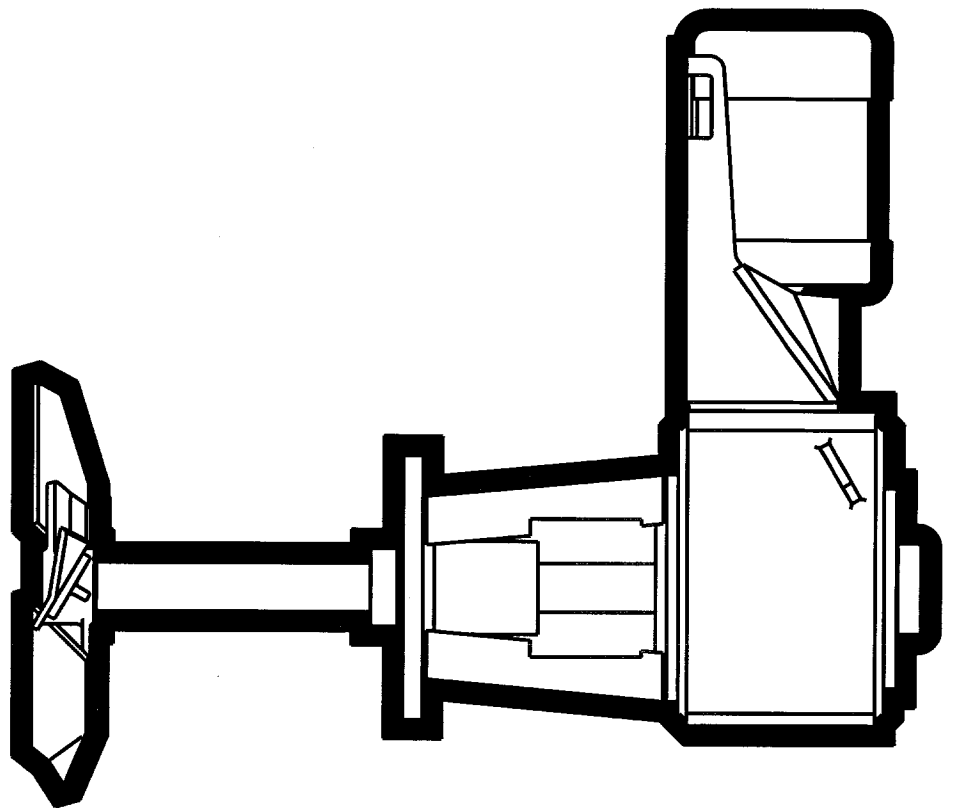


HSA Side-Entering Agitators Installation, Operation, Maintenance Manual

Equipment Reference:



For service and
information contact:

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INITIAL INSPECTION

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

Step 2: Uncrate. Check the contents. Do not uncrate the unit until you have read the *Installation* section of this manual and looked at the assembly drawing shipped with the unit. Be careful in uncrating and handling. Do not discard the crate without carefully making sure that all agitator parts have been removed. Correct assembly of this unit requires referring to both the unit assembly drawing and this manual.

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

CHEMINEER ASSISTANCE

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

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

Services available are as follows:

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

STORAGE

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

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

Short-Term Indoor Storage

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

Outdoor or Long-Term Indoor Storage

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

1. Fill the gear drive completely with oil.

TABLE 1: STORAGE OIL CAPACITY

CASE SIZE	COMPLETE FILL	
	GALLONS	LITERS
1	2.6	9.8
2	2.6	9.8
3	6.6	25.0
4	14.0	53.0

NOTE: The case size referred to in this manual can be determined by the first number in the model designation; for example, "1HSA-5" is a Case Size "1" agitator.

2. Rotate the motor and gear drive shafts 10 to 15 revolutions at least once per month to reduce the possibility of brinelling of the bearings.
3. Motor space heaters, if installed, should be energized during the storage period.
4. Apply a rust preventive to unpainted steel surfaces to prevent corrosion during storage.
5. The unit should be covered to prevent damage by the elements, but still allow free air circulation.

CAUTION! Before placing an agitator in service the storage oil must be completely drained from the gear drive. The gear drive should be filled with new oil as indicated in the Lubrication section of this manual.

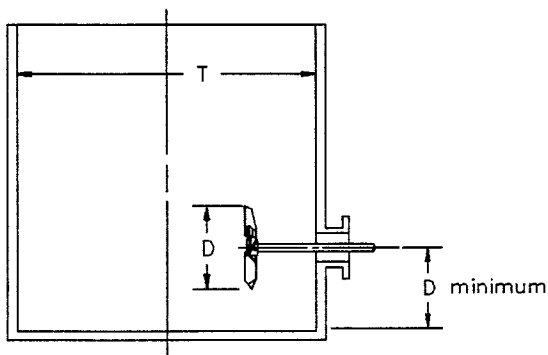
MOUNTING

A final check should be made of the agitator mounting nozzle for orientation, strength and rigidity. Inadequate strength and/or rigidity may allow excessive movement of the agitator and deflection of the vessel.

NOZZLES

Unless otherwise specified, the agitator mounting nozzle should be oriented as shown in *Figure 1*. The shaft centerline should be located one (1) impeller diameter from the tank bottom. The agitator nozzle should be level or corrected to within 1° before proceeding.

A. ELEVATION



B. PLAN VIEW

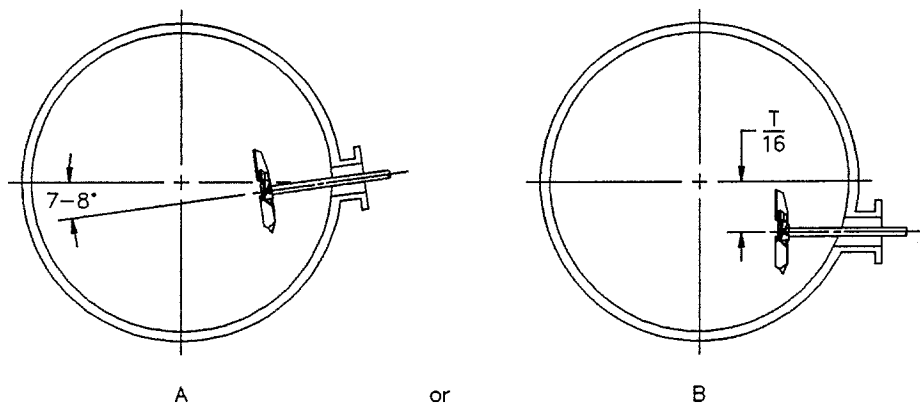


Figure 1: Nozzle Orientation

Nozzle Loads

The nozzle and vessel combination should be rechecked for strength and rigidity. The nozzle strength should be such that the maximum operating stresses will not exceed the fatigue limit of the material used. The nozzle rigidity should be designed so that the dynamic deflection is less than 1/64 inch (.4 mm) per foot of nozzle extension.

Side-Entering Agitators impose four types of loads on the supporting structure: torque, thrust, bending moment and a vertical downward load. *Figure 2* shows these four loads pictorially. See *Table 2* (page 6) for design load values.

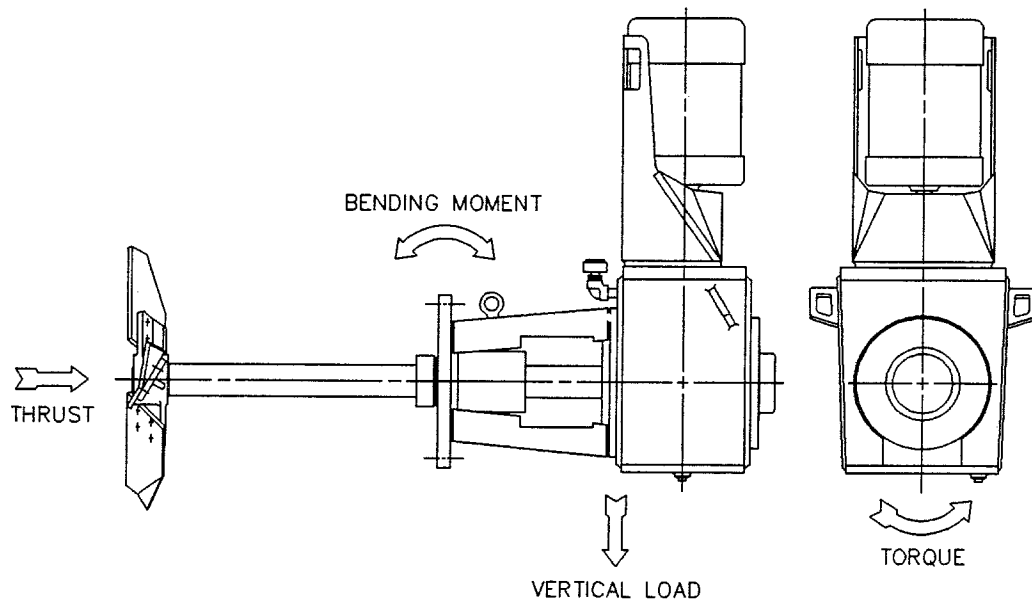


Figure 2: Agitator Mounting Nozzle Loads

Nozzle Loads (Cont'd)

TABLE 2: NOZZLE DESIGN LOAD VALUES

DESIGN LOAD ENGLISH UNITS	CASE SIZE			
	1	2	3	4
Torque, in-lb	1,080	5,400	16,450	27,000
Bending Moment, in-lb	6,240	7,000	16,750	33,700
Vertical Load, lbs	994	1,294	2,120	4,400
Thrust, lbs	275	1,000	2,200	3,650
DESIGN LOAD METRIC UNITS	CASE SIZE			
	1	2	3	4
Torque, Nm	122	610	1,859	3,051
Bending Moment, Nm	705	791	1,893	3,808
Vertical Load, kg	451	587	963	1,998
Thrust, kg	125	454	999	1,657

REINFORCING PADS & GUSSETING

Unless otherwise specified, use reinforcing pads and gussets to reduce the stress in the nozzle area and provide rigidity.

Figure 3 shows a typical design recommendation. Refer to *Table 3 (page 8)* for pad and gusset design. Trim the reinforcing plate near the tank floor as required. Gusset plate thickness is $t/2$ minimum.

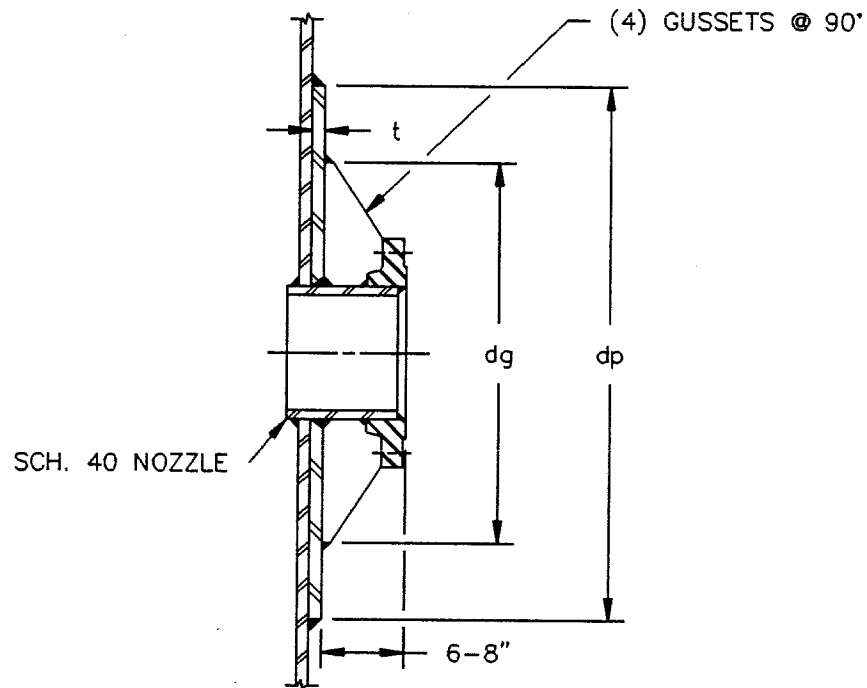


Figure 3: Reinforcing Pad & Gussets

REINFORCING PADS & GUSSETING

TABLE 3: REINFORCING PAD WITH GUSSET DESIGN

TANK DIA., FT.	8" ANSI						12" ANSI					
	CASE 1			CASE 2			CASE 3			CASE 4		
	t in	dg in	dp in	t in	dg in	dp in	t in	dg in	dp in	t in	dg in	dp in
12	5/16	27	27	1/2	27	30	7/8	27	52	3/4	41	45
18	3/8	27	27	5/8	27	38	1	27	60	1	41	60
24	7/16	27	27	5/8	27	38	1	27	60	1-1/8	41	68
30	7/16	27	27	3/4	27	45	1-1/4	27	75	1-1/4	41	75
36	7/16	27	27	3/4	27	45	1-1/4	27	75	1-1/4	41	75
42	7/16	27	27	3/4	27	45	1-1/4	27	75	1-1/4	41	75
48	7/16	27	27	3/4	27	45	1-1/4	27	75	1-3/8	41	82
54	7/16	27	27	3/4	27	45	1-1/4	27	75	1-3/8	41	82
> 60	1/2	27	30	3/4	27	45	1-1/4	27	75	1-3/8	41	82

TANK DIA., METERS	8" ANSI						12" ANSI					
	CASE 1			CASE 2			CASE 3			CASE 4		
	t mm	dg mm	dp mm	t mm	dg mm	dp mm	t mm	dg mm	dp mm	t mm	dg mm	dp mm
3.66	7.94	686	686	12.7	686	762	22.23	686	1321	19.05	1041	1143
5.40	9.53	686	686	15.88	686	965	25.40	686	1524	25.40	1041	1524
7.32	11.11	686	686	15.88	686	965	25.40	686	1524	28.56	1041	1727
9.14	11.11	686	686	19.05	686	1143	31.75	686	1905	31.75	1041	1905
10.97	11.11	686	686	19.05	686	1143	31.75	686	1905	31.75	1041	1905
12.80	11.11	686	686	19.05	686	1143	31.75	686	1905	31.75	1041	2083
14.63	11.11	686	686	19.05	686	1143	31.75	686	1905	31.75	1041	2083
16.46	11.11	686	686	19.05	686	1143	31.75	686	1905	31.75	1041	2083
> 18.29	12.7	686	762	19.05	686	1143	31.75	686	1905	31.75	1041	2083

INSTALLATION

AGITATOR

The HS Agitator is shipped fully assembled and ready to install. Review assembly drawings. Special instructions may be included for options not covered by this manual. Read all tags and instructions before installation and start-up.

Exercise caution in handling the agitator to avoid damage to the shaft or shaft seal components. Do not lift or support the unit by the end of the shaft or by the motor. The agitator nozzle should be level or corrected to within 1° before proceeding.

Remove all shipping restraints from the agitator (crate, straps, bolts, etc.). Remove the impeller from the end of the shaft, if required. A hoist or crane system for lifting the agitator must be available. The approximate lifting weights are shown in *Table 4*.

TABLE 4: HS AGITATOR LIFTING WEIGHTS

CASE SIZE	APPROXIMATE WEIGHT	
	POUNDS	KILOGRAMS
1	1000	454
2	1300	590
3	2200	998
4	4400	1996

NOTE: The case sizes referred to in this manual can be determined by the first number in the model designation; for example, "1HSA-5" is a Case Size "1" Agitator.

AGITATOR

1. Lift the agitator with a three-point system utilizing the cutouts on the sides of the motor bracket and the eyebolt on the pedestal near the mounting flange. The eyebolt may also be used with a come-a-long to align the shaft for mounting. Refer to *Figure 4*.

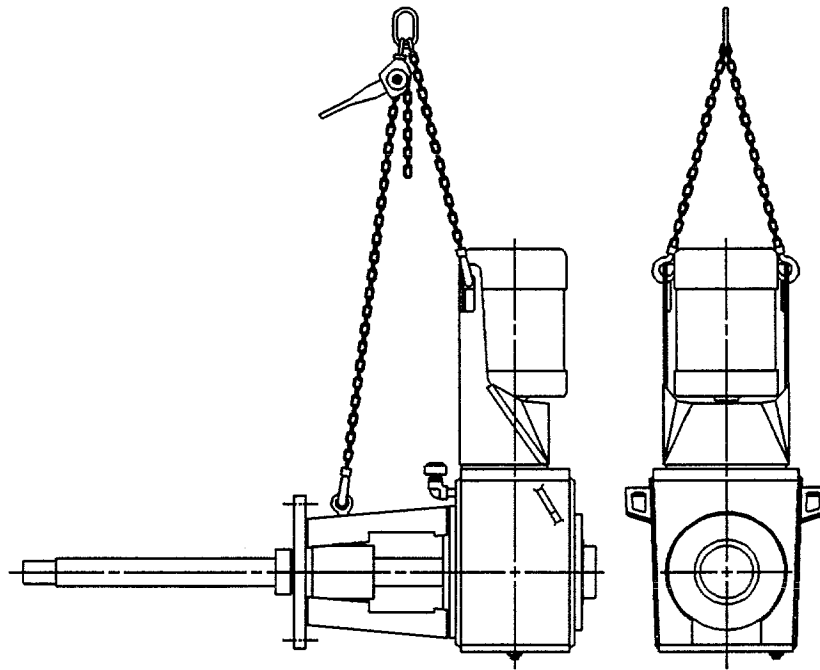


Figure 4: Agitator Lifting System

Be sure that the mating surfaces of the agitator mounting flange and the vessel nozzle are clean, free of nicks and scratches, and a mounting flange gasket (furnished by others) is properly located.

