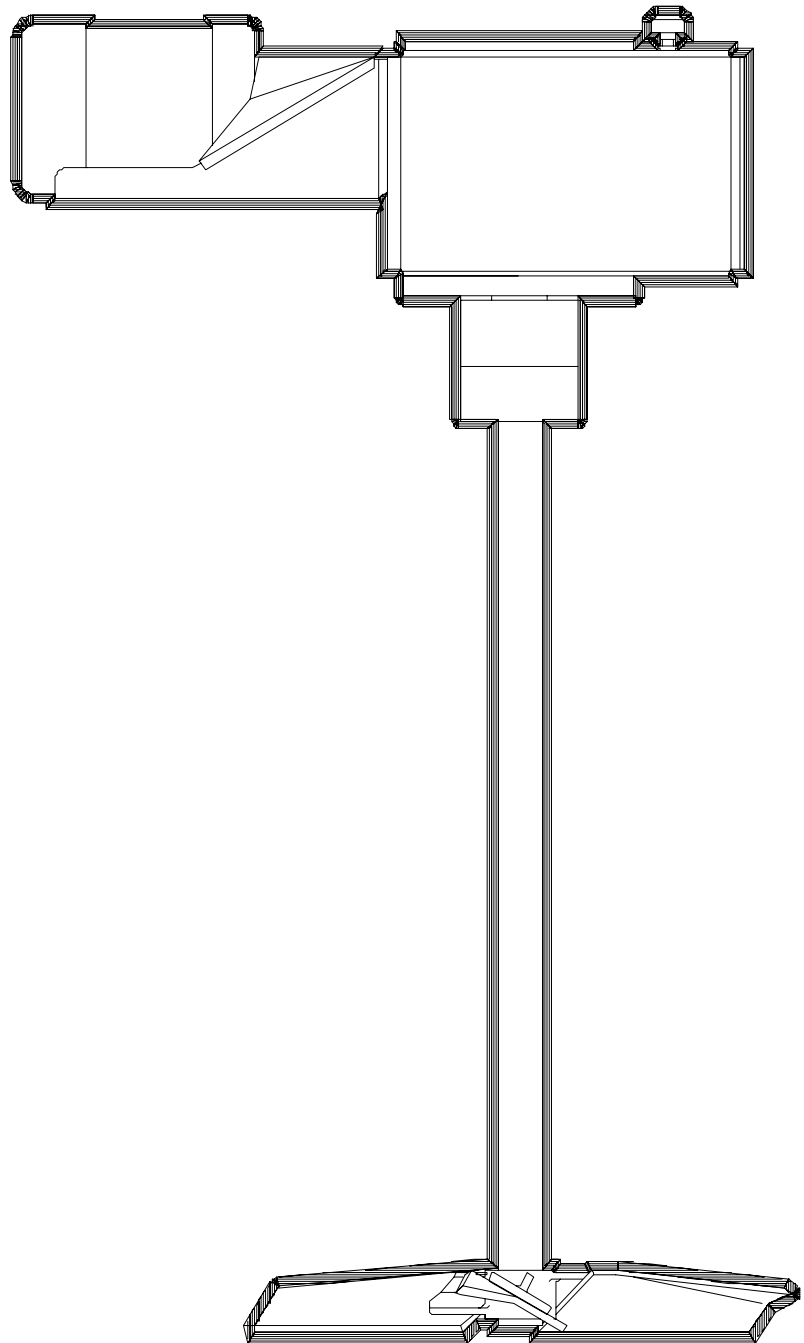


HTD/HTP Turbine Agitators Installation, Operation Maintenance Manual



Equipment Reference:

For Service and
Information Contact:

TABLE OF CONTENTS

Initial Inspection	1
<hr/>	
Chemineer Assistance	1
<hr/>	
Storage	2
<hr/>	
Mounting	4
<hr/>	
Installation	9
<hr/>	
Agitator	9
Impellers.....	16
Gear Drive	27
Motor.....	27
Flexible Shaft Coupling	27
Rigid Shaft Coupling.....	28
Options: Anchor Bolts.....	32
Options: In-Tank Coupling	33
Options: Auxiliary Shaft Seals	35
Options: Steady Bearings	40
Options: External Motor-Driven Oil Pump.....	47
Options: Tachometer	50
<hr/>	
Lubrication	53
<hr/>	
Motor.....	53
Gear Drive	56
Auxiliary Shaft Seals.....	67
Steady Bearings.....	67

TABLE OF CONTENTS

Operation **68**

Agitator.....	68
Motor	69
Flexible Motor Coupling	70
Gear Drive	70
Auxiliary Shaft Seals	71
Steady Bearings	71
Troubleshooting.....	72

Maintenance **73**

Gear Drive	73
Auxiliary Stuffing Box	74
Steady Bearings	76

Agitator Item List (Parts) **78**

Vendor Data

Flexible Motor Couplings

Supplemental Data

TABLE OF CONTENTS

Tables	Page
Table 1: Storage Oil Capacity	3
Table 2: Mounting Dimensions.....	7
Table 3: Recommended Beam Sizes.....	8
Table 4: Bolt Tightening Torque	12
Table 5: Coupling Half Shrink Fit Temperature	29
Table 6: Shaft Bolt Tightening Torque	31
Table 7: Cooling Water Flow Rate	47
Table 8: Typical NLGI No. 2 Greases	54
Table 9: Motor Bearing Grease Addition	55
Table 10: Lube Oil Selection	58
Table 11: Approximate Operating Oil Capacity	59
Table 12: Typical R&O Lube Oils.....	60
Table 13: Typical EP Lube Oils.....	61
Table 14: Troubleshooting	72
Table 15: Bracket and Pad Steady Bearing Wear Sleeve and Bushing Wear Allowances	76
Table 16: Tri-Pod Steady Bearing Stub Shaft and Bushing Wear Allowances	77

TABLE OF CONTENTS

Figures	Page
Figure 1: Open Tank Beam Mounting, HTD	5
Figure 2: Open Tank Beam Mounting, HTP.....	6
Figure 3: Model HTD Agitator Assembly	10
Figure 4: Model HTP Agitator Assembly.....	11
Figure 5: Agitator Lifting System.....	13
Figure 6: Model HTD	15
Figure 7: Model HTP	15
Figure 8: Hub and Pin Key Detail.....	17
Figure 9: Style P-4 Impeller.....	18
Figure 10: Style HE-3 Impeller.....	19
Figure 10a: Style XE-3 Impeller	20
Figure 11: Style S-4 Impeller.....	21
Figure 12: Style D-6, CD-6, BT-6 Impeller.....	22
Figure 13: Style SC-3 Impeller	23
Figure 14: Style Maxflo W Impeller.....	24
Figure 15: Thrust Bolt Impeller Attachment.....	26
Figure 16: Shrink-Fit Coupling Half.....	28
Figure 17: Removable Coupling Half.....	30
Figure 18: Anchor Bolt Assembly	32
Figure 19: In-Tank Couplings.....	34
Figure 20: Auxiliary Lip Seal	35
Figure 21: Auxiliary 3-Ring Stuffing Box	39
Figure 22: Auxiliary 6-Ring Stuffing Box.....	39
Figure 23: Bracket Steady Bearing	40
Figure 24: Tri-Pod Steady Bearing	42
Figure 25: Pad Steady Bearing.....	45
Figure 26: External Motor-Driven Oil Pump.....	48
Figure 27: Wiring Diagram.....	49
Figure 28: Magnetic Signal Tachometer.....	51
Figure 29: Tachometer Panel Meter.....	52
Figure 30: Optional Oil Level Dipstick	56
Figure 31: HT Gear Drive: Sizes 1,2,3	62
Figure 32: HT Gear Drive: Sizes 4,5,6	63
Figure 33: HT Gear Drive: Sizes 7,8,9	64
Figure 34: HT Gear Drive: Size 10.....	65
Figure 35: HT Gear Drive: Sizes 11,12,13	66
Figure 36: Auxiliary 3-Ring Stuffing Box.....	75
Figure 37: Auxiliary 6-Ring Stuffing Box.....	75

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.

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*.

NOTE: The case size referred to in this manual can be determined by the first number in the model designation; for example, "1HTD-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. 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.

Storage (Cont'd)

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

- 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.

MOUNTING

HTD and HTP (open tank) style units usually mount separately from the tank on either a steel structure or a concrete slab over the tank. The steel structure for open mounting is typically constructed of two main support beams, with lateral and diagonal bracing, spanning the tank. See *Figure 1, page 5 (HTD)* or *Figure 2, page 6 (HTP)*. HTD style units may include an auxiliary shaft seal as an option. Refer to the agitator assembly drawing for minimum required mounting height to allow for servicing the seal

The most frequent cause of mechanical difficulty with an agitator is improper mounting. The agitator extension shaft is designed to run in a true vertical position. *Do not angle or side mount. Do not mount on a surface which is not flat and horizontal.*

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) forces. Torque implies an unchanging load, but the actual operating torque will show plus or minus 10 to 20 percent variability due to the 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 an 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 mounting support. The support structure must be rigid enough to support the agitator weight and the live agitator reactions as a result of torque and bending moment. The structure should be sufficiently rigid so that the vibrational velocity of the drive system, based on agitator rotational speed, does not exceed 0.35 inches/sec (8.9 mm/sec). Refer to the agitator assembly drawing for the support structure design loads.

Table 3, page 8, Recommended Beam Sizes, is keyed to model, case size and tank diameter. Select the appropriate beam size for your application. Beams of equivalent section modulus and moment of inertia and/or modulus of elasticity can be used. See *Figure 1, page 5 (HTD)* or *Figure 2, page 6 (HTP)*. Refer to *Table 2, page 7* for mounting dimensions.

This information is intended as a guide and does not relieve the user of completely analyzing the entire mounting system. Unusually difficult service, such as solids impacting, liquid level operation, etc. may require support stiffness's greater than provided by support recommendations provided herein. Consult *your local Chemineer office* or *Chemineer Field Service* for design guidance.

THE AGITATOR SUPPORT IS TYPICALLY CONSTRUCTED OF TWO STEEL BEAMS (CLOSED AT BOTH ENDS) WITH LATERAL AND 45° BRACING BEAMS.

LATERAL AND BRACING BEAMS TO BE SAME SIZE AS MAIN SUPPORT BEAMS. SEE TABLE 3 FOR BEAM SIZE.

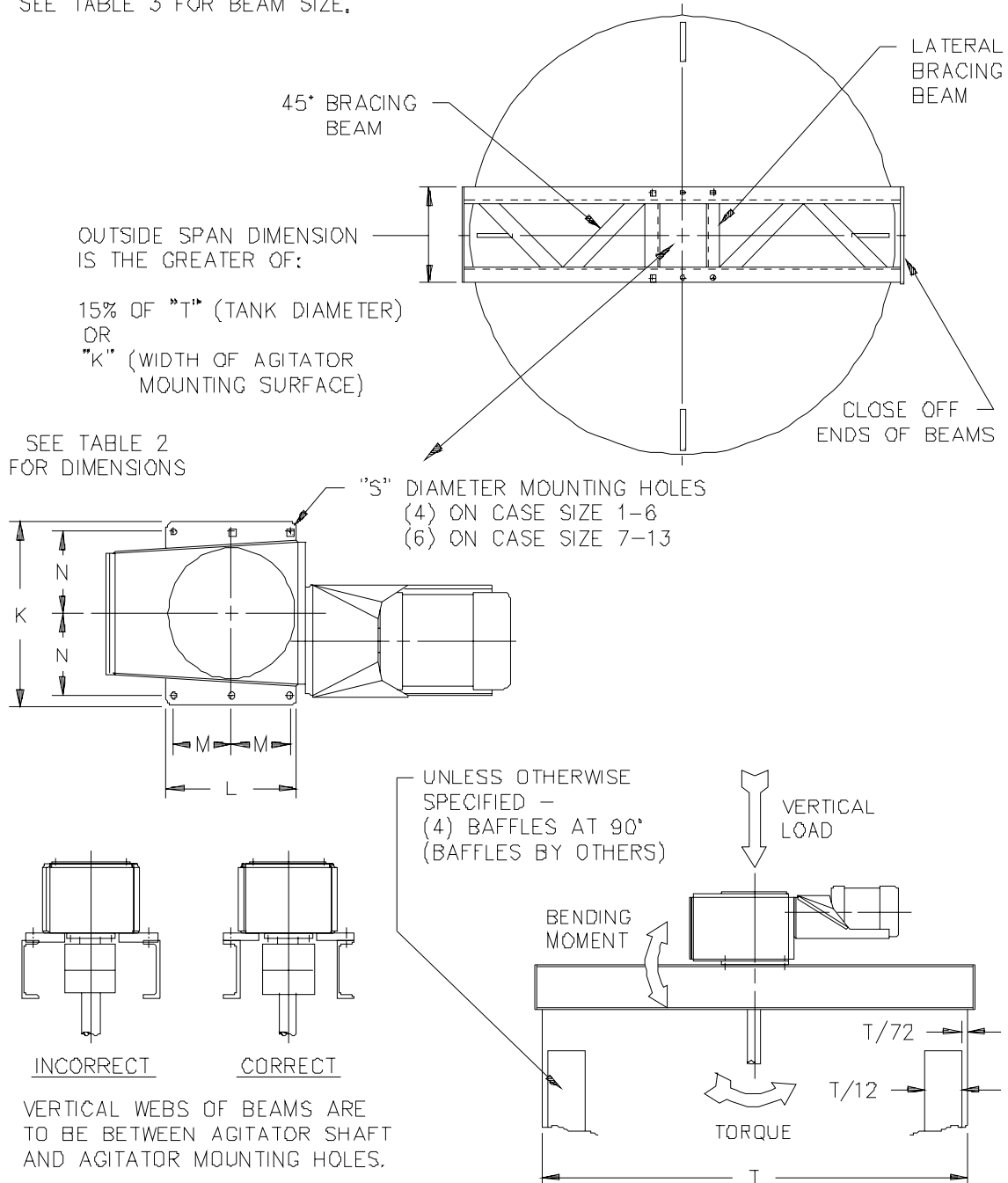


Figure 1: Open Tank Beam Mounting, HTD

THE AGITATOR SUPPORT IS TYPICALLY CONSTRUCTED OF TWO STEEL BEAMS (CLOSED AT BOTH ENDS) WITH LATERAL AND 45° BRACING BEAMS.

LATERAL AND BRACING BEAMS TO BE SAME SIZE AS MAIN SUPPORT BEAMS. SEE TABLE 3 FOR BEAM SIZE.

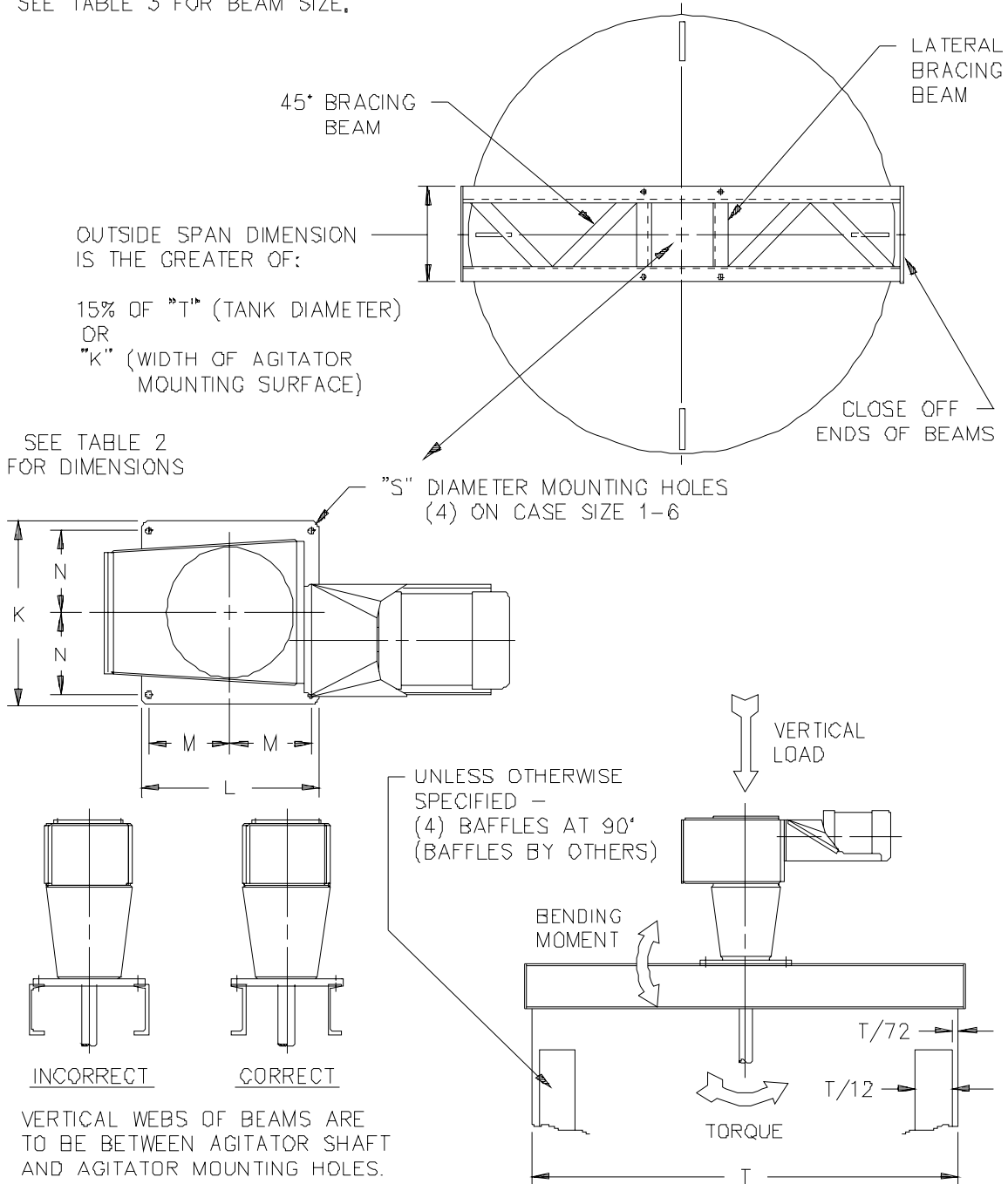


Figure 2: Open Tank Beam Mounting, HTP

TABLE 2: MOUNTING DIMENSIONS

CASE SIZE	Model HTD									
	K		L		M		N		S	
	in	mm	in	mm	in	mm	in	mm	in	mm
1	13.00	330.2	8.00	203.2	3.25	82.6	5.63	142.9	0.63	15.9
2	16.00	406.4	10.00	254.0	4.25	108.0	7.00	177.8	0.63	15.9
3	18.00	457.2	11.50	292.1	4.75	120.7	8.00	203.2	0.75	19.1
4	20.50	520.7	16.50	419.1	7.25	184.2	9.13	231.8	0.88	22.2
5	22.50	571.5	16.50	419.1	7.25	184.2	10.00	254.0	0.88	22.2
6	25.00	635.0	18.50	469.9	8.25	209.6	11.25	285.8	0.88	22.2
7	34.00	863.6	21.00	533.4	9.25	235.0	15.75	400.1	1.00	25.4
8	38.50	977.9	22.00	558.8	9.50	241.3	17.75	450.9	1.13	28.6
9	41.00	1041.4	26.00	660.4	11.50	292.1	19.00	482.6	1.13	28.6
10	45.00	1143.0	33.00	838.2	15.00	381.0	21.00	533.4	1.13	28.6
11	52.00	1320.8	39.00	990.6	17.75	450.9	24.25	616.0	1.38	34.9
12	57.00	1447.8	48.00	1219.2	22.25	565.2	26.75	679.5	1.63	41.3
13	68.00	1727.2	50.50	1282.7	23.00	584.2	32.25	819.2	1.63	41.3
CASE SIZE	Model HTP									
	K		L		M		N		S	
	in	mm	in	mm	in	mm	in	mm	in	mm
1	16.50	419.1	16.50	419.1	7.25	184.2	7.25	184.2	0.75	19.1
2	16.50	419.1	16.50	419.1	7.25	184.2	7.25	184.2	0.75	19.1
3	16.50	419.1	16.50	419.1	7.25	184.2	7.25	184.2	0.75	19.1
4	25.00	635.0	25.00	635.0	11.25	285.8	11.25	285.8	0.88	22.2
5	25.00	635.0	25.00	635.0	11.25	285.8	11.25	285.8	0.88	22.2
6	25.00	635.0	25.00	635.0	11.25	285.8	11.25	285.8	0.88	22.2

