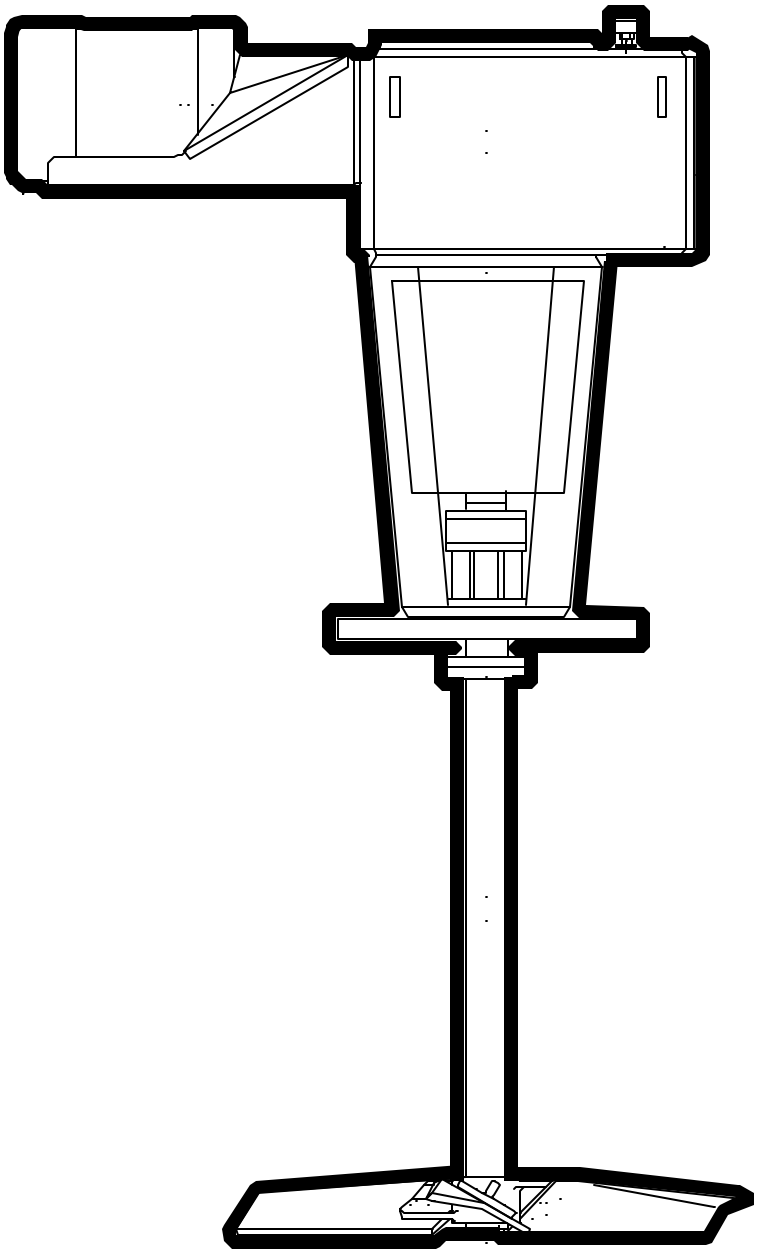
Chemineer

Manual 320

# HTN/HTNS Turbine Agitators Installation, Operation Maintenance Manual



Equipment Reference:

For Service and
Information Contact

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## INITIAL INSPECTION

**Step 1: Inspect crates.** Upon receipt, inspect all crates and equipment for shipping damage. Report shipping damage to your local Chemineer office or to the factory in Dayton, Ohio. A claim should be filed immediately with the carrier involved.

**Step 2: Uncrate. Check the contents.** Do not uncrate the unit until you have read the *Installation* section of this manual and looked at the assembly drawing shipped with the unit. Be careful in uncrating and handling. Do not discard the crating without carefully making sure that all agitator parts have been removed. Correct assembly of this unit requires referring to both the unit assembly drawing and this manual.

**Step 3: Questions? Call Chemineer.** If the shipment is not complete or you do not understand what you have received, please contact *your local Chemineer office* immediately.

## CHEMINEER ASSISTANCE

Chemineer maintains a fully staffed Parts and Field Service Department ready to help you with any service requirement. Simply contact *your local Chemineer office*, or you can contact Parts/Field Service at the Chemineer Factory in Dayton, Ohio:

Chemineer, Inc.
P.O. Box 1123
Dayton, OH 45401
Phone: (937) 454-3200
FAX: (937) 454-3375

Services available are as follows:

Installation and maintenance training seminars,
Installation and start-up supervision,
Preventive maintenance planning,
Parts order service,
Special instructions.

# STORAGE

Do not remove protective coatings until the agitator is to be put into service. If the shipment is to be stored, *do not stack crates*. Store in a clean dry indoor location which is free from wide variations in temperature. The storage area should be free from vibration and excessive heat.

At six-month intervals, inspect for external rust. Apply rust preventative as required. If the unit has been in storage for more than six months or subjected to adverse moisture conditions, the motor windings may have to be dried prior to operation.

Coated/rubber covered agitator parts require special storage procedures. Contact Chemineer Field Service for instructions.

**Short-Term Indoor Storage**

Agitators should be stored indoors in areas with no vibration and relatively constant temperatures and humidity. The factory storage preparations should be acceptable for up to six months storage. If the storage period will exceed six months, see Long-Term Indoor Storage section.

**Outdoor or Long-Term Indoor Storage**

**Storage of agitators and motors outdoors is not recommended.** If a unit is stored for an extended period indoors, stored outdoors or decommissioned, the following recommendations apply.

1. Fill the gear drive completely with oil. Refer to *Table 1, page 3*. Contact Chemineer Field Service for instructions.

   *NOTE: The case size referred to in this manual can be determined by the first number in the model designation; for example, "1HTN-5" is a Case Size "1" agitator. Refer to unit assembly drawing or unit nameplate for model number.*

2. Rotate the motor and gear drive shafts 10 to 15 revolutions at least once per month to reduce the possibility of brinelling of the bearings and to redistribute bearing grease.

3. Motor space heaters, if installed, should be energized during the storage period.

4. Fill the mechanical seal housing (HTN only) and mechanical seal lubricators with a rust preventative/lubricant which is compatible with the sealing fluid to be used in service.

5. Apply a rust preventative to unpainted carbon steel surfaces such as the gear drive output shaft coupling, the gear drive input shaft, the motor output shaft, and the agitator wetted parts (carbon steel) to prevent corrosion during storage.

*TABLE 1: STORAGE OIL CAPACITY*

| CASE SIZE | COMPLETE FILL | |
|---|---|---|
| | GALLONS | LITERS |
| 1 | 3 | 11 |
| 2 | 6 | 23 |
| 3 | 9 | 34 |
| 4 | 15 | 57 |
| 5 | 21 | 80 |
| 6 | 27 | 102 |
| 7 | 58 | 220 |
| 8 | 86 | 326 |
| 9 | 120 | 454 |
| 10 | 175 | 662 |
| 11 | 225 | 852 |
| 12 | 344 | 1302 |
| 13 | 600 | 2271 |

6. The unit should be covered to prevent damage by the elements but still allow free air circulation.

*CAUTION! Before placing an agitator in service the storage oil must be completely drained from the gear drive. Turn the gear drive upside down to completely drain. Failure to do this will result in oil being trapped in the "dry well" around the output shaft and could result in leakage at the output shaft seal. The gear drive should be filled with new oil and regreased as indicated in the Lubrication section of this manual.*

Mechanical seal housing and mechanical seal lubricator should be drained, flushed and filled with sealing fluid prior to use.

# MOUNTING

HTN and HTNS style units are designed to mount on an ANSI flange, nozzle or pad located on the vessel top head. See *Figure 1, page 5*.

Unless otherwise specified on the agitator assembly drawing, the agitator extension shaft is designed to run in a true vertical position. The agitator drive assembly must be **level within 1/4 degree.** The angular misalignment may be corrected by machining the nozzle or pad level and flat. In extreme cases, a tapered adapter will be required (supplied by others). Call *Chemineer Field Service* for assistance. *Do not angle or side mount.*

During operation of the agitator, the fluid motion in the vessel produced by the rotation of the turbine impeller can exert significant forces and moments on the agitator extension shaft. The forces and moments produced by the turbine rotating in a fluid are; torque, turbine thrust and turbine hydraulic (side) force. Torque implies an unchanging load, but the actual operating torque will show plus or minus 10 to 20 percent variability due to turbulent conditions within the agitated fluid. Start up of the agitator with the turbine impacted in solids is beyond the scope of these recommendations. Hydraulic forces acting on the turbine generate moments, which act on the shaft and are transmitted to the agitator drive. Because of the random nature of the forces and the rotation of the shaft, the direction of these forces is constantly changing. A pitched blade or axial flow turbine normally pumps downward and generates and upward thrust. The thrust force is generally less than the weight of the unit. Upward pumping turbine thrust force will add to the unit weight. The net effect of the turbine thrust force is to offset or add to the unit weight, contributing to the variability of the support structure loading. The agitator has been designed to accommodate these forces, and as a result, the forces are transmitted directly to the agitator mounting nozzle or pad. The nozzle or pad and vessel top head must be rigid enough support the agitator weight and limit the angular displacement of the agitator drive to .05 degrees as a result of the torque and bending moment. Refer to the agitator assembly drawing for the nozzle or pad size and design loads.

See *Tables 3 and 4, pages 8 and 9,* for the recommended vessel head thickness vs. vessel diameter, agitator case size and mounting nozzle or pad size. These tables are to be used as a guide for determining when vessel head reinforcement is required.

The tables are based upon the use of ASME flanged and dished heads, atmospheric design pressures and ChemScale® agitation levels of 6 to 7. Elliptical or hemispherical heads of the same diameter and thickness are more rigid than ASME flanged and dished heads. Design pressures greater than atmospheric may required vessel head thicknesses greater than the table values.

Very high ChemScale agitation levels may require vessel head thicknesses greater than the table values. If the vessel head is not rigid enough, the head thickness can be increased or a reinforcement pad (*Figure 2, page 6)* can be added.

This information is intended as a guide and does not relieve the user of completely analyzing the entire mounting system.

*CAUTION! Optional pad type steady bearing (see, Figure 18, page 36) may require the agitator mounting nozzle or pad to be precisely level and concentric with the steady bearing nozzle or pad. Call Chemineer Field Service for assistance.*

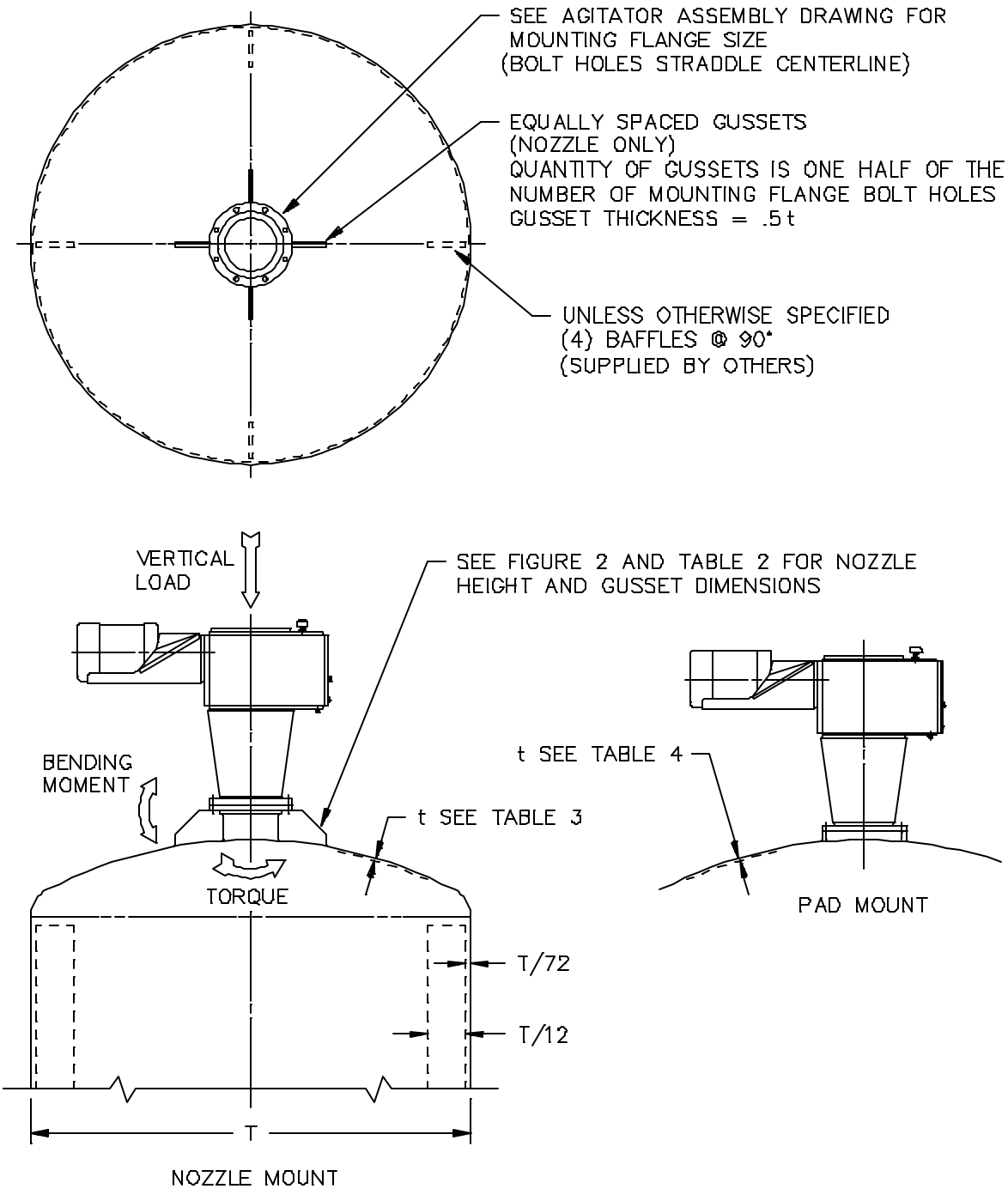



*Figure 1: Agitator Mounting*

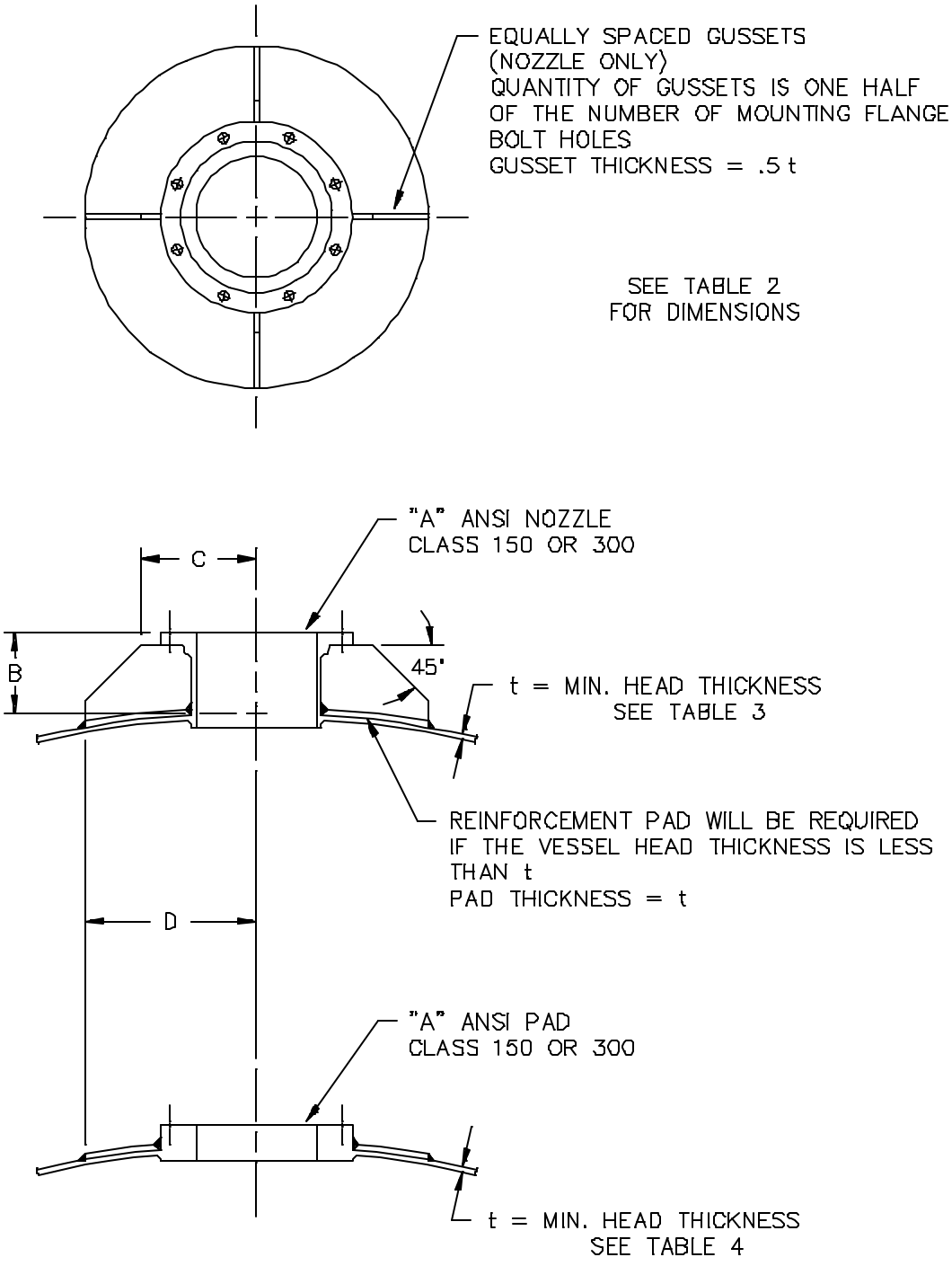



*Figure 2: Agitator Mounting Nozzle/Pad*

*TABLE 2: AGITATOR MOUNTING NOZZLE/PAD REINFORCEMENT DIMENSIONS*

| Case Size | A | B | C | D |
|---|---|---|---|---|
| 1, 2 & 3 | 8" | 6" (152 mm) | 8" (203 mm) | 12" (305 mm) |
| 4, 5 & 6 | 12" | 8" (203 mm) | 11.5" (292 mm) | 17" (432 mm) |
| 7 & 8 | 16" | 8" (203 mm) | 13.5" (343 mm) | 19" (483 mm) |
| 9 | 20" | 12" (305 mm) | 17.5" (445 mm) | 26" (660 mm) |
| 10 & 11 | 24" | 12" (305 mm) | 19.5" (495 mm) | 28" (711 mm) |
| 12 & 13 | 30" | 12" (305 mm) | 24" (610 mm) | 31" (787 mm) |

*TABLE 3: VESSEL HEAD THICKNESS (t), NOZZLE MOUNT*

| Case Size | Nozzle Size[1] | Vessel Diameter, Feet (Meters) | | | | |
|---|---|---|---|---|---|---|
| | | 4 (1.22) | 5 (1.52) | 6 (1.83) | 7 (2.13) | 8 (2.44) |
| 1 | 8"/10" | .125"(3.18mm) | .187"(4.76mm) | .187"(4.76mm) | .187"(4.76mm) | .250" (6.35 mm) |
| 2 | 8"/10" | .187" (4.76mm) | .250"(6.35mm) | .250"(6.35mm) | .312"(7.92mm) | .312" (7.92 mm) |
| 3 | 8"/10" | .312" (7.92mm) | .312"(7.92mm) | .375"(9.53mm) | .437"(9.53mm) | .437" (11.1 mm) |
| 4 | 12" | .187" (4.76mm) | .250"(6.35mm) | .312"(7.92mm) | .312"(7.92mm) | .375" (9.53 mm) |
| 5 | 12" | .250" (6.35mm) | .312"(7.92mm) | .375"(9.53mm) | .437"(11.1mm) | .500" (12.7 mm) |
| 6 | 12" | .375" (9.53mm) | .437"(11.1mm) | .500"(12.7mm) | .562"(14.3mm) | .625" (15.9 mm) |
| 7 | 16" | --- | --- | .375"(9.53mm) | .437"(11.1mm) | .500" (12.7 mm) |
| 8 | 16" | --- | --- | .500"(12.7mm) | .562"(14.3mm) | .562" (14.3 mm) |
| 9 | 20" | --- | --- | --- | .437"(11.1mm) | .500" (12.7 mm) |
| 10 | 24" | --- | --- | --- | --- | .500" (12.7 mm) |
| 11 | 24" | --- | --- | --- | --- | .500" (12.7 mm) |
| 12 | 30" | --- | --- | --- | --- | --- |
| 13 | 30" | --- | --- | --- | --- | --- |

| Case Size | Nozzle Size[1] | Vessel Diameter, Feet (Meters) | | | | |
|---|---|---|---|---|---|---|
| | | 9 (2.74) | 10 (3.05) | 12 (3.66) | 15 (4.57) | 20 (6.10) |
| 1 | 8"/10" | .250"(6.35mm) | .250"(6.35mm) | .312"(7.92mm) | .312"(7.92mm) | .375" (9.53 mm) |
| 2 | 8"/10" | .375"(9.53mm) | .375"(9.53mm) | .375"(9.53mm) | .437"(11.1mm) | .437" (11.1 mm) |
| 3 | 8"/10" | .500"(12.7mm) | .500"(12.7mm) | .500"(12.7mm) | .562"(14.3mm) | .562" (14.3 mm) |
| 4 | 12" | .437" (11.1mm) | .437"(11.1mm) | .500"(12.7mm) | .562"(14.3mm) | .625" (15.9 mm) |
| 5 | 12" | .500" (12.7mm) | .562"(14.3mm) | .625"(15.9mm) | .75" (19.1 mm) | .75" (19.1 mm) |
| 6 | 12" | .625" (15.9mm) | .75" (19.1 mm) | .75" (19.1 mm) | .875"(22.2mm) | .875" (22.2 mm) |
| 7 | 16" | .562" (14.3mm) | .562"(14.3mm) | .625"(15.9mm) | .75" (19.1 mm) | .875" (22.2 mm) |
| 8 | 16" | .625" (15.9mm) | .687"(17.5mm) | .75" (19.1 mm) | .875"(22.2mm) | 1.00" (25.4 mm) |
| 9 | 20" | .562" (14.3mm) | .625"(15.9mm) | .687"(17.5) | .875"(22.2mm) | 1.00" (25.4 mm) |
| 10 | 24" | .562" (14.3mm) | .625"(15.9mm) | .75" (19.1 mm) | .875"(22.2mm) | 1.00" (25.4 mm) |
| 11 | 24" | .562" (14.3mm) | .625"(15.9mm) | .75" (19.1 mm) | .875"(22.2mm) | 1.00" (25.4 mm) |
| 12 | 30" | --- | .625"(15.9mm) | .75" (19.1 mm) | .875"(22.2mm) | 1.25" (31.7 mm) |
| 13 | 30" | --- | --- | 1.00"(25.4mm) | 1.25"(31.7mm) | 1.50" (38.1 mm) |

[1] Vessel head thickness (t), may be reduced if the nozzle pressure class is greater than 150. Consult factory for recommendations. Refer to Assembly Drawing for actual nozzle size.

*TABLE 4: VESSEL HEAD THICKNESS (t), PAD MOUNT*

| Case Size | Pad[1] Size 150# | Vessel Diameter, Feet (Meters) | | | | |
|---|---|---|---|---|---|---|
| | | 4 (1.22) | 5 (1.52) | 6 (1.83) | 7 (2.13) | 8 (2.44) |
| 1 | 8"/10" | .125"(3.18mm) | .125"(3.18mm) | .125"(3.18mm) | .125"(3.18mm) | .125" (3.18 mm) |
| 2 | 8"/10" | .125" (3.18mm) | .125"(3.18mm) | .125"(3.18mm) | .187"(4.76mm) | .187" (4.76 mm) |
| 3 | 8"/10" | .187" (4.76mm) | .187"(4.76mm) | .187"(4.76mm) | .250"(6.35mm) | .250" (6.35 mm) |
| 4 | 12" | .187" (4.76mm) | .187"(4.76m) | .187"(4.76m) | .187"(4.76m) | .187" (4.76 mm) |
| 5 | 12" | .250" (6.35mm) | .250"(6.35mm) | .250"(6.35mm) | .250"(6.35mm) | .250" (6.35 mm) |
| 6 | 12" | .250" (6.35mm) | .250"(6.35mm) | .250"(6.35mm) | .312"(7.92mm) | .312" (7.92 mm) |
| 7 | 16" | --- | --- | .250"(6.35m) | .250"(6.35mm) | .250" (6.35 mm) |
| 8 | 16" | --- | --- | .312"(7.92mm) | .312"(7.92mm) | .312" (7.92 mm) |
| 9 | 20" | --- | --- | --- | .312"(7.92mm) | .312" (7.92 mm) |
| 10 | 24" | --- | --- | --- | --- | .375" (9.53 mm) |
| 11 | 24" | --- | --- | --- | --- | .375" (9.53 mm) |
| 12 | 30" | --- | --- | --- | --- | --- |
| 13 | 30" | --- | --- | --- | --- | --- |

| Case Size | Pad[1] Size 150# | Vessel Diameter, Feet (Meters) | | | | |
|---|---|---|---|---|---|---|
| | | 9 (2.74) | 10 (3.05) | 12 (3.66) | 15 (4.57) | 20 (6.10) |
| 1 | 8"/10" | .125"(3.18mm) | .125"(3.18mm) | .125"(3.18mm) | .187"(4.76mm) | .250" (6.35 mm) |
| 2 | 8"/10" | .187" (4.76mm) | .187"(4.76mm) | .250"(6.35mm) | .312"(7.92mm) | .375" (9.53 mm) |
| 3 | 8"/10" | .250" (6.35m) | .312"(7.92mm) | .312"(7.92mm) | .375"(9.53mm) | .437" (11.1 mm) |
| 4 | 12" | .250" (6.35mm) | .250"(6.35mm) | .250"(6.35mm) | .375"(9.53mm) | .500" (12.7 mm) |
| 5 | 12" | .312" (7.92mm) | .312"(7.92mm) | .375"(9.53mm) | .437"(11.1mm) | .500" (12.7 mm) |
| 6 | 12" | .375" (9.53mm) | .375"(9.53mm) | .437"(11.1mm) | .500"(12.7mm) | .625" (15.9 mm) |
| 7 | 16" | .312" (7.92mm) | .312"(7.92mm) | .375"(9.53mm) | .437"(11.1mm) | .562" (14.3 mm) |
| 8 | 16" | .375" (9.53mm) | .375"(9.53mm) | .437"(11.1mm) | .500"(12.7mm) | .625" (15.9 mm) |
| 9 | 20" | .375" (9.53mm) | .375"(9.53mm) | .437"(11.1mm) | .500"(12.7mm) | .625" (15.9 mm) |
| 10 | 24" | .437" (11.1mm) | .437"(11.1mm) | .437"(11.1mm) | .562"(14.3mm) | .687" (17.5 mm) |
| 11 | 24" | .375" (9.53mm) | .437"(11.1mm) | .437"(11.1mm) | .562"(14.3mm) | .687" (17.5 mm) |
| 12 | 30" | --- | .500"(12.7mm) | .500"(12.7mm) | .625"(15.9mm) | .75" (19.1 mm) |
| 13 | 30" | --- | --- | .625"(15.9mm) | .75" (19.1 mm) | 1.00" (25.4 mm) |

[1] Vessel head thickness (t), may be reduced if the pad pressure class is greater than 150#. Consult factory for recommendations. Refer to Assembly Drawing for actual pad size.

# INSTALLATION

## AGITATOR

Correct installation requires both the unit assembly drawing and this manual.

1. The HT agitator is shipped in two or more crates: one for extension shaft **[404]** and impeller **[500]** and one for the agitator drive *(Figure 3, page 12)*. Multiple impellers, large motors, mechanical seal assemblies, drive shaft and optional accessories may be crated separately.

2. Remove all shipping restraints. A hoist or crane system for lifting the agitator parts must be available. Refer to *Figure 4, page 14* for lifting. The approximate net weight of the unit is shown on the unit assembly drawing.