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

2. While fully supporting the agitator, insert the shaft into the nozzle opening and carefully position the flanges. Install all flange bolting. Torque the bolts according to the values shown in *Table 5*.

AGITATOR

3. The agitator has been provided with a floor support or an optional set of tie rods to be field located. The floor support should be bolted to a concrete pad and shimmed to insure proper fit. The required dimensions for the support are shown on the unit assembly drawing. (Do not raise or lower the unit with the support.)
4. Torque the floor support bolts to the value shown in *Table 5*.
5. Unbolt the gland plate, remove the split gland and check shaft runout with the inside surface of the stuffing box. If the runout exceeds .010" (.25 mm) FIM, the support must be changed.

TABLE 5: BOLT TIGHTENING TORQUE^{(1),(2)}

Bolt Size	CARBON STEEL ⁽³⁾				300 Series Stainless Steel, Alloy 20, Monels, Inconels & Hastelloys B & C ⁽⁴⁾	
	Grade 2		Grade 5			
	ft-lb	Nm	ft-lb	Nm	ft-lb	Nm
3/8-16	15	20	23	31	15	20
1/2-13	38	51	56	76	38	51
9/16-12	50	68	83	113	50	68
5/8-11	68	92	113	153	68	92
3/4-10	120	163	200	271	120	163
7/8-9	105	143	296	401	182	247
1-8	165	224	443	601	273	370
1 – 1/8-7	225	305	596	808	386	523
1 – 1/4-7	315	428	840	1139	545	739
1 – 3/8-6	417	566	1103	1495	715	969
1 – 1/2-6	555	752	1463	1983	948	1286

⁽¹⁾Tighten all fasteners to values shown unless specifically instructed to do otherwise.

⁽²⁾Lubricate all fasteners at assembly with grease, oil or an anti-seize material. Bolt threads and contact surfaces of bolt heads and nuts should be lubricated.

⁽³⁾If fasteners cannot be lubricated, multiply table values by 1.33.

⁽⁴⁾If fasteners cannot be lubricated, multiply table values by 1.25.

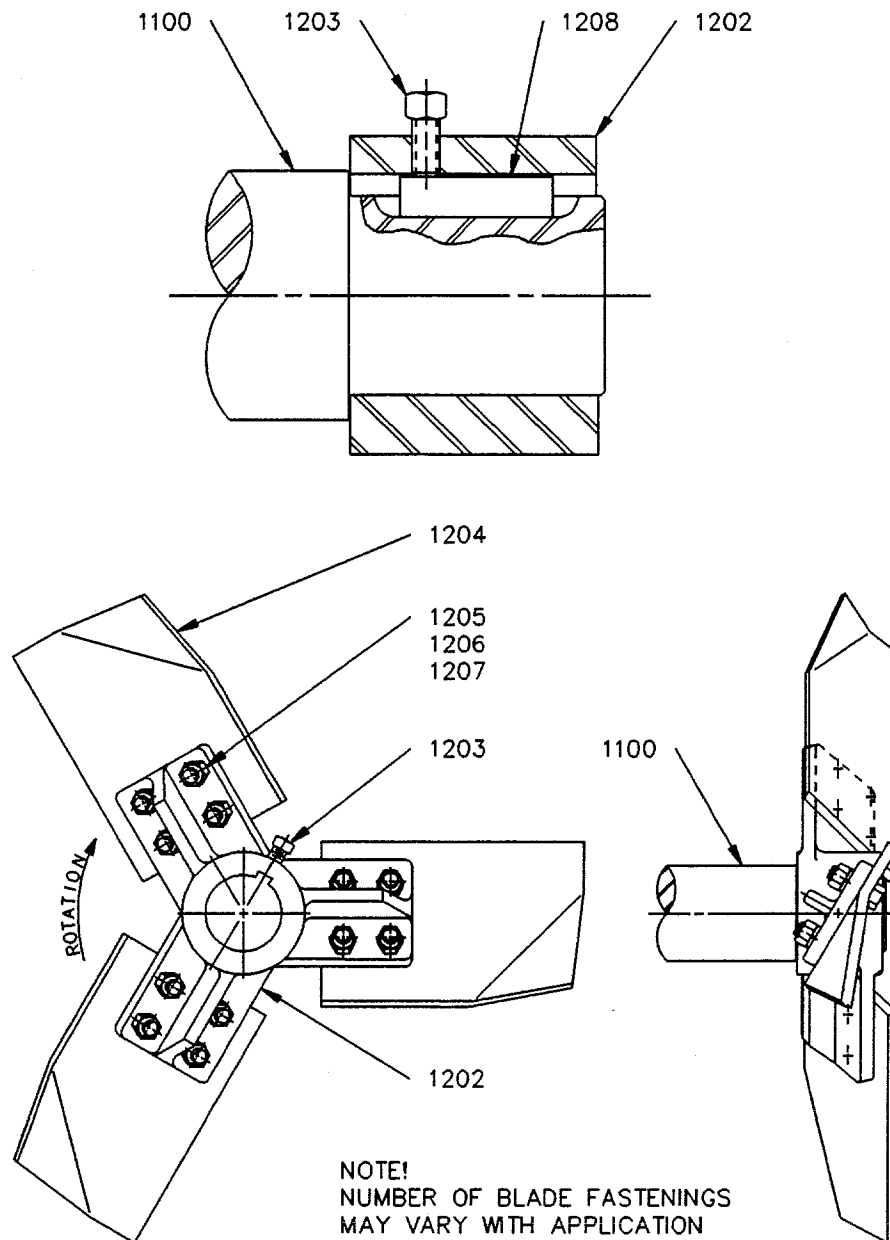


Figure 5: HS Impeller Hub

IMPELLER

1. Bolt extension blades [1204] to hub [1202] with bolts [1205, 1206, 1207]. Torque the bolts to the value shown in *Table 5 (page 11)*.

NOTE: Impeller parts are match marked. Install parts as marked so the impeller will be properly balanced.

2. Install the impeller as shown on *Figure 5* with the concave side of its blades away from the wall of the tank. Unless otherwise specified on the unit assembly drawing, the impeller attaches to the shaft with a key and setscrew. The tapped hole in the turbine hub is a self-locking thread form. Torque the setscrew to the value shown in *Table 5*.

GEAR DRIVE

The gear drive has been drained of oil for shipping; add lubricant to the gear drive according to the *Lubrication* section.

MOTOR

Chemineer side-entering agitators are normally shipped with the motor installed on the motor bracket. Before connecting the motor to the power supply:

1. Check the nameplate data on the motor to assure that the available power supply agrees with the motor requirements. Protective devices should be of the proper size and rating to safely carry the load and interrupt the circuit on overloads.
2. Turn the shaft by hand to check that it turns freely.
3. If the motor has been stored in a damp location, the windings may require drying.

NOTE: Do not obstruct the normal flow of ventilating air through or over the motor.

MOTOR

4. Connect the motor in accordance with the National Electric Code and local requirements, but do not make the connections permanent until the motor rotation has been checked.

Identify motor auxiliary devices such as space heaters or temperature sensors. Connect them in proper circuits and insulate them from motor power cables.

5. Jog the motor for correct rotation prior to securing wiring. Unless specified otherwise, rotation of the motor should be counterclockwise when viewed from the fan end of the motor.

MOTOR COUPLING

The standard flexible couplings used on the Chemineer side-entering agitator are as follows:

T.B. Woods "Sure-Flex" couplings are supplied for motor frames up to and including 320T Series.

Falk "T-10" couplings are supplied for motor frame Series 360T and larger.

Check the unit assembly drawing for the manufacturer, type and size coupling. Refer to the supplemental Motor Coupling section for installation, alignment, lubrication, operation, and maintenance instructions.

Verify motor coupling alignment and correct if necessary.

STUFFING BOX

The stuffing box is fully assembled at the factory. The gland plate is only loosely adjusted and will require adjustment as soon as the vessel is filled.

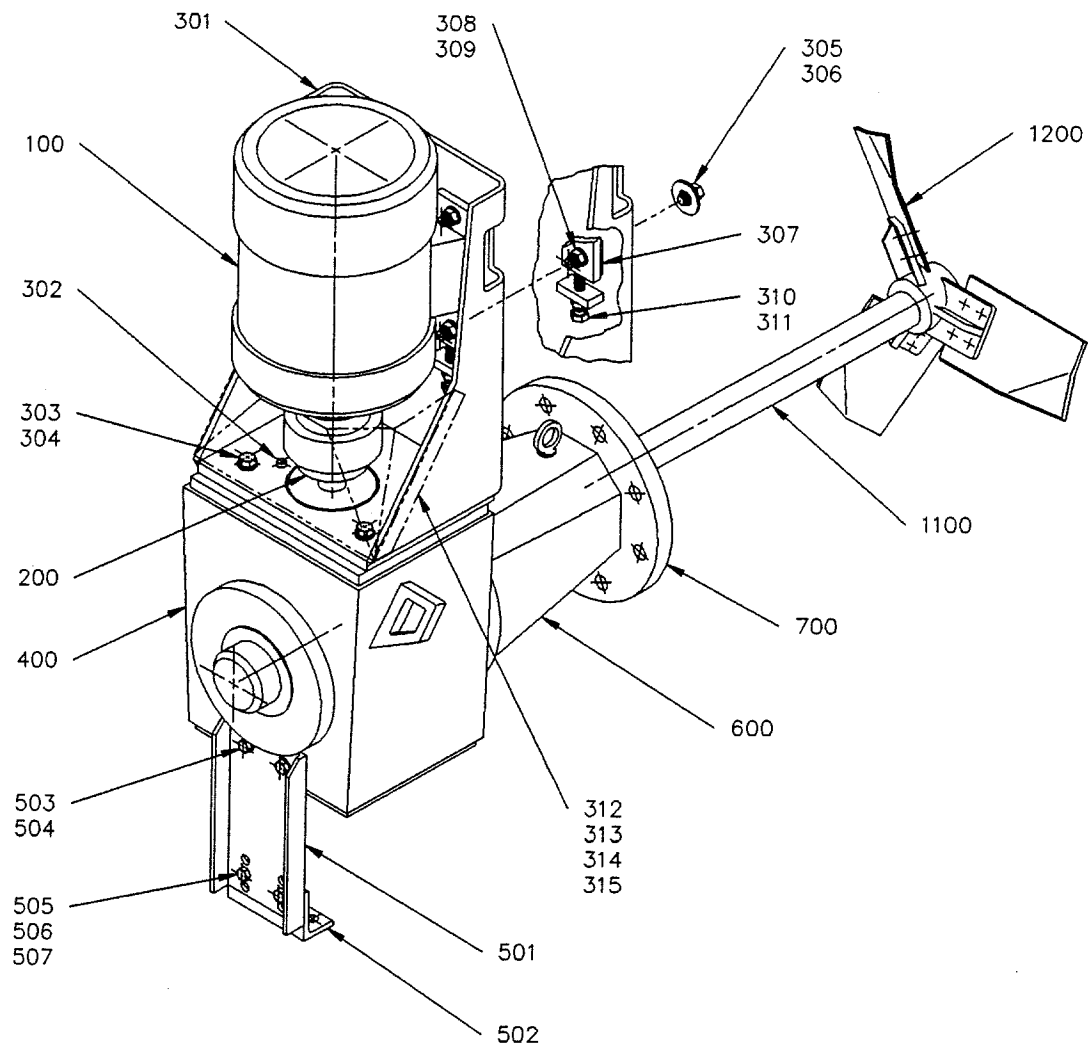


Figure 6: Model HS Agitator Assembly

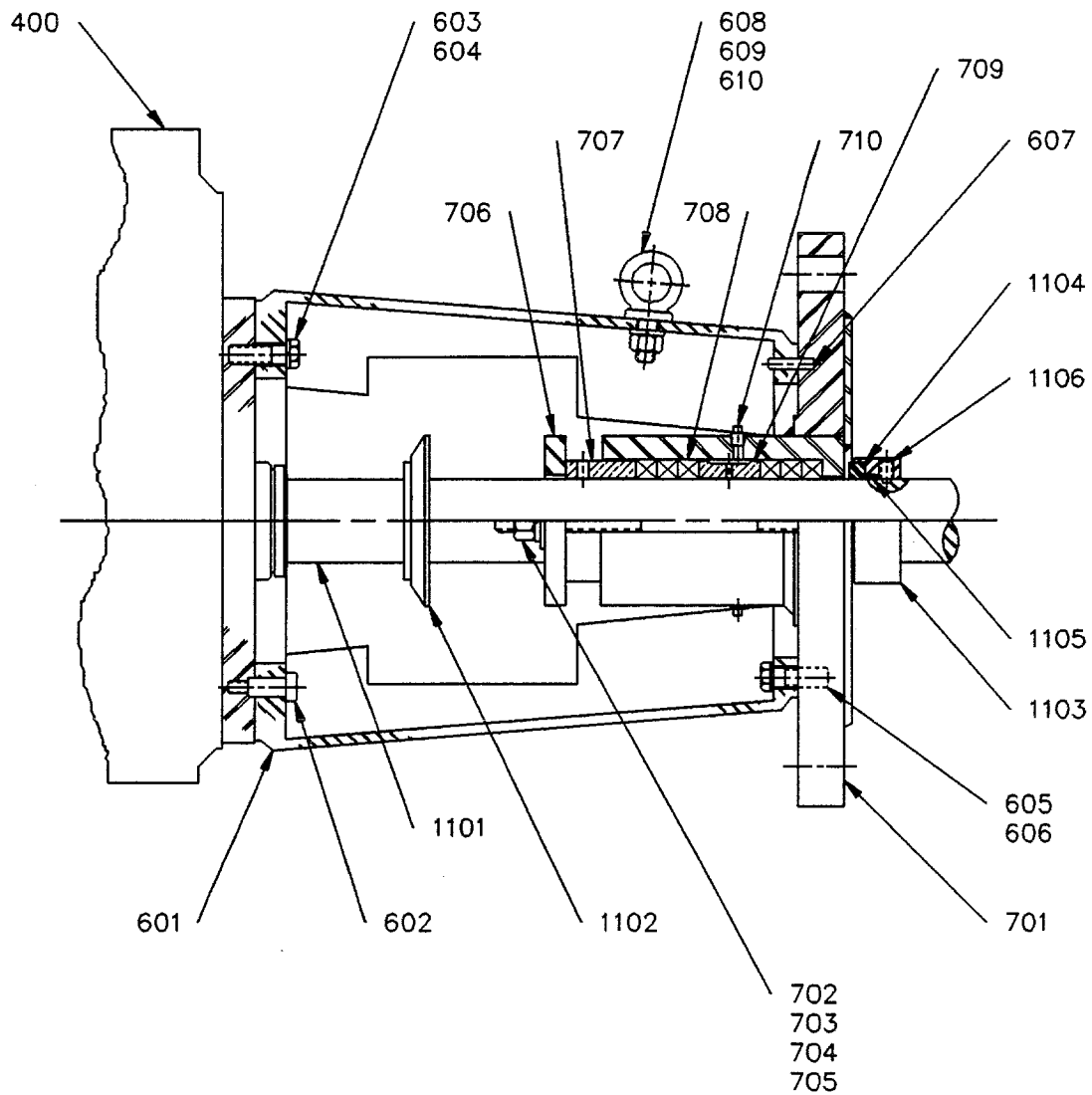


Figure 7: Model HSA Stuffing Box

LUBRICATION

This section defines the proper oils and greases that must be added to the unit for proper operation.

CAUTION! Check the gear drive for proper oil fill before operating.

MOTOR

The motor bearings have been properly greased by the manufacturer. Motor bearings should be regreased at 12-month intervals when installed in clean, dry environments or every six months, for heavy duty and dusty locations. Any good quality general purpose grease consisting of a refined base oil stock and a lithium or calcium-complex based soap, with an NLGI No. 2 classification, will work satisfactorily. Most major oil companies offer such products, usually with the addition of extreme pressure (EP) additives for additional protection. *Table 7, (page 18)* lists some commonly available greases.

When regreasing, stop the motor, remove the outlet plug and add grease according to *Table 6* with hand lever gun only. Run the motor for about ten minutes before replacing the outlet plug. Certain TEFC motors have a spring relief outlet fitting on the fan end. If the outlet plug is not accessible at the surface of the hood, it is the spring relief type and need not be removed when regreasing.

