10. EM

10. EM

W.S. Darley & Co.

REPAIR SERVICE INSTRUCTIONS
TYPE EM MIDSHIP FIRE PUMP

TO REMOVE ONLY PUMP AND TRANSMISSION ASSEMBLY FROM TRUCK CHASSIS

1. Remove the drive shafts from the front and rear of pump transmission.
2. Disconnect the parking brake linkage if applicable.
3. Remove pump shift rod if pump is equipped with manual shift.
4. Remove air lines at shift cylinder if equipped with power shift.
5. Remove power staging valve cylinder.
6. Disconnect the electric wires to the pump engaged switch on shift bar at front of pump.
7. Disconnect the following additional items from the pump:
   Heater Piping
   Gage Line Tubing
   Primer Tubing
   Drain Line Tubing
   Tachometer Drive Cable
8. Remove any other accessory that will prevent lowering the pump and transmission assembly.
9. Drain oil from gearcase.
10. Provide a floor jack or overhead hoist to support the pump and transmission weight of 1100 lbs.
11. Loosen four 5/8 bolts that fasten suction extensions to truck frame rail support brackets.
12. Loosen all pony suction, tank to pump lines, etc. by unbolting the companion flanges at suction extensions.
13. Remove the twenty 3/8NC cap screws each side that hold suction extensions to suction heads. Pry the flanges apart to free the extensions.
14. **CAUTION:** After the next step, the jack will be the only thing supporting the pump. Check the jack or hoist to make sure it is positioned correctly and is snug to support the pump. Also tie two loops of rope around the arms of the inboard suction head. 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.
15. Remove the fourteen 3/8NC nuts that hold the discharge head to the pump casing.
16. The pump is now ready to drop out, but may require some prying to loosen the gasket between the discharge head and the pump casing.1
17. Lowering the pump will require a coordinated effort between the man operating the floor jack and the man on top with the rope holding the pump upright.
18. 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.

PUMP DISASSEMBLY FOR OVERHAUL
Refer to Drawing DEC0100

1. Remove four 3/8NC cap screws and nuts each holding relief valves to relief valve manifold (45).
2. Remove four 3/8NC nuts each holding relief valves to inboard suction head (43) and remove relief valves.
3. Remove six 3/8NC cap screws and remove relief valve manifold (45) from pump casing (30). Discard o-rings (44).
4. Remove four 3/8NC socket head cap screws holding staging valve (11) to pump casing (30).

Refer to Drawing DEC0400:

5. Remove four 3/8NC heavy nuts holding staging valve (11) to outboard suction head (15) and remove staging valve. Discard o'rings (7) and (14).

NOTE: Staging valve disassembly may not be required unless parts are worn, or valve is not operating properly. If staging valve disassembly is not required, go to line 13.

6. Remove the two micro-switches from stop plate (64).
7. Remove staging valve lever (75) by loosening the 1/4-20NC socket head set screw (90), and sliding the lever off the stem (63). Remove key (66) form stem.
8. Remove valve seat (13) by turning it counter-clockwise. It may be beneficial to make a tool to use similar to that shown on drawing X4618.

NOTE: For staging valves older than June 1994, valve seats may not be threaded and may fall out freely. If the staging valve is older than June 1994, and still has the non-threaded seat, it is recommended that you contact the W. S. Darley & Co. parts department at 800-634-7812 for information on returning the staging valve body to be updated to the newer design.

9. Remove four 1/4-20NC socket head cap screws, and remove stop plate (64).
10. Remove valve stem (67) by firmly grasping it and pulling outward. Discard o'ring (63). Note the orientation of the key slots in relation to the ball sector; this is important during assembly.
11. Remove staging valve guide screw (60). Discard o'ring (59).
12. Remove staging valve ball sector (10) from body (11).

Refer to Drawing DEC0100

13. Remove four 1/4NC cap screws and remove bearing cap (16) from outboard suction head (15).
14. Remove twelve 1/2NC nuts holding outboard suction head (15) to pump casing (30).
15. Pry outboard suction head (15) off pump casing (30). Keep head square with casing bore to avoid damage to parts. Two 5/16NC tapped puller holes in flange will facilitate flange separation.
16. Press oil seal (17) out of outboard suction head (15) and remove by hand.
17. If necessary to replace outboard stuffing box (22), remove three slotted flat head screws, and press outboard stuffing box out of outboard suction head (15). Discard o'ring (87).
18. If necessary to replace, pry or tap seal ring (37) out of outboard suction head (15).
19. Remove o-ring (33) from outboard suction head (15).

20. Pry staked portion of impeller lock ring (29) out of slot of impeller lock nut (28).
21. Remove impeller lock nut (28) from pump shaft (19) with EM impeller nut tool (X4002). If impeller nut tool is not available, use a hammer and a punch to remove impeller lock nut.
22. Slide impeller lock ring (29) off pump shaft (19).
23. Mark second stage impeller (34) as to position. Slide impeller off pump shaft (19).
24. Remove twelve 1/2NC nuts holding pump casing (30) to inboard suction head (43).
25. Pry pump casing (30) away from inboard suction head (43). Keep pump casing square with pump shaft (19) to avoid damage to parts. Two 5/16NC tapped puller holes in flange will facilitate separation.
26. Remove casing gaskets (32) from pump casing (30).
27. If necessary to replace interstage seal ring (38), press seal ring out of pump casing (30).
28. Slide first stage impeller (35) off pump shaft (19).
29. Remove split retaining ring (42) from pump shaft (19).
30. Remove four 3/8NC cap screws and remove bearing cap (59dwgDEC0200) from gearcase (66dwgDEC0200). Two 5/16NC tapped puller holes in flange will facilitate separation.
31. Remove three 1/2NC cap screws and two 3/8NC cap screws holding inboard head (43) to gearcase. Separate the two parts and slide the inboard head and pump shaft assembly out of and away from gearcase.
32. Tap pump shaft (19) out of inboard suction head (43) with a rubber mallet.
33. Press oil seal (41) out of inboard suction head (43) and remove by hand.
34. If necessary to replace outboard stuffing box (39), remove three slotted flat head screws, and press outboard stuffing box out of outboard suction head (43). Discard o'ring (87).
35. If necessary to replace, pry or tap seal ring (37) out of inboard suction head (43).
36. Remove o-ring (33) from inboard suction head (43).

Refer to Drawing DEC0200

37. Press pinion gear (1), pinion spacer (63), and bearing (60) off of pump shaft (5) all at once.
38. Remove retaining ring (6) from impeller shaft (5), and slide backup washer (4) off impeller shaft.
39. Press bearing (3) off pump shaft (5).

TRANSMISSION DISASSEMBLY FOR OVERHAUL
Refer to Drawing DEC0200

40. Place transmission assembly on a bench.
41. Remove twelve 5/16NC cap screws and remove gearcase cover (31) from side of gearcase (66).
42. Remove eight 3/8NC cap screws. Separate rear bearing bracket (51) assembly from gearcase (66).
43. Cut safety wire (50) and remove lock bolt (52) from shift yoke (53). Slide shift yoke off shift bar (16) and slide shift bar out of gearcase (66).
44. Tap bearing (36) off transmission shaft (20) with sliding clutch gear (35).
45. Remove four 3/8NC cap screws and separate front bearing bracket (25) from gearcase.

NOTE: It may be necessary to apply heat up to 500 degrees F (260 degrees C) to the front bearing bracket (25) to break it loose from the bearing (26). The front bearing bracket (25) may be held with retaining compound that was applied to its bore during assembly.

46. Remove six 5/16NC cap screws to separate pump clutch gear (34) and bearing retainer (19) from drive gear (18). Push transmission shaft out of drive gear toward bearing retainer end.

NOTE: It may be necessary to apply up to 500°F (260°C) to the threaded end of the 5/16NC cap screws to break the thread locker that was applied to the threads on assembly.

47. Press bearing (26), spacer (21), and bearing (22) off transmission shaft (20) all at once.

48. Press second bearing (22) off of transmission shaft (20).

49. Remove four 3/8NC cap screws each and remove bearing caps (9) and (57). Discard gaskets (14) and (58).

50. Place gearcase with tachometer shaft (55) side down on arbor press table and push idler gear shaft (8) through idler gear (7), spacer (11), and bearing (13) on top side. Use a pusher that is 1.16 O.D. or less by 3.62 long or longer.

51. Press bearing (13) off idler gear shaft (8).

52. Remove tachometer drive shaft (55) from idler gear shaft (8) if necessary.

REAR BEARING BRACKET DISASSEMBLY

53. Remove lock nut (46) from rear drive shaft (48).

54. Slide universal joint yoke (44) and brake drum flange (if so equipped) off rear drive shaft (48).

55. Press drive shaft (48) out of bearing bracket (51), which removes bearing (41) and bearing backup washer (43) from shaft.

56. Remove four 3/8NC cap screws and remove bearing retainer (42) and brake yoke from rear bearing bracket (51).

57. Discard o'ring (358).

58. Press bearing (37) off rear drive shaft (48).

59. Press oil seals (38) and (40) out of rear bearing bracket (51).

60. Press bearing (41) out of the bearing cap (42). It may be necessary to apply heat up to 500 degrees F (260 degrees C) to the bearing cap to break loose the bearing cap (41) that is held with retaining compound that was applied to the bore of the bearing cap during assembly.

61. Press oil seal (49) out of bearing retainer (42).

PARTS INSPECTION AND MEASUREMENT

1. Clean all parts and examine carefully for wear or deterioration. Replace any questionable parts.
2. Measure the impeller seal rings, impellers, and interstage seal ring for wear. Use the following table for comparison.

Impeller Seal Ring O.D.	5.749 - 5.751
Impeller Seal Ring I.D.	5.376 - 5.378
Impeller Interstage Seal Ring	2.247 - 2.249
Seal Ring O.D.	5.764 - 5.766
Seal Ring I.D.	5.361 - 5.363
Interstage Seal Ring	2.262 - 2.264
Clearance O.D. - original	0.013 - 0.017
Clearance I.D. - original	0.013 - 0.017
Clearance - Interstage	0.013 - 0.017

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 (37dwgDEC0100) should also be replaced or you may purchase undersize seal rings. Call customer service for details.
4. Measure impeller shaft and stuffing boxes for wear. Use the following table for comparison.

	OUTBOARD	INBOARD
Impeller shaft diameter at packing area	1.431-1.432	1.749-1.750
Stuffing Box Bore - new	1.439-1.440	1.759-1.760
Stuffing Box Bore - max.	1.445	1.765
Clearance - original	0.007-0.009	0.009-0.011
Clearance - max. allowable	0.014	0.016

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

PART	REP. NO.	ORIGINAL BORE DIAMETER	
Bearing Cap - front	59(dwgDEC0200)		3.5433 - 3.5442
Bearing Cap - idler	9(dwgDEC0200)		2.4409 - 2.4416
Bearing Cap - idler	57(dwgDEC0200)		2.4409 - 2.4416
Rear Bearing Bracket	51(dwgDEC0200)	center	4.3307 - 4.3316
		rear	4.7244 - 4.7253
Front Bearing Bracket	25(dwgDEC0200)		4.7244 - 4.7253
Rear Drive Shaft	48(dwgDEC0200)	pilot	2.4409 - 2.4416
Drive Gear	18(dwgDEC0200)		3.9370 - 3.9379
Pump Clutch Gear	34(dwgDEC0200)		3.9370 - 3.9379

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

PART	REP. NO.	ORIGINAL JOURNAL DIA.	
Rear Drive Shaft	48(dwgDEC0200)	front	2.7560 - 2.7656
		rear	2.5592 - 2.5597
Transmission Shaft	20(dwgDEC0200)	front	2.5592 - 2.5597
		rear	2.5592 - 2.5597
		pilot	0.9842 - 0.9846
Idler Gear Shaft	8(dwgDEC0200)	both	1.1812 - 1.1816
Pump Shaft	19(dwgDEC0100)	front	1.1812 - 1.1816
		center	1.9686 - 1.9690
		rear	1.5749 - 1.5753

7. The original pump shaft diameter under the pinion gear is 1.7490 - 1.7495. The original pinion gear bore is 1.7495 - 1.7500 providing 0.0000 to 0.0010 clearance. The parts are still serviceable up to 0.0015 clearance. Pinion gear may be reversed to work other side of gear teeth.
8. The original idler gear shaft diameter under the idler gear is 1.3775 - 1.3780. The original idler gear bore is 1.3775 - 1.3780 providing 0.0005 press fit to 0.0005 clearance. The parts are still serviceable to 0.0010 clearance. Idler gear may be reversed to work other side of gear teeth.

ASSEMBLY OF TYPE E MIDSHIP PUMP AND TRANSMISSION

TRANSMISSION ASSEMBLY

Refer to drawing DEC0200

1. Apply a light coating of oil to tachometer drive shaft (55) and press evenly into the hole at shoulder end of idler gear shaft (8). Shaft must have 3/8 length extending.
2. Place gearcase (66) on bench with tachometer drive side up and place idler gear (7) inside gearcase. Tachometer side is opposite to pump mounting side.
3. Apply a light coating of oil to idler gear shaft (8). Place key (10) into idler gear shaft keyway, align with keyslot in gear (7) and press shaft evenly into idler gear bore until shaft shoulder is tight against side of gear.
4. Apply a light coating of oil to bore of bearing (13) and press evenly onto idler gear shaft (8) until inner race of bearing is tight against shaft shoulder.
5. Turn gearcase over and place spacer (11) on idler gear shaft (8).
6. Apply a light coating of oil to bore of second bearing (13) and press evenly on idler gear shaft until spacer, idler gear, and inner race of bearing are tight together.
7. Place gasket (58) into position against bearing cap (57).
8. Place gearcase on bench with tachometer drive side up and place two bearing support bars (X3847) between idler gear (7) and bearing (13). This is necessary to prevent spherical roller bearing from cocking out of line when installing bearing cap (57). Insert bars from pinion gear bored hole in gearcase with 0.825 side between gear and bearing.
9. Tap bearing cap (57) with a soft hammer over bearing (13) until cap touches X3847 supports. Remove bars and continue tapping until cap is against gearcase. Apply Loctite 243 or equivalent to the threads of four 3/8NC x 7/8 cap screws and attach bearing cap to gearcase.
10. Place gasket (14) into position against bearing cap (9).
11. Turn gearcase over and place two bearing support bars (X3847) between idler gear (7) and bearing (13) with 0.840 side between gear and bearing.

12. Tap bearing cap (9) with a soft hammer over bearing (13) until cap touches X3847 supports. Remove bars and continue tapping until cap is against gearcase. Apply Loctite 243 or equivalent to the threads of four 3/8NC x 7/8 cap screws and attach bearing cap and water shield to gearcase.

13. Place oil seal assembly plug (X3852) into end of tachometer drive shaft (55). Fill grease cavity of oil seal (56) with grease and lubricate oil seal lips. Press oil seal into bearing cap (57) with a sleeve, with lip spring of seal facing bearing. Remove oil seal assembly plug.

14. Press bearings (22) onto transmission shaft (20) until inner races are tight against shaft shoulders.

15. Oil lubricate bore of drive gear (18) and place inside gearcase with six smaller 5/16 diameter holes on pump clutch gear (34) side of gearcase.

16. Press transmission shaft (20) with bearings (22) into drive gear (18). Slide pump clutch gear (34) into position over bearing at rear of drive gear (18). Slide bearing retainer (19) into position over bearing at front of drive gear.

17. Drive Gear Assembly Procedures:

    a.) Clean the mating faces of the drive gear and pump clutch gear using isopropyl alcohol or another solvent that dries without leaving a residue, removing all grease and oil. Do not use a Loctite primer product.

    b.) Apply Loctite 680 to both mating faces, taking care not to spill any on to any bearings or bearing journals. Do not apply anything to the threaded bearing retainer.

    c.) Apply Loctite 262 to the threads of the six grade 9, zinc dichromate plated hex head cap screws that mount the pump clutch gear to the drive gear.

    d.) Tighten the screws in a crisscross pattern until they are snug.

    e.) Use a torque wrench calibrated to +/- 4% for the tightening procedure.

    f.) Torque the screws in a crisscross pattern to 17.5 ft-lb.

    g.) Using a crisscross pattern, tighten the screws to their final torque value of:

    Screw Size: 5/16-18 UNC , assembled with Loctite 262

Description:	Torque Value:
Grade 9, Zinc Dichromate Plated	22 ft-lb

    h.) Drive gear assembly must be allowed to cure for one hour before oil is added and the pump is started.

18. Slide spacer (21) over transmission shaft (20) and against bearing (22). Press bearing (26) onto transmission shaft against spacer.

19. Press oil seal (24) into front bearing bracket (25) flush with face of bracket with lip spring of seal facing bearing. Fill grease cavity with grease and lubricate oil seal lips.

20. Place gasket (27) into position against bearing bracket (25). Tap bearing bracket over bearing (26) and against gearcase. Apply Loctite 243 or equivalent to the threads of four 3/8NC x 1-1/4 cap screws and attach bearing bracket to gearcase with these cap screws. Tap transmission shaft with a rubber mallet from the rear until bearing is seated in front bearing bracket.

NOTE: If bearing (26) has "BL213Z" marked on its side then you will have to apply Loctite 603 (or equivelant) to the bore of the front bearing bracket (25), taking care not to spill any on the faces that touch the side of bearing (26).

21. Lubricate bore and place sliding clutch gear (35) on spline of transmission shaft (20) with long tooth gear to rear.
22. Press bearing (36) onto transmission shaft (20) tight against shaft shoulder.
23. Apply grease to o-ring (15) and install o-ring in groove in gearcase shift bar hole. Lubricate shift bar hole with oil.
24. Lubricate shift bar (16) with oil and slide into gearcase.
25. Install retaining ring (17) on shift bar (16). See drawing DGM0700 which shows sharp corner side of retaining ring in proper position to take thrust load.
26. Saturate oil wick holes in shift yoke (53) ears with oil.
27. Place shift yoke (53) into groove of sliding clutch gear (35) and slide shift bar (16) through hole in yoke. Align groove in shift bar with bolt hole in yoke.
28. Apply Loctite No. 242 Threadlocker to the threads of lock bolt (52). Install lock bolt in shift yoke (53) and torque to 20 - 23 ft. lbs. Attach safety wire (50) through hole in head of lock bolt and around end groove of shift bar (16).

ASSEMBLY REAR BEARING BRACKET

29. Press oil seals (38) and (40) into rear bearing bracket (51) with lip spring of seal facing bearing. Be sure to press the oil seals in until they are flush or slightly below the face of the rear bearing bracket they are sealing. Fill grease cavity with grease and lubricate oil seal lips.
30. Press bearing (37) onto rear drive shaft (48) at gear end.
31. Place oil seal assembly sleeve (X3851) over splined end of rear drive shaft (48) or wrap splines in shim stock to prevent damage to oil seals as shaft is inserted. Make sure the largest diameter step at spline end of shaft is covered.
32. Slide rear drive shaft (48) into rear bearing bracket (51) from the front. Remove sleeve or shim stock.
33. Place bearing backup washer (43) on rear drive shaft.
34. Press bearing (41) onto rear drive shaft (48) against backup washer (43).
35. Apply a thin layer of Loctite Master Gasket 518 or equivalent to flange of rear bearing bracket (51). Place rear bearing bracket assembly into position at rear of gearcase so bearing enters bore at gear end of rear drive shaft. Use two 3/8NC x 1 1/2 cap screws to draw flange up to gearcase mounting surface. Install remaining five 3/8NC x 1-1/2 cap screws, and one 3/8NC x 1-1/4 socket head cap screw and high collar washer at the housing extension flange. Apply Loctite 243 or equivalent.
36. Press oil seal (49) into bearing retainer/brake yoke (42) with lip spring of seal facing bearing. Fill grease cavity with grease and lubricate oil seal lips. Apply Loctite 603 (or equivalent) to bore of the bearing retained/brake yoke (42), taking care not to spill any on the faces that touch the sides of the bearing (41).
37. Slide o'ring (358) over bearing (41) until it is touching the rear bearing bracket (51).
38. Attach bearing retainer brake yoke (42) to rear bearing bracket (51) with four 3/8NC x 1-1/4 cap screws and Loctite 243 or equivalent.

39. Attach brake assembly (if so equipped) to brake yoke (42) with four 5/8NC x 1 cap screws and Loctite 243 or equivalent.
40. Slide brake drum flange (if so equipped) onto rear drive shaft (48).
41. Slide rear yoke (44) and washer (45) onto rear drive shaft (48). Spin on lock nut until snug, then turn to next cotter key slot. Install a 1/8 x 1-3/4 cotter key.

EM PUMP ASSEMBLY
Refer to Drawing DEC0200

42. Apply a light coating of oil to pump shaft (5). Place pinion gear key (2) in pump shaft keyway, align with keyslot in pinion gear (1) and press pump shaft into pinion gear bore until shaft shoulder is tight against side of gear.
43. Place retaining ring (6) on pump shaft (5) with sharp edge facing pinion gear (1).
44. Slide backup washer (4) onto pump shaft (5).
45. Press bearing (3) onto pump shaft (5) until it contacts backup washer (4).
46. Slide pinion spacer (63) onto pump shaft (5).
47. Press bearing (60) onto pump shaft (5) until pinion gear (1), pinion spacer (63), and inner race of bearing are tight together.

Refer to Drawing DEC0100:

48. Apply Loctite 603 (or equivalent) to inboard stuffing box (39).
49. Apply silicon lubricant and install o-ring (87) in grove of inboard head (43).
50. Place inboard stuffing box (39) into position in the inboard suction head (43) and install three 1/4NC x 1-1/2 (min.) cap screws through holes of stuffing box lugs and into tapped holes of inboard head.
51. Press inboard stuffing box into position with stuffing box flange tight against shoulder of inboard head. Remove three 1/4NC alignment cap screws and install three stainless steel 1/4NC x 3/4 flat head cap screws (88) with Loctite 243 or equivalent applied to the threads. Torque to 72 in-lbs.
52. Press seal ring (37) into inboard suction head (43).
53. Use a depth micrometer or a caliper and straightedge to check the stuffing box and seal ring for squareness.
54. Apply grease to one side of water slinger (40) and place into position against inboard stuffing box (39).
55. Press oil seal (41) into inboard suction head (43) with lip spring of seal facing bearing. Fill grease cavity with grease and lubricate oil seal lips.
56. Insert pump shaft (19) into inboard suction head (43). Tap on end of pump shaft with a rubber mallet until bearing is seated in bearing pocket in inboard head.
57. Slide water slinger (40) into its groove on pump shaft (19).
58. Apply a thin layer of Loctite Master Gasket 518 or equivalent to the flange surface of inboard suction head (43).
59. Slide impeller shaft suction head assembly into position in gearcase. Line up head square with gearcase.
60. Attach inboard suction head (43) to gearcase with one 1/2NC x 2 cap screw on top, two 1/2NC x 1-1/2 cap screws at sides, and two 3/8NC x 1 cap screws on bottom.
61. Place gasket (62dwgDEC0200) on bearing cap (59dwgDEC0200).