3. Motors **[100]** which are large relative to gear drive **[200]** are shipped separately with motor bracket **[131]**, flexible motor coupling **[110],** and coupling guard **[120]**. Reinstall the motor bracket, flexible motor coupling, motor and coupling guard prior to hoisting the agitator drive onto its mounting nozzle or pad. Check the flexible coupling alignment. If an auxiliary motor bracket support is supplied with the unit, remove the motor from the motor bracket, install the agitator drive assembly and auxiliary motor bracket support. Reinstall the motor and check the flexible coupling alignment.

4. Drive shafts **[403]** which are longer than standard may be shipped separately. Install the drive shaft after the agitator drive is assembled to the vessel nozzle or pad.

5. HTN, HTNS Units *(Figures 5 and 6, pages 15 and 16)*

   *NOTE: Extreme care should be taken in handling and installing to see that the agitator drive shaft is not jarred or bumped, causing damage to the mechanical seal parts. Do not lift the agitator drive with any attachment to the drive shaft.*

   5a. Lift the agitator drive assembly, less extension shaft **[404]** and assemble to the vessel nozzle or pad with the proper gasket and mounting bolts (supplied by others) and torque to the value shown in *Table 5, page 13*.

   *NOTE: Unrestrained cold flowing gasket materials must not be used to seal the agitator to the vessel.*

   5b. If the drive shaft has been shipped separately, install drive shaft **[403]**, shaft collar **[1530 or 1410]**, HTN mechanical seal cartridge assembly or HTNS mechanical seal assembly **[1500 or 1400]**, taper bore coupling half **[363]**, and spacer spool or coupling spacer **[367 or 371]**. Refer to *MAINTENANCE, Drive Shaft Replacement* for instructions.

## AGITATOR

5c. If the extension shaft is supplied with an optional removable extension shaft coupling half, install the coupling half. Refer to *INSTALLATION, Options: In-Tank Couplings* for instructions.

5d. Lift the extension shaft and lower it into the vessel.

5e. Lift and block the extension shaft so that extension shaft **[404]** coupling half is close enough to drive shaft **[403]** coupling half to allow installation of coupling bolts, nuts and lockwashers **[405, 407, 406]**. *(Figure 15, page 31)* The face and tenon of all rigid couplings must be perfectly clean and free of nicks. Line up match marks and install two bolts at 180°. Tighten the bolts to engage the tenon and pull the coupling faces together.

*CAUTION! Coated/rubber covered agitator parts require special handling to avoid damage to coatings/rubber coverings. Do not use chains or hooks on coated/covered surfaces. Special care is required to prevent damage to edges and outside corners. Special installation procedures are required for large one piece impeller/extension shaft assemblies. Contact Chemineer Field Service for instructions.*

5f. Install the remaining coupling bolts, nuts and lockwashers. Torque to the value shown in *Table 5, page 13*. Remove the shaft blocking.

6. Check the installed extension shaft runout. Place a dial indicator on the side of the extension shaft at the bottom. Manually turn the flexible motor coupling to rotate the extension shaft one turn.

7. Total shaft runout should not exceed .003" per foot (.25 mm per meter) FIM (Full Indicator Movement) of shaft length. If the shaft runout is excessive, the shaft can be restraightened in the field. Rotate the shaft to the maximum positive indicator reading. Apply heat to the shaft at a point 180° from the indicator and just below the first in-tank shaft coupling or just below the mounting flange if there is no in-tank coupling. As heat is applied to the shaft (do not allow surface temperature of shaft to exceed 500° F [260° C]), the shaft will move toward the indicator. After the shaft has moved .030 - .060" (.76 - 1.52 mm), remove the heat and allow the shaft to cool completely. The shaft will begin to move away from the indicator. The shaft will draw more than it moved initially, and as a result will be straightened. After each heating cycle, recheck the shaft until runout is within tolerance. Do not heat in the same location. Move up or down 2 to 3" (50 to 70 mm) to avoid reheating in the same location.

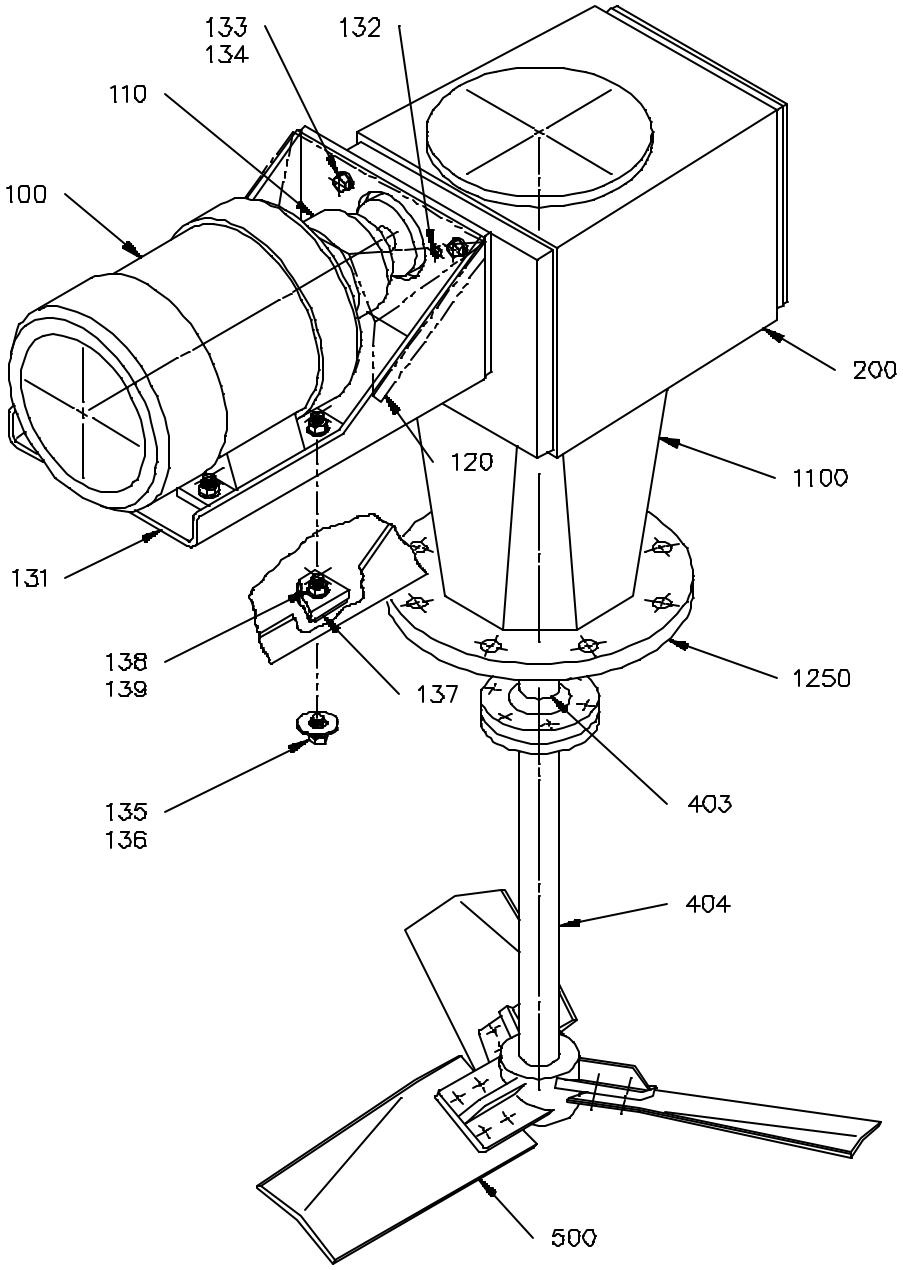



*Figure 3: Model HTN, HTNS Agitator Assembly*

# AGITATOR

*TABLE 5: BOLT TIGHTENING TORQUE[1],[2]*

| Bolt Size | CARBON STEEL[3] | | | | 300 Series Stainless Steel, Alloy 20, Monels, Inconels & Hastelloys B & C[4] | |
|---|---|---|---|---|---|---|
| | Grade 2 | | Grade 5 | | | |
| | ft-lb | Nm | ft-lb | Nm | ft-lb | Nm |
| 8 - 32 | 1.2 | 1.6 | 1.9 | 2.5 | 1.2 | 1.6 |
| 10 - 24 | 1.7 | 2.3 | 2.7 | 3.6 | 1.7 | 2.3 |
| 10 - 32 | 1.9 | 2.6 | 3.1 | 4.1 | 1.9 | 2.6 |
| 1/4 - 20 | 4.1 | 5.6 | 6 | 8.1 | 4.1 | 5.6 |
| 5/16 -18 | 8.3 | 11 | 13 | 17 | 8.3 | 11 |
| 5/16 -24 | 9 | 12 | 14 | 19 | 9 | 12 |
| 3/8 - 16 | 15 | 20 | 23 | 31 | 15 | 20 |
| 1/2 - 13 | 38 | 51 | 56 | 76 | 38 | 51 |
| 9/16 -12 | 50 | 68 | 83 | 113 | 50 | 68 |
| 5/8 - 11 | 68 | 92 | 113 | 153 | 68 | 92 |
| 3/4 - 10 | 120 | 163 | 200 | 271 | 120 | 163 |
| 7/8 - 9 | 105 | 143 | 296 | 401 | 182 | 247 |
| 1 - 8 | 165 | 224 | 443 | 601 | 273 | 370 |
| 1 1/8-7 | 225 | 305 | 596 | 808 | 386 | 523 |
| 1 1/4-7 | 315 | 428 | 840 | 1139 | 545 | 739 |
| 1 3/8-6 | 417 | 566 | 1103 | 1495 | 715 | 969 |
| 1 1/2-6 | 555 | 752 | 1463 | 1983 | 948 | 1286 |

[1]Tighten all fasteners to values shown unless specifically instructed to do otherwise.
[2]Lubricate all fasteners at assembly with grease, oil or an anti-seize material. Bolt threads and contact surfaces of bolt heads and nuts should be lubricated.
[3]If fasteners cannot be lubricated, multiply table values by 1.33.
[4]If fasteners cannot be lubricated, multiply table values by 1.25.

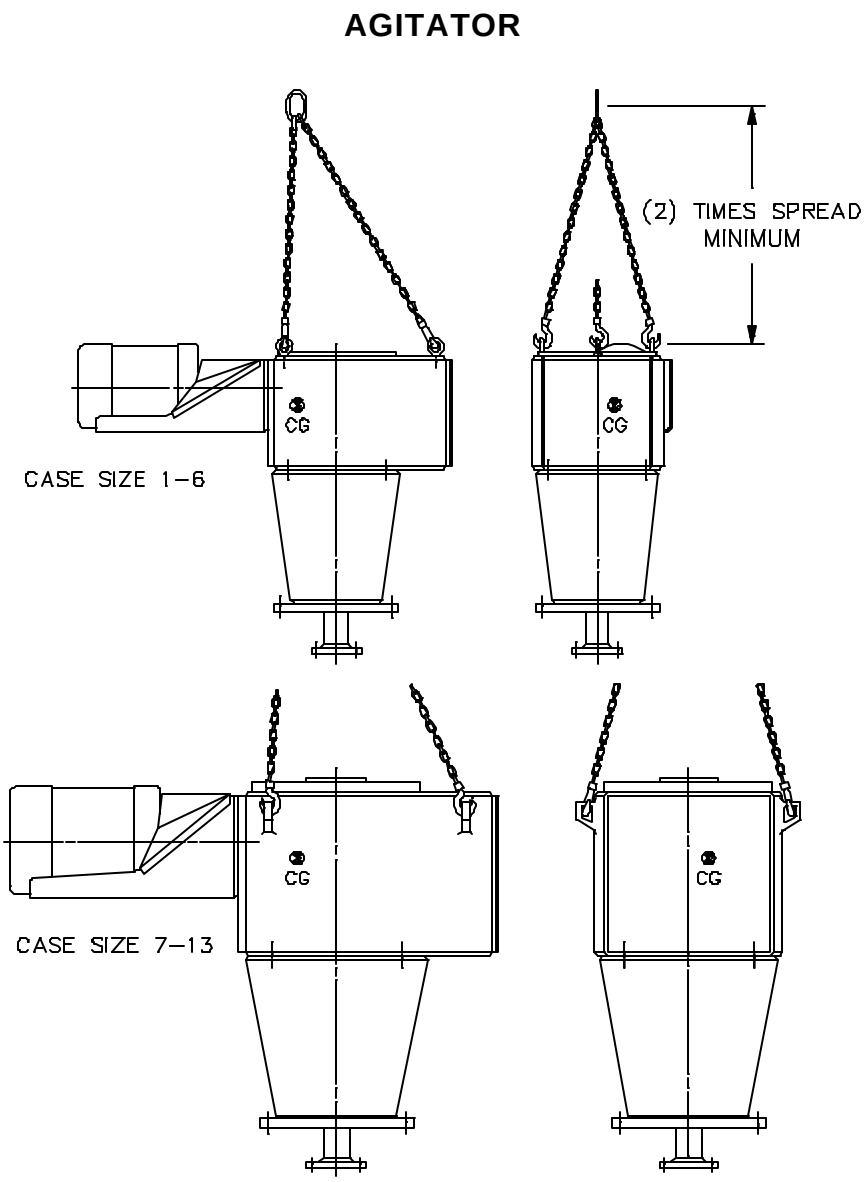



*Figure 4: Agitator Lifting System*

For case sizes 1-6, use a three point chain fall utilizing the three eyebolts installed in the top of the gear drive.

For case sizes 7-13, use a four point chain fall utilizing the lifting lugs located on the sides of the gear drive.

*CAUTION: Do not lift the agitator drive with any lifting lugs attached to the motor.*

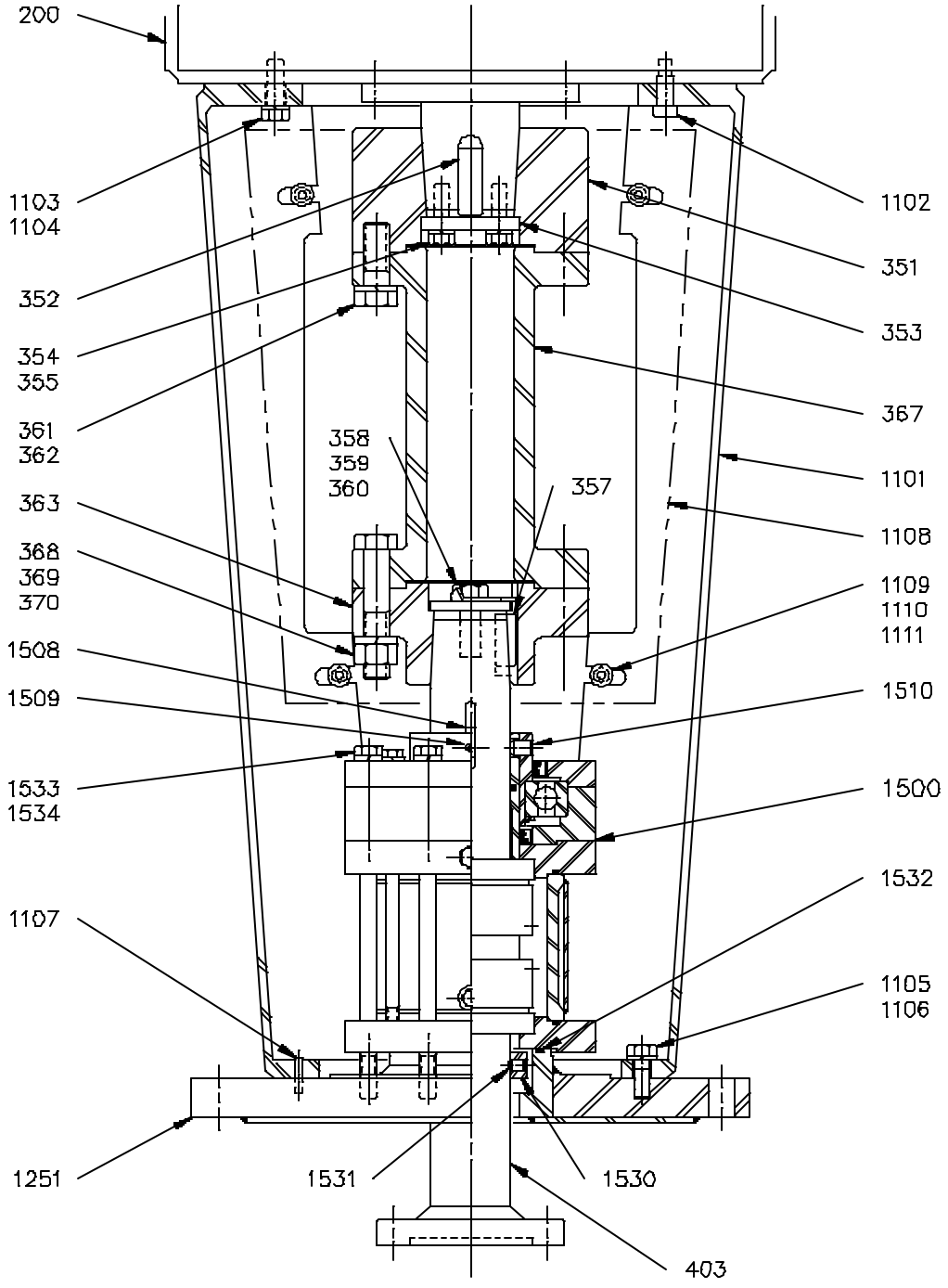



*Figure 5: Model HTN*

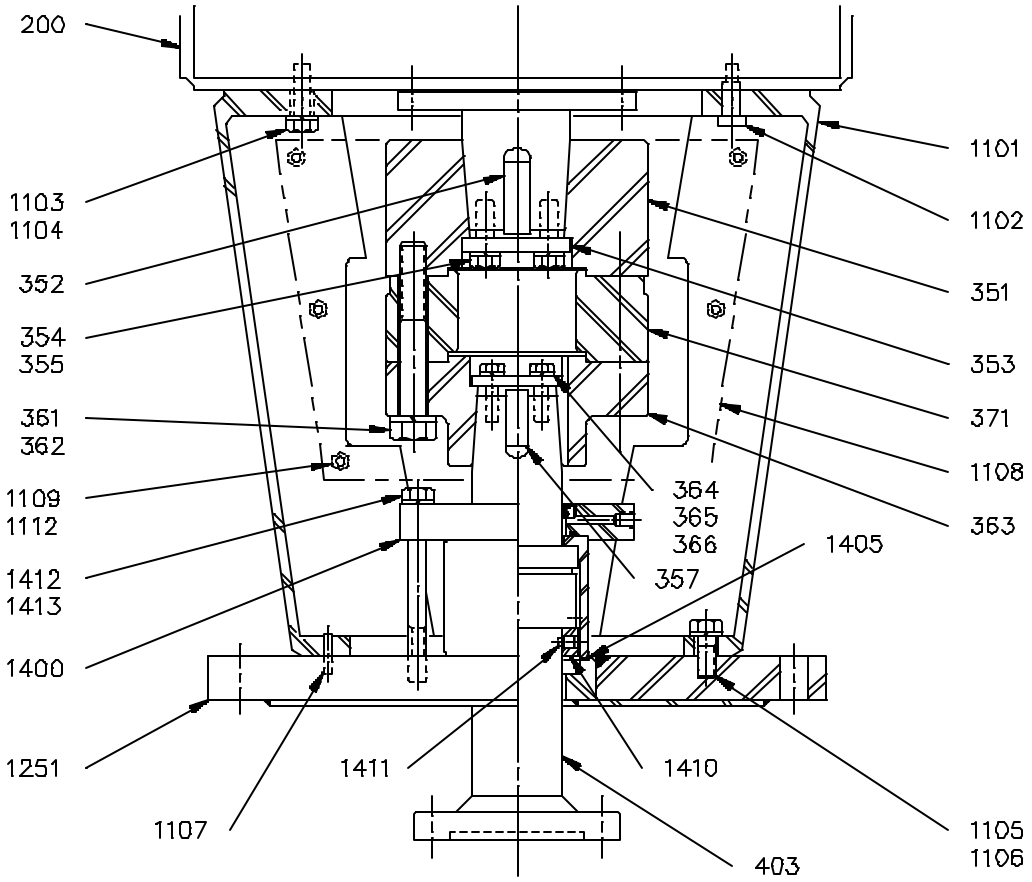



*Figure 6: Model HTNS*

## IMPELLERS

Unless otherwise specified on the unit assembly drawing, the impeller attaches to the shaft with a key and setscrew. Refer to *Figure 7, page 18*. With extended shaft keyways, the keyway is drilled at intervals for optional impeller placement.

Impeller assemblies (hub, blades, and stabilizer fins [if required]) may be match marked. Match marking is used on impellers that have been balanced or as an aid for locating multiple impellers on the shaft. All agitators operating at or above 100 RPM have match-marked impellers. Check the impeller parts for match marks before assembly.

Match-marked components are marked as a function of the agitator serial number and impeller location. Impellers are marked sequentially beginning with the bottom impeller and working up toward the agitator mounting surface. The following example assumes an order with two agitators, each having two 4-blade impellers with the lower impeller stabilized.

Markings for Serial Number 1-XXXXX-1

The lower impeller hub has stub blades marked 1-1, 1-2, 1-3, 1-4. The corresponding extension blades and stabilizer fins are marked 1-1, 1-2, 1-3, 1-4 with respect to the stub blades.

The upper impeller hub has stub blades marked 1-5, 1-6, 1-7, 1-8. The corresponding extension blades are marked 1-5, 1-6, 1-7, 1-8 with respect to the stub blades.

Markings for Serial Number 1-XXXXX-2

The lower impeller hub has stub blades marked 2-1, 2-2, 2-3, 2-4. The corresponding extension blades and stabilizer fins are marked 2-1, 2-2, 2-3, 2-4 with respect to the stub blades.

The upper impeller hub has stub blades marked 2-5, 2-6, 2-7, 2-8. The corresponding extension blades are marked 2-5, 2-6, 2-7, 2-8 with respect to the stub blades.

## IMPELLERS

1. Slide hub **[504]** up agitator extension shaft **[400]** past the desired key location.

2. Install pin key **[402]** in the shaft keyway so the pin extends into the drilled hole in the keyway. Slide the hub back down the agitator extension shaft, over the key, until the hub rests on the key step.

3. Tighten square head setscrew **[505]** firmly onto the key. Torque to the value shown in *Table 5, page 13*. The tapped hole for the setscrew is a self-locking thread form. Auxiliary fastener locking is not necessary.

4. Bolt extension blades **[506]** to the hub with bolts, nuts and lockwashers **[507, 509, 508]**. *Refer to Figures 8-13 pages 19-24.* Bolt split blades, if furnished, to extension blades with bolts, nuts and lockwashers **[529, 531, 530]**. Bolt stabilizer fins **[510]**, if furnished, to extension blades with bolts, nuts and lockwashers **[511, 513, 512]**. Torque to the values shown in *Table 5*.

   *NOTE: Extreme care should be taken to see that bolts are properly tightened. It is recommended that all in-tank fasteners be checked for tightness after the first two weeks of operation.*

