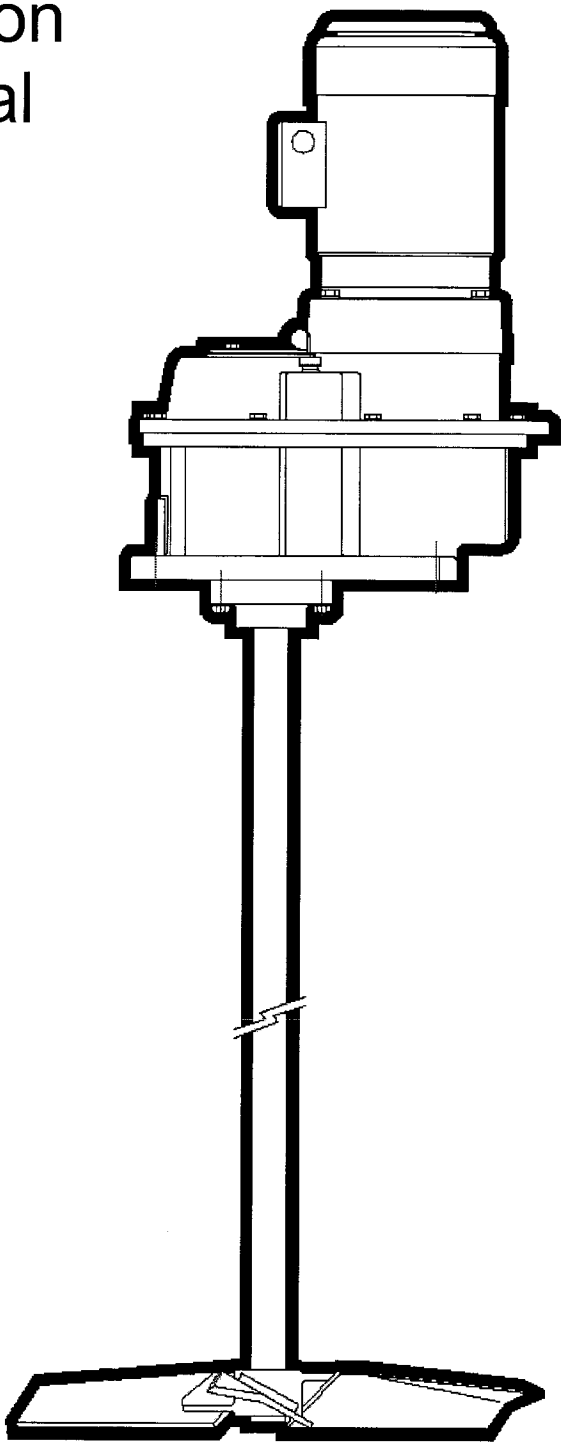
Chemineer

Manual 415.01

GTD/GTP Turbine Agitators Installation, Operation Maintenance Manual

Equipment Reference:
GTD Style Agitator
GTP Style Agitator



For service and
information contact:

TABLE OF CONTENTS

TABLE OF CONTENTS

TABLE OF CONTENTS

Page

Tables

TABLE OF CONTENTS

Page

Figures

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 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 contact Parts/Field Service at the Chemineer Factory in Dayton, Ohio:

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

Services available are as follows:

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

STORAGE

Do not remove protective packaging, desiccant, or any protective coatings applied to the wetted parts until the agitator is to be put into service. If the equipment 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.

Inspect for external rust at six-month intervals. 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 with oil until the oil level is 1" (25mm) above full mark on dipstick. 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, "1GTD-5" is a Case Size "1" agitator. Refer to unit assembly drawing or unit nameplate for model designation.

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 to prevent corrosion during storage.

STORAGE

TABLE 1: APPROXIMATE STORAGE OIL CAPACITY[1]

CASE SIZE	QUARTS	GALLONS	LITERS
1GT	6.0	1.5	5.7
2GT	6.0	1.5	5.7
3GT	11.6	2.9	11.0
4GT	11.2	2.8	10.6

[1] Fill to 1" (25 mm) above "Full Mark" on dipstick.

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

CAUTION! Before placing an agitator into service, the storage oil must be completely drained from the gear drive. Turn the gear drive onto the side opposite gear drive cover plate [121] (not installed) to completely drain. Failure to do this will result in oil being trapped in the "drywell" 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.*

AGITATOR MOUNTING

GTD and GTP (open tank) style units usually mount separately from the tank on either a steel structure or a concrete slab over the tank. GTD 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) force. 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 the agitator rotational speed, does not exceed 0.35 inches/sec (8.9mm/sec). Refer to the agitator assembly drawing for the support structure design loads.

Table 3, page 7, Recommended Beam Sizes is keyed to model, a case size and tank diameter. Select the appropriate beam size for you application. Beams of equivalent section modulus and moment of inertia and/or modulus of elasticity can be used.. See *Figure 1, page 5 (GTD) or Figure 2, page 6 (GTP)*. 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. Extreme applications or designs may require support stiffness greater than provided by support recommendations provided herein. Consult *your local Chemineer office* or *Chemineer Field Service* for design guidance.

OPEN TANK MOUNTING

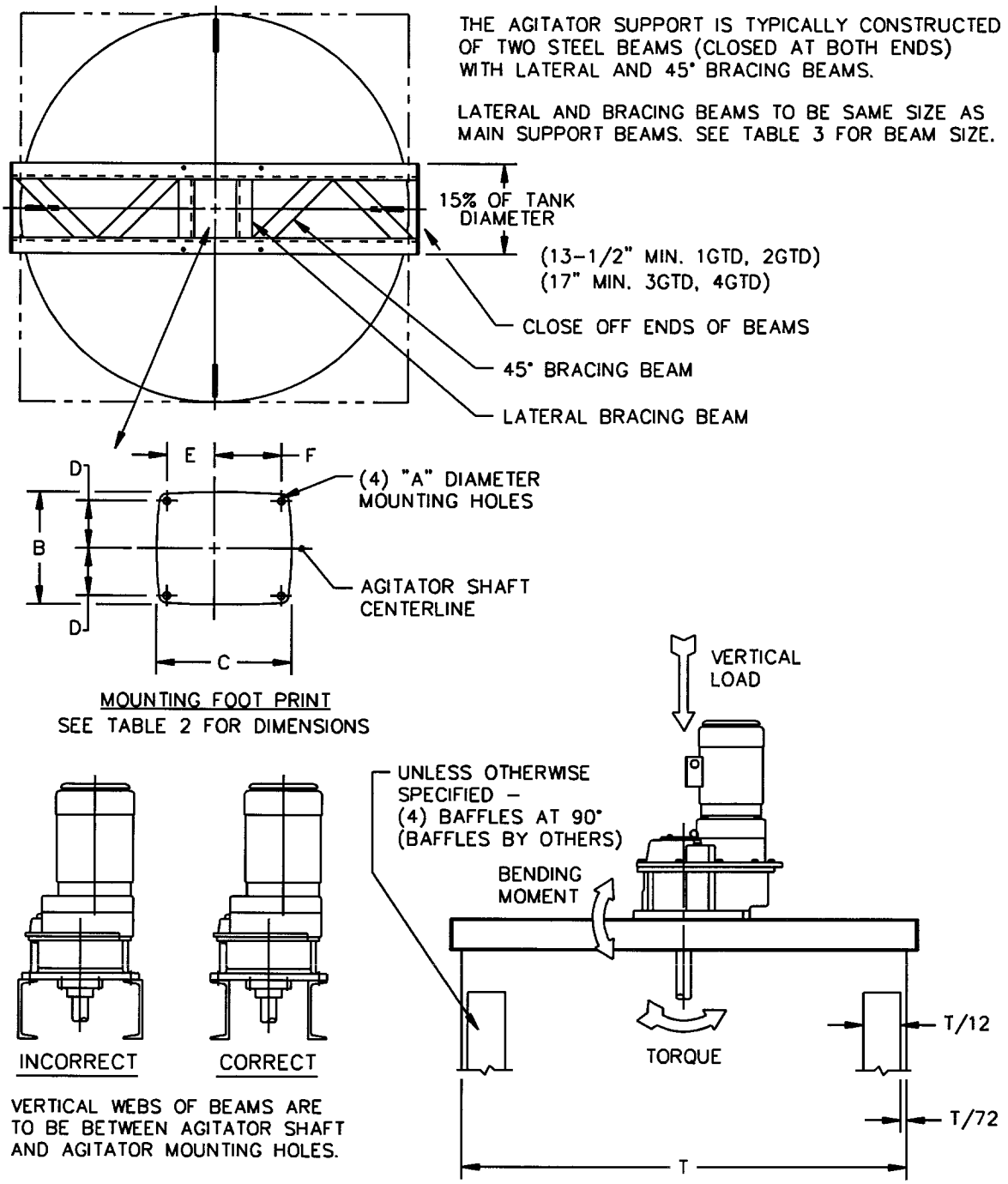


Figure 1: Open Tank Beam Mounting - GTD

OPEN TANK MOUNTING

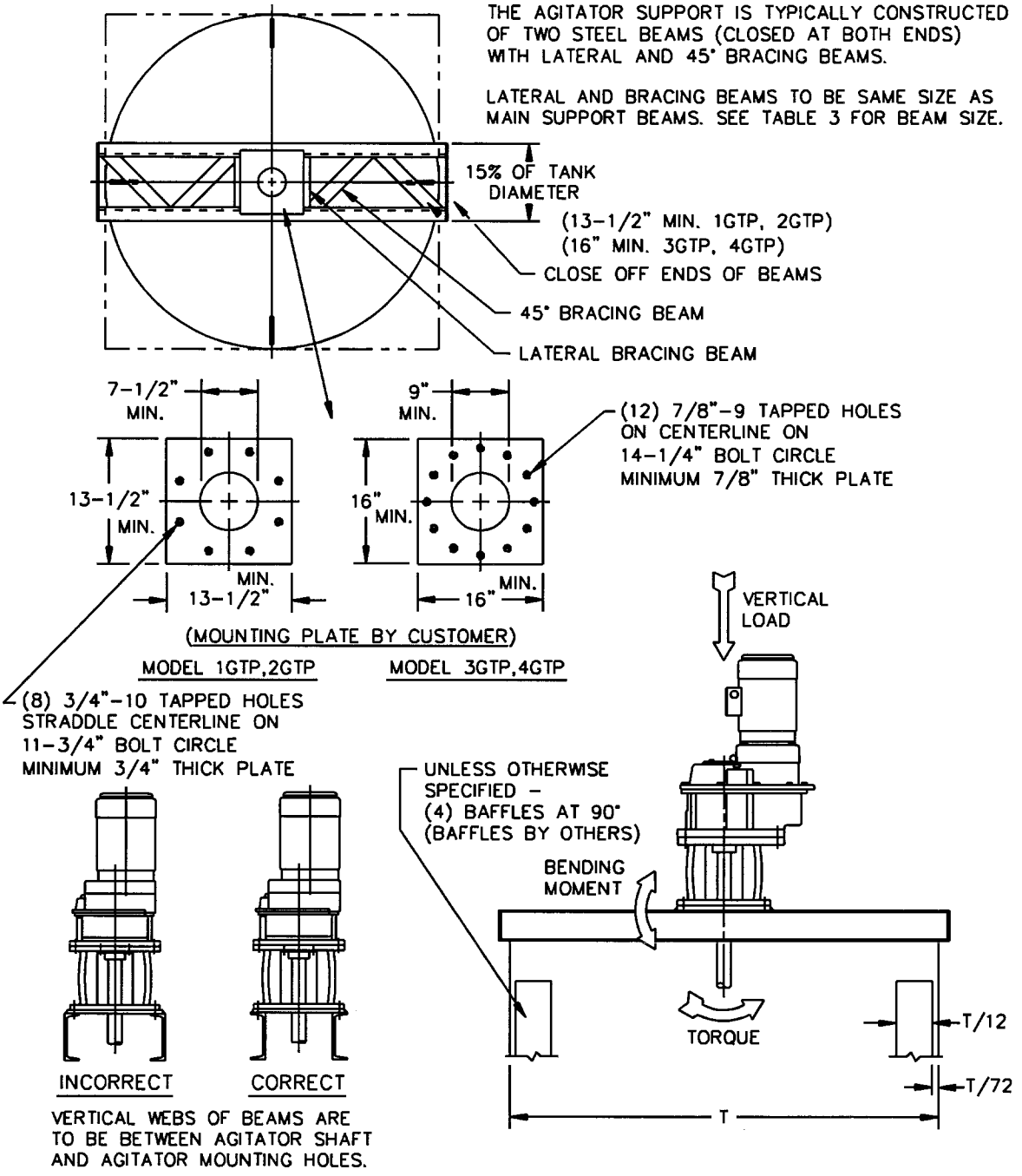


Figure 2: Open Tank Beam Mounting - GTP

OPEN TANK MOUNTING

TABLE 2: MOUNTING DIMENSIONS

CASE SIZE	MODEL GTD					
	A	B	C	D	E	F
1GT	27/32" (21.4mm)	13-1/2" (343 mm)	15-3/4" (400mm)	5-9/16" (141.3mm)	5-9/16" (141.3mm)	7-13/16" (198.4mm)
2GT	27/32" (21.4mm)	13-1/2" (343 mm)	15-3/4" (400mm)	5-9/16" (141.3mm)	5-9/16" (141.3mm)	7-13/16" (198.4mm)
3GT	1" (25.4mm)	17" (432mm)	20" (508mm)	7-1/16" (179.4mm)	7-1/16" (179.4mm)	10-1/16" (255.6mm)
4GT	1" (25.4mm)	17" (432mm)	20" (508mm)	7-1/16" (179.4mm)	7-1/16" (179.4mm)	10-1/16" (255.6mm)

