17. KSPAH

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W. S. DARLEY & CO.

REPAIR SERVICE INSTRUCTIONS
TYPE KSPAH PTO DRIVEN FIRE PUMP

REMOVAL OF PUMP AND TRANSMISSION FROM TRUCK CHASSIS

CAUTION: Using wheel chocks, block the vehicle wheels from rolling!

NOTE: Lowering the pump will require a coordinated effort between the person operating the floor jack and the person on top with the rope holding the pump upright.

Unless the truck is raised with approximately three feet of clearance at the running boards, the pump will have to be tipped to get it out from under the truck.

1. Drain oil from both of the pump gear cases.
2. Remove the drive shaft from the front of the pump.
3. Remove the air lines at the air clutch.
4. Disconnect any electric wires to the pump.
5. Disconnect all tubing and cables such as the following additional items from the pump:
   Primer Tubing
   Gage Line Tubing
   Drain Line Tubing
   Tachometer Drive Cable
6. Remove any other accessory that will prevent lowering the pump assembly.
7. Place a floor jack or transmission jack under gear case for support. Pump weighs 500 lbs.
8. Remove eight 3/8-NC cap screws holding the suction manifolding to the suction head, and swing the manifold out of the way. It may be necessary to entirely remove the suction sweep tee (item # 1 on drawing DKC1400).
9. Remove the eight 3/8-NC nuts holding the discharge manifolding from the main pump casing. Prying may be required to loosen the gasket between the discharge head and pump casing.
10. Unbolt the supply line from the suction of the high - pressure stage pump casing.
11. Disconnect the discharge from the high - pressure stage pump casing.

CAUTION: After the next step, the jack will be the only support for the pump. Check the jack to make sure it is positioned correctly and is snug to support the pump. Also tie two loops of rope around the discharge portion of the volute. Loop the rope around the discharge head or a beam above the truck. The rope will be used later to keep the pump upright on the jack while lowering the pump.

12. Remove the nuts from the top of the pump support cross members, two front and two rear. Tape the nuts on the bottom side of the cross members to the studs so they cannot turn and change the pump position when it is re-installed.

The pump is now ready to drop out, but may require some prying to loosen the gasket between the discharge head and pump casing.

KSPAH DISASSEMBLY FOR OVERHAUL
SEPARATING THE TWO PUMPS AT THE AIR CLUTCH
Refer to drawing DGC0121 and DKC1400

Unless otherwise noted, the reference numbers in this section refer to drawing DGC0121

CAUTION: This procedure is best and safest when performed by two people.

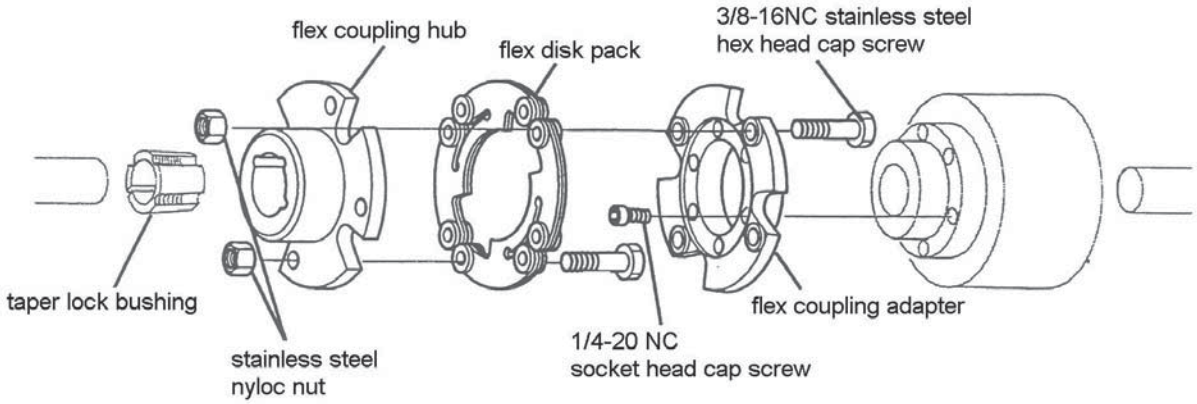


Figure 1

1. Remove the air supply hose from air clutch (4).
2. Using a 3/32 allen wrench, loosen the two set screws that lock the air clutch (4) to the shaft of the high pressure stage drive shaft.
3. Remove four 1/2-13NC cap screws, and remove the high pressure stage assembly from bearing bracket (30 drawing DKC1401) by sliding the shaft out of the air clutch. Be careful not to lose the drive key.
4. Using a 7/32 allen wrench, remove the two set screws from the end of flex coupling hub.
5. Screw one of the set screws into the third hole, and tighten. This will pull the taper lock bushing (2) away from flex coupling (3), loosening the taper bushing from the shaft. (Reference figure 2).

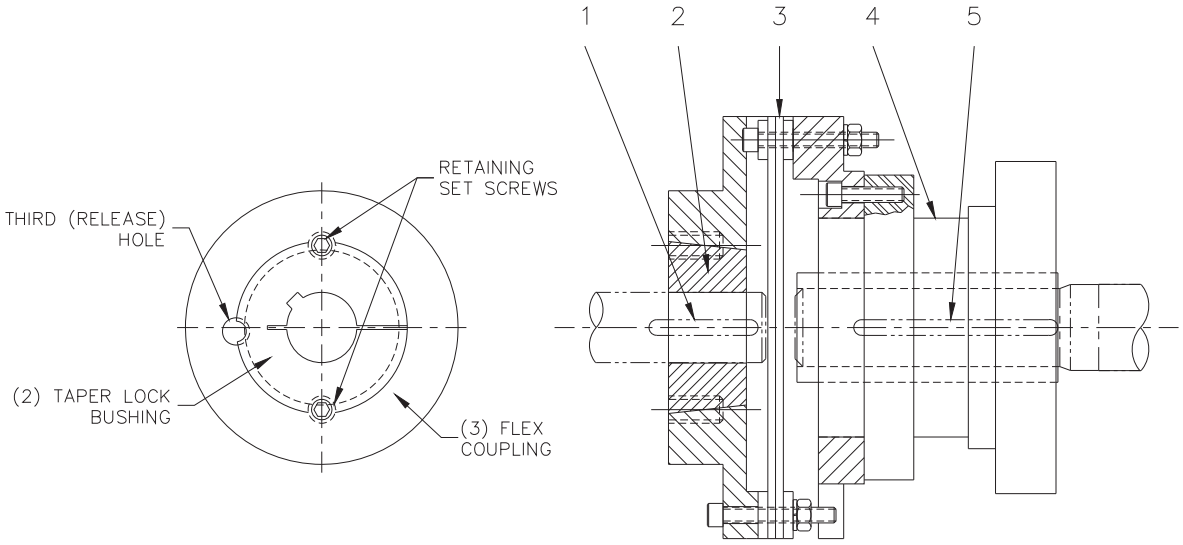


Figure 2
(Ref. DGC0121)

6. Remove the air clutch and flex plate assembly (4 drawing DKC1400) from the bearing bracket.
7. Slide the taper lock bushing (2) off the output shaft of the main pump. Be careful not to lose the drive key (1).

KSPAH MAIN PUMP DISASSEMBLY

Refer to drawing DKC0650

1. Remove twelve 3/8-NC nuts and remove suction head (73) from volute (70). Remove o-rings (71) and (72) from suction head.
2. If necessary to replace, tap or press seal ring (79) out of suction head (73).
3. Remove cotter-key (76) from impeller shaft (57). Remove impeller nut (77) and washer (75).
4. Slide impeller (78) off impeller shaft (57) using the two 1/4-NC tapped holes.
5. Remove four 5/16-NC cap screws and remove bearing cap (28 drawing DKC1401).

   NOTE: Due to the gear ratio, the pinion gear may be too large to fit through upper bearing cap openings in the gear case. If this is the case, steps 11, 12, and 13 must be completed prior to step 6.
6. Remove four 3/8-NC nuts from the studs and remove volute (70) and impeller shaft/pinion gear assembly from gear case (2 drawing DKC1401).
7. Slide impeller shaft (57) out of volute (70) and water slinger (60).
8. If necessary to replace, pull or pry seal ring (79) out of volute (70).
9. Press oil seal (2) out of volute (70).
10. If necessary to replace, press stuffing box (74) out of volute (70). Remove old packing (80) from stuffing box and plunger guide (82).

Refer to drawing DKC1401

11. Press bearing (26) off impeller shaft (5).
12. Pry tab of lock washer (25) out of slot in lock nut (27). Remove lock nut and lock washer from impeller shaft (5).
13. Press pinion gear (3) off impeller shaft (5). Mark the bearing side of the gear with a center punch.
14. Press bearing (7) off impeller shaft (5).

DISASSEMBLY OF KSPAH MAIN PUMP TRANSMISSION

Refer to drawing DKC1401

15. Remove eight 1/4-NC cap screws and remove gear case cover (23).
16. Remove flange nut (16) and companion flange (17) from transmission shaft (35).
17. Remove four 3/8-NC hex head cap screws and remove rear bearing cap (33) from gear case (2). Two 5/16-NC tapped holes in flange will facilitate separation.
18. Pull oil seal (37) out of bearing cap (33).
19. Remove four 3/8-NC cap screws and remove front bearing housing (21) from gear case (2). Two 5/16-NC tapped holes in flange will facilitate separation.
20. Pull oil seal (15) out of front bearing housing (21).
21. Press transmission shaft (35) forward and out of drive gear (34) and rear bearing (14).
22. Press front bearing (14) off transmission shaft (35).
23. Remove drive gear (33) from gear case (2).
24. Remove six 3/8-NC cap screws and bearing bracket (30).
25. Pull oil seal (31) out of bearing bracket (30).
26. Remove four 5/16-NC cap screws and idler shaft-bearing cap (9). Two 5/16-NC tapped holes in flange will facilitate separation.

27. Press output shaft (10) toward the front, out of idler gear (29), spacer (32), and bearing (12). Mark the front side of idler gear with a center punch.

28. Press the second bearing (12) off output shaft (10).

29. Remove idler gear (29) from gear case (2).

KSPAH MAIN PUMP PARTS INSPECTION AND MEASUREMENT

1. Clean all parts and examine carefully for wear or deterioration. Replace any questionable parts.

2. Measure the impeller and seal rings for wear. Use the following table for comparison:

Impeller Seal Ring O.D.	5.753 - 5.755
Impeller Seal Ring I.D.	5.504 - 5.506
Seal Ring O.D.	5.768 - 5.770
Seal Ring I.D.	5.489 - 5.491
Clearance O.D. - original	0.013 - 0.017
Clearance I.D. - original	0.013 - 0.017

3. If the outside diameter clearance exceeds 0.025 inch, impeller can be restored to original size by soldering a ring over trued surface that retains at least 0.090 wall thickness. Stationary seal rings (79) should also be replaced, or you may purchase oversize seal rings. Call customer service for details.

4. Measure the impeller shaft and stuffing box for wear. Use the following table for comparison:

Impeller shaft diameter at packing area	1.303 - 1.304
Stuffing box bore - new	1.317 - 1.318
Stuffing box bore - max.	1.323
Clearance - original	0.013 - 0.015
Clearance - max. allowable	0.020

5. Measure the bearing housing bores for proper size. Use the following table for comparison. If any bore exceeds the high limit by 0.0005, the part should be replaced.

PART	REP NO.	ORIGINAL BORE DIA.
Pump casing	70	3.1496 – 3.1503
Bearing cap	28	2.0472 - 2.0480
Bearing cap	9	2.8346 - 2.8353
Bearing bracket	30	2.8346 - 2.8353
Front bearing cap	21	3.5433 - 3.5442
Rear bearing cap	33	3.5433 - 3.5442

6. Measure the shaft bearing journals for proper size. Use the following table for comparison. The low limit under bearing is required to ensure a press fit with inner bearing race.

PART	REP. NO.	ORIGINAL JOURNAL DIA.
Impeller shaft	5	0.7874 - 0.7878
		1.3781 - 1.3785
Output shaft	10	front 1.1812 - 1.1816
		rear 1.1815 – 1.1818
Drive shaft	35	front 1.9686 – 1.9690
		rear 1.9686 – 1.9690

7. The original impeller shaft diameter under the pinion gear is 1.3781 - 1.3785. The original pinion gear bore is 1.3785 - 1.3790 providing 0.0000 to 0.0009 clearance. The parts are still serviceable up to 0.0014 clearance. The pinion gear may be reversed to work other side of the gear teeth.

8. The original output shaft diameter under the idler gear is 1.1815 - 1.1820 The original idler gear bore is 1.1820 - 1.1825 providing 0.0000 to 0.0010 clearance. The parts are still serviceable up to 0.0018 clearance. The idler gear may be reversed to work other side of gear teeth.

9. The original drive shaft diameter under the drive gear is 1.9998 – 2.0003. The original drive gear bore is 2.0000-2.0005, providing .0007 clearance - .0003 interference. The parts are still serviceable up to .0012 clearance. The drive gear may be reversed to work the other side of the gear teeth.

ASSEMBLY OF KSPAH MAIN PUMP AND TRANSMISSION

Refer to drawings DKC1401

NOTE: When reassembling the pump and transmission, only use all new bearings, oil seals, gaskets, o-rings, stainless steel cotter pins, etc…. DO NOT reuse any of these items, or any damaged parts.

1. Lay gear case (2) flat on workbench, front side up.
   NOTE: The opening on the gear case is on the lower left-hand side when the gear case is viewed from the front.
2. Check if pinion gear (3) can be inserted through upper bearing bore in gear case (2). If pinion gear cannot be inserted, insert pinion gear through large rectangular hole in the side of gear case.
3. Insert idler gear (29) through opening on side of gear case (2).
4. Apply a light coating of oil to output shaft (10), and the bore of the idler gear (29). Place idler gear key (11) in output shaft keyway; align with keyway in idler gear (29) and press shaft evenly into gear bore until shaft shoulder is tight against the side of gear.
5. If front bearing (12) is supplied with shields, remove both shields. Be careful not to contaminate the bearing. Apply light oil to the bore of the bearing and press it onto output shaft (10) until inner race of the bearing is tight against the shaft's shoulder.
6. Use bearing assembly fixture X4006 to support the idler shaft while second bearing (12) is installed. Attach to gear case (2) with raised side toward bearing with two 5/16-NC x 7/8 cap screws.
7. Turn gear case (2) over and make sure that the raised portion of fixture X4006 is centered against the end of output shaft (10).
8. Place idler gear spacer (32) on output shaft (10).
9. If rear bearing (12) is supplied with shields, remove one shield. Be careful not to contaminate the bearing. Apply light oil to bore of bearing and press it, with the open side of the bearing facing the gear, onto output shaft (10) until bearing, spacer, and idler gear are tight together.
10. Install oil seal (31) in bearing bracket (30) with the lip spring facing the bearing pocket for bearing (12). Lube the oil seal lip with heavy oil, preferably 80W90 gear lube.
11. Place bearing bracket gasket (8) onto bearing bracket (30). Apply Loctite 243 or equivalent to the threads of six 3/8-NC x 1 cap screws. Slide bearing bracket into position on rear of gear case and attach with these cap screws. Torque to 23 lbs.-ft.
12. Place gasket (8) on bearing cap (9). Apply Loctite 243 or equivalent to threads of four 5/16-NC x 7/8 cap screws. Attach bearing cap to gear case (2) with these screws and torque to 13 lbs.-ft.
13. If necessary to install, apply a light coating of oil to cable drive nut (38) and press evenly into the hole at end of drive shaft (35). Nut must have 3/8-shaft length extending.
14. If front transmission shaft bearing (14) is supplied with shields, remove one shield. Be careful not to contaminate the bearing. Apply light oil to bore of the bearing and press it, with the open side of the bearing facing the gear, onto transmission shaft (35) until inner race of bearing is tight against shaft shoulder.
15. Insert drive gear (34) through opening on side of gear case (2).
16. Apply a light coating of oil to transmission shaft (35). Place drive gear key (18) in transmission shaft keyway; align with keyway in drive gear (34) and press shaft evenly into gear bore from the front until shaft shoulder is tight against the side of gear.
17. Press oil seal (15) into front bearing housing (21) with lip spring of seal facing bearing. Lube the oil seal lip with heavy oil, preferably 80W90 gear lube.
18. Place bearing cap gasket (13) on front bearing cap (21). Tap bearing cap over bearing (14) and against gear case (2). Apply Loctite 243 or equivalent to the threads of four 3/8-NC x 1 cap screws to attach the bearing cap to the gear case. Torque to 23 lbs.-ft.
19. Slide transmission spacer (36) onto transmission shaft (35).

20. If rear transmission shaft bearing (14) is supplied with shields, remove one shield. Be careful not to contaminate the bearing. Apply a light coating of oil to bore of the bearing and press it, with the open side of the bearing facing the gear, onto transmission shaft (35) until inner race of bearing is tight against spacer (36).
21. Tap transmission shaft from rear with a clean rubber mallet until bearing is seated in front bearing bracket. **CAUTION: DO NOT** use a brass or other soft metal hammer!
22. Press tachometer shaft oil seal (37) into tachometer bearing cap (33) with lip spring of seal facing inward. Lube the oil seal lip with heavy oil, preferably 80W90 gear lube.
23. Place bearing cap gasket (13) on tachometer bearing cap (33). Tap bearing cap over bearing (14) and against gear case (2). Apply Loctite 243 or equivalent to the threads of four 3/8-NC x 1 cap screws to attach the bearing cap to the gear case. Torque to 23 lbs.-ft.
CAUTION: During this step, be careful not to damage oil seal (37) while installing bearing cap (33).
24. Attach gear case cover (23) and gasket (22) with eight 5/16-NC x 5/8 cap screws with Loctite 243 or equivalent. To tighten the cap screws, finger tighten, then torque to 6 lbs.-ft. (72 lbs.-in.) by alternating in a cross pattern to evenly tighten.
25. Slide drive yoke or companion flange (17) onto drive shaft (10). Using an impact wrench set at 50 – 75 lbs.-ft torque, install flanged lock nut (16).

