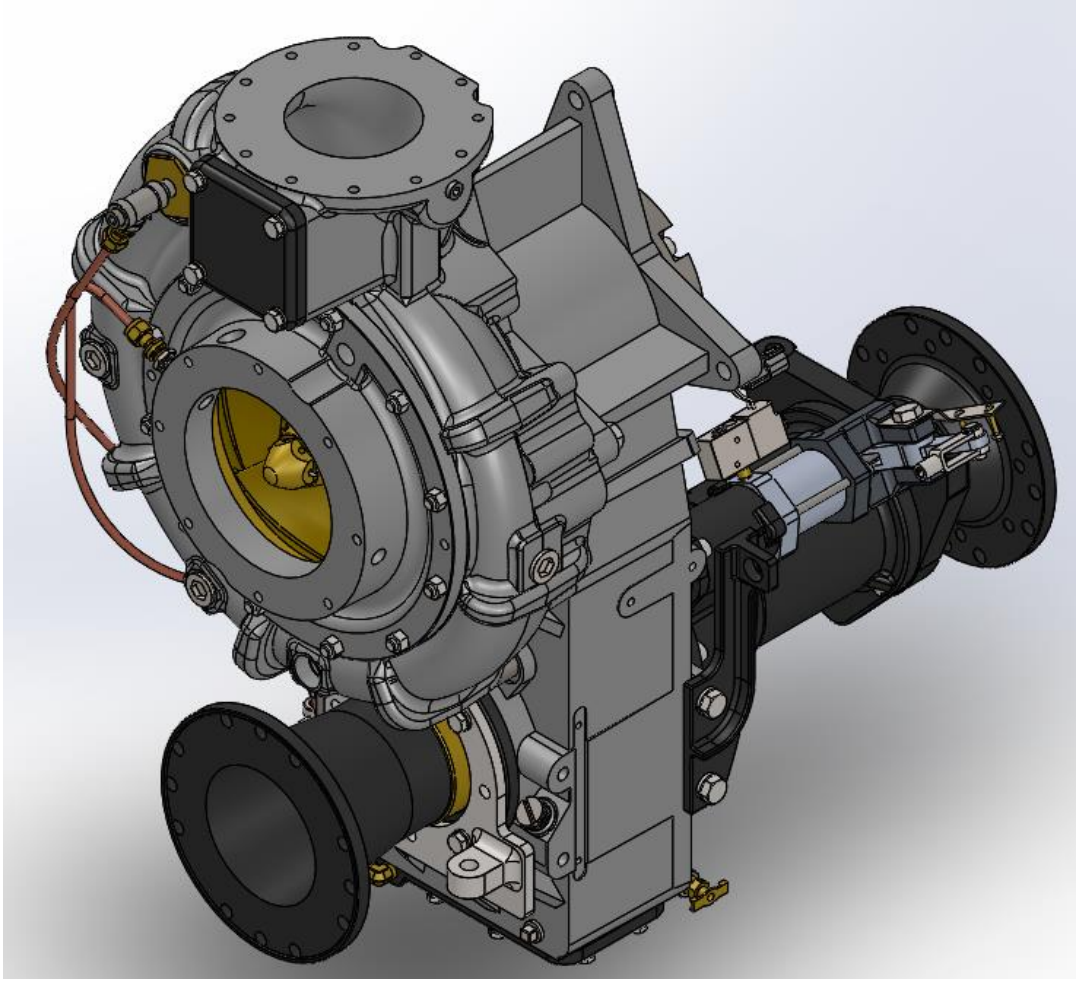
INSTALLATION, OPERATION, MAINTENANCE, REPAIR AND TROUBLESHOOTING INSTRUCTIONS FOR THE TSM Fire Pump



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This manual is for DARLEY FIRE PUMP:

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Introduction

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

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

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Section 1

Definition of Symbols and Immediate Safety Information

IMPORTANT

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

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

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

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

CAUTION - 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 impeller speed of 4800 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 or blocks is highly recommended.**

⚠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. Darley utilizes and can distribute the Allison Driveline Analysis program which is used for said analysis.

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.

Section 2

General Information and Operations

THINGS TO REMEMBER

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

PUMP SHIFTING PROCEDURE

For trucks equipped with manual transmissions, the following shifting procedure should be followed for pump operation:

1. Set parking brake.
2. Disengage truck clutch to stop shaft rotation.
3. Move pump shift lever to PUMP position.
4. Move truck transmission shift lever to neutral position.
5. Engage truck clutch.
6. Prime the pump (see priming instructions).
7. Disengage the truck clutch.
8. Move truck transmission shift lever to direct drive position and lock in place with safety latch.
9. Engage truck clutch to begin pumping.

If the power pump shift is provided, the procedure is identical except green indicator light (if provided) will come on at step #3 to show pump gear has been engaged.

To return to road operation:

1. Disengage truck clutch to stop shaft rotation.
2. Move truck transmission shift lever to neutral position.
3. Move pump shift lever to ROAD position.

When the truck is equipped with an automatic transmission, a danger exists that if the operator forgets to move the pump shift lever to PUMP position, and at the same time place transmission selector lever in high gear before leaving cab, the engine will continue to run due to converter slip. Upon advancing the vernier throttle at the pump operators panel, the engine could overcome the parking brake and accidentally move the truck. To prevent this possibility, the following shifting procedure should be followed for pump operation:

1. Set parking brake.
2. Place automatic transmission shift selector in neutral.
3. Move pump shift lever to PUMP position. "Pump Engaged" light in cab should now come on.
4. Prime the pump (see Priming Instructions).
5. Move automatic transmission shift selector to direct drive position (See Automatic Transmission Instructions).
6. Lock automatic transmission shift selector in direct drive position with safety latch provided.
7. Check that the parking brake is fully engaged.
8. Depress foot accelerator and observe that speedometer registers MPH. If pump is not engaged, speedometer will not indicate MPH.
9. Listen for pump shift and sound of pump gears turning.
10. At pump operators position, observe that the green indicator light above vernier throttle control is on. **Do not** operate throttle unless light is on.
11. 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.
12. Remember, the vernier throttle has a quick release emergency center button. Push it all the way in immediately, should the truck move.

To return to ROAD OPERATION:

1. Place the truck transmission selector lever in reverse position to stop forward rotation of transmission shaft.
2. Move transmission selector to neutral, and at the same time, move the pump shift lever from PUMP to the ROAD position.

GENERAL OPERATIONS INFO

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 the 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. 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 the 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 can deliver. This makes the priming difficult or causes the pump to lose its prime. Therefore, it is essential to keep the suction line and the suction side of pump casing air tight always when drafting water.

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

The usual cause of leaky suction lines is carelessness in handling the 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 the suction strainer is recommended where full capacity of the pump is required. Where sufficient submergence is not possible, a board or sheet of metal laid over end of the 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 a small 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 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 a pump is guaranteed for the static lift of 10 feet for ratings up to 1500 gpm with 20 feet of recommended suction hose at 2000 feet above sea level. To increase the capacity without reducing the static lift, or to increase lift without sacrificing capacity, a larger suction hose is required.

An excessively long suction line is a handicap to any pump, not just by reducing the capacity through the added friction lose, but it also retards priming and produces a detrimental effect known as “cavitation”. This means a separation of the water column in the pump suction, or void spaces, can occur, 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 the 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, the 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 the primer motor with the 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 openings 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 the 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 becomes primed. Do not stop the 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 the pump casing and is usually accessible from underneath the operators panel).

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

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

If pump transmission is equipped with a transmission cooler it must also be drained. If the master drain is located below the cooler outlets, it can be connected to the master drain. If it is not, two

separate drains must be connected to the transmission cooler. **Failure to drain transmission cooler may result in water entering the gearcase if water in the cooling coil freezes.**

If the pump is equipped with a heat exchanger, drain the 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 the top or drain cock at the bottom of the heat exchanger depending on the model. With the pump air-tight, open the primer with the engine running for about a minute and then close the primer. Drain the pump of water that was deposited when heat exchanger and lines were being drained.

A pump not often used for fire service should be inspected and run periodically to ensure that they will be ready in the case of 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 the operators of a 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, from high lifts with short and long suction lines, with the 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 the hose, insufficient submergence, and restriction of the suction line (suction lines 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 THE SUCTION LINE WHILE THE ENGINE IS OPERATING WITH THE THROTTLE OPEN. This will release the load and allow the engine to run away.

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

MEASURING PUMP PERFORMANCE

Pump performance is measured by the quantity of water it can deliver per minute against a certain pressure (“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 the pump is operating from a hydrant, the net pump pressure is the

difference between the discharge pressure and the incoming pressure from hydrant measured at the suction entrance of pump (Net Pump Pressure = Discharge Pressure – Incoming Hydrant Pressure).

The capacity of a 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 in 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 readings. 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 testing over a three-hour 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 the power the engine can deliver 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%.

The lowering of humidity reduces the 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 temperature 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

DEFINITIONS

HEAD OF WATER -- vertical depth of water measured in feet or in pressure. 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 (nozzle below pump) or minus (nozzle above pump) 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 remains constant over a wide range of capacities up to the maximum output of the pump if the speed remains constant.

If the discharge outlet of a centrifugal pump is entirely shut off with the speed kept constant a small rise in pressure will occur; 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; many factors enter 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 an exact amount (theoretically) 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

TABLE NO. 1
NFPA 1901 TEST

Class A							
TEST No.	GPM	Recom-mended Nozzles	Min. Nozzle Press. PSI	Min. Disch. Press. PSI	Min. Net Pump Press. PSI	Disch. Lines	Suction Hose
250 GPM Fire Pump							
1	250	(1), 1”	72	143	150	(1), 50'	20’ of 3”
2	175	(1), 7/8”	62	194	200		
3	125	(1), 3/4”	56	244	250		
4	250	(1), 1”	72	158	165		
350 GPM Fire Pump							
1	350	(1), 1-1/4”	58	144	150	(1), 50'	20’ of 4”
2	245	(1), 1”	69	195	200		
3	175	(1), 7/8”	62	245	250		
4	350	(1), 1-1/4”	58	159	165		
500 GPM Fire Pump							
1	500	(1), 1-1/2"	57	143	150	(1), 50'	20' of 4"
2	350	(1), 1-1/4"	58	194	200		
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' or (2), 100' Siamesed	20' of 4-1/2"
2	525	(1), 1-1/2"	62	193	200		
3	375	(1), 1-1/4"	66	244	250		
4	750	(1), 1-3/4" or (2), 1-1/4"	68 66	157	165		
1000 GPM Fire Pump							
1	1000	(1), 2" or (2), 1-1/2"	71 57	142	150	(2), 50' or (3), 100' Siamesed	20' of 5"
2	700	(1), 1-3/4" or (2), 1-1/4"	60 58	193	200		
3	500	(1), 1-1/2"	57	244	250		
4	1000	(1), 2" or (2), 1-1/2"	71 57	157	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
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 (3), 1-1/2”	55 76	143	150	(4), 50’	(2) 20’ of 6”
2	1225	(2), 1-5/8” or (2), 1-1/2” or (3), 1-1/4”	61 84 79	194	200	or	
3	875	(1), 2” or (2), 1-3/8”	55 61	245	250	(4), 100’	
4	1750	(2), 2” or (3), 1-1/2”	55 76	158	165		
2000 GPM Fire Pump							
1	2000	(2), 2” or (4), 1-1/2”	71 57	147	150	(4), 50’	(2) 20’ of 6”
2	1400	(2), 1-3/4” or (3), 1-1/2”	60 49	199	200	or	
3	1000	(1), 2” or (2), 1-1/2”	71 57	249	250	(4), 100’	
4	2000	(2), 2” or (4), 1-1/2”	71 57	163	165		
2250 GPM Fire Pump							
1	2250	(2), 2-1/4”	56	144	150	(2 Groups) (3), 100’ Siamesed	20’ of 8”
2	1575	(2), 1-3/4”	76	196	200		
3	1125	(2), 1-1/2”	72	246	250		
4	2250	(2), 2-1/4”	56	153	165		

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

TABLE NO. 1
NFPA 1901 TEST

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' Siamesed	20' of 8"
2	1750	(2), 2"	55	195	200		
3	1250	(2), 1-1/2"	88	246	250		
4	2500	(2), 2-1/4"	69	159	165		
3000 GPM Fire Pump							
1	3000	(2), 2-1/2"	65	146	150	(2 Groups) (3), 100' Siamesed	(2) 20' of 8"
2	2100	(2), 2"	78	196	200		
3	1500	(2), 1-3/4"	68	247	250		
4	3000	(2), 2-1/2"	65	161	165		
3000 GPM Industrial Fire Pump							
1	3000	(2), 2-1/2"	65	96	100	(2 Groups) (3), 100' Siamesed	(2) 20' of 8"
2	2100	(2), 2"	78	146	150		
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)-50' Siamesed	(2) 20' of 8"
2	2450	(2), 2-1/4"	67	146	150		
3	1750	(2), 2"	55	197	200		

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

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

DISCHARGE TABLES

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	SIZE	OF	NOZZLE	&	GALLONS	PER	MINUTE
PRESSURE LBS	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

TABLE NO. 5
REACH OF FIRE STREAMS

Size of Nozzle	1/4"	3/8"	1/2"	5/8"	3/4"	7/8"	1"	1-1/4"	1-1/2"
NOZZLE PRESSURE	**EFFECTIVE VERTICAL REACH - Feet**								
40	30	35	40	50	59	62	64	65	69
60	35	40	45	60	74	77	79	84	87
80	38	42	48	65	81	85	89	94	96
100	40	44	50	68	84	89	94	100	102
NOZZLE PRESSURE	**MAXIMUM VERTICAL REACH - Feet**								
40	60	65	70	75	78	79	80	80	80
60	70	75	85	95	105	106	108	110	110
80	78	83	95	105	117	125	132	140	140
100	80	88	100	110	122	135	145	155	155
NOZZLE PRESSURE	**EFFECTIVE HORIZONTAL REACH - Feet**								
40	20	25	30	40	44	50	55	62	66
60	25	32	37	50	54	61	67	75	80
80	28	35	40	57	62	70	76	84	88
100	30	37	42	60	66	76	84	93	95
NOZZLE PRESSURE	**MAXIMUM HORIZONTAL REACH - Feet**								
40	65	80	90	100	108	120	125	138	140
60	80	95	95	120	127	142	156	176	183
80	90	105	105	135	143	160	175	201	210
100	95	110	110	140	153	180	205	215	223

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

SIZE HOSE	LINEN HOSE			BEST RUBER LINED HOSE							
G.P.M.	1 1/2	2	2 1/2	3/4	1	1 1/2	2	2 1/2	3	3 1/2	(2)-2 1/2
10	1.0			13.5	3.5	0.5	.1				
15	2.2			29.0	7.2	1.0	0.3				
20	3.6			50.0	12.3	1.7	0.4				
25	5.5			75.0	18.5	2.6	0.6				
30	8.0	1.9		105.0	26.0	3.6	0.9				
40	13.0	3.2		180.0	44.0	6.1	1.5				
50	20.0	4.9	1.6		67.0	9.3	2.3				
60	28.0	7.0	2.2		96.0	13.5	3.3				
70	37.0	9.0	3.1		131.0	17.0	4..3				
80	47.0	11.5	3.8		171.0	23.0	5.6				
90	59.0	14.5	5.0		217.0	29.0	7.0				
100	72.0	17.5	5.9		268.0	33.0	8.4				
120		25.0	8.3		386.0	47.0	11.7				
140		34.0	11.0			62.0	16.0	5.2	2.0	0.9	1.4
160		43.0	14.0			78.0	20.0	6.6	2.6	1.2	1.9
180		53.0	17.7			97.0	25.0	8.3	3.2	1.5	2.3
200		63.0	21.5			121.0	30.6	10.1	3.9	1.8	2.8
220						146.0		12.0	4.6	2.1	3.3
240						173.0		14.1	5.4	2.5	3.9
260						204.0		16.4	6.3	2.9	4.5
280						237.0		18.7	7.2	3.3	5.2
300						272.0		21.2	8.2	3.7	5.9
320								23.8	9.3	4.2	6.6
340								26.9	10.5	4.7	7.4
360								30.0	11.5	5.2	8.3
380								33.0	12.8	5.8	9.2
400								36.2	14.1	6.3	10.1
425								40.8	15..7	7.0	11.3
450								45.2	17.5	7.9	12.5
475								50.0	19.3	8.7	13.8
500								55.0	21.2	9.5	15.2
525									23.2	10.5	16.6
550									25.2	11.4	18.1
575									27.5	12.4	19.6
600									29.9	13.4	21.2
650									34.5	15.5	24.8
700									39.5	17.7	28.3
750									45.0	20.1	32.2
800									50.5	22.7	36.2
850									56.5	25.4	40.7
900									63.0	28.2	45.2
1000									76.5	34.3	55.0

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

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

PIPE SIZE / 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
SuddenEnlarg 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

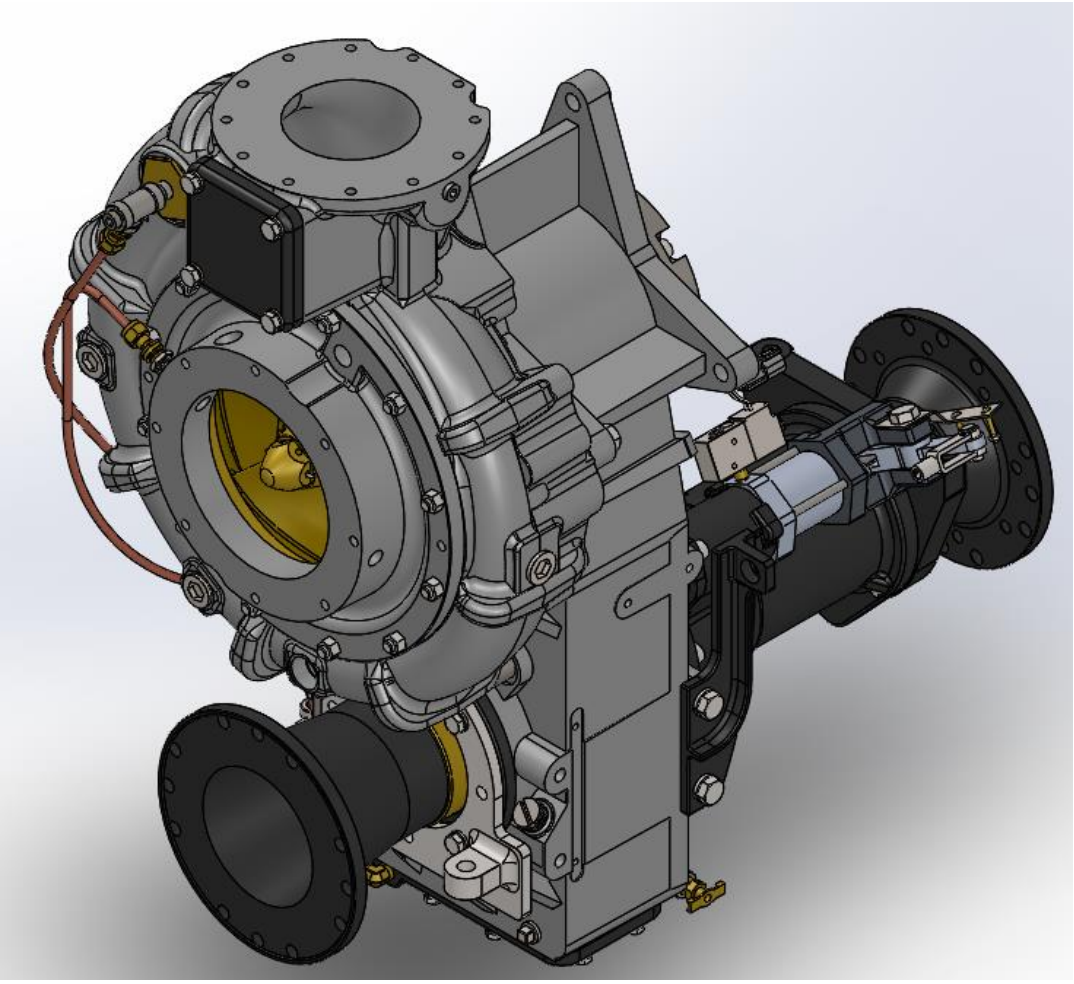
Underwriters Nozzle Tip Thread: 2.1875 O.D. - 12 threads per inch.

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

Section 3

Installation

INSTALLATION OF TYPE
TSM Fire Pump



Prepared by: SMS
Approved by: WAH
Revised by:

Revision: 0
Original release date:6/4/2020
Revision release date:

1201062.doc

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 driveshaft or pump when the engine is running or without the wheels chocked.

⚠WARNING

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

W.S. Darley requires that Power Take Off (PTO) driven pumps have at most 500 radians per second^2 torsional vibration and at most 1000 radians per second^2 inertial drive torsional vibration, as calculated by the Allison Multiple Joint Driveline Analysis program, for a completed driveline installation. A completed driveline installation includes the entire multi-driveshaft assembly from the power source of the PTO output flange to the input flange of the driven pump.

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

⚠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.

U-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).
    - This arrangement may be required if the coupling shaft between pump and chassis transmission is relatively short, or the engine is mounted with its driveshaft horizontal. Refer to attached drawing DGM1301 for examples of parallel shaft and intersecting angle installations.

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

Driveline and Mounting:

Determine the best location for the pump in your chassis.

Remove the driveshafts, and driveshaft hanger bearing and bracket assembly from the chassis.

In some applications it is necessary to move a truck frame cross-member forward or back to provide clearance for the pump. Cross-members are usually riveted to the truck frame. The rivets can be cut with a cold chisel and sledge. The cross-member may be refastened by drilling new holes and bolting them into position.

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). This arrangement may be required if the coupling shaft between pump and transmission is relatively short, or the engine is mounted with its driveshaft horizontal. Refer to attached drawing DGM1301 for examples of parallel shaft and intersecting angle installations.

Attach rear cross-member support to the pump using 5/8" diameter studs, nuts, and lock washers. Tighten stud locknuts on transmission-bearing bracket only. Omit lock washers on the top side of the cross members, as nuts only will be used to position the pump.

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 angle between the truck transmission shaft centerline and chassis frame (often 4°).

Place metal shims between the cross-member ends, and weld brackets to provide the same angle. 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 inline and parallel to the truck transmission shaft centerline. Example: If the truck transmission is at 4° with horizontal, the pump driveshaft should also be set at 4° with horizontal. This will insure that even if the transmission or pump is offset from each other, the universal joint operating angles will be equal.

Use the top hanger stud nuts, on cross-member (without lock washers) and shims under suction extensions to bring pump driveshaft centerline approximately in line and parallel to the truck transmission shaft. Pump shaft, transmission shaft, and differential shaft should now be at the same angle, relative to horizontal (often 4°). Make adjustment to shims between cross-member, and weld brackets so top nuts bear flat against the angle iron cross member. Establish proper operating angles for the front and rear shafts. Select a position so that when the truck is loaded, the u-joint on the drive shaft will be at the correct operating angle.

The input shaft of the truck differential must be at the same angle with horizontal as the pump driveshaft. This is especially important since the operating angles of this universal joint pair constantly change under load and road conditions, and very often the differential input shaft is offset from the truck centerline. Shimming under the leaf springs can change the differential shaft angle.

Before proceeding further, align the pump drive shaft so that it is parallel to the frame rails. By measuring from the frame flange to the centerline of the pump shaft at both front and rear, check to confirm the pump shaft is parallel to the transmission shaft.

Place mounting brackets into position as shown on detail drawing DGM1302 and securely clamp against side of frames. Attach brackets to the suction extensions with pipe U-bolts.

Drill holes through the side frames and attach the mounting brackets. 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 DGM1302.

The pump input and output shafts are supplied with lock on type end yokes sized to match existing driveline components. A slip type-coupling shaft must be supplied front and rear of the pump. See drawing DNM0000 for component numbers or contact your local driveline supplier for assistance.

Prepared by: SMS
Approved by: WAH
Revised by:

Revision: 0
Original release date:6/4/2020
Revision release date:

1201062.doc

Keep the following points in mind when positioning the pump and constructing the driveline.

1. Do not exceed recommended universal joint operating angles. Complimentary shaft angles should be equal and as low as possible.
2. Do not exceed universal joint torque limitations.
3. Do not exceed driveshaft speed/length limitations.
4. Yokes on each coupling shaft must be in phase. When in phase the slip yoke lugs (ears) and tube yoke lugs (ears) are in line.
5. Use balanced driveline components to help prevent vibration and to extend the life of drive yokes and other components related to the drive line.

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

U-BOLT	
SERIES	***RECOMMENDED NUT TORQUE***
1280	14-17 LB. FT
1310	14-17 LB. FT
1330	14-17 LB. FT
1350	20-24 LB. FT
1410	20-24 LB. FT
1480	32-37 LB. FT
1550	32-37 LB. FT

BEARING STRAP	
SERIES	***RECOMMENDED BOLT TORQUE***
SPL90	45-60 LB. FT
1210	13-18 LB. FT
1280	13-18 LB. FT
1310	13-18 LB. FT
1330	13-18 LB. FT
1350	30-35 LB. FT
1410	30-35 LB. FT
1480	55-60 LB.FT
1550	55-60 LB.FT
1610	55-60 LB.FT
1710	130-135 LB. FT
1760	130-135 LB. FT
1810	130-135 LB. FT

CAP & BOLT	
SERIES	***RECOMMENDED BOLT TORQUE***
1650	77-103 LB. FT
1850	110-147 LB. FT
1850	110-147 LB. FT
1910	110-147 LB. FT
1950	271-362 LB. FT
2010	102-118 LB. FT
2050	744- 844 LB. FT
2110	171-197 LB. FT
2150	744- 844 LB. FT
2210	260- 298 LB. FT

BEARING PLATE	
SERIES	***RECOMMENDED BOLT TORQUE***
1610	26-35 LB. FT
1710	38-48 LB. FT
1760	38-48 LB. FT
1810	38-48 LB. FT
1880	60-70 LB.FT

New part kits with lockstraps available from Spicer after Spring 1994

SERIES	***RECOMMEND BOLT TORQUE***
1610	17-24 LB. FT
1710	32-42 LB. FT
1760	32-42 LB. FT
1810	32-42 LB. FT
1880	50-66 LB. FT

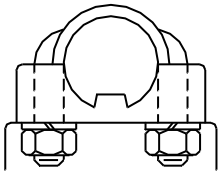
WARNING: Bearing strap retaining bolts must **NOT** be reused!
WARNING: Self-locking bolts must **NOT** be reused!

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

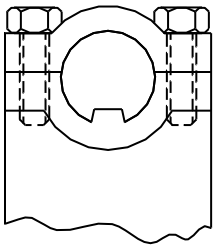
Prepared by: SMS
Approved by: WAH
Revised by:

Revision: 0
Original release date:6/4/2020
Revision release date:

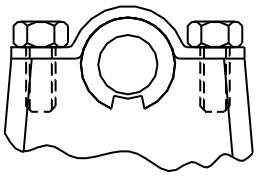
1201062.doc



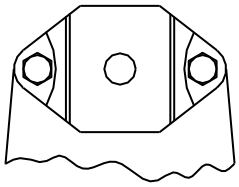
U-BOLT



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.

ENGINE COOLING/PUMP HEATER: 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 DGS1200 for automatic transmission wiring details.

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

Technical Bulletin on Midship Mounted Fire Pump Drivelines

1202519

FEB, 25 2016

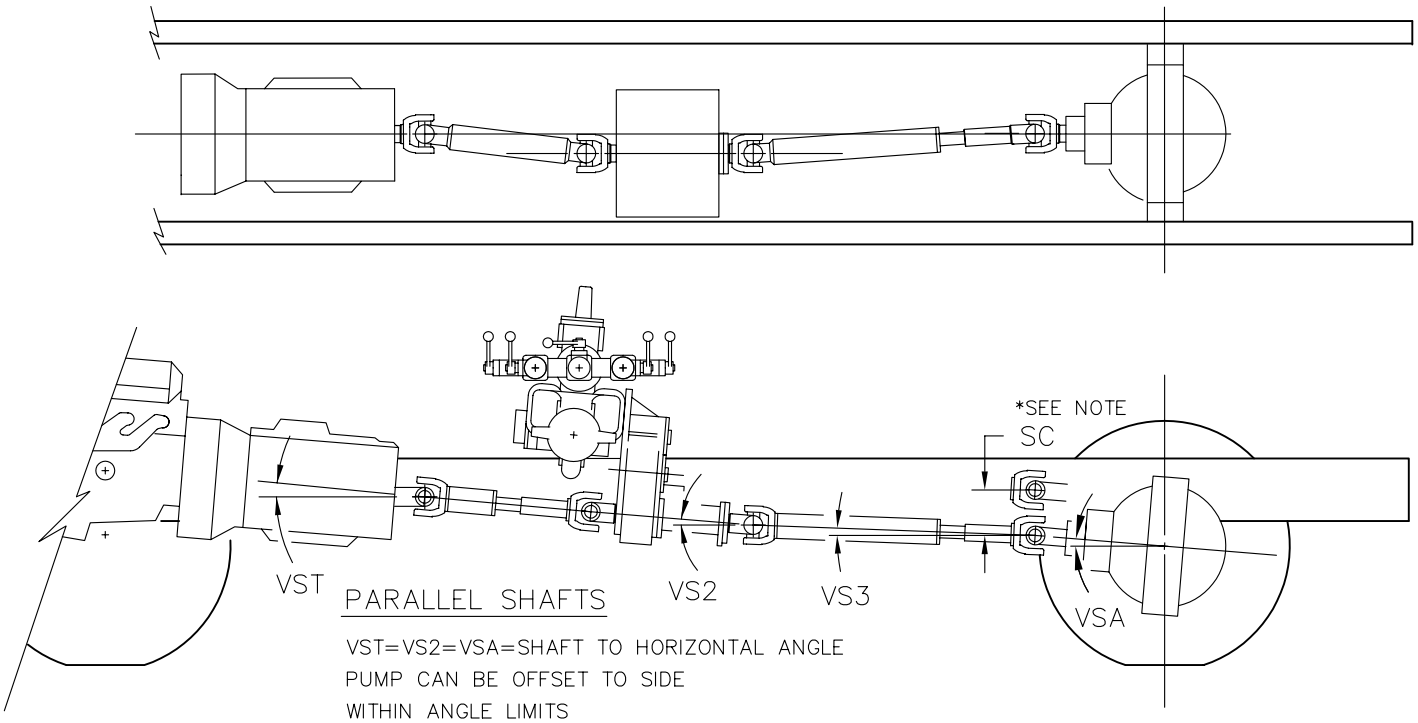
The driveline torque rating is 19,230 lb-ft (26,072 Nm) – exceeding this torque rating can result in a driveline failure.