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

TABLE 6: MOTOR BEARING GREASE ADDITION

Motor Frame Size	RELIANCE		SIEMENS		BALDOR	
	in ³	cm ³	in ³	cm ³	in ³	cm ³
140T	sealed for life		0.4	6.6	0.6	9.8
180T	0.5	8.2	0.6	9.8	0.6	9.8
210T	0.5	8.2	3.1	50.8	0.6	9.8
250T	1.0	16.4	4.4	72.1	1.2	19.7
280T	1.0	16.4	5.0	82.0	1.2	19.7
320T	1.5	24.6	10.6	173.7	1.5	24.6
360T	1.5	24.6	14.4	236.0	1.5	24.6
400T	2.5	41.0	14.4	236.0	4.1	67.2
440T	2.5	41.0	14.4	236.0	4.1	67.2
Other	(consult motor manufacturer's data)					

MOTOR

TABLE 7: TYPICAL NLGI NO. 2 GREASES

<i>For Ambient Temperature Range of 0° to 150°F (-18° to 66°C)</i>		
MANUFACTURER	GENERAL PURPOSE	EP
Amoco Oil Co.	Amolith grease: Grade 2	Amolith grease: Grade 2EP
Ashland Oil Co.		Multi-lube Lithium EP grease: Grade 2
		EP Lithium #2
Chevron U.S.A.Inc.	Industrial grease: Grade medium	Dura-Lith greases EP: Grade 2
CITGO Petroleum Corp.		Premium Lithium EP grease: Grade 2
Conoco Inc.		EP Conolith grease: Grade 2
Exxon Co. U.S.A.	Unirex N: Grade 2	Nebula EP: Grade 2
		Ronex MP: Grade 2
Mobil Oil Corp.		Mobilux EP 2
Pennzoil Products Co.		Pennlith EP grease 712
Phillips 66 Co.	Philube L Multi- purpose grease L-2	Philube EP grease: EP-2
Shell Oil Co.	Alvania grease 2	Alvania grease EP 2
		Alvania grease EP LF 2
Texaco Lubricants Co.	Premium RB grease	Multifak EP 2
Unocal 76		Unoba EP grease: Grade 2
		Multiplex EP: Grade 2

GEAR DRIVE

All bearings and gears are splash oil lubricated.

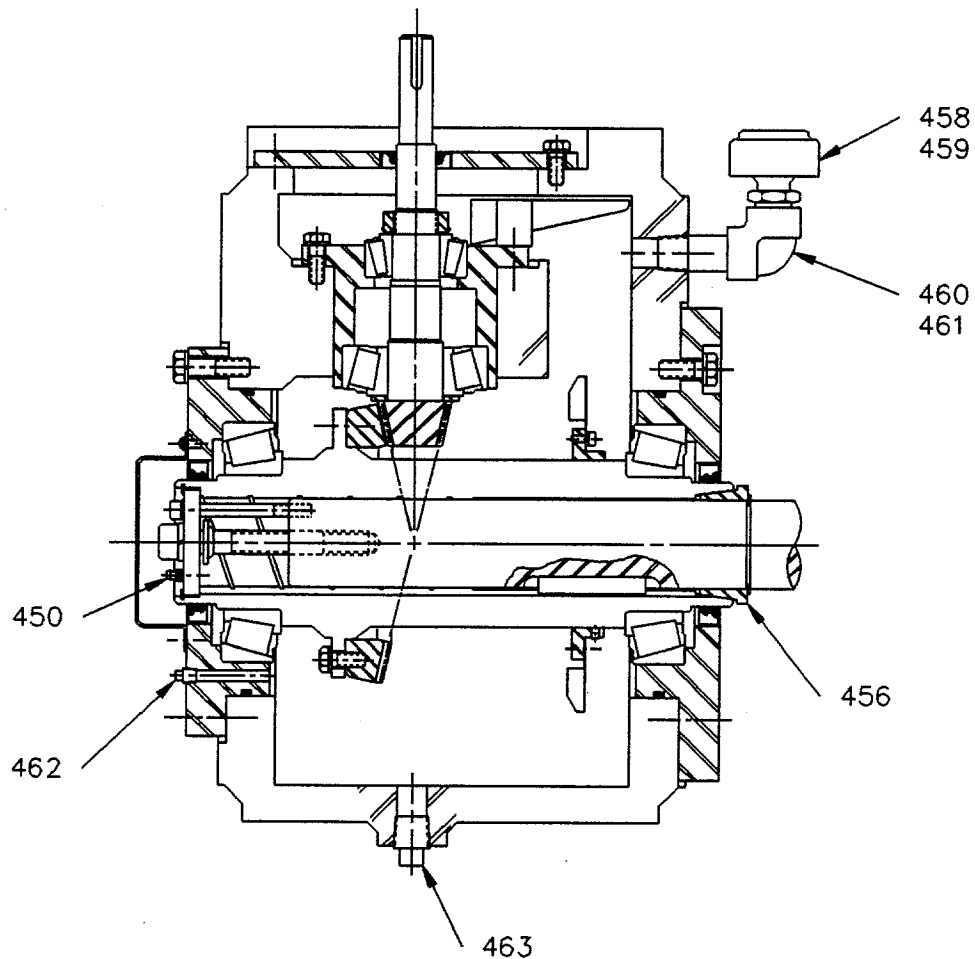


Figure 8: HS Gear Drive

The gear drive has been drained of oil for shipping. Remove oil level plug [462]. Remove breather [458] and bushing [459] from elbow [460]. Add oil through pipe elbow [460] until oil flows from the oil level plug hole. Always use new oil. Reinstall the oil level plug, bushing and breather.

GEAR DRIVE

The following table provides an oil selection guideline based upon ambient temperature according to AGMA 250.3.

TABLE 8: OIL SELECTION

Ambient Temperature	Lube Oil Selection	
	ISO Viscosity Grade	AGMA Lubricant Number
-10° to 15°F (-24° to -10°C)	32 to 46	- to 1
15° to 50°F (-10° to 10°C)	68 to 100	2 to 3
50° to 125°F (10° to 50°C)	150 to 220	4 to 5

NOTE: For low temperature operation the oil selected should have a pour point at least 9° F (5° C) below the expected ambient temperature and a viscosity which is low enough to allow the oil to flow freely at start-up temperature.

Approximate operating oil capacities of the HS agitators are as listed in *Table 9*.

TABLE 9: GEAR DRIVE OPERATING OIL CAPACITY

OIL CAPACITY			
Case	Qts.	Gal.	Liters
1	4	1	3.8
2	4	1	3.8
3	10	2.5	9.5
4	20	5	18.9

Drain and refill the gear drive after the first week or 100 hours of operation and then every six months or 2500 hours thereafter. Use a good quality, straight grade, R&O petroleum base gear oil (*Table 10*). When the loading is extremely heavy or when the gear drive temperature exceeds 160° F (71° C), an EP oil (*Table 11*) should be used. In general, an EP oil will be beneficial.

GEAR DRIVE

TABLE 10: TYPICAL R&O LUBE OILS

ISO Viscosity Grade	32	46	68	100	150	220
AGMA Lubricant Number	---	1	2	3	4	5
Viscosity Range (cSt) @ 104° F (40° C)	28.8 to 35.2	41.4 to 50.6	61.2 to 74.8	90 to 110	135 to 165	198 to 242
MANUFACTURER/ Product Line						
Amoco Oil Co./American Industrial Oils	32	46	68	100	150	220
Ashland Oil Inc. (Valvoline Oil Co.)/ Ashland ETC R&O Oils	R&O 15	R&O 20	R&O 30	R&O 45	R&O 70	R&O 100
Chevron U.S.A. Inc./ Chevron AW Machine Oils	----	----	----	100	150	220
CITGO Petroleum Corp./ Citgo Pacemaker Oils	32	46	68	100	150	220
Conoco Inc./ Dectol R&O Oil	32	46	68	100	150	220
Exxon Co. U.S.A./ Teresstic Oil	32	46	68	100	150	220
Mobil Oil Corp./ Mobil DTE Oil	Light	Medium	Heavy Medium	Heavy	Extra Heavy	BB
Pennzoil Products Co./ Pennzbell R&O Oils	32	46	68	100	150	220
Phillips 66 Co./ Magnus Oils	150	215	315	465	700	1000
Shell Oil Co./ Shell Turbo T Oils	32	46	68	100	150	220
Texaco Lubricants Co./ Regal Oil R&O	32	46	68	100	150	220
Unocal 76/ Unocal Turbine Oil	32	46	68	100	150	220

GEAR DRIVE

TABLE 11: TYPICAL EP LUBE OILS

ISO Viscosity Grade	68	100	150	220	320
AGMA Lubricant Number	2 EP	3 EP	4 EP	5 EP	6 EP
Viscosity Range (cSt) @ 104° F (40° C)	61.2 to 74.8	90 to 110	135 to 165	198 to 242	288 to 352
MANUFACTURER/ Product Line					
Amoco Oil Co./Permagear EP Lubricants	68	100	150	220	320
Ashland Oil Inc. (Valvoline Oil Co.)/AGMA Enclosed EP Gear Lubricants	#2 EP	#3 EP	#4 EP	#5 EP	#6 EP
Chevron U.S.A. Inc./Chevron NL Gear Compounds	68	100	150	220	320
CITGO Petroleum Corp./Citgo EP Compounds	68	100	150	220	320
Conoco Inc./Gear Oil	68	100	150	220	320
Exxon Co. U.S.A./Spartan EP	68	100	150	220	320
Mobil Oil Corp./Mobilgear 600 Series	626	627	629	630	632
Pennzoil Products Co./Maxol EP Gear Oils	68	100	150	220	320
Phillips 66 Co./Philube All Purpose or Superior Multi Purpose Gear Oils	APGO 80W	---	SMP 80W-90	APGO 85W-90	---
Shell Oil Co./Omala Oils	68	---	150	220	320
Texaco Lubricants Co./Meropa Gear Lubricants	68	100	150	220	320
Unocal 76/Unocal Extra Duty NL Gear Lube	2EP	3EP	4EP	5EP	6EP

Periodically check the oil level and add oil, if necessary. The agitator must be shut off when checking and adding oil.

GEAR DRIVE

The cavity between the drive shaft and the hollow reducer shaft is grease filled to prevent fretting and chemical corrosion and to provide for ease of retraction when a seal change is required. After a seal change, grease (*Table 7, page 18*) must be added through grease fitting [450] (*Figure 8, page 19*) until the shaft cavity is filled.

STUFFING BOX

The standard stuffing box (*Figure 7, page 16*) is supplied with six rings of packing and a lantern ring. See the agitator assembly drawings for packing type. Packing shown as 1065 or 1625 does not require external lubrication.

If other packing has been supplied, grease lubrication may be required. The lubricant selected must be compatible with but insoluble in the process fluid. To lubricate the stuffing box remove pipe plugs [710], install a grease fitting compatible with your hand pump system, and pump grease into the stuffing box until it comes out the remaining pipe plug hole. If the grease fitting has a check valve, leave it in place and reinstall only one pipe plug [710]. If the packing requires lubrication, lubricate the stuffing box once every 24 hours.

OPERATION

AGITATOR

Review the following procedure prior to start-up:

Make sure the gear drive is filled with the correct oil to the proper level. See the *Lubrication* section of this manual. Turn the shaft by hand to be sure that it turns freely. Recheck all fasteners for proper tightening. Check for proper motor rotation according to the arrow on the drive. Recheck the stuffing box for proper installation and lubrication. See *Installation* and *Lubrication* sections of this manual. If the stuffing box is flushed, check the flush connections and begin flow. Be sure that all coupling guards and safety covers are in place.

Do not operate the agitator without at least one impeller diameter of liquid depth over the shaft. Stuffing box units receive some lubrication and cooling from the tank fluid. Damage could result from dry operation. Operating the agitator as the tank liquid level approaches and passes through the impeller will severely reduce seal life. Liquid level switches may be used to shut off the agitator when the liquid level approaches the impeller. Never try to start the agitator with the impeller buried in settled solids.

Should there be problems operating the unit, review the Installation procedures and troubleshooting guide (*Table 12, page 27*). If you are unable to resolve the problem, contact your local Chemineer office.

MOTOR

Upon initial start-up it is recommended that the motor current be measured and compared to nameplate current. The motor on your unit should be kept free of dirt to allow proper cooling. Noise, vibration, or an increase in temperature may indicate increases in load, an electrical imbalance, or the need to replace the bearings.

MOTOR COUPLING

Most motor couplings provide years of operation with very few problems, provided they operate in a clean environment and are lubricated periodically, if required. Any time the motor is removed for service, the coupling alignment should be rechecked before restarting the unit. Refer to the *Motor Coupling* supplement with this manual.

GEAR DRIVE

The gear drive on this agitator is entirely oil lubricated. Failure to fill the gear drive with the proper amount and type of oil will result in damage to the gearing and bearings in a very short time. Overfilling the gear drive will result in elevated operating temperatures and premature oil breakdown. Surface temperature of the gear drive should not exceed 190° F (88° C). Normal operating temperature is 140-150° F (60-66° C).

STUFFING BOX

If the packing (*Figure 7, page 16*) requires lubrication, lubricate it regularly with a lubricant which is compatible with the process fluid. See the *LUBRICATION* section of this manual.

Adjust the stuffing box when leakage is objectionable by tightening gland nuts [703]. *NOTE: Stuffing boxes must leak slightly for proper operation. Do not overtighten the gland nuts.* Always strive for satisfactory sealing with the least gland force possible.

If leakage remains objectionable, tighten the gland nuts gradually (no more than one flat on the nuts every 15 minutes) until the leakage rate is acceptable. *Do not overtighten the gland nuts.* Make sure gland plate [706] remains square with the shaft.

NOTE: Packing receives cooling and lubrication from the leakage passing between the packing and the shaft. The packing should never be so tight that there is no leakage as this will cause scoring of the shaft. Normal leakage is 1 to 6 drops per second.

If adjustment of the gland nuts does not provide the necessary leakage control, then proceed to the repack procedure in the *MAINTENANCE* section of this manual.

TROUBLESHOOTING

TABLE 12: TROUBLESHOOTING

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

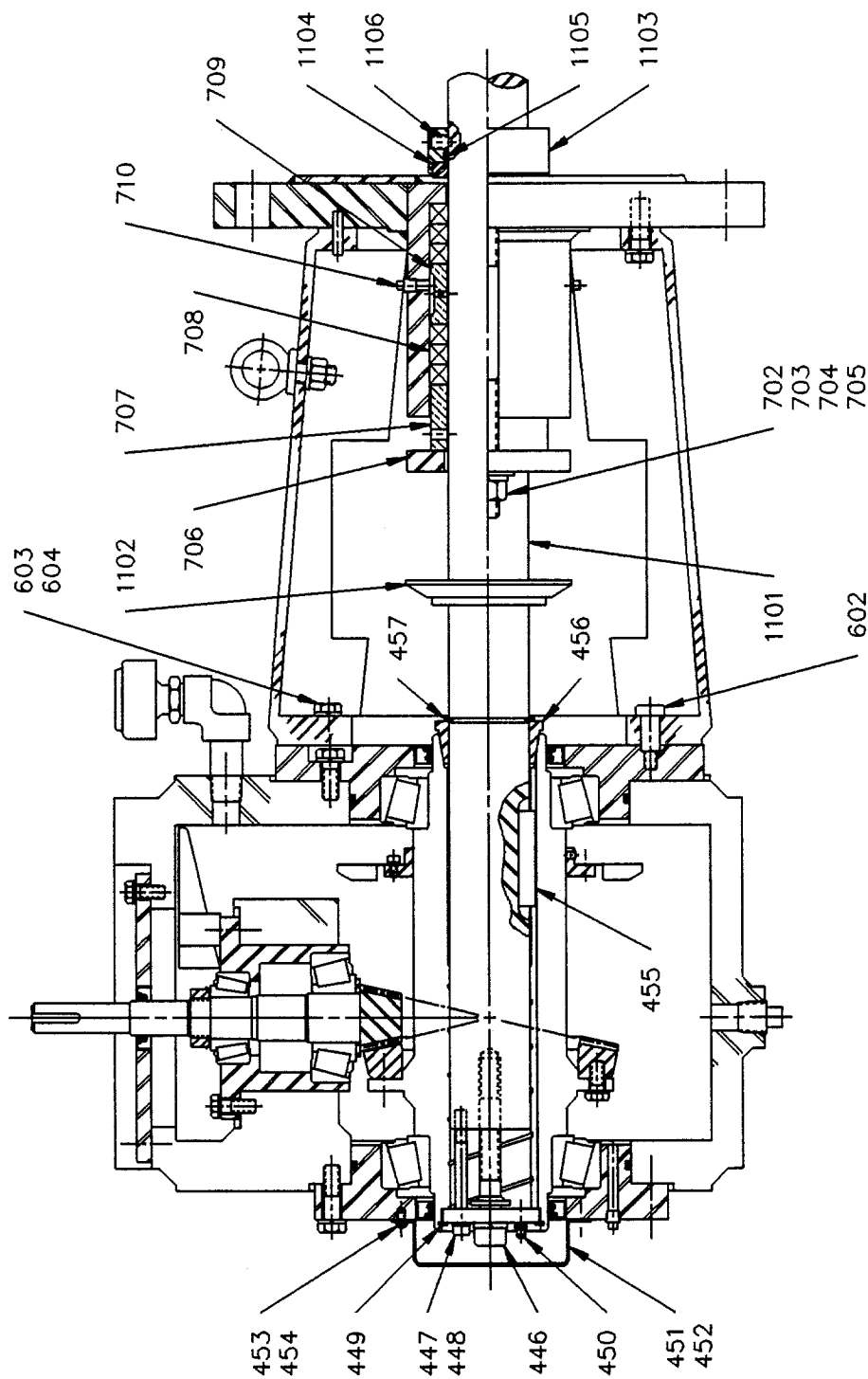


Figure 9: Model HSA Stuffing Box

MAINTENANCE

Routine maintenance on your HS Agitator consists of periodic lubrication and stuffing box packing replacement. The amount of maintenance will depend upon the service conditions and the type of packing used in the stuffing box.

