



OPERATING, MAINTENANCE, REPAIR AND TROUBLESHOOTING INSTRUCTIONS FOR THE KSP Fire Pump



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This manual is for DARLEY FIRE PUMP:

Model: **KSP** Pump Serial Number: _____

Prepared by: CWY
Approved by: RJG
Revised by:

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Introduction

This manual provides information for the correct installation, operation, maintenance, repair and troubleshooting of the Darley type KSP fire pump system. Please read and understand these instructions thoroughly before putting the system in service. Doing so will ensure optimal performance and long life of your Darley fire pump equipped apparatus.

The manual is divided into 5 sections plus an appendix. Each section details the operation, use, and maintenance of the KSP pump system. The appendix includes supplementary information.

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HM500 – Victaulic – PS, Dimensional – DHD0408 (reference)
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JMP500 Opposite Rotation, Engine Rotation/Tach. Drive – DJD0300 (reference)
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LSP 2 Gear, Lock-On Dimensional – DLD0800 (reference)
Spicer Driveline Guide J3311-1-DSSP – 1201026

SECTION 4 – Pump Detail

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**Related Drawings ----- Pump Cross Section & Explode Drawings – DKC0209, DLC1601,
DKC0205, DKC0604, DKC0651, DKC0602
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Section 1


Definition of Symbols and Immediate Safety Information


IMPORTANT

Throughout this manual you will find Caution, Warning and Danger symbols. Please pay close attention to these symbols as they are for your safety.

 - Signifies an imminently hazardous situation that could result in death or serious injury.

 or  WARNING - Signifies a potentially hazardous situation that could result in death or serious injury.

 - Signifies a potentially hazardous situation that might result in minor or moderate injury.

 - Signifies a potentially hazardous situation that might result in property damage.

Ignoring any of these identified hazards is not recommended. W.S. Darley does not advise such actions or take responsibility for the actions of any operator of this unit.

SAFETY

Always read safety instructions indicated by any of the above symbols.

⚠ WARNING

- 1) Open and close valves slowly.
- 2) Be prepared for high nozzle reactions – open nozzle slowly.

⚠ WARNING

- 1) Do not exceed system rated pressure of 250 PSI, capacity of 1000 GPM or impeller speed of 4730 RPM. If assistance is needed in determining engine speed to impeller speed correlation, contact W.S. Darley Customer Service.
- 2) Observe local regulations on the use of hearing protection.
- 3) Use only hoses with pressure rating higher than their intended use.
- 4) Remove all pressure from hoses before disconnecting.
- 5) Shutdown and depressurize completely before attempting maintenance.
- 6) Use of wheel chocks is required.

⚠ WARNING

Relay pumping is acceptable as long as system rated pressures are not exceeded. Receiving pump should be equipped with sufficient safety relief type devices, such as Suction Relief Valves and/or Discharge Relief Valves. Failure to follow this recommendation could result in phenomena such as water hammer and system pressure spikes. Such occurrences can cause severe personnel injury and severe equipment damage.

⚠ WARNING

Great care must be taken in the layout of pump systems drivelines. Interference and driveline vibration must be considered. A sufficiently experienced installer with knowledge of driveline considerations, proper layout and recommended guidelines should be utilized as well as a proper CAD system for technically precise layouts. Installation of said drivelines should not occur until a proper analysis is performed by either said drafter or W.S. Darley. Darley utilizes and can distribute the Allison Driveline Analysis program which they use for said analysis, along with an instruction for use.

Failure to do said layout and analysis could result in severe injury and damage to equipment, including items not furnished by Darley, including but not limited to: drive tubes, hanger bearings, u-joint crosses, gears, rear differentials, and main truck transmissions.

⚠ WARNING



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Exposed rotating drive-shafts should be guarded.

It is highly recommended by Darley to use safety rings around drive tubes. Especially near connecting u-joint crosses. Such safety rings would be sufficiently attached to the chassis frame and sufficiently strong enough to prevent a broken u-joint assembly from allowing a driveline to slide out from underneath the truck at high speeds while still rotating, causing severe personnel injury. Said safety rings would be larger than the drive tube OD and provide enough clearance for dynamic non-rotational movement of the drivelines through loaded and unloaded conditions, driving operations and where chassis flex may occur.

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Section 2

General Information and Operations

Recommendations (Things to Remember)

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SUMMARY OF THINGS TO REMEMBER

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

PTO Safety and Shifting Information

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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.

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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.

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PTO PUMP SHIFTING PROCEDURE

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

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

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

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

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

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

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

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

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

PTO PUMP SHIFTING PROCEDURE

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

PTO PUMP SHIFTING PROCEDURE

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

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

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

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

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

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

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

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

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

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

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

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

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

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

PTO PUMP SHIFTING PROCEDURE

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

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

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

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

PTO PUMP SHIFTING PROCEDURE

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

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

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

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

General Operations Information

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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, making the priming difficult or causing the 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 for ratings up to 1500 gpm, with 20 feet of recommended suction hose at 2000 feet. 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 22" of Hg is shown on the gage. The vacuum should hold for no more than 10" of drop in 5 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 usually accessible from underneath operators panel.)

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 may result in water in the gearcase if water in the cooling coil freezes.**

If pump is equipped with a 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,

Prepared by: EAP

Approved by: MCR

Revised by: JAF

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 materials, such as bronze, 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 3% higher pressure and require 3% 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 important 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 Pilot 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

A fire pump imposes heavy loads on the engine that drives it, sometimes 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, Operating Characteristics of Pumps and Conversion Factors

Prepared by: CWY
Approved by: RJG
Revised by:

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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

NFPA 1901 Tables

Prepared by: CWY
Approved by: RJG
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**TABLE NO. 1
NFPA 1901 TEST**

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

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

**TABLE NO. 1
NFPA 1901 TEST**

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

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

**TABLE NO. 1
NFPA 1901 TEST**

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

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

**TABLE NO. 1
NFPA 1901 TEST**

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

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

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

Discharge Tables

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Approved by: RJG
Revised by:

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

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

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

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

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

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

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

TABLE NO. 4

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

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

Reach and Friction Loss Tables

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

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

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

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

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

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

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

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

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

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

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

Ref. NFPA 1963

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

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

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Approved by: RJG
Revised by:

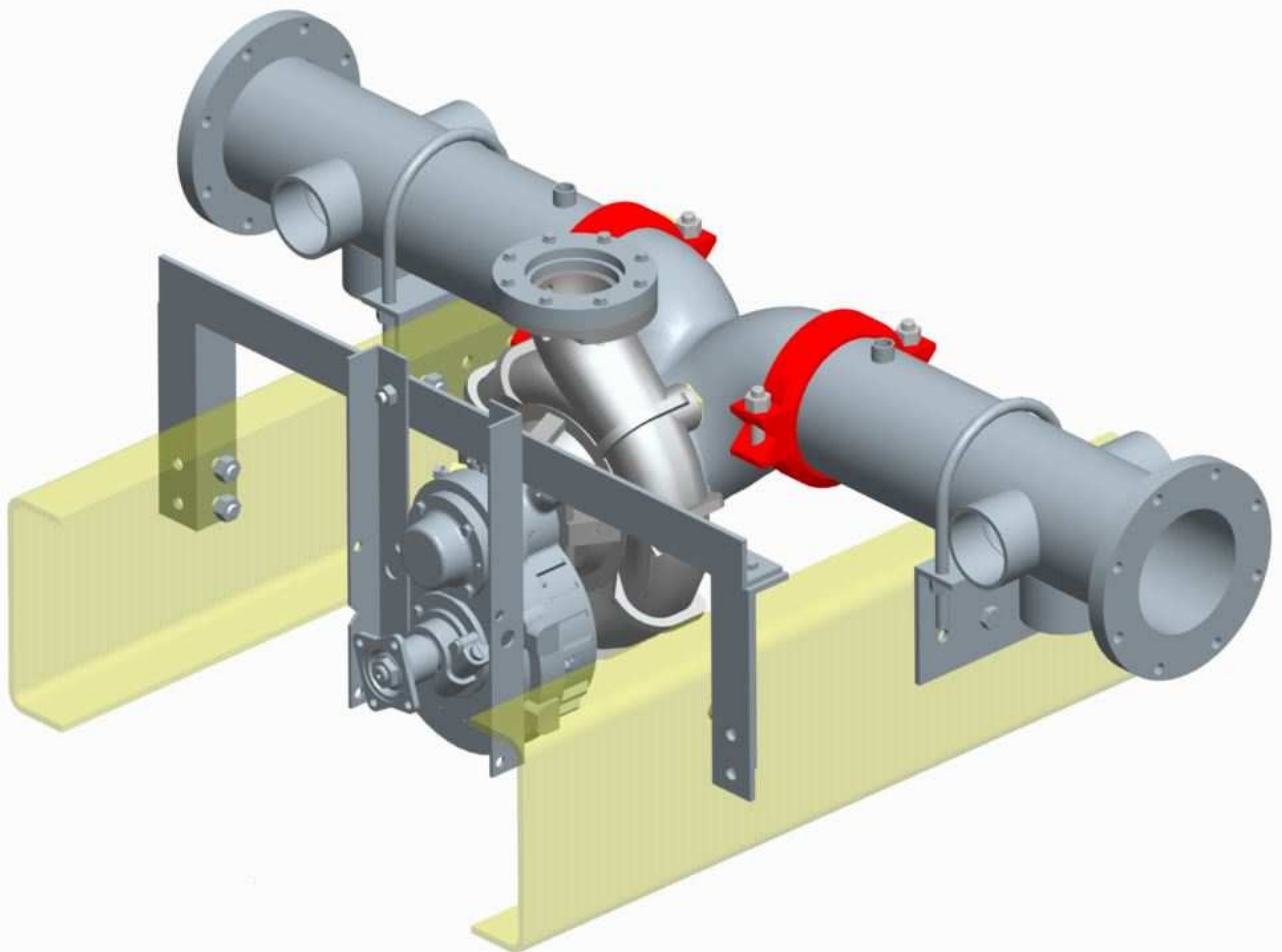
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Section 3

Installation



INSTALLATION OF TYPE AG, HM, JMP, KSP, LSP, PSP, & OTHER PTO DRIVEN PUMPS



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Important

! WARNING

Rotating shafts can be dangerous. Clothes, skin, hair, hands, etc. can become snagged or tangled, causing serious injury or death. **DO NOT** work on a drive shaft or pump when the engine is running and without the wheels chocked.

! WARNING

Great care must be taken in the layout of pump systems drivelines. Interference and driveline vibration must be considered. A sufficiently experienced installer with knowledge of driveline considerations, proper layout and recommended guidelines should be utilized as well as a proper CAD system for technically precise layouts. Installation of said drivelines should not occur until a proper analysis is performed by either said drafter or W.S. Darley. Darley utilizes and can distribute the Allison Driveline Analysis program which they use for said analysis, along with an instruction for use.

Failure to do said layout and analysis could result in severe injury and damage to equipment, including items not furnished by Darley, including but not limited to: drive tubes, hanger bearings, u-joint crosses, gears, rear differentials, and main truck transmissions.

! WARNING



Exposed rotating drive-shafts should be guarded.

It is highly recommended by Darley to use safety rings around drive tubes. Especially near connecting u-joint crosses. Such safety rings would be sufficiently attached to the chassis frame and sufficiently strong enough to prevent a broken u-joint assembly from allowing a driveline to slide out from underneath the truck at high speeds while still rotating, causing severe personnel injury. Said safety rings would be larger than the drive tube OD and provide enough clearance for dynamic non-rotational movement of the drivelines through loaded and unloaded conditions, driving operations and where chassis flex may occur.

Universal Joints:

- Universal joints must always be installed in pairs to transmit uniform rotary motion.
- The operating angles of each universal joint in the pair should be as close to equal as possible.
- The input and output shafts of each universal joint pair may be either parallel, or so located that the centerline of each shaft intersects the midpoint of the shaft connecting each universal joint (intersecting angles).
 - o This arrangement may be required if the coupling shaft between pump and PTO is relatively short, or the engine is mounted with its driveshaft horizontal. Refer

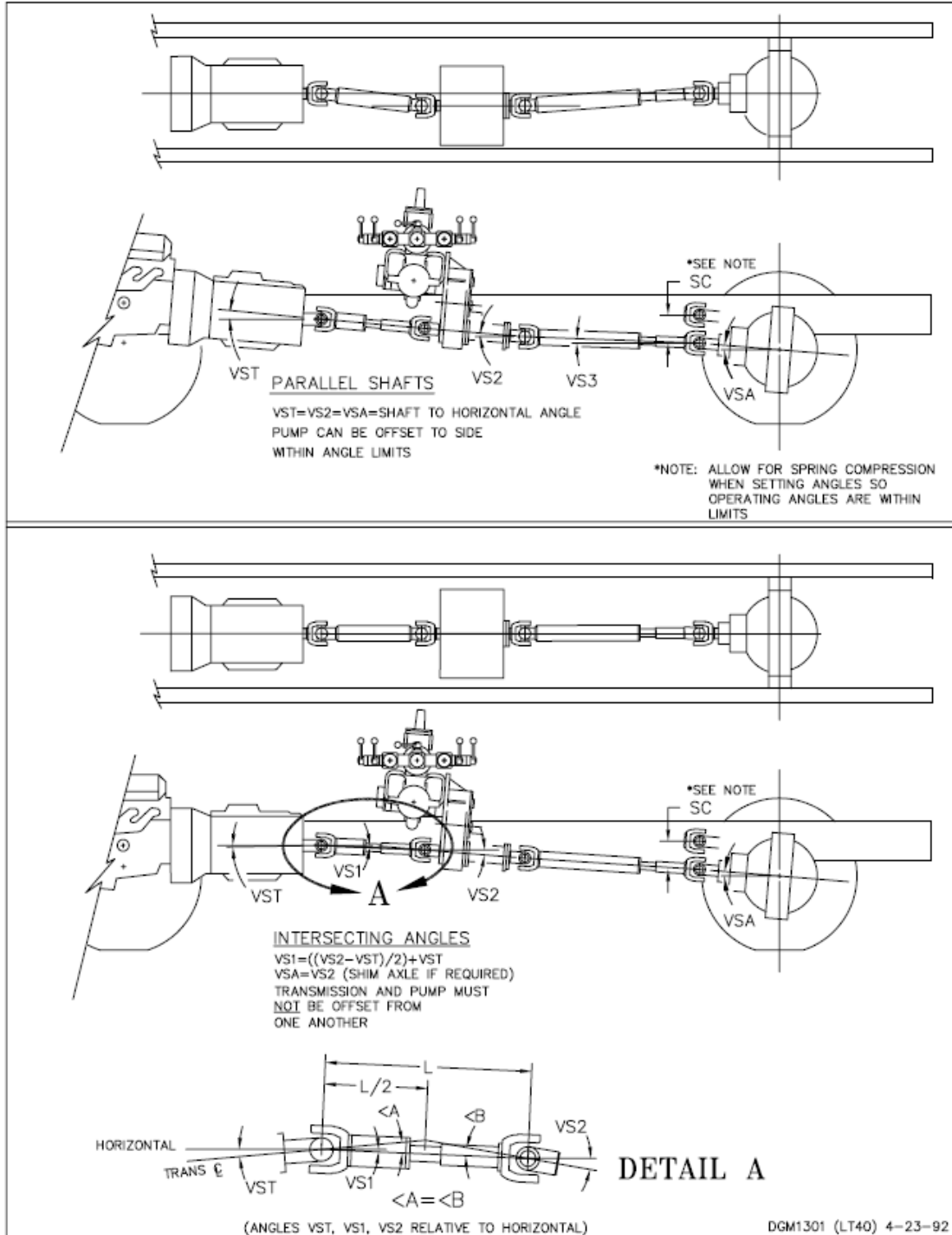
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to attached drawing DGM1301 for examples of parallel shaft and intersecting angle installations.

- o DGM1301 shows a midship split shaft style pump, but the same installation recommendation/information applies to PTO's and PTO driven pumps.

See the appendix of this portion of the manual for the Spicer Driveline Installation Guide (J3311-1-DSSP)

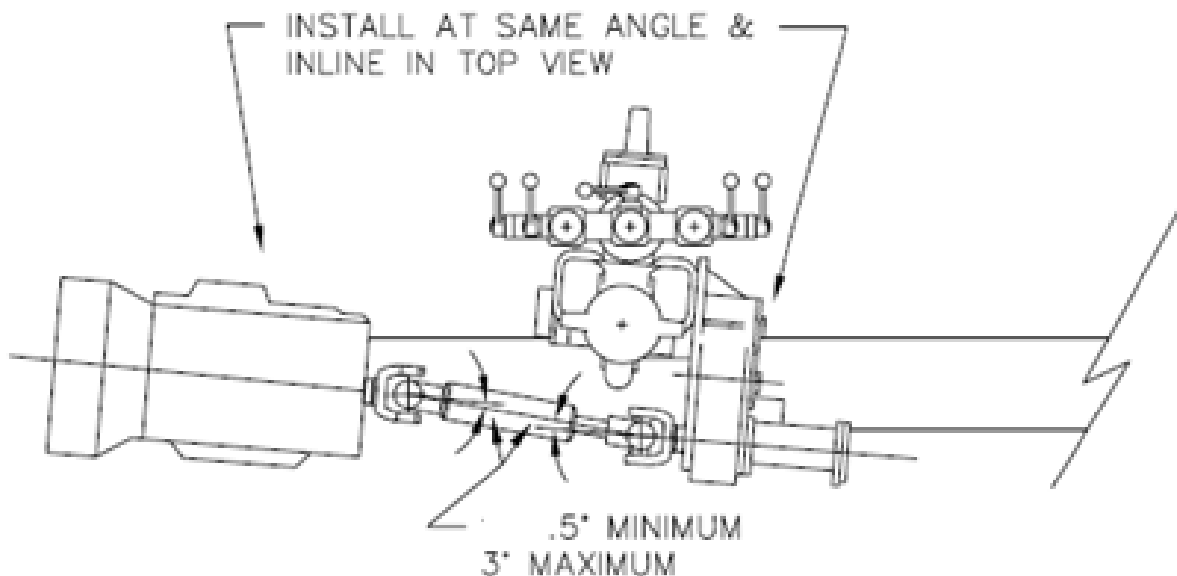


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Driveline and Mounting:

- Determine the best location for the pump in your chassis. Allow adequate room for pump maintenance.
- Place the pump/cross-member assembly on the chassis frame at the desired location. Be sure to set cross-member ends on the weld brackets. (See detail drawing DSM0103.)
- Measure the vertical angle between the truck PTO shaft centerline and chassis frame (often 4°).
- **For pumps that use studs to support the rear of the pump** from the pump cross member, attach the rear cross-member support to the pump using 5/8" diameter studs, nuts, and lockwashers.
 - o Tighten the stud locknuts on the pump transmission bearing cap only.
 - o Omit lockwashers on the top side of the cross-member, as nuts only will be used to position the pump.
- Place metal shims between the cross-member ends and weld brackets to provide the same angle.
 - o C-clamp the ends to the chassis frame rails temporarily.
- Suspend the pump so that the pump driveshaft centerline is as close as possible to being in line and parallel to the truck PTO shaft centerline. Example: If the truck PTO is at 4° with horizontal, the pump driveshaft should also be set at 4° with horizontal. This will insure that even if the PTO and pump are offset from each other, the universal joint operating angles will be equal.
- Check to confirm that the pump shaft is parallel to the PTO shaft.



- **For pumps that use studs to support the rear of the pump** from the pump cross member, use the top hanger stud nuts, on cross-member (without lockwashers) and shims under suction extensions to bring pump driveshaft centerline approximately in line and parallel to the truck PTO shaft. The pump shaft, and PTO shaft should now be at the same angle, relative to horizontal (often 4°).
 - o Make adjustment to shims between the cross-member, and weld brackets so top nuts bear flat against the angle iron cross member. Establish proper operating angles for the drive shaft.

- **For pumps that use angle iron to support the rear end of the pump** from the cross member, establish proper operating angles for the drive shaft. The pump shaft, and PTO should shaft now be at the same angle, relative to horizontal (often 4°).
 - o Make adjustment to shims between the cross-member, and weld brackets so the vertical angle iron bears flat against the angle iron cross member.
 - o C-clamp the vertical angle iron to the pump cross member temporarily.

- **Before proceeding further, align the pump drive shaft so that it is parallel to the frame rails. More importantly, check to confirm that the pump shaft is parallel to the PTO shaft.**

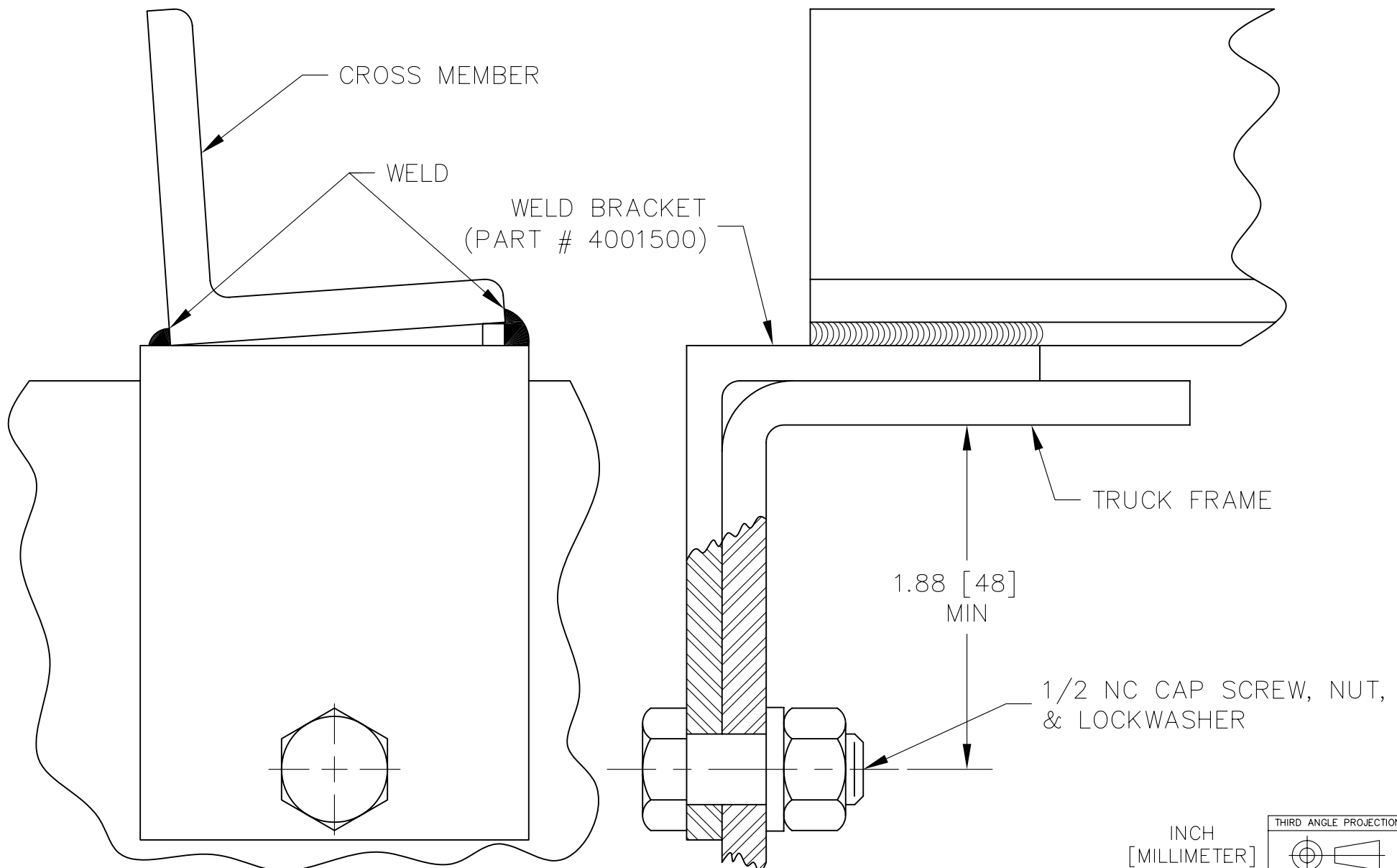
- Place mounting brackets into position as shown on detail drawing DGM1300 or DGM1302, as applicable, and securely clamp against side of frames.
 - o When pipe is used for suction extension, attach brackets to the suction extensions with pipe U-bolts.
 - o When mounting tabs are provided on cast suction extensions, attach the brackets to the suction extensions with 5/8" NC x 2-3/4" long cap screws. (Torque the 5/8" cap screws to 112 ft.lb.)

- Drill holes through the side frames and attach the mounting brackets.
 - o Note, one mounting bracket is designed to permit truck frame flex without imposing stress on pump extensions. The bracket must be free to pivot as seen in drawing DGM1300 or DGM1302 as applicable.

- Provide adequate support for all piping.

- **Keep the following points in mind when positioning the pump and constructing the driveline.**
 - o Do not exceed recommended universal joint operating angles. Complimentary shaft angles should be equal and as low as possible.
 - o Do not exceed universal joint torque limitations.

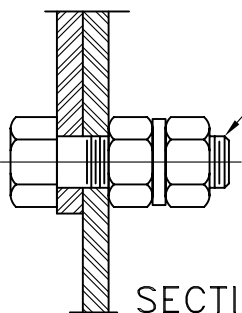
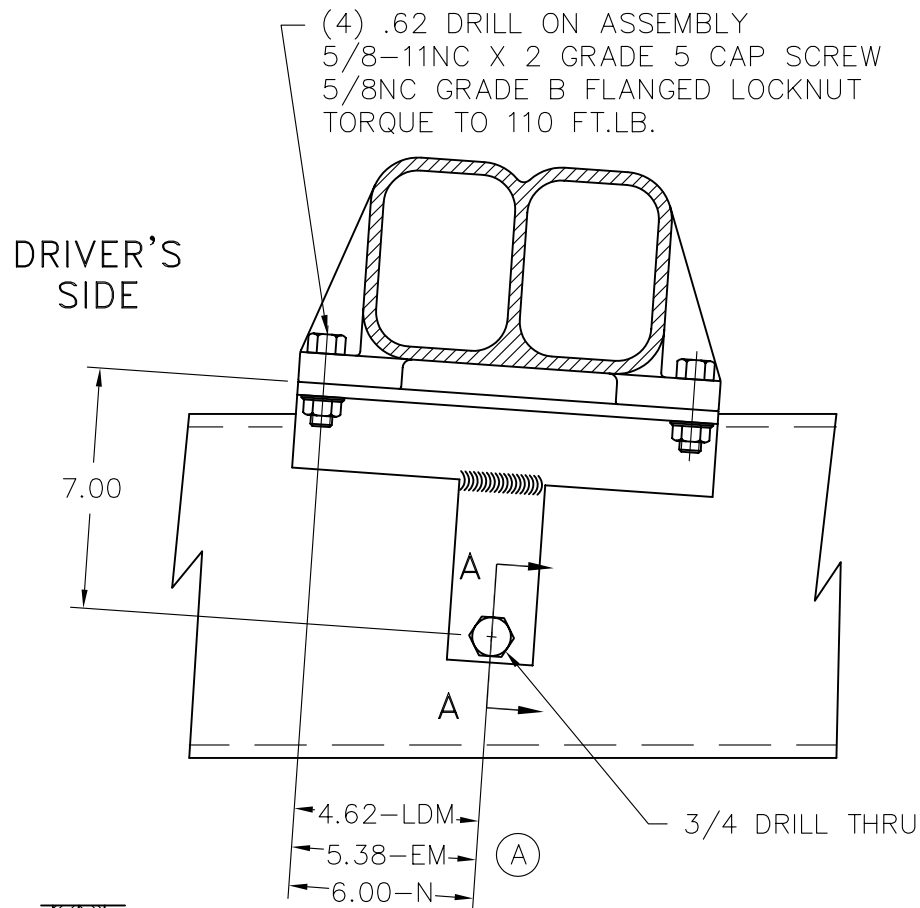
- Do not exceed driveshaft speed/length limitations.
- Yokes on each end of the drive shaft must be in phase. When in phase the yoke lugs (ears) at each end are in line.
- Use balanced driveline components to help prevent vibration and to extend the life of drive yokes and other components related to the drive line.



INCH
[MILLIMETER]

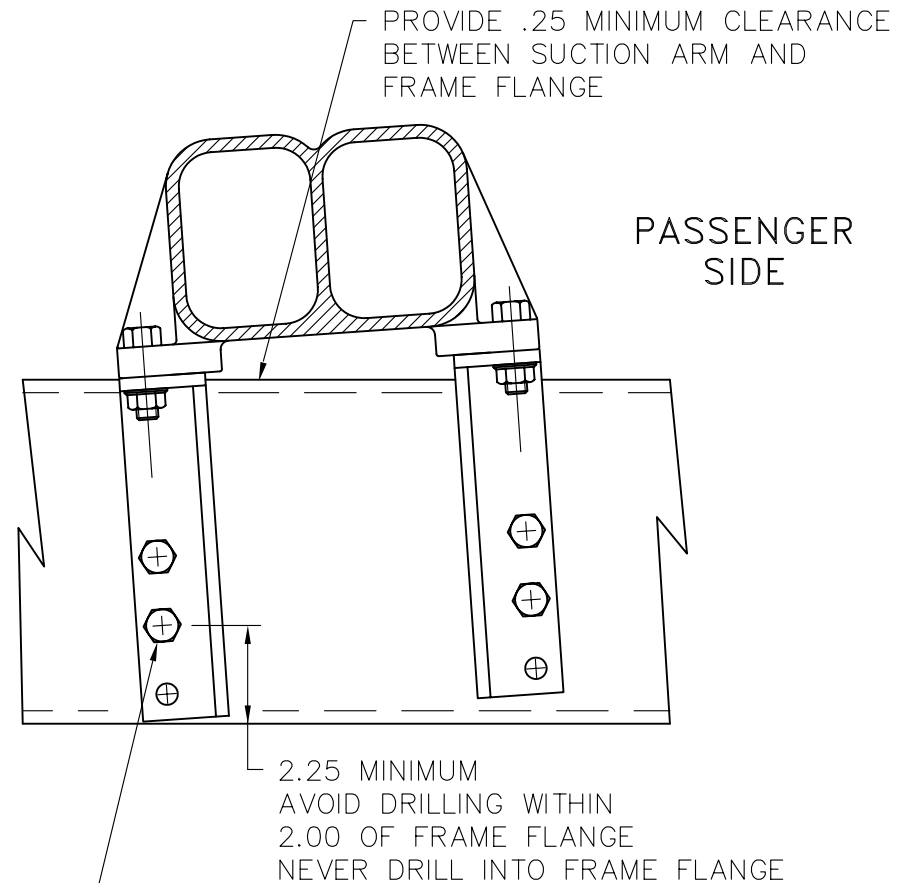
THIRD ANGLE PROJECTION

MATERIAL DESCRIPTION:		MATERIAL NO.	PATTERN NO.	OLD PART NO. S998	TOLERANCE EXCEPT AS NOTED .00 ±.03 .000 ±.010 ANGLES ±1°	W.S. DARLEY & CO. MELROSE PARK, IL - CHIPPEWA FALLS, WI	
—		—	—	—		DWG - PUMP SUPPORT —	
THIS DESIGN IS THE PROPERTY OF W.S. DARLEY AND CO. - UNAUTHORIZED REPRODUCTION IS PROHIBITED		ALL DIMENSIONS IN INCHES UNLESS NOTED		DO NOT SCALE PRINT		DR'N JCM	DATE 9-13-77
						CHKD	SCALE 1/1
						TRCD TED11/9/98	DSM0103



SECTION A-A
 SCALE 1=2

3/4-10NC X 2 1/2 GRADE 5 CAP SCREW
 TEE BRACKET MUST BE FREE TO PIVOT
 TIGHTEN PRIMARY NUT HAND TIGHT
 WHILE HOLDING PRIMARY NUT STATIONARY
 TIGHTEN JAM NUT TO 75-100 FT.LB.



(4) .62 DRILL ON ASSEMBLY
 5/8-11NC X 1 3/4 GRADE 5 CAP SCREW
 5/8NC GRADE B FLANGED LOCKNUT
 TORQUE TO 110 FT.LB.

REV.	DATE	CHANGE
A	30SEP2003	ADDED DIMENSIONS FOR LDM, AND N PUMP
TOLERANCE EXCEPT AS NOTED		
FRAC DIM ±.01		
.00 ±.01		
.000 ±.005		
ANGLES ±1°		
DR'N	DWS	DATE OCT16,1998
CHKD		SCALE 1/4
TRCD	TED	

W.S. DARLEY & CO.
 MELROSE PARK, IL - CHIPPEWA FALLS, WI
 DWG - MOUNTING BRACKET DETAIL
 EM, LDM, N

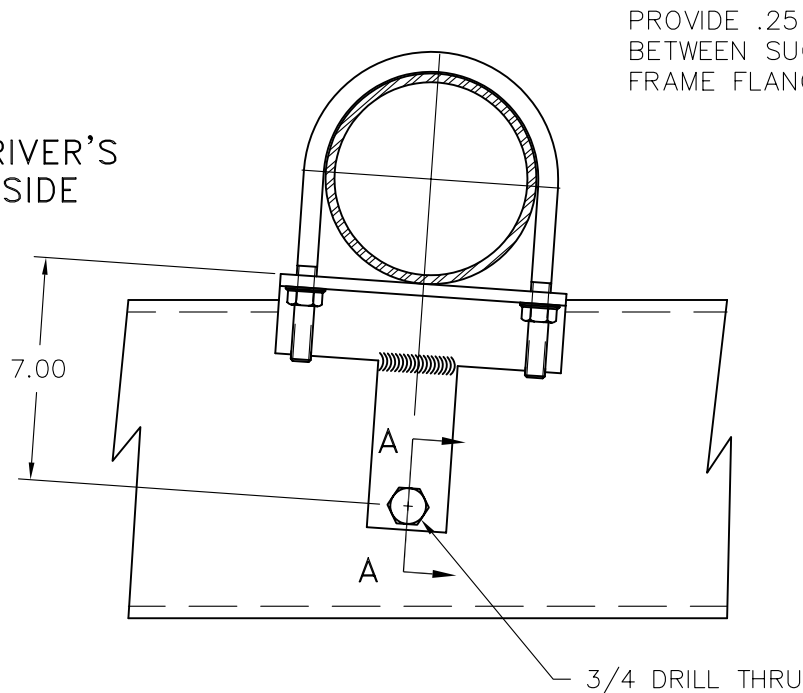
DGM1300

THIS DESIGN IS THE PROPERTY OF
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 REPRODUCTION IS PROHIBITED

ALL DIMENSIONS IN
 INCHES UNLESS NOTED

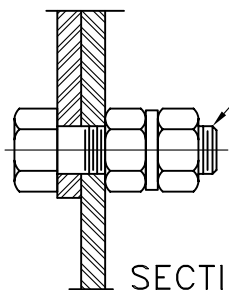
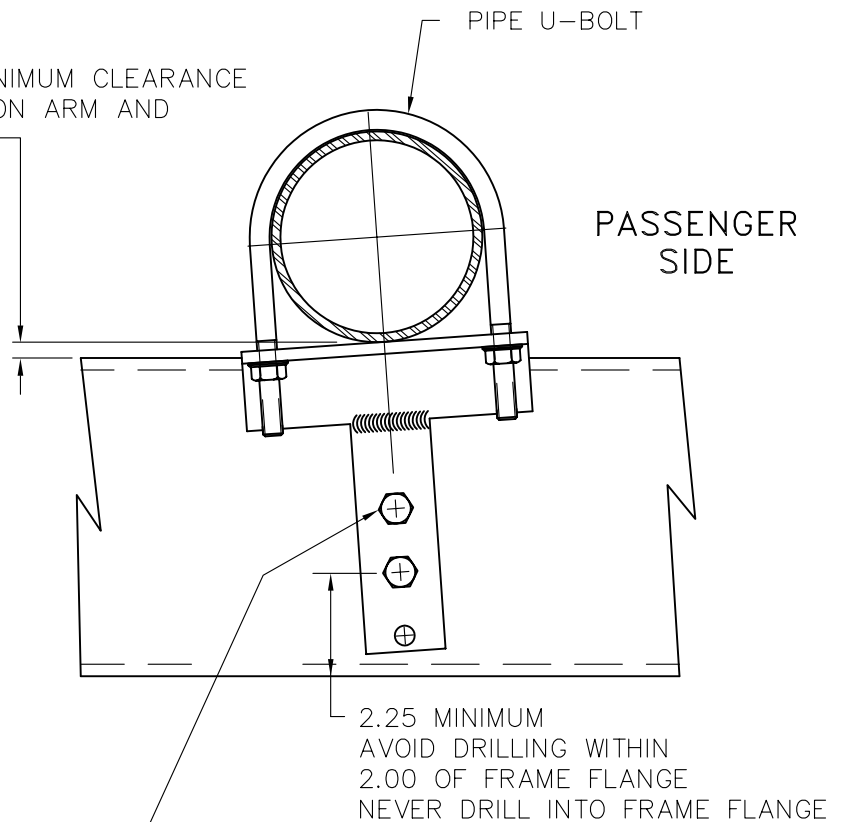
DO NOT SCALE PRINT

DRIVER'S SIDE



PROVIDE .25 MINIMUM CLEARANCE BETWEEN SUCTION ARM AND FRAME FLANGE

PASSENGER SIDE



3/4-10NC X 2 1/2 GRADE 5 CAP SCREW
TEE BRACKET MUST BE FREE TO PIVOT
TIGHTEN PRIMARY NUT HAND TIGHT
WHILE HOLDING PRIMARY NUT STATIONARY
TIGHTEN JAM NUT TO 75-100 FT.LB.

(2) .62 DRILL ON ASSEMBLY
5/8-11NC X 1 3/4 GRADE 5 CAP SCREW
5/8NC GRADE B FLANGED LOCKNUT
TORQUE TO 110 FT.LB.

SECTION A-A
SCALE 1=2

MATERIAL DESCRIPTION:

-

MATERIAL NO.

-

PATTERN NO.

-

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REPRODUCTION IS PROHIBITED

ALL DIMENSIONS IN
INCHES UNLESS NOTED

DO NOT SCALE PRINT



OLD PART NO.

-

TOLERANCE
EXCEPT
AS NOTED

FRAC DIM ±.01
.00 ±.01
.000 ±.005
ANGLES ±1°

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

DWG - MOUNTING BRKT DETAIL
AG, HM, JMP, KS, PS

DR'N TED

CHKD

TRCD

DATE NOV9,1998

SCALE 1/1

DGM1302

Torque the universal joint bearing cap retaining bolts to the following Dana Spicer Recommendations.

U-BOLT		CAP & BOLT	
SERIES	RECOMMENDED NUT TORQUE	SERIES	RECOMMENDED BOLT TORQUE
1280	14-17 LB. FT	1650	77-103 LB. FT
1310	14-17 LB. FT	1850	110-147 LB. FT
1330	14-17 LB. FT	1850	110-147 LB. FT
1350	20-24 LB. FT	1910	110-147 LB. FT
1410	20-24 LB. FT	1950	271-362 LB. FT
1480	32-37 LB. FT	2010	102-118 LB. FT
1550	32-37 LB. FT	2050	744- 844 LB. FT
		2110	171-197 LB. FT
BEARING STRAP		2150	744- 844 LB. FT
SERIES	RECOMMENDED BOLT TORQUE	2210	260- 298 LB. FT
SPL90	45-60 LB. FT		
1210	13-18 LB. FT	BEARING PLATE	
1280	13-18 LB. FT	SERIES	RECOMMENDED BOLT TORQUE
1310	13-18 LB. FT	1610	26-35 LB. FT
1330	13-18 LB. FT	1710	38-48 LB. FT
1350	30-35 LB. FT	1760	38-48 LB. FT
1410	30-35 LB. FT	1810	38-48 LB. FT
1480	55-60 LB.FT	1880	60-70 LB.FT
1550	55-60 LB.FT		
1610	55-60 LB.FT	New part kits with lockstraps available from Spicer after Spring 1994	
1710	130-135 LB. FT	SERIES	RECOMMEND BOLT TORQUE
1760	130-135 LB. FT	1610	17-24 LB. FT
1810	130-135 LB. FT	1710	32-42 LB. FT
		1760	32-42 LB. FT
		1810	32-42 LB. FT
		1880	50-66 LB. FT



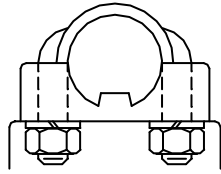
WARNING: Bearing strap retaining bolts must **NOT** be reused!

WARNING: Self locking bolts must **NOT** be reused!

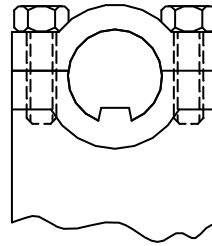
Note: The Dana Spicer fastener torque recommendations are per Dana Spicer's literature # 3119-5 DSD 4/94.

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

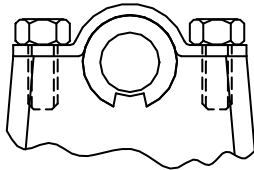
Rev. A
Date: 03/16/12
Rev. Date: 06/20/13
1201009.doc



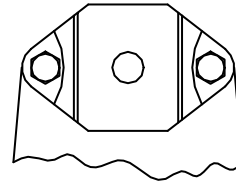
U-BOLT



CAP &
BOLT



BEARING
STRAP



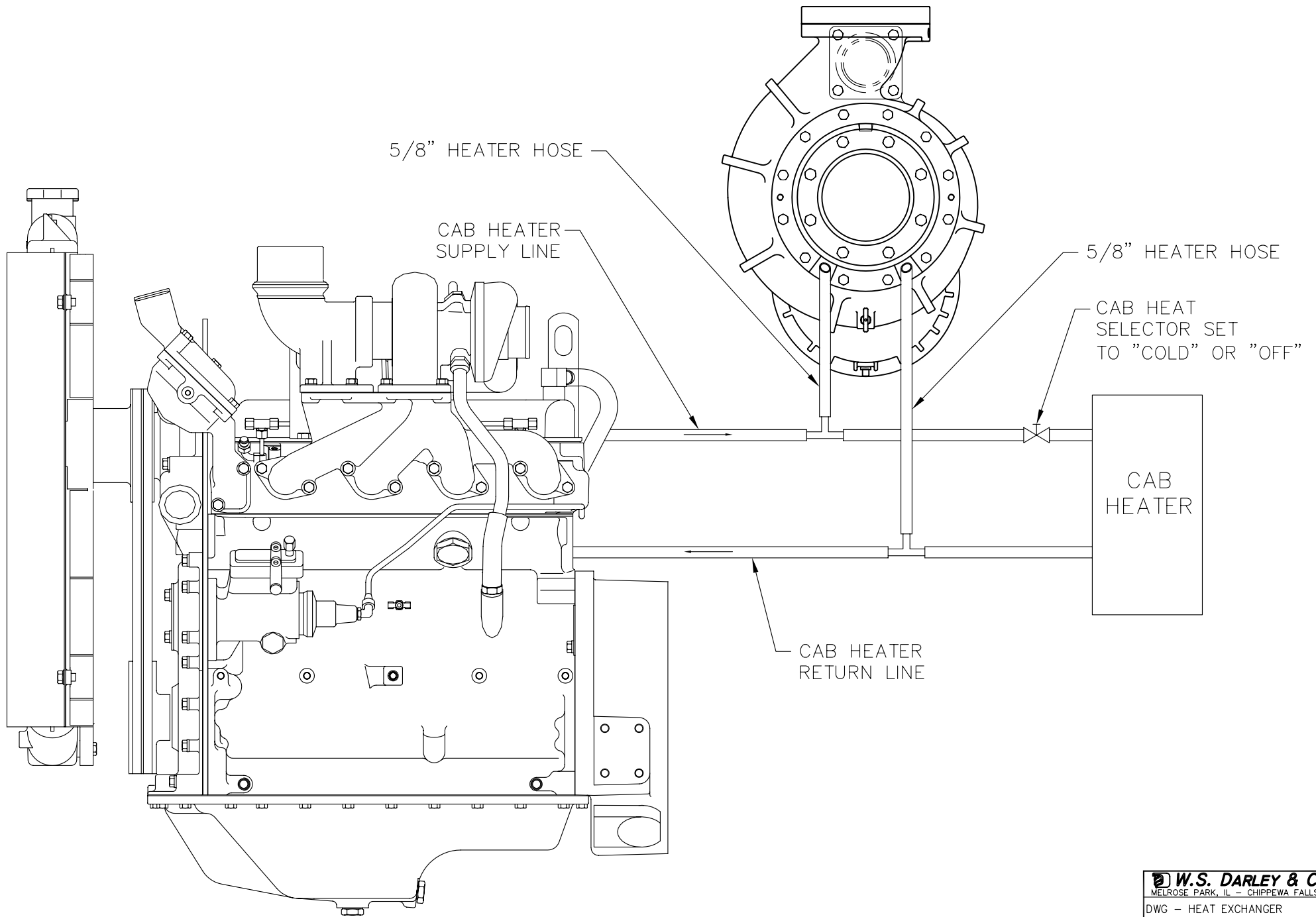
BEARING
PLATE

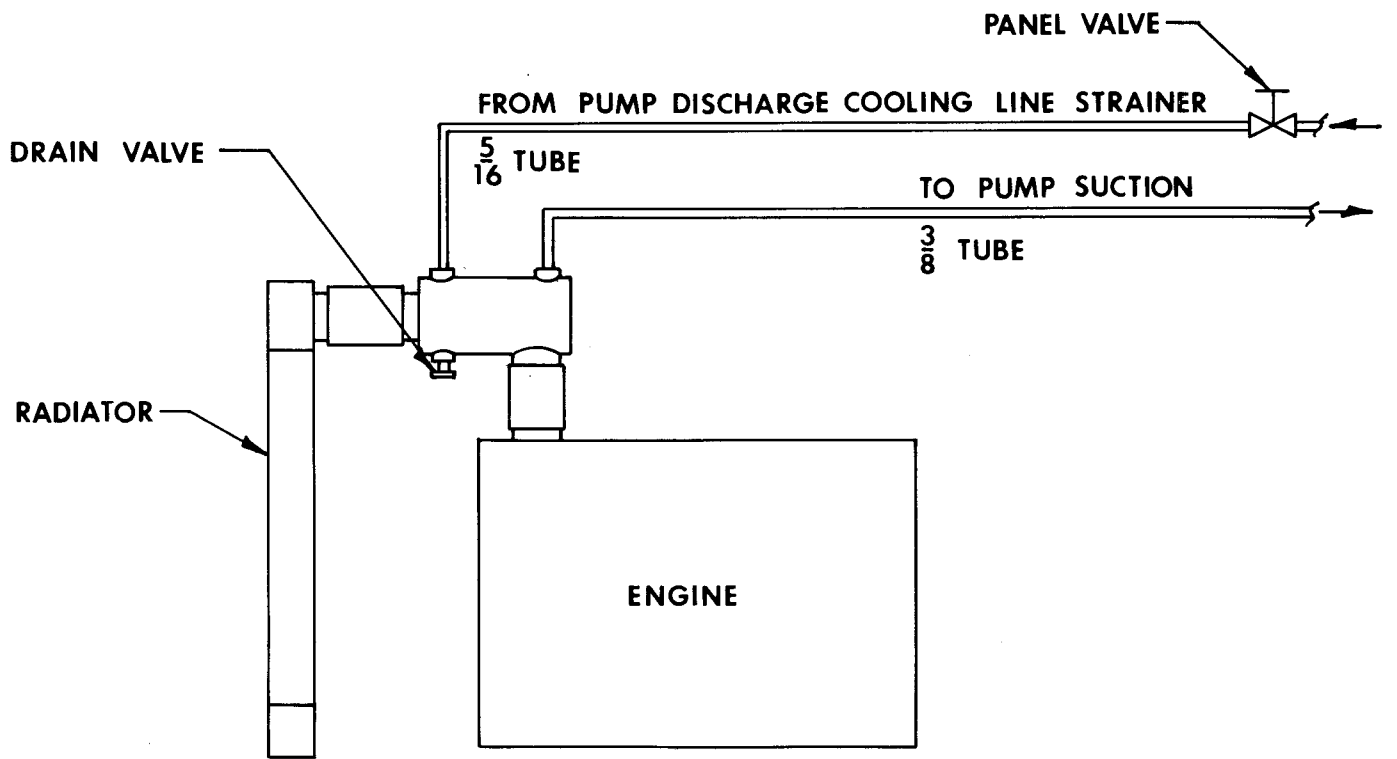
Lubricate universal joint cross using a good quality E.P. (extreme pressure) grease meeting N.L.G.I. E.P. Grade 2 specifications. (Consult your local lubricant source for greases that meet this specification.)

PRIMER CONNECTION: For 12/24-volt electric motor driven priming pump installation, see drawings DVC0207 through DVC0212 found in the “Pump Detail” section of your main pump “Installation, Operation, Maintenance, Repair and Troubleshooting Manual”.

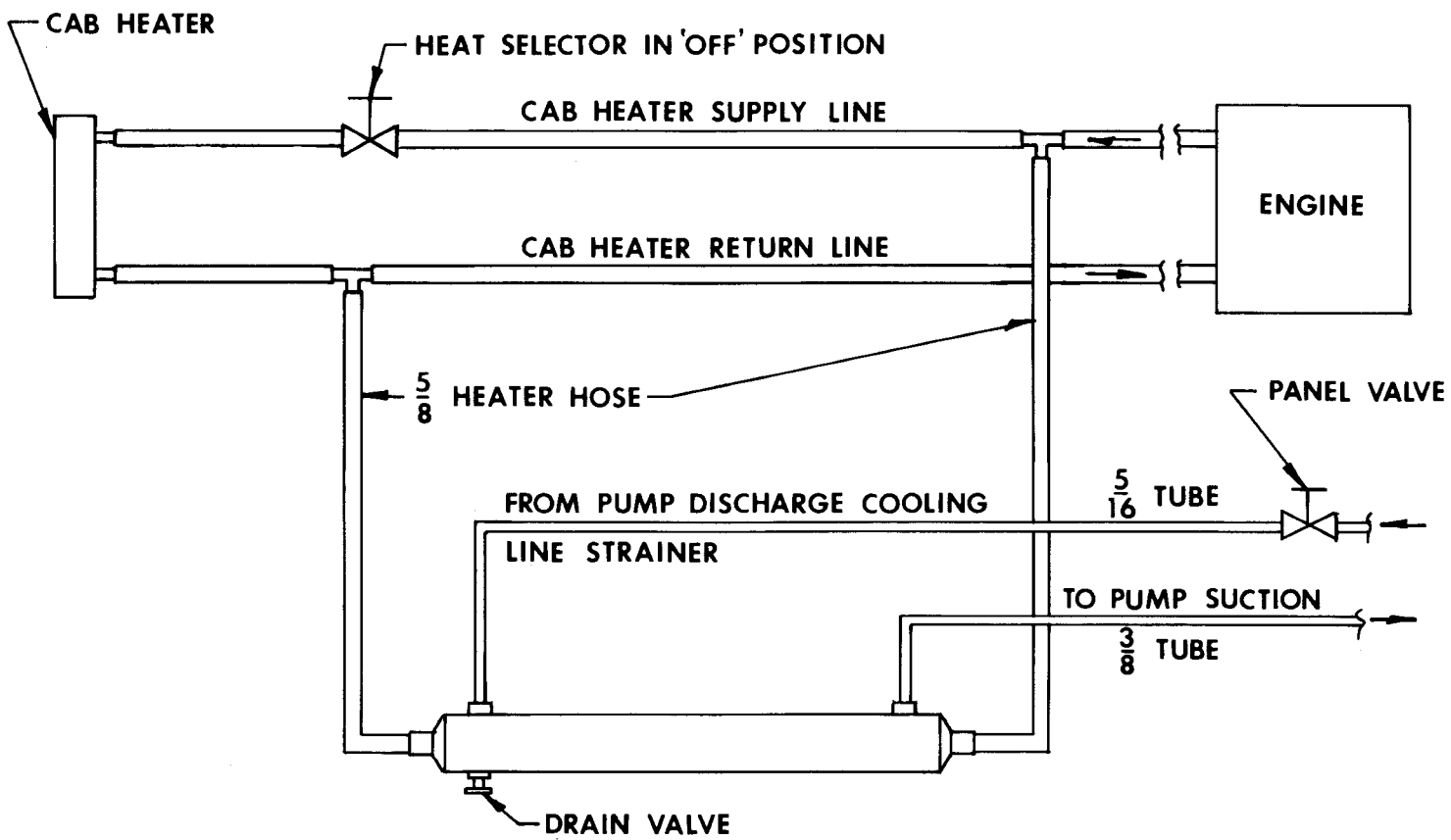
ENGINE COOLING/PUMP HEATER: On most pumps, two tapped openings in the pump suction head are provided for circulating engine coolant through the heater jacket/heat exchanger to prevent pump freezing in cold weather, and to aid in engine cooling in warm weather. Use no smaller than a 1/2” heater hose for this connection. See drawing DGS0400. An external heat exchanger should be added to aid in cooling the engine on units that do not have an internal heater jacket/heat exchanger in the suction head.

PUMP SHIFT INSTALLATION: For power shift installation, refer to DGS1100 for automatic transmission wiring details.





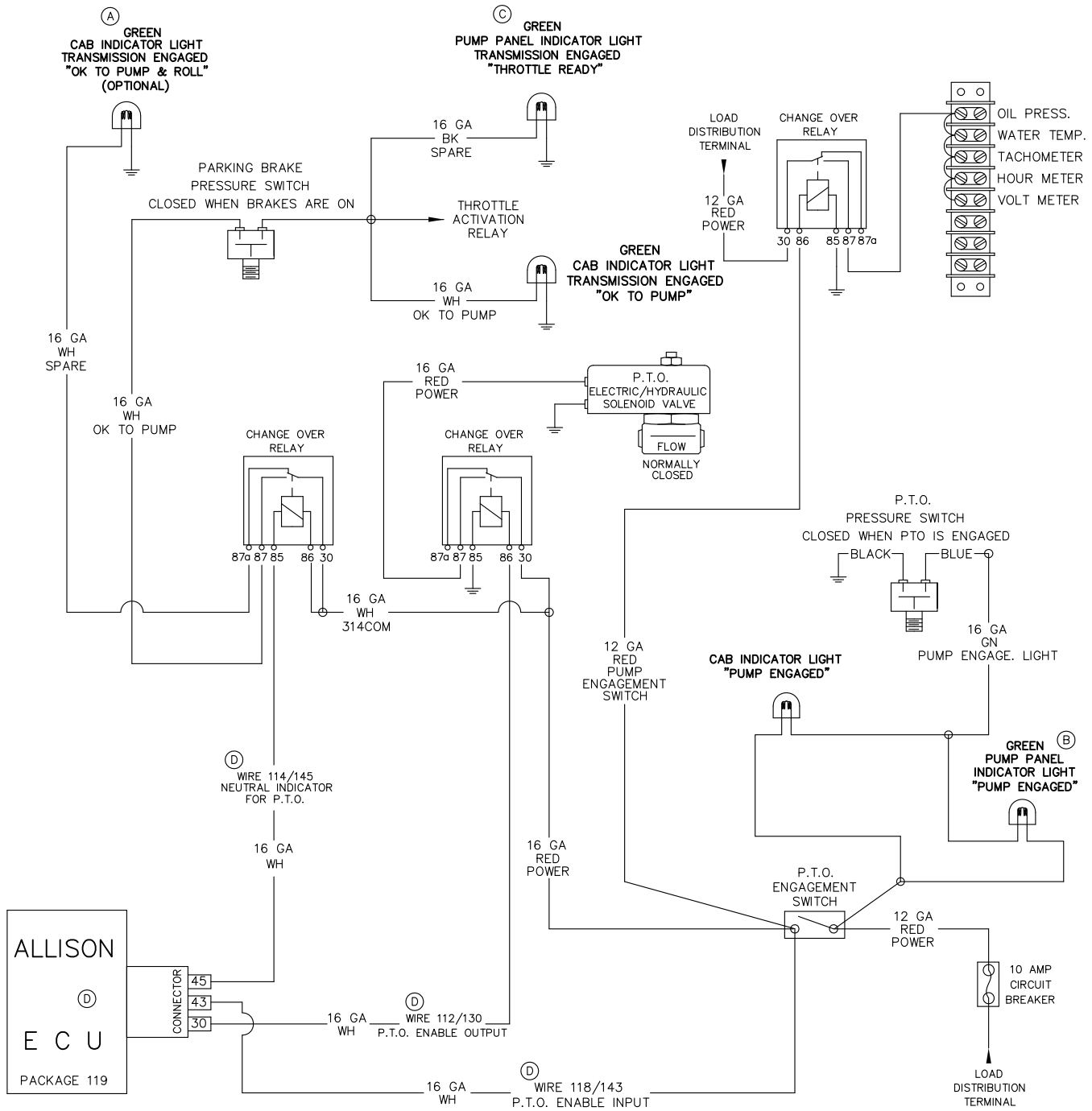
R592 HEAT EXCHANGER



F618 HEAT EXCHANGER

REVISIONS

LTR	DESCRIPTION	DATE	CHG NO.	APPR'D
A	WAS: RED, PUMP PANEL "DANGER DO NOT OPEN THROTTLE"	20JAN00	00-11	DLW
B	ADDED LIGHT	20JAN00	00-11	DLW
C	WAS: GREEN, "WARNING: DO NOT OPEN THROTTLE UNLESS LIGHT IS ON"	20JAN00	00-11	DLW
D	ADDED NEWEST WIRE DESIGNATION #'s: 145, 143, 130; ADDED ALLISON E C U CONNECTOR #'s: 45, 43, 30;	6/23/08	2008-166	RJG



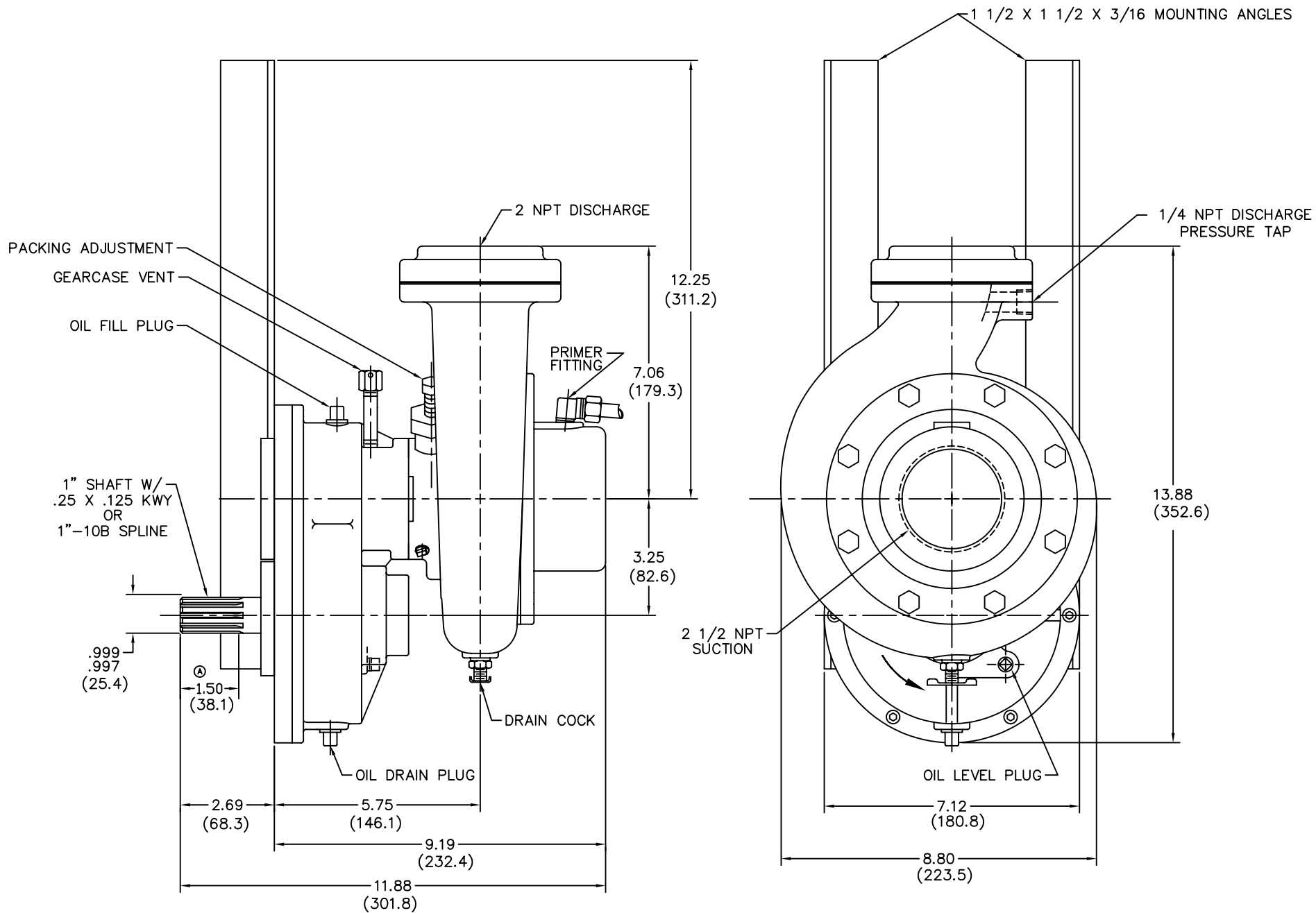
ELECTRICAL SCHEMATIC
ALLISON WORLD TRANS.
PTO/PUMP ENGAGEMENT



W.S. Darley & Co.