62. Slide bearing cap (59dwgDEC0200) over pump shaft bearing (60dwgDEC0200) until tight against gearcase.
63. Apply Loctite 243 or equivalent to four 3/8NC x 1 cap screws, and attach bearing cap to gearcase.
64. Apply a silicon lubricant, such as Dow Corning Compound 111 to suction head o-ring (33) and place on inboard suction head (43).
65. Place two halves of split retaining ring (42) on pump shaft (19) with step toward impeller (35).
66. Slide first stage impeller (35) onto pump shaft (19) until impeller hub slips over step of split retaining ring (42).
67. Press interstage seal ring (38) into pump casing (30).
68. Place casing gasket (32) into position on pump casing (30).
69. Push pump casing (30) into position on inboard suction head (43). Spin on twelve 1/2NC nuts, but do not tighten. Snug up two nuts on top and two nuts on bottom.
70. Slide second stage impeller (34) onto pump shaft (19).
71. Slide impeller lock ring (29) onto pump shaft (19). Tighten impeller lock nut (28) with EM lock nut tool (X4002). A hammer and punch can be used to tighten lock nut if impeller nut tool is not available. Stake the impeller lock ring into one of the grooves in the impeller lock nut.
72. Apply Loctite 603 (or equivalent) to outboard stuffing box (22).
73. Repeat steps 48 through 50 for outboard suction head (15), stuffing box (22), and o'ring (87).
74. Press seal ring (37) into outboard suction head (15) until seated.
75. Use a depth micrometer or a straightedge and a caliper to check the stuffing box and seal ring for squareness.
76. Apply silicon lubricant to pump casing o-ring (33) and place on outboard suction head (15).
77. Place pump casing gasket (32) into position on pump casing (30).
78. Push outboard suction head (15) onto pump casing (30), keeping bore square with pump shaft (19) to avoid damage to parts. Spin on twelve 1/2NC nuts, but do not tighten. Snug up two nuts on top and two nuts on bottom.
79. Line up alignment marks on suction heads (15) and (43) with marks on pump casing (30), or use a straightedge to align the suction flanges of the inboard and outboard heads. Tighten all nuts holding pump casing to suction heads.
80. Press water slinger (21) onto pump shaft (19).
81. Press outboard oil seal (17) into outboard suction head (15) with lip spring of seal facing bearing. Fill grease cavity with grease and lubricate oil seal lips.
82. Apply oil to end of pump shaft (19) and tap bearing (20) onto shaft.
83. Apply Loctite Master Gasket 518 or equivalent to flange surface of bearing cap (16). Attach to outboard suction head (15) with four 1/4NC x 7/8 cap screws and Loctite 243 or equivalent.

Refer to Drawing DEC0400.

84. Position the staging valve ball sector (10) into the staging valve body (11) with the slotted end of the ball sector facing the 1 1/8 in. hole in body.
85. Apply silicon lubricant to the ball guide screw o'ring (59), and position it in the o'ring groove in the ball guide screw (60).

86. Install the ball guide screw (60). The ball guide screw must squarely enter the hole in the valve ball sector (10) as it is being threaded into the valve body (11).
87. Apply a light coating of oil to bushing (65), and press it into the stop plate (64).
88. Apply silicon lubricant to the valve stem o'ring (63), and place it in the o'ring grove in the valve stem (67). Also apply a light coating of silicon lubricant to the inside of the 1 1/8 in. hole in the valve body (11).
89. Insert valve stem (67) through the 1 1/8 in. hole in the valve body, and into the valve ball sector (10) with the woodruff key slots facing the ball sector.
90. Slide stop plate (64) over valve stem (67). Position the plate so that the micro-switches are along each flange surface. Fasten it into place with four 1/4-20NC socket head cap screws, and Loctite 243 or equivalent.
91. Using Loctite 243 or equivalent on the threads, install the two stop pins (74) in the stop plate (64).
92. Install the two micro-switches.
93. Insert the woodruff key (66) into keyslot in the valve stem (67).
94. Slide valve lever (75) onto valve stem (67) and align lever with the two micro-switches so that the lever can activate each switch. Do not allow lever to contact stop plate.
95. Install valve seat (13) by applying Loctite 243 or equivalent to the threads and screwing it clockwise until it contacts the ball sector (10); then back it off 1 in. of travel at the thread diameter.
    NOTE: It may be helpful to use tool X4618.
96. Readjust the alignment of the valve lever (75), and the micro-switches as necessary. Install the 1/4-20NC X 1/4 lg. socket head set screw (90) in the lever.
97. Apply silicon lubricant to staging valve o-rings (7) and (14) and insert into o-ring grooves in staging valve (11).

Refer to Drawing DEC0100

98. Attach staging valve (11) to outboard suction head (15) with four 3/8NC heavy nuts on studs. Attach to pump casing (30) with four 3/8NC x 1-1/4 socket head cap screws and high collar washers.
99. Apply silicon lubricant to relief valve manifold o-rings (44) and insert into o-ring grooves in relief valve manifold (45).
100. Attach relief valve manifold (45) to pump casing (30) with six 3/8NC x 1-1/4 cap screws.
101. Apply silicon lubricant to four relief valve o-rings and insert into o-ring grooves in relief valves.
102. Attach relief valves to inboard suction head (43) with four 3/8NC nuts and lock washers on studs each.
103. Attach relief valves to relief valve manifold (45) with four 3/8NC x 1-3/4 cap screws and four nuts each.
104. Attach gearcase cover (31dwgDEC0200) and gearcase cover gasket (29dwgDEC0200) to gearcase with twelve 5/16NC x 5/8 cap screws.
105. Pack the stuffing boxes.

INSTALLING PUMP IN TRUCK CHASSIS

Reverse the procedures outlined under removal instructions.

Lubricate universal joint slip yoke on pump drive shaft.

Filler gearcase with 80W/90 Gear Lube oil to the bottom of the 3/8 NPT fill plug located in the rear of the gear case.

LUBRICATION

Use a transmission oil suction gun to fill and maintain oil level even with bottom of the oil fill/level plug every 25 hours. Use 80W/90 Gear Lube oil in the pump transmission.

CAUTION: Do not overfill

Change the pump transmission oil every 50 hours, or every 6 month, 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

W. S. DARLEY & CO.

REPAIR SERVICE SPECIAL INSTRUCTIONS
TYPE EM, LDM, N, & PSM FIRE PUMPS

IMPORTANT NOTICE:

When assembling a transmission on a type EM, LDM, N, or PSM pump, with gears that are approximately 2.62 wide, do not use gaskets between the bearing cap flanges and the gear case. If provisions for an o-ring seal have not been provided for, use Loctite 518 “Master Gasket” or equivalent in place of the gaskets.

When assembling a transmission on a type EM, LDM, N, or PSM pump, with gears that are approximately 3.50 wide, use gaskets between the bearing cap flanges and the gear case as specified in the repair instruction for the type of pump you are working on.

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

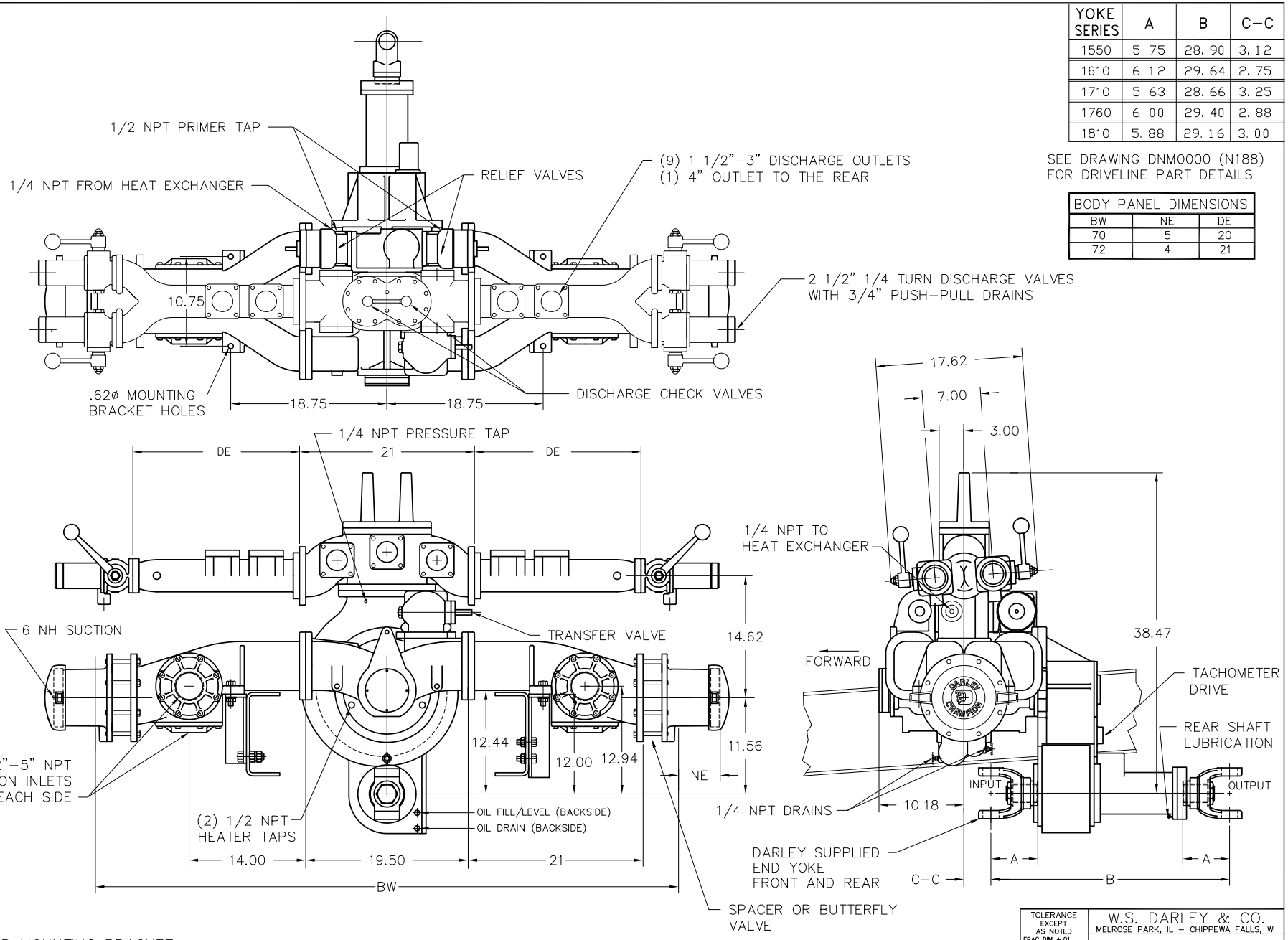
1200010

10.14

YOKE SERIES	A	B	C–C
1550	5.75	28.90	3.12
1610	6.12	29.64	2.75
1710	5.63	28.66	3.25
1760	6.00	29.40	2.88
1810	5.88	29.16	3.00

SEE DRAWING DNM0000 (N188)
FOR DRIVELINE PART DETAILS

BODY PANEL DIMENSIONS		
BW	NE	DE
70	5	20
72	4	21



FOR MOUNTING BRACKET
DIMENSIONS SEE DETAIL
DRAWING DGM1300

NET WEIGHT: 1450 LBS

OLD PART NO. E61

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

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

DWG–EM1500/2000 PUMP FORWARD DIMENSIONAL

DR'N S.LEE
CHKD
TRCD DWS
DATE DEC06,91
SCALE 1/8

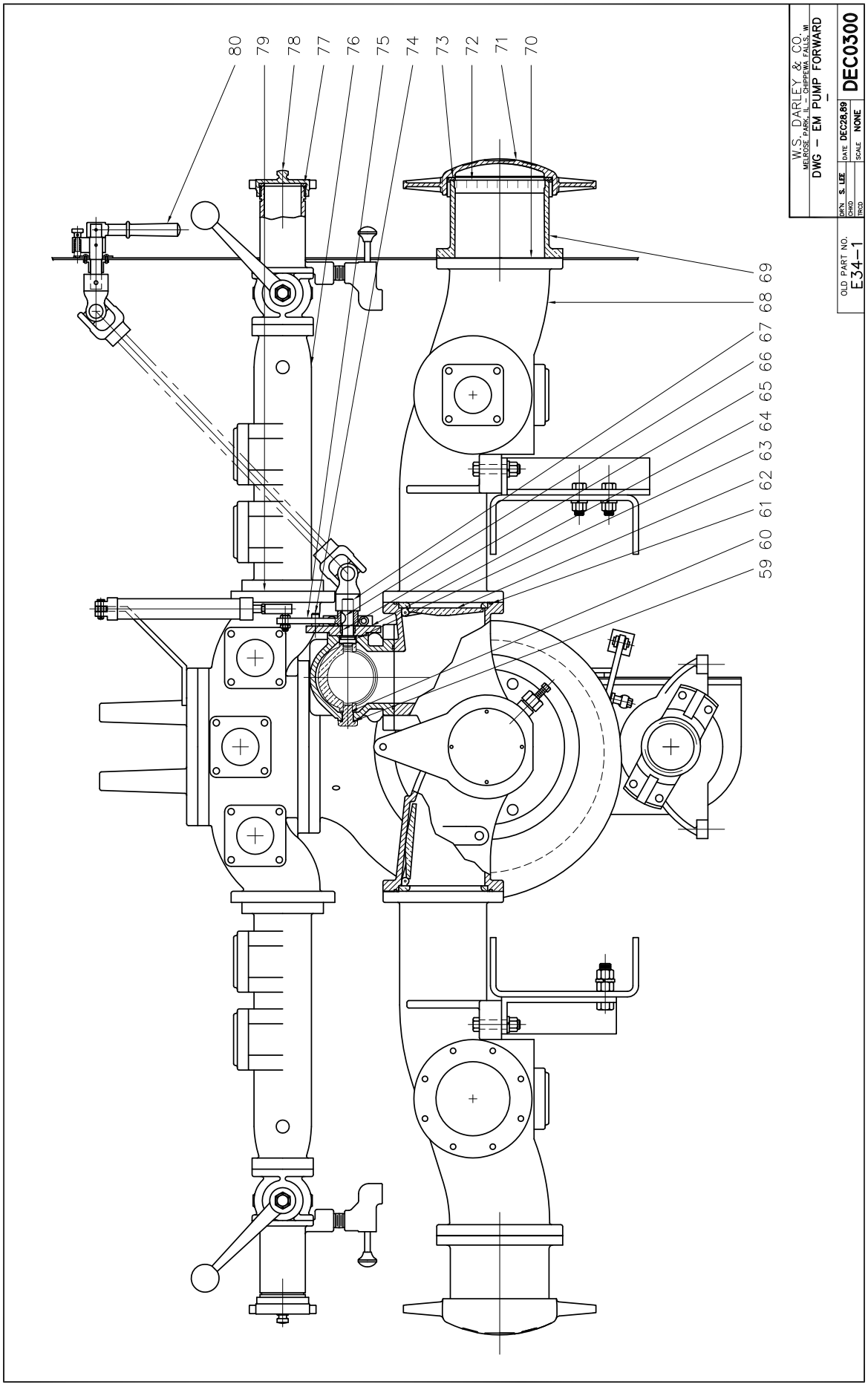
DED0000

ALL DIMENSIONS IN INCHES UNLESS NOTED

DO NOT SCALE PRINT

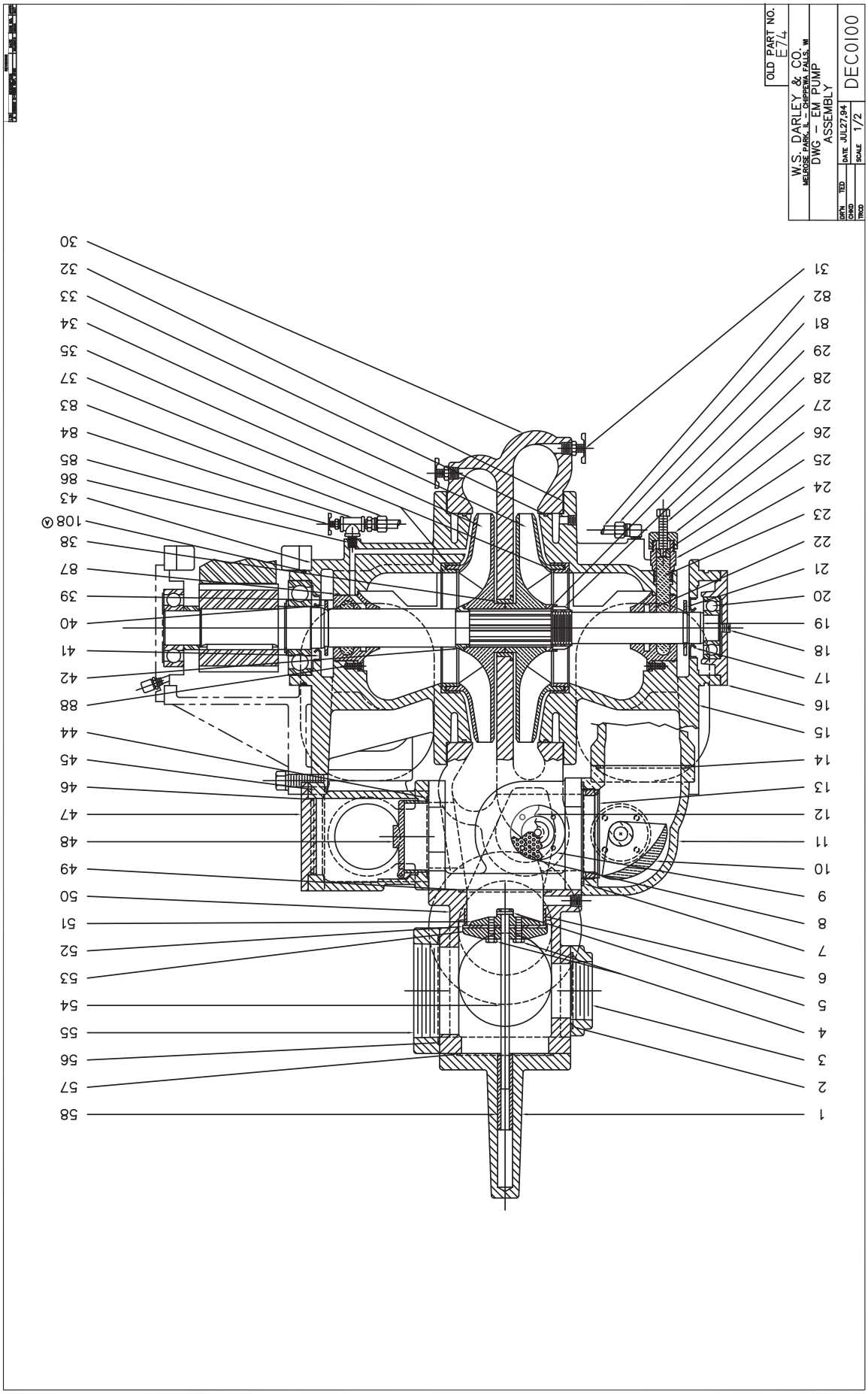
EM PUMP ASSEMBLY PARTS LIST
DRAWING NO. DEC0300

Rep. No.	Name of Part	Qty.
59	O Ring - Guide Screw	1
60	Ball Guide Screw	1
61	O Ring - Suction Extension	4
62	Suction Check Valve	2
63	O Ring - Staging Valve Stem	1
64	Stop Plate	1
65	Bushing	1
66	Key - Staging Valve	1
67	Staging Valve Stem	1
68	Suction Extension	2
69	Suction Nipple	1
70	Gasket - Suction Nipple	2
71	Suction Cap	2
72	Suction Screen	2
73	Gasket - Suction Cap	2
74	Stop Pin	2
75	Valve Lever	1
76	Discharge Extension	2
77	Gasket - Discharge Cap	VA.
78	Discharge Cap	VA.
79	Gasket - Discharge Extension	2
80	Manual Control Valve Assembly	1


80 79 78 77 76 75 74 73 72 71 70
59 60 61 62 63 64 65 66 67 68 69
W.S. DARLEY & CO.
MELROSE PARK, IL - CHIPPEWA FALLS, WI
DWG - EM PUMP FORWARD
DRN S. LEE
CHKD
TRCD
DATE DEC28.89
SCALE NONE
DEC0300
OLD PART NO.
E34-1

