

77C30

Ship To: BUNGE - ERGON VICKSBURG, LLC
Customer: BUNGE - ERGON VICKSBURG, LLC
PO Number: 61310-4500145584

Order: 0001013563 Line: 000060

READ AND UNDERSTAND THIS DOCUMENT PRIOR TO OPERATING OR SERVICING THIS PRODUCT.



Tagging:
AG-3108 / BEER WELL

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IMPORTANT: READ THIS SECTION THOROUGHLY SAFETY INSTRUCTIONS / CHECKLIST

IF YOU DO NOT UNDERSTAND ANY PORTION OF THESE INSTRUCTIONS **DO NOT** ATTEMPT TO INSTALL OR OPERATE THIS MIXER! CONTACT YOUR **LIGHTNIN®** REPRESENTATIVE FOR ANY QUESTIONS YOU MAY HAVE CONCERNING SAFETY OR THESE INSTRUCTIONS.

Your **LIGHTNIN®** mixer is equipped with safety labels which contain specific instructions pertaining to the safe handling and operation of the mixer. For your protection, you must understand that failure to follow the safety instructions imprinted on the safety labels or failure to follow the safety instructions printed in this instruction manual may result in serious personal injury or death. In addition, failure to adhere to safety instructions may cause damage to property or equipment.

In this publication, and on the mixer safety labels, the words DANGER, WARNING and CAUTION may be used to signify special instructions to be observed by the installer or user. These instructions warn of potential hazards concerning service, installation or operation if the instructions are performed incorrectly, carelessly or are ignored. Safety instructions alone cannot eliminate the hazards they signal. Strict compliance with these special instructions, along with safe work habits and simple "common sense" are major accident prevention measures.

CAUTION - Signals unsafe practices or hazards which could cause minor personal injury or property damage.

WARNING - Signals unsafe practices or hazards which could cause severe personal injury or death.

DANGER - Signals immediate hazards which will probably cause severe personal injury or death.

This mixer should be equipped with safety or instructional labels similar to those shown below. If any of the labels are missing, damaged or otherwise illegible, **DO NOT** install, service or operate the mixer. Contact your **LIGHTNIN®** representative immediately for instructions.



EXAMPLES:



SAFETY CHECK LIST

IMPORTANT WARNINGS

All **LIGHTNIN**® Mixers and Aerators are provided with properly designed lifting devices and safety covers to avoid potential injury and/or equipment damage. The following SAFETY CHECK LIST should be THOROUGHLY REVIEWED AND ADHERED TO before installing, operating or performing maintenance on the mixer. FAILURE TO FOLLOW THESE INSTRUCTIONS COULD RESULT IN SERIOUS INJURY. Ensure the use of qualified, quality trained and safety conscious personnel.

1. **WARNING:** When moving, installing or lifting this mixer, always use equipment which is rated to carry the full load of the mixer. Use only the lifting device, if provided, on your unit to install the mixer. Failure to follow these instructions could cause severe injury, death or damage to property. Consult the appropriate section of this manual for lifting and installation instructions.
2. **WARNING:** DO NOT attempt to connect a power source to this mixer unless you are licensed or certified to do so. Failure to follow this instruction could cause severe injury, death or damage to property.
3. **WARNING:** DO NOT connect the motor to the power source until all components are assembled, the mixer is installed, and all hardware is tightened to the proper torque which is specified in the operation and maintenance manuals supplied by **LIGHTNIN**®.
4. DO NOT operate shaft sealing devices at temperatures higher than those specified in the manual or on the nameplates.
5. DO NOT service the mixer until you have followed your "Control of Hazardous Energy Sources" (lockout, tagout procedure) as required by OSHA.
6. **WARNING:** Never touch a mixer, which has an electric motor, or any part of an electrical service line cord or conduit, while your hands or feet are wet or if you are standing on a wet or damp surface. Failure to follow this instruction may result in severe electrical shock or death.
7. **WARNING:** DO NOT touch any part of mixer that has the potential of having a hot surface including the motor, gear drive housing, seal, shafting and flange. When a mixer is running, the motor temperature rises. This is a normal occurrence, but the motor temperature may be high enough to cause burns to the hands or any other part of the body. DO NOT touch a mixer motor until it cools for at least one hour. Failure to follow these instructions may result in severe personal injury.
8. **DANGER:** Never touch any rotating part of a mixer with bare hands, gloved hands or any other part of your body, or with any hand held object. Rotating parts include, but are not limited to, the mixer shaft, impeller(s), set screws, hardware, couplings, mechanical seals and motor fans.
9. **WARNING:** DO NOT operate mixer for service other than its intended use, that being fluid mixing with the mixer attached to a rigid structure and connected to a power source appropriate to operate the mixer drive motor.
10. **WARNING:** Never attempt to move or adjust a mixer while it is running.

SAFETY CHECK LIST, cont'd.

IMPORTANT WARNINGS, cont'd.

11. DO NOT make any field changes or modifications (horsepower, seal material components, output speed, shaft lengths, impellers, etc.) without reviewing the changes with your **LIGHTNIN®** Sales Representative or the **LIGHTNIN®** Customer Service Department.
12. DO NOT install an aftermarket Variable Frequency Drive without first consulting your **LIGHTNIN®** Sales Representative or the **LIGHTNIN®** Customer Service Department to determine the compatibility of the existing motor with the Variable Frequency Drive.
13. DO NOT operate mixer until you have checked the following items:
 - A. Make sure the mixer is properly grounded.
 - B. Ensure all protective guards and covers are installed.
Guarding of the mixer shaft below the mixer mounting surface is the responsibility of the customer.
 - C. Ensure all detachable components are securely coupled to the mixer.
 - D. Thoroughly REVIEW and ADHERE TO the mixer operating instructions supplied by **LIGHTNIN®**.
 - E. Ensure the mixer output shaft rotates freely by hand.
 - F. Ensure all personnel and equipment are clear of rotating parts.
 - G. Ensure all external connections (electrical, hydraulic, pneumatic, etc.) have been completed in accordance with all applicable codes and regulations.
14. DO NOT enter the mixing vessel UNLESS:
 - A. The mixer power supply is locked out (follow item number 5).
 - B. The mixer shaft is firmly attached to the mixer drive or the shaft is supported securely from below.
 - C. You have followed applicable confined space regulations.
15. **WARNING:** Eye protection must be worn at all times while servicing this mixer. Failure to follow this instructions may result in severe injury or death.
16. **WARNING:** Never attempt to clean or service the mixer, or any part of it, while the mixer is running, or while it is connected to a power source. Always turn the mixer off and disconnect the power before cleaning or servicing.
17. **CAUTION:** When repairing the mixer, or replacing parts, use factory authorized parts and procedures. Failure to do so may result in damage to the mixer or injury to the user.

CE COMPLIANCE

If the mixer nameplate has a CE marking on it, then the equipment furnished conforms to the following directives:

Machinery Directive: 2006/42/EC
Electro-Magnetic Compatibility: 2004/108/EC
Low Voltage Directive: 2006/95/EC
Noise: 2000/14/EC



CAUTION: When applicable specific markings required by Pressure Equipment Directive 97/23/EC (PED) and/or Equipment for Use in Potential Explosive Atmospheres Directive 94/9/EC (ATEX) will be indicated on supporting nameplates. If there is any doubt relating to the intended use of this equipment please contact **LIGHTNIN®** before installation and operation.

Any CE marking and/or associated documentation applies to the mixer only. This has been supplied on the basis that the mixer is a unique system. When the mixer is installed, it becomes an integral part of a larger system which is not within the scope of supply and CE marking is the responsibility of others.

NOISE LEVELS

SOUND PRESSURE LEVELS

Portable Series: ECL, EV - maximum 80 dBA @ 1 meter.

Heavy Series: S10, 70/80, 500/600 - maximum 85 dBA @ 1 meter.

PATENTS

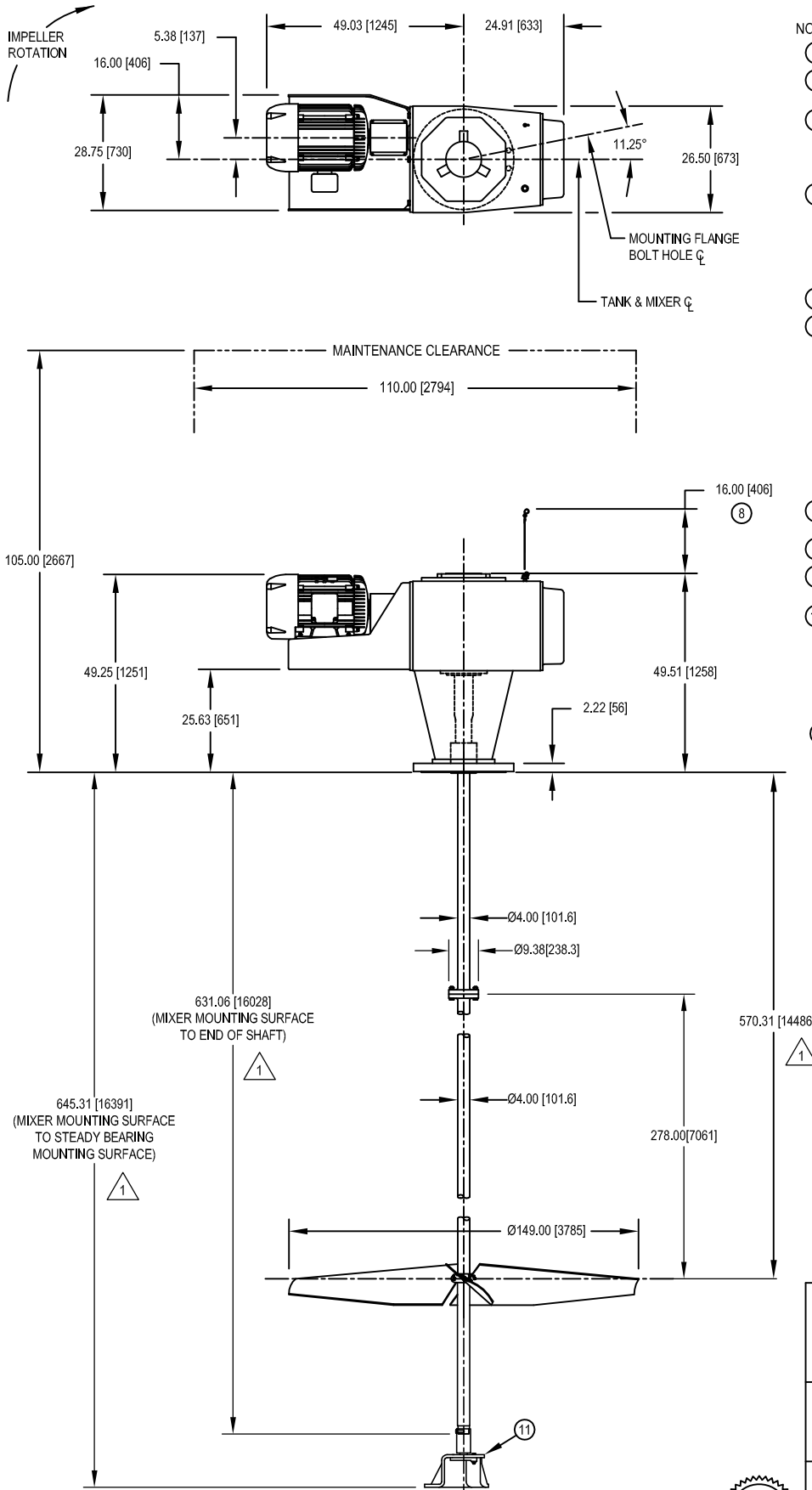
THIS PRODUCT MAY BE COVERED BY ONE OR MORE OF THE FOLLOWING U.S. PATENTS:

5152606	5501523	6517233	6860474	7168848	7387431	7550120
5152934	5511881	6517246	6877750	7168849	7407322	7572112
5203630	5568975	6742923	6986507	7278799	7473025	7726946
5344235	5779359	6746147	7001063	7328809	7481573	7753215
5368390	5925293	6789314	7056095	7329065	7488137	7874719
5470152	5988604	6796707	7114844	7331704	7507028	
5480228	6158722	6796770	7168641	7384551	7547135	

ENVIRONMENTAL NOTICE



Dispose of equipment responsibly at the end of its service, in accordance with local laws and directives. Correct disposal is the responsibility of the end user. If in doubt, consult with local environmental agencies for advice on the best method of disposal.



NOTES:

- ① MATERIAL OF IN-TANK MIXER PARTS IS 304/316.
- ② ALL DIMENSIONS ARE IN INCHES [mm]. DIMENSIONS ARE FOR REFERENCE ONLY.
- ③ MOTOR DATA:
H.P.: 30.0 R.P.M.: 1200 DUTY: STANDARD
VOLTS: 230/460 PHASE: 3 HZ: 60
ENCLOSURE: TEFC FRAME: 326T
- ④ IMPELLER DATA:
TYPE: A510E QUANTITY OF BLADES: 3
R.P.M.: 30.7
IMPELLER HUB NOT ADJUSTABLE OR REMOVABLE FROM POSITION SHOWN. BLADES/FINS ARE REMOVABLE.
- ⑤ TOTAL MIXER WEIGHT IS 7520 lbs [3412 kg].
- ⑥ MIXER MOUNTING DESIGN DATA:
VERTICAL DOWNWARD LOAD: 13700 LBS. [60938 N]
TORQUE: 99170 IN.-LBS. [11206 N•m]
BENDING MOMENT: 315000 IN.-LBS. [35595 N•m]
DESIGN LOADS ARE GREATER THAN ACTUAL LOADS BY A SUITABLE FACTOR, CONSISTENT WITH CONSTRUCTION CODES AND **LIGHTNIN** EXPERIENCE.
LIGHTNIN WARRANTIES AND GUARANTEES EXTEND FOR THOSE ITEMS FURNISHED BY IT. ALL OTHER EQUIPMENT AND DESIGNS ARE THE RESPONSIBILITY OF OTHERS.
- ⑦ MINIMUM OPENING REQUIRED TO PASS DISASSEMBLED MIXER PARTS IS 25.00" [635 mm].
- ⑧ CLEARANCE REQUIRED FOR REMOVAL OF OIL LEVEL GAUGE.
- ⑨ UNIT IS FURNISHED WITH A LOW PRESSURE STUFFING BOX PACKING MATERIAL: COMBINATION 50
- ⑩ MIXER MOUNTING FLANGE DATA:
150 LB. ANSI SERIES DRILLING
SIZE: 18" O.D.: 25.00 BOLT CIRCLE: 22.75
NO. OF HOLES: 16 BOLT DIA: 1.13
AS COMMON PRACTICE, FLANGE BOLT HOLES ARE SHOWN STRADDLING MIXER CENTERLINE
- ⑪ UNIT IS FURNISHED WITH A TRIPOD MOUNTED STEADY BEARING. BUSHING MATERIAL IS GLASS FILLED TEFLON. THE LATERAL DESIGN LOAD ACTING AT THE CENTERLINE OF THE BUSHING IS 976 LBS. [4343 N]. MIXER MOUNTING SURFACE AND STEADY BEARING MOUNTING SURFACE MUST BE PARALLEL WITHIN $\pm 25^\circ$ IF THEY ARE NOT A TAPERED GASKET, DUTCHMAN OR SHIMS SHOULD BE ADDED TO OBTAIN THE REQUIRED PARALLELISM. MOUNTING PAD TO BE AFFIXED TO TANK BOTTOM AT TIME OF STEADY BEARING INSTALLATION. RECOMMENDED MINIMUM PAD THICKNESS MEASURED AT TANK \downarrow IS 2.13" [54 mm]. IF TANK BOTTOM THICKNESS IS LESS THAN 3/8", **LIGHTNIN** RECOMMENDS THAT IT BE REINFORCED.

ALL EQUIPMENT DESIGN AND APPLICATION DATA SHOWN HEREIN AND RELATED KNOW-HOW IS CONFIDENTIAL AND THE PROPERTY OF THE LIGHTNIN GROUP OF COMPANIES. NO USE OR DISCLOSURE THEREOF MAY BE MADE WITHOUT OUR WRITTEN PERMISSION.

LIGHTNIN®
MIXERS AND AERATORS

GENERAL ARRANGEMENT

FOR: **BUNGE-ERGON VICKSBURG, LLC**
S.O. NO.: 1013563 ITEM NO.: 60
CUST. P.O. NO.: 61310-4500145584 QUANTITY: 1
TAG NO.: AG-3108 BEER WELL
MIXER MODEL: 77C30 RATIO: 38.1:1



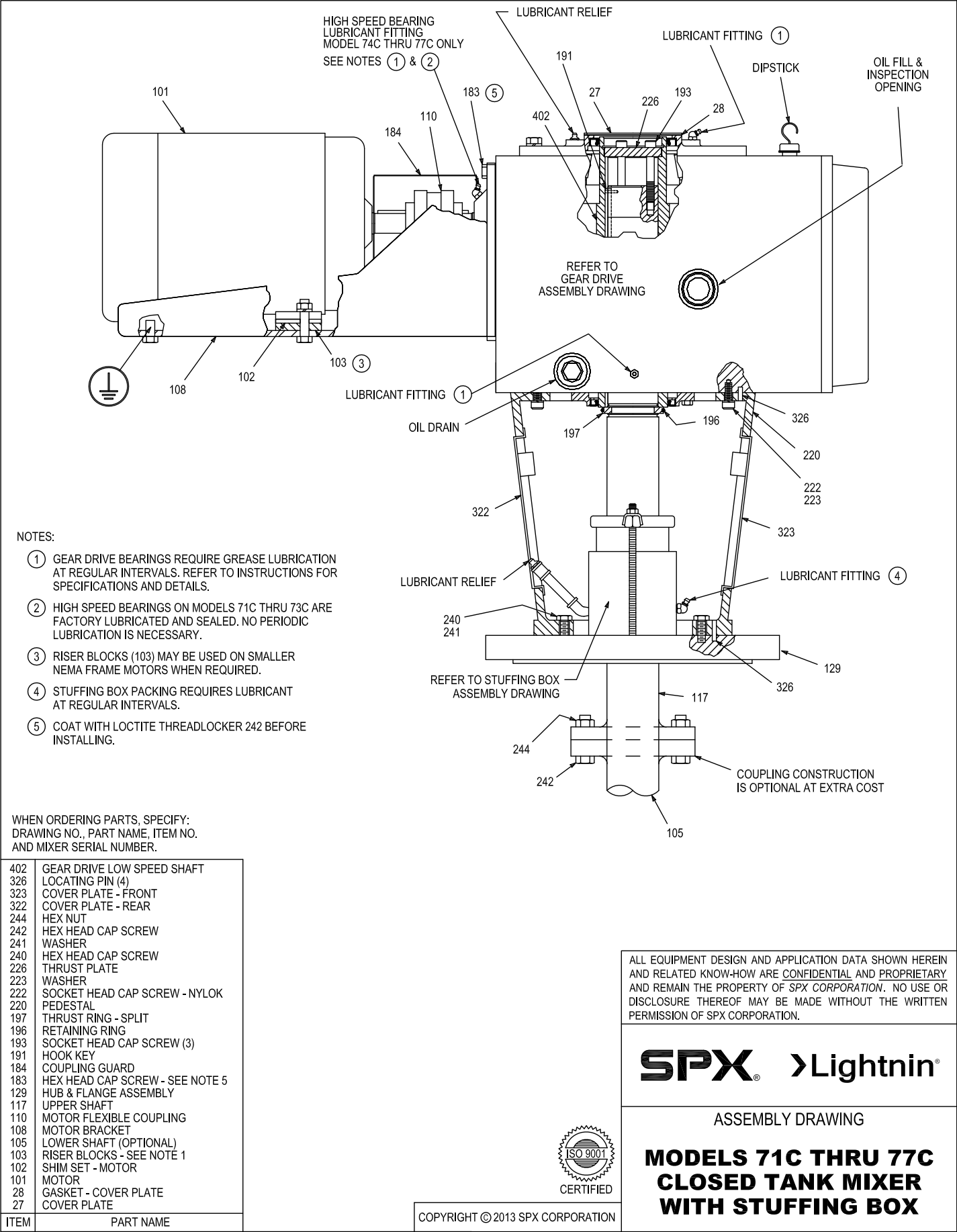
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2007

CERTIFIED AS BUILT DIMENSIONS



CERTIFIED BY: *Tim Finch*

DATE: 10/31/07



GENERAL INSTRUCTIONS FOR *LIGHTNIN®* 70 & 80 SERIES

SECTION 1 - INITIAL INSPECTION, SHIPPING ARRANGEMENTS

1.1 VISUAL INSPECTION

Check shipping crates and your **LIGHTNIN** equipment for possible shipping damage. Report any damage immediately to the carrier and our factory.

1.2 ASSEMBLE COMPONENTS

All mixers are shipped fully assembled whenever possible. If shipping restrictions limit overall size, major subassemblies will be crated separately, ready for quick, easy assembly at the job site. Generally, motor pedestals or motor brackets are assembled to the mixer. Pedestals or Brackets fitted with large or special drives may be shipped separately.

In addition, various small components, such as breather caps and plugs, sight gauges, dip sticks, etc. are often packaged separately to avoid damage during assembly or to ensure that the mixer remains sealed and properly preserved during shipment. These components should be identified and assembled to the mixer.

1.3 COUPLING ALIGNMENT

Before shipping, the motor pedestals or motor brackets and motors on all mixers are assembled, the flexible couplings factory aligned and the assembly removed, if necessary, for shipping. While care is taken at the factory to ensure proper alignment is achieved, it is possible that components may shift during shipping and thus the alignment of these components should be carefully checked at assembly and adjusted, if required. Section 2 of this manual provides reassembly instructions.

1.4 MOTOR POWER CONNECTIONS

In order to ensure proper functioning of the mixer, it is essential that the motor maintenance instructions in this manual and the nameplate be reviewed before connecting to power source.

1.5 LONG SHAFTS

Long in-tank shafts and impellers are usually crated separately for shipping ease and handling at the job site. They must be connected to the assembled drive mixer at installation. Check all connections for proper bolt torque before starting the mixer.

1.6 SHIPPING PROTECTION

All mixers are treated with corrosion inhibitors for protection during shipment and possible short term storage.

- a. External Steel Surfaces - All external steel surfaces not protected with permanent coatings are covered with a rust preventative that is easily removed with kerosene or a similar solvent. All preservatives must be removed before checking shaft alignments. Do not remove any wrappings or rotate the shafts until the mixer is ready for operation.
- b. Internal Surfaces - All internal surfaces are protected against corrosion due to water or water vapor in case the mixer will not be put into service right away. The treatments used are compatible with the lubricating oils specified in this manual and no special removal procedures beyond the start up instructions contained herein are required.
- c. Protection Period - Factory applied inhibitors will protect mixers from internal corrosion for periods up to one (1) year if stored indoors in clean, temperature controlled, dry surroundings. Review Section 7 of these instructions carefully if the mixer is to be stored in conditions other than those described above prior to installation.
- d. Outdoor Storage - Unprotected outdoor storage is NOT PERMITTED. Special preservation procedures are required for outdoor storage. These treatments are available for most mixers. Contact the factory for instructions.

SECTION 2 - INSTALLATION

CAUTION: MIXER COMPONENTS MAY BE UNSTABLE WHEN REMOVED FROM SHIPPING FIXTURES. THEY MUST BE SAFELY SUPPORTED UNTIL INSTALLED SECURELY TO THE MOUNTING STRUCTURE.

2.1 LIFTING

Recommended lifting procedures are covered in Section 3 of these instructions. Do not hoist, handle, or rest the mixer on any shaft extension. Always support the mixer so that all shaft extensions are free floating.

The following important mounting and operating information is shown on the Installation Drawing and should be referenced before beginning the installation procedure.

- a. Mixer weight and design loads imposed by mixer for mounting structure design.
- b. Location and mounting dimensions.
- c. Baffle information (when required).
- d. The minimum size opening required to pass disassembled in-tank parts into the vessel.
- e. Proper impeller off-bottom and relative spacing for multi-impeller applications.

2.2 IMPELLER ATTACHMENT

When installing the impeller(s) on a shaft, refer to the Impeller Drawing and Instructions. Make sure the impellers are installed for the shaft rotation indicated and that the impeller hardware is tightened to the specific torques in the impeller instructions. A torque wrench must be used to tighten all bolts to their specific torque values.

2.3 IN-TANK HARDWARE

Using a torque wrench, tighten all in-tank hardware to the specific torques listed in Section 8 or special torques that will be listed on individual instruction sheets where applicable.

2.4 SHAFT SEALS

If your mixer is equipped with a shaft seal, refer to the instructions in this manual for lubrication procedures before operating the mixer.

2.5 DISASSEMBLED MOTORS AND MOTOR PEDESTALS OR BRACKETS

Check to be sure that the motor is properly bolted to its motor pedestal or bracket. Check all bolt torques. Mount the motor pedestal or bracket, with motor attached, securely to the gear drive housing. Torque all mounting bolts to their specified torque values using a torque wrench. Check high speed coupling alignment and gap as outlined in the coupling instructions. Check and adjust motor as outlined in Section 2.6.c of these instructions to ensure proper alignment. Be sure to replace any safety guards that were removed to facilitate alignment.

2.6 FLEXIBLE COUPLINGS (ITEMS 50 & 110)

- a. Low Speed Couplings - On the 80 series ONLY, these couplings are tapered grid type that are factory installed, aligned and lubricated.
- b. High Speed Couplings - The standard high speed coupling provided depends on the type of application. For standard duty, a coupling with an elastomeric flexible element is used. For variable speed/variable torque applications, however, a tapered grid type is used.
- c. Alignment Check - Coupling life and performance depend on accurate alignment. The high speed coupling was aligned at our factory prior to shipment, but it is extremely **IMPORTANT** to **RECHECK ALIGNMENT** after the mixer is installed on the vessel in case misalignment occurred during shipping and handling. If a motor bracket outboard support is provided, check alignment only after the support is properly shimmed, mounted and secured. Face mounted motors do not need to be checked for alignment, unless damage is suspected.

Determine the type high speed coupling furnished and refer to the appropriate coupling instructions for required alignment and assembly procedures. Coupling identifiers are located on the coupling components.

Correct misalignment by adding or removing slotted shims under each motor foot. Distribute shims evenly to provide uniform support for each motor foot. After the assembly is aligned, retorque motor mounting bolts to their specified torque values using a torque wrench.

- d. Final Assembly - After tightening and checking the torque on all mounting bolts, recheck alignment to be sure that no shifting or slippage has occurred. Install flexible elements, secure hubs (and covers where furnished) and lubricate couplings as required. Elastomeric element type couplings do not require lubrication. All other types of couplings used on these mixers require lubrication and must be lubricated before starting the mixer. Refer to Section 5 (Lubrication) of these instructions for further information.
 - e. Coupling Guards - After completing coupling assembly, alignment and lubrication, it is important to be sure to reinstall the safety coupling guard (184). The guard must be securely in place before the mixer is started.
- 2.7 It is the customer's responsibility to touch up any paint damage incurred during installation and/or storage.

