
GTN/GTNC/GTNS Turbine Agitators Installation, Operation Maintenance Manual

Equipment Reference:
GTN Style Agitator
GTNC Style Agitator
GTNS Style Agitator

For service and
information contact:

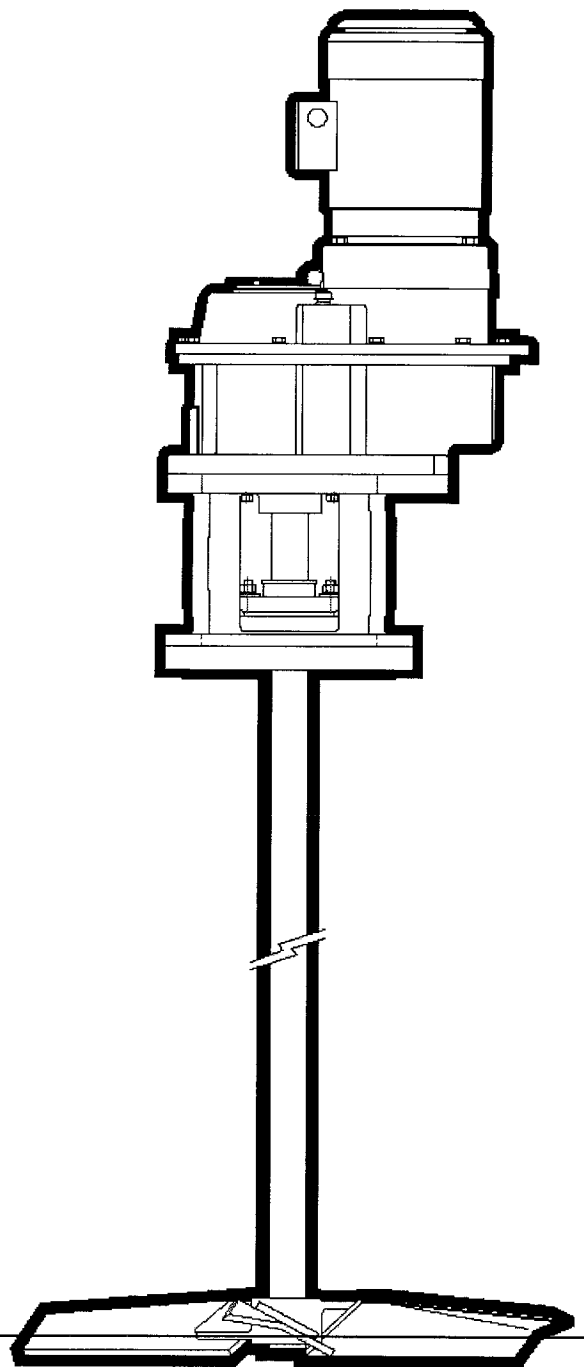


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INITIAL INSPECTION

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

Step 2: Uncrate. Check the contents. Do not uncrate the unit until you have read the *Installation* section of this manual and looked at the assembly drawing shipped with the unit. Be careful in uncrating and handling. Do not discard the crating without 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, "1GTN-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

GTN, GTNC and GTNS style units are designed to mount on an ANSI flange, nozzle or pad located on the vessel top head. See *Figure 1, page 6*.

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

During operation of the agitator, the fluid motion in the vessel produced by the rotation of the turbine impeller can exert significant forces and moments on the agitator extension shaft. The forces and moments produced by the turbine rotating in a fluid are; torque, turbine thrust and turbine hydraulic (side) force. Torque implies an unchanging load, but the actual operating torque will show plus or minus 10 to 20 percent variability due to 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 is to offset or add to the unit weight, contributing to the variability of the support structure loading. The agitator has been designed to accommodate these forces, and as a result, the forces are transmitted directly to the agitator mounting nozzle or pad. The nozzle or pad and vessel top head must be rigid enough to support the agitator weight and limit the angular displacement of the agitator drive to .05 degrees as a result of the torque and bending moment. Refer to the agitator assembly drawing for the nozzle or pad design loads.

See *Tables 2 and 3, page 8*, for the recommended vessel head thickness vs. vessel diameter, agitator case size and mounting nozzle or pad size. These tables are to be used as a guide for determining when vessel head reinforcement is required.

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

AGITATOR MOUNTING

Very high ChemScale® agitation levels may require vessel head thicknesses greater than the table values. If the vessel head is not rigid enough, the head thickness can be increased or a reinforcement pad (*Figure 2, page 7*) can be added.

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

VESSEL MOUNTING

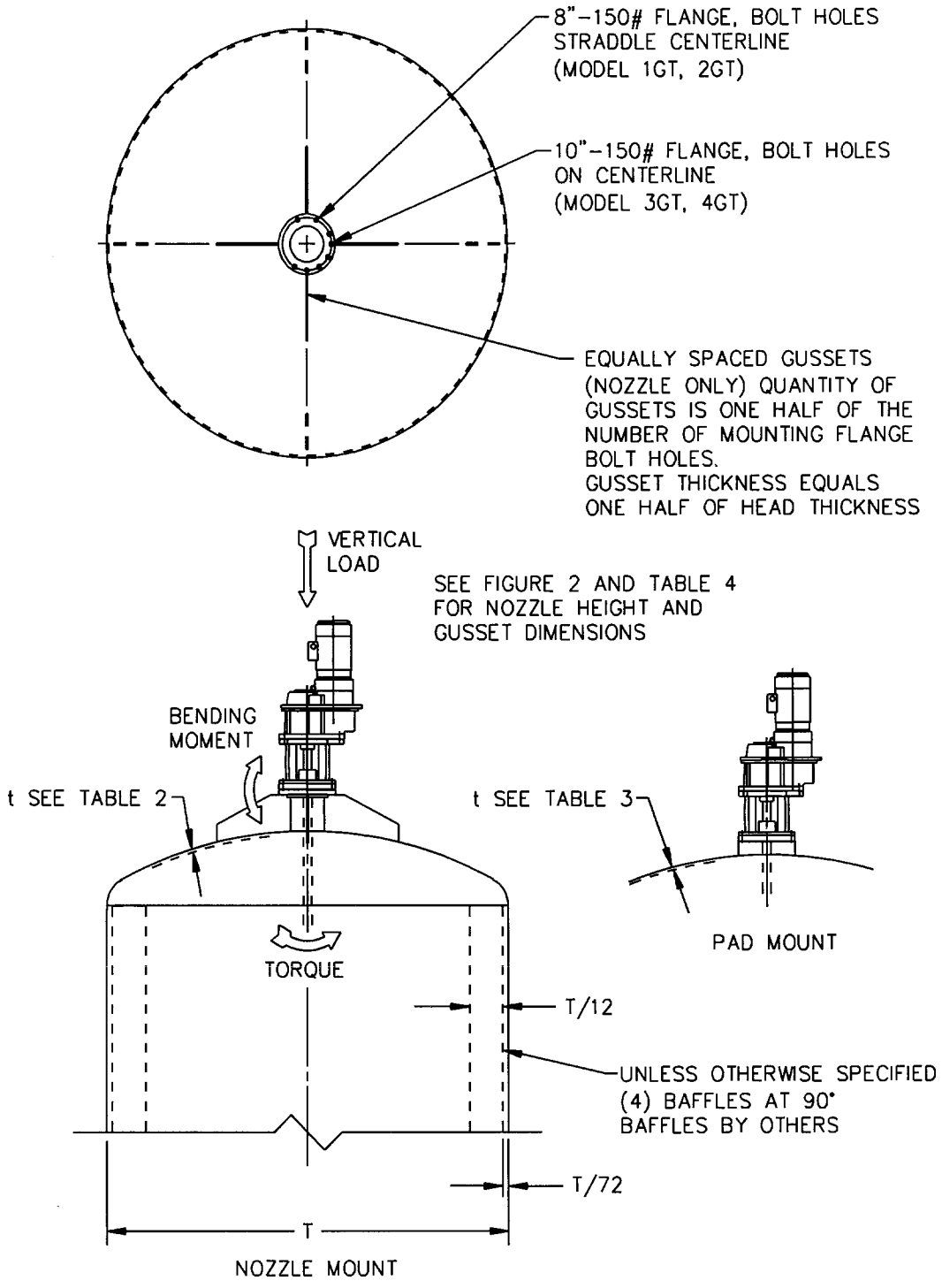


Figure 1: Vessel Mounting

VESSEL MOUNTING

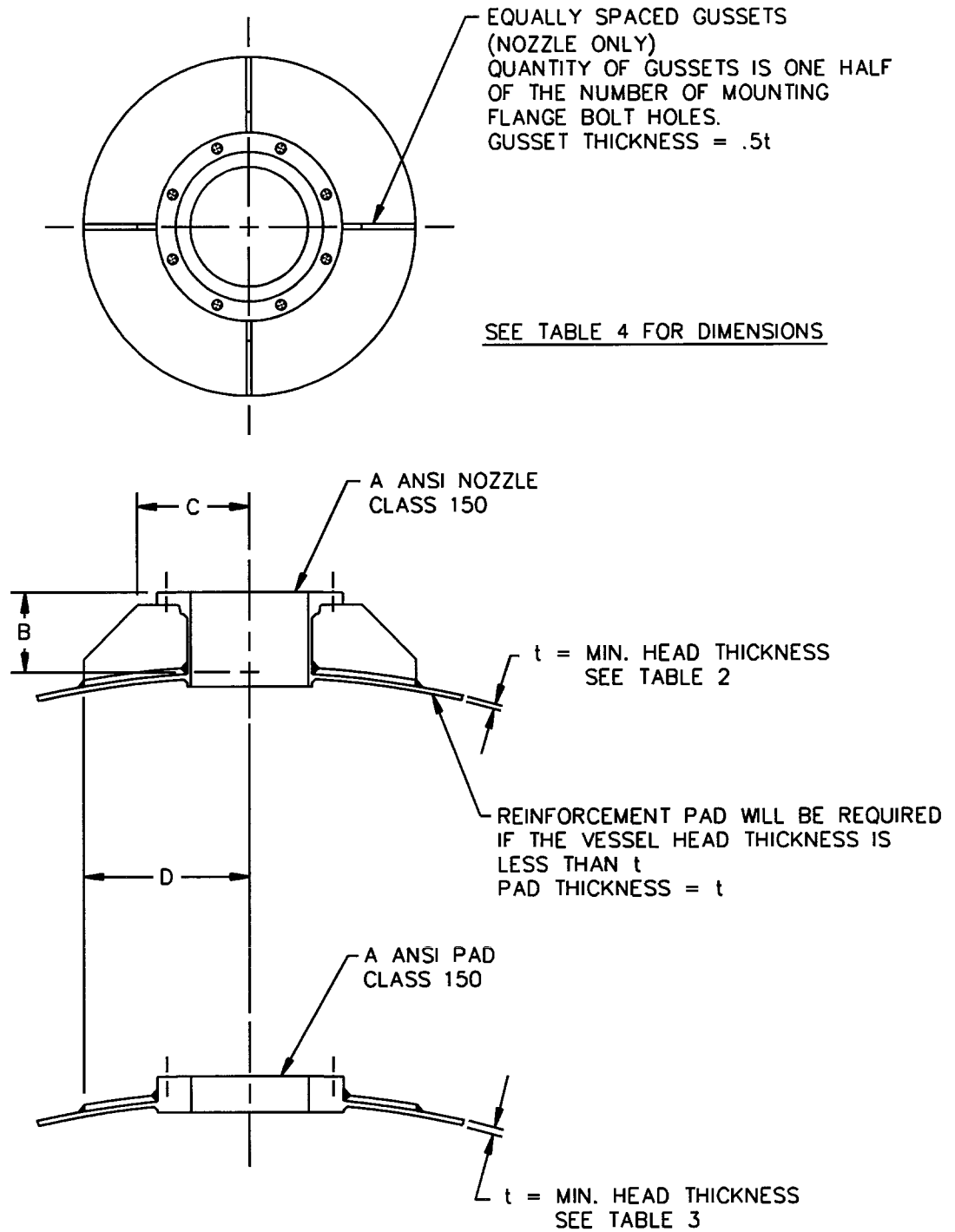


Figure 2: Vessel Mounting Nozzle/Pad

VESSEL MOUNTING

TABLE 2: VESSEL HEAD THICKNESS (t), NOZZLE MOUNT

VESSEL DIAMETER (Ft/m)	CASE SIZE (NOZZLE SIZE)			
	1GT (8")	2GT (8")	3GT (10")	4GT (10")
4 (1.22)	.125" (3.18mm)	.188" (4.78mm)	.188" (4.78mm)	.250" (6.35mm)
5 (1.52)	.188" (4.78mm)	.188" (4.78mm)	.250" (6.35mm)	.313" (7.95mm)
6 (1.83)	.188" (4.78mm)	.250" (6.35mm)	.313" (7.95mm)	.313" (7.95mm)
7 (2.13)	.250" (6.35mm)	.313" (7.95mm)	.375" (9.53mm)	.375" (9.53mm)
8 (2.44)	.250" (6.35mm)	.313" (7.95mm)	.375" (9.53mm)	.438" (11.12mm)
9 (2.74)	.313" (7.95mm)	.375" (9.53mm)	.438" (11.12mm)	.500" (12.70mm)
10 (3.05)	.313" (7.95mm)	.375" (9.53mm)	.500" (12.70mm)	.500" (12.70mm)
12 (3.66)	.375" (9.53mm)	.438" (11.12mm)	.563" (14.30mm)	.625" (15.88mm)
15 (4.57)	.500" (12.70mm)	.563" (14.30mm)	.688" (17.48mm)	.750" (19.05mm)
20 (6.10)	.625" (15.88mm)	.688" (17.48mm)	.875" (22.23mm)	.938" (23.83mm)

TABLE 3: VESSEL HEAD THICKNESS (t), PAD MOUNT

VESSEL DIAMETER (Ft/m)	CASE SIZE (NOZZLE SIZE)			
	1GT (8")	2GT (8")	3GT (10")	4GT (10")
4 (1.22)	.125" (3.18mm)	.125" (3.18mm)	.125" (3.18mm)	.188" (4.78mm)
5 (1.52)	.125" (3.18mm)	.125" (3.18mm)	.188" (4.78mm)	.188" (4.78mm)
6 (1.83)	.125" (3.18mm)	.125" (3.18mm)	.188" (4.78mm)	.188" (4.78mm)
7 (2.13)	.125" (3.18mm)	.125" (3.18mm)	.188" (4.78mm)	.188" (4.78mm)
8 (2.44)	.125" (3.18mm)	.188" (4.78mm)	.188" (4.78mm)	.250" (6.35mm)
9 (2.74)	.125" (3.18mm)	.188" (4.78mm)	.188" (4.78mm)	.250" (6.35mm)
10 (3.05)	.188" (4.78mm)	.188" (4.78mm)	.250" (6.35mm)	.250" (6.35mm)
12 (3.66)	.188" (4.78mm)	.188" (4.78mm)	.250" (6.35mm)	.250" (6.35mm)
15 (4.57)	.188" (4.78mm)	.250" (6.35mm)	.250" (6.35mm)	.313" (7.95mm)
20 (6.10)	.250" (6.35mm)	.250" (6.35mm)	.313" (7.95mm)	.375" (9.53mm)

VESSEL MOUNTING

TABLE 4: AGITATOR MOUNTING NOZZLE/PAD REINFORCEMENT DIMENSIONS

CASE SIZE	A	B	C	D
1GT	8"	6" (152mm)	8" (203mm)	10.5" (267mm)
2GT	8"	6" (152mm)	8" (203mm)	12" (305mm)
3GT	10"	6" (152mm)	8" (203mm)	13.75" (350mm)
4GT	10"	8" (203mm)	11.5" (292mm)	15.5" (394mm)

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, (*Figure 3, page 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 materials. Refer to *Figure 6, page 15* for lifting instructions of the agitator. 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. Install handhole cover bolts, lockwashers [1106, 1107] and socket bolt [1115] into the pedestal [1101]. Refer to *Figure 9, page 21*. Assemble pedestal to mounting flange [1251] using bolts and lockwashers [1116, 1117]. Torque bolts to value shown in *Table 6, page 22*. Install gear drive support pedestal/mounting flange assembly to vessel nozzle; gasket and fastener set furnished by customer (on stud mounted units, studs [1258] are supplied).

