TABLE OF CONTENTS

Pages

Tables Pages

Figures Pages

RECEIVING AND INSPECTION

Step 1: Inspect crates: Upon receipt, inspect all crates and equipment for shipping damage. Report shipping damage to your local Chemineer representative or 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 equipment until you have read the complete Installation section of this manual and reviewed the general data sheet and certified dimension drawings. Be careful when uncrating and handling. Do not discard the crating without carefully making sure that all parts have been removed. Installation and on-site assembly of the equipment requires reference to both the data sheet and the appropriate manual section.

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.

Note: Two common service tools supplied with the mixer include a Shaft Holding Device, usually fastened to the shaft in front of the stuffing box and a Belt Tensiometer (Spring Scale), usually packaged with the belt drive components. ***Do not discard or misplace these important service items.*** *Instructions for use of these items are in this manual.*

CHEMINEER ASSISTANCE

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

Chemineer, Inc.
P.O. Box 1123
Dayton, Ohio 45401
Phone: (513) 454-3200
FAX: (513) 454-3375

Services available are as follows: installation and maintenance training seminars, installation and start-up supervision, preventive maintenance planning, parts order service and special instructions.

STORAGE

Do not remove protective coatings (if applicable) until the agitator is to be put into service. If the equipment is to be stored, do not stack the skids or crates. Store in a clean, dry, indoor location that is free from wide variations in ambient temperature.

Rotate the agitator shaft and motor shaft monthly to coat the bearings with lubricant and retard oxidation and corrosion. At two-month intervals inspect for rust. Apply a rust preventive as required. **Outdoor storage of the agitator and motor is not recommended.**

Consider the unit in storage when:

1. It has been delivered to the job site and is awaiting installation.
2. The agitator is installed, but operation is delayed.
3. When long (30 days) periods between operating cycles occur.
4. The plant or operation is shut down.

A rust preventive has been applied to all unpainted machine surfaces on equipment incorporating carbon steel wetted parts. This protective coating can be removed with mineral spirits.

The belts must not be stored under tension. If the drive has been factory installed, the tension must be released. The belts should be thoroughly inspected before retensioning in case deterioration of the rubber has occurred. Ideally the agitator should be stored without belts and have new belts installed at start-up. Full belt drive installation instructions are contained on *page 21*.

Rubber-covered components must be stored away from direct sunlight, arc welding flash, heat or outdoor seasonal weathering. It is recommended that rubber-covered equipment be stored indoors away from extreme temperature conditions (below 32 F° or above 120 F°).

Storage requirements vary depending on the length of storage and the climatic environment. For storage periods longer than three months or when adverse climate conditions exist, consult Chemineer, Inc. for specific advice on adequate protection.

INSTALLATION

The following procedure is intended as a general guide for installing all Prochem MD model agitators. It is possible that not all the information presented here will be required. Before installing the agitator, check to ensure that the serial number on the equipment nameplate corresponds with the general data sheet and assembly drawing.

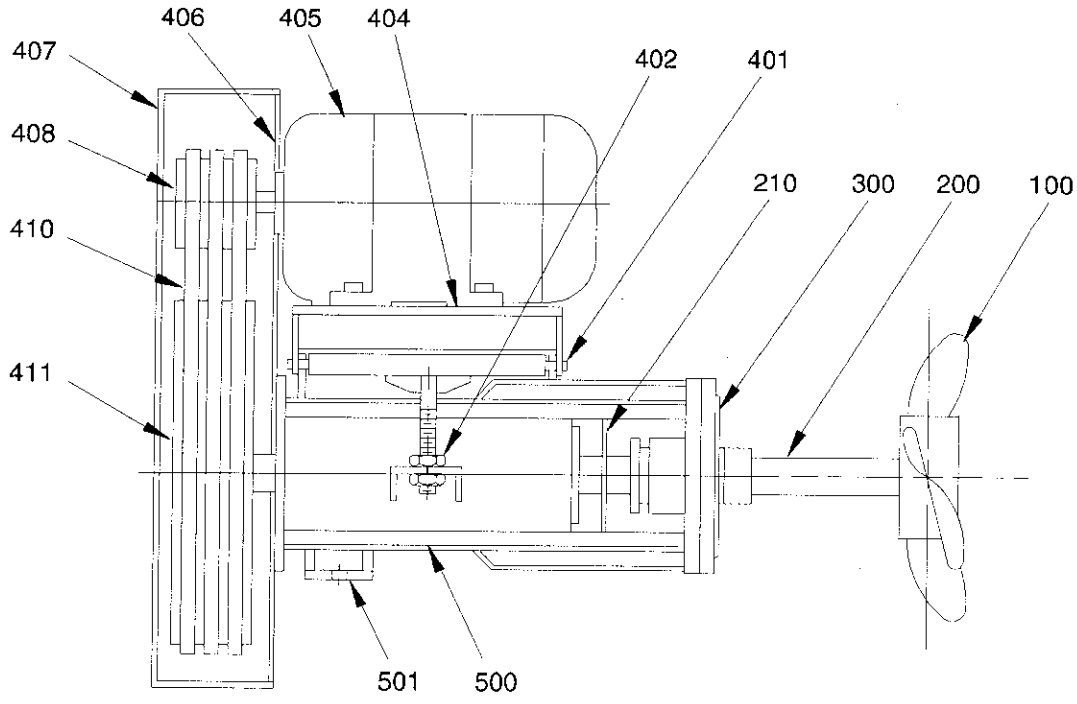

Figure 1: General Assembly

ITEM	DESCRIPTION	ITEM	DESCRIPTION
100	Impeller	406	Back Plate - Belt Guard
200	Shaft	407	Cover - Belt Guard
210	Shaft Slinger	408	Drive Sheave
300	Seal/Flange Assembly	410	Belts
401	Hinge Pin - Motor Mount	411	Driven Sheave
402	Adjusters - Motor Mount	500	Housing/Bearing Assembly
404	Motor Mount	501	Pedestal Base - Housing
405	Motor		

MOUNTING

The most frequent cause of mechanical difficulty with an agitator is improper mounting. The Prochem MD model agitator is designed to operate in a horizontal position, unless otherwise specified, and to handle the fluid forces exerted on the impeller during normal operation by transmitting these forces directly to the mounting support. As a result, the mounting system must be rigid enough to support the agitator weight and the live reactions caused by torque, bending moment and thrust. The support system must also handle additional stress experienced during more severe momentary loads, such as those caused by chunks of material in the process or liquid level changes.

The general data sheet and certified dimension drawing for the equipment supplies all design load values for which the support structure should be designed. If additional information is required to provide adequate agitator support, contact your local representative or factory.

NOTE: MD model agitators are assembled at the factory and pre-aligned through the stuffing box/mounting flange and shaft. No additional alignment is necessary unless accidental movement has occurred during shipping or installation. Refer to the trouble shooting section, page 83, of this manual for alignment instructions.

CAUTION: Do not lift the agitator from any other point except with the use of a lifting strap (or equivalent) around the bottom of the housing on the drive end, and another through the housing ribs at the flange end, *Figure 2.*

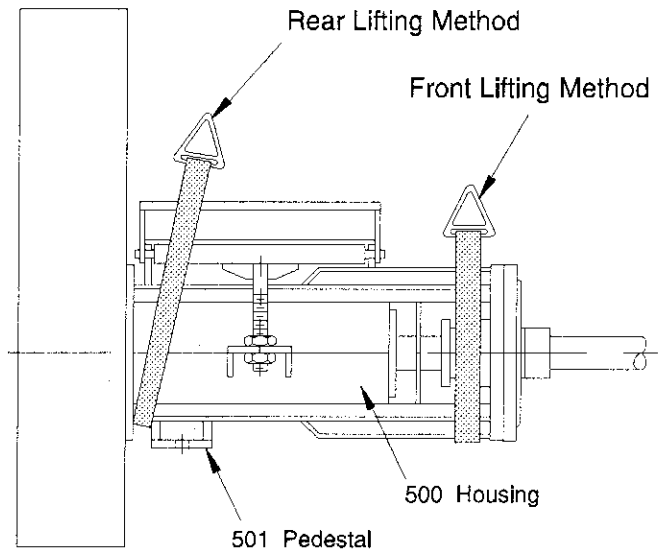

Figure 2: Lifting Lug Location

AGITATOR

Correct installation requires both the equipment certification package and this manual.

1. Ensure that the agitator is completely free of all shipping restraints and packaging material. A hoist or crane system must be available for lifting the agitator into position. *Refer to the assembly drawing for static equipment weight.*

2. Remove the impeller from the end of the shaft by unfastening the square head setscrews and locknuts, that bear down on the shaft and key, and pull the impeller off. Use a penetrating lubricant to aid in the removal. If the impeller cannot be easily removed, place a block of wood against the back of the impeller and knock it loose with a soft mallet.

NOTE: An optional threaded jack screw hole may exist in the outside face of the impeller hub to help in the removal. Thread size ranges from 3/8 to 3/4" UNC, depending on the impeller diameter.

TIP: To aid impeller removal, install a fitting and inject grease through the jack screw hole.

3. Remove the belt guard cover. On units with a horizontal drive, rotating the belt guard backplate to the proper position may be necessary. *Refer to the assembly drawing for drive orientation.*

4. Lift the agitator with a portable hoist or equivalent, using the designed lifting points shown in *Figure 2*, page 7, Ensure that the holes in the agitator base drop over the anchor studs in the support base. Do not rest the base on the support until the agitator is fastened to the tank nozzle or wall insert.

5. Install a gasket *(supplied by others)* between the seal flange and the face of the wall-insert flange.

6. While the agitator is supported by the hoist, align it perpendicular to the tank mounting surface. Move the agitator forward to mate with the connecting surfaces of the flange and wall insert or tank nozzle. Tighten the flange bolts to aid alignment but do not torque the fasteners until the base plate has been shimmed

7. Begin to shim the agitator pedestal to the support base, maintaining the perpendicular alignment set by fastening of the flange to the tank nozzle or wall insert. Use varying thicknesses of shimming bar and plates until this position is achieved.

8. Torque all the flange fasteners to the appropriate values. *See Table 13, page 81 for bolt and nut torque values.*

CAUTION! Do not allow the agitator to drop downward out of alignment with the tank mounting surface. Such action could cause undue stress that could lead to support failure or tank leakage.

9. Once the agitator base plate is in position, begin to tighten the four anchor nuts to secure the position. Torque each nut to the appropriate value, *Table 13, page 81.*

10. In cases where the support structure is a concrete pedestal, begin to fill the area between the base plate and the pedestal with grout. Allow sufficient time for grout to harden before proceeding with assembly work.

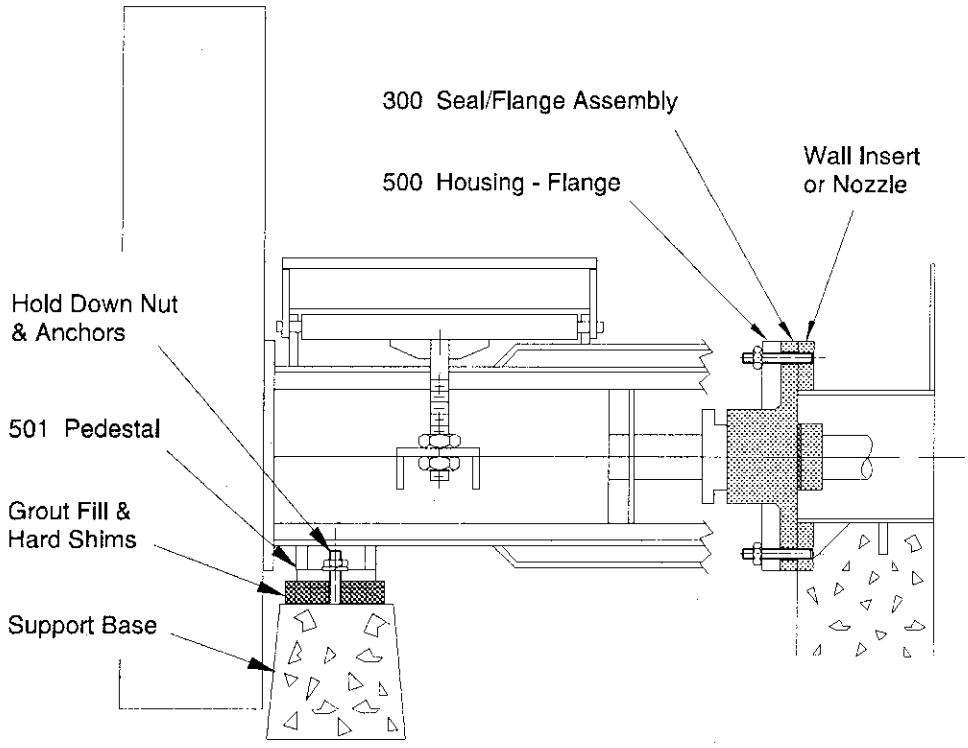

Figure 3: Agitator Installation

Optional Support Devices

Besides the regular pedestal support base, the Prochem MD agitator can also be supplied with optional pipe legs (921) or optional tie rods (920), *Figure 4*. These optional support devices are supplied on agitators with 2" diameter shafts or smaller.

1. Follow the preceding "Agitator Installation" instructions, steps 1 through 6.

CAUTION! Do not allow the agitator to drop downward out of alignment with the tank mounting surface. Such action could cause undue stress that could lead to support failure or tank leakage.

2. **Optional Pip Legs** (2) are installed into the holes of the pedestal base (510) and are screw fastened into place once the correct height is determined. Maintain the natural perpendicular alignment set by fastening the flange to the tank nozzle or wall insert.

3. **Optional Tie Rods** (2) are installed into the holes of the housing ribs where the pedestal base connects or into the housing lugs on size B agitators. The

tank end of the ½" dia. tie rods are supplied unfinished for attachment to the tank by others. Install into position as shown in *Figure 4*. Use the turn buckle on each rod to obtain the final position.

4. Torque all the flange fasteners to the appropriate values, *Table 13, page 81.*

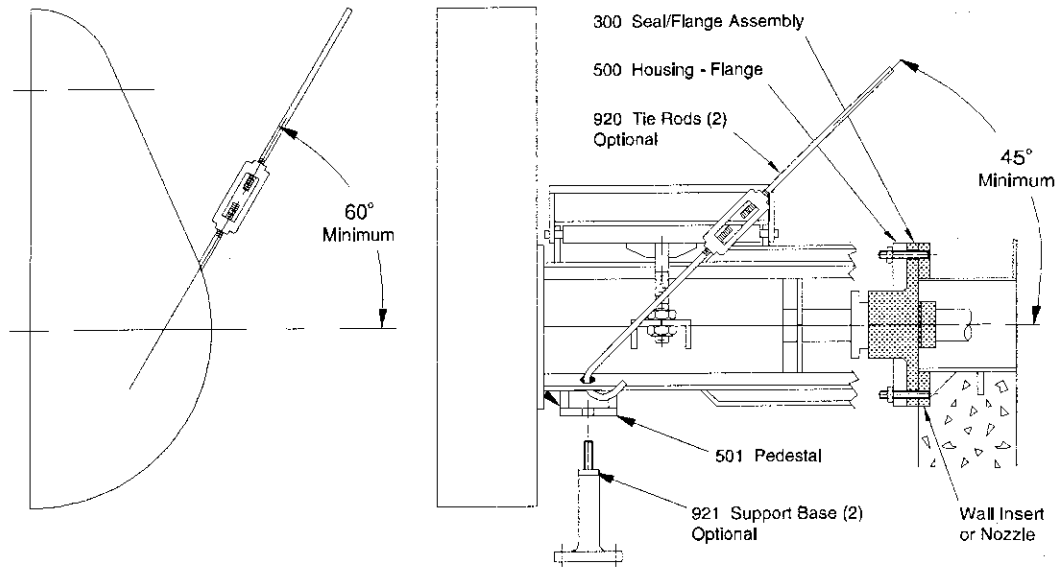

Figure 4: Optional Installation Methods

IMPELLER

The Maxflo Mark II and Mark III Impellers can pass through a tank opening in different ways depending on the number of blades and whether or not they are removable blades. Impellers with three blades can pass through an opening smaller than the impeller diameter by rotating it through the opening providing the wall thickness or nozzle length does not exceed the maximum allowable length.

The front view of a Maxflo Mark II Impeller is shown in *Figure 5* and *Figure 6* as it passes through a tank opening. Maxflo Mark III Impellers can be maneuvered in a similar manor. Refer to the equipment certification package to identify impeller type. Refer to *Table 1, page 13* for Mark II impellers and to *Table 2, page 17* for Mark III impellers to decide the minimum tank opening requirement for impeller installation.

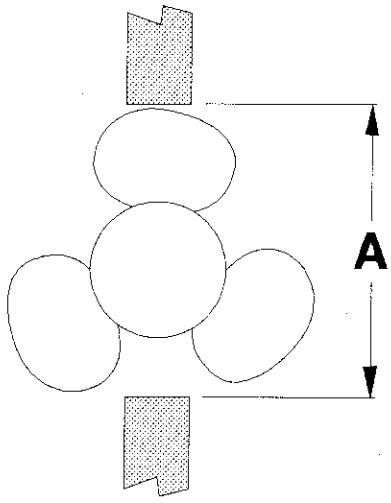

Figure 5: No Rotation

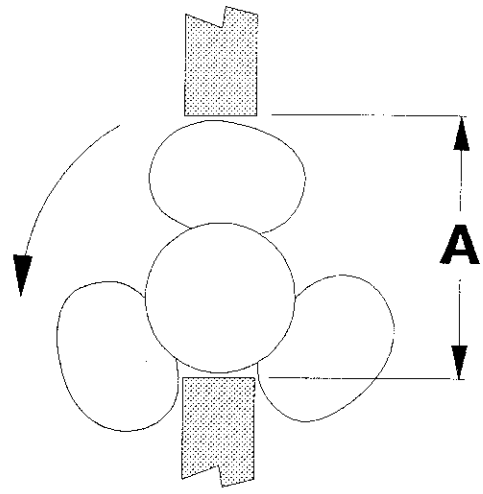

Figure 6: With Rotation

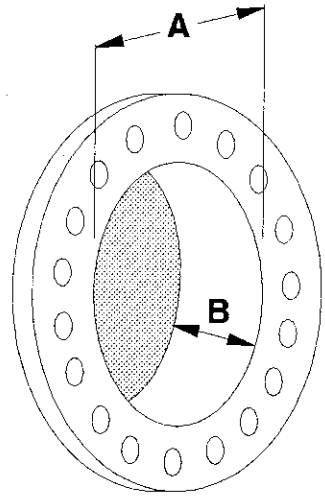

Figure 7: Typical Tank Opening

Maxflo Mark II Impeller

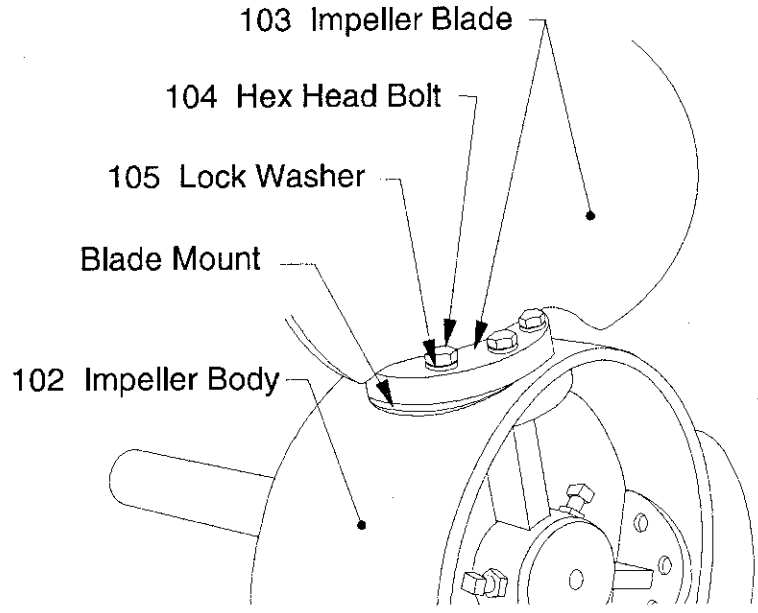

Figure 8: Maxflo Mark II Impeller

The Maxflo Mark II impeller shown in *Figure 8* has the standard open-body hub, but with optional removable blades for installation through smaller openings.

Table 1: Minimum Tank Opening - Maxflo Mark II Impeller

	IMPELLER DIAMETER (Inches)	NUMBER OF BLADES	BLADE FEATURE	MAXIMUM IMPELLER LENGTH WITH NOSE CONE (Inches)	MINIMUM OPENING REQUIREMENT (Inches)		
					NO ROTATION	WITH ROTATION	
					A	A	B (Max.)
1	**13**	3	WELDED	9.4	13	11	3
2		6			13	---	---
3	**16.5**	3		11.6	16	13	3.5
4		6			17	---	---
5	**22**	3		14.5	20	17	4.5
6		6			22	---	---
7	**27**	3		18.5	24	20	5.5
8		6			27	---	---
9	**33**	3		22	29	24	7.0
10		6			33	---	---
11		3	REMOV-ABLE		13	---	---
12		6			13	---	---
13	**41**	3	WELDED	25.3	36	30	8.5
14		6			41	---	---
15		3	REMOV-ABLE		16	---	---
16		6			16	---	---
17	**54**	3	WELDED	31.8	46	38	11
18		6			54	---	---
19		3	REMOV-ABLE		22	---	---
20		6			22	---	---
21	**66**	3	WELDED	33.0	56	46	13.5
22		6			66	---	---
23		3	REMOV-ABLE		25	---	---
24		6			25	---	---
25	**79.2**	3	WELDED	36.8	67	55	16
26		6			79	---	---

Unless otherwise specified in the equipment certification package, the impellers are typically manufactured with a slide fit onto the shaft end and held in place with a key (110), square head setscrews and locknuts (111). The quantity of setsrews varies according to the impeller diameter, *Figure 9, page 14 and Figure 13 ,page 18.*

1. Check to ensure that the stamped serial number marking on the impeller (typically found on the hub face, *Figure 9, page 14*) matches the same serial number shown on the equipment name plate on the agitator body.

2. Slide the impeller onto the shaft carefully. Use a light oil lubricant to help in this procedure.

3. Check to ensure that the impeller mounting hub is firm against the machined shoulder on the shaft stub end, typical on shaft diameters 2" and greater. On smaller diameter shafts, without the stub end, the hub face must bottom against the end of the shaft.