TABLE 3: RECOMMENDED BEAM SIZES

TANK DIAMETER Ft (m)	CASE SIZE			
	1GTD/1GTP	2GTD/2GTP	3GTD/3GTP	4GTD/4GTP
4 (1.22)	C4 x 5.4	C5 x 6.7	C6 x 8.2	*
6 (1.83)	C5 x 6.7	C6 x 8.2	C7 x 9.8	C7 x 9.8
8 (2.44)	C6 x 8.2	C7 x 9.8	C8 x 11.5	C8 x 11.5
10 (3.05)	C7 x 9.8	C8 x 11.5	C9 x 15	C12 x 20.7
15 (4.57)	C12 x 20.7	C12 x 20.7	C12 x 20.7	C15 x 33.9
20 (6.10	C12 x 20.7	C15 x 33.9	C15 x 50	MC18 x 42.7
25 (7.62)	C15 x 50	C15 x 50	MC18 x 51.9	*

* Consult Factory C = American Standard Channel MC = American Standard Miscellaneous Channel

AGITATOR INSTALLATION

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

1. The GT agitator is shipped in three or more crates: one for the agitator gear drive, *(Figures 3 & 4, pages 10 & 11)*, one for the shaft **[400]** and impeller **[500]**, and typically one for the motor **[100]**. Optional accessories, multiple shafts, or multiple impellers may be crated separately.

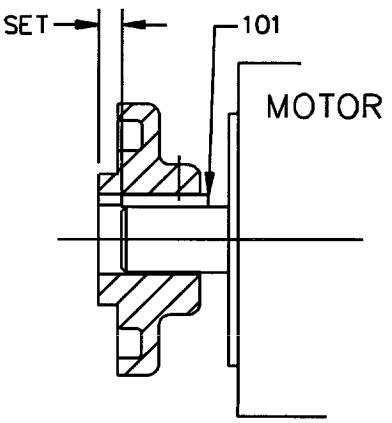
2. Remove all shipping restraints. A hoist or crane system for the lifting of the agitator parts must be available. Refer to *Figure 7, page 14* for lifting instructions. The approximate net weight of the unit is shown on the unit assembly drawing.

   Since gear drives are typically supplied with the motor unmounted, always verify that the motor being mounted is correct for the gear drive by checking the assembly drawing.

3. The standard flexible motor coupling **[110]** used on all Chemineer GT agitators is the T.B. Woods "Sure-Flex" coupling. Refer to ***Vendor Data, Flexible Motor Couplings*** for features. Install the flexible coupling hub with motor key **[101]** onto the motor shaft. See *Table 4* below to locate the hub from the end of the motor shaft. Tighten the hub setscrews to the torque value shown in *Table 5, page 15*. Turn the motor shaft by hand to check that the shaft rotates freely.

TABLE 4: MOTOR COUPLING SETTING

CASE SIZE	MOTOR FRAME SIZE				
	143TC 145TC	182TC 184TC	213TC 215TC	254TC 256TC	284TC 286TC
1	Flush	.50 in. 12.7 mm	Flush	N/A	N/A
2	Flush	.50 in. 12.7 mm	Flush	N/A	N/A
3	Flush	Flush	.63 in. 16 mm	Flush	Flush
4	Flush	Flush	.63 in. 16 mm	Flush	Flush



Remove the motor adapter **[131]** from the gear drive **[200]**. Install the remaining flexible coupling hub with input shaft key **[269]** onto the gear drive input shaft. Set the hub flush with the end of the input shaft. Tighten the hub setscrews to the torque value shown in *Table 5*.

Install the flexible coupling sleeve into the gear drive flexible coupling hub.

AGITATOR INSTALLATION

4. If the unit is supplied with an optional steady bearing assembly or optional auxiliary stuffing box, do not install the motor (step 5) until after the steady bearing or auxiliary stuffing box is installed.

5. Install bolts **[133]** and lockwashers **[134]** into motor adapter prior to installing adapter onto motor. Orient motor onto adapter with conduit box in an accessible position. Install motor mounting bolts **[135]** and lockwashers **[136]**. Torque bolts to the value shown in *Table 5, page 15*. Using hoist system, lift motor/adapter assembly above gear drive and lower onto alignment pins **[132]** in the gear drive. Ensure both flexible coupling halves fully engage coupling sleeve. Torque bolts **[133]** to the value shown in *Table 5*. The flexible coupling will not require alignment maintenance after installation. Install gear drive cover plate, bolts and lockwashers **[121,122,123]** and breather **[270]**.

6. For the style GTP (pedestal) units *(Figure 4, page 11)*, assemble the pedestal **[1101]** onto the agitator support structure or tank. Install mounting bolts (supplied by others) and torque to the value shown in *Table 5*.

7. If the unit is supplied with an optional auxiliary shaft seal, see ***Options, Auxiliary Shaft Seals.***

8. Clean the extension shaft **[400]** and coupling half **[351]** bore and make sure that both surfaces are free from burrs or nicks. Place key **[352]** *(Figure 5, page 12)* in the coupling keyway to make sure it slides freely. Install the key in the shaft keyway making sure it is properly oriented and fully bottomed in the keyway.

9. Slide the coupling half onto 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 coupling taper. Shaft and coupling tapers must be clean and dry.

10. Install Shaft Bolts: *(See Figure 5)*

2 Bolt Design:
Install coupling washer **[354]**. Install bolts **[357]** and lockwashers **[358]**. Torque bolts to the value shown in *Table 5*.

1 Bolt Design:
Install coupling washer **[353]**. Install bolt **[355]** and locking tab **[356]**. Torque bolt to 38 ft-lb (51 Nm). Bend corners of locking tab up around the head of the shaft bolt.

