

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

Description, Operation & Maintenance, & Lubrication-----	1200570
Related Drawings-----	DJC0500
 Mechanical Seal -----	 1200583
Seal Installation Instructions-----	1201040
Packing Adjustment-----	1200504 1200514
Pump Shift -----	1200591 1200590
High Pressure Stage-----	1200511 DLC0104
General Operation-----	1200509 1200510 1201500-1201502
Electric Primer -----	1200512 DVC0207 DVC0209
Multiple Drain Valve -----	1204506 DGC0903
Ball Valve-----	1200000 DGC0100
Relief Valve "Suction / Discharge Valve"-----	1200508 DGC0115 1200503 DGC0141 DGD0800 1201002
Tachometer -----	DGC0105 1201001
Butterfly Valve -----	DGD0104 DGD0101
Pump Overheat Protection-----	DGM0117 5209401 5209402

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

Prepared by: EAS
Revised by: EAS
Approved by: TED

Rev. 8
Date: 9/12/12
1200570

This manual is for DARLEY FIRE PUMP:

Model: **JMH** Pump Serial Number: _____

Description of Pump Type

The **Type JMH** pump is a high speed, two stage, centrifugal pump, adapted to operate with its two impellers in series as a two stage pump, or in parallel with the characteristics of a conventional single stage pump.

The pump is operated in series at restricted capacities for higher pressures, or lower engine speeds. Parallel operation is employed for maximum capacities at lower pressures.

If a two stage pump operating in parallel is switched to series and the capacity reduced by one half, and the engine speed kept the same, then the output pressure will be doubled.

The JMH pump is powered from a hydraulic motor.

OPERATION AND MAINTENANCE OF TYPE JMH FIRE PUMP

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

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

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 six month, and change it every 50 hours or 12 months.

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

CAUTION: Do not overfill.

Operation of Pump

The pump is directly coupled to the hydraulic motor through a step up gearbox. Prepare the pump for operation before starting the pump. Prime the pump system, then engage the pump.

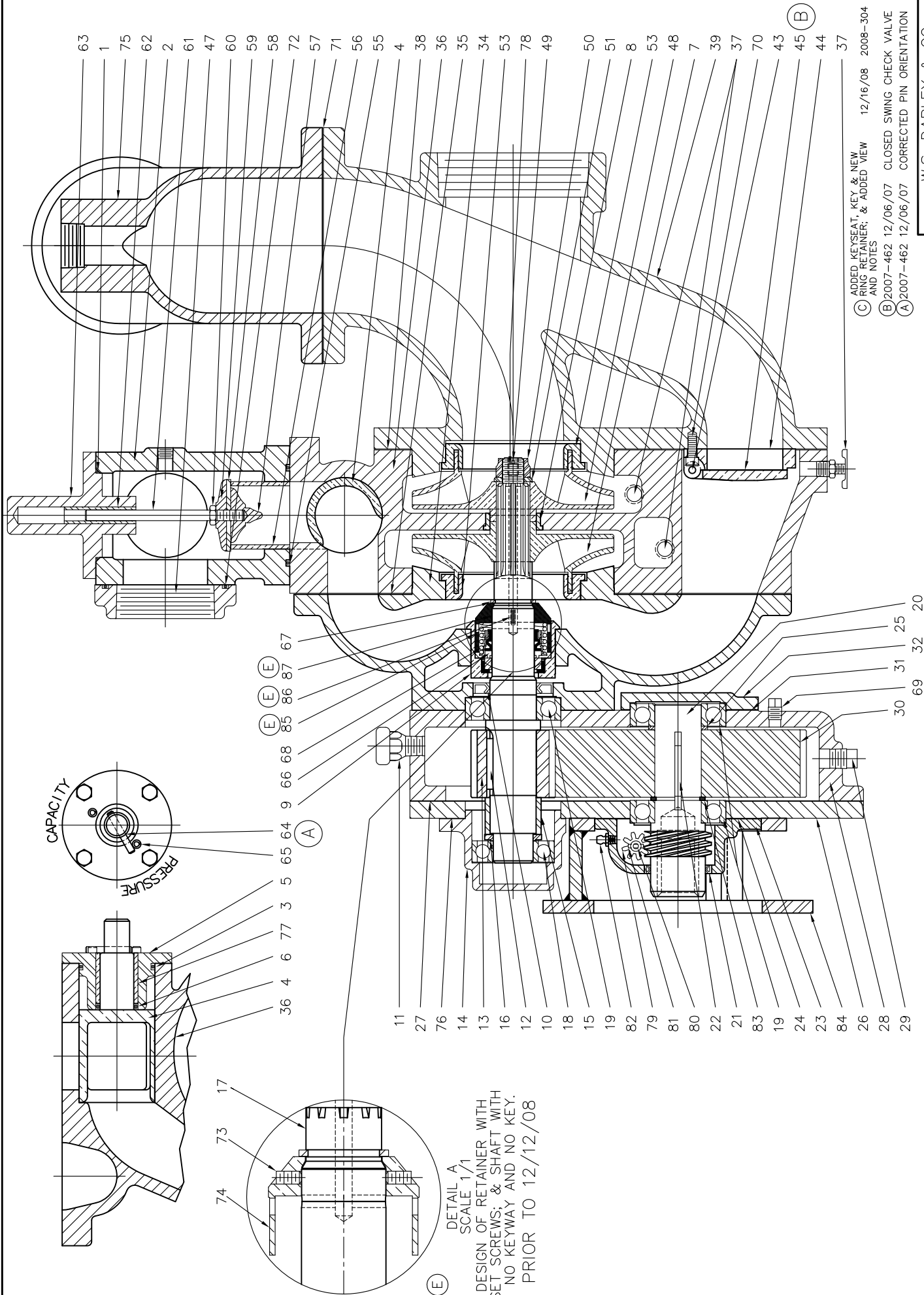
Series Parallel Control Valve

While facing the suction:

If the control valve is on the right, the staging control valve shaft must be rotated clockwise (facing the end of the valve shaft) to end of travel for parallel (capacity) operation, and counter clockwise to the end of travel for series (high pressure) operation.

If the control valve is on the left, the staging control valve shaft must be rotated counter clockwise (facing the end of the valve shaft) to end of travel for parallel (capacity) operation, and clockwise to the end of travel for series (high pressure) operation.

WARNING: Do not use this pump for hose testing.



ADDED KEYSEAT, KEY & NEW RING RETAINER; & ADDED VIEW AND NOTES
 2007-462 12/06/07 CLOSED SWING CHECK VALVE
 2007-462 12/06/07 CORRECTED PIN ORIENTATION

W.S. DARLEY & CO. MELROSE PARK, IL - CHIPPEWA FALLS, WI	
DWG - JMH, 2 GEAR, MECH SEAL	CROSS SECTION
DRN S.L.	DATE DEC14,90
CHKD	SCALE 1/2
TRCD DWS	

SUNDSTRAND 23-3501 HYDRAULIC MOTOR	
OLD PART NO. J278	DO NOT SCALE PRINT
ALL DIMENSIONS IN INCHES UNLESS NOTED	
THIS DESIGN IS THE PROPERTY OF W.S. DARLEY & CO. UNAUTHORIZED REPRODUCTION IS PROHIBITED	

DJC0500



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.

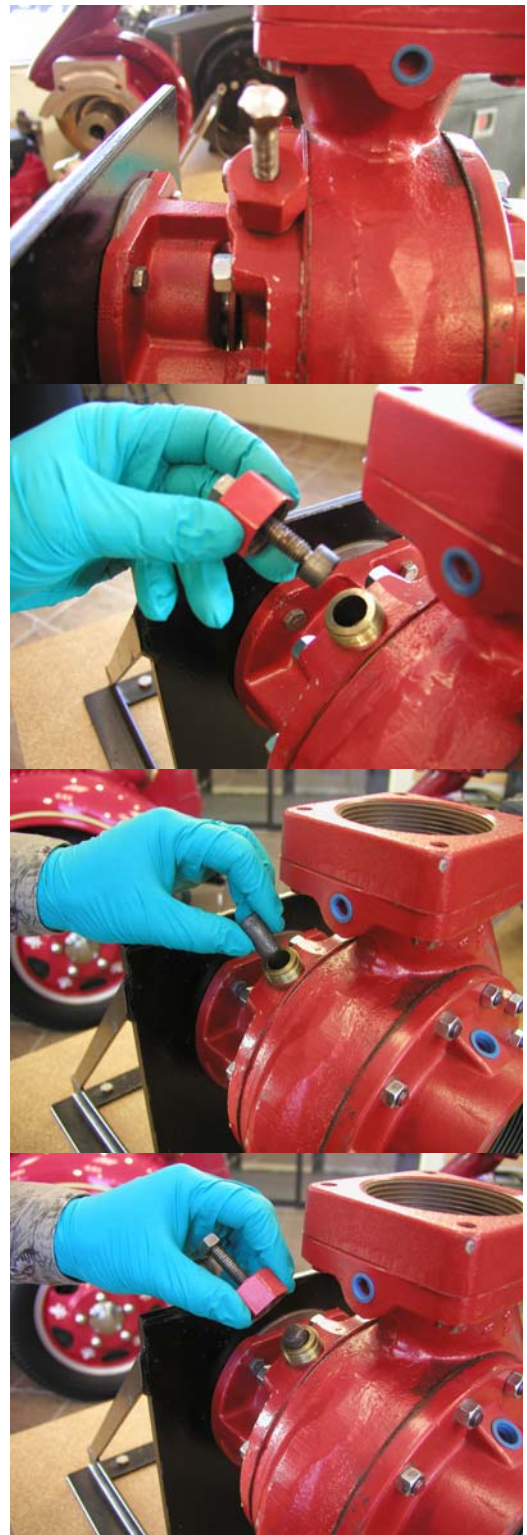
⚠ Caution: Do not attempt to use anything but Darley injection packing. Using the wrong packing material in your pump may cause catastrophic failure of the pump shaft sealing components.

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

Mechanical Shaft Seal

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

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

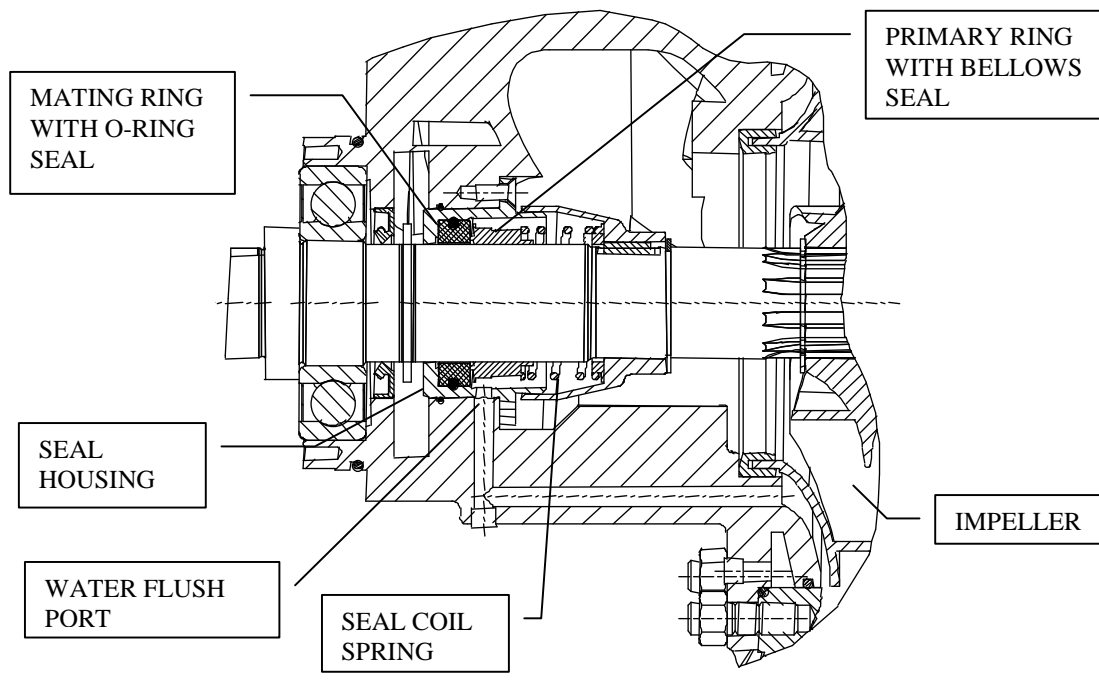
Mechanical Seal Basics

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

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

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

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



Operation and Maintenance

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

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

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

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



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



CAUTION: DO NOT USE THIS PUMP FOR HOSE TESTING



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



DARLEY

INSTALLATION OF MECHANICAL FACE SEAL WITH O'RING

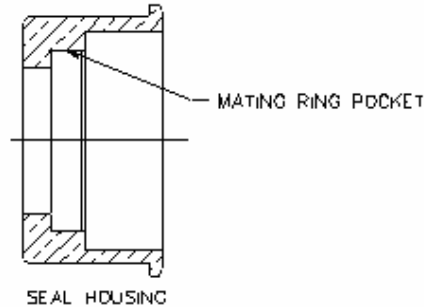
SPECIAL HANDLING

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

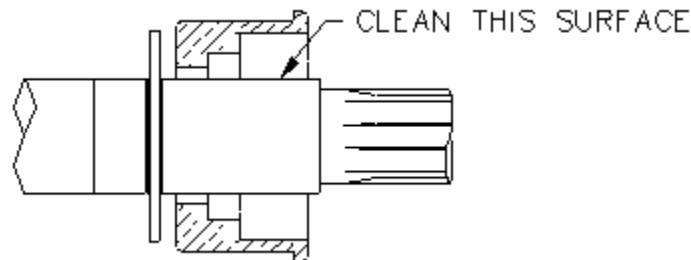
INSTRUCTION STEPS:

Instructions for Installing a Mechanical Shaft Seal

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



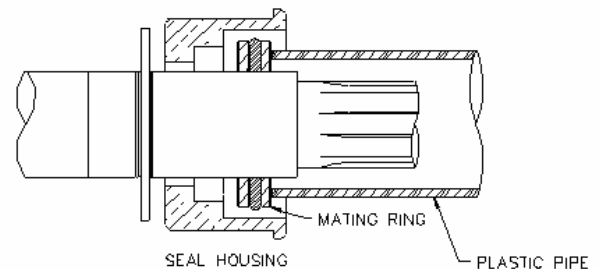
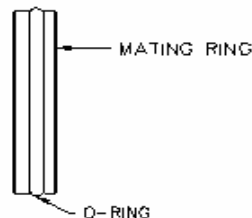
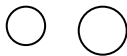
2. Inspect the pump shaft surface under the bellows, ensuring it is clean and nick free to provide a proper sealing surface. Isopropyl alcohol may be used to clean surface if required.



