

# CECO Dean

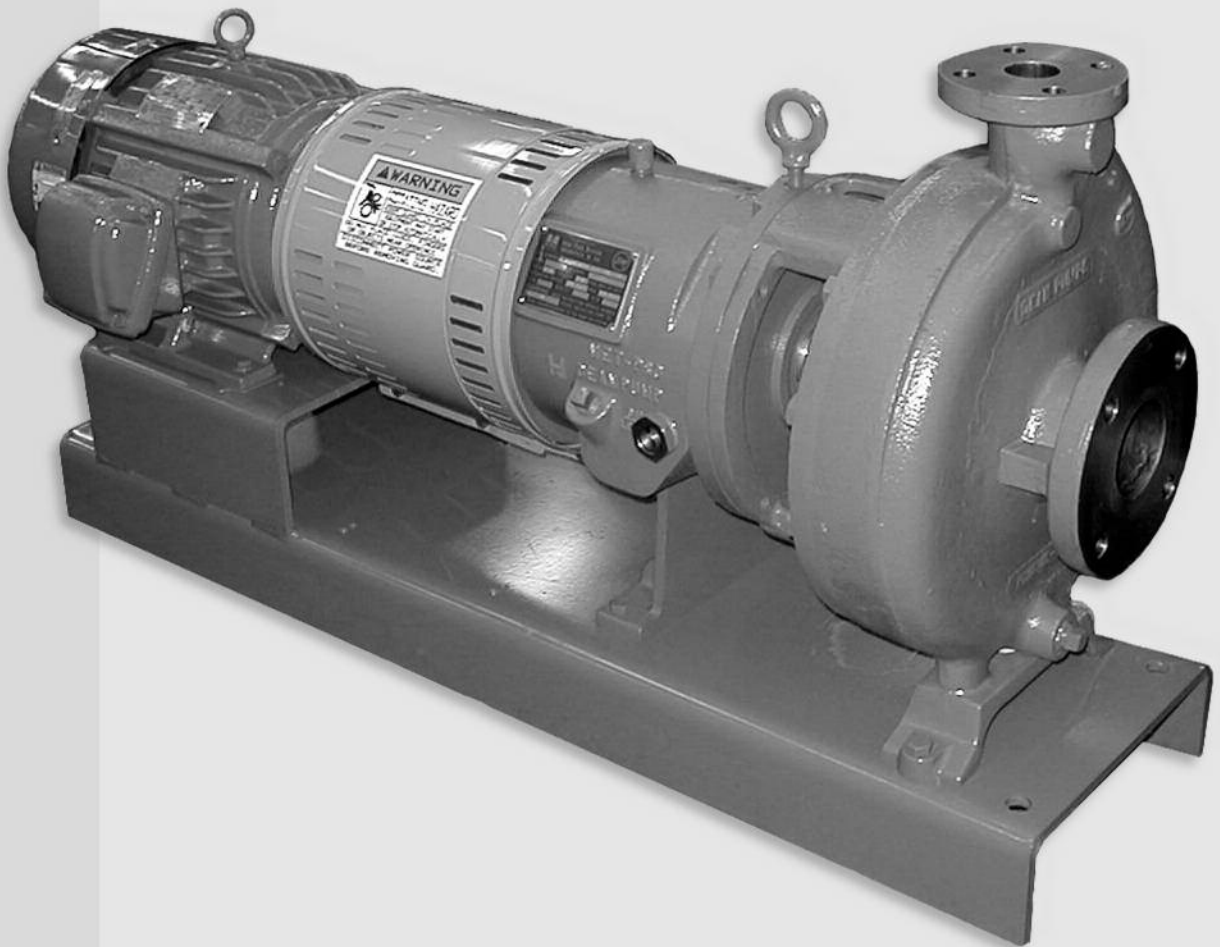
## DEAN PUMP® SERIES PH/PHP

### Horizontal Process Pumps

INSTALLATION

OPERATION

MAINTENANCE MANUAL



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

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**STANDARD, HORIZONTAL, SINGLE STAGE, END SUCTION, OPEN IMPELLER, CENTRIFUGAL PROCESS PUMPS**

**pH2110 Series: Types pH2111, 2112, 2114, 2116, 2117, 2118 • pH2140 Series: Types pH2141, 2142, 2144, 2146, 2147, 2148**  
**pH2170 Series: Types pH2171, 2172, 2174, 2176, 2177, 2178 • pH3170 Series: Types pH3171, 3172, 3174, 3176, 3177, 3178**  
**pH2180 Series: Types pH2181, 2182, 2184, 2186, 2187, 2188**

MECHANICAL DESIGN SPECIFICATIONS					
PUMP TYPE	pH2110 pHP2110	pH2140 pHP2140	pH2170	pH3170	pH2180
Direction of Rotation (Viewed from Coupling End)	CW	CW	CW	CW	CW
Horsepower Rating @ 3500 rpm @ 1750 rpm @ 1150 rpm	3.5 HP 1.5 HP 1.0 HP	100 HP 40 HP 30 HP	— 100 HP 60 HP	200 HP 100 HP —	— 125 HP 75 HP
Hydrostatic Test Pressure	430 psig	430 psig	430 psig	565 psig	450 psig
Corrosion Allowance	1/8"	1/8"	1/8"	1/8"	1/8"
Impeller Balance	Single Plane Dynamic Balance				
Flanges ANSI Class Facing – standard – optional	150 F.F. R.F. 125 Ra	150 F.F. R.F. 125 Ra	150 F.F. R.F. 125 Ra	300 F.F. R.F. 125 Ra	300 F.F. R.F. 125 Ra
Finish	—	—	—	—	—
Stuffing box jacket pressure maximum	125 psig	125 psig	125 psig	125 psig	125 psig
Bearing housing cooler pressure maximum	125 psig	125 psig	125 psig	125 psig	125 psig
Maximum Suction Pressure	275 psig	275 psig	275 psig	375 psig	300 psig
Bearings: Thrust Bearing Radial Bearing Lubrication	5306 207 Oil	5309 6309 Oil	7311 BG 6311 Oil	7311 BG 6311 Oil	5312 6312 Oil
Approximate oil capacity of bearing housing	26 oz	42 oz	36 oz	36 oz	64 oz
Seal Chamber Dimensions: Tapered Seal Chamber Length (Depth) Inside Diameter (Bore) Shaft Sleeve Diameter	23/8" 27/8" 13/8"	31/16" 31/2" 13/4"	31/16" 31/2" 21/8"	31/16" 37/8" 21/8"	45/8" 41/4" 21/4"
Cylindrical Seal Chamber Length (Depth) Inside Diameter (Bore) Shaft Sleeve Diameter	17/8" 27/8" 13/8"	21/4" 31/2" 13/4"	23/16" 31/2" 21/8"	23/16" 37/8" 21/8"	35/16" 41/4" 21/4"
Stuffing Box Dimensions: Length (Depth) Inside Diameter (Bore) Shaft Sleeve Diameter Lantern Gland Width	21/8" 2" 13/8" 7/16"	23/4" 21/2" 13/4" 5/8"	23/4" 27/8" 21/8" 5/8"	23/4" 27/8" 21/8" 5/8"	37/8" 31/4" 21/4" 3/4"
Packing Size – Square Number of Rings with Lantern Ring Number of Rings without Lantern Ring Spacing with Lantern Ring	5/16" 5 6 2-G-3	3/8" 5 7 2-G-3	3/8" 5 7 2-G-3	3/8" 5 7 2-G-3	1/2" 6 7 3-G-3
Pump Shaft Dimensions: Span Between Bearings Span Between Radial Bearing and Impeller Diameter Under the Sleeve Diameter with No Sleeve Diameter at Coupling Diameter Between Bearings Diameter at Impeller	315/16" 513/16" 11/8" 13/8" 7/8" 11/2" 3/4"	63/8" 77/8" 11/2" 13/4" 11/8" 21/8" 11/4"	515/16" 83/16" 17/8" 21/8" 15/8" 25/8" 11/4"	515/16" 83/16" 17/8" 21/8" 15/8" 25/8" 11/4"	87/16" 103/4" 2" 21/4" 15/8" 23/4" 15/8"
L <sup>3</sup> /D <sup>3</sup> Ratio Sleeved Shaft Solid Shaft (No Sleeve)	123 55	96 52	44 27	44 27	78 48

MAX. ALLOWABLE PUMP SUCTION PRESSURE (psi) WITH 2 YR. MIN. THRUST BEARING LIFE									
PUMP SIZE	With Balance Holes			Without Balance Holes			Values of Fn		
	3500 RPM	1750 RPM	1150 RPM	3500 RPM	1750 RPM	1150 RPM	3500 RPM	1750 RPM	1150 RPM
pH/pHP							psi	psi	psi
1 x 1 1/2 x 6 pH2110 1 1/2 x 3 x 6 2 x 3 x 6 1 x 1 1/2 x 8 1 1/2 x 3 x 8 / 1 1/2 x 1 1/2 x 8	maximum allowable suction pressure = maximum allowable discharge pressure less developed head						18	4.5	2.0
1 x 2 x 8 1/2 pH2140 1 1/2 x 3 x 8 1/2 2 x 3 x 8 1/2 3 x 4 x 8 1/2 #1 3 x 4 x 8 1/2 #2	110 115 115 110 110	185 185 185 180 175	200 200 200 210 200	180 190 195 200 230	200 195 205 200 220	205 205 25.2 39.0 22.0	25.2 18 18 22 18	4.5 4.5 4.5 5.5 4.5	2.7 2.7 2.7 3.5 2.0
1 x 2 x 10 1 1/2 x 3 x 10 / 2 x 2 x 10 2 x 3 x 10 / 3 x 3 x 10 3 x 4 x 10 #1 / 4 x 4 x 10 3 x 4 x 10 #2	110 110 110 110	180 180 180 180	200 200 200 210	185 185 185 205 200	195 195 205 210 205	205 205 25.2 39.0 205	25.2 18 18 22 18	6.3 6.3 6.3 6.3 9.7	2.7 2.7 2.7 2.7 4.2
1 1/2 x 3 x 11 1/2 2 x 3 x 11 1/2 3 x 4 x 11 1/2 4 x 6 x 11 1/2		105 105 170 150	180 180 200 180	180 180 190 200	200 200 205 205	25.2 25.2 14.0 14.0	6.3 6.3 6.0 6.0	2.7 2.7 6.0 6.0	
1 1/2 x 3 x 13 1/2 2 x 3 x 13 1/2 3 x 4 x 13 1/2		165 165 165	195 195 195	185 185 185	200 200 200	6.3 6.3 6.3	2.7 2.7 2.7		
4 x 6 x 13 1/2 pH2170		240	260	240	260	23	10.0		
1 1/2 x 3 x 13 1/2 pH3170 2 x 3 x 13 1/2 3 x 4 x 13 1/2	300 300 285					25.2 25.2 25.2			
4 x 6 x 13 1/2 pH2180 6 x 8 x 13 1/2		225 225	275 275	275 275	275 275	22.0 15.0	10.0 6.7		

**Seal Chamber Pressure:**  
**With Balance Holes:** seal chamber pressure = suction pressure  
**Without Balance Holes:** Pumps are normally furnished without balance holes.  
 seal chamber pressure = (suction pressure) + (Fn x sp. gr.)

STANDARD MATERIALS OF CONSTRUCTION							
Part No.	Part Name	Class 22	Class 50	Class 60	CD4MCu	Hast.	Titanium
3	Impeller	C.I. (1)	316 (12)	Alloy 20 (2)	CD4MCu	Hast.	Titanium
5	Casing	D.I. (10)	316 (12)	Alloy 20 (2)	CD4MCu	Hast.	Titanium
5A	Casing Drain Plug	1020 Steel	316 S/S	Alloy 20	316 S/S	Hast.	Titanium
5C	Casing Stud Nut	Ⓢ			Steel (4)		
5D	Casing Capscrew Casing Stud	Ⓢ <sup>Ⓢ</sup> †			Steel (11) Steel (6)		
7	Cradle Spacer	Ⓢ†			D.I. (13)		
7G	Spacer to Brg. Hsg. Capscr.	Ⓢ†			1020 Steel		
9	Bearing Housing Foot	Ⓢ†			C.I. (1)		
10	Shaft Sleeve	▲†	316 S/S	Alloy 20	316 S/S	Hast.	Titanium
10K	Sleeve Key	▲†			304 S/S		
13	Seal Chamber Gland		316 S/S	Alloy 20	316 S/S	Hast.	Titanium
14	Gland Stud		304 S/S	Alloy 20	304 S/S	Hast.	Titanium
15	Gland Nut		304 S/S	Alloy 20	304 S/S	Hast.	Titanium
17	Lantern Ring	Ⓢ†			Teflon ■		
	Lantern Ring	Ⓢ†	C.I. (1)	316 S/S	Alloy 20		
22	Casing Back Cover	Ⓢ†	D.I. (10)	316 (12)	Alloy 20 (2)	CD4MCu	Hast. Titanium
22A	Back Cover to Cradle Capscrew	▲†			1020 Steel		
25	Radial Bearing	▲†	—	—	—	—	—
25A	Thrust Bearing	▲†	—	—	—	—	—
26	Bearing Housing	†	D.I. (13) for pH2110 & pHP2110, C.I. (1) for all others				
27	Seal Ring	Ⓢ†			C.I. (1)		
28	Bearing End Cover	▲†			C.I. (1)		
28A	Bearing End Cover Capscrew	▲†			1020 Steel		
28B	End Cover Adjusting Screw	▲†			1020 Steel		
28C	Adjusting Screw Locking Nut	▲†			1020 Steel		
29	Pump Shaft	▲†			Steel (5)		
31	Thrust Bearing Lock Nut	Ⓢ†			1020 Steel		
31A	Thrust Bearing Lock Washer	Ⓢ†			1020 Steel		
56	Casing Foot	Ⓢ			C.I. (1)		
56A	Casing Foot Capscrew	Ⓢ†			1020 Steel		
56B	Casing Foot Dowel	Ⓢ†			1020 Steel		
75A	Tapered Retaining Ring	Ⓢ▲			Steel		
75B	Large Retaining Ring	Ⓢ†			Steel		
76	Labyrinth Seal – Front	▲†			Bronze & Viton ■		
76A	Labyrinth Seal – Rear	▲†			Bronze & Viton ■		
77	Casing Gasket	Ⓢ†			Teflon ■		
77A	Impeller Gasket	▲†			Teflon ■		
77B	End Cover Gasket	▲†			Buna (7)		
80	Vent	▲†			—		
83	Motor Support (C Face)	Ⓢ†			C.I. (1)		
95A	Mechanical Seal Stationary	▲†					
95B	Mechanical Seal Rotary	▲†					
109	Oil Cooler	▲†			S/S Tubing with Steel Fins and Steel Fittings		
231	Bearing Lock Ring	Ⓢ†			1020 Steel		
231A	Bearing Lock Ring Screw	Ⓢ†			1020 Steel		
231B	Bearing Lock Ring Washer	Ⓢ†			1020 Steel		