AGITATOR INSTALLATION

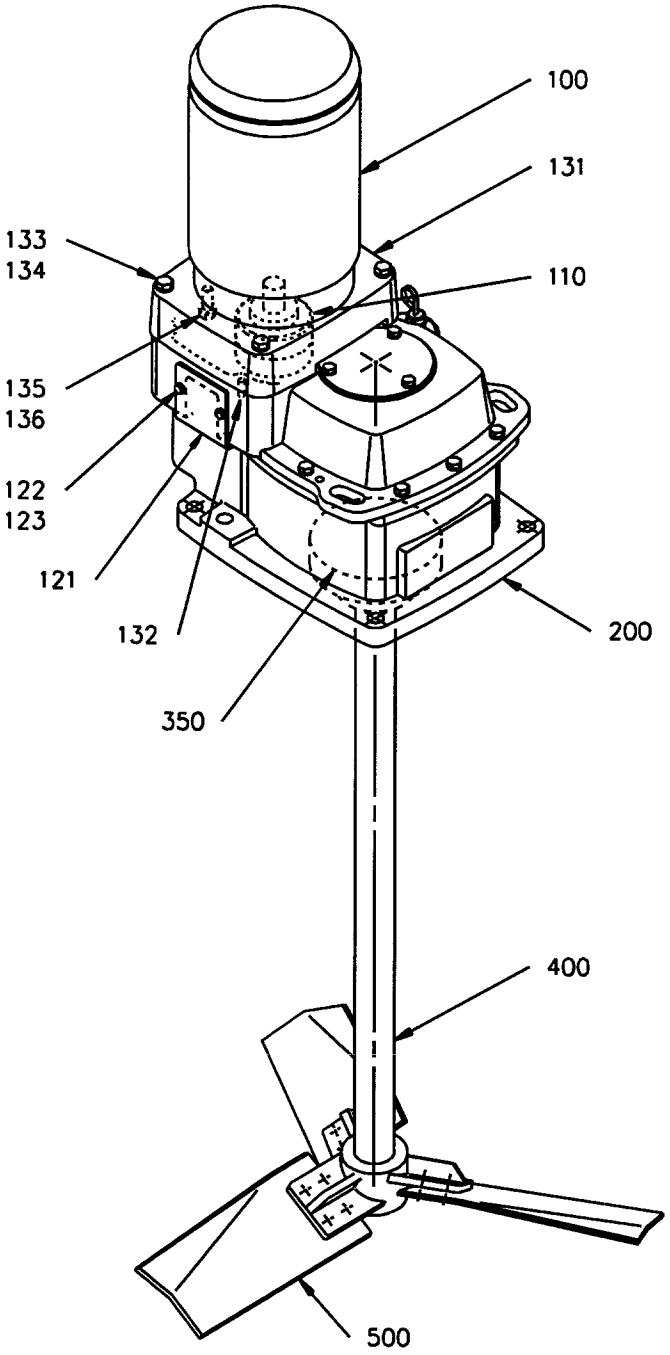


Figure 3: Model GTD Agitator Assembly

AGITATOR INSTALLATION

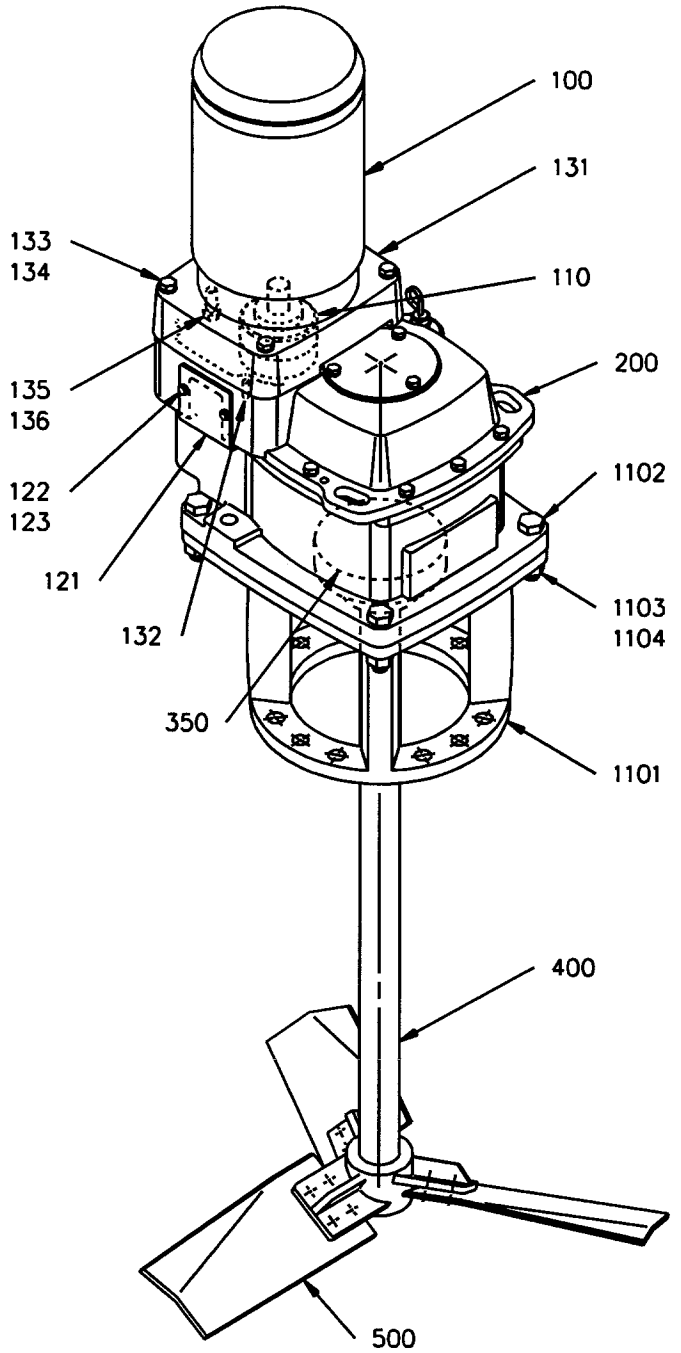


Figure 4: Model GTP Agitator Assembly

AGITATOR INSTALLATION

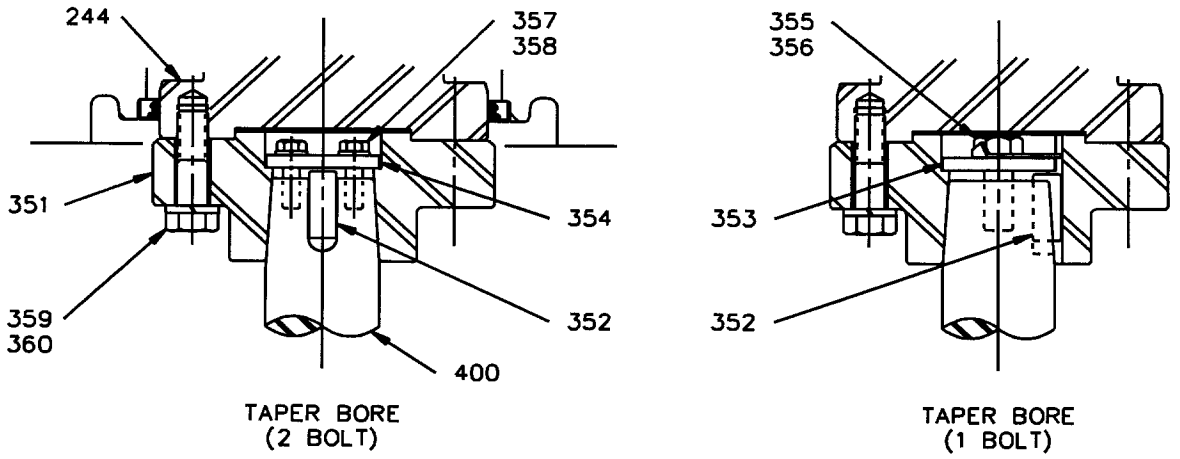


Figure 5: Shaft Coupling Installation

11. Lift the extension shaft from the coupling end. Lower shaft **[400]** into the tank through the agitator drive support structure. Block the shaft in place with extension shaft low speed coupling assembly **[350]** extending above the agitator drive mounting surface (GTD) or pedestal assembly (GTP).

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.

12. Avoid surface damage and bending of the shaft. Protect the tenon and the face of the coupling. These surfaces must be perfectly clean and free of nicks.

13. Lift and suspend the agitator drive assembly *(Figure 7, page 14)* over the extension shaft coupling half close enough to allow installation of coupling bolts and lockwashers **[359,360]**. Install two bolts at 180°. Tighten the bolts to engage the tenon and pull the coupling faces together.

14. Lift the agitator drive assembly and the extension shaft enough to remove shaft blocking. Remove blocking and install the remaining coupling bolts and lockwashers. Torque bolts to the value shown in *Table 5, page 15*.

AGITATOR INSTALLATION

15. For the GTD unit, lower the agitator drive assembly onto the support structure. The gear drive assembly must be level within 1/4° (.05 inches per foot; 4.4 mm per meter). If shimming is required, use full width shims under the agitator drive housing to provide a solid joint for bolting the agitator drive assembly to the support structure. Install the agitator drive mounting bolts (supplied by others) and torque to the value shown in *Table 5, page 15.*

16. For the GTP unit, install the handhole cover bolts and lockwashers **[1106, 1107]** into the pedestal **[1101]**. Lower the agitator drive assembly *(Figure 4, page 11)* onto the pedestal and mount with bolts, lockwashers and nuts **[1102, 1103, 1104]**. Torque bolts to the value shown in *Table 5.* Install handhole covers **[1105]** onto pedestal. Attach flatwasher, lockwasher and hex nut **[1108, 1109, 1110]** to previously installed bolt and lockwasher **[1106, 1107]** and tighten.

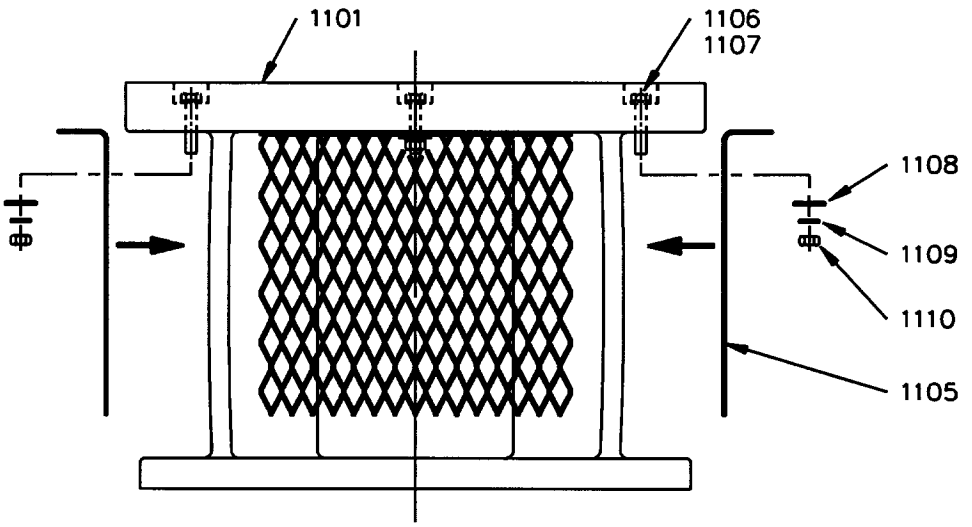


Figure 6: Handhole Cover Installation

17. Check the installed extension shaft runout. Place 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.

AGITATOR INSTALLATION

18. Total shaft runout should not exceed .005" per foot (.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 .030-.060" (.76-1.52mm), 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 or 3" (50-70 mm) to avoid reheating the same location.

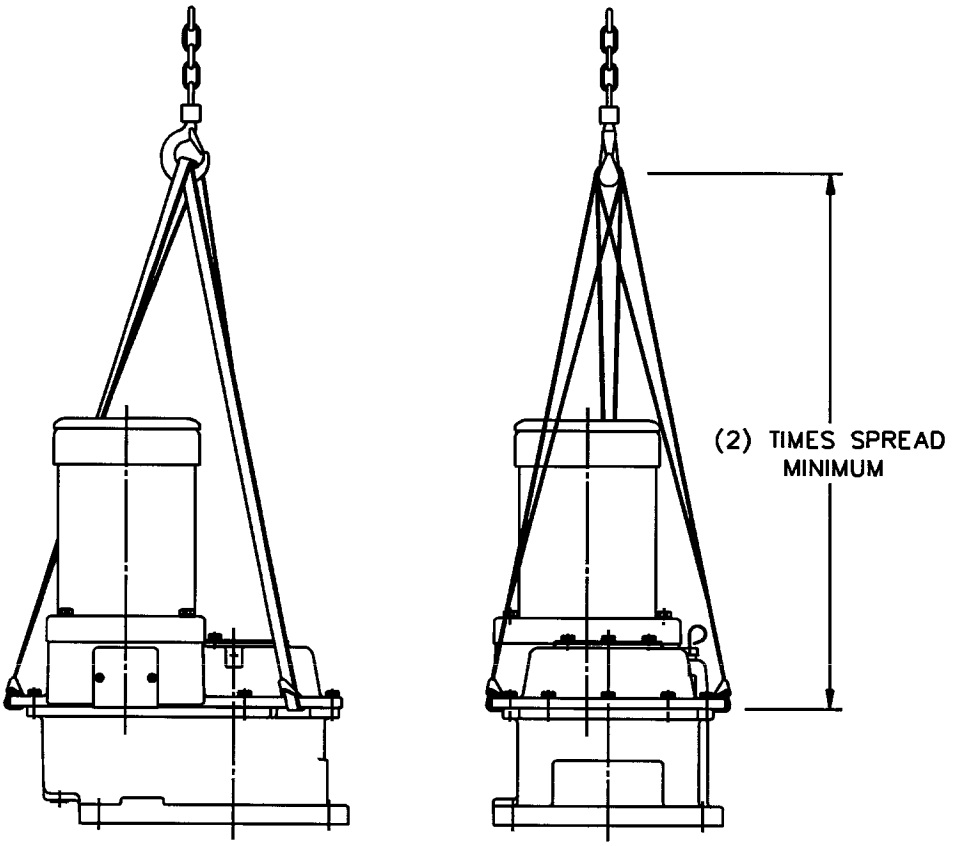


Figure 7: Agitator Lifting System

For Case sizes 1-4, use a three point nylon sling anchored through each of the three lifting handles on the gear drive. *CAUTION: Do not lift the agitator drive with any lifting lugs attached to the motor.*

AGITATOR INSTALLATION

TABLE 5: BOLT TIGHTENING TORQUE

BOLT SIZE	CARBON STEEL [1]				300 SERIES STAINLESS STEEL, ALLOY 20, MONELS, INCONELS & HASTELLOYS B & C [2]	
	GRADE 2 METRIC GRADE 4.8		GRADE 5 METRIC GRADE 8.8			
	ft-lb	Nm	ft-lb	Nm	ft-lb	Nm
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
M6 x 1.00	3.7	5.1	1.9	2.6	*	*
M8 x 1.25	9	12	14	19	*	*
M10 x 1.50	18	24	28	37	*	*
M12 x 1.75	33	44	48	66	*	*
M16 x 2.00	73	100	122	166	*	*
M20 x 2.50	143	199	238	323	*	*

Tighten all fasteners to values shown unless specifically instructed to do otherwise. 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.

[1]If fasteners cannot be lubricated, multiply table values by 1.33.

[2]If fasteners cannot be lubricated, multiply table values by 1.25.

*These fasteners supplied in steel only.

IMPELLERS - MATCH-MARKING

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 XXXXXX-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 XXXXXX-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 - INSTALLATION

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

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

3. Tighten square head setscrew **[505]** firmly onto the key. Torque to the value shown in *Table 5, page 15.* 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 **[504]** with bolts, nuts and lockwashers **[507, 509, 508]**. Refer to *Figures 9-13, pages 18-22.* 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 bolts to the value shown in *Table 5.*

