

Dean

DEAN PUMP® SERIES M300

Magnetically Coupled Horizontal Process Pumps

INSTALLATION

OPERATION

MAINTENANCE MANUAL



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CAUTION

CAUTION—THIS EQUIPMENT CONTAINS BRITTLE AND MAGNETIC MATERIALS.

CAUTION—EXTREME HAZARD

HEART Magnets in/from this pump can upset the timing of heart pacemakers and make them malfunction. This caution cannot be overstated due to the health risk involved.

EYES, HANDS, FINGERS, EXPOSED FLESH Brittle materials (such as silicon carbide and carbon used for wearing parts) can fracture and propel hard, sharp particles causing serious personal injury. Protective equipment must be utilized when servicing these parts.

The magnets are also very brittle and if cracked or fractured can propel hard, sharp particles causing serious personal injury. Protective equipment must be utilized when servicing these parts.

The magnets used in this pump are very strong and can cause parts and tools to slam together injuring hands and fingers. This could also crack the magnets and propel particles as cautioned above.

WARNING—EQUIPMENT DAMAGE

Some equipment, instruments, and personal possessions could be damaged and/or destroyed. For example, computers, computer tapes, computer discs, credit cards and any other magnetically actuated devices will be rendered useless if exposed to the strong magnetic field of this pump or its parts.

Watches, spring driven or electronic, will be ruined if exposed to the strong magnetic field of this pump or its parts.

WARNING—FREIGHT

When shipping raw or bare magnet assemblies, especially by air, special precautions may be necessary. Usually the shipment of an assembled pump is not a problem. Consultation with Dean Pump and the freight company is recommended.

This pump is designed incorporating a relatively new concept called a "Magnetic Coupling", and many mechanics will not have the experience to realize the potential hazard of the energy stored in the very powerful magnets.

The magnets are installed in two different parts of the pump; the outer magnet assembly (167), which is driven by the driver (electric motor), and the inner magnet assembly (175), which is driven through its magnetic attraction with the outer magnet assembly (167). There is little magnetic field outside the confines of the pump components when they are in a completely assembled pump.

When the pump is partially or completely disassembled, however, there is a very strong magnetic field, which, if mishandled, could cause personal injury and/or mechanical damage. Pinched fingers and hands are the most common personal injury when any ferrous part comes close to a magnetic field.

This hazard also exists when holding parts with your hands during assembly.

The most common mechanical damage is chipped magnets and ruined wrist watches. Chipped magnets, if used, can cause extensive mechanical damage when particles come loose during operation. Wrist watches stop dead when they are exposed to the magnetic field. Non-magnetic tools should be used when working on, or in close proximity to, magnetic assemblies.

Cleanliness of the magnetic parts is very important as it is difficult to remove ferrous particles which are "stuck" to the magnets. Magnetic parts should be sealed in plastic bags and stored away from the presence of ferrous articles and particles.

The magnetic coupling in each individual pump is selected for that particular service and is mated with the motor size (power and inertia) and coupling size. It is critical that maximum and minimum values of operating condition are known; particularly temperature, vapor pressure, specific gravity, and viscosity. Any change in operating conditions which affects specific gravity, viscosity, differential head, temperature, specific heat, capacity or speed, may cause the couplings to dis-engage. Change of motor or coupling could cause the same problem.

If any of the above changes are desired, contact Dean Pump with all the changes in conditions and we will recalculate the unit to see if it is acceptable or, if not, what modifications might be possible.

PRODUCT INSPECTION AND TEST

The Products of Dean Pump Division are subject to thorough and rigorous quality control and inspection procedures throughout the whole of the manufacturing process to assure proper operation in full conformity with established performance standards. On completion of inspection, each unit is sprayed internally with rust inhibitor (if material is subject to atmospheric corrosion), sealed against the entrance of dirt, and tagged with a signed certificate of inspection prior to shipment. Each pump when shipped is ready to perform the service for which it was designed with minimum maintenance and expense if properly installed and operated in accordance with the instructions furnished.

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 lip seals, and mechanical seals; (III) products or parts manufactured by others but furnished by us which, if defective, shall be repaired or replaced only to the extent of the original manufacturer's

warranty; (IV) any loss or damage to or defects in any Dean Products resulting from the misuse or improper storage, installation, or operation thereof; or (V) any loss or damages to or defects in any Dean Products resulting from any alteration or modification thereof not expressly authorized and approved by us in writing. We shall not be liable, directly or indirectly, under any circumstances for consequential or incidental damages, including, but not limited, to: (I) any loss of business or profits; and (II) labor, material or other charges, claims, losses or damages incurred or suffered from, in connection with or in consequence of the working upon, alteration, or repair of any defective Dean Products by persons or firms other than us. Our liability for breach of warranty hereunder is limited solely to the repair in our factory or the replacement F.O.B. our factory, as the case may be, of 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, EXPRESS OR IMPLIED, INCLUDING IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR PARTICULAR PURPOSE.

WARNING

Proper storage while not in use and proper installation and start-up 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 SHOULD 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.

Magnetically coupled pumps quite often contain brittle components which can be broken by the shock of mishandling or dropping of the unit.

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 all exposed machined surfaces. A rust preventative must be used to protect all steel or cast iron parts. The pump shaft and the motor shaft must be rotated by hand every three months.

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.

MECHANICAL DESIGN SPECIFICATIONS

	Frame I	Frame II	Frame III
Pump Sizes	1 x 1 1/2 x 6 1 1/2 x 3 x 6 1 x 1 1/2 x 8	2 x 3 x 6 1 1/2 x 3 x 8 1/2	2 x 3 x 8 1/2 1 1/2 x 3 x 10 4 x 6 x 10 3 x 4 x 8 1/2 2 x 3 x 10 1 x 2 x 10 3 x 4 x 10
Direction of Rotation (viewed from coupling end)	CW	CW	CW
Corrosion Allowance-Casing Shell (.047" min wall thickness)	0.125" .010" (Hastelloy - C)	0.125" .010" (Hastelloy - C)	0.125" .010" (Hastelloy - C)
Impeller Balance: Standard	Single Plane Dynamic Balance		
Magnet Assembly Balance: Standard	Double Plane Dynamic Balance		
Flanges			
ANSI Class	150	150	150
Facing: Standard	F. F.	F. F.	F. F.
Optional Finish	R. F. 125 Ra	R. F. 125 Ra	R. F. 125 Ra
Outer Bearings (Ball)			
Radial	6210 -2 RS	6012 -2 RS	6012 -2 RS
Thrust	6305NR -2 RS	6307NR -2 RS	6307NR -2 RS
Lubrication	Grease - Lube for Life	Grease - Lube for Life	Grease - Lube for Life
Internal Bearings	Silicon Carbide vs. Silicon Carbide	Silicon Carbide vs. Silicon Carbide	Silicon Carbide vs. Silicon Carbide
Magnets	Samarium Cobalt	Samarium Cobalt	Samarium Cobalt
Hydrostatic Test Pressure	430 psig	430 psig	430 psig
Minimum Operating Temp.	0°F	0°F	0°F
Maximum Operating Temp. /	350°F	350°F	350°F
Maximum Working Pressure/ @ 100°F	Ductile Iron 250 psig 316 Stainless Steel 275 psig Alloy 20 230 psig	Ductile Iron 250 psig 316 Stainless Steel 275 psig Alloy 20 230 psig	Ductile Iron 250 psig 316 Stainless Steel 275 psig Alloy 20 230 psig
Minimum Viscosity	0.3 Cp.	0.3 Cp.	0.3 Cp.
Maximum Viscosity	300 Cp.	300 Cp.	300 Cp.
Maximum Solids Size	100 Micron	100 Micron	100 Micron
Maximum Solids Content	1.5%	1.5%	1.5%
Pump Shaft Dimensions:			
Diameter at Coupling	0.875"	1.125"	1.125"
Diameter at Impeller	0.750"	.750"	1.250"
Minimum Pump Shaft End Play	0.009"	0.009"	0.009"
Maximum Pump Shaft End Play	0.030"	0.030"	0.030"
Maximum Drive Shaft End Play	0.010"	0.010"	0.010"
Casing Bolt Torque	50 Ft.Lb.	50 Ft.Lb.	50 Ft.Lb.
Containment Shell (Clamp Ring) Bolt Torque	20 Ft.Lb.	20 Ft.Lb.	35 Ft.Lb.
Bearing Cartridge Bolt Torque	15 Ft.Lb.	15 Ft.Lb.	35 Ft.Lb.

/ Refer to Allowable Working Pressure vs Pumping Temperature on page 7.