EM PUMP ASSEMBLY PARTS LIST
DRAWING NO. DEC0100

Rep. No.	Name Of Part	Qty.
1	Discharge Head over	1
2	O Ring - Adapter Flange	9
3	Adapter Flange	9
4	Hex Head Cap Screw	4
5	Brass Pin	2
6	Check Valve Seat	2
7	O Ring - Staging Valve	1
8	Cooling Strainer	1
9	Strainer Flange	1
10	Staging Valve	1
11	Staging Valve Body	1
12	Gasket - Cooling Strainer	1
13	Staging Value Seat	1
14	O Ring - Staging Value	1
15	Suction Head - Outboard	1
16	Bearing Cap	1
17	Oil Seal - Outboard	1
18	Slotted Head Pipe Plug	1
19	Pump Shaft	1
20	Bearing - Pump Shaft	1
21	Water Slinger - Outboard	1
22	Stuffing Box - Outboard	1
23	Pump Packing	10
24	Packing Plunger Guide	2
25	Packing Plunger	2
26	Packing Plunger Nut	2
27	Packing Plunger Stud	2
28	Impeller Lock Nut	1
29	Impeller Lock Ring	1
30	Pump Casing	1
31	Drain Cock	2
32	Gasket - Pump Casing	2
33	O Ring - Pump Casing	2
34	Impeller - Second Stage	1
35	Impeller - First Stage	1
37	Seal Ring	2
38	Interstage Seal Ring	1
39	Stuffing Box - Inboard	1
40	Water Slinger - Inboard	1
41	Oil Seal - Inboard	1
42	Impeller Retaining Ring	1
43	Suction Head - Inboard	1
44	Ring - Relief Valve Manifold	2
45	Relief Valve Manifold	1
46	O Ring - Manifold Cover	1
47	Manifold Cover	1
48	Bypass Check Valve	1
49	O Ring - Discharge Head	2
50	Discharge Head	1
51	Check Valve Diffuser	2
52	Check Valve Rubber	2
53	Check Valve Plate	2
54	Check Valve Stem	2
55	Adapter Flange	1
56	O Ring - Adapter Flange	1
57	O Ring - Discharge Head Cover	2
58	Check Valve Bushing	2
81	Compression Fitting -90	1
82	Tubing	2
83	Compression Fitting	1
84	Pipe Tee	1
85	Drain Cock	1
86	Close Nipple	1
87	O Ring - Stuffing Box	2
88	Stuffing Box Screw	6
108	O Ring – Suction Head	1


OLD PART NO.
E74
W.S. DARLEY & CO.
MELROSE PARK, IL - CHIPPEWA FALLS, WI
DWG - EM PUMP
ASSEMBLY
DRN TED
CHKD
TRCD
DATE JUL27,94
SCALE 1/2
DEC0100
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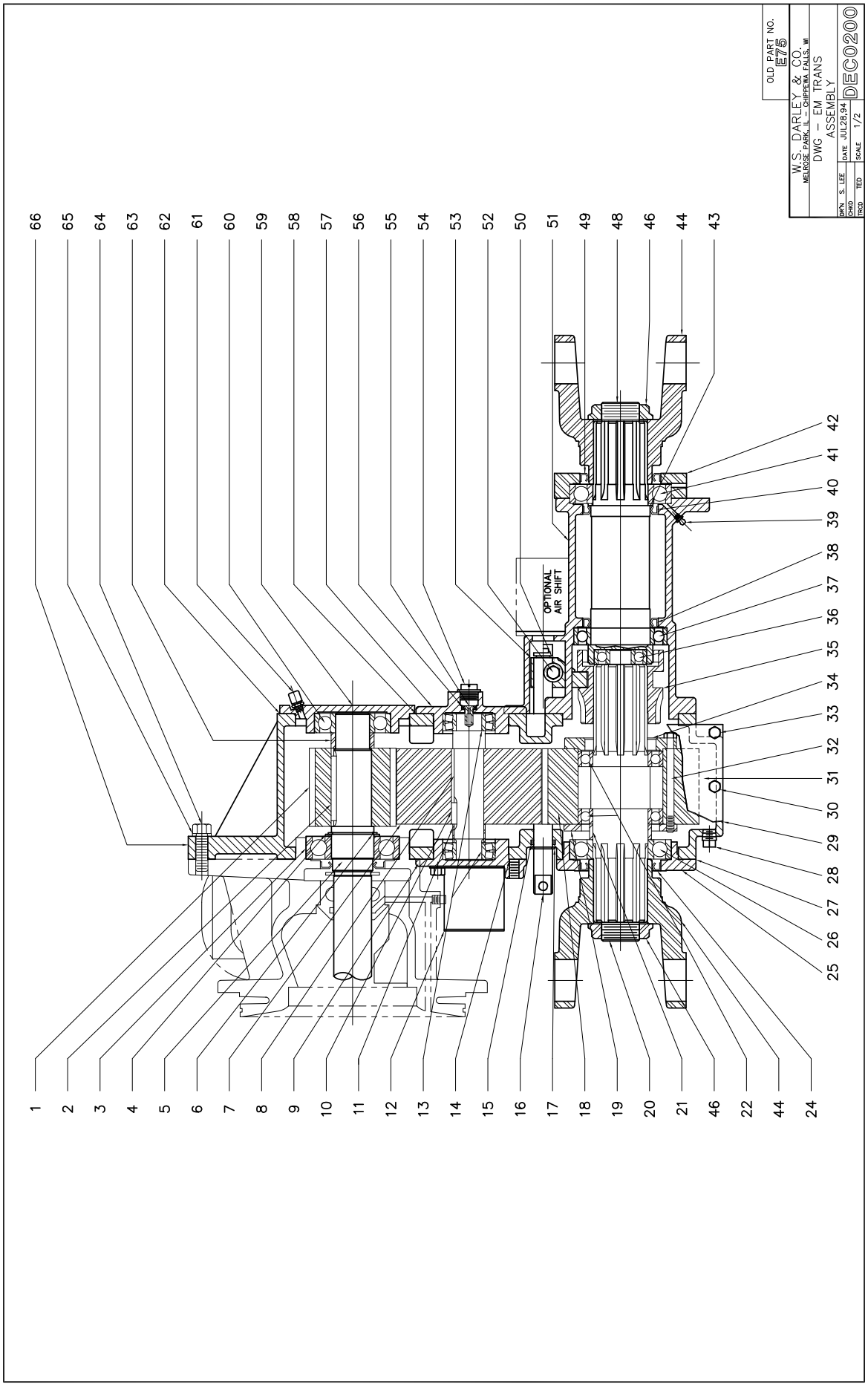
OLD PART NO.
E75
W.S. DARLEY & CO.
MELROSE PARK, IL – CHIPPEWA FALLS, WI
DWG – EM TRANS
ASSEMBLY
DRN S. LEE
CHKD
TRCD
DATE JUL28,94
SCALE 1/2
DEC0200
OPTIONAL AIR SHIFT
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 46 22 44 24
25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 46 48 49 51 50 52 53 54 55 56 57 58 59 60 61 62 63 64 65 66

EM TRANSMISSION ASSEMBLY
DRAWING NO. DEC0200

Rep No.	Name of Part.	Qty.
1	Pinion Gear	1
2	Key -Pinion Gear	1
3	Bearing - Pump Shaft	1
4	Back Up Shaft	1
5	Pump Shaft	1
6	Retaining Ring	1
7	Idler Gear	1
8	Idler Gear Shaft	1
9	Bearing Cap - Idler	1
10	Key- Idler Gear	1
11	Idler Gear Spacer	1
12	Water Shield	1
13	Bearing - Idler Shaft	2
14	Gasket - Bearing Cap	1
15	O Ring - Shift Bar	1
16	Shift Bar	1
17	Retaining Ring	1
18	Drive Gear	1
19	Bearing Retainer	1
20	Transmission Shaft	1
21	Transmission Shaft Spacer	1
22	Bearing- Transmission Shaft	2
24	Oil Seal - Front Yoke	1
25	Front Bearing Bracket	1
26	Bearing - Transmission Shaft	1
27	Gasket - Bearing Bracket	1
28	Oil Drain Plug	1
29	Gasket - Bearing Bracket	12
30	Hex Head Cap Screw	1
31	Gearcase Cover	6
32	Bolt- Drive Gear	12
33	Lock Washer	1
34	Pump Clutch Gear	1
35	Sliding Clutch Gear	1
36	Bearing - Transmission Shaft	1
37	Bearing- Rear Drive Shaft	1
38	Oil Seal - Rear Drive Shaft	1
39	Grease Zerk	1
40	Oil Seal - Rear Drive Shaft	1

EM TRANSMISSION ASSEMBLY
DRAWING NO. DEC0200

Rep No.	Name Of Part	Qty.
41	Bearing - Rear Drive Shaft	1
42	Bearing Retainer	1
43	Back Up Washer	1
44	Rear Drive Yoke	1
46	U Joint Retaining Nut	1
48	Rear Drive Shaft	1
49	Oil Seal - Rear Yoke	1
50	Safety Wire	10"
51	Rear Bearing Bracket	1
52	Lock Bolt	1
53	Clutch Shift Yoke	1
54	Tachometer Plug	1
55	Tachometer Drive Shaft	1
56	Oil Seal - Tachometer Shaft	1
57	Bearing Cap - Idler	1
58	Gasket - Bearing Cap	1
59	Bearing Cap - Pump Shaft	1
60	Bearing - Pump Shaft	1
61	Gearcase Vent	1
62	Gasket - Bearing Cap	1
63	Pinion Spacer	1
64	Gearcase Bolt	1
65	Lock Washer	3
66	Gearcase	1
358	O'Ring	1

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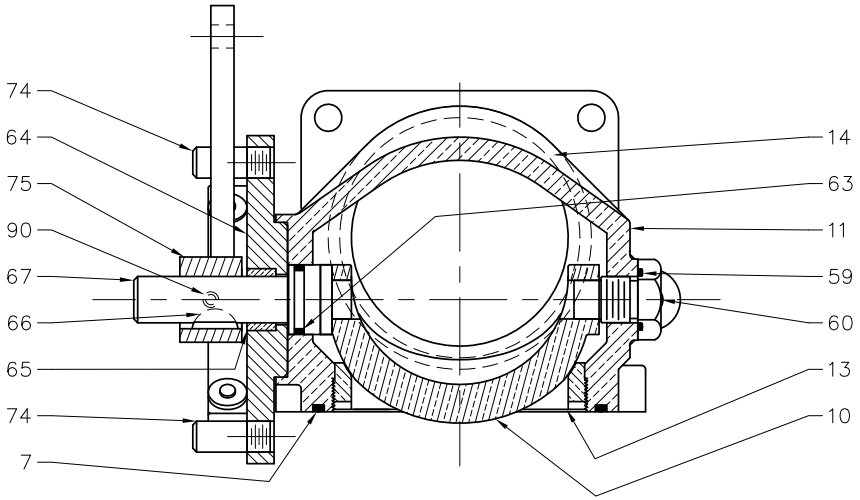
REP#	NAME OF PART	QTY
7	VALVE FLANGE O'RING	1
10	VALVE BALL SECTOR	1
11	VALVE BODY	1
13	VALVE SEAT	1
14	VALVE FLANGE O'RING	1
59	GUIDE SCREW O'RING	1
60	BALL GUIDE SCREW	1
63	VALVE STEM O'RING	1
64	STOP PLATE	1
65	BUSHING	1
66	WOODRUFF KEY	1
67	VALVE STEM	1
74	STOP PIN	2
75	VALVE LEVER	1
90	1/4–20 X 1/4 SET SCREW	1



MATERIAL NO.
E76

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

EM STAGING VALVE

DR'N TED
CHKD
TRCD

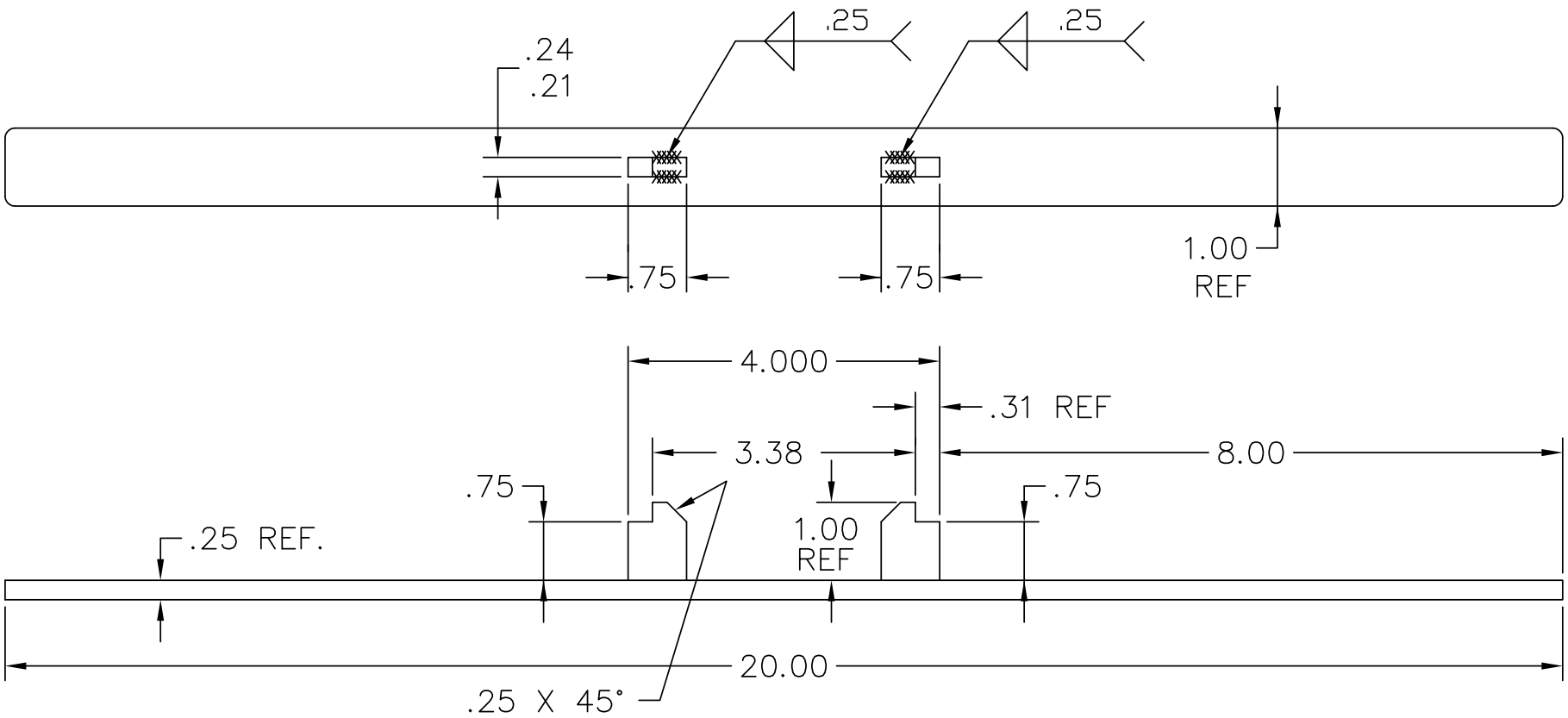
DATE AUG31,94
SCALE 1/2

DEC0400

ALL DIMENSIONS IN INCHES UNLESS NOTED

DO NOT SCALE PRINT

REVISIONS				
LTR	DESCRIPTION	DATE	CHG NO.	APPR'D



NOTE: REMOVE ALL SHARP EDGES

MATERIAL DESCRIPTION: (2) 1/4 X 1.00 X .75 LG. FMS 1/4 X 1.00 X 20.00 FMS	MATERIAL NO. —	PATTERN NO. —	OLD PART NO. —

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

DR'N TED
CHKD
TRCD

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

EM STAGING VALVE SEAT ASSEMBLY TOOL

DATE SEP.18,94
SCALE 1/2

X4618

ALL DIMENSIONS IN INCHES UNLESS NOTED

DO NOT SCALE PRINT

10.23

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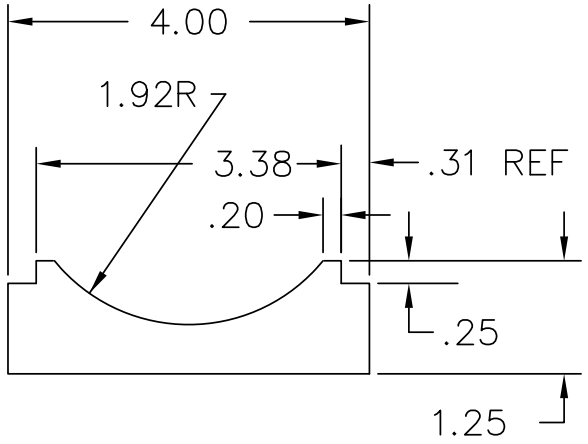
1200010

10.24

REVISIONS				
LTR	DESCRIPTION	DATE	CHG NO.	APPR'D

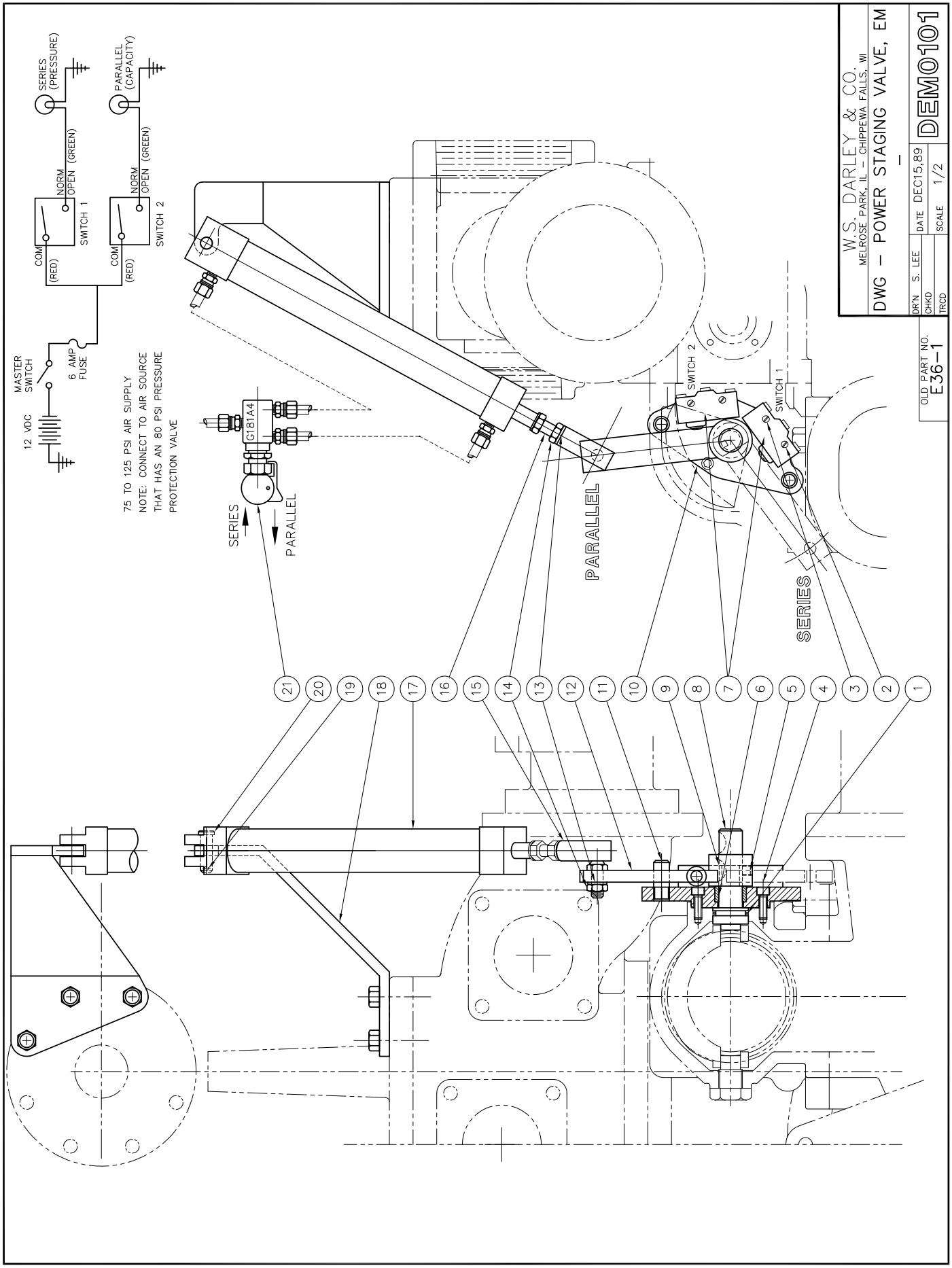


NOTE: REMOVE ALL SHARP EDGES

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

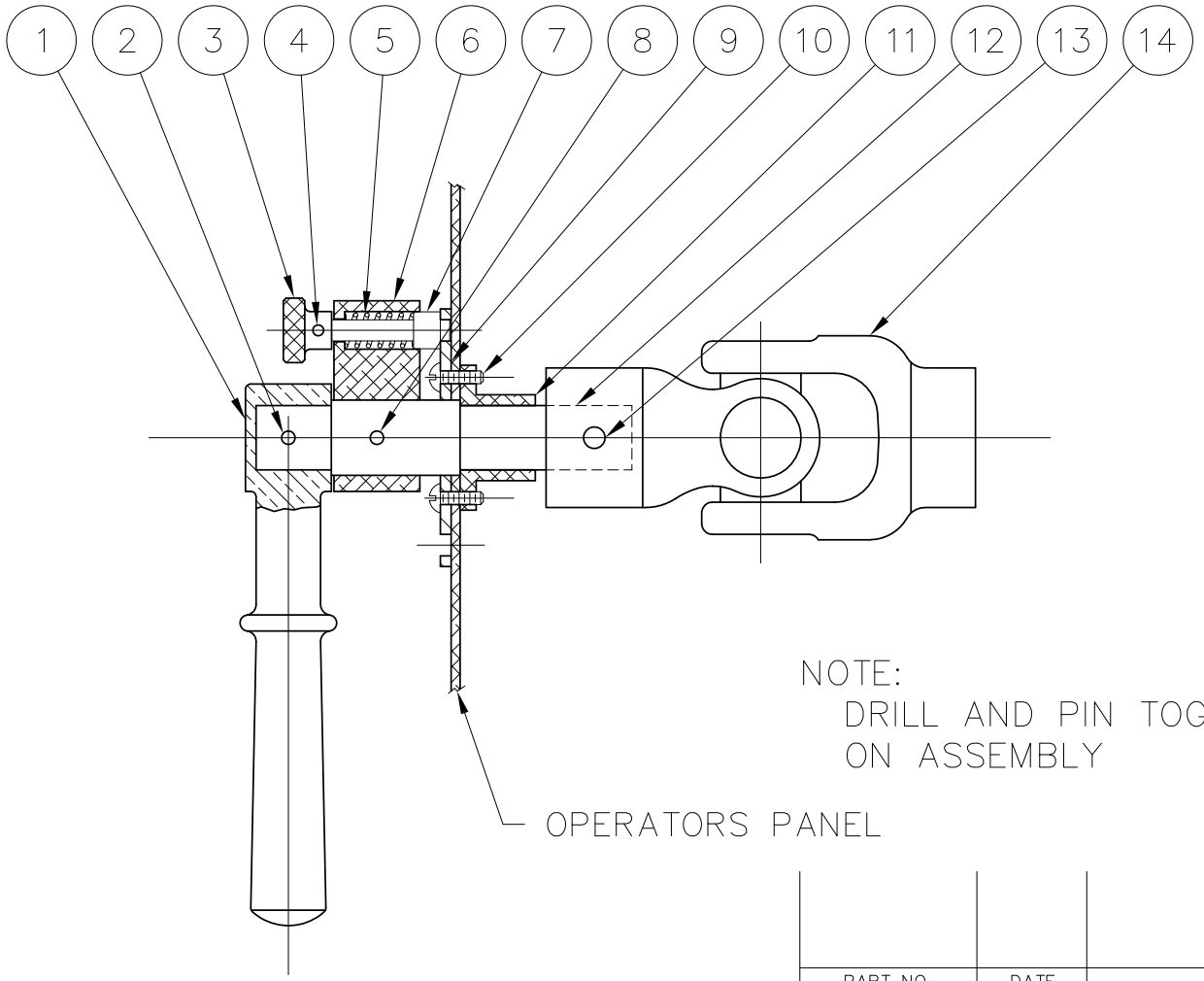
MATERIAL DESCRIPTION:	MATERIAL NO.	PATTERN NO.	EM STAGING VALVE SEAT ASSEMBLY TOOL
1/4 X 1–1/4 X 4 LG FMS	–	–	