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

4. Install drop collar [1253], with the flanged side up if applicable, onto the tapered end of the agitator extension shaft [400]. Slide the collar down until the collar covers the setscrew relief area machined in the extension shaft. Rotate the collar until one of the tapped holes in the collar line up with the spot on the shaft. Install half dog point setscrew [1254] into the spot on the shaft. Install the remaining cup point setscrews [1255] in the collar. Torque the setscrews to the value shown in *Table 6*.

Lift the agitator extension shaft and lower it through the mounting flange until the shaft drop collar is seated in the mounting flange counter bore. If the headroom will not allow the agitator shaft to be lowered through the mounting flange, or if the extension shaft is furnished with an optional in-tank coupling (*Figure 17, page 34*), lift the extension shaft and lower it into the vessel. Lift the shaft up through the mounting flange from inside the vessel. Assemble the drop collar to the shaft.

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.

AGITATOR INSTALLATION

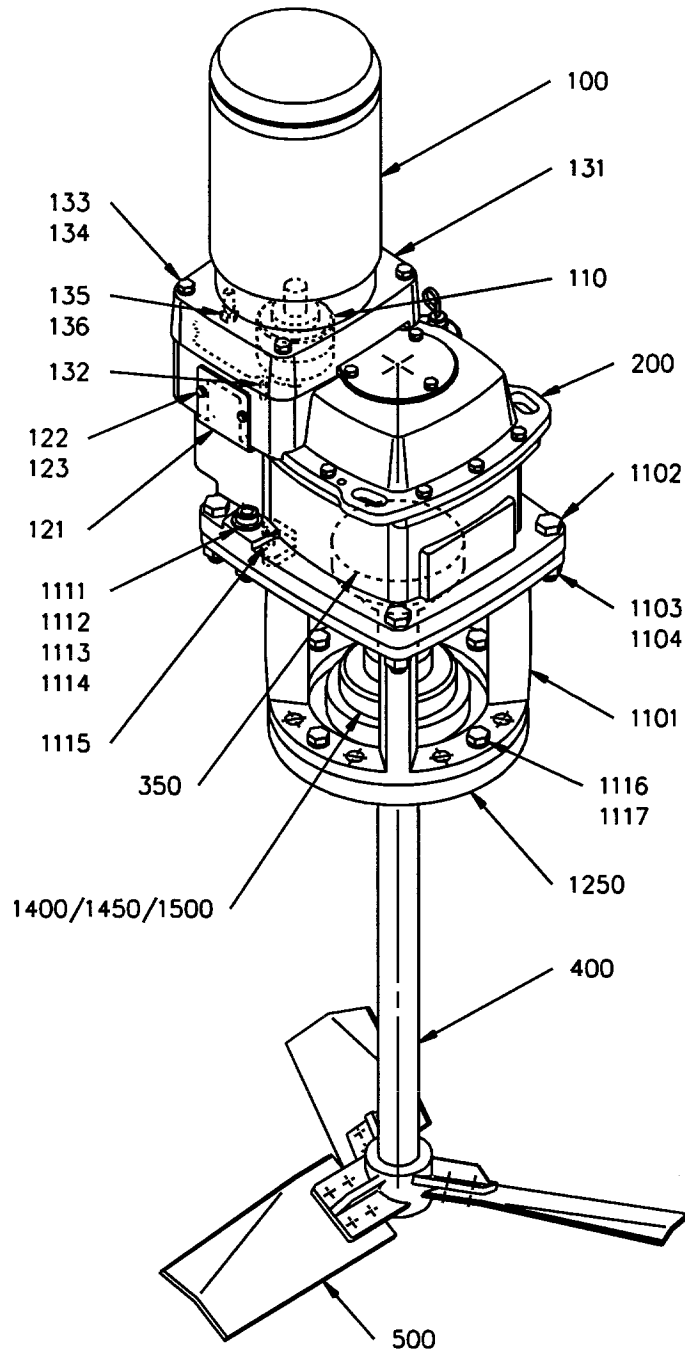


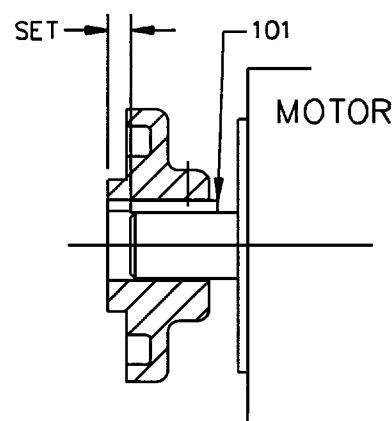
Figure 3: Model GTN, GTNC, GTNS Agitator Assembly

AGITATOR INSTALLATION

- 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 5* below to locate the hub from the end of the motor shaft. Tighten the hub setscrews to the torque value shown in *Table 6, page 22*. Turn the motor shaft by hand to check that the shaft rotates freely.

TABLE 5: 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 6*.

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

- Do not install the motor/motor adapter assembly [100,131], until after the gear drive [200] has been installed on the pedestal [1101] and the mechanical seal cartridge is completely installed.

The procedure for the installation of the mechanical seal and any optional steady bearing assembly will require access to the gear drive input shaft.

AGITATOR INSTALLATION

Model GTN: (Refer to Figure 4)

- 7a. Place o-ring [1252] into the groove in mounting flange [1251].
- 7b. Install studs [1262] into mechanical seal adapter plate [1261]. Install the adapter plate and bolts and lockwashers [1266, 1267]. *Do not tighten bolts at this time.*
- 7c. The GTN cartridge mechanical seal [1500] is packaged separately in its own carton, ready to install. Remove the mechanical seal from the carton and read the manufacturer's installation instructions. Check that the mechanical seal sleeve cup point setscrews [1502] do not protrude into the bore of the sleeve and that the centering clips [1503] are in place.

NOTE: Silicone lubricant is packaged with the cartridge mechanical seal. If this lubricant is not compatible with your process, do not use. Select a more suitable lubricant.

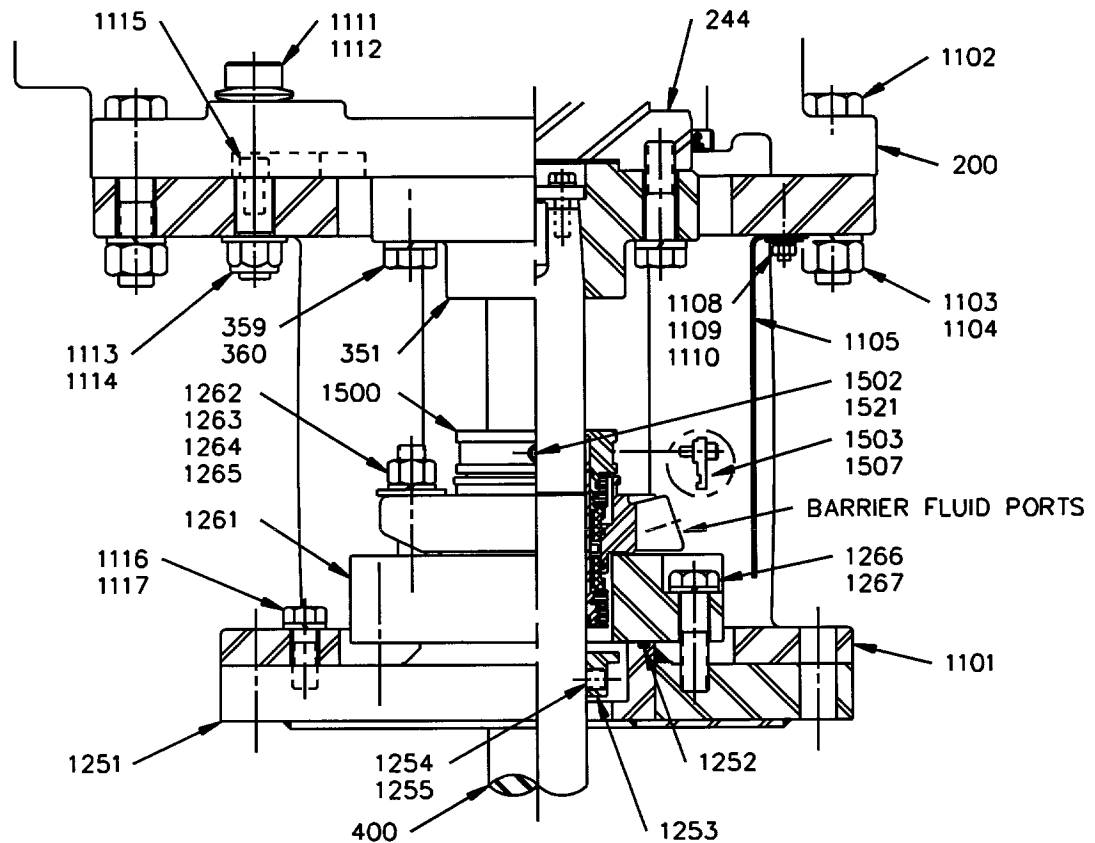


Figure 4: GTN, Chesterton 255 Seal

AGITATOR INSTALLATION

- 7d. Apply a light coat of suitable lubricant to the agitator extension shaft [400] and slide the cartridge mechanical seal down the shaft to rest on the mechanical seal adapter plate.
- 7e. 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*) 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.

NOTE: Do not apply lubricant or anti-seize compound to coupling taper. Shaft and coupling tapers must be clean and dry.

- 7f. 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.

- 7g. Install Shaft Bolts:

2 Bolt Design:

Install coupling washer [354]. Install bolts [357] and lockwashers [358]. Torque bolts to the value shown in *Table 6, page 22*.

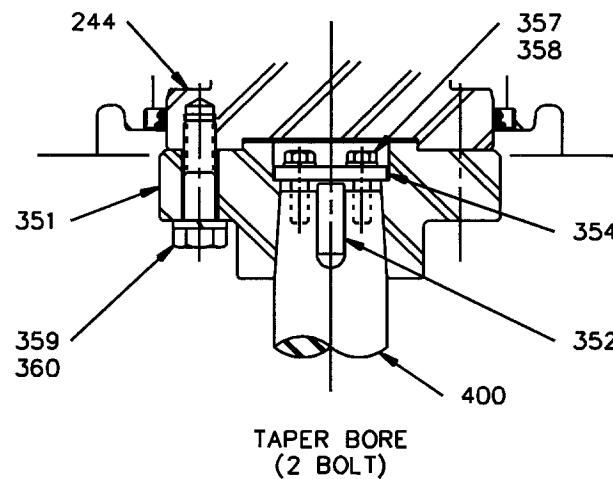


Figure 5: Shaft Coupling Installation

- 7h. Lift the agitator drive assembly (*Figure 6, page 15*) and lower it onto the pedestal [1101]. Install pivot shoulder bolt [1111] with Belleville washers [1112] into the gear drive housing. Install flatwasher [1113] and locknut [1114]. Tighten the locknut until the Belleville washers are compressed 1/16" (1.5 mm).
- 7i. Install bolts, lockwashers and nuts [1102, 1103, 1104]. Torque bolts to the value shown in *Table 6*.

AGITATOR INSTALLATION

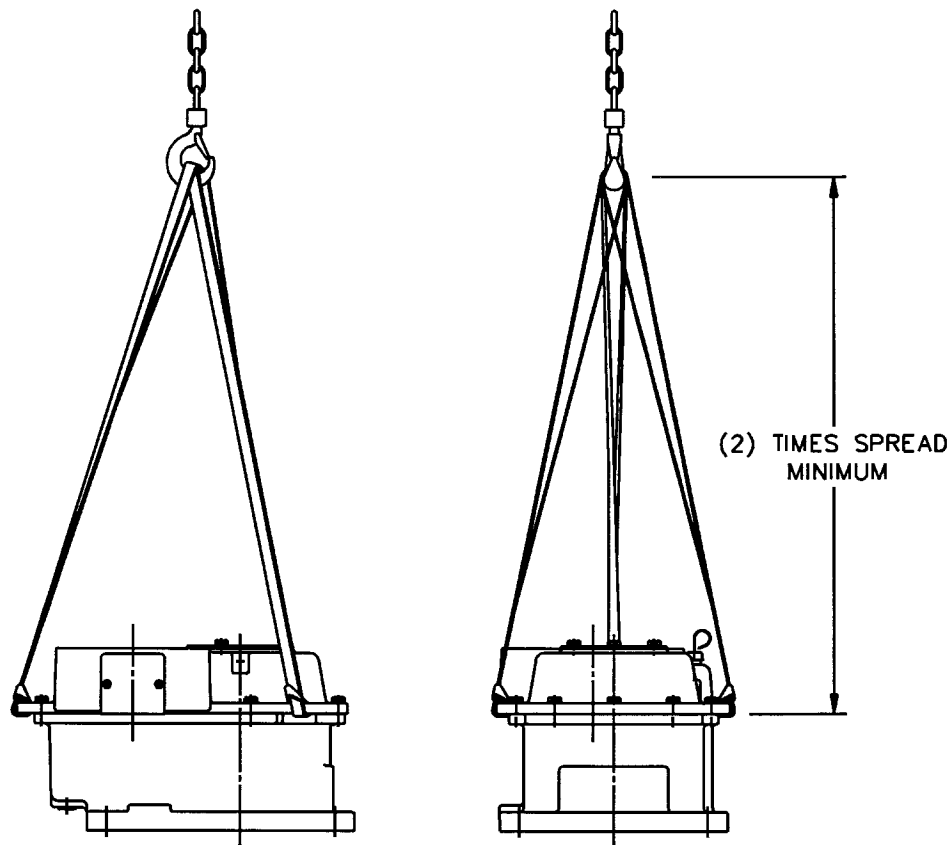


Figure 6: Agitator Lifting System

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.

- 7j. Install two bolts and lockwashers [359,360] at 180° into the flange of the taper bore coupling half [351]. Engage the bolt threads into the gear drive output shaft [244]. Tighten the bolts evenly to engage the tenon and pull the faces together. Install the remaining bolts and lockwashers [359,360]. Torque the bolts to the value shown in *Table 6, page 22*.
- 7k. Slide the mechanical seal cartridge up the extension shaft. Center seal adapter plate [1261] on the extension shaft. Tighten bolts [1266] to the value shown in *Table 6*.
- 7l. Slide the mechanical seal cartridge down the shaft. Orient the barrier fluid ports as shown in *Figure 4, page 13*. Install nuts, lockwashers and flatwashers [1263,1264,1265]. Torque the nuts to the value shown in *Table 6*.

AGITATOR INSTALLATION

- 7m. Evenly tighten all collar setscrews [1502, 1521]. Torque the setscrews to 50-60 in lb (5.7-6.8 Nm).
- 7n. Remove centering clip socket head cap screws [1507] and centering clips [1503]. Retain the clips and manufacturer's installation instructions for later use.
- 7o. It is important to make sure that the mechanical seal is centered on the shaft. To do this, rotate the gear drive output shaft [244] one or more revolutions to make sure the seal turns freely. If you hear metal to metal contact within the seal, it was improperly centered.
- 7p. To center the mechanical seal cartridge on the shaft, replace the centering clips finger tight, loosen nuts [1263], tighten centering clip socket head cap screws [1507], re-tighten nuts [1263] and then remove the centering clips. If metal to metal contact still exists, check the centering of the mechanical seal adapter plate [1261].
- 7q. This seal is equipped with a pumping device to circulate the barrier fluid.

NOTE: The barrier fluid port connections are dependant upon the agitator extension shaft rotation.

- 7r. For clockwise shaft rotation (as viewed from above), the barrier fluid supply enters through the left port. The barrier fluid return exits through the right port.
- 7s. For counter-clockwise shaft rotation (as viewed from above), the barrier fluid supply enters through the right port. The barrier fluid return exits through the left port.
- 7t. Connect the barrier fluid lines. Charge the system with barrier fluid and pressure test.
- 7u. If your agitator drive is furnished with an optional mechanical seal lubricator, See **Options: Mechanical Seal Lubricator** for installation instructions.

AGITATOR INSTALLATION

Model GTNC: (Refer to Figure 7)

- 8a. Place o-ring [1252] into the groove in mounting flange [1251].
- 8b. Install studs [1262] into mechanical seal adapter plate [1261]. Install the adapter plate over the extension shaft. Install bolts and lockwashers [1266, 1267]. *Do not tighten bolts at this time.*
- 8c. The GTNC cartridge mechanical seal [1400] is packaged separately in its own carton, ready to install. Remove the mechanical seal from the carton and read the manufacture's installation instructions. Check that the mechanical seal sleeve cup point setscrews [1402] do not protrude into the bore of the sleeve.

