13. HM

Darley

Repair Service Instructions

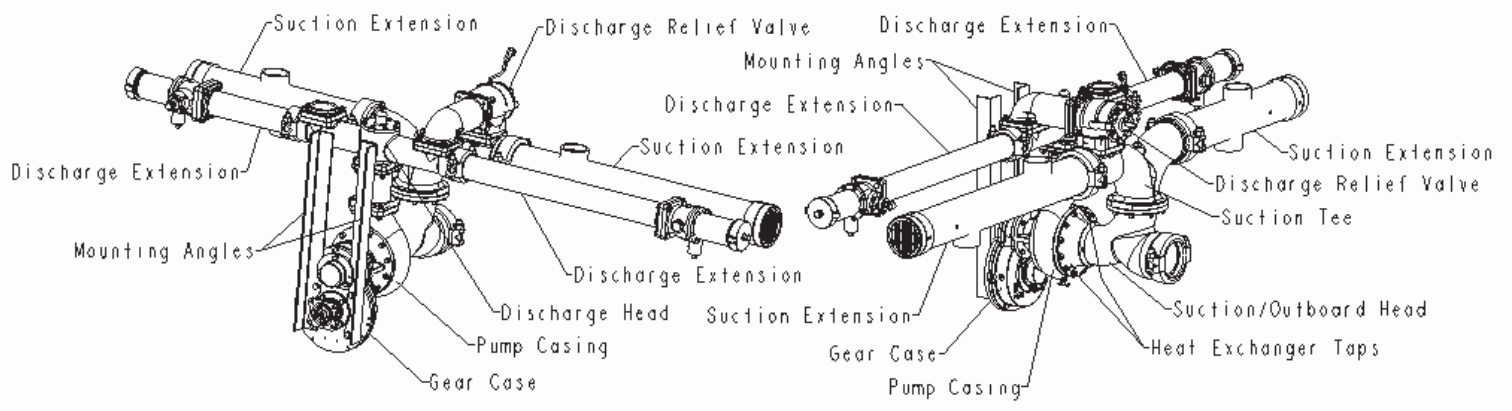
Type **HM** - PTO Driven Fire Pumps,
With Two Gear Transmission

Glossary and abbreviations:

HHCS: Hex Head Cap Screw
ID: Inside Diameter
OD: Outside Diameter
SHCS: Socket Head Cap Screw
NC: National Coarse Thread
Q-ring: Quad Ring - A ring, similar to an o-ring, used for gasket type sealing.
SS: Stainless Steel
Tach: Tachometer
Volute: Pump Casing

Remove HM Pump and Transmission from Truck Chassis

Refer to Drawings DHC1701 & DHC0506



The HM pump, when supplied with the Darley suction manifold and discharge head, may be removed by unbolting at both of the companion flanges, leaving the suction and discharge piping in place, when properly supported. The HM pump should have a separable joint in the suction piping so that the pump, including its suction head, may be removable independently of the piping.

1. Drain all oil from the pump gear case.
2. Disconnect the following from the pump:
   Gage Line Tubing
   Primer Tubing
   Drain Line Tubing
   Tach Drive Cable if equipped
   Pump Heat Exchanger Plumbing
3. Disassemble the PTO drive shaft from the pump. Mark the PTO shaft halves, at the slip joint, to ensure proper alignment (fazing) of the yokes during re-installation.
4. Remove four 3/8-NC fasteners from discharge adapter flange or discharge head.
5. Remove bolting between the suction head (73 dwg DHC1701) and manifold piping.

6. - If possible to use an overhead hoist capable of supporting not less than 500 pounds to support the weight of the pump assembly, remove the bolting from the two angle iron hangers attached to the gear case, and carefully lower the pump to the ground.
   - If it is not possible to use an overhead hoist, provide proper support to the pump from below, capable of supporting not less than 500 pounds to support the weight of the pump assembly, remove the bolting from the two angle iron hangers attached to the gear case, and carefully lower the pump to the ground.

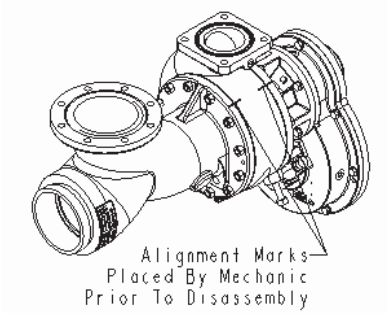
Pump Disassembly for Overhaul

Refer to Drawing DHC1701

Additional reference drawings: DHC1702, DHC0506, DHC0511, DHC0505, & DHC0700

NOTE: Discard and replace with new: all oil seals, bearings, gaskets, o-rings, and q-rings.

1. Mark the volute (18), inboard head (2), and outboard head (73), to ensure the volute is put back on, in the correct orientation, during re-assembly.



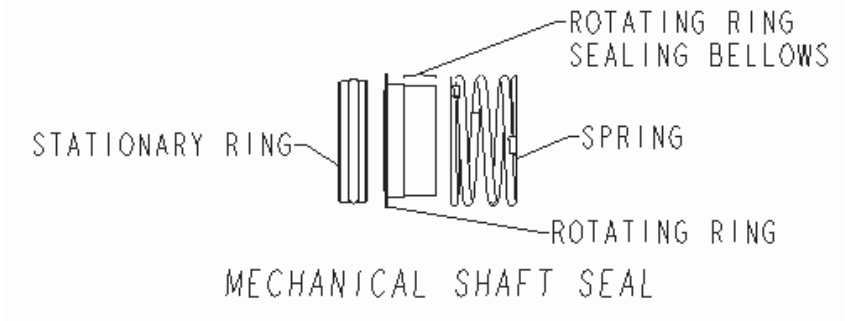
2. Remove twelve 3/8-NC nuts (95) holding the outboard head (73) to the volute (18), and separate the parts.
3. Remove twelve 3/8-NC nuts (95) holding the volute (18) to the inboard head (2) and separate the parts.
4. Remove the cotter pin (26), impeller nut (25), and impeller washer (27). Remove the impeller (21) by placing two flat pry bars between the impeller shroud and the inboard head (2), on opposite sides and in line with vane support.

   Pumps with a Mechanical Shaft Seal:

   - Slide the mechanical seal (90 dwg DHC1702) spring off the impeller shaft.
5. Remove the packing gland nut (84), adjustment screw (85), and piston (12). If the impeller shaft (24) is sealed with a mechanical shaft seal (90 dwg DHC1702) these items will not be present.
6. Remove the four 5/16-NC cap screws (10 dwg DHC0506) and lock washers (32 dwg DHC0506) holding the inboard head (2) to the gear case (30 dwg DHC0506) and slide the inboard head off the impeller shaft (24). The water slinger (4) will also slip off.

   Pumps with a Mechanical Shaft Seal:

   - As you slide the inboard head off the impeller shaft, the rotating portion of the mechanical seal (90 dwg DHC1702) will also need to slide off the impeller shaft. The sealing bellows of the rotating portion of the mechanical shaft seal will be adhered to the impeller shaft.
   - After removing the inboard head from the impeller shaft, remove both the rotating and stationary rings of the mechanical seal from the mechanical seal housing (87 dwg DHC1702).



7. At this point the impeller seal rings (21), stuffing box (87) and impeller shaft may be checked for wear. (Note pumps equipped with a mechanical shaft seal will not need to have the seal housing (87 dwg DHC1702) measured.) Original impeller seal ring OD is 3.864/3.862" and stationary seal ring (22) ID 3.877/3.875", which provides clearance of .011 to .015" on the diameter. Measure both seal ring diameters with vernier calipers. If the clearance exceeds .025" on the diameter and impeller is otherwise in good condition, the stationary seal rings can be replaced with special undersized seal rings, and the impeller seal rings can be trued to an OD of 3.814/3.812" to match.

   If the impeller seal rings have already been turned down once, the impeller seal rings can be restored to original size by soldering a ring over a trued surface that retains a minimum wall thickness of .090". Stationary seal rings also need to be replaced with the original sized seal rings.

   The original stuffing box hole diameter is 1.2535/1.2525". The original impeller shaft diameter is 1.246/1.245", which provides .006 to .008" clearance on the diameter. If the measurements of the shaft and stuffing box hole show diametric clearance of .012" or more, the shaft should be replaced or restored to its original size by having the metallizing replaced, and/or stuffing box replaced.

8. If the stuffing box (87) needs replacing, the impeller shaft oil seal (20 dwg DHC0506) and stuffing box may be removed at the same time by pressing against the oil seal with a suitable pusher, about 2.00" diameter.

   If the stuffing box does not need to be removed, the oil seal can be pulled out, using a hook.

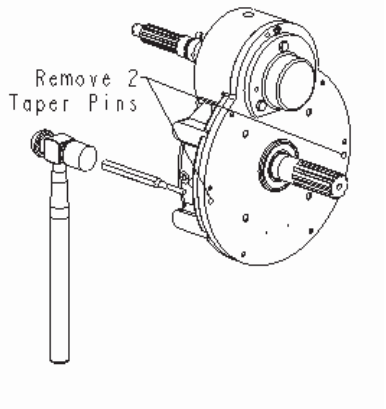
Gear Case Disassembly for Overhaul

Refer to Drawing DHC0506

Additional reference drawings: DHC1701, DHC1702, DHC0511, DHC0505, & DHC0700

NOTE: Discard and replace with new: all oil seals, bearings, gaskets, o-rings, and q-rings.

1. Remove four 5/16-NC HHCS (10) and lock washers (32); and the drive shaft bearing cap (6).
2. Remove and discard the oil seal (21) from the bearing cap (6).
3. Remove the three 5/16-NC cap screws (10) and lock washers (32); and the drive shaft bearing cap (5).
4. Mark one of the two taper pins in the flange of the gearcase (30), to ensure that, during reassembly, the same pin goes back into the same hole it came out of. Drive the two taper pins out of the gear case flange, from the gear case side, to the gear case cover side.



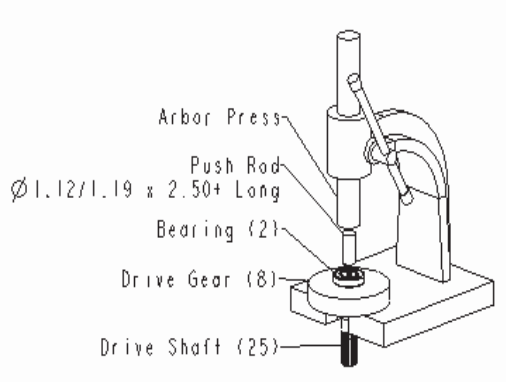
5. Remove seven 5/16-NC cap screws and lock washers holding the gear case cover to the gear case (30) and separate. Three 5/16-NC jack screws holes are provided to assist separation. Screw the jack screws in evenly. Both impeller shaft (26) and drive shaft (25) assemblies may now be removed form the gear case halves.
6. Remove the three 5/16-NC cap screws (10), lock washers (32), and the impeller shaft bearing cap (1).

Pumps with a Tachometer/Speed Counter Drive (refer to drawing DHC0700):

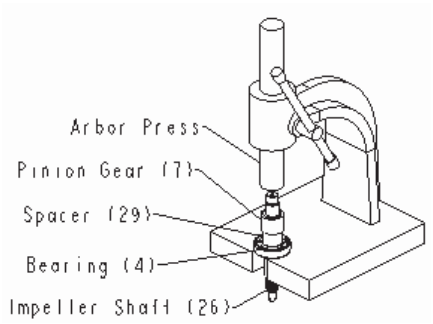
- Prior to 1993, the tach worm gear (8) was pressed onto the pump drive shaft. Pumps that do not have the worm gear pressed onto the shaft have a retaining ring (7) holding the worm gear to the shaft.
- If there is a retaining ring (7) holding the worm gear (8) in place:
  - Using a small flat screwdriver, remove the retaining ring (7).
  - Slide the worm gear (8) off the drive shaft (49).
  - Remove the tach drive key (6).
- If there is no retaining ring (7) holding the worm gear (8) in place, and the worm gear is pressed onto the drive shaft (25 dwg DHC0506), then using an arbor press, press the worm gear off the shaft, while

pressing the gear (8 dwg DHC0506), spacer (28 dwg DHC0506) and bearing (2 dwg DHC0506) off the shaft, all at once. See step 7.

7. Use an arbor press to remove the drive shaft (25) from the drive gear (8). Support the shaft spline side of the gear, and place a 1-3/16" dia. x 2-1/2" long pusher rod against the end of the shaft to press the shaft out of the gear, spacer (28), and bearing (2).



8. Support the bearing (2) that is closest to the splined end of the drive shaft (25), and press the drive shaft out of the bearing.
9. Use an arbor press to press off the smaller bearing (3) from the impeller shaft (26).
10. Straighten the lock tab of the lock washer (14), and unscrew the locknut (13) from the impeller shaft (26).
11. Support the larger impeller shaft bearing (4), and press the impeller shaft (26) out of the pinion gear (7), spacer (29) and bearing.



12. Clean all parts and carefully inspect for wear or deterioration. Both the drive and pinion gears may be reversed to work the other side of the gear teeth. Replace any questionable parts. Measure bearing housing bores for proper size as follows:

PART	REP. NO.	ORIGINAL BORE DIA. IN.
Gear case Cover		2.8353/2.8346
Gear case		2.8353/2.8346
Bearing Cap	1	2.4409/2.4416
Inboard Head	9	3.1503/3.1496

If any bore exceeds the high limit by .0005", the part should be replaced.

The original impeller shaft (26) diameters are as follows:

Under the pinion gear (7) is 1.1880/1.1875"
Under bearing (4) is 1.3785/1.3871"
Under bearing (3) is 0.9848/0.9844"

The sizes under the bearings are required to insure a press fit with the inner bearing race.

The original pinion gear (7) bore size is 1.1875/1.1870"; providing .000 to .001" press fit. The parts could still be serviceable up to .0005" of clearance.

The original drive shaft (25) diameter under the drive gear (8) and both bearings (2) is 1.3783/1.3779".

The original drive gear (8) bore size is 1.3780/1.3785" providing .0003" press fit to .0006" clearance. The parts could be serviceable up to .0011" clearance.

Pumps with a Tachometer/Speed Counter Drive (refer to drawing DHC0700):

- If the tach gear (3) shows excessive wear, or the tach shaft (2) shows signs of excessive play inside the tach sleeve bearing (1), disassemble and replace worn parts with new ones.
- Using a hammer, and a small punch, drive the drive pin (4) out of the tach gear (3) and tach shaft (2).
- Remove the tach shaft (2) and tach gear (3) by sliding the tach shaft out of the sleeve bearing (1).
- To replace the sleeve bearing (1), it is necessary to first push the plug (5) into the tach gear cavity of the bearing cap (35). Remove the plug, and press the sleeve bearing out of the bearing cap.

HM Transmission Assembly

Refer to Drawing DHC0506

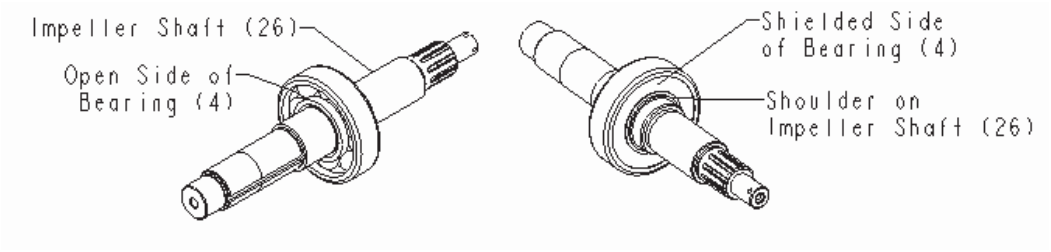
Additional reference drawings: DHC1701, DHC1702, DHC0511, DHC0505, & DHC0700

Before Starting Assembly:

- Please read the Darley Basic Assembling Techniques (document 1205529), for the proper techniques recommended for assembling most Darley pumps.
- Replace all oil seals, bearings, gaskets, o-rings, and q-rings with new ones.
- When lubricating parts with oil for assembly, use the same oil used in the pump transmission gear case.
- When installing an o-ring or a q-ring in the transmission assembly, lubricate it prior to installation with the same oil used in the pump transmission gear case.
- When installing an o-ring or a q-ring in the pump assembly, suction, or discharge, lightly lubricate it prior to installation with silicon based grease, such as Dow Corning 111. Be careful not to apply too thick of a film of lubricant, because over application of the grease can cause the o-ring/q-ring to bridge and leak.
- If no o-ring or gasket was used between the inboard head, engine adapter, or bearing caps, and the gear case, use a bead of Loctite 518 Master Gasket, or the equivalent.

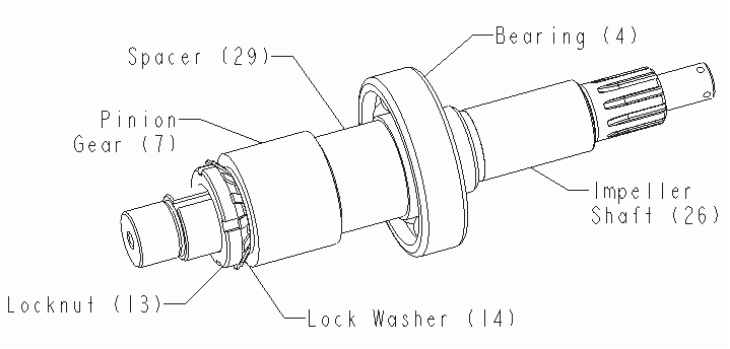
Impeller Shaft Assembly

1. Apply a light coating of oil to the bore of the larger impeller shaft bearing (4). Pressing only on the inner race of the bearing, press this bearing evenly into position, with the shielded side of the bearing against the shoulder of the impeller shaft (26).

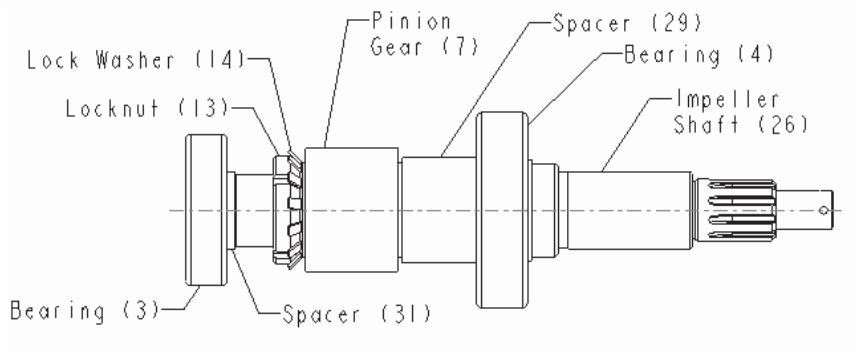


2. Place the spacer (29) against the bearing (4).
3. Place the pinion key (12) in the keyway in the impeller shaft (26).
4. Apply a light coating of oil to the bore of the pinion gear (7) and the pinion gear journal of the impeller shaft (26), line up the keyway in the gear with the key in the shaft, and press the pinion gear into place, tight against the spacer (29).

5. Put the bearing lock washer (14) and locknut (13) onto the impeller shaft (26), and tighten securely. Bend one of the lock washer locking tabs into one of the locknut notches.

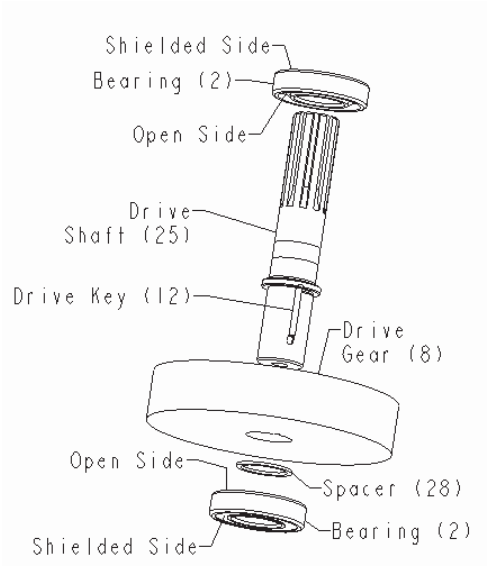


6. Put the bearing back up spacer (31) in place, on the impeller shaft (26).
7. Apply a light coating of oil to the bore of the smaller impeller shaft bearing (3). Pressing only on the inner race of the bearing, press this bearing evenly into position, against the bearing backup spacer (31).



Drive Shaft Assembly

8. Place drive gear key (12) in the drive shaft (25) keyway.
9. Apply a light coating of oil to the drive gear journal of the drive shaft (25) and the bore of the drive gear (8). Align the drive key (12), with the keyway in the drive gear, and press the shaft evenly into the drive gear bore, until the shaft shoulder is tight against the side of the gear.
10. Slide spacer (28) onto drive shaft (25).
11. Apply a light coating of oil to the bore of the bearing (2) next to spacer (28). Pressing only on the inner race of the bearing, press it onto the drive shaft (25); with the open side (side with no shield) facing the spacer, until the gear, spacer, and bearing are tight together against the shaft shoulder.
12. Apply a light coating of oil to the bore of bearing (2). With the open side of the bearing toward the drive shaft shoulder (25) and gear (8), and pressing only on the inner race of the bearing, press the bearing onto the drive shaft, until it is tight against the shaft shoulder.



