

Geareducer[®]

User Manual

SERIES 20.2

Operation and Service Instructions

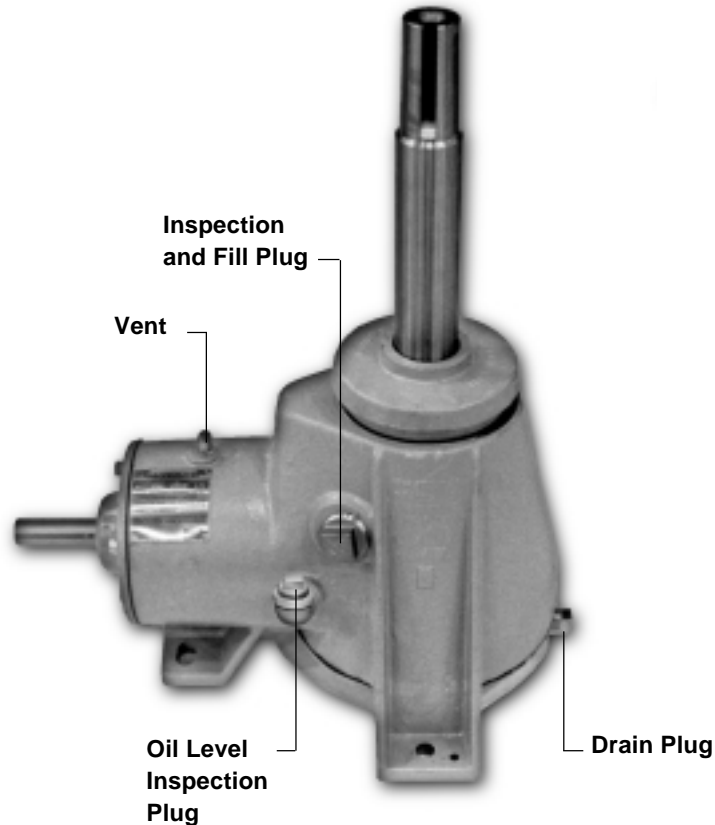


Figure 1 Service Fittings

Initial Operation

Check to be sure that the Geareducer is filled with oil and that there are no visible oil leaks. If equipped with an external dipstick/oil level gauge, be sure the oil full mark corresponds with the full level at the Geareducer.

Geareducers furnished as original equipment on factory-assembled towers are shipped prefilled with Marley Gearlube™ Synthetic Oil. Geareducers for field-erected towers are shipped with the oil packaged in separate containers for installation by the tower erector. Replacement Geareducers do not come with oil as part of the Geareducer assembly. It is the purchaser's responsibility to furnish and install the proper oil for replacement Geareducers prior to start-up.

△ **Note**—If this tower is equipped with a two-speed motor, allow a time delay of at least 20 seconds when switching from high speed to low speed. Allow a time delay of at least two minutes when changing direction of fan rotation. Failure to provide these delays may significantly reduce equipment service life.

Alignment

In order to assure long service life, the mechanical drive system must be properly aligned. Refer to the alignment instructions in the Drive Shaft or Coupling Service Manual (copies available from your Marley Sales engineer).

Lubricants for Marley Geareducers

To insure maximum performance and service life, Marley Cooling Tower Company recommends Marley factory lubricants be used in all Marley Geareducers. Marley lubricants can be purchased through your local Marley sales office in one-gallon (3.8 litre) and five-gallon (19 litre) containers.

The Series 20.2 Geareducer was designed for 5-year oil change intervals. To maintain five-year change intervals, use only Marley Gearlube. 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.

Operation and Service Instructions

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	Severe Duty/High Temperature
Air Temperature At Geareducer		
Below 32° F (0° C) (Heat Exchangers Only)	32° F to 110° F (0° C to 43° C)	Above 110° F (43° C)
Marley Gearlube ISO150	Marley Gearlube ISO150	Marley Gearlube ISO220

Table 1 Synthetic oil

Winter	Winter or Summer	Severe Duty/ High Temperature
Air Temperature At Geareducer		
Below 32° F (0° C) (Heat Exchangers Only)	32° F to 110° F (0° C to 43° C)	Above 110° F (43° C)
ISO 68	ISO 100	ISO 220

Table 2 Turbine-Type oil

Scheduled Maintenance

△ Warning—Make certain that mechanical equipment is inoperable during periods of maintenance—or during any situation of possible endangerment to personnel. If your electrical system contains a disconnect switch, lock it out until the period of exposure to injury is over.