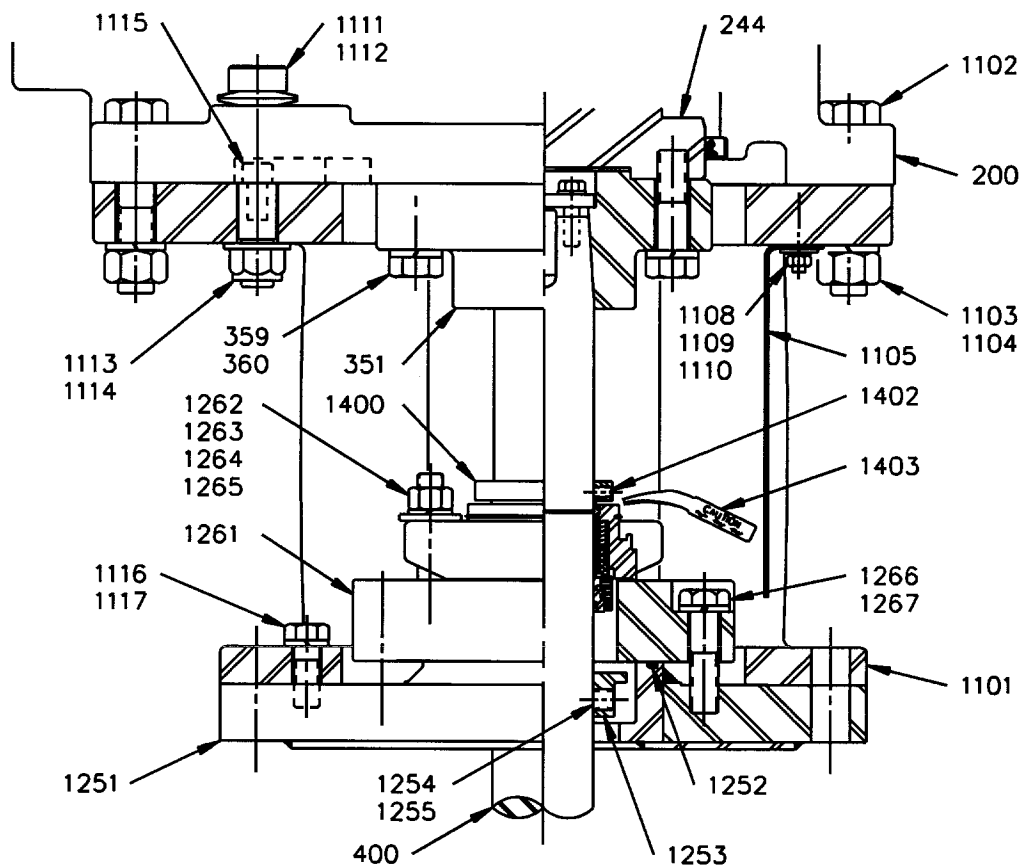


Figure 7: GTNC, Chesterton 155 Seal

NOTE: Silicone lubricant is packaged with the cartridge mechanical seal. If this lubricant is not compatible with your process, do not use. Select a more suitable lubricant.

AGITATOR INSTALLATION

- 8d. Apply a light coat of suitable lubricant to the agitator extension shaft [400] and slide the cartridge mechanical seal down the shaft to rest on the mechanical seal adapter plate.
- 8e. Install the taper bore coupling half [351]. Refer to *Installation*, page 14.
- NOTE: Do not apply lubricant or anti-seize compound to coupling taper. Shaft and coupling tapers must be clean and dry.*
- 8f. Lift the agitator drive assembly (Figure 6, page 15) and lower it onto the pedestal [1101]. Install pivot shoulder bolt [1111] with Belleville washers [1112] into the gear drive housing. Install flatwasher [1113] and locknut [1114]. Tighten the locknut until the Belleville washers are compressed 1/16" (1.5 mm).
- 8g. Install bolts, lockwashers and nuts [1102, 1103, 1104]. Torque bolts to the value shown in Table 6, page 22.
- 8h. Install two bolts and lockwashers [359,360] at 180° into the flange of the taper bore coupling half [351]. Engage the bolt threads into the gear drive output shaft [244]. Tighten the bolts evenly to engage the tenon and pull the faces together. Install the remaining bolts and lockwashers [359,360]. Torque the bolts to the value shown in Table 6.
- 8i. Slide the mechanical seal cartridge up the extension shaft. Center seal adapter plate [1261] on the extension shaft. Tighten bolts [1266] to the value shown in Table 6.
- 8j. Slide the mechanical seal cartridge down the shaft. Install nuts, lockwashers and flatwashers [1263,1264,1265]. Torque the nuts to the value shown in Table 6.
- 8k. Evenly tighten all collar setscrews [1402, 1420]. Torque the setscrews to 50-60 in lb (5.7-6.8 Nm).
- 8l. Remove centering strap [1403]. Retain the strap and the manufacturer's installation instructions for later use.
- 8m. It is important to make sure that the mechanical seal is centered on the shaft. To do this, rotate the gear drive output shaft [244] one or more revolutions to make sure the seal turns freely. If you hear metal to metal contact within the seal it was improperly centered.
- 8n. To center the mechanical seal cartridge on the shaft, loosen nuts [1263], install centering strap, re-tighten nuts [1263] and then remove the centering strap. If metal to metal contact still exists, check the centering of the mechanical seal adapter plate [1261].

AGITATOR INSTALLATION

Model GTNS: (Refer to Figure 8)

- 9a. Place o-ring [1252] into the groove in the mounting flange [1251].
- 9b. Press anti-rotation pin [1451] into the mechanical seal gland plate [1272].
- 9c. Install the mechanical seal gland plate [1272]. Do not install bolts [1266] at this time.
- 9d. Install stationary seal insert and o-ring [1458,1457] into the mechanical seal gland plate [1272].
- 9e. Remove o-ring [1452] from rotary seal ring [1453]. Slide rotary seal ring down the shaft to rest on the stationary seal insert.
- 9f. Lubricate o-ring [1452]. Install the o-ring into the rotary seal ring.

CAUTION: Do not get lubricant on the sealing faces.

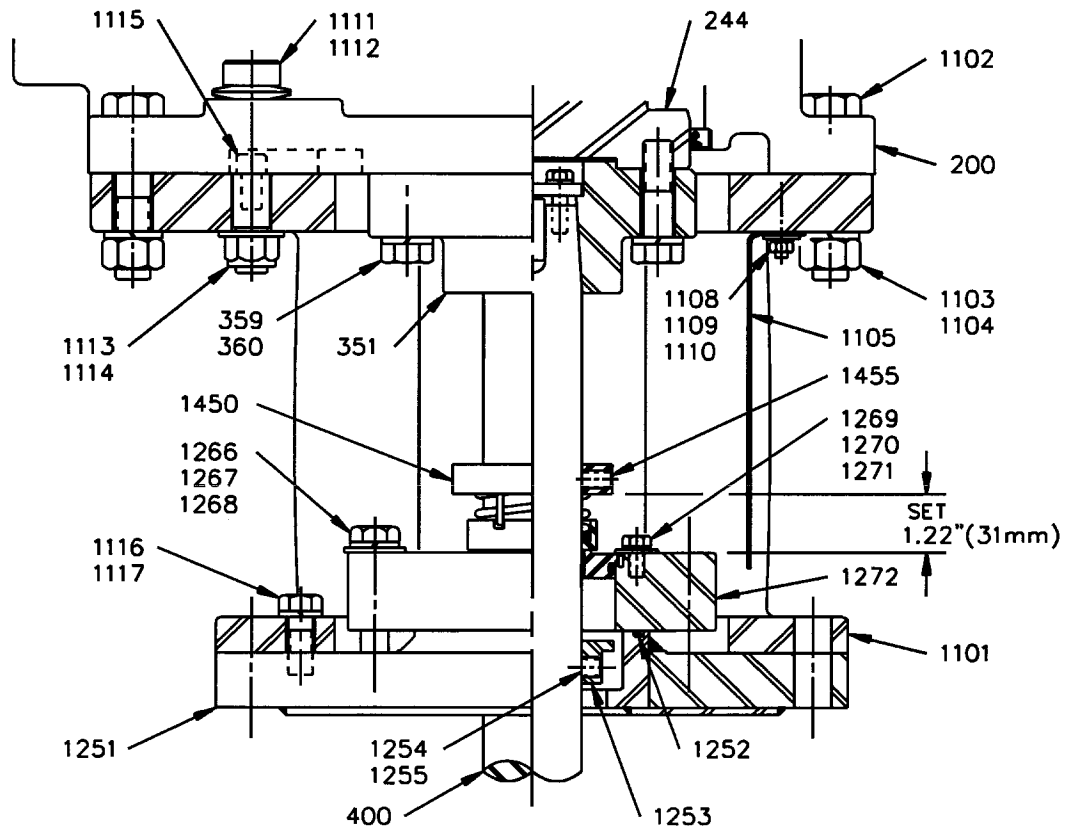


Figure 8: GTNS, Flowserve MCRO Seal

AGITATOR INSTALLATION

- 9g. Install spring [1454] and collar [1456] with setscrews [1455].
- 9h. Install the taper bore coupling half [351]. Refer to *Installation*, page 14.

NOTE: Do not apply lubricant or anti-seize compound to coupling taper. Shaft and coupling tapers must be clean and dry.

- 9i. Lift the agitator drive assembly (*Figure 6*, page 15) and lower it onto the pedestal [1101]. Install pivot shoulder bolt [1111] with Belleville washers [1112] into the gear drive housing. Install flatwasher [1113] and locknut [1114]. Tighten the locknut until the Belleville washers are compressed 1/16" (1.5 mm).
- 9j. Install bolts, lockwashers and nuts [1102, 1103, 1104]. Torque bolts to the value shown in *Table 6*, page 22.
- 9k. Install two bolts and lockwashers [359,360] at 180° into the flange of the taper bore coupling half [351]. Engage the bolt threads into gear drive output shaft [244]. Tighten the bolts evenly to engage the tenon and pull the faces together. Install the remaining bolts and lockwashers [359,360]. Torque the bolts to the value shown in *Table 6*.
- 9l. Slide the rotary seal ring up the extension shaft. Center mechanical seal gland plate/stationary seal insert [1272/1458] on the extension shaft. Install bolts, lockwashers and flatwashers [1266,1267, 1268]. Torque the bolts to the value shown in *Table 6*.
- 9m. Install bolts, lockwashers, and flatwashers [1269, 1270, 1271]. Torque to the value shown in *Table 6*.
- 9n. Set collar [1456] at 1.22" (31 mm). Evenly tighten all cup point setscrews [1455]. Torque the setscrews to the value shown in *Table 6*.

AGITATOR INSTALLATION

10. Install handhole covers [1105] onto pedestal. Attach flatwasher, lockwasher and nut [1108, 1109, 1110] to previously installed bolt and lockwasher [1106, 1107] and tighten.

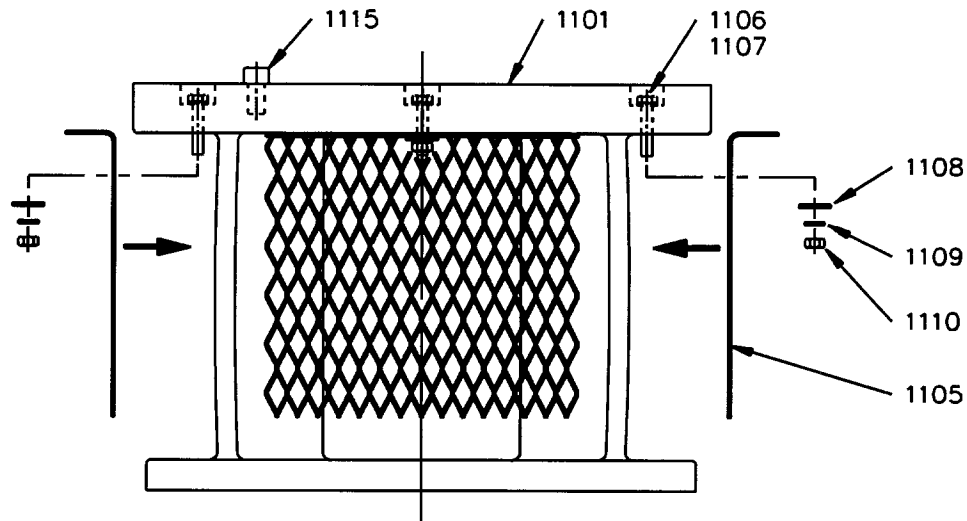


Figure 9: Handhole Cover Installation

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 .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 shaft coupling. As heat is applied to the shaft (do not allow surface temperature of shaft to exceed 500°F [260°C]), the shaft will move toward the indicator. After the shaft has moved .030-.060" (.76-1.52 mm), remove the heat and 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.
13. Install bolts [133] and lockwashers [134] into motor adapter prior to installing adapter onto motor. Refer to *Figure 3, page 11*. 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 6, page 22*. 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 6*. The flexible coupling will not require alignment maintenance after installation. Install gear drive cover plate, bolts and lockwashers [121, 122, 123] and breather [270].

AGITATOR INSTALLATION

TABLE 6: 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 10, page 24*. 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 6, page 22*. 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 11-15, pages 25-29*. 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 6*.

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.