			DR'N JCM	DATE NOV23,94	X4618–1
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	CHKD	SCALE 1/2	
			TRCD		


W.S. DARLEY & CO.
MELROSE PARK, IL – CHIPPEWA FALLS, WI
DWG – POWER STAGING VALVE, EM –
DR'N S. LEE
CHKD
TRCD
DATE DEC15,89
SCALE 1/2
DEM0101
OLD PART NO.
E36–1
SERIES (PRESSURE)
PARALLEL (CAPACITY)
NORM OPEN (GREEN)
SWITCH 1
SWITCH 2
COM
(RED)
MASTER SWITCH
6 AMP FUSE
12 VDC
75 TO 125 PSI AIR SUPPLY
NOTE: CONNECT TO AIR SOURCE
THAT HAS AN 80 PSI PRESSURE
PROTECTION VALVE
G181A4
SERIES
PARALLEL
21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1

EM PUMP STAGING VALVE
DRAWING NO. DEM0101

Rep. No.	Name of Part	Qty.
1	O Ring- Staging Valve Stem	1
2	Round Head Machine Screw	4
3	Lockwasher	4
4	Socket Head Cap Screw	4
5	Set Screw	1
6	Bushing - Staging Valve Stem	1
7	Micro Switch	2
8	Staging Valve Stem	1
9	Woodruff Key	1
10	Stop Plate	1
11	Stop Pin	2
12	Valve Lever	1
13	Lockwasher - Internal	3
14	Jam Nut	3
15	Ball Joint	1
16	Stud	1
17	Cylinder Assembly	1
18	Cylinder Bracket	1
19	Cotter Pin	1
20	Clevis Pin	1
21	4-Way Valve Assembly	1



PART NO.	DATE	CHANGE

	OLD PART NO. G2304	TOLERANCE EXCEPT AS NOTED FRAC DIM ±.01 .00 ±.01 .000 ±.005 ANGLES ±1°	W.S. DARLEY & CO. MELROSE PARK, IL – CHIPPEWA FALLS, WI	
MATERIAL: ASSEMBLY NO. AA00218 (G52A4)	MATERIAL NO. – / PATTERN NO.		DWG – LEVER, STAGING CONTROL –	
		DR'N S. LEE CHKD TRCD	DATE MAY31,89 SCALE 1/2	DGC1100

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

ALL DIMENSIONS IN INCHES UNLESS NOTED

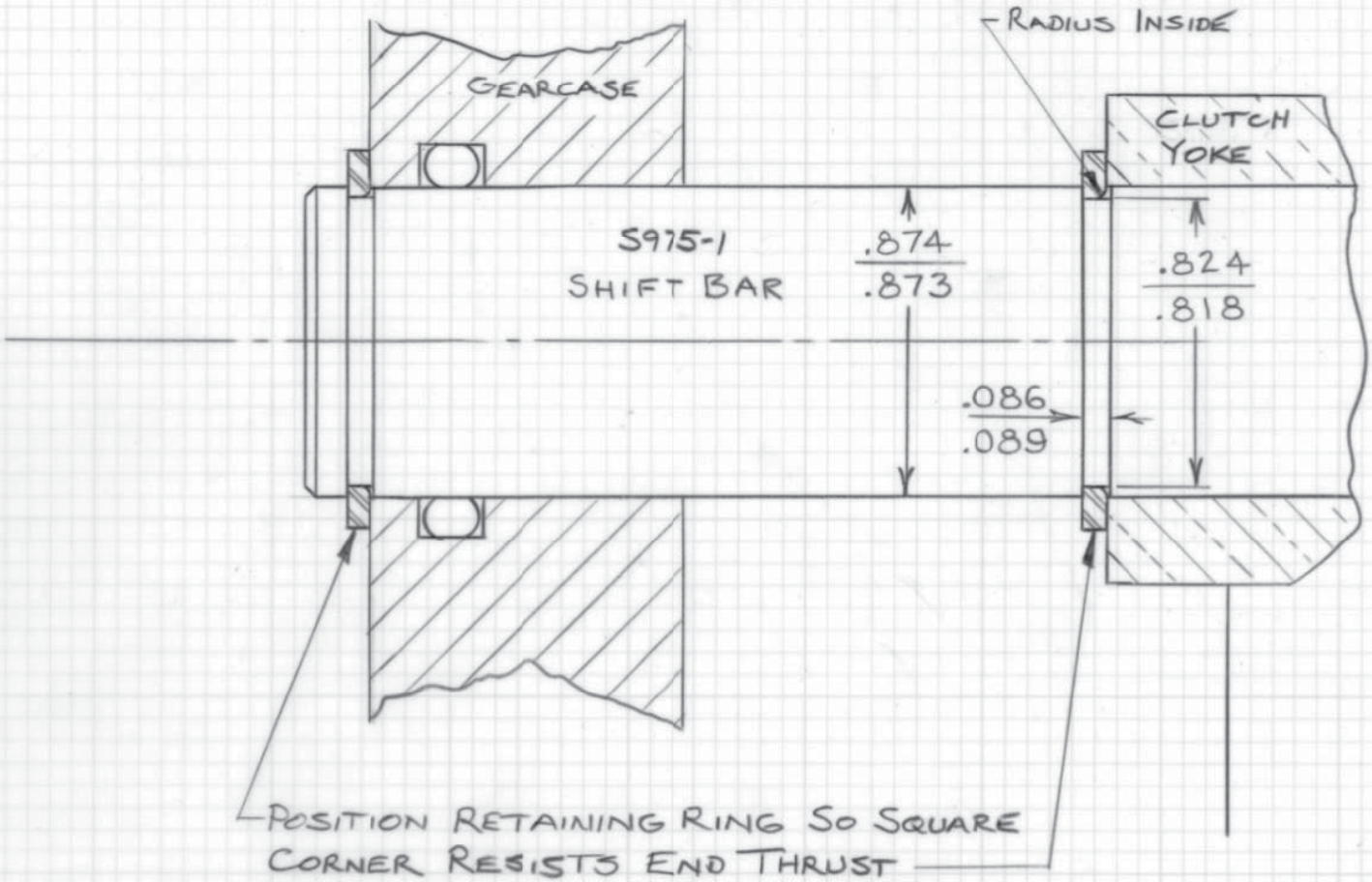
DO NOT SCALE PRINT

10.27

1200010

CONTROL VALVE ASSEMBLY
DRAWING NO. DGC1100

Rep. No.	Name Of Part	Qty.
1	Control Valve Handle	1
2	Drive Lock Pin	1
3	Lever Latch Knob	1
4	Drive Loc Pin	1
5	Spring	1
6	Spring Latch Lever	1
7	Lever Latch	1
8	Drive Loc Pin	1
9	Latch Lock Plate	1
10	Round Head Machine Screw	2
11	Universal Joint Guide	1
12	Control Valve Shaft	1
13	Drive Loc Pin	2
14	Universal Joint	2



NOTE: TO INSTALL RETAINING RINGS USE S-K No. 7640 PLIERS AND BEND TIPS AT RIGHT ANGLE TO HANDLES

DO NOT OVERSTRESS RING

OK

PART NO.	DATE	CHANGE

TOLERANCE EXCEPT AS NOTED
FRAC. DIM. ±.010
.00 ±.010
.000 ±.005
ANGLES ±1°

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

SHIFT BAR RETAINING RING

MATERIAL:

OLD PART # X3494

PATTERN NO.

DR'N DWS
CHKD
TRCD

DATE 9-21-84
SCALE 2/1

DGM0700

ALL DIMENSIONS IN INCHES UNLESS NOTED.

DO NOT SCALE PRINT

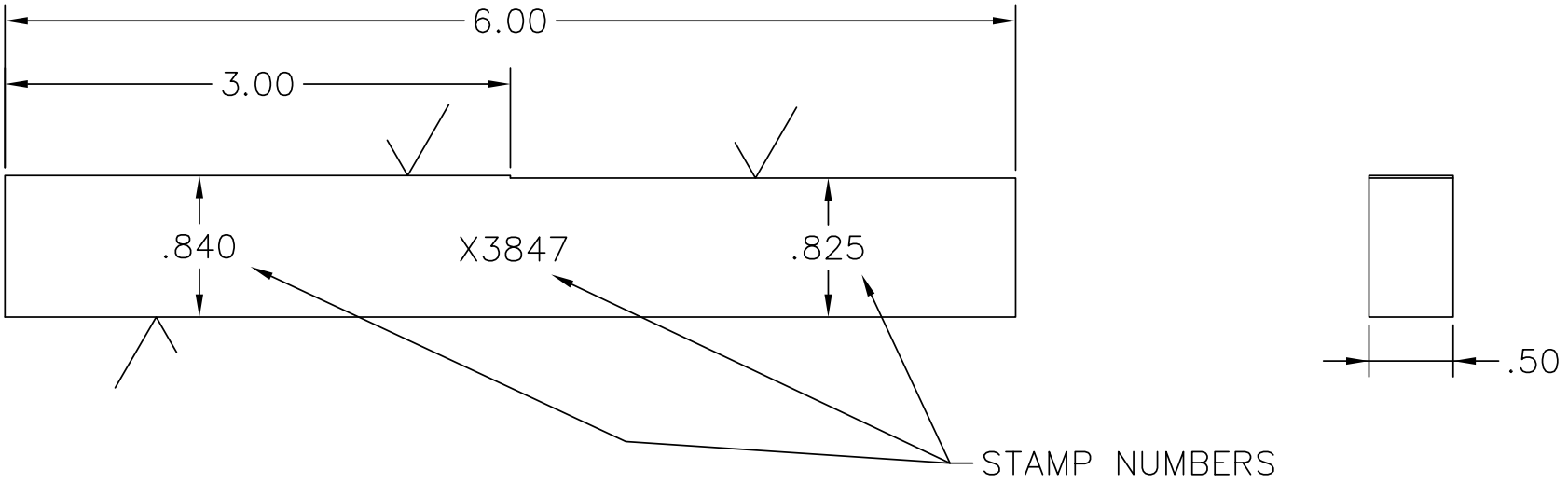
10.29

1200010

1200010

10.30

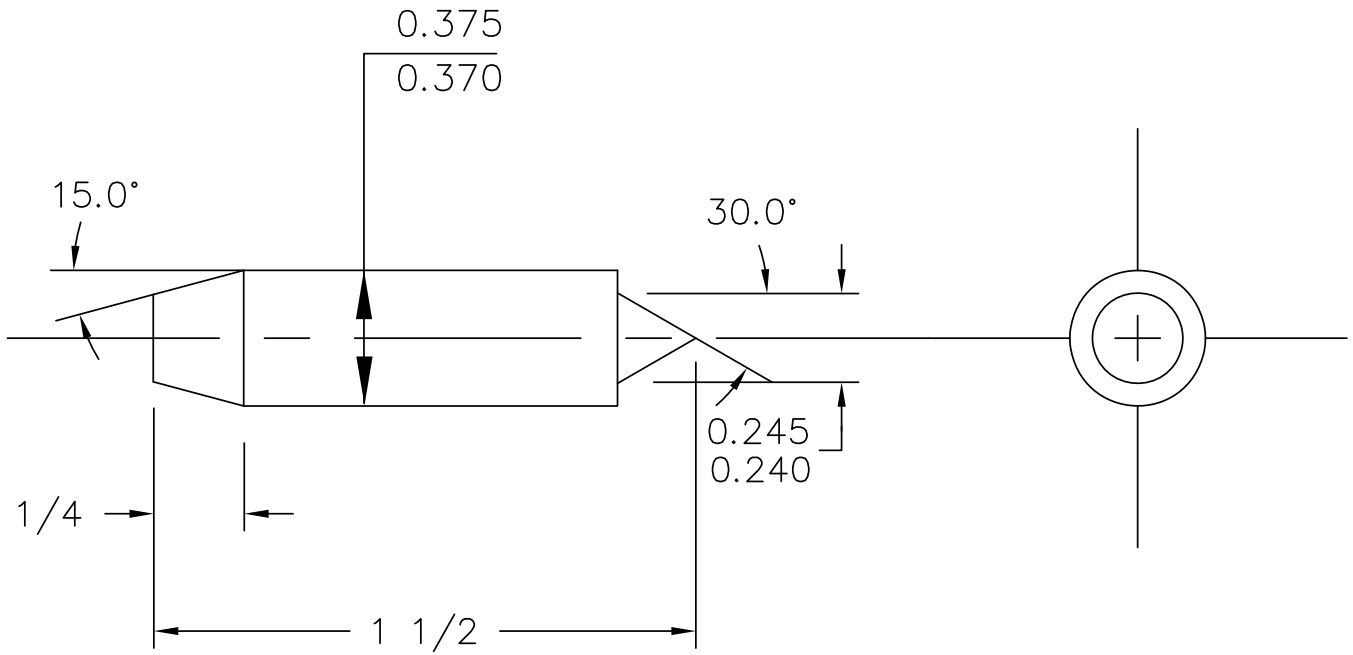
REVISIONS				
LTR	DESCRIPTION	DATE	CHG NO.	APPR'D



NOTE: (2) PC. REQ'D FOR BEARING SUPPORT

MATERIAL: 1/2" X 1" X 6" LG. CRS	PATTERN NO.	
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

TOLERANCE EXCEPT AS NOTED FRAC DIM ±.01 .00 ±.01 .000 ±.005 ANGLES ±1°	W.S. DARLEY & CO. MELROSE PARK, IL – CHIPPEWA FALLS, WI	
	22206 BEARING INSTALL. SUPPORT BARS	
DR'N JCM	DATE JAN21,88	X3847
CHKD		
TRCD TED062294	SCALE 1/1	



MATERIAL: 3/8" OD X 1 5/8" LG 360 BRASS		PATTERN NO. 1100606	
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	

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	
	OIL SEAL ASSEMBLY PLUG	
DR'N JCM	DATE FEB9,88	X3852
CHKD		
TRCD	SCALE 2/1	

10.31

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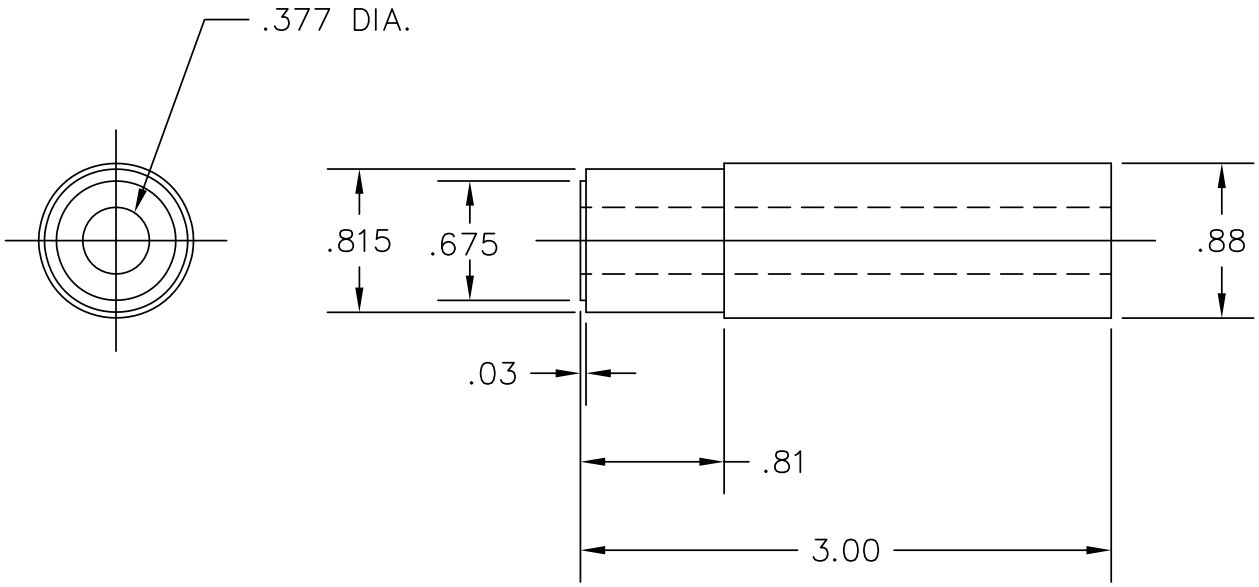
1200010

10.32

REVISIONS				
LTR	DESCRIPTION	DATE	CHG NO.	APPR'D

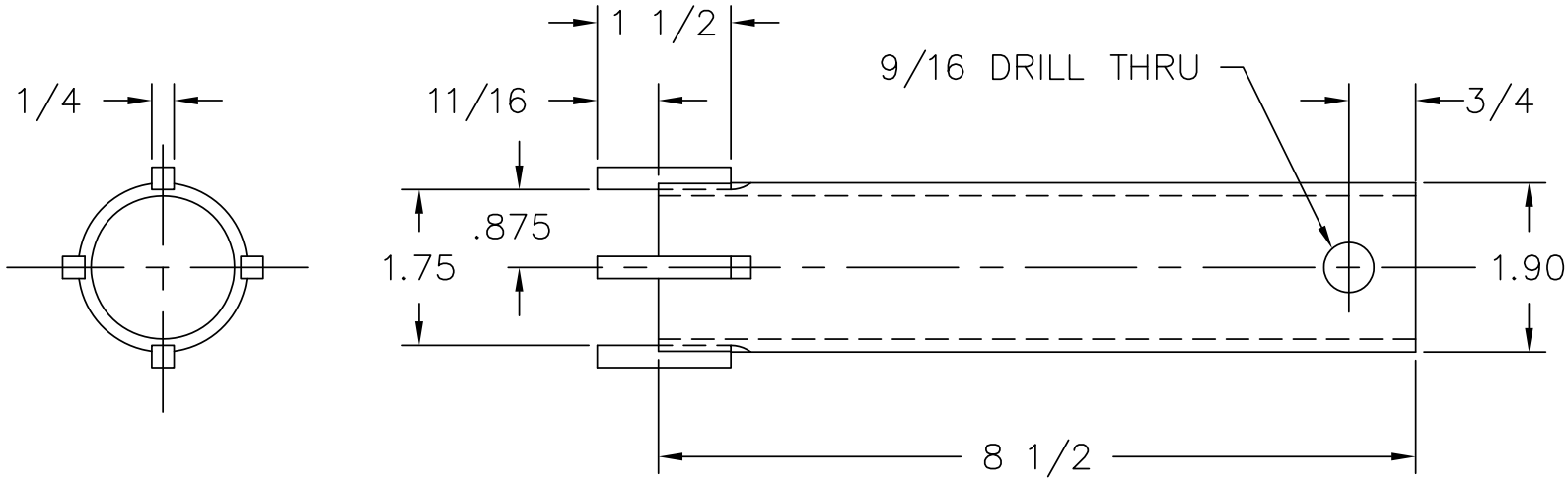


REMOVE SHARP EDGES

INCH
[MILLIMETER]

THIRD ANGLE PROJECTION

MATERIAL DESCRIPTION: .875 X 3.12 360 BRASS	MATERIAL NO. 1100613	OLD PART NO. — / PATTERN NO. —	TOLERANCE EXCEPT AS NOTED .00 ±.03 .000 ±.010 ANGLES ±1°	W.S. DARLEY & Co. MELROSE PARK, IL – CHIPPEWA FALLS, WI
				OIL SEAL ASSEMBLY TOOL
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 S. LEE CHKD CKE TRCD	DATE MAY6,02 SCALE 1/1
				X3852-1