SECTION 3 - RECOMMENDED LIFTING PROCEDURES

3.1 LIFTING

LIGHTNIN mixers are provided with the following lifting arrangements:

- a. 71/81 - 74/84 with Motor Brackets: (2) integral lifting slots in the side of the motor bracket.
Refer to Figure 1A.
- b. 75/85 - 77/87 with Motor Brackets: (2) integrally cast or welded lifting lugs on the body of the gear drive.
Refer to Figure 1B.
- c. 71/81 - 77/87 with Motor Pedestals: (2) integrally cast or welded lifting lugs on the body of the gear drive.
Refer to Figure 1C.

These slots/lugs and ONLY these slots/lugs, except when the mixer is under slung as described below, should be used as the primary devices for lifting. An eyebolt is also provided but it is to be used as a counterbalance device only.

DO NOT USE motor eyebolts for any purpose other than lifting the motor itself when disassembled from the gear drive mixer.

3.2 LIFTING LOAD

Do not include the lower shaft and impeller(s) as part of the total mixer being lifted due to excessive lift heights and maneuvering required. Install the gear drive and motor assembly and attach the lower shaft and impeller assemblies after the gear drive has been installed and properly bolted in place.

Check the capacity of the lifting straps or cables and attachments against the total weight of the mixer being lifted to be sure these items are capable of safely lifting the total weight of the assembled motor and gear drive.

Visually check the condition of all lifting straps or cables and connectors to be sure they are not damaged in any way. When lifting the mixer, take slack out of the lifting straps or cables to avoid sudden impact loads that may damage the lifting devices.

3.3 LIFTING ANGLE

Great care must be exercised to ensure that the angle of lift is as close to vertical as possible. Under no circumstances should the lift angle be less than the minimum shown in Figure 1.

3.4 UNDER SLINGING

Under slinging can be used to lift the mixer when headroom is a problem. Sling directly under the gear drive only and use constraints to ensure the cables cannot slip out of position during the lift. DO NOT sling under the motor bracket or other members except to counterbalance the mixer when required.

3.5 BOLTED LIFTING DEVICES

If a bolted lifting device is used, make sure the hardware is tightened securely to proper torques. Always use a torque wrench to check torque before lifting. Consult the lifting device manufacturer's instructions for proper instructions in their use and especially for the proper bolt torque.

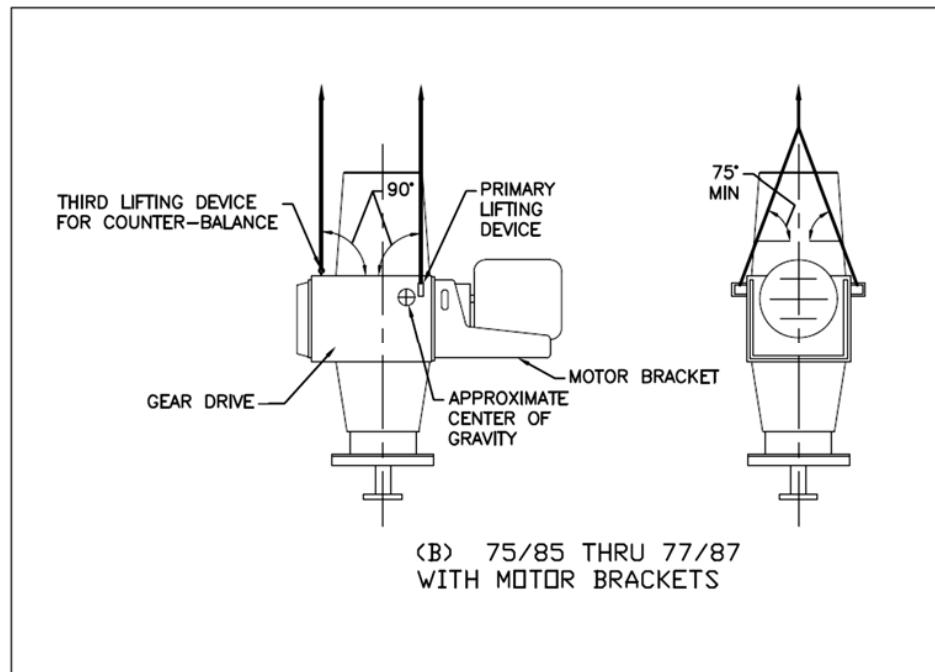
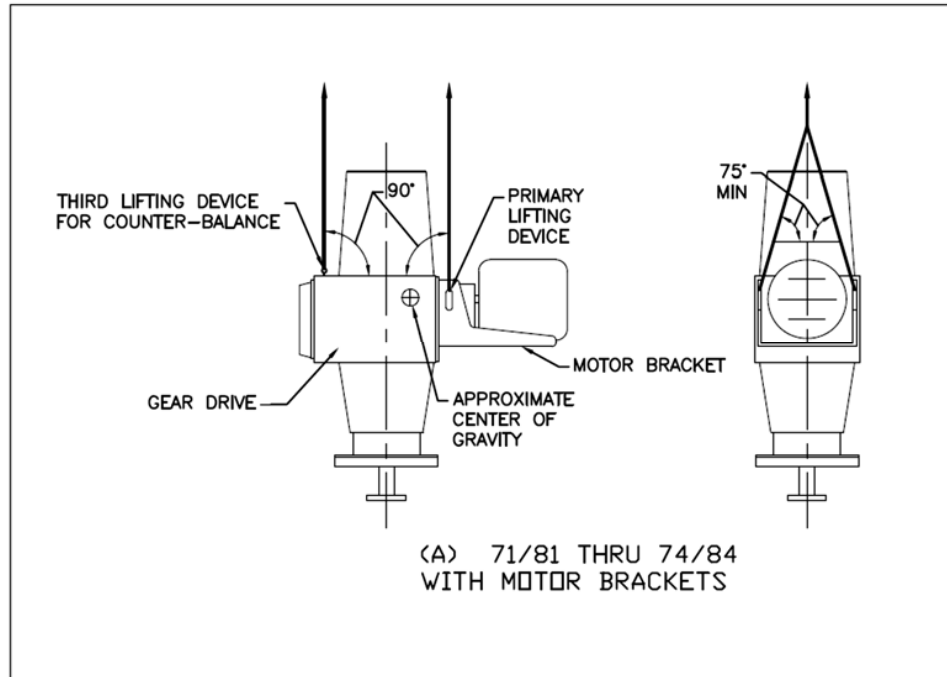
3.6 EYEBOLTS

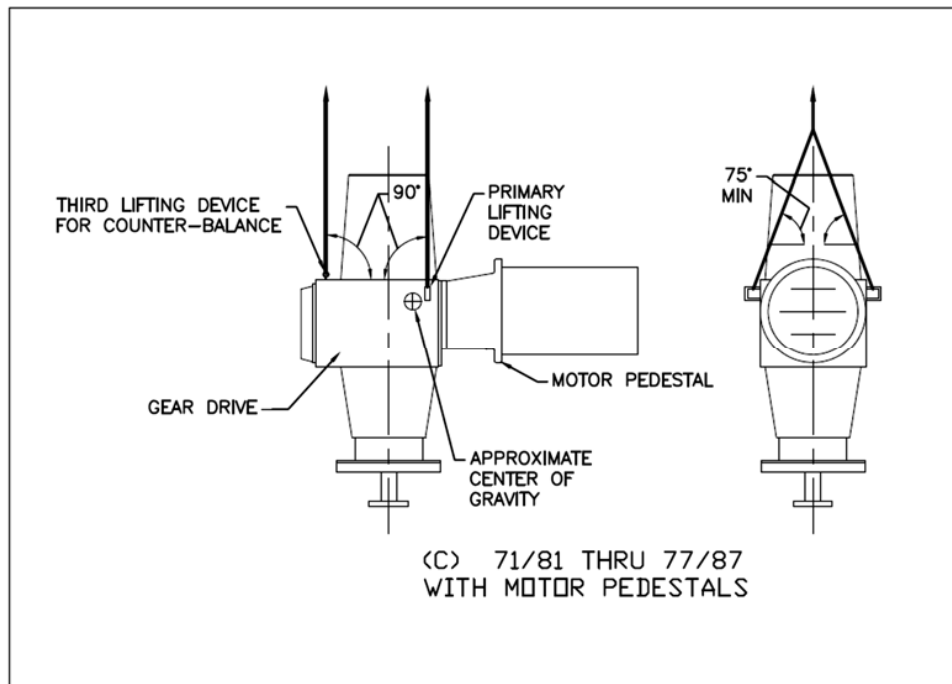
Whenever lifting devices are eyebolts, it is important that the eyebolts are shouldered against the mounting surface and tightened securely. Always use a torque wrench to check torque before lifting. Consult the lifting device manufacturer's instructions for proper instructions in their use and especially for the proper bolt torque.

While eyebolts can be used successfully, they require special care to ensure that bending loads are not applied to their shanks. CAUTION must therefore be exercised to ensure that the applied lifting load is in line with the axis of the shank of the eyebolt so that shank bending loads can be avoided.

FIGURE 1 – RECOMMENDED LIFTING PRACTICE

CAUTION: When taking up slack on lifting cables, avoid sudden impact loading on the lifting devices.





SECTION 4 - START UP

4.1 DIPSTICK AND BREATHER

The gear drive dipstick and breather assembly are removed prior to shipment, and replaced with solid plugs to provide an airtight gear drive housing. The dipstick and breather are packed separately with other installation hardware. Both the dipstick and breather assembly must be installed prior to start up. Tighten all bolts using a torque wrench. Refer to Section 8 of these instructions for torque requirements.

4.2 INITIAL LUBRICATION

Before attempting to start up this mixer, be sure that adequate quantities of the required lubricants are available at the site. All lubricants must be fresh and free of contaminants. Review Section 5 of these instructions for specific lubrication requirements before proceeding with the remainder of the start up instructions. Failure to properly lubricate the mixer will cause damage to the mixer.

The materials used to preserve the gear drive during shipping are compatible with the oil specified in Section 5 of these instructions. However, optimum operation of the mixer will be obtained if excess preservative oil is drained from the mixer before it is activated. In order to accomplish this, the drain plug should be removed and excess preservative oil allowed to drain. The drain plug should be removed at the start of the installation process so that the preservative oil may drain slowly as the mixer is prepared for start up. A container should be provided to receive the preservative oil.

- a. Gear Drive Oil - Fill the gear drive with oil to the proper level. Add the quantity of oil specified in Table 1. Check the oil level with the dipstick. Recheck the oil level after the mixer has been run for at least 10 minutes. If the oil level is below the full mark on the dipstick, add additional oil to raise the level to the full mark. If the oil level is above the full mark on the dipstick, drain off excess oil to bring the level to the full mark on the dipstick. Recheck the oil again after 10 minutes of additional running. Repeat this procedure until the oil level before and after a 10 minute run remains approximately at the full mark. Always stop the mixer to check the oil level.

Oil type and viscosity specifications are given in Section 5. Specific oil brands and types that are approved for use in these mixers are also provided in Section 5. **USE ONLY THE OILS SPECIFIED.**

- b. Stuffing Box - Lubricate and adjust packing on stuffing box models. Packing should be "run-in" per instructions before pressurizing vessels.

- c. Mechanical Seal - Add lubricant and pressurize mechanical seal chambers per instructions before pressurizing vessel.
- d. Grease Packed Bearings - All grease lubricated bearings are provided with an initial fill of grease at the factory. No additional grease is required at start up.

4.3 MOTOR PREPARATION

Review the motor maintenance instructions supplied with this manual for motor start up procedures. The motor must be properly prepared, checked and connected to a source of electrical power before the mixer is started. Failure to comply with the required procedures may result in damage to the mixer or personal injury. Because it may be necessary to run the mixer briefly while the motor is being connected to its power source, the above initial lubrication must be accomplished before attempting to connect the motor to a power source.

- a. Initial Inspection - As a minimum, with the electrical power source locked out to prevent injury, turn the motor shaft by hand to check for free rotation. The stator windings should be checked for insulation resistance. If resistance is less than one megohm, winding may be wet and should be dried thoroughly before start up is attempted.
- b. Power Connection - Connect the motor to a power source that matches the line voltage specified on the order and according to the wiring diagram on the motor nameplate. Before permanently connecting the motor leads, check impeller shaft rotation. Jog the motor until it is determined that rotation is correct, and then make permanent connections. Motors must be properly grounded in accordance with applicable U.L. standards and codes. All local codes must also be observed.

4.4 INITIAL RUNNING

Before filling and/or pressurizing the vessel, the gear drive should be run briefly to check for unusual conditions.

- a. Operation - Run mixer in air and check for any unusual noise or vibration. The general operation of the mixer should be observed to determine if any leaks or other anomalous operating conditions are apparent.
- b. Power and Speed - In order to be sure that the mixer is properly connected, both load and output shaft speed should be checked. Surface temperature of the gear drive should also be noted. Gear drive temperature must not exceed 140° F at any location.
- c. Recheck Fastener Torques - After completing the checks noted above, stop the mixer and, with a torque wrench, recheck all bolts and fasteners for proper torque. Care should be exercised to ensure that each bolt is checked and retorqued if necessary.

4.5 PLACING MIXER IN SERVICE

After filling and/or pressurizing the vessel, jog the motor or rotate the input shaft by hand to ensure the shafts and impeller(s) are free of obstructions. Obstructions must be cleared prior to attempting to start the mixer. NEVER start up the mixer with the impeller imbedded in solids or set-up liquids. After two weeks of operation, stop mixer and, using a torque wrench, recheck all bolts and fasteners for proper torque.

SECTION 5 - GEAR DRIVE LUBRICATION

5.1 OIL VISCOSITY SELECTION

Fill the gear drive to the proper level with an industrial gear oil with a viscosity as defined in Table 3. The gear drive may be filled at the oil fill and inspection opening. It is imperative that the oil viscosity grade specified in Table 3 be used and that the specific lubricant be selected only from the listings provided in these instructions. See Section 5.3 for a more detailed description of approved oils.

Mixers that are equipped with an oil pump must be interwired, so that the mixer may not be started unless the oil pump has already been started. Pump equipped mixers must also be wired such that they automatically shut down if the pump fails to deliver oil to the mixer.

TABLE 1 APPROXIMATE OIL CAPACITIES (REFERENCE ONLY - USE DIPSTICK FULL MARK FOR MOST ACCURATE GUIDE)			
MIXER SIZE	NOMINAL TOTAL RATIO	OIL CAPACITY (QUARTS)	STANDARD DIPSTICK NUMBER
71 / 81	ALL	5	206999
72 / 82	ALL	10	121219
73 / 83	9 THRU 32	16	121218
	37 THRU 105	20	121218
74 / 84	6 THRU 26	27	121216
	30 THRU 38	32	121215
	45 THRU 104	36	121215
75 / 85	6 THRU 26	32	121234
	32 THRU 38	37	121235
	47 THRU 105	44	121235
76 / 86	6 THRU 26	44	121237
	31 THRU 38	54	121238
	47 THRU 105	63	121238
77 / 87	6 THRU 39	77	121239
	47 THRU 108	96	121240

- 5.2 DO NOT operate the mixer if the oil sump temperature exceeds the maximum oil operating temperature in Table 2. Gear drives exposed to direct sunlight for extended periods where ambient temperatures reach 100°F (38°C) or greater, should be protected from this solar energy. A canopy over the drive or reflective paint can be used. If not possible, a heat exchanger or other cooling device may be required.

When the oil temperatures are less than those listed in Table 2, heat the oil.

TABLE 2 START UP - TEMPERATURE GUIDELINES				
OIL TYPE	MINIMUM OIL COLD START UP TEMPERATURE		MAXIMUM OIL SUMP TEMPERATURE	
	(°C)	(°F)	(°C)	(°F)
AGMA 6, 7, 8	23.9	75	93.3	200
AGMA 5	18.3	65		
AGMA 4	12.8	55		
AGMA 3	7.2	45	82.2	180
AGMA 2	-1.1	30	62.8	145

5.3 APPROVED GEAR OILS

- a. **LIGHTNIN** provides a list of recommended oils based on successful field experience with mixer gear drive applications and specific lubricant performance data. **All lubricants do not perform equally**, even though they may be the same AGMA viscosity grade. Each lubricant has different performance levels based on the specific additives and formulations.
- b. The specific viscosity grade required is shown in Table 3. The viscosity is dependant on the ambient conditions expected. It is imperative that the appropriate viscosity be selected for each mixer and that the viscosity of the oil be changed to meet any anticipated change in ambient temperature conditions. Certain regions will experience significant seasonal variations in temperature range. **This requires a seasonal oil viscosity change.** Ambient Temperature Range is the average temperature during daylight hours.
- c. Tables 4 and 5 show approved oils for **LIGHTNIN 70 / 80 Series gear drives**. **ONLY the specific lubricants shown in these tables are approved for use in LIGHTNIN gear drives.** These are lubricants with which **LIGHTNIN** has had successful field experience.
- d. Petroleum based oils provide excellent performance at moderate cost. Synthetic lubricants also provide excellent performance, however, for a small additional cost, they are capable of wider temperature ranges and longer drain intervals. The use of synthetic oils is recommended wherever a longer oil change interval is required. Synthetic oils are especially recommended where wider than normal changes in ambient temperature may occur between normal oil change intervals or where the mixers are subjected to particularly high ambient temperatures for long periods of time.

5.4 LUBRICATION INSTRUCTION REVISIONS

- a. Both AGMA Standards and Lubricant Manufacturer's offerings change, over time. The lubricant information in this general instruction may be different than in older versions. In most cases **LIGHTNIN** urges the customer to be consistent with AGMA lubrication standards, but we recognize that they may have had successful field experience based on the older instructions. Immediate conversion is not required, however a gradual transition to the current lubrication standards is recommended.

TABLE 3 – REQUIRED OIL VISCOSITY GRADES (1)			
AMBIENT TEMPERATURE RANGE (°C)	AMBIENT TEMPERATURE RANGE (°F)	AGMA GRADE (2)	
		OUTPUT RPM < 130	OUTPUT RPM = or > 130
- 40 to - 10	- 40 to + 14	3	3
- 10 to + 10	+ 14 to + 50	4	3
+ 10 to + 35	+ 50 to + 95	6	5
+ 35 to + 55	+ 95 to + 131	8	7

(1) Mixers equipped with any type of oil heating device: Consult Factory for proper oil viscosity grade.

(2) Per AGMA Standard 9005-D94. Applies to both "EP" and synthetic oils.

TABLE 4 – APPROVED PETROLEUM BASED EP GEAR OILS								
MANUFACTURER	BRAND	PRODUCT	PRODUCT BY AGMA GRADE					
			3 EP	4 EP	5 EP	6 EP	7 EP	8 EP
EXXONMOBIL	MOBIL	MobilGear 600 XP	100	150	220	320	460	680
EXXONMOBIL	EXXON	Spartan EP	100	150	220	320	460	680
CHEVRON	CHEVRON	Gear Compound EP	100	150	220	320	460	680
CHEVRON	TEXACO	Meropa	100	150	220	320	460	680
SHELL	SHELL	Omala	100	150	220	320	460	680

TABLE 5 – APPROVED SYNTHETIC EP GEAR OILS

MANUFACTURER	BRAND	PRODUCT	PRODUCT BY AGMA GRADE					
			3 S	4 S	5 S	6 S	7 S	8 S
SPX/LIGHTNIN	N/A	N/A	100	150	220	320		
EXXONMOBIL	MOBIL	Mobil SHC 600 / 600* (1)	100	150	220	320	460	680
EXXONMOBIL	EXXON	MobilGear SHC		150	220	320	460	680
CHEVRON	CHEVRON	Tegra		150	220	320	460	680
CHEVRON	TEXACO	Pinnacle EP		150	220	320	460	680
SHELL	SHELL	Omala S4 GX	100	150	220	320	460	680
BEL-RAY	BEL-RAY	Synthetic Gear Oil		150	220	320	460	680

(1) Mobil does not rate this product as “EP” due to the lack of “EP” additives. The load carrying capability of these oils is equal to or greater than the limits of “EP” oils.

For reference purposes, Table 6 shows a viscosity/grade comparison for the required oil viscosities defined in Table 3.

**TABLE 6 – LUBRICANT VISCOSITY GRADES
(Kinematic Viscosity Range)**

AGMA GRADE EP / Synthetic	ISO GRADE	cSt (mm ² /s) @ 40 °C
2 EP / 2 S	68	61.2 – 74.8
3 EP / 3 S	100	90 – 110
4 EP / 4 S	150	135– 165
5 EP / 5 S	220	198 – 242
6 EP / 6 S	320	288 – 352
7 EP / 7 S	460	414 – 506
8 EP / 8 S	680	612 – 748

5.5 ALTERNATE OILS

- Mixer gear drives operate continuously under very high loads. Care must be taken to choose an appropriate lubricant that can perform under these high loads and high temperatures. Great care must be exercised in the selection of alternate oils for use in mixer gear drives.
- The selection of an alternate oil should be done only after thorough evaluation by a qualified individual. Lubrication is a complex subject with numerous variables.

NOTE: The gear drive contains elastomers, gear case sealer and other materials that may not be suitable for use with an alternate oil. It is the customer’s responsibility to insure that the oil is compatible.

- All lubricants DO NOT perform equally, even though they may be the same AGMA viscosity grade. Each lubricant has different performance levels based on the specific additives and formulations. Additives can be depleted under high shear loads and temperatures, over time. **It is the Customer’s responsibility to understand the performance capability of the alternate lubricant they will be using.**

- d. **LIGHTNIN** provides a list of recommended oils based on, successful field experience with mixer gear drives, and specific lubricant performance data.
- e. **LIGHTNIN DOES NOT APPROVE OR INVESTIGATE ALTERNATE OILS.** We recognize, however, that alternate oils may perform adequately and provide other benefits to the customer. Customers may want an alternate oil due to cost, availability or commonality of use with other equipment. In light of this, **LIGHTNIN provides general guidance for the customer or a third party to evaluate alternate oils.**
- f. **LIGHTNIN** offers general guidelines for evaluating alternate oils, however, successful field experience is critical to the selection. The customer benefits from understanding the performance of the specific product and additive package (anti-wear, anti-foaming, anti-oxidation, water solubility etc.).
- g. Most lubricant manufacturers can provide, upon request, product specification data sheets for each of their products. These data sheets generally provide all or most of the data required.
- h. Proper evaluation requires:
 1. An understanding of the additives and oil performance as indicated in Table 7.
 2. Adequate field experience in similar equipment with similar operating parameters, to confirm the lubricant's long-term performance.
- i. If a lubrication related failure occurs, the Customer's lubricant evaluation and field experience would be considered in the failure analysis.
- j. **The Warranty may be voided if the customer has not conducted a proper lubricant evaluation, before using the alternate lubricant.**
- k. For suggestions of a third party to perform an oil evaluation, the Society of Tribologists and Lubrication Engineers may be contacted at www.stle.org.

TABLE 7
MINIMUM PHYSICAL AND PERFORMANCE REQUIREMENTS FOR
EXTREME PRESSURE AND SYNTHETIC GEAR LUBRICANTS

PROPERTY	TEST PROCEDURE	ACCEPTANCE CRITERIA
Flash Point (°F)	ASTM D 92	400 (Minimum)
Viscosity	ASTM D 445	Per AGMA 9005-E02 Table 4
Viscosity Index	ASTM D 2270	EP: 90 (Minimum), SYN: 120 (Minimum)
Oxidation Stability	ASTM D 2893 (Increase in Kinematic Visc. of a sample at 250°F)	6% Maximum
Rust Protection	ASTM D 665 B (24 hrs in synthetic sea water)	No Rust
Corrosion Protection	ASTM D 130 (Copper strip corrosion after 3 hrs. @ 212°F	1b strip
Foam Suppression	ASTM D 892 (Must be within the limits shown)	Maximum Volume of Foam (ml) after: Sequence: I II III Temp. °F: 75 200 75 After 5 Min. Blow: 75 75 75 After 10 Min. Rest: 10 10 10
Demulsibility	ASTM D 2711 MOD (Must be within the limits shown)	AGMA Grades EP Syn. 2-7 8-13 Max. % H ₂ O in oil 2.0 2.0 1.0

		after 5 hr. test
		Max. Cuff after centrifuging (ml) 1.0 4.0 2.0
		Min. Total free water collected during entire test (start w/ 90 ml of water) (ml) 80.0 50.0 60.0
Cleanliness	None	Must be free from grit and abrasives.
Pour Point	ASTM D 97	
Timken OK Load (lbs.)	ASTM D 2782	60 (Minimum)
FZG Test (No. of stages passed)	DIN 51 354 (A/8.3/90°C parameters)	12 (Minimum)
Filterability	None	Must be filterable to 25 microns without the loss of additives.

5.6 OIL MAINTENANCE

Proper operation of the gear drive is dependant on the careful maintenance of its oil lubrication system. The oil level must be checked (with the mixer shut down and after all rotation has ceased) at regular intervals and the entire fill must be drained and replaced when it has begun to lose its load carrying capacity or when it becomes contaminated.

- Oil Capacity - The gear case oil capacity is shown for reference in Table 1. Due to the physical size variations of gears and other internal components, the actual capacity of individual drives may vary from the volumes listed in Table 1. For this reason, the dipstick full mark should be used as the most accurate guide to the actual oil level in a specific mixer.
- Initial Oil Change – For best performance the lubricant in a new gear drive should be drained after two (2) weeks of operation to ensure that all initial wear products and contamination that may have occurred during shipping and installation are removed from the gear drive. Drain the gear drive while the oil is still at operating temperature. The original oil should be conditioned and reused OR discarded and new oil installed.
- Normal Oil Change Interval - The oil change frequency required for the gear drive is dependant upon the type of oil being used and the overall operating conditions. Table 8 provides specific guidance regarding the oil change interval for these gear drives. These oil change intervals must be adhered to.
- Oil Change Interval for Adverse Conditions - In general, higher operating or local ambient temperatures or adverse operating conditions will require more frequent oil changes. When adverse operating conditions, such as rapidly changing temperatures, chemical fumes or vapors, dusty or humid atmospheres, high solar gain, etc. are present, the oil change interval must be reduced. Under such conditions, oil change intervals should be determined based on an oil analysis program.

More frequent oil changes at intervals of one to three months will be necessary for unfavorable operating conditions that tend to deteriorate oil and/or cause condensation.

Rapid changes in oil temperatures caused by intermittent operation or wide fluctuations in ambient temperatures or operation in humid atmospheres, all promote condensation that can result in the formation of harmful sludge.

Harmful vapors or chemical fumes and dusty atmospheres also tend to deteriorate oil and the beneficial additives.

- Oil Analysis - In order to determine the optimum change interval for the lubricating oil in the gear drive, an oil analysis program may be utilized. It is very important, however, that the type of analyses performed and the individuals evaluating the results be selected to insure that inappropriate conclusions are not reached. In general, a successful oil analysis program must consider a wide range of parameters including both wear particle and spectral analysis of the basic lubricant.

Reputable lubricant suppliers can test oil and recommend economical oil change schedules when adverse operating conditions are present. Severe duty applications should be referred to our factory for specific recommendations.