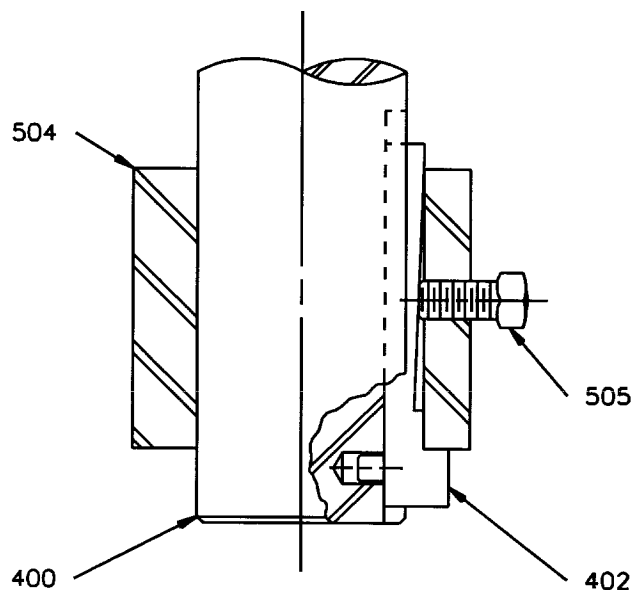


Figure 10: Hub and Pin Key Detail

IMPELLERS - STYLES

NOTE:
 STABILIZER FINS FURNISHED
 ONLY WHEN NECESSARY

 NUMBER OF BLADE FASTENERS
 MAY VARY WITH APPLICATION

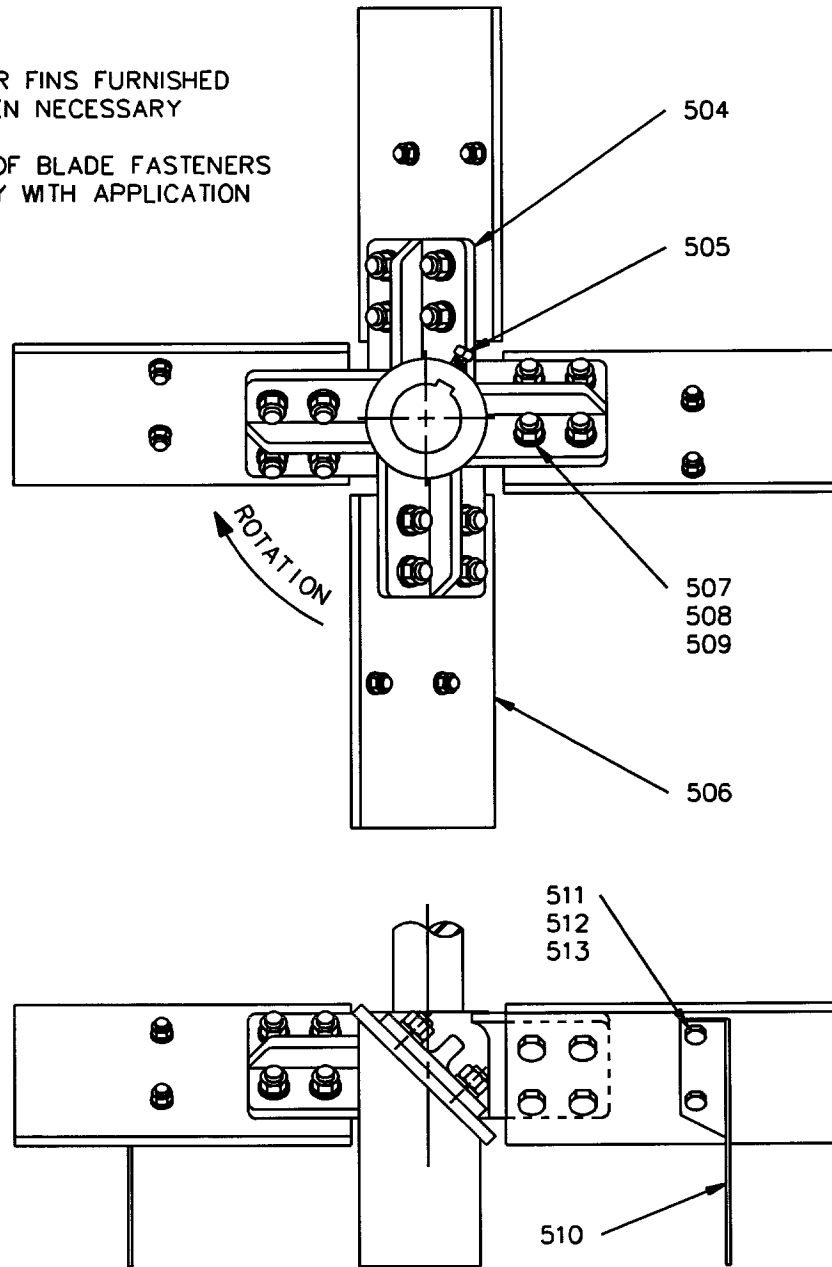
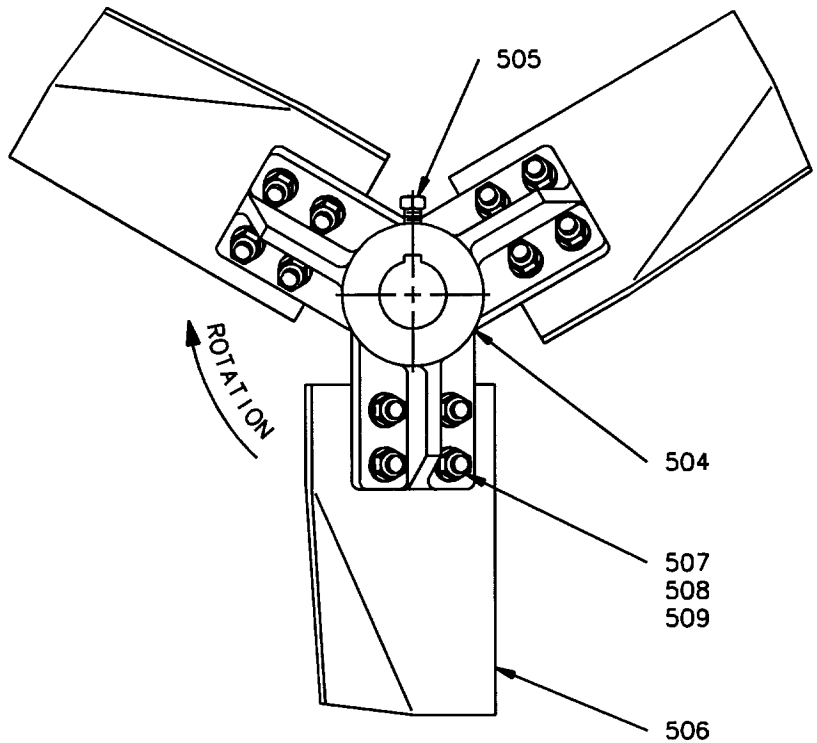


Figure 11: Style P-4 Impeller

IMPELLERS - STYLES



NOTE:
NUMBER OF BLADE FASTENERS
MAY VARY WITH APPLICATION

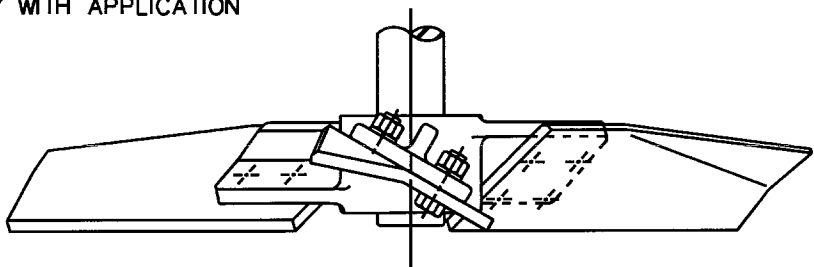


Figure 12: Style HE-3 Impeller

IMPELLERS - STYLES

NOTE:
 STABILIZER FINS FURNISHED
 ONLY WHEN NECESSARY

 NUMBER OF BLADE FASTENERS
 MAY VARY WITH APPLICATION

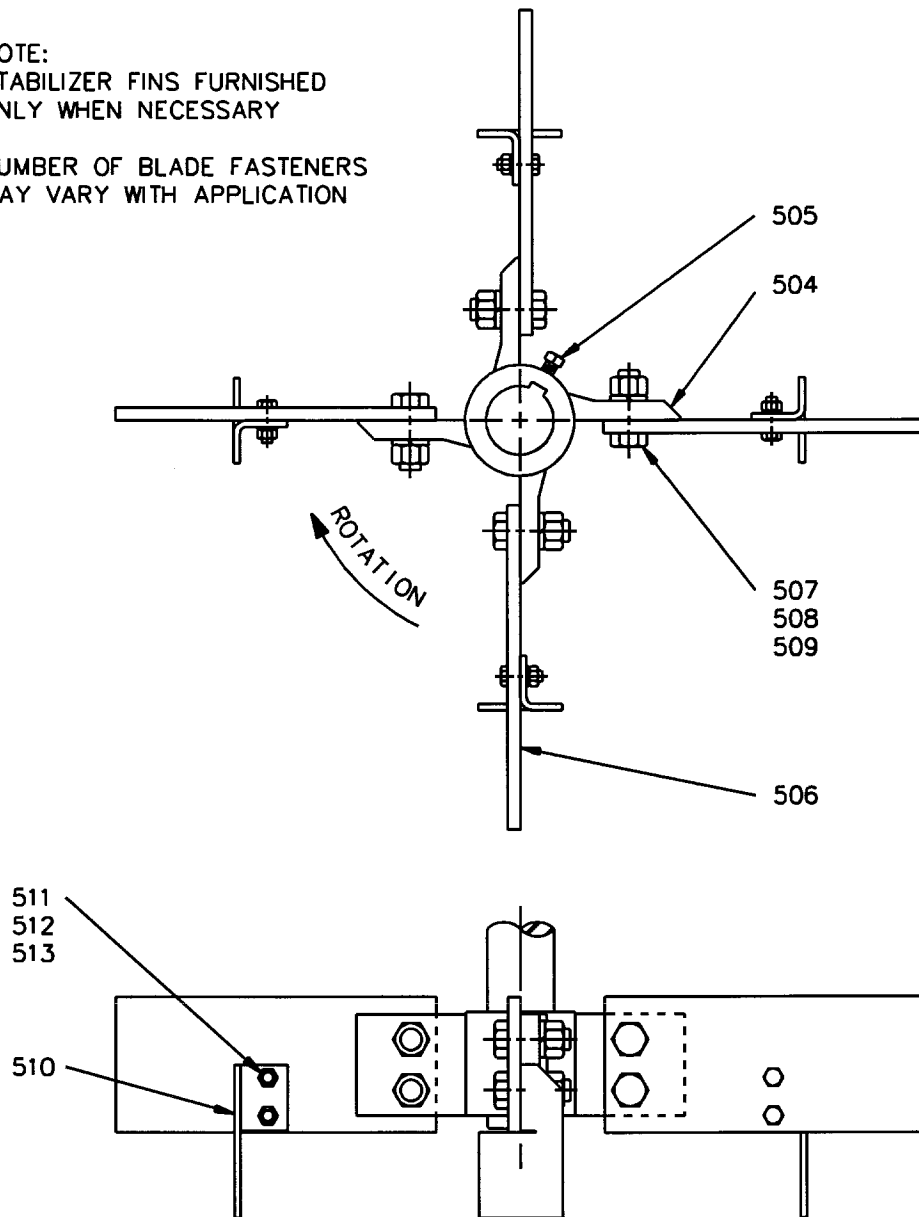
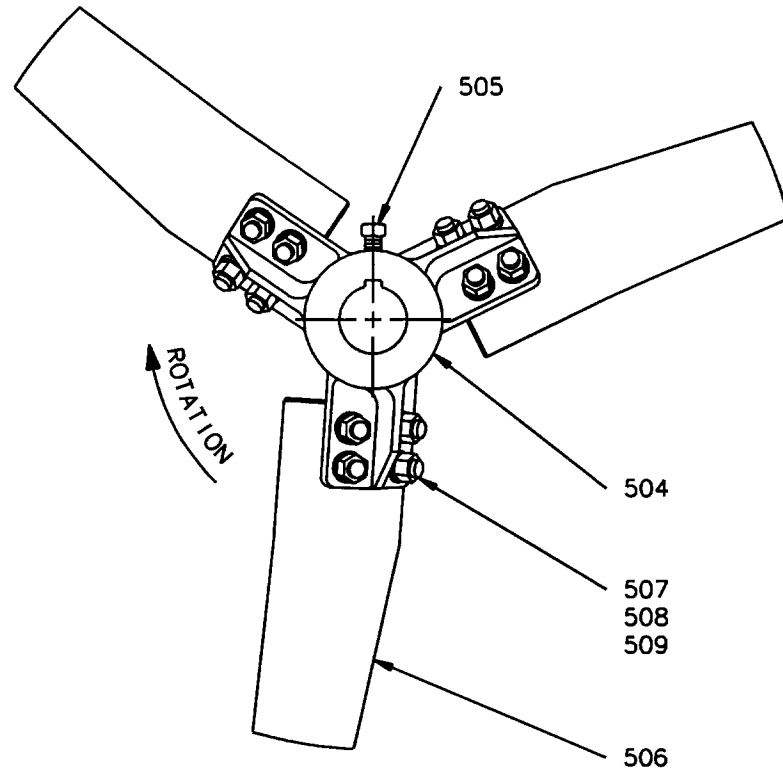


Figure 13: Style S-4 Impeller

IMPELLERS - STYLES



NOTE:
NUMBER OF BLADE FASTENERS
MAY VARY WITH APPLICATION

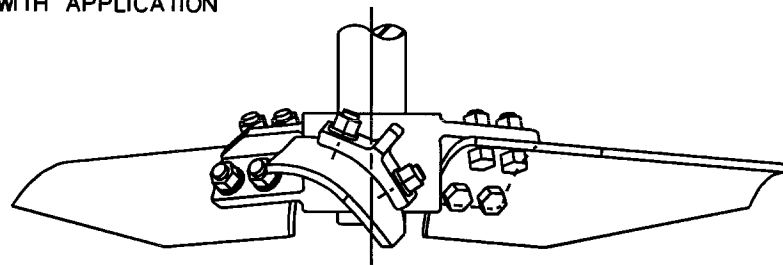


Figure 14: Style SC-3 Impeller

IMPELLERS - STYLES

NOTE:
 SPLIT BLADES FURNISHED
 ONLY WHEN NECESSARY FOR
 VESSEL INSERTION

 NUMBER OF BLADE FASTENERS
 MAY VARY WITH APPLICATION

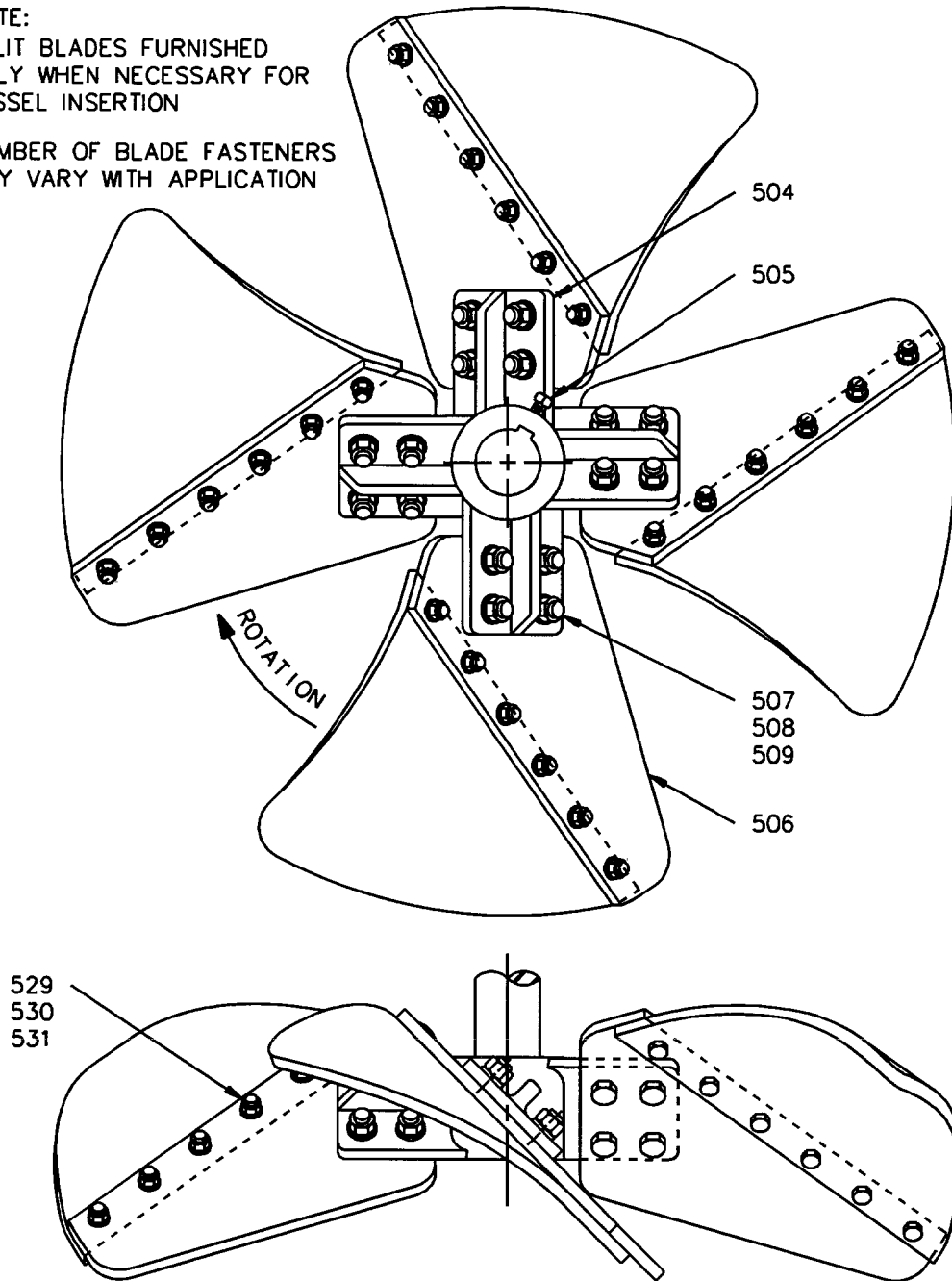


Figure 15: Style Maxflo W Impeller

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 \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 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 16, page 31*.

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 6, page 22*.
7. Remove the hoist from the impeller.

IMPELLERS - COATED/RUBBER COVERED

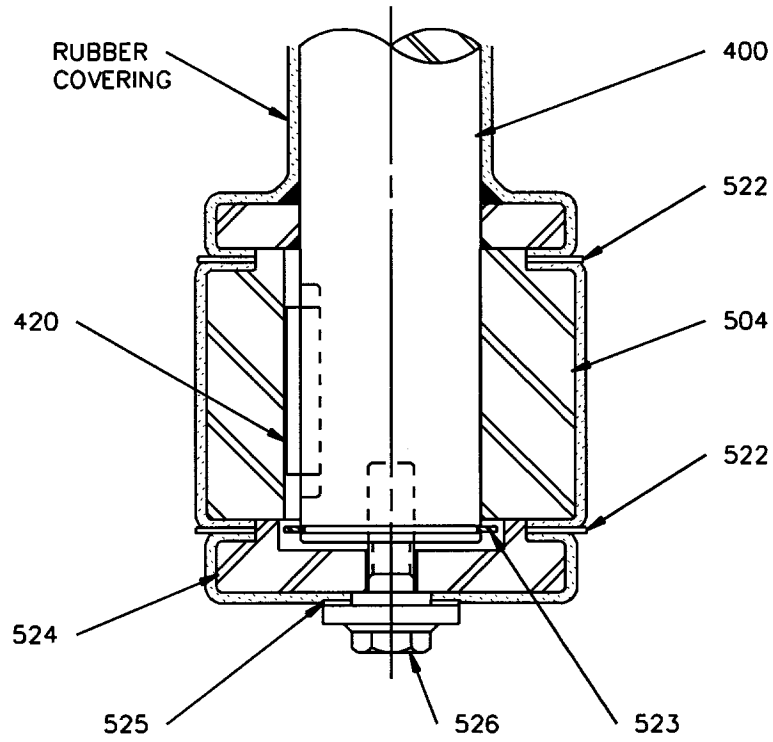


Figure 16: Thrust Bolt Impeller Attachment

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.