TABLE 3: RECOMMENDED BEAM SIZES

Case Size	Tank Diameter, Feet (Meters)				
	4 (1.22)	6 (1.83)	8 (2.44)	10 (3.05)	15 (4.57)
1	C4 x 5.4	C5 x 6.7	C6 x 8.2	C7 x 9.8	W12 x 14
2	C5 x 6.7	C6 x 8.2	C7 x 9.8	W8 x 10	W12 x 14
3	C6 x 8.2	C7 x 9.8	W8 x 10	W10 x 12	W12 x 19
4	---	C7 x 9.8	W8 x 10	W12 x 14	W14 x 22
5	---	W8 x 10	W10 x 12	W12 x 14	W16 x 26
6	---	W8 x 10	W10 x 12	W12 x 16	W16 x 31
7	---	---	W12 x 14	W14 x 22	W18 x 35
8	---	---	W12 x 16	W14 x 22	W18 x 40
9	---	---	---	W16 x 26	W21 x 44
10	---	---	---	W18 x 31	W24 x 55
11	---	---	---	---	W24 x 62
12	---	---	---	---	W24 x 76

Case Size	Tank Diameter, Feet (Meters)				
	20 (6.10)	25 (7.62)	30 (9.14)	40 (12.19)	50 (15.24)
1	W12 x 19	W16 x 26	W18 x 35	W24 x 55	W24 x 76
2	W14 x 22	W16 x 31	W18 x 40	W24 x 62	W27 x 84
3	W16 x 26	W18 x 40	W21 x 50	W27 x 84	W30 x 116
4	W18 x 35	W21 x 50	W24 x 62	W30 x 99	W36 x 135
5	W18 x 40	W24 x 55	W24 x 76	W30 x 116	W36 x 160
6	W21 x 44	W24 x 62	W27 x 84	W33 x 118	W36 x 194
7	W24 x 55	W27 x 84	W30 x 99	W36 x 160	W36 x 280
8	W24 x 62	W27 x 84	W30 x 116	W36 x 194	W36 x 280
9	W24 x 76	W30 x 99	W33 x 130	W36 x 260	*
10	W27 x 84	W33 x 118	W36 x 160	*	*
11	W30 x 99	W36 x 135	W36 x 194	*	*
12	W30 x 116	W36 x 160	W36 x 260	*	*
13	*	*	*	*	*

* Consult Chemineer C = American Standard Channel W = Wide Flange Beam

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 shaft [400] and impeller [500] and one for the agitator drive (*Figures 3 and 4, pages 10 and 11*). Optional accessories, multiple impellers and large motors may be crated separately.
2. Remove all shipping restraints. A hoist or crane system for the lifting of the agitator parts must be available. Refer to *Figure 5, page 13* for lifting. The approximate net weight of the unit is shown on the unit assembly drawing.

For HTP units (*Figure 7, page 15*), unbolt the gear drive [200] and remove from pedestal [1101]. Place the pedestal assembly on the agitator support structure with mounting plate [1201] over the anchor bolts.

3. Motors [100] which are large relative to gear drive [200] are shipped separately with their mounting 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 structure. See *Figures 3 and 4*. 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. If the unit is supplied with an optional auxiliary shaft seal, see *Options, Auxiliary Shaft Seals*.
5. Lift the extension shaft from the coupling end.

NOTE: Refer to INSTALLATION, Rigid Shaft Couplings, if the extension shaft is supplied without the coupling half installed.

Lower shaft [400] into the tank through the agitator drive support structure. Block the shaft in place with extension shaft coupling half [350] extending above the agitator drive mounting surface, (HTD) or pedestal assembly (HTP).

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.

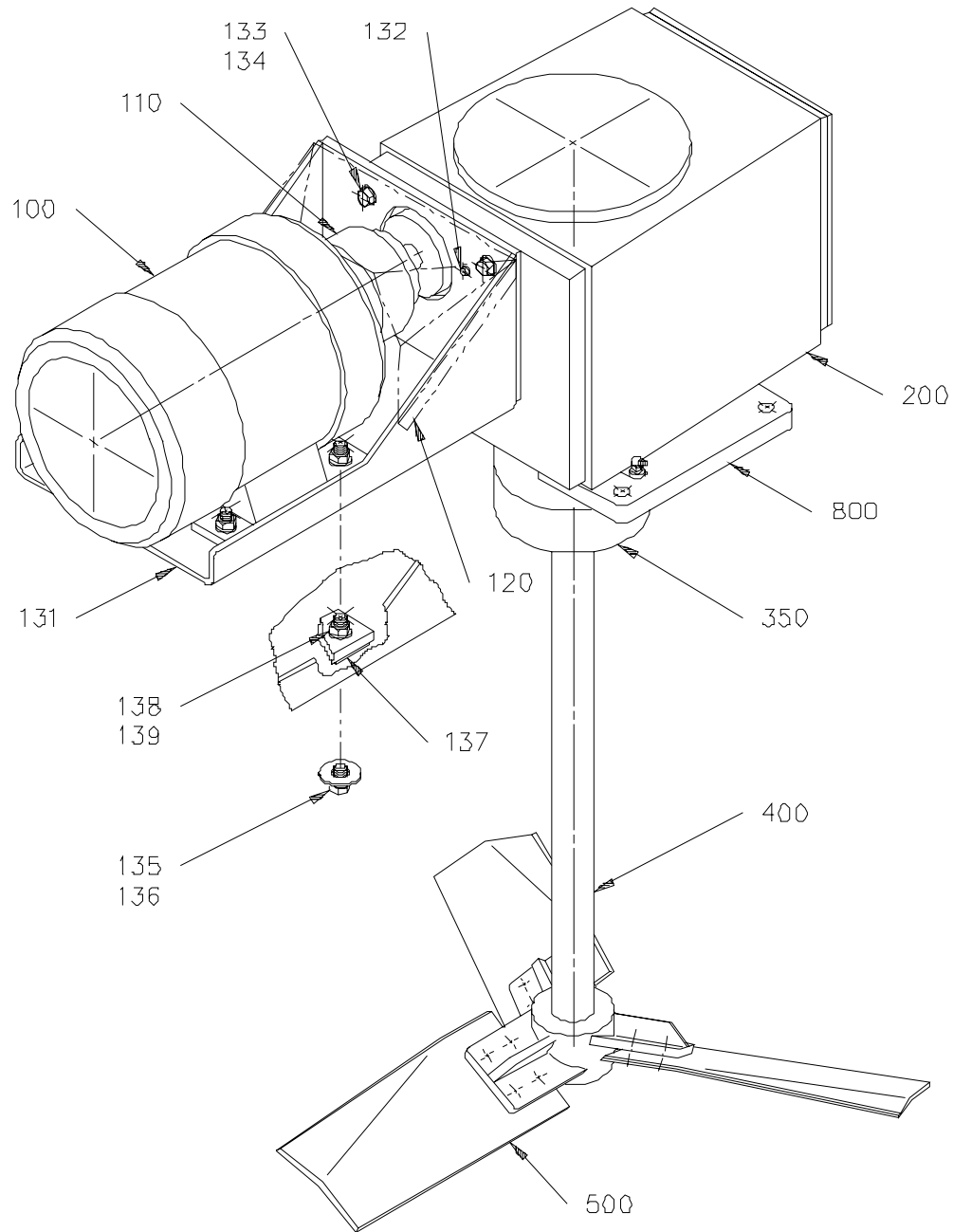


Figure 3: Model HTD Agitator Assembly

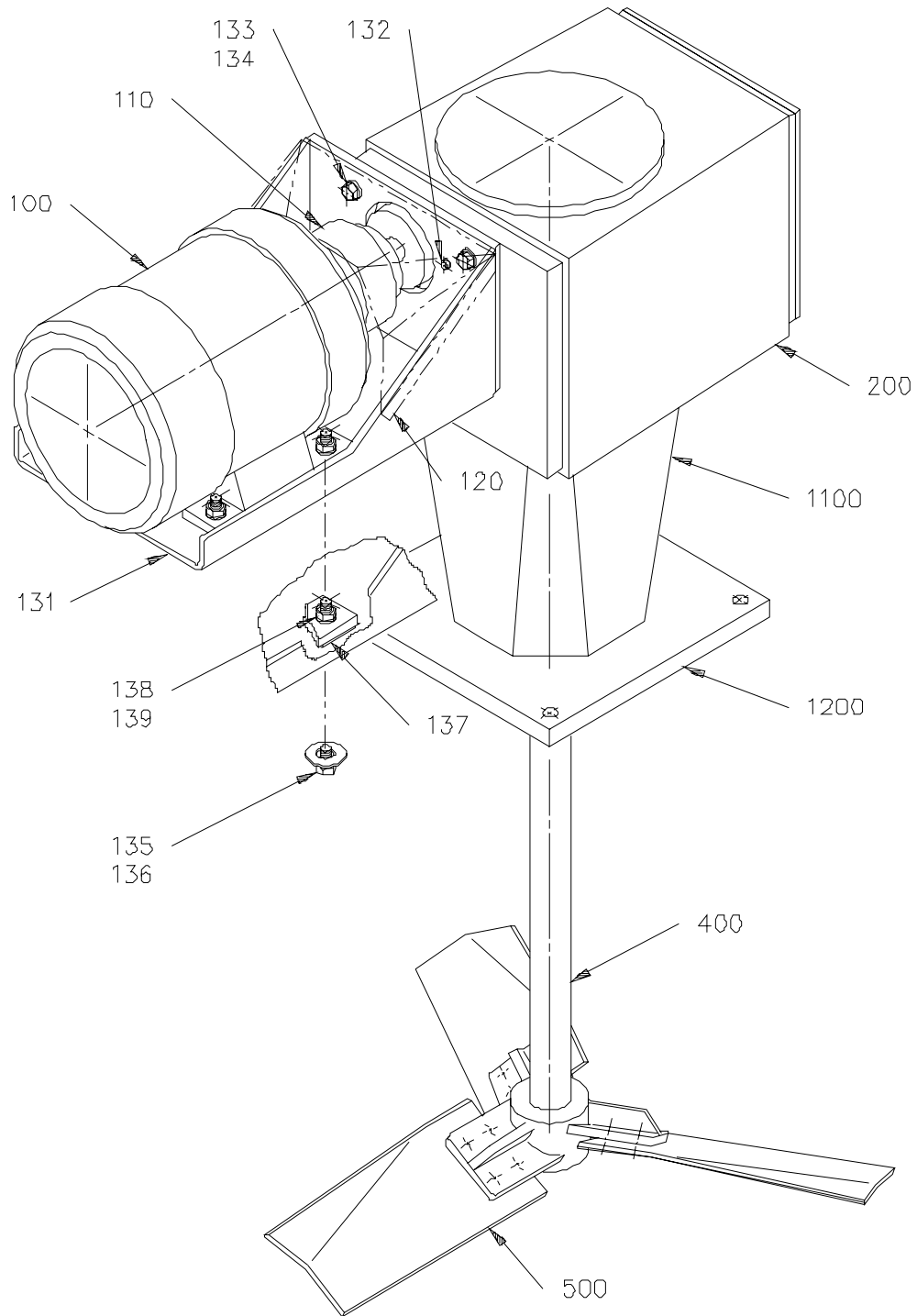


Figure 4: Model HTP Agitator Assembly

AGITATOR

TABLE 4: 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.

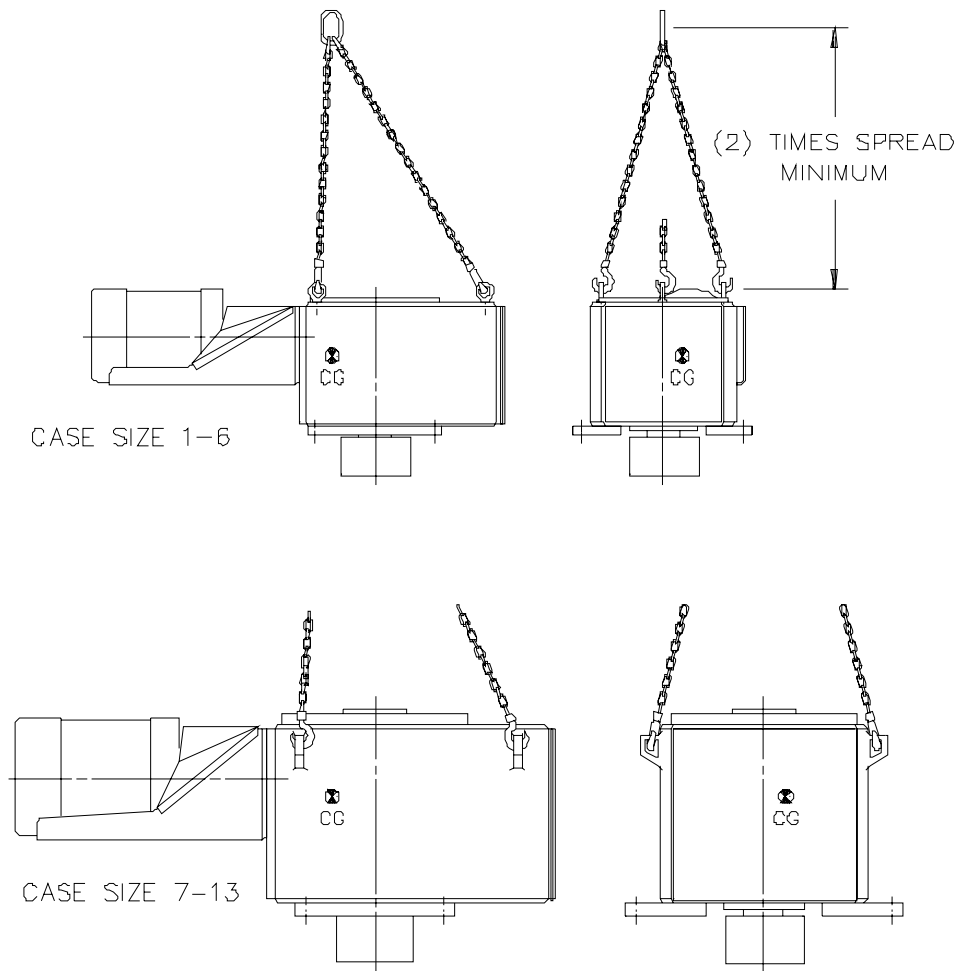
AGITATOR

Figure 5: Agitator Lifting System

For cases size 1-6, use a three point chain fall utilizing the three eye bolts 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.

AGITATOR

6. Avoid surface damage and bending of the shaft. Protect the tenon and the face of the coupling. The face and tenon of all rigid couplings must be perfectly clean and free of nicks. Line up match mark arrows when assembling couplings.
7. Lift and suspend the agitator drive assembly over the extension shaft coupling half close enough to allow installation of coupling bolts and lockwashers [361, 362]. Install two bolts at 180°. Tighten the bolts to engage the tenon and pull the coupling faces together. See *Figures 6 and 7, page 15*.
8. Lift the agitator drive assembly and the extension shaft. Remove the shaft blocking. Install the remaining coupling bolts and lockwashers. Torque to the value shown in *Table 4, page 12*.
9. Lower the agitator drive assembly onto the support structure (HTD) or pedestal (HTP). For HTP units, rebolt the gear drive to the pedestal. Install shoulder bolts [1102] first to ensure alignment, then install bolts [1103]. Torque the bolts to the value shown in *Table 4*. The agitator drive assembly must be level within 1/4 degree (0.05 inches per foot; 4.4 mm per meter). If shimming is required, use full width shims under mounting feet [801] or mounting plate [1201] to provide a solid joint for bolting the agitator drive assembly to the support structure.
10. Install the agitator drive mounting bolts (supplied by others) and torque to the value shown in *Table 4*.
11. 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.
12. Total shaft runout should not exceed 0.005" per foot (0.42 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 surface 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 0.030 - 0.060" (0.76 - 1.52 mm), remove the heat and 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.

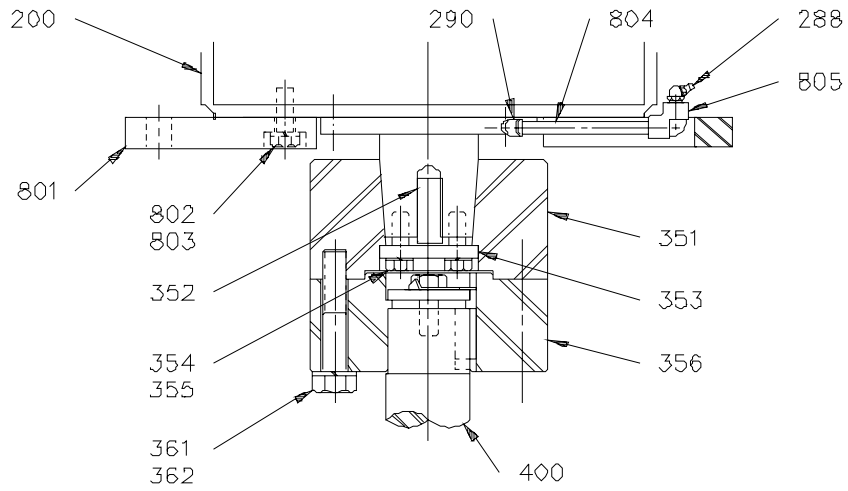


Figure 6: Model HTD

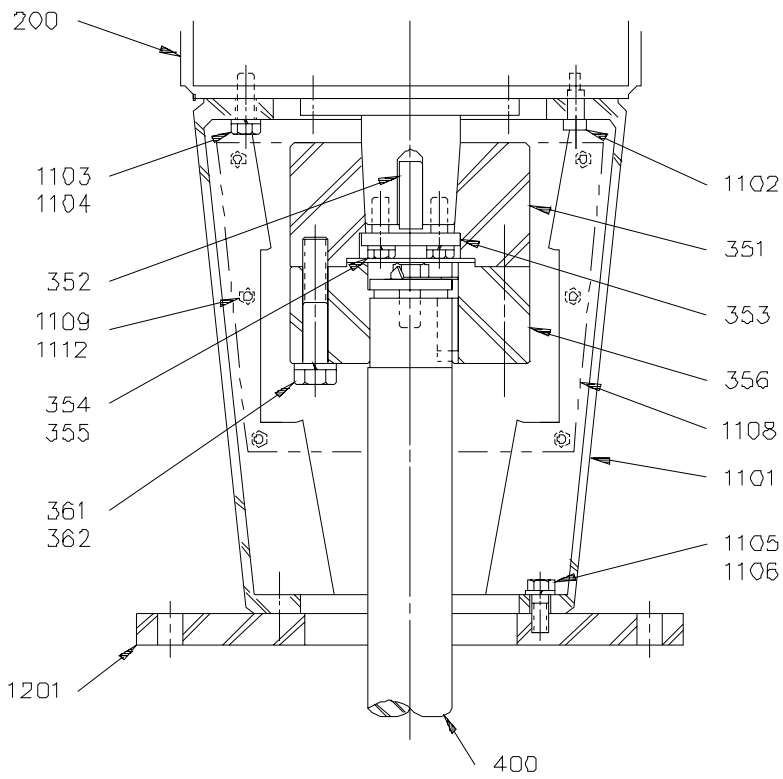


Figure 7: Model HTP

IMPELLERS

Unless otherwise specified on the unit assembly drawing, the impeller attaches to the shaft with a key and setscrew. Refer to *Figure 8, page 17*. 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 4, page 12*. 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, 508, 509]. Refer to *Figures 9 - 14, pages 18 - 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 4*.

