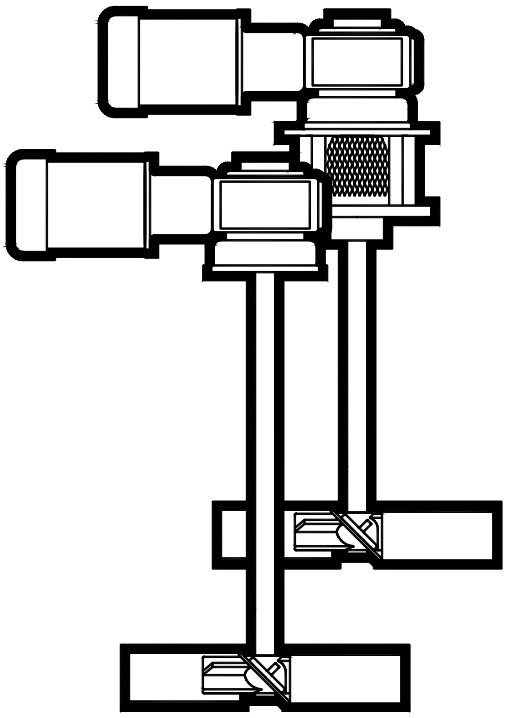
QED*Plus* Mixers

Installation, Operation, and Maintenance Manual



Document Number Manual 514	Rev 3 Date 1/20/2016
Equipment Information: QED-D Style Agitator QED-A Style Agitator QED-L Style Agitator	

Contact Information

Mixing Technologies
Dayton Facility
5870 Poe Ave.
Dayton, OH 45414
+1 937 454 3200
+1 800 643 0641
chemineer@nov.com
chemineerexpress@nov.com

United Kingdom Facility
7 Cranmer Road West Meadows
Derby DE21 6XT
United Kingdom
+44 1332 363 175
chemineeruk@nov.com

China Facility
Building 4, 1250 Sicheng Road
Jiading District, Shanghai 201801
People's Republic of China
+86 21 6124
chemineercn@nov.com

Rep Information
Name:
Address:

Phone:
Email:

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

1. Initial Inspection

Step 1: Inspect crates. Upon receipt, inspect all crates and equipment for any damage during shipping. If you observe any damage, please report it to your nearest Mixing Technologies contact. A claim should be filed immediately with the carrier involved.

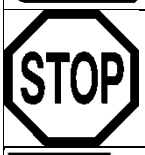
Step 2: Uncrate. Check the contents. Do not un-crate the unit until you have read all the Installation instructions and viewed the assembly drawing shipped with the unit. Be careful in uncrating and handling. Before discarding the crating, make sure that all agitator parts have been removed. Correct assembly of this unit requires referring to both the unit assembly drawing and this manual.

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

2. Safety

2.1. Safety Symbols

Please always observe the following safety and information symbols!

	**Danger!**
	Risk of fatalities and injury
	**Attention!**
	Machine may be damaged
	**Note!**
	Useful information

All work including transportation, storage, installation, electrical connection, commissioning, servicing, maintenance and repair must be performed **only by qualified specialist personnel**.

	**Danger!**
	Installation and maintenance work may only be performed when gear units are at a standstill. The drive must be isolated and secured to prevent accidental start-up. Tighten the drive elements or secure the parallel key before switching on.
	**Danger!**
	Only transport using the eyebolts attached to the gear unit. No additional loads may be attached. Transportation aids and lifting gear must have an adequate load-bearing capacity.

If geared motors have an additional eyebolt attached to the motor, this must also be used. Avoid pulling the eyebolts at an angle. The thread of the eyebolt must be fully screwed in.
Observe all safety information, including that provided in the individual sections of this Operating Manual. All national and other regulations on safety and accident prevention must also be observed.

	**Danger!**
	Serious physical and property damage may result from inappropriate installation, non-designated use, incorrect operation, non-compliance with safety information, unauthorised removal of housing components or safety covers, and structural modifications to the gear unit.

2.2. Vessels

All types of vessels either open or closed pose special safety challenges. It is essential that Installers, Operators and Maintainers of the equipment understand these special hazards.

Particular safety hazards arise because the vessel is typically defined as a “Confined Space”. This creates a number of special hazards, including the risk of having oxygen shortages. Never enter a confined space unless you are fully trained on the procedures and have the correct safety equipment and procedures in place.

One must not enter a confined space unless fully assured that it is safe. Typically, before entering a vessel you should require proof of power and process fluid lock out. Always carry with you an oxygen sensor (in order to verify a safe atmosphere), a suitable safety harnesses and lifting equipment. Typically, a shoulder lift harness and a man-lifting crane are required (a man on the end of a rope or a center back lift offers no safety protection). A suitable safety cover must be provided at all time.

In cases where a vessel has been in service, tests must be made to ensure that no hazardous products or product residues are present.

The work site is often within a designated hazardous area. Where potentially explosive conditions exist, all efforts must be made to make the area safe before proceeding with work.
Where this is not possible, a detailed, individual hazard assessment is vital. Special working procedures and tooling are required.

2.3. Fasteners

Important fasteners should not be re-used. When a fastener is disturbed, always replace it with a new one. Dispose of used fasteners. Do not keep them for re-use.

2.4. CE Marking (Where applicable)

Any CE marking and associated documentation applies to the mixer only on the basis that it is an individual product. After installation of the mixer into the mixing system, it becomes an integral part of a larger installation. **NOV is not responsible for the CE marking once the mixer has been installed into the mixing system.** As a standard, the mounting flange has been designed for the design conditions stated on the arrangement drawing and a fiber flange gasket (supplied by others). Where other conditions apply, they will be stated on the assembly drawing.

2.5. Safety Checklist

- ☑ This Installation, Operation and Maintenance Manual, assembly drawings, and any supplements must be reviewed and understood before commencing installation and operation.
- ☑ All site rules must be observed for the installation and operation of this mixer.
- ☑ Ensure all external connections are made in accordance with applicable codes of practice.
- ☑ The mixer must be earthed (connected to ground).
- ☑ Correct rotation must be checked prior to operation.
- ☑ **Do not** exceed the operating pressures, temperatures, and other conditions for which the machine has been designed.
- ☑ **Do not** operate the agitator unless all guards are securely fixed. Do not modify any guarding. Open tanks fitted with agitators must be provided with suitable guarding to prevent personnel contacting agitator-moving parts. The user is responsible for providing these guards.
- ☑ Ensure mechanical seal setting clips are disengaged before operation. These clips should be retained for future use.
- ☑ Ensure gas supply system, (if applicable) is correctly installed, pressurized and ready for operation.
- ☑ **Do not** touch rotating components.
- ☑ During servicing of the mixer, the motor must be isolated from the power supply and the supply locked out.
- ☑ **Do not** operate the mixer for applications other than for its intended use.
- ☑ **Do not** modify the mixer without reviewing the change with NOV. It is unsafe to use non-standard parts without NOV approval. When in doubt, ask your local Mixing Technologies office.

WHEN IN DOUBT, ASK!

2.6. Disposal

Observe the current local regulations. In particular, lubricants must be collected and disposed of correctly.

Table 1: Disposal of Gearbox Components

Gear unit components:	Material:
Toothed wheels, shafts, rolling bearings, parallel keys, locking rings	Steel
Gear unit housing, housing components	Grey cast iron
Radial seals, sealing caps, rubber components	Elastomers with steel
Coupling components	Plastic with steel
Flat seals	Asbestos-free sealing material
Gear oil	Additive mineral oil
Synthetic gear oil (rating plate code: CLP PG)	Polyglycol-based lubricants
Cooling spiral, embedding material of the cooling spiral, screw fittings	Copper, epoxy, yellow brass

3. Storage

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

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

Short-Term Indoor Storage

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

Outdoor or Long-Term Indoor Storage

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

1. Install standpipe (not supplied) into breather [215] port and place breather into top of standpipe. Fill gear drive completely with oil. This allows oil to expand with temperature change without damaging the gear drive seals.

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. Apply a rust preventative to unpainted carbon steel surfaces and the agitator wetted parts to prevent corrosion during storage.

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

CAUTION! Before placing an agitator in service the storage oil must be completely drained from the gear drive. Turn the gear drive upside down to completely drain. Failure to do this will result in oil being trapped in the "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.

4. Mounting

4.1. Mounting – All Models

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

1. In addition to this manual, the contents of the gear reducer box should include: the reducer, a bag of motor mounting hardware with a reducer input shaft key, a high speed coupling, reducer oil, and a unit assembly drawing. *NOTE: THE GEAR REDUCER IS SHIPPED WITHOUT INTERNAL OIL.*

2. A sling attached to a hoist may be used to assist in lifting the reducer unit. Do not strap any lifting device through the hollow low speed shaft [205] of the reducer. It is recommended that the reducer and motor be lifted onto a workbench type table for easier access and handling.

3. The motor key [101] will be in the envelope with the motor wiring diagram or taped onto the motor shaft. If taped to the shaft, remove tape and clean any residue from both the key and the shaft. Place the key into the motor output shaft to prepare for installation of flexible coupling. Unwrap the coupling [150] from its bag. Note that the bore of each hub is marked on the coupling hub. Place the reducer key [234] into the input shaft of the reducer and install reducer half of the coupling per set dimension in Table 2: High Speed Coupling Set Dimensions, page 8. To gain access to the setscrew in the coupling hub, remove plug [231] on the reducer bell housing [227]. Lightly tighten setscrew with an Allenwrench. Mount the motor output shaft coupling half per the set dimension shown in Table 2: High Speed Coupling Set Dimensions and tighten setscrew securely into hub. Install the coupling flexible center member into the hub. It may be helpful to place the Allenwrench in the setscrew in the reducer hub and leave the wrench extending out of the bell housing. This will help mark the orientation of the reducer hub half so that it can be more easily interlocked with the motor hub coupling half during motor mounting.

4. Motor must be mounted to reducer bell housing [227] in a manner to engage the coupling hubs and to allow the conduit box to be in an accessible position. Fasten motor to reducer bell housing flange using the bolts [235] and lockwashers [239].

5. Lubricate and torque bolts to the value shown in Table 9: Bolt Tightening Torque, page 21. Tighten reducer hub setscrew and remove Allenwrench. Replace plug [231] in bell housing.

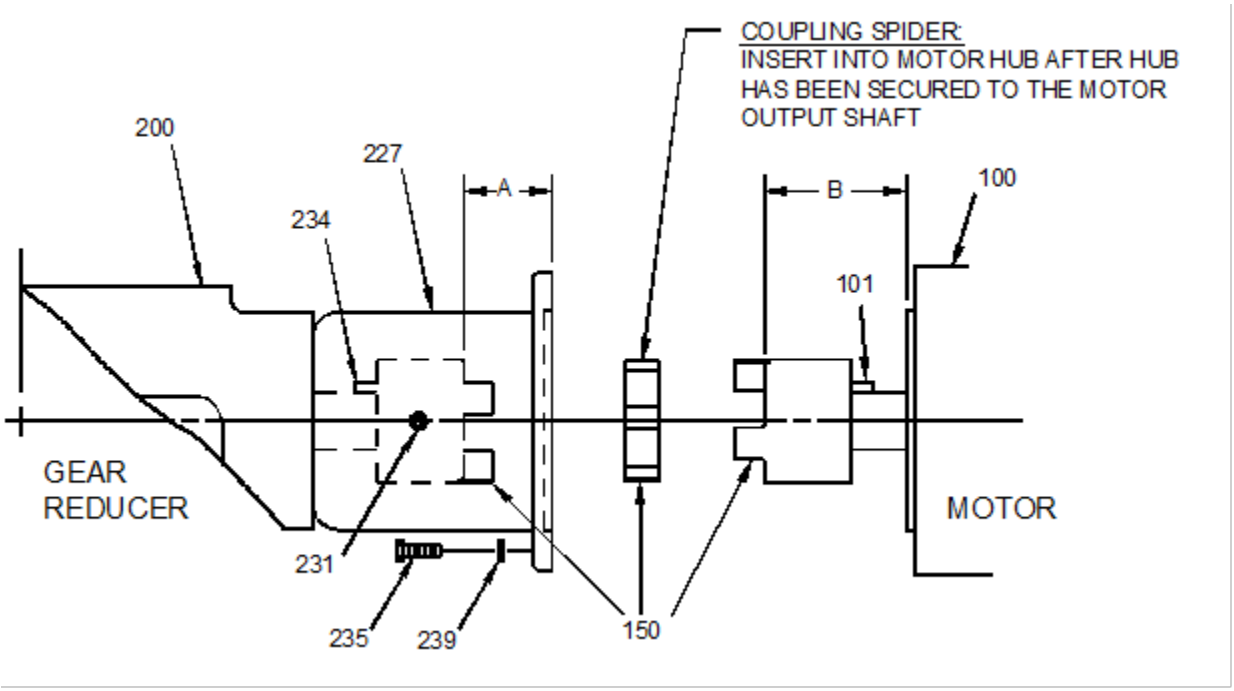


Figure 1: Coupling Attachment

Table 2: High Speed Coupling Set Dimensions

Case Size	Motor Frame	Reduction Type	A, inches (mm)	B, inches (mm)
1QED	56C	Single	2.75	2.12
1QED	140TC	Single	2.75	2.12
1QED	56C	Double	2.62	2.00
2QED	56C	Single	2.62	2.00
2QED	140TC	Single	2.62	2.00
2QED	180TC	Single	3.75	2.82
2QED	56C	Double	2.62	2.00
2QED	140TC	Double	2.62	2.00
3QED	140TC	Single	2.75	1.95
3QED	180TC	Single	3.75	2.82
3QED	210TC	Single	4.56	3.50
3QED	140TC	Double	2.62	2.00

4.2. Mounting – Model QED-D

Refer to agitator assembly drawing for required support structure design loads.

In designing the structure to accommodate bending moment, the structure should be sufficiently rigid so that the agitator extension shaft will not move more than 1/64 inch (.4 mm) per foot of length due to deflection of mounting system. Reference Figure 2, page 10.

The agitator support in open tanks is typically constructed of two steel beams with lateral bracing. See Table 3: Recommended Beam Sizes for Open Tank Agitators (American Standard Channels) below for beam size.

Table 3: Recommended Beam Sizes for Open Tank Agitators (American Standard Channels)

	Tank Diameter, ft (m)					
Model	3 (0.91)	4 (1.22)	6 (1.83)	8 (2.44)	11 (3.35)	16 (4.88)
1QED-D	C3x5	C4x5.4	C6x8.2	C7x9.8	C9x13.4	C12x20.7
2QED-D	C4x5.4	C5x6.7	C6x8.2	C7x9.8	C9x15	C12x20.7
3QED-D	C4x5.4	C5x6.7	C6x8.2	C7x9.8	C9x15	C12x20.7

Diagonal bracing (45 degree) should be used between the span beams. The ends of the span beams should be boxed in. Both lateral bracing and diagonal bracing to be identical to span beams.

Table 4: Mounting Dimensions for Open Tank Agitators – inch, (mm)

Model	A	B	C	D	E	F
1QED-D	.56 (14.2)	10.75 (273)	8.00 (203.2)	3.25 (82.6)	6.50 (165.1)	8.00 (203.2)
2QED-D	.56 (14.2)	11.00 (279.4)	9.00 (228.6)	3.53 (89.7)	7.06 (179.3)	9.00 (228.6)
3QED-D	.69 (17.5)	10.50 (266.7)	10.50 (266.7)	4.06 (103.1)	8.13 (206.5)	10.50 (266.7)

Note: “F” (minimum channel spread) applies for drive orientation 90 degrees from that shown in Figure 2, next page.

Mount the agitator drive onto support structure using a similar lifting technique as described above. Attach unit to the support structure using customer supplied fastener set [1/2 inch (12mm) for 1QED or 2QED; 5/8 inch (15mm) for 3QED].

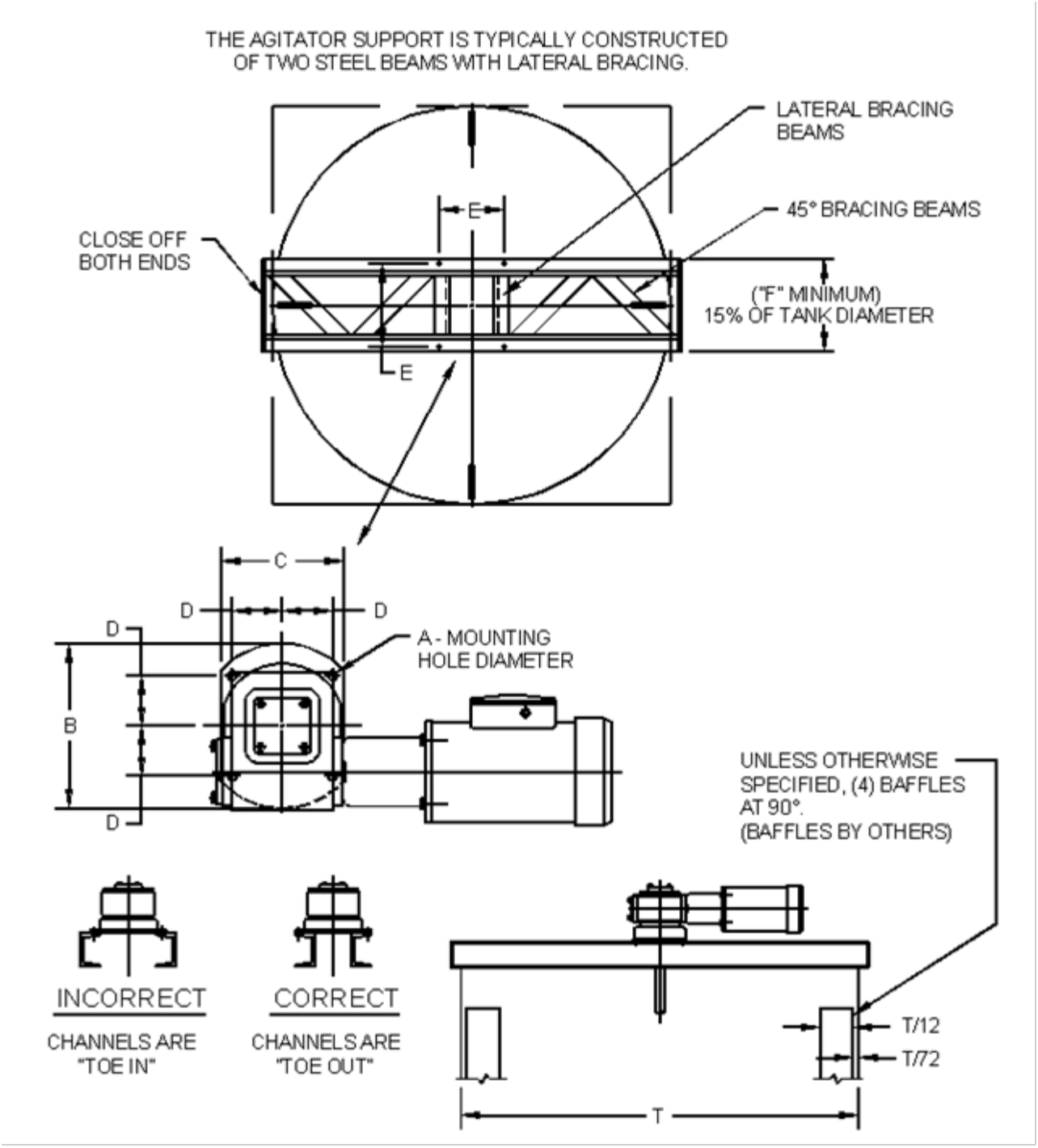


Figure 2: Open Tank Mounting

4.3. Mounting – Models QED-A & QED-L

Refer to agitator assembly drawing for required support structure design loads.

