

Operator's Manual Table of Contents For Darley PTO Driven AG Fire Pump

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

This manual is for DARLEY FIRE PUMP:

Model: 1½AG and 2½AG Pump Serial Number: _____

Description of Pump Type

The **Type AG** pump is a high speed, single stage, centrifugal pump.

The pump is normally powered from a transmission driven power take-off (PTO), but can be adapted to alternative power sources such as Hydraulic drives.

OPERATION AND MAINTENANCE OF TYPE AG FIRE PUMP

Right and left, and front and rear locations are referred to from a position facing the pump suction inlet.

Lubrication

Keep the gear case filled with oil to the level of the oil level plug, which is marked on the pump gear case.

Check the oil level every 25 hours or every 3 month, and change it every 50 hours or 6 months.

Use 80W/90 gear lube oil - not grease - in the pump transmission.

CAUTION: Do not overfill.

Inject grease in zerk fittings on the driveline universal joints once a year.

If the pump is equipped with hydraulic drive, check and change the hydraulic oil and filters according to the hydraulic components' manufactures' recommendations.

Operation of Pump

This pump is driven from a standard automotive power take-off with sliding gear engagement. This power take-off is shifted from the driver's seat. Motor clutch must be disengaged while shifting. Engage the PTO shift after pump is primed.

Never run the pump dry except momentarily and at low speeds.

WARNING: Do not use this pump for hose testing.



Darley
Pump Division
1051 Palmer St.
Chippewa Falls, WI 54729
715-726-2650

Technical Bulletin on PTO Mounted Fire Pump Drivelines

1202520

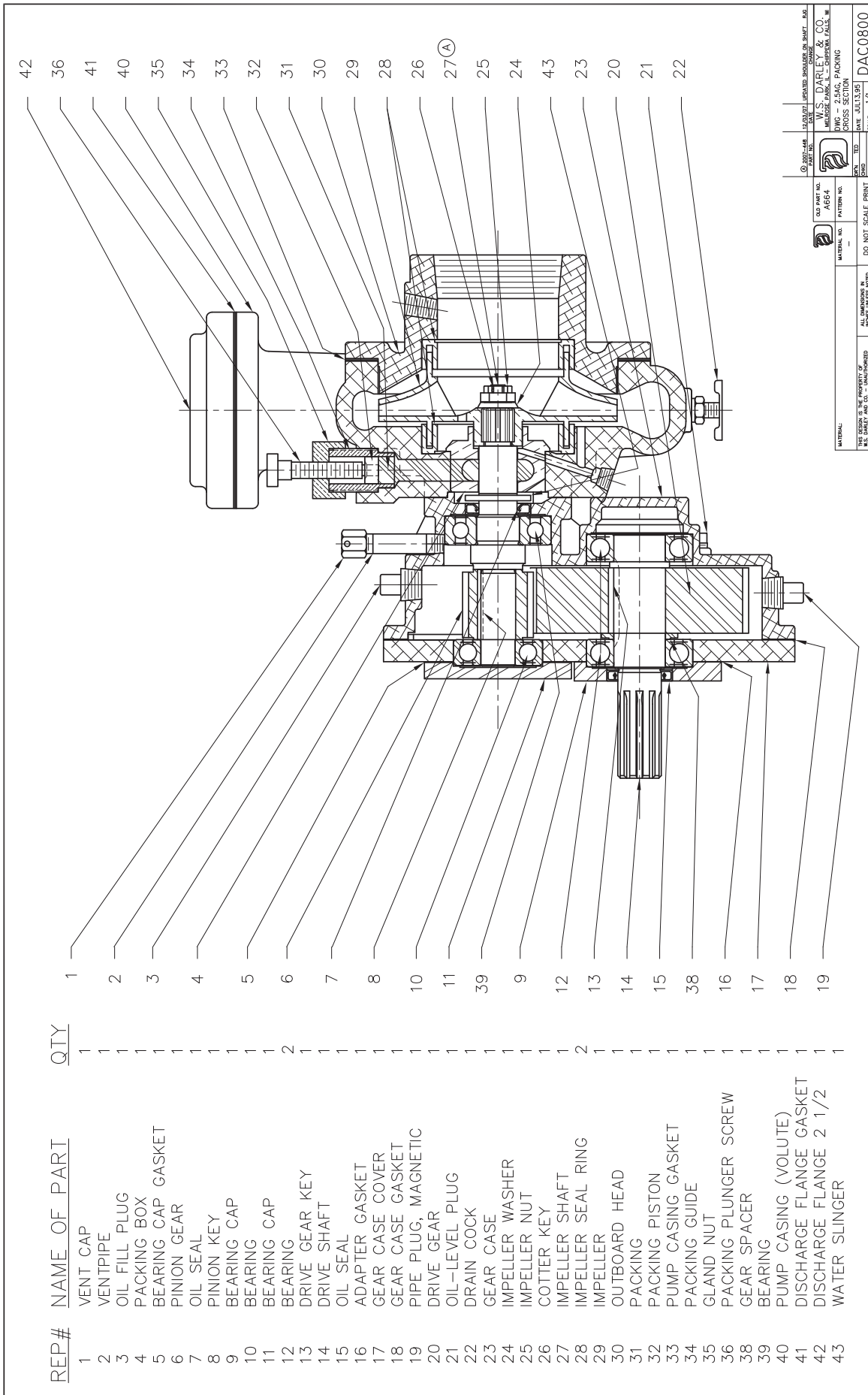
FEB, 25 2016

Great care must be taken in the layout of pump drivelines. Interference and driveline vibration must be considered. An experienced installer with knowledge of driveline considerations, proper layout and recommended guidelines should be utilized as well as proper CAD systems for driveline layouts. Installation of the driveline should not occur until a proper analysis is performed by either a qualified driveline specialist or W.S. Darley. W.S. Darley utilizes, can distribute and can train qualified individuals to use the Allison Multiple Joint Driveline Analysis program.

W.S. Darley requires that Power Take Off (PTO) driven pumps have at most 500 radians per second² torsional vibration and at most 1000 radians per second² inertial drive torsional vibration, as calculated by the Allison Multiple Joint Driveline Analysis program, for a completed driveline installation. A completed driveline installation includes the entire multi-driveshaft assembly from the power source of the PTO output flange to the input flange of the PTO driven pump.

Failure to design and analyze a proper driveline layout could result in severe injury and damage to equipment, including but not limited to: the water pump, the water pump transmission, drive tubes, hanger bearings, u-joint crosses, gears, the rear differential, and the main truck transmission.

Questions can also be directed to our Customer Service Department at
800-634-7812 or 715-726-2650.

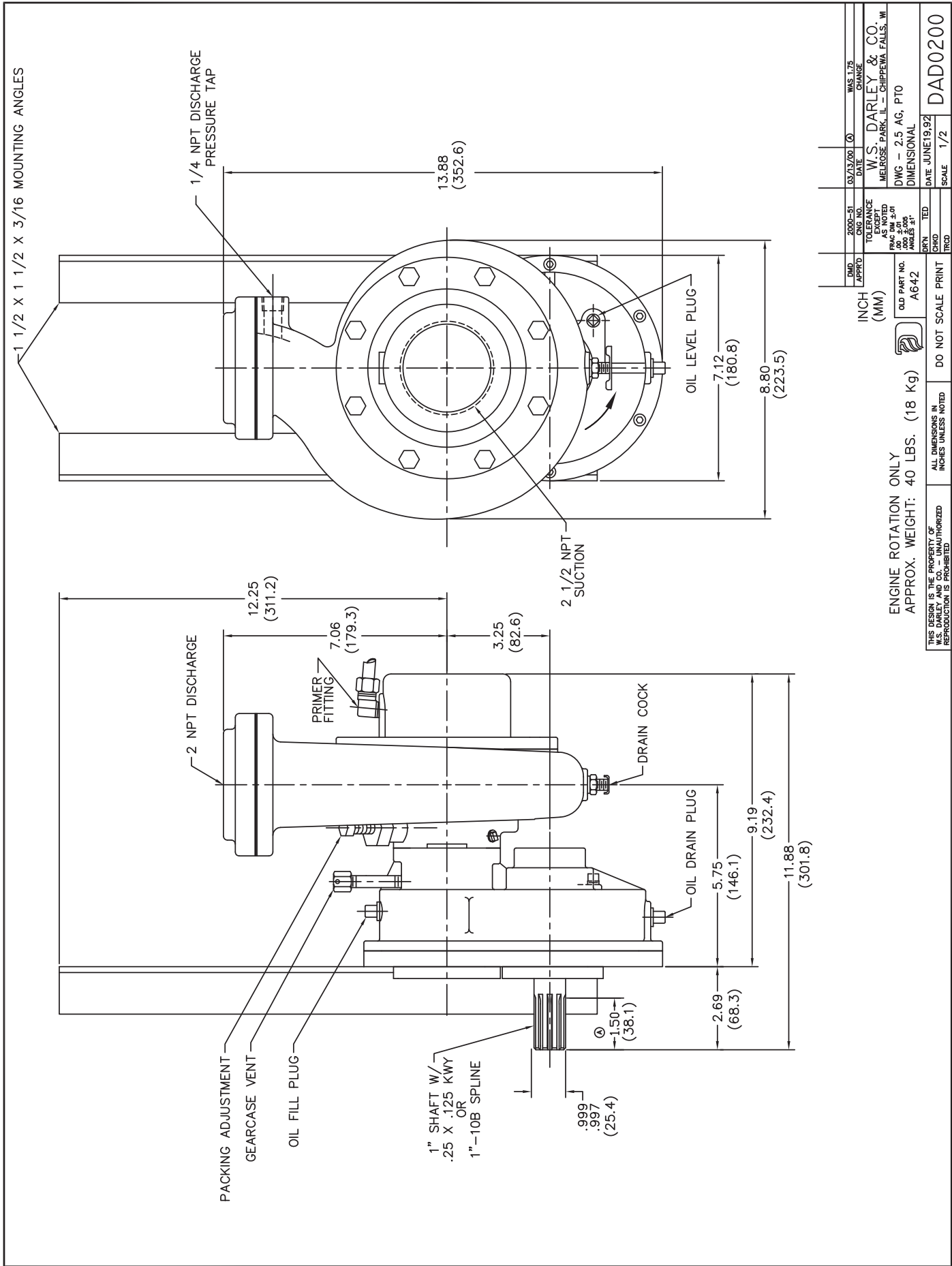


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REP#	NAME OF PART	QTY
1	VENT CAP	1
2	VENTPIPE	1
3	OIL FILL PLUG	1
4	PACKING BOX	1
5	BEARING CAP GASKET	1
6	PINION GEAR	1
7	OIL SEAL	1
8	PINION KEY	1
9	BEARING CAP	1
10	BEARING	1
11	BEARING CAP	1
12	BEARING	2
13	DRIVE GEAR KEY	1
14	DRIVE SHAFT	1
15	OIL SEAL	1
16	ADAPTER GASKET	1
17	GEAR CASE COVER	1
18	GEAR CASE GASKET	1
19	PIPE PLUG, MAGNETIC	1
20	DRIVE GEAR	1
21	OIL-LEVEL PLUG	1
22	DRAIN COCK	1
23	GEAR CASE	1
24	IMPELLER WASHER	1
25	IMPELLER NUT	1
26	COTTER KEY	1
27	IMPELLER SHAFT	1
28	IMPELLER SEAL RING	2
29	IMPELLER	1
30	OUTBOARD HEAD	1
31	PACKING	1
32	PACKING PISTON	1
33	PUMP CASING GASKET	1
34	PACKING GUIDE	1
35	GLAND NUT	1
36	PACKING PLUNGER SCREW	1
38	GEAR SPACER	1
39	BEARING	1
40	PUMP CASING (VOLUTE)	1
41	DISCHARGE FLANGE GASKET	1
42	DISCHARGE FLANGE 2 1/2	1
43	WATER SLINGER	1

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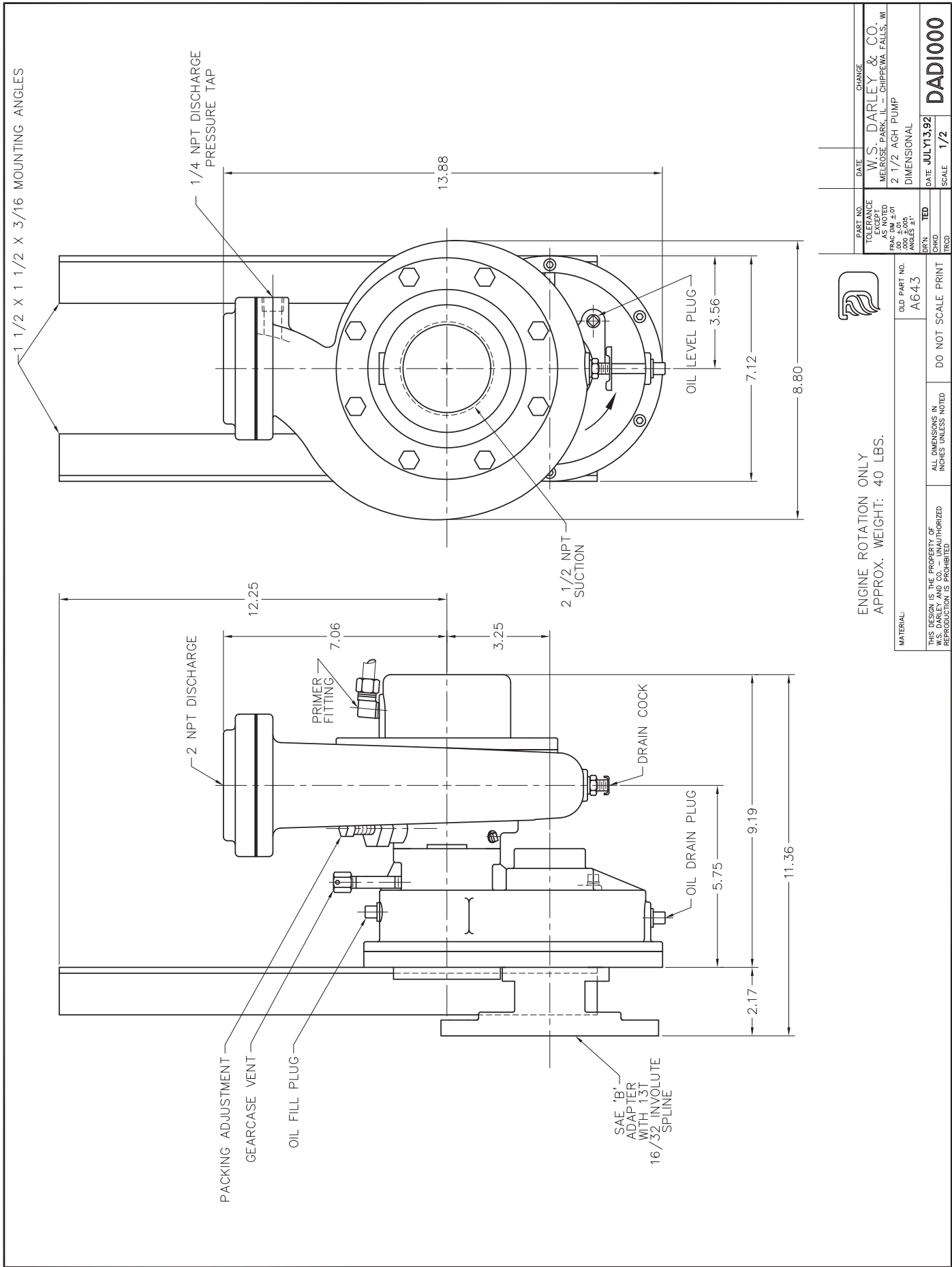
W.S. DARLEY & CO.
 MANAGER PARK, L. - CHESTER, PA., U.S.A.
 PATENT NO. 1,000,000
 CROSS SECTION
 DATE JUL 13, 1961
 SCALE 1/1
 DO NOT SCALE PRINT
 MATERIAL: 304 STAINLESS STEEL
 FINISH: POLISHED
 TOLERANCES: AS SHOWN
 UNLESS OTHERWISE SPECIFIED




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DWG - 2.5 AG, PTO		
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DO NOT SCALE PRINT		
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THIS DESIGN IS THE PROPERTY OF W.S. DARLEY & CO. UNLESS AUTHORIZED REPRODUCTION IS PROHIBITED		

ENGINE ROTATION ONLY
 APPROX. WEIGHT: 40 LBS. (18 Kg)

DAD0200



		PART NO. CHANGE TOLERANCE EXCEPT AS NOTED DECIMALS TO 0.001 UNLESS OTHERWISE SPECIFIED ANGLES 90° UNLESS OTHERWISE SPECIFIED	DATE W.S. DARLEY & CO. MICROSE PARK, ILL. - CHIPPEWA FALLS, WI 2 1/2" ACH PUMP DIMENSIONAL
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MATERIAL: ENGINE ROTATION ONLY APPROX. WEIGHT: 40 LBS.	DO NOT SCALE PRINT	ALL DIMENSIONS IN INCHES UNLESS NOTED	DADI000
THIS DESIGN IS THE PROPERTY OF W.S. DARLEY & CO. UNLESS OTHERWISE NOTED. REPRODUCTION IS PROHIBITED.			

Mechanical Shaft Seal

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

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

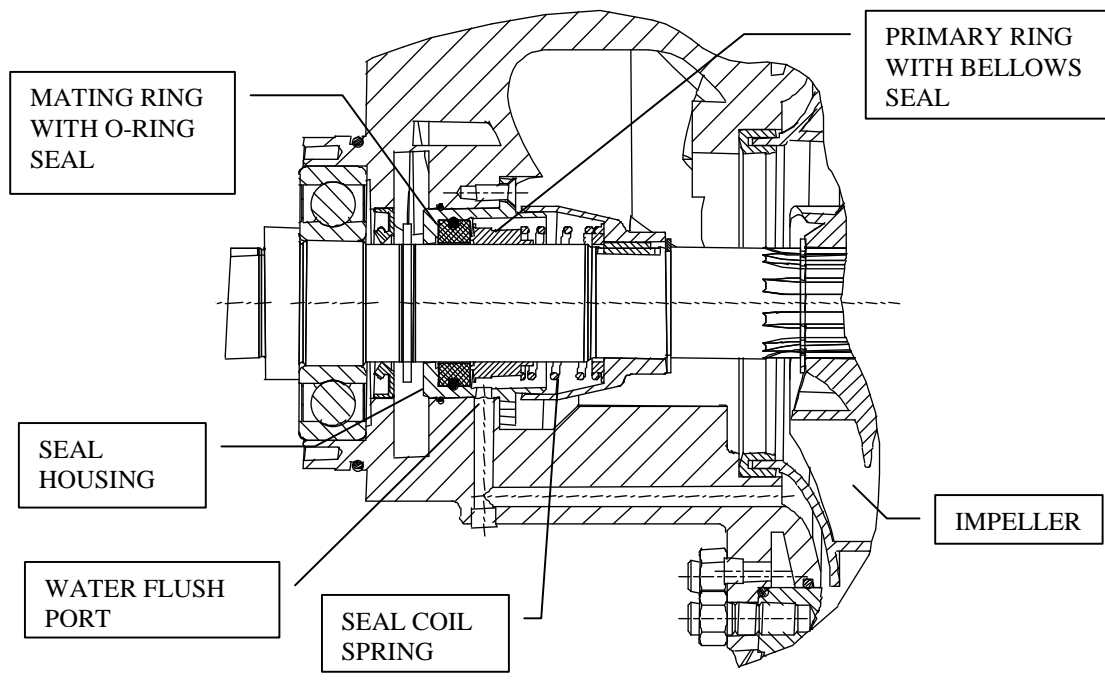
Mechanical Seal Basics

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

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

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

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



Operation and Maintenance

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

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

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

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



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



CAUTION: DO NOT USE THIS PUMP FOR HOSE TESTING



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



DARLEY

INSTALLATION OF MECHANICAL FACE SEAL WITH O-RING

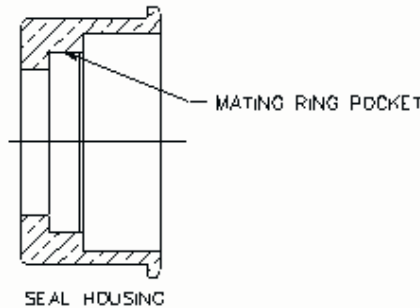
SPECIAL HANDLING

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

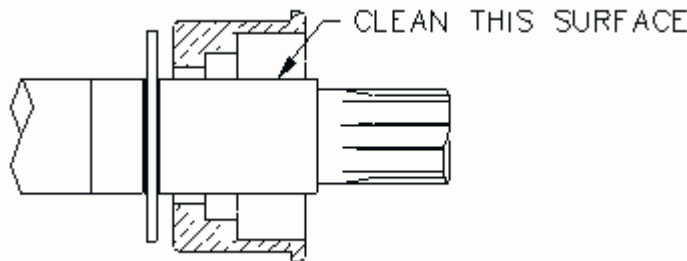
INSTRUCTION STEPS:

Instructions for Installing a Mechanical Shaft Seal

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

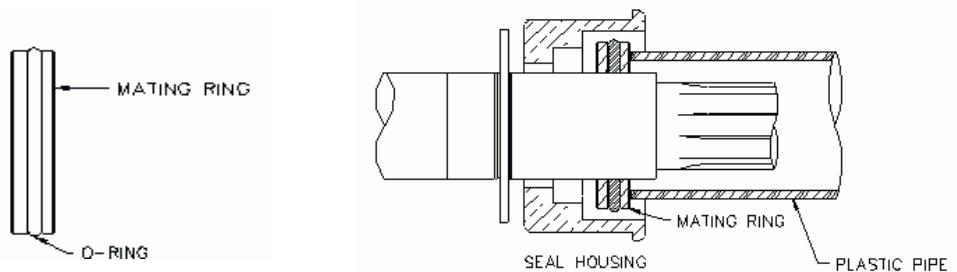
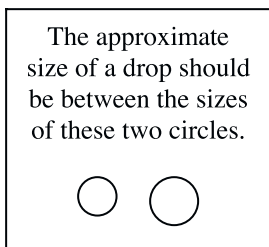


2. Inspect the pump shaft surface under the bellows, ensuring it is clean and nick free to provide a proper sealing surface. Isopropyl alcohol may be used to clean surface if required.



3. Lightly lubricate the o-ring on the mating ring with a single drop of P-80 water soluble rubber lubricant (do not over lubricate) and push it into the cavity using the recommended installation tool or other suitable plastic tube free of contaminants, firmly seating the mating ring square.

Note: The polished face of the mating ring must face out – away from the pump’s gear case. Try to not touch the polished sealing face with your fingers; the oils from your fingerprint can cause the seal to leak. Remove any P-80 from the sealing face after installation.

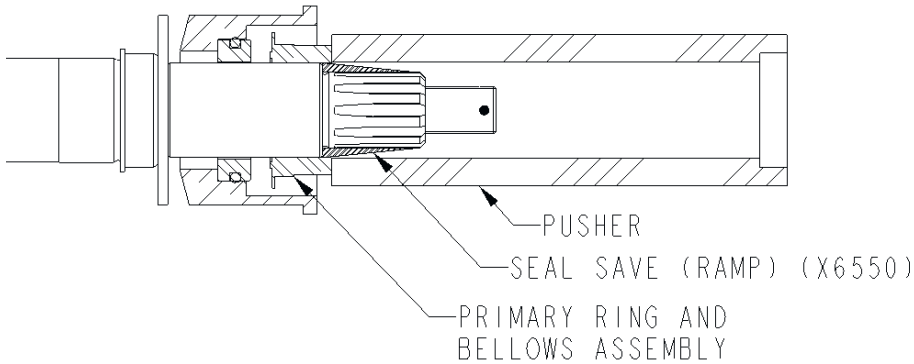


4. Clean the mating ring surface with isopropyl alcohol to remove any fingerprints and any other contaminants left on mating ring.

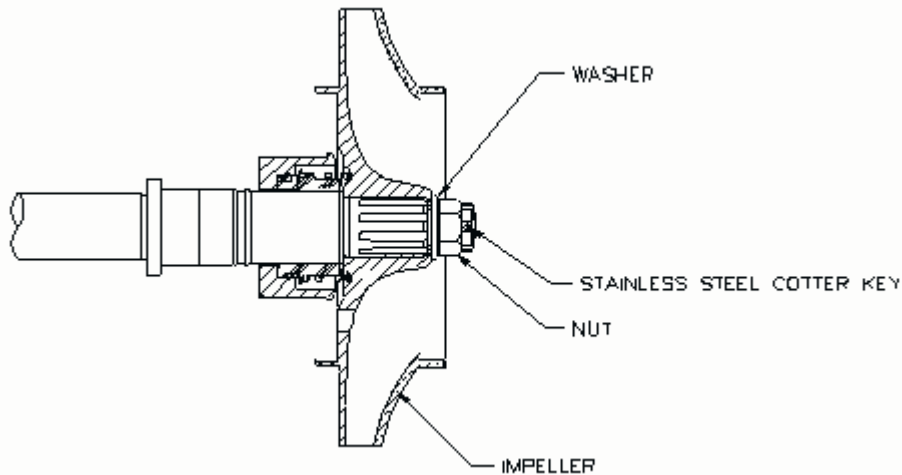
Note: Steps 5 – 9 need to all be completed with in 15 minutes or less.

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

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



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



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

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

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

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



W. S. DARLEY & CO.

DARLEY INJECTION TYPE STUFFING BOX ADJUSTMENT

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

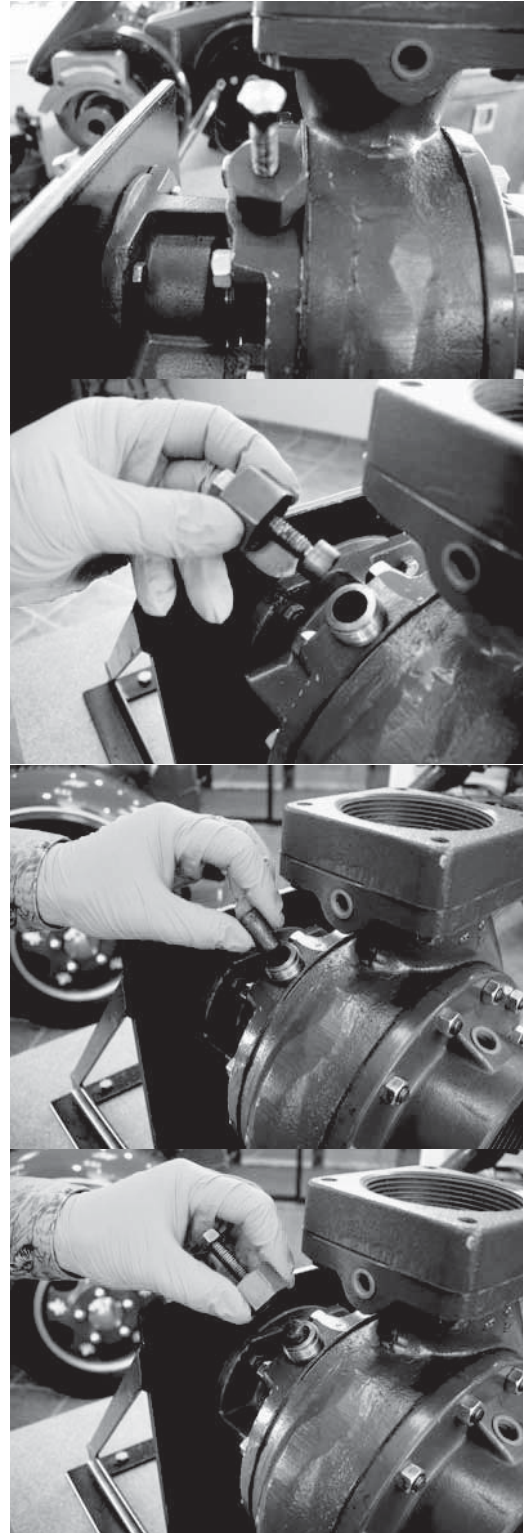
⚠ Caution: Do not attempt to use anything but Darley injection packing. Using the wrong packing material in your pump may cause catastrophic failure of the pump shaft sealing components.

