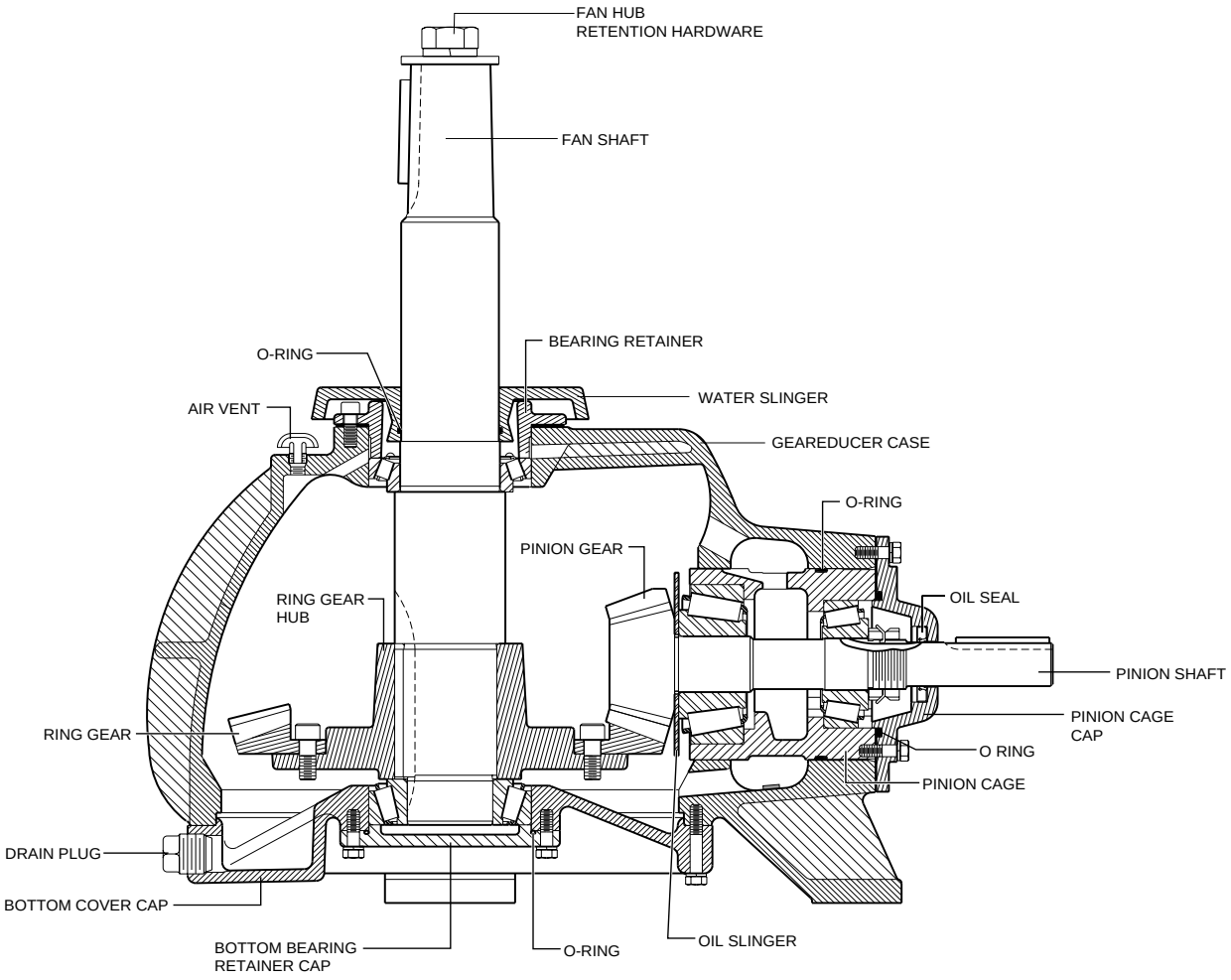
Geareducer®

Repair Manual

SERIES 22.2/22.3

RM-22.2 & 22.3

Manual 92-1411A



Series 22.2 and 22.3 Cross Section

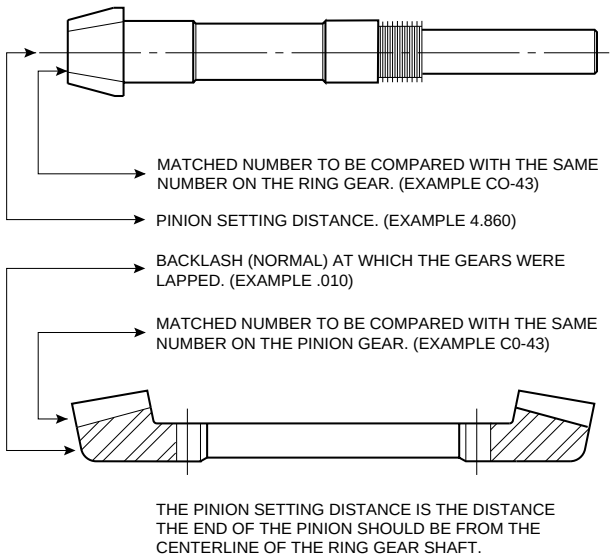


Figure 1 Gear Match Numbers and Setting Data

General

Geareducers can be repaired in the field—however, major repairs require the use of a fully equipped machine shop. When field repair or replacement of parts is necessary, the following procedure is recommended for the disassembly and assembly of the unit. If any O-ring, oil seal or gasket is to be reused, care should be taken not to damage it during disassembly. Parts which contain O-rings or seals should not be jerked or twisted past a shoulder or edge. These parts are marked with an asterisk (*****) in the description below. O-rings, oil seal and gaskets should be carefully inspected for damage before being reinstalled. Marley recommends that new O-rings and oil seal be installed during a major overhaul.

Disassembly

Part numbers—refer to Figure 2, pages 4 and 5.

1. Remove drain plug and drain oil.
2. Remove outer ring of bolts in pinion cage cap and remove pinion subassembly*.
   CAUTION: *The thickness of the shim pack (Part 1.9B) is important in resetting the gears. The shim pack should either be saved or carefully measured with a micrometer. If the gears are to be replaced, record the pinion setting distance that is etched on the pinion gear.*
3. Remove water slinger*.