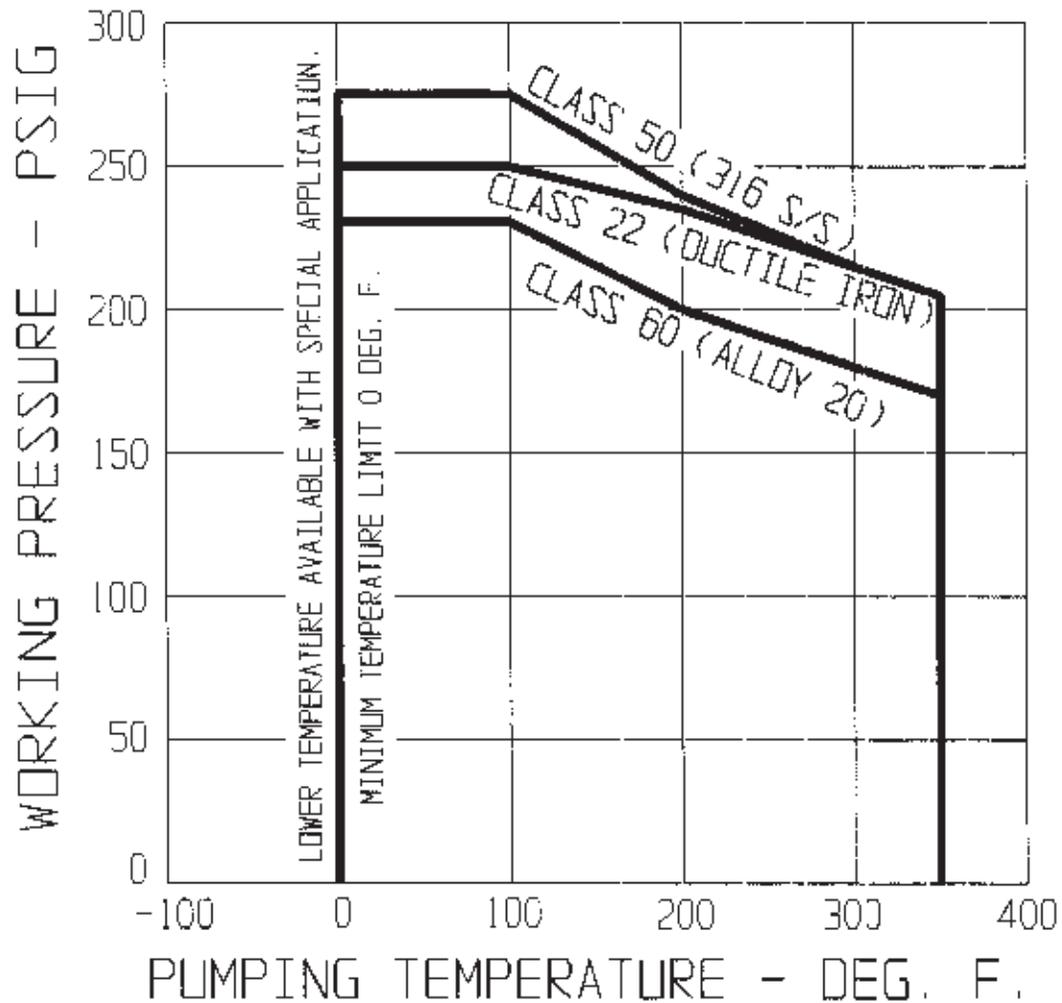
STANDARD MATERIALS OF CONSTRUCTION

Part #	Part Name	Class 22	Class 50	Class 60
3	Impeller	Cast Iron (1)	316 S/S (2)	Alloy 20 (3)
4	Impeller Key	316 S/S (15)	316 S/S (15)	Alloy 20
5	Casing	Ductile Iron (4)	316 S/S (2)	Alloy 20 (3)
5A	Casing Drain Plug	Steel	316 S/S (15)	Alloy 20
9 ○	Frame Foot	Cast Iron (5)	Cast Iron (5)	Cast Iron (5)
9F	Frame Foot Jack Bolt	Steel	Steel	Steel
9G	Frame Foot Jack Bolt Nut	Steel	Steel	Steel
12	Impeller Nut	316 S/S (15)	316 S/S (15)	Alloy 20
12A	Impeller Washer	316 S/S (15)	316 S/S (15)	Alloy 20
12B	Impeller Spring Washer	316 S/S (15)	316 S/S (15)	Hastelloy C
12D	Locking Set Screw	Steel	316S/S (15)	Hastelloy C
13 ▲	Gland	316 S/S (15)	316 S/S (15)	316 S/S (15)
17	Bearing Spacer	316 S/S (15)	316 S/S (15)	Alloy 20
22	Casing Cover	Ductile Iron (4)	316 S/S (2)	Alloy 20 (3)
25	Inboard Bearing	Steel	Steel	Steel
25A	Outboard Bearing	Steel	Steel	Steel
26	Frame	Ductile Iron (4)	Ductile Iron (4)	Ductile Iron (4)
28	Outboard Bearing Cover	Cast Iron (5)	Cast Iron (5)	Cast Iron (5)
29	Pump Shaft	316 S/S (6)	316 S/S (6)	Alloy 20 (7)
29A	Drive Shaft	Steel (8)	Steel (8)	Steel (8)
31	Bearing Lock Nut	Steel	Steel	Steel
31A	Bearing Lock Nut Washer	Steel	Steel	Steel
76 ▲	Lip Seal	Viton (10)	Viton (10)	Viton (10)
77	Casing Gasket	Teflon (16)	Teflon (16)	Teflon (16)
77G	Containment Shell Gasket	Viton (10)	Viton (10)	Teflon Encased Viton (10 & 16)
77H	Sleeve Gasket	Aramid Fiber	Teflon (16)	Teflon (16)
77L▲	Drive Shaft O-ring	Viton (10)	Viton (10)	Viton (10)
95 ▲	Mechanical Seal	Carbon/416ss	Carbon/416ss	Carbon/416ss
149	Clamp Ring	316 S/S (15)	316 S/S (15)	316 S/S (15)
149A	Clamp Ring Dowel	Steel	Steel	Steel
149B	Clamp Ring Screw	Steel	Steel	Steel
150	Containment Shell	Hastelloy C (9)	Hastelloy C (9)	Hastelloy C (9)
163A	Outer Rotor Key	Steel	Steel	Steel
167	Outer Magnet Assembly	Sam. Cobalt (11)	Sam. Cobalt (11)	Sam. Cobalt (11)
171A	Inner Rotor Key	316 S/S (15)	316 S/S (15)	Alloy 20
175	Inner Magnet Assembly	Sam. Cobalt (12)	Sam. Cobalt (12)	Sam. Cobalt (13)
180	Bearing Cartridge			
	181	Bearing Housing	Steel	316 S/S Alloy 20
	182	Bearing Bushing	Silicon Carbide	Silicon Carbide Silicon Carbide
	182A	Bearing Dowel	316 S/S	316 S/S Alloy 20
180A	Bearing Housing Screw	316 S/S	316 S/S	Alloy 20
190	Casing Ring Assembly	Carbon/316 S/S	Carbon/316 S/S	Carbon/Alloy 20
195	Casing Cover Ring Assembly	Carbon/316 S/S	Carbon/316 S/S	Carbon/Alloy 20
200	Journal Sleeve	Silicon Carbide	Silicon Carbide	Silicon Carbide
200B	Tolerance Ring	Hastelloy-C (9)	Hastelloy-C (9)	Hastelloy-C (9)
210	Thrust Collar	Silicon Carbide	Silicon Carbide	Silicon Carbide
210A	Thrust Collar Dowel	316 S/S (15)	316 S/S (15)	Alloy 20
324▲	Gland O-ring	Viton (10)	Viton (10)	Viton (10)
325▲	Gland O-ring	Viton (10)	Viton (10)	Viton (10)

- 1) ASTM A-278 Class 35
- 2) ASTM A-744 Grade CF8M
- 3) ASTM A-744 Grade CN-7M
- 4) ASTM A-395 Grade 60/40/18
- 5) ASTM A-48 Class 20
- 6) ASTM A-276 Grade 316
- 7) ASTM B-473 Grade-87
- 8) Alloy Steel 12S5TS, 100YP
- 9) ASTM B-575, C-276
- 10) Viton-Reg. Trademark of E.I. DuPont deNemours & Co.
- 11) Samarium Cobalt magnets in steel assembly
- 12) Sam. Cobalt magnets in 316 S/S assembly
- 13) Sam. Cobalt magnets in Alloy 20 assembly
- 14) Buna "N" Rubber
- 15) AISI - 316 S/S
- 16) Teflon - Reg. Trademark of E.I. Dupont deNemours & Co.

○ Frame I has foot cast integral with frame
 ▲ Optional parts for secondary containment seal

ALLOWABLE WORKING PRESSURE VS PUMPING TEMPERATURE



If the pump has optional drain connections, there will be a drain connection in the bottom of the casing (5) and a containment shell drain in the bottom of the casing cover (22). Do not connect these two drains together, as it would cause a "short circuit" in the internal lubrication and cooling flow. This would cause severe failure.

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, adjacent to each foundation bolt, to properly level the unit. Check this with a spirit level. Tightly pull down the baseplate mounting bolt nuts and recheck for levelness. Correct if necessary.
- 3) Check driver rotation by removing the coupling spacer and bumping the motor starting button. **Operating the pump in reverse rotation may cause extensive damage.** If driver rotation is correct, proceed with alignment. If not, reconnect the motor wiring properly and again check for rotation. When the driver rotation is correct, proceed with the alignment.
- 4) Align the driver to the pump. (See PUMP AND DRIVER ALIGNMENT.)
- 5) Grout the baseplate. **Do not grout the baseplate to the foundation until the pump and driver are correctly aligned.**
- 6) Determine that piping to the pump is in exact alignment with the pump flanges and imposes no piping strain on the pumping unit. When the alignment is exact, the piping may be bolted in place.
- 7) 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.
- 8) When alignment is correct, install the coupling spacer.
- 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.

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 rotor shaft when the unit is running. Although pumps and drivers are check aligned at the factory, 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 and short bearing life, and unit failure.**

Pumps are not constructed to be used as pipe anchors. Both suction and discharge piping must be supported independently of the pumping unit and thermal expansion joints provided to guard against expansion loads on the pump. Pipes should be anchored between the expansion joint and the pump and as closely to the pump as possible. Failure to provide proper piping support and expansion joints may impose strains on the pumping unit which will result in serious misalignment. Maximum allowable piping loads are shown on page 11 of this manual.

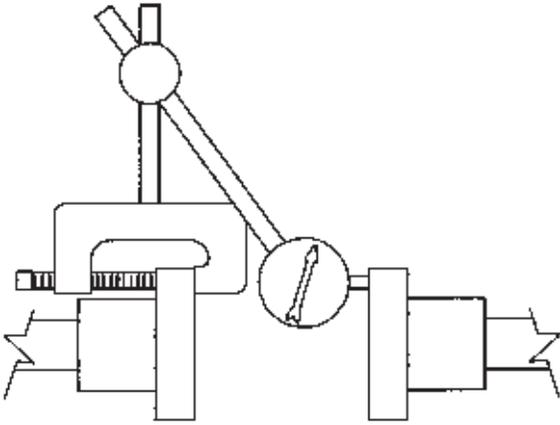
No allowance for thermal expansion is made for motor driven units in mounting the driver. Allowance for turbine mounting should be in accordance with the turbine manufacturer's recommendations. **Final alignment must always be checked and corrected at the operating temperatures of the pump and driver.**

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

Coincident alignment of the driver and rotor shaft is measured at the faces of the coupling hubs. Because of the variety of coupling types furnished at customer's request, the procedure given here 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.

INDICATOR SETUP TO READ ANGULAR MISALIGNMENT



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 releveled before proceeding with alignment.**

Moderate alignment adjustments may be made by using the jack bolts provided on some frame feet. Loosen the frame foot hold-down bolt(s) and the jack bolt lock nuts. Adjustments of the jack bolts may then be made.

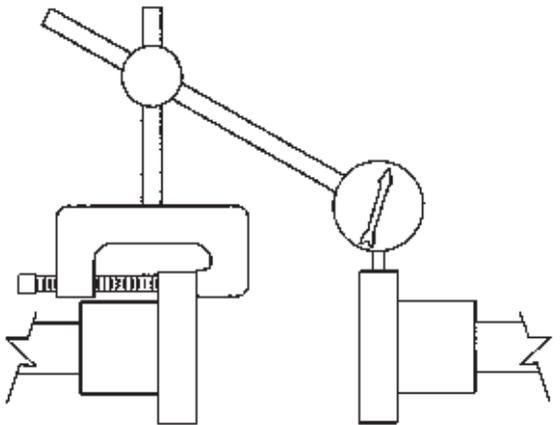
After each change, by shims or jack bolts, it is necessary to recheck both angular and offset alignment of the coupling. After the pump and driver are aligned, tighten all hold-down and jack bolt lock nuts and then recheck alignment.

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, as any misalignment applies loads to both the pump and motor. The greater the misalignment, the greater the load.

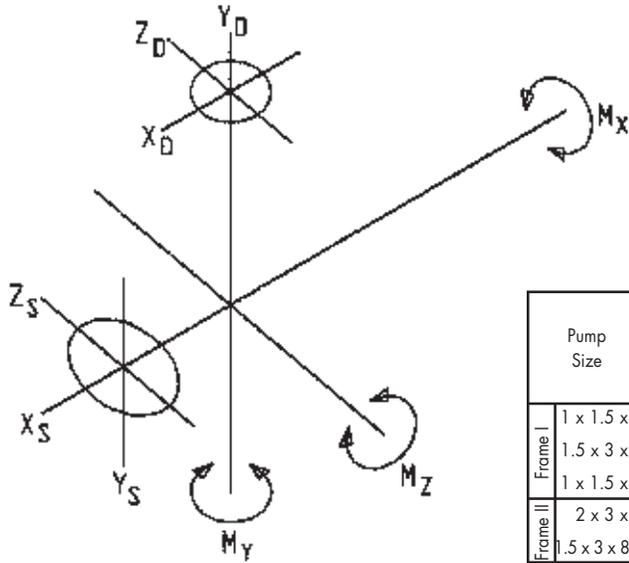
GROUTING THE BASEPLATE

Channel type baseplates are made with open ends to allow easy grouting and do not require grouting holes in the baseplate. **Do not grout the baseplate until the alignment explained under "Baseplate Mounting and Alignment," steps 1 through 4 has been completed.** Fill the entire void under the baseplate with grout and firmly embed the baseplate edges.