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

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

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

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



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

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



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

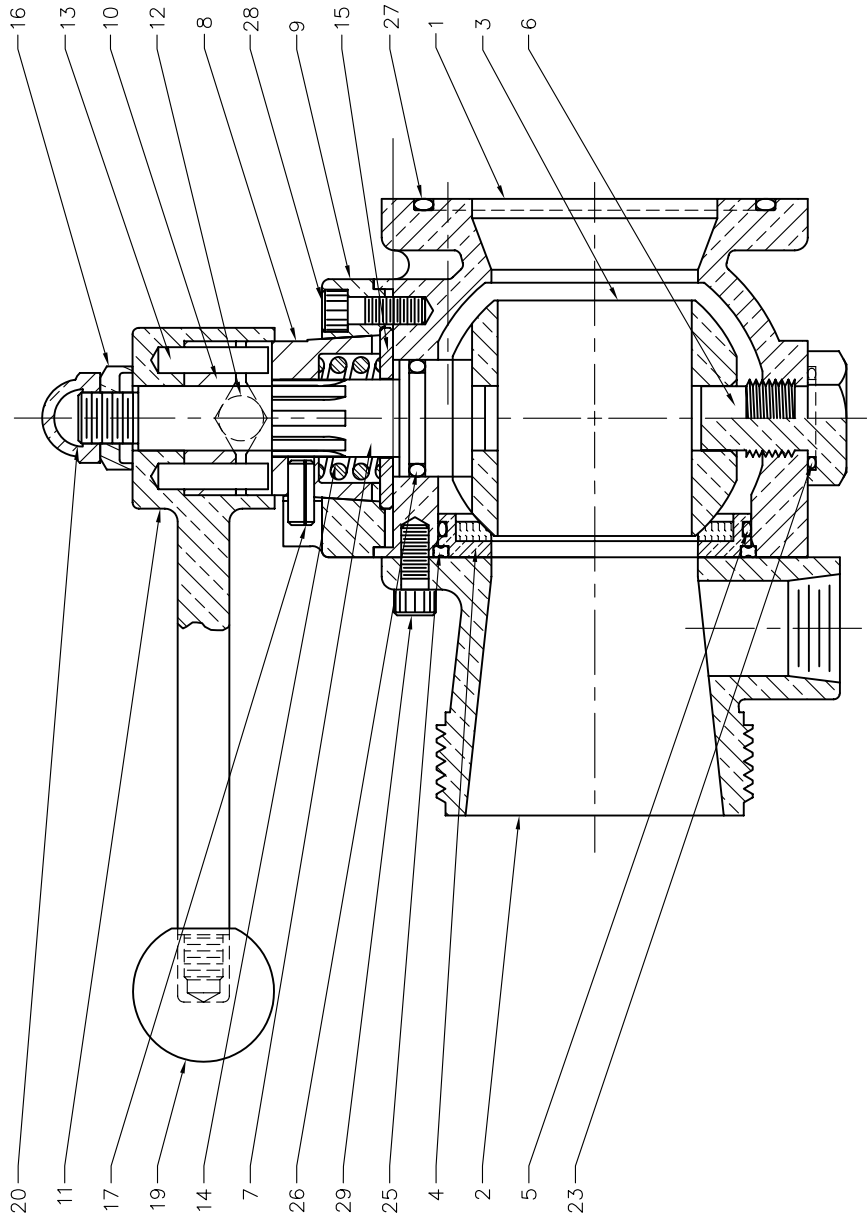
Model	Approximate # Packing Pellets
A	6
2BE	6
EM	15
H	8
JM	8
KD	10
KS	8
LD	15
LS	9
P	10
U2	5
U4	10

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

SUMMARY OF THINGS TO REMEMBER

1. Always shift pump clutches with engine clutch disengaged.
2. Do not clash clutch gears when shifting.
3. Close booster valves, drain valves, cooling line and third stage discharge valve before attempting to prime the pump.
4. Always keep primer shut-off valve closed, except while priming.
5. Re-open and close primer valve to re-prime or eliminate trapped air from suction line.
6. Always drive a midship mounted split-shaft pump with truck transmission in the gear recommended by the chassis manufacturer.
7. Never run the pump without water in it except momentarily while priming.
8. Accelerate and retard speed of engine gradually.
9. Watch the engine temperature, and start the cooling water at the first signs of overheating.
10. Keep good gaskets in suction hoses, and handle carefully to avoid damage to coupling threads.
11. Air leakage into suction lines is the most frequent source of trouble when pumping from a suction lift (draft).
12. Always use a suction strainer when pumping from draft, and a hydrant strainer when pumping from a hydrant.
13. Foreign matter in impellers is a result of failure to use adequate strainers and is a common source of trouble.
14. Drain pump immediately after each run. This is especially critical in freezing conditions.
15. Do not run the pump long with discharge completely shut off.
16. Do not close a "Shutoff" nozzle when pumping with motor throttle wide open, unless relief valve or pressure regulator is set for the correct pressure.
17. Keep the pump gear case filled with oil to the level of the oil level plug/dipstick.
18. Check oil level in the pump transmission after every 25 hours of operation or 3 months, and changed it after every 50 hours of operation or 6 months.
19. In such equipped transmissions, once the oil is drained, remove the strainer screen oil sump fitting and thoroughly cleanse in a parts washer or with isopropyl alcohol, ensuring any debris is washed away.
20. If pump is equipped with a Darley plastallic (injection) packing shaft seal, check the drip rate frequently, and adjust according to the packing adjustment instruction, as required. The drip rate may vary between 5 and 60 drops per minute.
21. Work all suction and discharge valves often to ensure free and easy operation.

REP. NO.	NAME OF PART	QTY.
1	DISCHARGE VALVE BODY	1
2	VALVE NIPPLE	1
3	VALVE BALL	1
4	VALVE SEAT	1
5	O'RING	1
6	BALL GUIDE SCREW	1
7	VALVE STEM	1
8	CLUTCH SLEEVE	1
9	CLUTCH RING	1
10	LEVER CAM	1
11	FRONT MOUNT LEVER	1
12	CAM BALL	2
13	VALVE PIN	2
14	VALVE SPRING	1
15	VALVE STEM WASHER	1
16	ADJUSTING NUT	1
17	SPRING PIN-STL (A)	1
19	CONTROL LEVER BALL	1
20	CAP NUT	1
23	O'RING	1
25	QUAD RING	1
26	O'RING	1
27	O'RING	1
28	SOCKET HEAD CAP SCREW	4
29	SOCKET HEAD CAP SCREW	8



INCH [MILLIMETER] THIRD ANGLE PROJECTION

W.S. DARLEY & Co.
 MELROSE PARK, ILL. - CHIPPEWA FALLS, WI

DWG. - BALL VALVE ASSEMBLY
 CROSS SECTION

DATE NOV12,95
 SCALE 1/1

DGC0100

TOLERANCE EXCEPT AS NOTED
 .005 ±.010
 .000 ±.010
 ANGLES 3:1

DRN JCM
 CHK NOV12,95
 TRCDLMH 5/96

OLD PART NO. G1200

DO NOT SCALE PRINT

ALL DIMENSIONS IN INCHES UNLESS NOTED

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PTO PUMP SHIFTING PROCEDURE

This pump is driven by a transmission mounted (SAE) PTO, a front-of-engine crank shaft PTO, or engine flywheel PTO. Depending on the PTO and transmission configuration, the PTO may be either a sliding gear type or “hot shift” clutch type. This power take-off is normally shifted from within the driver’s compartment. In most cases, if the PTO is driven via a manual transmission, the truck clutch must be disengaged while shifting the PTO. The PTO should only be engaged at a low engine rpm, idle up to 1000 rpm maximum. Review and understand the PTO manufacturer’s safety and operating instructions before attempting operation.

If the apparatus manufacturer has configured the apparatus per NFPA 1901, Standard for Automotive Fire Apparatus, 2009 Edition, the following sections apply:

16.10.4 Stationary Pump Driven Through Transmission-Mounted PTO, Front-of-Engine Crankshaft PTO, or Engine Flywheel PTO – Automatic Chassis Transmission. Where the apparatus is equipped with an automatic chassis transmission, the water pump is driven by a transmission-mounted (SAE) PTO, front-of-engine crankshaft PTO, or engine flywheel PTO, and the apparatus is to be used for stationary pumping only with the chassis transmission in neutral, an interlock system shall be provided to ensure that the pump drive system components are engaged in the pumping mode of operation so that the pump system can be operated from the pump operator’s position.

16.10.4.1 A “Pump Engaged” indicator shall be provided both in the driving compartment and on the pump operator’s panel to indicate that the pump shift has been successfully completed

16.10.4.2 An “OK to Pump” indicator shall be provided in the driving compartment to indicate that the pump is engaged, the chassis transmission is in neutral, and the parking brake is engaged.

16.10.5 Stationary Pump Driven Through Transmission-Mounted PTO, Front-of-Engine Crankshaft PTO, or Engine Flywheel PTO – Manual Chassis Transmission. Where the apparatus is equipped with a manual chassis transmission, the water pump is driven by a transmission-mounted (SAE) PTO, front-of-engine crankshaft PTO, or engine flywheel PTO, and the apparatus is to be used for stationary pumping only with the chassis transmission in neutral, an interlock system shall be provided to ensure that the pump drive system components are engaged in the pumping mode of operation so that the pump system can be operated from the pump operator’s position.

16.10.5.1 A “Pump Engaged” indicator shall be provided both in the driving compartment and on the pump operator’s panel to indicate that the pump shift has been successfully completed

16.10.5.2 An “OK to Pump” indicator shall be provided in the driving compartment to indicate that the pump is engaged, the chassis transmission is in neutral, and the parking brake is engaged.

16.10.6 Stationary Pump and “Pump-and-Roll” – Automatic Chassis Transmission. Where the water pump is driven by a transmission-mounted (SAE) PTO, front-of-engine crankshaft PTO, or engine flywheel PTO, and the apparatus is designed to be used in both the stationary pumping mode and the “pump-and-roll” pumping mode with the automatic chassis transmission in neutral for stationary pumping and in a road gear for pump-and-roll pumping, an interlock system shall be provided to ensure that the pump

PTO PUMP SHIFTING PROCEDURE

drive system components are engaged in the pumping mode of operation so that the apparatus can be operated in either stationary or pump-and-roll pumping modes.

16.10.6.1 A "Pump Engaged" indicator shall be provided both in the driving compartment and on the pump operator's panel to indicate that the pump shift has been successfully completed

16.10.6.2 An "OK to Pump" indicator shall be provided in the driving compartment to indicate that the pump is engaged, the chassis transmission is in neutral, and the parking brake is engaged.

16.10.6.3 An "OK to Pump and Roll" indicator shall be provided in the driving compartment and shall be energized when the pump is engaged, the chassis transmission is in road gear, and the parking brake is released.

16.10.6.4 When the "OK to Pump and Roll" indicator is energized, the "OK to Pump" indicator shall not be energized.

16.10.7 Stationary Pump and "Pump-and-Roll" – Manual Chassis

Transmission. Where the water pump is driven by a transmission-mounted (SAE) PTO, front-of-engine crankshaft PTO, or engine flywheel PTO, and the apparatus is designed to be used in both the stationary pumping mode and the pump-and-roll pumping mode with the chassis transmission in neutral for stationary pumping or in a road gear for pump-and-roll pumping, an interlock system shall be provided to ensure that the pump drive system components are properly engaged in the pumping mode of operation so that the apparatus can be operated in either stationary or pump-and-roll pumping modes.

16.10.7.1 A "Pump Engaged" indicator shall be provided both in the driving compartment and on the pump operator's panel to indicate that the pump shift has been successfully completed

16.10.7.2 An "OK to Pump" indicator shall be provided in the driving compartment to indicate that the pump is engaged and the parking brake is engaged.

16.10.7.3 An "OK to Pump and Roll" indicator shall be provided in the driving compartment and shall be energized when the pump is engaged and the parking brake is released.

16.10.7.4 When the "OK to Pump and Roll" indicator is energized, the "OK to Pump" indicator shall not be energized.

16.10.10 Pump Operator's Panel Engine Speed Advancement – Automatic Transmission.

16.10.10.1 An engine speed control shall be provided at the pump operator's panel.

16.10.10.2 A "Throttle Ready" indicator that lights when the pump is in the "OK to Pump" mode shall be provided on the pump operator's panel.

16.10.10.3* The "Throttle Ready" indicator at the pump operator's panel shall be permitted to light when the chassis transmission is in neutral and the parking brake is engaged.

A. 16.10.10.3 Engine speed advancement control at the operator's panel might be required for apparatus with the need to control the engine speed for operation of a generator, aerial device, alternator, or other chassis engine-driven device. The indicating device for this "Throttle Ready" condition is the same indicating device as in 16.10.10.2.

Other apparatus may not have equipment for which there is a need to control engine speed from the pump operator's panel. Engine speed control at the pump operator's panel for these apparatus may not be desirable since, on many chassis engines, activating remote throttle operation will automatically disable the in-cab accelerator pedal. For such apparatus, engine speed advancement control at the pump operator's panel is not

PTO PUMP SHIFTING PROCEDURE

required when the chassis transmission is in neutral and the parking brake is engaged, and "Throttle Ready" indication for this condition is not required.

16.10.10.4 An interlock system shall be provided to prevent advancement of the engine speed at the pump operator's panel unless the apparatus has "Throttle Ready" indication.

16.10.10.5 Loss of power to the interlock system in 16.10.10.4 shall return the engine speed to idle and prevent advancement from the pump operator's panel.

16.10.11 Pump Operator's Panel Engine Speed Advancement – Manual Transmission.

16.10.11.1 An engine speed control shall be provided at the pump operator's panel.

16.10.11.2 A "Throttle Ready" indicator that lights when the pump is in the "OK to Pump" mode shall be provided on the pump operator's panel.

*16.10.11.3** The "Throttle Ready" indicator at the pump operator's panel shall be permitted to light when the parking brake is engaged.

A. 16.10.11.3 Engine speed advancement control at the operator's panel might be required for apparatus with the need to control the engine speed for operation of a generator, aerial device, alternator, or other chassis engine-driven device. The indicating device for this "Throttle Ready" condition is the same indicating device as in 16.10.11.2.

Other apparatus may not have equipment for which there is a need to control engine speed from the pump operator's panel. Engine speed control at the pump operator's panel for these apparatus may not be desirable since, on many chassis engines, activating remote throttle operation will automatically disable the in-cab accelerator pedal. For such apparatus, engine speed advancement control at the pump operator's panel is not required when the chassis transmission is in neutral and the parking brake is engaged, and "Throttle Ready" indication for this condition is not required.

16.10.11.4 Loss of power to the interlock system in 16.10.11.3 shall return the engine speed to idle and prevent advancement from the pump operator's panel.

16.10.12 If a pump shift manual override device is provided the "Pump Engaged", "OK to Pump", and "Throttle Ready" indicators and the pump operator's panel engine speed advancement interlock system shall be operationally functional when the manual override device is used to shift the pump.

16.10.13 Pump Operator's Panel Engine Speed Advancement – Automatic Transmission.

16.10.13.1 With parallel/series centrifugal pumps, the control positions for parallel operation (volume) and series operation (pressure) shall be indicated.

16.10.13.2 The control for changing the pump from series to parallel, and vice versa, shall be operable at the pump operator's position.

PTO PUMP SHIFTING PROCEDURE

For **STATIONARY** pumping, proceed as follows for pump engagement:

1. Set parking brake.
2. Shift chassis transmission to neutral.
3. Reduce engine speed to idle or below 1000 rpm.
4. Following the PTO manufacturer's shifting instructions, engage chassis PTO. *The "Pump Engaged" indicator both in the driving compartment and on the pump operator's panel will indicate if the pump shift has been successfully completed. The "OK to Pump" indicator in the driving compartment will indicate that the pump is engaged, the chassis transmission is in neutral, and the parking brake is engaged. The "Throttle Ready" indicator at the pump operator's panel is now illuminated.*
5. Prime the pump (see priming instructions). Primer motor should be engaged within 2 minutes of PTO engagement. Pump should then prime within 1 minute of primer operation. If the pump can not be primed within 3 minutes of PTO engagement, disengage PTO and troubleshoot priming difficulty. Do not run the pump dry for extended periods of time.
6. Confirm that the "Throttle Ready" indicator at the pump operator's panel is now illuminated.
7. Observe discharge pressure gage on panel while advancing vernier throttle, to ensure that it is indicating pressure. If Pump is not engaged, no pressure will show.
8. Remember, the vernier throttle has a quick release emergency center button. If the truck moves, immediately push the center emergency button all the way in to close throttle.
9. To ensure maximum operational life for the PTO, driveline, and pump components, increase engine speed to 1000 rpm minimum when the PTO is engaged and the pump is flowing water. This slight increase in rpm induces a small load on the drive system. This load will eliminate the system rattle produced by the clearances in the PTO and pump gears being excited by the combustion engine power strokes.

To disengage the pump, reduce engine rpm to idle and shift PTO out of gear.

IMPORTANT: Failure to follow proper shifting or operating sequences will result in premature PTO failure with possible damage to other components

PTO PUMP SHIFTING PROCEDURE

For **PUMP and ROLL** pumping, proceed as follows for pump engagement:

1. Set parking brake.
2. Shift chassis transmission to neutral.
3. Reduce engine speed to idle or below 1000 rpm.
4. Following the PTO manufacturer's shifting instructions, engage chassis PTO. *The "Pump Engaged" indicator both in the driving compartment and on the pump operator's panel will indicate if the pump shift has been successfully completed. The "OK to Pump" indicator in the driving compartment will indicate that the pump is engaged, the chassis transmission is in neutral, and the parking brake is engaged. The "Throttle Ready" indicator at the pump operator's panel that is now illuminated.*
5. Prime the pump (see priming instructions). Primer motor should be engaged within 2 minutes of PTO engagement. Pump should then prime within 1 minute of primer operation. If the pump can not be primed within 3 minutes of PTO engagement, disengage PTO and troubleshoot priming difficulty. Do not run the pump dry for extended periods of time.
6. Return to the driving compartment driver's position.
7. Release parking brake.
8. Shift chassis transmission into road gear. *The "Pump Engaged" indicator both in the driving compartment and on the pump operator's panel will indicate if the pump shift has been successfully completed. The "OK to Pump" indicator will not be illuminated. The "OK to Pump and Roll" indicator in the driving compartment will indicate that the pump is engaged, the chassis transmission is in drive, and the parking brake is released.*
9. While advancing foot throttle, observe discharge pressure gage in the cab. If the pump is properly engaged and primed, discharge pressure will increase as engine rpm increases. Use care when in the pump and roll mode to maintain a steady engine rpm (constant pressure) and do not exceed rated pump pressure rating.
10. To ensure maximum operational life for the PTO, driveline, and pump components, increase engine speed to 1000 rpm minimum when the PTO is engaged and the pump is flowing water. This slight increase in rpm induces a small load on the drive system. This load will eliminate the system rattle produced by the clearances in the PTO and pump gears being excited by the combustion engine power strokes.

To disengage the pump, reduce engine rpm to idle and shift PTO out of gear.

IMPORTANT: Failure to follow proper shifting or operating sequences will result in premature PTO failure with possible damage to other components.

OPERATION OF OPTIONAL HIGH PRESSURE STAGE

The sliding gear clutch which drives the optional high pressure stage is operated by a shift lever marked "FOG" for pumping position, and "OUT" for disengaged position. The shift lever must be locked in one or the other of these positions before the pump can be started.

The high pressure stage clutch must not be shifted while the main pump is running.

When the main pump is in operation, it must always be stopped (engine clutch disengaged) for shifting of the high pressure stage clutch either in or out.

The high pressure stage is always primed by pressure from the main pump.

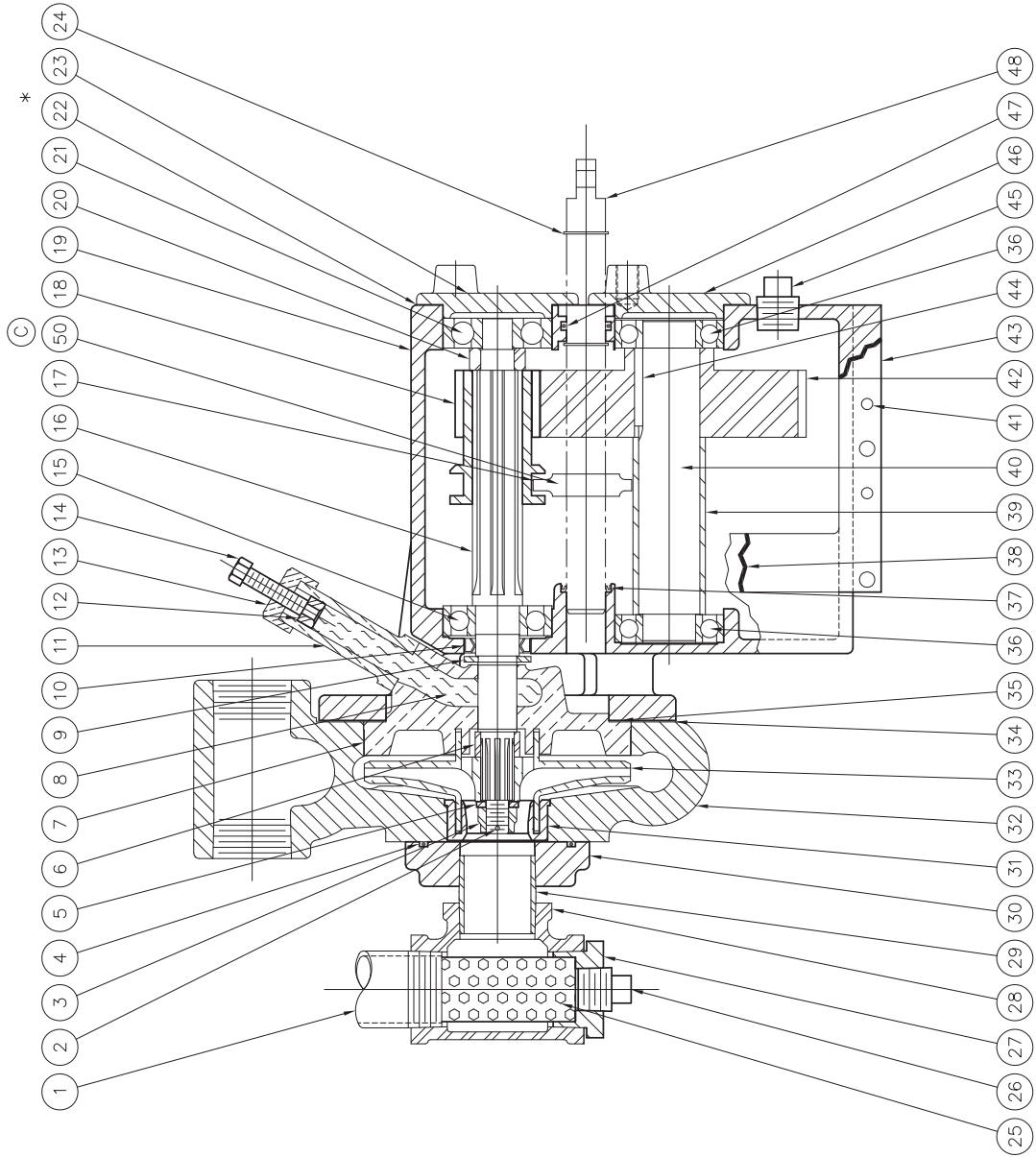
The high pressure stage has a small by-pass line with a valve to the booster tank. Open the by-pass valve when running with the high pressure stage discharge lines completely shut off.

HIGH PRESSURE BOOSTER PUMP DRAWING DLC0104

Rep. No.	Name of Part	Qty	Rep. No.	Name of Part	Qty
1	Inlet Pipe	1	26	Pipe Plug	1
2	Cotter Pin	1	27	Stainer Fitting	1
3	Impeller Pin	1	28	Inlet Tee	1
4	Flange O-ring	1	29	Close Nipple	1
5	Impeller Washer	1	30	Inlet Flange	1
6	Impeller Spacer	1	31	Seal Ring	1
7	Stuffing Box Head	1	32	Pump Casing	1
8	Pump Packing	10	33	Impeller	1
9	Water Slinger	1	34	Pump Casing Gasket	1
10	Impeller Shaft Oil Seal	1	35	Stuffing Box Gasket	1
11	Packing Cylinder	1	36	Idler Shaft Bearing	2
12	Gland Stud Piston	1	37	Shift Bar Oil Seal	1
13	Gland Nut	1	38	Gearcase Gasket	2
14	Packing Screw	1	39	Idler Shaft Spacer	1
15	Impeller Shaft Bearing	1	40	Idler Shaft	1
16	Impeller Shaft	1	41	Alignment Pin	2
17	Shift Collar	1	42	Idler Gear	1
18	Pump Drive Pinion	1	43	Gearcase Spacer	1
19	Gear Case	1	44	Idler Gear Key	1
20	Pinion Spacer	1	45	Oil Level & Fill plug	1
21	Impeller Shaft Bearing	1	46	Bearing Cap	1
22	Bearing Cap Gasket	2	47	Shift Bar O-ring	1
23	Bearing Cap	1	48	Shift Bar	1
24	Retaining Ring	2	49	Retaining Ring	2
25	Strainer Sleeve	1			

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CHIPPEWA FALLS, WI. AT 800-634-7812 or 715-726-2650**

LEAVE PAGE BLANK FOR DRAWING DLC0104



C2002-134 SHCS ADDED 09SEP02 JSS
 * GASKET REMOVED 5/94
 (49) ADDED 3-23-90

TOLERANCE EXCEPT AS NOTED	W.S. DARLEY & CO. MELROSE PARK, IL. - CHIPPENVA, FALLS, WI
FRACTIONAL DIMENSIONS ANGLES 30°	DWG - LDM SECOND STAGE CROSS SECTION PUMP ASSY
DATE BY CHKD TRCD	DATE SCALE
S. LEE	AUG28.89
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	DLC0104

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ALL DIMENSIONS IN
 INCHES UNLESS NOTED

DO NOT SCALE PRINT

OLD PART NO.
 L88

WARNING: DO NOT USE THIS PUMP FOR HOSE TESTING

OPERATING THE ENGINE

After the pump has been primed, the engine speed should be increased gradually -- never jerk throttle wide open. Likewise, the engine speed should be decreased gradually when shutting down.

Watch the pump pressure gage and open throttle only enough to give the desired pressure. The pressure may rise high enough to burst the discharge hose, when using small nozzles, if the engine is given full throttle (except pumps equipped with pressure regulators set for desired pressure).

Never run engine at high speeds except when pump is primed and ready to discharge water.

COOLING THE ENGINE

NFPA 1901 requires that a supplementary heat exchanger cooling system be provided. On most models, this heat exchanger is an integral part of the pump, and the installation of two hoses from the engine cooling system to the pump is all that is required. Valves or other shut offs are not required.

On some models an external heat exchanger must be used. In that case two hoses from the engine cooling system and two lines from the pump will run to the heat exchanger.

The cooling line should not be opened until pressure develops in the pump, and pump should never be operated under heavy loads prolonged without an adequate supply of cooling water flowing.

Water temperatures should never be allowed to exceed 200° F while pumping and 180° F is usually taken as a safe operating temperature.

Always shut off cooling line when through pumping.

SUCTION STRAINERS

A large suction strainer, which will prevent the passage of a body larger than the pump impeller ports, must always be used on the free end of the suction line when pumping from draft.

The small hydrant strainer must always be inserted in the suction manifold of pump, when pumping from hydrants and at all other times except when maximum capacity is required from draft.

Failure to use a strainer at all times when pumping will cause serious trouble by clogging the pump because, even in water mains, foreign matter is invariably present, and will be drawn into pump by the high velocity of the water entering.

SUCTION LINE

The suction line of a fire pump can be the source of more operating difficulties than all the rest of the pump when working with a suction lift. Faults in the suction line which cause trouble in operation are as follows.

AIR LEAKS -- A small amount of air, expanding in the vacuum of the suction line, displaces a considerable volume of water which subtracts from the capacity that the pump is able to deliver, makes the priming difficult or causes pump to lose its prime. Therefore, it is absolutely essential to keep the suction line and the suction side of pump casing air tight at all time when drafting water.

Air leakage into pump while operating is usually indicated by a rattling sound in pump casing, miniature explosions in stream issuing from the nozzle, or by losing of prime when operating at very low capacities.

The usual cause of leaky suction lines is carelessness in handling of suction hose. Bruising of hose threads by bumping against hard surfaces or sand in the coupling often prevents tightening of the joints up against the gaskets. The hose gaskets are often defective and are sometimes lost without being noticed by the operator.

INSUFFICIENT SUBMURGENCE -- The free end of suction hose must be submerged to a sufficient depth to prevent the entrance of air that may be sucked down from the surface of the water to a considerable depth when operating at large capacities.

Entrance of air into suction lines in this manner is indicated by a small whirlpool, or vortex, on the surface of the water over the end of the hose.

A minimum submergence of 4 times the hose diameter to the upper holes in suction strainer is recommended where full capacity of pump is required. Where sufficient submergence is not possible, a board or sheet of metal laid over end of suction line will keep air from entering.

SUCTION LINE ENTRANCE TOO CLOSE TO BOTTOM -- If the end of suction line is laid on the bottom of the source of supply, a part of the suction opening will be shut off; and if the bottom is soft the hose will suck itself down into the earth, closing more of the opening and loosening sand and mud to be carried into the pump.

The suction entrance should be suspended a foot or more above the bottom, or if this is not possible, it should be laid on a board or piece of sheet metal. A rope tied to the suction strainer is a convenient means of holding it off the bottom.

OBSTRUCTION OF SUCTION STRAINER BY FOREIGN MATTER -- The high velocity of water entering the suction line will carry loose foreign bodies in against the strainer from a considerable distance. Therefore, all weeds and refuse should be removed from close proximity of the suction entrance.

SUCTION LINE TOO SMALL OR TOO LONG -- The flow of water into the pump is opposed by the frictional resistance in the suction line. This friction loss must be added to the height of the pump above the water (static lift) to determine the "total lift" of the pump. When all of the vacuum in the pump (atmospheric pressure) is consumed in raising water through this total lift, then the limit of capacity has been reached. This capacity can be increased only by decreasing total lift. If the static lift cannot be reduced, then the friction loss must be reduced by using a shorter or larger suction hose.

The rated capacity of the pump is guaranteed for a static lift of 10 feet, with 20 feet of recommended suction hose at sea level. To increase the capacity without reducing the static lift, or to increase lift without sacrificing capacity, requires larger suction hose.

An excessively long suction line is a handicap to any pump, for besides reducing capacity through the added friction loss, it retards priming and it produces a detrimental effect known as "cavitation". This means a separation of the water column in the pump suction, or void spaces, produced by the inertia of the heavy mass of water in the line resisting sudden change in the velocity when the pump starts to deliver or when discharge valves are opened or closed. This phenomenon reduces capacity further, and usually sets up a vibratory motion and "water hammer" as the water surges in and out of the void spaces.

When operating with a long suction line, the driving engine should be accelerated gradually, the discharge gates opened gradually, and the capacities of the pump should be held down to within the range of smooth performance.

AIR TRAP IN SUCTION LINE -- If the suction line is laid so that part of it is higher than any other part that is nearer to the pump, as when hose is laid over a high bridge rail, an air trap is formed at the highest part of the hose from which the air cannot be sucked out by the primer. This trapped air is expanded and carried into the pump with the first rush of water causing the pump to immediately lose its prime.

If suction line cannot be laid so that it slopes all the way from pump to water, it can still be primed easily by simply allowing the primer to continue to function until all the trapped air in the hose has been carried into the pump and picked up by the primer.

TESTING FOR AIR LEAKS

Tests for leakage should be made with the suction hose attached and capped, discharge gate open, and all other openings closed tightly.

Idle engine or run electric priming pump with primer shut-off valve open, until maximum vacuum is shown on the gage. The vacuum should hold for several minutes before satisfactory performance of pump can be expected.