4. Turn case upside down and remove bearing retainer cap* and shim pack (Part 1.9C).
   CAUTION*: The thickness of this shim pack is important in the backlash setting of the gears. The shim pack should either be saved or carefully measured with a micrometer.*
5. Remove bottom cap and fan shaft assembly.
6. Turn Geareducer case right side up and remove bearing retainer and shim pack (Part 1.9A).
   CAUTION*: The thickness of this shim pack is important in setting the fan shaft bearing endplay. This pack should be saved or carefully measured with a micrometer.*
7. Remove bearing cups (Bearing Assemblies 1.7B and 1.7A) from the bottom bearing retainer cap and Geareducer case using a soft metal punch or mallet.

Pinion Cage Disassembly

1. Remove pinion cage cap* from pinion cage.
2. Remove O-rings* (Parts 1.8B and 1.8C).
3. Remove locknuts and lockwasher (Part 1.1C); then press pinion shaft (Gear Set 1.1A) out of pinion cage. This will free tail bearing cone (Bearing Assembly 1.3B). A hydraulic press or jack is recommended for removing or assembling press fit parts.
4. Press oil slinger*, O-rings* (Parts 1.2 and 1.8D), and head bearing cone (Bearing Assembly 1.3A) from the pinion shaft. Bearings must not be exposed to dirt, dust or moisture.
5. Press bearing cups (Bearing Assemblies 1.3A and 1.3B) out of pinion cage.
6. If oil seal* (Part 1.4) in pinion cage cap is worn or damaged and is to be replaced, it can be removed with a hammer and punch.