APPARATUS DIVISION
920 KURTH ROAD
CHIPPEWA FALLS, WISCONSIN 54729
1-715-726-2645

DWG BY SCHULTZ	SCALE SIZE A, 1:2	REV D
DATE 8-29-96	JOB NO.	DWG. NO. DGS1100



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

INCH
(MM)

OLD PART NO.
A642

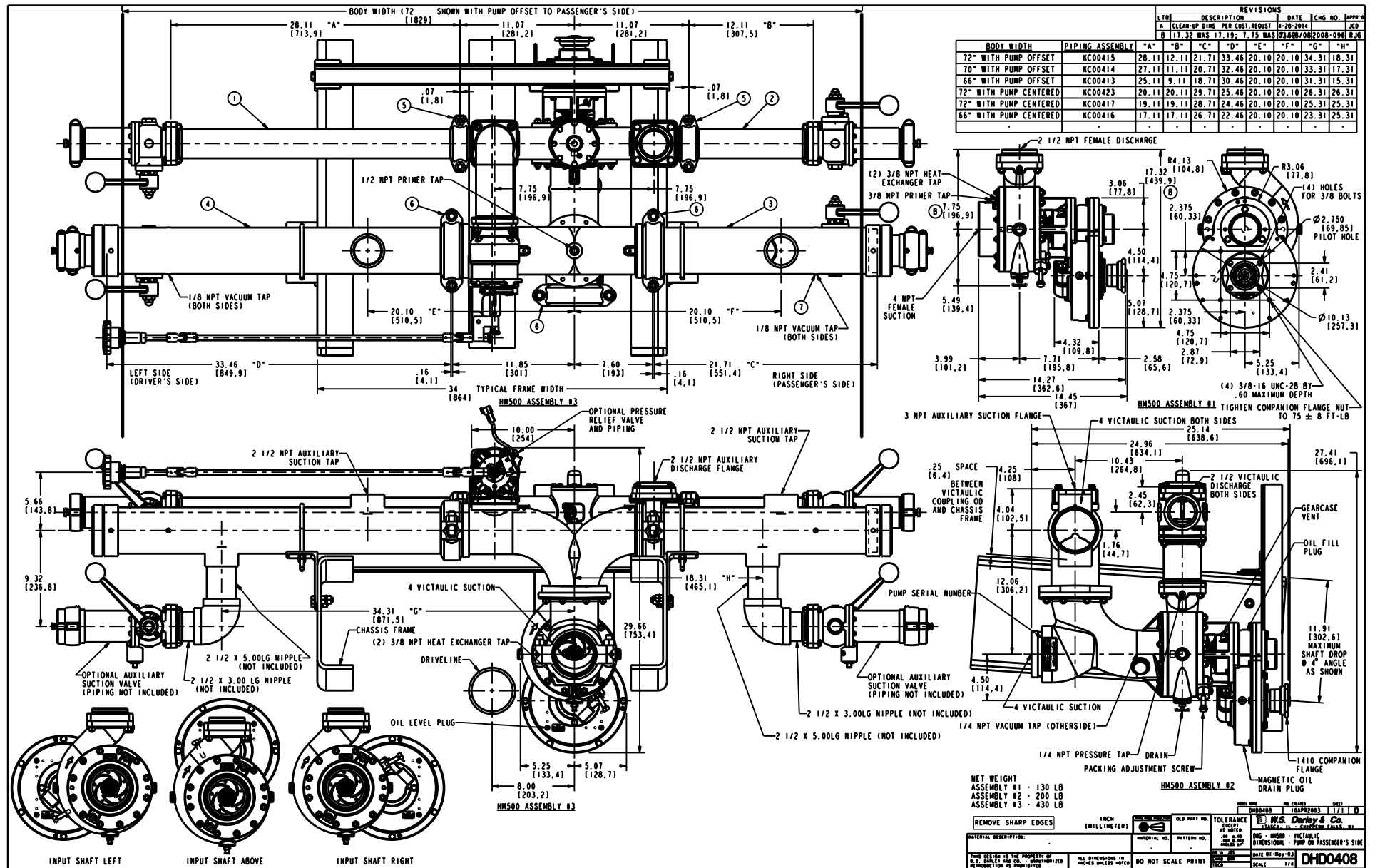
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ALL DIMENSIONS IN
INCHES UNLESS NOTED

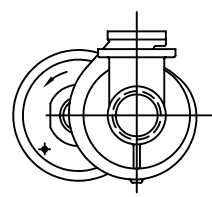
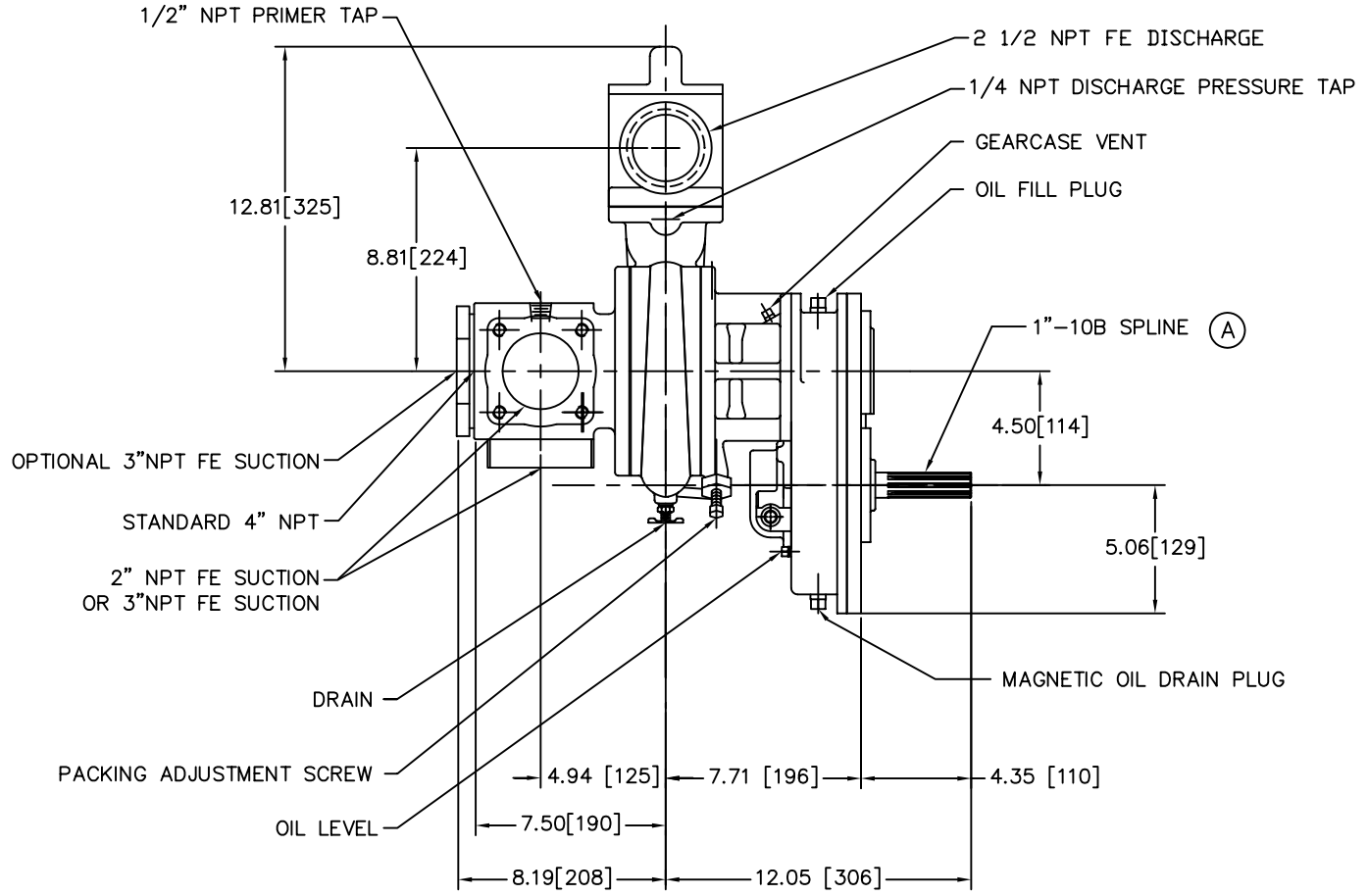
DO NOT SCALE PRINT

DMD	2000-51	03/13/00	(A)	WAS 1.75
APPR'D	CNG NO.	DATE		CHANGE
TOLERANCE EXCEPT AS NOTED		W.S. DARLEY & CO.		
FRAC DIM ±.01		MELROSE PARK, IL - CHIPPEWA FALLS, WI		
.000 ±.005		DWG - 2.5 AG, PTO		
ANGLES ±1°		DIMENSIONAL		
DR'N	TED	DATE JUNE19,92		
CHKD		SCALE 1/2		
TRCD		DAD0200		

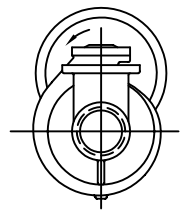
NAME:MW OBJECT:DHD0408 DATE:27-Jul-09 16:12:15



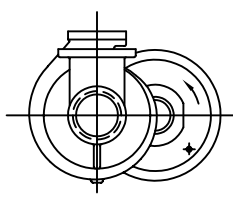
REVISIONS				
LTR	DESCRIPTION	DATE	CHG NO.	APPR'D
A	UPDATED DRIVE SHAFT TO #5015600 UPDATED BRG.CAP TO #2303204 MODIFIED DIMS PER CUST. REQST.	04/28/04	-	JCD



INPUT SHAFT LEFT



INPUT SHAFT ABOVE



INPUT SHAFT RIGHT

OPTIONAL GEARCASE ROTATIONS

150 LBS
[68 KG]

OLD PART NO.
H469

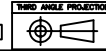
TOLERANCE EXCEPT AS NOTED .00 ±.03 .000 ±.010 ANGLES ±1°	W.S. DARLEY & Co. MELROSE PARK, IL - CHIPPEWA FALLS, WI	DWG - HM250/350
DRN TED CHKD TRCD		DATE NOV.29,95

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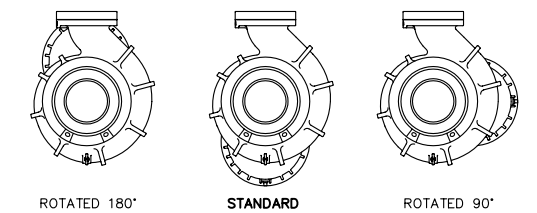
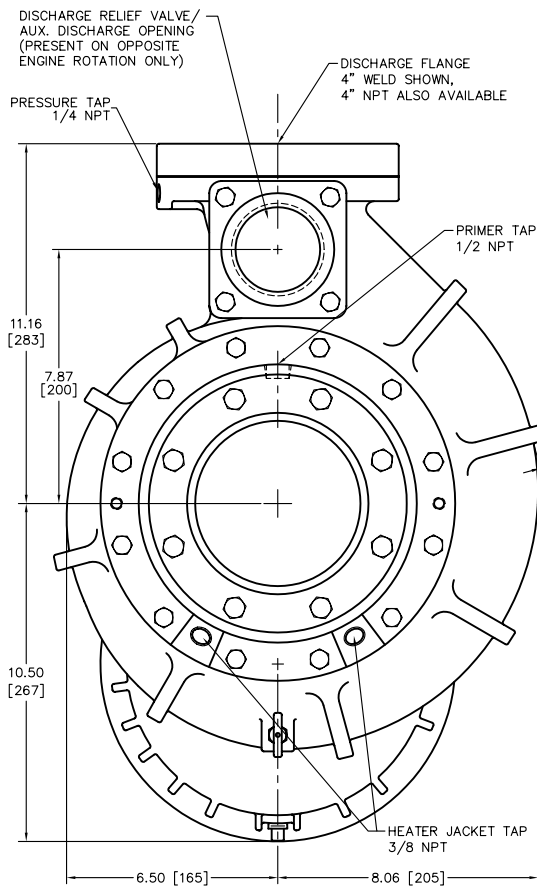
ALL DIMENSIONS IN
INCHES UNLESS NOTED

DO NOT SCALE PRINT

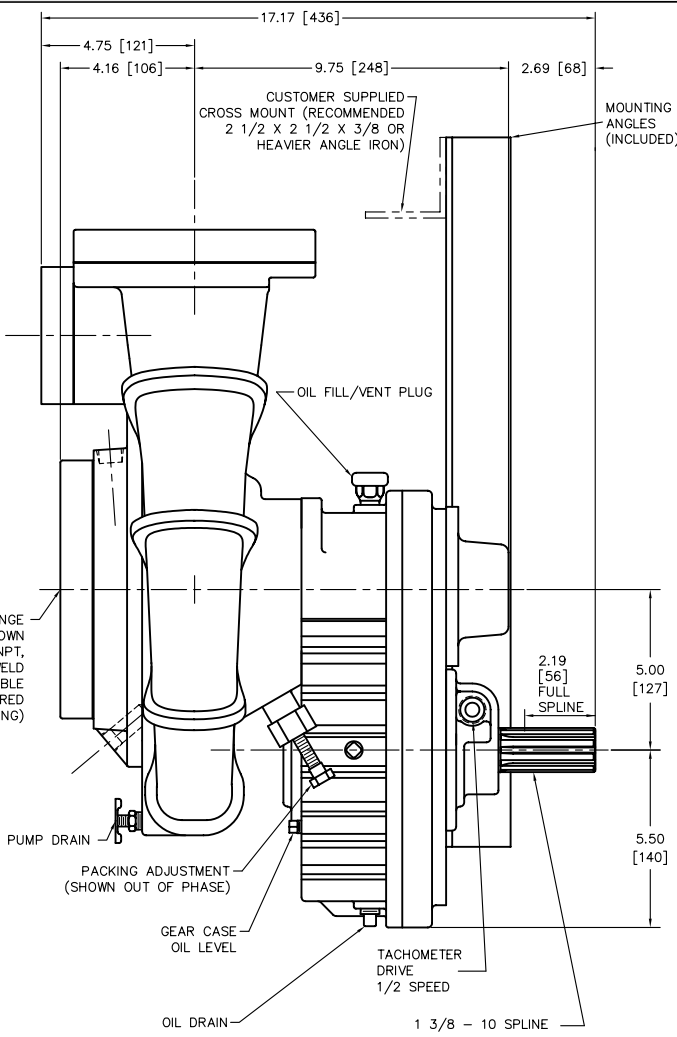
INCH
[MILLIMETER]



DHD0406



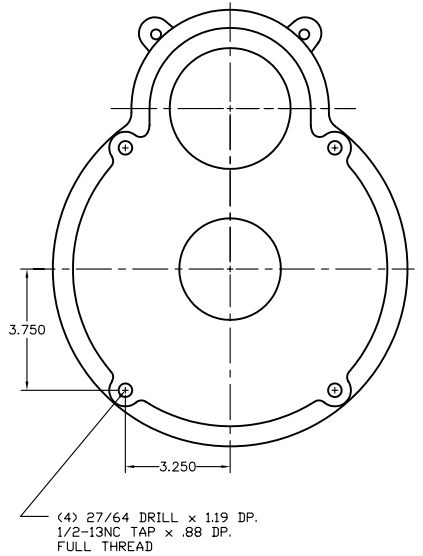
OPTIONAL GEAR CASE ORIENTATION



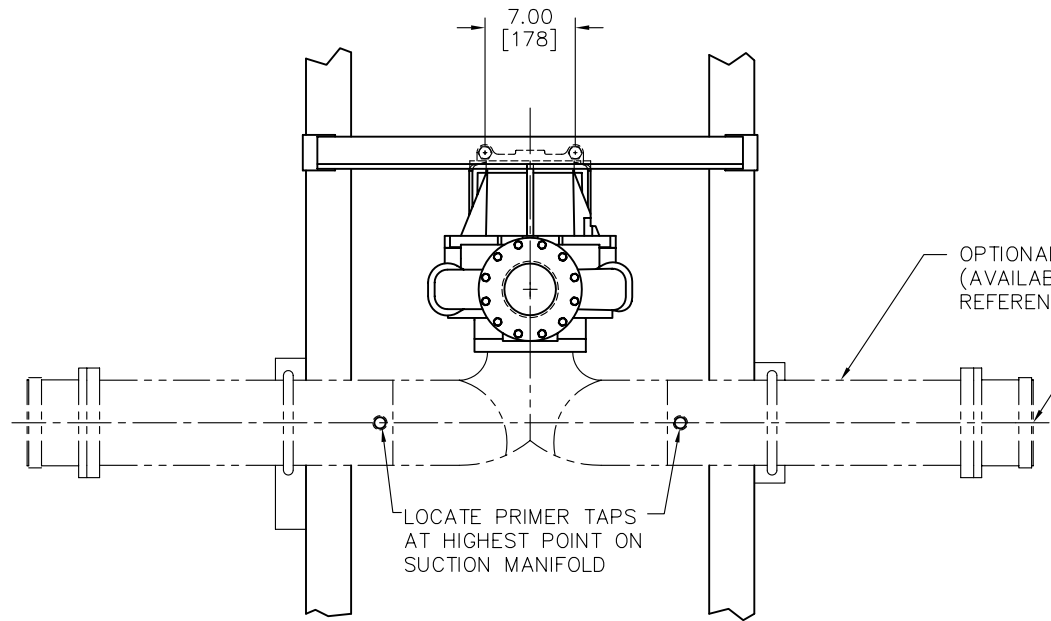
NOTE:
 1) SUPPORT SUCTION AND/OR DISCHARGE PIPING. (ALLOW PIVOT POINTS FOR CHASSIS FLEXING.)
 2) OPPOSITE ENGINE ROTATION SHOWN, ENGINE ROTATION IS ALSO AVAILABLE.
 3) OVERALL HEIGHT AND WIDTH MAY VARY WITH THE TYPE OF DISCHARGE AND SUCTION.

NET WEIGHT: 215 lb.[98 kg.]

REVISIONS				
LTR	DESCRIPTION	DATE	CHG NO.	APPR'D
A	ADDED VIEW FOR MOUNTING HOLES	22JAN01	-	DMD



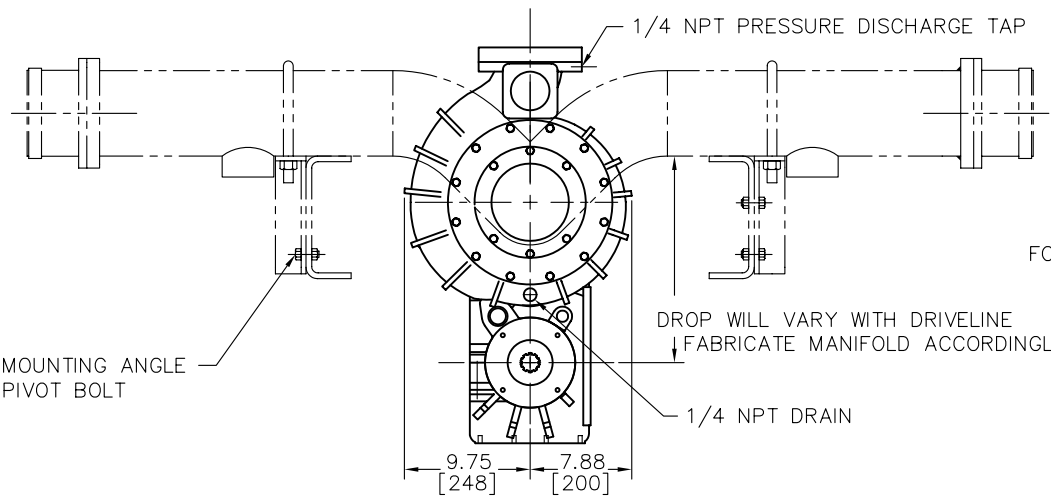
(A) MOUNTING ANGLE HOLES



OPTIONAL 6 SUCTION MANIFOLD
(AVAILABLE UPON REQUEST
REFERENCE DRAWING P185)

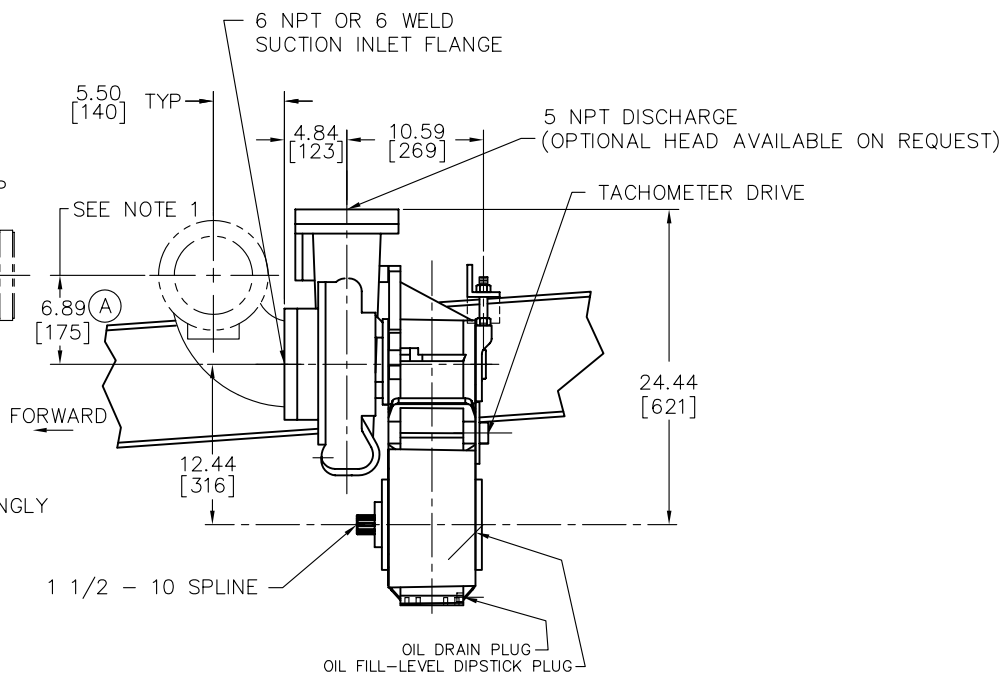
6NH SUCTION NIPPLE
S309-1 (REF ONLY)

LOCATE PRIMER TAPS
AT HIGHEST POINT ON
SUCTION MANIFOLD



DROP WILL VARY WITH DRIVELINE
FABRICATE MANIFOLD ACCORDINGLY

MOUNTING ANGLE
PIVOT BOLT



5.50 [140] TYP

6 NPT OR 6 WELD
SUCTION INLET FLANGE

5 NPT DISCHARGE
(OPTIONAL HEAD AVAILABLE ON REQUEST)

TACHOMETER DRIVE

SEE NOTE 1

FORWARD

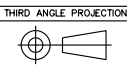
1 1/2 - 10 SPLINE

OIL DRAIN PLUG
OIL FILL-LEVEL DIPSTICK PLUG

NOTE:
1) DIMENSION (A) IS REFERENCE
TO A P185 MANIFOLD AND
MAY VARY WITH DRIVELINE.
2) AVAILABLE IN PUMP FOR-
WARD, OR PUMP REAR.

NET WEIGHT: 475 LBS
[215 KG]

INCH
[MILLIMETER]



(B) UPDATED GEARCASE
9JUN00 TED



OLD PART NO.
P215

TOLERANCE EXCEPT AS NOTED
FRAC DIM ±.01
.00 ±.01
.000 ±.005
ANGLES ±1°
DR'N TED
CHKD
TRCD

W.S. DARLEY & CO.
MELROSE PARK, IL - CHIPPEWA FALLS, WI
DWG - PSP, 3 GEAR
DIMENSIONAL

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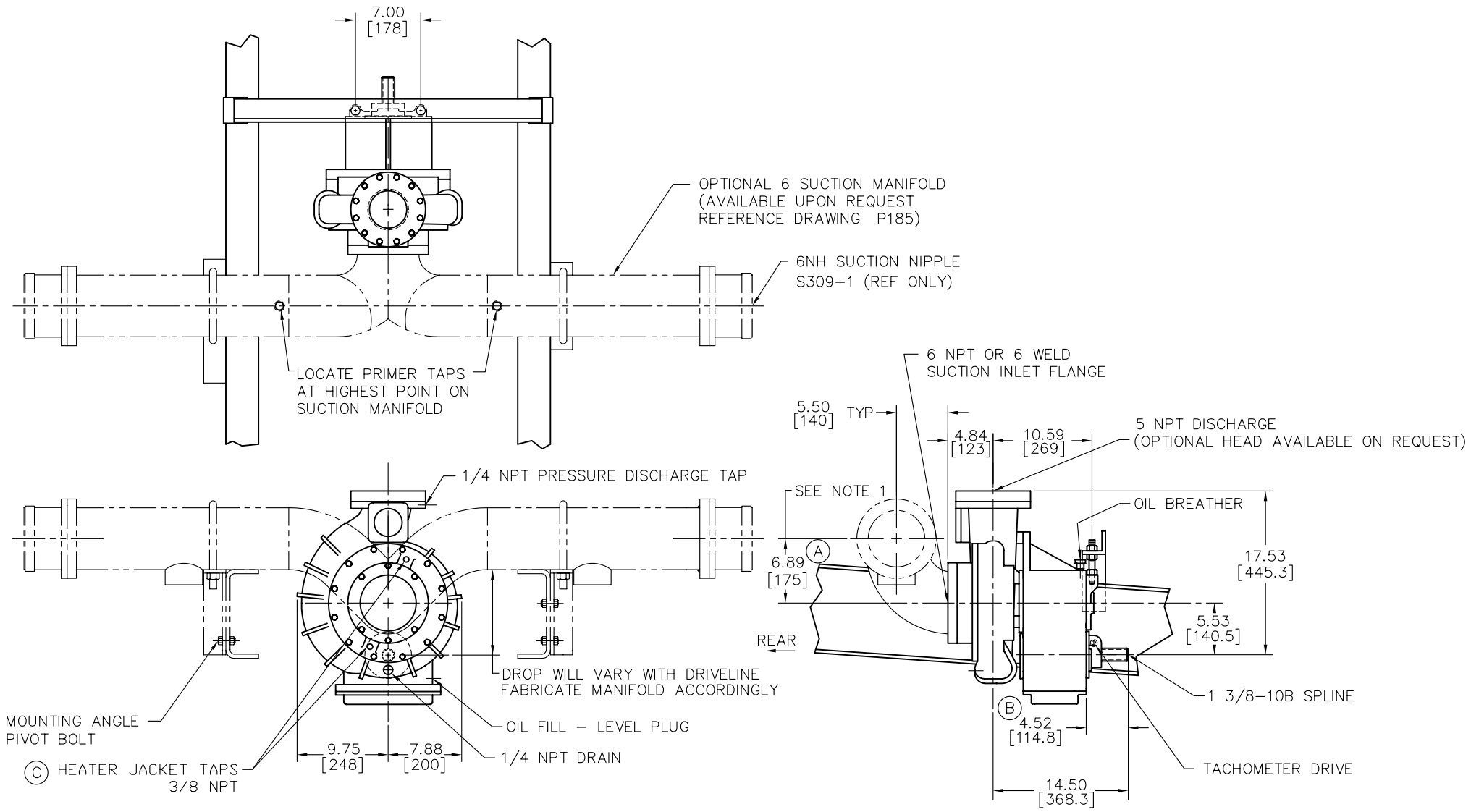
ALL DIMENSIONS IN
INCHES UNLESS NOTED

DO NOT SCALE PRINT

DATE OCT12,92
SCALE 1/8

DPD0400

REVISIONS				
LTR	DESCRIPTION	DATE	CHG NO.	APPR'D
B	ADDED DIMENSION OF SHAFT LENGTH	22JAN01	-	DMD
C	ADDED HEATER JACKET TAPS	22JAN01	-	DMD



NOTE:
 1) DIMENSION (A) IS REFERENCE TO A P185 MANIFOLD AND MAY VARY WITH DRIVELINE.

NET WEIGHT: 345 LBS [155 KG]

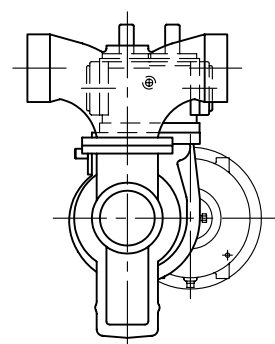
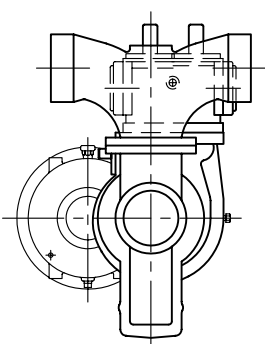
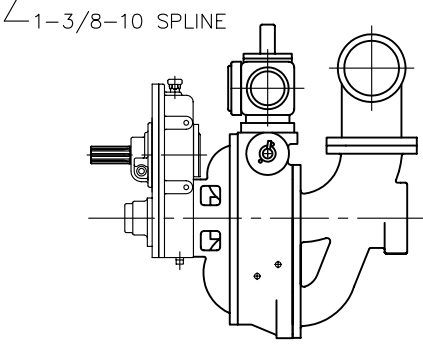
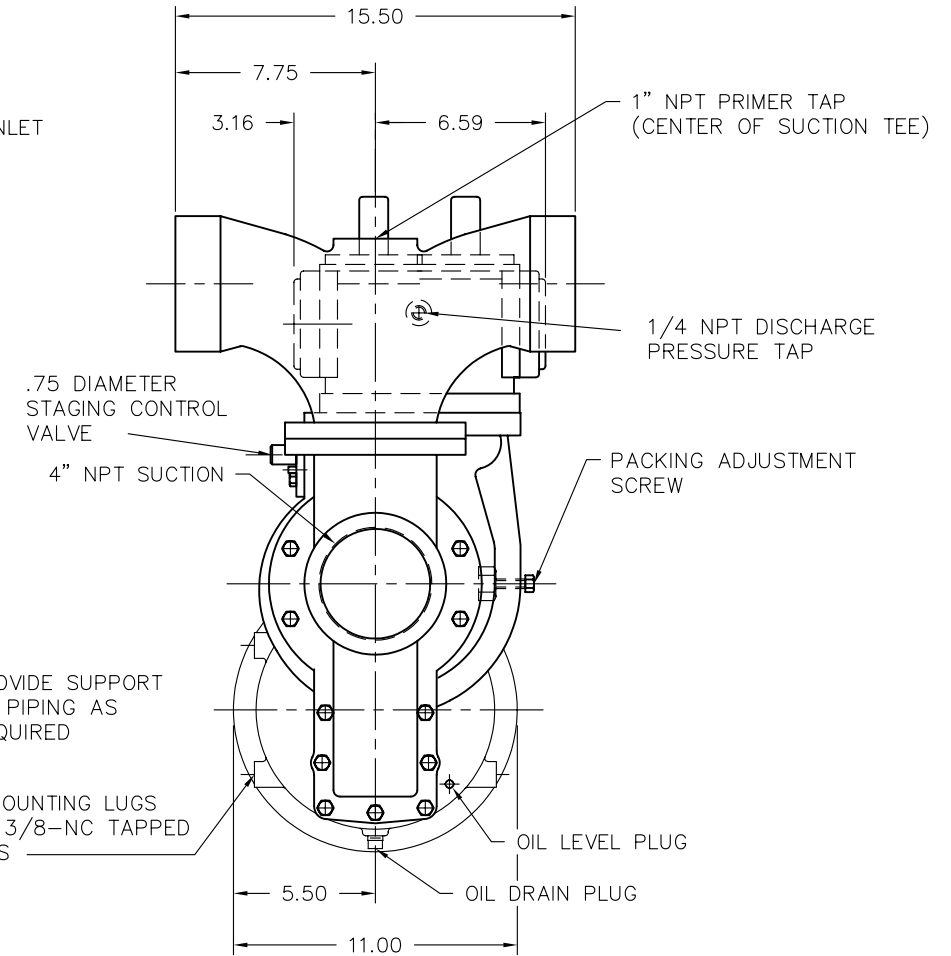
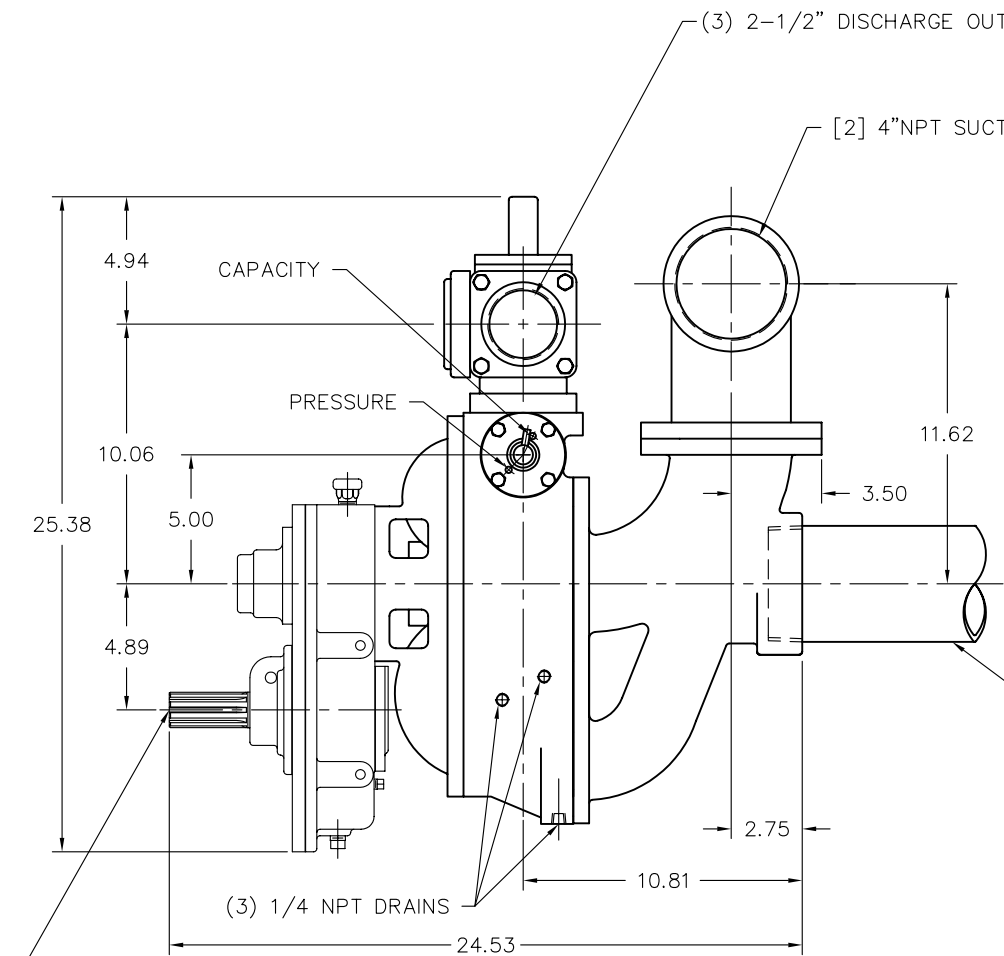
INCH [MILLIMETER]

TOLERANCE EXCEPT AS NOTED FRAC DIM ±.01 .00 ±.01 .000 ±.005 ANGLES ±1°	W.S. DARLEY & CO. MELROSE PARK, IL - CHIPPEWA FALLS, WI
	DWG - PSP, 2 GEAR DIMENSIONAL
DR'N TED	DATE MAR11,93
CHKD	SCALE 1/8
TRCD	DPD0500

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ALL DIMENSIONS IN INCHES UNLESS NOTED

DO NOT SCALE PRINT



INPUT SHAFT ABOVE

INPUT SHAFT LEFT

INPUT SHAFT RIGHT

OPTIONAL GEARCASE ROTATIONS

APPROXIMATE WEIGHT - 300 LBS
136 KG

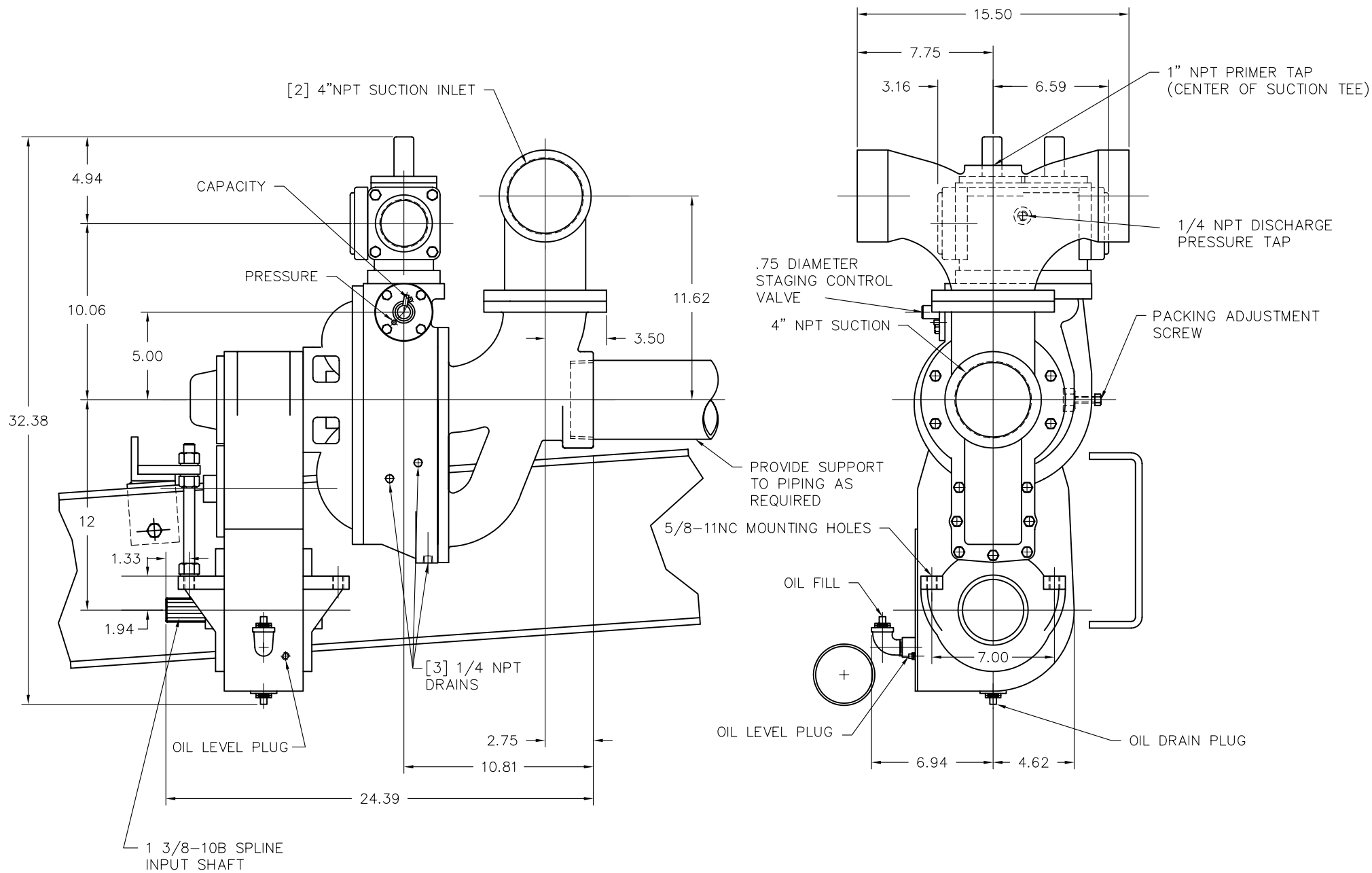


TOLERANCE EXCEPT AS NOTED		W.S. DARLEY & CO. MELROSE PARK, IL - CHIPPEWA FALLS, WI	
FRAC DIM ±.01		JMP500 OPPOSITE ROTATION ENGINE ROTATION /TACH. DRIVE	
.00 ±.01		DR'N S.LEE/TED	DATE AUG.9,94
.000 ±.005		CHKD	SCALE 1/4
ANGLES ±1°		TRCD	
OLD PART NO. J290		DJD0300	

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ALL DIMENSIONS IN INCHES UNLESS NOTED

DO NOT SCALE PRINT



APPROXIMATE WEIGHT - 415 LBS
188 KG



OLD PART NO.
J273

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

DR'N SEITZ
CHKD
TRCD

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

DWG - JMP, 3 GEAR, ENG ROT
DIMENSIONAL

DATE OCT05,88
SCALE 1/4

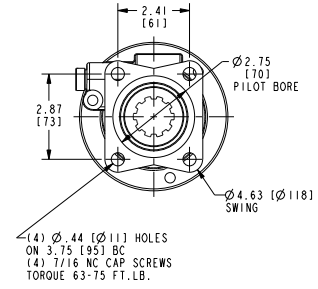
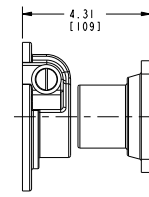
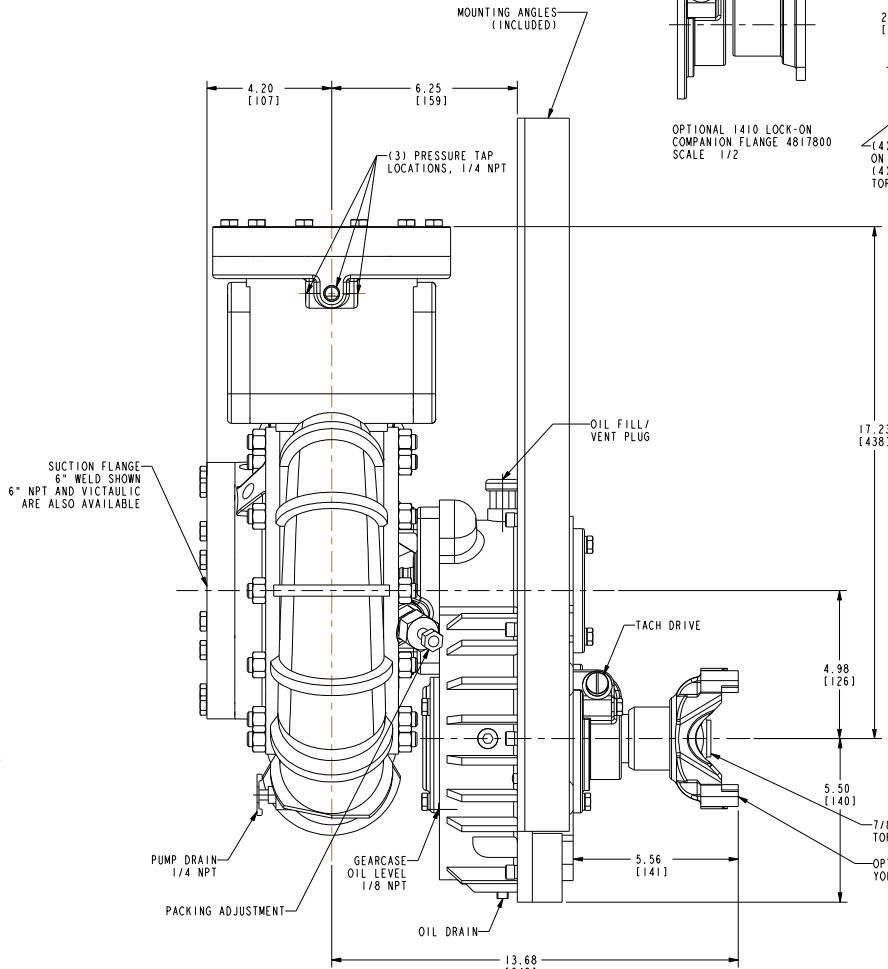
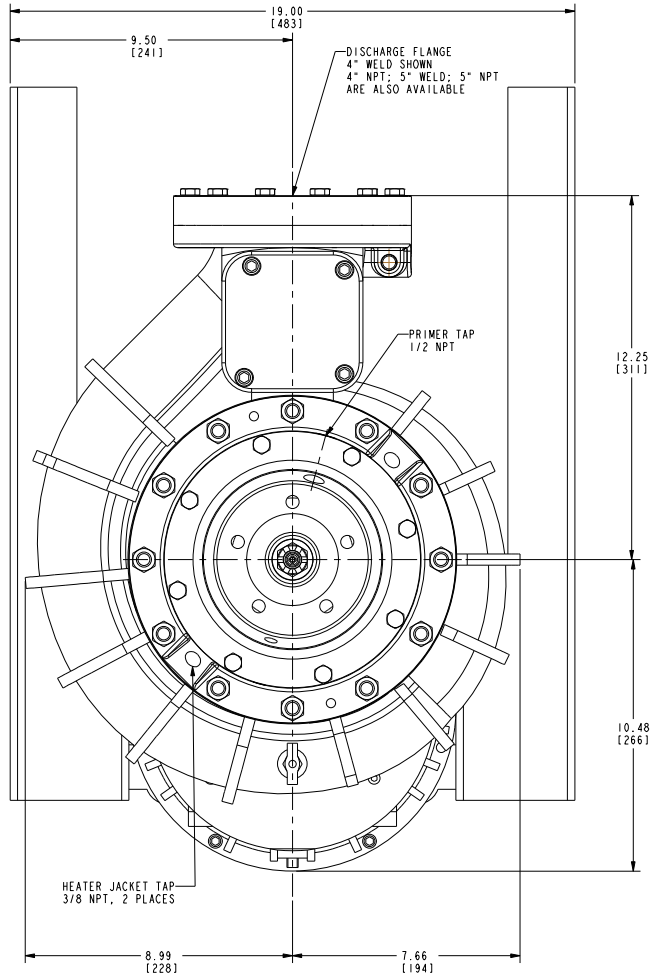
DJD0400

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ALL DIMENSIONS IN INCHES UNLESS NOTED

DO NOT SCALE PRINT

REVISIONS			
LTR	DESCRIPTION	DATE	CHG. NO. / APPR'D



OPTIONAL 1410 LOCK-ON
COMPANION FLANGE 4817800
SCALE 1/2

REMOVE SHARP EDGES	INCH (MILLIMETERS)	OLD PART NO.	TOLERANCE EXCEPT AS NOTED	DR. IN. JES DATE 14-May-03
MATERIAL DESCRIPTION:		MATERIAL NO.	PATTERN NO.	DR. IN. JES
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	SCALE 1/2	DLD0800

MODEL NAME	NO. CREATED	SHEET
DLD0800	5/14/03	1/1

W.S. Darley & Co.
SHEPHERD FALLS, WI - WISCONSIN, PAKE, WI

LSP 2 GEAR, LOCK-ON
DIMENSIONAL

**W.S. Darley & Co., 1051 Palmer Street, Chippewa Falls, WI 54729
1-800-634-7812 or (715) 726-2650 Fax: (715) 726-2656**

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

Rev. A
Date: 03/16/12
Rev. Date: 06/20/13
1201009.doc

Appendix to Installation

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

Rev. A
Date: 03/16/12
Rev. Date: 06/20/13
1201009.doc

SPICER[®]

DRIVETRAIN COMPONENTS



DRIVELINE INSTALLATION



**J3311-1-DSSP
AUGUST 2008**

**Supersedes
J3311-1-HVTSS, Dated
February 2005**



SPICER[®]

Drivetrain Products

General Safety Information

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

- Read carefully all owners 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.



WARNING: ROTATING DRIVESHAFTS

- 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 engine is running.
- Shut off engine before working on power take-off or driven equipment.
- Exposed rotating driveshafts must be guarded.



WARNING: GUARDING AUXILIARY DRIVESHAFTS

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 PTO installer to install a guard.



WARNING: USING SET SCREWS

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.



WARNING: THIS SYMBOL WARNS OF POSSIBLE PERSONAL INJURY.

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Introduction

This brochure is intended for:

- Installers who install Spicer driveshafts into an application where the transmission and axle are not in direct line with each other, causing the driveshaft universal joints to operate at an angle.
- Anyone experiencing vibration problems with their application or their vehicle that driveshaft assembly balancing will not correct.
- Truck Equipment Distributors who:
 - Re-work a chassis to change the wheel base.
 - Install a midship mounted power take-off or fire pump.
 - Mount any other PTO-driven device such as a blower, hydraulic pump, or hydraulic motor.

Universal joint failures, as a rule, are of a progressive nature, which, when they occur, generally accelerate rapidly resulting in a mass of melted trunnions and bearings.

Some recognizable signs of universal joint deterioration are:

1. Vibrations - Driver should report to maintenance.
2. Universal joint looseness - End play across bearings.
3. Universal joint discoloration due to excessive heat build-up.
4. Inability to purge all four trunnion seals when re-lubing universal joint.

Items 2) thru 4) should be checked at re-lube cycle and, if detected, reported to the maintenance supervisor for investigation.

Experience with universal joint failures has shown that a significant majority are related to lubricating film breakdown. This may be caused by a lack of lubricant, inadequate lube quality for the application, inadequate initial lubrication, or failure to lubricate properly and often enough.

Failures which are not the result of lubrication film breakdown are associated with the installation, angles and speeds, and manufacturing discrepancies.

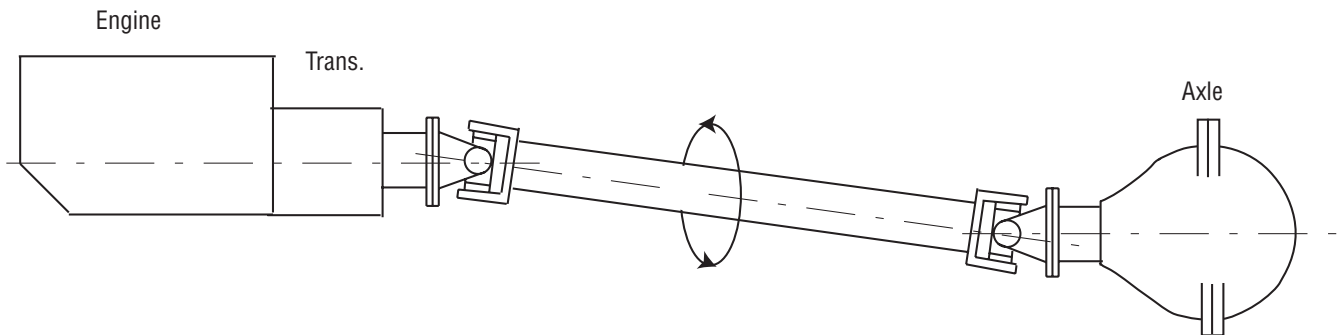
Driveshaft failures through torque, fatigue, and bending are associated with overload, excessively high universal joint angles, and drive shaft lengths excessive for operating speeds.

Driveshaft Torque

The following problems are usually a result of torque overloads:

- Twisted driveshaft tube
- Broken yoke shaft, slip yoke, tube yoke, flange yoke, end yoke
- Broken journal cross

How much torque can be generated in your application?



How to Calculate Torque:

$$LGT = T \times TLGR \times TE \times SR \times TCR \times C$$

LGT = Maximum Driveshaft Low Gear Torque

T = Net Engine Torque or 95% of the Gross Engine Torque

TLGR = Transmission Low Gear Ratio (forward)*

TE = Transmission Efficiency (automatic = 0.8; manual = 0.85)

SR = Torque Converter Stall Ratio (if applicable)

TCR = Transfer Case Ratio (if applicable)

C = Transfer Case Efficiency (if applicable, 0.95)

How to Calculate Wheel Slip:

$$WST = (.71 \times W \times RR) / (11.4 \times AR)$$

WST = Wheel Slip Torque Applied to the Driveshaft

W = Axle Capacity (lbs)

RR = Tire Rolling Radius (in)

AR = Axle Ratio

For On Road Applications

Relate the lesser of above to Spicer universal joint ratings. If your torque exceeds the Spicer rating for the universal joint used in your application, switch to a size with a rating compatible to your calculation. However, the series selected cannot be more than one series below the series called for by the LGT calculation.

For Off Road or On-Off Road Applications

Use Low Gear Torque value only to verify or switch to a size with a rating compatible to your calculation.

Common Causes of Vibrations

The three most common causes of driveshaft vibration are: Driveshaft Imbalance, Critical Speed, and Universal Joint Operating Angles.

Driveshaft Imbalance

Eliminate the potential for balance problems before you undertake any other measures.

A driveshaft on a vehicle usually rotates at a higher rate of speed than the tire. For that reason, like tires, driveshafts should be balanced.

Any time you build or rework a driveshaft, make sure it is dynamically balanced at, 3000 RPM for Light Duty or 2500 RPM for Heavy Duty, to the following specifications:

Series	Specification
1310, 1330	.375 oz-in total at each end of shaft *
1350, 1410	.500 oz-in total at each end of shaft *
1480 - 1880	1.00 oz-in for each ten pounds of driveshaft weight divided proportionally at each end of shaft
* Passenger Car, Light Truck, Van, and SUV only. Industrial, Mobile Off-Highway, PTO, etc. same as 1480 - 1880.	

Critical Speed

Every driveshaft has a critical speed. Critical speed is the point at which a rotating driveshaft begins to bow off its normal rotating centerline.

Driveshafts begin to vibrate as they approach critical speed. If they are operated at near critical speed for an extended period, they often fail. This can damage the vehicle and possibly injure persons nearby.

As a driveshaft fabricator or installer, you are responsible for checking the safe operating speed of any driveshaft you fabricate or specify into an application. Make sure it will not operate at a speed higher than Spicer's recommended safe operating speed. Use Spicer Calculator (P/N J 3253) to determine safe operating speed.

Checking for a Possible Critical Speed Problem

Here is what you must do to make sure you won't have a critical speed problem:

- Determine the safe operating speed of the driveshaft you want to use in your application. Insert the tube diameter and center-to-center installed length of the shaft you want to use into a Spicer Safe Operating Speed Calculator (P/N. J3253). The calculator will tell you the safe operating speed of the shaft you have chosen.
- Determine the NORMAL and MAXIMUM POSSIBLE operating speed of the driveshaft.
REMEMBER:
 - On vehicles with a standard transmission that have a 1:1 direct drive high gear and no overdrive, MAXIMUM POSSIBLE driveshaft RPM is the same as the maximum possible ENGINE RPM.
 - On vehicles that have an overdrive transmission, MAXIMUM POSSIBLE driveshaft RPM is higher than maximum possible ENGINE RPM.

Maximum Possible Driveshaft RPM

To calculate the maximum possible driveshaft RPM in vehicles having an overdrive transmission, divide the maximum possible engine RPM by the overdrive ratio. (See examples below.)

Example 1:
Max. engine RPM: 2100
Overdrive ratio: .79
$2100 / .79 = 2658$ maximum possible driveshaft RPM

Example 2:
Max. engine RPM 6000
Overdrive ratio: .66
$6000 / .66 = 9091$ maximum possible driveshaft RPM

Compare the maximum possible driveshaft RPM with the safe operating speed determined from the Safe Operating Speed Calculator. If the maximum possible driveshaft RPM meets or exceeds the safe operating speed determined from the calculator, you must do whatever is required to raise the critical speed of the driveshaft you have chosen for the application.

Sample Specification:

To specify a driveshaft for the application described in Example 1 above, compare the safe operating speed for the driveshaft selected with the maximum possible driveshaft RPM calculated (2658 RPM). Make sure the safe operating speed of the driveshaft is greater than 2658 RPM.

Changing the Safe Operating Speed of a Driveshaft

A driveshaft's safe operating speed can be raised by increasing its tube diameter or by shortening the installed center-to-center length of the driveshaft. Changing the installed length of a driveshaft will require the use of multiple driveshafts with center bearings.

Important: The critical speed of an assembly can be affected by driveshaft imbalance, improper universal joint operating angles, or improperly phased driveshafts. (A properly phased driveshaft has the in-board yokes of the shaft in line with each other.) Each of the above items will tend to lower the true critical speed from the values shown on the calculator.

Since critical speed can ultimately cause driveshaft failure, it is extremely important to be very precise in all applications.

Universal Joint Operating Angles

Every Universal Joint that Operates at an Angle Creates a Vibration

Universal joint operating angles are probably the most common causes of driveline vibration in vehicles that have been reworked, or in vehicles that have had auxiliary equipment installed.

Universal joint operating angles are a primary source of problems contributing to:

- Vibrations
- Reduced universal joint life
- Problems with other drivetrain components that may include:
 - Transmission gear failures
 - Synchronizer failures
 - Differential problems
 - Premature seal failures in axles, transmissions, pumps, or blowers
 - Premature failure of gears, seals, and shafts in Power Take-Offs

When you rework a chassis or install a new driveshaft in a vehicle, make sure that you follow the basic rules that apply to universal joint operating angles:

RULE 1: UNIVERSAL JOINT OPERATING ANGLES AT EACH END OF A DRIVESHAFT SHOULD ALWAYS BE AT LEAST 1 DEGREE.

RULE 2: UNIVERSAL JOINT OPERATING ANGLES ON EACH END OF A DRIVESHAFT SHOULD ALWAYS BE EQUAL WITHIN 1 DEGREE OF EACH OTHER (ONE HALF DEGREE FOR MOTOR HOMES AND SHAFTS IN FRONT OF TRANSFER CASE OR AUXILIARY DEVICE).

RULE 3: FOR VIRTUAL VIBRATION FREE PERFORMANCE, UNIVERSAL JOINT OPERATING ANGLES SHOULD NOT BE LARGER THAN 3 DEGREES. IF THEY ARE, MAKE SURE THEY DO NOT EXCEED THE MAXIMUM RECOMMENDED ANGLES.

A universal joint operating angle is the angle that occurs at each end of a driveshaft when the output shaft of the transmission and driveshaft and the input shaft of the axle and driveshaft are not in line. (See Fig 1)

The connecting driveshaft operates with an angle at each universal joint. It is that angle that creates a vibration.

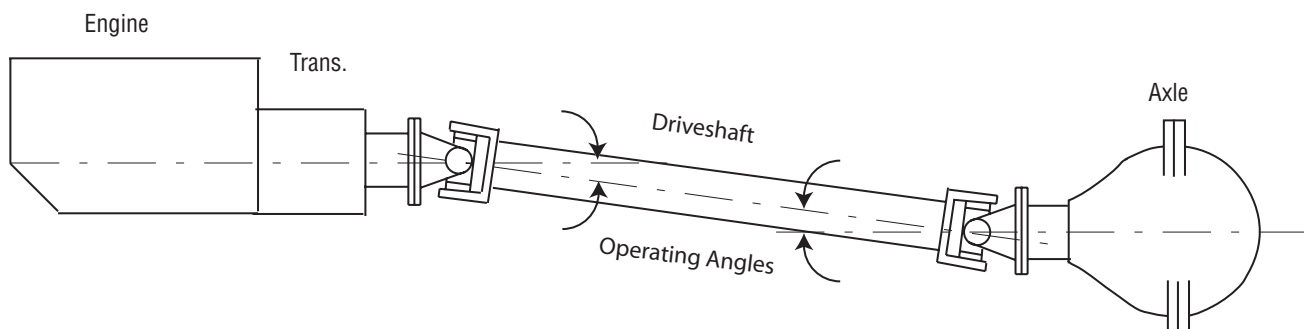


Figure 1

Reducing and Canceling Vibration

A key point to remember about universal joint operating angles: To reduce the amount of vibration, the angles on each end of a driveshaft should always be **SMALL**.

To cancel an angle vibration, the universal joint operating angles need to be **EQUAL** within 1 degree at each end of a driveshaft. On motor home applications and auxiliary transmission installations, the tolerance is 1/2 degree. (See Fig 2)

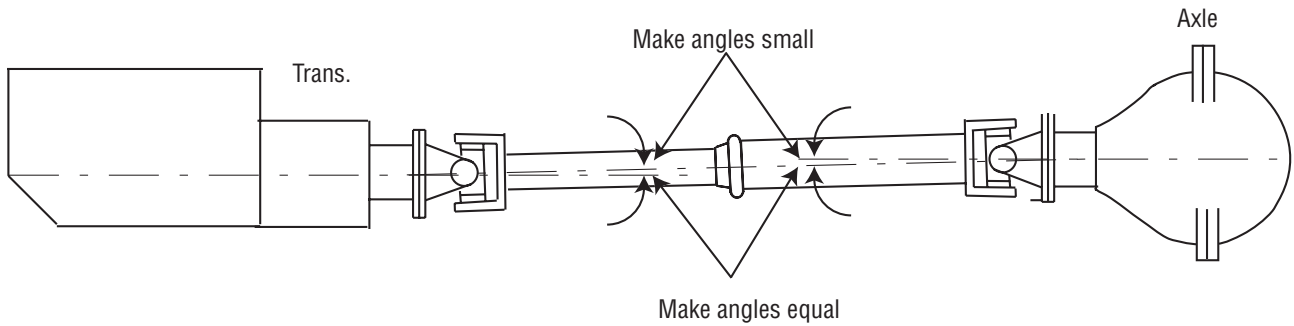


Figure 2

Single Plane and Compound Universal Joint Operating Angles

There are two types of universal joint operating angles: Single Plane and Compound.

Single Plane

Single Plane angles occur when the transmission and axle components are in line when viewed from either the top or side, but not both.

Determining the universal joint operating angle in an application where the components are in line when viewed from the top, but not in line when viewed from the side, is as simple as measuring the slope of the components in the side view, and adding or subtracting those slopes to determine the angle. (See Fig. 3)

These angles should be **small** and **equal** within 1 degree.

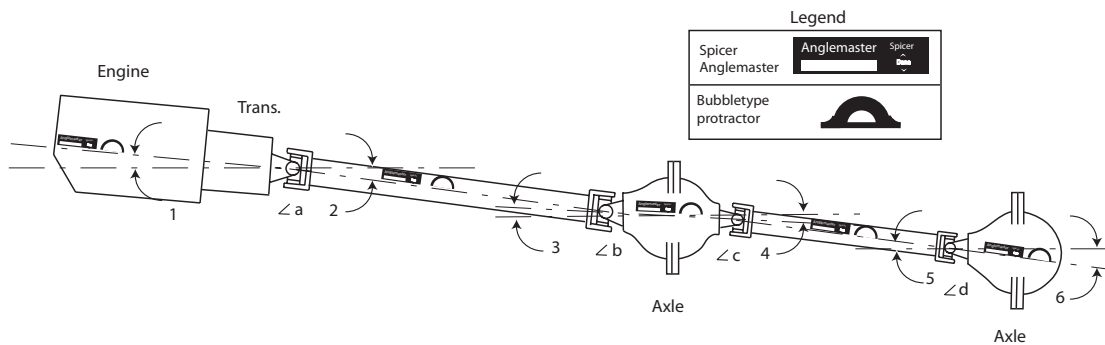


Figure 3

The most convenient way to determine universal joint angles in the side view is through the use of a Spicer Anglemaster™ or a bubble type protractor.

Using an Anglemaster or a bubble protractor, record inclination angles of drivetrain components. Set Anglemaster or protractor on machined surfaces of engine, transmission, axle, or on machined lugs of transmission and axle yoke(s).

Note: Universal joint angles can change significantly in a loaded situation. Therefore, check vehicle loaded and unloaded to achieve the accepted angle cancellation.