PUMP ASSEMBLY
Refer to drawings DKC0605

NOTE: When reassembling the pump and transmission, only use all new bearings, oil seals, gaskets, o-rings, stainless steel cotter pins, etc…. DO NOT reuse any of these items, or any damaged parts.

26. Apply Loctite 603 or equivalent to entire outside diameter of stuffing box (74). Align packing guide hole in stuffing box with packing guide hole in volute (70). Press stuffing box into volute.
27. Apply Loctite 603 or equivalent to entire outside diameter of one seal ring (79). Press it into volute (70) until seated.
28. Press impeller shaft oil seal (2) into volute (70) with lip spring of seal facing bearing. Lube the oil seal lip with heavy oil, preferably 80W90 gear lube.
29. If impeller shaft bearing (3) is supplied with shields, remove one shield. Be careful not to contaminate the bearing. Apply light oil to the bore of the bearing and press it onto impeller shaft (57). The open side of the bearing faces the shoulder on the shaft.

NOTE: If pinion gear (3) will pass through opening in gear case (2), continue with the next line of instruction and omit alternate procedure A - F. If pinion gear will not pass through opening in gear case, skip to alternate procedure A-F.

30. Apply a light coat of oil to the bore of pinion gear (3 drawing DKC1401). Place pinion key (24 drawing DKC1401) into impeller shaft keyway; align with keyway in pinion gear and press impeller shaft into pinion gear bore until shaft shoulder is tight against side of gear.
31. Slide lock washer (25 drawing DKC1401) onto impeller shaft (5 drawing DKC1401) and install lock nut (27 drawing DKC1401). Tighten the lock nut until a tab of the lock washer aligns with a slot on the lock nut. Press a tab of the washer into a slot on the nut.
32. If impeller shaft bearing (26 drawing DKC1401) is supplied with shields, remove both shields. Be careful not to contaminate the bearing. Apply a light coat of oil to bore of the bearing and press it onto impeller shaft (57 drawing DKC1401) until it is tight against the shaft shoulder.
33. Apply grease to one side of water slinger (60) and firmly place the greased side into position against stuffing box (74). **NOTE:** The grease is for retaining the water slinger position during assembly only.
34. Insert impeller shaft/pinion gear assembly into volute (70). Slide water slinger (60) into its groove on the shaft.
35. Apply a thin layer of Loctite Master Gasket 518 or equivalent to gasket flange surface of volute (70).

36. Apply Loctite 243 or equivalent to the four studs that hold volute (70) to gear case (2 drawing DKC1401). Insert impeller shaft assembly into gear case and place the volute into position on the gear case. Attach the volute to the gear case with four 3/8-NC nuts and lock washers on the studs. Tighten to a recommended torque of 23 lbs.-ft.

ALTERNATE PROCEDURE WHEN PINION GEAR MUST BE ASSEMBLED INSIDE THE GEARCASE:

A. Apply a light coat of oil to impeller shaft (5 drawing DKC1401). Place pinion key (24 drawing DKC1401) into impeller shaft keyway. Align the key with keyway in pinion gear (3 drawing DKC1401) and press impeller shaft evenly into pinion gear bore until shaft shoulder is tight against side of gear.

B. Apply a thin layer of Loctite Master Gasket 518 or equivalent to gasket flange surface of volute (70).

C. Apply Loctite 243 or equivalent to the four studs that hold volute (70) to gear case (2 drawing DKC1401). Slide volute assembly over impeller shaft (5 drawing DKC1401) and onto impeller shaft bearing (7 drawing DKC1401). Make sure seal is seated. Push volute into position in gear case. Attach the volute to the gear case with four 3/8-NC nuts and lock washers on the studs. Tighten to a recommended torque of 23 lbs.-ft.

D. Slide water slinger (60) into its groove.

E. Slide lock washer (25 drawing DKC1401) onto impeller shaft (5 drawing DKC1401) and install lock nut (27 drawing DKC1401). Tighten the lock nut until a tab of the lock washer aligns with a slot on the lock nut. Press a tab of the washer into a slot on the nut.

F. If supplied with shields, remove both of the shields from impeller shaft bearing (26 drawing DKC1401). Be careful not to contaminate the bearing. Apply a light coat of oil to bore of the bearing and press it onto impeller shaft (57 drawing DKC1401) until it is tight against the shaft shoulder.

37. Place gasket (8 drawing DKC1401) in position on bearing cap (28 drawing DKC1401).
38. Attach bearing cap (28 drawing DKC1401) to gear case (2 drawing DKC1401) with four 5/16-NC x 1 cap screws and Loctite 243 or equivalent. Torque to 13 lbs. ft.
39. Slide impeller (78) onto impeller shaft (57). Place impeller washer (75) on shaft with the flat side towards the impeller.
40. Clean and dry the threads of the impeller shaft (57) and impeller nut (77) to remove dirt, grease, and oil. (Loctite 7649 “Primer N" can be used to clean parts and shorten the thread locker cure time.)
41. Apply Loctite 243 or equivalent thread locker to impeller shaft (57) thread and impeller nut (77) thread.
42. Tighten impeller nut (77) until it contacts the impeller washer (75), and then turn to the next cotter-key hole. **(DO NOT OVER TIGHTEN!)**
43. Install a 1/8 x 1 **STAINLESS STEEL** cotter-key (76) in impeller nut cotter-key hole.
44. Apply Loctite 603 or equivalent to the entire outside diameter of seal ring (79). Press seal ring into suction head (73) until it is seated.
45. Lubricate o-rings (71) and (72) and place in position on suction head (73). Oil, grease, or a silicone lubricant such as Dow Corning Compound 111 all work well for this.
46. Apply Loctite 243 or equivalent thread locker to twelve studs on the suction of the volute and attach suction head (73) to volute (70) with twelve 3/8-NC nuts. Torque to 23 lbs. ft.
47. Apply Loctite 262 or equivalent thread locker to the 7/8-14 threads of packing gland (82). Do not apply any thread locker to the 1” thread. Install packing gland.
48. Pack the pump. See “Darley Injection Type Stuffing Box Adjustment”

KSPAH HIGH PRESSURE STAGE DISASSEMBLY

Refer to Drawing DHC1102

1. Remove sixteen 3/8-NC nuts from studs and remove pump casing (28) from inboard head (24).
2. If necessary to replace seal ring (34), press or tap it out of pump casing (28).
3. Remove cotter-key (31) from impeller shaft (11).
4. Remove impeller nut (32) and impeller washer (33) from impeller shaft (11).
5. Slide impeller (35) off of impeller shaft (11).
6. Remove four 5/16-NC cap screws and slide inboard head (24) assembly off impeller shaft (11). Keep impeller shaft with gear case.
7. Pull oil seal (19) out of inboard head (24) with a hooked seal puller.
8. If necessary to replace, press stuffing box (26) out of inboard head (24).
9. Remove three 5/16-NC cap screws and remove bearing cap (9) from gear case cover (91).
10. Remove bearing (10) from impeller shaft (11) with a suitable puller. Slide spacer (13) off of shaft.
11. Slide impeller shaft (11) assembly out of gear case (38).
12. Press bearing (17) off impeller shaft (11).
13. Press pinion gear (15) off of impeller shaft (11).
14. Remove three 5/16-NC cap screws and remove bearing cap (37) from gear case (38).
15. Remove seven 5/16-NC socket head cap screws, and separate gear case cover (2) from gear case (38). The drive gear shaft/gear assembly may remain with either gear case or gear case cover.
    NOTE: It may be necessary to drive two #6 tapered dowel pins out of gear case (38) flange from gear case side towards gear case cover (2) side to facilitate separation of the gear case and cover.
16. Remove drive shaft (7) assembly from gear case (38) or cover (2).
17. Press drive shaft (7) out of drive gear (3), spacer (4), and bearing (8) all at once.
18. Press bearing (8) off of drive shaft (7).
19. Remove oil seal (5) from bearing bracket.

PARTS INSPECTION AND MEASUREMENT

1. Clean all parts and examine carefully for wear or deterioration. Replace any questionable parts. Replace all bearings, oil seals, gaskets, o-rings, stainless steel cotter pins, etc…. DO NOT reuse any of these types of items, or any damaged parts.
2. Measure the impeller seal rings and seal rings for wear. Use the following table for comparison.

PART	REP. NO.	DIAMETER
Impeller Seal Ring O.D.	(35)	1.868 – 1.870”
Impeller Seal Ring I. D.	(35)	1.626 – 1.628”
Seal Ring O.D.	(34) & (26)	1.878 - 1.880”
Seal Ring I.D.	(34) & (26)	1.616 – 1.618”
Clearance O.D. - original		0.008 - 0.012”
Clearance I.D. - original		0.008 - 0.012”

3. If clearance exceeds 0.025” on diameter, impeller seal rings can be restored to original size by soldering a ring over trued surface, which retains at least 0.090” wall thickness. Stationary seal rings should also be replaced.
4. Measure impeller shaft and stuffing box for wear. Use the following table for comparison.

PART	REP. NO.	DIAMETER
Impeller Shaft diameter at packing area	(11)	1.124 - 1.125”
Stuffing Box bore- new	(26)	1.130 - 1.131”
Stuffing box bore - max.		1.136”
Clearance - original		0.005 - 0.007”
Clearance - max. allowable		0.012”

5. Measure bearing housing bores for proper size. Use the following table for comparison. If any bore exceeds the high limit by 0.0005", the part should be replaced.

PART	REP. NO.	ORIGINAL BORE DIA.
Gear Case	(38)	2.8346 - 2.8353"
Gear Case Cover	(2)	2.8346 - 2.8353"
Bearing Bracket		2.8346 - 2.8353"
Inboard Head	(24)	2.8346 - 2.8353"
Bearing Cap	(9)	2.4410 - 2.4415"

6. Measure shaft bearing journals for proper size. Use the following table for comparison. The low limit under bearing is required to insure a press fit with inner bearing race.

PART	REP. NO.	ORIGINAL BORE DIA.
Impeller Shaft	(11)	small 0.9844 - 0.9848"
		large 1.1812 - 1.1816"
Drive Shaft	(7)	both 1.3781 - 1.3785"
Drive Shaft - Gear Journal	(7)	1.3781 - 1.3785"

7. The original impeller shaft diameter under the pinion gear is .9998 to 1.0002". The original pinion gear bore is .9998 to 1.0003" providing 0.0004" press fit to 0.0005" clearance fit. The parts are still serviceable up to 0.001" clearance. The pinion gear may be reversed to work other side of gear teeth.
8. The original drive shaft diameter under the drive gear is 1.3781 to 1.3785". The original drive gear bore is 1.3780 to 1.3785" providing 0.0005" press fit to 0.0004" clearance fit. The parts are still serviceable up to .0009" clearance. The drive gear may be reversed to work other side of gear teeth.

KSPAH HIGH PRESSURE STAGE ASSEMBLY

Refer to Drawing DHC1102

NOTE: When reassembling the pump and transmission, only use all new bearings, oil seals, gaskets, o-rings, stainless steel cotter pins, etc…. DO NOT reuse any of these items, or any damaged parts.

1. Apply a light coating of oil to drive shaft (7) gear journal. Place drive gear key (6) in drive gear shaft keyway, align with keyway in drive gear (3), and press shaft evenly into drive gear until shaft shoulder is tight against side of gear.
2. Slide spacer (4) onto drive shaft (7), against drive gear (3).
3. If rear drive shaft bearing (8) is supplied with shields, remove both shields. Be careful not to contaminate the bearing. Apply light oil to the bore of the bearing and press it onto drive shaft (7) until gear (3), spacer (4), and inner race of bearing are tight together.
4. If front drive shaft bearing (8) is supplied with shields, remove one shield. Be careful not to contaminate the bearing. The open side of the bearing faces the shoulder on the shaft. Apply light oil to the bore of the bearing and press it onto drive shaft (7) until the inner race is tight against the shaft shoulder.
5. Apply a light coating of oil to impeller shaft (11) gear journal. Place pinion gear key (12) in impeller shaft keyway, align with keyway in pinion gear (15), and press shaft evenly into pinion gear until shaft shoulder is tight against side of gear.
6. If impeller shaft bearing (17) is supplied with shields, remove one shield. Be careful not to contaminate the bearing. The open side of the bearing faces the shoulder on the shaft. Apply light oil to the bore of the bearing and press it onto impeller shaft (11) until the inner race is tight against the shaft shoulder.
7. Apply Loctite 518 "MASTER GASKET" or equivalent to the flange surface of bearing cap (37).
8. Apply Loctite 243 or equivalent to the threads of three 5/16-NC x 7/8" hex head cap screws and attach bearing cap (37) to gear case (38) with these screws and lock washers. Torque to 13 lbs. ft.
9. Apply a light coating of oil to the bearing bore of gear case cover (2) and bearing cap (9).
10. Insert drive shaft (7) into gear case cover (2) until bearing (8) is seated in its bore.
11. Place gear case gasket (16) into position on gear case (38).
12. Slide spacer (13) onto impeller shaft (11), against pinion gear (15).

13. If impeller shaft bearing (10) is supplied with shields, remove both shields. Be careful not to contaminate the bearing. Apply light oil to the bore of the bearing and press it onto impeller shaft (11) until gear (15), spacer (13), and inner race of bearing are tight together.
14. Apply Loctite 243 or equivalent to the threads of three 5/16-NC x 1" hex head cap screws, and attach bearing cap (37) to gear case (38) with these cap screws and lock washers. Torque to 13 lbs. ft.
15. Insert impeller shaft (11) assembly into gear case cover (2).
16. Gently tap impeller shaft (11) assembly into bearing cap (9) until bearing (10) is seated in its bore.
17. Place gear case (38) against gasket (16) on gear case cover (2). Locate gear case to gear case cover with two #6 tapered dowel pins. Tap dowel pins in from gear case cover side.
18. Attach gear case (38) to gear case cover (2) with six 5/16-NC x 1" and one 5/16-NC x 5/8" socket head cap screws. Loctite 243 or equivalent should be first applied to the threads of these fasteners, and they should be torqued to 13 lbs. ft.
19. Apply Loctite 603 or equivalent to the outer surface of stuffing box (26). Align packing holes in stuffing box with packing holes in inboard head (24), and press stuffing box squarely into inboard hard until seated.
20. Apply Loctite 603 or equivalent to the outer surface of seal ring (34). Press seal ring squarely into volute (28) until seated.
21. Place oil seal (19) into inboard head (24) with lip spring of seal facing bearing. Lube the oil seal lip with heavy oil, preferably 80W90 gear lube.
22. Apply grease to one side of water slinger (20) and firmly place the greased side into position against stuffing box (74). **NOTE:** The grease is for retaining the water slinger position during assembly only.
23. Apply a thin layer of Loctite 518 "Master Gasket" or equivalent to the flange surface of inboard head (24).
24. Slide inboard head (24) over impeller shaft (11), making sure water slinger (20) is in its proper position.
25. Apply Loctite 243 or equivalent to with four 5/16-NC x 7/8" hex head cap screws, and attach inboard head (24) to gear case (38) with these fasteners and lock washers. Torque to 13 lbs. ft.
26. Slide water slinger (20) into its groove on impeller shaft (11).
27. Slide impeller (35) and impeller washer (33) onto impeller shaft (11).
28. Clean and dry threads of impeller shaft (11) and impeller nut (32), removing dirt, grease, and oil. (Loctite 7649 "Primer N" or Loctite 7070 can be used to clean the parts and shorten cure time.)
29. Apply Loctite 243 or equivalent to the threads of impeller shaft (11) and impeller nut (32).
30. Tighten the impeller nut (32) until it contacts the impeller washer (33); then turn to the next cotter-key hole. **(DO NOT OVER TIGHTEN!)**
31. Install a 1/8" x 1" **STAINLESS STEEL** cotter-key (31) in impeller shaft cotter-key hole.
32. Apply a silicon lubricant, such as Dow Corning Compound 111 or equivalent to pump casing o-ring (25), and place into position on inboard head (24). Slide pump casing (28) into position on inboard head. Apply Loctite 243 or equivalent to the sixteen 3/8" studs in the volute and attach the volute to the inboard head with sixteen 3/8-NC nuts on the studs. Tighten nuts evenly. The final torque should be 23 lbs. ft.