Every Six Months—Check Geareducer oil level. Shut down the unit and allow 5 minutes for the oil level to stabilize. Add oil if required, noting the addition in your maintenance log. If equipped with an external dipstick/oil level gauge, small quantities of oil can be added at that location.

Check that all the assembly bolts and cap screws are tight, that oil plugs and pipe connections are in place and free from leaks, and that the vent on the Geareducer (and external dipstick/oil level gauge, if present) is clear—a clogged vent can lead to oil leaks. Check mechanical equipment anchor bolts, drive shaft coupling bolts, and coupling set screws. Tighten as required. If using turbine-type mineral oil, change oil (see below for instructions).

Every 5 Years—Change the Geareducer oil by removing the drain plug. See Figure 1 for location. If equipped with an



Operation and Service Instructions

Scheduled Maintenance—continued

external dipstick/oil level gauge, remove the drain plug at that location, and drain the entire system. Clean the drain plug before reinstalling.

To maximize service life of the Geareducer, remove a sample from the drained oil and look for evidence of foreign material, such as water, metal shavings or sludge, or send the oil sample to an oil analysis lab for inspection. If you find unacceptable condensation or sludge, flush the Geareducer with mineral oil before refilling.

After inspection is complete, fill the Geareducer with **5 quarts** (4.7 liters) of Gearlube. See Figure 1 for location. If the geareducer is equipped with an external dipstick/oil level gauge an additional 2 to 3 quarts (1.9 to 2.8 liters) of oil will be required. Be certain that the vent on the Geareducer (and external dipstick/oil level gauge, if present) is not plugged. Verify that the gauge/drain line is full and that there aren't any leaks at the connections.

Protection Against Corrosion

All Marley Geareducer units ship from the factory with a protective coating of epoxy enamel paint on all unmachined parts and with rust-proofing coatings on machined surfaces. These coatings normally protect a new Geareducer against atmospheric corrosion during storage periods for up to six months. After Geareducer is filled with oil it should be run once a week to keep a protective coating of oil on all interior machined surfaces.

Check Geareducer exterior yearly and touch up with epoxy paint if required. If your Geareducer is equipped with an oil gauge and drain line, coat any exposed threads at pipe joints to prevent corrosion.

Repair and Overhaul

If your Geareducer ever needs replacement or repair, Marley recommends returning the unit to the Marley factory service center. A factory reconditioned Geareducer carries a one year warranty. Obtain a "Customer Return Material" tag from your Marley Sales engineer and attach the tag to the Geareducer for return.

Major repairs require the use of a fully equipped machine shop. If you decide to repair or overhaul your Geareducer, refer to the Field Repair Section and Geareducer Parts List.