Example:

Engine-Transmission Output	4°30' Down (1)
Main Driveshaft	7°00' Down (2)
Input 1st Rear Axle	4°00' Up (Input Shaft Nose Up) (3)
Output 1st Rear Axle	4°00' Down (4)
Inter-axle Shaft	7°00' Down (5)
Input 2nd Rear Axle	4°15' Up (Pinion Shaft Nose Up) (6)
Note: If inclination of driveshaft is opposite connecting component, add angles to obtain the universal joint operating angle.	
Angle a = (2) - (1) = 7°00' - 4°30' = 2°30' (2.50°)	
Angle b = (2) - (3) = 7°00' - 4°00' = 3°00' (3.00°)	
Angle c = (5) - (4) = 7°00' - 4°00' = 3°00' (3.00°)	
Angle d = (5) - (6) = 7°00' - 4°15' = 2°45' (2.75°)	

Determining the universal joint operating angles on a driveshaft that is straight when viewed from the side and offset when viewed from the top requires the use of a special chart (See Angle Chart). In this type of application, the centerlines of the connected components **must be parallel** when viewed from the top as shown. These angles also should be **small** and **equal** within 1 degree. (See Fig. 4)

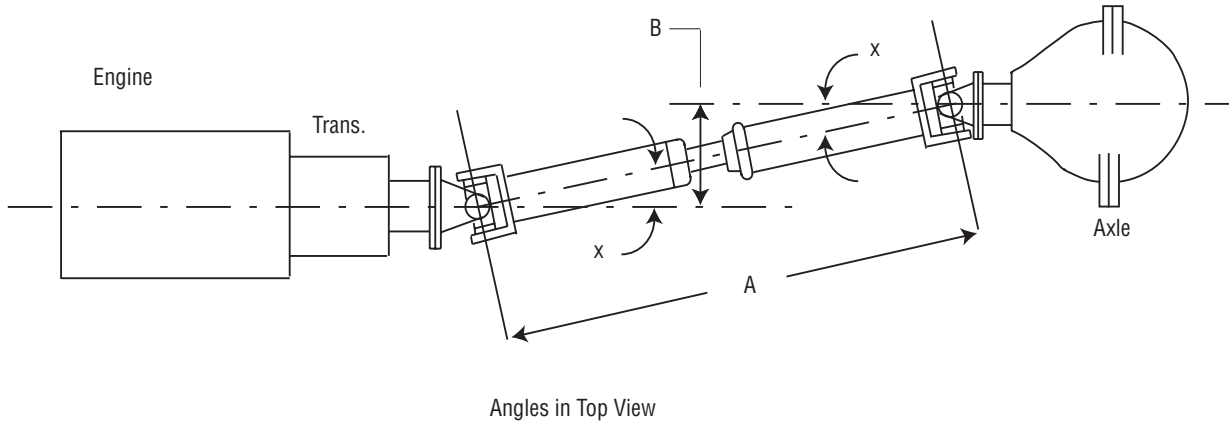


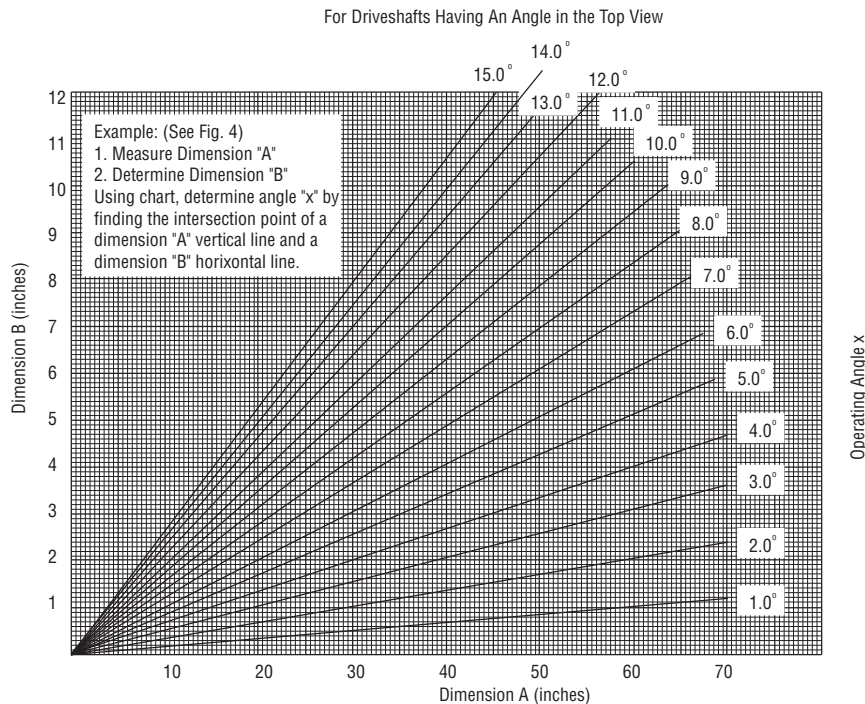
Figure 4

Measure dimensions "A" and "B" shown in figure 4. Use the instructions in the angle chart below to determine the size of the angle. Look at the Angle Chart and note that the smaller the offset, the smaller the resultant angle.

To reduce the possibility of vibration, keep any offset between connected points to a minimum.

There are two things you can do to always make sure Single Plane angles are SMALL and EQUAL: Make sure the transmission and axle are mounted so their centerlines are parallel when viewed from both the side and the top. Make sure the offset between them is small in both views.

ANGLE CHART



Compound Angles

Compound universal joint operating angles occur when the transmission and axle are not in line when viewed from BOTH the top and side. Their centerlines, however, are parallel in both views. (See Fig. 5)

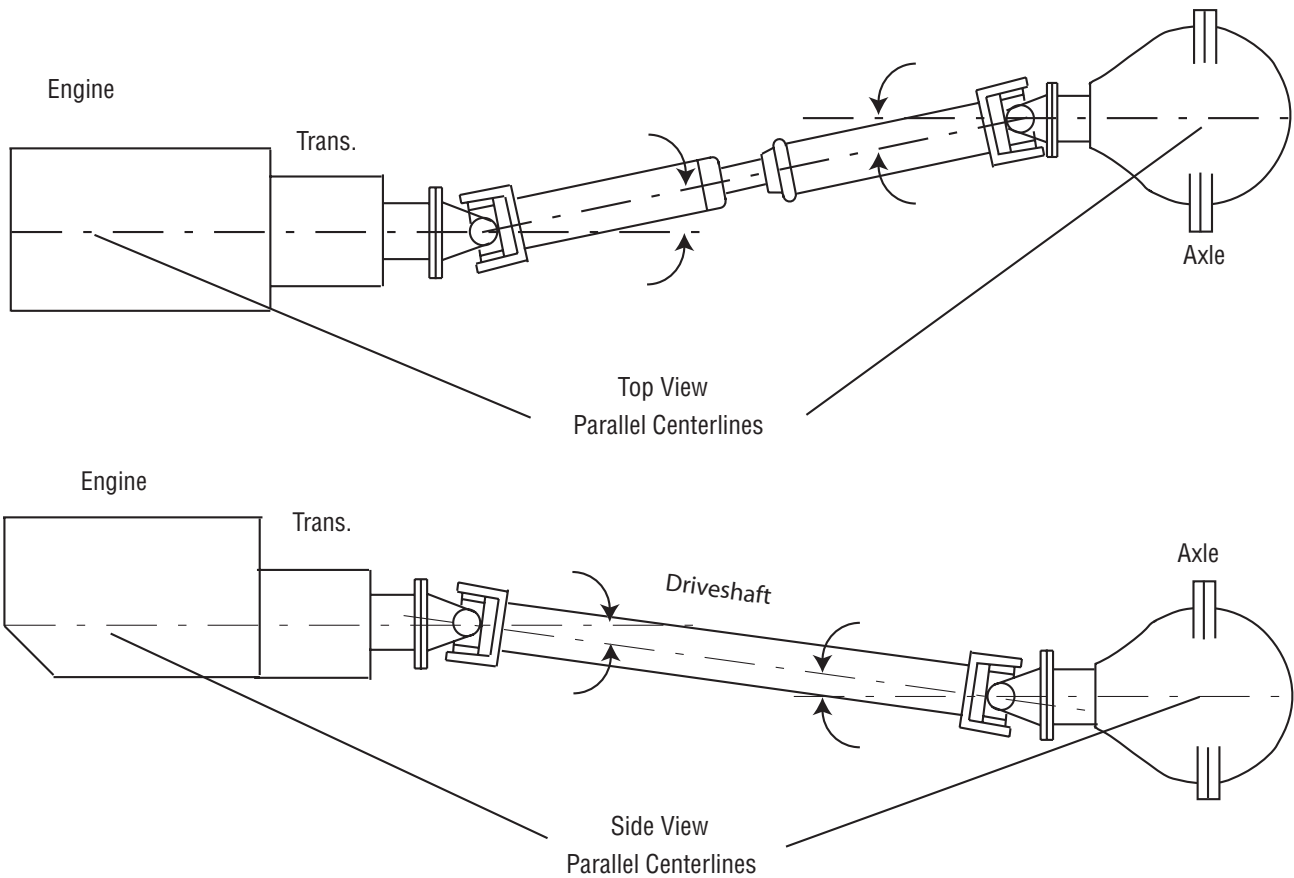


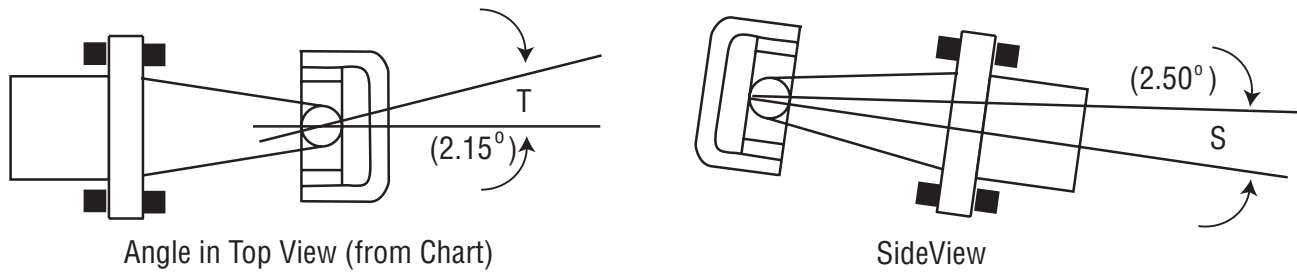
Figure 5

When you have a compound angle, you have to calculate the "True Universal Joint Operating Angle" of each universal joint. It is the True Universal Joint Operating Angle that must meet the three rules shown on page 5.

True Universal Joint Operating Angle

The True Universal Joint Operating Angle, which must be calculated for each end of the shaft with compound angles, is a combination of the universal joint operating angle in the top view, as determined from the chart, and the measured universal joint operating angle in the side view.

To determine the true universal joint operating angle for one end of a shaft, (compound angle C° in the formula shown in Fig. 6) insert the universal joint operating angle measurement obtained in the side view and the universal joint operating angle obtained from the chart into the formula.



$$\text{Compound Angle } (C^\circ) = \sqrt{T^2 + S^2}$$

$$T = 2.15^\circ \text{ (A calculated angle)}$$

$$S = 2.5^\circ \text{ (The measured angle)}$$

$$C = \sqrt{2.15^2 + 2.5^2}$$

$$C = \sqrt{10.873}$$

$$C = 3.3^\circ \text{ (True operating angle)}$$

Figure 6

Do the same for the other end of the shaft. Compare the resultant calculated universal joint operating angle for each end. They should be EQUAL within 1 degree. If they're not, the driveshaft will vibrate.

Eliminating Compound Angle Induced Vibrations

Compound universal joint operating angles are one of the most common causes of driveline vibration. To avoid these problems, remember these important points:

- When setting up an application that requires compound universal joint operating angles, always keep the centerlines of the transmission and axle parallel in both views.
- Always keep the offset between their horizontal and vertical centerlines small.

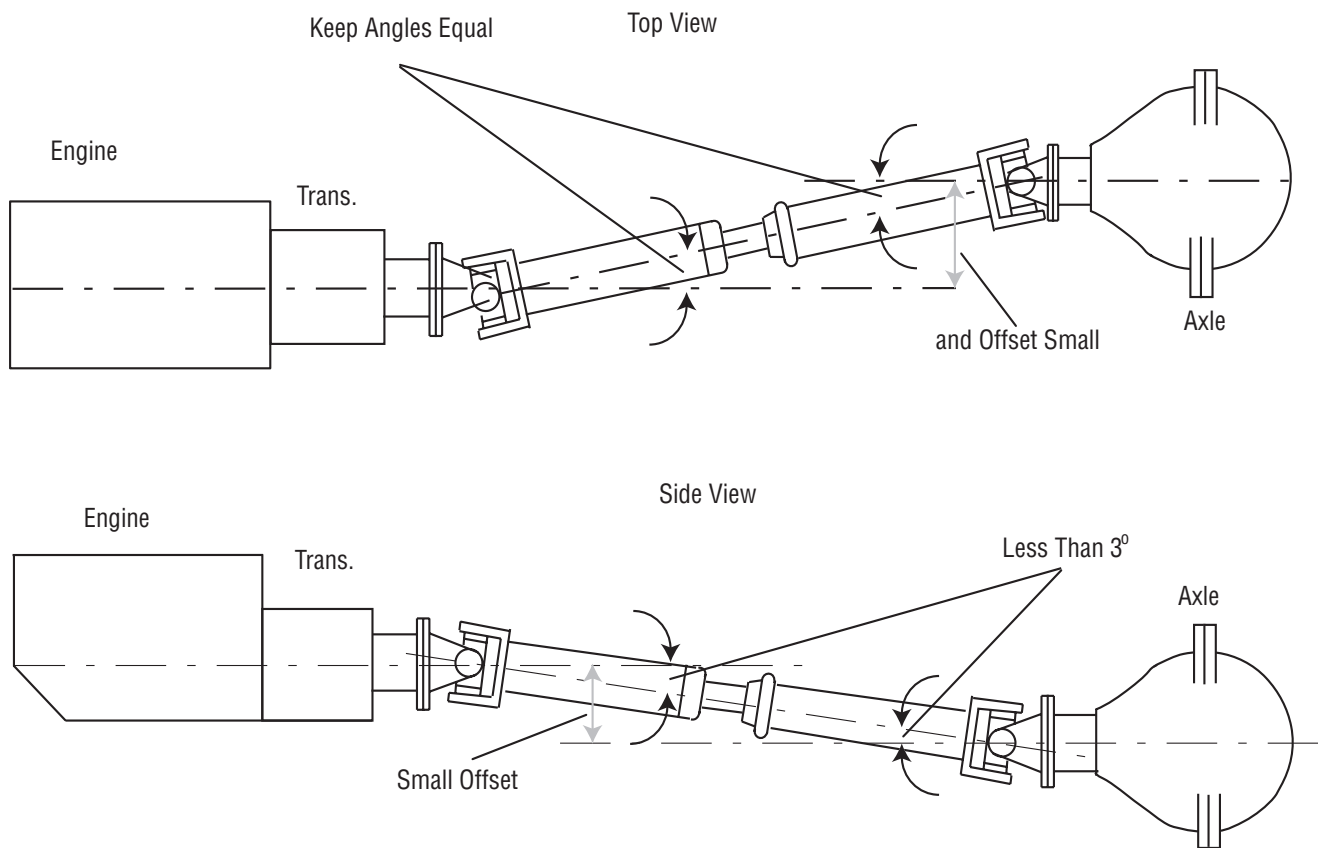


Figure 7

Note: Centerlines of transmission and axle must be parallel in both top and side views to use this method of determining true universal joint operating angle. Please contact Spicer Driveshaft Engineering if you have an application where the components cannot be installed with their centerlines parallel.

If adjustments must be made to the system:

- Install shims between the axle housing and springs to rotate the axle input yoke to change operating angles.
- Change operating angle on torque arm type suspensions by lengthening or shortening torque arms.
- Raise, lower, or shift side-to-side a pump, blower, or other piece of auxiliary equipment to change operating angles.

Note: It is important to remember to keep the centerlines of two components that are connected by a driveshaft parallel in both the top and side views, so the operating angles will ALWAYS be equal.

Angle Size

The magnitude of a vibration created by a universal joint operating angle is proportional to the size of the universal joint operating angle. Spicer Engineers recommend true universal joint operating angles of 3 degrees or less.

Obtain the true universal joint operating angle, as explained above, and if it is greater than 3 degrees, compare it to this chart.

Driveshaft RPM	Maximum Operating Angle	Interaxle	
		Parallel	Intersecting
5000	3.2°	-	-
4500	3.7°	-	-
4000	4.2°	3.8°	3.8°
3500	5.0°	4.4°	4.4°
3000	5.8°	5.1°	4.8°
2500	7.0°	6.0°	4.8°
2000	8.7°	6.0°	4.8°
1500	11.5°	6.0°	4.8°

The angles shown on this chart are the maximum universal joint operating angles recommended by Spicer Engineers and are directly related to the speed of the driveshaft. Any universal joint operating angle greater than 3 degrees will lower universal joint life and may cause a vibration. Remember to check maximum safe driveshaft RPM by using the Spicer Safe Operating Speed Calculator.

Multiple Shaft Installations

Multiple Shaft Set Up Recommendations

In general, multiple shaft installations follow the same guidelines, except there are different recommendations for setting up the driveline:

- For a 2-shaft application, set up the first coupling shaft (sometimes called a jackshaft) so that the universal joint operating angle that occurs at the transmission end is 1 to 1-1/2 degrees. (See Fig. 8)

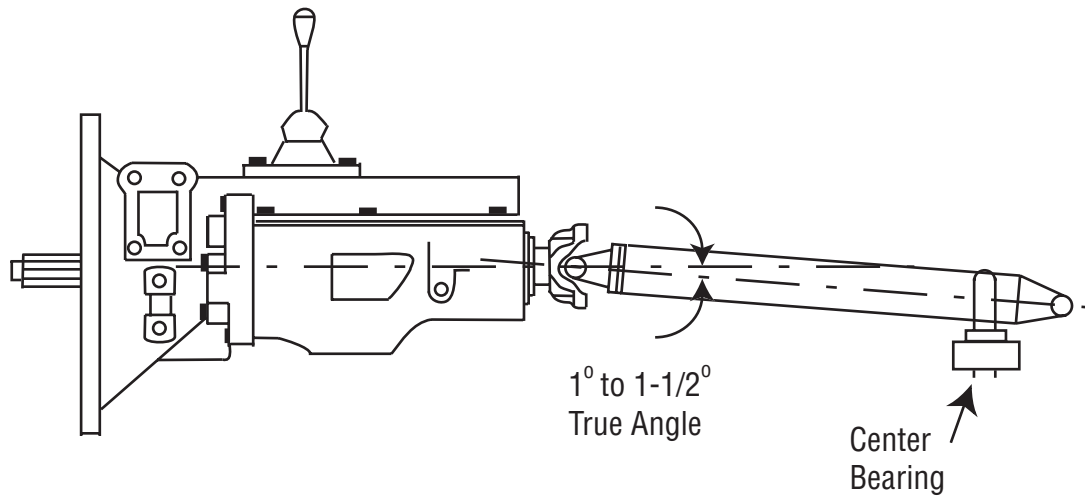


Figure 8

- Try to avoid building a compound universal joint operating angle into the first coupling shaft by installing it in line with the transmission.
- If it ends up being compound, make sure the true universal joint operating angle, determined by using the information mentioned earlier, is 1 to 1-1/2 degrees.

Install or tilt the axle so it is mounted on the same angle as the first coupling shaft (the centerlines of the axle and the first coupling shaft will be parallel).

Note: BY FOLLOWING THIS PROCEDURE, THE UNIVERSAL JOINT OPERATING ANGLE AT EACH END OF THE LAST SHAFT WILL AUTOMATICALLY BE EQUAL. (See Fig. 9)

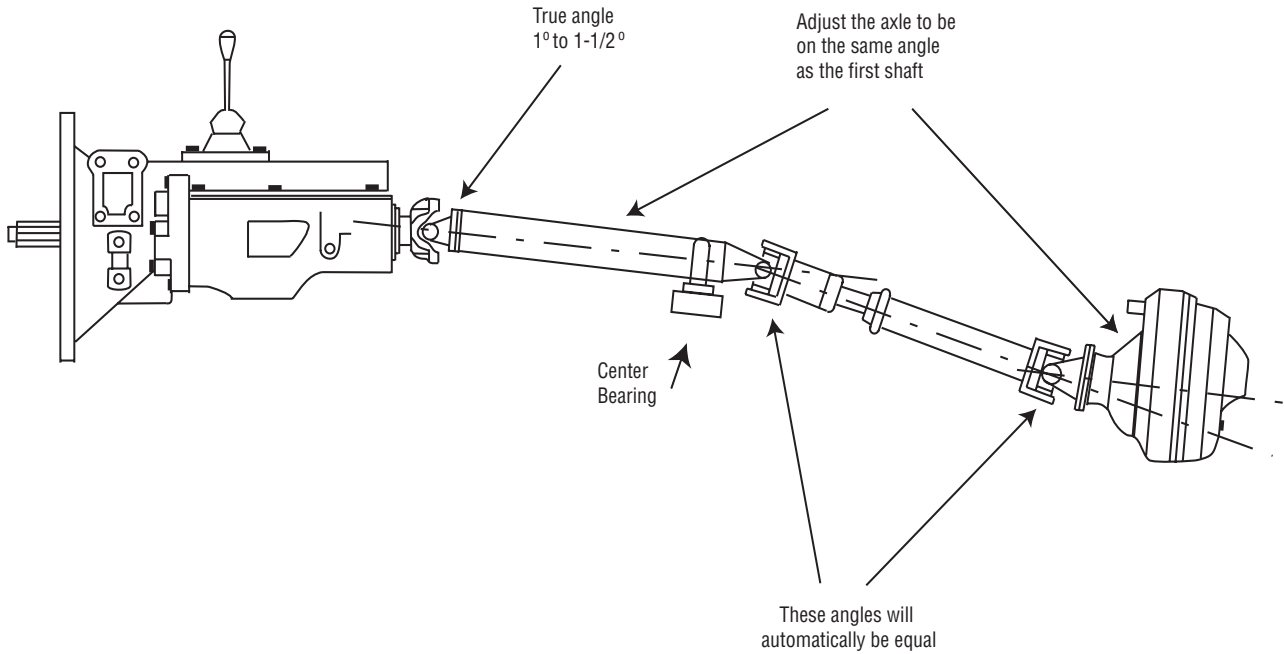


Figure 9

If there is an offset in the installation of the axle, make sure it does not create too large of a compound universal joint operating angle. Whenever possible, mount the axle directly in line with the first coupling shaft (when viewed from the top).

Check the actual universal joint operating angle at the rear of the first coupling shaft. If it is less than 1° and the transmission universal joint operating angle is greater than 1.5°, rotate the end yoke at the center bearing position so that the ears of the yoke are 90° to the ears of the tube yoke on the transmission end of the coupling shaft. (See Fig. 10) As an alternative, rotate the slip yoke on the driveshaft 90° if the slip spline has 16 teeth.

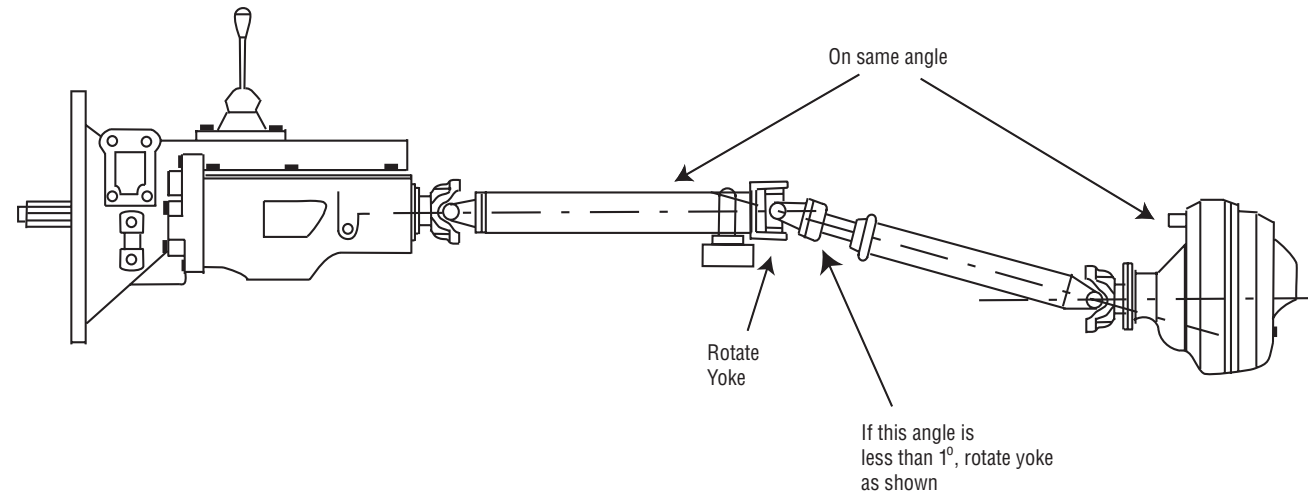


Figure 10

On applications having more than two shafts, mount the first coupling shaft as outlined in the preceding example, and each additional coupling shaft at a 1 to 1-1/2 degree universal joint operating angle to the previous coupling shaft.

Install or tilt the axle to the same angle as the last fixed coupling shaft so the centerline of the axle and the last fixed coupling shaft are parallel.

Note: THIS ASSURES THE UNIVERSAL JOINT OPEARTING ANGLE AT EACH END OF THE LAST SHAFT WILL AUTOMATICALLY BE EQUAL (See Fig. 11).

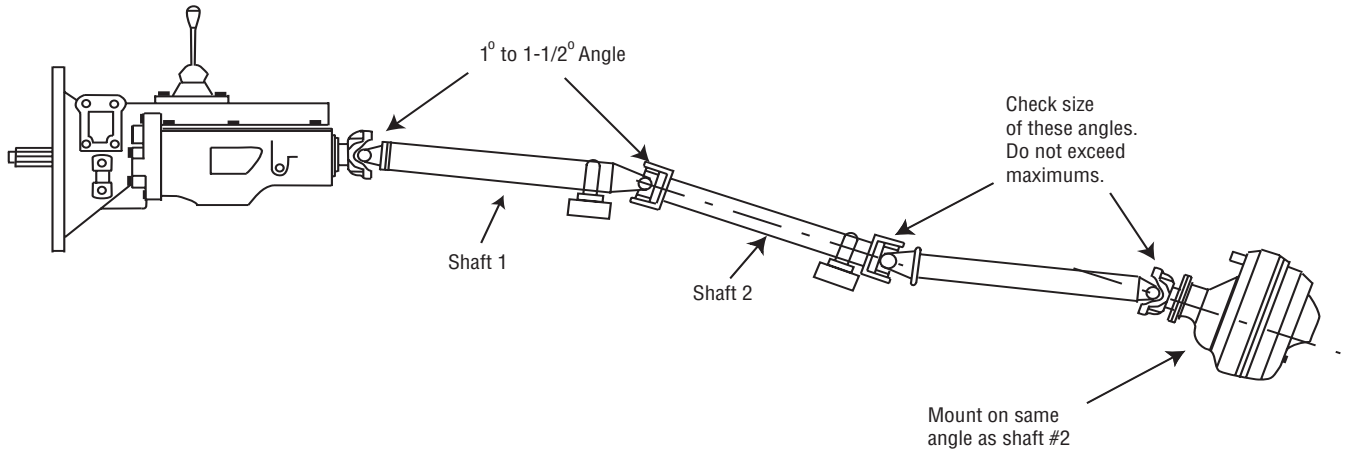


Figure 11

Mounting a Midship-Mounted PTO, Pump, or Auxiliary Transmission

When installing a midship-mounted PTO, auxiliary transmission, or midship-mounted pump into the main driveline of a vehicle, install it at the same angle as the transmission. Keep the offset to a minimum to reduce universal joint operating angles.

Note: Do not make the universal joint operating angle less than 1/2 degree.

Before bolting the device in place, check the universal joint operating angles that occur at each end of the driveshaft. They must be 1 to 1-1/2 degrees and they must be equal to within 1/2 degree for this type of application.

If the device ends up being installed in direct line with the transmission, with little or no universal joint operating angle on the joints, raise or lower it so there is enough offset to create the required 1 to 1-1/2 degree universal joint operating angle on each end of the driveshaft. (See Fig. 12)

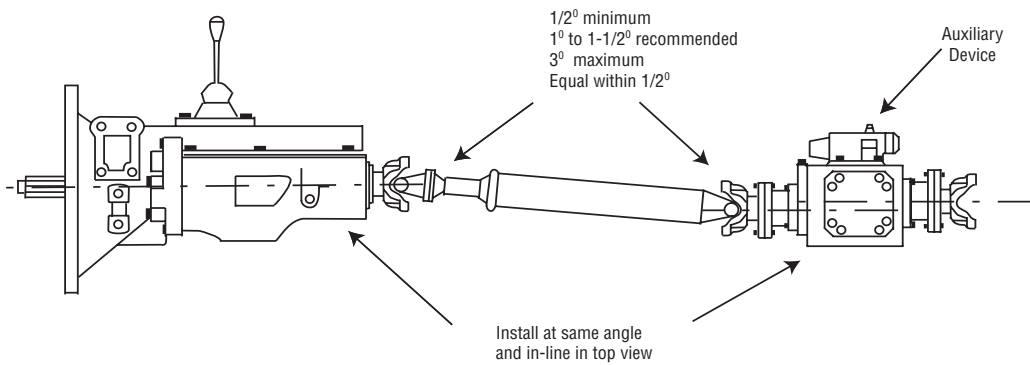


Figure 12

If there is only one driveshaft between the device and the rear axle, rotate the rear axle (using shims in the appropriate place) so it is the same angle as the device. This makes the universal joint operating angle at each end of the driveshaft equal (See Fig. 13). Check the size of the universal joint operating angles to determine if they meet recommendations.

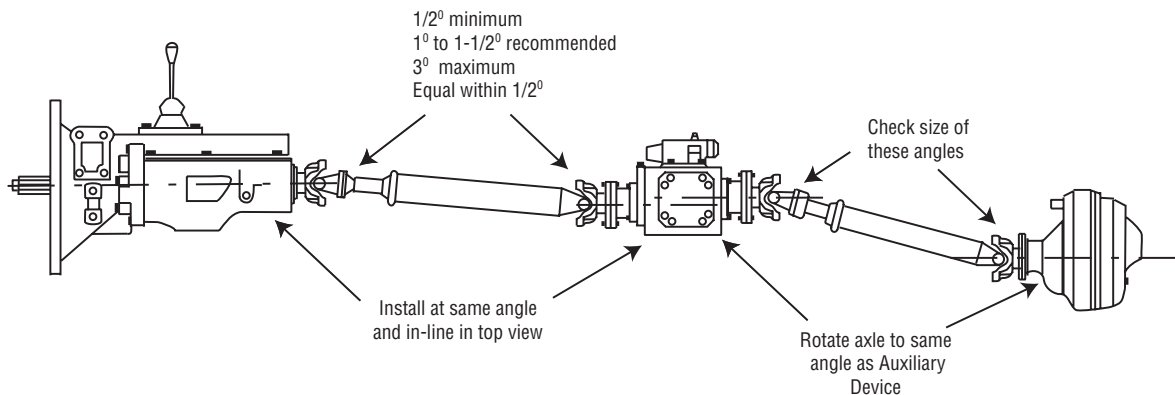


Figure 13

If there is more than one driveshaft between the device and the rear axle, install the driveshaft as outlined earlier with a 1 to 1-1/2 degree universal joint operating angle on the input end of each shaft. Then rotate the axle so it is on the same angle as the last fixed shaft. The universal joint operating angle on each end of the last shaft will automatically be equal. (See Fig. 14)

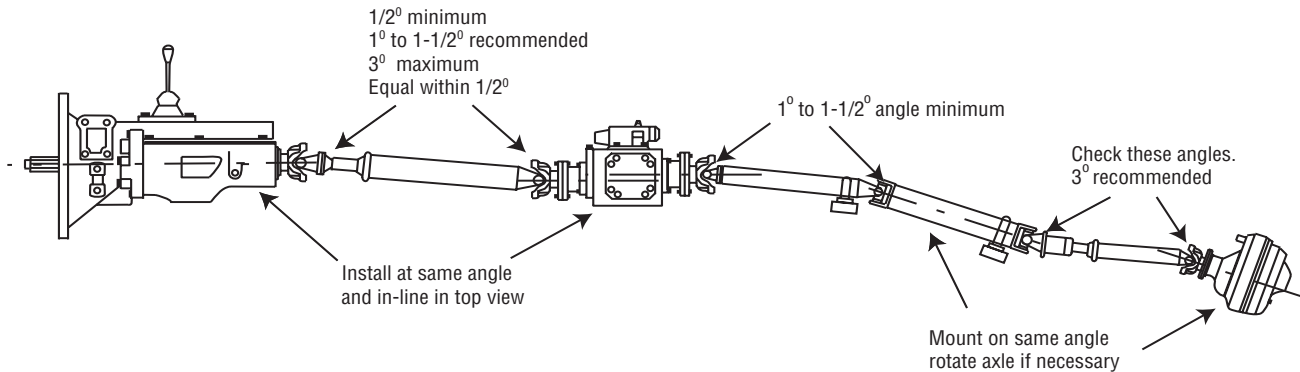


Figure 14

Mounting a Remote-Driven Pump, Blower, or Similar Device

Remote mounted-pumps, blowers, or similar devices are usually driven by a side, top, or bottom-mounted PTO and use an auxiliary driveshaft.

Many times these devices are mounted to the vehicle frame or cross member. The usual method of mounting, where the driven device is mounted parallel with the ground without regard to the mounted angle of the PTO, will produce a vibration that may cause failure of the PTO, pump, blower, or other driven device.

Any remote driven device must be mounted parallel and in line, if possible, with the PTO.

To select the appropriate auxiliary driveshaft for these types of applications, you should consider proper torque, safe operating speed (which is different than the critical speed for tubular driveshafts), and angularity. (See Maximum Safe Operating Speed Chart on page 18).

An auxiliary driveshaft must be capable of transmitting the maximum torque and RPM required by the driven equipment. For most low-torque applications operating at less than 1200 RPM, solid bar-stock constructed driveshafts are adequate. For applications requiring additional torque or RPMs, tubular shafts should be fabricated.

Maximum Safe Operating Speed

MAXIMUM OPERATING SPEED* BY TUBE SIZE, SOLID SHAFT SIZE, AND LENGTH											
*(For speeds over 6000 RPM, contact Spicer Universal Joint Division Engineering)											
TUBING	MAXIMUM INSTALLED LENGTH (IN INCHES) FOR GIVEN RPM										
Diameter & Wall Thickness W - Welded S - Seamless	Centerline to Centerline of Joints for a Two Joint Assembly or Centerline of Joint to Centerline of Center Bearing for a Joint and Shaft										
	RPM - Revolutions Per Minute										
	1000	1500	2000	2500	3000	3500	4000	4500	5000	5500	6000
1.750" x .065" W	82"	67"	58"	52"	-	-	-	-	-	-	-
1.250" x .095" S	64"	52"	45"	40"	37"	34"	32"	-	-	-	-
2.500" x .083" W	87"	70"	62"	55"	50"	45"	43"	41"	39"	37"	35"
3.000" x .083" W	-	-	85"	76"	70"	64"	60"	57"	54"	51"	49"
SOLID SHAFT DIAMETER											
.750"	42"	35"	30"	27"	25"	-	-	-	-	-	-
.812"	44"	36"	31"	28"	26"	-	-	-	-	-	-
.875"	46"	37"	32"	29"	27"	-	-	-	-	-	-
1.000"	49"	40"	35"	31"	28"	-	-	-	-	-	-
1.250"	55"	45"	39"	35"	32"	-	-	-	-	-	-

Maximum Operating Speed

To prevent premature wear, auxiliary driveshaft breakage, and possible injury to people or equipment, be aware of the critical speed of these types of driveshafts. Critical speed, explained earlier in this guide, is different for these solid shaft and small tube driveshafts.

Refer to the chart above for maximum safe operating speed information on these types of shafts.

If the chart indicates that the critical speed may be a problem, use multiple shafts. Be sure to use support bearings where necessary and set up the true universal joint operating angles as indicated earlier in this guide.

As with all driveshafts, auxiliary driveshafts should be:

- Carefully installed to minimize vibrations caused by incorrect universal joint operating angles
- Capable of absorbing shock loads
- Capable of changing length as needed
- Guarded so as to prevent inadvertent entanglement

Special Notes Regarding Auxiliary Driveshafts



WARNING: Working on or near an auxiliary driveshaft when the engine is running is extremely dangerous and should be avoided. You can snag clothes, skin, hair, hands, etc. This can cause serious injury or death.

- Shut off engine before working on power take-off or driven equipment.
- Do not go under the vehicle when the engine is running.
- Do not engage or disengage driven equipment by hand from under the vehicle when the engine is running.
- Fasteners should be properly selected and torqued to the manufacturer's specifications.
- If a setscrew protrudes above the hub of an end yoke, you may want to replace it with a recessed (Allen-type) setscrew.
- If you decide that a recessed setscrew does not have enough holding power for your application and you must use a protruding setscrew, be sure no one can come in contact with the rotating driveshaft or the protruding setscrew.
- **Exposed rotating driveshafts must be guarded!**
- Lubricate auxiliary driveshafts according to manufacturer's specifications.



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Section 4

Pump Detail

Description, Operation, Maintenance/Repair, & Lubrication

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Description of Pump Type

The Type KSP pump is a high speed, high volume, single stage, UL rated, centrifugal Fire Fighting Pump with an electric motor driven, high volume rotary vane primer system.

Inherent characteristics of the KSP pump are medium volume, high efficiency, compactness, and light weight when compared to similarly rated pumps.

The KSP pump is a midship or rear mounted pump and is powered via a transmission driven Power Take Off (PTO) capable of sufficient power and torque throughput for said pump system.

OPERATION AND MAINTENANCE OF TYPE KSP FIRE PUMP

Operation of Pump

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

This pump is driven from a standard automotive power take-off. This power take-off is shifted from the driver's seat. The truck clutch should be disengaged to stop the rotation of the truck transmission main drive gear while shifting the PTO.

As well this pump can be driven from an auxiliary midship split-shaft transmission with PTO output or similar PTO output from a transfer case where driveline feasibility exists. These types of applications must follow similar precautions when using this pump system and the truck clutch should always be disengaged to stop the rotation of the truck transmission main drive gear while shifting said PTO's into PUMP MODE.

To Engage the Pump --- Stationary Operation

1. Shift Transmission into Neutral (N)

Before engaging a PTO-driven pump for stationary operation, shift the transmission into NEUTRAL (N). Vehicles with a PTO-driven pump display a "Pump in Neutral" label.

2. Pull Parking Brake to Apply

If you fail to apply the parking brake, safety interlocks prevent operation of throttle or pressure governor.

NOTE: If the parking brake is released during pump operation, the throttle or pressure governor is disconnected AND the engine speed falls to IDLE. Water pressure to the hose will drop. The pump speed will then be controlled only by the drivers pedal. That is the manual override.

3. Chock the Wheels

Block both front and rear of tire using wheel chocks.

CAUTION

- **Engage the pump only at engine idle speed.**
- **Begin pumping water immediately after engaging the pump and prime is reached.**
- **Do not operate the engine at speeds higher than 1000 RPM during the priming cycle.**
- **If prime is not attained in 90 seconds, check your system and fittings to be air tight, resolve the matter, and reattempt prime.**
- **Running the pump dry for more than a few minutes will cause damage.**
- **Circulate water if hoses are not ready to keep water cool.**

4. Engage the Pump

Confirm engine is at idle RPM. Activate the Pump/PTO Shift control located on the driver's panel in the cab.

5. Prime the Pump

Press the "Push-to-Prime" momentary switch and hold. Engine speed should not exceed 1000 RPM and no more than 90 seconds should elapse before prime.

CAUTION

- If this time comes and goes without achieving prime.
- Disengage the pump.
- Check your system and fittings to be air tight, resolve the matter, and reattempt prime after re-engaging the pump.

6. Observe Pump Engaged and OK to Pump indicator lamps

The PUMP ENGAGED and OK TO PUMP indicator lights turn ON when:

- Pump is engaged AND
- Pump is spinning

Engaging PTO-Driven Pump when Vehicle is Driving (Optional)

⚠ WARNING

- Pump-and-roll operation is dangerous.
- NEVER ride outside the cab when the vehicle is moving.
- Keep personnel walking to the side of the vehicle and in sight of the driver at all times.
- Drive slowly.

1. Stop Vehicle
2. Shift Transmission into Neutral (N)
3. Pull Parking Brake to Apply

CAUTION

- Engage the pump only at engine idle speed.
- Begin pumping water immediately after engaging the pump and prime is reached.
- Do not operate the engine at speeds higher than 1000 RPM during the priming cycle.
- If prime is not attained in 90 seconds, check your system and fittings to be air tight, resolve the matter, and reattempt prime.
- Running the pump dry for more than a few minutes will cause damage.
- Circulate water if hoses are not ready to keep water cool.

4. Engage the Pump

Confirm the engine is at idle RPM. Activate the Pump Shift control located on the driver's panel in the cab.

5. Observe the Indicator Light

The PUMP ENGAGED indicator lights only when the PTO has been engaged and the pump is spinning.

6. Provide Water Supply to Pump

Open the Tank-to-Pump valve to provide water to the pump.

7. Shift Transmission into Drive (D)

For pump-and-roll operation the transmission must be in the Drive (D) position.

8. Release Parking Brake

9. Look at Indicator Light

The OK TO PUMP light turns ON when:

- Pump is engaged, AND
- Transmission has been successfully shifted into DRIVE, AND
- Parking Brake is released

CAUTION

- Never run the pump dry except momentarily and at low speeds.
- Do not use this pump for hose testing.

Operation of Primer

To prime the pump a certain amount of dry running of the pump along with a recommended engine speed are given. Significant testing has proven these figures at W.S. Darley and should never be exceeded without W.S Darley Customer Service approval.

Priming time should not exceed 90 seconds. If pump fails to prime within 90 seconds, shut down and thoroughly inspect the pump system for air leaks and resolve the issue before attempting to re-prime.

Engine speed during priming should NOT exceed 1000 RPM regardless of the pump or PTO ratio in relation to engine speed.

To Prime: After disengaging the trucks main truck drive gear and engaging the PTO while none of the equipment is still spinning, re-engage the main truck drive gear and ramp engine RPM to no more than 1000 RPM, press the "Push-to-Prime" momentary switch and hold. Prime should occur within 90 seconds. Indication of Prime should be noticed when water discharges from the primer pump exhaust port. Releasing the momentary switch will disengage the primer clutch and close the primer ¼ turn ball valve. Prime should now be attained and contained.

Under normal conditions, the primer, will evacuate the pump and 20' of 6" hose within 30 seconds.

As soon as prime is reached the pump will begin pumping.

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 Pump with Fluid Reservoir

The electric motor driven rotary-vane 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 of lubricant from the tank after the pump is stopped. Do not increase the size of this 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-rings as necessary.

CAUTION

Dry running of the pump, especially the mechanical seal and seal rings of the pump, can be detrimental to seal life. The figures given here are within a certain safety factor to prevent premature failure of the seal as well as the primer assembly. Exceeding these figures is never recommended and will cause premature wear, blistering and failure of seal faces as well as premature failure and wear of the primer assembly including but not limited to: overheating of the body, seizure of the rotor, and cracking of primer vanes.

CAUTION

Do not use this pump for hose testing.

CAUTION

FOR ALL PRIMING SCENARIOS:

If water does not discharge from the primer exhaust within 90 seconds stop the primer pump, check for air leaks and resolve the issue before attempting to re-prime. MAX PRIMER OPERATION TIME = 90 seconds. DO NOT EXCEED 90 SECONDS OF PRIMER OPERATION. Repeated operation should be avoided.

CAUTION

The primer pump generates 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 accelerated wear or premature failure of the primer pump assembly. If an attempt to prime should fail, thoroughly inspect the pump system for air leaks and resolve the issue before attempting re-prime.

Pump Gear Case Lubrication

Maintain gear case oil level to be just below the max fill mark on the oil level dipstick which is located on the passenger side of the pump transmission.

Check the oil level every 25 hours or every 3 months, whichever comes first. Change the oil every 50 hours or 6 months, whichever comes first.

Ensure the sump magnetic drain is clean and clear of debris after draining oil. To do this remove from the transmission and using a parts washer or isopropyl alcohol wash the magnetic plug. (Reference #36 on drawing DKC0209)

Service the pump transmission with SAE 80W/90, GL4/GL5 gear lubricant. Do not use grease.

CAUTION

Do not overfill. Overfilling may cause excessive gear case operating temperatures as well as foaming of the oil.

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

Repair Service Instructions

To Remove KSP Pump and Transmission from Truck Chassis Refer to Drawing DKC0209

1. Remove the following from the pump:
 - Primer Tubing
 - Gage Line Tubing
 - Auxiliary Cooling Lines
 - Tachometer Cable
2. Drain oil from transmission case.
3. Remove universal joint from transmission shaft (26).
4. Support the pump from the bottom with blocks or a floor jack.
5. Remove eight 3/8" NC cap screws holding suction flange (59) to suction head (73), or remove Victaulic coupling if so equipped.
6. Remove eight 3/8" NC nuts holding pump casing (70) to discharge flange (34).
7. Remove four 1/2" NC cap screws holding transmission case (39) to mounting brackets on truck chassis.
8. Lower pump and transmission out of truck chassis.

KSP PTO Pump Disassembly for Overhaul Refer to Drawing DKC0209

1. Remove twelve 3/8" NC nuts and remove suction head (73) from pump casing (70).
2. If necessary to remove, tap seal ring (79) out of suction head (73) and remove o-rings (71 & 72).
3. Remove cotter key (9), impeller nut (77) and impeller washer (75) from impeller shaft (54).
4. Slide impeller (78) off of impeller shaft (54).
5. Remove four 5/16" NC cap screws and remove bearing cap (4). The two 5/16" NC tapped holes in flange will facilitate separation.
6. Remove four 3/8" NC heavy nuts and four 3/8" grade 8 flat washers from studs and remove pump casing (70) and impeller shaft/pinion gear assembly from transmission case (39).
7. Slide impeller shaft (54) out of pump casing (70) being careful not to damage the mechanical seal if your pump is equipped with this seal (it is likely this part will be damaged in disassembly and will require replacing – Darley recommends replacing the seal whenever it is disassembled).

If equipped with a mechanical seal, carefully remove mechanical seal that is remaining in the mechanical seal housing. For more in depth instruction on the mechanical seal and housing removal/installation refer to the "Mechanical Seal" and "Mechanical Seal Installation" in Section 4 of this manual, documents 1200583 and 1201040. It is important that care be taken when working with the mechanical seal. Once a mechanical seal has been installed, it is recommended that it not be reused.

8. If necessary to replace, pull or pry seal ring (79) out of pump casing (70).
9. Press oil seal (2) out of pump casing (70).
10. If necessary to replace, press stuffing box (if so equipped) (74) out of pump casing (70). Remove old packing (80) from stuffing box (74) and packing cylinder (82).

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If equipped with a mechanical seal, press mechanical seal housing out of pump casing (7). For more in depth instruction on the mechanical seal and housing removal/installation refer to the "Mechanical Seal" and "Mechanical Seal Installation" in Section 4 of this manual, documents 1200583 and 1201040. It is important that care be taken when working with the mechanical seal. Once a mechanical seal has been installed, it is recommended that it not be reused.

11. Press bearing (16) off of impeller shaft (54).
12. Pry tab of lock washer (8) out of slot in lock nut (6). Remove lock nut and lock washer from impeller shaft (54).
13. Press pinion gear (42) off of impeller shaft (54). Remove key (17). Mark bearing side of gear with center punch.
14. Press bearing (15) off of impeller shaft (54).
15. Remove three 5/16" NC cap screws and remove bearing cap (50).
16. Remove three 5/16" NC cap screws and remove bearing cap (32).
17. Press oil seal (30) out of bearing cap (32).
18. Tap two dowel pins out of transmission case (gear case) (39) and remove transmission case cover from cover side (shaft side). Remove eight 5/16" NC socket head cap screws, and remove transmission case cover from transmission case (39).
19. Remove transmission shaft/drive gear (86) from transmission case (39).
20. Press tachometer worm gear (if so equipped - 31(32 on DLC1601)) off of transmission shaft (26), Remove woodruff key (35).
21. Press transmission shaft (26) out of drive gear (86), spacer (5), and bearing (15) all at once.
22. Press rear bearing (215) off of transmission shaft (26).

If tachometer disassembly is required:

23. If tachometer driven gear (32 on DLC1601) is pinned, tap out drive lock pin (36 on DLC1601).
24. Tap or press tachometer shaft (33 on DLC1601) out of tachometer driven gear (32 on DLC1601) and bearing (34 on DLC1601). Remove tachometer gear.
25. Press or tap tachometer bearings (34 on DLC1601) out of bearing cap (32).

Pump Parts Inspection and Measurement

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

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

- If the clearance exceeds 0.025" on diameter, impeller seal ring can be restored to original size by soldering a ring over trued surface which retains at least 0.090" wall thickness. Stationary seal rings (79) should also be replaced.
- Measure stuffing box and impeller shaft for wear. Use the following table for comparison.

Impeller shaft diameter at packing area	1.303 - 1.304"
Stuffing box bore - new	1.312 - 1.313"
Stuffing box - max.	1.318"
Clearance - original	0.008 - 0.010"
Clearance- maximum	0.015"

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

<u>Part</u>	<u>Rep. No.</u>	<u>Original Bore Dia.</u>
Pump casing	70	3.1496 - 3.1503"
Bearing cap	4	2.0472 - 2.0480"
Bearing cap	32	3.1496 - 3.1509"
Bearing cap	50	3.1500 - 3.1560"
Transmission case	39	3.1496 - 3.1503"
Transmission case cover (Shaft side)	39	3.1496 - 3.1503"

- Measure shaft bearing journals for proper size. Use the following table for comparison. Low limit under bearings is required to insure a press fit with inner ball bearing race.

<u>Part</u>	<u>Rep. No.</u>	<u>Original Journal Dia.</u>
Impeller shaft	54 small	0.7874 - 0.7878"
	large	1.3781 - 1.3785"
Transmission shaft	26 both	1.3781 - 1.3785"

- The original impeller shaft diameter under the pinion gear is 1.3781 -1.3785". The original pinion gear bore is 1.3785 - 1.3790" providing 0.0000 - 0.0009" clearance. The parts are still serviceable up to 0.0014" clearance. Pinion gear may be reversed to work other side of gear teeth.
- The original transmission shaft diameter under the drive gear is 1.781 - 1.3785". The original drive gear bore s 1.3781 - 1.3785" providing 0.0004 inch press fit to 0.0004" clearance. The parts are still serviceable up to 0.0009" clearance. Drive gear may be reversed to work other side of gear teeth.

Assembly of KSP PTO Pump Refer to Drawing DKC0209

- Apply a light coating of bearing lube oil to transmission shaft (26). Place key (17) in transmission shaft keyway, align with key slot in drive gear (86), and press shaft into drive gear bore until shaft shoulder is tight against side of gear.
- Slide spacer (5) onto transmission shaft (26). Apply a light coating of bearing lube oil to bore of bearing (15) and press bearing evenly onto shaft until inner race of bearing, spacer, and drive gear are tight together.

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3. If equipped with tachometer, place woodruff key (35) in its groove in transmission shaft (26). Apply a light coating of bearing lube oil to bore of tachometer worm gear (31) and press onto transmission shaft.
4. Apply a silicon lubricant, such as a Dow Corning Compound 111 (or equivalent), to o-ring (58) and place in position on flange surface of bearing cap (32).
5. Attach bearing cap to transmission case (39) with three 5/16" NC x 3/4" cap screws and lock washers, but do not tighten cap screws.
6. Insert transmission shaft/drive gear assembly into transmission case (39), making sure rear bearing (215) is in its bore.
7. Apply a silicon lubricant, such as a Dow Corning Compound 111 (or equivalent), to transmission case cover o-ring and place in position on transmission case cover.
8. Locate transmission case cover to transmission case with two 5/16" dowel pins. Tap pins in from transmission case side. Attach cover to case with eight 5/16" NC x 1" socket head cap screws and lock washers.
9. Press oil seal (30) into bearing cap (32) with lip spring of seal facing bearing.

If tachometer drive shaft has been disassembled, follow steps 10 through 15 (if not skip to 16)

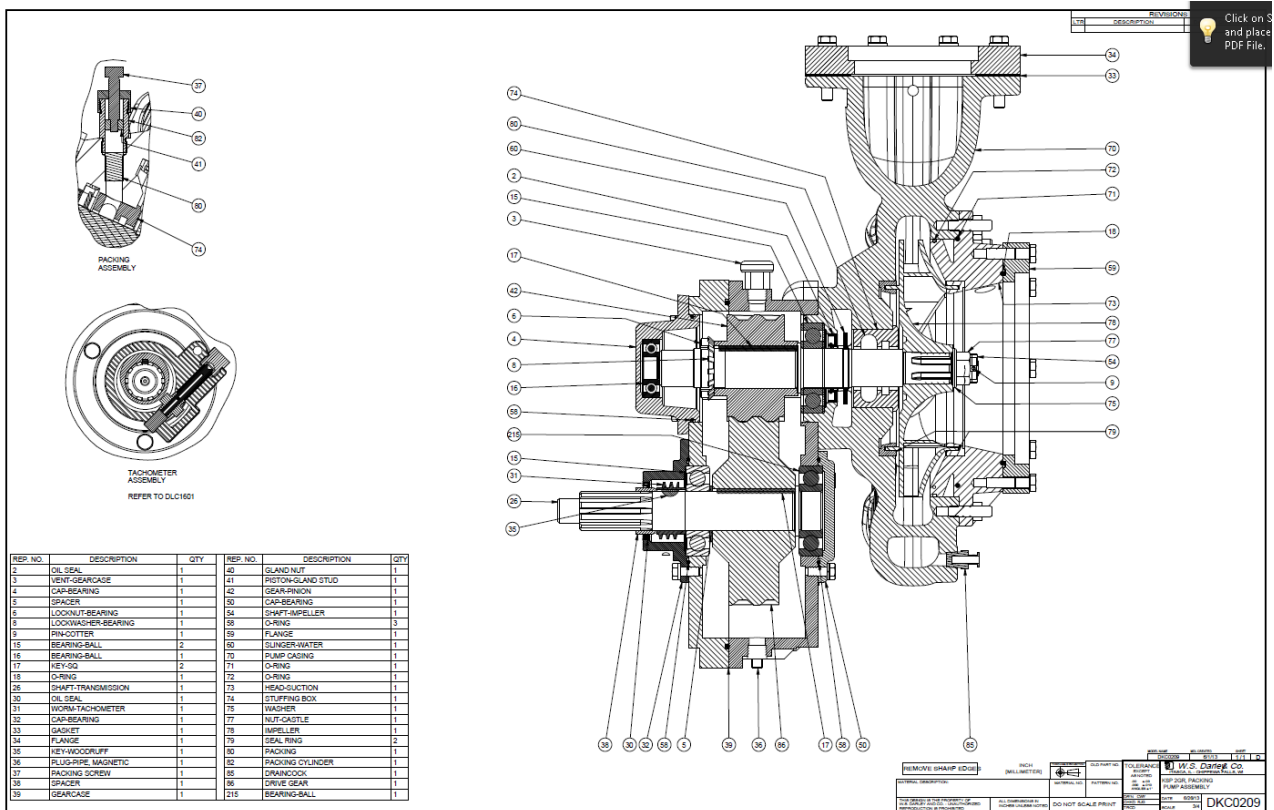
10. Press bearing (34 on DLC1601) into bearing cap (32) flush with inside of gear pocket.
11. Ream bearings (34 on DLC1601) with a 5/16" x 4" (or longer) ream.
12. Place tachometer driven gear (32) in pocket between bearings (34 DLC1601).
13. Press or tap tachometer shaft (33 on DLC1601) through bearing (34 on DLC1601) and into driven gear (32 on DLC1601) with square key hole and facing tachometer cable pocket.
14. On newer style of tachometer shaft, tap a 3.32" x 7/16" drive lock pin (36 on DLC1601) into tachometer driven gear (32 on DLC1601) and tachometer shaft (33 on DLC1601).
15. Make sure gear and shaft rotate freely.
16. Apply a silicon lubricant, such as a Dow Corning Compound 111 (or equivalent), to o-ring (58) and place in position on flange surface of bearing cap (32).
17. Attach bearing cap (32) and o-ring (58) to transmission case cover with three 5/16" NC x 3/4" cap screws and lock washers.
18. Tighten cap screws holding bearing cap (50).
19. Apply a light coating of grease to impeller shaft (54). Place key (17) in impeller shaft keyway, align with key slot in pinion gear (42), and press shaft evenly into pinion gear bore until shaft shoulder, spacer, and pinion gear are tight together.
20. Slide lock washer (8) onto impeller shaft (54) and install lock nut (6). Tighten lock nut until a tab of lock washer aligns with a slot on lock nut. Press tab of lock washer into slot on lock nut.

21. Apply a light coating of bearing lube oil to bore of bearing (15), and press bearing onto shaft (54) until tight against shaft shoulder.
22. Apply a light coating of bearing lube oil to bore of bearing (16), and press bearing onto shaft (54) until tight against shaft shoulder.
23. Apply a light ring of Loctite 609 Green cylindrical retaining compound (or equivalent) around OD of stuffing box (if so equipped). Align packing guide hole in stuffing box (74) with hole in pump casing (70). Press stuffing box into pump casing until seated.
If equipped with a mechanical seal, refer to the “Mechanical Seal” and “Mechanical Seal Installation” in Section 4 of this manual, documents 1200583 and 1201040. It is important that care be taken when working with the mechanical seal. Make sure to align small mechanical seal flush hole with flush hole in pump casing.
24. Press seal ring (79) into pump casing (70) until seated.
25. Press oil seal (2) into pump casing (70) with lip spring of seal facing bearing.
26. Install water slinger (60) in slot on back of pump casing (70).
27. Insert impeller shaft/pinion gear assembly into pump casing (70). Slide water slinger (60) into its groove on impeller shaft.
28. Apply a thin layer of Loctite 518 or equivalent to gasket flange surface of pump casing (70).
29. Insert impeller shaft/pinion gear into transmission case (39) and place pump casing (70) in position on transmission case (39). Attach pump casing to transmission case with four 3/8”NC heavy nuts and 3/8” grade 8 washers on studs.
30. Apply a silicon lubricant, such as a Dow Corning Compound 111 (or equivalent), to o-ring (58) and place in position on flange surface of bearing cap (4).
31. Attach bearing cap (4) to transmission case cover with four 5/16” NC x 7/8” cap screws and lock washers.
32. Slide impeller (78) onto impeller shaft (54). Place impeller washer (75) on shaft.
33. Clean and dry shaft thread and impeller nut (77), removing dirt, grease and oil. (Loctite Klean N’ Prime Part No. 2556, can be used to clean parts and shorten cure time.)
34. Apply Loctite 243 or equivalent Thread locker to shaft thread and nut thread.
35. Tighten impeller nut (77) until it contacts with impeller washer (75), then turn to the next cotter key hole. (DO NOT OVER TIGHTEN.)
36. Install a 1/8” x 1” STAINLESS STEEL cotter key (9) in impeller shaft cotter key hole.
37. Press seal ring (79) into suction head (73).
38. Apply a silicon lubricant, such a Dow Corning Compound 111 (or equivalent), to o-rings (71 & 72) and place in position on suction head (73).
39. Attach suction fitting (73) to pump casing (70) with twelve 3/8” NC nuts on studs.

Installing Pump in Truck Chassis

- Reverse the procedures outlined under removal instructions.
- Lubricate universal joint slip yoke on pump drive shaft.
- Fill gear case with SAE 80W/90 Gear Lube Oil to the level of the oil-level plug on the gear case cover.
DO NOT OVERFILL.
- Maintain the pump transmission oil level every 25 hours, or 3 months which ever comes first, and change the oil every 50 hours, or 6 months, whichever comes first.
- Change the pump transmission oil every 50 hours, or every 6 months, whichever comes first.