ASSEMBLY OF THE FLEX COUPLING TO THE AIR CLUTCH

Refer to FIGURE 3, and DGC0121

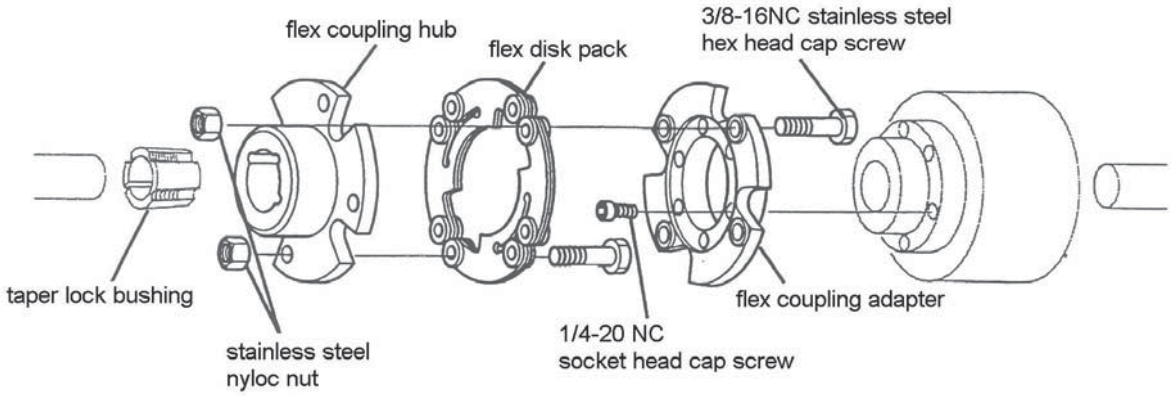
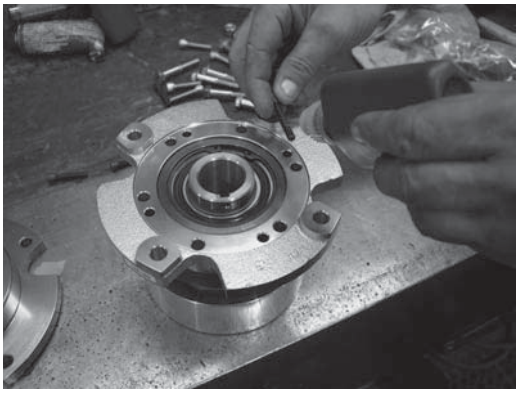
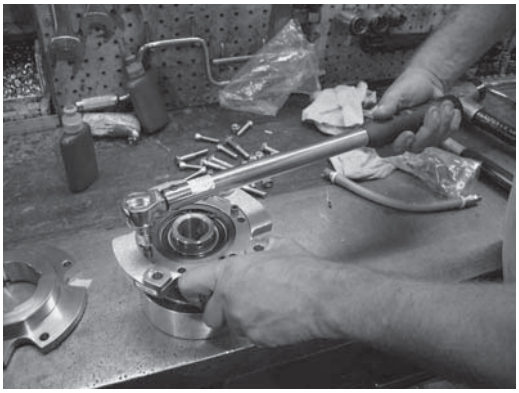


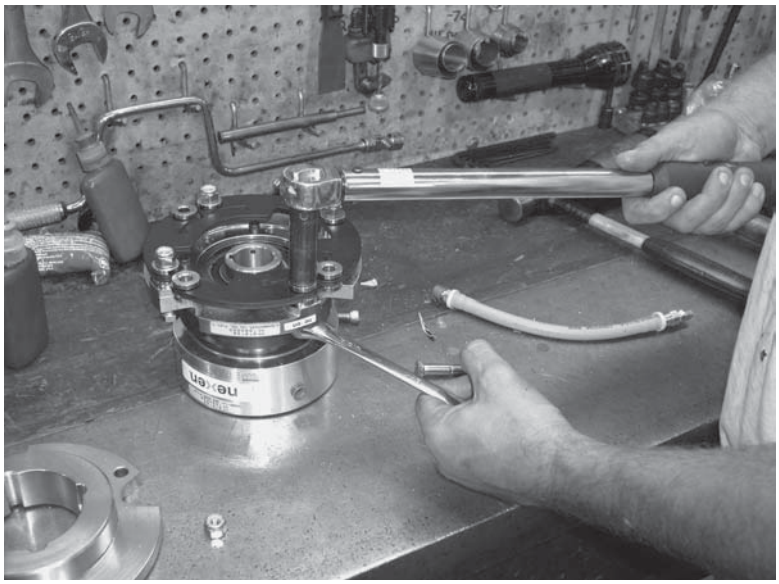
Figure 3

1. Using a 3/16 allen wrench and Loctite 243 or equivalent on the threads of four 1/4-20NC socket head cap screws, attach flex coupling adapter to the air clutch. Torque to 12 lbs. ft. (144 lbs. in.).





2. Assemble the flex disc pack to the clutch side coupling adapter with four stainless steel nyloc nuts and the four stainless steel 3/8-16NC hex head cap screws. Torque to 18 lbs. ft. (216 lbs. in.).



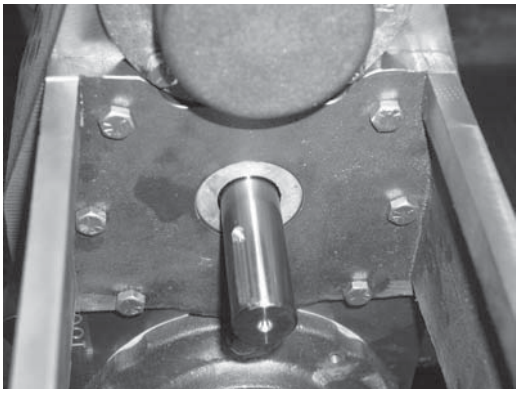
REJOINING THE TWO PUMPS AT THE AIR CLUTCH

Refer to drawing DGC0121, and DKC1400

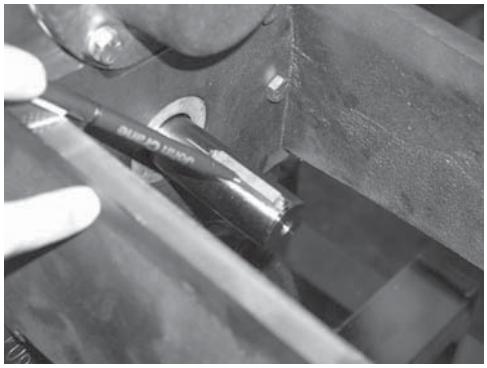
Unless otherwise noted, the reference numbers in this section refer to drawing DGC0121

CAUTION: This procedure is best and safest when performed by two people.

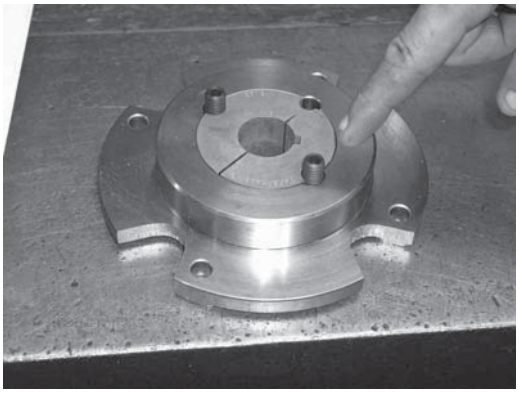
1. Install oil seal (5 drawing DHC1102) in bearing bracket. Lube the oil seal lip as well as the shaft surface with heavy oil, preferably 80W90 gear lube.



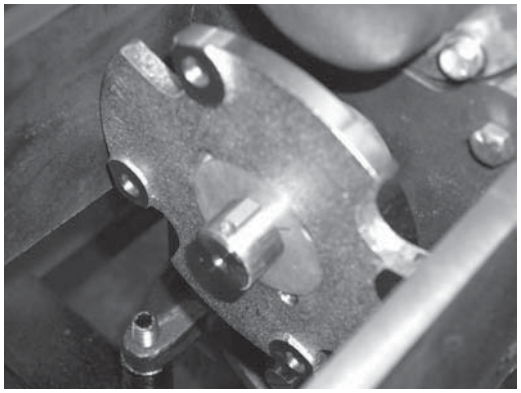
2. Place the drive key (1) in the keyway on the output shaft of the main pump.



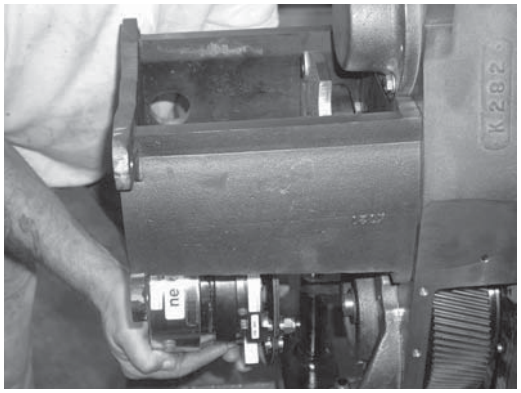
3. Carefully clean and inspect the mating surfaces of the taper lock bushing and coupling half to assure they are clean and free of nicks and burrs. Insert the taper lock bushing into the tapered flex coupling bore. Align the two unthreaded holes in the tapered bushing with the threaded holes in the coupling. The retaining holes will have threads in the hub, but not in the taper lock bushing. Apply Loctite 243 or equivalent to the two 7/16NC x 7/8 socket head set screws and thread into the bushing/coupling finger tight.



4. Lubricate shaft and bushing bore with a film of oil. Slide the taper lock bushing (2) and flex coupling (3) onto the output shaft of the main pump. Be careful not to dislodge the drive key. Do not yet tighten the taper lock retaining bolts.

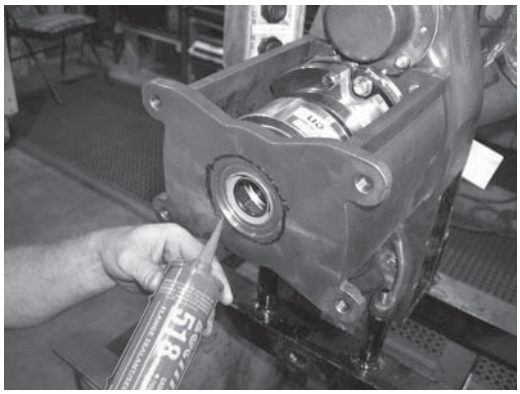


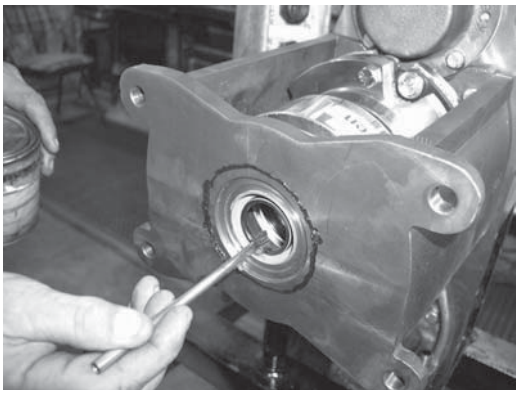
5. Raise clutch and flex disk assembly up from below and align four holes in the flex disk pack with mating holes in drive shaft coupling hub.



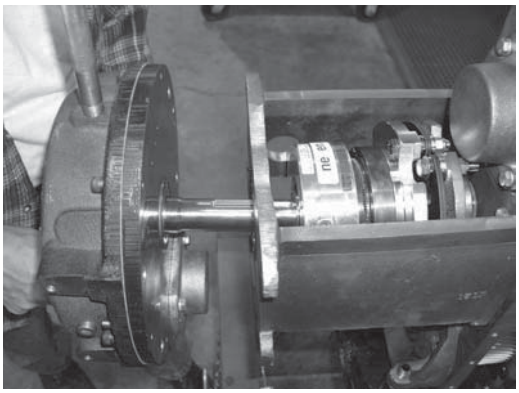
6. Assemble the flex disc pack/clutch assembly to the flex coupling hub with four stainless steel nyloc nuts and the four stainless steel 3/8-16NC hex head cap screws. Torque to 18 lbs. ft. (216 lbs. in.).

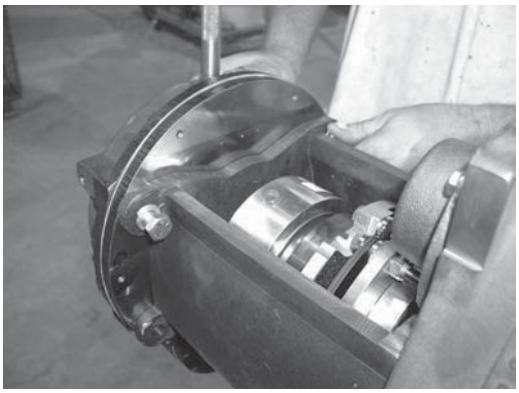
7. Apply Loctite 243 thread locker or equivalent to four 1/2-13NC x 1 3/4" hex head cap screws and set aside. Apply a thin bead of Loctite 518 "MASTER GASKET" or equivalent to the flange surface as shown below. Liberally apply lubricant to the high pressure pump input shaft oil seal.





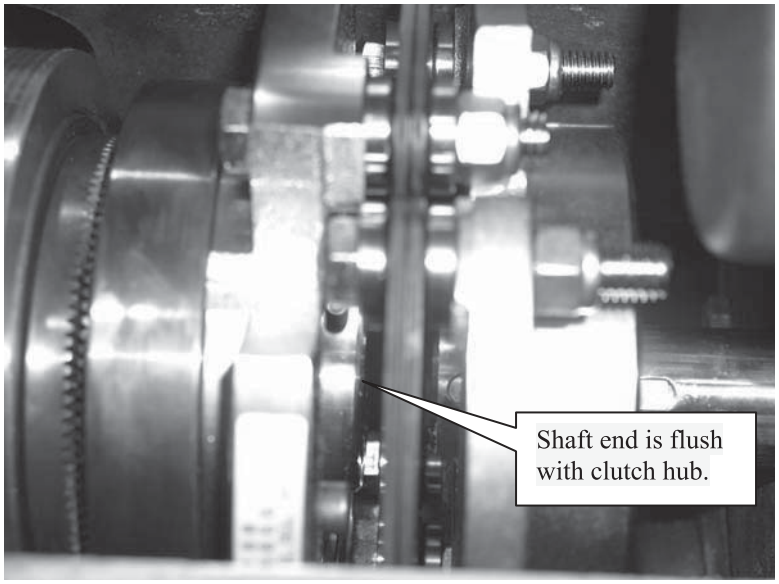
8. Support high pressure pump assembly in a manner which will allow the input shaft to be inserted through the bracket oil seal and into the clutch bore while maintaining axial alignment. (Illustration below shows an overhead hoist ring attached to the oil fill port.) Install a .25 x 1.50 square drive key in the high pressure pump input shaft. Lubricate shaft, key, and clutch bore to aid with assembly. Carefully insert shaft with key through the oil seal and into the clutch. Careful axial alignment is extremely important at this point to avoid damage to the oil seal and clutch flex plate assembly. Guide the shaft into the clutch until the HP pump input shaft bearing has engaged into its pilot and the bracket face is mated to the gear case face.



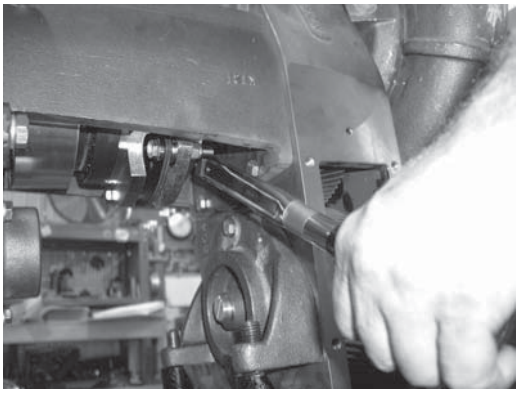


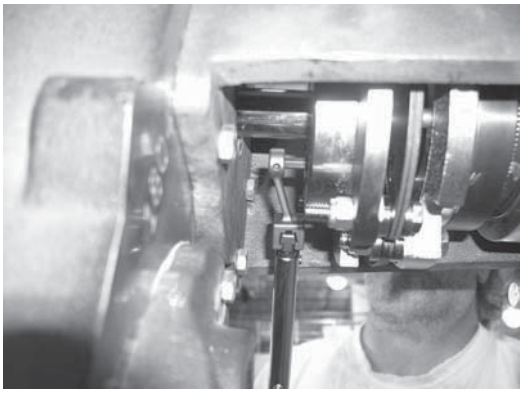
9. Attach the high pressure stage assembly (5 on drawing DKC1400) to bearing bracket (30 drawing DKC1401). Apply Loctite 243 thread locker or equivalent to four 1/2-13NC x 1 3/4” hex head cap screws and using split lock washers, secure the pump assembly to the adapter bracket.

10. Slide the entire clutch assembly axially so that the end of the pump input shaft is flush with the inside clutch hub. The two set screws in the clutch hub will now engage the shaft when tightened. See below.