If excessive leakage of air occurs, the source of leaks can be located by shutting off primer motor, with vacuum at its highest point, and listening for the hiss of air.

In the absence of a vacuum gage, the vacuum in pump may be judged by closing suction opening with the flat of hand or a rubber pad.

Water or air pressure may be applied to pump casing to test for air leakage if more convenient.

SOURCE OF WATER SUPPLY

Water may be drafted from a pond, lake, stream, cistern, stock tank, or well; but whatever the source, the static lift must not exceed 20 feet from the center of the pump to the surface of the water and a lift not exceeding 10 feet is recommended. The source of supply should be reasonably clear and free from foreign matter. It is recommended that all water holes, which may be needed for fire protection, be deepened if necessary and kept free from weeds and refuse. In many fire protection areas, cisterns or reservoirs are built and allowed to fill up with rain water to be used in emergencies.

PUMPING IN COLD WEATHER

The first insurance against cold weather trouble is to keep fire apparatus stored in heated quarters. All water must be eliminated from pump casing and primer line between periods of operations.

When setting up for pumping, unnecessary delays should be avoided by having thoroughly trained pump operators. Be sure that primer and booster lines are kept closed until ready for use. Having discharge lines ready so that pump may be started as soon as it have become primed. Do not stop flow of water through the pump until ready to drain and return to the station.

Engine Coolant from the engine circulated through the heater jacket in pump casing prevents all ordinary freezing troubles.

WHEN FINISHED PUMPING

Drain water out of pump casing immediately. (Drain valve is located at lowest point in pump casing, and accessible from underneath chassis.)

Don't forget to close all drain cocks after all water has been drained out. Trouble in priming will follow on the next run if this is forgotten.

Shut off cooling line to make pump ready for priming again.

If pump transmission is equipped with a transmission cooler it must be drained also. If the master drain is located below the cooler outlets it can be connected to the master drain, if not, two separate drains must be connected to the transmission cooler. **Failure to drain transmission cooler will result in water in the gearcase if water in the cooling coil freezes.**

If pump is equipped with an external heat exchanger, drain heat exchanger using gravity and vacuum drain on all trucks as follows: Close all open lines and drain cocks. Open cooler valve and open air vent at top or drain cock at bottom of heat exchanger depending on model. With the pump air-tight open primer with engine running for about a minute and then close primer. Drain pump of water which was deposited when heat exchanger and lines were being drained.

Pump not often used for fire service should be inspected and run periodically to insure that they will be in readiness for an emergency.

PUMPING SALT WATER

The pump should be flushed out with fresh water immediately after pumping salt water to prevent excessive rusting. (Except pumps which are built of special material to resist the corrosive action of the brine.)

When measuring sea water with a Pitot Gage, capacities shown in Table No. 2 should be discounted approximately 1 1/2% to determine the correct capacity.

A centrifugal pump will show 2 1/2% higher pressure and require 2 1/2% more power when handling sea water than when handling fresh water if operated at the same speed and capacity.

TESTING OF EQUIPMENT FOR PRACTICE

It frequently happens that operators of fire apparatus, who are not thoroughly familiar with its operations, become confused under the stress of emergency and neglect some little detail that may cause trouble or delay

in getting the equipment into operation. Therefore, we urge that practice tests be conducted repeatedly until operators are thoroughly trained. More than one person in the department should be a competent operator.

Practice should include pumping from low lifts, high lifts with short and long suction lines, with suction line elevated to form an air trap, and from hydrants, at large and small capacities.

It is well, also, to note the effects of air leaks in hose, insufficient submergence and restriction of suction line. (Suction line can be restricted by placing a can or other strong closure around the suction strainer).

NEVER BREAK OR RESTRICT SUCTION OR ALLOW AIR TO ENTER SUCTION LINE WHILE ENGINE IS OPERATING WITH THROTTLE OPEN. This will release the load and allow engine to run away.

Do not allow personnel to hold a large nozzle while working at high pressures for serious accidents may result if hose breaks loose.

MEASURING PUMP PERFORMANCE

Pump performance is measured by the quantity of water it can deliver per minute against a certain pressure called "Total Head" or "Net Pump Pressure", as it is usually termed in fire pump testing.

The net pump pressure is the sum of the pump discharge pressure, as shown on the pressure gage with which the pump is regularly equipped, and the total suction lift converted to equivalent pounds per square inch. If pump is operating from a hydrant, the net pump pressure is the discharge pressure less the incoming pressure from hydrant measured at the suction entrance of pump.

Capacity of fire pump is measured in gallon per minute. The usual method of measurement is to determine the pressure of the jet of water leaving a given size of nozzle by means of a "Pitot Gage" from which the capacity is computed mathematically.

A Pitot Gage consists of a small tube adapted to a point directly into the hose nozzle from the center of the issuing stream, the other end of the tube being connected to an accurate pressure gage.

The nozzle jet drives straight into the Pitot tube and converts the velocity of the jet to pressure which is an accurate measure of velocity of the water as it leaves the nozzle. The tip of the Pitot tube should be one-half the diameter of the nozzle away from nozzle tip while taking reading. Table No. 2 gives nozzle capacities for various Pitot Gage readings.

If a Pitot gage is not available approximate pump capacities can be determined by reference to Table No.3

ACCEPTANCE TESTS

Acceptance tests require continuous tests of three hours duration: 2 hours at 100% rated capacity and 150 PSI net pump pressure; one-half hour at 70% capacity and 200 PSI; one-half hour at 50% capacity and 250 PSI; and a spurt test at 100% capacity and 165 PSI.

Table No. 1 shows recommended set-ups and gage readings for rating tests.

To adjust nozzle pressure for the correct capacity, while maintaining the correct pump pressure, it is necessary to make simultaneous adjustments of engine throttle and the discharge gate valve partially closing the latter until just the right discharge resistance is built up.

ENGINES

An Underwriter fire pump imposes heavy loads on the engine that drives it, often absorbing all of the power the engine is capable of delivering at full throttle. Continuous pumping gives the engine no time to rest. Therefore, a new engine and pump unit must be thoroughly broken-in before it is required to deliver prolonged maximum pump performance.

We recommend a minimum break in period of 20 hours at light pumping loads, with occasional spurt tests and interruptions. Temperature and lubrication should be checked during this period.

Engine manufacturers' power ratings usually show maximum performance of a selected, factory adjusted engine, operating without fan, generator, muffler or other accessories, and corrected for "ideal" conditions,

i.e. sea level barometer (29.92" of mercury) 60°F and high humidity. Therefore, the actual power delivered by an average truck mounted engine is considerably lower than the manufacturers' rating, and allowances must be made in predicting pump performance.

EFFECTS OF ATMOSPHERIC CONDITIONS ON ENGINE AND PUMP PERFORMANCE

Each one inch of drop in Barometric pressure or each 1000 feet of elevation of the pumping site reduces engine power approximately 3 1/2% for engines not equipped with a turbo charger.

Each 12° rise in temperature above 60° F of carburetor intake air reduces engine power approximately 1%.

Lowering of humidity reduces power slightly.

Each one inch drop in Barometric pressure or each 1000 feet of elevation reduces the maximum possible static lift of a pump approximately one foot.

Temperature of the water supply affects the attainable suction lift of a pump. The effect is slight at low water temperatures but becomes increasingly detrimental as the temperature rises.

A 10° rise from 70°F will subtract about 1/2 foot from the maximum attainable suction lift, while an equal rise from 100°F will reduce the lift at least 1 1/2 feet.

Temperature is an important consideration when pumping from a test pit where the water is heated by recirculation.

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

OPERATING CHARACTERISTICS OF PUMPS

CENTRIFUGAL PUMPS: A centrifugal pump develops pressure by centrifugal force of the liquid rotating in the impeller wheel. The pressure developed depends upon the peripheral speed of the impeller (increasing as the square of the speed) and it remains fairly constant over a wide range of capacities up to the maximum output of the pump, if speed remains constant.

If the discharge outlet of a centrifugal pump is entirely shut off, with speed kept constant, there is a small rise in pressure, the water churns in the pump casing and the power drops to a low value. If the discharge is opened wide, with little resistance to flow the pressure drops while the capacity and power both increase to their maximum.

A centrifugal pump is an extremely simple mechanism mechanically, but rather complex hydraulically, in that many factors enter into the design of the impeller and water ways which will affect the pump's efficiency.

DISPLACEMENT PUMPS: Rotary and piston pumps are termed "Positive Displacement" pumps because each revolution displaces or discharge (theoretically) an exact amount of liquid, regardless of the resistance. The capacity is, therefore, proportional to the number of revolutions of the pump per minute and independent of the discharge pressure except as it is reduced by "slip" (leakage past the pistons or rotors). For a given speed the power is directly proportional to the head. If the discharge is completely shut off, the pressure, power, and torque climb indefinitely until the drive power is stalled or breakage occurs.

Slip is the greatest factor affecting efficiency of a displacement pump, and this factor is greatly influenced by the condition of and wear on the working parts.

DEFINITIONS

HEAD OF WATER -- vertical depth of water measured in feet or in pressure per unit or area. In hydraulics, head always represents pressure and it is expressed interchangeably in feet of water or pounds per square inch and sometimes in inches of depth of mercury.

STATIC HEAD -- the pressure that is exerted by a stationary column of water of a given height or depth.

TOTAL HEAD OR TOTAL DYNAMIC HEAD -- the maximum height above the source of supply to which the pump would elevate the water plus all the resistance to flow in the pipe or hose line.

DISCHARGE HEAD -- the pressure measured at the discharge outlet of a pump.

SUCTION HEAD -- the positive pressure measured at the suction entrance of a pump (when pumping from an elevated tank or hydrant).

VELOCITY HEAD -- the equivalent pressure represented by fluid in motion as measured by means of a Pitot Gage.

STATIC LIFT -- the vertical height of the center of the pump above the source of supply (when pump from draft).

TOTAL SUCTION LIFT -- the static lift plus the friction in suction line plus entrance losses.

NET PUMP PRESSURE -- the total dynamic head of the pump.

EFFECTIVE NOZZLE PRESSURE -- the pump discharge pressure minus hose friction plus or minus the difference in elevation above or below pump.

WATER HORSEPOWER - the theoretical power required to deliver a given quantity of water per minute against a given head.

BRAKE HORSEPOWER -- Actual power as delivered by a motor or engine to a driven machine.

PUMP EFFICIENCY -- The quotient of the water horsepower divided by brake horsepower required to produce it.

WATER HAMMER -- a series of shock waves produced in a pipeline or pump by a sudden change in water velocity. A sudden change in flow velocity can result from rapid closure of valves. A pressure wave is set up which travels back and forth in the water column at extremely high speed producing rapid vibrations that may be violent and destructive if the water column is long.

THE MAXIMUM THEORETICAL LIFT of a pump is 34 feet, which is the pressure of the atmosphere at sea level. The maximum practical total lift at sea level is 20 to 25 feet (depending on the type and condition of the pump) and this decreases with drops in barometric pressure.

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CHIPPEWA FALLS, WI. AT 800-634-7812 or 715-726-2650**

CONVERSION FACTORS

One pound per square inch	=	2.31 feet of water
	=	2.04 inches of mercury
	=	27.7 inches of water
One foot of water	=	0.43 pounds per square inch
One inch of mercury	=	1.13 feet of water
	=	0.49 pounds per square inch
One cubic foot of water	=	62.4 pounds
	=	7.5 gallons
One gallon of water	=	231 cubic inches
	=	0.13 cubic feet
	=	8.34 pounds
	=	3.8 liters
One Imperial Gallon	=	1.2 U.S. gallons
Atmospheric Pressure (Sea Level)	=	14.8 pounds per square inch
	=	29.9 inches of mercury
	=	34 feet of water

**TABLE NO. 1
NFPA 1901 TEST**

Class A							
TEST No.	GPM	Recom- mended Nozzles	Min. Nozzle Press. PSI	Min. Disch. Press. PSI	Min. Net Pump Press. PSI	Disch. Lines	Suction Hose
250 GPM Fire Pump							
1	250	(1), 1"	72	143	150		
2	175	(1), 7/8"	62	194	200	(1), 50'	20' of 3"
3	125	(1), 3/4"	56	244	250		
4	250	(1), 1"	72	158	165		
350 GPM Fire Pump							
1	350	(1), 1-1/4"	58	144	150		
2	245	(1), 1"	69	195	200	(1), 50'	20' of 4"
3	175	(1), 7/8"	62	245	250		
4	350	(1), 1-1/4"	58	159	165		
500 GPM Fire Pump							
1	500	(1), 1-1/2"	57	143	150	(1), 50'	
2	350	(1), 1-1/4"	58	194	200		20' of 4"
3	250	(1), 1"	72	245	250		
4	500	(1), 1-1/2"	57	158	165		
750 GPM Fire Pump							
1	750	(1), 1-3/4" or (2), 1-1/4"	68 66	142	150	(2), 50'	
2	525	(1), 1-1/2"	62	193	200	or	20' of 4-1/2"
3	375	(1), 1-1/4"	66	244	250	(2), 100'	
4	750	(1), 1-3/4" or (2), 1-1/4"	68 66	157	165	Siamesed	
1000 GPM Fire Pump							
1	1000	(1), 2" or (2), 1-1/2"	71 57	142	150	(2), 50'	
2	700	(1), 1-3/4" or (2), 1-1/4"	60 58	193	200	or	20' of 5"
3	500	(1), 1-1/2"	57	244	250	(3), 100'	
4	1000	(1), 2" or (2), 1-1/2"	71 57	157	165	Siamesed	

Min. discharge pressures listed above are for pumps operating with full 10' static suction lift. These pressures must be increased by 1 PSI for each 2.3 ft. less than 10' of lift.

**TABLE NO. 1
NFPA 1901 TEST**

Class A							
TEST No.	GPM	Recom- mended Nozzles	Min. Nozzle Press. PSI	Min. Disch. Press. PSI	Min. Net Pump Press. PSI	Disch. Lines	Suction Hose
1250 GPM Fire Pump							
1	1250	(1), 2-1/4" or (2), 1-1/2"	69 88	143	150	(3), 50'	20' of 6"
2	875	(1), 2" or (2), 1-3/8"	55 61	194	200	or (3), 100'	
3	625	(1), 1-1/2" 2-1/4"	88 69	245	250	and (1), 50'	
4	1250	or (2), 1-1/2"	88	158	165	Siamesed	
1500 GPM Fire Pump							
1	1500	(2), 1-3/4" or (3), 1-1/2"	68 57	142	150	(3), 50'	20' of
2	1050	(1), 2" or (2), 1-1/2"	78 62	194	200	or (3), 100'	6" Min or
3	750	(1), 1-3/4" or (2), 1-1/4"	68 66	245	250	and (1), 50'	(2) 20' of
4	1500	(2), 1-3/4" or (3), 1-1/2"	68 57	157	165	Siamesed	6" Max

Min. discharge pressures listed above are for pumps operating with full 10' static suction lift. These pressures must be increased by 1 PSI for each 2.3 ft. less than 10' of lift.

**TABLE NO. 1
NFPA 1901 TEST**

Class A							
TEST No.	GPM	Recom- mended Nozzles	Min. Nozzle Press. PSI	Min. Disch. Press. PSI	Min. Net Pump Press. PSI	Disch. Lines	Suction Hose
1750 GPM Fire Pump							
1	1750	(2), 2" or (3), 1-1/2" (2), 1-5/8" or	55 76 61	143	150	(4), 50'	(2) 20' of 6"
2	1225	(2), 1-1/2" or (3), 1-1/4"	84 79	194	200	or	
3	875	(1), 2" or (2), 1-3/8" (2), 2" or	55 61 55	245	250	(4), 100'	
4	1750	(3), 1-1/2"	76	158	165		
2000 GPM Fire Pump							
1	2000	(2), 2" or (4), 1-1/2" (2), 1-3/4" or	71 57 60	147	150	(4), 50'	(2) 20' of 6"
2	1400	(3), 1-1/2" (1), 2" or	49 71	199	200	or	
3	1000	(2), 1-1/2" (2), 2" or	57 71	249	250	(4), 100'	
4	2000	(4), 1-1/2"	57	163	165		
2250 GPM Fire Pump							
1	2250	(2), 2-1/4"	56	144	150	(2 Groups) (3), 100'	20' of 8"
2	1575	(2), 1-3/4"	76	196	200	Siamesed	
3	1125	(2), 1-1/2"	72	246	250		
4	2250	(2), 2-1/4"	56	153	165		

Min. discharge pressures listed above are for pumps operating with full 10' static suction lift. These pressures must be increased by 1 PSI for each 2.3 ft. less than 10' of lift.

**TABLE NO. 1
NFPA 1901 TEST**

Class A							
TEST No.	GPM	Recom- mended Nozzles	Min. Nozzle Press. PSI	Min. Disch. Press. PSI	Min. Net Pump Press. PSI	Disch. Lines	Suction Hose
2500 GPM Fire Pump							
1	2500	(2), 2-1/4"	69	144	150	(2 Groups) (3), 100'	20' of 8"
2	1750	(2), 2"	55	195	200	Siamesed	
3	1250	(2), 1-1/2"	88	246	250		
4	2500	(2), 2-1/4"	69	159	165		
3000 GPM Fire Pump							
1	3000	(2), 2-1/2"	65	146	150	(2 Groups) (3), 100'	(2) 20' of 8"
2	2100	(2), 2"	78	196	200	Siamesed	
3	1500	(2), 1-3/4"	68	247	250		
4	3000	(2), 2-1/2"	65	161	165		
3000 GPM Industrial Fire Pump							
1	3000	(2), 2-1/2"	65	96	100	(2 Groups) (3), 100'	(2) 20' of 8"
2	2100	(2), 2"	78	146	150	Siamesed	
3	1500	(2), 1-3/4"	68	197	200		
3500 GPM Industrial Fire Pump							
1	3500	(2), 2-1/2" and (1), 2-1/4"	45 44	95	100	(2 Groups) (3), 100' Siamesed	(2) 20' of 8"
2	2450	(2), 2-1/4"	67	146	150	& (2)-50'	
3	1750	(2), 2"	55	197	200	Siamesed	

Min. discharge pressures listed above are for pumps operating with full 10' static suction lift. These pressures must be increased by 1 PSI for each 2.3 ft. less than 10' of lift.

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

TABLE NO. 2
DISCHARGE FROM SMOOTH BORE NOZZLE
Pressures measured by Pitot gage.

Nozzle Pressure PSI	1/4	3/8	1/2	5/8	3/4	7/8	1	1 1/8	1 1/4	1 3/8	1 1/2	1 5/8	1 3/4	2	2 1/4	2 1/2
	GALLONS PER MINUTE DELIVERED															
5	4	9	16	26	37	50	66	84	103	125	149	175	203	266	337	415
6	4	10	18	28	41	55	72	92	113	137	163	192	223	292	369	455
7	4	11	19	30	44	59	78	99	122	148	176	207	241	315	399	491
8	5	11	21	32	47	64	84	106	131	158	188	222	257	336	427	525
9	5	12	22	34	50	67	89	112	139	168	200	235	273	357	452	557
10	6	13	23	36	53	71	93	118	146	177	211	248	288	376	477	587
12	6	15	25	40	58	78	102	130	160	194	231	271	315	412	522	643
14	7	15	27	43	63	84	110	140	173	210	249	293	340	445	564	695
16	7	16	29	46	67	90	118	150	185	224	267	313	364	475	603	743
18	7	17	31	49	71	95	125	159	196	237	283	332	386	504	640	788
20	8	18	33	51	75	101	132	167	206	250	298	350	407	532	674	830
22	8	19	34	54	79	105	139	175	216	263	313	367	427	557	707	871
24	8	20	36	56	82	110	145	183	226	275	327	384	446	582	739	909
26	9	21	37	59	85	115	151	191	235	286	340	400	464	606	769	947
28	9	21	39	61	89	119	157	198	244	297	353	415	481	629	799	982
30	10	22	40	63	92	123	162	205	253	307	365	429	498	651	826	1017
32	10	23	41	65	95	127	167	212	261	317	377	443	514	673	854	1050
34	11	23	43	67	98	131	172	218	269	327	389	457	530	693	880	1082
36	11	24	44	69	100	135	177	224	277	336	400	470	546	713	905	1114
38	11	25	45	71	103	138	182	231	285	345	411	483	561	733	930	1144
40	11	26	46	73	106	142	187	237	292	354	422	496	575	752	954	1174
42	11	26	47	74	109	146	192	243	299	363	432	508	589	770	978	1203
44	12	27	49	76	111	149	196	248	306	372	442	520	603	788	1000	1231
46	12	28	50	78	114	152	200	254	313	380	452	531	617	806	1021	1259
48	12	28	51	80	116	156	205	259	320	388	462	543	630	824	1043	1286
50	13	29	52	81	118	159	209	265	326	396	472	554	643	841	1065	1313
52	13	29	53	83	121	162	213	270	333	404	481	565	656	857	1087	1339
54	13	30	54	84	123	165	217	275	339	412	490	576	668	873	1108	1364
56	13	30	56	86	125	168	221	280	345	419	499	586	680	889	1129	1389
58	13	31	56	87	128	171	225	285	351	426	508	596	692	905	1149	1414
60	14	31	57	89	130	174	229	290	357	434	517	607	704	920	1168	1437
62	14	32	58	90	132	177	233	295	363	441	525	617	716	936	1187	1462
64	14	32	59	92	134	180	237	299	369	448	533	627	727	951	1206	1485
66	14	33	60	93	136	182	240	304	375	455	542	636	738	965	1224	1508
68	14	33	60	95	138	185	244	308	381	462	550	646	750	980	1242	1531
70	15	34	61	96	140	188	247	313	386	469	558	655	761	994	1260	1553
72	15	34	62	97	142	191	251	318	391	475	566	665	771	1008	1278	1575
74	15	35	63	99	144	193	254	322	397	482	574	674	782	1023	1296	1597
76	15	35	64	100	146	196	258	326	402	488	582	683	792	1036	1313	1618
78	15	36	65	101	148	198	261	330	407	494	589	692	803	1050	1330	1639

TABLE NO. 2
DISCHARGE FROM SMOOTH BORE NOZZLE
Pressures measured by Pitot gage.

Nozzle Pressure PSI	1/4	3/8	1/2	5/8	3/4	7/8	1	1 1/8	1 1/4	1 3/8	1 1/2	1 5/8	1 3/4	2	2 1/4	2 1/2
	GALLONS PER MINUTE DELIVERED															
80	16	36	66	103	150	201	264	335	413	500	596	700	813	1063	1347	1660
82	16	37	66	104	152	204	268	339	418	507	604	709	823	1076	1364	1681
84	16	37	67	105	154	206	271	343	423	513	611	718	833	1089	1380	1701
86	16	37	68	107	155	208	274	347	428	519	618	726	843	1102	1396	1721
88	16	38	69	108	157	211	277	351	433	525	626	735	853	1115	1412	1741
90	17	39	70	109	159	213	280	355	438	531	633	743	862	1128	1429	1761
92	17	39	70	110	161	215	283	359	443	537	640	751	872	1140	1445	1780
94	17	39	71	111	162	218	286	363	447	543	647	759	881	1152	1460	1800
96	17	40	72	113	164	220	289	367	452	549	654	767	890	1164	1476	1819
98	17	40	73	114	166	223	292	370	456	554	660	775	900	1176	1491	1838
100	18	41	73	115	168	225	295	374	461	560	667	783	909	1189	1506	1856
105	18	42	75	118	172	230	303	383	473	574	683	803	932	1218	1542	1902
110	19	43	77	121	176	236	310	392	484	588	699	822	954	1247	1579	1947
115	19	43	79	123	180	241	317	401	495	600	715	840	975	1275	1615	1991
120	19	44	80	126	183	246	324	410	505	613	730	858	996	1303	1649	2033
125	20	45	82	129	187	251	331	418	516	626	745	876	1016	1329	1683	2075
130	20	46	84	131	191	256	337	427	526	638	760	893	1036	1356	1717	2116
135	21	47	85	134	195	262	343	435	536	650	775	910	1056	1382	1750	2157
140	21	48	87	136	198	266	350	443	546	662	789	927	1076	1407	1780	2196
145	21	49	88	139	202	271	356	450	556	674	803	944	1095	1432	1812	2235
150	22	50	90	141	205	275	362	458	565	686	817	960	1114	1456	1843	2273

TABLE NO. 3
Approximate Discharge Flow From Different Nozzles
At the end of Fifty Feet of Average, 2 1/2”
Rubber Lined Fire Hose, for Various
Pump Pressures with Discharge
Valve Wide Open

PUMP PRESSURE LBS	SIZE OF NOZZLE & GALLONS PER MINUTE						
	3/4	7/8	1	1 1/8	1 1/4	1 3/8	1 1/2
30	90	119	153	187	217	250	282
40	103	137	177	216	253	290	327
50	115	153	198	242	284	325	367
60	126	168	216	265	311	357	402
70	136	182	234	287	337	385	435
80	145	194	250	308	361	414	465
90	154	206	265	325	383	437	492
100	162	217	280	343	405	462	520
110	171	228	295	360	425	485	549
120	179	239	307	377	444	510	572
130	186	249	318	392	462	530	596
140	193	258	330	407	480	549	618
150	200	267	341	421	497	567	
175	215	288	374	455	538		
200	230	309	395	486			
225	243	328	420				
250	257	345					

This table is offered as an aide in testing pump performance where facilities for accurate measurement of capacity are not available. The capacities given above are conservative, and will not vary more than 5% from actual capacities with any of the standard hose that might be used.

TABLE NO. 4

**Pump or Hydrant Pressure required to give
Effective Nozzle Pressure through various
Lengths of Rubber Lined Hose.**

Size of Hose		1				1 1/2		2		2 1/2				3	
Size of Nozzle		1/4	3/8	1/2	5/8	5/8	3/4	3/4	7/8	1	1 1/4	1 1/2	1 1/4	1 1/2	
Nozzle Press PSI	Length of Hose Feet	PUMP OR HYDRANT PRESSURE - PSI													
40	100	45	43	48	60	42	50	44	46	51	64	88	51	62	
	200	49	46	56	79	43	60	47	52	60	86	130	59	78	
	400	58	51	73	118	46	79	53	62	79	129	212	75	110	
	600	67	57	89	158	50	99	59	74	97	172		92	143	
	800	76	62	106	196	53	119	65	85	116	215		108	176	
	1000	85	68	122	235	56	138	72	96	134	258		124	208	
	1500	108	72	142		64	187	87	118	181			165		
	2000	130	96	204		72	226	103	151	227			205		
60	100	67	64	72	89	63	73	65	69	75	95	132	76	92	
	200	74	68	84	117	65	86	70	78	89	126	196	88	115	
	400	87	76	107	173	69	112	79	94	116	188		111	161	
	600	101	85	131	231	74	138	88	111	143	250		135	208	
	800	114	93	153		79	164	98	127	170			158		
	1000	127	101	178		83	190	107	143	197			182		
	1500	161	122	237		95	155	130	184	264					
	2000	195	142			106		153	225						
80	100	88	85	96	117	83	99	87	92	99	126	175	101	103	
	200	97	91	112	154	86	117	93	103	115	167		116	154	
	400	115	102	143	228	92	154	105	125	148	249		147		
	600	132	112	174		98	191	117	147	181			178		
	800	150	123	206		104	228	129	167	214			209		
	1000	167	134	238		110		141	191	247					
	1500	211	161			125		171	245						
	2000	254	188			140		201							
100	100	111	107	120	146	104	123	108	115	125	157		126	152	
	200	122	113	139	192	108	145	116	128	150	209		146	190	
	400	143	127	177	284	115	190	130	154	200			184		
	600	165	140	217		123	235	145	180	250			223		
	800	186	154	256		131		159	206						
	1000	208	167			138		174	232						
	1500	262	200			157		211							
	2000		234			175		253							

**TABLE NO. 5
REACH OF FIRE STREAMS**

Size of Nozzle	1/4"	3/8"	1/2"	5/8"	3/4"	7/8"	1"	1-1/4"	1-1/2"
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**NOZZLE
PRESSURE EFFECTIVE VERTICAL REACH - Feet**

40	30	35	40	50	59	62	64	65	69
60	35	40	45	60	74	77	79	84	87
80	38	42	48	65	81	85	89	94	96
100	40	44	50	68	84	89	94	100	102

**NOZZLE
PRESSURE MAXIMUM VERTICAL REACH - Feet**

40	60	65	70	75	78	79	80	80	80
60	70	75	85	95	105	106	108	110	110
80	78	83	95	105	117	125	132	140	140
100	80	88	100	110	122	135	145	155	155

**NOZZLE
PRESSURE EFFECTIVE HORIZONTAL REACH - Feet**

40	20	25	30	40	44	50	55	62	66
60	25	32	37	50	54	61	67	75	80
80	28	35	40	57	62	70	76	84	88
100	30	37	42	60	66	76	84	93	95

**NOZZLE
PRESSURE MAXIMUM HORIZONTAL REACH - Feet**

40	65	80	90	100	108	120	125	138	140
60	80	95	95	120	127	142	156	176	183
80	90	105	105	135	143	160	175	201	210
100	95	110	110	140	153	180	205	215	223

TABLE NO. 6
Friction Loss in Fire Hose
 Loss in PSI per 100 Feet of Hose

SIZE HOSE G.P.M.	LINEN HOSE			BEST RUBER LINED HOSE							
	1 1/2	2	2 1/2	3/4	1	1 1/2	2	2 1/2	3	3 1/2	(2)-2 1/2
10	1.0			13.5	3.5	0.5	.1				
15	2.2			29.0	7.2	1.0	0.3				
20	3.6			50.0	12.3	1.7	0.4				
25	5.5			75.0	18.5	2.6	0.6				
30	8.0	1.9		105.0	26.0	3.6	0.9				
40	13.0	3.2		180.0	44.0	6.1	1.5				
50	20.0	4.9	1.6		67.0	9.3	2.3				
60	28.0	7.0	2.2		96.0	13.5	3.3				
70	37.0	9.0	3.1		131.0	17.0	4.3				
80	47.0	11.5	3.8		171.0	23.0	5.6				
90	59.0	14.5	5.0		217.0	29.0	7.0				
100	72.0	17.5	5.9		268.0	33.0	8.4				
120		25.0	8.3		386.0	47.0	11.7				
140		34.0	11.0			62.0	16.0	5.2	2.0	0.9	1.4
160		43.0	14.0			78.0	20.0	6.6	2.6	1.2	1.9
180		53.0	17.7			97.0	25.0	8.3	3.2	1.5	2.3
200		63.0	21.5			121.0	30.6	10.1	3.9	1.8	2.8
220						146.0		12.0	4.6	2.1	3.3
240						173.0		14.1	5.4	2.5	3.9
260						204.0		16.4	6.3	2.9	4.5
280						237.0		18.7	7.2	3.3	5.2
300						272.0		21.2	8.2	3.7	5.9
320								23.8	9.3	4.2	6.6
340								26.9	10.5	4.7	7.4
360								30.0	11.5	5.2	8.3
380								33.0	12.8	5.8	9.2
400								36.2	14.1	6.3	10.1
425								40.8	15.7	7.0	11.3
450								45.2	17.5	7.9	12.5
475								50.0	19.3	8.7	13.8
500								55.0	21.2	9.5	15.2
525									23.2	10.5	16.6
550									25.2	11.4	18.1
575									27.5	12.4	19.6
600									29.9	13.4	21.2
650									34.5	15.5	24.8
700									39.5	17.7	28.3
750									45.0	20.1	32.2
800									50.5	22.7	36.2
850									56.5	25.4	40.7
900									63.0	28.2	45.2
1000									76.5	34.3	55.0

Losses in rough walled, rubber hose may be 50% higher than values given above.