STUFFING BOX

Repacking is required when satisfactory control over leakage is not attainable or when the holes in split gland [707] meet the outboard end of the stuffing box barrel. All HS Agitators are equipped as standard with an easy to use shaft retract mechanism to seal off the vessel contents. This feature allows the packing to be replaced without having to drain the vessel.

Repack Procedure (see Figure 9)

The following procedure should be used when repacking the stuffing box and/or replacing the shaft.

1. Turn off the agitator. Lock out all electrical power for safety, and remove dust cap [451] and the coupling guard.
2. Loosen three small cap screws [447] approximately 1/4 inch (6 mm). Rotate center retract bolt [446] *counterclockwise* moving the shaft toward the tank 1/8" (3 mm) thus removing the load on snap ring [457] and split tapered collar [456].

NOTE: Hold the flexible coupling to prevent the drive shaft from rotating when the center retract bolt is turned.

3. Remove snap ring [457] from its groove with a snap ring tool or pointed nose pliers, and slide it towards the vessel to allow removal of split tapered collar [456]. Slide the split tapered collar forward and remove it.

STUFFING BOX

Repack Procedure (Cont'd)

4. Rotate center retract bolt [446] *clockwise* moving the drive shaft approximately 1/4" (6 mm) until shutoff collar gasket [1104] seats against the mounting flange.

At this point, the shutoff should be in place and the tank contents sealed so shaft seal maintenance may take place.

5. Remove gland plate nuts [703] and slide gland plate [706] towards the gear drive. Remove split gland [707]. With packing tools remove three rings of packing [708], lantern ring [709] and the remaining rings of packing. The lantern ring is provided with two #8-32 tapped holes to aid in removal.

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

The packing is of square cross section with the size as shown in *Table 13*. Units supplied with shaft sleeves may have different size packing (refer to assembly drawing).

TABLE 13: SHAFT PACKING SIZE

HSA	SHAFT DIAMETER	PACKING SIZE
1	2"	1/2"
2	2"	1/2"
3	3"	5/8"
4	3-1/2"	5/8"

STUFFING BOX

Repack Procedure (Cont'd)

6. Install three new packing rings [708]; lantern ring [709]; three new packing rings [708]; split glands [707]; gland plate [706]; and flat washers, lockwashers, and gland nuts [703, 704, 705].
7. Tighten the gland nuts until the lockwashers are compressed.

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

After repacking, lubricate the stuffing box, if required, according to the *LUBRICATION* section of this manual.

8. Rotate center retract bolt [446] *counterclockwise* moving the shaft toward the tank about 1/8" (3 mm).
9. Install split tapered collar [456] and snap ring [457].
10. Rotate center retract bolt [446] *clockwise* until the split collar is seated. Torque retract bolts [446, 447] to the values shown in *Table 14*.

TABLE 14: RETRACT BOLT TIGHTENING TORQUE

CASE SIZE	CENTER BOLT		SMALL CAP SCREW	
	1 & 2	27 ft. lbs.	37 Nm	6 ft. lbs.	8 Nm
3	101 ft. lbs.	137 Nm	17 ft. lbs.	23 Nm
4	152 ft. lbs.	206 Nm	30 ft. lbs.	41 Nm

STUFFING BOX

Repack Procedure (Cont'd)

11. Pump grease into fitting [450] until the cavity is full.
12. Install dust cap and gasket [451, 452] using screws and lockwashers [453, 454].

The stuffing box will require adjustment at startup. *NOTE: Stuffing boxes must leak slightly for proper operation. Do not overtighten gland nuts [703].* Always strive for satisfactory sealing with the least gland force possible.

Tighten the gland nuts gradually (no more than one flat on the nuts every 15 minutes) until the leakage rate is acceptable. *Do not overtighten the gland nuts.* Make sure gland plate [706] remains square with the shaft.

NOTE: Packing receives cooling and lubrication from the leakage passing between the packing and the shaft. The packing should never be so tight that there is no leakage as this will cause scoring of the shaft. Normal leakage is 1 to 6 drops per second.

AGITATOR SHAFT

Removal

Anytime the agitator shaft is removed from the unit, the packing should be replaced. Packing tends to conform to the shaft surface and even the best shaft packing wears out. The agitator shaft can only be removed after the tank has been completely emptied and cleared for access. The general procedure is as follows:

1. Turn off the agitator. Empty the tank. Lock out all electrical power for safety.
2. Remove impeller [1200] (*see Figure 6, page 15*).

Refer to *Figure 9, page 28*:

3. Remove dust cap [451] and the coupling guard.
4. Loosen three small cap screws [447] approximately 1/4 inch (6 mm). Rotate center retract bolt [446] *counterclockwise* moving the shaft toward the tank 1/8" (3 mm) thus removing the load on snap ring [457] and split tapered collar [456].

NOTE: Hold the flexible coupling to prevent the drive shaft from rotating when the center retract bolt is turned.

5. Remove snap ring [457] from its groove with a snap ring tool or pointed nose pliers, and slide it towards the vessel to allow removal of split tapered collar [456]. Slide the split tapered collar forward and remove it.
6. Remove three small cap screws [447] and rotate center retract bolt [446] *counterclockwise* moving the shaft toward the tank until it releases from the center retract bolt. Loosen stuffing box gland nuts [703].

The shaft is now free to be pulled through the mounting flange into the tank for removal. Key [455], snap ring [457] and slinger [1102] must be removed from the shaft as the shaft passes through the stuffing box.

AGITATOR SHAFT

Installation

If the old shaft is to be reinstalled, be sure the shaft is clean and a new shutoff collar o-ring [1105] and gasket [1104] are in place.

1. Install shutoff collar [1103] with gaskets [1104] onto shaft and seat setscrews [1106] in the original spots in the shaft. (If a new shaft is to be installed, refer to the section *Installing New Agitator Shaft*.) Insert the shaft through the mounting flange from inside the tank. Position slinger [1102], snap ring [457] and key [455] as the shaft passes through the stuffing box.
2. Push the shaft into the gear drive until the center retract bolt can be engaged.
3. Rotate center retract bolt [446] *clockwise* until three small cap screws [447] with lockwashers [448] can be engaged.
4. Position split tapered collar halves [456] properly and install snap ring [457] in the snap ring groove.
5. Rotate center retract bolt [446] *clockwise* until the shaft, snap ring and split tapered collar draw tight. Torque the retract bolts to the values shown in *Table 14 (page 31)*.

Repack the stuffing box according to the *Repack Procedure* outlined on *page 29*.

6. Add grease to fitting [450] until grease fills the cavity.
7. Install dust cap and gasket [451, 452] using screws and lockwashers [453, 454].
8. Bolt extension blades [1204] to hub [1202] with bolts [1205, 1206, 1207]. Torque the bolts to the value shown in *Table 5 (page 11)*.

NOTE: Impeller parts are match marked. Install parts as marked so the impeller will be properly balanced.

AGITATOR SHAFT

Installation (Cont'd)

9. Install the impeller as shown in *Figure 5 (page 12)* with the concave side of its blades away from the wall of the tank. Unless otherwise specified on the unit assembly drawing, the impeller attaches to the shaft with a key and setscrew. The tapped hole in the impeller hub contains a self-locking thread form. Torque the setscrew to the value shown in *Table 5 (page 11)*.

The stuffing box will require adjustment at startup. *NOTE: Stuffing boxes must leak slightly for proper operation. Do not overtighten gland nuts [703].* Always strive for satisfactory sealing with the least gland force possible.

Tighten the gland nuts gradually (no more than one flat on the nuts every 15 minutes) until the leakage rate is acceptable. *Do not overtighten gland nuts.* Make sure gland plate [706] remains square with the shaft.

NOTE: Packing receives cooling and lubrication from the leakage passing between the packing and the shaft. The packing should never be so tight that there is no leakage as this will cause scoring of the shaft. Normal leakage is 1 to 6 drops per second.

AGITATOR SHAFT

Installing New Agitator Shaft

If a new shaft is to be installed, be sure shutoff collar o-ring [1105] and gasket [1104] are in place before installing the shaft in the unit. *Do not seat setscrews [1106].*

1. Insert the shaft through the mounting flange from inside the tank. Position snap ring [457] on the shaft as it passes through the stuffing box.
2. Push the shaft into the gear drive until the center retract bolt can be engaged.
3. Rotate center retract bolt [446] *clockwise* until three small cap screws [447] with lockwashers [448] can be engaged.
4. Position tapered collar halves [456] properly and install snap ring [457] in the snap ring groove.
5. Rotate center retract bolt [446] *clockwise* until the shaft, snap ring, and split tapered collar draw tight.
6. Position shutoff collar [1103] such that shutoff gasket [1104] is about 1/8" (3 mm) from the shutoff sealing face of the stuffing box flange and mark the collar location on the shaft.
7. Remove the agitator shaft from the unit.
8. Spot the shaft to accept setscrew's [1106] dog point.
9. Reposition the shutoff collar with the gasket and o-ring on the shaft and seat the setscrews in the spotted holes.
10. Insert the shaft through the mounting flange from inside the tank.
11. Position slinger [1102], snap ring [457], and shaft key [455] as the shaft passes through the stuffing box.
12. Push the shaft into the gear drive until the center retract bolt can be engaged.

AGITATOR SHAFT

Installing New Agitator Shaft (Cont'd)

13. Rotate center retract bolt [446] *clockwise* until three small cap screws [447] with lockwashers [448] can be engaged.
14. Position split tapered collar halves [456] properly and install snap ring [457] in the snap ring groove.
15. Rotate center retract bolt [446] clockwise until the shaft, snap ring, and split tapered collar draw tight. Torque the retract bolts to the values shown in *Table 14 (page 31)*.
16. Add grease to fitting [450] until grease fills the cavity.
17. Install dust cap and gasket [451, 452] using screws and lockwashers [453, 454].
18. Install the impeller as shown on *Figure 5 (page 12)* with the concave side of its blades away from the wall of the tank. Unless otherwise specified on the unit assembly drawing, the impeller attaches to the shaft with a key and setscrew. The tapped hole in the impeller hub is a self-locking thread form. Torque the setscrew to the value shown in *Table 5 (page 11)*.

The stuffing box will require adjustment at startup. *NOTE: Stuffing boxes must leak slightly for proper operation. Do not overtighten gland nuts [703].* Always strive for satisfactory sealing with the least gland force possible.

Tighten the gland nuts gradually (no more than one flat on the nuts every 15 minutes) until the leakage rate is acceptable. *Do not overtighten the gland nuts.* Make sure gland plate [706] remains square with the shaft.

NOTE: Packing receives cooling and lubrication from the leakage passing between the packing and the shaft. The packing should never be so tight that there is no leakage as this will cause scoring of the shaft. Normal leakage is 1 to 6 drops per second.

GEAR DRIVE

This section covers the removal, disassembly, assembly and installation of the HS Agitator gear drive.

CAUTION! The tank must be drained before removing the gear drive. When the gear drive is fully disassembled, all bearings, lip seals, o-rings, shims and gaskets should be replaced with new parts. When replacing bearings, always replace both cup and cone. Spiral bevel gears must always be replaced in matched sets.

Agitator Shaft Removal

Remove the agitator shaft per the shaft removal procedure on page 33.

Gear Drive Removal

1. With a hoist or crane system, hook up to the cutouts on the sides of the motor bracket and apply enough tension to relieve the gear drive and motor weight from the drive support.
2. Remove channel support [501] (see *Figure 6, page 15*) or tie-rods.
3. Remove shoulder bolts [602] and bolts [603] (see *Figure 9, Page 28*) securing the gear drive to the pedestal.
4. Remove the gear drive and motor assembly.

GEAR DRIVE

Preparation for Gear Drive Disassembly

1. Clean external surfaces and drain the oil.
2. Remove setscrews securing the flexible coupling hub to the input pinion shaft. This coupling hub must be free to slide off the shaft as the motor and motor bracket assembly are removed from the gear drive.
3. Remove bolts [303] securing motor bracket [301] to gear drive [400] (see *Figure 6, Page 15*). Remove the motor and motor bracket as an assembly.

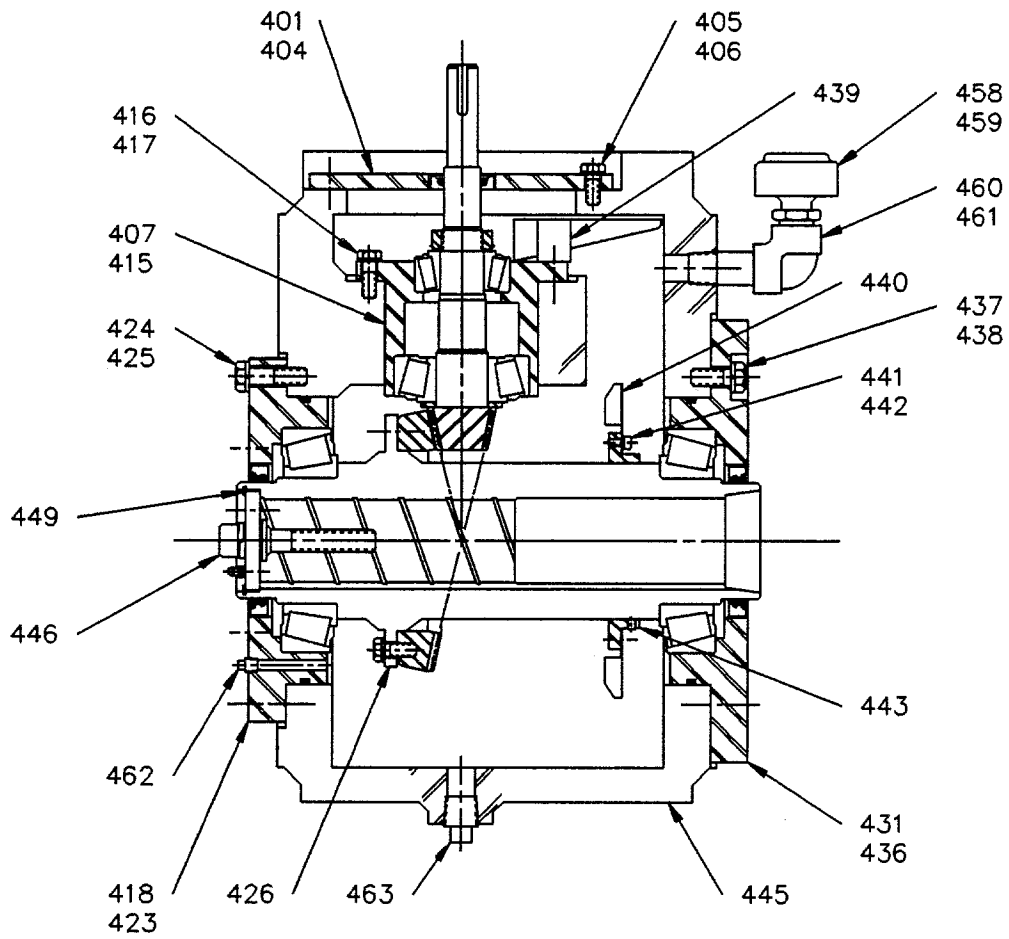


Figure 10: HS Gear Drive

GEAR DRIVE

Disassembly

1. Remove snap ring [449] and retract bolt assembly [446] (*Figure 10, page 40*).
2. Remove drive shaft [1110] and key [455] from hollow output shaft.
3. Remove breather [458] and fittings [459, 460, 461].
4. Set the gear drive on a clean work surface with the hollow shaft vertical, outer bearing cap [418] down.
5. Remove bolts [437], inner bearing cap assembly [431] and shim set [436]. Keep the shim set intact for reference at assembly.
6. Remove cap screws [441] and slingers [440].
7. Remove bolts [405], input cap assembly [401] and gasket [404].
8. Remove bolts [416] securing the spiral bevel pinion cartridge to the housing. Remove lube trough [439], cartridge assembly [407] and shim set [415]. Keep the shim set intact for reference at assembly.
9. Remove hollow shaft assembly [426].
10. Tip the gear drive housing up, remove bolts [424], outer bearing cap assembly [418] and shim set [423]. Keep the shim set intact for reference at assembly.