Field Repair Instructions

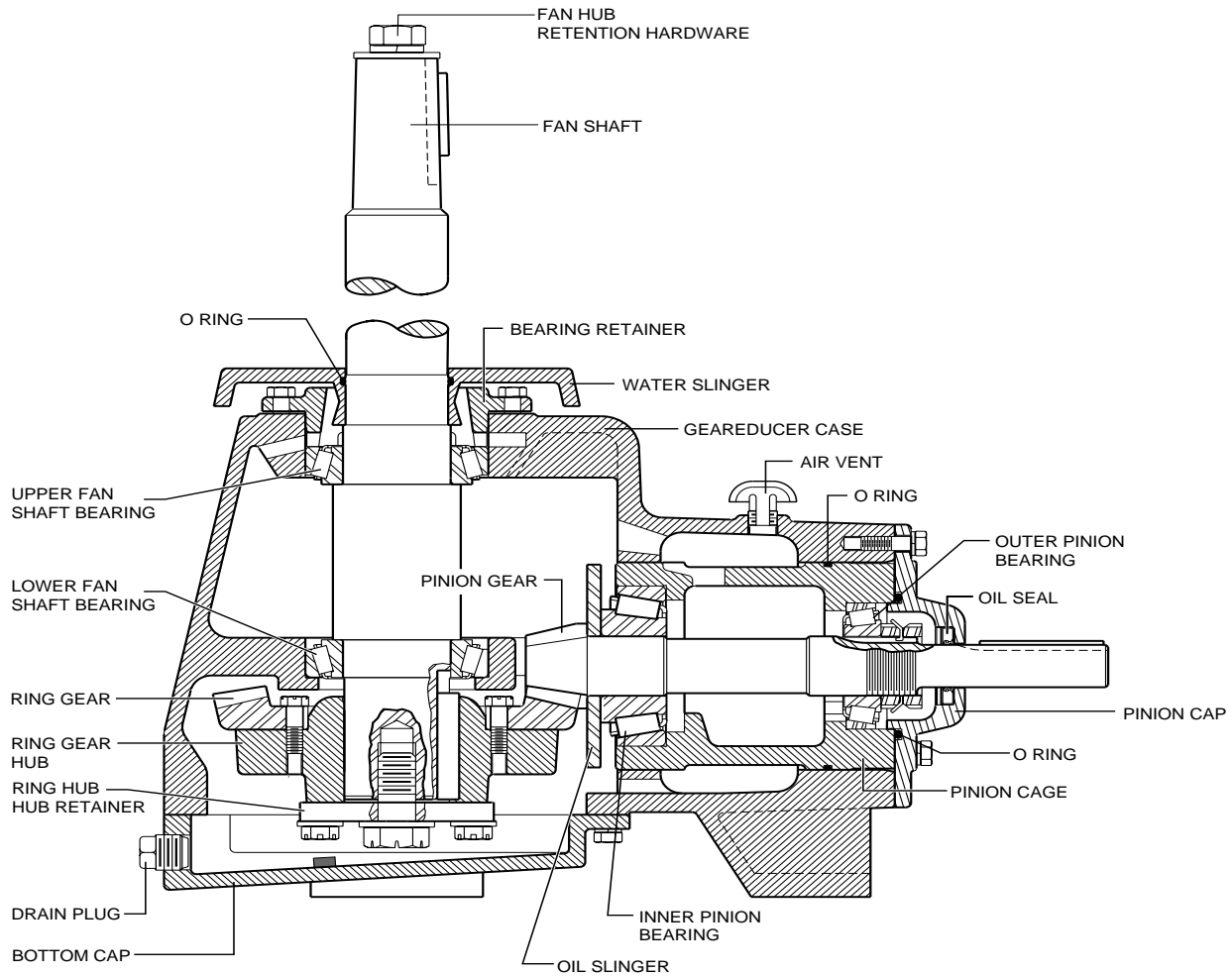


Figure 2 Cross Section

When field repair is necessary, the following procedure is recommended for the disassembly and assembly of the unit. Marley recommends that new O-rings and oil seal be installed if disassembly of the Geareducer requires those parts be removed or during a major overhaul.

Disassembly

Item numbers—refer to Fig. 3, pages 6 and 7.

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 this shim pack (Item 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 bottom cap.
4. Remove ring gear hub retainer (Item 1.5) and shim pack (Item 1.9C) and pull ring gear hub (Item 1.5).