**TABLE 8
RECOMMENDED NORMAL OIL CHANGE INTERVALS**

DUTY CLASSIFICATION	OIL SELECTED FROM TABLE	OIL CHANGE INTERVAL (WHICHEVER OCCURS FIRST)	
		OPERATING HOURS	CALENDAR MONTHS
OCCASIONAL (IDLE PERIODS > 50 HRS.)	4	1500	4
	5	4500	8
INTERMITTANT (> 5 HRS PER DAY)	4	2500	6
	5	7500	12
CONTINUOUS (24 HRS PER DAY)	4	4380	6
	5	13140	18

- f. Oil Level Check - The oil level should be checked at regular intervals, preferably not longer than biweekly. DO NOT overfill the gear drive with oil as leakage and severe overheating can occur.
- g. Oil Compatibility - While most quality oils are mutually compatible, different brands of the same or different grades should not be mixed. If a change in lubricant brand or type is required, the gear drive must be drained as fully as possible and flushed with the new lubricant prior to placing the mixer back in service.
- Flushing may be accomplished simply by first draining the current lubricant from the gear drive, refilling it with the new oil and running for at least 12 hours but not longer than 24 hours. After this period of time, the gear drive should be drained fully and then refilled with fresh oil of the new type. The used oil must be discarded.

5.7 GEAR DRIVE BEARING LUBRICATION

Each of the bearings in the gear drive is lubricated either by oil splash or grease. The maintenance procedures required for each method of lubrication vary and must be adhered to carefully to ensure optimum performance of the gear drive.

- Oil Lubricated Bearings - Oil lubricated bearings within the gear drive require no separate maintenance. They are lubricated by the oil that lubricates the gears and regular changes of this oil will adequately maintain these bearings.
- Sealed Grease Lubricated Bearings - Some grease lubricated bearings are packed with grease and sealed by the bearing manufacturer and require no periodic maintenance. These sealed bearings are primarily used on high speed shafts of the smaller mixers. Such bearings are not fitted with grease fittings since no regreasing is required.
- Regreaseable Bearings - All of the low speed bearings (Items 404 & 408) and some high speed bearings (Item 205) are prepacked with grease at the factory and thus do not require initial lubrication. All of these bearings do, however, require periodic regreasing after the mixer has been placed in service. All regreaseable bearing locations are provided with a grease fitting to permit periodic regreasing. Some of these bearings are also provided with a purge fitting.
- Initial Grease Fill - All regreaseable bearings are initially lubricated at the factory with lithium based grease. The factory grease is lithium soap NLGI #2 consistency grease having rust and oxidation inhibitors and a base oil viscosity of at least 500 SSU at 100° F.
- Regreasing Procedures - Before attempting to relubricate any bearing, **be sure to clean all grease fittings and greasing equipment thoroughly. Also, make sure that the recommended type of grease has been loaded into the regreasing device and is also clean and free of contamination.** Refer to the assembly drawings for the location of the grease fittings. Use only one of the approved greases listed in these instructions when relubricating bearings on these gear drives.

Without compromising safety, whenever possible, bearings should be regreased while the mixer is operating. This will ensure that the grease is properly distributed within the bearing and effectively displaces the old, worn out grease pack. If it is not possible to regrease the bearings while the mixer is in operation, **LOCKOUT THE POWER SUPPLY** and rotate either the input or output shaft slowly by hand while the bearings are being regreased.

For bearings that are equipped with purge ports, fresh grease should be added to the pressure fitting until *fresh, clean* grease is observed to flow from the purge port. **DO NOT** stop pumping in fresh grease at the first sign of grease at the purge port. It is important that the new grease displace as much of the old, worn grease pack as possible. This will ensure that maximum bearing life is obtained.

For bearings that are not equipped with purge plugs (e.g. output shaft bearings in a dry well), care should be exercised to ensure the appropriate quantity of grease as defined in Table 9 is introduced into the bearing when the bearings are regreased.

The regreasing procedure to be followed differs somewhat for each bearing location. The following specific procedures must be followed for each location identified:

- f. HIGH SPEED OUTER BEARING (ITEM 205)
 1. The standard bearings on the 71/81 thru 73/83 size drives are factory lubricated and sealed ball bearings. No periodic relubrication is necessary.
 2. The size 74/84 thru 77/87 drives have open type bearings requiring fresh lubricant at regular intervals. Add the minimum amount of grease shown in Table 9.
- g. LOW SPEED BEARINGS (ITEMS 404 & 408)
 1. Upper bearing (Item 404), 70 Series Mixers - Add grease until fresh grease emerges from the relief located opposite the grease fitting.
 2. Upper bearing (Item 404), 80 Series Mixers - Add fresh grease until it purges out between the low speed coupling and the top of the gear drive.
 3. Lower bearing (Item 408) - To ensure that this bearing, which is situated in a dry well, is adequately supplied with fresh grease, add the amount shown in Table 9 at the intervals defined in Table 10.

TABLE 9 MINIMUM AMOUNT OF BEARING GREASE REQUIRED		
MIXER SIZE	AMOUNT OF GREASE, OZ.	
	LOW SPEED BEARING (408)	HIGH SPEED BEARING (205)
71/81 THRU 73/83	3.5	--
74/84 THRU 76/86	8	2
77/87	16	6

- h. Section 6 of this document provides listings defining the greases approved for use in **LIGHTNIN** drives.

5.8 LUBRICATION INTERVALS

- a. Open type bearings require fresh lubricant at regular intervals. The frequency of relubrication depends on the extent of atmospheric contamination, humidity, variations in ambient temperature and actual bearing operating temperatures. Bearings operating at high temperatures require fresh grease at more frequent intervals. Under most circumstances, the bearings in these gear drives should be regreased at the intervals defined in Table 10.

TABLE 10 BEARING LUBRICANT INTERVALS (Months)			
TYPE OF GREASE	BEARING OPERATING TEMPERATURE (°F)		
	UNDER 160	160 - 185	186 - 200
STANDARD NLGI # 2	6	4	3
NLGI # 2 (EP) EXTREME PRESSURE	4	3	1

* NLGI – NATIONAL GREASE LUBRICATING INSTITUTE

- 5.9 Bearing operating temperatures can be determined with a surface pyrometer or thermometer. For inaccessible bearings, grease or oil temperatures can be measured. Add 10° F to lubricant temperatures to compensate for heat transfer loss.

Periodic temperature checks should be made to establish lubrication intervals and also to detect potential problems that can result from overheating.

- 5.10 It is normal for a bearing to show a slight temperature increase (as much as 20° F) for a short period of time (up to 10 hours) after regreasing. This is due to the heat generated within the bearing as the fresh grease is redistributed inside the bearing by the motion of the rolling elements. For this reason, bearings should not, except under special circumstances as defined by the factory for a particular gear drive, be regreased on a daily basis.

SECTION 6 - MIXER SHAFT LUBRICATION (80 SERIES UPPER SHAFT BEARINGS)

6.1 BEARING TYPES

80 Series Mixers with 4 inch diameter and smaller shafts through the bearings (81 thru 85) are equipped with sealed bearings. 80 Series with 4¹/₄ inch diameter shafts through the bearings (86 & 87 with 4¹/₂" and smaller lower shafts) are equipped with open type ball bearings. 80 Series with shafts 4³/₄" and larger through the bearings (87 with 5" and larger lower shafts) are equipped with open type spherical roller bearings. Since the lubrication requirements for each type of bearing vary somewhat, the user should determine which bearings are used in the mixer before proceeding. These bearings should be treated with care and only the highest quality lubricants should be used. Only the greases specified in Tables 11 and 12 are to be used to lubricate bearings in **LIGHTNIN** drives.

6.2 SEALED BEARINGS

Whenever available, ball bearings are equipped with contact rubbing seals or double shields that are prepacked with lubricant by the bearing manufacturer. As standard practice, no provisions are made for relubricating this type of bearing.

6.3 REGREASEABLE BEARINGS

Open type bearings are initially lubricated at our factory. Housings are provided with grease fittings and automatic relief fittings or relief plugs when required. Lithium based NLGI #2 consistency grease is used to lubricate all open bearings.

Lithium base grease is a multipurpose grease most ideally suited to covering a broad range of operating conditions bearings are subjected to. It offers good resistance to water and remains stable through a wide range of varying mechanical, oxidation and temperature conditions.

With the exception of polyurea greases, as noted below, only lithium greases must be used. Without taking a bearing apart and thoroughly cleaning it, it is virtually impossible to remove all of the lithium grease that was installed at our factory and thus undesirable cross contamination is unavoidable. Many greases are not compatible with one another and cross contamination can, therefore, create serious problems. Since it is not practical to present a complete compatibility chart in these instructions, it is best not to mix greases.

Greases made with polyurea complex thickeners are compatible with most grease, including lithium thickened greases. Polyurea greases are generally higher in load capacity and may be used where an EP grease is required.

6.4 LUBRICATION INTERVALS (refer to Table 10)

Open type bearings require fresh lubricant at regular intervals. The frequency of relubrication depends on:

- a. Presence of excessive moisture
- b. Extent of atmospheric contamination
- c. Variations in ambient temperature
- d. Bearing operating temperatures

For most applications, the regreasing intervals specified in Table 10 are adequate. Bearings operating at high temperatures and/or bearings lubricated with extreme pressure (EP) grease require fresh grease at more frequent intervals.

Periodic temperature checks should be made to establish lubrication intervals and to detect potential problems that can result from overheating. Bearing operating temperatures can be determined with a surface pyrometer or thermometer placed on bearing housing wall adjacent to the bearing. Add 10° F to lubricant temperatures to the actual reading to compensate for heat transfer loss.

6.5 BEARING LUBRICATION PROCEDURE

- a. The following procedure will ensure that the grease is properly distributed with the bearing and effectively displaces the old, worn out grease pack.
- b. Stop the mixer and disconnect or otherwise lock out the power supply.
- c. Remove safety cover(s), (Items 320 & 322).

- d. For bearings that are equipped with grease fittings, fresh grease should be added to the lubricant fitting until fresh, clean grease is observed to flow from the grease relief. **DO NOT** stop pumping in fresh grease at the first sign of grease at the relief fitting. It is important that the new grease displace as much of the old, worn grease pack as possible. This will ensure that maximum bearing life is obtained.
- e. Install safety covers and reconnect the mixer to its power supply.
- f. Run the mixer for (10) minutes.
- g. Again, stop the mixer and disconnect or otherwise lock out the power supply.
- h. Remove the safety covers.
- i. Add lubricant per 6.5d.
- j. Install the safety covers.

6.6 APPROVED GREASES

LIGHTNIN Mixers and Aerators are equipped with high quality ball and roller bearings that are housed in sealed enclosures for maximum protection. These bearings should be treated with care and only the highest quality lubricants should be used. Only the greases defined in Tables 11 and 12 are to be used in these bearings.

- a. Open Type Ball Bearings - These bearings are designed to use a premium quality lithium soap NLGI #2 consistency grease having rust and oxidation inhibitors and a base oil viscosity of at least 500 SSU at 100° F. Lists of suitable greases are provided in Tables 11 and 12.
- b. Spherical Roller Bearings - These bearings should use only an NLGI #2 consistency lithium based EXTREME PRESSURE (EP) grease that contains an oil whose viscosity is 800-1000 SSU at 100° F. A listing of suitable greases conforming to this specification is given in Table 11 and 12.
 - a. EP Greases - The products shown in Table 11 are EP greases. They may be used in all applications and are **REQUIRED** for all spherical roller bearings on **LIGHTNIN** drives.

TABLE 11 APPROVED LITHIUM EP BEARING GREASES			
MANUFACTURER	BRAND	PRODUCT	TIMKEN OK LOAD LBS (N)
AMOCO	AMOCO	AMOLITH EP 2	40 (180)
EXXONMOBIL	MOBIL	MOBILUX EP 2	
CHEVRON	TEXACO	MULTIFAK EP 2	
	CHEVRON	DURA-LITH EP 2	
GULF	GULF	GULFCROWN GREASE EP 2	
PENWALT	PENWALT	KEYSTONE 81 EP LT	75 (330)
SHELL	SHELL	ALVANIA EP 2	60 (270)

- b. Alternate High Temperature Greases - The products shown in Table 12 may be used for gear drive bearings **and 80 Series upper shaft bearings**, which may experience higher than normal operating temperatures, in mixers with high output speeds.

Note: These greases are not to be used in lieu of correcting any special high temperature ambient operating conditions (including high temperature process equipment, presence of solar radiation, very dusty atmosphere or enclosed space).

TABLE 12 HIGH TEMPERATURE LITHIUM COMPLEX BEARING GREASES	
MANUFACTURER	PRODUCT
MOBIL	MOBILITH SHC 220
CASTROL	TRIBOL 4020 / 220-2

6.7 GREASE QUANTITIES

The minimum quantity of grease needed to adequately lubricate each of the mixer shaft bearings is given in Table 13.

TABLE 13 MIXER SHAFT MINIMUM GREASE QUANTITY			
MODEL SIZE	UPPER SHAFT DIAMETER (IN.)	LOWER SHAFT DIAMETER (IN.)	MIN. QTY. OF GREASE (OZ.)
81 – 85	≤ 4	≤ 4	N/A
86 – 87	4.25	≤ 4.5	3
87	4.75	≥ 5	5

6.8 REGREASING PROCEDURES

Mixer shaft bearings may be relubricated either while they are installed in a mixer or after disassembly and cleaning.

- a. Installed Bearings - **Before attempting to relubricate any bearing, be sure to clean all grease fittings and greasing equipment thoroughly. Make sure that the recommended type of grease has been loaded into the regreasing device and is also clean and free of contamination.** Refer to the assembly drawings for location of the grease fittings. Use only one of the approved greases listed in these instructions when relubricating the mixer shaft bearings.

Without compromising safety, whenever possible, bearings should be regreased while the mixer is operating. This will ensure that the grease is properly distributed within the bearing and effectively displaces the old, worn out grease pack. If it is not possible to regrease the bearings while the mixer is in operation, **LOCKOUT THE POWER SUPPLY** and rotate either the input or output shaft slowly by hand while the bearings are being regreased.

On bearings that are equipped with purge ports, fresh grease should be added to the pressure fitting until *fresh, clean* grease is observed to flow from the purge port. **DO NOT** stop pumping in fresh grease at the first sign of grease at the purge port. It is important that the new grease displace as much of the old, worn grease pack as possible. This will ensure that maximum bearing life is obtained.

On bearings that are not equipped with purge plugs (e.g. output shaft bearings in a dry well), care should be exercised to ensure the appropriate quantity of grease as defined in Table 13 is installed. Rotate the shaft while adding grease to help distribute it.

- b. Uninstalled Bearings - If a bearing is removed from the shaft assembly it should be thoroughly cleaned with kerosene or a similar solvent until all old grease and foreign matter is removed. Allow to air dry. **DO NOT SPIN DRY BEARINGS.** Dip bearing in a light lubricating oil for protection if it is not to be regreased immediately.

Regrease the bearing by forcing grease between the rolling elements and the inner and outer races. Thoroughly work the grease in from both sides of the bearing to ensure that it is fully packed.

Before reinstalling the bearing, thoroughly clean the housing and coat it with fresh bearing grease. In addition, pack the cavity below the bearing with fresh bearing grease of the same type. Replace all covers and add lubricant through the fitting to purge the housing of air pockets and ensure that the channels are full.

6.9 MOTOR BEARINGS

Prior to shipment, motor bearings are greased with the proper amount and grade of lubricant by the motor vendor. Motors equipped with sealed bearings require no additional lubrication. Motors equipped with open ball bearings require lubrication periodically. Refer to motor manufacturer's maintenance instructions for further details.

SECTION 7 - STORAGE PROCEDURES

7.1 STORAGE CONSIDERATIONS

LIGHTNIN Mixers and Aerators, like all precision equipment, must be protected against corrosion during prolonged periods of inactivity. The primary cause of corrosion is condensation due to fluctuating temperatures, high humidity, or both. Properly treated and located in clean, dry surroundings, inactive equipment can be successfully stored for up to one year without damage from corrosive attack.

REVIEW AND FOLLOW THE PROCEDURES IN THE INSTRUCTIONS THAT FOLLOW. FAILURE TO PROPERLY STORE AND PROTECT THE EQUIPMENT AS OUTLINED MAY VOID ANY WARRANTY, EXPRESSED OR IMPLIED.

Electric motors or other prime movers are not prepared for indoor storage beyond the periods shown below by **LIGHTNIN**. Outdoor storage of electric motors is not recommended by any motor manufacturer. For storage periods beyond those shown below, refer to motor maintenance instructions furnished with this manual for further details.

The seal cartridge of mechanical seal mixers is not filled with lubricant at the factory. Fill the seal cartridge with lubricant as outlined in the seal maintenance instructions of this manual.

7.2 STORAGE OF NEW MIXERS

LIGHTNIN Mixers are factory treated with high quality corrosion inhibitors and rust preventatives. With reasonable care at the site, the products will effectively protect new, uninstalled mixers from corrosion due to water and water vapor, for up to one year, depending on how the mixer is stored. Outdoor, unprotected storage is not permitted under any circumstances unless the mixer has been specifically prepared for such storage at the factory prior to shipment.

- a. Uninstalled, Protected Storage - Depending on the conditions under which a new mixer that has not been installed is stored, the initial factory applied corrosion protection treatment will last up to one year. Actual preservation periods, as a function of storage conditions are defined in Table 14. This table also defines the required intervals at that the corrosion protection must be renewed.

TABLE 14 CORROSION PROTECTION PERIODS		
STORAGE CONDITIONS	PROTECTION PERIOD, MONTHS	
	INITIAL	REPRESENTATION
INDOORS IN A DRY AMBIENT ATMOSPHERE WITH CONTROLLED TEMPERATURES	12	12
INDOORS IN A DRY AMBIENT ATMOSPHERE WITHOUT TEMPERATURE CONTROL	6	6
OUTDOORS AS CRATED WITH SUITABLE PROTECTION FROM THE ELEMENTS. COVERINGS MUST BE WATERPROOF, BUT HAVE PROVISIONS FOR FREE CIRCULATION OF AIR TO AVOID BUILDUPS OF CONDENSATION. EQUIPMENT MUST BE ELEVATED AT LEAST 12 INCHES ABOVE GROUND LEVEL TO REDUCE MOISTURE PICKUP.	4	4

- b. Installed, Inoperative Mixers - Mixers that have been installed, but not serviced for operation (as defined in Section 4), and that will be inactive for more than three months must be prepared for storage per Paragraph 7.3, below.

- c. Installed, Operative Mixers - Mixers that have been installed, serviced for operation (as defined in Section 4) and run, but that will be inactive for more than three months must be prepared for storage per Paragraph 7.4, below.
- d. Periodic Inspection - All protective coatings and wrappings must be maintained in good condition. Stored mixers should be visually inspected periodically to ensure that the factory wrappings and coatings are intact. If factory wrappings and coatings are accidentally removed or damaged, reapply them over the exposed areas.

7.3 CORROSION PROTECTION RENEWAL

Table 14 defines the length of time that mixers, originally preserved at the factory, may be stored under various conditions. This table also defines the time period after which a stored mixer must be represerved. Careful adherence to the protection renewal procedures defined herein will afford adequate protection for the same period covered by a factory prepared mixer when stored under conditions defined in Table 14. These procedures should be repeated at the same intervals as noted in Table 14.

In order to represerve a stored mixer, the following steps must be taken:

- a. The upper portion of direct connected mixer shafts (70 Series mixers) is coated with anti-seize compound. Reapply if necessary. On 70 Series mixers, the low speed reducer shaft is coated with anti-seize compound. Check the condition of the anti-seize compound and reapply if necessary. Approved anti-seize compounds are listed in Table 15.

For 80 Series mixers where the upper shaft is not installed, check the condition of the anti-seize compound on the low speed flexible coupling. Reapply if necessary.

TABLE 15 APPROVED ANTI-SEIZE COMPOUNDS	
MANUFACTURER	PRODUCT
BOSTIK DIV., EMHART CORP. BROADVIEW, IL	NEVER-SEEZ, REGULAR GRADE
MASTER LUBRICANTS CO. PHILADELPHIA, PA	LUBRIKO 450

- b. Remove all covers and protective wrappings. Add fresh grease to all regreaseable bearings in accordance with the instructions provided in Section 6.8 of these instructions.
- c. Remove the oil filler plug or inspection cover, dipstick and breather plug(s) in the gear drive.
- d. The interior of the mixer must be treated with a Vapor Phase Inhibitor (VPI) product to retard corrosion. An approved product is listed in Table 16. Use only approved VPI products. Distribute the required quantity of the VPI product through one or more of the openings, directing the product to all corners for maximum coverage. With an assembled mixer, the liquid products are generally easiest to apply, through the use of a fine mist sprayer, and are strongly recommended.
- e. Replace the oil filler plug and inspection cover, dipstick and breather plug(s) that were removed to permit application of the VPI.
- f. Seal off breathing passages by wrapping the flexible couplings and open ends of hollow shafts with VPI treated paper and waterproof tape. Add a tablespoon of the VPI product defined in Table 16 to the hollow quill shaft cavities before sealing up with VPI paper and tape.

TABLE 16 APPROVED VAPOR PHASE INHIBITOR PRODUCT	
MANUFACTURER	PRODUCT
DAUBERT CHEMICAL CO. CHICAGO, IL	NOX RUST VCI NO. 10

- g. The factory provided coating on exposed steel surfaces is RustGard or equivalent rust preventative. Check all steel surfaces to determine the integrity of this coating. If it is damaged or disturbed, clean the surfaces with kerosene or a

similar solvent, allow them to dry thoroughly and recoat completely with RustGard or equivalent. It can be applied with a brush or sprayed on.

- h. Refer to electric motor maintenance instructions furnished with this manual for further details on represervation of the electric motor.
- i. Check the seal cartridge lubricant and add more lubricant if necessary to top off the seal chamber. Review the seal maintenance instructions for further details.

7.4 STORAGE OF DEACTIVATED MIXERS

Under normal circumstances mixers that have been in service, but will be idle less than 3 months, must be run for at least 15 minutes every week, to redistribute oil and grease, and receive regular maintenance. If this procedure is followed carefully, such mixers do not require represervation.

If an inactive mixer will be subjected to conditions of very high humidity, extreme temperature fluctuations, or other potentially harmful environmental conditions, the mixer should be preserved as described below.

Inactive mixers subjected to potentially harmful environmental conditions as described above and all mixers that will be inactive for more than 3 months should be preserved as follows:

- a. Drain the oil from the gear drive and replace the drain plug. This oil should be conditioned for reuse OR discarded.
- b. Remove the dipstick and breather assembly. Store the breather in a safe place. Tape the dipstick tight against the housing with waterproof tape.
- c. The interior of the mixer must be treated with a Vapor Phase Inhibitor (VPI) product to retard corrosion. Approved products are listed in Table 17. Use only approved VPI products. Distribute the required quantity of the VPI product through the dipstick and breather openings (remove inspection plate for better access, if required), directing the product to all corners for maximum coverage. With an assembled mixer, the liquid products are generally the easiest to apply, through the use of a fine mist sprayer, and are strongly recommended.

TABLE 17 REQUIRED QUANTITY OF VPI PRODUCT	
MIXER SIZE	DAUBERT NOX RUST (FLUID OZ.)
71 OR 81	4
72 OR 82	
73 OR 83	8
74 OR 84	12
75 OR 85	16
76 OR 86	20
77 OR 87	

- d. Seal the breather and dipstick openings with solid plugs. Replace the inspection port cover, if it was removed to facilitate application of the VPI.
- e. Cover mixers stored outdoors with waterproof covering, allowing for free air circulation.
- f. Visually inspect the drive and perform the following represervation steps every 4 months:
 - 1. Add fresh grease to all regreaseable bearings in accordance with the instructions provided in Section 6.8 of these instructions.
 - 2. Add additional VPI as outlined in Step c, above.
- g. Refer to the electric motor maintenance instructions furnished with this manual for further details on represervation of the electric motor.
- h. Check the seal cartridge lubricant and add more lubricant if necessary to top off the seal chamber. Review the seal maintenance instructions for further details.

7.5 START-UP PREPARATION

When a mixer is removed from storage, the start up instructions defined in Section 4 of these instructions should be followed in order to place the mixer back in service.

SECTION 8 - BOLT TIGHTENING TORQUE RECOMMENDATIONS

- 8.1 Recommended torques for tightening metric bolts and screws on **LIGHTNIN** Mixers and Aerators and their mounting structures are listed in table below for your general reference. These average torque values should be considered only as guides and not as absolute values.

The amount of torque required to maintain a tight connection can vary considerably for bolts of the same size under different operating conditions. Variations such as basic joint design, compression factors, type and strength of base and hardware material, surface finish of mating parts and lubrication are only some of the factors that influence the tightness of bolted connections for given bolt torques.

UNLESS SPECIFICALLY LISTED ELSEWHERE IN THE DETAILED INSTRUCTIONS, TIGHTEN THE MIXER AND MOUNTING HARDWARE TO THE RECOMMENDED VALUES SHOWN IN TABLE. A torque wrench must be used to ensure compliance with these torque requirements.

Certain assembly connections may require special torques that are not listed in table below. These torques can be found in the detailed assembly and disassembly sections of your manual. **REVIEW YOUR MANUAL CAREFULLY TO DETERMINE WHERE SPECIAL TORQUES ARE REQUIRED.**

For severe duty service, torques higher than listed, to tighten a bolt to maximum capacity, can often be used. However, due to the many variables previously mentioned, the only absolute method to determine optimum torque is to deliberately yield a bolt under actual conditions. If a bolt does yield or shear, 75% of the torque applied in yielding the bolt can be used to obtain a tight connection that is satisfactory.

ALL BOLTS SHOULD BE RETIGHTENED 12 HOURS AFTER ASSEMBLY, AND AT EACH SCHEDULED SHUT DOWN THEREAFTER.

RECOMMENDED TIGHTENING TORQUES FOR LIGHTNIN GRADE 5.6 & 8.8 STEEL, 304 & 316 STAINLESS STEEL HARDWARE (1) (2) (4)					
BOLT THREAD SIZE	Tightening Torque (ft-lbs) Grade 5.6 or 304/316 SS (5) Lubricated (4)	Tightening Torque (ft-lbs) Grade 8.8 Lubricated (4)	Tightening Torque (N-m) Grade 5.6 or 304/316 SS (5) Lubricated (4)	Tightening Torque (N-m) Grade 8.8 Lubricated (4)	ISO MARKING REFERENCE GUIDE (2)
M5	1.9	3.9	2.5	5.3	HEX HEAD CAP SCREWS
M6	3.2	6.6	4.3	8.9	
M7	5	11	7	15	
M8	8	16	10	22	
M10	15	32	21	43	
M12	27	55	36	75	
M14	42	88	57	119	HEX NUTS
M16	66	137	89	186	
M18	91	195 (3)	123	265 (3)	
M20	129	277	174	375	
M22	175	377	237	511	
M24	222	479	301	649	
M27	245 (3)	700	382 (3)	950	SOCKET HEAD CAP SCREWS
M30	332	951	450	1 290	
M33	452	1 294	618	1 755	
M36	581	1 662	787	2 254	
M39	752	2 151	1 019	2 917	
M42	930	2 661	1 261	3 608	

(1) ALL BOLTS SHOULD BE COATED WITH OIL, GREASE OR AN ANTI-SEIZE COMPOUND WHENEVER POSSIBLE. THE THREADS AND BEARING FACE OF BOLT HEADS AND/OR NUTS SHOULD BE LUBRICATED.