Fan Shaft Disassembly

1. Remove ring gear (Gear Set 1.1A) from the ring gear hub (Part 1.5).
2. Press ring gear hub and lower bearing cone (Bearing Assembly 1.7B) off of the fan shaft (Part 1.6).
3. Remove lower fan shaft key (Part 1.6C).
4. Press the top bearing cone (Bearing Assembly 1.7A) off of the shaft.

Assembly

Before assembling a new pinion gear in the pinion cage, check match numbers on pinion gear and spiral bevel ring gear to be certain that they are a matched set. Gears are lapped in matched sets at the factory and should not be separated. Numbers are etched on both the pinion and ring gear as illustrated in Figure 1, page 2.

All parts that are to be reused should be thoroughly cleaned with kerosene before being reinstalled. Do not remove new bearings from carton until ready to use. Wash all bearings (new or used) with kerosene. Do not spin dry bearings. Take each bearing set and roll the cup on the cone to note any roughness. Replace bearing if necessary. If bearings cannot be installed immediately after washing, lubricate and cover them to protect against dust, moisture, etc.

If a press is not available to install bearing cones, they can be heated as long as the temperature does not exceed 275°-300°F. If the bearings get hotter than this, they will begin to draw and soften. Bearings can be heated with infrared lamps or with oil baths. If an oil bath is used, the bearing should be supported an inch or so above the pan to prevent local overheating.

Pinion Cage Subassembly

1. Place O-ring (Part 1.8D) on pinion shaft (Gear Set 1.1A).
2. Place oil slinger (Part 1.2) on pinion shaft.
3. Press head bearing cone (Bearing Assembly 1.3A) on pinion shaft making sure oil slinger and bearing are against gear.
4. Press bearing cups (Bearing Assemblies 1.3A and 1.3B) into pinion cage.