11. Using a 7/32 allen wrench, tighten the two 7/16NC screws in the retaining holes in the end of flex coupling (3) (Reference figure 4). Alternating between the two set screws, torque the screws to 23 lb-ft (280 lb-inch). **Note: Recheck screw torque after initial run-in and periodically thereafter.**





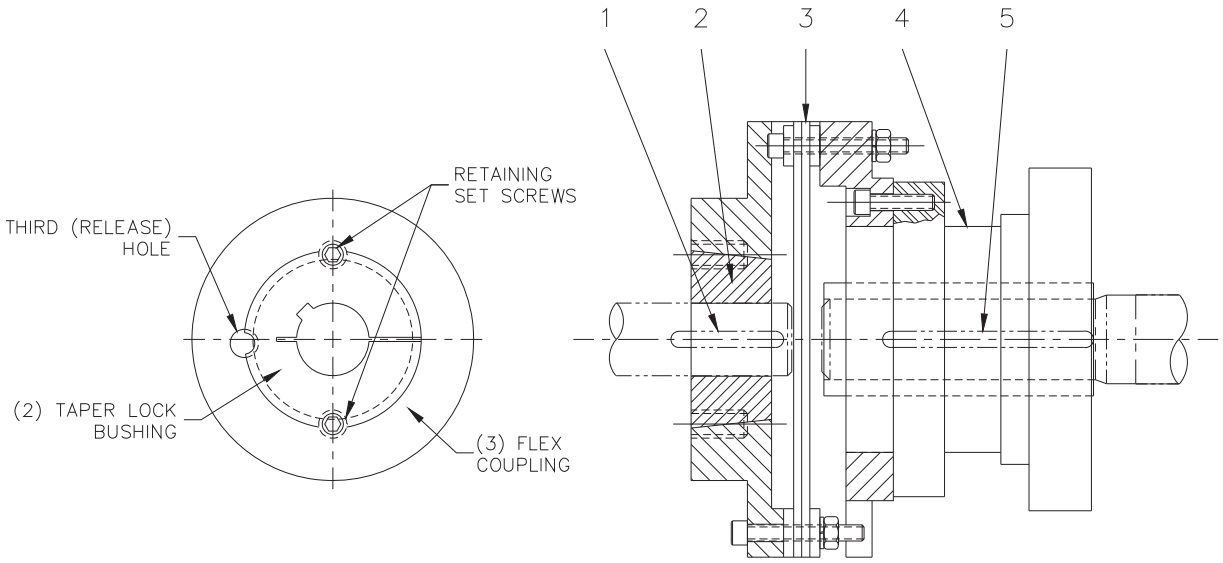
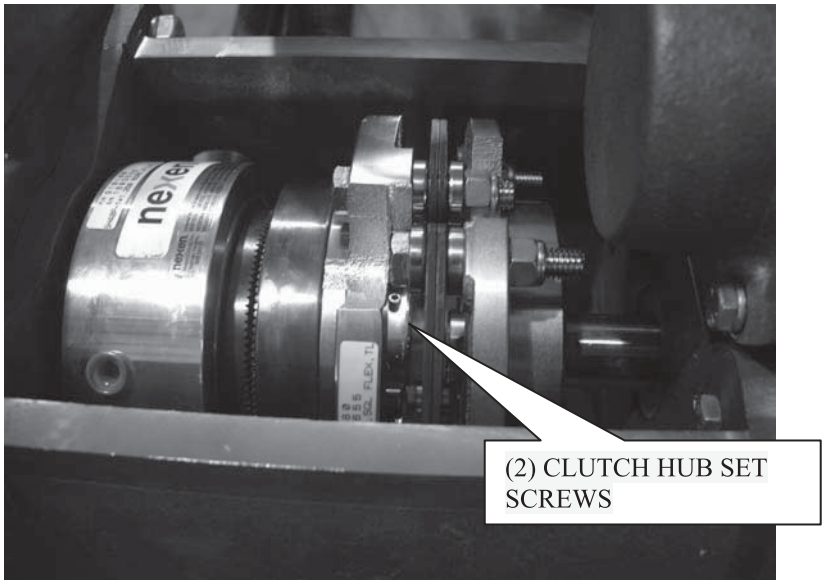
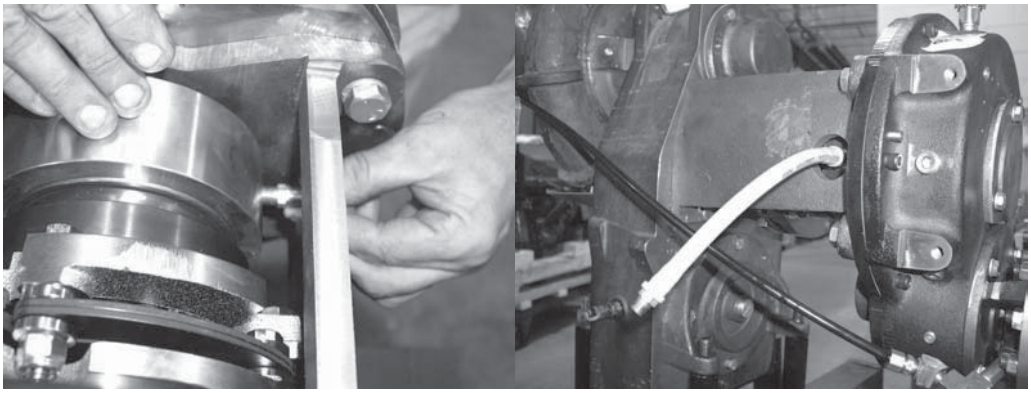


Figure 4
(Ref. DGC0121)

12. Using a 3/32 allen wrench, and Loctite 243 or equivalent on the set screw threads, tighten the two setscrews in the air clutch hub firmly against the shaft to prevent the clutch from sliding on the shaft.



13. Install the air supply fitting and hose to air clutch (4). Note that the fitting and hose must extend through the side hole opening to prevent rotation of the clutch stationary head.



INSTALLING PUMP IN TRUCK CHASSIS

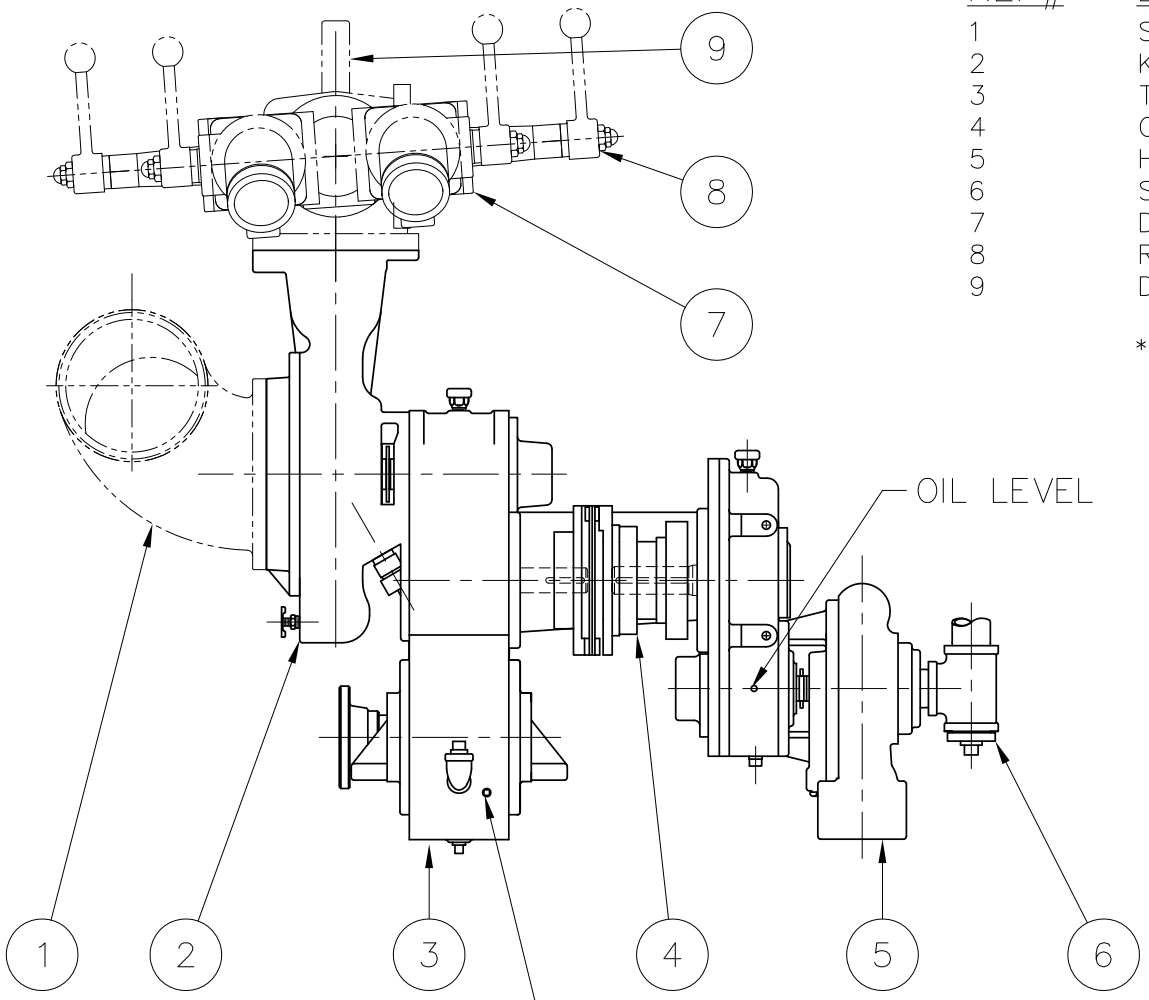
Reverse the procedures outlined under removal instructions.

Lubricate drive shaft slip joints.

Fill both pump gear cases with SAE 80W/90 Gear Lube Oil to the level of the oil-level plugs. This pump has two oil reservoirs that are independent from each other and must be checked & filled separately.
DO NOT OVERFILL.

Check the oil level every 25 hours or 3 months, which ever comes first, and change the oil every 50 hours or 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



REP#	DESCRIPTION	REF DWG
1	SUCTION TEE *	3105300
2	KS PUMP ASSEMBLY	DKC0650
3	TRANSMISSION ASSEMBLY	DKC1401
4	CLUTCH ASSEMBLY	DGC0121
5	HP100 PUMP ASSEMBLY	DHC1101
6	SUCTION INLET ASSEMBLY	DGC0119
7	DISCH. VALVE ASSEMBLY *	DGC0100
8	REMOTE VALVE CONTROL *	–
9	DISCH. HEAD ASSEMBLY *	–

* DENOTES OPTIONAL ASSEMBLY

		OLD PART NO. K728	TOLERANCE EXCEPT AS NOTED FRAC DIM ±.01 .00 ±.01 .000 ±.005 ANGLES ±1°	W.S. DARLEY & CO. MELROSE PARK, IL – CHIPPEWA FALLS, WI
MATERIAL DESCRIPTION: –	MATERIAL NO. –	PATTERN NO. –		KSPAH BASIC ASSEMBLY
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 DWS CHKD TRCD	DATE DEC21,94 SCALE 1/8

DKC1400

17.17

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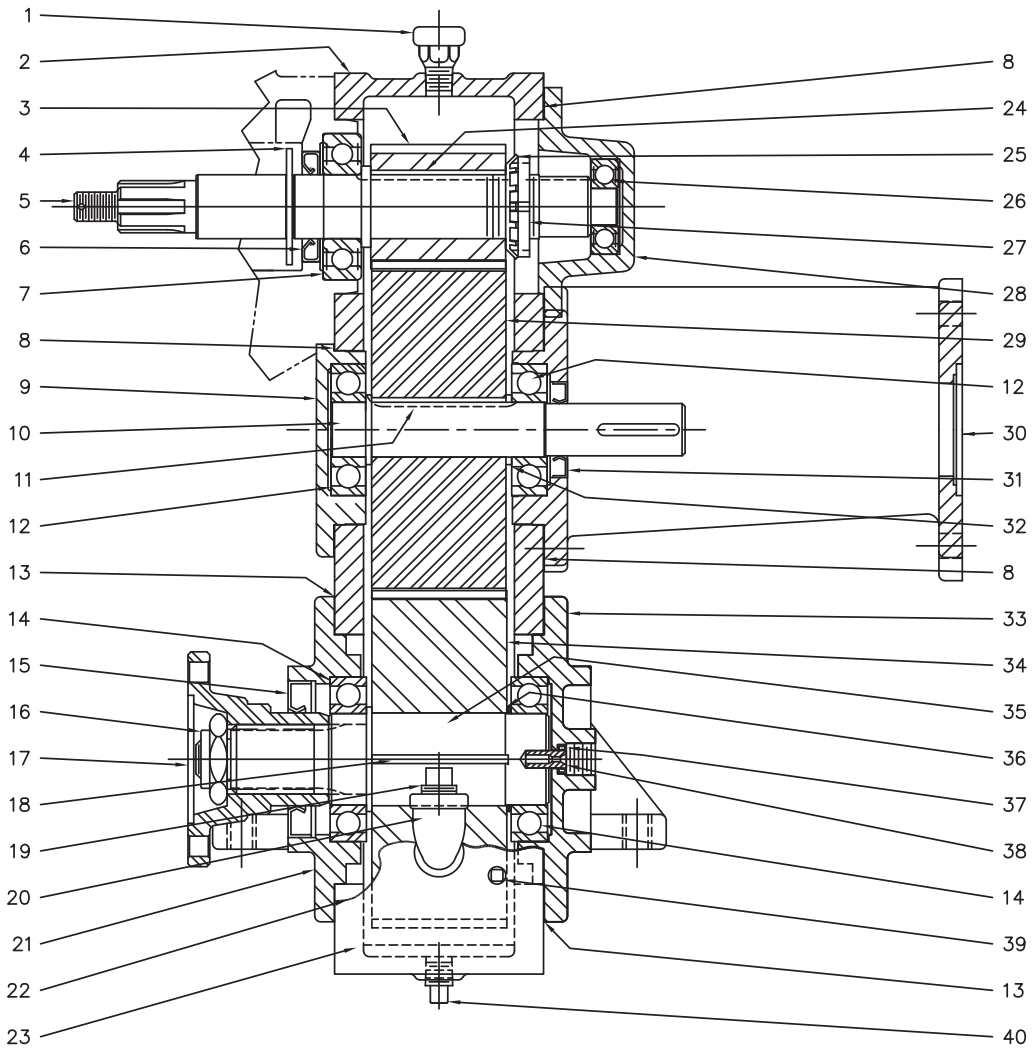
REVISIONS				
LTR	DESCRIPTION	DATE	CHG NO.	APPR'D
A	ADDED NOTE: 125 FT-LB	9/30/08	2008-231	AAN



REP#	DESCRIPTION	QTY
1	VENT	1
2	GEARCASE	1
3	PINION GEAR	1
4	WATER SLINGER	1
5	IMPELLER SHAFT	1
6	OIL SEAL	1
7	BEARING	1
8	GASKET	3
9	BEARING CAP	1
10	OUTPUT SHAFT	1
11	IDLER KEY	1
12	BEARING	2
13	GASKET	2
14	BEARING	2
15	OIL SEAL	1
16	FLANGE NUT – 125 FT-LB (A)	1
17	COMPANION FLANGE	1
18	DRIVE GEAR KEY	1
19	OIL FILL PLUG	1
20	STREET ELBOW	1
21	FRONT BEARING BRACKET	1
22	COVER GASKET	1
23	COVER	1
24	PINION KEY	1
25	BEARING LOCKWASHER	1
26	BEARING	1
27	BEARING LOCKNUT	1
28	BEARING CAP	1
29	IDLER GEAR	1
30	BEARING BRACKET	1
31	OIL SEAL	1
32	IDLER GEAR SPACER	1
33	REAR BEARING BRACKET	1
34	DRIVE GEAR	1
35	TRANSMISSION SHAFT	1
36	DRIVE GEAR SPACER	1
37	OIL SEAL, TACHOMETER SHAFT	1
38	TACH DRIVE NUT	1
39	OIL LEVEL PLUG	1
40	OIL DRAIN PLUG	1

OLD PART NO. K727

TOLERANCE EXCEPT AS NOTED
FRAC DIM ±.01
.00 ±.01
.000 ±.005
ANGLES ±1°

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

DWG – KSPAH, TRANSMISSION CROSS SECTION

MATERIAL DESCRIPTION: –

MATERIAL NO. –

PATTERN NO. –

DR'N DWS
CHKD
TRCD

DATE DEC16,94

SCALE 1/2

DKC1401

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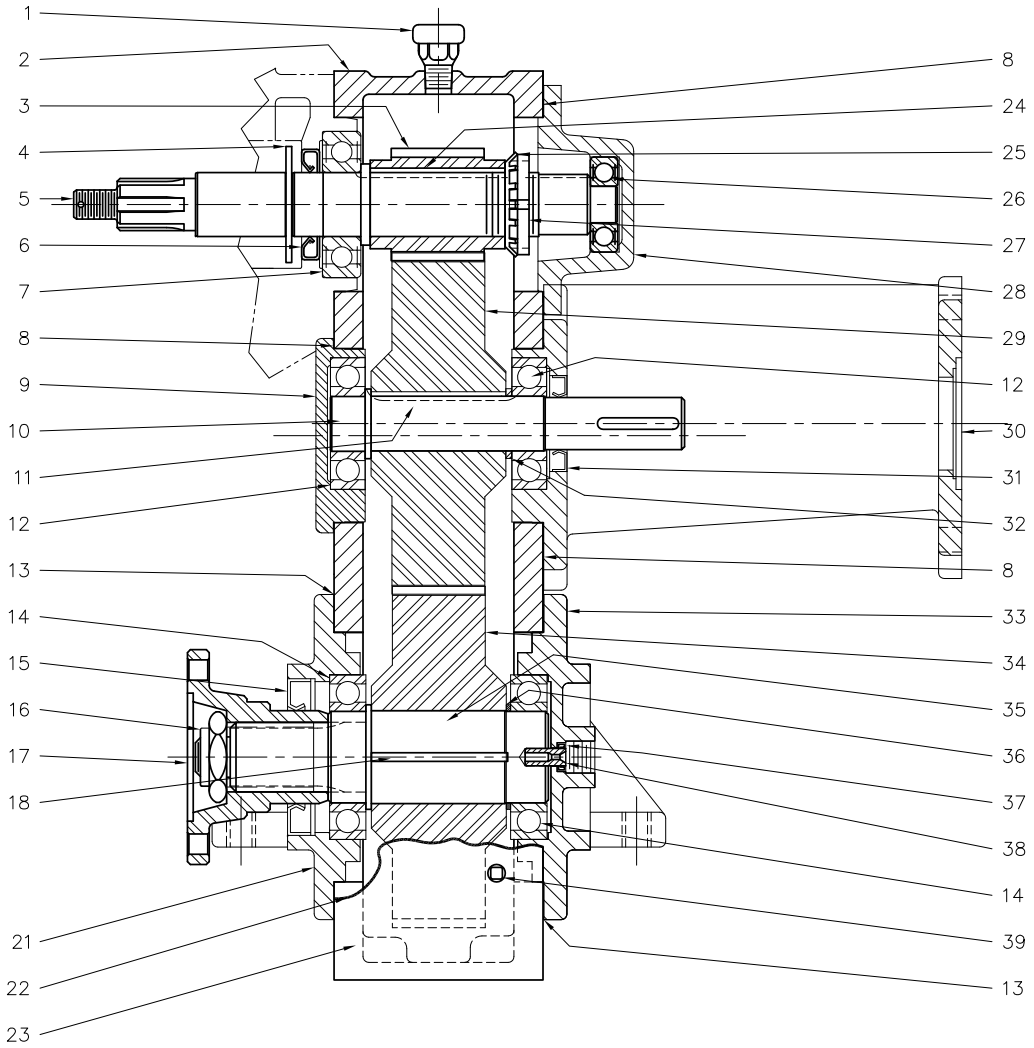
LTR	DESCRIPTION	DATE	CHG NO.	APPR'D