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Field Repair Instructions

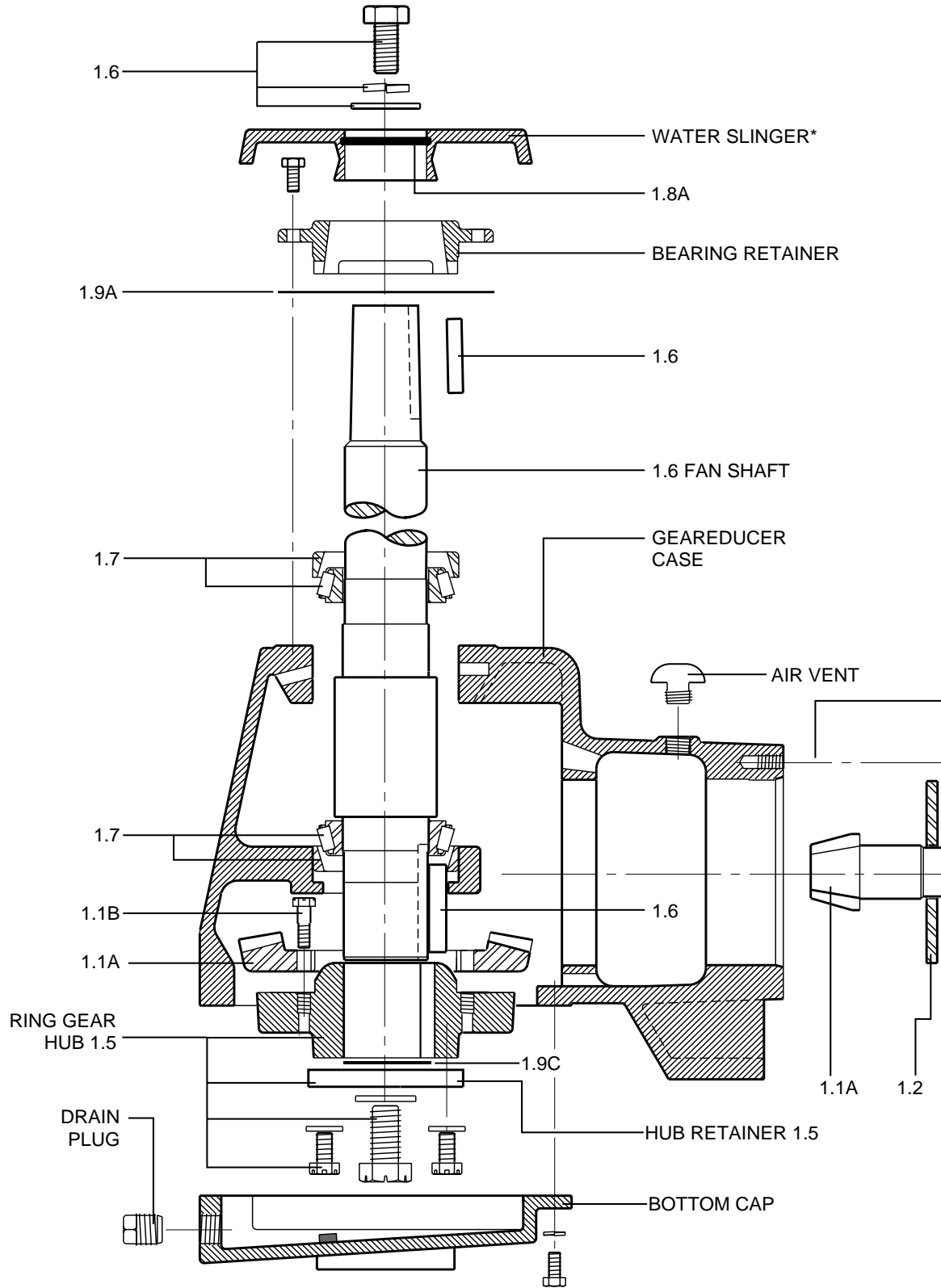


Figure 3 Exploded Cross Section

Field Repair Instructions

Replacement Parts

1.0 COMPLETE GEAREDUCER ASSEMBLY

Ready for installation. Oil required.

1.1 SPIRAL BEVEL GEAR SET

- A. Set of matched spiral bevel gears including integral pinion shaft with key and ring gear attaching hardware.
- B. Pinion shaft locknuts and lockwasher (included with 1.1A).

1.2 OIL SLINGER

1.3 SET OF TWO PINION GEAR BEARINGS

- A. Head (inner)–tapered roller bearing.
- B. Tail (outer)–tapered roller bearing.

1.4 PINION GEAR OIL SEAL

1.5 RING GEAR HUB

with ring gear hub retainer and attaching hardware.

1.6 FAN SHAFT

with keys and fan hub retaining hardware.

1.7 SET OF TWO FAN SHAFT BEARINGS

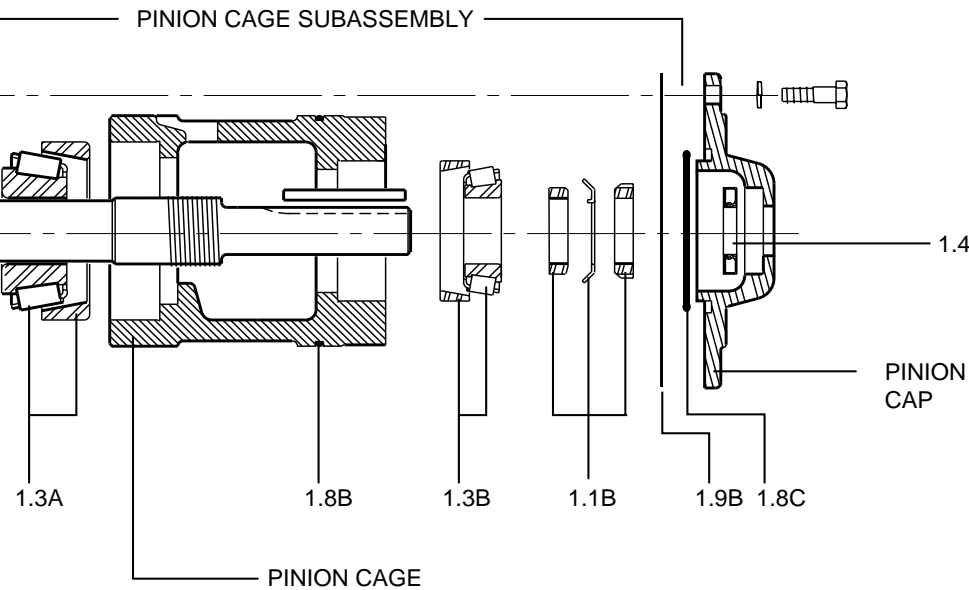
Upper and lower.