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

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

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

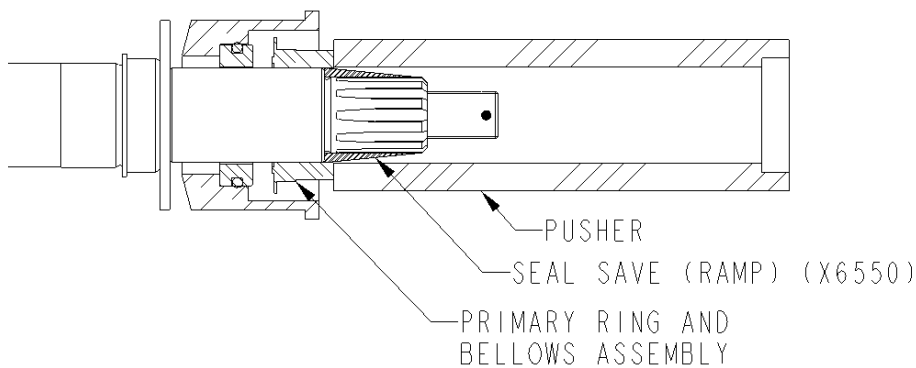
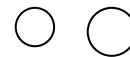


4. Clean the mating ring surface with isopropyl alcohol to remove any fingerprints and any other contaminants left on mating ring.

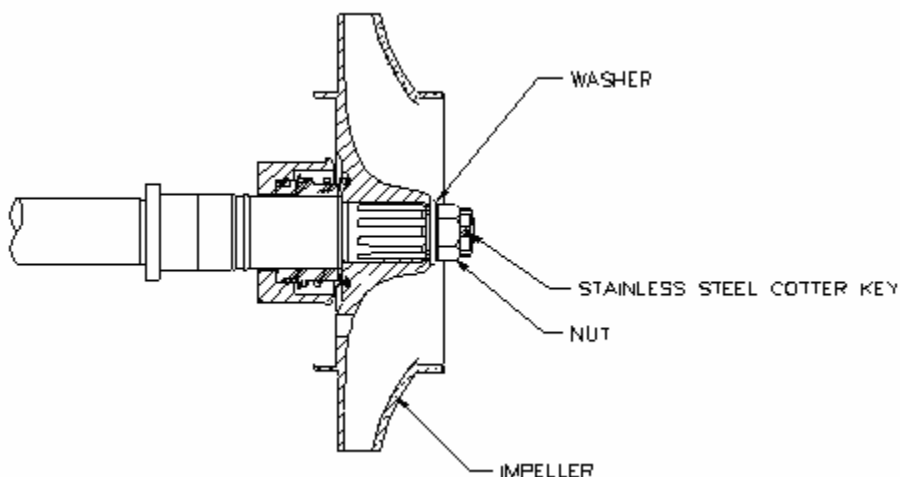
Note: Steps 5 – 9 need to all be completed with in 15 minutes or less.

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

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



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



*** Reference pump configuration for individual mechanical seal instructions.*

*** Reference pump assembly drawings and pump assembly tips for further assembly.*

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

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

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

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 midship mounted pump with truck transmission in direct (high) gear lock up.
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.

PTO Safety Information

These instructions are for your safety and the safety of the end user. Read them carefully until you understand them.

General Safety Information

To prevent injury to yourself and/or damage to the equipment:

- Read carefully all owner's manuals, service manuals, and/or other instructions.
- Always follow proper procedures, and use proper tools and safety equipment.
- Be sure to receive proper training.
- Never work alone while under a vehicle or while repairing or maintaining equipment.
- Always use proper components in applications for which they are approved.
- Be sure to assemble components properly.
- Never use worn-out or damaged components.
- Always block any raised or moving device that may injure a person working on or under a vehicle.
- Never operate the controls of the Power Take-Off or other driven equipment from any position that could result in getting caught in the moving machinery.

Proper Matching of P.T.O.



WARNING: A Power Take-Off must be properly matched to the vehicle transmission and to the auxiliary equipment being powered. An improperly matched Power Take-Off could cause severe damage to the vehicle transmission, the auxiliary driveshaft, and/or to the auxiliary equipment being powered. **Damaged components or equipment could malfunction causing serious personal injury to the vehicle operator or to others nearby.**

To avoid personal injury and/or equipment damage:

- Always refer to Chelsea catalogs, literature, and owner's manuals. Follow Chelsea recommendations when selecting, installing, repairing, or operating a Power Take-Off.
- Never attempt to use a Power Take-Off not specifically recommended by Chelsea for the vehicle transmission.
- Always match the Power Take-Off's specified output capabilities to the requirements of the equipment to be powered.
- Never use a Power Take-Off whose range of speed could exceed the maximum.

Cold Weather Operation of Powershift P.T.O.



WARNING: During extreme cold weather operation [32° F (0°C) and lower], a disengaged Powershift Power Take-Off can momentarily transmit high torque that will cause unexpected output shaft rotation. This is caused by the high viscosity of the transmission oil when it is extremely cold. As slippage occurs between the Power Take-Off clutch plates, the oil will rapidly heat up and the viscous drag will quickly decrease.

The Power Take-Off output shaft rotation could cause unexpected movement of the driven equipment resulting in serious personal injury, death, or equipment damage.

To avoid personal injury or equipment damage:

- Driven equipment must have separate controls.
- The driven equipment must be left in the disengaged position when not in operation.
- Do not operate the driven equipment until the vehicle is allowed to warm up.



This symbol warns of possible personal injury.

Reprinted with permission from: Parker Hannifin Corporation, Chelsea Products Division
Bulletin HY25-1380-M1/US, April 2002

Rotating Auxiliary Driveshafts



WARNING:



- Rotating auxiliary driveshafts are dangerous. You can snag clothes, skin, hair, hands, etc. This can cause serious injury or death.
- Do not go under the vehicle when the engine is running.
- Do not work on or near an exposed shaft when the engine is running.
- Shut off the engine before working on the Power Take-Off or driven equipment.
- Exposed rotating driveshafts must be guarded.

Guarding Auxiliary Driveshafts



WARNING: We strongly recommend that a Power Take-Off and a directly mounted pump be used to eliminate the auxiliary driveshaft whenever possible. If an auxiliary driveshaft is used and remains exposed after installation, it is the responsibility of the vehicle designer and P.T.O. installer to install a guard.

Using Set Screws



WARNING: Auxiliary driveshafts may be installed with either recessed or protruding set screws. If you choose a square head set screw, you should be aware that it will protrude above the hub of the yoke and may be a point where clothes, skin, hair, hands, etc. could be snagged. A socket head set screw, which may not protrude above the hub of the yoke, does not permit the same amount of torquing as does a square head set screw. Also, a square head set screw, if used with a lock wire, will prevent loosening of the screw caused by vibration. Regardless of the choice made with respect to a set screw, an exposed rotating auxiliary driveshaft must be guarded.

Important: Safety Information and Owner's Manual

Chelsea Power Take-Offs are packaged with safety information decals, instructions, and owner's manual. These items are located in the envelope with the P.T.O. mounting gaskets. Also, safety information and installation instructions are packaged with some individual parts and kits. **Be sure to read the owner's manual before installing or operating the P.T.O.** Always install the safety information decals according to the instructions provided. Place the owner's manual in the vehicle glove compartment.



WARNING: Operating the P.T.O. with the Vehicle in Motion

Some Power Take-Offs may be operated when the vehicle is in motion. To do so, the P.T.O. must have been properly selected to operate at highway speeds and correctly matched to the vehicle transmission and the requirements of the driven equipment.

If in doubt about the P.T.O. specifications and capabilities, avoid operating the P.T.O. when the vehicle is in motion. Improper applications and/or operation can cause serious personal injury or premature failure of the vehicle, the driven equipment, and/or the P.T.O.

Always remember to disengage the P.T.O. when the driven equipment is not in operation.



This symbol warns of possible personal injury.

Reprinted with permission from: Parker Hannifin Corporation, Chelsea Products Division
Bulletin HY25-1380-M1/US, April 2002

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.

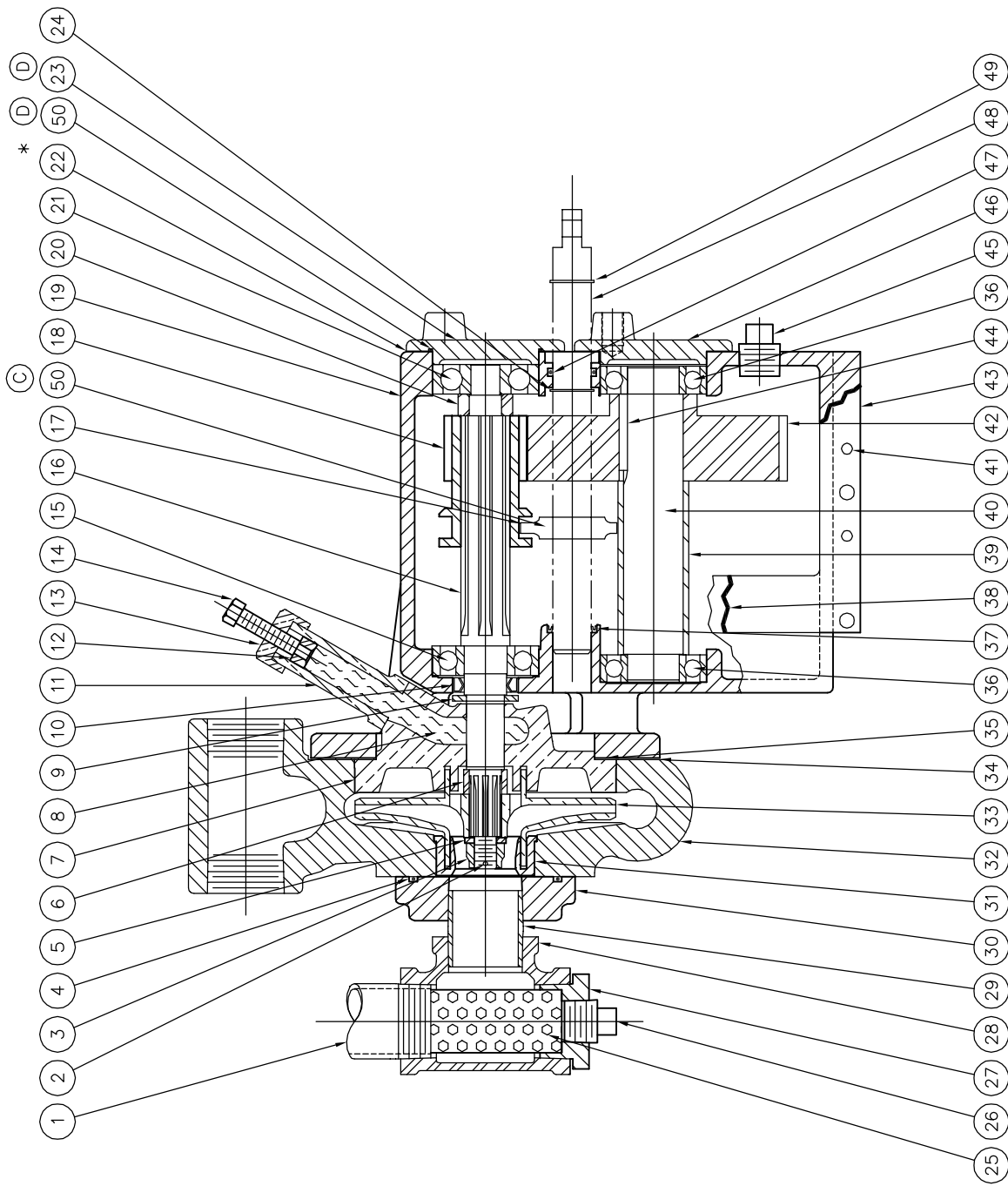
The high pressure stage is always primed by pressure from the main pump.

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			

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



(D) REPL 2302600 W/ 2302604 AND 3601007 23SEP05 2005-285 CKE
 (C) 2002-134 SHCS ADDED 09SEP02 JSS
 * GASKET REMOVED 5/94
 (49) ADDED 3-23-90

TOLERANCE EXCEPT AS NOTED		W.S. DARLEY & CO. MELROSE PARK, IL - CHIPPEWA FALLS, WI	
FINISH	AS NOTED	DWG	- LDM SECOND STAGE
DECIMALS	$\pm .01$	CROSS	SECTION PUMP ASSY
THOUS	$\pm .005$	DATE	AUG28,89
ANGLES	$\pm 1^\circ$	BY	S. LEE
CHKD		SCALE	1/2
TRCD			



OLD PART NO.
 L88

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

DLC0104

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.

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.

Coolant 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 SUBMERGENCE -- 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.

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. **DO NOT** pressurize with air beyond 10 PSI

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 ensure 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 gallons 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**

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.

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 wears on the working parts.