(2) TORQUE VALUES SHOWN SUPERSEDE PREVIOUS TABLES THAT MAY HAVE ALLOWED LOWER VALUES. IT IS RECOMMENDED THAT ONLY FASTENERS BE USED THAT ARE PROPERLY MARKED, INCLUDING MANUFACTURER'S TRADE MARKING. ONLY FASTENERS MARKED AS SHOWN ARE GUARANTEED TO MEET SPECIFICATION AND PERFORMANCE REQUIREMENTS.

(3) ALLOWABLE BOLT STRESS VALUES CHANGE AT THESE LOCATIONS AND IS REFLECTED IN THE SUGGESTED TORQUE VALUES.

(4) **CONVERSION FACTORS:**

DRY VALUES MULTIPLY LUBRICATED VALUE BY 1.33.

METRIC VALUES IN N-m 1FT-LB = 1.3558 N-m

(5) TORQUE VALUES ARE BASED ON THE LOWER OF GRADE 5.6 STEEL OR STAINLESS STEEL:

A2/A4 CLASS 70 FOR BOLTS LESS THAN OR EQUAL TO M24

A2/A4 CLASS 50 FOR BOLTS LARGER THAN M24

8.2 Recommended torques for tightening ANSI standard bolts and screws are listed in table below for your general reference. These average torque values should be considered only as guides and not as absolute values.






The amount of torque required to maintain a tight connection can vary considerably for bolts of the same size under different operating conditions. Variations such as basic joint design, compression factors, type and strength of base and hardware material, surface finish of mating parts and lubrication are only some of the factors that influence the tightness of bolted connections for given bolt torques.

UNLESS SPECIFICALLY LISTED ELSEWHERE IN THE DETAILED INSTRUCTIONS, TIGHTEN THE MIXER AND MOUNTING HARDWARE TO THE RECOMMENDED VALUES SHOWN IN TABLE. A torque wrench must be used to ensure compliance with these torque requirements.

Certain assembly connections may require special torques that are not listed in table below. These torques can be found in the detailed assembly and disassembly sections of your manual. REVIEW YOUR MANUAL CAREFULLY TO DETERMINE WHERE SPECIAL TORQUES ARE REQUIRED.

For severe duty service, torques higher than listed, to tighten a bolt to maximum capacity, can often be used. However, due to the many variables previously mentioned, the only absolute method to determine optimum torque is to deliberately yield a bolt under actual conditions. If a bolt does yield or shear, 75% of the torque applied in yielding the bolt can be used to obtain a tight connection that is satisfactory.

ALL BOLTS SHOULD BE RETIGHTENED 12 HOURS AFTER ASSEMBLY, AND AT EACH SCHEDULED SHUT DOWN THEREAFTER.

RECOMMENDED TIGHTENING TORQUES FOR <i>LIGHTNIN</i> STEEL AND STAINLESS STEEL HARDWARE (1) (2) (4)					
BOLT THREAD SIZE	Tightening Torque (ft-lbs) Grade 5 STEEL (5) Lubricated (4)	Tightening Torque (ft-lbs) 304SS & 316SS (5) Lubricated (4)	Tightening Torque (N-m) Grade 5 STEEL (5) Lubricated (4)	Tightening Torque (N-m) 304SS & 316SS (5) Lubricated (4)	MARKING REFERENCE GUIDE (2)
1/4 - 20	7.2	5.1	10.0	6.9	
5/16 - 18	15	10	20	14	
3/8 - 16	26	19	35	25	
7/16 - 14	42	30	57	40	
1/2 - 13	64	45	87	61	 SAE Grade 5 Steel ASTM A449 Type 1
9/16-12	92	65	125	88	
5/8-11	128	90	173	122	
3/4-10	226	112 (3)	307	152 (3)	 SAE Grade 8 Steel
7/8 - 9	365	180	495	244	
1 - 8	547	270	742	366	
1-1/8 - 7	675 (3)	383	915 (3)	520	 All Socket Head Cap Screws SAE Grade 8
1-1/4 - 7	952	541	1 291	733	
1-3/8 - 6	1249	709	1 693	961	
1-1/2 - 6	1657	941	2 247	1 275	 304SS ASTM F593 Cold Worked
1-3/4 - 5	1600 (3)	640 (3)	2 169 (3)	868 (3)	
2 - 4-1/2	2406	962	3 262	1 304	
2-1/4 - 4-1/2	3519	1407	4 771	1 907	 316SS ASTM F593 Cold Worked
2-1/2 - 4	4813	1924	6 525	2 609	

(1) ALL BOLTS SHOULD BE COATED WITH OIL, GREASE OR AN ANTI-SEIZE COMPOUND WHENEVER POSSIBLE. THE THREADS AND BEARING FACE OF BOLT HEADS AND/OR NUTS SHOULD BE LUBRICATED.

(2) TORQUE VALUES SHOWN SUPERSEDE PREVIOUS TABLES THAT MAY HAVE ALLOWED LOWER VALUES. IT IS RECOMMENDED THAT ONLY FASTNERS BE USED THAT ARE PROPERLY MARKED, INCLUDING MANUFACTURER'S TRADE MARKING. ONLY FASTENERS MARKED AS SHOWN ARE GUARANTEED TO MEET SPECIFICATION AND PERFORMANCE REQUIREMENTS.

(3) ALLOWABLE BOLT STRESS VALUES CHANGE AT THESE LOCATIONS AND IS REFLECTED IN THE SUGGESTED TORQUE VALUES.

(4) **CONVERSION FACTORS:**

FRICTION LOCKING DEVICES MULTIPLY LUBRICATED VALUE BY 1.15. THESE TORQUES PERTAIN TO BOLTS OR NUTS WITH FRICTION LOCKING DEVICES SUCH AS NYLON PELLETS OR PATCHES, FIBER INSERTS OR UPSET THREADS.

DRY VALUES MULTIPLY LUBRICATED VALUE BY 1.33.

METRIC VALUES IN N-m 1FT-LB = 1.3558 N-m

(5) **APPLICABLE MATERIAL GRADES FOR SPECIFIED TORQUE VALUES:**

STEEL - SAE J429/J995 Grade 5 or higher, ASTM A449 Type 1

304SS - ASTM F593/F594C, F593/F594D - cold worked condition. Includes 1/4" through 1.5" hardware sizes.

316SS - ASTM F593/F594G, F593/F594H - cold worked condition. Includes 1/4" through 1.5" hardware sizes.

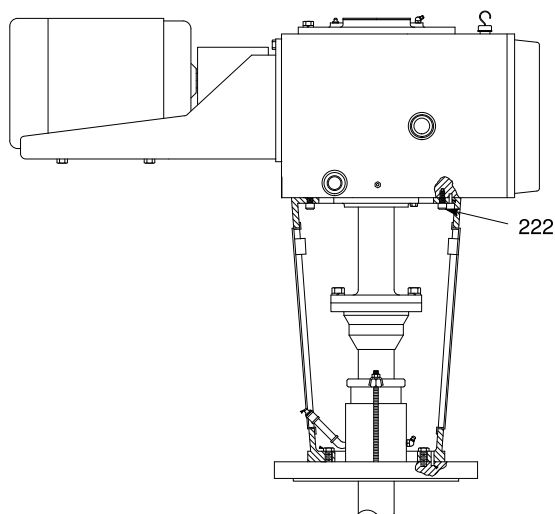
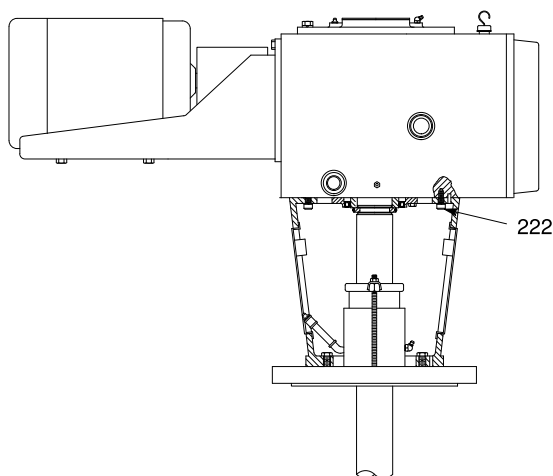
304SS & 316SS for sizes greater than 1.5" diameter are based on ASTM A276.

CRITICAL HARDWARE TORQUE VALUES FOR 70C SERIES MIXERS

Inadequate or improperly tightened hardware can loosen due to vibration, or the load reactions imposed by fluid forces. This can result in reduced service life, or damage and failure. Certain assembly connections may require either special torque values, or are critical to performance so that the torque values must be closely monitored.

Refer to the following itemized sketches and Table 1 for critical hardware location/size, and tighten the hardware to the torque values listed.

ALL BOLTS SHOULD BE RETIGHTENED 12 HOURS AFTER ASSEMBLY, AND AT EACH SCHEDULED SHUT DOWN THEREAFTER.



MODEL 71 THRU 77C

MIXER MODEL	ITEM NUMBER	BOLT THREAD SIZE	TIGHTENING TORQUE IN FT-LBS	BOLT TORQUE BASE VALUE (1)
71C	222	1/2-13	48	GRADE 2
72C		5/8-11	95	
73C		5/8-11	95	
74C		3/4-10	168	
75C		1"-8	244	
76C		3/4-10	168	
77C		3/4-10	168	

NOTE:

1. Grade 2 torque values are used to clamp mild steel items.

SHAFT MAINTENANCE INSTRUCTIONS FOR 70C MODELS

SECTION 1 – INSTALLATION OF SHAFT

- 1.1 70C Models with REMOVABLE COUPLING ABOVE STUFFING BOX are shipped with the upper shaft (117) installed and lower shaft (105) disassembled.
- 1.2 To install 70C lower shaft (105) with removable coupling (251), raise the shaft up through the stuffing box until the key (252), coupling (251), thrust plate (253) and cap screw/s (254) can be installed on the shouldered portion of the shaft. Tighten the cap screws (254) securely to the torque listed in Table 1. **CAUTION: This is a critical connection. It is essential that the cap screws (254) are tightened to the specific torque values listed in Table 1.** Couple the lower shaft (105) to the removable coupling (251) using care so as not to damage the coupling rabbets.

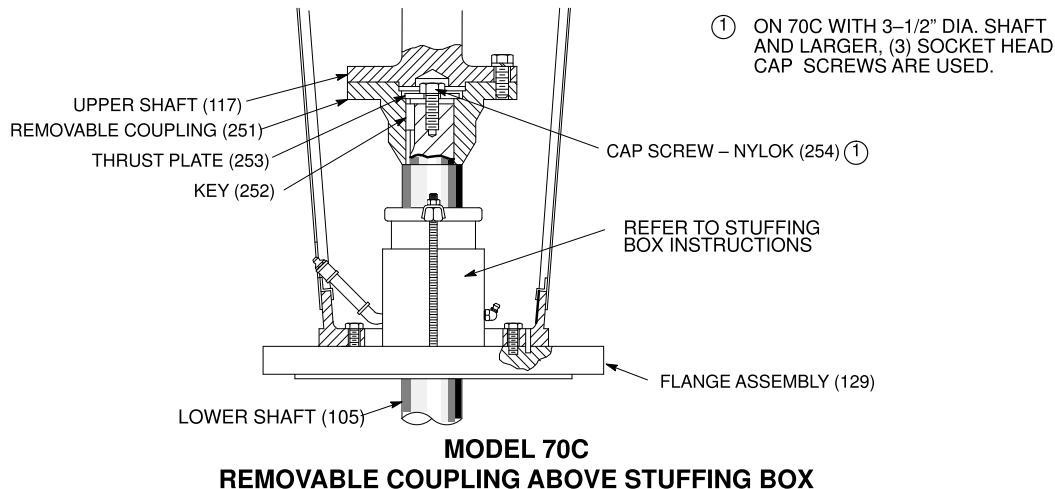


TABLE 1 Item 254 Cap Screw Tightening Torque		
Thread Size	Torque (FT-LBS.) – Grade 5 Hardware	
	Standard Cap Screw	With Friction Locking Device
5/8 – 11	128	147
3/4 – 10	226	260
1" – 8	547	629

TORQUE VALUES ARE FOR CAP SCREWS COATED WITH OIL, GREASE OR ANTI-SEIZE COMPOUND. COAT THREADS AND HEAD BEARING FACE WITH LUBRICANT.

- 1.3 70C models with one piece shaft are shipped with the shaft (117) disassembled from the unit.
- 1.4 The upper end of the shaft (117), split thrust ring (197), and inside of the tubular drive shaft (402) are covered with a high quality anti-seize lubricating compound.
- 1.5 Remove the coverplate (27), gasket (28), thrust plate (226) and the three (3) nylok cap screws (193).
- 1.6 Insert the key and pin assembly (191) in the shaft (117) keyway with the pin extending into the hole in the shaft. Place the retaining ring (196) on the packing gland and slide it over the end of the shaft as the shaft clears the stuffing box.

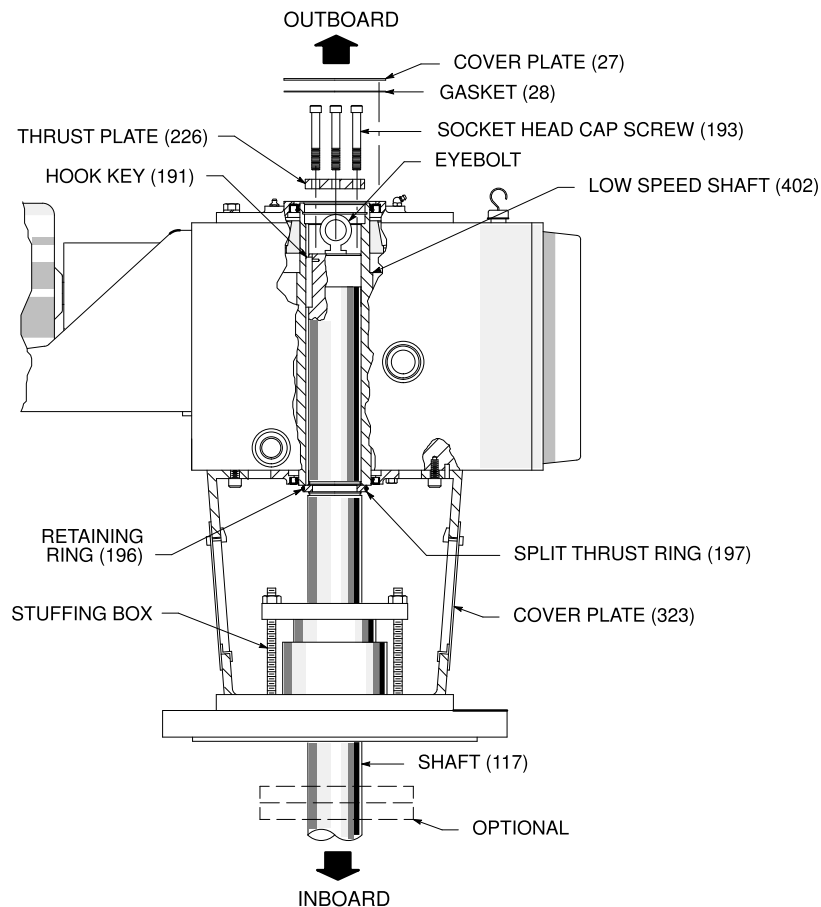
- 1.7 Install an eyebolt (see Table) in the center tapped hole of the shaft (117) and position the shaft under the gear drive. Use only a heavy-duty shouldered eyebolt. If the eyebolt shoulder will not seat against the shaft, use a spacer or jam nut to insure a tight connection.

We strongly recommend that either the eyebolt or hoist ring be of the safety swivel type with a 360° rotational capability.

EYEBOLT TABLE

Unit Size	Eyebolt Size	Working Load Capacity in Pounds
71 72	3/8-16	1400
73 74	1/2-13	2600
75 76	5/8-11	4000
77	3/4-10	6000

- 1.8 Position the shaft so that it is in the vertical position and ready to be inserted upward into the unit assembly.
- 1.9 Install split thrust ring (197) and retaining ring (196). (Not furnished on 70C models with optional coupling or removable coupling). Slide the retaining ring over the end of the shaft and install the thrust ring after the shaft clears the stuffing box.
- 1.10 Raise the shaft until the thrust ring (197) or shaft shoulder contacts the bottom of the low speed shaft (402).
- 1.11 Support the shaft in this position. A **brace** can be wedged between the bearing member and the thrust ring (197) or coupling half to support the shaft. This will allow for removal of the eyebolt and installation of the thrust plate (226) and socket head cap screws (193).
- 1.12 Lubricate the (193) cap screw threads and head bearing surfaces with a light oil or anti-seize lubricating compound.
- 1.13 Carefully take tension off the lifting device. CHECK RIGIDITY AND STABILITY OF THE "BRACING" before disconnecting the lifting device or removing the eyebolt from the shaft.



**MODEL 70C
ONE PIECE SHAFT AND OPTIONAL COUPLING**

- 1.14 Install the thrust plate (226) in the low speed shaft (402).
- 1.15 Insert socket head cap screws (193) and tighten them evenly, drawing the shaft up into position; then **TIGHTEN THE CAP SCREWS TO THE TORQUE LISTED IN THE TABLE BELOW.**

ITEM 193 CAP SCREW TIGHTENING TORQUE		
Unit Size	Thread Size	Torque Ft. Lbs.
71 thru 73	3/8-16	27
74	1/2-13	65
75 thru 77	5/8-11	125

Torque values are for cap screws coated with oil, grease or anti-seize compound. Coat threads and head bearing face with lubricant.

- 1.16 Install the packing – refer to Stuffing Box Instructions.
- 1.17 Replace the coverplate (27) and gasket (28).
- 1.18 Retighten the upper cap screws to the proper torque 12 hours after assembly, and at each scheduled shut down thereafter.

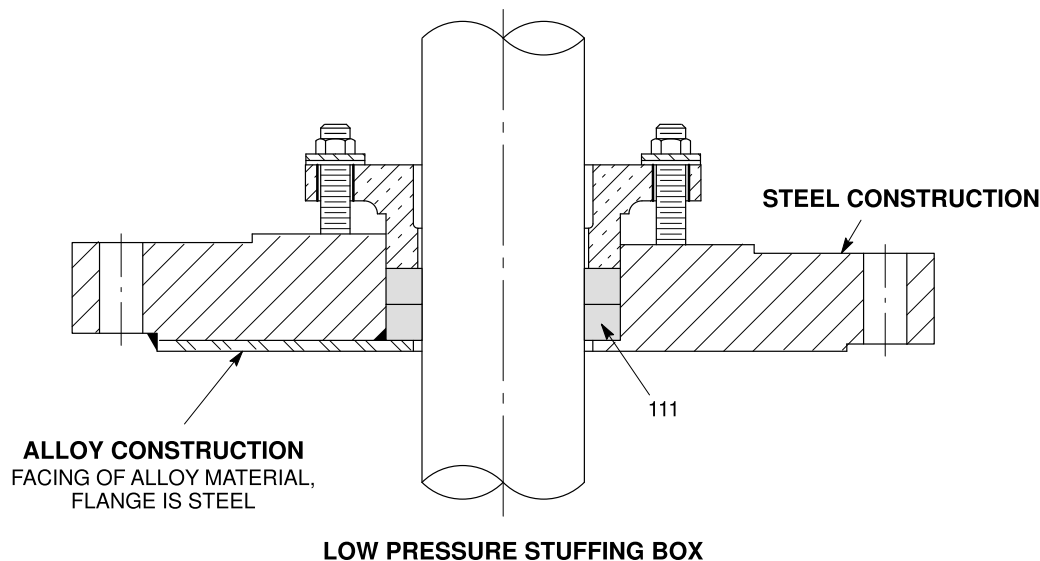
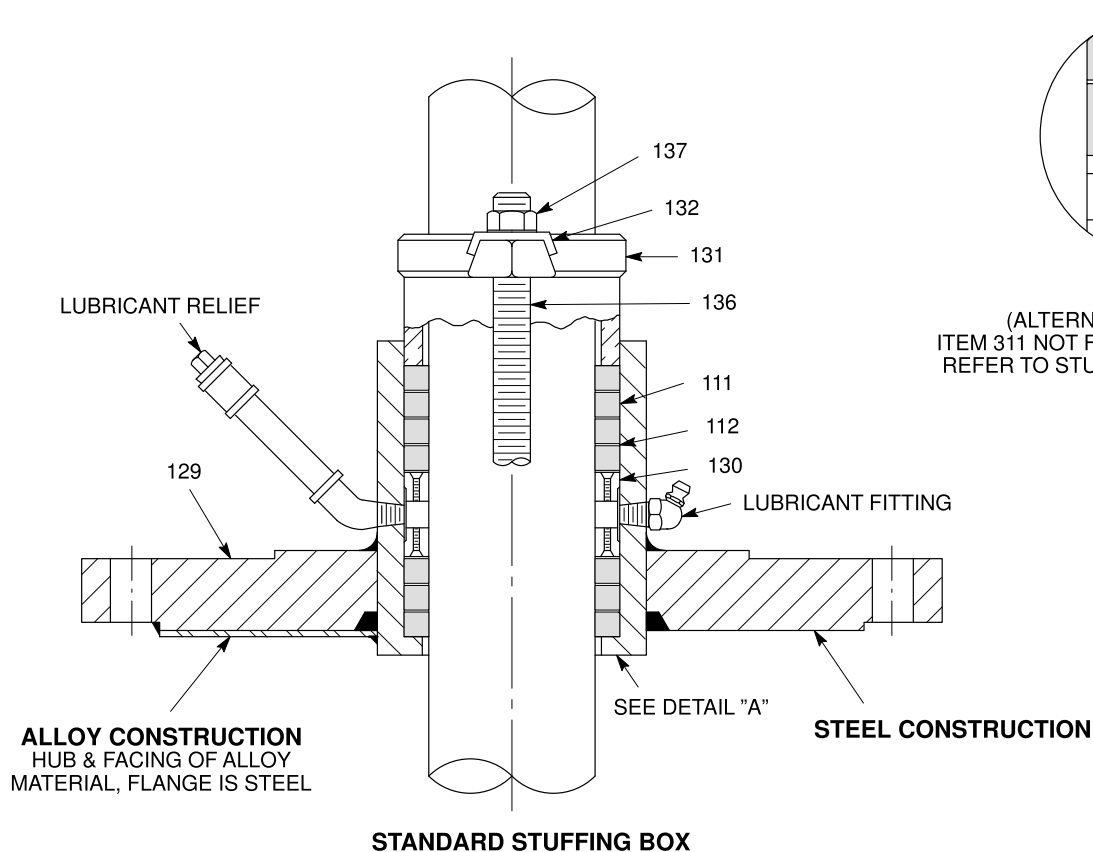
SECTION 2 – SHAFT REMOVAL

- 2.1 Remove the coverplates (27 and 322) and gasket (28).
- 2.2 For 70C models with REMOVABLE COUPLING ABOVE STUFFING BOX:
 - a . Loosen gland adjusting nuts (137).

- b . Remove the coupling hardware and move the lower shaft down until the removable coupling half rests on the packing gland (131).
 - c . Remove the lubricant relief line from the stuffing box hub.
 - d . Disconnect the lower bearing member (122) from the flange (129) and move the entire drive assembly away from the mounting flange.
- 2.3 For 70C models without removable coupling, unpack the stuffing box. Refer to Stuffing Box Instructions.
- 2.4 Support the unit shaft (117) so that it will not drop after it is disengaged from the 3 socket head cap screws (193). A brace can be wedged between the bottom of the bearing member and the thrust ring (197) or coupling half to support the shaft.
- 2.5 Remove the three (3) socket head cap screws (193).
- 2.6 Remove thrust plate (226).
- 2.7 Insert an eyebolt with the correct threads, per the eyebolt table, into the upper end of the shaft for use in supporting the shaft when it is being lowered out of the unit assembly.
- 2.8 Remove split thrust ring (197) and retaining ring (196). (Not furnished on 70C models with optional coupling or removable coupling).
- 2.9 Lower the shaft until it is free of the unit assembly and remove.
- A small amount of high quality anti-seize lubricating compound has been applied to the entire length of the inside diameter of the gear drive low speed shaft (402). It is recommended that this be repeated whenever the shaft (117) is replaced.
- 2.10 On 70C models with removable coupling (251), if the stuffing box is to be serviced, raise the removable coupling off the packing gland (131) to a point where the split packing gland (131) and split rings of packing (111) and separators (112) can be removed. Refer to the Stuffing Box Instructions for repacking the stuffing box.

SECTION 3 – REPLACING THE SHAFT

- 3.1 For 70C models without REMOVABLE COUPLING, install the shaft as outlined in Section 1, steps 1.5 thru 1.18.
- 3.2 For 70C models with REMOVABLE COUPLING ABOVE STUFFING BOX:
- a . Check the cap screws (254) and tighten securely to the torque listed in Table 1. **CAUTION: This is a critical connection. It is essential that the cap screws (254) are tightened to the specific torque values listed in Table 1.**
 - b . Replace the entire drive assembly and connect the lower bearing member (122) to the mounting flange (129).
 - c . Replace the lubricant relief line in the stuffing box.
 - d . Raise the lower shaft (105) and install the coupling hardware. Use care so as not to damage the coupling rabbets.
 - e . Readjust the packing gland (131) in accordance with the Stuffing Box Instructions in this booklet.



WHEN ORDERING PARTS, SPECIFY:
MACHINE SERIAL NO., ITEM NO.
AND DRAWING NO.

311	SPLIT RING
137	GLAND ADJUSTING NUT
136	GLAND STUD (2)
132	GLAND CLAMP (2)
131	PACKING GLAND
130	LANTERN RING
129	HUB & FLANGE ASSEMBLY
112	PACKING SEPARATORS
111	PACKING
ITEM	PART NAME



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LIGHTNIN

MIXERS AND AERATORS
ASSEMBLY DRAWING

STUFFING BOX FOR MODELS
70 & 80 SERIES
500 & 600 SERIES

DRAWING NO. L-16283C

STUFFING BOX INSTRUCTIONS

SECTION 1 – PACKING SPECIFICATIONS

- 1.1 A **LIGHTNIN**[®] standard packing and separator combination is furnished unless otherwise specified. The combination number (or special packing) is listed on the specification sheet. See Table 1 for **LIGHTNIN** combinations.