NOTE:
MILL SLOTS 180° APART
INSERT KEY STOCK INTO SLOTS
WELD IN POSITION

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

EM IMPELLER
NUT TOOL

MATERIAL: (1) 1 1/2 X 8 1/2 BLACK PIPE
(4) 1/4 X 1/4 X 1 1/2 HEAT TREATED KEY STOCK

DR'N S. LEE
CHKD TAB
TRCD

DATE AUG16,89
SCALE 1/2

X4002

ALL DIMENSIONS IN INCHES UNLESS NOTED

DO NOT SCALE PRINT

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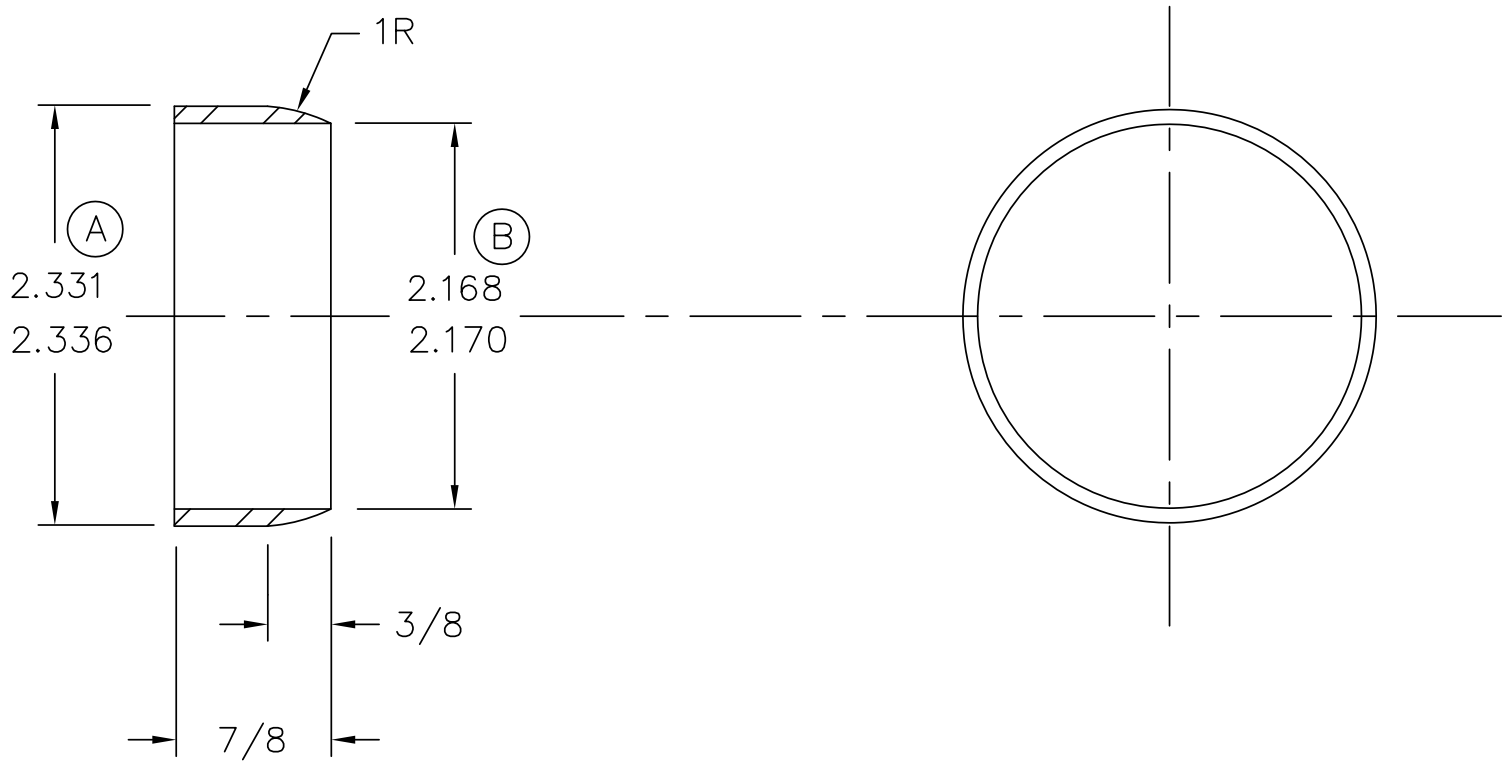


10.34

X3851–1	2–9–88	B=2.562/2.564 A=2.750/2.745
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
	OIL SEAL ASSEMBLY SLEEVE
DR'N JCM CHKD TRCD	DATE FEB9,88 SCALE 1/1

X3851

MATERIAL: 2 3/8" OD X 1" LG CRS
2 3/4" OD X 1" LG CRS FOR –1

PATTERN NO.

ALL DIMENSIONS IN INCHES UNLESS NOTED

DO NOT SCALE PRINT

W.S. Darley & Co.

INSTRUCTIONS – MECHANICAL SEAL

RETRO-FIT EM MODEL PUMP

REMOVAL OF PUMP & TRANSMISSION

ASSEMBLY FROM TRUCK CHASSIS

FOR USE WITH RETRO FIT KIT KA00047

Refer to Drawings DED0000 & DEC0300

Summary: This manual is written in reference to replacing the packing seal system with a mechanical seal system only. To rebuild the pump and gear-case refer to document 1200010.doc – REPAIR SERVICE INSTRUCTIONS TYPE EM MIDSHIP FIRE PUMP. When retrofitting from packing seal system to a mechanical seal system for the high pressure stage refer to documents 1201012.doc – BOOSTER PUMP MECHANICAL SEAL RETRO FIT and 1201013.doc – SEAL FLUSH INSTALLATION.

NOTE: 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. Remove the drive shafts from the front and rear of pump transmission.
2. Disconnect the parking brake linkage if applicable.
3. Remove pump shift rod if pump is equipped with manual shift.
4. Remove air lines at shift cylinder if equipped with power shift.
5. Remove power staging valve cylinder.
6. Disconnect the electric wires to the pump engaged switch on shift bar at front of pump.
7. Disconnect the following additional items from the pump:
   Heater Piping
   Gage Line Tubing
   Primer Tubing
   Drain Line Tubing
   Tachometer Drive Cable
8. Remove any other accessory that will prevent lowering the pump and transmission assembly.
9. Drain oil from gear-case.
10. Provide a floor jack or overhead hoist to support the pump and transmission weight of 1100 lbs.
11. Loosen four 5/8 bolts that fasten suction extensions to truck frame rail support brackets.
12. Loosen all pony suction, tank to pump lines, etc. by unbolting the companion flanges at suction extensions.
13. Remove the twenty 3/8NC cap screws each side that hold suction extensions to suction heads. Pry the flanges apart to free the extensions.

14. **CAUTION:** After the next step, the jack will be the only thing supporting the pump. Check the jack or hoist to make sure it is positioned correctly and is snug to support the pump. Also tie two loops of rope around the arms of the inboard suction head. 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.
15. Remove the fourteen 3/8NC nuts that hold the discharge head to the pump casing.
16. The pump is now ready to drop out, but may require some prying to loosen the gasket between the discharge head and the pump casing.
17. Lowering the pump will require a coordinated effort between the man operating the floor jack and the man on top with the rope holding the pump upright.

PUMP DISASSEMBLY FOR SEAL REPLACEMENT
Refer to Drawing DEC0100

NOTE: Drawing DEC0100 is drawn as pump forward.

1. Remove four 3/8NC cap screws and nuts each holding relief valves to relief valve manifold (45).
2. Remove four 3/8NC nuts each holding relief valves to inboard suction head (43) and remove relief valves.
3. Remove six 3/8NC cap screws and remove relief valve manifold (45) from pump casing (30). Discard O-rings (44).
4. Remove four 3/8NC socket head cap screws holding staging valve (11) to pump casing (30).

Refer to Drawing DEC0400:

5. Remove four 3/8NC heavy nuts holding staging valve (11) to outboard suction head (15) and remove staging valve. Discard O-rings (7) and (14).

Refer to Drawing DEC0100

6. Remove four 1/4NC cap screws and remove bearing cap (16) from outboard suction head (15).
7. Remove twelve 1/2NC nuts holding outboard suction head (15) to pump casing (30).
8. Pry outboard suction head (15) off pump casing (30). Keep head square with casing bore to avoid damage to parts. Two 5/16NC tapped puller holes in flange will facilitate flange separation. Mark suction head ‘outboard’
9. Pry staked portion of impeller lock ring (29) out of slot of impeller lock nut (28).
10. Remove impeller lock nut (28) from pump shaft (19) with EM impeller nut tool (X4002). If impeller nut tool is not available, use a hammer and a punch to remove impeller lock nut.
11. Slide impeller lock ring (29) off pump shaft (19). Discard impeller lock ring (29).
12. Mark second stage impeller (34) as to position ‘outboard’. Slide impeller off pump shaft (19).
13. Remove twelve 1/2NC nuts holding pump casing (30) to inboard suction head (43). Mark discharge flange on pump casing (30) with arrow pointing forward to indicate proper reinstallation.
14. Pry pump casing (30) away from inboard suction head (43). Keep pump casing square with pump shaft (19) to avoid damage to parts. Two 5/16NC tapped puller holes in flange will facilitate separation.
15. Remove and discard casing gaskets (32) from pump casing (30).
16. Replace inter-stage seal ring (38), press seal ring out of pump casing (30). Discard inter-stage seal ring (38).

17. Slide first stage impeller (35) off pump shaft (19).
18. Remove split retaining ring (42) from pump shaft (19).
19. Remove four 3/8NC cap screws and remove bearing cap (59dwgDEC0200) from gear-case (66dwgDEC0200). Two 5/16NC tapped puller holes in flange will facilitate separation.
20. Remove three 1/2NC cap screws and two 3/8NC cap screws holding inboard head (43) to gear-case. Separate the two parts and slide the inboard head and pump shaft assembly out of and away from gear-case. Mark suction head (43) as 'inboard'.
21. Tap pump shaft (19) out of inboard suction head (43) with a rubber mallet.

Refer to Drawing DEC0200

22. Press pinion gear (1), pinion spacer (63), and bearing (60) off of pump shaft (5) all at once.

PARTS INSPECTION AND MEASUREMENT

1. Clean all parts and examine carefully for wear or deterioration. Replace any questionable parts.
2. Measure the impeller seal rings, impellers, and inter-stage seal ring for wear. Use the following table for comparison.

Impeller Seal Ring O.D.	5.749 - 5.751
Impeller Seal Ring I.D.	5.376 - 5.378
Impeller Inter-stage Seal Ring	2.247 - 2.249
Seal Ring O.D.	5.764 - 5.766
Seal Ring I.D.	5.361 - 5.363
Inter-stage Seal Ring	2.262 - 2.264
Clearance O.D. - original	0.013 - 0.017
Clearance I.D. - original	0.013 - 0.017
Clearance – Inter-stage	0.013 - 0.017

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 (37dwgDEC0100) should also be replaced.

EM PUMP ASSEMBLY with MECHANICAL SEALS

Refer to Drawing DEC0200

NOTE: Backup washer (4) and retaining ring (6) have been omitted. Use supplied pump shaft (5) in KA00047. The impeller shaft (5) has woodruff key slots cut into it.

1. Apply a light coating of oil to pump shaft (5) on pinion & tail bearing area. Place pinion gear key (2) in pump shaft keyway, align with keyslot in pinion gear (1) and press pump shaft into pinion gear bore until shaft shoulder is tight against side of gear.
2. Press bearing (3) onto pump shaft (5) until it contacts shoulder of impeller shaft (9).
3. Slide pinion spacer (63) onto pump shaft (5).
4. Press bearing (60) onto pump shaft (5) until pinion gear (1), pinion spacer (63), and inner race of bearing are tight together.

Refer to Drawing DEC0600 AND DOC. No. 1201010

NOTE: Drawing DEC0100 is drawn as pump forward.

5. Identify the required suction heads (15, 43) needed by marking them 'outboard' and 'inboard'. Use removed suction heads as guides. Plug 1/8"NPT ports with 1/8"NPT socket head plug on both suction heads (15,43). These 1/8" NPT ports are located in 'packing nut' location.
6. Use new suction head with larger seal bore. Bore is 3.250/3.249 I.D. Press seal ring (37) into 'inboard' suction head (43).
7. Use a depth micrometer or a caliper and straightedge to check seal ring (37) for square-ness.
8. Rotate pump shaft so that woodruff keys slot are on top.

Inboard seal installation

9. Use a clean thin piece of cardboard for the next step. Press larger of the two mating rings in mechanical seal housing (39) using light oil or soap with mirror side up. Use the cardboard between the mating ring and tool used to press ring in. Take care not to get any lubricant on the seal face itself. Make sure that mating ring is firmly pressed and is square with the face of the mechanical seal housing (39).
10. Apply light grease or oil on to O-ring (87) and install on to groove of inboard mechanical seal housing (39).
11. Place inboard mechanical seal housing (39) into position in the inboard suction head (43). Then install 1/4NC x 1-1/2 (min.) flat head screws (88) with Loctite 243 or equivalent applied to the threads through holes of inboard mechanical seal housing (39) and into tapped holes of the inboard suction head (43).

Pump assembly

12. Press oil seal (41) into inboard suction head (43) with lip spring of seal facing bearing. Lubricate oil seal lips with oil.
13. Insert pump shaft assembly (19) into inboard suction head (43). Be careful when inserting the pump shaft that it doesn't knock out the mating ring in the mechanical seal housing (39). Tap on end of pump shaft with a rubber mallet until bearing is seated in bearing pocket in inboard head.
14. Apply a thin layer of Loctite Master Gasket 518 or equivalent to the flange surface of inboard suction head (43).
15. Slide suction head (43) into position in gear-case. Make sure the pump shaft does not slide out of the outboard head while assembling the inboard suction head to the gear-case. Line up head square with gear-case.
16. Attach inboard suction head (43) to gear-case with one 1/2NC x 2 cap screw on top, two 1/2NC x 1-1/2 cap screws at sides, and two 3/8NC x 1 cap screws on bottom.
17. Place gasket (62dwgDEC0200) on bearing cap (59dwgDEC0200).
18. Slide bearing cap (59dwgDEC0200) over pump shaft bearing (60dwgDEC0200) until tight against gear-case.
19. Apply Loctite 243 or equivalent to four 3/8NC x 1 cap screws, and attach bearing cap to gear-case.
20. Apply light grease or oil to suction head O-ring (33) and place on inboard suction head (43).

Inboard seal installation

21. Apply P80 lubricant to impeller shaft (19) on the second step with the scribe on it and on the larger of the two mechanical seal bellows. Take care not to get any lubricant on carbon seal face. Install the mechanical seal assembly on to impeller shaft (19) carbon primary ring first – by pushing on the assembly close to the

shaft until the neoprene bellows edge is even with the scribe line on the impeller shaft (19). Use a close fitting plastic sleeve as an installation tool.

22. Apply Loctite 243 to woodruff (102) and place into the slot in impeller shaft (19).

    NOTE: When installing the 'inboard' mechanical seal make sure its spring locates on the outside of the brass ring inside the mechanical seal housing (101). Discard stainless steel spring retainer for this seal. Also the next two steps will take two people to perform. Person one needs to install the seal housing (101) in place while person two to holds the mechanical seal (101) housing in place.

23. Person one installs the mechanical seal housing (101) by sliding it on to shaft (19) compressing the mechanical seal spring. Make sure that the housing's (101) keyway lines up with the woodruff key and stops against the pump shaft's shoulder. The retaining ring groove should be visible. Person two holds the assembly in place while person one gets retaining ring (100).

24. Person one install retaining ring (100) into groove on the impeller shaft (19). The retaining ring (100) is installed by sliding its rounded edge facing the mechanical seal housing (101). Place retaining ring (100) into groove and make sure that it is in all the way. Person two can now release mechanical seal housing (101).

Pump Assembly

25. Place two halves of split retaining ring (42) on pump shaft (19) with step toward inboard impeller (35).

26. Install first stage impeller (35) marked 'inboard' on to the shaft (19) until impeller hub slips over step of split retaining ring (42).

27. Press inter-stage seal ring (38) into the pump casing (30).

28. Place casing gasket (32) into position on suction head (43).

29. Push pump casing (30) into position on inboard suction head (43). Start on twelve 1/2NC nuts, but do not tighten. Snug up two nuts on top and two nuts on bottom.

30. Install second stage impeller marked 'outboard' (34) on to shaft (19). Slide on until it stops against the first stage impeller (35).

31. Slide impeller lock ring (29) onto pump shaft (19). Tighten impeller lock nut (28) with EM lock nut tool (X4002). A hammer and punch can be used to tighten lock nut if impeller nut tool is not available. Stake the impeller lock ring into one of the grooves in the impeller lock nut.

32. Press seal ring (37) into 'outboard' suction head (15).

33. Use a depth micrometer or a caliper and straightedge to check seal ring for square-ness.

Outboard Seal Installation

34. With the sharp edge of the retaining ring facing toward the pump, install retaining ring (24) on to impeller shaft (19) into the second small groove.

35. Apply Loctite 243 to woodruff key (103). Install woodruff key (103) into impeller shaft (19).

36. Apply light grease or oil to O-ring (104) and install into O-ring groove on the mechanical seal housing (23).

37. Slide on mechanical seal housing (23) on to shaft (19). Make sure to align the mechanical seal housing's (23) keyway with woodruff key (103). Continue to side the assembly towards the pump casing until the 'cone' stops against retaining ring (24).

38. With the rounded edge of the retaining ring facing toward the pump, install retaining ring (21) on to impeller shaft (19). Slide it on to the shaft until it stops against mechanical seal housing (23) and drops into the first small groove in impeller shaft (19).

39. Slide small spring retainer (stainless steel disk) on to 'tube' portion of mechanical seal housing so that the raised center section is facing out.

40. Apply small amount of P80 lubricant to tube portion of mechanical seal assembly (22). Be careful not to get any lubricant on mechanical seal face.

    Caution: A large amount of lubricant may cause the seal to shoot off the 'tube' portion of the mechanical seal housing (23) under loading of seal spring.

41. Assemble (22) by sliding it on to the mechanical seal housing (23) until the neoprene bellow's edge is even with the scribe line. Press on the stainless steel ring that holds the spring in place, not on the carbon seal face. Make sure the mechanical seal spring locates on the outside groove to of the spring retainer.

42. Use a clean thin piece of cardboard for the next step. Press smaller of the two mating rings in mechanical seal housing (107) using P80 lubricant with mirror side up. Use the cardboard between the mating ring and tool used to press ring in. Take care not to get any lubricant on the seal face itself. Make sure that mating ring is firmly pressed and is square with the face of the mechanical seal housing (107).

43. Apply light grease or oil to O-ring (106). Install O-ring (106) on to the mechanical seal housing (107).

44. Place outboard mechanical seal housing (107) into position in the outboard suction head (15). Then install 1/4NC x 1-1/2 (min.) flat head screws (88) with Loctite 243 or equivalent applied to the threads through holes of outboard mechanical seal housing (107) and into tapped holes of the inboard suction head (15)

45. Apply light grease or oil to pump casing O-ring (33) and place on outboard suction head (15).

46. Place pump casing gasket (32) into position on suction head (30).

    NOTE: Install X5785 tool onto impeller shaft. Take special pre-cautions when sliding the outboard head (15) over the end of impeller shaft (19) and it goes through the exact center of the mechanical seal housing (107). This is to prevent the end of the impeller shaft (19) striking the mating ring seal face of the mechanical seal.

47. Push outboard suction head (15) onto pump casing (30), keeping bore square with pump shaft (19) to avoid damage to parts. Spin on twelve 1/2NC nuts, but do not tighten. Snug up two nuts on top and two nuts on bottom. Remove X5785 tool from impeller shaft.

48. Line up alignment marks on suction heads (15) and (43) with marks on pump casing (30), or use a straightedge to align the suction flanges of the inboard and outboard heads. Tighten all nuts holding pump casing to suction heads. Outboard seal is installed.

Pump Assembly

49. Press outboard oil seal (17) into outboard suction head (15) with lip spring of seal facing bearing and lubricate oil seal lip.

50. Apply oil to end of pump shaft (19) and tap bearing (20) onto shaft.

51. Apply Loctite Master Gasket 518 or equivalent to flange surface of bearing cap (16). Attach to outboard suction head (15) with four 1/4NC x 7/8 cap screws and Loctite 243 or equivalent.

Refer to Drawing DEC0400

52. Apply light grease or oil staging valve O-rings (7) and (14) and insert into O-ring grooves in staging valve (11).

Refer to Drawing DEC0100

53. Attach staging valve (11) to outboard suction head (15) with four 3/8NC heavy nuts on studs. Attach to pump casing (30) with four 3/8NC x 1-1/4 socket head cap screws and high collar washers.
54. Apply light grease or oil to relief valve manifold O-rings (44) and insert into O-ring grooves in relief valve manifold (45).
55. Attach relief valve manifold (45) to pump casing (30) with six 3/8NC x 1-1/4 cap screws.
56. Apply light grease or oil to four relief valve O-rings and insert into O-ring grooves in relief valves.
57. Attach relief valves to inboard suction head (43) with four 3/8NC nuts and lock washers on studs each.
58. Attach relief valves to relief valve manifold (45) with four 3/8NC x 1-3/4 cap screws and four nuts each.
59. Attach gear-case cover (31dwgDEC0200) and gear-case cover gasket (29dwgDEC0200) to gear-case with twelve 5/16NC x 5/8 cap screws.
60. Reinstall seal flush line (items 81, 82, 83, 85 & 86) as shown in drawing DEC0600.

INSTALLING PUMP IN TRUCK CHASSIS

Reverse the procedures outlined under removal instructions.

Lubricate universal joint slip yoke on pump drive shaft.

Filler gear-case with 80W/90 Gear Lube oil to the bottom of the 3/8 NPT fill plug located in the rear of the gear case.

LUBRICATION

Use a transmission oil suction gun to fill and maintain oil level even with bottom of the oil fill/level plug every 25 hours. Use 80W/90 Gear Lube oil in the pump transmission.