—continues on page 6

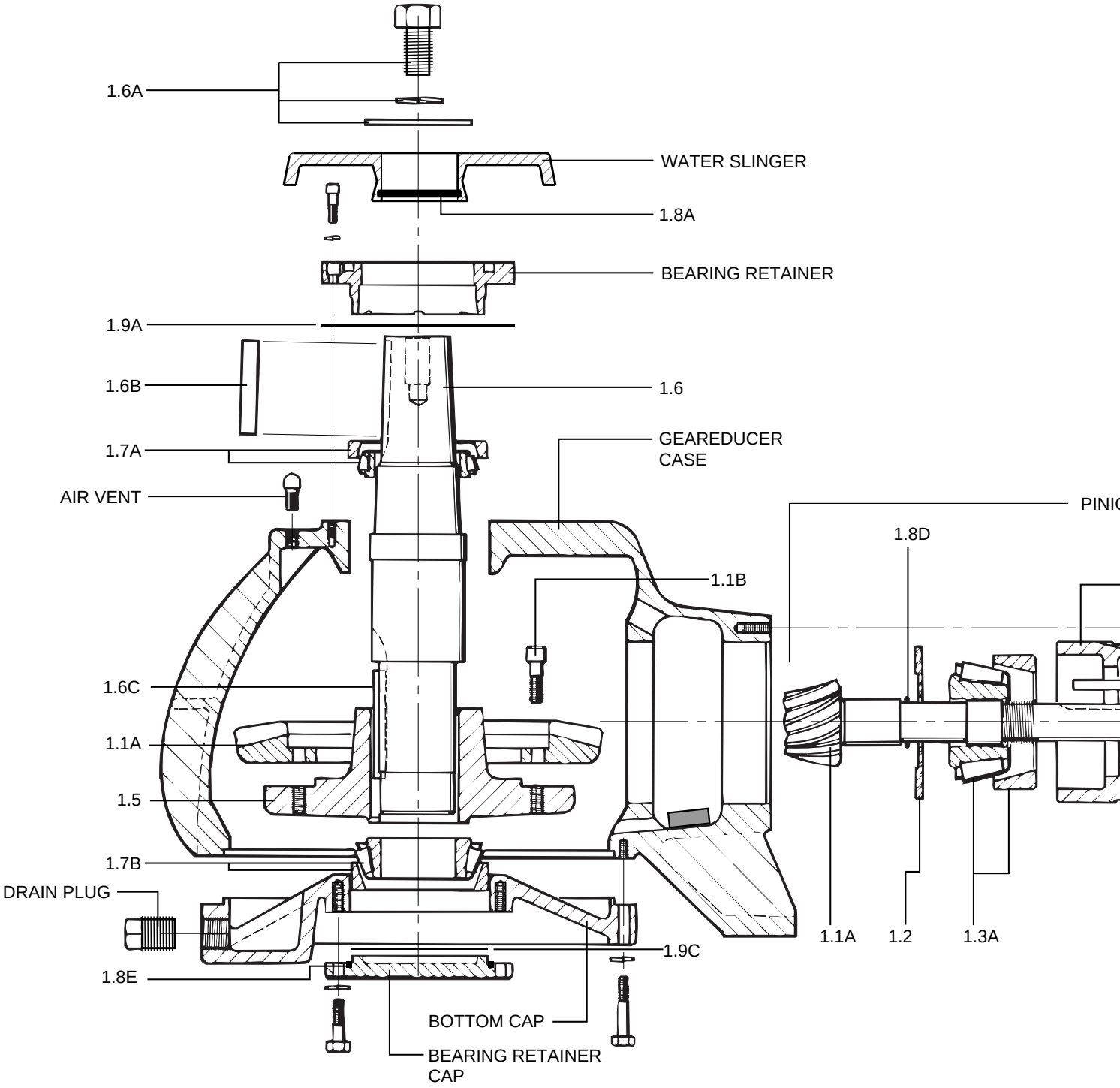


Figure 2 Exploded Cross Section

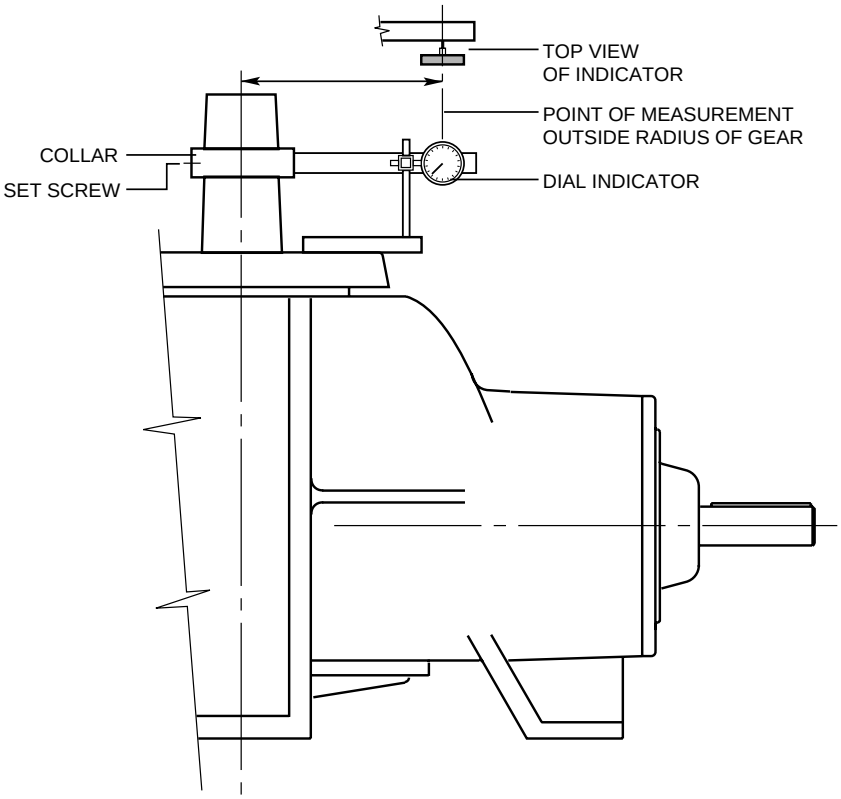
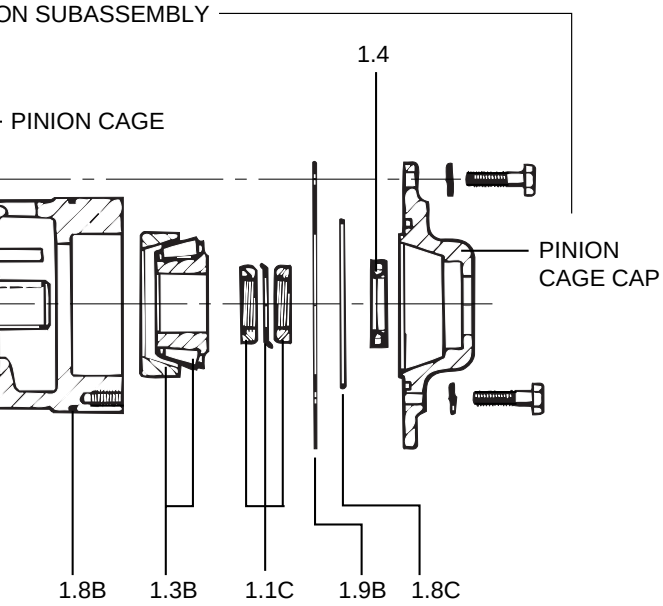