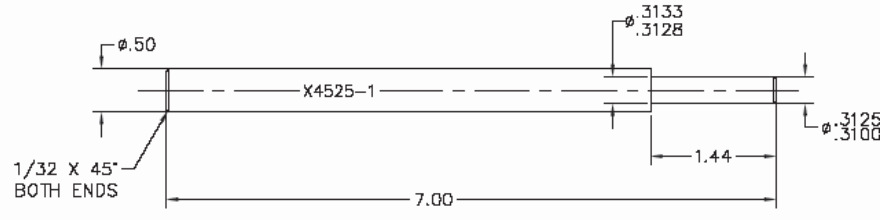
Pumps with a Tachometer/Speed Counter Drive (refer to drawing DHC0700):

If the tach worm gear (8) is pressed onto the drive shaft (49):

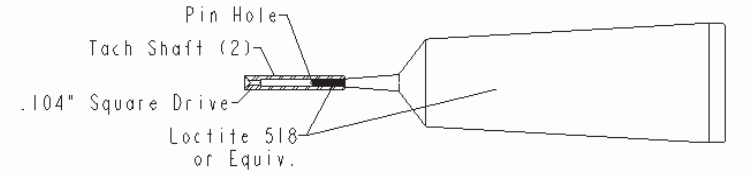
- Apply a light coat of oil to the bore of the tach worm (8) and press evenly into place against the bearing (2 dwg DHC0506), with the tach worm gear's shoulder towards the bearing.

If the tach worm gear (8) is held in place with a retaining ring (7):

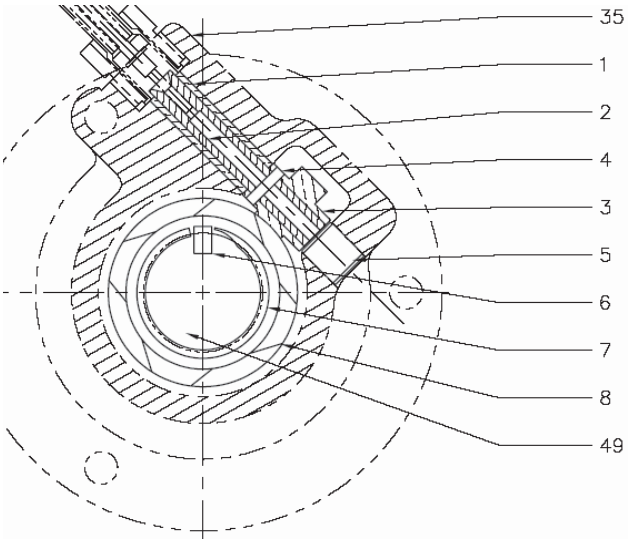
- Install the woodruff drive key (6) in the keyway in the drive shaft (49).
- Apply a light coating of oil to the bore of the tach worm (8) and the gear journal of the drive shaft (49), and slide the worm gear into place against the bearing (2 dwg DHC0506), with the tach worm's shoulder towards the bearing.
- With the sharp edge of the retaining ring (7) facing the away from the tach worm (8), install the retaining ring in the groove in the end of the drive shaft (49).
- Apply Loctite 603 or equivalent to the OD of the tach shaft sleeve bearing (1), and push or press it into place in the bearing cap (35), with the end flush with the casting, inside of the 3/4"-20 threaded hole. Wipe off any excess Loctite. It is beneficial to use a pusher, with the dimensions given below.



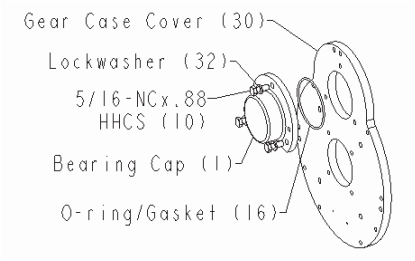
- Ensure there are no burrs on either end of the tach shaft (2), or at either end of the pin hole.
- Fill the end of the tach shaft (2), opposite the 0.104 in. square drive, with Loctite 518, or equivalent, until it can be seen through the pin hole drilled across the shaft.



- Place the tach gear (3) in the cavity of the bearing cap (35). The end of the tach gear, with the drive pin hole, goes against the end of the sleeve bushing (1).
- Slide the tach shaft (2) through the sleeve bearing (1) and tach gear (3). The end of the tach shaft, with the 0.104" square drive will be at the end of the bearing at the 3/4-20 threaded hole.
- Using a hammer and punch, lightly tap the tach drive pin (4) through the tach gear (3) and tach shaft (2).
- Apply a light coat of Loctite 603 or equivalent to the OD of the tach plug (5). Using a piece of .010" shim stock to maintain a .005-.015" gap between the tach plug and the end of the tach gear (3), press the tach plug (5) into the bearing cap (35) and remove the shim stock.
- Apply a coating of oil to the tach gear (3).

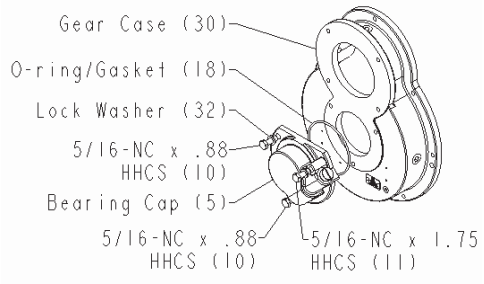


Gear Case Assembly

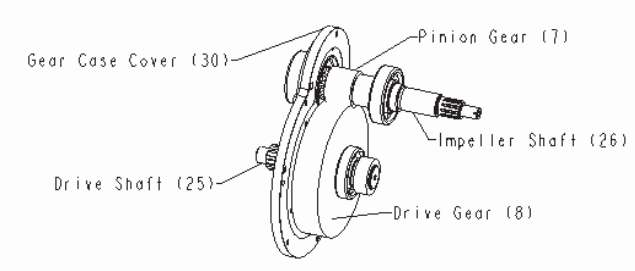


13. Apply Loctite 243 or equivalent, to three 5/16-NC x .88 long HHCS (10). With these three HHCS and three 5/16 lockwashers (32), attach the impeller shaft bearing cap (1) and gasket/o-ring (16) to the gear case cover (30). Tighten until fully torqued. [Reference torque: 13 ft-lbs]

14. Apply Loctite 243 or equivalent, to two 5/16-NC x .88 long HHCS (10), and one 5/16-NC x 1.75 long HHCS (11). With these three HHCS and three 5/16 lockwashers (32), attach bearing cap (5) and gasket/o-ring (18) to gear case (30). Only tighten finger tight,at this time, to allow the bearings on the drive shaft assembly to seat properly.

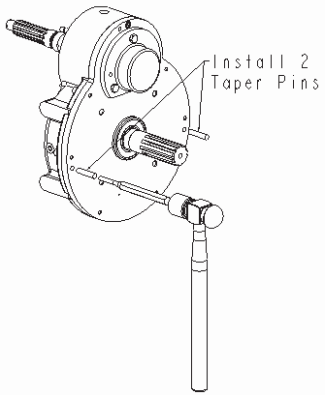


15. Apply a light coating of oil to the OD of the two drive shaft bearings (2) and the two impeller shaft bearings (3 & 4). Insert the impeller shaft assembly into the bearing pocket of the impeller shaft bearing cap (1). Before seating the smaller impeller shaft bearing (3) in the bearing cap, insert the drive shaft assembly into the bearing pocket of the gear case cover (30). Gently tap the impeller shaft bearing into the bearing pocket of the impeller shaft bearing pocket, until the bearing is seated in the bearing cap.

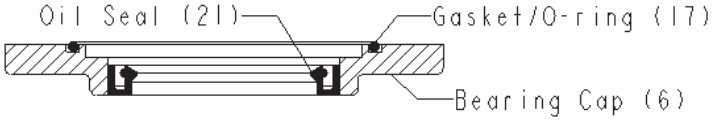


16. Place the gear case gasket into position on the gasket flange of the gear case cover (30).

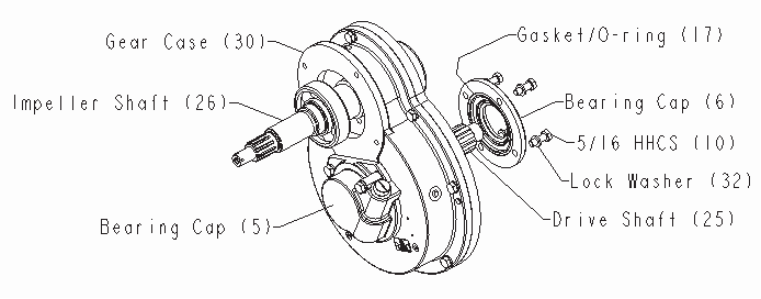
17. Place the gearcase (30) over the impeller shaft (26) and drive shaft (25) assemblies, against the gearcase gasket and cover. Tap the gear case over the drive shaft bearing (2) and impeller shaft bearing (4). Apply Loctite 243 or equivelent to seven 5/16-NC HHCS. Install these HHCS finger tight, along with seven 5/16 lockwashers, to attach the gear case to the gear case cover. Locate the gear case to the cover by tapping the two tapered dowel pins into the gear case cover and gear case, from the cover side, ensuring the marked pin is tapped into the marked hole it came out of. The rounded end of the taper pin must be inserted first. Tap in only until snug. Finish evenly tightening the seven HHCS to a final torque of 13 ft-lbs by alternating fasteners from side to side, until all seven are fully torqued.



18. Apply a light coating of oil to the OD of the drive shaft oil seal (21), and press it flat and straight into the bearing cap (6). The oil seal must cup toward the gear case (30).



19. Oil the lip of the drive shaft oil seal (21), and slide the bearing cap (6) and gasket/o-ring (17) over the drive shaft (25). Apply Loctite 243 or equivalent to the threads of four 5/16-NC x .88 long HHCS (10). Use these screws and four 5/16 lock washers (32) to attach the bearing cap to the gear case cover (30). Tighten until fully tightened. [Reference torque: 13 ft-lbs]



20. Evenly tighten the three HHCS (10 & 11) for the drive shaft bearing cap (5) until fully tightened. [Reference torque: 13 ft-lbs]

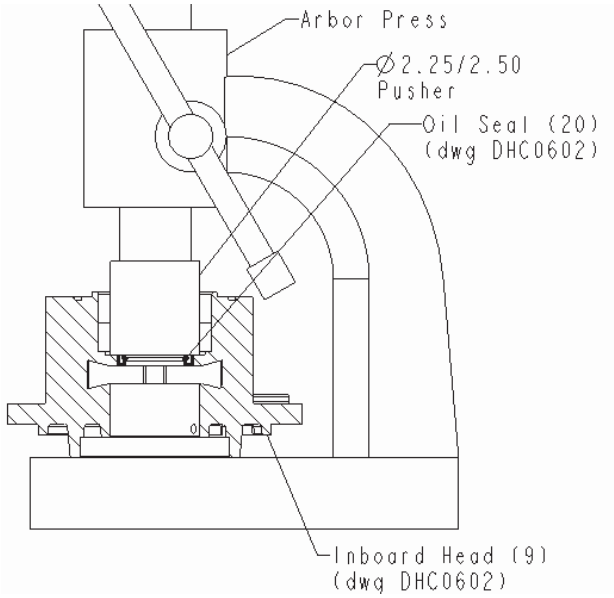
21. Ensure that the impeller shaft (26) assembly is seated in the impeller shaft bearing cap (1), and rotate the drive shaft (25). If the drive shaft will not rotate, loosen the drive shaft bearing caps (5 and 6), reseat the bearings, and retighten the bearing caps.

HE Pump Assembly

Refer to Drawing DHC1701
Additional reference drawings: DHC1702, DHC0506, DHC0511, DHC0505, & DHC0700

Before Starting Assembly:

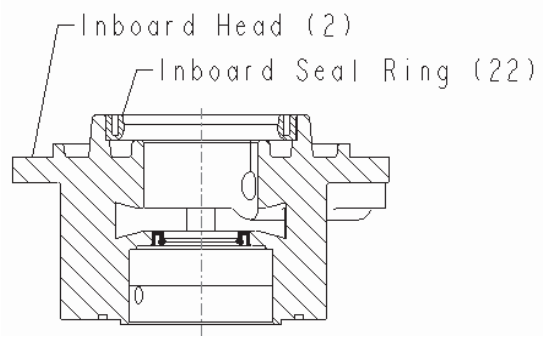
- Please read the Darley Basic Assembling Techniques (document 1205529), for the proper techniques recommended for assembling most Darley pumps.
- Replace all oil seals, bearings, gaskets, o-rings, and q-rings with new ones.
- When lubricating parts, with oil, for assembly, use the same oil used in the pump transmission gear case.
- When installing an o-ring or a q-ring in the transmission assembly, lubricate it prior to installation, with the same oil used in the pump transmission gear case.
- When installing an o-ring or a q-ring in the pump assembly, suction, or discharge, lightly lubricate it prior to installation with silicon based grease, such as Dow Corning 111. Be careful not to apply too thick of a film of lubricant, because over application of the grease can cause the o-ring/q-ring to bridge and leak.
- If no o-ring or gasket was used between the inboard head, engine adapter, or bearing caps, and the gear case, use a bead of Loctite 518 “Master Gasket”, or the equivalent.



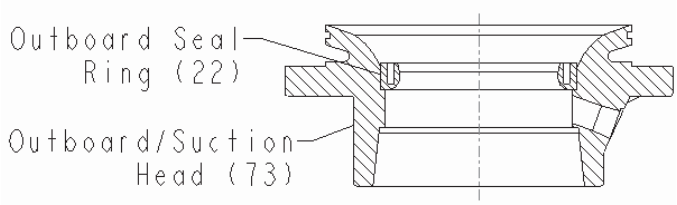
Pump Assembly

1. Ensure there are no sharp edges on either side of the oil seal bore of the inboard head (9 dwg DHC0506). Apply a light coating of oil to the OD of the impeller shaft oil seal (20 dwg DHC0506), and press it flat and straight into the inboard head. The oil seal must cup toward the gear case (30 dwg DHD0506), and the back edge of the open side is flush with the face of the bearing recess.

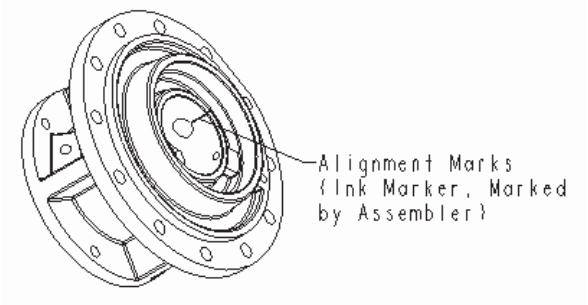
2. Apply Loctite 603 or equivalent to the OD of the inboard seal ring (22), and press it evenly into the inboard head (2). Make sure seal ring is seated tight and square against the inboard head's shoulder.

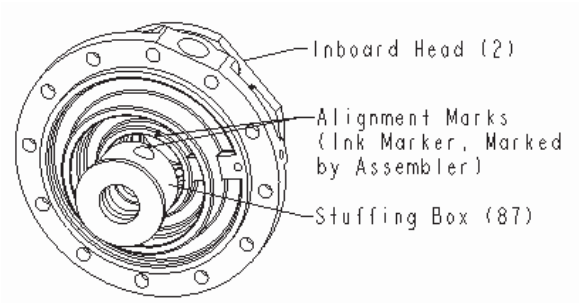


3. Apply Loctite 603 or equivalent to the OD of the outboard seal ring (22), and press it evenly into the suction head (73). Make sure the seal ring is seated tight and square against the suction head's shoulder.



4. Using a fine lined ink marker, draw an alignment line from middle of the packing feed hole in the inboard head (2), to the start of the bore for the stuffing box. Draw another alignment line on the stuffing box (87), from the middle of the packing feed hole, to the end of the stuffing box. Apply Loctite 603 or equivalent to the full OD of the stuffing box. Using a pusher of 2.5" - 2.75" diameter, line up the alignment marks on the stuffing box and inboard head, (ensure the 5/8" dia packing feed hole and 1/4" dia. water supply hole in the stuffing box line up with the corresponding holes in the inboard head) and press the stuffing box evenly into position until the stuffing box shoulder is tight against the head.



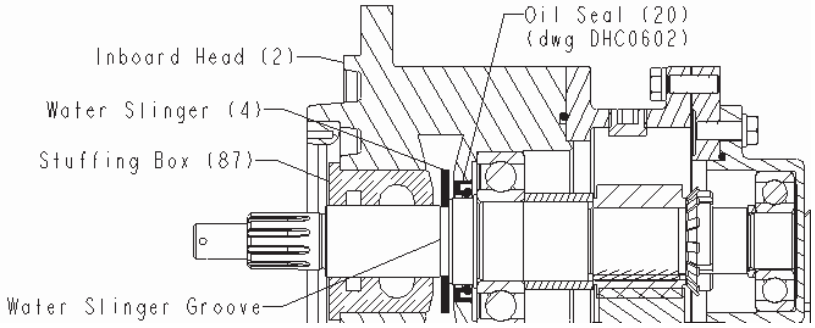


Pumps with a Mechanical Shaft Seal:

- There are no holes to line up, in the mechanical seal housing (87 dwg DHC1702), so it is not necessary to mark the seal housing or inboard head (2), for pumps that use a mechanical seal
- Apply Loctite 603 or equivalent to the full OD of the mechanical seal housing (87 dwg DHC1702). Using a 2.5" dia. pusher, press the mechanical seal housing evenly into position, until the shoulder of the seal housing is tight against the inboard head (2).

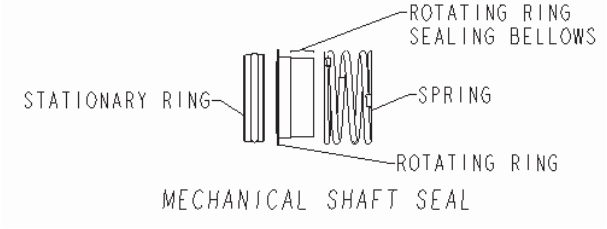
Pumps with a Packing Type Shaft Seal (refer to drawing DHC1701):

5. Place the gasket/o-ring (93) on the flange face of the inboard head (2). Place the water slinger (4) into the recess between the stuffing box (87) and oil seal (20 dwg DHC0506). (Note: A small amount of grease on one side of the slinger will help hold it against the stuffing box, during assembly.) Slide the inboard head over the impeller shaft (24), ensuring the shaft passes through the slinger. Use care as the shaft enters the oil seal. Apply Loctite 243 or equivalent, to four 5/16-NC HHCS (10 dwg DHC0506). Use these, with four 5/16 lockwashers (32 dwg DHC0506), to secure and tighten the inboard head to the gear case (30 dwg DHC0506). [Reference torque: 13 ft-lbs] Position the water slinger in the groove in the impeller shaft.

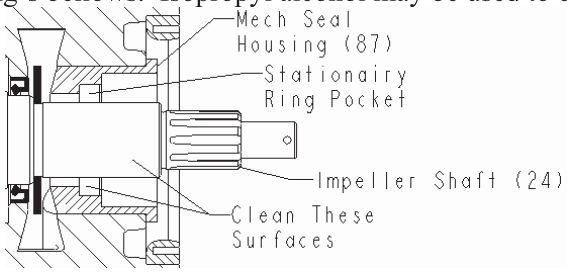


Pumps with a Mechanical Shaft Seal (refer to drawing DHC1702):

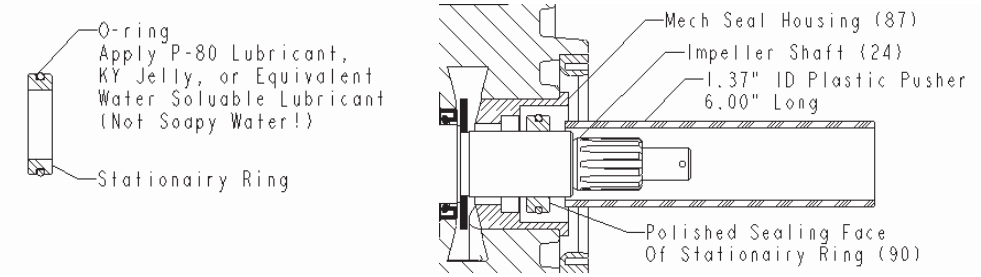
- Before Starting The Mechanical Seal Installation:
  - Please read the Darley Mechanical Shaft Seal Basics (document 1200583)
  - Clear a clean - flat work area, to unwrap and set the mechanical shaft seal on, during installation.



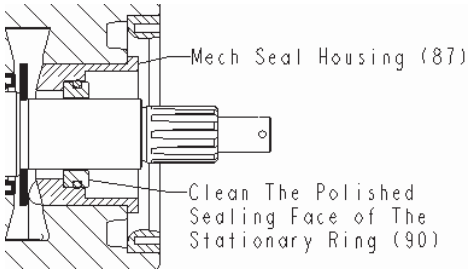
- Inspect the mating ring pocket in the seal housing (87), and the surface of impeller shaft (24) under the bellows of shaft seal (90), ensuring they are clean, to provide a proper sealing surfaces for the stationary ring o-ring and the rotating ring's bellows. Isopropyl alcohol may be used to clean surface if required.