**IF FURTHER INFORMATION IS NEEDED, CALL W.S. DARLEY & CO. AT
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	1-50"	20' of 3"
2	175	1,7/8"	62	194	200		
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	1-50"	20' of 4"
2	245	1,1"	69	195	200		
3	175	1,7/8"	62	245	250		
4	350	1, 1-1/4"	58	159	165		
500 GPM Fire Pump							
1	500	1-1/2"	57	143	150	1-50"	20' of 4"
2	350	1-1/4"	58	194	200		
3	250	1"	72	245	250		
4	500	1-1/2"	57	158	165		
750 GPM Fire Pump							
1	750	1-3/4" or 2, 1-1/4"	68 66	142	150	2-50'	20' of 4-1/2"
2	525	1-1/2"	62	193	200	or	
3	375	1-1/4"	66	244	250	2-100'	
4	750	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'	20' of 5"
2	700	1-3/4" or 2, 1-1/4"	60 58	193	200	or	
3	500	1-1/2"	57	244	250	3-100'	
4	1000	1, 2" or 2, 1-1/2"	71 57	157	165	Siamesed	
1250 GPM Fire Pump							
1	1250	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	625	1-1/2"	88	245	250	3-100'	
4	1250	2-1/4" or 2, 1-1/2"	69 88	158	165	and 1-50' 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
1500GPM 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	6" Min
3	750	1, 1-3/4" or 2, 1-1/4"	68 66	245	250	3-100' and 1-50'	or (2) 20' of
4	1500	2, 1-3/4" or 3, 1-1/2"	68 57	157	165	Siamesed	6" Max
1750 GPM Pump							
1	1750	2, 2" or 3, 1-1/2"	55 76	143	150	4-50'	(2) 20' of 6"
2	1225	2, 1-5/8" or 2, 1-1/2" or 3, 1-1/4"	61 84 79	194	200	or	
3	875	1, 2" or 2, 1-3/8"	55 61	245	250	4-100'	
4	1750	2, 2" or 3, 1-1/2"	55 76	158	165		
2000 GPM Fire Pump							
1	2000	2, 2" or 4, 1-1/2"	71 57	147	150	4-50'	(2) 20' of 6"
2	1400	2, 1-3/4" or 3, 1-1/2"	60 49	199	200	or	
3	1000	1, 2" or 2, 1-1/2"	71 57	249	250	4-100'	
4	2000	2, 2" or 4, 1-1/2"	71 57	163	165		
2250 GPM Fire Pump							
1	2250	2, 2-1/4"	56	144	150	(2) 3-100' Siamesed	20' of 8"
2	1575	2, 1-3/4"	76	196	200		
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**

2500 GPM Fire Pump							
1	2500	2,2-1/4"	69	144	150	(2) 3-100' Siamesed	20' of 8"
2	1750	2,2"	55	195	200		
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) 3-100' Siamesed	(2) 20' of 8"
2	2100	2-2"	78	196	200		
3	1500	2, 1-3/4"	68	247	250		
4	3000	2, 2-1/2"	65	161	165		
3500 GPM Industrial Fire Pump							
1	3500	2, 2-1/2" and 1, 2-1/4"	45 44	95	100	(2) 3-100' Siamesed & 2-50' Siamesed	(2) 20' of 8"
2	2450	2, 2-1/4"	67	146	150		
3	1750	2,2"	55	197	200		

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

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

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

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	17 7	284	115	190	130	15 4	20 0			184	
	600	165	140	21 7		123	235	145	18 0	25 0			223	
	800	186	154	25 6		131		159	20 6					
	1000	208	167			138		174	23 2					
	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"
---------------------------	-------------	-------------	-------------	-------------	-------------	-------------	-----------	---------------	---------------

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	LINEN HOSE			BEST RUBER LINED HOSE							
G.P.M.	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	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
G.P.M.														
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

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	3/4	1	1 1/2	2 1/2	3	3 1/2	4	4 1/2	5	6
Thr'ds per inch	8	8	9	7.5	6	6	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
Max. O.D. Male	1.3750	1.3750	1.9900	3.0686	3.6239	4.2439	5.0109	5.7609	6.2600	7.0250

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

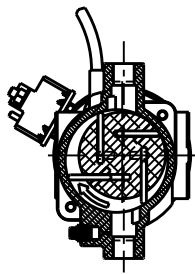
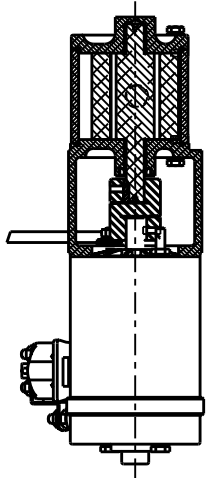
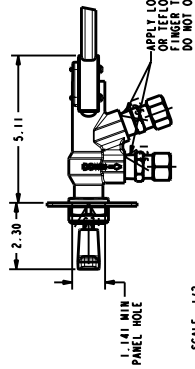
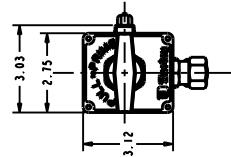
The fluidless electric-motor rotary-vane primer pump creates a high vacuum by using a special material for the vanes and an initial factory applied lubricant film. This film must be present in order for the primer to operate properly and to provide maximum life for the primer components.

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.

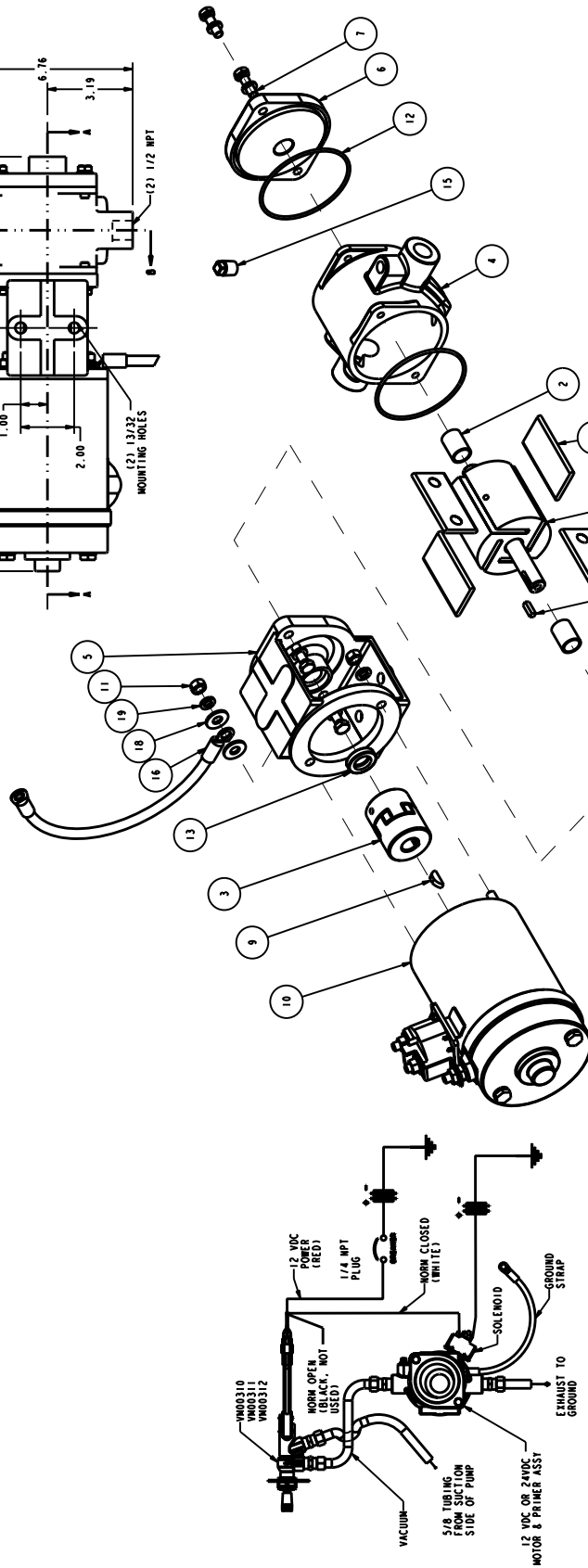
After the main pump is drained, run the primer motor to drain primer lines.

NO.	DESCRIPTION	PART NO.	QTY.
1	ASSEMBLY - PRIMER, MOTOR	4240105	1
2	BEARING - OILITE, 0.625 ID	1760023	2
3	COUPLING - 844093	2404500	1
4	CYLINDER - VACUUM PUMP	020800	1
5	HEAD - CYLINDER INBOARD	2800904	1
6	HEAD - CYLINDER OUTBOARD	2800900	1
7	SHCS - 3/16 x 1.00 SST	5400610	4
8	KEY - SO. 0.18 x 0.62 GR2	3402425	1
9	KEY - WOODRUFF, 606	3402200	1
10	MOTOR - PRIMER, 12V	4223400	1
11	NUT - HEL. 5/16, STEEL	5403024	2
12	O-RING - 3.50 x 3.69 x 0.09	3401101	2
13	OIL SEAL - 0.625 ID x 1.128 OD	3400505	1
14	PLUG - PIPE, 0.250, BR. SO. NO.	0802504	1
15	STRAP - GROUND, 12V PRIMER	2400516	1
16	WASHER - FLAT, 5/16, STEEL	3403802	2
17	WASHER - LOCK, 0.313 ID	3403502	6

REVISIONS			
NO.	DESCRIPTION	DATE	BY
1	REVISED FOR SIZE	01/03/09	SSG



NOTE:
- FOR CROSS SECTION AND EXPLODED VIEW DRAWING
- SEE CROSS SECTION B, DIMENSIONS
- 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
TO CLEAN, PAINT FREE GROUNDING SURFACE
IF SUPPLIED GROUND STRAP
IS REMOVED FROM ASSEMBLY,
RETIGHTEN CYLINDER HEAD ADAPTER
RETAINING NUTS EQUALLY
TO 90 IN. LB.

POSITIVE LEAD WIRE SIZES FOR 12 V & 24 V PRIMERS:
0 - 10 STANDARD 18 (12V), 18 (24V) COPPER
0 - 10 25 - 25 (12V), 25 (24V) COPPER
0 - 10 25 - 25 (12V), 25 (24V) COPPER

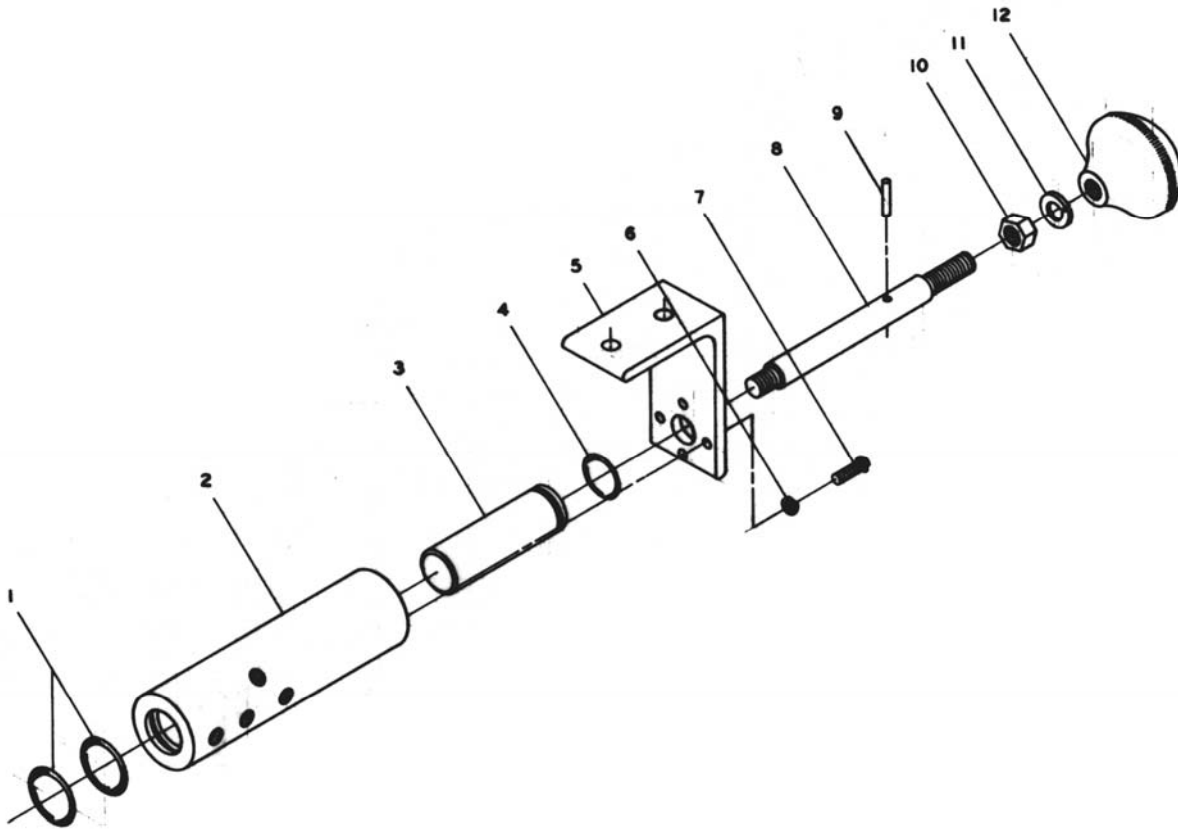
THESE GAGE WIRES CORRESPOND WITH AMP DRAW
REQUIREMENTS FOR EACH MOTOR AS WELL AS IN RELATION
TO RESISTANCE OVER GIVEN LENGTH.