4. Secure the impeller to the shaft by tightening all fasteners to the recommended torque value, *Table 13, page 81.*

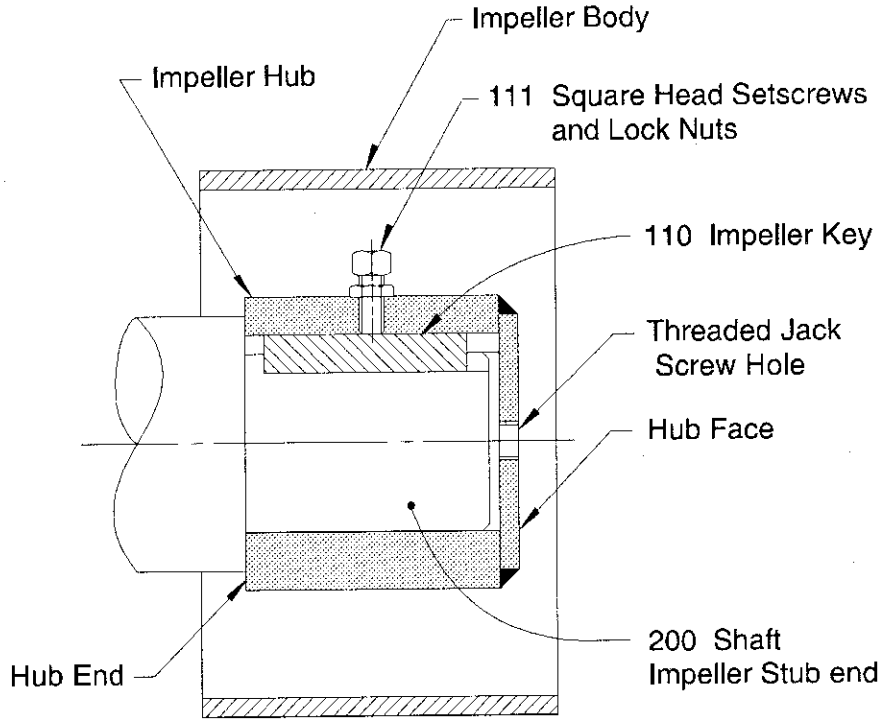

Figure 9: Impeller Hub Attachment - Open Body Design

Optional Removable Blades

CAUTION! Incorrectly assembled blades or inadequately tightened bolts may cause the impeller blades to become loose, due to vibration or load reactions imposed by fluid forces, leading to extensive equipment damage.

Note: To ensure a balanced Impeller assembly, the blades are matched to the blade mounts and identified by stamped markings.

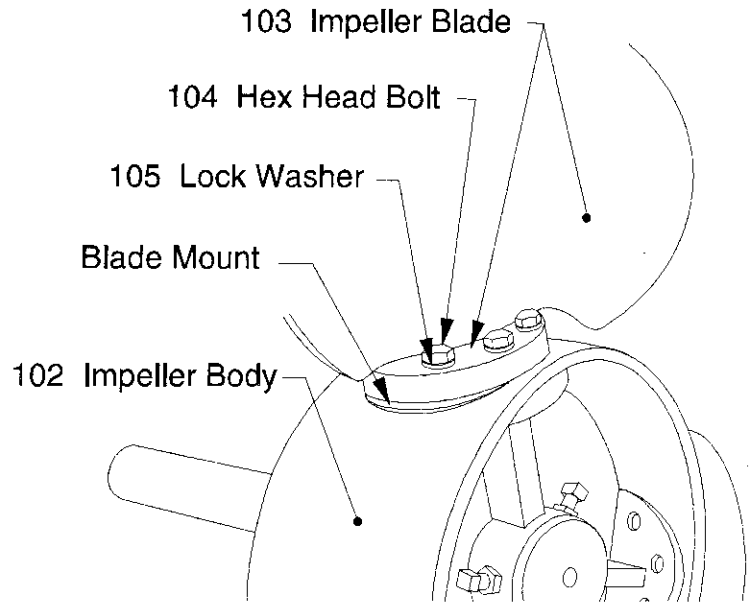

Figure 10: Removable Blades - Maxflo Mark II Impeller

1. Match impeller blades (103) to the corresponding mounting as shown in *Figure 10.*

2. Insert the bolts (104) lock washers (105) and fasten the blades into place. Tighten each bolt to the full recommended torque value, *Table 13, page 81.*

NOTE: It is recommended that all of the blade fastening hardware be inspected for wear and retightened to torque values periodically. Check all fasteners during each shutdown. Tack welding the head of the bolts after assembly is not necessary or recommended.

Maxflo Mark III Impeller

The Maxflo Mark III Impeller shown in *Figure 11* has the standard open-body design with welded blades. Both the Mark II and Mark III impellers are also available with a nose cone in a closed-body design, *Figure 12*.

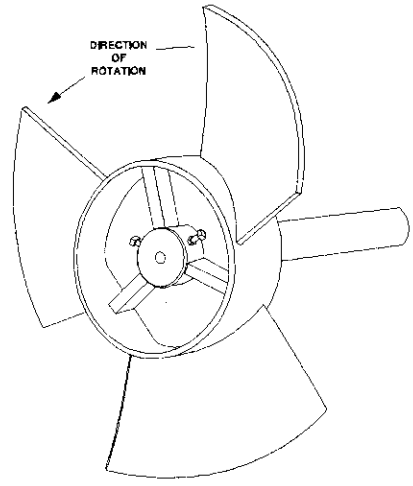

Figure 11: Maxflo Mark III Impeller

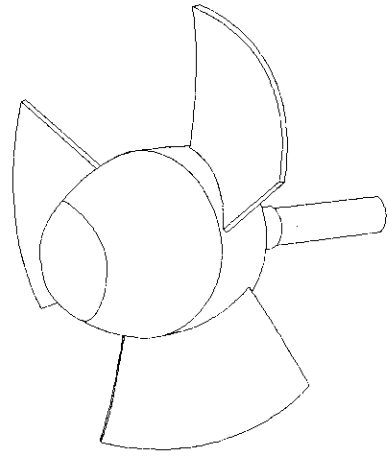

Figure 12: Maxflo Mark III Impeller with Optional Nose Cone

Mark III impellers are also available with removable blades for installation in tanks with small openings.

Table 2: Minimum Tank Opening - Maxflo Mark III Impeller

	IMPELLER DIAMETER (Inches)	NUMBER OF BLADES	BLADE FEATURE	MAXIMUM IMPELLER LENGTH WITH NOSE CONE (Inches)	MINIMUM OPENING REQUIREMENT (Inches)		
					NO ROTATION	WITH ROTATION	
					A	A	B (Max.)
1	27	3	WELDED	18.7	25.5	18.8	2.3
2		6			27.0	---	---
3		3	REMOVABLE		16.3	---	---
4		6			16.3	---	---
5	33	3	WELDED	21.3	31.3	22.8	3.3
6		6			31.3	---	---
7		3	REMOVABLE		20.0	---	---
8		6			20.0	---	---
9	42	3	WELDED	26.0	39.5	28.5	4.5
10		6			39.5	---	---
11		3	REMOVABLE		25.3	---	---
12		6			25.3	---	---
13	54	3	WELDED	33.6	50.8	37.5	6.5
14		6			50.8	---	---
15		3	REMOVABLE		32.5	---	---
16		6			32.5	---	---
17	66	3	WELDED	31.8	62.0	47.5	10.0
18		6			62.0	---	---
19		3	REMOVABLE		39.8	---	---
20		6			39.8	---	---

Unless otherwise specified in the equipment certification package, the impellers are typically manufactured with a slide fit onto the shaft end and held in place with a key (110), square head setscrews and locknuts (111). The quantity of setsrews varies according to the impeller diameter, *Figure 9, page 14 and Figure 13 ,page 18.*

1. Check to ensure that the stamped serial number marking on the impeller (typically found on the hub end, *Figure 13*) matches the same serial number shown on the equipment name plate on the agitator body.

2. Slide the impeller onto the shaft carefully. Use a light oil lubricant to help in this procedure.

3. Check to ensure that the impeller mounting hub is firm against the machined shoulder on shaft stub end, typical on shaft diameters 2" and greater. On smaller diameter shafts, without the stub end, the internal hub face must bottom against the end of the shaft.

4. Secure the impeller to the shaft by tightening all fasteners to the recommended torque value, *Table 13, page 81.*

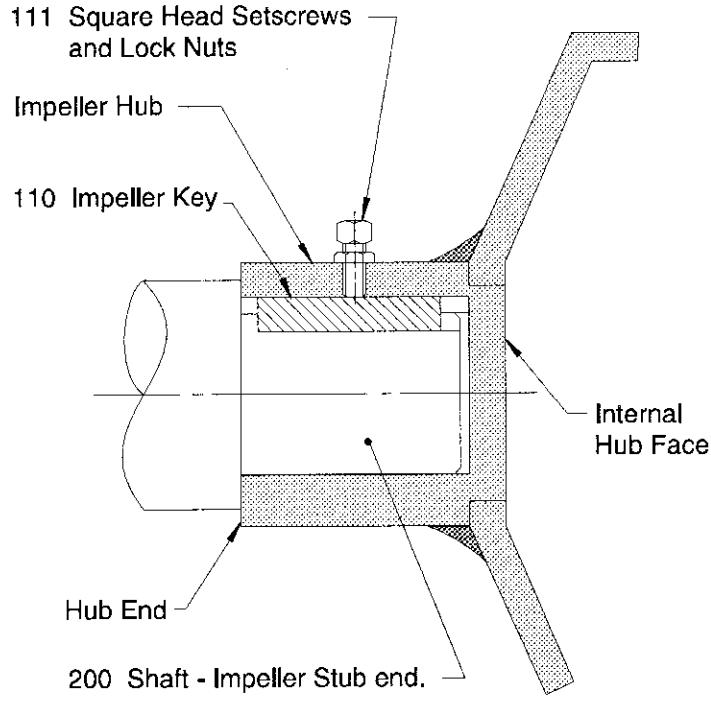

Figure 13: Impeller Hub Attachment - Closed-Body Design

Optional Removable Blades

CAUTION! Incorrectly assembled blades or inadequately tightened bolts may cause the impeller blades to become loose, due to vibration or load reactions imposed by fluid forces, leading to extensive equipment damage.

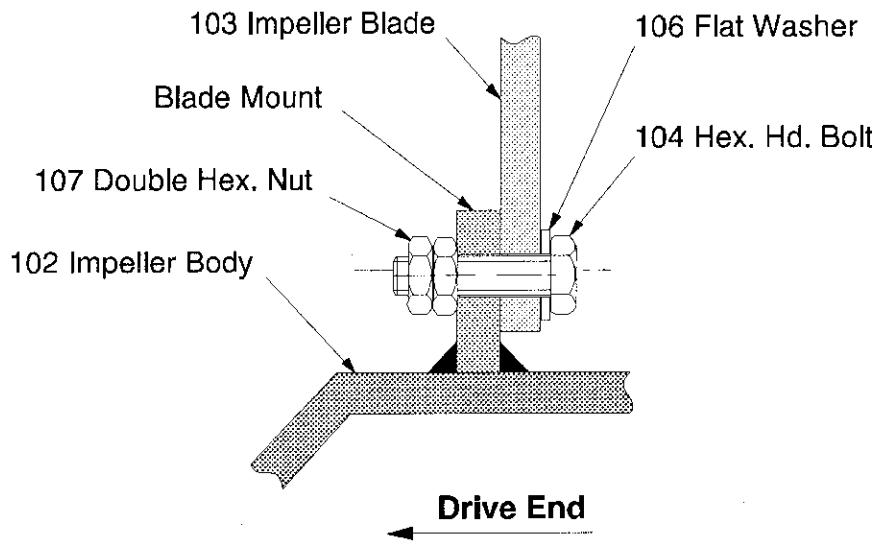

Figure 14: Removable Blades Maxflo Mark III Impeller

Note: To ensure a balanced Impeller assembly, the blades are matched to the blade mounts and identified by stamped markings, i.e., blade (A) with mount (A).

1. Assemble Impeller blades (103) to the front (the side away from the drive) of matching blade mount as shown in *Figure 14*.

2. Insert bolts (104) and flat washers (106) starting with the center location and work outward, alternating sides, with remaining fasteners. Tighten the first nut to the full recommended torque value, *Table 13, page 81.*

3. Add the second nut to each bolt and tighten to the full recommended torque value, *Table 13, page 81.*

NOTE: It is recommended that all of the blade fastening hardware be retightened after approximately two weeks of operating under load conditions. Periodic checking of all fasteners should be done during each scheduled shutdown period after that. Tack welding the head of the bolts after assembly is not necessary or recommended.

MOTOR

Correct installation requires both the equipment certification package and this manual.

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

1. Check to ensure that the motor specifications match the drive design requirements of the agitator. *Refer to the certified data sheet or dimension drawing for designed motor requirements.*

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

3. Turn the shaft by hand to check that it turns freely and that the insulation resistance is no less than 1 megohm.

4. If the motor has been stored in a damp location, the windings may require drying. The motor may be dried by placing heaters around it or by running a small current through the windings.

5. Make sure the motor shaft is parallel to the agitator shaft and tightly secured to the mounting base. The motor may need to be shimmed to correct any motor shaft to agitator shaft alignment problems.

6. Bolt the motor to the predrilled holes in the adjustable motor mount and torque the bolts to the appropriate values, *Table 13, page 81*.

7. Connect the motor according to the local electrical code, but do not make the connections permanent until the motor rotation has been checked with the agitator's direction of rotation. The direction of agitator rotation is shown by a label on the belt guard cover and on a plate on the tank mounting flange. Additional electrical wiring details can usually be found in the motor junction box.

BELT DRIVE

Correct installation requires both the equipment certification package and this manual.

1. Ensure that the sheave bore and mating bushing surfaces are clean and free of any particles that may cause the sheave to wobble when rotating.

2. Determine the bushing flange orientation that will provide the best shaft contact upon completion of installation, *i.e.*, "flange in mounting," *Figure 15, page 21* or "flange out mounting," *Figure 16, page 22.* The most desirable orientation is with the bushing "flange in" toward the tank.

Mounting "Flange In"

1. Line up the clearance holes (A) in the sheave hub with the threaded holes (B) in the bushing flange, *Figure 15, page 21.* Insert the capscrews with lockwashers through the hub of the sheave and engage the threaded holes in the bushing flange.

2. Slip the loosely assembled unit on the shaft, bushing flange first, and align both sheaves to their desired position on the shaft. V-belts can tolerate misalignment up to 1/32" per foot of center distance. Use a straight edge across four points on both sheaves to help obtain proper alignment, *Figure 17, page 22.*

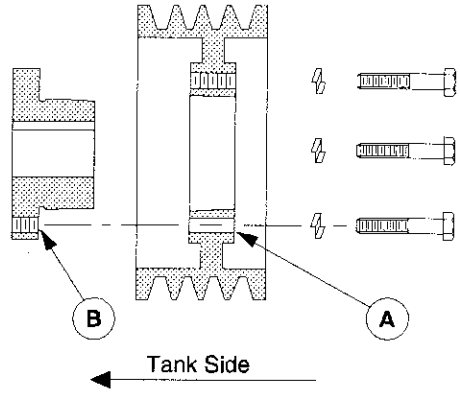

Figure 15: "Flange-In" Mounting

3. Using a torque wrench tighten each capscrew alternately, applying no more torque than is recommended, *Table 3, page 23.* The split tapered "QD" bushing will then grip the full circumference of the shaft tightly. No additional leverage is necessary.

Mounting "Flange Out"

1. Line up the clearance holes (A) in the bushing flange with the threaded holes (B) in the sheave hub, *Figure 17, page 22.* Insert the capscrews with

lockwashers through the flange of the bushing and engage the threaded holes in the sheave hub.

2. Slip the loosely assembled unit on the shaft, sheave hub first, and align both sheaves to their desired position on the shaft. V-belts can tolerate misalignment up to 1/32" per foot of center distance. Use a straight edge across four points on both sheaves to help obtain proper alignment, *Figure 17, page 22.*

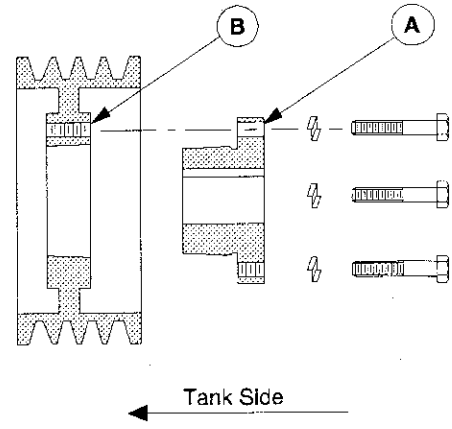

Figure 16: "Flange-Out" Mounting

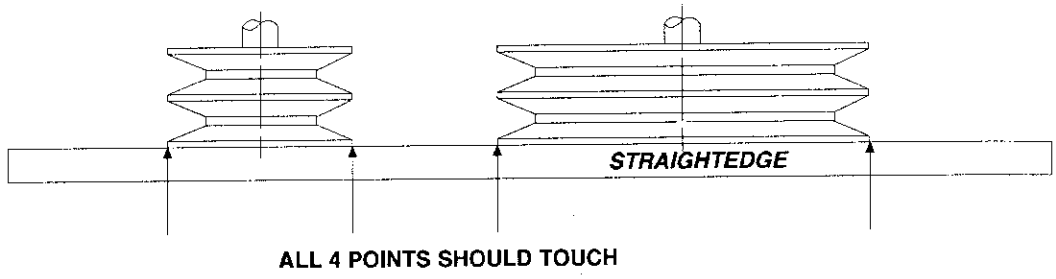

Figure 17: Sheave Alignment

3. Using a torque wrench tighten each capscrew alternately, applying no more pressure than is recommended, *Table 3, page 23.* The split tapered "QD" bushing will then grip the full circumference of the shaft tightly. No additional leverage is necessary.

Table 3: Torque Values - "QD" Style Bushings

Use this table to determine the proper torque to apply to the capscrews when engaging the sheave bushings.

BUSHING TYPE	CAPSCREW	TORQUE (Ft. lbs.)	BUSHING TYPE	CAPSCREW	TORQUE (Ft. lbs.)
JA	#10-24 UNC	5	J	5/8-11 UNC	135
SH,SDS,SD	1/4-20 UNC	9	M	3/4-10 UNC	225
DK	5/16-18 UNC	15	N	7/8-9 UNC	300
SF	3/8-16 UNC	30	P	1-8 UNC	450
E	1/2-13 UNC	60	W	1 1/8-7 UNC	600
F	9/16-12 UNC	75	S	1 1/4-7 UNC	750

Without exception, the most important factor in the successful operation of a belt drive is proper belt tensioning. To achieve the long, trouble-free service associated with belt drives, the belt tension must be sufficient to overcome slipping under maximum peak loads. The general method to increase the tension of the belt drive is to increase the center distance between the two sheaves.

NOTE: Keep all new belts together as a set, separate from other belts. Mixing new and used belts during installation may result in a loss of power transmitting capability.

1. Reduce the center distance between the sheaves by lowering the motor with the adjustable motor support base.

2. Make sure the motor shaft remains parallel with the agitator shaft and that the sheaves are aligned with each other.

3. Place the belts over the sheaves and in the grooves, do not force them over the sides of the grooves. Arrange the belts so that all have about the same amount of sag before tensioning.

4. Apply tension to the belts by increasing the center distance until the belts are snug. Increasing the center distance is achieved by raising the motor with the adjustable motor support base. Operate the agitator drive for a few minutes to seat the belts in the sheave grooves.

5. Stop the drive and tension the belts to the maximum deflection force recommended, *Table 4, page 25 and Table 5, page 25*. Measure the deflection

value using a tensiometer or equivalent spring scale. Apply a perpendicular force to any one belt at the mid point of the span, *Figure 18.*

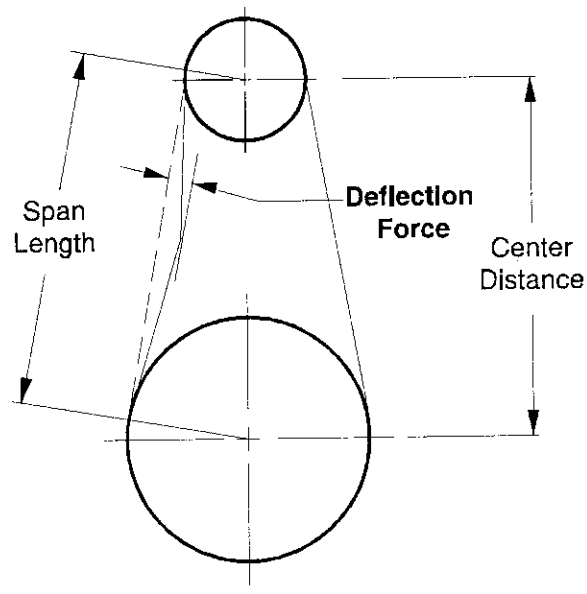

Figure 18: Belt Tensioning

6. Observe the force required to deflect any one belt 1/64" for every inch of span length. For example, the deflection for a 32" span would be 1/64" x 32", which equals 1/2" of deflection.

7. Achieve correct belt deflection by increasing or decreasing the sheave center distance using the adjustable motor support base. The correct operating tension for a V-belt drive (if applicable) is the lowest tension at which the belts will not slip under peak load conditions.

Check the tension on the new belt drive at least twice during the first day's operation and adjust as required. Normally a rapid decrease in belt tension will occur until belts have run in. After a few days of operation the belts will seat themselves in the sheave grooves and it may become necessary to readjust the tension again.

Table 4: Recommended Deflection Force per Belt - Ultra-V Belts

Force required to deflect any one of the belts 1/64" for every inch of span length.

ULTRA-V BELTS			
BELT SECTION	SMALL SHEAVE DIAMETER	DEFLECTION FORCE (LBS.)	
		MINIMUM	MAXIMUM
3V	2.65 - 3.65	3.5	5.5
	4.75 - 6.90	5.0	7.5
5V	7.1 - 9.0	11.0	16.0
	14.0 - 21.2	13.0	19.5
8V	12.5 - 17.0	27.0	40.5
	21.2 - 24.8	30.0	45.0

ULTRA-V COG BELTS			
BELT SECTION	SMALL SHEAVE DIAMETER	DEFLECTION FORCE (LBS.)	
		MINIMUM	MAXIMUM
3VX	2.2 - 3.0	4.0	6.0
	4.12 - 6.90	5.5	8.0
5VX	4.4 - 5.2	10.0	15.0
	6.3 - 7.1	12.0	18.0
	9.0 - 14.0	15.0	22.0

Table 5: Recommended Deflection Force per Belt - HTD Belts

Force required to deflect any one of the belts 1/64" for every inch of span length.

HTD BELTS					
PITCH	BELT WIDTH	DEFLECTION (FORCE-LBS.)	PITCH	BELT WIDTH	DEFLECTION (FORCE-LBS.)
5mm	15mm	1 to 2	14mm	85mm	13 to 26
	25mm	1.5 to 3		115mm	19 to 27
8mm	20mm	2 to 4		170mm	29 to 58
	30mm	3 to 6	20mm	115mm	28 to 56
	50mm	6 to 11		170mm	43 to 86
	85mm	10 to 19		230mm	60 to 120
14mm	40mm	5 to 11		290mm	76 to 150
	55mm	8 to 16		340mm	90 to 180

OPERATION

AGITATOR

Your Modular Design side entry 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. Should there be problems operating the unit, review the installation and trouble shooting sections of this manual. If you are unable to resolve a problem, contact your local representative or factory.

Do not operate the agitator before reading and following the instructions on all tags, decals and nameplates attached to the equipment.

Do not operate the agitator in an empty tank or in a fluid with a specific gravity or viscosity higher than that for which the unit was designed.

Do not operate the stuffing box dry. Ensure that the flushing fluid and/or lubrication fluid is operating and that the run-in procedure has been followed. *Refer to page 30 for run-in procedure.*

Do not modify the agitator (i.e., motor horsepower, agitator speed, impeller diameter or blade pitch, etc.) without consulting a Chemineer representative.

Start-up Check List

After installation, the following areas should be checked before putting the agitator into service.

Check that the agitator is correctly positioned (see certified location drawing) and that all fasteners are tightened to the recommended torque values, *Table 13, page 81.*

Check that the motor, starting and control device connections agree with wiring diagrams commonly found in motor conduit boxes.