TABLE NO. 7
Friction Loss in 15-year-old Steel Pipe
 Loss in PSI per 100 Feet of Pipe

PIPE SIZE G.P.M.	1/8	1/4	3/8	1/2	3/4	1	1 1/4	1 1/2	2	2 1/2	3	4	6	8
1	52.0	12.0	2.8	0.9										
2		45.0	10.0	3.2	4.0									
5			55.0	18.0	4.5	1.4	0.4							
10				64.0	16.0	5.0	1.3	0.6						
15				135.0	34.0	11.0	2.7	1.3	0.5					
20					59.0	18.0	4.7	2.2	0.8					
25					89.0	27.0	7.1	3.4	1.2					
30					125.0	39.0	10.0	4.7	1.7	0.6				
35						51.0	13.0	6.3	2.2	0.7				
40						66.0	17.0	8.0	2.9	0.9				
45						82.0	21.0	10.0	3.6	1.2				
50						99.0	26.0	12.0	4.3	1.4	0.6			
60						140.0	38.0	17.0	6.1	2.0	0.8			
70							49.0	23.0	8.0	2.7	1.1			
80							63.0	29.0	10.0	3.4	1.5			
90							78.0	36.0	13.0	4.3	1.8			
100							96.0	44.0	15.0	5.1	2.2	0.5		
125							144.0	66.0	24.0	7.8	3.3	0.8		
150								93.0	33.0	11.0	4.6	1.1		
175								125.0	44.0	15.0	6.1	1.5		
200									56.0	19.0	7.8	1.9		
250									84.0	28.0	12.0	2.9		
300									114.0	40.0	16.0	4.0	0.6	
350										53.0	22.0	5.4	0.8	
400										68.0	28.0	6.9	1.0	
450										84.0	35.0	8.6	1.2	
500										102.0	42.0	10.0	1.4	0.4
600											60.0	15.0	2.1	0.6
800												25.0	3.5	1
1000												37.0	5.2	1.3
1500													11.0	2.7
2000													19.0	4.7
2500													29.0	7.1
3000														10

TABLE NO. 8
Resistance of Fittings
Equivalent Lengths of Straight Pipe - Feet

PIPE SIZE	1/2	3/4	1	1 1/4	1 1/2	2	2 1/2	3	4	5	6	8
Gate Valve	0.4	0.6	0.8	1.1	1.4	1.8	2.2	2.8	4.1	5.3	6.7	9.4
Global Valve	3.0	4.5	6.0	8.5	10.5	14.0	17.0	22.0	32.0	42.0	53.0	75.0
Angle Valve	1.4	2.0	2.7	3.8	4.8	6.3	7.9	10.5	14.5	18.5	23.0	33.0
Std. Elbow	1.1	1.5	2.0	2.8	3.5	4.7	5.8	7.5	11.0	14.0	18.0	24.0
45 Elbow	0.6	0.8	1.0	1.4	1.6	2.1	2.5	3.1	4.2	5.2	6.3	8.5
Long Sweep EI Str Run Tee	0.5	0.8	1.0	1.4	1.7	2.3	2.8	3.7	5.3	7.0	9.0	12.5
Std. Tee Thru Side Outlet	2.1	2.9	3.9	5.5	6.9	9.1	11.6	14.8	21.0	27.0	34.0	49.0
Sudden Enlarg or contraction	1.8	2.5	3.2	4.2	5.0	6.5	7.5	9.5	13.0	16.0	19.0	25.0
Entrance to Pipe	1.0	1.3	1.6	2.2	2.6	3.3	3.9	4.9	6.5	8.2	10.0	13.0

TABLE NO. 9
To Convert Pounds per Square Inch to
Feet Elevation of Water

2.308ft head = 1.0 psi
1ft head = .433psi

Feet	5	10	15	20	25	30	35	40	45	50	60	70	80	90
Pounds	2.2	4.3	6.5	8.7	11	13	15	17	20	22	26	30	35	39
Feet	100	120	130	140	150	160	170	180	190	200	220	240	260	280
Pounds	43	52	56	61	65	69	74	78	82	87	95	104	113	121
Feet	300	320	340	360	380	400	425	450	475	500	525	550	600	700
Pounds	130	139	147	156	165	173	184	195	206	217	227	238	260	303

Table NO. 10
American National Fire Hose Connection Screw Thread - NH

Size of Hose	4-Mar	1	1 1/2	2 1/2	3	3 1/2	4	4 1/2	5	6	8
Thr'ds per inch	8	8	9	7.5	6	6	4	4	4	4	4
Thread Designation	0.75-8 NH	1-8 NH	1.5-9 NH	2.5-7.5 NH	3-6 NH	3.5-6 NH	4-4 NH	4.5-4 NH	5-4 NH	6-4 NH	8-4 NH
Max. O.D. Male	1.375	1.375	1.99	3.0686	3.6239	4.2439	5.0109	5.7609	6.26	7.025	9.05

Ref. NFPA 1963

Underwriters Nozzle Tip Thread: 2.1875 O.D. - 12 threads per inch.

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.

OPERATING INSTRUCTIONS - ELECTRIC PRIMING PUMP

The Darley electric primer will develop up to 25 in. Hg. in an air tight pumping system.

The Primer is activated by a combination spring return on-off valve and electric switch. Pulling the valve out opens the valve and closes the electrical circuit to start the motor.

Before the pump can be primed, booster line valves, drain valves, cooling line valve, and all other openings into the pump must be closed and absolutely air tight. The discharge side of the pump is sealed by a check valve, therefore the main discharge valves need not be closed.

When operating from draft, suction hose connections must be tight and free of air leaks.

Make certain the suction hose strainer is properly submerged and free of foreign material.

The main pump drive should remain disengaged until priming is complete to prevent possible damage to impeller seal rings by running "dry".

Pull the primer shutoff valve all the way out to start priming and hold open until water discharges from primer pump exhaust port. Push valve all the way in to shut off primer motor and seal tight.



CAUTION: FOR PRIMING UP TO 10' OF LIFT:

If water does not discharge from the primer exhaust within about 30 seconds (45 seconds with 2 – 20' lengths of hose) stop the primer pump, check for air leaks and make sure primer pump is receiving lubricant from its reservoir, if one is present. **MAX PRIMER OPERATION TIME = 90 seconds every 5 minutes. DO NOT EXCEED 90 SECONDS OF PRIMER OPERATION.**



CAUTION: FOR PRIMING 10' OF LIFT AND HIGHER:

If water does not discharge from the primer exhaust within 90 seconds stop the primer pump, check for air leaks and make sure primer pump is receiving lubricant from its reservoir, if one is present. **DO NOT EXCEED 90 SECONDS OF PRIMER OPERATION.**



CAUTION: The primer pump and motor will begin to generate heat as soon as operation begins. Extended run times (up to 90 seconds) and repeating priming cycles consecutively or within short time periods may lead to premature failure of the primer pump assembly: such failures include but are not limited to: overheating of the motor, seizure of the rotor, and cracking of primer vanes. To avoid this, after your first priming attempt, thoroughly inspect the pump system for air leaks, check that the primer is

receiving lubricant from its reservoir if such is present, and resolve the issue before attempting re-prime.

Engage “Pump” shift to start pumping water.

When pumping from hydrants, the primer is not needed and must be kept closed.

It may be necessary to use the primer momentarily when pumping from a booster tank when the suction head is insufficient to force all the air out of the pump.

LUBRICATING SYSTEM - ELECTRIC PRIMING PUMPS WITH FLUID RESERVOIR

The electric motor rotary van primer pump creates a high vacuum by continuous lubrication of rotor and vanes. Therefore the primer lubricant supply tanks (4 quarts) should be kept full at all times. Recommended primer system lubricant is Darley PRIME GREEN. PRIME GREEN is an environmentally safe, non-toxic, biodegradable lubricant. Its use assures proper primer vane lubricant while minimizing environmental effects.

After the main pump is drained, run the primer motor to drain primer lines and re-lubricate the primer pump.

The vent hole on the lubricant tank cap should be kept open at all times to prevent siphoning lubricant from the tank after the pump is stopped. Do not increase the size of the hole.

Locate the lubricant tank where it may be conveniently inspected and filled.

Should water appear in the lubricant supply tank, the primer valve is leaking. Check and replace valve plug seal o-ring if necessary.

ELECTRIC PRIMING PUMPS WITHOUT FLUID RESERVOIR

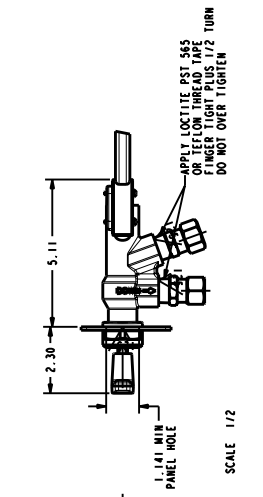
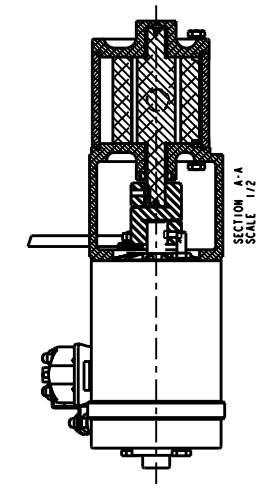
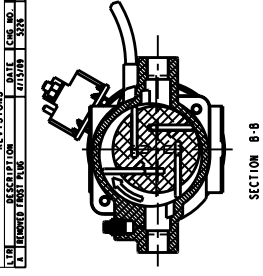
The fluidless electric-motor rotary-vane primer pump creates a high vacuum by using a special material for the vanes and an initial factory applied lubricant film. This film must be present in order for the primer to operate properly and to provide maximum life for the primer components.

This film should not wash away completely if the pump is used to pump clean water. If the priming pump is disassembled for any reason, all internal surfaces of the housing and end caps must be cleaned and coated completely with Dow Corning #111 Silicone valve lubricant prior to operating the primer. If a degradation of performance is noticed, performance may be restored by re-applying the film in this manner. It is recommended to service the primer annually to clean and re-apply the silicone film to the inside of the primer housing and end caps. Do not apply grease to the rotor slots, or the sides of the vanes.

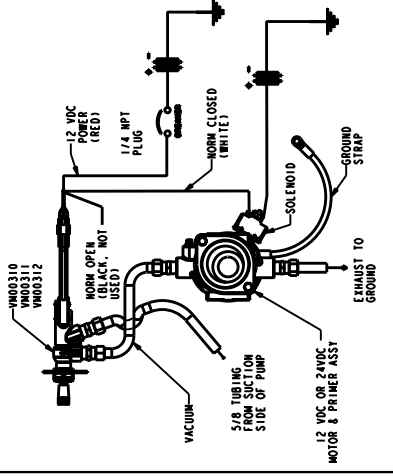
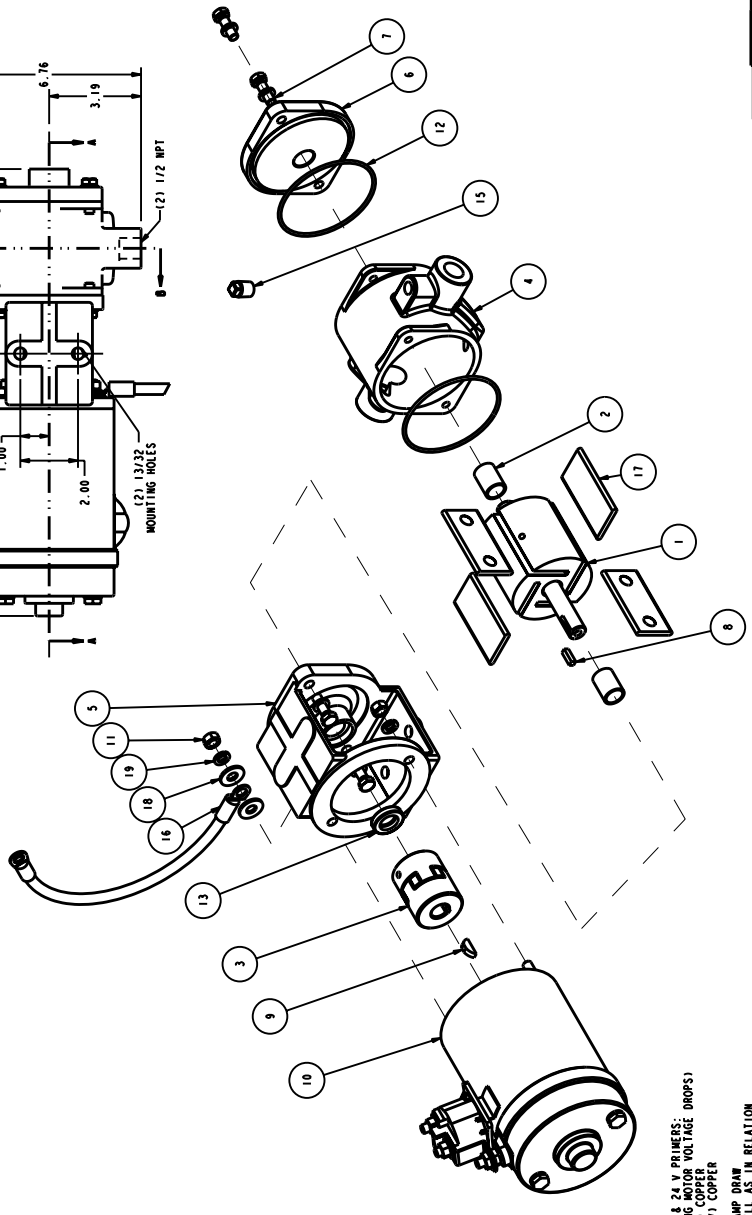
After the main pump is drained, run the primer motor to drain primer lines.

AN	DESCRIPTION	PART NO.	QTY.
1	ASSEMBLY - PRIMER, MOTOR	4220105	1
2	BEARING - OILITE, 0.625 ID	1760023	2
3	COUPLING - 844093	2404500	1
4	CYLINDER - VACUUM PUMP	020800	1
5	HEAD - CYLINDER INBOARD	200800	1
6	HEAD - CYLINDER, OUTBOARD	200800	1
7	SHIMS - .313-18 X 1.00 SST	540610	4
8	KEY - .50, 0.19 X 0.62 GR2	3602425	1
9	KEY - WOODRUFF, .606	3602200	1
10	MOTOR - PRIMER, 12V	4223400	1
11	NUT - HEX, .313-15, SST	5403024	2
12	O-RING - 3.50 X 3.69 X 0.69	3801101	2
13	OIL SEAL - 0.625 ID X 1.128 OD	3800305	1
14	PLUG - PIPE, 0.250, BR, 50, 10	080504	1
15	STRAP - GROUND, 12V PRIMER	080516	1
16	WASHER - FLAT, 5/16, STEEL	3403802	2
17	WASHER - LOCK, 0.313 ID	3403502	6

REV.	DESCRIPTION	DATE	BY	CHKD.	APP.
1	REVISED FOR USER				



NOTE:
 - FOR CROSS SECTION AND EXPLODED VIEW DRAWING SEE WORKING DRAWING 8-DVC0207.
 - THIS NEW VERSION OF THIS VALVE WITH BUSHING 7162500 CAN BE USED TO RETROFIT IT TO THE EXISTING PANEL.



NOTE:
 MOUNT WITH EXHAUST OUTLET DOWN
 CONNECT 4 GA COPPER GROUND STRAP TO CLEAN, PAINT FREE GROUNDING SURFACE IF SUPPLIED GROUND STRAP IS REMOVED FROM ASSEMBLY, RETIGHTEN CYLINDER HEAD ADAPTER TO 90 IN.-LB.
 POSITIVE LEAD WIRE SIZES FOR 12 V & 24 V PRIMERS:
 0 - 10 AMP STANDARD (12V), 12 AWG COPPER (VOLTAGE DROPS)
 0 - 10 AMP (12V), 12 AWG COPPER
 0 - 10 AMP (24V), 12 AWG COPPER
 0 - 10 AMP (24V), 12 AWG COPPER
 THESE GAGE WIRES CORRESPOND WITH AMP DRAW REQUIREMENTS FOR GIVEN WIRE AS WELL AS IN RELATION TO RESISTANCE OVER GIVEN LENGTH.
 12 V = 240 AMP
 24 V = 140 AMP

WEIGHT = 27 LB. (12.1 KG)

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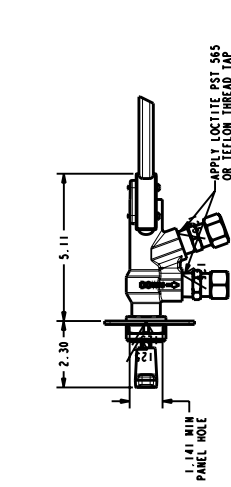
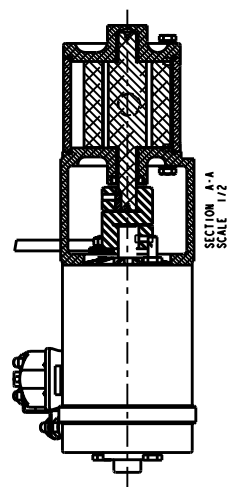
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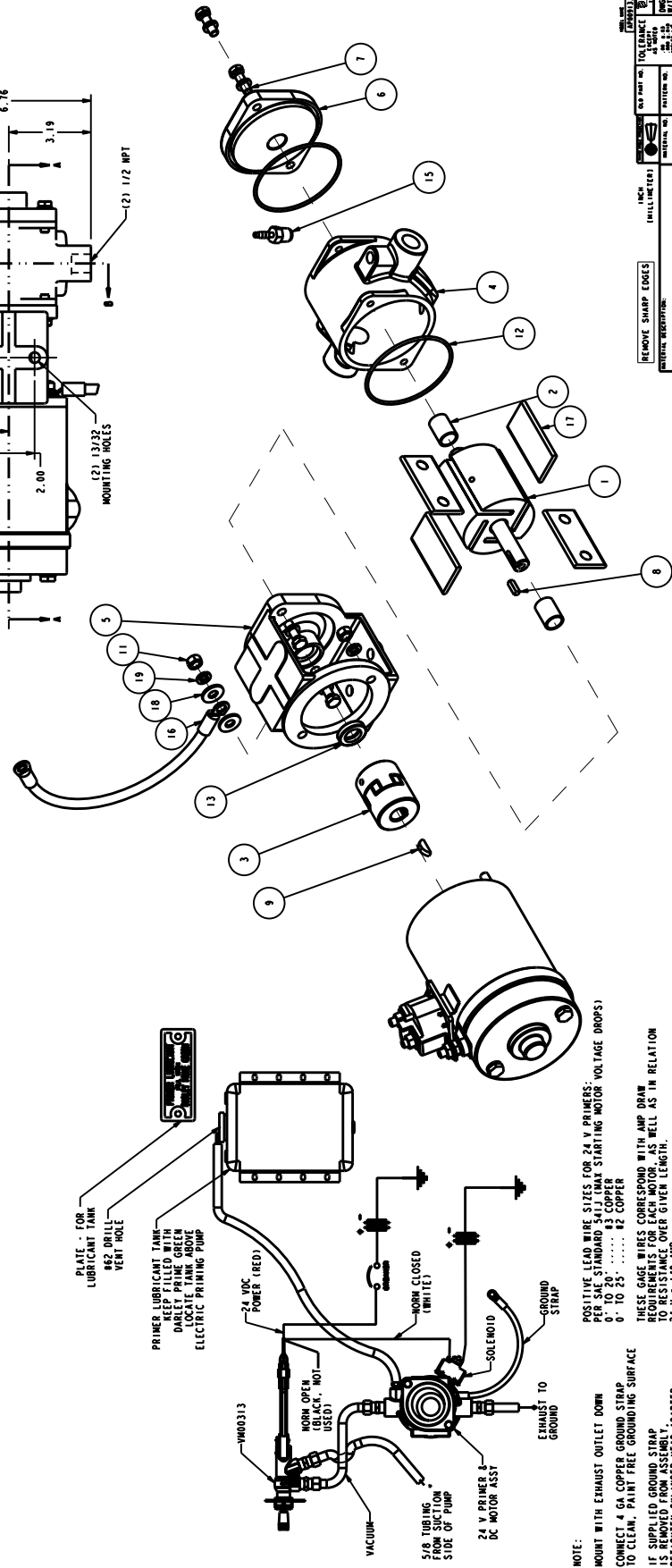
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1	ASSEMBLY - PRIMER, MOTOR	425105	1
2	BEARING - OILITE, 0.625 ID	176023	2
3	COUPLING - 844093	2404500	1
4	CYLINDER - VACUUM PUMP	1024800	1
5	HEAD - CYLINDER IMBOARD	200904	1
6	HEAD - CYLINDER, OUTBOARD	200900	1
7	NUCS - 313-18 X 1.00, SST	5408610	4
8	KEY - SO. 0.19 X 0.62 GR2	3602425	1
9	KEY - WOODRUFF, 606	3602200	1
10	MOTOR - PRIMER, 24V	4225500	1
11	MUT - MET. 313-15, SST	5403024	2
12	O-RING - 3.50 X 3.69 X 0.09	3601101	2
13	OIL SEAL - 0.625 ID X 1.128 OD	3600905	1
14	TUBE FITTING - STR. .25 X .19	3300021	1
15	STRAP - GROUND, 12V PRIMER	2600516	1
16	WASHER - FLAT, 5/16, STEEL	400760	4
17	WASHER - LOCK, 0.313 ID	3603502	2
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91	WASHER - LOCK, 0.313 ID	3603502	2
92	WASHER - LOCK, 0.313 ID	3603502	2
93	WASHER - LOCK, 0.313 ID	3603502	2
94	WASHER - LOCK, 0.313 ID	3603502	2
95	WASHER - LOCK, 0.313 ID	3603502	2
96	WASHER - LOCK, 0.313 ID	3603502	2
97	WASHER - LOCK, 0.313 ID	3603502	2
98	WASHER - LOCK, 0.313 ID	3603502	2
99	WASHER - LOCK, 0.313 ID	3603502	2
100	WASHER - LOCK, 0.313 ID	3603502	2

REVISIONS

NO.	DESCRIPTION	DATE	BY	CHKD.	APP.
1	REVISED FOR USE				



NOTE:
 FOR CROSS SECTION AND EXPLODED VIEW DRAWING
 SEE DRAWING DVC0203
 ALSO, WHEN REPLACING THE OLD VERSION OF THIS VALVE WITH
 THE NEW VERSION, THE NEW VALVE MUST BE USED TO RETROFIT
 IT TO THE EXISTING PANEL.



NOTE:
 MOUNT WITH EXHAUST OUTLET DOWN
 CONNECT 4 GA COPPER GROUND STRAP
 TO CLEAN, PAINT FREE GROUNDING SURFACE
 IF SUPPLIED GROUND STRAP
 RETIGHTEN CYLINDER HEAD ADAPTER
 RETAINING NUTS EQUALLY
 TO 90 IN. LB.

POSITIVE LEAD WIRE SIZES FOR 24 V PRIMERS:
 PER SAE STANDARD 541J (MAX STARTING MOTOR VOLTAGE DROPS)
 0 TO 20' #3 COPPER
 0 TO 25' #2 COPPER

THESE GAGE WIRES CORRESPOND WITH AMP DRAW
 REQUIREMENTS FOR EACH MOTOR, AS WELL AS IN RELATION
 TO 24 V = 140 AMP

WEIGHT : 27 LB (12.1 KG)

REMOVE SHARP EDGES

INCH DIMENSIONS

DO NOT SCALE PRINT

DVC0209

W.S. DARLEY & CO.

OPERATING INSTRUCTIONS - ELECTRIC PRIMING PUMP

PUSH BUTTON ELECTRIC ACTUATED VALVE

The Darley electric primer will develop up to 25 in. Hg. in an air tight pumping system.

The Primer is activated by a push button, 0.8 second cycle time, electric-actuated valve. This valve has three wires: ground (black), +12 or +24 VDC constant power (red), and +12 or +24 VDC energizing power (white). The valve has two internal micro-switches that cut the power to the valve when it is either fully closed or fully open. The push button is a simple SPST switch, that bypasses the red (constant power) wire with the white wire and energizes the valve to the open position when it is pushed; and cuts power to the white wire and resumes power to the red wire, closing the valve when it is released. When the button is pushed, the circuit for the primer motor is also completed, priming will begin instantaneously, and likewise when the button is released, the primer motor will shut off instantaneously.

Before the pump can be primed, booster line valves, drain valves, cooling line valve, and all other openings into the pump must be closed and absolutely air tight. The discharge side of the pump is sealed by a check valve; therefore the main discharge valves need not be closed.

When operating from draft, suction hose connections must be tight and free of air leaks.

Make certain the suction hose strainer is properly submerged and free of foreign material.

The main pump drive should remain disengaged until priming is complete to prevent possible damage to impeller seal rings by running "dry".

Push the primer/valve activation button, located on your control panel, and hold until water discharges from primer pump exhaust port.

If water does not discharge from primer exhaust within about 30 seconds (45 seconds with 2-20' lengths) stop primer pump, check for air leaks and make sure primer pump is receiving lubricant from its reservoir.

NOTE: Do not run the primer for more than one minute; it will burn up the motor, if prime is not reached within one minute, repeat the steps above.

Engage "Pump" shift to start pumping water.

When pumping from hydrants, the primer is not needed and must be kept closed.

It may be necessary to use the primer momentarily when pumping from a booster tank when the suction head is insufficient to force all the air out of the pump.

LUBRICATING SYSTEM - ELECTRIC PRIMING PUMPS WITH FLUID RESERVOIR

The electric motor rotary van primer pump creates a high vacuum by continuous lubrication of rotor and vanes. Therefore the primer lubricant supply tanks (4 quarts) should be kept full at all times. Recommended primer system lubricant is Darley PRIME GREEN. PRIME GREEN is an environmentally safe, non-toxic, biodegradable lubricant. Its use assures proper primer vane lubricant while minimizing environmental effects.

After the main pump is drained, run the primer motor to drain primer lines and re-lubricate the primer pump.

The vent hole on the lubricant tank cap should be kept open at all times to prevent siphoning lubricant from the tank after the pump is stopped. Do not increase the size of the hole.

Locate the lubricant tank where it may be conveniently inspected and filled.

Should water appear in the lubricant supply tank, the primer valve is leaking. Check and replace valve plug seal o-ring if necessary.

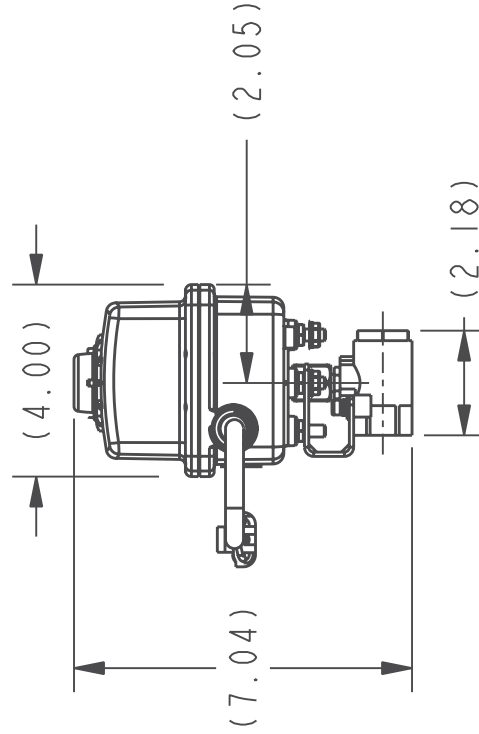
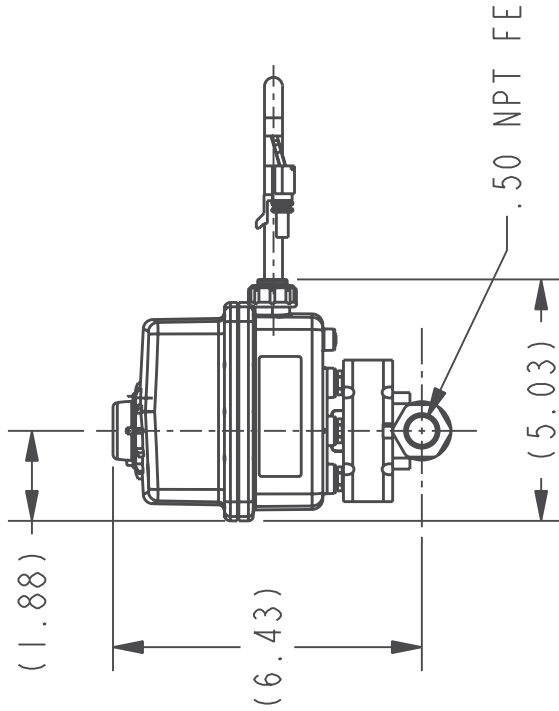
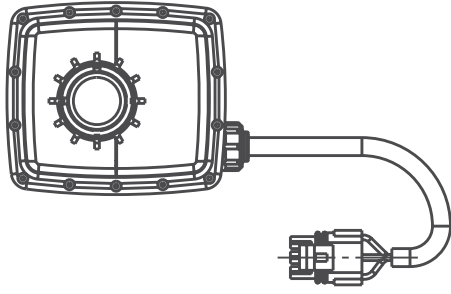
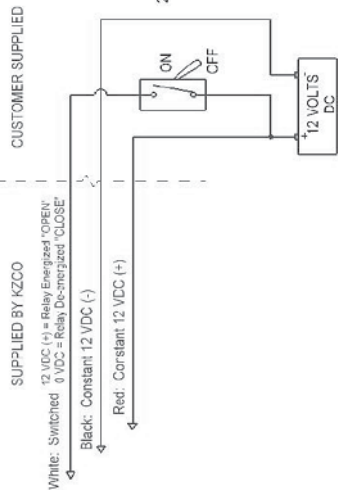
ELECTRIC PRIMING PUMPS WITHOUT FLUID RESERVOIR

The fluidless electric-motor rotary-vane primer pump creates a high vacuum by using a special material for the vanes and an initial factory applied lubricant film. This film must be present in order for the primer to operate properly and to provide maximum life for the primer components.