12 V = 240 AMP
24 V = 140 AMP

REVISIONS			
NO.	DESCRIPTION	DATE	BY
1	REVISED FOR SIZE	01/03/09	SSG

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100
---	---	---	---	---	---	---	---	---	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	-----

WEIGHT = 27 LB (12.1 KG)



PARTS LIST FOR MULTIPLE DRAIN VALVE

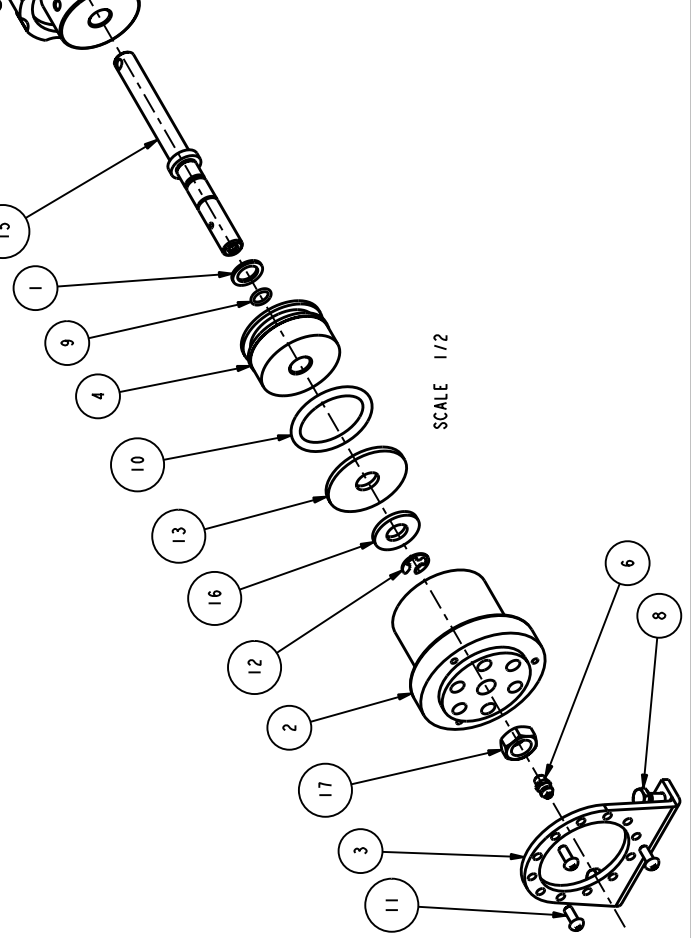
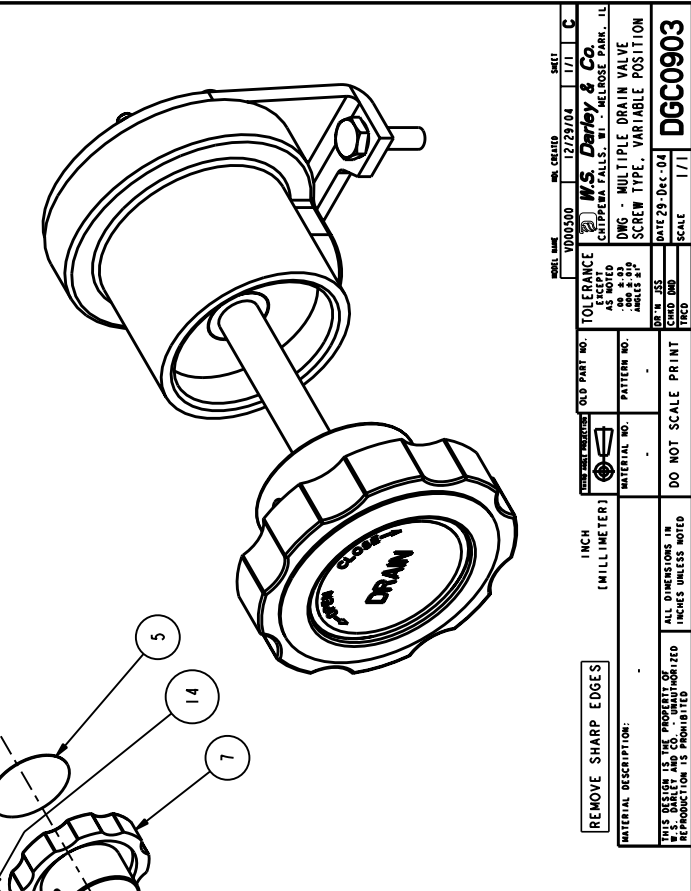
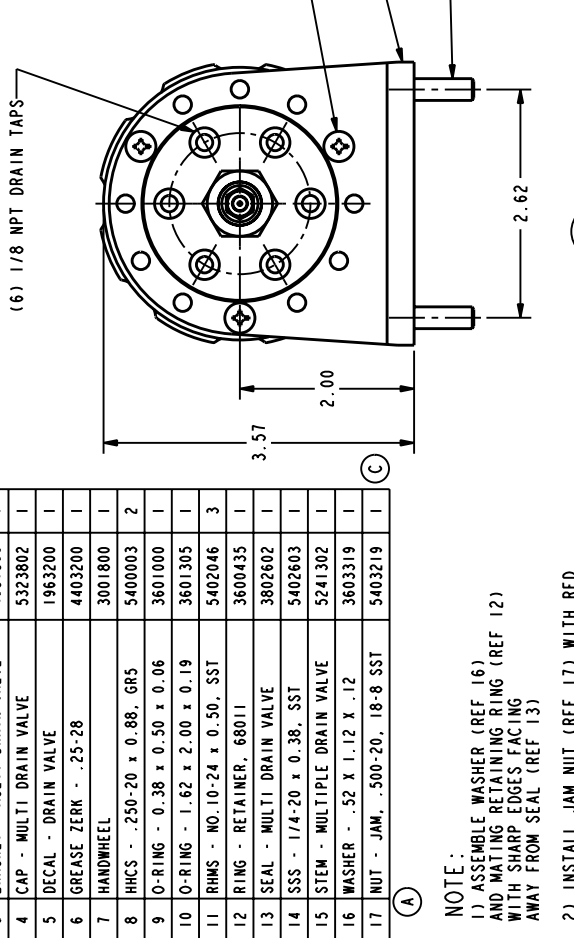
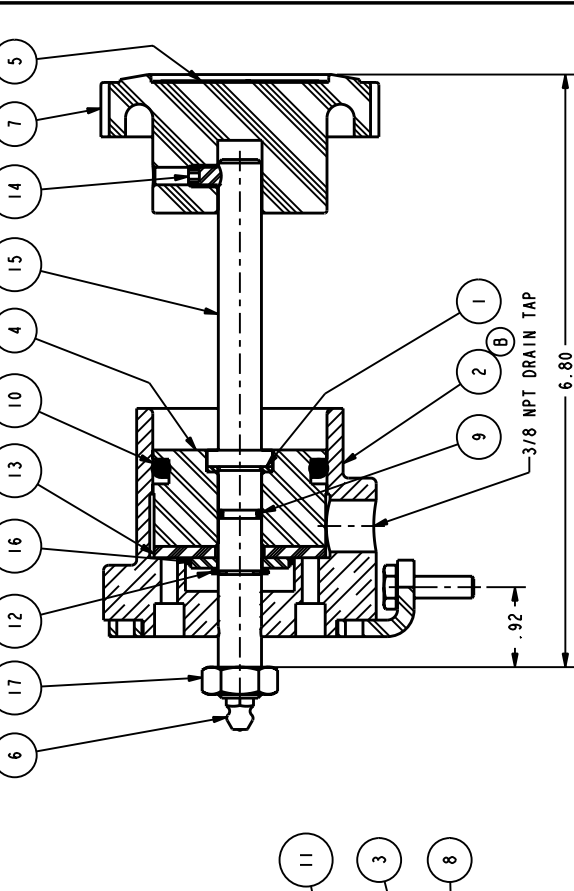
DRAWING NO. DGC0112

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

REVISIONS			
LTR	DESCRIPTION	DATE	CHK NO.
A	ADDED ASSEMBLY NOTE	28SEP2005	2005-281 EWH
B	WAS 4031300	03MAY2006	2006-110
C	WAS RETAINER RING 3600435	28NOV2007	2007-456 SMS

REVISIONS			
LTR	DESCRIPTION	DATE	CHK NO.
A	ADDED ASSEMBLY NOTE	28SEP2005	2005-281 EWH
B	WAS 4031300	03MAY2006	2006-110
C	WAS RETAINER RING 3600435	28NOV2007	2007-456 SMS

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, GR5	5400003	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



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

MODEL NAME	1000300	REV. CREATED	12/29/04	1/1	C
TOLERANCE	AS NOTED	EXCEPT	UNLESS NOTED	UNLESS NOTED	UNLESS NOTED
UNIT	INCH	(MILLIMETER)			
REMOVE SHARP EDGES					
MATERIAL DESCRIPTION:					
THIS DESIGN IS THE PROPERTY OF					
W.S. BARETT AND CO. UNAUTHORIZED					
REPRODUCTION IS PROHIBITED					
ALL DIMENSIONS IN					
INCHES UNLESS NOTED					
DO NOT SCALE PRINT					
SCALE	1/1				
DATE	29-Dec-04				
DRW	JSS				
CHKD	DMO				
INCD					
FILED					
W.S. Barett & Co.					
CALIFORNIA FALLS, WI					
MIL ROSE PARK, IL					
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.

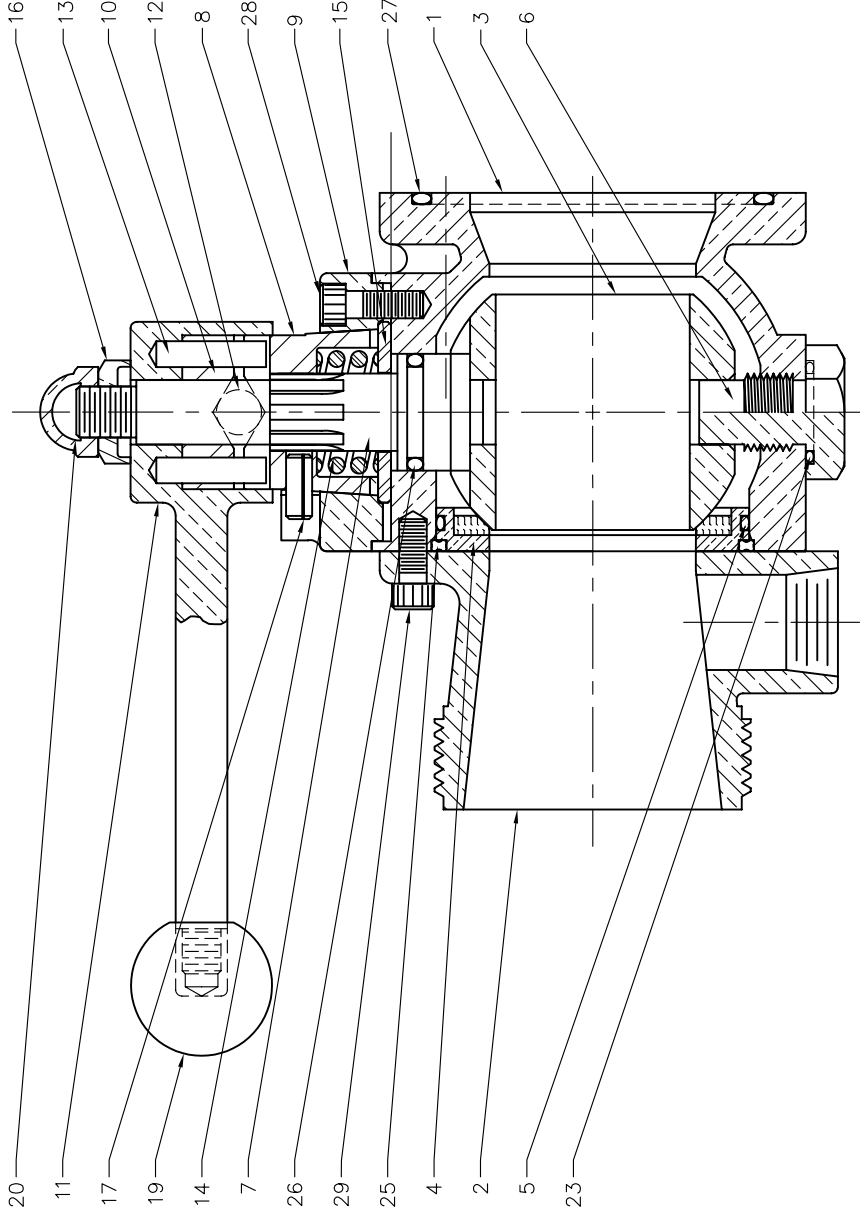
REASSEMBLY OF BALL VALVE ILLUSTRATION DGC0100

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**

LETTER	CHANGE NO.	DATE
(A)	96-53	5/15/96

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]

TOLERANCE

EXCEPT AS NOTED

.000 ± .003
 .000 ± .010
 ANGLES ±1°

OLD PART NO.

G1200

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

DWG - BALL VALVE ASSEMBLY
 CROSS SECTION
 DATE NOV12.65
 SCALE 1/1

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

DO NOT SCALE PRINT

ALL DIMENSIONS IN INCHES UNLESS NOTED

DO NOT SCALE PRINT

DGC0100

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.