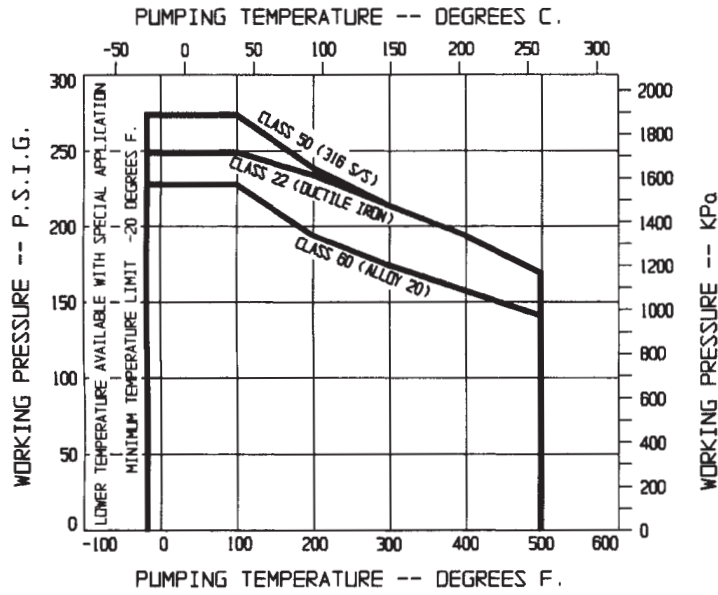
- Ⓢ pH2140, pH2170, pH3170, pH2180 and pHP2140 only
- Ⓢ pH2110, pH2140, pH2170, pH2180, pHP2110 and pHP2140 only
- Ⓢ pH2110, and pHP2110 only
- Ⓢ pH2170, pH3170, and pH2180 only
- Ⓢ pH2140 and pHP2140 only
- Ⓢ pH3170 only
- Ⓢ pH2110, pH2140, pHP2110, and pHP2140 only
- † Denoted parts are interchangeable in all pH2110 and pHP2110 pumps
- † Denoted parts are interchangeable in all pH2140 and pHP2140 pumps
- † Denoted parts are interchangeable in all pH2170 and pH3170 pumps
- † Denoted parts are interchangeable in all pH2180 pumps
- Registered Trademark of the E.I. DuPont Company

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

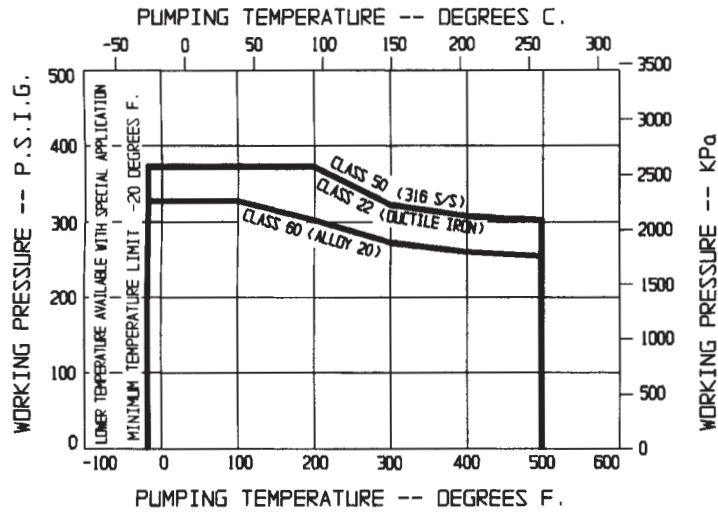
- |   |                                      |
|---|--------------------------------------|
| (1) Cast Iron                             | (8) Fibre Sheet — Non-Asbestos Fibre |
| (2) Alloy 20 S/S: ASTM #A744, Grade CN-7M | (9) Manila Paper                     |
| (3) Cast Steel: ASTM #A216, Grade WCB     | (10) Ductile Iron: ASTM A395         |
| (4) Steel: ASTM #A194, Grade 2            | (11) Steel: ASTM #A449               |
| (5) Alloy Steel: 125,000 TS, 100,000 YP   | (12) 316 S/S: ASTM #A744 Grade CF-8M |
| (6) Steel: ASTM #A193, Grade B7           | (13) Ductile Iron: ASTM A536         |
| (7) Buna "N" Rubber                       |                                      |

MAXIMUM ALLOWABLE WORKING PRESSURE CURVES

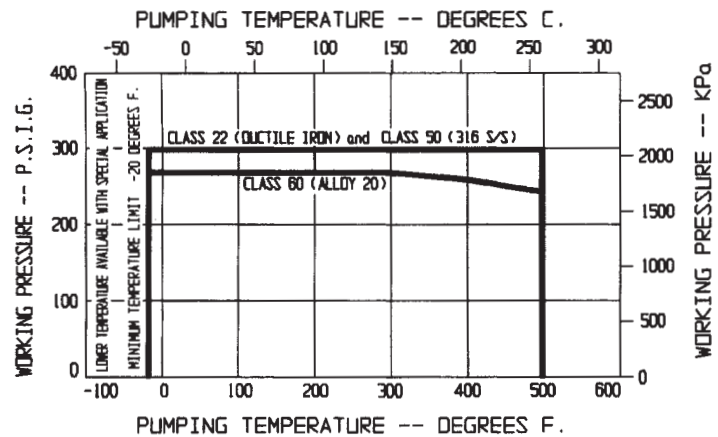
PH2110, PH2140, PH2170, PHP2110, PHP2140



PH3170



PH2180



## 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 con-

sequential 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.

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

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

**NOTE: Refer to MC 1.2.34 FBP when Dean FRP baseplates are used.**

### BASEPLATE MOUNTING AND ALIGNMENT

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

- 1) Place baseplate, with pump and driver mounted thereon, on the pump foundation.
- 2) Use wedges under the baseplate edges, at each foundation bolt, to properly support and level the unit. Check this with a spirit level. Pull down the baseplate mounting bolt nuts tightly and recheck for level. Correct if necessary.
- 3) Align the driver to the pump. See **"Pump and Driver Alignment"** on page 5.
- 4) Grout the baseplate. **Do not grout the baseplate to the foundation until the pump and driver are correctly aligned.** Channel type baseplates are made with open ends to allow easy grouting and do not require grouting holes in the baseplate. Fabricated structural steel baseplates are provided with grouting holes. Fill the entire void under the baseplate with grout and firmly embed the baseplate edges.
- 5) Connect the suction and discharge piping without forcing the piping into position. See **"Suction and Discharge Piping"** on page 5. The pipe flanges must line up with the pump flanges "freely".

Install a "new" bolt, of the correct size per ASME/ANSI B16.5 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 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 10.

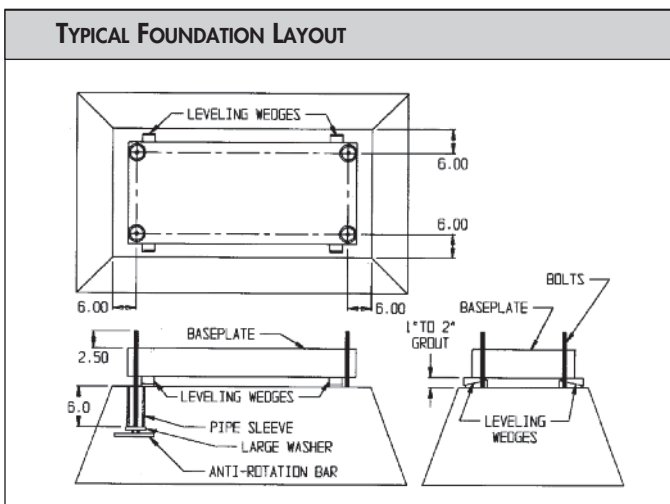
#### WARNING:

**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



pipng to remove the distorting load, and realign the pump and driver.

- 9) The pump and driver alignment must again be checked 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 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. **NOTE: Refer to MC 1.2.34 FBP when Dean FRP baseplates are used.**

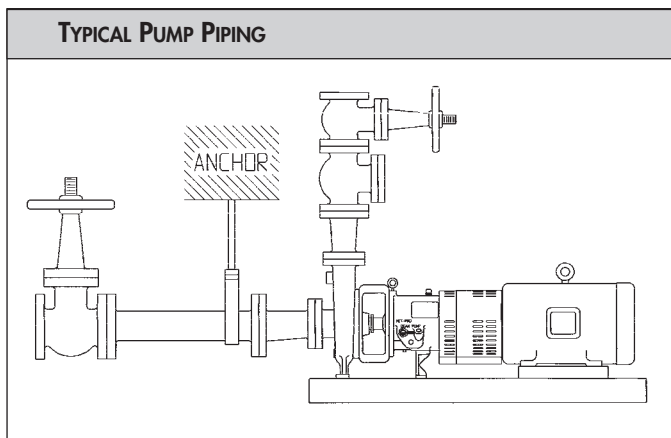
### SUCTION AND DISCHARGE PIPING

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) avail-

able to the pump and should be considered at the time the system is designed.

**NOTE: See page 26 for Installation of pHHP self-priming pumps.**

### 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 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. Any and all loads upon the pump must be within the maximum allowable values given in the section titled "Allowable Nozzle Loads" on page 6.

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.**

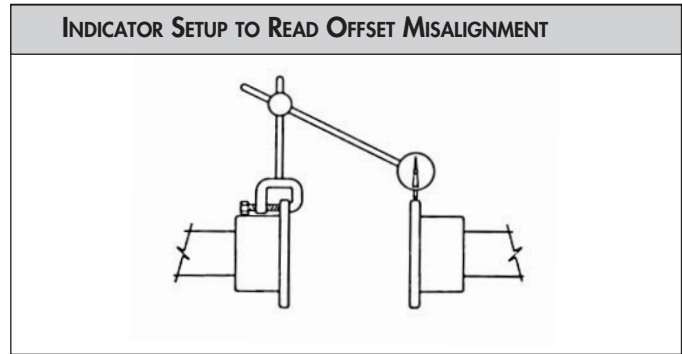
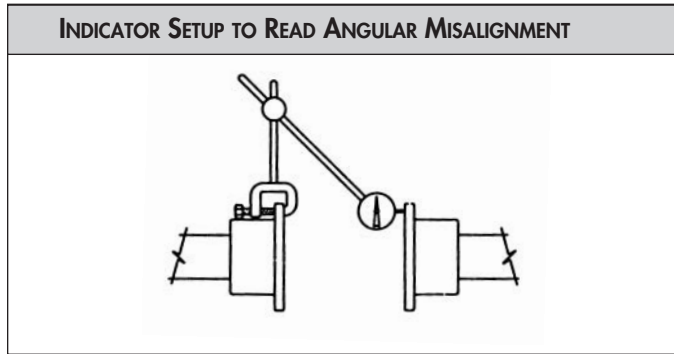
Misalignment of the two shafts is of two kinds. The first of these is angular misalignment where the axis of one shaft is at an angle from the other. The other is offset alignment where the center of one shaft is offset from the center of the other shaft. These effects usually occur together so that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

The allowable loads given below and the procedure for application are as specified by the "American National Standard for Centrifugal and Vertical Pumps for Allowable Nozzle Loads", ANSI/HI 9.6.2-2001. For additional information and application, including examples, refer to this standard.