The gear drive is now disassembled into major subassemblies; spiral bevel pinion cartridge, hollow shaft assembly and bearing caps.

GEAR DRIVE

Disassembly (Cont'd)

Bearing cups mounted in caps are interference fit and can be difficult to remove with a commercial bearing puller. Removal can be made easier by welding a 1/8" (3 mm) bead completely around the cup in the center of the roller race. Upon cooling the cup will shrink allowing removal. Be sure to protect adjacent surfaces from weld spatter.

Spiral Bevel Pinion Cartridge

1. Remove the setscrew from locknut [409]. Remove locknut and lockwasher [409 and 410] from pinion shaft.
2. Press spiral bevel pinion shaft [408] out of bearing [411] cone. Press bearing [413] cone (and pinion washer [414], Case 4 only) off the pinion shaft.
3. Pull bearing [411, 413] cups out of the cartridge.

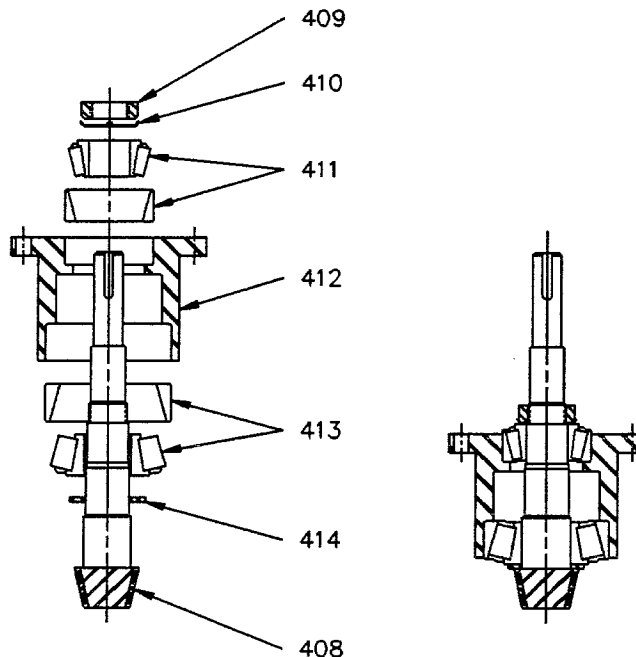


Figure 11: Spiral Bevel Pinion Cartridge [407]

GEAR DRIVE

Disassembly (Cont'd)

Hollow Shaft

1. Press bearing [420, 433] cones off the shaft.
2. Loosen setscrews [444] and remove slinger collar [443].
3. Remove gear mounting bolts [429] and spiral bevel gear [428].

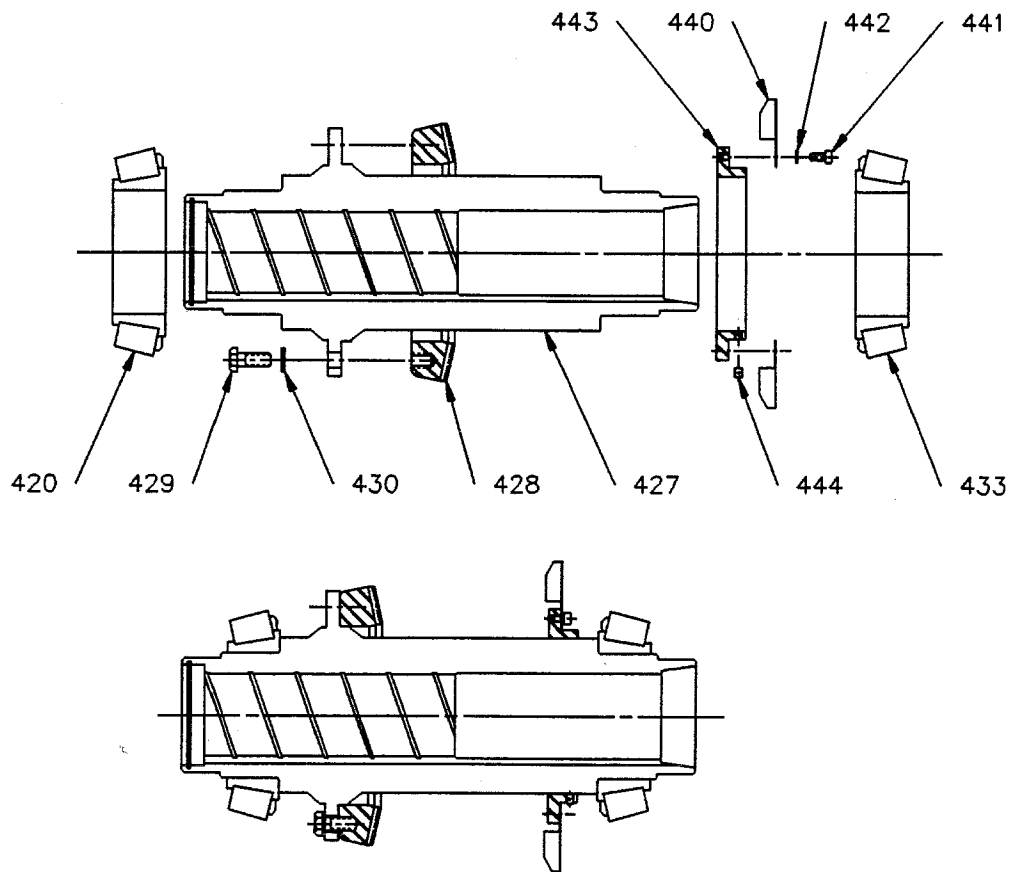


Figure 12: Hollow Shaft [426]

GEAR DRIVE

Disassembly (Cont'd)

Bearing Caps

1. Remove each bearing [420, 433] cup from its respective cap.
2. Press lip seals [421, 434] out of the caps.
3. Remove o-rings [422, 435].

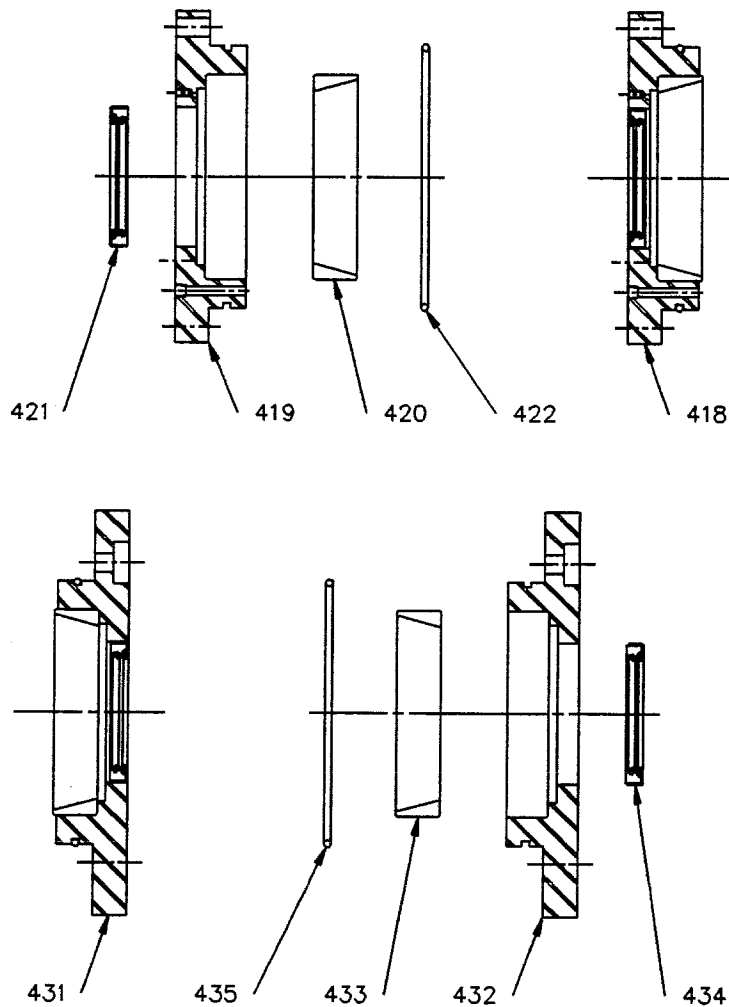


Figure 13: Outer [418] and Inner [431] Bearing Cap

GEAR DRIVE**Disassembly (Cont'd)****Input Cap**

1. Press lip seal [403] out of cap [402].
2. Remove gasket [404].

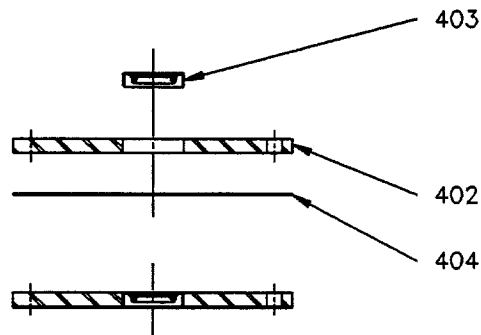


Figure 14: Input Cap [401]

The gear drive is now fully disassembled. Clean all parts and inspect for wear. Replace worn parts as required.

GEAR DRIVE

Assembly

Inspect all bolts and setscrews for damage after cleaning (threads, shank and head). If replacement is required, replace with the equivalent type and strength grade.

CAUTION! The tapped holes in the slinger collar are a self-locking thread form. Do not chase threads with a standard tap. Thread damage will require replacement of the slinger collar.

Inspect and clean all tapped holes. If threads are damaged, chase with an appropriate tap.

CAUTION! The recommended assembly procedure requires the use of a torque wrench. The values listed in Table 15 (page 47) are proper tightening torques as a function of thread size.

All bearing cones are mounted with interference fits. Heat the cones and press onto the shaft. Heat bearings in oven or oil bath.

NOTE: Do not heat parts in excess of 275°F (135°C). Do not apply direct flame. Do not allow parts to touch the bottom or sides of the oven or oil bath.

All bearing cups are mounted with interference fits. Press bearing cups into their housings cold. *Placing the cups in dry ice will cause them to shrink and ease installation.*

Before installing lip seals clean the cap bore and apply Permatex #2 or equivalent to the outside of the lip seal. Install the lip seal with the spring facing the bearing. Before installation on a shaft, coat the shaft and lip seal with bearing grease.

GEAR DRIVE

Assembly (Cont'd)

TABLE 15: BOLT TIGHTENING TORQUE

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⁾ 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.

GEAR DRIVE

Assembly (Cont'd)

Most gear drive bolt patterns are circular with six- or eight-hole spacings. Install all bolts finger-tight, then tighten in sequential order (see below) to 50% of the prescribed torque values. Repeat the sequence, tightening the bolts to full torque values.

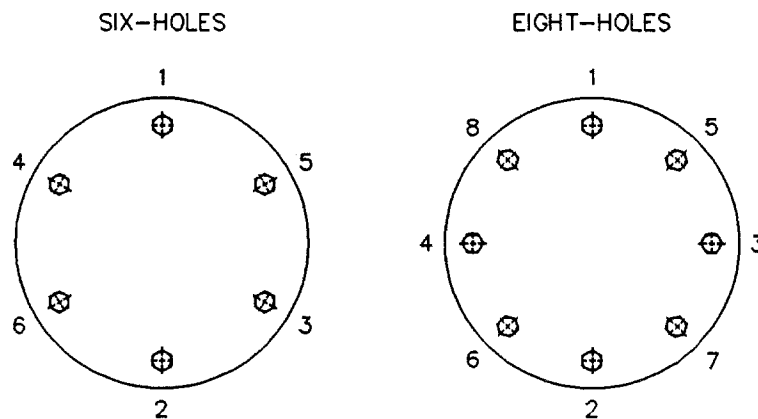


Figure 15: Sequential Tightening

When tightening two or more setscrews which retain a collar, flange, or sleeve to a shaft, tighten alternately, working back and forth or around the shaft. Tighten in steps to final torque values.

GEAR DRIVE

Assembly (Cont'd)

Spiral Bevel Pinion Cartridge

1. Press bearing [411, 413] cups into housing [412]. The cup must be firmly seated against the shoulder. Check with a feeler gauge.
2. Install pinion washer [414] (Case 4 only) onto pinion shaft [408]. Heat and press bearing [413] cone onto the pinion shaft. Allow the bearing to cool. The cone must be firmly seated against the shoulder. Check with a feeler gauge.
3. Insert the pinion shaft into cartridge housing [412].
4. Heat bearing [411] cone and press it onto the pinion shaft until the cartridge housing shows slight resistance to turning by hand.

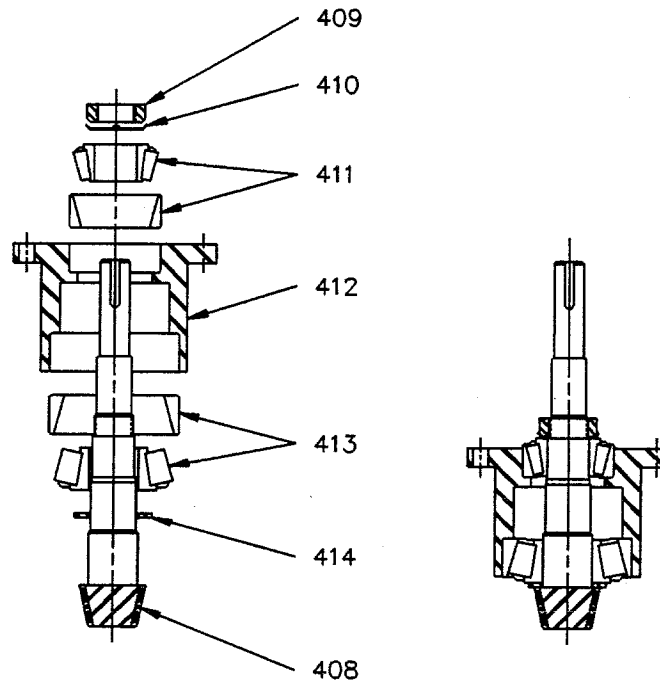


Figure 16: Spiral Bevel Pinion Cartridge [407]

GEAR DRIVE

Assembly (Cont'd)

Spiral Bevel Pinion Cartridge

5. Clamp the housing flange of the cartridge assembly in a soft jawed bench vise.
6. Spray bearings [411, 413] and shaft threads with light machine oil and install locknut and lockwasher [409, 410] finger tight.
7. Wrap the keyed end of the pinion shaft with tape and force a 12-point socket over the taped end.

NOTE: Case Sizes 1 and 2 will require a 3/4" socket. Case Size 3 requires a 1-1/8" socket. Case Size 4 requires a 1-7/16" socket.

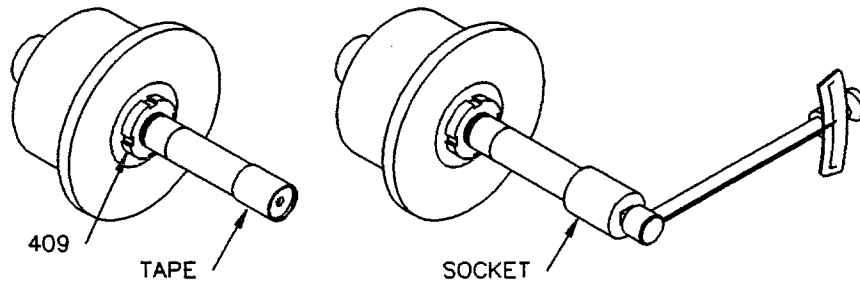


Figure 17: Pinion Cartridge Torque Reading

8. Apply a torque wrench and measure the shaft turning torque. The torque reading is to be taken while rotating the pinion shaft at about 3 rpm. Increase turning torque by tightening locknut [409]. Turn shaft one complete revolution between adjustments. Adjust to:

Case Size 1 and 2 -- 2 to 4 in-lb (.3 to .5 Nm)

Case Size 3 and 4 -- 4.5 to 8.5 in-lb (.5 to 1.0 Nm)

GEAR DRIVE**Assembly (Cont'd)****Spiral Bevel Pinion Cartridge**

- Engage lockwasher [410] and tighten the setscrew to 23 in-lb (2.6 Nm). Precision measure and record the assembled height "A" of the spiral bevel pinion cartridge. This measurement will be required to set the mounting distance of the spiral bevel pinion. Delete the original dimension stamped on the housing.

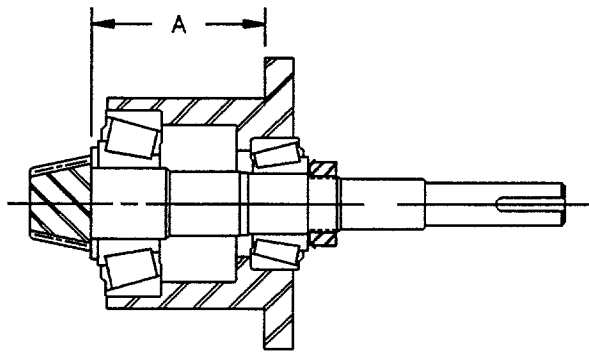


Figure 18: Pinion Cartridge Measurement

GEAR DRIVE

Assembly (Cont'd)

Hollow Shaft

1. Install spiral bevel gear [428].
2. Install bolts and lockwashers [429, 430] and torque the bolts according to the values shown in *Table 15* (page 47).
3. Install slinger collar [443], set at the shaft scribe mark. Tighten setscrews [444] to 8.3 ft-lb (11.3 Nm).
4. Heat bearing [420, 433] cones and press onto the hollow shaft. Cones must be firmly seated against the shaft shoulders. Check with a feeler gauge.