In designing the structure to accommodate bending moment, the structure should be sufficiently rigid so the agitator extension shaft will not move more than 1/64 inch (.4 mm) per foot of length due to deflection of mounting system. Reference Figure 3, page 13 and Figure 4, page 14.

QED-A and QED-L style units are supplied with an integral pedestal/flange that is designed to mount on an ANSI or DIN flange, nozzle, or pad located on the vessel top head. Optional special flanges are available to adapt the standard agitator mounting to other specific vessel nozzle sizes. Refer to the agitator assembly drawing for agitator mounting flange size and weight for your unit.

Vessel top heads and nozzles are often not sufficiently rigid to properly support an agitator. Table 5: Recommended Head Thickness, "t", [inches (mm)] for Closed Tank Agitator on Nozzles or Table 7: Recommended Head Thicknesses, "t", [inches (mm)] for Closed Tank Agitators on Pads provide guidelines for determining when vessel head reinforcement is required. If the vessel head is not sufficiently rigid, head thickness can be increased or gussets and reinforcing pads can be added to provide the equivalent rigidity of a thicker head. Reference reinforcement dimensions on Table 6: Agitator Mounting Nozzle Reinforcement Dimensions, inches (mm) and Table 7: Recommended Head Thicknesses, "t", [inches (mm)] for Closed Tank Agitators on Pads.

Table 5: Recommended Head Thickness, "t", [inches (mm)] for Closed Tank Agitator on Nozzles

	Tank Diameter, ft (m)					
Model	3 (0.91)	4 (1.22)	6 (1.83)	8 (2.44)	10 (3.05)	12 (3.66)
1QED	0.125 (3.18)	0.125 (3.18)	0.188 (4.76)	0.250 (6.35)	0.250 (6.35)	0.312 (7.94)
2QED	0.125 (3.18)	0.125 (3.18)	0.188 (4.76)	0.250 (6.35)	0.312 (7.94)	0.312 (7.94)
3QED	0.125 (3.18)	0.188 (4.76)	0.188 (4.76)	0.250 (6.35)	0.312 (7.94)	0.375 (9.52)

Table 6: Agitator Mounting Nozzle Reinforcement Dimensions, inches (mm)

Model	A ANSI - DIN	B[1] Nozzle Height Minimum	C[1] Gusset Dimension	D[1] Backup Plate Radius
1QED	6 (150)	4 (102)	6.5 (165)	11 (279)
2QED	6 (150)	4 (102)	6.5 (165)	12 (305)
3QED	8 (200)	6 (152)	8 (203)	12 (305)

[1]Four (4) gussets at 90 degrees. Thickness same as head thickness in Table 5: Recommended Head Thickness, "t", [inches (mm)] for Closed Tank Agitator on Nozzles.
Backup plate required if head thickness is less than Table 5: Recommended Head Thickness, "t", [inches (mm)] for Closed Tank Agitator on Nozzles. Reference Figure 3.

Table 7: Recommended Head Thicknesses, "t", [inches (mm)] for Closed Tank Agitators on Pads

	Tank Diameter, ft (m)					
Model	3 (0.91)	4 (1.22)	6 (1.83)	8 (2.44)	10 (3.05)	12 (3.66)
1QED	0.125 (3.18)	0.125 (3.18)	0.125 (3.18)	0.125 (3.18)	0.125 (3.18)	0.188 (4.76)
2QED	0.125 (3.18)	0.125 (3.18)	0.125 (3.18)	0.125 (3.18)	0.188 (4.76)	0.188 (4.76)
3QED	0.125 (3.18)	0.125 (3.18)	0.125 (3.18)	0.188 (4.76)	0.188 (4.76)	0.188 (4.76)

Table 8: Agitator Mounting Pad Reinforcement Dimensions, inches (mm)

Model	A ANSI - DIN	D^2 Backup Plate Radius
1QED	6 (150)	11 (279)
2QED	6 (150)	12 (305)
3QED	8 (200)	12 (305)

[2]Backup plate required if head thickness is less than Table 7: Recommended Head Thicknesses, "t", [inches (mm)] for Closed Tank Agitators on Pads. Reference Figure 4.

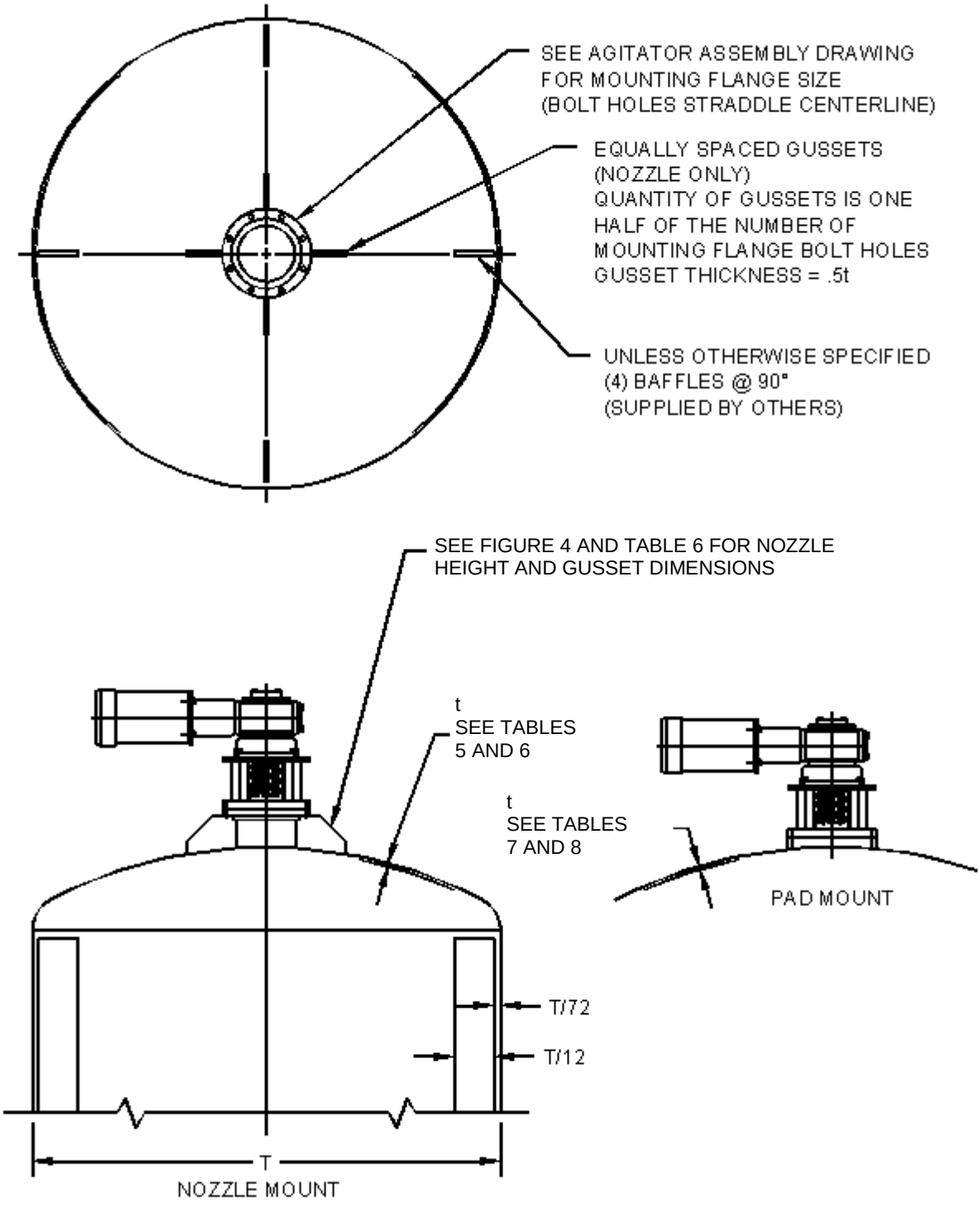


Figure 3: Closed Tank Agitator Mounting

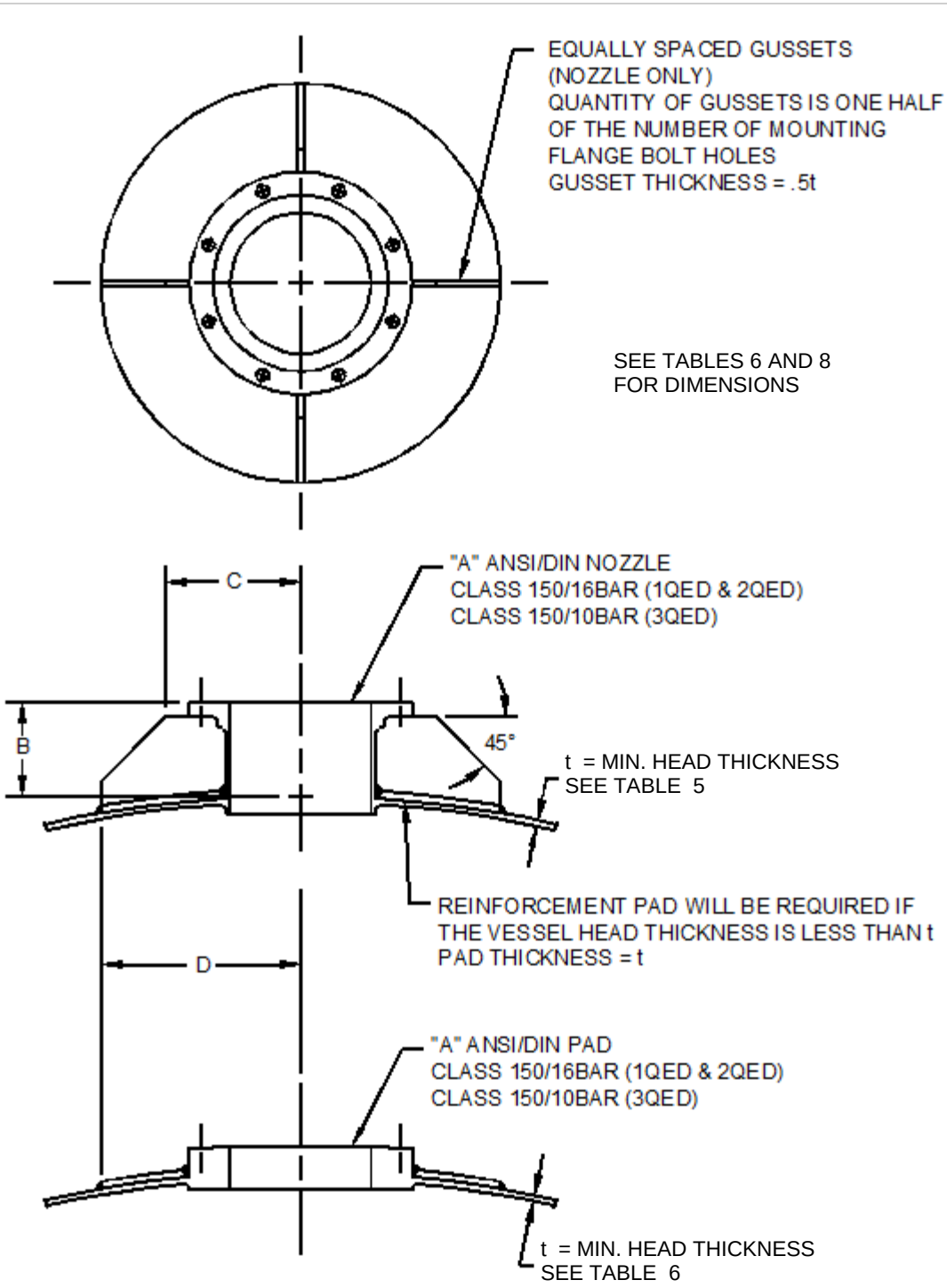


Figure 4: Closed Tank Mounting Nozzle/Pad

5. Installation

5.1. Agitator Drive Assembly

For QED-D models, skip to Step 6, next page.

1. The QED-A and QED-L style mixers are designed with a one-piece pedestal/mounting flange. Install the pedestal onto the vessel nozzle with a customer supplied gasket and fastener set.

2. If an adapter flange [1201] has been included with your unit, lubricate and insert o-ring [1202] into machined groove on inner diameter of flange. Assemble pedestal [1101] to adapter flange using bolts [1203] and lockwashers [1204]. Lubricate and install bolts and torque to the value shown in Table 9: Bolt Tightening Torque, page 21. Install pedestal/adapter flange assembly onto vessel nozzle with a customer supplied gasket and fastener set. The 1QED and 2QED 8"-150# adapter flange and the 3QED 10"-150# adapter flange require stud mounting to the vessel nozzle. Use the supplied studs [1205], lockwashers [1206], and hex nuts [1207]. Reference Figure 5.

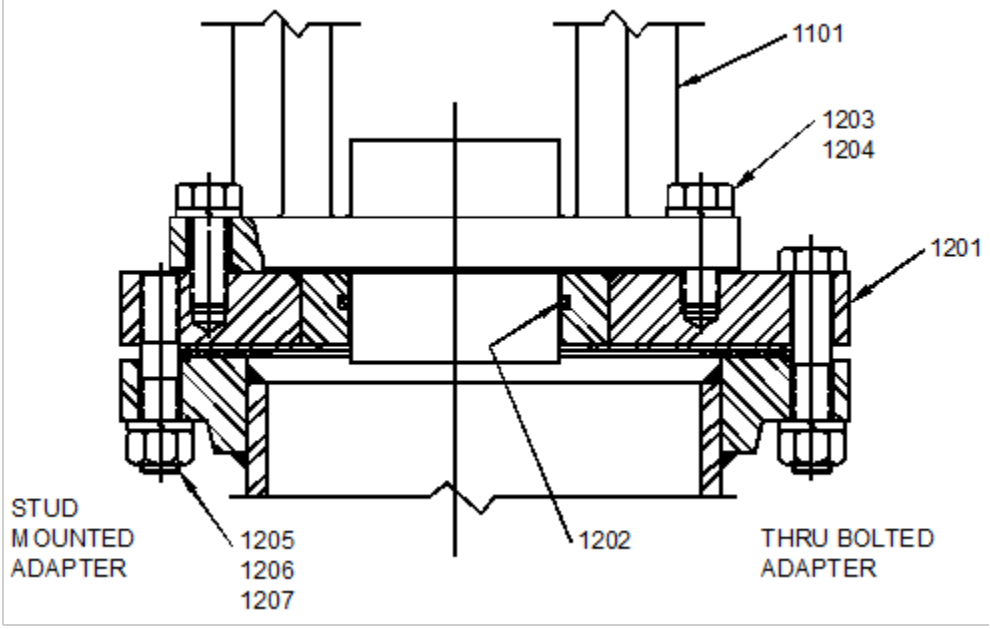


Figure 5: Adapter Flange Mounting

3. QED-A: Place packing rings over extension shaft [400]. Carefully lower the extension shaft into the vessel through the pedestal until the tapered end of the shaft is just above the top of the pedestal, with the keyway fully in view. Block the shaft securely in place.

   QED-L: Place lip seal [1802] and snap ring [1801] over extension shaft [400]. Carefully lower the extension shaft into the vessel through the pedestal until the tapered end of the shaft is just above the top of the pedestal, with the keyway fully in view. Block the shaft securely in place.

4. Install handhole cover bolts [1107] and lockwashers [1108] into the counterbored and tapped holes in the top of the pedestal. Tighten bolts onto lockwashers. Reference Figure 9, page 19. Handhole covers [1102] and remaining fasteners will be assembled in Step 13.

5. Mount the agitator onto the pedestal using bolts [1105] and lockwashers [1106]. *Do not fully tighten bolts at this time.* Reference Figure 6, page 17.

For Model QED-D, complete Steps 6-8, then skip to Step 14 on page 20. All steps apply for Models QED-A or QED-L.

6. Remove bolts [228] and lockwashers [229] and low speed shaft guard [203].

7. Clean all dirt and grease from the agitator extension shaft [400] and reducer low speed shaft [205]. Make sure both surfaces are completely dry and free from any burrs or nicks.
   CAUTION: Do not apply lubricant or anti-seize compound to the extension shaft taper. This area must be clean, dry, and free from all lubricants.

8. Install the shaft key [304] into the extension shaft keyway, making sure it is fully bottomed into the keyway. Insert the agitator extension shaft into the reducer low speed shaft [205] until both seat firmly against each other. Be sure that the shaft is not placed at an angle to the reducer.

9. *CAUTION:* Carefully remove the blocks securing the agitator extension shaft and insert the shaft into the reducer low speed shaft [205] until both seat firmly against each other. Be sure that the shaft is not placed at an angle to the reducer.

10. Shaft bolt installation, reference Figure 6, next page:

    (1) bolt design (1QED): Install coupling washer [303]; lubricate and install shaft bolt [301] and locking tab [302]. Torque to the value shown in Table 9: Bolt Tightening Torque, page 21.

    (2) bolt design (2QED & 3QED): Install coupling washer [307]; lubricate and install bolts [305] and lockwashers [306]. Torque to the value shown in Table 9: Bolt Tightening Torque, page 21.