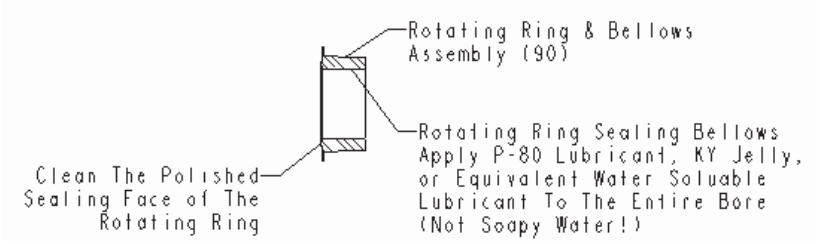
- Use caution to not get oils or greases on the polished face of the stationary ring (90). Apply P-80 Rubber Lubricant, KY Jelly, or equivalent water-soluble lubricant (not soapy water), to the o-ring on the stationary ring, and push it into the cavity, firmly seating it square. If not possible to insert the stationary ring with your fingers, use a suitable plastic pusher, free of contaminants, measuring about 1.37” ID x 6.0” long. Firmly push the stationary mating ring square into its pocket.



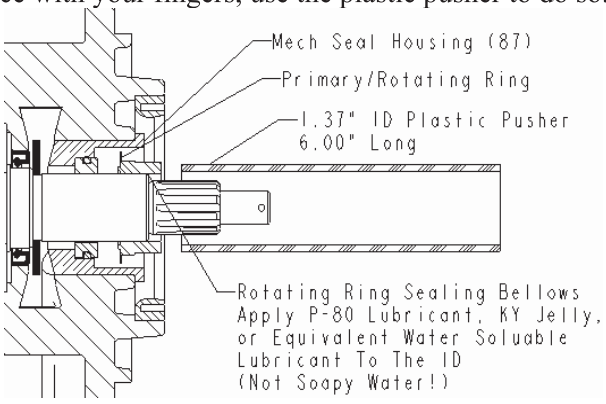
- Clean the stationary ring’s (90) polished sealing surface with isopropyl alcohol to remove any fingerprints or other foreign matter.



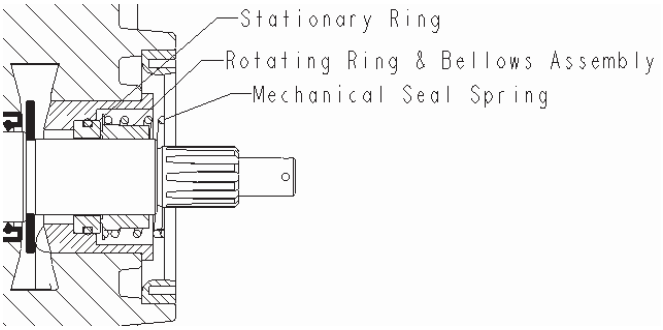
- Clean the rotating ring’s (90) polished sealing surface with isopropyl alcohol to remove any fingerprints and foreign matter, and apply P-80 Rubber Lubricant, KY Jelly, or equivalent water-soluble lubricant (not soapy water) to the entire inside bore of the bellows assembly (66).

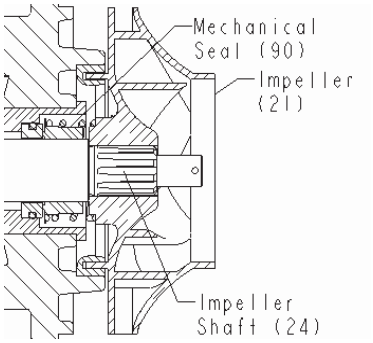


- Place the rotating ring and bellows assembly (90) [but not the spring yet] onto the impeller shaft (24) and slide the assembly into position, so that the seal surfaces are in contact. If it is not possible to slide the bellows assembly into place with your fingers, use the plastic pusher to do so.



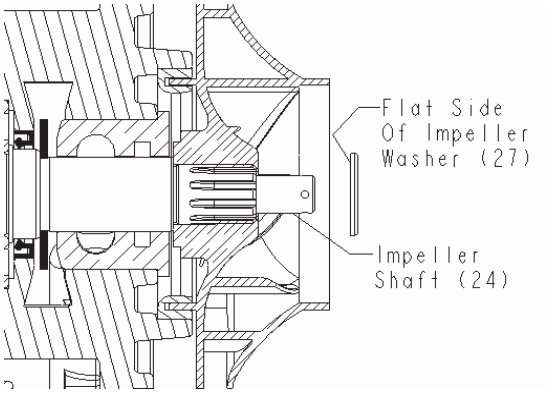
- Put the spring into position, seated against the retainer stop flange, on the rotating ring.



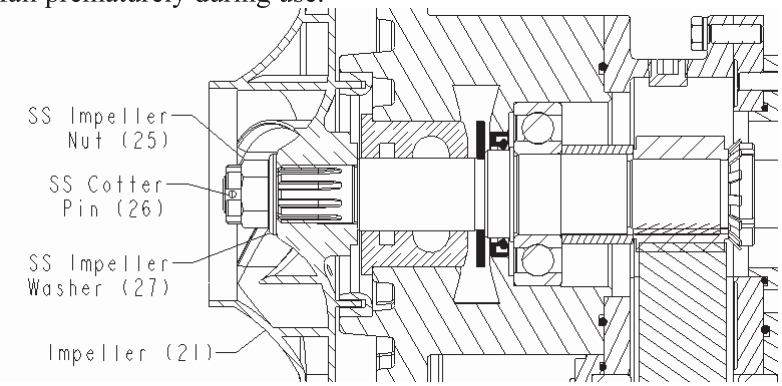


All HM Pumps (refer to drawing DHC1701):

6. Slide the impeller (21) onto the impeller shaft (24), with the flat side first.
7. Clean and dry the threads of the impeller shaft (24) and SS impeller nut (25), removing dirt, grease, and oil. Loctite Klean N' Prime, Part No.2556 or equivalent, can be used to clean the parts and shorten cure time of the thread locker.
8. Slide the SS impeller washer (27) onto the impeller shaft (24), with the flat side against the impeller.
9. Apply Loctite 243 or equivalent thread locker to the threads of the impeller shaft (24) and impeller nut (25).
10. Install the SS impeller nut (25) by tightening it until it contacts the SS impeller washer (27); then, tighten it to the next cotter pin hole.
    ⚠**CAUTION:** DO NOT OVER TIGHTEN THE IMPELLER NUT! Over tightening of the impeller nut can damage the impeller washer and the impeller shaft, causing the pump to fail during use.



11. Insert the 1/8” x 1.00” long SS cotter pin (26), and bend the tabs to lock its position.
    ⚠**CAUTION:** Failure to use a **stainless steel** cotter pin will cause the cotter pin to corrode quickly, and the pump can then fail prematurely during use.



12. Install the pump casing gasket (19) onto the studs (96 & 97) in the inboard head (2) side of the volute (18).
13. Line up the alignment marks that were placed on the volute (18) and the inboard head (2), at the start of dissassembly, and slide the volute onto the inboard head. If the alignment marks are missing, the two longer studs (97), are placed on each side of the packing cylinder boss. The image below, shows the relationship of the pump casing to the direction of the impeller roatation and vane angle. Apply Loctite 243 or equivalent to the threads of the twelve 3/8-NC studs for holding the volute to the inboard head. With twelve 3/8-NC nuts

(95) secure the volute to the inboard head. [Reference torque: 23 ft-lbs]

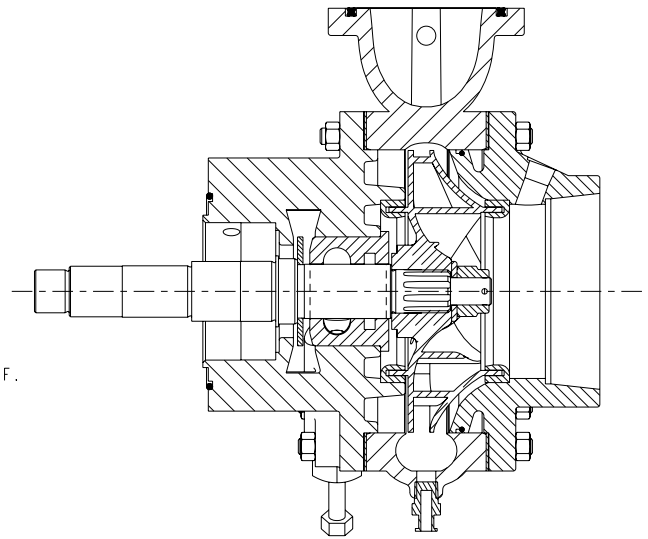
14. Install the pump casing gasket (19) onto the studs (96) in the suction head (73) side of the volute (18).
15. Install the o-ring (92) in the groove on the suction head (73).
16. Slide the suction head (73) into the volute (18). Apply Loctite 243 or equivalent to the threads of the twelve 3/8-NC studs (96) for holding the suction head to the volute, and install twelve 3/8-NC nuts (95). [Reference torque: 23 ft-lbs]
17. Screw the packing cylinder (86) into the inboard head (2), and tighten securely.
18. Following the “Darley Injection Type Stuffing Box Adjustment” instructions, install the Darley plastallic packing.

Reinstalling the HM Pump and Transmission in the Chassis

- Reverse the procedures outlined under the removal instructions
- Lubricate universal joint slip yoke on pump drive shaft.
- Fill gear case with SAE 80W/90 Gear Lube Oil to the level of the oil level plug.

NO.	DESCRIPTION	PART NO.	QTY.	
2	HEAD - INBOARD, HM	-	1	
4	SLINGER - WATER, H500, 1.21 ID	-	1	
12	PISTON-GLAND STUD, S	-	1	
14	PLUG - VENT, .125 NPT	-	1	
18	PUMP CASING - H, CAST IRON	-	1	
19	GASKET - PUMP CASING, H	-	2	
21	IMPELLER - HM500, LH, AURORA	-	1	
22	SEAL RING - H500	-	2	
24	SHAFT - IMPELLER, H500	-	1	
25	NUT - CASTLE, .625-18, 303 SST	-	1	
26	PIN - COTTER, .125 x 1.00, SST	-	1	
27	WASHER - 0.64 X 1.25 X .12 303	-	1	
44	DRAINCOCK - 0.250 NPTM, 9KC BR	-	1	
73	HEAD - SUCTION, H, 4 NPT SHORT	-	1	REF.
84	GLAND NUT - A	-	1	
85	SCREW - PACKING	-	1	
86	PACKING PLUNGER GUIDE - H	-	1	
87	STUFFING BOX	-	1	
90	PACKING #927 - PELLET	-	1	
92	O-RING - 6.25 x 6.44 x 0.09	-	1	
93	O-RING - 4.25 x 4.50 X 0.12	-	1	
94	QUAD RING - 3.25 x 3.62 x 0.19	-	1	
95	NUT - HEX, .375-16, GR2	-	24	REF.
96	STUD - 0.375-16 X 1.500, GR5	-	22	REF.
97	STUD - 0.375-16 X 2.000, GR5	-	2	REF.
98	PLUG - PIPE, 0.125, SST SOC HD	-	1	

REVISIONS				
LTR	DESCRIPTION	DATE	CHG NO.	APPR'D



SECTION A-A

REMOVE SHARP EDGES	INCH [MILLIMETER]	THIRD ANGLE PROJECTION	OLD PART NO.	TOLERANCE EXCEPT AS NOTED .00 ±.03 .000 ±.010 ANGLES ±1°	W.S. Darley & Co. CHIPPEWA FALLS, WI - MELROSE PARK, IL	
MATERIAL DESCRIPTION: -		MATERIAL NO.	PATTERN NO.		PUMP - HM/HF/HE500, PACK, LEFT PUMP ONLY	
THIS DESIGN IS THE PROPERTY OF W.S. DARLEY AND CO. - UNAUTHORIZED REPRODUCTION IS PROHIBITED	ALL DIMENSIONS IN INCHES UNLESS NOTED	DO NOT SCALE PRINT		DR'N TED CHKD CKE TRCD	DATE 13MAR2006 SCALE 1/2	DHC1701

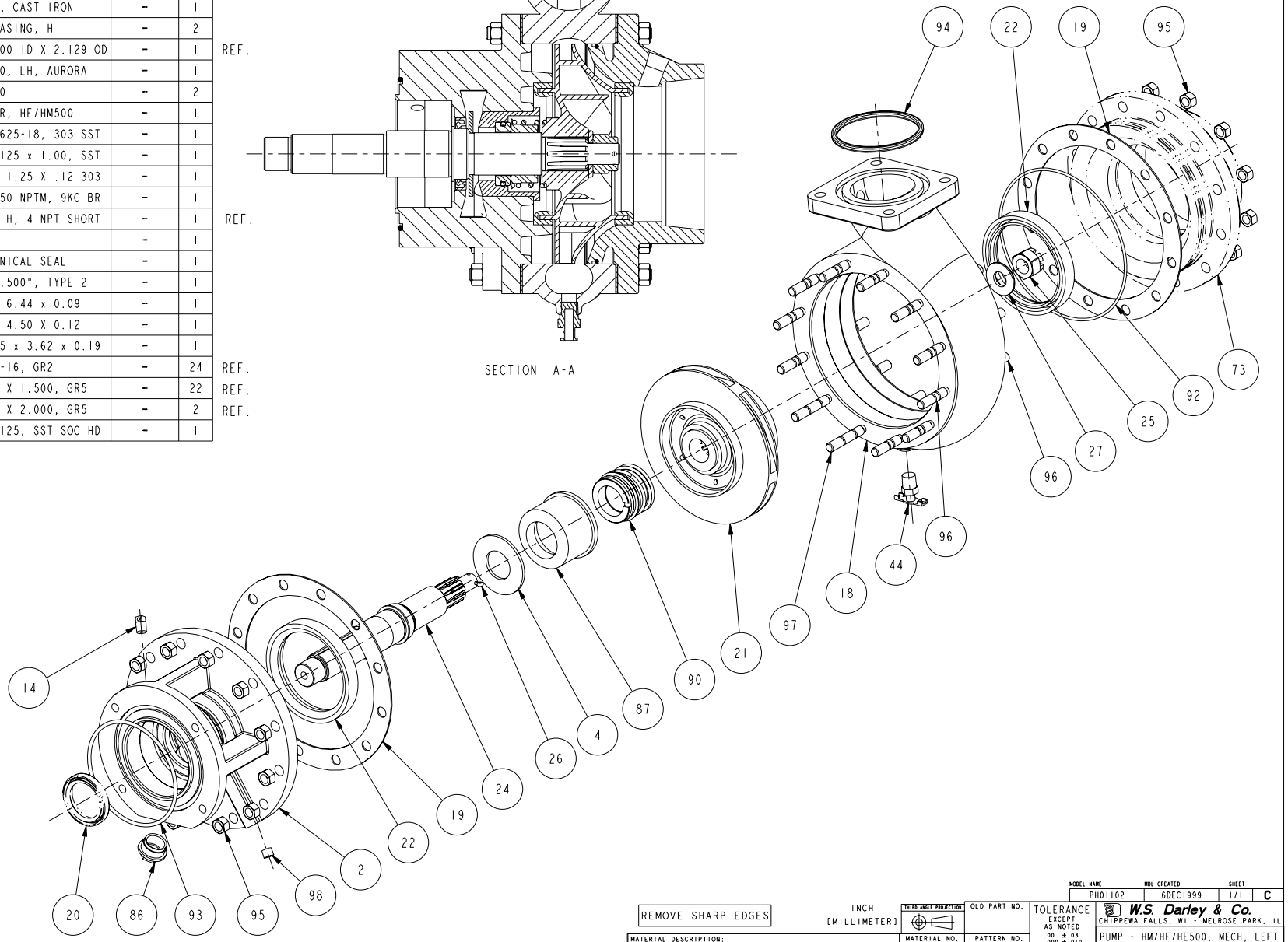
MODEL NAME	MDL CREATED	SHEET	
PH01100	6DEC1999	1/1	C

13.15

1200060

NO.	DESCRIPTION	PART NO.	QTY.	
2	HEAD - INBOARD, HM	-	1	
4	SLINGER - WATER, H500, 1.21 ID	-	1	
14	PLUG - VENT, .125 NPT	-	1	
18	PUMP CASING - H, CAST IRON	-	1	
19	GASKET - PUMP CASING, H	-	2	
20	OIL SEAL - 1.500 ID X 2.129 OD	-	1	REF.
21	IMPELLER - HM500, LH, AURORA	-	1	
22	SEAL RING - H500	-	2	
24	SHAFT - IMPELLER, HE/HM500	-	1	
25	NUT - CASTLE, .625-18, 303 SST	-	1	
26	PIN - COTTER, .125 x 1.00, SST	-	1	
27	WASHER - 0.64 X 1.25 X .12 303	-	1	
44	DRAINCOCK - 0.250 NPTM, 9KC BR	-	1	
73	HEAD - SUCTION, H, 4 NPT SHORT	-	1	REF.
86	PLUG -1"-14	-	1	
87	HOUSING - MECHANICAL SEAL	-	1	
90	SEAL - SHAFT, 1.500", TYPE 2	-	1	
92	O-RING - 6.25 x 6.44 x 0.09	-	1	
93	O-RING - 4.25 x 4.50 X 0.12	-	1	
94	QUAD RING - 3.25 x 3.62 x 0.19	-	1	
95	NUT - HEX, .375-16, GR2	-	24	REF.
96	STUD - 0.375-16 X 1.500, GR5	-	22	REF.
97	STUD - 0.375-16 X 2.000, GR5	-	2	REF.
98	PLUG - PIPE, 0.125, SST SOC HD	-	1	

SECTION A-A



REVISIONS				
LTR	DESCRIPTION	DATE	CHG NO.	APPR'D

BASED ON B.O.M. PH01102
(EXCEPT FOR REF. ITEMS)

MODEL NAME	MDL CREATED	SHEET	
PH01102	6DEC1999	1/1	C

REMOVE SHARP EDGES | INCH [MILLIMETER] | THIRD ANGLE PROJECTION | OLD PART NO. | TOLERANCE EXCEPT AS NOTED .00 ±.03 .000 ±.010 ANGLES ±1°

W.S. Darley & Co.
CHTPPEWA FALLS, WI - MELROSE PARK, IL

MATERIAL DESCRIPTION: -

MATERIAL NO. | PATTERN NO.