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

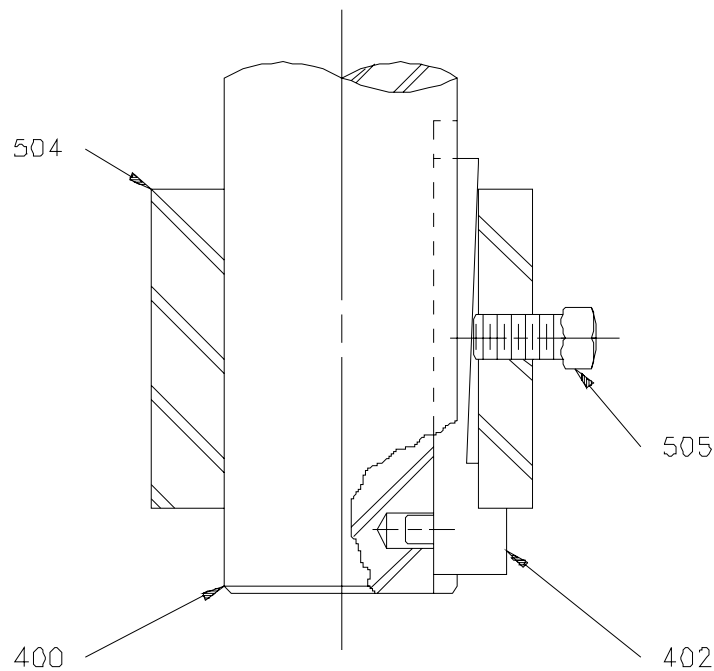


Figure 8: Hub and Pin Key Detail

NOTE:
STABILIZER FINS FURNISHED
ONLY WHEN NECESSARY

NUMBER OF BLADE FASTENERS
MAY VARY WITH APPLICATION

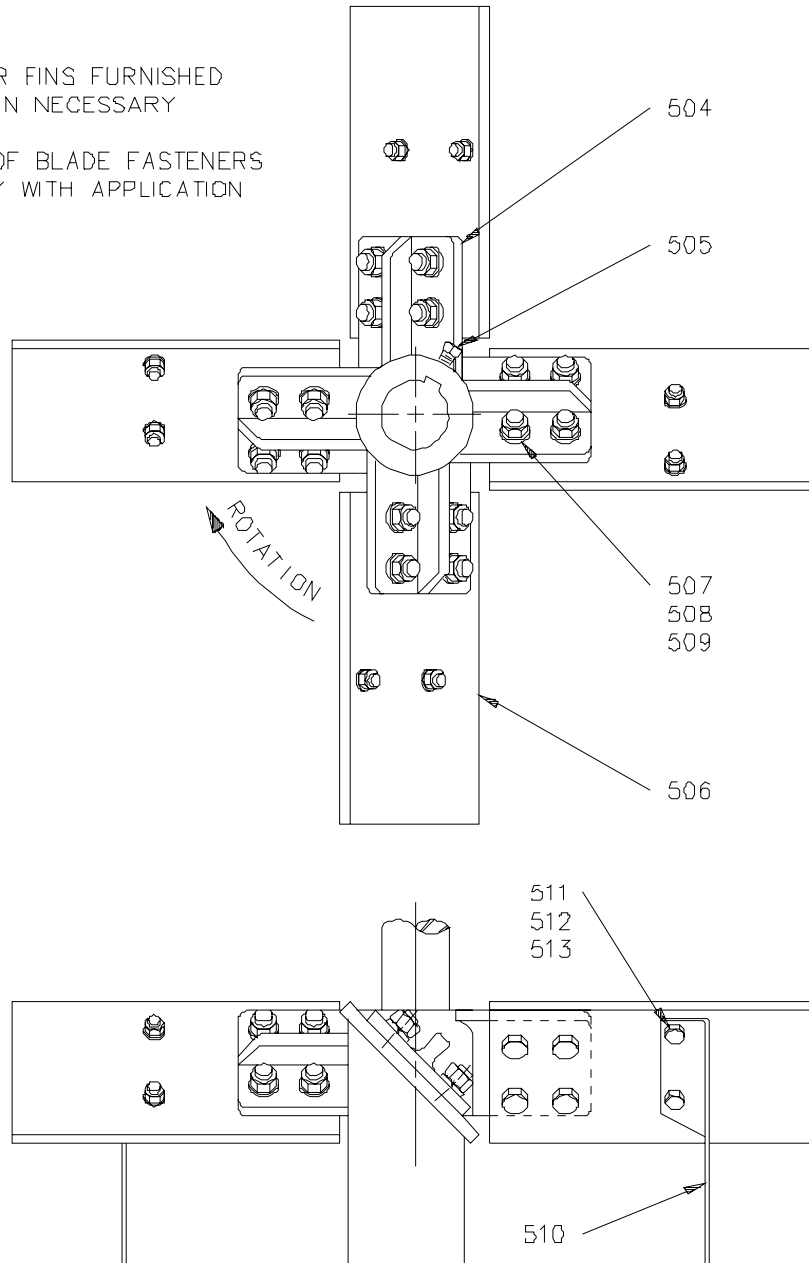
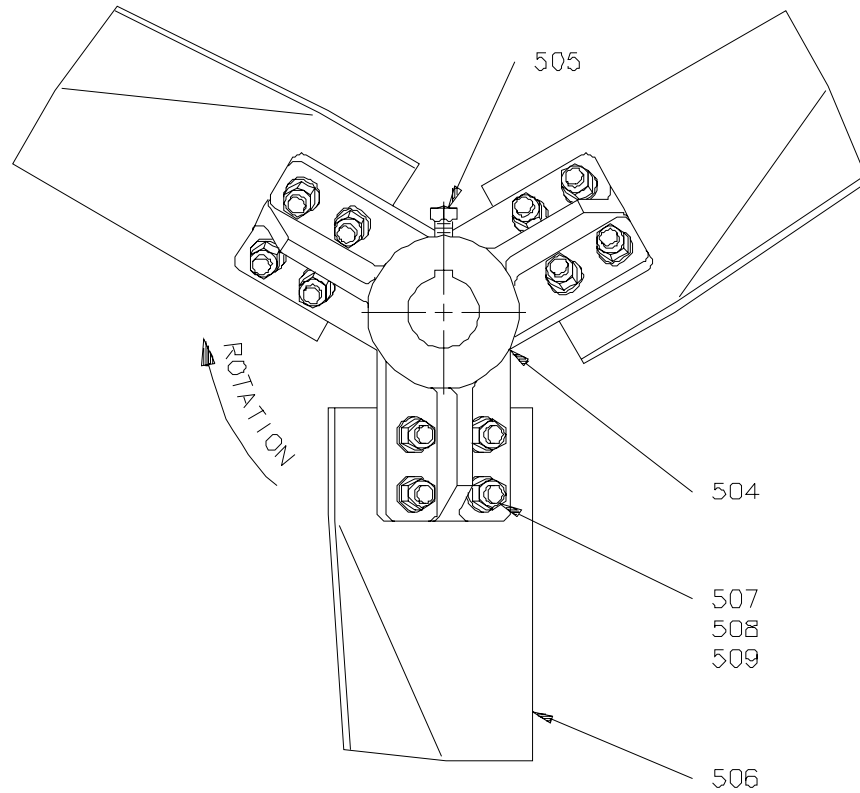


Figure 9. Style P-4 Impeller



NOTE:
NUMBER OF BLADE FASTENERS
MAY VARY WITH APPLICATION

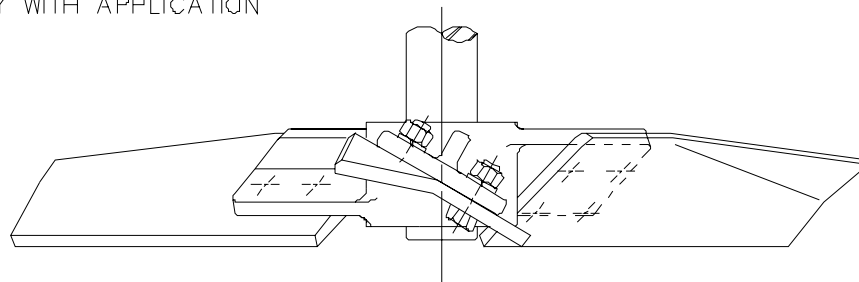
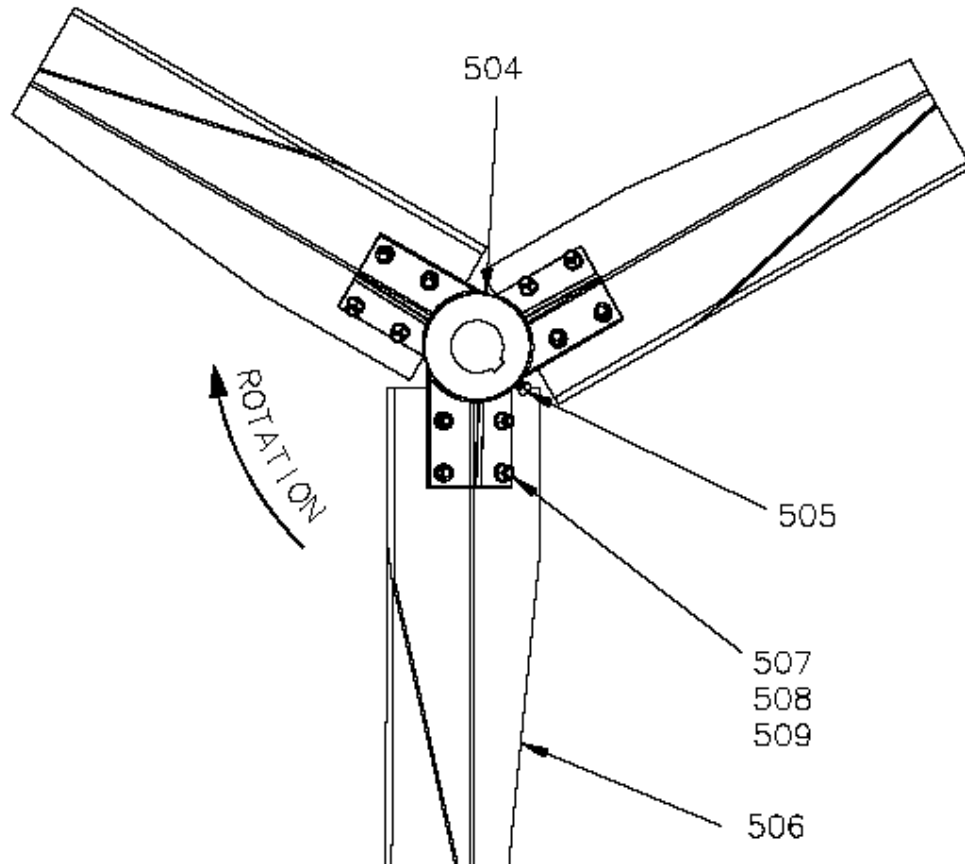


Figure 10. Style HE-3 Impeller



NOTE:
NUMBER OF BLADE FASTENERS
MAY VARY WITH APPLICATION

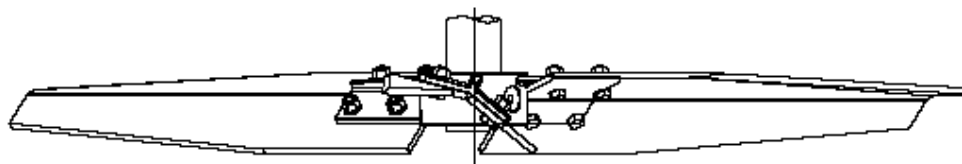


Figure 10a: Style XE-3 Impeller

NOTE:
STABILIZER FINS FURNISHED
ONLY WHEN NECESSARY

NUMBER OF BLADE FASTENERS
MAY VARY WITH APPLICATION

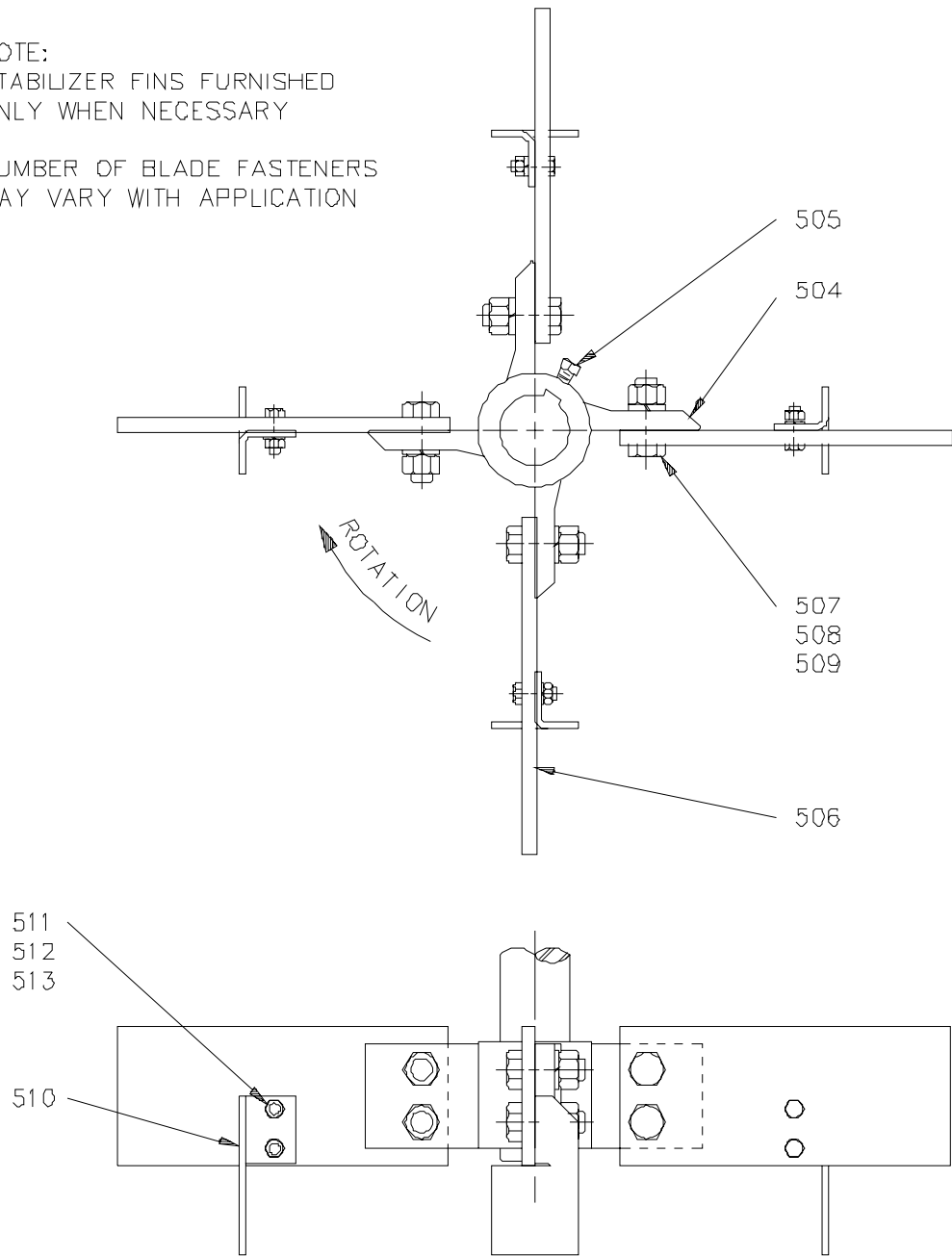


Figure 11: Style S4 Impeller

NOTE:
NUMBER OF BLADE FASTENERS
MAY VARY WITH APPLICATION

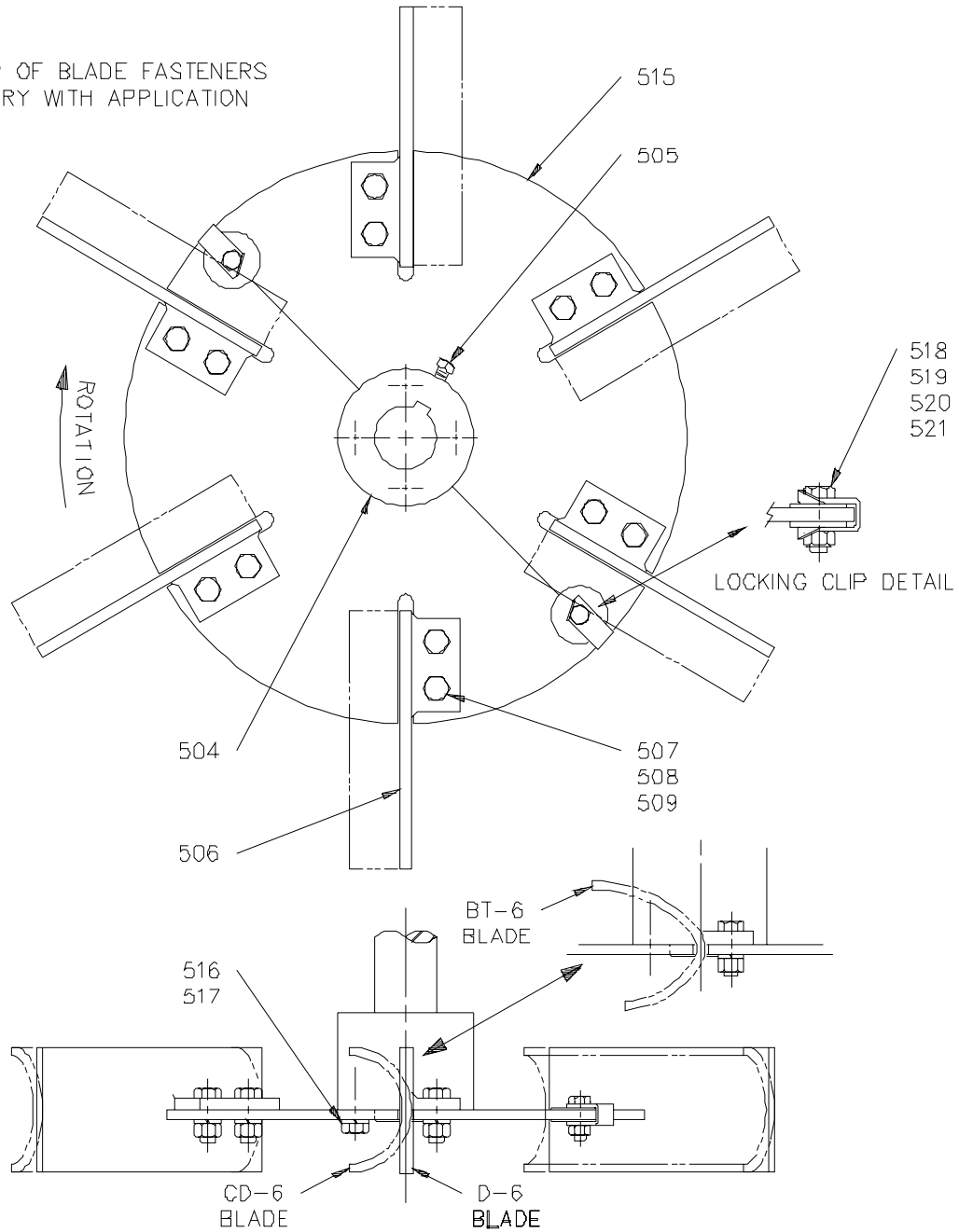
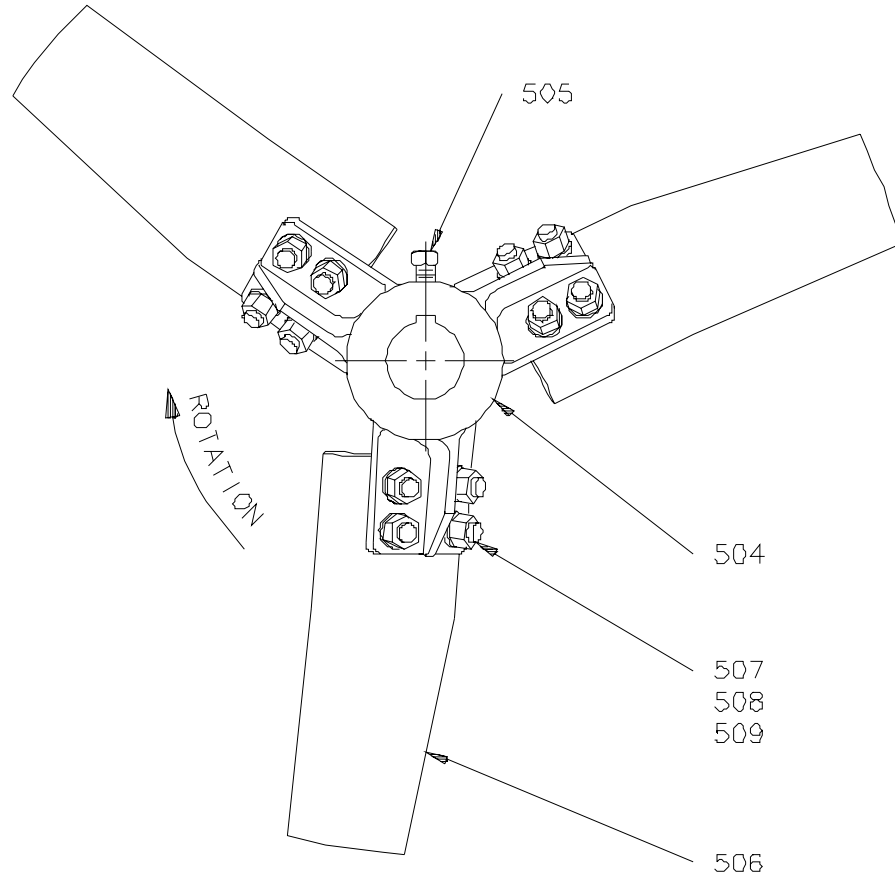