CAUTION: Do not overfill

Change the pump transmission oil every 50 hours, or every 6 month, 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

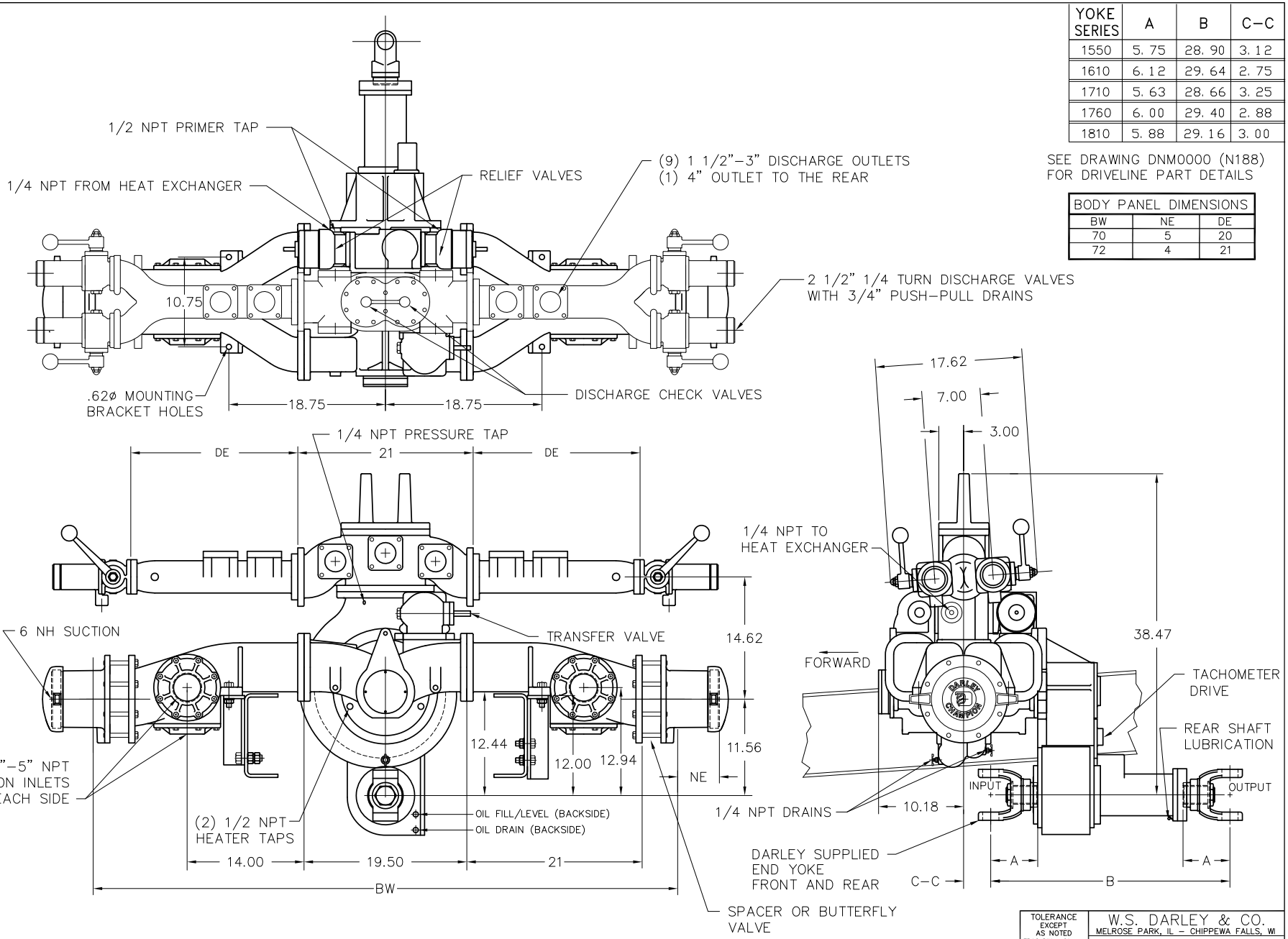
1200010

10.42

YOKE SERIES	A	B	C–C
1550	5.75	28.90	3.12
1610	6.12	29.64	2.75
1710	5.63	28.66	3.25
1760	6.00	29.40	2.88
1810	5.88	29.16	3.00

SEE DRAWING DNM0000 (N188)
FOR DRIVELINE PART DETAILS

BODY PANEL DIMENSIONS		
BW	NE	DE
70	5	20
72	4	21



FOR MOUNTING BRACKET
DIMENSIONS SEE DETAIL
DRAWING DGM1300

NET WEIGHT: 1450 LBS

ALL DIMENSIONS IN INCHES UNLESS NOTED

DO NOT SCALE PRINT

OLD PART NO. E61

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

DR'N S.LEE
CHKD
TRCD DWS

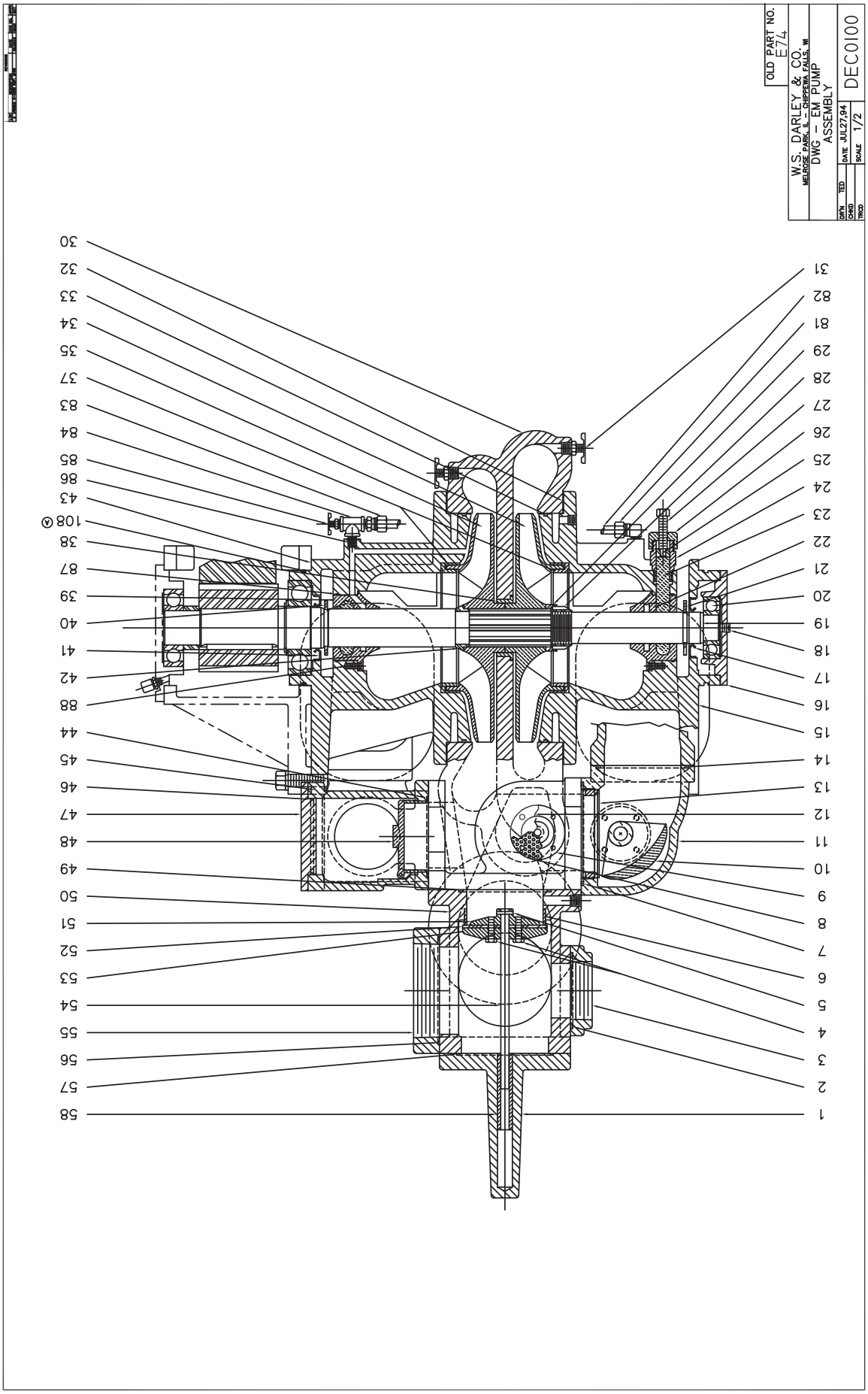
W.S. DARLEY & CO.
MELROSE PARK, IL – CHIPPEWA FALLS, WI

DWG–EM1500/2000 PUMP FORWARD DIMENSIONAL

DATE DEC06,91

SCALE 1/8

DED0000


OLD PART NO.
E74
W.S. DARLEY & CO.
MELROSE PARK, IL - CHIPPEWA FALLS, WI
DWG - EM PUMP
ASSEMBLY
DRN. TED
CHKD
TRCD
DATE JUL27,94
SCALE 1/2
DEC0100
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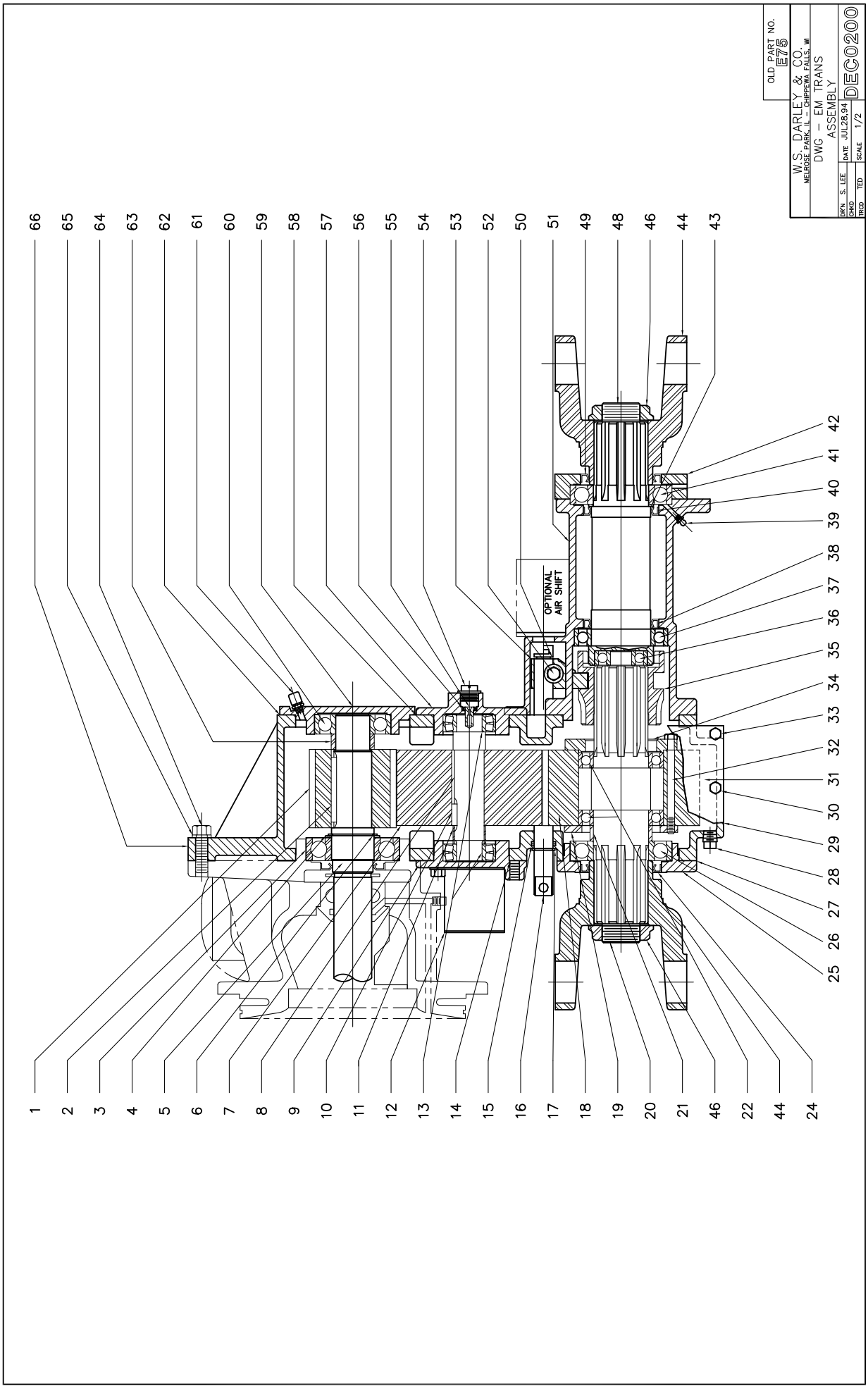
EM PUMP ASSEMBLY PARTS LIST
DRAWING NO. DEC0100

Rep. No.	Name Of Part	Qty.
1	Discharge Head over	1
2	O Ring - Adapter Flange	9
3	Adapter Flange	9
4	Hex Head Cap Screw	4
5	Brass Pin	2
6	Check Valve Seat	2
7	O Ring - Staging Valve	1
8	Cooling Strainer	1
9	Strainer Flange	1
10	Staging Valve	1
11	Staging Valve Body	1
12	Gasket - Cooling Strainer	1
13	Staging Value Seat	1
14	O Ring - Staging Value	1
15	Suction Head - Outboard	1
16	Bearing Cap	1
17	Oil Seal - Outboard	1
18	Slotted Head Pipe Plug	1
19	Pump Shaft	1
20	Bearing - Pump Shaft	1
21	Water Slinger - Outboard	1
22	Stuffing Box - Outboard	1
23	Pump Packing	10
24	Packing Plunger Guide	2
25	Packing Plunger	2
26	Packing Plunger Nut	2
27	Packing Plunger Stud	2
28	Impeller Lock Nut	1
29	Impeller Lock Ring	1
30	Pump Casing	1
31	Drain Cock	2
32	Gasket - Pump Casing	2
33	O Ring - Pump Casing	2
34	Impeller - Second Stage	1
35	Impeller - First Stage	1
37	Seal Ring	2
38	Interstage Seal Ring	1
39	Stuffing Box - Inboard	1
40	Water Slinger - Inboard	1
41	Oil Seal - Inboard	1
42	Impeller Retaining Ring	1
43	Suction Head - Inboard	1
44	Ring - Relief Valve Manifold	2
45	Relief Valve Manifold	1
46	O Ring - Manifold Cover	1
47	Manifold Cover	1
48	Bypass Check Valve	1
49	O Ring - Discharge Head	2
50	Discharge Head	1
51	Check Valve Diffuser	2
52	Check Valve Rubber	2
53	Check Valve Plate	2
54	Check Valve Stem	2
55	Adapter Flange	1
56	O Ring - Adapter Flange	1
57	O Ring - Discharge Head Cover	2
58	Check Valve Bushing	2
81	Compression Fitting -90	1
82	Tubing	2
83	Compression Fitting	1
84	Pipe Tee	1
85	Drain Cock	1
86	Close Nipple	1
87	O Ring - Stuffing Box	2
88	Stuffing Box Screw	6
108	O Ring – Suction Head	1


OLD PART NO.
E75
W.S. DARLEY & CO.
MELROSE PARK, IL - CHIPPEWA FALLS, WI
DWG - EM TRANS
ASSEMBLY
DRWN S. LEE
CHKD
TRCD TED
DATE JUL.26.94
SCALE 1/2
DEG0200
OPTIONAL AIR SHIFT
66 65 64 63 62 61 60 59 58 57 56 55 54 53 52 50 51 49 48 46 44 43
42 41 40 39 38 37 36 35 34 33 32 31 30 29 28 27 26 25
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 46 22 44 24

EM TRANSMISSION ASSEMBLY
DRAWING NO. DEC0200

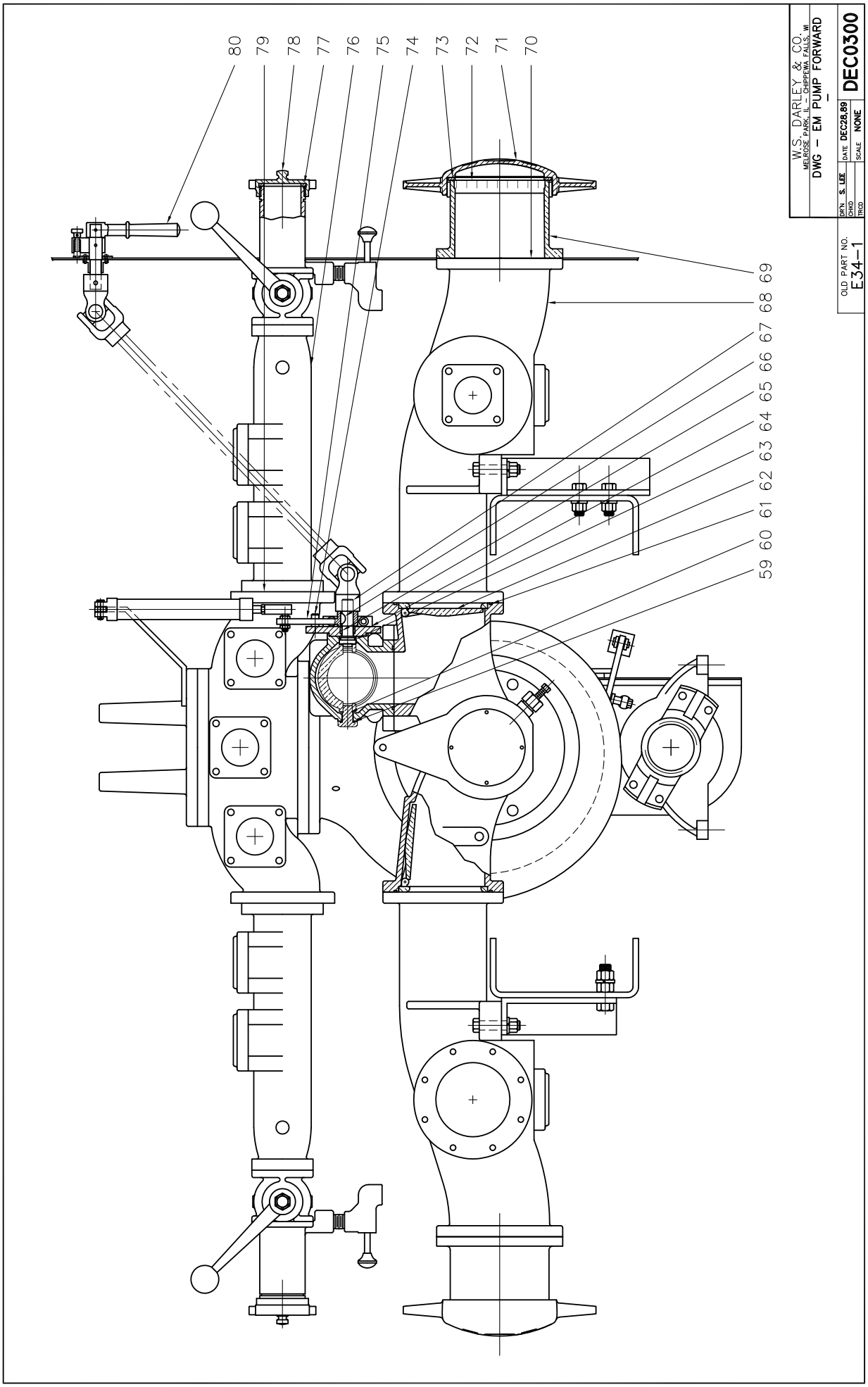
Rep No.	Name of Part.	Qty.
1	Pinion Gear	1
2	Key -Pinion Gear	1
3	Bearing - Pump Shaft	1
4	Back Up Shaft	1
5	Pump Shaft	1
6	Retaining Ring	1
7	Idler Gear	1
8	Idler Gear Shaft	1
9	Bearing Cap - Idler	1
10	Key- Idler Gear	1
11	Idler Gear Spacer	1
12	Water Shield	1
13	Bearing - Idler Shaft	2
14	Gasket - Bearing Cap	1
15	O Ring - Shift Bar	1
16	Shift Bar	1
17	Retaining Ring	1
18	Drive Gear	1
19	Bearing Retainer	1
20	Transmission Shaft	1
21	Transmission Shaft Spacer	1
22	Bearing- Transmission Shaft	2
24	Oil Seal - Front Yoke	1
25	Front Bearing Bracket	1
26	Bearing - Transmission Shaft	1
27	Gasket - Bearing Bracket	1
28	Oil Drain Plug	1
29	Gasket - Bearing Bracket	12
30	Hex Head Cap Screw	1
31	Gearcase Cover	6
32	Bolt- Drive Gear	12
33	Lock Washer	1
34	Pump Clutch Gear	1
35	Sliding Clutch Gear	1
36	Bearing - Transmission Shaft	1
37	Bearing- Rear Drive Shaft	1
38	Oil Seal - Rear Drive Shaft	1
39	Grease Zerk	1
40	Oil Seal - Rear Drive Shaft	1

EM TRANSMISSION ASSEMBLY
DRAWING NO. DEC0200

Rep No.	Name Of Part	Qty.
41	Bearing - Rear Drive Shaft	1
42	Bearing Retainer	1
43	Back Up Washer	1
44	Rear Drive Yoke	1
46	U Joint Retaining Nut	1
48	Rear Drive Shaft	1
49	Oil Seal - Rear Yoke	1
50	Safety Wire	10"
51	Rear Bearing Bracket	1
52	Lock Bolt	1
53	Clutch Shift Yoke	1
54	Tachometer Plug	1
55	Tachometer Drive Shaft	1
56	Oil Seal - Tachometer Shaft	1
57	Bearing Cap - Idler	1
58	Gasket - Bearing Cap	1
59	Bearing Cap - Pump Shaft	1
60	Bearing - Pump Shaft	1
61	Gearcase Vent	1
62	Gasket - Bearing Cap	1
63	Pinion Spacer	1
64	Gearcase Bolt	1
65	Lock Washer	3
66	Gearcase	1
358	O'Ring	1

EM PUMP ASSEMBLY PARTS LIST
DRAWING NO. DEC0300

Rep. No.	Name of Part	Qty.
59	O Ring - Guide Screw	1
60	Ball Guide Screw	1
61	O Ring - Suction Extension	4
62	Suction Check Valve	2
63	O Ring - Staging Valve Stem	1
64	Stop Plate	1
65	Bushing	1
66	Key - Staging Valve	1
67	Staging Valve Stem	1
68	Suction Extension	2
69	Suction Nipple	1
70	Gasket - Suction Nipple	2
71	Suction Cap	2
72	Suction Screen	2
73	Gasket - Suction Cap	2
74	Stop Pin	2
75	Valve Lever	1
76	Discharge Extension	2
77	Gasket - Discharge Cap	VA.
78	Discharge Cap	VA.
79	Gasket - Discharge Extension	2
80	Manual Control Valve Assembly	1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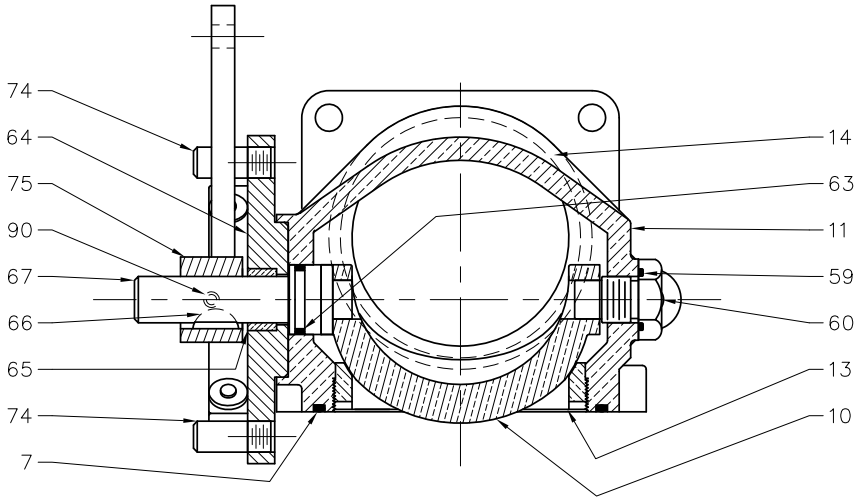
W.S. DARLEY & CO.
MELROSE PARK, IL – CHIPPEWA FALLS, WI
DWG – EM PUMP FORWARD –
DEC0300
DRN S. LEE
CHKD
TRCD
DATE DEC28,89
SCALE NONE
OLD PART NO.
E34–1