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

W.S. Darley requires that midship driven pumps have at most 500 radians per second^2 torsional vibration, at most 1000 radians per second^2 inertial drive torsional vibration and at most 1000 radians per second^2 inertial coast torsional vibration, as calculated by the Allison Multiple Joint Driveline Analysis program, for a completed driveline installation. A completed driveline installation includes the entire multi-driveshaft assembly from the power source on apparatus transmission output flange to the input flange of the rear axle.

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

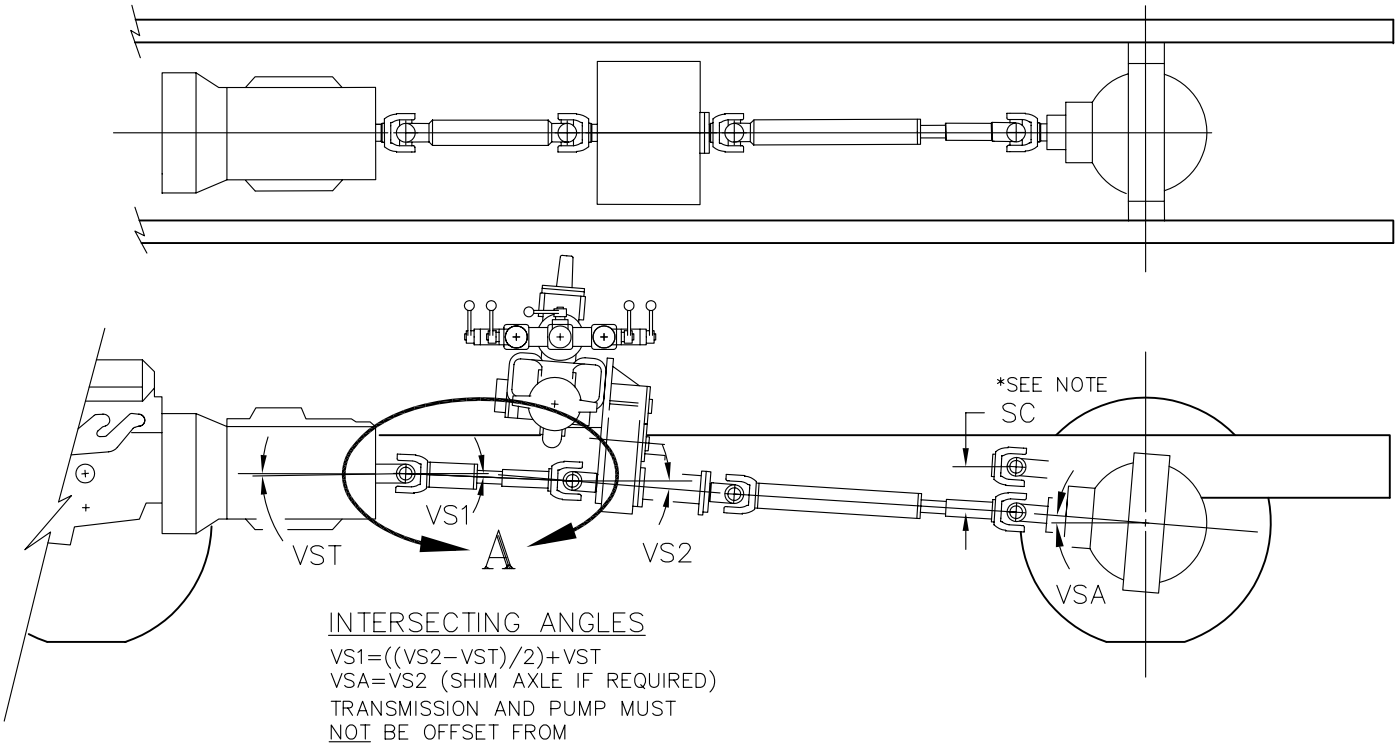
Questions can also be directed to our Customer Service Department at 800-634-7812 or 715-726-2650.



PARALLEL SHAFTS

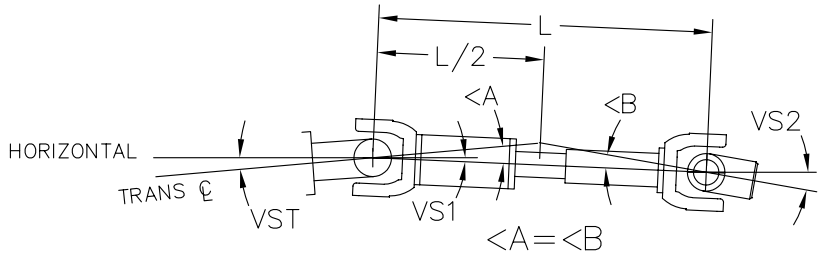
VST=VS2=VSA=SHAFT TO HORIZONTAL ANGLE
PUMP CAN BE OFFSET TO SIDE
WITHIN ANGLE LIMITS

*NOTE: ALLOW FOR SPRING COMPRESSION WHEN SETTING ANGLES SO OPERATING ANGLES ARE WITHIN LIMITS



INTERSECTING ANGLES

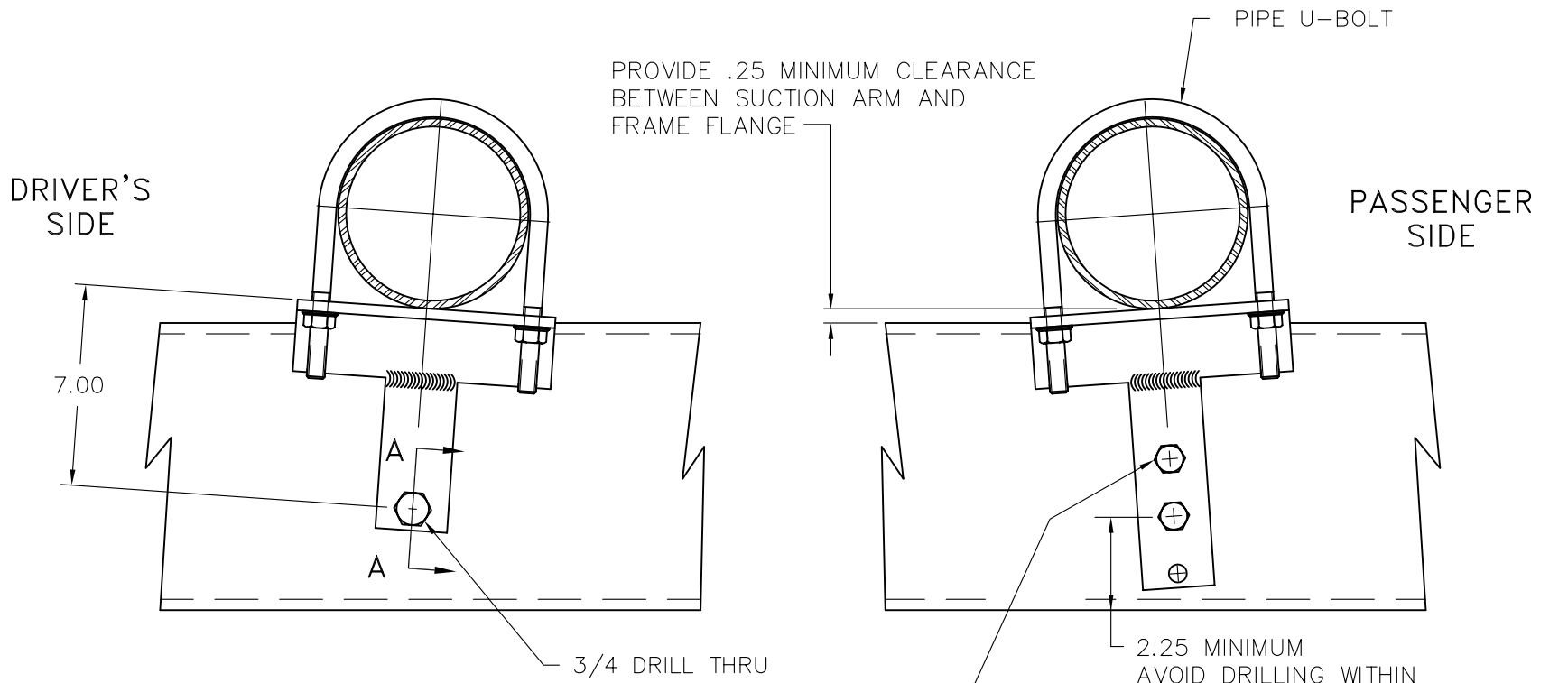
VS1=((VS2−VST)/2)+VST
VSA=VS2 (SHIM AXLE IF REQUIRED)
TRANSMISSION AND PUMP MUST
NOT BE OFFSET FROM
ONE ANOTHER

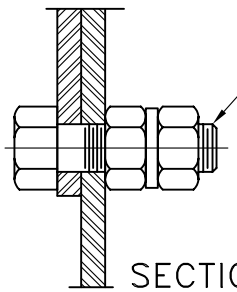


DETAIL A

(ANGLES VST, VS1, VS2 RELATIVE TO HORIZONTAL)

DGM1301 (LT40) 4−23−92





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.

SECTION A-A
SCALE 1=2

(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.

MATERIAL DESCRIPTION: –		MATERIAL NO. –	PATTERN NO. –	OLD PART NO. –
THIS DESIGN IS THE PROPERTY OF W.S. DARLEY AND CO. – UNAUTHORIZED REPRODUCTION IS PROHIBITED	ALL DIMENSIONS IN INCHES UNLESS NOTED	DO NOT SCALE PRINT		

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

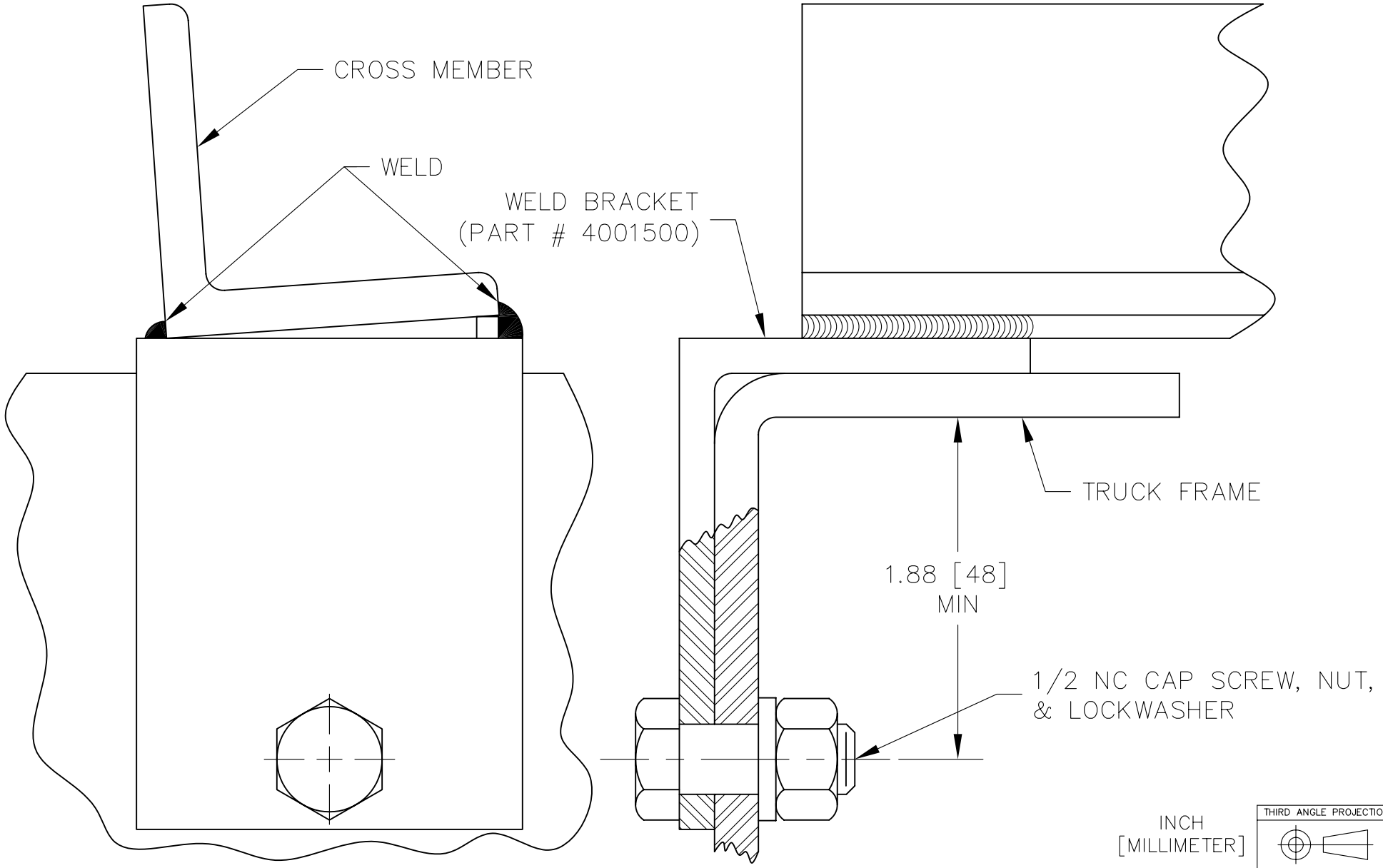
DR'N TED
CHKD
TRCD

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

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

DATE NOV9,1998
SCALE 1/1

DGM1302



INCH
[MILLIMETER]

THIRD ANGLE PROJECTION

MATERIAL DESCRIPTION: —	MATERIAL NO. —	PATTERN NO. —	OLD PART NO. S998
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TOLERANCE
EXCEPT
AS NOTED
.00 ±.03
.000 ±.010
ANGLES ±1°

DR'N JCM
CHKD
TRCD TED11/9/98

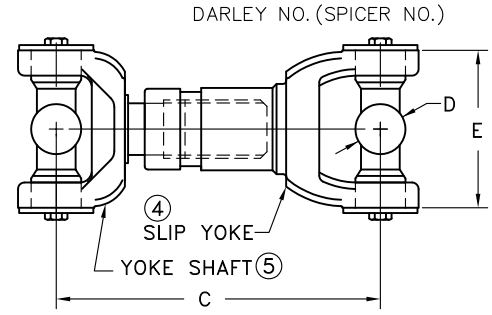
W.S. DARLEY & CO.
MELROSE PARK, IL – CHIPPEWA FALLS, WI

DWG – PUMP SUPPORT
—

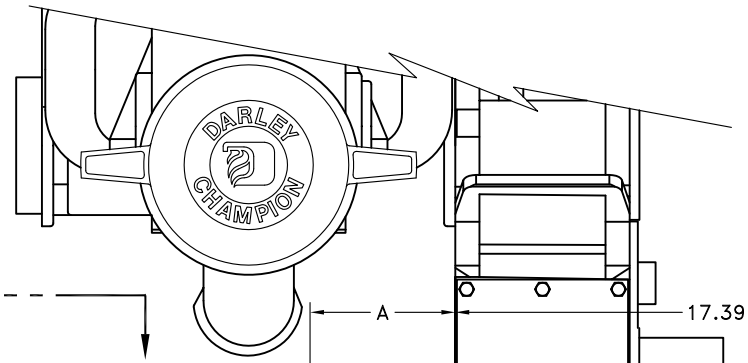
DATE 9–13–77
SCALE 1/1

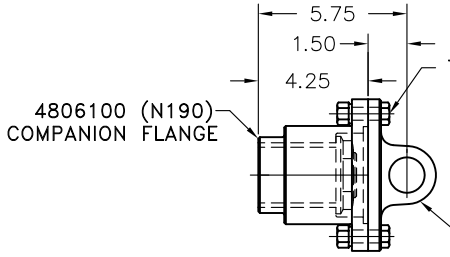
DSM0103

YOKE SERIES	TUBE SIZE	SLIP STUB SHAFT ①	TUBE YOKE ②	PUMP YOKE ③	SLIP YOKE ④	YOKE SHAFT (FOR CLOSE COUPLE) ⑤	BEARING KIT ⑥	A	B	C CLOSE COUPLED	D	E
1550	3.00x.095W	PA671 (4-40-821)	PA678 (4-28-377X)	ASSEMBLY: AU01001 [G452A1] (REF. DETAIL A)	PA690 (4-3-1241KX)	PA695 (4-82-371)	PA620 (5-155X)	5.75	28.90	10.31	1.38	4.97
1550	3.50x.095W	PA672 (4-40-761)	PA679 (4-28-307)									
1610	3.50x.095W	PA673 (5-40-451)	4816900 (5-28-167)	4813310 (K)	4814201 (5-3-108KX)	PA696 (5-82-871)	4809900 (5-279X)	6.12	29.64	11.25	1.88	5.31
1610	3.50x.134W	4814401 (5-40-1151)	4810800 (5-28-627)									
1710	4.00x.134W	PA675 (6-40-711)	4811700 (6-28-347)	4813410 (K)	4813700 (6-3-2741KX)	4813800 (6-82-1251)	4810300 (5-280X)	5.63	28.66	11.42	1.94	6.09
1710	4.50x.134W	PA676 (6-40-631)	PA682 (6-28-407)									
1760	4.00x.134W	PA675 (6-40-711)	PA683 (6.3-28-17)	4813510 (K) SEE NOTE 3. (H)	PA693 (6.3-3-41KX)	PA698 (6.3-82-21-13)	4810600 (5-407X)	6.00	29.40	13.66	1.94	7.00
1760	4.50x.134W	PA676 (6-40-631)										
1810	4.50x.134W	PA677 (6.5-40-201)	PA684 (6.5-28-117)	4813610 (K)	PA694 (6.5-3-1431KX)	PA699 (6.5-82-451-8)	PA633 (5-281X)	5.88	29.16	13.46	1.94	7.55



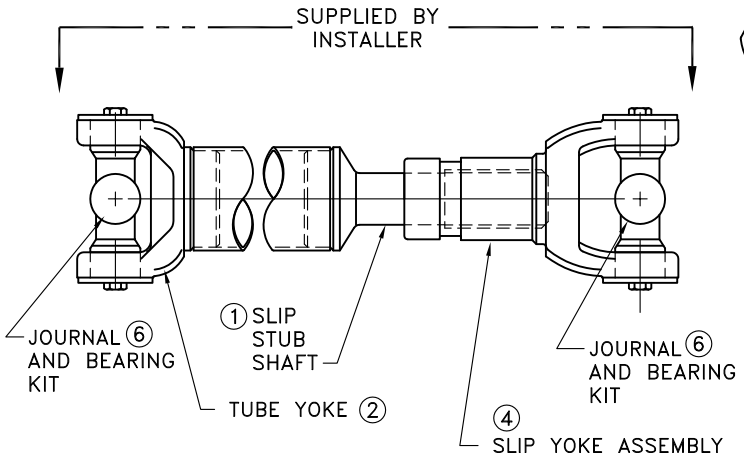
CLOSE COUPLED SHAFT

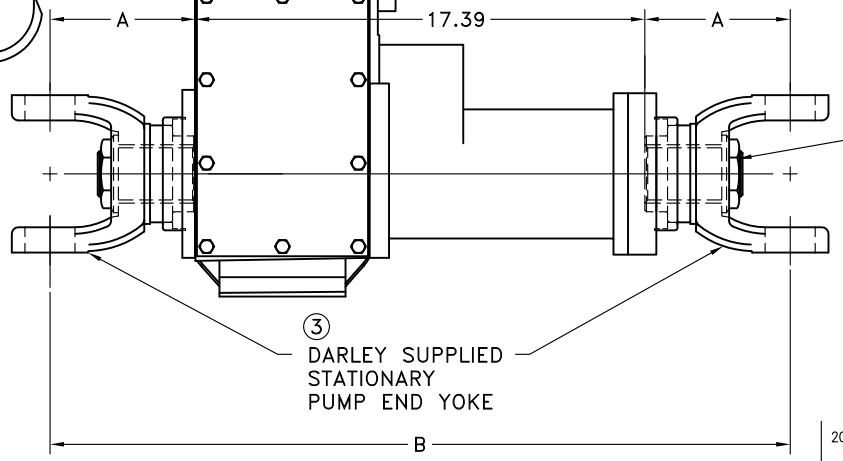




1550 SERIES ASSEMBLY – AU01001 (G452A1)
1480 SERIES ASSEMBLY – AU01002 (G452A2)

DETAIL A





NOTES:
1] REFERENCE DIMENSION 'B' IS FOR ALL CHAMPION PUMPS WHICH USE THE 'N' STYLE GEAR BOX [EM-LDM-N-PSM]
2] 1810 SERIES JOINTS WILL NOT SWING UNDER CASING OF 'N' PUMP FORWARD OF GEAR CASE
3] 1760 SERIES JOINTS REQUIRE SPECIAL YOKE KIT KA00051 TO SWING UNDER CASING OF 'N' PUMP FORWARD OF GEAR CASE (H)

2004-301	(K) 04FEB05	UPDATED TO YOKE ASSY
	(J) 16JUL02	UPDATED TO NEW GEARCASE
	(H) 11FEB00	REVISION (2000-65)
	JUL11,94	REVISION (94-60)
	DEC15,92	REVISION (92-121)
PART NO.	DATE	CHANGE

MATERIAL:

OLD PART NO. N188

ALL DIMENSIONS IN INCHES UNLESS NOTED

DO NOT SCALE PRINT

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

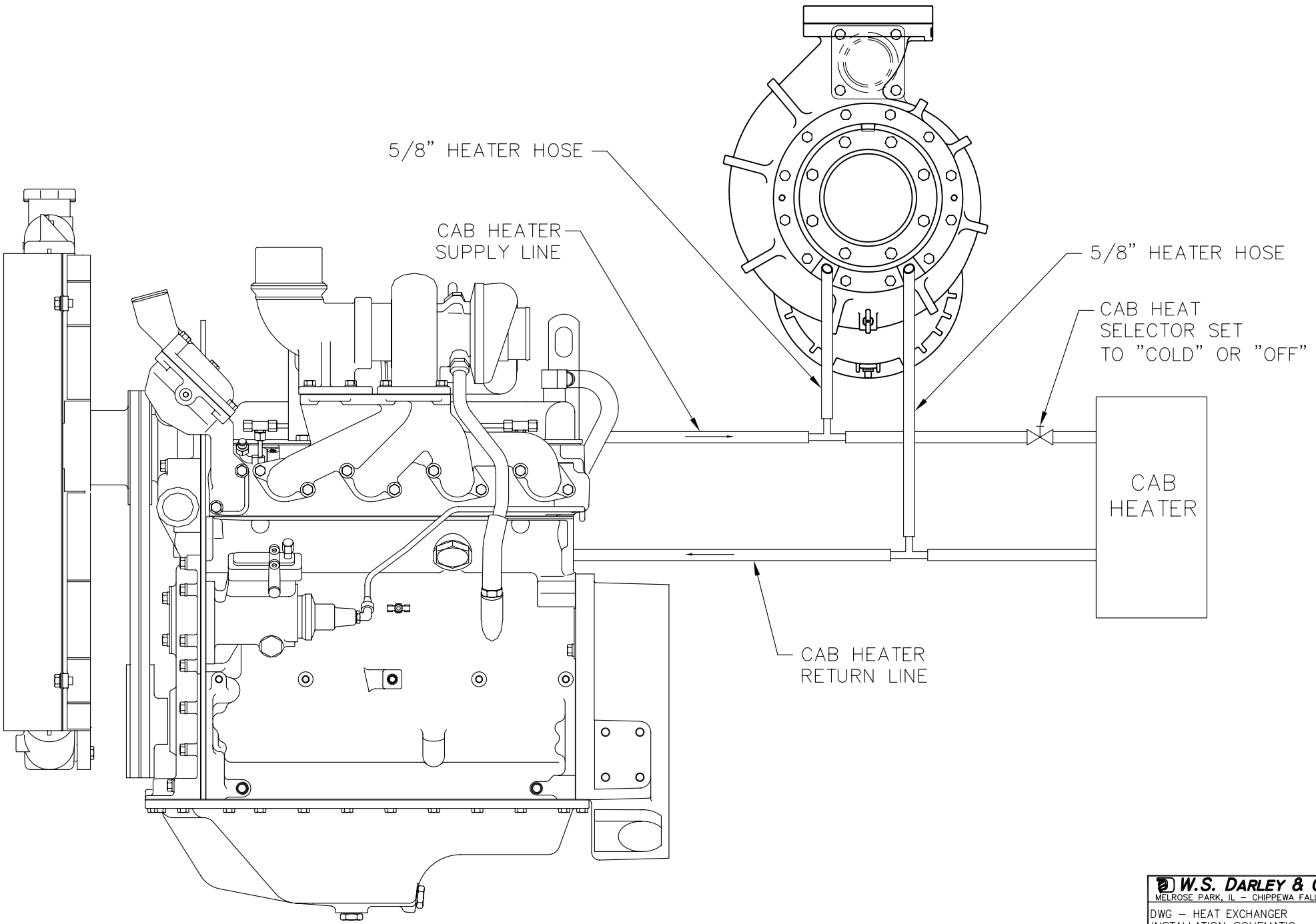
DR'N SEITZ
CHKD
TRCD

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

DRIVELINE DETAIL
SPICER LOCKON YOKE

DATE FEB22,91
SCALE 1/4

DNM0000

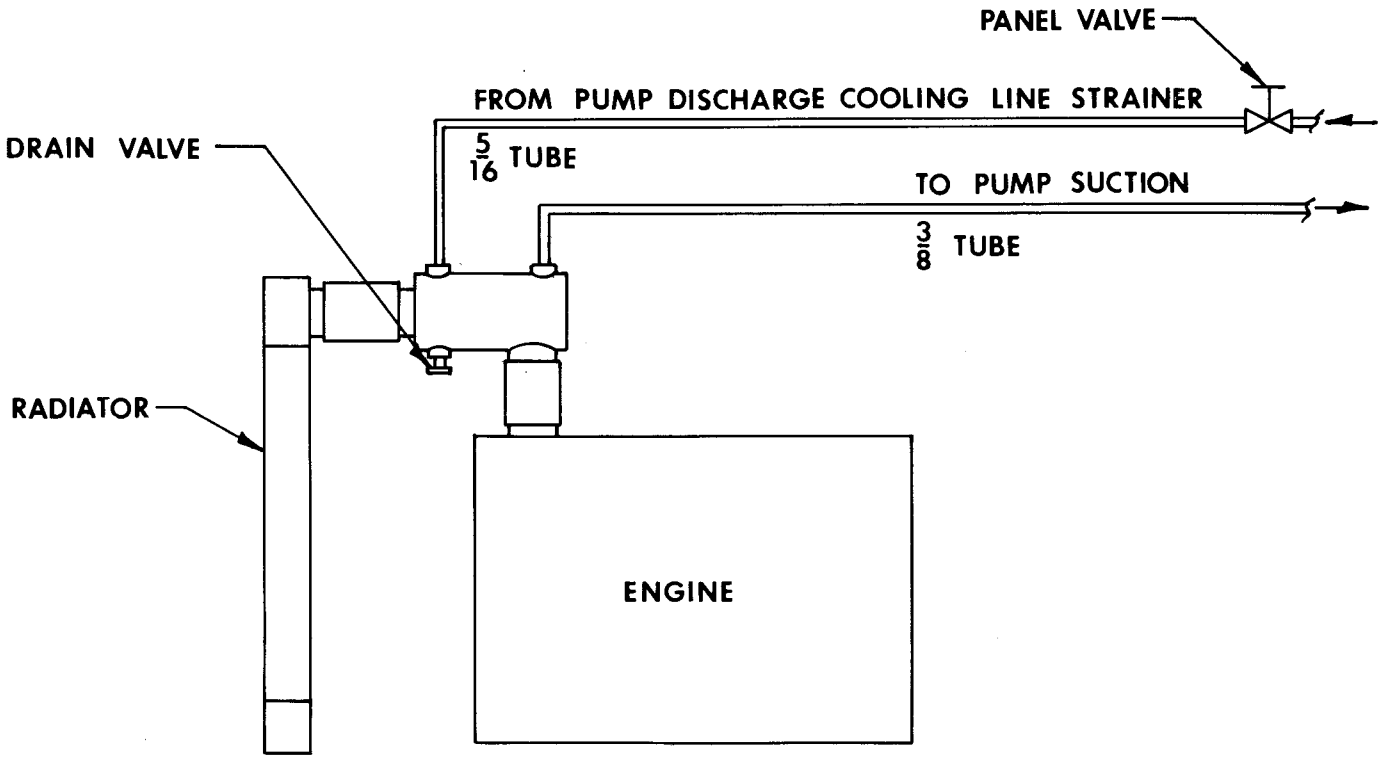


W.S. DARLEY & Co.
MELROSE PARK, IL – CHIPPEWA FALLS, WI

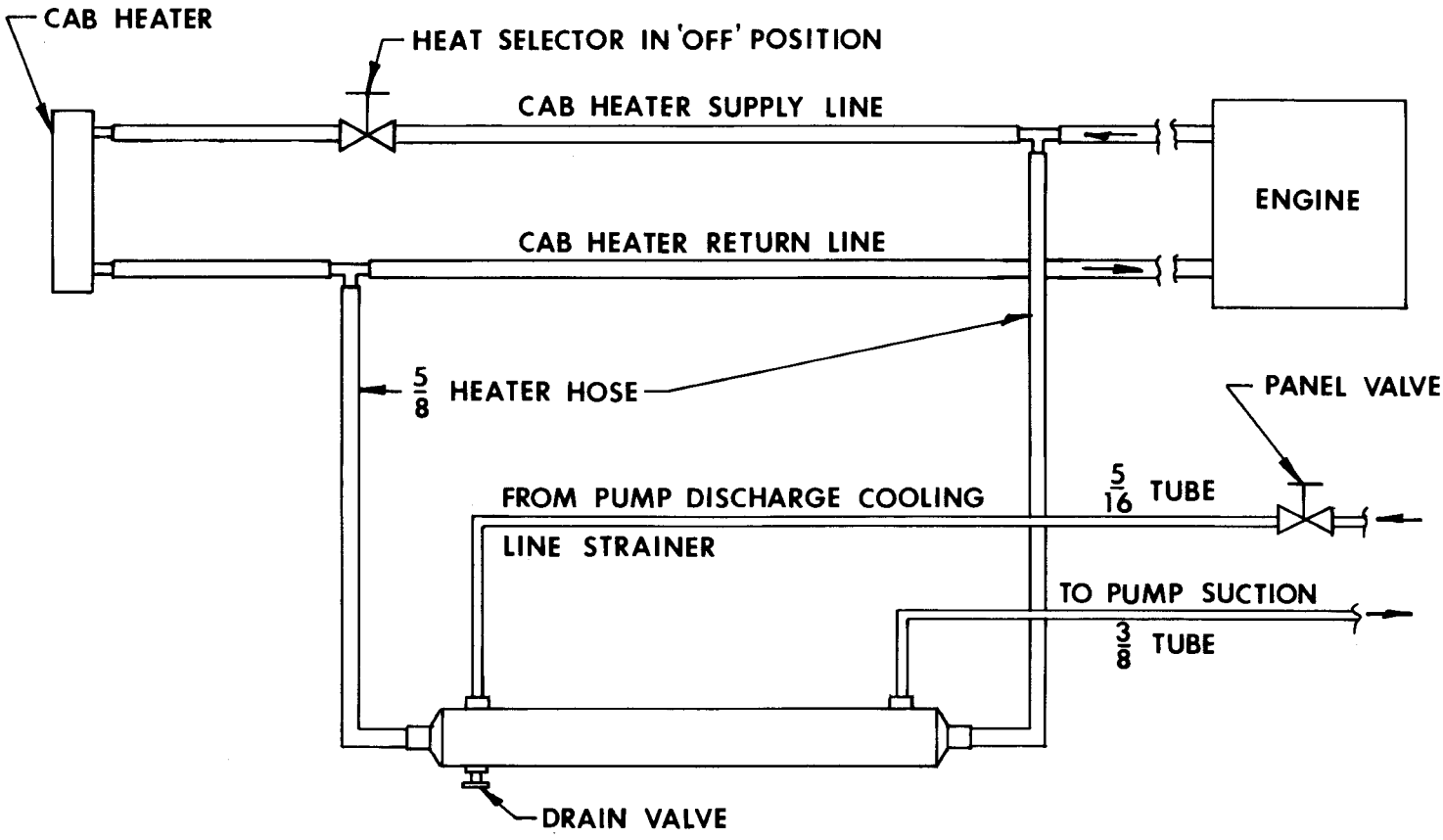
DWG – HEAT EXCHANGER
INSTALLATION SCHEMATIC

DATE NOV13,96
DRW'N BY TED

DGS0400

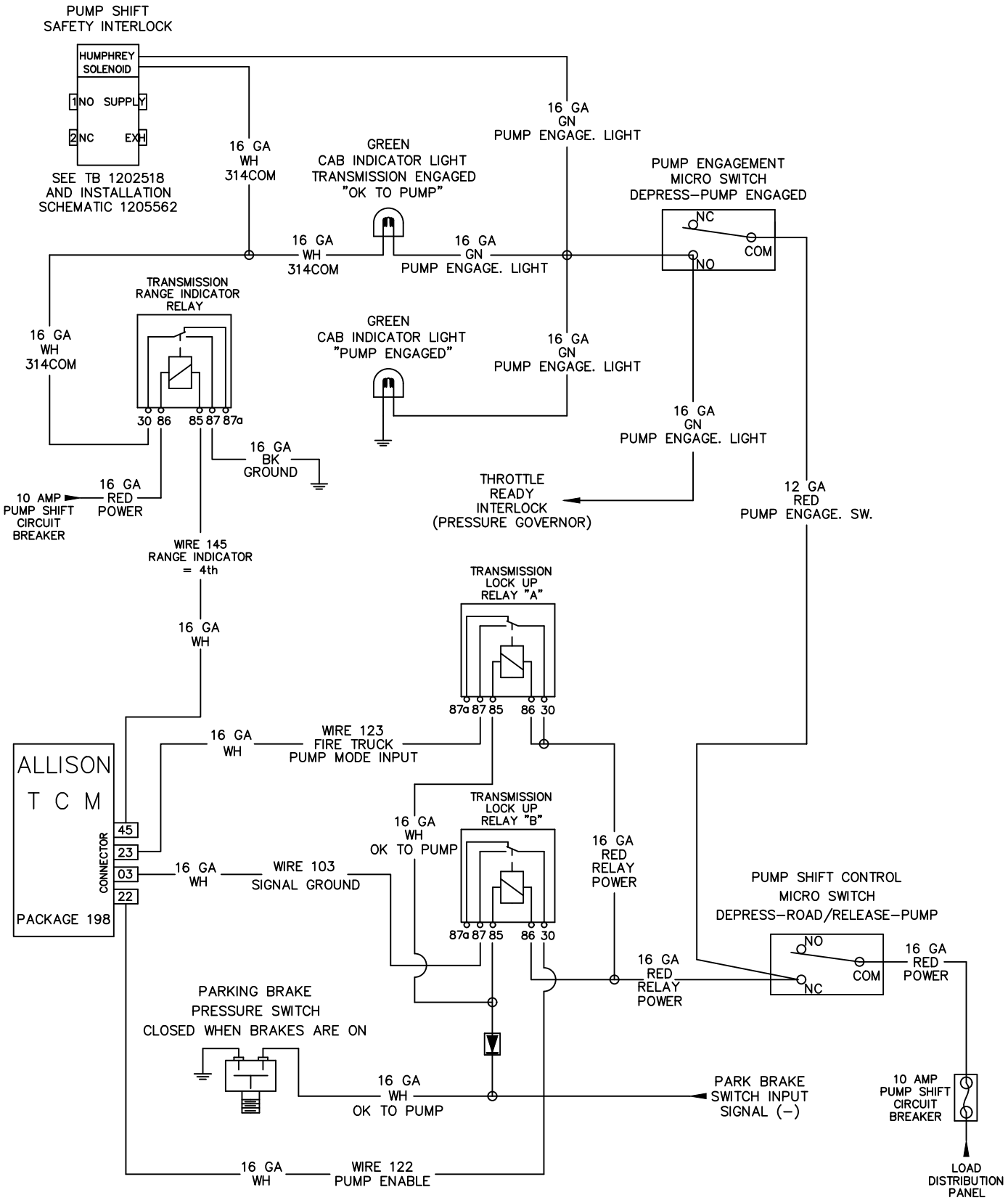


R592 HEAT EXCHANGER



F618 HEAT EXCHANGER

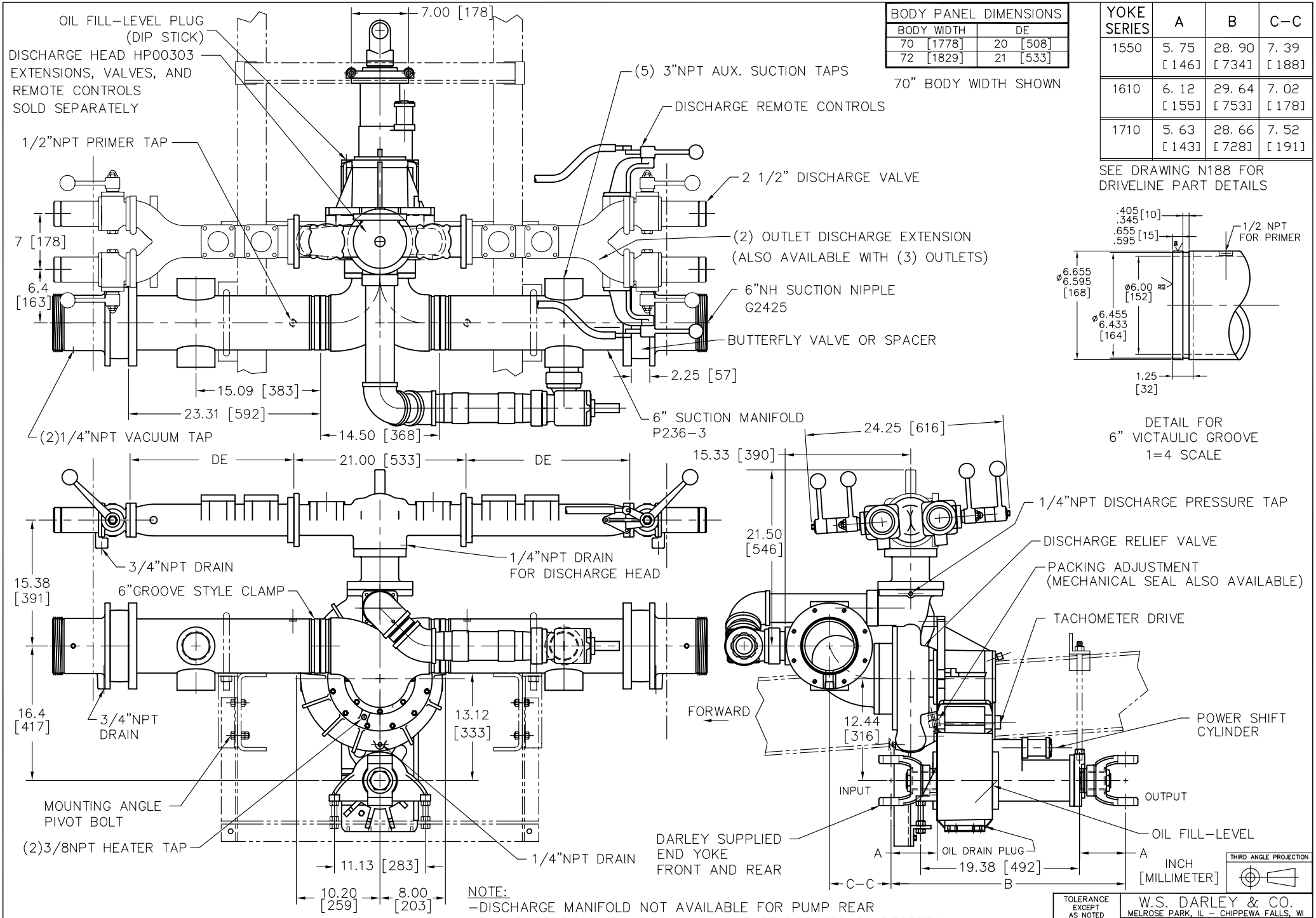
REVISIONS			
SYM.	DATE	BY	REVISION
C	22FEB19	PWS	UPDATED TO 5TH GENERATION



ELECTRICAL SCHEMATIC
ALLISON 5th GENERATION
PUMP ENGAGEMENT

W.S. Darley & Co.
APPARATUS DIVISION
920 KURTH ROAD
CHIPPEWA FALLS, WISCONSIN 54729
1-715-726-2645

DWG BY SCHULTZ	SCALE NONE	REV C
DATE 5–25–17	JOB NO.	DWG. NO. DGS1200



BODY PANEL DIMENSIONS	
BODY WIDTH	DE
70 [1778]	20 [508]
72 [1829]	21 [533]

70" BODY WIDTH SHOWN

YOKE SERIES	A	B	C-C
1550	5.75 [146]	28.90 [734]	7.39 [188]
1610	6.12 [155]	29.64 [753]	7.02 [178]
1710	5.63 [143]	28.66 [728]	7.52 [191]

SEE DRAWING N188 FOR
DRIVELINE PART DETAILS

DETAIL FOR
6" VICTAULIC GROOVE
1=4 SCALE

NOTE:
-DISCHARGE MANIFOLD NOT AVAILABLE FOR PUMP REAR
-FOR PUMP REAR, PUMP CASING MUST BE ROTATED 30 DEGREES
-NET WEIGHT: 920LBS [414 KG]

REVISIONS				
LTR	DESCRIPTION	DATE	CHG NO.	APPR'D
E	UPDATED TO REVISED GEARCASE	27APR2000	-	TED
D	SEE HISTORICAL COPY	4/7/99	-	DLL

ALL DIMENSIONS IN INCHES UNLESS NOTED

DO NOT SCALE PRINT

OLD PART NO. P238

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

DR'N TED
CHKD
TRCD -

INCH [MILLIMETER]

THIRD ANGLE PROJECTION

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

DWG - PSM, PUMP FORWARD DIMENSIONAL

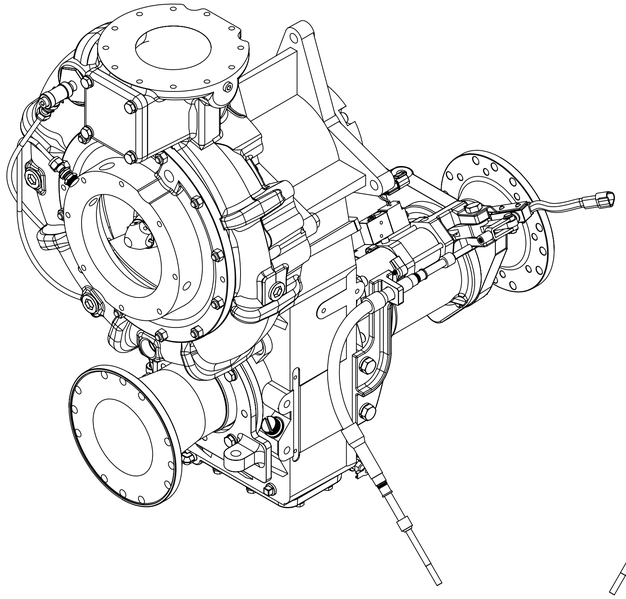
DATE JAN17,95

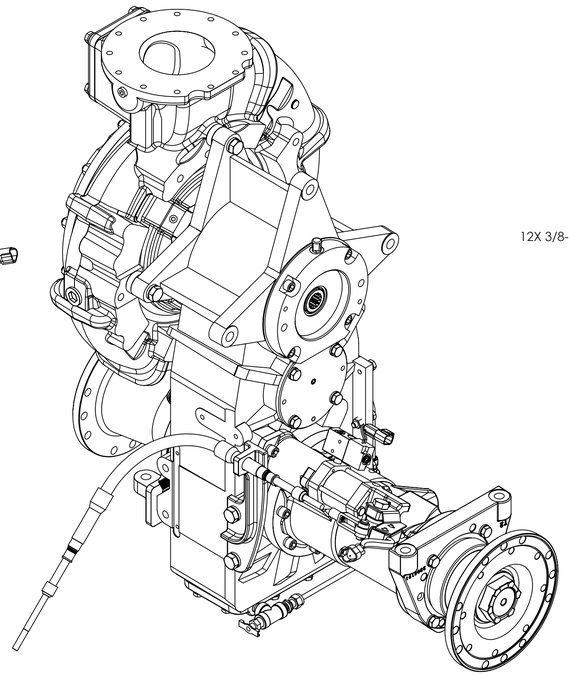
SCALE 1/8

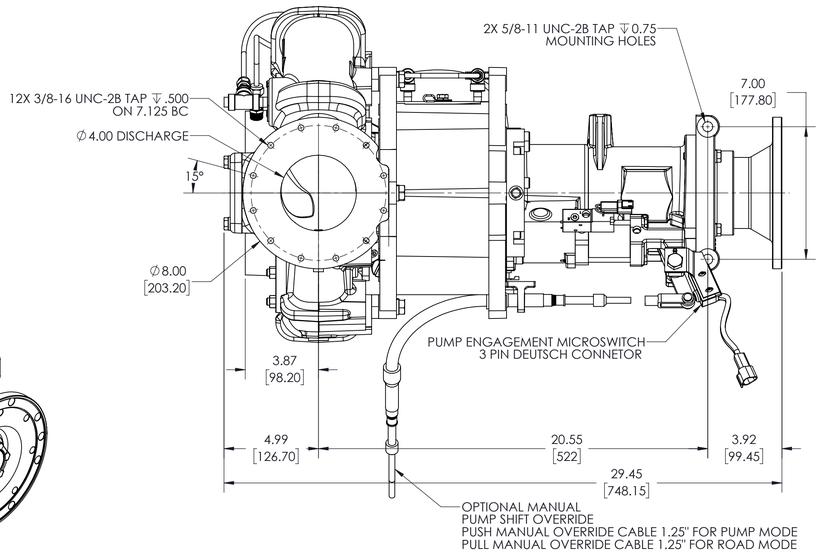
DPD0600

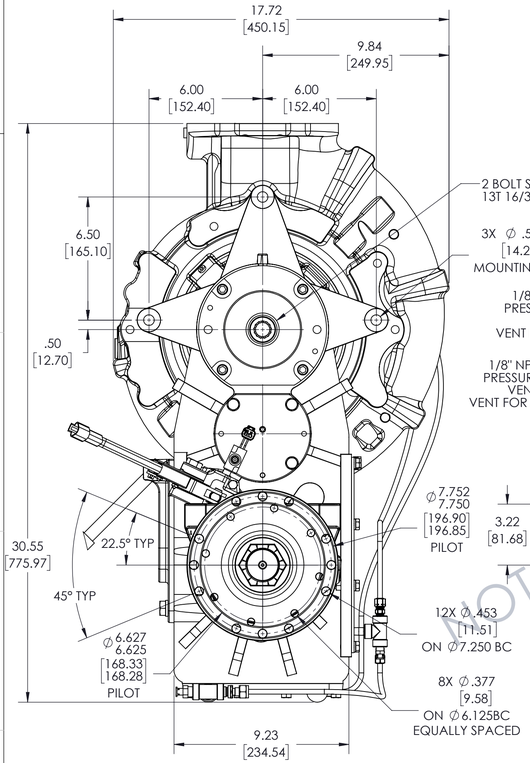
NOTES:
1) ONLY SHIFT PUMP WHEN DRIVELINE IS NOT SPINNING
2) APPROXIMATE WEIGHT: 510 LBS [231 KG]

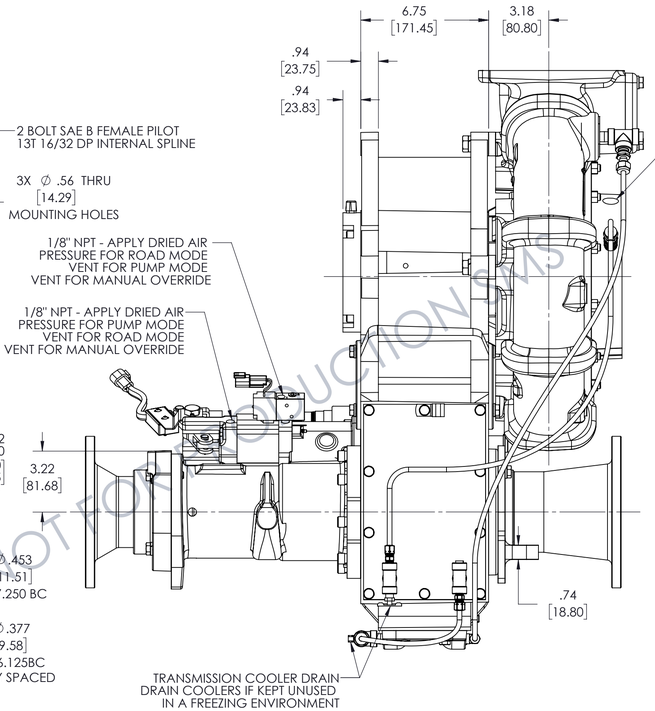
ASSEMBLIES SHOWN:
CAST IRON PUMP - PT01002
TRANSMISSION - TM00237
CAST IRON GEAR CASE - 1804204
INPUT FLANGE - 4816811
OUTPUT FLANGE - 4816810
TRANSMISSION COOLER - AM00401
TRANSMISSION COOLER - AM00403
GEAR RATIO 2.12:1 - KR07701
RV FLANGE - YF00601
PUMP SHIFT - AH00117
PUMP SHIFT - AH00110
NO BRAKE - AB00403
SHIFT INTERLOCK - AH00600

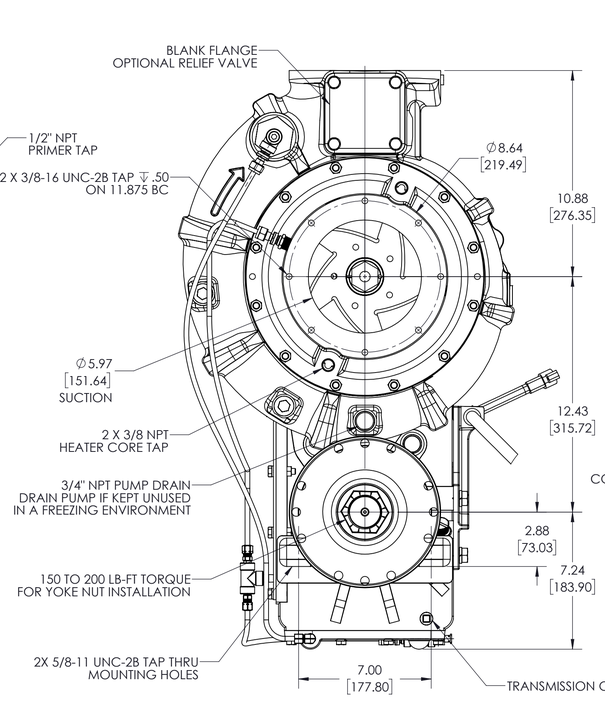


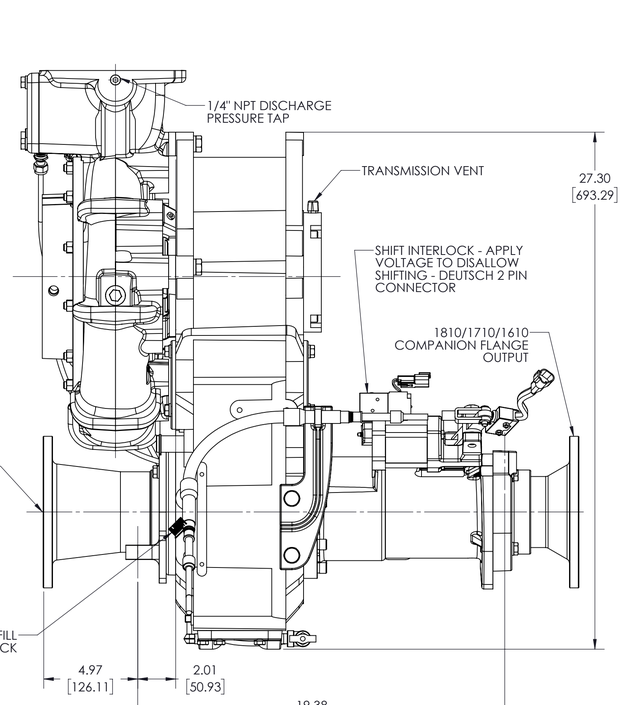










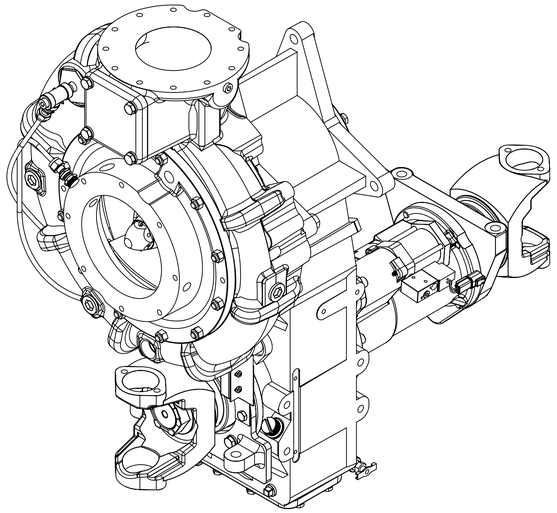


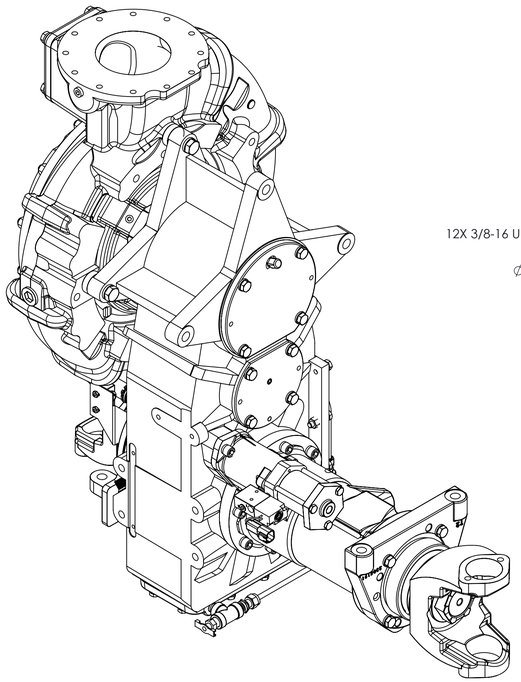
REMOVE SHARP EDGES	INCH [MILLIMETER]	THIRD ANGLE PROJECTION	OLD PART NO.	TOLERANCE EXCEPT AS NOTED .00 ±.03 .000 ±.010 ANGLES ±1	Darley ITASCA, IL CHIPPEWA FALLS, WI
MATERIAL DESCRIPTION	MASS	MATERIAL NO.	PATTERN NO.		DWG - TSM, PUMP FORWARD
	511.57 LBS			DRWN SMS	SAE B HYD ADAPT
THIS DESIGN IS THE PROPERTY OF WS. DARLEY CO. - UNAUTHORIZED REPRODUCTION IS PROHIBITED	ALL DIMENSIONS IN INCHES UNLESS NOTED	DO NOT SCALE PRINT		CKHD WAH	DATE: 04/03/2020 DTD1000
				TRCD	SCALE: 1:4

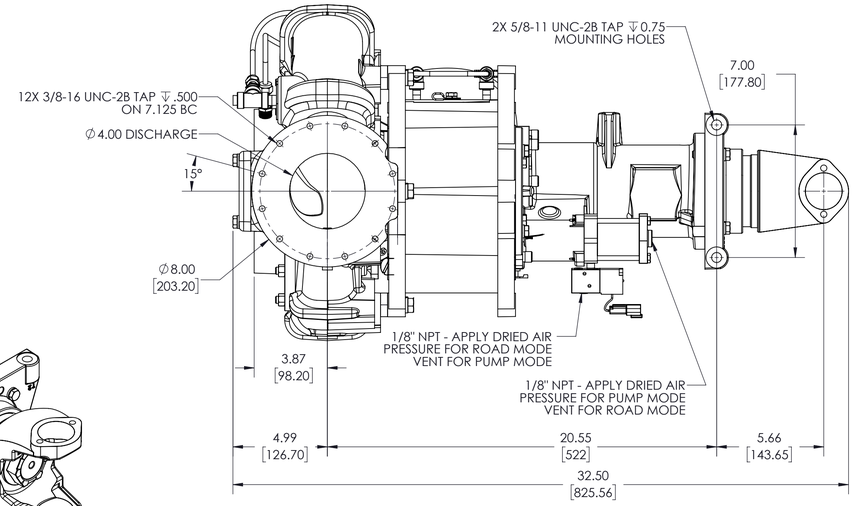
MODEL	SHEET
DTD1000	1/1 D

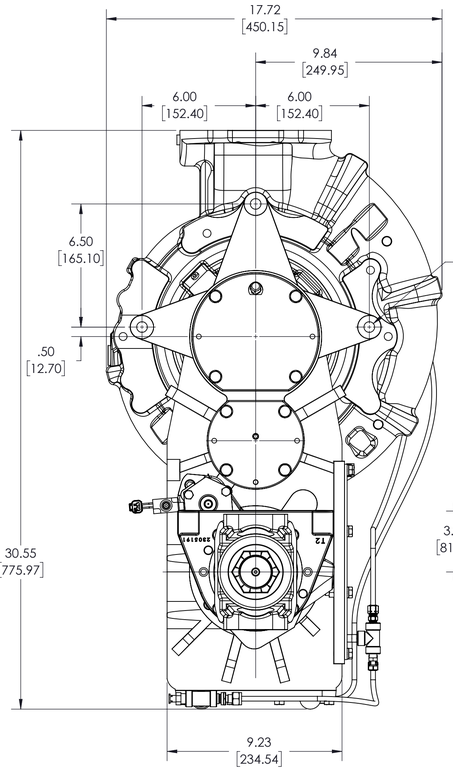
NOTES:
1) ONLY SHIFT PUMP WHEN DRIVELINE IS NOT SPINNING
2) APPROXIMATE WEIGHT: 506 LBS [229 KG]