PUMP - HM/HF/HE500, MECH, LEFT PUMP ONLY

THIS DESIGN IS THE PROPERTY OF W.S. DARLEY AND CO. - UNAUTHORIZED REPRODUCTION IS PROHIBITED | ALL DIMENSIONS IN INCHES UNLESS NOTED | DO NOT SCALE PRINT

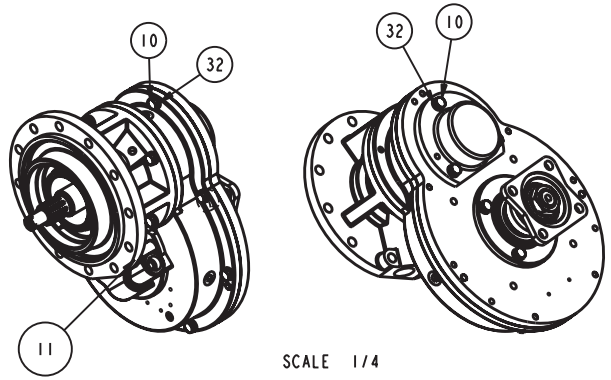
DR'N TED | CHKD CKE | TRCD

DATE 30MAR2006 | SCALE 1/2

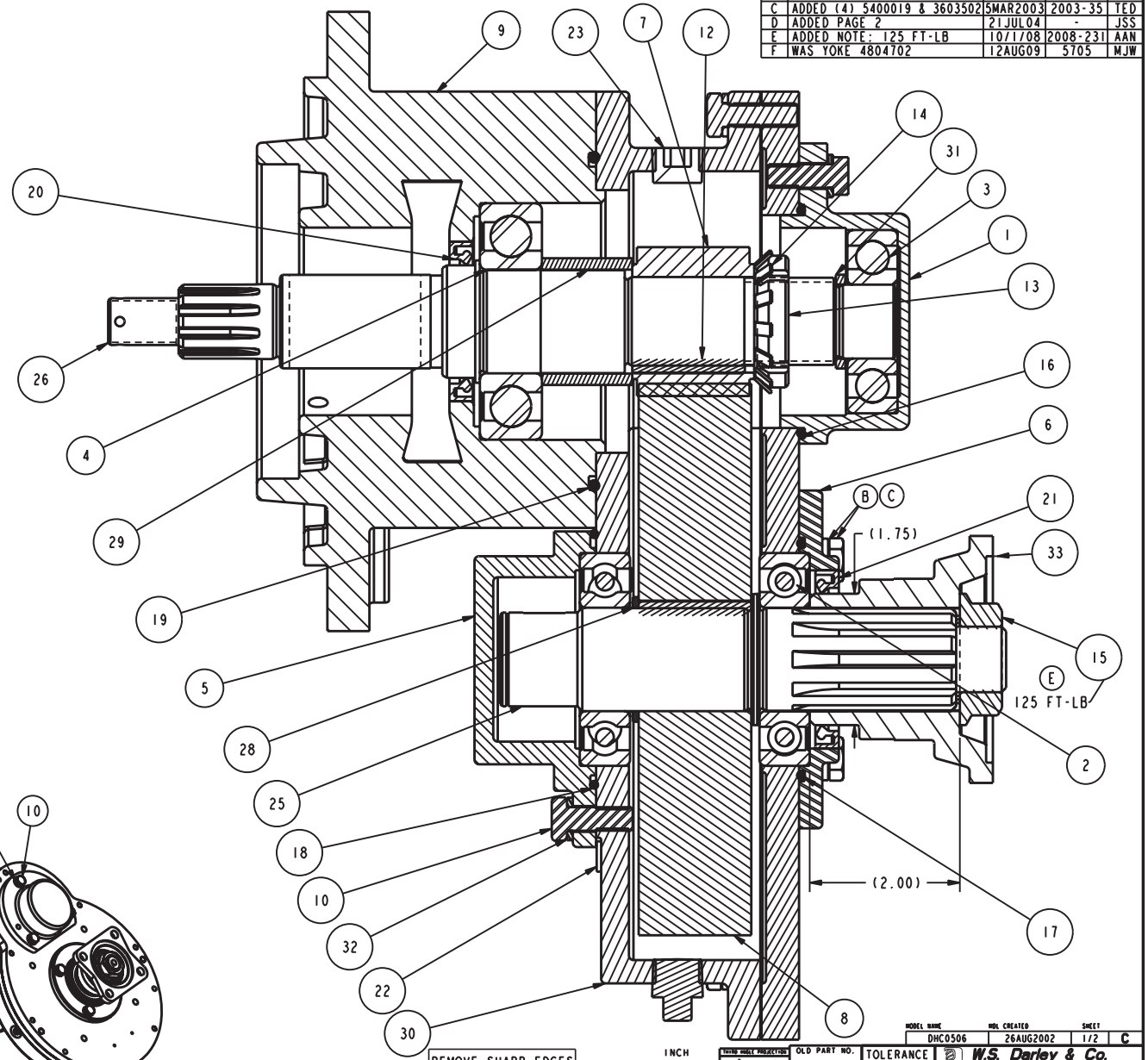
DHC1702

NO.	DESCRIPTION	PART NO.	QTY.	
1	BEARING CAP	2300601	1	
2	BEARING-BALL, 207SF	1720103	2	
3	BEARING-BALL, 305S	1720000	1	
4	BEARING-BALL, 307SF	1721903	1	
5	CAP - BEARING, HM	2303206	1	
6	CAP BEARING, U/HM/JMP	2308301	1	
7	GEAR - PINION, HM, 21T, 12DP	2702013	1	
8	GEAR - DRIVE, HM, 83T, 12DP	2702113	1	
9	HEAD - INBOARD, HM	2803609	1	
10	HHCS - .313-18 x 0.88, GR5	5400019	13	C
11	HHCS - .313-18 x 1.75, GR5	5400022	1	
12	KEY - SQ., 0.19X1.50 GR2	3602441	2	
13	LOCKNUT - BEARING, NO6	3602106	1	
14	LOCKWASHER - BEARING, WO6	3602126	1	
15	NUT - FLANGE, 7/8-14	4814501	1	
16	O-RING - 2.88 x 3.06 X 0.09	3601126	1	
17	O-RING - 3.00 x 3.19 X 0.09	3601125	1	
18	O-RING - 3.25 x 3.44 x 0.09	3601119	1	A
19	O-RING - 4.25 x 4.50 X 0.12	3601239	1	
20	OIL SEAL - 1.500 ID X 2.129 OD	3600526	1	
21	OIL SEAL - 1.750 ID X 2.378 OD	3600528	1	
22	PLUG - PIPE, 0.125, ZN SOC HD	1080537	3	
23	PLUG - PIPE, 0.375, ZN SOC HD	1080541	3	
24	PLUG - PIPE, 0.375, MAG SQ HD	1080536	1	
25	SHAFT - DRIVE	5017000	1	
26	SHAFT - IMPELLER, H500	5003300	1	
28	SPACER - 1.37 X 1.66 X 0.08	3301601	1	
29	SPACER - 1.38 X 1.69 X 1.20	3301900	1	
30	TRANS - GEARCASE ONLY, H	TG00202	1	
31	WASHER - .99 x 1.25 x .12 STL	3603018	1	
32	WASHER - LOCK, 0.313 ID	3603502	14	C
33	COMP FLANGE - 1350/1410, 1.38"	4817804	1	F

REVISIONS				
LTR	DESCRIPTION	DATE	CHG NO.	APPR'D
A	3601119 WAS 3601124	7JAN2003	2003-05	TED
B	REMOVED (4) 5/16 X .75 SHCS (5401009)	5MAR2003	2003-35	TED
C	ADDED (4) 5400019 & 3603502	5MAR2003	2003-35	TED
D	ADDED PAGE 2	21JUL04	-	JSS
E	ADDED NOTE: 125 FT-LB	10/1/08	2008-231	AAN
F	WAS YOKE 4804702	12AUG09	5705	MJW



SCALE 1/4



MODEL NAME	MDL CREATED	SHEET	
DHC0506	26AUG2002	1/2	C

REMOVE SHARP EDGES

INCH (MILLIMETER)

THIRD ANGLE PROJECTION

OLD PART NO.

MATERIAL DESCRIPTION: -

MATERIAL NO. -

PATTERN NO. -

TOLERANCE EXCEPT AS NOTED .00 ±.03 .000 ±.010 ANGLES ±1°

W.S. Darley & Co. ITASCA, IL - CHIPPEWA FALLS, WI

DWG - HM, TRANSMISSION O-RING

DR'N TED

CHKD MCR

TRCD

DATE 13-Sep-02

SCALE 1/1

DHC0506

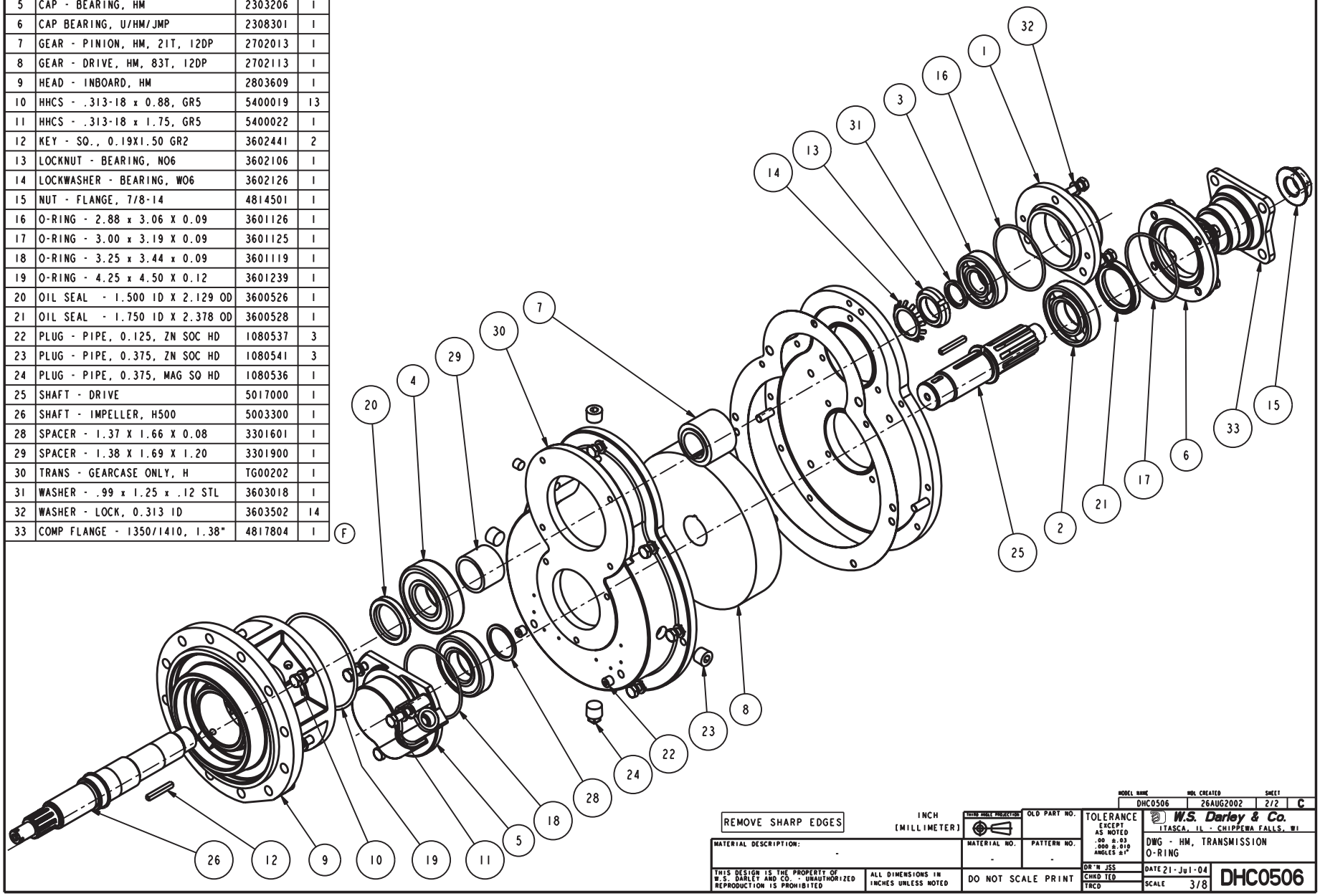
THIS DESIGN IS THE PROPERTY OF W.S. DARLEY AND CO. - UNAUTHORIZED REPRODUCTION IS PROHIBITED

ALL DIMENSIONS IN INCHES UNLESS NOTED

DO NOT SCALE PRINT

NO.	DESCRIPTION	PART NO.	QTY.
1	BEARING CAP	2300601	1
2	BEARING-BALL, 207SF	1720103	2
3	BEARING-BALL, 305S	1720000	1
4	BEARING-BALL, 307SF	1721903	1
5	CAP - BEARING, HM	2303206	1
6	CAP BEARING, U/HM/JMP	2308301	1
7	GEAR - PINION, HM, 21T, 12DP	2702013	1
8	GEAR - DRIVE, HM, 83T, 12DP	2702113	1
9	HEAD - INBOARD, HM	2803609	1
10	HHCS - .313-18 x 0.88, GR5	5400019	13
11	HHCS - .313-18 x 1.75, GR5	5400022	1
12	KEY - SQ., 0.19X1.50 GR2	3602441	2
13	LOCKNUT - BEARING, NO6	3602106	1
14	LOCKWASHER - BEARING, WO6	3602126	1
15	NUT - FLANGE, 7/8-14	4814501	1
16	O-RING - 2.88 x 3.06 X 0.09	3601126	1
17	O-RING - 3.00 x 3.19 X 0.09	3601125	1
18	O-RING - 3.25 x 3.44 x 0.09	3601119	1
19	O-RING - 4.25 x 4.50 X 0.12	3601239	1
20	OIL SEAL - 1.500 ID X 2.129 OD	3600526	1
21	OIL SEAL - 1.750 ID X 2.378 OD	3600528	1
22	PLUG - PIPE, 0.125, ZN SOC HD	1080537	3
23	PLUG - PIPE, 0.375, ZN SOC HD	1080541	3
24	PLUG - PIPE, 0.375, MAG SQ HD	1080536	1
25	SHAFT - DRIVE	5017000	1
26	SHAFT - IMPELLER, H500	5003300	1
28	SPACER - 1.37 X 1.66 X 0.08	3301601	1
29	SPACER - 1.38 X 1.69 X 1.20	3301900	1
30	TRANS - GEARCASE ONLY, H	TG00202	1
31	WASHER - .99 x 1.25 x .12 STL	3603018	1
32	WASHER - LOCK, 0.313 ID	3603502	14
33	COMP FLANGE - 1350/1410, 1.38"	4817804	1

REVISIONS				
LTR	DESCRIPTION	DATE	CHG NO.	APPR'D
D	ADDED PAGE 2	21JUL04	-	JSS
E	ADDED NOTE: 125 FT-LB	10/1/08	2008-231	AAN
F	WAS YOKE 4804702	12AUG09	5705	MJW



REMOVE SHARP EDGES

INCH [MILLIMETER]

THIRD ANGLE PROJECTION

OLD PART NO. -

MATERIAL DESCRIPTION: -

MATERIAL NO. -

PATTERN NO. -

TOLERANCE EXCEPT AS NOTED .00 ±.03 .000 ±.010 ANGLES ±1°

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DR'N JSS

CHKD TED

TRCD

W.S. Darley & Co.
ITASCA, IL - CHIPPEWA FALLS, WI

DWG - HM, TRANSMISSION O-RING

DATE 21-Jul-04

SCALE 3/8

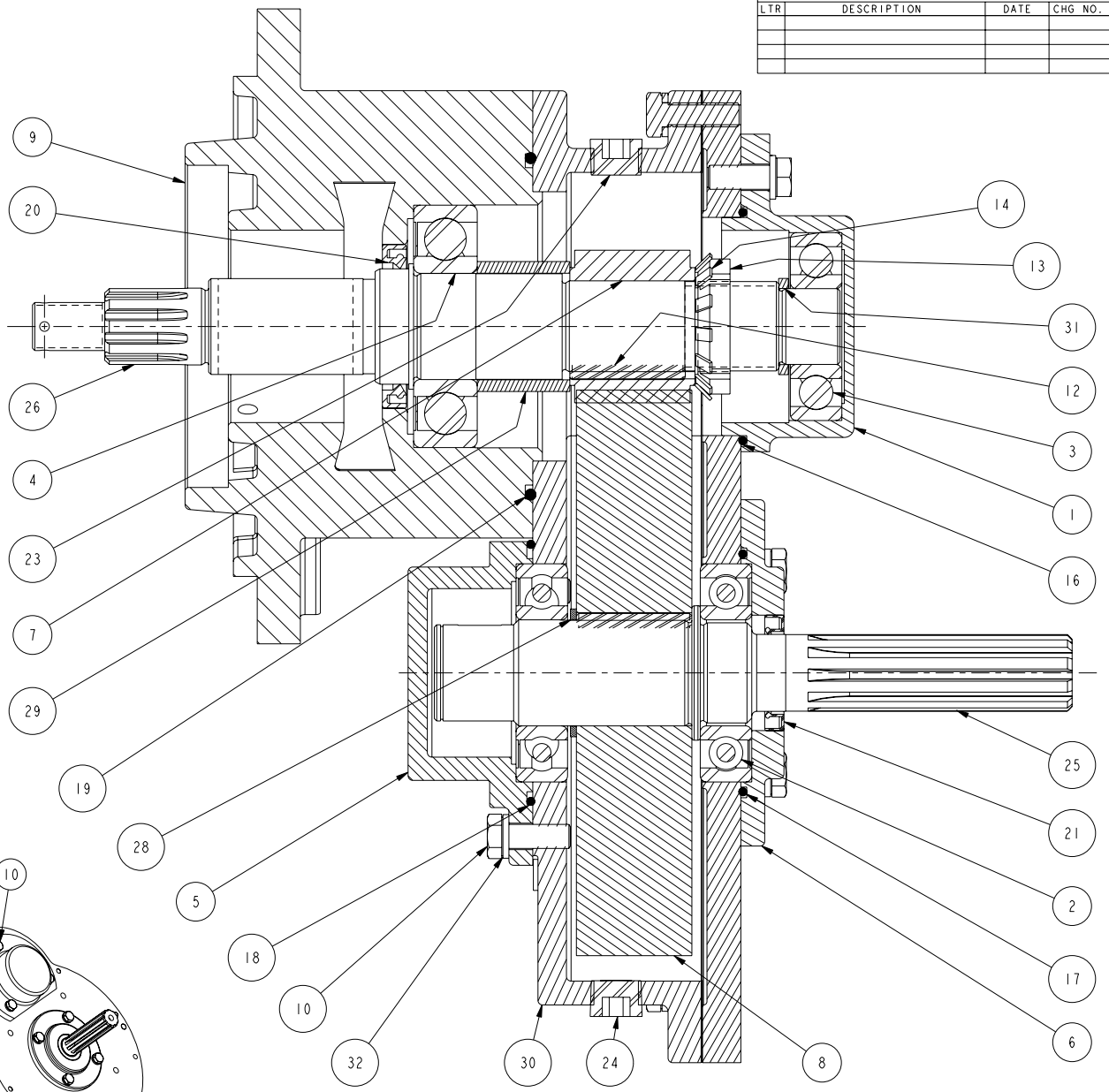
DHC0506

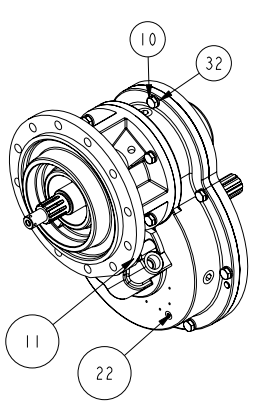
MODEL NAME	MDL CREATED	SHEET	
DHC0506	26AUG2002	2/2	C

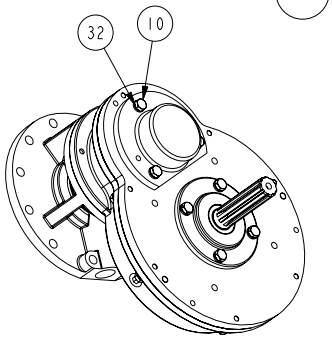
NO.	DESCRIPTION	PART NO.	QTY.
1	BEARING CAP	2300601	1
2	BEARING-BALL, 207SF	1720103	2
3	BEARING-BALL, 305S	1720000	1
4	BEARING-BALL, 307SF	1721903	1
5	CAP - BEARING, HM	2303206	1
6	CAP BEARING, U/HM/JMP	2308302	1
7	GEAR - PINION, HM, 21T, 12DP	2702013	1
8	GEAR - DRIVE, HM, 83T, 12DP	2702113	1
9	HEAD - INBOARD, HM	2803609	1
10	HHCS - .313-18 x 0.88, GR5	5400019	13
11	HHCS - .313-18 x 1.75, GR5	5400022	1
12	KEY - SQ., 0.19X1.50 GR2	3602441	2
13	LOCKNUT - BEARING, NO6	3602106	1
14	LOCKWASHER - BEARING, WO6	3602126	1
16	O-RING - 2.88 x 3.06 X 0.09	3601126	1
17	O-RING - 3.00 x 3.19 X 0.09	3601125	1
18	O-RING - 3.25 x 3.44 x 0.09	3601119	1
19	O-RING - 4.25 x 4.50 X 0.12	3601239	1
20	OIL SEAL - 1.500 ID X 2.129 OD	3600526	1
21	OIL SEAL - 1.000 ID X 1.503 OD	3600503	1
22	PLUG - PIPE, 0.125, SST SOC HD	1080533	3
23	PLUG - PIPE, 0.375, BLK SOC HD	1080508	3
24	PLUG - PIPE, 0.375, MAG SOC HD	1080538	1
25	SHAFT - DRIVE, H, W/ TACH	5005600	1
26	SHAFT - IMPELLER, H500	5003300	1
28	SPACER - 1.37 X 1.66 X 0.08	3301601	1
29	SPACER - 1.38 X 1.69 X 1.20	3301900	1
30	TRANS - GEARCASE ONLY, H	TG00202	1
31	WASHER - .99 x 1.25 x .12 STL	3603018	1
32	WASHER - LOCK, 0.313 ID	3603502	14

REVISIONS

LTR	DESCRIPTION	DATE	CHG NO.	APPR'D







SCALE 1/4

MODEL NAME	MDL CREATED	SHEET	
DHC0511	21JUL2004	1/2	C

REMOVE SHARP EDGES | INCH [MILLIMETER] | THIRD ANGLE PROJECTION | OLD PART NO.