Figure 3 Gear Backlash Measurement



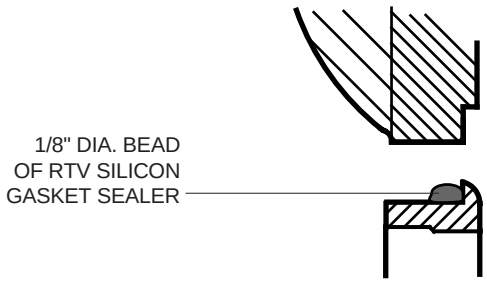


Figure 4 Flange Seal of Bottom Bearing Cap

5. Lower pinion cage on pinion shaft, until head bearing cone and cup mate.
6. Press tail bearing cone (Bearing Assembly 1.3B) on pinion shaft until it mates with its bearing cup.
7. Install locknuts and lockwasher (Part 1.1C). Tighten nuts on bearing cone until 5 to 15 in-lbs of bearing preload is obtained. Bearing preload is the resistance in the bearings to shaft rotation measured in in-lbs torque required to rotate the shaft at uniform velocity. Preload is necessary to insure the stability of the gear engagement. Crimp the lockwasher to hold the two nuts in place.
8. Install O-ring (Part 1.8B) in groove.
9. Install oil seal (Part 1.4) in pinion cage cap. This seal is to prevent oil leaking out of the Geareducer—therefore the sealing lip must point inward. Clean oil seal seat in cap and press seal in place. Use a short piece of pipe with outside diameter .010 to .020 in. less than the seal outside diameter. Do not apply hammer blows or uneven pressure directly to seal surface. Be careful not to tip seal while installing it. Provide a sleeve to protect the seal lip as it passes over the shaft keyway. Shim stock .010 to .015 in. thick can be used for this sleeve as long as the lapping edge is smoothed off and the seal is turned with the lap in the sleeve rather than against it. A small amount of light grease can be used to lubricate the sealing lip.
10. Position O-ring (Part 1.8C) and push cap (with seal and sleeve) in place on shaft. Attach cap to pinion cage and slide sleeve from cap.
11. Record the pinion setting distance that is etched on the pinion gear.