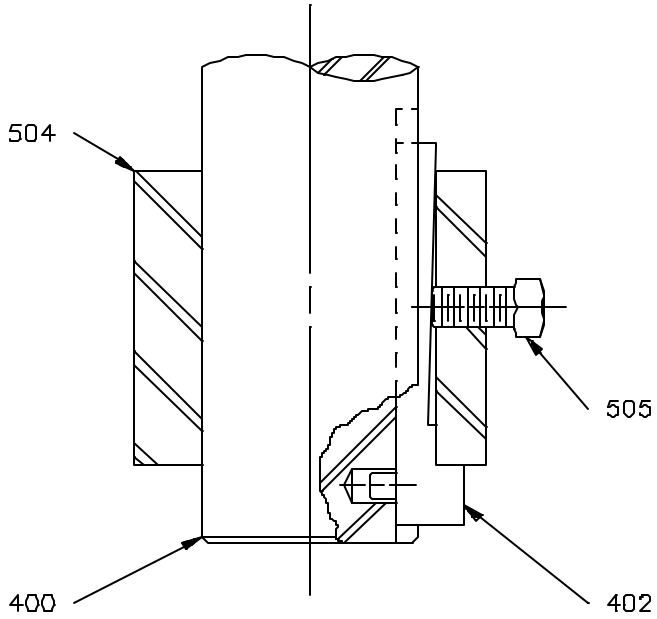



*Figure 7: Hub and Pin Key Detail*

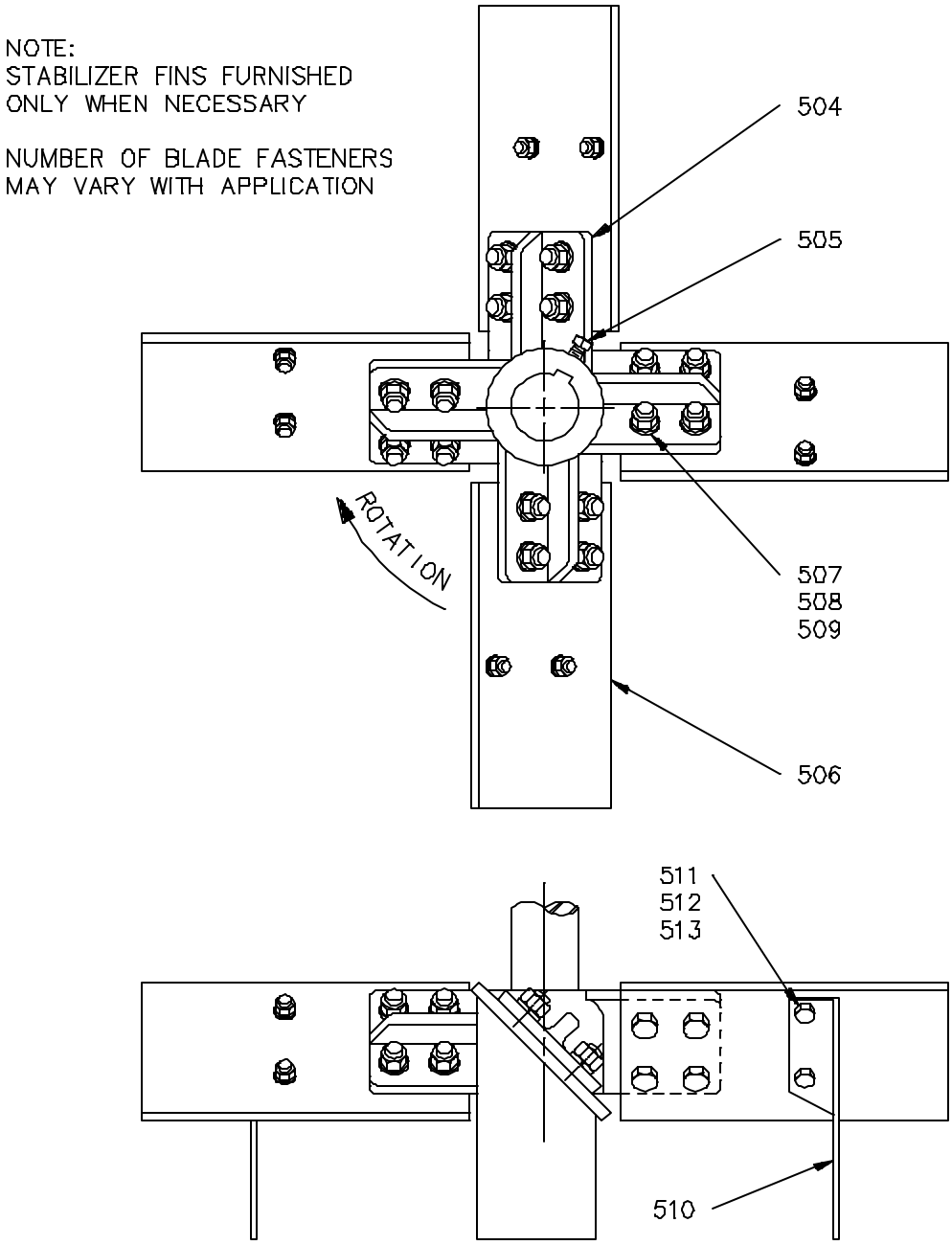



*Figure 8: Style P-4 Impeller*

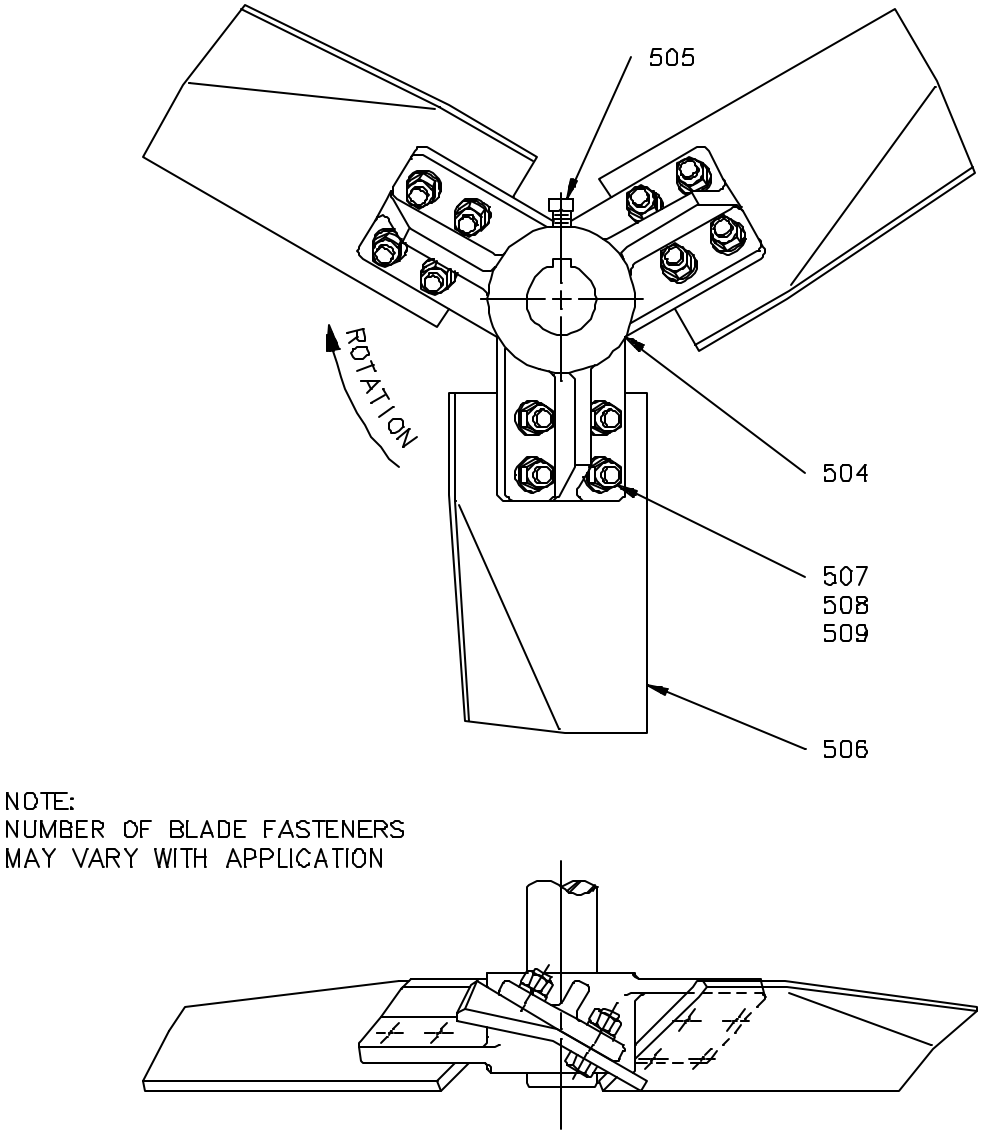



*Figure 9: Style HE-3 Impeller*

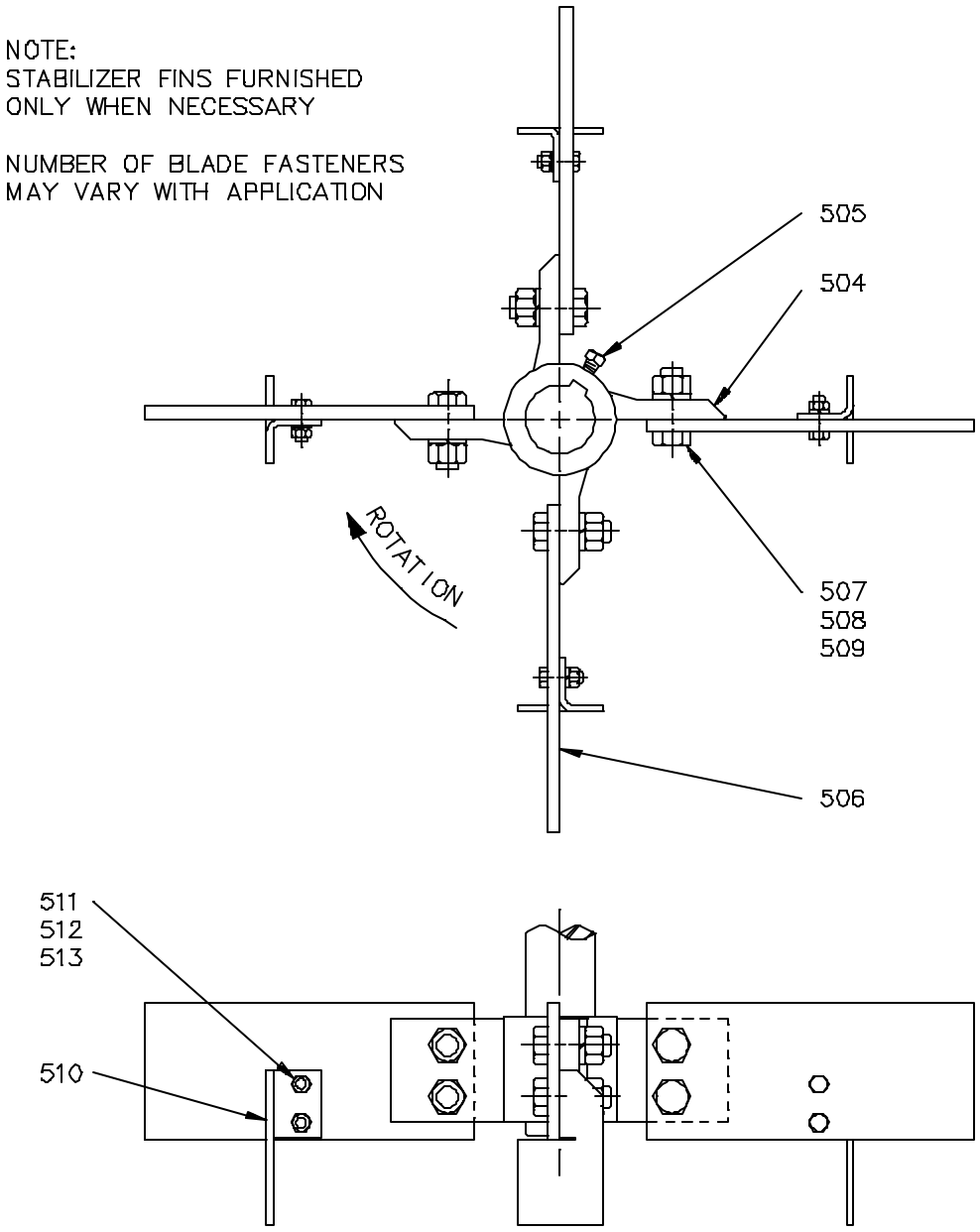



*Figure 10: Style S-4 Impeller*

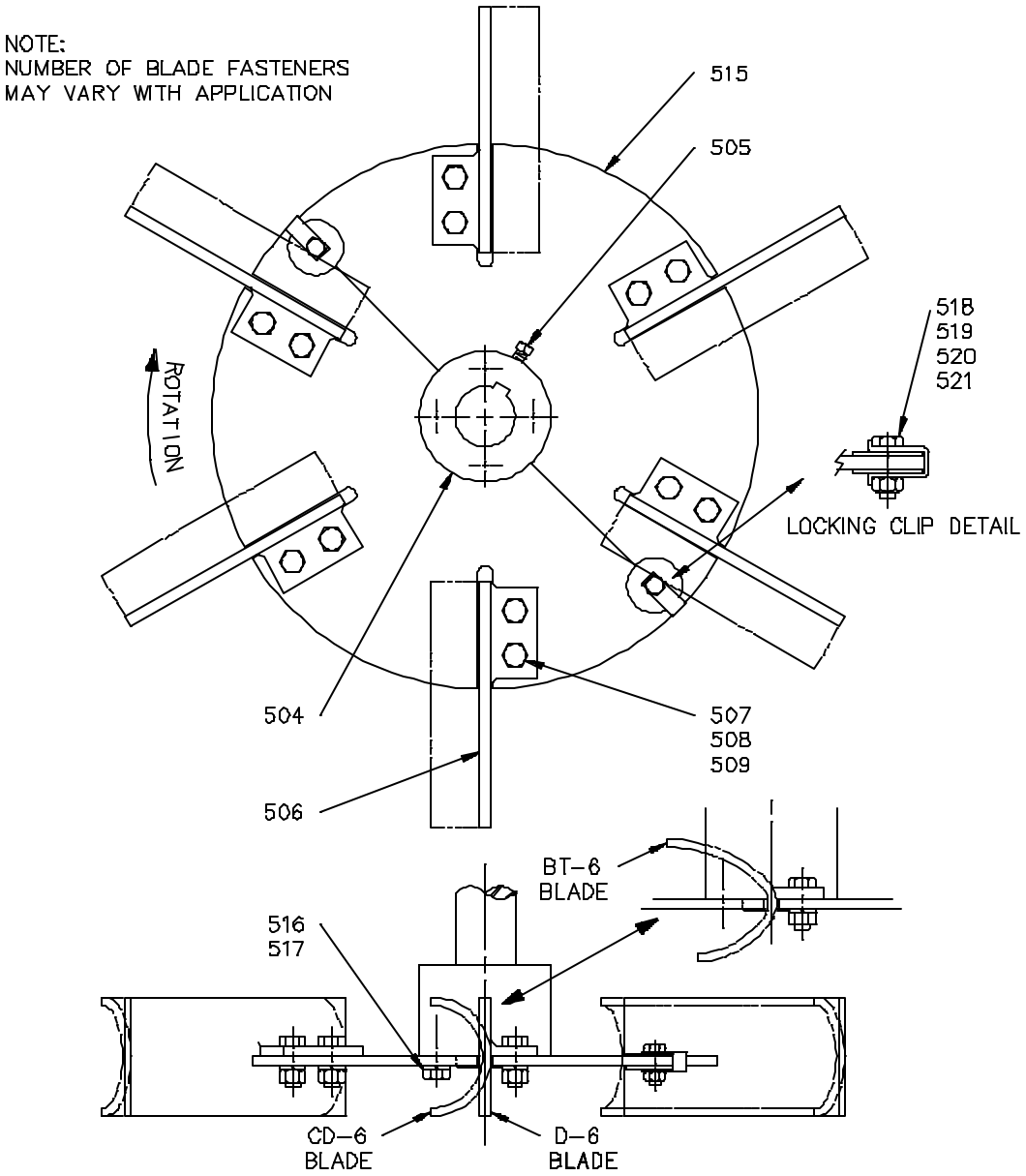



*Figure 11: Style D-6, CD-6, BT-6 Impeller*

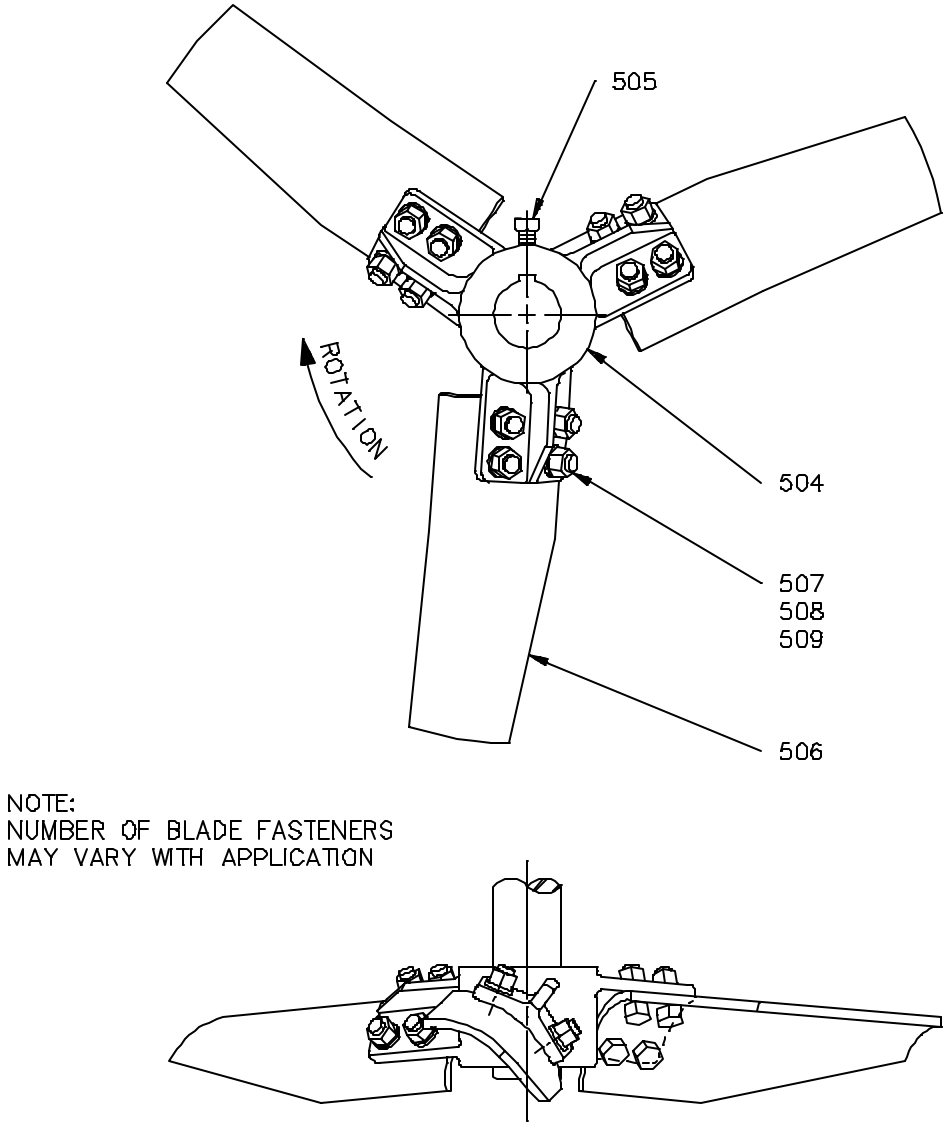



*Figure 12: Style SC-3 Impeller*

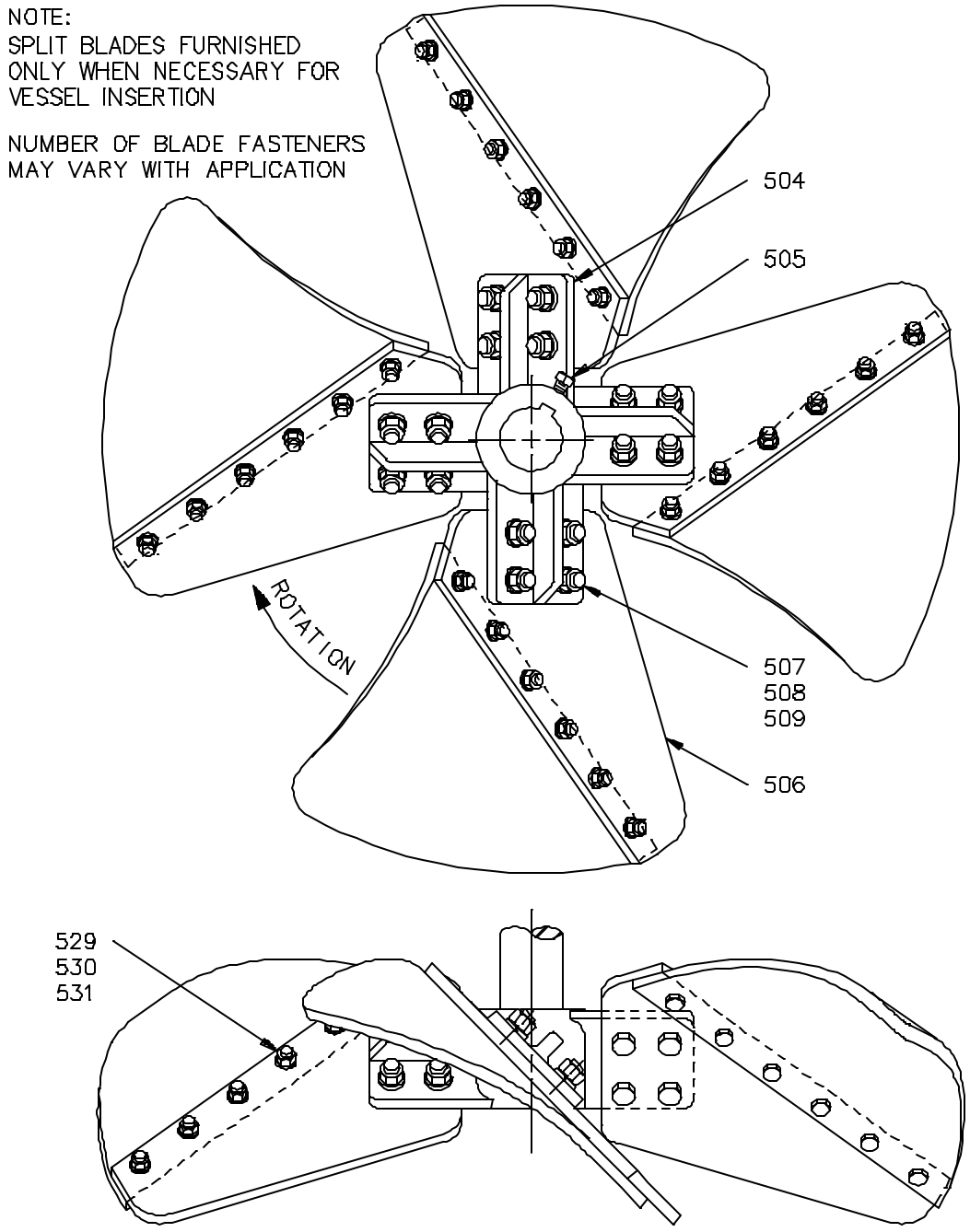



*Figure 13: Style Maxflo W Impeller*

# IMPELLERS

(Coated/Rubber Covered)

If the unit includes a coating or rubber covering on the wetted parts, follow these instructions for installation. Refer to the unit assembly drawing.

**Impeller diameter # 84" (2133 mm)** :
The shaft and impeller are usually supplied as a one-piece (welded) coated/covered assembly, and no impeller assembly is required. If your impeller was shipped separate from the shaft, follow the assembly instructions for impeller diameters > 84".

**Impeller diameter > 84" (2133 mm)** :
The impeller is supplied as a one-piece (welded) coated/covered assembly. For attachment to the shaft, refer to *Figure 14, page 26*.

1. Put gasket **[522]** on top of hub **[504]**.

2. Install key **[420]** in the shaft keyway.

3. Hoist impeller onto shaft **[400]**, being careful not to damage the coating/covering.

4. Install snap ring **[523]** in the groove at the bottom of the shaft.

   *CAUTION! Do not remove the hoist until mounting bolt assembly* **[522]**, **[524]**, **[525]**, *and* **[526]** *is installed.*

5. Place gasket **[522]** on thrust plate **[524]**.

6. Place the thrust plate over the bottom of the shaft and install mounting bolt **[526]** with gasket **[525]**. Torque to the value shown in *Table 5, page 13*.

7. Remove the hoist from the impeller.

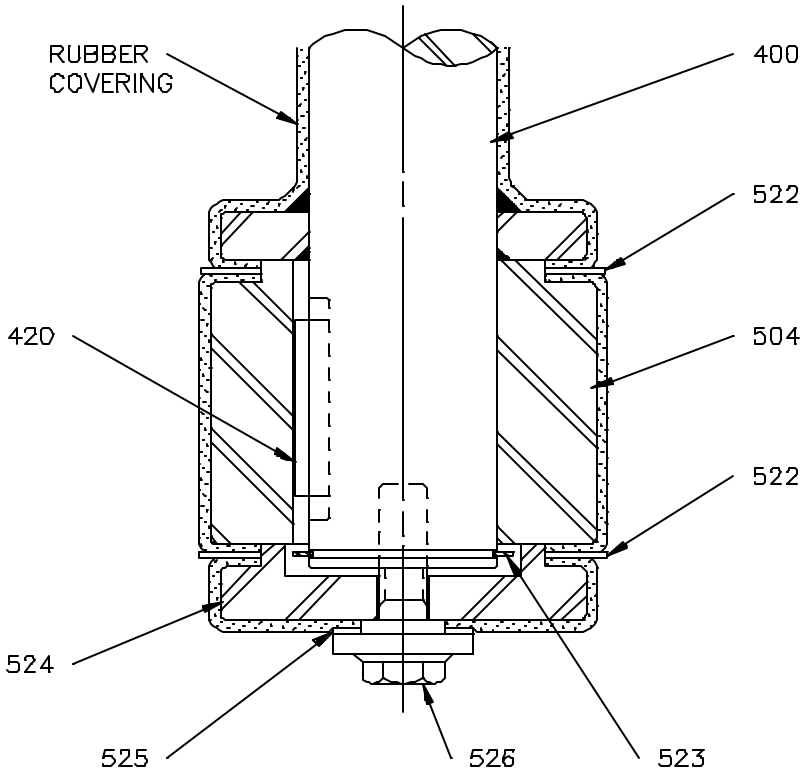



*Figure 14: Thrust Bolt Impeller Attachment*

## GEAR DRIVE

*CAUTION! The gear drive has been drained of oil for shipping.* Add oil to the gear drive according to the *Lubrication* section.

## MOTOR

1. Check the nameplate data on the motor to assure that the available power supply agrees with the motor requirements. Protective devices should be of the proper size and rating to safely carry the load and interrupt the circuit on overloads.

2. Turn the shaft by hand to check that it turns freely.

3. If the motor has been stored in a damp location, the windings may require drying.

   *NOTE: Do not obstruct the normal flow of ventilating air through or over the motor.*

4. Connect the motor in accordance with the National Electric Code and local requirements, but do not make the connections permanent until the motor rotation has been checked.

   Identify motor auxiliary devices such as space heaters or temperature sensors. Connect them in proper circuits and insulate them from motor power cables.

5. Jog the motor to check for correct rotation prior to securing wiring.

## FLEXIBLE MOTOR COUPLING

The standard flexible motor couplings **[110]** *(Figure 3, page 12)* used on Chemineer HT agitators are as follows:

T.B. Woods "Sure-Flex" couplings are supplied for motor frames up to and including Series 320T.

Falk "T-10" couplings are supplied for motor frame Series 360TS and larger.

Check the unit assembly drawing for the manufacturer, type and size coupling. Refer to *Vendor Data, Flexible Motor Couplings* for Installation, Alignment, Lubrication, Operation, and Maintenance instructions.

Verify coupling alignment and correct if necessary.

## SHAFT SEALS

Mechanical seals may require lubrication, pressurized lubrication and cooling. Refer to unit assembly drawings for requirements. See *OPERATION* and *LUBRICATION* sections.

## RIGID SHAFT COUPLINGS

HTN and HTNS style units are normally supplied with a welded drive shaft coupling half below the mounting flange. The extension shaft is usually supplied with a welded coupling half. Refer to the unit assembly drawing for specific coupling types.

To connect shaft sections:

1. If coupling halves are not installed refer to *Options: In-Tank Couplings* for installation instructions.

2. If coupling halves are installed on the shaft, refer to *Figure 15, page 31*, to see how fasteners are installed.

3. **Assemble Coupling Halves**:

   Connect extension shaft **[404]** coupling half to drive shaft **[403]** coupling half making sure the match marks are lined up and the coupling faces are clean and free from burrs or nicks. Install coupling bolts, lockwashers and nuts **[405, 406, 407]**. Torque to the value shown in *Table 5, page 13*.

# OPTIONS: IN-TANK COUPLINGS

Optional in-tank couplings are available in welded (non-removable) and taper bore (removable) construction.

**Assembly of Rigid, Removable, Taper Bore Coupling Half [408, 413]** *(Figure 15, page 31)*

1. Clean the shaft and coupling bore and make sure that both surfaces are free from burrs or nicks. Place key **[409, 414]** in the coupling keyway to make sure it slides freely. Place the key in the shaft keyway to make sure it is properly oriented and fully bottomed in the keyway. Install the key in the shaft keyway.

   *CAUTION! Do not apply lubricant or anti-seize compound to shaft or coupling taper. Shaft and coupling taper must be clean and dry prior to assembly.*

2. Slide the coupling half on the tapered shaft end until both seat firmly against each other. Be sure the coupling half is not hung up on the key or cocked at an angle to the shaft.

3. Shaft Bolt Installation:

   **2 Bolt Design:**
   Install coupling washer **[421, 424]**; lubricate and install bolts and lockwashers **[422, 423, 425, 426]**. Torque to the value shown in *Table 5, page 13*.

   **1 Bolt Design:**
   Install coupling washer **[410, 415]** and locking clip **[412, 416];** lubricate and install shaft bolt **[418, 419]**. Torque to the value shown in *Table 6, page 30*. Bend exposed tabs of the locking clip around the shaft bolt head.

4. Assemble Coupling Halves:

   Connect extension shaft **[404]** coupling half to drive shaft **[403]** coupling half making sure the match marks are lined up and the coupling faces and tenons are clean and free from burrs or nicks. Install coupling bolts and lockwashers **[405, 406]** (and nuts **[407]** if welded construction). Torque to the value shown in *Table 5*.

## RIGID SHAFT COUPLINGS

*TABLE 6: SHAFT BOLT TIGHTENING TORQUE[(1),(2),(3)]*

| Bolt Size | ALL MATERIALS | |
|---|---|---|
| | ft-lb | Nm |
| 1/2 - 13 | 38 | 51 |
| 5/8 - 11 | 68 | 92 |
| 3/4 - 10 | 120 | 163 |
| 7/8 - 9 | 105 | 143 |
| 1 - 8 | 165 | 224 |
| 1 ! 1/8 - 7 | 225 | 305 |
| 1 ! 1/4 - 7 | 315 | 428 |
| 1 ! 3/8 - 6 | 417 | 566 |
| 1 ! 1/2 - 6 | 555 | 752 |
| 1 ! 3/4 - 5 | 825 | 1119 |
| 2 - 4 ! 1/2 | 1125 | 1525 |
| 2 ! 1/4 - 4 ! 1/2 | 1725 | 2339 |
| 2 ! 1/2 - 4 | 2325 | 3153 |

(1) Regardless of material or head markings, tighten all 1 bolt design shaft bolts to the value shown.

(2) Lubricate all fasteners at assembly with grease, oil or an anti-seize material. Bolt threads and contact surfaces of bolt heads and nuts should be lubricated.

(3) If fasteners cannot be lubricated, multiply table values by 1.33.