MATERIAL DESCRIPTION: - | MATERIAL NO. - | PATTERN NO. -

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W.S. Darley & Co.
CHIPPEWA FALLS, WI - MELROSE PARK, IL

DWG - HM, TRANSMISSION, I-10 SPL O-RING

DR'N TED | DATE 22JUL2004
CHKD JSS | SCALE 1/1
TRCD

DHC0511

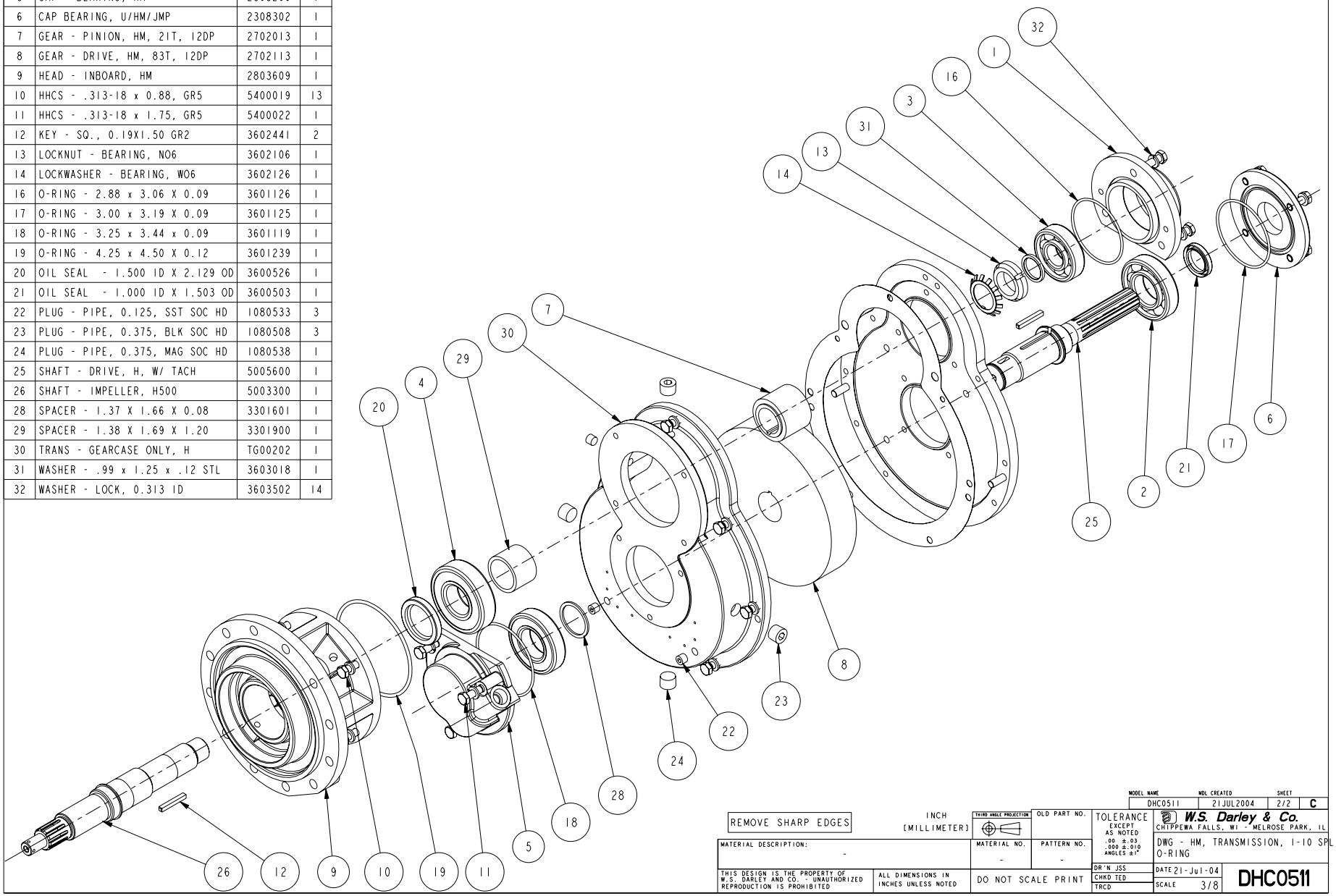
13.19

1200060

1200060

13.20

NO.	DESCRIPTION	PART NO.	QTY.
1	BEARING CAP	2300601	1
2	BEARING-BALL, 207SF	1720103	2
3	BEARING-BALL, 305S	1720000	1
4	BEARING-BALL, 307SF	1721903	1
5	CAP - BEARING, HM	2303206	1
6	CAP BEARING, U/HM/JMP	2308302	1
7	GEAR - PINION, HM, 21T, 12DP	2702013	1
8	GEAR - DRIVE, HM, 83T, 12DP	2702113	1
9	HEAD - INBOARD, HM	2803609	1
10	HHCS - .313-18 x 0.88, GR5	5400019	13
11	HHCS - .313-18 x 1.75, GR5	5400022	1
12	KEY - SQ., 0.19X1.50 GR2	3602441	2
13	LOCKNUT - BEARING, NO6	3602106	1
14	LOCKWASHER - BEARING, WO6	3602126	1
16	O-RING - 2.88 x 3.06 X 0.09	3601126	1
17	O-RING - 3.00 x 3.19 X 0.09	3601125	1
18	O-RING - 3.25 x 3.44 x 0.09	3601119	1
19	O-RING - 4.25 x 4.50 X 0.12	3601239	1
20	OIL SEAL - 1.500 ID X 2.129 OD	3600526	1
21	OIL SEAL - 1.000 ID X 1.503 OD	3600503	1
22	PLUG - PIPE, 0.125, SST SOC HD	1080533	3
23	PLUG - PIPE, 0.375, BLK SOC HD	1080508	3
24	PLUG - PIPE, 0.375, MAG SOC HD	1080538	1
25	SHAFT - DRIVE, H, W/ TACH	5005600	1
26	SHAFT - IMPELLER, H500	5003300	1
28	SPACER - 1.37 X 1.66 X 0.08	3301601	1
29	SPACER - 1.38 X 1.69 X 1.20	3301900	1
30	TRANS - GEARCASE ONLY, H	TG00202	1
31	WASHER - .99 x 1.25 x .12 STL	3603018	1
32	WASHER - LOCK, 0.313 ID	3603502	14



REVISIONS				
LTR	DESCRIPTION	DATE	CHG NO.	APPR'D

REMOVE SHARP EDGES

INCH [MILLIMETER]

THIRD ANGLE PROJECTION

OLD PART NO.

MATERIAL DESCRIPTION: -

MATERIAL NO. -

PATTERN NO. -

TOLERANCE EXCEPT AS NOTED .00 ±.03 .000 ±.010 ANGLES ±1°

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DR'N JSS

CHK'D TED

TRC'D

MODEL NAME: DHC0511 | MDL CREATED: 21JUL2004 | SHEET: 2/2 | C

W.S. Darley & Co.
CHIPPEWA FALLS, WI - MELROSE PARK, IL

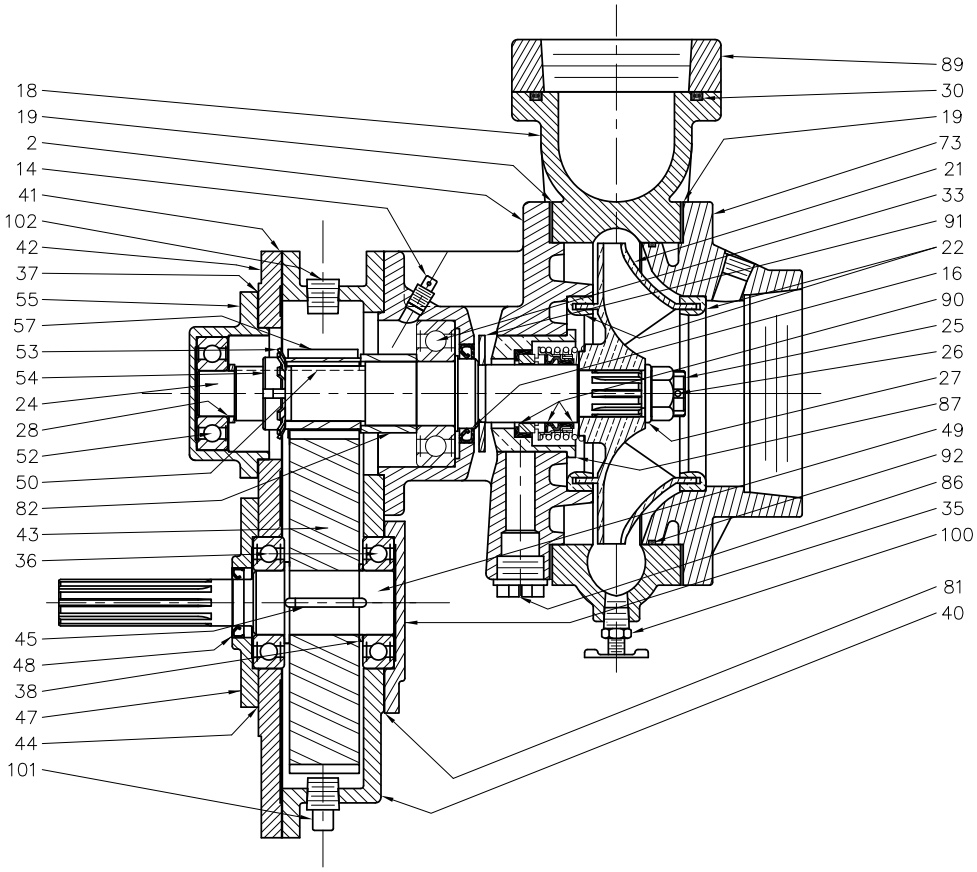
DWG - HM, TRANSMISSION, 1-10 SPL
O-RING

DATE 21-Jul-04

SCALE 3/8

DHC0511

REP#	NAME OF PART	QTY
2	INBOARD HEAD	1
14	VENT PLUG – 1/8 NPT	1
16	OIL SEAL – IMPELLER SHAFT	1
18	VOLUTE	1
19	PUMP CASING GASKET	2
21	IMPELLER	1
22	SEAL RING	2
24	IMPELLER SHAFT	1
25	IMPELLER NUT	1
26	COTTER KEY	1
27	IMPELLER WASHER	1
28	WASHER	1
30	QUAD–RING – DISCHARGE	1
33	BEARING – IMPELLER SHAFT	1
35	BEARING CAP	1
36	BEARING – DRIVE SHAFT	2
37	BEARING CAP GASKET – IMPELLER SHAFT	1
38	SPACER	1
40	GEAR CASE	1
41	GEAR CASE GASKET	1
42	GEAR CASE COVER	1
43	DRIVE GEAR	1
44	BEARING CAP GASKET – DRIVE SHAFT	1
45	KEY – DRIVE GEAR	1
47	BEARING CAP – DRIVE SHAFT	1
48	OIL SEAL – DRIVE SHAFT	1
49	DRIVE SHAFT	1
50	KEY – PINION GEAR	1
52	BEARING – IMPELLER SHAFT	1
53	BEARING LOCKWASHER	1
54	BEARING LOCKNUT	1
55	BEARING CAP – IMPELLER SHAFT	1
57	PINION GEAR	1
73	OUTBOARD HEAD – (REF)	1
81	BEARING CAP GASKET – DRIVE SHAFT	1
82	SPACER	1
86	PLUG	1
87	MECHANICAL SEAL BOX	1
89	DISCHARGE FLANGE – (REF)	1
90	MECHANICAL SEAL	1
91	WATER SLINGER	1
92	O–RING – SUCTION HEAD	1
100	DRAIN COCK–1/4 NPT	1
101	OIL DRAIN PLUG–3/8 NPT – MAGNETIC	1
102	OIL FILL PLUG – 3/8 NPT	1



ALL DIMENSIONS IN INCHES UNLESS NOTED

DO NOT SCALE PRINT

DR'N TED
CHKD CKE
TRCD

W.S. DARLEY & CO.
MELROSE PARK, IL – CHIPPEWA FALLS, WI

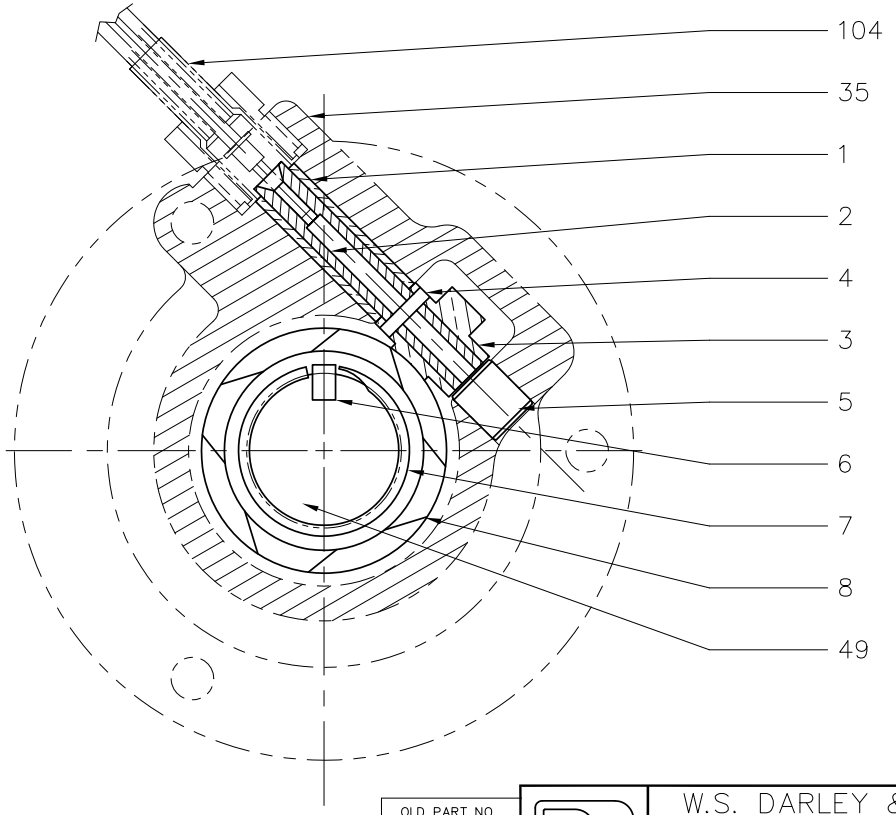
DWG – HM, MECH SEAL
NO TACH

DATE 2JAN2002
SCALE 1/2

DHC0505

REVISIONS				
LTR	DESCRIPTION	DATE	CHG NO.	APPR'D

REP#	NAME OF PART	QTY
1	BUSHING – TACH SHAFT	1
2	TACH. SHAFT	1
3	TACH. GEAR	1
4	DRIVE PIN – TACH. GEAR	1
5	PLUG	1
6	WOODRUFF KEY	1
7	RETAINER RING – TACH. WORM	1
8	TACH. WORM	1
35	BEARING CAP – (REF)	1
49	DRIVE SHAFT – (REF)	1
104	TACH. CABLE – (REF)	1



OLD PART NO. H447

SPEC NO. G431A1

W.S. DARLEY & CO.
MELROSE PARK, IL – CHIPPEWA FALLS, WI

DWG – OPTIONAL HM TACH DRIVE CROSS SECTION

DR'N TED
CHKD
TRCD

DATE DEC.8,93

SCALE 1/1

DHC0700

ALL DIMENSIONS IN INCHES UNLESS NOTED

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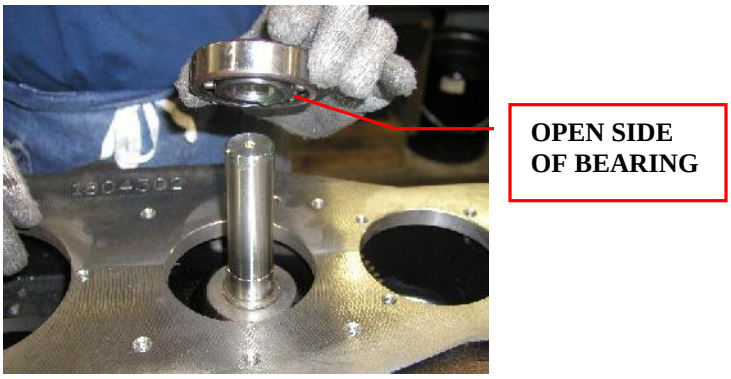
DARLEY
BASIC ASSEMBLING TECHNIQUES

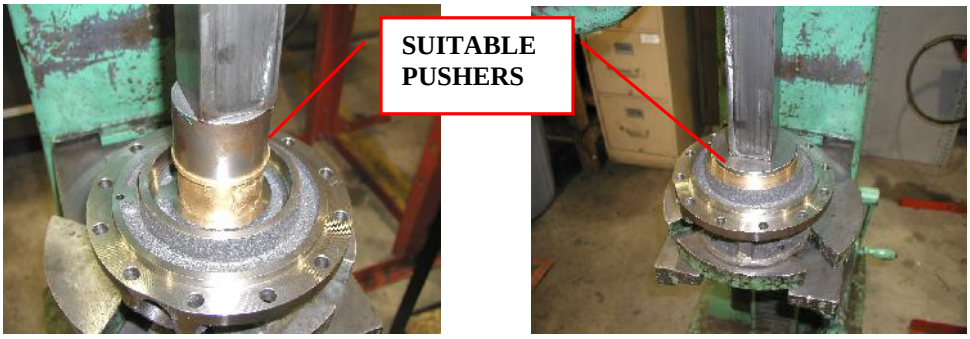
- Work with clean tools in clean surroundings during assembly.
- Clean parts thoroughly and keep free from nicks and abrasions.
- Keep loose parts marked otherwise identified to avoid error in assembly.
- **Bearings:** Keep bearings in original containers until ready to install.
- **Bearings/Press fits:** Clean and oil bearing seats and other parts having press fits to prevent galling.
- **Bearings:** When pressing a bearing onto a shaft, the bearing must be started perpendicular (square) to the shaft.

- **Bearings:** When pressing bearings onto a shaft all forces applied to the bearing need to be applied to the inner race.
- **Bearings:** When pressing bearings into a pocket all forces applied to the bearing need to be applied to the outer race.
- **Bearings:** When installing a bearing with one shield, the open side goes toward the oil cavity/gear case. Typically the single shield will be next to an oil seal.



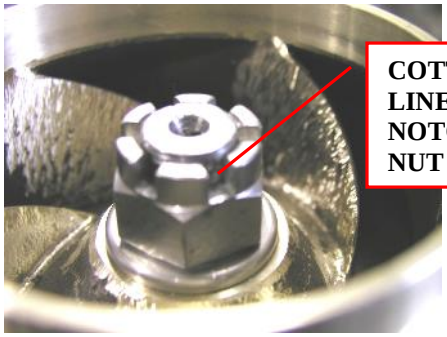
- **Bearings:** When pressing a bearing onto a shaft, lightly lube the bore of the bearing and the shaft journal for the bearing with oil. Also when installing bearings into bearing pockets, lightly lube the OD of the bearing and the bore of the bearing pocket with oil.

- **Bearings:** If necessary to remove a ball bearing from a shaft by forcing against the outer race, the bearing should be discarded and replaced.
- **Press fits:** Use suitable machined pushers (The end faces of the pusher should be flat, parallel and burr free) for pressing operations.

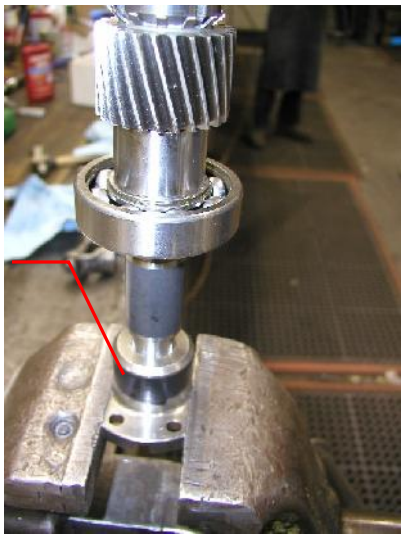


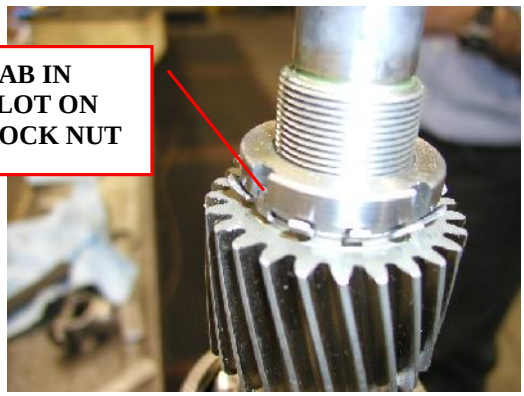
- **Press fits:** When pressing a part into housing (ex. Stuffing box, seal ring, etc.), the part needs to be started perpendicular to the housing.

- **Press fits:** Use a press for forcing press fits whenever possible. If necessary to use a hammer, use one having soft plastic heads. Do not use brass or lead hammers, for the face of the hammer may easily chip or flake, contaminating the assembly, which can cause severe damage to bearings and other precision components.
- **Impeller Nuts:** When installing impeller nuts, DO NOT use an impact wrench. Use of impact wrenches has proven to damage the impeller washers, impellers, and impeller shafts. Proper tightening procedure is to bring it snug tight, and then tighten it to the next available cotter pin hole in shaft and notch in the castle nut. Then install stainless steel cotter pin.