Check that the motor is wired for the correct direction of impeller rotation. Correct rotation is most important so as not to endanger the mechanical integrity of the agitator.

Check that the lubrication and/or flushing fluid supply to the stuffing box is operating and that the "run-in" packing procedure has been followed. *Refer to page 30 for packing procedure.*

STUFFING BOX SEALS

Flush Requirements - Type L Stuffing Box

All type L stuffing box seals are designed to be run with a proper flushing fluid supplied to the appropriate stuffing box inlet. The most common fluid supply to the stuffing box is cool, clean water. Any selected fluid should be compatible with the process fluid.

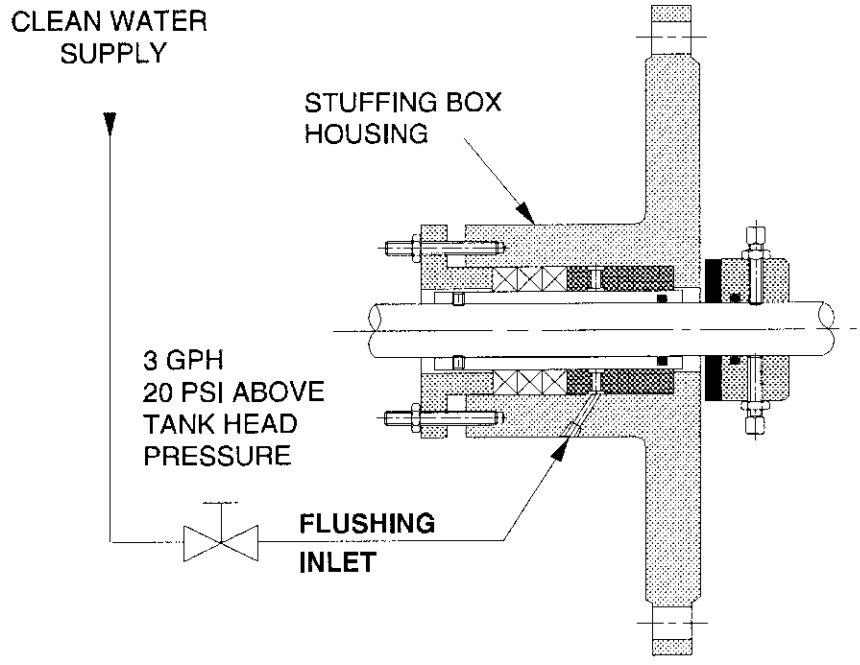

Figure 19: Type L Stuffing Box Lubrication

Flushing Fluid Supply - The flushing fluid should be introduced to the stuffing box flushing inlet at a rate of 3 gph and a pressure 20 PSI above tank head pressure. In units with a type L seal, the back flushing fluid also serves as a lubricant for the packing rings with some leakage. Although no simple definition of an acceptable leakage rate exists, a drop of lubricant every few seconds is needed during normal operation, ?.

Lubrication and Flush Requirements - Type DL Stuffing Box

All type DL stuffing box seals are designed to be run with proper lubrication and flushing fluid supplied to the appropriate stuffing box inlets. The most common fluid supply to the stuffing box is clean water. However, any selected fluid should be compatible with the process fluid.

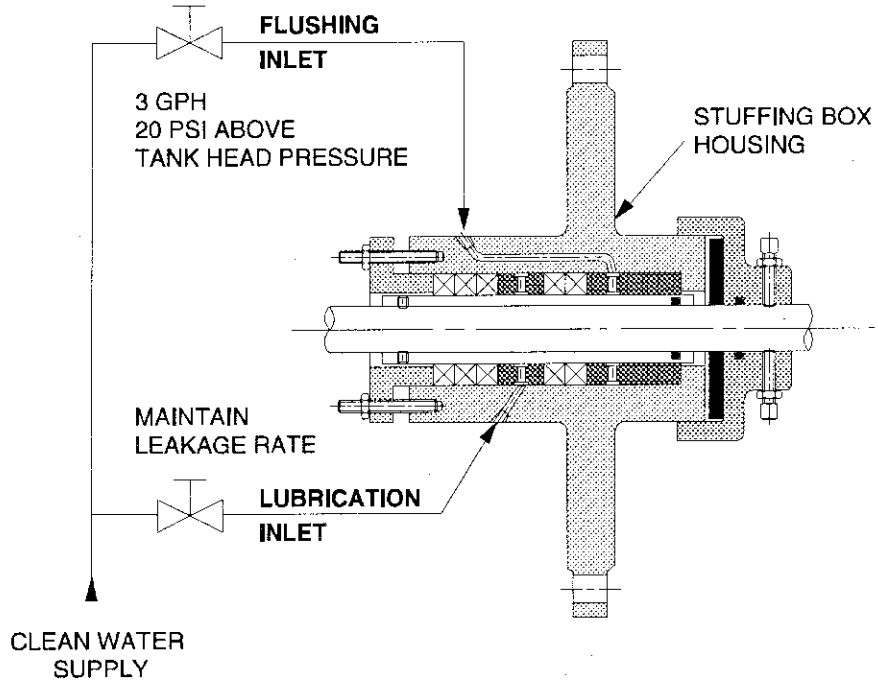

Figure 20: Type DL Stuffing Box Lubrication

Lubrication Fluid Supply - The fluid introduced to the lubrication inlet in the stuffing box should be sufficient to maintain the desired leakage rate. Although no simple definition of an acceptable leakage rate exists, a drop of lubricant every few seconds, during normal operation, is needed.

Flushing Fluid Supply - The flushing fluid should be introduced to the stuffing box flushing inlet at a rate of 3 gph and a pressure 20 PSI above tank head pressure, *Figure 20, page 29.*

NOTE: The stuffing boxes of Prochem MD agitators are preassembled at the factory and are ready to go into service once the fluid supply is operating and the "Run-In" procedure has been followed.

Packing "Run-In" procedure

1. Introduce the fluid supply to the stuffing box with sufficient pressure to allow an abnormal rate of leakage, not less than one pint per minute for one hour to lubricate the packing properly.

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

SAFETY CAUTION!! To Avoid Possible Injury, check to make sure all belt and shaft guards are in place and tools are clear of moving parts. Turn on the lubricant supply and flushing water to the stuffing box (if applicable). Take all necessary precautions and follow applicable safety procedures before starting the agitator.

3. Start the agitator.

4. 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 over tighten the gland nuts and make sure the gland plate remains square with the shaft. Always strive for satisfactory sealing with the least gland force possible.

MECHANICAL SEALS

Flush Requirements - Type OM - Outside Mounted (Split Design)

All type OM mechanical seals have built-in flushing ports for reliable service in high solids applications. A 3/8 NPT fitting is provided in the end of each gland half. The most common fluid supply to the mechanical is clean water. However, any selected fluid should be compatible with the process fluid.

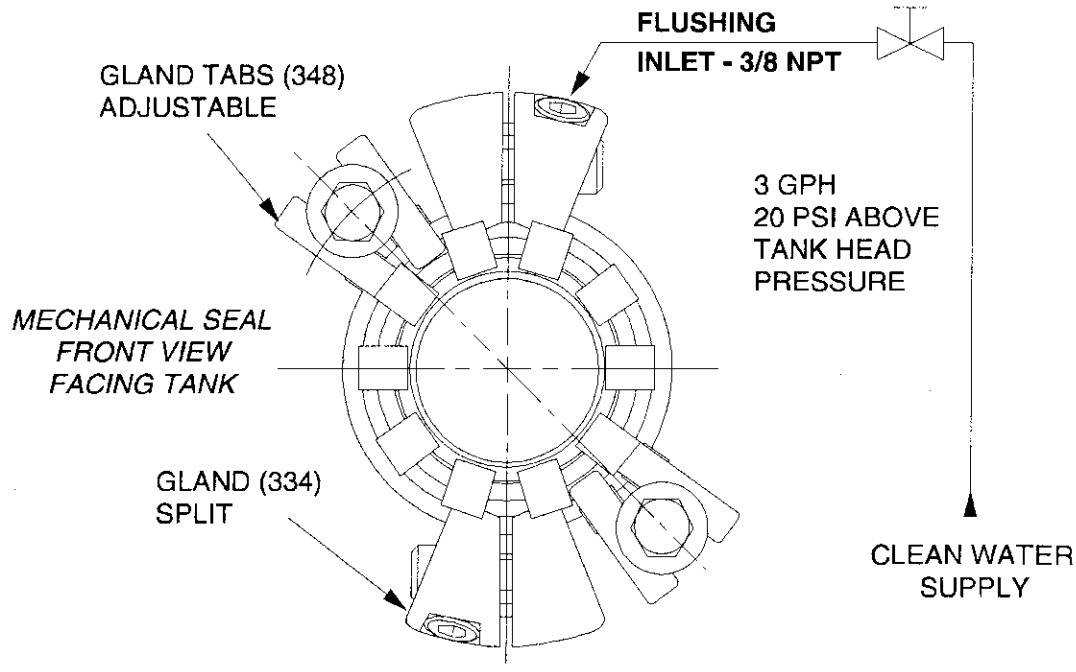

Figure 21: Type OM Mechanical Seal Lubrication

Flushing Fluid Supply - The flushing fluid should be introduced to the seal housing inlet at a rate of 3 gph and a pressure 20 PSI above tank head pressure. The back flushing fluid also serves as a clean lubricant for the sealing faces with some leakage. Although no simple definition of an acceptable leakage rate exists, a drop of lubricant every few seconds is needed during normal operation, *Figure 21.*

Flush Requirements - Other Mechanical Seals

Most other types of mechanical seals are designed to be run with a proper flushing fluid supplied to the appropriate seal housing inlet. The most common fluid supply to the mechanical seal flush is cool, clean water. Any selected fluid should be compatible with the process fluid. Typically, the flushing fluid should be introduced to the seal housing flushing inlet at a rate of 3 gph and a pressure 20 PSI above tank head pressure.

Because there are many types of mechanical seals, some of which require pressurized lubrication, details of the exact type of mechanical seal installed on the agitator should be carefully understood. Refer to supplemental drawings and manuals supplied separately or with the agitator.

CAUTION: These instructions are general in nature. It is assumed that the installer is familiar with seals and certainly with the requirements of the application for successful use of mechanical seals. If in doubt, get assistance from someone in the plant who is familiar with seals or delay the installation until your local Chemineer representative or a representative of the seal manufacturer is available. All necessary auxiliary arrangements for successful operation (cooling and flushing) as well as safety devices must be employed. These decisions are to be made by the user.

BELT DRIVE

During the first 24 hours of operation the initial tension on the belt drive will drop rapidly. Check the tension frequently during this time and adjust as required, *page 75.*

During the start-up period inspect the agitator for any signs of vibration, heat buildup, belt squealing or any other unusual noises. Any of these signs could lead to early failure of the agitator so the cause should be determined and corrective action should be taken immediately. *Refer to the trouble shooting guide on page 83.*

NORMAL OPERATION

During normal operation Chemineer recommends a program of routine maintenance to prolong the useful life of your agitator. A weekly walk through inspection of the agitator should include a visual inspection of the belt drive, mechanical seal or stuffing box, and a check of the bearings for smooth operation. Things to look for include overturned, broken or damaged belts, seal leakage rate, bearing temperature, unusual noises or vibrations. Refer to maintenance section for additional instructions on routine maintenance. If any problem should be discovered, the cause must be determined and the problem corrected immediately. *Refer to the trouble shooting guide on page 83.*

MAINTENANCE

Chemineer recommends a weekly-walk through inspection to check the following:

INSPECT:
1. Seal leakage rate
2. Bearing temperature
3. Belt drive wear and tension
4. For unusual noises or vibrations

Through a good program of routine maintenance and diagnostic practices, many causes of premature agitator failure can be avoided, thus prolonging the equipment life.

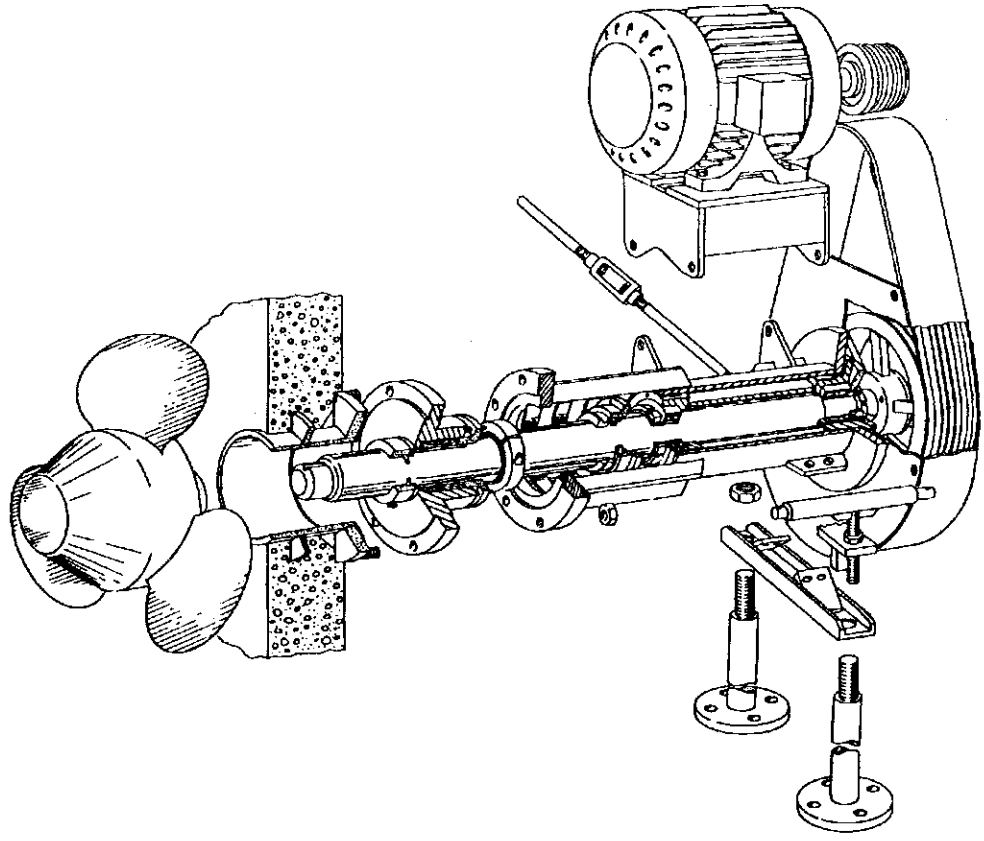

Figure 22: Agitator Overview

TANK SHUT-OFF ACTIVATION
(optional feature)

SAFETY CAUTION!! To Avoid Possible Injury, Turn Off the Agitator. Lock out and disconnect all power to the drive motor and any optional devices. Turn off and disconnect the lubricant supply and flushing water to the stuffing box (if applicable).

Table 6: Torque Values - Tank Shut-Off Activation

Use this table to determine the proper torque to apply to the jackscrews when activating the tank shut-off feature.

SHAFT DIA. (inches)	TORQUE (ft.lbs.)	SHAFT DIA. (inches)	TORQUE (ft.lbs.)
1.00 to 1.50	5	6.00 to 6.50	60 - 90
2.00 to 2.50	10 - 15	7.00	90 - 130
3.00 to 4.00	25 - 35	8.00	130 - 160
5.00 to 5.50	40 - 60	--	--

NOTE: If the packing is so tight as to hinder activation of the shut-off, loosening slightly the packing gland nuts may be necessary (308).

The tank shut-off feature is an option and available only with Type 1 and Type 3 bearing modules. *Refer to Table 8, page 52 to help determine module type.* If your agitator does not have the shut-off feature, draining the tank below the agitator shaft will be necessary.

Complete activation of the tank shut-off feature will have effectively sealed the tank contents from leakage to allow servicing of the stuffing box. Deactivation of the tank shut-off feature is done by reversing the shut-off procedure.

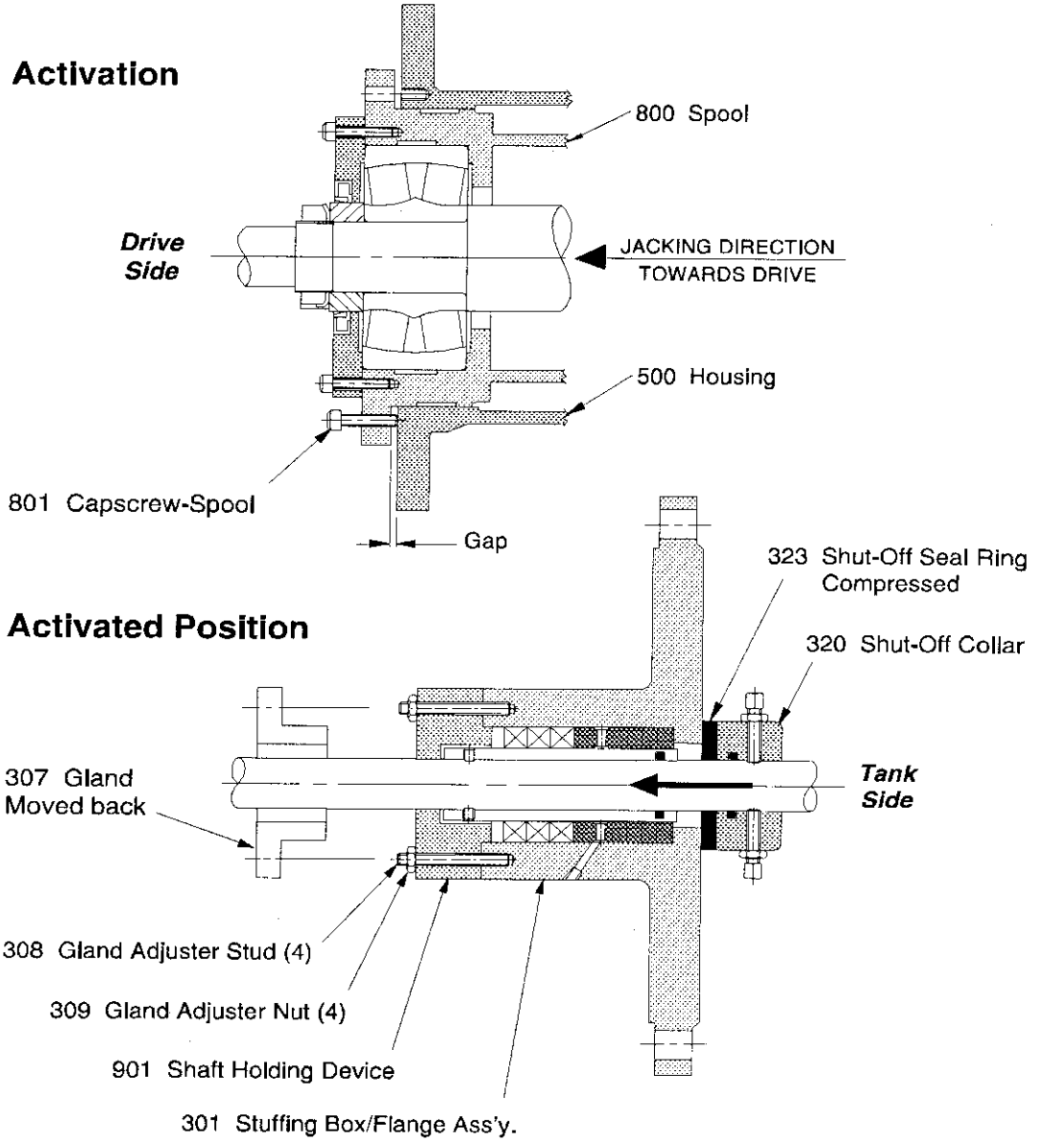

Figure 23: Tank Shut-Off Activation Feature

Agitator Assembly Type 1
Refer to Table 8, page 52,

1. Disconnect and remove the belt guard cover (407), the drive assembly, *See page 75 for instructions,* and belt guard backplate (406).

2. Remove the four spool retaining capscrews (607) and insert them into the threaded jacking holes in the flange of the spool (609), *Figure 28, page 56.*

3. Evenly turn the four capscrews inward causing the spool to move back, away from the tank, compressing the shut-off seal ring (323) between the stuffing box and the shut-off Collar (320) thus activating the tank shut-off feature.

4. During the jacking procedure, observe the gap between the spool flange and the housing flange caused by the movement of the shaft, spool and all fixed bearing internals toward the drive by approximately 1/16".

NOTE: If movement of the spool continues without resistance and the gap increases easily beyond a 1/16", the shut-off collar (320) has moved from the original secured position making positive activation of the shut-off feature impossible. In this event corrective action must be taken. See page 38 for shut-off collar replacement instructions.

5. Test the positive activation of the shut-off feature with an optional flange mounted spigot, if available.

6. Remove the gland adjuster nuts (309). Slide the gland (307) toward the drive.

7. Remove the gland adjuster studs (308) from the stuffing box taking care not to damage the threads.

Tip: Locking two nuts together will provide a surface to turn and unscrew each stud from the stuffing box without damaging the threads.

8. Install the split shaft holding device (901) in the gland location. Reinstall the gland adjuster studs with nuts into the stuffing box. Tighten the gland adjuster nuts, to the appropriate torque value, securing the shaft holding device against the face of the stuffing box housing, *Table 13, page 81.*

9. Secure the shaft holding device to the shaft by tightening the halves together. This support will prevent shaft movement and maintain activation of the tank shut-off feature. Complete activation of the tank shut-off feature will have effectively sealed the tank contents from leakage while servicing the bearings.

Agitator Assembly Type 3
Refer to Table 8, page 52

1. Disconnect and remove the belt guard cover (407), the drive assembly, *See page 75 for instructions,* and belt guard backplate (406).

2. Remove the four spool retaining capscrews (607) and insert them into the threaded jacking holes in the flange of the spool (609), *Figure 28, page 56.*

3. Evenly turn the four capscrews inward causing the spool to move back, away from the tank, compressing the shut-off seal ring (323) between the stuffing box and the shut-off Collar (320) thus activating the tank shut-off feature.

4. During the jacking procedure, observe the gap between the spool flange and the housing flange caused by the movement of the shaft, spool and all fixed bearing internals toward the drive by approximately 1/16".

NOTE: If movement of the spool continues without resistance and the gap increases easily beyond a 1/16", the shut-off collar (320) has moved from the original secured position making positive activation of the shut-off feature impossible. In this event corrective action must be taken. See page 38 for shut-off collar replacement instructions.

5. Test the positive activation of the shut-off feature with an optional flange mounted spigot, if available.

6. Remove the gland adjuster nuts (309). Slide the gland (307) toward the drive and separate it completely from the shaft.

7. Install the split shaft holding device (901) in the gland location. Tighten the gland adjuster nuts, to the appropriate torque value, securing the shaft holding device against the face of the stuffing box housing, *Table 13, page 81.*

8. Secure the shaft holding device to the shaft by tightening the halves together. This support will prevent shaft movement and maintain activation of the tank shut-off feature. Complete activation of the tank shut-off feature will have effectively sealed the tank contents from leakage while servicing the bearings.

TANK SHUT-OFF

Tank Shut-Off Inspection

Refer to Figure 23, page 35.

SAFETY CAUTION!! To Avoid Possible Injury, Turn Off the Agitator. Lock out and disconnect all power to the drive motor and any optional devices. Turn off and disconnect the lubricant supply and flushing water to the stuffing box (if applicable).