TABLE 1
STANDARD **LIGHTNIN**[®] PACKING COMBINATIONS

COMBINATION NUMBER	PACKING TYPE	SEPARATOR TYPE	MAX. TEMP. ° F
40	INTERLACE BRAID BLEACHED MULTI-FILAMENT TEFLON YARN IMPREGNATED WITH TEFLON DISPERSION PH RANGE 0-14	NON-STICK HIGH STRENGTH VIRGIN TEFLON	500
50	INTERLACE BRAID SPECIAL HIGH TENSILE STRENGTH ARAMID FIBER IMPREGNATED WITH TEFLON DISPERSION AND A SPECIAL HIGH TEMPERATURE LUBRICANT PH RANGE 3-12	NON-STICK HIGH STRENGTH VIRGIN TEFLON	500
60	SPECIAL INTERLACE BRAID PTFE YARN IMPREGNATED WITH A SPECIAL FDA APPROVED LUBRICANT FOR FOOD SERVICE, EDIBLE OILS AND FATS PH RANGE 3-10	NON-STICK HIGH STRENGTH VIRGIN TEFLON	500

- 1.2 Most units are shipped with the stuffing box components installed. If the packing and separators are not installed at our factory, a separate package containing the stuffing box components will be attached to the unit.
- 1.3 If the packing is not suitable for the service conditions, it should be replaced.

SECTION 2 – INSTALLATION OF PACKING

- 2.1 Remove bearing member coverplates.
- 2.2 Remove gland adjustment nuts (137), gland clamps (132) and packing gland halves (131).
- 2.3 Standard Stuffing Box (see Figure 1)
- The packing is not lubricated because of the danger of using a lubricant that could contaminate the product. Thoroughly coat all surfaces of the packing rings (111), separators (112) and lantern ring (130) with a product compatible lubricant. Teflon lantern rings are standard for applications up to 300° F. Over 300° F, lantern ring is metal.
- 2.4 Insert packing, separators, split lantern ring and split ring (if furnished) in the EXACT order shown on the Stuffing Box assembly drawing.
- 2.5 Install each packing ring and separator with their joints staggered 90 degrees and carefully seat each packing ring by firm even tamping on the separator above each packing ring with a piece of split pipe. Make sure a separator is placed on either side of the lantern ring.
- 2.6 Install packing gland (131), clamps (132) and adjustment nuts (137). Lubricate and seal the packing as outlined in Sections 3 and 4.

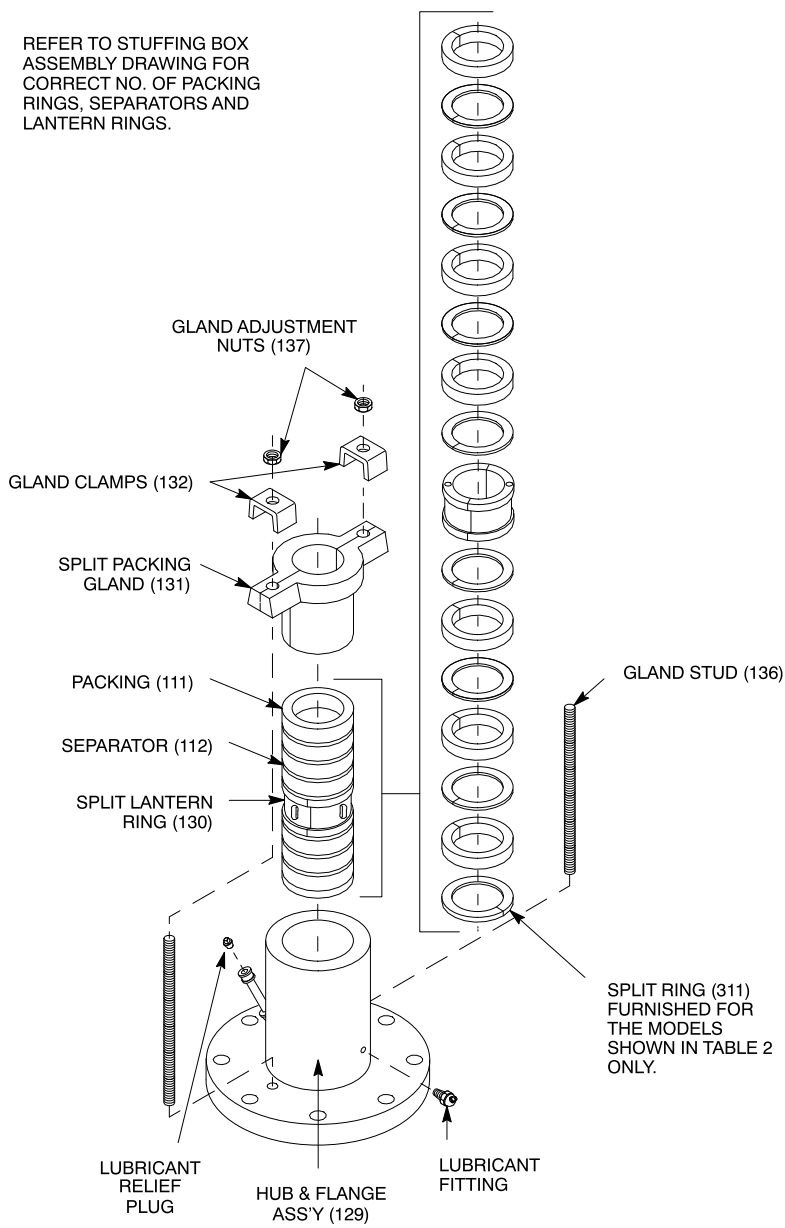


FIGURE 1 – STANDARD STUFFING BOX CONSTRUCTION

2.7 Low Pressure Stuffing Box (see Figure 2)

This stuffing box (10 PSIG MAX.) consists of 2 rings of packing and gland components only. No separators or lantern rings are furnished. The low pressure packing rings have been impregnated with lubricant. No additional lubricant is necessary.

2.8 Seat the packing rings as outlined in Section 4.

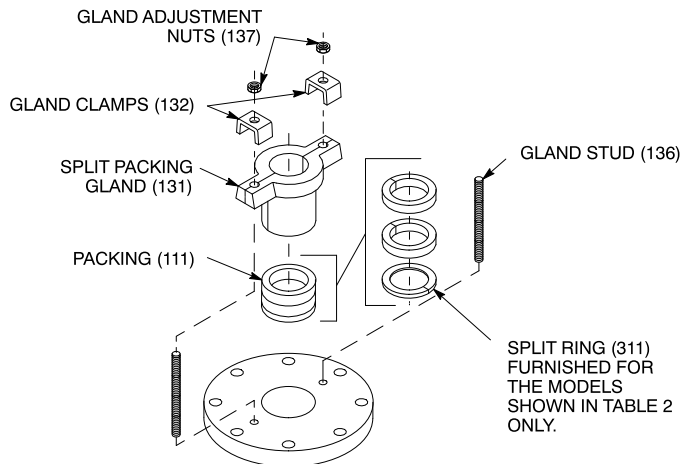


FIGURE 2 – ALTERNATE LOW PRESSURE CONSTRUCTION

SECTION 3 – LUBRICATION

- 3.1 The unit is shipped without lubricant in the Stuffing Box because of the danger of using a lubricant that may contaminate the product. **LUBRICATE THE STUFFING BOX BEFORE SEATING THE PACKING.** Use only a high quality lubricant physically and chemically suitable for the service conditions and compatible with the product.
- 3.2 For good stuffing box performance and proper lubrication of the packing, it is desirable to supply the lubricant continuously at a constant pressure of approximately 5 lbs. per square inch higher than that in the vessel. For continuous constant pressure lubrication, the "**LIGHTNIN** Weight Loaded Lubricator" is recommended. In the event this is not possible, careful lubrication at proper intervals will give satisfactory results.
- 3.3 For intermittent lubrication, remove lubricant relief plug, and when the lubricant begins to show at the relief hole, replace the plug. Apply an additional amount of lubricant to insure spreading throughout the stuffing box.
- 3.4 If the stuffing box has a water jacket, circulate water throughout the jacket continuously while in operation.

SECTION 4 – SEATING THE PACKING

- 4.1 Tighten the gland adjusting nuts firmly and evenly to initially seat the packing.
- 4.2 Back off the adjusting nuts and re-seat fingertight. DO NOT adjust further until the unit is started up.
- 4.3 Adjust the packing by "running in".
 - a . Tighten each gland nut 1/4 to 1/2 turn every 10 minutes or so until the box is hot to the touch. Stop the unit.
 - b . While the packing is still soft and hot, compress the packing into the box by even tightening of the gland nuts.
 - c . Let stand at least 10 – 15 minutes to allow the packing to adjust and conform under heat and pressure.
 - d . Loosen the gland nuts and then tighten finger tight only. Check for even gland force by measuring the distance from the stuffing box hub to the underside of the gland shoulder.
- 4.4 Ideally, the packing takes up all the room between the inside diameter of the stuffing box hub and the outside diameter of the shaft. It should be packed in good and tight, but still allow the shaft to turn easily. If the packing is packed too loose, it will not seal well. On the other hand, if it is packed too tight, excess friction will be detrimental to the packing and the shaft.
- 4.5 As the shaft turns, there is a tendency for the shaft to deflect or run out. The shaft pushes against the inside diameter of the packing, tending to increase the clearance between the shaft and the packing. On the other hand, tightening the gland nuts pushes the gland against the end of the packing and this tends to decrease the clearance between the shaft and packing inside diameter.
- 4.6 Adjust the packing as required during operating cycles to minimize shaft runout and/or leakage. DO NOT OVERTIGHTEN. We suggest that the gland nuts be tightened no more than 1/4 to 1/2 turn at each adjustment. However, experience with each individual application must dictate the amount and frequency of adjustment and/or replacement of packing rings.

SECTION 5 – REPACKING STUFFING BOX

- 5.1 Remove packing rings and separators using corkscrew packing pullers.
- 5.2 Remove the split lantern ring (130);
 - a . Teflon lantern ring halves can be removed by inserting packing hooks in the notches on the O.D. of each ring half.
 - b . Metal lantern rings (when furnished) are removed by inserting lantern ring puller screws into piloted and tapped (#8–32) holes in the split lantern ring (130) and removing the ring halves.
- 5.3 Remove the lower rings of packing and separators.
- 5.4 Remove the split ring (311) if necessary. (Furnished only with models shown in Table 2.)
 - a . Remove glass filled Teflon rings with a corkscrew packing puller.
 - b . Alloy rings can be removed with a wire hook.
- 5.5 Thoroughly clean the shaft and stuffing box. Flush out any old lubricant. Check the shaft surface for damage. If the shaft is damaged, do not repack the stuffing box until the shaft surface is repaired. Be sure the shaft and stuffing box are in alignment.
- 5.6 Die-molded rings of packing are recommended for the stuffing box. If die-molded packing is not used, cut coil packing to exact length so that the ends meet with no gap or overlap.
- 5.7 Repack the stuffing box, lubricate and seat the packing in accordance with the procedures outlined in Sections 2 and 4.

TABLE 2 – MODELS WITH SPLIT RING (311) ▲

UNIT SIZE ●	72 & 82	73 & 83	74 & 84	75 & 85	76 & 86	77 & 87	780 & 880	781 & 881	782 & 882
Shaft Dia. thru Stuffing Box	2	2	2-1/2	3	3-1/2	4	4-1/2	5	5-1/2

- ▲ THE SPLIT RING (ITEM 311) STANDARD MATERIAL IS GLASS FILLED TEFLON. IF OPERATING TEMPERATURE IS OVER 450° F, THE MATERIAL WILL BE THE SAME AS THE IN-TANK WETTED PARTS.
- SPLIT RING (311) NOT FURNISHED WHEN UNIT IS CONSTRUCTED WITH REMOVABLE COUPLING ABOVE BOX. REFER TO MIXER ASSEMBLY DRAWING.

STUFFING BOX PERFORMANCE

(Knowledgeable attention, at regular intervals, makes the difference)

SECTION 1 – LUBRICATION

- 1.1 A stuffing box should always be well lubricated. If you are using a continuous lubrication method, such as the weight loaded lubricator or the spring loaded lubricator, be sure to keep a regular check on the lubricant. If you are using the intermittent grease gun method, be sure to remove the relief plug before greasing. For most applications, the stuffing box should be regreased once every 24 hours. Some specific applications will require more, or less frequent schedules.
- 1.2 On side entering units, or on bottom entering units, the stuffing box is below the liquid level in the tank. It is, therefore, important that the lubricant be as insoluble as possible in the liquid being mixed, to reduce the chances of the lubricant being washed out or thinned out. The more soluble the lubricant is, the more frequently the lubricant will be used up and the more frequently lubricant will have to be added.

SECTION 2 – SEATING THE PACKING

- 2.1 Ideally, the packing takes up all the room between the inside diameter of the stuffing box hub and the outside diameter of the shaft. It should be packed in good and tight, but still allow the shaft to turn easily. If the packing is packed too loose, it will not seal well. On the other hand, if packed too tight, excess friction will be detrimental to the packing, the lubricant, and the shaft.
- 2.2 There are two ways of seating the packing. One way obviously consists of merely pushing each ring of packing in as tight and firm as you can by hand, as you pack the box. This method is common on top entering mixers, where leakage is not critical. (Homemade tamping tools are common. They are made out of a piece of a half round of pipe or tubing that will fit in between the box and the shaft. You can push down on each ring of packing by hitting or tamping from outside the box.)
- 2.3 After the packing is installed, the packing can be seated further by "running in". This procedure is simply a way of heating up the packing and compressing it uniformly in place. It takes time, but will result in vastly improved performance. This procedure is used most often where liquid is being sealed or when leakage is critical. It is considered good, common practice.

SECTION 3 – PROCEDURE FOR SEATING THE PACKING BY "RUNNING IN"

- 3.1 Make sure gland nuts are only finger tight, then turn on the mixer.
- 3.2 Tighten the gland nuts about 1/4 to 1/2 turn every 10 minutes or so, until the box is hot to the touch. (NOTE: Never really bear down on the gland nuts while the unit is running, because this can cause damage to the shaft, the packing and the lubricant.)
- 3.3 Stop the unit. Immediately, while the packing is still hot and soft, seat the packing by jamming the packing down in the box by tightening on the gland nuts.
- 3.4 Let it all just sit there for at least 10 to 15 minutes. This gives the packing a chance to adjust and conform under heat and pressure.
- 3.5 Loosen up the gland nuts until they are only finger tight. The packing has now been "run in", and seated, once. "Once" is enough for most applications of 150 PSI or less. For higher pressures or for very critical applications, repeated "run in and seating" operations can be worthwhile.

SECTION 4 – KEEPING THE PACKING SEATED

- 4.1 The shaft turns, and when it does, there is a tendency for the shaft to deflect or wiggle or run out. The shaft pushes against the inside diameter of the packing, tending to increase the clearance between the shaft and the packing. On the other hand, tightening the gland nuts pushes the gland against the end of the packing and this tends to decrease the clearance between the shaft and the packing inside diameter.
- 4.2 Tightening the gland nuts, by the right amount, every other minute, would completely nullify the run out action of the shafts and keep the stuffing box in tip-top shape. However, "every other minute" is not practical or necessary. The problem, of course, is to know just how much to tighten the nuts, and how often. The answer varies from job to job because of the many variable, such as shaft diameter, shaft speed, pressure, temperature, type of lubricant, type of packing, etc.

- 4.3 If you have no experience to go by, we would suggest a 1/4 to 1/2 turn on the gland nuts every 24 hours. For the first week, stop by at more frequent intervals to see how the box is doing, and revise the amount of turns and/or the scheduled frequency, if and as required.

SECTION 5 – WHAT IF IT LEAKS?

- 5.1 If sometime you find the box leaking unacceptably and it must be corrected in a short amount of time, the natural impulse is to quickly overtighten the gland nuts. While this might temporarily seal off the leak, IT CAN CAUSE PERMANENT DAMAGE to the shaft and packing and it is not recommended. Instead, we recommend stopping the mixer and reseating the packing by tightening down hard on the gland nuts. BE SURE TO LOOSEN THE NUTS TO FINGER TIGHT BEFORE TURNING THE MIXER ON AGAIN.
- 5.2 However, if the mixer cannot be stopped, or if the packing is not hot enough to seat, we recommend taking a 1/4 to 1/2 turn every 10 minutes or so, until the leak is eliminated or reduced to an acceptable level. If the packing has now become hot enough and if the machine can be turned off, consider reseating the packing.

INSTALLATION OF A510 AND A510E AXIAL FLOW IMPELLER ONE PIECE HUB WELDED TO IMPELLER SHAFT BOLTED ON BLADES

SECTION 1 – GENERAL

- 1.1 Refer to the appropriate table for the minimum diameter opening that the impeller will pass through. Opening shown is based on disassembled impellers with the hub on the shaft.
- 1.2 A510 type impellers are shipped disassembled for ease of shipment and handling at the job site. Refer to Section 2 for impeller assembly guides.

SECTION 2 – IMPELLER ASSEMBLY

- 2.1 Mate the three blades (convex side up) on the hub ears. If fins (168) are furnished, mount them before installing hex nuts (167).

WARNING: Before securing the hardware, apply pressure to the blade so that its edge is firmly seated against the raised shoulder on each hub ear. After tightening hardware, check to make sure that the blade has not shifted away from the hub ear shoulder. PROPER BLADE POSITIONING IS IMPORTANT TO IMPELLER FUNCTION.

- 2.2 **IT IS ESSENTIAL** that the hardware securing the blades to the hub is tightened to the specific torques in Table 1. It is important that tight connections are maintained as impellers are usually subjected to a wide range of adverse loading conditions imposed by fluid force reactions.
- 2.3 It is good practice to **RETIGHTEN** all bolted connections after the equipment has been in operation. It is recommended that all hardware be checked for tightness 12 hours after assembly, and at each scheduled shut down thereafter.

TABLE 1 – IMPELLER TIGHTENING TORQUES

BOLT THREAD SIZE	TORQUE (FT-LBS)	
	GRADE 2, 3 OR 304 / 316 SS BOLTS	GRADE 5 BOLTS
3/8-16	17	26
1/2-13	41	64
5/8-11	83	128
3/4-10	120	226
7/8-9 (1)	142	365
1-8	212	547
1-1/8-7	301	675
1-1/4-7	425	952

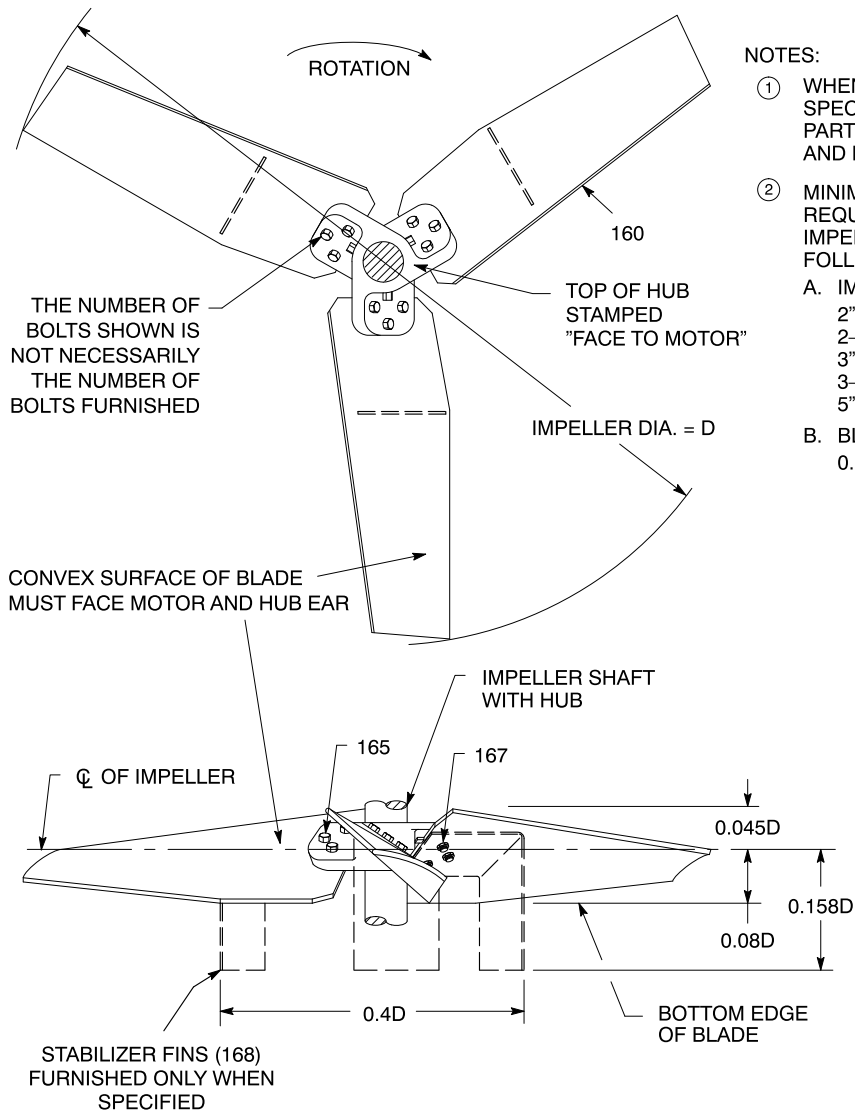
Torque must be applied to the hex nuts. Restrain the bolt heads and tighten the hex nuts.

Torque values are based on hardware, threads and bearing surfaces lubricated with a light oil.

LIGHTNIN standard steel material is SAE Grade 5.

(1) Allowable bolt stress values change at these locations and this is reflected in the torque values.

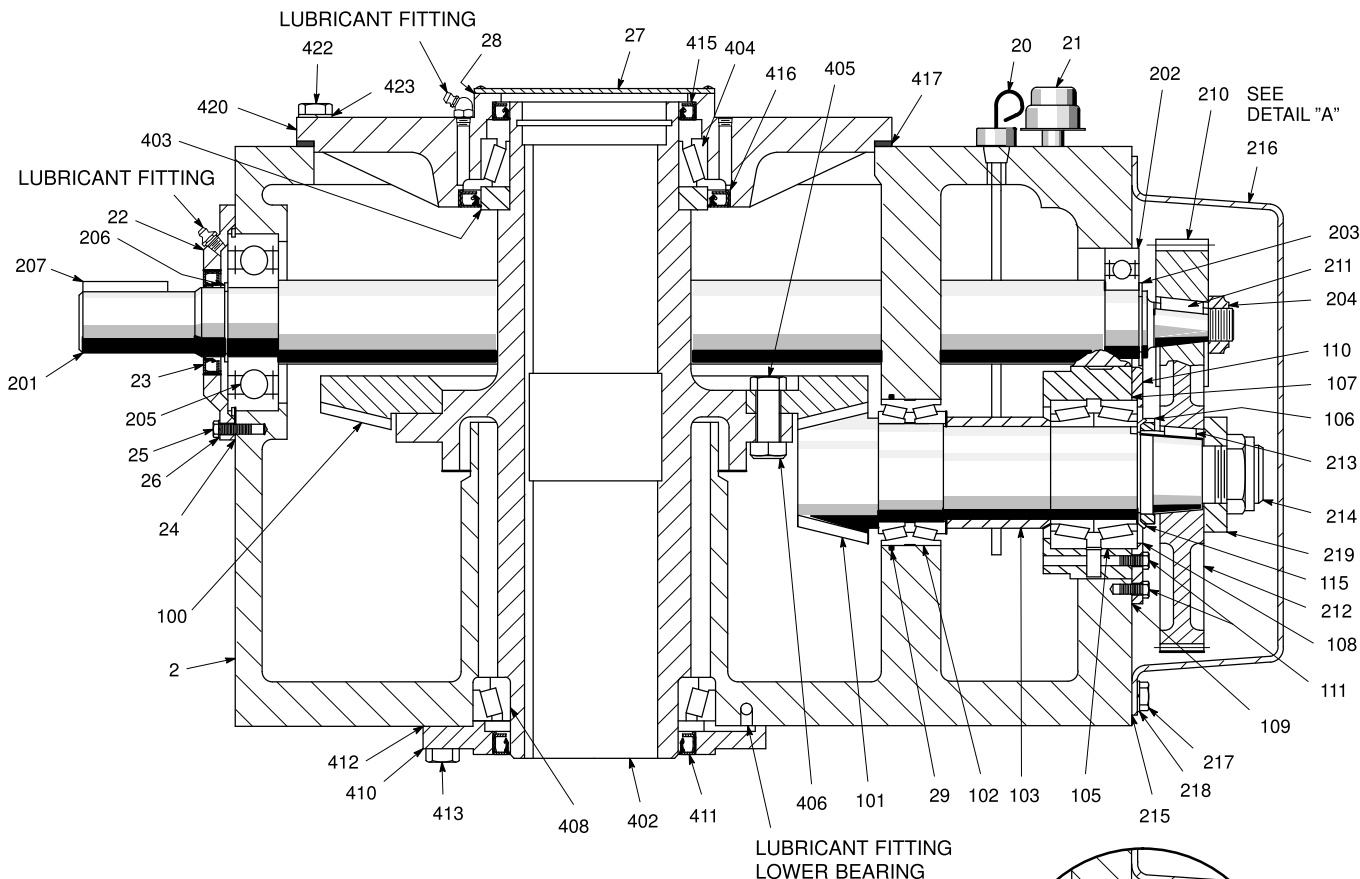
FIGURE 1 – A510 AND A510E AXIAL FLOW IMPELLER
ONE PIECE HUB WELDED TO IMPELLER SHAFT
BOLTED ON BLADES



NOTES:

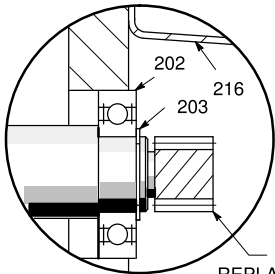
- ① WHEN ORDERING PARTS, SPECIFY DRAWING NUMBER, PART NAME, ITEM NUMBER, AND MACHINE SERIAL NUMBER
- ② MINIMUM DIAMETER OPENING REQUIRED TO PASS DISASSEMBLED IMPELLER IS THE LARGER OF THE FOLLOWING:
 - A. IMPELLER SHAFT WITH HUB:
 2" SHAFT – 9" DIA.
 2-1/2" SHAFT – 13" DIA.
 3" SHAFT – 15" DIA.
 3-1/2" THRU 4-1/2" SHAFT – 17" DIA.
 5" & 5-1/2" SHAFT – 20" DIA.
 - B. BLADE (160) OFF HUB:
 0.165D

168	STABILIZER FIN
167	HEX NUT
165	HEX HD. CAP SCREW
160	BLADE
ITEM	PART NAME



NOTES:

- ITEMS 100 & 101, BEVEL GEAR AND PINION ARE AVAILABLE IN MATCHED SETS ONLY. NOT SOLD SEPARATELY.
- ITEMS 210 & 212, HELICAL PINION AND GEAR ARE AVAILABLE IN MATCHED SETS ONLY. NOT SOLD SEPARATELY.
- WHEN ORDERING PARTS, SPECIFY: MODEL & SERIAL NUMBER, ITEM NUMBER AND DRAWING NO.



DETAIL "A"

MODEL 77 TOTAL RATIOS 25.4, 30.7 AND 38.1 ONLY.
MODEL 78 TOTAL RATIOS 25.9, 30.6 AND 38.1 ONLY.