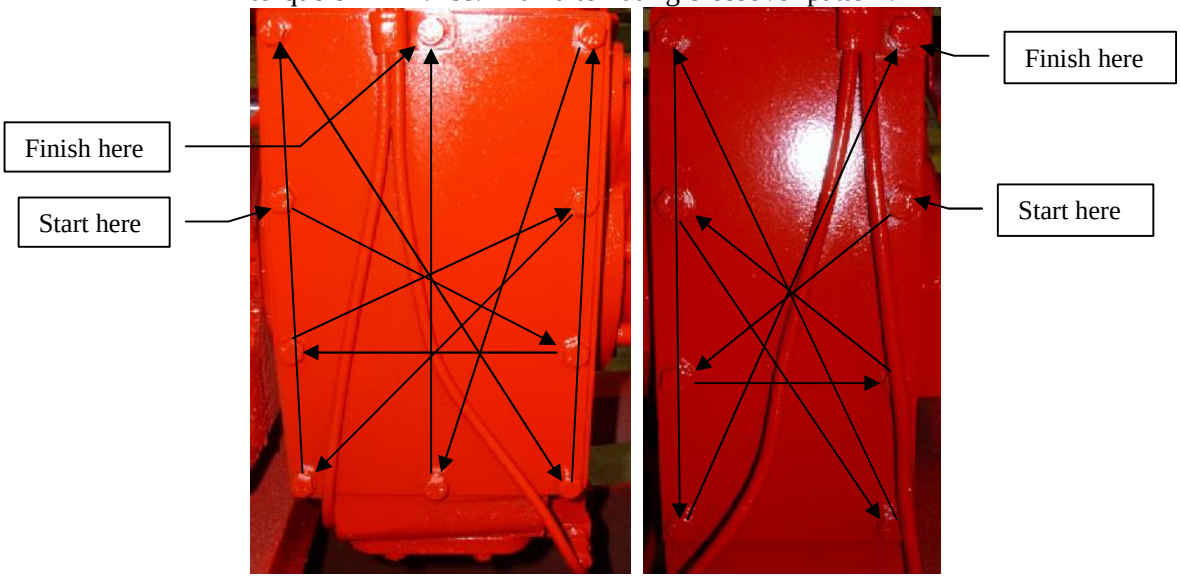
- **Lock Washer/Lock Nut:** Secure shaft so that it doesn't rotate when tightening lock nut. Line up tab on lock washer with keyway slot in shaft and slide washer onto shaft. Screw lock nut onto shaft until snug, then turn until a tab and slot line up. Using a punch, tap tab from lock washer into slot on lock nut.





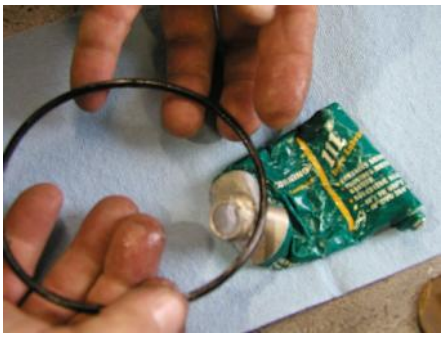
- **Loctite/thread locker:** When applying Loctite/thread lockers, only use one small drop per hole, unless explicitly told differently by engineering, a WI, or assembly/repair instruction or assembly supervisor.
- **Loctite/thread locker:** When applying Loctite/thread lockers to lock fasteners going into captive holes (a hole that is only open on one end), apply the thread locker to the threads of the hole.

- **Loctite/thread locker:** When applying Loctite/thread lockers, to lock fasteners that are going to be installed with a pneumatic/power wrench, apply the thread locker to the female threads.
- **Transmission Threads:** Use only lock washers on captive holes. The only exception is if it is an aluminum gear case, then use Loctite 243, or equivalent, and no lock washers.
- **Transmission Threads:** Use lock washers and Loctite 243, or equivalent, if holes are tapped thru.
- **Inspection Plate Fasteners:** Use Loctite 243, or equivalent, on the fasteners that hold the rectangular inspection plate to the side of the transmissions gear case. When installing these fasteners, install all of the fasteners to finger tight, then torque them to a final torque of 72 in.-lbs. in an alternating crossover pattern.



- **Fastener Lock Washers and Aluminum:** Do not use lock washers against aluminum. Use the appropriate thread locker instead.

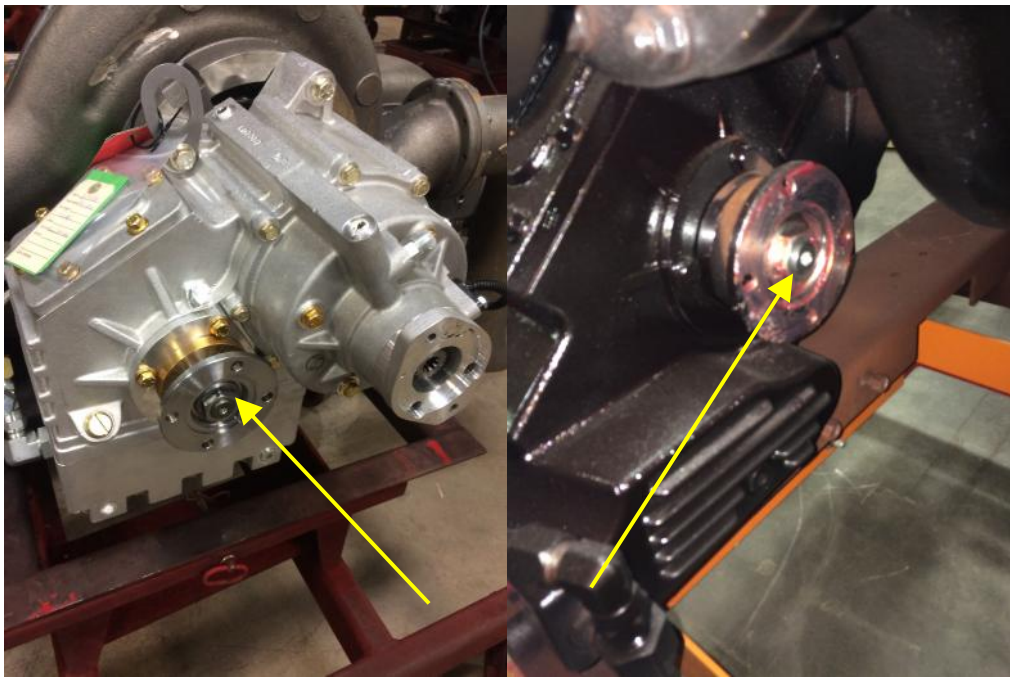
- **O-rings/Quad rings:** When installing o-rings and quad rings LIGHTLY lube with oil or silicon grease (Dow Corning 111). Be careful not to apply too thick of a film of lubricant when using the silicone grease because over application of the grease can cause the o-ring/quad ring to bridge and leak.



- **Gear Lube:** When filling the gear case with oil, fill with SAE80W/90 gear lube oil to the bottom of the oil level plug on the gear case, or the oil level mark on the dipstick. Maintain the gear case oil level every 25 hours or 3 months, which ever comes first, and change the oil every 50 hours or 6 months.

- **Oil Seal lubrication:** When lubricating oil seals prior to installation, apply a minimal amount of SAE 80/W90 oil on the outside diameter of the seal and the sealing lip on the inside diameter of the seal. Do not use any lubricant other than SAE 80W/90 oil unless a Darley document dated after February 14, 2012 specifically calls it out.

- **Yoke nut installation torque for PUC and PUC-3G pumps:** Torque PUC and PUC-3G yoke nuts to 300-350 ft-lb. After the yoke nut has been torqued down, check to make sure the yoke nut engages the yoke face it bumps up against.

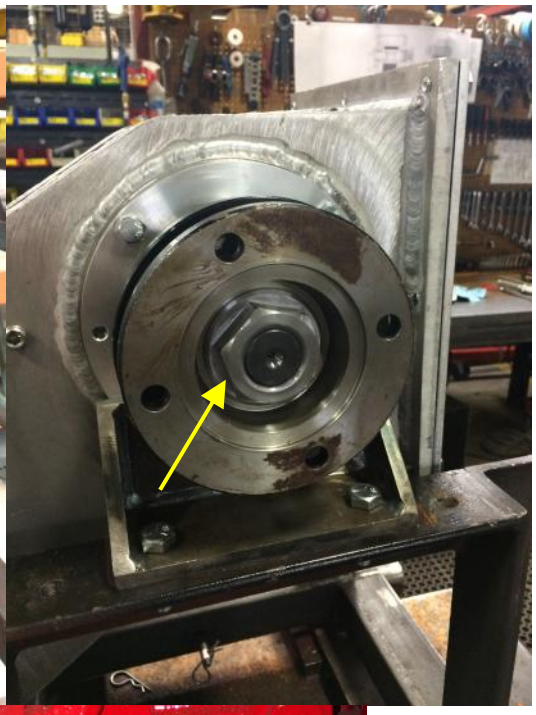


PUC and PUC-3G yoke nuts are tightened to 300-350 lb-ft.

- **Yoke nut torque for 1.75-12 thread, 1.25-12 thread and 7/8-14 thread yoke nuts:** Unless otherwise specified, torque 1.75-12 interference threaded yoke nuts to 150-200 ft-lb. Unless otherwise specified, torque all 1.25-12 thread yoke nuts to 150-200 ft-lb. Unless otherwise specified, torque all 7/8-14 interference threaded yoke nuts to 125 ft-lb. After the yoke nut has been torqued down, check to make sure the yoke nut engages the yoke face it bumps up against.

1.75-12 thread yoke nuts are typically used on Midship pump.
1.25-12 thread yoke nuts are typically used on ZSD & ZSP pumps.
7/8-14 thread yoke nuts are used on PTO pumps.

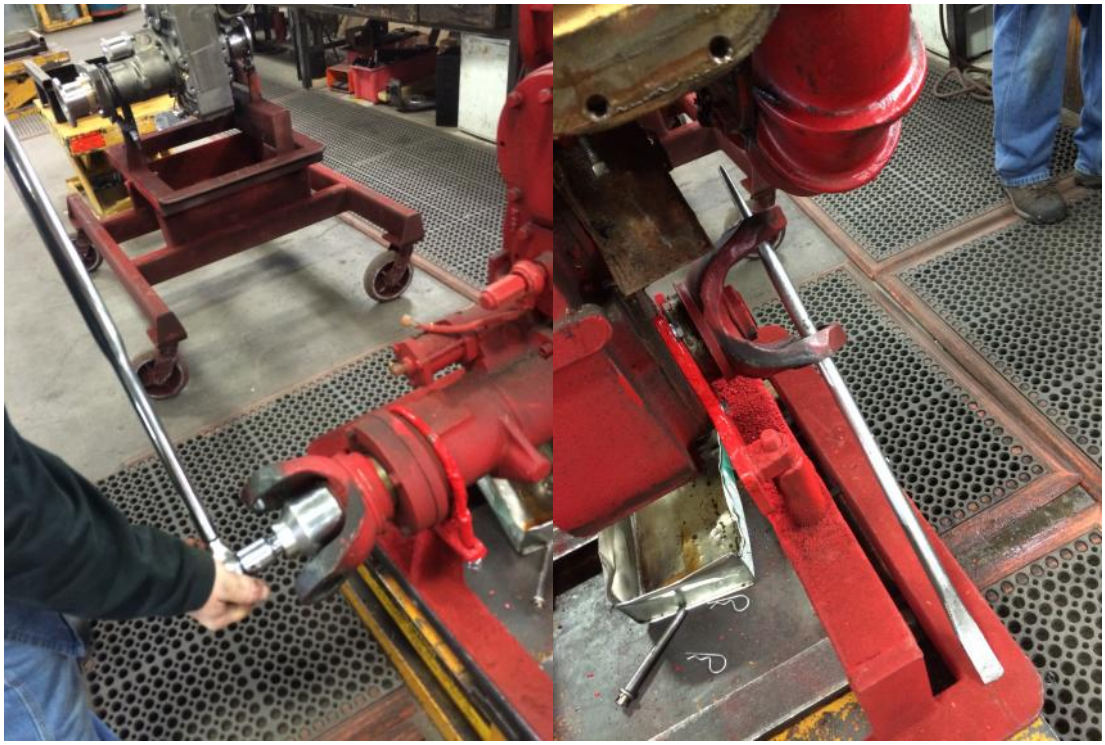
All 1.75-12 interference threaded yoke nuts are torqued to 150-200 ft-lb.



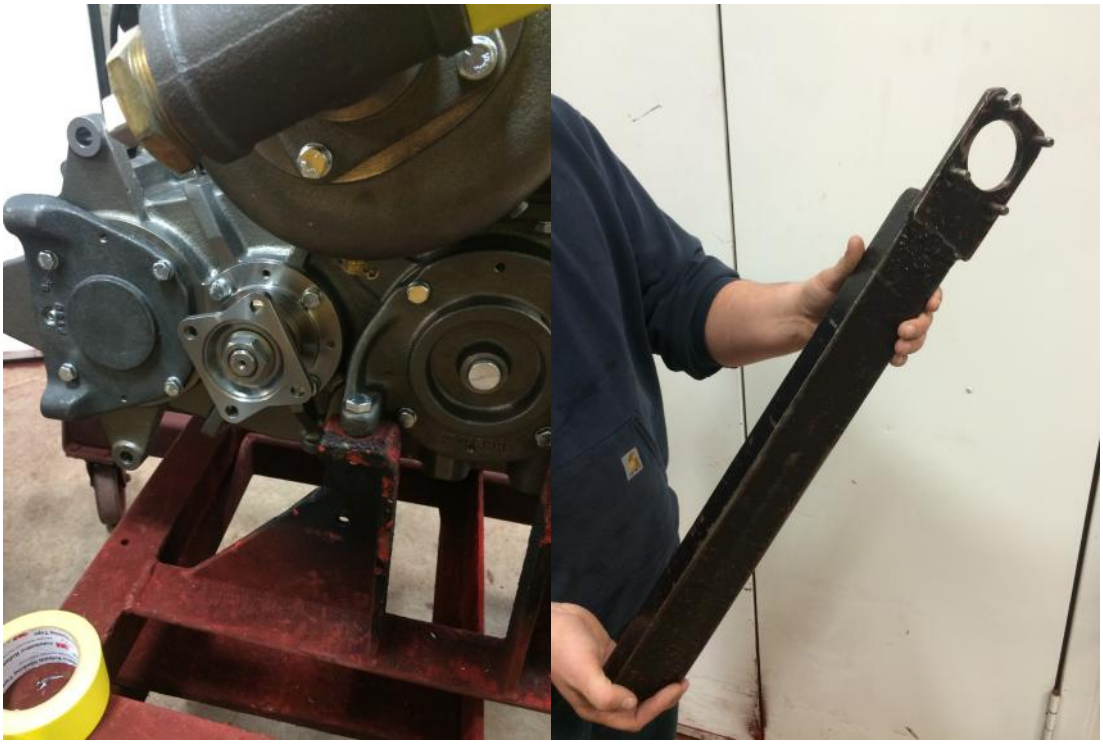
All 1.25-12 threaded yoke nuts are torqued to 150-200 ft-lb.

All 7/8-14 interference thread yoke nuts are tightened to 125 ft-lb.

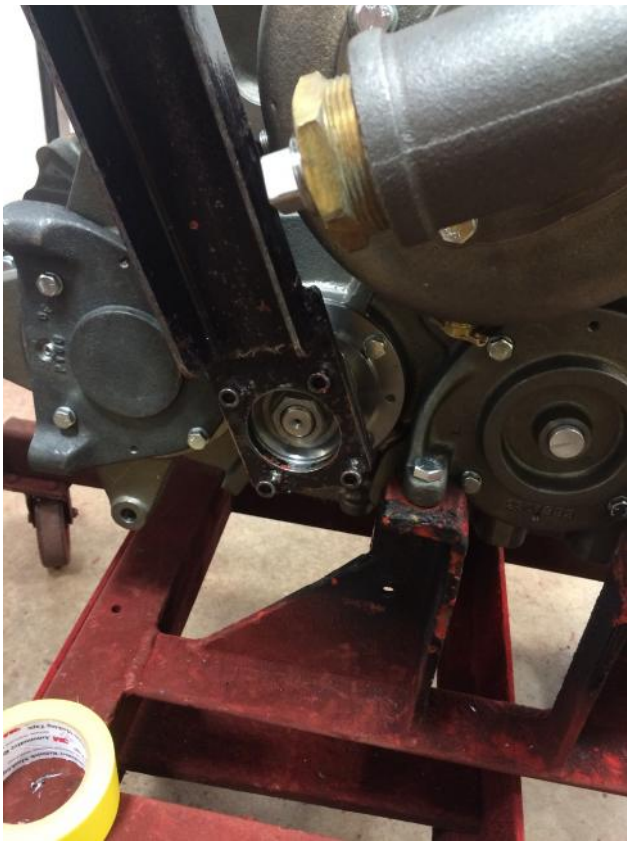
After torqueing the yoke nut down, check to make sure there is not a gap between the yoke nut and the yoke.



To help with the yoke nut torqueing on midship pumps, shift the transmission into road mode. Put a bar thru the yoke that is not being torqued down to stop the driveline from rotating. Then the driveline will not rotate as the yoke nut is being torqued.



To help with tightening yoke nuts on PTO pumps use the tool shown in the above picture.



Place the tool over the companion flange as shown above. Make sure to finger tighten a nut on one of the tool's fasteners to secure the tool to the yoke.

Now let the tool bump up against a rigid surface and use the torque wrench to tighten the yoke nut as shown above.

Recommended fastener tightening torque unless otherwise specified: The following tables will give recommended tightening torques depending upon the fasteners material and if a Loctite type product was used. Use these recommended tightening torques if you are not confident torqueing a fastener. For fasteners that had a Loctite type product applied to their threads, use the K = .20 (Clean non-plated bolt) recommended tightening torque even if either the nut or bolt was zinc electroplated.

Best practice is to; use an SAE Grade 8 bolt with an SAE Grade 8 nut, use an SAE Grade 5 bolt with and SAE Grade 5 nut, use an SAE Grade 2 bolt with an SAE Grade 2 nut and use the same bolt material as what the nut is made from.

Fastener Size	Recommended tightening torque	Clamp load
#6 – 32 Grade 8	18 to 27 in-lb	654 to 981 lb
#6 – 40 Grade 8	20 to 30 in-lb	730 to 1,095 lb
#8 – 32 Grade 8	33 to 50 in-lb	1,009 to 1,513 lb
#8 – 36 Grade 8	35 to 52 in-lb	1,060 to 1,591 lb
#10 – 24 Grade 8	48 to 72 in-lb	1,262 to 1,893 lb
#10 – 32 Grade 8	55 to 82 in-lb	1,440 to 2,159 lb
¼ - 20 Grade 8	115 to 172 in-lb	2,291 to 3,437 lb
¼ - 28 Grade 8	131 to 196 in-lb	2,619 to 3,928 lb
5/16 – 18 Grade 8	20 to 29 ft-lb	3,775 to 5,662 lb
5/16 – 24 Grade 8	22 to 33 ft-lb	4,181 to 6,271 lb
3/8 – 16 Grade 8	35 to 52 ft-lb	5,579 to 8,369 lb
3/8 – 24 Grade 8	40 to 59 ft-lb	6,324 to 9,485 lb
7/16 – 14 Grade 8	56 to 84 ft-lb	7,654 to 11,481 lb
7/16 – 20 Grade 8	62 to 93 ft-lb	8,548 to 12,821 lb
½ - 13 Grade 8	85 to 128 ft-lb	10,217 to 15,325 lb
½ - 20 Grade 8	96 to 144 ft-lb	11,517 to 17,275 lb
5/8 – 11 Grade 8	170 to 254 ft-lb	16,272 to 24,408 lb
5/8 – 18 Grade 8	192 to 288 ft-lb	18,429 to 27,643 lb
¾ - 10 Grade 8	301 to 452 ft-lb	24,081 to 36,122 lb
¾ - 16 Grade 8	336 to 503 ft-lb	26,853 to 40,280 lb
7/8 – 9 Grade 8	485 to 727 ft-lb	33,245 to 49,867 lb
7/8 – 14 Grade 8	535 to 802 ft-lb	36,682 to 55,023 lb
1 – 8 Grade 8	727 to 1,090 ft-lb	43,614 to 65,421 lb
1 – 12 Grade 8	796 to 1,193 ft-lb	47,739 to 71,608 lb

The above table is for SAE Grade 8 fasteners, K = .20 (Clean non-plated fasteners or Loctited zinc electroplated fasteners)

Fastener Size	Recommended tightening torque	Clamp load
#6 – 32 Grade 8	20 to 30 in-lb	654 to 981 lb
#6 – 40 Grade 8	22 to 33 in-lb	730 to 1,095 lb
#8 – 32 Grade 8	36 to 55 in-lb	1,009 to 1,513 lb
#8 – 36 Grade 8	38 to 57 in-lb	1,060 to 1,591 lb
#10 – 24 Grade 8	53 to 79 in-lb	1,262 to 1,893 lb
#10 – 32 Grade 8	60 to 90 in-lb	1,440 to 2,159 lb
¼ - 20 Grade 8	126 to 189 in-lb	2,291 to 3,437 lb
¼ - 28 Grade 8	144 to 216 in-lb	2,619 to 3,928 lb
5/16 – 18 Grade 8	22 to 32 ft-lb	3,775 to 5,662 lb
5/16 – 24 Grade 8	24 to 36 ft-lb	4,181 to 6,271 lb
3/8 – 16 Grade 8	38 to 58 ft-lb	5,579 to 8,369 lb
3/8 – 24 Grade 8	43 to 65 ft-lb	6,324 to 9,485 lb
7/16 – 14 Grade 8	61 to 92 ft-lb	7,654 to 11,481 lb
7/16 – 20 Grade 8	69 to 103 ft-lb	8,548 to 12,821 lb
½ - 13 Grade 8	94 to 140 ft-lb	10,217 to 15,325 lb
½ - 20 Grade 8	106 to 158 ft-lb	11,517 to 17,275 lb
5/8 – 11 Grade 8	186 to 280 ft-lb	16,272 to 24,408 lb
5/8 – 18 Grade 8	211 to 317 ft-lb	18,429 to 27,643 lb
¾ - 10 Grade 8	331 to 497 ft-lb	24,081 to 36,122 lb
¾ - 16 Grade 8	369 to 554 ft-lb	26,853 to 40,280 lb
7/8 – 9 Grade 8	533 to 800 ft-lb	33,245 to 49,867 lb
7/8 – 14 Grade 8	588 to 883 ft-lb	36,682 to 55,023 lb
1 – 8 Grade 8	800 to 1,199 ft-lb	43,614 to 65,421 lb
1 – 12 Grade 8	875 to 1,313 ft-lb	47,739 to 71,608 lb