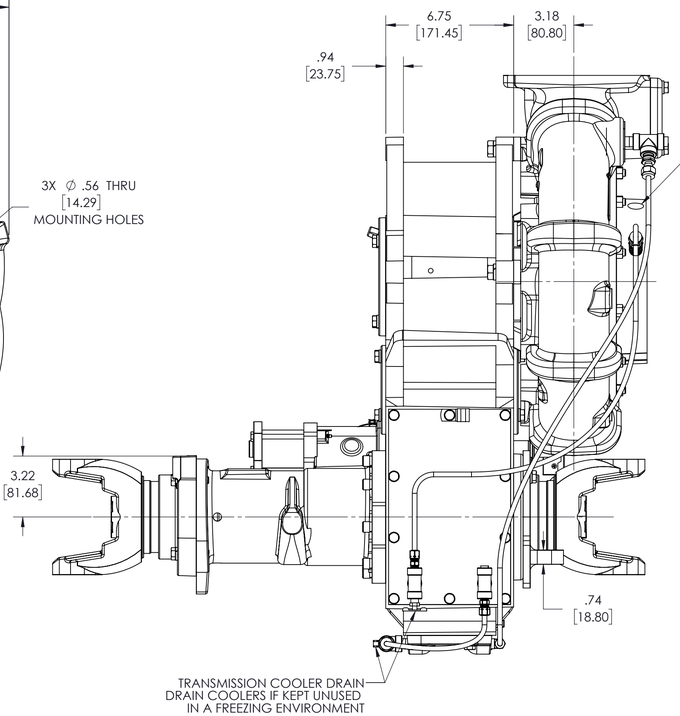
ASSEMBLIES SHOWN:
CAST IRON PUMP - PT01000
TRANSMISSION - TM00238
CAST IRON GEAR CASE - 1804204
INPUT FLANGE - 4813410
OUTPUT FLANGE - 4813410
TRANSMISSION COOLER - AM00401
TRANSMISSION COOLER - AM00403
GEAR RATIO 2.12:1 - KR07701
RV FLANGE - YF00601
PUMP SHIFT - AH00403
NO BRAKE - AB00403
SHIFT INTERLOCK - AH00600

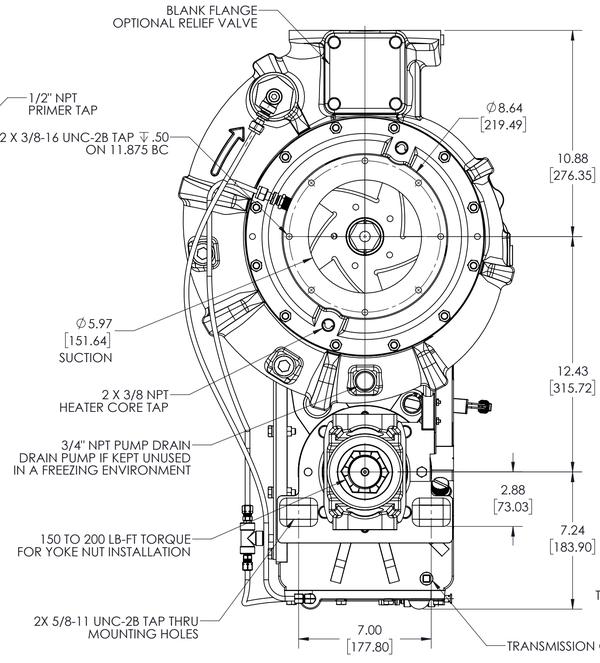


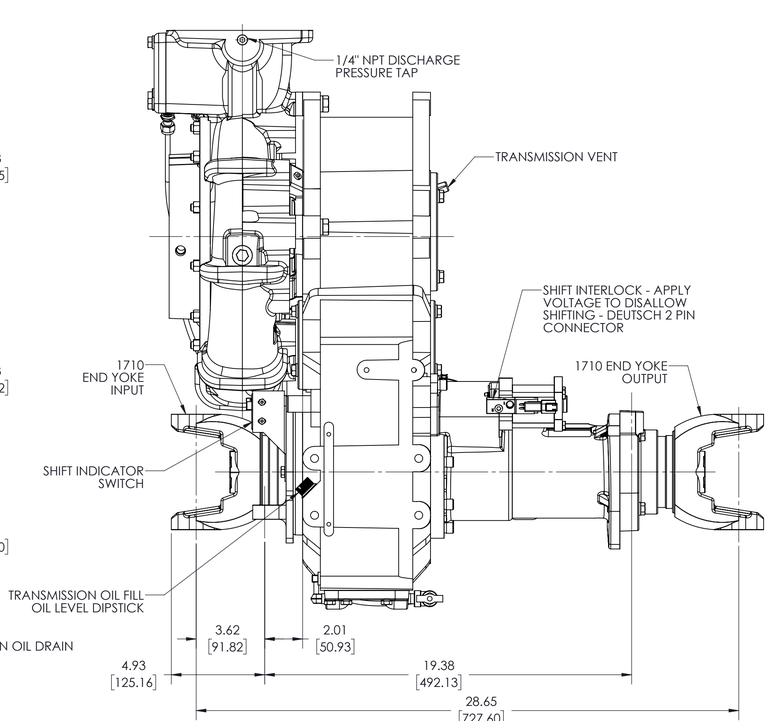










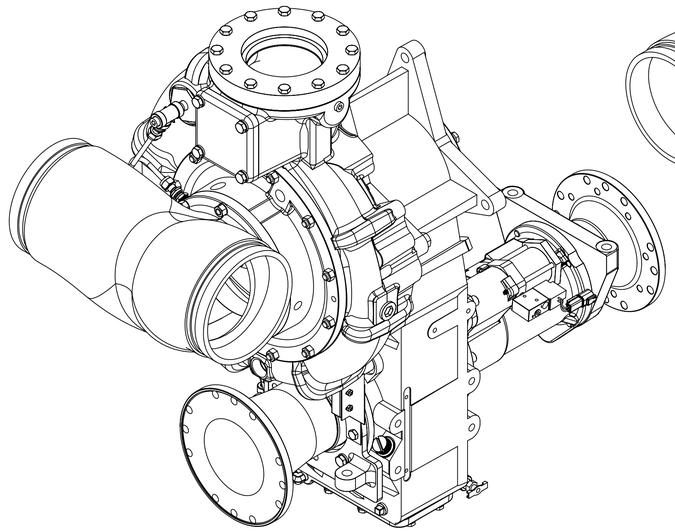


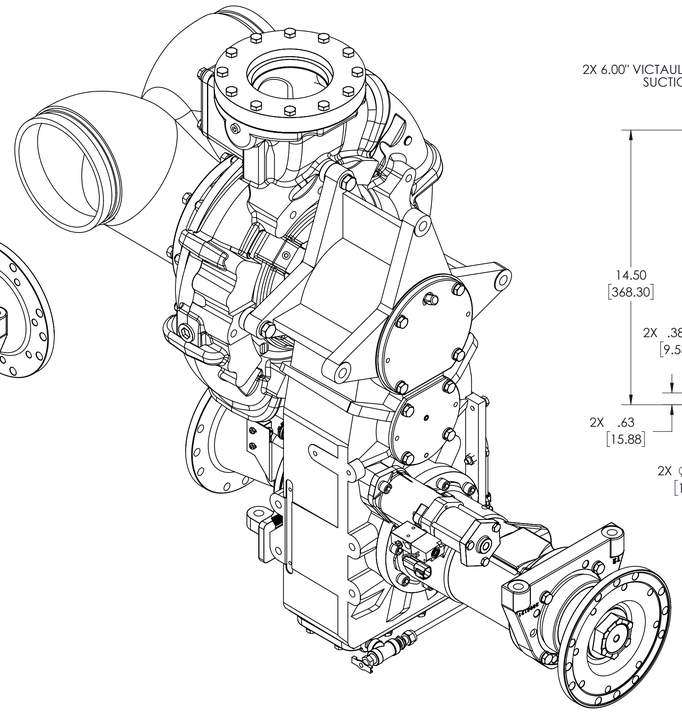
REMOVE SHARP EDGES	INCH [MILLIMETER]	THIRD ANGLE PROJECTION	OLD PART NO.	TOLERANCE EXCEPT AS NOTED .00 ±.03 .000 ±.010 ANGLES ±1	Darley® ITASCA, IL CHIPPEWA FALLS, WI
MATERIAL DESCRIPTION	MASS	MATERIAL NO.	PATTERN NO.	DRWN SMS	DWG - TSM, PUMP FORWARD
	507.14 LBS			CKHD WAH	1710 YOKES, NO MANIFOLDS
THIS DESIGN IS THE PROPERTY OF WS. DARLEY CO. - UNAUTHORIZED REPRODUCTION IS PROHIBITED	ALL DIMENSIONS IN INCHES UNLESS NOTED	DO NOT SCALE PRINT		TRCD	DATE: 4/22/2020 SCALE: 1:4 DTD1001

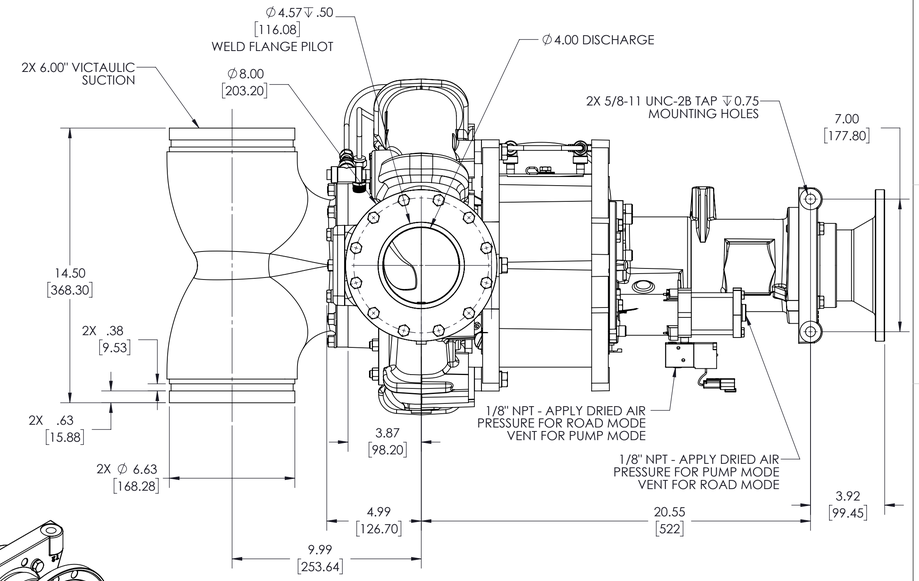
MODEL	SHEET
DTD1001	1/1 D

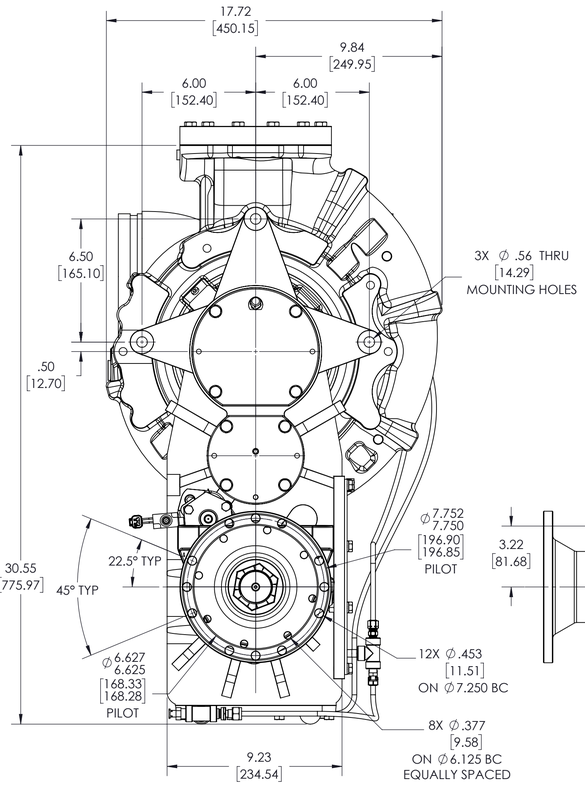
NOTES:
1) ONLY SHIFT PUMP WHEN DRIVELINE IS NOT SPINNING
2) APPROXIMATE WEIGHT: 557 LBS [253 KG]

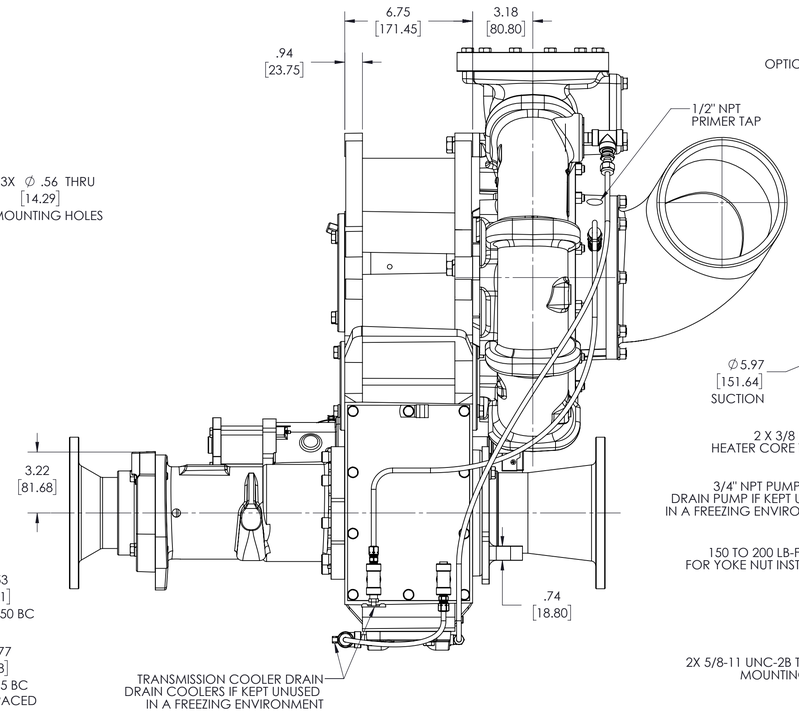
ASSEMBLIES SHOWN:
CAST IRON PUMP - PT01000
TRANSMISSION - TM00238
CAST IRON GEAR CASE - 1804204
INPUT FLANGE - 4816811
OUTPUT FLANGE - 4816810
TRANSMISSION COOLER - AM00401
TRANSMISSION COOLER - AM00403
GEAR RATIO 2.12:1 - KR07701
RV FLANGE - YF00601
PUMP SHIFT - AH00403
NO BRAKE - AB00403
SHIFT INTERLOCK - AH00600
SUCTION - KC02500
DISCHARGE FLANGE - YF00141

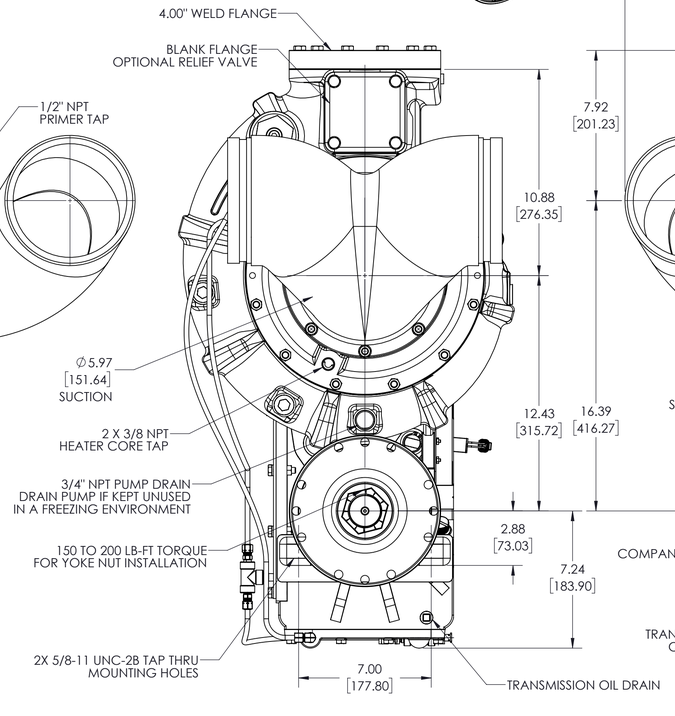


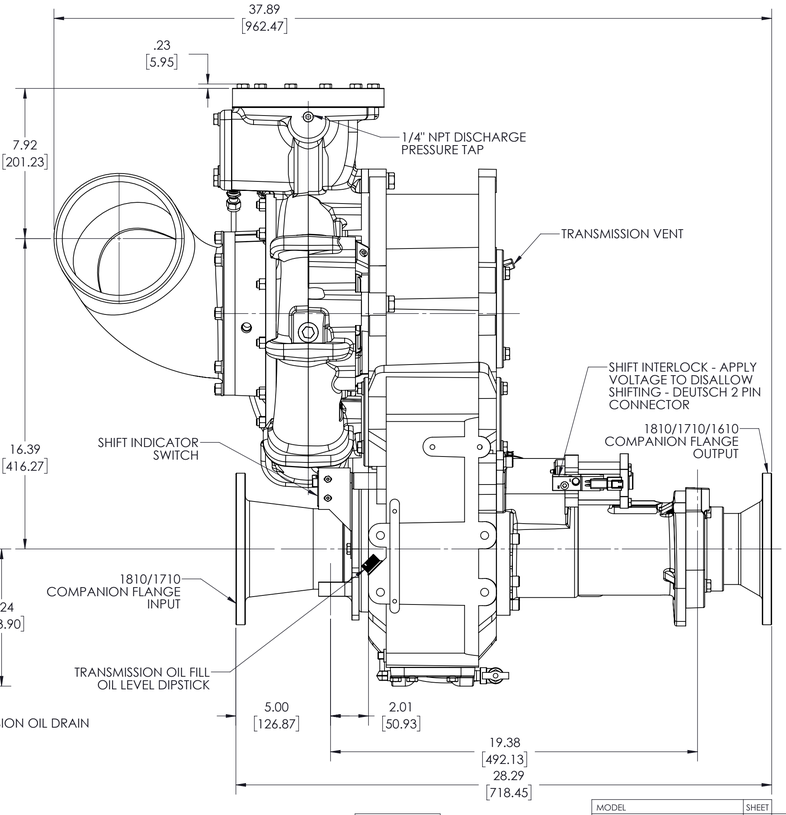








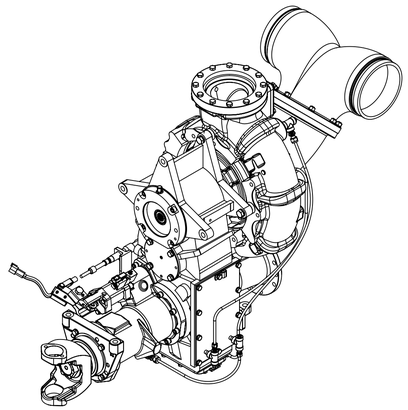


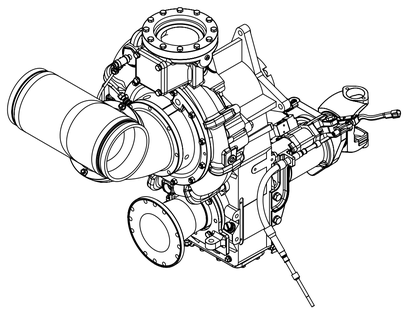


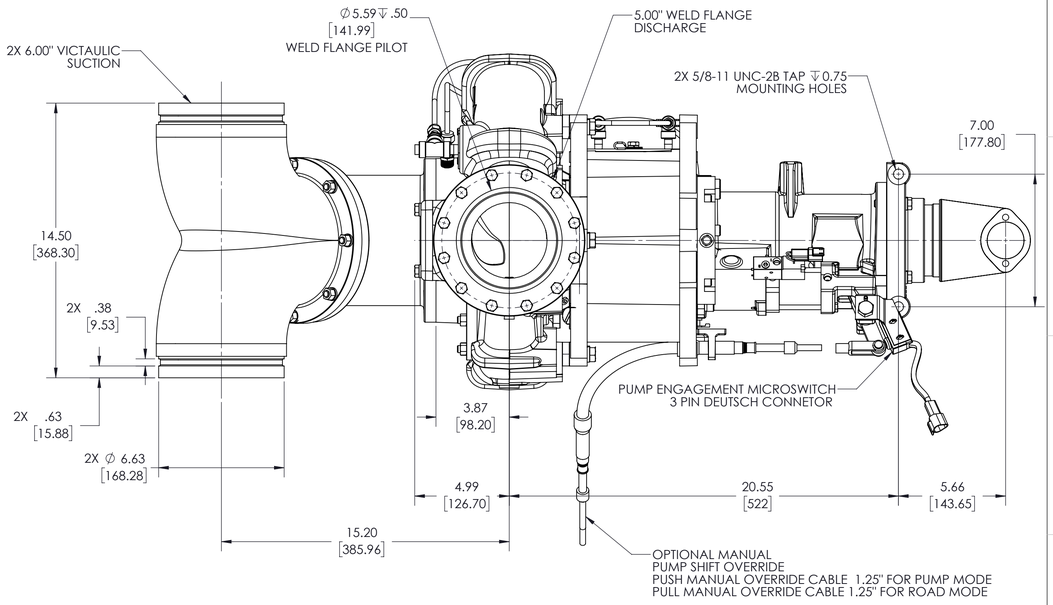
		THIRD ANGLE PROJECTION		MODEL	SHEET
				DTD1002	1/1 D
REMOVE SHARP EDGES	INCH [MILLIMETER]		OLD PART NO.	TOLERANCE EXCEPT AS NOTED .00 ±.03 .000 ±.010 ANGLES ±1	Darley® ITASCA, IL CHIPPEWA FALLS, WI
MATERIAL DESCRIPTION	MASS		MATERIAL NO.	PATTERN NO.	DWG - TSM, PUMP FORWARD COMP FLANGES, SWEPT TEE
	558.02 LBS			DRWN SMS	
THIS DESIGN IS THE PROPERTY OF WS. DARLEY CO. - UNAUTHORIZED REPRODUCTION IS PROHIBITED	ALL DIMENSIONS IN INCHES UNLESS NOTED	DO NOT SCALE PRINT		CKHD WAH	DATE: 4/22/2020 DTD1002
				TRCD	SCALE: 1:4

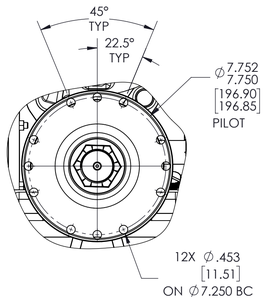
NOTES:
1) ONLY SHIFT PUMP WHEN DRIVELINE IS NOT SPINNING
2) APPROXIMATE WEIGHT: 585 LBS [265 KG]

ASSEMBLIES SHOWN:
CAST IRON PUMP - PT01002
TRANSMISSION - TM00237
CAST IRON GEAR CASE - 1804204
INPUT FLANGE - 4816811
OUTPUT FLANGE - 4813410
TRANSMISSION COOLER - AM00401
TRANSMISSION COOLER - AM00403
GEAR RATIO 2.12:1 - KR07701
RV FLANGE - YF00601
PUMP SHIFT - AH00117
PUMP SHIFT - AH00110
NO BRAKE - AB00403
SHIFT INTERLOCK - AH00600
SUCTION EXT - KC02600
SUCTION TEE - KC2501
DISCHARGE FLANGE - YF00142

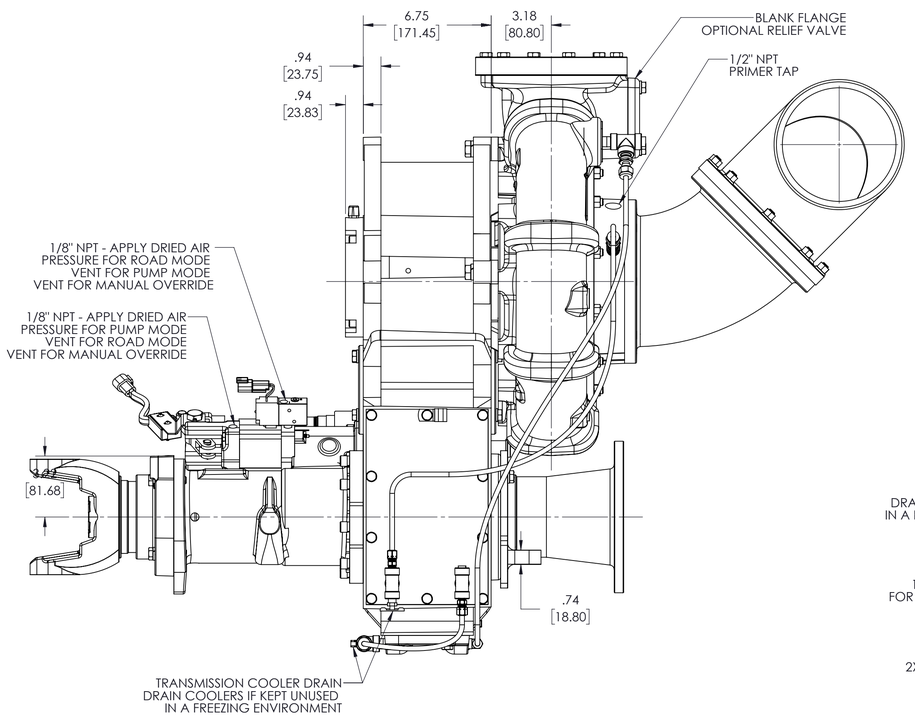


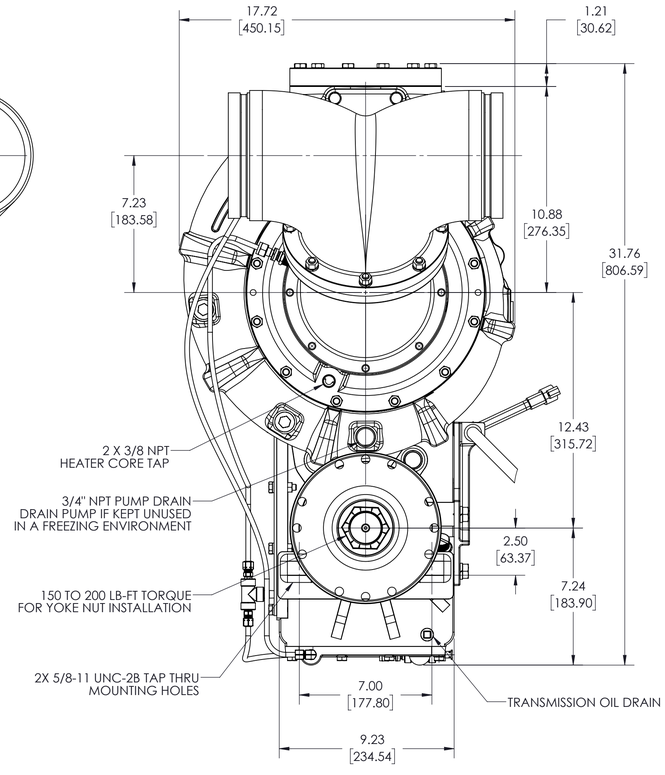


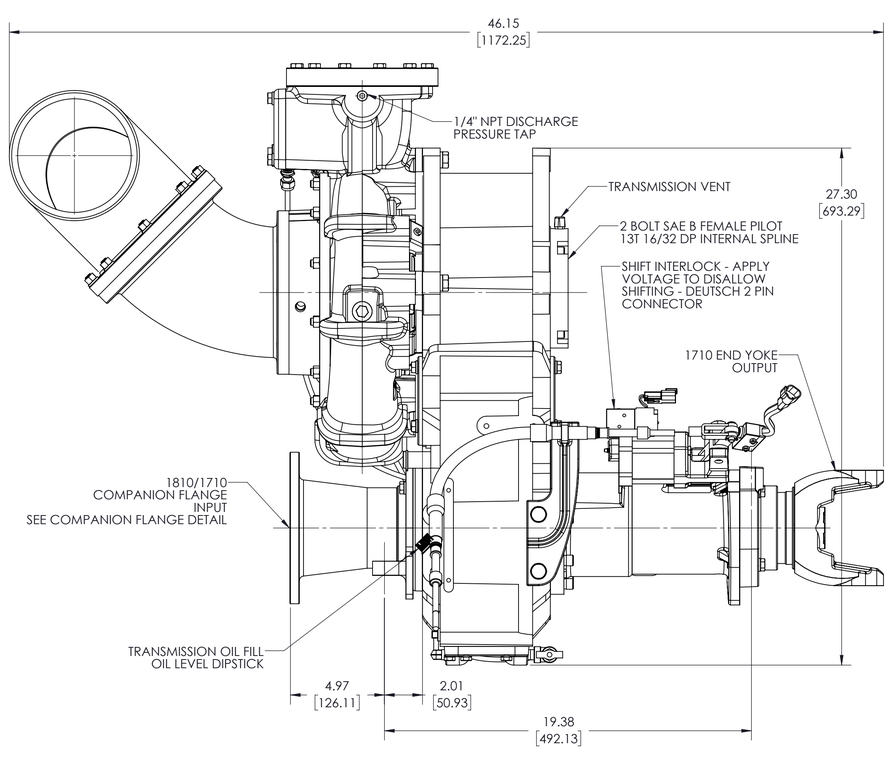




COMPANION FLANGE DETAIL







		THIRD ANGLE PROJECTION		MODEL	SHEET
				DTD1003	1/1 D
REMOVE SHARP EDGES	INCH [MILLIMETER]		OLD PART NO.	TOLERANCE EXCEPT AS NOTED .00 ±.03 .000 ±.010 ANGLES ±1	Darley ITASCA, IL CHIPPEWA FALLS, WI
MATERIAL DESCRIPTION	MASS		MATERIAL NO. / PATTERN NO.		DWG - TSM, PUMP FORWARD
	586.09 LBS			DRWN SMS	SAE B HYD ADAPT, MANIFOLDS
THIS DESIGN IS THE PROPERTY OF WS. DARLEY CO. - UNAUTHORIZED REPRODUCTION IS PROHIBITED	ALL DIMENSIONS IN INCHES UNLESS NOTED	DO NOT SCALE PRINT		CKHD WAH	DATE: 5/6/2020 DTD1003
				TRCD	SCALE: 1:4

SPICER®
DRIVETRAIN COMPONENTS
DANA

DRIVELINE INSTALLATION

J3311-1-DSSP
AUGUST 2008

Supersedes
J3311-1-HVTSS, Dated
February 2005

DANA
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.