CERTIFIED

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LIGHTNIN

MIXERS AND AERATORS
ASSEMBLY DRAWING

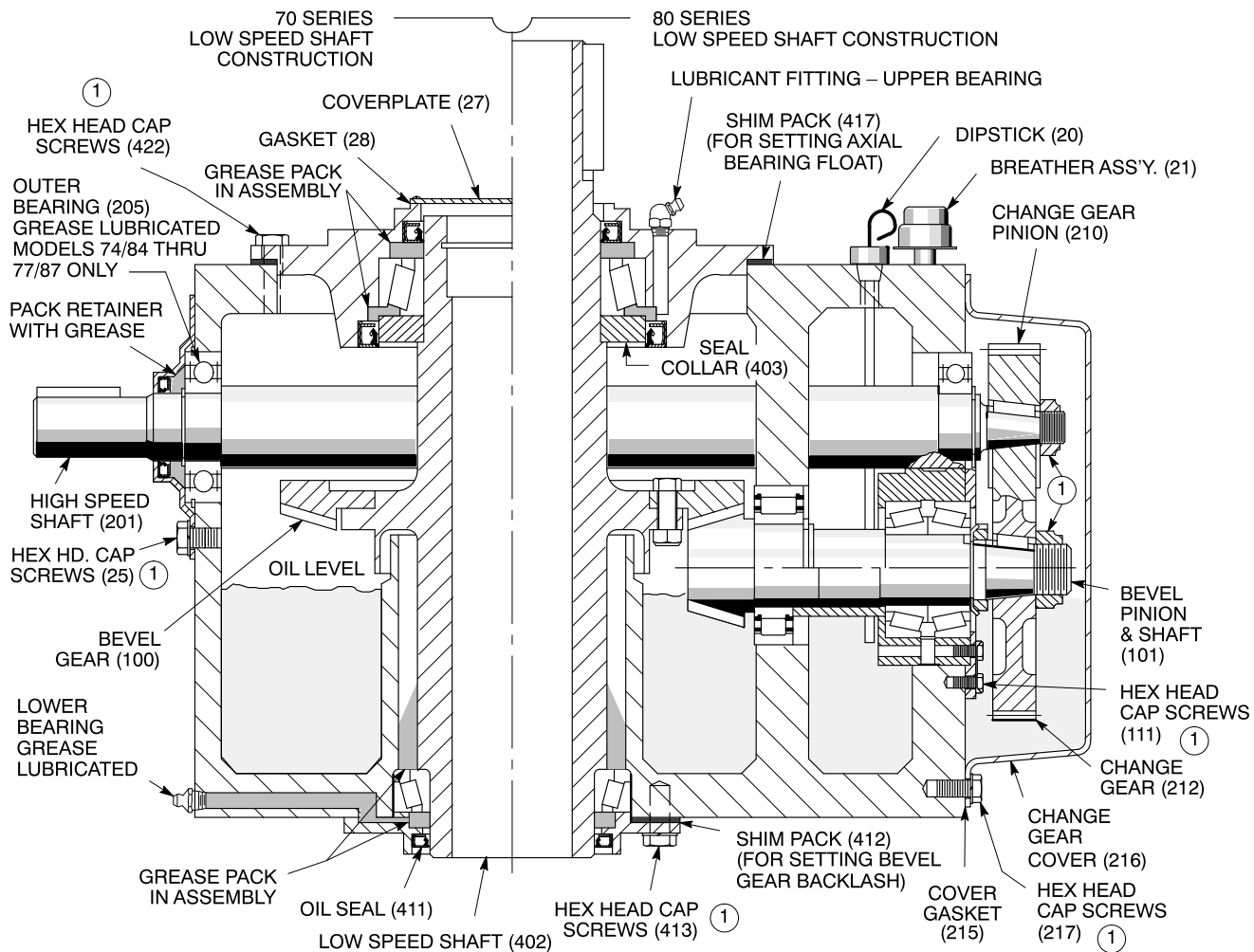
**MODEL 77 & 78
GEAR DRIVE**

DOUBLE REDUCTION

206	RETAINING RING	423	LOCKWASHER
205	OUTER BEARING	422	HEX HEAD CAP SCREW
204	LOCKNUT – CHANGE GEAR PINION	420	LOW SPEED BEARING CAGE
203	RETAINING RING	417	SHIM PACK – LOW SPEED BRG. CAGE
202	INNER BEARING	416	OIL SEAL – INNER
201	HIGH SPEED SHAFT	415	OIL SEAL – OUTER
115	SPACER – MODEL 78 ONLY	413	HEX HEAD CAP SCREW – NYLOK
111	HEX HEAD CAP SCREW – NYLOK	412	SHIM PACK – LOW SPEED RETAINER
110	RETAINER	411	OIL SEAL – LOWER
109	SHIM PACK – BEVEL PINION ADJUST.	410	LOW SPEED RETAINER
108	SHIM PACK – BEARING ADJUSTMENT	408	LOWER BEARING
107	BEARING CAGE – BEVEL PINION	406	LOCKNUT
106	LOCKNUT & WASHER	405	HEX HEAD CAP SCREW
105	OUTER BEARING	404	UPPER BEARING
103	SPACER	403	COLLAR
102	INNER BEARING	402	LOW SPEED SHAFT
101	BEVEL PINION ①	219	KEEPER PLATE – MODEL 78 ONLY
100	BEVEL GEAR ①	218	LOCKWASHER
29	O-RING	217	HEX HEAD CAP SCREW
28	GASKET – COVERPLATE	216	CHANGE GEAR COVER
27	COVERPLATE	215	GASKET – CHANGE GEAR COVER
26	LOCKWASHER	214	LOCKNUT – CHANGE GEAR
25	HEX HEAD CAP SCREW	213	KEY – CHANGE GEAR ②
24	GASKET – H.S. SEAL CAGE	212	CHANGE GEAR
23	OIL SEAL	211	KEY – CHANGE GEAR PINION
22	HIGH SPEED SEAL CAGE	210	CHANGE GEAR PINION ②
21	BREATHER	209	CHANGE GEAR PINION AND SHAFT
20	OIL DIPSTICK	207	KEY – HIGH SPEED SHAFT
2	HOUSING		
ITEM	PART NAME	ITEM	PART NAME

GEAR DRIVE MAINTENANCE INSTRUCTIONS

70 & 80 SERIES MODELS – UNIT SIZES 2 THRU 7



NOTE (1) SEE TABLES 4 & 5 FOR TIGHTENING TORQUES

**FIGURE 1 – TYPICAL DOUBLE REDUCTION
UNIT SIZE 2 THRU 6 GEAR DRIVE ILLUSTRATED**

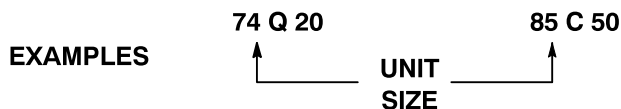
SECTION 1 – GENERAL

WARNING: EYE PROTECTION MUST BE WORN AT ALL TIMES WHILE SERVICING THIS MIXER.

WARNING: DISCONNECT MOTOR LEADS OR OTHERWISE LOCK-OUT POWER SUPPLY BEFORE SERVICING THIS MIXER.

1.1 Model 70 & 80 Series Gear Drives are precision manufactured and assembled to provide long trouble-free service when properly maintained. If it becomes necessary to disassemble the unit, careful precise re-assembly is necessary.

- 1.2 These gear drives are available in 2 series, Models 72 thru 77 and 82 thru 87. The unit size referred to in the instructions that follow can be identified by the second digit in the model number.



- 1.3 Equipment that may be required to service a unit, in addition to standard mechanics tools, are hoists, slings, arbor press, wheel pullers, torque wrench, feeler gauges, dial indicator and micrometers.
- 1.4 Before dismantling the unit, drain the oil. To speed up drainage, remove the dipstick (20).
- 1.5 When disassembling a unit, clean external surfaces adjacent to covers to prevent dirt from entering the housing.
- 1.6 During disassembly, keep old shim pack sets with their respective cages and retainers for reference when reassembling.
- 1.7 It is recommended that oil seals, O-rings and non-metallic gaskets be replaced when units are reassembled.

SECTION 2 – PARTS REPLACEMENT

2.1 SEAL REPLACEMENT

Inspect oil seals and O-rings for nicks, gouges and deformities. Drive out all old oil seals and remove accumulations of sealing compound. When replacing seals:

- a . Pack the interior and coat the lips of seals with a lithium base NLGI #2 bearing grease. Refer to General Instructions.
- b . Install oil seals with the lips facing the direction indicated on the assembly drawing.
- c . Coat the section of shaft sealing surface with oil. If the oil seal must pass over a keyway, wrap the shaft with thin paper or tape, coat with grease and pass the oil seal over. Do not expand seal lips over 1/32".

2.2 BEARING REPLACEMENT

Inspect bearings carefully and replace if necessary.

- a . Remove worn bearings with a puller or at an arbor press.
- b . New bearings can be pressed on the shafts and can be preheated to make installation easier.
- c . Maximum oil bath or oven temperature for heating bearings are:
Roller bearings (taper and roller) 275° F
Ball bearings 200° F
When preheating bearings, do not apply direct flame or rest bearings on the bottom or side walls of oven.
- d . Thoroughly coat bearing surfaces and shaft seats with oil.
- e . Make sure bearings are tightly seated against shaft shoulders with no clearance. Check with feeler gauges.

2.3 CHANGE GEAR REPLACEMENT

The majority of change gears are taper bored. The pinion (210) and change gear (212) can be removed with wheel pullers, wedges or a pry bar and brass hammer.

- a . Remove the change gear cover (216) and gasket (215).
- b . Wedge a cloth or leather strap between the mesh of the pinion and gear and loosen the locknuts (204 & 214).
- c . When wedges or pry bars are used, be sure to use soft brass or copper shims between the wedge or bar to protect the gear teeth. Apply pressure behind the gear in line with the keyway and sharply tap the gear 90° from the keyway between the outside diameter and the hub. A brass hammer or mallet should be used.
- d . The change gears on unit size 76–86 and 77–87 are provided with jack screw holes to facilitate removal. Two high strength bolts (Grade 5 or equivalent) may be threaded into these holes and tightened securely against the retainer. Then sharply tap the gear 90° from the bolts, between the outside diameter and the hub. A brass hammer or mallet should be used.

- e . If removal is stubborn, apply heat evenly around the circumference of the gear hub with a torch or other device, but do not allow the hub temperature to exceed 275° F. The heat should be applied quickly to the hub to prevent the shaft from heating.
 - f . Remove straight bore pinions from shafts at an arbor press.
 - g . To replace straight bore pinions, preheat to 275° F and press on shaft with large chamfered side tight against shaft shoulder. Check with feelers for zero clearance between shaft shoulder and pinion before tightening locknut.
 - h . Some units are furnished with an integral shaft and pinion (209) (pinion teeth machined directly on shaft) for the higher ratios. Remove shaft and pinion (209) as outlined in Section 3 to change speeds.
- 2.4 Unit size 77–87 models require an oil pan as shown in Figure 2 for the total ratio and input speed combinations designated by an "X" in Table 1. If the unit is dismantled, make sure the oil pan is re-installed.
- a . If converting to a speed and ratio which no longer requires an oil pan, remove the front half of the pan. The adapter can remain assembled to the retainer (110).
 - b . If the unit was not equipped with an oil pan, and the unit is converted to a speed and ratio that requires one, an oil pan must be added.
 - c . For variable speed applications, an oil pan is required if either extremity of the speed range falls within the input speeds (and ratio) shown in Table 1.

TABLE 1 – OIL PAN USAGE					
UNIT SIZE	INPUT RPM	NOMINAL TOTAL RATIO			
		6.2	7.6	9.3	11.4
77–87	1750	X	X	X	X
	1450	X	X		

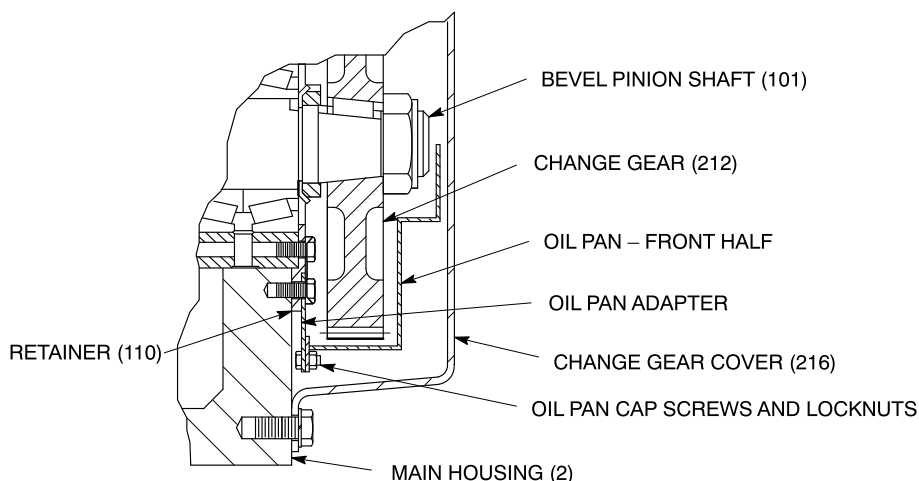


FIGURE 2 – OIL PAN DETAIL

SECTION 3 – HIGH SPEED OR (TRIPLE REDUCTION) INTERMEDIATE SHAFT REMOVAL

3.1 These shafts must be removed from the motor end of the gear drive.

3.2 DOUBLE REDUCTION – HIGH SPEED SHAFT (201 or 209) REMOVAL

- Remove the pinion (210) to prevent damage to the gear teeth. For integral shaft and pinion (209), or pinions that are not removed, wrap the teeth with a strong tape prior to removal.
- Remove the high speed seal cage (22), oil seal (23) and gasket (24). Use care so as not to damage the oil seal.
- Remove high speed shaft (201) assembly from unit to provide clearance for bevel gear removal. Inspect bearings (202 & 205) and replace if necessary.

CAUTION: Proceed slowly and maneuver the shaft until the bearings clear the bevel gear (100), low speed shaft (402) and bearing cage (420).

3.3 TRIPLE REDUCTION – INTERMEDIATE SHAFT (315) REMOVAL

- Remove the high speed head (30).

When removing and replacing the high speed head (30), rotate the high speed shaft (310) so that the key is in the relative position shown in Figure 3. This position allows the oil slinger (306) to clear the high speed gear (312) without damage.

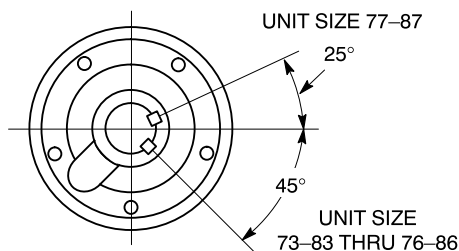


FIGURE 3 – UNIT SIZES 3 THRU 7

- Remove the high speed head (30) assembly and place it in a clean, protected area.
- Remove locknut (314), high speed gear (312) and key (313).
- Remove retainer (316).
- Remove the intermediate shaft assembly. Inspect bearings (202 and 205) and replace if necessary.

CAUTION: Proceed slowly and maneuver the shaft until the bearings clear the bevel gear (100), low speed shaft (402) and bearing cage (420).

3.4 HIGH SPEED HEAD (30) DISASSEMBLY – TRIPLE REDUCTION ONLY

- Oil slinger (306) removal:
 - Unit Size 73–83 thru 76–86 – Remove hex head cap screws (307) and slinger (306).
 - Unit Size 77–87 – Remove locknut (320), slinger (306) and pinion (310).
- Remove the high speed cage (32) and oil seal (33). Use care so as not to damage the oil seal.
- High speed shaft removal:
 - Unit Size 73–83 thru 76–86 – Remove the high speed shaft and pinion (310) assembly.
 - Unit Size 77–87 – Remove the high speed shaft (311) assembly.
- Inspect the bearings (303 and 305) and replace if necessary.

3.5 HIGH SPEED HEAD (30) ASSEMBLY – TRIPLE REDUCTION ONLY

- a . Press the inner bearing (303) on the high speed pinion (310).
- b . Install the retaining ring (304) in the two grooves just above the bearing (303).
- c . Carefully press the outer bearing (305), with its external retaining ring facing up, onto the pinion shaft until it registers against the retaining ring. Do not impact or distort the ring.
- d . Install the third retaining ring (304) in the outer most groove.
- e . Install the high speed shaft and bearing assembly in the high speed head (30).
- f . Install the oil seal (33) with the appropriate driver in the high speed cage (32). Oil seal lip must face in.
- g . **IMPORTANT: PACK THE INTERIOR OF THE SEAL CAGE AND OIL SEAL LIP WITH A LITHIUM BASED NLGI #2 GREASE.**
- h . **STRICTLY ADHERE TO THESE PROCEDURES TO PREVENT THE POSSIBILITY OF OIL LEAKAGE.**
- i . **Use an appropriate amount of grease to fill the cavity, allowing space for the shaft and portion of the bearing extending into the cavity. Overfilling the cavity will allow grease to be squeezed out during installation of the seal cage causing failure of the gasket eliminator.**
- j . **Apply a bead of Loctite 515 Gasket Eliminator on machined surface of the high speed head casting. This bead is to be applied around and in between each threaded hole.**
- k . **Install gasket (34).**
- l . **Apply a bead of Loctite 515 Gasket Eliminator on mounting surface of high speed seal cage (32). This bead is to be applied around entire diameter, tangent to inside of each hole.**
- m . **Install the high speed seal cage (32) with hex head cap screws (35) and lockwashers (36). Tighten cap screws to 27 ft-lbs.**
- n . Install the slinger (306):
 - 1 . Unit size 73–83 thru 76–86 – Install the slinger (306) with hex head cap screws (307).
 - 2 . Unit size 77–87 – Install the high speed pinion (310), slinger (306) and locknut (320). Tighten the locknut to the value shown in Table 5.

SECTION 4 – BEVEL SET REMOVAL AND ASSEMBLY

4.1 BEVEL GEAR REMOVAL

- a . The high speed shaft (201) assembly / intermediate shaft (209) assembly must be removed from unit to provide clearance for bevel gear removal.
- b . Remove the cap screws (422) from the low speed bearing cage (420). Install 2 eyebolts and lift cage straight up. Use caution so as not to damage the oil seal (415 and 416) lips. Inspect the oil seals and bearing (404) cup. Remove if necessary.
- c . Wrap and interlock two web straps around the low speed shaft (402) directly below the seal collar (403) and carefully lift the shaft out.
- d . Remove the low speed retainer (410) and shims (412). Inspect oil seal (411) and replace if necessary.
- e . Remove the bevel gear (100) from the low speed shaft (402).
 - 1 . For units 72–82 and 73–83 – Press the bevel gear off the shaft.
 - 2 . For units 74–84 thru 77–87 – Remove the cap screws (405) by restraining the locknuts and remove the gear.
- f . Inspect bearings (404 and 408) and replace if necessary.

4.2 BEVEL PINION REMOVAL

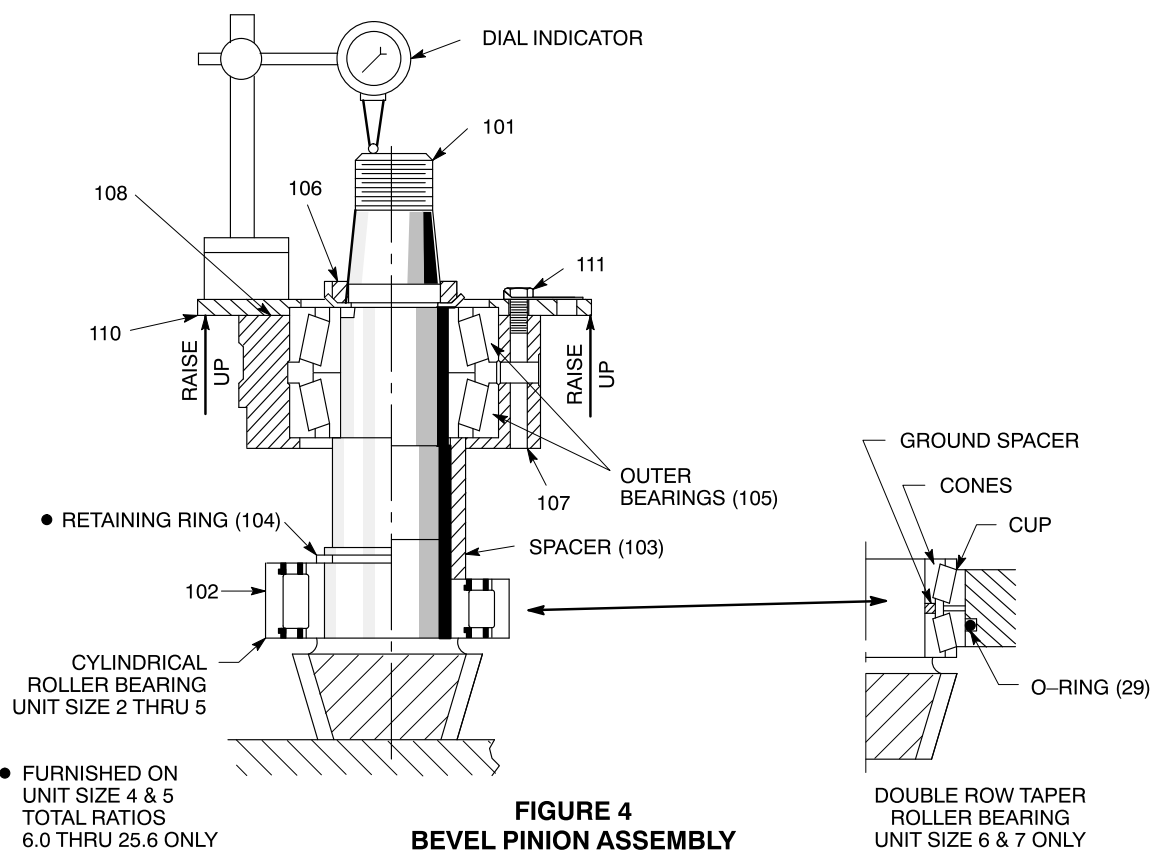
CAUTION: DO NOT USE POWER WRENCHES ON NYLOK CAP SCREWS OR JACKING SCREWS.

- a . Remove the outer set of cap screws (111) in the retainer (110).
- b . Insert jacking screws in the retainer (110) and remove the bevel pinion assembly.
- c . Remove the inner set of cap screws (111) and the retainer (110).
- d . Remove the outer bearing cup (105) by pushing the bearing cage (107) inward.
- e . Models 76–86 only: Remove O–ring (29).
- f . Remove the locknut and washer (106).
- g . Press the bearings (102 and 105) off the shaft.

CAUTION: Unit sizes 6 and 7 are furnished with a double row taper roller bearing (Item 102) that is fitted with a custom spacer, ground to provide a specific end play clearance for each individual bearing. DO NOT substitute spacers or interchange any components of the bearing set.

4.3 BEVEL PINION ASSEMBLY (SEE FIGURE 4)

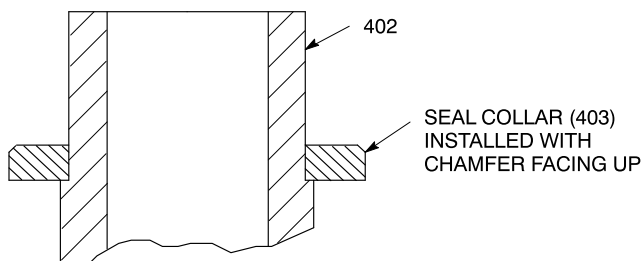
- a . Insert the inner cup of the inside tapered roller bearing (105) in the bearing cage (107).
- b . Mount the inner bearing (102) on the shaft.
 - 1 . Unit size 72–82 thru 75–85: Mount the cylindrical roller bearing (102) with the large radius against the pinion shoulder.
 - 2 . Unit size 76–86 and 77–87: Mount the 2 roller bearing cones with ground spacer between the 2 cones.
- c . Press one of the outer bearing (105) cups into the bearing cage (107), thicker section down, using the appropriate bearing driver to seat firmly against the cage shoulder.
- d . Slide the bearing cage (107) over the shaft.
- e . Install the 2 bearing (105) cones, oriented back to back, until the lower cone registers against the shaft shoulder or the spacer (103).
- f . Seat the bearing cones at an arbor press and check for spacer rotation or a zero clearance shoulder fit.
- g . Install the lockwasher and locknut (106) and tighten securely.
- h . Push the bearing cage (107) into position and rest the bottom of the cage on a flat surface with the bevel pinion suspended.
- i . Insert the outer bearing (105) cup and tap radially into position. To fully seat the cup, install the retainer (110) without shims (108) and cross–tighten the cap screws (111).
- j . Measure the gap between the retainer (110) and the bearing cage (107). Add shims (108) equal to the measured gap, +.003 to +.005 inches.
- k . Install all cap screws (111) and tighten. Raise the bearing cage upward evenly (do not tip) and recheck bearing float (.003 to .005 inches). Re–shim if necessary.



4.4 BEVEL GEAR ASSEMBLY

a . If bearings (404 and 408) were removed:

- 1 . Preheat the seal collar (403) to 275° F and install it against the shoulder on the upper end of the low speed shaft (402) with its chamfer facing up.



- 2 . Preheat the bearing (404 and 408) cones to 225° F maximum and install them on the low speed shaft (402).

b . For unit sizes 72–82 and 73–83:

- 1 . Insert the key (120) in the low speed shaft (402).

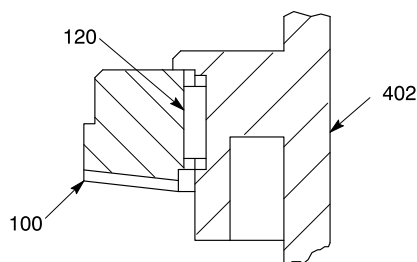


FIGURE 6

- 2 . Preheat the bevel gear to 225° F maximum and press the gear tight against the shaft shoulder.

NOTE: DO NOT USE LUBRICANTS OF ANY KIND ON THE SHAFT (402) OR GEAR (100) BORE.

c . For unit sizes 74–84 thru 77–87:

- 1 . Coat bevel gear cap screw (405) and locknut (406) threads and heads with oil. Place the bevel gear (100) on shaft flange and install the cap screws (405) and locknuts (406).
- 2 . Always use an open end wrench to restrain the locknuts (406) and tighten the cap screws (405) to the torques listed in Table 2.

TABLE 2				
ITEM 405 BEVEL GEAR CAPSCREW TORQUES				
UNIT SIZE	74–84	75–85	76–86	77–87
TORQUE FT–LBS	50	98	165	273

4.5 PREPARATION FOR SETTING BEVEL GEAR MOUNTING DISTANCE AND BACKLASH

Prior to setting the bevel gears as outlined in Section 5, follow these preliminary steps:

- a . Record the mounting distance (MD) and backlash (BL) values etched on the periphery of the bevel gear.
- b . Measure the outside diameter of the machined portion of the oil dam, divide by 2, and record for reference.
- c . Place the lower roller bearing (408) cup in the housing so that the face of the cup is recessed 1/16 inch into the housing.
- d . Check alignment of the grease channel in the low speed retainer (410) with the grease holes in the housing (2) and shims (412).
- e . Add the following tentative shim pack (412):

72–82 thru 74–84	75–85 thru 77–87
(1) .015 thick	(1) .015 thick
(1) .010 thick	(1) .009 thick
(1) .0075 thick	(1) .007 thick

- f . Mount the shims (412) and retainer (410) to the housing, making sure the face of the bearing cup is in full contact with the raised face of the retainer. Do not install the oil seal (411) at this time.