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

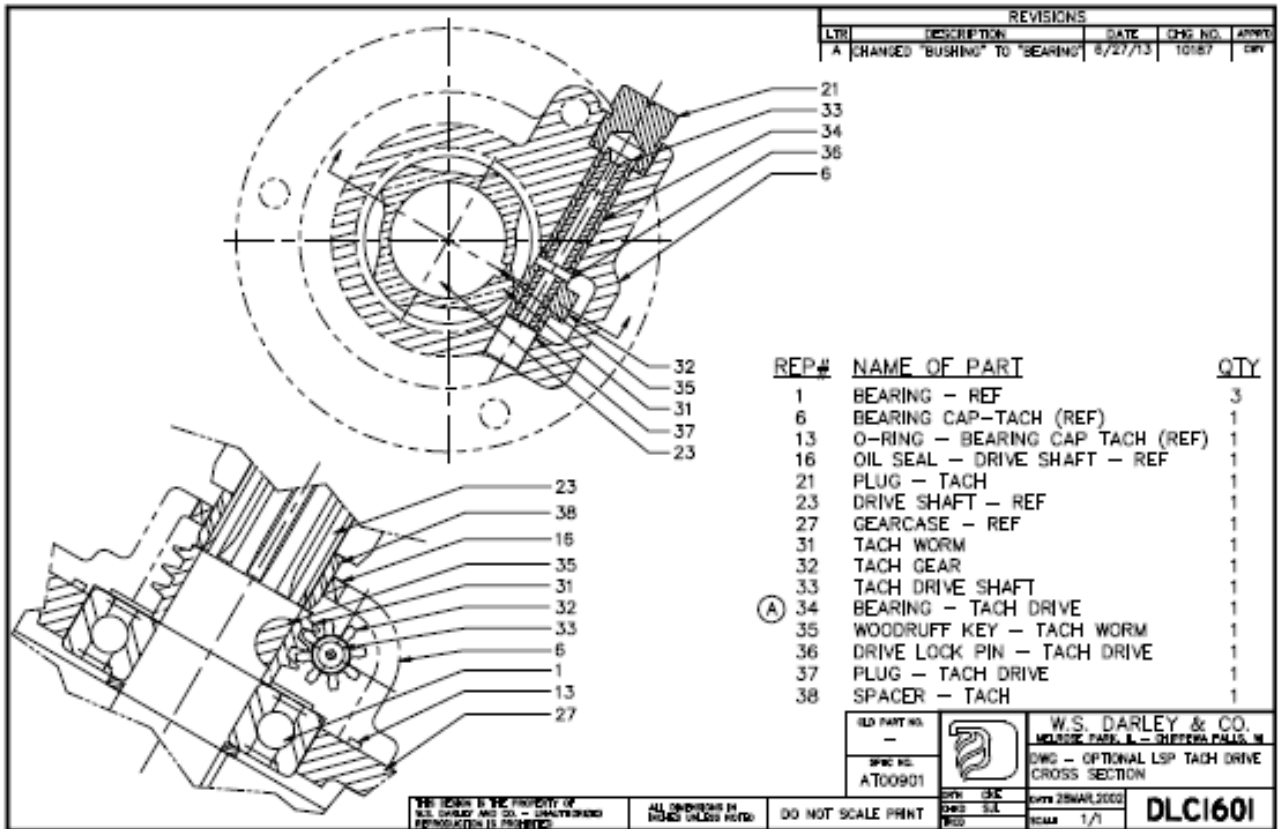


**Type KSP Fire Pump Parts List
Drawing DKC0209**

Rep. No.	Name of Part	Qty.	Rep. No.	Name of Part	Qty.
2	Oil Seal	1	40	Gland Nut	1
3	Vent-Gearcase	1	41	Piston-Gland Stud	1
4	Cap-Bearing	1	42	Gear-Pinion	1
5	Spacer	1	50	Cap-Bearing	1
6	Locknut-Bearing	1	54	Shaft-Impeller	1
8	Lockwasher-Bearing	1	58	O-Ring	3
9	Pin-Cotter	1	59	Flange	1
15	Bearing-Ball	2	60	Slinger-Water	1
16	Bearing-Ball	1	70	Pump Casing	1
17	Key-Sq.	2	71	O-Ring	1
18	O-Ring	1	72	O-Ring	1
26	Shaft-Transmission	1	73	Head-Suction	1
30	Oil Seal	1	74	Stuffing Box	1
31	Worm-Tachometer	1	75	Washer	1
32	Cap-Bearing	1	77	Nut-Castle	1
33	Gasket	1	78	Impeller	1
34	Flange	1	79	Seal Ring	2
35	Key-Woodruff	1	80	Packing	1
36	Plug-Pipe, Magnetic	1	82	Packing Cylinder	1
37	Packing Screw	1	85	Draincock	1
38	Spacer	1	86	Drive Gear	1
39	Gearcase	1	215	Bearing-Ball	1

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Type KSP Fire Pump Parts List Drawing DLC1601

Rep No.	Name of Part	Qty.	Rep No.	Name of Part	Qty.
21	Plug-Tach	1	35	Woodruff Key-Tach Worm	1
31	Tach Worm	1	36	Drive Lock Pin-Tach Drive	1
32	Tach Gear	1	37	Plug-Tach Drive	1
33	Tach Drive Shaft	1	38	Spacer-Tach	1
34	Bearing-Tach Drive	1			

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 Revised by:

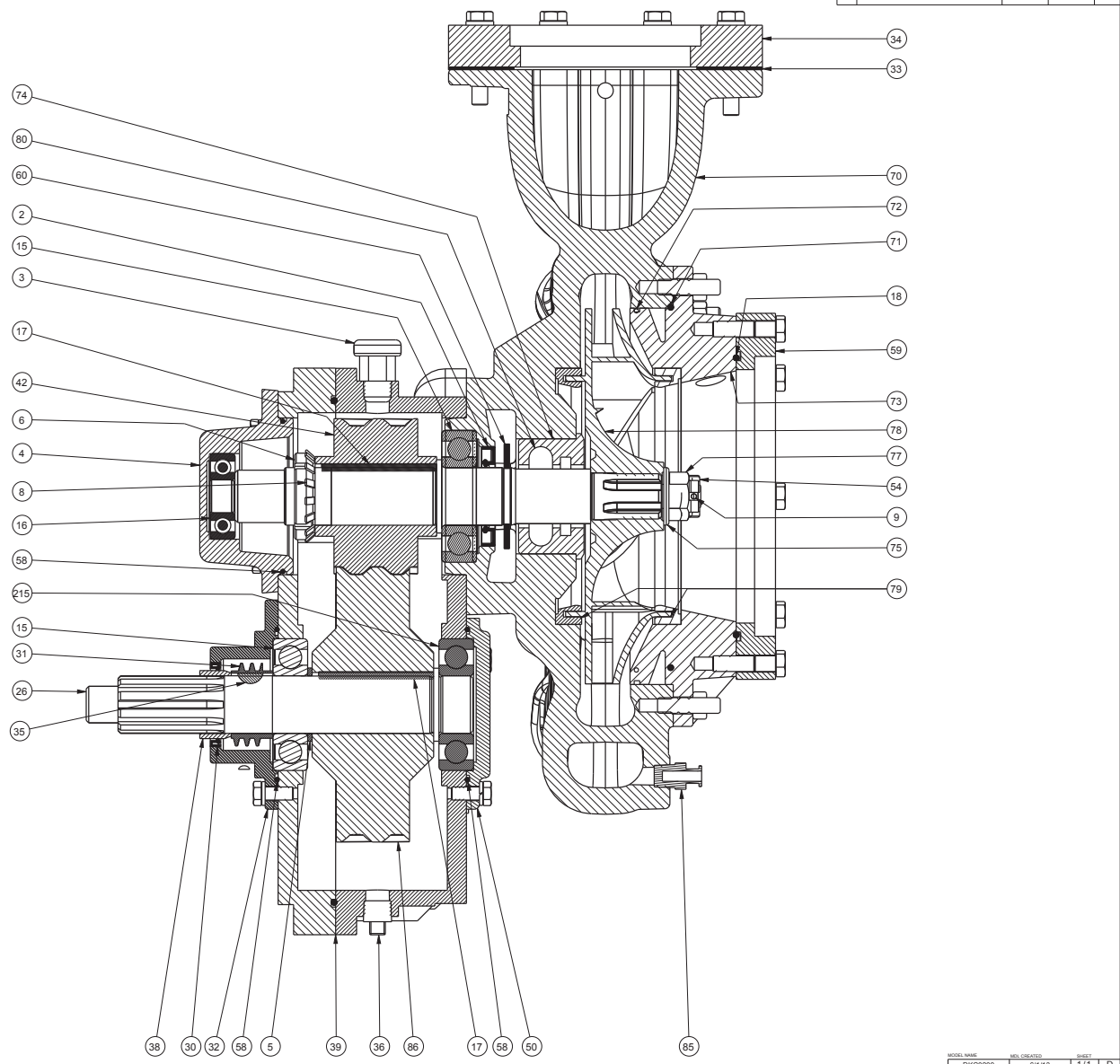
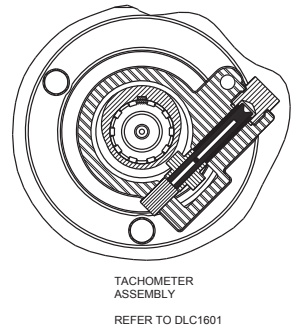
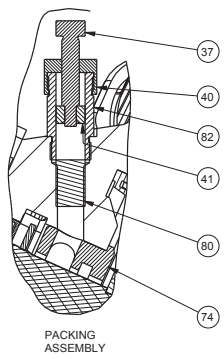
Rev. 0
 Date: 06/20/13
 Rev. Date:
 1200652.doc

Related Drawings

Prepared by: CWY
Approved by: RJG
Revised by:

Rev. 0
Date: 06/20/13
Rev. Date:
1200652.doc

REVISIONS				
LTR	DESCRIPTION	DATE	CHG NO.	APPROV



REP. NO.	DESCRIPTION	QTY	REP. NO.	DESCRIPTION	QTY
2	OIL SEAL	1	40	GLAND NUT	1
3	VENT-GEARCASE	1	41	PISTON-GLAND STUD	1
4	CAP-BEARING	1	42	GEAR-PINION	1
5	SPACER	1	50	CAP-BEARING	1
6	LOCKNUT-BEARING	1	54	SHAFT-IMPELLER	1
8	LOCKWASHER-BEARING	1	58	O-RING	3
9	PIN-COTTER	1	59	FLANGE	1
15	BEARING-BALL	2	60	SLINGER-WATER	1
16	BEARING-BALL	1	70	PUMP CASING	1
17	KEY-SQ	2	71	O-RING	1
18	O-RING	1	72	O-RING	1
26	SHAFT-TRANSMISSION	1	73	HEAD-SUCTION	1
30	OIL SEAL	1	74	STUFFING BOX	1
31	WORM-TACHOMETER	1	75	WASHER	1
32	CAP-BEARING	1	77	NUT-CASTLE	1
33	GASKET	1	78	IMPELLER	1
34	FLANGE	1	79	SEAL RING	2
35	KEY-WOODRUFF	1	80	PACKING	1
36	PLUG-PIPE, MAGNETIC	1	82	PACKING CYLINDER	1
37	PACKING SCREW	1	85	DRAINCOCK	1
38	SPACER	1	86	DRIVE GEAR	1
39	GEARCASE	1	215	BEARING-BALL	1

REMOVE SHARP EDGES

INCH [MILLIMETER]

OLD PART NO. DK02209

TOLERANCE DECIMALS AS NOTED

MATERIAL DESCRIPTION: KSP 2GR, PACKING PUMP ASSEMBLY

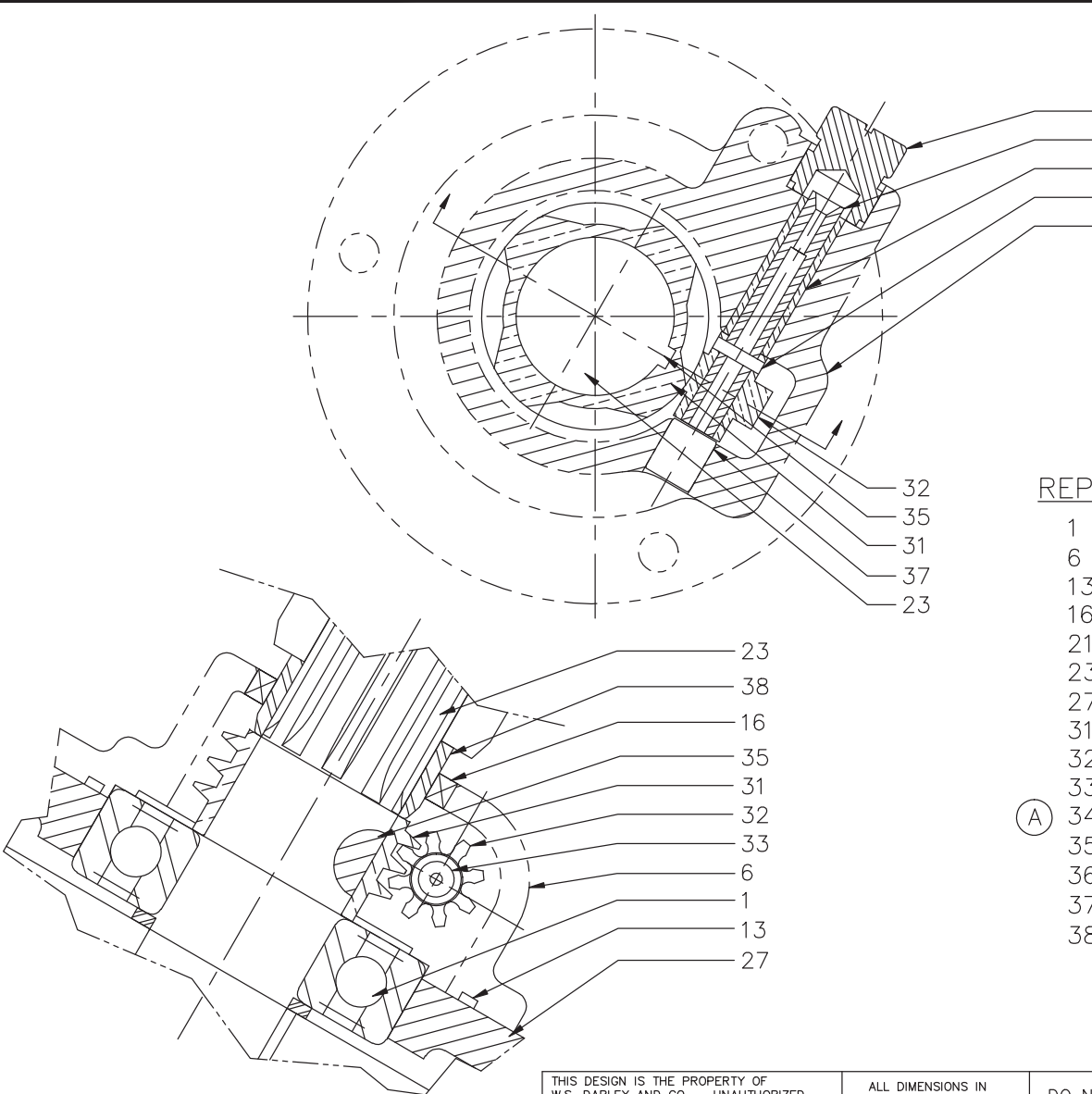
DATE: 6/26/13

SCALE: 3/4

W.S. Darby & Co. METEORICAL, GREENSBORO, N.C. 27409

DKC0209

REVISIONS				
LTR	DESCRIPTION	DATE	CHG NO.	APPR'D
A	CHANGED "BUSHING" TO "BEARING"	6/27/13	10187	CWY



REP#	NAME OF PART	QTY
1	BEARING - REF	3
6	BEARING CAP-TACH (REF)	1
13	O-RING - BEARING CAP TACH (REF)	1
16	OIL SEAL - DRIVE SHAFT - REF	1
21	PLUG - TACH	1
23	DRIVE SHAFT - REF	1
27	GEARCASE - REF	1
31	TACH WORM	1
32	TACH GEAR	1
33	TACH DRIVE SHAFT	1
(A) 34	BEARING - TACH DRIVE	1
35	WOODRUFF KEY - TACH WORM	1
36	DRIVE LOCK PIN - TACH DRIVE	1
37	PLUG - TACH DRIVE	1
38	SPACER - TACH	1

OLD PART NO.
-
SPEC NO.
AT00901



W.S. DARLEY & CO.
MELROSE PARK, IL - CHIPPEWA FALLS, WI
DWG - OPTIONAL LSP TACH DRIVE
CROSS SECTION

DR'N CKE
CHKD SJL
TRCD

DATE 28MAR,2002
SCALE 1/1

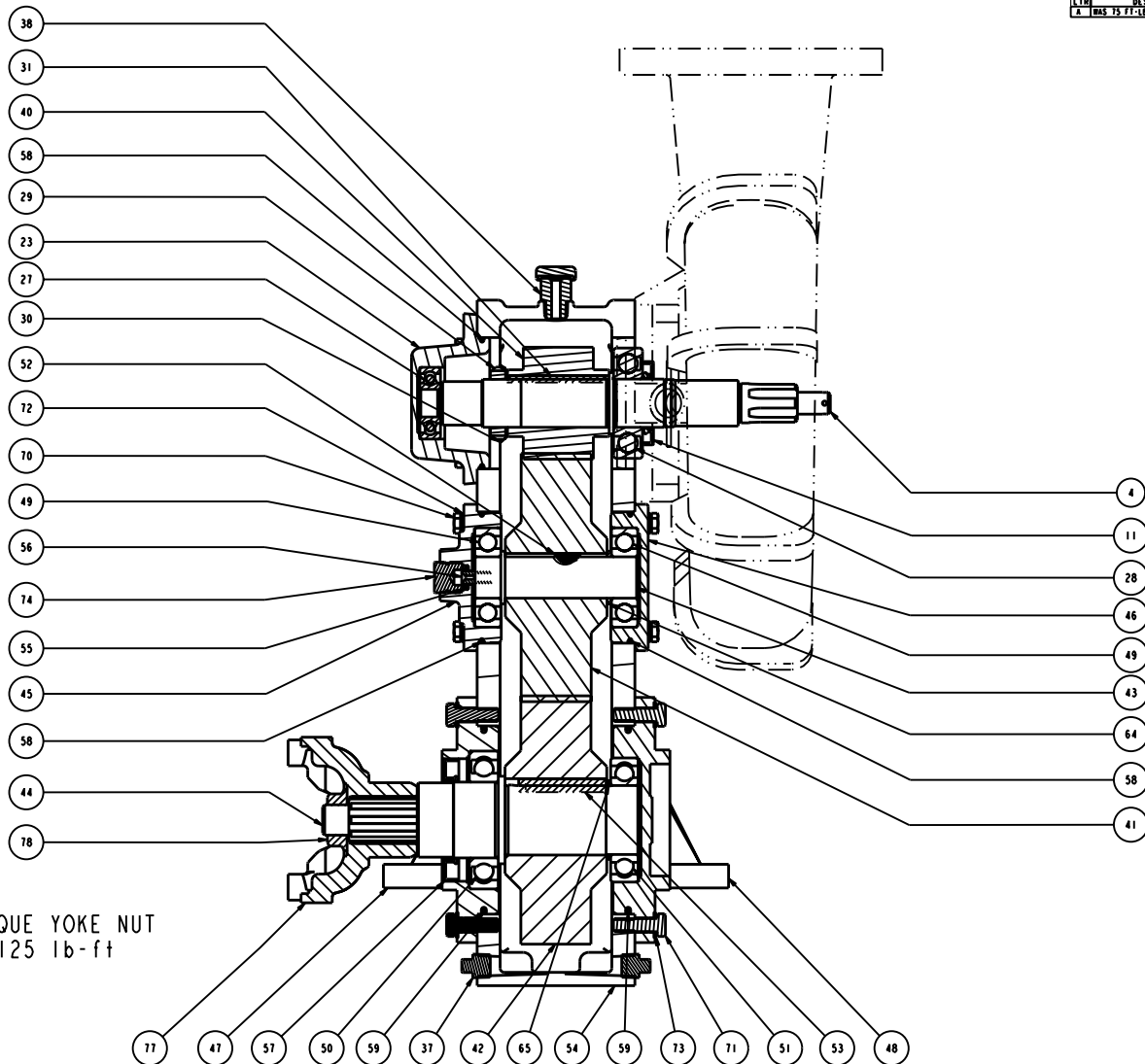
DLCI601

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W.S. DARLEY AND CO. - UNAUTHORIZED
REPRODUCTION IS PROHIBITED

ALL DIMENSIONS IN
INCHES UNLESS NOTED

DO NOT SCALE PRINT

NO.	DESCRIPTION	PART NO.	QTY.
4	SHAFT - IMPELLER,KS	-	1
11	OIL SEAL - 1.375 ID X 2.378 OD	-	1
23	CAP - BEARING, JME & P	-	1
27	BEARING-BALL, 304S	-	1
28	BEARING-BALL, 307SF	-	1
29	LOCKNUT - BEARING, W07	-	1
30	LOCKWASHER - BEARING, W07	-	1
31	KEY - SQ., 0.19 X 2.75	-	1
37	PLUG - PIPE, 0.375, MAG SQ HD	-	2
38	VENT - GEARCASE	-	1
40	GEAR - PINION, KSM/R/EH, 12DP	-	1
41	GEAR - IDLER, KDH, 12 DP	-	1
42	GEAR - IDLER, KDH, 12DP	-	1
43	SHAFT - IDLER GEAR, K	-	1
44	SHAFT-DRIVE, KDM, P10	-	1
45	CAP - BEARING, KDM 2.28:1	-	1
46	CAP - BEARING, 0 OFFSET	-	1
47	BRACKET - FRONT BEARING	-	1
48	BRACKET - FRONT BEARING	-	1
49	BEARING-BALL, 6306.C3	-	2
50	BEARING-BALL, 211SF	-	1
51	BEARING-BALL, 210S	-	1
52	KEY - WOODRUFF, 606	-	1
53	KEY - SQ., 0.38 X 2.50	-	1
54	GEARCASE - KS/LS SERIES, P10	-	1
55	OIL SEAL - 0.375 ID X 0.688 OD	-	1
56	NUT - CABLE DRIVE, KDM, 0.104	-	1
57	OIL SEAL - 2.125 ID X 3.505 OD	-	1
58	O-RING - 3.50 X 3.69 X 0.09	-	3
59	O-RING - 5.00 X 5.25 X 0.12	-	2
64	SPACER - 1.19 X 1.50 X 0.13	-	1
65	SPACER - 1.97 X 2.25 X 0.09	-	1
70	HMS - .313-18 X 0.88, GR5	-	20
71	HMS - .375-16 X 1.25, GR5	-	8
72	WASHER - LOCK, 0.313 ID	-	20
73	WASHER - LOCK, 0.375 ID	-	8
74	PLUG - TACH, .88-18UNS	-	1
76	PIN - DOWEL, .250 X 0.50, GR8	-	2
77	YOKE - 1410, END, 1.38-10 SPL	-	1
78	NUT - FLANGE, 1/8-14	-	1



(A) NOTE: TORQUE YOKE NUT TO 125 lb-ft

REVISIONS			
NO.	DESCRIPTION	DATE	ENG. NO. / APPR. / SIGN.
1	ISS 15 11-18	10/27/08	2008-231 / AKS

REMOVE SHARP EDGES

1 INCH (25.4 MILLIMETER)

OLD PART NO. DKC0205

TOLERANCE LIMITS: .0005, .001, .002, .005, .010, .015, .030, .050, .100, .150, .300, .500, 1.000, 1.500, 3.000, 5.000, 10.000, 15.000, 30.000, 50.000, 100.000, 150.000, 300.000, 500.000, 1000.000

DATE 31-May-05

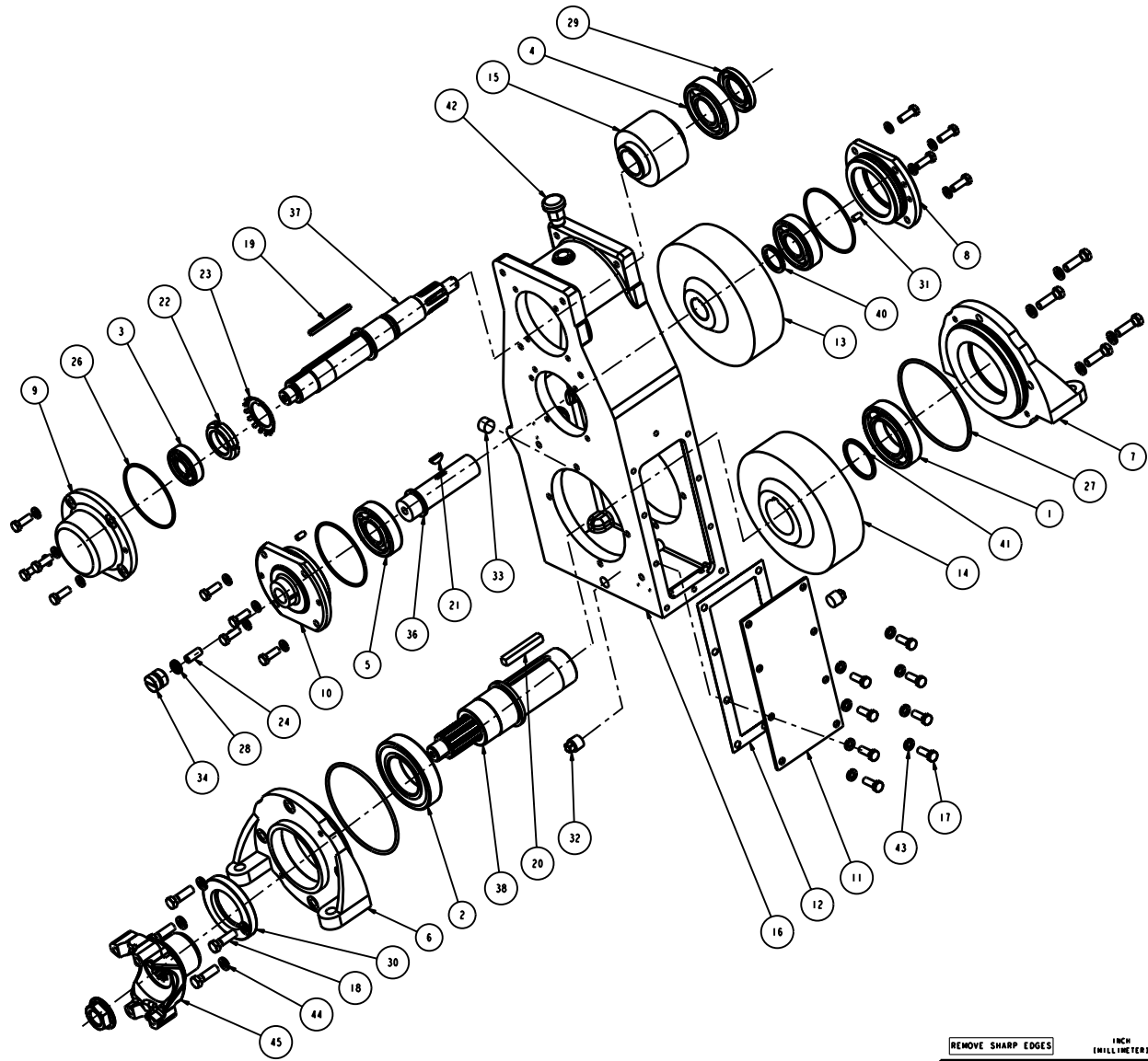
SCALE 5/8

DKC0205

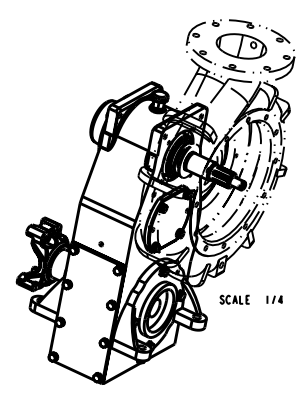
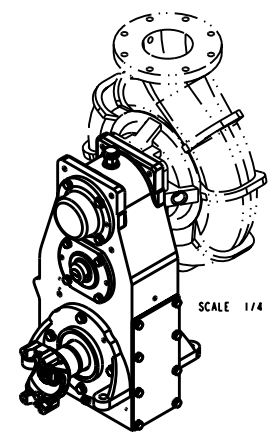
TRANS - KSP, P10, NO CLUTCH

W.S. Durley & Co. STAMPA, IL - CAIRO, ILL. - U.S.A.

NO.	DESCRIPTION	PART NO.	QTY.
1	BEARING-BALL, 2105	-	1
2	BEARING-BALL, 2115F	-	1
3	BEARING-BALL, 3045	-	1
4	BEARING-BALL, 3075F	-	1
5	BEARING-BALL, 6306.C3	-	2
6	BRACKET - FRONT BEARING	-	1
7	BRACKET - FRONT BEARING	-	1
8	CAP - BEARING, 0 OFFSET	-	1
9	CAP - BEARING, JME & P	-	1
10	CAP - BEARING, RDM 2.28:1	-	1
11	COVER - GEARCASE	-	1
12	GASKET - GEARCASE COVER, RDMH	-	1
13	GEAR - IDLER, RDMH, 12 DP	-	1
14	GEAR - IDLER, RDM, 12DP	-	1
15	GEAR - PINION, RSM/R/EH, 12DP	-	1
16	GEARCASE - KS/LS SERIES, PTO	-	1
17	HMS - .313-18 x 0.88, GR5	-	20
18	HMS - .375-16 x 1.25, GR5	-	8
19	KEY - SO., 0.19 x 2.75	-	1
20	KEY - SO., 0.38 x 2.50	-	1
21	KEY - WOODRUFF, 606	-	1
22	LOCKWASHER - BEARING, M07	-	1
23	LOCKWASHER - BEARING, M07	-	1
24	NUT - CABLE DRIVE, RDM, 0.104	-	1
25	NUT - FLANGE, 7/8-14	-	1
26	O-RING - 3.50 x 3.69 x 0.09	-	3
27	O-RING - 5.00 x 5.25 x 0.12	-	2
28	OIL SEAL - 0.375 ID x 0.688 OD	-	1
29	OIL SEAL - 1.375 ID x 2.378 OD	-	1
30	OIL SEAL - 2.125 ID x 3.505 OD	-	1
31	PIN - DOWEL, .250 x 0.50, GR8	-	2
32	PLUG - PIPE, 0.375, MAG 50 HD	-	2
33	PLUG - PIPE, 0.375, ZN SOC HD	-	1
34	PLUG - TACH, .88-18UNS	-	1
35	PUMP CASING - KS, LH IMPELLER	-	1
36	SHAFT - IDLER GEAR, K	-	1
37	SHAFT - IMPELLER, KS	-	1
38	SHAFT-DRIVE, RDM, PTO	-	1
39	SLINGER - WATER, 1.332 ID	-	1
40	SPACER - 1.19 x 1.50 x 0.13	-	1
41	SPACER - 1.97 x 2.25 x 0.09	-	1
42	VENT - GEARCASE	-	1
43	WASHER - LOCK, 0.313 ID	-	20
44	WASHER - LOCK, 0.375 ID	-	8
45	YOKE - 1410, END, 1.38-10 SPL	-	1



REVISIONS				
LTB	DESCRIPTION	DATE	ENG NO.	APP'D
4	105 15 11-18	10/27/08	2008-231	AKB



REMOVE SHARP EDGES

1 INCH (25.4 MILLIMETER)

OLD PART NO. DKC0205

TOLERANCE AS SHOWN

MATERIAL NO. 316L SS

PATTERN NO.

DATE 18-Apr-05

SCALE 3/8

DKC0205

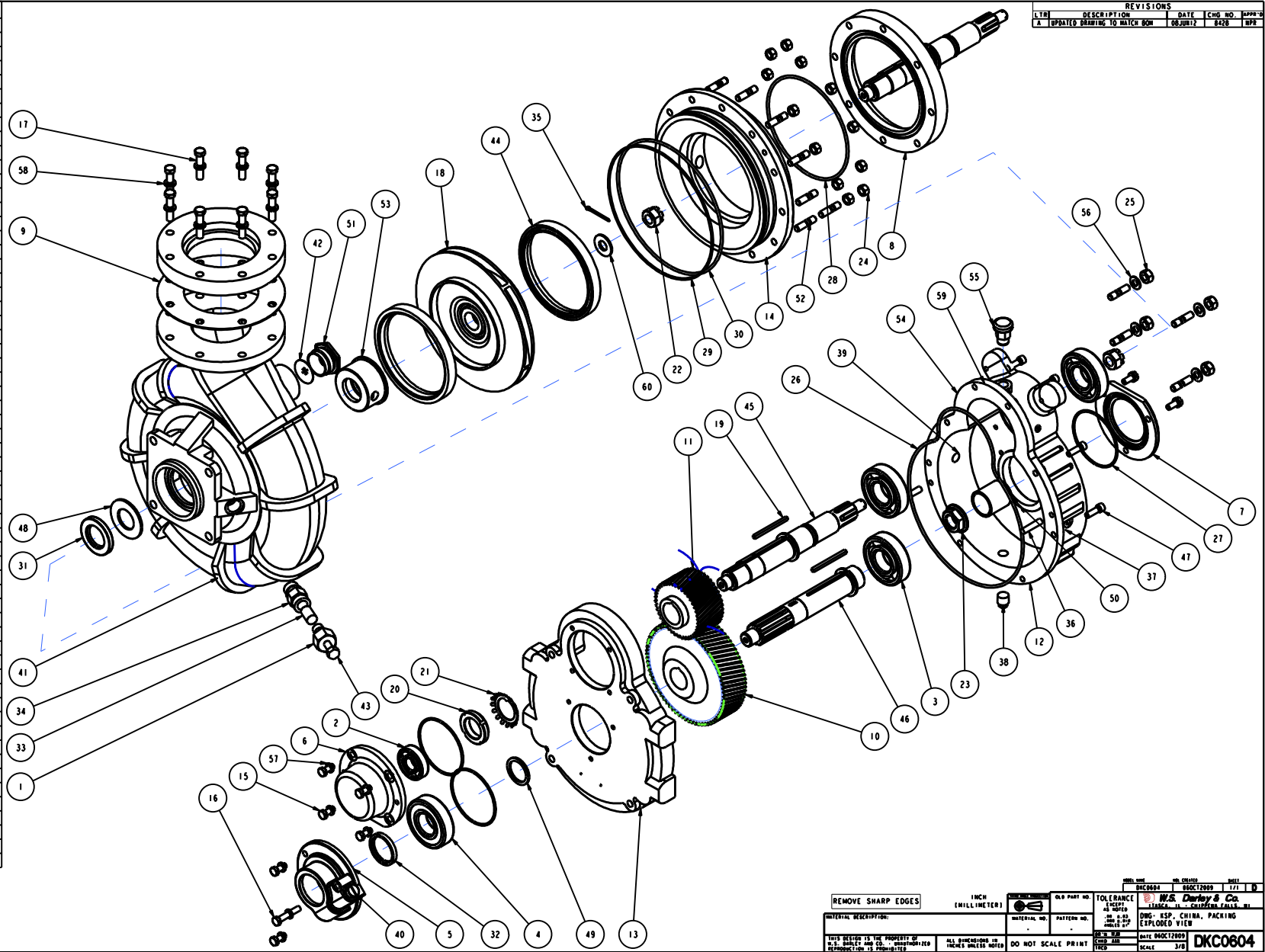
TRANS - KSP, PTO, NO CLUTCH

DATE 18-Apr-05

SCALE 3/8

DKC0205

NO.	DESCRIPTION	PART NO.	QTY.
1	ASST - PACKING NUT, 1-14 UNS	-	1
2	BEARING-BALL, 304S	-	1
3	BEARING-BALL, 307S	-	1
4	BEARING-BALL, 307SF	-	3
5	CAP - BEARING	-	1
6	CAP - BEARING, JME & P	-	1
7	CAP - BEARING, KS	-	1
8	FLANGE - 6 WELD, O-RING	-	1
9	GASKET - COMPANION FLANGE	-	1
10	GEAR - DRIVE, LS, 12 DP	-	1
11	GEAR - PINION, LS, 12DP	-	1
12	GEARCASE - BLANK, KS	-	1
13	GEARCASE - COVER, BLANK, KS	-	1
14	HEAD - SUCTION, KSF	-	1
15	HMCS - .313-18 x 0.75, GR5	-	9
16	HMCS - .313-18 x 1.75, GR5	-	1
17	HMCS - .375-16 x 1.75, GR5	-	8
18	IMPELLER - KS	-	1
19	KEY - SQ., 0.19 x 2.75	-	2
20	LOCKNUT - BEARING, M07	-	1
21	LOCKWASHER - BEARING, M07	-	1
22	NUT - CASTLE, .625-18, 303 SSI	-	2
23	NUT - FLANGE, 7/8-14	-	1
24	NUT - HEX, .375-16, GR2	-	12
25	NUT - HEX, .375-16, HEAVY, GR2	-	4
26	O-RING - 10.50 X 10.75 X .12	-	1
27	O-RING - 3.50 x 3.69 x 0.09	-	3
28	O-RING - 6.50 x 6.75 x 0.12	-	1
29	O-RING - 8.50 x 8.69 x 0.09	-	1
30	O-RING - 8.50 x 8.75 x 0.12	-	1
31	OIL SEAL - 1.375ID X 2.378 OD	-	1
32	OIL SEAL - 1.625 ID X 2.000 OD	-	1
33	PACKING #927 - PELLET	-	1
34	PACKING CYLINDER - B	-	1
35	PIN - COTTER, .125 x 1.50, SSI	-	1
36	PIN - TAPER, #6 x 1.500, GR2	-	2
37	PLUG - PIPE, 0.125, 2H SOC HD	-	3
38	PLUG - PIPE, 0.375, MAG SO HD	-	1
39	PLUG - PIPE, 0.375, 2H SOC HD	-	2
40	PLUG - TACH, .750-20, ALUM	-	1
41	PUMP CASING - KS, LH IMPELLER	-	1
42	SCREEN STRAINER	-	1
43	SCREW - PACKING	-	1
44	SEAL RING - KS	-	2
45	SHAFT - IMPELLER, KS	-	2
46	SHAFT - TRANSMISSION	-	1
47	SHCS - .313-18 x 1.00, GR8	-	8
48	SLINGER - WATER, 1.332 ID	-	1
49	SPACER - 1.38 x 1.75 x 0.10	-	1
50	SPACER - 1.63 x 1.37 x .75	-	1
51	STRAINER - FITTING	-	1
52	STUD - 0.375-16 x 1.500, GR5	-	16
53	STUFFING BOX - KS	-	1
54	TRANS - GEARCASE ONLY, K	-	1
55	VENT - GEARCASE	-	1
56	WASHER - FLAT	-	4
57	WASHER - LOCK, 0.313 ID	-	10
58	WASHER - LOCK, 0.375 ID	-	8
59	WASHER - LOCK, HC, 0.313 ID	-	8
60	WASHER-IMPELLER	-	1



REVISIONS				
LT#	DESCRIPTION	DATE	CHG NO.	APPR
A	UPDATED DRAWING TO MATCH BOM	08/20/17	8428	HPF

REMOVE SHARP EDGES

1 INCH (25.4 MILLIMETERS)

OLD PART NO. TOLERANCE EXP. AS NOTED

MATERIAL NO. PARTNO. NO. OF SH. UNITS

DATE 08/02/2009

SCALE 3/8"

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

ALL DIMENSIONS IN INCHES UNLESS NOTED

DO NOT SCALE PRINT

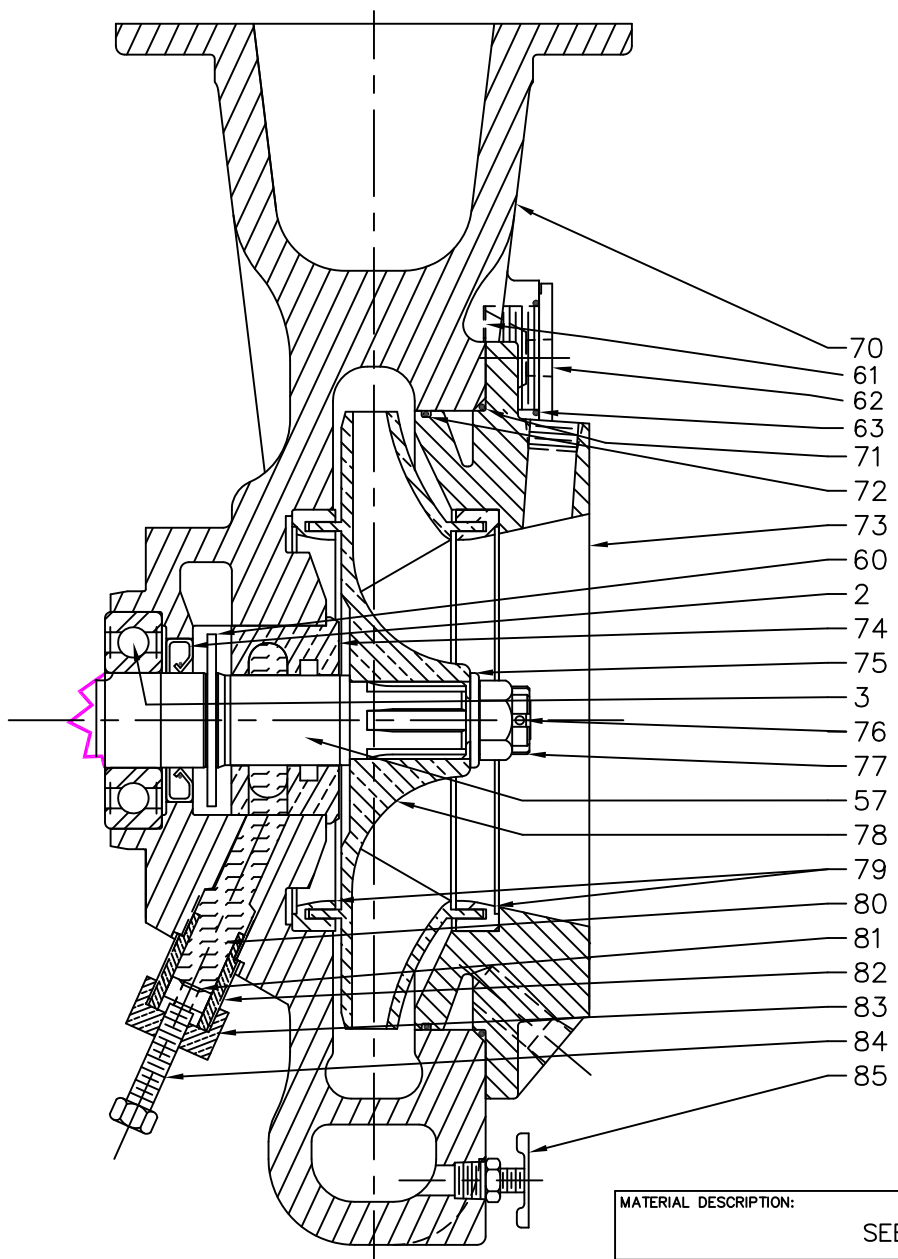
DATE 08/02/2009

SCALE 3/8"

W.S. Darley & Co. ST. LOUIS, MO. 63103

DMG - ESP. CHINA, EXPLODED VIEW

DKC0804



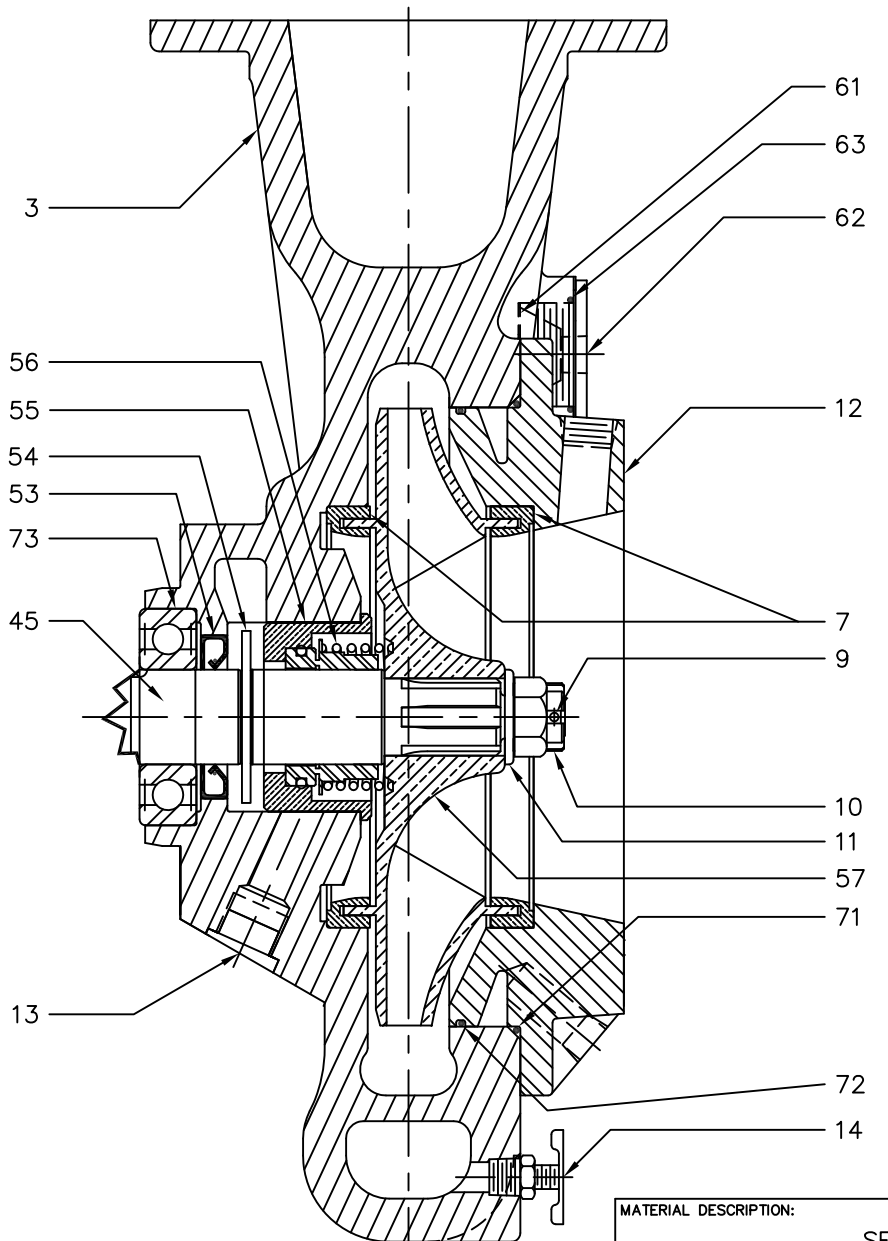
REVISIONS				
LTR	DESCRIPTION	DATE	CHG NO.	APPR'D

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

INCH
[MILLIMETER]

THIRD ANGLE PROJECTION


REMOVE SHARP EDGES		OLD PART NO. -	TOLERANCE EXCEPT AS NOTED .00 ±.03 .000 ±.010 ANGLES ±1°	W.S. DARLEY & Co. MELROSE PARK, IL - CHIPPEWA FALLS, WI DWG - KS CROSS SECTION PACKING, STRAINER
MATERIAL DESCRIPTION: SEE LIST	MATERIAL NO. -	PATTERN NO. -	DR'N AAN CHKD SJL TRCD	
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	DATE 10/10/2007 SCALE 1/2	DKC0651




REVISIONS				
LTR	DESCRIPTION	DATE	CHG NO.	APPR'D

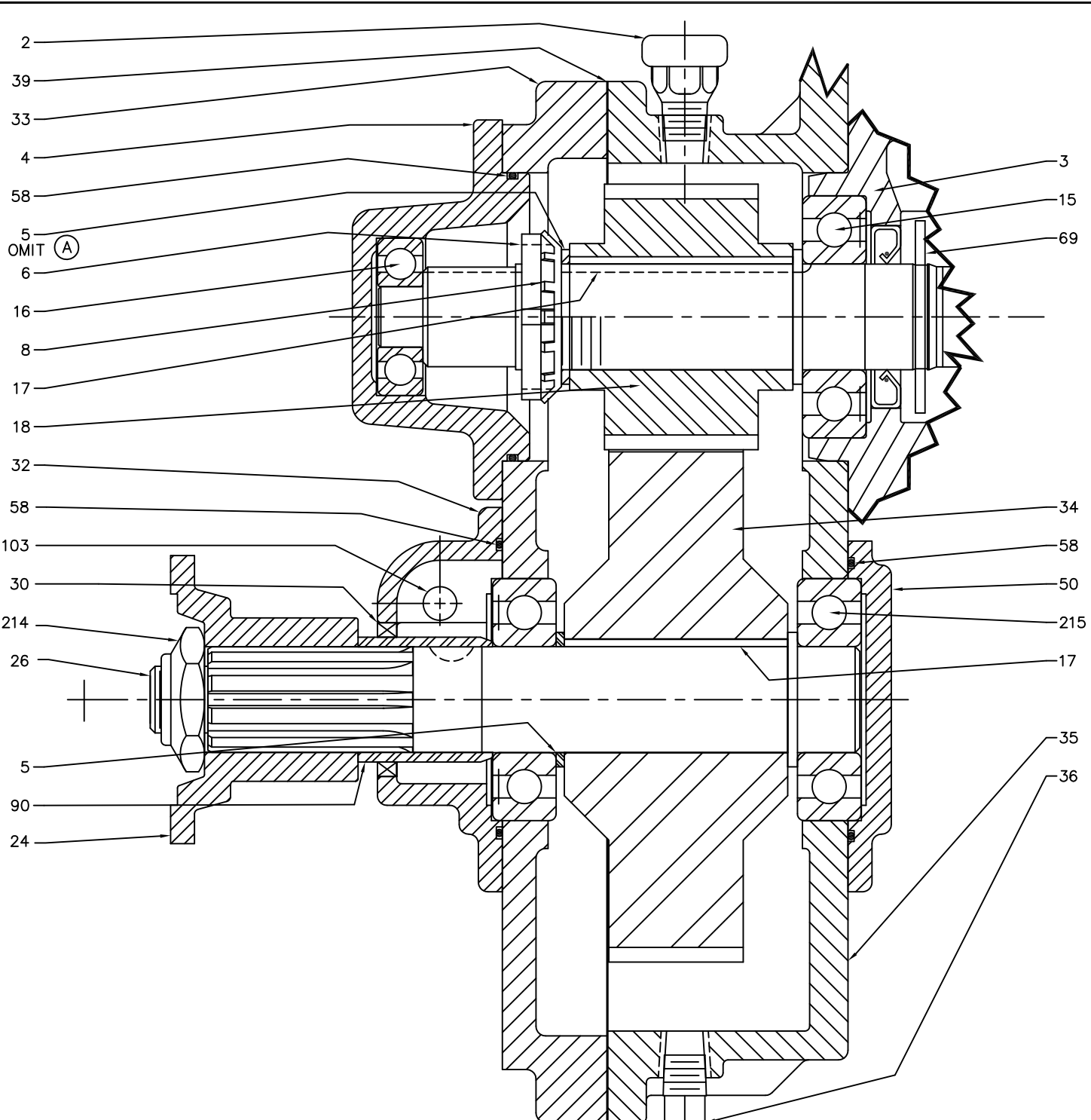
REP#	NAME OF PART	QTY
3	VOLUTE	1
7	SEAL RINGS	2
9	COTTER KEY – STAINLESS STEEL	1
10	IMPELLER NUT	1
11	WASHER – IMPELLER SHAFT	1
12	SUCTION HEAD	1
13	PLUG	1
14	DRAIN COCK	1
45	IMPELLER SHAFT	1
53	OIL SEAL	1
54	WATER SLINGER	1
55	SEAL HOUSING	1
56	MECHANICAL SEAL	1
57	IMPELLER	1
61	SCREEN – STRAINER	1
62	STRAINER – FITTING	1
63	O’RING	1
71	O’RING	1
72	O’RING	1
73	BEARING	1

REMOVE SHARP EDGES

INCH [MILLIMETER] 

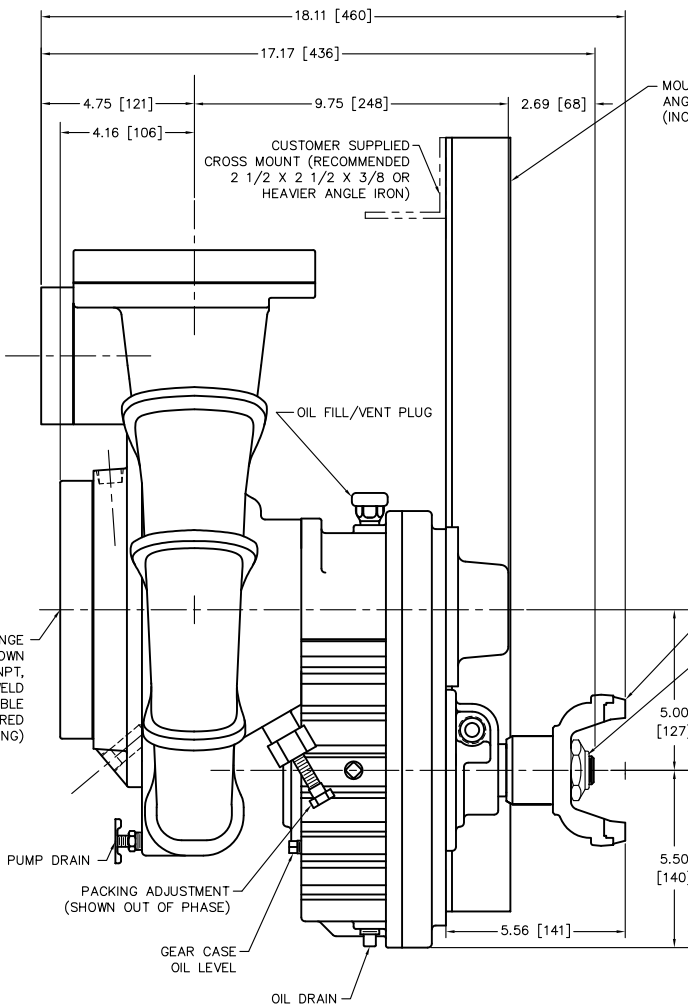
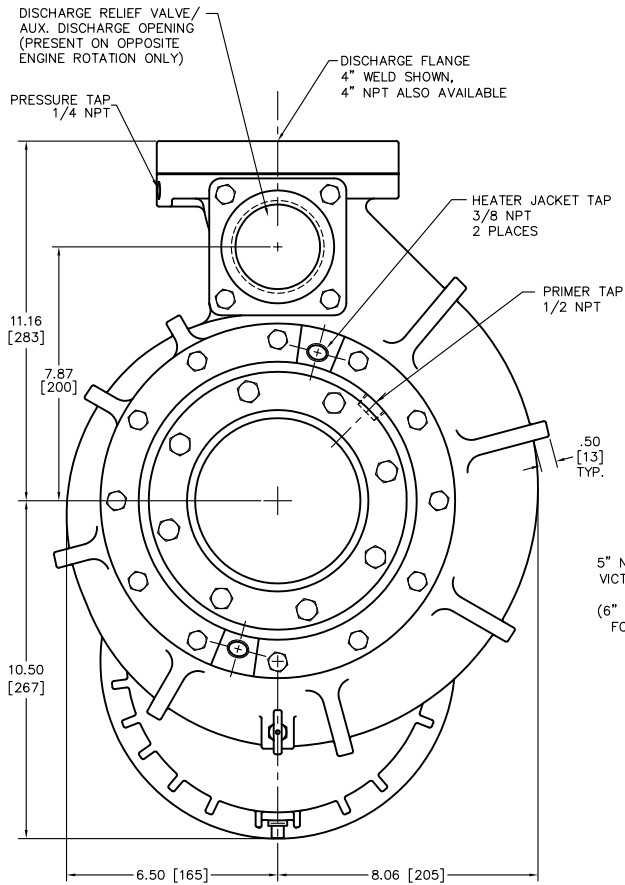
MATERIAL DESCRIPTION: SEE LIST		MATERIAL NO. —	PATTERN NO. —	OLD PART NO. —	TOLERANCE EXCEPT AS NOTED .00 ±.03 .000 ±.010 ANGLES ±1°	 W.S. DARLEY & Co. MELROSE PARK, IL – CHIPPEWA FALLS, WI DWG – KS CROSS SECTION MECHANICAL SEAL, STRAINER
THIS DESIGN IS THE PROPERTY OF W.S. DARLEY AND CO. – UNAUTHORIZED REPRODUCTION IS PROHIBITED		ALL DIMENSIONS IN INCHES UNLESS NOTED	DO NOT SCALE PRINT	DR’N AAN CHKD SJL TRCD	DATE 10/10/2007 SCALE 1/2	

DKC0602

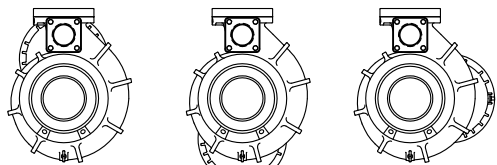
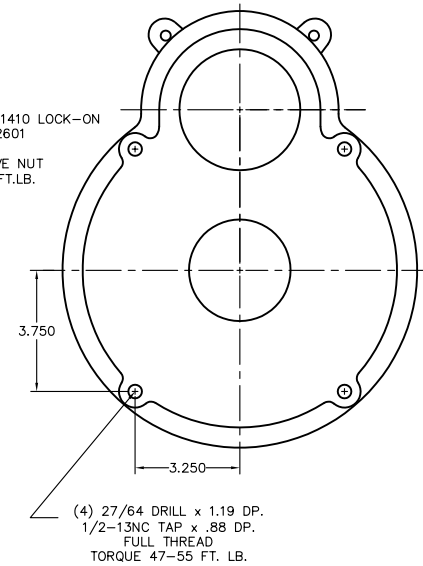
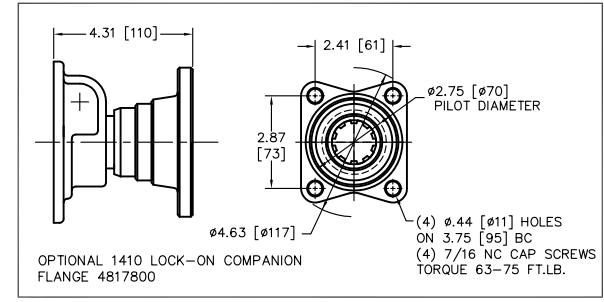


REVISIONS				
LTR	DESCRIPTION	DATE	CHG NO.	APPR'D
(A)	REMOVED (1) SPACER FROM ASSY NOT REQ. W/CARB. GEARS	21SEP2005	2005-278	CKE
(B)	ADDED NOTE: 125 FT-LB	9/30/08	2008-231	AAN

REP#	NAME OF PART	QTY
2	GEAR CASE VENT	1
3	VOLUTE - [REF]	1
4	BEARING CAP - IMP. SHAFT	1
5	GEAR SPACER	(A) 1
6	BEARING LOCKNUT	1
8	BEARING LOCKWASHER	1
15	BEARING	2
16	BEARING - IMP. SHAFT	1
17	KEY - SQ, 0.19 x 2.75	2
18	PINION GEAR	1
24	COMPANION FLANGE	1
26	DRIVE SHAFT	1
30	OIL SEAL	1
32	BEARING CAP	1
33	GEARCASE COVER	1
34	DRIVE GEAR	1
35	GEARCASE	1
36	3/8 OIL DRAIN PLUG - MAGNETIC	1
39	GASKET - GEARCASE	1
50	BEARING CAP	1
58	O'RING - BEARING CAP	3
69	WATER SLINGER	1
90	SPACER (REF)	1
103	PLUG	2
214	NUT - 125 FT-LB (B)	1
215	BEARING	1



REVISIONS				
LTR	DESCRIPTION	DATE	CHG NO.	APPR'D



ROTATED 180° STANDARD ROTATED 90°

OPTIONAL GEAR CASE ORIENTATION

NOTE:

- 1) SUPPORT SUCTION AND/OR DISCHARGE PIPING.
(ALLOW PIVOT POINTS FOR CHASSIS FLEXING.)
- 2) OPPOSITE ENGINE ROTATION SHOWN, ENGINE ROTATION IS ALSO AVAILABLE.
- 3) OVERALL HEIGHT AND WIDTH MAY VARY WITH THE TYPE OF DISCHARGE AND SUCTION.
- 4) OPTIONAL TACHOMETER DRIVE AVAILABLE

NET WEIGHT: 215 lb.[98 kg.]

MOUNTING ANGLE HOLES

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ALL DIMENSIONS IN INCHES UNLESS NOTED

DO NOT SCALE PRINT

DATE: 25 APR 2003

SCALE: 1/2

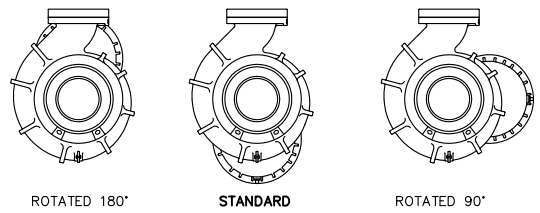
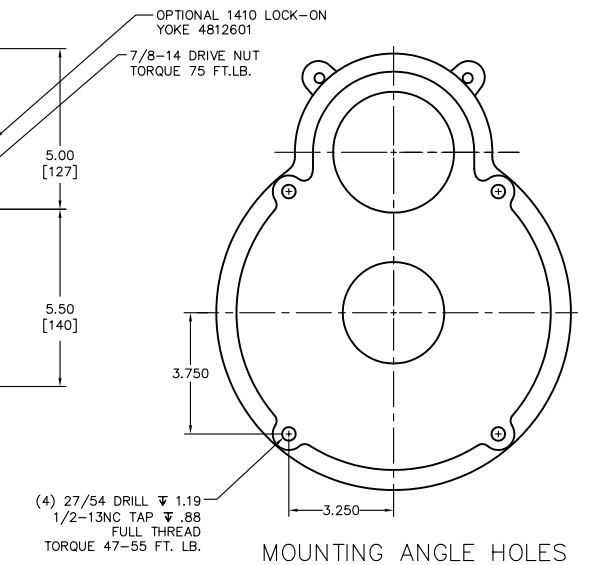
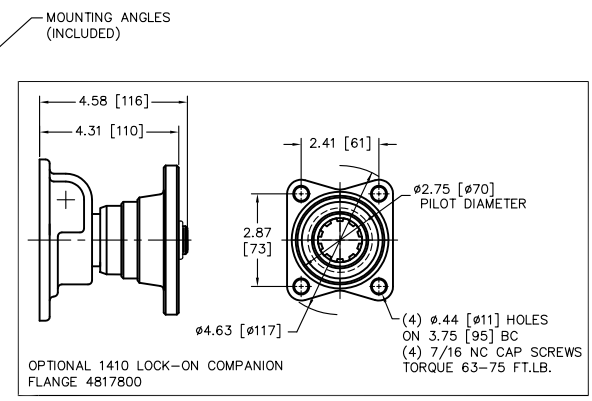
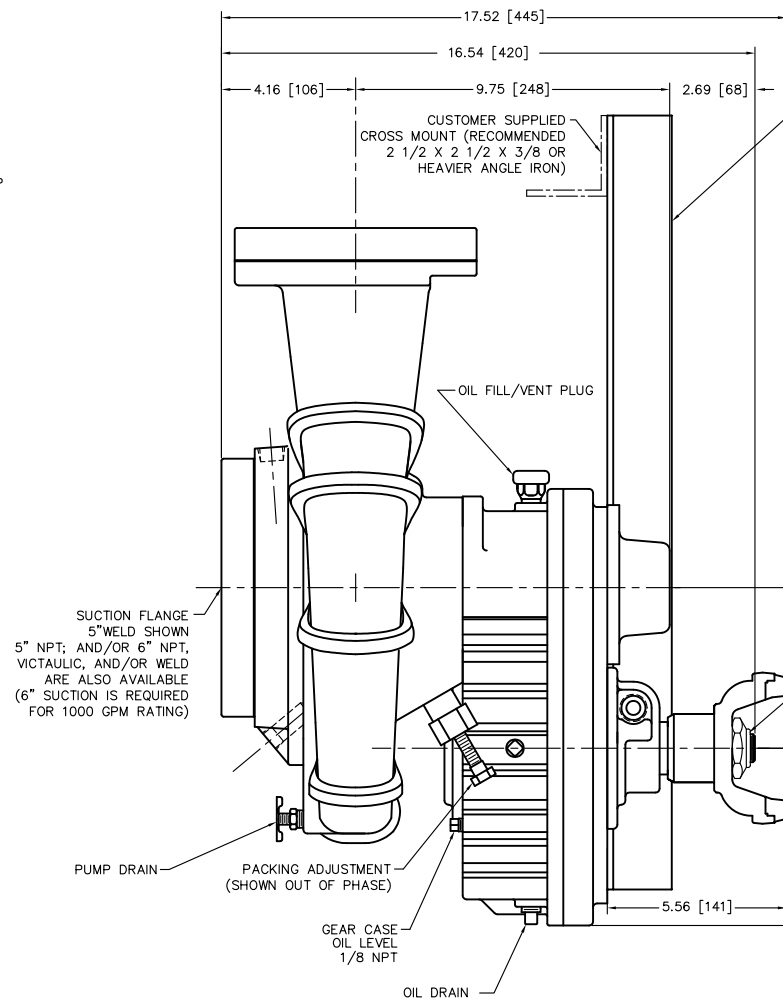
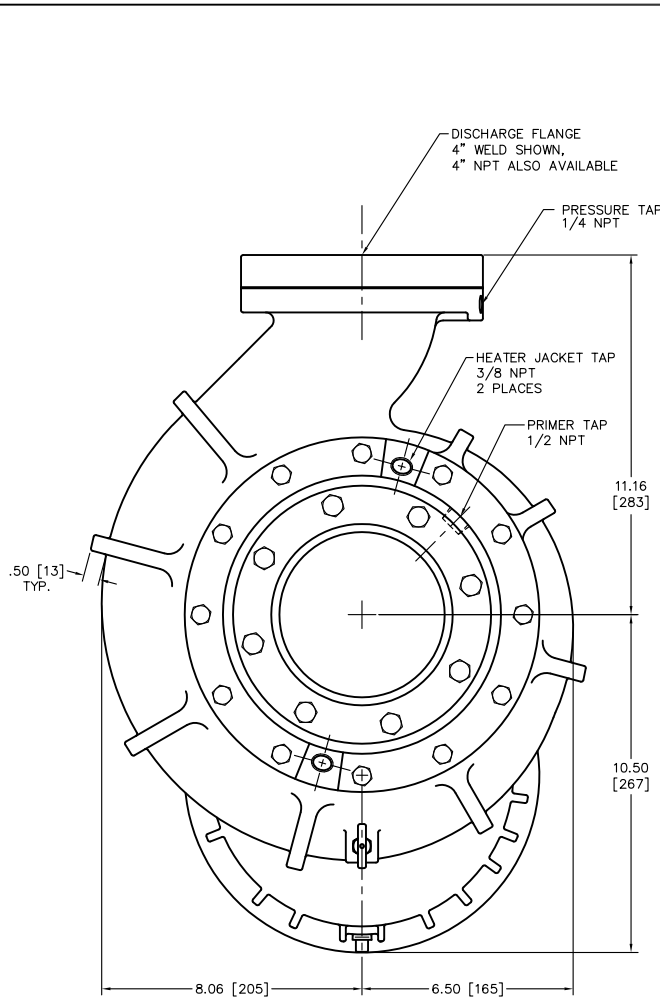
OLD PART NO. -

DATE: 25 APR 2003

SCALE: 1/2

W.S. DARLEY & CO.
MELROSE PARK, IL - SHEPPARD FALLS, WI
DWG - KSP 2GR LOCK-ON OPP ENG DIMENSIONAL

DKD0408



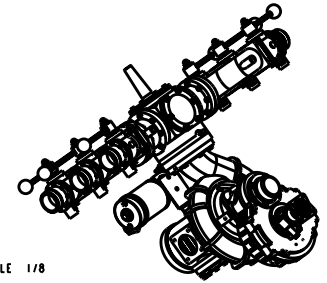
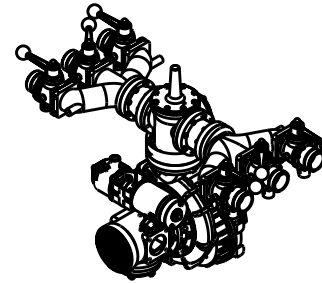
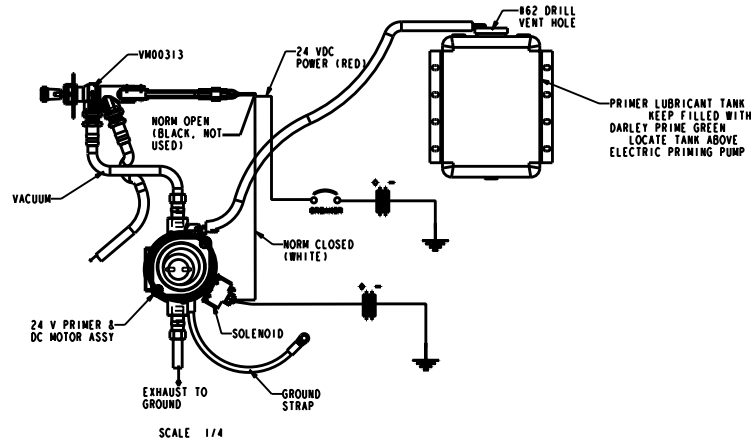
OPTIONAL GEAR CASE ORIENTATION

- NOTES:
- 1) SUPPORT SUCTION AND/OR DISCHARGE PIPING.
(ALLOW PIVOT POINTS FOR CHASSIS FLEXING.)
 - 2) ENGINE ROTATION SHOWN, OPOSITE ENGINE ROTATION IS ALSO AVAILABLE. SEE DRAWING DKD0408
 - 3) OVERALL HEIGHT AND WIDTH MAY VARY WITH THE TYPE OF DISCHARGE AND SUCTION.