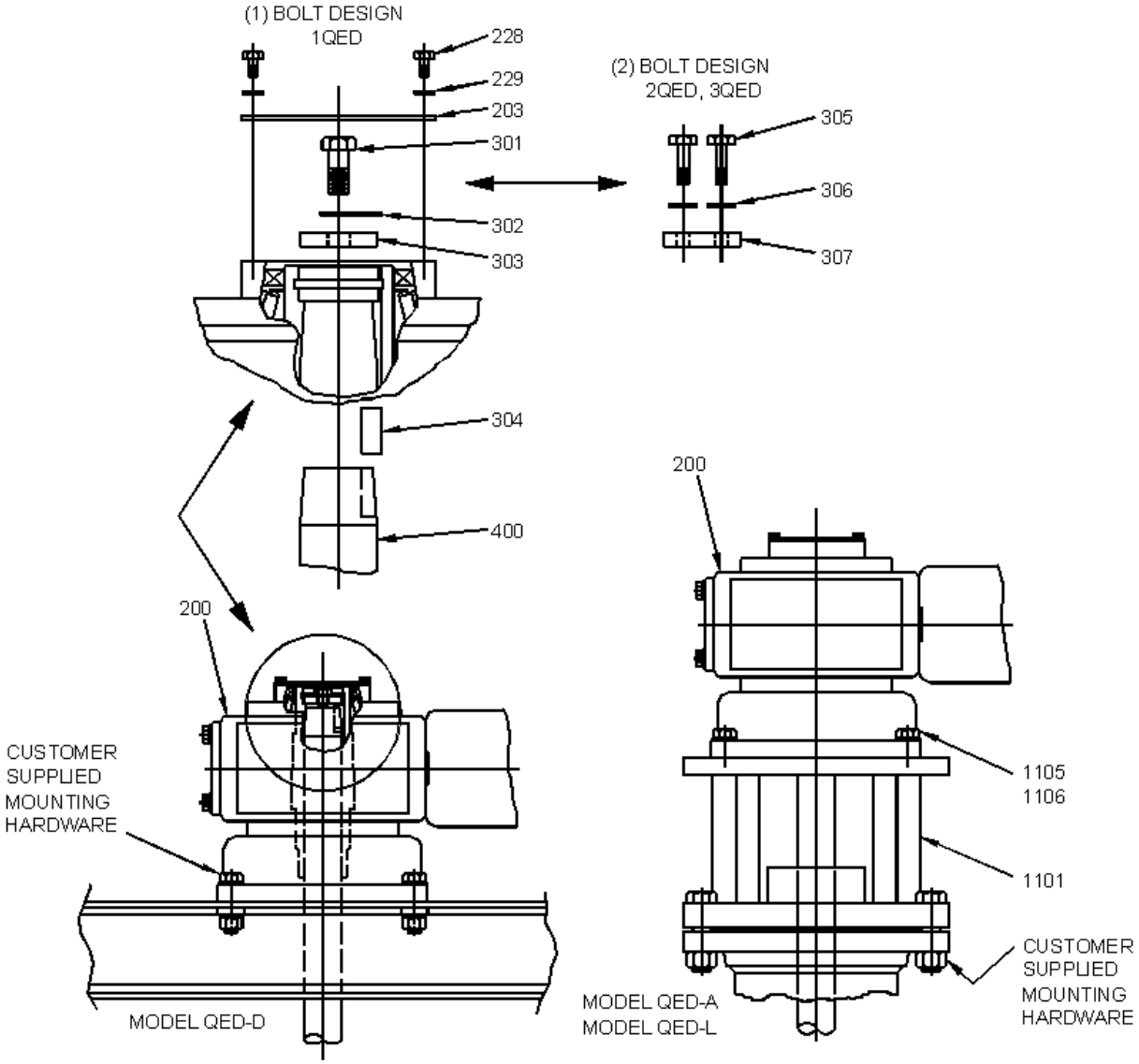


Figure 6: Agitator Extension Shaft Installation

11. QED-A: Install threaded studs [1305] into pedestal tapped holes (two at 180 degrees). Install packing rings [1307] into pedestal housing [1101] with packing split staggered. Seat each packing ring as it is installed. Install split packing gland [1306] over threaded studs [1305] with gland clamps [1304], flatwashers [1303], lockwashers [1302], and hex adjusting nuts [1301]. Refer to Figure 7. The split packing gland must be square with the packing housing section of the pedestal. Tighten the hex adjusting nuts.

    Let the packing sit for five or ten minutes so that it can cold flow and adjust to the gland pressure. Loosen the hex adjusting nuts, then finger tighten. After starting the unit, adjust the packing by tightening the hex adjusting nuts one flat at a time, allowing 15 minutes between each take-up for the packing to reseat itself. Repeat these adjustments at 15 minute intervals until the desired leakage is obtained. Do not over tighten.

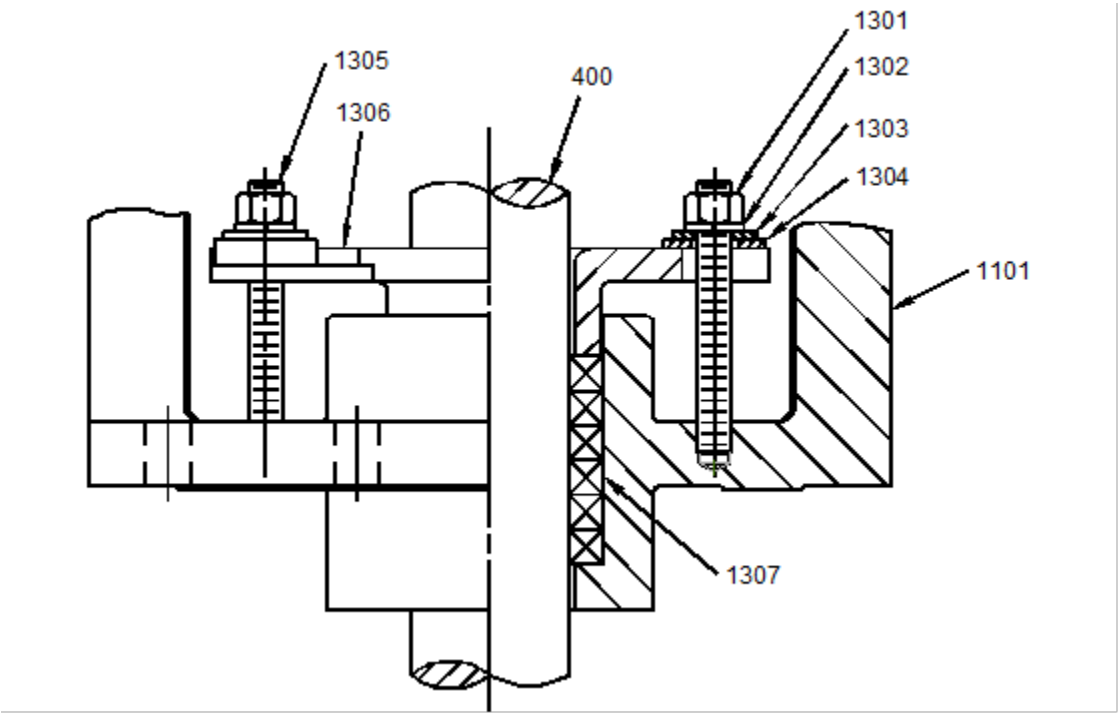


Figure 7: Stuffing Box Installation

12. QED-L: Install lip seal [1802] and snap ring [1801] into pedestal housing [1101]. See Figure 8, next page.

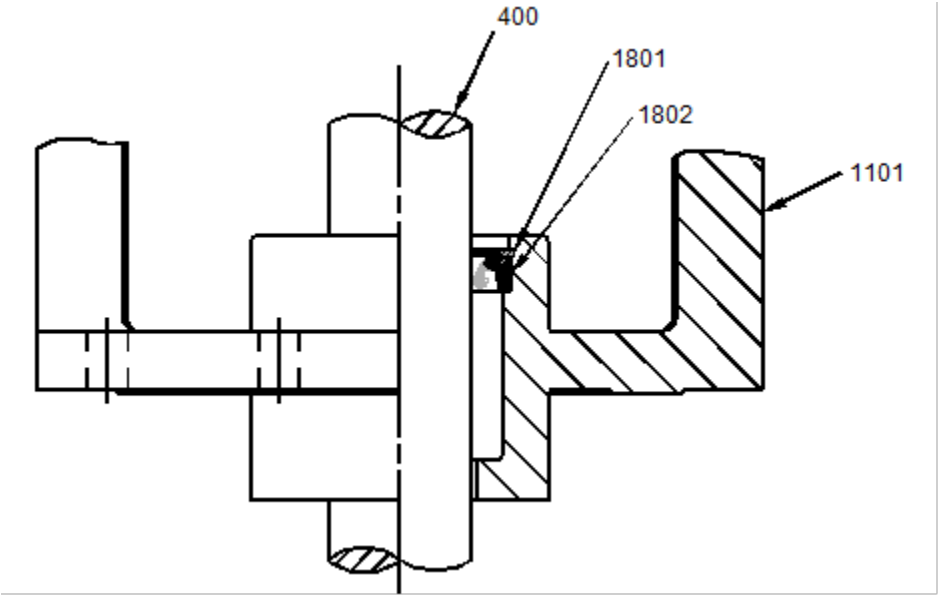


Figure 8: Lip Seal Installation

13. Torque reducer mounting bolts [1105] to value shown in Table 9: Bolt Tightening Torque, page 21. Install the handhole covers [1102] onto existing bolts [1107] and lockwashers [1108] using one flatwasher [1104] and one hex nut [1103] per cover.

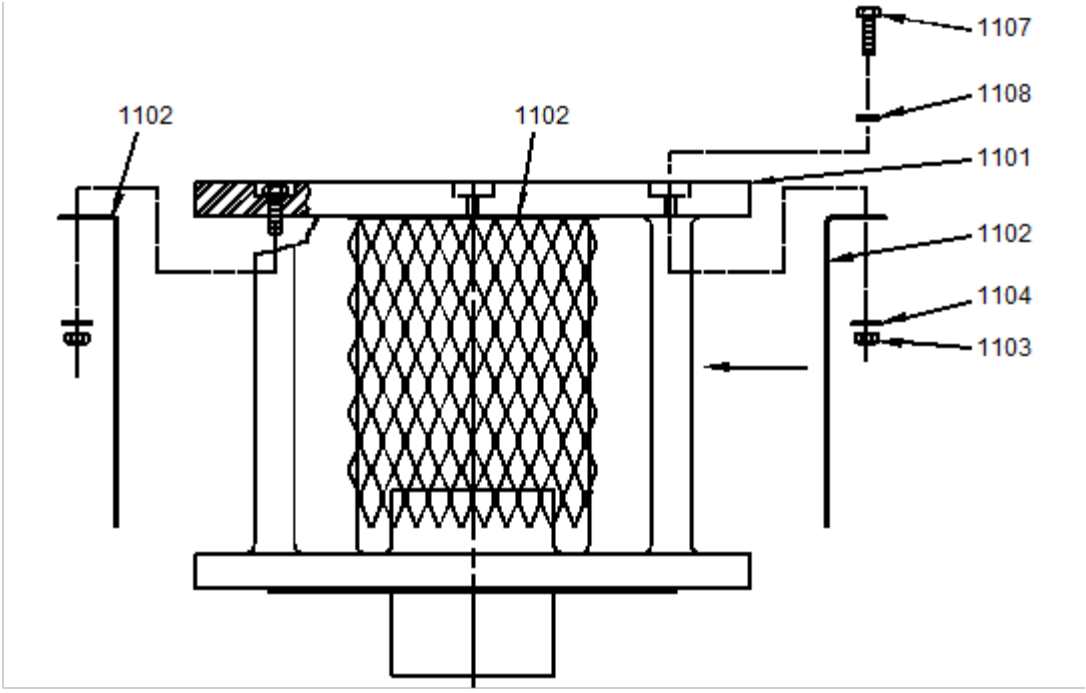


Figure 9: Handhole Cover Installation

14. Check the installed extension shaft runout. Place dial indicator on the side of the extension shaft at the bottom. Manually turn the exposed low speed shaft [205] at the top of the reducer one full turn.

15. Total extension 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^{o} from the indicator and just below the first in-tank shaft coupling or just below the mounting surface if there is no in-tank coupling. As heat is applied to the shaft (do not allow surface temperature of shaft to exceed 500^{o}F [260^{o}C]), the shaft will move toward the indicator. After the shaft has moved .030-.060" (.76-1.52mm), remove the heat and the shaft will begin to move away from the indicator. The shaft will draw more than it moved initially, and as a result will be straightened. After each heating cycle, recheck the shaft until runout is within tolerance. Do not heat in the same location. Move up or down 2-3" (50-70 mm) to avoid reheating the same location.

16. Reinstall low speed shaft guard [203] with bolts [228] and lockwashers [229].

17. Install breather [215] into port at top of reducer. Reference Figure 26, page 47 for port location.

Table 9: 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
10-24	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.

5.2. Impeller Installation

Unless otherwise specified on the unit assembly drawing, the impeller attaches to the shaft with a key and setscrew. Refer to Figure 10, page 23. With extended shaft keyways, the keyway is drilled at intervals for optional impeller placement.

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

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

Markings for Serial Number 1-XXXXX-1

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

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

Markings for Serial Number 1-XXXXX-2

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

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

5.2.1. Steps to Install Impeller

1. Slide hub [503] onto agitator shaft [400] up past the desired key location. Place pin key [501] into shaft keyway so that pin extends into the drilled hole in shaft keyway (see Figure 10 for key orientation). Slide hub back down agitator shaft, over key, until the hub rests on the key.

2. Tighten square head setscrew [504] firmly onto the key. Torque to the value shown in Table 9: Bolt Tightening Torque, page 21.

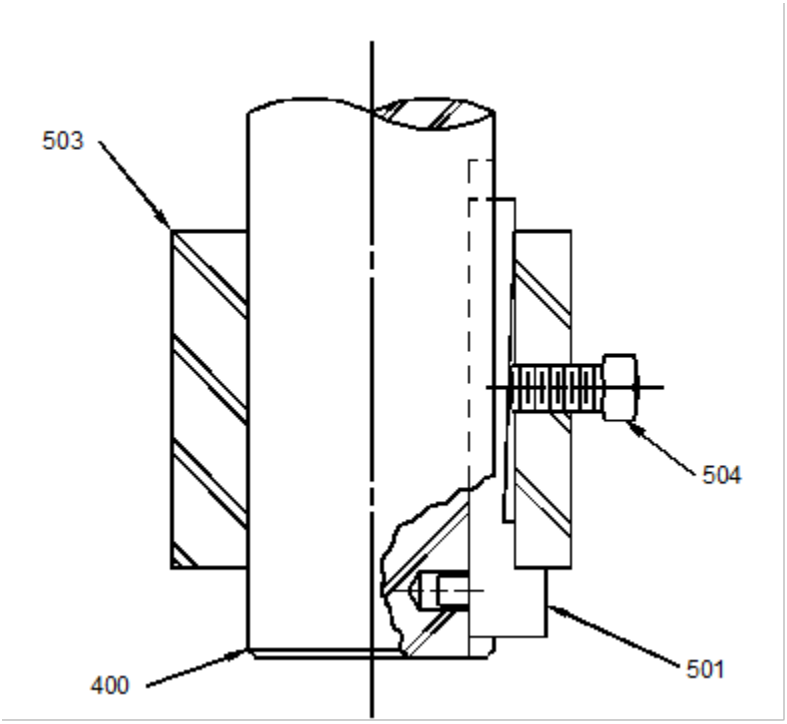


Figure 10: Turbine Hub Installation

3. Bolt extension blades [505] to hub [503] with bolts [506], lockwashers [507], and hex nuts [508]. Bolt stabilizer fins [509] (if furnished) to extension blades [505] with bolts [510], lockwashers [511], and hex nuts [512]. Torque to the value shown in Table 9: Bolt Tightening Torque, page 21.

NOTE: If "optional" impeller balancing has been purchased, the impeller parts will be matched marked. Install parts as marked so these impellers will be properly balanced.

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.