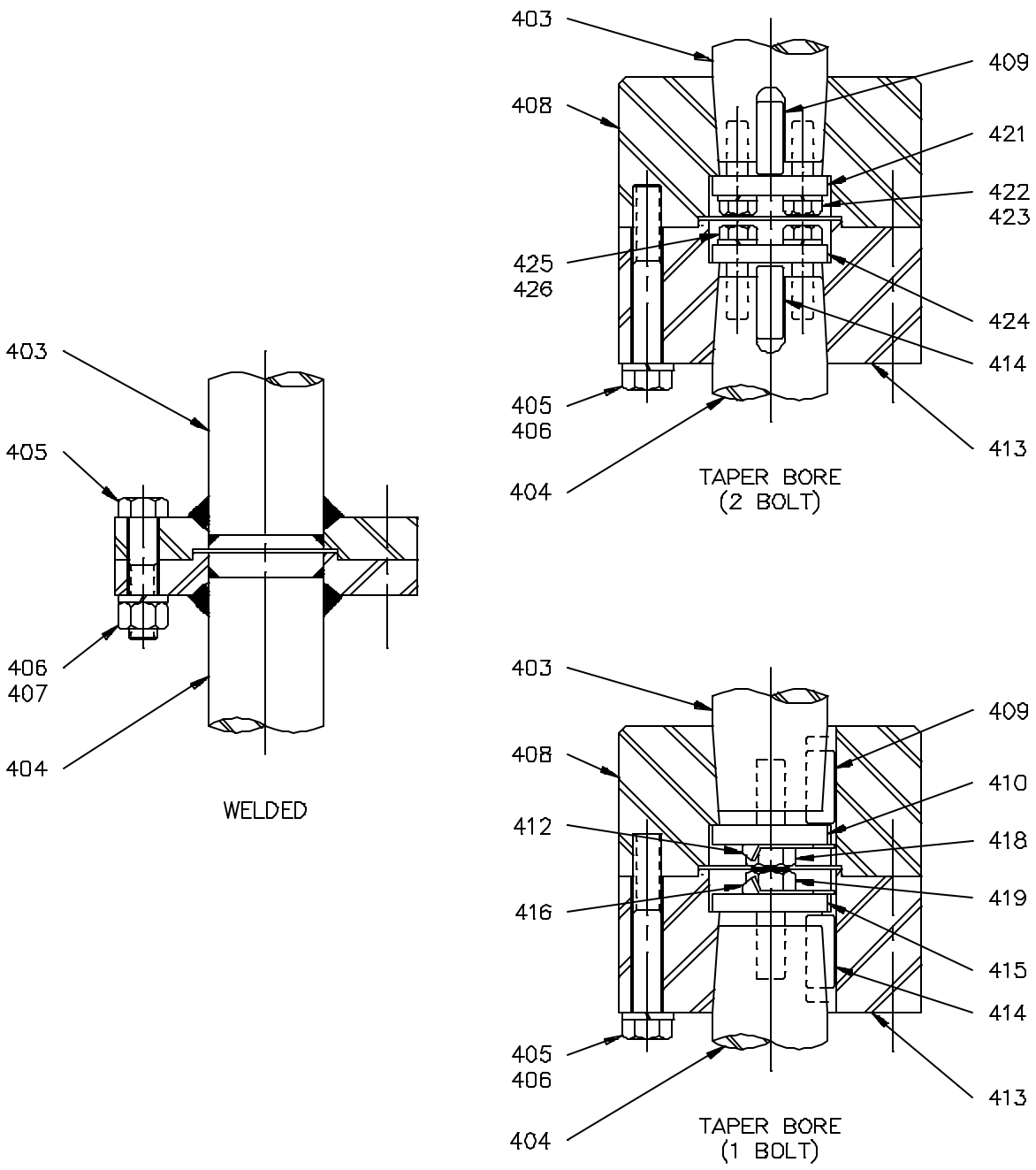



*Figure 15: In-Tank Couplings*

## OPTIONS: STEADY BEARINGS

HT agitators may include an optional in-tank steady bearing. See the unit assembly drawing for the steady bearing style, type of mounting, side load and vessel installation requirements.

Proper steady bearing operation requires the agitator extension shaft to be straight and the steady bearing to be centered on the shaft. *See INSTALLATION, page 11* for checking and straightening the shaft. Steady bearing mountings should be located from the installed agitator extension shaft. Design steady bearing support for a maximum deflection of .010" (.25 mm) per 1000 lbs. (455 kg) of side load.

**Bracket Steady Bearing**

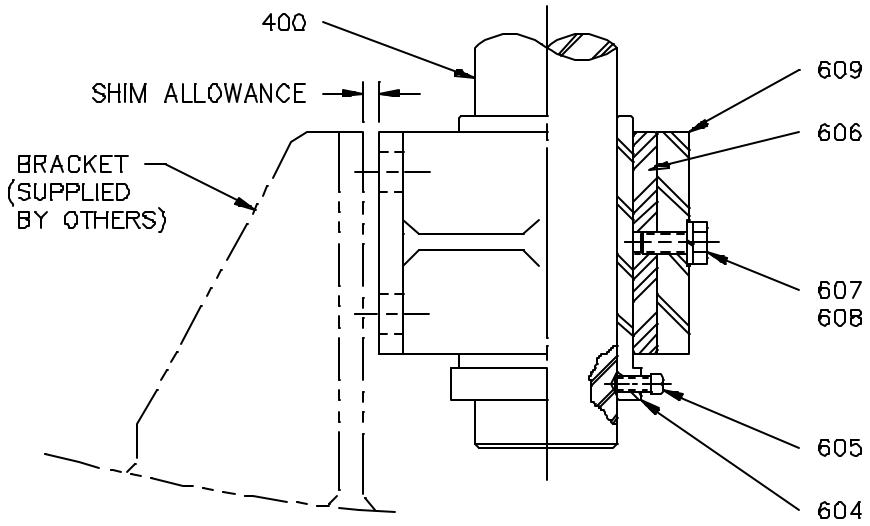



*Figure 16: Bracket Steady Bearing [601]*

1. Place the steady bearing assembly on the end of the shaft and attach it to the support bracket (supplied by others). The support bracket should be located such that the steady bearing assembly is centered on the shaft. Bolt steady bearing housing [609] to the support bracket. Tighten the bracket bolts (supplied by others) to 25% of specified torque per *Table 5, page 13*.

## OPTIONS: STEADY BEARINGS

**Bracket Steady Bearing** (Cont'd)

2. Loosen setscrews [605] and remove wear sleeve [604]. Remove bushing retaining bolt and lockwasher [607, 608] and bushing [606] from steady bearing housing [609].

3. Attach a dial indicator to the shaft and set it so the point of the indicator extends inside the steady bearing housing bore.

4. Manually turn the flexible motor coupling to rotate the extension shaft one turn. Shim the steady bearing housing until it is located concentric to the shaft centerline within .050" (1.27 mm) FIM (Full Indicator Movement).

5. Install bushing, bushing retaining bolt, lockwasher, wear sleeve and setscrews [606, 607, 608, 604, 605]. See the unit assembly drawing for the position of the wear sleeve on the shaft. Tighten the bushing retaining bolt and the setscrews.

6. With a feeler gage check the clearance between the wear sleeve and the bushing at the top and bottom in 90° increments. For proper angular alignment, the gap at all locations should be within .010" (.25 mm) of each other.

7. If the angular alignment needs correction, repeat *Steps 1 through 6*.

8. Once the final steady bearing housing location has been determined, drill the steady bearing housing and its support bracket at two locations and install roll or dowel alignment pins (supplied by others). Torque the bracket bolts to the value shown in *Table 5, page 13*.

9. Remove the wear sleeve setscrews one at a time and transfer punch a center into the agitator shaft. Take the wear sleeve off the shaft. Spot the shaft for the setscrews using a drill of the same diameter as the setscrews. Drill to the depth of the drill point.

10. Reinstall the wear sleeve with the setscrews over the drill spots located in Step 9. Torque the setscrews and the bushing retaining bolt to the value shown in *Table 5*. The tapped holes for the setscrews are a self-locking thread form. Auxiliary fastener locking is not necessary.

    *CAUTION! Do not operate the agitator without the steady bearing being submerged.*

## OPTIONS: STEADY BEARINGS

### Tri-Pod Steady Bearing

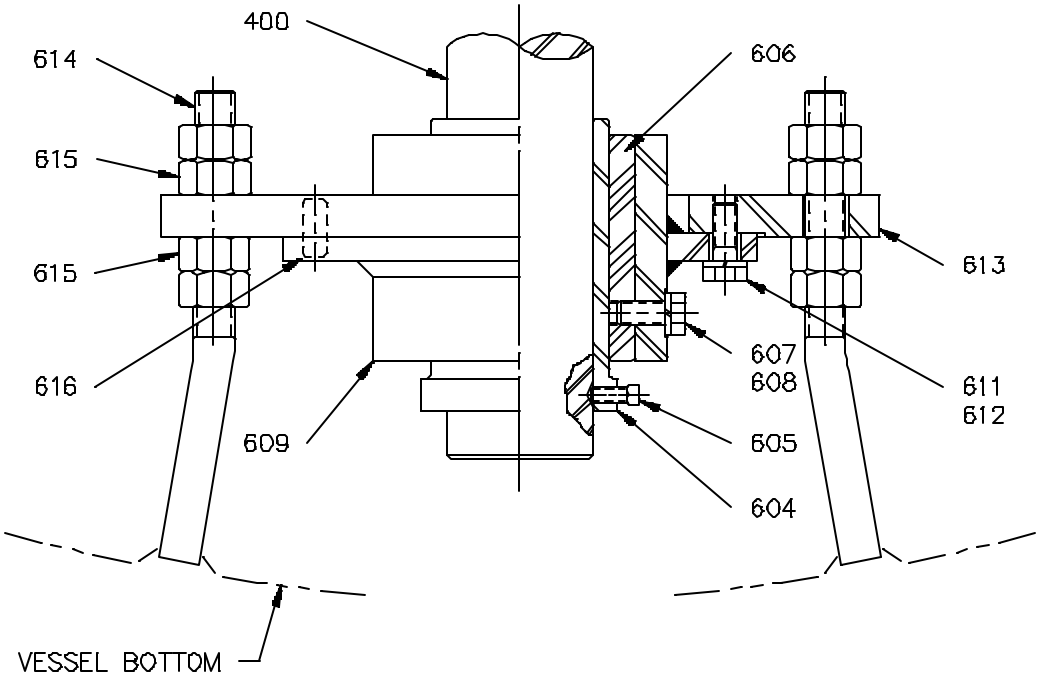



*Figure 17: Tri-Pod Steady Bearing [603]*

1. Locate the steady bearing assembly so that it is centered on the shaft. Attach support legs [614] to the vessel bottom.

2. Loosen setscrews [605] and remove wear sleeve [604].

3. Attach a dial indicator to the shaft and set the point of the indicator on the top face of housing hub [609].

4. Manually turn the flexible motor coupling to rotate the extension shaft one turn. Adjust nuts [615] to obtain .010" (.25 mm) FIM (Full Indicator Movement) maximum.

## OPTIONS: STEADY BEARINGS

**Tri-Pod Steady Bearing** (Cont'd)

5. Place the indicator point on the outside diameter of housing hub [609] and rotate the extension shaft one turn. Loosen bolts [611] and move steady bearing housing [609] until it is located concentric to the shaft centerline within .050" (1.27 mm) FIM. Adjust nuts [615] to obtain .010" (.25 mm) FIM maximum.

6. Tighten the bolts and nuts to the values shown in *Table 5, page 13* and recheck alignment with the dial indicator.

7. If the angular alignment needs correction, repeat *Steps 2 through 6*.

8. Once the final steady bearing housing location has been determined, drill the steady bearing housing and mounting plate [613] at two locations and install dowel alignment pins [616].

9. Install the wear sleeve. See the unit assembly drawing for the position of the wear sleeve on the shaft. Tighten setscrews [605].

10. Remove the wear sleeve setscrews one at a time and transfer punch a center into the agitator shaft. Take the wear sleeve off the shaft. Spot the shaft for the setscrews using a drill of the same diameter as the setscrews. Drill to the depth of the drill point.

11. Reinstall the wear sleeve with the setscrews over the drill spots located in Step 10. Torque the setscrews to the value shown in *Table 5*. The tapped holes for the setscrews are a self-locking thread form. Auxiliary fastener locking is not necessary.

    *CAUTION! Do not operate the agitator without the steady bearing being submerged.*

## OPTIONS: STEADY BEARINGS

### Pad Steady Bearing

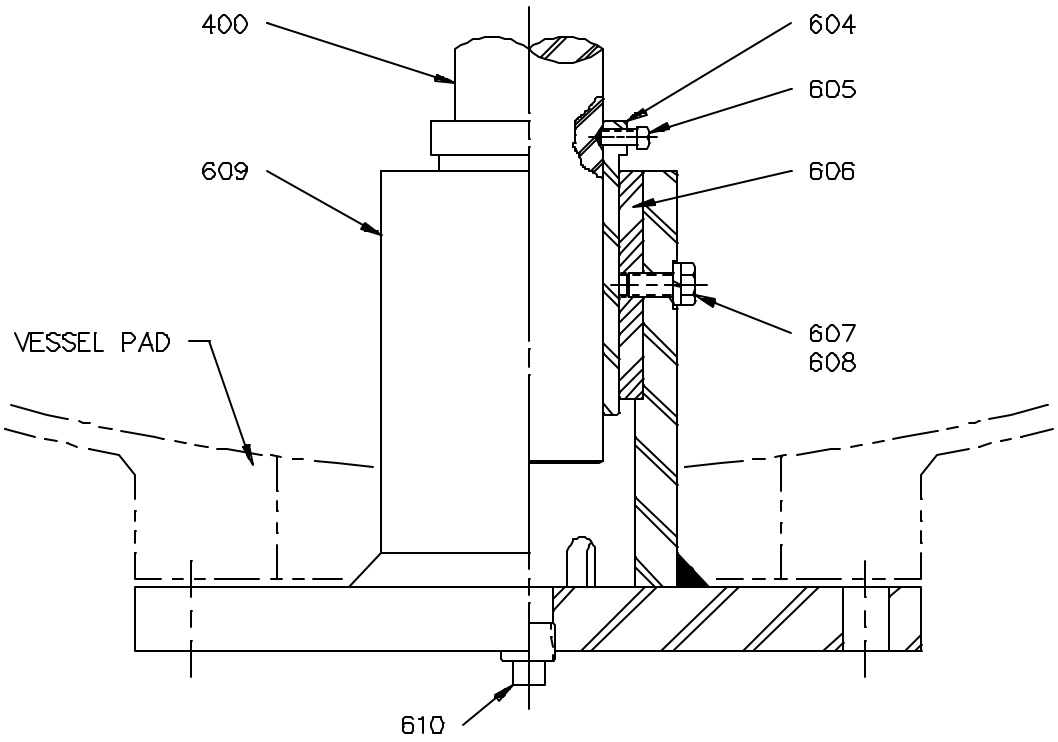



*Figure 18: Pad Steady Bearing [602]*

1. Assemble steady bearing housing **[609]** to the vessel pad with the proper gasket and flange bolts (supplied by others). Tighten the flange bolts to 25% of specified torque per *Table 5, page 13*.

2. Loosen setscrews **[605]** and slide wear sleeve **[604]** up the extension shaft to disengage from bushing **[606]**.

3. Attach a dial indicator to the shaft and set the point of the indicator on the top face of housing hub **[609]**.

## OPTIONS: STEADY BEARINGS

**Pad Steady Bearing** (Cont'd)

4. Manually turn the flexible motor coupling to rotate the extension shaft one turn. If the runout exceeds .010" (.25 mm) FIM (Full Indicator Movement) maximum, a tapered adapter (supplied by others) should be installed between the housing mounting flange and the vessel mounting pad. Call Chemineer Field Service for assistance.

5. Place the indicator point on the outside diameter of the housing hub and rotate the extension shaft one turn. Loosen the flange bolts and move the steady bearing housing until it is located concentric to the shaft centerline within .050" (1.27 mm) FIM. Torque the flange bolts to the value shown in *Table 5, page 13*.

6. In extreme cases the agitator drive may have to be shimmed to correct for angular misalignment. Call Chemineer Field Service for assistance.

7. If the angular alignment needs correction, repeat *Steps 1 through 5*.

8. Once the final steady bearing housing location has been determined, drill the steady bearing housing flange at two locations on or outside of the bolt circle and install roll or dowel alignment pins (supplied by others).

9. Slide the wear sleeve down the shaft into the bushing. See the unit assembly drawing for the position of the wear sleeve on the shaft. Tighten setscrews **[605]**.

10. Remove the wear sleeve setscrews one at a time and transfer punch a center into the agitator shaft. Slide the wear sleeve up the shaft and retain. Spot the shaft for the setscrews using a drill of the same diameter as the setscrews. Drill to the depth of the drill point.

    *CAUTION! Cover the opening between the extension shaft and the bushing to prevent drill chips from getting into the housing.*

11. Reinstall the wear sleeve with the setscrews over the drill spots located in *Step 10*. Torque the setscrews to the value shown in *Table 5*. The tapped holes for the setscrews are a self locking thread form. Auxiliary fastener locking is not necessary.

    *CAUTION! Do not operate the agitator without the steady bearing being submerged.*

## OPTIONS: EXTERNAL MOTOR-DRIVEN OIL PUMP

HT gear drives may include an optional external motor-driven oil pump *(Figures 19 and 20; pages 39 and 40)*. See the unit assembly drawing for the power requirements.

The pump motor is marked with an arrow indicating the proper rotation. Do not operate the agitator without checking the pump motor rotation.

The pump motor and the agitator drive motor must be interconnected so the agitator drive motor cannot be energized without energizing the pump motor.

All external motor-driven oil pump systems are furnished with an oil flow alarm switch. If the oil flow is interrupted, this switch is to be used to activate an alarm and stop the agitator drive motor. See the unit assembly drawing for the switch current rating.

*CAUTION! For all case sizes the oil flow alarm switch must be used to stop the agitator drive motor.*

If the gear drive requires cooling, the external motor-driven oil pump will include a water-to-oil heat exchanger and temperature actuated water regulating valve. Cooling water will have to be provided to the heat exchanger. See the unit assembly drawing for the required flow rates. Unless otherwise specified see *Table 7*.

*TABLE 7: COOLING WATER FLOW RATE*

| Case Size | Flow Rate* | |
|---|---|---|
| | Gallons/Minute | Liters/Minute |
| 3,4,5 | 2 to 3 | 7.5 to 11.5 |
| 6,7,8,9 | 3 to 4 | 11.5 to 15 |
| 10,11 | 5 to 6 | 19 to 22.5 |
| 12,13 | 7 to 8 | 26.5 to 30.5 |

* 85° F (29° C) water temperature

**All cooling systems are provided with an oil temperature alarm switch. The factory temperature setting is 180° F (83° C). This switch is to be used to activate an alarm. See the unit assembly drawing for t**

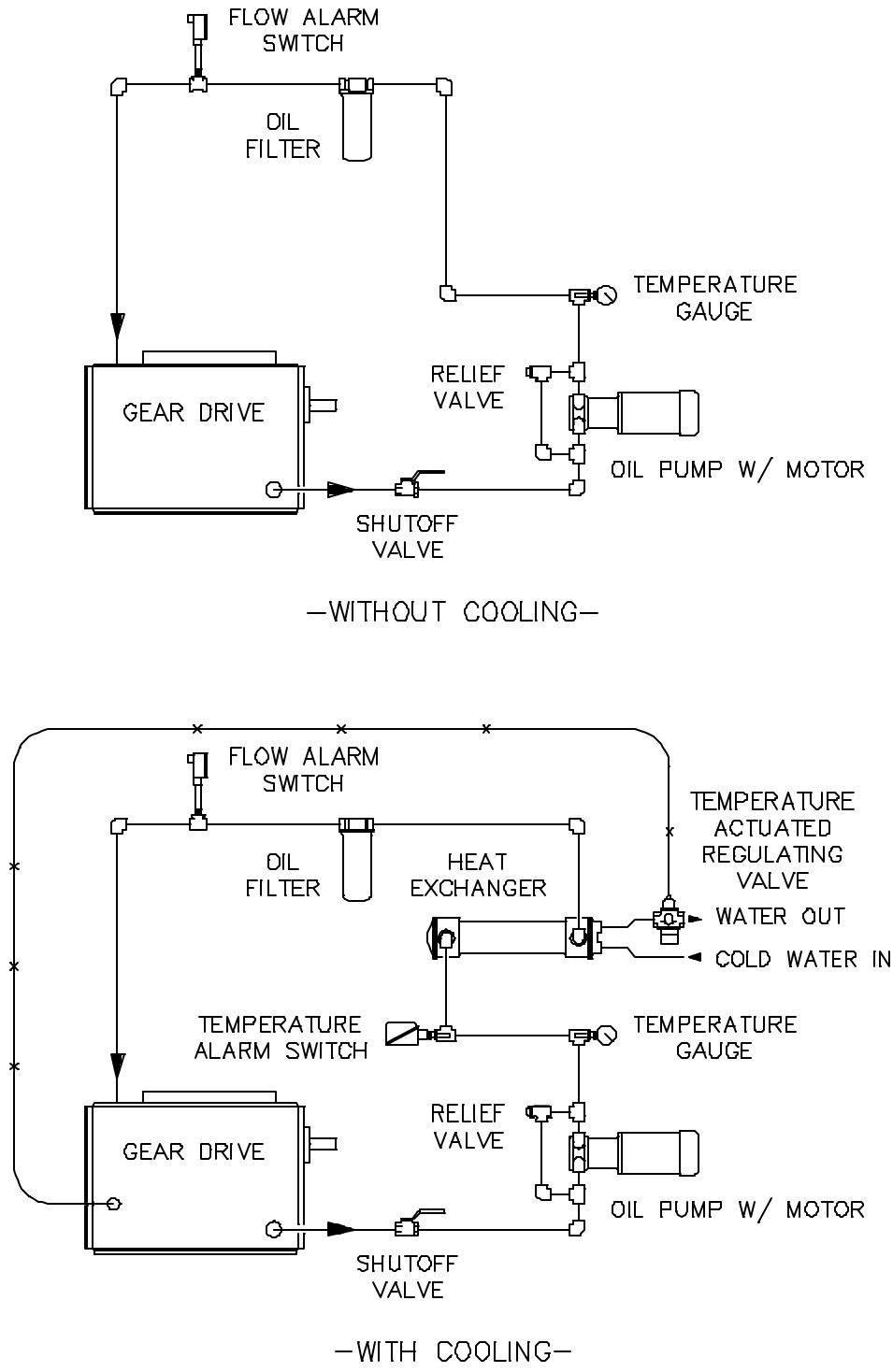



*Figure 19: External Motor-Driven Oil Pump*

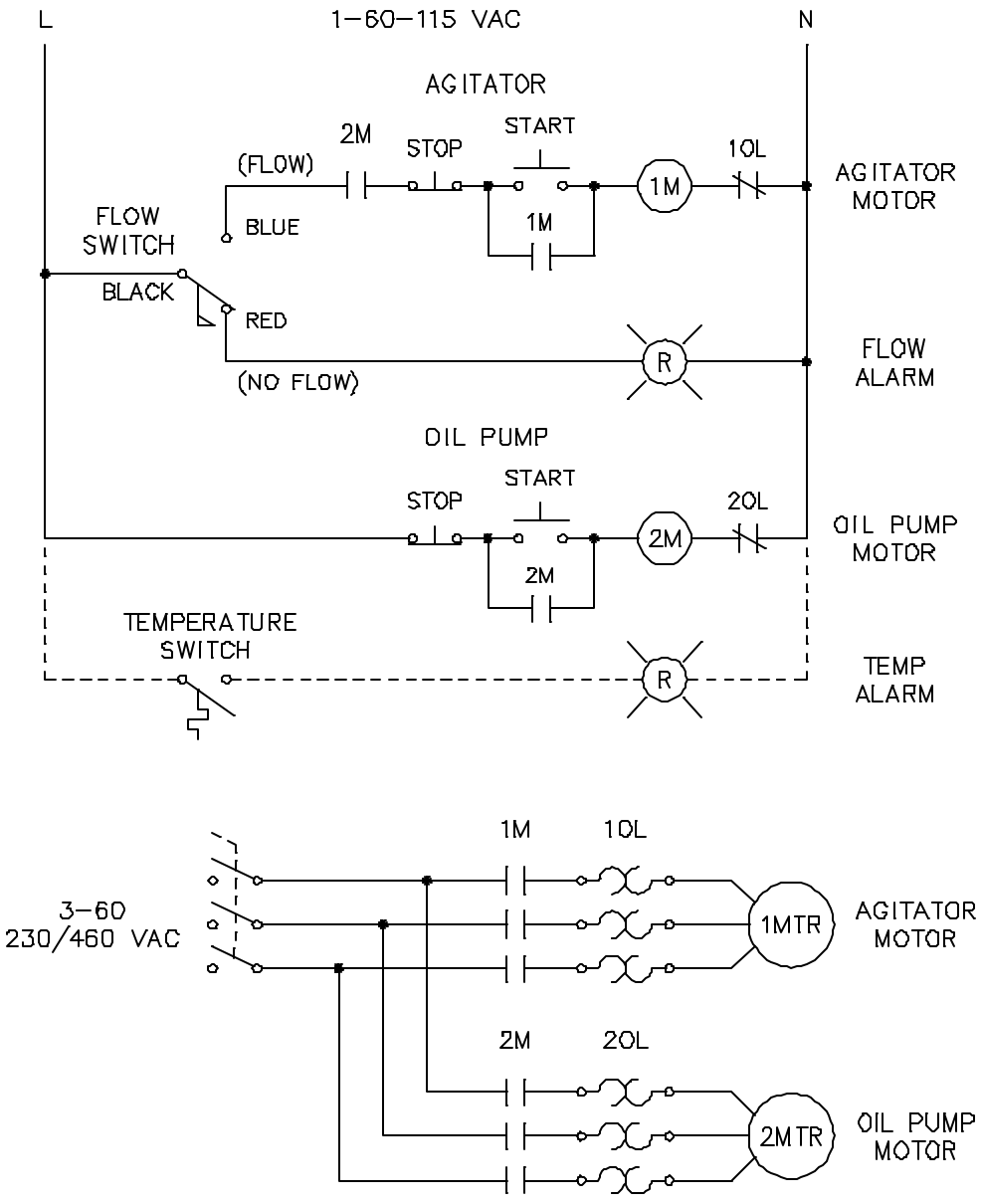



*Figure 20: Wiring Diagram*

# OPTIONS: TACHOMETER

HT gear drives may include an optional magnetic signal tachometer.

The tachometer assembly is shipped in a separate box and requires assembly to the gear drive. Tachometer is mounted on the top of the gear drive and is driven by the gear drive output shaft.

**Magnetic Signal Tachometer**

1. Remove bolts, lockwashers and tachometer cover [2021, 2022, 2018].

2. Install speed sensor [2004] to bracket [2011] using U-bolts [2014]. Assemble the speed sensor/bracket assembly to the gear drive with bolts, lockwashers, and flatwashers [2015, 2016, 2017].

3. Adjust the speed sensor to obtain a 1/8 to 1/4" (3 to 6 mm) air gap and tighten bolts [2015] securely.

4. Assemble the tachometer cover to the bracket assembly with screws, lockwashers and flatwashers [2023, 2024, 2025]. Install bolts and lockwashers [2021, 2022]. Tighten all fasteners securely.

5. The speed sensor is mounted in an enclosure with a 1/2" NPT conduit connection. A 3-wire shielded cable 10 ft (30.5 m) long is provided for connection to the digital panel meter. If required, longer cables (supplied by others) are commercially available.

6. The digital meter [2003] is housed in a plastic case and designed for installation in a control panel designated suitable for non-hazardous areas. Ambient operating temperature range is 32° to 158° F (0° to 70° C). The input power required is single phase, 50/60 Hz, 115 VAC. See *Figure 22, page 43* for the wiring diagram and panel cut-out dimensions.