#### SYMBOLS

$F_{xs}$  = applied force on x-axis on suction nozzle  
 $F_{ys}$  = applied force on y-axis on suction nozzle  
 $F_{zs}$  = applied force on z-axis on suction nozzle

$M_{xs}$  = applied moment about x-axis on suction nozzle  
 $M_{ys}$  = applied moment about y-axis on suction nozzle  
 $M_{zs}$  = applied moment about z-axis on suction nozzle

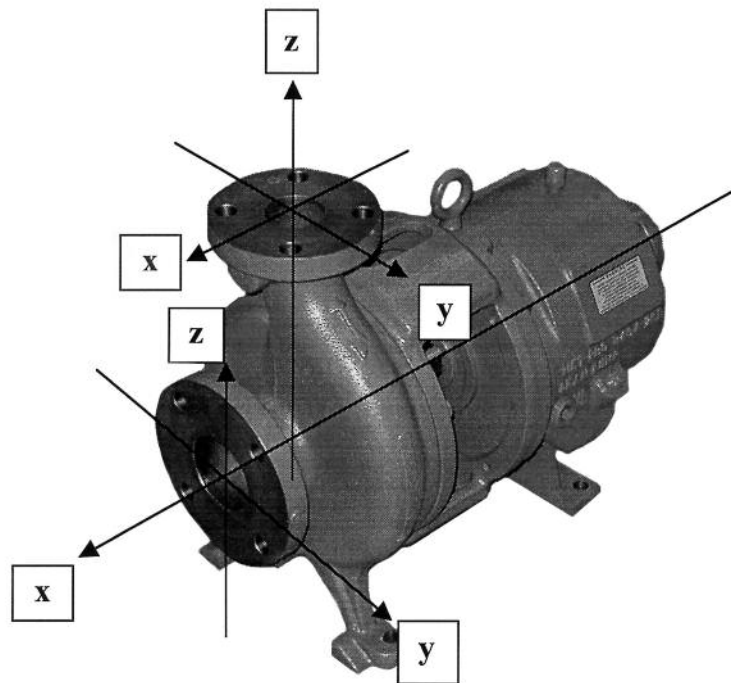
$F_{xd}$  = applied force on x-axis on discharge nozzle  
 $F_{yd}$  = applied force on y-axis on discharge nozzle  
 $F_{zd}$  = applied force on z-axis on discharge nozzle

$M_{xd}$  = applied moment about x-axis on discharge nozzle  
 $M_{yd}$  = applied moment about y-axis on discharge nozzle  
 $M_{zd}$  = applied moment about z-axis on discharge nozzle

$F_{xs}$  max = allowable force on x-axis on suction nozzle  
 $F_{ys}$  max = allowable force on y-axis on suction nozzle  
 $F_{zs}$  max = allowable force on z-axis on suction nozzle

$M_{xs}$  max = allowable moment about x-axis on suction nozzle  
 $M_{ys}$  max = allowable moment about y-axis on suction nozzle  
 $M_{zs}$  max = allowable moment about z-axis on suction nozzle

$F_{xd}$  max = allowable force on x-axis on discharge nozzle  
 $F_{yd}$  max = allowable force on y-axis on discharge nozzle  
 $F_{zd}$  max = allowable force on z-axis on discharge nozzle



$M_{xd}$  max = allowable moment about x-axis on discharge nozzle  
 $M_{yd}$  max = allowable moment about y-axis on discharge nozzle  
 $M_{zd}$  max = allowable moment about z-axis on discharge nozzle



### INSTRUCTIONS FOR USE OF ALLOWABLE LOADS

- 1) Determine the applied nozzle loads from the suction and discharge piping systems.
- 2) Use the correction factor from Table 5 for the pump material and operating temperature. For intermediate temperatures not shown in Table 5 linear interpolation is permitted. Multiply the values in Table 2 (For the applicable pump size) by the correction factor to obtain the allowable values.
- 3) If the base plate is metal, fully grouted, and anchored, evaluate the values of the de-rated Table 2 to see if any value is lower than the corresponding value in Table 1. If so, substitute the lower of the values into Table 1. No corrections are needed to Tables 3 and 4. Go to step 7.
- 4) If the base plate is un-grouted metal that is anchored down, use the corrected values of Table 2 from Step 2 above and 80% of the values in Tables 3 and 4. After adjusting the values in Tables 3 and 4, if the absolute values of any of them or the adjusted values of Table 2 (from Step 2 above) are lower than the corresponding values in Table 1, substitute the lower of the values into Table 1. Go to step 7.
- 5) If the base plate is grouted, anchored, and non-metallic, multiply the original values of Table 2 by 80%. Compare these corrected values with the Table 2 corrected values of Step 2 above. Use the lesser of the two corrected values as the Table 2 corrected values. Multiply the values of Tables 1, 3, and 4 by 80%. If any of the values of the de-rated table 2 are lower than the corresponding values in the de-rated Table 1, substitute the lower of the values into Table 1. Go to step 7.
- 6) If the base plate is un-grouted, nonmetallic, and is anchored down, multiply the original values of Table 2 by 70%. Compare these values with the Table 2 corrected values of Step 2 above. Use the lesser of the two corrected values as the Table 2 corrected values. Multiply the values of Tables 1, 3, and 4 by 70%. If any of the values of the de-rated Table 2 are lower than the corresponding values in the de-rated Table 1, substitute the lower of the values into Table 1.
- 7) Solve the equation of Equation Set #1 using the corrected allowable values of Table 1. The result for each of the twelve equations must be less than 1.00 for an acceptable application.
- 8) Solve the equation of Equation Set #2 using the corrected allowable values of Table 2. The result must be less than 1.0 to be acceptable.
- 9) Solve the equation of Equation Set #3 using the allowable (or corrected values if the base plate is either non-metal or un-grouted) values from Table 3. The result must be between -1.0 and +1.0 to be acceptable.
- 10) Solve the equation of Equation Set #4 using the allowable (or corrected values if the base plate is either non-metal or un-grouted) values from Table 4. The result must be between -1.0 and +1.0 to be acceptable.
- 11) Use the solution of equation 3(a) and the solution of equation 4(b) to solve equation #5. The result must be less than 1.0.
- 12) If all the solutions of all the equation sets result in acceptable values, the loads are within acceptable limits.

EQUATION SETS					
SET	EQUATIONS			REFERENCE	REMARKS
1	$\left  \frac{F_{xs}}{F_{xs \max}} \right  \leq 1.0, \left  \frac{F_{ys}}{F_{ys \max}} \right  \leq 1.0, \left  \frac{F_{zs}}{F_{zs \max}} \right  \leq 1.0, \left  \frac{M_{xs}}{M_{xs \max}} \right  \leq 1.0, \left  \frac{M_{ys}}{M_{ys \max}} \right  \leq 1.0, \left  \frac{M_{zs}}{M_{zs \max}} \right  \leq 1.0,$	$\left  \frac{F_{xd}}{F_{xd \max}} \right  \leq 1.0, \left  \frac{F_{yd}}{F_{yd \max}} \right  \leq 1.0, \left  \frac{F_{zd}}{F_{zd \max}} \right  \leq 1.0, \left  \frac{M_{xd}}{M_{xd \max}} \right  \leq 1.0, \left  \frac{M_{yd}}{M_{yd \max}} \right  \leq 1.0, \left  \frac{M_{zd}}{M_{zd \max}} \right  \leq 1.0$		Table 1	Individual Loading
2	$\frac{1}{2} \times \left[ \left  \frac{F_{xs}}{F_{xs \max}} \right  + \left  \frac{F_{ys}}{F_{ys \max}} \right  + \left  \frac{F_{zs}}{F_{zs \max}} \right  + \left  \frac{M_{xs}}{M_{xs \max}} \right  + \left  \frac{M_{ys}}{M_{ys \max}} \right  + \left  \frac{M_{zs}}{M_{zs \max}} \right  + \left  \frac{F_{xd}}{F_{xd \max}} \right  + \left  \frac{F_{yd}}{F_{yd \max}} \right  + \left  \frac{F_{zd}}{F_{zd \max}} \right  + \left  \frac{M_{xd}}{M_{xd \max}} \right  + \left  \frac{M_{yd}}{M_{yd \max}} \right  + \left  \frac{M_{zd}}{M_{zd \max}} \right  \right] \leq 1.0$			Table 2	Nozzle Stress, Hold-Down Bolt Stress, Pump Slippage
3	$-1.0 \leq a = \left[ \frac{F_{ys}}{F_{ys \max}} + \frac{M_{xs}}{M_{xs \max}} + \frac{M_{ys}}{M_{ys \max}} + \frac{M_{zs}}{M_{zs \max}} + \frac{F_{yd}}{F_{yd \max}} + \frac{M_{xd}}{M_{xd \max}} + \frac{M_{yd}}{M_{yd \max}} + \frac{M_{zd}}{M_{zd \max}} \right] \leq 1.0$			Table 3	y-Axis Movement
4	$-1.0 \leq b = \left[ \frac{F_{xs}}{F_{xs \max}} + \frac{F_{zs}}{F_{zs \max}} + \frac{M_{xs}}{M_{xs \max}} + \frac{M_{ys}}{M_{ys \max}} + \frac{M_{zs}}{M_{zs \max}} + \frac{F_{xd}}{F_{xd \max}} + \frac{F_{yd}}{F_{yd \max}} + \frac{F_{zd}}{F_{zd \max}} + \frac{M_{xd}}{M_{xd \max}} + \frac{M_{yd}}{M_{yd \max}} + \frac{M_{zd}}{M_{zd \max}} \right] \leq 1.0$			Table 4	z-Axis Movement
5	$\sqrt{a^2 + b^2} \leq 1.0$				Combined Axis Movement

#### Notes:

- 1) The loads shown in Tables 1 through 4 are for a pump mounted upon a fully grouted metal base plate with anchor bolts.
  - 2) The loads given in Tables 1 through 4 are for pumps constructed of 316 Stainless Steel when operated between -20°F and 100°F.
  - 3) The temperature for a corresponding allowable nozzle load is the temperature of the pumped liquid.
  - 4) For an individual (single) load, the value of the applied load must not exceed the maximum allowable value, for that location, given in Table 1. i.e. the applied load divided by the allowable load must be less than or equal to 1.0.
  - 5) For a combination of more than one force and/or moment, the applied loads must not exceed any limit of any Equation (Sets 2 through 5) or any table (2 through 4).
  - 6) When combining loads, the absolute value of any individual load must not exceed the value given in Table 1.
  - 7) The loads in the tables must be multiplied by adjustment factors when applicable. The lowest correction factor must be applied when more than one adjustment factor is involved. There are cases where one adjustment factor is applied in Table 2 and another adjustment factor is applied to Tables 3 and 4.
- Adjustment of allowable loads is required for:
- Pump constructed of a material other than 316 S/S.
  - Pumping liquid at temperatures above 100°F.
  - The base plate is not grouted.
  - The base plate is nonmetallic.