Table of Contents

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

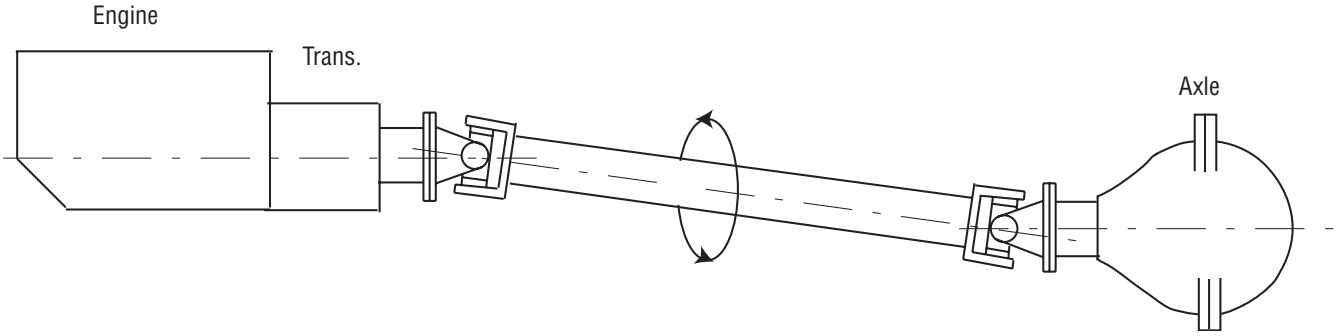
The following problems are usually a result of torque overloads:

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 x TLGR x TE x SR x TCR x 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 x W x RR) / (11.4 x 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.

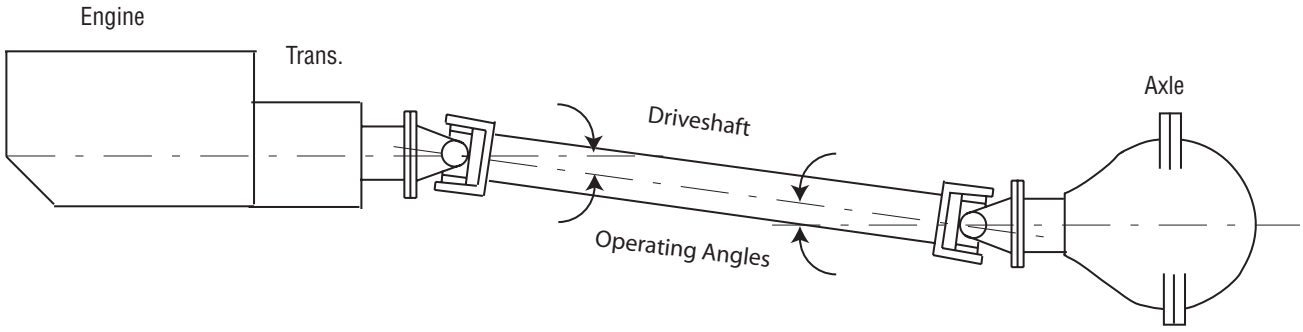


Figure 1

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)

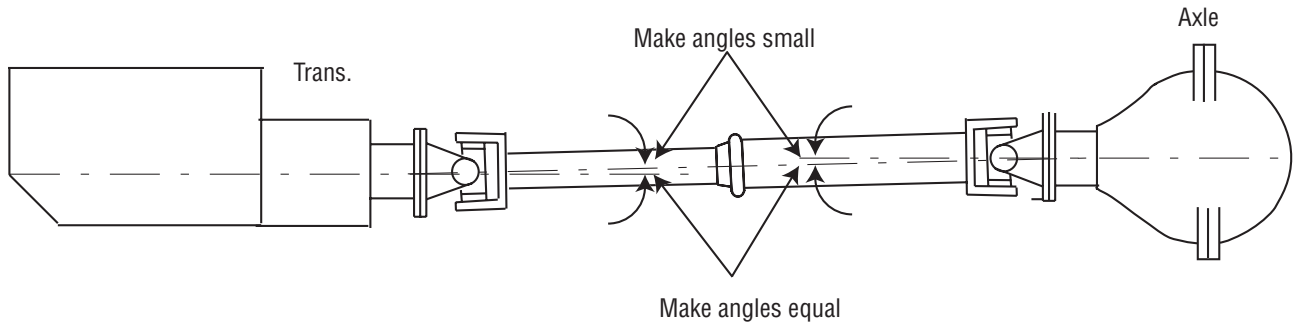


Figure 2

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.

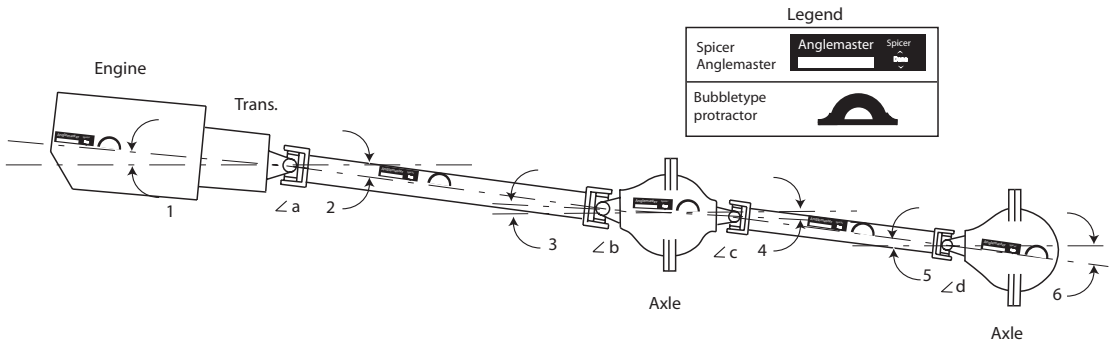


Figure 3

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.

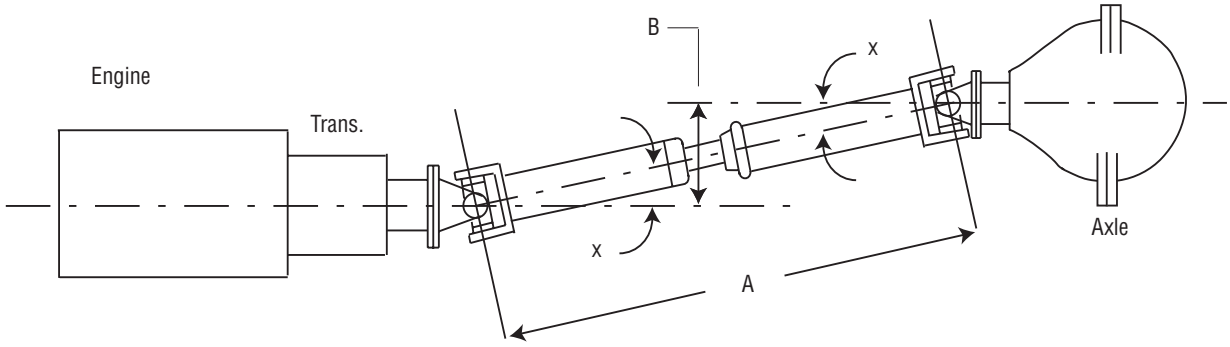
Using an Anglemaster or a bubble protractor, record inclination angles of drivetrain components. Set Anglemaster or protractor on machined surfaces of engine, transmission, axle, or on machined lugs of transmission and axle yoke(s).

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)



Angles in Top View

Figure 4

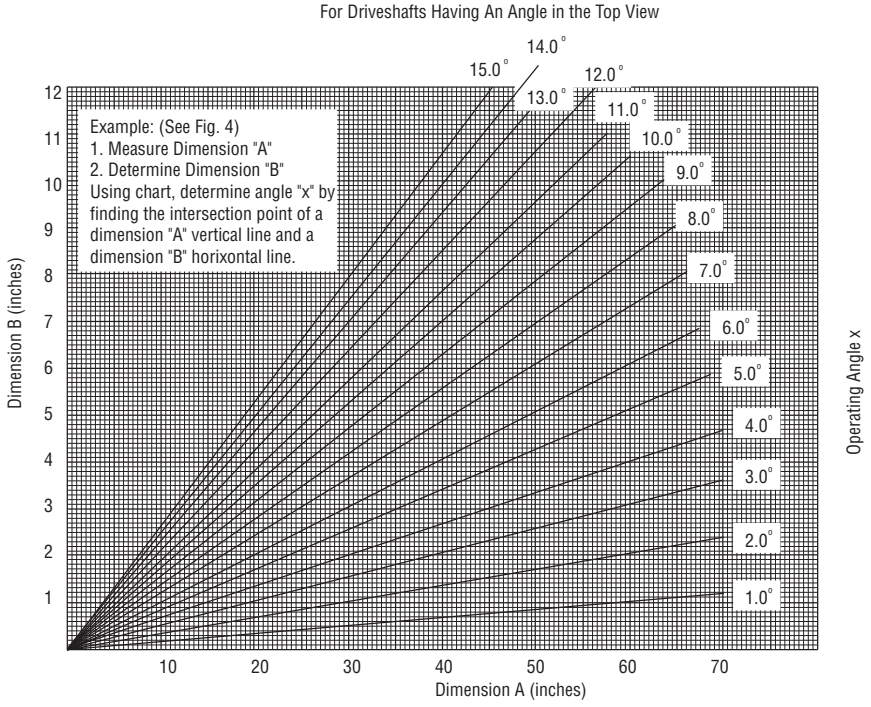
Measure dimensions "A" and "B" shown in figure 4. Use the instructions in the angle chart below to determine the size of the angle.

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)

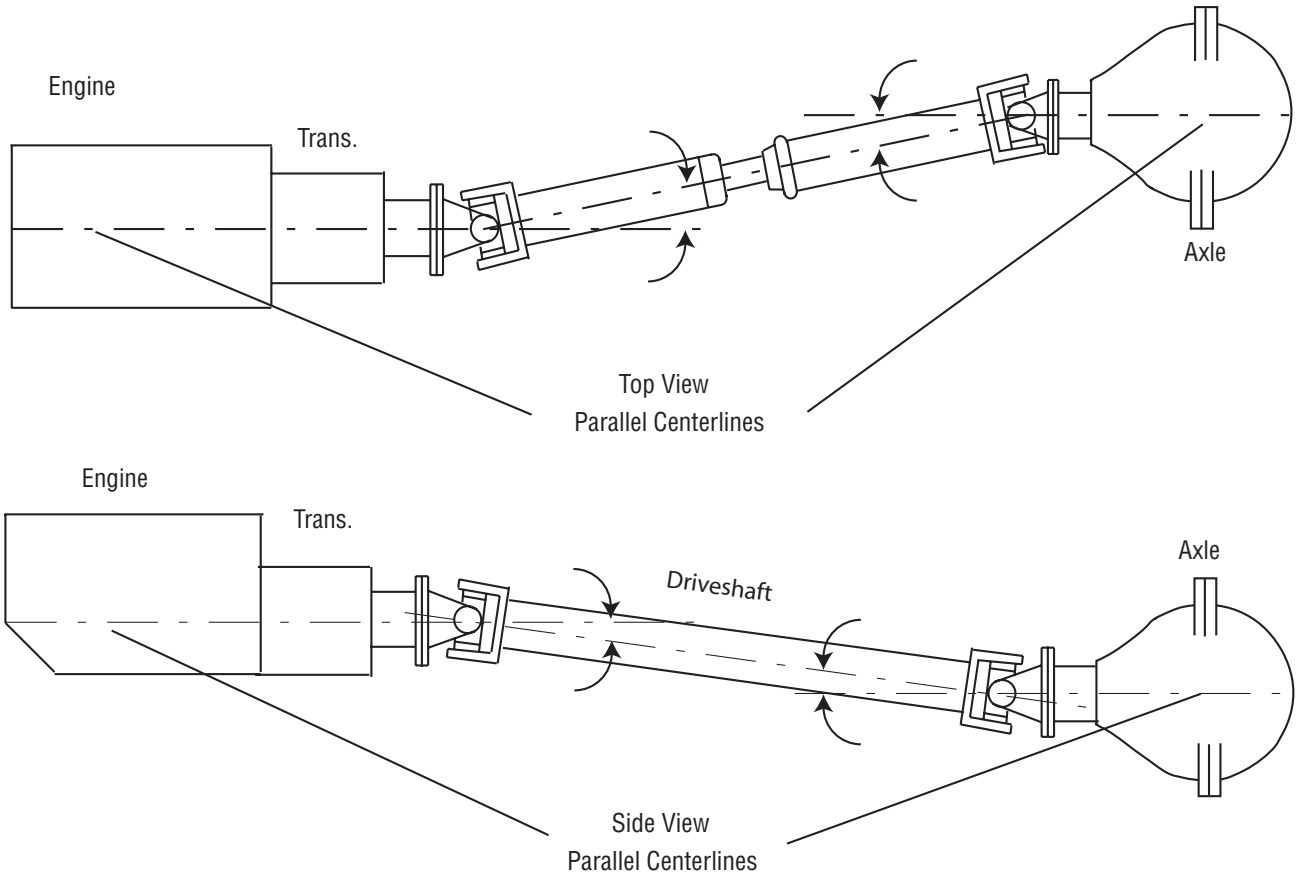


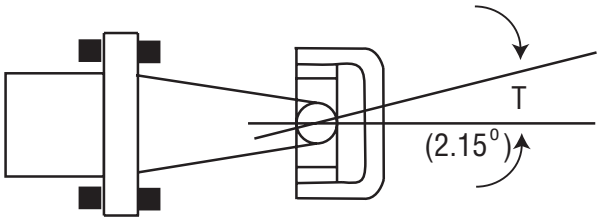
Figure 5

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.

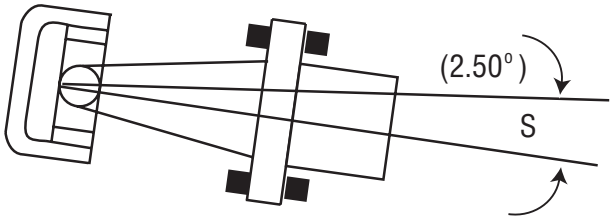
True Universal Joint Operating Angle

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.



Angle in Top View (from Chart)



SideView

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

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

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

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

$$C = \sqrt{10.873}$$

$C = 3.3^{\circ}$ (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 theses 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.

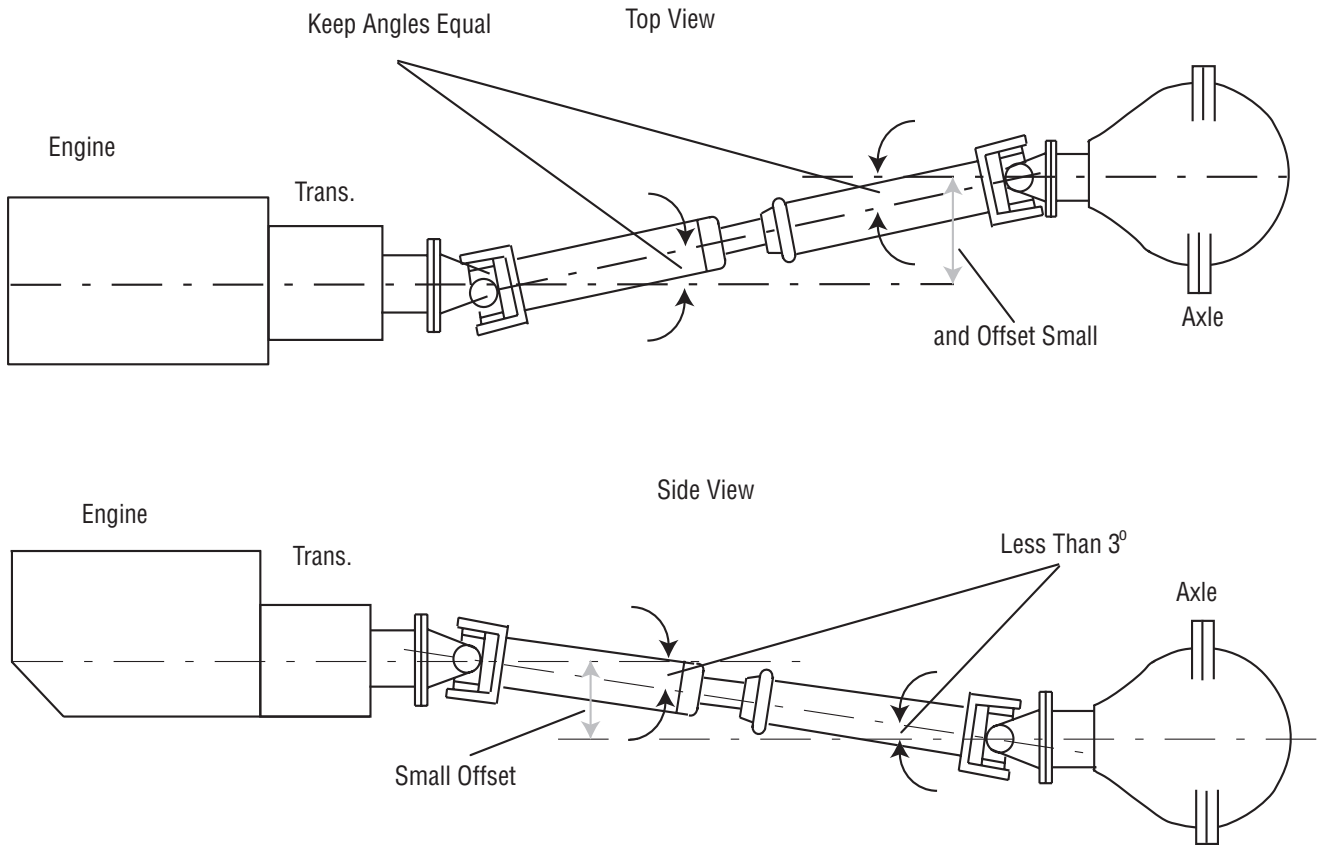


Figure 7

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)

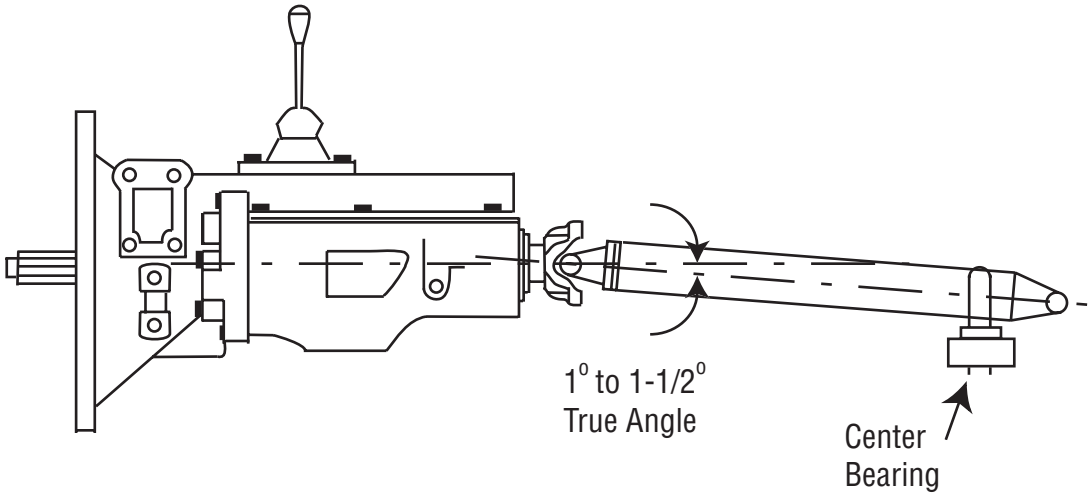


Figure 8

- 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)

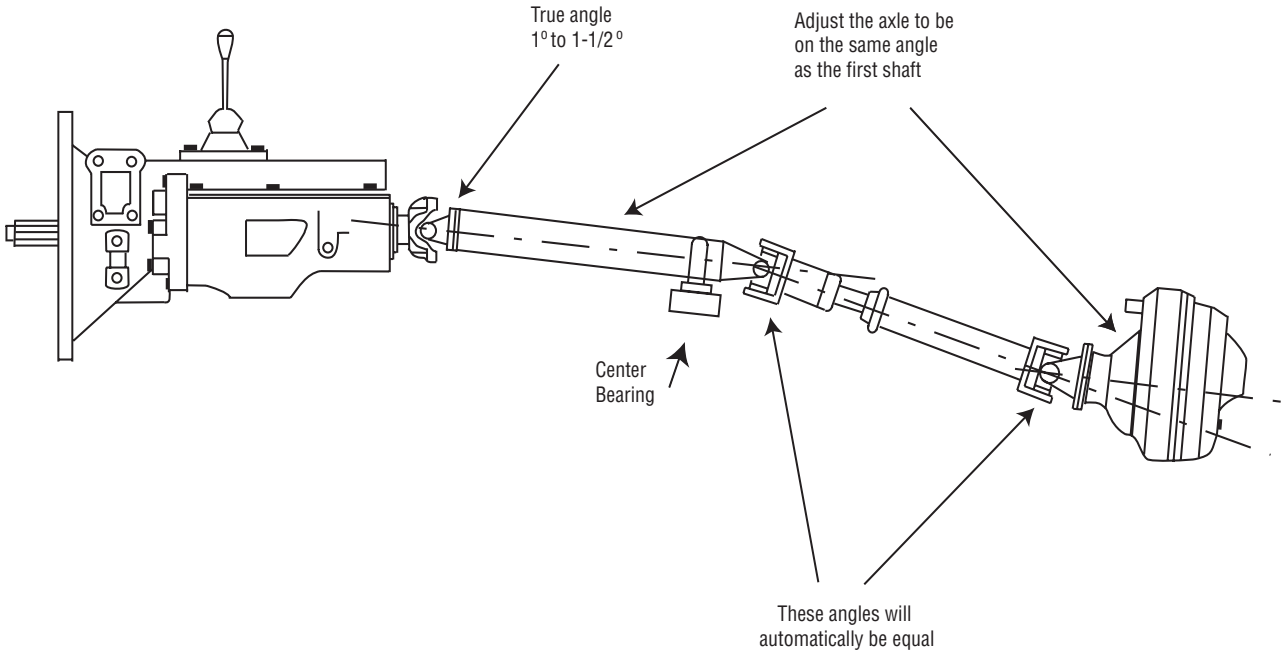


Figure 9

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.

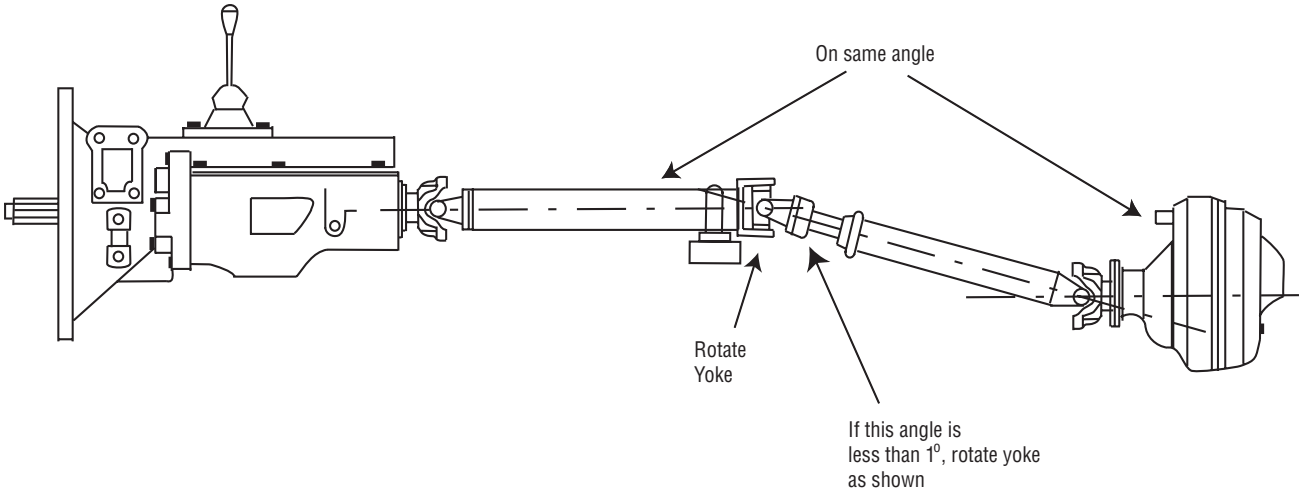


Figure 10

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).

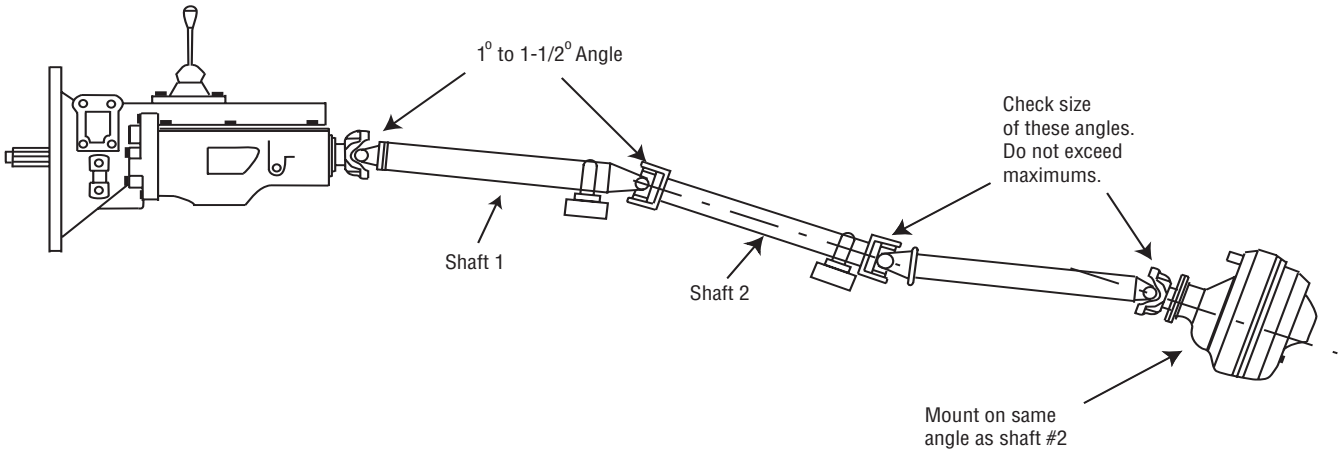


Figure 11

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)

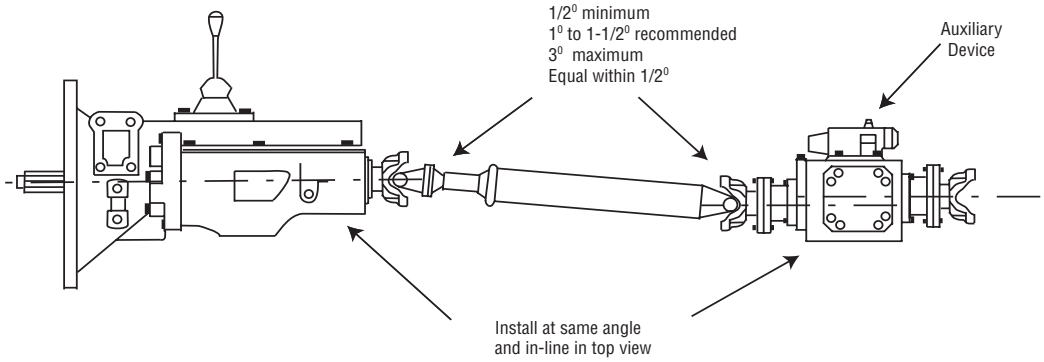


Figure 12

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.