Note: The tank shut-off collar (320) and shut-off seal ring (323) are generally in an area of poor access but can usually be reached from inside the tank provided the wall insert or nozzle is not too deep. If inspection of the collar assembly or tightening of the collar fasteners cannot be accomplished from inside the tank, the agitator must be removed from the nozzle.

The fasteners that hold the shut-off collar (320) in place are spotted to the shaft. If the collar has moved from its original position, during an attempt to activate the shut-off, repositioning the collar with the fasteners bearing down on new or old spot holes in the shaft will be necessary. Spot holes will properly secure the shut-off collar to prevent movement.

1. Inspect the shut-off collar (320) for signs of movement from the original position and check the condition of the shut-off seal ring (323).

2. If all parts are in satisfactory condition but the collar has moved, reposition the collar to the original location, so that the setscrews return to the spot hole in the shaft. Check to ensure that the shut-off seal ring is snug but free to turn between the shut-off collar and stuffing box face. Torque the square head setscrew (322) and lock nuts to the recommended value, *Table 13, page 81.*

Tank Shut-Off Replacement

Refer to Figure 23, page 35

SAFETY CAUTION!! To Avoid Possible Injury, Turn Off the Agitator. Lock out and disconnect all power to the drive motor and any optional devices. Turn off and disconnect the lubricant supply and flushing water to the stuffing box (if applicable).

Note: This task can only be accomplished with the tank empty and the agitator completely removed from the tank.

1. Remove the impeller from the end of the shaft by unfastening the square head setscrews and locknuts that hold the shaft and key. *See Figure 9, page 14 and Figure 13, page 18 for typical hub mounting arrangements.* Pull the impeller off the end of the shaft. Use a penetrating lubricant to aid in the removal. If the impeller cannot be easily removed, place a block of wood against the hub end of the impeller and knock it loose with a soft mallet.

NOTE: An optional threaded jack screw hole may exist in the outside end of the impeller hub to help in the removal. Jack-screw hole sizes range from 3/8" to 3/4" UNC, depending on the impeller diameter.

TIP: To aid impeller removal, install a fitting and inject grease through the jack screw hole.

2. Disconnect and remove the belt guard cover (407), the drive assembly, *see page 75 for instructions,* and belt guard backplate (406).

3. Begin removing the agitator by unbolting the seal flange (301) from the tank and the mixer housing from the pedestal base (501), *Figure 3, page 9,* or other support devices (e.g., tie rods or pipe legs), *Figure 4,* page 10, as applicable.

4. Unfasten the collar square head setscrews (322) and lock nuts. *See Figure 24, Figure 20, or Figure 26 for seal details.*

5. Clean the shaft thoroughly and apply a thin coat of oil to help the collar (320) with o-ring (321) to slide along the shaft and off the end.

6. Replace the shut-off collar (320) and seal ring (323). Insert a new o-ring (321) into the collar.

7. Check the spot holes in the shaft used to position the square head setscrews for the shut-off collar. If the spots are damaged, redrilling holes may be necessary to secure the shut-off collar for future use.

8. Position the seal ring (323) followed by the shut-off collar (320) assembly on the shaft. Carefully slide the collar along the shaft avoiding damage to the o-ring (321). Use a thin oil on the shaft to help slide into position.

9. Reposition the collar to the original location, so that the setscrews return to new or old spot holes in the shaft. Check to ensure that the shut-off seal ring is snug but free to turn between the shut-off collar and stuffing box face. Torque the square head setscrew (322) and lock nuts to the recommended value, *Table 13,* page 81.

Note: If the original spot holes are damaged or the shaft has been replaced, spotting the shaft with a drill for the setscrews to seat securely will be necessary.

Care must be exercised during the replacement of the shut-off collar, as damage to the o-ring cannot be detected once the assembly is in place.

STUFFING BOX

A visual inspection of the stuffing box leakage rate should be carried out weekly (minimum) to ensure correct operation. A noticeable amount of lubricant should be seen leaking from the stuffing box. Although no simple definition of an acceptable leakage rate exists, a drop of lubricant every few seconds is necessary.

If the leakage of lubricant from the stuffing box seems excessive, check the lubricant flow rate and/or back flushing. If they are acceptable, then the packing gland needs to be tightened evenly until the desired leakage rate is obtained.

NOTE: Repacking is required when satisfactory control over leakage is not attainable or when the packing gland flange meets the outboard end of the stuffing box housing. If no noticeable lubricant drops are leaking and/or signs of a heat buildup are evident, corrective action must be taken immediately to prevent permanent damage to the stuffing box components and the shaft.

Repacking Procedure
Refer to Figure 24, page 43 and Figure 25, page 44.

NOTE: Ensure the correct order of all stuffing box components as shown in Figure 24 and Figure 25. Refer to the equipment specifications for the composition the components. For special Stuffing Box design, refer to the certified equipment drawings or contact your local representative for assistance.

Due to the nature of packing seals, wear occurs and the stuffing box must be repacked eventually. When it becomes necessary to repack the stuffing box, follow the steps listed below. Spare parts for this procedure are readily available through your local Chemineer representative or an industrial supplier.

1. Activate the optional tank shut-off feature, if available, *page 34, 45.*

2. Unfasten gland adjusters (308). Slide gland (307) toward the drive or separate it and remove completely from the shaft. With packing tools remove old packing (305), throttle bushing (304) and/or lantern ring (317). All bushings and rings have sufficient clearance to aid in removal with hook type tools.

TIP: With the tank shut-off feature activated, the seal lubricant water pressure can be used to push the packing out of the stuffing box.

3. Check shaft or shaft sleeve (309) for nicks, score marks or other damage. Replace damaged parts. Clean the stuffing box bore and ensure free entry of lubricant. Check that the channels and holes in the throttle bushing and/or lantern ring are not plugged. Replace parts if necessary.

   NOTE: Never add new packing on top of old packing as this will cause accelerated wear and scoring of the shaft or shaft sleeve. If the shaft sleeve is being replaced put it 5/8" from the mounting face of the seal flange (301).

4. Begin re-packing the stuffing box by installing the throttle bushing and/or lantern ring and packing ensuring that each ring is seated squarely with scarfed joints staggered 120 degrees apart. A little grease or oil smeared on the packing I.D. will make the installation easier.

5. Install the gland and seat the packing rings, throttle bushing and/or lantern ring by tightening the gland nuts. Seat the packing according to the "Packing Run-In Procedure," *page 41, 47.*

6. Reintroduce the lubricant to the stuffing box with sufficient pressure to allow an abnormal rate of leakage, not less than one pint per minute for one hour to lubricate the packing properly.

7. Tighten the gland nuts uniformly and gradually (one sixth of a turn at a time every ten minutes) until the leakage rate is acceptable. Make sure the gland plate remains square with the shaft.

Do not over tighten gland nuts. Always strive for satisfactory sealing with the least gland force possible. At any sign of an excessive heat buildup back off the gland nuts and gland until the stuffing box is again cool to touch. This process may take several hours until the desired conditions are attained.

Packing "Run-In" Procedure

1. Introduce the fluid supply to the stuffing box with sufficient pressure to allow an abnormal rate of leakage, not less than one pint per minute for one hour to lubricate the packing properly.

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

SAFETY CAUTION!! To Avoid Possible Injury, check to make sure all belt and shaft guards are in place and tools are clear of moving parts. Turn on the lubricant supply and flushing water to the stuffing box (if applicable). Take all necessary precautions and follow applicable safety procedures before starting the agitator.

3. Start the agitator.

4. 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 over tighten the gland nuts and make sure the gland plate remains square with the shaft. Always strive for satisfactory sealing with the least gland force possible.

Table 7: Packing Sizes

Use this table as a guide to determine the proper packing size for a given shaft diameter.

SHAFT DIA. (inches)	PACKING SIZE	SHAFT DIA. (Inches)	PACKING SIZE
1.00	1/4" sq.	5.00 to 6.50	5/8" sq.
1.50 to 2.00	3/8" sq.	7.00	3/4" sq.
3.00 to 4.50	1/2" sq.	8.00	7/8" sq.

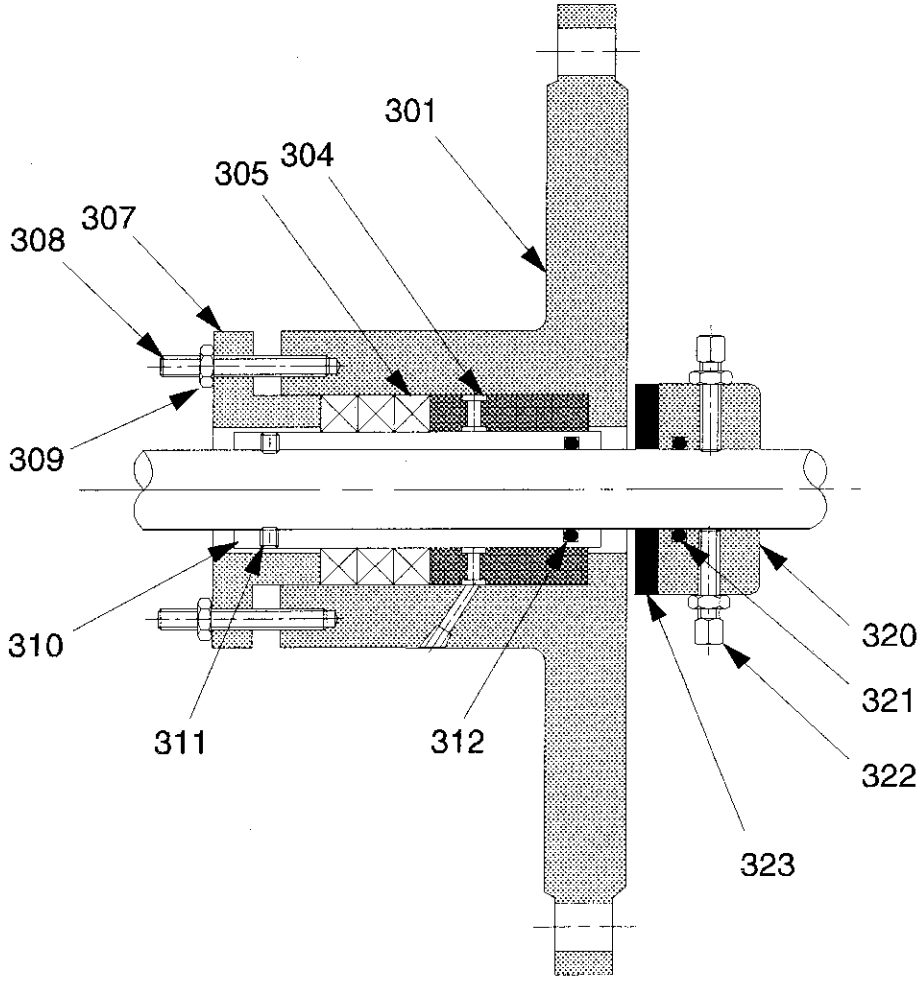

Figure 24: Type L Stuffing Box

ITEM	DESCRIPTION	ITEM	DESCRIPTION
301	Stuffing Box/Flange	311	Setscrews - Sleeve
304	Throttle Bushing	312	O-Ring - Sleeve
305	Packing Rings (3)	320	Shut-Off Collar (optional)
307	Gland - split	321	O-Ring - Collar (optional)
308	Gland Adjuster Stud (4)	322	Sq.Hd.Setscrews (optional)
309	Gland Adjuster Nut (4)	323	Shut-Off Seal Ring (optional)
310	Shaft Sleeve		

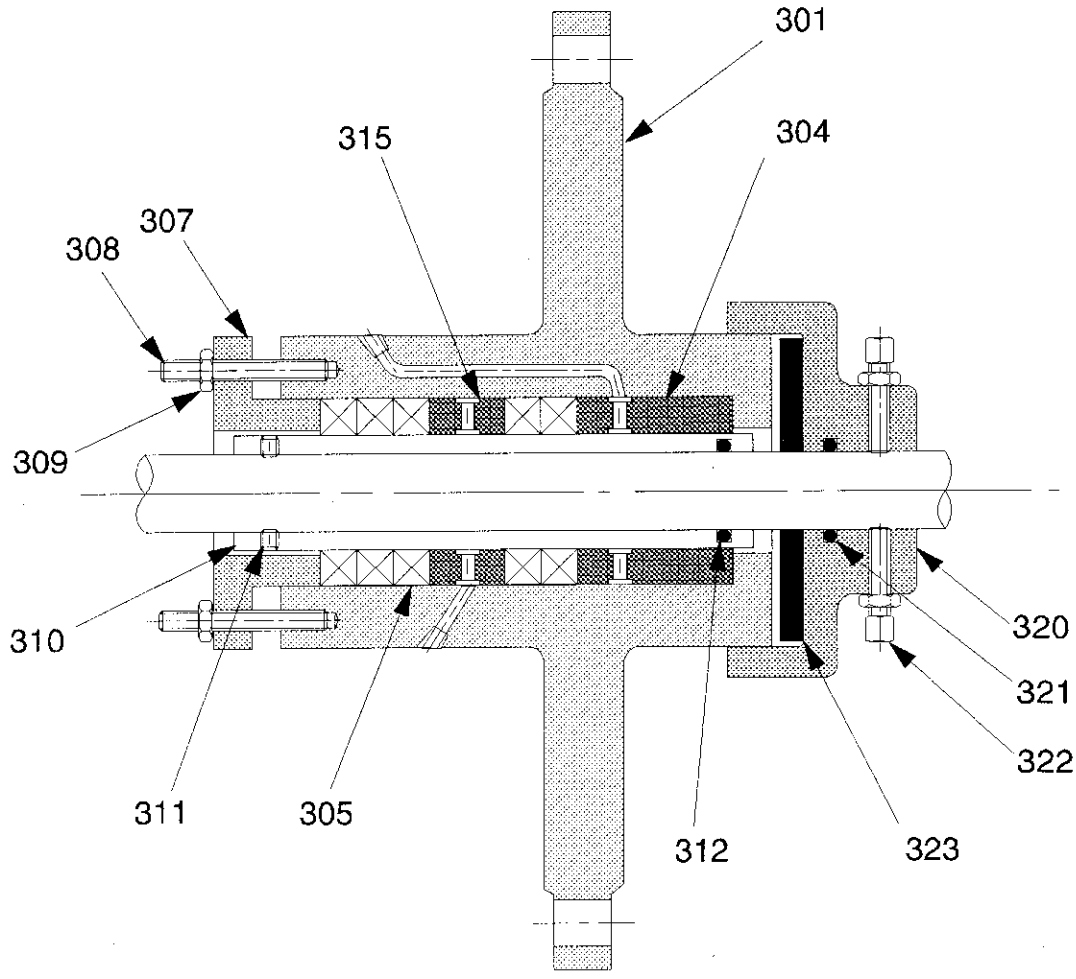

Figure 25: Type DL Stuffing Box

ITEM	DESCRIPTION	ITEM	DESCRIPTION
301	Stuffing Box/Flange	311	Setscrews - Sleeve
304	Throttle Bushing	312	O-Ring - Sleeve
305	Packing Rings (3)	315	Lantern Ring
307	Gland - split	320	Shut-Off Collar (optional)
308	Gland Adjuster Stud (4)	321	O-Ring - Collar (optional)
309	Gland Adjuster Nut (4)	322	Sq.Hd.Setscrews (optional)
310	Shaft Sleeve	323	Shut-Off Seal Ring (optional)

MECHANICAL SEAL

A visual inspection of the mechanical seal should be carried out weekly (minimum) to ensure correct operation. The leakage from a mechanical seal should be almost negligible. If the leakage from the mechanical seal seems excessive, check to be sure that the flushing flow rate and/or pressure is not excessive. If the flushing is acceptable and the leakage is greater than 60 drops per minute, investigate the seal condition and correct immediately.

Repair Procedure

CAUTION: These instructions are general in nature. It is assumed that the installer is familiar with seals and certainly with the requirements of the application for successful use of mechanical seals. If in doubt, get assistance from someone in the plant who is familiar with seals or delay the installation until your local Chemineer representative or a representative of the seal manufacturer is available. All necessary auxiliary arrangements for successful operation (cooling and flushing) as well as safety devices must be employed. These decisions are to be made by the user.

Tank Shut-Off Activation for Mechanical Seal (optional feature)
Refer to Figure 23, page 35.

SAFETY CAUTION!! To Avoid Possible Injury, Turn Off the Agitator. Lock out and disconnect all power to the drive motor and any optional devices. Turn off and disconnect the lubricant supply and flushing water to the stuffing box (if applicable).

1. Remove the four spool retaining capscrews (801) and insert them into the threaded jacking holes in the flange of the spool (800), *Figure 23, page 35.*

2. Evenly turn the four capscrews inward causing the spool to move back, away from the tank, compressing the shut-off seal ring (323) between the stuffing box & the shut-off Collar (320) thus activating the tank shut-off feature.

During the jacking procedure, observe the gap between the spool flange and the housing flange caused by the movement of the shaft and all fixed bearing internals toward the drive by approximately 1/16".

NOTE: If movement of the spool continues without resistance and the gap increases easily beyond a 1/16", the shut-off collar (320) has moved from the original secured

position, making positive activation of the shut-off feature impossible. Then, corrective action must be taken, see page 38 for shut-off collar replacement instructions.

3. Test the positive activation of the shut-off feature with the optional flange mounted spigot, if available.

Complete activation of the tank shut-off feature will have effectively sealed the tank contents from leakage to allow servicing of the stuffing box. If your agitator does not have this feature, draining the tank to the required level will be necessary.

Deactivation of the tank shut-off feature is done by reversing the above procedure.

Mechanical Seal Removal
Refer to Figure 26, page 49.

1. Prepare a clean work surface on which to place parts during disassembly.

2. Remove the seal mounting nuts and washers (338). Slide the split gland (334) toward the drive and separate the halves by unfastening the gland cap screws (333) and remove them from the shaft.

3. Disassemble the remaining seal, noting the condition of the parts. Analyze the cause of failure and correct the problem, if possible before reinstalling new seal parts. A spare parts kit is readily available, upon request, to repair the mechanical seal. Only the gland and rotary holder (337) are reused.

4. Follow the specific instructions, for mechanical seal removal, supplied with the original seal assembly or the spare part kit.

NOTE: The gland holder, and face halves are matched pairs. Do not mix halves from different seals since this will cause seal failure.

5. Check the condition of the seal flange (331) particularly the mating face that contacts the mechanical seal. It must be flat and smooth enough to seal a gasket; maximum 125 microinches (3.2 microns) AA finish.

6. If misalignment of the stuffing box compared with the shaft, is suspected, corrective action must be taken before proceeding with the installation of a new seal. Using a dial indicator to check the run out of the stuffing box that should not exceed 0.003" TIR per inch (0,003 mm TIR per millimeter) of shaft diameter.

7. Remove all burrs and scratches in the seal area of the shaft and polish if necessary to achieve a 32-microinch (0.8 microns) AA finish.

8. Use a dial indicator to measure the shaft run out just outside the seal flange. Readings should not exceed 0.001" TIR per inch (0,001 mm TIR per millimeter) of shaft diameter.

Mechanical Seal Installation
Refer to Figure 26, page 49.

1. Prepare a clean work surface on which to place parts during assembly.

2. Read the manufacturer's instructions, for mechanical seal installation, carefully and make sure you understand them before installing new seal parts.

3. Handle and install the parts are carefully making sure your hands are clean. Any dirt particles placed on the seal faces or scratches caused during handling may cause seal failure.

4. Follow the specific instructions, for mechanical seal installation, supplied with the original seal assembly or the spare part kit. Ensure that the flushing inlet in gland halves (334) is in the original position for reconnecting the plumbing.

5. Upon completing the mechanical seal installation, rotate the shaft by hand to ensure no metal-to-metal contact within the seal. A slight drag may be found due to the seal faces but the shaft should rotate freely.

6. Deactivate the tank shut-off feature by reversing the previous activation procedure.

7. Reconnect the flushing line to the gland. Reconnect all power to the drive motor and any optional device. Reintroduce the flushing supply to the seal with sufficient pressure to expel solids from the seal.

SAFETY CAUTION!! To Avoid Possible Injury, take all necessary precautions and follow normal safety procedures before starting the agitator.

8. Depending on how carefully the seal components were handled during installation, split seals may leak on startup. For example, greasy fingerprints on the faces or misaligned face splits may cause leakage. This type of leakage usually decreases and stops over a time as a carbon face wears in or leak paths are clogged.

9. Seal leakage greater than 60 drops per minute should be investigated immediately. If leakage remains steady, check o-rings and gaskets for proper installation and check the faces for chips and scratches.

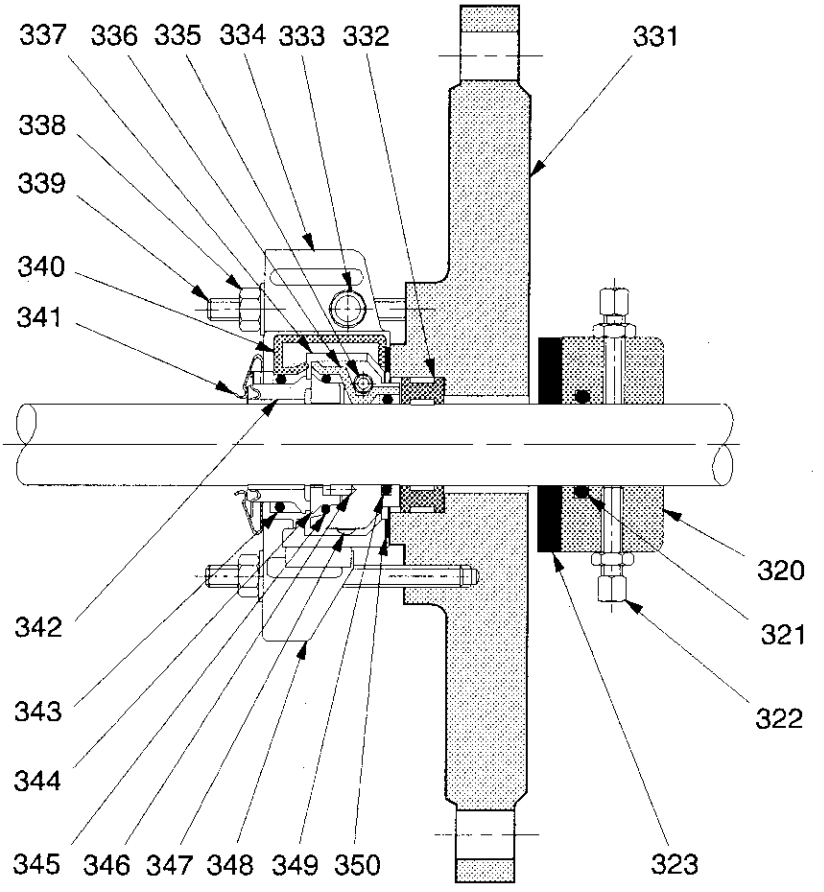

Figure 26: Type OM Split Mechanical Seal

ITEM	DESCRIPTION	ITEM	DESCRIPTION
320	Shut-Off Collar (optional)	339	Rotary Holder
321	O-Ring - Collar (optional)	340	Gland Gasket
322	Sq.Hd.Setscrews (optional)	341	Finger Springs
323	Shut-Off Seal Ring (optional)	342	Stationary Face
331	Seal Flange	343	O-Ring - Stationary Face
332	Throttle Bushing	344	Rotary Face
333	Cap Screws - Gland	345	O-Ring - Rotary Face
334	Gland - split	346	Drive Pin
335	Cap Screws - Rotary Holder	347	Centering Buttons
336	Holder Gasket	348	Gland Tabs - Adjustable
337	Rotary Holder	349	O-Ring - Static
338	Mounting Nut & Washer	350	Flange Gasket

Shaft Steady Installation

After activation of the tank shut-off feature, the shaft steady device is used to maintain a horizontal shaft position during bearing replacement. Steadying the shaft is necessary to prevent upward movement caused by the cantilever effect of the impeller weight. Support can be provided by a block and tackle arrangement or the purchase/fabrication of a reusable service tool, shown in *Figure 27*. Installing the steady at an initial location close to the tank side of the outboard bearing is recommended.