Figure 12: Style D-6, CD-6, BT-6 Impeller



NOTE;
NUMBER OF BLADE FASTENERS
MAY VARY WITH APPLICATION

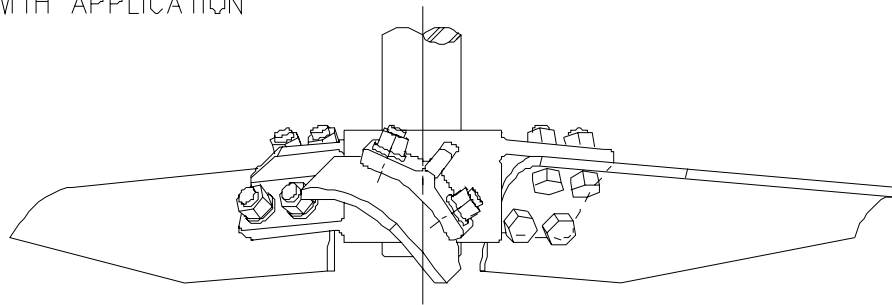


Figure 13: Style SC-3 Impeller

NOTE:
SPLIT BLADES FURNISHED
ONLY WHEN NECESSARY FOR
VESSEL INSERTION

NUMBER OF BLADE FASTENERS
MAY VARY WITH APPLICATION

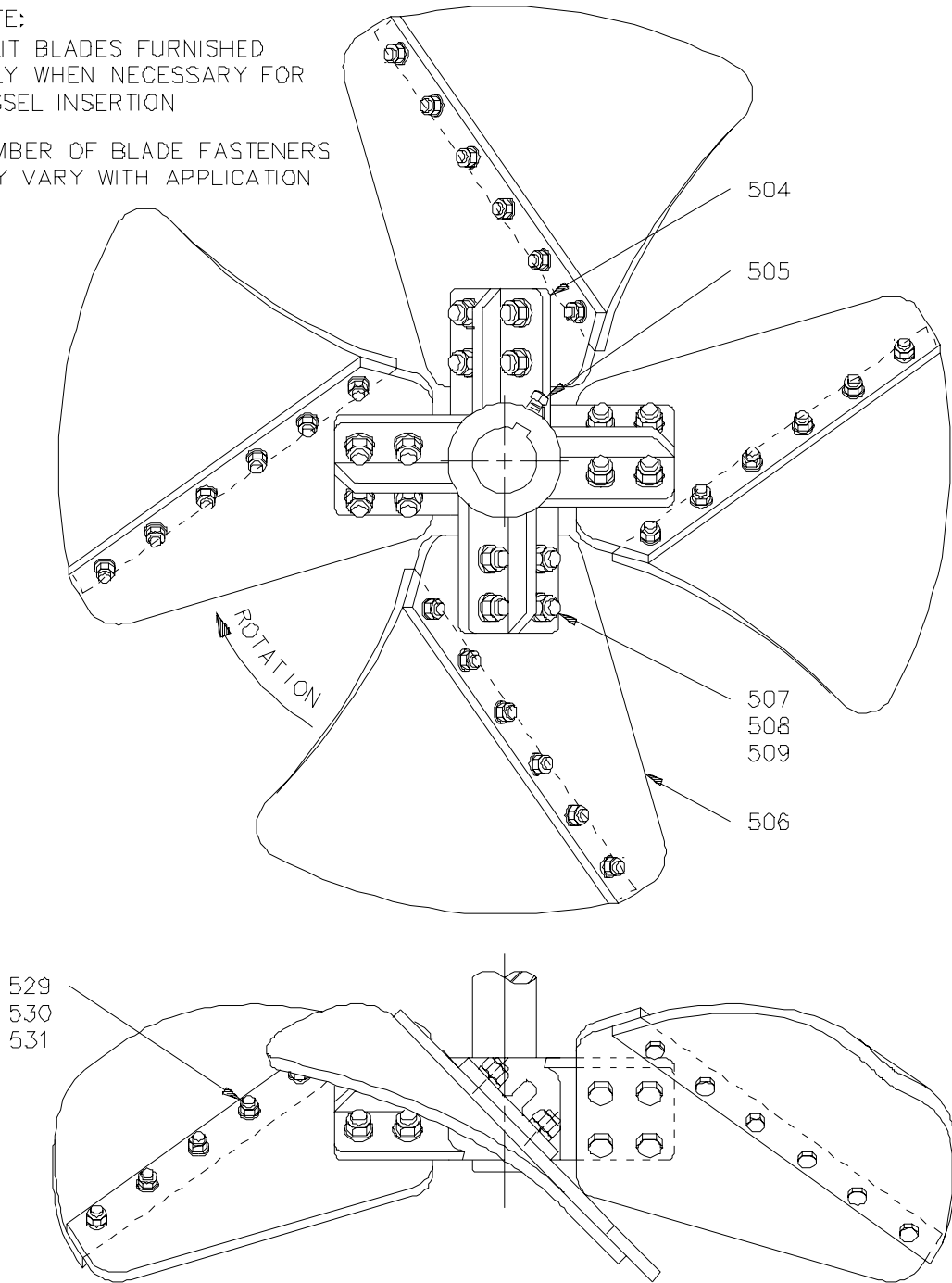


Figure 14: Style Maxflo Wimpeller

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 \leq 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 directions 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 15, 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 4, page 12*.
7. Remove the hoist from the impeller.

**IMPELLERS
(Coated/Rubber Covered)**

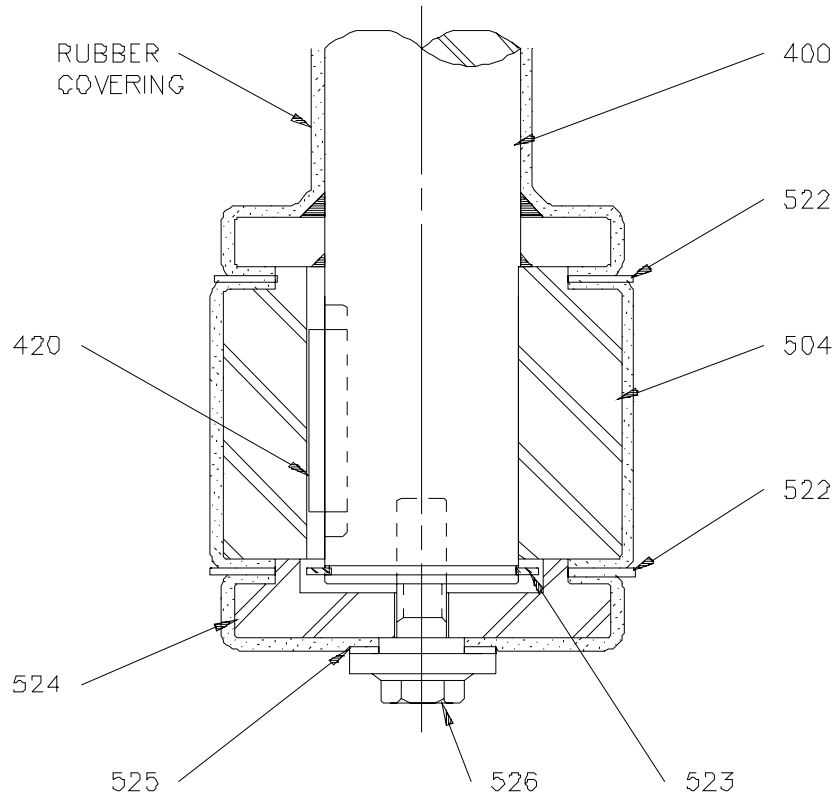


Figure 15: Thrust Bolt Impeller Attachment

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 for correct rotation prior to securing wiring.

FLEXIBLE MOTOR COUPLING

The standard flexible motor couplings [110] (*Figures 3 and 4, pages 10 and 11*) 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 360T 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.

RIGID SHAFT COUPLINGS

All HT gear drive coupling halves [351] are rigid, removable taper bore 2 bolt design, and are installed at the factory.

The extension shaft for HTD and HTP style units normally has a non-removable, shrink (interference) fit, straight bore coupling half installed at the factory. HTD style units supplied with (1) a shaft covering or coating, (2) a non-removable, in-tank shaft coupling and an optional auxiliary shaft seal, or (3) an impeller hub which would be "trapped" on the shaft, are all supplied without the extension shaft coupling half installed. All case size 3 HTP units are supplied without the extension shaft coupling half installed.

If the unit requires assembly of the shaft coupling half, see page 29. *NOTE: Be sure to install any auxiliary shaft seal, impeller hub, etc. which may be "trapped" on the shaft prior to installing a non-removable, shrink fit, straight bore coupling half.*

If the unit's extension shaft has a rigid, removable taper bore coupling half that was not installed at the factory, see page 30.

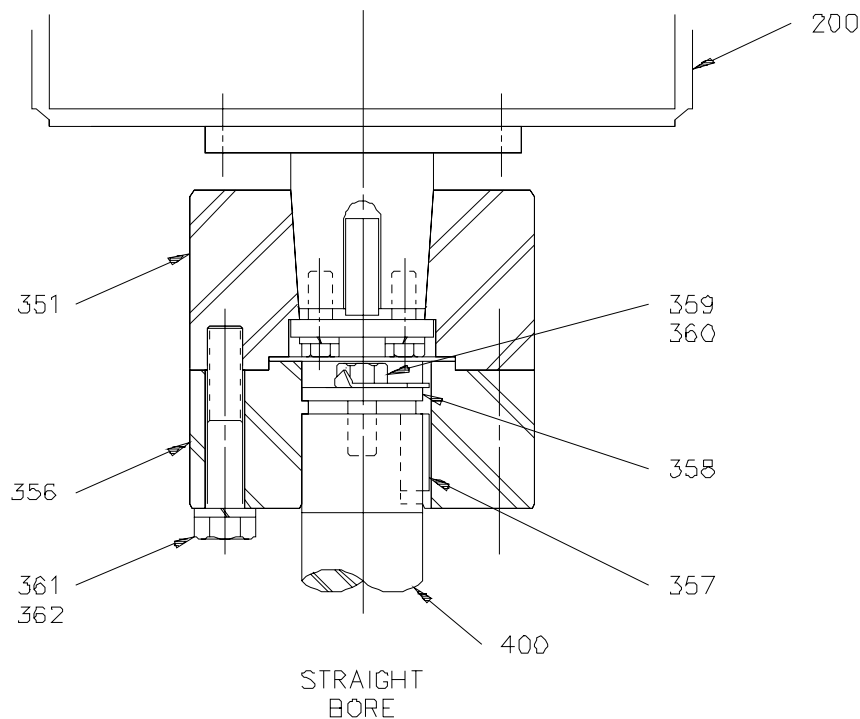


Figure 16: Shrink-Fit Coupling Half [356]

RIGID SHAFT COUPLINGS

Assembly of Rigid, Non-removable, Shrink Fit, Straight Bore Coupling Half (Figure 16, page 28)

1. Clean the shaft and coupling bore and make sure that both surfaces are free from burrs or nicks. Place key [357] 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.
2. Heat the coupling half per *Table 5* and install on the shaft.

TABLE 5: COUPLING HALF SHRINK FIT TEMPERATURE

Coupling Bore (Nominal) inches (mm)	Temperature °F (°C)*
1.5 - 3.0" (38.1 - 76.2 mm)	650°F (343°C)
3.5 - 4.5" (88.9 - 114.3 mm)	500°F (260°C)
5.0 - 8.0" (127 - 203.2 mm)	400°F (204°C)
8.5 - 10.0" (215.9 - 254 mm)	300°F (149°C)

* At 100°F (38°C) ambient.

NOTE: Install coupling half quickly. Be sure it is not cocked on the shaft and is seated properly.

3. Install coupling washer [358] and locking clip [359]; lubricate and install shaft bolt [360]. Torque to the value shown in *Table 6, page 31*. Bend exposed tabs of the locking clip around the shaft bolt head.
4. Assemble Coupling Halves:

Connect extension shaft coupling half [356] to gear drive coupling half [351] making sure that the coupling faces are clean and free from burrs or nicks. Install coupling bolts and lockwashers [361, 362]. Torque to the value shown in *Table 4, page 12*.

RIGID SHAFT COUPLINGS

Assembly of Rigid, Removable, Taper Bore Coupling Half

1. Clean the shaft and coupling bore and make sure that both surfaces are free from burrs or nicks. Place key [357] 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.
2. Slide the coupling half on the tapered shaft end until both seat firmly against each other. Be sure that the coupling half is not hung up on the key or cocked at an angle to the shaft.

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.

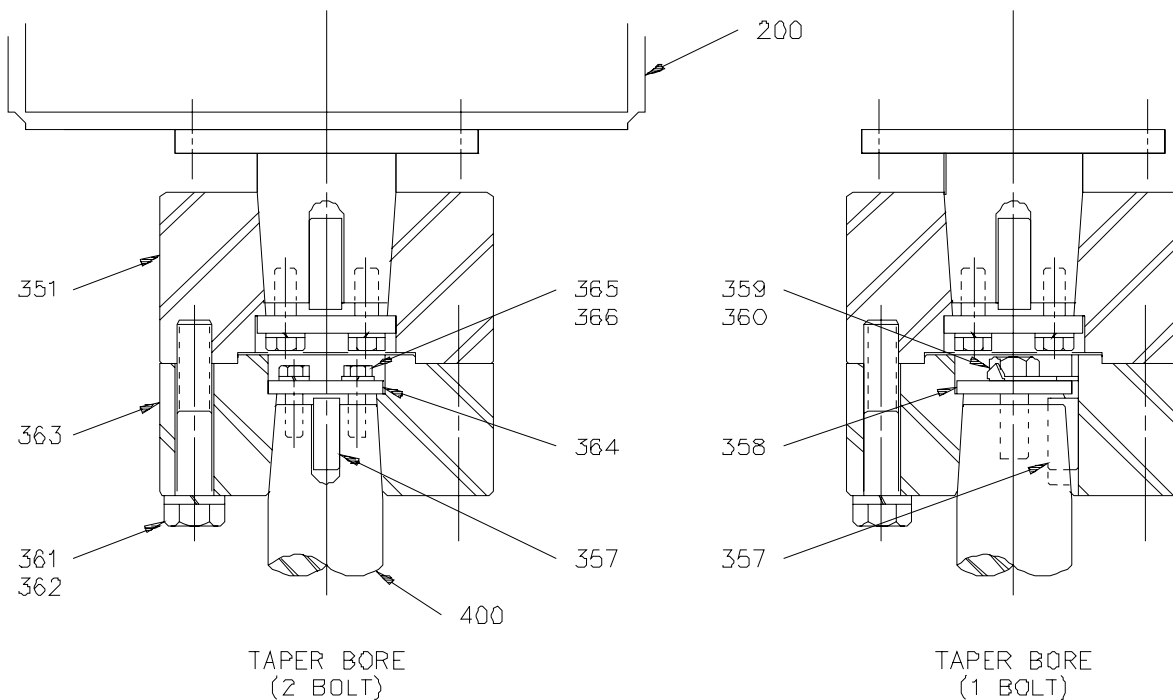


Figure 17: Removable Coupling Half [363]

RIGID SHAFT COUPLINGS

3. Shaft Bolt Installation:

2 Bolt Design:

Install coupling washer [364]; lubricate and install bolts and lockwashers [365, 366]. Torque bolts to the value shown in *Table 4, page 12*.

1 Bolt Design:

Install coupling washer [358] and locking clip [359]; lubricate and install shaft bolt [360]. Torque to the value shown in *Table 6*. Bend exposed tabs of the locking clip around the shaft bolt head.

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.

4. Assemble Coupling Halves:

Connect extension shaft coupling half [363] to gear drive coupling half [351] making sure the coupling faces are clean and free from burrs or nicks. Install coupling bolts and lockwashers [361, 362]. Torque to the value shown in *Table 4*

OPTIONS: ANCHOR BOLTS

Anchor bolts [901] are to be located on centers as specified on the unit assembly drawing or *Table 2, page 7*. Mount the agitator drive on the anchor bolts and install flatwashers, lockwashers and nuts [904, 903, 902]. Torque to the value shown in *Table 4, page 12*.

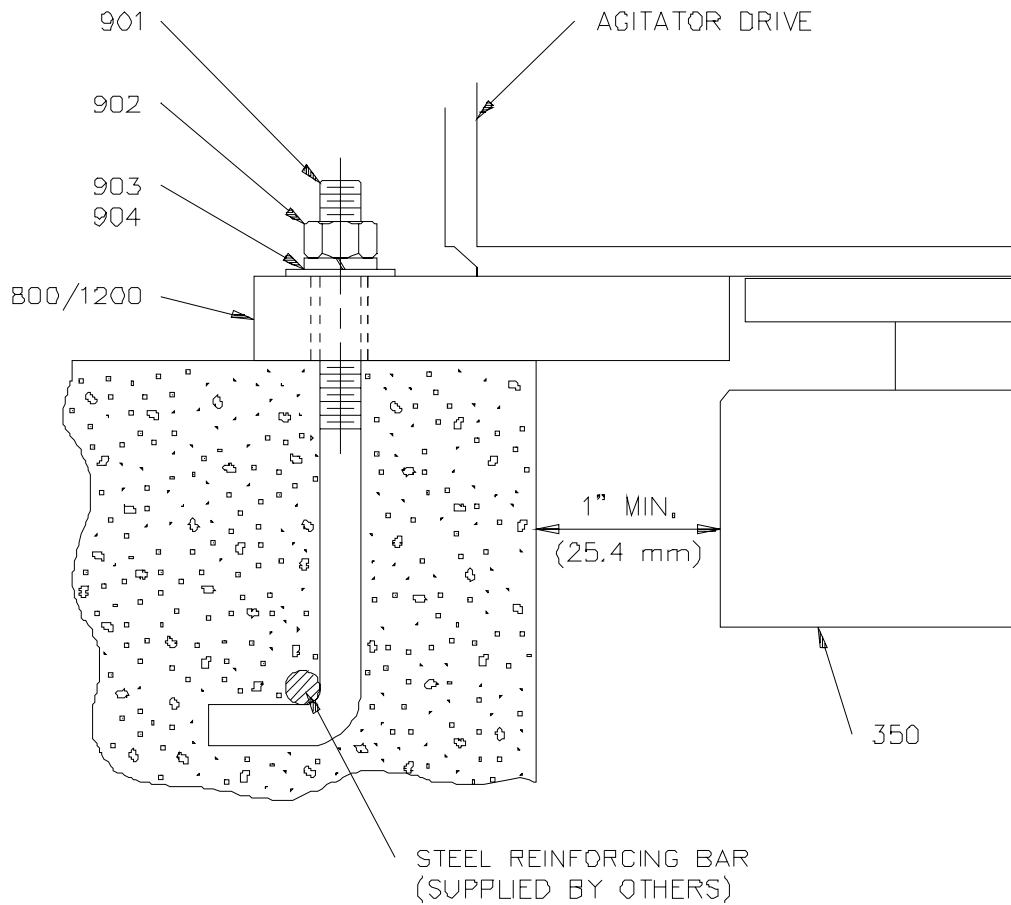


Figure 18: Anchor Bolt Assembly

OPTIONS: IN-TANK COUPLINGS

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

NOTE: Whenever assembly or disassembly of an agitator with an in-tank coupling is referred to in this manual, substitute flanged drive shaft [403] and/or flanged extension shaft [404] (Figure 19, page 34) for all references to the agitator extension shaft [400] (Figures 3 and 4, pages 10 and 11).