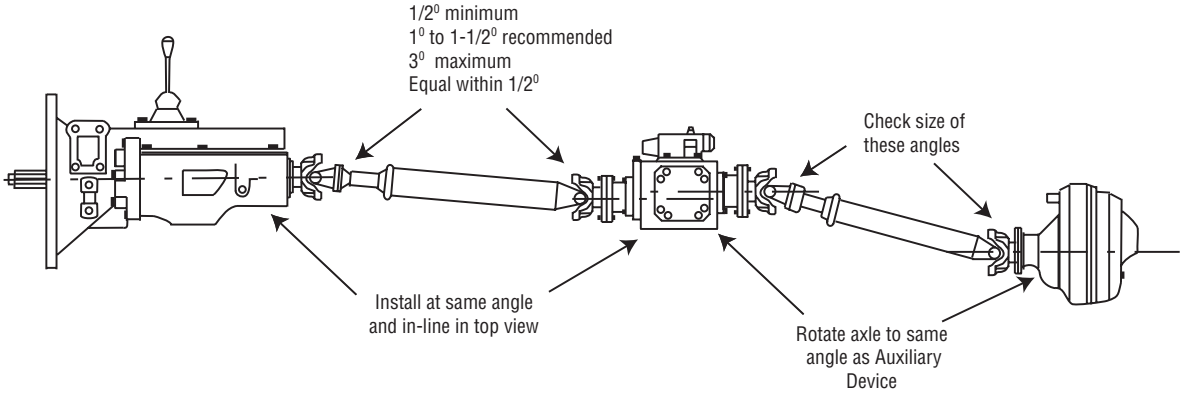


Figure 13

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)

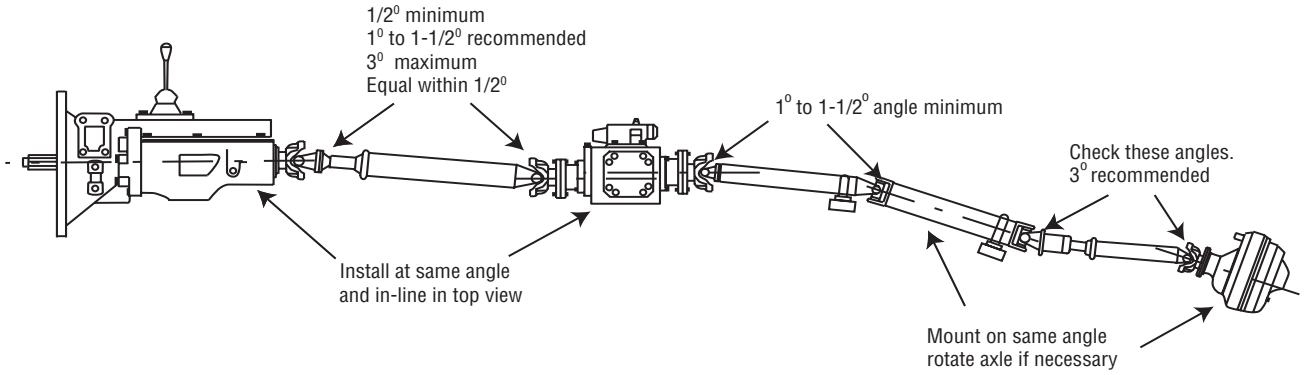


Figure 14

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	Centerline to Centerline of Joints for a Two Joint Assembly or Centerline of Joint to Centerline of Center Bearing for a Joint and Shaft										
W - Welded	RPM - Revolutions Per Minute										
S - Seamless	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"	-	-	-	-	-	-

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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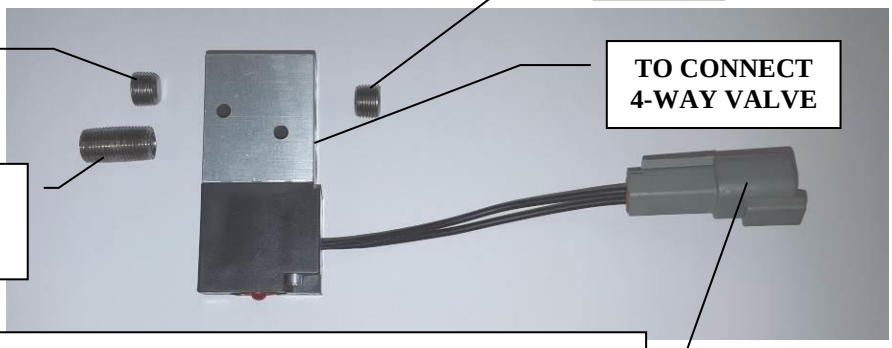
SHIFT SAFETY INTERLOCK
SCHEMATIC
MID-SHIP GEAR CASE

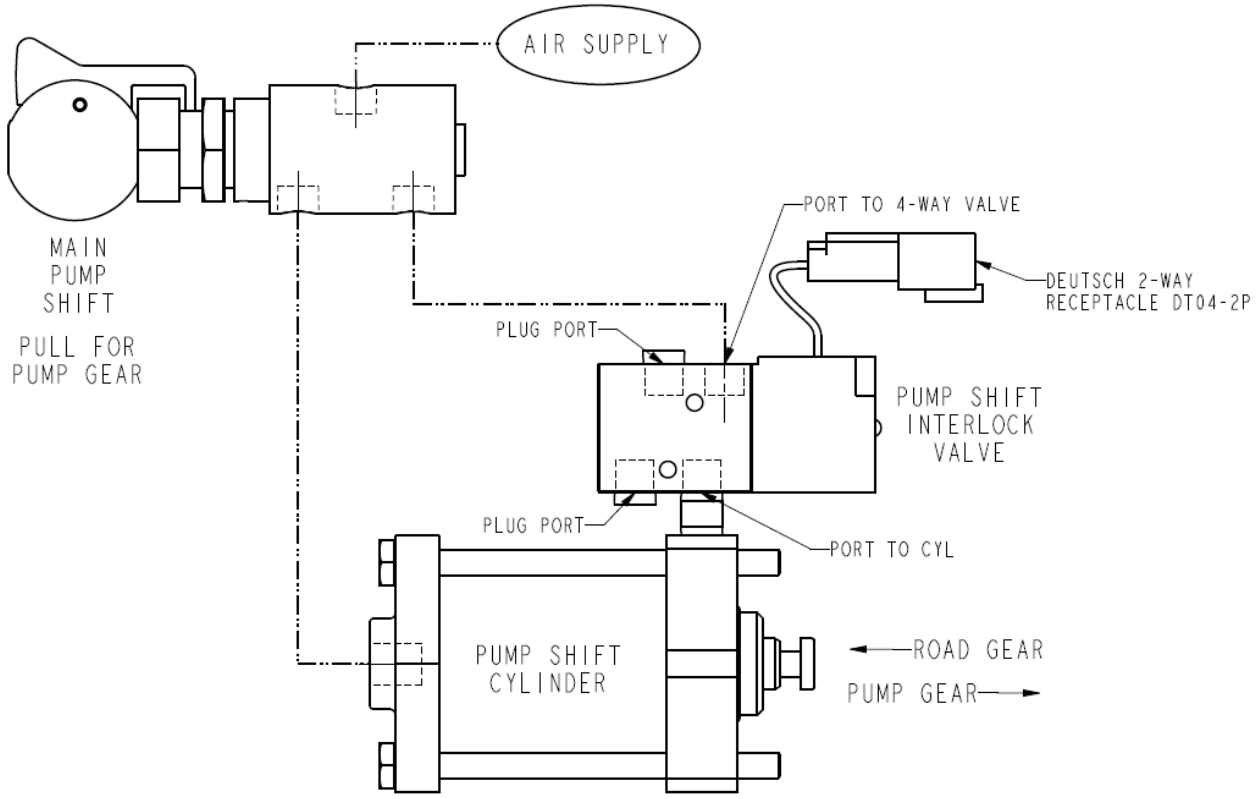
The safety interlock prevents the main pump shift from actuating while the automatic truck transmission is in drive gear. This eliminates clashing and possible damage of the pump gear set.

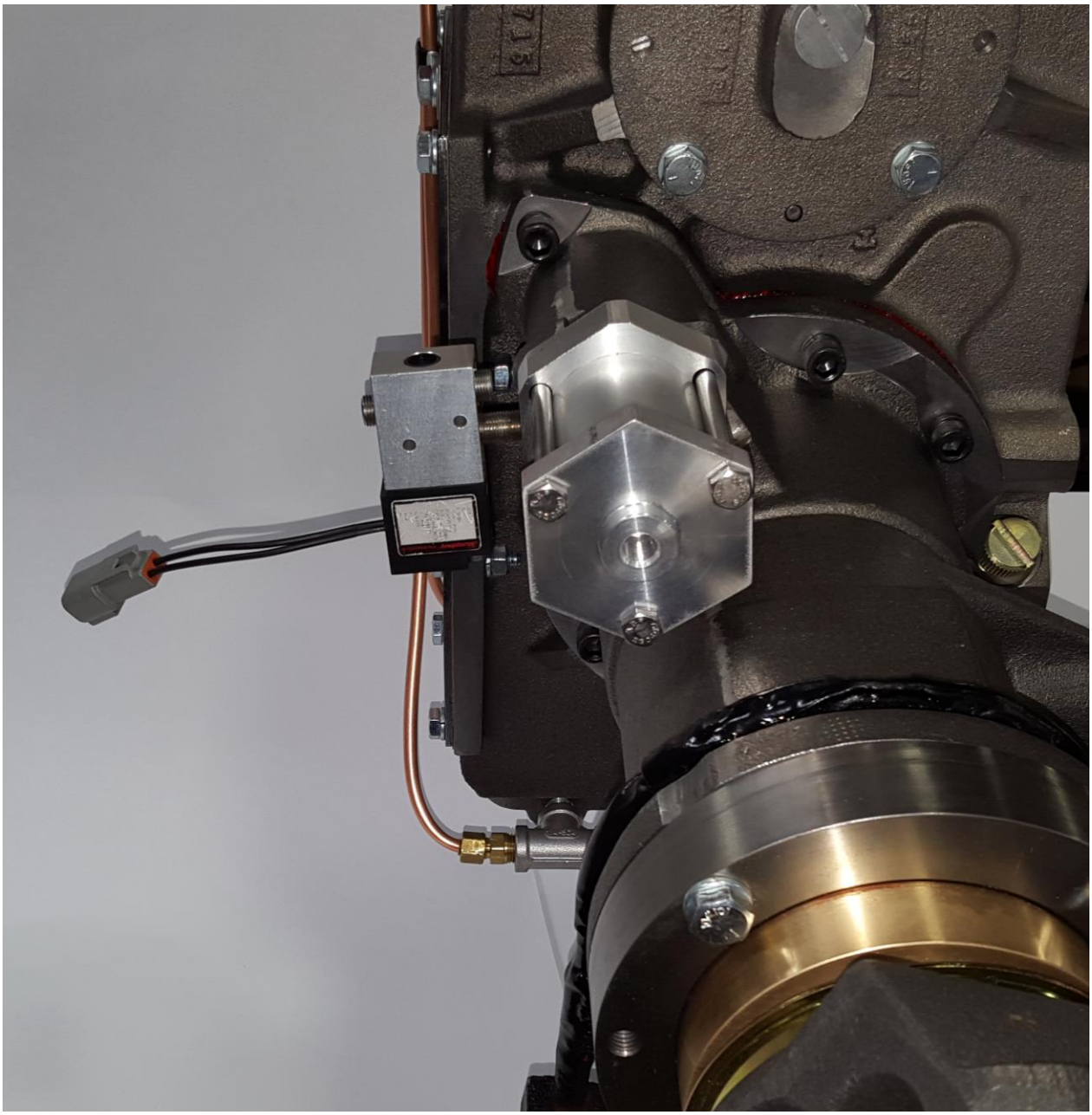


-DEUTSCH 2-WAY RECEPTACLE DT04-2P.
-SUPPLY VOLTAGE AND GROUND TO CLOSE VALVE WHEN MAIN CHASSIS TRANSMISSION IS IN PUMP GEAR (POLARITY IS NOT IMPORTANT)
-THIS WILL PREVENT THE PUMP FROM SHIFTING WHEN THE MAIN CHASSIS TRANSMISSION IS IN PUMP GEAR

Assembly Notes:

1) Use Loctite 565 PST or equivalent pipe sealant on tapered pipe joints. (DO NOT USE TEFLON TAPE)
2) DO NOT over tighten fittings, doing so may damage thread.





Section 4

Pump Detail

Description of Pump Type

The Type TSM pump is a high speed, high volume, single stage, UL rated, centrifugal Fire Fighting Pump.

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

The TSM pump is a midship mounted pump and is powered via the transmission capable of sufficient power and torque throughput for said pump system.

OPERATION AND MAINTENANCE OF TYPE TSM 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 trucks main driveline. The midship pump features a split-shaft gearbox design. Shifting of the split-shaft from road (driving) mode to pump mode is shifted from the driver's seat. Only shift the pump when the driveline is stationary and not spinning.

The pump gear shift consists of a sliding clutch gear splined to the transmission shaft which can be moved forward to engage the pump clutch gear or to the rear to engage the rear drive shaft connected to the truck drive axle. A neutral position is half way between.

The sliding clutch gear is moved either by direct mechanical linkage from a shift lever, or air powered cylinder controlled by a selector switch. The shift lever must be moved all the way and locked into either ROAD mode to drive the truck, or PUMP mode to power the pump.

The truck clutch must always be disengaged to stop the rotation of the truck transmission output shaft before shifting into either ROAD or PUMP mode to prevent clashing or damaging the gear teeth. A butt tooth position of the gears may be encountered occasionally preventing engagement.

To Engage the Pump --- Stationary Operation

1. Shift Transmission into Neutral (N)
Before engaging a spilt-shaft driven pump for operation, shift the transmission into NEUTRAL (N).

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 when the driveline is not spinning.**
- **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 45 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

See Priming Instructions.

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

Pump Gear Case Lubrication

Maintain transmission oil level to the oil level fill line on the dipstick.

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.

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

CAUTION

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

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

Repair

TSM PUMP REPAIR
REMOVAL OF PUMP AND TRANSMISSION FROM TRUCK CHASSIS

Reference Drawing DTC1000 and DTC1003

NOTE: It will be beneficial to have a second person present to assist during removal and reinstallation of the pump.

1. Remove the drive shafts from the front and rear of pump transmission.

2. Disconnect the parking brake linkage if applicable.

3. Remove air lines at shift cylinder.

4. Disconnect the wires to the pump engaged switch on shift bar at front of pump.

5. Disconnect the following additional items from the pump:

    - Heater piping
    - Gage line tubing
    - Primer tubing
    - Drain line tubing
    - Manual shift assist cable (if applicable)

6. Remove any other accessory that will prevent lowering the pump transmission assembly.

7. Drain oil from gear case. Inspect oil for debris, or cloudiness (entrapped water).

8. Provide a floor jack or overhead hoist to support the pump weight of 500 plus pounds for removing the pump from the chassis.

9. NOTE: If pump is to be lowered for removal, the floor jack must be positioned to securely support the pump. Also tie two loops of rope around the pump casing discharge flange. Loop the rope around the discharge manifolding or a beam above the truck. The rope will be used to keep the pump upright on the jack while lowering.

10. Remove the twelve 3/8-16 UNC cap screws that hold the discharge to the pump casing.

11. Remove the eight 3/8-16 UNC nuts that hold the suction adapter to the suction flange.

12. The pump is now ready for removal. Some prying may be required to loosen the gasket between the discharge and pump, and the suction and pump. Lowering the pump will require a coordinated effort between the man operating the floor jack and the man on top with the rope that is holding the pump upright.

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

TSM PUMP REPAIR
PUMP AND TRANSMISSION DISASSEMBLY FOR OVERHAUL

Reference drawings DTC1000 and DTC1003

1. Remove four 3/8-16UNC cap screws (55) and bearing cap (15). Two 5/16-18UNC tapped pusher holes will facilitate flange separation. Discard o-ring (35).

2. Remove three ½-13UNC caps screws (59) holding the volute (21) and spacers (3) to the gear case (14). Separate the volute and impeller shaft (24) assembly from the gear case while keeping the parts square with each other to avoid damage to the pinion gear (22) and impeller shaft. If prying is required, pry evenly on both sides.

3. Remove 12 3/8-16UNC nuts (8) from studs (27) and separate the suction head (4) from the volute (21). Use the two 3/8-16UNC pusher holes in the suction head to facilitate separation. Discard o-rings (11) and (12).

4. If necessary to replace outboard seal ring (23) pry or tap it out of the suction head (4).

5. Remove cotter key (16), impeller nut (9) and washer (28) from impeller shaft (24).

6. Pull the impeller (6) off the impeller shaft (24). If necessary use two of the 3/8-16UNC tapped holes in the impeller hub to push the impeller off the shaft. Use caution as there will be spring pressure from the mechanical seal (7).

7. Tap the impeller shaft assembly out of the volute (21), keeping the shaft square with the bore to avoid damage to parts.

8. Pull or pry oil seal (15) out of the volute (21), and retrieve water slinger (25).

9. If necessary to replace, remove four ¼-20UNC stainless flush head machine screws (2) and remove the mechanical seal housing (5) from the volute (21) using the four ¼-20UNC puller holes. To remove, apply pressure with puller screws in a circular pattern, one-quarter turn per bolt per pattern revolution. The flush head machine screws may be used as the puller screws for stuffing box removal. Discard mechanical seal housing o'ring (13).

10. If necessary to replace, pry inboard seal ring (23) out of volute (21).

11. Press bearing (9), spacer (24), and pinion gear (22) off impeller shaft (52) all at once.

12. Remove pinion gear key (38).

13. Press bearing (10) off impeller shaft (52).

GEAR CASE DISASSEMBLY FOR OVERHAUL

1. Place the transmission assembly on a bench.
2. Remove lock nut (49), universal joint yoke (48) from front drive shaft (51).
3. Remove twelve 5/16-18UNC cap screws and remove the gear case cover from side of gear case (14).
4. Remove the air shift cylinder (64).
5. Remove eight 3/8-16NC socket head cap screws (61) and separate rear bearing bracket (17) assembly from gear case (14).
6. Cut safety wire (2) and remove lock bolt from shift yoke (3). Slide shift yoke off of shift bar (4) and slide shift bar out of gear case (14).
7. Remove bearing (8) and sliding clutch gear (20) from transmission shaft (51).
8. Remove four 3/8-16UNC cap screws (56) and separate front bearing bracket (16) from gear case (14). Discard o-ring (35).
9. Remove retaining ring (28) from drive gear (21).
10. Push transmission shaft (51) out of drive gear (21) towards bearing retainer ring end.
11. Press bearing (7), spacer (25), and bearing (11) off of transmission shaft (51) all at once. If the retaining ring (28) cannot be accessed for removal from the drive gear (21) then use X8141 bearing puller to remove the bearing (7) from the driveshaft (51).
12. Press second bearing (11) off of transmission shaft (51).
13. Remove eight 3/8-16UNC cap screws (54) and remove bearing caps (19). 5/16-18UNC threaded pusher holes are present to assist in bearing cap flange separation. Remove keys (37) and discard o-rings (33) and (32).
14. Press shaft through bearings (13) spacer (26) and gear (23) all at once.
15. Remove idler gear (23) from gearcase (14). If idler gear (23) or bearings (13) need to be replaced a new gear (23) and bearings (13) will be required.

REAR BEARING BRACKET DISASSEMBLY

1. Remove lock but (49) and universal joint yoke (48) from rear drive shaft (50).
2. Remove four 3/8-16UNC caps screws (57) and remove rear bearing cap (18). 5/16-18UNC threaded pusher holes are present to assist in bearing cap separation. Remove and discard o-ring (31).
3. Press drive shaft (50) out of bearing bracket (17), which removes bearing (6) from shaft.
4. Press bearing (12) off of rear drive shaft (50).
5. Press both oil seals (29) out of rear bearing bracket (17).
6. Press oil seal (30) out of bearing cap (18).

PARTS INSPECTION AND MEASUREMENT

1. Clean all parts and carefully examine for wear or deterioration. Any questionable parts should be replaced.
2. Measure the impeller seal rings and the seal rings for wear. Use the following table for comparison

Impeller seal ring O.D – Original	7.557”–7.559”
Impeller seal ring I.D – Original	7.249”–7.251”
Seal ring O.D – Original	7.573”- 7.757”
Seal ring I.D – Original	7.233”-7.235”
Clearance O.D – Original	0.014” – 0.020”
Clearance I.D – Original	0.014” – 0.018”

3. If clearance exceeds 0.025” on diameter, impeller seal rings or impeller may need to be replaced. Call customer service for details.

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

Part	Rep No.	Original Diameter
Bearing cap – Impeller shaft	15	3.5433" – 3.5442"
Front bearing bracket	16	4.7244" – 4.7253"
Rear bearing bracket - Center	17	4.3307" – 4.3316"
Rear bearing bracket - Rear	18	4.7244" - 4.7253"
Pump casing	21	4.3307" – 4.3316"
Drive gear	21	3.9370" – 3.9379"
Rear drive shaft	50	2.4409" – 2.4416"
Idler gear	23	4.3296" – 4.3300"

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

Part	Rep No.	Original Diameter
Impeller shaft - #10 Bearing	52	1.9686" – 1.9690"
Impeller shaft - #9 Bearing	52	1.5749" – 1.5753"
Idler shaft	53	1.9675" – 1.9681"
Drive shaft - #7 Bearing	51	2.5592" – 2.5597"
Drive shaft - #11 Bearing	51	2.5592" – 2.5597"
Drive shaft - #8 Bearing	51	.9844" – .9848"
Rear drive shaft - #12 Bearing	50	2.7560" – 2.7565"
Rear drive shaft - #6 Bearing	23	2.5592" – 2.5597"

TSM PUMP AND TRANSMISSION ASSEMBLY

REFERENCE DRAWINGS DTC1000 AND DTC1003

TRANSMISSION ASSEMBLY

1. Press one bearing (13) into idler gear (23) until the outer race is tight against the gear. Place spacer (26) into place and press other bearing (13) into idler gear from opposite side. Apply a light coat of oil to bearing bores before assembling.
2. Place gear (23) and bearing assembly into gear case (14).
3. Assemble o-ring (33) to one side of idler shaft (53). Place key (37) into idler shaft bearing cap (19). Install o-ring (32) onto idler shaft bearing cap (19). Apply a light coat of oil to the inside bores of the idler gear bearings (13). Install the idler shaft assembly with bearing cap into the idler gear and bearing assembly. Tap in place until the idler bearing cap is tight against the gear case (14). Apply a small amount of Loctite 243 or equivalent to four 3/8-16UNC cap screws (54) and assemble to gear case with lock washers. 3/8-16 set screw (62) may need to be removed during assembly to prevent an air lock.
4. Install o-ring (33) to idler shaft (53). Install o-ring (32) to idler shaft bearing cap (19). Install idler shaft bearing cap (19) onto idler shaft (53) and tap into place until bearing cap is tight against the gear case (14). Apply a small amount of Loctite 243 or equivalent to four 3/8-16UNC cap screws (54) and assemble to gear case with lock washers.
5. Apply a light coating oil to the O.D. of transmission shaft (51). Press both bearings (11) onto transmission shaft until inner races are tight against shaft shoulders.
6. Apply a light coating of oil to the bore of the drive gear (21) and place inside gear case (14) with splined bore towards sliding clutch gear (20) side of gear case.
7. Press transmission shaft (51) with bearings (11) into drive gear (21).
8. Install retaining ring (28) sharp side away from bearing into drive gear (21).
9. Slide spacer (25) over transmission shaft (51) and against bearing (11). Press bearing (7) onto transmission shaft against spacer. Open side of bearing should be against the spacer.
10. Press oil seal (30) into the front bearing bracket (16) flush with face of bracket with lip spring of seal facing bearing.
11. Install o-ring (35) onto front bearing bracket (16). Tap bearing bracket over bearing (7) and against gear case (14). Apply Loctite 243 or equivalent thread locker to the threads of four 3/8-16NC x 1-1/4" cap screws and attach bearing bracket to gear case with these cap screws and lock washers. Tap transmission shaft (51) with a rubber mallet from the rear until bearing is seated in front bearing bracket. Torque to 23 ft-lb.
12. Lubricate shift bar (4) with oil and slide into gear case (14).

13. Apply an o-ring lubricant to o-ring (34) and install o-ring in groove in gear case shift bar hole. Lubricate shift bar hole with oil.

14. Install retaining ring (27) on shift bar (4). Retaining ring must be positioned with sharp edge away from gearcase to take the thrust load. All retaining rings should be tight in the groove. Replace any loose rings.

15. Saturate oil wick holes in shift yoke (3) ears with oil.

16. Apply a light coating of oil to the bore of the sliding clutch gear (20). Place it on spline of transmission shaft (51) with external gear teeth toward pump drive gear (20).

17. Apply an o-ring lubricant to o-ring (34) and install o-ring in groove in gear case shift bar hole. Lubricate shift bar hole with oil.

18. Place shift yoke (3) into groove of sliding clutch gear (20) and slide shift bar (4) through hole in yoke. Align groove in shift bar with bolt hole in yoke.

19. Apply a light coating of oil to the inside diameter of bearing (8). Press bearing onto transmission shaft (51) tight against shaft shoulder.

20. Apply Loctite 242 thread locker to the threads of lock bolt (5). Install lock bolt in shift yoke (3) and torque to 20 - 23 ft-lbs. Attach safety wire (2) through hole in head of lock bolt and around end groove of shift bar (3).

REAR BEARING BRACKET ASSEMBLY

21. Press both oil seals (29) into rear bearing bracket (17) with lip spring of seals facing bearings. Be sure to press the oil seals in until they are flush or slightly below the face of the rear bearing bracket they are sealing.

22. Apply a light coating of oil to both the inside and outside diameters of bearing (12). Press bearing onto rear drive shaft (50) at truck gear end.

23. Place oil seal assembly sleeve (X3851) over splined end of rear drive shaft (50), or wrap splines with masking tape to prevent damage to oil seals. Largest step in splined end of shaft must be covered. Slide shaft into rear bearing bracket (17) from the front.

24. Place bearing backup washer (39) on rear drive shaft.

25. Apply a light coating of oil to both the inside and outside diameters of bearing (6). Press bearing onto rear drive shaft (50) and into rear bearing bracket (17) until it is seated tight against backup washer (39).

26. Apply a thin layer of Gasket Maker “Ready Gasket Adhesive 18” or equivalent to flange of rear bearing bracket (17). Place bracket assembly into position at rear of gear case so bearing (8) enters bore at gear end of shaft. Use two 3/8-16NC x 1-1/2" cap screws and lock washers to draw flange up to gear case mounting surface. Install remaining five 3/8-16NC x 1-1/2" cap screws and lock washers and one 3/8-16NC x 1-1/4" socket head cap screw and high collar washer at housing extension flange. Loctite 243 or equivalent thread locker is to be applied to threads prior to installation. Torque to 23 ft-lb.

28. Attach bearing retainer (18) to rear bearing bracket (17) with four 3/8-16UNC x 1-3/4” cap screws, lock washers, and Loctite 243 or equivalent. Torque to 23 ft-lb.
29. Slide rear yoke (48) onto rear drive shaft (50). Spin on lock nut (49) until snug, then torque to 150-200 ft-lbs.
30. Slide front yoke (48) onto front drive shaft (51). Spin on lock nut (49) until snug, then torque to 150-200 ft-lbs.

32. Apply a line of retaining compound around the outside of the seal ring (Adhesive R&D 09 Green or equivalent) Press inboard seal ring (23) into volute (21) until seated.

33. Apply a silicone lubricant to mechanical seal housing o'ring (13), and place in groove of volute (21).

34. Align mechanical seal housing (5) with volute (21). Ensure that hole in bore of mechanical seal housing (5) aligns with pressure bypass hole in volute (21). Press mechanical seal housing into position and install four ¼-20 UNC stainless flush head machine screws (2). Use Loctite 243 or equivalent to threads and torque to 72 in-lbs.

35. Apply grease to one side of water slinger (25). Firmly place greased side of water slinger into position against mechanical seal housing (5). NOTE: Grease is for retaining water slinger position during assembly only.

36. Apply a light coating of oil to oil seal (15) press into volute (21). Lubricate oil seal lips.

37. Install o-ring (14) onto pump casing (21).

38. Apply a light coating of oil to pinion gear (22) and impeller shaft bore. Install key (38) in impeller shaft keyway. Install pinion gear (22) spacer (24) and bearings (10) and (9) and press all together at once.

39. Apply a light coating of oil to the bearing bore of the pump casing (21). Slide seal save onto impeller shaft spline or wrap them with masking tape. Tap shaft assembly into pump casing (21) until the bearing is tightly seated against the pump casing.

40. Install the mechanical seal (7) into the mechanical seal housing (5). Follow the Mechanical seal installation instructions described in document 1201040.