NET WEIGHT: 215 lb.[98 kg.]

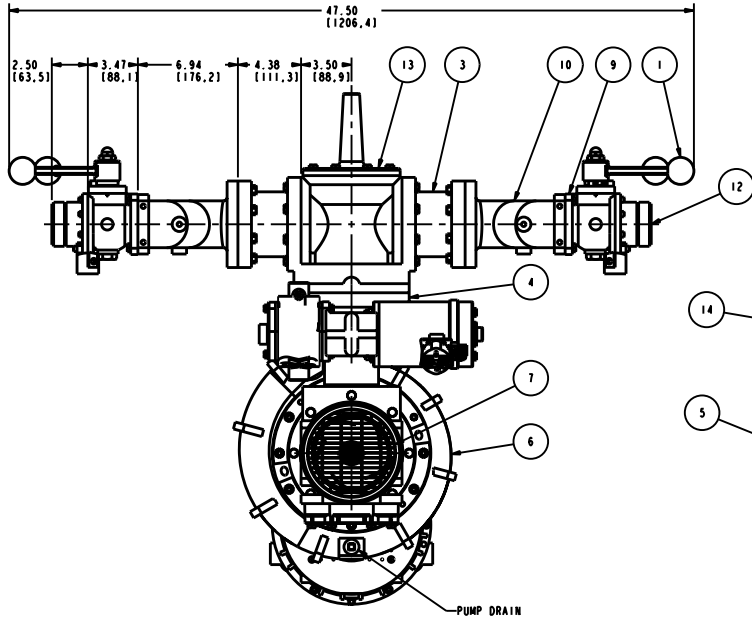
THIS DESIGN IS THE PROPERTY OF W.S. DARLEY AND CO. - UNAUTHORIZED REPRODUCTION IS PROHIBITED		ALL DIMENSIONS IN INCHES UNLESS NOTED	DO NOT SCALE PRINT	INCH [MILLIMETER]	THIRD ANGLE PROJECTION											
OLD PART NO. -	DATE 06MAY,03	SCALE 1/2	W.S. DARLEY & CO. MELROSE PARK, IL - SHEPHERD FALLS, WI DWG - KSP 2 GR, LOCK-ON, ENG. DIMENSIONAL													
<table border="1"> <tr> <td>DRN</td> <td>CKE</td> <td>DATE</td> <td>06MAY,03</td> </tr> <tr> <td>DRD</td> <td>SAL</td> <td>SCALE</td> <td>1/2</td> </tr> <tr> <td>TRD</td> <td></td> <td></td> <td></td> </tr> </table>		DRN	CKE	DATE	06MAY,03	DRD	SAL	SCALE	1/2	TRD				<p>DKD0409</p>		
DRN	CKE	DATE	06MAY,03													
DRD	SAL	SCALE	1/2													
TRD																

NO.	DESCRIPTION	PART NO.	QTY.
1	ASSY - LEVER, FT MT, 5.0"	YM0122	6
2	COMP FLANGE - 1410	4B17800	1
3	ASSY - DIS EXT, 4.00	YE06003	2
4	RIT - ADAPTER, NS DISCHARGE	KC02203	1
5	RIT - LSF 6 NH SUCT & GASKET	KC01800	1
6	PUMP - KS, LH IMPELLER	PK00220	1
7	SCREEN - SUCTION, 6.00"	1120500	1
8	TRANS - KSP, PTO, 2 GR, O-RING	TP00405	1
9	VALVE - BALL, BASIC ASSY	VB00100	6
10	ASSY - DIS, TRIPLE, 5.12 BC	YE03801	2
11	ASSY - FLANGE CWR, BLNK, O-RING	YF03500	1
12	ASSY - NIPPLE, FT MT HOSE THD	YM00215	6
13	HEAD ASSY - LS/PS	HL00203	1
14	PRIMER - 12V ELEC, NO TANK	AP00913_CH18A	1

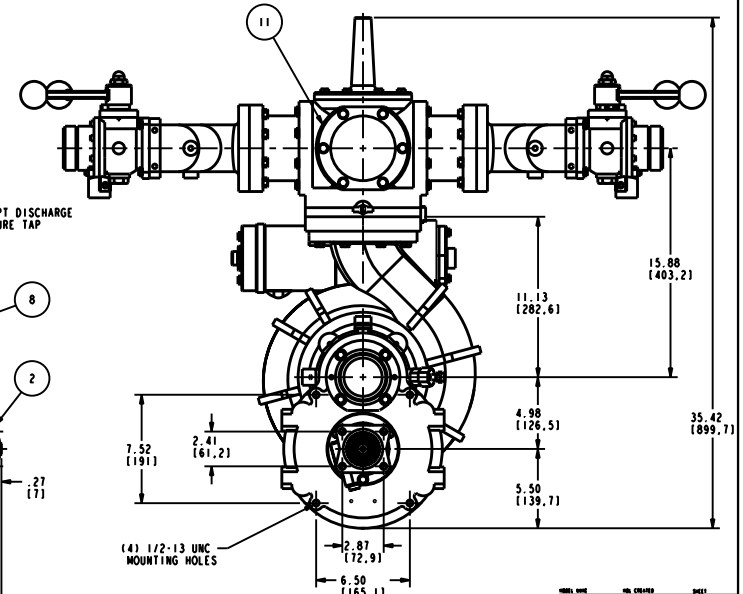
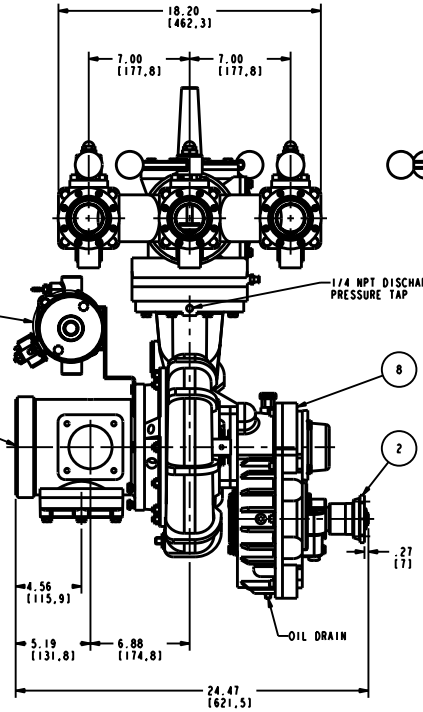


REVISIONS				
LTB	DESCRIPTION	DATE	CHG NO.	APP'D

SCALE 1/8



SCALE 1/4



REMOVE SHARP EDGES

1 INCH (25.4 MILLIMETER)

TOLERANCE UNLESS OTHERWISE SPECIFIED

DATE 13-7-09

SCALE 1/4

OLD PART NO.

PATTERN NO.

DATE 13-7-09

SCALE 1/4

TOLERANCE UNLESS OTHERWISE SPECIFIED

DATE 13-7-09

SCALE 1/4

SCALE 1/4

W.S. Darley & Co.

PLANK, IL - CALIFORNIA, USA

DWG - KSP, 2GR, CHINA

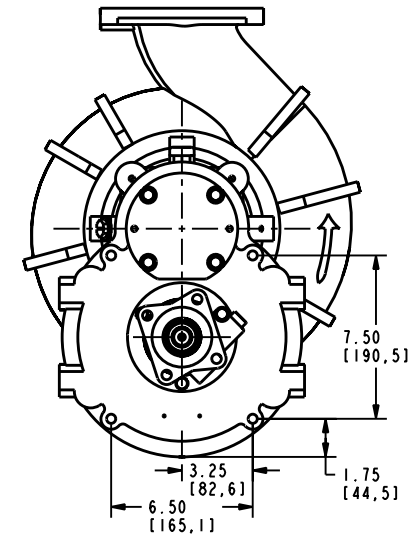
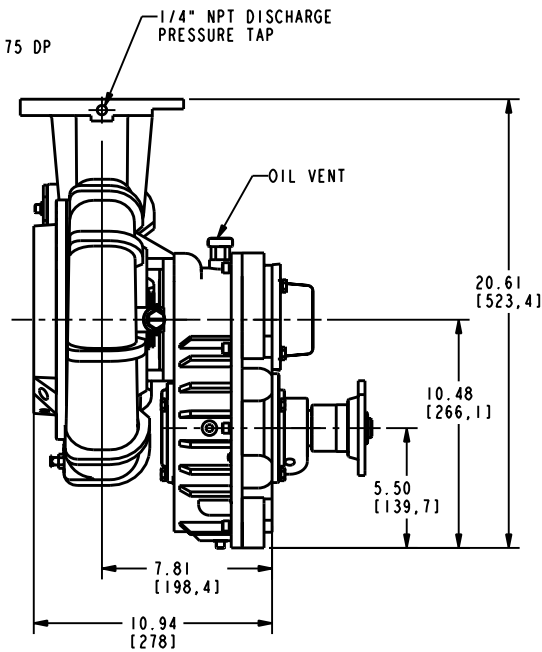
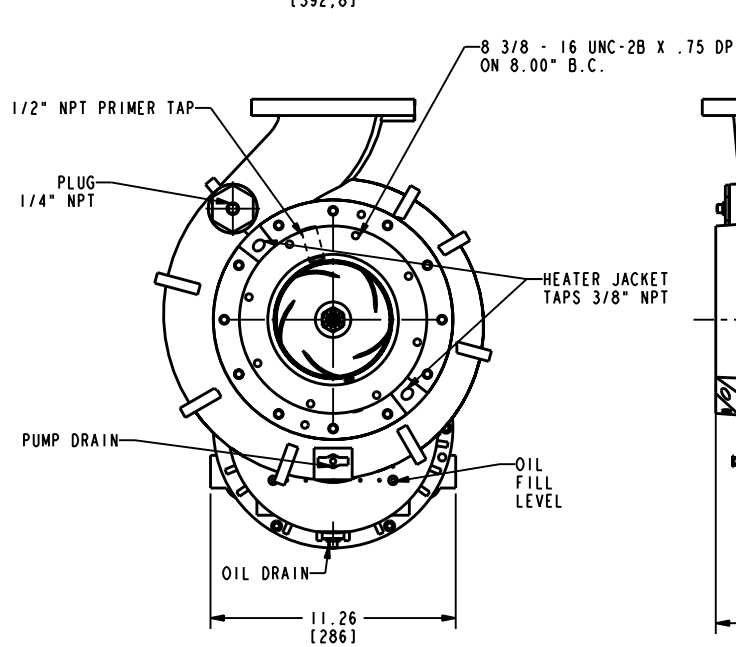
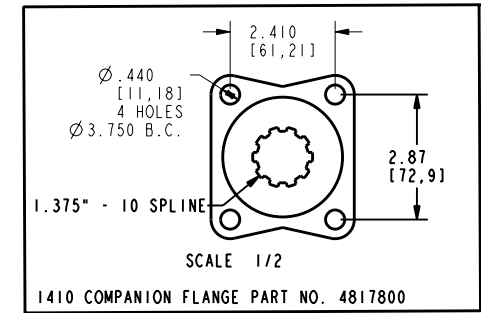
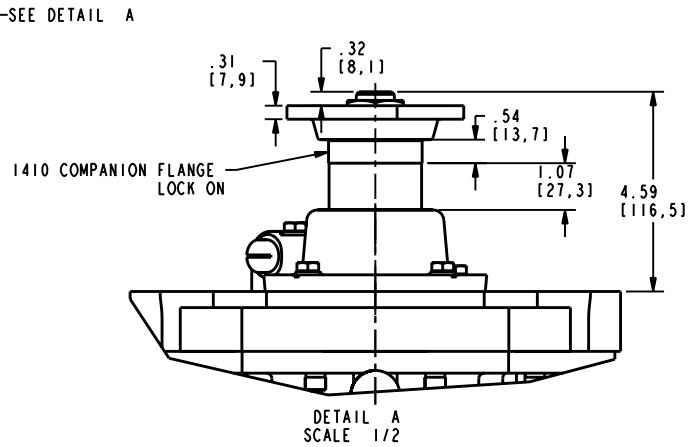
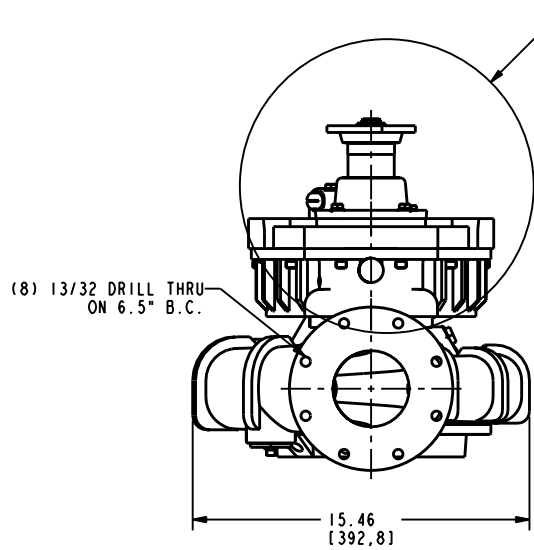
SCALE 1/4

DKD0412

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

NAME:KMD OBJECT:DKD0415 DATE:10-Jun-11 12:32:41

REVISIONS				
LTR	DESCRIPTION	DATE	CHG NO.	APPR'D



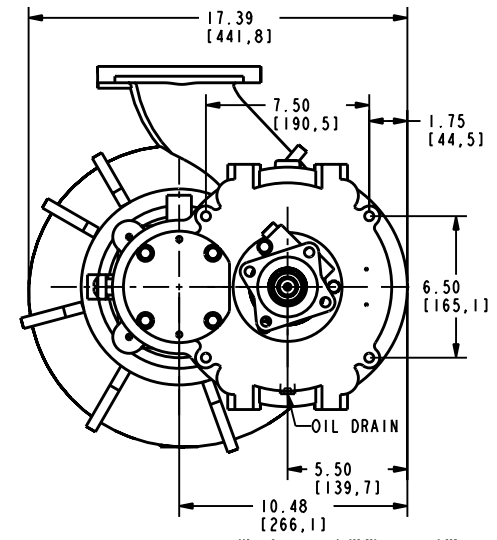
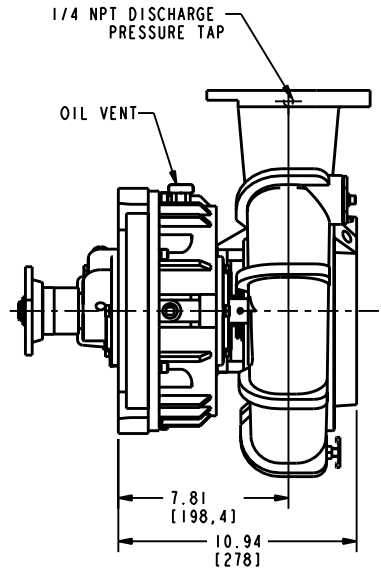
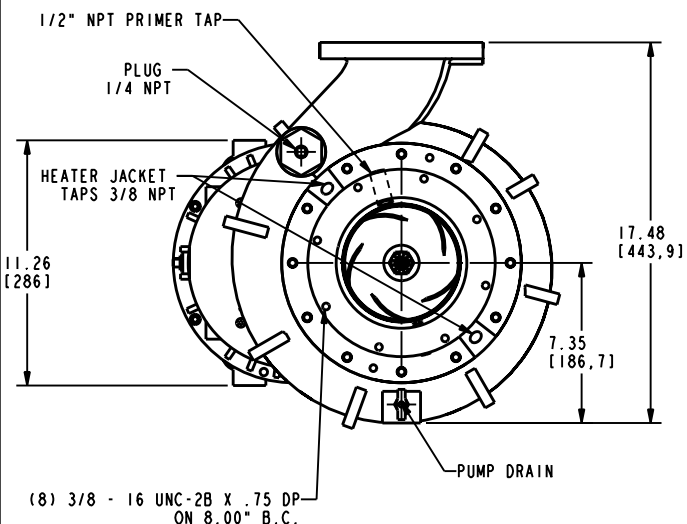
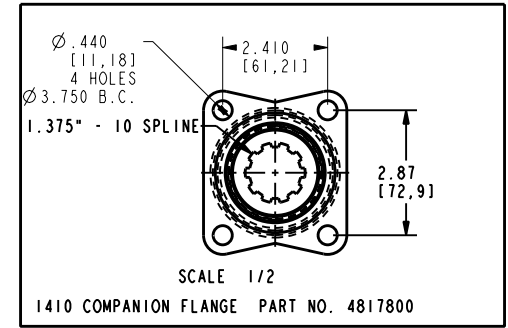
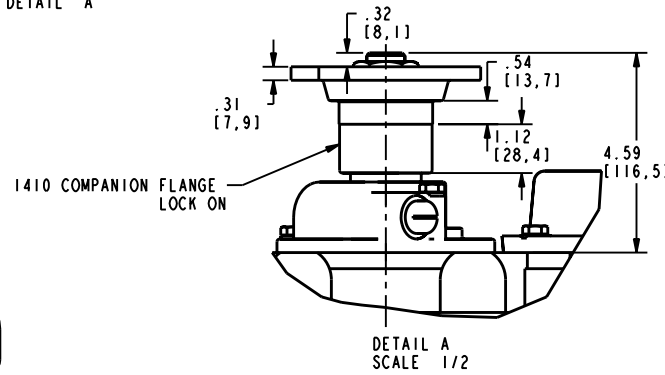
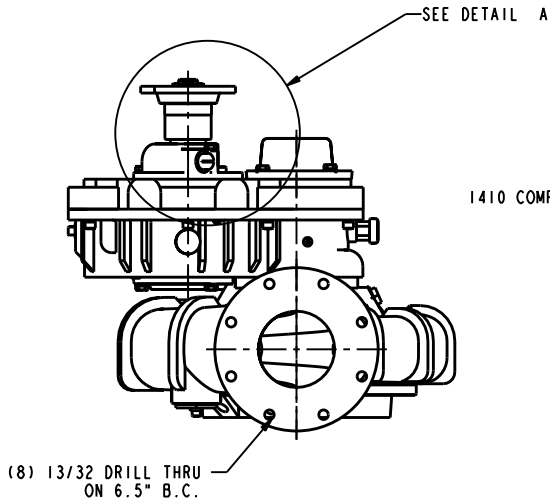
REMOVE SHARP EDGES		INCH (MILLIMETER)	OLD PART NO.	TOLERANCE EXCEPT AS NOTED ±.000 ±.003 ±.000 ±.010 ANGLES 2°	W.S. Darley & Co. TASCA, IL - CHIPPEWA FALLS, WI
MATERIAL DESCRIPTION:		MATERIAL NO.	PATTERN NO.	DR'N BND CHWD TRCD	KSP 2GR MECH. CHINA
THIS DESIGN IS THE PROPERTY OF W.S. DARLEY AND CO. - UNAUTHORIZED REPRODUCTION IS PROHIBITED		ALL DIMENSIONS IN INCHES UNLESS NOTED		DO NOT SCALE PRINT	DATE 24-May-11 SCALE 1/4

MODEL NAME	NO. CREATED	SHEET
DKD0415	5-24-11	1/1 C

DKD0415

NAME:KMD OBJECT:DKD0416 DATE:10-Jun-11 12:45:54

REVISIONS				
LTR	DESCRIPTION	DATE	CHG NO.	APPR'D



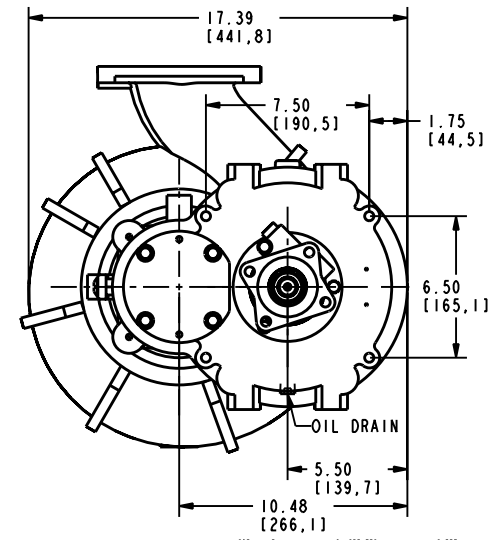
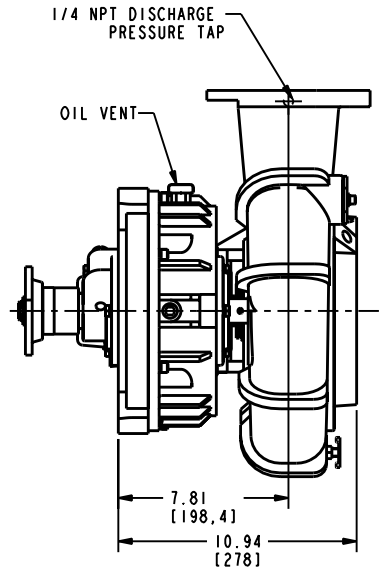
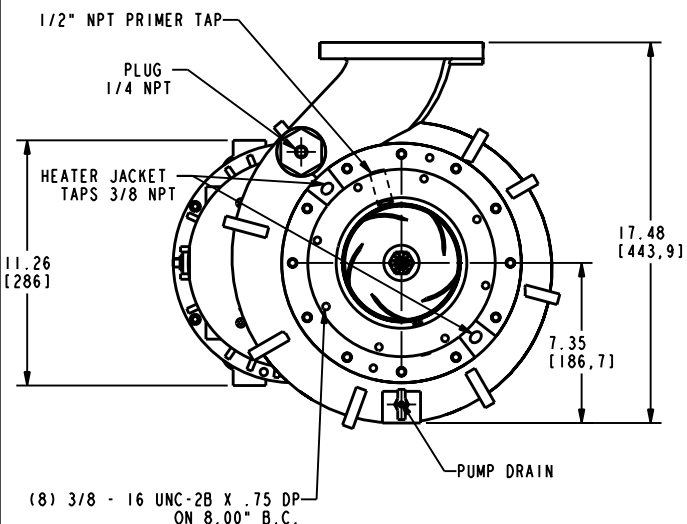
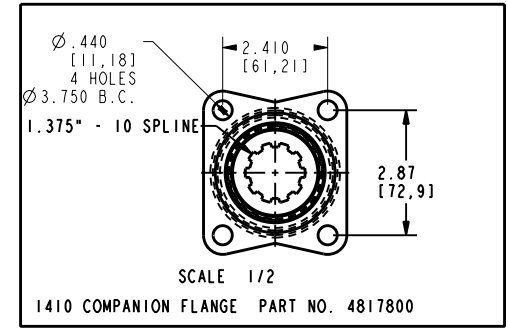
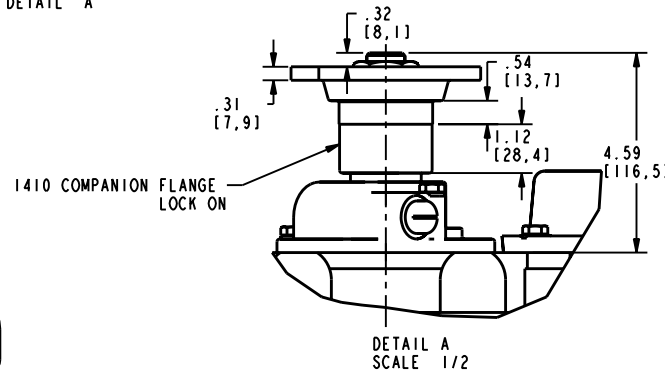
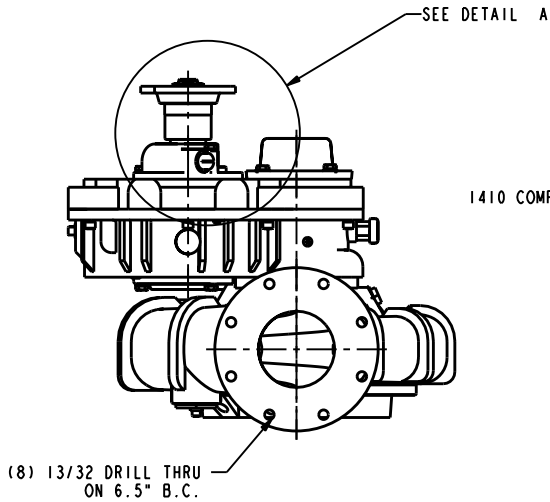
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MATERIAL DESCRIPTION:		MATERIAL NO.	PATTERN NO.	KSP 2GR MECH. 90 DEG. CHINA	DATE 03-Jun-11
THIS DESIGN IS THE PROPERTY OF W.S. DARLEY AND CO. - UNAUTHORIZED REPRODUCTION IS PROHIBITED		ALL DIMENSIONS IN INCHES UNLESS NOTED		DO NOT SCALE PRINT	SCALE 1/8

MODEL NAME	DKD0416	REV. CREATED	5-24-11	SHEET	1/1	C
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DKD0416

NAME:KMD OBJECT:DKD0416 DATE:10-Jun-11 12:45:54

REVISIONS				
LTR	DESCRIPTION	DATE	CHG NO.	APPR'D



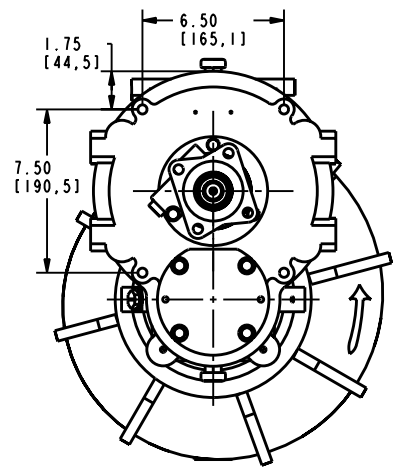
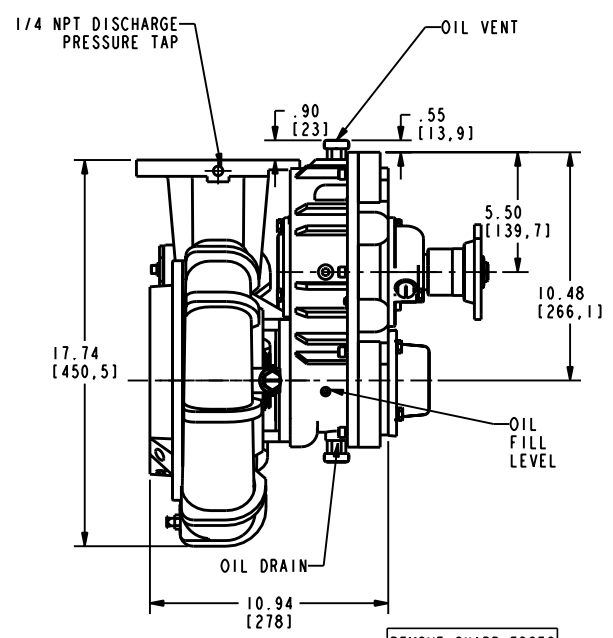
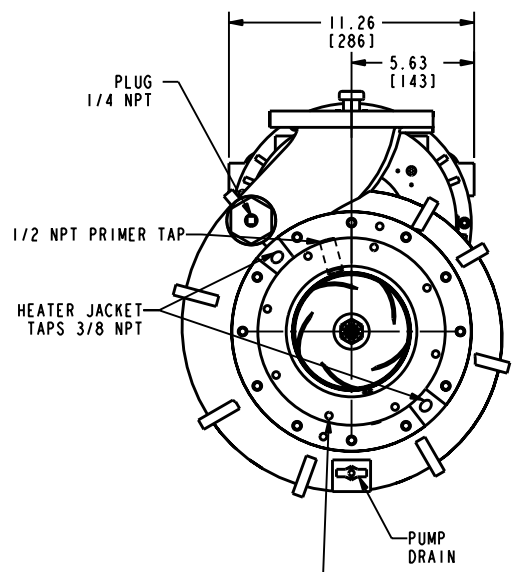
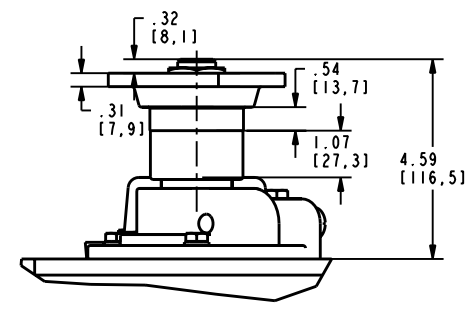
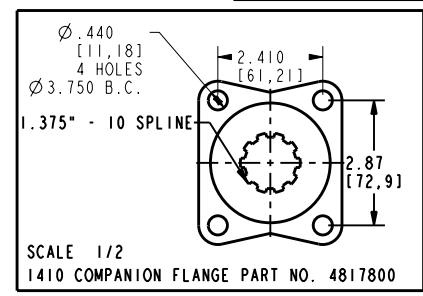
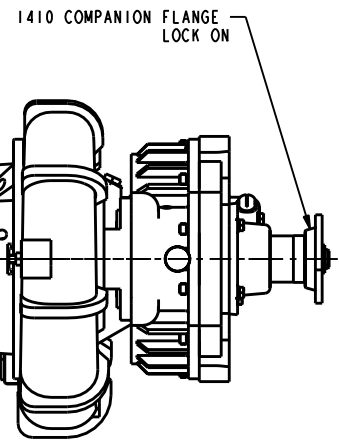
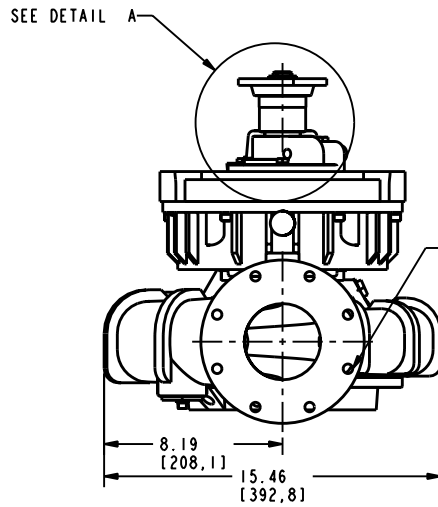
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THIS DESIGN IS THE PROPERTY OF W.S. DARLEY AND CO. - UNAUTHORIZED REPRODUCTION IS PROHIBITED		ALL DIMENSIONS IN INCHES UNLESS NOTED		DO NOT SCALE PRINT			

MODEL NAME	DKD0416	REV. CREATED	5-24-11	SHEET	1/1	C
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W.S. Darley & Co.
 TASCA, IL - CHIPPEWA FALLS, WI
 KSP 2GR
 MECH. 90 DEG. CHINA

NAME:KMD OBJECT:DKD0417 DATE:10-Jun-11 12:33:29

REVISIONS				
LTR	DESCRIPTION	DATE	CHG NO.	APPR'D



(8) 3/8 - 16 UNC - 2B X .75 DP ON 8.00" B.C.

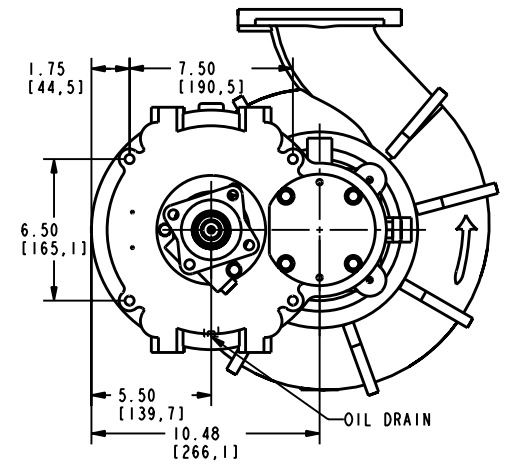
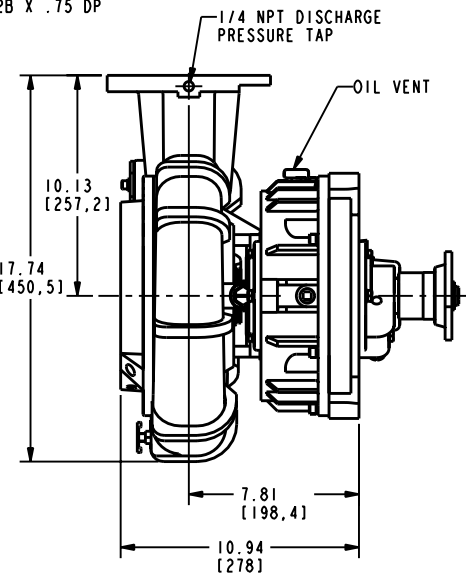
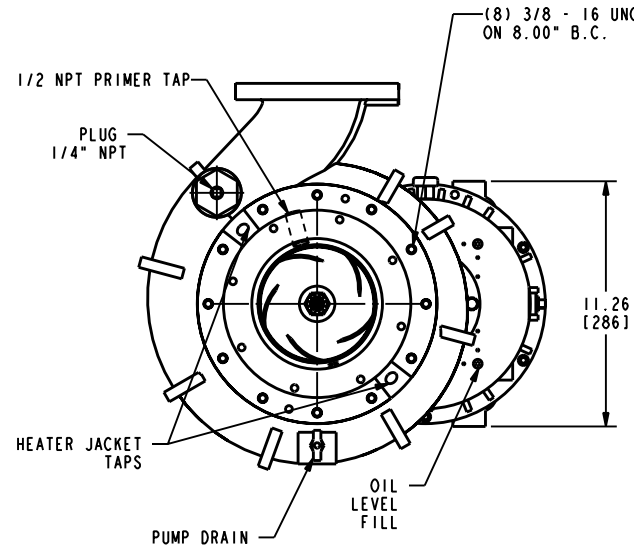
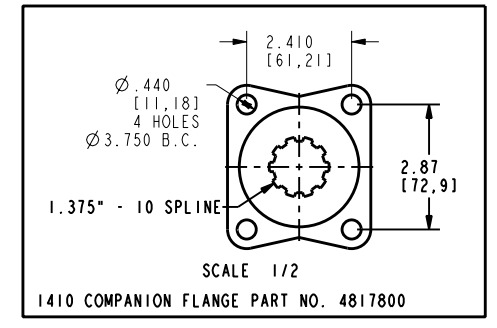
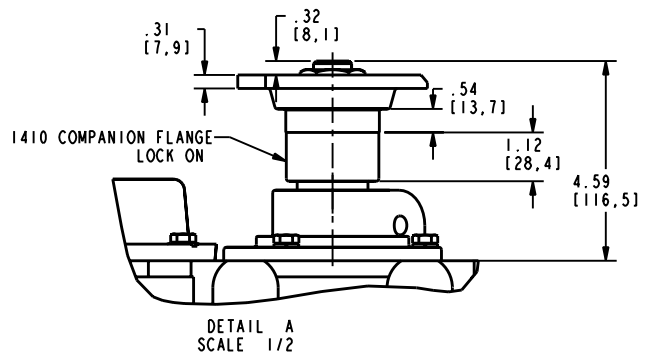
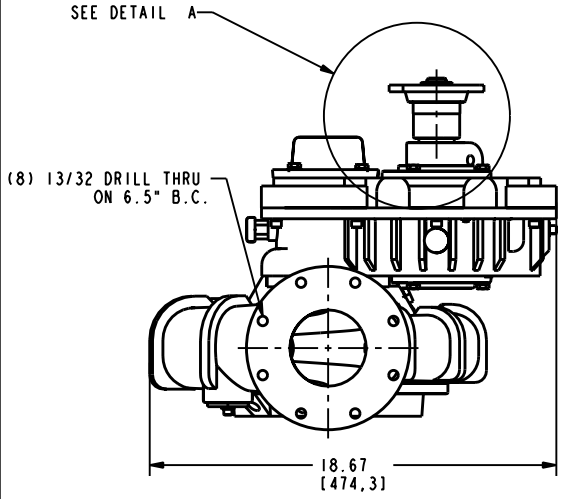
REMOVE SHARP EDGES

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	DATE 03-Jun-11	DR'N BND	SCALE 1/8	
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	DATE 03-Jun-11	SCALE 1/8

DKD0417

NAME:KMD OBJECT:DKD0418 DATE:10-Jun-11 12:46:52

REVISIONS				
LTR	DESCRIPTION	DATE	CHG NO.	APPR'D



REMOVE SHARP EDGES		INCH [MILLIMETER]	OLD PART NO.	TOLERANCE EXCEPT AS NOTED .00 ±.03 .000 ±.010 ANGLES 2R	W.S. Darley & Co. TASCA, IL - CHIPPEWA FALLS, WI
MATERIAL DESCRIPTION:		MATERIAL NO.	PATTERN NO.	KSP 2GR MECH. 270 DEG CHINA	DATE 06-Jun-11
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	SCALE 1/8
MODEL NAME DKD0418		MFG CREATED 5-24-11		SHEET 1/1 C	
				DKD0418	

Mechanical Seal

Prepared by: CWY
Approved by: RJG
Revised by:

Rev. 0
Date: 06/20/13
Rev. Date:
1200652.doc

Mechanical Shaft Seal

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

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

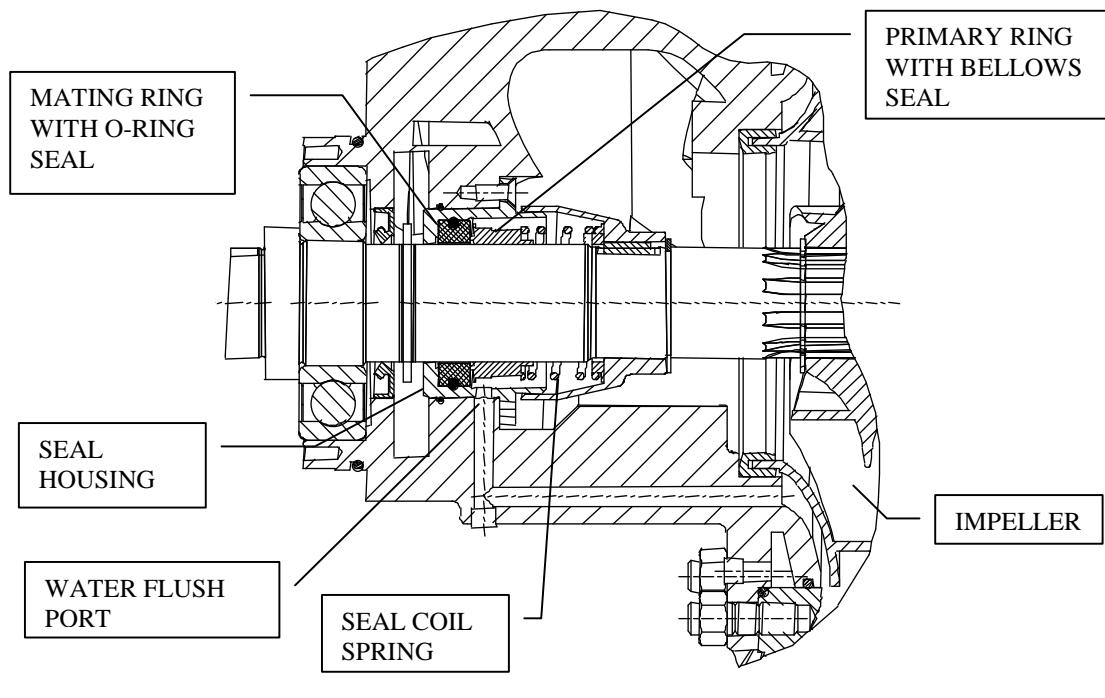
Mechanical Seal Basics

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

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

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

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



Operation and Maintenance

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

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

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

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



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



CAUTION: DO NOT USE THIS PUMP FOR HOSE TESTING



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



DARLEY

INSTALLATION OF MECHANICAL FACE SEAL WITH O’RING

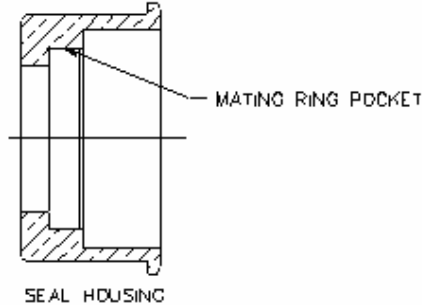
SPECIAL HANDLING

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

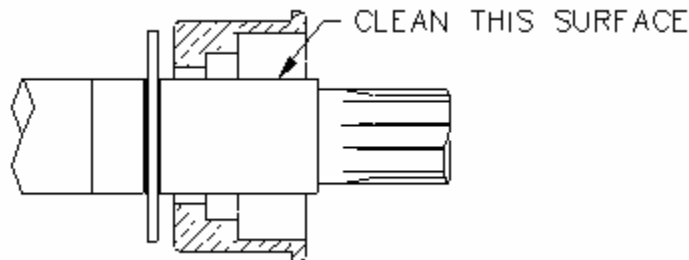
INSTRUCTION STEPS:

Instructions for Installing a Mechanical Shaft Seal

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

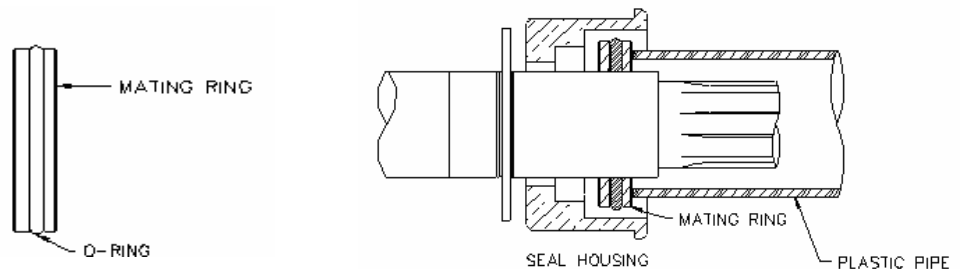
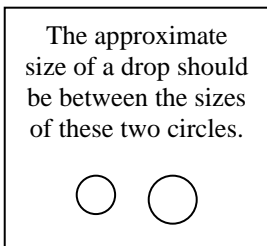


2. Inspect the pump shaft surface under the bellows, ensuring it is clean and nick free to provide a proper sealing surface. Isopropyl alcohol may be used to clean surface if required.



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

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

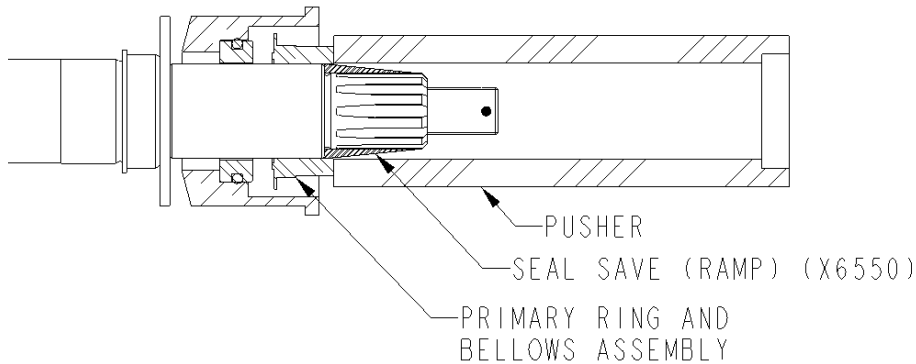
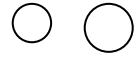


4. Clean the mating ring surface with isopropyl alcohol to remove any fingerprints and any other contaminants left on mating ring.

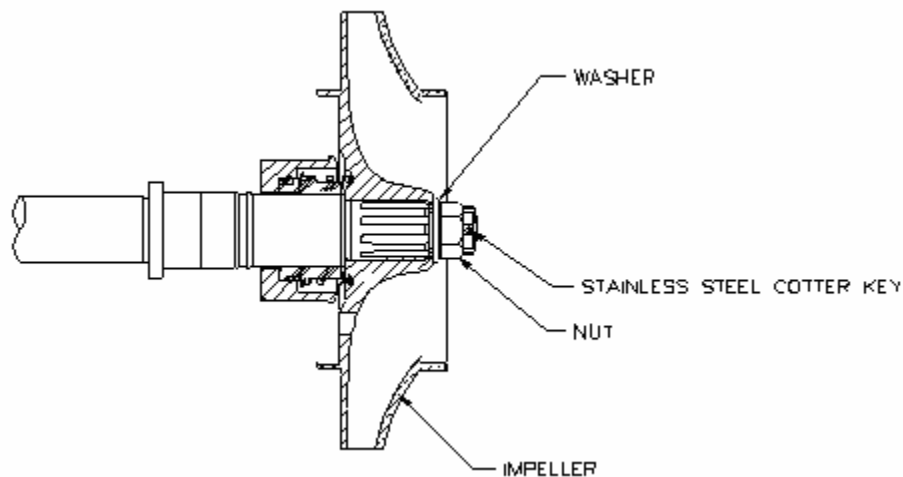
Note: Steps 5 – 9 need to all be completed with in 15 minutes or less.

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

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



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



** Reference pump configuration for individual mechanical seal instructions.

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

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

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

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

Stuffing Box Adjustment

Prepared by: CWY
Approved by: RJG
Revised by:

Rev. 0
Date: 06/20/13
Rev. Date:
1200652.doc



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.

⚠ Attention: Prop 65 Warning does not apply to white packing, which does not contain lead.

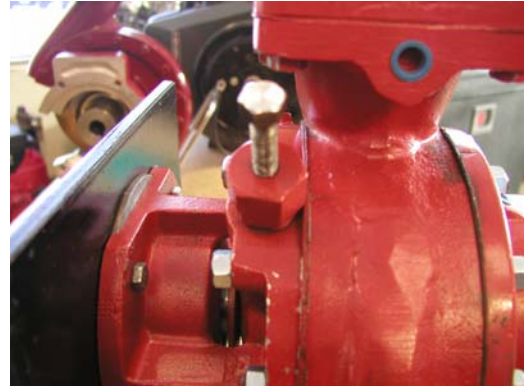
⚠ Caution: Do not attempt to use anything but Darley injection packing. Using the wrong packing material in your pump may cause catastrophic failure of the pump shaft sealing components.

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

Electric Primer

Prepared by: CWY
Approved by: RJG
Revised by:

Rev. 0
Date: 06/20/13
Rev. Date:
1200652.doc

W.S. DARLEY & CO.

OPERATING INSTRUCTIONS - ELECTRIC PRIMING PUMP

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

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

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

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

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

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

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



CAUTION: FOR PRIMING UP TO 10' OF LIFT:

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



CAUTION: FOR PRIMING 10' OF LIFT AND HIGHER:

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



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

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

Engage “Pump” shift to start pumping water.

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

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

LUBRICATING SYSTEM - ELECTRIC PRIMING PUMPS WITH FLUID RESERVOIR

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

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

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

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

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

ELECTRIC PRIMING PUMPS WITHOUT FLUID RESERVOIR

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

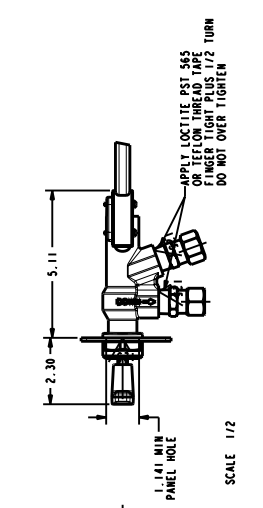
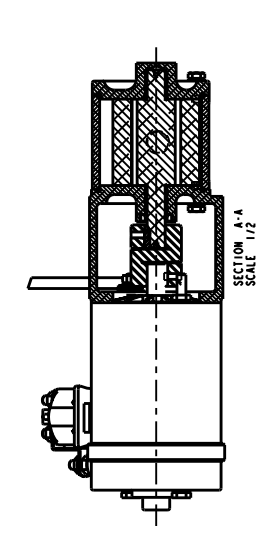
This film should not wash away completely if the pump is used to pump clean water. If the priming pump is disassembled for any reason, all internal surfaces of the housing and end caps must be cleaned and coated completely with Dow Corning #111 Silicone valve lubricant prior to operating the primer.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

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

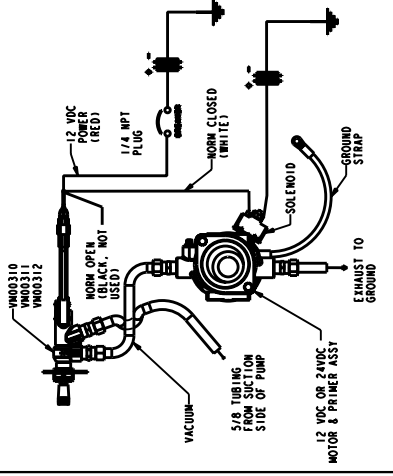
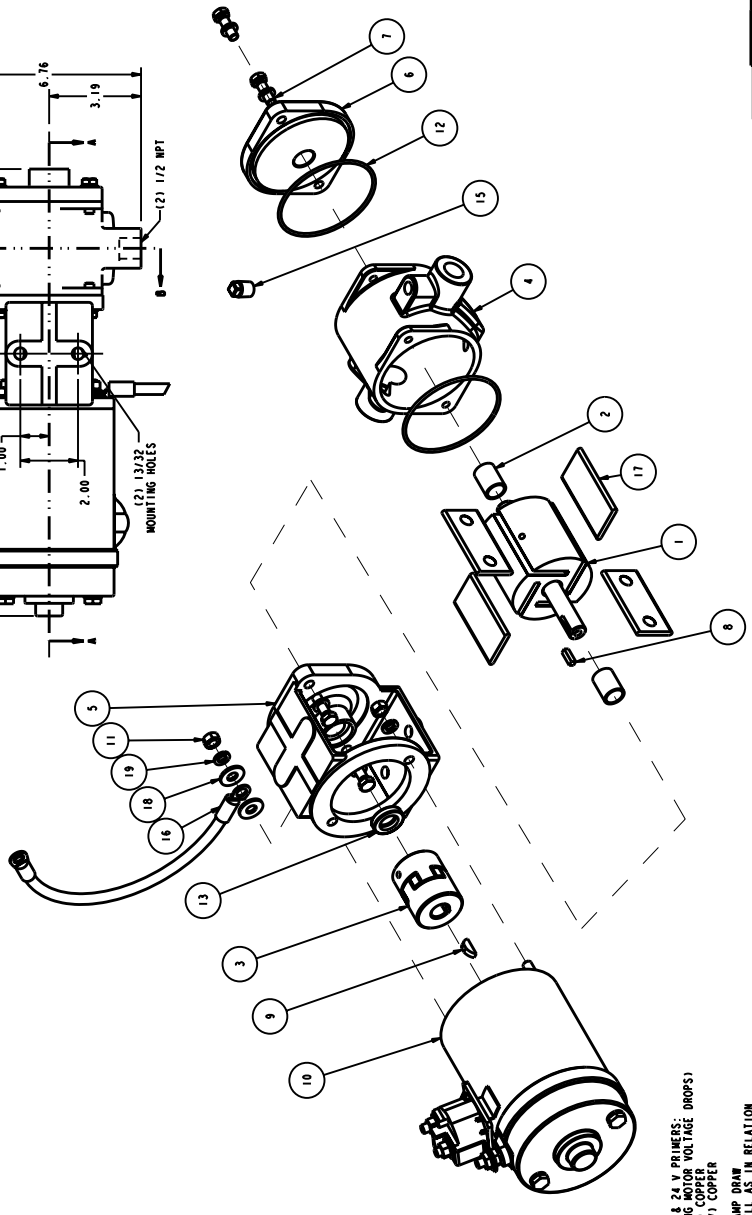
AN	DESCRIPTION	PART NO.	QTY.
1	ASSEMBLY - PRIMER, MOTOR	4220105	1
2	BEARING - OILITE, 0.625 ID	1760023	2
3	COUPLING - 844093	2404500	1
4	CYLINDER - VACUUM PUMP	020800	1
5	HEAD - CYLINDER INBOARD	200800	1
6	HEAD - CYLINDER, OUTBOARD	200800	1
7	SHIMS - .313-18 X 1.00 SST	540610	4
8	KEY - .50, 0.19 X 0.62 GR2	3602425	1
9	KEY - WOODRUFF, .606	3602200	1
10	MOTOR - PRIMER, 12V	4223400	1
11	NUT - HEX, .313-15, SST	5403024	2
12	O-RING - 3.50 X 3.69 X 0.69	3801101	2
13	OIL SEAL - 0.625 ID X 1.128 OD	3800305	1
14	PLUG - PIPE, 0.250, BR, 50, 10	080504	1
15	STRAP - GROUND, 12V PRIMER	080516	1
16	SOLENOID	4407601	1
17	WASHER - FLAT, 5/16, STEEL	3403802	2
18	WASHER - LOCK, 0.313 ID	3403502	6

REVISIONS

NO.	DESCRIPTION	DATE	BY	CHKD.	APP.
1	REVISED FOR USE	11/11/08	SSG	SSG	SSG



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



NOTE:
 MOUNT WITH EXHAUST OUTLET DOWN
 CONNECT 4 GA COPPER GROUND STRAP TO CLEAN, PAINT FREE GROUNDING SURFACE IF SUPPLIED GROUND STRAP IS REMOVED FROM ASSEMBLY, RETIGHTEN CYLINDER HEAD ADAPTER TO 90 IN.-LB.
 POSITIVE LEAD WIRE SIZES FOR 12 V & 24 V PRIMERS:
 0 - 1/8" STANDARD (12V), #12 (24V) COPPER
 0 - 10 25' #10 (12V), #2 (24V) COPPER
 THESE GAGE WIRES CORRESPOND WITH AMP DRAW REQUIREMENTS FOR EACH WIRE AS WELL AS IN RELATION TO RESISTANCE OVER GIVEN LENGTH.
 12 V = 240 AMP
 24 V = 140 AMP

WEIGHT = 27 LB. (12.1 KG)

REMOVE SHARP EDGES

PLEASE DESCRIBE IN FULL THE MODIFICATION TO THIS DRAWING IN THE COMMENTS SECTION OF THE REVISIONS

DO NOT SCALE PRINT

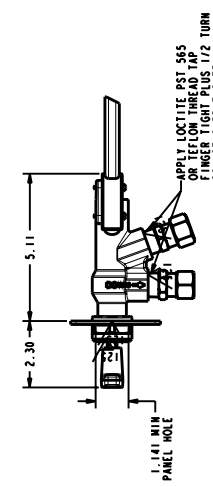
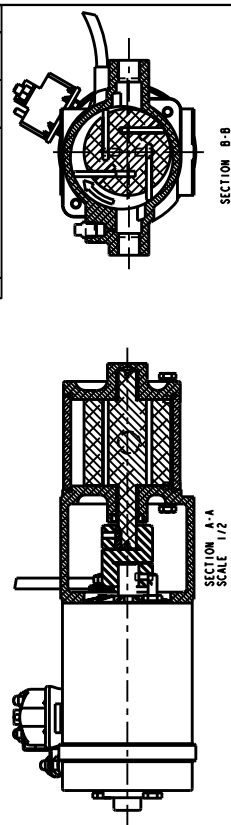
REV.	NO.	DATE	BY	CHKD.	APP.
1	1	11/11/08	SSG	SSG	SSG

INCH DIMENSIONS
 MILLIMETER DIMENSIONS

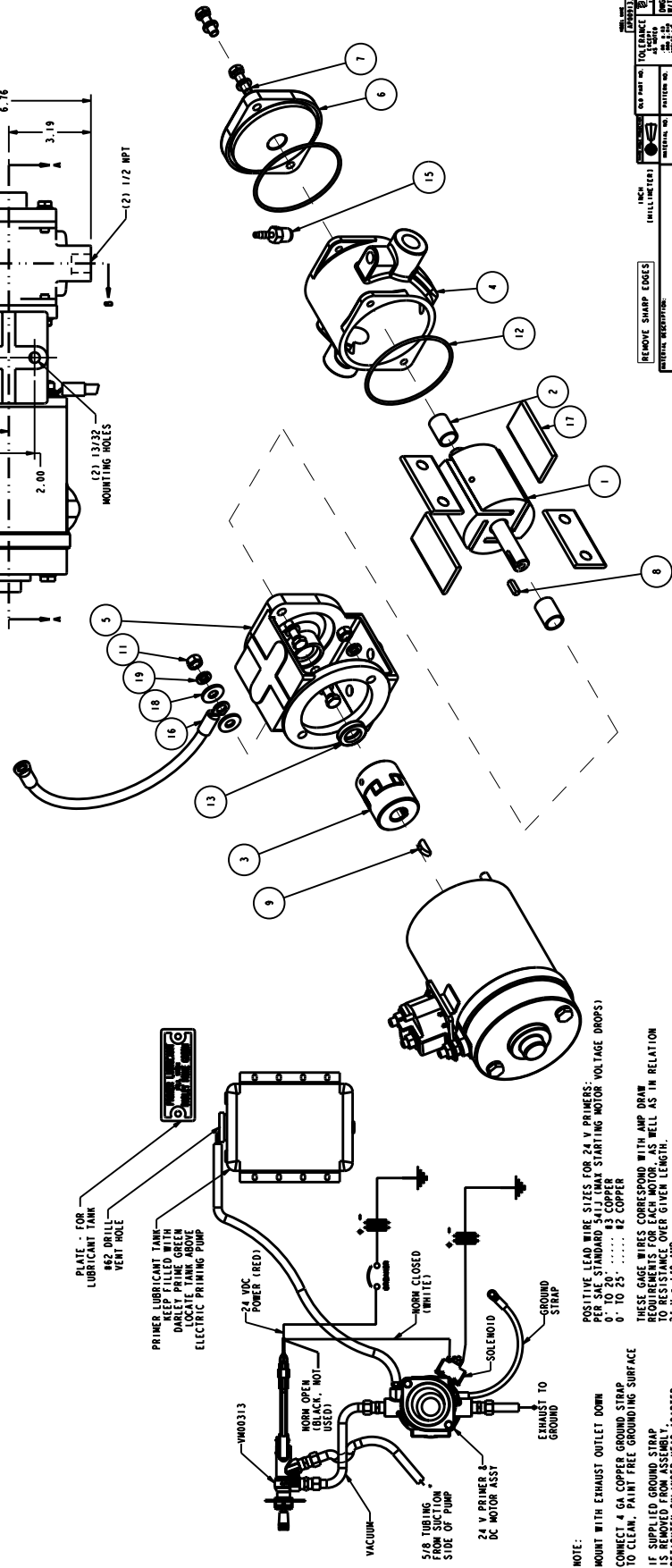
DESIGNED BY: M. J. CAMPBELL
 DRAWN BY: M. J. CAMPBELL
 CHECKED BY: M. J. CAMPBELL
 DATE: 10-09-08
 SECTION: 15P080
 DVC0207

NO.	DESCRIPTION	PART NO.	QTY.
1	ASSEMBLY - PRIMER, MOTOR	425105	1
2	BEARING - OILITE, 0.625 ID	176023	2
3	COUPLING - 844093	2404500	1
4	CYLINDER - VACUUM PUMP	1024800	1
5	HEAD - CYLINDER IMBOARD	2008904	1
6	HEAD - CYLINDER, OUTBOARD	2008900	1
7	NUCS - 313-18 X 1.00, SST	5408610	4
8	KEY - 50, 0.19 X 0.62 GR2	3602425	1
9	KEY - WOODRUFF, 608	3602200	1
10	MOTOR - PRIMER, 24V	4223500	1
11	WASHER - MET., 313-15, SST	5403024	2
12	O-RING - 3.50 X 3.69 X 0.09	3601101	2
13	OIL SEAL - 0.625 ID X 1.128 OD	3600905	1
14	TUBE FITTING - STR., .25 X .19	3300021	1
15	STRAP - GROUND, 12V PRIMER	2600516	1
16	WASHER - FLAT, 5/16, STEEL	4407640	4
17	WASHER - LOCK, 0.313 ID	3603502	2
18	WASHER - LOCK, 0.313 ID	3603502	2
19	WASHER - LOCK, 0.313 ID	3603502	2
20	WASHER - LOCK, 0.313 ID	3603502	2
21	WASHER - LOCK, 0.313 ID	3603502	2
22	WASHER - LOCK, 0.313 ID	3603502	2
23	WASHER - LOCK, 0.313 ID	3603502	2
24	WASHER - LOCK, 0.313 ID	3603502	2
25	WASHER - LOCK, 0.313 ID	3603502	2
26	WASHER - LOCK, 0.313 ID	3603502	2
27	WASHER - LOCK, 0.313 ID	3603502	2
28	WASHER - LOCK, 0.313 ID	3603502	2
29	WASHER - LOCK, 0.313 ID	3603502	2
30	WASHER - LOCK, 0.313 ID	3603502	2
31	WASHER - LOCK, 0.313 ID	3603502	2
32	WASHER - LOCK, 0.313 ID	3603502	2
33	WASHER - LOCK, 0.313 ID	3603502	2
34	WASHER - LOCK, 0.313 ID	3603502	2
35	WASHER - LOCK, 0.313 ID	3603502	2
36	WASHER - LOCK, 0.313 ID	3603502	2
37	WASHER - LOCK, 0.313 ID	3603502	2
38	WASHER - LOCK, 0.313 ID	3603502	2
39	WASHER - LOCK, 0.313 ID	3603502	2
40	WASHER - LOCK, 0.313 ID	3603502	2
41	WASHER - LOCK, 0.313 ID	3603502	2
42	WASHER - LOCK, 0.313 ID	3603502	2
43	WASHER - LOCK, 0.313 ID	3603502	2
44	WASHER - LOCK, 0.313 ID	3603502	2
45	WASHER - LOCK, 0.313 ID	3603502	2
46	WASHER - LOCK, 0.313 ID	3603502	2
47	WASHER - LOCK, 0.313 ID	3603502	2
48	WASHER - LOCK, 0.313 ID	3603502	2
49	WASHER - LOCK, 0.313 ID	3603502	2
50	WASHER - LOCK, 0.313 ID	3603502	2

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



NOTE:
FOR CROSS SECTION AND EXPLODED VIEW DRAWING
SEE DRAWING DVC0203
ALSO, WHEN REPLACING THE OLD VERSION OF THIS VALVE WITH
A NEW VERSION, PART NUMBER 1762500 CAN BE USED TO RETROFIT
IT TO THE EXISTING PANEL.