Assembly of Rigid, Removable, Taper Bore Coupling Half [408, 413] (Figure 19)

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

NOTE: 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

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 4, page 12*.

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 31*. Bend exposed tabs of the locking clip around the shaft bolt head.

4. Assemble Coupling Halves:

Connect flanged extension shaft [404] to flanged drive shaft [403] making sure the match marks are lined up and the coupling faces 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 4*.

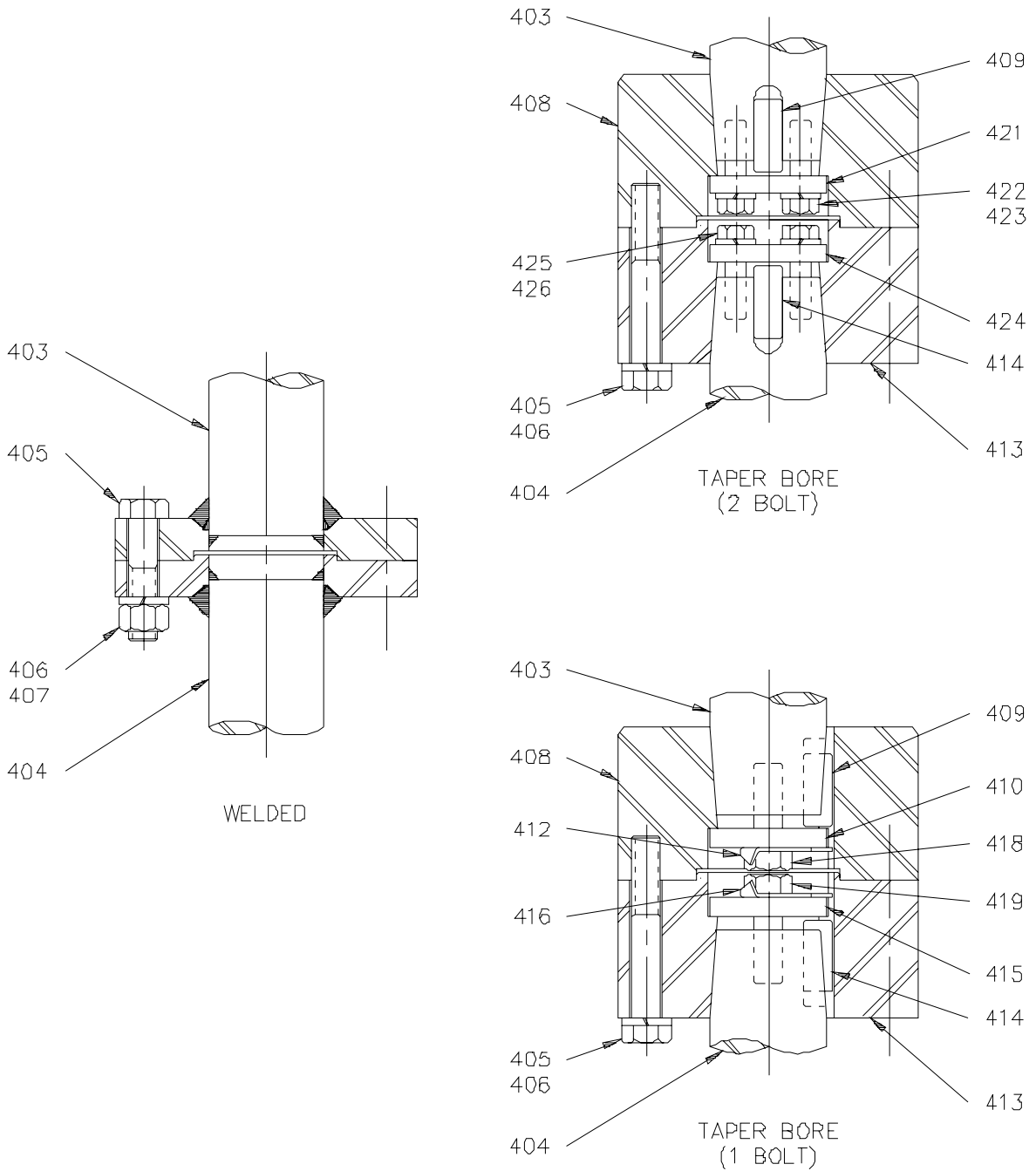


Figure 19: In-Tank Couplings

OPTIONS: AUXILIARY SHAFT SEALS

HTD style units may include an optional auxiliary shaft seal. The gear drive must be parallel to the seal mounting surface and the output shaft must be centered over the seal mounting surface for proper seal operation.

Auxiliary Lip Seal

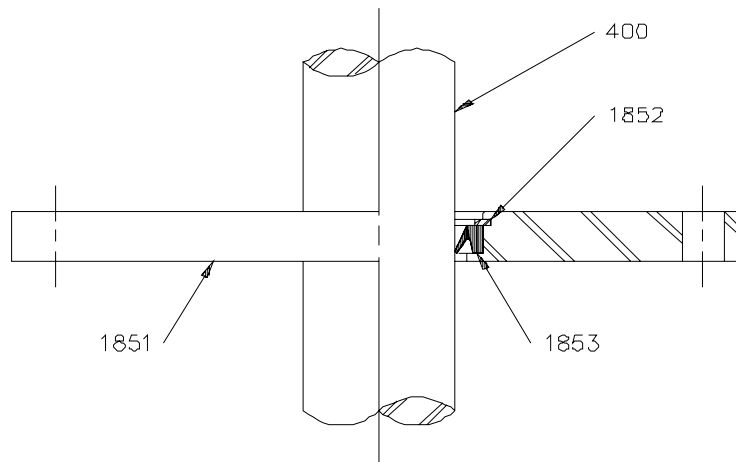


Figure 20: Auxiliary Lip Seal

1. Remove snap ring [1852] and lip seal [1853] from flange [1851].
2. Assemble the auxiliary lip seal flange to the vessel with the proper gasket and bolts (supplied by others). *Do not install the bolts at this time.*
3. Lower extension shaft [400] (*Figure 3, page 10*) into the vessel through the auxiliary lip seal flange. If the extension shaft coupling half is not installed, the shaft may be lifted up through the auxiliary lip seal from inside the tank. Block the shaft from inside the vessel such that the extension shaft extends above the agitator drive mounting surface.

OPTIONS: AUXILIARY SHAFT SEALS

Auxiliary Lip Seal (Cont'd)

4. Place the lip seal and the snap ring over the extension shaft. Assemble lip seal and snap ring to the flange.
5. Install the extension shaft coupling half if required. Refer to *Installation, Rigid Shaft Couplings* for instructions.
6. Lift the agitator drive (*Figure 5, page 13.*)
7. Suspend the agitator drive assembly over the extension shaft coupling half, close enough to allow installation of coupling bolts and lockwashers [361, 362]. Coupling faces and tenons must be clean and free of nicks or burrs. Line up match-mark arrows when making up the coupling. Install two bolts and lockwashers at 180°. Tighten the bolts to engage the tenon and pull the coupling faces together.
8. Lift the agitator drive assembly and the extension shaft. Remove the shaft blocking. Install the remaining coupling bolts and lockwashers. Torque to the value shown in *Table 4, page 12.*
9. Lower the agitator drive assembly onto the support structure. Install the mounting bolts (supplied by others). *Do not tighten the bolts at this time.*
10. Install the auxiliary lip seal flange bolts finger tight. If the bolt holes in the lip seal flange and the vessel flange are not properly aligned, the agitator drive will have to be moved laterally or shimmed. If shimming is required, use full width shims under the mounting feet to provide a solid joint for bolting the agitator drive to the support structure. Torque the agitator drive mounting bolts to the value shown in *Table 4.* Then torque the auxiliary lip seal flange bolts to the value shown in *Table 4.*
11. Auxiliary lip seals do not require any adjustment or lubrication. Buna N and teflon lip seals [1853] as supplied are not split.
12. Continue with the agitator installation.

OPTIONS: AUXILIARY SHAFT SEALS

Auxiliary Stuffing Boxes

1. Remove gland plate [1355], split gland [1356], packing [1357] and lantern ring [1358] (six ring stuffing box only).
2. Assemble the auxiliary stuffing box flange to the vessel with the proper gasket and bolts (supplied by others). *Do not install the bolts at this time.*
3. Place packing [1357], lantern ring [1358] and gland plate [1355] over the extension shaft and lower the extension shaft into the vessel through the auxiliary stuffing box flange.
4. If the extension shaft coupling half is not installed, the shaft may be lifted up through the auxiliary stuffing box from inside the vessel. Block the shaft from inside the vessel such that the extension shaft extends above the agitator drive mounting surface. Install packing, lantern ring and gland plate over the extension shaft.
5. Install the extension shaft coupling half if required. Refer to *Installation, Rigid Shaft Couplings* for instructions.
6. Lift the agitator drive (*Figure 5, page 13*).
7. Suspend the agitator drive assembly over the extension shaft coupling half close enough to allow installation of the coupling bolts and lockwashers [361, 362]. Coupling faces and tenons must be clean and free of nicks or burrs. Line up match-mark arrows when making up the coupling. Install two bolts and lockwashers at 180°. Tighten the bolts to engage the tenon and pull the coupling faces together.
8. Lift the agitator drive assembly and the extension shaft. Remove the shaft blocking. Install the remaining coupling bolts and lockwashers. Torque to the value shown in *Table 4, page 12*.
9. Lower the agitator drive assembly onto the support structure. Install the mounting bolts (supplied by others). *Do not tighten the bolts at this time.*
10. Install the auxiliary stuffing box flange bolts finger tight. If the bolt holes in the stuffing box flange and the vessel flange are not properly aligned, the agitator drive will have to be moved laterally or shimmed. If shimming is required, use full width shims under the mounting feet to provide a solid joint for bolting the agitator drive to the support structure.

OPTIONS: AUXILIARY SHAFT SEALS

Auxiliary Stuffing Boxes (Cont'd)

11. Tape gland plate [1355] to the extension shaft coupling half. Attach an indicator to the extension shaft and set the point of the indicator on the top face of the stuffing box housing.
12. Manually turn the flexible motor coupling to rotate extension shaft one turn. Shim the agitator drive until the indicator reading is within 0.005" (0.127 mm) FIM (Full Indicator Movement) maximum. Install and torque the agitator drive mounting bolts (supplied by others) to the value shown in *Table 4, page 12*.
13. In extreme cases a tapered adapter will be required (supplied by others) to correct the angular misalignment. Call Chemineer Field Service for assistance.
14. Attach an indicator to the extension shaft and set the point of the indicator on the inside diameter of the stuffing box housing. Align the stuffing box housing to within 0.005" (0.127 mm) FIM of the shaft centerline and then tighten the stuffing box flange bolts (supplied by others). Torque to the value shown in *Table 4*.
15. Install packing, lantern ring, split gland, and gland plate [1357, 1358, 1356, 1355]. Install gland nuts and lockwashers [1353, 1354]. Tighten finger tight.
16. Stuffing box auxiliary shaft seals will require adjustment at start up. See the *Lubrication* and *Maintenance* sections of this manual.
17. Continue with the agitator installation.

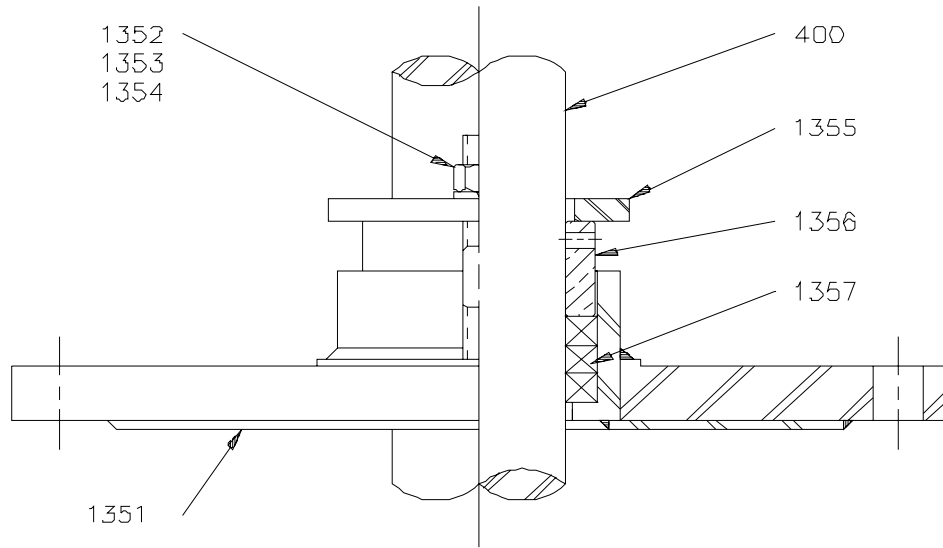


Figure 21: Auxiliary 3-Ring Stuffing Box

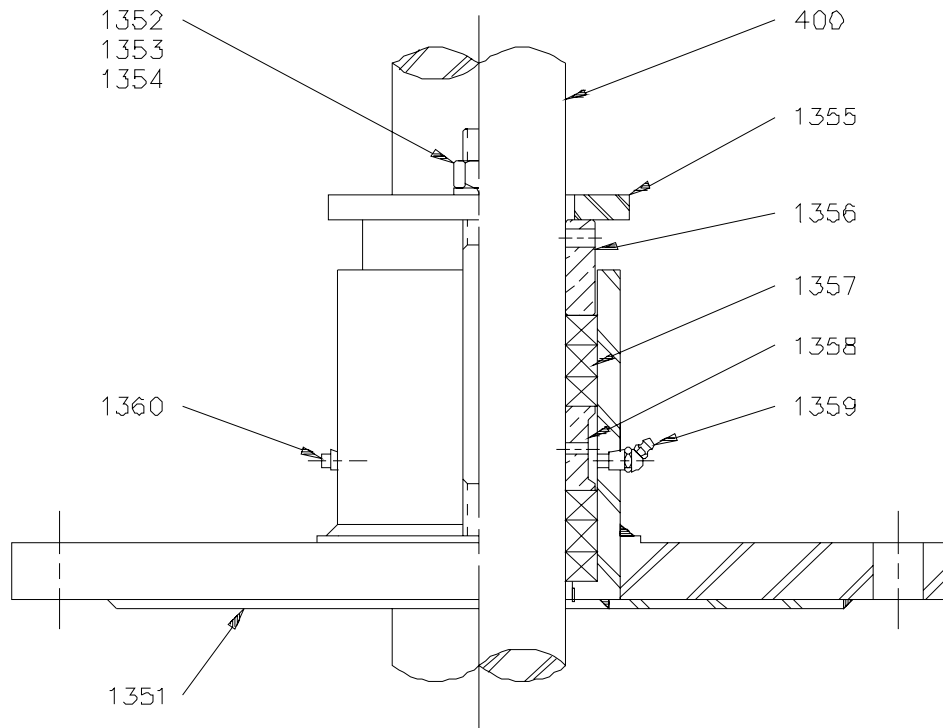


Figure 22: Auxiliary 6-Ring Stuffing Box

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, 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 14*, for checking and straightening the shaft. Steady bearing mountings should be located from the installed agitator extension shaft.

Bracket Steady Bearing

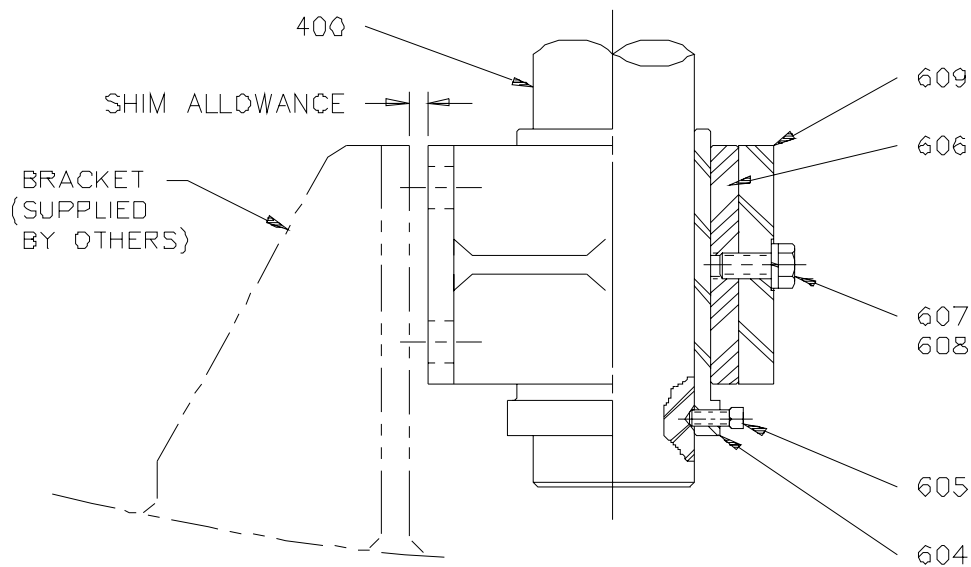


Figure 23: Bracket Steady Bearing

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 4, page 12*.