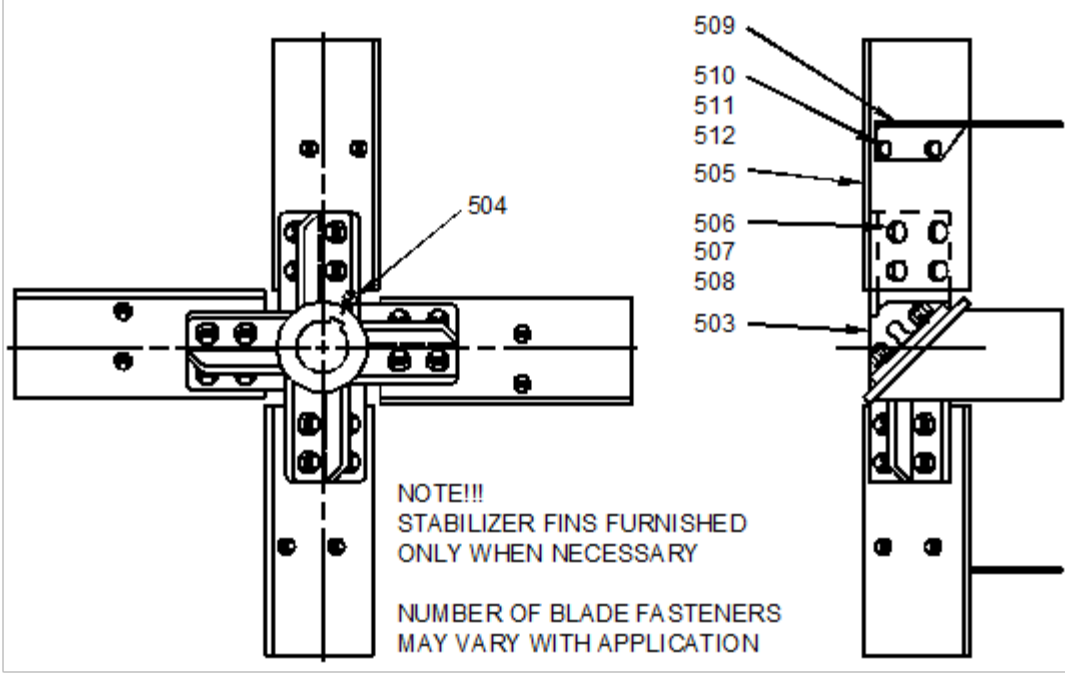


Figure 11: Style P-4 Impeller

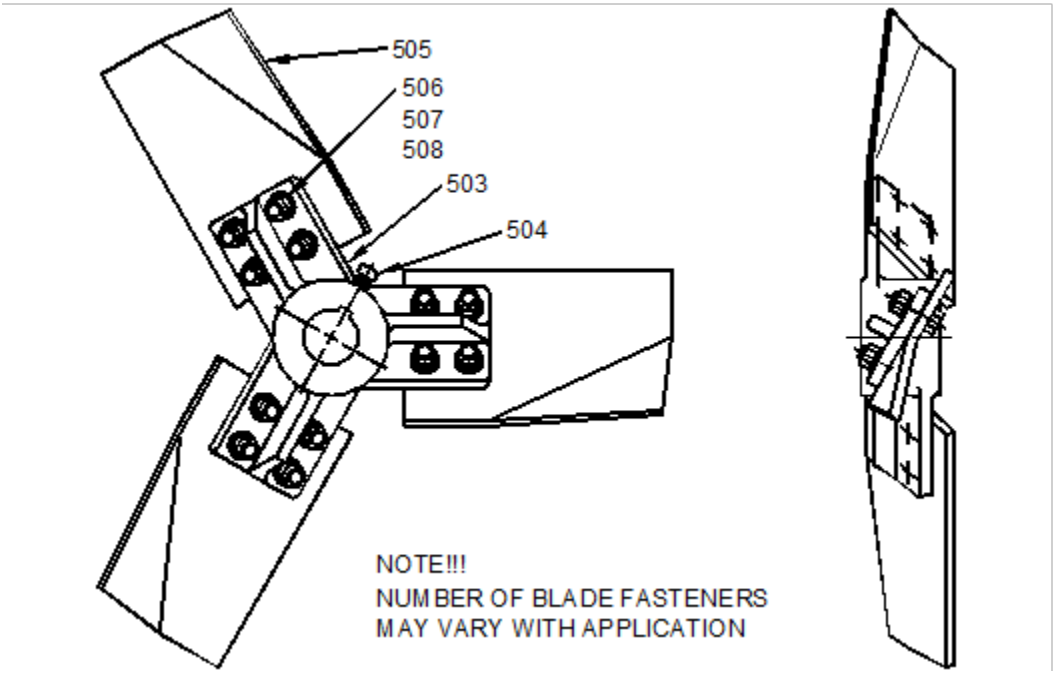


Figure 12: Style HE-3 Impeller

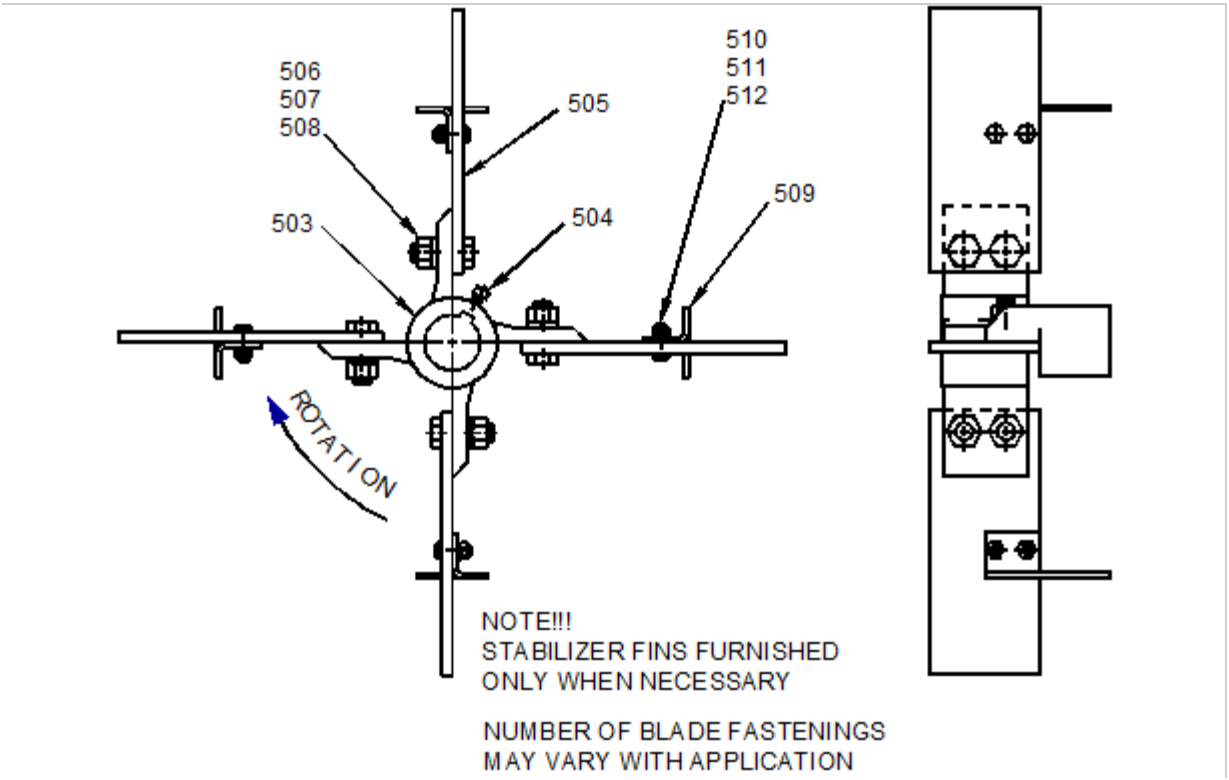


Figure 14: Style S-4 Impeller

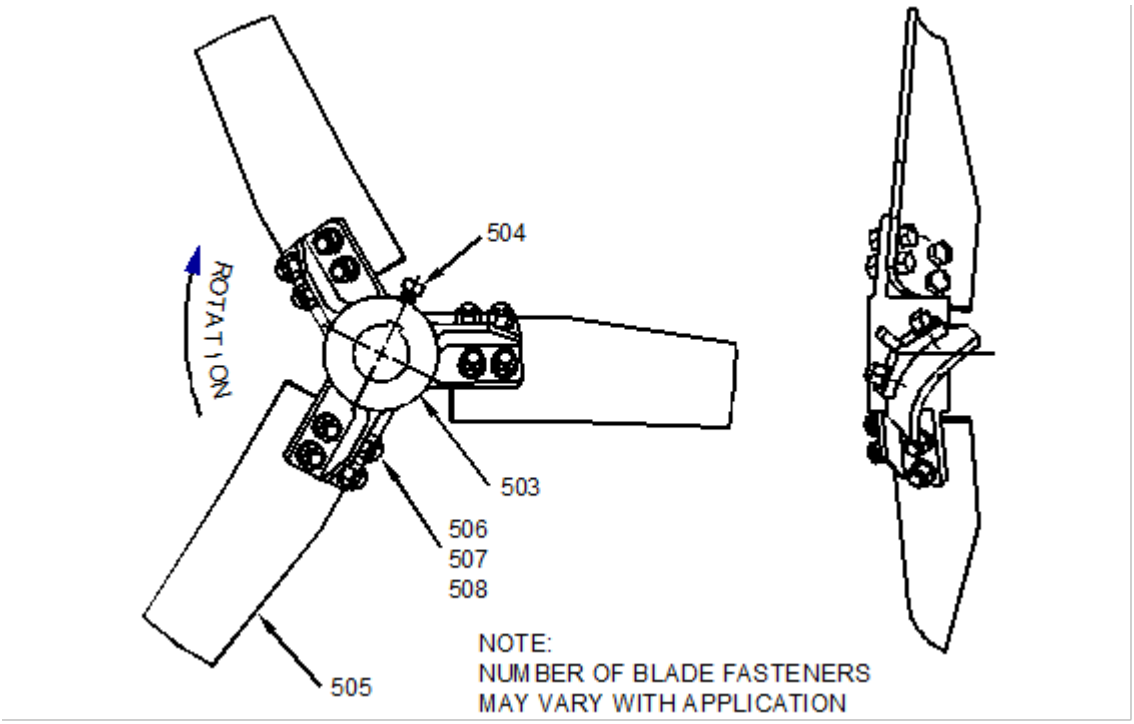


Figure 13: Style SC-3 Impeller

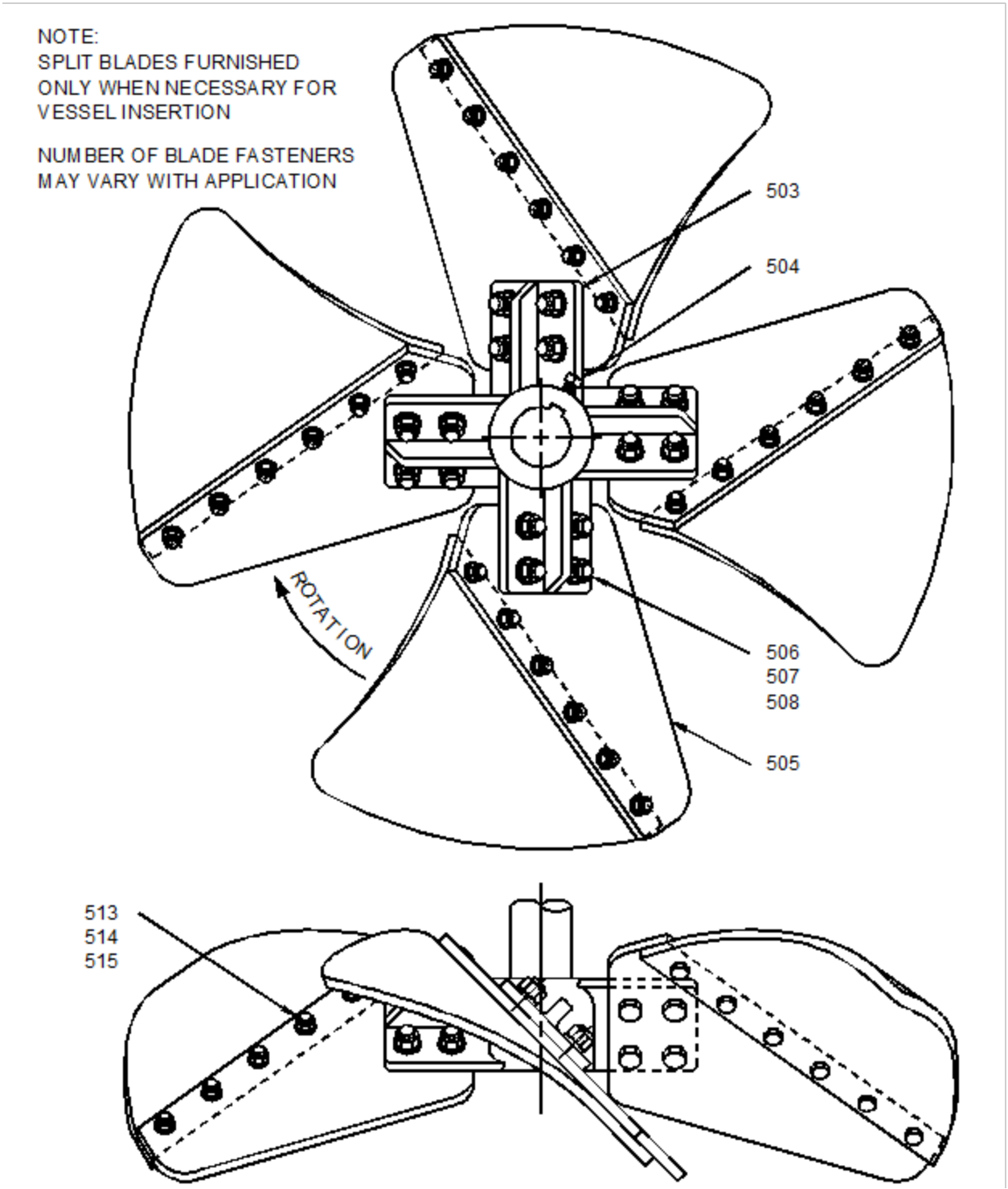


Figure 15: Style Maxflo W Impeller

5.2.2. Rubber Impeller Covering

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

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

Impeller diameter > 84" (2133 mm) :
The impeller is supplied as a one-piece (welded) coated/covered assembly. For attachment to the shaft, refer to Figure 16, page 28.

1. Put gasket [522] on top of hub [521].
2. Install key [520] 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.
    i. *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 9: Bolt Tightening Torque, page 21.
7. Remove the hoist from the impeller.

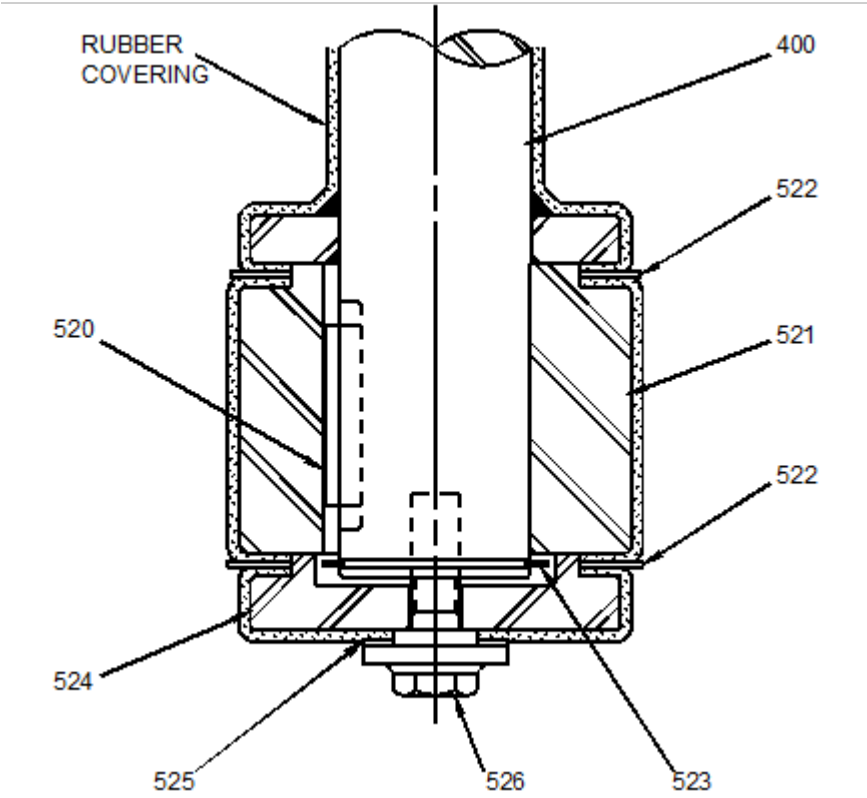


Figure 16: Thrust Bolt Impeller Attachment

6. Options

6.1. In-Tank Couplings

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

NOTE: Whenever assembly or disassembly of an agitator with an in-tank coupling is referred to in this manual, substitute flanged drive shaft [403] *and/or flanged extension shaft* [404] *(*Figure 17*, page 30) 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. Install the key into the shaft keyway and make sure it is properly oriented and fully bottomed in the keyway.

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

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

3. Shaft Bolt Installation:

2 Bolt Design:

→ Install coupling washer [421, 424]; lubricate and install bolts and lockwashers [422, 423, 425, 426]. Torque to the value shown in Table 9: Bolt Tightening Torque, page 21.

1 Bolt Design:

→ Install coupling washer [410, 415] and locking clip [412, 416]**;** lubricate and install shaft bolt [418, 419]. Torque to the value shown in Table 9: Bolt Tightening Torque, page 21. 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 9: Bolt Tightening Torque.

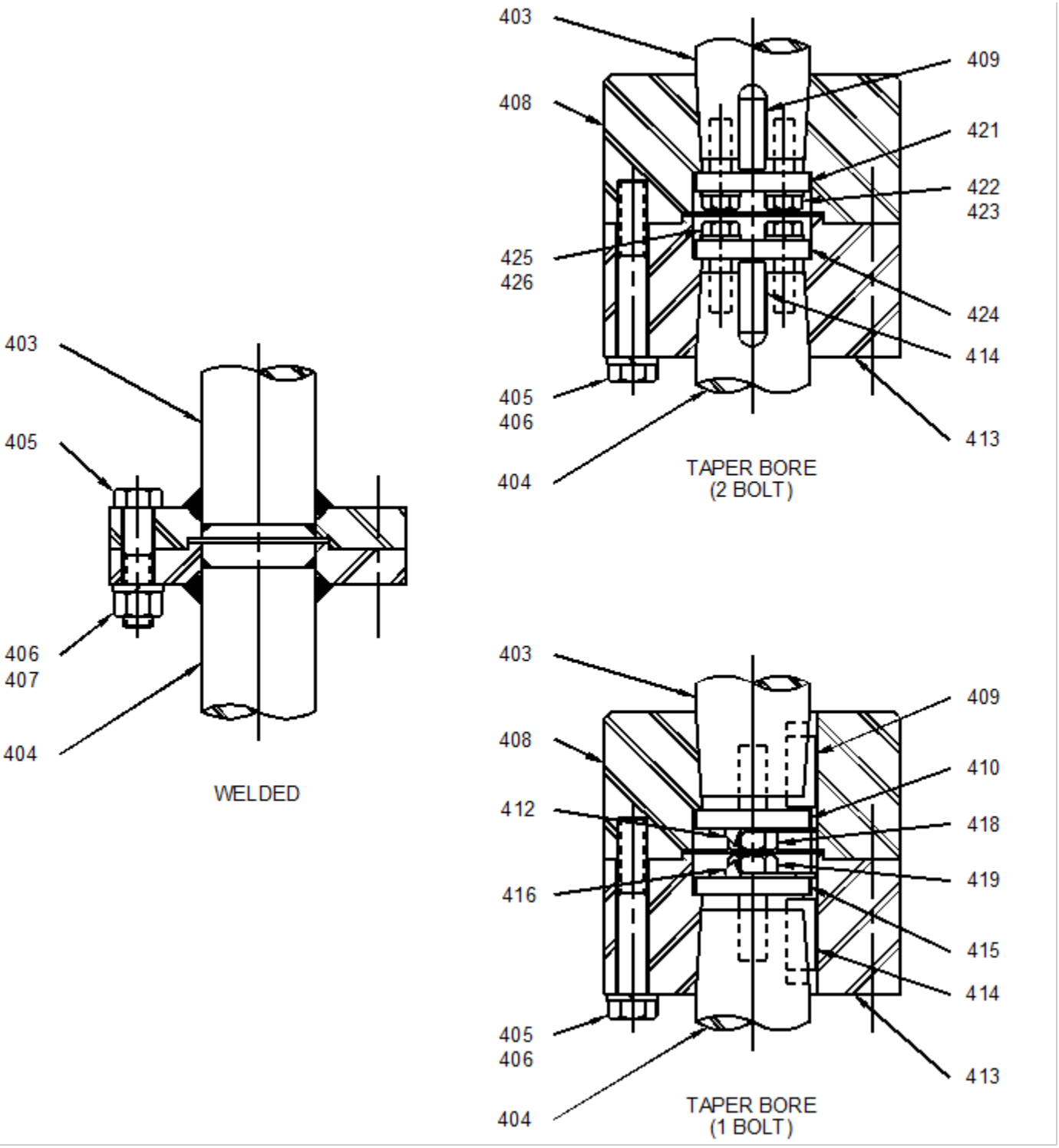


Figure 17: In-Tank Couplings

6.1.1. Auxiliary Shaft Seal

6.1.1.1. Auxiliary Lip Seal

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

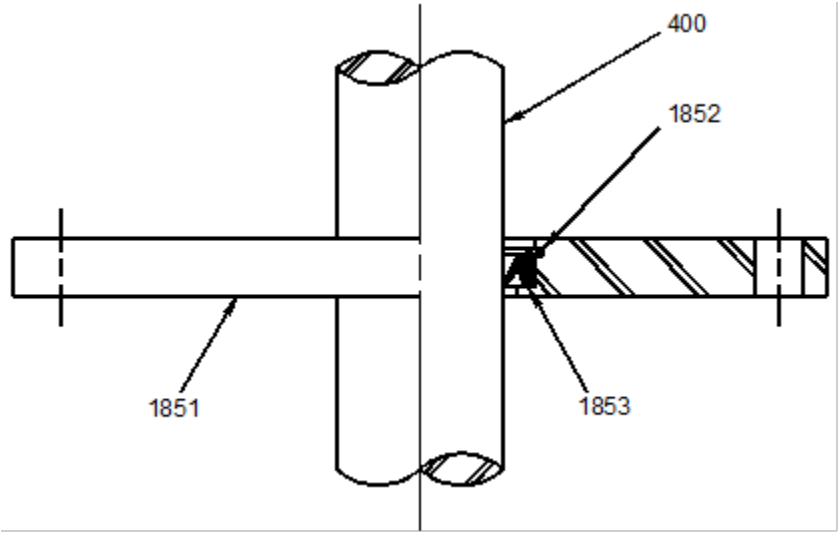


Figure 18: Auxiliary Shaft Seal

1. Locate snap ring [1852], lip seal [1853], and flange [1851]. Assemble the lip seal flange [1851] to the vessel with the proper gasket (supplied by others). *Do not install the bolts (supplied by others) at this time.*

2. Lower extension shaft [400] into the vessel through the auxiliary lip seal flange. Block the shaft from inside the vessel such that the extension shaft taper fully extends above the flange face, to a few inches below the agitator drive mounting surface. The shaft taper should be fully accessible.