1.8 O-RING SEAL SET.

- A. Water slinger seal.
- B. Pinion cage seal.
- C. Pinion cage cap seal.

1.9 SHIM Kit.

- A. Upper fan shaft shims.
- B. Pinion cage shims.
- C. Ring gear hub shims.



Field Repair Instructions

△ **CAUTION**—The thickness of this shim pack (Item 1.9C) is important in the backlash setting of the gears. The shim pack should either be saved or carefully measured with a micrometer. The gear hub may be removed by using the fan shaft disc and place bolts, or a hub puller can be used by making a special plate; similar to the fan shaft disc, with a clearance hole that will allow the puller to push against the fan shaft (Item 1.6). Loosely attach plate to gear hub and pull against plate with hub puller. A metal disc should be placed between the fan shaft and the hub puller to protect the end of the fan shaft.

5. Remove water slinger.
6. Remove bearing retainer and shim (Item 1.9A).
7. Press or pull fan shaft (Item 1.6). The top bearing cup (Item 1.7) will be removed with the fan shaft.
8. Remove ring gear (Item 1.1A) from ring gear hub.

Pinion Cage Disassembly

1. Remove pinion cap from pinion cage.
2. Remove pinion cage subassembly.
3. Remove O-rings (Items 1.8C and 1.8B).
4. Remove locknuts and lock washer (Items 1.1B) then press pinion shaft (Item 1.1A) out of pinion cage. This will free the tail bearing cone (Item 1.3B). A hydraulic press or jack is recommended for removing or assembling press fit parts.
5. Press oil slinger (Item 1.2) and head bearing cone (Item 1.3A) from the pinion shaft. Bearings must not be exposed to dirt, dust or moisture.
6. Press bearing caps (Item 1.3A and 1.3B) out of pinion cage.
7. If oil seal (Item 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. Press or pull top upper cone (Item 1.7) from end of fan shaft.
2. Press or pull lower bearing cone (Item 1.7) from fan shaft.
3. Press lower fan shaft bearing cup (Item 1.7) out of case.

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 4, below.

All parts that are to be reused should be thoroughly cleaned with solvent before being reinstalled. Bearings that are to be reused should be checked by rolling each bearing on the bearing cone to note any roughness. Replace bearing if necessary.

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 (135° to 149°C). 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 (25 mm) or so above the pan to prevent local overheating.