41. Place the impeller (6) on to the impeller shaft splines (24). Hold impeller (6) tight against the spring of the mechanical seal (7). Apply (1) drop of Loctite 243 to shaft threads, install spacer (28) and thread impeller nut (9) onto pump shaft (24). Impeller nut (24) should be hand tight and then tightened to the next open cotter pin hole. **DO NOT OVER TIGHTEN**

42. Install 1/8" x 1" stainless steel cotter key (16) through the impeller nut (9) and impeller shaft (24) cotter key hole.

43. Apply a bead of retaining compound around the outside of the seal ring (Adhesive R&D 09 Green or equivalent) Press inboard seal ring (23) into suction head (4) until seated.

44. Apply as silicon lubrication, such as Dow Corning Compound 111 or equivalent to suction head o-rings (11) and (12) and place on suction head (4).

45. Apply Loctite 243 or equivalent to threads of twelve suction head mounting studs (27) in pump casing (21). Tap suction head (4) into position on volute and attach with 3/8-16UNC nuts (8). Torque to 23 ft-lbs.

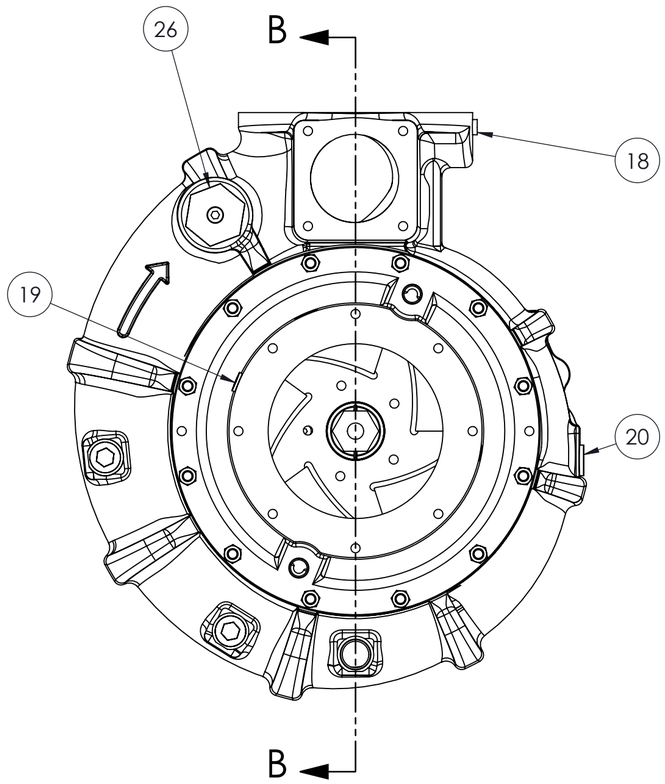
45. Apply one drop of blue Loctite 243 or equivalent to three 1/2”-13UNC cap screws (59) and insert into mounting holes on gear case (14) with lock washers. Install spacers (3) and attach to pump assembly.

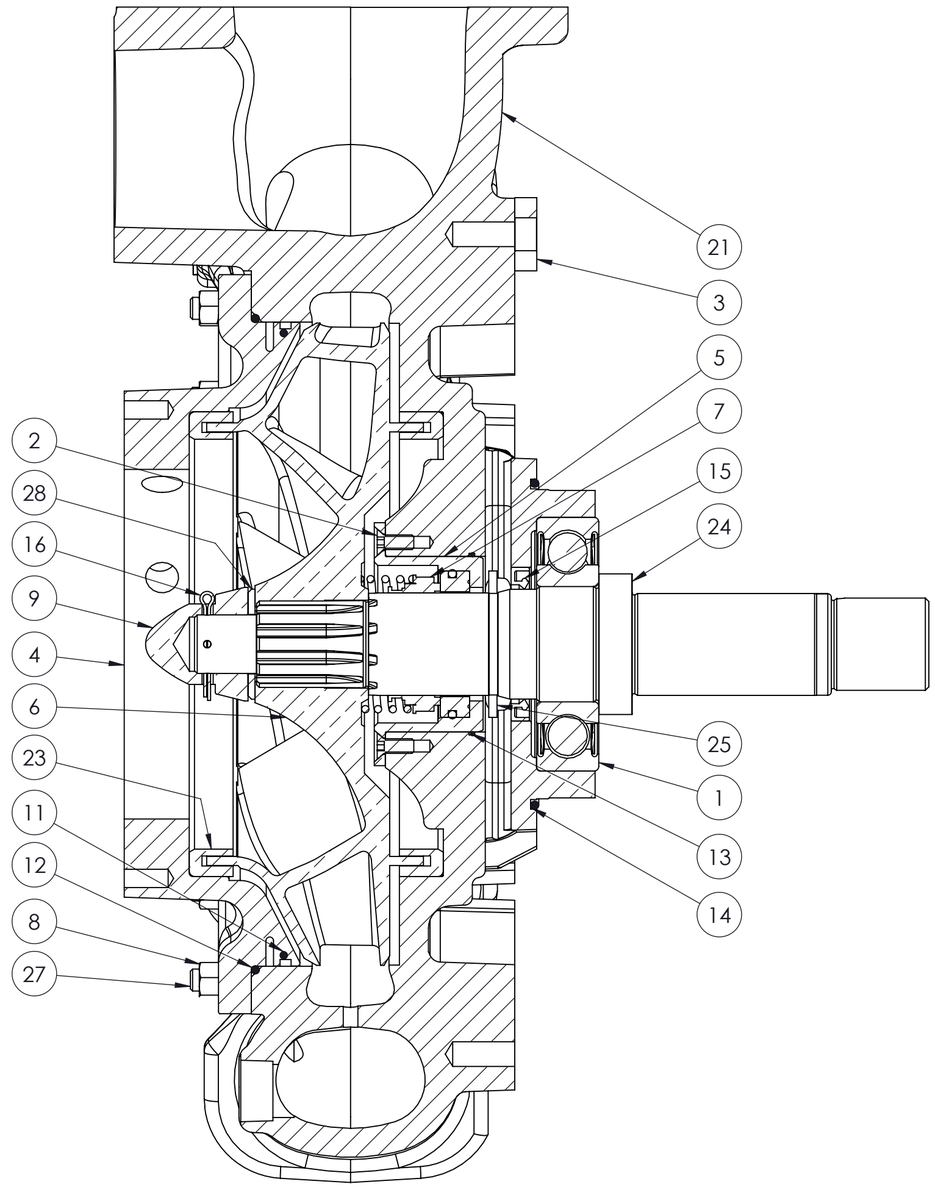
46. Install bearing cap o-ring (35) and apply a small amount of oil to bearing cap (15) outside and inside bearing bores. Use an alignment pin and tap bearing cap (15) into gear case (14) and over bearing (9). Tighten to gear case using four 3/8-16UNC cap screws with lock washers. Thread gear case vent into bearing cap (47).

PUMP
DRAWINGS

ITEM NO.	File Name	Darley Item Description (Line 1)	QTY.
1	1722100	BEARING - BALL, 310SFF	1
2	5402402	FHMS - .250-20 X 0.63, SS SOCK	4
3	3603016	FLAT WASHERS	3
4	2806609	HEAD - SUCTION, TS	1
5	1840901	HOUSING - MECHANICAL SEAL, PS	1
6	2909700	IMPELLER - TS, L.H. 10.969 OD	1
7	1845400	MECHANICAL SEAL - 1.75 WELD SPRG	1
8	5403002	NUT - HEX, .375-16, GR2	12
9	5403476	NUT - IMPELLER, CONE, PUC	1
10	3601401	O-RING - 1.47 X 1.71 X 0.09	1
11	3601228	O-RING - 10.50 X 10.75 X .14	1
12	3601220	O-RING - 11.00 x 11.25 x 0.12	1
13	3601011	O-RING - 3.00 x 3.12 x 0.06	1
14	3601244	O-RING - 5.37 X 5.62 X 0.12	1
15	3600530	OIL SEAL - 1.875 ID x 2.627 OD	1
16	3605205	PIN - COTTER, .125 X 1.00, 316	1
17	1080533	PLUG - PIPE, .125, SST SOC HD	1
18	1080535	PLUG - PIPE, .250, SS SOC HD	2
19	1080547	PLUG - PIPE, 0.375, SST SOC HD	1
20	1080551	PLUG - PIPE, 0.750, SS SOC HD	3
21	2056702	PUMP CASING - TS	1
22	1122400	SCREEN - STRAINER, 1.50"	1
23	3404208	SEAL RING - TS	2
24	5016106	SHAFT - IMP, PS, MECH SEAL	1
25	3203201	SLINGER - WATER, 1.661 ID	1
26	1122300	STRAINER FITTING	1
27	3606203	STUD - 0.375-16 x 1.500, GR5	12
28	3603328	WASHER - IMPELLER	1

NOTE:
1) ITEM (1) IS PART OF THE TRANSMISSION ASSY AND SHOWN FOR REF ONLY



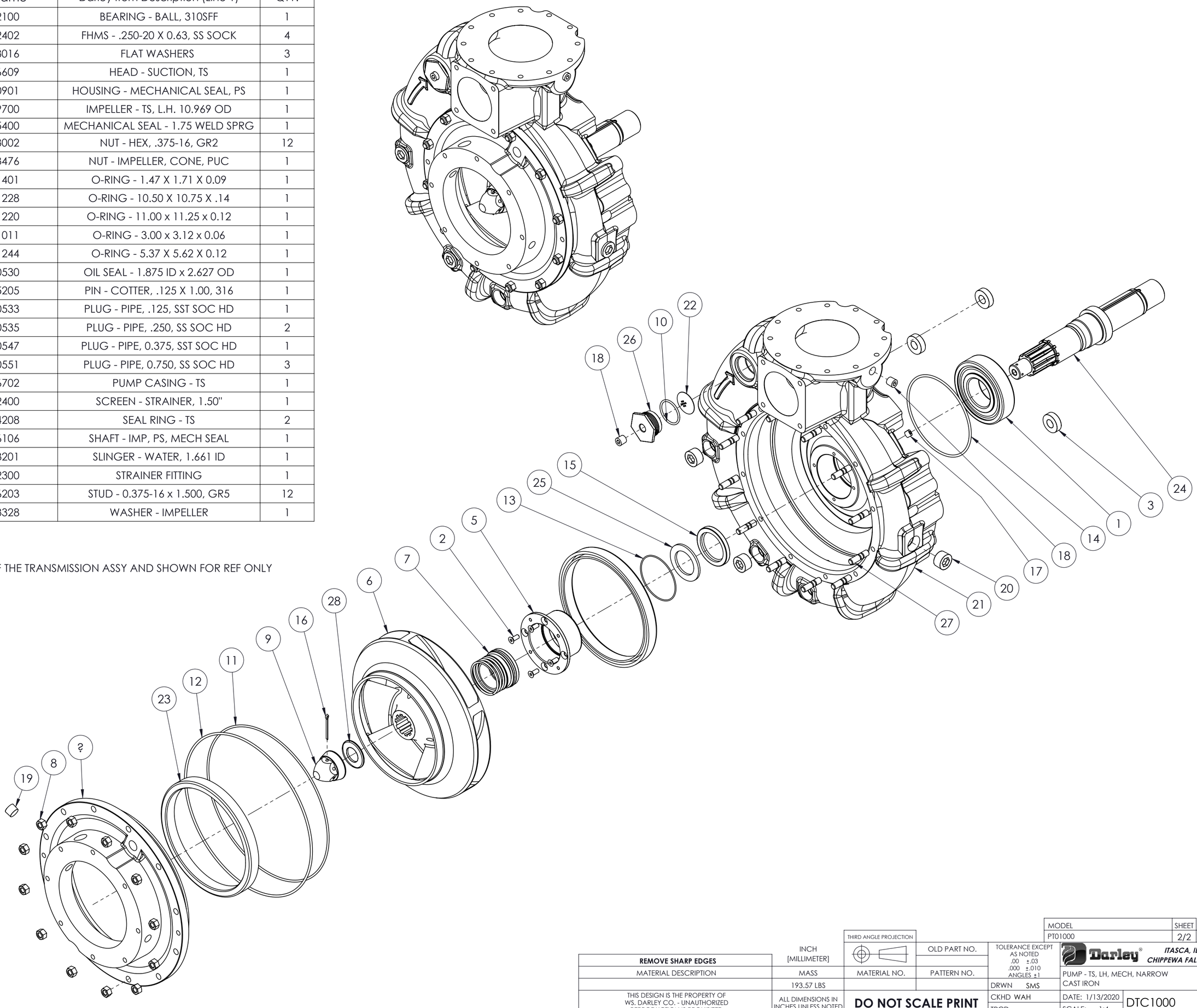


SECTION B-B

		THIRD ANGLE PROJECTION		MODEL	SHEET
				PT01000	1/2 C
REMOVE SHARP EDGES	INCH [MILLIMETER]		OLD PART NO.	TOLERANCE EXCEPT AS NOTED .00 ±.03 .000 ±.010 ANGLES ±1	Darley® ITASCA, IL CHIPPEWA FALLS, WI
MATERIAL DESCRIPTION	MASS	MATERIAL NO.	PATTERN NO.		PUMP - TS, LH, MECH, NARROW CAST IRON
	193.57 LBS			DRWN SMS	
THIS DESIGN IS THE PROPERTY OF WS. DARLEY CO. - UNAUTHORIZED REPRODUCTION IS PROHIBITED	ALL DIMENSIONS IN INCHES UNLESS NOTED	DO NOT SCALE PRINT		CKHD WAH	DATE: 1/13/2020 DTC1000
				TRCD	SCALE: 1:2

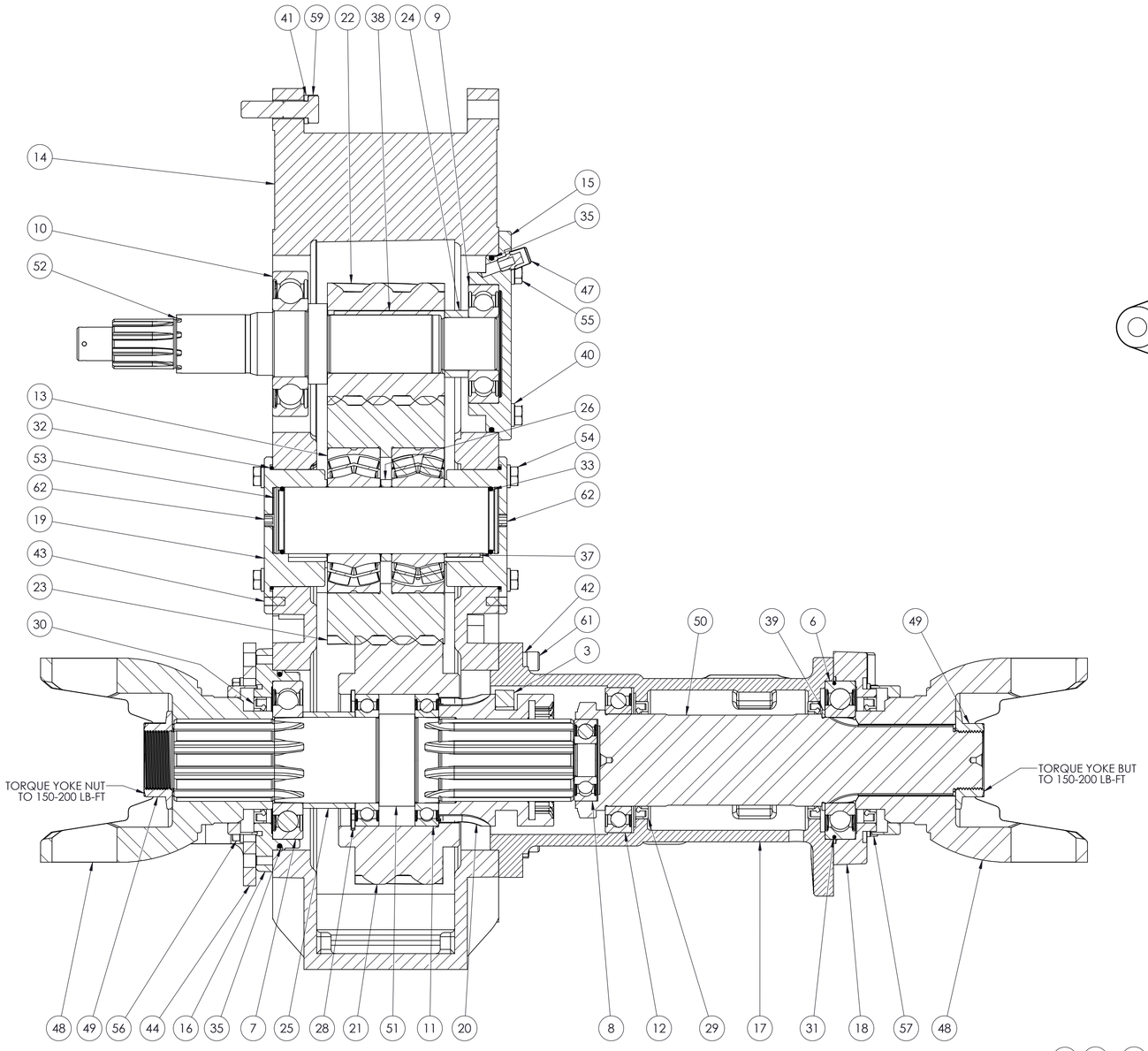
ITEM NO.	File Name	Darley Item Description (Line 1)	QTY.
1	1722100	BEARING - BALL, 310SFF	1
2	5402402	FHMS - .250-20 X 0.63, SS SOCK	4
3	3603016	FLAT WASHERS	3
4	2806609	HEAD - SUCTION, TS	1
5	1840901	HOUSING - MECHANICAL SEAL, PS	1
6	2909700	IMPELLER - TS, L.H. 10.969 OD	1
7	1845400	MECHANICAL SEAL - 1.75 WELD SPRG	1
8	5403002	NUT - HEX, .375-16, GR2	12
9	5403476	NUT - IMPELLER, CONE, PUC	1
10	3601401	O-RING - 1.47 X 1.71 X 0.09	1
11	3601228	O-RING - 10.50 X 10.75 X .14	1
12	3601220	O-RING - 11.00 x 11.25 x 0.12	1
13	3601011	O-RING - 3.00 x 3.12 x 0.06	1
14	3601244	O-RING - 5.37 X 5.62 X 0.12	1
15	3600530	OIL SEAL - 1.875 ID x 2.627 OD	1
16	3605205	PIN - COTTER, .125 X 1.00, 316	1
17	1080533	PLUG - PIPE, .125, SST SOC HD	1
18	1080535	PLUG - PIPE, .250, SS SOC HD	2
19	1080547	PLUG - PIPE, 0.375, SST SOC HD	1
20	1080551	PLUG - PIPE, 0.750, SS SOC HD	3
21	2056702	PUMP CASING - TS	1
22	1122400	SCREEN - STRAINER, 1.50"	1
23	3404208	SEAL RING - TS	2
24	5016106	SHAFT - IMP, PS, MECH SEAL	1
25	3203201	SLINGER - WATER, 1.661 ID	1
26	1122300	STRAINER FITTING	1
27	3606203	STUD - 0.375-16 x 1.500, GR5	12
28	3603328	WASHER - IMPELLER	1

NOTE:
1) ITEM (1) IS PART OF THE TRANSMISSION ASSY AND SHOWN FOR REF ONLY

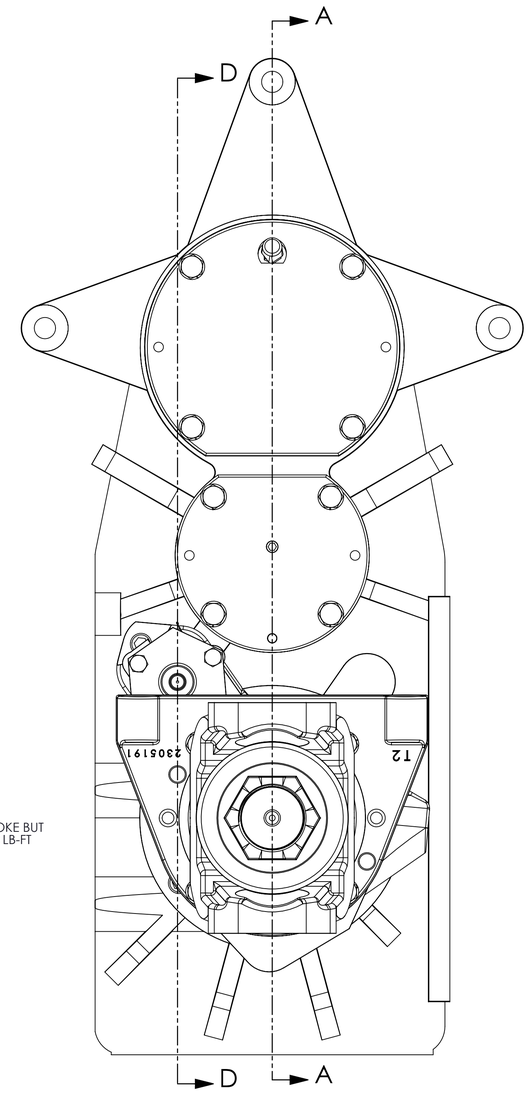


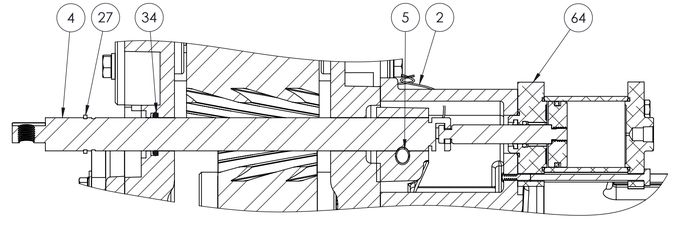
		THIRD ANGLE PROJECTION			MODEL: PT01000 / SHEET: 2/2 C
REMOVE SHARP EDGES	INCH [MILLIMETER]		OLD PART NO.	TOLERANCE EXCEPT AS NOTED .00 ±.03 .000 ±.010 ANGLES ±1	Darley® ITASCA, IL CHIPPEWA FALLS, WI
MATERIAL DESCRIPTION	MASS	MATERIAL NO.	PATTERN NO.		PUMP - TS, LH, MECH, NARROW CAST IRON
	193.57 LBS			DRWN SMS	
THIS DESIGN IS THE PROPERTY OF WS. DARLEY CO. - UNAUTHORIZED REPRODUCTION IS PROHIBITED	ALL DIMENSIONS IN INCHES UNLESS NOTED	DO NOT SCALE PRINT		CKHD WAH / DATE: 1/13/2020	DTC1000
				TRCD / SCALE: 1:4	

ITEM NO.	File Name	Darley Item Description (Line 1)	QTY.
1	1080536	PLUG - PIPE, 0.375, MAG, ZINC	1
2	1102619	WIRE - 0.041 DIA, 304 SS	1
3	1183700	SHIFT YOKE/FORK	1
4	1183900	SHIFT BAR, PSM	1
5	1184000	LOCK BOLT - SHIFT BAR	1
6	1721400	BEARING - BALL, 213 SFF	1
7	1721401	BEARING - BALL, 213SF	1
8	1721700	BEARING - BALL, 305SFF	1
9	1722003	BEARING - BALL, 308S	1
10	1722101	BEARING - BALL, 310SF	1
11	1723400	BEARING - BALL, 113KSFF	2
12	1723502	BEARING - BALL, 114KSFC0	1
13	1726700	BEARING- 22310E C3	2
14	1804204	GEARCASE - LDMH	1
15	2304202	CAP - BEARING, PUMP SHAFT	1
16	2304403	BRACKET - BEARING, FRONT, N	1
17	2304700	BRACKET - BEARING, REAR, N	1
18	2305107	CAP - BEARING, REAR, N, LSM	1
19	2317101	CAP - BEARING, IDLER	2
20	2410800	GEAR - SLIDING CLUTCH, n	1
21	2716106	GEAR - DRIVE, N, 8DP, 20 DEG PA, 55T	1
22	2718102	GEAR - PINION, N/EM, 8DP, 3.50 WIDE	1
23	2721502	GEAR - IDLER, EM, 55T, 8DP	1
24	3303400	SPACER - 1.57 X 2.00 X 0.71	1
25	3304704	SPACER - 2.56 X 2.88 X 1.56	1
26	3309800	SPACER - 1.983 X 2.44 X .320	1
27	3600403	RING - RETAINER, 5160-87	1
28	3600438	RING - RETAINER, N5000-393	1
29	3600511	OIL SEAL - 2.750 ID x 3.505 OD	2
30	3600543	OIL SEAL - 2.938 ID x 3.75 OD	2
31	3601105	O-RING - 4.50 x 4.69 x 0.09	1
32	3601124	O-RING - 3.50 X 3.69 X 0.09 VI	2
33	3601205	O-RING - 1.75 x 2.00 x 0.12	2
34	3601212	O-RING - 0.88 x 1.12 x 0.12	1
35	3601227	O-RING - 5.00 x 5.25 x 0.12	2
36	3601702	O-RING - 20MM x 25MM x 2.5MM	1
37	3602432	KEY - SQ., 0.25 X 1.00, GR2	1
38	3602453	KEY - SQ., 0.25 X 3.30	1
39	3603023	WASHER - 2.56 X 3.00 X .09 STL	1
40	3603503	WASHER - LOCK, 0.375 ID	20
41	3603505	WASHER - LOCK, 0.500 ID	3
42	3603512	WASHER - LOCK, HC, 0.375 ID	8
43	3605401	PIN - DOWEL, .250 X .625, GR8	2
44	4037000	MOUNTING BRACKET	1
45	4219000	DIPSTICK - M22X2.5 THR'D	1
46	4400902	PELLET - OIL WICK	6
47	4403400	VENT - AIR, STRAIGHT	1
48	4813410	YOKE - PUMP, LOCK ON, 1710	2
49	4814600	NUT - 1227D940	2
50	5009500	SHAFT - TRANSMISSION	1
51	5009701	SHAFT - TRANSMISSION, EM, LDM	1
52	5016106	SHAFT - IMP, PS, MECH SEAL	1
53	5023500	SHAFT - IDLER GEAR, ZS	1
54	5400035	HHCS - .375-16 x 0.88, GR5	8
55	5400036	HHCS - .375-16 x 1.00, GR5	4
56	5400037	HHCS - .375-16 x 1.25, GR5	4
57	5400039	HHCS - .375-16 x 1.75, GR5	4
58	5400068	HHCS - .500-13 x 1.75, GR5	2
59	5400069	HHCS - .500-13 x 2.00, GR5	1
60	5401023	SHCS - .375-16 x 1.00, GR8	1
61	5401024	SHCS - .375-16 x 1.25, GR8	7
62	5402611	SSS - .375-16 x 0.50, GR5	2
63	AN00212	ASSY - SHIFT IND SWITCH	1
64	AY00201	ASSY - 1.75 BORE AIR CYLINDER	1



SECTION A-A



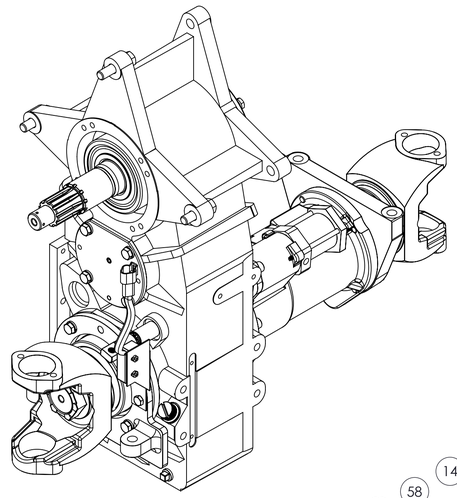


SECTION D-D

NOTE:
IMPELLER SHAFT (ITEM 52) SHOWN AS REFERENCE ONLY AND IS NOT PART OF THE TRANSMISSION ASSEMBLY

		THIRD ANGLE PROJECTION		MODEL	SHEET
				TM00238	1/2 D
REMOVE SHARP EDGES	INCH [MILLIMETER]		OLD PART NO.	TOLERANCE EXCEPT AS NOTED .00 ±.03 .000 ±.010 ANGLES ±1	Darley ITASCA, IL CHIPPEWA FALLS, WI
MATERIAL DESCRIPTION	MASS		MATERIAL NO.	PATTERN NO.	TRANS - TSM, MIDSHIP, OR
	300.64 LBS			DRWN SMS	2.500 LOCK ON SHAFT
THIS DESIGN IS THE PROPERTY OF WS. DARLEY CO. - UNAUTHORIZED REPRODUCTION IS PROHIBITED	ALL DIMENSIONS IN INCHES UNLESS NOTED	DO NOT SCALE PRINT		CKHD WAH	DATE: 4/28/2020 DTC1003
				TRCD	SCALE: 1:2