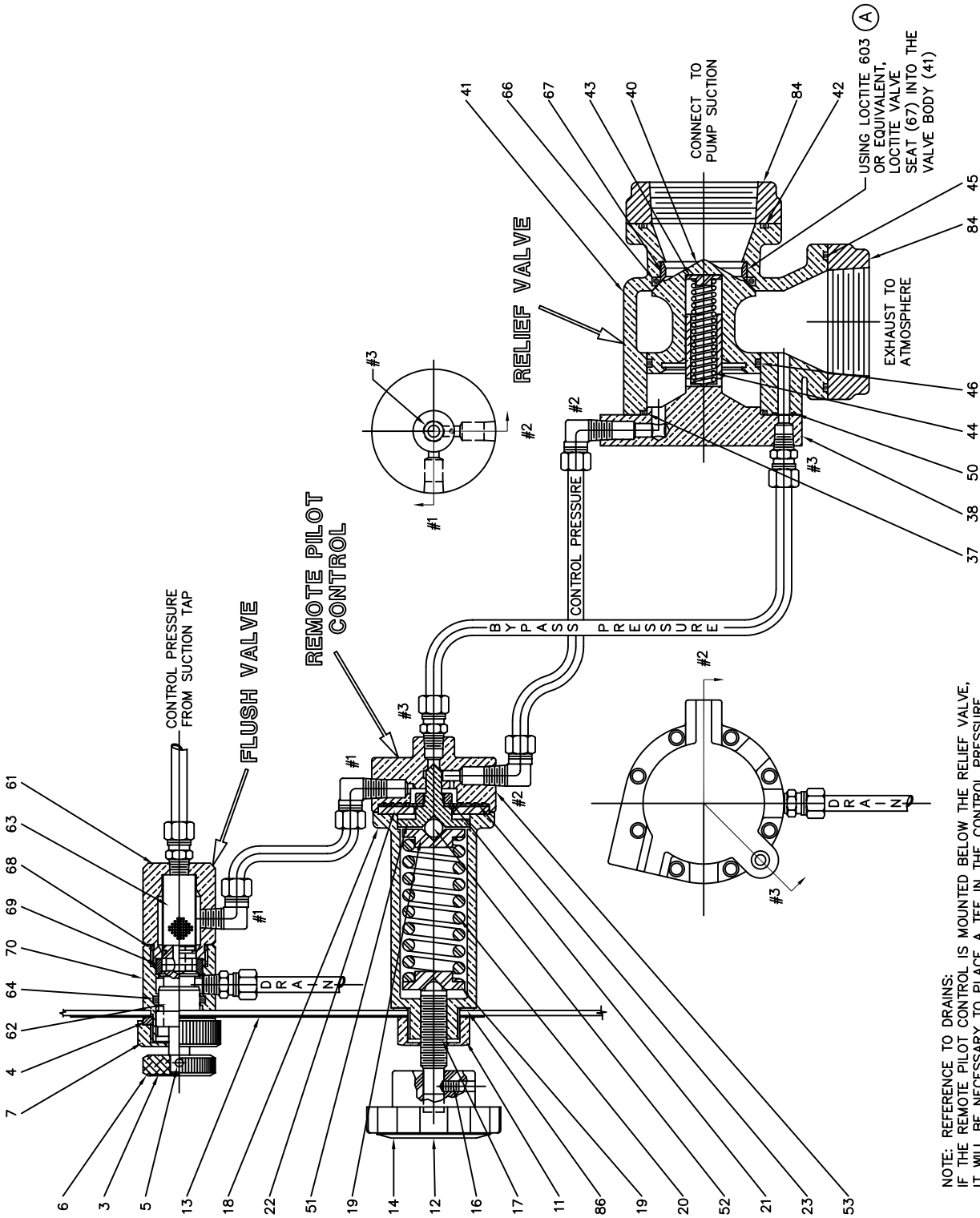
To replace flush valve seat (69), remove stem/screen assembly. Disconnect tubing lines attached to (61) body half, unscrew (61) body half from (70) body half. Replace (69) valve seat. Reverse procedure to reassemble valve.


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. APPROV.
A	ADDED LOCITING NOTE	4NOV2002	2002-175
			ED



		TOLERANCE EXCEPT AS NOTED		OLD PART NO. G2453		PATTERN NO. —		MATERIAL NO. —		DO NOT SCALE PRINT		DATE DEC17,91		SCALE 1/2		DWG — SUCTION RELIEF VALVE		W.S. DARLEY & CO. MELROSE PARK, IL — CHIPPewa FALLS, WI		DGC0115	
		FRAC DIM ±.01 DIM ±.005 ANGLES ±1°		DRN S. LEE		CHD		TRCD		ALL DIMENSIONS IN INCHES UNLESS NOTED		THIS DESIGN IS THE PROPERTY OF W.S. DARLEY & CO. ANY REPRODUCTION IS PROHIBITED									

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.

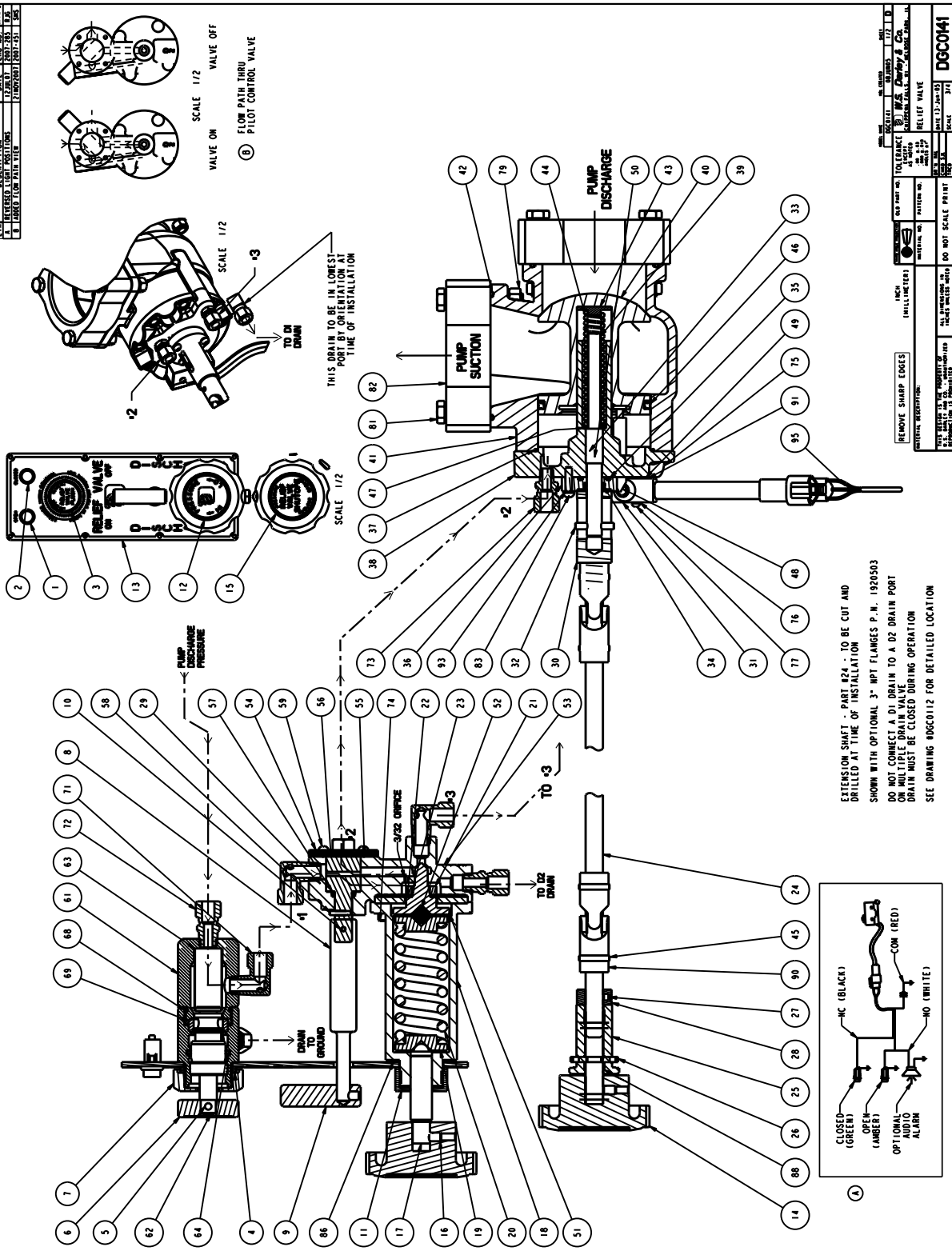
Self-cleaning strainer (63) can be removed for inspection or replacement by alternately turning valve knob (6) and stop nut (7) counter clockwise until stem is free for removal. To avoid discharging water through opening created by stem (62) removal, pump should be completely shut down before stem (62) 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.

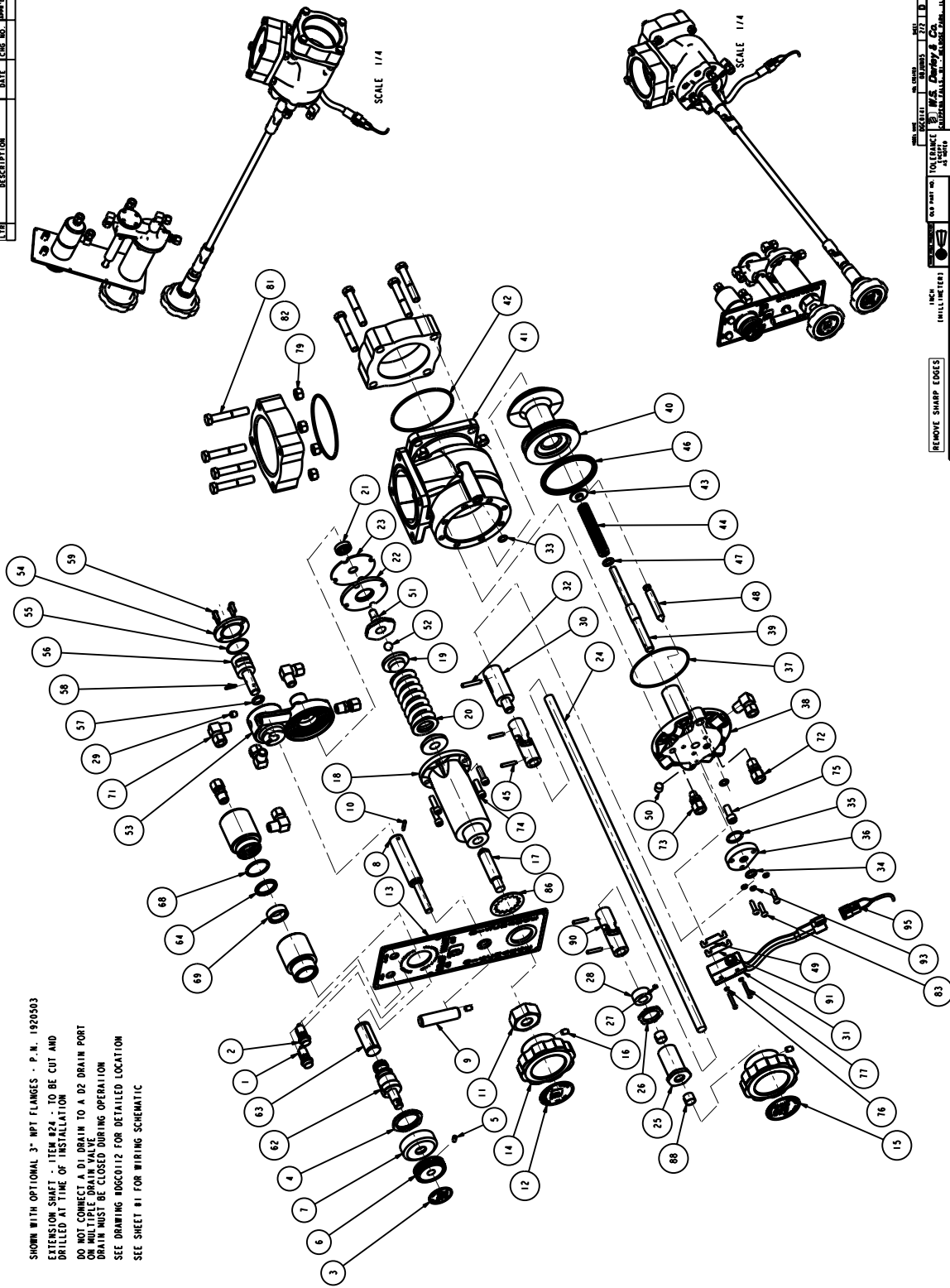
**IF FURTHER INFORMATION IS NEEDED, CALL W.S. DARLEY & CO. AT
CHIPPEWA FALLS, WI. AT 800-634-7812 or 715-726-2650**

POS.	NO.	NAME	DATE
1	1	1001 - 1001.100	
2	2	1002 - 1002.100	
3	3	1003 - 1003.100	
4	4	1004 - 1004.100	
5	5	1005 - 1005.100	
6	6	1006 - 1006.100	
7	7	1007 - 1007.100	
8	8	1008 - 1008.100	
9	9	1009 - 1009.100	
10	10	1010 - 1010.100	
11	11	1011 - 1011.100	
12	12	1012 - 1012.100	
13	13	1013 - 1013.100	
14	14	1014 - 1014.100	
15	15	1015 - 1015.100	
16	16	1016 - 1016.100	
17	17	1017 - 1017.100	
18	18	1018 - 1018.100	
19	19	1019 - 1019.100	
20	20	1020 - 1020.100	
21	21	1021 - 1021.100	
22	22	1022 - 1022.100	
23	23	1023 - 1023.100	
24	24	1024 - 1024.100	
25	25	1025 - 1025.100	
26	26	1026 - 1026.100	
27	27	1027 - 1027.100	
28	28	1028 - 1028.100	
29	29	1029 - 1029.100	
30	30	1030 - 1030.100	
31	31	1031 - 1031.100	
32	32	1032 - 1032.100	
33	33	1033 - 1033.100	
34	34	1034 - 1034.100	
35	35	1035 - 1035.100	
36	36	1036 - 1036.100	
37	37	1037 - 1037.100	
38	38	1038 - 1038.100	
39	39	1039 - 1039.100	
40	40	1040 - 1040.100	
41	41	1041 - 1041.100	
42	42	1042 - 1042.100	
43	43	1043 - 1043.100	
44	44	1044 - 1044.100	
45	45	1045 - 1045.100	
46	46	1046 - 1046.100	
47	47	1047 - 1047.100	
48	48	1048 - 1048.100	
49	49	1049 - 1049.100	
50	50	1050 - 1050.100	
51	51	1051 - 1051.100	
52	52	1052 - 1052.100	
53	53	1053 - 1053.100	
54	54	1054 - 1054.100	
55	55	1055 - 1055.100	
56	56	1056 - 1056.100	
57	57	1057 - 1057.100	
58	58	1058 - 1058.100	
59	59	1059 - 1059.100	
60	60	1060 - 1060.100	
61	61	1061 - 1061.100	
62	62	1062 - 1062.100	
63	63	1063 - 1063.100	
64	64	1064 - 1064.100	
65	65	1065 - 1065.100	
66	66	1066 - 1066.100	
67	67	1067 - 1067.100	
68	68	1068 - 1068.100	
69	69	1069 - 1069.100	
70	70	1070 - 1070.100	
71	71	1071 - 1071.100	
72	72	1072 - 1072.100	
73	73	1073 - 1073.100	
74	74	1074 - 1074.100	
75	75	1075 - 1075.100	
76	76	1076 - 1076.100	
77	77	1077 - 1077.100	
78	78	1078 - 1078.100	
79	79	1079 - 1079.100	
80	80	1080 - 1080.100	
81	81	1081 - 1081.100	
82	82	1082 - 1082.100	
83	83	1083 - 1083.100	
84	84	1084 - 1084.100	
85	85	1085 - 1085.100	
86	86	1086 - 1086.100	
87	87	1087 - 1087.100	
88	88	1088 - 1088.100	
89	89	1089 - 1089.100	
90	90	1090 - 1090.100	
91	91	1091 - 1091.100	
92	92	1092 - 1092.100	
93	93	1093 - 1093.100	
94	94	1094 - 1094.100	
95	95	1095 - 1095.100	
96	96	1096 - 1096.100	
97	97	1097 - 1097.100	