NOTE: Agitator seal maintenance can be made easier by installing a union in a section of the electrical conduit along the pivot shoulder bolt [1111] axis. Refer to the unit assembly drawing for the location of the pivot shoulder bolt.

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: 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 17, page 34) for all references to the agitator extension shaft [400].

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]; Install bolts and lockwashers [422, 423, 425, 426]. Torque to the value shown in *Table 6, page 22*.

1 Bolt Design:

Install coupling washer [410, 415] and locking clip [412, 416]; 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 6*.

OPTIONS: IN-TANK COUPLING

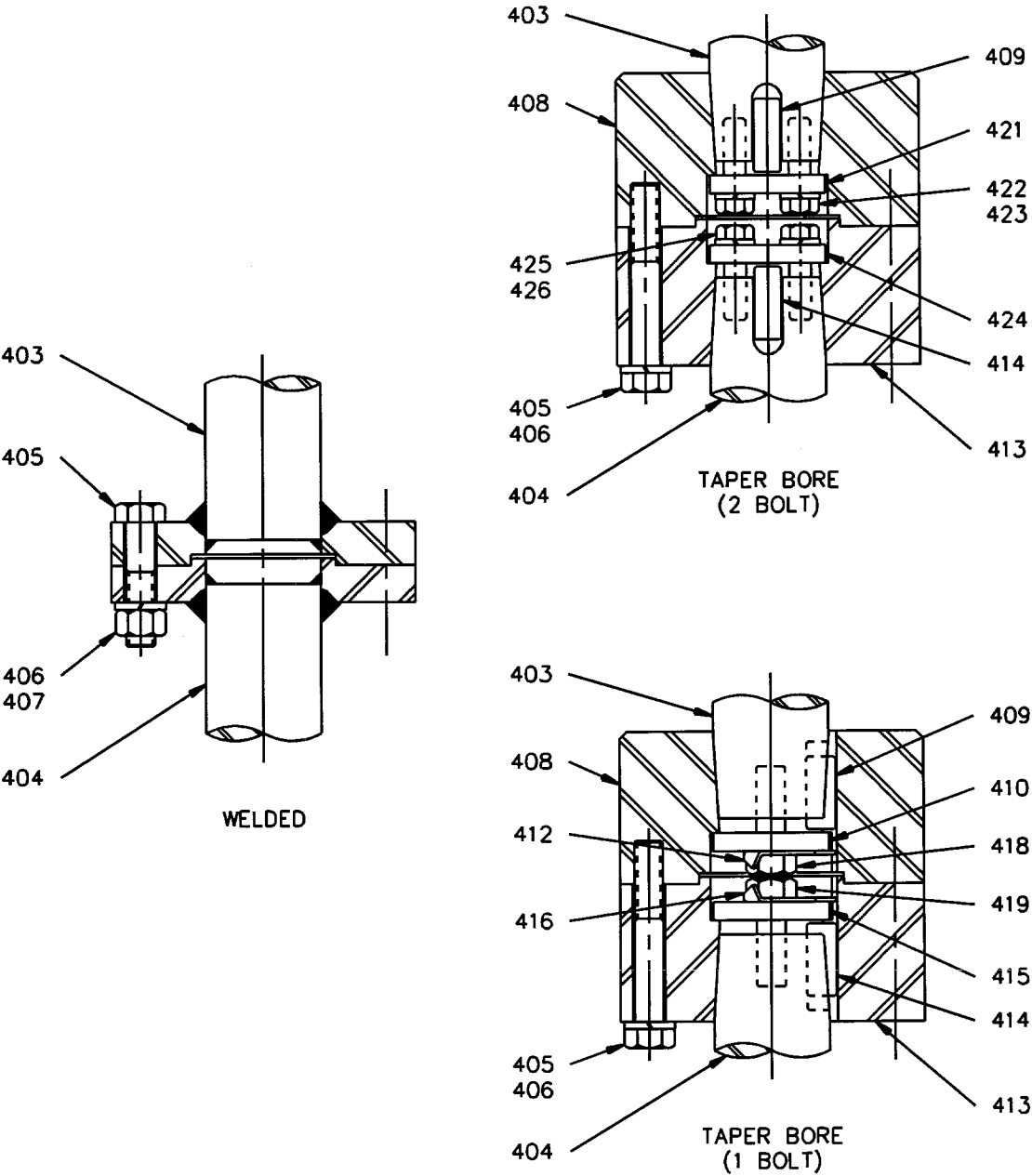


Figure 17: In-Tank Couplings

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

Bracket Steady Bearing

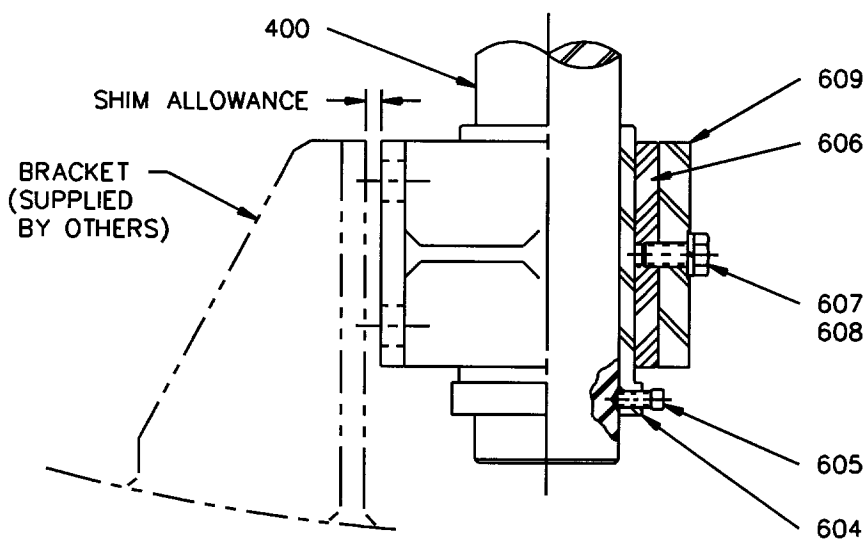


Figure 18: Bracket Steady Bearing

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 6, page 22*.
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 6, page 22*.
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 6*. 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

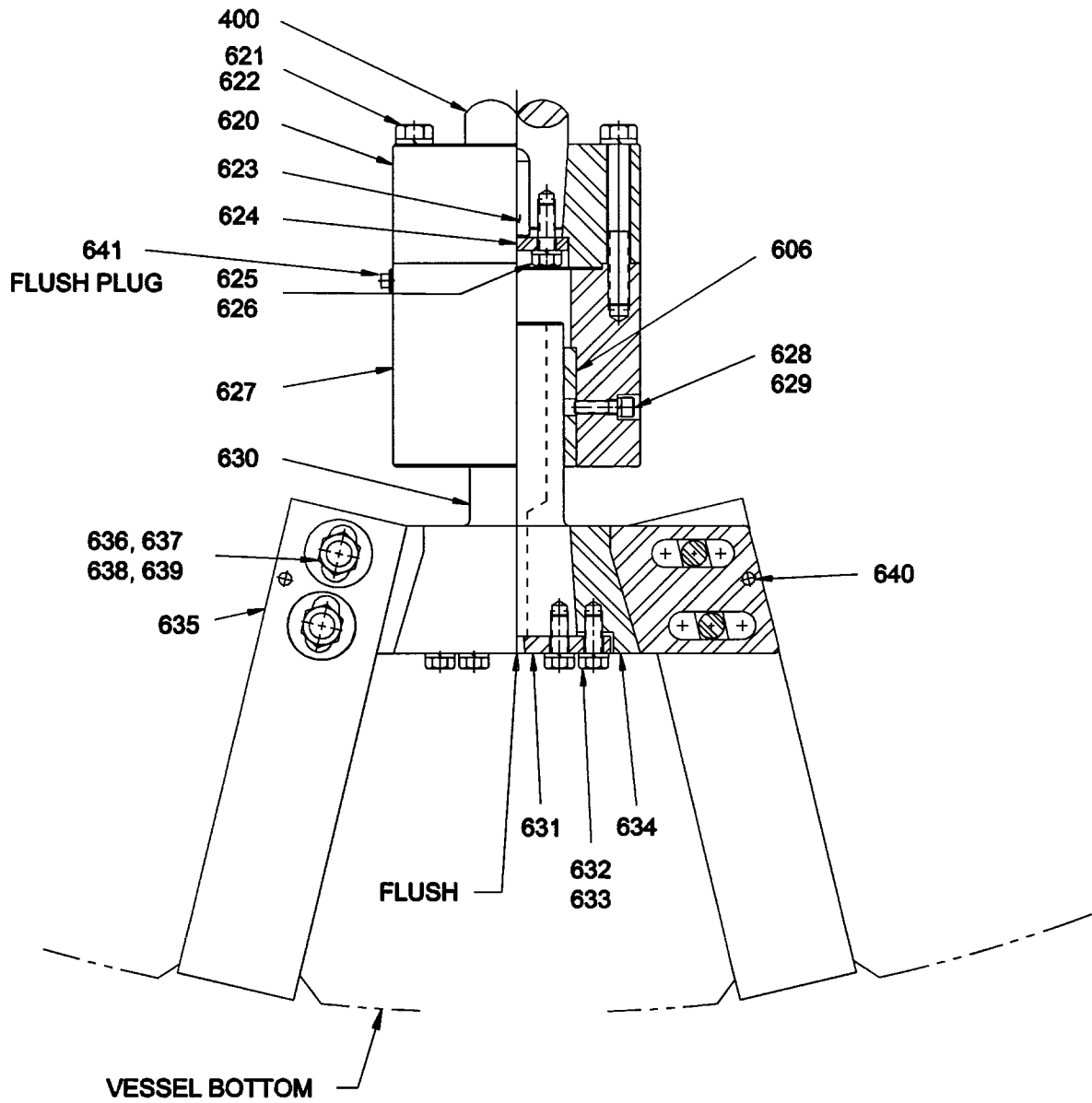


Figure 19: Tri-pod Steady Bearing

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 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 6, page 22*. *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 6*. 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 6*.
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 6, page 22*.
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 6*. 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.

OPTIONS: MECHANICAL SEAL LUBRICATOR

Assemble lubricator mounting bracket [1710] to the mechanical seal lubricator [1701]. Refer to *Figure 20, page 41*. Install mounting bolts, flatwashers and lockwashers [1711, 1712, 1713]. Torque bolts to the value shown in *Table 6, page 22*.

Remove all plastic shipping plugs from mechanical seal barrier fluid ports. Install sight glass [1704], drain plug [1705], and pipe nipples [1706, 1708].

Install flexible metal hoses [1707, 1709], NPT male end into the cartridge mechanical seal barrier fluid ports. Install NPT female union ends onto pipe nipples [1706, 1708].

Remove two gear drive mounting bolts, lockwashers, and nuts, [1102, 1103, 1104]. Install lubricator/mounting bracket assembly. Re-install the gear drive mounting bolts, lockwashers, and nuts. Torque bolts to the value shown in *Table 6*.

Connect the flexible metal hose, union ends. Fill the mechanical seal lubricator to the center of the sight glass. The approximate capacity is 0.8 gallons U.S. (3 liters). Install the 3/8-inch NPT fill plug [1703].

Connect a pressure line to the mechanical seal lubricator pressure inlet port, 1/4-inch NPT. Pressurize using a gas bottle, or other means, to 25-50 psi (172-344 kPa) above the maximum vessel pressure. Check all fittings for leaks.

CAUTION: Never pressurize the vessel without having the mechanical seal fully pressurized.

*See page 51 in the **Lubrication** section for additional information.*

Install handhole covers [1105, 1714].

OPTIONS: MECHANICAL SEAL LUBRICATOR

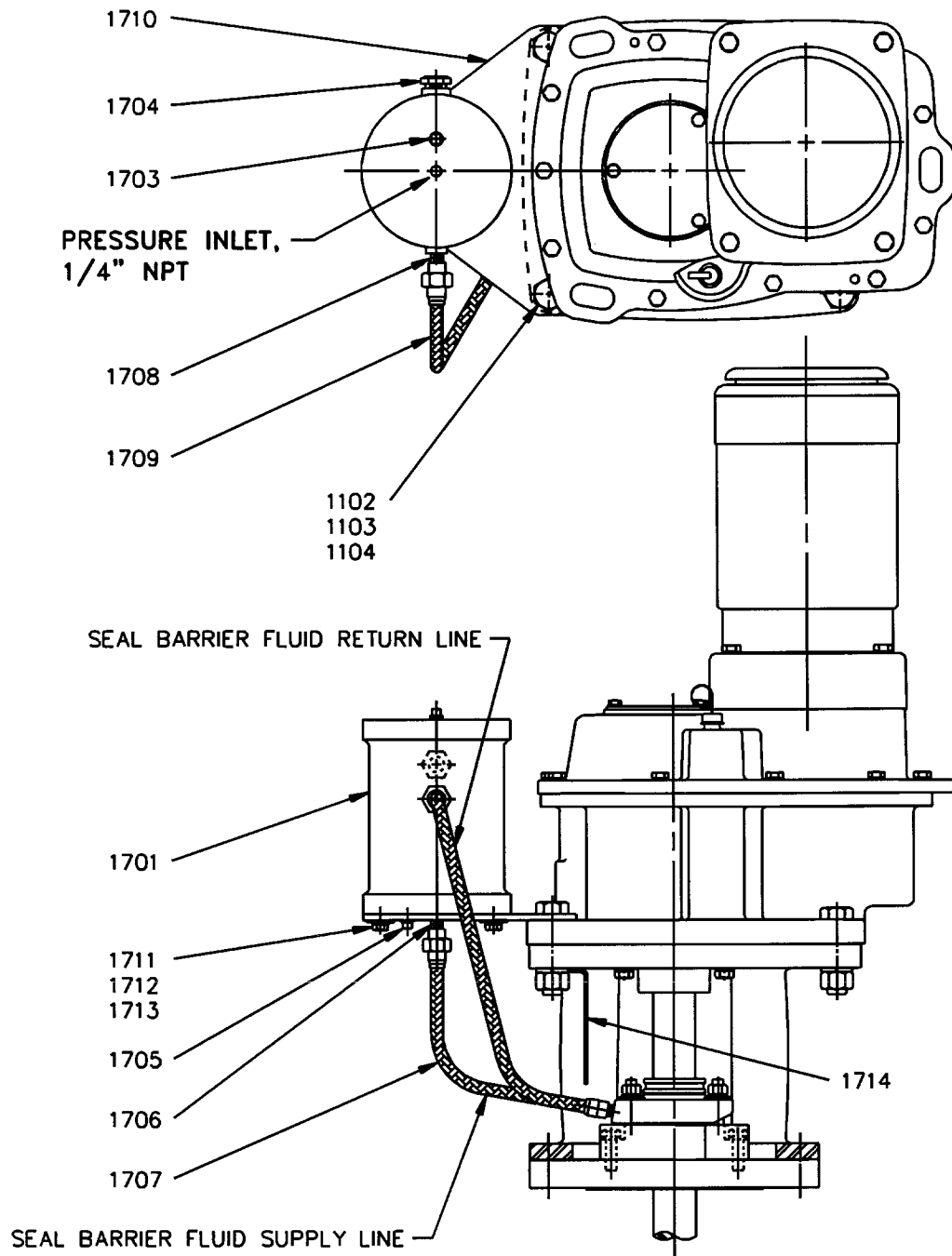


Figure 20: GTN, Mechanical Seal Lubricator

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 7, page 43* lists some commonly available greases.