1200010

10.50

REP#	NAME OF PART	QTY
7	VALVE FLANGE O'RING	1
10	VALVE BALL SECTOR	1
11	VALVE BODY	1
13	VALVE SEAT	1
14	VALVE FLANGE O'RING	1
59	GUIDE SCREW O'RING	1
60	BALL GUIDE SCREW	1
63	VALVE STEM O'RING	1
64	STOP PLATE	1
65	BUSHING	1
66	WOODRUFF KEY	1
67	VALVE STEM	1
74	STOP PIN	2
75	VALVE LEVER	1
90	1/4–20 X 1/4 SET SCREW	1



MATERIAL NO.
E76

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

EM STAGING VALVE

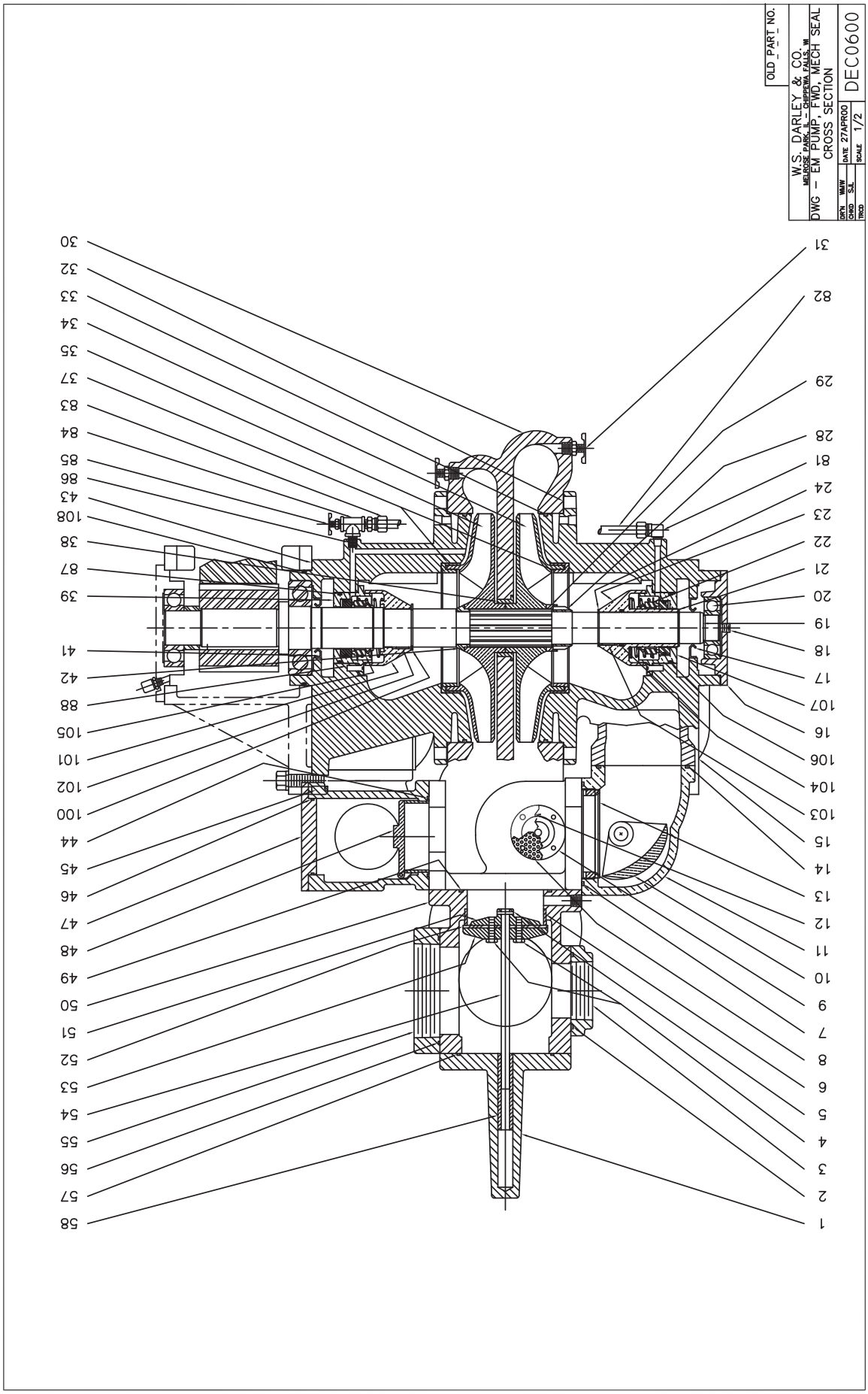
DR'N TED
CHKD
TRCD

DATE AUG31,94
SCALE 1/2

DEC0400

ALL DIMENSIONS IN INCHES UNLESS NOTED

DO NOT SCALE PRINT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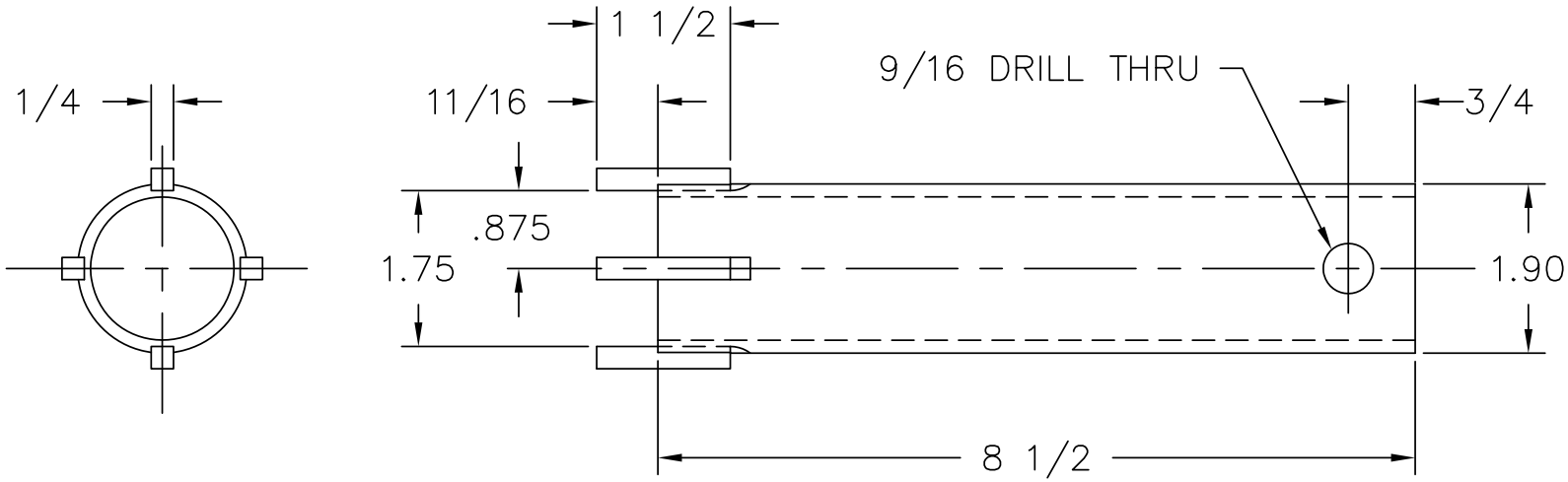
W.S. DARLEY & CO.
MELROSE PARK, IL - CHIPPEWA FALLS, WI
DWG - EM PUMP, FWD, MECH SEAL
CROSS SECTION
DEC0600
DRN WMW
CHKD SJL
TRCD
DATE 27APR00
SCALE 1/2
1 2 3 4 5 6 8 7 9 10 11 12 13 14 15 103 104 106 16 107 17 18 19 20 21 22 23 24 81 28 29 82 31
30 32 33 34 35 37 83 84 85 86 43 108 38 87 39 41 42 88 105 101 102 100 44 45 46 47 48 49 50 51 52 53 54 55 56 57 58

EM PUMP ASSEMBLY PARTS LIST
DRAWING NO. DEC0600

Rep. No.	Name Of Part	Qty.
1	Discharge Head Cover	1
2	O Ring - Adapter Flange	9
3	Adapter Flange	9
4	Hex Head Cap Screw	4
5	Brass Pin	2
6	Check Valve Seat	2
7	O Ring - Staging Valve	1
8	Cooling Strainer	1
9	Strainer Flange	1
10	Staging Valve	1
11	Staging Valve Body	1
12	Gasket - Cooling Strainer	1
13	Staging Valve Seat	1
14	O Ring - Staging Valve	1
15	Suction Head - Outboard	1
16	Bearing Cap	1
17	Oil Seal - Outboard	1
18	Slotted Head Pipe Plug	1
19	Pump Shaft	1
20	Bearing - Pump Shaft	1
21	Retaining Ring	1
22	Mechanical Seal Outboard	1
23	Mech.Seal Hsg. Outboard	1
24	Retaining Ring	1
25	OMIT	2
26	OMIT	2
27	OMIT	2
28	Impeller Lock Nut	1
29	Impeller Lock Ring	1
30	Pump Casing	1
31	Drain Cock	2
32	Gasket - Pump Casing	2
33	O Ring - Pump Casing	2
34	Impeller - Second Stage	1
35	Impeller - First Stage	1
37	Seal Ring	2
38	Interstage Seal Ring	1
39	Mech.Seal Hsg. Inboard	1
40	OMIT	1
41	Oil Seal - Inboard	1
42	Impeller Retaining Ring	1
43	Suction Head - Inboard	1
44	Ring - Relief Valve Manifold	2
45	Relief Valve Manifold	1
46	O Ring - Manifold Cover	1
47	Manifold Cover	1
48	Bypass Check Valve	1
49	O Ring - Discharge Head	2
50	Discharge Head	1
51	Check Valve Diffuser	2
52	Check Valve Rubber	2
53	Check Valve Plate	2
54	Check Valve Stem	2
55	Adapter Flange	1
56	O Ring - Adapter Flange	1
57	O Ring - Discharge Head Cover	2
58	Check Valve Bushing	2
81	Compression Fitting -90	1
82	Tubing	2
83	Compression Fitting	1
84	Pipe Tee	1
85	Drain Cock	1
86	Close Nipple	1
87	O Ring - Mech. Seal Hsg.	1
88	Mech. Seal. Hsg. Screw	6
100	Retaining Ring	1
101	Mech. Seal. Hsg.	1
102	Woodruff Key	1
103	Woodruff Key	1
104	O Ring - Mech. Seal Hsg.	1
105	Mechanical Seal	1
106	O Ring - Mech. Seal Hsg.	1
107	Mech. Seal Hsg.	1
108	O Ring – Suction Head	1



NOTE:
MILL SLOTS 180° APART
INSERT KEY STOCK INTO SLOTS
WELD IN POSITION

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

EM IMPELLER
NUT TOOL

MATERIAL: (1) 1 1/2 X 8 1/2 BLACK PIPE
(4) 1/4 X 1/4 X 1 1/2 HEAT TREATED KEY STOCK

DR'N S. LEE
CHKD TAB
TRCD

DATE AUG16,89
SCALE 1/2

X4002

ALL DIMENSIONS IN INCHES UNLESS NOTED

DO NOT SCALE PRINT

10.53

1200010

W.S. DARLEY & CO.

WATER FLINGER INSTALLATION INSTRUCTION

- Place ***4431200*** assembly tool on bed of press
- Place ***3206100*** water flinger over 4431200 assembly tool as shown in Fig 1a. Apply Loctite #603 to inside flinger surface.

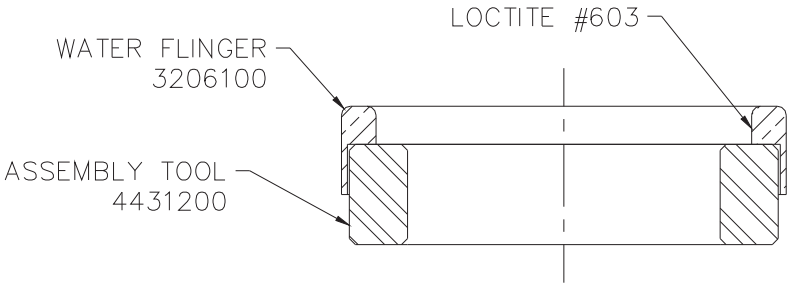


Fig 1a

- Position drive yoke on top of water flinger keeping it straight and centered. (See Fig 1b)

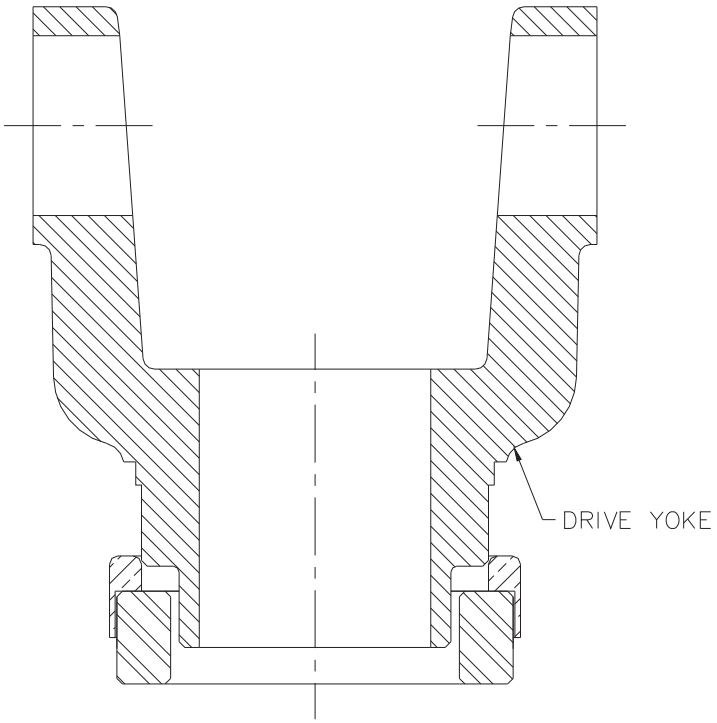


Fig 1b

- When yoke is positioned properly, press into place. Yoke will stop when it is fully seated as shown in Fig 2a.

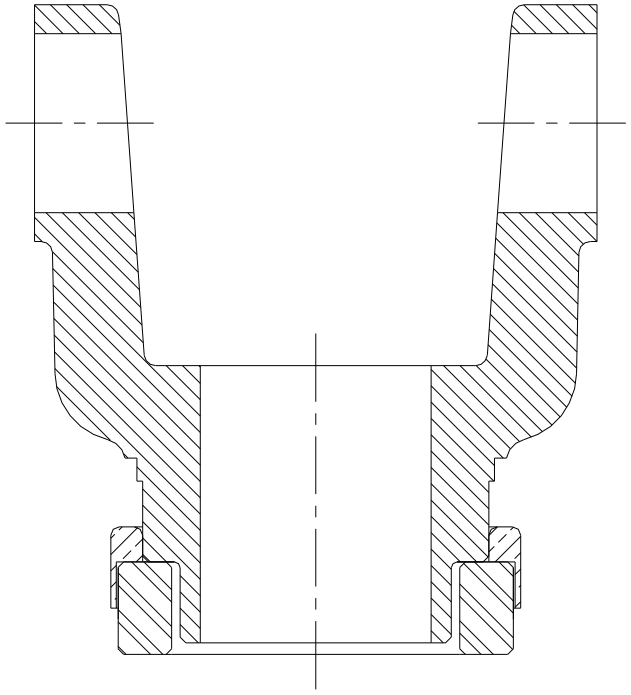


Fig 2a

- Inspect flinger/yoke assembly to make sure faces are flush as shown in Fig 2b.

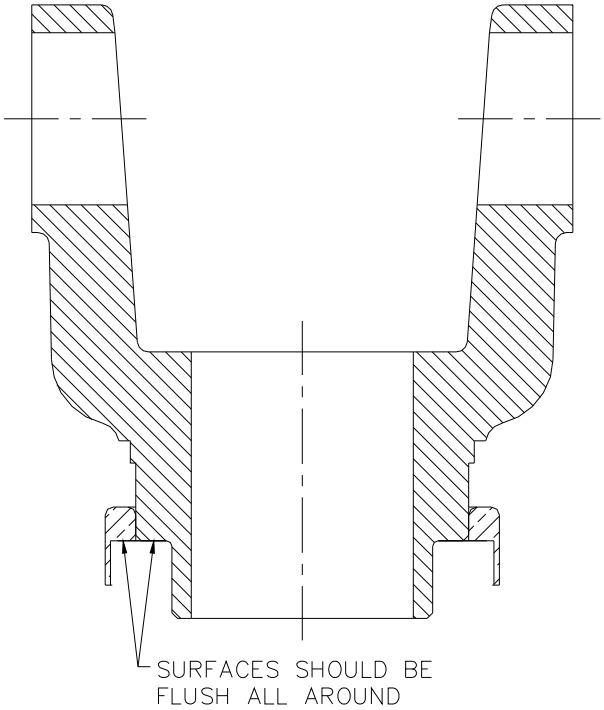
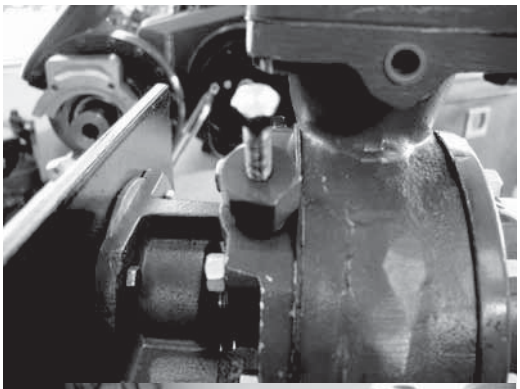
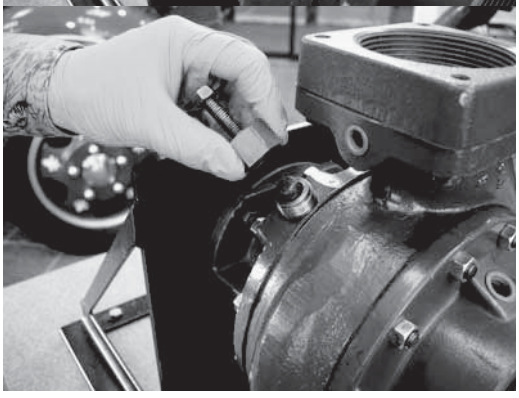


Fig 2b

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:

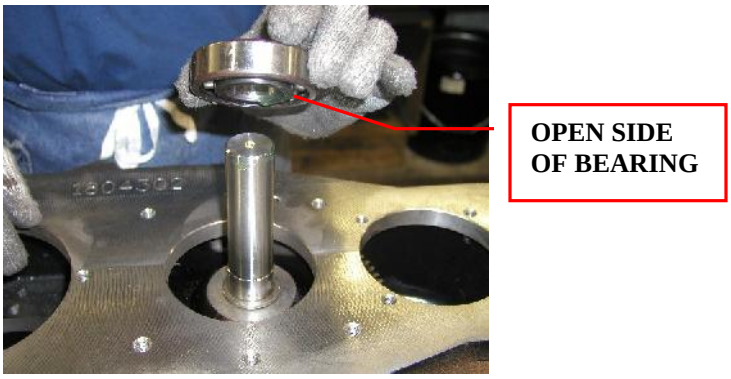
Model	Approximate # Packing Pellets
A	6
2BE	6
EM	15
H	8
JM	8
KD	10
KS	8
LD	15
LS	9
P	10
U2	5
U4	10

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

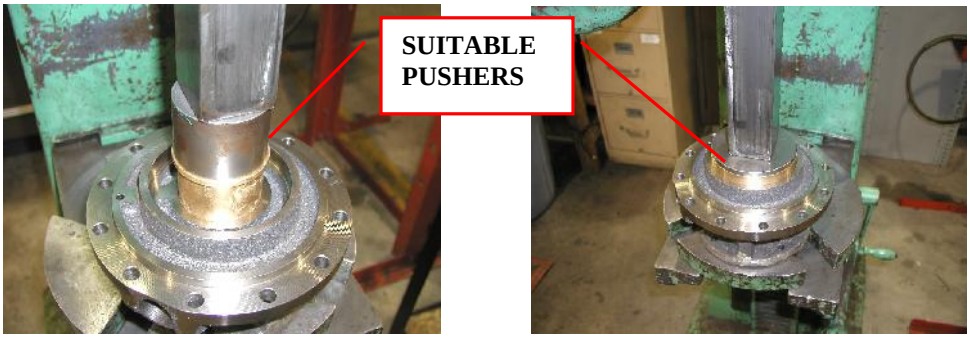
- Work with clean tools in clean surroundings during assembly.
- Clean parts thoroughly and keep free from nicks and abrasions.
- Keep loose parts marked otherwise identified to avoid error in assembly.
- **Bearings:** Keep bearings in original containers until ready to install.
- **Bearings/Press fits:**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



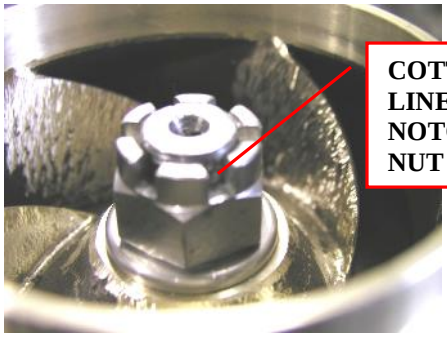
- **Bearings:** When pressing a bearing onto a shaft, lightly lube the bore of the bearing and the shaft journal for the bearing with oil. Also when installing bearings into bearing pockets, lightly lube the OD of the bearing and the bore of the bearing pocket with oil.