NOTE: To prevent any downward movement of the shaft, it must be supported on the tank side of the inboard bearing before servicing (split design only). Such movement occurs if the tank shut-off feature has not been properly activated or a shaft holding device is not in place.

CAUTION! Improper installation of a shaft steady apparatus may damage the tank shut-off feature causing leakage and could also damage the stuffing box assembly.

1. Position the jack screw supports (930) between the shaft and the ribs of the agitator housing (500).

2. Back off all four jack screw nuts (931) evenly until they are tight against the housing ribs. The jack screws should apply pressure against the shaft from all directions to provide adequate support.

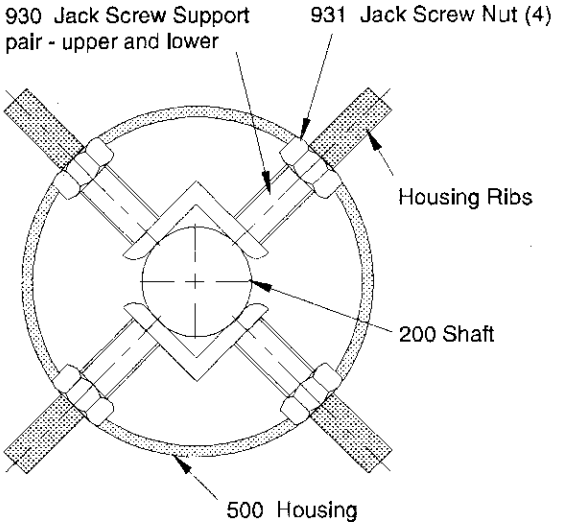

Figure 27: Jack Screw Support

BEARINGS

NOTE: All bearing assemblies are shipped from the factory prelubricated to the specification outlined by the bearing manufacturer and are ready for use. Additional bearing lubrication at start-up time is not necessary and should be avoided to prevent over lubrication. Prelubricated and sealed ball bearings are

installed on agitators with 1" and 1-½" diameter shafts only. These sealed bearings need no other attention for the life of the agitator.

A routine maintenance inspection of the bearings should be carried out weekly (minimum) to ensure correct operation and maintenance. These bearings are designed to run from cool to slightly warm to the touch. If a bearing is running HOT or overheating, corrective action must be taken to prevent any permanent damage to the bearing rollers and housing components. If during the routine maintenance inspection any unusual noises or vibrations are detected, the cause should be determined and corrective action taken immediately. Refer to the trouble shooting guide for solutions to any noticeable bearing problems.

Lubrication

Always rotate bearings while regreasing. Grease can be injected with a gun into the upper housing half through the regular 1/4" N.P.T. fitting on-center. Always use the same type of grease previously used in the bearing. Some greases lose lubricating capability when mixed with another grease. Never mix greases with unlike bases without first checking compatibility with the supplier. Chemineer prelubricates the bearings with Lithium EP, NLGI Grade 2, nonchanneling grease (Quaker State) and recommends using the same type of grease or compatible equivalent.

Routine Greasing

As a guide to frequency of lubrication, under moderate operating conditions of dirt, temperature and moisture, one or two shots from a grease gun every two weeks are adequate. Lubricating more frequently is necessary in applications where a risk of heavy contamination exists. The same applies to bearings in wet environments such as papermaking machinery.

NOTE: Modular design agitators (MD) are equipped with self-aligning spherical roller bearings on the outboard (drive end) and inboard end (tank end). These bearings include the W33 feature (with grooves and three holes around the outer ring). This feature allows grease flow through the center holes to the bearing rollers. When reordering replacement bearings, be sure this feature is present.

Assembly Type Identification

Identify the agitator assembly type before proceeding to the appropriate bearing maintenance section in the manual. Refer to the equipment certification package to

find out the shaft diameter, whether the agitator is supplied with a modular or standard feature, and if the optional tank shut-off feature is available.

Table 8: Agitator Assembly Types

<table>
<tr><th rowspan="2">Agitator Size</th><th rowspan="2">Shaft Diameter (Inches)</th><th colspan="2">Agitator Assembly Type</th><th rowspan="2">Bearing Type</th><th rowspan="2">New grease Volume per Bearing (ounces)</th></tr>
<tr><th>Modular with Spool</th><th>Standard no Spool</th></tr>
<tr><td rowspan="2">A</td><td>1.0</td><td rowspan="4">1</td><td rowspan="4">2</td><td rowspan="4">Ball</td><td rowspan="4">Pre-Lubricated</td></tr>
<tr><td>1.25</td></tr>
<tr><td rowspan="2">B</td><td>1.25</td></tr>
<tr><td>1.5</td></tr>
<tr><td>I</td><td>2.0</td><td rowspan="9">3</td><td>4</td><td rowspan="9">Spherical Roller</td><td>56</td></tr>
<tr><td rowspan="2">II</td><td>2.5</td><td rowspan="8">Not Applicable</td><td>70</td></tr>
<tr><td>3.0</td><td>84</td></tr>
<tr><td rowspan="2">III</td><td>3.5</td><td>98</td></tr>
<tr><td>4.0</td><td>112</td></tr>
<tr><td rowspan="2">IV</td><td>4.5</td><td>126</td></tr>
<tr><td>5.0</td><td>140</td></tr>
<tr><td rowspan="3">V</td><td>5.5</td><td>154</td></tr>
<tr><td>6.0</td><td>168</td></tr>
<tr><td>6.5</td><td>182</td></tr>
<tr><td>VI</td><td>7.0</td><td>196</td></tr>
</table>

BEARING REPLACEMENT

SAFETY CAUTION!! To Avoid Possible Injury, Turn Off the Agitator. Lock out and disconnect all power to the drive motor and any optional devices. Turn off and disconnect the lubricant supply and flushing water to the stuffing box (if applicable). Do not attempt any bearing removal without activating the tank shut-off feature, installing the shaft holding device (901), and securing the shaft with a shaft steady as described on page 50.

NOTE: Check the equipment certification package to find out if the agitator is equipped with the tank shut-off feature is before attempting its activation.

On small agitators with standard assembly (no spool) and without the optional tank shut-off feature, the tank must be drained below the nozzle and the agitator removed before servicing the bearings.

On larger agitators with modular assembly (with a spool) but without the optional tank shut-off feature, the tank must be drained below the nozzle. The shaft holding device must be installed, as described in steps 6 to 8 of the "Tank Shut-Off Activation" instructions. On agitators with a 4-1/2" diameter shaft or greater, the jack screw support must be installed to steady the shaft. See page 50 for the jack screw support installation instructions.

NOTE: Before servicing the bearings, holding the shaft concentric with the I.D. of the stuffing box housing is important. The shaft and impeller weight along with tank loads will force the shaft downward inside the stuffing box causing permanent damage to the components. Misalignment through the bearing centers will also make bearing replacement difficult.

Tank Shut-Off Activation (optional feature)
Refer to Figure 23, page 35.

SAFETY CAUTION!! To Avoid Possible Injury, Turn Off the Agitator. Lock out and disconnect all power to the drive motor and any optional devices. Turn off and disconnect the lubricant supply and flushing water to the stuffing box (if applicable).

The tank shut-off feature is an integral part of the modular agitator assembly (with spool). It allows replacement of the bearings or seal components, while the agitator remains installed on a full tank.

Type 1 Bearing Module
Refer to Figure 28, page 56.

Bearing Removal (Type 1)

Note: Type 1 modular agitator assemblies include the bearing spool and the tank shut-off feature. As a result draining the tank to the required level to service the bearings will not be necessary. Chemineer recommends that both bearings be replaced simultaneously.

SAFETY CAUTION!! To Avoid Possible Injury, Turn Off the Agitator. Lock out and disconnect all power to the drive motor and any optional devices. Turn off and disconnect the lubricant supply and flushing water to the stuffing box (if applicable).

1. Disconnect and remove the belt guard cover (407), the drive assembly, *see page 75 for instructions,* and belt guard backplate (406).

2. Activate the in tank shut-off feature. *See page 53 for instructions.*

3. Slide the V-Ring (706) along the shaft toward the seal. Unfasten the V-Ring plate (704) from the Spool (800) and move toward the seal.

4. Using the appropriate pliers, open the shaft retaining ring (604) and remove.

5. Unfasten the inboard bearing locking collar (702) and outboard bearing locking collar (602).

6. Continue to tighten the spool retaining capscrews (801) until the spool moves off its seat within the housing (500). Slide the spool and bearings along the shaft and off the drive end.

7. Using the appropriate pliers, open the housing retaining rings (603) and (703) and remove the bearings from the spool (800).

Bearing Replacement (Type 1)

Note: Before replacing the bearings it is assumed that all instructions for removal have been followed. See preceding instructions for bearing removal.

To obtain satisfactory bearing performance, it is important that strict cleanliness be observed during the replacement procedure.

1. Inspect the bearing cavities for foreign material and burrs. Clean thoroughly along with the shaft and abutment surfaces. Install the new inboard bearing (701) and the outboard bearing (601) into the spool (800) and fix them in place with the housing retaining rings (703) and (603).

2. Do not remove the new bearing from its original package until immediately before it is to be mounted. The rust inhibiting compound should be left intact except the bearing bore. Wash the bore with a white spirit and dry it with a clean lint free rag.

3. Position a new v-ring (706) and v-ring plate (704) on the shaft ahead of the spool assembly. Slide the spool and bearing assembly along the shaft and seat within the housing (500). Replace the shaft retaining ring (604). Pull the bearing assembly toward the drive with the outboard bearing locking collar (602) resting against the shaft retaining ring.

4. Tighten the outboard locking collar to the shaft. Ensure that the previous gap between the spool and housing flange is present to allow deactivation of the tank shut-off feature.

5. Replace the spool retaining capscrews into the fastening holes of the spool flange. Finger tighten in place with the housing flange. Do Not Tighten.

6. Deactivate the tank shut-off feature by unfastening and removing the shaft holding device (901), *Figure 23, page 35.*

7. Torque the spool retaining capscrews to the appropriate value, *Table 13, page 81.*

Note: Type 1 agitator assemblies are equipped with prelubricated sealed ball bearings and require no additional lubrication.

8. Check to ensure that the inboard bearing is equally spaced within the spool bearing cavity. Screw fasten the inboard bearing locking collar (702) to the shaft.

9. Replace the V-Ring plate (704) and a new V-Ring (706).

10. Replace the belt guard backplate (406) and reinstall the belt drive. *See page 21 for belt drive installation.* Replace the belt guard cover (407).

11. Reconnect the lubricant supply and flushing water (if applicable) entering the stuffing box. *See page 28 for stuffing box start-up procedure.* Finger tighten the gland (307) in place and follow the packing "run-in" procedure, *page 30.*

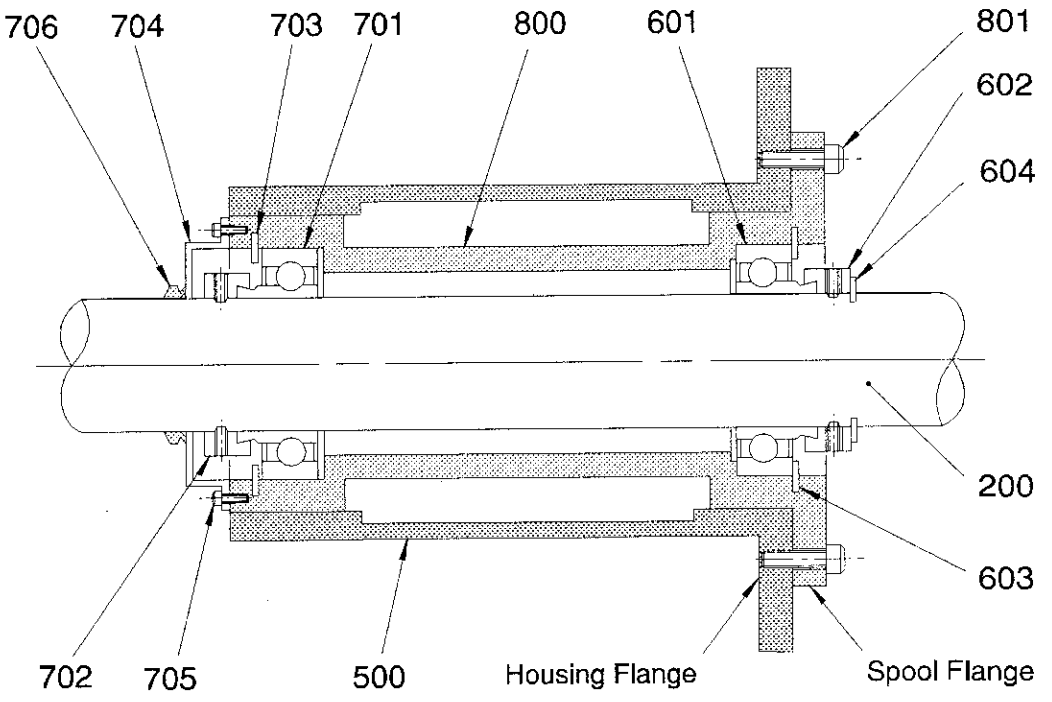

Figure 28: MD Agitator Assembly - Type 1

ITEM	DESCRIPTION	ITEM	DESCRIPTION
200	Shaft	702	Locking Collar - Inboard Brg.
500	Housing	703	Retaining Ring - Spool Inboard
601	Outboard Bearing	704	V-Ring Plate
602	Locking Collar - Outbrd. Brg.	705	Capscrew - V-Ring Plate
603	Retaining Ring - Spool Outbrd.	706	V-Ring
604	Retaining Ring - Shaft	800	Spool
701	Inboard Bearing		

Type 2 Bearing Module
Refer to *Figure 29*, page 60.

Bearing Removal (Type 2)

Note: Type 2 agitator assemblies do not have a bearing spool and tank shut-off feature. Therefore, draining the tank below the agitator nozzle will be necessary and completely remove the agitator from the tank to service the bearings. Chemineer recommends that both bearings be replaced simultaneously.

SAFETY CAUTION!! To Avoid Possible Injury, Turn Off the Agitator. Lock out and disconnect all power to the drive motor and any optional devices. Turn off and disconnect the lubricant supply and flushing water to the stuffing box (if applicable).

1. Remove the Impeller from the end of the shaft by unfastening the square head setscrews and locknuts, that bear down on the shaft and key, and pull off. Use a penetrating lubricant to aid in the removal. If the impeller cannot be easily removed, place a block of wood against the hub end of the impeller and jar it loose with a soft mallet, *Figure 9, page 14 and Figure 13, page 18.*

NOTE: An optional threaded jack screw hole may exist in the vertical outside face of the impeller hub to help in the removal. Size ranges from 3/8 to 3/4" UNC, depending on the impeller diameter.

TIP: To aid impeller removal, install a fitting and inject grease through the jack screw hole.

2. Disconnect and remove the belt guard cover (407), the drive assembly, *see page 75 for instructions,* and belt guard backplate (406).

3. Begin removing the agitator unbolting the stuffing box/flange (301) and housing flange from the tank and unbolting the pedestal base (501) or other support devices (eg. tie rods or pipe legs), if applicable, *Figure 4, page 10.*

4. Unbolt and separate the stuffing box/flange assembly from the housing (500). Remove the stuffing box assembly along with all related components completely from the agitator.

5. Slide the V-Ring (706) along the shaft toward the tank end. Unfasten the V-Ring plate (704) from the Spool (800) and move toward the tank end of housing.

6. Using the appropriate pliers, open the shaft retaining ring (604) and the outer housing retaining rings (603) and (703) and remove.

7. Unfasten the inboard bearing locking collars (602) and outboard bearing locking collar (702) and remove the bearings from the housing (500).

Bearing Replacement (Type 2)

Note: Before replacing the bearings it is assumed that all instructions for removal have been followed. See preceding instructions for bearing removal.

To obtain satisfactory bearing performance, it is important that strict cleanliness be observed during the replacement procedure.

1. Using the appropriate pliers, replace the inner housing retaining rings (607) and (707), if required.

2. Inspect the bearing cavities for foreign material and burrs. Clean thoroughly along with the shaft and abutment surfaces. Install the new inboard bearing (701) and the outboard bearing (601) into the housing (500) and fix in place with the outer housing retaining rings (703) and (603).

3. Do not remove the new bearing from its original package until immediately before it is to be mounted. The rust inhibiting compound should be left intact except the bearing bore. Wash the bore with a white spirit and dry it with a clean lint free rag.

4. Replace the shaft retaining ring (604) and position the housing with bearings onto the shaft by sliding the assembly along until the locking collar of the outboard bearing (602) rests against the shaft retaining ring.

5. Screw fasten the inboard bearing locking collar (602) to the shaft.

6. Check to ensure that the inboard bearing is equally spaced within the spool cavity. Screw fasten the inboard bearing locking collar (702) to the shaft.

Note: Type 2 agitator assemblies are equipped with prelubricated sealed ball bearings and require no additional lubrication.

7. Replace the V-Ring plate (704) and a new V-Ring (706).

8. Replace the stuffing box/flange assembly (301) with all relating components. Fasten the flange securely to the housing.

9. Install the agitator to the tank and replace the support device, if applicable. Replace the impeller. *See "Impeller Installation," page 10.*

10. Replace the belt guard backplate (406) and reinstall the belt drive. *See page 21 for belt drive installation.* Replace the belt guard cover (407).

11. Reconnect the lubricant supply and flushing water (if applicable) entering the stuffing box. *See page 28 for stuffing box start-up procedure.* Finger tighten the gland (307) in place and follow the packing "run-in" procedure, *page 30.*

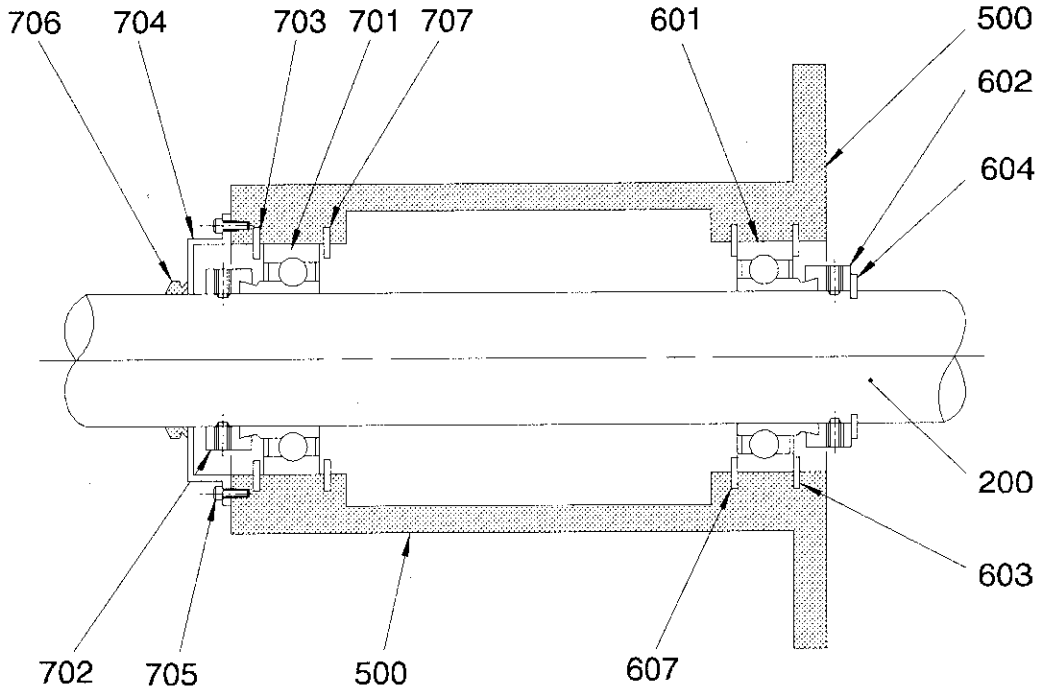

Figure 29: MD Agitator Assembly - Type 2

ITEM	DESCRIPTION	ITEM	DESCRIPTION
200	Shaft	701	Inboard Bearing
500	Housing	702	Locking Collar - Inboard Brg.
601	Outboard Bearing	703	Retaining Ring - Hsg. Outer
602	Locking Collar - Outboard Brg.	704	V-Ring Plate
603	Retaining Ring - Hsg. Outer	705	Capscrew - V-Ring Plate
604	Retaining Ring - Shaft	706	V-Ring
607	Retaining Ring - Hsg. Inner	707	Retaining Ring - Hsg. Inner

Type 3 Bearing Module
Refer to Figure 31, page 65.

Bearing Removal (Type 3)

Note: Type 3 modular agitator assemblies include the bearing spool but may not include the optional tank shut-off feature. The following instructions pertain to those agitators with that feature in place. Check the equipment certification package to decide if the tank shut-off feature is in place before attempting its activation. Draining the tank to the required level to service the bearings may be necessary.

SAFETY CAUTION!! To Avoid Possible Injury, Turn Off the Agitator. Lock out and disconnect all power to the drive motor and any optional devices. Turn off and disconnect the lubricant supply and flushing water to the stuffing box (if applicable).

1. Disconnect and remove the belt guard cover (407), the drive assembly, *see page 75 for instructions*, and belt guard backplate (406).

2. Disconnect the outboard bearing lubrication line (606). This condition does not apply to agitators with 2" and 7" diameter shafts.

3. Activate the in tank shut-off feature. *See page 53 for instructions.*

4. Slide the V-Ring (706) along the shaft toward the tank. Unfasten the grease plate (704) from the spool (800) and move it toward the tank.

5. Back off the inboard adapter sleeve locknut (707), approximately 3/16", by lifting the lockwasher tang and turning the locknut counter clockwise.

6. Insert the adapter sleeve release ring (915), a split ring service tool, into the grease plate and reassemble to the spool using four of the grease plate capscrews (705) equally spaced. Ensure that the thread engagement is at least 1-1/2 to 2 times the capscrew diameter.

7. Evenly tighten the grease plate capscrews until the taper lock on the adapter sleeve is released. Although the adapter sleeve will likely be replaced, care should be taken to avoid damage to the surrounding parts.

8. Unfasten and remove the retaining plate (604) and outboard grease seal (603). Remove the bearing spacer(602) and shaft locknut (607) and lockwasher (608) by turning the nut counter clockwise. Remove the outboard bearing from the housing.