This film will not wash away completely if the pump is used to pump water. If the priming pump is disassembled for any reason, all internal surfaces of the housing and end caps must be coated completely with Dow Corning #111 Silicone valve lubricant prior to operating the primer. If after several years, a degradation of performance is noticed, performance may be restored by re-applying the film in this manner.

After the main pump is drained, run the primer motor to drain primer lines.

REVISIONS			
LTR	DESCRIPTION	DATE	CHG NO. APPR'D



MODEL NAME 5209401 MDL CREATED 11/13/08 SHEET 1/2 A

REMOVE SHARP EDGES		THIRD ANGLE PROJECTION		OLD PART NO.	TOLERANCE
INCH [MILLIMETER]					EXCEPT AS NOTED
MATERIAL DESCRIPTION: KZCO 84D23-10D20-PO1		MATERIAL NO.	PATTERN NO.		.00 ±.03 .000 ±.010 ANGLES ±1°
THIS DESIGN IS THE PROPERTY OF W.S. DARLEY AND CO. - UNAUTHORIZED REPRODUCTION IS PROHIBITED		DO NOT SCALE PRINT			DR'N RJG CHKD DWS TRCD
W.S. Darley & Co. ITASCA, IL - CHIPPEWA FALLS, WI		VALVE - ACTUATED, 12VDC, .50NPT FE KZCO 84D23-10D20-PO1		DATE 13-Nov-08	SCALE 1/4
5209401		5209401		5209401	
11/13/08		11/13/08		1/2	
A		A		A	

REVISED -24	REVISIONS 7/15/2008 9:41:57 AM	REVISIONS BY drc/mjl
----------------	-----------------------------------	----------------------------

ACTUATOR LABEL
MASSCO LABEL DESCRIPTION
"ACTUATOR, EH3 12/24 VDC"

ACTUATOR LABEL
MASSCO LABEL DESCRIPTION
"ACTUATOR, EH3 12/24 VDC"

INPUT/OUTPUT POWER - 1224 VDC
1 - BLACK - POWER (-) NEGATIVE
2 - RED - POWER (+) POSITIVE
3 - WHITE - SIGNAL (+) POSITIVE TO OPEN
4 - . . .

DIP SW 4 ON

RED MOTOR LEAD TO RED DOT

PIN A - RED
PIN B - BLACK
PIN C - WHITE

PROGRAM NOTE

SCALE .500

PROGRAM NOTE

SCALE .500

STANDARD TOLERANCES
ALL DIMENSIONS IN INCHES UNLESS OTHERWISE SPECIFIED

FINISHES: 20-30 RA
SLIP FIT ASSEMBLY
20-30 RA
20-30 RA

IDENTIFY BY LABEL OR MARKING
MATERIAL IDENTIFICATION

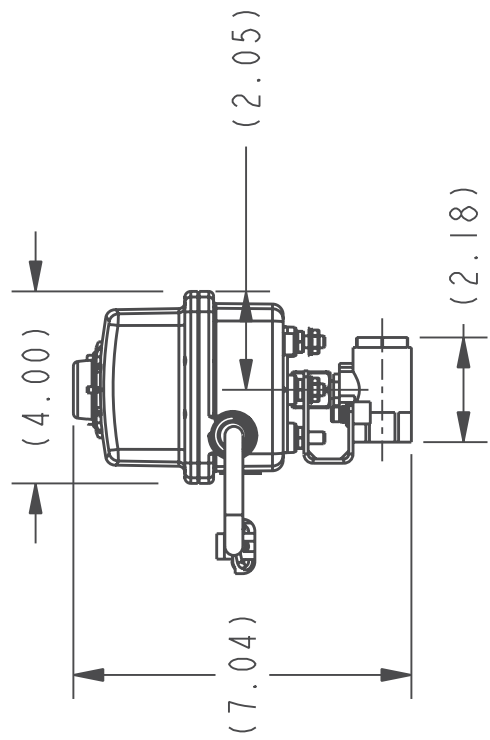
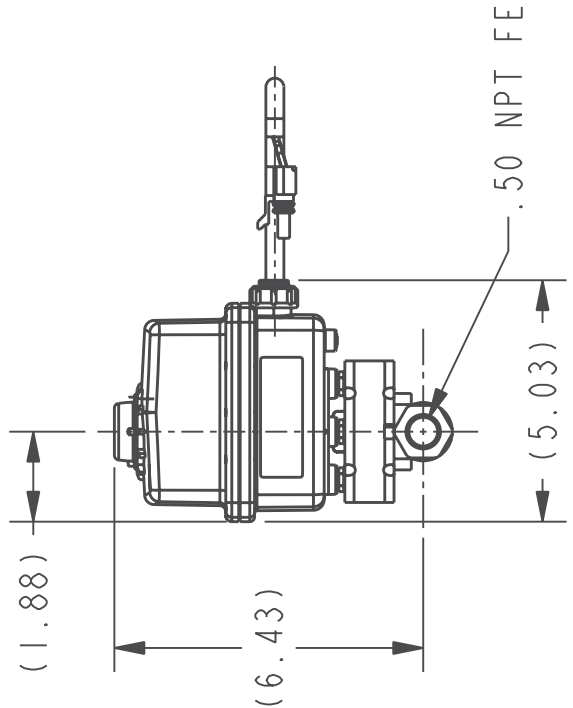
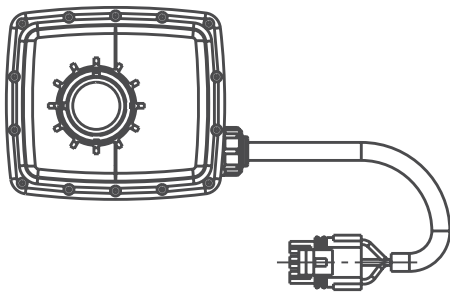
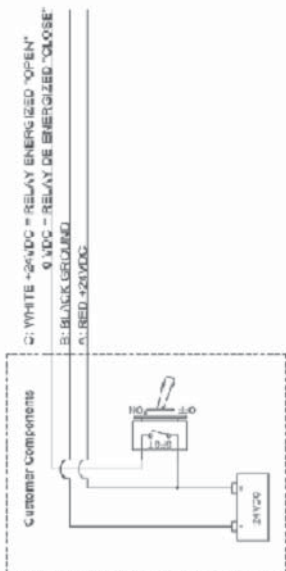
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FEEDBACK = 0
OPERATION = 0
MOTOR = M2
SPEED CT = 0.8
ZEROSSET = 135
RANGE TOLERANCE = 1
ROTATION = CCW
ACTUATOR RANGE = 0.00/0.00
DESIGN VOLTAGE = E
DIP SW = 3
LABEL = K2000
OPTIONS = 0
PLUS TYPE = P
TEST PLUG =

QTY	PART NUMBER	DESCRIPTION	MATERIAL
21	1	EH-502 LABEL, EH ACTUATOR, 2.8" X 1", THERMAL TRANSFER, WHITE	NO MATERIAL
20	1	800019 HARNESS, BMA SST, WYS122.5"	POLYPROPYLENE TAIC 20
19	1	EH3-15-Y FLAG, YELLOW	
18	1	309-0029 PCB ASSY, EH3 LT SOLID STATE 12 VDC	NO MATERIAL
17	1	100-001 GEAR MOTOR, M2 18 RPM/CLON	STAINLESS STEEL TYPE 303
16	3	03X-22 NUT, HEX HEAD, SEPARATED FLANGE, .250-20 UNC-2B	STAINLESS STEEL TYPE 303
15	4	EH3-136 STD, 1/4-20 X 1/2 MTG	STAINLESS STEEL TYPE 303
14	1	EH-104 RETAINER, PUSH ON 5/16" SHAFT	NO MATERIAL
13	1	494-0109 CAM ASSY, EXTD LOBE FOR EH3 E-OMP	SILICONE RED, W/ DURUMETER
12	1	EH-502 LABEL, EH ACTUATOR, 2.8" X 1", THERMAL TRANSFER, WHITE	POLYCARBONATE
11	1	EH-130 O-RING, DOME	STAINLESS STEEL TYPE 303
10	1	EH3-114 DOME CLEAR	NYLON DPC BK/SHL BLACK
9	14	EHPT-1103 SCREW PAN, PHILLIPS, HIGH-LOW, 5-20 X .502	STAINLESS STEEL TYPE 303
8	1	EH3-1001-N UID, CASE, EH3, DOME	STAINLESS STEEL TYPE 303
7	4	EH3-100 O-RING, 8-32 X 1.18 PPHAS SS	STAINLESS STEEL TYPE 303
6	1	EH-157 SCREW, 8-18 X .307 150 PPH SS	STAINLESS STEEL TYPE 303
5	1	EH3-1030 O-RING, EH3, CASE LD, # 120	SILICONE RED, W/ DURUMETER
4	1	EH-130 O-RING, 80/06, PRESSURE TEST POINT	FLUOROCARBON (BLACK), 7E, DURCOMET 100
3	1	EHPT-540 O-RING, #112, MOTOR SHAFT, VITON	FLUOROCARBON (BLACK), 7E, DURCOMET 100
2	1	EH3-1003H LOWER CASE - EH3 INTERNAL MTG	NYLON DPC BK/SHL BLACK
1	1	408-0012 CASE KIT, EH3 IM DOME NYLON MO MTR	MATERIAL

REVISIONS

LTR	DESCRIPTION	DATE	CHG NO.	APPR'D

60AD WIRING
Standard On/Off applications, SPST Switch
24 VDC



REMOVE SHARP EDGES

INCH
[MILLIMETER]



OLD PART NO.

PATTERN NO.

MATERIAL DESCRIPTION:
KZCO 84D23-60AD-M

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

MODEL NAME 5209402 MDL CREATED 11/13/08 SHEET 1/3 A

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

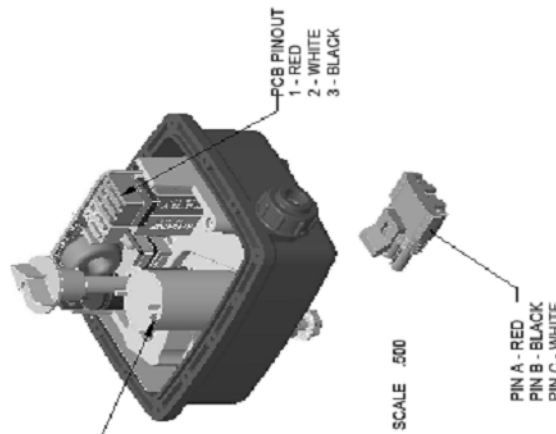
VALVE - ACTUATED, 24VDC, .50NPT FE
KZCO 84D23-60AD-M

DATE 13-Nov-08 SCALE 1/4
5209402

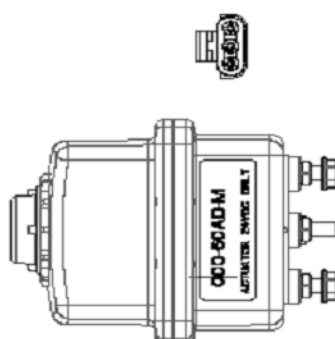
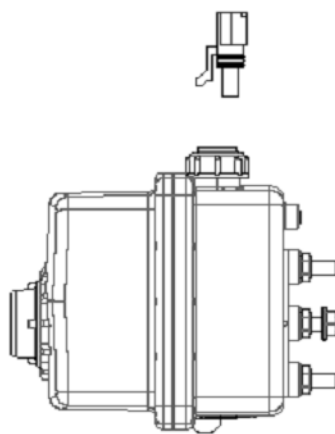
TOLERANCE
EXCEPT
AS NOTED

.00 ±.03
.000 ±.010
ANGLES ±1°

DR'N R/JG
CHKD DWS
TRCD



MAS80 SET DATA
 CONTROL INPUT = 1
 FEEDBACK = 0
 OPERATION = 0
 MOTOR = M
 SPEED CT = 0.8
 ZEROSET = 135
 RANGE TOLERANCE = 1
 ROTATION = CC081
 ACTUATOR RANGE = 0.0010.00
 DESIGN VOLTAGE = D
 DIP SX =
 LABEL = KZCO
 OPTIONS = 0
 PLUG TYPE =
 TEST PLUG =



KZCO inc.
 2180 KZ PARKWAY
 GREENWOOD, NE 68308 USA
 TEL: 402.334.2020
 FAX: 402.344.2022

DATE: 2007-04-10
 DESIGNED: L. ERDKAMP
 DRAWN: W. FEDDE
 APPROVED: A. KOTTAS

SCALE: 500
 SIZE: B

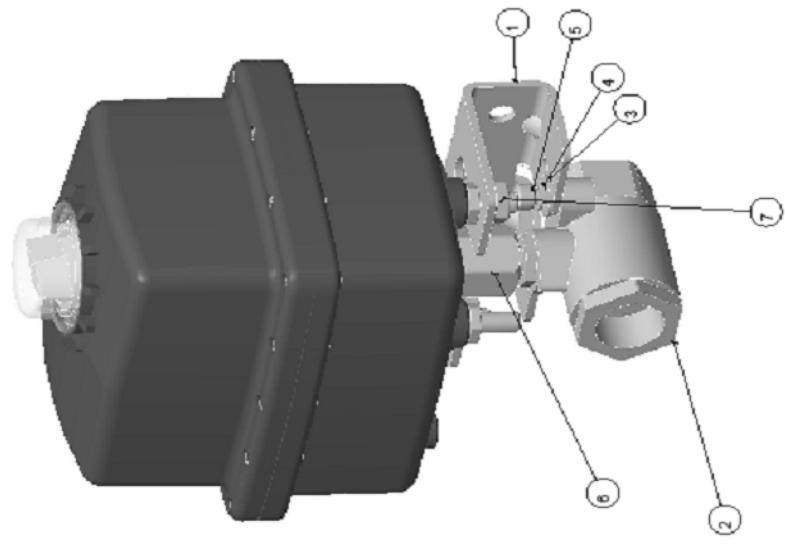
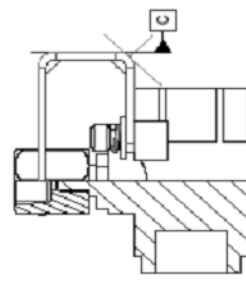
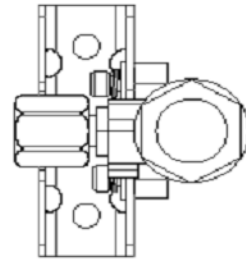
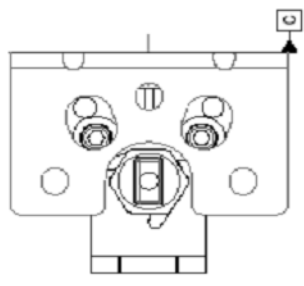
PART NO: 000-60AD-M
 DRAWING NO: 000-60AD-M

REVISION: 001 .1
 SHEET: 1 OF 1

STANDARD TOLERANCES - ALL DIMENSIONS IN UNLESS SHOWN:	
TOTAL FINISH	±.0010
CHAMFER	±.0010
SURFACE FINISH	12.5 μIN
XX.1	±.0010
XX.2	±.0010
XX.3	±.0010
XX.4	±.0010
XX.5	±.0010
XX.6	±.0010
XX.7	±.0010
XX.8	±.0010
XX.9	±.0010
XX.10	±.0010
XX.11	±.0010
XX.12	±.0010
XX.13	±.0010
XX.14	±.0010
XX.15	±.0010
XX.16	±.0010
XX.17	±.0010
XX.18	±.0010
XX.19	±.0010
XX.20	±.0010
XX.21	±.0010
XX.22	±.0010
XX.23	±.0010
XX.24	±.0010
XX.25	±.0010
XX.26	±.0010
XX.27	±.0010
XX.28	±.0010
XX.29	±.0010
XX.30	±.0010
XX.31	±.0010
XX.32	±.0010
XX.33	±.0010
XX.34	±.0010
XX.35	±.0010
XX.36	±.0010
XX.37	±.0010
XX.38	±.0010
XX.39	±.0010
XX.40	±.0010
XX.41	±.0010
XX.42	±.0010
XX.43	±.0010
XX.44	±.0010
XX.45	±.0010
XX.46	±.0010
XX.47	±.0010
XX.48	±.0010
XX.49	±.0010
XX.50	±.0010

QTY	PART NUMBER	DESCRIPTION	MATERIAL	NO. MATERIAL
1	EH-502	LABEL, EH ACTUATOR, 2.5" X 1", THERMAL TRANSFER, WHITE		
2	QX-222	NUT, HEX HEAD, SERRATED FLANGE, .250-20 UNC-2B	STAINLESS STEEL, TYPE 303	
4	EH3-135	STUD, 1/4-20 X 1/2 MTG	STAINLESS STEEL, TYPE 303	
5	800018	HARNASS, 60A, 3ST, WPST, 22.5"		
4	EH3-115-Y	FLAG, YELLOW	POLYPROPYLENE, TALC_20	
3	800468	PCB ASSY, EH3 24VDC 60AD/60DF		
2	EH3-110	GEAR MOTOR, EH3 SERIES M1 18 RPM @ 12VDC		
1	488-0005	CASE KIT, EH3 IM DOME NYLON M1 & N1 MTR		

REVISION	REVISION DATE	REVISION BY
-6+	8/12/2008 9:18:50 AM	bgotschal



ACTUATOR SHOWN IS REPRESENTATIVE USED
ONLY TO SHOW PROPER ORIENTATION TO VALVE.

DET	QTY	PART NUMBER	DESCRIPTION	MATERIAL
7	3	QK-222	NUT, HEX HEAD, SERRATED FLANGE, .250-20 UNC-2B	STAINLESS STEEL TYPE 303
6	1	EH-146	COUPLER, 1/4" ~ 1/2" APOLLO	STAINLESS STEEL TYPE 316
5	2	EH-158	SCREW, #10-24 X 3/8" SS SOCKET HEAD	STAINLESS STEEL TYPE 303 OR 316
4	2	EHPT-105	WASHER, LOCK, .197 ID X .334 OD X .047 T	STAINLESS STEEL TYPE 316
3	2	EHPT-110	WASHER, FLAT, #10 18-8 SS	STAINLESS STEEL TYPE 316
2	1	EH3-54D	VALVE, 1/2" 2-WAY APOLLO 70-03-01 BRONZE BALL VALVE	BRONZE
1	1	EH3-174	BRACKET, MOUNTING EH3 SERIES	STAINLESS STEEL TYPE 304

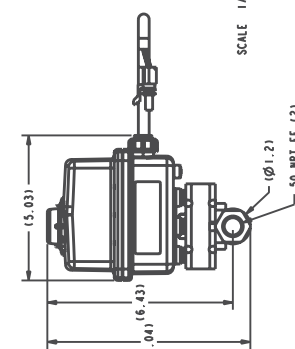
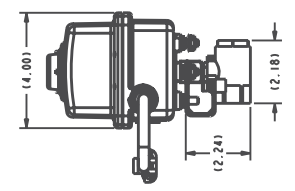
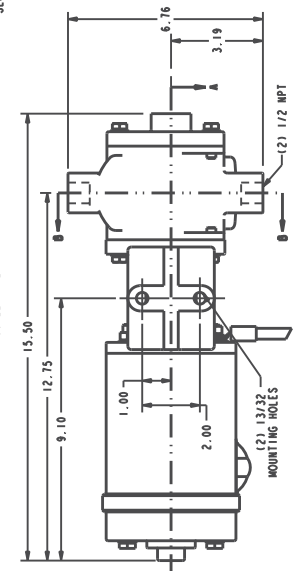
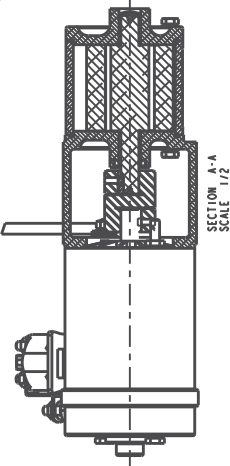
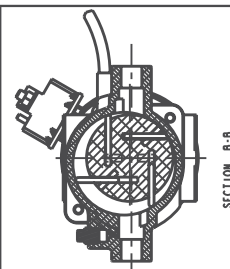
DATE: 2007-08-08	DESIGNED: L. LERDKAMP	APPROVED: L. LERDKAMP
DRAWN: C. HOWARD	SCALE: .750	MATERIAL: AS NOTED
PART NO: 84D23	SIZE: B	
DRAWING NO: 84D23		

KZCO Inc. 2080 ICE PARADISE GREENHACK, NE 85388 USA PHONE: 714.824.1217 FAX: 714.824.1212	TITLE: VALVE KIT, EH3 OFFSET MTG 1/2" 2-PC BRZ REF:
-------------------------------------------------------------------------------------------------------	--------------------------------------------------------

CREATED BY: RYAN M. C. REATOR ON: 8/12/2008 9:18:50 AM REV: 6+ VER: 6+ REL: RYAN M. LOCATION: R04 KMPR02008081850TR13 BRANCH: NMR

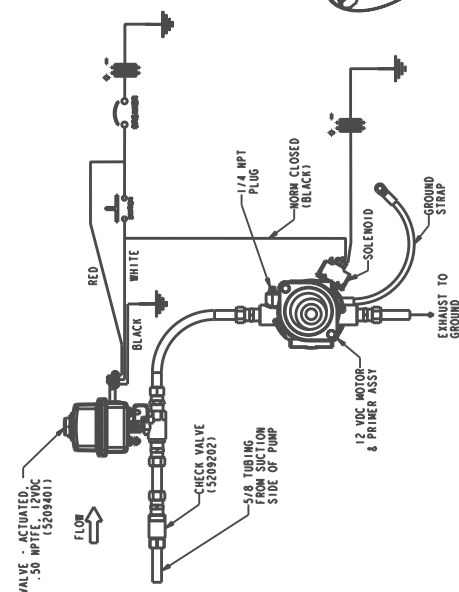
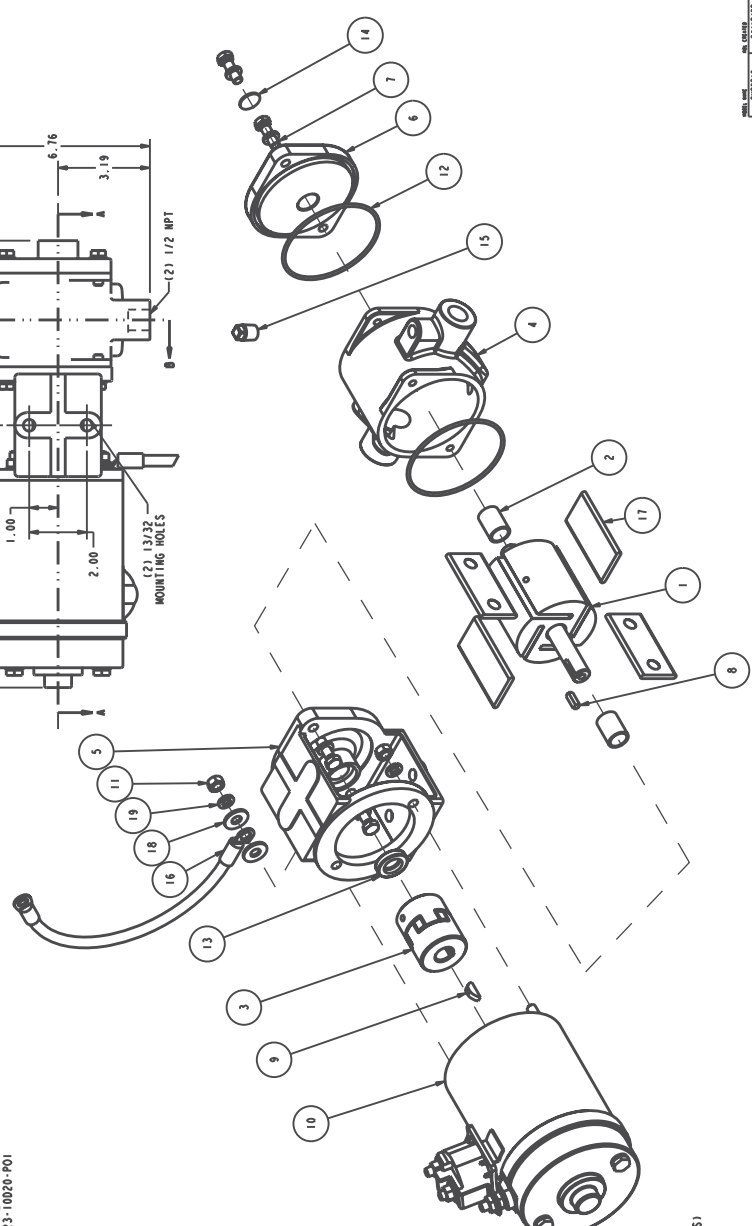
REV.	DESCRIPTION	DATE	CHK. NO.	APP. NO.

NO.	DESCRIPTION	PART NO.	QTY.
1	ASSEMBLY - PRIMER, ROTOR	4420105	1
2	BEARING - OILITE, 0.626 ID	1760023	2
3	COUPLING - #44093	2404500	1
4	CYLINDER - VACUUM PUMP	1020600	1
5	HEAD - CYLINDER INBOARD	2808904	1
6	HEAD - CYLINDER OUTBOARD	2808800	1
7	WCS - 3/13" x 1.00" SST	5400510	4
8	HEAT - 50 - 0.19 x 0.82 ORZ	3602325	1
9	HEAT - WOODRUFF, 606	3602200	1
10	MOTOR - PRIMER, 12V	4223400	1
11	NUT - HEX., 3/13" x 1.5" SST	5403624	2
12	O-RING - 3.50 x 3.69 x 0.09	3601101	2
13	OIL SEAL - 0.625 ID x 1.128 OD	3600505	1
14	PLUG - 0.75" FREEZE	4402500	1
15	PIPE - 0.750, BR SO HD	1080504	1
16	STRAP - GROUND, 12V PRIMER	2600516	1
17	WASHER - ELEC PRIMER	4407601	4
18	WASHER - FLAT, 3/16, STEEL	3603802	2
19	WASHER - LOCK, 0.313 ID	3603202	6



5209401 - RZCO VALVE - ACTUATED.
12 VDC, .50MPT FE
RZCO MOL 86023-10020-POI

5209401 - RZCO VALVE - ACTUATED.
12 VDC, .50MPT FE
RZCO MOL 86023-10020-POI



NOTE:
MOUNT WITH EXHAUST OUTLET DOWN
CONNECT 4 GA COPPER GROUND STRAP TO CLEAN, PAINT FREE GROUNDING SURFACE
IF SUPPLIED GROUND STRAP IS REMOVED FROM ASSEMBLY, RETIGHTEN CYLINDER HEAD ADAPTER REMAINING NUTS EQUALLY TO 90 IN.LB.

POSITIVE LEAD WIRE SIZES FOR 12 V PRIMER:
PER SAE STANDARD S-111 MAX STARTING MOTOR VOLTAGE DROPS:
0 - TO 25' 800 (12V)
0 - TO 25' 800 (12V)

THESE GAGE WIRES CORRESPOND WITH AMP DRAW TO RESISTANCE OVER GIVEN LENGTH.
12 V : 240 AMP

WEIGHT - 27 LB (12.1 KG)

REV.	DESCRIPTION	DATE	CHK. NO.	APP. NO.

REV.	DESCRIPTION	DATE	CHK. NO.	APP. NO.

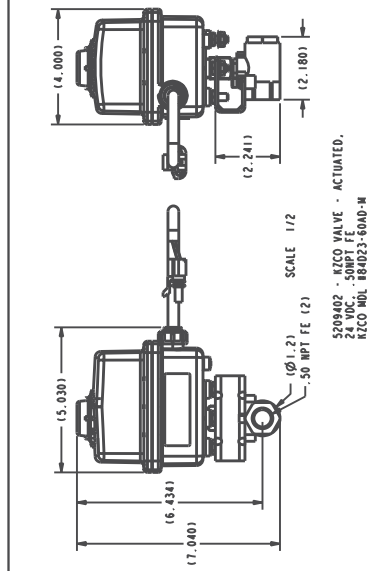
REV.	DESCRIPTION	DATE	CHK. NO.	APP. NO.

REV.	DESCRIPTION	DATE	CHK. NO.	APP. NO.