3. Place the lip seal and the snap ring over the extension shaft.

4. Lift the agitator drive assembly onto the mounting structure and set into place above the exposed extension shaft. Clean the hollow reducer low speed shaft [205] and clean the shaft taper. Both surfaces must be clean and free of nicks or burrs. *Do not apply any lubricant or anti-seize to either tapered surface.*

5. Insert shaft key [304] into the extension shaft keyway, making sure it is fully bottomed in the keyway. Carefully remove the blocks securing the agitator extension shaft and insert the shaft into the reducer low speed shaft [205] until both seat firmly against each other. Be sure that the shaft is not placed at an angle to the reducer.

6. Shaft bolt installation, reference Figure 6, page 17:

(1) bolt design (1QED): Install coupling washer [303]; lubricate and install shaft bolt [301] and locking tab [302]. Torque to the value shown in Table 9: Bolt Tightening Torque, page 21.

(2) bolt design (2QED & 3QED): Install coupling washer [307]; lubricate and install bolts [305] and lockwashers [306]. Torque to the value shown in Table 9: Bolt Tightening Torque, page 21.

7. Assemble lip seal and snap ring into the flange.

8. Install the auxiliary lip seal flange bolts finger tight. If the bolt holes in the lip seal flange and the vessel flange are not properly aligned, the agitator drive will have to be moved laterally or shimmed. If shimming is required, use full width shims under the mounting feet to provide a solid joint for bolting the agitator drive to the support structure. Torque the agitator drive mounting bolts to the value shown in Table 8: Agitator Mounting Pad Reinforcement Dimensions, inches (mm). Then torque the auxiliary lip seal flange bolts to the value shown in Table 8: Agitator Mounting Pad Reinforcement Dimensions, inches (mm).

9. Auxiliary lip seals do not require any adjustment or lubrication. Both Buna-N and Teflon lip seals as supplied are not split.

10. Continue with the agitator installation.

6.1.1.2. Auxiliary Stuffing Box

1. Locate gland plate [1355], split gland [1356], packing [1357] and lantern ring [1358]. Assemble the stuffing box flange [1351] to the vessel with the proper gasket (supplied by others). *Do not install the bolts (supplied by others) at this time.*

2. Lower extension shaft [400] into the vessel through the auxiliary stuffing box flange. Block the shaft from inside the vessel such that the extension shaft taper fully extends to a few inches below the agitator drive mounting surface. The shaft taper should be fully accessible. Place three rings of packing [1357], the lantern ring [1358], the additional rings of packing [1357], and the gland plate [1355] over the extension shaft.

3. Lift the agitator drive assembly onto the mounting structure and set into place above the exposed extension shaft. Clean the hollow reducer low speed shaft [205] and clean the shaft taper. Both surfaces must be clean and free of nicks or burrs. *Do not apply any lubricant or anti-seize to either tapered surface.*

4. Insert shaft key [304] into the extension shaft keyway, making sure it is fully bottomed in the keyway. Carefully remove the blocks securing the agitator extension shaft and insert the shaft into the reducer low speed shaft [205] until both seat firmly against each other. Be sure that the shaft is not placed at an angle to the reducer.

5. Shaft bolt installation, reference Figure 6, page 17:

   (1) bolt design (1QED): Install coupling washer [303]; lubricate and install shaft bolt [301] and locking tab [302]. Torque to the value shown in Table 9: Bolt Tightening Torque, page 21.

   (2) bolt design (2QED & 3QED): Install coupling washer [307]; lubricate and install bolts [305] and lockwashers [306]. Torque to the value shown in Table 9: Bolt Tightening Torque, page 21.

6. Install the auxiliary stuffing box flange bolts finger tight. If the bolt holes in the stuffing box flange and the vessel flange are not properly aligned, the agitator drive will have to be moved laterally or shimmed. If shimming is required, use full width shims under the gear drive mounting surface to provide a solid joint for bolting the agitator drive to the support structure.

7. Tape gland plate [1355] to the extension shaft coupling half. Attach an indicator to the extension shaft and set the point of the indicator on the top face of the stuffing box housing. Manually the exposed low speed shaft [205] at the top of the reducer one full turn. Shim the agitator drive until the indicator reading is within .005" (.127mm) FIM (Full Indicator Movement) maximum. Torque to the value shown in Table 9: Bolt Tightening Torque, page 21.

8. Attach an indicator to the extension shaft and set the point of the indicator on the inside diameter of the stuffing box housing. Align the stuffing box housing to within .005" (.127 mm) FIM of the shaft centerline and then tighten the stuffing box flange bolts (supplied by others). Torque to the value shown in Table 9: Bolt Tightening Torque, page 21.

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

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

11. Continue with the agitator installation.

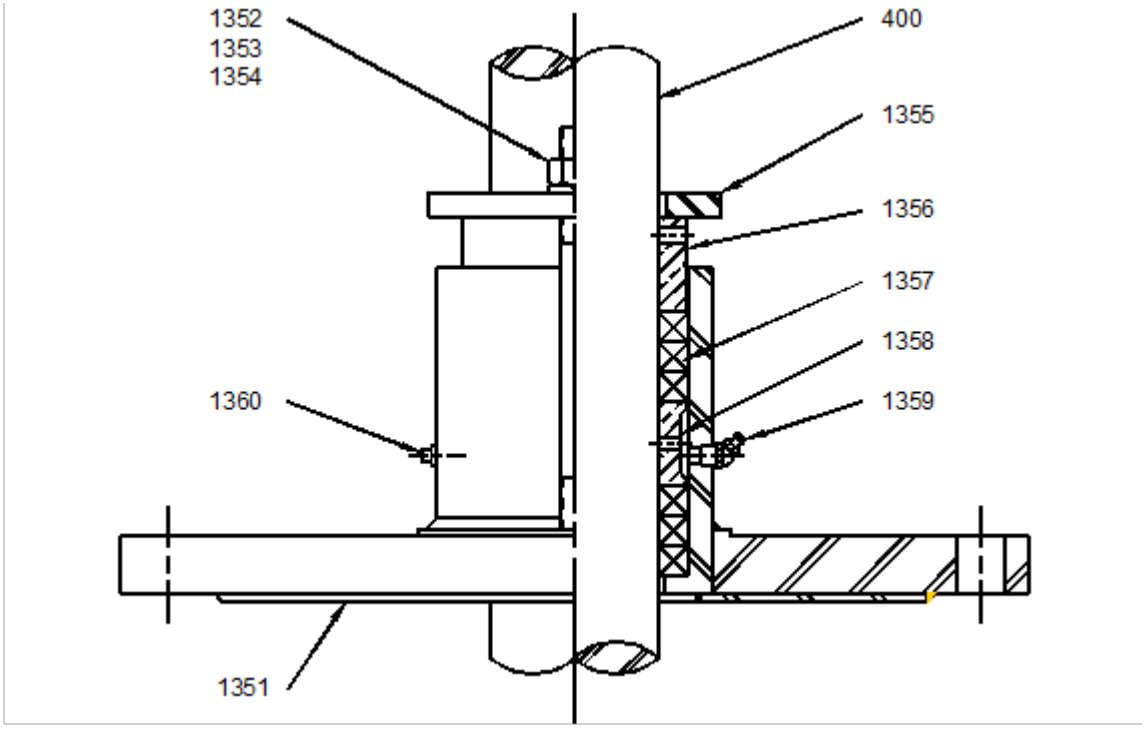


Figure 19: Auxiliary 6-Ring Stuffing Box

6.1.2. Steady Bearing

QED 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 Mounting & Installation sections for checking and straightening the shaft. Steady bearing mountings should be located from the installed agitator extension shaft.

6.1.2.1. Bracket Steady Bearing

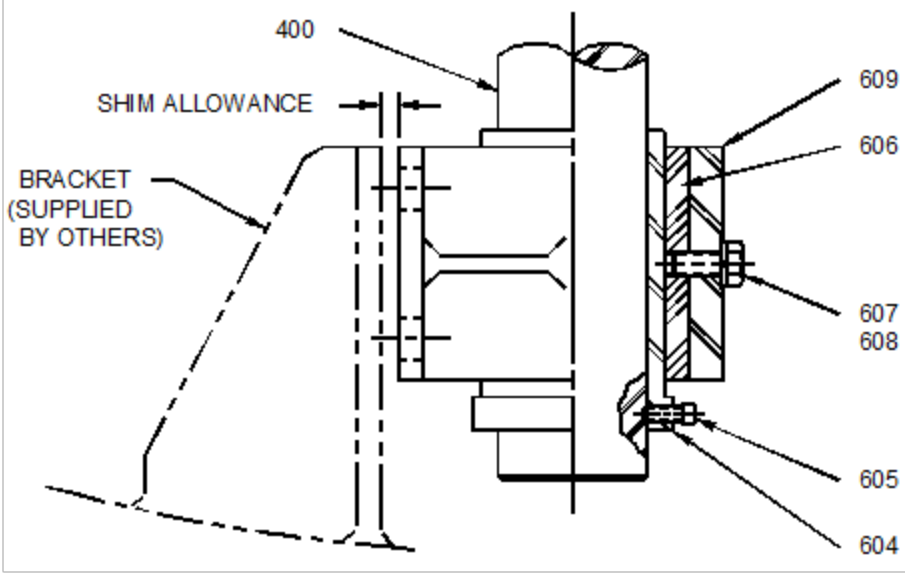


Figure 20: Bracket Steady Bearing

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 9: Bolt Tightening Torque, page 21.

2. Loosen setscrews [605] and remove wear sleeve [604]. Remove bushing retaining bolt [607] and bushing [606] from steady bearing housing [609]. Attach a dial indicator to the shaft and set it so the point of the indicator extends inside the steady bearing housing bore.

3. Manually turn the exposed low speed shaft [205] at the top of the reducer one full turn. Shim the steady bearing housing until it is located concentric to the shaft centerline within .050" (1.27 mm) FIM (Full Indicator Movement).

4. 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.

5. 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.

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

7. 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 9: Bolt Tightening Torque, page 21.

8. 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.

9. Reinstall the wear sleeve with the setscrews over the drill spots located in Step 8. Torque the setscrews and the bushing retaining bolt to the value shown in Table 8: Agitator Mounting Pad Reinforcement Dimensions, inches (mm). 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.

6.1.2.2. Tri-Pod Steady Bearing

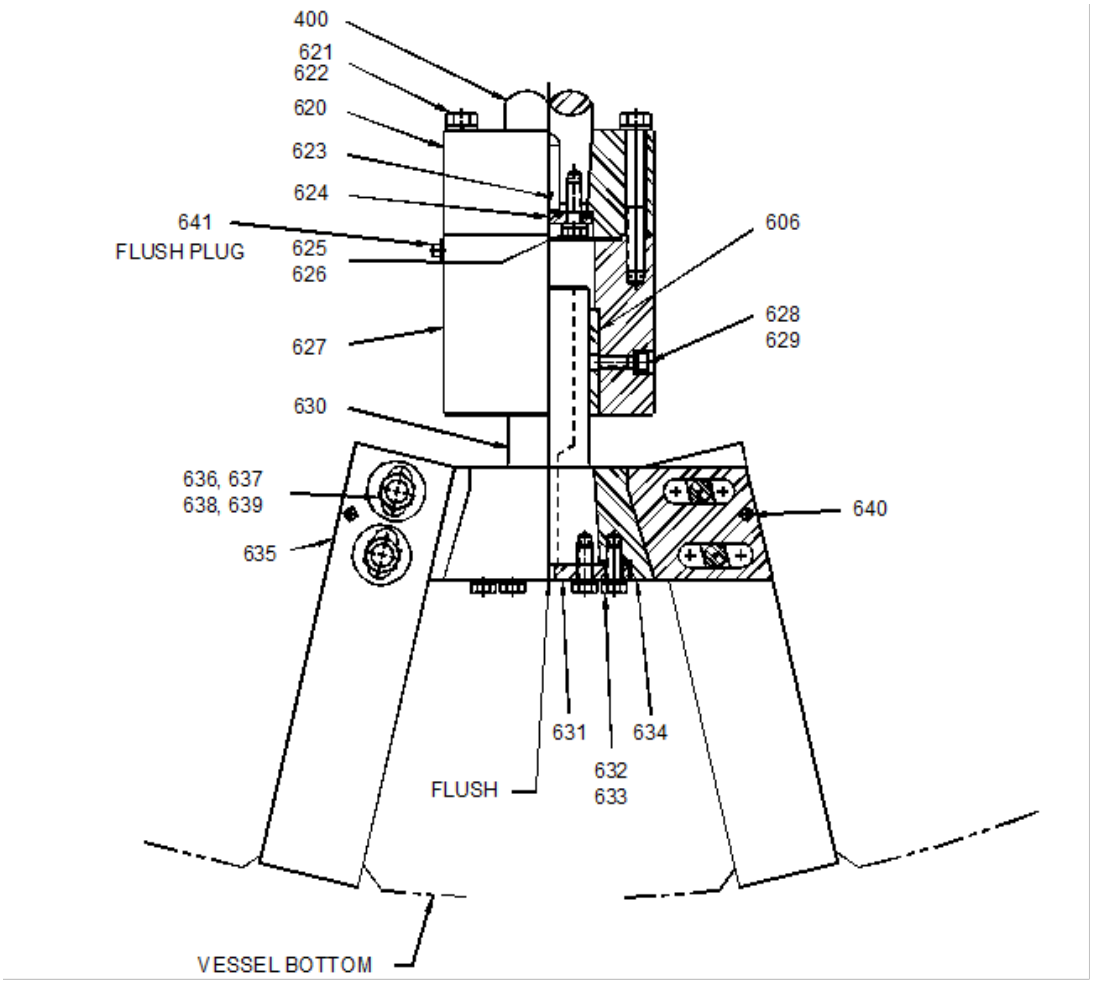


Figure 21: Tri-Pod Steady Bearing

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 Mounting & Installation sections 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 9: Bolt Tightening Torque, page 21.
   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 9: Bolt Tightening Torque, page 21. 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 exposed low speed shaft [205] at the top of the reducer 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 9: Bolt Tightening Torque, page 21.

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

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. Assemble the bushing housing [627], with the bushing [606] installed, to the coupling [620] using bolts and lockwashers [621, 622]. Torque the bolts to the value shown in Table 9: Bolt Tightening Torque, page 21.
    NOTE: For bushing [606] installation procedures, refer to the Maintenance section, page 49.

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 8: Agitator Mounting Pad Reinforcement Dimensions, inches (mm), page 17. 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.

6.2. Angle Risers

6.2.1. Model QED-D

Optional 10° angle risers are available for QED-D mixer drives. Mount angle risers such that the motor end is down. Reference Figure 22, page 40.

Assemble angle risers [801 & 802] to gear drive [200]. Install mounting bolts [803], with flatwashers, lockwashers and hex nuts [804, 805, & 806]. Torque bolts to the value shown in Table 9: Bolt Tightening Torque, page 21.

Install the mixer drive to the support structure using customer supplied fastener set.

Table 10: Angle Riser Mounting Dimensions – inch (mm)

Model	G	H	J	K	L
1QED-D	3.75 (95.3)	6.31 (160.3)	.75 (19.1)	14.62 (371.3)	11.00 (279.4)
2QED-D	3.75 (95.3)	6.62 (168.1)	.75 (19.1)	15.25 (387.4)	11.00 (279.4)
3QED-D	3.75 (95.3)	8.00 (203.2)	.75 (19.1)	18.00 (457.2)	11.00 (279.4)

Table 11: Off Center Mounting Dimensions – inch (mm)

Shaft Extension Range	X	Minimum Tank Diameter
38-53 (965-1346)	7.5 (191)	22 (559)
54-76 (1372-1930)	10.75 (273)	32 (813)
77-110 (1956-2794)	15.5 (394)	46 (1168)
111-158 (2819-4013)	22.5 (572)	66 (1676)
159-227 (4039-5766)	32 (813)	96 (2438)