REP#	DESCRIPTION	QTY
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3	PINION GEAR	1
4	WATER SLINGER	1
5	IMPELLER SHAFT	1
6	OIL SEAL	1
7	BEARING	1
8	GASKET	3
9	BEARING CAP	1
10	OUTPUT SHAFT	1
11	IDLER KEY	1
12	BEARING	2
13	GASKET	2
14	BEARING	2
15	OIL SEAL	1
16	FLANGE NUT	1
17	COMPANION FLANGE	1
18	DRIVE GEAR KEY	1
21	FRONT BEARING BRACKET	1
22	COVER GASKET	1
23	COVER	1
24	PINION KEY	1
25	BEARING LOCKWASHER	1
26	BEARING	1
27	BEARING LOCKNUT	1
28	BEARING CAP	1
29	IDLER GEAR	1
30	BEARING BRACKET	1
31	OIL SEAL	1
32	IDLER GEAR SPACER	1
33	REAR BEARING BRACKET	1
34	DRIVE GEAR	1
35	TRANSMISSION SHAFT	1
36	DRIVE GEAR SPACER	1
37	OIL SEAL, TACHOMETER SHAFT	1
38	TACH DRIVE NUT	1
39	OIL LEVEL PLUG	1

MATERIAL DESCRIPTION: –	MATERIAL NO. –	PATTERN NO. –	OLD PART NO. –	TOLERANCE EXCEPT AS NOTED FRAC DIM ±.01 .00 ±.01 .000 ±.005 ANGLES ±1°
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W.S. DARLEY & CO.
MELROSE PARK, IL – CHIPPEWA FALLS, WI

DWG – KSPAH, TRANS, CARB CROSS SECTION

DATE 17SEP,2002

SCALE 1/2

DKC1403

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REVISIONS				
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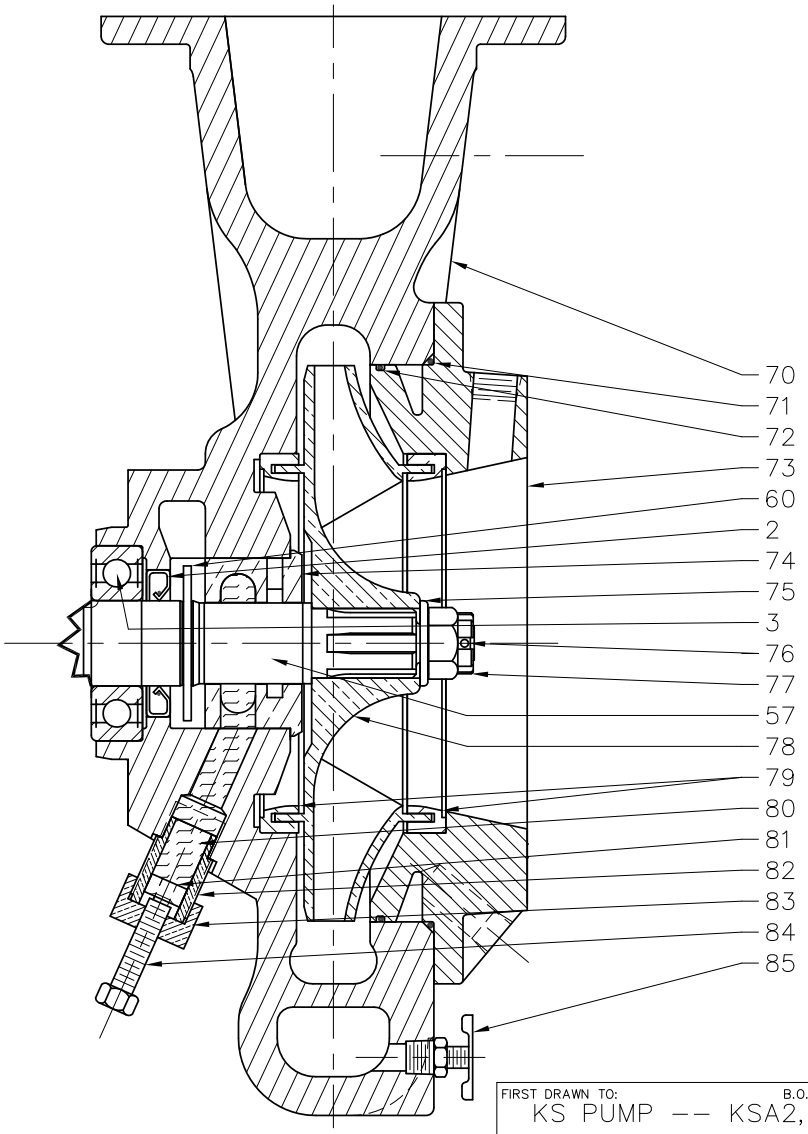
	REMOVED REF. TO RH IMPELLER	SEP22,95		DWS



REP#	NAME OF PART	QTY
2	OIL SEAL	1
3	BEARING	1
57	IMPELLER SHAFT	1
60	WATER SLINGER	1
70	VOLUTE	1
71	O'RING	1
72	O'RING	1
73	SUCTION HEAD	1
74	STUFFING BOX	1
75	WASHER – IMPELLER SHAFT	1
76	COTTER KEY – STAINLESS STEEL	1
77	IMPELLER NUT	1
78	IMPELLER	1
79	SEAL RINGS	2
80	PACKING	1
81	PACKING PLUNGER	1
82	PACKING PLUNGER GUIDE	1
83	GLAND NUT	1
84	PACKING PLUNGER STUD	1
85	DRAIN COCK	1

OLD PART NO.
K720

FIRST DRAWN TO: B.O.M. #:
KS PUMP -- KSA2, KSA7

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

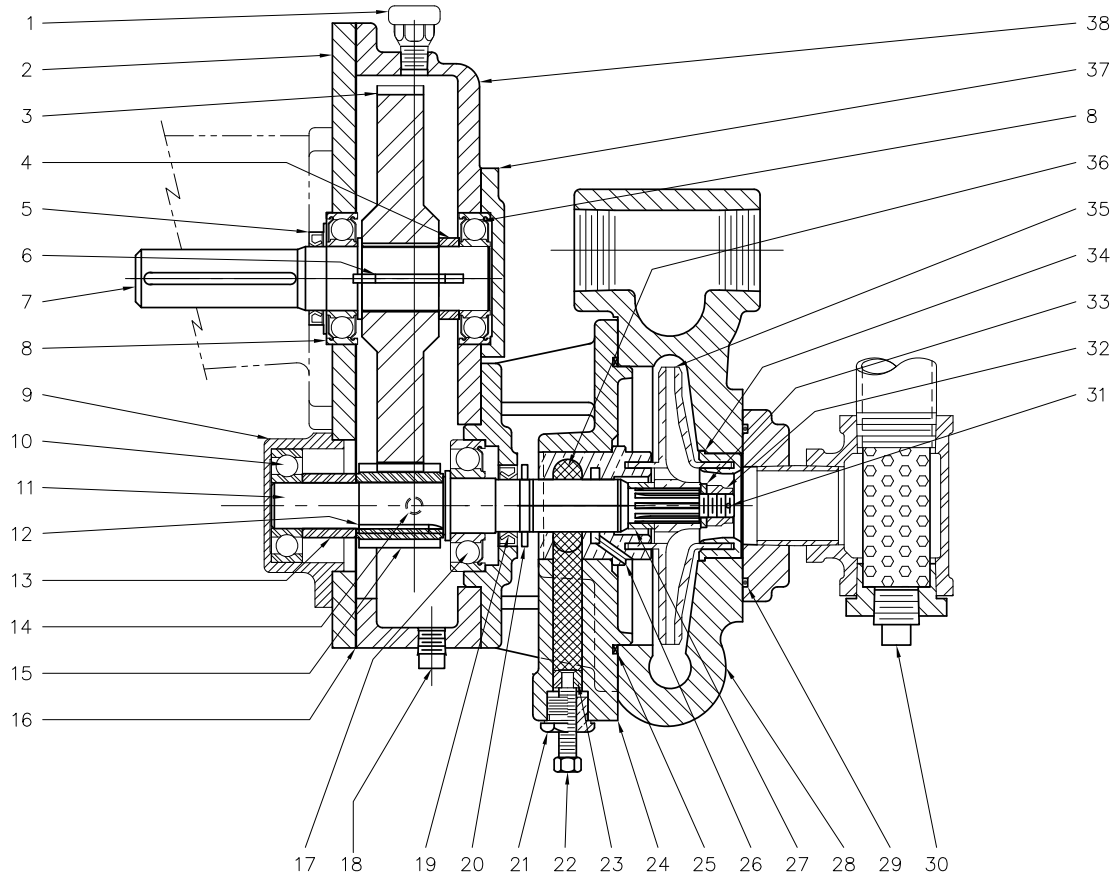
DWG – KS CROSS SECTION PACKING

DATE OCT17,94

SCALE 1/2

DKC0650

REVISIONS				
LTR	DESCRIPTION	DATE	CHG NO.	APPR'D



REP#	DESCRIPTION	QTY
1	VENT	1
2	GEARCASE COVER	1
3	DRIVE GEAR	1
4	SPACER	1
5	OIL SEAL	1
6	KEY, DRIVE GEAR	1
7	INPUT SHAFT	1
8	BEARING	2
9	BEARING CAP	1
10	BEARING	1
11	IMPELLER SHAFT	1
12	KEY, PINION GEAR	1
13	PINION SPACER	1
14	OIL LEVEL PLUG	1
15	PINION GEAR	1
16	GEARCASE GASKET	1
17	BEARING	1
18	OIL DRAIN PLUG – MAGNETIC	1
19	OIL SEAL	1
20	WATER SLINGER	1
21	PACKING NUT	1
22	PACKING PLUNGER STUD	1
23	PACKING PLUNGER	1
24	INBOARD HEAD	1
25	O–RING	1
26	STUFFING BOX	1
27	SPACER	1
28	VOLUTE	1
29	O–RING	1
30	INLET ASSEMBLY	1
31	STAINLESS STEEL COTTER KEY	1
32	IMPELLER NUT	1
33	IMPELLER WASHER	1
34	SEAL RING	1
35	IMPELLER	1
36	PACKING	11
37	BEARING CAP	1
38	GEARCASE	1

		OLD PART NO. –	TOLERANCE EXCEPT AS NOTED FRAC DIM ±.01 .00 ±.01 .000 ±.005 ANGLES ±1°	W.S. DARLEY & CO. MELROSE PARK, IL – CHIPPEWA FALLS, WI
MATERIAL DESCRIPTION: –	MATERIAL NO. –	PATTERN NO. –		DWG – HP100, CARB GEAR
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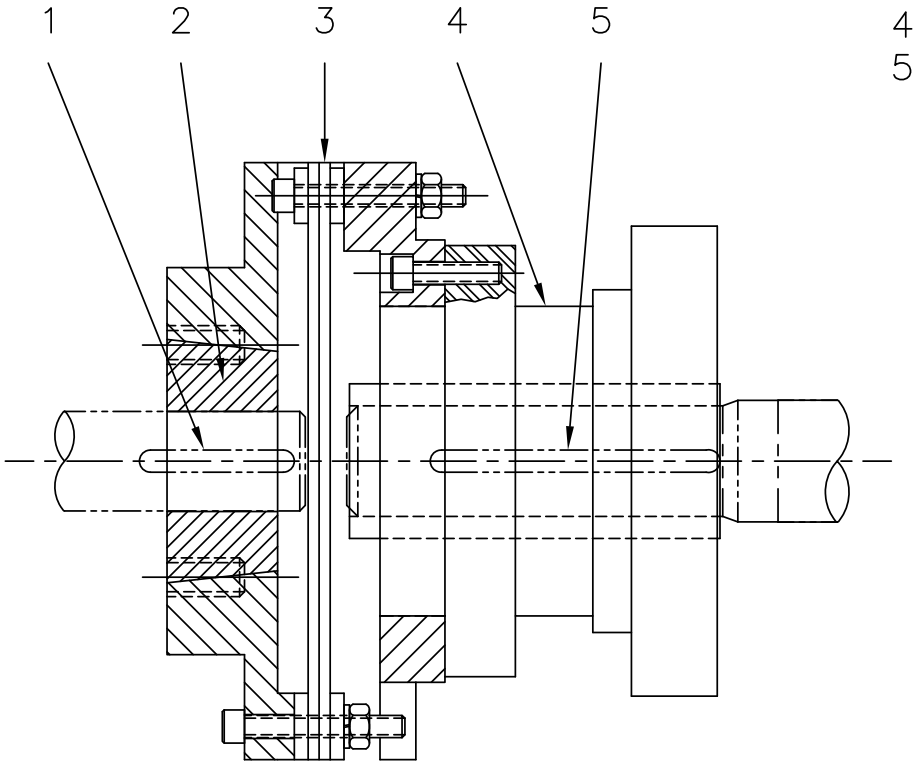
17.22

REVISIONS				
LTR	DESCRIPTION	DATE	CHG NO.	APPR'D

REP#	DESCRIPTION	QTY
1	KEY, INPUT SHAFT	1
2	TAPER LOCK BUSHING	1
3	SINGLE FLEX COUPLING	1
4	AIR CLUTCH	1
5	KEY, OUTPUT SHAFT	1



OLD PART NO. G2589

TOLERANCE EXCEPT AS NOTED
FRAC DIM ±.01
.00 ±.01
.000 ±.005
ANGLES ±1°

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

DWG – AIR CLUTCH

MATERIAL DESCRIPTION:	MATERIAL NO.	PATTERN NO.
–	–	–

DR'N DWS
CHKD
TRCD

DATE DEC21,94
SCALE 1/2

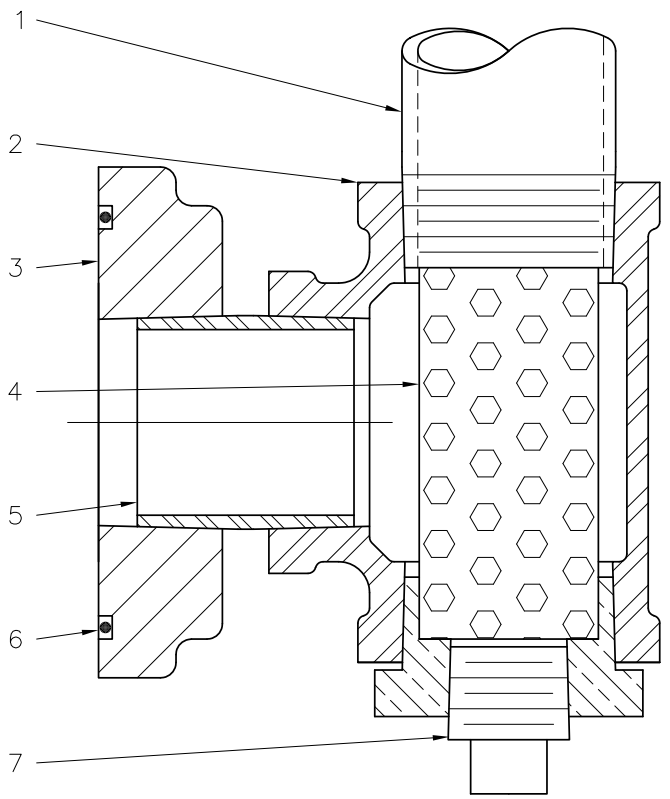
DGC0121

ALL DIMENSIONS IN INCHES UNLESS NOTED

DO NOT SCALE PRINT

REVISIONS				
LTR	DESCRIPTION	DATE	CHG NO.	APPR'D

REP#	DESCRIPTION	QTY
1	HOSE	1
2	TEE	1
3	FLANGE	1
4	STRAINER ASSEMBLY	1
5	PIPE NIPPLE	1
6	O-RING	1
7	PLUG	1



OLD PART NO.
G2588

TOLERANCE EXCEPT AS NOTED
FRAC DIM ±.01
.00 ±.01
.000 ±.005
ANGLES ±1°

DR'N DWS
CHKD
TRCD

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

DWG – INLET ASSEMBLY, HP100

DATE DEC21,94
SCALE 1/1

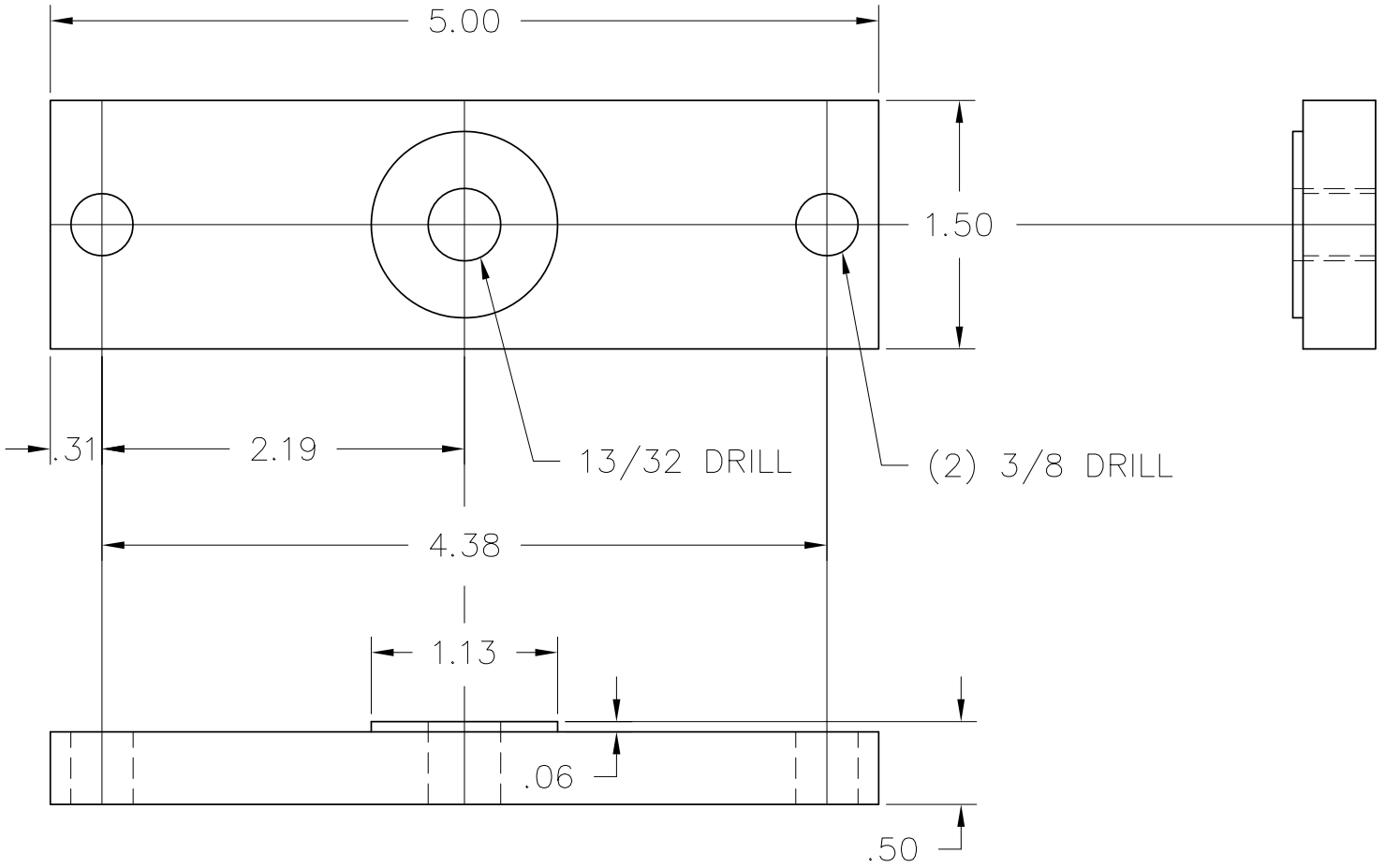
DGC0119

ALL DIMENSIONS IN INCHES UNLESS NOTED

DO NOT SCALE PRINT

1200050

17.24



PART NO.	DATE	CHANGE

TOLERANCE EXCEPT AS NOTED
FRAC DIM ±.01
.00 ±.01
.000 ±.005
ANGLES ±1°

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

KDM IDLER SHAFT BRG. ASSEMBLY FIXTURE

MATERIAL: 1/2" X 1 1/2" X 5" LG CRS

PATTERN NO.