OPTIONS: STEADY BEARINGS

Bracket Steady Bearing (Cont'd)

2. Loosen setscrews [605] and remove wear sleeve [604]. Remove bushing retaining bolt [607] 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 extension shaft one turn. Shim the steady bearing housing until it is located concentric to the shaft centerline within 0.050" (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 0.010" (0.25 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 4, page 12*.
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 4*. 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

Cup Tri-Pod Steady Bearing

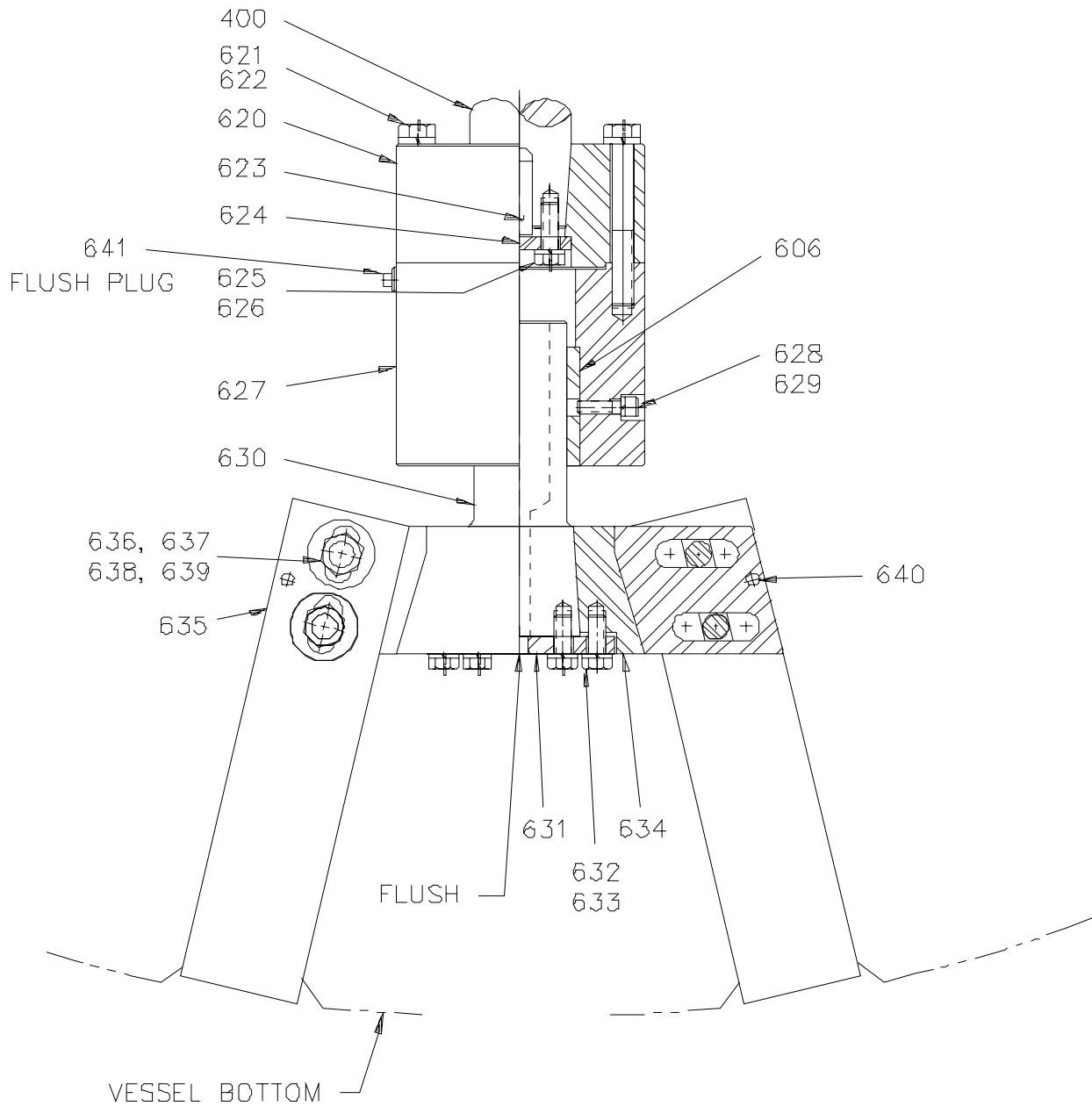


Figure 24: Cup Tri-Pod Steady Bearing

OPTIONS: STEADY BEARINGS

Cup Tri-Pod Steady Bearing (Cont'd)

1. Install the coupling [620] onto the end of the extension shaft [400] with key [623] and bolts, lockwashers, and coupling washer [625, 626, 624]. Refer to the *Installation* section, *page 33* for in-tank coupling installation.
2. Assemble the stub shaft [630], stub shaft housing [634], and retainer plate [631] with bolts [632] and lockwashers [633]. Torque bolts to the value shown in *Table 4, page 12*. *NOTE: Be sure to assemble the stub shaft [630] to the retainer plate [631] before inserting into the stub shaft housing [634]. Alignment of the stub shaft [630] to the retainer plate [631] is crucial to future maintenance.*
3. Attach legs [635] with bolts, nuts, lockwashers, and two flatwashers [636, 637, 638, 639]. *Do not torque bolts at this time.* Locate the steady bearing assembly so that it is centered with the extension shaft.
4. Adjust the leg angle and steady bearing assembly height. Torque leg bolts [636] to the value shown in *Table 4*. Refer to the steady bearing assembly drawing for the proper steady bearing set dimensions. *NOTE: Later in the procedure, the stub shaft housing will need to be adjusted for shaft concentricity and parallelism. Be sure to leave room in the leg and housing slots for future adjustment.*
5. Attach the legs [635] to the vessel bottom. *CAUTION! The stub shaft [630] will need to be removed periodically for future maintenance. Be certain there are no obstructions below the steady bearing assembly that would hinder the stub shaft removal.*
6. Attach an indicator to the coupling [620] and set the point of the indicator on the top of the stub shaft housing [634]. Manually turn the extension shaft [400] one full turn. Loosen the leg bolts [636] and nuts [637] and adjust the stub shaft housing [634] to obtain 0.010" (0.25 mm) FIM (Full Indicator Movement) maximum.
7. Place the indicator point on the outside diameter of the stub shaft [630] and rotate the extension shaft one turn. Loosen the leg bolts [636] and nuts [637] and move the stub shaft housing [634] until the stub shaft is located concentric to the shaft centerline within 0.050" (1.27 mm) FIM.
8. Torque the leg bolts [636] and nuts [637] to the value shown in *Table 4*.
9. Recheck the steady bearing alignment with the dial indicator. If the alignment needs correction, repeat steps 6 through 8.

OPTIONS: STEADY BEARINGS

Cup Tri-Pod Steady Bearing (Cont'd)

10. Once the final steady bearing housing location has been determined, drill the stub shaft housing and install the dowel alignment pins [640].
11. Loosen and remove bolts and lockwashers [632, 633] anchoring the retainer plate [631] to the stub shaft housing [634]. Re-install bolts into tapped holes at 90 degrees in the retainer plate. Progressively tighten these bolts around the bolt circle to remove the stub shaft [630] from stub shaft housing. *CAUTION! Tapers can disengage with a great deal of force. On larger units, the stub shaft/retainer assembly can be very heavy. It may be advantageous to only remove half of the retainer plate to housing bolts and use those removed to break the stub shaft taper as described above. This will allow for the stub shaft to still be held when it disengages.*
12. Install bushing [606] into bushing housing [627] and secure with bushing retaining bolt [628] and lockwasher [629]. With bushing installed, assemble bushing housing to coupling [620] using bolts and lockwashers [621, 622]. Torque the bolts to the value shown in *Table 4, page 12*.
13. Install the stub shaft [630] through the stub shaft housing [634] and into the bushing [606]. Attach the retainer plate [631] with bolts [632] and lockwashers [633]. Torque the bolts to the value shown in *Table 4*. *NOTE: The retainer plate has been drilled and tapped for a NPT pipe fitting, be sure to orient the plate so that the larger end of the tapped fitting hole is facing downward.*
14. The tri-pod steady bearing has an optional flush feature for lubrication and cooling. If the flush is utilized, attach the flush piping to the flush hole in the retainer plate [631]. Keep the flush plug [641] in place on the bushing housing [627]. *NOTE: The flush inlet pressure should be 15 to 20 psi (69 - 138 kpa) above the vessel pressure*
15. If the flush is not utilized, remove the flush plug [641] from the bushing housing [627].

CAUTION! Do not operate the agitator without the steady bearing flush on or the steady bearing being submerged.

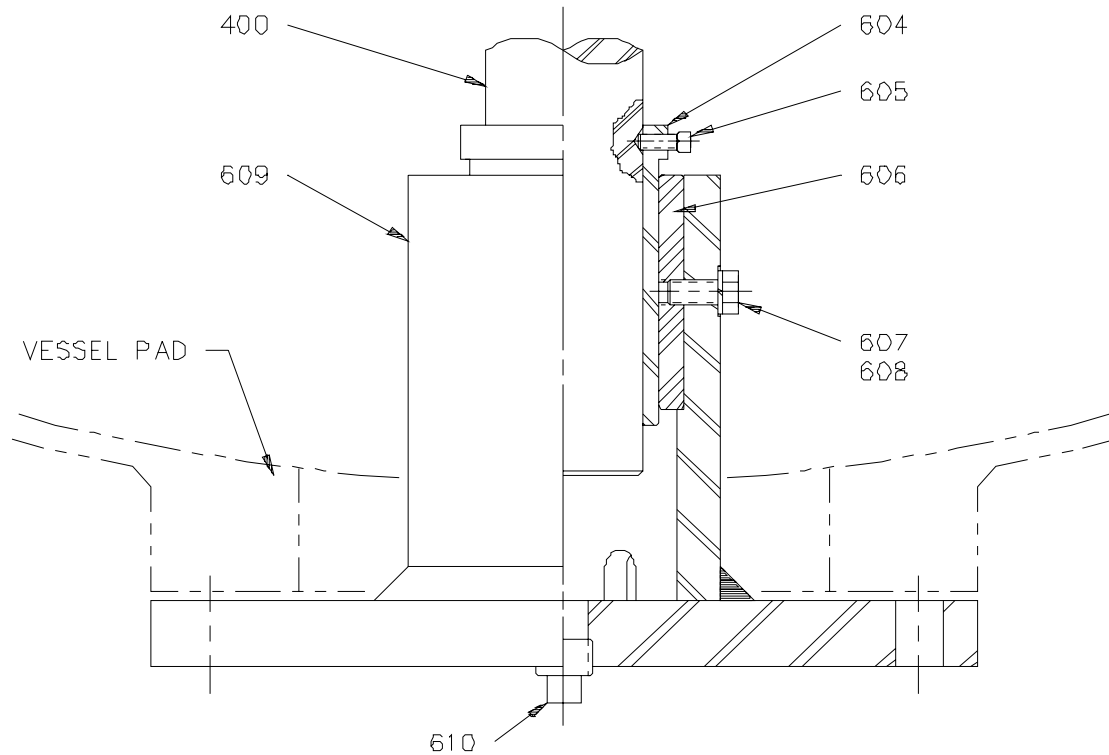
OPTIONS: STEADY BEARINGS**Pad Steady Bearing**

Figure 25: Pad Steady Bearing

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 4, page 12*.
2. Slide wear sleeve [604] up the extension shaft to disengage from bushing [606].
3. Attach an indicator to the shaft and set the point of the indicator on the outside diameter 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 0.010" (0.25 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 top face 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 0.050" (1.27 mm) FIM . Torque the flange bolts to the value shown in *Table 4, page 12*.
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 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 4*. 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 26, 27; pages 48, 49*). 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 case sizes 11,12 and 13, the oil flow alarm switch must be used to stop the agitator drive motor.

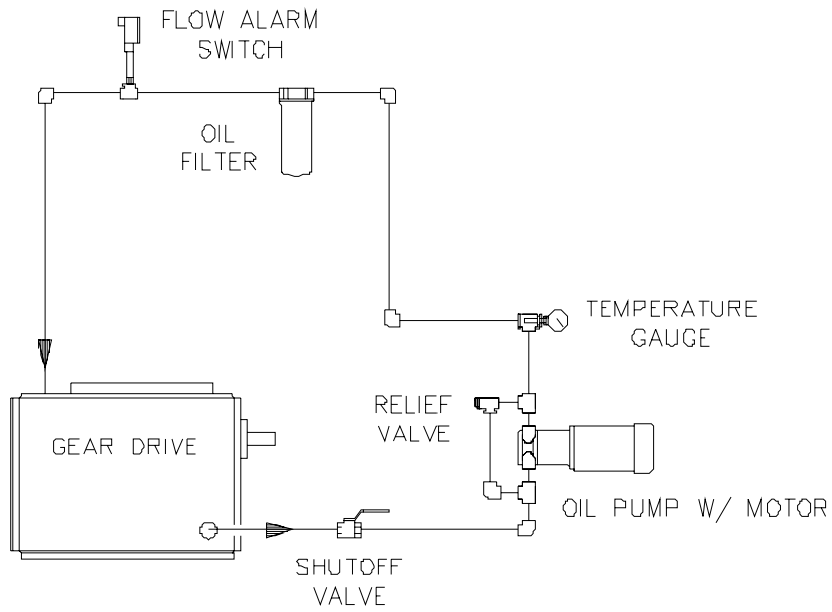
If the gear drive requires cooling, the external motor-driven oil pump will include a water-to-oil heat exchanger and temperature actuated regulating valve. Cooling water will have to be provided to the heat exchanger. See the unit assembly drawing for the required flow rates. Unless otherwise specified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

TABLE 7: COOLING WATER FLOW RATE

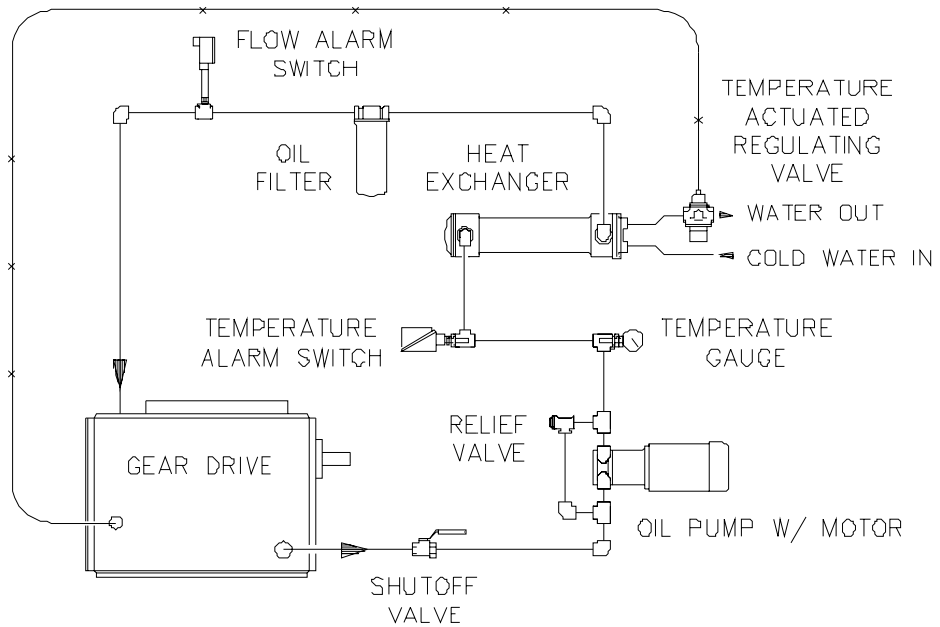
Case Size	Flow Rate*	
	Gallons/Minute	Liters/Minute
3,4,5	2 to 3	7.5 to 11.5
6,7,8,9	3 to 4	11.5 to 15
10,11	5 to 6	19 to 22.5
12,13	7 to 8	26.5 to 30.5

* 85° F (29° C) water temperature

All cooling systems are provided with a temperature alarm switch. The factory temperature setting is 180°F (93°C). This switch is to be used to activate an alarm. See the unit assembly drawing for the switch current rating.



— WITHOUT COOLING —



— WITH COOLING —

Figure 26: External Motor-Driven Oil Pump

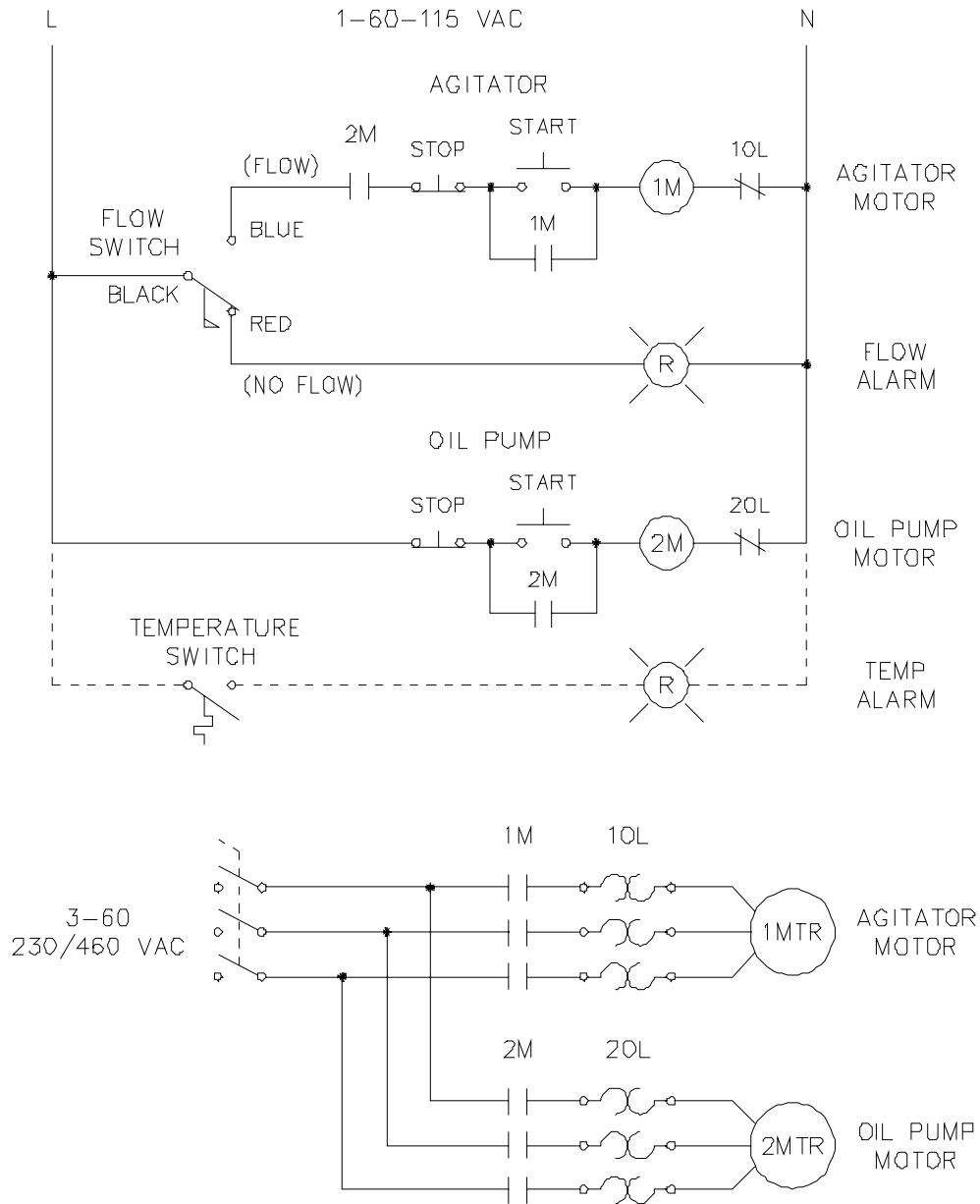


Figure 27: Wiring Diagram

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. The magnetic pulsar wrap is mounted on the top of the gear drive and is driven by the gear reducer output shaft.

Magnetic Signal Tachometer

1. Remove bolts, lockwashers and tachometer cover **[2021, 2022 and 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 and 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 (30.48 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 29, page 52* for the wiring diagram and panel cut-out dimensions.