Installation of Fan Shaft

1. Press ring gear hub (Part 1.5) and the upper and lower bearing cones (Bearing Assemblies 1.7A and 1.7B) on the fan shaft (Part 1.6). Install ring gear (Gear Set 1.1A) on ring gear hub and tighten cap screws to 90 ft-lbs torque.
2. Install upper fan shaft bearing cup (Bearing Assembly 1.7A) and bearing retainer using no shims.
3. Turn the Geareducer case upside down and install the fan shaft assembly seating the upper fan shaft bearing cone into its cup. Install the lower bearing cup (Bearing Assembly 1.7B).
4. Install the bottom cover cap using Permatex #2 as indicated in Figure 4 and tighten cap screws to 25 ft-lbs torque. Use old shim pack or make up equivalent thickness shim pack (Part 1.9C) and install the bottom bearing retainer cap. Do not install the O-ring for the bottom bearing retainer at this time. Tighten the cap screws to 25 ft-lbs torque.
5. Turn the Geareducer right side up and rotate the fan shaft several turns in each direction to seat the bearing rollers. With a dial indicator and using the Geareducer case as a reference, measure and adjust the fan shaft bearings to .003-.005 inch endplay. The endplay is adjusted by adding shims (Part 1.9A) under the bearing retainer.

Installation of Pinion Cage

1. The “X” marked pinion and gear teeth should be clearly identified with chalk or other markings which can be seen from the inspection opening or the bottom of the case.
2. Find the difference between the pinion setting distance of the old gear and the new pinion gear and adjust the old shim pack (Part 1.9B) or make a new shim pack to compensate for the different setting distances.
   Example:

Pinion setting distance of old gear	4.883
Pinion setting distance of new gear	4.878
Difference	*.005*

   Remove .005 from shim gap.

3. Install shims (Part 1.9B) and pinion cage subassembly. ***NOTE:*** *Care must be taken not to damage the pinion gear teeth by forcing them into the ring gear teeth.*

Gear Setting Procedure

The proper mounting of the gear set is essential to obtain long life and smooth operation of the gears. The pinion and ring gears were positioned approximately in the preceding steps. The correct gear position is determined by the gear tooth contact pattern and by the backlash.

With the “X” marked tooth on the pinion gear engaged between the two “X” marked teeth on the ring gear, check the backlash with a dial indicator as shown in Figure 3. Lock the pinion shaft against rotation. The amount of movement of the fan shaft, measured at a distance equal to the outside radius of the ring gear is the backlash. The backlash on the 6.50/1 gear set should be between .013 and .018. The backlash on all other ratios of the 22.2 and 22.3 Geareducers should be between .010 and .015. With the “X” teeth engaged, the backlash should be approximately in the middle of the allowable range. Check the backlash at three other points around the ring gear to be sure the backlash is within the specified limits. Adjust ring gear axially by removing or adding shims (Part 1.9C) at bottom bearing retainer.