INDICATOR SETUP TO READ OFFSET MISALIGNMENT



ALLOWABLE PIPING LOADS M300 SERIES PUMPS



Pump Size	Pump									Flanges					
	Forces				Moments				Σ F & M	Discharge		Suction		Σ Fr & Mr	
	F _x	F _y	F _z	ΣF	M _x	M _y	M _z	ΣM		Fr	Mr	Fr	Mr		
Frame I	1 x 1.5 x 6	394	267	311	284	556	384	182	350	ΣF (Actual) ΣF (Allowable) ≤ 1.0	194	56	267	136	Mr (Actual) Mr (Allowable) ≤ 1.0
	1.5 x 3 x 6	394	270	311	285	556	532	182	395		194	136	270	182	
	1 x 1.5 x 8	394	222	311	274	556	264	182	321		194	56	222	136	
Frame II	2 x 3 x 6	484	489	519	431	1035	391	260	568	ΣF (Actual) ΣF (Allowable) + ΣM (Actual) ΣM (Allowable) ≤ 1.0	225	234	489	391	Mr (Actual) Mr (Allowable) + Fr (Actual) Fr (Allowable) ≤ 1.0
	1.5 x 3 x 8.5	484	455	519	422	1035	391	260	568		221	136	455	391	
Frame III	2 x 3 x 8.5	484	482	519	429	1035	391	260	568	ΣF (Actual) ΣF (Allowable) + ΣM (Actual) ΣM (Allowable) ≤ 1.0	205	234	482	380	Mr (Actual) Mr (Allowable) + Fr (Actual) Fr (Allowable) ≤ 1.0
	3 x 4 x 8.5	484	488	519	431	1035	391	260	568		185	391	488	391	
	1 x 2 x 10	484	387	519	407	468	391	260	331		221	56	397	234	
	1.5 x 3 x 10	484	399	519	407	1035	391	260	568		221	136	399	391	
	2 x 3 x 10	484	421	519	413	1035	391	260	568		205	234	421	219	
	3 x 4 x 10	484	473	519	426	1035	391	260	568		185	391	473	391	
	4 x 6 x 10	454	488	554	433	1202	391	260	645		123	391	454	391	

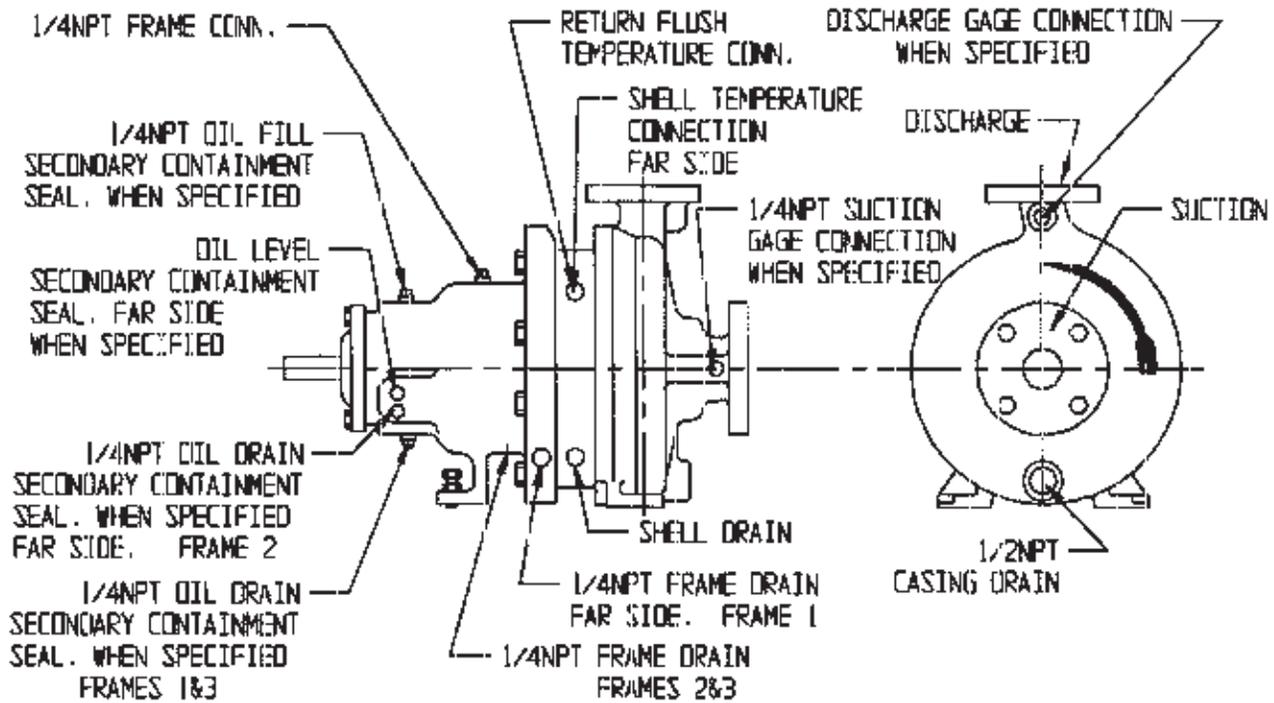
NOTES:

- 1) All forces and moments are considered at, through and about the three axes x, y and z.
 - a) All forces (F_x, F_y, F_z, ΣF) and moments (M_x, M_y, M_z, ΣM) listed under the "Pump" section of the chart are considered at the intersection of the three axes and apply to the pump as a complete unit.
 - b) All forces (Fr) and moments (Mr) listed under the "Flanges" section of the chart are resultant values, and are considered at the intersection of the axis and the face of that particular flange.
 - c) All values are maximums and no value may be exceeded. The summation of forces (ΣF) applies whenever forces exist in more than one direction. The summation of moments (ΣM) applies whenever moments exist about more than one axis.
 - d) All forces are given in pounds.
 - e) All moments are given in foot pounds.
 - f) All of these values are good for pumps constructed of ductile iron, steel, and stainless steels. For pumps of any other materials, contact the engineering department for the allowable piping loads.
- 2) Forces and moments are limited by reduction of internal pump clearances and/or a movement of 0.010 inch of the coupling end of the pump shaft.
- 3) The pump and motor shafts must be realigned after the forces and moments are applied, to reduce the frequency of bearing and mechanical seal maintenance.
- 4) The summation of forces (ΣF) is obtained by taking the square root of the sum of squares of the individual forces.

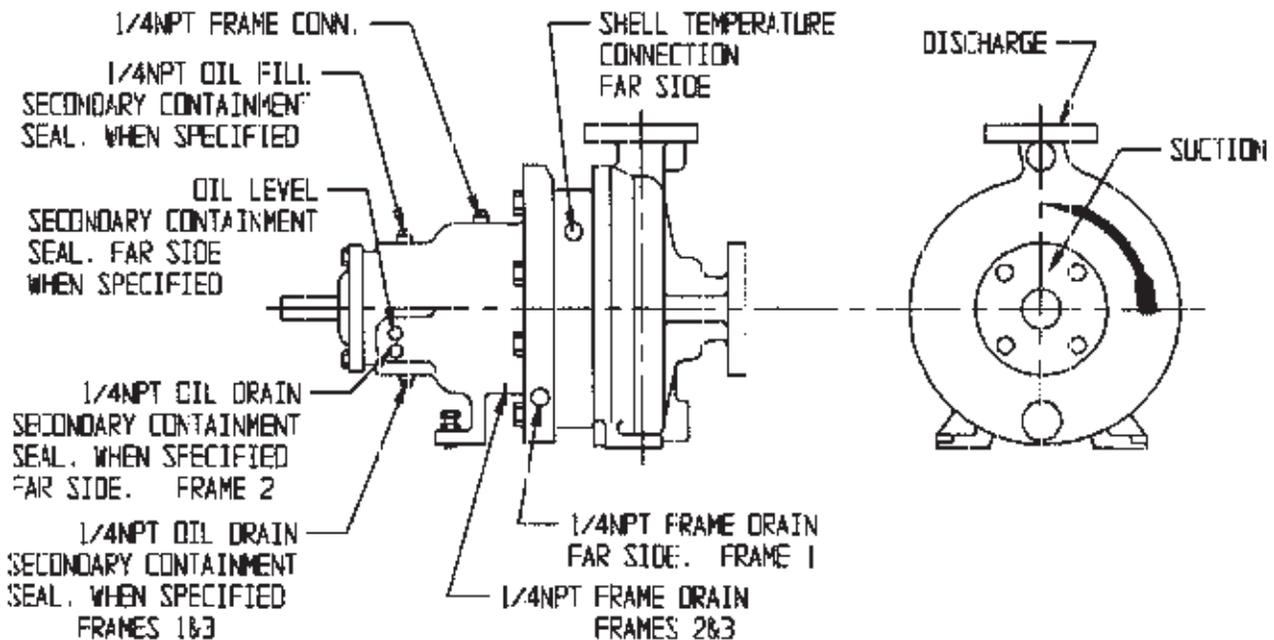
$$\Sigma F = [(F_x)^2 + (F_y)^2 + (F_z)^2]^{1/2}$$
- 5) The summation of moments (ΣM) is obtained by taking the square root of the sum of the squares of the individual moments.

$$\Sigma M = [(M_x)^2 + (M_y)^2 + (M_z)^2]^{1/2}$$
- 6) The three axes are identified as follows:
 - a) The x axis is the same as the axial centerline of the pump shaft.
 - b) The y axis is vertical through the center of the discharge flange and intersects and is perpendicular to the x axis.
 - c) The z axis is horizontal through the intersection of the x and y axes, and is perpendicular to both the x and y axes.