[illegible]

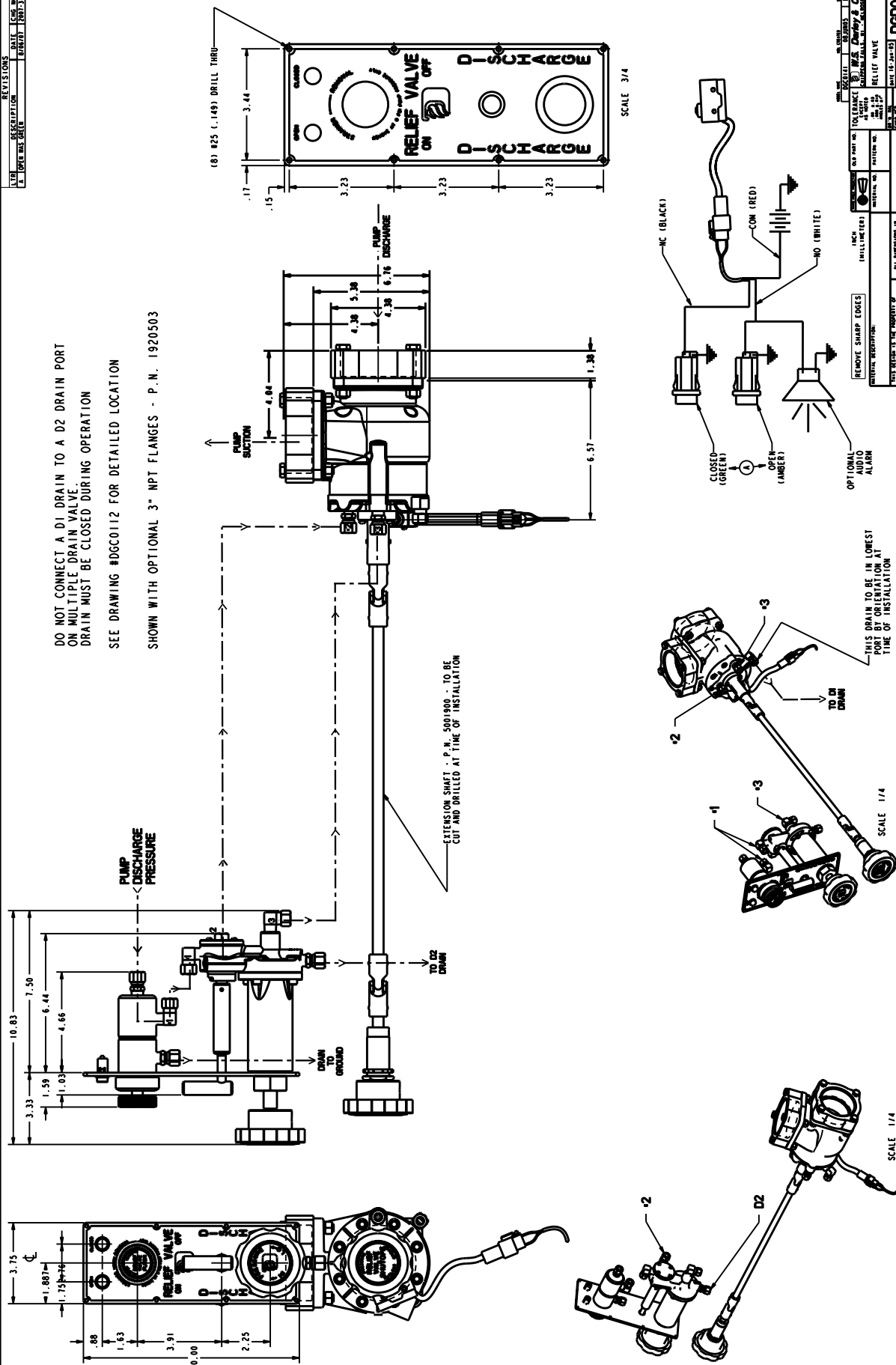
QTY.	PART NO.	DESCRIPTION
1	1001	1001 - 1001-200
2	1002	1002 - 1002-200
3	1003	1003 - 1003-200
4	1004	1004 - 1004-200
5	1005	1005 - 1005-200
6	1006	1006 - 1006-200
7	1007	1007 - 1007-200
8	1008	1008 - 1008-200
9	1009	1009 - 1009-200
10	1010	1010 - 1010-200
11	1011	1011 - 1011-200
12	1012	1012 - 1012-200
13	1013	1013 - 1013-200
14	1014	1014 - 1014-200
15	1015	1015 - 1015-200
16	1016	1016 - 1016-200
17	1017	1017 - 1017-200
18	1018	1018 - 1018-200
19	1019	1019 - 1019-200
20	1020	1020 - 1020-200
21	1021	1021 - 1021-200
22	1022	1022 - 1022-200
23	1023	1023 - 1023-200
24	1024	1024 - 1024-200
25	1025	1025 - 1025-200
26	1026	1026 - 1026-200
27	1027	1027 - 1027-200
28	1028	1028 - 1028-200
29	1029	1029 - 1029-200
30	1030	1030 - 1030-200
31	1031	1031 - 1031-200
32	1032	1032 - 1032-200
33	1033	1033 - 1033-200
34	1034	1034 - 1034-200
35	1035	1035 - 1035-200
36	1036	1036 - 1036-200
37	1037	1037 - 1037-200
38	1038	1038 - 1038-200
39	1039	1039 - 1039-200
40	1040	1040 - 1040-200
41	1041	1041 - 1041-200
42	1042	1042 - 1042-200
43	1043	1043 - 1043-200
44	1044	1044 - 1044-200
45	1045	1045 - 1045-200
46	1046	1046 - 1046-200
47	1047	1047 - 1047-200
48	1048	1048 - 1048-200
49	1049	1049 - 1049-200
50	1050	1050 - 1050-200
51	1051	1051 - 1051-200
52	1052	1052 - 1052-200
53	1053	1053 - 1053-200
54	1054	1054 - 1054-200
55	1055	1055 - 1055-200
56	1056	1056 - 1056-200
57	1057	1057 - 1057-200
58	1058	1058 - 1058-200
59	1059	1059 - 1059-200
60	1060	1060 - 1060-200
61	1061	1061 - 1061-200
62	1062	1062 - 1062-200
63	1063	1063 - 1063-200
64	1064	1064 - 1064-200
65	1065	1065 - 1065-200
66	1066	1066 - 1066-200
67	1067	1067 - 1067-200
68	1068	1068 - 1068-200
69	1069	1069 - 1069-200
70	1070	1070 - 1070-200
71	1071	1071 - 1071-200
72	1072	1072 - 1072-200
73	1073	1073 - 1073-200
74	1074	1074 - 1074-200
75	1075	1075 - 1075-200
76	1076	1076 - 1076-200
77	1077	1077 - 1077-200
78	1078	1078 - 1078-200
79	1079	1079 - 1079-200
80	1080	1080 - 1080-200
81	1081	1081 - 1081-200
82	1082	1082 - 1082-200
83	1083	1083 - 1083-200
84	1084	1084 - 1084-200
85	1085	1085 - 1085-200
86	1086	1086 - 1086-200
87	1087	1087 - 1087-200
88	1088	1088 - 1088-200
89	1089	1089 - 1089-200
90	1090	1090 - 1090-200
91	1091	1091 - 1091-200
92	1092	1092 - 1092-200
93	1093	1093 - 1093-200
94	1094	1094 - 1094-200
95	1095	1095 - 1095-200
96	1096	1096 - 1096-200
97	1097	1097 - 1097-200
98	1098	1098 - 1098-200
99	1099	1099 - 1099-200
100	1100	1100 - 1100-200

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
ON MULTIPLE DRAIN VALVE
DRAIN MUST BE CLOSED DURING OPERATION
SEE DRAWING #DGC0112 FOR DETAILED LOCATION
SEE SHEET #1 FOR WIRING SCHEMATIC

[illegible]

REVISIONS			
LTR	DESCRIPTION	DATE	CHG NO. APPR'D
A	OPEN WAS GATE	8/06/07	2007-313 RJS

DO NOT CONNECT A DI DRAIN TO A D2 DRAIN PORT
ON MULTIPLE DRAIN VALVE.
DRAIN MUST BE CLOSED DURING OPERATION
SEE DRAWING #DGC0112 FOR DETAILED LOCATION
SHOWN WITH OPTIONAL 3" NPT FLANGES - P. N. 192

[illegible]

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

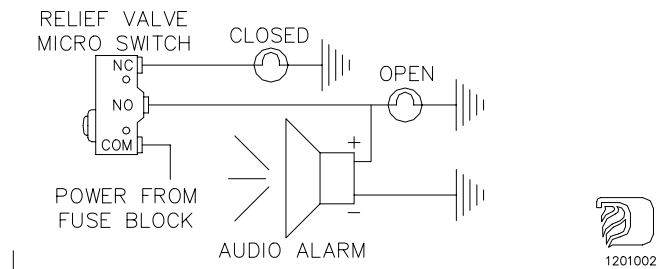
THIS ALARM IS DESIGNED TO CONCENTRATE AUDIBLE SOUND IN THE OPERATOR ZONE ONLY. FOR OPTIMUM PERFORMANCE, POSITION ALARM SOUND OPENING SO IT IS FACING THE OPERATOR AT A DISTANCE OF 24-36 INCHES.

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

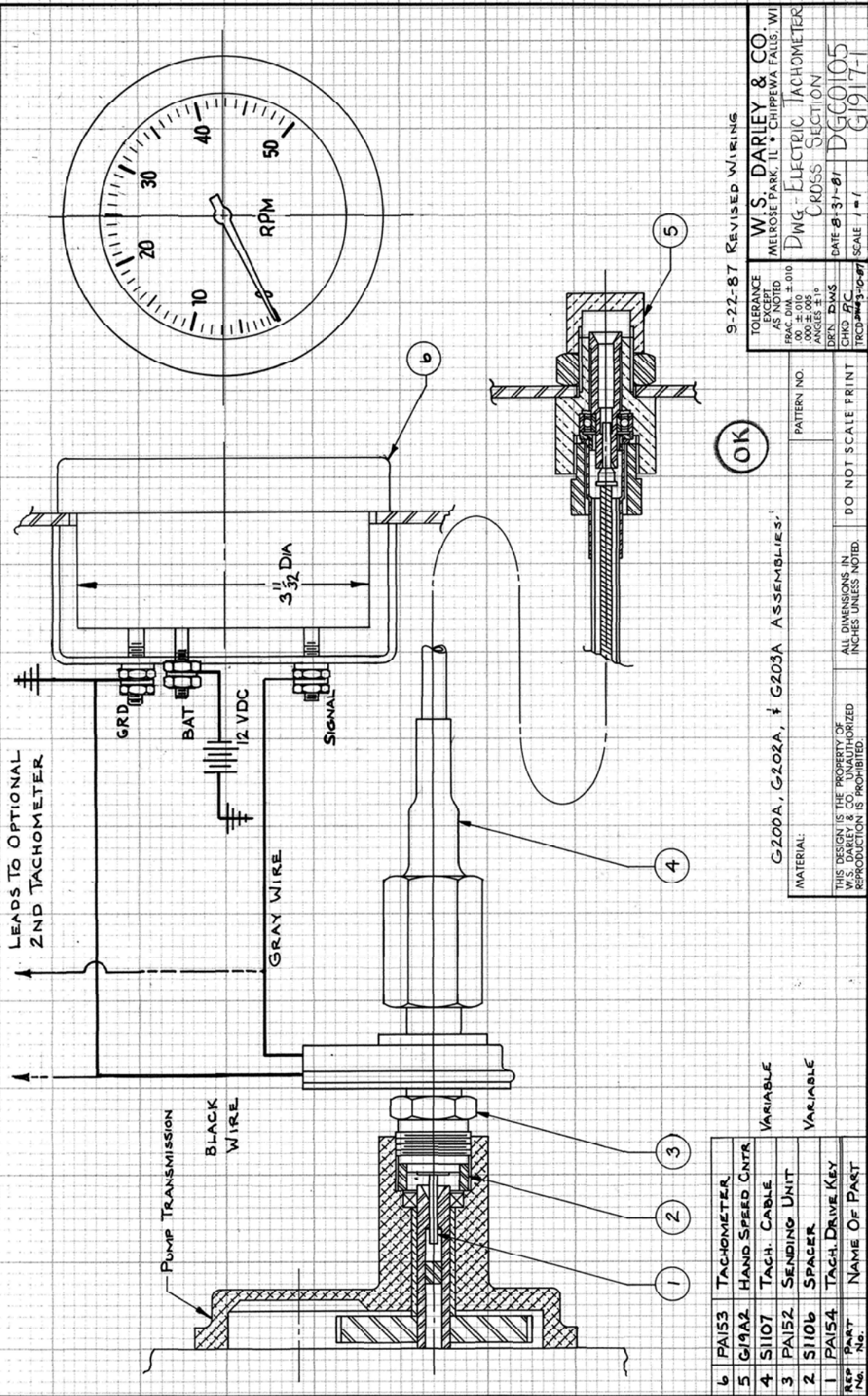
DO NOT MOUNT WITH SOUND OPENING IN AN UPWARD POSITION. DO NOT OBSTRUCT OPENING.