9. Install the jack screw supports (916) or a shaft steady apparatus on all agitators with shafts 4-1/2" diameter and greater. Blocking the shaft from movement is necessary while servicing the bearings. *See "Shaft Steady Installation," page 50.*

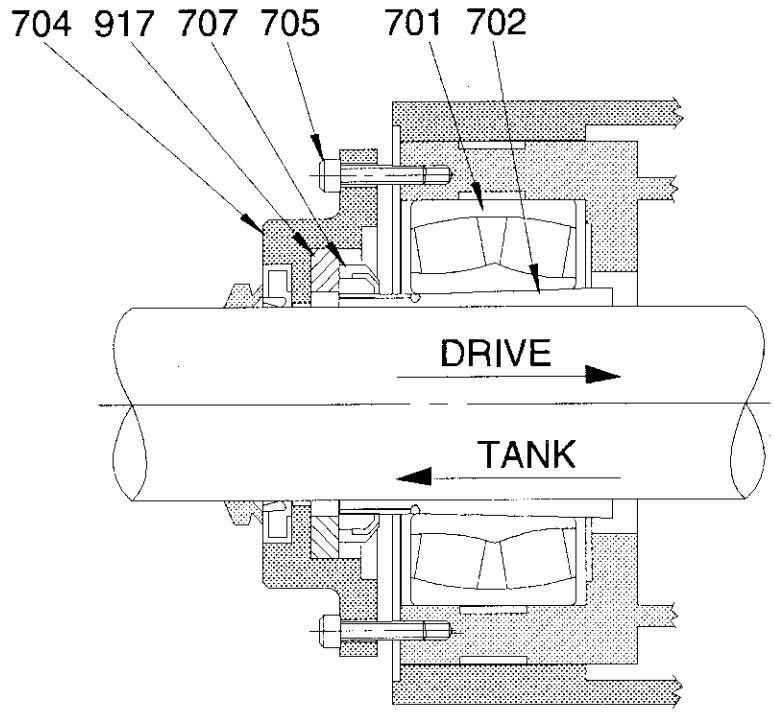

Figure 30: Adapter Sleeve Release Ring

TIP: To aid in the reinstallation of the spool and bearings, install a shaft steady on all shaft sizes to align the shaft during the reinstallation of the spool and bearings.

10. Continue to tighten the spool retaining capscrews (801) until the spool moves off its seat within the housing (500). Slide the spool and bearings along the shaft and off the drive end.

Bearing Replacement (Type 3)

Note: Before replacing the bearings it is assumed that all instructions for removal have been followed. See preceding instructions for bearing removal.

Before mounting the tapered bore spherical roller bearing to the adapter sleave, checking the initial internal radial bearing clearance is important. Radial clearance can be measured before or after the bearing is positioned on the adapter sleave

without tightening. On larger sizes the bearing should be supported by the shaft weight when measurements are taken.

To obtain satisfactory bearing performance, it is important that strict cleanliness be observed during the replacement procedure.

1. Inspect the bearing cavities for foreign material and burrs. Clean thoroughly along with the shaft and abutment surfaces. Install new inboard bearing (701) and outboard bearing (601) into the spool (800).

2. Do not remove the new bearing from its original package until immediately before it is to be mounted. The rust inhibiting compound should be left intact except the bearing bore. Wash the bore with a white spirit and dry it with a clean lint free rag. If the bearing has been hot dipped, removing the preservative before mounting is advisable. Such a bearing can be recognized by the thick coat of greasy preservative with which it is covered.

3. Spray a dry powder film lubricant to the tapered OD surface and threads of the adapter sleave (702) and the inside surface of the lock nut (707). Lubrication will greatly reduce the force required when mounting to the shaft. Do not apply this lubricant to the adapter sleeve bore or shaft. These surfaces must remain dry.

4. Position on the shaft in the correct order, a new V-ring (706) and grease plate (704) with a new inboard grease seal (703) pressed in place.

5. Slide the spool (800) with a loosely assembled inboard bearing adapter sleeve (702) along the shaft and seat within the housing (500) to the previous position with the gap between the spool flange and the housing flange. Do not fasten the spool in place at this time. Ensure that the adapter sleeve lock nut (707) is backed off enough to prevent engaging the taper lock, while sliding along the shaft, making reinstallation difficult.

6. Remove the jack screw support or shaft steady apparatus, if applicable.

7. Ensure that the outboard bearing (601) is making contact between the vertical face of the inner bearing race and the machined shoulder of the shaft.

8. Replace the bearing spacer (602) and shaft locknut (607) and lockwasher (608). Begin tightening the locknut, as snugly as possible, with a hook spanner wrench. Ensure that the chamfered face is toward the bearing. Tighten the locknut just enough to bend over the lockwasher tang into the nearest locknut slot. Do not loosen the locknut, but tighten to meet a washer tang.

NOTE: Larger size bearings will require a heavy duty spanner wrench and sledge hammer to obtain the required reduction in radial internal clearance. Do not attempt to tighten the locknut with a cold chisel and hammer as inadequate tightening and damage will result. Adding lubricant to the threads and face of the locknut, where it contacts the bearing spacer, will allow easer mounting and give protection corrosion that would impede future removal.

9. Apply a Teflon gasket sealing material (Zip Joint or equivalent), cut to size the length following the full circumference within the bolt circle of the grease plate (704) and retaining plate (604). Gasket material will spread and seal once compressed.

10. Replace the bearing retaining plate (604) with a new outboard bearing grease seal (603) and fasten to the spool with the capscrews (801). Torque to the appropriate value, *Table 13, page 81.* Ensure that the location of the lubrication fitting in the retaining plate returns to the original position, if applicable.

11. Mount the inboard bearing (701) to the adapter sleeve while observing the reduction of radial clearance during the drive up procedure. *See "Bearing to Adapter Sleeve Mounting," page 71.*

12. Fasten the grease plate and inboard grease seal to the spool with the capscrews. Torque to the appropriate value, *Table 13, page 81.* Ensure that the location of the lubrication fitting in the grease plate returns to the original position, (applicable to agitators with 2" diameter shafts only).

13. Reposition the v-ring (706) and reconnect the outboard bearing lubrication line, if applicable. Replace the capscrews (801) that fasten the spool to the housing (500) but do not tighten.

14. Deactivate the tank shut-off feature by unfastening and removing the shaft holding device (901), *Figure 23, page 35.*

15. Continue fastening the spool to housing by tightening the capscrews to the appropriate value, *Table 13, page 81*

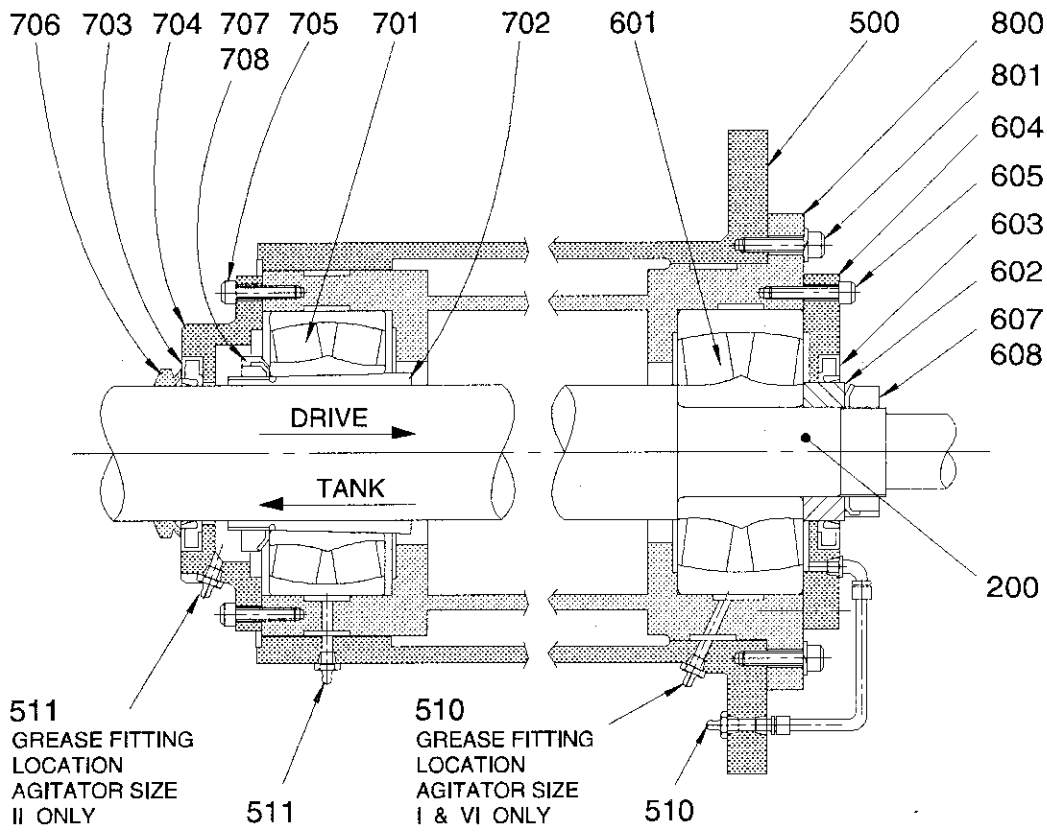

Figure 31: MD Agitator Assembly - Type 3

ITEM	DESCRIPTION	ITEM	DESCRIPTION
200	Shaft	701	Inboard bearing
500	Housing	702	Adapter Sleeve - Inboard Brg.
510	Grease Fitting - Outboard Brg.	703	Grease Seal - Inboard
511	Grease Fitting - Inboard Brg.	704	Grease Plate
601	Outboard Bearing	705	Capscrew - Grease Plate
602	Bearing Spacer	706	V-Ring
603	Grease Seal - Outboard	707	Locknut - Adpt. Sleeve
604	Retaining plate	708	Lockwasher - Adpt. Sleeve
605	Capscrew - Retaining Plate	800	Spool
607	Locknut - Shaft	801	Capscrew - Spool
608	Lockwasher - Shaft		

Type 4 Bearing Module
Refer to Figure 32, page 70.

Bearing Removal (Type 4)

Note: Type 4 agitator assemblies are without the bearing spool and the in tank shut-off feature. As a result draining the tank to the required level will be necessary and completely remove the agitator from the tank to service the bearings.

SAFETY CAUTION!! To Avoid Possible Injury, Turn Off the Agitator. Lock out and disconnect all power to the drive motor and any optional devices. Turn off and disconnect the lubricant supply and flushing water to the stuffing box (if applicable).

1. Remove the Impeller from the end of the shaft by unfastening the square head setscrews and locknuts, that bear down on the shaft and key, and pull off. Use a penetrating lubricant to aid in the removal. If the impeller cannot be easily removed, place a block of wood against the hub end of the impeller and jar it loose with a soft mallet, *Figure 9, page 14 and Figure 13, page 18.*

NOTE: An optional threaded jack screw hole may exist in the vertical outside face of the impeller hub to help in the removal. Size ranges from 3/8 to 3/4" UNC, depending on the impeller diameter.

TIP: To aid impeller removal, install a fitting and inject grease through the jack screw hole.

1. Disconnect and remove the belt guard cover (407), the drive assembly, *see page 75 for instructions,* and belt guard backplate (406).

3. Begin removing the agitator unbolting the stuffing box/flange assembly (301) from the tank and unbolting the pedestal base (501) or other support devices (eg. tie rods or pipe legs), if applicable, *Figure 4, page 10.*

4. Unbolt and separate the stuffing box/flange from the housing (500). Remove the stuffing box along with all related components completely from the agitator.

5. Slide the V-Ring (706) along the shaft toward the seal. Unfasten the grease plate (704) and the inboard grease seal (703) from the spool (800) and move toward the seal end of the housing.

6. Back off the inboard adapter sleeve locknut (707), approximately 3/16", by lifting the lockwasher (708) tang and turning the locknut counter clockwise.

7. Insert the adapter sleeve release ring (917), a split ring service tool, into the grease plate and reassemble to the spool using four of the fastening capscrews (705) equally spaced. Ensure that the thread engagement is at least 1-1/2 to 2 times the capscrew diameter, *Figure 30, page 62*

8. Evenly tighten the grease plate capscrews until the taper lock on the adapter sleeve is released. Although the adapter sleeve will likely be replaced, care should be taken to avoid damage to the surrounding parts. Remove the inboard bearing and adapter sleeve from the agitator housing (500).

9. Install the jack screw supports (930) or a shaft steady apparatus on all agitators with shafts 4-1/2" diameter and greater. Blocking the shaft from movement is necessary while servicing the bearings. *See "Shaft Steady Installation," page 50.*

10. Unfasten and remove the retaining plate (604) and outboard grease seal (603). Remove the bearing spacer(602) and shaft locknut (607) and lockwasher (608) by turning the nut counter clockwise. Remove the outboard bearing from the housing.

TIP: To aid in the reinstallation of the spool and bearings, install a shaft steady on all shaft sizes to help align the shaft during the reinstallation of the spool and bearings.

Bearing Replacement (Type 4)

NOTE: Before replacing the outboard bearing it is assumed that all instructions for removal have been followed and the shaft steady is securely in place (if applicable).

Before mounting the tapered bore spherical roller bearing to the adapter sleave, checking the initial internal radial bearing clearance is important. Radial clearance can be measured before or after the bearing is positioned on the adapter sleave without tightening. On larger sizes the bearing should be supported by the shaft weight when measurements are taken.

To obtain satisfactory bearing performance, it is important that strict cleanliness be observed during the replacement procedure.

1. Inspect the bearing cavities for foreign material and burrs. Clean thoroughly along with the shaft and abutment surfaces. Install new inboard bearing (701) and outboard bearing (601) into the spool (800).

2. Replace the inboard bearing grease seal (703) on the grease plate (704) and outboard bearing grease seal (603) on the retaining plate (604).

3. Do not remove the new bearing from its original package until immediately before it is to be mounted. The rust inhibiting compound should be left intact except the bearing bore. Wash the bore with a white spirit and dry it with a clean lint free rag. If the bearing has been hot dipped, removing the preservative before mounting is advisable. Such a bearing can be recognized by the thick coat of greasy preservative with which it is covered.

4. Spray a dry powder film lubricant to the tapered OD surface and threads of the adapter sleave (702) and the inside surface of the lock nut (707). Lubrication will greatly reduce the force required when mounting to the shaft. Do not apply this lubricant to the adapter sleeve bore or shaft. These surfaces must remain dry.

5. Install the outboard bearing (601) onto the shaft ensuring contact between the vertical face of the inner bearing race and the machined shoulder of the shaft.

6. Replace the bearing spacer (602) and bearing locknut (607) and washer (608). Begin tightening the locknut, as snugly as possible, with a hook spanner wrench. Ensure that the chamfered face is toward the bearing. Tighten the locknut just enough to bend over the lockwasher tang into the nearest locknut slot. Do not loosen the locknut, but tighten to meet a washer tang.

NOTE: Larger size bearings will require a heavy duty spanner wrench and sledge hammer to tighten the locknut effectively. Do not attempt to tighten the locknut with a cold chisel and hammer as inadequate tightening and damage will result. Adding lubricant to the threads and face of the locknut, where it contacts the bearing spacer, will allow easer mounting and give protection against corrosion that would impede future removal.

7. Remove the jack screw support or shaft steady apparatus, if applicable.

8. Position the inboard bearing adapter sleeve (702) and inboard bearing (701) on the shaft within the bearing cavity of the housing, with the threaded end of the adapter sleeve toward the tank, along with the inboard bearing.

9. Apply a Teflon gasket sealing material (Zip Joint or equivalent), cut to size the length following the full circumference within the bolt circle of the grease plate (704) and retaining plate (604). Gasket material will spread and seal once compressed.

10. Replace the bearing retaining plate (604) with a new outboard grease seal (603) to the housing with the capscrews (605). Torque to the appropriate value, *Table 13, page 81*. Ensure that the location of the lubrication fitting in the retaining plate returns to the original position, if applicable.

11. Mount the inboard bearing to the adapter sleeve while observing the reduction of radial clearance during the drive up procedure. *See "Bearing to Adapter Sleeve Mounting," page 71*

12. Fasten the grease plate (704) and the inboard grease seal (703) to the housing with the capscrews (705). Torque to the appropriate value, *Table 13, page 81*. Ensure that the location of the lubrication fitting in the grease plate returns to the original position, (applicable to agitators with 2" diameter shafts only).

13. Reposition the v-ring (706) against the inboard grease seal (703).

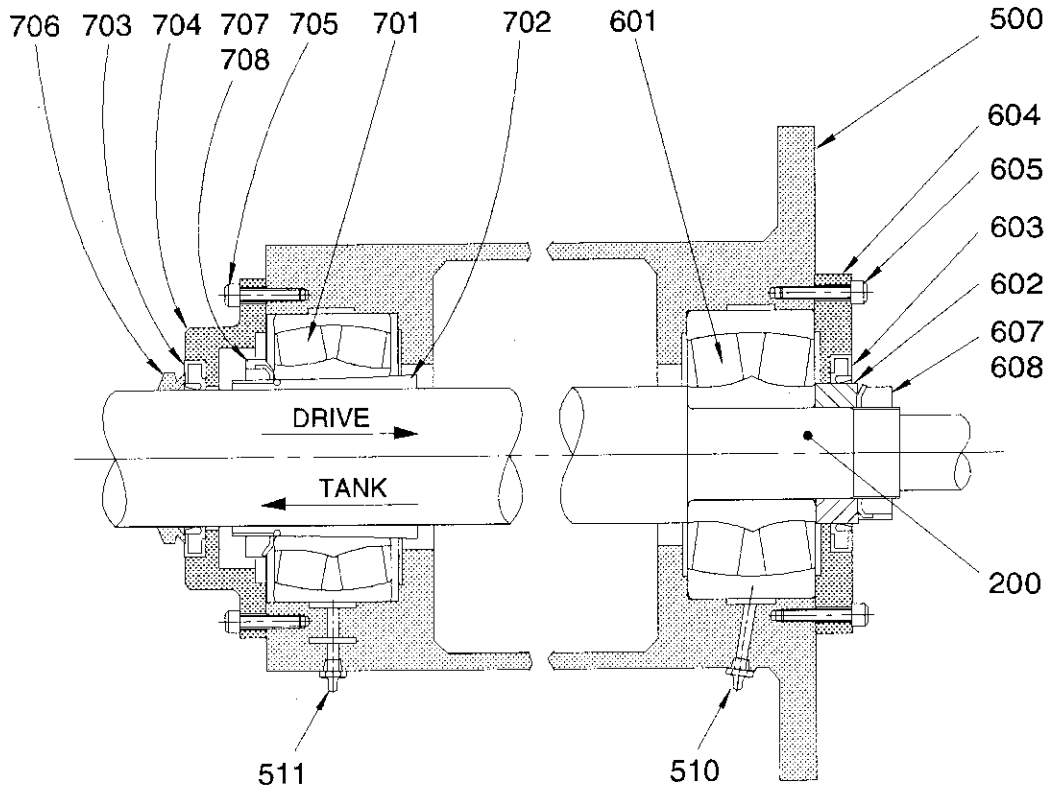

Figure 32: MD Agitator Assembly - Type 4

ITEM	DESCRIPTION	ITEM	DESCRIPTION
200	Shaft	608	Lockwasher - Shaft
500	Housing	701	Inboard bearing
510	Grease Fitting - Outboard Brg.	702	Adapter Sleeve - Inboard Brg.
511	Grease Fitting - Inboard Brg.	703	Grease Seal - Inboard
601	Outboard Bearing	704	Grease Plate
602	Bearing Spacer	705	Capscrew - Grease Plate
603	Grease Seal - Outboard	706	V-Ring
604	Retaining plate	707	Locknut - Adpt. Sleeve
605	Capscrew - Retaining Plate	708	Lockwasher - Adpt. Sleeve
607	Locknut - Shaft		

Bearing to Adapter Sleeve Mounting
Refer to *Figure 35*, page 79 or *Figure 36*, page 80 and *Table 12*, page 80.

The inboard bearing is a self aligning spherical roller bearing with a tapered bore. This bearing is mounted to the shaft using a tapered adapter sleeve. The inner ring of the bearing is mounted to the adapter sleeve with an interference fit. How much interference depends on how far the bearing is driven up the sleeve. During the drive-up, the unmounted radial internal clearance of the bearing will be reduced gradually as the inner ring expands. That reduction in internal clearance is a measure of how much interference.

NOTE: Before mounting the tapered bore spherical roller bearing to the adapter sleave it is important that all associated components of the bearing assembly are clean and free of any foreign material and burrs.

1. Measure the unmounted radial initial clearance of the bearing to establish a starting point for mounting the bearing to the adapter sleeve. The measurement can be taken before or after the bearing is positioned on the adapter sleave without tightening.

   With smaller inboard spherical bearings used on agitators with 2" and 2-1/2" diameter shafts, and where space for measuring the radial clearance is limited, the axial drive-up of the inner ring on the adapter sleeve must be measured. Use the axial drive-up values in *Table 9, page 73* to find the interference fit instead of the clearance reduction.

   Insert progressively larger feeler blades the full length of the roller between the most vertical unloaded roller and the outer ring sphere. Do not roll the feeler blade through the clearance, slide it through. Record the measurement of the largest size blade that will slide through. This size is the unmounted radial internal clearance.

2. Begin tightening the locknut (603) with lockwasher (000), as snugly as possible, with a hook spanner wrench. Lubricant on the threads and face of the lockwasher where it contacts with the locknut will make easer mounting. Ensure that the chamfered face of the locknut is toward the bearing and the contact surfaces of the lockwasher and bearing are dry.

NOTE: Larger size bearings will require a heavy duty spanner wrench and sledge hammer to obtain the required reduction in radial internal clearance. Do not attempt to tighten the locknut with a cold chisel and hammer as inadequate tightening and damage will result.

3. Remeasure the internal radial clearance during the tightening of the locknut, with the feeler blades inserted between the most vertical unloaded roller and the outer ring sphere. Continue this measuring and tightening procedure until the radial internal clearance value reduces by the amount shown as the "reduction in radial internal clearance," *Table 9, page 73.*

4. Check to ensure that the radial internal clearance value is not less than the "minimum permissible residual clearance after mounting," in *Table 9,* and that the final bearing location is equally spaced within the bearing cavity, *Figure 33, page 72*

NOTE: The inboard bearing is the "floating bearing" and must be equally spaced within the bearing cavity of the spool or housing to allow for shaft deflection in the loaded bearing zone.

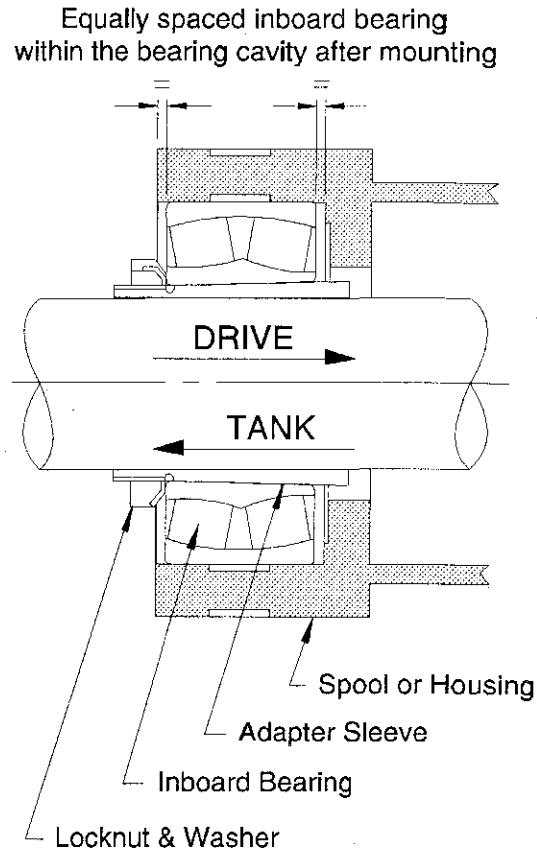

Figure 33: Inboard Bearing Position

5. When the desired reduction of internal radial clearance is achieved, tighten the locknut just enough to bend over the lockwasher tang into the nearest locknut slot. Do not loosen the locknut, but tighten to meet a washer tang.