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

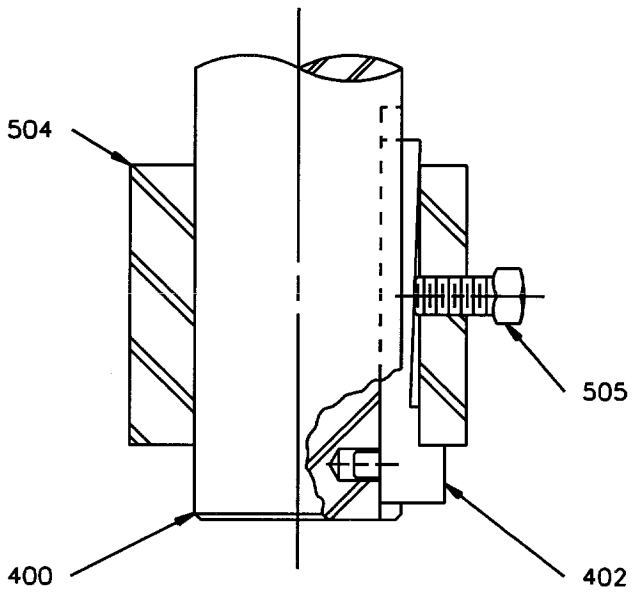


Figure 8: Hub and Pin Key Detail

IMPELLERS - STYLES

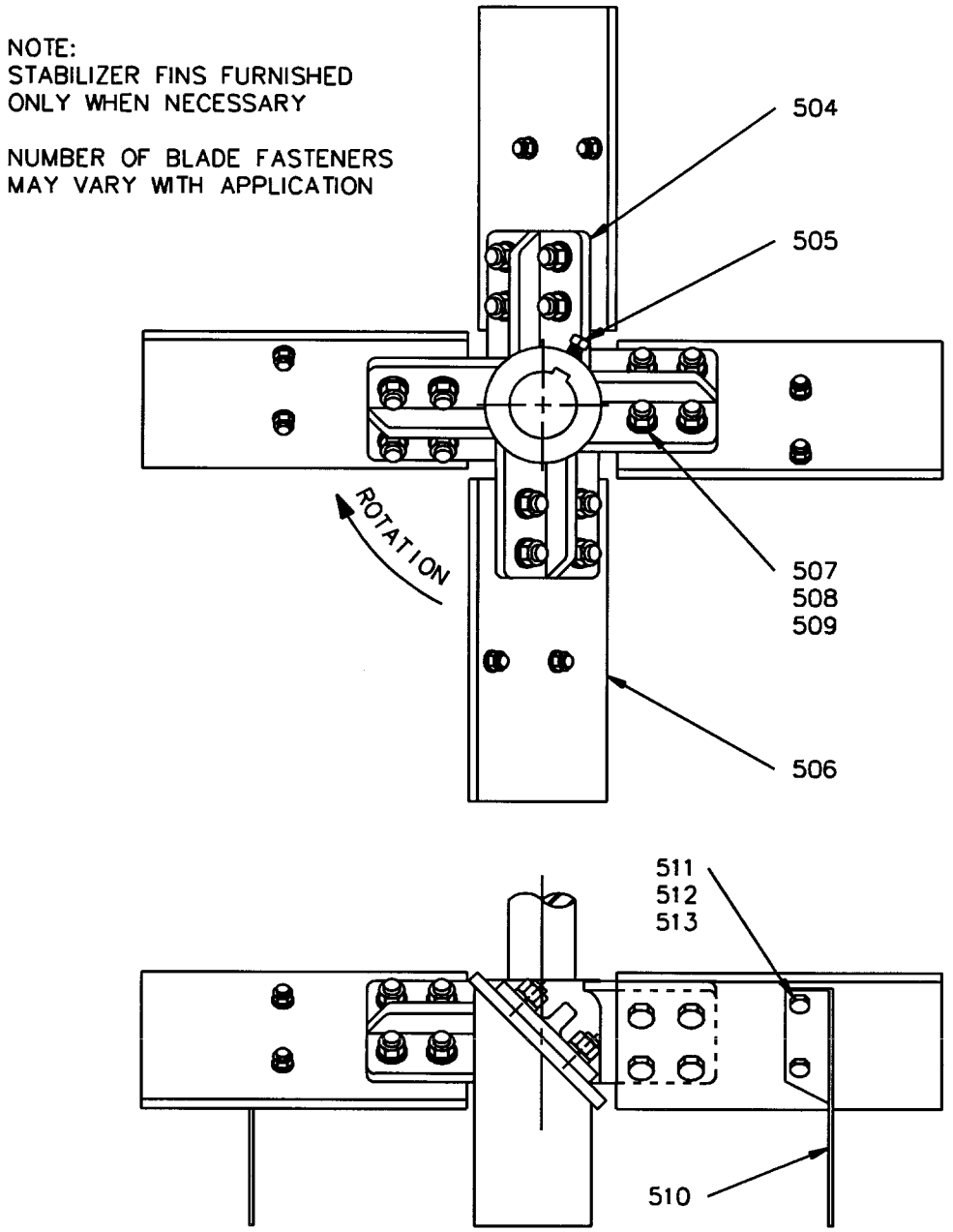


Figure 9: Style P-4 Impeller

IMPELLERS - STYLES

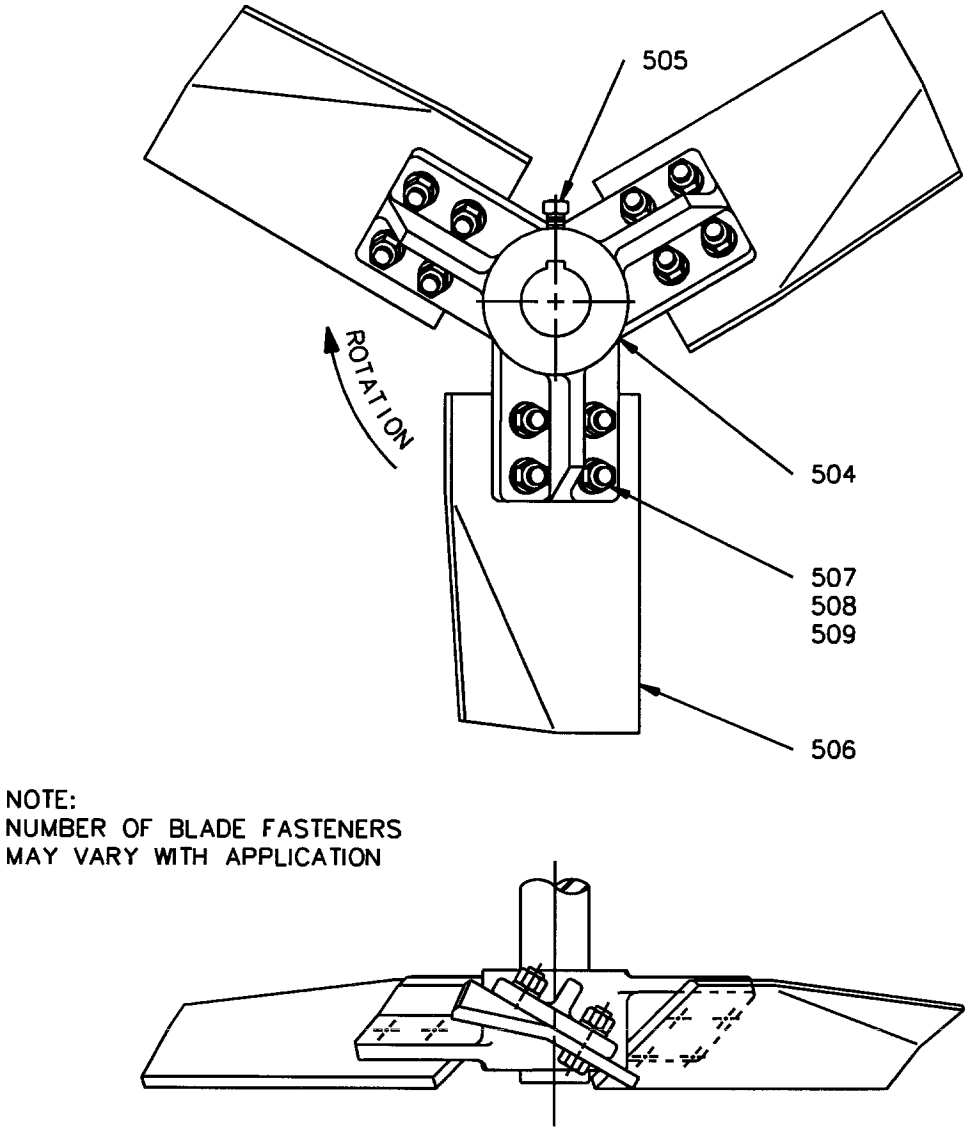


Figure 10: Style HE-3 Impeller

IMPELLERS - STYLES

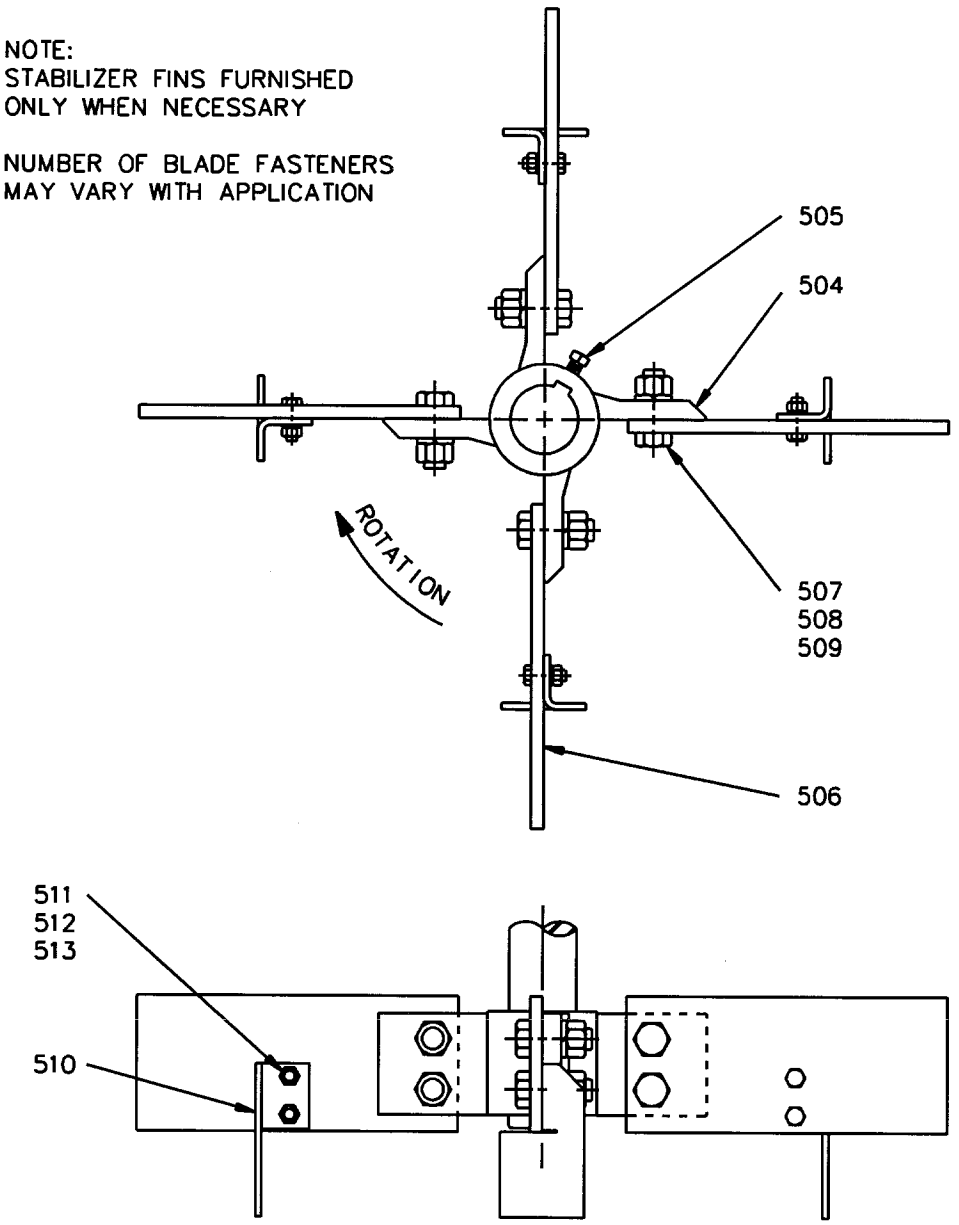


Figure 11: Style S-4 Impeller

IMPELLERS - STYLES

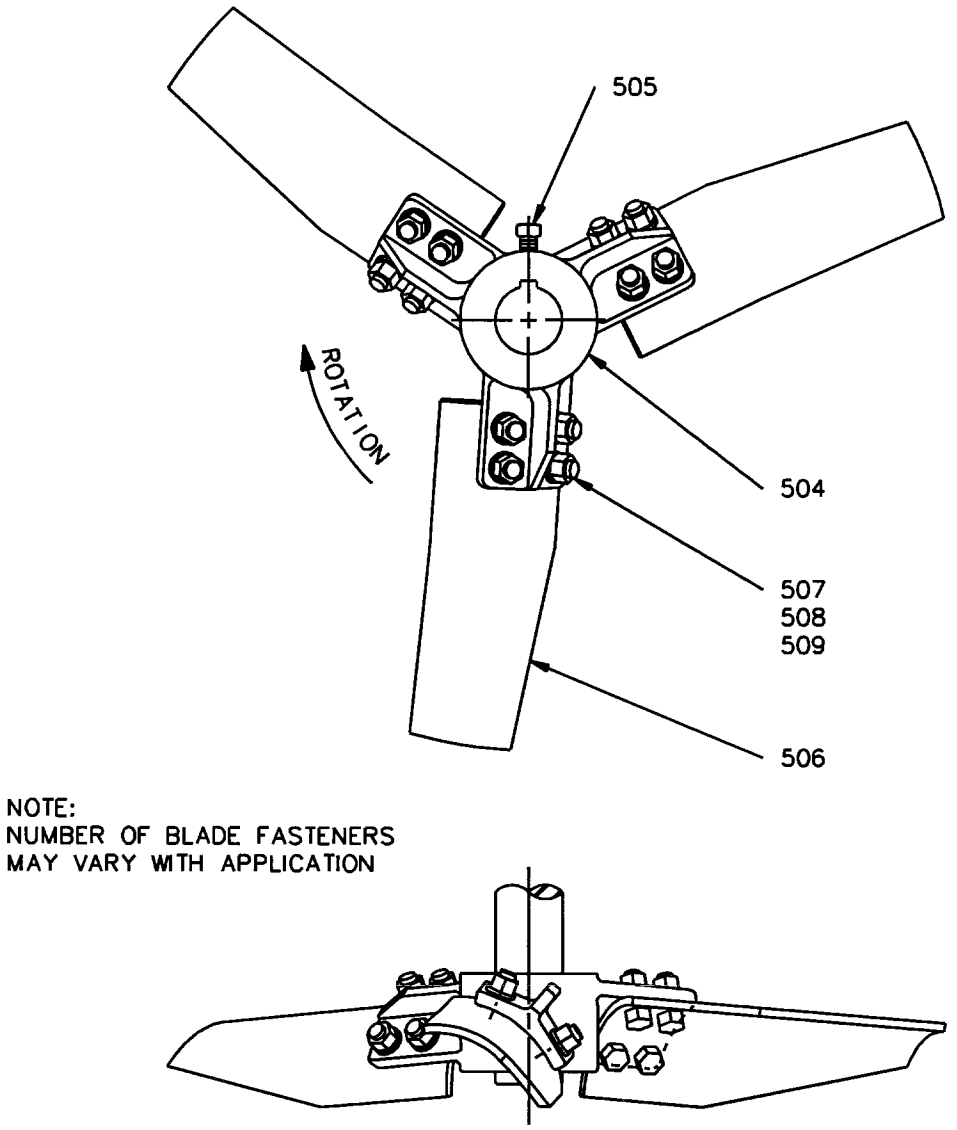


Figure 12: Style SC-3 Impeller

IMPELLERS - STYLES

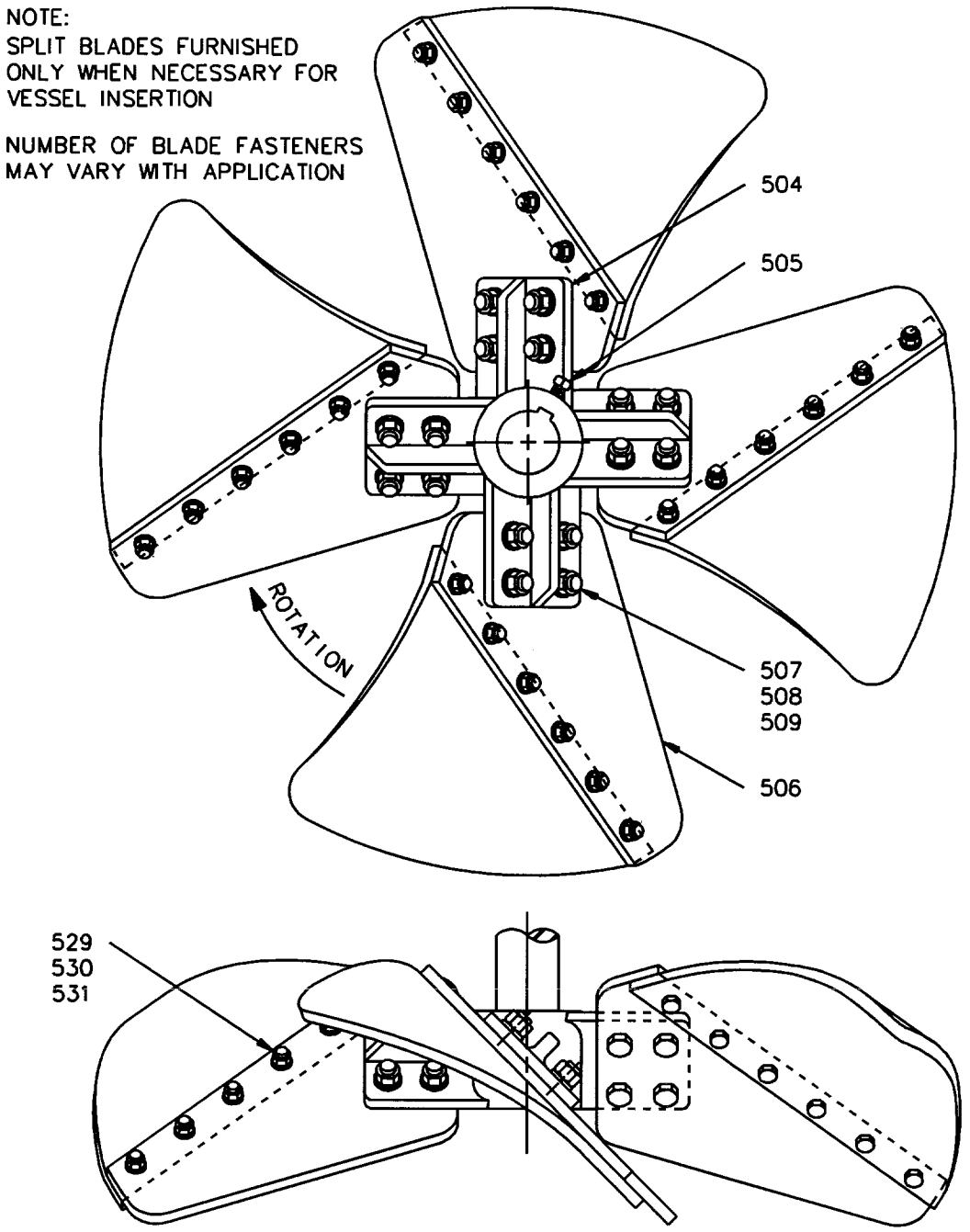


Figure 13: Style Maxflo W Impeller

IMPELLERS - COATED/RUBBER COVERED

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

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

Impeller diameter > 84" (2133 mm) :
The impeller is supplied as a one-piece (welded) coated/covered assembly. For attachment to the shaft, refer to *Figure 14, page 24.*

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

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

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

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

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

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