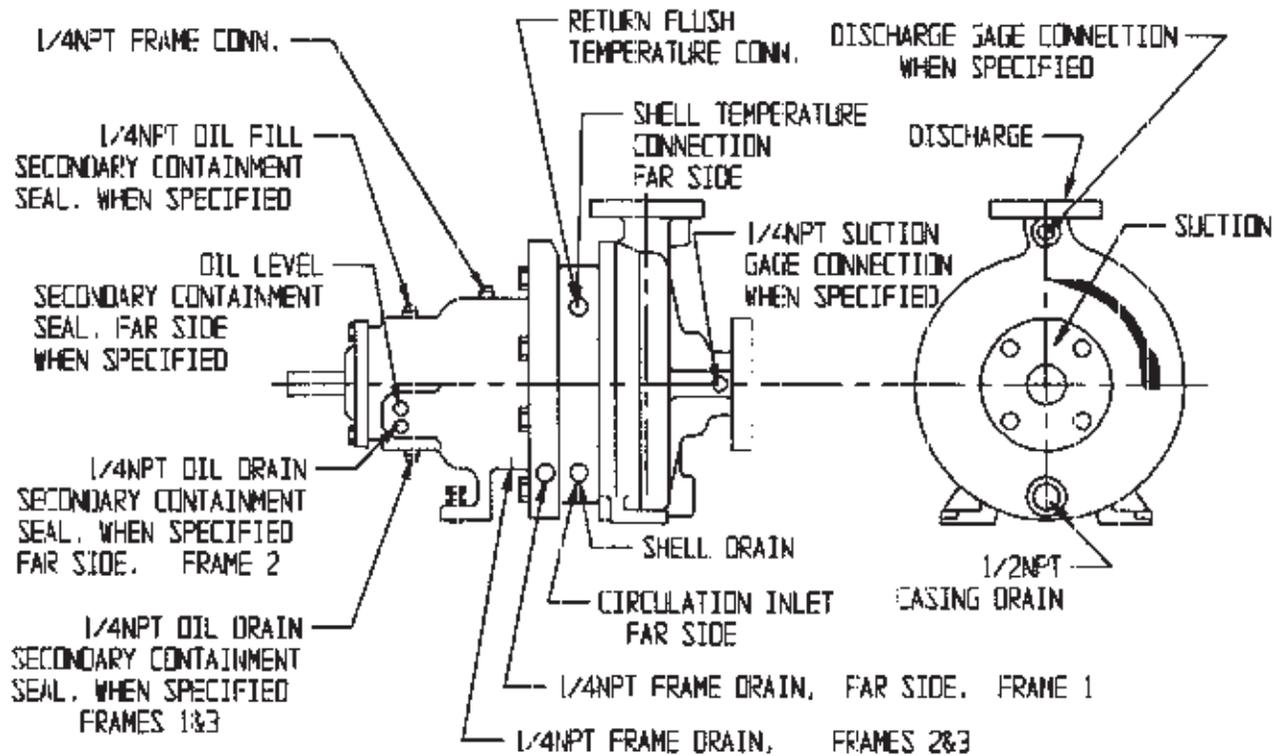
"INTERNAL/INTERNAL" FLUSH PATH



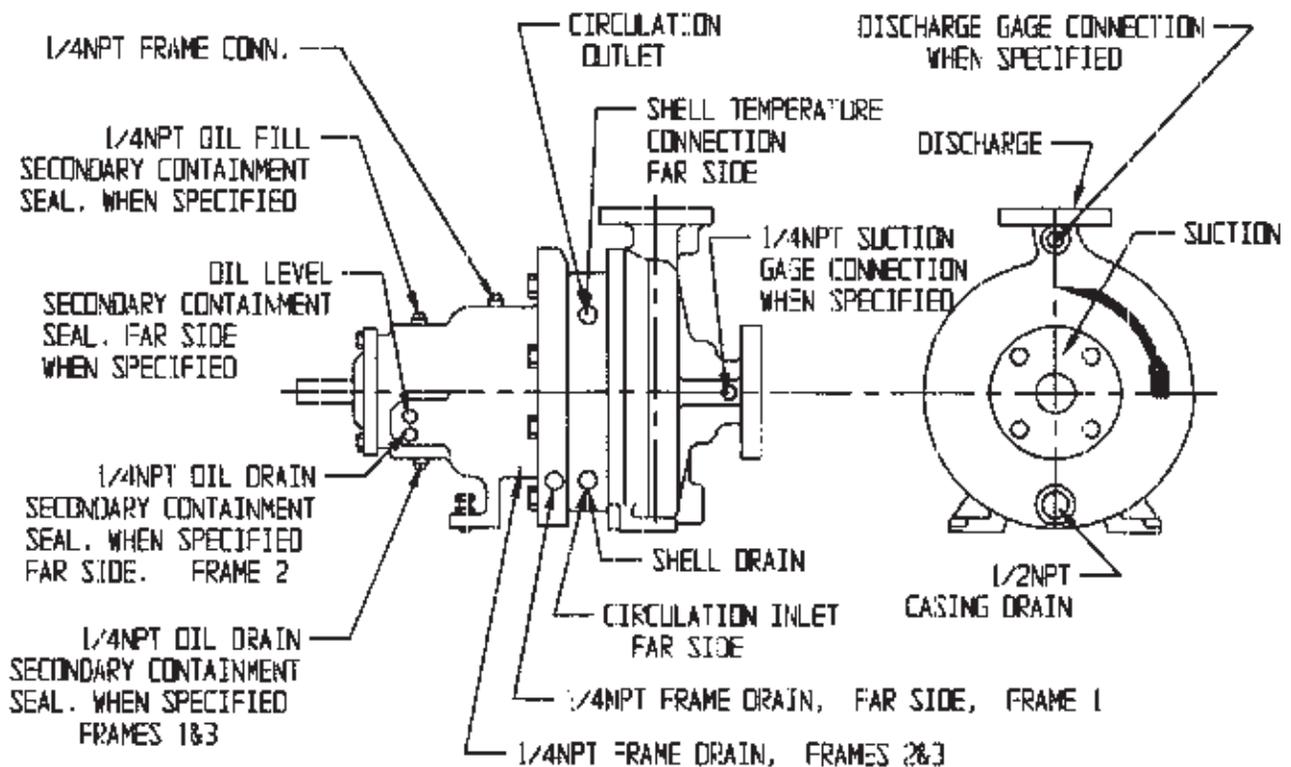
"INTERNAL/INTERNAL" FLUSH PATH WITHOUT AUXILIARY LIQUID CONNECTIONS



"EXTERNAL/INTERNAL" FLUSH PATH



"EXTERNAL/EXTERNAL" FLUSH PATH



OPTIONAL PROTECTION SYSTEMS

The M300 series pumps incorporate the latest technology and are expertly manufactured and assembled to provide long, trouble free operation. Additional security and safety can be achieved with the installation of one or more optional monitoring and protection systems.

- 1) TEMPERATURE PROBE. Many operational malfunctions will directly result in a rapid increase in temperature of the containment shell and/or the return flush liquid. Temperature probes can be installed in the shell temperature connection to monitor the containment shell and the return flush liquid. The output signal from the temperature probe(s) can be used to sound an alarm and should be wired to shut down the pump when readings exceed pre-set limits.
- 2) ELECTRICAL POWER. Current and power sensing devices are available, to be mounted in the user's electrical cabinet, which allows setting to electrical current or power levels for shut down of the motor. In the event of a disengagement (de-coupling) of the magnetic coupling, the lower amperage or power sensed would shut down the motor to protect the pump from more serious damage.
- 3) VIBRATION. A transducer is available which mounts on the frame of the pump to monitor the vibration. It sends a signal to a vibration switch mounted on the baseplate to shut down the pump in the event of excessive vibration.

- 4) PRESSURE SWITCH. A pressure switch can be mounted to sense pressure from the 1/4" NPT frame connection or the 1/4" NPT frame drain. Pressure at these connections would occur in case of a containment shell leakage and would shut down the motor.
- 5) LEVEL SWITCH. A liquid level switch can be mounted to the baseplate to detect leakage through the 1/4" NPT frame drain in case of a containment shell leak to shut down the motor.
- 6) SECONDARY CONTAINMENT SEAL. In the unlikely event of a containment shell rupture, a secondary containment sealing device, located in the frame, can be provided for backup protection against leakage of hazardous liquids to the atmosphere. If a shell rupture should occur, the pumpage is contained in the frame surrounding the containment shell, by a conventional mechanical seal.

CAUTION: The secondary sealing arrangement is provided for short term emergency backup only and is not intended for prolonged operation. The pump should be shut down immediately after the secondary seal is activated. A pressure or level switch as described above must be used to sound an alarm and shut down the pump immediately. The frame drain connection and the secondary containment seal drain are provided to drain any leakage to a safe area, before opening the pumping unit for repairs.

PUMP LUBRICATION

The ball type rotor shaft bearings are permanently grease lubricated and require no additional lubrication.

The sleeve type bearings on the pump shaft are lubricated by the liquid being pumped through internal flush passages, or from an external flush. Conditioning of the liquid may be required (such as filtering or cooling) for proper lubrication.

If the pump is fitted with the optional "Secondary Containment Sealing Arrangement" it will be necessary to provide lubricant for the mechanical seal. Use a good grade of rust and oxida-

tion inhibiting, non-foaming, industrial oil of 425-525 SSU Viscosity at 100°F (ISO 100) for this lubrication.

Remove the oil fill plug from the top of the frame (26) (located between the ball bearings [25 and 25A] near the coupling end of the frame). Remove the oil level plug from the side of the frame (26). Pour oil into the oil fill connection until it runs from the oil level connection. This will be only about one cubic inch of oil (approximately 0.5 fluid ounce). Replace the oil fill and the oil level plugs and tighten.

STARTING THE PUMP

The pump must be primed prior to start-up.

When the source of liquid supplied to the pump is below atmospheric pressure or located below the pump, priming may be accomplished in any of the three ways listed below:

- 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. A foot valve may create excessive friction 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 in the same manner as the exhauster (See step 1).

When the source of liquid supplied to the pump is above the 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.

When the pump is supplied with the standard "internal/internal" flush path, for cooling the magnets and lubricating the bearings, the containment shell area of the pump is automatically vented when the above procedure is followed. If the pump is arranged with an "external/internal" flush path, all high points in the flush piping must also be vented when filling to remove any trapped gas (air). If the pump is arranged with an "external/external" flush path, all high points in the flush piping must be vented when filling and vented again several times during the first start up period until the pump reaches stabilized operating temperature.

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 an external flush system is equipped with cooling water piping, this should be turned on before filling the pump. Any other heating or cooling should be turned on before starting the pump. Turn the coupling end of the rotor shaft to see if the pump turns freely. If it does not, investigate and correct the cause before starting the motor.

CAUTION—EXTREME HAZARD TO PERSONNEL: Do not operate a pump at no flow condition. Do not operate a pump at a low flow condition, unless provision has been made to prevent dangerous heat build up within the pump. Operating this pump with the discharge and/or suction valves closed may be extremely hazardous. 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. The heat will also severely damage the pump.

This pump should never be run without liquid in the casing. Extensive damage will result, particularly to the sleeve bearings and the magnets. When the pump is furnished with external flushing piping, vent liquid through the high points in the piping system to provide lubrication to the sleeve bearings.

It is important to check the direction of rotation of the pump before allowing the pump to come up to speed. To check rotation direction, remove the coupling spacer, push the starting button and instantly push the stop button. This will allow the motor to turn over a few revolutions and the direction of rotation to be observed. A direction of rotation arrow is shown on the front of the pump casing. If rotation is incorrect, change the wiring connections and recheck the rotation. Replace the coupling spacer and the coupling guard. **Operating the pump in reverse rotation may cause extensive damage.**

If the rotation direction is correct and the pump properly filled with liquid, it may now be started.

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

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

CAUTION – When the pump is started, immediately observe the discharge pressure gauge and/or the flow meter to confirm that the pump is actually operating and at the expected values of pressure and flow.