- **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.

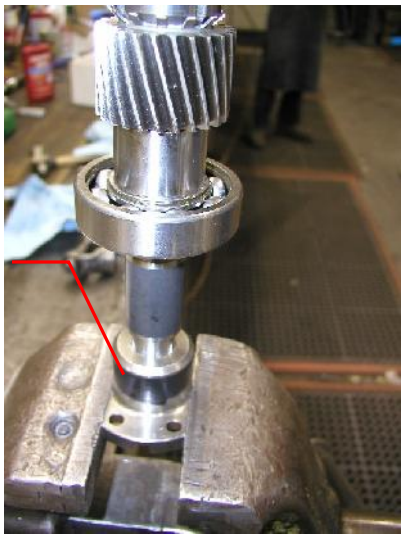


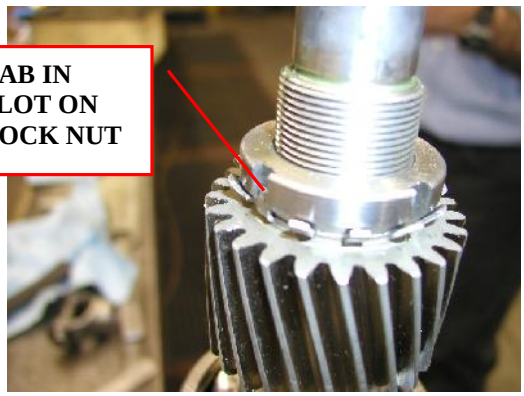
- **Press fits:** When pressing a part into housing (ex. Stuffing box, seal ring, etc.), the part needs to be started perpendicular to the housing.

- **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.



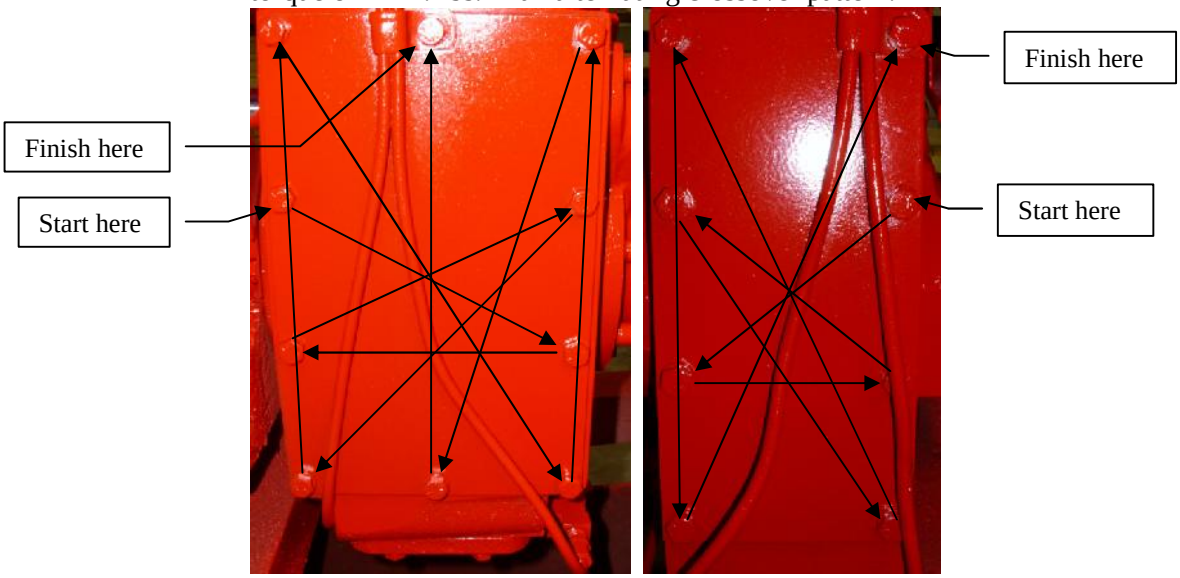
- **Lock Washer/Lock Nut:** Secure shaft so that it doesn't rotate when tightening lock nut. Line up tab on lock washer with keyway slot in shaft and slide washer onto shaft. Screw lock nut onto shaft until snug, then turn until a tab and slot line up. Using a punch, tap tab from lock washer into slot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





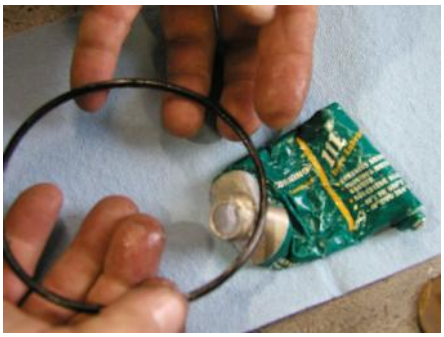
- **Loctite/thread locker:** When applying Loctite/thread lockers, only use one small drop per hole, unless explicitly told differently by engineering, a WI, or assembly/repair instruction or assembly supervisor.
- **Loctite/thread locker:** When applying Loctite/thread lockers to lock fasteners going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

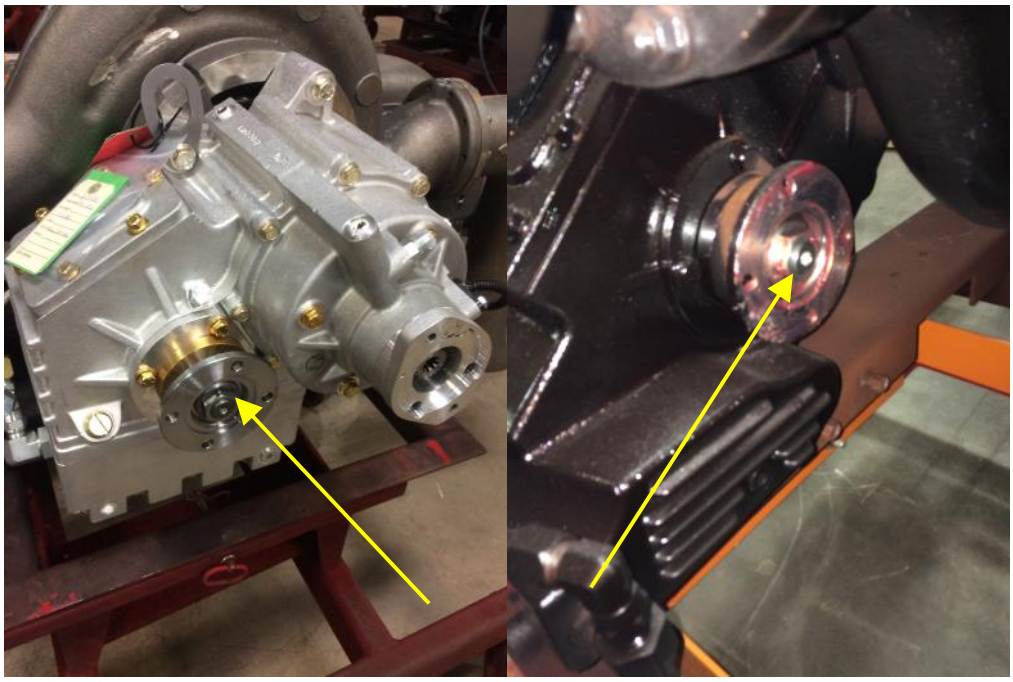
- **O-rings/Quad rings:** When installing o-rings and quad rings LIGHTLY lube with oil or silicon grease (Dow Corning 111). Be careful not to apply too thick of a film of lubricant when using the silicone grease because over application of the grease can cause the o-ring/quad ring to bridge and leak.



- **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.

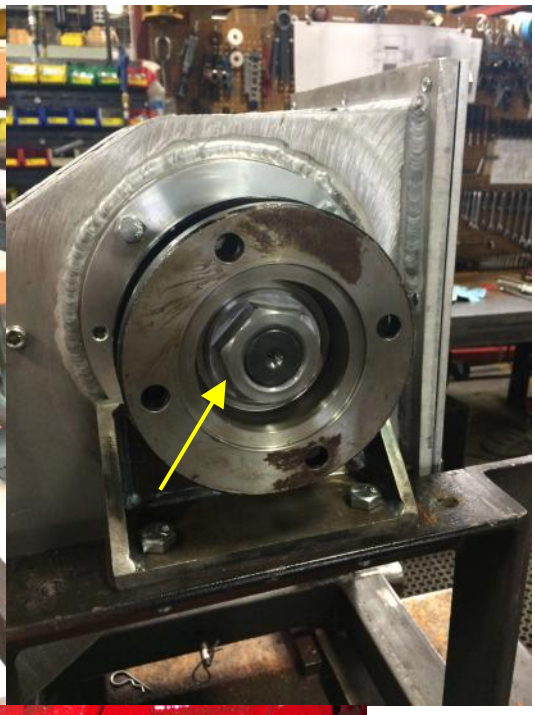


PUC and PUC-3G yoke nuts are tightened to 300-350 lb-ft.

- **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.

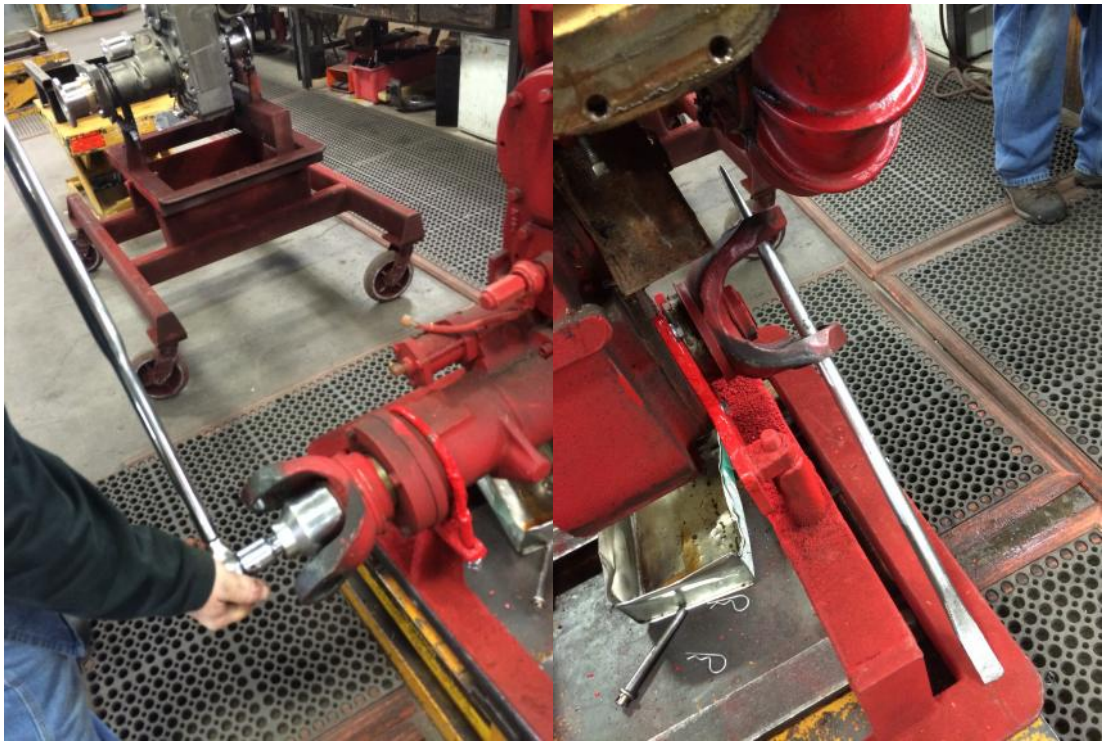
All 1.75-12 interference threaded yoke nuts are torqued to 150-200 ft-lb.



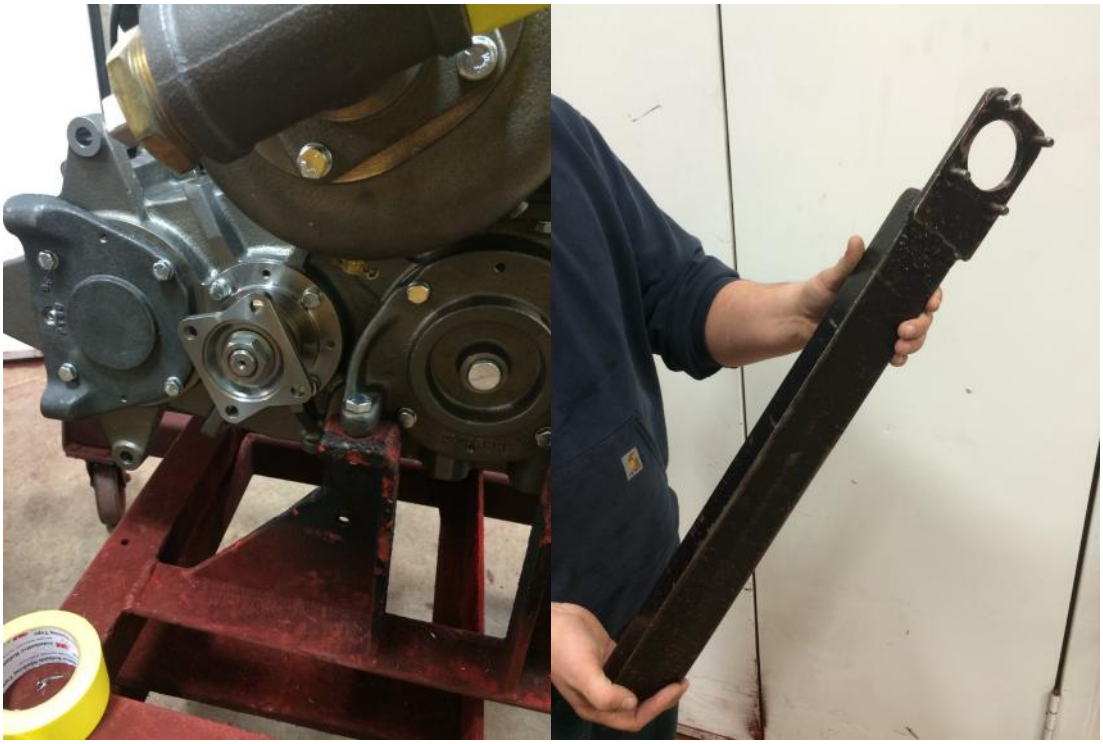
All 1.25-12 threaded yoke nuts are torqued to 150-200 ft-lb.

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

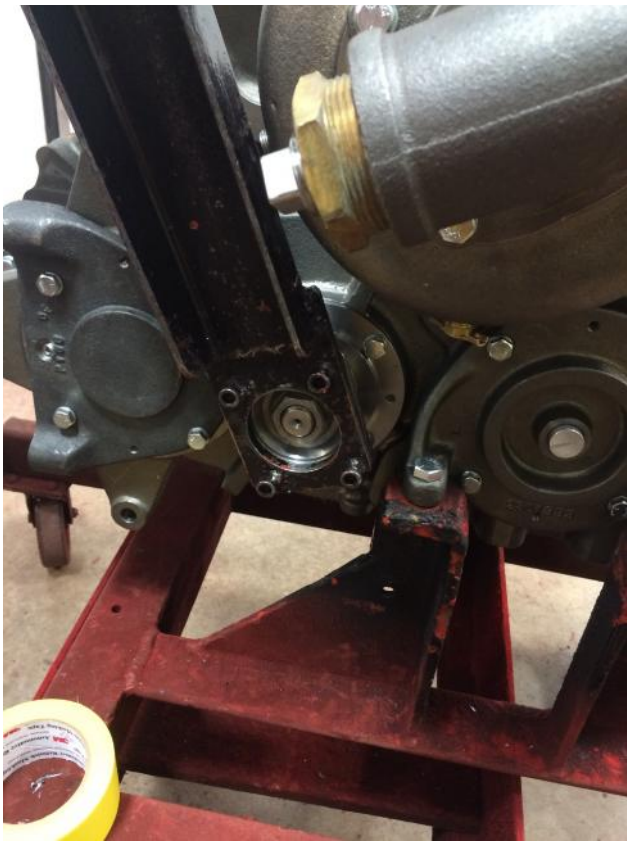
After torqueing the yoke nut down, check to make sure there is not a gap between the yoke nut and the yoke.



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

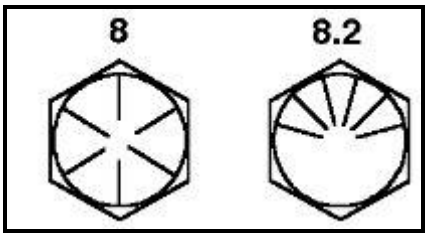
For reference, Recommended tightening torque is found by the following equation;

T = KDP

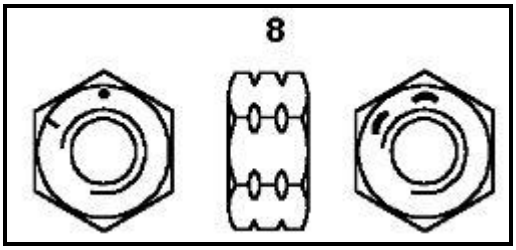
T = Tightening torque in units of inch-pound.
K = Nut factor and it is unit less.
D = Nominal bolt diameter in units of inch.
P = Clamp load in units of pounds.

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.

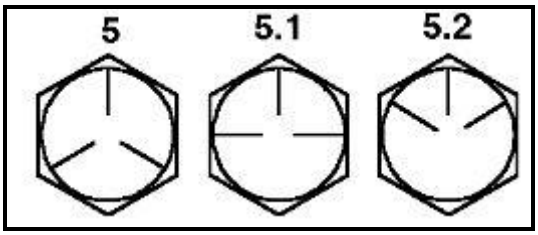
Fastener Size	Nominal bolt diameter (in)	Tensile stress area (square inch)	Stainless, Brass, Bronze or Aluminum proof load (lb)	SAE Grade 2 proof load (lb)	SAE Grade 5 proof load (lb)	SAE Grade 8 proof load (lb)
#6 – 32	.1380	.00909	209	500	981	1,090
#6 – 40	.1380	.01015	233	558	1,095	1,217
#8 – 32	.1640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



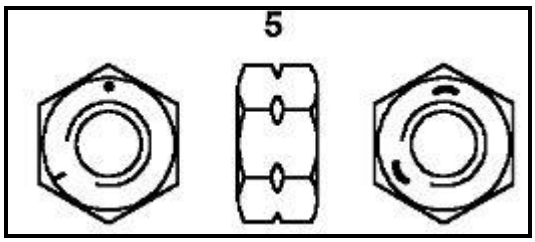
The above image shows how SAE Grade 8 hex head bolts can be identified.



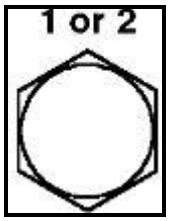
The above image shows how SAE Grade 8 hex nuts can be identified.



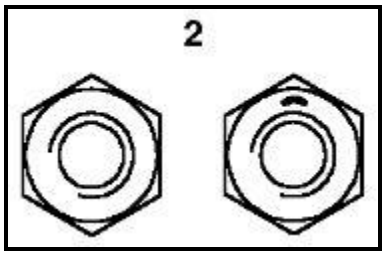
The above image shows how SAE Grade 5 hex head bolts can be identified.



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



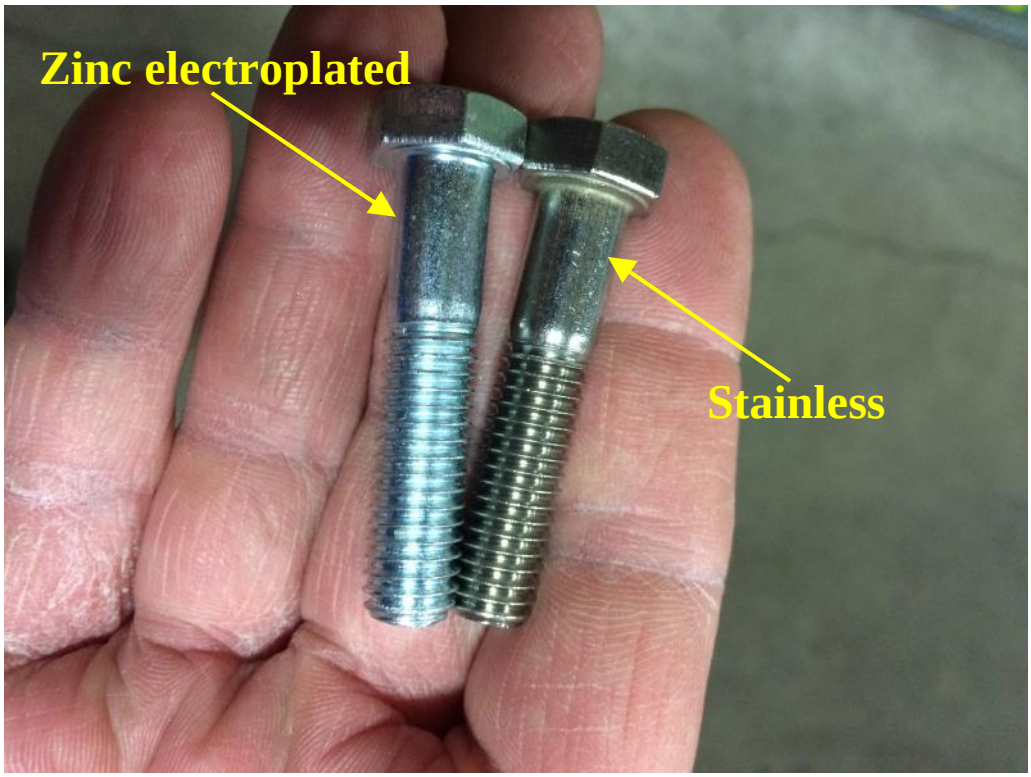
The above image shows how SAE Grade 2 hex head bolts can be identified.



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