6. Place the thrust plate over the bottom of the shaft and install mounting bolt **[526]** with gasket **[525]**. Torque to the value shown in *Table 5, page 15.*

7. Remove the hoist from the impeller.

IMPELLERS - COATED/RUBBER COVERED

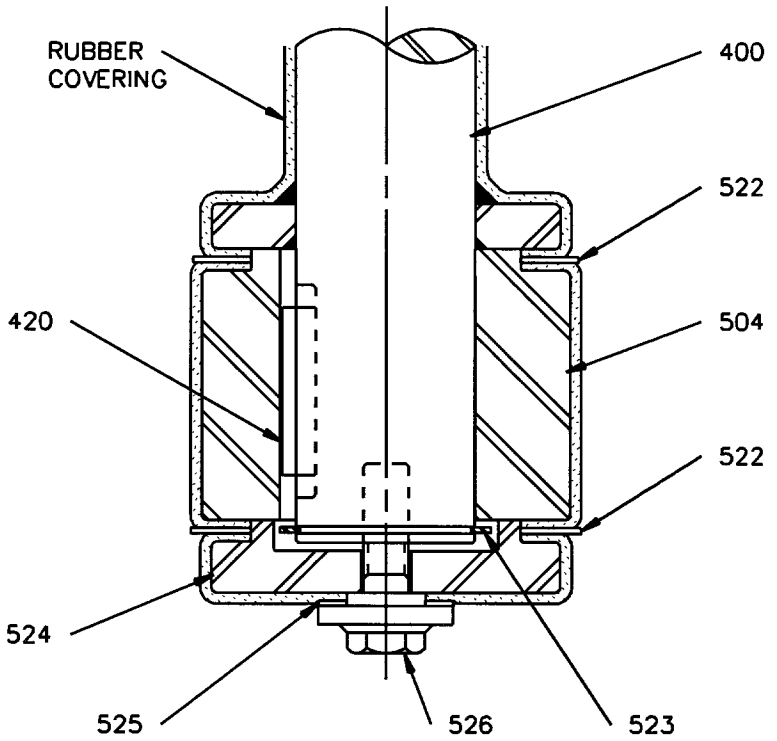


Figure 14: Thrust Bolt Impeller Attachment

GEAR DRIVE

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

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. If 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.

3. 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.

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

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 5, page 15.*

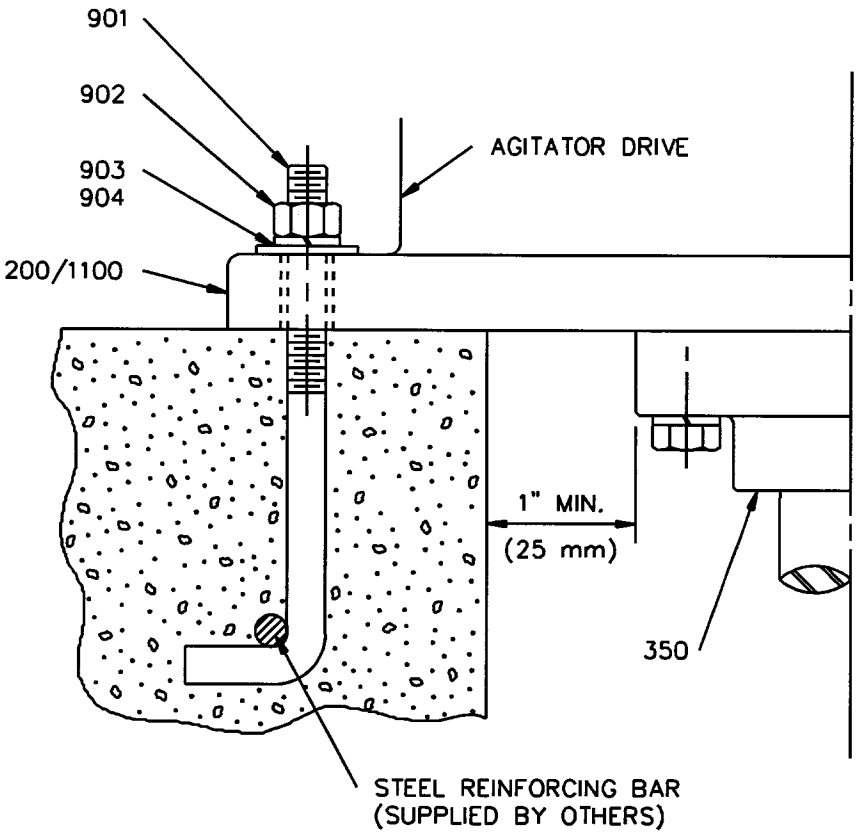


Figure 15: Anchor Bolt Assembly

OPTIONS: IN-TANK COUPLING

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 16, page 28) for all references to the agitator extension shaft* **[400]**. *Reference Figures 3 & 4, pages 10 & 11.*

Assembly of Rigid, Removable, Taper Bore Coupling Half [408, 413]

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 5, page 15.*

   1 Bolt Design:
   Install coupling washer **[410, 415]** and locking clip **[412, 416]**; lubricate and install shaft bolt **[418, 419]**. Torque to 38 ft-lb (51 Nm). 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 5.*