Operation of a magnetically coupled pump cannot be confirmed by visual observation of the driver shaft (29A) (outer pump shaft) rotation. The motor shaft and the driver shaft (29A) (visible, external pump shaft) may be turning at full speed, but if the magnetic coupling (inside the pump) has disengaged, the pump is not moving liquid. This condition, if not stopped immediately, will cause rapid overheating, equipment damage and possible rupture of the pressure containing parts.

PUMP START-UP CHECKLIST

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

- 1) Read the instruction manual thoroughly and understand it.
- 2) Review the pump order headsheet for the service rating of the pump and any special features.
- 3) Check all piping connections making certain they are both tight and in the proper places. Piping includes flushing, cooling or heating piping. Be sure that the casing drain and the containment shell drain are not connected together.
- 4) Make certain no insulation has been placed over any air cooling surfaces of the pump or its auxiliary piping.
- 5) Make sure the baseplate has been properly installed.
- 6) Check the electrical or steam line connections to the driver.
- 7) If the pump is equipped with air cooled (finned) auxiliary piping, make sure the drive motor is fan cooled.
- 8) Break the coupling by removing the coupling spacer and bump the motor starting button to check motor rotation. Operating the pump in reverse rotation may cause extensive damage.
- 9) Check the coupling for proper alignment of the motor and rotor shafts. Re-align if necessary. Replace the coupling spacer.
- 10) If the pump has the optional "Secondary Containment Seal" check to see that it is properly lubricated.
- 11) Make sure the pump is filled with liquid and vented to remove any air.
- 12) Turn on any cooling or heating to the pump and/or auxiliary equipment.
- 13) 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.
- 14) Remove all dirt, waste, tools and construction debris from the area.
- 15) Make sure the coupling guard is securely in place.
- 16) Start the pump and immediately check for proper flow and pressure.
- 17) Perform extra venting procedure if required. See "Starting the Pump".

SPARE PARTS

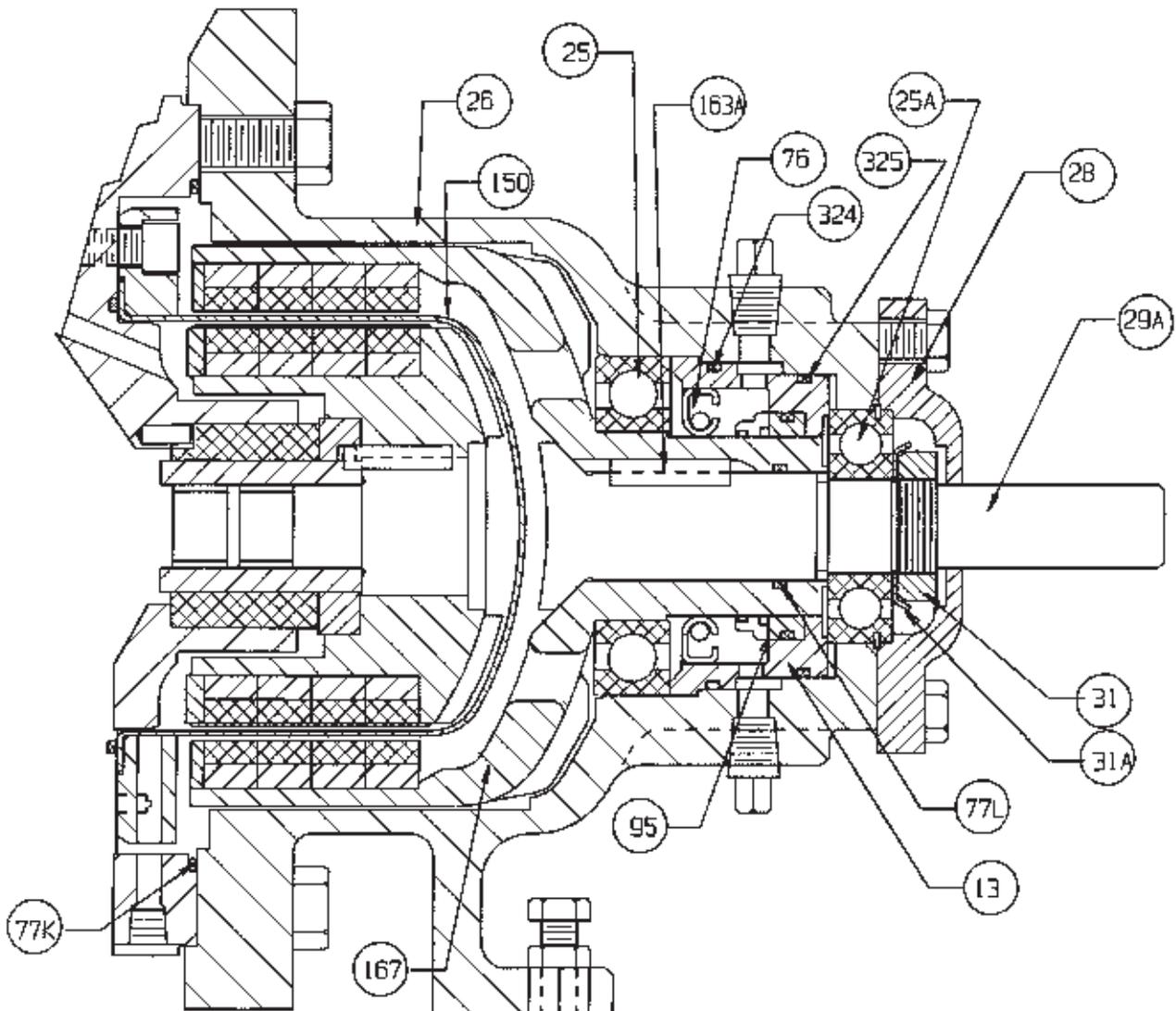
To avoid prolonged down time and facilitate rapid repair of damaged pump parts, Dean recommends the pump user maintain a minimum stock of spare parts. If the pump service is critical or the pump parts are of special materials, a spare parts stock is even more important to the user. Such a spares inventory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

ORDERING SPARE PARTS

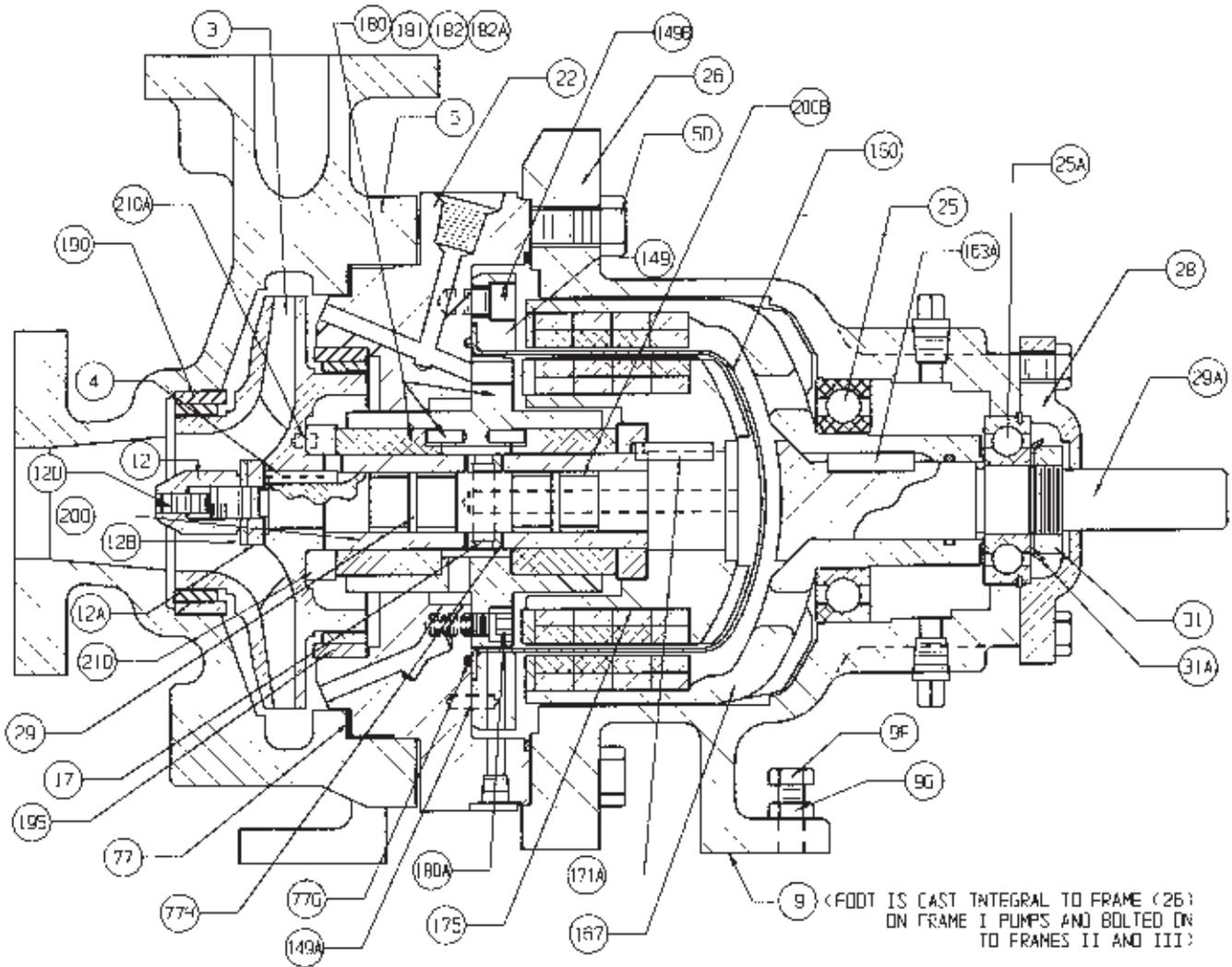
Spare part orders will be handled with a minimum delay if the following information is furnished by the customer with the order:

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

OPTIONAL SECONDARY CONTAINMENT SEALING ARRANGEMENT



PUMP SECTION VIEW



Part #	Part Name
3	Impeller
4	Impeller Key
5	Casing
5A	Casing Drain Plug
9 ○	Frame Foot
9F	Frame Foot Jack Bolt
9G	Frame Foot Jack Bolt Nut
12	Impeller Nut
12A	Impeller Washer
12B	Impeller Spring Washer
12D	Locking Set Screw
13 ▲	Gland
17	Bearing Spacer
22	Casing Cover
25	Inboard Bearing
25A	Outboard Bearing
26	Frame