   Example: Determine the amount to reduce the radial internal clearance for a 3" diameter shaft

   A) Unmounted radial internal clearance from step 1 = 0.0040"

   B) Reduction in radial internal clearance from *Table 9* = 0.0018" min. / 0.0024" max.

C) Final mounted radial internal clearance = 0.0015" min. to 0.0022" max.
(0.0040" - 0.0024" = 0.0016" minimum)
(0.0040" - 0.0018" = 0.0022" maximum)

Bearing to Adapter Sleeve Mounting

Table 9: Reduction in Radial Internal Clearance

This table contains guideline values for the reduction in radial internal clearance and axial drive-up for the inboard spherical roller bearing with tapered bore. These values are measured at normal ambient temperature and zero measuring load before mounting.

AGITATOR SHAFT DIAMETER (Inches)	BEARING BORE DIAMETER (mm)	RADIAL INTERNAL CLEARANCE BEFORE MOUNTING (Inches)		REDUCTION IN RADIAL INTERNAL CLEARANCE (Inches)		AXIAL DRIVE-UP (Inches)		RESIDUAL CLEARANCE AFTER MOUNTING (Inches)
		MIN	MAX	MIN	MAX	MIN	MAX	MINIMUM
2.0	55	0.0022	0.0030	0.0012	0.0015	0.018	0.024	0.0010
2.5	75	0.0028	0.0037	0.0016	0.0020	0.025	0.030	0.0010
3.0	85	0.0032	0.0044	0.0018	0.0024	0.027	0.035	0.0014
3.5	100	0.0032	0.0044	0.0018	0.0024	0.027	0.035	0.0014
4.0	110	0.0039	0.0053	0.0020	0.0028	0.030	0.045	0.0020
4.5	130	0.0047	0.0063	0.0026	0.0035	0.045	0.055	0.0022
5.0	140	0.0047	0.0063	0.0026	0.0035	0.045	0.055	0.0022
5.5	160	0.0051	0.0071	0.0030	0.0039	0.047	0.063	0.0022
6.0	170	0.0055	0.0079	0.0030	0.0045	0.050	0.070	0.0024
6.5	180	0.0055	0.0079	0.0030	0.0045	0.050	0.070	0.0024
7.0	200	0.0063	0.0088	0.0035	0.0050	0.055	0.080	0.0028

New Bearing Lubrication

The life expectancy of a grease depends on several factors such as the type of grease, speed and operating temperature of the bearings. **Old grease should be removed and replaced once every two years,** or during every scheduled maintenance shut down if possible.

The bearings on the modular design (MD) agitator should be greased after re-assembly is completed. Packing the machined recess of the grease plate (704) with grease before fastening to the spool (800) or housing (500) is important. Grease will

better help in the proper lubrication of the inboard bearing. **For the volume of new grease required for each bearing, *see Table 8*. As a guide it is equal to 10 injections of grease per 1" of shaft diameter for both bearings.** This guide is based on the use of a conventional pneumatic grease pump or equivalent.

Re-grease the bearing as it rotates. Grease can be injected with a gun into the housing or grease plates (depending on design) through the regular 1/4" NPT fitting. Always use the same type of grease previously used in the bearing. Some greases lose lubricating capability when mixed with another grease. Never mix greases with unlike bases without first checking compatibility with the supplier. The bearings were prelubricated with Lithium EP NLGI Grade 2 nonchannelling grease (Quaker State). Chemineer recommends the same type of grease or compatible equivalent.

New Bearing Test Run

Chemineer recommends that the agitator bearings be test run before going fully into service. The bearings must not be given a test run without proper lubrication. The quietness of operation can be determined by listening through a screw driver or a length of metal rod with one end pressed firmly against the bearing housing. If a rumbling or unevenness is noticed, it may be due to dirt. A whistling sound is attributable to improper lubrication. Unusual noises should be investigated immediately and corrective action taken. Check again after operating for a short time.

BELT DRIVE

Checking Belt Tension

Refer to Figure 34, page 77.

SAFETY CAUTION!! To Avoid Possible Injury, Turn Off the Agitator. Lock out and disconnect all power to the drive motor and any optional devices. Turn off and disconnect the lubricant supply and flushing water to the stuffing box (if applicable).

NOTE: Do not apply belt dressing during the tensioning procedure as dressing will damage the belts and cause early failure.

Without exception, the most important factor in the successful operation of a belt drive is proper belt tensioning. To achieve the long, trouble-free service associated with belt drives, the belt tension must be sufficient to overcome slipping under maximum peak loads. The general method to increase the tension of the belt drive is to increase the center distance between the two sheaves.

1. Unbolt and slide the metal mesh on the side of the belt guard cover, allowing access to check the belt condition and tension. If excessive belt wear is evident, replace all belts as a complete set. *See page 76 for instructions on belt replacement.*

2. Check the tension of belts by measuring the deflection force using a tensiometer or equivalent spring scale. Apply a perpendicular force to any one of the belts or belt at the mid point of the span length, *Figure 34, page 77.*

3. Observe the force required to deflect any one belt 1/64" for every inch of span length. For example, the deflection for a 32" span would be 1/64" x 32" equals 1/2" of deflection.

4. Achieve correct belt deflection by increasing or decreasing the sheave center distance using the adjustable motor support base. The correct operating tension for a V-belt drive (if applicable) is the lowest tension at which the belts will not slip under peak load conditions.

Belt Replacement

SAFETY CAUTION!! To Avoid Possible Injury, Turn Off the Agitator. Lock out and disconnect all power to the drive motor and any optional devices. Turn off and disconnect the lubricant supply and flushing water to the stuffing box (if applicable).

NOTE: Keep all new belts together as a set, separate from other belts. Mixing new and old belts during replacement may result in a loss of power transmitting capability.

1. Remove the belt guard cover from the supporting back panel.

2. Reduce the center distance between the sheaves by lowering the motor with the adjustable motor support base. Remove all the belts from the sheaves.

3. Make sure the motor shaft remains parallel with the agitator shaft and tightly secured to the mounting base. Shimming the motor may be required to correct any motor shaft to agitator shaft parallel misalignment.

4. Check that the sheaves remain properly aligned when installed. V-belts can tolerate only up to 1/32" per foot of center distance misalignment. Use a straight edge to help obtain proper alignment

5. Place the belts over the sheaves and in the grooves without forcing them over the sides of the grooves. Arrange the belts so all have about the same amount of sag before tensioning.

6. Apply tension to the belts by increasing the center distance until the belts are snug. Increased center distance is achieved by raising the motor with the adjustable motor support base. Operate the agitator drive for a few minutes to seat the belts in the sheave grooves.

7. Stop the drive and tension the belts to the maximum deflection force recommended, *see Table 10 and Table 11*. Measure the deflection value using a tensiometer or equivalent spring scale. Apply a perpendicular force to any one belt at the mid point of the span, *Figure 34, page 77*.

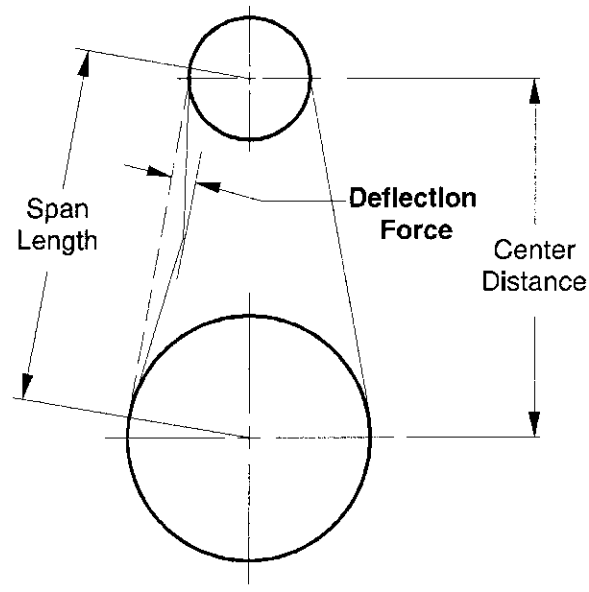

Figure 34: Belt Tensioning

8. Achieve correct belt deflection by increasing or decreasing the sheave center distance using the adjustable motor support base. The correct operating tension for a V-belt drive (if applicable) is the lowest tension at which the belts will not slip under peak load conditions.

Check the tension on the new belt drive at least twice during the first day of operation and adjust as required. Normally, a rapid decrease in belt tension will occur until belts have run in. After a few days of operation the belts will seat themselves in the sheave grooves and it may become necessary to readjust the tension again.

Table 10: Recommended Deflection Force per Belt - Ultra-V Belts

Force required to deflect any one of the belts 1/64" for every inch of span length.

ULTRA-V BELTS			
BELT SECTION	SMALL SHEAVE DIAMETER	DEFLECTION FORCE (LBS.)	
		MINIMUM	MAXIMUM
3V	2.65 - 3.65	3.5	5.5
	4.75 - 6.90	5.0	7.5
5V	7.1 - 9.0	11.0	16.0
	14.0 - 21.2	13.0	19.5
8V	12.5 - 17.0	27.0	40.5
	21.2 - 24.8	30.0	45.0

ULTRA-V COG BELTS			
BELT SECTION	SMALL SHEAVE DIAMETER	DEFLECTION FORCE (LBS.)	
		MINIMUM	MAXIMUM
3VX	2.2 - 3.0	4.0	6.0
	4.12 - 6.90	5.5	8.0
5VX	4.4 - 5.2	10.0	15.0
	6.3 - 7.1	12.0	18.0
	9.0 - 14.0	15.0	22.0

Table 11: Recommended Deflection Force per Belt - HTD Belts

Force required to deflect any one of the belts 1/64" for every inch of span length.

HTD BELTS					
PITCH	BELT WIDTH	DEFLECTION (FORCE-LBS.)	PITCH	BELT WIDTH	DEFLECTION (FORCE-LBS.)
5mm	15mm	1 to 2	14mm	85mm	13 to 26
	25mm	1.5 to 3		115mm	19 to 27
8mm	20mm	2 to 4		170mm	29 to 58
	30mm	3 to 6	20mm	115mm	28 to 56
	50mm	6 to 11		170mm	43 to 86
	85mm	10 to 19		230mm	60 to 120
14mm	40mm	5 to 11		290mm	76 to 150
	55mm	8 to 16		340mm	90 to 180

SHEAVE REPLACEMENT

SAFETY CAUTION!! To Avoid Possible Injury, Turn Off the Agitator. Lock out and disconnect all power to the drive motor and any optional devices. Turn off and disconnect the lubricant supply and flushing water to the stuffing box (if applicable).

1. Remove the belt guard cover from the supporting back panel.

2. Reduce the center distance between the sheaves by lowering the motor with the adjustable motor support base. Remove all the belts from the sheaves.

3. Check the condition of the belts and replace (as a complete set only), if required. *See Belt Replacement on page 76.*

4. Note the mounting orientation of the sheave bushing flanges to decide if the sheaves have standard mounting ("Flange In") or reverse mounting ("Flange Out"). This observation is important to ensure that the same mounting orientation is repeated after the sheave(s) has been replaced, *Figure 35.*

Dismounting "Flange In"
Refer to Figure 35.

1. Remove the sheave(s) from the bushing by removing the connecting fasteners and inserting them into the threaded jacking screw holes (A) in the sheave hub.

2. Tighten the fasteners equally against the bushing flange to break the grip of the split "QD" bushing on the shaft and allow the sheave to slide off freely. No wheel puller or heavy tool is necessary to remove the sheave.

3. Loosen the setscrews in the bushing over the key. Remove the bushing from the shaft.

4. Install the new sheave and/or bushing as required by following the Belt Drive Installation instructions, *page 21.*

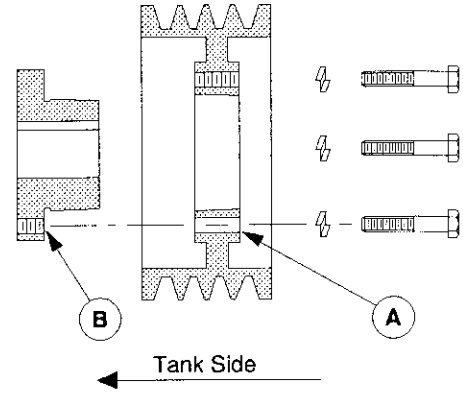

Figure 35: "Flange-In" Dismounting

Dismounting "Flange Out"
Refer to Figure 36.

1. Remove the sheave(s) from the bushing by removing the connecting fasteners and inserting them into the threaded jacking screw holes (A) in the bushing flange.

2. Tighten the fasteners equally up against the bushing flange to break the grip of the split "QD" bushing on the shaft and allow the sheave to slide off freely. No wheel puller or heavy tool is necessary to remove the sheave.

3. Loosen the setscrews in the bushing over the key. Remove the bushing from the shaft.

4. Install the new sheave and/or bushing as required by following the Belt Drive Installation instructions, *page 21*.

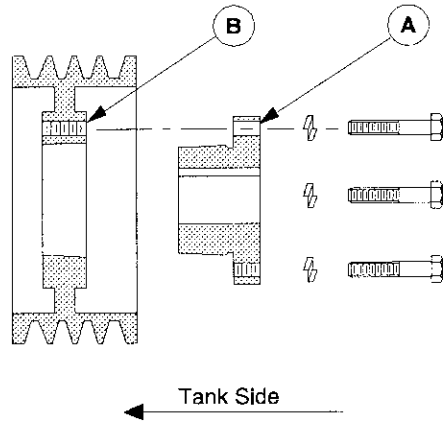

Figure 36: "Flange-Out" Dismounting

Table 12: Torque Values - "QD"Style Bushings

Use this table to determine the proper torque to apply to the capscrews when engaging the sheave bushings.

BUSHING TYPE	CAPSCREW	TORQUE (Ft. lbs.)	BUSHING TYPE	CAPSCREW	TORQUE (Ft. lbs.)
JA	#10-24 UNC	5	J	5/8-11 UNC	135
SH,SDS,SD	1/4-20 UNC	9	M	3/4-10 UNC	225
DK	5/16-18 UNC	15	N	7/8-9 UNC	300
SF	3/8-16 UNC	30	P	1-8 UNC	450
E	1/2-13 UNC	60	W	1 1/8-7 UNC	600
F	9/16-12 UNC	75	S	1 1/4-7 UNC	750

Use *Table 13* as a guide to decide the proper torque when tightening the fasteners on your equipment. Torque values listed are in both foot pounds (ft.lbs.) and Newton meters (Nm). Values are based on fasteners with lubricated threads. When fasteners cannot be lubricated, multiply values by 1.33.

Table 13: Recommended Bolt Torque Values

Bolt Size	CARBON STEEL[3]			
	Grade 2		Grade 5	
	ft lb	Nm	ft lb	Nm
8-32	1.2	1.6	1.9	2.5
10-24	1.7	2.3	2.7	3.6
10-32	1.9	2.6	3.1	4.1
1/4-20	4.1	5.6	6	8.1
5/16-18	8.3	11	13	17
5/16-24	-	-	14	19
3/8-16	15	20	23	31
3/8-24	-	-	26	36
1/2-13	38	51	56	76
1/2-20	-	-	68	92
5/8-11	68	92	113	153
5/8-18	-	-	135	161
3/4-10	120	163	200	271
3/4-16	-	-	225	305
7/8-9	105	143	296	401
1-8	165	224	443	601
1-1/8-7	225	305	596	808
1-1/4-7	315	428	840	1139
1-3/8-6	417	566	1103	1495
1-1/2-6	555	752	1463	1983
1-3/4-5	825	1118	2175	2948

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

Use *Table 14* as a guide when sourcing bearing lubricants for Prochem mixers. Some of these lubricants are of the EP type and may contain toxic substances not allowed in the food processing industry. Check with lubricant manufacturer for approval.

Table 14: Compatible Bearing Lubricants

Manufacturer	Lubricant
Amoco Oil Co.	Amolith Grease No.2
Ashland Oil, Inc.	Multilube Lithium Grease
Atlantic Richfield Co.	Litholine H EP 2 Grease
Castrol	Spheerol AP2
Chevron U.S.A., Inc.	Industrial Grease Medium
Cities Service Co.	Premium Lithium Grease No.2
Conoco Inc.	EP Conolith Grease No.2
Esso	Beacon 2
Exxon Company, USA	Unirex N2
Gulf Oil Corp.	Gulfcrown Grease No.2
Gulf Canada Limited	Gulfcrown Medium
E.F. Houghton & Co.	Cosmolube 2
Imperial Oil Ltd.	Unirex N2L
Kendall Refining Co.	Multi-Purpose Lithium Grease L-421
Keystone Div Pennwalt Corp.	81 Light
Mobil Oil Corp.	Mobilux 2
Phillips Petroleum Co.	Philube IB and RB
Quaker State	Multi-Purpose Lithium NLGI No.2
Shell Oil Co.	Alvania Grease 2
Shell Canada Limited	Alvania Grease R2
Skf Canada Limited	LGEP 2
Standard Oil Co.	Factogard EP2
Sun Oil Co.	Prestige 42 Grease
Texaco Inc.	Premium RB Grease
Texaco Canada Inc.	Marfak MP2
Union Oil Co.	Unoba Ep

TROUBLESHOOTING

The troubleshooting guide has been divided into a series of tables dealing with different problem areas to be as concise and complete as possible.

Table 15: Troubleshooting - Electric Motor

OBSERVATION	POSSIBLE CAUSE	ACTION
Motor won't start	Usually line trouble - single phasing at starter	Check source of power supply.
	Improper connection	Check connections with diagram.
	Load too heavy	Disconnect motor from agitator to see if it starts without load.
Excessive hum	High voltage	Check input voltage.
		Check connections.
Regular clicking	Foreign matter in air gap	Take out rotor; remove matter.
Rapid knocking	See bearing guide	-----
Motor overheating (Check with thermometer don't depend on hand)	Overload	Measure load. Check for excessive friction in motor, drive, or machine. Potential process problem - contact Chemineer. Do not reduce the load or replace motor with one of greater capacity without first consulting Chemineer.
	Single phase	Check current, all phases.
	Dirt in motor	Check air flow at ventilation ducts. Blow out motor. Use solvent on wound section if necessary.
	Unbalanced voltage	Check voltage, all phases.
	Rotor rubbing on stator	Check alignment. Clean air gap. Check and replace bearings, as necessary.

Table 15: Troubleshooting - Electric Motor (continued)

OBSERVATION	POSSIBLE CAUSE	ACTION
Motor overheating (cont.) (Check with thermometer don't depend on hand)	Open stator windings	Disconnect motor from load. Check idle amps balance in all three phases. Check stator resistance in all three phases for balance.
	Open voltage	Check voltage.
	Grounding (short circuiting)	Locate with test lamp and repair.
	Improper connections	Recheck connections.

Table 16: Troubleshooting - V-Belt Drive

OBSERVATION	POSSIBLE CAUSE	ACTION
Rapid belt wear	Worn sheave grooves	Inspect sheave grooves. Replace if necessary.
	Mismatched belts	Replace with matched set.
	Belts slipping	Apply correct tension (use tensiometer).
	Improper installation	Replace belts - install properly.
	Improper belt storage	Replace belts.
	Sheave misalignment	Realign sheaves.
	Shock loads from process	Contact Chemineer.
	Foreign objects in drive	Provide drive shroud.
Belt turned over	Broken cord in belt, due to improper installation	Replace belts - install properly.
	Impulse loads	Apply proper tension.
	Misalignment of sheave and shaft	Realign drive.
	Worn sheave grooves	Replace sheave grooves.
	Loose belts	Tighten belts.
	Excessive belt vibration	Check alignment.
		Check equipment for solid mounting.

Table 16: Troubleshooting - V-Belt Drive (continued)

OBSERVATION	POSSIBLE CAUSE	ACTION
Belts slipping	Insufficient tension	Increase tension.
	Worn sheave grooves	Inspect sheave grooves, replace if necessary.
Belt Squealing	Insufficient tension	Increase tension.
	Belt bottoming grooves	Replace sheave and/or belts.
	Heavy starting load	Investigate load source and contact Chemineer.
Checked or cracked belts	Excessive heat due to slippage	Replace belts and apply correct tension.
	Excessive ambient temperature	Improve ventilation.
Mismatched belts	Sheave grooves worn unevenly; Improper groove angle. Give appearance of mismatched belts.	Replace sheaves, belt set and align.
	Sheave shafts not parallel. Give appearance of mismatched belts.	Align drive.
Hot bearings	Excessive tension	Apply correct tension.
	Excessive heat due to slippage	See belt slippage.

Table 17: Troubleshooting - Stuffing Box

OBSERVATION	POSSIBLE CAUSE	ACTION
No leakage at start-up	Packing gland too tight on packing in stuffing box	Back off gland to encourage generous leakage.
Excessive leakage at start-up	Incorrect size packing	Install correct size packing.
	Incorrect installation	Install packing in accordance with instructions and diagrams outlined in manual.
Packing rings flat-tened out on I.D. under the shaft	Shaft misalignment	Realign shaft and repack stuffing box.
	Bent shaft	Check run out at stuffing box and shaft end. Refer to Chemineer with results.
	Worn bearings	Check bearings and replace if necessary.
	Unbalanced impeller	Check impeller for damage.
Sealing face of rings are dried up and charred, while the rest of the packing remains in good condition	High temperature with lack of lubricants	Increase lubrication. Select packing with a higher heat conductivity. Reduce gland follower pressure to a minimum. Repack stuffing box.

Table 17: Troubleshooting - Stuffing Box (continued)

OBSERVATION	POSSIBLE CAUSE	ACTION
Torn packing	Burns on sleeve	Check shaft sleeve. Replace if necessary.
	In contact with abrasive medium	Clean fluid lubrication/flushing required. Abrasion resistant packing may be considered.
Packing hardens	See "burned rings"	----
Unexplained leakage	Leakage may be from under shaft sleeve sealing) - rings missing or damaged	Replace sleeve seal under sleeve.
Distinct bulge on side of ring	Adjacent rings cut too short	Cut rings to precise dimensions on shaft or mandrel having the same diameter.
One or more rings missing from the bottom of the set	Bottom of the stuffing box badly worn and packing is being extruded into system	Install neck bushing to prevent extrusion or use end rings of adequate densities to prevent extrusion into system.
Gland end rings in poor condition, bottom rings O.K.	Improper installation	Install packing in accordance with instructions and diagrams outlined in manual.
Rings extruding past gland follower	Excessive gland pressure	Reduce gland follower pressure.