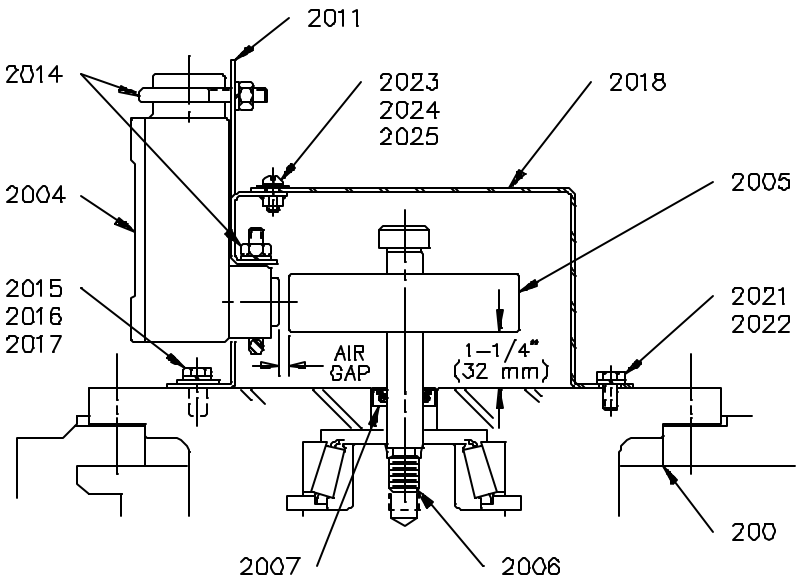



*Figure 21: Magnetic Signal Tachometer*

**The meter is factory set and no adjustment or maintenance is re**

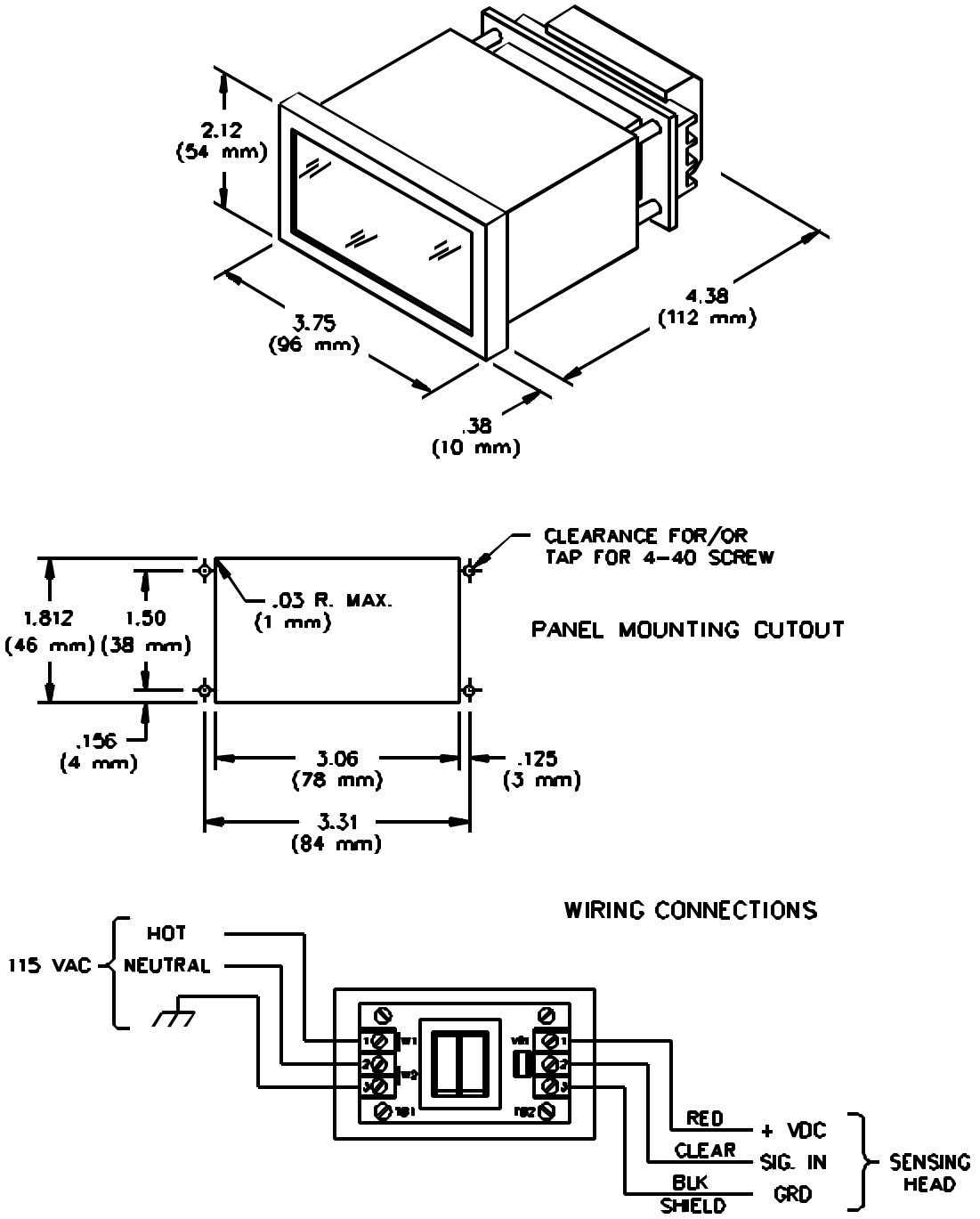



*Figure 22: Tachometer Panel Meter*

# OPTIONS: MECHANICAL SEAL LUBRICATORS

HT agitators may include an optional mechanical seal lubricator or oiler. See the unit assembly drawing for installation requirements.

## Mechanical Seal Lubricator

The Chemineer mechanical seal lubricator *(Figure 23, page 45)* will have to be pressurized (by others) to a constant pressure level using a gas bottle or other means. See the unit assembly drawing for the required pressure. See *LUBRICATION and OPERATION, SHAFT SEALS sections, pages 61 and 65.*

*CAUTION! Never pressurize the vessel without having the lubricator fully pressurized.*

## Mechanical Seal Oiler

The Chemineer mechanical seal oiler *(Figure 24, page 46)* is non-pressurized. See *LUBRICATION and OPERATION, SHAFT SEAL sections.*

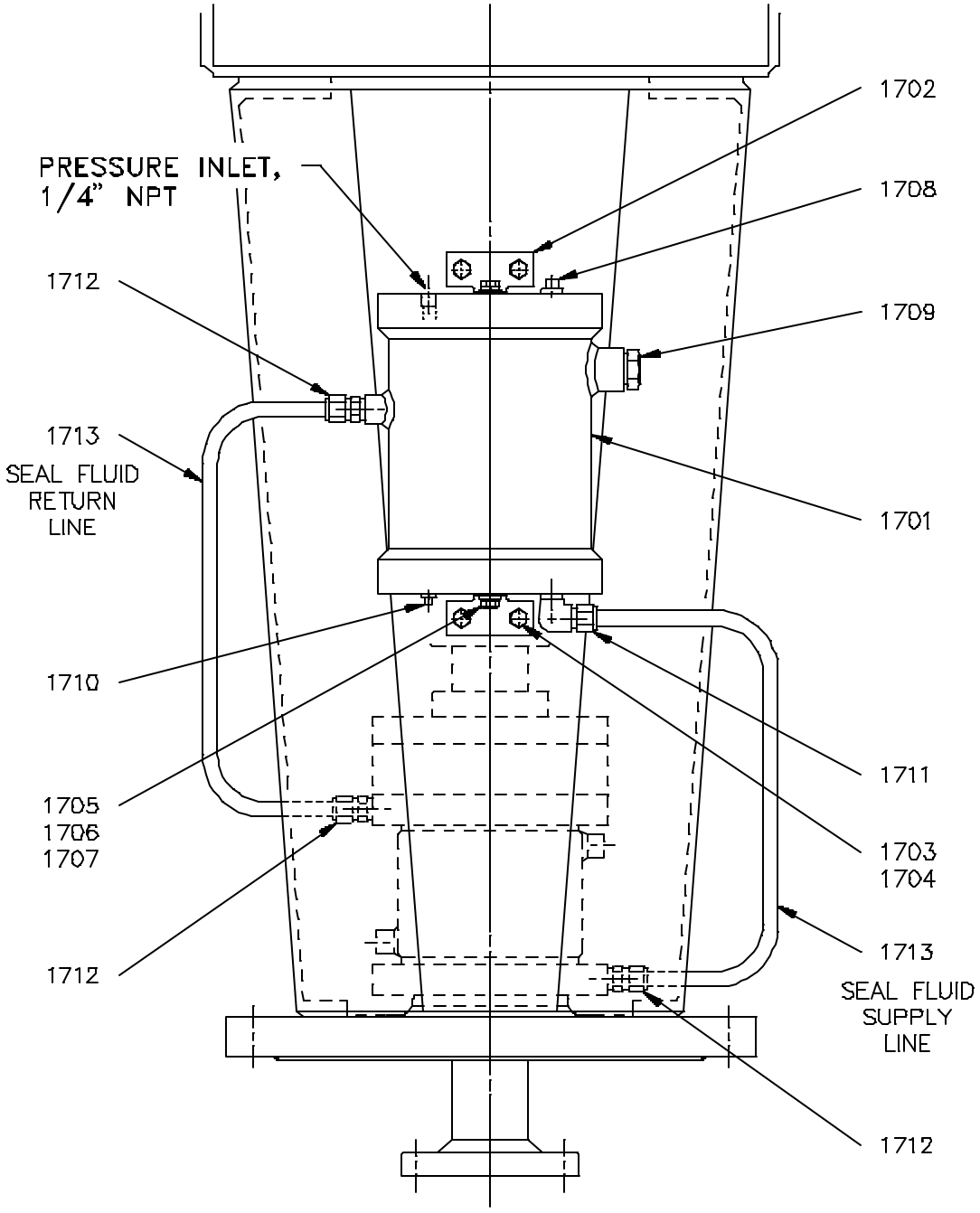



*Figure 23: Mechanical Seal Lubricator*

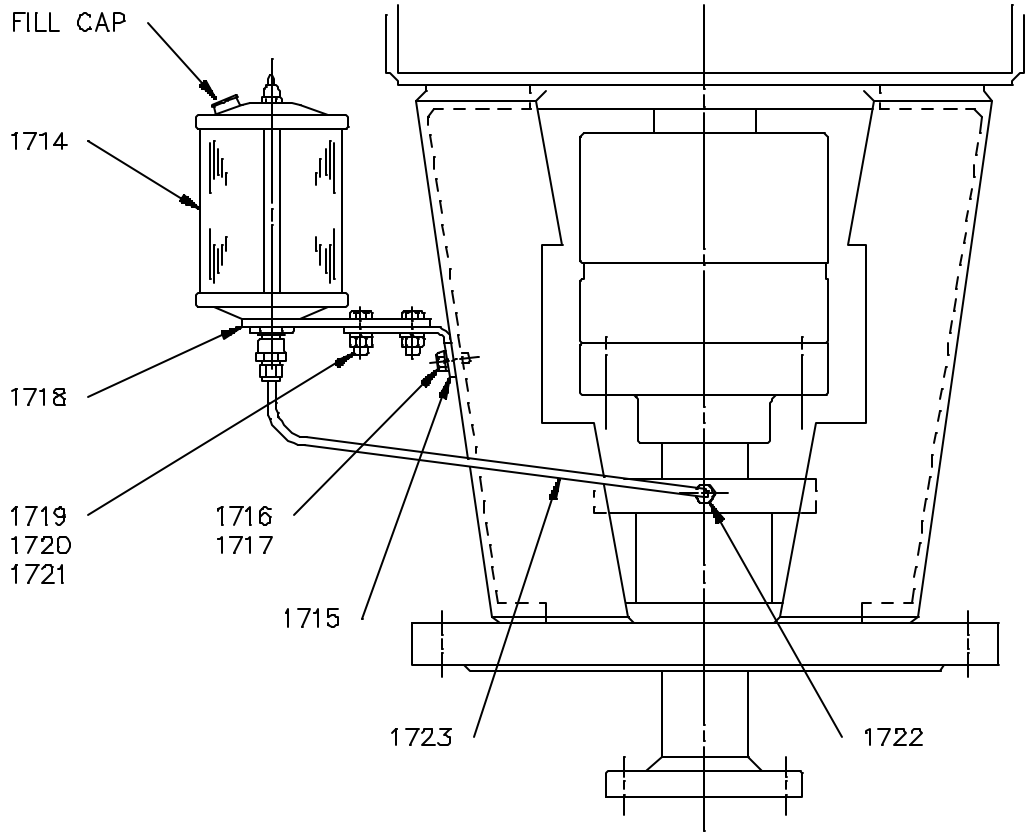



*Figure 24: Mechanical Seal Oiler*

# LUBRICATION

This section defines the proper oils and greases that must be used with this equipment.

*CAUTION! Check the gear drive for proper oil fill before operating.*

## MOTOR

The motor bearings have been properly greased by the manufacturer. Motor bearings should be regreased at 12-month intervals when installed in clean, dry environments, or every six months for heavy duty and dusty locations. Any good quality general purpose grease consisting of a refined base oil stock and a lithium or calcium-complex based soap, with an NLGI No. 2 classification, will work satisfactorily. Most major oil companies offer such products, usually with extreme pressure (EP) additives for additional protection. *Table 8, page 48* lists some commonly available greases.

When regreasing, stop the motor, remove the outlet plug and add grease according to *Table 9, page 49* with a hand lever gun only. Run the motor for about ten minutes before replacing the outlet plug. Certain TEFC motors have a spring relief outlet fitting on the fan end. If the outlet plug is not accessible at the surface of the hood, it is the spring relief type and need not be removed when regreasing.

*CAUTION! Overgreasing is a major cause of bearing and motor failure.*

## MOTOR

*TABLE 8: TYPICAL NLGI NO. 2 GREASES*

| *For Ambient Temperature Range of 0º to 150º F (-18º to 66º C)* | | |
|---|---|---|
| **MANUFACTURER** | **GENERAL PURPOSE** | **EP** |
| Amoco Oil Co. | Amolith grease: Grade 2 | Amolith grease: Grade 2EP |
| Ashland Oil Co. | | Multi-lube Lithium EP grease: Grade 2 |
| | | EP Lithium #2 |
| Chevron U.S.A.Inc. | Industrial grease: Grade medium | Dura-Lith greases EP: Grade 2 |
| CITGO Petroleum Corp. | | Premium Lithium EP grease: Grade 2 |
| Conoco Inc. | | EP Conolith grease: Grade 2 |
| Exxon Co. U.S.A. | Unirex N: Grade 2 | Nebula EP: Grade 2 |
| | | Ronex MP: Grade 2 |
| Mobil Oil Corp. | | Mobilux EP 2 |
| Pennzoil Products Co. | | Pennlith EP grease 712 |
| Phillips 66 Co. | Philube L Multi-purpose grease L-2 | Philube EP grease: EP-2 |
| Shell Oil Co. | Alvania grease 2 | Alvania grease EP 2 |
| | | Alvania grease EP LF 2 |
| Texaco Lubricants Co. | Premium RB grease | Multifak EP 2 |
| Unocal 76 | | Unoba EP grease: Grade 2 |
| | | Multiplex EP: Grade 2 |

## MOTOR

*TABLE 9: MOTOR BEARING GREASE ADDITION*

| Motor Frame Size | RELIANCE | | SIEMENS | | BALDOR | |
|---|---|---|---|---|---|---|
| | $in^3$ | $cm^3$ | $in^3$ | $cm^3$ | $in^3$ | $cm^3$ |
| 140T | sealed for life | | 0.4 | 6.6 | 0.6 | 9.8 |
| 180T | 0.5 | 8.2 | 0.6 | 9.8 | 0.6 | 9.8 |
| 210T | 0.5 | 8.2 | 3.1 | 50.8 | 0.6 | 9.8 |
| 250T | 1.0 | 16.4 | 4.4 | 72.1 | 1.2 | 19.7 |
| 280T | 1.0 | 16.4 | 5.0 | 82.0 | 1.2 | 19.7 |
| 320T | 1.5 | 24.6 | 10.6 | 173.7 | 1.5 | 24.6 |
| 360T | 1.5 | 24.6 | 14.4 | 236.0 | 1.5 | 24.6 |
| 400T | 2.5 | 41.0 | 14.4 | 236.0 | 4.1 | 67.2 |
| 440T | 2.5 | 41.0 | 14.4 | 236.0 | 4.1 | 67.2 |
| Other | (consult motor manufacturer's data) | | | | | |

## GEAR DRIVE

In HT gear drives, all gearing and all bearings except **[241]**, **[255]** (and **[322]** on case sizes 11, 12 and 13) *(Figures 26-30, pages 56-60)* are normally splash lubricated. Bearings **[241]** and **[322]** may be oil lubricated if the gear drive is supplied with an external motor-driven oil pump. *CAUTION! The gear drive has been drained of oil for shipping.*

Always use new oil to avoid damage to the gearing or bearings. When checking oil level the agitator must be shut off.

For all case sizes, except case size 10, remove the shipping plug from the top of the gear drive. Add oil until the level is at the center of sight glass **[285]** located on change gear cover **[276]**. Install breather **[280]** in place of the shipping plug. If the gear drive is supplied with an optional oil level dipstick **[298]** *(Figure 25)*, it can be used to check oil level by removing the dipstick and resting it on top of the gear drive (do not engage threads) so it hangs vertically. Oil level should be at the full mark.

For case size 10, remove shipping plug and install breather-dipstick **[280]**. Remove oil fill plug **[281]** and add oil until the level is at the center of sight glass **[285]** located on change gear cover **[276]**. Replace oil fill plug. When checking oil level with the breather-dipstick, rest the dipstick on top of hex bushing **[282]** (do not engage threads) so it hangs vertically. Oil level should be at the full mark.

Case sizes 11, 12 and 13 require the following additional lubrication step. Remove oil fill plug **[281]** and add one (1) quart of oil. Replace oil fill plug.

*Caution! Do not over or under fill the gear drive. Do not operate before filling with oil.*

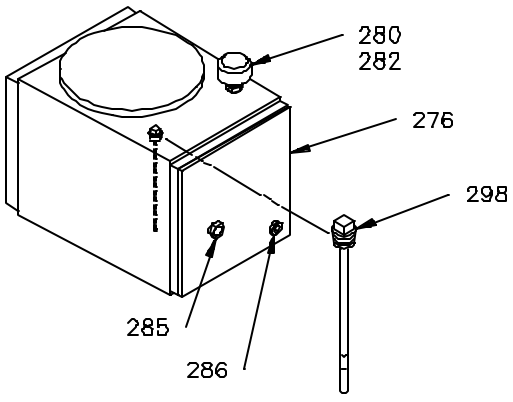



*Figure 25: Optional Oil Level Dipstick*

## GEAR DRIVE

The agitator nameplate or *Table 10, page 52*, should be used to select the proper viscosity oil based on ambient temperature conditions.

*Table 11, page 53* should be used as a guide to determine the quantity of oil required. Units equipped with an external motor-driven oil pump will require more oil.

Use a good quality straight grade, R & O petroleum base gear oil per *Table 12, page 54* for most applications. If the gear drive loading is extremely heavy or if the ambient temperature exceeds 100° F (38° C), an EP oil per *Table 13, page 55* should be used. In general an EP oil will be beneficial for all operating conditions. *Tables 12 and 13* are presented for guidance and equivalent oils from other suppliers may be used.

Drain oil by removing drain plug **[284, 286 or 287]** and refill the gear drive after the first week or 100 hours of operation, and then every six months or 2500 hours thereafter. If operated in adverse conditions such as an extremely dusty or humid environment, more frequent oil changes are advisable.

Bearings **[241]** and **[255]** on all case sizes and bearing **[322]** on case sizes 11, 12 and 13 are grease lubricated. These bearings are packed with grease prior to shipment from the factory. At 3 to 4 month intervals, bearings **[241]** and **[322]** should be regreased by pumping grease into the grease fitting **[288]** until new grease appears at the relief fitting **[289]**. Bearing **[255]** should be regreased by adding approximately twice the volume of grease to fitting **[288]** as required at bearing **[241]**. Any good quality general purpose grease consisting of a refined base oil stock and a lithium or calcium-complex based soap with an NLGI No. 2 classification will work satisfactorily. Most major oil companies offer such products usually with extreme pressure (EP) additives for additional protection. *Table 8, page 48* lists some commonly available greases.

## GEAR DRIVE

*TABLE 10: LUBE OIL SELECTION*

| **LUBE OIL SELECTION FOR CASE SIZES 1-6** | | |
|---|---|---|
| Ambient Temperature | Lube Oil Selection | |
| | ISO Viscosity Grade | AGMA Lubricant Number |
| -10º to 15º F (-24º to -10º C) | 32 to 46 | - to 1 |
| 15º to 50º F (-10º to 10º C) | 68 to 100 | 2 to 3 |
| 50º to 125º F (10º to 50º C) | 100 to 150 | 3 to 4 |
| | | |
| **LUBE OIL SELECTION FOR CASE SIZES 7-11** | | |
| Ambient Temperature | Lube Oil Selection | |
| | ISO Viscosity Grade | AGMA Lubricant Number |
| -10º to 15º F (-24º to -10º C) | 46 to 68 | 1 to 2 |
| 15º to 50º F (-10º to 10º C) | 100 to 150 | 3 to 4 |
| 50º to 125º F (10º to 50º C) | 150 to 220 | 4 to 5 |
| | | |
| **LUBE OIL SELECTION FOR CASE SIZES 12-13** | | |
| Ambient Temperature | Lube Oil Selection | |
| | ISO Viscosity Grade | AGMA Lubricant Number |
| -10º to 15º F (-24º to -10º C) | Consult factory for recommendations | |
| 15º to 50º F (-10º to 10º C) | 150 to 220 | 4EP to 5EP |
| 50º to 125º F (10º to 50º C) | 220 to 320 | 5EP to 6EP |

*NOTE: For low temperature operation the oil selected should have a pour point at least 9º F or 5º C below the expected ambient temperature and a viscosity which is low enough to allow the oil to flow freely at start up temperature.*

## GEAR DRIVE

*TABLE 11: APPROXIMATE OPERATING OIL CAPACITY*

| | Volume | |
|---|---|---|
| **CASE SIZE** | **GALLONS** | **LITERS** |
| 1 | 1 | 4 |
| 2 | 2 | 8 |
| 3 | 3 | 11 |
| 4 | 5 | 19 |
| 5 | 6.5 | 25 |
| 6 | 9 | 34 |
| 7 | 18 | 68 |
| 8 | 28 | 106 |
| 9 | 39 | 148 |
| 10 | 53 | 201 |
| 11 | 77 | 291 |
| 12 | 125 | 473 |
| 13 | 203 | 768 |

## GEAR DRIVE

*TABLE 12: TYPICAL R&O LUBE OILS*

| **ISO Viscosity Grade** | **32** | **46** | **68** | **100** | **150** | **220** |
|---|---|---|---|---|---|---|
| **AGMA Lubricant Number** | --- | 1 | 2 | 3 | 4 | 5 |
| **Viscosity Range (cSt) @ 104º F (40º C)** | 28.8 to 35.2 | 41.4 to 50.6 | 61.2 to 74.8 | 90 to 110 | 135 to 165 | 198 to 242 |
| **MANUFACTURER/ Product Line** | | | | | | |
| Amoco Oil Co./American Industrial Oils | 32 | 46 | 68 | 100 | 150 | 220 |
| Ashland Oil Inc. (Valvoline Oil Co.)/ Ashland ETC R&O Oils | R&O 15 | R&O 20 | R&O 30 | R&O 45 | R&O 70 | R&O 100 |
| Chevron U.S.A. Inc./ Chevron AW Machine Oils | ---- | ---- | ---- | 100 | 150 | 220 |
| CITGO Petroleum Corp./ Citgo Pacemaker Oils | 32 | 46 | 68 | 100 | 150 | 220 |
| Conoco Inc./ Dectol R&O Oil | 32 | 46 | 68 | 100 | 150 | 220 |
| Exxon Co. U.S.A./ Teresstic Oil | 32 | 46 | 68 | 100 | 150 | 220 |
| Mobil Oil Corp./ Mobil DTE Oil | Light | Medium | Heavy Medium | Heavy | Extra Heavy | BB |
| Pennzoil Products Co./ Pennzbell R&O Oils | 32 | 46 | 68 | 100 | 150 | 220 |
| Phillips 66 Co./ Magnus Oils | 150 | 215 | 315 | 465 | 700 | 1000 |
| Shell Oil Co./ Shell Turbo T Oils | 32 | 46 | 68 | 100 | 150 | 220 |
| Texaco Lubricants Co./ Regal Oil R&O | 32 | 46 | 68 | 100 | 150 | 220 |
| Unocal 76/ Unocal Turbine Oil | 32 | 46 | 68 | 100 | 150 | 220 |

## GEAR DRIVE

*TABLE 13: TYPICAL EP LUBE OILS*

| **ISO Viscosity Grade** | **68** | **100** | **150** | **220** | **320** |
|---|---|---|---|---|---|
| **AGMA Lubricant Number** | 2 EP | 3 EP | 4 EP | 5 EP | 6 EP |
| **Viscosity Range (cSt) @ 104° F (40° C)** | 61.2 to 74.8 | 90to | 135 to 165 | 198 to 242 | 288 to 352 |
| **MANUFACTURER/ Product Line** | | | | | |
| Amoco Oil Co./Permagear EP Lubricants | 68 | 100 | 150 | 220 | 320 |
| Ashland Oil Inc. (Valvoline Oil Co.)/AGMA Enclosed EP Gear Lubricants | #2 EP | #3 EP | #4 EP | #5 EP | #6 EP |
| Chevron U.S.A. Inc./ Chevron NL Gear Compounds | 68 | 100 | 150 | 220 | 320 |
| CITGO Petroleum Corp./ Citgo EP Compounds | 68 | 100 | 150 | 220 | 320 |
| Conoco Inc./Gear Oil | 68 | 100 | 150 | 220 | 320 |
| Exxon Co. U.S.A./ Spartan EP | 68 | 100 | 150 | 220 | 320 |
| Mobil Oil Corp./ Mobilgear 600 Series | 626 | 627 | 629 | 630 | 632 |
| Pennzoil Products Co./ Maxol EP Gear Oils | 68 | 100 | 150 | 220 | 320 |
| Phillips 66 Co./Philube All Purpose or Superior Multi Purpose Gear Oils | APGO 80W | --- | SMP 80W-90 | APGO 85W-90 | --- |
| Shell Oil Co./Omala Oils | 68 | --- | 150 | 220 | 320 |
| Texaco Lubricants Co./ Meropa Gear Lubricants | 68 | 100 | 150 | 220 | 320 |
| Unocal 76/Unocal Extra Duty NL Gear Lube | 2EP | 3EP | 4EP | 5EP | 6EP |