OPTIONS: IN-TANK COUPLING

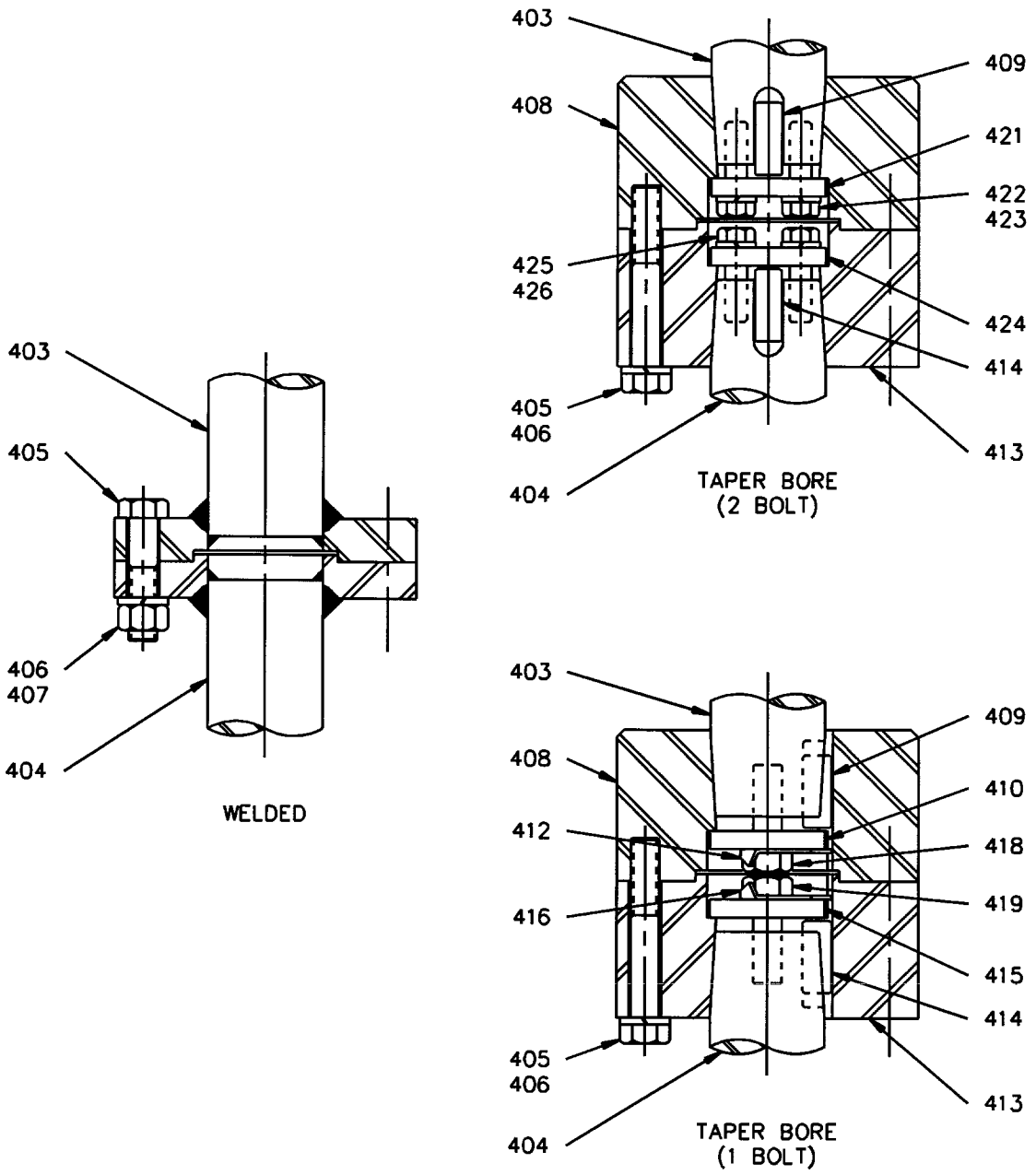


Figure 16: In-Tank Couplings

OPTIONS: AUXILIARY SHAFT SEALS

GTD 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

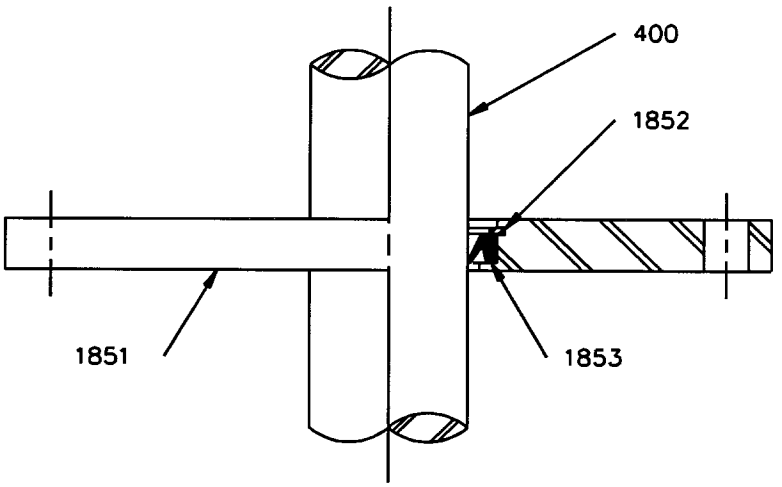


Figure 17: Auxiliary Lip Seal

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.

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 ***Agitator Installation***, *page 9 and Figure 5, page 12.*

OPTIONS: AUXILIARY SHAFT SEALS

Auxiliary Lip Seal (Cont'd)

6. Lift the agitator drive. See *Figure 7, page 14.*

7. Suspend the agitator drive assembly over the extension shaft coupling half, close enough to allow installation of coupling bolts and lockwashers **[359, 360]**. The coupling faces and tenons must be clean and free of nicks or burrs. 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 5, page 15.*

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 5.* Then torque the auxiliary lip seal flange bolts to the value shown in *Table 5.*

11. Auxiliary lip seals do not require any adjustment or lubrication. Both Buna-N and Teflon lip seals 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]**.

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 *Agitator Installation, page 9 and Figure 5, page 12.*

6. Lift the agitator drive *(Figure 7, page 14).* Suspend the agitator drive assembly over the extension shaft coupling half, close enough to allow installation of coupling bolts and lockwashers **[359, 360]**. The coupling faces and tenons must be clean and free of nicks or burrs. Install two bolts and lockwashers at 180°. Tighten the bolts to engage the tenon and pull the coupling faces together.

7 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 5, page 15.* Lower the agitator drive assembly onto the support structure. Install the mounting bolts (supplied by others). *Do not tighten the bolts at this time.*

8 . 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 gear drive mounting surface to provide a solid joint for bolting the agitator drive to the support structure.

9 . 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. Manually turn the flexible motor coupling to rotate extension shaft one turn. Shim the agitator drive until the indicator reading is within .005" (.127mm) FIM (Full Indicator Movement) maximum. Torque agitator mounting bolts to value shown in *Table 5.*

OPTIONS: AUXILIARY SHAFT SEALS

Auxiliary Stuffing Boxes (Cont'd)

10. In extreme cases a tapered adapter will be required (supplied by others) to correct the angular misalignment. Call Chemineer Field Service for assistance.

11. 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 .005" (.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 5, page 15.*

12. Install packing, lantern ring, split gland, and gland plate **[1357, 1358, 1356, 1355]**. Install gland nuts and lockwashers **[1353, 1354]**. Tighten finger tight.

13. Stuffing box auxiliary shaft seals will require adjustment at start up. See the ***Lubrication*** and ***Maintenance*** sections of this manual.

14. Continue with the agitator installation.

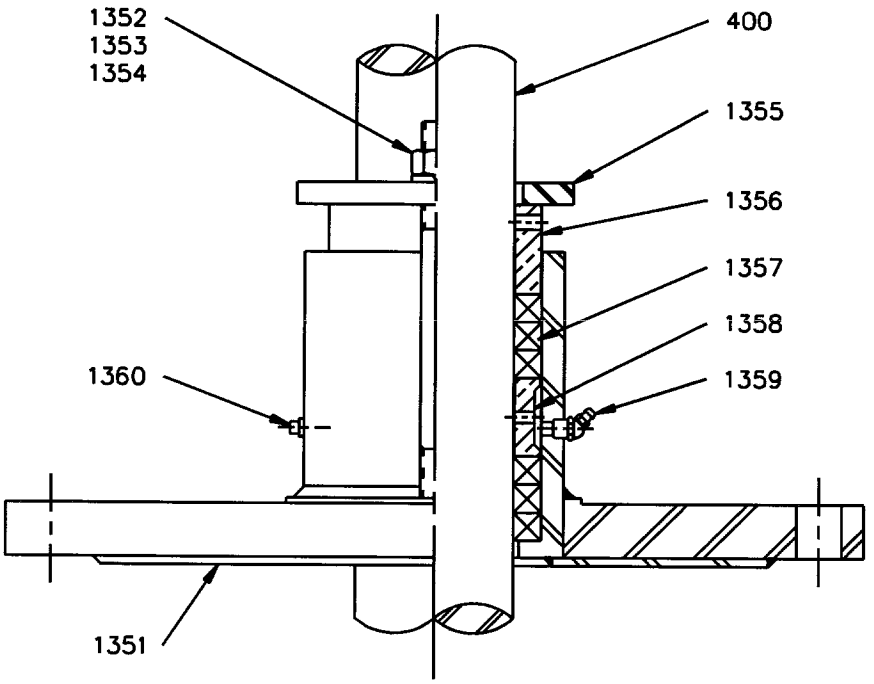


Figure 18: Auxiliary 6-Ring Stuffing Box

OPTIONS: STEADY BEARINGS

GT 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

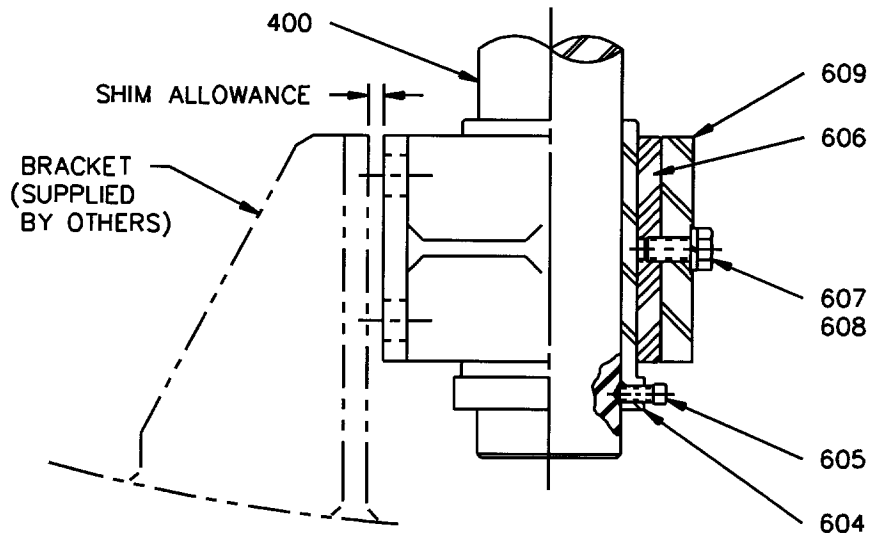


Figure 19: Bracket Steady Bearing

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 5, page 15.*

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.

OPTIONS: STEADY BEARINGS

Bracket Steady Bearing (Cont'd)

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

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

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

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

8. Once the final steady bearing housing location has been determined, drill the steady bearing housing and its support bracket at two locations and install roll or dowel alignment pins (supplied by others). Torque the bracket bolts to the value shown in *Table 5, page 15.*

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

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

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

OPTIONS: STEADY BEARINGS

Tri-Pod Steady Bearing

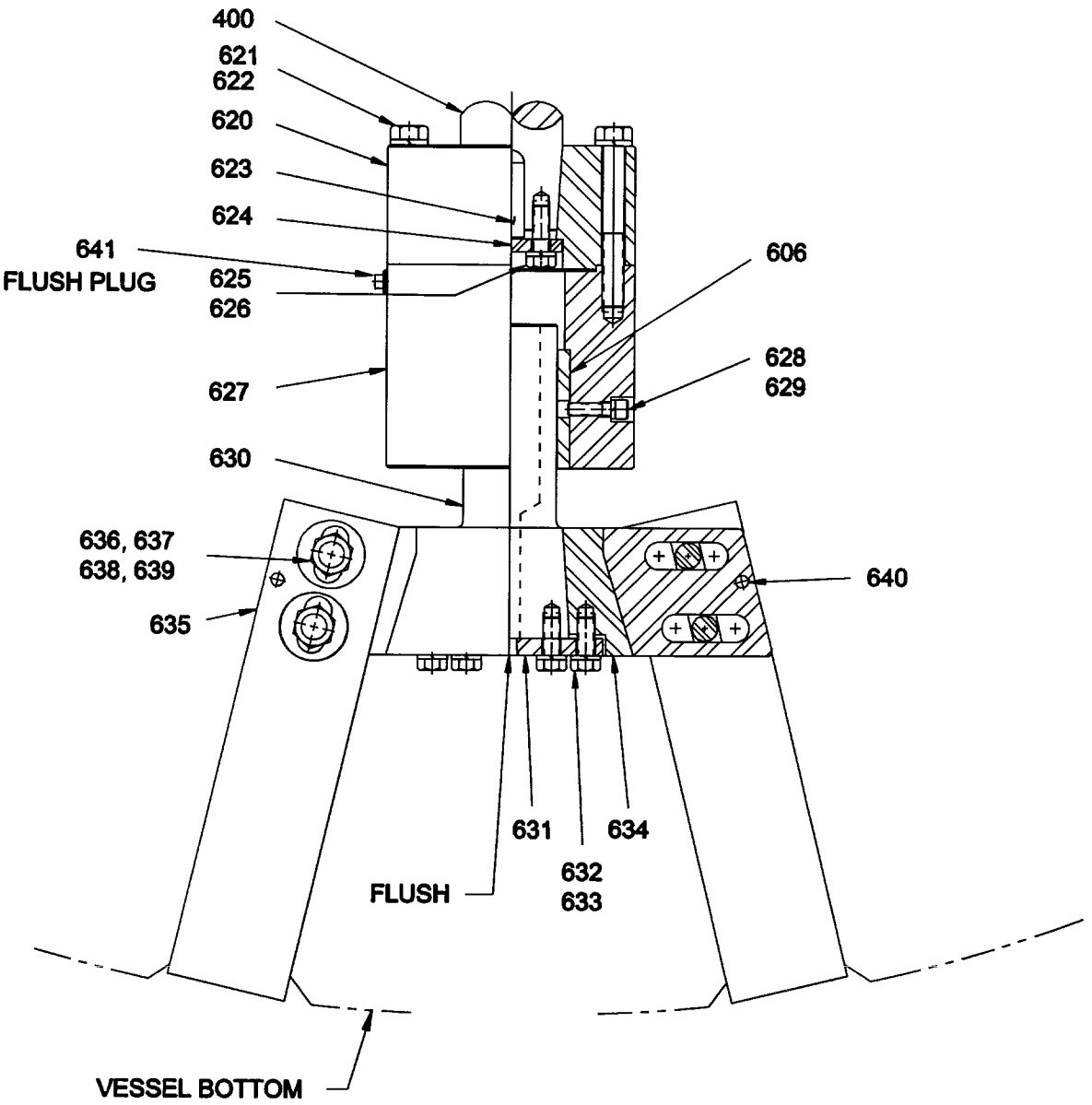


Figure 20: Tri-pod Steady Bearing

OPTIONS: STEADY BEARINGS

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 ***Installation***, *page 30* 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 5, page 15*. *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 flat washers **[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 5*. 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 Indicated 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 5*.