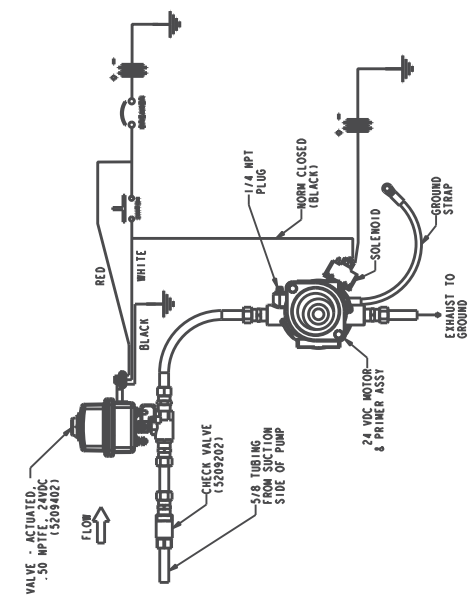
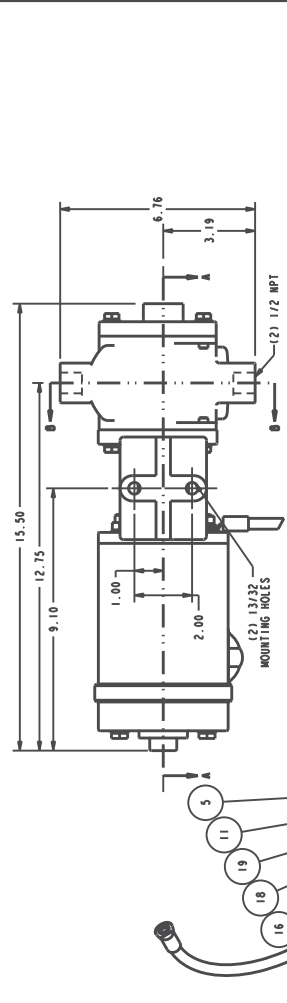
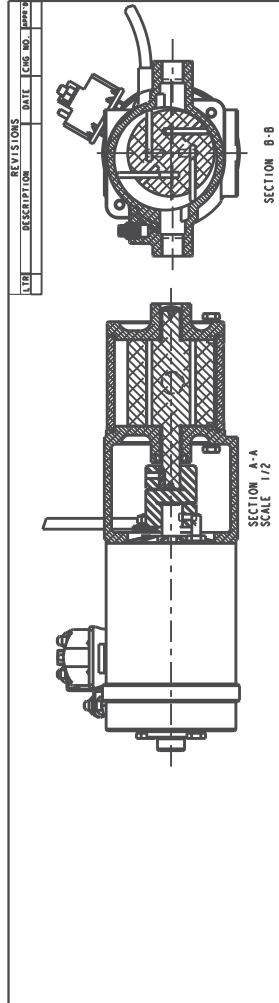
REMOVE SHARP EDGES
ALL DIMENSIONS IN INCH UNLESS OTHERWISE SPECIFIED
DO NOT SCALE PRINT
SCALE: 1/2"

DVC0210

NO.	DESCRIPTION	PART NO.	QTY.
1	ASSEMBLY - PRIMER, ROTOR	4420105	1
2	BEARING - OILITE, 0.626 ID	1760023	2
3	COUPLING - #44093	2404500	1
4	CYLINDER - VACUUM PUMP	1020000	1
5	HEAD - CYLINDER, INBOARD	2808904	1
6	HEAD - CYLINDER, OUTBOARD	2808900	1
7	WASHER - 3/16 X 1.00, SST	5400510	4
8	WASHER - 5/16 X 0.82 GR2	3602425	1
9	WASHER - WOODRUFF, 606	3602500	1
10	WASHER - PRIMER, 24V	4423500	1
11	WASHER - HEX., 3/16 X 1.00, SST	5403024	2
12	O-RING - 3.50 X 3.69 X 0.09	3601101	2
13	OIL SEAL - 0.625 ID X 1.128 OD	3600505	1
14	PLUG - 0.75" FREEZE	4402500	1
15	PLUG - PIPE, 0.250, BR 50 HD	1080504	1
16	STRAP - GROUND, 12V PRIMER	2600516	1
17	WASHER - ROTOR, ELEC PRIMER	4407601	4
18	WASHER - FLAT, 5/16, STEEL	3603802	2
19	WASHER - LOCK, 0.313 ID	3603502	6



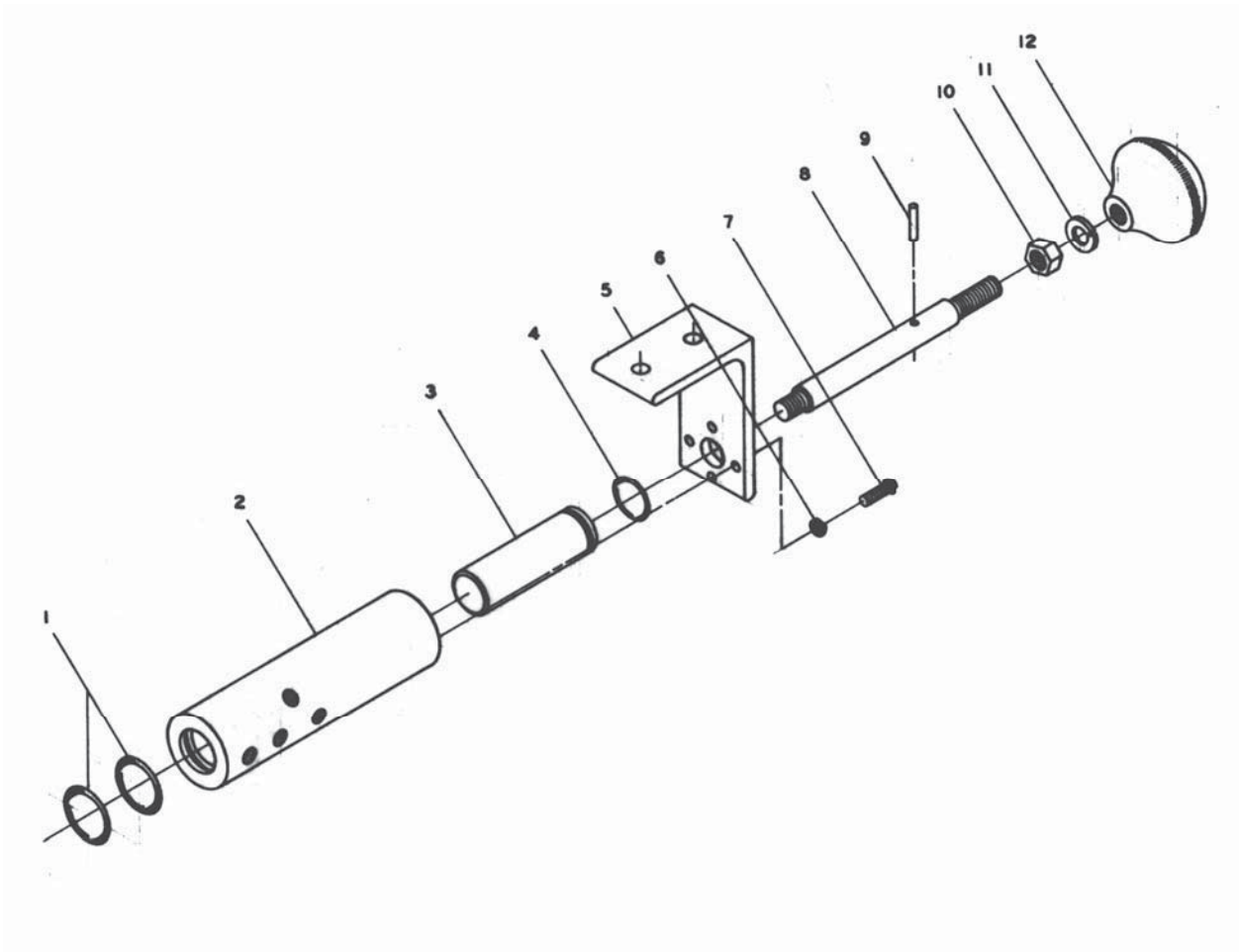
5209402 - RZCO VALVE - ACTUATED,
 24 VDC, .50MPT FEE
 RZCO MDL 664023-60AD-M



NOTE:
 MOUNT WITH EXHAUST OUTLET DOWN
 CONNECT 4 GA COPPER GROUND STRAP TO CLEAN, PAINT FREE GROUNDING SURFACE
 IF SUPPLIED GROUND STRAP IS REMOVED FROM ASSEMBLY, RETIGHTEN CYLINDER HEAD ADAPTER REMAINING NUTS EQUALLY TO 90 IN.LB.
 POSITIVE LEAD WIRE SIZES FOR 24 V PRIMER:
 PER SAE STANDARD S410 MAX STARTING MOTOR VOLTAGE DROPS)
 0' TO 25' 42 COPPER (24V)
 THESE GAUGE WIRES CORRESPOND WITH AMP DRAW TO RESISTANCE OVER GIVEN LENGTH.
 24 V = 140 AMP

WEIGHT - 27 LB (12.1 KG)

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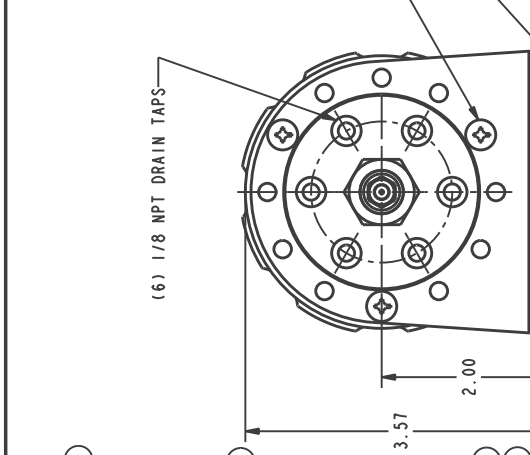
PARTS LIST FOR MULTIPLE DRAIN VALVE

DRAWING NO. DGC0112

Rep. No.	Name of Part	Qty	Rep. No.	Name of Part	Qty
1	O-ring – Body	2	7	Round Head Cap Screw	4
2	Drain Valve Body	1	8	Drain Valve Stem	1
3	Drain Valve Plug	1	9	Pin	1
4	O-ring – Plug	1	10	Hex Nut	1
5	Drain Valve Mounting Bracket	1	11	Lock Washer	1
6	Lock Washer	4	12	Knob	1

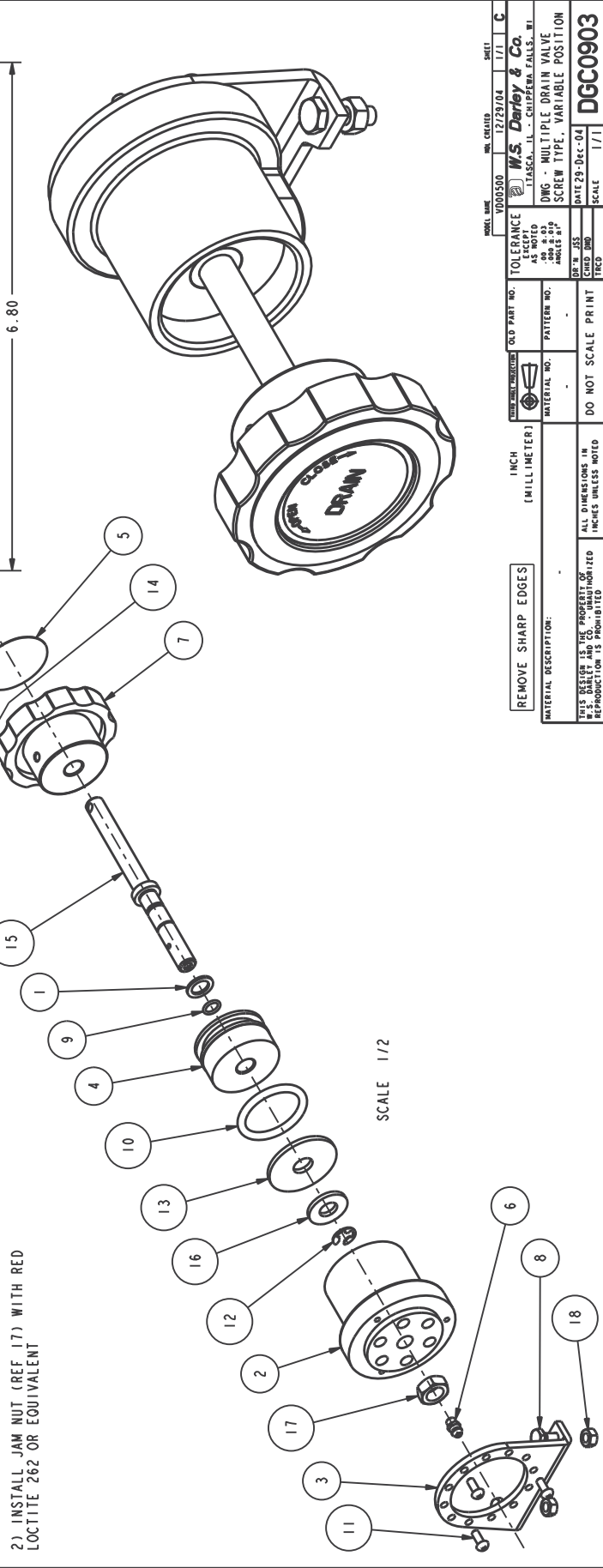
LTR	DESCRIPTION	DATE	CHG. NO.	APPR'D
A	ADDED ASSEMBLY NOTE	29SEP2005	2005-287	EWB
B	WAS 4031300	03APR2006	2006-110	
C	WAS RETAINER RING 3600435	28NOV2007	2007-456	SHS
D	WAS 5400003	30JAN2008	2008-042	SHS
E	ADDED 5403027	15FEB2008	2008-061	SHS

REV. NO.	DESCRIPTION	DATE	CHG. NO.	APPR'D
1	SEE NOTE 1			
2	SEE NOTE 2			



NO.	DESCRIPTION	PART NO.	QTY.
1	BEARING - OILITE, 0.500 ID	1760024	1
2	BODY - MULTI DRAIN VALVE	5329401	1
3	BRACKET - MULTI DRAIN VALVE	4031300	1
4	CAP - MULTI DRAIN VALVE	5323802	1
5	DECAL - DRAIN VALVE	1963200	1
6	GREASE ZERK - .25-28	4403200	1
7	HANDWHEEL	3001800	1
8	HHCS - .250-20 x 0.88, 18-8	5400658	2
9	O-RING - 0.38 x 0.50 x 0.06	3601000	1
10	O-RING - 1.62 x 2.00 x 0.19	3601305	1
11	RHMS - NO.10-24 x 0.50, SST	5402046	3
12	RING - RETAINER, 68011	3600435	1
13	SEAL - MULTI DRAIN VALVE	3802602	1
14	SSS - 1/4-20 x 0.38, SST	5402603	1
15	STEM - MULTIPLE DRAIN VALVE	5241302	1
16	WASHER - .52 X 1.12 X .12	3603319	1
17	NUT - JAM, .500-20, 18-8 SST	5403219	1
18	NUT - HEX, .250-20, 18-8 SST	5403027	2

NOTE:
 1) ASSEMBLE WASHER (REF 16) AND MATING RETAINING RING (REF 12) WITH SHARP EDGES FACING AWAY FROM SEAL (REF 13)
 2) INSTALL JAM NUT (REF 17) WITH RED LOCTITE 262 OR EQUIVALENT



SCALE 1/2

MODEL NAME	DATE	REV. NO.	SHEET
V000500	12/29/04	1/1	1/1

OLD PART NO.	PATTERN NO.	MATERIAL NO.	DO NOT SCALE PRINT

TOLERANCE	INCH	(MILLIMETER)
AS NOTED		
.00 & .01		
.0005 & .001		

DATE	SCALE	1/1
DATE 29-Dec-04	SCALE 1/1	1/1

ALL DIMENSIONS IN INCHES UNLESS NOTED
REPRODUCTION IS PROHIBITED

W.S. Darley & Co.
ATASCANA, IL - CHIPPEWA FALLS, WI
DWG - MULTIPLE DRAIN VALVE
SCREW TYPE, VARIABLE POSITION
DGC0903

BALL VALVE QUARTER TURN - SELF LOCKING

The Darley Ball Valve is a quarter turn, all bronze valve designed for the fire service.

The ball is cast bronze, precision machined *stainless steel ball* for long trouble free service. It is easily serviced in the field.

The lever is self locking and easily adjusted, even under extreme high pressure.

TO DISASSEMBLE AND REPAIR THE BALL VALVE ILLUSTRATION DGC0100

TOOLS REQUIRED:

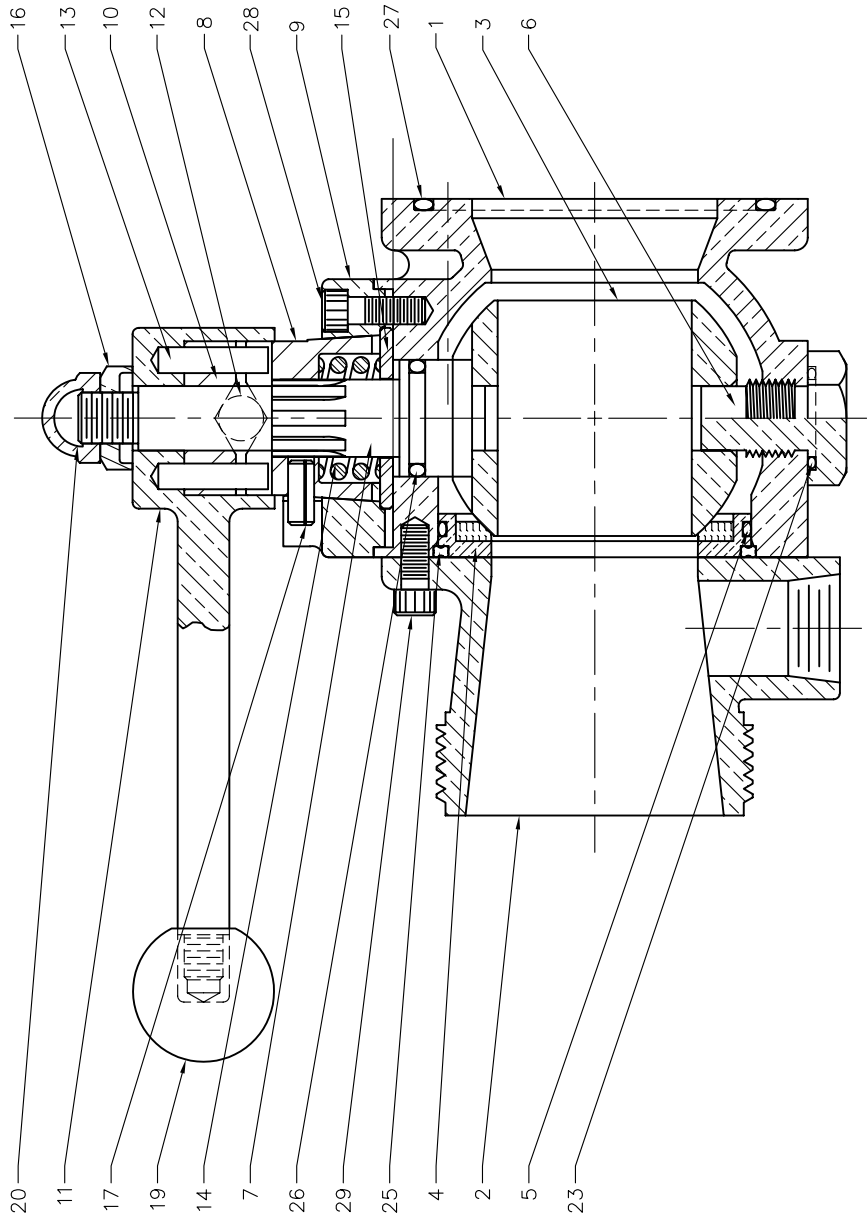
- 3/16" Allen Wrench
 - 1-1/8" Wrench
 - 3/4" & 1" Wrench
 - Vise Grips or Pliers
1. Remove cap nut (20) and adjusting nut (16).
 2. Lever Assembly (11) pulls straight up. Watch for 2 cam balls (12).
 3. Unbolt and remove clutch ring (9), clutch sleeve (8), valve stem (7), spring (14), and valve stem washer (15). Check clutch ring (9) and sleeve (8) for scoring or excessive wear. Check o-ring (26). Replace if necessary.
 4. Remove nipple (2). Check Quad Ring (25). Replace if necessary.
 5. Unscrew ball guide screw (6). Check o-ring (23). Replace if necessary.
 6. Remove valve ball (3). Check for scratches, corrosion, and wear. Replace if necessary.
 7. Remove seat assembly (4). Check condition of rubber seat. Replace seat assembly if necessary.

REASSEMBLY OF BALL VALVE ILLUSTRATION DGC0100

1. Position ball (3) in body so ball guide screw (6) engages bottom of ball as it is screwed into position.
2. Put valve stem (7) into position. Make certain stem engages slot on top of ball.
3. Slip washer (15), spring (14), and clutch sleeve (8) over the stem. Place clutch ring (9) over the sleeve and secure with the four (4) 1/4" NC x 5/8" socket head cap screws.
4. Set the two cam balls (12) into the V grooves in the clutch sleeve (8) and drop lever assembly over them. Tighten the adjusting nut (16) so that approximately 1/8" play is left at the end of a 6" lever. Over tightening this nut will make the clutch lock inoperative. Lock adjusting nut (16) with cap nut (20). Recheck this adjustment after valve is placed in service.
5. Place seat assembly (4), seat o-ring (5), and quad ring (25) into position.
6. Secure nipple (2) to valve body with eight (8) 1/4" NC x 5/8" socket head cap screws.

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

REP. NO.	NAME OF PART	QTY.
1	DISCHARGE VALVE BODY	1
2	VALVE NIPPLE	1
3	VALVE BALL	1
4	VALVE SEAT	1
5	O'RING	1
6	BALL GUIDE SCREW	1
7	VALVE STEM	1
8	CLUTCH SLEEVE	1
9	CLUTCH RING	1
10	LEVER CAM	1
11	FRONT MOUNT LEVER	1
12	CAM BALL	2
13	VALVE PIN	2
14	VALVE SPRING	1
15	VALVE STEM WASHER	1
16	ADJUSTING NUT	1
17	SPRING PIN-STL (A)	1
19	CONTROL LEVER BALL	1
20	CAP NUT	1
23	O'RING	1
25	QUAD RING	1
26	O'RING	1
27	O'RING	1
28	SOCKET HEAD CAP SCREW	4
29	SOCKET HEAD CAP SCREW	8



INCH
[MILLIMETER]

W.S. DARLEY & Co.
 MELROSE PARK, ILL. - CHIPPEWA FALLS, WI

DWG - BALL VALVE ASSEMBLY
 CROSS SECTION

DATE NOV12,95
 SCALE 1/1

DGC0100

TOLERANCE EXCEPT AS NOTED
 .005 ±.010
 .000 ±.010
 ANGLES 3:1

DRN JCM
 CHK NOV12,95
 TRCDLMH 5/96

OLD PART NO. G1200

DO NOT SCALE PRINT

ALL DIMENSIONS IN INCHES UNLESS NOTED

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

REMOTE CONTROL SUCTION RELIEF VALVE DRAWING DGC0115

The suction relief valve bypasses water from the pump suction extension to the ground at a set pressure, preventing excessive rise of supply pressure when relay hose lines are shut off.

Turning pressure setting hand wheel (14) clockwise raises the relief pressure, and counterclockwise lowers it.

The self cleaning fine mesh strainer will prevent entry of solids that could cause the relief valve to malfunction. Open the strainer flush valve to remove small accumulations. This is accomplished by turning the strainer flush valve knob (6) counterclockwise 2 to 3 full turns. Strainer trapped debris will be flushed to the ground. Pump supply pressure should be 50-100 PSI when performing this procedure.

TO SET SUCTION RELIEF VALVE

1. Connect a discharge line from an auxiliary pump to the pump suction containing the suction relief valve. The auxiliary pump must be able to supply a pressure greater than the desired pressure setting of the suction relief valve.
2. Close all other discharge and suction valves.
3. Increase auxiliary pump engine throttle setting until pressure gage indicates the pressure that suction relief valve is open.
4. If suction relief valve opens to bypass excessive pressure, slowly turn hand wheel (14) clockwise until valve closes.
5. If suction relief valve does not open, turn hand wheel (14) counterclockwise until valve opens and begins bypassing water. Continue to turn hand wheel (14) counterclockwise 2 more complete turns. Now slowly turn hand wheel clockwise until valve closes and stops bypassing water.

The suction relief valve will now prevent damage to the pump from a pressure surge (water hammer) which is the result of rapid closing or opening of relay line valves.

Should a higher or lower relief pressure be desired, repeat the above procedure.

CAUTION: With all discharge valves closed, the water in auxiliary pump casing will heat up rapidly. Avoid damage by allowing a very low flow of water to discharge when pump is running.

REMOTE CONTROL SUCTION RELIEF VALVE WITH MECHANICAL SHUTOFF DRAWING DGC0115

MAINTENANCE

Open the relief valve strainer flush valve (6) during every operation at 50-100 PSI supply pressure to insure against foreign material blocking the screen.

The relief valve, pilot unit, and strainer assemblies should be taken apart for inspection and cleaning at least annually, or as often as found necessary to insure trouble free performance.

To disassemble pilot head, first turn hand wheel (14) counterclockwise to remove spring compression. Remove the four 1/4" screws holding regulator spring housing (18). Lift out diaphragm (23) and pilot valve (51) assembly. Clean and make certain 3/32" diameter orifice hole is free of obstruction.

When reassembling pilot head, turn hand wheel (14) a few times clockwise to compress spring before tightening four screws holding spring housing. This will properly center valve seat and diaphragm.

The valve piston (40) and spring (44) chamber should be inspected and cleaned.

Replace diaphragm and o-rings if damaged or deteriorated.

Apply a thin coating of waterproof grease lubricant: to spring housing counterbore that guides pilot valve (51) and ball (52), to end of tension screw (17), and between piston (40) and center post

Self cleaning strainer (63) can be removed for inspection or replacement by alternately turning valve knob (6) and stop nut (7) counterclockwise until stem is free for removal. To avoid discharging water through opening created by stem (62) removal, pump should be completely shut down before stem (62) is removed. Inspect and clean screen (63) if required. Check quad ring (64) for damage or deterioration. Reverse procedure to reassemble valve. Use care when initially inserting screen into body to avoid damaging quad ring (64) or valve seat.

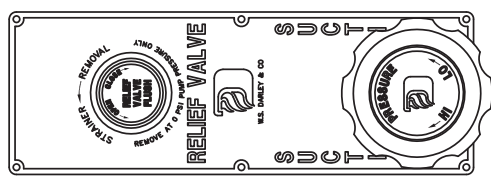
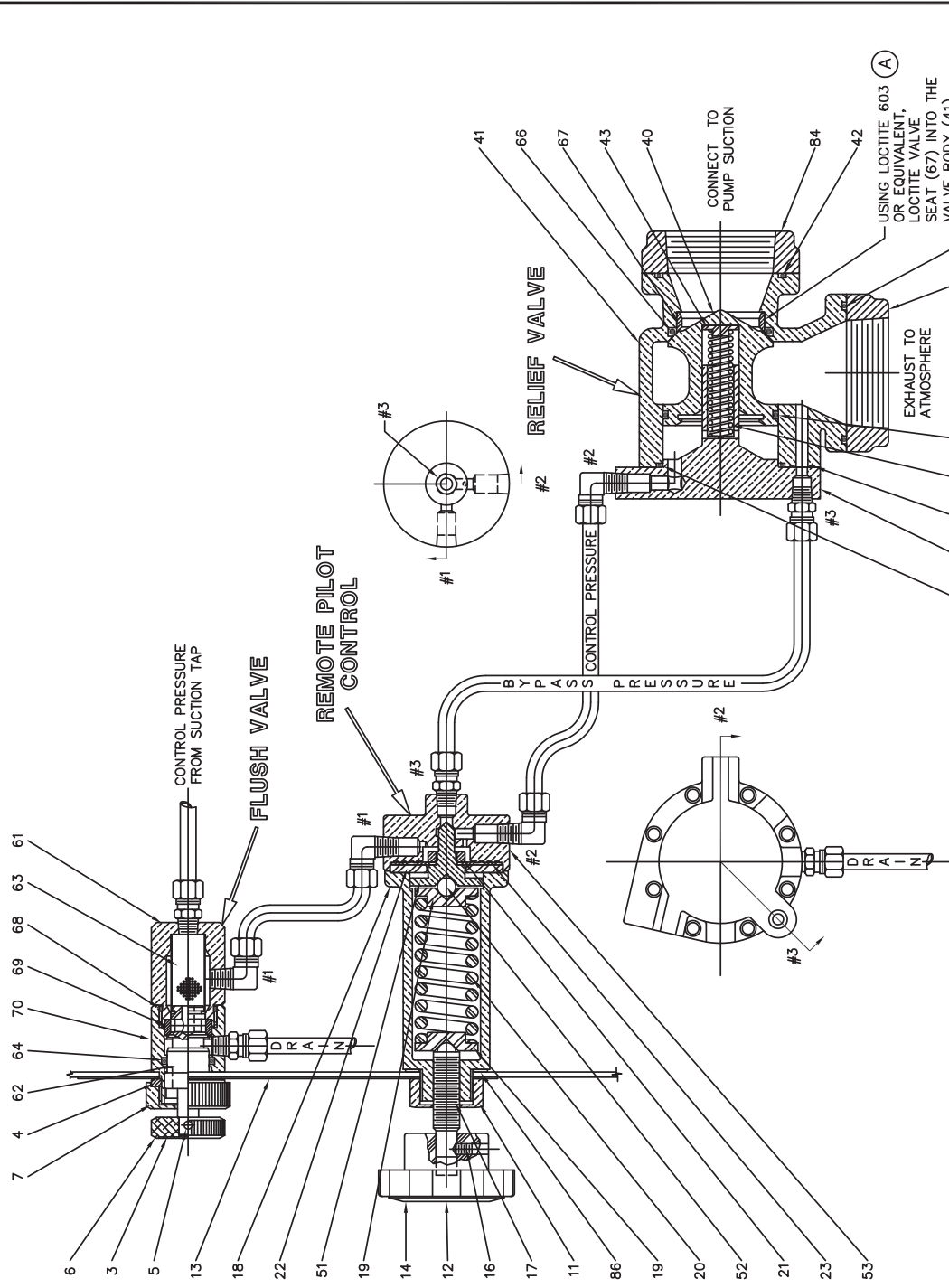
To replace flush valve seat (69), remove stem/screen assembly. Disconnect tubing lines attached to (61) body half, unscrew (61) body half from (70) body half. Replace (69) valve seat. Reverse procedure to reassemble valve.