DR'N JCM
CHKD
TRCD

DATE Aug31,89

SCALE 1/1

X4006

ALL DIMENSIONS IN INCHES UNLESS NOTED

DO NOT SCALE PRINT

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.

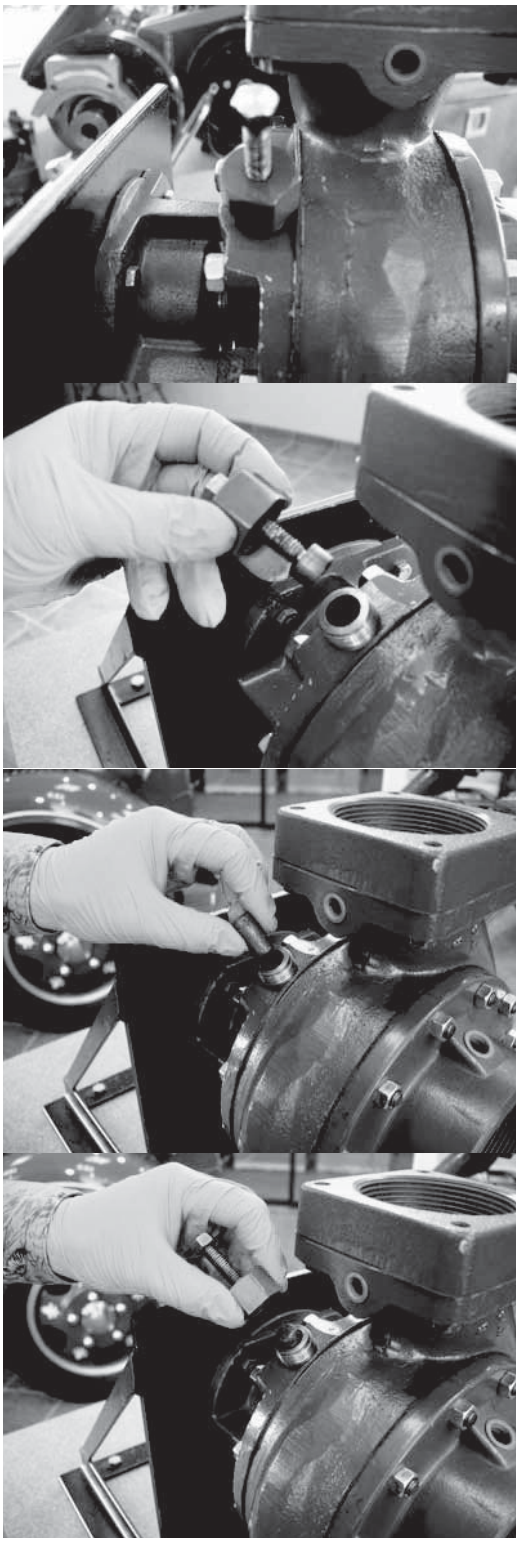
⚠ Caution: Do not attempt to use anything but Darley injection packing. Using the wrong packing material in your pump may cause catastrophic failure of the pump shaft sealing components.

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:

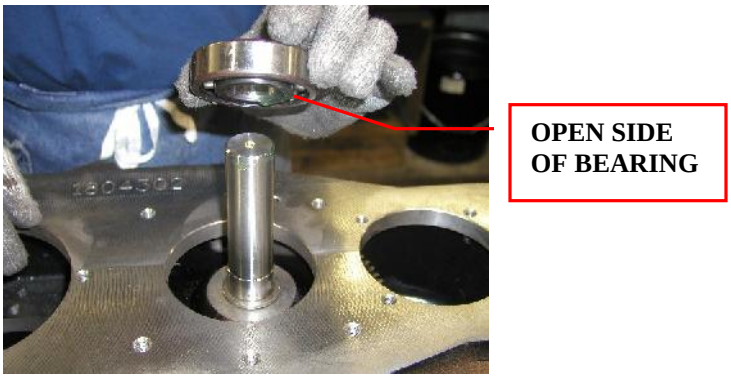
Model	Approximate # Packing Pellets
A	6
2BE	6
EM	15
H	8
JM	8
KD	10
KS	8
LD	15
LS	9
P	10
U2	5
U4	10

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

DARLEY
BASIC ASSEMBLING TECHNIQUES

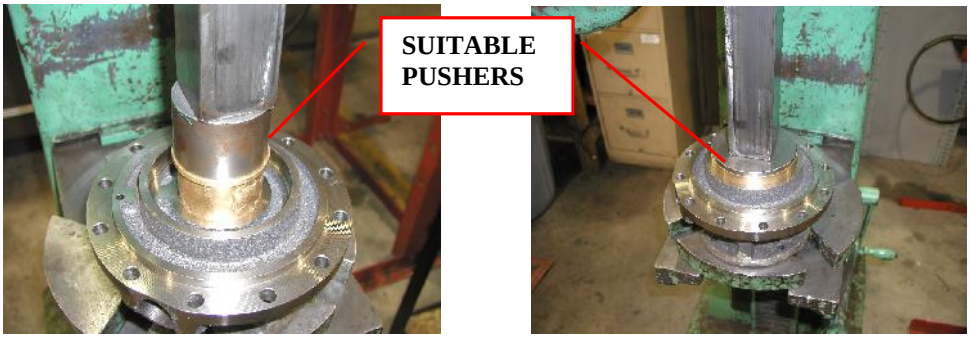
- Work with clean tools in clean surroundings during assembly.
- Clean parts thoroughly and keep free from nicks and abrasions.
- Keep loose parts marked otherwise identified to avoid error in assembly.
- **Bearings:** Keep bearings in original containers until ready to install.
- **Bearings/Press fits:** 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.



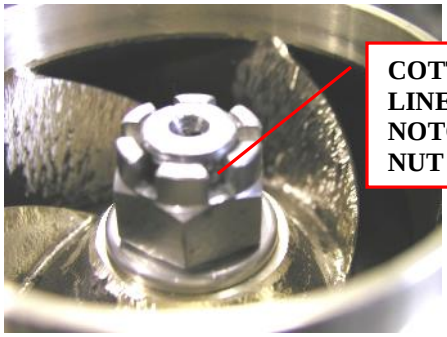
- **Bearings:** When pressing a bearing onto a shaft, lightly lube the bore of the bearing and the shaft journal for the bearing with oil. Also when installing bearings into bearing pockets, lightly lube the OD of the bearing and the bore of the bearing pocket with oil.

- **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.

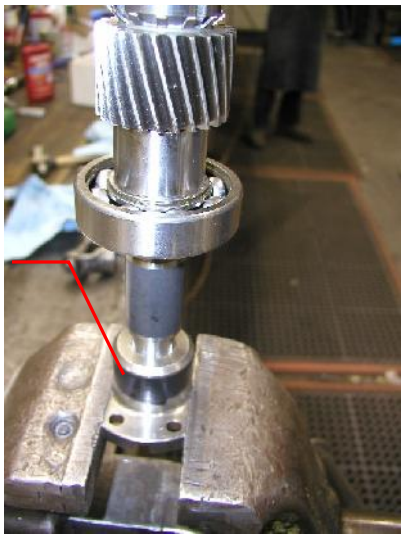


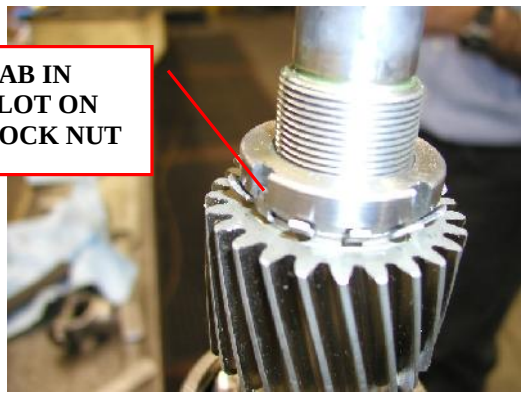
- **Press fits:** When pressing a part into housing (ex. Stuffing box, seal ring, etc.), the part needs to be started perpendicular to the housing.

- **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.



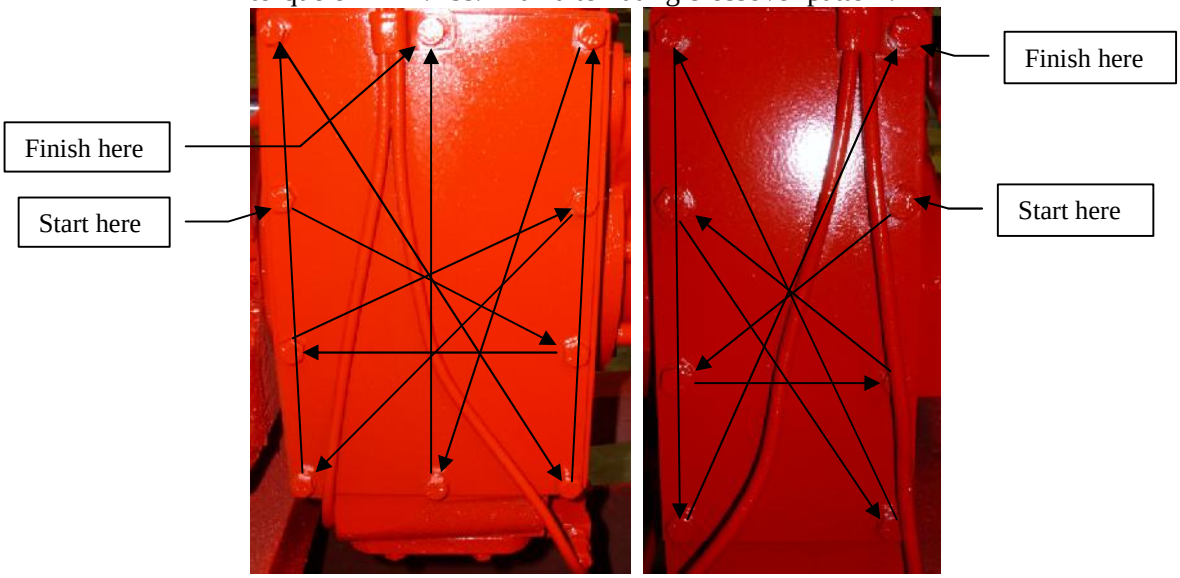
- **Lock Washer/Lock Nut:** Secure shaft so that it doesn't rotate when tightening lock nut. Line up tab on lock washer with keyway slot in shaft and slide washer onto shaft. Screw lock nut onto shaft until snug, then turn until a tab and slot line up. Using a punch, tap tab from lock washer into slot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





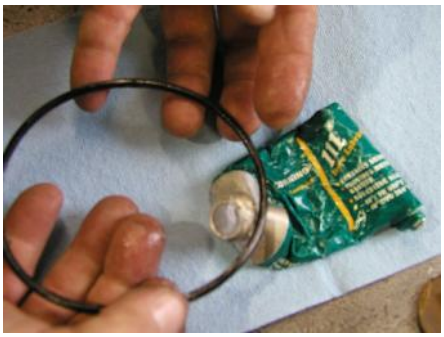
- **Loctite/thread locker:** When applying Loctite/thread lockers, only use one small drop per hole, unless explicitly told differently by engineering, a WI, or assembly/repair instruction or assembly supervisor.
- **Loctite/thread locker:** When applying Loctite/thread lockers to lock fasteners going 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.

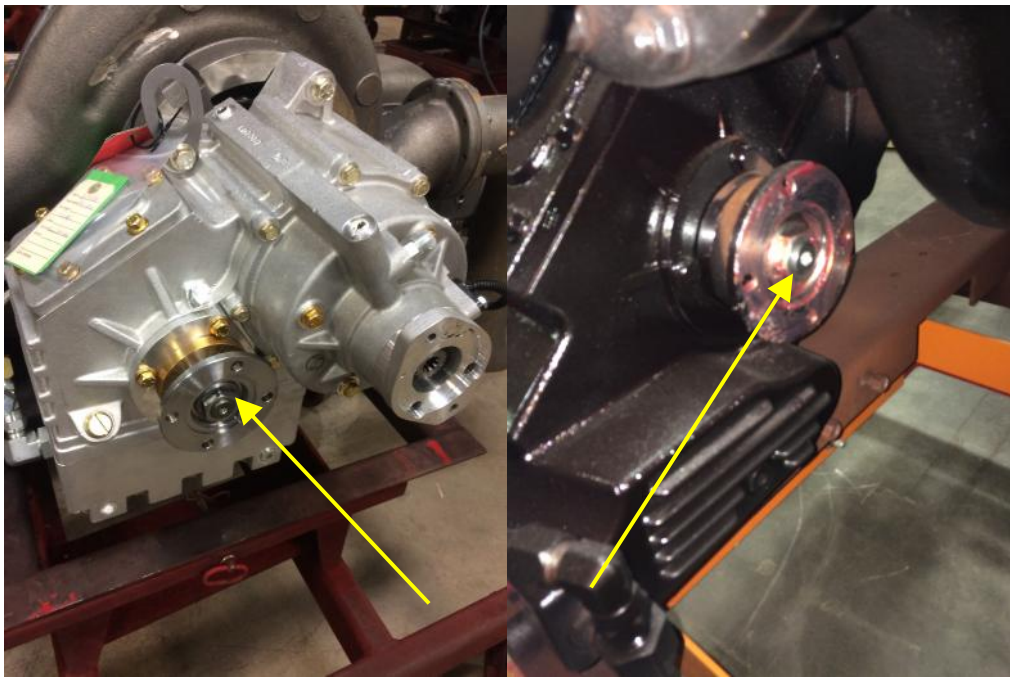
- **O-rings/Quad rings:** When installing o-rings and quad rings LIGHTLY lube with oil or silicon grease (Dow Corning 111). Be careful not to apply too thick of a film of lubricant when using the silicone grease because over application of the grease can cause the o-ring/quad ring to bridge and leak.



- **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.

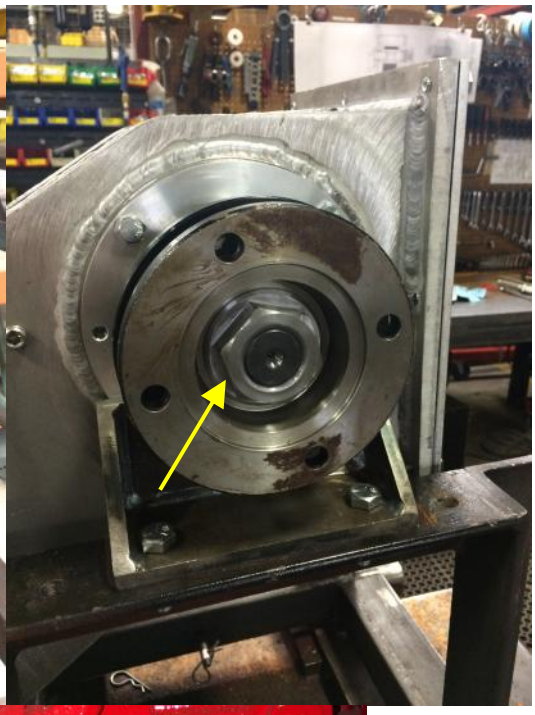


PUC and PUC-3G yoke nuts are tightened to 300-350 lb-ft.

- **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.