NOTE:
MOUNT WITH EXHAUST OUTLET DOWN
CONNECT 4 GA COPPER GROUND STRAP
TO CLEAN, PAINT FREE GROUNDING SURFACE
IF SUPPLIED GROUND STRAP
RETIGHTEN CYLINDER HEAD ADAPTER
RETAINING NUTS EQUALLY
TO 90 IN. LB.
POSITIVE LEAD WIRE SIZES FOR 24 V PRIMERS:
PER SAE STANDARD 541J (MAX STARTING MOTOR VOLTAGE DROPS)
0 TO 20' #3 COPPER
0 TO 25' #2 COPPER
THESE GAGE WIRES CORRESPOND WITH AMP DRAW
REQUIREMENTS FOR EACH MOTOR, AS WELL AS IN RELATION
TO 24 V = 140 AMP

WEIGHT : 27 LB (12.1 KG)

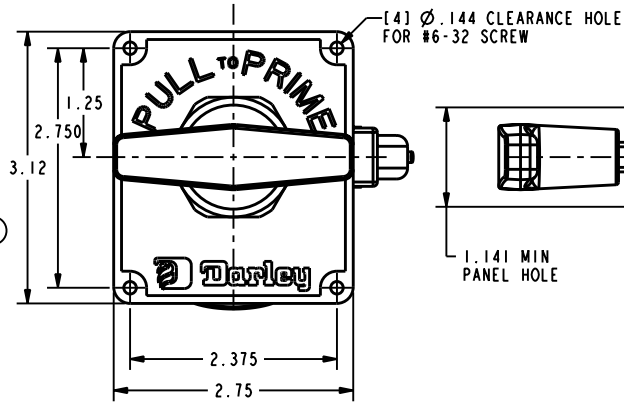
REV.	DESCRIPTION	DATE	BY	CHKD.	APP.
1	REVISED FOR USE				

REMOVE SHARP EDGES
DO NOT SCALE PRINT

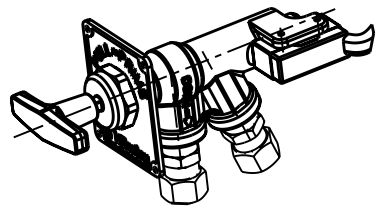
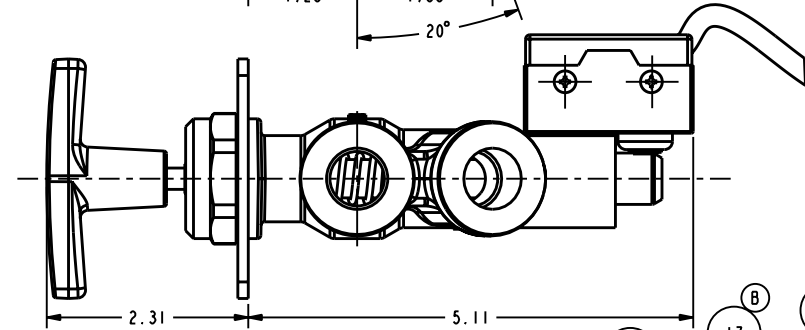
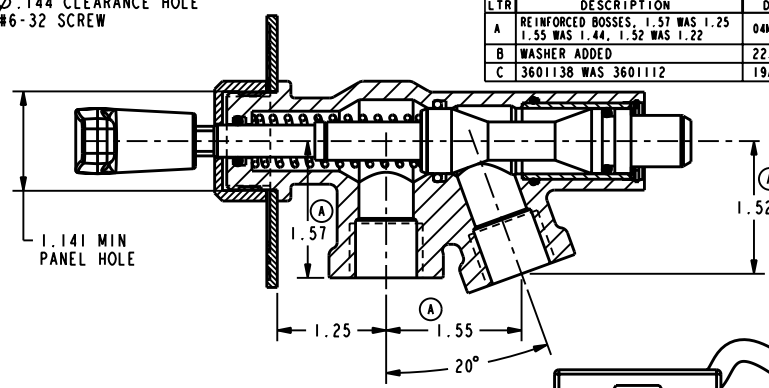
DVC0209

NAME:DWS OBJECT:DVC0203 DATE:19-Apr-12 09:28:56

NO.	DESCRIPTION	PART NO.	QTY.
1	BODY - PRIMER VALVE	2056300	1
2	CONNECTOR - DUETCH DT 06-3S	2601618	1
3	HANDLE - PRIMER TEE	3012400	1
4	MICROSWITCH - PRIMER VALVE	2600146	1
5	NUT - PANEL VALVE, 1.250-12	5403511	1
6	O-RING - 0.38 x 0.56 x 0.09	3601104	1
7	O-RING - 0.562 x 0.750 x 0.09	3601128	1
8	O-RING - 0.75 x 0.94 x 0.09	3601138	1
9	PLATE - PRIMER, CAST ZINC	1977200	1
10	RHMS - NO.6-32 X1.00, BR	5402012	2
11	RING - RETAINER, 5000-87	3600453	1
12	SPRING - PRIMER VALVE	3600042	1
13	STEM - PUSH-PULL PRIMER VALVE	5243200	1
14	WASHER - LOCK, NO.6 ID, SST	3603508	2
15	BEARING - PRIMER VLV, IGLIDE	1762600	1
16	O-RING - 0.88 x 1.00 x 0.06	3601009	1
17	WASHER - 0.62 x 0.88 x .04, 303	3603339	1



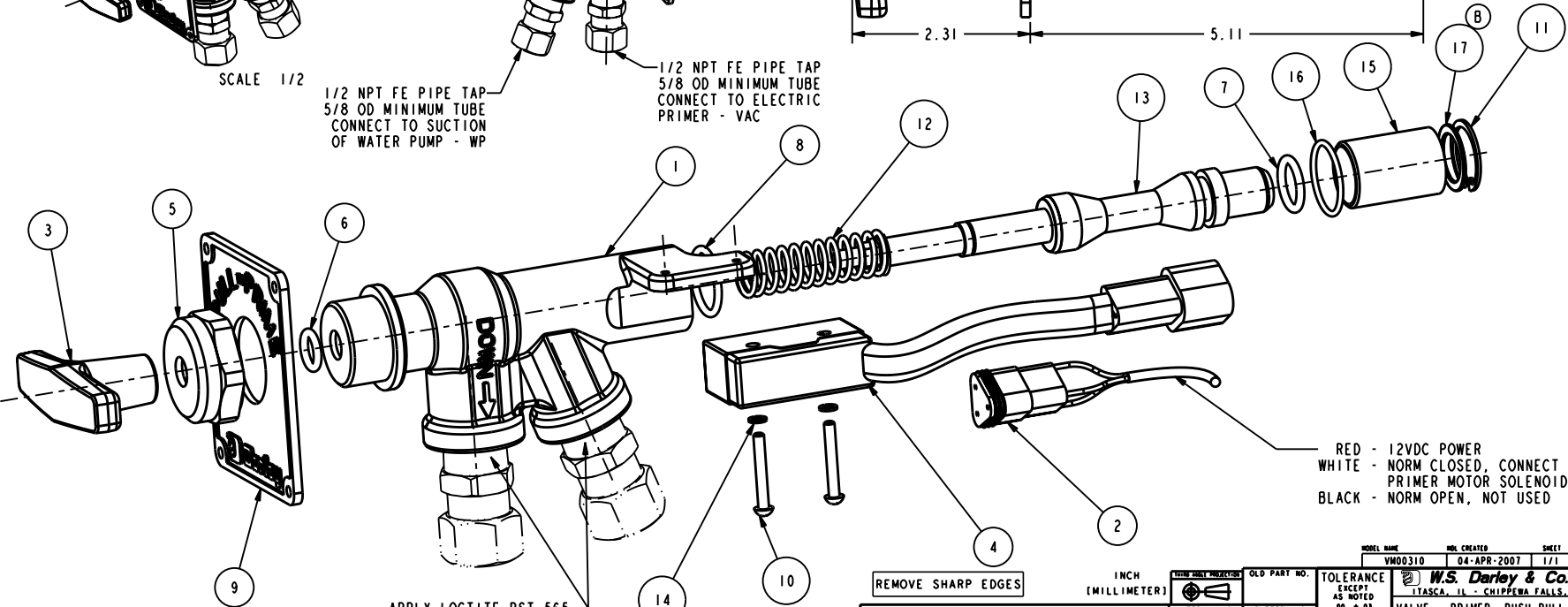
REVISIONS				
LTR	DESCRIPTION	DATE	CHG NO.	APPR'D
A	REINFORCED BOSSES, 1.57 WAS 1.25	04MAY09	5408	DWS
B	WASHER ADDED	22JUL09	5642	DWS
C	3601138 WAS 3601112	19APR12	8281	DWS



SCALE 1/2

1/2 NPT FE PIPE TAP
5/8 OD MINIMUM TUBE
CONNECT TO SUCTION
OF WATER PUMP - WP

1/2 NPT FE PIPE TAP
5/8 OD MINIMUM TUBE
CONNECT TO ELECTRIC
PRIMER - VAC



APPLY LOCTITE PST 565
OR TEFLON THREAD TAPE
FINGER TIGHT PLUS 1/2 TURN
DO NOT OVER TIGHTEN

RED - 12VDC POWER
WHITE - NORM CLOSED, CONNECT TO
PRIMER MOTOR SOLENOID
BLACK - NORM OPEN, NOT USED

REMOVE SHARP EDGES		INCH (MILLIMETER)	OLD PART NO.	TOLERANCE EXCEPT AS NOTED ±.000 ±.003 ±.000 ±.010 ANGLES ±5°	DATE 03-Apr-07	DVC0203
MATERIAL DESCRIPTION:		MATERIAL NO.	PATTERN NO.	DRN DWS	SCALE 1/1	
THIS DESIGN IS THE PROPERTY OF W.S. DARLEY AND CO. - UNAUTHORIZED REPRODUCTION IS PROHIBITED		DO NOT SCALE PRINT		CHWD		
ALL DIMENSIONS IN INCHES UNLESS NOTED				TRCD		

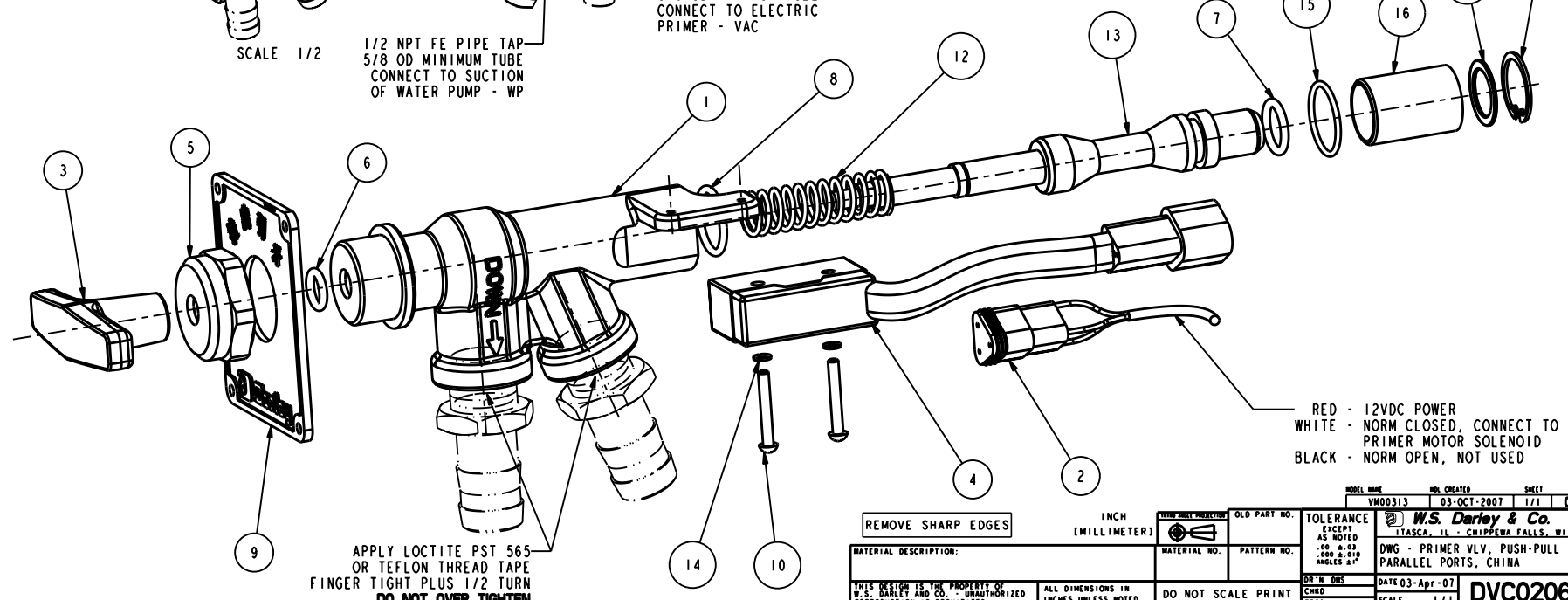
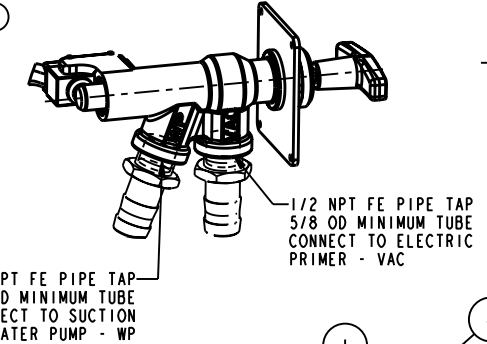
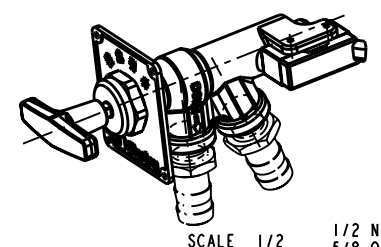
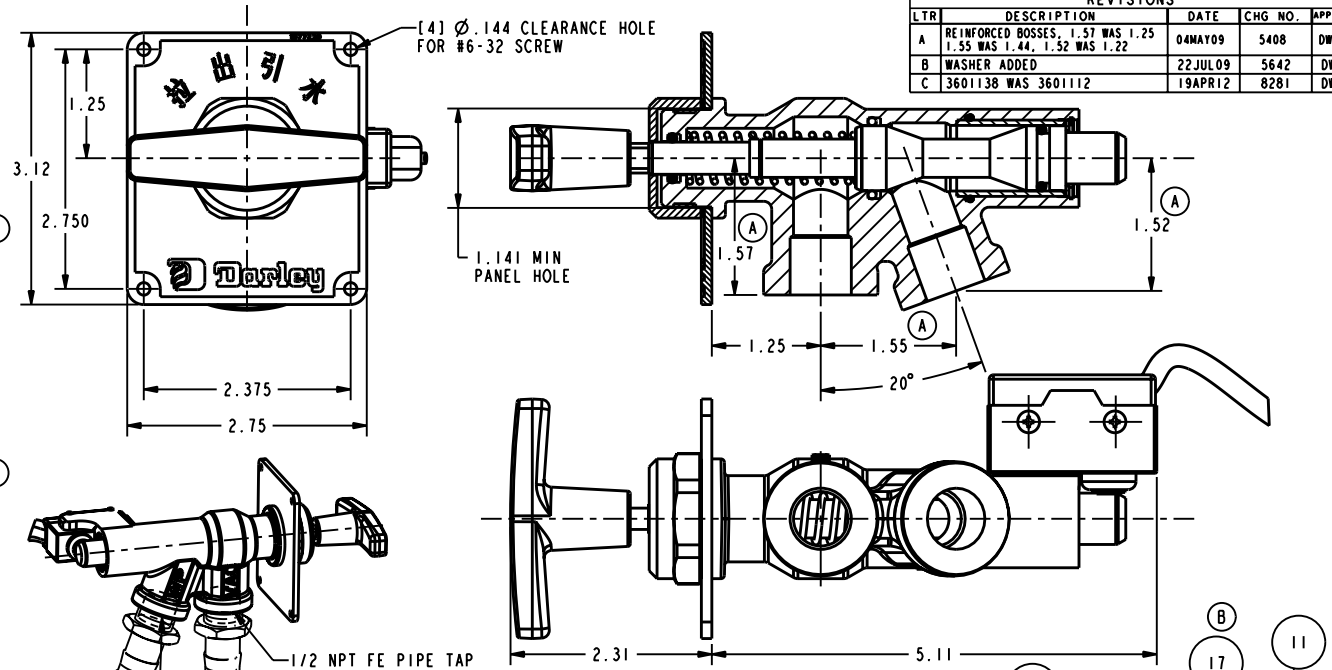
MODEL NAME: VM00310
MFG CREATED: 04-APR-2007
SHEET: 1/1 C

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

VALVE - PRIMER, PUSH-PULL
HVY SPRING

NO.	DESCRIPTION	PART NO.	QTY.
1	BODY - PRIMER VALVE	2056300	1
2	CONNECTOR - DUETCH DT 06-3S	2601618	1
3	HANDLE - PRIMER TEE	3012400	1
4	MICROSWITCH - PRIMER VALVE	2600146	1
5	NUT - PANEL VALVE, 1.250-12	5403511	1
6	O-RING - 0.38 x 0.56 x 0.09	3601104	1
7	O-RING - 0.562 x 0.750 x 0.09	3601128	1
8	O-RING - 0.75 x 0.94 x 0.09	3601138	1
9	PLATE - PRIMER, CAST ZINC	1977230	1
10	RHMS - NO.6-32 X1.00, BR	5402012	2
11	RING - RETAINER, 5000-87	3600453	1
12	SPRING - PRIMER VALVE	3600042	1
13	STEM - PUSH-PULL PRIMER VALVE	5243200	1
14	WASHER - LOCK, NO.6 ID, SST	3603508	2
15	O-RING - 0.88 x 1.00 x 0.06	3601009	1
16	BEARING - PRIMER VLV, 1GLIDE	1762600	1
17	WASHER - 0.62 x 0.88 x .04, 303	3603339	1

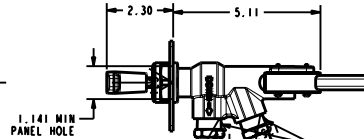
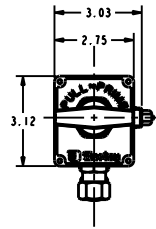
REVISIONS				
LTR	DESCRIPTION	DATE	CHG NO.	APPR'D
A	REINFORCED BOSSES, 1.57 WAS 1.25 1.55 WAS 1.44, 1.52 WAS 1.22	04MAY09	5408	DWS
B	WASHER ADDED	22JUL09	5642	DWS
C	3601138 WAS 3601112	19APR12	8281	DWS



REMOVE SHARP EDGES		INCH (MILLIMETER)	OLD PART NO.	TOLERANCE EXCEPT AS NOTED Ø .000 ± .03 Ø .000 ± .010 ANGLES ± 5°	 W.S. Darley & Co. TYASCA, IL - CHIPPewa FALLS, WI DWG - PRIMER VLV, PUSH-PULL PARALLEL PORTS, CHINA
MATERIAL DESCRIPTION:		MATERIAL NO.	PATTERN NO.	DRN DWS CWD TRCD	DATE 03-Apr-07 SCALE 1/1
THIS DESIGN IS THE PROPERTY OF W.S. DARLEY AND CO. - UNAUTHORIZED REPRODUCTION IS PROHIBITED		ALL DIMENSIONS IN INCHES UNLESS NOTED		DO NOT SCALE PRINT	

DVC0206

NO.	DESCRIPTION	PART NO.	QTY.
1	ASSEMBLY - PRIMER, ROTOR	4420105	1
2	BEARING - OILITE, 0.626 ID	1760023	2
3	COUPLING - R44093	2404500	1
4	CYLINDER - VACUUM PUMP	1020800	1
5	HEAD - CYLINDER, INBOARD	2808904	1
6	HEAD - CYLINDER, OUTBOARD	2808800	1
7	NCS - .313-18 x 1.00, SST	5400610	4
8	KEY - SQ., 0.19 x 0.62 GR2	3602425	1
9	KEY - WOODRUFF, 606	3602200	1
10	MOTOR - PRIMER, 12V	4223400	1
11	NUT - HEX., .313-15, SST	5403024	2
12	O-RING - 3.50 x 3.69 x 0.09	3601101	2
13	OIL SEAL - 0.625 ID x 1.128 OD	3600505	1
15	PLUG - PIPE, 0.250, BR SQ HD	1080594	1
16	STRAP - GROUND, 12V PRIMER	2600516	1
17	WASHER - ROTOR, ELEC PRIMER	4407601	4
18	WASHER - FLAT, 5/16, STEEL	3603802	2
19	WASHER - LOCK, 0.313 ID	3603502	6

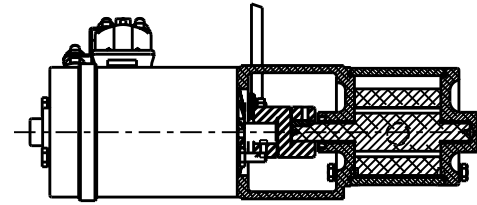


SCALE 1/2

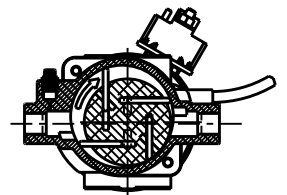
APPLY LOCTITE PST 565 OR TEFLOW THREAD TAPE FINGER TIGHT PLUS 1/2 TURN DO NOT OVER TIGHTEN

NOTE:
 FOR CROSS SECTION AND EXPLODED VIEW DRAWING SEE DVC0203, DVC0204 & DVC0205
 - ALSO, WHEN REPLACING THE OLD VERSION OF THIS VALVE WITH THIS NEW VERSION; BUSHING 1762500 CAN BE USED TO RETROFIT IT TO THE EXISTING PANEL.

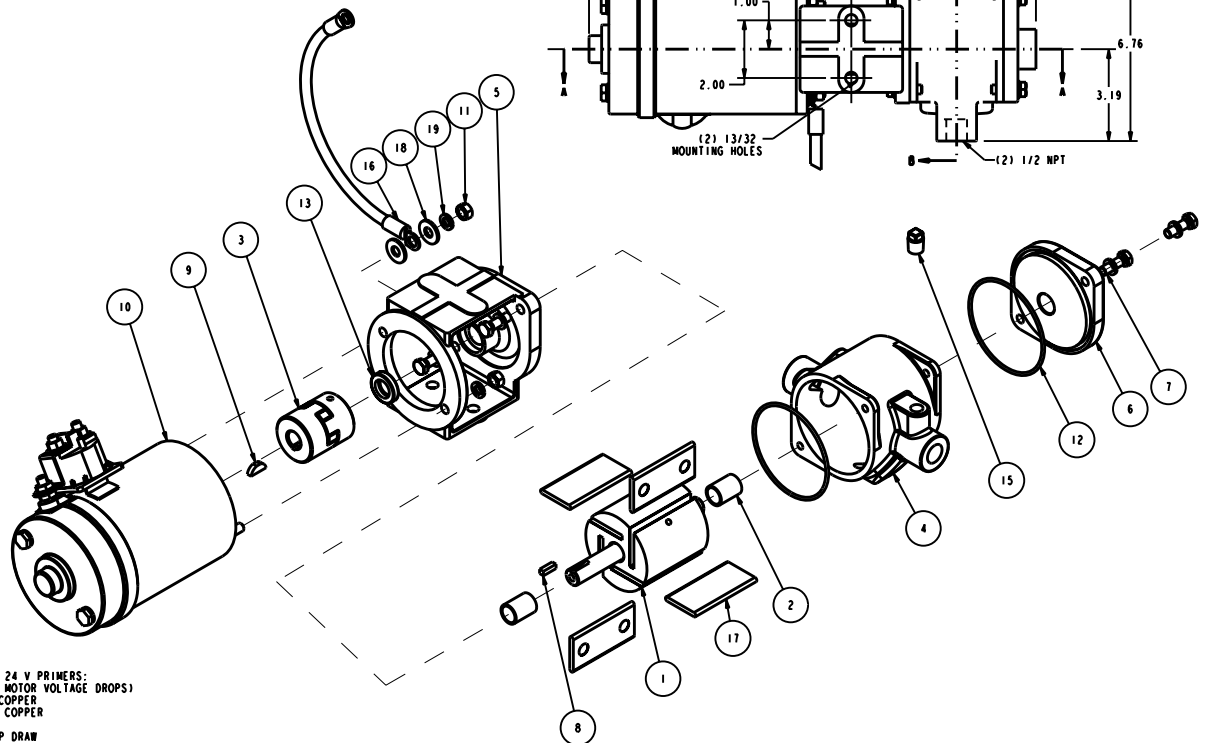
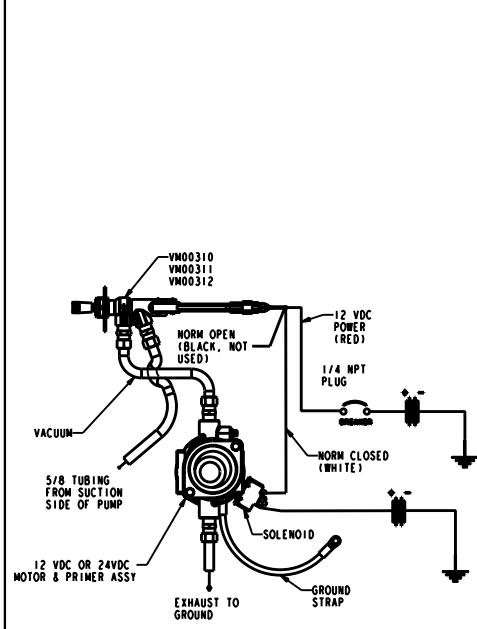
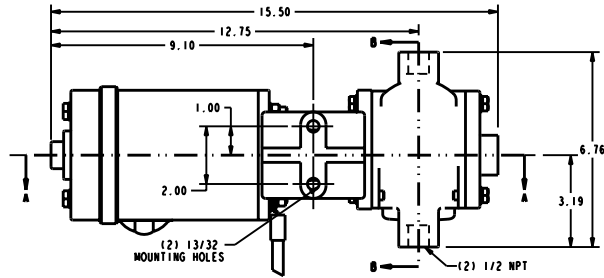
REVISIONS				
LTN	DESCRIPTION	DATE	CHK NO.	APP'D
4	REMOVED FIRST PLUG	8/15/19	3226	AAN



SECTION A-A
SCALE 1/2



SECTION B-B



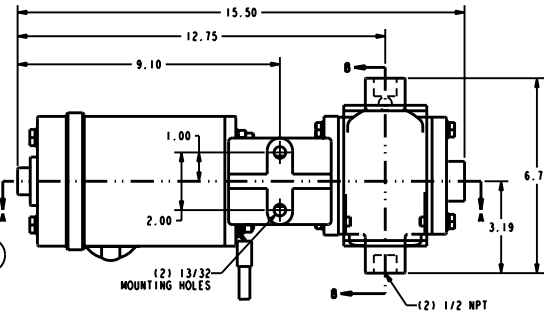
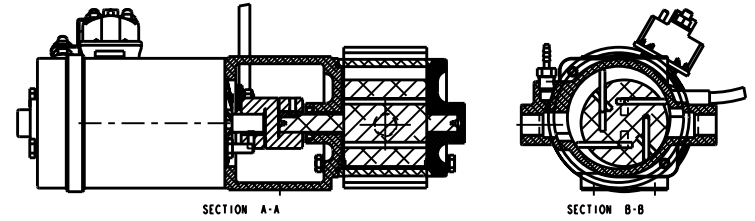
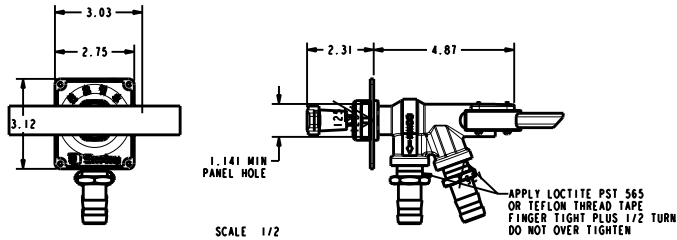
NOTE:
 MOUNT WITH EXHAUST OUTLET DOWN
 CONNECT 4 GA COPPER GROUND STRAP TO CLEAN, PAINT FREE GROUNDING SURFACE
 IF SUPPLIED GROUND STRAP IS REMOVED FROM ASSEMBLY, RETIGHTEN CYLINDER HEAD ADAPTER RETAINING NUTS EQUALLY TO 90 IN. LB.
 POSITIVE LEAD WIRE SIZES FOR 12 V & 24 V PRIMERS:
 PER SAE STANDARD 541J (MAX STARTING MOTOR VOLTAGE DROPS)
 0' TO 20' : : : : 80 (12V), 83 (24V) COPPER
 0' TO 25' : : : : 800 (12V), 82 (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

WEIGHT = 27 LB (12.1 KG)

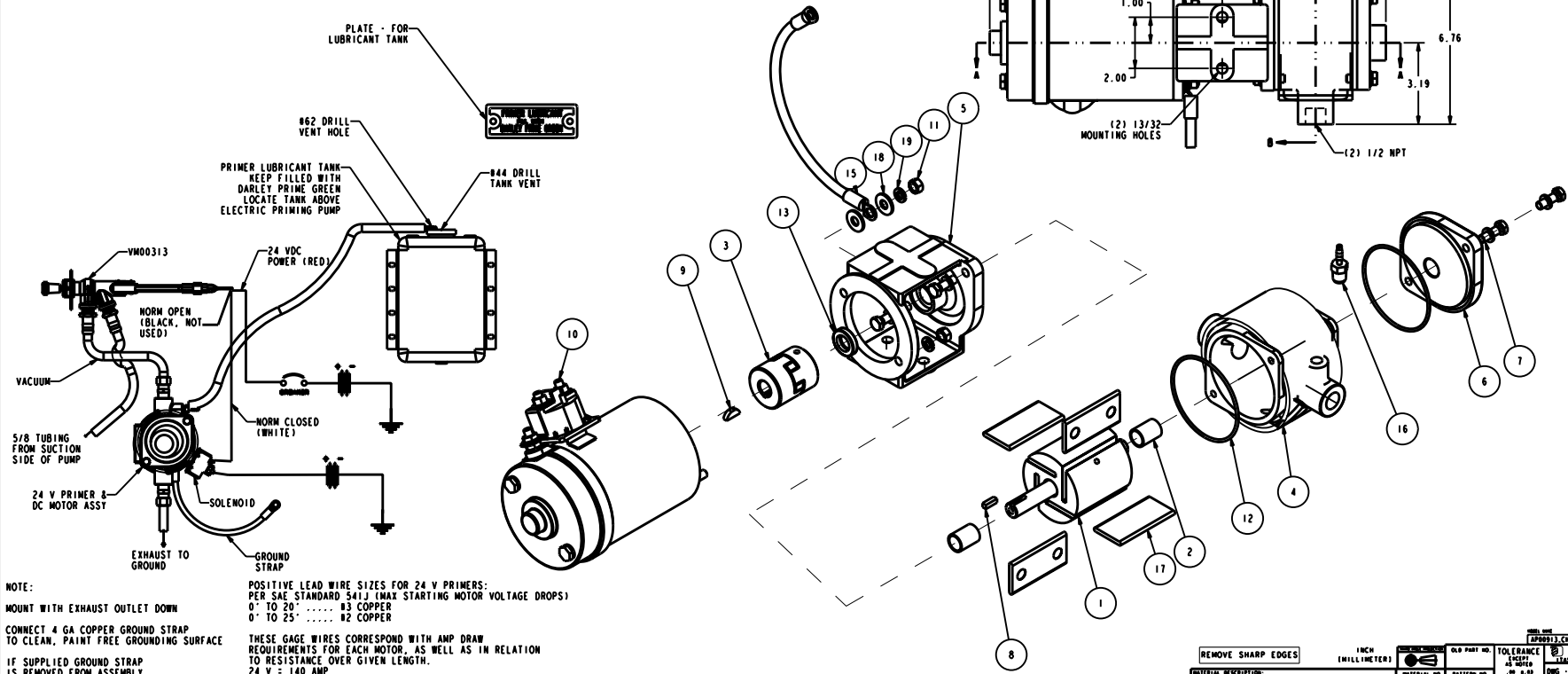
REMOVE SHARP EDGES		1 INCH (25.4 MM) (SMALL THEFT)	OLD PART NO.	TOLERANCE	DATE 18-Apr-09	SCALE 1/2
MATERIAL DESCRIPTION:		MATERIAL NO.	PATTERN NO.	AS SHOWN	DATE 18-Apr-09	SCALE 1/2
THIS DRAWING IS THE PROPERTY OF D.C. BENTLEY AND CO. UNAUTHORIZED REPRODUCTION IS PROHIBITED.		ALL DIMENSIONS IN INCHES UNLESS NOTED		DO NOT SCALE PRINT		DVC0207

NO.	DESCRIPTION	PART NO.	QTY.
1	ASSEMBLY - PRIMER, ROTOR	4420105	1
2	BEARING - OILITE, 0.626 ID	1760023	2
3	COUPLING - #44093	2404500	1
4	CYLINDER - VACUUM PUMP	1020800	1
5	HEAD - CYLINDER INBOARD	2808904	1
6	HEAD - CYLINDER, OUTBOARD	2808900	1
7	NHCS - .313-18 x 1.00, SST	5400610	4
8	RET - 50, .019 x 0.62 GR2	3602425	1
9	RET - WOODRUFF, 606	3602200	1
10	MOTOR - PRIMER, 24V	4223500	1
11	NUT - HEX, .313-15, SST	5403024	2
12	O-RING - 3.50 x 3.69 x 0.09	3601101	2
13	OIL SEAL - 0.625 ID x 1.128 OD	3600505	1
15	STRAP - GROUND, 12V PRIMER	2600516	1
16	TUBE FITTING - STR., 25 x .19	3500021	1
17	VANE - ROTOR, ELEC PRIMER	4407601	4
18	WASHER - FLAT, 5/16, STEEL	3603802	2
19	WASHER - LOCK, 0.313 ID	3603502	6

REVISIONS				
LTN	DESCRIPTION	DATE	CHK NO.	APP'D
4	REMOVED FIRST PILE	4/15/09	329	AKB



NOTE:
 - FOR CROSS SECTION AND EXPLODED VIEW DRAWING SEE DRAWING DVC0206
 - ALSO, WHEN REPLACING THE OLD VERSION OF THIS VALVE WITH THIS NEW VERSION, BUSHING 1762500 CAN BE USED TO RETROFIT IT TO THE EXISTING PANEL.



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

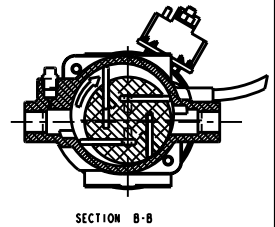
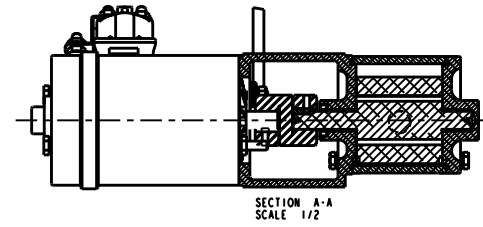
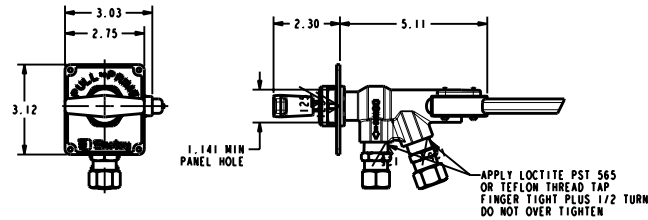
POSITIVE LEAD WIRE SIZES FOR 24 V PRIMERS:
 PER SAE STANDARD 541J (MAX STARTING MOTOR VOLTAGE DROPS)
 0' TO 20' #3 COPPER
 0' TO 25' #2 COPPER
 THESE GAGE WIRES CORRESPOND WITH AMP DRAW REQUIREMENTS FOR EACH MOTOR, AS WELL AS IN RELATION TO RESISTANCE OVER GIVEN LENGTH.
 24 V = 140 AMP

WEIGHT : 27 LB (12.1 KG)

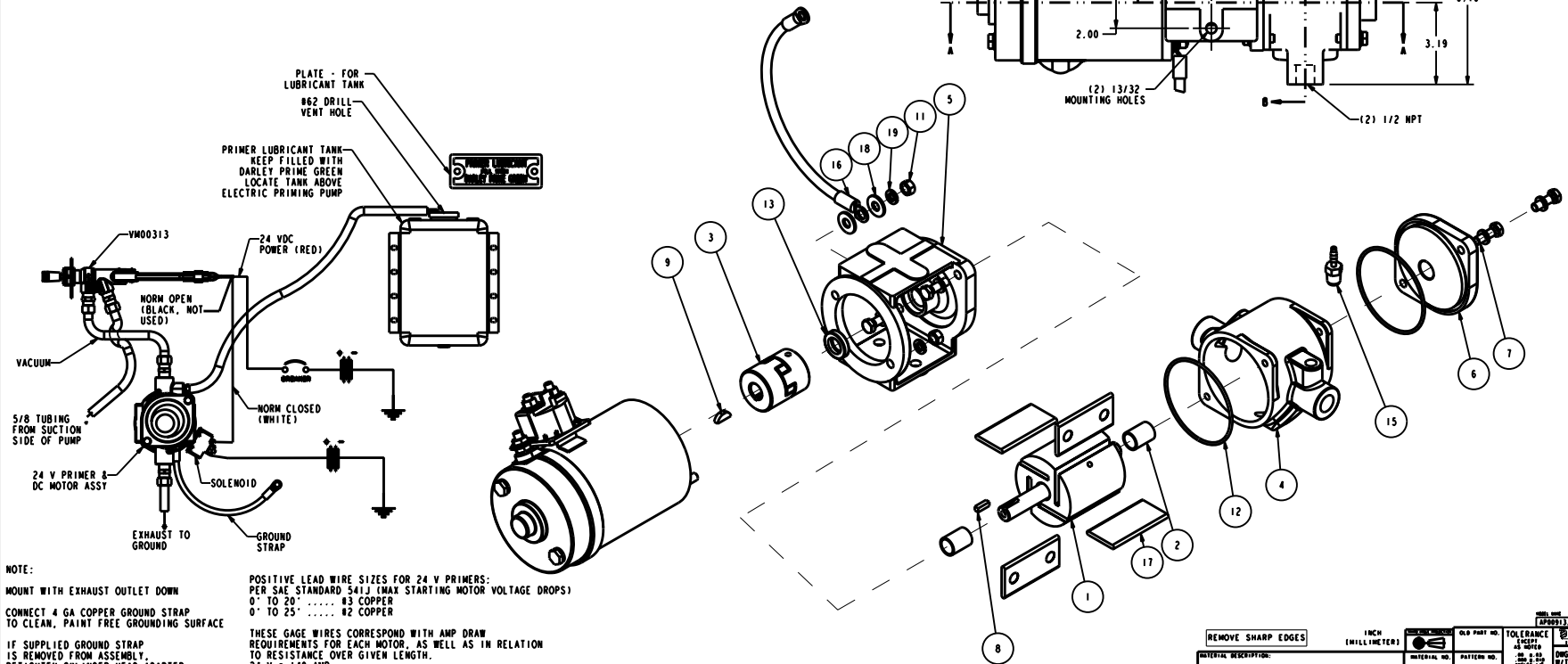
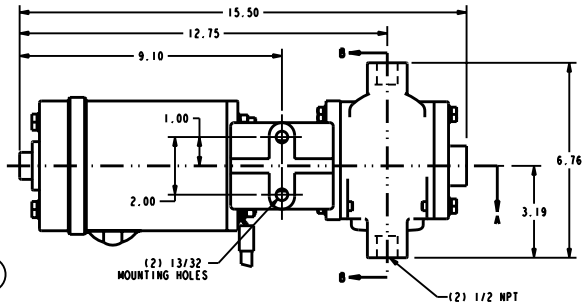
REMOVE SHARP EDGES	1 INCH (25.4 MILLIMETER)	TOLERANCE AS SHOWN	MATERIAL NO. 1	PATTERN NO. 1	DATE 18-Apr-08	SCALE 1/2	DVC0208
THIS DRAWING IS THE PROPERTY OF DAVLEY PRIME AND IS UNCLASSIFIED REPRODUCTION IS PROHIBITED							
ALL DIMENSIONS IN INCHES UNLESS NOTED							
DO NOT SCALE PRINT							

NO.	DESCRIPTION	PART NO.	QTY.
1	ASSEMBLY - PRIMER, ROTOR	4420105	1
2	BEARING - OILITE, 0.626 ID	1760023	2
3	COUPLING - #44093	2404500	1
4	CYLINDER - VACUUM PUMP	1020800	1
5	HEAD - CYLINDER INBOARD	2808904	1
6	HEAD - CYLINDER, OUTBOARD	2808800	1
7	NHCS - .313-18 x 1.00, SST	5400610	4
8	RET - SO., 0.19 x 0.62 GR2	3602425	1
9	RET - WOODRUFF, 606	3602200	1
10	MOTOR - PRIMER, 24V	4223500	1
11	NUT - HEX., .313-15, SST	5403024	2
12	O-RING - 3.50 x 3.69 x 0.09	3601101	2
13	OIL SEAL - 0.625 ID x 1.128 OD	3600505	1
15	TUBE FITTING - STR, .25 x .19	3500021	1
16	STRAP - GROUND, 12V PRIMER	2600516	1
17	VANE - ROTOR, ELEC PRIMER	4407601	4
18	WASHER - FLAT, 5/16, STEEL	3603802	2
19	WASHER - LOCK, 0.313 ID	3603502	6

REVISIONS				
LTN	DESCRIPTION	DATE	CHK NO.	APP'D
4	REMOVED FIRST PLUG	4/15/09	325	AAN



NOTE:
 - FOR CROSS SECTION AND EXPLODED VIEW DRAWING SEE DRAWING DVC0203
 - ALSO, WHEN REPLACING THE OLD VERSION OF THIS VALVE WITH THIS NEW VERSION, BUSHING 1762500 CAN BE USED TO RETROFIT IT TO THE EXISTING PANEL.



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

POSITIVE LEAD WIRE SIZES FOR 24 V PRIMERS:
 PER SAE STANDARD 541J (MAX STARTING MOTOR VOLTAGE DROPS)
 0' TO 20' #3 COPPER
 0' TO 25' #2 COPPER
 THESE GAGE WIRES CORRESPOND WITH AMP DRAW REQUIREMENTS FOR EACH MOTOR, AS WELL AS IN RELATION TO RESISTANCE OVER GIVEN LENGTH.
 24 V = 140 AMP

WEIGHT : 27 LB (12.1 KG)

REMOVE SHARP EDGES

1 INCH (25.4 MILLIMETER)

OLD PART NO. 4223500

TOLERANCE LIMITS AS SHOWN

MATERIAL NO. 303

PATTERN NO.

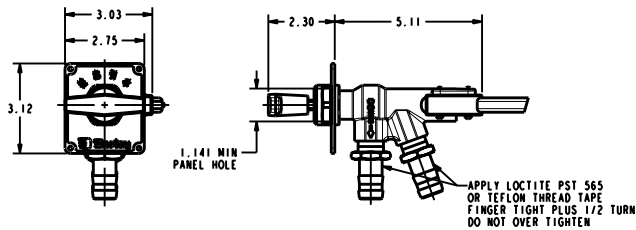
DATE 18-Apr-09

SCALE 1/2

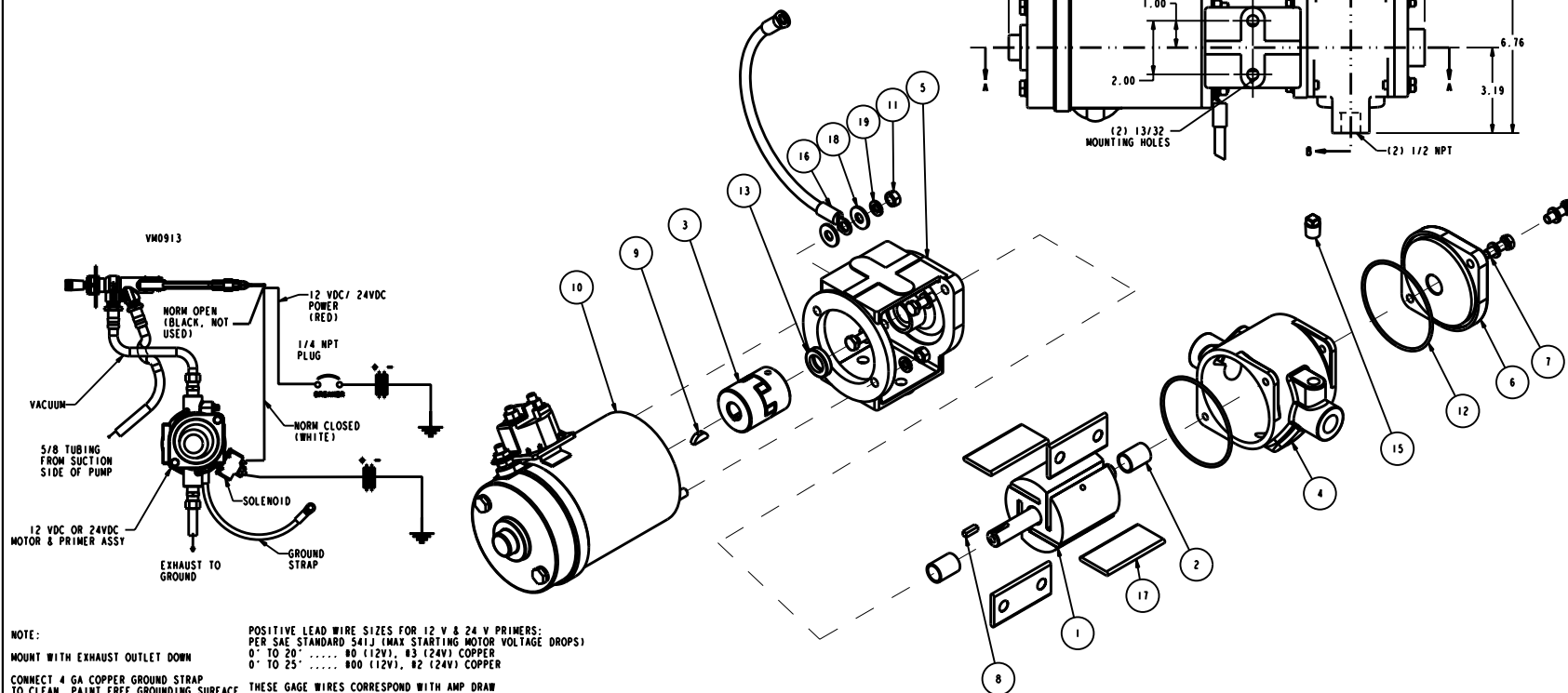
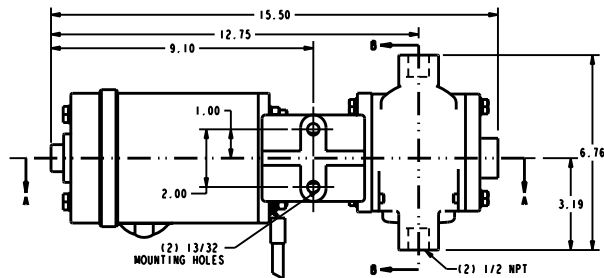
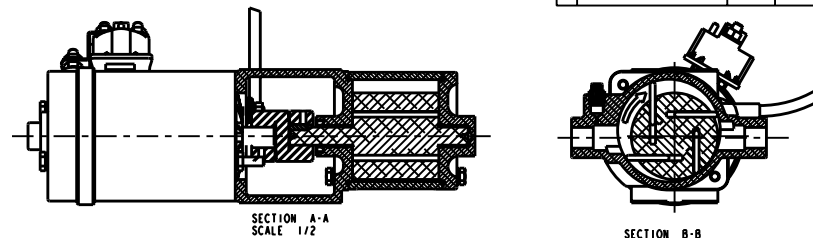
DVC0209

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

NO.	DESCRIPTION	PART NO.	QTY.
1	ASSEMBLY - PRIMER, ROTOR	4420105	1
2	BEARING - OILITE, 0.626 ID	1760023	2
3	COUPLING - R44093	2404500	1
4	CYLINDER - VACUUM PUMP	1020800	1
5	HEAD - CYLINDER INBOARD	2808904	1
6	HEAD - CYLINDER, OUTBOARD	2808800	1
7	NUTS - .313-18 x 1.00, SST	5400610	4
8	KEY - SQ., 0.19 x 0.62 GR2	3602425	1
9	KEY - WOODRUFF, 606	3602200	1
10	MOTOR - PRIMER, 12V	4223400	1
11	NUT - HEX., .313-15, SST	5403024	2
12	O-RING - 3.50 x 3.69 x 0.09	3601101	2
13	OIL SEAL - 0.625 ID x 1.128 OD	3600505	1
15	PLUG - PIPE, 0.250, BR SQ HD	1080594	1
16	STRAP - GROUND, 12V PRIMER	2600516	1
17	WASHER - ROTOR, ELEC PRIMER	4407601	4
18	WASHER - FLAT, 5/16, STEEL	3603802	2
19	WASHER - LOCK, 0.313 ID	3603502	6



NOTE:
 FOR CROSS SECTION AND EXPLODED VIEW DRAWING SEE DVC0208
 ALSO, WHEN REPLACING THE OLD VERSION OF THIS VALVE WITH THIS NEW VERSION; BUSHING 1762500 CAN BE USED TO RETROFIT IT TO THE EXISTING PANEL.



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

POSITIVE LEAD WIRE SIZES FOR 12 V & 24 V PRIMERS:
 PER SAE STANDARD 541J (MAX STARTING MOTOR VOLTAGE DROPS)
 0' TO 20' : : : : 80 (12V), 83 (24V) COPPER
 0' TO 25' : : : : 800 (12V), 82 (24V) COPPER

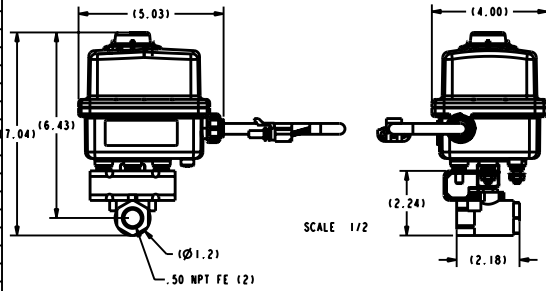
THESE GAGE WIRES CORRESPOND WITH AMP DRAW REQUIREMENTS FOR EACH MOTOR, AS WELL AS IN RELATION TO RESISTANCE OVER GIVEN LENGTH.
 12 V = 240 AMP
 24 V = 140 AMP

WEIGHT = 27 LB (12.1 KG)

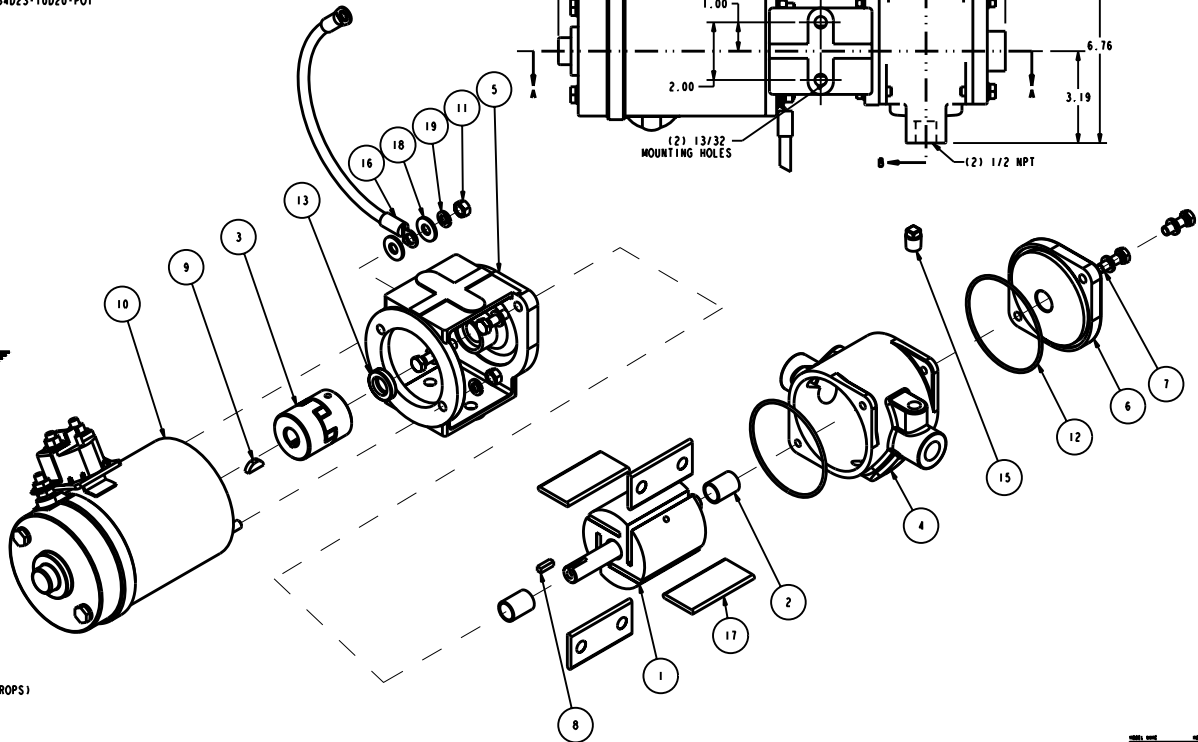
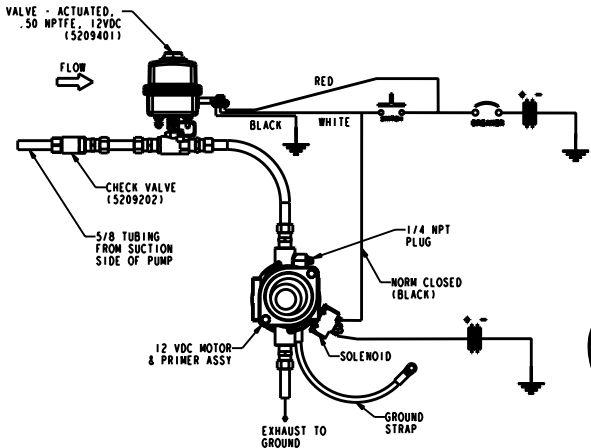
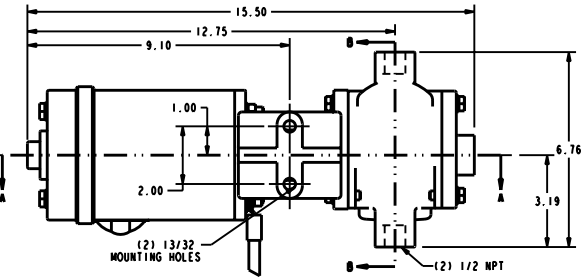
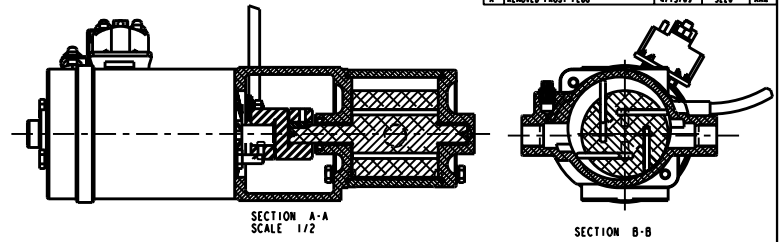
REMOVE SHARP EDGES		1 INCH (MILLIMETER)	OLD PART NO.	TOLERANCE	DATE 23-Apr-09	SCALE 1/2
MATERIAL DESCRIPTION:		MATERIAL NO.	PATTERN NO.	STANDARD	DATE 23-Apr-09	SCALE 1/2
THIS DRAWING IS THE PROPERTY OF W.S. DUNLAP & CO. ALL DIMENSIONS IN INCHES UNLESS NOTED		DO NOT SCALE PRINT		DVC0212		

NO.	DESCRIPTION	PART NO.	QTY.
1	ASSEMBLY - PRIMER, ROTOR	4420105	1
2	BEARING - OILITE, 0.626 ID	1760023	2
3	COUPLING - #44093	2404500	1
4	CYLINDER - VACUUM PUMP	1020800	1
5	HEAD - CYLINDER, INBOARD	2808904	1
6	HEAD - CYLINDER, OUTBOARD	2808900	1
7	NUTS - .313-18 x 1.00, SST	5400610	4
8	KEY - SO., 0.19 x 0.62 GR2	3602425	1
9	KEY - WOODRUFF, 606	3602200	1
10	MOTOR - PRIMER, 12V	4223400	1
11	NUT - HEX., .313-15, SST	5403024	2
12	O-RING - 3.50 x 3.69 x 0.09	3601101	2
13	OIL SEAL - 0.625 ID x 1.128 OD	3600505	1
15	PLUG - PIPE, 0.250, BR SQ HD	1080594	1
16	STRAP - GROUND, 12V PRIMER	2600516	1
17	WASHER - ROTOR, ELEC PRIMER	4407601	4
18	WASHER - FLAT, 5/16, STEEL	3603802	2
19	WASHER - LOCK, 0.313 ID	3603502	6

REVISIONS			
LTN	DESCRIPTION	DATE	CHK NO. APPROV
4	REMOVED FIRST PLUG	8/15/89	3226 AAN



5209401 - NZCO VALVE - ACTUATED,
12 VDC, .50NPT FE
NZCO MDL #84023-10D20-PO1



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

POSITIVE LEAD WIRE SIZES FOR 12 V PRIMER:
PER SAE STANDARD 541J (MAX STARTING MOTOR VOLTAGE DROPS)
0' TO 20' 80 (12V)
0' TO 25' 800 (12V)

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

WEIGHT = 27 LB (12.1 KG)

REMOVE SHARP EDGES

1 INCH (25.4 MILLIMETER)

TOLERANCE LIMITS AS SHOWN

DATE 18-Apr-08

SCALE 1/2

DVC0210

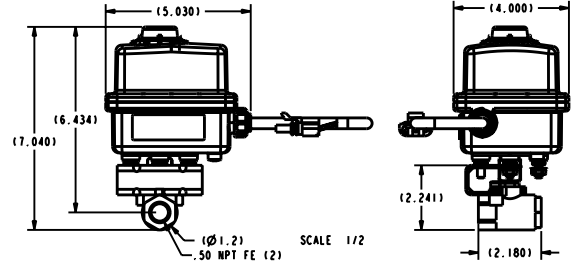
W.S. Durley & Co.