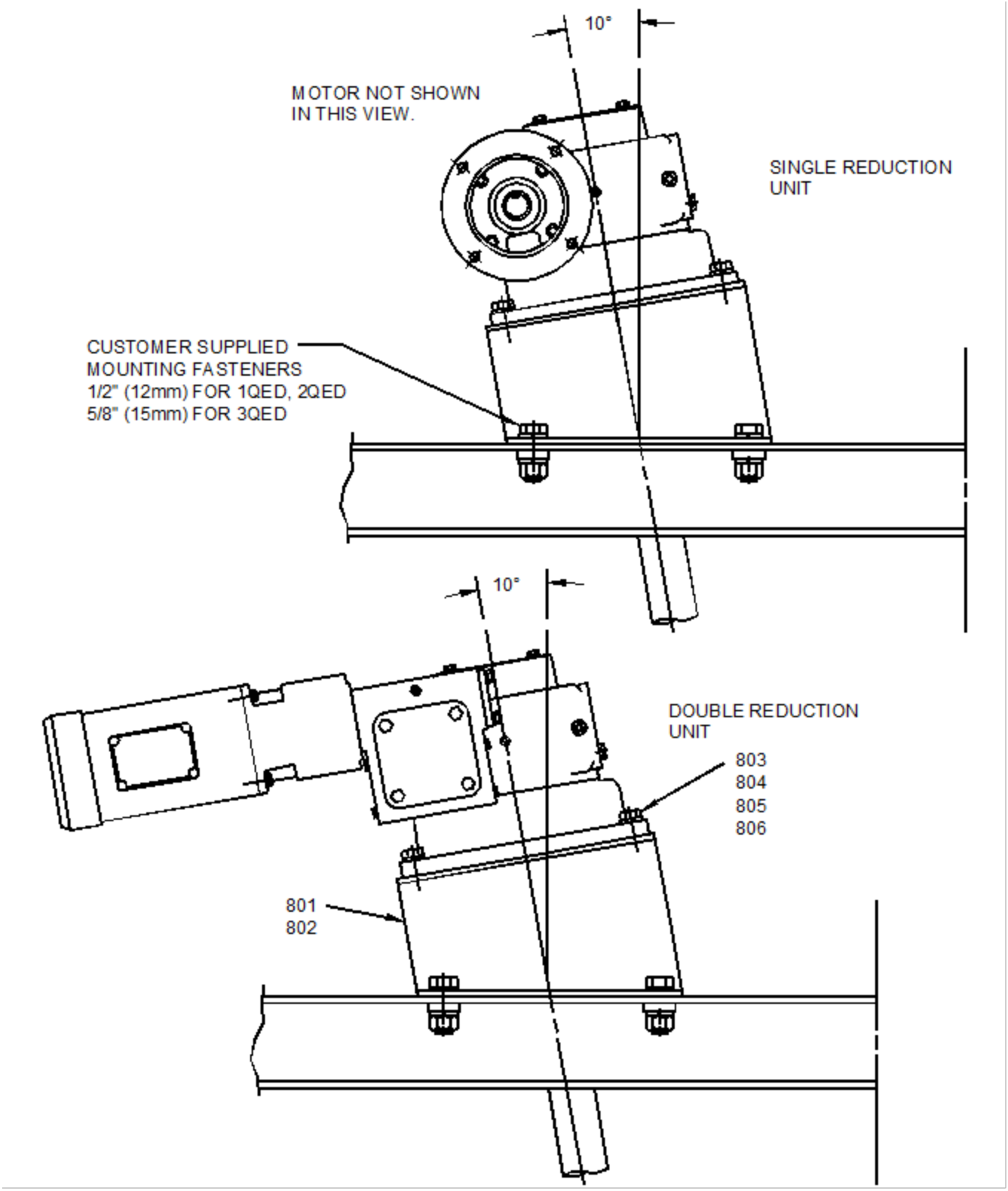


Figure 22: Angle Riser Mounting

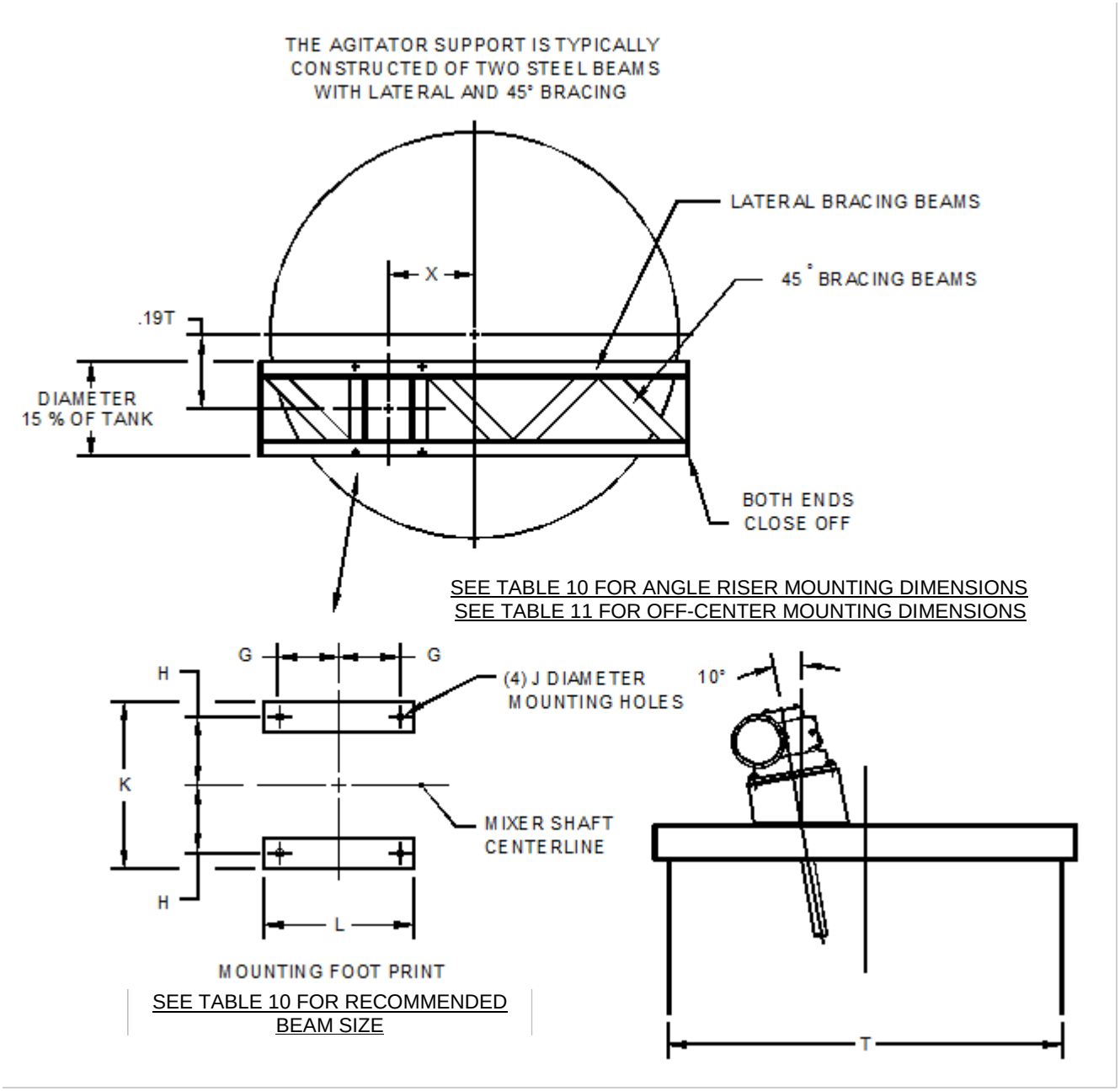


Figure 23: Angle Riser Mounting - Orientation

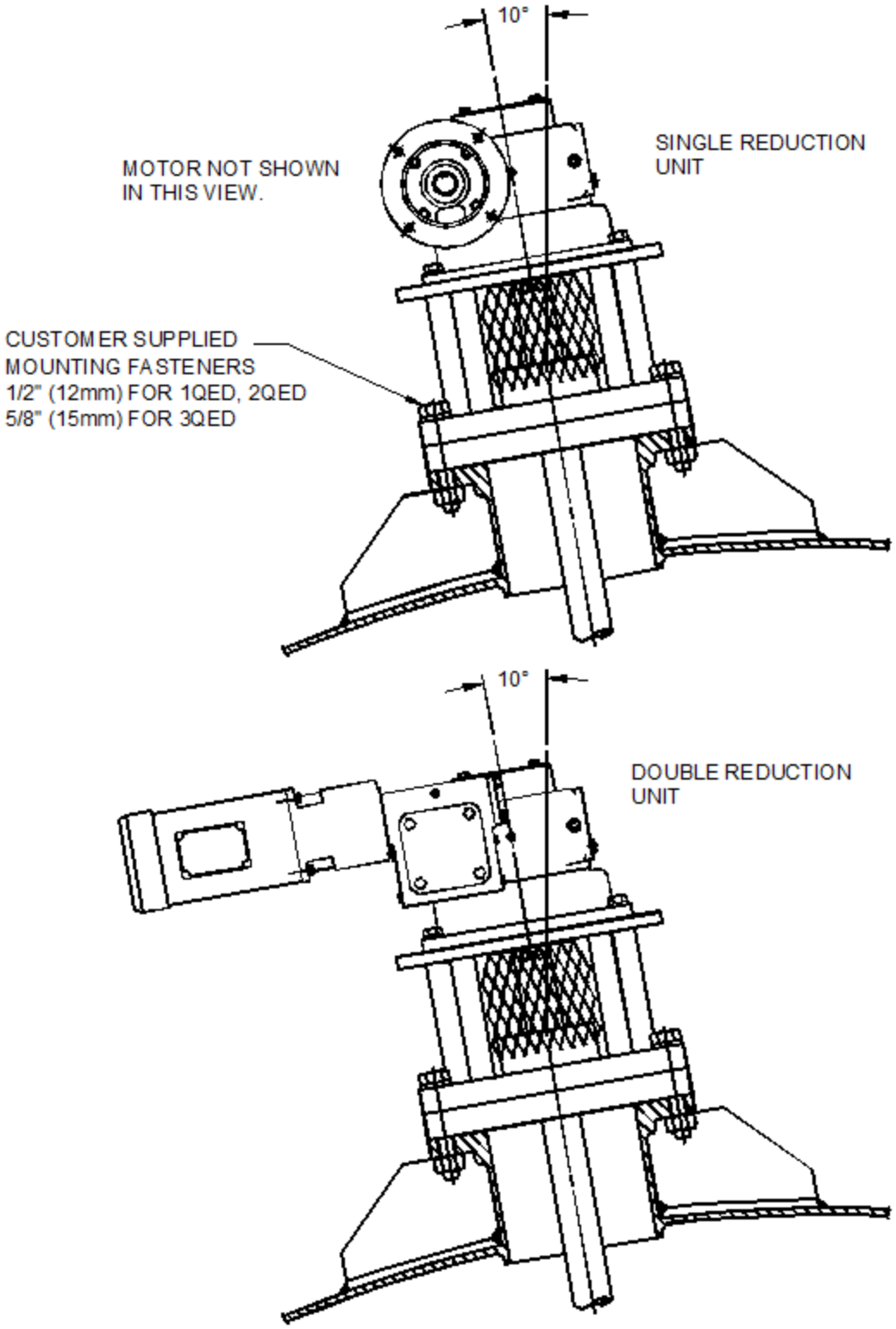


Figure 24: Closed Tank Angle Mounting

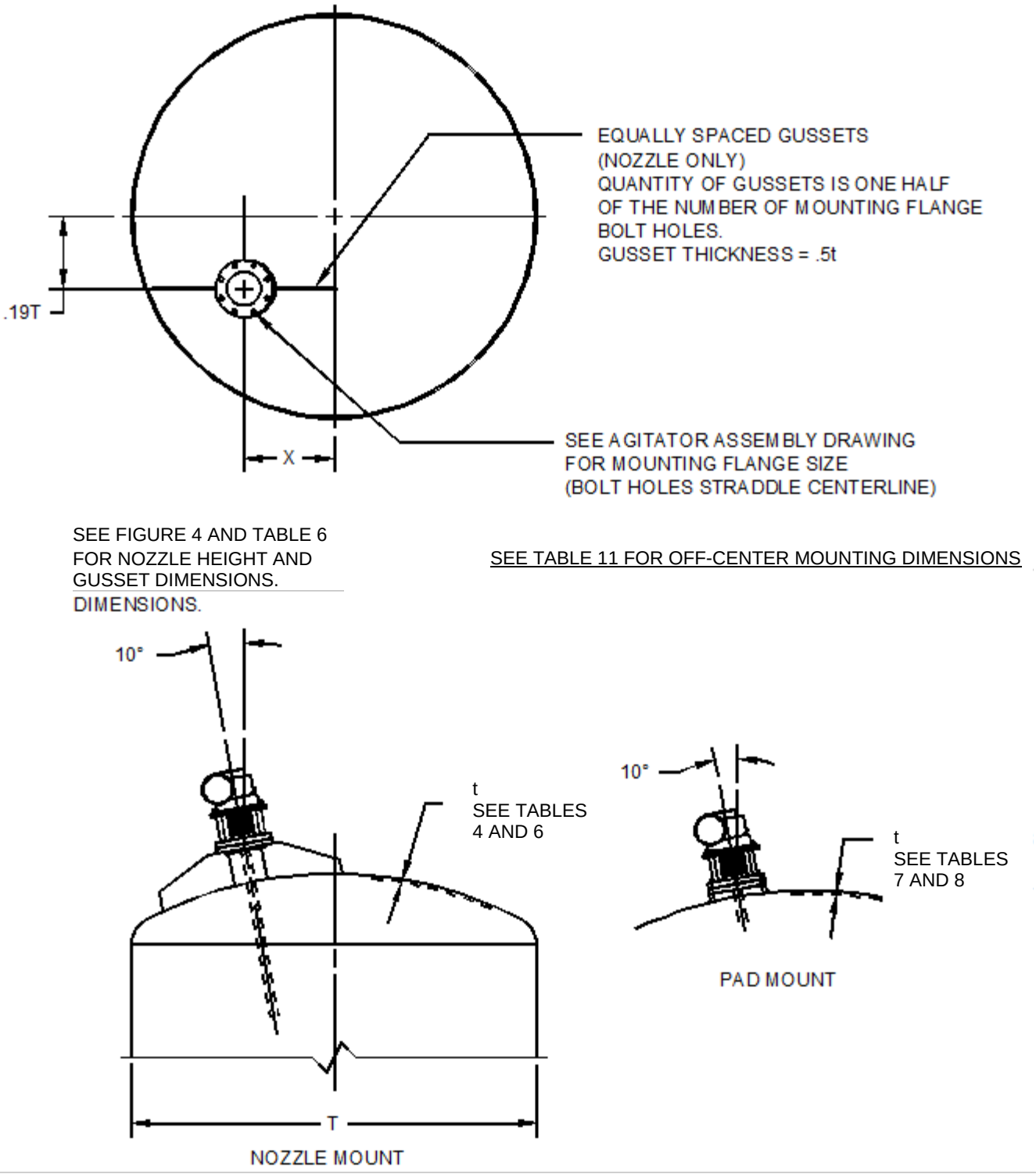


Figure 25: Closed Tank Angle Mounting - Orientation

7. 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.

7.1. Motor Lubrication

The motor bearings have been properly greased by the manufacturer. Motor bearings should be re-greased 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 13: Typical NLGI No. 2 Grease on page 45, lists some commonly available greases.

Always lubricate motor bearings with motor at a standstill.

When re-greasing, stop the motor, remove the outlet plug and add grease according to Table 13: Typical NLGI No. 2 Grease on page 45, 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 re-greasing.

CAUTION! Over-greasing is a major cause of bearing and motor failure.

The following table may be used as a guide in determining frequency of lubrication. The periods listed assume a clean, dry environment with an ambient temperature not exceeding 104°F (40°C). If conditions are less desirable than this, adjust the frequency accordingly. (Table 12: Lubrication Frequency is for motor speeds 1800 RPM or slower).

Table 12: Lubrication Frequency

DUTY	LUBRICATION INTERVAL (Months)
Intermittent	36
8-16 Hours/Day	30
Continuous	24

7.1.1. Motor and Gear Drive Bearings

Table 13: Typical NLGI No. 2 Grease

For Ambient Temperature Range Of 0° To 150° F (-18°To 66° C)		
Manufacturer	**General Purpose**	**EP**
Amoco Oil Co.	Amolith Grease: Grade 2	Amolith Grease: Grade 2ep
Ashland Oil Co.		Multi-Lube Lithium Ep Grease: Grade 2
		Ep Lithium #2
Chevron U.S.A.Inc.	Industrial Grease: Grade Medium	Dura-Lith Greases Ep: Grade 2
Citgo Petroleum Corp.		Premium Lithium Ep Grease: Grade 2
Conoco Inc.		Ep Conolith Grease: Grade 2
Exxon Co. U.S.A.	Unirex N: Grade 2	Nebula Ep: Grade 2
		Ronex Mp: Grade 2
Mobil Oil Corp.		Mobilux Ep 2
Pennzoil Products Co.		Pennlith Ep Grease 712
Phillips 66 Co.	Philube L Multi-Purpose Grease L-2	Philube Ep Grease: Ep-2
Shell Oil Co.	Alvania Grease 2	Alvania Grease Ep 2
		Alvania Grease Ep Lf 2
Texaco Lubricants Co.	Premium Rb Grease	Multifak Ep 2
Unocal 76		Unoba Ep Grease: Grade 2
		Multiplex Ep: Grade 2

7.2. Gear Drive Lubrication

Other than periodic lubrication, no routine operational maintenance to the gear drive is needed. It is recommended, however, that you inspect the gear drive regularly for lubricant leaks, abnormal noise, vibration, etc. A breather [215] is installed on top of the gear drive to allow pressures inside and outside the gear case to equalize. Do not obstruct its function.

The gear drive is shipped from the factory drained of oil. Oil has been included for the initial oil fill. Fill the gear drive to the proper level before operation. Refer to Figure 26, page 47 for general oil level, oil fill plug, oil drain plug, and grease fitting locations.

For double-reduction units:

- Remove both the filler plugs and the oil level plugs from each stage reducer housing. There is one fill plug and oil level plug on the primary stage reducer and one fill plug and oil level plug on the secondary stage reducer.

- The reducer lubricating oil has a path between the primary and secondary housing cavity. However, lubricant must travel between the housings through an intermittent shaft taper roller bearing, which at room temperature takes significant time. Therefore, to minimize reducer oil fill time, each stage reducer should be filled separately to the bottom of the respective oil level plug. These oil level plugs will be on the same horizontal line when the unit is in its normal operating position.

Do not overfill. Overfilling can cause overheating and may void the proper operation of the output drywell and cause lubricant leakage from the output seals.

The normal gear drive operating temperature can range to 200° F (93.3°C). Operating temperature in excess of 200°F (93.3°C) may cause damage to the seals or other components.

For ambient temperature from -30°F (-34°C) to 165°F (74°C) use Mobil SHC 634 or equal. *Do not use a phosphorous based oil.*

The oil should be changed after the first 1500 hours of operation. Drain oil by removing the drain plug and refill with proper type and amount of oil. Subsequent oil changes under normal operating conditions should be made every 5000 hours of operation or once a year whichever occurs first. Under adverse conditions such as rapid temperature changes, moist, dirty conditions or corrosive environment, more frequent oil changes are advisable.

Some units are equipped with upper and lower grease fittings [222] to lubricate bearings not adequately lubricated by the oil splash. These fittings must be lubricated every 3-6 months depending on operating conditions. Bearing greases must be compatible with the type of gear lubricant being used. For synthetic gear oils, use a synthetic bearing grease such as Mobil Synthetic Universal grease, Mobilith SHC 100 or a suitable equivalent. For food grade gear lubricants, use a Chevron FM grease, NLGI 2 or suitable equivalent.