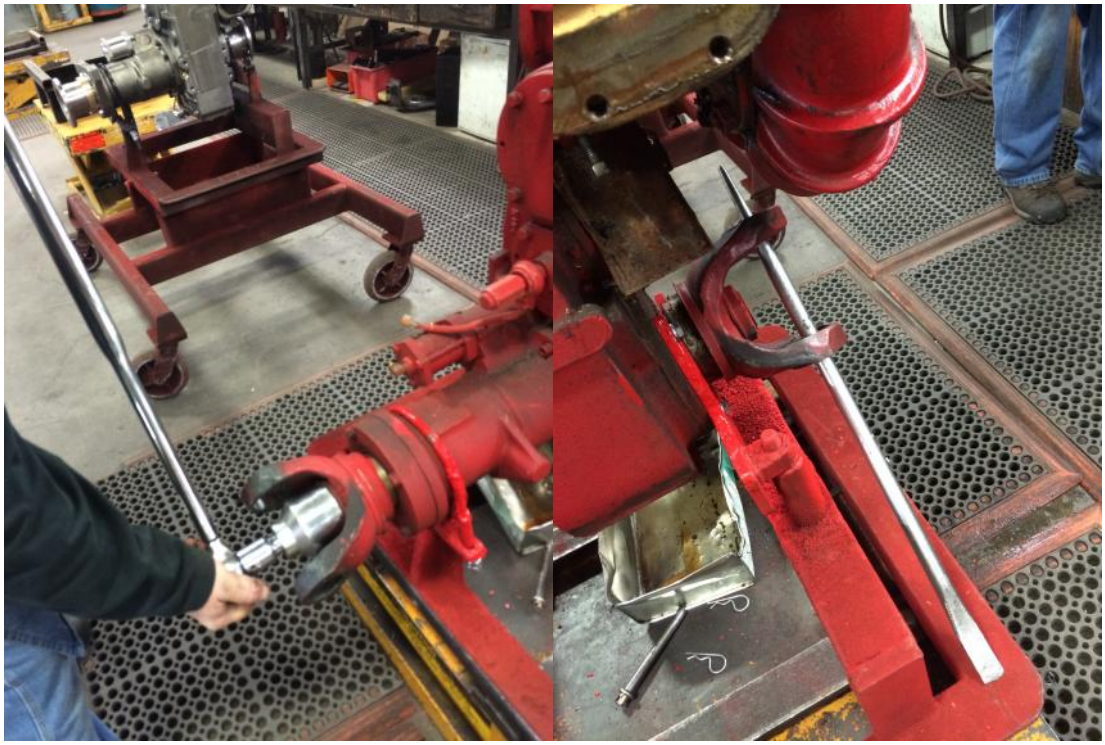
All 1.75-12 interference threaded yoke nuts are torqued to 150-200 ft-lb.



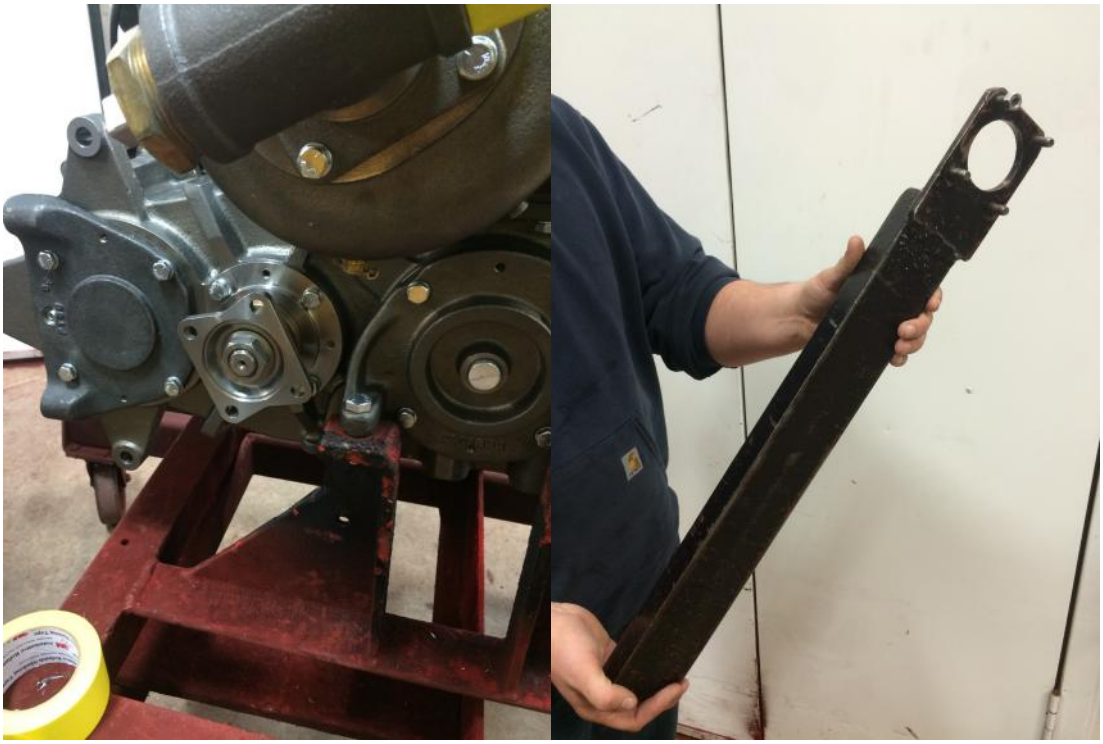
All 1.25-12 threaded yoke nuts are torqued to 150-200 ft-lb.

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

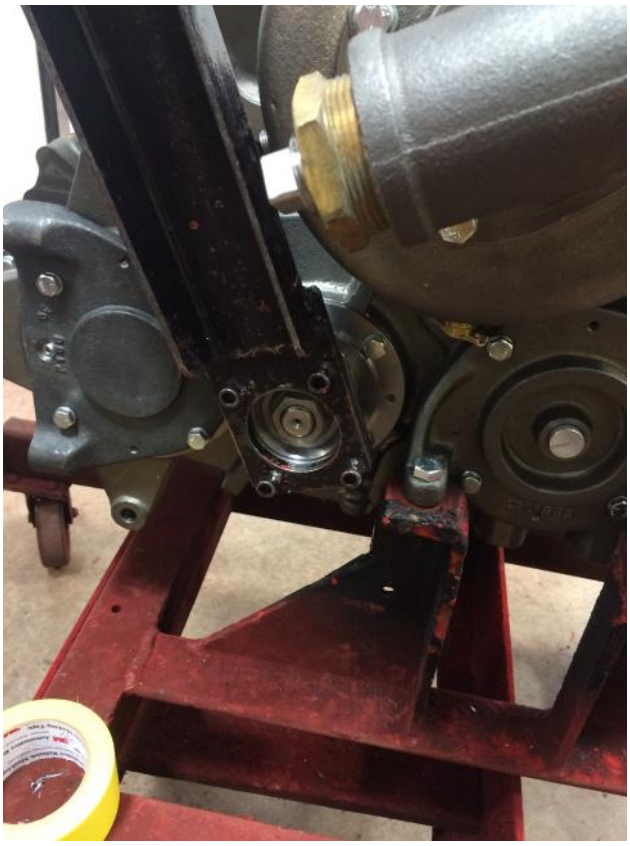
After torqueing the yoke nut down, check to make sure there is not a gap between the yoke nut and the yoke.



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

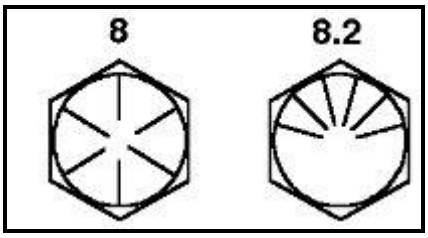
For reference, Recommended tightening torque is found by the following equation;

T = KDP

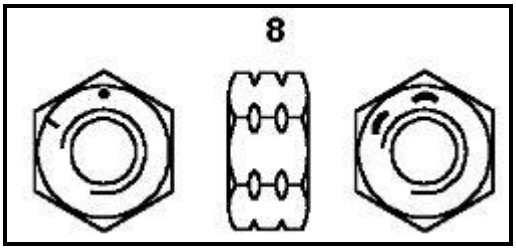
T = Tightening torque in units of inch-pound.
K = Nut factor and it is unit less.
D = Nominal bolt diameter in units of inch.
P = Clamp load in units of pounds.

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.

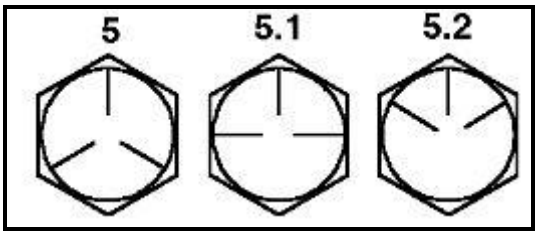
Fastener Size	Nominal bolt diameter (in)	Tensile stress area (square inch)	Stainless, Brass, Bronze or Aluminum proof load (lb)	SAE Grade 2 proof load (lb)	SAE Grade 5 proof load (lb)	SAE Grade 8 proof load (lb)
#6 – 32	.1380	.00909	209	500	981	1,090
#6 – 40	.1380	.01015	233	558	1,095	1,217
#8 – 32	.1640	.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



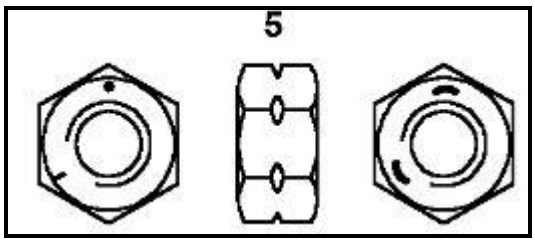
The above image shows how SAE Grade 8 hex head bolts can be identified.



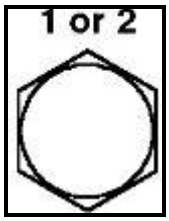
The above image shows how SAE Grade 8 hex nuts can be identified.



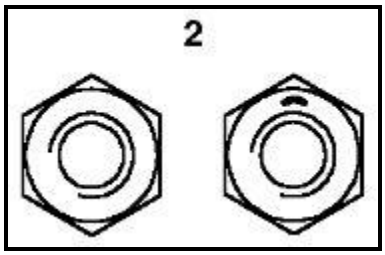
The above image shows how SAE Grade 5 hex head bolts can be identified.



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



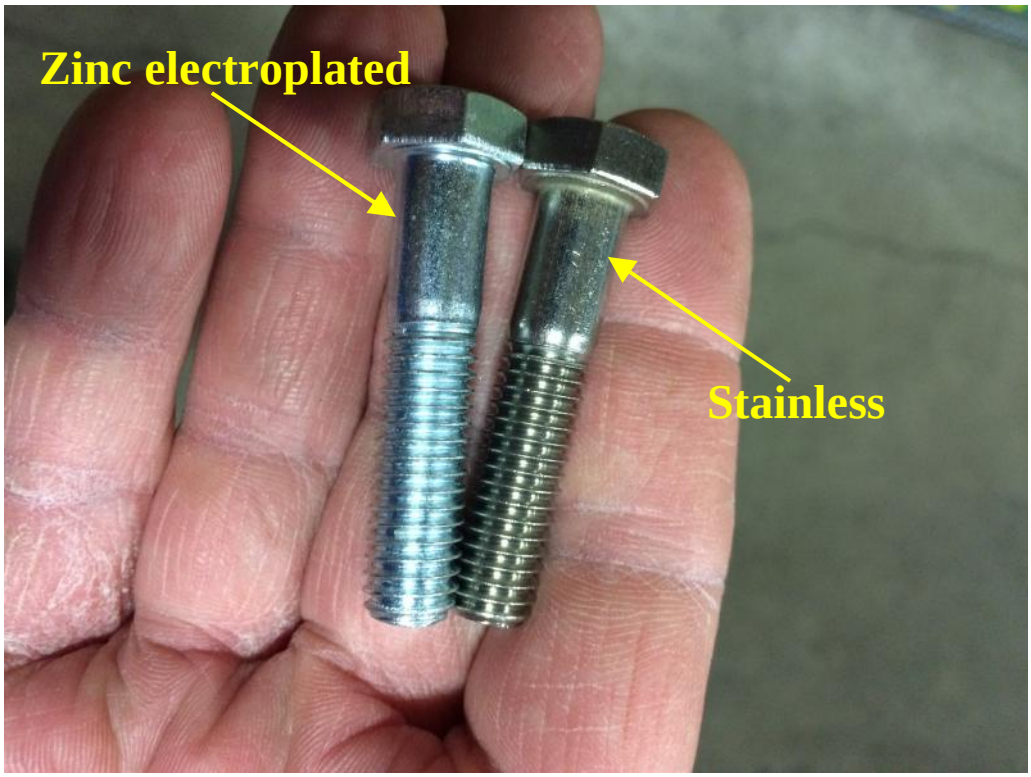
The above image shows how SAE Grade 2 hex head bolts can be identified.



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

W. S. DARLEY & CO.

SPECIAL REPAIR INSTRUCTIONS
- HIGH PRESSURE MECH SEAL INSTALLATION INSTRUCTION-
TYPE KSPAH PTO DRIVEN FIRE PUMP

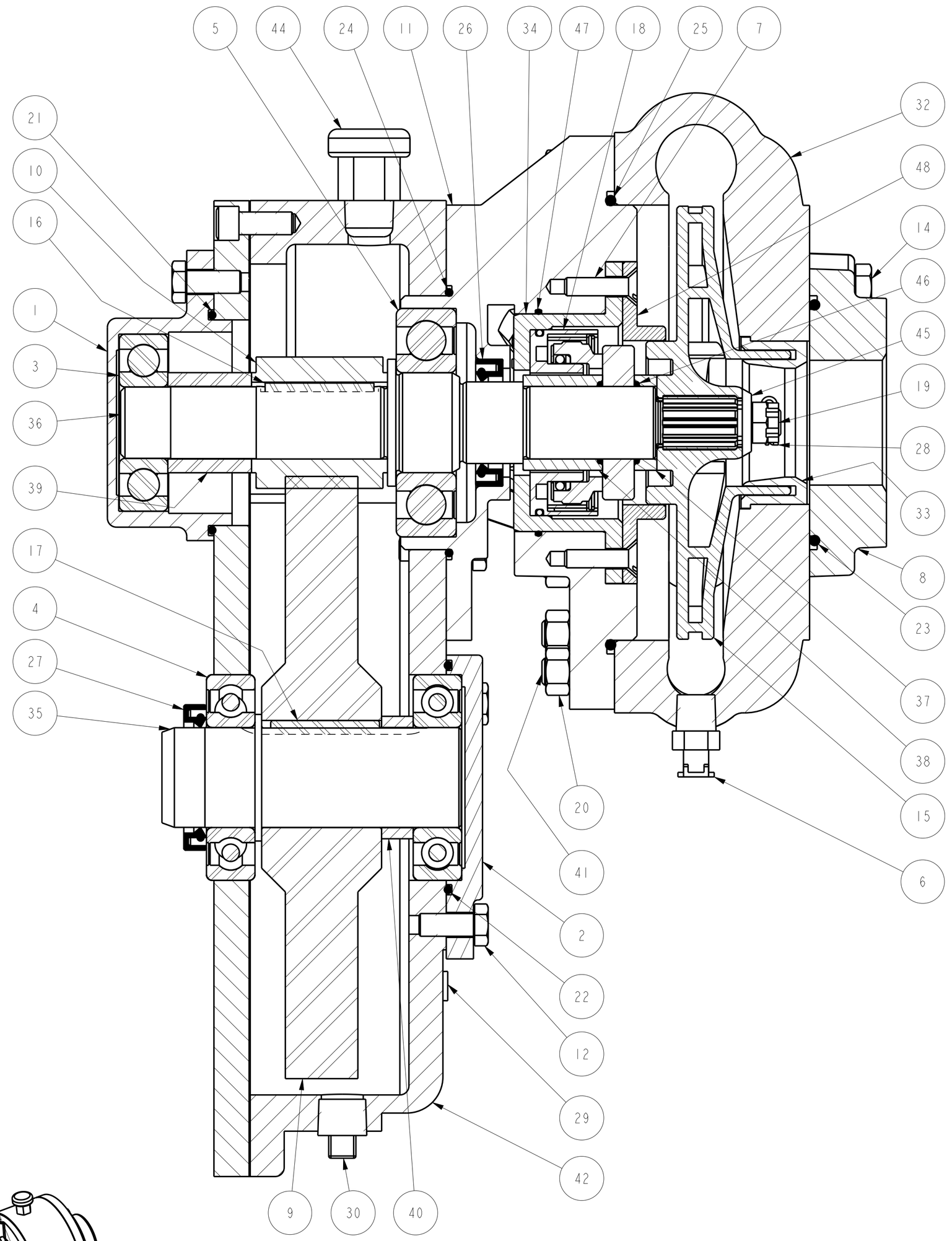
Refer to DHC1403

– Gearcase is assembled through step 18 of the KSPAH High Pressure Stage Assembly of instruction 1200050. The inboard head is not yet attached.