12 V - ELEC PRIMER, RLY, 4 V NO TAMB, CR, SECTION, EXPLODED

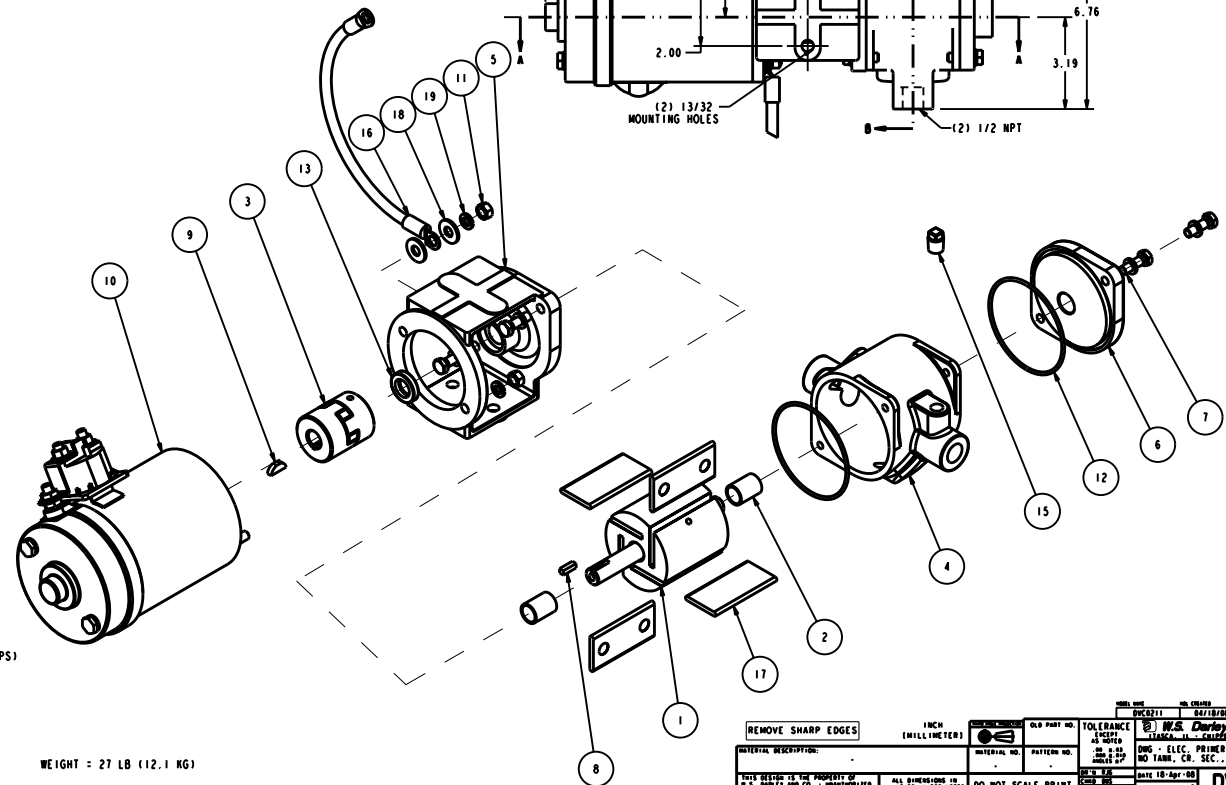
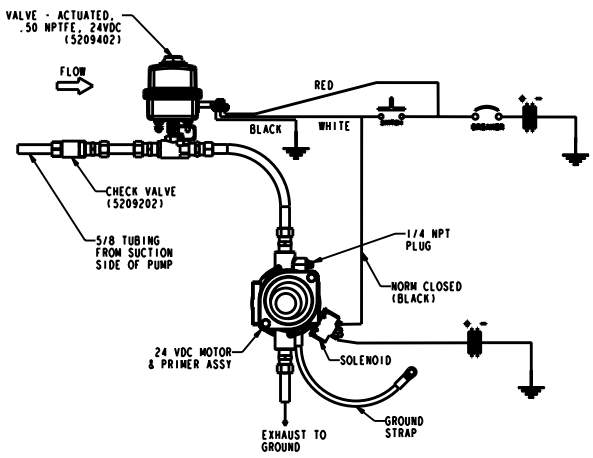
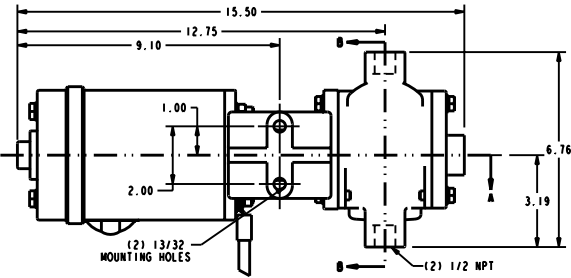
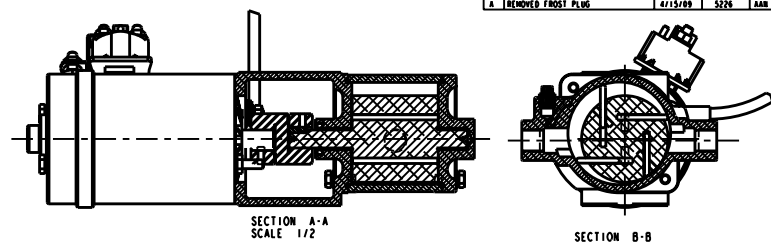
DO NOT SCALE PRINT

NO.	DESCRIPTION	PART NO.	QTY.
1	ASSEMBLY - PRIMER, ROTOR	4420105	1
2	BEARING - OILITE, 0.626 ID	1760023	2
3	COUPLING - R44093	2404500	1
4	CYLINDER - VACUUM PUMP	1020800	1
5	HEAD - CYLINDER, INBOARD	2808904	1
6	HEAD - CYLINDER, OUTBOARD	2808800	1
7	NUTS - .313-18 x 1.00, SST	5400610	4
8	KEY - SO., 0.19 x 0.62 GR2	3602425	1
9	KEY - WOODRUFF, 606	3602200	1
10	MOTOR - PRIMER, 24V	4223500	1
11	NUT - HEX., .313-15, SST	5403024	2
12	O-RING - 3.50 x 3.69 x 0.09	3601101	2
13	OIL SEAL - 0.625 ID x 1.128 OD	3600505	1
15	PLUG - PIPE, 0.250, BR SQ HD	1080594	1
16	STRAP - GROUND, 12V PRIMER	2600516	1
17	NAME - ROTOR, ELEC PRIMER	4407601	4
18	WASHER - FLAT, 5/16, STEEL	3603802	2
19	WASHER - LOCK, 0.313 ID	3603502	6

REVISIONS			
LTN	DESCRIPTION	DATE	ENG NO. / APPR
4	REMOVED FIRST PLUG	8/15/89	3226 / AAN



5209402 - KZCO VALVE - ACTUATED,
24 VDC, .50NPT FE
KZCO MDL #84023-60AD-M



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

CONNECT 4 GA COPPER GROUND STRAP TO CLEAN, PAINT FREE GROUNDING SURFACE
THESE GAGE WIRES CORRESPOND WITH AMP DRAW REQUIREMENTS FOR EACH MOTOR, AS WELL AS IN RELATION TO RESISTANCE OVER GIVEN LENGTH.
24 V = 140 AMP

IF SUPPLIED GROUND STRAP IS REMOVED FROM ASSEMBLY, RETIGHTEN CYLINDER HEAD ADAPTER RETAINING NUTS EQUALLY TO 90 IN. LB.

WEIGHT = 27 LB (12.1 KG)

REMOVE SHARP EDGES

1 INCH (25.4 MILLIMETER)

DATE 18-Apr-09

SCALE 1/2

DVC0211

W.S. Durley & Co.

ENG - ELEC PRIMER, REV. 4 V

NO TABS, CR. SEC., EXPL., 24VDC

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ALL DIMENSIONS IN INCHES UNLESS NOTED

DO NOT SCALE PRINT

Prepared by: CWY
Approved by: RJG
Revised by:

Rev. 0
Date: 06/20/13
Rev. Date:
1200652.doc

Section 5

Optional Equipment

Multiple Drain Valve

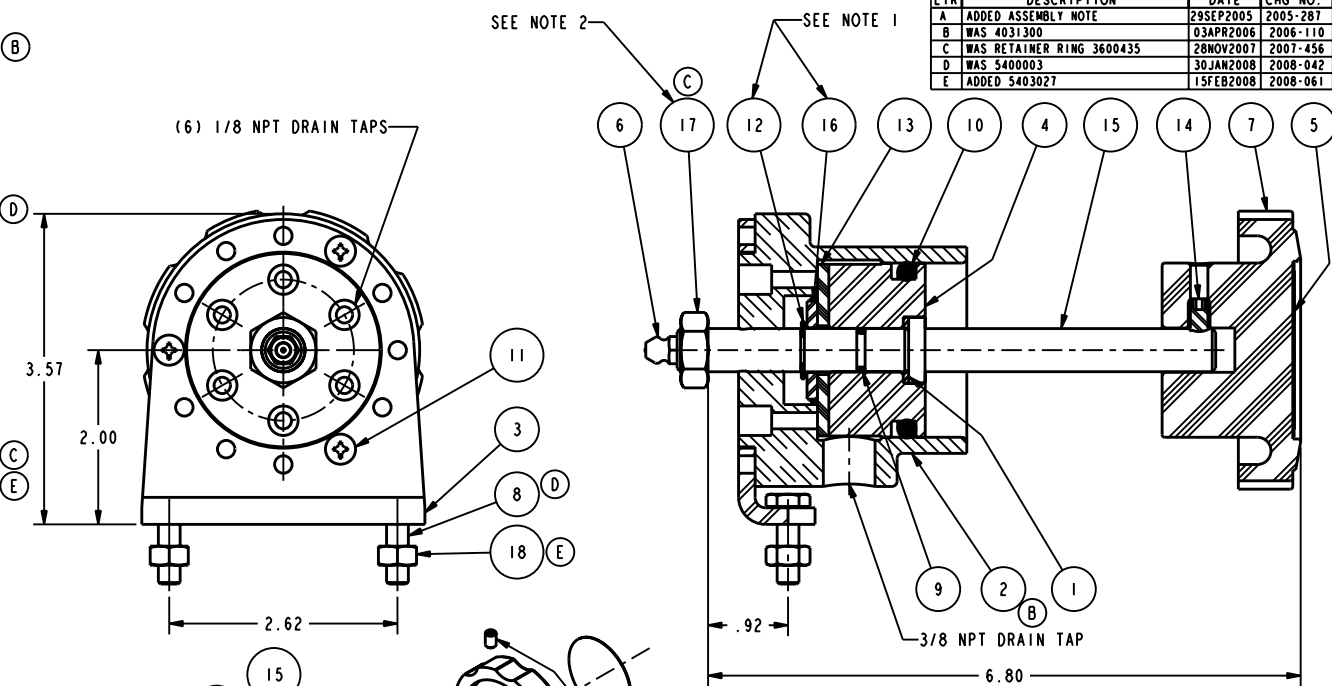
Prepared by: CWY
Approved by: RJG
Revised by:

Rev. 0
Date: 06/20/13
Rev. Date:
1200652.doc

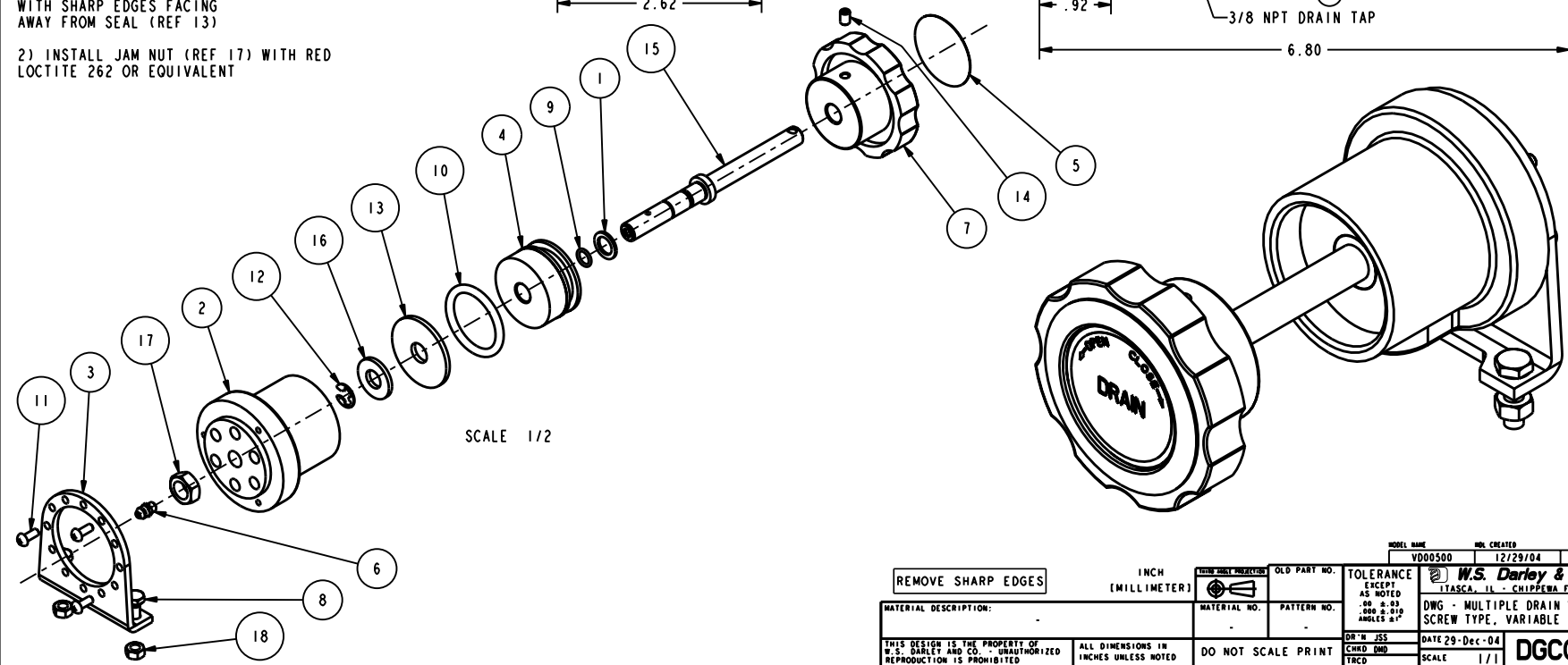
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NO.	DESCRIPTION	PART NO.	QTY.
1	BEARING - OILITE, 0.500 ID	1760024	1
2	BODY - MULTI DRAIN VALVE	5329401	1
3	BRACKET - MULTI DRAIN VALVE	4031300	1
4	CAP - MULTI DRAIN VALVE	5323802	1
5	DECAL - DRAIN VALVE	1963200	1
6	GREASE ZERK - .25-28	4403200	1
7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

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



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



REMOVE SHARP EDGES		INCH (MILLIMETER)	OLD PART NO.	TOLERANCE EXCEPT AS NOTED .000 ±.03 .000 ±.010 ANGLES 8°	DATE 29-Dec-04	SCALE 1/1	DGC0903
MATERIAL DESCRIPTION:		MATERIAL NO.	PATTERN NO.	DRN JSS CMO DMD TRCD	W.S. Darley & Co. TYASCA, IL - CHILPEWA FALLS, WI DWG - MULTIPLE DRAIN VALVE SCREW TYPE, VARIABLE POSITION		
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			

Ball Valve

Prepared by: CWY
Approved by: RJG
Revised by:

Rev. 0
Date: 06/20/13
Rev. Date:
1200652.doc

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.

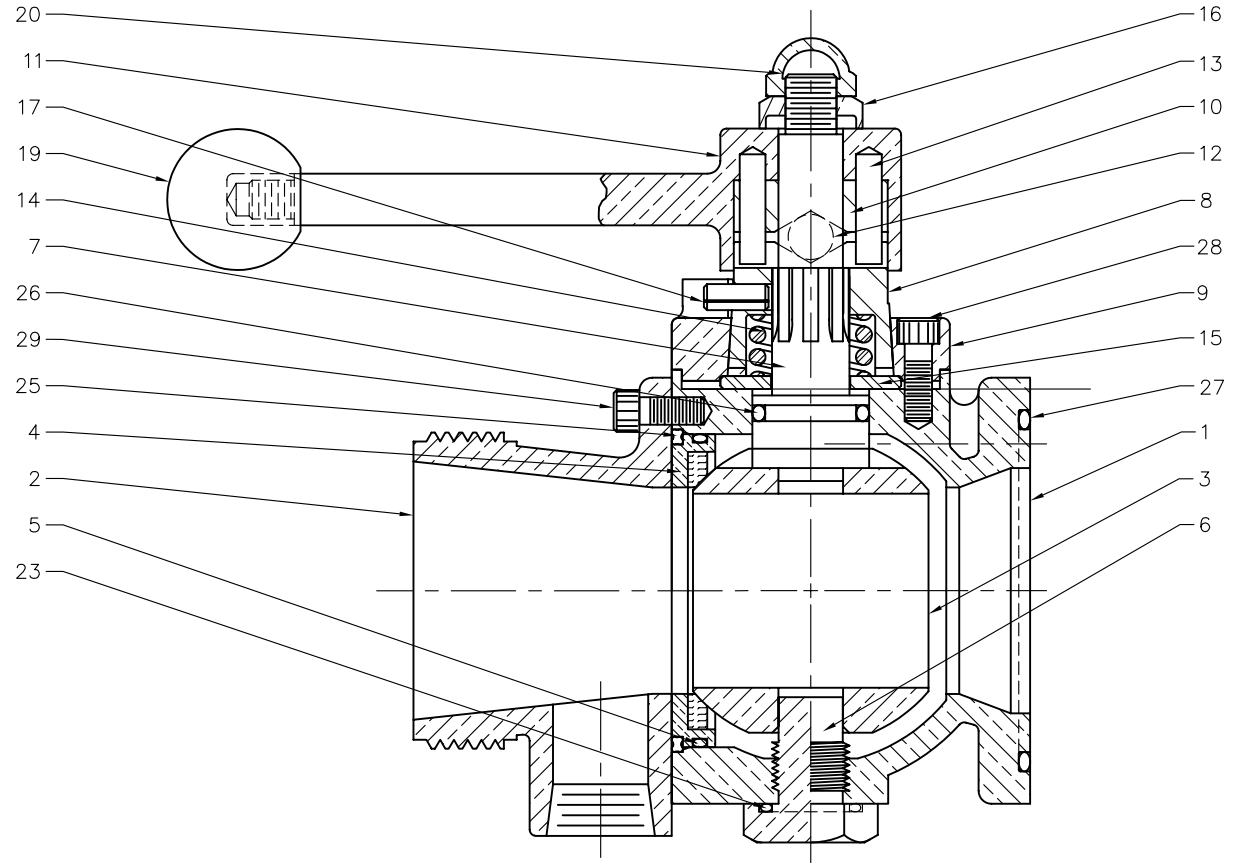
REASSEMBLY OF BALL VALVE ILLUSTRATION DGC0100

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]



OLD PART NO.
G1200

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

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

DWG - BALL VALVE ASSEMBLY
CROSS SECTION

DR'N JCM
CHKD TRCDLMH 5/96

DATE NOV12,65
SCALE 1/1

DGC0100

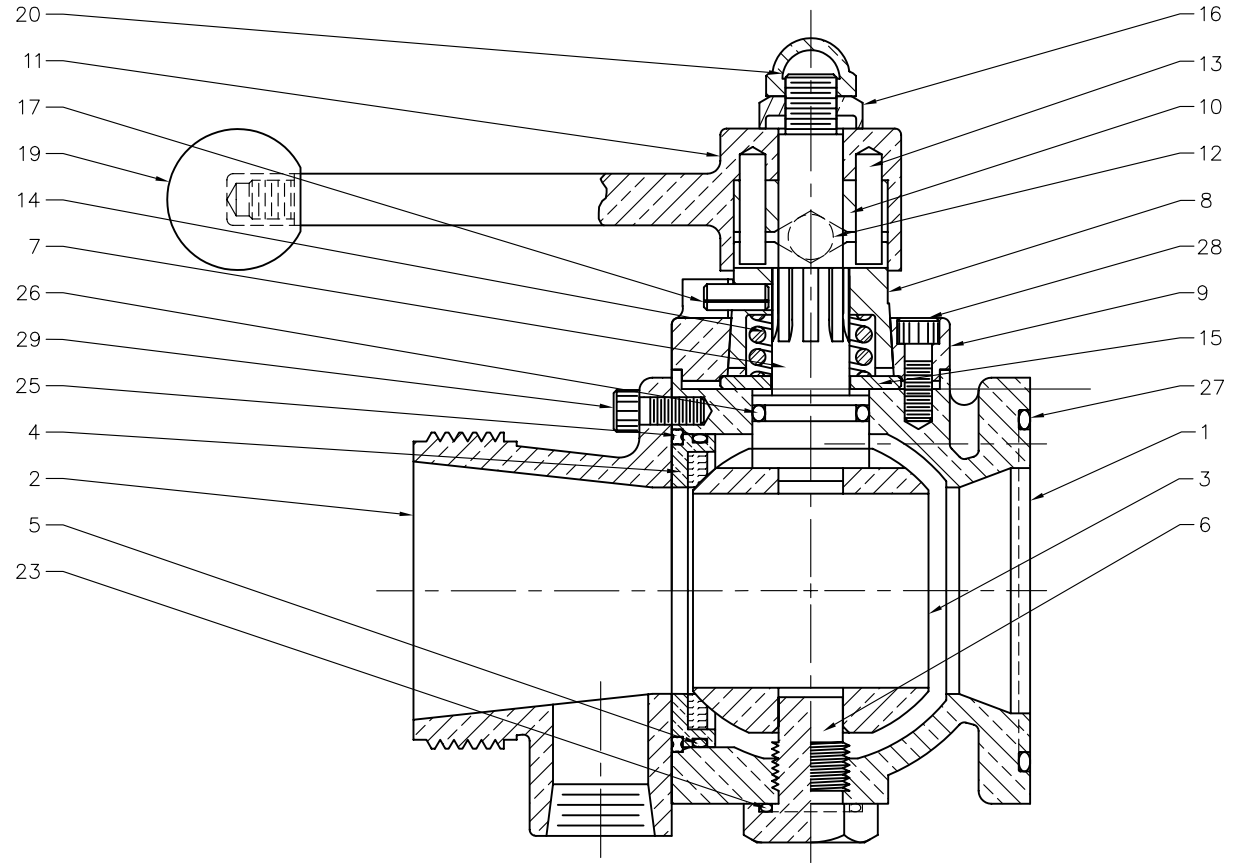
THIS DESIGN IS THE PROPERTY OF
W.S. DARLEY AND CO. - UNAUTHORIZED
REPRODUCTION IS PROHIBITED

ALL DIMENSIONS IN
INCHES UNLESS NOTED

DO NOT SCALE PRINT

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 .00 ±.03 .000 ±.010 ANGLES ±1°	W.S. DARLEY & Co. MELROSE PARK, IL - CHIPPEWA FALLS, WI	
	DWG - BALL VALVE ASSEMBLY CROSS SECTION	
DR'N JCM	DATE NOV12,65	DGC0100
CHKD TRCDLMH 5/96	SCALE 1/1	



OLD PART NO.
G1200

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REPRODUCTION IS PROHIBITED

ALL DIMENSIONS IN
INCHES UNLESS NOTED

DO NOT SCALE PRINT

Relief Valve “Discharge Valve”

Prepared by: CWY
Approved by: RJG
Revised by:

Rev. 0
Date: 06/20/13
Rev. Date:
1200652.doc

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.

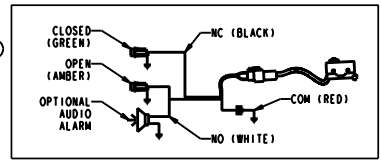
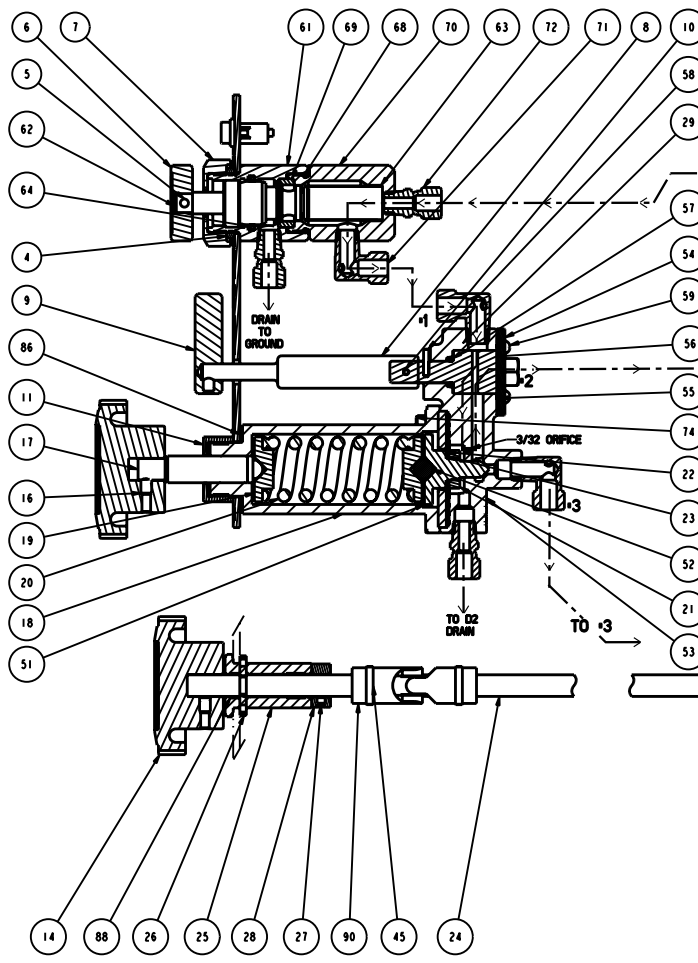
Self-cleaning strainer (63) can be removed for inspection or replacement by alternately turning valve knob (6) and stop nut (7) counter clockwise until stem is free for removal. To avoid discharging water through opening created by stem (62) removal, pump should be completely shut down before stem (62)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

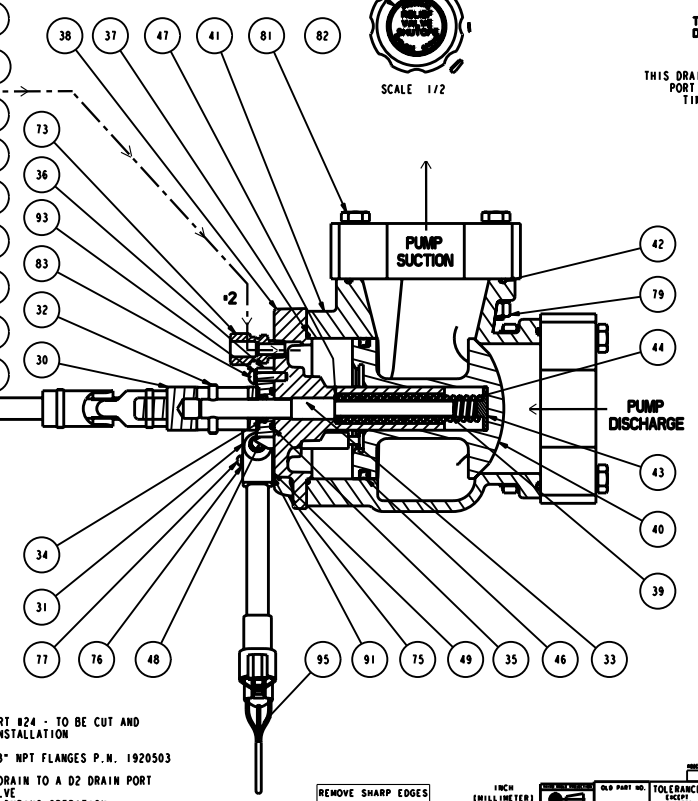
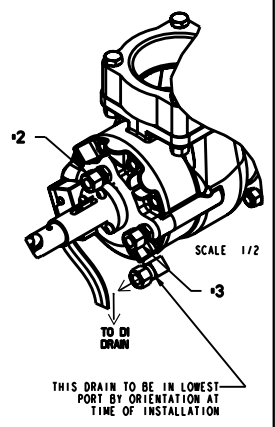
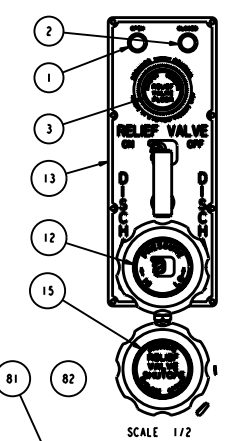
All Darley relief valves can be provided with a micro switch and either one or two pilot lights to indicate when the valve is open or closed.

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

NO.	DESCRIPTION	QTY	UNIT
1	LIGHT - AMBER, 240	-	1
2	LIGHT - GREEN, 240	-	1
3	MECA. - FLUSH SCREEN	-	1
4	HOT - PANEL, FLUSH VALVE	-	1
5	SSS - NO.10-32 x 0.30, GSS	-	1
6	HOSE - FLUSH VALVE	-	1
7	HOT - PANEL, 1.20-12	-	1
8	COUPLING - RELIEF VALVE STEW	-	1
9	LEVER - R.V. ON/OFF	-	1
10	PIV - DRIVE LHM, 0.125 x 0.150	-	1
11	HOT - PANEL VALVE, 1.250-12	-	1
12	MECA. - PRESSURE, MIXED	-	1
13	PLATE - TONG, REMOTE HEAD	-	1
14	HOUSING	-	1
15	MECA. - PRESSURE RELIEF VALVE	-	1
16	SSS - 1/4-20 x 0.30, SSI	-	3
17	SCREW - SPRING TENSION	-	1
18	HOUSING - PILOT VALVE	-	1
19	RETAINER - SPRING	-	2
20	SPRING - PRESSURE REGULATOR	-	1
21	HOT - PILOT VALVE	-	1
22	RING - HOLDING PILOT	-	1
23	BEARING - PILOT HEAD	-	1
24	SHAFT - R.V. EXTENSION, 24"	-	1
25	HOUSING - RETAINER, PANEL	-	1
26	HOT - 750, CONDUIT	-	1
27	SSS - NO.10-24 x 0.19, GSS	-	1
28	COLLAR - SHAFT, 1/2" BORE	-	1
29	SSS - 3/4 x 0.31, GSS	-	1
30	COUPLING - RELIEF VALVE STEW	-	1
31	MICROSWITCH - ON/OFF	-	1
32	PIV - SPRING, 0.10 x 0.12	-	1
33	O-RING - 0.30 x 0.50 x 0.66	-	2
34	O-RING - 0.44 x 0.62 x 0.69	-	1
35	O-RING - 0.75 x 0.94 x 0.89	-	1
36	PLATE - SEAL, VALVE STEW	-	1
37	O-RING - 3.25 x 3.30 x 0.66	-	1
38	HEAD - RELIEF VALVE, REMOTE, 3"	-	1
39	STEM - RELIEF VALVE, 3"	-	1
40	PISTON - RELIEF VALVE, 3"	-	1
41	BODY - RELIEF VALVE, 3"	-	1
42	O-RING - 3.50 x 3.60 x 0.69	-	2
43	CENTER PLUG - PISTON SPRING	-	1
44	SPRING - PISTON	-	1
45	PIV - SPRING, 0.16 x 0.60	-	4
46	ORAD RING - 2.00 x 3.25 x 0.19	-	1
47	WASHER - 0.30 x 0.61 x .06.00	-	1
48	STEM - RELIEF VALVE SWITCH	-	1
49	SHAFT - SWITCH SPACER, 0.8425	-	1
50	PLUG - P.W.P., 0.125, SSI DGC NO	-	1
51	PIV - PILOT VALVE	-	1
52	SHOULDER - CAL, 0.147	-	1
53	HEAD - PILOT CONTROL	-	1
54	COVER - ON/OFF VALVE	-	1
55	O-RING - 1.12 x 1.25 x 0.66	-	1
56	PLUG - VALVE	-	1
57	O-RING - 0.50 x 0.69 x 0.69	-	1
58	PIV - SPRING, 0.12 x 0.62, SSI	-	1
59	HMS - NO.8-32 x 0.50, 0P	-	4
60	BODY - FLUSH VALVE HANDLE	-	1
61	STEM - FLUSH VALVE	-	1
62	STRAINER - SCREEN	-	1
63	ORAD RING - 1.00 x 1.25 x 0.12	-	1
64	O-RING - 1.19 x 1.30 x 0.69	-	1
65	SEAT - FLUSH VALVE	-	1
66	BODY - FLUSH VALVE HANDLE	-	1
67	TUBE FITTING - EL., .30 x .25	-	5
68	TUBE FITTING - STR., .30 x .25	-	4
69	TUBE FITTING - STR., .30 x .25	-	1
70	GCS - .250-10 x 0.60, SSI	-	4
71	GCS - .213-10 x 0.75, GSS	-	8
72	WASHER - LOCK, NO.6-18, SSI	-	2
73	HMS - NO.6-32 x 1.00, 0P	-	2
74	HOT - HEAT, .375-18, GSS	-	8
75	HMS - .375-18 x 2.25, GSS	-	8
76	FLANGE - ADAPTER, 3 MP	-	2
77	HMS - NO.10-24 x 0.75, GSS	-	3
78	WASHER - INT., 100PH, 1.250-10	-	1
79	BEARING - INT. HEAT, 0.20-10	-	2
80	SHAFT - UNIVERSAL, 500P	-	2
81	SHAFT - SWITCH SPACER, 0.825	-	1
82	WASHER - LOCK, NO.10-18, SSI	-	3
83	CONNECTION - SHEET BT 00-35	-	1



EXTENSION SHAFT - PART #24 - TO BE CUT AND DRILLED AT TIME OF INSTALLATION
 SHOWN WITH OPTIONAL 3" NPT FLANGES P.N. 1920503
 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

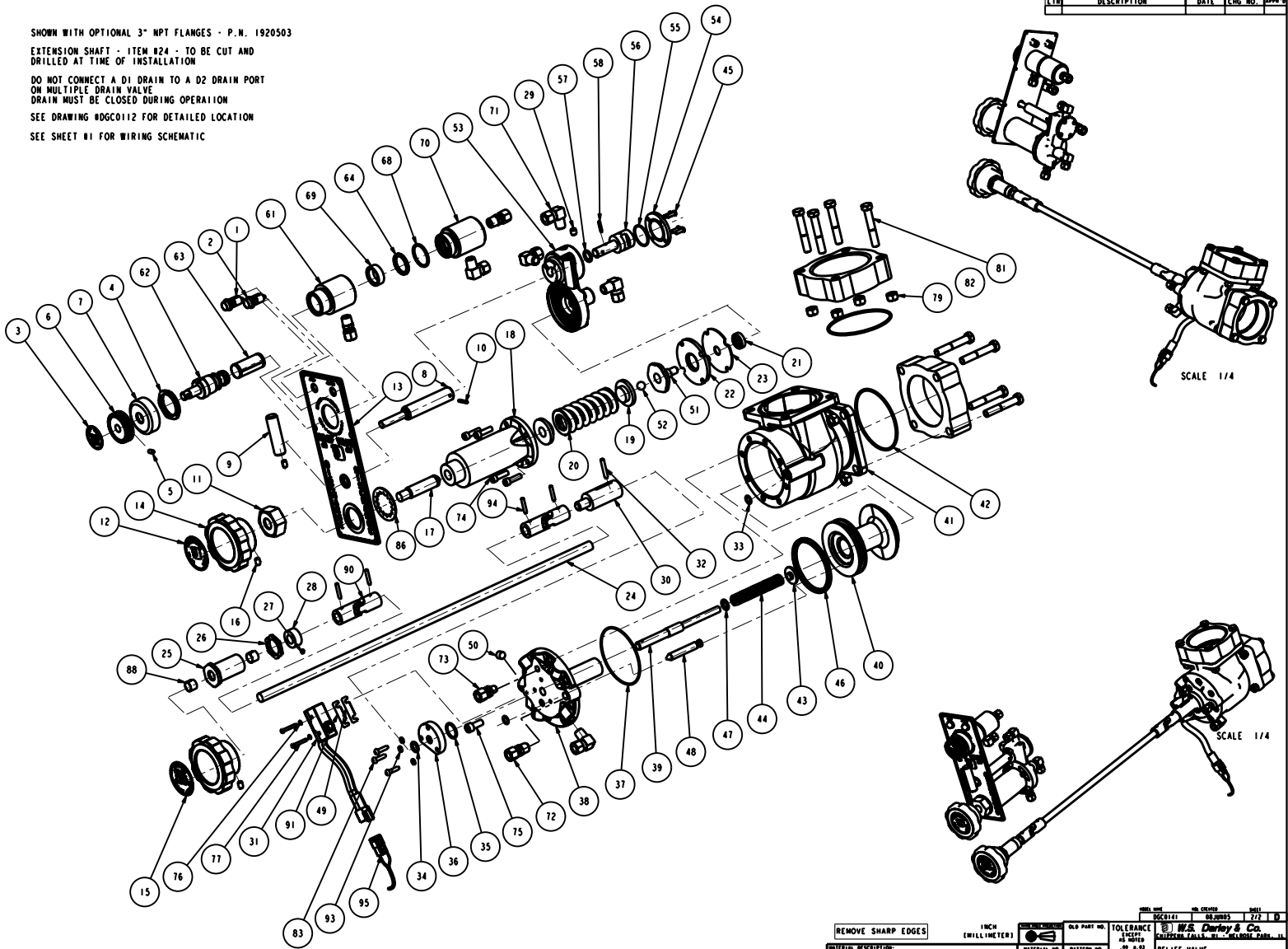


REVISIONS				
LTB	DESCRIPTION	DATE	CHG NO.	APP'D
A	REVERSED LIGHT POSITIONS	12 JUL 07	2007-285	RJS

REMOVE SHARP EDGES	INCH (MILLIMETERS)	OLD PART NO.	TOLERANCE (UNLESS NOTED)	DATE 13-Jan-05	DGC0141
MATERIAL DESCRIPTION:		PATTERN NO.	RELIEF VALVE	SCALE 3/4	
THIS DRAWING IS THE PROPERTY OF B.S. DARBY & CO. UNAUTHORIZED REPRODUCTION IS PROHIBITED.		ALL DIMENSIONS IN INCHES UNLESS NOTED		DO NOT SCALE PRINT	

NO.	DESCRIPTION	PART NO.	QTY.
1	LIGHT - GREEN, 2W	-	1
2	LIGHT - GREEN, 2W	-	1
3	MECA - FLUSH SCREEN	-	1
4	HOI - PANEL, FLUSH VALVE	-	1
5	SSS - NO.18-32 x 0.30, GRS	-	1
6	HOI - FLUSH VALVE	-	1
7	HOI - PANEL, 1.20-12	-	1
8	COMPLING - RELIEF VALVE STEM	-	1
9	LEVEL - 0. V. DRUM	-	1
10	PIV - DRIVE SHAFT, 0.125 x 0.125	-	1
11	HOI - PANEL VALVE, 1.250-12	-	1
12	MECA - PRESSURE, HYD	-	1
13	PLATE - TRIM, HANDLE HEAD	-	1
14	HOI - PANEL	-	2
15	MECA - PRESSURE RELIEF VALVE	-	1
16	SSS - 1/4-20 x 0.30, SSI	-	3
17	SCREW - SPRING TENSION	-	1
18	HOI - SPRING - PILOT VALVE	-	1
19	RETAINER - SPRING	-	2
20	SPRING - PRESSURE REGULATOR	-	1
21	HOI - PILOT VALVE	-	1
22	RING - HOI - PILOT	-	1
23	DIAPHRAGM - PILOT HEAD	-	1
24	SHAFT - 0. V. EXTENSION, 24"	-	1
25	DRUM - RETAINER, PANEL	-	1
26	HOI - 150, COMBIT	-	1
27	SSS - NO.18-24 x 0.19, GRS	-	1
28	COLLAR - SHAFT, 1.250-20	-	1
29	SSS - 3/32 x 0.75, GRS	-	1
30	COMPLING - RELIEF VALVE STEM	-	1
31	MICROSWITCH - DRUM	-	1
32	PIV - SPRING, 0.19 x 1.12	-	1
33	O-RING - 0.30 x 0.50 x 0.60	-	2
34	O-RING - 0.64 x 0.62 x 0.60	-	1
35	O-RING - 0.75 x 0.54 x 0.60	-	1
36	PLATE - SEAL, VALVE STEM	-	1
37	O-RING - 3.25 x 3.20 x 0.60	-	1
38	HEAD - RELIEF VALVE, HANDLE, 3"	-	1
39	STEM - RELIEF VALVE, 3"	-	1
40	PISTON - RELIEF VALVE, 3"	-	1
41	BODY - RELIEF VALVE, 3"	-	1
42	O-RING - 3.50 x 3.60 x 0.60	-	2
43	CENTER PIV - PISTON SPRING	-	1
44	SPRING - PISTON	-	1
45	RMS - NO.8-32 x 0.50, BR	-	4
46	DRUM RING - 2.00 x 3.25 x 0.19	-	1
47	HOI - 0.30 x 0.67 x .00 BR	-	1
48	STEM - RELIEF VALVE SWITCH	-	1
49	SHAFT - SWITCH SPACER, 0.625	-	1
50	PIV - PIPE, 0.125, SSI DGC NO	-	1
51	PIV - PILOT VALVE	-	1
52	BALL - CARB, 0.40"	-	1
53	HEAD - PILOT CONTROL	-	1
54	COVER - GROUP VALVE	-	1
55	O-RING - 1.12 x 1.25 x 0.60	-	1
56	PIV - VALVE	-	1
57	O-RING - 0.50 x 0.60 x 0.60	-	1
58	PIV - SPRING, 0.12 x 0.62, SSI	-	1
59	HOI - FLUSH VALVE HANDLE	-	1
60	STEM - FLUSH VALVE	-	1
61	STRAINER - SCREEN	-	1
62	DRUM RING - 1.00 x 1.25 x 0.12	-	1
63	O-RING - 1.19 x 1.20 x 0.60	-	1
64	SEAT - FLUSH VALVE	-	1
65	HOI - FLUSH VALVE HANDLE	-	1
66	HOI - VALVE	-	1
67	TUBE FITTING - EL - 3/8 x .25	-	5
68	TUBE FITTING - STD - 3/8 x .25 WPM	-	1
69	TUBE FITTING - STD - 3/8 x .12 WPM	-	1
70	SHCS - .250-20 x 0.60, SSI	-	4
71	SHCS - .313-18 x 0.75, GRS	-	8
72	HOI - LOCK, NO. 6 1/8, SSI	-	2
73	RMS - NO.8-32 x 1.00, BR	-	2
74	HOI - MECH - .375-16, GRS	-	8
75	HOI - MECH - .375-16 x 2.25, GRS	-	2
76	FLANGE - HOI - 3.00"	-	2
77	RMS - NO.18-24 x 0.75, GRS	-	3
78	HOI - INT - 10000, 1.250 1/8	-	1
79	BEARING - UNIVERSAL, 0.50 1/8	-	2
80	JOINT - UNIVERSAL, .500"	-	2
81	SHAFT - SWITCH SPACER, 0.625	-	1
82	HOI - LOCK, NO.18 1/8, SSI	-	3
83	PIV - SPRING, 0.16 x 0.60	-	4
84	CONNECTION - HOI - 0.60-35	-	1

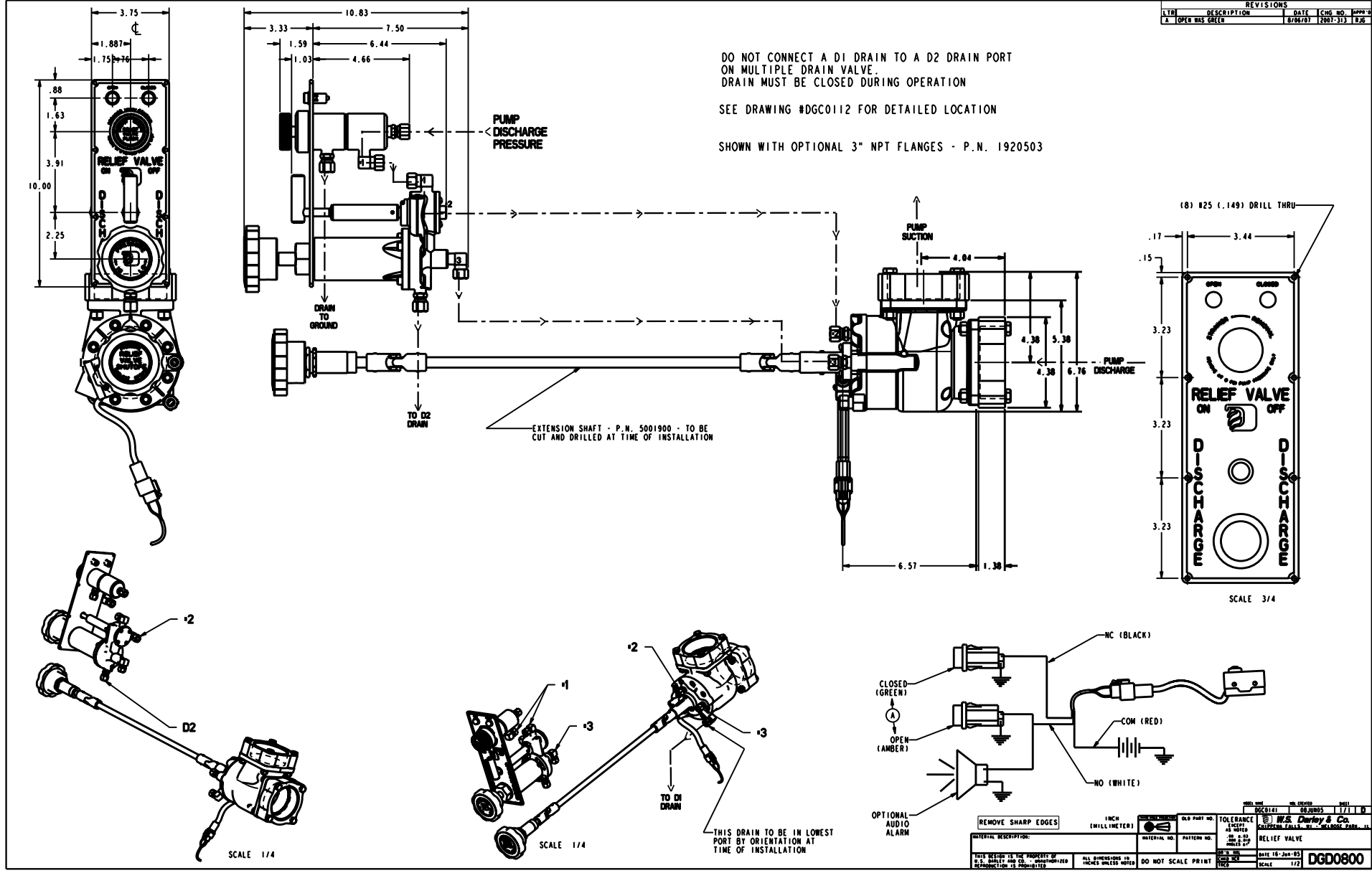
SHOWN WITH OPTIONAL 3" NPT FLANGES - P.N. 1920503
 EXTENSION SHAFT - ITEM #24 - TO BE CUT AND DRILLED AT TIME OF INSTALLATION
 DO NOT CONNECT A D1 DRAIN TO A D2 DRAIN PORT ON MULTIPLE DRAIN VALVE DRAIN MUST BE CLOSED DURING OPERATION
 SEE DRAWING #DGC0112 FOR DETAILED LOCATION
 SEE SHEET #1 FOR WIRING SCHEMATIC



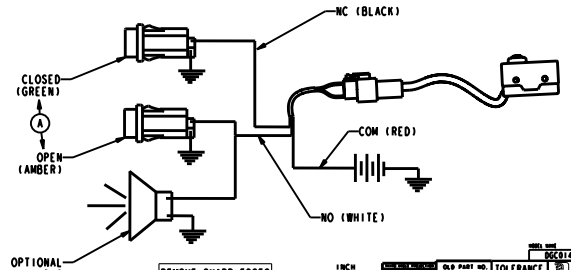
REVISIONS			
LTB	DESCRIPTION	DATE	CHG NO. APPR

REMOVE SHARP EDGES	1 INCH (25.4 MILLIMETERS)	OLD PART NO.	TOLERANCE (UNLESS OTHERWISE SPECIFIED)	DATE 15-Jan-05
MATERIAL DESCRIPTION:	MATERIAL NO.	PATTERN NO.	RELIEF VALVE	SCALE 3/4"
THIS DESIGN IS THE PROPERTY OF U.S. DUNN AND CO. UNAUTHORIZED REPRODUCTION IS PROHIBITED.		ALL DIMENSIONS IN INCHES UNLESS NOTED		DO NOT SCALE PRINT
DGC0141		U.S. Dunn & Co. CALIFORNIA FALLS, CA - RELIEF VALVE		DGC0141

REVISIONS				
LT#	DESCRIPTION	DATE	CHG. NO.	APP'D.
A	OPEN WAS GATE	5/20/70	2001-313	J.P.S.



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
SHOWN WITH OPTIONAL 3" NPT FLANGES - P.N. 1920503



REMOVE SHARP EDGES	INCH (MILLIMETERS)	OLD PART NO.	TOLERANCE AS SHOWN	DATE 18-Jun-83	DWG. NO. DGD0800
MATERIAL DESCRIPTION: RELIEF VALVE	INTERVAL NO.	PATTERN NO.	SCALE 1/2	SCALE 1/2	SCALE 1/2
<small>THIS DESIGN IS THE PROPERTY OF W.S. DARVEY & CO. UNAUTHORIZED REPRODUCTION IS PROHIBITED.</small>					

7.35

1200503

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

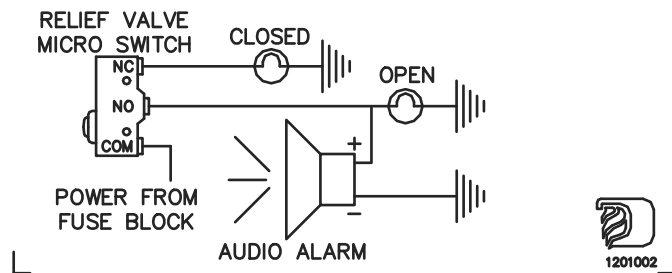
THIS ALARM IS DESIGNED TO CONCENTRATE AUDIBLE SOUND IN THE OPERATOR ZONE ONLY. FOR OPTIMUM PERFORMANCE, POSITION ALARM SOUND OPENING SO IT IS FACING THE OPERATOR AT A DISTANCE OF 24-36 INCHES.

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.

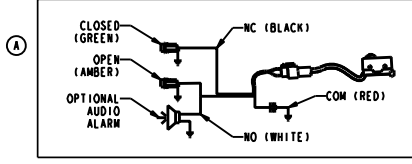
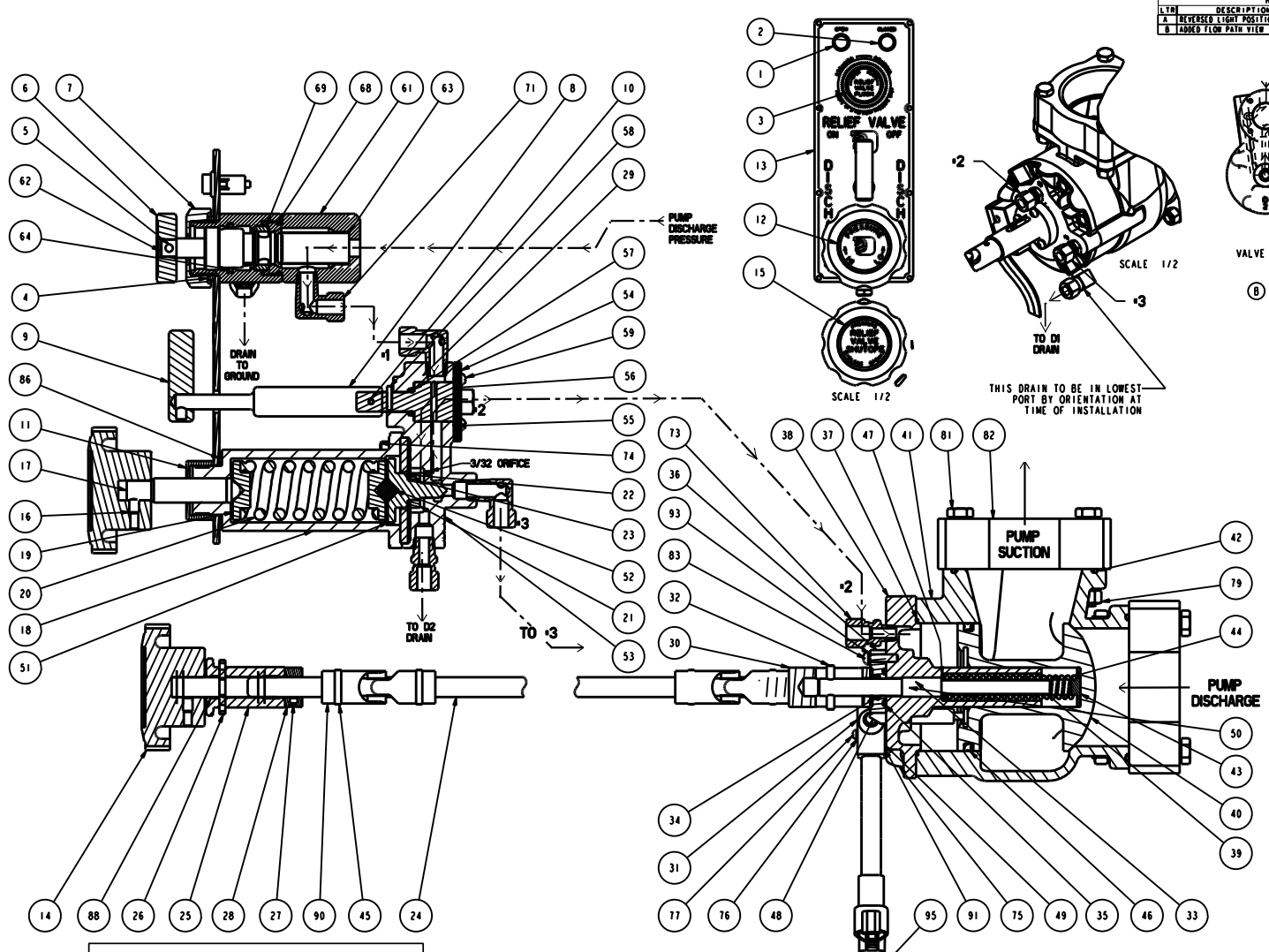
CONNECT TO 12 VDC ONLY.