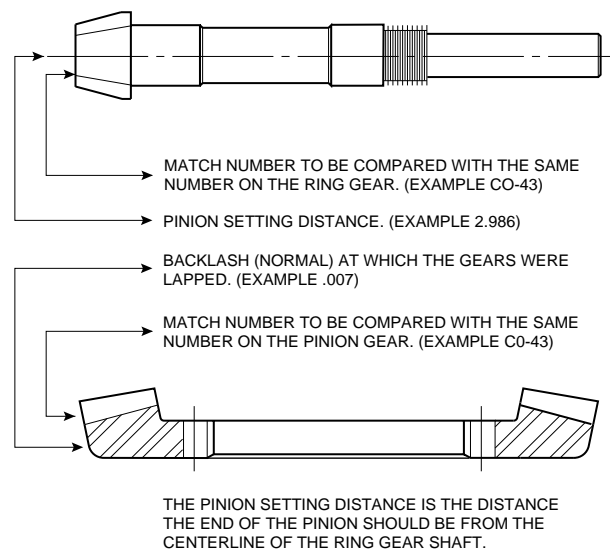


Figure 4 Gear Match Numbers and Setting Data

Field Repair Instructions

Pinion Cage Subassembly

1. Place oil slinger (Item 1.2) on pinion shaft (Item 1.1A).
2. Press head bearing cone (Item 1.3A) on pinion shaft making sure oil slinger and bearing are against gear.
3. Press bearing cups (Items 1.3A and 1.3B) into pinion cage.
4. Lower pinion cage on pinion shaft, until head bearing cone and cup mate.
5. Press tail bearing cone (Item 1.3B) on pinion shaft until it mates with its bearing cup.
6. Install locknuts and lockwasher (Items 1.1B). Tighten nuts on bearing cone until 5 to 15 in-lb_f (.57 to 1.7 N·m) of bearing preload is obtained. Bearing preload is the resistance in the bearings to shaft rotation measured in in-lb_f torque required to rotate the shaft at uniform velocity. Preload is necessary to insure the stability of the gear engagement. Crimp the lock-washer to hold the two nuts in place.
7. Install O-ring (Item 1.8B) in groove.
8. Install oil seal (Item 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 an outside diameter .010 to .020 in. (.254 to .508 mm) less than the retainer 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. (.254 to .381 mm) 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.
9. Position O-ring (Item 1.8C) and push pinion cage cap (with seal and sleeve) in place on shaft. Attach cap to pinion cage and slide sleeve from cap.
10. Record the pinion setting distance that is etched on the pinion gear.

Installation of Fan Shaft

1. Press lower bearing cup (Item 1.7) in case.
2. Press bearing cones (Items 1.7) on fan shaft (Item 1.6).
3. Lower fan shaft into case until bearing cone mates with bearing cup.

4. Press upper bearing cup (Item 1.7) into case.
5. Install bearing retainer and adjust cap screws until a bearing preload of 5 to 15 in-lb_f (.57 to 1.7 N·m) is obtained. Measure the gap between the bearing retainer and the case. Make a shim pack (Item 1.9A) equal to the thickness of this gap. Remove ring and install shim pack. Reinstall bearing retainer and check bearing preload. If necessary, adjust shim gap to obtain the proper bearing preload .

Installation of Ring Gear Hub

1. Attach ring gear (Item 1.1A) to the hub (Item 1.5). Use 50 to 55 ft-lb_f (68 to 75 N·m) torque on place bolts.
2. Press ring gear hub on the fan shaft.

△ **CAUTION**—Block the end of the fan shaft while pressing hub on shaft. Do not press against top bearing. The tapped hole—7/8-14NF x 1.50 deep—in the end of the fan shaft may be used to pull the hub on. (If the tapped hole is used, check around the hole after the hub is on to be sure there are no raised edges that would keep the shims (Item 1.9C) from seating properly against the shaft.) Stop the bottom edge of the hub approximately .100 in. (2.54 mm) from the end of the shaft.

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 (Item 1.9B) or make a new shim pack to compensate for the different setting distances.

Example:

Pinion setting distance of old gear	2.883" (73.23 mm)
Pinion setting distance of new gear	2.878" (73.10 mm)
Difference	.005" (.130 mm)

Remove .005 (.13 mm) from shim pack.

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



Field Repair Instructions

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 5. 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 all gear ratios should be between .005" and .012" (.127 mm and .305 mm). With the "X" teeth engaged the backlash should be approximately in the middle of the allowable range. Adjust the ring gear axially until the proper backlash is obtained. Check the backlash at three other points around the ring gear to be sure the backlash is within the specified limits. The fan shaft disc and the standard place bolts may be used to adjust the ring gear in either direction. After the correct backlash is obtained, remove fan shaft disc and measure the distance from the end of the fan shaft with a depth micrometer. Install a shim pack (Item 1.9C) equal to this depth and replace the disc. Tighten the center bolt (before tightening the outside bolt circle) to 200 ft·lb_f (272 N·m) torque. Tighten outside bolt circle to 85-90 ft·lb_f (116-122 N·m) torque.