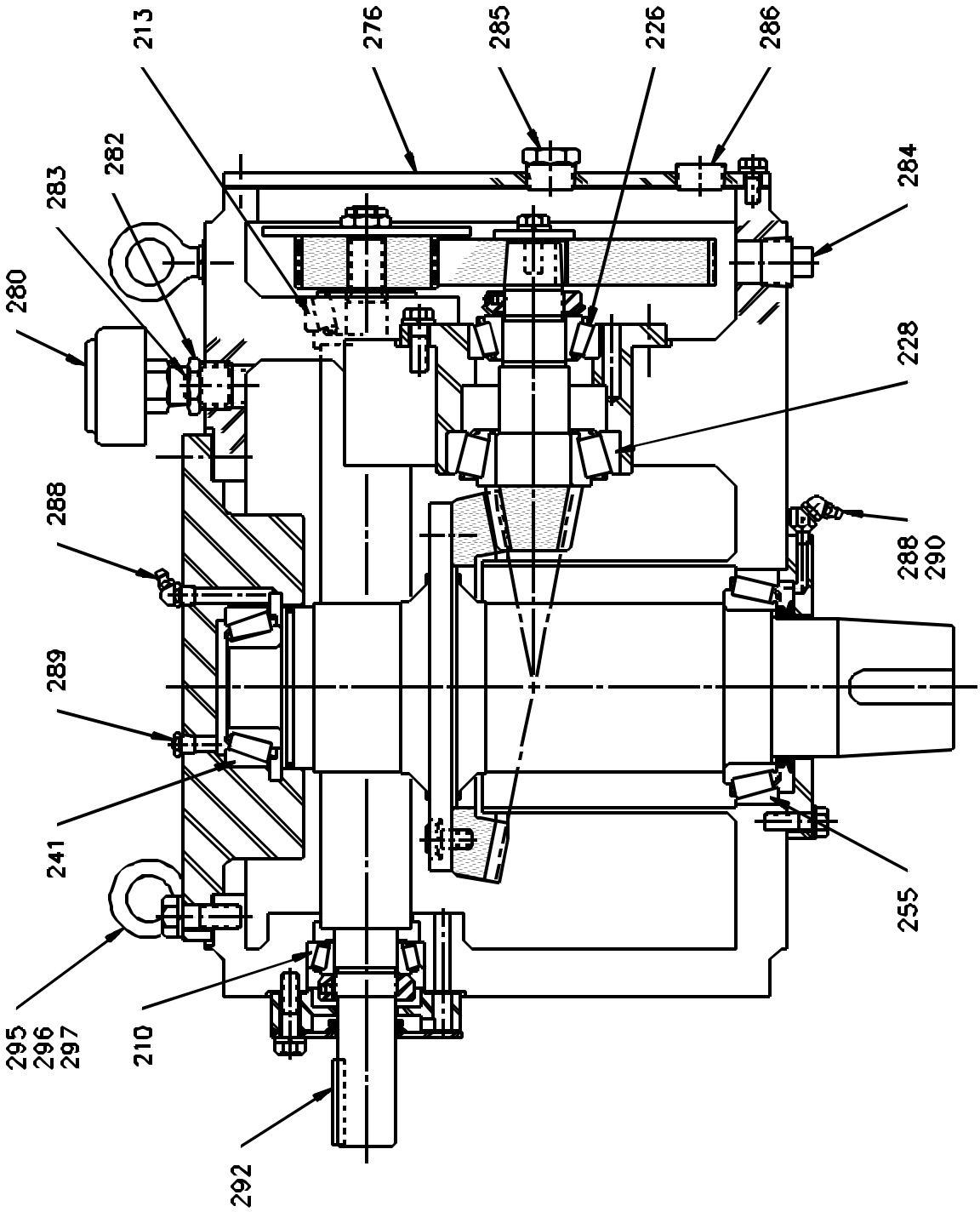



*Figure 26: Gear Drive: Sizes 1,2,3*

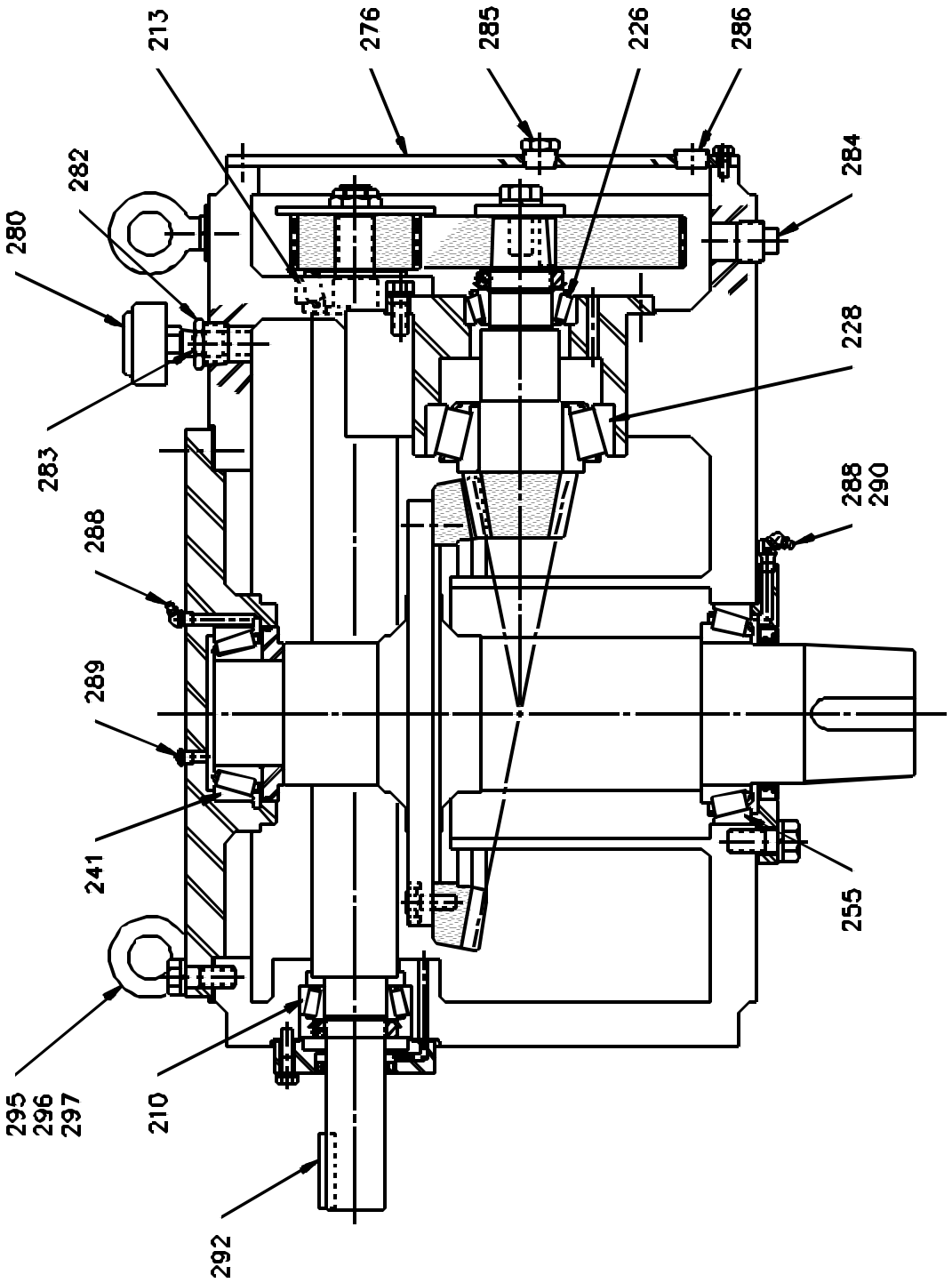



*Figure 27: Gear Drive: Sizes 4,5,6*

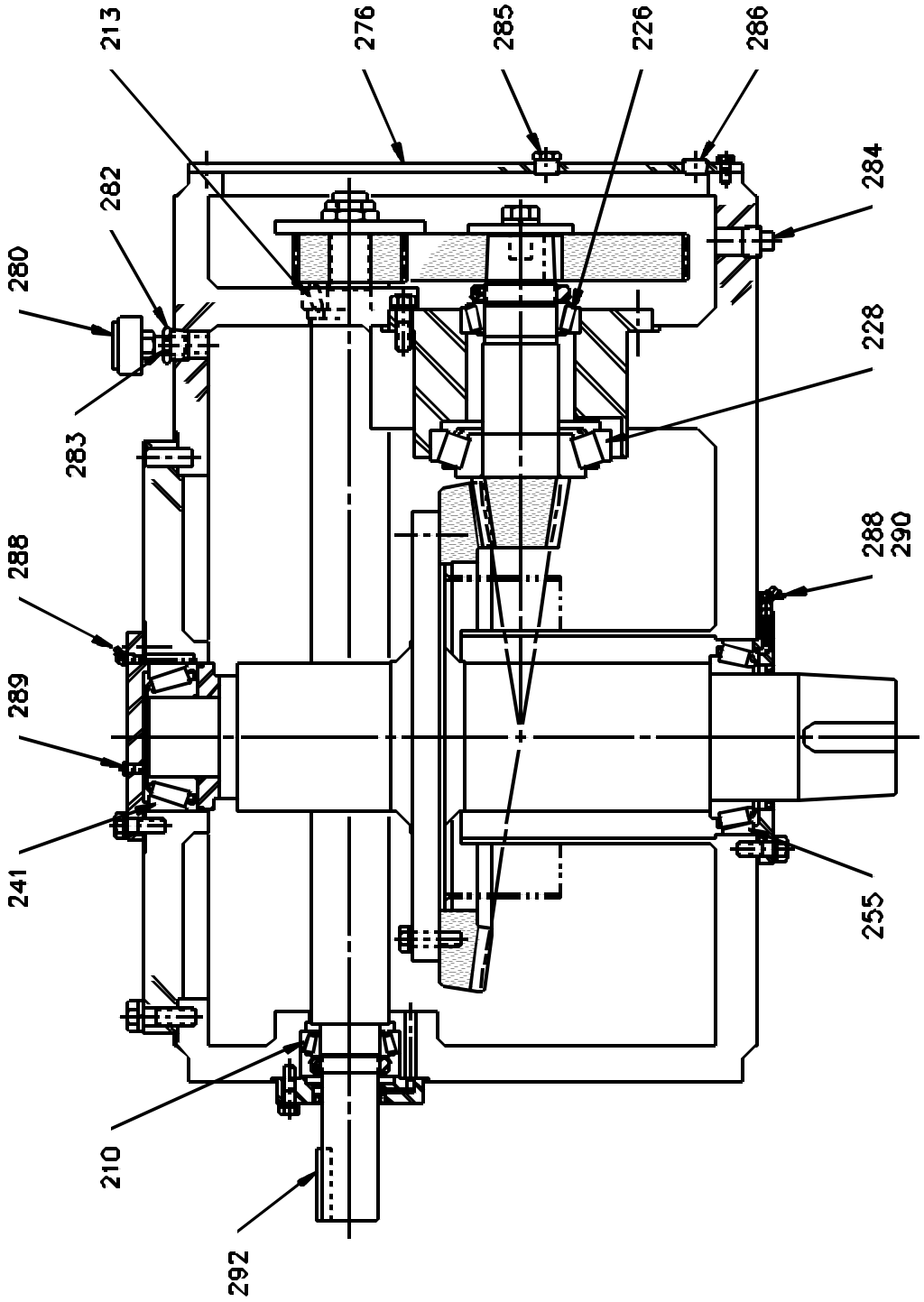



*Figure 28: Gear Drive: Sizes 7,8,9*

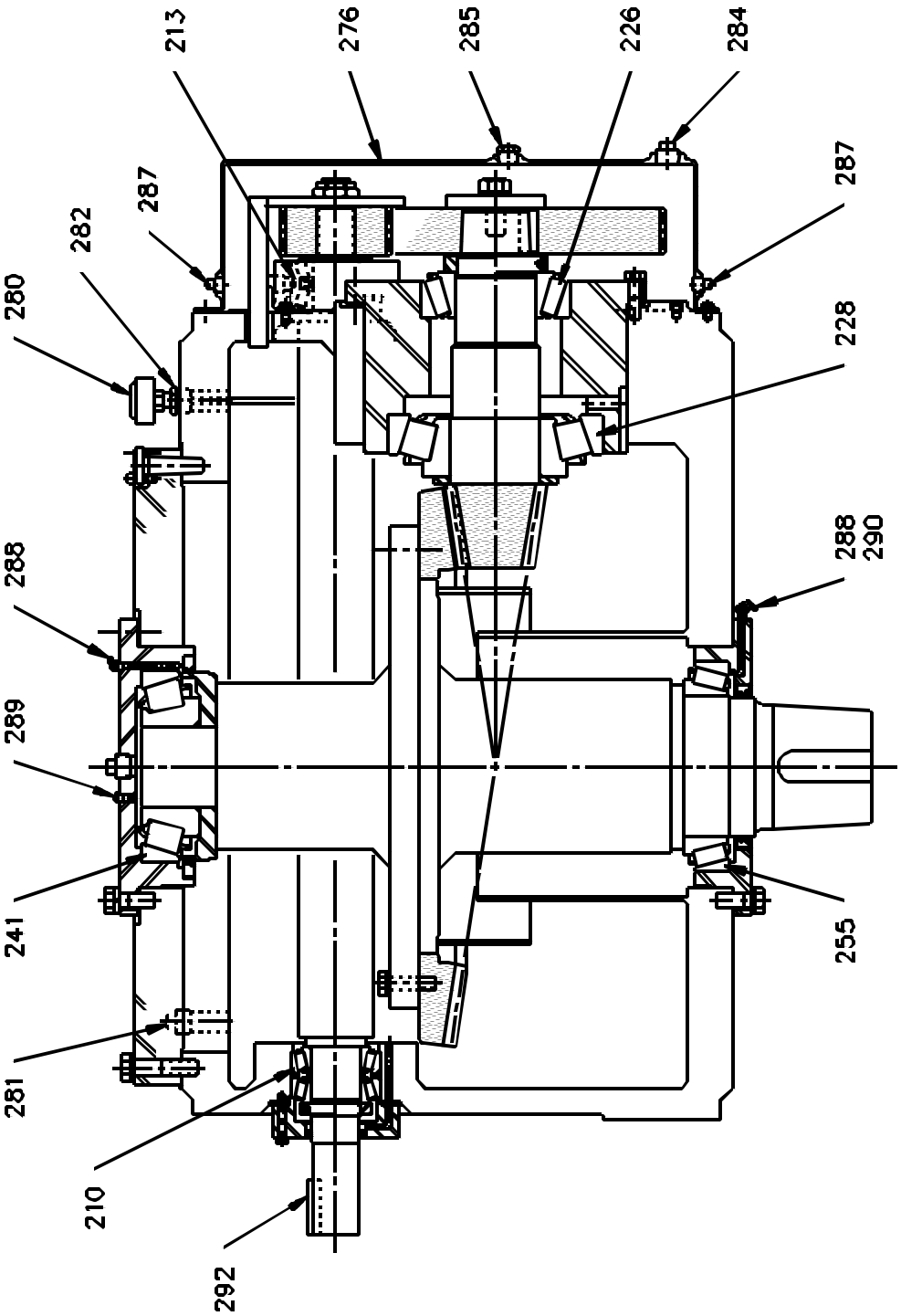



*Figure 29: Gear Drive: Size 10*

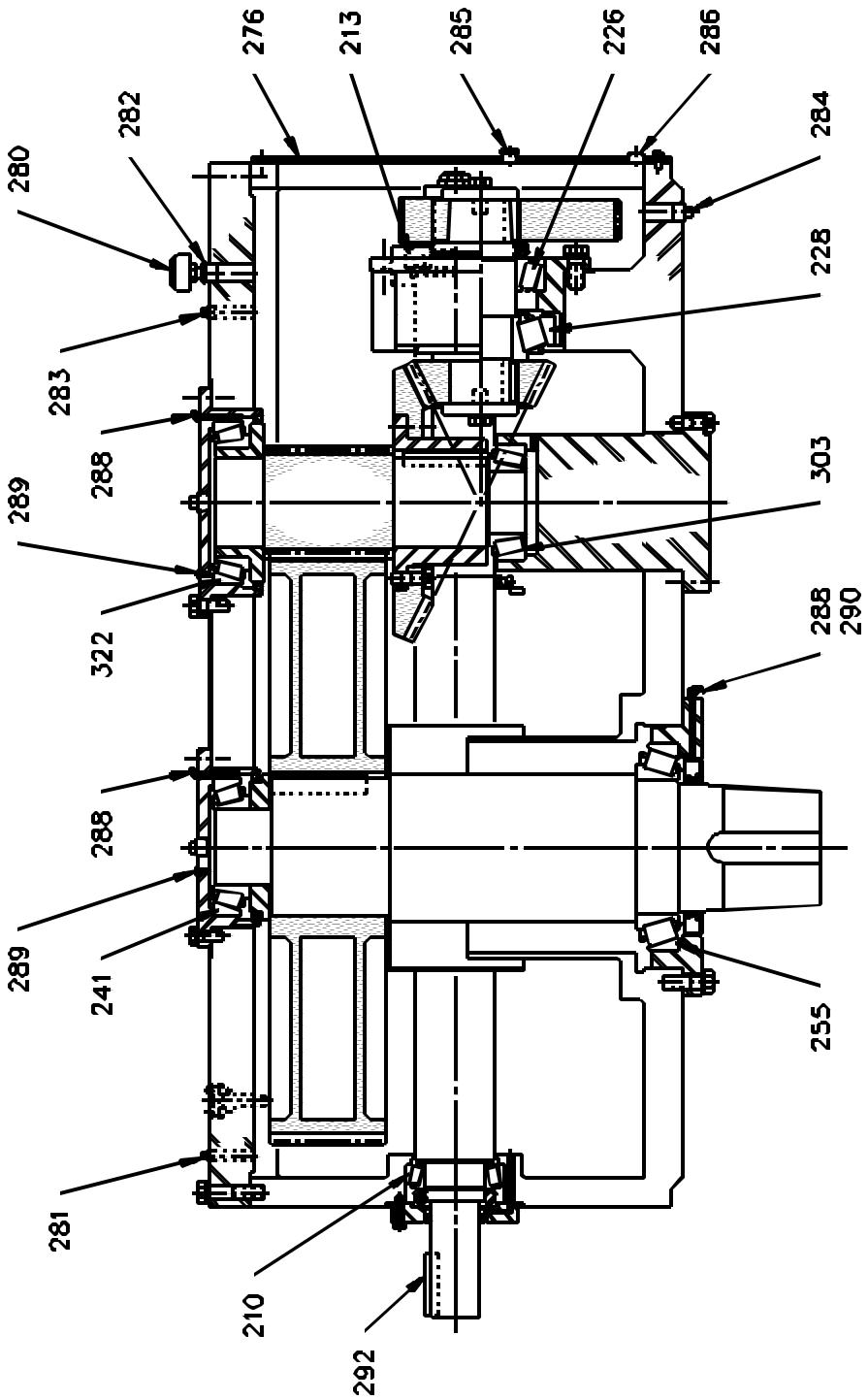



*Figure 30: Gear Drive: Sizes 11,12,13*

## SHAFT SEALS

Mechanical seals (Models HTN, HTNS) must be supplied with adequate lubricant and coolant (if required) in order to operate properly. The lubricant can be supplied a number of ways (see *OPERATION, SHAFT SEALS*). The lubricant can be any low viscosity fluid with reasonable lubricity, compatible with the process fluid, and stable over the full range of pressures and temperatures at which the mechanical seal will be operated. Common liquid lubricants (barrier fluids) include glycerine, ethylene glycol, mineral oil and water. Operating temperature limits for these lubricants are listed below. Consult the Chemineer Factory for other lubricants.

*TABLE 14: MECHANICAL SEAL LUBRICANTS*

| Lubricant | Temperature Limit | |
|---|---|---|
| | °F | °C |
| Glycerine | # 150 | # 66 |
| Ethylene Glycol | # 250 | # 121 |
| Mineral Oil | # 400 | # 204 |
| Water | # 160 | # 71 |

**Refer to unit assembly drawings for specific agitator/seal pressure and**

*NOTE: The maximum temperature limits for HTN units can be increased by 100° F or 56° C with proper use of the standard cooling jacket on the seal cartridge.*

The specific gravity of any liquid lubricant should never be less than .63 at a reference temperature 50° F or 28° C above the maximum vessel temperature. The boiling (flash) point of a lubricant should never be less than 25° F or 14° C above maximum vessel operating temperature. The standard seal cavity (Model HTN) operating pressure is 25-50 psi (172-345 kpa) above the maximum vessel operating pressure.

The HTN mechanical seal cartridge includes an integral bearing which maintains proper seal alignment. *Refer to Figures 33 and 34, pages 83 and 84*. This bearing **[1505]** is grease lubricated. Grease fitting **[1515]** and relief fitting **[1516]** are located in bearing housing **[1513]** and bearing cap **[1512]**. The bearing should be regreased at one month intervals. Remove the relief fitting and add new grease **slowly** at the grease fitting until new grease is evident at the relief fitting hole. Install the relief fitting. See *Table 8, page 48* for typical greases.

## STEADY BEARINGS

Steady bearings are lubricated and cooled by the process fluid. Do not operate the agitator unless the steady bearing is submerged.

# OPERATION

## AGITATOR

Your Chemineer HT agitator has been designed for your specific application. Proper operating procedures will allow maximum performance. The following list will aid in the safe operation of your unit.

! **Do not** operate the unit before reading and following the instructions on all tags and nameplates attached to the unit.

! **Do not** operate the unit in a fluid with a specific gravity or viscosity higher than that for which the unit was designed.

! **Do not** attempt to start a unit with the mixing impeller buried in solids or a "set up" fluid.

! **Do not** operate face type mechanical seals at temperatures or pressures higher than those for which the unit was designed. Refer to unit assembly drawing.

! **Do not** pressurize the vessel without having the mechanical seal housing fully pressurized. (Model HTN.)

! **Do not** locate large pump discharges, other agitators, down comers, coils, baffles, or other vessel internals close to the agitator impellers and extension shaft.

! **Do not** make any changes in the field (i.e. motor horsepower, agitator speed, shaft length, impeller diameter, impeller blade width, etc.) without reviewing the change with *your local Chemineer office* or Chemineer Field Service.

Should there be problems operating the unit, review the installation and the *Troubleshooting Guide, Table 15, page 66*. If you are unable to resolve the problem, contact *your local Chemineer office*.

## MOTOR

*Electric motors furnished on Chemineer HT agitators are designed to deliver their rated output when properly installed and maintained.*

Air circulation is very important to get full performance and long life from an electric motor. Do not block the suction inlets on fan cooled motors. Life of the motor will be decreased if its temperature exceeds its thermal rating. The allowable temperature is stamped on the motor nameplate.

Prior to permanently wiring the electric motor:

- **!** Check nameplate data on motor to assure that the available power supply agrees with the motor requirements. Protective devices should be the proper size and rating to safely carry the load and to interrupt the circuit on overloads.

- **!** Check motor leads with connection diagrams on motor nameplate and/or conduit box so that the proper connections are made. All motors should be installed in accordance with the National Electric Code and local requirements.

- **!** Check the gear drive output shaft rotation against the proper rotation indicated on the unit nameplate. For standard three-phase electric motors, the rotation is reversed by switching any two power leads.

- **!** Check operating motor amperage against motor nameplate amperage.

The motor should start quickly and run smoothly. If the motor should fail to start or make abnormal noise, immediately shut motor off, disconnect it from the power supply, and investigate the cause. If the problem cannot be corrected, contact *your local Chemineer office* for assistance.

## FLEXIBLE MOTOR COUPLING

Most flexible motor couplings provide years of operation with very few problems, provided they operate in a clean environment and are lubricated as required. If the motor is removed for service, the coupling alignment should be rechecked before restarting the unit. Refer to the *Vendor Data, Flexible Motor Couplings*.

## GEAR DRIVE

Gearing and most bearings are oil lubricated. Be sure the gear drive has been filled with the proper amount and type of oil before operation. Refer to the *Lubrication* section of this manual. Improper lubrication will result in damage to gearing and bearings in a very short time.

When required, the gear drive will include an optional external motor-driven oil pump *(Figure 19, page 39)*. Do not operate the unit without checking pump motor rotation. The pump motor coupling guard is marked with an arrow indicating proper rotation. The pump motor and agitator drive motor must be interconnected so the agitator drive motor cannot be energized without energizing the pump motor.

The pump system includes an oil flow alarm switch which should be hooked up before operation. The gear drive should be installed in an unobstructed area with ample air circulation. The gear drive will commonly operate at temperatures of 125° to 175° F (52° to 80° C). Do not be alarmed if the surface of the gear drive feels extremely hot to the touch. The gear drive surface temperature should not exceed 190° F (88° C). If a temperature greater than 190° F (88° C) exists anywhere on the gear drive housing, review the installation for unusually high ambient, poor air circulation, or other unusual conditions.

If gear drive cooling is required, the external motor-driven oil pump will include a water-to-oil heat exchanger and temperature actuated water regulating valve. This system will include both an oil flow alarm switch and an oil temperature alarm switch which should be hooked up before operation. Plumb water to the heat exchanger before operation. With the agitator operating at full load, adjust the temperature actuated regulating valve to obtain a temperature gauge reading of 140° to 150° F (60° to 66° C). Several valve adjustments may be required to obtain a stabilized temperature reading.

## SHAFT SEALS

Face type mechanical seals must be lubricated and cooled (if required) to operate properly. The unit may be supplied with an optional Chemineer seal lubricator or oiler *(see Figures 23 and 24, pages 45 and 46)* or the seal lubricator system may be supplied by others. Before operation, the seal cavity (Model HTN) should be vented, filled with lubricant and pressurized to 25-50 psi (172-345 kpa) above the maximum vessel operating pressure. Refer to unit assembly drawing for operating pressures.

*CAUTION! Never pressurize the vessel without first pressurizing the seal cavity (seal lubricator) on HTN style units.*

The Chemineer standard mechanical seal lubricator *(Figure 23)* should be filled with lubricant (remove pipe plug **[1708]**) which will gravity flow into and fill the seal cavity. The lubricator is self-venting while being filled. After filling, replace and tighten the pipe plug. Pressurize the lubricator using a constant pressure source such as a gas bottle to the recommended seal cavity pressure. This is a thermosiphon system for use with seals operating from low to high vessel pressures.

The Chemineer standard seal oiler *(Figure 24)* should be filled with lubricant. This is a non-pressurized seal oiler. It is a dead-ended system for use with seals operating at low vessel pressures.

Chemineer cartridge mechanical seals (Model HTN) are supplied as standard with a water cooling jacket on the mechanical seal housing. Refer to *Figure 33, page 83.*
Refer to unit assembly drawing for cooling water temperature and flow rate. If required, connect water supply and return lines and set water temperature and flow rate before operating the agitator.

*NOTE: Cooler seal operation will usually extend seal and bearing life.*

During normal operation it is common for mechanical seals to leak a few drops per minute across the seal faces. The seal lubricator or seal oiler lubricant level should be checked regularly and refilled as required.

## STEADY BEARINGS

If a steady bearing is supplied, do not operate agitator unless it is properly installed. Failure to install a required steady bearing will cause severe damage to the agitator assembly if operated. Do not operate the agitator unless the steady bearing is submerged.

# TROUBLESHOOTING

*TABLE 15: TROUBLESHOOTING*

| OBSERVATION | POSSIBLE CAUSE | ACTION |
|---|---|---|
| Noisy Operation | Worn or damaged parts | Check bearings and gears for excessive wear. Replace worn parts. Try to find cause of wear. Check for water and/or abrasives in oil, overload, incorrect rotation, excessive shock, etc. |
| | Overloading | Overloading can cause excessive separation of gear teeth and loud operation. Check process fluid (specific gravity and viscosity) vs. design conditions. Check agitator speed and impeller diameter against unit assembly drawing information. |
| | Worn or improperly installed or maintained couplings | Couplings can generate noise which seems to emanate from gear drive. Check for proper lubrication, alignment, or worn parts. |
| | Structural vibration and sound amplification | Steel mounting structures often amplify small amounts of normal noise into excessive noise. This can be corrected by adding stiffness or sound deadening material to the structure. |
| Abnormal Heating | Incorrect Oil | Review *Lubrication* section of manual. Replace with proper oil. |
| | Unusual ambient | Units installed in a hot area of a plant where air flow is restricted can overheat. Remove obstruction and if necessary force circulate air. |
| | Improper oil level | Add or remove oil. |
| | Cleanliness | Remove dirt and/or product buildup from motor/gear drive. |
| Leaking | Worn oil seals | Replace defective seals. |
| | Plugged breather | Clean or replace breather. |
| | Oil in Drywell | Remove grease fitting from lower bearing cap and drain drywell. Replace grease fitting and grease the bearing. |
| | Worn mechanical seal | Replace mechanical seal. |

# MAINTENANCE

## GEAR DRIVE

### Agitator Drive Removal

*CAUTION! Prior to removing the agitator drive, review the agitator installation to assure that all safety issues are resolved.*

1. Lock out and disconnect all power to the gear drive motor and any optional devices.

2. Disconnect any water lines to oil coolers, mechanical seal housing, etc.

3. Depressurize vessel and then mechanical seal housing.

4. Remove hand hole covers **[1108]**.

5. Loosen setscrews **[1509 and 1510]** one turn. (Model HTN only.) *(Figure 5, page 15)*

6. Lower drive shaft **[403]** by evenly loosening bolts **[361]**. *(Figures 5 and 6, pages 15 and 16)*. The drive shaft should drop approximately 1/2" (12 mm) allowing shaft collar **[1530 or 1410]** to seat on mounting flange **[1251]**. If the shaft does not drop, tapped holes are provided in spacer spool **[367]** upper flange (HTN) or in taper bore coupling half **[363]** flange (HTNS) for inserting bolts to jack the shaft down.

   *CAUTION! Do not jack the drive shaft down more than shown on the unit seal assembly drawing.*

7. Remove bolts and lockwashers **[361 and 362]**.

8. Attach lifting system to the agitator drive *(Figure 4, page 14)*. Unbolt gear drive **[200]** from pedestal **[1101]**.

9. Remove the agitator drive to a suitable service area.

# GEAR DRIVE

## Preparation for Gear Drive Disassembly

1. Clean external surfaces and drain the oil.

2. Remove coupling guard **[120]**. See *Figure 3, page 12*.

3. Remove the setscrews securing flexible motor coupling hub **[110]** to the gear drive input shaft. This hub must be free to slide off the input shaft as the motor and motor bracket assembly are removed from the gear drive.