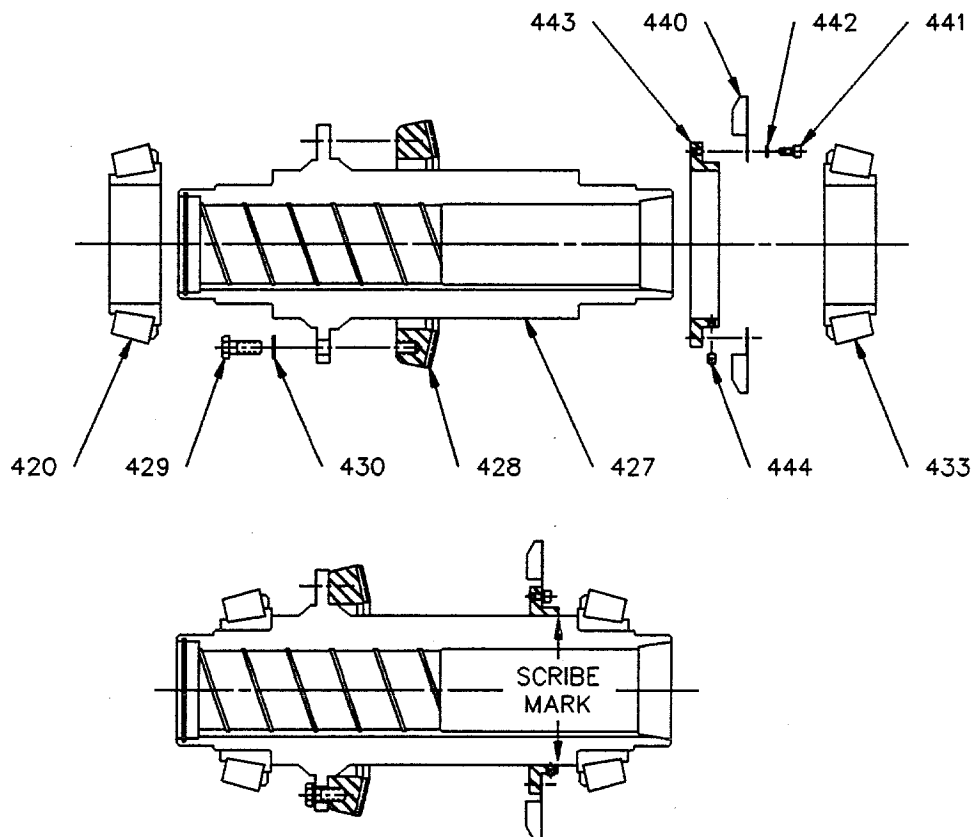


Figure 19: Hollow Shaft [426]

GEAR DRIVE

Assembly (Cont'd)

Hollow Shaft

5. Install slingers [440] onto the slinger collar using cap screws and lockwashers [441, 442]. Position the slingers in the retracted position (see below) and tighten the cap screws finger tight.
6. Spray the inside diameter of the hollow shaft with light oil.

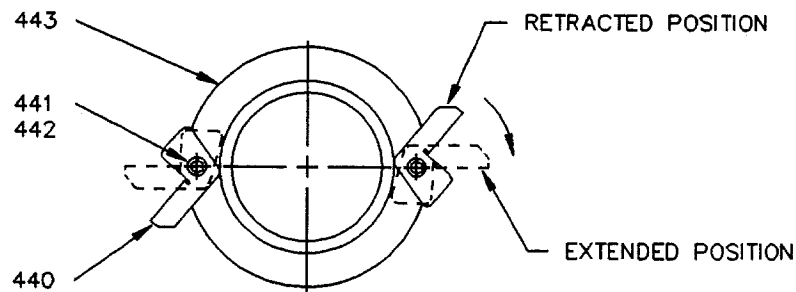


Figure 20: Slinger

GEAR DRIVE

Assembly (Cont'd)

Bearing Caps

- 1. Install each bearing [420, 433] cup in its respective cap. *Do not install the lip seals or o-rings at this time.*

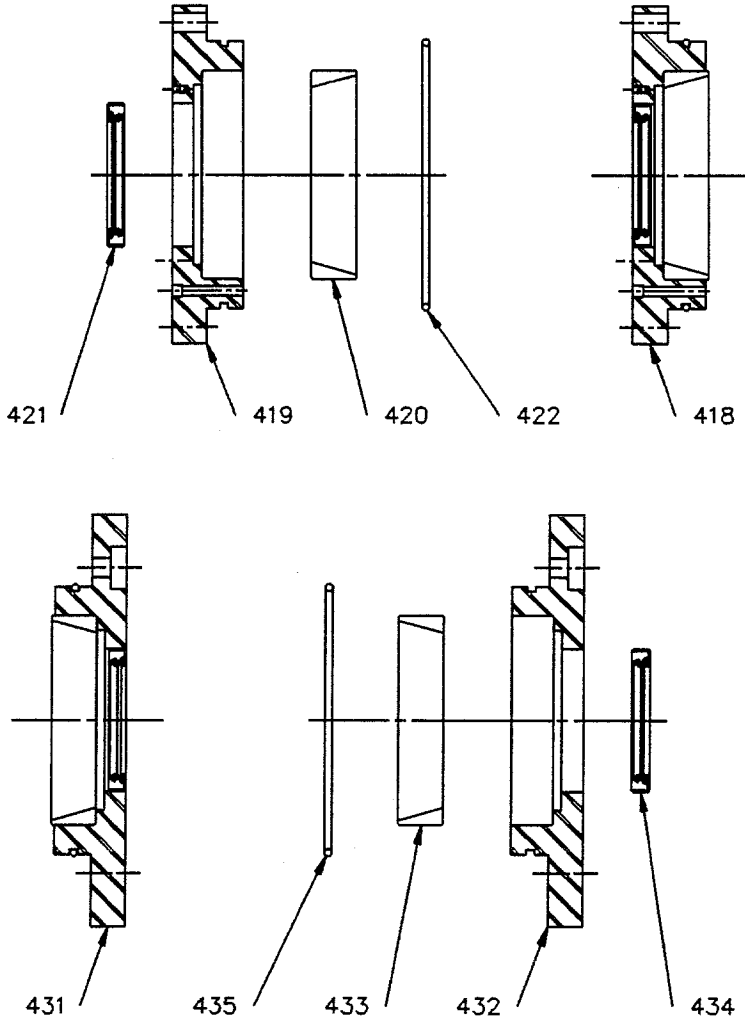


Figure 21: Outer [418] and Inner [431] Bearing Cap

GEAR DRIVE

Assembly (Cont'd)

Gear Drive (Figure 10, page 40)

1. Mike the thickness of original shim set [436] for the inner bearing cap and duplicate the thickness with new shims.

Example:

If the thickness of the old shim set was .062", use (12) blue shims and (1) red shim to equal .062" when compressed.

Red = .002" (.051 mm) thick

Blue = .005" (.127 mm) thick

2. Install inner bearing cap [431] and new shim set [436] into the gear drive housing [445] using only four bolts [437], equally spaced. Torque the bolts to the value shown in *Table 15* (page 47).
3. Calculate required pinion cartridge shim set [415] thickness as follows:

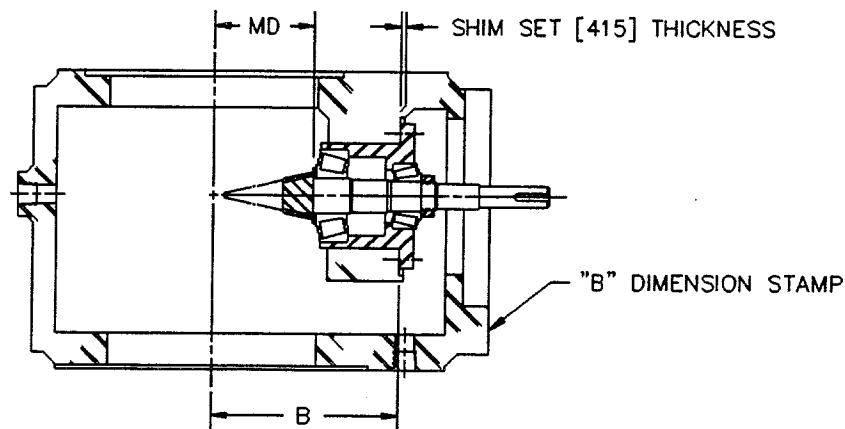


Figure 22: Shim Calculation

GEAR DRIVE

Assembly (Cont'd)

Gear Drive

$A + MD - B = \text{Shim Set [415] thickness}$

MD = Pinion mounting distance (MD X.XXX) etched on the small end of the pinion.

B = Dimensional value marked on the motor end of the gear housing (*Figure 22*)

A = Assembled cartridge height measurement (*Figure 18, page 51*)

Duplicate the calculated thickness with new shims.

4. Using a paint stick, highlight the top edge of the tooth marked with an "X" on pinion shaft [408].
5. Install spiral bevel pinion cartridge assembly [407] and shim set [415] into the housing.
6. Install lube trough [439]. Install bolts and lockwashers [416, 417] and torque bolts according to the values shown in *Table 15*.

NOTE: Make sure there is no interference between the lube trough and the rotating portion of the bearing. If there is an interference, bend the lube trough just enough to provide clearance.

7. Position the gear drive housing so the inner cap assembly [431] is down. Rotate the pinion shaft until the tooth marked "X" is at top center.
8. Using a paint stick, highlight the "X" match marks on the outside of spiral bevel gear [428] (*Figure 19, page 52*).
9. Spray bearings [420, 433] with light machine oil and lower hollow shaft assembly [426] into the housing. *CAUTION: Make sure the spiral bevel gear teeth marked "X" straddle the pinion shaft tooth marked "X."*

GEAR DRIVE

Assembly (Cont'd)

Gear Drive

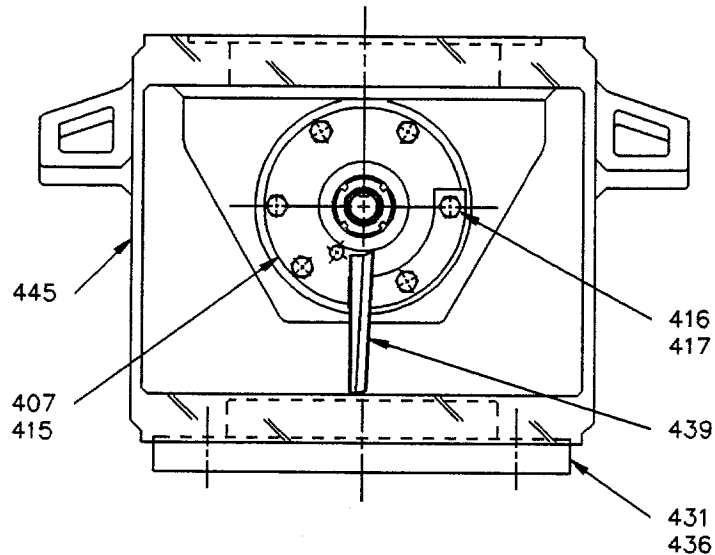


Figure 23: Lube Trough Installation

10. Install outer bearing cap [418]. Bolt it in place using three equally spaced bolts [424]. Alternately tighten the bolts until cap is seated on the bearing. *Do not torque the bolts; finger tighten only.*
11. Install the key in the pinion shaft, tape the key in place, and measure the backlash by placing a dial indicator against the key at a right angle to the rotation. Restrain the hollow output shaft from turning and rotate the pinion shaft back and forth measuring the free movement. (*Figure 24, page 58.*)

Backlash Setting (Dial Indicator Movement)

- Case 1 and 2 = .002 to .0025" (.05 to .06 mm)
 Case 3 and 4 = .003 to .004" (.08 to .1 mm)

GEAR DRIVE

Assembly (Cont'd)

Gear Drive

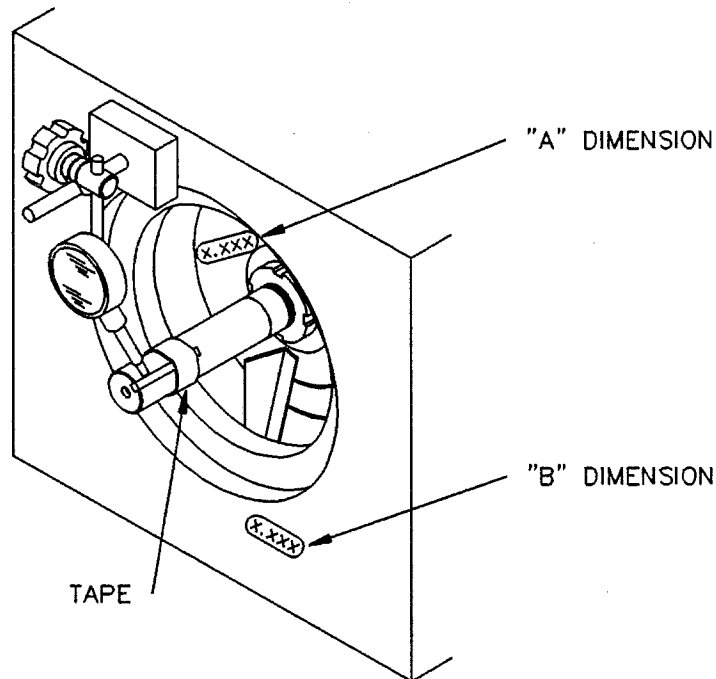


Figure 24: Backlash Setting

12. Take four consecutive backlash readings. Rotate the pinion shaft one revolution counterclockwise after each reading. If there is any variation in the backlash readings, turn the pinion shaft back to the position of the lowest backlash reading.
13. Add shims [436] to inner bearing cap [431] to decrease backlash; remove shims to increase backlash.

NOTE: Before each shim change, the bolts on the outer bearing cap should be loosened. After changing the shims, the bolts on the inner bearing cap should be torqued to the value shown in Table 15 (page 47) and then the bolts on the outer bearing cap should be finger tightened.

GEAR DRIVE

Assembly (Cont'd)

Gear Drive

14. Measure the gap between the outer bearing cap [418] and the gear drive housing. Count out new shims equal to the gap minus .002". This should provide a bearing setting of .000" end play to .002" (.051 mm) preload.
15. Remove outer bearing cap [418]. Install lip seal [421] and o-ring [422].
16. Spray the o-ring and the housing bore with light machine oil. Install outer bearing cap assembly [418] with new shim set [423] (see step 14). Use bolts and lockwashers [424, 425] and torque to the value shown in *Table 15, page 47*.
17. Remove inner bearing cap [431].
18. Loosen slinger cap screws [441] and extend the blades. Torque the cap screws to the value shown in *Table 15*.
19. Install lip seal [434] and o-ring [435] on inner bearing cap [431]. Spray the o-ring and housing bore with light machine oil.
20. Install inner bearing cap assembly [431] with new shim set [436]. Use bolts and lockwashers [437, 438] and torque to the value shown in *Table 15*.
21. Check the spiral bevel gear backlash; adjust if required (*see Steps 11, 12 and 13*). Check the hollow drive shaft end play; adjust if required (*see Step 14*). Turn the pinion shaft by hand until the hollow shaft makes one revolution. The shaft should turn easily with no binding.

GEAR DRIVE

Assembly (Cont'd)

Input Cap

1. Install lip seal [403] into input cap [402].
2. Coat the gasket surfaces on cap and housing with Permatex #2 or equivalent.
3. Install gasket [404] and the input cap. Install bolts and lockwashers [405, 406] and torque the bolts to the value shown in *Table 15 (page 47)*.

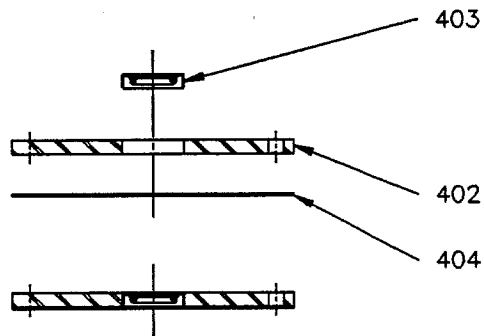


Figure 25: Input Cap [401]

GEAR DRIVE

Assembly (Cont'd)

Motor Bracket (*Figure 6, page 15*)

1. Install the motor bracket assembly, the pinion shaft key, and the flexible coupling hub. Install bolts and lockwashers [303, 304] and dowel pins [302] and torque the bolts to the value shown in Table 5 (*page 11*).
2. Assemble the flexible coupling and make sure the alignment is correct (see *MAINTENANCE - Motor Couplings*).
3. Install oil drain plug [463] and oil level plug [462] (*Figure 10, page 40*).
4. With the gear drive in the operating position, fill with oil to the operating level (see *LUBRICATION*). Plug the gear drive breather connection so that the oil does not spill during handling. Coat the inside diameter of the hollow shaft with a light coating of bearing grease.