When regreasing, stop the motor, remove the outlet plug and add grease according to *Table 8, page 44* 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 7: 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 8: MOTOR BEARING GREASE ADDITION

MOTOR FRAME SIZE	RELIANCE		SIEMENS		BALDOR	
	in ³	cm ³	in ³	cm ³	in ³	cm ³
140TC	sealed for life		0.4	6.6	0.6	9.8
180TC	0.5	8.2	0.6	9.8	0.6	9.8
210TC	0.5	8.2	3.1	50.8	0.6	9.8
250TC	1.0	16.4	4.4	72.1	1.2	19.7
280TC	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 49* for double reduction units and *Figure 23, page 50* 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 10, page 46* 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].

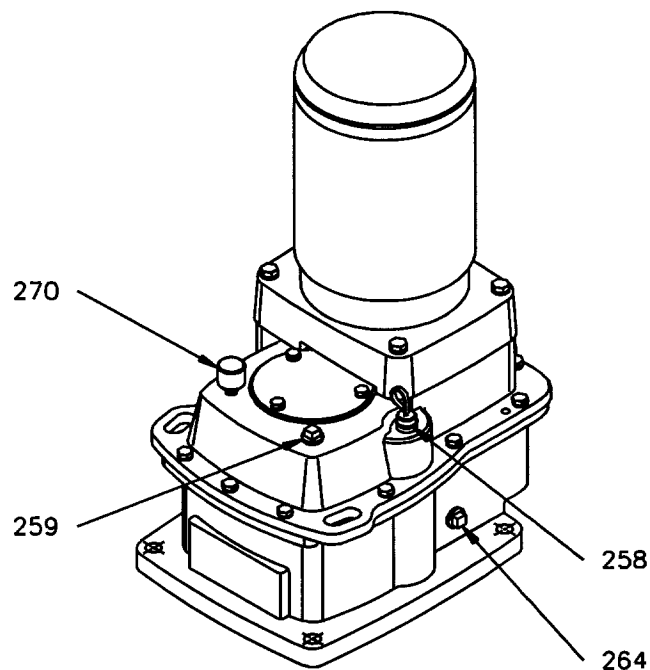


Figure 21: Gear Drive Oil Level Dipstick

The agitator nameplate or *Table 9, page 46*, should be used to select the proper viscosity oil based on ambient temperature conditions.

Table 10 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 11, page 47* 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 12, page 48* 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.

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 7, page 43* lists some commonly available greases.

TABLE 9: 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 10: 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 11: 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	Medi um	Heav y Medi um	Heav y	Extra Heav y	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 12: 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

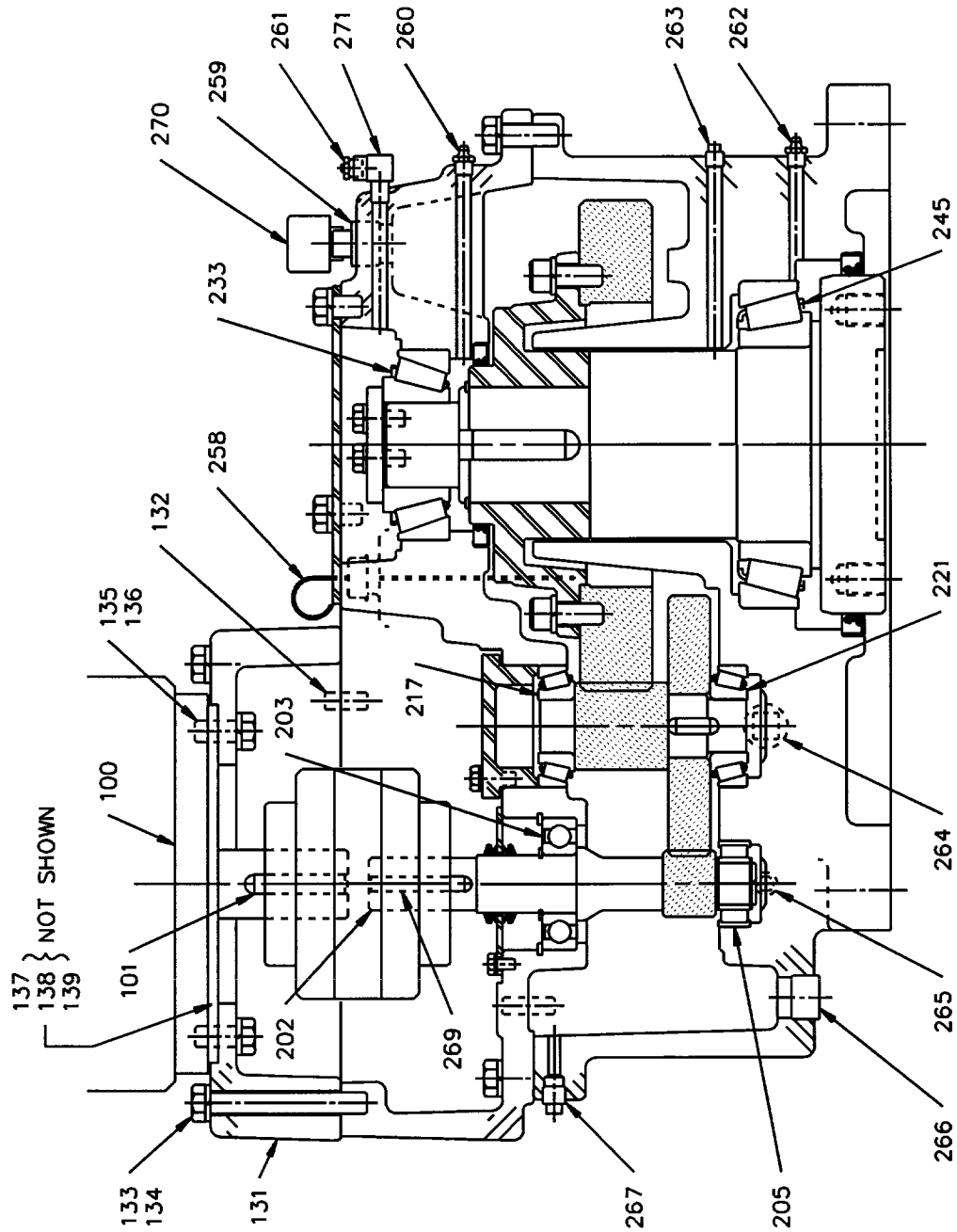


Figure 22: GT Double Reduction Gear Drive, Size 1,2,3,4

GEAR DRIVE

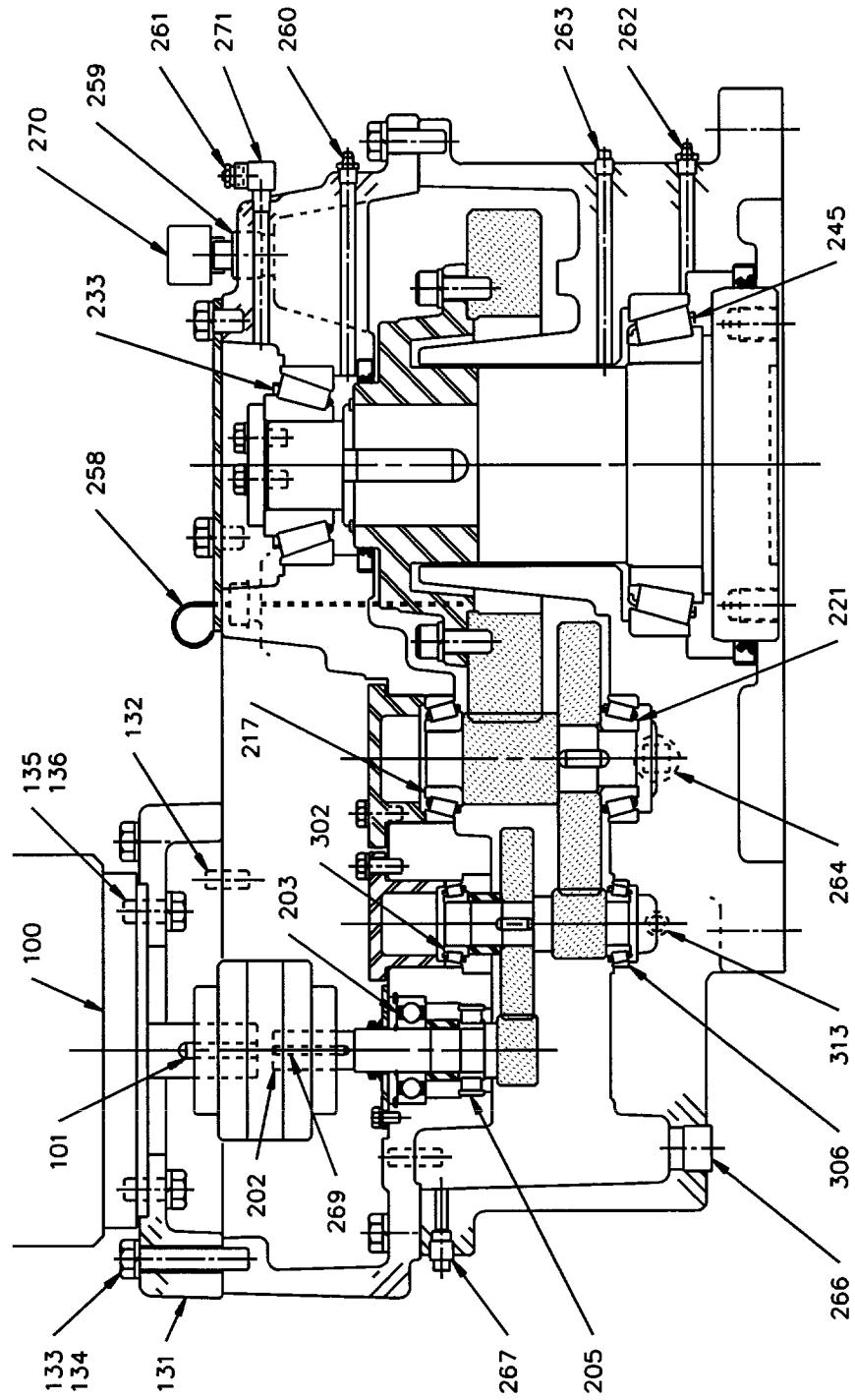


Figure 23: GT Triple Reduction Gear Drive, Size 3,4

SHAFT SEALS

Model GTN mechanical seals are designed to be operated “dry” with a gas barrier fluid or “wet” with a liquid barrier fluid. The barrier fluid can be supplied a number of different ways (*see Operation, Shaft Seals*). The barrier fluid can be a gas or a low viscosity liquid with reasonable lubricity, compatible with the process fluid, and stable over the full range of operating pressures and temperatures. Common liquid barrier fluids include glycerine, ethylene glycol, mineral oil and water. The most common gas barrier fluid is dry nitrogen.

The seal barrier fluid is to be pressurized 25-50 psi (172-344 kPa) above the maximum vessel pressure. The seal should always be pressurized before pressurizing the vessel and operating the agitator.

Units supplied with an optional Chemineer mechanical seal lubricator or other customer-supplied lubrication system should be checked regularly for proper lubricant level (*see Operation*).

Models GTNC and GTNS are furnished with single mechanical seals. The seals are designed to run dry. *Do not lubricate sealing faces.*

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 mechanical 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 13, page 56*. 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.

SHAFT SEALS

Model GTN mechanical seals must be pressurized to operate properly. Before operation, the seal cavity should be pressurized to 25-50 psi (172-344 kPa) above the maximum vessel operating pressure.

The maximum operating limits are:

Pressure: 150 psig (1034 kPa)

Temperature: 250°F (121°C)

Speed: 155 RPM

CAUTION! Never pressurize the vessel without first pressurizing the mechanical seal cavity (mechanical seal lubricator).

If using a liquid barrier fluid, the unit may be supplied with an optional Chemineer mechanical seal lubricator (*see Figure 20, page 40*) or the mechanical seal lubricator system may be supplied by others. The Chemineer mechanical seal lubricator should be filled by removing fill plug [1703] and slowly pouring in the barrier fluid. The lubricator is self-venting while being filled. As the seal lubricator is being filled, gravity flow will fill and purge the seal cavity. After filling, replace and tighten the fill plug. Pressurize the lubricator using a constant pressure source, such as a gas bottle, to the recommended seal cavity pressure. This is a thermosiphon system for use with model GTN mechanical seals only.

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

Model GTNC and GTNS single mechanical seals are designed for the following maximum operating limits:

Model GTNC

Pressure: 150 psig (1034 kPa)

Temperature: 250°F (121°C)

Speed: 155 RPM

Model GTNS

Pressure: 25 psig (172 kPa)

Temperature: 250°F (121°C)

Speed: 155 RPM

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 13: 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 mechanical seal.	Replace mechanical seal.

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. Depressurize and ventilate vessel.
3. Remove handhole covers [1105].
4. **Model GTN** (*Figure 4, page 13*): Depressurize the mechanical seal barrier fluid lines, disconnect and plug the ports. Clean the portion of the agitator shaft [400] between the tapered shaft coupling [351] and the mechanical seal cartridge [1500]. Install three centering clips [1503] spaced at 120°. Loosen the mechanical seal sleeve cup point setscrews [1502] one turn.

Model GTNC (*Figure 7, page 17*): Clean the portion of the agitator shaft [400] between the tapered shaft coupling [351] and the mechanical seal cartridge [1400]. Install the centering strap [1403]. A standard wire wrap .054" thick x .187" wide [1.37 mm x 4.75mm] can be used for 2" (50.8 mm) and 2-1/2" (63.5 mm) shaft diameters; .068" thick x .300" wide [1.73 mm x 7.6mm] can be used for 3" (76.2 mm) and 3-1/2" (88.9 mm) shaft diameters. Loosen the mechanical seal sleeve cup point setscrews [1402] one turn.

Model GTNS (*Figure 8, page 19*): Clean the portion of the agitator shaft [400] between the tapered shaft coupling [351] and the mechanical seal cartridge [1450]. Loosen cup point setscrews [1455] in collar [1456] one turn. Slide the collar up the shaft.

5. Lower the agitator shaft by loosening the coupling bolts [359]. Lower evenly until the shaft is supported by the shaft drop collar [1253]. The shaft should drop approximately 3/4" (19mm). Remove bolts and lockwashers [359,360].
6. 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]. Refer to *Figure 3, page 11*.
3. Refer to the *GT Gear Drive Maintenance Manual* for gear drive disassembly and assembly instructions and parts listings.

MECHANICAL SEALS

Model GTN, Double Mechanical Seal Cartridge: (Refer to Figure 4, page 13 and Figure 25, page 60)

The Chesterton 255 mechanical seal cartridge will require periodic replacement of wearing parts. Due to ease of replacement of the seal cartridge, it is preferable to remove the old seal cartridge and replace it with a new or rebuilt cartridge.

Seal Cartridge 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. Depressurize and ventilate vessel.
3. Remove handhole covers [1105, 1714].
4. Depressurize the mechanical seal barrier fluid lines, disconnect and plug the ports. Clean the portion of the agitator shaft [400] between the tapered shaft coupling [351] and the mechanical seal cartridge [1500]. Install three centering clips [1503] spaced at 120°. Loosen the mechanical seal sleeve cup point setscrews [1502] one turn.
5. Lower the agitator shaft by loosening the coupling bolts [359]. Lower evenly until the shaft is supported by the shaft drop collar [1253]. The shaft should drop approximately 3/4" (19mm). Remove bolts and lockwashers [359,360].
6. Prepare the motor electrical conduit for pivoting the gear drive. Remove all electrical conduits connected to the motor or loosen the union installed in a section of the conduit along the pivot shoulder bolt [1111] axis.
7. Remove gear drive mounting bolts [1102]. **CAUTION:** Do not remove pivot shoulder bolt [1111]. Rotate the gear drive 90 degrees counter-clockwise. See Figure 24, page 59.
8. Install one bolt [1102] through the gear drive housing flange and pedestal flange. Install nut [1104], and torque to the value shown in Table 6, page 22.
9. Remove bolts [357], coupling washer and lockwashers [354,358]. Disengage the taper by tapping the coupling half [351] with a mallet or apply a puller. Remove the coupling half.