   *NOTE: Larger units may be furnished with shrink fit flexible motor coupling hubs. Remove the motor from the motor bracket and remove the hub with a puller.*

4. Remove bolts **[133]** securing motor bracket **[131]** to gear drive **[200]**. Remove the motor and motor bracket as an assembly.

5. Loosen bolts, **[354]** *(Figures 5 and 6; pages 15 and 16)*. Disengage the taper by tapping with a mallet or by using a puller.

   *CAUTION! Release of taper fit can cause the gear drive coupling half to jump off the shaft if not retained.*

6. Remove bolts, lockwashers, coupling washer and coupling half **[354, 355, 353, 351]**.

7. Refer to the *HT Gear Drive Maintenance Manual* for gear drive disassembly and assembly instructions and parts listings.

# MECHANICAL SEALS

Face type mechanical seals will require periodic replacement of wearing parts. When the mechanical seal is disassembled, all lip seals, o-rings and packing rings should be replaced. Order replacement parts from Chemineer or obtain full manufacturer's data from Chemineer before ordering.

## Model HTNS, Mechanical Seal Replacement

Non-cartridge mechanical seals allow for replacement of the mechanical seal without removing the agitator drive from the vessel.

*CAUTION! Lock out and disconnect all power to the gear drive motor and any optional devices, and depressurize the vessel before servicing this equipment.*

1. **Removal of HTNS mechanical seal [1400]**. *(Figures 6, 24, and 31, pages 16, 46 and 73.)*

1a. Remove pedestal handhole covers **[1108]**. Disconnect optional mechanical seal oiler plumbing.

1b. Lower drive shaft **[403]** by evenly loosening bolts **[361]**. The drive shaft should drop approximately 1/2" (12 mm) allowing shaft collar **[1410]** to seat on mounting flange **[1251]**. If the shaft does not drop, tapped holes are provided in the taper bore coupling half flange for inserting bolts to jack the shaft down.

*CAUTION! Do not jack the drive shaft down more than shown on the unit seal assembly drawing.*

1c. Remove bolts and lockwashers **[361, 362]**.

1d. Remove coupling spacer **[371]**.

1e. Loosen shaft bolts **[365]**. Disengage the taper by tapping with a mallet or by using a puller.

*CAUTION! Release of taper fit can cause the coupling half to jump off the shaft if not retained.*

1f. Remove bolts, lockwashers, coupling washer and coupling half **[365, 366, 364, 363]**.

1g. Remove bolts and lockwashers **[1412, 1413]**.

## MECHANICAL SEALS

**Mechanical Seal Replacement** (Cont'd)

1h. Remove gland plate, o-ring, seal housing and gasket **[1403, 1402, 1404, 1405]**.

1i. Remove the setscrews from seal head **[1409]**.

1j. Slide the seal head off the drive shaft.

1k. Press seal seat **[1406]** out of the seal housing. Slots have been provided in the housing to facilitate removal of the seat.

1l. Press lip seal **[1401]** out of the gland plate.

2. Prior to installation of a new or rebuilt mechanical seal assembly, inspect the drive shaft, taper bore coupling half and coupling spacer for fit and finish. All mating surfaces must be clean and free from burrs and nicks.

2a. The taper bore coupling half should be checked for fit with the drive shaft. Place the taper bore coupling half on the tapered shaft end. Seat the coupling half on the shaft with coupling weight only. Do not use the shaft bolts and the coupling washer. The coupling half should slide down tight and not exhibit any tendency to rock. If it rocks on the shaft, the coupling and/or shaft will have to be machined for a more precise fit. Contact Chemineer Field Service for instructions.

*CAUTION! Do not apply lubricant or anti-seize compound to shaft or coupling taper. Shaft and coupling taper must be clean and dry prior to assembly.*

2b. Inspect the mechanical seal head mounting area of the drive shaft for wear and/or damage. Clean the drive shaft and polish out any scratches. Coat this area of the drive shaft with a lubricant which is compatible with the process and seal elastomers.

2c. Clean and inspect the seal housing mounting bore on the mounting flange.

2d. Clean and inspect the seal housing.

3. **Installation of HTNS mechanical seal [1400]** *(Figures 6 and 31, pages 16 and 73)*

3a. Install new gasket **[1405]**.

# MECHANICAL SEALS

**Mechanical Seal Replacement** (Cont'd)

3b. Install a new or rebuilt seal head **[1409]** on the drive shaft. Slide the seal head down against shaft collar **[1410]**. Tighten the seal head setscrews and torque to the value shown in *Table 5, page 13*.

3c. Install a new or relapped seal seat **[1406]** with new seat packing **[1407]** in the seal housing.

3d. Carefully install the seal housing/seal seat assembly over the drive shaft. Guide the assembly down the drive shaft until the seal housing rests on the gasket.

3e. Install new lip seal **[1401]** in gland plate **[1403]** with the seal lip towards the seal seat. Coat the seal lip with silicone grease. Install new o-ring **[1402]**. Retain the o-ring in the groove with silicone grease. Install the gland plate over the drive shaft and seat on top of the seal housing.

3f. Install bolts and lockwashers **[1412, 1413]**. Alternately tighten, then torque bolts to the value shown in *Table 5, page 13*.

3g. Install taper bore coupling half **[363]**. Refer to *INSTALLATION, RIGID SHAFT COUPLINGS.*

3h. Install coupling spacer **[371]**. Align the match marks on the outside diameter of the coupling spacer to the match marks on taper bore coupling half **[363]** and gear drive coupling half **[351]**.

3i. Install (2) bolts and lockwashers **[361, 362]** at 180° into the taper bore coupling assembly. Alternately tighten these bolts, lifting the drive shaft and pulling the coupling faces and coupling spacer together.

*NOTE: Pull the faces together evenly to avoid damage to the coupling tenons.*

Install the remaining bolts and lockwashers. Torque to the value shown in *Table 5*.

# MECHANICAL SEALS

**Mechanical Seal Replacement** (Cont'd)

3j. Rotate the drive shaft two revolutions before measuring runout. Measure the drive shaft runout by placing the point of a dial indicator on the drive shaft between the mechanical seal assembly and the taper bore coupling half. Do not mount the indicator base on the seal assembly. Rotate the drive shaft by turning the flexible motor coupling **[110]** *(Figure 3, page 12)*.

The maximum F.I.M. (Full Indicator Movement) is .005" (.13 mm). Measurements greater than .005" (.13 mm) would indicate a problem such as mismatched coupling/coupling spacer, improperly mounted taper bore coupling half or a bent drive shaft.

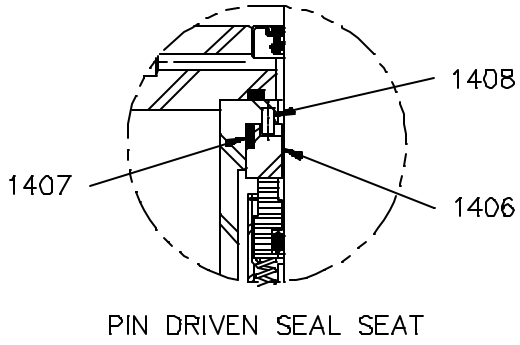
The drive shaft coupling half, coupling spacer and gear drive coupling half are match marked at the factory. The match marking is located on the outside diameter of these components. If the match marks are aligned and the measured runout is slightly over the maximum, some runout correction can be made by rotating these components with respect to each other.

Measure the drive shaft runout after each change in orientation. If the runout cannot be reduced to .005" (.13 mm) maximum, disassembly of the drive shaft, coupling spacer and drive shaft coupling half will be required to determine the cause. Corrective measures ranging from recleaning to machining one or more components may be required. Call Chemineer Field Service for assistance.

3k. With the drive shaft runout within limits, torque bolts **[1412]** in sequential order *(see Figure 32, page 78)* to 25% of the value shown in *Table 5, page 13*. Repeat this tightening sequence in several steps until the bolts are torqued to the value shown in *Table 5*. Check drive shaft runout to be sure it is still within tolerance.

3l. Connect seal fluid line and fill the seal oiler with seal fluid. Refer to *LUBRICATION and OPERATION*.

3m. Install pedestal handhole covers **[1108]**.




PIN DRIVEN SEAL SEAT

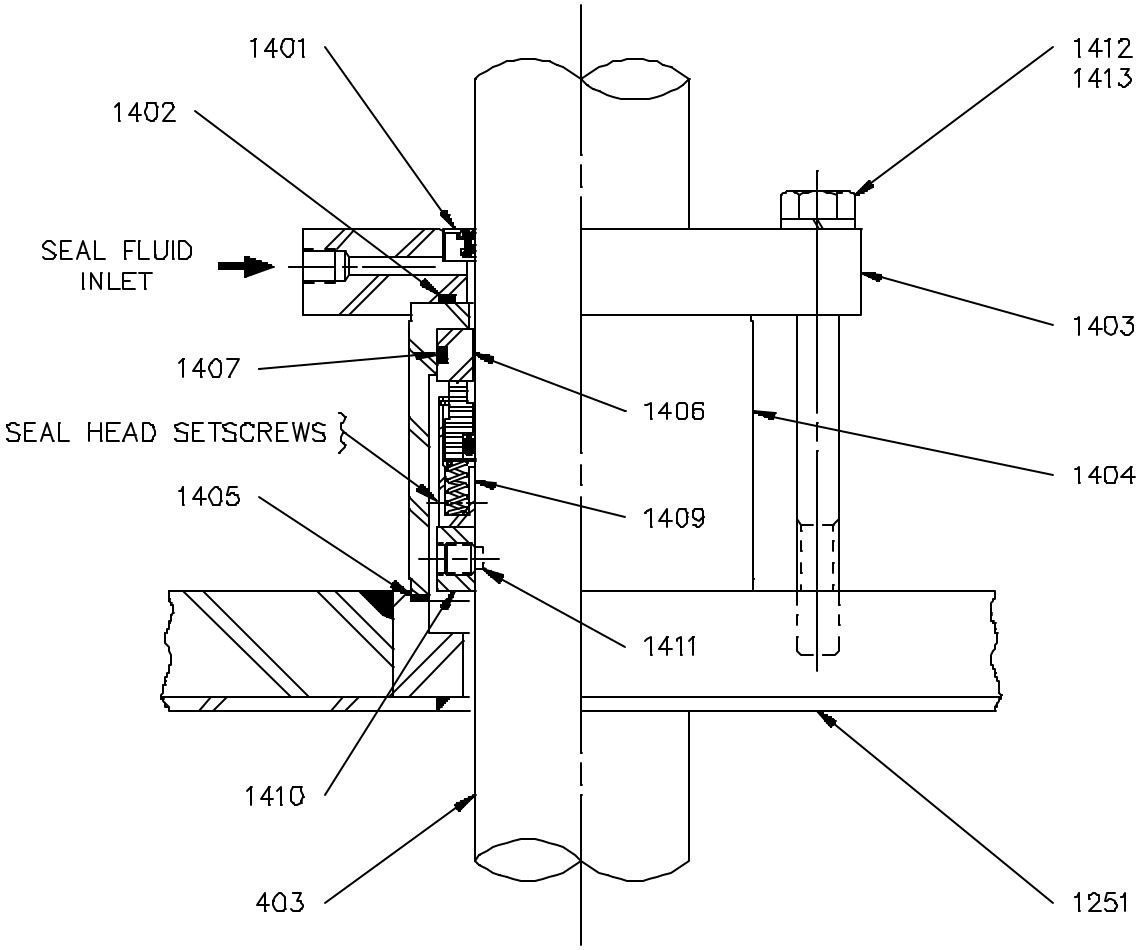



*Figure 31: HTNS Mechanical Seal*

# MECHANICAL SEALS

## Model HTN, Mechanical Seal Cartridge Replacement

Chemineer mechanical seal cartridges are easily replaced by removing the old cartridge and replacing with a new or rebuilt cartridge.

*CAUTION! Lock out and disconnect all power to the gear drive motor and any optional devices and depressurize the vessel, mechanical seal housing and mechanical seal housing jacket before servicing this equipment. Cap lines and housing ports as they are disconnected to prevent contamination.*

1. **Removal of HTN mechanical seal cartridge [1500]** *(Figures 5, 23, 33 and 34, pages 15, 45, 83, and 84)*

   1a. Remove pedestal handhole covers **[1108]**. Disconnect optional mechanical seal lubricator and housing jacket plumbing.

   1b. Loosen setscrews **[1509 and 1510]** one turn.

   1c. Lower drive shaft **[403]** by evenly loosening bolts **[361]**. The drive shaft should drop approximately 1/2" (12 mm) allowing shaft collar **[1530]** to seat on mounting flange **[1251]**. If the shaft does not drop, tapped holes are provided in spacer spool **[367]** upper flange for inserting bolts to jack the shaft down.

   *CAUTION! Do not jack the drive shaft down more than shown on the unit seal assembly drawing.*

   1d. Remove bolts and lockwashers **[361, 362]**.

   1e. Remove bolts, nuts and lockwashers **[368, 370, 369]**. Remove the spacer spool.

   1f. Bend down the tabs on locking clip **[359]** (1 bolt design only). Loosen shaft bolt **[360].** Disengage the taper by tapping with a mallet or by using a puller.

   *CAUTION! Release of taper fit can cause the coupling half to jump off the shaft if not retained.*

   1g. Remove shaft bolt, locking clip, coupling washer and coupling half **[360, 359, 358, 363]**.

   1h. Remove key **[1508]**.

# MECHANICAL SEALS

**Mechanical Seal Cartridge Replacement** (Cont'd)

1i. Remove bolts and lockwashers **[1533, 1534]**.

*NOTE: Do not remove cartridge bolts and lockwashers* **[1517, 1518]**.

1j. Slide the mechanical seal cartridge up the drive shaft. Remove the mechanical seal cartridge to a suitable service area.

*NOTE: The drive shaft is relieved under the seal sleeve such that once the shaft has dropped approximately 1/2" (12 mm) there is a minimum of .010" (.25 mm) clearance between the shaft and sleeve. There should be minimal resistance when raising the cartridge up the shaft.*

1k. See *MAINTENANCE, MECHANICAL SEAL CARTRIDGE* for cartridge disassembly, assembly instructions.

2. Prior to installation of a new or rebuilt mechanical seal cartridge, inspect the drive shaft, taper bore coupling half and spacer spool for fit and finish. All mating surfaces must be clean and free from burrs and nicks.

2a. The taper bore coupling half should be checked for fit with the drive shaft. Place the taper bore coupling half on the tapered shaft end. Seat the coupling half on the shaft with coupling weight only. Do not use the shaft bolts and the coupling washer. The coupling half should slide down tight and not exhibit any tendency to rock. If it rocks on the shaft, the coupling and/or shaft will have to be machined for a more precise fit. Contact Chemineer Field Service for instructions.

*CAUTION! Do not apply lubricant or anti-seize compound to shaft or coupling taper. Shaft and coupling taper must be clean and dry prior to assembly.*

2b. Inspect the seal cartridge mounting area of the drive shaft for wear and/or damage. Clean the drive shaft and polish out any scratches. Coat this area of the drive shaft with a lubricant which is compatible with the process and seal elastomers.

2c. Clean and inspect the mechanical seal cartridge mounting boss on the mounting flange.

# MECHANICAL SEALS

**Mechanical Seal Cartridge Replacement** (Cont'd)

3. **Installation of HTN mechanical seal cartridge [1500]** *(Figures 5, 33 and 34, pages 15, 83 and 84)*.

3a. Install new o-ring **[1532]**.

3b. Carefully lift the new or rebuilt mechanical seal cartridge over the drive shaft. Line up the key slot in the seal sleeve with the keyway in the drive shaft and lower the cartridge onto the drive shaft. Guide the seal cartridge down the drive shaft until the cartridge rests on the mounting boss on the mounting flange.

3c. Install key **[1508]**.

3d. Install bolts and lockwashers **[1533, 1534]**. Install the bolts finger tight. Do not tighten setscrews **[1509 and 1510]**.

3e. Install taper bore coupling half **[363]**. Refer to *INSTALLATION, RIGID SHAFT COUPLINGS*. A new locking clip **[359]** (1 bolt design only) should be used.

3f. Install spacer spool **[367]**. Align the match marks on the outside diameter of the spacer spool lower flange to the match marks on the taper bore coupling flange. Install bolts, nuts and lockwashers **[368, 370, 369]**. Torque to the value shown in *Table 5, page 13*.

*NOTE: Pull the faces together evenly to avoid damage to the coupling tenons.*

3g. Align the match marks on the outside diameter of the spacer spool upper flange with the match marks on gear drive coupling half **[351]**. Install (2) bolts and lockwashers **[361, 362]** at 180° into the spacer spool upper flange. Alternately tighten these bolts, lifting the drive shaft and pulling the coupling faces together.

*NOTE: Pull the faces together evenly to avoid damage to the coupling tenons.*

Install the remaining bolts and lockwashers. Torque to the value shown in *Table 5*.

# MECHANICAL SEALS

**Mechanical Seal Cartridge Replacement** (Cont'd)

3h. Rotate the drive shaft two revolutions before measuring runout. Measure the drive shaft runout by placing the point of a dial indicator on the drive shaft between the mechanical seal cartridge and the taper bore coupling half. Do not mount the indicator base on the seal cartridge. Rotate the drive shaft by turning the flexible motor coupling **[110]** *(Figure 3, page 12)*.

*NOTE: The key will interfere with the dial indicator probe. Rotate the drive shaft clockwise and lift the indicator probe to avoid the key.*

The maximum F.I.M. (Full Indicator Movement) is .005" (.13 mm). Measurements greater than .005" (.13 mm) would indicate a problem such as mismatched coupling/spacer spool flanges, improperly mounted taper bore coupling half or a bent drive shaft.

The drive shaft coupling half, spacer spool and gear drive coupling half are match marked at the factory. The match marking is located on the outside diameter of these components. If the match marks are aligned and the measured runout is slightly over the maximum, some runout correction can be made by rotating these components with respect to each other.

Measure the drive shaft runout after each change in orientation. If the runout cannot be reduced to .005" (.13 mm) maximum, disassembly of the drive shaft, spacer spool and drive shaft coupling half will be required to determine the cause. Corrective measures ranging from recleaning to machining one or more components may be required. Call Chemineer Field Service for assistance.

3i. With the drive shaft runout within limits, torque bolts **[1533]** in sequential order *(see Figure 32, page 78)* to 25% of the value shown in *Table 5, page 13*. Repeat this tightening sequence in several steps until the bolts are torqued to the value shown in *Table 5*. Check drive shaft runout to be sure it is still within tolerance.

3j. Locate the point of the dial indicator on the drive shaft opposite one of the setscrews **[1510]**. Begin to tighten this setscrew. As soon as the dial indicator starts to move, stop tightening and rotate the shaft until the next setscrew is opposite the indicator. Tighten this setscrew until the indicator starts to move. Repeat this procedure until all three setscrews are torqued to the value shown in *Table 5*. The drive shaft runout should be within ± .001" (.025 mm) of the runout measured in step 3i.

## MECHANICAL SEALS

**Mechanical Seal Cartridge Replacement** (Cont'd)

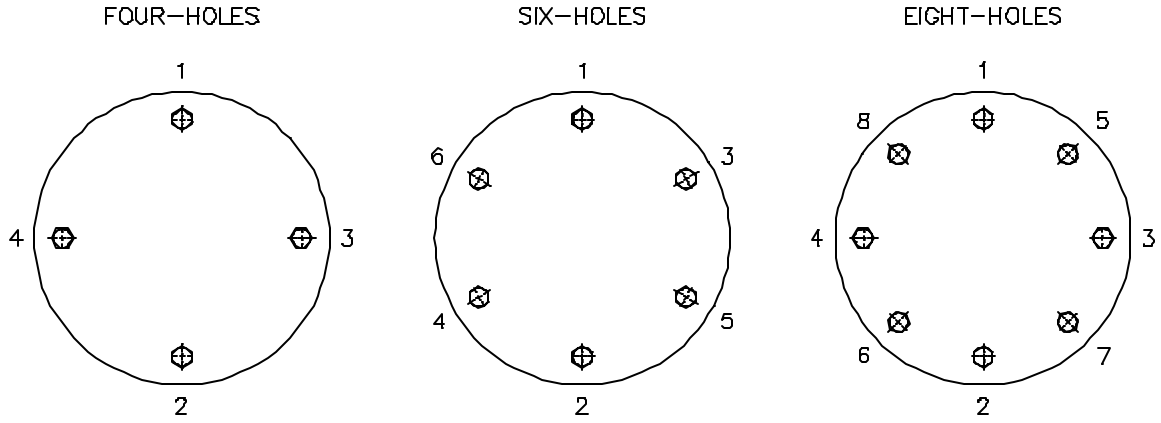



*Figure 32: Sequential Tightening*

3k. Tighten setscrew **[1509]** against key **[1508]**. Torque to the value shown in *Table 5, page 13*.

3l. Connect seal fluid lines and fill the seal lubricator and seal housing with seal fluid. Pressurize the seal lubricator. Refer to *LUBRICATION and OPERATION*.

*CAUTION! The seal housing must be pressurized to 25 to 50 psi (172 - 345 kpa) above the maximum vessel operating pressure prior to pressurizing the vessel.*

3m. Connect the seal housing jacket water lines and turn water flow on.

3n. Install pedestal handhole covers **[1108]**.

# MECHANICAL SEAL CARTRIDGE

When the mechanical seal cartridge is disassembled, the bearing, lip seals, o-rings and packing rings should be replaced. Order replacement parts from Chemineer or obtain full manufacturer's data from Chemineer before ordering.

Prepare a **clean** work area prior to disassembly/assembly of the mechanical seal cartridge. Mechanical seal cartridges for shaft sizes 6" (150 mm) and larger may require the use of an overhead hoist for handling.

**Mechanical Seal Cartridge Disassembly** *(Figures 33 and 34, pages 83 and 84)*

1. Remove setscrews **[1509 and 1510]**.

2. Loosen but do not remove cartridge bolts and lockwashers **[1517, 1518]**.

3. Turn the cartridge over. Set the cartridge down on bearing adapter **[1504]**.

4. Completely loosen the cartridge bolts. Remove lower gland **[1525]** and o-ring **[1523]**.

   *CAUTION! Upper and lower glands are dimensionally identical but may be made of different materials. Refer to unit seal assembly drawing.*

5. Remove seal housing **[1524]**.

6. Push seal sleeve **[1501]** complete with seal heads **[1522 and 1528]** out of the bearing adapter **[1504]**.

7. Remove upper gland **[1519]** and o-ring **[1523]**.

8. Remove bearing cap **[1512]**. Remove bearing **[1505]** and the bearing adapter from bearing housing **[1513]**.

9. Remove snap ring **[1507]** and bearing spacer **[1506]**. Press the bearing off of the bearing adapter.

10. Press lip seals **[1511 and 1514]** out of the bearing cap and the bearing housing.

11. Press seal seats **[1520 and 1526]** out of the upper and lower glands. Slots have been provided in the gland bores to facilitate removal of the seal seats.

12. Remove the setscrews from the mechanical seal heads. Push the mechanical seal heads off the seal sleeve. Remove o-rings **[1502 and 1503]** from seal sleeve.

## MECHANICAL SEAL CARTRIDGE

**Mechanical Seal Cartridge Disassembly** (Cont'd)

The mechanical seal cartridge is now fully disassembled. Clean and inspect all parts for wear or damage. Replace all worn or damaged parts.

Inspect all bolts and setscrews for damage after cleaning (threads, shank and head). If replacement is required, replace with the equivalent type, material and strength grade.

Clean and inspect all tapped holes. If threads are damaged, chase with an appropriate tap.

# MECHANICAL SEAL CARTRIDGE

**Mechanical Seal Cartridge Assembly** *(Figures 33 and 34, pages 83 and 84)*

1. Assemble the bearing and the bearing adapter. Thoroughly solvent clean bearing adapter **[1504]** and bearing **[1505]** bore. Apply a thin even coating of "Loctite Bearing Mount" or equal to the bearing adapter between the shoulder and snap ring groove. Slide the bearing onto the bearing adapter. Install bearing spacer **[1506]** and snap ring **[1507]**.

2. Assemble lip seals in bearing cap **[1512]** and bearing housing **[1513]**. Clean the lip seal bores and apply Permatex #2 or equal to the outside of lip seals **[1511 and 1514]**. Install the lip seals in the bearing cap and bearing housing with the seal lips toward the bearing. Before installation on the seal sleeve, coat the seal lips with bearing grease.

3. Install the bearing/bearing adapter into bearing housing **[1513]**.

4. Assemble bearing cap **[1512]** to the bearing housing. Position relief fitting **[1516]** at 180° from grease fitting **[1515]**.

   *NOTE: During mechanical seal cartridge assembly refer to agitator assembly drawing(s) for orientation of the seal fluid and seal housing jacket connections.*

5. Install cartridge bolts and lockwashers **[1517, 1518]** through the bearing cap/bearing housing. Turn this assembly over and set down on the bearing adapter.

6. Install seal seats and seat packing **[1520, 1526, and 1521, 1527]** into upper and lower glands **[1519 and 1525]**. Install o-rings **[1523]**. Retain the o-rings in the grooves with silicone grease.

7. Assemble the upper gland to the bearing housing. Refer to unit assembly drawing for orientation of all openings.

   *CAUTION! The upper gland may be carbon steel. The lower gland will be the same alloy as the wetted parts. The upper and lower glands are dimensionally identical. Refer to unit seal assembly drawing.*

   *NOTE: For balanced seals only (Figure 34), install a new or rebuilt upper seal head* **[1522]** *on seal sleeve* **[1501]**.

8. Install the seal sleeve into the bearing adapter. The key slot in the seal sleeve must be aligned with small setscrew **[1509]** hole in the bearing adapter.

9. Install and thread setscrews **[1509 and 1510]** into the clearance holes in the seal sleeve until the setscrew points are just short of projecting into the seal sleeve bore.

## MECHANICAL SEAL CARTRIDGE

**Mechanical Seal Cartridge Assembly** (Cont'd)

10. For unbalanced seals only *(Figure 33, page 83),* install a new or rebuilt upper seal head **[1522]** on seal sleeve **[1501]**. Tighten the setscrews over the original setscrew marks. If the setscrew marks are not visible, refer to the unit seal assembly drawing for the set dimension.

11. Measure and set the height of the upper seal head. Refer to the unit seal assembly drawing for the set dimension. Reset the set height if required. Torque the seal head setscrews to the value shown in *Table 5, page 13*.

12. Install a new or rebuilt lower seal head **[1528]** on the seal sleeve and set to the dimension shown on the unit seal assembly drawing. Tighten the setscrews. Torque to the value shown in *Table 5*.

13. Install o-rings **[1502 and 1503]** in the seal sleeve.

14. Install seal housing **[1524]**.

15. Install lower gland **[1525]**. Refer to unit assembly drawings for orientation of all openings. Tighten cartridge bolts and lockwashers **[1517 and 1518]**. Torque to the value shown in *Table 5*.

16. Add grease to bearing **[1505]**. Remove relief fitting **[1516]**. Fill **slowly** using grease fitting **[1515]** until grease appears at the relief fitting hole. Install the relief fitting. See *Table 8, page 48* for typical greases.

17. Install all bolts **[1533]** through the mechanical seal cartridge with flatwashers and nuts (supplied by others). Torque to 50% of the value shown in *Table 5*. Pressure test the mechanical seal cartridge before use.

    Fill the seal housing with a fluid which is compatible with the process. This is normally the seal lubricant. Pressurize the mechanical seal housing to the lowest of either a.) 50 psi (345 kpa) above the maximum vessel operating pressure, or b.) 100 psi (690 kpa). Check for leaks and correct as required.

18. If the mechanical seal cartridge is to be placed into inventory, the seal housing should be completely filled with a rust preventative/lubricant which is compatible with the sealing fluid to be used in service. Plug the seal fluid ports.