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 6. 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 the 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

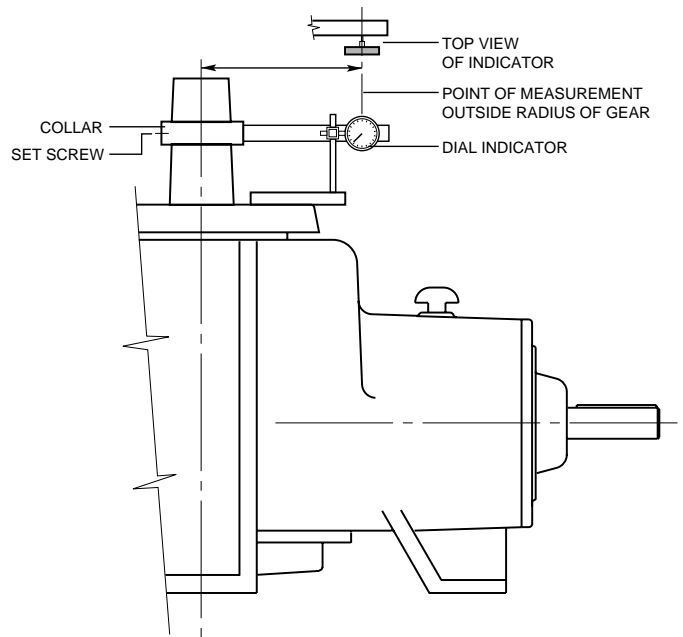


Figure 5 Gear Backlash Measurement

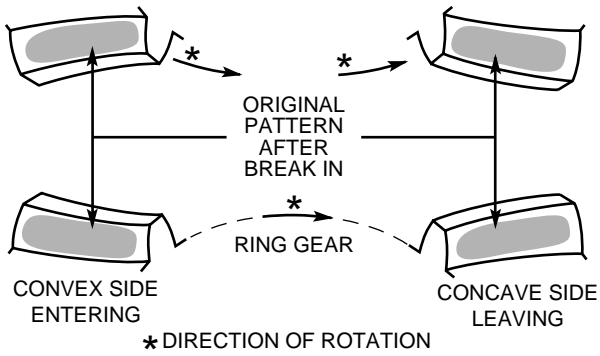
correct tooth contact pattern cannot be obtained, contact your local Marley sales representative for information on factory repair service.

Final Assembly

1. Apply 1/8" (3 mm) diameter bead of RTV silicone gasket sealer to flange of bottom cap. Bead to be centered on flange, and to be inside of and adjacent to bolt holes (see Figure 7).
2. Install bottom cap and tighten attaching cap screws to 25 ft·lb_f (34 N·m) torque.
3. Install O-ring (Item 1.8A) in water slinger.
4. Install water slinger on fan shaft (Item 1.6).
5. Replace air vent and all pipe plugs.
6. Fill with lubricant selected from Table 1, page 3. Refer to Operation and Service Instructions for complete service and lubrication instructions.

Field Repair Instructions

Correct Pinion and Gear Tooth Contact Patterns



Incorrect Ring Gear Tooth Contact Patterns

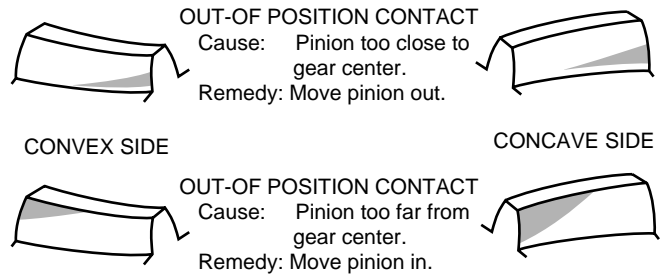


Figure 6 Tooth Contact Pattern—Correct and Incorrect

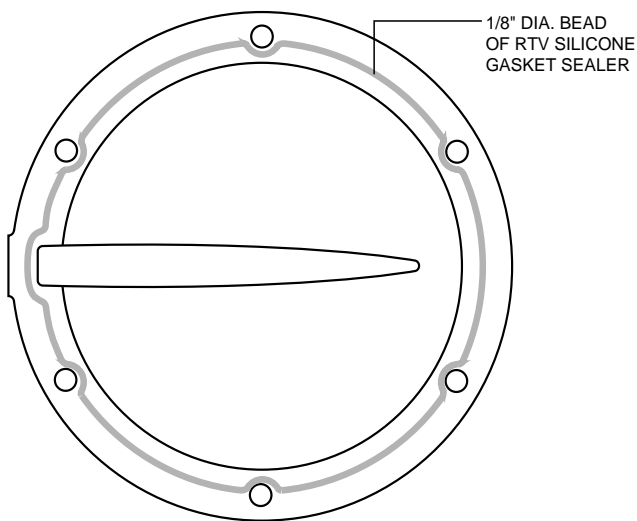


Figure 7 Bottom Cap



Marley Cooling Tower

A United Dominion Company

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