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

MECHANICAL SEALS

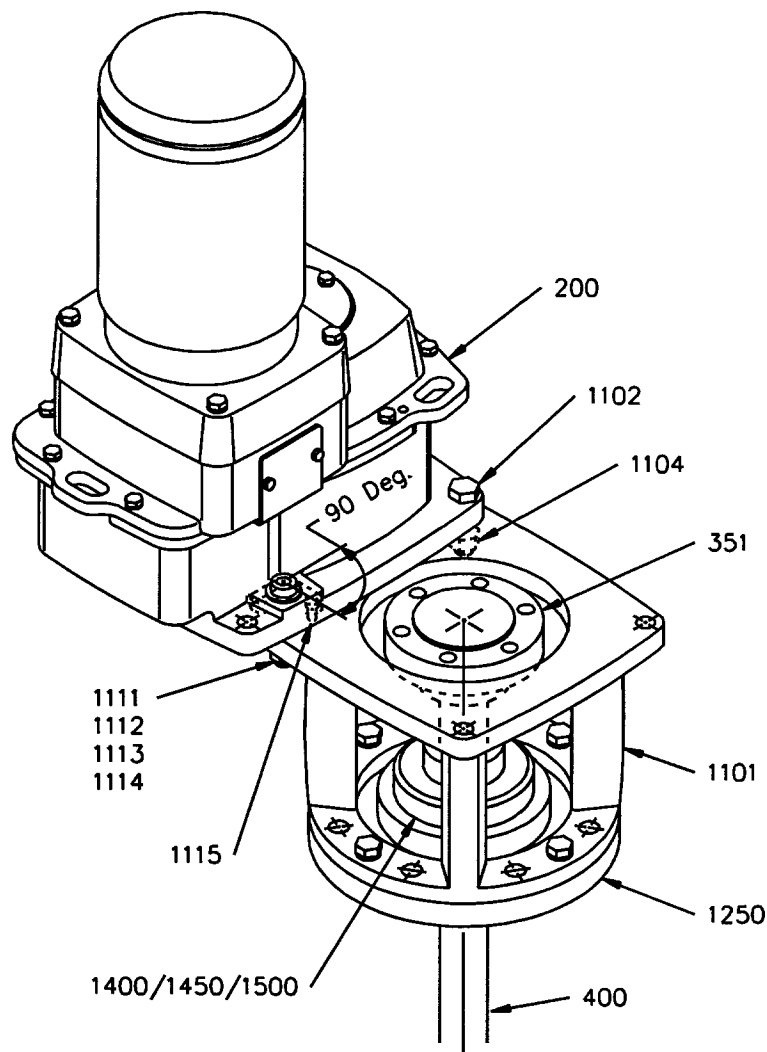


Figure 24: Gear Drive Pivot Feature

10. Remove nuts [1263], lockwashers and flatwashers [1264, 1265]. Remove the cartridge mechanical seal.
11. Remove bolts [1266] and lockwashers [1267]. Remove mechanical seal adapter plate [1261] and o-ring [1252].
12. To disassemble the cartridge mechanical seal, remove three centering clips [1503], press down on lock ring [1501] and back off all setscrews [1502, 1521] so they disengage from the sleeve. Refer to *Figure 25, page 60*.
13. Inspect parts for wear. Replace worn or damaged parts as required.
- 14.

MECHANICAL SEALS

Seal Cartridge Installation:

- 101 Place a new o-ring [1252] into the groove in the mounting flange [1251].
- 102 Install the mechanical seal adapter plate [1261] over the extension shaft. Install bolts and lockwashers [1266,1267]. *Do not tighten bolts at this time.*
- 103 Install a new or rebuilt cartridge mechanical seal [1500]. Check that the mechanical seal sleeve cup point setscrews [1502] do not protrude into the bore of the sleeve. Centering clips [1503] must be installed.

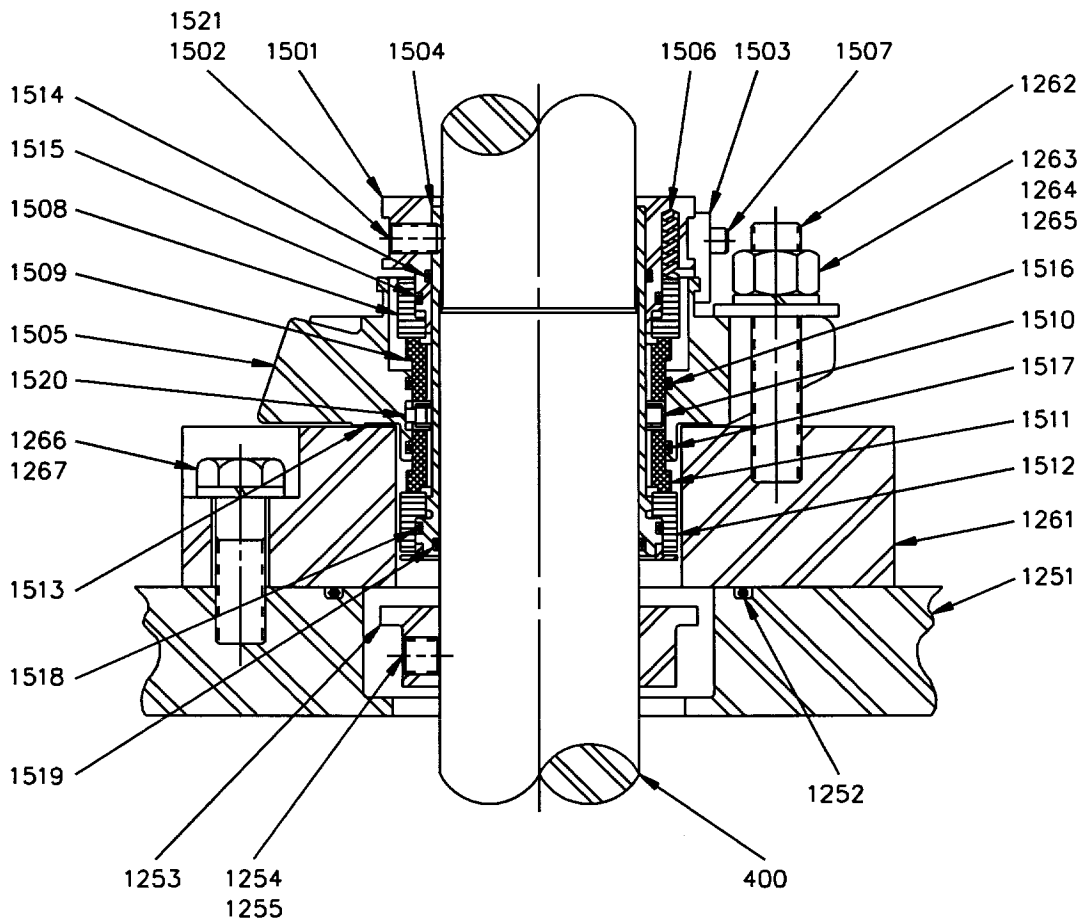


Figure 25: Model GTN, Chesterton 255 Double Mechanical Seal

- 104 Apply a light coat of suitable lubricant to the agitator extension shaft [400] and slide the cartridge mechanical seal down the shaft to rest on the mechanical seal adapter plate.

MECHANICAL SEALS

NOTE: Silicone lubricant is packaged with a new cartridge mechanical seal. If this lubricant is not compatible with your process, do not use. Select a more suitable lubricant.

- 105 Install the taper bore coupling half **[351]**. Refer to *Installation*, page 14.

NOTE: Do not apply lubricant or anti-seize compound to coupling taper. Shaft and coupling tapers must be clean and dry.

- 106 Remove bolt and nut **[1102, 1104]**. Rotate the gear drive 90 degrees clockwise. Install four bolts **[1102]**, lockwashers and nuts **[1103, 1104]**. Torque bolts to the value shown in *Table 6*, page 22.
- 107 Install two bolts and lockwashers **[359, 360]** at 180° into the flange of the taper bore coupling half **[351]**. Engage the bolt threads into gear drive output shaft **[244]**. Tighten the bolts evenly to engage the tenon and pull the faces together. Install the remaining bolts and lockwashers **[359, 360]**. Torque the bolts to the value shown in *Table 6*.
- 108 Slide the mechanical seal cartridge up the extension shaft. Center seal adapter plate **[1261]** on the extension shaft. Torque bolts **[1266]** to the value shown in *Table 6*.
- 109 Slide the mechanical seal cartridge down the shaft. Orient the barrier fluid ports. Refer to *Installation*, page 16. Install nuts, lockwashers and flatwashers **[1263, 1264, 1265]**. Torque the nuts to the value shown in *Table 6*.
- 110 Evenly tighten all setscrews **[1502, 1521]**. Torque the setscrews to 50-60 in lb (5.7- 6.8 Nm).
- 111 Remove centering clip socket head cap screws and centering clips **[1507, 1503]**. Retain the clips, cap screws and the manufacturer's installation instructions for later use.
- 112 It is important to make sure that the mechanical seal is centered on the shaft. To do this, rotate the gear drive output shaft **[244]** one or more revolutions to make sure the seal turns freely. If you hear metal to metal contact within the seal it is improperly centered.
- 113 To center the mechanical seal cartridge on the shaft, replace the centering clips **[1503]** finger tight, loosen nuts **[1263]**, tighten centering clip socket head cap screws **[1507]**. Tighten nuts **[1263]** and then remove the centering clips. If metal to metal contact still exists, check the centering of the mechanical seal adapter plate **[1261]**.
- 114 Connect the barrier fluid lines. Charge the system with barrier fluid and pressure test.
- 115 Install handhole covers.

MECHANICAL SEALS

Model GTNC, Single Mechanical Seal Cartridge: (Refer to Figure 7, page 17 and Figures 26 and 27, pages 63 and 64)

The Chesterton 155 mechanical seal cartridge will require periodic replacement of wearing parts. Due to ease of replacement of the seal cartridge, it is preferable to remove the old seal cartridge and replace it with a new or rebuilt cartridge.

Seal Cartridge 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. Depressurize and ventilate vessel.
3. Remove handhole covers [1105].
4. Clean the portion of the agitator shaft [400] between the tapered shaft coupling [351] and the mechanical seal cartridge [1400]. Install the centering strap [1403]. A standard wire wrap .054" thick x .187" wide [1.37 mm x 4.75mm] can be used for 2" (50.8 mm) and 2-1/2" (63.5 mm) shaft diameters; .068" thick x .300" wide [1.73 mm x 7.6mm] can be used for 3" (76.2 mm) and 3-1/2" (88.9 mm) shaft diameters. Loosen the mechanical seal sleeve cup point setscrews [1402] one turn. Do not loosen flat head socket screws.
5. Lower the agitator shaft by loosening the coupling bolts [359]. Lower evenly until the shaft is supported by the shaft drop collar [1253]. The shaft should drop approximately 3/4" (19mm). Remove bolts and lockwashers [359,360].
6. Prepare the motor electrical conduit for pivoting the gear drive. Remove all electrical conduits connected to the motor or loosen the union installed in a section of the conduit along the pivot shoulder bolt [1111] axis.
7. Remove gear drive mounting bolts [1102]. *CAUTION: Do not remove pivot shoulder bolt [1111].* Rotate the gear drive 90 degrees counter-clockwise. See Figure 24, page 59.
8. Install one bolt [1102] through the gear drive housing flange and pedestal flange. Install nut [1104], and torque to the value shown in Table 6, page 22.
9. Remove bolts [357], coupling washer and lockwashers [354,358]. Disengage the taper by tapping the coupling half [351] with a mallet or apply a puller. Remove the coupling half.

MECHANICAL SEALS

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

10. Remove nuts [1263], lockwashers and flatwashers [1264,1265]. Remove the cartridge mechanical seal.
11. Remove bolts [1266] and lockwashers [1267]. Remove mechanical seal adapter plate [1261] and o-ring [1252].
12. To disassemble the cartridge mechanical seal, press down on lock ring [1401] and back off all setscrews [1402, 1420] so they disengage from the sleeve. Remove the flat head socket screws [1416].
13. Inspect parts for wear. Replace worn or damaged parts as required.