9. Recheck the steady bearing alignment with the dial indicator. If the alignment needs correction, repeat steps 6 through 8.

OPTIONS: STEADY BEARINGS

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 5, page 15*.

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 bolts to the value shown in *Table 5*. 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 tripod 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 over the vessel pressure.*

15. If the flush is not utilized, remove flush plug **[641]** from the bushing housing **[627]**.

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

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 6, page 39* lists some commonly available greases.

When regreasing, stop the motor, remove the outlet plug and add grease according to *Table 7, page 40* with a hand lever gun only. Run the motor for about ten minutes before replacing the outlet plug. Certain TEFC motors have a spring relief outlet fitting on the fan end. If the outlet plug is not accessible at the surface of the hood, it is the spring relief type and need not be removed when regreasing.

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

MOTOR

TABLE 6: TYPICAL NLGI NO. 2 GREASES

For Ambient Temperature Range of 0° to 150° F (-18° to 66° C)

MANUFACTURER	GENERAL PURPOSE	EP
Amoco Oil Co.	Amolith grease: Grade 2	Amolith grease: Grade 2EP
Ashland Oil Co.		Multi-lube Lithium EP grease: Grade 2
		EP Lithium #2
Chevron U.S.A.Inc.	Industrial grease: Grade medium	Dura-Lith greases EP: Grade 2
CITGO Petroleum Corp.		Premium Lithium EP grease: Grade 2
Conoco Inc.		EP Conolith grease: Grade 2
Exxon Co. U.S.A.	Unirex N: Grade 2	Nebula EP: Grade 2
		Ronex MP: Grade 2
Mobil Oil Corp.		Mobilux EP 2
Pennzoil Products Co.		Pennlith EP grease 712
Phillips 66 Co.	Philube L Multi-purpose grease L-2	Philube EP grease: EP-2
Shell Oil Co.	Alvania grease 2	Alvania grease EP 2
		Alvania grease EP LF 2
Texaco Lubricants Co.	Premium RB grease	Multifak EP 2
Unocal 76		Unoba EP grease: Grade 2
		Multiplex EP: Grade 2

MOTOR

TABLE 7: MOTOR BEARING GREASE ADDITION

MOTOR FRAME SIZE	RELIANCE		SIEMENS		BALDOR	
	in^3	cm^3	in^3	cm^3	in^3	cm^3
140T	sealed for life		0.4	6.6	0.6	9.8
180T	0.5	8.2	0.6	9.8	0.6	9.8
210T	0.5	8.2	3.1	50.8	0.6	9.8
250T	1.0	16.4	4.4	72.1	1.2	19.7
280T	1.0	16.4	5.0	82.0	1.2	19.7

GEAR DRIVE

The GT gear drive features oil bath lubrication for all gears and all bearings except **[233, 245]** and triple reduction **[203-002]**. Refer to *Figure 22, page 45* for double reduction units and *Figure 23, page 46* for triple reduction units. *CAUTION! The gear drive has been drained of oil for shipping.* **Fill gear drive with oil prior to operating!** See *Table 9, page 41* for operating oil capacity.

Always use new oil to avoid damage to the gearing or bearings. When checking oil level, the agitator must be shut off. Remove the shipping plug from the top of the gear drive. Install breather **[270]** in place of the shipping plug. Remove the fill plug **[259]** from the top of the gear drive. Add oil until the level is at the "full" mark on the dipstick **[258]**. *Caution! Do not over or under fill the gear drive. Do not operate before filling with oil.* Re-install the fill plug **[259]**.

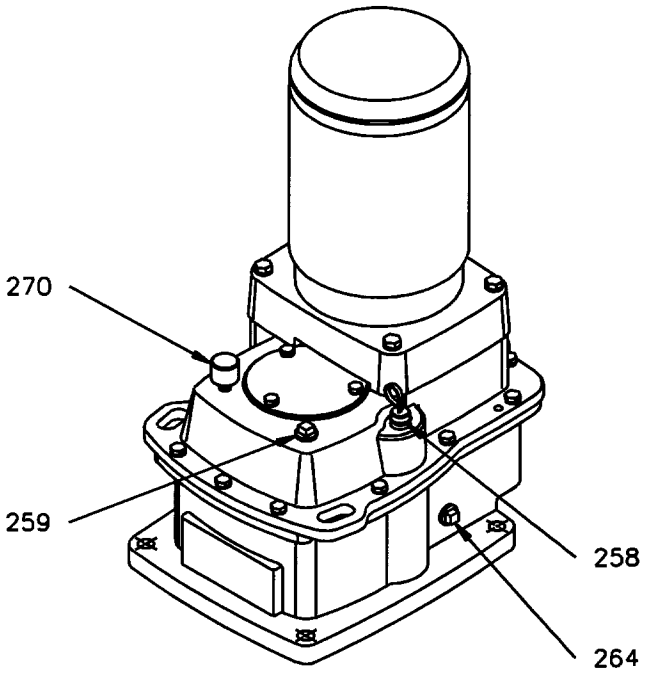


Figure 21: Gear Drive Oil Level Dipstick

The agitator nameplate or *Table 8, page 42*, should be used to select the proper viscosity oil based on ambient temperature conditions.

Table 9, page 42 should be used as a guide to determine the quantity of oil required.

Use a good quality straight grade, R & O petroleum base gear oil per *Table 10, page 43* for most applications. If the gear drive loading is extremely heavy or if ambient temperature exceeds 100°F (38°C), an EP oil per *Table 11, page 44* should be used. In general an EP oil will be beneficial for all operating conditions. *Tables 10 and 11* are presented for guidance and equivalent oils from other suppliers may be used.

GEAR DRIVE

Drain oil by removing drain plug **[264]** 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 **[233, 245]** are grease lubricated. These bearings are packed with grease prior to shipment from the factory. At 3 or 4 month intervals, bearings **[233]** and **[245]** should be regreased. Remove relief fitting **[261]** from elbow fitting **[271]** and pump grease into grease fitting **[260]** until new grease appears at the relief fitting hole. Re-install relief fitting **[261]**. Remove pipe plug **[263]** and pump approximately the same amount of grease into grease fitting **[262]** that was pumped into grease fitting **[260]**. Re-install pipe plug **[263]**. Triple reduction bearing **[203-002]** is sealed and lubricated for life. Any good quality general purpose grease consisting of a refined base oil stock and a lithium or calcium-complex based soap with a NLGI No. 2 classification will work satisfactorily. Most major oil companies offer such products usually with extreme pressure (EP) additives for additional protection. *Table 6, page 39* lists some commonly available greases.

TABLE 8: LUBE OIL SELECTION

Ambient Temperature	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

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.

TABLE 9: APPROXIMATE OPERATING OIL CAPACITY[1]

CASE SIZE	QUARTS	GALLONS	LITERS
1GT	4.8	1.2	4.5
2GT	4.8	1.2	4.5
3GT	9.2	2.3	8.7
4GT	8.8	2.2	8.3

[1] Fill to "Full" mark on dipstick.

GEAR DRIVE

TABLE 10: 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 11: 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./Permagear EP Lubricants	68	100	150	220	320
Ashland Oil Inc. (Valvoline Oil Co.)/AGMA Enclosed EP Gear Lubricants	#2 EP	#3 EP	#4 EP	#5 EP	#6 EP
Chevron U.S.A. Inc./ Chevron NL Gear Compounds	68	100	150	220	320
CITGO Petroleum Corp./ Citgo EP Compounds	68	100	150	220	320
Conoco Inc./Gear Oil	68	100	150	220	320
Exxon Co. U.S.A./ Spartan EP	68	100	150	220	320
Mobil Oil Corp./ Mobilgear 600 Series	626	627	629	630	632
Pennzoil Products Co./ Maxol EP Gear Oils	68	100	150	220	320
Phillips 66 Co./Philube All Purpose or Superior Multi Purpose Gear Oils	APG O 80W	---	SMP 80W-90	APG O 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