The gear drive is now ready to be assembled to the drive support.

GEAR DRIVE

Installation

NOTE: Clean all components thoroughly before reassembly. Lightly lubricate all parts during reassembly to prevent galling and for ease of assembly.

1. Use the cutouts on the sides of motor bracket [301] (*Figure 6, page 15*) and hoist the gear drive into position.
2. Attach the gear drive to the pedestal using shoulder bolts [602] (*Figure 9, page 28*). These bolts insure the alignment of the gear drive with the pedestal. Torque these bolts to:

Case 1, 2, and 3	-- 15 ft-lb (20.3 Nm)
Case 4	-- 38 ft-lb (51.5 Nm)
3. Install pedestal bolts and lockwashers [603, 604]. Torque the bolts to the value shown in *Table 5 (page 11)*.
4. Insert retract bolt assembly [446] and snap ring [449] into the hollow output shaft.
5. Install shutoff collar [1103] with gaskets onto the shaft and seat setscrews [1106] in the original spots in the shaft. (If a new shaft is to be installed, refer to the section *Installing New Agitator Shaft*.) Insert the shaft through the mounting flange from inside the tank. Position slinger [1102], snap ring [457] and key [455] as the shaft passes through the stuffing box.
6. Push the shaft into the gear drive until the center retract bolt can be engaged.
7. Rotate center retract bolt [446] *clockwise* until the three small cap screws [447] with lockwashers [448] can be engaged.

GEAR DRIVE

Installation (Cont'd)

8. Position split tapered collar halves [456] properly and install snap ring [457] in the snap ring groove.
9. Rotate center retract bolt [446] *clockwise* until the shaft, snap ring and split tapered collar draw tight. Torque the retract bolts to the values shown in *Table 14 (page 31)*.

Repack the stuffing box according to the *Repack Procedure (page 29)*.

10. Add grease to fitting [450] until grease fills the cavity.
11. Install dust cap and gasket [451, 452] using screws and lockwashers [453, 454].
12. Remove the plug from the gear drive breather connection and install fittings [459, 460, 461] and breather [458] (*Figure 10, page 40*).
13. Bolt extension blades [1204] to hub [1202] with bolts [1205, 1206, 1207] (*Figure 5, page 12*). Torque the bolts to the values shown in *Table 5 (page 11)*.

NOTE: Impeller parts are match marked. Install parts as marked so the impeller will be properly balanced.

14. Install the impeller as shown in *Figure 5* with the concave side of its blades away from the wall of the tank. Unless otherwise specified on the unit assembly drawing, the impeller attaches to the shaft with a key and setscrew. The tapped hole in the impeller hub is a self-locking thread form. Torque the setscrew to the value shown in *Table 5*.

GEAR DRIVE

Installation (Cont'd)

15. Turn flexible coupling [200] (*Figure 6, page 15*) by hand until the drive shaft makes one complete revolution to insure that the shaft is free to rotate under power. Install coupling guard [312], channel support [501] or tie-rods. Check the gear drive oil level.
16. Connect the electrical power, jog the motor and check the drive shaft rotation. The proper rotation is indicated by an arrow on the drive.

The stuffing box will require adjustment at startup.

NOTE: Stuffing boxes must leak slightly for proper operation. Do not overtighten gland nuts [703].

Always strive for satisfactory sealing with the least gland force possible.

Tighten the gland nuts gradually (no more than one flat on the nuts every 15 minutes) until the leakage rate is acceptable. *Do not overtighten the gland nuts.* Make sure gland plate [706] remains square with the shaft.

NOTE: Packing receives cooling and lubrication from the leakage passing between the packing and the shaft. The packing should never be so tight that there is no leakage as this will cause scoring of the shaft. Normal leakage is 1 to 6 drops per second.

HSA AGITATOR ITEM LIST

Item #	Description	Qty.
100	motor	1
101	motor key	1
200	flexible coupling assembly	1
300	motor bracket assembly	1
301	motor bracket	1
302	dowel pin	2
303	hex bolt	4
304	spring lockwasher	4
305	hex bolt	4
306	large flatwasher	4
307	shim set	4
308	spring lockwasher	4
309	hex nut	4
310	hex bolt	2
311	hex nut	2
312	coupling guard	1
313	hex bolt	4
314	flatwasher	4
315	wellnut	4
400	gear drive assembly	1
401	input cap assembly	1
402	input cap	1
403	lip seal	1
404	gasket	1
405	hex bolt	6
406	spring lockwasher	6
407	pinion shaft assembly	1
408	spiral bevel pinion shaft	1
409	locknut w/setscrew	1
410	keyed lockwasher	1

HSA AGITATOR ITEM LIST

Item #	Description	Qty.
411	bearing	1
412	cartridge housing	1
413	bearing	1
414	pinion washer (Case 4 only)	1
415	shim set	1
416	hex bolts	6
417	spring lockwasher	6
418	outer bearing cap assembly	1
419	outer bearing cap	1
420	bearing	1
421	lip seal	1
422	o-ring	1
423	shim set	1
424	hex bolt	6
425	spring lockwasher	6
426	hollow shaft assembly	1
427	hollow shaft	1
428	spiral bevel gear	1
429	-001 hex bolt	6
	-002 hex bolt	8
	-003 hex bolt	10
430	-001 spring lockwasher	6
	-002 spring lockwasher	8
	-003 spring lockwasher	10
431	inner bearing cap assembly	1
432	inner bearing cap	1
433	bearing	1
434	lip seal	1
435	o-ring	1
436	shim set	1
437	hex bolt	8
438	spring lockwasher	8
439	lube trough	1
440	slinger	2

HSA AGITATOR ITEM LIST

Item #	Description	Qty.
441	cap screw	2
442	spring lockwasher	2
443	slinger collar	1
444	setscrew, cup point	2
445	gear drive housing	1
446	retract bolt assembly	1
447	cap screw	3
448	spring lockwasher	3
449	snap ring	1
450	grease fitting	1
451	dust cap	1
452	gasket	1
453	-001 screw, round head	4
	-002 screw, round head	6
454	-001 lockwasher	4
	-002 lockwasher	6
455	key	1
456	split tapered collar	1
457	snap ring	1
458	breather	1
459	hex bushing	1
460	pipe elbow	1
461	pipe nipple	1
462	oil level plug, NPT	1
463	magnetic drain plug, NPT	1
464	pinion shaft key	1
500	drive support assembly	1
501	channel support	1
502	angle bracket	1
503	hex bolt	2
504	spring lockwasher	2
505	hex bolt	2
506	spring lockwasher	2
507	hex nut	2
550	tie rod support assembly	1

HSA AGITATOR ITEM LIST

Item #	Description	Qty.
600	pedestal assembly	1
601	pedestal	1
602	shoulder bolt	2
603	hex bolt	6
604	spring lockwasher	6
605	hex bolt	8
606	spring lockwasher	8
607	roll pin	2
608	eye bolt	1
609	spring lockwasher	1
610	hex nut	1
700	mounting flange stuffing box assy	1
701	mounting flange stuffing box	1
702	stud	2
703	hex adjusting nut	2
704	spring lockwasher	2
705	flatwasher	2
706	gland plate	1
707	split gland	1
708	packing (2 sets of 3 rings)	6
709	lantern ring	1
710	plug, NPT	2
1100	shaft assembly	1
1101	drive/extension shaft	1
1102	slinger	1
1103	shutoff collar	1
1104	shutoff gasket	1
1105	o-ring	1
1106	setscrew, dog point	2

HSA AGITATOR ITEM LIST

Item #	Description	Qty.
1200	impeller assembly	1
1201	impeller assembly HE-3S	1
1202	impeller hub	1
1203	setscrew, square head cup point	1
1204	extension blades	3
1205	hex bolts	12
1206	spring lockwasher	12
1207	hex nut	12
1208	key	1

INTRODUCTION

Adequate lubrication is essential for satisfactory operation. This manual provides a list of typical lubricants and specifications for general purpose and long term greases.

The use of general purpose grease requires re-lubrication of the coupling at least annually. By initially using Falk long term grease (LTG), re-lubrication will not be required again until the connected equipment is stopped for servicing.

LONG TERM GREASE (LTG)

The high centrifugal forces encountered in couplings separate the base oil and thickener of general purpose greases. Heavy thickener which has no lubrication qualities, accumulates in the grid-groove area of Steelflex couplings resulting in premature hub or grid failure unless periodic lubrication cycles are maintained.



Falk LTG was developed specifically for couplings. It resists separation of the oil and thickener. LTG is an extreme pressure grease manufactured to a NLGI #1 consistency. While in the container, the consistency changes to a NLGI #3. In working areas of couplings, such as the grid-groove area of Steelflex couplings, LTG is in a semifluid condition providing the necessary lubrication. In non-working areas near seals and gaskets, the consistency is comparable to NLGI #3.

Steelflex couplings initially lubricated with Falk Long Term Grease (LTG) will not require re-lubrication until the connected equipment is stopped for servicing. If a coupling leaks grease, is exposed to extreme temperatures, excessive moisture or experiences frequent reversals, more frequent lubrication may be required.

USDA APPROVAL

LTG has the United States Department of Agriculture Food Safety & Inspection Service approval for applications where there is no possibility of contact with edible products. (H-2 rating).

CAUTION

Do not use LTG in bearings.

SPECIFICATIONS

Ambient Temperature Range—-40°F (-40°C) to 190°F (88°C).

Minimum Base Oil Viscosity—3300SSU (715cSt) @ 100°F (38°C).

Thickener—7.5% (lithium soap and polyethylene)

Separation Characteristics (Proposed ASTM Centrifuge Test)—K36 = 6/24, very high resistance to centrifuging.

NLGI Grade (ASTM D-217)—#1.

Minimum Dropping Point—225°F (108°C).

Minimum Timken O.K. Load—50 lbs.

Additives—Rust and oxidation inhibitors that do not corrode steel or swell or deteriorate synthetic seals.

INSPECTION—When connected equipment is serviced, disassemble the coupling and inspect for wear. Replace worn parts. Clean the grease from the coupling and repack with fresh LTG. Install coupling using new gasket as instructed in the appropriate installation manual.

PACKAGING

4 oz. Tubes—Suitable for initial handpacking Size 1060T and smaller or Size 7F and smaller.

14 oz. Cartridges—For use in standard grease guns. Sufficient quantity to initially lubricate Size 1090T or 13F.

35 lb. Pail—Ideal for larger size couplings or many smaller sizes.

380 lb. Drum—For plants with central storage areas. A pump with a pressurized follower plate is required for dispensing grease.

Case lots of 150-4 oz. tubes and 24-14 oz. cartridges are also available.

GENERAL PURPOSE GREASE

Annual Lubrication—The following specifications and lubricants for general purpose grease apply to Falk Steelflex couplings that are lubricated annually and operate within ambient temperatures of 0° to 150°F (-18° to 66°C). For temperatures beyond this range, consult the Factory.

If coupling leaks grease, is exposed to extreme temperatures, excessive moisture or experiences frequent reversals; more frequent lubrication may be required.

SPECIFICATIONS

Dropping Point—300°F (149°C) or higher.

Consistency—NLGI #2 with worked penetration value in the range of 250-300.

Separation and Resistance—Low oil separation rate and high resistance to separation from centrifuging.

Liquid Constituent—Possess good lubricating properties—equivalent to a high quality, well refined, petroleum oil.

Inactive—Must not corrode steel or cause swelling or deterioration of synthetic seals.

Clean—Free from foreign inclusions.

**GENERAL PURPOSE GREASES MEETING
FALK SPECIFICATIONS**

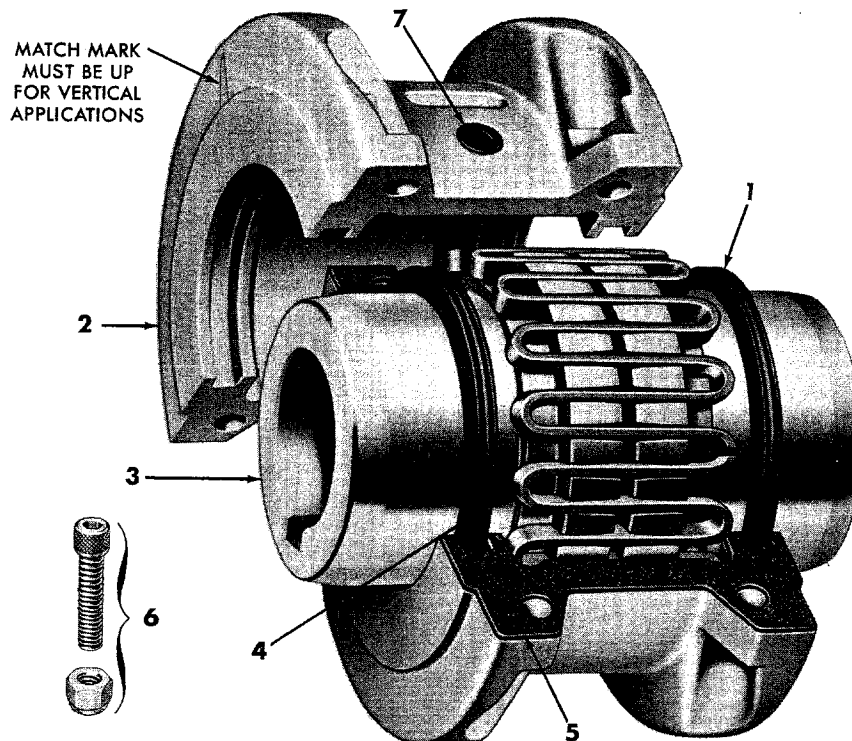
Lubricants listed below are typical products only and should not be construed as exclusive recommendations.

Ambient Temperature Range	0°F to 150°F (-18°C to +66°C)	-30°F to 100°F* (-34°C to +38°C)
NLGI Grade	#2	#2
Manufacturer	Lubricant †	Lubricant †
Amoco Oil Co.	Amolith Grease #2	Amolith Grease #2
Ashland Petroleum Co.	Val-Lith EP #2	Val-Lith EP #2
Atlantic Richfield Co.	Litholene HEP 2	Litholene HEP 2
Chevron U.S.A. Inc.	Chevron Dura-Lith EP-2	Chevron Dura-Lith EP 2
Cities Service Co.	Citgo HEP-2	Citgo HEP-2
Conoco Inc.	EP Conolith #2	EP Conolith #2
Exxon Company, USA	Ronex MP	Ronex MP
Gulf Oil Corp.	Gulfcrown Grease #2	Gulfcrown Grease #2
E. F. Houghton & Co.	Cosmolube #2	Cosmolube #1
Imperial Oil Ltd.	Esso MP Grease H	Lotemp EP
Kendall Refining Co.	Kenlube L-421 Grease	Kenlube L-427 Grease
Keystone Div. (Pennwalt)	#81 Light	#84 Light
Mobil Oil Corp.	Mobilux #2	Mobilux #1
Phillips Petroleum Co.	IB & RB Grease	Philube IB & RB Grease
Shell Oil Co.	Alvania Grease #2	Alvania Grease #2
Standard Oil Co. (OH)	Factran #2	Factran #2
Sun Oil Company	Prestige 42	Prestige 42
Texaco Inc.	Marfak Hvy Duty #2	1917 Marfak All-Purpose Grease
Texaco Canada Inc.	Marfak HD2	Marfak AP
Union Oil Co. (CA)	Union Unoba #2	Union Unoba #2

* For northern climate applications. For continuous operation at constant ambient temperatures less than 0°F or -18°C (for example, refrigeration systems) consult The Falk Corporation.

† Lubricants listed may not be suitable for use in the food processing industry; check with lube manufacturer for approved lubricants.

TYPE T10 STEEFLEX COUPLING PARTS



PART NUMBERS

1. Seal (T10)
2. Cover (T10)
3. Hub (Specify bore and keyway)
4. Grid
5. Gasket (T10)
6. Fasteners (T10)
7. Lube Plug

WHEN ORDERING SPARE PARTS, SPECIFY COUPLING SIZE AND TYPE AS SHOWN ON COUPLING COVER

INTRODUCTION—This manual applies to Sizes 20 thru 140T10 and 1020 thru 1140T10 Falk Steelflex Tapered Grid Couplings. Unless otherwise stated, information for Sizes 1020 thru 1140 applies to Sizes 20 thru 140 respectively, e.g. 1020 = 20, 1100 = 100, etc. These couplings are designed to operate in either the horizontal or vertical position without modification. However, for vertical applications, the match mark shown above, must be up. The performance and life of the couplings depend largely upon how you install and service them. Carefully follow the instructions in this manual for optimum performance and trouble free service.