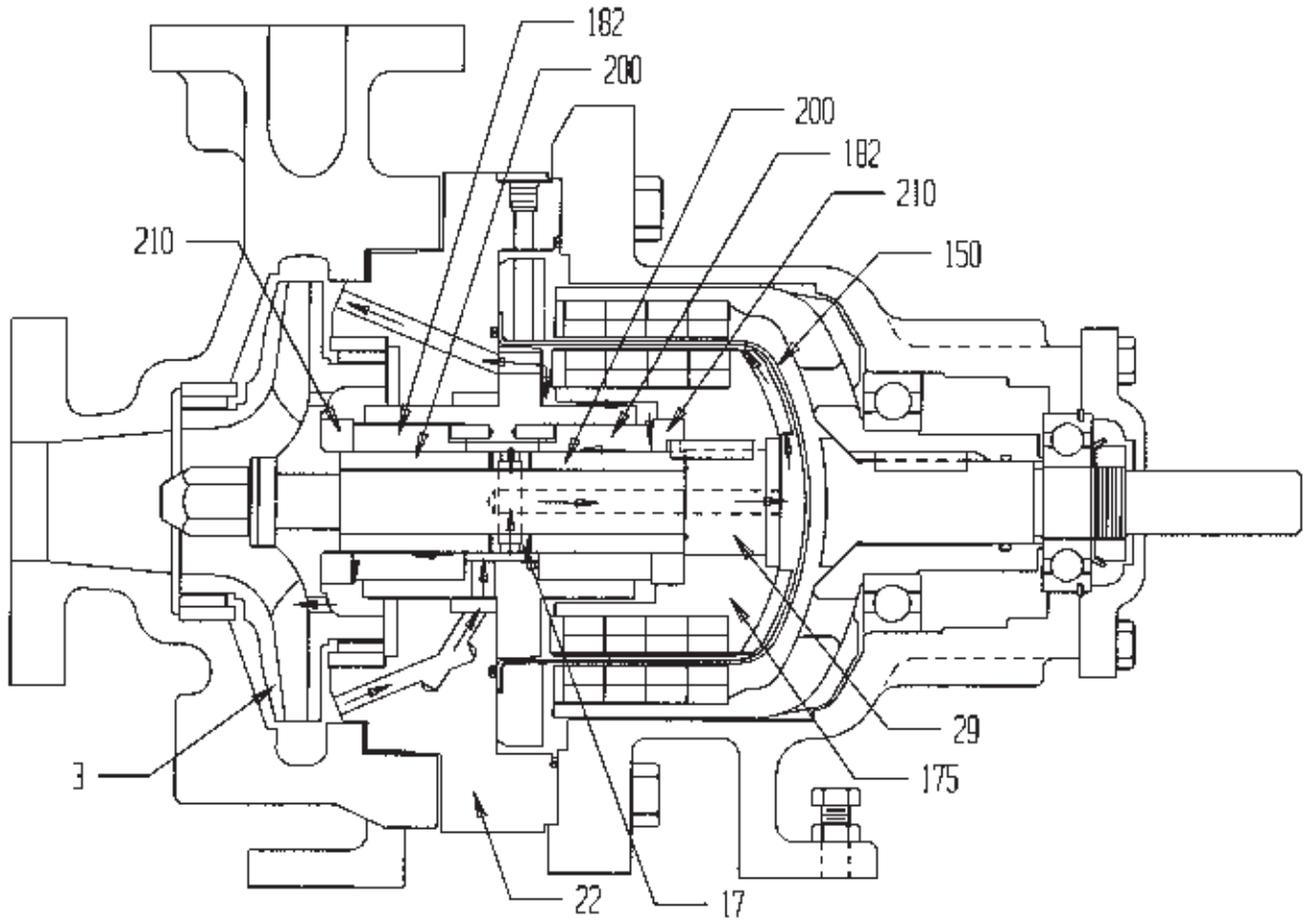
Part #	Part Name
28	Outboard Bearing Cover
29	Pump Shaft
29A	Drive Shaft
31	Bearing Lock Nut
31A	Bearing Lock Nut Washer
76 ▲	Lip Seal
77	Casing Gasket
77G	Containment Shell Gasket
77H	Sleeve Gasket
77K ▲	Frame Gasket
77L ▲	Drive Shaft O-ring
95 ▲	Mechanical Seal
149	Clamp Ring
149A	Clamp Ring Dowel
149B	Clamp Ring Screw
150	Containment Shell
163A	Outer Rotor Key

Part #	Part Name
167	Outer Magnet Assembly
171A	Inner Rotor Key
175	Inner Magnet Assembly
180	Bearing Cartridge
181	Bearing Housing
182	Bearing Bushing
182A	Bearing Dowel
180A	Bearing Housing Screw
190	Casing Ring Assembly
195	Casing Cover Ring Assembly
200	Journal Sleeve
200B	Tolerance Ring
210	Thrust Collar
210A	Thrust Collar Dowel
324 ▲	Gland O-ring
325 ▲	Gland O-ring

○ Frame I has foot cast integral with the bearing housing.

▲ Optional parts for secondary containment seal.

INTERNAL CIRCULATION FLOW PATH



The internal circulation flow path through the bearings and the magnetic coupling is supplied with discharge pressure and returns to discharge pressure. The differential pressure required to do this is supplied by an impeller built into the outer end of the inner magnet assembly (175). This flow provides cooling to the magnets (175) and the containment shell (150) and also lubrication as well as cooling to the bearings (182), journal sleeves (200) and thrust collars (210).

The flow (as shown in the drawing above) is fed from the perimeter of the impeller (3) and flows through a passage in the casing cover (22) to an area between the bearings (182). The flow splits at this point with part of the flow proceeding between the front bearing (182) and journal (200), past the

front thrust collar (210), through the balance holes in the impeller (3) back to the suction of the pump. The rest of the flow passes through the bearing spacer (17) and the pump shaft (29) to the end of the inner bearing assembly (175) where the impeller blades on this assembly increase the pressure, forcing the pumpage between the inner magnet assembly (175) and the containment shell (150), through a passage in the casing cover (22) back to the perimeter of the impeller (3). A small amount of this flow is diverted before it can enter the passage in the casing cover (22) and passes between the rear bearing (182), thrust washer (210) and journal (200) and then returns to the bearing spacer (17) where it merges with a new supply of internal circulation flow.

DISASSEMBLY AND ASSEMBLY PROCEDURES

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

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.

CAUTION - EXTREME HAZARD

HEART. Magnets in/from this pump can upset the timing of heart pacemakers and make them malfunction. This caution cannot be overstated due to the health risk involved.

EYES, HANDS, FINGERS, EXPOSED FLESH. Brittle materials (such as silicon carbide and carbon used for wearing parts) can fracture and propel hard, sharp particles causing serious personal injury. Protective equipment must be utilized when servicing these parts.

The magnets are also very brittle and, if cracked or fractured, can propel hard, sharp particles causing serious personal injury. Protective equipment must be utilized when servicing these parts.

The magnets used in this pump are very strong and can cause parts and tools to slam together injuring hands and fingers. This could also crack the magnets and propel particles as cautioned above.

CAUTION: In addition to safety related cautions due to the mechanics of a magnetically coupled pump, safety precautions must be taken due to the nature of the liquid being pumped.

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.

Sealless pumps often handle flammable, toxic or hazardous liquids. The user shall take caution that all the fluid is drained from the containment shell before disassembly and repair work is begun.

If the pump was not purchased with casing and shell drains, a considerable amount of liquid will remain in the pump.

When the pump is handling flammable, toxic or hazardous fluids, the internals of the pump must be properly decontaminated by qualified personnel before disassembly. This may include flushing the pump and system before disassembly. Prior to flushing, decontamination and disassembly the Material Safety Data Sheet (MSDS) for the pumped liquid shall be reviewed to ensure proce-

dures and precautions as specified are adhered to. Proper attire shall be worn during disassembly and decontamination.

Pumps requiring factory repair must not be returned or transported until a certified and documented decontamination has taken place.

Decontamination certificate and MSDS must be part of the shipment package returned for factory repair.

CAUTION: In spite of thorough cleaning and flushing prior to maintenance of sealless pumps, some contamination of pump internals may exist. Repair shop personnel should be advised of the nature of the hazardous liquid handled, and of the requirement for protective clothing and equipment needed during maintenance work. Care must be taken in disposing of residue and contaminated parts being replaced.

Use only top quality tools.

REMOVING THE PUMP'S "FRAME ASSEMBLY"

The Dean magnetic coupled pump, with "back pull out" centrifugal design, allows the complete disassembly of the pump without disturbing the suction or discharge piping.

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

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

- f) Flush each sub-system with a compatible, non-toxic, non-hazardous, stable liquid. Drain into individual containers for each fluid. Disconnect and remove all auxiliary piping.
- g) Carefully bleed off any pressure remaining in the pump. Pressure remaining in the pump will be dependent upon the pressure in the system when the pump was stopped; the quality, type, and condition of the isolation valves; the thermal expansion values of the fluid and the pump material; and the change in the vapor pressure of the fluid between the temperature at the time the isolation valves were closed and the ambient temperature. Bleeding must be through a valved drain line from the casing drain 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. Now drain pumpage from the containment shell drain connection in the same manner as above for the casing drain.

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

- h) Now drain any small piping, that contains the fluid pumped, from all low points into the same container used to drain the pump. Do not drain any other fluids (different than the pumpage) into this container as they may not be compatible. Personal injury, death, and/or equipment damage could occur. Remove the frame drain plug which will drain any fluid that may have leaked into the frame. Drain and remove any auxiliary piping. Remove the 1/4" NPT plug from the secondary containment seal drain connection in the bottom of the frame (26). Drain the oil and/or any residual pumpage from a possible leak of the primary pressure containment.

Remove the frame foot mounting bolts.

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

- i) Because of the above possibility, when you loosen the gasketed joint at the back of the casing (5), loosen the casing bolts (5D) only one full turn, and then use jack

screws in the flange of the casing cover (22) 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 are loosened and the gasket seal is broken.

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

- j) Remove the casing bolts (5D) and using a mechanical lifting apparatus to support the weight, pull the frame assembly from the casing (5).

In some instances, it may be necessary to remove the coupling hubs from the drive shaft and the motor shaft to allow the removal of the frame assembly.

- k) Flush the wetted parts, now exposed, with a compatible, non-toxic, non-hazardous, stable liquid.
- l) Remove the gasket from the face of the casing (5) or the 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 requirement. 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. Take care to not scratch the metal surfaces. 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.
- m) Remove the casing ring assembly (190) by prying it out of the casing (5). Remove only if it needs to be replaced. The inner component is made of carbon and will most likely be broken during removal. CAUTION: Wear face shield, gloves and a long sleeved shirt during this disassembly as the carbon ring is under compression and may fly apart.
- n) The frame 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 OF THE "FRAME ASSEMBLY"

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 the 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.

WARNING—EXTREME HAZARD TO PERSONS WITH PACEMAKERS: DO NOT WORK IN CLOSE PROXIMITY WITH UNASSEMBLED OR DIS-ASSEMBLED MAGNETIC PARTS WITHOUT FIRST CONSULTING YOUR PHYSICIAN. IT IS POSSIBLE THAT THE STRONG MAGNETIC FIELD ASSOCIATED WITH THESE PARTS COULD RESET YOUR PACEMAKER HEART RATE OR CAUSE OTHER SERIOUS PROBLEMS.

CAUTION: This unit contains powerful magnets. Personal injury could occur if parts are not adequately restrained when in the presence of the magnetic field. Remove your watch as the magnetic field will ruin it. Proceed with dis-assembly in an area which has been cleared of loose, ferrous articles and particles. A wood bench is the preferred work top, but a steel bench, with a 3/4" plywood board laid on top, will suffice.

If there is any question about the strength of the magnetic coupling, it should be checked at this time.

Measure the strength of the magnetic coupling (the attracting force between the inner magnet assembly (175) and the outer magnet assembly (167)) to see if the magnets are still capable of transmitting the needed power. Hold the impeller (3) against rotation by inserting a piece of flat steel into its periphery between the blades for use as a lever. DO NOT use the impeller nut (12) to resist the torque. Use a torque wrench to apply torque to the coupling end of the drive shaft (29A).