GEAR DRIVE

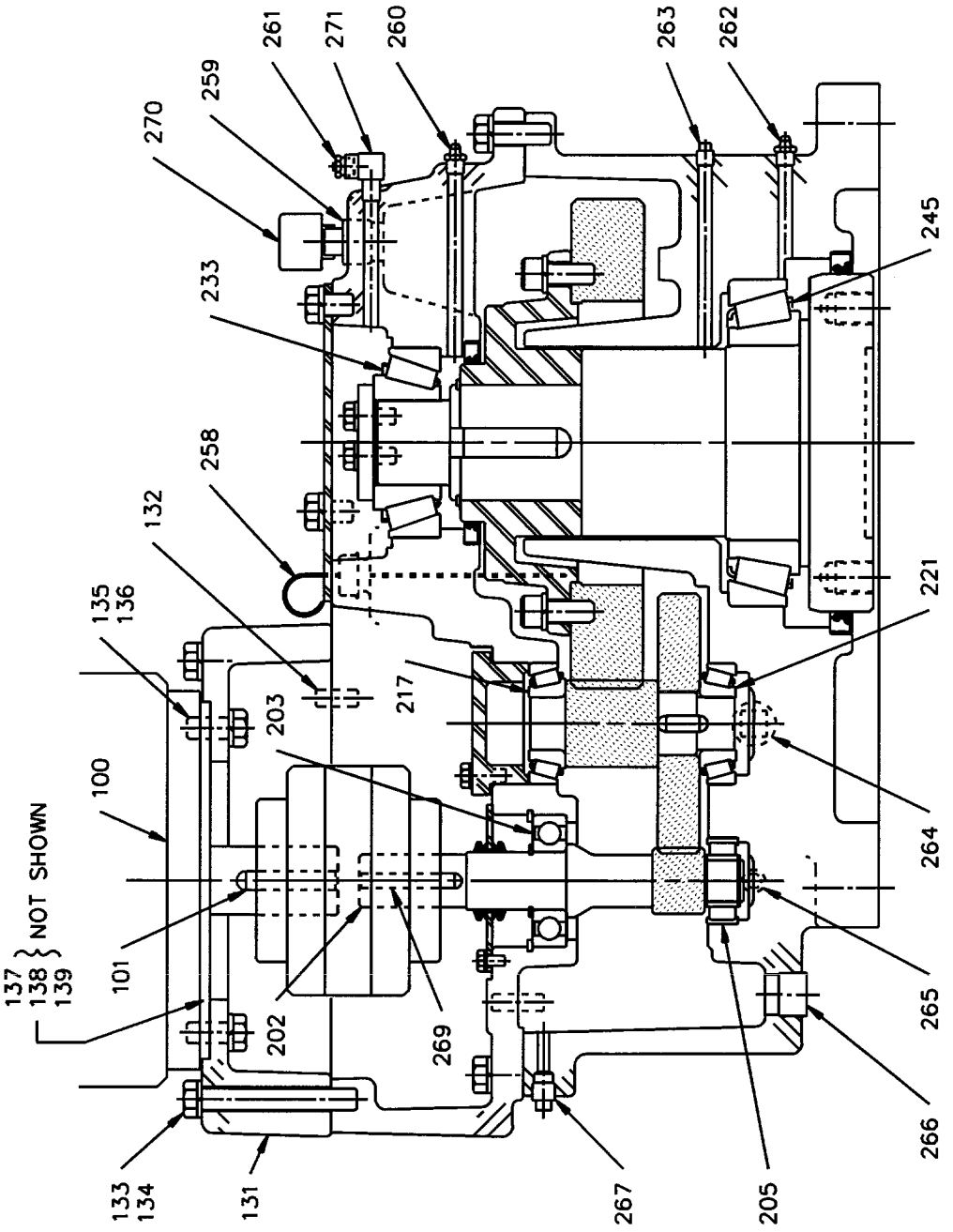


Figure 22: GT Double Reduction Gear Drive, Size 1,2,3,4

GEAR DRIVE

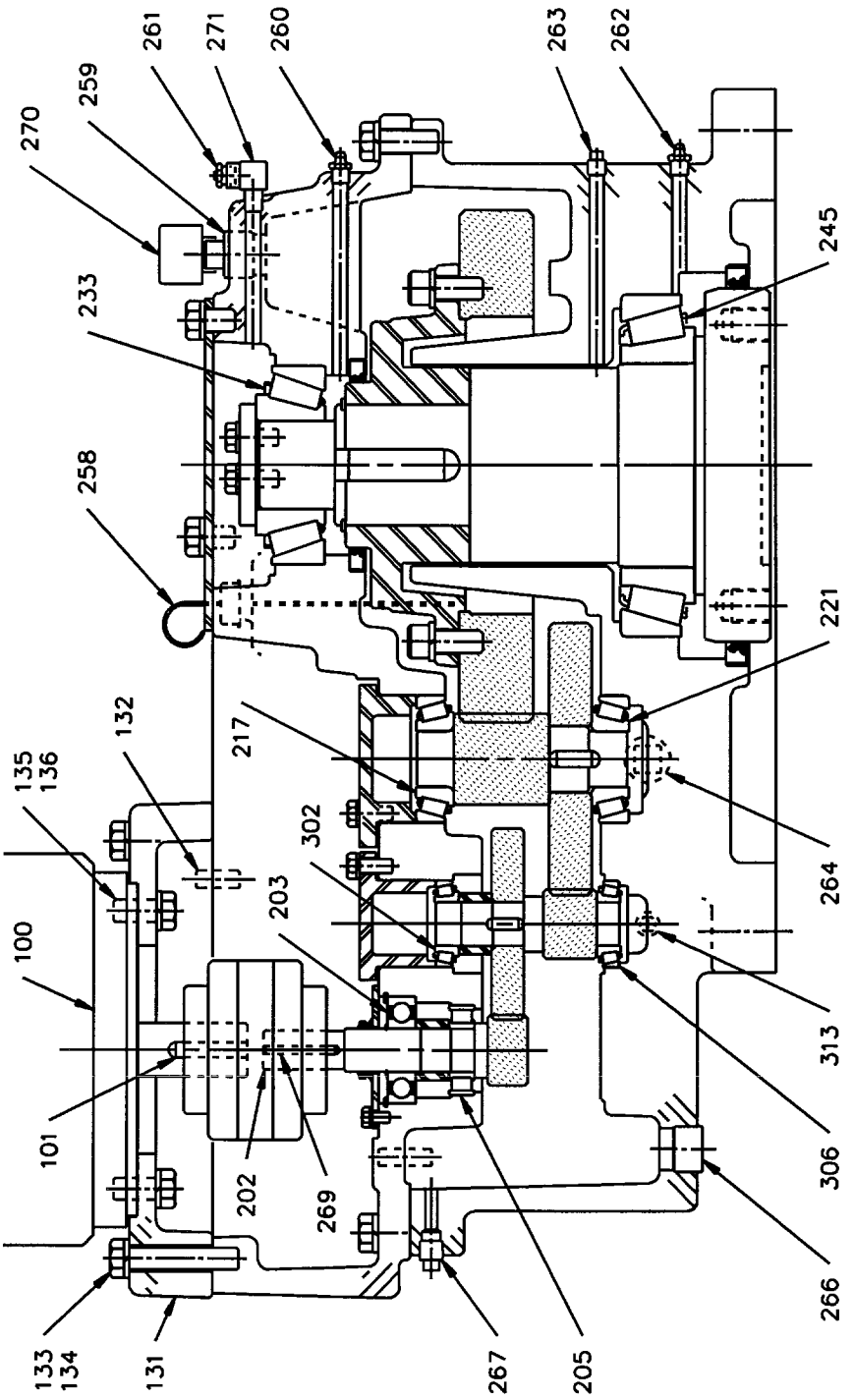


Figure 23: GT Triple Reduction Gear Drive, Size 3,4

AUXILIARY SHAFT SEALS

Refer to agitator assembly drawings for seal style and packing type. The 6-ring auxiliary stuffing box *(Figure 18, page 32)* is supplied with six rings of packing and a lantern ring. Packing shown as 1065 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 fitting **[1359]** until grease comes out of pipe plug hole. Replace pipe plug. Relubricate as required, approximately every 24 hours.

STEADY BEARINGS

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

AGITATOR

Your Chemineer GT 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 12, page 51*. If you are unable to resolve the problem, contact your local *Chemineer office*.

MOTOR

Electric motors furnished on Chemineer GT 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

Woods Sureflex motor couplings will provide years of operation with very few problems. If the motor is removed for service, the coupling should be inspected for wear.

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.

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 unusual conditions.

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 tripod 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 over the vessel pressure. If the flush is not utilized, the pipe plug **[641]** must be removed.

TROUBLE-SHOOTING

TABLE 12: TROUBLE-SHOOTING GUIDE

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 flexible couplings	Couplings can generate noise which seems to emanate from gear drive. Check for worn parts.
	Structural vibration and sound amplification	Steel mounting structures often amplify small amounts of normal noise into excessive noise. This can be corrected by adding stiffness or sound deadening material to the structure.
Abnormal Heating	Incorrect Oil	Review Lubrication section of manual. Replace with proper oil.
	Unusual ambient	Units installed in a hot area of a plant where air flow is restricted can overheat. Remove obstruction and if necessary force circulate air.
	Improper oil level	Add or remove oil.
	Cleanliness	Remove dirt and/or product buildup from motor/gear drive.
Leaking	Worn oil seals	Replace defective seals.
	Plugged breather	Clean or replace breather.
	Oil in Drywell	Remove pipe plug **[263]** and drain drywell. Grease the bearing and replace pipe plug.
	Worn Packing	Replace packing.

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. If an optional auxiliary shaft seal is installed, depressurize vessel and loosen the gland nuts (on stuffing box seals).

3. Remove agitator mounting bolts. With a hoist or crane system, lift the agitator assembly *(Figure 7, page 14)* and block the extension shaft in place. Remove coupling half bolts **[359]** and lockwashers **[360]**. See *Figure 5, page 12.*

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

Preparation for Gear Drive Disassembly

1. Clean external surfaces and drain the oil.

2. Remove motor adapter mounting bolts **[133]**. Remove motor **[100]** and motor adapter **[131]**. See *Figure 3, page 10 and Figure 4, page 11.*

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

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 Figure 18, page 32)*

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

1. Auxiliary 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.

   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.

2. Auxiliary 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.

3. Tighten the gland nuts until the lockwashers are compressed.

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.

BRACKET STEADY BEARING

In-tank steady bearings will require periodic inspection and replacement of bushing and wear sleeve **[606, 604]**. *(Figure 19, page 33)*

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 wear allowance is:

TABLE 13: BRACKET STEADY BEARING WEAR SLEEVE AND BUSHING WEAR ALLOWANCES

SHAFT DIAMETER	UP TO 3" (76.2mm)	LARGER THAN 3" (76.2mm)
WEAR SLEEVE	.040" (1mm)	.060" (1.5 mm)
BUSHING	.120" (3mm)	.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.

2. Unbolt the housing from the bracket or tri-pod.

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. Torque all fasteners to the value shown in *Table 5, page 15.*

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

TRIPOD STEADY BEARING

In-tank steady bearings will require periodic inspection and replacement of bushing and stub shaft **[606, 630]**. *(Figure 20, page 35)*

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

Unless otherwise specified the recommended wear allowance is:

TABLE 14: TRI-POD STEADY BEARING WEAR SLEEVE AND BUSHING WEAR ALLOWANCES

SHAFT DIAMETER	UP TO 3" (76.2mm)	LARGER THAN 3" (76.2mm)
WEAR SLEEVE	.040" (1mm)	.060" (1.5 mm)
BUSHING	.120" (3mm)	.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; also the stub shaft/retainer assembly can be very heavy on larger size agitators. In order to hold the stub shaft when it disengages use half of the supplied retainer plate 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 bushing housing prior to pressing the bushing in place.*

4. Reinstall the bushing housing, new stub shaft, and retainer plate as described in the ***Installation*** section of this supplement. Torque fasteners to the value shown in *Table 5, page 15.*

5. Reattach the flush piping.

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

GTD/GTP AGITATOR PART NUMBERS

Part#	Description	Qty.
100	**motor**	**1**
101	motor key	1
110	**flexible motor coupling assembly**	**1**
120	**cover plate assembly**	**1**
121	cover plate	1
122	bolt	2
123	lockwasher	2
130	**motor adapter assembly**	**1**
131	motor adapter	1
132	alignment pin	2
133	bolt	4
134	lockwasher	4
135	bolt	4
136	lockwasher	4
137	motor spacer	1
138	bolt	2
139	lockwasher	2
200	**gear drive assembly**	**1**
202	input shaft	1
203-001	bearing (shielded)	1
-002	bearing (sealed)	1
205-001	bearing	1
-002	bearing	1
217	bearing	1
221	bearing	1
233	bearing	1
244	output shaft	1
245	bearing	1
258	dipstick	1
259	oil fill plug, npt	1
260	grease fitting	1
261	relief fitting	1
262	grease fitting	1
263	pipe plug, npt	1
264	magnetic drain plug, npt	1
265	pipe plug, npt	1
266	pipe plug, npt	1
267	pipe plug, npt	1
269	input shaft key	1
270	breather	1

GTD/GTP AGITATOR PART NUMBERS

Part#	Description	Qty.
271	elbow fitting	1
302	bearing	1
306	bearing	1
313	pipe plug, npt	1
350	**low speed coupling assembly**	**1**
351	rigid, removable, taper bore coupling half	1
352	key	1
353	coupling washer	1
354	coupling washer	1
355	shaft bolt	1
356	locking clip	1
357	shaft bolt	2
358	lockwasher	2
359	bolt	6
360	lockwasher	6
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	
408	rigid, removable, taper bore coupling half	1
409	key	1
410	coupling washer	1
412	locking clip	1
413	rigid, removable, taper bore coupling half	1
414	key	1
415	coupling washer	1
416	locking clip	1
418	shaft bolt	1
419	shaft bolt	1
420	key	1
421	coupling washer	1
422	bolt	2
423	lockwasher	2
424	coupling washer	1
425	bolt	2
426	lockwasher	2

GTD/GTP AGITATOR PART NUMBERS

Part#	Description	Qty.
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	
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	

GTD/GTP AGITATOR PART NUMBERS

Part#	Description	Qty.
600	**steady bearing assembly**	**1**
601	bracket 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
611	bolt	
612	lockwasher	
613	mounting plate	1
614	support leg 3	
615	nut 12	
616	dowel pin 2	
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	
639	flat washer 6	
640	alignment pin	3
641	pipe plug (flush)	1

GTD/GTP AGITATOR PART NUMBERS

Part#	Description	Qty.
900	**anchor bolt assembly**	**1**
901-001	anchor bolt, 3/4"-10 (Case Size 1,2)	4
-002	anchor bolt, 7/8"-9 (Case Size 3,4)	4
902-001	nut	4
-002	nut	4
903-001	lockwasher	4
-002	lockwasher	4
904-001	flatwasher	4
-002	flatwasher	4
1100	**pedestal assembly**	**1**
1101	pedestal	1
1102	bolt	4
1103	lockwasher	4
1104	nut	4
1105	handhole cover	4
1106	bolt	4
1107	lockwasher	4
1108	flatwasher	4
1109	lockwasher	4
1110	nut	4
1350	**auxiliary stuffing box assembly**	**1**
1351-001	flanged stuffing box (6 ring)	1
1352	stud	2
1353	gland nut	2
1354	lockwasher	2
1355	gland plate	1
1356	split gland	1
1357-001	packing (2 sets of 3 rings)	6
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

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