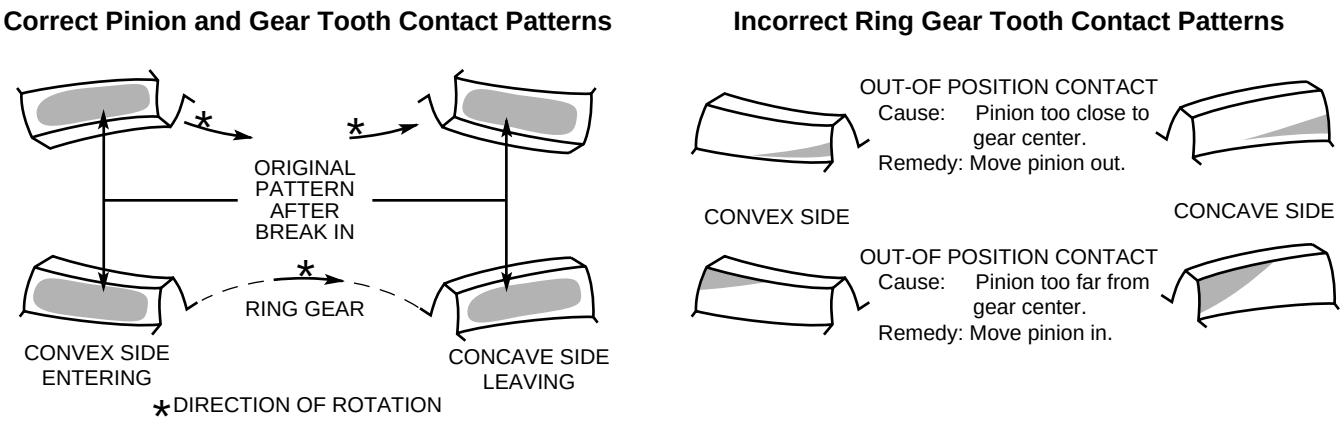


Figure 5 Tooth Contact Pattern—Correct and Incorrect

NOTE: *To maintain bearing adjustment corresponding shim (Part 1.9A) adjustment must be made at the bearing retainer. Example:* Removing .003 shims at the bottom bearing retainer requires the addition of .003 shims at the top bearing retainer to maintain correct bearing adjustment.

Recheck the backlash to make sure it is within the proper limits.

With gears adjusted to the proper backlash, blue (Prussian blue in oil) the pinion teeth. (By using a long handled brush or swab, the pinion teeth can be reached through the inspection opening.) Drive the pinion by turning the fan shaft in both directions for several revolutions. Observe the markings on both gears on both sides of the teeth. Compare the markings with the contact pattern shown in Figure 5.

If contact pattern is incorrect, adjust the pinion position with shims between the pinion cage cap and Geareducer case.

When tooth contact is correct, recheck backlash. If necessary, adjust ring gear to obtain proper backlash and recheck contact pattern. Proper contact is more important of the two. On a used set of gears, it may be necessary to set the gears with slightly greater backlash in order to obtain proper tooth contact. Should a condition be encountered where correct contact cannot be obtained, contact your local Marley sales representative for information on factory repair service.

Final Assembly

1. Remove bottom bearing retainer cap and install the O-ring (Part 1.8E). Reinstall the bottom bearing retainer cap and tighten the cap screws to 25 ft-lbs torque.
2. Install O-ring (Part 1.8A) in water slinger.
3. Install water slinger on fan shaft (Part 1.6).
4. Replace air vent and all pipe plugs.
5. Fill with lubricant selected from Table I or II, page 8. Refer to Geareducer Service Manual for complete service and lubrication instructions.

Lubricants for Marley Geareducers

To insure maximum performance and service life, Marley Cooling Tower Company recommends Marley factory lubricants be used in all Marley spiral bevel Geareducers. Marley lubricants can be purchased through your local Marley sales office in one-gallon and five-gallon containers.

Geareducer model 22.3 was designed for 5-year oil change intervals. To maintain five-year change intervals, use only Marley Gearlube™ designed specifically for this Geareducer model. Gearlube is also recommended for Geareducer model 22.2. Approved alternate synthetic lubricants as outlined in Table I may also be used. If turbine-type mineral oil is used, the oil must be changed every six months.

If lubricants other than Marley factory lubricants are used, they must not contain any additives (such as detergents or EP additives) which are adversely affected by moisture and could reduce the service life of the Geareducer. The responsibility for use of lubricants other than Marley factory lubricants rests with the customer/owner and the lubricant supplier.

Seasonal temperature changes may require one viscosity of oil for summer operation and another for winter operation. Refer to the tables below for the seasonal selection information.

Winter	Winter or Summer	Summer
Air Temperature At Geareducer		
Below 32°F (Heat Exchangers Only)	32°F to 110°F	Above 110°F
SAE 20	**SAE 30**	**SAE 40**
Viscosity S.U.S at 100°F 230-310	Viscosity S.U.S at 100°F 450-610	Viscosity S.U.S at 100°F 750-1000

Table I. Synthetic oil.

Winter	Winter or Summer	Severe Duty/High Temperature
Air Temperature At Geareducer		
Below 32°F (Heat Exchangers Only)	32°F to 110°F	Above 110°F
Marley Gearlube SAE30	**Marley Gearlube SAE30**	**Marley Gearlube SAE40**
Mobil SHC 629	Mobil SHC 629	Mobil SHC 630

Table II. Turbine-type oil.

The Marley Cooling Tower Company
5800 Foxridge Drive
Mission, KS 66202
913 362-1818