Apply torque gently and evenly until you feel a "slight" softening of resistance, and read this torque. Do not continue to increase the torque beyond this point as the magnets will disengage (decouple) and jump one sixth (60 degrees) of a revolution. If the magnets disengage and "jump" the shock could break the internal bearing components.

Compare the torque reading you obtain with the chart below for the size of the magnetic coupling in your pump.

MINIMUM TORQUE IN FOOT-POUNDS						
Pump Size	Rows of Magnets/Length					
	1 .6"	2 1.1"	3 1.7"	4 2.3"	5 2.8"	6 3.4"
1 x 1½ x 6	7.5	16.7	27.2	38.4	NA	NA
1½ x 3 x 6	7.5	16.7	27.2	38.4	NA	NA
1 x 1½ x 8	7.5	16.7	27.2	38.4	NA	NA
2 x 3 x 6	7.5	16.7	27.2	38.4	50.3	62.4
1½ x 3 x 8½	7.5	16.7	27.2	38.4	50.3	62.4
All Other Pump Sizes	Rows of Magnets/Length					
	1 .8"	2 1.5"	3 2.3"	4 3.0"	5 3.8"	
	22.8	58.2	90.6	125	159	

The number of rows of magnets in your pump will be shown in the paperwork for that particular pump. If you do not have that information at hand, you can measure the axial length of the magnets in the outer magnet assembly (167) and compare it with the value shown in the chart above for your particular pump size. This, of course, can not be accomplished until the pump is further disassembled.

If the torque you obtain is less than the minimum value shown in the chart, the inner magnet assembly (175), the outer magnet assembly (167), or both need to be replaced. Return these to Dean Pump for determination of which or both are bad.

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

- Insert a piece of flat steel into the periphery of the impeller (3), between the blades of the impeller (3), to restrain it from turning while loosening the locking set screw (12D), and then the impeller nut (12) (both right hand threads). Remove the locking set screw (12D), from the impeller nut (12), and throw it away. Remove the impeller nut (12), the impeller spring washer (12B), the impeller washer (12A), the impeller (3), the impeller key (4) and the front thrust collar (210).
 - Make a handle by drilling a hole in the middle of a piece of flat steel bar stock. For Frame I & II pumps, use a 1/2" or 5/8" thick, 1-1/2" or 2" wide, 15" to 18" long bar and drill a 3/4" or 13/16" diameter hole. For Frame III pumps, use a 1/2" or 5/8" thick, 2" or 2-1/2" wide, 16" to 20" long bar, and drill a 1-1/4" to 1-3/8" diameter hole. Place this handle over the pump shaft (29) and replace the impeller washer (12A) and impeller nut (12).
- An optional eye bolt is available from Dean Pump which screws onto the end of the pump shaft to facilitate lifting instead of the bar described above. The eye bolt would provide a place to hook a hoist.
- Remove the two cap screws which hold the frame (26) to the casing cover (22).
 - Stand the unit up on end so that the pump shaft axis is vertical and the unit is resting upon the face of the coupling hub. Support the pump in this position.

Use a small hoist hooked to the flat bar handle described in paragraph (b) or to the optional eye bolt mentioned in paragraph (b). Using great caution, lift the inner rotating assembly out of the frame (26).

CAUTION: the assemblies which you are separating contain very strong magnets which will resist the separation. You must have both assemblies held firmly as they are pulled apart because the energy in the magnets will work to "snap" them back together like a strong spring.

DO NOT attempt this separation manually due to the possibility of personal injury and damage to equipment.

- CAUTION:** The inner (175) and the outer (167) magnet assemblies are now exposed and will attract any ferrous metal which comes within about four inches. Wrenches will "snap" rapidly against the magnets and pinch fingers or chip the magnets.

- Any loose metal attracted to the magnets must be completely removed before re-assembly; therefore, attempt to keep the surfaces as clean as possible.
- f) Continue disassembly on a clean, wooden (nonferrous) surface.
 - g) Use an Allen wrench to remove the eight socket head cap screws (149B) which retain the clamp ring (149) to the casing cover (22). Remove the clamp ring (149), the containment shell (150) and the containment shell gasket (77G). The clamp ring dowel pin (149A) may also be removed if so desired.
 - h) Remove the impeller nut (12), the impeller washer (12A) and handle from the pump shaft (29), or remove the optional eye bolt.
 - i) Slide the inner magnet assembly (175), pump shaft (29), rear thrust collar (210), bearing spacer (17), and journal sleeves (200) from the casing cover (22) and bearing bushings (182).
 - j) Press the pump shaft (29) with the sleeves (200) and bearing spacer (17) from the inner magnet assembly (175) and remove the rear thrust collar (210) from the inner magnet assembly (175).
 - k) Store the inner magnet assembly (175) in a ziplock plastic bag, or some similar container, as soon as possible to reduce the amount of material which might be attracted by the magnetic field. Any such material is difficult to remove.
 - l) Remove the inner rotor key (171A) from the pump shaft (29).
 - m) Pull the journal sleeves (200) and the bearing spacer (17) from the pump shaft (29). The journal sleeves (200) may be tight on the pump shaft (29) and require substantial pull. If the journal sleeves (200) do not need to be replaced, do not remove them. If they do need to be replaced, and you cannot pull them off, you can fracture them by placing them in a vice and closing it.
CAUTION: This operation will fling sharp particles. Wear face shield, gloves, and a long sleeved shirt during this operation and be careful to not squeeze on the bearing spacer (17). Remove and discard the sleeve gaskets (77H).
 - n) Remove the four tolerance rings (200B) from the pump shaft (29) and discard them.
 - o) **CAUTION:** Strong magnetic field - steel wrenches will be attracted. A protective pad will make the job easier. Coil a piece of 1/8" thick rubber gasket sheet - cut 3-1/2" by 14" for Frames I & II or 4" by 17" for Frame III - into a cylinder and insert it into the bore of the magnets in the outer magnet assembly (167) to protect the face of the magnets.
 - p) Remove the four outboard bearing cover cap screws and pull the outboard bearing cover (28) off the end of the drive shaft (29A).
Bend the tab of the bearing lock washer (31A) out of the slot in the bearing lock nut (31) and loosen the bearing lock nut (31) about a half turn while holding the drive shaft (29A) against rotation with a hook spanner in the keyway of the drive shaft (29A).
 - q) Remove the snap ring from the outer race of the outboard bearing (25A). Do not remove the bearing lock nut (31). Push the outer magnet assembly (167), drive shaft (29A), inboard bearing (25) and outboard bearing (25A), as a unit, from the frame (26). If the pump was supplied with an optional "Secondary Containment Seal", it will also come out of the frame with the above unit.
 - r) Remove the bearing lock nut (31) and bearing lock washer (31A) and press the drive shaft (29A) through the outboard bearing (25A) and the outer magnet assembly (167). **CAUTION:** Do not strike the magnets with the drive shaft (29A) as you are removing it, the magnetic field will attract the shaft. The rubber gasket sheet (described in paragraph o) inserted into the bore of the magnets before removing the rotor shaft will help to protect the magnets' inner diameter. Also, support the end of the outer magnet assembly (167) on a sheet of gasket material when performing this operation to protect the face of the assembly.
 - s) If the pump has the optional "Secondary Containment Seal", pull the gland (13), mechanical seal (95) and lip seal (76) as an assembly from the outer magnet assembly (167). Remove the lip seal (76), mechanical seal (95) and O-rings (324 and 325) from the gland (13). Remove drive shaft O-ring (77L) from the outer magnet assembly (167). Remove the frame gasket (77K) from the casing cover (22).
 - t) Press the inboard bearing (25) from the outer magnet assembly (167). Store the outer magnet assembly (167) in a zip-lock plastic bag, or some similar container, as soon as possible to reduce the amount of material which might be attracted by the magnetic field. Any such material is difficult to remove.
 - u) Remove the four cap screws (180A) which retain the bearing cartridge (180) to the casing cover (22). Slide the bearing cartridge (180) from the casing cover (22). The flange of the bearing cartridge (180) is tapped to accept two jackscrews to facilitate disassembly if necessary.
 - v) Remove the casing cover ring assembly (195) by prying it from the casing cover (22). Remove only if it is to be replaced. The inner component is made of carbon and will most likely be broken during removal. **CAUTION:** Wear face shield, gloves, and a long sleeved shirt during this disassembly as the carbon ring is under compression and may fly apart.
 - w) If the pump has a removable frame foot (9), it can be removed from the frame (26) if so desired.
 - x) Clean all of the parts thoroughly and inspect them for wear and/or damage. Make certain that all ports, lubrication grooves, and flow passages are completely clean and free of any debris. Replace parts as required. We recommend that you always replace all gaskets, lip seals, O-rings, bearings and tolerance rings whenever the pump is disassembled. Store the magnetic parts (167 & 175) in an area free from loose ferrous articles and particles.

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.

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

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

WARNING—EXTREME HAZARD TO PERSONS WITH PACE MAKERS:

DO NOT WORK IN CLOSE PROXIMITY WITH UNASSEMBLED OR DISASSEMBLED MAGNETIC PARTS WITHOUT FIRST CONSULTING YOUR PHYSICIAN. IT IS POSSIBLE THAT THE STRONG MAGNETIC FIELD ASSOCIATED WITH THESE PARTS COULD RESET YOUR PACEMAKER HEART RATE OR CAUSE OTHER SERIOUS PROBLEMS.

CAUTION: This unit contains powerful magnets. Personal injury could occur if parts are not adequately restrained when in the presence of the magnetic field. Remove your watch as the magnetic field will ruin it.

Assemble the pump in an area that has been cleared of loose ferrous articles and particles. A wood bench is the preferred work top, but a steel bench with a 3/4" plywood board, laid on top, will suffice.

To assemble the pump, perform the following steps:

- a) Clean all parts thoroughly. Make certain that all ports, lubrication grooves, and flow passages are completely clean and free of any debris.
- b) Replace all worn, corroded, eroded, or otherwise deteriorated parts. Use only new gaskets, new ball bearings, new O-rings and new tolerance rings.
- c) Replace the frame foot (9) if it was removed.
- d) If the pump is furnished with the optional "Secondary Containment Seal", install a new drive shaft O-ring (77L) into the outer magnet assembly (167) and apply some light oil to lubricate the O-ring.
- e) Thoroughly clean the outer magnet assembly (167). Be certain that all ferrous particles are removed. A piece of masking tape, rubbed "sticky side" across the surface of the part, is quite effective in removing such particles. Press a new inboard bearing (25) onto the outer magnet assembly (167). Press only on the inner race. Support the end of the outer magnet assembly (167) on a sheet of gasket material when performing this operation to protect the magnets.
- f) If the pump is equipped with an optional "Secondary Containment Seal", install new gland O-rings (324 & 325) into the grooves in the gland (13) and lubricate the O-rings with a light oil. Carefully remove both O-rings from a new mechanical seal assembly (95), lubricate them with the special lubricant supplied, and then re-install them into the mechanical seal assembly. Separate the stationary portion of the mechanical seal assembly (95) and carefully push it into the gland (13) with the

polished face exposed. Lubricate the polished face with a light film of light oil. Place the carbon face of the rotating portion of the mechanical seal against the polished face and center it. Press a new lip seal (76) into the gland (13) with the lip pointed towards the mechanical seal (95). Lubricate the lip seal (76) with a light oil. Be sure that the "rotating" portion of the mechanical seal assembly (95) is centered in the gland (13). Carefully slide this assembly over the outer magnet assembly (167) and against the inboard bearing (25).