Table 18: Troubleshooting - Bearings

OBSERVATION	POSSIBLE CAUSE	ACTION
Overheating bearing	Wrong type of grease or oil causing break-down of lubricant	Consult reliable lubricant manufacturer for proper type of lubricant.
	Inadequate amount of lubricant	Consult reliable lubricant manufacturer for proper amount of lubricant.
	Excessive amount of lubricant	Clean and repack bearing with correct amount of lubricant.
	Excessive distortion of the housing	Check and scrape housing bore to relieve pinching of bearing. Be sure pedestal surface is flat. Ensure that shims cover the entire area of pillowblock base.
	Adapter tightened	Loosen locknut and sleeve assembly. Retighten, but be sure that bearing turns freely.
	Housing bore too large	Replace housing with one having proper size.
	Incorrect linear or angular alignment of two or more shafts with two or more bearings	Shim housing bases. Be sure that shafts are coupled in a straight line.
	Prong rubbing against bearing	Remove lockwasher. Straighten prong or replace with a new washer.
Hard turning of shaft	Wrong type of grease or oil causing break-down of lubricant	Consult reliable lubricant manufacturer for proper type of lubricant.
	Inadequate amount of lubricant	Consult reliable lubricant manufacturer for proper amount of lubricant.
	Excessive amount of lubricant	Check and repack with correct amount of lubricant.
	Excessive distortion of housing	Check and scrape housing bore to relieve pinching of bearing. Be sure pedestal surface is flat. Ensure that shims cover the entire area of pillowblock base.

Table 18: Troubleshooting - Bearings (continued)

OBSERVATION	POSSIBLE CAUSE	ACTION
Hard turning of shaft (contd.)	Adapter tightened excessively	Loosen locknut and sleeve assembly. Retighten, but be sure that bearing turns freely.
	Foreign matter in housing	Clean out bearing housing. Replace worn-out seals, or improve seal design to obtain adequate protection of bearings.
	Corrosive agents entering the bearing housing	Addition of a shroud or flinger to throw off foreign matter.
	Distortion of out housing and ring. Pinching of bearing.	Remachine housing fillet to obtain proper support.
	Distortion of shaft and inner ring. Uneven expansion of bearing inner ring.	Remachine shaft fillet to obtain proper support.
	Inadequate support in housing causing cocking of outer ring	Remachine housing fillet to relieve stress. May require shoulder collar.
	Inadequate shoulder support causing bending of shaft	Remachine shaft fillet to relieve stress. May require shoulder collar.
Noisy bearing	Wrong type of grease or oil causing break-down of lubricant	Consult reliable lubricant manufacturer for proper type of lubricant.
	Insufficient amount of lubricant	Consult reliable lubricant manufacturer for proper amount of lubricant.
	Foreign matter in housing	Clean out housing. Replace worn-out seals, or improve seal design to obtain adequate protection of bearings.
	Corrosive agents entering the bearing housing	Addition of a shroud or flinger to throw off foreign matter.
	Excessive distortion of housing	Check and scrape housing to relieve pinching of bearing. Be sure pedestal surface is flat. Ensure that shims cover the entire area of pillowblock base.

Table 18: Troubleshooting - Bearings (continued)

OBSERVATION	POSSIBLE CAUSE	ACTION
Noisy bearing (cont.)	Shaft diameter too small	Metallize shaft and regrind to obtain proper fit.
	Adapter not tightened sufficiently	Retighten adapter.
	Adapter tightened excessively	Loosen locknut and sleeve assembly. Retighten, but be sure that bearing turns freely.
	Flat on roller due to skidding (result of fast starting)	Carefully examine rollers, looking for flat spots on the surface. Replace bearing.
	Prong rubbing against bearing	Remove lockwasher, straighten prong or replace with a new washer.
	Incorrect method of mounting, hammer blows on bearing	Replace with new bearing. Never hammer any part of bearing when mounting.
	Distorted shaft and other parts of bearing assembly	Only in extreme case should a blow torch be used to facilitate removal of a failed bearing. Care should be exercised to avoid high heat concentration at any one point so distortion is eliminated.
	Bearing exposed to vibration while machine is idle	Carefully examine bearing for wear spots separated by distance equal to the spacing of the balls or rollers. Replace bearing.
	Unbalanced load. Housing bore too large.	Rebalance unit. Replace housing with one having proper bore.
	Bearing seat diameter machined oversize causing excessive expansion of shaft and bearing inner ring, thus reducing clearance in bearing	Grind shaft to get proper fit between inner ring of bearing and shaft.

Table 18 Troubleshooting - Bearings (continued)

OBSERVATION	POSSIBLE CAUSE	ACTION
Vibration	Foreign matter entering housing	Clean out bearing housing. Replace worn-out seals or improve seal design to obtain adequate protection of bearing.
	Corrosive agents entering the bearing housing	Addition of a shroud or flinger to throw off foreign matter.
	Excessive distortion of housing	Check and scrape housing to relieve pinching of bearing. Be sure pedestal surface is flat. Ensure that shims cover the entire area of pillowblock base.
	Shaft diameter too small	Metallize shaft and regrind to obtain proper fit.
	Adapter not tightened sufficiently	Retighten adapter.
	Flat on roller due to skidding (result of fast starting)	Carefully examine rollers, looking for flat spots on the surface. Replace bearing.
	Housing bore too large	Remove lockwasher, straighten prong or replace with a new washer.
	Incorrect method of mounting. Hammer blows on bearing.	Replace with new bearing. Never hammer any part of bearing when mounting.
	Excessive clearance in bearing, resulting in vibration	Use bearings with recommended internal clearances.
	Distortion of outer housing and ring. Pinching of bearing	Remachine housing fillet to obtain proper support.
	Distortion of shaft and inner ring. Uneven expansion of bearing inner ring.	Remachine shaft fillet to obtain proper support.
	Vibration of machine	Check balance of rotating parts.
	Inadequate support in housing causing cocking of outer ring	Remachine housing fillet to relieve stress. May require shoulder collar.
	Inadequate shoulder support causing bending of shaft	Remachine shaft fillet to relieve stress. May require shoulder collar.

PARTS

Item No.	Description	Qty.
100	**Impeller Assembly**	**1**
101	Impeller	1
102	Body (removable Blade option)	1
103	Blade (removable Blade option)	3 (6)
104	Hex. Head Bold (removable Blade option)	18 (36)
105	Lock Washer (removable Blade option)	18 (36)
106	Flat Washer (removable Blade option)	18 (36)
107	Hex. Nut (removable Blade option)	36 (72)
110	Impeller Key	1
111	Square Head Set Screw & Nut	1
200	**Shaft**	**1**
210	Shaft Slinger	1
300	**Seal Flange Assembly**	**1**
301	Stuffing Box/Flange	1
304	Throttle Bushing	1
305A	Packing Ring - Type L	3
305B	Packing Ring - Type DL	5
307	Gland	1
308	Gland Adjuster Studs	4
309	Gland Adjuster Nuts	4
310	Shaft Sleeve Assembly	1
311	Setscrews	6
312	O-Ring - Sleeve	1
315	Lantern Ring	1
320	Shut-Off Collar assembly (optional)	1
321	O-Ring - Collar	1
322	Sq. Hd. Setscrews	4
323	Shut-Off Seal Ring (optional)	1

Item No.	Description	Qty.
400	**Belt Drive Assembly**	**1**
401	Support - motor mount	1
402	Adjuster - motor mount	4
404	Motor Mount	1
405	Motor	1
406	Back Plate - belt guard	1
407	Cover - belt guard	1
408	Drive Sheave	1
410	Belts	
411	Driven Sheave	1
500	**Housing**	**1**
501	Pedestal Base	1
510	Grease Fitting - Outboard Bearing	1
511	Grease Fitting - Inboard Bearing	1

Agitator Assembly Type 1 & 2

600	**Outboard Bearing Assembly**	**1**
601	Outboard Bearing	1
602	Locking Collar - Outboard Bearing	1
603	Retaining Ring - Spool outboard	1
604	Retaining Ring - Shaft	1
700	**Inboard Bearing Assembly**	**1**
701	Inboard Bearing	1
702	Locking Collar - Intboard Bearing	1
703	Retaining Ring - Spool inboard	1
704	V-Ring Plate	1
705	Capscrew - V-Ring Plate	
706	V-Ring	1

Item No.	Description	Qty.
Agitator Assembly Type 3 & 4		
600	**Outboard Bearing Assembly**	**1**
601	Outboard Bearing	1
602	Bearing Spacer	1
603	Grease Seal - Outboard	1
604	Retaining Plate	1
605	Capscrew - Retaining Plate	
607	Locknut - Shaft	1
608	Lockwasher - Shaft	1
700	**Inboard Bearing Assembly**	**1**
701	Inboard Bearing	1
702	Adapter Sleeve - Inboard Bearing	1
703	Grease Seal - Intboard	1
704	Grease Plate	1
705	Capscrew - Grease Plate	
706	V-Ring	1
707	Locknut - Adapter Sleeve	1
708	Lockwasher - Adapter Sleeve	1
800	**Spool**	**1**
801	Capscrew - Spool	

Item No.	Description	Qty.
900	**Service Tools & Miscellaneous**	**1**
901	Shaft Holding Device	1
902	Tensiometer	1
905	Wall Insert of Tank Nozzle	1
910	Dial Indicator	1
911	Hold Down Nut & Anchor	4
912	Hard Shims and/or Grout	
913	Support Base	1
914	Calipers	
915	Adapter Sleeve Release Ring - Split	1
920	Tie Rods (optional)	1 pair
921	Pipe Legs (optional)	1 pair
930	Jack Screw Support	1 pair
931	Nuts - Jack Screw Support	4

Addendum - New Mark II Impellers

Mark II impellers are manufactured with bolted blades for sizes 25A through 87D , and with welded blades for sizes 13A through 23D as they will pass easily through a 24" manway. They are manufactured in both three (3) and six (6) bladed versions. A bolted three (3) blade version is shown below in **Figure 1**

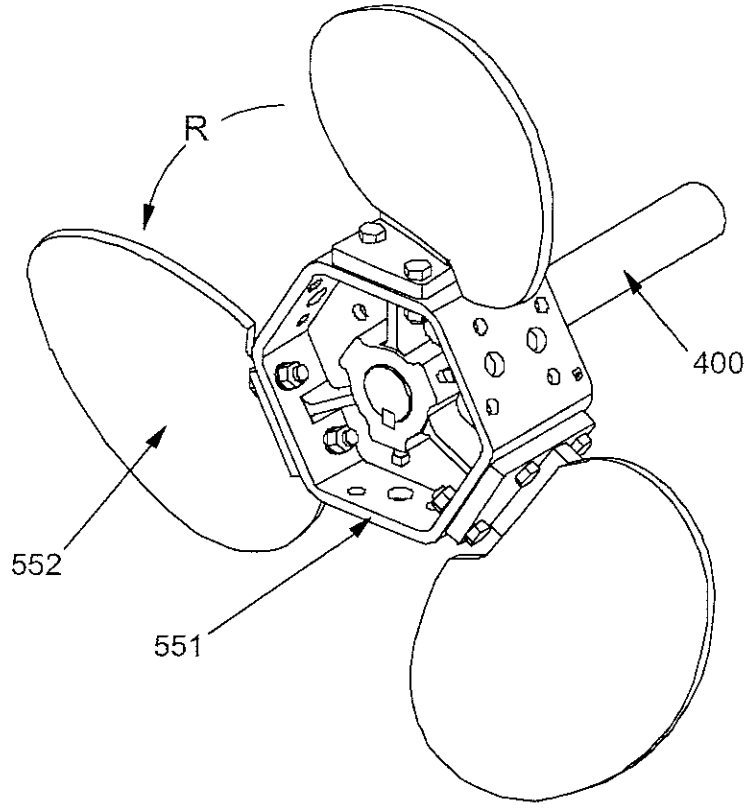

Figure 1 Maxflo Mark II Impeller (Bolted Blade Shown)

Item	Description	Item	Description
400	Shaft	552	Impeller Blade - Mark II
551	Impeller Body - Mark II		
R	Direction of Rotation		

Unless specified otherwise on the unit assembly drawing, the impeller attaches to the shaft with a key and set screws.

Bolted Blade Impellers (Figure 2): If the impeller is received assembled, disassemble each blade. The minimum insertion opening diameter for these impellers is listed in **Table 1** below:

Table 1: Minimum Insertion Diameters

Impeller Diameter, in.	Minimum Insertion Openiing Diameter, in.		
	Dissassembled 3 or 6 Blade	Assembled 3 Blade	Assembled 6 Blade
25A - 25D	13	23.5	25
27A - 27D	13	25.5	27
30A - 30D	13	28.5	30
32A - 32D	13	30.0	32
35A - 35D	17	33.0	35
38A - 38D	17	36.0	38
41A - 41D	17	38.5	41
45A - 45D	17	42.5	45
49A - 49D	23	46.0	49
53A - 53D	23	50.0	53
57A - 57D	23	53.5	57
62A - 62D	23	58.5	62
68A - 68D	32	64.0	68
74A - 74D	32	69.5	74
80A - 80D	32	75.5	80
87A - 87D	32	82.0	87

Care should be exercised in handling each component. It is recommended that mechanical assists be used to insert and install all impellers or components weighing over 40 lbs. Approximate component weights are shown in **Table 2**:

Table 2: Blade and Hub Weights - Bolted Blades

Bolted Impellers		
Impeller Diameter, in	Hub Weight, lbs.	Blade Weight, lbs
25A-25D	42.4	12.3
27A-27D	42.4	13.4
30A-30D	42.4	14.8
32A-32D	42.4	16.4
35A-35D	102	27.5
38A-38D	102	30.2
41A-41D	102	33.7
45A-45D	102	43.2
49A-49D	208	65.7
53A-53D	208	72.7
57A-57D	208	81.2
62A-62D	208	102
68A-69D	498	161
74A-74D	498	177
80A-80D	498	197
87A-87D	498	222

All blades are match marked to fit against a matching face. The impeller balance test was performed with the blades in their respective positions. They must be installed in these same relative positions.

For 3 bladed impellers, the blades are to be installed on the sides marked 1, 2, and 3. When a six (6) bladed impeller is supplied, three (3) blades will match to the sides 1, 2, and 3 and the other three (3) blades to the sides 4, 5, and 6. The bolt patterns are different for sides 1, 2, and 3 versus sides 4, 5, and 6. Be sure to match the correct blade to each of the hub surfaces. Bolt tolerances are tight to hold blade pitch tolerances. No attempt should be made to redrill any of the holes. The blades (552) may be installed on the hub (551) either before the hub is mounted on the shaft or afterwards. However, it is recommended that the hub be installed first.

1. Install the key (595) onto the end of shaft (400)
2. Slide the hub (551) onto the end of the shaft (400) with key (595) in position and tighten the four (4) set screws (596) to values shown in the Table 3. The tapped holes for the set screws have been made with a self locking, Spiralock® thread form. Auxiliary fastener locking is not necessary. These set screws will only perform as designed if torqued to the prescribed values.

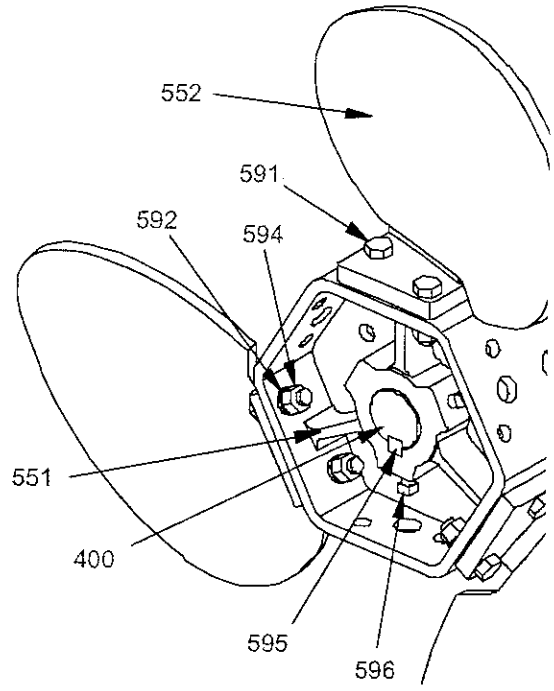

Figure 2 Maxflo Mark II with Bolted Blades
25" Through 87" Diameter

Item	Description	Item	Description
400	Shaft	592	Lockwasher
551	Impeller Body - Mark II	594	Hex. Nut
552	Impeller Blade - Mark II	595	Impeller Key
591	Hex. Head Bolt	596	Sq. Hd. Setscrew

3. Bolt the blades (552) in their match marked positions using fasteners (591), hex nuts (594), and lockwashers (592). Keep the bolt heads to the outside. Use the tightening torques shown in **Table 3**.

Table 3: Bolt and Set Screw Tightening Torques for 300 Series Stainless Fasteners[1][2]

Bolt Size	Tightening Torque[3]	
	$ft\text{-}lb_f$	Nm
5/16-18	8.3	11
3/8-16	15	20
1/2-13	38	51
5/8-11	68	92
3/4-10	120	163
7/8-9	182	247
1-8	273	370

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

Welded Blade Impellers : Maxflo Mark II impellers from 13" through 23" are provided with welded blades as shown in **Figure 3**. Impeller sizes from 13" through 17" use set screws for driving the impeller. Impeller sizes from 18" through 23" use a key and set screws.

A welded Mark II impeller can pass through a tank opening in different ways depending on the number of blades. Impellers with three blades can pass through an opening smaller than the impeller diameter by rotating it through the opening. For all practical purposes the six bladed version cannot be rotated through a nozzle. The front view of a Maxflo Mark II impeller is shown in ***Figure 4*** and ***Figure 5*** as it passes through a tank opening. Refer to the equipment certification package to identify impeller diameter and number of blades.

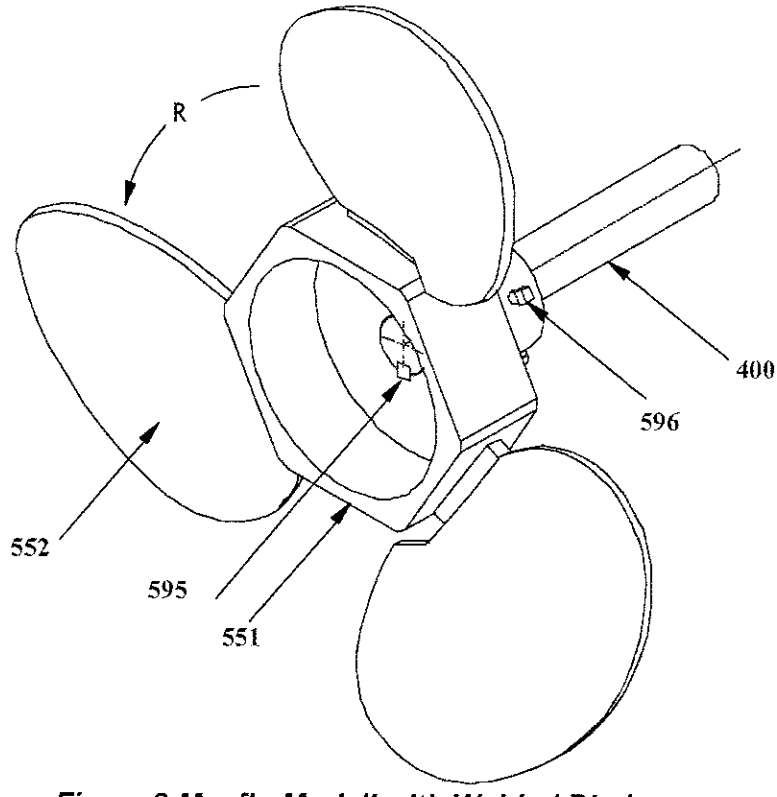

Figure 3 Maxflo Mark II with Welded Blades 13" Through 23" Diameter

Item	Description	Item	Description
400	Shaft	595	Impeller Key (18" thru 23" only)
551	Impeller Body - Mark II		
552	Impeller Blade - Mark II	596	Sq. Hd. Setscrew

Refer to **Table 4** below for the minimum insertion diameter. The minimum insertion diameter for three bladed Mark II impellers with rotation depends on the length of the nozzle. If the length of the nozzle exceeds dimension "B" as shown in **Figure 6**, use the dimension for no rotation to be certain the impeller can be introduced into the tank or chest.

Table 4: Minimum Insertion Openings for Welded Impellers

Impeller Dia., in.	Minimum Insertion Opening Diameter, in.			
	3 Blade			6 Blade
	No Rotation	With Rotation	B (Max)	
13A-13-D	12	9.12	3.00	13
14A-14D	13	9.88	3.25	14
16A-16D	14.5	11.25	3.75	16
17A-17D	15.5	11.88	3.88	17
18A-18D	16.5	12.62	4.12	18
20A-20D	18.5	14.00	4.50	20
21A-21D	19.5	14.75	4.75	21
23A-23D	21.5	16.12	5.25	23

Welded three (3) and six (6) blade impeller weights are shown in the **Table 5**. It is recommended that mechanical assists be used to insert and install all impellers weighing over 40 lbs.

Table 5: Welded Impeller Weights

Welded Impellers		
Impeller Diameter, in.	3 Blade Impeller Weight, lbs.	6 Blade Impeller Weight, lbs.
13A-13D	5.70	7.40
14A-14D	6.00	8.00
16A-16D	6.40	8.80
17A-17D	6.80	9.70
18A-18D	26.0	37.5
20A-20D	27.1	39.7
21A-21D	28.5	42.4
23A-23D	30.1	45.6

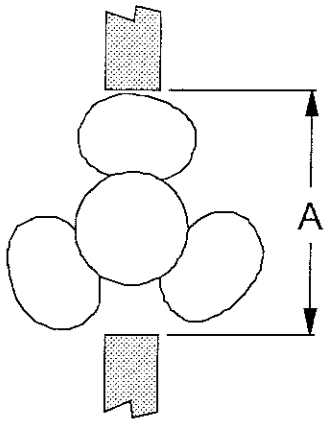

Figure 4: No Rotation

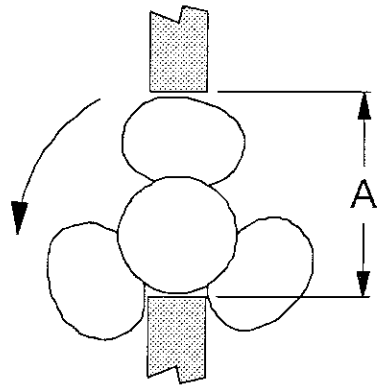

Figure 5: With Rotation

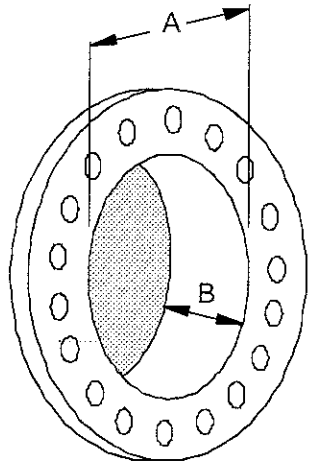

Figure 6: Typical Tank Opening

Item	Description	Item	Description
A	Minimum Opening Diameter	B	Maximum Opening Length

To install impellers 13" through 17" onto the shaft (refer to **Figure 3**)

1. Slide the hub (551) onto the end of the shaft (400)
2. Tighten the four (4) set screws (596) to values shown in the **Table 3**. The tapped holes for the set screws have been made with a self locking, Spiralock® thread form. Auxiliary fastener locking is not necessary. These set screws will only perform as designed if torqued to the prescribed values.

To install impellers 18" through 23" onto the shaft (refer to **Figure 3**)

1. Install the key (595) onto the end of shaft (400)
2. Slide the hub (551) onto the end of the shaft (400) with key (595) in position
3. Tighten the four (4) set screws (596) to values shown in the **Table 3**. The tapped holes for the set screws have been made with a self locking, Spiralock® thread form. Auxiliary fastener locking is not necessary. These set screws will only perform as designed if torqued to the prescribed values.

Chemineer, Inc.
A Unit of Robbins & Myers, Inc.