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**

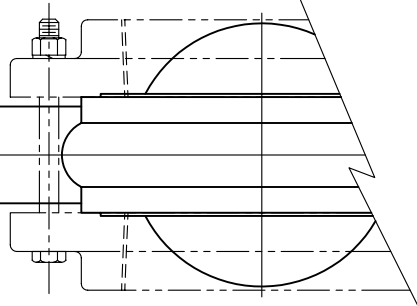
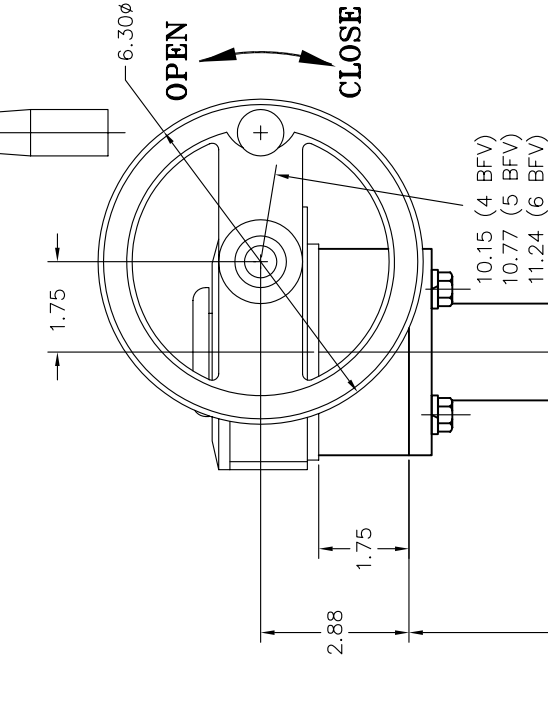
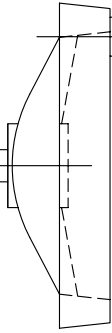
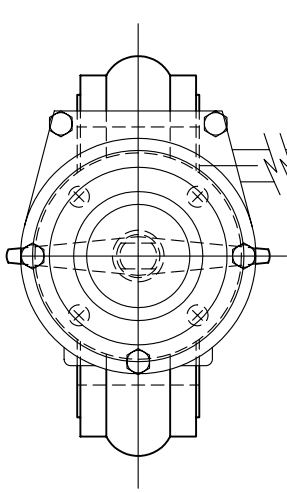


W.S. DARLEY & CO.

SWITCHING DIESEL TACHOMETER

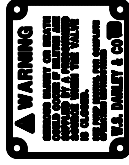
1. CAUTION: Disconnect the battery during installation. Tighten nuts on back clamp only slightly more than you can tighten them with our fingers. Six inch pounds of torque is sufficient. Over tightening may result in damage to the instrument and may void your warranty!
2. Location: The tachometer should 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**



APPROXIMATE WEIGHT

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



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

96-115/19/96 ⓐ ADDED PLATE LMH

PART NO.	DATE	CHANGE
1	19/09/96	ADDED PLATE LMH

TOLERANCE	EXCEPT
FRAC DIM $\pm .01$	AS NOTED
DEC DIM $\pm .005$	AS NOTED
ANGLES $\pm 1^\circ$	AS NOTED

OLD PART NO.	DO NOT SCALE	PRINT
G2420		

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

DATE	SCALE	1/2
SEP25,91		



W.S. DARLEY & CO.
MELROSE PARK, IL - CHIPPewa FALLS, WI
DWG - BTRFLY VALVE ASSY
MANUAL CONTROLLED

DGD0104

16.71

CUT FLANGE FLUSH FOR USE
WITH PANEL LENGTH SUCTION EXTENSIONS

[2] 5/16 DRILL THRU ON 3.25 BC
INSERT 5/16 X 7/8 SPRING PIN

ADJUST MICROSWITCHES TO LIMIT LEVER
TRAVEL IN THE OPEN AND CLOSED
POSITIONS. WHEN CLOSED, THE BFV
BLADE MUST BE PARALLEL TO VALVE
FACE. WHEN OPEN, THE BLADE MUST BE
PERPENDICULAR TO FACE. FOR
ELECTRONIC STOPS TO FUNCTION PROPERLY,
SWITCHES MUST BE WIRED PER SCHEMATIC.



ATTACH WARNING PLATE
(ASSY AM00700) TO
CONTROL PANEL VIA
REV. NO. 96-115 (REF). ④

8.22

OPTIONAL — G2444 VENT VALVE BRACKET
PA246 3/4 NPT VENT VALVE

G2368-1 LEVER — 4" BFV
G2368-2 LEVER — 5" & 6" BFV

G2437 COUPLING

1/2 X 2 CLEVIS PIN
PA245

G2438 CLAMP PLATE

G2369 BRACKET

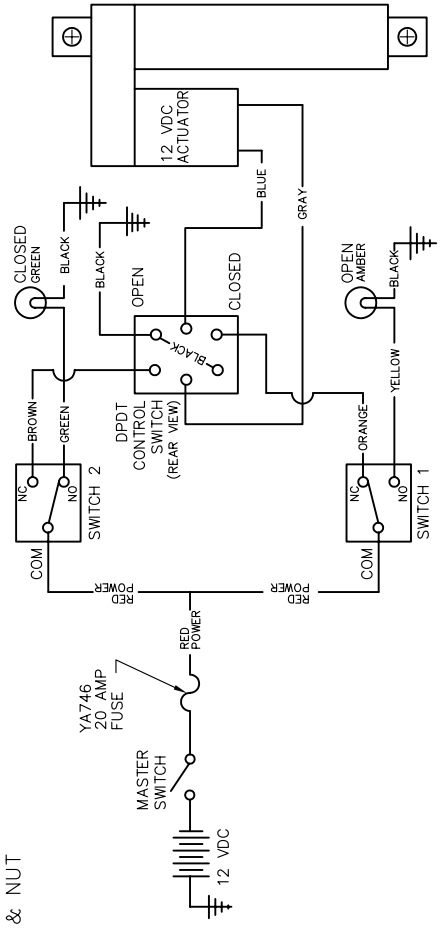
(2) PA360 HAIR PIN CLIP

[2] 3/8NC X 1.25
HEX HD CAP SCREW
LOCKWASHER & NUT

13.25 (6" BFV)
12.75 (5" BFV)
12.12 (4" BFV)

10.75 (6" BFV)
10.25 (5" BFV)
9.62 (4" BFV)

8.25 (6" BFV)
7.75 (5" BFV)
7.12 (4" BFV)



96-115 9/19/96 ④ ADDED PLATE LMH

PART NO.	DATE	CHANGE

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

DWG - BUTTERFLY VALVE ASSEMBLY
ELECTRIC ACTUATED

DATE NOV20,91
SCALE 1/2

Q/D PART NO. G2370

TOLERANCE EXCEPT AS NOTED

FRACTIONAL DIM ±.01

DECIMAL DIM ±.005

ANGLES ±1°

MATERIAL NO. —

PATTERN NO. —

DO NOT SCALE PRINT

ALL DIMENSIONS IN INCHES UNLESS NOTED

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

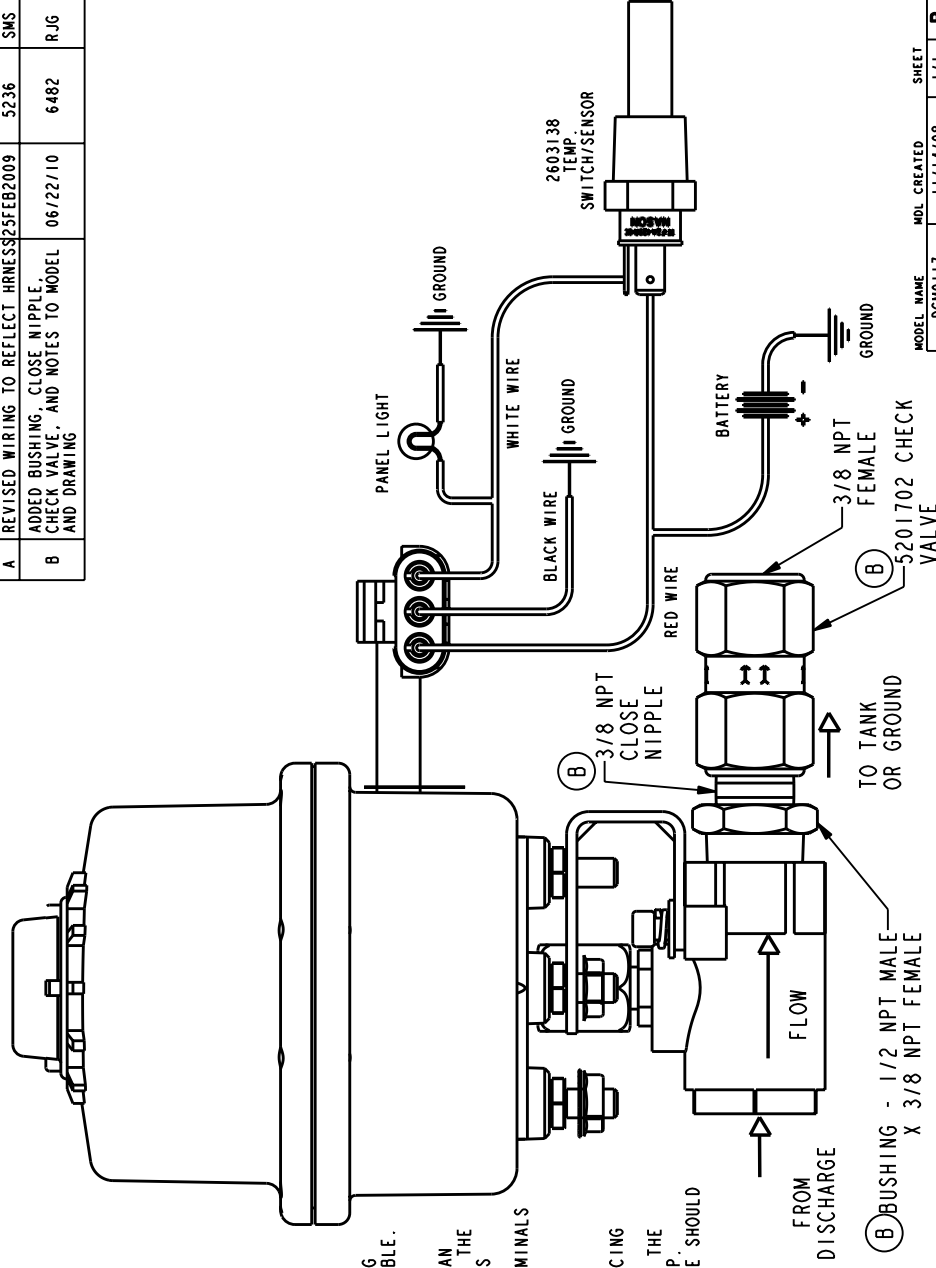
APPROXIMATE WEIGHT = 35 LB = 15.9 KG (6" BFV)
30 LB = 13.6 KG (5" BFV)
27 LB = 12.2 KG (4" BFV)

DGD0101

REVISIONS				
LTR	DESCRIPTION	DATE	CHG NO.	APPR'D
A	REVISED WIRING TO REFLECT HRNESS25FEB2009	5236		SMS
B	ADDED BUSHING, CLOSE NIPPLE, CHECK VALVE, AND NOTES TO MODEL AND DRAWING	06/22/10	6482	RJG

INSTALLATION INSTRUCTIONS:

- 1) INSTALL TEMPERATURE SWITCH ON SUCTION SIDE OF PUMP, AS NEAR TO IMPELLER AS POSSIBLE, PREFERABLY BETWEEN THE IMPELLER AND THE RELIEF VALVE.
 - 2) INSTALL THE ACTUATOR VALVE ON THE DISCHARGE SIDE OF THE PUMP. ITS LOCATION IS NOT CRITICAL. IT CAN BE MOUNTED DIRECTLY TO THE PUMP OR POSITIONED REMOTELY AND CONNECTED WITH A 3/8 OD MINIMUM LINE.
 - 3) VALVE DOES NOT NEED TO BE MOUNTED VERTICALLY AS SHOWN.
 - 4) *PLUMB THE VALVE OUTLET TO TANK, IF DESIRED, USING 3/8 OD MINIMUM LINE. KEEP ALL LINES AS SHORT AS POSSIBLE.
 - 5) ATTACH ONE LEAD OF VALVE TO THE TERMINAL ON THE TEMPERATURE SWITCH. ATTACH THE OTHER LEAD TO A FUSED VOLTAGE SOURCE. IF DESIRED, THE TEMPERATURE SWITCH CAN ALSO BE USED TO CONTROL A LIGHT ON THE PANEL NOTIFYING THE OPERATOR THAT OVERHEATING IS OCCURRING AND THE UNIT HAS BEEN ACTIVATED.
 - 6) TO TEST THE VALVE: WITH PUMP RUNNING, JUMP THE TERMINALS ON THE TEMPERATURE SWITCH. IF THE VALVE DOES NOT DISCHARGE, IT MAY BE INSTALLED BACKWARDS OR WIRING CONNECTIONS MAY BE INCORRECT.
- * CONNECTION TO TANK MAY CAUSE TANK TO OVERHEAT, REDUCING THE EFFECTIVENESS OF THIS DEVICE.
 - TO PREVENT FREEZING DAMAGE, WHEN CONNECTING TO TANK, THE VALVE SHOULD BE MOUNTED ON THE TANK, BUT ABOVE THE PUMP.
 - IF THE VALVE IS TO DISCHARGE TO ATMOSPHERE, THE VALVE SHOULD BE MOUNTED ON, OR AS CLOSE TO THE PUMP AS POSSIBLE.