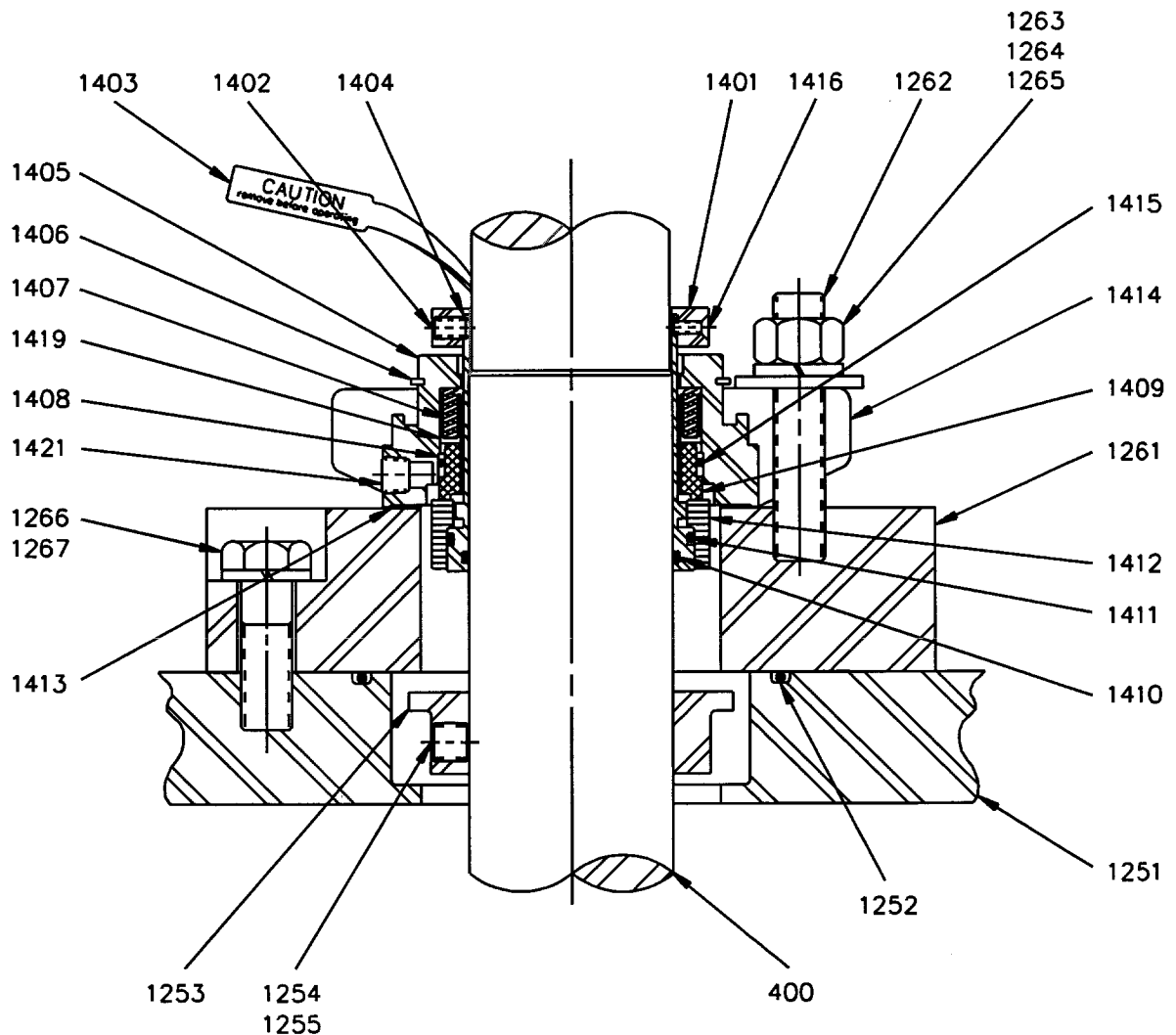


Figure 26: Model GTNC, Chesterton 155 Single Mechanical Seal
2" and 2-1/2" Shaft

MECHANICAL SEALS

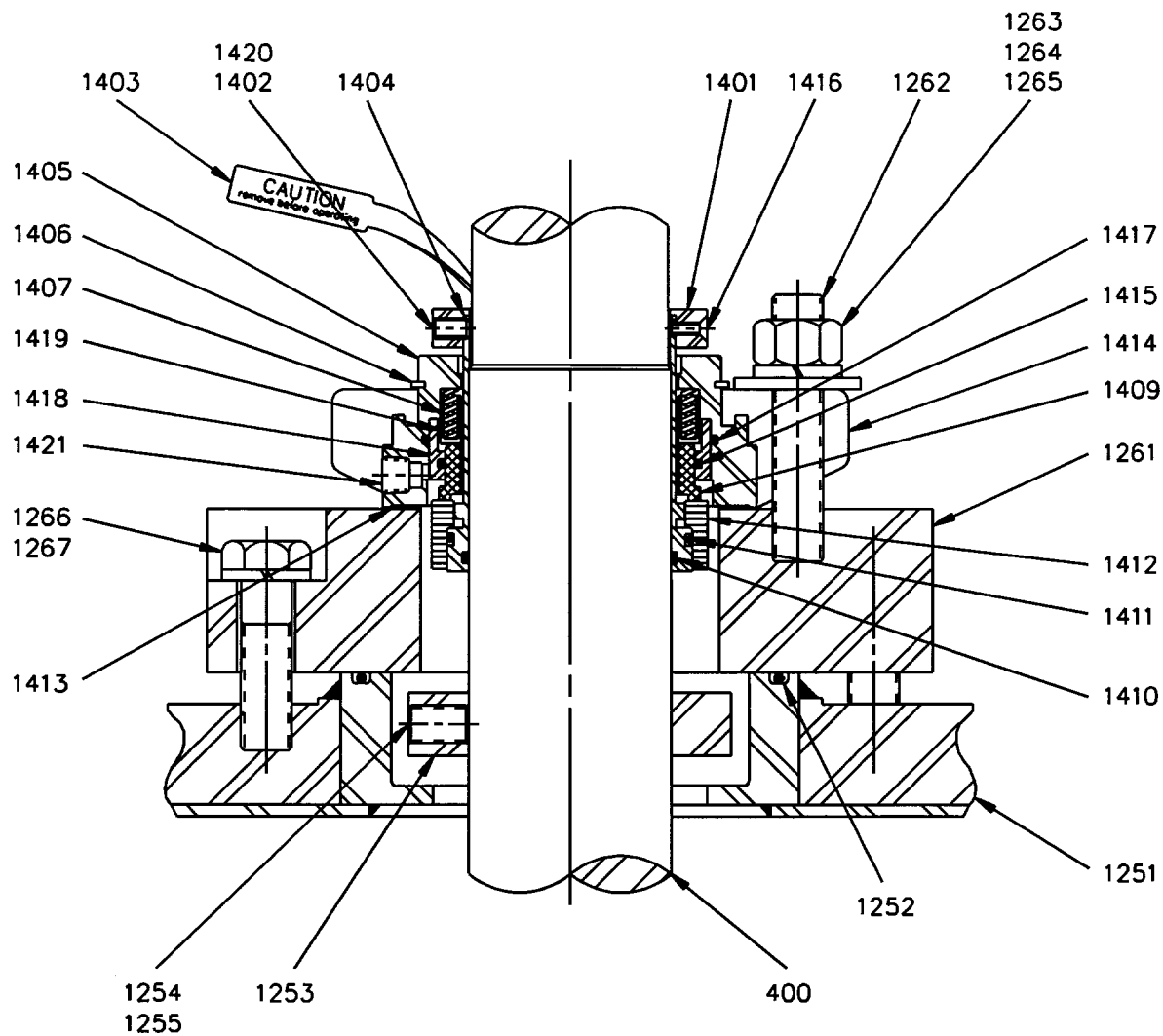


Figure 27: Model GTNC, Chesterton 155 Single Mechanical Seal
3" and 3-1/2" Shaft

MECHANICAL SEALS

Seal Cartridge Installation:

1. Place a new o-ring [1252] into the groove in the mounting flange [1251].
2. Install the mechanical seal adapter plate [1261] over the extension shaft. Install bolts and lockwashers [1266,1267]. *Do not tighten bolts at this time.*
3. Install a new or rebuilt cartridge mechanical seal [1400]. Check that the mechanical seal sleeve cup point setscrews [1402] do not protrude into the bore of the sleeve. The centering strap [1403] must be installed.
4. Apply a light coat of suitable lubricant to the agitator extension shaft [400] and slide the cartridge mechanical seal down the shaft to rest on the mechanical seal adapter plate.

NOTE: Silicone lubricant is packaged with a new cartridge mechanical seal. If this lubricant is not compatible with your process, do not use. Select a more suitable lubricant.

5. Install the taper bore coupling half [351]. Refer to *Installation*, page 14.

NOTE: Do not apply lubricant or anti-seize compound to coupling taper. Shaft and coupling tapers must be clean and dry.

6. Remove bolt and nut [1102,1104]. Rotate the gear drive 90 degrees clockwise. Install four bolts [1102], lockwashers and nuts [1103,1104]. Torque bolts to the value shown in *Table 6*, page 22.
7. Install two bolts and lockwashers [359,360] at 180° into the flange of the taper bore coupling half [351]. Engage the bolt threads into gear drive output shaft [244]. Tighten the bolts evenly to engage the tenon and pull the faces together. Install the remaining bolts and lockwashers [359,360]. Torque the bolts to the value shown in *Table 6*.
8. Slide the mechanical seal cartridge up the extension shaft. Center seal adapter plate [1261] on the extension shaft. Torque bolts [1266] to the value shown in *Table 6*.
9. Slide the mechanical seal cartridge down the shaft. Install nuts, lockwashers and flatwashers [1263,1264,1265]. Torque the nuts to the value shown in *Table 6*.
10. Evenly tighten all setscrews [1402, 1420]. Torque the setscrews to 50-60 in lb (5.7-6.8 Nm).

MECHANICAL SEALS

11. Remove centering strap [1403]. Retain the strap and the manufacturer's installation instructions for later use.
12. It is important to make sure that the mechanical seal is centered on the shaft. To do this, rotate the gear drive output shaft [244] one or more revolutions to make sure the seal turns freely. If you hear metal to metal contact within the seal it is improperly centered.
13. To center the mechanical seal cartridge on the shaft, loosen nuts [1263], install centering strap, re-tighten nuts [1263] and then remove the centering strap. If metal to metal contact still exists, check the centering of the mechanical seal adapter plate [1261].
14. Install handhole covers.

MECHANICAL SEALS

Model GTNS, Single Mechanical Seal: (Refer to Figure 8, page 19 and Figure 28, page 68)

The Flowserve MCRO mechanical seal will require periodic replacement of wearing parts.

Seal 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. Depressurize and ventilate vessel.
3. Remove handhole covers [1105].
4. Clean the portion of the agitator shaft [400] between the tapered shaft coupling [351] and the mechanical seal [1450]. Loosen cup point setscrews [1455] one turn. Slide the collar [1456] up the shaft.
5. Lower the agitator shaft by loosening the coupling bolts [359]. Lower evenly until the shaft is supported by the shaft drop collar [1253]. The shaft should drop approximately 3/4" (19mm). Remove bolts and lockwashers [359,360].
6. Prepare the motor electrical conduit for pivoting the gear drive. Remove all electrical conduits connected to the motor or loosen the union installed in a section of the conduit along the pivot shoulder bolt [1111] axis.
7. Remove gear drive mounting bolts [1102]. *CAUTION: Do not remove pivot shoulder bolt [1111].* Rotate the gear drive 90 degrees counter-clockwise. Refer to *Figure 24, page 59*.
8. Install one bolt [1102] through the gear drive housing flange and pedestal flange. Install nut [1104], and torque to the value shown in *Table 6, page 22*.
9. Remove bolts [357], coupling washer and lockwashers [354,358]. Disengage the taper by tapping the coupling half [351] with a mallet or apply a puller. Remove the coupling half.

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

10. Remove collar, spring, rotary seal ring and o-ring [1456,1454,1453,1452].
11. Remove bolts, lockwashers and flatwashers [1269, 1270,1271]. Remove stationary seal insert [1458] and o-ring [1457].

MECHANICAL SEALS

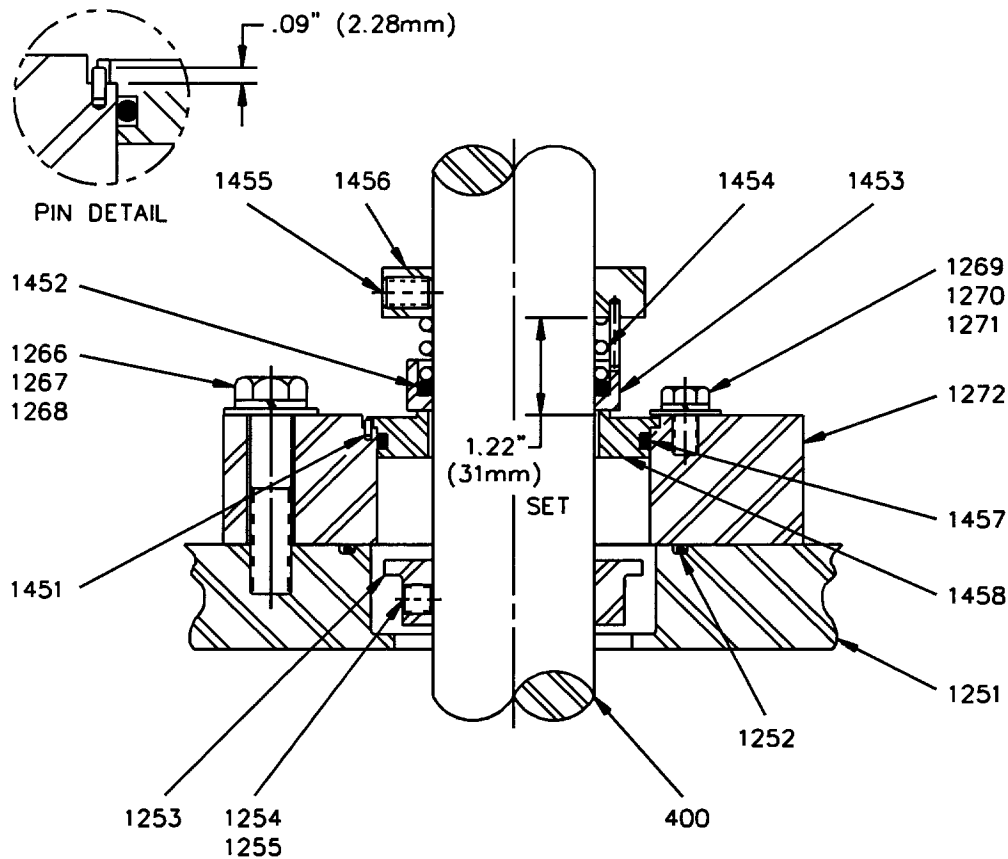


Figure 28: Model GTNS, Flowserve MCRO Single Mechanical Seal

12. Remove bolts [1266] and lockwashers and flatwashers [1267, 1268]. Remove mechanical seal gland plate [1272] and o-ring [1252].
13. Inspect parts for wear. Replace worn or damaged parts as required.

Seal Cartridge Installation:

1. Place a new o-ring [1252] into the groove in the mounting flange [1251].
2. Install the mechanical seal gland plate [1272] over the extension shaft. Do not install bolts [1266] at this time.
3. Install a new stationary seal insert and o-ring [1458, 1457] into the mechanical seal gland plate [1272]. Do not install bolts [1269] at this time.
4. Slide a new rotary seal ring [1453] down the shaft to rest on the stationary seal insert.

MECHANICAL SEALS

5. Lubricate and install a new o-ring [1452] into the rotary seal ring.

CAUTION! Do not get lubricant on the sealing faces.

6. Install a new spring [1454] and collar [1456] with cup point setscrews [1455].

7. Install the taper bore coupling half [351]. Refer to *Installation*, page 14.

NOTE: Do not apply lubricant or anti-seize compound to coupling taper. Shaft and coupling tapers must be clean and dry.

8. Remove bolt and nut [1102,1104]. Rotate the gear drive 90 degrees clockwise. Install four bolts [1102], lockwashers and nuts [1103,1104]. Torque bolts to the value shown in *Table 6*, page 22.

9. Install two bolts and lockwashers [359,360] at 180° into the flange of the taper bore coupling half [351]. Engage the bolt threads into gear drive output shaft [244]. Tighten the bolts evenly to engage the tenon and pull the faces together. Install the remaining bolts and lockwashers [359,360]. Torque the bolts to the value shown in *Table 6*.

10. Slide the rotary seal ring [1453] up the extension shaft. Center mechanical seal gland plate/stationary seal insert [1272/1458] on the extension shaft. Install bolts, lockwashers, and flatwashers [1266,1267, 1268]. Torque the bolts to the value shown in *Table 6*.

11. Install bolts, lockwashers, and flatwashers [1269,1270, 1271]. Torque the bolts to the value shown in *Table 6*.

12. Set the collar [1456] at 1.22" (31 mm). Evenly tighten all cup point setscrews [1455]. Torque the setscrews to the value shown in *Table 6*.

13. Install handhole covers.

BRACKET STEADY BEARING

In-tank steady bearings will require periodic inspection and replacement of bushing and wear sleeve [606, 604]. (Figure 18, page 35)

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 14: 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 6, page 22.

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 19, page 37)

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 15: 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 6, page 22.*
5. Reattach the flush piping.

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

GTN/GTNC/GTNS AGITATOR PART NUMBERS

Part#	Description	Qty.
100	motor	1
101	motor key	1
110	flexible motor coupling assembly	1
120	gear drive 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	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

GTN/GTNC/GTNS 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

GTN/GTNC/GTNS 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	

GTN/GTNC/GTNS 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

GTN/GTNC/GTNS AGITATOR PART NUMBERS

Part#	Description	Qty.
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
1111	pivot shoulder bolt	1
1112	Belleville washer	2
1113	flatwasher	1
1114	locknut	1
1115	socket bolt	1
1116-001	bolt	4
-002	bolt	8
1117-001	lockwasher	4
-002	lockwasher	8
1250	mounting flange assembly	1
1251	mounting flange	1
1252	o-ring	1
1253	drop collar	1
1254	setscrew, half dog point	1
1255-001	setscrew, cup point	2
-002	setscrew, cup point	3
1258-001	stud	8
-002	stud	12
1260	mechanical seal adapter plate assembly	1
1261	adapter plate	1
1262	stud	4
1263	nut	4
1264	lockwasher	4
1265	flatwasher	4
1266	bolt	4
1267	lockwasher	4
1268	flatwasher	4
1269	bolt	4
1270	lockwasher	4
1271	flatwasher	4
1272	gland plate	1

GTN/GTNC/GTNS AGITATOR PART NUMBERS

Part#	Description	Qty.
1400	Chesterton 155 single cartridge seal assembly	1
1401	lock ring	1
1402	setscrew, cup point	6
1403-001	centering strap	1
-002	centering strap	1
1404	sleeve	1
1405	hub gland	1
1406	snap ring	1
1407-001	spring	6-7
1408	back-up washer	1
1409	stationary seal ring	1
1410	o-ring	1
1411	o-ring	1
1412	rotary seal ring	1
1413	gasket	1
1414	bolt tab (w/ springs)	8
1415	o-ring	1
1416	flat head socket screw	3
1417	o-ring	1
1418	adapter	1
1419	stationary drive	1
1420	setscrew, quarter dog point	3
1421	pipe plug, npt	1
1450	Flowsolve MCRO single seal assembly	1
1451	anti-rotation pin	1
1452	o-ring	1
1453	rotary seal ring	1
1454	spring	1
1455	setscrew, cup point	4
1456	collar (w/ drive pins)	1
1457	o-ring	1
1458	stationary seal insert	1

GTN/GTNC/GTNS AGITATOR PART NUMBERS

Part#	Description	Qty.
1500	Chesterton 255 double seal assembly	1
1501	lock ring	1
1502-001	setscrew, cup point	3
-002	setscrew, cup point	6
1503	centering clip	3
1504	sleeve	1
1505	gland	1
1506	spring	6-9
1507	centering clip socket head cap screw	3
1508	rotary seal ring, outboard	1
1509	stationary seal ring, outboard	1
1510	flow channel (w/ drive clips)	1
1511	stationary seal ring, inboard	1
1512	rotary seal ring, inboard	1
1513	gasket	1
1514	o-ring	1
1515	o-ring	1
1516	o-ring	1
1517	o-ring	1
1518	o-ring	1
1519	o-ring	1
1520	drive lug	1
1521	setscrew, quarter dog point	3
1700	mechanical seal lubricator assembly	1
1701	mechanical seal lubricator	1
1703	fill plug, npt	1
1704	sight glass, npt	1
1705	drain plug, npt	1
1706	pipe nipple, npt	1
1707	flexible metal hose	1
1708	pipe nipple, npt	1
1709	flexible metal hose	1
1710-001	mounting bracket	1
-002	mounting bracket	1
1711	bolt	2
1712	flatwasher	2
1713	lockwasher	2
1714	lubricator handhole cover	1



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