TABLE 1 – ALLOWABLE INDIVIDUAL NOZZLE LOADS													
ANSI Size	Pump Size	Suction						Discharge					
		Forces (lb)			Moments (ft-lb)			Forces (lb)			Moments (ft-lb)		
		F <sub>xs</sub> max	F <sub>ys</sub> max	F <sub>zs</sub> max	M <sub>xs</sub> max	M <sub>ys</sub> max	M <sub>zs</sub> max	F <sub>xd</sub> max	F <sub>yd</sub> max	F <sub>zd</sub> max	M <sub>xd</sub> max	M <sub>yd</sub> max	M <sub>zd</sub> max
PH2110													
AA	1x1½x6	1050	750	750	720	170	170	800	1350	3000	410	410	410
AB	1½x3x6	1050	1240	1250	900	490	490	800	1350	3000	500	550	510
AC	2x3x6	1050	1240	1250	900	490	490	800	1350	3000	500	550	510
AA	1x1½x8	1050	1210	1210	720	190	190	800	1350	3000	360	360	360
AB	1½x3x8	1050	1240	1250	900	490	490	800	1350	3000	440	440	440
PH2140													
A05	1x2x8½	2340	960	960	1270	200	200	1400	1350	3250	660	660	660
A50	1½x3x8½	2700	1350	1500	1300	370	370	1400	1350	3250	460	460	460
A60	2x3x8½	2700	1350	1500	1300	600	600	1400	1350	3250	660	660	660
A70	3x4x8½ #1	2700	1350	1500	1300	350	350	1400	1350	3250	1200	1460	690
	3x4x8½ #2	2700	1350	1500	1300	350	350	1400	1350	3250	1200	1460	690
A05	1x2x10	2340	960	960	1270	220	220	1400	1350	3250	660	660	660
A50	1½x3x10	2700	1350	1500	1300	420	420	1400	1350	3250	370	370	370
A60	2x3x10	2700	1350	1480	1300	310	310	1400	1350	3250	560	560	560
A70	3x4x10 #1	2300	1350	1500	1300	310	310	1400	1350	3250	1200	1460	690
	3x4x10 #2	2300	1350	1500	1300	310	310	1400	1350	3250	1200	1460	690
A20	1½x3x11½	2700	1350	1500	1300	670	670	1400	1350	3250	530	530	530
A30	2x3x11½	1920	1230	1230	1300	350	350	1400	1350	3250	1200	1270	690
A40	3x4x11½	2700	1350	1500	1300	400	400	1400	1350	3250	1200	1500	690
A80	4x6x11½	2700	1350	1500	1300	1100	1100	1400	1350	3250	1200	1500	690
A20	1½x3x13½	2700	1350	1500	1300	670	670	1400	1350	3250	530	530	530
A30	2x3x13½	1920	1230	1230	1300	350	350	1400	1350	3250	1200	1270	690
A40	3x4x13½	2700	1350	1500	1300	400	400	1400	1350	3250	1200	1500	690
PH2170													
A80	4x6x13½	2700	1350	1500	1300	1300	1100	1400	1350	3250	1200	1500	690
PH3170													
A20	1½x3x13½	2700	1350	1500	1300	670	670	1400	1350	3250	530	530	530
A30	2x3x13½	1920	1230	1230	1300	350	350	1400	1350	3250	1200	1270	690
A40	3x4x13½	2700	1350	1500	1300	400	400	1400	1350	3250	1200	1500	690
PH2180													
	4x6x13½	2700	1350	1500	1300	1170	1100	1400	1350	3250	1200	1500	690
	6x8x13½	3500	3180	2000	1500	1170	1170	1500	3000	3500	1250	2840	2840
TABLE 2 – ALLOWABLE COMBINATION NOZZLE LOADS FOR NOZZLE STRESS, HOLD-DOWN BOLT STRESS, AND PUMP SLIPPAGE ON BASEPLATE													
PH2110													
AA	1x1½x6	2020	750	750	1830	170	170	2020	1350	6240	410	410	410
AB	1½x3x6	2020	1240	2110	2290	490	490	2020	1350	6240	550	550	510
AC	2x3x6	2020	1240	2110	2290	490	490	2020	1350	6240	550	550	510
AA	1x1½x8	2020	1210	1210	1830	190	190	2020	1350	6240	360	360	360
AB	1½x3x8	2020	1240	1640	2290	490	490	2020	1350	6240	440	440	440
PH2140													
A05	1x2x8½	2340	960	910	3640	200	200	2020	1350	6240	660	660	660
A50	1½x3x8½	2700	1350	1820	3730	370	370	2020	1350	6240	460	460	460
A60	2x3x8½	2700	1350	2490	3730	600	600	1970	1350	6240	660	660	660
A70	3x4x8½ #1	2700	1350	1840	3730	350	350	2020	1350	6240	1460	1460	690
	3x4x8½ #2	2700	1350	1840	3730	350	350	2020	1350	6240	1460	1460	690
A05	1x2x10	2340	960	960	3640	220	220	2020	1350	6240	660	660	660
A50	1½x3x10	2700	1350	1910	3730	420	420	1940	1350	6240	370	370	370
A60	2x3x10	2700	1350	1480	3730	310	310	2020	1350	6240	560	560	560
A70	3x4x10 #1	2300	1350	1640	3730	310	310	2020	1350	6240	1460	1460	690
	3x4x10 #2	2300	1350	1640	3730	310	310	2020	1350	6240	1460	1460	690
A20	1½x3x11½	2700	1350	3060	3730	670	670	2020	1350	6240	530	530	530
A30	2x3x11½	1920	1230	1230	3730	350	350	2020	1350	6240	1460	1460	690
A40	3x4x11½	2700	1350	2390	3730	400	400	2020	1350	6240	1730	1730	690
A80	4x6x11½	2700	1350	6240	3730	1100	1100	2020	1350	6240	2150	2150	690

**TABLE 2 – ALLOWABLE COMBINATION NOZZLE LOADS FOR NOZZLE STRESS, HOLD-DOWN BOLT STRESS, AND PUMP SLIPPAGE ON BASEPLATE (CON'T)**

ANSI Size	Pump Size	Suction						Discharge					
		Forces (lb)			Moments (ft-lb)			Forces (lb)			Moments (ft-lb)		
		F <sub>xs</sub> max	F <sub>ys</sub> max	F <sub>zs</sub> max	M <sub>xs</sub> max	M <sub>ys</sub> max	M <sub>zs</sub> max	F <sub>xd</sub> max	F <sub>yd</sub> max	F <sub>zd</sub> max	M <sub>xd</sub> max	M <sub>yd</sub> max	M <sub>zd</sub> max
PH2140 (con't)													
A20	1½x3x13½	2700	1350	3060	3730	670	670	2020	1350	6240	530	530	530
A30	2x3x13½	1920	1230	1230	3730	350	350	2020	1350	6240	1460	1460	690
A40	3x4x13½	2700	1350	2390	3730	400	400	2020	1350	6240	1730	1730	690
PH2170													
A80	4x6x13½	2700	1350	6240	3730	4980	1100	2020	1350	6240	2150	2150	690
PH3170													
A20	1½x3x13½	2700	1350	3060	3730	670	670	2020	1350	6240	530	530	530
A30	2x3x13½	1920	1230	1230	3730	350	350	2020	1350	6240	1460	1460	690
A40	3x4x13½	2700	1350	2390	3730	400	400	2020	1350	6240	1730	1730	690
PH2180													
	4x6x13½	2700	1350	5080	3730	1170	1100	2020	1350	6240	2150	2150	690
	6x8x13½	6360	3180	5080	8970	1170	1170	6360	3180	13460	6780	3850	3840

**TABLE 3 – ALLOWABLE COMBINATION NOZZLE LOADS FOR Y-AXIS MOVEMENT**

Pump Size	Suction						Discharge					
	Forces (lb)			Moments (ft-lb)			Forces (lb)			Moments (ft-lb)		
		F <sub>ys</sub> max		M <sub>xs</sub> max	M <sub>ys</sub> max	M <sub>zs</sub> max		F <sub>yd</sub> max		M <sub>xd</sub> max	M <sub>yd</sub> max	M <sub>zd</sub> max
PH2110		-2000		900	1200	1250		1500		-500	1500	1250
PH2140/2170/3170		-3500		1300	1300	3000		2500		-1200	1500	3000
PH2180		-5000		1500	2000	4000		3000		-1250	5000	4000

**TABLE 4 – ALLOWABLE COMBINATION NOZZLE LOADS FOR Z-AXIS MOVEMENT**

Pump Size	Suction						Discharge					
	Forces (lb)			Moments (ft-lb)			Forces (lb)			Moments (ft-lb)		
	F <sub>xs</sub> max		F <sub>zs</sub> max	M <sub>xs</sub> max	M <sub>ys</sub> max	M <sub>zs</sub> max	F <sub>xd</sub> max	F <sub>yd</sub> max	F <sub>zd</sub> max	M <sub>xd</sub> max	M <sub>yd</sub> max	M <sub>zd</sub> max
PH2110	1050		-1250	1500	1200	-2500	800	2000	-3000	-1500	1000	-2500
PH2140/2170/3170	3500		-1500	1500	1300	-3500	1400	2500	-3250	-1500	2150	-3500
PH2180	3500		-2000	1500	4100	-4000	1500	4000	-3500	-1500	5000	-4000

**TABLE 5 – PUMP TEMPERATURE AND MATERIAL ADJUSTMENT VALUES TO BE USED ON TABLE 2 VALUES**

Material	Temperature - °F									
	-20 to 100	150	200	250	300	350	400	450	500	
Ductile Iron (Class 22) ASTM-A395	0.89	0.86	0.83	0.80	0.78	0.75	0.73	0.71	0.69	
Type 316 S/S (Class 50) ASTM-A744 Grade CF-8M	1.00	0.93	0.86	0.82	0.78	0.75	0.72	0.69	0.67	
Type Alloy 20 S/S (Class 60) ASTM-A744 Grade CN-7M	0.83	0.80	0.77	0.75	0.73	0.70	0.67	0.66	0.65	
Type CD4MCu S/S ASTM-A351 Grade CD4MCu	1.00	1.00	1.00	1.00	1.00	0.99	0.98	0.95	0.92	
Hastelloy – C ASTM-A494 Grade CW-12MW	1.00	1.00	1.00	1.00	1.00	0.99	0.98	0.95	0.92	

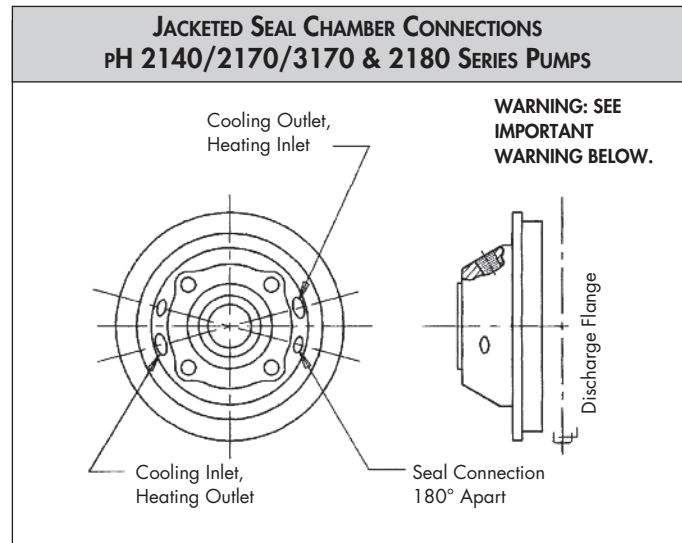
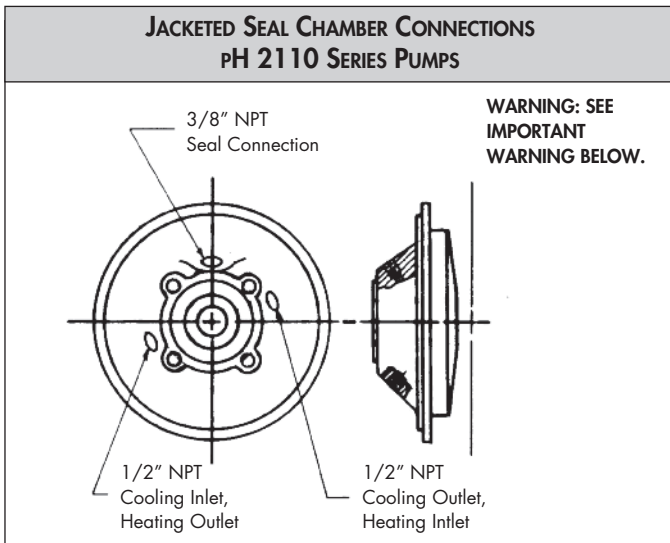
## PUMP COOLING REQUIREMENTS

Pumps are furnished with optional seal chamber jacket, jacketed casing, jacketed mechanical seal gland, and bearing housing cooling coil according to the pump service.

### SEAL CHAMBER COOLING

Cooling is recommended under these conditions:

- 1) With a mechanical seal when the pumping temperature is above 350°F. Individual plant specifications may require cooling above 250°F. **Specific applications or liquids may require cooling at lower temperatures.**
- 2) With a mechanical seal when pumping liquids of 0.75 specific gravity, or less, when the pumping temperature permits further cooling.
- 3) With packing at temperatures above 250°F.



## IMPORTANT WARNING

**INSTALLATION OF COOLING AND/OR SEAL CONNECTION PIPING TO THE PROPER CONNECTIONS IS MANDATORY. PUMP JACKET COOLING WATER INSTALLED TO THE SEAL CONNECTIONS WILL RESULT IN INJECTION OF WATER INTO THE PUMPAGE WHICH MAY CAUSE SERIOUS CONTAMINATION OF THE PRODUCT AND HEAVY CORROSION. DEPENDING ON TEMPERATURE, IT MAY ALSO CAUSE A VIOLENT STEAM EXPLOSION IN THE PUMP OR ASSOCIATED PIPING OR EQUIPMENT WITH EXTREME HAZARD TO PERSONNEL.**

### 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 Seal Chamber Cooling, and Bearing Housing Cooling Coil, 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.

The relief valve is installed between the jacket and the flow control valve to relieve any dangerous pressure that could develop in the jacket. Pipe each outlet from the flow control valve to an open sight drain or through a suitable flow indicating device into the plant cooling water return system.

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

Cooling jacket piping should be run to provide inlet water at the lowest jacket connection and outlet from the highest connection.

### COOLING WATER FLOW RATES

**Seal chamber jacket cooling** water flow rates are related to pumping temperature. A rate of 2 to 5 GPM is advisable, the higher rate at a pumping temperature of 500°F.

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

**Bearing housing cooling coil** water flow rate should be adjusted to 1/2 GPM. This will maintain the bearing housing temperature in the 120°F to 200°F range. The pump may be operated without bearing housing cooling if experience in the particular installation shows that bearing housing temperatures do not rise above 200°F.

## PUMP HEATING REQUIREMENTS

The optional seal chamber, mechanical seal gland, and pump casing jackets may be used to provide pump heating. The jackets are good for pressure to 125 psig and may be used with steam or heat transfer liquids. Series or parallel piping of the seal chamber and pump casing jackets may be used. The mechanical seal gland jacket piping should be run independently so as not to be a flow restriction.

When steam is used as the heating medium, inlet piping should be run to the highest jacket connection and outlet should be from the lowest connection to allow condensate to drain.

The casing and backhead may be lagged to minimize heat loss.

Remember that seal chamber temperatures above 350°F may cause early failure of mechanical seal parts.

## 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 pump is fitted with a "Bull's Eye" type oil level indicator, and fill openings on both sides of the bearing housing. If it would be easier to see, the "Bull's Eye" can be removed and repositioned on the opposite side of the bearing housing. Fill the sump through one of the NPT fill 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 1" NPT tapped hole 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.