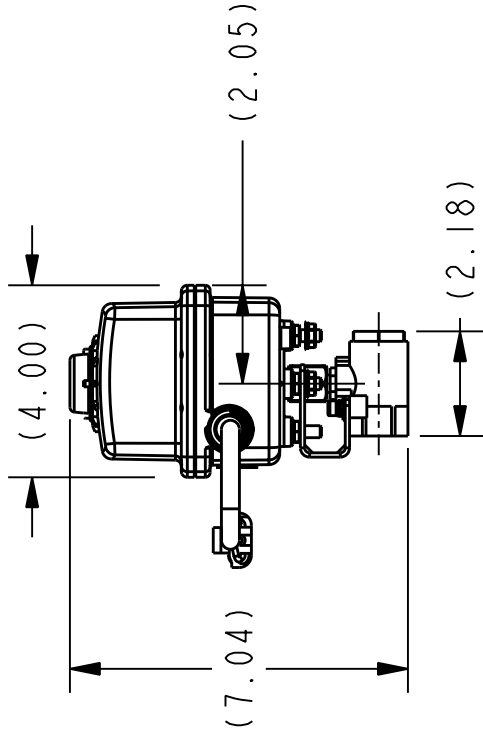
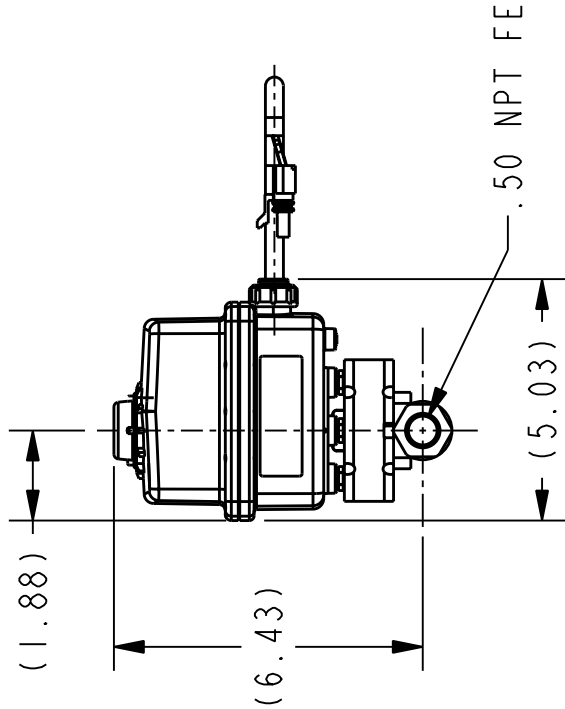
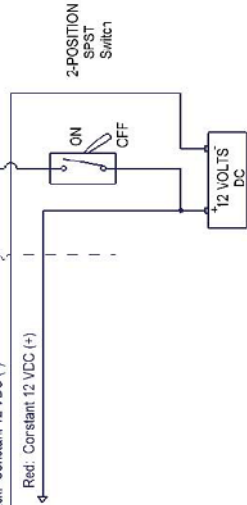


REMOVE SHARP EDGES		INCH (MILLIMETER)	
MATERIAL DESCRIPTION:		ALL DIMENSIONS IN INCHES UNLESS NOTED	
THIS DESIGN IS THE PROPERTY OF W.S. DARLEY AND CO. UNAUTHORIZED REPRODUCTION IS PROHIBITED		DO NOT SCALE PRINT	
DR'N RJG		SCALE 1/1	
CHGD DWS		DATE 14-Nov-08	
TRCD		DGM0117	
TOLERANCE EXCEPT AS NOTED .00 ± .03 ANGLES ±1°		OLD PART NO.	
PATTERN NO.		MATERIAL NO.	
W.S. Darley & Co. ITASCA, IL - CHIPPEWA FALLS, WI		DWG - THERMAL RELIEF SYSTEM KZCO VALVE, 2603138 TEMP. SENSOR	
MODEL NAME DGM0117		MDL CREATED 11/14/08	
SHEET 1/1		B	

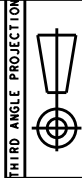
REVISIONS			
LTR	DESCRIPTION	DATE	CHG NO. APPR'D

SUPPLIED BY KZCO

White: Switched 12VDC (+) - Relay Energized "CLOSE"
 Black: Constant 12VDC (-)



REMOVE SHARP EDGES



OLD PART NO.

MATERIAL DESCRIPTION:
 KZCO 84D23-10D20-P01

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

DO NOT SCALE PRINT

TOLERANCE
 EXCEPT
 AS NOTED

.00 \pm .03
 .000 \pm .010
 ANGLES \pm 1°

DR'N RJG
 CHKD DWS
 TRCD

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

VALVE - ACTUATED, 12VDC, .50NPT FE
 KZCO 84D23-10D20-P01

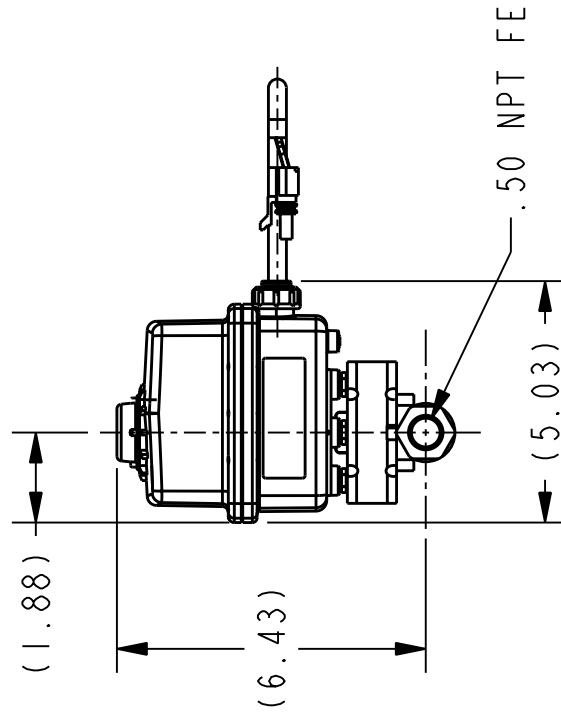
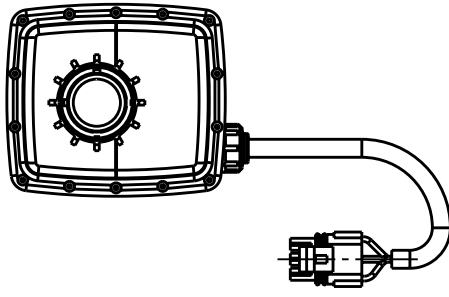
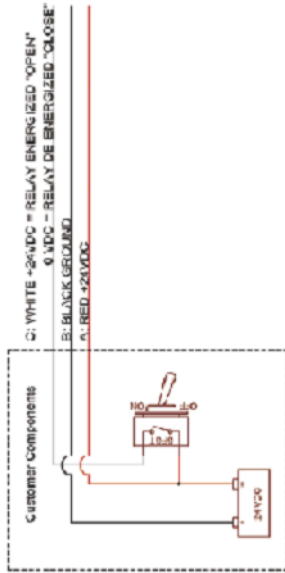
DATE 13-Nov-08
 SCALE 1/4

5209401


[illegible][illegible][illegible]

Address	City	State	Zip	Phone	Fax	E-mail	Web Site
1000 N. 1st St.	Phoenix	AZ	85004	(602) 944-1111	(602) 944-1112	info@phoenix.gov	www.phoenix.gov

[illegible][illegible][illegible]

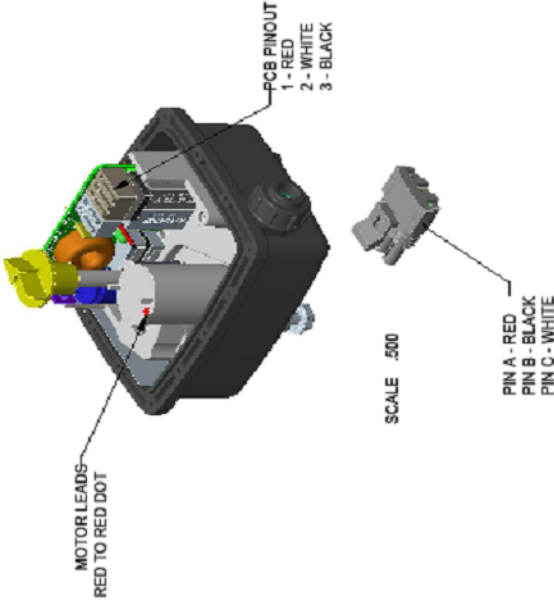
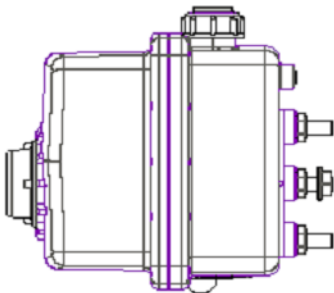
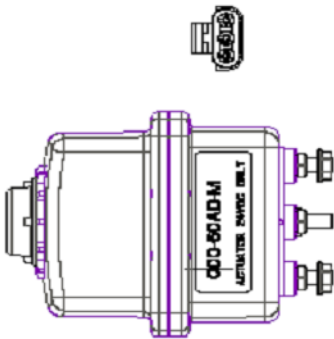


REVISIONS				
LTR	DESCRIPTION	DATE	CHG NO.	APPR'D

MODEL NAME										MDL CREATED										SHEET																			
5209402										11/13/08										1/3																			
A																																							
TOLERANCE EXCEPT AS NOTED										W.S. Darley & Co. ITASCA, IL - CHIPPEWA FALLS, WI																													
.00 ± .03 .000 ± .010 ANGLES ± 1°										VALVE - ACTUATED, 24VDC, .50NPT FE KZCO 84D23-60AD-M																													
DR 'N RJG										DATE 13-Nov-08										5209402																			
CHKD DWS										SCALE 1/4																													
TRCD																																							
THIRD ANGLE PROJECTION										OLD PART NO.																													
										PATTERN NO.																													
MATERIAL NO.										DO NOT SCALE PRINT																													
-										ALL DIMENSIONS IN INCHES UNLESS NOTED																													
REMOVE SHARP EDGES										THIS DESIGN IS THE PROPERTY OF W.S. DARLEY AND CO. - UNAUTHORIZED REPRODUCTION IS PROHIBITED																													
INCH [MILLIMETER]										KZCO 84D23-60AD-M																													
MATERIAL DESCRIPTION:																																							

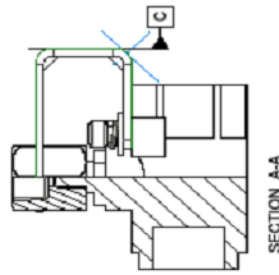
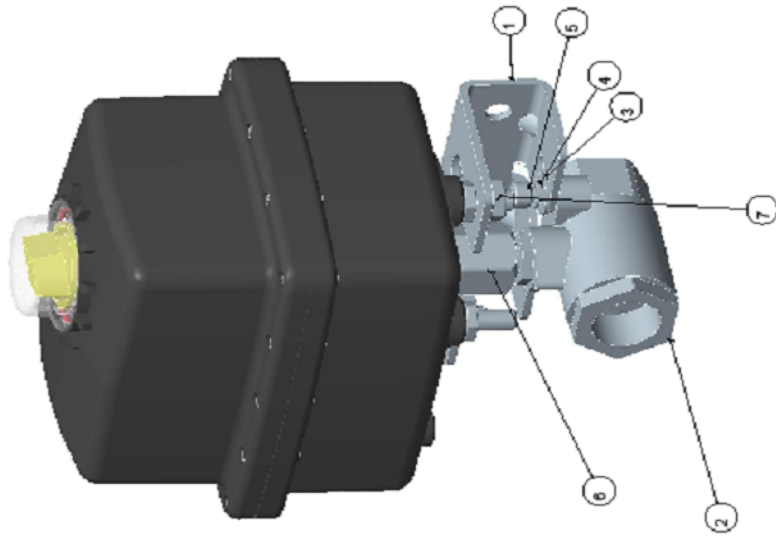
CREATED BY: wtkm CREATED ON: 3/25/2008 1:49:30 PM REV: -- VER: -- REL: -- LOCATION: ROOF DRAWING/PRINTS BRANCH: --

DET	QTY	PART NUMBER	DESCRIPTION	MATERIAL
8	1	EH-502	LABEL, EH ACTUATOR, 2.5" X 1", THERMAL TRANSFER, WHITE	NO_MATERIAL
7	2	OX-222	NUT, HEX HEAD, SERRATED FLANGE, .250-20 UNC-2B	STAINLESS_STEEL_TYPE_303
6	4	EH3-135	STUD, 1/4-20 X 1/2 MTG	STAINLESS_STEEL_TYPE_303
5	1	800018	HARNISS, 60A, 3ST, WP3T, 22.5"	
4	1	EH3-115-Y	FLAG, YELLOW	POLYPROPYLENE_TALC_20
3	1	800468	PCB ASSY, EH3 24VDC 60AD/60DF	
2	1	EH3-110	GEAR MOTOR, EH3 SERIES M1 18 RPM @ 12VDC	
1	1	485-0005	CASE KIT, EH3 IM DOME NYLON M1 & N1 MTR	



MASRO SET DATA
CONTROL INPUT = 1
FEEDBACK = 0
OPERATION = 0
MOTOR = M
SPEED CT = 0.8
ZEROSSET = 135
RANGE TOLERANCE = 1
ROTATION = CC091
ACTUATOR RANGE = 0.0010.00
DESIGN VOLTAGE = D
DIP SX =
LABEL = KZCO
OPTIONS = 0
PLUG TYPE =
TEST PLUG =

STANDARD TOLERANCES ALL DIMENSIONS IN INCHES UNLESS NOTED OTHERWISE		DATE: 2007-04-10	DESIGNED: L. EROKAMP DRAWN: W. FEDDE		KZCO inc. 330000 PARKWAY GREENSBORO, NC 27407 PHONE: 336.402.9443 FAX: 336.402.9443
.25+/- .01 X24 .01 X24 .01 X24 .01	TOTAL BUBOUT DIA DIM CORNER BUBOUT DIA DIA SURFACE FINISH 125/10 X24 .01				
DESIGN: 24V 18RPM IN MOTOR: 18RPM IN VOLUME: 12.00 CU IN		APPROVED: A. KOTTAS			
		SCALE: .500	SIZE: B		
				PART NO: 000-60AD-M	REVISION: .1
					SHEET: 1 of 1

[illegible]

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