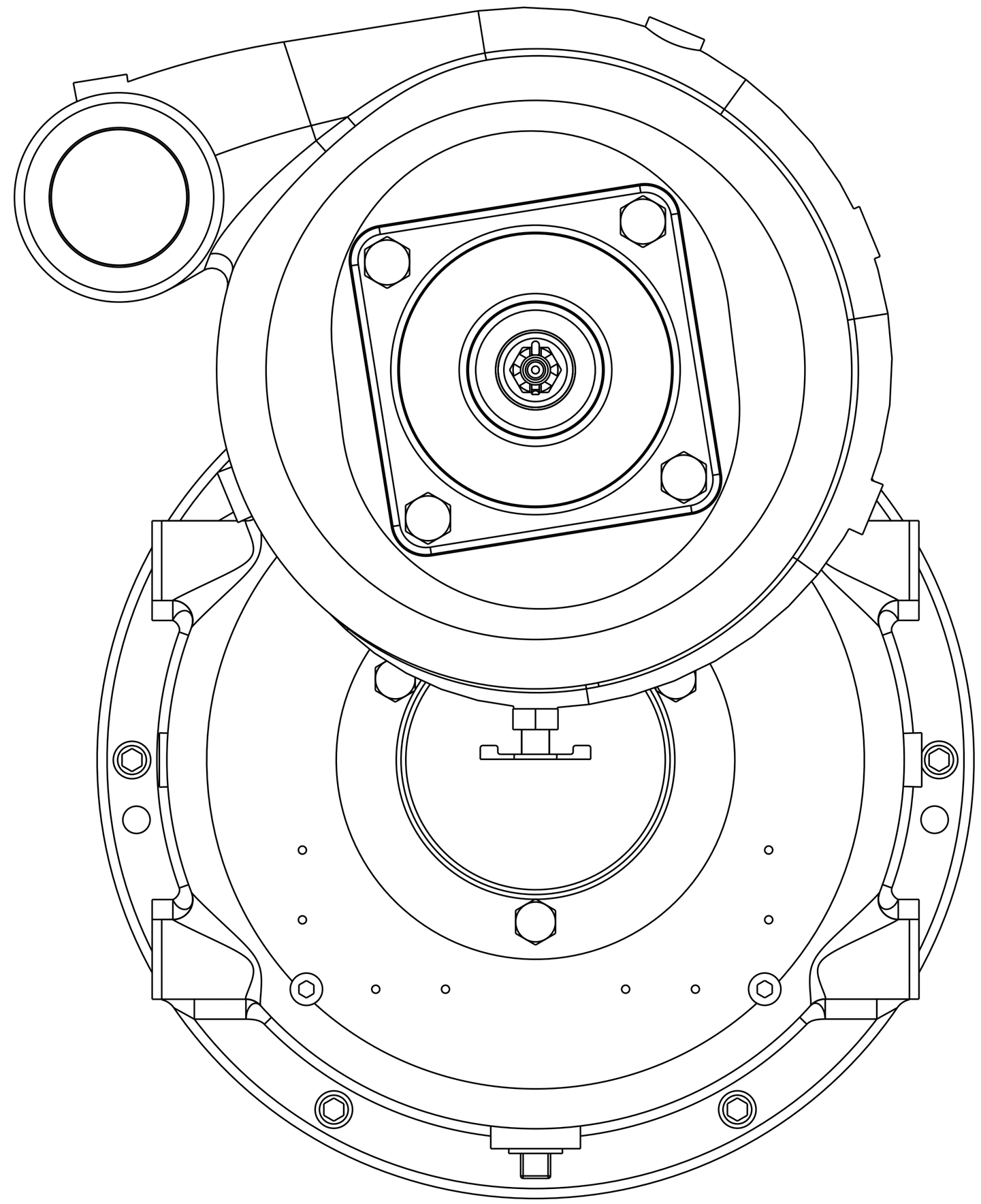
1. Place oil seal (26) into inboard head (11) with the lib spring of the seal facing the bearing.
2. Apply a light coat of silicone grease to the O-ring (47) that seals between the inboard head (11) and the seal housing (34) and install it into the groove in the bore of the inboard head.
3. Apply P-80 rubber lubricant to the O-ring on the outside of the mechanical seal (18) stationary ring and install the primary head of the mechanical seal into the seal housing (34), aligning the anti-rotation pins in the mechanical seal with the holes in the seal housing. Gently push the seal into the seal hosing, taking care not to touch the ceramic face. DO NOT hit or pound the seal to install it. After installing the seal into the seal housing, clean the face with a clean - lint free rag, and isopropyl alcohol.
4. Install O-ring (24) with light coat of silicone grease into the groove in the gearcase side of the inboard head (11).
5. Slide inboard head (11) over impeller shaft (36) and attach the inboard head to the gearcase (42) with four – 1” long 5/16-18 HHCS (13) with a drop of Loctite 243 on the thread of each screw.
6. Slide spacer (38) onto the impeller shaft (36), with the internal chamfer facing the impeller end of the shaft.
7. Apply a light coat of P-80 to one of the two O-rings (46) and slide it onto the impeller shaft (36) until it is in the chamfer of spacer (38).
8. Clean the faces of the mating ring of the mechanical seal (18) and slide it onto the impeller shaft (36) until it contacts.
9. Apply a light coat of P-80 to the second of the two O-rings (46) and slide it onto the impeller shaft (36) until it is against the mating ring of the mechanical seal (18).
10. Apply a drop of Loctite 222 to the threads of four FHM screws (7) an install seal ring (48).
11. Slide spacer (37) onto impeller shaft (36), with the internal chamfer towards the mechanical seal (18) mating ring.
12. Clean the impeller shaft (36) threads and apply a drop of blue Loctite 243 to them.
13. Install impeller (15), stainless steel beveled washer (45) – small side out, and stainless-steel impeller/castle nut (19). Tighten finger tight, then turn to the next available hole. **(DO NOT OVER TIGHTEN!)**
14. Install new 1/8” x 1” long **STAINLESS-STEEL** cotter pin (28).
15. Return to step 32 of the KSPAH High Pressure Stage Assembly of instruction 1200050

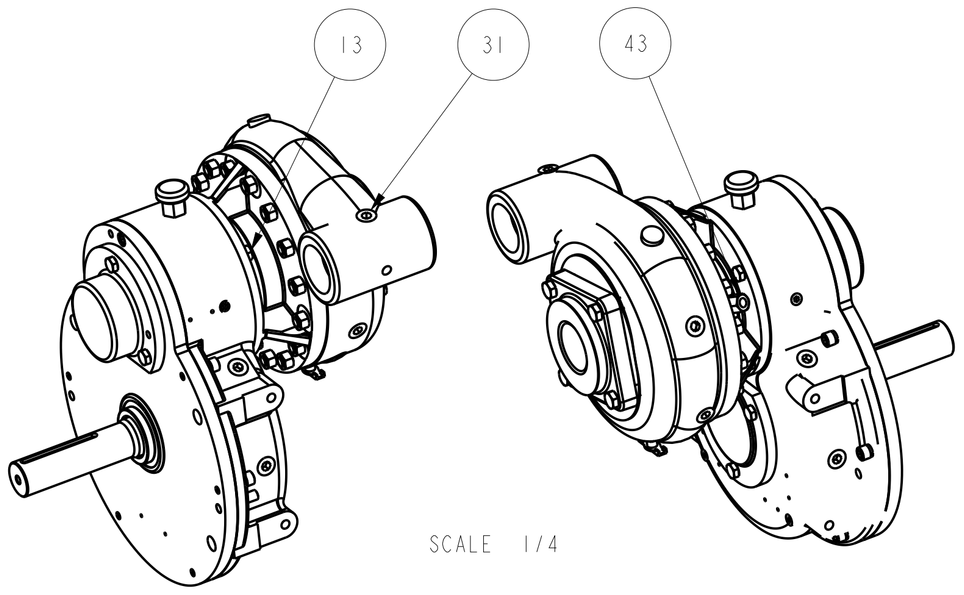
Prepared by: TED Date: 29Oct2018

NO.	DESCRIPTION	PART NO.	QTY.
1	BEARING CAP	2300601	1
2	BEARING CAP	2301008	1
3	BEARING-BALL	1721702	1
4	BEARING-BALL, 207SF	1720103	2
5	BEARING-BALL, 307SF	1721903	1
6	DRAINCOCK - 0.250 NPTM, 9KC BR	5203600	1
7	FHMS - .250-20 x 1.00, BR	5402405	4
8	FLANGE - 1.5 NPT, O-RING, CDI	1920405	1
9	GEAR - DRIVE, H100, 12 DP	2713201	1
10	GEAR - PINION, 19T, RH	2713402	1
11	HEAD - INBOARD, H100	2805603	1
12	HHCS - .313-18 x 0.75, GR5	5400018	6
13	HHCS - .313-18 x 1.00, GR5	5400020	4
14	HHCS - .375-16 x 1.00, GR5	5400036	4
15	IMPELLER - H100, MECH SEAL	2908004	1
16	KEY - SQ., 0.12 X 1.50 GR2	3602423	1
17	KEY - SQ., 0.19X1.50 GR2	3602441	1
18	MECHANICAL SEAL - 1.00" KSPAH	1846100	1
19	NUT - CASTLE, .375-24, 303	5403431	1
20	NUT - HEX, .375-16, GR2	5403002	16
21	O-RING - 2.88 x 3.06 X 0.09	3601126	1
22	O-RING - 3.00 x 3.19 X 0.09	3601125	1
23	O-RING - 3.12 x 3.38 x 0.12	3601200	1
24	O-RING - 3.50 x 3.69 X 0.09	3601124	1
25	O-RING - 6.00 x 6.25 x 0.12	3601226	1
26	OIL SEAL - 1.125 ID X 1.750 OD	3600559	1
27	OIL SEAL - 1.375 ID X 2.004 OD	3600544	1
28	PIN - COTTER, .094 x 1.00, SST	3605202_B	1
29	PLUG - PIPE, 0.125, ZN SOC HD	1080537	4
30	PLUG - PIPE, 0.375, MAG SQ HD	1080536	1
31	PLUG - PIPE, 0.375, ZN SOC HD	1080541	8
32	PUMP CASING - KDM/LDM/KSPAH	2054902	1
33	SEAL RING - HH100	3406001	1
34	HOUSING - MECHANICAL SEAL, H100	1846101	1
35	SHAFT - DRIVE, H, 1.25 KEY	5015800	1
36	SHAFT - IMPELLER, H100	5016906	1
37	SLEEVE - KSPAH, EXTERNAL	1886801	1
38	SLEEVE - KSPAH, INTERNAL	1886800	1
39	SPACER - 1.00 X 1.38 X 1.15	3306200	1
40	SPACER - 1.38 x 1.69 x 0.44	3301704	1
41	STUD - 0.375-16 X 1.500, GR5	3606203	16
42	TRANS - GEARCASE ASSY, J	TG00300	1
43	TUBE FITTING - STR, .31 x .25	3500010	1
44	VENT - GEARCASE	4401800	1
45	WASHER - 0.39 X 0.94 X .12 303	3603303	1
46	O-RING - 1.00 x 1.12 x 0.06	3601016	2
47	O-RING - 3.00 x 3.12 x 0.06	3601011	1
48	SEAL RING - KSPAH	3407401	1



SECTION A-A





SCALE 1/4

NOTE:
1) O-RINGS (46) ARE SUPPLIED WITH MECHANICAL SEAL

REVISIONS				
LTR	DESCRIPTION	DATE	CHG NO.	APPR'D

MODEL NAME	MDL CREATED	SHEET	
PH00936	29OCT12	1/2	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°

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

DWG - HP100, MECH SEAL 1.00" CROSS SECTION, KSPAH, 8AB MECH

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

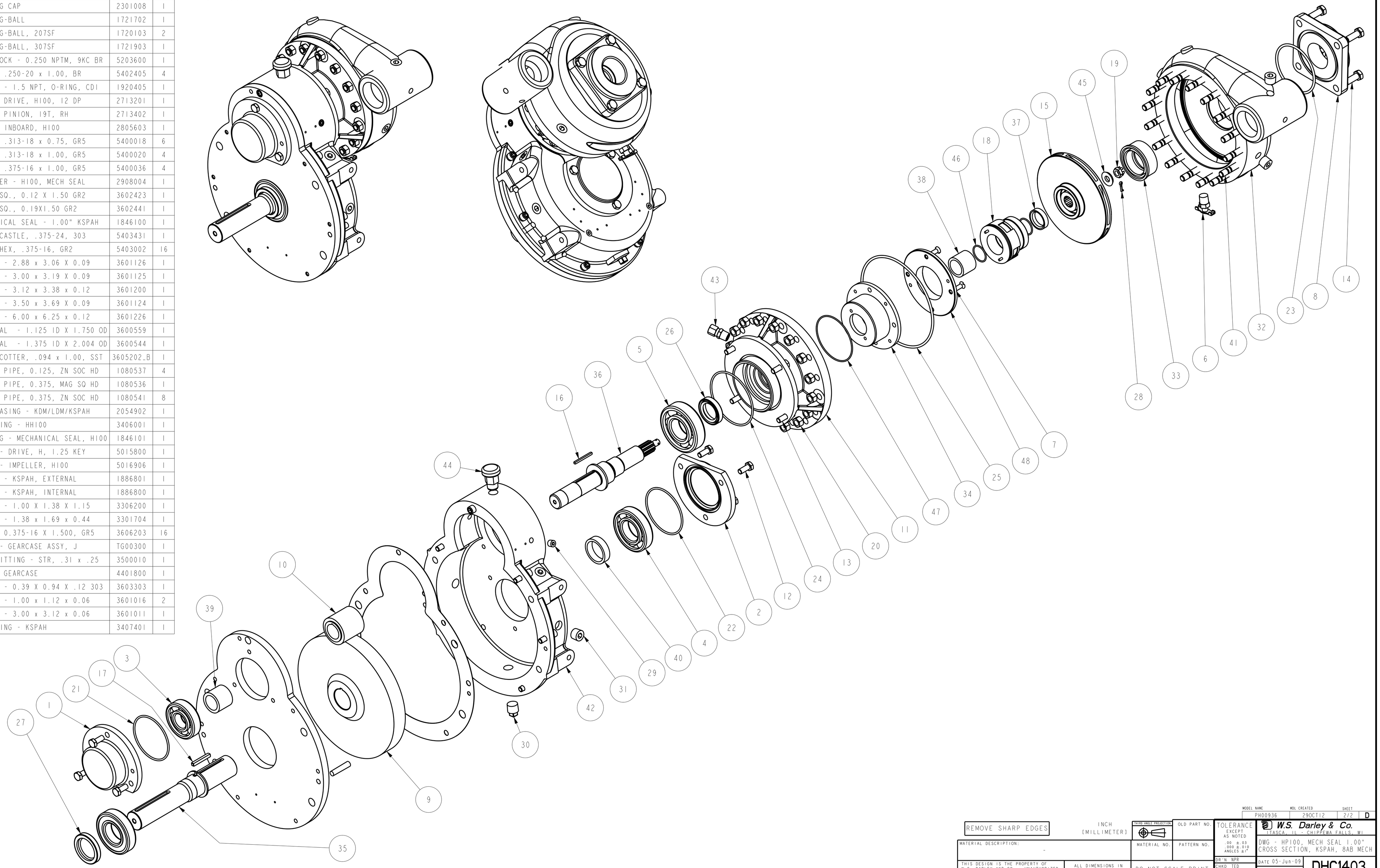
DR'N NPR
CHKD MCR
TRCD

DATE 02-Jun-09
SCALE 1/1

DHC1403

NO.	DESCRIPTION	PART NO.	QTY.
1	BEARING CAP	2300601	1
2	BEARING CAP	2301008	1
3	BEARING-BALL	1721702	1
4	BEARING-BALL, 207SF	1720103	2
5	BEARING-BALL, 307SF	1721903	1
6	DRAINCOCK - 0.250 NPTM, 9KC BR	5203600	1
7	FHMS - .250-20 x 1.00, BR	5402405	4
8	FLANGE - 1.5 NPT, O-RING, CDI	1920405	1
9	GEAR - DRIVE, HI00, 12 DP	2713201	1
10	GEAR - PINION, 19T, RH	2713402	1
11	HEAD - INBOARD, HI00	2805603	1
12	HHCS - .313-18 x 0.75, GR5	5400018	6
13	HHCS - .313-18 x 1.00, GR5	5400020	4
14	HHCS - .375-16 x 1.00, GR5	5400036	4
15	IMPELLER - HI00, MECH SEAL	2908004	1
16	KEY - SQ., 0.12 X 1.50 GR2	3602423	1
17	KEY - SQ., 0.19X1.50 GR2	3602441	1
18	MECHANICAL SEAL - 1.00" KSPAH	1846100	1
19	NUT - CASTLE, .375-24, 303	5403431	1
20	NUT - HEX, .375-16, GR2	5403002	16
21	O-RING - 2.88 x 3.06 X 0.09	3601126	1
22	O-RING - 3.00 x 3.19 X 0.09	3601125	1
23	O-RING - 3.12 x 3.38 x 0.12	3601200	1
24	O-RING - 3.50 x 3.69 X 0.09	3601124	1
25	O-RING - 6.00 x 6.25 x 0.12	3601226	1
26	OIL SEAL - 1.125 ID X 1.750 OD	3600559	1
27	OIL SEAL - 1.375 ID X 2.004 OD	3600544	1
28	PIN - COTTER, .094 x 1.00, SST	3605202_B	1
29	PLUG - PIPE, 0.125, ZN SOC HD	1080537	4
30	PLUG - PIPE, 0.375, MAG SQ HD	1080536	1
31	PLUG - PIPE, 0.375, ZN SOC HD	1080541	8
32	PUMP CASING - KDM/LDM/KSPAH	2054902	1
33	SEAL RING - HHI00	3406001	1
34	HOUSING - MECHANICAL SEAL, HI00	1846101	1
35	SHAFT - DRIVE, H, 1.25 KEY	5015800	1
36	SHAFT - IMPELLER, HI00	5016906	1
37	SLEEVE - KSPAH, EXTERNAL	1886801	1
38	SLEEVE - KSPAH, INTERNAL	1886800	1
39	SPACER - 1.00 X 1.38 X 1.15	3306200	1
40	SPACER - 1.38 x 1.69 x 0.44	3301704	1
41	STUD - 0.375-16 X 1.500, GR5	3606203	16
42	TRANS - GEARCASE ASSY, J	TG00300	1
43	TUBE FITTING - STR, .31 x .25	3500010	1
44	VENT - GEARCASE	4401800	1
45	WASHER - 0.39 X 0.94 X .12 303	3603303	1
46	O-RING - 1.00 x 1.12 x 0.06	3601016	2
47	O-RING - 3.00 x 3.12 x 0.06	3601011	1
48	SEAL RING - KSPAH	3407401	1

NOTE:
1) O-RINGS (46) ARE SUPPLIED WITH MECHANICAL SEAL



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.

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ALL DIMENSIONS IN INCHES UNLESS NOTED

DO NOT SCALE PRINT

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

DR'N NPR
CHKD TED
TRCD

MODEL NAME: PH00936 | WOL CREATED: 290CT12 | SHEET: 2/2 | D

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

DWG - HP100, MECH SEAL 1.00" CROSS SECTION, KSPAH, 8AB MECH

DATE 05-Jun-09

SCALE 3/8

DHC1403