The above table is for SAE Grade 8 fasteners, K = .22 (Zinc electroplated bolt or nut)

Fastener Size	Recommended tightening torque	Clamp load
#6 – 32 Grade 5	16 to 24 in-lb	589 to 883 lb
#6 – 40 Grade 5	18 to 27 in-lb	657 to 986 lb
#8 – 32 Grade 5	30 to 45 in-lb	908 to 1,362 lb
#8 – 36 Grade 5	31 to 47 in-lb	954 to 1,432 lb
#10 – 24 Grade 5	43 to 65 in-lb	1,136 to 1,704 lb
#10 – 32 Grade 5	49 to 74 in-lb	1,296 to 1,943 lb
¼ - 20 Grade 5	81 to 122 in-lb	1,623 to 2,434 lb
¼ - 28 Grade 5	93 to 139 in-lb	1,855 to 2,783 lb
5/16 – 18 Grade 5	14 to 21 ft-lb	2,674 to 4,011 lb
5/16 – 24 Grade 5	15 to 23 ft-lb	2,961 to 4,442 lb
3/8 – 16 Grade 5	25 to 37 ft-lb	3,952 to 5,928 lb
3/8 – 24 Grade 5	28 to 42 ft-lb	4,479 to 6,719 lb
7/16 – 14 Grade 5	40 to 59 ft-lb	5,422 to 8,133 lb
7/16 – 20 Grade 5	44 to 66 ft-lb	6,055 to 9,082 lb
½ - 13 Grade 5	60 to 90 ft-lb	7,237 to 10,855 lb
½ - 20 Grade 5	68 to 102 ft-lb	8,158 to 12,236 lb
5/8 – 11 Grade 5	120 to 180 ft-lb	11,526 to 17,289 lb
5/8 – 18 Grade 5	136 to 204 ft-lb	13,054 to 19,581 lb
¾ - 10 Grade 5	213 to 320 ft-lb	17,057 to 25,586 lb
¾ - 16 Grade 5	238 to 357 ft-lb	19,021 to 28,532 lb
7/8 – 9 Grade 5	343 to 515 ft-lb	23,548 to 35,323 lb
7/8 – 14 Grade 5	379 to 568 ft-lb	25,983 to 38,975 lb
1 – 8 Grade 5	515 to 772 ft-lb	30,893 to 46,340 lb
1 – 12 Grade 5	564 to 845 ft-lb	33,815 to 50,723 lb

The above table is for SAE Grade 5 fasteners, K = .20 (Clean non-plated fasteners or Loctited zinc electroplated fasteners)

Fastener Size	Recommended tightening torque	Clamp load
#6 – 32 Grade 5	18 to 27 in-lb	589 to 883 lb
#6 – 40 Grade 5	20 to 30 in-lb	657 to 986 lb
#8 – 32 Grade 5	33 to 49 in-lb	908 to 1,362 lb
#8 – 36 Grade 5	34 to 52 in-lb	954 to 1,432 lb
#10 – 24 Grade 5	47 to 71 in-lb	1,136 to 1,704 lb
#10 – 32 Grade 5	54 to 81 in-lb	1,296 to 1,943 lb
¼ - 20 Grade 5	89 to 134 in-lb	1,623 to 2,434 lb
¼ - 28 Grade 5	102 to 153 in-lb	1,855 to 2,783 lb
5/16 – 18 Grade 5	15 to 23 ft-lb	2,674 to 4,011 lb
5/16 – 24 Grade 5	17 to 25 ft-lb	2,961 to 4,442 lb
3/8 – 16 Grade 5	27 to 41 ft-lb	3,952 to 5,928 lb
3/8 – 24 Grade 5	31 to 46 ft-lb	4,479 to 6,719 lb
7/16 – 14 Grade 5	43 to 65 ft-lb	5,422 to 8,133 lb
7/16 – 20 Grade 5	49 to 73 ft-lb	6,055 to 9,082 lb
½ - 13 Grade 5	66 to 100 ft-lb	7,237 to 10,855 lb
½ - 20 Grade 5	75 to 112 ft-lb	8,158 to 12,236 lb
5/8 – 11 Grade 5	132 to 198 ft-lb	11,526 to 17,289 lb
5/8 – 18 Grade 5	150 to 224 ft-lb	13,054 to 19,581 lb
¾ - 10 Grade 5	235 to 352 ft-lb	17,057 to 25,586 lb
¾ - 16 Grade 5	262 to 392 ft-lb	19,021 to 28,532 lb
7/8 – 9 Grade 5	378 to 567 ft-lb	23,548 to 35,323 lb
7/8 – 14 Grade 5	417 to 625 ft-lb	25,983 to 38,975 lb
1 – 8 Grade 5	566 to 850 ft-lb	30,893 to 46,340 lb
1 – 12 Grade 5	620 to 930 ft-lb	33,815 to 50,723 lb

The above table is for SAE Grade 5 fasteners, K = .22 (Zinc electroplated bolt or nut)

Fastener Size	Recommended tightening torque	Clamp load
#6 – 32 Grade 2	8 to 12 in-lb	300 to 450 lb
#6 – 40 Grade 2	9 to 14 in-lb	335 to 502 lb
#8 – 32 Grade 2	15 to 23 in-lb	462 to 693 lb
#8 – 36 Grade 2	16 to 24 in-lb	486 to 729 lb
#10 – 24 Grade 2	22 to 33 in-lb	579 to 868 lb
#10 – 32 Grade 2	25 to 38 in-lb	660 to 990 lb
¼ - 20 Grade 2	53 to 79 in-lb	1,050 to 1,575 lb
¼ - 28 Grade 2	60 to 90 in-lb	1,200 to 1,801 lb
5/16 – 18 Grade 2	108 to 162 in-lb	1,730 to 2,595 lb
5/16 – 24 Grade 2	120 to 180 in-lb	1,916 to 2,874 lb
3/8 – 16 Grade 2	16 to 24 ft-lb	2,557 to 3,836 lb
3/8 – 24 Grade 2	18 to 27 ft-lb	2,898 to 4,347 lb
7/16 – 14 Grade 2	26 to 38 ft-lb	3,508 to 5,262 lb
7/16 – 20 Grade 2	29 to 43 ft-lb	3,918 to 5,876 lb
½ - 13 Grade 2	39 to 59 ft-lb	4,683 to 7,024 lb
½ - 20 Grade 2	44 to 66 ft-lb	5,278 to 7,918 lb
5/8 – 11 Grade 2	78 to 117 ft-lb	7,458 to 11,187 lb
5/8 – 18 Grade 2	88 to 132 ft-lb	8,447 to 12,670 lb
¾ - 10 Grade 2	138 to 207 ft-lb	11,037 to 16,556 lb
¾ - 16 Grade 2	154 to 231 ft-lb	12,308 to 18,462 lb
7/8 – 9 Grade 2	133 to 200 ft-lb	9,142 to 13,714 lb
7/8 – 14 Grade 2	147 to 221 ft-lb	10,088 to 15,131 lb
1 – 8 Grade 2	200 to 300 ft-lb	11,994 to 17,991 lb
1 – 12 Grade 2	219 to 328 ft-lb	13,128 to 19,692 lb

The above table is for SAE Grade 2 fasteners, K = .20 (Clean non-plated fasteners or Loctited zinc electroplated fasteners)

Fastener Size	Recommended tightening torque	Clamp load
#6 – 32 Grade 2	9 to 14 in-lb	300 to 450 lb
#6 – 40 Grade 2	10 to 15 in-lb	335 to 502 lb
#8 – 32 Grade 2	17 to 25 in-lb	462 to 693 lb
#8 – 36 Grade 2	18 to 26 in-lb	486 to 729 lb
#10 – 24 Grade 2	24 to 36 in-lb	579 to 868 lb
#10 – 32 Grade 2	28 to 41 in-lb	660 to 990 lb
¼ - 20 Grade 2	58 to 87 in-lb	1,050 to 1,575 lb
¼ - 28 Grade 2	66 to 99 in-lb	1,200 to 1,801 lb
5/16 – 18 Grade 2	119 to 178 in-lb	1,730 to 2,595 lb
5/16 – 24 Grade 2	132 to 198 in-lb	1,916 to 2,874 lb
3/8 – 16 Grade 2	18 to 26 ft-lb	2,557 to 3,836 lb
3/8 – 24 Grade 2	20 to 30 ft-lb	2,898 to 4,347 lb
7/16 – 14 Grade 2	28 to 42 ft-lb	3,508 to 5,262 lb
7/16 – 20 Grade 2	31 to 47 ft-lb	3,918 to 5,876 lb
½ - 13 Grade 2	43 to 64 ft-lb	4,683 to 7,024 lb
½ - 20 Grade 2	48 to 73 ft-lb	5,278 to 7,918 lb
5/8 – 11 Grade 2	85 to 128 ft-lb	7,458 to 11,187 lb
5/8 – 18 Grade 2	97 to 145 ft-lb	8,447 to 12,670 lb
¾ - 10 Grade 2	152 to 228 ft-lb	11,037 to 16,556 lb
¾ - 16 Grade 2	169 to 254 ft-lb	12,308 to 18,462 lb
7/8 – 9 Grade 2	147 to 220 ft-lb	9,142 to 13,714 lb
7/8 – 14 Grade 2	162 to 243 ft-lb	10,088 to 15,131 lb
1 – 8 Grade 2	220 to 330 ft-lb	11,994 to 17,991 lb
1 – 12 Grade 2	241 to 361 ft-lb	13,128 to 19,692 lb

The above table is for SAE Grade 2 fasteners, K = .22 (Zinc electroplated nut or bolt)

Fastener Size	Recommended tightening torque	Clamp load
#6 – 32	3 to 5 in-lb	125 to 188 lb
#6 – 40	4 to 6 in-lb	140 to 210 lb
#8 – 32	6 to 10 in-lb	193 to 290 lb
#8 – 36	7 to 10 in-lb	203 to 305 lb
#10 – 24	9 to 14 in-lb	242 to 363 lb
#10 – 32	10 to 16 in-lb	276 to 414 lb
¼ - 20	22 to 33 in-lb	439 to 659 lb
¼ - 28	25 to 38 in-lb	502 to 753 lb
5/16 – 18	45 to 68 in-lb	724 to 1,085 lb
5/16 – 24	50 to 75 in-lb	801 to 1,202 lb
3/8 – 16	80 to 120 in-lb	1,069 to 1,604 lb
3/8 – 24	91 to 136 in-lb	1,212 to 1,818 lb
7/16 – 14	128 to 193 in-lb	1,467 to 2,201 lb
7/16 – 20	143 to 215 in-lb	1,638 to 2,457 lb
½ - 13	16 to 24 ft-lb	1,958 to 2,937 lb
½ - 20	18 to 28 ft-lb	2,207 to 3,311 lb
5/8 – 11	32 to 49 ft-lb	3,119 to 4,678 lb
5/8 – 18	37 to 55 ft-lb	3,532 to 5,298 lb
¾ - 10	58 to 87 ft-lb	4,616 to 6,923 lb
¾ - 16	64 to 97 ft-lb	5,147 to 7,720 lb
7/8 – 9	93 to 139 ft-lb	6,372 to 9,558 lb
7/8 – 14	103 to 154 ft-lb	7,031 to 10,546 lb
1 – 8	139 to 209 ft-lb	8,359 to 12,539 lb
1 – 12	152 to 229 ft-lb	9,150 to 13,725 lb

The above table is for Stainless Steel, Bronze or Aluminum fasteners. By fasteners we are implying nuts or bolts – not stationary components in the clamped joint. K = .20 (Clean non-plated fasteners with or without a Loctite type product)

Socket set screw size	Minimum tightening torque for alloy steel socket set screws	Minimum tightening torque for stainless socket set screws
#6	10 in-lb	7 in-lb
#8	19 in-lb	16 in-lb
#10	34 in-lb	26 in-lb
¼	78 in-lb	70 in-lb
5/16	156 in-lb	130 in-lb
3/8	23 ft-lb	230 in-lb
7/16	36 ft-lb	28 ft-lb
1/2	51 ft-lb	42 ft-lb
5/8	110 ft-lb	82 ft-lb
3/4	179 ft-lb	142 ft-lb
7/8	428 ft-lb	333 ft-lb
1	584 ft-lb	467 ft-lb

The above table is the recommended minimum tightening torque for alloy steel and stainless socket set screws. Please note the recommended tightening torque is the same for both fine threaded and coarse threaded set screws

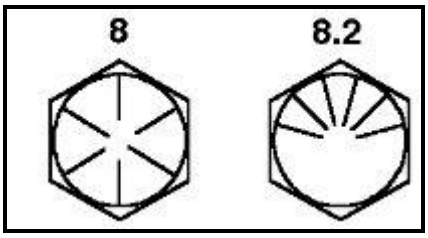
For reference, Recommended tightening torque is found by the following equation;

T = KDP

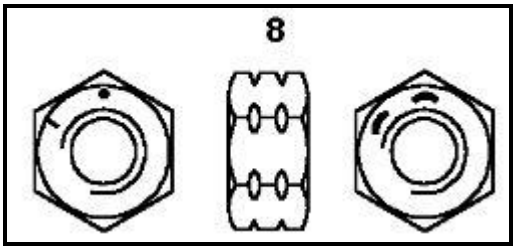
T = Tightening torque in units of inch-pound.
K = Nut factor and it is unit less.
D = Nominal bolt diameter in units of inch.
P = Clamp load in units of pounds.

Nut factor = K = .20 or .22 in these tables. K = .20 for clean non-plated bolts. K = .25 for zinc electroplated bolts. See IFI handbook 6th edition on page M-64 for more details.
Our recommended tightening torques is intended to maintain a clamp load of 60% to 90% of the bolt's proof load. See Mechanical Engineering Design ISBN 0-07-056888-X page 382 for more details.
We assumed a Grade 8 proof load of 120,000 psi for all fasteners sizes.
We assumed a Grade 5 proof load of 85,000 psi for fasteners ¼" in bolt diameter up to 1" in bolt diameter. We assumed a Grade 5 proof load of 108,000 psi for fasteners #6 up to #10 in bolt diameter.
We assumed a Grade 2 proof load of 33,000 psi for fasteners larger than 3/4" in bolt diameter up to 1-1/2" in bolt diameter. We assumed a Grade 2 proof load of 55,000 psi for fasteners #6 in bolt diameter up to 5/8" in bolt diameter.
We assumed a proof load of 23,000 psi for all Stainless Steel, Bronze and Aluminum material fasteners. Sand cast 356.0-T6 aluminum has a yield strength of 24,000 psi listed in the ASM Specialty Handbook Aluminum and Aluminum Alloys on page 720.

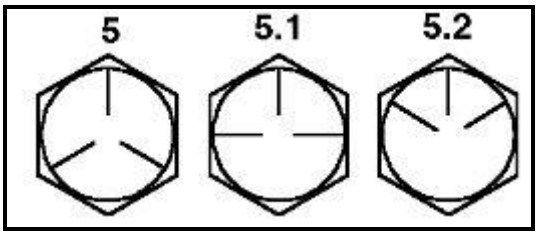
Fastener Size	Nominal bolt diameter (in)	Tensile stress area (square inch)	Stainless, Brass, Bronze or Aluminum proof load (lb)	SAE Grade 2 proof load (lb)	SAE Grade 5 proof load (lb)	SAE Grade 8 proof load (lb)
#6 – 32	.1380	.00909	209	500	981	1,090
#6 – 40	.1380	.01015	233	558	1,095	1,217
#8 – 32	.1640	.0140	322	770	1,513	1,681
#8 – 36	.1640	.01474	339	810	1,591	1,767
#10 – 24	.1900	.0175	403	964	1,893	2,104
#10 – 32	.1900	.0200	460	1,100	2,159	2,399
¼ - 20	.250	.0318	732	1,750	2,705	3,819
¼ - 28	.250	.0364	837	2,001	3,092	4,365
5/16 – 18	.3125	.0524	1,206	2,884	4,457	6,292
5/16 – 24	.3125	.0580	1,336	3,194	4,936	6,968
3/8 – 16	.375	.0775	1,782	4,262	6,587	9,299
3/8 – 24	.375	.0878	2,020	4,831	7,465	10,539
7/16 – 14	.4375	.1063	2,445	5,847	9,036	12,757
7/16 – 20	.4375	.1187	2,730	6,529	10,091	14,246
½ - 13	.500	.1419	3,264	7,804	12,061	17,028
½ - 20	.500	.1599	3,679	8,797	13,596	19,194
5/8 – 11	.625	.226	5,198	12,430	19,210	27,120
5/8 – 18	.625	.256	5,887	14,078	21,759	30,715
¾ - 10	.750	.334	7,693	18,395	28,429	40,135
¾ - 16	.750	.373	8,578	20,513	31,702	44,755
7/8 – 9	.875	.462	10,620	15,237	39,247	55,408
7/8 – 14	.875	.509	11,718	16,813	43,305	61,137
1 – 8	1.000	.606	13,932	19,990	51,488	72,689
1 – 12	1.000	.663	15,250	21,880	56,359	79,565



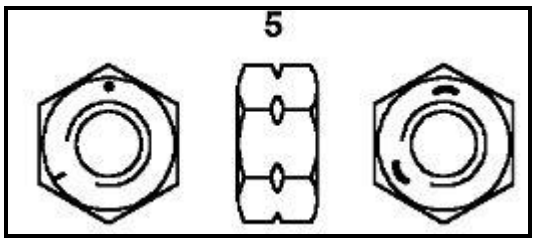
The above image shows how SAE Grade 8 hex head bolts can be identified.



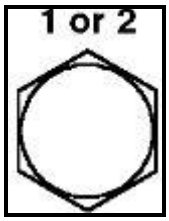
The above image shows how SAE Grade 8 hex nuts can be identified.



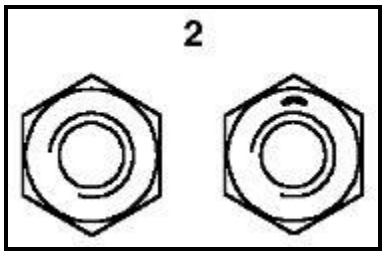
The above image shows how SAE Grade 5 hex head bolts can be identified.



The above image shows how SAE Grade 5 hex nuts can be identified.



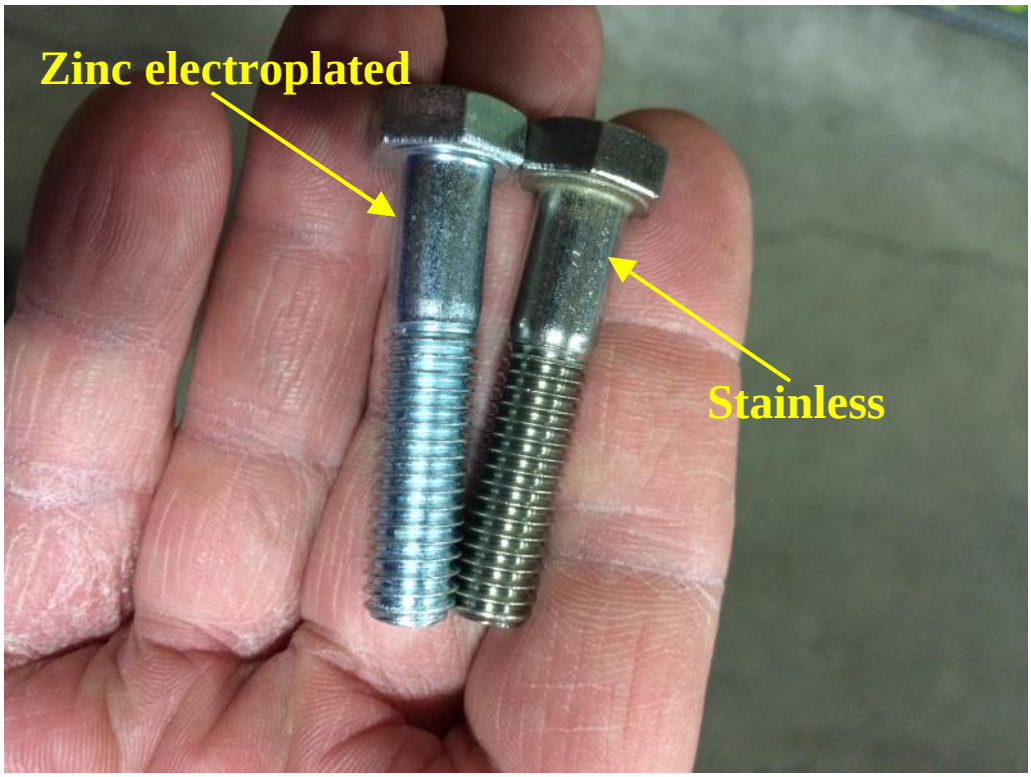
The above image shows how SAE Grade 2 hex head bolts can be identified.