SUCTION RELIEF VALVE PARTS LIST DRAWING DGC0115

REP NO.	DESCRIPTION	REP NO.	DESCRIPTION
3	Decal - RV Flush	41	Relief Valve Body
4	Panel Nut	42	O-ring Flange
5	Socket Set Screw	43	Spring Centering Plug
6	Flush Valve Knob	44	Spring
7	Stop Nut	45	O-ring Body Flange
11	Panel Valve Nut	46	O-ring Piston
12	Decal - Pressure Hi-Lo	50	O-ring, Bleed Port
13	Trim Plate	51	Pilot Valve
14	Hand wheel	52	Ball
16	Socket Set Screw	53	Pilot Valve Body
17	Spring Tension Screw	61	Body Half, Flush Valve
18	Spring Housing	62	Stem
19	Spring Retainer	63	Screen
20	Regulator Spring	64	Quad Ring
21	Pilot Valve Nut	66	O-ring Valve Seat
22	Housing Pilot Ring	67	Valve Seat Ring
23	Diaphragm	68	O-ring Flush Valve Body
37	O-ring, Relief Valve Head	69	Flush Valve Seat
38	Relief Valve Head	70	Body Half, Flush Valve
40	Relief Valve Piston	84	Flange
		86	Lock Washer Internal

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

REVISIONS			
LTR	DESCRIPTION	DATE	CHG NO. / APPRD
A	ADDED LOCTITING NOTE	4NOV2002	2002-175 / TED



NOTE: REFERENCE TO DRAINS:
 IF THE REMOTE PILOT CONTROL IS MOUNTED BELOW THE RELIEF VALVE,
 IT WILL BE NECESSARY TO PLACE A TEE IN THE CONTROL PRESSURE
 LINE AND BYPASS PRESSURE LINE, AT THE LOWEST POINT, TO PROVIDE
 DRAINING. SUCH A DRAIN, IF INSTALLED, SHOULD NOT BE CONNECTED
 TOGETHER WITH THE RELIEF VALVE DRAIN. CONNECT DRAIN LINES TO
 SEPARATE INLET TAPS OF MULTIPLE DRAIN VALVE. DRAINS MUST BE
 CLOSED DURING OPERATION.

TOLERANCE UNLESS NOTED OTHERWISE FRACTIONS TO 0.015 IN. DECIMALS TO 0.0005 IN. ANGLES TO 10'		W.S. DARLEY & CO. MELROSE PARK, ILL. - CHIPPENAW FALLS, WI	
OLD PART NO. G2453	PATTERN NO.	DATE DEC 17, 91	SCALE 1/2
MATERIAL NO.	DO NOT SCALE PRINT	DRN. S. LEE	DWG - SUCTION RELIEF VALVE
MATERIAL DESCRIPTION:		CHKD. TRCD	DGC0115
THIS DESIGN IS THE PROPERTY OF W.S. DARLEY & CO. UNAUTHORIZED REPRODUCTION IS PROHIBITED.		DO NOT SCALE PRINT	
ALL DIMENSIONS IN INCHES UNLESS NOTED			

W.S. DARLEY & CO.

REMOTE CONTROL PRESSURE RELIEF VALVE WITH MECHANICAL SHUTOFF

Refer to Drawing DGC0141

The relief valve bypasses water from the pump discharge manifold to the suction chamber at a set pump pressure, preventing excessive rise of discharge pressure when hose lines are shut off.

Turning pressure setting hand wheel (14) clockwise raises the relief pressure, and counter clockwise lowers it.

The self-cleaning fine mesh strainer will prevent the entry of solids that could cause the relief valve to malfunction. Open the strainer flush valve to remove small accumulations. This is accomplished by turning the strainer flush valve knob (6) counter clockwise 2 to 3 full turns. Strainer trapped debris will be flushed to the ground. Pump supply pressure should be 50-100 PSI when performing this procedure.

TO SET RELIEF VALVE

1. Turn four-way valve OFF.
2. Open at least one discharge valve and increase engine throttle setting until pressure gage indicates the pressure at which relief valve is to open.
3. Turn four-way valve ON.
4. If gage reading drops below pressure set in step 2, turn hand wheel (14) clockwise until pressure returns to set point.
5. If gage reading does not drop, turn hand wheel (14) counter clockwise until pressure drops 5 to 10 PSI below set point. Then slowly turn hand wheel clockwise until pressure returns to pressure set in step 2.

The relief valve will now prevent the discharge pressure from rising above that for which it is set, and requires no further attention.

Should a higher or lower relief pressure be desired, repeat above procedure.

CAUTION

With all discharge valves closed, water in the auxiliary pump casing will heat up rapidly. To avoid possible damage, allow a very small stream of water to discharge when the pump is running.

REMOTE CONTROL PRESSURE RELIEF VALVE WITH MECHANICAL SHUTOFF

MAINTENANCE DRAWING DGC0141

Open the relief valve strainer flush valve (6) during every operation at 50-100 PSI supply pressure to insure foreign material is not blocking the screen.

The 3/32" diameter metering orifice and diaphragm chamber at (21) may be back-flushed if necessary while the pump is delivering water by opening the pilot head drain and placing valve handle (9) midway between ON and OFF position.

The relief valve, pilot unit, and strainer assemblies should be taken apart for inspection and cleaning at least annually, or as often as found necessary to insure trouble free performance.

To disassemble pilot head, first turn hand wheel (14) counter clockwise to remove spring compression. Remove the four 1/4" screws holding regulator spring housing (18). Lift out diaphragm (23) and pilot valve (51) assembly. Clean and make certain 3/32" diameter orifice hole is free of obstruction.

When reassembling pilot head, turn hand wheel (14) a few times clockwise to compress spring before tightening four screws holding spring housing. This will properly center valve seat and diaphragm.

The valve piston (40) and spring (44) chamber should be inspected and cleaned.

Replace diaphragm and o-rings if damaged or deteriorated.

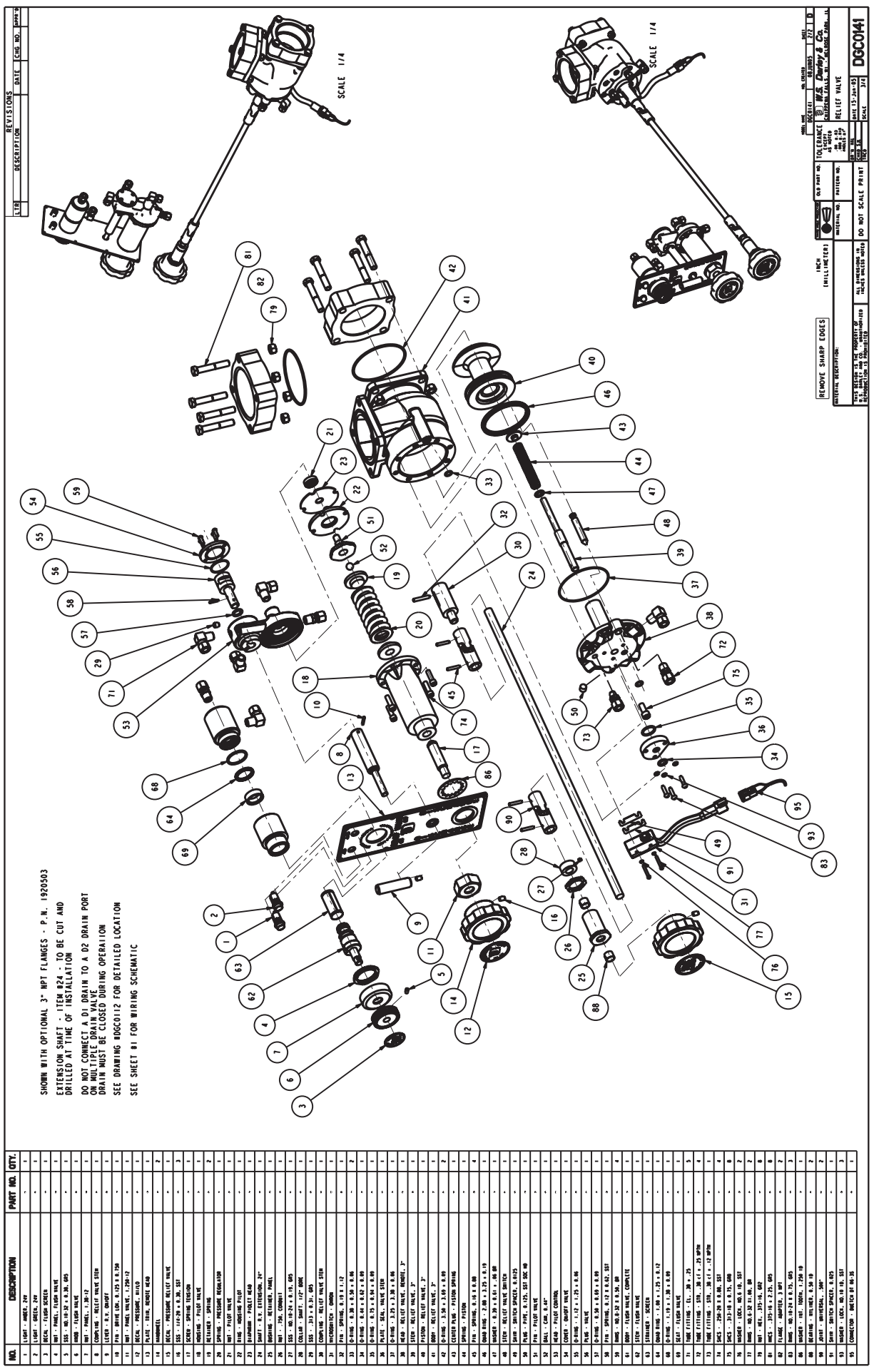
Apply a thin coating of waterproof grease lubricant: to spring housing counterbore that guides the pilot valve (51) and ball (52), to end of tension screw (17), and between piston (40) and center post.

Self-cleaning strainer (63) can be removed for inspection or replacement by alternately turning valve knob (6) and stop nut (7) counter clockwise until stem is free for removal. To avoid discharging water through opening created by stem (62) removal, pump should be completely shut down before stem (62) is removed. Inspect and clean screen (63) if required. Check quad ring (64) for damage or deterioration. Reverse procedure to reassemble valve. Use care when initially inserting screen into body to avoid damaging quad ring (64) or valve seat.

To replace flush valve seat (69), remove stem/screen assembly, disconnect tubing lines attached to (61) body half and unscrew (61) body half from (70) body half. Replace (69) valve seat. Reverse procedure to reassemble valve.

All Darley relief valves can be provided with a micro switch and either one or two pilot lights to indicate when the valve is open or closed.

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



SHOWN WITH OPTIONAL 3" NPT FLANGES - P. N. 1920503
 EXTENSION SHEET - ITEM #24 - TO BE CUT AND
 DRILLED AT TIME OF INSTALLATION
 DO NOT CONNECT A D1 DRAIN TO A D2 DRAIN PORT
 DRAIN MUST BE CLOSED DURING OPERATION
 SEE DRAWING DGC0012 FOR DETAILED LOCATION
 SEE SHEET #1 FOR WIRING SCHEMATIC

NO.	DESCRIPTION	PART NO.	QTY.
1	SCREW - 1/4" X 1/2"	1	1
2	SCREW - 1/4" X 1/2"	1	1
3	SCREW - 1/4" X 1/2"	1	1
4	SCREW - 1/4" X 1/2"	1	1
5	SCREW - 1/4" X 1/2"	1	1
6	SCREW - 1/4" X 1/2"	1	1
7	SCREW - 1/4" X 1/2"	1	1
8	SCREW - 1/4" X 1/2"	1	1
9	SCREW - 1/4" X 1/2"	1	1
10	SCREW - 1/4" X 1/2"	1	1
11	SCREW - 1/4" X 1/2"	1	1
12	SCREW - 1/4" X 1/2"	1	1
13	SCREW - 1/4" X 1/2"	1	1
14	SCREW - 1/4" X 1/2"	1	1
15	SCREW - 1/4" X 1/2"	1	1
16	SCREW - 1/4" X 1/2"	1	1
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93	SCREW - 1/4" X 1/2"	1	1
94	SCREW - 1/4" X 1/2"	1	1
95	SCREW - 1/4" X 1/2"	1	1

REV. NO.	DESCRIPTION	DATE	SCALE	NO.
1	ISSUED FOR PRODUCTION	12/15/11	1/4"	1
2	REVISED TO ADD OPTION #24	08/08/13	1/4"	2
3	REVISED TO ADD OPTION #25	11/05/13	1/4"	3
4	REVISED TO ADD OPTION #26	08/08/13	1/4"	4
5	REVISED TO ADD OPTION #27	08/08/13	1/4"	5
6	REVISED TO ADD OPTION #28	08/08/13	1/4"	6
7	REVISED TO ADD OPTION #29	08/08/13	1/4"	7
8	REVISED TO ADD OPTION #30	08/08/13	1/4"	8
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93	REVISED TO ADD OPTION #115	08/08/13	1/4"	93
94	REVISED TO ADD OPTION #116	08/08/13	1/4"	94
95	REVISED TO ADD OPTION #117	08/08/13	1/4"	95

Prepared By: EAP
 Revised By: EAP
 Approved By: TED

Rev. 13
 Date: 08/08/07
 Rev Date: 11/05/10
 1200559.doc

W.S. DARLEY & CO.

Relief Valve Alarm Installation Instruction

This Alarm is designed to concentrate audible sound in the operator zone only. For optimum Performance, position alarm sound opening so it is facing the operator at a distance of 24 - 36 inches.

Mount unit in 1.12 diameter panel hole. If panel is thicker than .09 inches, invert nut.

Do not mount with sound opening in an upward position. Do not obstruct opening.

Connect to 12 VDC only.

Two (2) wires are required to complete the circuit. The alarm is sensitive to polarity and will not operate if connected with polarity reversed.

Relief Valve Alarm Installation Instructions

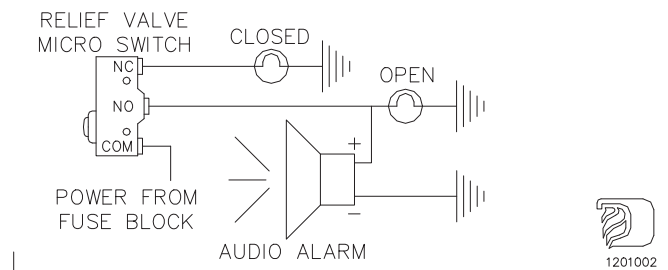
THIS ALARM IS DESIGNED TO CONCENTRATE AUDIBLE SOUND IN THE OPERATOR ZONE ONLY. FOR OPTIMUM PERFORMANCE, POSITION ALARM SOUND OPENING SO IT IS FACING THE OPERATOR AT A DISTANCE OF 24-36 INCHES.

MOUNT UNIT IN 1.12 DIAMETER PANEL HOLE. IF PANEL IS THICKER THAN .09 IN., INVERT NUT.

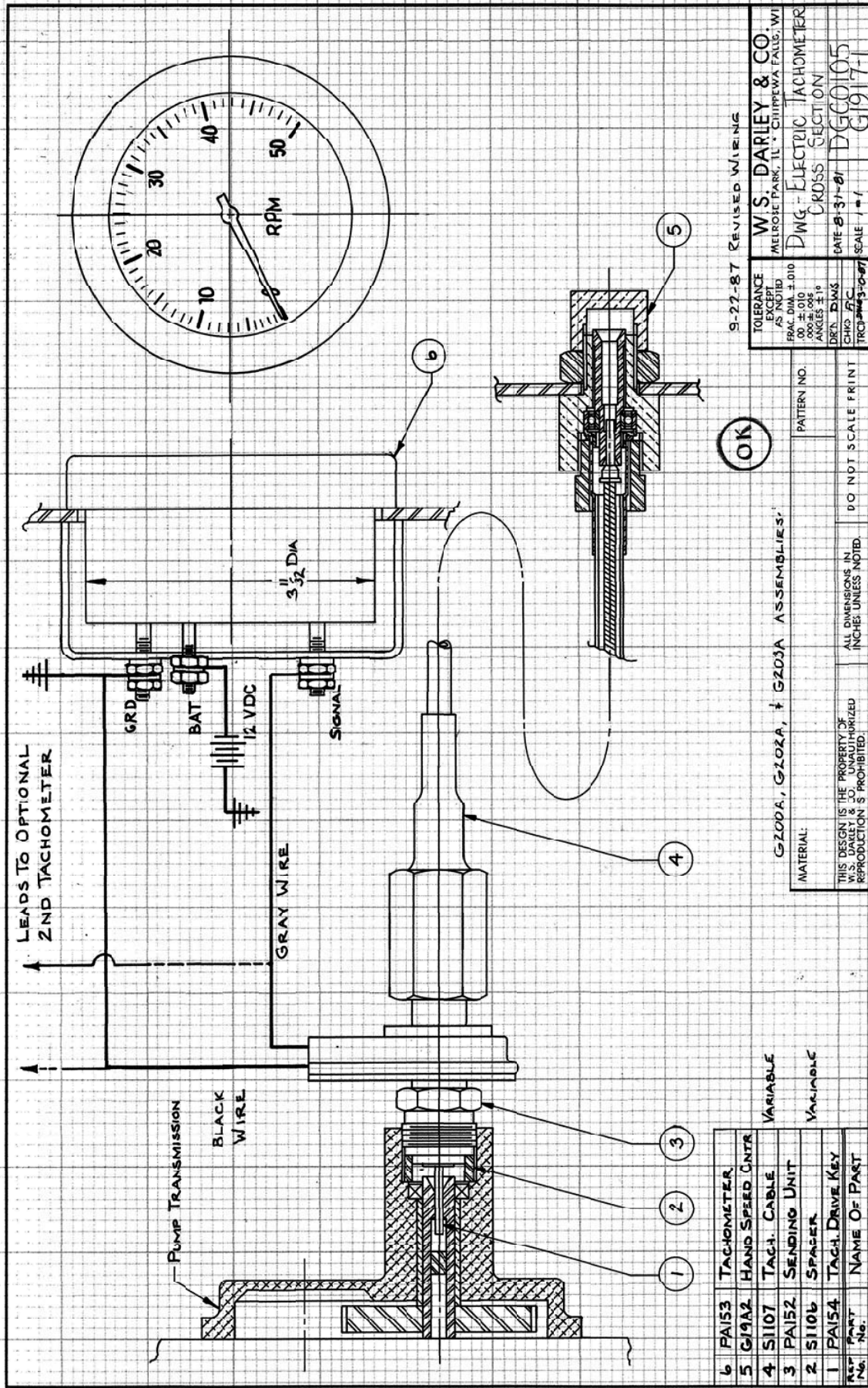
DO NOT MOUNT WITH SOUND OPENING IN AN UPWARD POSITION. DO NOT OBSTRUCT OPENING.

CONNECT TO 12 VDC ONLY.

TWO (2) WIRES ARE REQUIRED TO COMPLETE THE CIRCUIT. THE ALARM IS SENSITIVE TO POLARITY AND WILL NOT OPERATE IF CONNECTED WITH POLARITY REVERSED.



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



9-27-87 REVISED WIRING

W.S. DARLEY & CO.
 MELROSE PARK, ILL. CHICAGO FALLS, WI

DWG. - ELECTRIC TACHOMETER
 CROSS SECTION

DATE 8-31-81 DGC0105
 SCALE 1 = 1 G1917-I

TOLERANCE EXCEPT AS NOTED
 FRACTIONAL DIMS ±.010
 DECIMAL DIMS ±.005
 ANGLES ±1°

CHKD BY C
 TRG/MS/MS-0-87

OK

G202A, G202A, † G203A ASSEMBLIES.

MATERIAL: DO NOT SCALE PRINT

PATTERN NO.

ALL DIMENSIONS IN INCHES UNLESS NOTED.

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

6	PA153	TACHOMETER	
5	G19A2	HAND SPEED CNTR	VARIABLE
4	S1107	TACH. CABLE	VARIABLE
3	PA152	SENDING UNIT	
2	S1106	SPACER	
1	PA154	TACH DRIVE KEY	
REF PART No.		NAME OF PART	

W.S. DARLEY & CO.

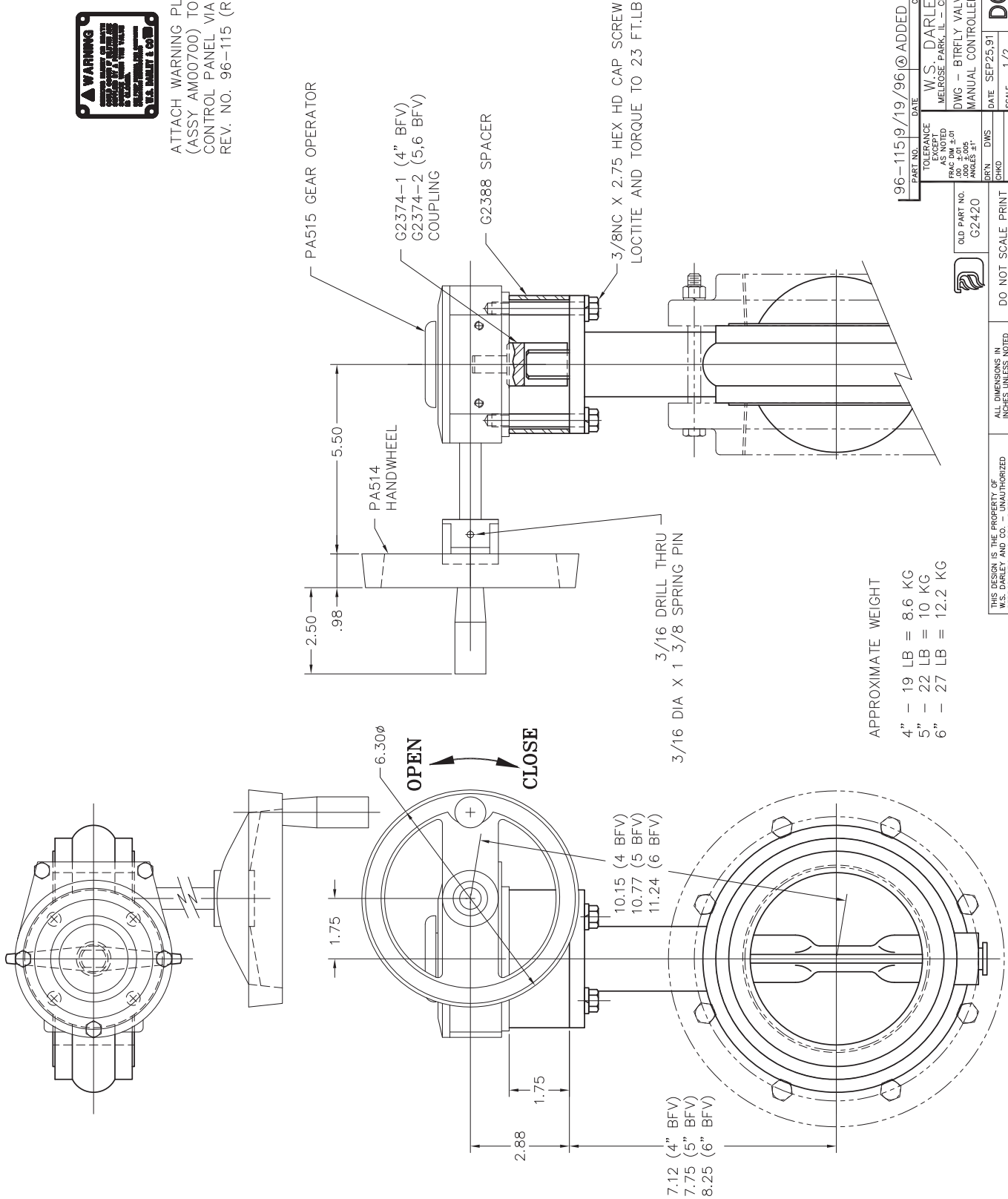
SWITCHING DIESEL TACHOMETER

1. CAUTION: Disconnect the battery during installation. Tighten nuts on back clamp only slightly more than you can tighten them with our fingers. Six inch pounds of torque is sufficient. Over tightening may result in damage to the instrument and may void your warranty!
2. Location: The tachometer should be located at least 18" from a magnetic compass. Some interference (erratic operation) may be noticed on the tachometer during radio transmission. This will neither damage a Faria tachometer nor affect accuracy when not transmitting.
3. Be certain to use insulated wire not less than 18 gauge that is approved for marine use. It is recommended that insulated wire terminals, preferably ring type, be used on all connections to the tachometer except for the light which requires a 1/4" female blade terminal.
4. The tach sender, DK-3 or equivalent, must be used in conjunction with the tachometer. One DK-3 sender will operate two tachometers. Mount the sender to the pump at the mechanical tachometer drive take-off using the correct drive tip (supplied with DK-3) to properly engage the sender.
5. Using a small screwdriver, SLIGHTLY depress and turn the selector switch on the back of the tachometer to match the tachometer drive take-off (see label on side of tachometer).
DEPRESSING THE SWITCH TOO HARD MAY CAUSE DAMAGE TO THE TACHOMETER.
Be sure the selector switch has locked into the detent at the correct position by slightly rotating the switch back and forth with the screwdriver. (PTO Pump tach ratio = 1/2, Midship Pump tach ratio = 1/1).
6. Cut a 3-3/8" diameter hole in the dash and mount the tach with back clamp supplied.
7. Connect a wire to the tach stud marked "BAT" (battery) and secure with nut and lockwasher. Connect opposite end of the 12 VDC circuit that is activated by the ignition switch.
8. Connect a wire to the tach stud marked "SIGNAL" and secure with a nut and lockwasher. Connect the opposite end to the gray wire of the diesel tachometer sender. Connect the black wire of the diesel tachometer sender to the engine ground.
9. Connect a wire to the tach stud marked "GND" (ground) and secure with a nut and lockwasher. Connect opposite end to the electrical ground.
10. Connect the blade terminal adjacent to the twist-out light assembly to the positive "+" side of the vehicle's instrument lighting circuit. No separate ground is required for lighting.
11. Reconnect the battery.
12. NOTE: To change light bulb, twist black socket assembly one-eighth (1/8) turn counter clockwise until it pops out. Bulb pulls straight out of socket assembly. It is a GE #158 instrument lamp.

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



ATTACH WARNING PLATE
(ASSY AM00700) TO
CONTROL PANEL VIA
REV. NO. 96-115 (REF). ©



APPROXIMATE WEIGHT
 4" - 19 LB = 8.6 KG
 5" - 22 LB = 10 KG
 6" - 27 LB = 12.2 KG

PART NO.	DATE	CHANGE
96-115/19/96	19/96	ADDED PLATE LMH
TOLERANCE EXCEPT AS NOTED		
FRACTIONS ±.01		
DECIMALS ±.005		
ANGLES ±.5		
OLD PART NO.	DATE	
G2420	SEP25,91	
DWG - BIRFLY VALVE ASSY		
MANUAL CONTROLLED		
DRWN	DWS	SCALE
CPHD	1/2	
PRGD		

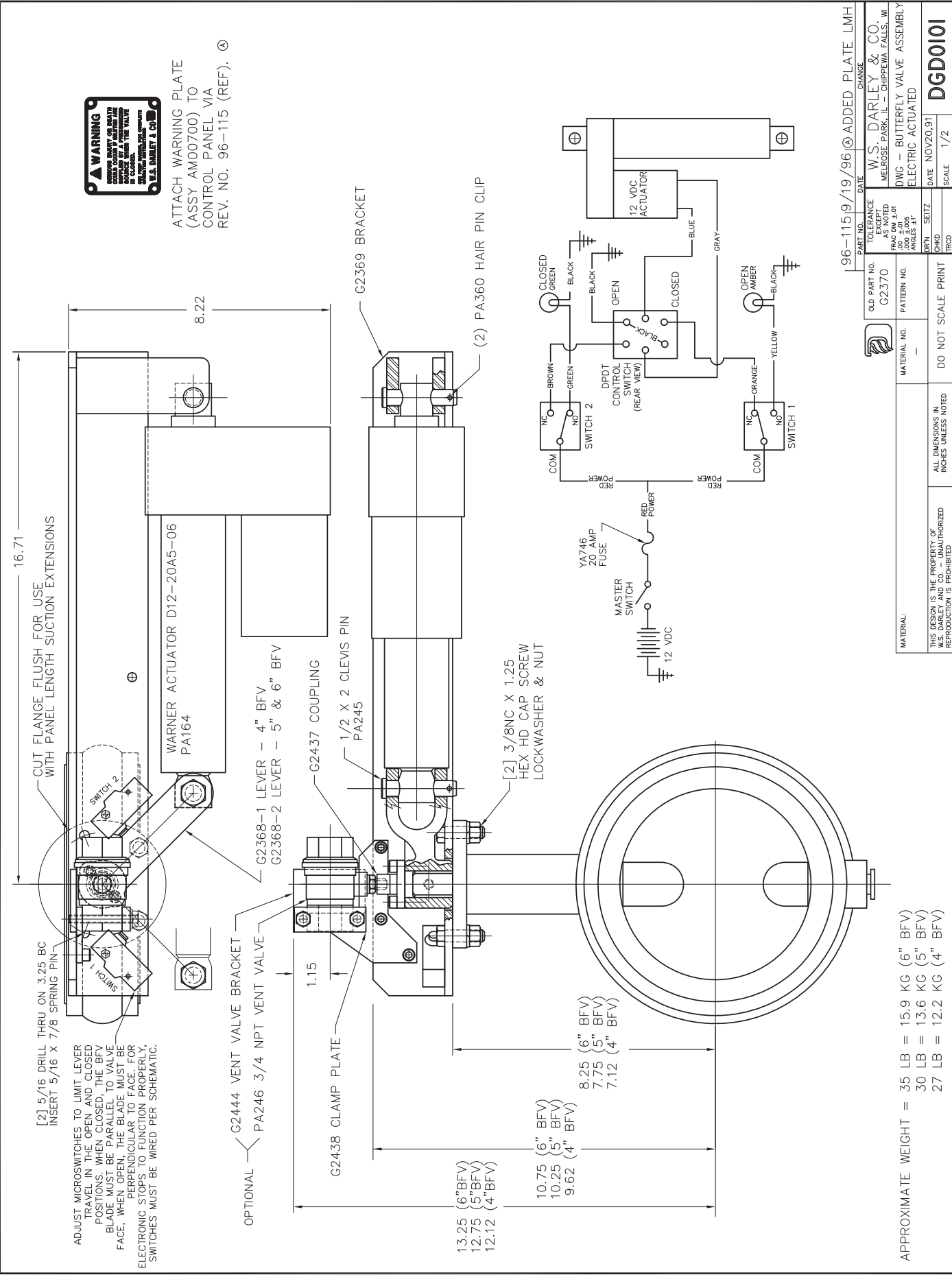
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ALL DIMENSIONS IN INCHES UNLESS NOTED

DO NOT SCALE PRINT

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

DGD0104



96-1159/19/96 ⓐ ADDED PLATE LMH

PART NO.	DATE	CHANGE
G2370		

TOLERANCE
 UNLESS NOTED
 AS SHOWN

FRAC DIM ±.01
 DEC DIM ±.005
 ANGLES ±1°

W.S. DARLEY & CO.
 MELROSE PARK, IL - CHIPPewa FALLS, WI

DWG - BUTTERFLY VALVE ASSEMBLY
 ELECTRIC ACTUATED

DATE NOV20.91

SCALE 1/2

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 INCHES UNLESS NOTED

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MATERIAL:

OLD PART NO.
 G2370

PATTERN NO.