SECTION 5 – SETTING BEVEL GEARS

Bevel gears are precision generated and custom matched. They are precision lapped for optimum tooth contact and should always be replaced as **MATCHED SETS**. They require precise assembly with accurate setting of the bevel pinion mounting distance (MD) and backlash (BL).

5.1 SETTING THE MOUNTING DISTANCE

- a . Unit size 76–86 only: Install O–ring (29).
- b . Insert the bevel pinion sub–assembly into the housing without shims (109) and tap lightly until tight against face of the housing.
- c . Apply pressure to the end of the bevel pinion shaft (101), and measure the gap between the oil dam and the toe of the bevel pinion (Dimension "C"). Record the measured gap.
- d . Determine the shims (109) required by referring to the mounting distance (MD) and oil dam diameter (B/2) recorded previously and referring to the method shown below (see Figure 7).

$$A(\text{MD}) \text{ minus } (B/2 + C) = \text{SHIM PACK REQUIRED } \pm .001$$
- e . Back off the bevel pinion sub–assembly approximately 1 inch from the housing. (Use jacking screws in the holes provided.)
- f . Split the calculated amount of shims (109) and insert under the face of the retainer (110).
- g . Push the assembly back into the housing and tighten all the outer cap screws (111).
- h . Recheck the mounting distance after tightening and re–adjust if necessary.

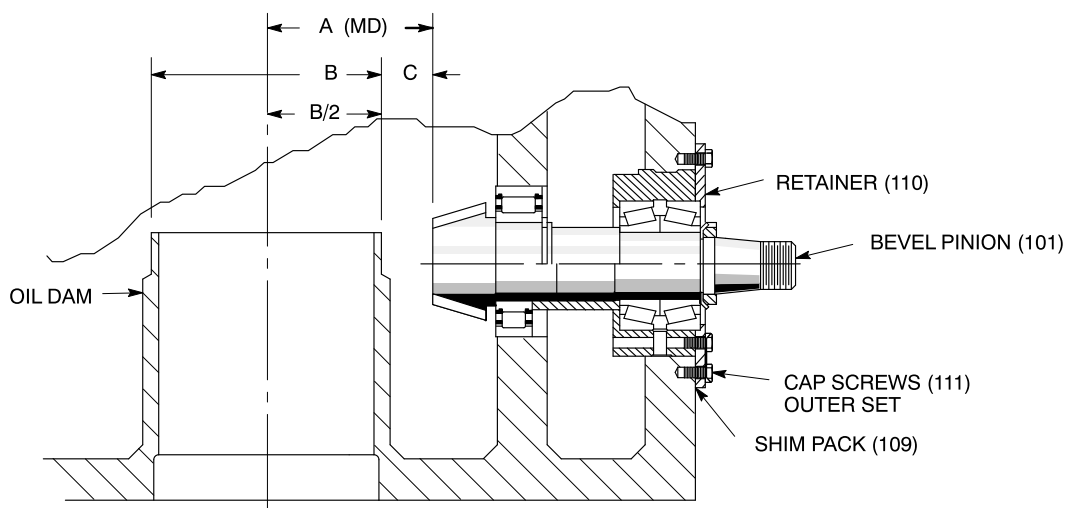


FIGURE 7 – SETTING MOUNTING DISTANCE

5.2 SETTING THE BACKLASH (SEE FIGURE 8)

- a . Carefully lower the low speed shaft (402) assembly into the housing (2).
- b . Install low speed bearing cage (420) with the full shim pack (417) and tighten the 4 cap screws (422).
- c . Check the actual backlash against the value previously recorded from the bevel gear.
- d . To measure the backlash (see Figure 8):
 - 1 . Wedge a key into the key seat and set up a dial indicator with the indicator tip located at dimension "D".
 - 2 . Rotate the bevel pinion shaft (101) back and forth while holding the low speed shaft immobile and read the backlash on the indicator. The indicator reading should be two times the backlash etched on the bevel gear.

- e . To obtain the required backlash, add or remove shims from the lower shim pack (412) equal to 1/2 the indicator reading. Loosen and retighten the 4 upper bearing cage cap screws (422) and tap down the low speed shaft (402) each time the shim pack (412) is adjusted. When the proper backlash is obtained, measure the total shim pack.
- f . The final indicator reading should be 2 times (BL) etched on the bevel gear within a tolerance of plus .004, minus .000.
- g . If backlash is satisfactory, tighten the cap screws (413). Recheck the backlash.

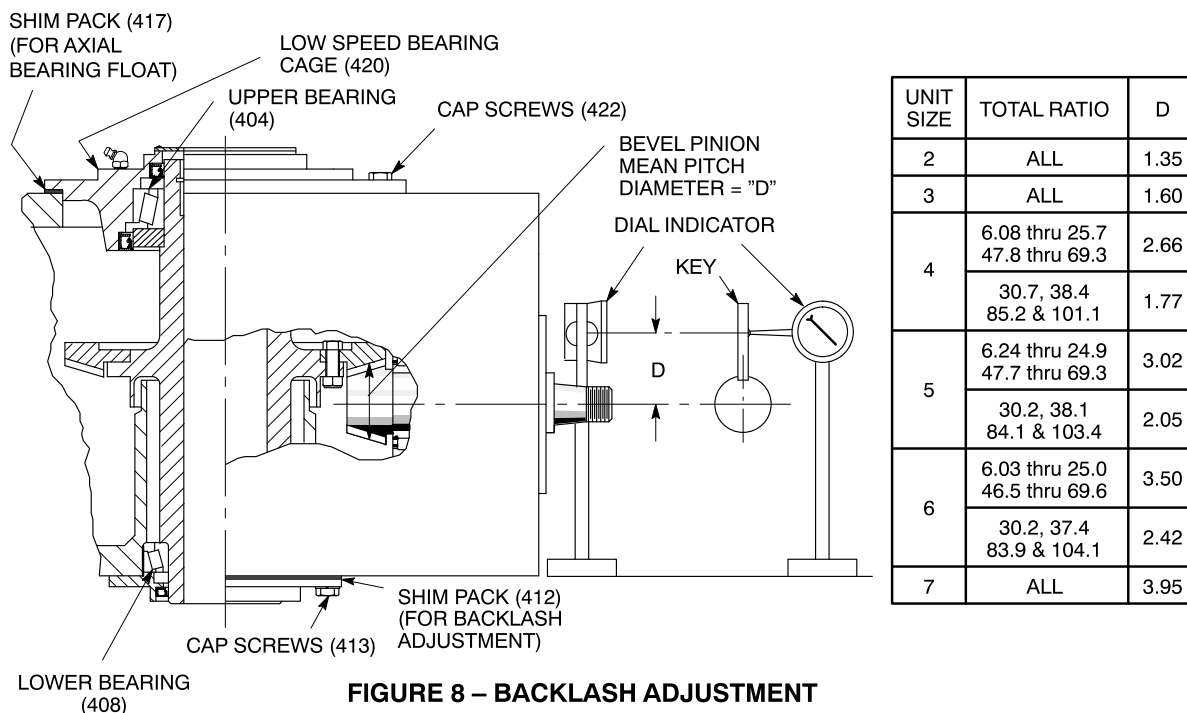


FIGURE 8 – BACKLASH ADJUSTMENT

5.3 SETTING THE AXIAL FLOAT IN THE LOW SPEED SHAFT ROLLER BEARINGS

- a . To set axial float:
 - 1 . Tap the low speed shaft (402) downward.
 - 2 . Lower a sling through the shaft and insert a bar through the sling across the bottom end of the shaft.
 - 3 . Place a dial indicator on the top face of the shaft and carefully raise the shaft with a hoist.
 - 4 . Read the axial bearing float on the indicator and adjust shim pack if necessary.

TABLE 3 AXIAL BEARING FLOAT		
UNIT SIZE	70 SERIES	80 SERIES
2, 3 & 4	.001 TO .004	.003 TO .005
5 THRU 7	.003 TO .005	

SECTION 6 – FINAL ASSEMBLY

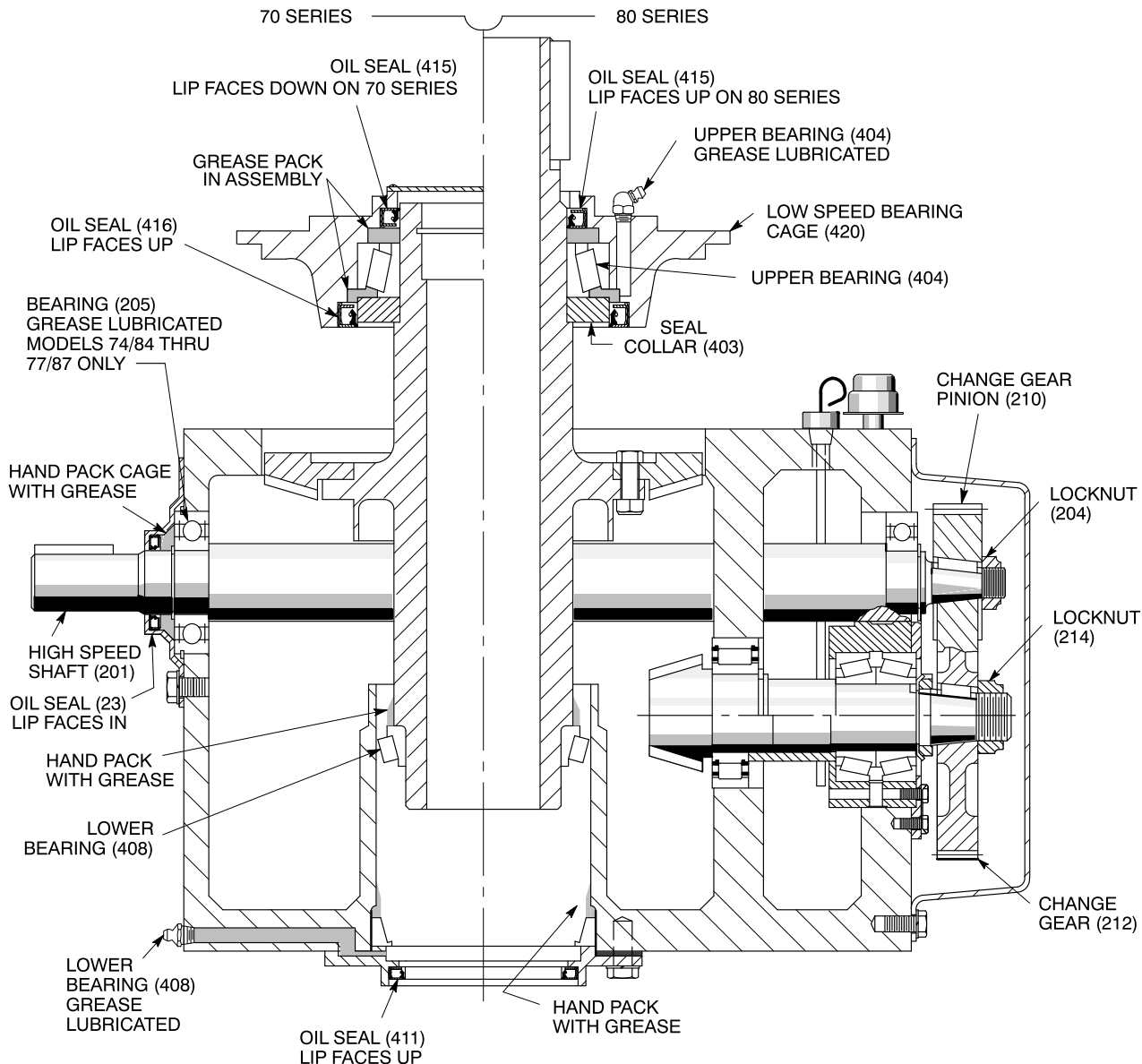






FIGURE 9 – FINAL ASSEMBLY

- 6.1 Remove the low speed shaft (402) and cage assembly (420).
- 6.2 Use a lithium based NLGI #2 ball and roller bearing grease throughout the following steps.
- 6.3 Pack the interior and coat the lips of all oil seals with grease.
- 6.4 Make sure oil seal lips are facing the direction shown on the assembly drawings in this manual.
- 6.5 Carefully clean and pack the bearing rollers of the upper (404) and lower (408) bearings. Pack the interior of the oil dam up to 2" above the lower bearing.
- 6.6 Install the oil seals (415 and 416).
 - a . Install the outer oil seal (415) and the inner oil seal (416) with the appropriate seal driver.
 - b . Reinstall the low speed shaft (402) and bearing cage (420) assembly using cap screws (422).

-
- c . 70 Series units only: Install gasket (28) and coverplate (27).
- 6.7 Change Gear Installation:
- a . Double Reduction Units:
- 1 . Install the high speed shaft (201) and bearings (202 and 205) in the reducer housing (2).
 - 2 . If removed, install a new oil seal (23) in the high speed seal cage (22) with the lips facing the direction indicated on the assembly drawing.
 - 3 . **IMPORTANT: Pack the interior of the seal cage and oil seal lip with a lithium based NLGI #2 grease.**
 - 4 . Install gasket (24).
 - 5 . Install the high speed seal cage (22) using hex head cap screws (25) and lockwashers (26).
 - 6 . Install the key (213), change gear (212) and locknut (214) on the bevel pinion shaft (101).
 - 7 . Install the key (211), change gear pinion (210) and locknut (204) on the high speed shaft (201).
 - 8 . Wedge a cloth or leather strap between the mesh of the pinion and gear and tighten the locknuts (204 & 214) to the values shown in Table 5.
- b . Triple Reduction Units:
- 1 . Install the intermediate shaft (315) and change gear pinion (210).
 - 2 . Install the retainer (316).
 - 3 . Install the key (313), high speed gear (312) and locknut (314).
 - 4 . Install the key (213), change gear (212) and locknut (214) on the bevel pinion shaft (101).
 - 5 . Wedge a cloth or leather strap between the mesh of the pinion and gear and tighten the locknuts (204, 214 & 314) to the values shown in Table 5.
 - 6 . If removed, install the 1/2 inch diameter dowel pin in the bottom surface of the housing (2).
 - 7 . Model 74–84 & 75–85 only: Install the Locthread studs.
 - 8 . Install the gasket (31).
 - 9 . Install the high speed head (30) assembly. Align the high speed shaft as shown in Figure 3 to allow the oil slinger (306) to clear the high speed gear (312) without damage. Use care to align and not damage the high speed pinion (310) or high speed gear (312).
 - 10 . Install hex head cap screws (38), hex nuts (74–84 & 75–85 only) and lockwashers (39). Rotate the high speed pinion (310) shaft several times before tightening the hardware to the values shown in Table 4.
- 6.8 Install lower oil seal (411).
- 6.9 To insure grease channels are full, and purged of air, add grease through the fittings to the upper and lower bearings (404 & 408) and (205, 74–84 thru 77–87). Rotate the shafts while adding grease.
- a . On 70 Series units, remove the pipe plug at the top.
- b . On 80 Series units, add until grease flows into the cavity above the upper oil seal (415).
- 6.10 Unit size 77–87: Refer to Table 1 and install oil pan if necessary.
- 6.11 Install change gear cover (216) and gasket (215) using hex head cap screws (217) and washers (218).
- 6.12 Tighten all external hardware to the recommended torques in Table 4.
- 6.13 Fill the unit with oil through the large opening with the socket head plug in the side of the housing to the dipstick full mark. The approximate oil capacity is shown in the General Instructions.
- 6.14 Rotate the high speed shaft a few revolutions by hand to check for free running.
- 6.15 Re-assemble gear drive to the mixer. Install all safety guards.
- 6.16 Reconnect power to motor. Jog the motor and check for proper impeller shaft rotation.

TABLE 4
RECOMMENDED TIGHTENING TORQUES FOR COMMERCIAL GRADE STEEL, ① ②
GR5, 304 AND 316 STAINLESS

BOLT THREAD SIZE	TIGHTENING TORQUES (FT-LBS) ④ GRADE 2, 3 OR 304/316 SS BOLTS LUBRICATED	TIGHTENING TORQUES (FT-LBS) ④ GRADE 5 304/316 SS BOLTS LUBRICATED	STEEL SAE GRADE MARKING REFERENCE GUIDE	
			GRADE MARKING	STANDARD BOLTS COMMERCIAL GRADES ②
1/4 – 20	4.6	7.2	 No Mark	SAE Grades 0, 1 and 2
5/16 – 18	9.6	15		
3/8 – 16	17	26		
7/16 – 14	27	42		SAE Grade 3
1/2 – 13	41	64		
9/16 – 12	60	92		SAE Grade 5
5/8 – 11	83	128		
3/4 – 10	146	226		
7/8 – 9 ③	142	365		All Socket Head Cap Screws SAE Grade 8
1 – 8	212	547		
1 1/8 – 7	301	675		
1 1/4 – 7	425	952		
1 3/8 – 6	557	1249		
1 1/2 – 6	739	1657		
1 3/4 – 5 ③	754	1600		
2 – 4 1/2	1134	2406		
2 1/4 – 4 1/2	1659	3519		
2 1/2 – 4	2269	4813		

① ALL BOLTS SHOULD BE COATED WITH OIL, GREASE OR AN ANTI-SEIZE COMPOUND WHENEVER POSSIBLE. THE THREADS AND BEARING FACE OF BOLTS AND / OR NUTS SHOULD BE LUBRICATED.

② TORQUE VALUES SHOWN SUPERSEDE PREVIOUS TABLES THAT MAY HAVE ALLOWED LOWER VALUES. IT IS RECOMMENDED THAT ONLY FASTENERS BE USED THAT ARE PROPERLY MARKED, INCLUDING MANUFACTURER'S TRADE MARKING. ONLY FASTENERS MARKED AS SHOWN ARE GUARANTEED TO MEET SPECIFICATIONS AND PERFORMANCE REQUIREMENTS.

③ ALLOWABLE BOLT STRESS VALUES CHANGE AT THESE LOCATIONS AND IS REFLECTED IN THE SUGGESTED TORQUE VALUES.

④ **CONVERSION FACTORS:**

FRICTION LOCKING DEVICES MULTIPLY LUBRICATED VALUE BY 1.15. THESE TORQUES PERTAIN TO BOLTS OR NUTS WITH FRICTION LOCKING DEVICES SUCH AS NYLON PELLETS OR PATCHES, FIBER INSERTS OR UPSET THREADS.

DRY VALUES MULTIPLY LUBRICATED VALUE BY 1.33.

METRIC VALUES IN N-m 1 FT-LB = 1.3558 N-m

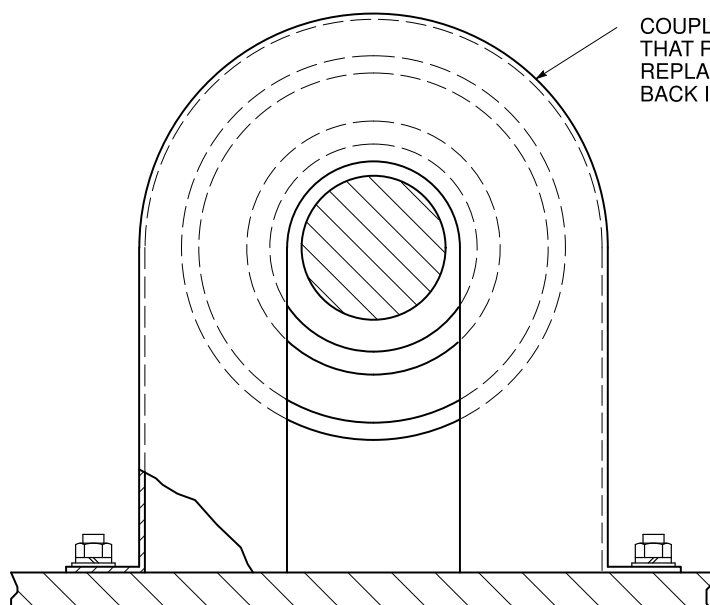
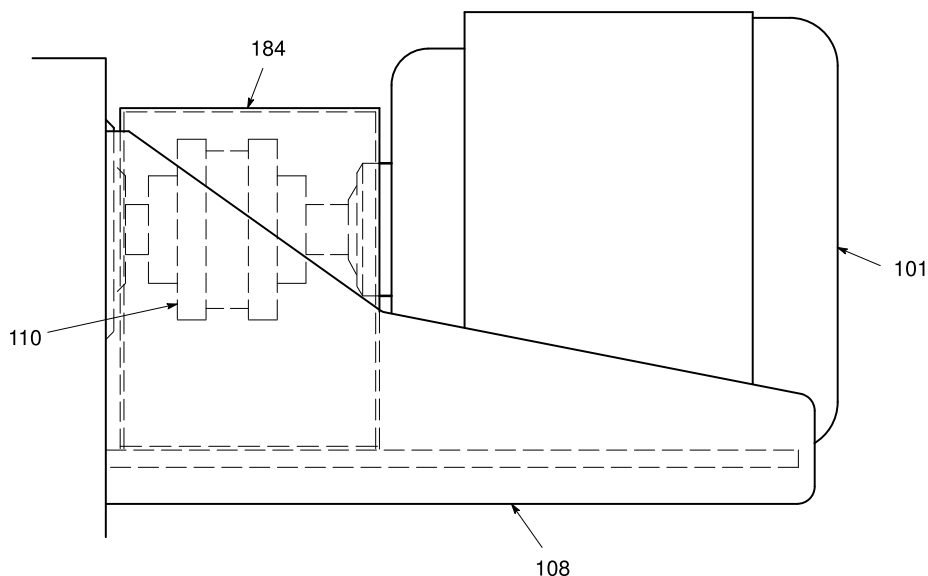
**TABLE 5
HELICAL GEARING LOCKNUT TIGHTENING TORQUES**

UNIT SIZE	REDUC- TION	TOTAL RATIO	CHANGE GEAR PINION (210)		CHANGE GEAR (212)		HIGH SPEED GEAR (312)			
			(204) LOCKNUT THREAD	TORQUE FT-LBS ①	(214) LOCKNUT THREAD	TORQUE FT-LBS ①	(314) LOCKNUT THREAD	TORQUE FT-LBS ①		
72-82	DOUBLE	5.17 thru 17.0	7/8-14	105	1-14	160	NONE	NONE		
		21.1 and 25.6	1/2-20	20						
		② 32.1	NO LOCKNUT							
73-83	DOUBLE	5.17 thru 16.7	7/8-14	105	1-1/8-12	210	NONE	NONE		
	TRIPLE	37.8 thru 55.9					1-14	160		
	DOUBLE	20.9 thru 31.4	1/2-20	20			NONE	NONE		
	TRIPLE	69.9 thru 105					1-14	160		
74-84	DOUBLE	6.07 thru 13.6	1-14	160	1-1/4-12	250	NONE	NONE		
	TRIPLE	45.4					1-14	160		
	DOUBLE	16.7 thru 38.2	5/8-18	50			NONE	NONE		
	TRIPLE	55.1 thru 105					1-14	160		
75-85	DOUBLE	6.03 thru 14.1	1-14	160	1-1/2-12	460	NONE	NONE		
		17.4, 21.5 and 32.1	3/4-16	60			1-1/8-12	210		
	TRIPLE	47.7, 58.9 and 87.9					NONE	NONE		
	DOUBLE	② 25.5 and 38.1	SOLID ON SHAFT NO LOCKNUT				1-1/8-12	210		
	TRIPLE	69.6 and 105								
76-86	DOUBLE	6.03 thru 9.50	1-1/2-12	460	1-3/4-12	750	NONE	NONE	HIGH SPEED PINION (310)	
		11.5 and 14.2	1-1/2-12	300						
		17.1 thru 21.1 & 31.7	7/8-14	105					(320) NUT THREAD	TORQUE FT-LBS ①
		③ 25.3 and 37.9	7/8-14	120						
	TRIPLE	47.4, 58.6 and 87.6	7/8-14	105			1-1/4-12	250		
		③ 70.3 and 105	7/8-14	120						
77-87	DOUBLE	6.14 thru 14.0	1-1/2-12	460	1-3/4-12	750	NONE	NONE	NONE	NONE
		16.8 and 20.5	1-14	160						
		② 25.4 thru 38.1	NO LOCKNUT							
	TRIPLE	48.0 and 58.0	1-14	160			1-1/2-12	460	1-14	160
		71.6 thru 108							3/4-16	100

① TORQUE VALUES ARE BASED ON LOCKNUT BEARING FACES AND SHAFT THREADS THAT ARE LUBRICATED.

② THE PINION IS AN INTEGRAL PART OF THE HIGH SPEED SHAFT (SOLID ON SHAFT).

③ TORQUE VALUES BASED ON STRAIGHT BORE PINIONS. HEAT PINION PER PARAGRAPH 2.3g BEFORE INSTALLING LOCKNUT.



COUPLING GUARD MUST BE REMOVED FOR COUPLINGS THAT REQUIRE LUBRICATION. REFER TO INSTRUCTIONS. REPLACE THE GUARD BEFORE PLACING THE MIXER BACK INTO SERVICE.

WHEN ORDERING PARTS, SPECIFY:
DRAWING NO., PART NAME, ITEM
NO. AND SERIAL NUMBER

184	COUPLING GUARD
110	MOTOR FLEXIBLE COUPLING
108	MOTOR BRACKET
101	MOTOR
ITEM	PART NAME



CERTIFIED

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LIGHTNIN

MIXERS AND AERATORS
ASSEMBLY DRAWING

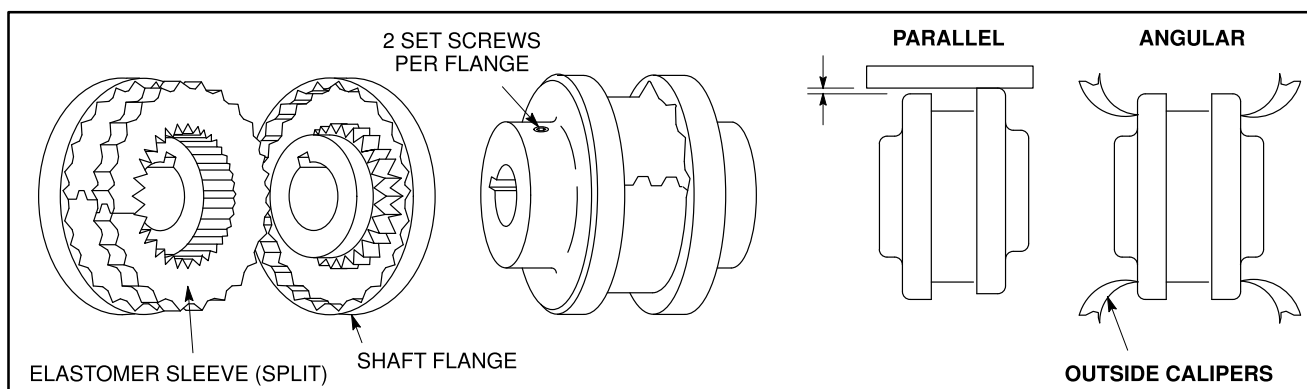
**MOTOR
COUPLING GUARD**

DRAWING NO. L-16303E

INSTALLATION INSTRUCTIONS FOR ELASTOMER SLEEVE COUPLINGS

NOTE: The mixer is furnished with either an Elastomeric or T10/H high speed, and/or a T20/V low speed tapered grid coupling. Determine the coupling size and manufacturer so that correct coupling alignment procedure can be employed. Coupling identifiers are located on the coupling components.