PARTS IDENTIFICATION—All coupling parts have identifying part numbers as shown above. Parts 3 and 4 (Hubs and Grids), are the same for both T10 and T20 couplings; all other coupling parts are NOT INTERCHANGEABLE between Types T10 and T20. Parts are interchangeable between Sizes 20 and 1020, 30 and 1030, etc., but do not use orange grids in place of blue grids. However, blue grids may be used in place of orange grids. When ordering parts, always SPECIFY SIZE and TYPE shown on the COVER. Sizes 80 thru 140T10 covers have been manufactured with two and three ribs; DO NOT mix these cover halves.

LUBE FITTINGS—Cover halves have 1/8 NPT lube holes. Use a standard grease gun and lube fitting as instructed in Step 6 on Page 2.

LIMITED END FLOAT—When electric motors, generators, engines, compressors and other machines are fitted with sleeve or straight roller bearings, limited axial end float kits are recommended for protecting the bearings. Falk Steelflex couplings are easily modified to limit end float; refer to Manual 428-820 for instructions.

LUBRICATION—Adequate lubrication is essential for proper operation of the coupling. Refer to Table 1 on Page 2 for the amount of lubricant required. It is recommended that the coupling be checked once a year and lubricant added if required. For extreme or unusual operating conditions, check more frequently.

LONG TERM GREASE (LTG)—Steelflex couplings initially lubricated with Falk LTG will not require re-lubrication until the connected equipment is stopped for servicing. Refer to Manual 428-010.

CAUTION

Consult applicable local and national safety codes for proper guarding of rotating members. Observe all safety rules when installing or servicing couplings. During assembly, seal keyways of oil lubricated couplings.

LUBRICANT SPECIFICATIONS—Refer to Manual 428-010 for recommended lubricants. The following specifications apply to lubricants for Falk couplings which are lubricated annually and operate within ambient temperatures of 0° to 150°F (-18° to +66°C). For temperatures beyond this range, consult the Factory.

Dropping Point—300°F (149°C) or higher.

Consistency—NLGI No. 2 with worked penetration value in the range of 250 to 300.

Separation and Resistance—Low oil separation rate and high resistance to separation from centrifuging.

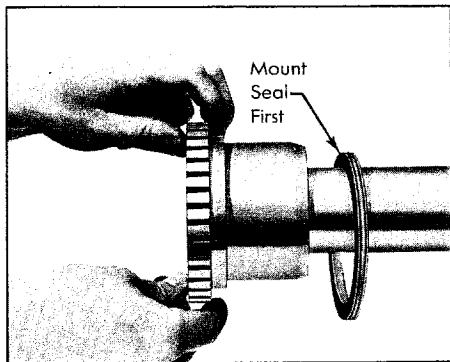
Liquid Constituent—To possess good lubrication properties . . . equivalent to a high quality, well refined petroleum oil.

Inactive—Must not corrode steel or cause swelling or deterioration of synthetic seals.

Clean—Free from foreign inclusions.

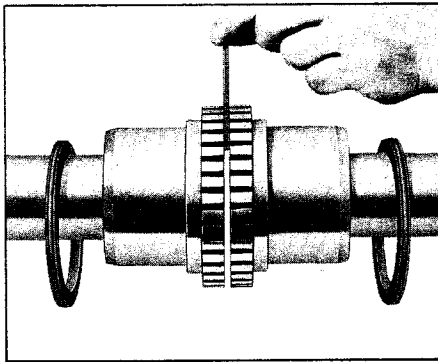
INSTALLATION—Only standard mechanics tools, wrenches, a straight edge and feeler gauges are required to install Falk Steelflex couplings. Coupling Sizes 1020 thru 1090 are generally furnished for CLEARANCE FIT with set screws. Sizes 1100 and larger are furnished for an INTERFERENCE FIT without set screws. Heat hubs with interference fit in an oil bath to a maximum of 275°F (135°C) to mount. The oil flashpoint must be 350°F (177°C) or higher. Refer to Page 2 for detailed mounting instructions.

INSTALLATION OF TYPE T10 STEELFLEX TAPERED GRID COUPLINGS



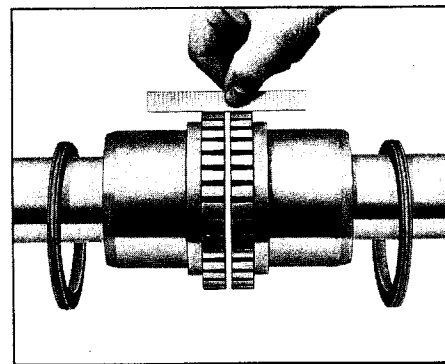
1 MOUNT SEALS AND HUBS

Lock out starting switch of prime mover. Clean all metal parts using a non-flammable solvent. Lightly coat seals with grease and place on shafts BEFORE mounting hubs. For vertical couplings, seal keyway to prevent leakage. Mount hubs on their respective shafts so the hub face is flush with the end of its shaft. Tighten set screws when furnished. Heat interference fit hubs as instructed on Page 1.



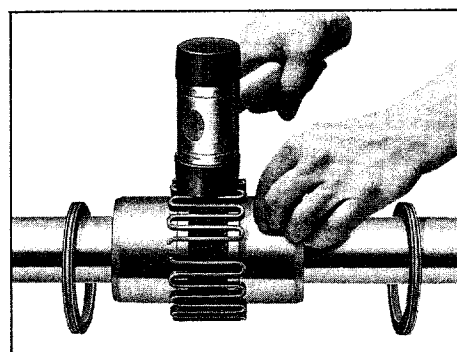
2 GAP & ANGULAR ALIGNMENT

Use a spacer bar equal in thickness to the gap specified in Table 1. Insert bar, as shown above, to same depth at 90° intervals and measure clearance between bar and hub face with feelers. The difference in minimum and maximum measurements must not exceed the ANGULAR limit specified in Table 1.



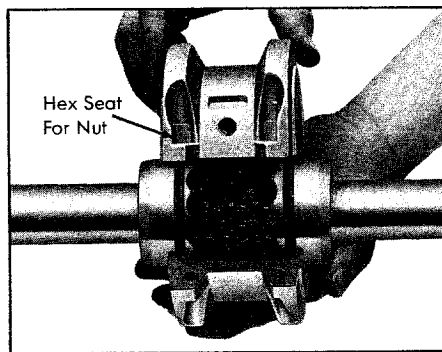
3 OFFSET ALIGNMENT

Align so that a straight edge rests squarely (or within the limits specified in Table 1) on both hubs as shown above and also at 90° intervals. Check with feelers. The clearance must not exceed the OFFSET limit specified in Table 1. Tighten all foundation bolts and repeat Steps 2 and 3. Realign coupling if necessary. NOTE: Use a dial indicator for more accurate alignment.



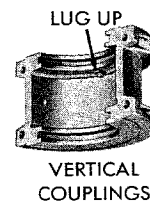
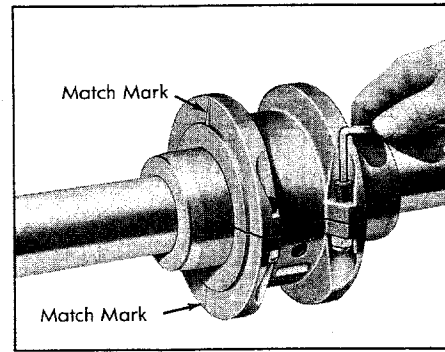
4 INSERT GRID

Pack gap and grooves with specified lubricant before inserting grid. When grids are furnished in two or more segments, install them so that all cut ends extend in the same direction; this will assure correct grid contact with non-rotating pin in cover halves. Spread the grid slightly to pass over the coupling teeth and seat with a soft mallet.



5 PACK WITH GREASE AND ASSEMBLE COVERS

Pack the spaces between and around the grid with as much lubricant as possible and wipe off excess flush with top of grid. Position seals on hubs to line up with grooves in cover. Position gaskets on flange of lower cover half and assemble covers so that the match marks are on the same side (see above). If shafts are not level (horizontal) or coupling is to be used vertically, assemble cover halves with the lug and match mark UP, or on the high side. Secure cover halves with fasteners and tighten to torque specified in Table 1. (Note that Sizes 1020 thru 1070 have a self-locking feature for the stop nuts.) CAUTION: Make certain lube plugs are installed before operating.



LUG UP
VERTICAL COUPLINGS

TABLE 1 INSTALLATION DATA* (Dimensions-Inches)						
SIZE	Gap	Installation Alignment Limits		Cover Bolt Torque (lb-in)	Allow. Speed (rpm)	Lube Wt (lb)
		Offset (Max)	Angular (Max)			
1020T	.125	.006	.003	100	4500	.06
1030T	.125	.006	.003	100	4500	.09
1040T	.125	.006	.003	100	4500	.12
1050T	.125	.008	.004	200	4500	.15
1060T	.125	.008	.005	200	4350	.19
1070T	.125	.008	.005	200	4125	.25
1080T	.125	.008	.006	200	3600	.38
1090T	.125	.008	.007	200	3600	.56
1100T	.188	.010	.008	260	2440	.94
1110T	.188	.010	.009	260	2250	1.1
1120T	.250	.011	.010	650	2025	1.6
1130T	.250	.011	.012	650	1800	2.
1140T	.250	.011	.013	650	1650	2.5

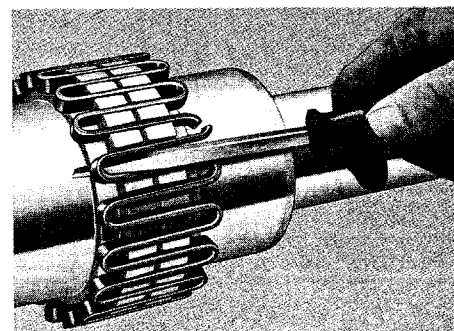
* Refer to bulletin for maximum bores and Engineering 427-108 for reboring instructions.

■ Flexible couplings are designed to accommodate changes in operating conditions. Coupling life expectancy between initial alignment and maximum operating limits is a function of load, speed and lubrication. Application requirements in excess of twice the OFFSET and/or four times the ANGULAR limits shown, must be referred to Falk for review.

6 PERIODIC LUBRICATION—Remove both lube plugs and insert lube fitting. Fill with recommended lubricant until an excess appears at the opposite hole. CAUTION: Make certain all plugs have been inserted after lubricating.

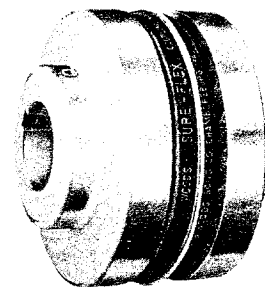
COUPLING DISASSEMBLY AND GRID REMOVAL

Whenever it is necessary to disconnect the coupling, remove the cover halves and grid. A round rod or screw driver that will conveniently fit into the open loop ends of the grid is required. Begin at the open end of the grid section and insert the rod or screw driver into the loop ends. Use the teeth adjacent to each loop as a fulcrum and pry the grid out radially in even, gradual stages, proceeding alternately from side to side.



Wood's

Sure-Flex® Couplings



Installation Instructions

Sure-Flex flanges (outer metallic parts) and sleeves (inner elastomeric members) come in many sizes and types. First, determine the size and type of components being used. Remove all components from their boxes, and loosely assemble the coupling on any convenient surface. (Do not attempt to install the wire ring on the two-piece E or N sleeve at this time.) Also check maximum RPM values in Table 2 against operating speed. All rubber sleeves (EPDM and Neoprene) have the same ratings for a given size and may be used interchangeably. However, because rubber and Hytrel sleeves have completely different ratings, they never should be used interchangeably.

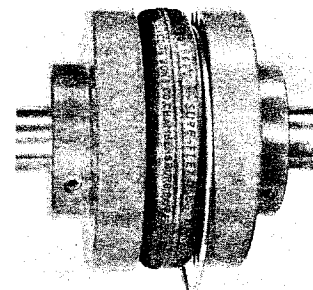
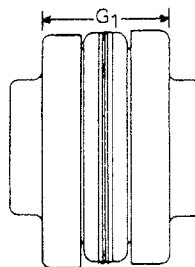


1 Inspect all coupling components and remove any protective coatings or lubricants from bores, mating surfaces and fasteners. Remove any existing burrs, etc. from the shafts.

2 Slide one coupling flange onto each shaft, using snug-fitting keys where required. With

the Type B flange, it may be necessary to expand the bore by wedging a screwdriver into the saw cut of the bushing.

3 Position the flanges on the shafts to approximately achieve the G_1 dimension shown in Table 2. It is usually best to have an equal length of shaft extending into each flange. Tighten one flange in its final position. Refer to Table 1 for fastener torque values. Slide the other far enough away to install the sleeve. With a two-piece sleeve, do not move the wire ring to its final position; allow it to hang loosely in the groove adjacent to the teeth, as shown.



4 Slide the loose flange on the shaft until the sleeve is completely seated in the teeth of each flange. (The " G_1 " dimension is for reference and not critical.) Secure the flange to the shaft using the torque values from Table 1.

TABLE 1 — FASTENER TORQUE VALUES (ft.-lbs.)

Coupling Size	TYPE J	TYPE S	TYPE B	TYPE SC*		TYPE C	
	2 Setscrews at 90°	2 Setscrews at 90°	3 Hex Head Cap Screws	4 Hex Head Cap Screws Flange to Hub	1 Setscrew over Keyway in Hub	Clamping Screws	1 Setscrew over Keyway
3	3	...	...	...	...	...	...
4	3	...	...	5½**	13	...	...
5	7	13	...	4	13	...	...
6	13	13	5	9	13	15	13
7	13	13	5	9	13	30	13
8	23	23	9	18	23	55	13
9	...	23	9	31	23	55	13
10	...	23	15	50	50	130	13
11	...	23	30	75	50	130	13
12	...	50	60	150	100	250	13
13	...	100	75	150	165	...	...
14	...	100	75	150	165	...	...
16	...	100	135	150	165	...	...

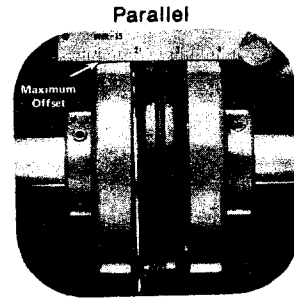
*Torque values apply to hub size when different than flange size.

**Value for socket head clamping screw.

Sure-Flex Installation Instructions (continued)

Different coupling sleeves require different degrees of alignment precision. Locate the alignment values for your sleeve size and type in Table 2 below.

5 Check parallel alignment by placing a straightedge across the two coupling flanges and measuring the maximum offset at various points around the periphery of the coupling **without rotating** the coupling. If the maximum offset exceeds the figure shown under "Parallel" in Table 2, realign the shafts.



6 Check angular alignment with a micrometer or caliper. Measure from the outside of one flange to the outside of the other at intervals around the periphery of the coupling. Determine the maximum and minimum dimensions **without rotating** the coupling. The difference between the maximum and minimum must not exceed the figure given under "Angular" in Table 2. If a correction is necessary, be sure to recheck the parallel alignment.

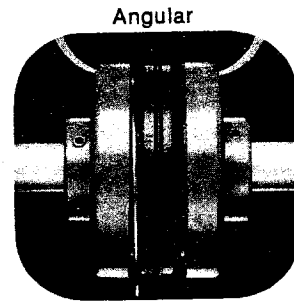


TABLE 2 – MAXIMUM RPM AND ALLOWABLE MISALIGNMENT
(Dimensions in inches)

Sleeve Size	Maximum RPM	Types JE, JN, JES, JNS, E & N			*Type H & HS		
		Parallel	Angular	G ₁	Parallel	Angular	G ₁
3	9200	.010	.035	1.188	....	....	....
4	7600	.010	.043	1.500	....	....	....
5	7600	.015	.056	1.938	....	....	....
6	6000	.015	.070	2.438 (1)	.010	.016	2.500
7	5250	.020	.081	2.563	.012	.020	2.625
8	4500	.020	.094	2.938	.015	.025	3.000
9	3750	.025	.109	3.500	.017	.028	3.563
10	3600	.025	.128	4.063	.020	.032	4.125
11	3600	.032	.151	4.875	.022	.037	4.938
12	2800	.032	.175	5.688	.025	.042	5.750
13	2400	.040	.195	6.688	.030	.050	6.688
14	2200	.045	.242	7.750	.035	.060	7.813
16	1500	.062	.330	10.250	....	....	....

Note: Values shown above apply if the actual torque transmitted is more than 1/4 the coupling rating. For lesser torque, reduce the above values by 1/2.

* Type H and HS sleeves **should not** be used as direct replacements for EPDM or Neoprene sleeves.

(1) Value when using 6J flanges is 2.125.

7 If the coupling employs the two-piece sleeve with the wire ring, force the ring into its groove in the center of the sleeve. It may be necessary to pry the ring into position with a blunt screwdriver.

8 Install coupling guards per OSHA requirements.

CAUTION: Coupling sleeves may be thrown from the coupling assembly with substantial force when the coupling is subjected to a severe shock load or abuse.

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