MATERIAL NO.

CHKD

TRCD

DGD0101

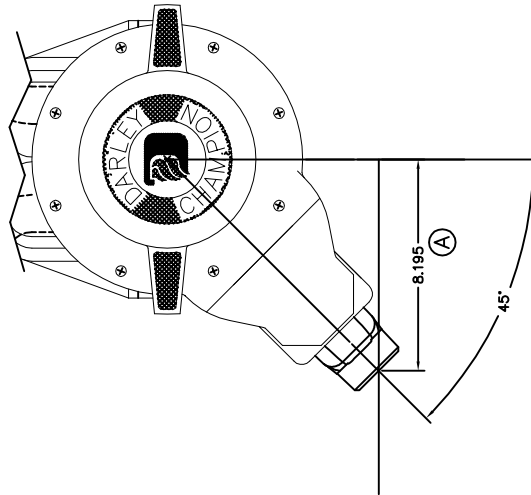
Prepared By: EAP
 Revised By: EAP
 Approved By: TED

INLET RELIEF VALVE INFORMATION: (A)

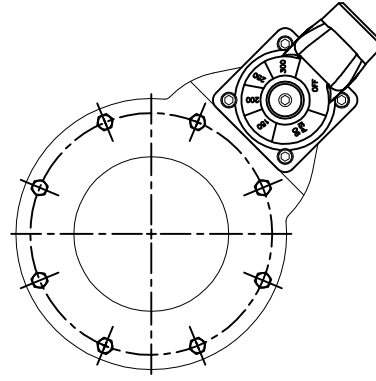
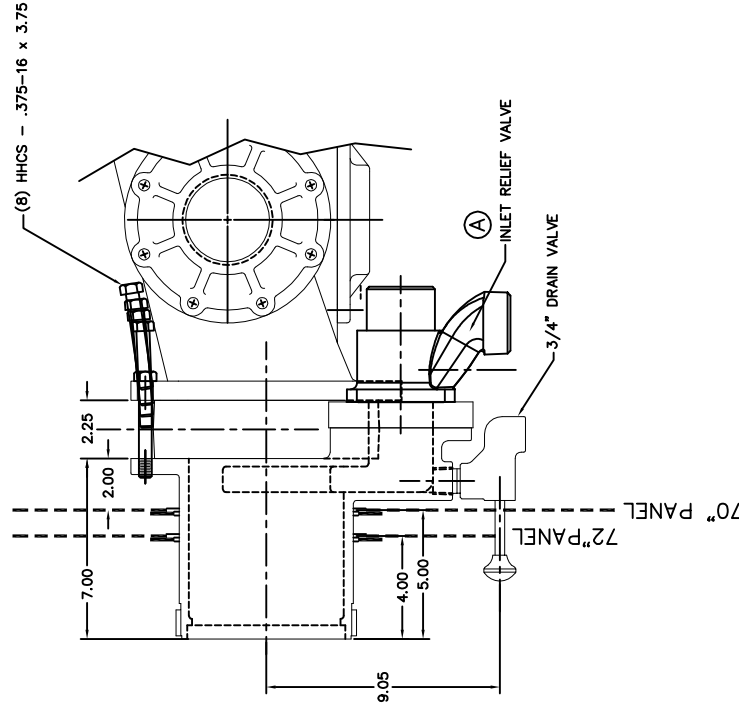
ACTUAL PRESSURE RANGE IS 90PSI - 300PSI
 THERE MAY BE SOME DIMINISH IN FLOW AT HIGHER
 PRESSURE SETTINGS. (SETTINGS BELOW 200 PSI
 RECOMMENDED FOR MOST APPLICATIONS).
 RELIEF VALVE IS FACTORY SET AT 125 PSI AND
 WHEN PRESET AT 125 PSI, THE PRESSURE RELIEF
 VALVE SHALL NOT ALLOW A PRESSURE RISE GREATER
 THAN 60 PSI AT THE DEVICE INLET WHILE FLOWING A
 MINIMUM OF 150 GPM.
 THIS VALVE IS NFPA 2009 1901 COMPLIANT PER SECTION
 16.6.6.3

ADJUSTMENT INSTRUCTIONS (IF REQUIRED): (A)

ADJUST CENTER HEX COUNTERSUNK HEX HEAD PRESSURE
 ADJUSTING BOLT WITH A 1/4" ALLEN WRENCH, 9/16" OR
 14 MM SOCKET.
 TO SET AT THE DESIRED RELIEF PRESSURE, ADJUST THE ADJUSTING
 BOLT HEAD SO THE TOP OF THE BOLT HEAD IS EVEN WITH
 THE DESIRED PRESSURE.



NOTE:
 SUCTION NIPPLE WILL BE ROTATED
 45° OFF CENTER WHEN MOUNTED.



TYPICAL SUCTION EXTENSION CONFIGURATION FOR EM, LDM, N, & S PUMP

EXTENSION AND NIPPLE
 ARE THE SAME FOR 70 & 72"
 ASSEMBLIES WITH AND
 WITHOUT BUTTERFLY VALVES.
 IF BFV IS NOT REQUIRED, THEN
 KC00300 ASSY W/2.25 THICK SPACER IS USED.
 USE 1962503 STAINLESS STEEL PANEL TRIM RING



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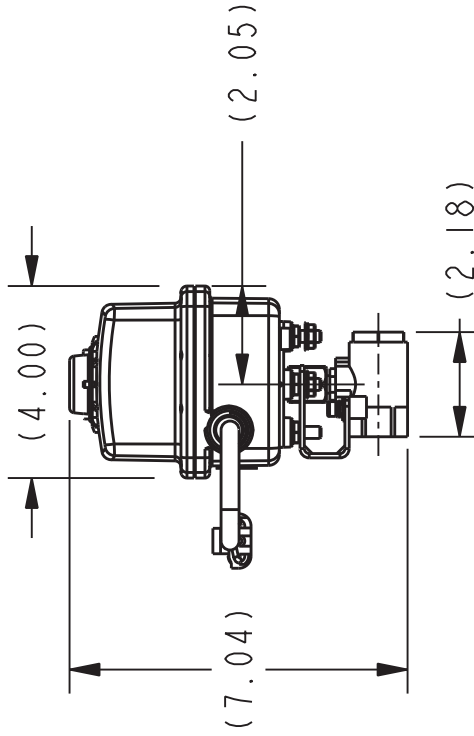
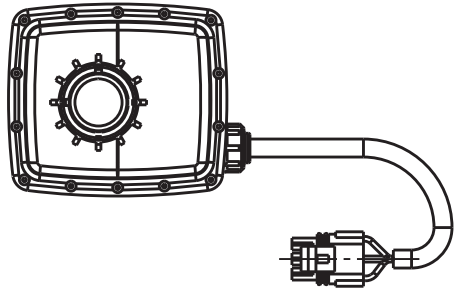
07/18/12	DATE	UPDATED DRAWING TO REFLECT USE OF 8.20 WAS 5.22. UPDATED INFO AND ADDED PART SECTION
A - #9312	PART NO.	
	TOLERANCE EXCEPT AS NOTED	
	FRAC DIM ±.01	
	DEC DIM ±.005	
	ANGLES ±1°	
	DRN	CKE
	CHKD	SJL
	TRGD	
03FEB10	DATE	0.3FEB.00
1/4	SCALE	1/4

W.S. DARLEY & CO.
 MELROSE PARK, IL - CHIPPENVA FALLS, WI
 INSTR - INLET RV ADJUSTMENT

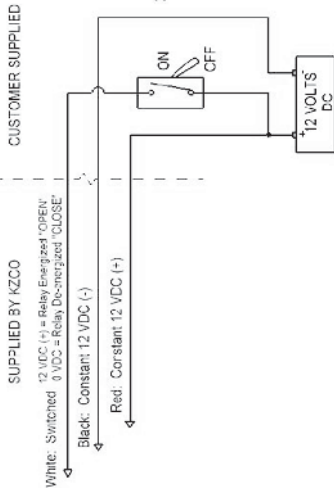
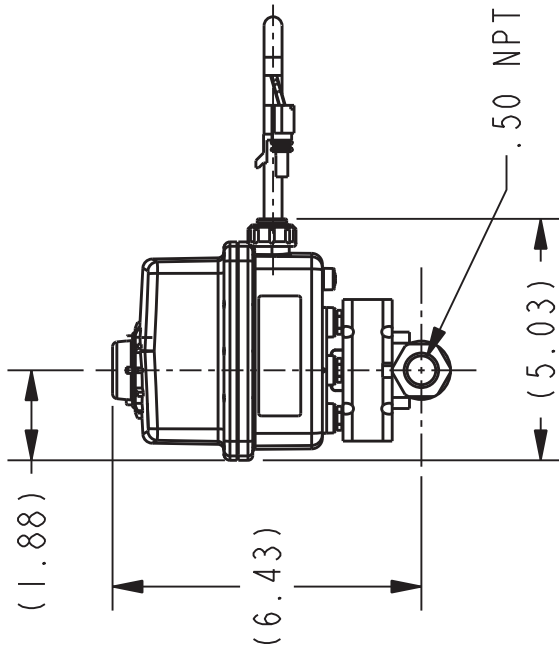
1200572

REVISIONS

LTR	DESCRIPTION	DATE	CHG NO.	APPR'D



.50 NPT FE



CUSTOMER SUPPLIED

SUPPLIED BY KZCO

White: Switched 12 VDC (+) = Relay Energized 'OPEN'
Black: Constant 12 VDC (-)
Red: Constant 12 VDC (+)

2-POSITION
SPST
Switch

12 VOLTS
DC

REMOVE SHARP EDGES

INCH
[MILLIMETER]

THIRD ANGLE PROJECTION



OLD PART NO.

TOLERANCE
EXCEPT
AS NOTED

5209401 11/13/08 1/2 A

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

PATTERN NO.

.00 ±.03
.000 ±.010
ANGLES ±1°

VALVE - ACTUATED, 12VDC, .50NPT FE
KZCO 84D23-10D20-POI

MATERIAL NO.

MATERIAL DESCRIPTION:
KZCO 84D23-10D20-POI

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ALL DIMENSIONS IN
INCHES UNLESS NOTED

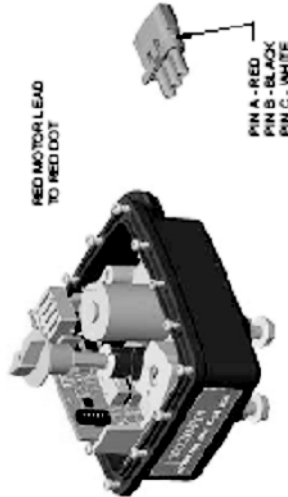
DO NOT SCALE PRINT

DR'N RJG
CHKD DWS
TRCD

DATE 13-Nov-08
SCALE 1/4

5209401

INPUT/OUTPUT POWER = 1224 WDC
 1 - BLACK - POWER (-) NEGATIVE
 2 - RED - POWER (+) POSITIVE
 3 - WHITE - SIGNAL (+) POSITIVE TO OPEN
 4 - ...
 DIP SW 4 ON



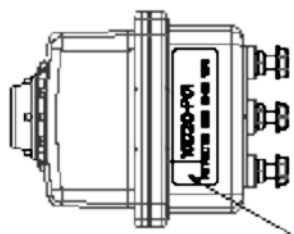
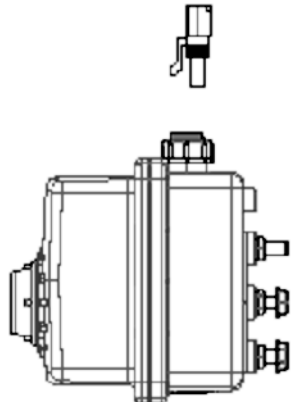
RED MOTOR LEAD TO RED DOT
 PIN A - RED
 PIN B - BLACK
 PIN C - WHITE

SCALE .500

PROGRAM NOTE

MA320 SET DATA
 CONTROL INPUT = 1
 FEEDBACK = 0
 OPERATOR = 0
 MOTOR MC
 SPEED CT = 0.8
 ZEROPST = 0.8
 RANGE TO LE RANGE = 1
 ROTATION = CCW
 ACTUATOR RANGE = 0.00/0.00
 DESIGN VOLTAGE = E
 DIP SW = 3
 LABEL = KZ00
 CAPTIONS = 0
 PLUG TYPE = P
 TEST PLUG =

KZCOO INC.
 THE ACTUATOR ENH SOLID STATE
 Part No 1002(AP0) 1
 COMMENTS 10020(P0) 1
 REV: 1 of 1

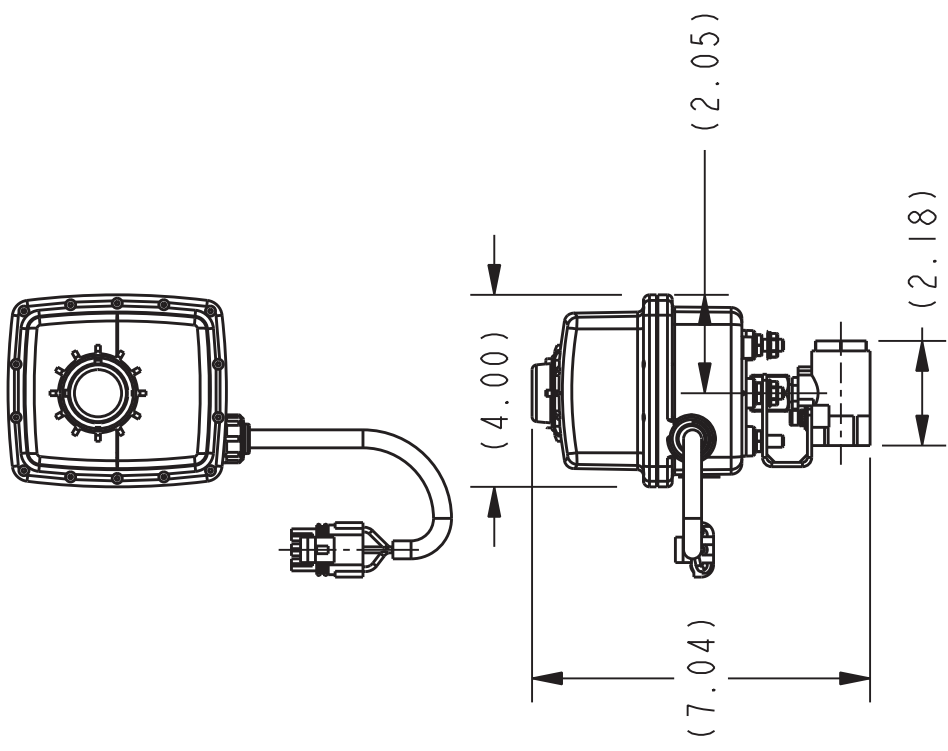
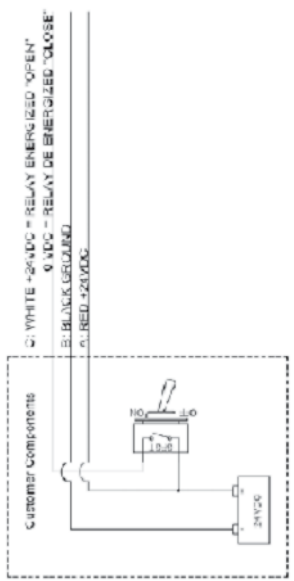


ACTUATOR LABEL
 MA320 LABEL DESCRIPTION
 ACTUATOR, ENH 12/24 VDC

QTY	PART NUMBER	DESCRIPTION	MATERIAL
21	1	ENH-902 LABEL, ENH ACTUATOR, 2.5" X 1", THERMAL TRANSFER, WHITE	NO MATERIAL
20	1	80019 HARNESSE, 9BA, 3ST, W/P312, 2.5"	
19	1	ENH-115-Y FLAG, YELLOW	POLYPROPYLENE, TAU, 20
18	1	309-0029 PCB ASSY, ENH L1 SOLID STATE 12 VDC	
17	1	100-801 GEAR MOTOR, MG 18 RPM/MOLON	NO MATERIAL
16	3	016-222 PLT, HEX HEAD, SERRATED FLANGE, .281-30 UNC, .25	STAINLESS STEEL TYPE 303
15	4	ENH-135 STD, 1/4-20 X 1/2 MTG	STAINLESS STEEL TYPE 303
14	1	ENH-104 RETAINER, PUSH ON 5/16" SHAFT	STAINLESS STEEL TYPE 303
13	1	493-8100 CAM ASSY, EXTD LOGS FOR EPDS E-COPT	
12	1	ENH-002 LABEL, ENH ACTUATOR, 2.5" X 1", THERMAL TRANSFER, WHITE	NO MATERIAL
11	1	ENH-130 O-RING, DOME	SILICONE, RED, 3/8" DIAMETER
10	1	ENH-114 DOME, CLEAR	POLYCARBONATE,
9	14	ENPT-1103 SCREW, PAN, PHILLIPS, HIGH-LOW, 5-20 X .562	STAINLESS STEEL TYPE 410
8	1	ENH-100-14 LID, CASE, ENH, DOME	NYLON 6/6, 6/6, 303A, BLACK
7	4	ENH-109 SCREW, 3-32 X 1/8 PHRMS SS	STAINLESS STEEL TYPE 303
6	1	ENH-107 SCREW, 3-18 X 3/8" T58 PHRMS SS	STAINLESS STEEL TYPE 303
5	1	ENH-1030 O-RING, EP3, CASE LD, # 120	SILICONE, RED, 3/8" DIAMETER
4	1	ENH-109 O-RING, 80IR, PRESSURE TEST PORT	FLUOROCARBON BLACK, 7/16" DIAMETER
3	1	ENPT-140 O-RING, #12, MOTOR SHAFT, VITON	FLUOROCARBON BLACK, 7/16" DIAMETER
2	1	ENH-10034H LOWER CASE - ENH INTERNAL MTG	NYLON 6/6, 6/6, 303A-BLACK
1	1	493-0002 CASE KIT, ENH IM DOME NYLON MC MTR	NYLON 6/6, 6/6, 303A-BLACK

REVISIONS			
LTR	DESCRIPTION	DATE	CHG NO. APPR'D

60AD WIRING
Standard On/Off applications, SPST Switch
24 VDC



.50 NPT FE

REMOVE SHARP EDGES

INCH
[MILLIMETER]



OLD PART NO.

TOLERANCE
EXCEPT
AS NOTED

MODEL NAME 5209402 MDL CREATED 11/13/08 SHEET 1/3 A

MATERIAL DESCRIPTION:
KZCO 84D23-60AD-M

MATERIAL NO. -
PATTERN NO. -

VALVE - ACTUATED, 24VDC, .50NPT FE
KZCO 84D23-60AD-M

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

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DR'N RJG
CHKD DWS
TRCD

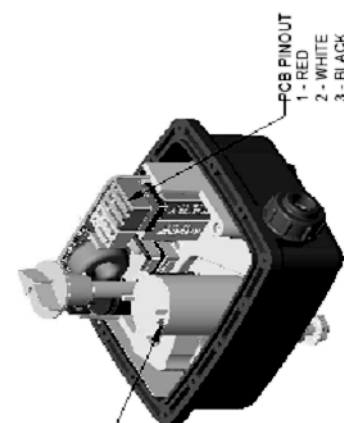
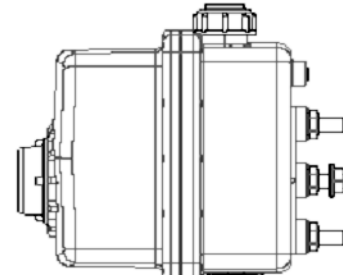

DATE 13-NOV-08
SCALE 1/4

5209402

REVISION 001 01	REVISION ECO 001 01	REVISION/REVISION DATE 3/28/2008 1:49:38 PM	REVISION/REVISION BY wfeclde
-----------------------	---------------------------	------------------------------------------------	---------------------------------

DATE: 2007-04-16 DESIGNED: L. ERDWAMP DRAWN: W. FEDDE APPROVED: A. KOTTAS	TITLE: ACTUATOR EH3_85@24VDC PART NO: 000-60AD-M SCALE: 500 MATERIAL:	ALL DIMENSIONS IN INCHES UNLESS NOTED OTHERWISE TOTAL FINISH: 80% MIN CORNER BREAK: R0.010 SURFACE FINISH: 125µIN DIM TOLERANCES: XX.X ±.015 XX.XX ±.005 XX.XXX ±.001	DENSITY: 1.15 G/CM ³ SURF AREA: 181.308 SQ IN VOLUME: 12.503 CU IN
------------------------------------------------------------------------------------	--------------------------------------------------------------------------------	--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------	-------------------------------------------------------------------------------------

QTY	PART NUMBER	DESCRIPTION	MATERIAL
8	EH-502	LABEL, EH ACTUATOR, 2.5" X 1", THERMAL TRANSFER, WHITE	NO_MATERIAL
7	QX-222	NUT, HEX HEAD, SERRATED FLANGE, 250-20 UNC-28	STAINLESS_STEEL,TYPE_303
6	EH-135	STUD, 1/4-20 X 1/2 MTG	STAINLESS_STEEL,TYPE_303
5	800018	HARNISS, 60A,35T, WP3T,22.5"	
4	EH-115-Y	FLAG, YELLOW	POLYPROPYLENE_TALC_20
3	800488	PCB ASSY, EH3 24VDC 60AD/60DF	
2	EH-110	GEAR ASSY, EH3 SERIES M1 18 RPM @ 12VDC	
1	498-0005	CASE KIT, EH3 IM DOME NYLON M1 & N1 MTR	

MOTOR LEADS - RED TO RED DOT

PCB PINOUT
 1 - RED
 2 - WHITE
 3 - BLACK

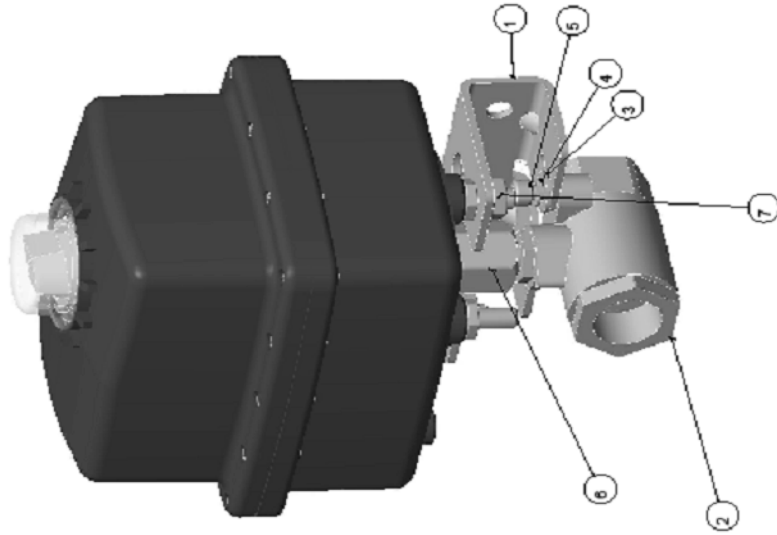
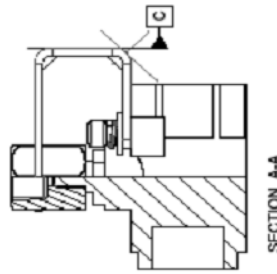
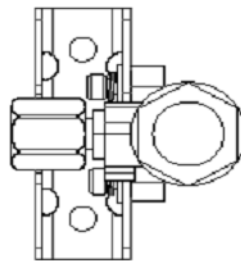
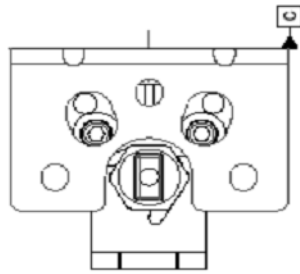
SCALE .500

PIN A - RED
 PIN B - BLACK
 PIN C - WHITE

MASRO SET DATA
 CONTROL INPUT = 1
 FEEDBACK = 0
 OPERATION = 0
 MOTOR = M
 SPEED CT = 0.8
 ZEROSET = 135
 RANGE TOLERANCE = 1
 ROTATION = CC081
 ACTUATOR RANGE = 0.000.00
 DESIGN VOLTAGE = D
 DIP SX =
 LABEL = KZCO
 OPTIONS = 0
 PLUG TYPE =
 TEST PLUG =

KZCO inc.
 2700 S. FARMWAY
 GREENWICH, NE 68381 USA
 PHONE: 402.342.2767
 FAX: 402.342.2702

REVISION	REVISION DATE	REVISION/REVISION BY
-8+	8/12/2008 9:18:50 AM	bgolschall



ACTUATOR SHOWN IS REPRESENTATIVE USED
ONLY TO SHOW PROPER ORIENTATION TO VALVE.

QTY	PART NUMBER	DESCRIPTION	MATERIAL
7	QK-222	NUT, HEX HEAD, SERRATED FLANGE, .250-20 UNC-2B	STAINLESS_STEEL_TYPE_303
6	EH-145	COUPLER, 1/4" - 1/2" APOLLO	STAINLESS_STEEL_TYPE_316
5	EH-158	SCREW, #10-24 X 3/8" SS SOCKET HEAD	STAINLESS_STEEL_TYPE_303_OR_316
4	EHPT-103	WASHER, LOCK, .187 ID X .334 OD X .047 T	STAINLESS_STEEL_TYPE_316
3	EHPT-150	WASHER, FLAT, #10-18-8 SS	STAINLESS_STEEL_TYPE_316
2	EH3-640	VALVE, 1/2" 2-WAY APOLLO 70-103-01 BRONZE BALL VALVE	BRONZE
1	EH3-174	BRACKET, MOUNTING EH3 SERIES	STAINLESS_STEEL_TYPE_304
			MATERIAL

DATE: 2007-08-08	DESIGNED L. ERDKAMP	DATE: 2007-08-08	DESIGNED L. ERDKAMP
DRAWN C. HOWARD	APPROVED L. ERDKAMP	SCALE: .750	SIZE: B
REF:		PART NO: 84D23	REVISION: -8+
		DRAWING NO: 84D23	SHEET: 1 OF 1

STANDARD TOLERANCES - ALL DIMENSIONS IN INCHES UNLESS NOTED OTHERWISE	DATE: 2007-08-08
TOTAL FINISH: .001 FIM	DESIGNED L. ERDKAMP
AXIS: .004 FIM	DRAWN C. HOWARD
XXX: .004 FIM	APPROVED L. ERDKAMP
XXXX: .004 FIM	SCALE: .750
XXXXX: .004 FIM	SIZE: B
XXXXXX: .004 FIM	MATERIAL: AS NOTED

STAINLESS_STEEL_TYPE_303	DATE: 2007-08-08
STAINLESS_STEEL_TYPE_316	DESIGNED L. ERDKAMP
STAINLESS_STEEL_TYPE_303_OR_316	DRAWN C. HOWARD
STAINLESS_STEEL_TYPE_316	APPROVED L. ERDKAMP
STAINLESS_STEEL_TYPE_310	SCALE: .750
BRONZE	SIZE: B
STAINLESS_STEEL_TYPE_304	MATERIAL: AS NOTED

STAINLESS_STEEL_TYPE_303	DATE: 2007-08-08
STAINLESS_STEEL_TYPE_316	DESIGNED L. ERDKAMP
STAINLESS_STEEL_TYPE_303_OR_316	DRAWN C. HOWARD
STAINLESS_STEEL_TYPE_316	APPROVED L. ERDKAMP
STAINLESS_STEEL_TYPE_310	SCALE: .750
BRONZE	SIZE: B
STAINLESS_STEEL_TYPE_304	MATERIAL: AS NOTED

STAINLESS_STEEL_TYPE_303	DATE: 2007-08-08
STAINLESS_STEEL_TYPE_316	DESIGNED L. ERDKAMP
STAINLESS_STEEL_TYPE_303_OR_316	DRAWN C. HOWARD
STAINLESS_STEEL_TYPE_316	APPROVED L. ERDKAMP
STAINLESS_STEEL_TYPE_310	SCALE: .750
BRONZE	SIZE: B
STAINLESS_STEEL_TYPE_304	MATERIAL: AS NOTED