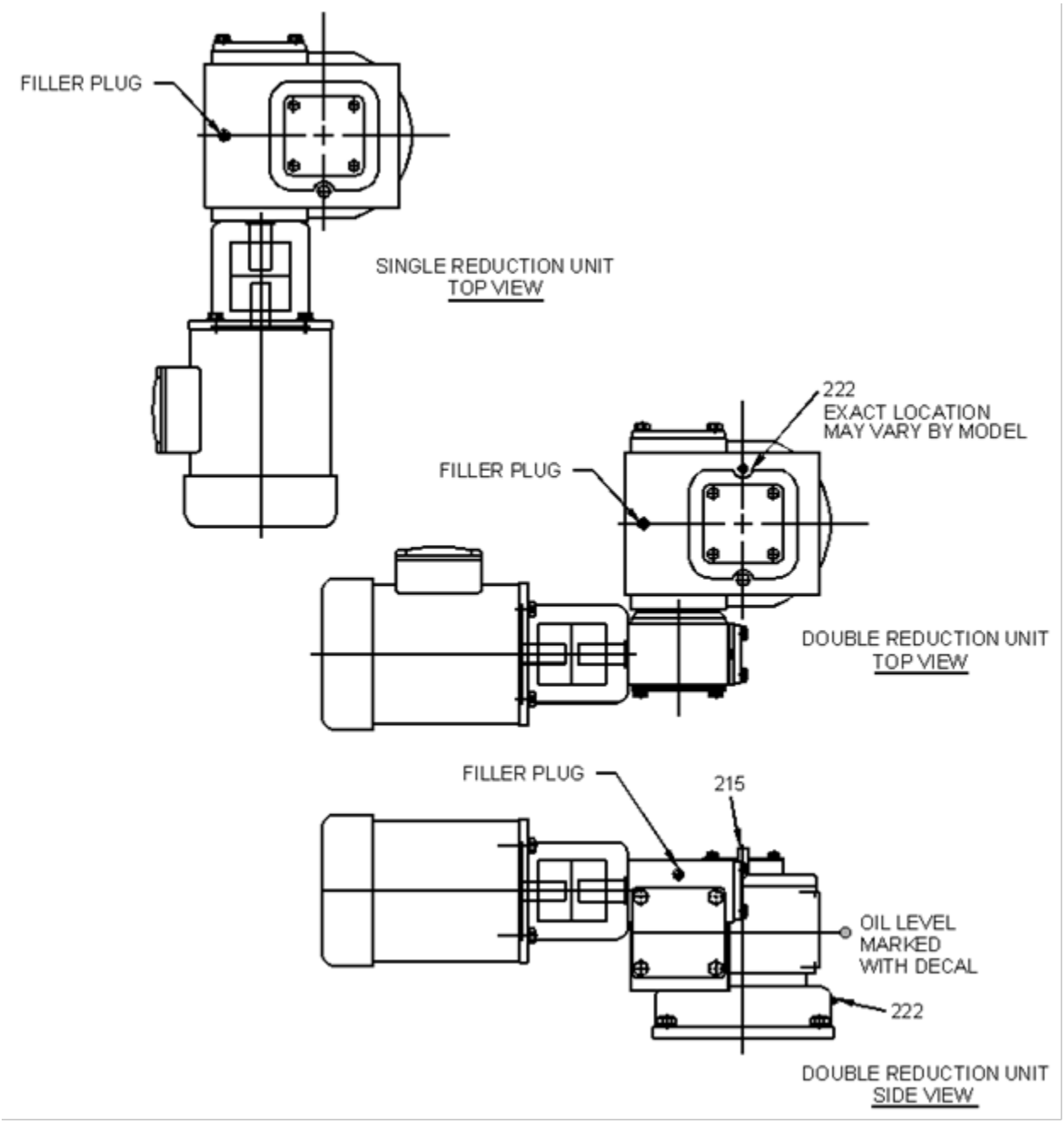


Figure 26: Drive Configuration

7.3. Shaft Seals Lubrication

Only 6-ring stuffing box seals may require lubrication. Refer to agitator assembly drawings for seal style and packing type. The 6-ring auxiliary stuffing box (Figure 19, page 34) is supplied with six rings of packing and a lantern ring. Packing shown as 1065 does not require external lubrication.

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

7.4. Steady Bearings Lubrication

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

8. Operation Agitator

Your Chemineer QED 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 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 NOV office* or NOV Field Service.

Should there be problems operating the unit, review the Installation and see Table 14: Troubleshooting, page 52. If you are unable to resolve the problem, contact your local NOV office.

8.1. Motor Operation

- ☑ *Electric motors furnished on Chemineer QED 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 NOV Mixing Technologies office for assistance.

8.2. Gear Drive Operation

The gear drive is shipped from the factory drained of oil. Be sure the gear drive has been filled with the proper amount and type of oil before operation. See Gear Drive Lubrication in the Lubrication section of this manual for specific recommendations.

Be sure the gear drive breather vent [215] is installed and not obstructed.

The normal gear drive operating temperature can reach 200°F (93°C). The surface temperature should not exceed 200°F (93.3°C). Should a temperature greater than 200°F exist, review the installation for unusually high ambient conditions, poor air circulation, or other unusual conditions.

8.3. Shaft Seals

QED-D, Auxiliary stuffing box shaft seals require extreme care during initial installation and operation if proper packing life is to be realized. Six (6) ring stuffing boxes are equipped with a lantern ring. Lubricate packing if required before operation. Refer to the Lubrication section of this manual. In order to obtain proper sealing from a stuffing box the packing must be allowed to "run in". Prior to operation, the gland nuts [1353] should be tightened finger tight. As the unit is started up, the packing should be allowed to "run in" by tightening the gland nuts gradually (no more than one flat on the nuts every 15 minutes) until the desired level of sealing is obtained. Once the packing has been "run in", the gland nuts should be retightened on a regular basis. This can vary from weekly to monthly depending upon the desired level of sealing.

QED-A, Stuffing box shaft seals require extreme care during initial installation and operation if proper packing life is to be realized. The QED-A stuffing box is a six (6) ring design with self-lubricating packing suitable for 100 psig (689 kPa) at 300^{o}F (149^{o}C). At start-up, the packing should be “run-in” by tightening the hex adjusting nut [1301] one flat at a time, allowing 15 minutes between each take-up for the packing to reseat itself. These steps should be repeated until the desired leakage is obtained. Make periodic inspections for leakage, but do not take-up on the gland unless necessary. Overtightening wears out packings prematurely and causes scoring and damage to the shaft.

8.4. Steady Bearings

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

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

9. Troubleshooting

Table 14: Troubleshooting

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

10. Maintenance

10.1. Gear Drive

10.1.1. 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. For Models QED-A or QED-L: Remove handhole covers [1102] and fasteners [1103 & 1104].

3. Remove low speed shaft guard [203] and fasteners [228 & 229]. Block extension shaft in place. With shaft secured, loosen gear drive mounting bolts. *Do not remove bolts*. Remove shaft end hardware [300].

4. A groove is provided in the top of low speed shaft [205] to allow the use of a gear puller (not provided) to assist in disengaging the taper connection between the extension shaft [400] and the low speed shaft. See Figure 27 below. After the taper connection is broken, remove gear drive mounting fasteners, and lift gear drive away from vessel.

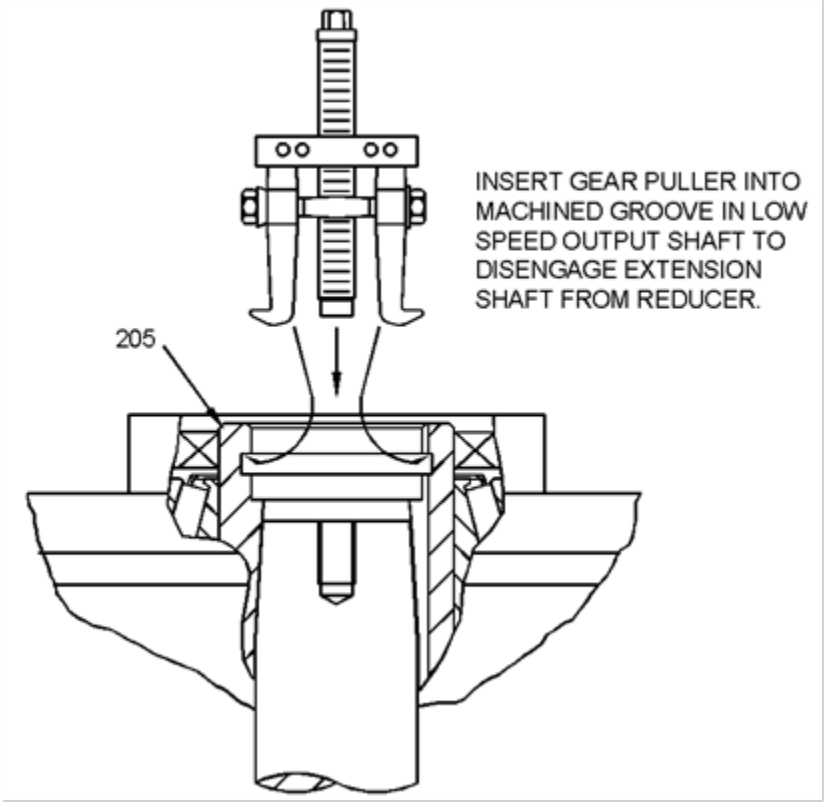


Figure 27: Extension Shaft Removal

10.1.2. Disassembly of Output Shaft

1. Disconnect gearbox from all other equipment including motor. It may be helpful to place gear drive on a workbench for easier access and handling.

2. Drain oil from gear drive.

3. For 3QED, remove low speed shaft cover [202].

4. Remove the fasteners holding the low speed cover/flange [206] to the housing [201]. Do not remove the cover/flange.

5. Loosen the fasteners in the high speed cap [204] about 1/8" and tap the opposite end of the high speed worm shaft [212] to loosen the bearings and provide clearance in the gear mesh for disassembly.

6. Remove the entire low speed shaft [205], worm gear [211], and cover/flange [206] assembly from housing [201]. It may be necessary to tap on the upper end of the low speed shaft (the end opposite the cover/flange) to free these parts from the housing.

7. Remove the low speed shaft [205] and gear subassembly from the cover/flange [206]. Note the drywell [224] and the lower bearing [210] stay with the cover/flange. It may be necessary to tap on the low speed shaft (at the cover/flange end) to free the parts.

8. To remove upper bearing and gear, press upper bearing cone [210], Nylos ring [223], and worm gear [211] off low speed shaft [205]. Note the position of the bearing on the shaft so the unit can be properly reassembled. Caution must be taken not to damage the seal area of the shaft.

9. Remove keys [226], Forsheda v-ring [225], and all low speed oil seals [208].

10. Press on the exposed shoulder of the lower bearing cone [210] as it rests against the low speed shaft [205] to remove it from the shaft. Remove the lower bearing cup [210] from the cover/flange [206] using a soft metal drift. When driving out the bearing cup, exercise caution not to damage the housing or cover bearing seat.

11. If replacing upper bearing [210], remove upper bearing cup from housing using the same precautions as above.

10.1.3. Disassembly of Input Shaft

1. Disassemble motor adapter [227] from housing [201]. For 1QED, remove high speed spacer [230] located behind motor adapter.

2. Disassemble high speed cap [204] from housing [201].

3. Remove high speed shaft [212] and bearings [209] from housing [201].

4. If changing the bearings or worm, press both bearing cones [209] off the worm.

5. Remove high speed oil seal [207] from motor adapter.

10.1.4. Gear Drive Maintenance

QED reducers are supplied with a drywell, which will generally prevent leakage through the internal seals on the low speed output shaft [205]. However, the high speed shaft seal [207] will require periodic replacement. Refer to Figure 28, below and the following procedure for seal replacement.

1. After the gear reducer [200] has been moved to a suitable workspace, remove the motor [100] by removing bolts and lockwashers [235, 239].

2. Remove flexible coupling [150] and reducer key [234]. Refer to Mounting & Installation, page 3 for assistance with coupling.

3. Remove lip seal [207]. Thoroughly clean the reducer input shaft [212] and tape over the key slot to avoid damaging the lip seal.

4. Slide new lip seal [207] into the back bore of the bell housing [227] being certain that it is not cocked to the reducer shaft.

5. Remove tape over keyway and reinstall key, coupling, and motor per the instructions in the Mounting & Installation sections of this manual.

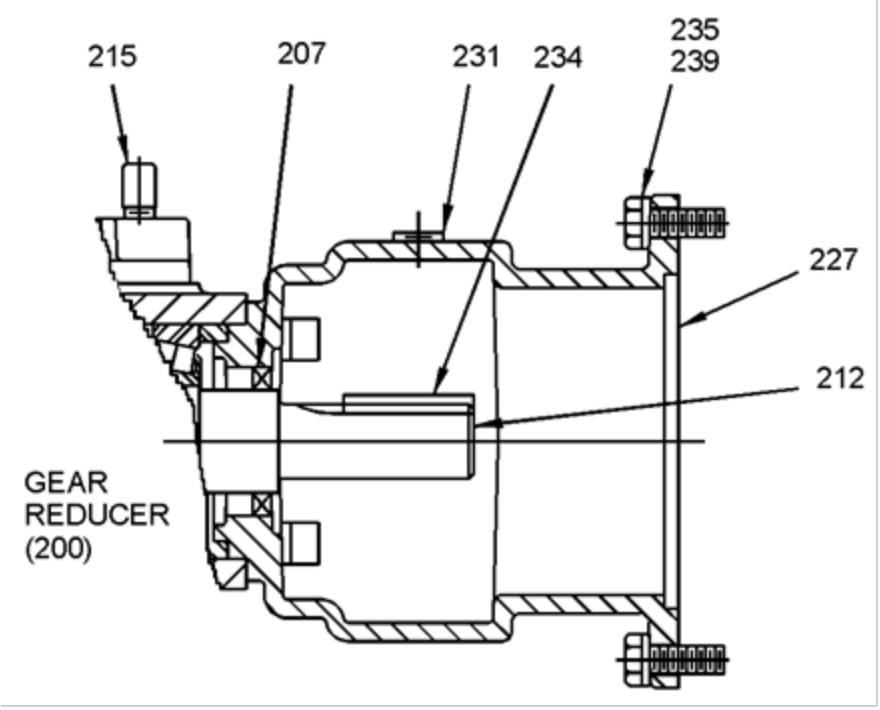


Figure 28: Gear Drive Lip Seal Replacement

10.1.5. Unit Reassembly

This procedure covers the complete unit. If some components are not being replaced, such as bearings, then certain steps may not be applicable, and can be ignored.

Thoroughly clean all parts in preparation for reassembly. Remove all gasket material and sealant from mating surfaces. Inspect all parts for damage or wear and replace as necessary.

CAUTION: If a shaft seal area is cleaned with emery paper, the direction of the resulting finishing marks in the shaft must be perpendicular to the shaft axis. Any small lead inscribed in the shaft surface while cleaning may create a path of oil seepage.

1. Press bearing cones [209] against the shoulders on both sides of high speed worm shaft [212]. To prevent damage to bearings, press on inner race only.

2. Install high speed seal [207] into motor adapter [227]. Apply a thin coat of liquid sealant to the bore area that supports the seal. Tap into place using a blunt surface that will not deform the seal casing. When properly installed, the seal should be flush with the casting surface and perpendicular to the shaft axis.

3. Insert bearing cup [209] into housing bore on motor adapter end.

4. Assemble motor adapter [227] using one (.010" thick) gasket [213]. For 1QED, include spacer [230]. Dip fasteners [217] into pipe sealant compound before installing to prevent oil seepage.

5. Insert high speed worm shaft [212] from the opposite end of the housing until it seats against bearing cup [209]. To protect the seal during assembly, cover the shaft keyway with tape and apply a thin coat of oil to the shaft seal surface. Once in place, make sure the seal lip is seated properly and not rolled over.

6. Install the second bearing cup.

7. Attach high speed cap [204] using the remaining (.010" thick) gasket [213] to achieve .002-.004 inch endplay. Tap each end of high speed worm shaft with non-metallic hammer to seat bearings before checking endplay.

8. Once the proper endplay is established, loosen high speed cap [204] about 1/8" and tap the worm extension to loosen the bearings and provide clearance in the mesh for reassembly of the gear.

9. Press upper bearing cup [210] into counterbore of housing [201] (1QED and 2QED) or low speed shaft cover [202] (3QED).

10. Press lower bearing cup [210] into counterbore of the cover/flange [206].

11. For 3QED, temporarily install low speed shaft cover [202] to the housing without gasket.

12. Insert keys [226] (two at 90 degrees) into low speed shaft [205]. Press gear [211] onto low speed shaft [205] over keys and against shoulder.

13. Install Nylos ring [223] onto low speed shaft [205] against the shoulder of gear [211]. Press upper bearing cone [210] against the Nylos ring.

Rest housing [201] on a flat surface with flange side facing up.

NOTE: The following steps 14-18 determine the bearing adjustment and gear position.

14. Insert the low speed shaft assembly into the gearbox housing [201], until the bearing cone rests on the cup of the upper bearing [210].

15. Slide lower bearing cone (this bearing has a sliding fit) [210] onto low speed shaft [205] against the shoulder.

16. Lower the cover/flange assembly with lower bearing cup installed (see Step 10) onto the lower bearing cone using the proper thickness of gaskets to provide a maximum of .002" endplay while avoiding any bearing preload. Tap each end of the shaft with a non-metallic hammer to seat the bearings, before checking endplay. For (1QED and 2QED), proceed to Step 19.

17. For 3QED, remove cover/flange [206] and low speed shaft cover [202]. Equally distribute the gaskets [214] between the two covers.

18. Brush worm threads with blue dye and reassemble cover/flange [206] and low speed shaft cover [202]. Retighten high speed cap [204] and rotate gear one full revolution in each direction while applying a slight drag on the output shaft. Disassemble and check the contact on the gear teeth. If off center, remove a small amount of gasket from the side of least contact and move to opposite side. *CAUTION: Do not add or delete gaskets at this point as this will change the bearing adjustment. Repeat this step until contact is centered.*

19. Remove cover/flange assembly. Remove the lower bearing cone [210] from the shaft, then reinstall the shaft and the gear assembly in the housing. Rest bearing cone on the cup in the cover/flange assembly.

20. Apply a thin coating of (#242) Loctite [232] in the counterbore of cover/flange.

21. Press drywell sleeve [224] into the counterbore of cover/flange [205], making sure that the lower bearing cone is resting on cup (see Step 19).

22. Install Forsheda v-ring [225] over drywell sleeve [224].

23. Reinstall the drywell and cover/flange subassembly onto the low speed shaft [205] in the housing. Make sure the bearing adjustment determined in Steps 16-18 remains in place.

24. Secure the cover/flange to the housing. Dip the fasteners [217] into pipe sealant compound before installing to prevent oil seepage.

25. Install low speed seals [208]. Reference Step 2 for proper seal installation procedure.

26. Attach low speed shaft guard [203] to housing [201] (1QED and 2QED) or low speed shaft cover [202] (3QED).

27. Apply an adequate supply of grease to the upper and lower low speed bearings [210]. Refer to Gear Drive Lubrication for proper type and grade.