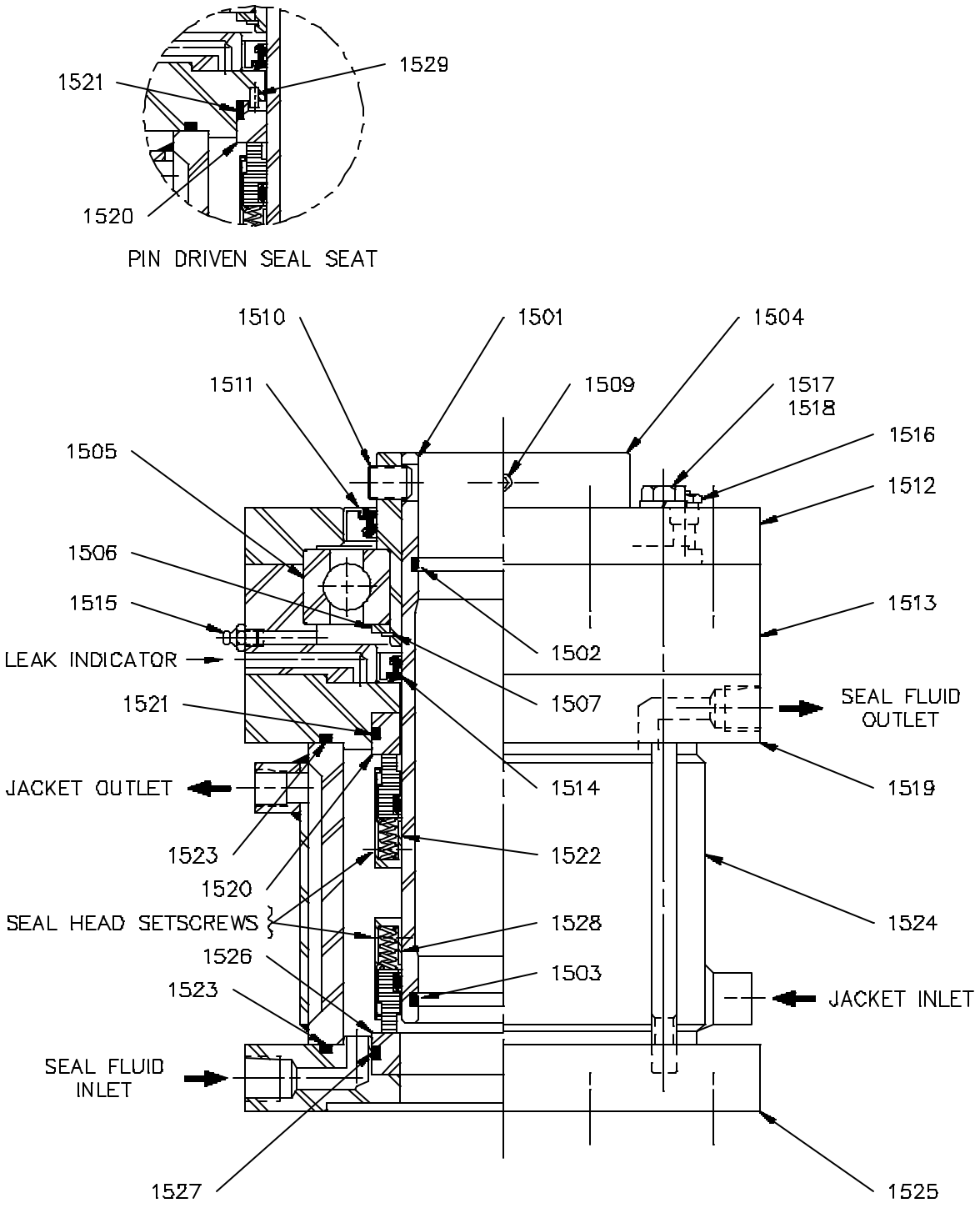



*Figure 33: HTN Mechanical Seal Cartridge (Unbalanced Seals)*

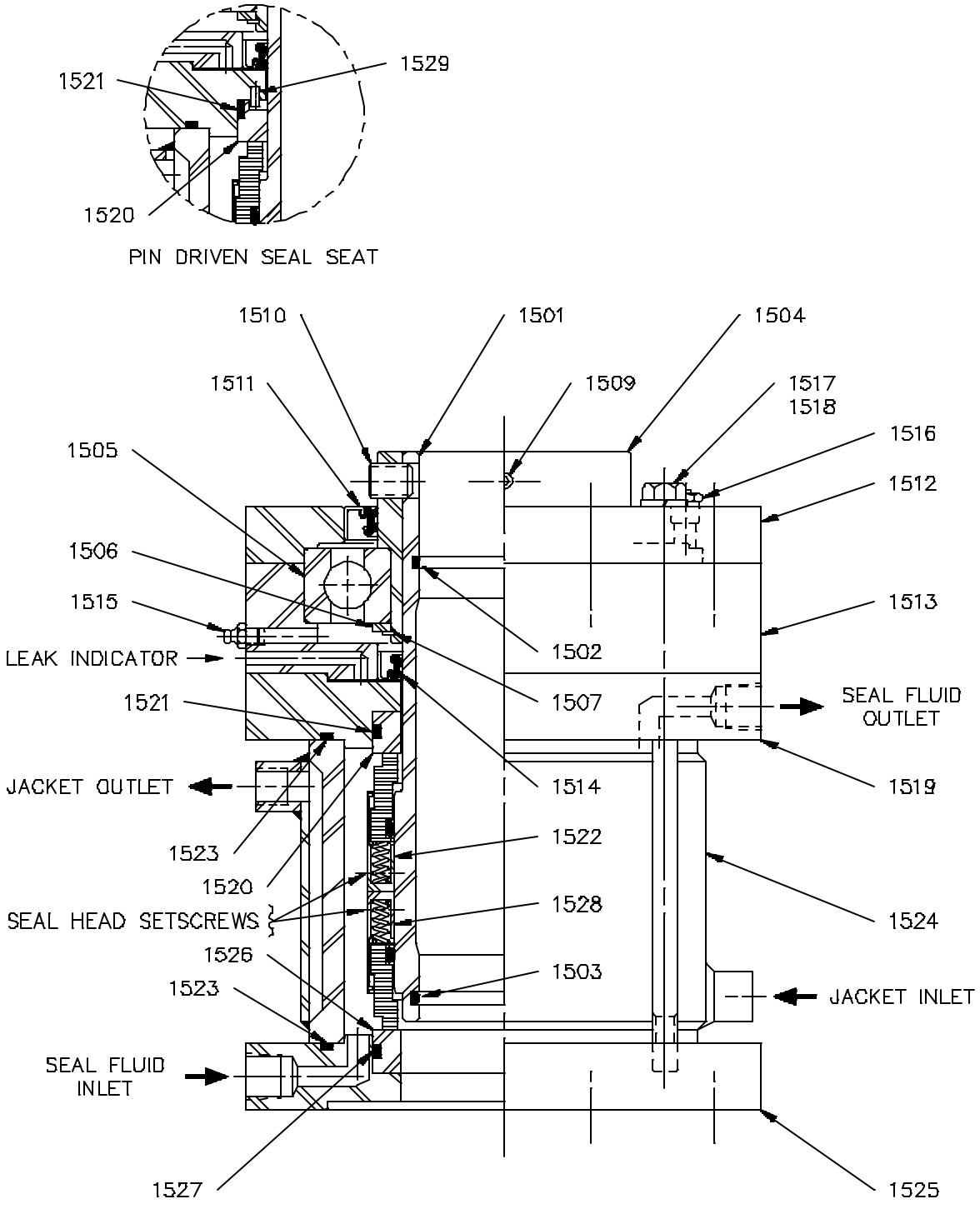



*Figure 34: HTN Mechanical Seal Cartridge (Balanced Seals)*

# DRIVE SHAFT

## Drive Shaft Removal

*CAUTION! Lock out and disconnect all power to the gear drive motor and any optional devices and depressurize the vessel, mechanical seal housing and mechanical seal housing jacket before servicing this equipment. Cap lines and housing ports as they are disconnected to prevent contamination.*

1. If a steady bearing is installed, remove the steady bearing.

2. Remove handhold covers **[1108]**.

3. Loosen setscrews **[1509 and 1510]** one turn. (HTN only.) *(Figure 5, page 15)*

4. Lower drive shaft **[403]** by evenly loosening bolts **[361]**. *(Figures 5 and 6, pages 15 and 16)*. The drive shaft should drop approximately 1/2" (12 mm) allowing shaft collar **[1530 or 1410]** to seat on mounting flange **[1251]**. If the shaft does not drop, tapped holes are provided in spacer spool **[367]** upper flange (HTN) or in taper bore coupling half **[363]** flange (HTNS) for inserting bolts to jack the shaft down.

   *CAUTION! Do not jack the drive shaft down more than shown on the unit seal assembly drawing.*

5. Remove bolts and lockwashers **[361, 362]**.

6. **Removal of HTNS mechanical seal [1400]**. *(Figures 6 and 31, pages 16 and 73)*

   6a. Remove coupling spacer **[371]**.

   6b. Loosen shaft bolts **[365]**. Disengage the taper by tapping with a mallet or by using a puller.

   *CAUTION! Release of taper fit can cause the coupling half to jump off the shaft if not retained.*

   6c. Remove bolts and lockwashers **[1412, 1413]**.

   6d. Remove gland plate, o-ring, seal housing and gasket **[1403, 1402, 1404, 1405]**.

   6e. Remove the setscrews from seal head **[1409]**.

   6f. Slide the seal head off the drive shaft.

## DRIVE SHAFT

**Drive Shaft Removal** (Cont'd)

7. Raise drive shaft **[403]** and extension shaft **[404]** enough to allow access to setscrews **[1411]** in shaft collar **[1410]**. Securely support the drive and extension shaft assembly.

8. Remove the setscrews and slide the shaft collar off the drive shaft.

9. While supporting the shaft assembly disconnect the drive shaft from the extension shaft. Remove coupling bolts and lockwashers **[405, 406]** (and nuts **[407]** if welded construction) *(Figure 15, page 31)*.

10. Lower the drive shaft into the vessel and remove through the manway.

11. **Removal of HTN mechanical seal cartridge assembly [1500]** *(Figures 5, 33, and 34, pages 15, 83 and 84)*.

    11a. Remove bolts, nuts and lockwashers **[368, 370, 369]**. Remove the spacer spool.

    11b. Bend down the tabs on locking clip **[359]** (1 bolt design only). Loosen shaft bolt **[360].** Disengage the taper by tapping with a mallet or by using a puller.

    *CAUTION! Release of taper fit can cause the coupling half to jump off the shaft if not retained.*

    11c. Remove shaft bolt, locking clip, coupling washer and coupling half **[360, 359, 358, 363]**.

    11d. Remove key **[1508]**.

    11e. Remove bolts and lockwashers **[1533, 1534]**.

    *NOTE: Do not remove cartridge bolts and lockwashers* **[1517, 1518]**.

    11f. Slide the mechanical seal cartridge up the drive shaft and remove.

12. Raise drive shaft **[403]** and extension shaft **[404]** enough to allow access to setscrews **[1531]** in shaft collar **[1530]**. Securely support the drive and extension shaft assembly.

## DRIVE SHAFT

**Drive Shaft Removal** (Cont'd)

13. Remove the setscrews and slide the shaft collar off the drive shaft.

14. While supporting the shaft assembly, disconnect the drive shaft from the extension shaft. Remove coupling bolts and lockwashers **[405, 406]** (and nuts **[407]** if welded construction) *(Figure 15, page 31)*.

15. Lower the drive shaft into the vessel and remove through the manway.

# DRIVE SHAFT

## Drive Shaft Replacement

The following procedure describes the steps required to measure and transfer the shaft collar location from the original drive shaft onto a new drive shaft. If the original drive shaft and taper bore coupling half are to be reinstalled, refer to *Drive Shaft Installation*.

*NOTE: Replace drive shaft* **[403]** *and taper bore coupling* **[363]** *half as a set. Do not mix old and new taper bore couplings and drive shafts.*

1. Replacement of the drive shaft will require spot-drilling of the new shaft to accept the shaft collar **[1410 or 1530]** setscrews **[1411]** (Model HTNS) or **[1531]** (Model HTN).

   1a. Assemble the original shaft collar onto the original drive shaft with the original half dog point setscrews engaged into the drill spots in the drive shaft.

   1b. Install original taper bore coupling half **[363]** onto the original drive shaft. Refer to *INSTALLATION, RIGID SHAFT COUPLINGS.*

   1c. Measure and record the distance from the flange face of the taper bore coupling half to the top of the shaft collar.

   1d. Remove the taper bore coupling half and shaft collar from the drive shaft.

2. Remove the half dog point setscrews from the shaft collar. Install new carbon steel cup point setscrews (supplied by others) in the shaft collar.

   *NOTE: The cup point setscrews will be used to mark the new shaft for spot drilling.*

3. Slide the shaft collar down the new drive shaft. Do not tighten the setscrews.

4. Install the new taper bore coupling half onto the new drive shaft. Refer to *INSTALLATION, RIGID SHAFT COUPLINGS*.

5. Measure from the flange face of the taper bore coupling half and locate the shaft collar at the dimension measured in step 1c.

6. Tighten the cup point setscrews to mark the new drive shaft.

7. Remove the taper bore coupling half and shaft collar from the new drive shaft.

## DRIVE SHAFT

**Drive Shaft Replacement** (Cont'd)

8. Remove the cup point setscrews from the shaft collar and discard them.

9. Spot drill the new drive shaft for the half dog point setscrews originally furnished in the shaft collar. Use a drill 1/16" (1.5 mm) larger in diameter than the thread diameter of the half dog point setscrew. Drill depth (from drill point) is to be 25% of the drill diameter.

**Drive Shaft Installation**

1. Prior to installation of a new or refurbished drive shaft **[403]**, inspect taper bore coupling half **[363]**, coupling spacer **[371]** (Model HTNS), spacer spool **[367]** (Model HTN) and the drive shaft for fit and finish. All mating surfaces must be clean and free from burrs and nicks.

   1a. The taper bore coupling half should be checked for fit with the drive shaft. Place the taper bore coupling half on the tapered shaft end. Seat the coupling half on the shaft with coupling weight only. Do not use the shaft bolts and the coupling washer. The coupling half should slide down tight and not exhibit any tendency to rock. If it rocks on the shaft, the coupling and/or shaft will have to be machined for a more precise fit. Contact Chemineer Field Service for instructions.

   1b. Inspect the mechanical seal mounting area of the drive shaft for damage. Clean and polish out any scratches.

2. Lower the drive shaft into the vessel through the manway and raise it through the agitator mounting flange. Support the drive shaft such that the drill spots for shaft collar **[1530 or 1410]** are accessible above the flange.

3. Slide the shaft collar down the drive shaft. Install half dog point setscrews **[1531 or 1411]** through the shaft collar and into the drill spots in the drive shaft. Torque to the value shown in *Table 5, page 13*.

4. Lower the drive shaft until the shaft collar rests on mounting flange **[1251]**.

5. Model HTN: Install mechanical seal cartridge **[1500]**, taper bore coupling half and spacer spool. Refer to *MAINTENANCE, Installation of HTN Mechanical Seal Cartridge*.

6. Model HTNS: Install mechanical seal assembly **[1400]**, taper bore coupling half and coupling spacer. Refer to *MAINTENANCE, Installation of HTNS Mechanical Seal*.

7. Install extension shaft **[404]**. Refer to *INSTALLATION, Agitator*.

## STEADY BEARINGS

In-tank steady bearings will require periodic inspection and replacement of bushing and wear sleeve **[606, 604]**. *(Figures 16, 17 and 18; pages 32, 34 and 36.)*

It is recommended that the steady bearing fasteners be checked for tightness and the bushing and wear sleeve for wear after the first two weeks of operation.

Unless otherwise specified the recommended diametral wear allowance is :

*TABLE 16: STEADY BEARING WEAR SLEEVE AND BUSHING WEAR ALLOWANCES*

| Shaft Diameter | Up to 3" Size (76.2 mm) | Larger than 3" (76.2 mm) |
|---|---|---|
| Wear Sleeve | .040" (1 mm) | .060" (1.5 mm) |
| Bushing | .120" ( 3 mm) | .180" (4.5 mm) |

The wear sleeve and bushing should be replaced in sets.

*CAUTION! Lock out and disconnect all power to the gear drive motor, any optional devices and depressurize vessel before servicing this equipment.*

1. Loosen setscrew **[605]** and slide wear sleeve **[604]** off the shaft. Pad type steady bearings *(Figure 16)* will require removal of steady bearing housing **[609]** prior to removal of the wear sleeve.

2. Unbolt the housing from the bracket or tripod.

3. Remove bushing retaining bolt and lockwasher **[607, 608]**. Press the bushing out of the steady bearing housing.

4. Press a new bushing into the steady bearing housing. Install the bushing retaining bolt and lockwasher. *NOTE: Line up the clearance hole in the new bushing with the tapped hole in the housing prior to pressing the bushing into the housing.*

5. Reinstall the wear sleeve and housing/bushing assembly. Reinstall dowel alignment pins. Torque all fasteners to the values shown in *Table 5, page 13.*

   *CAUTION! Do not operate the agitator without the steady bearing being submerged.*

## HTN, HTNS AGITATOR ITEM LIST

| Item # | Description | Qty. |
|---|---|---|
| **100** | **motor** | **1** |
| 101 | motor key | 1 |
| **110** | **flexible motor coupling assembly** | **1** |
| **120** | **coupling guard assembly** | **1** |
| 121 | coupling guard | 1 |
| 122 | bolt | |
| 123 | flatwasher | |
| 124 | wellnut | |
| **130** | **motor bracket assembly** | **1** |
| 131 | motor bracket | 1 |
| 132 | dowel pin | 2 |
| 133 | bolt | |
| 134 | lockwasher | |
| 135 | bolt | 4 |
| 136 | large flatwasher | 4 |
| 137 | shim set | 4 |
| 138 | lockwasher | 4 |
| 139 | nut | 4 |
| **200** | **gear drive assembly** | **1** |
| 210-001 | bearing | 1 |
| -002 | bearing assembly with spacer | 1 |
| 213-001 | bearing | 1 |
| -002 | bearing assembly with spacer | 1 |
| 226 | bearing | 1 |
| 228 | bearing | 1 |
| 241 | bearing | 1 |
| 255 | bearing | 1 |
| 276 | change gear cover | 1 |
| 280-001 | breather | 1 |
| -002 | breather-dipstick | 1 |
| 281 | pipe plug, NPT | 1 |
| 282 | hex bushing | 1 |
| 283 | pipe plug, NPT | 1 |
| 284 | magnetic drain plug, NPT | 1 |
| 285 | oil level sight glass | 1 |
| 286 | pipe plug, NPT | 1 |
| 287 | pipe plug, NPT | 2 |
| 288 | grease fitting | |

## HTN, HTNS AGITATOR ITEM LIST

| Item # | Description | Qty. |
|---|---|---|
| 289 | relief fitting | |
| 290 | elbow fitting | 1 |
| 292 | input shaft key | 1 |
| 295 | lifting eye bolt | 3 |
| 296 | lockwasher | 3 |
| 297 | flatwasher | |
| 298 | dipstick (optional) | 1 |
| 303 | bearing | 1 |
| 322 | bearing | 1 |
| **350** | **low speed coupling assembly** | **1** |
| 351 | gear drive coupling half | 1 |
| 352 | key | 1 |
| 353 | coupling washer | 1 |
| 354 | shaft bolt | |
| 355 | lockwasher | |
| 357 | key | 1 |
| 358 | coupling washer | 1 |
| 359 | locking clip | 1 |
| 360 | shaft bolt | 1 |
| 361 | bolt | |
| 362 | lockwasher | |
| 363 | rigid, removable, taper bore coupling half | 1 |
| 364 | coupling washer | 1 |
| 365 | bolt | 2 |
| 366 | lockwasher | 2 |
| 367 | spacer spool | 1 |
| 368 | bolt | |
| 369 | lockwasher | |
| 370 | nut | |
| 371 | coupling spacer | 1 |
| **400** | **extension shaft assembly** | **1** |
| 402 | pin key | 1 |
| 403-001 | drive shaft (welded coupling) | 1 |
| -002 | drive shaft (removable coupling) | 1 |
| 404-001 | extension shaft (welded coupling) | 1 |
| -002 | extension shaft (removable coupling) | 1 |
| 405 | bolt | |
| 406 | lockwasher | |
| 407 | nut | |

## HTN, HTNS AGITATOR ITEM LIST

| Item # | Description | Qty. |
|---|---|---|
| 408 | rigid, removable, taper bore coupling half | 1 |
| 409 | key | 1 |
| 410 | coupling washer | 1 |
| 412 | locking clip | 1 |
| 413 | rigid, removable, taper bore coupling half | 1 |
| 414 | key | 1 |
| 415 | coupling washer | 1 |
| 416 | locking clip | 1 |
| 418 | shaft bolt | 1 |
| 419 | shaft bolt | 1 |
| 420 | key | 1 |
| 421 | coupling washer | 1 |
| 422 | bolt | 2 |
| 423 | lockwasher | 2 |
| 424 | coupling washer | 1 |
| 425 | bolt | 2 |
| 426 | lockwasher | 2 |
| **500** | **impeller assembly** | |
| 501 | impeller assembly P-4 | |
| 502 | impeller assembly S-4 | |
| 503 | impeller assembly HE-3 | |
| 504 | hub | |
| 505 | setscrew, square head | |
| 506 | extension blade | |
| 507 | bolt | |
| 508 | lockwasher | |
| 509 | nut | |
| 510 | stabilizer fin | |
| 511 | bolt | |
| 512 | lockwasher | |
| 513 | nut | |
| 514 | impeller assembly D-6, CD-6, BT-6 | |
| 515 | split disc | |
| 516 | bolt | |
| 517 | lockwasher | |
| 518 | bolt | |
| 519 | flatwasher | |
| 520 | locking clip | |

## HTN, HTNS AGITATOR ITEM LIST

| Item # | Description | Qty. |
|---|---|---|
| 521 | nut | |
| 522 | gasket | 2 |
| 523 | snap ring | 1 |
| 524 | thrust plate | 1 |
| 525 | gasket | 1 |
| 526 | mounting bolt | 1 |
| 527 | impeller assembly SC-3 | |
| 528 | impeller assembly Maxflo W | |
| 529 | bolt | |
| 530 | lockwasher | |
| 531 | nut | |
| **600** | **steady bearing assembly** | **1** |
| 601 | bracket steady bearing | 1 |
| 602 | pad steady bearing | 1 |
| 603 | tri-pod steady bearing | 1 |
| 604 | wear sleeve | 1 |
| 605 | setscrew, square head | 2 |
| 606-001 | bushing | 1 |
| -002 | bushing | 1 |
| 607 | bushing retaining bolt | 1 |
| 608 | lockwasher | 1 |
| 609 | steady bearing housing | 1 |
| 610 | pipe plug, NPT | 1 |
| 611 | bolt | |
| 612 | lockwasher | |
| 613 | mounting plate | 1 |
| 614 | support leg | 3 |
| 615 | nut | 12 |
| 616 | dowel pin | 2 |
| **1100** | **pedestal assembly** | **1** |
| 1101 | pedestal | 1 |
| 1102 | shoulder bolt | 2 |
| 1103 | bolt | |
| 1104 | lockwasher | |
| 1105 | bolt | |
| 1106 | lockwasher | |
| 1107 | roll pin | 2 |
| 1108 | handhole cover | 2 |
| 1109 | bolt | |
| 1110 | flatwasher | |
| 1111 | wellnut | |
| 1112 | lockwasher | |

## HTN, HTNS AGITATOR ITEM LIST

| Item # | Description | Qty. |
|---|---|---|
| **1250** | **mounting flange assembly** | **1** |
| 1251-001 | HTNS mounting flange | 1 |
| -002 | HTN mounting flange | 1 |
| **1400** | **HTNS mechanical seal assembly** | **1** |
| 1401 | lip seal | 1 |
| 1402 | o-ring | 1 |
| 1403 | gland plate | 1 |
| 1404 | seal housing | 1 |
| 1405 | gasket | 1 |
| 1406 | seal seat | 1 |
| 1407 | seat packing | 1 |
| -001 | o-ring | 1 |
| -002 | teflon ring | 1 |
| 1408 | seat pin | 1 |
| 1409 | seal head | 1 |
| 1410 | shaft collar | 1 |
| 1411 | setscrew, half dog point | |
| 1412 | bolt | 4 |
| 1413 | lockwasher | 4 |
| **1500** | **HTN mechanical seal cartridge assembly** | **1** |
| 1501-001 | seal sleeve (unbalanced) | 1 |
| -002 | seal sleeve (balanced) | 1 |
| 1502 | o-ring | 1 |
| 1503 | o-ring | 1 |
| 1504 | bearing adapter | 1 |
| 1505 | bearing | 1 |
| 1506 | bearing spacer | 1 |
| 1507 | snap ring | 1 |
| 1508 | key | 1 |
| 1509 | setscrew, knurled cup point | 1 |
| 1510 | setscrew, cup point with nylok | 3 |
| 1511 | lip seal | 1 |
| 1512 | bearing cap | 1 |
| 1513 | bearing housing | 1 |
| 1514 | lip seal | 1 |
| 1515 | grease fitting | 1 |
| 1516 | relief fitting, NPT | 1 |

## HTN, HTNS AGITATOR ITEM LIST

| Item # | Description | Qty. |
|---|---|---|
| 1517 | cartridge bolt | 2 |
| 1518 | lockwasher | 2 |
| | | |
| 1519 | upper gland | 1 |
| 1520 | seal seat, upper | 1 |
| 1521 | seat packing | 1 |
| -001 | o-ring | 1 |
| -002 | teflon ring | 1 |
| 1522-001 | seal head, upper (unbalanced) | 1 |
| -002 | seal head, upper (balanced) | 1 |
| | | |
| 1523 | o-ring | 2 |
| 1524 | seal housing, jacketed | 1 |
| | | |
| 1525 | lower gland | 1 |
| 1526 | seal seat, lower | 1 |
| 1527 | seat packing | 1 |
| -001 | o-ring | 1 |
| -002 | teflon ring | 1 |
| 1528-001 | seal head, lower (unbalanced) | 1 |
| -002 | seal head, lower (balanced) | 1 |
| | | |
| 1529 | seat pin | |
| | | |
| 1530 | shaft collar | 1 |
| 1531 | setscrew, half dog point | |
| 1532 | o-ring | 1 |
| 1533 | bolt | 8 |
| 1534 | lockwasher | 8 |
| | | |
| **1700** | **mechanical seal lubricator assembly** | **1** |
| 1701 | seal lubricator | 1 |
| 1702 | mounting bracket | 2 |
| 1703 | bolt | 4 |
| 1704 | lockwasher | 4 |
| 1705 | bolt | 2 |
| 1706 | lockwasher | 2 |
| 1707 | flatwasher | 2 |
| 1708 | pipe plug, NPT | 1 |
| 1709 | sight glass, NPT | 1 |
| 1710 | pipe plug, NPT | 1 |
| -001 | magnetic drain plug, NPT | 1 |

## HTN, HTNS AGITATOR ITEM LIST

| Item # | Description | Qty. |
|---|---|---|
| 1711 | tube fitting | 1 |
| 1712 | tube fitting | 3 |
| 1713 | tubing | 2 |
| 1714 | seal oiler | 1 |
| 1715 | mounting bracket | 1 |
| 1716 | bolt | 2 |
| 1717 | lockwasher | 2 |
| 1718 | bracket adapter | 1 |
| 1719 | bolt | 2 |
| 1720 | lockwasher | 2 |
| 1721 | nut | 2 |
| 1722 | tube fitting | 1 |
| 1723 | tubing | 1 |
| **1900** | **external motor-driven oil pump assembly** | **1** |
| **2000** | **tachometer assembly** | **1** |
| 2003 | digital panel meter | 1 |
| 2004 | speed sensor | 1 |
| 2005 | magnetic pulsar wrap | 1 |
| 2006 | drive spindle | 1 |
| 2007 | lip seal | 1 |
| 2011 | bracket | 1 |
| 2014 | U-bolt with nut, lockwasher | 2 |
| 2015 | bolt | 2 |
| 2016 | lockwasher | 2 |
| 2017 | flatwasher | 2 |
| 2018 | cover | 1 |
| 2021 | bolt | |
| 2022 | lockwasher | |
| 2023 | screw, round head | 2 |
| 2024 | lockwasher | 2 |
| 2025 | flatwasher | 2 |