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.** 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. If the pump is fitted with the optional "C" face motor support (83), the shaft coupling will be installed, causing the pump shaft to rotate with the motor shaft. Be careful that you push the start and stop buttons essentially at the same time so that the unit does not come up to speed. The impeller is threaded on to the pump shaft, and will unscrew causing damage if operated in reverse direction. A direction of rotation arrow is shown on the front of the pump casing. If rotation is incorrect, change the wiring connections and recheck rotation. **Operating the pump in reverse rotation may cause extensive damage.**

#### **WARNING:**

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

**Install the shaft coupling spacer. Be sure that you install all the retaining devices and bolts and that they are tight. Read and comply with the coupling 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 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 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. 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.

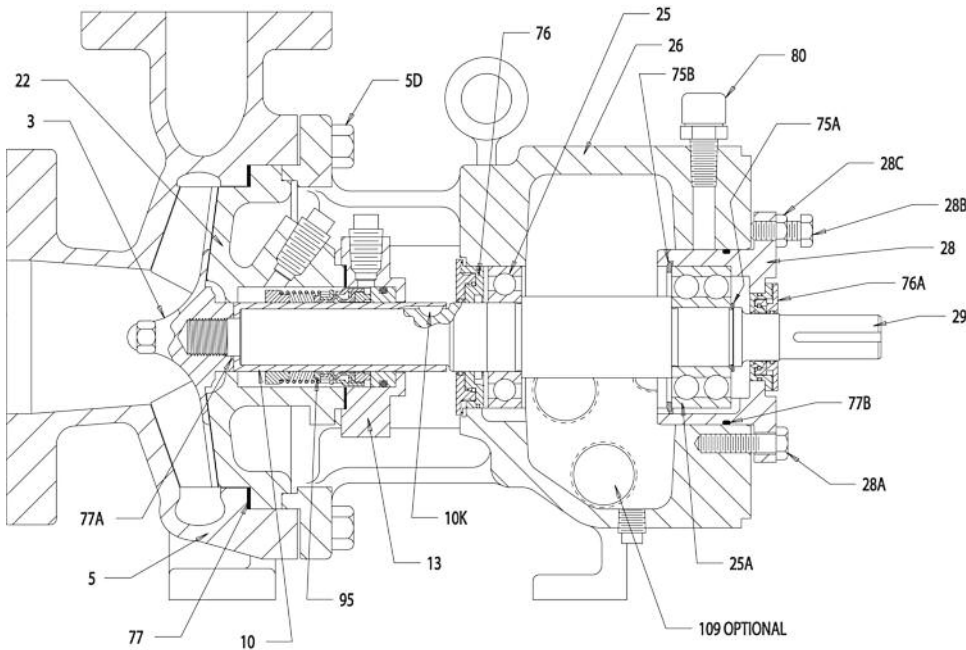
### ORDERING SPARE PARTS

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.

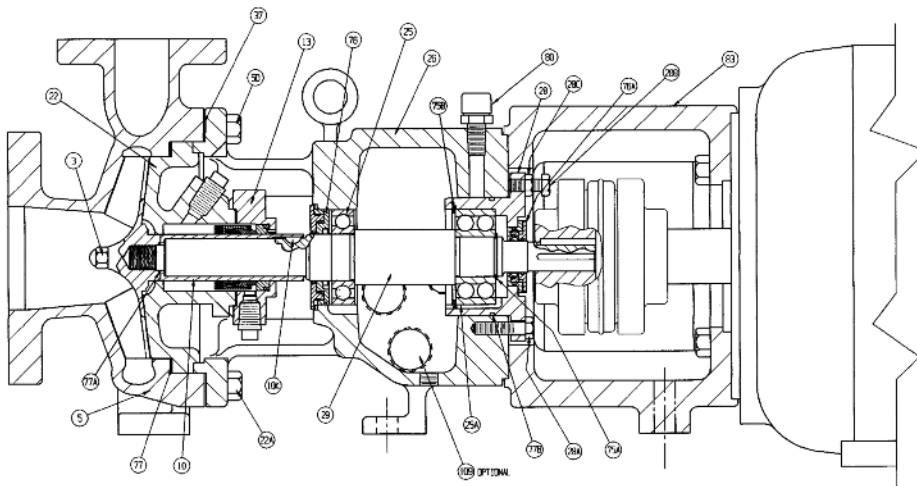
# PUMP DESIGNATION CODE FOR PH2110

## PUMP WITH STANDARD SEAL CHAMBER PH2111



Section Drawing  
#01950H

## PUMP WITH STANDARD SEAL CHAMBER PH2111 AND OPTIONAL "C" FACE MOTOR SUPPORT



Section Drawing  
#01950J

- pH2111 Pump with Standard Seal Chamber (no jacketing)
- pH2112 Pump with Jacketed Seal Chamber
- pH2114 Pump with Jacketed Seal Chamber and Bearing Housing Oil Cooler
- pH2116 Pump with Large Bore Seal Chamber
- pH2117 Pump with Jacketed Seal Chamber and Jacketed Casing
- pH2118 Pump with Jacketed Seal Chamber, Jacketed Casing, and Bearing Housing Oil Cooler

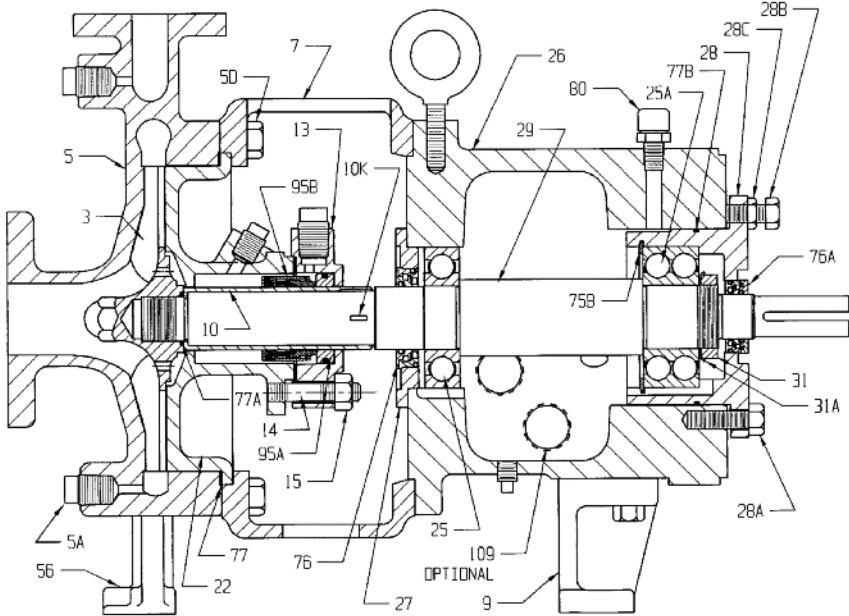
### PARTS LIST

Part #	Part Name
3	Impeller
5	Casing
5A	Casing Drain Plug
5D	Casing Capscrew*
10	Shaft Sleeve*
10K	Sleeve Key
13	Seal Chamber Gland
14	Gland Stud
15	Gland Nut
17	Lantern Ring*
22	Casing Back Cover
22A	Back Cover to Bearing Housing Capscrew*
25	Radial Bearing*
25A	Thrust Bearing*
26	Bearing Housing
28	Bearing End Cover*
28A	Bearing End Cover Capscrew*
28B	End Cover Adjusting Screw*
28C	Adjusting Screw Locking Nut*
29	Pump Shaft
75A	Tapered Retaining Ring*
75B	Large Tapered Retaining Ring*
76	Labyrinth Seal – Front*
76A	Labyrinth Seal – Back*
77	Casing Gasket
77A	Impeller Gasket*
77B	End Cover Gasket*
80	Vent*
83	Motor Support (C Face)
95A	Mechanical Seal Stationary
95B	Mechanical Seal Rotary
109	Bearing Housing Oil Cooler

\* Denotes parts that are interchangeable in all pH2110 series pumps.

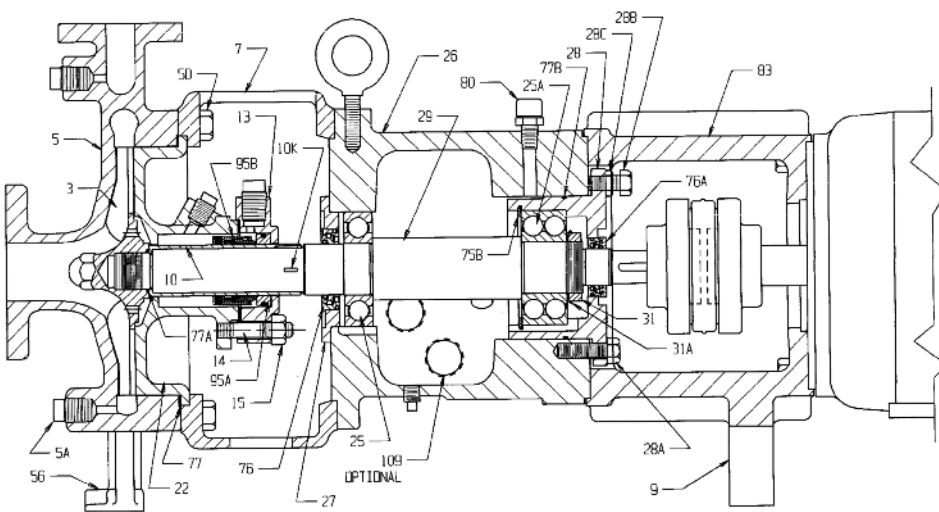
# PUMP DESIGNATION CODE FOR PH2140

## PUMP WITH STANDARD SEAL CHAMBER PH2141



Section Drawing  
#01916AA

## PUMP WITH STANDARD SEAL CHAMBER PH2141 AND OPTIONAL "C" FACE MOTOR SUPPORT



Section Drawing  
#01916AB

- pH2141 Pump with Standard Seal Chamber (no jacketing)
- pH2142 Pump with Jacketed Seal Chamber
- pH2144 Pump with Jacketed Seal Chamber and Bearing Housing Oil Cooler
- pH2146 Pump with Large Bore Seal Chamber
- pH2147 Pump with Jacketed Seal Chamber and Jacketed Casing
- pH2148 Pump with Jacketed Seal Chamber, Jacketed Casing, and Bearing Housing Oil Cooler

### PARTS LIST

Part #	Part Name
3	Impeller
5	Casing
5A	Casing Drain Plug
5D	Casing Capscrew*
7	Cradle Spacer
9	Bearing Housing Foot
10	Shaft Sleeve*
10K	Sleeve Key
13	Seal Chamber Gland
14	Gland Stud
15	Gland Nut
17	Lantern Ring*
22	Casing Back Cover
22A	Back Cover to Cradle Capscrew*
25	Radial Bearing*
25A	Thrust Bearing*
26	Bearing Housing
27	Seal Ring*
28	Bearing End Cover*
28A	Bearing End Cover Capscrew*
28B	End Cover Adjusting Screw*
28C	Adjusting Screw Locking Nut*
29	Pump Shaft
31	Bearing Lock Nut*
31A	Bearing Lock Washer*
56†	Casing Foot
75B	Large Tapered Retaining Ring*
76	Labyrinth Seal – Front*
76A	Labyrinth Seal – Rear*
77	Casing Gasket
77A	Impeller Gasket*
77B	End Cover Gasket*
80	Vent*
83	Motor Support (C Face)
95A	Mechanical Seal Stationary
95B	Mechanical Seal Rotary
109	Bearing Housing Oil Cooler

\* Denotes parts that are interchangeable in all pH2140 series pumps.

† Feet are cast integral with the casing in certain pump sizes and materials.