The above image shows how SAE Grade 2 hex nuts can be identified.

The above images show different types of zinc electroplated fasteners.

The above images show different types of clean non-plated fasteners.



The bolt on the left is zinc electroplated.
The bolt on the right is stainless steel.

The above image is a brass machine screw and brass hex nut.

All alloy steel socket head cap screws are have an 180,000 psi tensile strength for ½" and smaller bolts and 170,000 psi tensile strength for 5/8" and larger bolts. Use the SAE Grade 8 recommended tightening torque tables for socket head cap screws.

All alloy steel socket flat countersunk head cap screws have a 150,000 psi minimum tensile strength. Use the SAE Grade 8 recommended tightening torque tables for alloy steel socket flat countersunk head cap screws.

All alloy steel socket button head cap screws have a 137,000 psi minimum tensile strength. Use the SAE Grade 5 recommended tightening torque tables for alloy steel socket button head cap screws.

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The fasteners on the left are alloy steel socket set screws. The fasteners on the right are stainless socket set screws.

If further information is needed, call **Darley** at
Chippewa Falls, WI. - 800-634-7812 or 715-726-2650

Mechanical Shaft Seal

This pump assembly incorporates high quality mechanical shaft seal(s) separating the pump housing components from atmosphere. Depending on the pump design, there may be one or two seals on each impeller shaft.

The seal size, design type, component materials, and housing configuration have been specifically designed for this pump application and rated operating parameters.

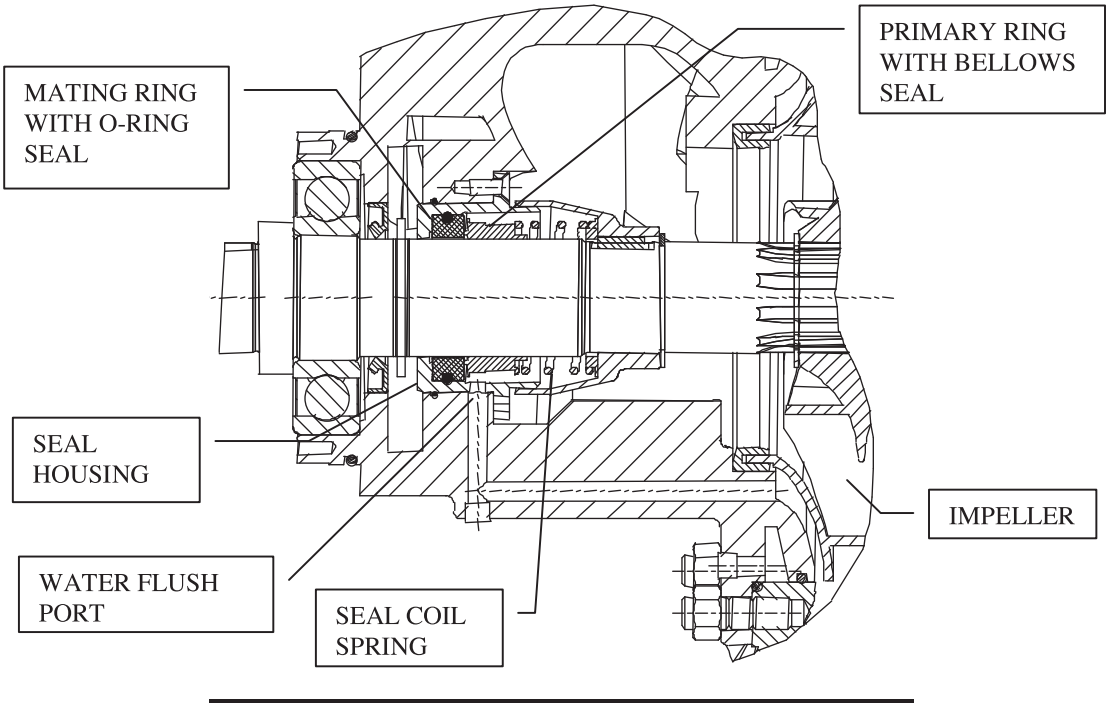
Mechanical Seal Basics

A mechanical seal is a device that houses two highly polished components (known as faces). One face rotates, the other is stationary. A secondary elastomer bellows seals the primary ring to the shaft. An o-ring or cup seal seals the mating ring in the housing. The polished seal faces of the primary and mating rings are pressed together by a spring mechanism to provide adequate force to affect a seal. The force acting between the seal faces increases in direct proportion to product pressure.

The elastomer bellows seal utilized in this pump has the following design features:

- Mechanical drive of the primary seal ring. The drive band's notch design eliminates overstressing the elastomer sealing bellows.
- Bellows design provides automatic compensation for shaft endplay, run out, and primary ring wear.
- Seal face contact pressure is controlled by a single, non-clogging coil spring. This coil spring has been custom welded per Darley specifications to eliminate high-speed spring distortion.

The seal housing is designed and ported to provide optimal water flow and pressure assuring proper cooling and flushing of the seal components.



Operation and Maintenance

When operated within rated operating conditions of this pump, these seals will provide trouble free service for extended periods.

Properly selected and applied mechanical shaft seals are leak free and require no adjustment. Should the seal area develop a leak, investigate the cause as soon as possible. Seal failure, leakage, may be the result of; worn seal faces, leaking bellows, or damaged o-rings. These failures may be attributed to bearing failure, impeller blockage, impeller imbalance, seal housing contamination, operating beyond pump design rating, or dry running,

Mechanical shaft seal design relies on the sealed media, in this case, water, to cool and lubricate the sealing surfaces. Therefore, extended dry operation may cause overheating and scoring or damage to the sealing surfaces, resulting in excessive leakage or a much shortened seal life.

To maximize seal life, minimize operation at pump pressures higher than pump rating. While operating at pressures beyond rating will not immediately damage the seal, it will increase sealing surface wear rate.

CAUTION: **DO NOT RUN THE PUMP DRY EXCEPT MOMENTARILY AND AT LOW SPEEDS**

CAUTION: **DO NOT USE THIS PUMP FOR HOSE TESTING**

CAUTION: **THE MECHANICAL SEAL SHOULD NOT BE RUN DRY, WHILE THE PUMP IS NOT ENTRAINED WITH WATER, FOR A PERIOD LONGER THAN 2 MINUTES. FAILURE TO FOLLOW THIS RECOMMENDATION WILL LEAD TO PREMATURE WEAR AND FAILURE OF YOUR MECHANICAL SHAFT SEAL.**

DARLEY

INSTALLATION OF MECHANICAL FACE SEAL WITH O'RING

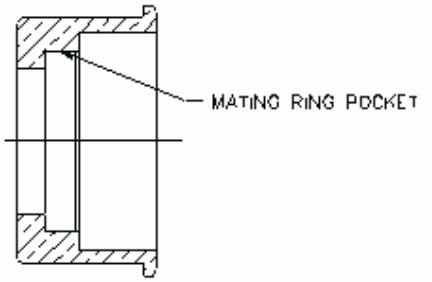
SPECIAL HANDLING

Study the engineering layout before installing the seal. This shaft seal is a precision product and should be handled and treated with care. Take special care to prevent scratches on the lapped faces of the primary and mating ring. Provide a very clean work area where the assembly will take place. Clean hands prior to assembly.

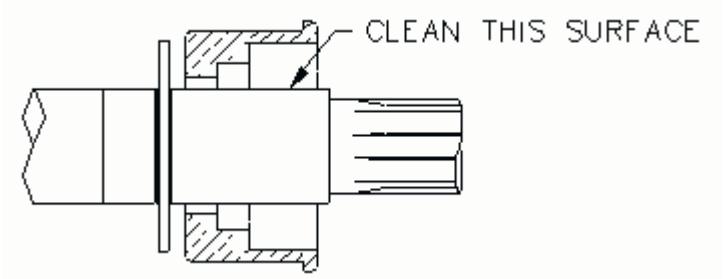
INSTRUCTION STEPS:

Instructions for Installing a Mechanical Shaft Seal

1. Inspect mating ring pocket in seal housing ensuring it is clean, free of chips, and nick free, to provide a proper sealing surface. Isopropyl alcohol may be used to clean the surfaces if required.

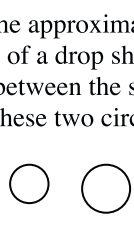


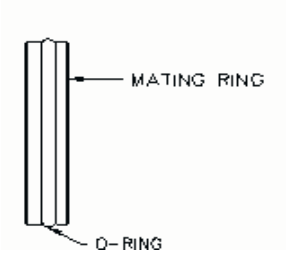
2. Inspect the pump shaft surface under the bellows, ensuring it is clean and nick free to provide a proper sealing surface. Isopropyl alcohol may be used to clean surface if required.

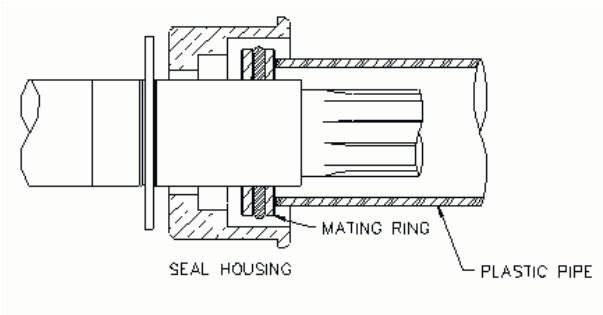


3. Lightly lubricate the o-ring on the mating ring with a single drop of P-80 water soluble rubber lubricant (do not over lubricate) and push it into the cavity using the recommended installation tool or other suitable plastic tube free of contaminants, firmly seating the mating ring square.
   Note: The polished face of the mating ring must face out – away from the pump's gear case. Try to not touch the polished sealing face with your fingers; the oils from your fingerprint can cause the seal to leak. Remove any P-80 from the sealing face after installation.

The approximate size of a drop should be between the sizes of these two circles.





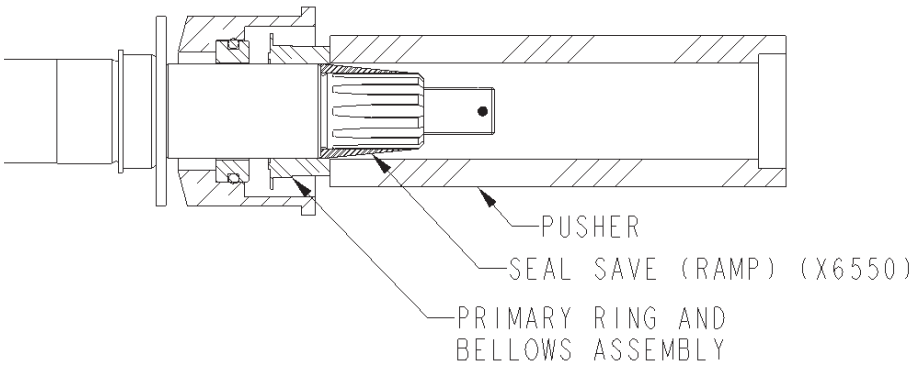


4. Clean the mating ring surface with isopropyl alcohol to remove any fingerprints and any other contaminants left on mating ring.

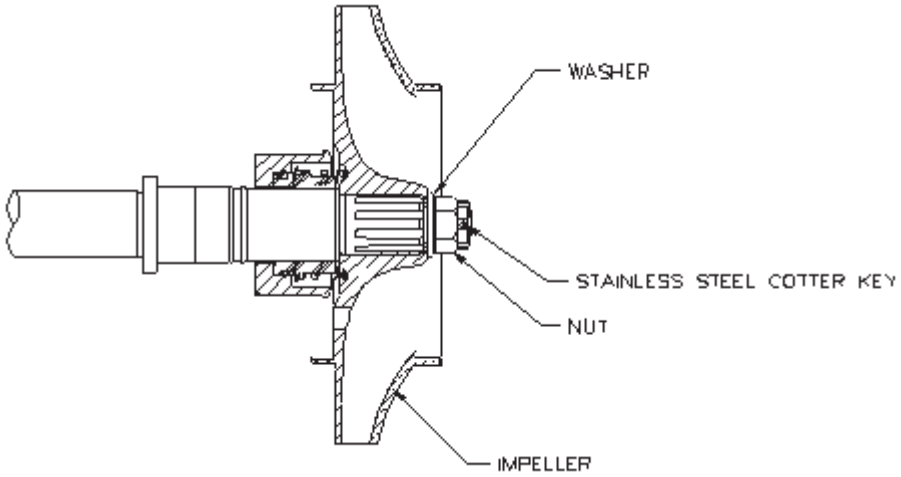
Note: Steps 5 – 9 need to all be completed with in 15 minutes or less.

5. Apply a small drop of P-80 rubber lubricant or water-soluble lubricant (not soapy water) to the inside diameter of the bellows assembly allowing it to be pushed easily into position.
6. Clean the polished sealing face of the primary ring with a clean lint free rag with isopropyl alcohol to remove all fingerprints and other contaminants.
7. Slide a seal save, similar to X6550, over the shaft splines to ensure that the seal is not damaged during installation. Place the primary ring and lubricated bellows assembly (without the spring) on the shaft, using a proper pusher - push the assembly into position so that the seal surfaces are in contact. Remove the seal save from the shaft.

The approximate size of a drop should be between the sizes of these two circles.



8. Put the spring in place, seated tight against the spring retainer on the primary ring.
   Note: Some springs may be slightly tapered, so one end fits the seal better than the other. The end of the spring that best fits the seal should go towards the seal to ensure even spring pressure all the way around.
9. Slide impeller onto impeller shaft, engage the spring into the groove of the impeller hub and install impeller washer, impeller nut, and stainless steel cotter key.



** *Reference pump configuration for individual mechanical seal instructions.*
** *Reference pump assembly drawings and pump assembly tips for further assembly.*

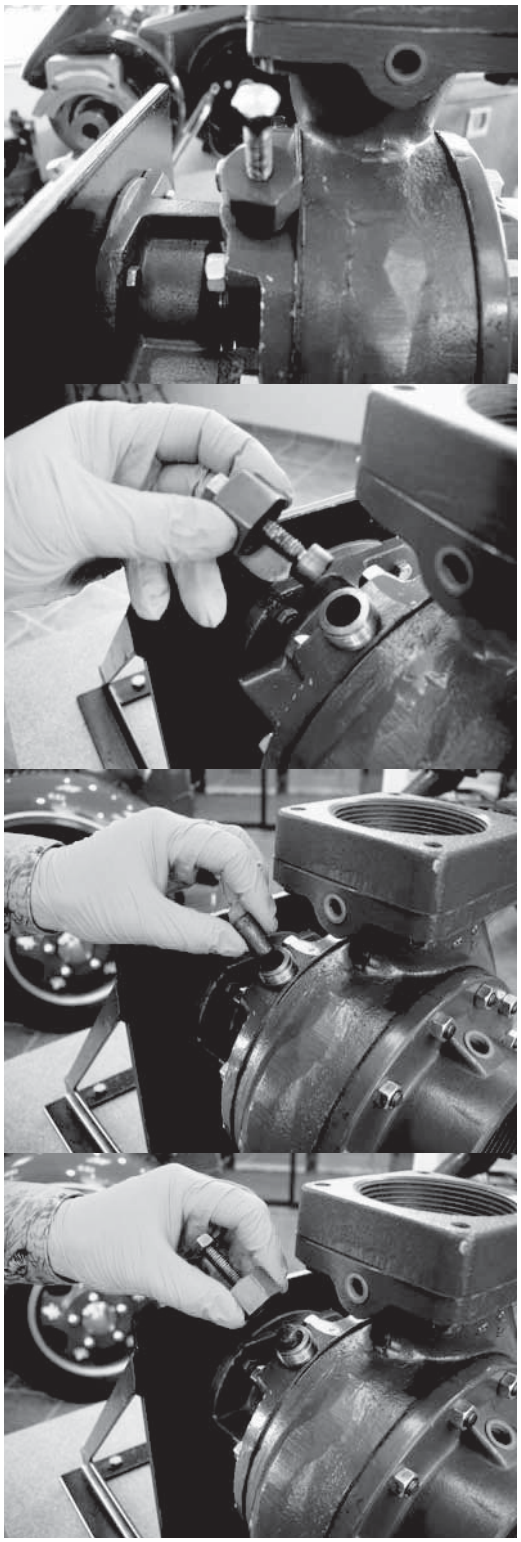
Note: If the seal leaks slightly after assembly, it may be necessary to run the pump for approximately 30 minutes at 50-60 psi to rinse out excess lubricant and other contaminants.

Once a mechanical seal has been installed, it is recommended that it not be reused.

If further information is needed, call **DARLEY** in
Chippewa Falls, WI. at 800-634-7812 or 715-726-2650

W. S. DARLEY & CO.

DARLEY INJECTION TYPE STUFFING BOX ADJUSTMENT



Prop 65 Warning: This product contains lead, a chemical known to the State of California to cause cancer, birth defects, and other reproductive harm. Wash hands after handling.

Caution: Do not attempt to use anything but Darley injection packing. Using the wrong packing material in your pump may cause catastrophic failure of the pump shaft sealing components.

Only use W.S. Darley & Co.'s plastallic injection packing material. It is made of a special composition of shredded fibers, and a special bonding and lubricating compound.

It is important that the stuffing box is completely filled solid with packing and compressed firm during adjustment to prevent formation of voids and excessive leakage.

To pack the stuffing box when empty and assembled in the pump, remove the packing screw and nut assembly, and insert pellet form packing into the packing plunger guide. Replace the packing screw assembly and use a hand speed wrench to force the pellets into the gland. DO NOT USE A POWER TOOL! Repeat pellet additions while turning the impeller shaft by hand until resistance to turning is felt when the stuffing box is almost full. Continue turning packing screw by hand using a standard 6" long 9/16" end wrench until 4 lb. of force is felt at the end of the wrench. This is equivalent to 2 ft-lb or 24 in-lb torque. Continue turning until a few flakes of packing are extruded out the opening between the impeller shaft and the stuffing box hole. The gland is now ready for pressure testing or pumping.

After priming the pump with water, start the pump and raise the discharge pressure to 50 psi. Tighten the packing screw using a 6" long 9/16" end wrench until 4 lb. force is felt at the end of the wrench (24 in-lb torque). Continue operating the pump at 50 psi for 5 minutes to dissipate packing pressure against the shaft and permit cooling water to flow between the shaft and stuffing box hole. Make sure that water actually does come through before operating pump at any higher pressure. The normal drip rate may vary between 5 and 60 drops per minute.

Operate the pump for 10 minutes at the highest normal operating pressure flowing sufficient water to prevent overheating. Do not run the pump blocked tight. Lower discharge pressure to 50 psi and repeat the packing screw tightening procedure outlined above.

The pump may now be operated for any time period required within its rated capacity. However, the drip rate should be monitored more frequently during the first few hours, and adjusted if necessary to achieve a stable flow rate. Several more adjustments may be required.

For a list of approximate quantity of packing pellets required by model (completely repacked), see below:

Model	Approximate # Packing Pellets
A	6
2BE	6
EM	15
H	8
JM	8
KD	10
KS	8
LD	15
LS	9
P	10
U2	5
U4	10

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at Chippewa Falls, WI. at 800-634-7812 or 715-726-2650

W. S. DARLEY & CO.

SOME CARE AND HANDLING INSTRUCTIONS

1. **DO NOT USE THIS PUMP FOR HOSE TESTING!**
2. Avoid unnecessary force and rough handling of parts during disassembly and reassembly.
3. Clean parts thoroughly and maintain free from abrasive foreign matter.
4. Keep bearings in original containers until ready to install.
5. Work with clean tools in clean surroundings during reassembly.
6. Do not bump or abrade machined surfaces, giving special care to wearing surfaces, shaft shoulders, gear and impeller hub faces, gear teeth, etc.
7. Use an arbor press for forcing press fits whenever possible. If necessary to use a hammer, use one having soft plastic heads.
8. Use suitable machined and fitted sleeves or bars for forcing or pressing ball bearings and other parts having press fits.
9. Do not press a ball bearing onto a shaft by forcing against the outer race. Heavy pressure or impact against bearing balls will damage the bearing and cause premature failure.
10. If necessary to remove a ball bearing from a shaft by forcing against the outer race, the bearing should be discarded and replaced.
11. When forcing or pressing a bearing or other part onto a tight fitting shaft, the part must be started square with the shaft and forced on squarely all the way.
12. Clean and oil bearing seats and other parts having press fits to prevent galling.
13. Keep loose parts marked or otherwise identified to avoid errors in assembly.
14. When filling the gearcase with oil, fill it with SAE80W/90 gear lube oil to the bottom of the oil level plug located on the gear case.
15. Maintain the gearcase oil level every 25 hours, or every 3 months which ever comes first, and change the oil every 50 hours, or every 6 months, which ever comes first.

IF FURTHER INFORMATION IS NEEDED, CALL **W.S. DARLEY & CO.** AT CHIPPEWA FALLS, WI. AT 800-634-7812 or 715-726-2650