28. Add oil to the proper level as indicated on the gear drive. See Gear Drive Lubrication for recommended type and amount. *CAUTION: Do not overfill, as this may allow oil to spill over into the drywell sleeve and defeat its purpose.*

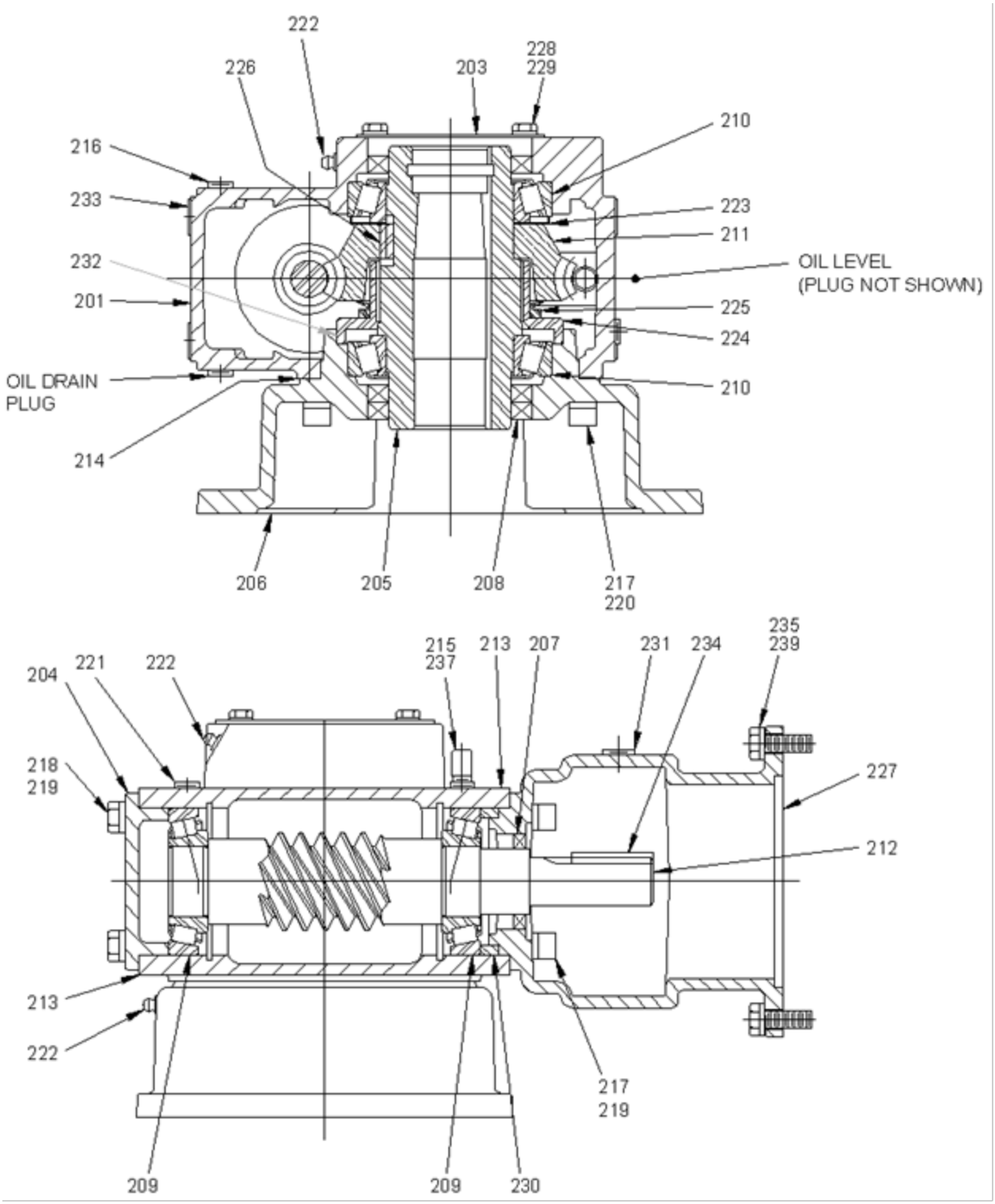


Figure 29: 1QED Reducer, Single Reduction

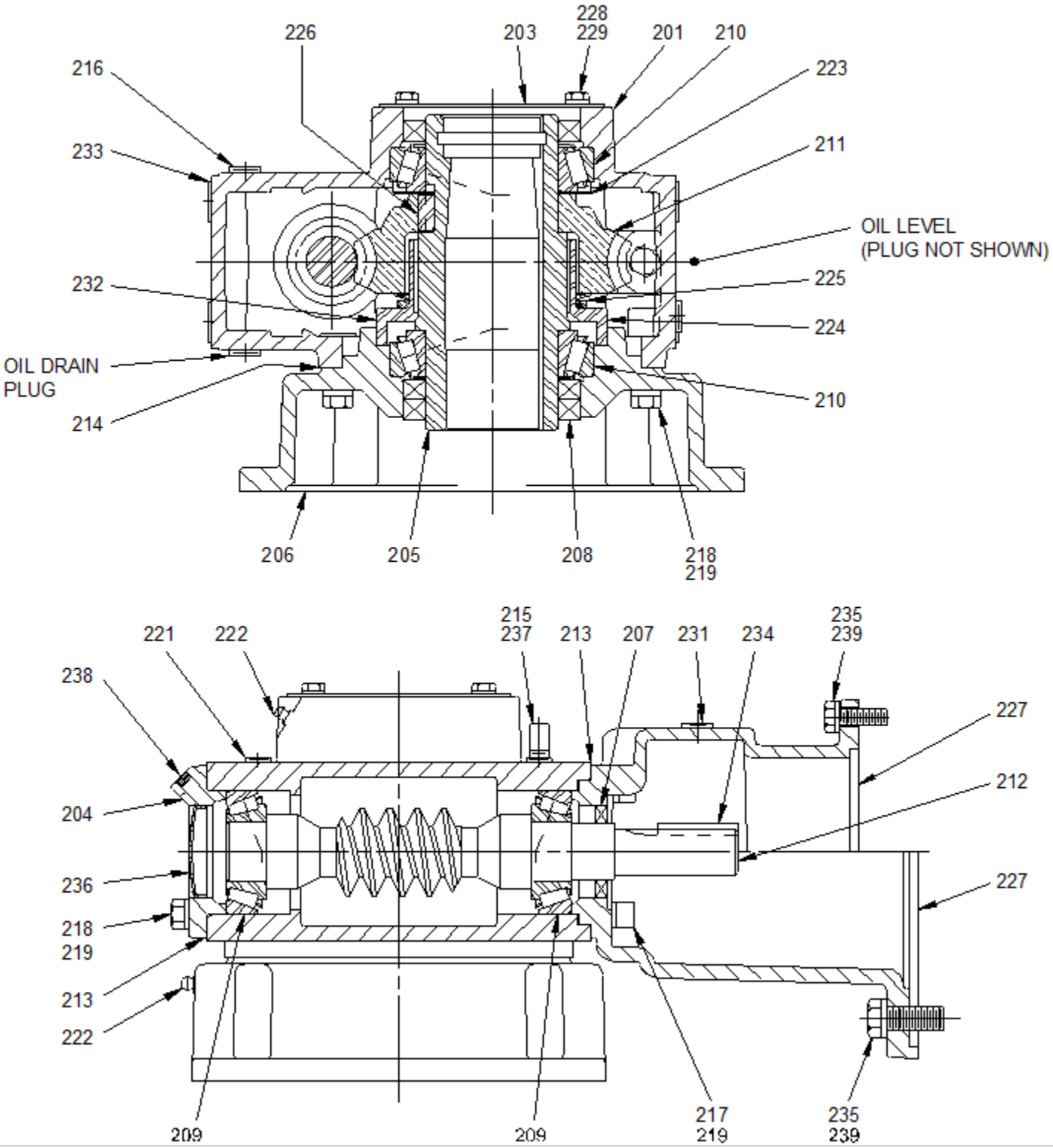


Figure 30: 2QED Reducer, Single Reduction

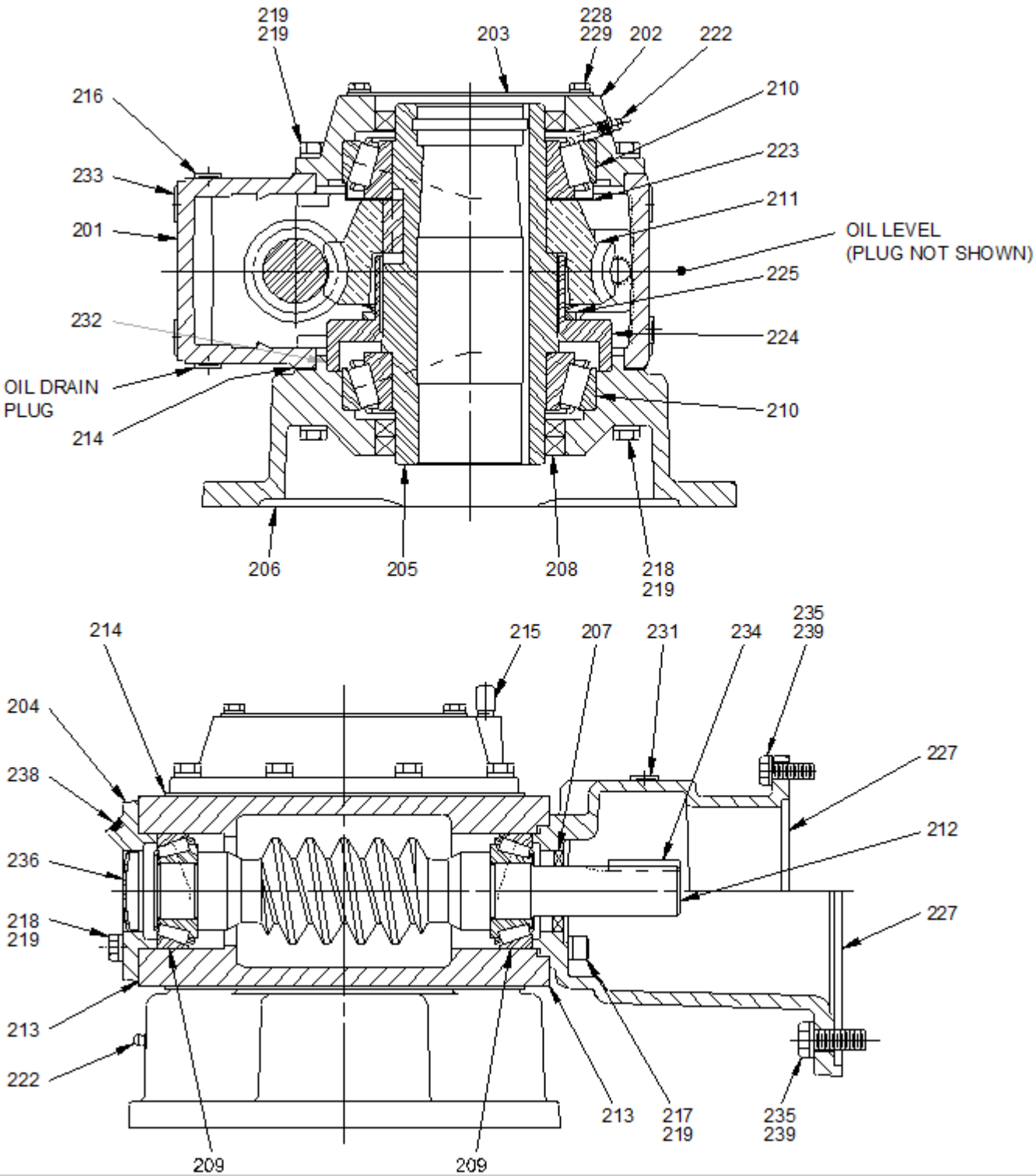


Figure 31: 3QED Reducer, Single Reduction

10.2. Stuffing Box

The QED-A stuffing box is furnished with self-lubricating packing and will not require any additional lubrication for the life of the packing.

Routine maintenance consists of periodic inspections for leakage and tightening of adjusting nuts [1301]. Refer to Figure 7, page 18.

10.2.1. Stuffing Box Packing Replacement

1. Lockout power and disconnect electrical service to the motor.

2. Remove handhole covers [1102].

3. Remove hex adjusting nuts [1301], spring lockwashers [1302], flatwashers [1303], and gland clamps [1304]. Remove split packing gland [1306], and with a packing hook (not provided), remove packing [1307].

4. Clean the packing housing part of pedestal [1101] and the agitator extension shaft [400]. Inspect the shaft surface for damage. Repair or replace shaft as required.

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

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

5. Install new packing rings [1307]. Stagger each packing split 90 degrees. Seat each packing ring as it is installed. Install split packing gland [1306] and hardware [1301, 1302, 1303, 1304, & 1305]. The split packing gland must be square with the packing housing section of the pedestal. Tighten the hex adjusting nuts.

6. Let packing sit for five or ten minutes so that it can cold flow and adjust to the gland pressure. Loosen the hex adjusting nuts, then finger tighten. After starting the unit, adjust the packing by tightening the hex adjusting nuts one flat at a time, allowing 15 minutes between each take-up for the packing to reseat itself. Repeat these adjustments at 15 minute intervals until the desired leakage is obtained. Do not over tighten.

7. Re-install handhole covers [1102] using one flatwasher [1104] and hex nut [1103] per cover. Refer to Figure 9, page 19.

10.3. Auxiliary Stuffing Box

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

Repack Procedure (see Figure 19, page 34)

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

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

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

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

2. Auxiliary 6-ring stuffing box: Install three packing rings, lantern ring, three more packing rings, split gland (holes at top), gland plate, lockwashers and gland nuts.

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

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

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

10.4. Bracket Steady Bearings

In-tank steady bearings will require periodic inspection and replacement of bushing and wear sleeve [606, 604]. (Figure 20, page 35 and Figure 21, page 36*).* It is recommended that the steady bearing fasteners be checked for tightness and the bushing and wear sleeve for wear after the first two weeks of operation.

Unless otherwise specified the recommended diametral wear allowance is:

Table 15: Bracket Steady Bearing Wear Sleeve and Bushing Wear Allowances

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

The wear sleeve and bushing should be replaced in sets.

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

1. Loosen setscrew [605] and slide wear sleeve [604] off the shaft. Unbolt the housing from the bracket.

2. Remove bushing retaining bolt and lock washer [607, 608]. Press the bushing out of the steady bearing housing.

3. Press a new bushing into the steady bearing housing. Install the bushing retaining bolt and lock washer.

NOTE: Line up the clearance hole in the new bushing with the tapped hole in the housing prior to pressing the bushing into the housing.

4. Reinstall the wear sleeve and housing/bushing assembly. Reinstall dowel alignment pins. Torque all fasteners to the values shown in Table 9: Bolt Tightening Torque, page 21.

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

10.5. Tri- Pod Steady Bearings

In-tank steady bearings will require periodic inspection and replacement of bushing and stub shaft [606, 630]. (Figure 21, page 36). It is recommended that the steady bearing fasteners be checked for tightness and the bushing and stub shaft for wear after the first two weeks of operation.

Unless otherwise specified the recommended diametral wear allowance is:

Table 16: Tri-Pod Steady Bearing Stub Shaft and Bushing Wear Allowances

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

The stub shaft and bushing should be replaced in sets.

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

1. 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.*

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 [628] and lockwasher [629]. *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 [627], new stub shaft [630], and retainer plate [631] as described in the Mounting & Installation sections of this manual. Tighten all fasteners to the values shown in Table 9: Bolt Tightening Torque, page *21*.

5. Reattach the flush piping.

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

Part# **Description** **Qty.**

100	**Motor**	**1**
101	motor key	1
150	**Flexible Motor Coupling Assembly**	**1**
200	**Gear Drive**	
201	housing	1
202	low speed shaft cover	1
203	low speed shaft guard	1
204	high speed cap	1
205	low speed shaft	1
206	low speed cover/flange	1
207	high speed oil seal	1
208	low speed oil seal	3
209	high speed bearing (cup/cone)	2
210	low speed bearing (cup/cone)	2
211	low speed worm gear	1
212	high speed worm shaft	1
213	high speed gasket	2
214	low speed gasket	1-2
215	breather	1
216	pipe plug	4-5
217	socket head cap screw	4-12
218	hex head cap screw	8-12
219	spring lockwasher	16-24
220	hi-collar lockwasher	8
221	pipe plug	1
222	grease fitting	2
223	Nylos ring	1
224	drywell sleeve	1
225	Forsheda v-ring	1
226	key	2
227	reducer bell housing	1
228	hex head cap screw	4
229	spring lockwasher	4
230	high speed spacer	1
231	pipe plug	1
232	Loctite	as req'd
233	button plug	8
234	key	1
235	hex head cap screw	4
236	high speed cap plug	1
237	hex reducer bushing	1
238	drive fitting plug	1
239	spring lockwasher	4
Part#	**Description**	**Qty.**

400	**Extension Shaft Assembly**	
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
421	coupling washer	1
422	bolt	2
423	lockwasher	2
424	coupling washer	1
425	bolt	2
426	lockwasher	2

Part#	Description	Qty.
500	**Impeller Assembly**	
501	pin key	
503	hub	
504	square head set screw	
505-001	extension blades (one piece)	
505-002	extension blades (split)	
506	blade bolts	
507	blade spring lockwashers	
508	blade hex nuts	
509	stabilizer fin	
510	stabilizer bolts	
511	stabilizer spring lockwashers	
512	hex nuts	
513	split blade bolts	
514	split blade spring lockwashers	
515	split blade hex nuts	
520	key	1
521	hub	1
522	gasket	2
523	snap ring	1
524	thrust plate	1
525	gasket	1
526	mounting bolt	1

Part#	Description	Qty.
600	**Steady Bearing Assembly**	
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
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	hex	6
638	lockwasher	6
639	flat washer	12
640	dowel pin	3
641	flush plug	1
800	**Angle Riser Assembly**	**1**
801-001	right hand angle riser	1
802-001	left hand angle riser	1
803-001	bolt, 1/2" x 13 x 2.00, (1,2QED)	4
-002	bolt, 5/8" x 11 x 2.25 (3QED)	4
804-001	flatwasher, 1/2", (1,2QED)	4
-002	flatwasher, 5/8", (3QED)	4
805-001	lockwasher, 1/2", (1,2QED)	4
-002	lockwasher, 5/8", (3QED)	4
806-001	hex nut, 1/2" x 13, (1,2QED)	4
-002	hex nut, 5/8" x 11, (3QED)	4

Part#	Description	Qty.
1100	**Pedestal/Flange Assembly**	
1101	pedestal	1
1102	handhole cover	4
1103	hex nut	4
1104	flatwasher	4
1105	hex head cap screw	4
1106	spring lockwasher	4
1107	hex head cap screw	4
1108	spring lockwasher	4
1200	**Adapter Flange Assembly**	
1201	adapter flange	1
1202	o-ring	1
1203	hex head cap screw	8
1204	spring lockwasher	8
1205	stud	8-12
1206	spring lockwasher	8-12
1207	hex nut	8-12
1300	**Stuffing Box Assembly**	
1301	hex adjusting nut	2
1302	spring lockwasher	2
1303	flatwasher	2
1304	gland clamp	2
1305	threaded stud	2
1306	split packing gland	2
1307	packing	6
1350	**Auxiliary Stuffing Box Assembly**	
1351	flanged stuffing box (6 ring)	1
1352	stud	2
1353	gland nut	2
1354	lockwasher	2
1355	gland plate	1
1356	split gland	1
1357	packing (2 sets of 3 rings)	6
1358	lantern ring	1
1359	grease fitting	1
1360	pipe plug, NPT	1
1800	**Lip Seal Assembly**	
1801	snap ring	1
1802	lip seal	1

Part#	Description	Qty.
1850	**Auxiliary Lip Seal Assembly**	
1851	lip seal flange	1
1852	snap ring	1
1853	lip seal	1