## PUMP DESIGNATION CODE FOR PH2170/pH3170

pH2171/pH3171 Pump with Standard Seal Chamber (no jacketing)  
 pH2172/pH3172 Pump with Jacketed Seal Chamber  
 pH2174/pH3174 Pump with Jacketed Seal Chamber and Bearing Housing Oil Cooler

pH2176/pH3176 Pump with Large Bore Seal Chamber  
 pH2177/pH3177 Pump with Jacketed Seal Chamber and Jacketed Casing  
 pH2178/pH3178 Pump with Jacketed Seal Chamber, Jacketed Casing, and Bearing Housing Oil Cooler

### PARTS LIST

Part #	Part Name
3	Impeller
5	Casing
5A	Casing Drain Plug
5C	Casing Nut (pH3170 only)
5D	Casing Capscrew – pH2170 Casing Stud – pH3170
7	Cradle Spacer
7G	Spacer to Brg. Hsg. Capscrew
9	Bearing Housing Foot
10	Shaft Sleeve*
10K	Sleeve Key
13	Seal Chamber Gland
14	Gland Stud
15	Gland Nut
17	Lantern Ring*

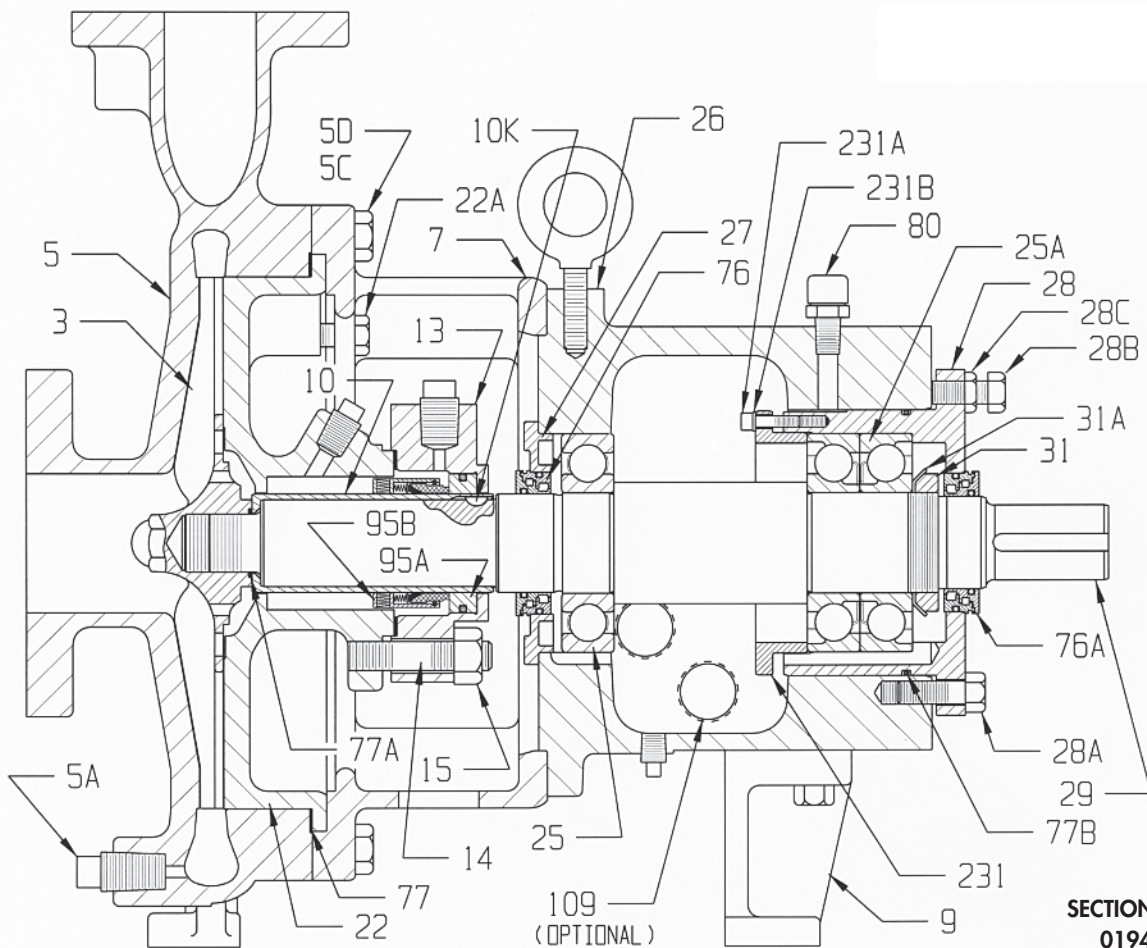
Part #	Part Name
22	Casing Back Cover
22A	Back Cover to Bearing Housing Capscrew*
25	Radial Bearing*
25A	Thrust Bearing*
26	Bearing Housing
27	Seal Ring*
28	Bearing End Cover*
28A	Bearing End Cover Capscrew*
28B	End Cover Adjusting Screw*
28C	Adjusting Screw Locking Nut*
29	Pump Shaft
31	Bearing Lock Nut*
31A	Bearing Lock Washer*
56†	Casing Foot

Part #	Part Name
56A	Casing Foot Capscrew
56B	Casing Foot Dowel
76	Labyrinth Seal – Front*
76A	Labyrinth Seal – Rear*
77	Casing Gasket
77A	Impeller Gasket*
77B	End Cover Gasket*
80	Vent*
95A	Mechanical Seal Stationary
95B	Mechanical Seal Rotary
109	Bearing Housing Oil Cooler
231	Bearing Lock Ring*
231A	Bearing Lock Ring Screw*
231B	Bearing Lock Ring Washer*

\* Denotes parts that are interchangeable in all pH2170/pH3170 series pumps.

† Feet are cast integral with the casing in certain pump sizes and materials.

### PUMP WITH STANDARD SEAL CHAMBER pH2171/pH3171



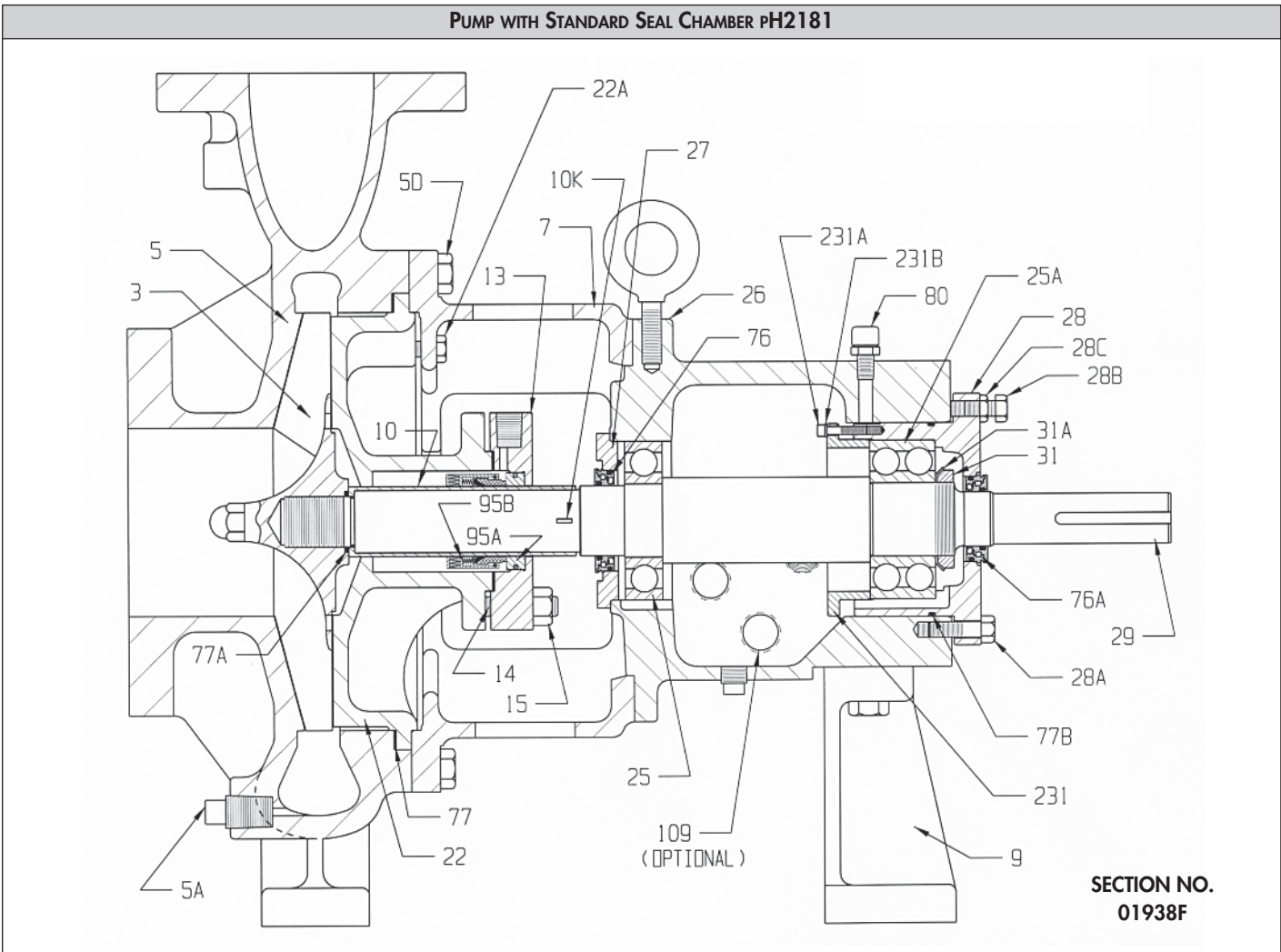
## PUMP DESIGNATION CODE FOR PH2180

pH2181	Pump with Standard Seal Chamber (no jacketing)	pH2186	Pump with Large Bore Seal Chamber
pH2182	Pump with Jacketed Seal Chamber	pH2187	Pump with Jacketed Seal Chamber and Jacketed Casing
pH2184	Pump with Jacketed Seal Chamber and Bearing Housing Oil Cooler	pH2188	Pump with Jacketed Seal Chamber, Jacketed Casing, and Bearing Housing Oil Cooler

### PARTS LIST

Part #	Part Name	Part #	Part Name	Part #	Part Name
3	Impeller	22	Casing Back Cover	31A	Bearing Lock Washer*
5	Casing	22A	Back Cover to to Brg. Hsg. Capscrew*	76	Labyrinth Seal - Front*
5A	Casing Drain Plug	25	Radial Bearing*	76A	Labyrinth Seal - Rear*
5C	Casing Nut (pH3170 only)	25A	Thrust Bearing*	77	Casing Gasket*
5D	Casing Capscrew (pH2170)*	26	Bearing Housing*	77A	Impeller Gasket*
7	Cradle Spacer*	27	Seal Ring*	77B	End Cover Gasket*
7G	Spacer to Brg. Hsg Capscrew	28	Bearing End Cover*	80	Vent*
9	Bearing Housing Foot	28A	Bearing End Cover Capscrew*	95A	Mechanical Seal Stationary
10	Shaft Sleeve*	28B	End Cover Adjusting Screw*	95B	Mechanical Seal Rotary
10K	Sleeve Key*	28C	Adjusting Screw Locking Nut*	109	Brg. Hsg. Oil Cooler*
13	Seal Chamber Gland	29	Pump Shaft	231	Bearing Lock Ring*
14	Gland Stud	31	Bearing Lock Nut*	231A	Bearing Lock Ring Screw*
15	Gland Nut			231B	Bearing Lock Ring Washer*
17	Lantern Ring*				

\* Denotes parts that are interchangeable in all pH2180 series pumps.



## DISASSEMBLY AND RE-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 secure 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. Remove any conduit and/or piping from the driver. Place wood blocks and wedges, under the rear feet of motors sizes 143TC through 215TC, or under the motor support (83) of motors sizes 254TC thru 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 365TC, 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) Hook a lifting hoist to the lifting eye in the top of the bearing housing (26) 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. Because of the above possibility, when you loosen the gasketed joint at the back of the casing (5), loosen the casing capscrews (5D) or the casing stud nuts (5C) (pH3170) only one full turn. Use jack screws in the holes provided in the flange of the cradle spacer (7), or the bearing housing (26) of the pH2110, 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 bolts (or 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 capscrews (5D) or the casing stud nuts (5C) (pH3170) 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. 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) Remove the impeller (3) using a wrench on the flats of the pump coupling hub to rotate the pump shaft (29) while holding the impeller against turning. The impeller has a hex boss to aid removal. The impeller thread is right hand.
- d) Remove the two capscrews that secure the casing back cover (22), to the bearing housing (26) of the pH2110 and pHP2110 series pumps, or to the cradle spacer (7) of all other series pumps. Carefully remove the casing back cover (22) axially, so as to not damage the pump shaft (29), shaft sleeve (10), or mechanical seal rotary (95B).
- 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) Remove the impeller gasket (77A) from the end of the pump shaft (29) or from the impeller (3) depending on where the gasket remained when the impeller (3) was removed.
- g) Remove the shaft sleeve (10) and the sleeve key (10K) from the pump shaft (29).
- h) If the pump is of the pH2140, pHP2140, pH 2170, pH 3170, or pH2180 series, and if you desire to do so, you can remove the spacer cradle (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).
- i) Remove the pump coupling hub from the pump shaft (29).
- j) If the pump is fitted with an optional oil cooler (109), remove it at this time. Remove the "1/2" tube X 1/2" male pipe thread" fitting from one end of the oil 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 in the opposite side of the bearing housing (26), from the bearing housing and pull the oil cooler (109) out through the 1" NPT opening.
- k) Remove the bearing end cover capscrews (28A). Pull the pump shaft (29), bearings (25 & 25A), and bearing end cover (28) as an assembly, axially, from the bearing housing (26).

- l) Place the shaft assembly in a hydraulic press and remove the radial bearing (25) by pressing it off of the pump shaft (29). Do not hammer on the bearings in any way as it may result in serious damage to the bearings or the pump shaft (29).
- m) If the pump is of the pH2110, pHP2110, pH2140, or pHP2140 series, use snap ring pliers to remove the large tapered retaining ring (75B) from the bearing end cover (28). If the pump is of the pH2170, pH3170, or pHP2180 series, use an Allen wrench to loosen the bearing lock ring screws (231A). Remove the bearing lock ring screws (231A), the lock ring washers (231B), and the bearing lock ring (231). Slide the bearing end cover (28) and the rear labyrinth seal (76A) as an assembly, axially, off the thrust bearing (25A) and the end of the pump shaft (29).
- n) If the pump is of the pH2110 or pHP2110 series, use snap ring pliers to remove the tapered retaining ring (75A) from the pump shaft (29). If the pump is of the pH2140, pHP2140, pH2170, pH3170, or pH2180 series, bend the tab of the bearing lock washer (31A) out of the slot in the bearing lock nut (31). Remove the bearing lock nut (31) and bearing lock washer (31A) from the pump shaft (29).
- o) Press the thrust bearing(s) (25A) from the pump shaft (29). Do not hammer on the bearings in any way as it may result in serious damage to the pump shaft (29).
- p) If the pump is of the pH2110 or pHP2110 series, press the front labyrinth seal (76) from the front of the bearing housing (26).
- q) If the pump is of the pH2140, pHP2140, pH2170, pH3170, or pH2180 series, press the seal ring (27) and the front labyrinth seal (76), as an assembly, from the front of the bearing housing (26). Press the front labyrinth seal (76) from the seal ring (27).
- r) Press the rear labyrinth seal (76A) from the bearing end cover (28).
- s) Remove the o-rings from the O.D. and the I.D. of both the labyrinth seals (76 & 76A).
- t) Remove the end cover gasket (77B), which is an o-ring, from the bearing end cover (28).
- u) Remove the bearing housing vent (80) and the bull's eye sight glass from the bearing housing (26).
- v) If so desired, the bearing housing foot (9), of the pH2140, pHP2140, pH2170, pH3170, and pH2180 series, pumps, can be removed from the bottom of the bearing housing (26).
- w) Clean and inspect all parts. Discard and replace any damaged or worn parts.