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



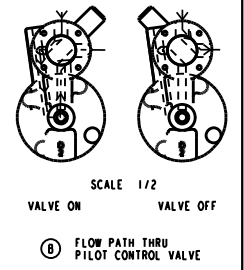
**IF FURTHER INFORMATION IS NEEDED, CALL W.S. DARLEY & CO. AT
CHIPPEWA FALLS, WI. AT 800-634-7812 or 715-726-2650**

NO.	DESCRIPTION	PART NO.	QTY.
1	LIGHT - AMBER	-	1
2	LIGHT - GREEN	-	1
3	BECA - FLUSH SCREEN	-	1
4	HUT - PANEL, FLUSH VALVE	-	1
5	SSS - NO.10-32 x 0.30, GRS	-	1
6	HODD - FLUSH VALVE	-	1
7	HUT - PANEL, 1.30-12	-	1
8	COUPLING - RELIEF VALVE STEM	-	1
9	LEVER - R.V., GRADY	-	1
10	PIV - DRIVE COIL, 0.250 x 0.750	-	1
11	HUT - PANEL VALVE, 1.250-12	-	1
12	BECA - PRESSURE, HYDRO	-	1
13	PLATE - TRIM, REMOTE HEAD	-	1
14	HARDWHEEL	-	2
15	BECA - PRESSURE RELIEF VALVE	-	1
16	SSS - 1/4-20 x 0.30, S&T	-	3
17	SCREW - SPRING TENSION	-	1
18	HOUSING - PILOT VALVE	-	1
19	RETAINER - SPRING	-	2
20	SPRING - PRESSURE REGULATOR	-	1
21	HUT - PILOT VALVE	-	1
22	RING - HOLLOWING PILOT	-	1
23	TRIMRING - PNEUMATIC HEAD	-	1
24	SHAFT - 0.2, EXTENDING, 24"	-	1
25	HOUSING - RETAINER, PANEL	-	1
26	HUT - 750, CONDUIT	-	1
27	SSS - NO.10-24 x 0.19, GRS	-	1
28	COLLAR - SHAFT, 1/2" BORE	-	1
29	SSS - 3/32 x 0.31, GRS	-	1
30	COUPLING - RELIEF VALVE STEM	-	1
31	MICROSWITCH - ON/OFF	-	1
32	PIV - SPRING, 0.10 x 1.12	-	1
33	O-RING - 0.30 x 0.50 x 0.06	-	2
34	O-RING - 0.44 x 0.62 x 0.09	-	1
35	O-RING - 0.75 x 0.90 x 0.09	-	1
36	PLATE - SEAL, RELIEF STEM	-	1
37	O-RING - 3.25 x 3.30 x 0.06	-	1
38	HEAD - RELIEF VALVE, REMOTE, 3"	-	1
39	STEM - RELIEF VALVE, 3"	-	1
40	PISTON - RELIEF VALVE, 3"	-	1
41	BOOP - RELIEF VALVE, 3"	-	1
42	O-RING - 3.50 x 3.60 x 0.09	-	2
43	CENTER PLUG - PISTON SPRING	-	1
44	SPRING - PISTON	-	1
45	PIV - SPRING, 0.10 x 0.60	-	4
46	ORND RING - 2.00 x 3.25 x 0.10	-	1
47	WASHER - 0.20 x 0.61 x .30 BR	-	1
48	STEM - RELIEF VALVE SWITCH	-	1
49	SWIM - SWITCH SPACER, 0.825	-	1
50	PLUG - PIPE, 0.175, S&T, SDC 40	-	1
51	PIV - PILOT VALVE	-	1
52	BALL - CMB, 0.40"	-	1
53	HEAD - PILOT CONTROL	-	1
54	COVER - GRADY VALVE	-	1
55	O-RING - 1.12 x 1.25 x 0.06	-	1
56	PLUG - VALVE	-	1
57	O-RING - 0.50 x 0.60 x 0.09	-	1
58	PIV - SPRING, 0.12 x 0.62, S&T	-	1
59	HMS - NO.8-32 x 0.50, BR	-	4
60	BOOP - FLUSH VALVE, COMPLETE	-	1
61	STEM - FLUSH VALVE	-	1
62	STRITCHER - SCREEN	-	1
63	ORND RING - 1.00 x 1.25 x 0.12	-	1
64	O-RING - 1.10 x 1.30 x 0.09	-	1
65	SEAT - FLUSH VALVE	-	1
66	HMS - NO.8-32 x 1.00, BR	-	2
67	HUT - HET, 1.750-10, GRD	-	0
68	HMS - 3/16-16 x 0.75, GRS	-	0
69	FLANGE - ADAPTER, 3/8"	-	2
70	HMS - NO.10-24 x 0.75, GRS	-	2
71	WASHER - INT, 1.00IN, 1.250-10	-	1
72	BEARING - MYLOR, 0.50-10	-	2
73	JOINT - UNIVERSAL, .500"	-	2
74	SWIM - SWITCH SPACER, 0.825	-	1
75	WASHER - LOCK, NO.10-10, S&T	-	3
76	CONNECTOR - SWITCH BY DR-35	-	1



EXTENSION SHAFT - PART #24 - TO BE CUT AND DRILLED AT TIME OF INSTALLATION
 SHOWN WITH OPTIONAL 3" NPT FLANGES P.N. 1920503
 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

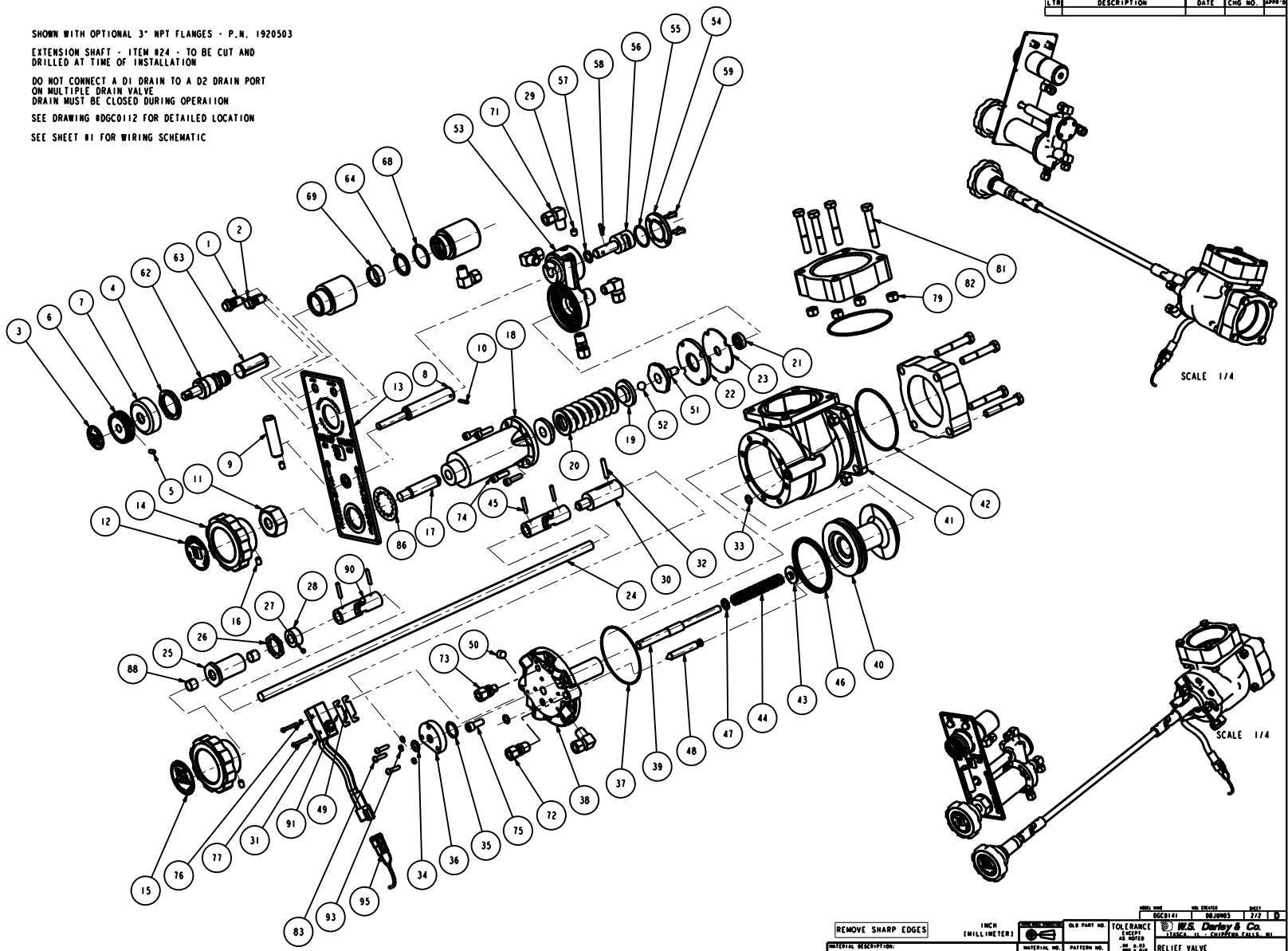
REVISIONS				
LTN	DESCRIPTION	DATE	CHK NO.	APPR'D
A	REVERSED LIGHT POSITIONS	12/20/01	2007-285	R.26
B	ADDED FLOW PATH VIEW	21/MOV2007/2007-451		SMS



REMOVE SHARP EDGES	1/8" (MILLIMETERS)	OLD PART NO.	TOLERANCE	DATE 12-200-03	SCALE 3/4"
INTERNAL DESCRIPTION:		PATTERN NO.	RELIEF VALVE		
THIS DESIGN IS THE PROPERTY OF W.S. DARLEY & CO. UNLESS OTHERWISE SPECIFIED REPRODUCTION IS PROHIBITED		ALL DIMENSIONS IN INCHES UNLESS NOTED	DO NOT SCALE PRINT	DGC0141	

NO.	DESCRIPTION	PART NO.	QTY.
1	LIGHT - AMBER	-	1
2	LIGHT - GREEN	-	1
3	BECK - FLUSH SCREEN	-	1
4	NUT - PANEL, FLUSH VALVE	-	1
5	SSS - NO.10-32 x 0.30, GRS	-	1
6	WHD - FLUSH VALVE	-	1
7	NUT - PANEL, 1.30-12	-	1
8	COUPLING - RELIEF VALVE STEM	-	1
9	LEVER - R.V. SHUTTLE	-	1
10	PIST - DRIVE PLUG, 0.125 x 0.250	-	1
11	NUT - PANEL VALVE, 1.250-12	-	1
12	BECK - PRESSURE, HYDRO	-	1
13	PLATE - TRIM, REMOTE HEAD	-	1
14	WASHER -	2	
15	BECK - PRESSURE RELIEF VALVE	-	1
16	SSS - 1/4-20 x 0.30, SSI	-	3
17	SCREEN - SPRING TENSION	-	1
18	HOUSING - PILOT VALVE	-	1
19	RETAINER - SPRING	2	
20	SPRING - PRESSURE REGULATION	-	1
21	NUT - PILOT VALVE	-	1
22	RING - HOUSING PILOT	-	1
23	SHAPING - PILOT HEAD	-	1
24	SHAFT - R.V. EXTENSION, 24"	-	1
25	WASHER - RETAINER, PANEL	-	1
26	NUT - 1/20, CONDUIT	-	1
27	SSS - NO.10-24 x 0.15, GRS	-	1
28	COLLAR - SHAFT, 1/2" BORE	-	1
29	SSS - 3/16 x 0.31, GRS	-	1
30	COUPLING - RELIEF VALVE STEM	-	1
31	HYDROTECH - O-RING	-	1
32	PIN - SPRING, 0.10 x 1.12	-	1
33	O-RING - 0.30 x 0.50 x 0.06	2	
34	O-RING - 0.40 x 0.60 x 0.09	-	1
35	O-RING - 0.75 x 0.94 x 0.09	-	1
36	PLATE - SEAL, VALVE STEM	-	1
37	O-RING - 3.25 x 3.30 x 0.04	-	1
38	HEAD - RELIEF VALVE, REMOTE, 3"	-	1
39	STEM - RELIEF VALVE, 3"	-	1
40	PISTON - RELIEF VALVE, 3"	-	1
41	HOOP - RELIEF VALVE, 3"	-	1
42	O-RING - 3.50 x 3.69 x 0.09	2	
43	CENTER PLUG - PISTON SPRING	-	1
44	SPRING - PISTON	-	1
45	PIN - SPRING, 0.10 x 0.80	4	
46	O-RING - 2.00 x 3.25 x 0.10	-	1
47	WASHER - 0.20 x 0.61 x .06 MP	-	1
48	STEM - RELIEF VALVE, COMPLETE	-	1
49	SPAC - SPRING SPACER, 0.025	-	1
50	PLUG - PIPE, 0.125, SSI, SEC HD	-	1
51	PIN - PILOT VALVE	-	1
52	BALL - CAR, 0.44"	-	1
53	HEAD - PILOT CONTROL	-	1
54	COVER - SHUTTLE VALVE	-	1
55	O-RING - 1.12 x 1.25 x 0.06	-	1
56	PLUG - VALVE	-	1
57	O-RING - 0.50 x 0.69 x 0.09	-	1
58	PIN - SPRING, 0.12 x 0.62, SSI	-	1
59	SSS - NO.8-32 x 0.50, MP	4	
60	HOOP - FLUSH VALVE, COMPLETE	-	1
61	STEM - FLUSH VALVE	-	1
62	STRAINER - SCREEN	-	1
63	O-RING - 1.00 x 1.25 x 0.12	-	1
64	O-RING - 1.19 x 1.30 x 0.09	-	1
65	SEAT - FLUSH VALVE	-	1
66	TUBE FITTING - EL, .30 x .25	5	
67	TUBE FITTING - STR, .30 x .25 MPIN	3	
68	TUBE FITTING - STR, .30 x .12 MPIN	-	1
69	SMCS - 1/20-20 x 0.60, SSI	4	
70	SMCS - 3/16-18 x 0.75, GRS	0	
71	WASHER - LOCK, NO.8 18, SSI	2	
72	SMCS - NO.8-32 x 1.00, MP	2	
73	NUT - NCS, 1/20-18, GRS	0	
74	SMCS - 1/16-18 x 2.25, GRS	0	
75	FLANGE - ADAPTER, 3 MP	2	
76	SMCS - NO.10-24 x 0.75, GRS	3	
77	WASHER - INT, 100TH, 1.250 10	-	1
78	BEARING - OYLER, 0.50 10	-	2
79	SHAFT - UNIVERSAL, .500"	-	2
80	SMCS - UNIVERSAL, .500"	-	1
81	SMCS - LOCK, NO.10 10, SSI	-	3
82	CONNECTOR - NUTTECH BY 08-35	-	1

SHOWN WITH OPTIONAL 3" NPT FLANGES - P.N. 1920503
 EXTENSION SHAFT - 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



REVISIONS			
LTB	DESCRIPTION	DATE	CHK NO. APPR

REMOVE SHARP EDGES

1 INCH (MILLIMETERS)

OLD PART NO. TOLERANCE (SEE DRAWING) **W.S. Darby & Co.**
 STOCK - IN - CLEVELAND, OHIO

MATERIAL NO. PATTERN NO. RELIEF VALVE

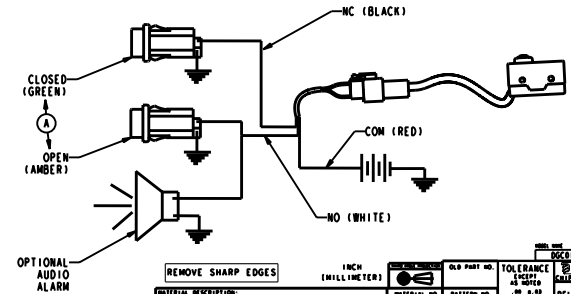
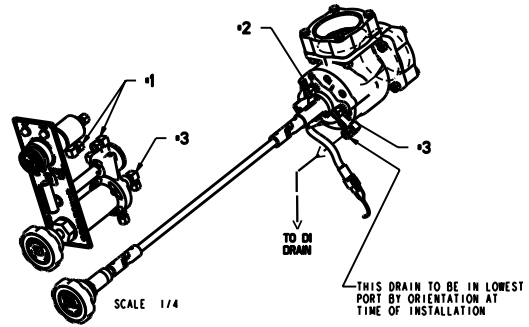
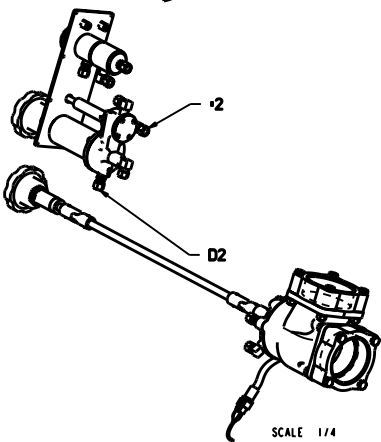
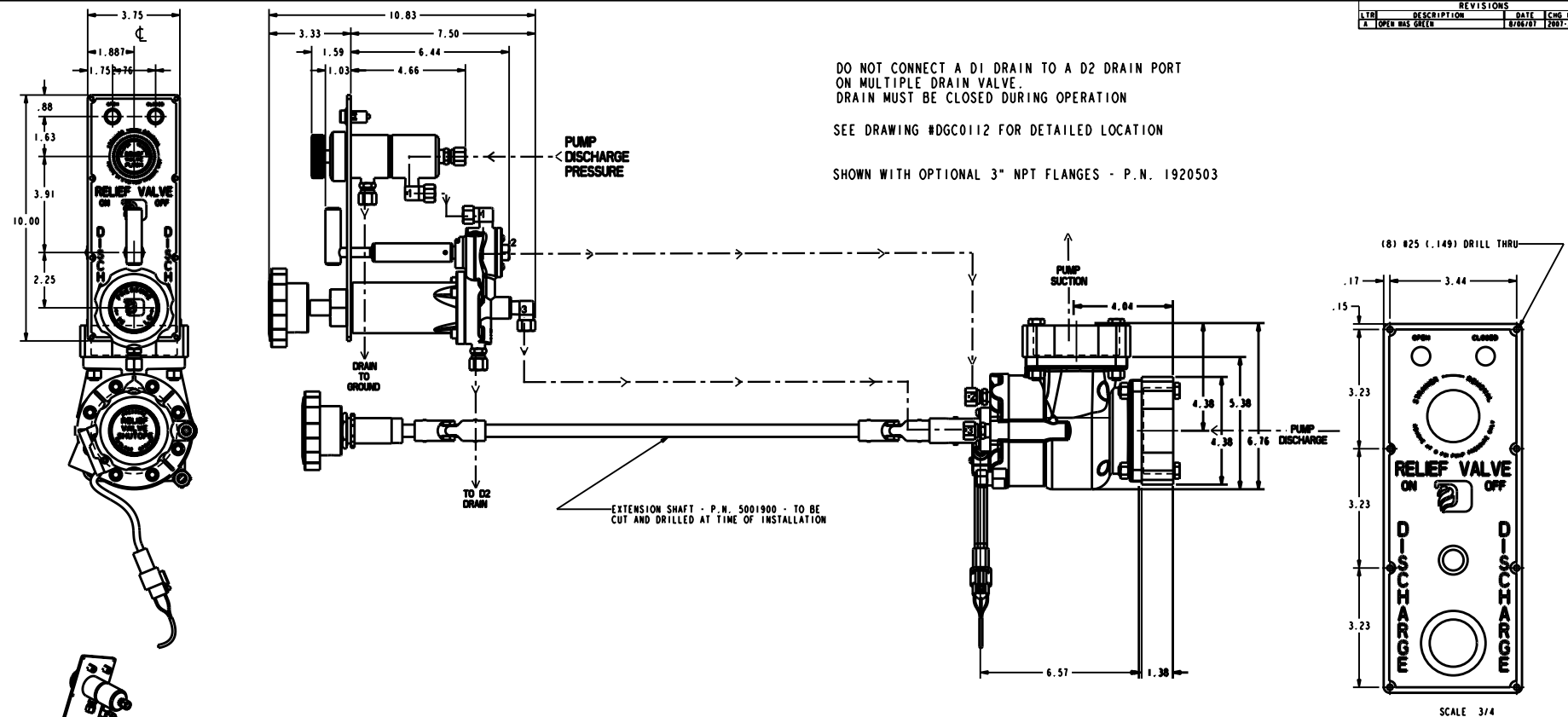
THIS DESIGN IS THE PROPERTY OF W.S. DARBY AND CO. UNAUTHORIZED REPRODUCTION IS PROHIBITED. ALL DIMENSIONS IN INCHES UNLESS NOTED. DO NOT SCALE PRINT.

DATE 15-JUN-93
 SCALE 3/4" = 1"

DGC0141

NAME:RG OBJECT:DGD0800 DATE:06-Aug-07 09:18:21

REVISIONS				
LTN	DESCRIPTION	DATE	CHK NO.	APP'D
1	OPEN HAS GATE	8/16/07	200-313	RJS



REMOVE SHARP EDGES	1 INCH (25.4 MILLIMETER)	OLD PART NO.	TOLERANCE AS SHOWN	DATE 18-JAN-05	SCALE 1/2
INTERNAL DESCRIPTION: RELIEF VALVE		PATTERN NO.	MATERIAL NO.	DATE 18-JAN-05	SCALE 1/2
THIS DESIGN IS THE PROPERTY OF D.G. DUNN AND TO BE KEPT UNREPRODUCED UNLESS AUTHORIZED		ALL DIMENSIONS IN INCHES UNLESS NOTED		DO NOT SCALE PRINT	

DGC0141
 W.S. Durley & Co.
 RAUZZON FALLS, N.H.
 RELIEF VALVE
 DGD0800

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

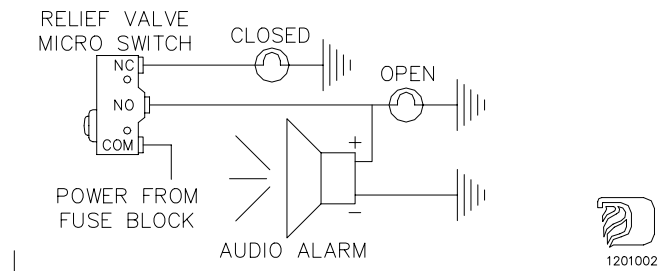
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MOUNT UNIT IN 1.12 DIAMETER PANEL HOLE. IF PANEL IS THICKER THAN .09 IN., INVERT NUT.

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.

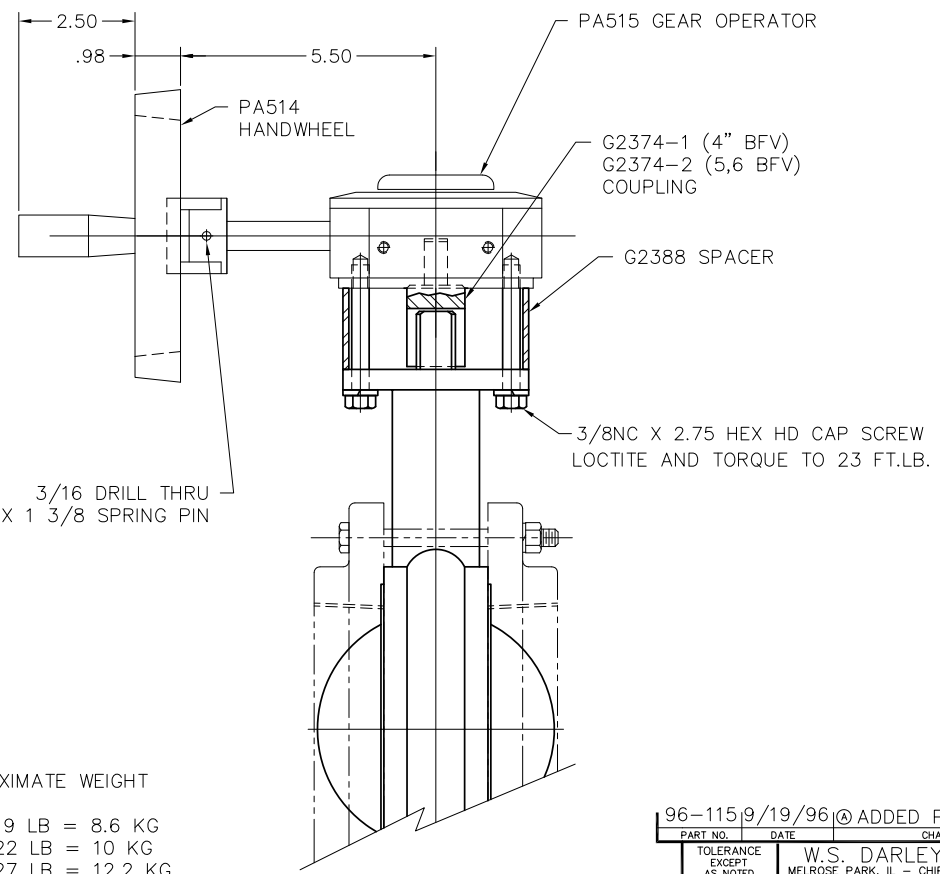
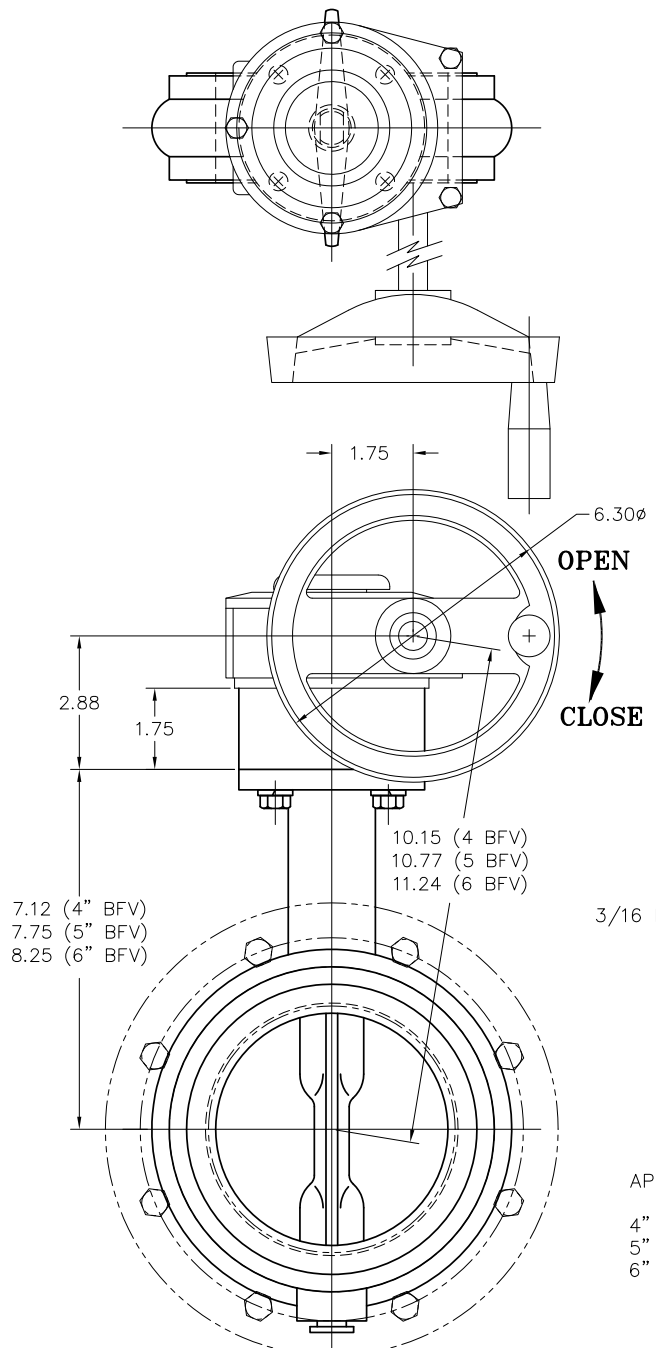


**IF FURTHER INFORMATION IS NEEDED, CALL W.S. DARLEY & CO. AT
CHIPPEWA FALLS, WI. AT 800-634-7812 or 715-726-2650**

Butterfly Valve

Prepared by: CWY
Approved by: RJG
Revised by:

Rev. 0
Date: 06/20/13
Rev. Date:
1200652.doc



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 9/19/96 ⓐ ADDED PLATE LMH

PART NO.	DATE	CHANGE



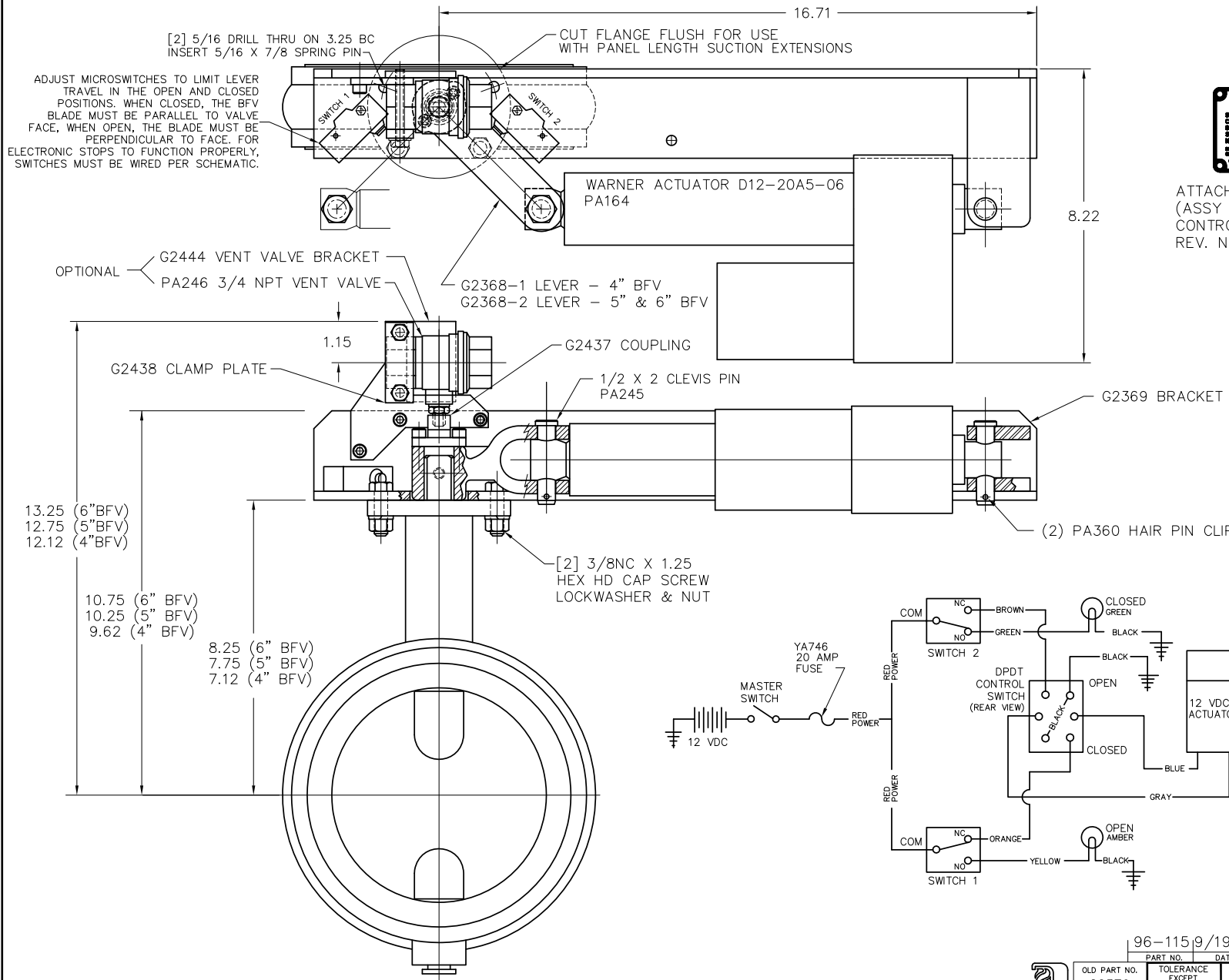
OLD PART NO.
G2420

TOLERANCE EXCEPT AS NOTED		W.S. DARLEY & CO.	
FRAC DIM $\pm .01$.00 $\pm .01$	MELROSE PARK, IL - CHIPPEWA FALLS, WI	
.000 $\pm .005$	ANGLES $\pm 1^\circ$	DWG - BTRFLY VALVE ASSY	
		MANUAL CONTROLLED	
DRN DWS	DATE SEP25,91	DGD0104	
CHKD	SCALE 1/2		
TRCD			

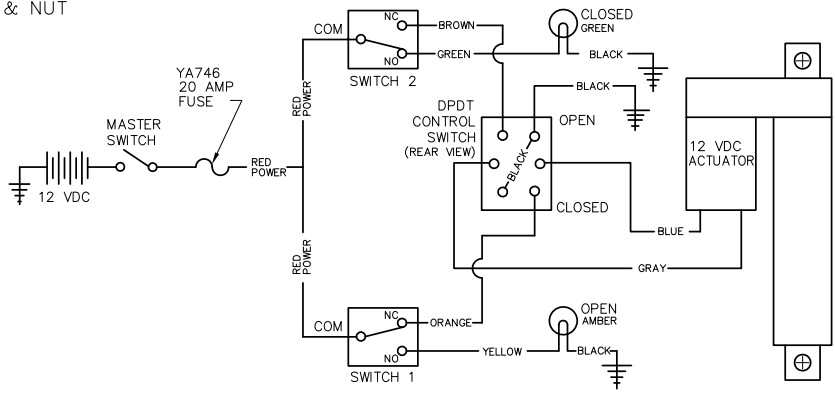
THIS DESIGN IS THE PROPERTY OF W.S. DARLEY AND CO. - UNAUTHORIZED REPRODUCTION IS PROHIBITED

ALL DIMENSIONS IN INCHES UNLESS NOTED

DO NOT SCALE PRINT



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



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

96-115/9/19/96ⓐ ADDED PLATE LMH

PART NO.		DATE		CHANGE	
OLD PART NO.	TOLERANCE EXCEPT AS NOTED	W.S. DARLEY & CO.			
G2370	FRAC DIM ±.01	MELROSE PARK, IL - CHIPPEWA FALLS, WI			
MATERIAL:	MATERIAL NO.	PATTERN NO.	DR'N	DATE	DWG - BUTTERFLY VALVE ASSEMBLY ELECTRIC ACTUATED
THIS DESIGN IS THE PROPERTY OF W.S. DARLEY AND CO. - UNAUTHORIZED REPRODUCTION IS PROHIBITED	-	-	SEITZ	NOV20,91	
ALL DIMENSIONS IN INCHES UNLESS NOTED	DO NOT SCALE PRINT	CHKD	TRCD	SCALE 1/2	

DGD0101

INLET RELIEF VALVE INFORMATION: (A)

ACTUAL PRESSURE RANGE IS 90PSI – 300PSI
THERE MAY BE SOME DIMINISH IN FLOW AT HIGHER
PRESSURE SETTINGS. (SETTINGS BELOW 200 PSI
RECOMMENDED FOR MOST APPLICATIONS).

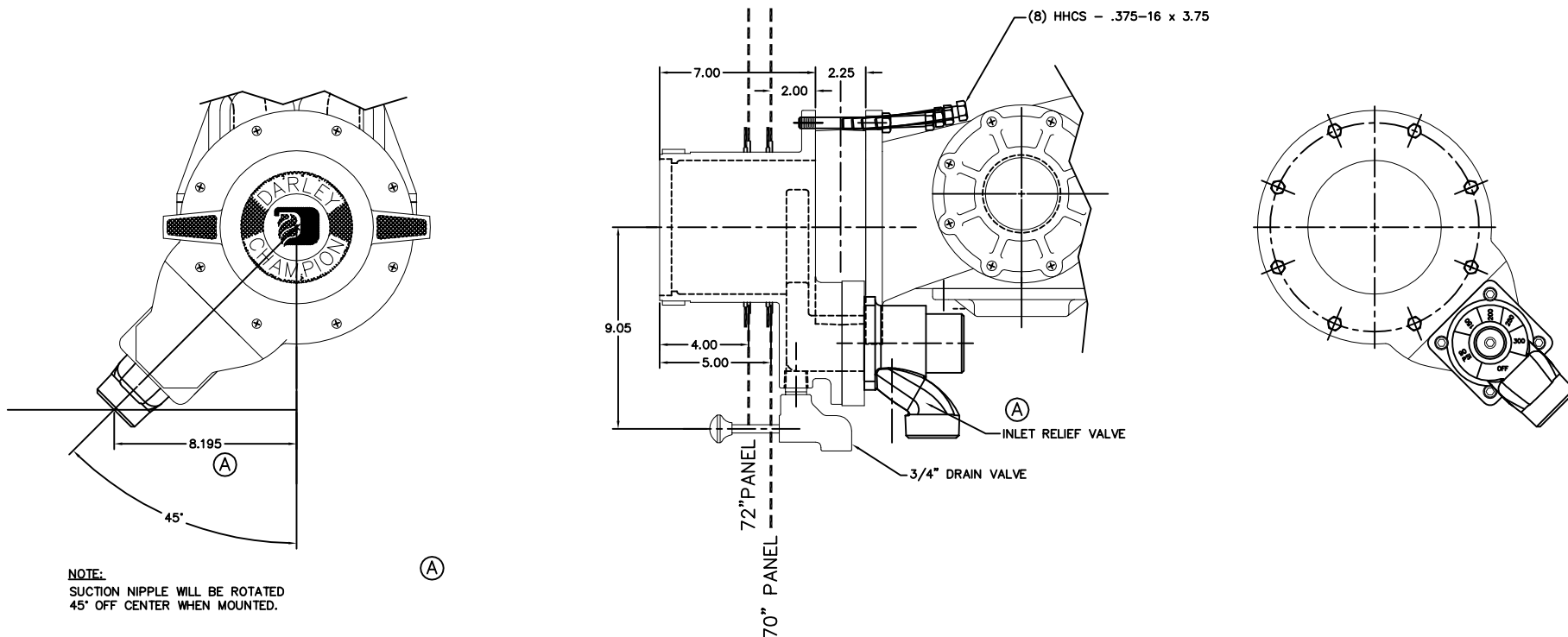
RELIEF VALVE IS FACTORY SET AT 125 PSI AND
WHEN PRESET AT 125 PSI, THE PRESSURE RELIEF
VALVE SHALL NOT ALLOW A PRESSURE RISE GREATER
THAN 60 PSI AT THE DEVICE INLET WHILE FLOWING A
MINIMUM OF 150 GPM.

THIS VALVE IS NFPA 2009 1901 COMPLIANT PER SECTION
16.6.6.3

ADJUSTMENT INSTRUCTIONS (IF REQUIRED): (A)

ADJUST CENTER HEX COUNTERSUNK HEX HEAD PRESSURE
ADJUSTING BOLT WITH A 1/4" ALLEN WRENCH, 9/16" OR
14 MM SOCKET.

TO SET AT THE DESIRED RELIEF PRESSURE, ADJUST THE ADJUSTING
BOLT HEAD SO THE TOP OF THE BOLT HEAD IS EVEN WITH
THE DESIRED PRESSURE.



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

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

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

MATERIAL:		PATTERN NO.	
THIS DESIGN IS THE PROPERTY OF W.S. DARLEY AND CO. - UNAUTHORIZED REPRODUCTION IS PROHIBITED		DO NOT SCALE PRINT	
ALL DIMENSIONS IN INCHES UNLESS NOTED		DATE 03FEB,00	
DR'N CKE		SCALE 1/4	
CHKD SJL		1200572	
TRCD			

A - #8512	07/18/12	UPDATED DRAWING TO REFLECT USE OF TFT SUCTION RELIEF VALVE 8.20 WAS 5.22. UPDATED INFO AND ADJUSTMENT SECTION
PART NO.	DATE	CHANGE
TOLERANCE EXCEPT AS NOTED	W.S. DARLEY & CO. MELROSE PARK, IL - CHIPPEWA FALLS, WI	
FRAC DIM ±.01	INSTR - INLET RV ADJUSTMENT	
.00 ±.01	-	
.000 ±.005	-	
ANGLES ±1°	-	
DR'N CKE	DATE 03FEB,00	1200572
CHKD SJL	SCALE 1/4	
TRCD		

Pump Overheat Protection

Prepared by: CWY
Approved by: RJG
Revised by:

Rev. 0
Date: 06/20/13
Rev. Date:
1200652.doc

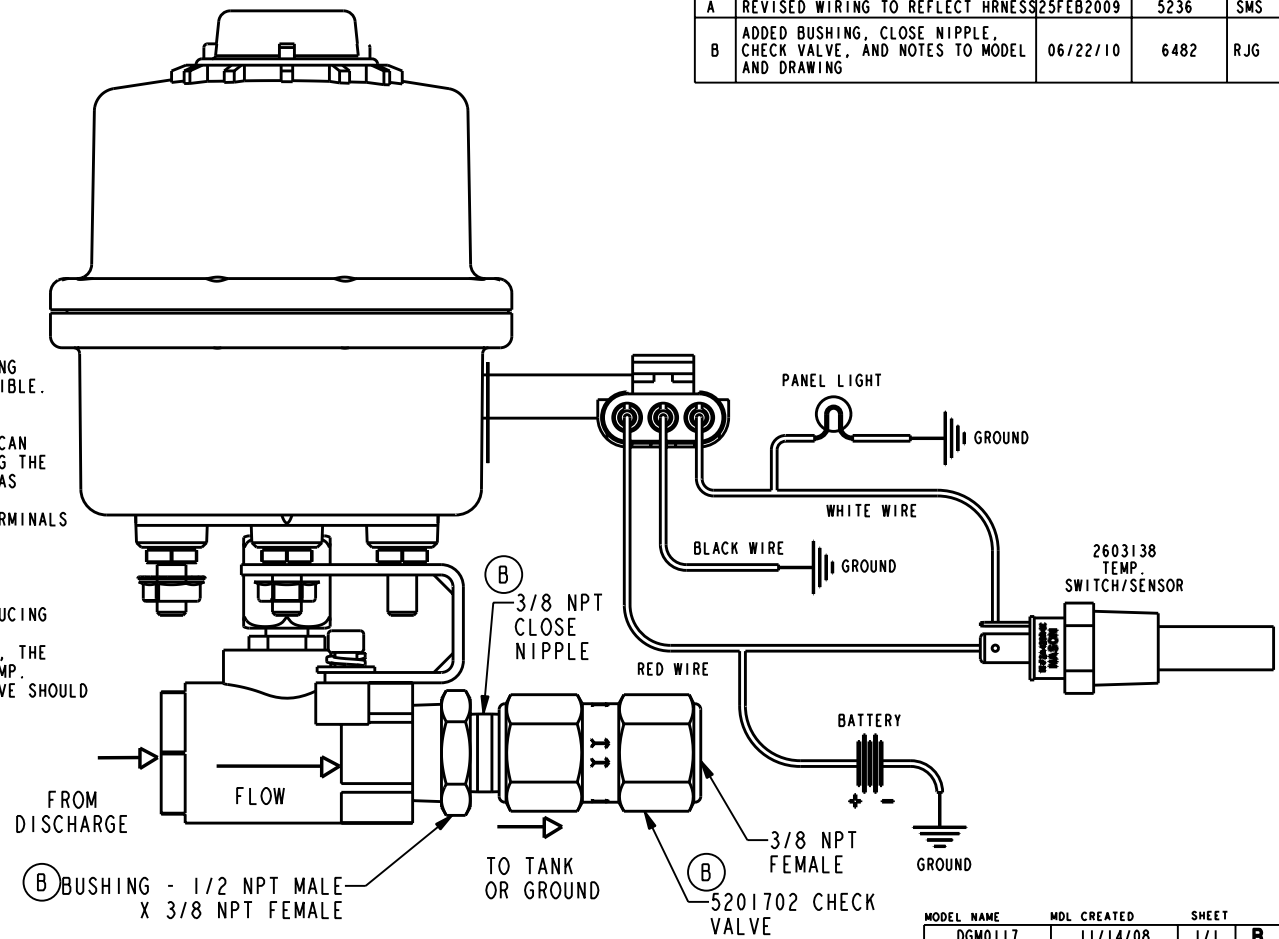
NAME:RJG OBJECT:DGM0117 DATE:22-Jun-10 14:41:12

REVISIONS				
LTR	DESCRIPTION	DATE	CHG NO.	APPR'D
A	REVISED WIRING TO REFLECT HRNESS	25FEB2009	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 VOLATAGE 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)



OLD PART NO.

TOLERANCE EXCEPT AS NOTED

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

MATERIAL DESCRIPTION:

MATERIAL NO.

PATTERN NO.

.00 ± .03
.000 ± .010
ANGLES ± 1°

DWG - THERMAL RELIEF SYSTEM
KZCO VALVE, 2603138 TEMP. SENSOR

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ALL DIMENSIONS IN INCHES UNLESS NOTED

DO NOT SCALE PRINT

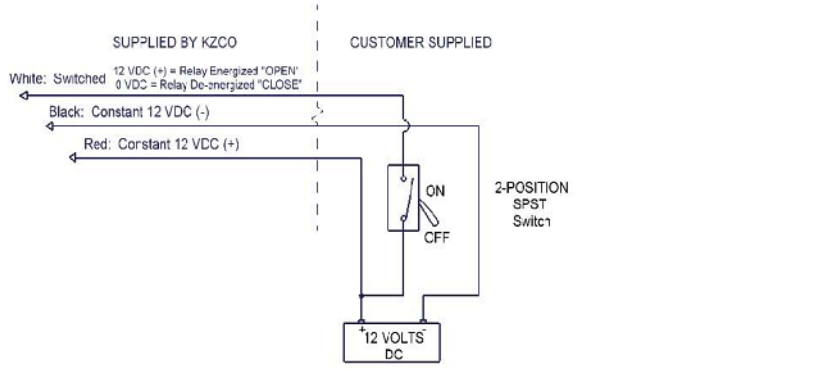
DR'N RJG
CHKD DWS
TRCD

DATE 14-Nov-08
SCALE 1/1

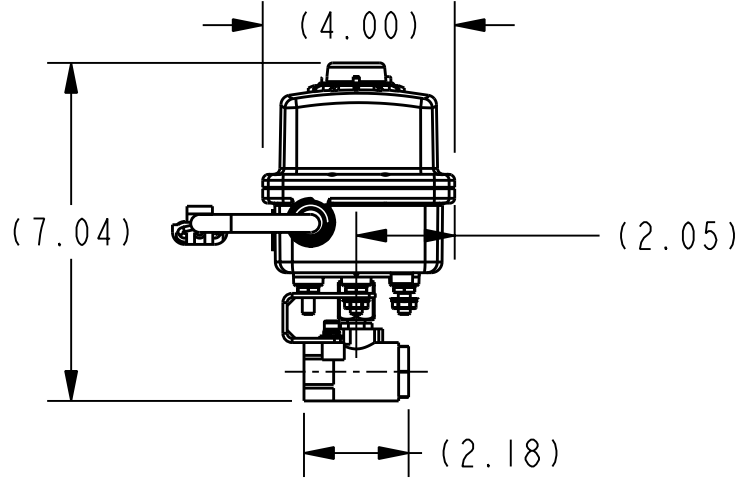
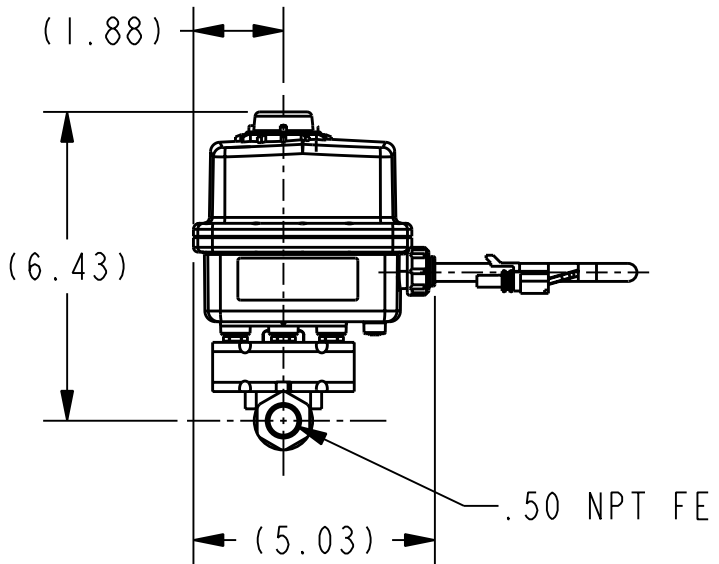
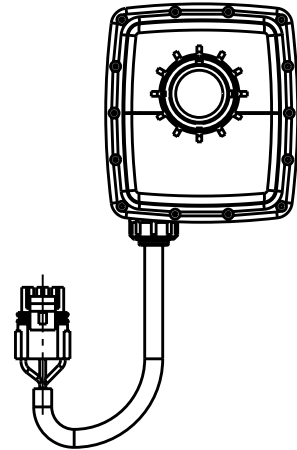
DGM0117

MODEL NAME	MDL CREATED	SHEET
DGM0117	11/14/08	1/1 B

NAME:RG OBJECT:5209401_1 DATE:17-Nov-08 11:49:17



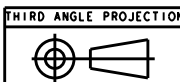
REVISIONS				
LTR	DESCRIPTION	DATE	CHG NO.	APPR'D



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

REMOVE SHARP EDGES

INCH
[MILLIMETER]



OLD PART NO.

TOLERANCE
EXCEPT
AS NOTED

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

MATERIAL DESCRIPTION:
KZCO 84D23-10D20-PO1

MATERIAL NO.

PATTERN NO.

.00 ±.03
.000 ±.010
ANGLES ±1°

VALVE - ACTUATED, 12VDC, .50NPT FE
KZCO 84D23-10D20-PO1

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REPRODUCTION IS PROHIBITED

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INCHES UNLESS NOTED

DO NOT SCALE PRINT

DR: N RJG
CHKD: DWS
TRCD

DATE 13-Nov-08
SCALE 1/4

5209401

REV#	REV# DSC	REVISION DATE	REVISION BY
-2*		7/15/2008 9:41:57 AM	bjdtschell

ACTUATOR LABEL
K200-P01 / LABEL DESCRIPTION
"ACTUATOR, EH3 12/24 VDC"

RED MOTOR LEAD TO RED DOT

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

INPUT/OUTPUT
 POWER = 12/24 VDC
 1 - BLACK - POWER (-) NEGATIVE
 2 - RED - POWER (+) POSITIVE
 3 - WHITE - SIGNAL 1 (+) POSITIVE TO OPEN
 4 - ***

DIP SWITCH

SCALE .500

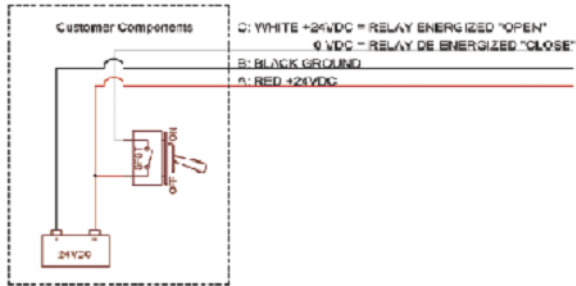
PROGRAM NOTE:

MAS20 SET DATA
 CONTROL INPUT = 1
 FEEDBACK = 0
 OPERATION = 0
 MOTOR = NG
 SPEED CT = 0.8
 ZEROSET = 135
 RANGE TOLERANCE = 1
 ROTATION = 0032
 ACTUATOR VOLTAGE = 0.000.00
 DESIGN VOLTAGE = E
 DIP SW = 3
 LABEL = K200
 OPTIONS = 0
 PLUG TYPE = P
 TEST PLUG =

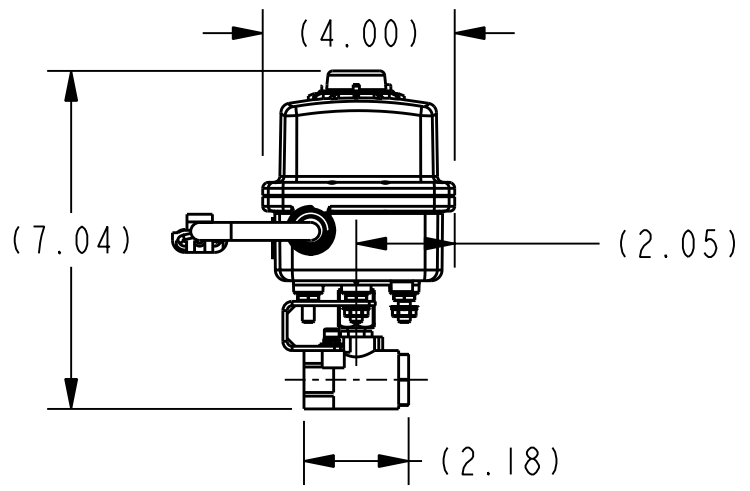
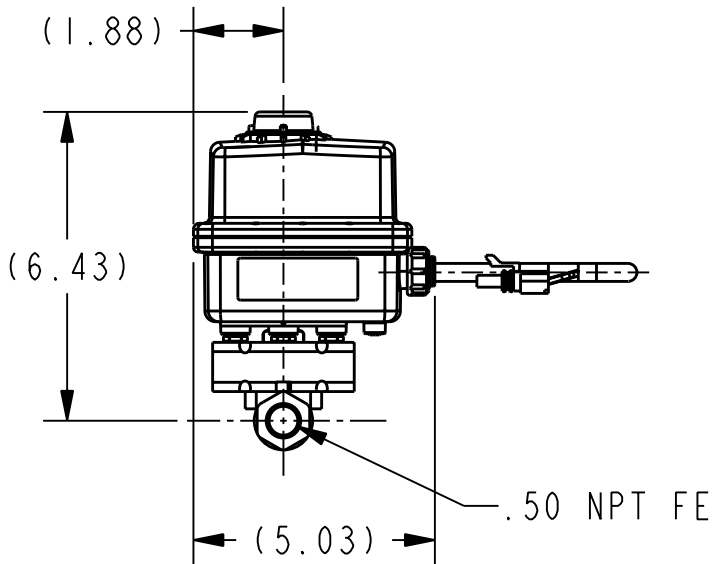
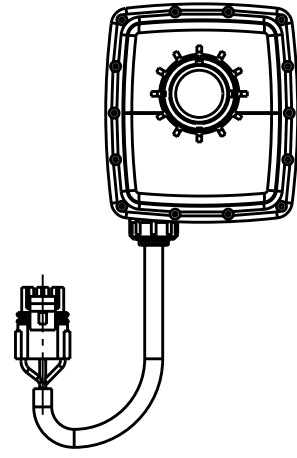
21	1	EH-502	LABEL, EH ACTUATOR, 2.5" X 1", THERMAL TRANSFER, WHITE	NO MATERIAL
20	1	800018	HARNESS, 80A, SST, WP3T, 22.5"	
19	1	EH3-115-Y	FLAG, YELLOW	POLYPROPYLENE, TALC, 20
18	1	399-0029	POB ASSY, EH3 L1 SOLID STATE 12 VDC	
17	1	100401	GEAR MOTOR, NG 18 RPM/MOLON	NO MATERIAL
16	3	OX-222	NUT, HEX HEAD, SEPRATED FLANGE, .250-20 UNC-2B	STAINLESS_ST DEL TYPE 303
15	4	EH3-135	STUD, 1/4-20 X 1/2 MTG	STAINLESS_ST DEL TYPE 303
14	1	EH-104	RETAINER, PUSH ON 5/16" SHAFT	STAINLESS_ST DEL TYPE 303
13	1	499-0100	GAM ASSY, EXTD LOBE FOR EH25 E-OPT	
12	1	EH-502	LABEL, EH ACTUATOR, 2.5" X 1", THERMAL TRANSFER, WHITE	NO MATERIAL
11	1	EH-130	O-RING, DOME	SILICONE, RED, 35, DIAPHRAGMETER
10	1	EH3-114	DOME, CLEAR	POLYCARBONATE,
9	14	EHPT-1103	SCREW, PAN, PHILLIPS, HIGH-LOW, 5-20 X .562	STAINLESS_ST DEL TYPE 410
8	1	EH3-10014N	LID, CASE, EH3, DOME	NYLON, DPC, ENG3L, BLACK
7	4	EH3-130	SCREW, 8-32 X 1.25 PPHMS SS	STAINLESS_ST DEL TYPE 15-6
6	1	EH-157	SCREW, 8-18 X 3/8" TSB PPH SS	STAINLESS_ST DEL TYPE 15-6
5	1	EH3-1030	O-RING, EH3, CASE I.D., # 120	SILICONE, RED, 35, DIAPHRAGMETER
4	1	EH-130	O-RING, 8008, PRESSURE TEST PORT	FLUOROCARBON BLACK, 75, DIAPHRAGMETER
3	1	EHPT-140	O-RING, #1 1/2, MOTOR SHAFT, VITON	FLUOROCARBON BLACK, 75, DIAPHRAGMETER
2	1	EH3-1003-N	LOWER CASE - EH3 INTERNAL MTG	NYLON/DPC, ENG3-L, BLACK
1	1	498-0002	CASE KIT, EH3 IM DOME NYLON NG MTR	
DEL QTY		PART NUMBER	DESCRIPTION	MATERIAL

STANDARD TOLERANCES ALL DIMENSIONS IN INCHES (mm)	DATE: 2008-05-29	KZCO inc.	2008 05 29 09:00 AM OPERATION: 14 3000 USA PAGE: 1 (REV A 270) P20-1483 MAS20
3/16 3/32 1/16 1/8 1/4 1/2 3/4 1 1 1/2 2 3 4 6 8 12 16 20 24 30 36 48 60 72 96 120 144 180 240 300 360 480 600 720 960 1200 1440 1800 2400 3000 3600 4800 6000 7200 9600 12000	TOTAL PARTS: 80 PPM COPPER BRASS: 8000 ALUMINUM: 8000 SILICON: 8000 NYLON: 8000	DESIGNED: L. ERICKAMP DRAWN: W. FEDDE APPROVED: A. KOTTAS	TYPE: ACTUATOR, EH3, SOLID STATE
CHECKED BY: M. LARSEN DATE: 2008-05-29 SUPPORT: 8000 MATERIAL: 8000	SCALE: .500 SHEET: 0 MATERIAL:	PART NO: 10020-P01 DRAWING NO: 10020-P01	REV: -2+ SHEET: 1 OF 1

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



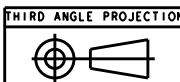
REVISIONS				
LTR	DESCRIPTION	DATE	CHG NO.	APPR'D



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

REMOVE SHARP EDGES

INCH
[MILLIMETER]



OLD PART NO.

TOLERANCE
EXCEPT
AS NOTED

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

MATERIAL DESCRIPTION:
KZCO 84D23-60AD-M

MATERIAL NO.

PATTERN NO.

.00 ±.03
.000 ±.010
ANGLES ±1°

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

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ALL DIMENSIONS IN
INCHES UNLESS NOTED

DO NOT SCALE PRINT

DR *N RJG
CHKD DWS
TRCD

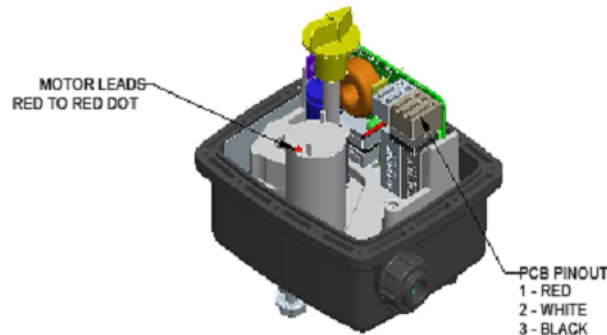
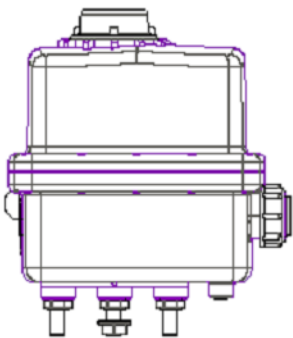
DATE 13-Nov-08
SCALE 1/4

5209402

NAME:RG OBJECT:5209402.1 DATE:19-Nov-08 13:40:10

BRANCH: ---
 CREATED BY: WFS308 CREATED ON: 30/06/00 1:46:30 PM REV: --- REL: --- LOCATION: ROOF F.40175/08/01/01/01/01

REVISION	REVISION ECD	REVISION/VERSION DATE	REVISION/VERSION BY
*** .1		3/26/2008 1:49:38 PM	wfedde



SCALE .500



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

MAS80 SET DATA
 CONTROL INPUT = 1
 FEEDBACK = 0
 OPERATION = 0
 MOTOR = M
 SPEED CT = 0.8
 ZEROSET = 135
 RANGE TOLERANCE = 1
 ROTATION = CC091
 ACTUATOR RANGE = 0.00/0.00
 DESIGN VOLTAGE = 0
 DIP SX =
 LABEL = KZCO
 OPTIONS = 0
 PLUG TYPE =
 TEST PLUG =

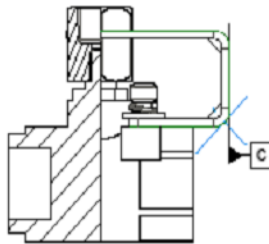
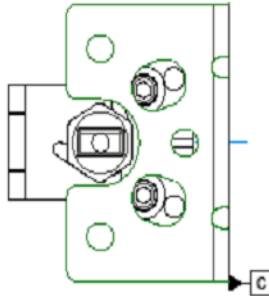
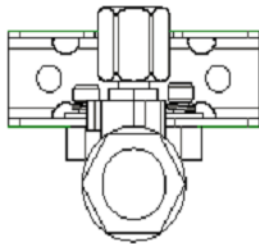
DET	QTY	PART NUMBER	DESCRIPTION	MATERIAL	
	8	1	EH-502	LABEL, EH ACTUATOR, 2.5" X 1", THERMAL TRANSFER, WHITE	NO_MATERIAL
	7	2	QX-222	NUT, HEX HEAD, SERRATED FLANGE, .250-20 UNC-2B	STAINLESS_STEEL_TYPE_303
	6	4	EH3-135	STUD, 1/4-20 X 1/2 MTG	STAINLESS_STEEL_TYPE_303
	5	1	800018	HARNESS, 60A,3ST, WP3T,22.5"	
	4	1	EH3-115-Y	FLAG, YELLOW	POLYPROPYLENE_TALC_20
	3	1	800488	PCB ASSY, EH3 24VDC 60AD/60DF	
	2	1	EH3-110	GEAR MOTOR, EH3 SERIES M1 18 RPM @ 12VDC	
	1	1	498-0005	CASE KIT, EH3 IM DOME NYLON M1 & N1 MTR	

STANDARD TOLERANCES - ALL DIMENSIONS IN INCHES UNLESS SHOWN	
.Xxx - .1	TOTAL RUNOUT .025 FIM
.XXx - .01	CORNER BREAK .001/010
.XXX - .005	SURFACE FINISH 125µIN
.XX" ± .1"	
DENSITY: .047 LB/INCU IN	
MASS: .502 LB	
SURF AREA: 183.703 SQ IN	
VOLUME: 12.043 CU IN	

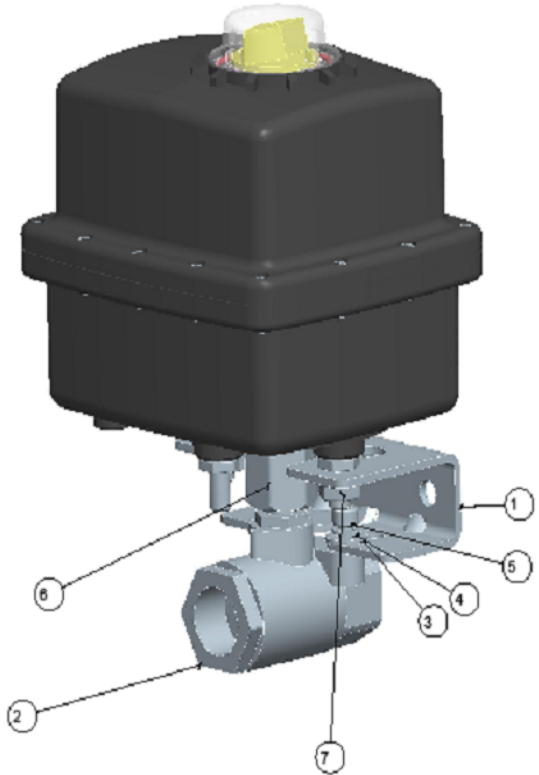
DATE: 2007-04-16
DESIGNED: L. ERDKAMP
DRAWN: W. FEDDE
APPROVED: A. KOTTAS
SCALE: .500
SIZE: B
MATERIAL:

		23880 KEE PARKWAY QUINNAPROCK, MS 38988 USA PHONE: +1.402.944.2787 FAX: +1.402.944.2402
TITLE: ACTUATOR, EH3, .8S @24VDC		
REF:		
PART NO: 000-60AD-M	REVISION: *** .1	
DRAWING NO: 000-60AD-M		SHEET: 1 OF 1

REVISOR	REVISION ECO	REVISION/VERSION DATE	REVISION/VERSION BY
-B+		8/12/2008 9:18:50 AM	bgothschal




SECTION A-A



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

DET	QTY	PART NUMBER	DESCRIPTION	MATERIAL
7	3	QX-222	NUT, HEX HEAD, SERRATED FLANGE, .250-20 UNC-2B	STAINLESS STEEL TYPE 303
6	1	EH-145	COUPLER, 1/4" - 1/2" APOLLO	STAINLESS STEEL TYPE 316
5	2	EH-158	SCREW, #10-24 X 3/8" SS SOCKET HEAD	STAINLESS STEEL TYPE 303 OR 316
4	2	EHPT-105	WASHER, LOCK, .197 ID X .334 OD X .047 T	STAINLESS STEEL TYPE 316
3	2	EHPT-150	WASHER, FLAT, #10 18-8 SS	STAINLESS STEEL TYPE 316
2	1	EH3-84D	VALVE, 1/2" 2-WAY APOLLO 70-103-01 BRONZE BALL VALVE	BRONZE
1	1	EH3-174	BRACKET, MOUNTING EH3 SERIES	STAINLESS STEEL TYPE 304

STANDARD TOLERANCES - ALL DIMENSIONS IN INCHES (mm): X & 1 XXX & 05 XX & 11	TOTAL RUNOUT: .005 FIM CORNER BREAK: .001010 SURFACE FINISH: 125µIN	DATE: 2007-08-08	 21500 1/2 PARDONAY GREENWOOD, NE 68108 USA PHONE: +1.402.944.3267 FAX: +1.402.944.3402
DESIGNED: L. ERDKAMP DRAWN: C. HOWARD APPROVED: L. ERDKAMP		TITLE: VALVE KIT, EH3 OFFSET MTG 1/2" 2-PC BRZ REF:	
DENSITY: .258 LB/CM3 IN MASS: 3.184 LBM SURF AREA: 142.871 SQ IN VOLUME: 12.142 CU IN		SCALE: .750 SIZE: B MATERIAL: AS NOTED PART NO: 84D23 DRAWING NO: 84D23 REVISOR: -.B+ SHEET: 1 OF 1	

Prepared by: CWY
Approved by: RJG
Revised by:

Rev. 0
Date: 06/20/13
Rev. Date:
1200652.doc

Appendix

Prepared by: CWY
Approved by: RJG
Revised by:

Rev. 0
Date: 06/20/13
Rev. Date:
1200652.doc

Detailed Specification

Darley KSP 750-1000

A Darley model KSP 500-1000 GPM single stage shaft driven fire pump shall be provided and installed.

The pump shall be midship or rear mounted and designed to operate through an integral transmission. The pump shall be driven by a driveline from a chassis transmission mounted PTO, transfer case PTO, split-shaft PTO or sandwich PTO. The engine, transmission and driveline components shall provide sufficient horsepower and RPM to enable the pump to meet and exceed its rated performance.

The pump casing shall be manufactured from Class 40 Cast Iron with a minimum tensile strength of 30,000 PSI. The casing shall be vertically split allowing for access to the impeller and impeller drive shaft without removing the pump from the vehicle in the event maintenance is ever required.

The pump shall contain a cored heating jacket feature that, if selected, can be connected into the vehicle cooling system to protect the pump from freezing in cold climates, and to help reject engine heat from engine coolant, providing longer life for the engine.

Pump Shaft

The pump shaft shall be precision ground stainless steel. The shaft shall be splined to receive shaped impeller hubs, for greater resistance to wear, torsional vibration, and torque imposed by engine, as well as ease of maintenance and repair.

Impeller

The impeller shall be a high strength bronze alloy of mixed flow design, splined to the pump shaft for precision fit, durability, and ease of maintenance. Impeller shall be vacuum cast designed for maximum lift and highest capacity. The seal rings shall be renewable, double labyrinth, wrap around bronze type.

Impeller shaft oil seals shall be constructed to be free from steel components except for the internal lip spring. The impeller shaft oil seals shall carry a lifetime warranty against damage from corrosion from water and other fire-fighting fluids.

Impeller shaft mechanical seal primary ring shall be constructed of Silicone Carbide material with a mating rating material of Carbon. Due to the superior performance and resistance to failure in the event of "running dry," tungsten carbide or ni-resist face materials shall not meet the requirements of the specification. No Exceptions shall be made to this portion of the specification.

Pump PTO Driven 2 Gear Transmission

The transmission case shall be heavy duty class 30 cast iron. A magnetic drain plug shall be provided. Transmission case shall include a readily accessible lubricant fill port with plug for checking and maintaining oil level.

The pump drive shaft shall be precision ground, heat treated alloy steel, with a minimum 1.375"-10 spline. Gears shall be helical design and shall be precision ground for quiet operation and extended life. The gears shall be manufactured from alloy steel, carburized and ground for surface finish, hardness and strength.

The bearings provided shall be heavy duty, deep groove, radial ball type bearings. Sleeve bearings on any portion of the pump or transmission shall be prohibited due to wear, deflection, and alignment concerns. The bearings shall be protected at all openings from road dirt and water splash with oil seals and water slingers.

The transmission shall include a splash lubrication system which will provide continued bearing and gear lubrication.

High Capacity Vacuum Primer

When specified, the pump shall include an electrically driven, high capacity, rotary vane vacuum primer. The high capacity primer will be capable of evacuating 20' of 6" suction hose within 30 seconds with a pump input speed of no more than 1000 rpm. The primer shall be actuated by a panel mounted, manual operated, 'PULL to PRIME' valve.

Driveline Installation

The chassis drivelines shall be sized for intended application and torque requirements. The installation shall comply with driveline manufacturer's guidelines as well as with the pump manufacturer's guidelines. Improper installation will void the warranties provided from the pump manufacturer.

Manuals

One manual covering the fire pump transmission and selected options of the fire pump shall be provided with the apparatus in either printed copies or on CD.

Contacts

Corporate Darley Office

325 Spring Lake Drive
Itasca, Illinois 60143-2072
Toll Free Phone: 800-323-0244
Phone: 630-735-3500
Fax: (708) 345-8993

Apparatus Division

920 Kurth Rd.
Chippewa Falls, WI 54729
Toll Free Phone: 800-527-0068
Phone: 715-726-2645
Fax: (715) 726-2648

Pump Manufacturing

1051 Palmer St.
Chippewa Falls, WI 54729
Toll Free Phone: 800-634-7812
Phone: 715-726-2650
Fax: (715) 726-2656