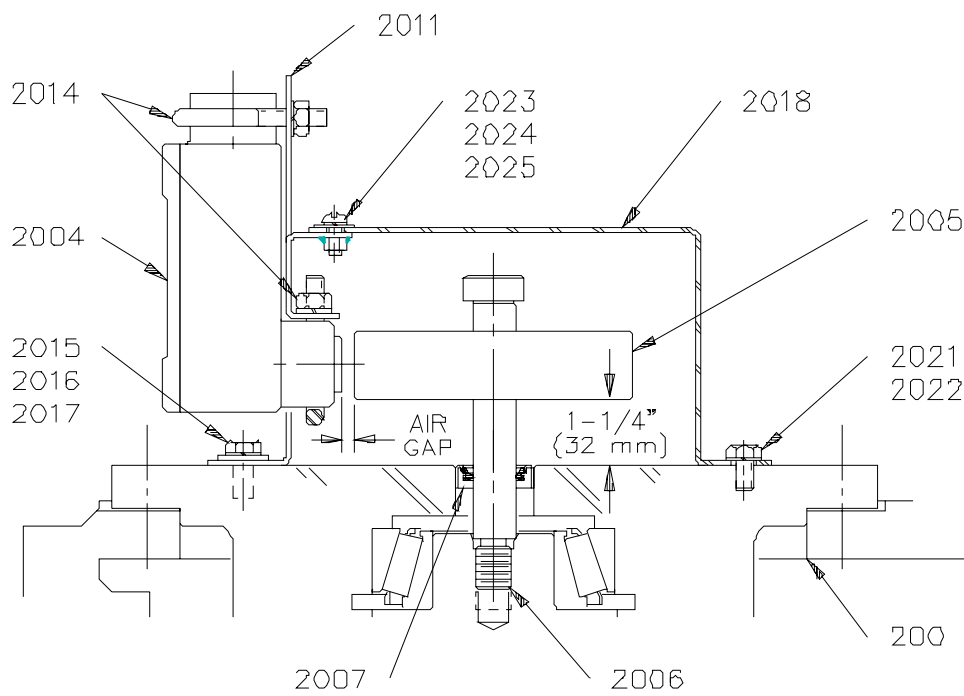


Figure 28: Magnetic Signal Tachometer

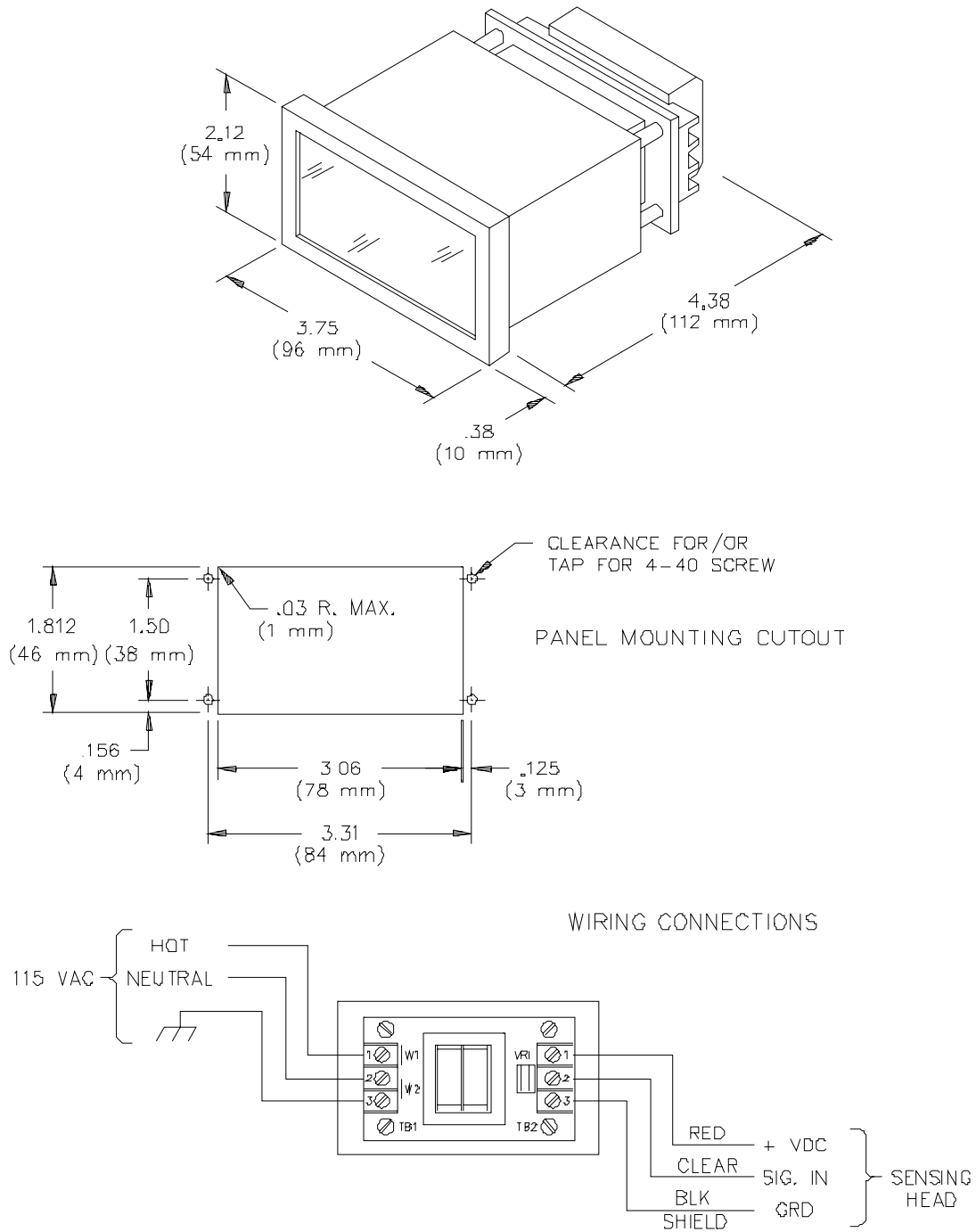


Figure 29: Tachometer Panel Meter [2003]

The meter is factory set and no adjustments or maintenance is required

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 54* lists some commonly available greases.

When regreasing, stop the motor, remove the outlet plug and add grease according to *Table 9, page 55* 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! Over greasing is a major cause of bearing and motor failure.

MOTOR / GEAR DRIVE BEARINGS

TABLE 8: TYPICAL NLGI NO. 2 GREASES

<i>For Ambient Temperature Range of 0° to 150° F (-18° to 66° C)</i>		
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	
	<i>in</i> ³	<i>cm</i> ³	<i>in</i> ³	<i>cm</i> ³	<i>in</i> ³	<i>cm</i> 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 31-35, pages 62-66*) 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 30*), 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.

For case sizes 11, 12 and 13, 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.*

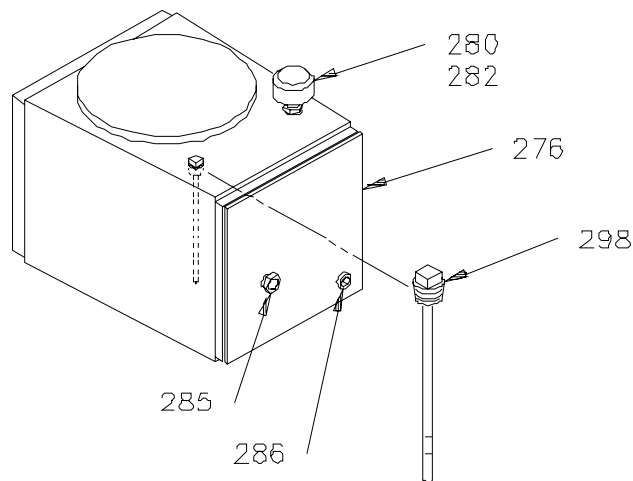


Figure 30: Optional Oil Level Dipstick

GEAR DRIVE

The agitator nameplate or *Table 10, page 58*, should be used to select the proper viscosity oil based on ambient temperature conditions.

Table 11, page 59 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 60* 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 61* should be used. In general an EP oil will be beneficial for all operating conditions. *Tables 11 and 12* 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 54* 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
-10° to 15° F (-24° to -10° C)	32 to 46	- to 1
15° to 50° F (-10° to 10° C)	68 to 100	2 to 3
50° to 125° F (10° to 50° 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
-10° to 15° F (-24° to -10° C)	46 to 68	1 to 2
15° to 50° F (-10° to 10° C)	100 to 150	3 to 4
50° to 125° F (10° to 50° 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
-10° to 15° F (-24° to -10° C)	Consult factory for recommendations	
15° to 50° F (-10° to 10° C)	150 to 220	4EP to 5EP
50° to 125° F (10° to 50° C)	220 to 320	5EP to 6EP

NOTE: For low temperature operation the oil selected should have a pour point at least 9°F or 5°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*

CASE SIZE	Volume	
	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) @ 104° F (40° 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	90 to 110	135 to 165	198 to 242	288 to 352
MANUFACTURER/ Product Line					
Amoco Oil Co./Permaseal 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