IMPORTANT: ALWAYS RECHECK HIGH SPEED COUPLING ALIGNMENT PRIOR TO INITIAL START IN CASE MISALIGNMENT OCCURS DUE TO SHIPPING, HANDLING AND INSTALLATION.



INTRODUCTION:

Elastomeric couplings consist of three basic elements - two shaft flanges and one elastomer split sleeve. Each shaft flange is identified with basic size and shaft bore. Elastomer sleeves are identified with basic size and a material code letter stamped on or molded in.

Rubber sleeves are black and are coded with size/style designations 4JES thru 8JES and 9E. Polyester sleeves are peach color and designated as 6HS thru 11HS.

INSTALLATION AND MAINTENANCE:

Only simple tools are required; an allen wrench, straightedge and outside calipers. To install or replace elastomer sleeves, loosen both set screws in one of the shaft flanges and slide the flange back. Remove the two piece sleeve or spread apart one-piece split sleeves and replace with the same type new sleeve. Install the new sleeve over the shafts and slide the sleeve into the stationary shaft flange until it seats firmly against the flange inner wall. For couplings equipped with a type E sleeve (two piece with a retaining ring), the retaining ring has to be pried out of the sleeve groove for sleeve removal and back into position after installing new sleeve and checking alignments. Slide the loose shaft flange into position, engaging the sleeve teeth until the sleeve fits snugly against the flange inner wall. The teeth on the elastomer sleeve should be fully engaged and slightly underflush within each shaft flange. **DO NOT** force the flanges together so as to compress the sleeve in any way.

NOTE: Shaft gap is determined by the width of the elastomer element when engaged in both hub halves.

PARALLEL ALIGNMENT:

Place a straightedge across the 2 coupling flange rims and measure the maximum offset at 90° intervals around the coupling. If the maximum offset exceeds the allowable values in the table, add or subtract equal thicknesses of motor foot shims until parallel alignment is as close as possible.

ANGULAR ALIGNMENT:

Check angular alignment with outside calipers (or micrometers) as shown above. Check at 90° intervals around the coupling. **DO NOT ROTATE** the coupling during this measurement. The difference between the maximum and minimum measurement should not exceed the allowable value in the table. Re-check parallel alignment once angular alignment has been achieved.

NOTE: To insure maximum sleeve life, keep misalignment values as near zero as possible.

TABLE 1 - ELASTOMERIC INSTALLATION DATA

MAXIMUM ALLOWABLE MISALIGNMENT (DIMENSIONS IN INCHES)					
BASIC SLEEVE SIZE	FLANGE SET SCREW TORQUE (FT-LBS)	RUBBER SLEEVES (TYPE JES & E)		POLYESTER SLEEVES (TYPE H.S.)	
		PARALLEL	ANGULAR	PARALLEL	ANGULAR
4	3	.005	.014	--	--
5	7	.008	.018	--	--
6	13	.008	.023	.005	.005
7	23	.010	.026	.006	.007
8		.010	.031	.008	.008
9		.013*	.036*	.008	.009
10		--	--	.010	.011
11		--	--	.011	.012

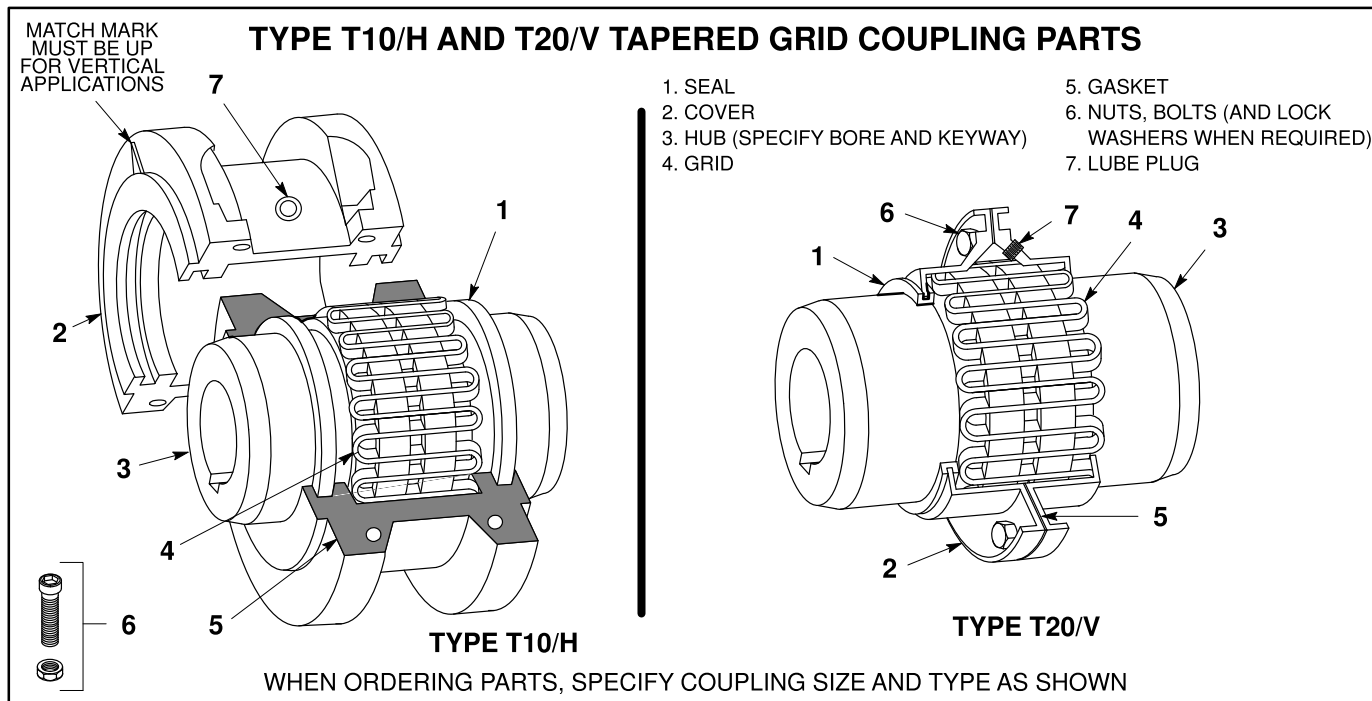
* THESE ARE TYPE E SLEEVES (TWO-PIECE WITH RING)

IMPORTANT: Before starting up, be sure the coupling guard is replaced and properly secured. Elastomer sleeves can be thrown from the assembly when subjected to a severe shock load.

Due to vastly different torque ratings, NEVER substitute a polyester (peach) sleeve with a rubber (black) sleeve or vice versa. Do not use polyester sleeves on variable speed applications until the application has been reviewed by **LIGHTNIN** Engineering personnel.

INSTALLATION AND MAINTENANCE INSTRUCTIONS FOR GRID TYPE FLEXIBLE COUPLINGS

IMPORTANT: ALWAYS RECHECK HIGH SPEED COUPLING ALIGNMENT PRIOR TO INITIAL START IN CASE MISALIGNMENT OCCURS DUE TO SHIPPING, HANDLING AND INSTALLATION.



INTRODUCTION:

These instructions apply to Type T10/H and Type T20/V Tapered Grid Couplings. 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 that follow 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/H and T20/V couplings; all other coupling parts are NOT INTERCHANGEABLE. Therefore, when ordering parts, always SPECIFY SIZE and TYPE.

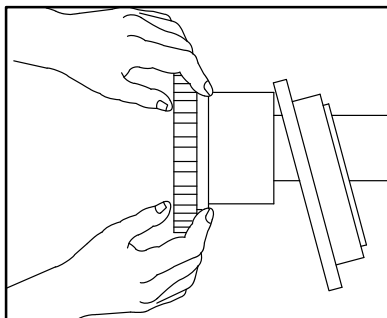
INSTALLATION:

Only standard mechanic's tools, wrenches, a straight edge and feeler gauges, are required to install Taper Grid couplings. Couplings are furnished for PUSH or LIGHT TAP FIT with set screws. For best results, clean all parts thoroughly and align coupling for minimum angular and parallel misalignment. Set the coupling gap as recommended; permanently fasten unit foundation bolts and then recheck alignment. Refer to Page 5 for detailed instructions.

LIMITED END FLOAT:

When electric motors are fitted with sleeve bearings, limited axial and float couplings should normally be employed to protect motor bearings. Tapered Grid couplings are easily modified to limit end float. Consult the factory if this feature is required.

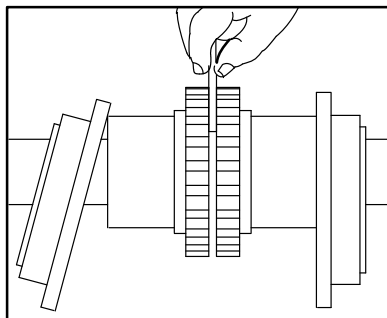
INSTALLATION OF TYPE T10/H AND T20/V TAPERED GRID COUPLINGS



1 MOUNT COVERS, SEALS AND HUBS

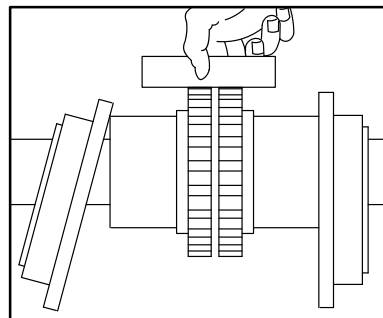
Place Type T20/V cover and seal, or Type T10/H seal only on shaft BEFORE mounting hub (the Type T10/H cover is mounted later). Mount hubs on their respective shafts so the hub face is flush with the end of its shaft.

NOTE: Recommended minimum engagement is one shaft diameter.



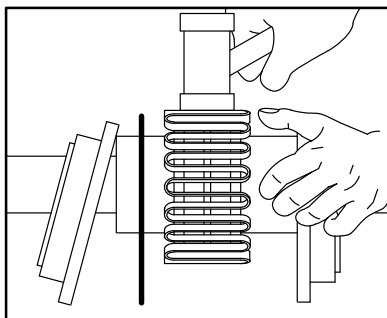
2 CHECK GAP AND ANGULAR ALIGNMENT

For best results, use a spacer bar equal in thickness to the gap specified in Table 2. Check alignment by placing the spacer between the hubs as shown, and at 90° intervals around the hub.



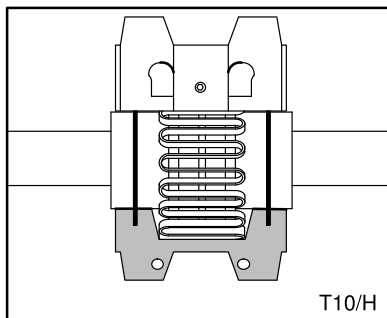
3 CHECK OFFSET MISALIGNMENT

Align shafts so that a straight edge will rest squarely on both hubs as shown, and at a position 90° away. Fasten foundation bolts and recheck both angular and offset alignment before doweling connected machinery in place.



4 INSERT GRID

After coupling hubs are aligned, insert the Type T20/V gasket through the gap and hang it on either hub. Pack gap and grooves with lubricant before inserting grid. When grids are furnished in two segments, install them so that all cut ends extend in the same direction. This will assure correct grid contact with lug in the T10/H cover and permit cover installation. Since grid runs are truly radial, it is necessary to spread the grid slightly to pass it over the coupling teeth. To minimize spreading, start grid at either end and then tap it into place. DO NOT attempt to force grid to the bottom of the groove, it will seat easily after all runs are positioned.



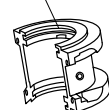
5 POSITION COVERS

Pack the spaces between and around the grid with as much lubricant as possible and wipe off excess flush with top of grid. Covers will be easier to install if lube plugs are not in place during this operation to allow trapped air to escape.

Type T10/H Cover: Assemble cover halves with the lug and match mark UP, or on the high side of the coupling so that the cover will be correctly positioned. The adjacent cover outer rib is match marked to indicate location of the lug. Slide seals into position on the hubs. Cover halves assemble in only one position. The correct position is with the lube holes (one in each cover half) at 180°. If bolt holes do not line up, reverse one cover half. Insert gaskets at cover splits and secure with cap screws and elastic stop nuts furnished. Lubricate per Step 6.

Type T20/V Cover: Place seals on cover halves and slide into hubs. Position cover halves with lube holes (one in each half cover) at 180°. Draw gasket and cover halves together, and secure with cap screws, nuts and lockwashers furnished. Lubricate per Step 6.

LUG UP



VERTICAL COUPLINGS

6 LUBRICATE - With the lube relief plug removed, fill the coupling through fitting with recommended grease until an excess appears at the relief. INSTALL LUBE PLUG when lubrication is completed.

7 COUPLING DISASSEMBLY AND GRID REMOVAL - Whenever it is necessary to disconnect the coupling, draw back the cover halves and remove the grid. A round rod or screwdriver 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 screwdriver into the loop ends. Use the teeth adjacent to each loop as a fulcrum and pry the grid out radially in even, gradual stages. Proceed alternately from side to side, lifting the grid about halfway out until the end of the grid is reached. By following the same procedure once again, the grid will clear the teeth.

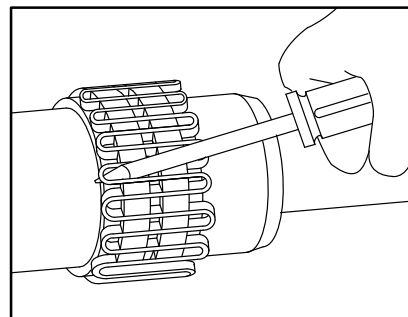
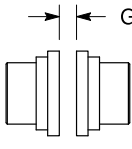
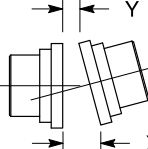
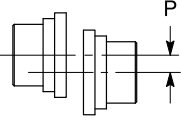


TABLE 2 - TAPER GRID INSTALLATION DATA

GAP AT CENTERLINE	ANGULAR MISALIGNMENT	OFFSET MISALIGNMENT
		
G NOMINAL	X MINUS Y**	P MAXIMUM

SERVICE LIFE OF COUPLING DEPENDS ON GOOD ALIGNMENT

ALL DIMENSIONS ARE IN INCHES

SIZE	MAXIMUM SPEED (RPM)		GAP AT CENTERLINE			X - Y** MAX.	P MAX.	COVER BOLT TORQUE (IN-LBS)	LUBE WGT. (LBS.)
	T10/H	T20/V	MIN.	NOMINAL	MAX.				
1020T	4500	6000	.062	.125	.188	.005	.005	100	.06
1030T	4500	6000	.062	.125	.188	.005	.005	100	.06
1040T	4500	6000	.062	.125	.188	.005	.005	100	.12
1050T	4500	6000	.062	.125	.188	.005	.005	200	.12
1060T	4350	6000	.062	.125	.188	.010	.010	200	.19
1070T	4125	5500	.062	.125	.188	.010	.010	200	.19
1080T	3600	4750	.062	.125	.250	.010	.010	200	.38
1090T	3600	4000	.062	.125	.250	.012	.012	200	.56
1100T	2440	3250	.062	.188	.375	.012	.012	260	.94
1110T	2250	3000	.062	.188	.375	.012	.012	260	1.1
1120T	2025	2700	.062	.250	.500	.012	.012	650	1.6
1130T	1800	2400	.062	.250	.500	.012	.012	650	2.0
1140T	1650	2200	.062	.250	.500	.015	.015	650	2.5
1150T	1500	2000	.062	.250	.500	.015	.015	650	4.2
1160T	1350	1750	.062	.250	.500	.015	.015	650*	6.2
1170T	1225	1600	.062	.250	.500	.015	.015	1300	7.7

* 160T20/V TORQUE = 1300 IN-LBS

** X MINUS Y IS THE DIFFERENCE IN MINIMUM AND MAXIMUM CLEARANCE BETWEEN THE HUBS AT 180° AT THE OUTER EXTREMITY OF THE HUBS.

MOTOR MAINTENANCE INSTRUCTIONS FOR C-FACE AND FOOT MOUNTED MOTORS FURNISHED BY *LIGHTNIN*

SECTION 1 – INITIAL INSPECTION, SHIPPING ARRANGEMENTS

1.1 Care is taken at the factory to assure that the motor arrives at its destination in first class condition. If there is evidence of rough handling or damage in shipment, file a claim at once with the carrier and notify our factory.

Examine the outside of the motor carefully for damage, with particular attention to the conduit box, fans and covers. Check nameplate for correct speed, horsepower/kilowatt, voltage, hertz and phase for conformance with power supply. See warning below for explosion proof motors.

1.2 WARNING

EXPLOSION PROOF MOTORS – These motors are constructed to comply with the U.L. Label Service Procedure manual. When repairing and reassembling a motor that has an Underwriter's Label, it is imperative that the unit be reinspected and:

- All original fits and tolerances must be maintained.
- All plugs and hardware to be securely fastened.
- Any part replacements, including hardware, be accurate duplicates of the original.

REPAIR WORK ON EXPLOSION PROOF MOTORS CAN ONLY BE DONE BY THE ORIGINAL MANUFACTURER OR U.L. CERTIFIED SERVICE SHOPS. VIOLATIONS OF ANY OF THE ABOVE ITEMS WILL INVALIDATE THE SIGNIFICANCE OF THE U.L. LABEL.

SECTION 2 – START-UP

2.1 After unpacking and inspection to see that all parts are in good condition, turn the shaft by hand to be sure there are no obstructions to free rotation. Equipment which has been in storage should be tested prior to putting into service.

- It is best to check the insulation resistance of the stator winding with a megohmmeter. If resistance is lower than one megaohm, the windings should be dried thoroughly before operating. Do not exceed a temperature of 80 degrees C (185 degrees F) in drying.
- Motors are shipped from the factory properly packed with grease and ready to operate. Where the motor has been subjected to extended storage (6 months or more), the bearings should be relubricated prior to starting. Refer to motor manufacturer's instruction manual for bearing lubrication details.

2.2 **WIRING** – Examine the nameplate data to see that it agrees with the power circuit to which the motor is to be connected. The motor is guaranteed to operate successfully with frequency not more than 5% and voltage not more than 10% above or below the nameplate data, or combined variation of voltage and frequency of not more than 10% above or below the nameplate data. Efficiency, power factor and current may vary from nameplate data.

2.3 Temporarily connect the motor leads to a power source that matches the line voltage and wiring diagram specified on the motor nameplate, inside the conduit box, or the motor manufacturer's instruction manual.

2.4 Check impeller shaft rotation by jogging the motor until it is determined that rotation is correct

2.5 CAUTION

Repeated trial starts can overheat the motor (particularly for across-the-line starting). If repeated trial starts are made, allow sufficient time between trials to permit heat to dissipate from the windings or rotor to prevent overheating. Starting currents are several times running currents, and heating varies as the square of the current.

When checks are satisfactory, make permanent connections.

2.6 WARNING

The frames and other metal exteriors of motors should be grounded to limit their potential to ground in the event of accidental connection or contact between live electrical parts and the metal exteriors. All motors should be grounded through the conduit box. Explosion proof motors have an integral ground lead for grounding.

2.7 WARNING

Before starting motor, remove all unused shaft keys and loose rotating parts to prevent them from flying off.

- 2.8 Start motor and operate at minimum load prior to filling the tank or basin. Look for any unusual condition. The motor should run smoothly with little noise. If the motor should fail to start and produces a decided hum, it may be that the load is too great for the motor or that the motor has been connected improperly. Shut down the motor immediately and investigate for trouble.

It is recommended that condensation drain plugs be removed, if motor is so equipped. These are located in the lower portion of the end shields or frame.

SECTION 3 – MOTOR MAINTENANCE AND STORAGE

- 3.1 To ensure continued, reliable operation of electric motors, the following basic rule applies: **KEEP THE MOTOR CLEAN, DRY AND PROPERLY LUBRICATED.** Motors should be inspected at regular intervals, with frequency depending upon the type of motor and service.

Windings should be cleaned by blowing or vacuuming dust from them. Ventilation openings must be kept clear. If dust or dirt is to be removed with a vacuum cleaner, nozzle should be of the non-metallic type. Deposits of dirt and grease may be removed using a commercially available low volatile solvent. **DO NOT USE GASOLINE OR OTHER FLAMMABLE SOLVENTS.**

- 3.2 Terminal connections and assembly hardware may loosen from vibration during service and should be tightened.

- 3.3 Insulation resistance should be checked at operative temperature and humidity conditions to determine possible deterioration of insulation due to excessive moisture or extremes in operating environment. If wide variations are detected, motor should be reconditioned.

- 3.4 LUBRICATION – Prior to shipment, motor bearings are greased with the proper amount and grade of lubricant by the motor manufacturer. It is recommended that the bearing lubricant be inspected at the end of two or three months to determine the necessity to add grease. Frequency of re-lubrication will vary with particular applications. Refer to the motor manufacturer's instruction manual for complete details.

NOTE: The greatest cause of bearing failure is over-greasing rather than under-greasing.

3.5 TYPE OF LUBRICANT

- Check the motor nameplate or manufacturer's instruction manual to determine whether a specific grease has been recommended by the motor manufacturer, and use that grease if possible.
- Lacking a specific grease recommendation, refer to the following:
For best results, grease should be compounded from a lithium soap base and a good grade of petroleum oil. It should be No. 2 consistency and stabilized against oxidation. Most leading oil companies have a special bearing grease that is satisfactory. Your local lubricant supplier may be able to assist.

3.6 LUBRICATION PROCEDURE

- Each motor manufacturer has a specific method for regreasing the bearings. Refer to the motor manufacturer's instruction manual for complete details.

NOTE: Bearings and grease **MUST** be kept free of dirt.

3.7 OIL LUBRICATED MOTORS (Sleeve Bearing equipped)

- Electric motor or SAE 20 oil should be added after 3 years of normal service or 1 year of heavy duty service. For more specific instructions, consult the motor manufacturer's instruction manual or contact motor manufacturer's local representative.

SECTION 4 – STORAGE

Electric motors or other prime movers are not prepared by **LIGHTNIN** for indoor storage beyond 12 months in a dry ambient atmosphere with controlled temperatures, or 6 months in a dry ambient atmosphere with no temperature control. **OUTDOOR STORAGE OF ELECTRIC MOTORS IS NOT RECOMMENDED BY ANY MOTOR MANUFACTURER.** For information on storage periods beyond those shown, consult **LIGHTNIN**.

4.1 STORAGE REQUIREMENTS FOR MOTORS – These extended storage requirements must be followed to allow the submission of a valid warranty claim:

- The motor, if not mounted, is to be stored in the original container in a clean, dry, protected warehouse.
- The storage area is to be free from any vibration and from extremes in temperature.
- Bearings:
 - Ball & Roller (anti-friction) – The bearings are to be fully greased at the time the motor goes into extended storage. Motor shaft is to be rotated manually every month at least 10 to 15 revolutions. Every six months, and at time of removal from storage, the bearings are to be purged, making sure an ample supply of fresh grease is in the bearing. Refer to the motor manufacturer's instruction manual for details.
 - Sleeve (oil lube) – The bearings are tested using oil containing a rust inhibitor. If motor is stored for more than one month, the oil reservoir must be filled in accordance with the motor manufacturer's instruction manual. The shaft should be rotated by hand every month at least 10 to 15 revolutions to assure that an oil film is on the shaft and bearing surfaces.
- All drains are to be operable while motor is in storage, and/or the drain plugs removed. The motor must be stored so that the drain is at the lowest point. Any breathers or automatic "T" drains must be operable to allow breathing at points other than through the bearing fits.
- Motor equipped with a heater is to have the heater connected if storage conditions in any way simulate or approach atmospheric conditions experienced in operation.
- Windings are to be megged at the time the motor is put into storage. At the time of removal from storage, the resistance reading must not have dropped more than 50% from the initial reading. Any drop below this point necessitates electrical or mechanical drying. Where a large quantity of motors is stored, an inspection or sampling should be made by removing the end brackets and visually inspecting for the presence of water in the grease or rust on the bearings. If present, replace the bearing and relubricate.
- All external parts and motors subjected to corrosion should be protected by a corrosion resistant coating.
- Where motor is not stored in the original container, the mounting must be such that the drains and breathers are fully operable. In this respect, the drains must be kept at the lowest point in the motor and/or drain plugs removed so that all condensation can automatically drain out.
- All other storage conditions apply, including rotation of the motor shafts. Where such conditions cannot be met, then the motor must be treated the same as if it were mounted in its normal position, and all protective devices such as heaters, breathers and drains fully operational.

Notes

LIMITED WARRANTY

Unless otherwise noted on the face hereof, SPX goods, auxiliaries and parts thereof are warranted to the original purchaser against defective workmanship and material for a period of twelve (12) months from date of installation or (18) months from date of shipment from factory, whichever expires first. If the goods or services do not conform to the warranty stated above, then as Buyer's sole remedy, SPX shall, at SPX's option, either repair or replace the defective goods or re-perform defective services. Third party goods furnished by SPX will be repaired or replaced as Buyer's sole remedy, but only to the extent provided in and honored by the original manufacturer's warranty. Unless otherwise agreed to in writing, SPX shall not be liable for breach of warranty or otherwise in any manner whatsoever for: (i) normal wear and tear; (ii) corrosion, abrasion or erosion; (iii) any good or services which, following delivery or performance by SPX, has been subjected to accident, abuse, misapplication, improper repair, alteration, improper installation or maintenance, neglect, or excessive operating conditions; (iv) defects resulting from Buyer's specifications or designs or those of Buyer's contractors or subcontractors other than SPX; or (v) defects resulting from the manufacture, distribution, promotion or sale of Buyer's products.

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TECHNICAL SERVICES

The Lightnin brand dedicated after sales support teams are on hand to offer advice and support. With more than 85 years' experience in the manufacture and supply of agitation equipment, we know what parts need to be on hand to support our customer base so that your downtime is minimized. Our team of highly experienced field service technicians is on call to support the on-site servicing of equipment, or supervise and train your maintenance staff in best practice care of equipment.

INSTALLATION AND COMMISSIONING

Proper installation of your Lightnin mixer is critical to its long term performance and reliability. To ensure that installation

procedures are followed, a certified technician will:

- Audit the equipment
- Supervise job-site contractors
- Perform a final inspection

SERVICE SUPPORT & REFURBISHMENT

The equipment audit is specifically designed to identify potential mechanical problems before they occur. Using many forms of modern technology and drawing on our mixer manufacturing experience, our technicians can identify the onset of bearing and gear failures, misalignment and system problems without the need to interrupt production. Factory gearbox exchange and refurbishment programs offer a fast and cost-effective route to extending equipment life.

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Please contact your local sales representative for product availability in your region. For more information visit www.spx.com.

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