## 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 Division of Met-Pro Corporation parts.**

To reassemble the pump, perform the following steps:

- a) Clean all parts thoroughly.
- b) If the pump is of the pH2140, pHP2140, pH2170, pH3170, or pH2180 series, and 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 pH2140, pHP2140, pH2170, pH3170 pumps. Tighten the capscrews to 80 ft. lb for series pH2180 pumps.
- c) Apply pipe sealant to the threads of the bull's eye sight glass and tighten it into the side of the bearing housing (26). Torque to 50 ft. lb.
- d) Install the vent (80), without thread sealant, into the top of the bearing housing (26). Tighten to 20 ft. lb.
- e) Install new o-rings onto the O.D. and into the I.D. of both the labyrinth seals (76 & 76A). Lubricate the o-rings on the O.D. of both labyrinths.
- f) If the pump is of the pH2110 or the pHP2110 series, press the front labyrinth seal (76) 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).
- g) If the pump is of the pH2140, pHP2140, pH2170, pH3170, or pH2180 series, press the front labyrinth seal (76) into the seal ring (27). 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).
- h) 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 inline with the "oil return" (slot in the bore) of the end cover (28).
- i) Press a new thrust bearing(s) (25A) onto the pump shaft (29) and against the shaft shoulder. Do not hammer on the bearings in any way as it will result in serious damage to the bearings or the pump shaft. Press on the inner race of the bearing only, do not press on the outer race of the bearing. The thrust bearing in the pH2170 and pH3170 series pumps is made up of a matched pair of angular contact bearings that must be installed "back-to-back". See the cross sectional drawing for the pH2170/pH3170 pumps.

- j) If the pump is of the pH2110 or pHP2110 series, install the tapered retaining ring (75A) into the groove in the pump shaft (29) with the tapered side away from the bearing.
- k) If the pump is of the pH2140, pHP2140, pH2170, pH3170, or pH2180 series, place a new bearing lock washer (31A) onto the pump shaft. 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. Another way to keep the shaft from turning is to place the coupling hub onto the shaft and hold it with a wrench. Tighten the nut to the torque value below:  
 75 ft. lb. on the pH2140 & pHP2140 series  
 90 ft. lb. on the pH2170 & pH3170 series  
 100 ft. lb. on the pH2180 series  
 Bend one of the tabs of the bearing lock washer (31A) into the corresponding slot in the bearing lock nut (31).
- l) Lubricate the O.D. of the thrust bearing (25A), the bore of the end cover (28), the I.D. of the rear labyrinth seal (76A), and the area of the pump shaft (29) on which the labyrinth will be mounted. Slide the bearing end cover (28), labyrinth seal (76A) assembly carefully over the end of the pump shaft (29), and fully onto the thrust bearing (25A). 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 be damaged. Placing a piece of plastic electrical tape over the keyway, before this assembly operation, will give a measure of protection. The fit between the bearing (25A) and the bearing end cover (28) may be tight enough that you may need to tap the end of the pump shaft (29) lightly with a soft faced hammer to slide the bearing (25A) into the bearing end cover (28).
- m) If the pump is of the pH2110, pHP2110, pH2140, or pHP2140 series, install the large tapered retaining ring (75B), with the tapered side away from the bearing (25A), into the bearing end cover (28) and against the face of the thrust bearing (25A). Position the gap between the ends of the retaining ring (75B) so that it is centered over the oil return slot in the bore of the end cover (28). If the pump is of the pH2170, pHP3170, or pH2180 series, install the bearing lock ring (231) into the bearing end cover (28) and against the face of the thrust bearing. Place the bearing lock ring washers (231B) onto the bearing lock ring screws (231A) and snug them evenly against the bearing lock ring (231). Tighten the bearing lock screws (231A) evenly to 8 ft. lb.
- n) Press a new radial bearing (25) onto the pump shaft (29) and against the shaft shoulder. Press on the inner race, of the bearing, only, do not press on the outer race of the bearing. Press against the coupling end of the pump shaft (29), do not press against the end cover (28).
- o) Lubricate and install a new end cover gasket (77B), which is an o-ring, into the groove in the O.D. of the bearing end cover (28).
- p) Lubricate the I.D. of the front labyrinth seal (76), both of the bores in the bearing housing (26), the O.D. of the radial bearing (25), the O.D. of the bearing end cover (28), and the area of the pump shaft (29) onto which the front labyrinth seal (76) will be located.
- q) Carefully slide the shaft (29) and bearing (25 & 25A) assembly, impeller end of shaft first, into the bearing housing (26), from the back end of the bearing housing. Rotate the bearing end cover (28) so that the "expulsion port" of the rear labyrinth seal (76A) is towards the bottom of the bearing housing (26). At this point the drilled holes in the bearing end cover (28) will line up with the tapped holes in the bearing housing (26). Be careful to hold the axis of the shaft (29) inline with the axis of the bearing housing (26), and not damage the o-ring in the bore of the front labyrinth seal (76).
- r) Back-off the end cover adjusting screws (28B) until they are not protruding through the opposite side of the flange of the bearing end cover (28). Install the bearing end cover capscrews (28A) and lightly snug them down, about 5 ft. lbs.
- s) If the pump was purchased with the optional bearing housing oil cooler (109), re-install it 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 dis-assembly and re-assembly without damaging the cooling tube. When tightening these connectors, tighten only to 5 ft. lb.
- t) If the pump is of the pH2140, pHP2140, pH2170, pH3170, or pH2180 series, and if the cradle (7) was removed, replace it. Center the four tapped holes in the cradle (7) in the holes in the bearing housing (26). Install the capscrews and tighten them to:  
 50 ft. lb. for series pH2140, pHP2140, pH2170, and pH3170  
 65 ft. lb. for series pH2180 series
- u) Replace the shaft sleeve key (10K) and install a new shaft sleeve (10) onto the pump shaft (29).
- v) Replace the coupling key into the keyway at the coupling end of the pump shaft (29).
- w) 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 (y).
- x) If the pump and driver are connected together by a "C" faced motor support (83), 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 the pump shaft by  $\frac{1}{16}$ ".
- For use with motor sizes 182TC and 184TC,  
 place pump hub so that the pump shaft protrudes  $\frac{3}{16}$ ".
- For use with motor sizes 213TC and 215TC,  
 place pump hub to overhang the pump shaft  $\frac{5}{16}$ ".
- For use with motor sizes 254TC and 256TC,  
 place the pump hub flush with the end of the pump shaft.
- For use with motor sizes 284TSC and 286TSC,  
 place pump hub to overhang the pump shaft by  $\frac{3}{16}$ ".
- For use with the motor sizes 324TSC, 326TSC,  
 364TSC and 365TSC,  
 place the pump hub flush with the end of the pump shaft.

- y) If the pump is to be sealed with packing, slide the packing gland (13) over the pump shaft (29) and up against the front labyrinth seal (76).
- z) Install the casing back cover (22) to the bearing housing (26) of the pH2110 and the pHP2110 series pumps, or to the cradle spacer of the pH2140, pHP2140, pH2170, pH3170, and pH2180 series pumps. Install the two capscrews (22A) that hold the casing back cover (22) into place. Tighten the capscrews (22A) to 20 ft. lb.. Do not overtighten.
- ac) Place a new impeller gasket (77A) over the end of the pump shaft (29) and against the shaft sleeve (10). Screw the impeller (3) on to the end of the pump shaft (29) and tighten it to the torque value below:
  - 40 ft. lb. for pH2110 and pHP2110 series
  - 90 ft. lb. for pH2140 and pHP2140 series
  - 120 ft. lb. for pH2180 series
- ab) Screw the end cover adjusting screws (28B) into the bearing end cover (28) by hand until they firmly contact the bearing housing (26). Loosen the bearing end cover capscrews (28A) and back them off until there is about 1/4" between the underside of the screw heads and the face of the bearing end cover (28). Carefully tighten the end cover adjusting screws (28B) evenly (turn each screw the same number of revolutions) until the clearance between the back of the impeller (3) and the casing back cover (22) is 0.008" to 0.012". Measure this clearance with a feeler gauge. Tighten the bearing end cover capscrews (28A), to 20 ft. lb. if the pump is of the pH2110 or pHP2110 series, and 50 ft. lb. if the pump is of the pH2140, pHP2140, pH2170, pH3170, or pH2180 series. Recheck the clearance, if it is still correct, tighten the adjusting screw lock nuts to 20 ft. lb. if the pump is of the pH2110 or pHP2110 series, and 50 ft. lb. if the pump is of the pH2140, pHP2140, pH2170, pH3170, or pH2180 series.
- ac) If the pump is to be sealed with packing, do so now. See the "Installation and Maintenance of Seal Chamber Packing" section of this manual. Go to step (ai).
- ad) If the mechanical seal, to be installed, is not of the cartridge type, scribe a line on the shaft sleeve (10) exactly in line with the face of the seal chamber as described in the section "Installation of Mechanical Seals".
- ae) Remove the impeller (3). Remove the casing back cover (22).
- af) Install the mechanical seal components onto the shaft sleeve (10). See the "Installation of Standard Mechanical Seals" section of this manual, and the seal drawing supplied with the new mechanical seal.
- ag) Install the casing back cover (22), to the bearing housing (26) of the pH2110 and pHP2110 series pumps, or to the cradle spacer of the pH2140, pHP2140, pH2170, pH3170, or pH2180 series pumps. Install the two capscrews (22A) that hold the casing back cover (22) into place. Tighten the capscrews (22A) to 20 ft. lb. Do not overtighten.
- ah) Reinstall the impeller gasket (77A) and the impeller (3) onto the pump shaft (29). Tighten the impeller (3) to 40 ft. lb. for pH2110 and pHP2110 series pumps. Tighten the impeller (3) to 90 ft. lb. for pH2140 pHP2140, pH2170, and pH3170 series pumps. Tighten the impeller (3) to 120 ft. lb. for the pH2180 series pumps.
- ai) Rotate the pump shaft by hand to be sure there is no internal rubbing or binding.
- aj) The partial assembly can now be taken to the installation site. Use proper lifting equipment and methods.
- ak) Place a new casing gasket over the casing back cover (22). Unscrew the two casing jack bolts, in the flange of the bearing housing (26) of the pH2110 and pHP2110 pumps, or the cradle spacer (7) of the pH2140, pHP2140, pH2170, pH3170, or pH2180 series pumps, 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.
- al) Using a hoist, to lift and position, the partial pump assembly, install it into the pump casing (5). If the pump is of the pH2110, pHP2110, pH2140, pHP2140, pH2170, or pH2180 series, screw the casing capscrews (5D) by hand into the casing (5) but do not tighten them yet. If the pump is of the pH3170 series, screw the casing stud nuts (5C) onto the casing studs (5D) by hand but do not tighten them yet.
- am) If the pump and driver are independently mounted to a common baseplate, go to step (ax).
- an) If the pump and driver are connected together by a "C" faced motor support (83), place wood blocks and wedges under the bearing housing (26) to support the pump.
- ao) 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 the motor hub flush with the end of the motor shaft.
  - On motor sizes 182TC and 184TC,  
place the motor hub so that the motor shaft protrudes 1/4".
  - On motor sizes 213TC and 215TC,  
place the motor hub to overhang the motor shaft by 5/16".
  - On motor sizes 254TC and 256TC,  
place the motor hub flush with the end of the motor shaft.
  - On motor sizes 284TSC and 286TSC,  
place the motor hub to overhang the motor shaft by 3/16".
  - On motor sizes 324TSC, 326TSC, 364TSC and 365TSC,  
place the motor hub flush with the end of the motor shaft.
- ap) On motor sizes 143TC, 145TC, 182TC and 184TC, bolt the spacer section of the coupling to the motor hub.
- aq) Place the coupling elastomer into the pump coupling hub.
- ar) 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 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.

