. for 5/8" studs, 65 Ft.Lb. for 3/4" studs, or 75 Ft.Lb. for 7/8" studs. Make sure that the lapped face of the seal insert is towards the rotary unit. Reassemble the pump. Now carefully slide the rotary unit and set it to the mark on the shaft sleeve and lock the rotary unit tightly in place with the set screws. Be careful not to cock the rotary unit.

Before starting the pump, bleed the air from the seal chamber. The seal chamber must be full of liquid or the seal faces may be damaged by lack of lubrication when the pump is started.

Occasionally a seal may leak very slightly when the pump is first started. If the leakage continues more than a few minutes the pump should be shut down and the seal removed to discover the cause.



**INSTALLATION OF DOUBLE INSIDE UNBALANCED SEALS**

To make the seal installation, with the pump partially assembled as noted above, scribe a mark on the shaft sleeve (10) exactly in line with the face of the pump seal chamber. The impeller (3) and casing back cover (22) are now removed from the pump. If this marking or subsequent marking causes roughness on the shaft sleeve remove the burr carefully with crocus cloth. Any roughness on the shaft sleeve may damage the mechanical seal shaft packing when the seal is assembled.

Referring to the mechanical seal drawing, determine the two "D" dimensions for the two rotary units. Be sure to determine those for the particular pump type. Measure carefully from the mark which you have made on the shaft sleeve and make two new marks on the shaft sleeve, towards the seal chamber, exactly to these dimensions.

Double seal stationary inserts are of two types depending on the service conditions of the pump. The inserts may be of rectangular cross section grooved for a "O" ring or the inserts may be of L-shaped cross-section used with a Teflon or Grafoil seat ring. This construction frequently utilizes seat locking pins (375) pressed into the throat bushing (54) and the gland (300) to keep the inserts from rotating. Check the condition of the pins (375) in the throat bushing (54) and the gland (300). If they need replacing, pull the old pins out and press new pins (375) in. Press the pins (375) into the throat bushing (54) and the gland (300) to the point where there is 1/32" of clearance between it and the bottom of the mating notch in the insert (315). Check this by installing the inserts (315) into the casing back cover (22) and the gland (300) without the seat rings (328). After checking the clearance, remove the inserts (315) from the casing back cover (22) and the gland (300).

To position the "O" ring mounted inserts, place the "O" rings (328) into the grooves of the inserts (315). Lubricate the "O" rings (328), the inside of the casing back cover (22), and the inside of the mechanical seal gland (300). Slide the inserts (315) into the casing back cover (22) and the seal gland (300) being careful not to damage the "O" rings (328). When installing the insert (315) into the casing back cover (22), be sure to slide it smoothly and continuously past the drilled holes in the bore of the seal chamber. Do not pause as the insert crosses these drilled holes. Make sure that the lapped faces of the inserts (315) face towards the seal rotary units and that the pins (375) enter the notches in the inserts (315). Also be sure that the pins (375) do not touch the bottom of the notches in the inserts (315).

To install the Teflon or Grafoil mounted inserts, place the seat rings (328) carefully on to the inserts (315). The seat rings (328) are

chamfered on the outside diameter on one end, it is necessary to have this chamfer facing away from the insert (315). Lubricate the outside diameter of the seat rings (328), the inside of the casing back cover (22), and the inside of the mechanical seal gland (300), if the seat rings (328) are Grafoil, use a round dowel (or similar object) and carefully smooth the chamfered edge. Carefully slide the insert (315), seat ring (328) assemblies into position into the casing back cover (22) and the seal gland (300) being careful not to damage the seat rings (328). When installing the insert/seat assembly into the casing back cover (22), be sure to slide it smoothly and continuously past the drilled holes in the bore of the seal chamber. Do not pause as the insert crosses these drilled holes. Make sure that the lapped faces of the inserts (315) face toward the seal rotary units and that the pins (375) enter the notches in the inserts (315). Also be sure that the pins (375) do not touch the bottom of the notches in the inserts (315).

Put the mechanical seal gland (300), with insert installed, on the pump shaft sleeve (10) and slide it back towards the bearing housing (26). Put the seal gland gasket (324) over the sleeve (10) and into the gland (300). Slide one seal rotary unit on the sleeve (10) with the carbon face towards the bearing housing. Be careful not to damage the seal shaft packaging (345). Be sure that the shaft sleeve (10) hook is firmly against the shoulder on the shaft. Set the rotary unit carefully to its setting mark on the shaft sleeve (10) and lock it tightly in place with the set screws. Slide the second rotary unit onto the shaft sleeve (10) with the carbon face away from the bearing housing. Set it carefully to its setting mark and lock it tightly in place. Recheck both rotary settings and correct if necessary. Slide the pump casing back cover (22) very carefully in place over the seals and secure it with the two capscrews. Slide the gland gasket (324) and seal gland (300) into place and carefully tighten the gland stud nuts (15) evenly to; 20 Ft.Lb. for 1/2" studs, 40 Ft.Lb. for 5/8" studs, 65 Ft.Lb. for 3/4" studs, or 75 Ft.Lb. for 7/8" studs. Do not cock the gland. The pump may now be reassembled.

Double seals require a liquid in the seal chamber between the seal inserts to provide lubrication. This barrier liquid must be supplied at a pressure of 10 to 15 psi above seal chamber throat pressure to activate the inboard seal. Before starting the pump be sure that the seal chamber is full of this lubrication and that all supply lines for this liquid are in place and in operation.

Leakage from the outboard seal can be easily spotted. Leakage through the inboard seal can be detected only by the loss of the barrier (lubricating) liquid from between the seals. If leakage occurs, the pump must be disassembled and the cause of leakage determined.

CUSTOMER'S PLANT MAINTENANCE RECORD	
Dean Pump Serial Number _____	Service _____
Plant Property Number _____	Location _____
Capacity _____ ; T.D.H. _____ ; Imp. Dia. _____ ; Temp. _____ ; RPM _____	
Materials of Construction: Casing _____ ; Impeller _____ ; Shaft _____ ; Shaft Sleeve _____	
Spare Parts in Plant Stock Room _____	
Interchangeable with Dean Serial Numbers _____	
_____	
_____	

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

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

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

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

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

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

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

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

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

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

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

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

Use only top quality tools.

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

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

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

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

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

Remove the coupling guard. Remove the coupling spacer.

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

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

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

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

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

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

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

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

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

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

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

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

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

Use mechanical lifting equipment to lift assemblies and components.

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

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

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

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

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

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

Use only Dean Pump Division of MetPro Corporation parts.