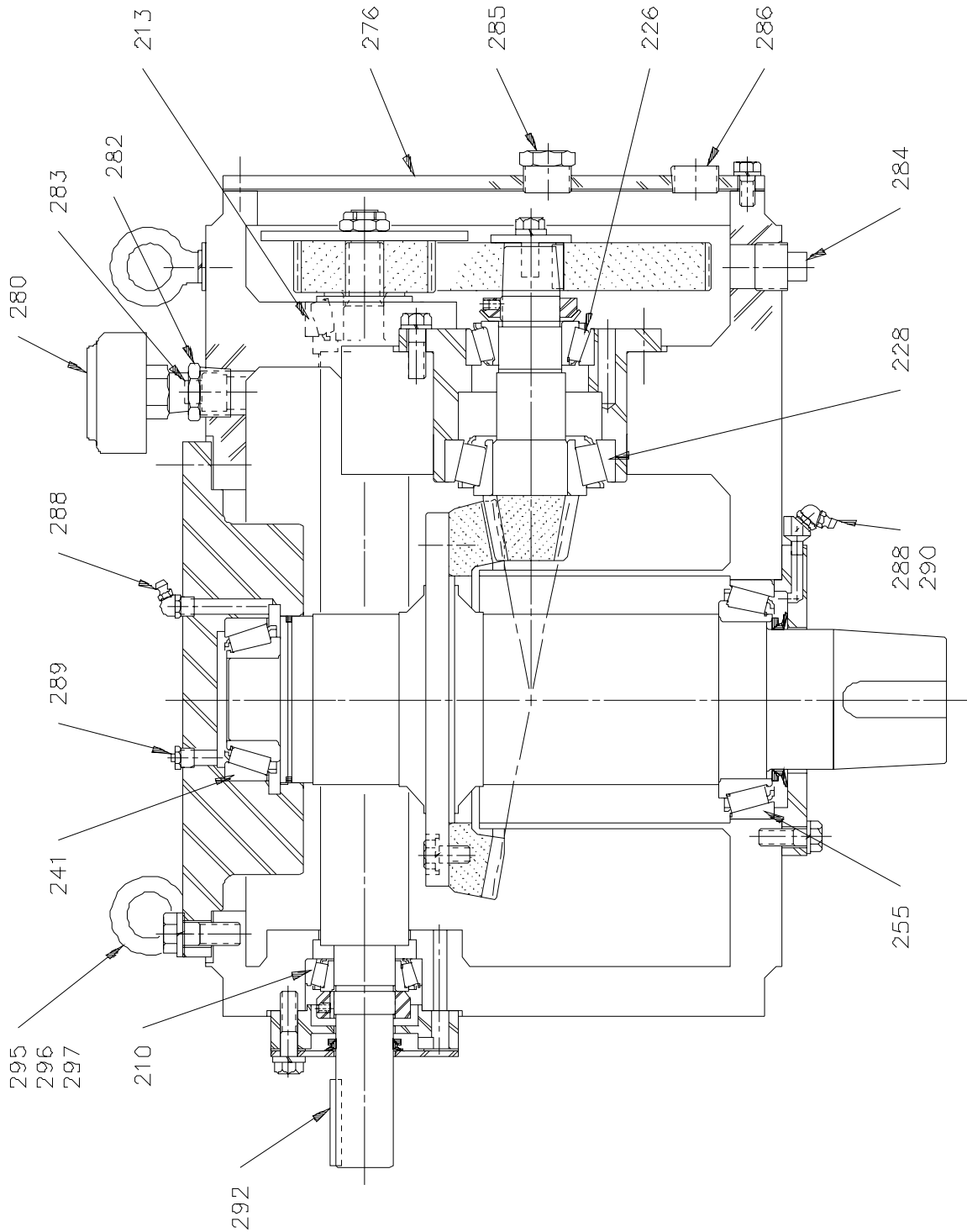


Figure 31: HT Gear Drive: Sizes 1,2,3

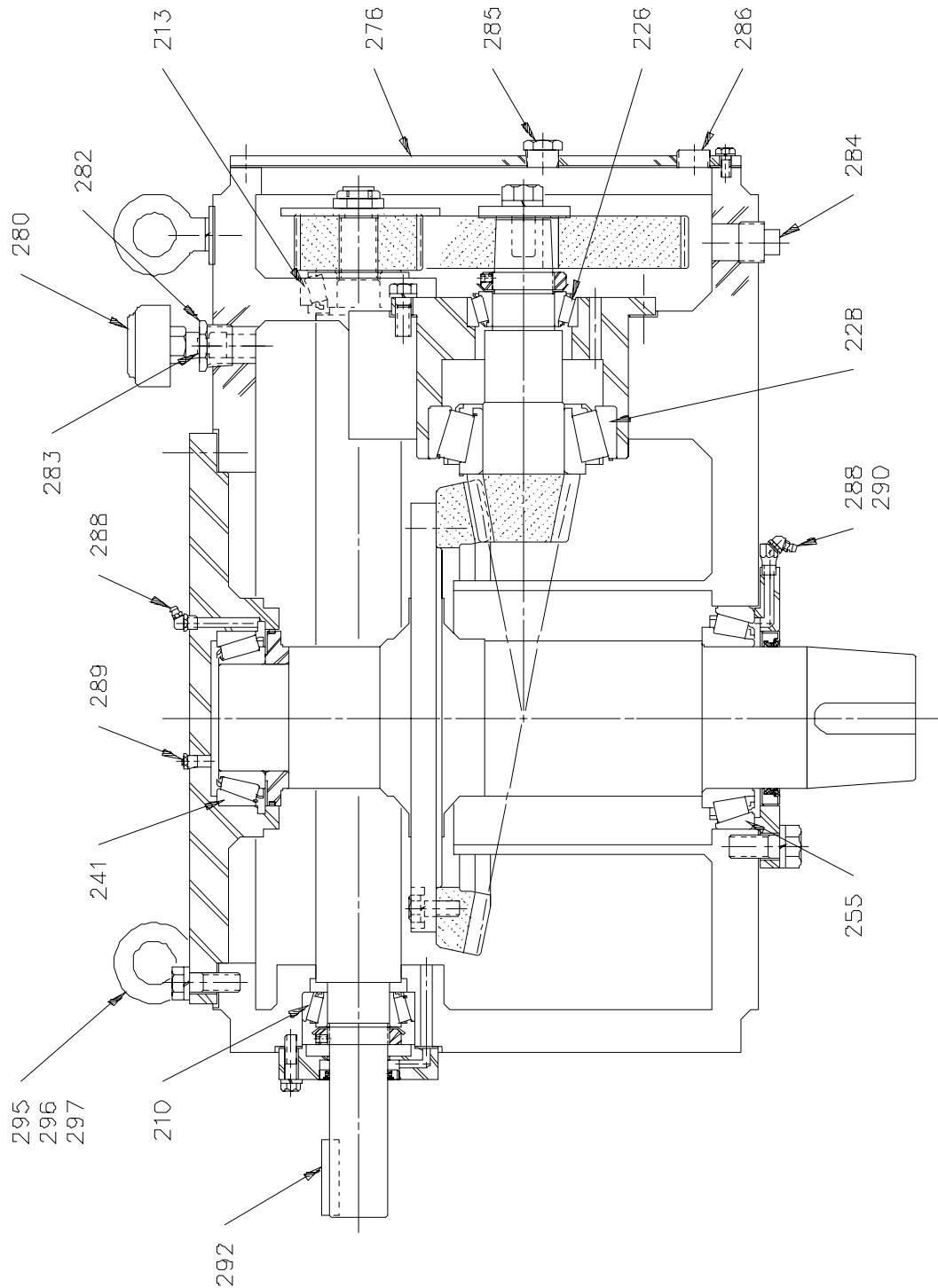


Figure 32: HT Gear Drive: Sizes 4,5,6

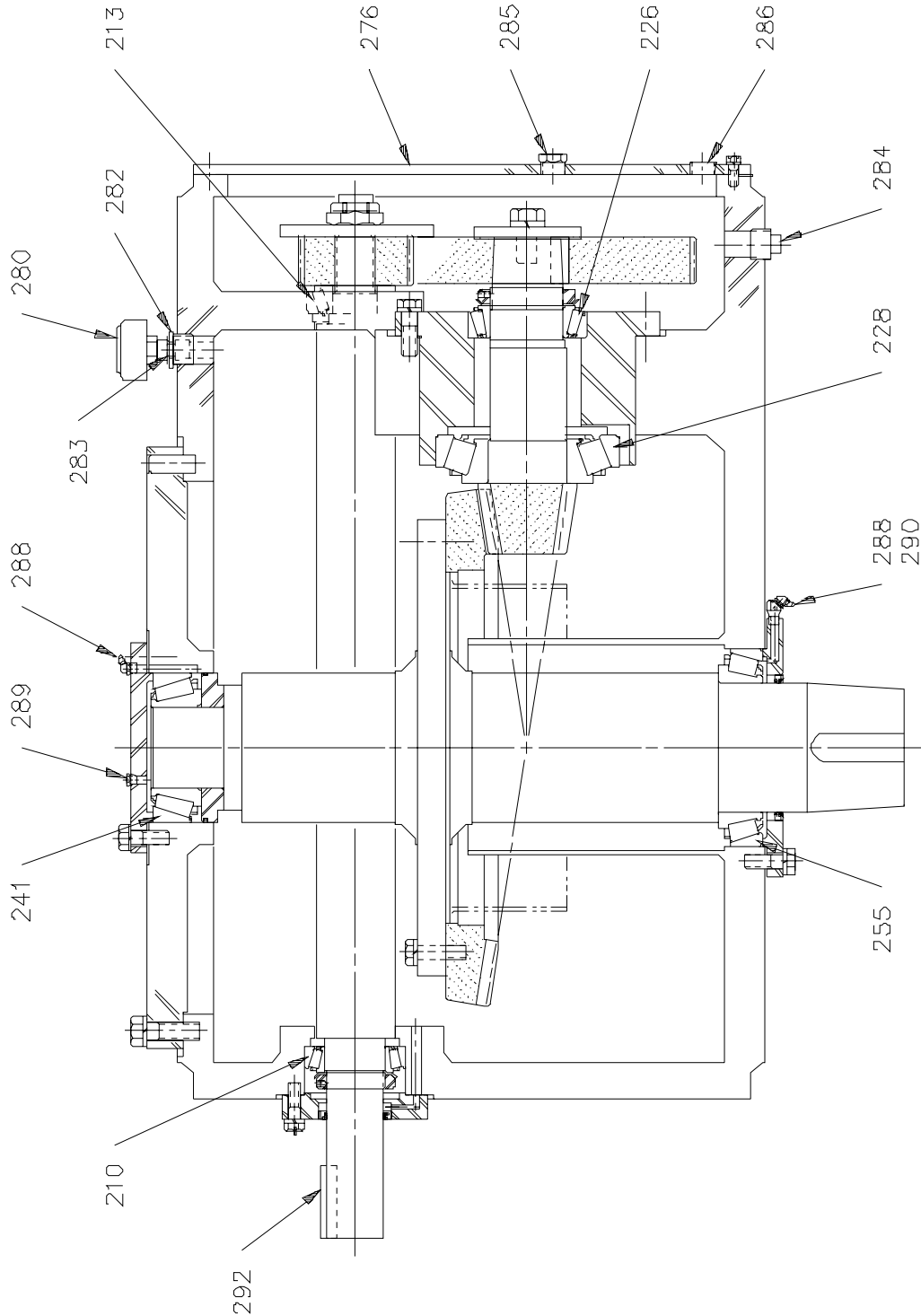


Figure 33: HT Gear Drive: Sizes 7,8,9

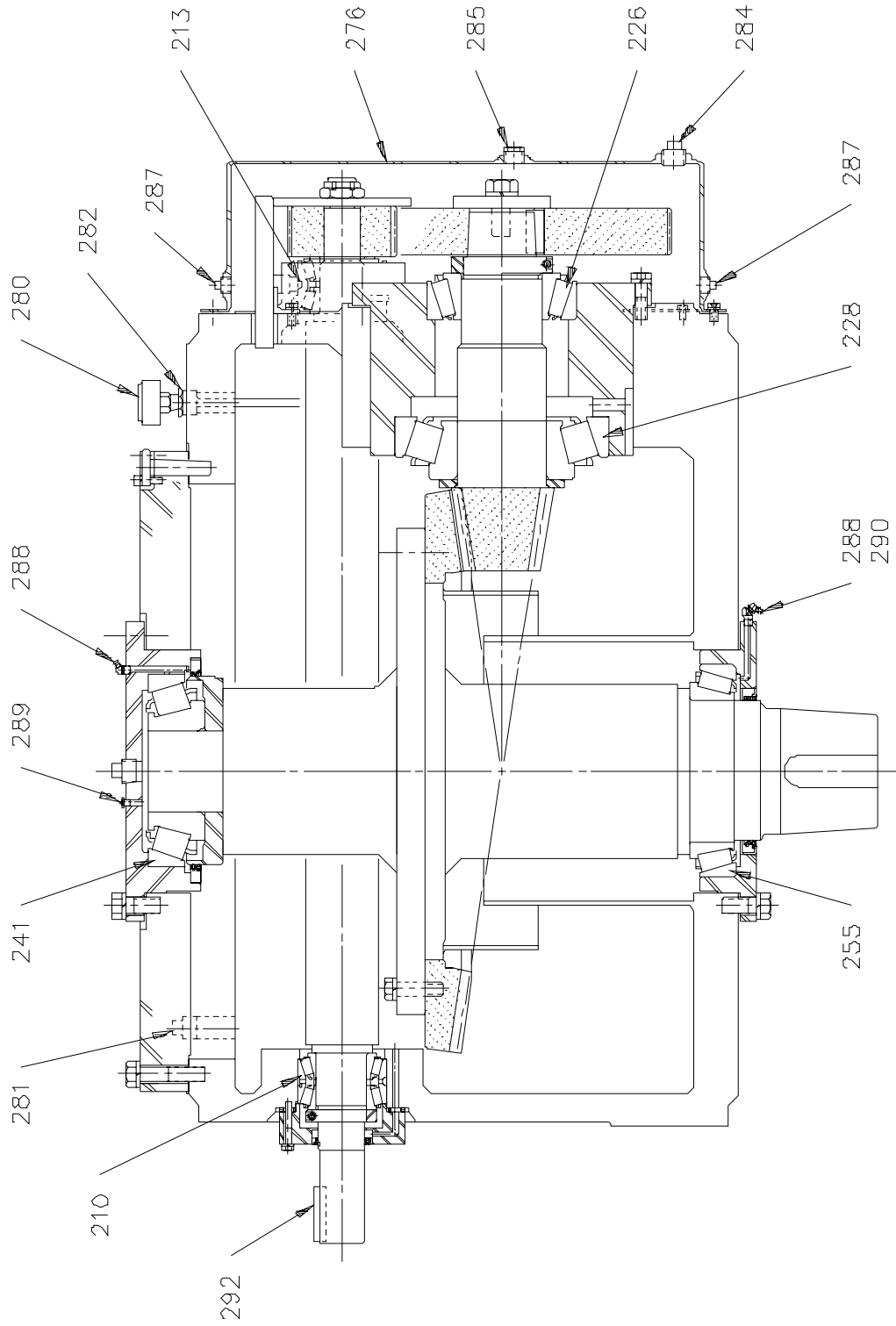


Figure 34: HT Gear Drive: Size 10

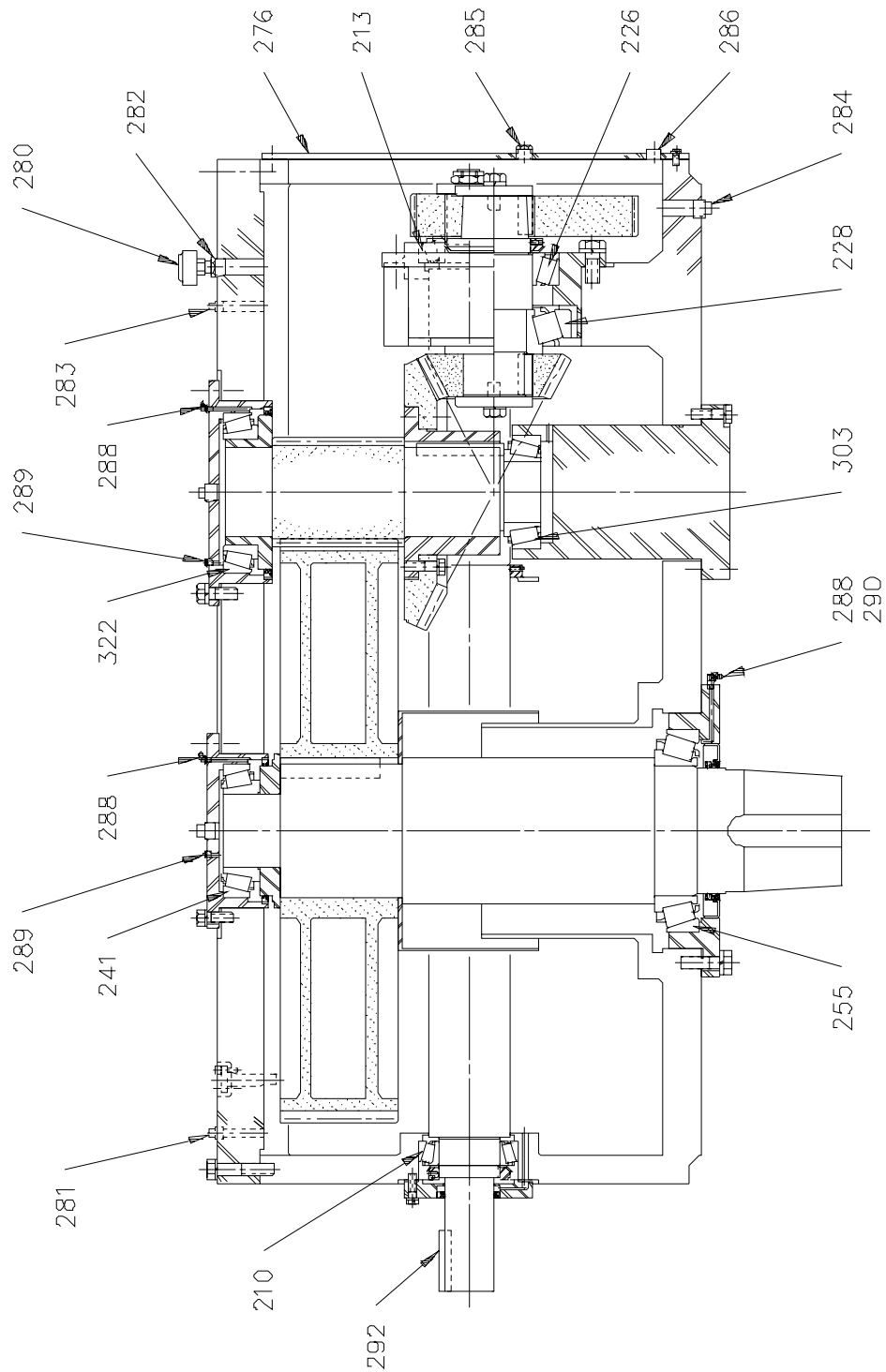


Figure 35: HT Gear Drive: Sizes 11,12,13

AUXILIARY SHAFT SEALS

Only 6-ring stuffing box seals may require lubrication. Refer to agitator assembly drawings for seal style and packing type. The 6-ring stuffing box (*Figures 22 and 37, pages 39 and 75*) is supplied with six rings of packing and a lantern ring. Packing shown as 1065 or 1625 does not require external lubrication.

If other packing has been supplied, grease lubrication may be required. The lubricant selected should be compatible with the process fluid. To lubricate the stuffing box, remove pipe plug **[1360]** and pump grease into grease fitting **[1359]** until grease comes out of the pipe plug hole. Replace the pipe plug. Relubricate as required, approximately every 24 hours.

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 auxiliary shaft seals at temperatures or pressures higher than those for which the unit was designed. Refer to unit assembly drawing.
- **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 14, page 72*. 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 *Motor Coupling* supplement with this manual.

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 26, page 48*). 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 main 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 regulating valve. This system will include both an oil flow alarm switch and a temperature alarm switch which should be hooked up before operation. Plumb water to 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.

AUXILIARY SHAFT SEALS

Before start up, make sure any auxiliary shaft seal is installed and centered on the agitator shaft.

Stuffing box shaft seals require extreme care during initial installation and operation if proper packing life is to be realized. Six (6) ring stuffing boxes are equipped with a lantern ring. Lubricate packing if required before operation. Refer to the *Lubrication* section of this manual. In order to obtain proper sealing from a stuffing box the packing must be allowed to "run in". Prior to operation, the gland nuts should be tightened finger tight. As the unit is started up, the packing should be allowed to "run in" by tightening the gland nuts gradually (no more than one flat on the nuts every 15 minutes) until the desired level of sealing is obtained. Once the packing has been "run in", the gland nuts should be retightened on a regular basis. This can vary from weekly to monthly depending upon the desired level of sealing.

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 agitator unless the steady bearing is submerged.

The tri-pod steady bearing has been supplied with an optional flush feature for lubrication and cooling. If the flush is utilized, the pipe plug [641] must remain installed on the bushing housing [627] and the inlet pressure should be maintained at 15 to 20 psi (69 - 138 kpa) above the vessel pressure. If the flush is not utilized, the pipe plug [641] must be removed.

TROUBLESHOOTING

TABLE 14: 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 <i>Lubrication</i> 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 Packing	Replace packing.

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 optional devices.
2. Disconnect any water lines to oil coolers.
3. If an optional auxiliary shaft seal is installed, depressurize vessel and loosen the gland nuts (on stuffing box seals).
4. For HTP units, remove handhole covers [1108].
5. If a bracket steady bearing is installed, remove the wear sleeve.
6. Remove agitator mounting bolts. With a hoist or crane system, lift the agitator assembly (*Figure 5, page 13*) and block the extension shaft in place. Remove the rigid coupling bolts.
7. Remove the agitator drive to a suitable service area.

Preparation for Gear Drive Disassembly

1. Clean external surfaces and drain the oil.
2. 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. See *Figures 3 and 4, pages 10 and 11*.

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.

3. Remove bolts [133] securing motor bracket [131] to gear drive [200]. Remove the motor and motor bracket as an assembly.
4. Remove gear drive coupling half [351], (*Figures 6 and 7, page 15*). Remove bolts, lockwashers, and coupling washer [354, 355, 353]. Remove coupling half with a gear puller.

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

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

MAINTENANCE

AUXILIARY STUFFING BOX

Repacking is required when satisfactory control over leakage is not attainable or when the holes in the split gland meet the outboard end of the stuffing box housing.

Repack Procedure (*see Figures 36 and 37, page 75*)

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

1. For HTP units, remove handhole covers [1108].
2. Auxilliary 6-ring stuffing box: Remove gland nuts [1353] and lockwashers [1354]. Slide gland plate [1355] towards the gear drive. Remove split gland [1356]. With packing tools remove three rings of packing [1357], lantern ring [1358] and the remaining three rings of packing. The lantern ring is provided with two #8-32 tapped holes to aid in removal.
3. Auxilliary 3-ring stuffing box: Remove gland nuts [1353] and lockwashers [1354]. Slide gland plate [1355] towards the gear drive. Remove split gland [1356]. With packing tools remove three rings of packing.

NOTE: Never add new packing on top of the old packing, as this will cause accelerated wear and scoring of the shaft.

Refer to the unit assembly drawing for the number and composition of the packing rings supplied originally with your agitator.

4. Auxilliary 6-ring stuffing box: Install three packing rings, lantern ring, three more packing rings, split gland (holes at top), gland plate, lockwashers and gland nuts.
5. Auxilliary 3-ring stuffing box: Install three packing rings, split gland (holes at top), gland plate, lockwashers and gland nuts.
6. Tighten the gland nuts until the lockwashers are compressed.
7. For HTP units, install pedestal handhole covers [1108].

After repacking, relubricate the stuffing box (if required) according to the *Lubrication* section of this manual.

The stuffing box will require adjustment at start-up. Do not overtighten gland nuts. Always strive for satisfactory sealing with the least gland force possible. Tighten the gland nuts uniformly and gradually (no more than one flat on the nuts every 15 minutes) until the leakage rate is acceptable. Do not overtighten the gland nuts. Make sure the gland plate remains square with the shaft.

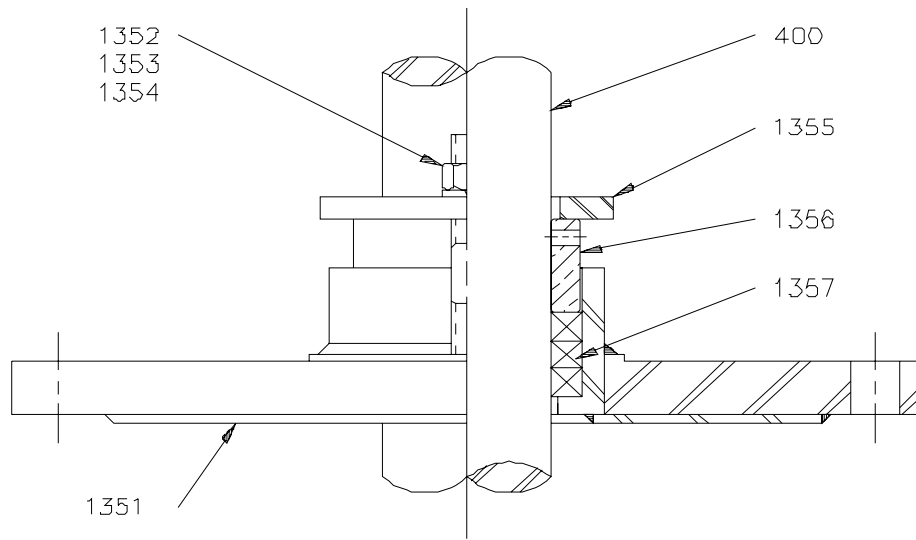


Figure 36: Auxiliary 3-Ring Stuffing Box

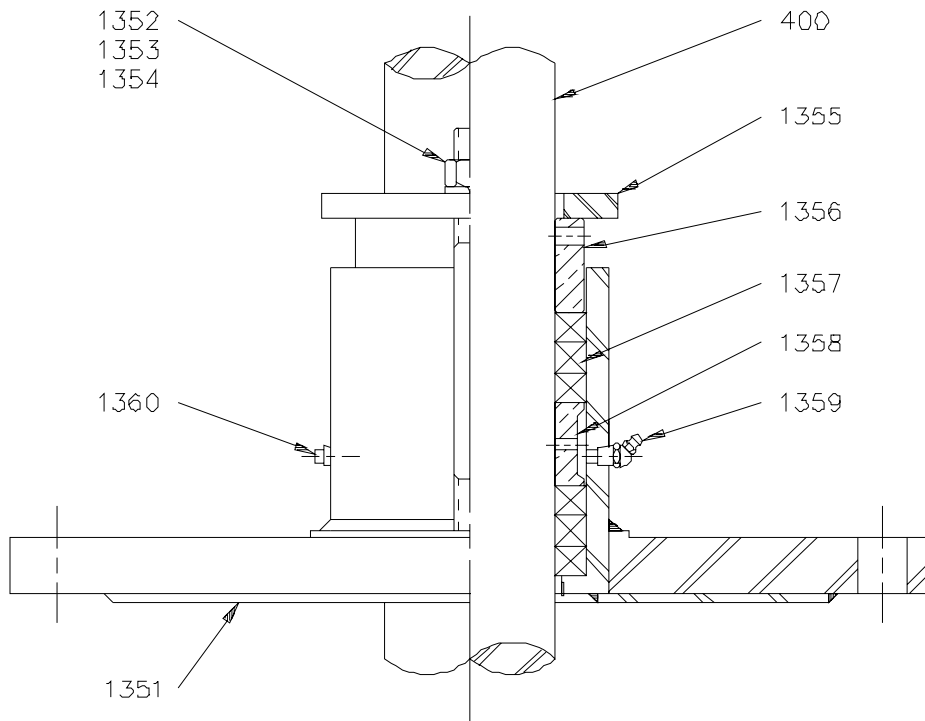


Figure 37: Auxiliary 6-Ring Stuffing Box

MAINTENANCE

BRACKET AND PAD STEADY BEARINGS

In-tank steady bearings will require periodic inspection and replacement of bushing and wear sleeve [606, 604]. (Figures 23 and 25; pages 40 and 45). 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 diametric wear allowance is:

TABLE 15: BRACKET AND PAD 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 25*) will require removal of steady bearing housing [609] prior to removal of the wear sleeve.
2. Unbolt the housing from the bracket.
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 4, page 12*.

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

MAINTENANCE

CUP TRI-POD STEADY BEARINGS

In-tank steady bearings will require periodic inspection and replacement of bushing and stub shaft [606, 630]. (Figure 24, page 42). It is recommended that the steady bearing fasteners be checked for tightness and the bushing and stub shaft for wear after the first two weeks of operation. Unless otherwise specified the recommended diametric wear allowance is:

TABLE 16: CUP TRI-POD STEADY BEARING STUB SHAFT AND BUSHING WEAR ALLOWANCES

Shaft Diameter	Up to 3" size (76.2 mm)	Larger than 3" (76.2 mm)
Stub Shaft	.040" (1 mm)	.060" (1.5 mm)
Bushing	.120" (3 mm)	.180" (4.5 mm)

The stub shaft 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. Remove the retainer plate [631] and the stub shaft [630] from the stub shaft housing [634]. Remove the retainer to housing bolts and install them into the threaded holes on the retainer plate. Progressively tighten these bolts around the bolt circle to remove the stub shaft. *CAUTION! Tapers can disengage with a great deal of force. On larger units, the stub shaft/retainer assembly can be very heavy. In order to hold the stub shaft when it disengages use half of the supplied retainer bolts threaded into the stub shaft housing.*
2. Unbolt the bushing housing [627] from the coupling [620]. Remove the bushing retaining bolt [628] and lockwasher [629]. Press the bushing [606] out of the bushing housing [627].
3. Press a new bushing into the bushing 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.*
4. Reinstall the bushing housing, new stub shaft, and retainer plate as described in the **Installation** section of this manual. Torque all fasteners to the values shown in *Table 4, page 12*.
5. Reattach the flush piping if utilized.
CAUTION! Do not operate the agitator without the steady bearing flush on or the steady bearing being submerged.

HTD/HTP 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	

HTD/HTP 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	
356	rigid, non-removable, shrink fit, straight bore coupling half	1
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
400	extension shaft assembly	1
401	extension shaft	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	

HTD/HTP AGITATOR ITEM LIST

Item #	Description	Qty
408	rigid, removable, taper bore coupling half	1
409	key	1
410	coupling washer	1
412	locking tab	1
413	rigid, removable, taper bore coupling half	1
414	key	1
415	coupling washer	1
416	locking tab	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	

HTD/HTP 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	
532	impeller assembly XE-3	
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	bushing	1
607	bushing retaining bolt	1
608	lockwasher	1
609	steady bearing housing	1
610	pipe plug, NPT	1
620	coupling	1
621	coupling bolt	4,6
622	lockwasher	4,6
623	key	1
624	coupling washer	1
625	shaft bolt	2
626	lockwasher	2
627	bushing housing	1
628	bushing retaining bolt	1
629	lockwasher	1
630	stub shaft	1
631	retainer plate	1
632	retainer plate bolt	4,8
633	lockwasher	4,8
634	stub shaft housing	1
635	leg	3
636	leg bolt	6
637	leg nut	6
638	lockwasher	6

HTD/HTP AGITATOR ITEM LIST

Item #	Description	Qty
639	flatwasher	6
640	alignment pin	3
641	pipe plug (flush), NPT	1
800	mounting feet assembly	1
801	mounting foot	2
802	bolt	
803	lockwasher	
804	pipe nipple	1
805	pipe elbow	1
810	channel riser assembly	1
900	anchor bolt assembly	1
901-001	anchor bolt	4
-002	anchor bolt	6
902-001	nut	4
-002	nut	6
903-001	lockwasher	4
-002	lockwasher	6
904-001	flatwasher	4
-002	flatwasher	
1100	pedestal assembly	1
1101	pedestal	1
1102	shoulder bolt	2
1103	bolt	6
1104	lockwasher	6
1105	bolt	8
1106	lockwasher	8
1108	handhole cover	2
1109	bolt	
1112	lockwasher	
1200	mounting plate assembly	1
1201	mounting plate	1
1350	auxiliary stuffing box assembly	1
1351-001	flanged stuffing box (6 ring)	1
-002	flanged stuffing box (3 ring)	1
1352	stud	2
1353	gland nut	2
1354	lockwasher	2

HTD/HTP AGITATOR ITEM LIST

Item #	Description	Qty
1355	gland plate	1
1356	split gland	1
1357-001	packing (2 sets of 3 rings)	6
-002	packing (1 set of 3 rings)	3
1358	lantern ring	1
1359	grease fitting	1
1360	pipe plug, NPT	1
1850	auxiliary lip seal assembly	1
1851	lip seal flange	1
1852	snap ring	1
1853	lip seal	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



P.O. Box 1123
Dayton, Ohio 45401
Phone: (937) 454-3200
FAX: (937) 454-3379

www.chemineer.com