- as) 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 capscrews (5D) and the bolts that retain the motor support (83) to the bearing housing (26).
- at) Tighten the casing capscrews (5D) evenly to 50 ft. lb. for 1/2" bolts and 80 ft. lb. for 5/8" bolts.
- au) Tighten the motor support (83) to bearing housing (26) bolts to 50 ft. lb. for pH2110 or pHP2110 series pumps and 65 ft. lb. for pH2140 and pHP2140 series pumps.
- av) 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.
- aw) Rotate the pump shaft by hand to check for rubbing or binding. Go to step (bb).
- ax) Gently allow the hoist to lower the pump assembly until the weight of the unit seats the bearing housing foot (9) firmly against the baseplate. Tighten the casing bolting evenly to the torque value below:
  - 50 ft. lb. for 1/2" capscrews (5D)
  - 80 ft. lb. for 5/8" nuts (5C) or capscrews (5D)
  - 105 ft. lb. for 3/4" capscrews (5D)
- ay) Bolt the bearing housing foot (9) to the baseplate. Tighten the capscrews evenly to the torque value below:
  - 50 ft. lb. for 1/2" capscrews (5D)
  - 105 ft. lb. for 3/4" capscrews (5D)
- az) Rotate the pump shaft by hand to check for rubbing or binding.
- ba) Align the pump and driver shafts. Reinstall the coupling spacer.
- bb) Reinstall the coupling guard(s).
- bc) Lubricate the pump according to the "Pump Lubrication" instructions.
- bd) Reinstall any auxiliary piping and drain plugs that were removed during disassembly.
- be) Remove tools, old parts, and debris from the area around the pump.
- bf) Follow "Starting the Pump" instructions, to restart the pump.



## INSTALLATION AND MAINTENANCE OF SEAL CHAMBER 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. All 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.

Dean pumps are shipped from the factory without packing in the seal chamber. A complete set of die molded packing specified for the service is shipped with the pump in a separately labeled carton. The pump seal chamber must be properly packed before the pump is put into service.

The seal chamber 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 section pressure is above 100 psig a lantern ring is not recommended. When the pump is a self-priming type, the lantern gland should be used to provide a means to seal against air leakage into the pump during the priming cycle.

### 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 seal chamber with packing for these reasons:

- 1) To permit the introduction of a sealing liquid into the seal chamber 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. This is required on self-priming pumps.
- 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 seal chamber 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

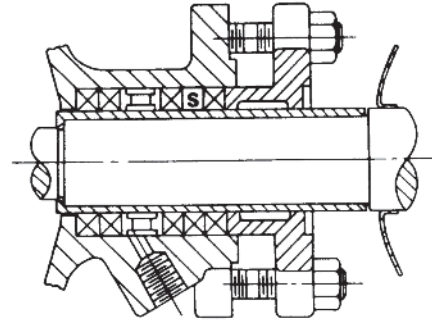
The sealing liquid introduced to the lantern ring may be from a source external to the pump. It must be introduced at a pressure above seal chamber pressure and must be non-corrosive, non-abrasive and 150°F or less in temperature. The connection is made to the lantern ring connections on the pump seal chamber.

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

### LANTERN RING NOT USED

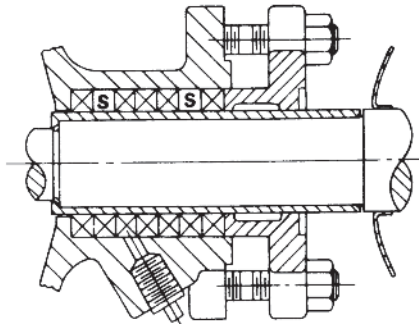
When the pump suction pressure is above atmospheric pressure or the seal chamber is pressure sealed (no impeller balance holes) and neither internal nor external liquid or lubricant is required to the packing, the lantern ring is not used and the seal chamber is packed full with rings of packing.

### PACKED SEAL CHAMBER 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 SEAL CHAMBER 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 seal chamber 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 seal chamber bore. Split the piece lengthwise to allow insertion in the seal chamber. More than one length of packing tamper may be necessary. Suit the lengths to the particular pump.

All packing rings furnished by Dean Pump are die-molded to fit the seal chamber. To place a ring on the shaft sleeve, open the ring at the split at the 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 packing 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 fibrous 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 against the splash collar, place a ring of packing on the shaft sleeve and enter it carefully into the seal chamber. Install a second ring, and a third ring if appropriate. Stagger all joints at 90° intervals. Follow the proper sequence if hard and soft rings are used. Using a packing tamper in the seal chamber, slide the packing gland up on the packing gland studs, put on the gland stud nuts and tighten them evenly and firmly, seating the packing rings firmly against the bottom of the seal chamber. This should make the shaft difficult to turn by hand.
- 2) Back off the gland stud nuts and the packing gland and remove the packing tamper.
- 3) If a lantern ring is to be used, check the packing and pump specifications to determine its position and install it with the proper number of rings of packing between it and the bottom of the seal chamber.
- 4) Continue to pack the pump with packing rings placed on the shaft sleeve until the seal chamber is nearly full and seat them firmly as above. Packing ring joints should be staggered at 90° intervals.
- 5) Back off the gland stud nuts 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, seal chamber 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 seal chamber. When the gland has again been taken up to full travel the seal chamber should be repacked completely.

#### **USUAL CAUSES OF PACKING FAILURE AND EXCESSIVE SEAL CHAMBER 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 seal chamber so that outer rings are carrying all the load.
- 4) Dirt and foreign particles in seal chamber are causing rapid scoring of shaft sleeve.
- 5) Seal chamber 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 pump disassembly and assembly see the instruction manual relating to the specific pump type.

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 proper impeller adjustment.

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 of an inch 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.

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

Flexibly mounted inserts are 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 mounting ring.

To position the o-ring mounted insert, lubricate the inside of the mechanical seal gland. Place the o-ring in the groove of the insert and carefully slide the insert into position. Be careful not to damage the o-ring. Make sure that the lapped face of the insert faces towards the pump.

To position the Teflon mounted insert, lubricate the inside of the mechanical seal gland. Carefully slide the Teflon mounting ring into position in the gland and then slide the insert into place. The slot in the stationary insert must index with the drive pin.

Put the mechanical seal gland and insert on the shaft and slide it back against the flinger. Be careful not to damage the insert or its mounting. Put the gland gasket (324) on the shaft. 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 carefully into place and 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.

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 moments the pump should be shut down and the seal removed to discover the cause.

**Note 1**—Pumps using a single inside balanced seal except Type 609 (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.

#### 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 against the shaft splash collar 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 against the splash collar. Assemble the seal insert gasket (326), the mechanical seal insert (315), and seal insert gasket (325) to the face of the seal chamber and, placing the gland (300) in position, pull down the gland stud nuts tightly and evenly. Make sure that the lapped face of the seal insert is towards the rotary unit. Reassemble the pump. Now carefully slide the rotary unit against the seal insert, compress 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 moments 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 pump end, exactly to these dimensions.

Double seal stationary inserts are two types depending on the service conditions of the pump. The insert may be of rectangular cross section grooved for an o-ring or the insert may be of L-shaped cross section used with a Teflon mounting ring.

To position the o-ring mounted insert, lubricate the inside of the seal chamber and the inside of the mechanical seal gland. Place the o-rings in the grooves and carefully slide the inserts into position in the seal chamber and seal gland. Be most careful not to damage the o-ring.

To position the Teflon mounted insert, lubricate the inside of the seal chamber and the inside of the seal gland. Carefully slide the Teflon mounting rings into position and then slide the stationary inserts into place. The slots in the stationary inserts must index with the drive pins.

Put the mechanical seal gland, with insert installed, on the pump shaft sleeve and slide it back against the splash collar. Put the seal gland gasket on the sleeve and slide it back against the gland. Slide one seal rotary unit on the sleeve with the carbon face towards the bearing housing. Be careful not to damage the seal shaft packing. Be sure that the shaft sleeve hook is firmly against the shoulder on the shaft. Set the rotary unit carefully to its setting mark on the shaft sleeve and lock it tightly in place with the set screws. Slide the second rotary unit onto the shaft sleeve 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 very carefully in place over the seals. Slide the gland gasket and seal gland into place and carefully and evenly tighten the gland stud nuts. 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.

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***If you do not have the correct mechanical seal drawing, write to the factory giving complete information on pump size, type, and serial number and the correct seal drawing will be sent.***

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## 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.

**Only Dean Authorized Service Parts shall be used.**

### 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.

## INSTALLATION, OPERATION AND MAINTENANCE PHP SELF-PRIMING PUMPS

The preceding general and descriptive information for pH Series pumps also applies to the pHHP Series pumps. Special variations are described below.

### INSTALLATION

**Suction piping** to a self priming pump **must be free of air leaks**. If it is not, the pump will not prime. Suction piping should be as short and direct as possible. Long horizontal runs should be avoided. The less suction piping, the less chance for air leaks. Flanged joints may be coated with a rubber compound to avoid leaks at these points.

In applying a self-priming pump, consideration of the discharge piping is necessary. The air from the pump casing must be expelled without being compressed substantially above atmospheric pressure. Although a self-priming pump will prime against a small discharge pressure, the priming time will increase and, if the pressure is high enough, it will not permit the pump to prime.

If the pump expels air into an empty discharge system, there is more than adequate volume available to contain the discharged air. If the discharge line contains a check valve, it should be located a distance away from the pump so as to leave a volume in the discharge line (between the pump and the check valve) equal to about half the volume of the suction line.

If the check valve must be installed closer to the pump, install a valved line from the pump discharge system back to the suction source. This is left open during the priming cycle and closed when priming is accomplished and during pumping. The check valve must be installed in the pump discharge line downstream from the bypass connection.

If the pump is fitted with a double mechanical seal a barrier liquid must be supplied at a pressure 10-15 pounds above seal chamber pressure when the pump is pumping.

If seal chamber packing is used it must include a lantern ring. Sealing liquid compatible with the pumpage must be supplied under

pressure to the lantern ring connection in the seal chamber of the pump.

Air leaks through the mechanical seal or packing will prevent pump priming.

### OPERATION

A self priming pump requires an initial prime after installation and before normal operation. Be sure the end of the suction piping is properly immersed in the liquid to be pumped. Remove the priming plug in the top of the casing. Use a liquid which is compatible with the normal pumpage. Pour this into the pump casing until the liquid level stops rising. Any excess is going out of the pump through the suction opening. Replace the priming plug and tighten it securely. Start the pump and let it prime. Stop the pump. There will now be a quantity of pumpage retained in the special casing. This will permit the pump to reprime thereafter.

If during the initial prime or repriming, the pump runs without actual priming, there are two possible causes. The first of these is an air leak in the suction piping. A very small hole is a major air leak and will prevent priming. A leak of air into the seal chamber will likewise prevent priming, air being constantly drawn into the pump.

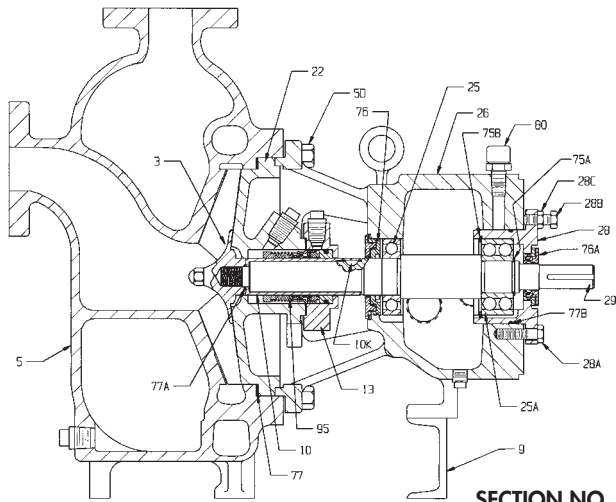
### MAINTENANCE

The maintenance of this pump is that described in the manual to which this addendum is attached. Lubrication, installation, disassembly and assembly instructions therein apply to the pHHP pump. The only difference is the shape of the casing.

Unlike the standard centrifugal pump casing, the pHHP self priming pump casing retains liquid. Care should be taken to drain the casing thoroughly before the pump is removed from the line.

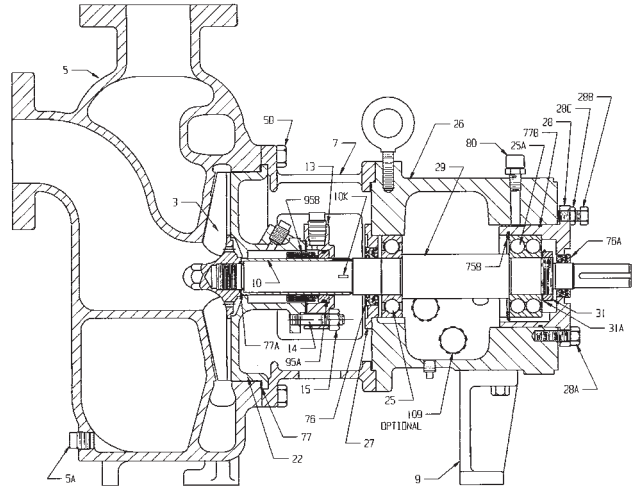
When a pump has been removed from the line and replaced, the initial prime described above will be necessary before normal pump operation.

PHP2110



SECTION NO.  
01951B

PHP2140



SECTION NO.  
01947C

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

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Interchangeable with Dean Serial Numbers \_\_\_\_\_

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# CECO Dean

6040 Guion Road, Indianapolis, IN 46254 USA

Phone: 317-293-2930, Fax: 317-297-7028

Email: info@ceco.com • Website: cecoenviro.com

## READ WARNINGS

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

Use only top quality tools.

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

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

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

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

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

Remove the coupling guard. Remove the coupling spacer.

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

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

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

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

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

Even though it might appear that, the cavity being drained has completely drained, be extremely careful about opening the system and/or opening the pump. If something solid in the pumpage moves to the vicinity of the drain connection, it could seal-off the drain and maintain pressure in the cavity though 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.