- g) Insert the outer rotor key (163A) into the keyway in the drive shaft (29A) and slide the drive shaft (29A) into the outer magnet assembly (167).

CAUTION: Do not strike the magnets with the drive shaft (29A) as you are installing it, the magnetic field will attract the shaft. A piece of 1/8" thick rubber gasket sheet cut 3-1/2" by 14" for frames I and II or 4" by 17" for frame III and coiled into a cylinder and then inserted into the bore of the magnets before installing the rotor shaft will make this assembly easier, and reduce the possibility of damage.

- h) Stand the drive shaft (29A) and outer magnet assembly (167) with the shaft axis vertical and the magnets down, upon the cupped end of the drive shaft (29) on a non-magnetic (brass, bronze or 316 S/S) spindle so that the outboard bearing (25A) can be pressed onto the shaft. Press a new outboard bearing (25A) onto the drive shaft (29A) with the snap ring, in its outer diameter, towards the outer end of the drive shaft (29A). Pressing only on the inner race, press the outer bearing (25A) against the outer magnet assembly (167). Place a new bearing lock washer (31A) onto the drive shaft (29A), screw the bearing lock nut (31) onto the drive shaft (29A) and snug against the outboard bearing (25A). Do not wrench tighten at this time.
- i) Remove the snap ring from the outside diameter of the thrust bearing (25A). If the pump is furnished with an optional "Secondary Containment Seal", lubricate the O-rings (324, 325) and the inside diameters of the frame (26) where the "O" rings (324, 325) seal with a light oil. Carefully slide the outer magnet assembly (167) into the frame (26) until the snap ring groove in the outboard bearing (25A) appears on the outboard bearing cover (28) end of the frame (26). Install the snap ring into the groove in the outboard bearing (25A).
- j) Tighten the bearing lock nut (31) while holding the drive shaft (29A) against rotation with a hook spanner in the keyway of the drive shaft (29A). Bend one of the bearing lock washer (31A) tabs into one of the slots in the bearing lock nut (31) to keep the nut tight.

Place the outboard bearing cover (28) over the end of the drive shaft (29A) and bolt it to the bearing housing (26), tighten the bolts to 20 Ft. Lb. Set this assembly aside and cover it with a clean cloth to restrict the accumulation of ferrous particles on the magnet surfaces.

- k) Press the casing cover ring assembly (195) into the casing cover (22) with the stepped side of the assembly facing out from the casing cover (22). **CAUTION:** Wear

safety glasses, gloves, and a long sleeved shirt during this operation. Care must be exercised so that the brittle inner member of the casing cover wear ring assembly (195) is not broken. Drive the clamp ring dowel (149A) into the casing cover (22).

- l) Slide a new bearing cartridge (180) into the casing cover (22) and rotate it until the four bolt holes line up with the four tapped holes in the casing cover (22). The four holes are unequally spaced so that the bearing cartridge (180) will be in correct orientation with the casing cover (22). Be sure the tapped holes and the cap screws are clean. Apply two drops of Loctite "Thread Lock" #222 to the threads of each of the cap screws (180A) and secure the bearing cartridge (180) to the casing cover (22). Tighten the bearing housing screws (180A) to 15 Ft. Lb. on Frames I & II which have 5/16" screws, or 35 Ft. Lb. on Frame III which has 7/16" screws.
- m) Be sure that the pump shaft (29) is clean. Snap new tolerance rings (200B) into the two grooves in the pump shaft (29) closest to the larger end of the pump shaft (29). Rotate the tolerance rings (200B) so that their joints are 180 degrees apart. Press a new journal sleeve (200), slotted end first, onto the pump shaft (29), against the shaft shoulder, being careful to align the slot in the journal sleeve (200) with the keyway in the pump shaft (29). Handle the journal sleeves (200) very carefully as they are very brittle and therefore will break easily.

Place a new sleeve gasket (77H), the bearing spacer (17) and a second sleeve gasket (77H) over the pump shaft (29). Install two new tolerance rings (200B) into the remaining grooves in the pump shaft (29). Rotate the tolerance rings (200B) so that their joints are 180 degrees apart. Press a new journal sleeve (200), slotted end last, onto the pump shaft (29) being careful to align the slot in the journal sleeve (200) with the keyway in the pump shaft (29).

- n) **CAUTION:** The inner magnet assembly (175) contains powerful magnets. Be sure that the inner magnet assembly (175) is clean. Ferrous particles attracted to the magnets are very difficult to remove. A piece of masking tape drawn "sticky side" across the surface of the inner magnet assembly (175) will help remove particles. Place the inner rotor key (171A) into the keyway in the pump shaft (29), being sure that it engages the slot in the journal sleeve (200). Apply four drops of Loctite "Thread Lock" #222 to the diameter of the pump shaft (29) which engages the inner magnet assembly (171). Carefully slide the pump shaft (29) into the inner magnet assembly (175) until the shoulder of the pump shaft (29) seats firmly against the face of the counter-bore in the inner magnet assembly (175); a light press may be required. Set this assembly aside, with the shaft horizontal, until the Loctite dries.
- o) Carefully place a new thrust collar (210), slotted end first, over the pump shaft (29) and into the inner magnet assembly (175) positioning the slot to engage the inner rotor key (171A).

- p) Lubricate the bearings (182), the journal sleeves (200) and the face of the thrust collar (210) with a light oil. Slide the pump shaft (29) carefully through the bearings (182) in the bearing cartridge (180). It is most important when assembling these parts to assure that the thrust collar (210) does not move away from its seating face in the inner magnet assembly (175); therefore, in all handling of this assembly be sure that the impeller (3) end of the pump shaft (29) is always kept higher than the inner magnet assembly (175) end.
- q) Place the handle, described in paragraph b of the Disassembly Procedures, over the end of the pump shaft (29) and clamp it into place with the impeller washer (12A) and the impeller nut (12), or use the optional eye bolt.
- r) Place a new containment shell gasket (77G) into the groove in the casing cover (22). Place the containment shell (150) into position over the bearing cartridge (180) and place the clamping ring (149) into position, engaging the dowel pin in the casing cover (22). Apply two drops of Loctite "Thread Lock" #222 to the threads of each of the cap screws (149B) and tighten them to 20 Ft. Lb. on Frames I & II which have 3/8" screws, or 35 Ft. Lb. on Frame III which has 7/16" screws, to secure the clamping ring (149) to the casing cover (22).
- s) If the pump is equipped with an optional "Secondary Containment Seal", place a new frame gasket (77K) into the O-ring groove in the casing cover (22).
- t) Remove the 1/8" thick rubber protective pad, as described in paragraph g), from the inside of the outer magnet assembly (167). Clean both the outer magnet assembly (167) and the containment shell (150) of any particles which might have been attracted to them, to prevent damage to the magnets during operation. Ferrous particles which stick to the magnet surfaces can be removed by using a piece of masking tape rubbed "sticky side" across the magnet surfaces.
- u) **CAUTION:** Strong magnetic field, parts must be mechanically restrained to prevent injury or damage.

Stand the frame (26) assembly up vertically on the end of the drive shaft (29A) and have one man hold it in position while a second man, using a small hoist, hooked to the handle or eyebolt described in paragraph q, carefully lowers the inner magnet assembly (175) into the outer magnet assembly (167). **CAUTION:** The outer magnet assembly (167) will strongly attract the inner magnet assembly (175) when the magnetic fields approach each other, snapping the parts together rapidly. Fingers attempting to hold the parts during this assembly could be severely damaged. The containment shell (150) must also be carefully centered as it is lowered into the outer magnet assembly (167) so that it does not strike and damage the magnets.
- v) Rotate the casing cover (22) until the two tapped holes line up with the drilled holes in the frame (26). These holes are unequally spaced so that the parts will locate in only one position. Install and tighten the two cap screws.

- w) Lay the assembly over so that the shaft is in a horizontal position.
- x) Remove the impeller nut (12), impeller washer (12A) and the handle, or the optional eye bolt.
- y) Lubricate the unslotted face of a new thrust collar (210) with a light oil and place it over the exposed end of the journal sleeve (200), so that the lubricated face mates against the face of the bearing bushing (182). Place the impeller key (4) into the keyway of the pump shaft (29), being sure that it engages the slot in the end of the journal sleeve (200). Drive the thrust collar dowel (210A) into the impeller (3). Slide the impeller (3) onto the pump shaft (29), being careful to have the thrust collar (210) rotated to such a position that its dowel hole receives the thrust collar dowel (210A). Place the impeller washer (12A) over the end of the pump shaft (29) and against the impeller (3). Place the impeller spring washer (12B) over the end of the pump shaft (29) so that its concave (dished) side rests against the impeller washer (12A). Install and tighten the impeller nut (12) to 30 ft. lb. (for Frames I and II) or 60 ft. lb. (for Frame III) while holding the impeller (3) against rotation with a piece of bar stock placed between the impeller blades (3). It is important to restrain the impeller (3) from rotation in this manner to reduce the possibility of breaking the internal silicon carbide parts.

Apply two drops of Locite "Thread Lock" #222 to the threads of a new locking set screw (12D) and thread it into the impeller nut (12). Tighten the locking set screw (12D) to 15 Ft. Lb., while holding the impeller (3) against rotation as described above.
- z) Press a new casing wear ring assembly (190) into the casing (5) with the stepped side of the assembly facing out.

CAUTION: Wear safety glasses, gloves, and a long sleeved shirt during this operation. Care must be exercised so that the brittle inner member of the casing wear ring assembly (190) is not broken.

- aa) Install any auxiliary piping which must be affixed to the pump before it is mounted to the baseplate.
- ab) Place a new casing gasket (77) into the casing (5) and then carefully slide the rotating assembly into the casing and tighten the casing bolts, slowly and evenly to 50 Ft. Lb.
- ac) Rotate the drive shaft (29A) by hand to check for any internal interference. Correct as required.
- ad) Bolt the pump to the baseplate, install the coupling hubs, realign the pump and driver; refer to "PUMP AND DRIVER ALIGNMENT."
- ae) Check the motor rotation, install the coupling spacer and the coupling guard.
- af) Install any remaining auxiliary piping. Close any drain valves or open connections in the auxiliary piping.
- ag) Fill, lubricate, and vent the pump per the sections titled, "PUMP LUBRICATION" and "STARTING THE PUMP."
- ah) Follow instructions under "PUMP START-UP CHECK LIST."

CUSTOMER'S PLANT MAINTENANCE RECORD

Dean Pump Serial Number _____

Plant Property Number _____

Service _____

Location _____

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

Spare Parts in Plant Stock Room _____

Interchangeable with Dean Serial Numbers _____

READ WARNINGS

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

Use only top quality tools.

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

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

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

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

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

Remove the coupling guard. Remove the coupling spacer.

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

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

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

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

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

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

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

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

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

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

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

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

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

Use mechanical lifting equipment to lift assemblies and components.

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

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

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

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

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

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

Use only Dean Pump MetPro Corporation parts.