ITEM NO.	File Name	Darley Item Description (Line 1)	QTY.
1	1080536	PLUG - PIPE, 0.375, MAG, ZINC	1
2	1102619	WIRE - 0.041 DIA, 304 SS	1
3	1183700	SHIFT YOKE/FORK	1
4	1183900	SHIFT BAR, PSM	1
5	1184000	LOCK BOLT - SHIFT BAR	1
6	1721400	BEARING - BALL, 213 SFF	1
7	1721401	BEARING - BALL, 213SF	1
8	1721700	BEARING - BALL, 305SFF	1
9	1722003	BEARING - BALL, 308S	1
10	1722101	BEARING - BALL, 310SF	1
11	1723400	BEARING - BALL, 113KSFF	2
12	1723502	BEARING - BALL, 114KSFC0	1
13	1726700	BEARING- 22310E C3	2
14	1804204	GEARCASE - LDMH	1
15	2304202	CAP - BEARING, PUMP SHAFT	1
16	2304403	BRACKET - BEARING, FRONT, N	1
17	2304700	BRACKET - BEARING, REAR, N	1
18	2305107	CAP - BEARING, REAR, N, LSM	1
19	2317101	CAP - BEARING, IDLER	2
20	2410800	GEAR - SLIDING CLUTCH, n	1
21	2716106	GEAR - DRIVE, N, 8DP, 20 DEG PA, 55T	1
22	2718102	GEAR - PINION, N/EM, 8DP, 3.50 WIDE	1
23	2721502	GEAR - IDLER, EM, 55T, 8DP	1
24	3303400	SPACER - 1.57 X 2.00 X 0.71	1
25	3304704	SPACER - 2.56 X 2.88 X 1.56	1
26	3309800	SPACER - 1.983 X 2.44 X .320	1
27	3600403	RING - RETAINER, 5160-87	1
28	3600438	RING - RETAINER, N5000-393	1
29	3600511	OIL SEAL - 2.750 ID x 3.505 OD	2
30	3600543	OIL SEAL - 2.938 ID x 3.75 OD	2
31	3601105	O-RING - 4.50 x 4.69 x 0.09	1
32	3601124	O-RING - 3.50 X 3.69 X 0.09 VI	2
33	3601205	O-RING - 1.75 x 2.00 x 0.12	2
34	3601212	O-RING - 0.88 x 1.12 x 0.12	1
35	3601227	O-RING - 5.00 x 5.25 x 0.12	2
36	3601702	O-RING - 20MM x 25MM x 2.5MM	1
37	3602432	KEY - SQ., 0.25 X 1.00, GR2	1
38	3602453	KEY - SQ., 0.25 X 3.30	1
39	3603023	WASHER - 2.56 X 3.00 X .09 STL	1
40	3603503	WASHER - LOCK, 0.375 ID	20
41	3603505	WASHER - LOCK, 0.500 ID	3
42	3603512	WASHER - LOCK, HC, 0.375 ID	8
43	3605401	PIN - DOWEL, .250 X .625, GR8	2
44	4037000	MOUNTING BRACKET	1
45	4219000	DIPSTICK - M22X2.5 THR'D	1
46	4400902	PELLET - OIL WICK	6
47	4403400	VENT - AIR, STRAIGHT	1
48	4813410	YOKE - PUMP, LOCK ON, 1710	2
49	4814600	NUT - 1227D940	2
50	5009500	SHAFT - TRANSMISSION	1
51	5009701	SHAFT - TRANSMISSION, EM, LDM	1
52	5016106	SHAFT - IMP, PS, MECH SEAL	1
53	5023500	SHAFT - IDLER GEAR, ZS	1
54	5400035	HHCS - .375-16 x 0.88, GR5	8
55	5400036	HHCS - .375-16 x 1.00, GR5	4
56	5400037	HHCS - .375-16 x 1.25, GR5	4
57	5400039	HHCS - .375-16 x 1.75, GR5	4
58	5400068	HHCS - .500-13 x 1.75, GR5	2
59	5400069	HHCS - .500-13 x 2.00, GR5	1
60	5401023	SHCS - .375-16 x 1.00, GR8	1
61	5401024	SHCS - .375-16 x 1.25, GR8	7
62	5402611	SSS - .375-16 x 0.50, GR5	2
63	AN00212	ASSY - SHIFT IND SWITCH	1
64	AY00201	ASSY - 1.75 BORE AIR CYLINDER	1

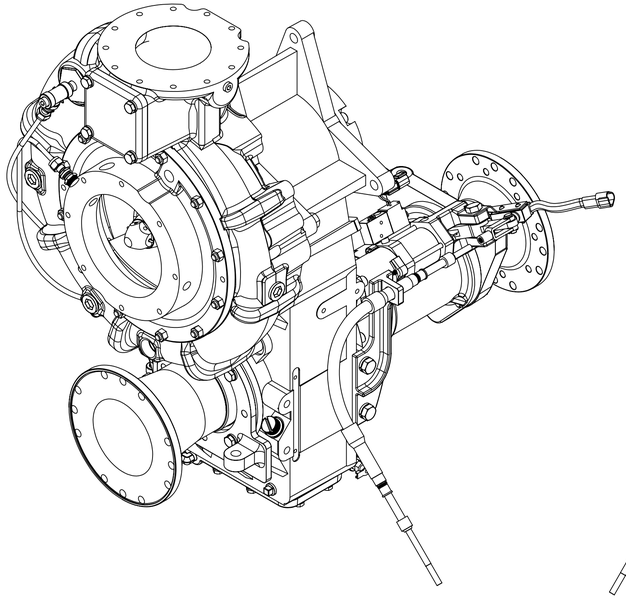


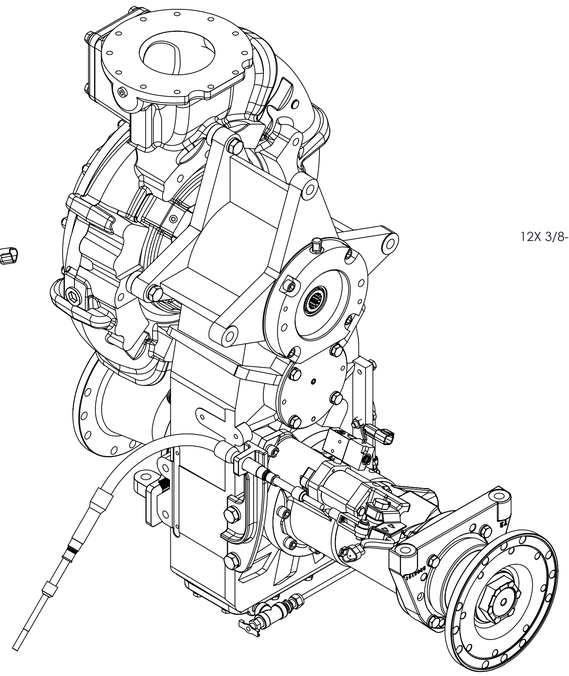
NOTE:
IMPELLER SHAFT (ITEM 52) SHOWN AS REFERENCE ONLY AND IS NOT PART OF THE TRANSMISSION ASSEMBLY

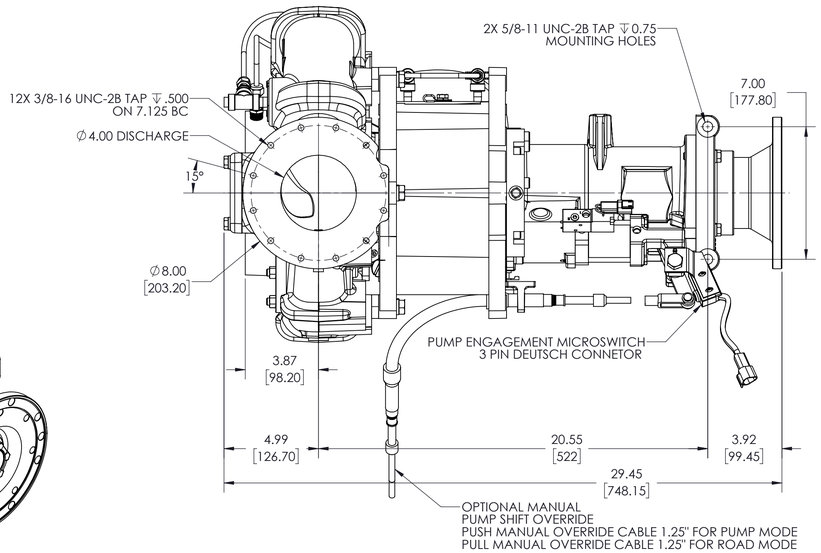
		THIRD ANGLE PROJECTION		MODEL	SHEET
				TM00238	2/2 D
REMOVE SHARP EDGES	INCH [MILLIMETER]		OLD PART NO.	TOLERANCE EXCEPT AS NOTED .00 ±.03, .000 ±.010, ANGLES ±1	Darley ITASCA, IL CHIPPEWA FALLS, WI
MATERIAL DESCRIPTION	MASS	MATERIAL NO.	PATTERN NO.		TRANS - TSM, MIDSHIP, OR 2.500 LOCK ON SHAFT
	300.64 LBS			DRWN SMS	
THIS DESIGN IS THE PROPERTY OF WS, DARLEY CO. - UNAUTHORIZED REPRODUCTION IS PROHIBITED	ALL DIMENSIONS IN INCHES UNLESS NOTED	DO NOT SCALE PRINT		CKHD WAH	DATE: 4/28/2020 DTC1003
				TRCD	SCALE: 1:4

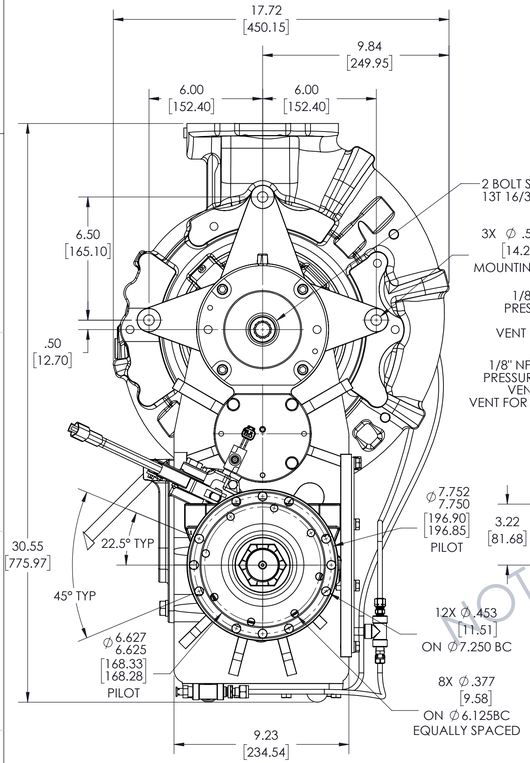
NOTES:
1) ONLY SHIFT PUMP WHEN DRIVELINE IS NOT SPINNING
2) APPROXIMATE WEIGHT: 510 LBS [231 KG]

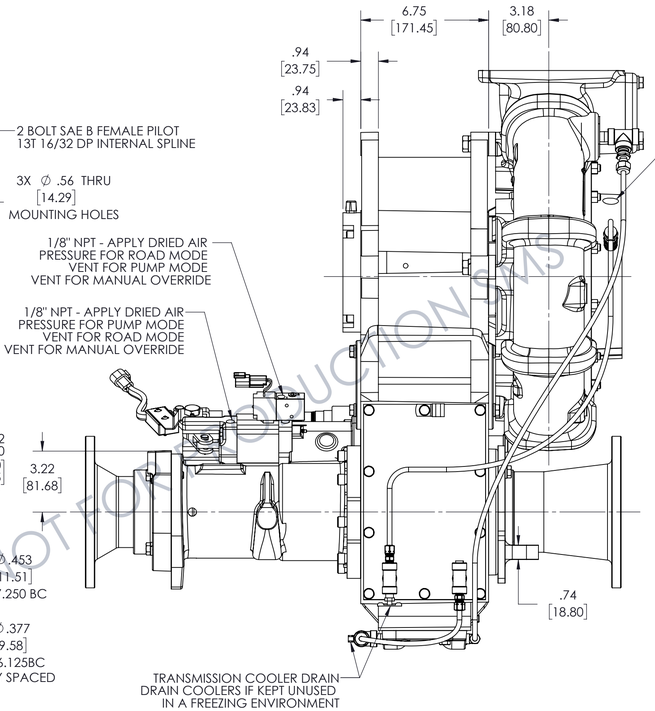
ASSEMBLIES SHOWN:
CAST IRON PUMP - PT01002
TRANSMISSION - TM00237
CAST IRON GEAR CASE - 1804204
INPUT FLANGE - 4816811
OUTPUT FLANGE - 4816810
TRANSMISSION COOLER - AM00401
TRANSMISSION COOLER - AM00403
GEAR RATIO 2.12:1 - KR07701
RV FLANGE - YF00601
PUMP SHIFT - AH00117
PUMP SHIFT - AH00110
NO BRAKE - AB00403
SHIFT INTERLOCK - AH00600

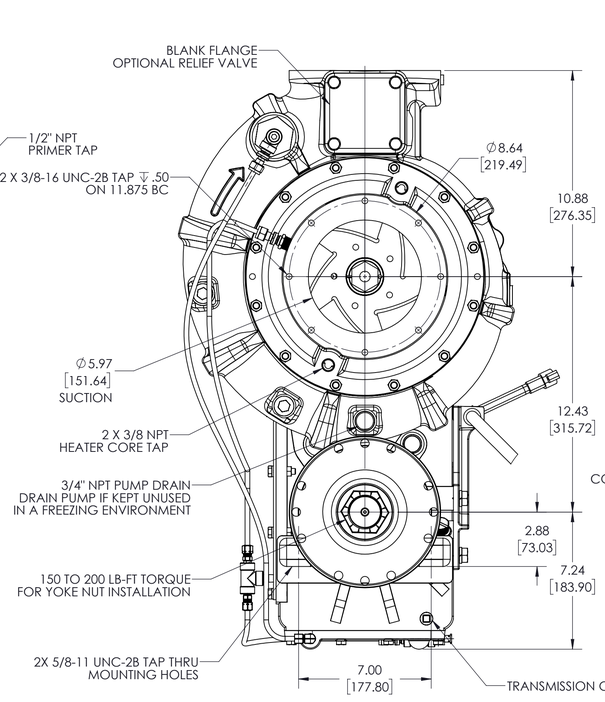


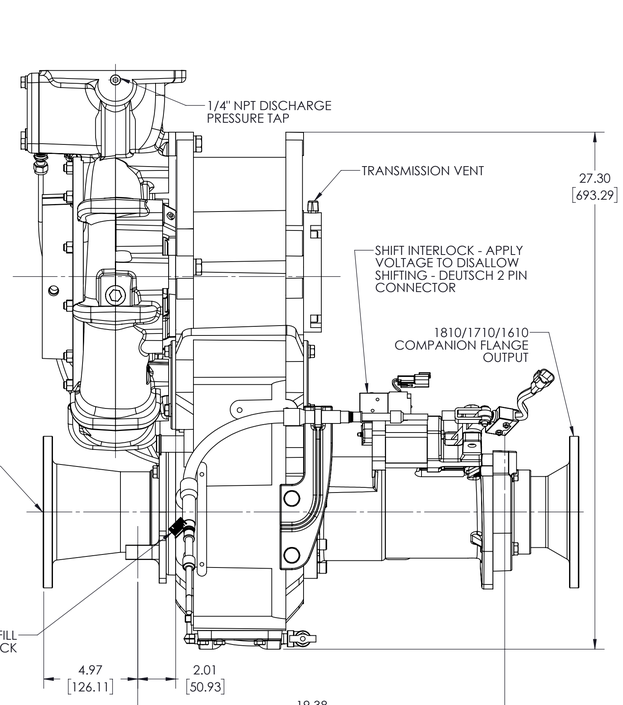










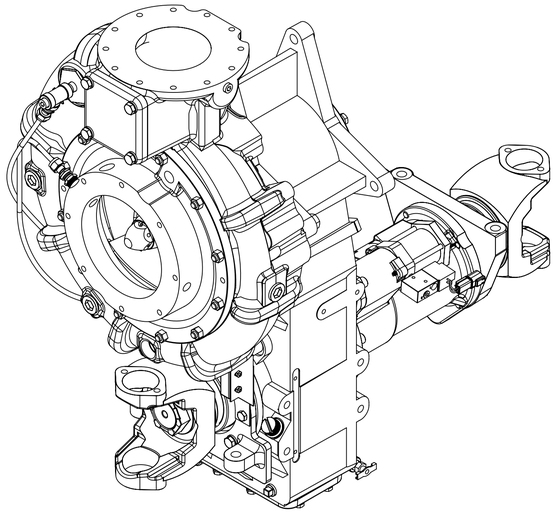


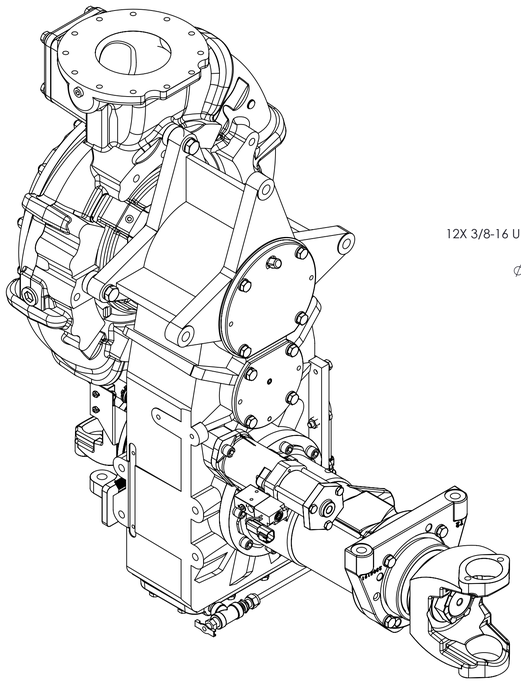
REMOVE SHARP EDGES	INCH [MILLIMETER]	THIRD ANGLE PROJECTION	OLD PART NO.	TOLERANCE EXCEPT AS NOTED .00 ±.03 .000 ±.010 ANGLES ±1	Darley ITASCA, IL CHIPPEWA FALLS, WI
MATERIAL DESCRIPTION	MASS	MATERIAL NO.	PATTERN NO.		DWG - TSM, PUMP FORWARD
	511.57 LBS			DRWN SMS	SAE B HYD ADAPT
THIS DESIGN IS THE PROPERTY OF WS. DARLEY CO. - UNAUTHORIZED REPRODUCTION IS PROHIBITED	ALL DIMENSIONS IN INCHES UNLESS NOTED	DO NOT SCALE PRINT		CKHD WAH	DATE: 04/03/2020 DTD1000
				TRCD	SCALE: 1:4

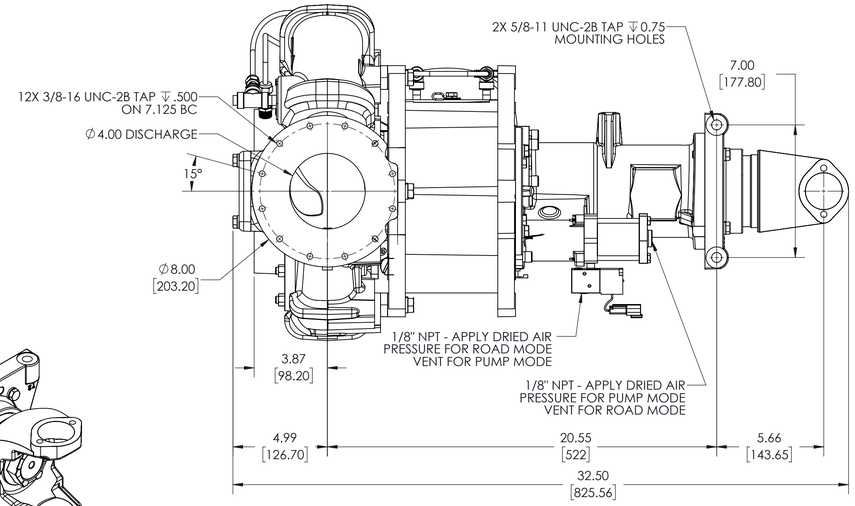
MODEL	SHEET
DTD1000	1/1 D

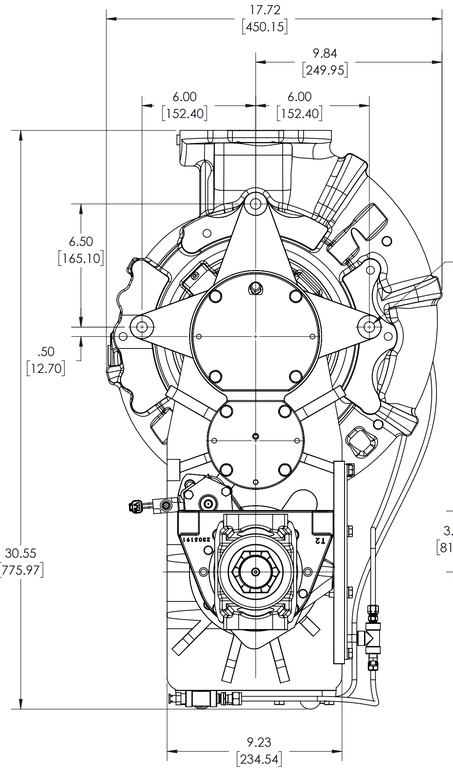
NOTES:
1) ONLY SHIFT PUMP WHEN DRIVELINE IS NOT SPINNING
2) APPROXIMATE WEIGHT: 506 LBS [229 KG]

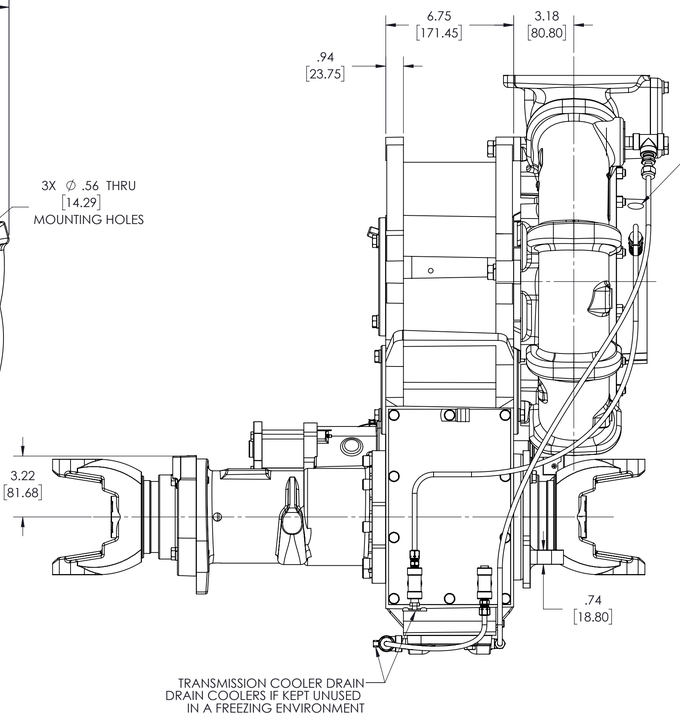
ASSEMBLIES SHOWN:
CAST IRON PUMP - PT01000
TRANSMISSION - TM00238
CAST IRON GEAR CASE - 1804204
INPUT FLANGE - 4813410
OUTPUT FLANGE - 4813410
TRANSMISSION COOLER - AM00401
TRANSMISSION COOLER - AM00403
GEAR RATIO 2.12:1 - KR07701
RV FLANGE - YF00601
PUMP SHIFT - AH00403
NO BRAKE - AB00403
SHIFT INTERLOCK - AH00600

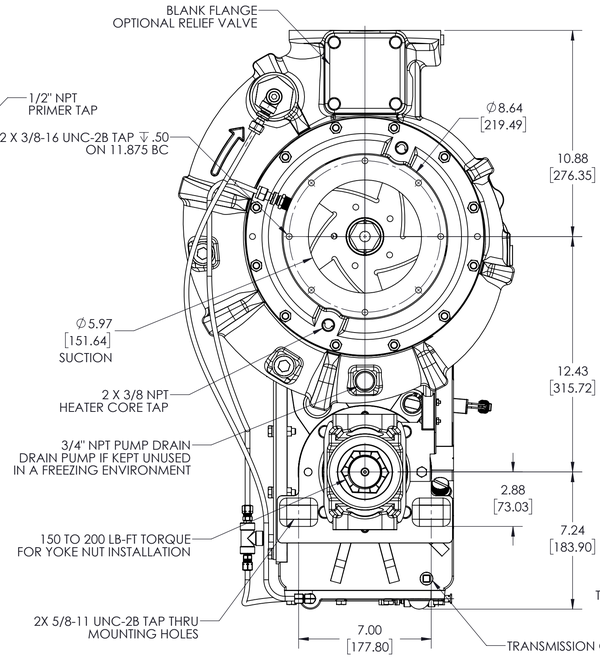


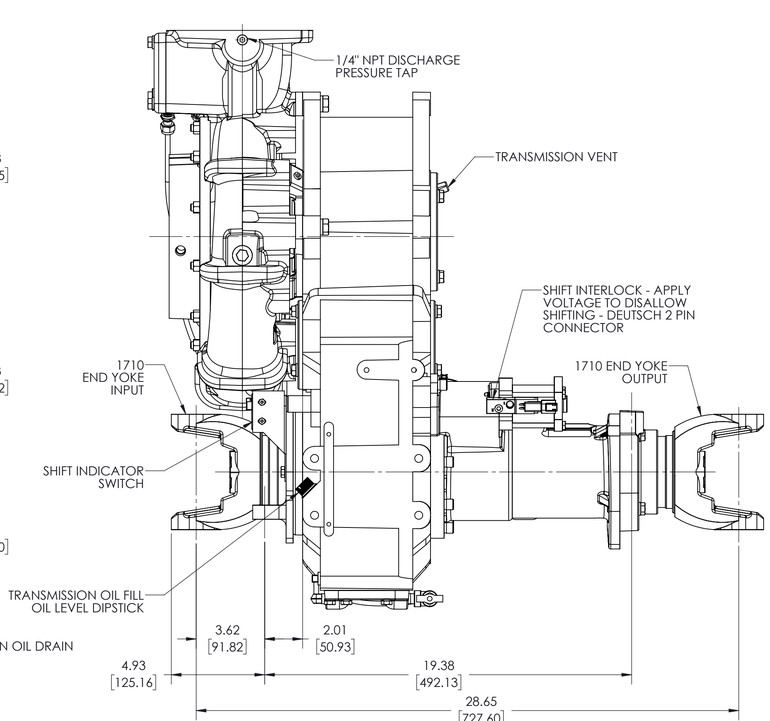










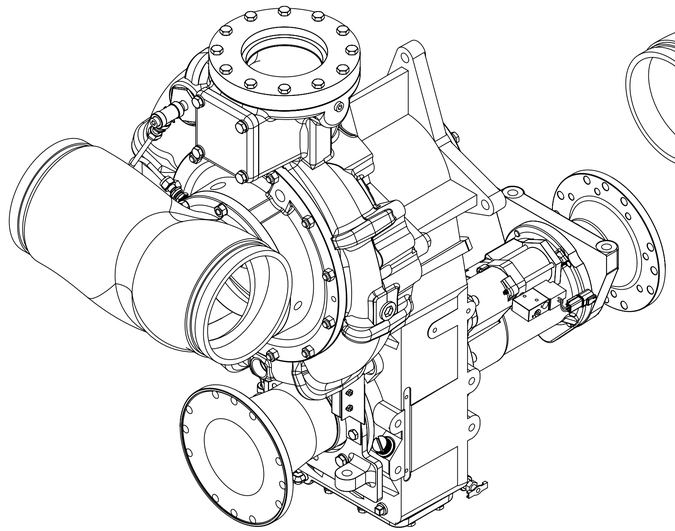


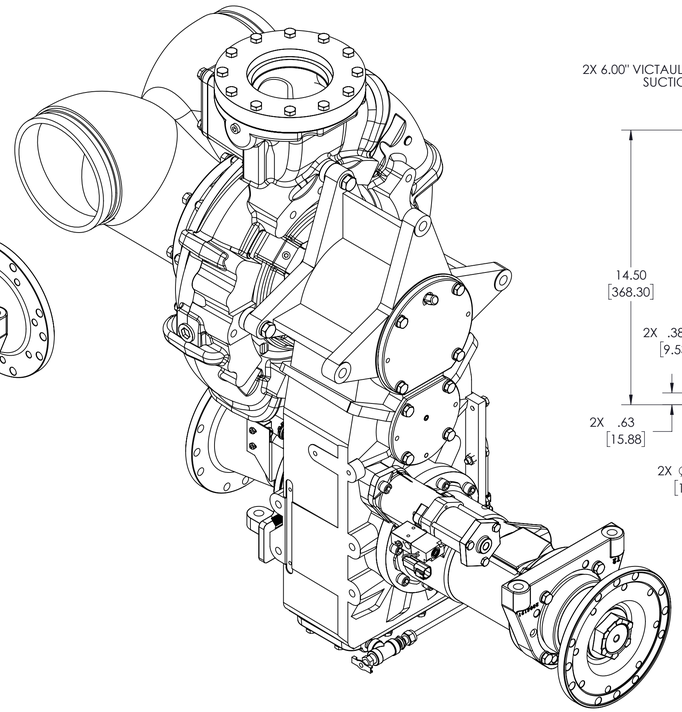
REMOVE SHARP EDGES	INCH [MILLIMETER]	THIRD ANGLE PROJECTION	OLD PART NO.	TOLERANCE EXCEPT AS NOTED .00 ±.03 .000 ±.010 ANGLES ±1	Darley® ITASCA, IL CHIPPEWA FALLS, WI
MATERIAL DESCRIPTION	MASS	MATERIAL NO.	PATTERN NO.	DRWN SMS	DWG - TSM, PUMP FORWARD
	507.14 LBS			CKHD WAH	1710 YOKES, NO MANIFOLDS
THIS DESIGN IS THE PROPERTY OF WS. DARLEY CO. - UNAUTHORIZED REPRODUCTION IS PROHIBITED	ALL DIMENSIONS IN INCHES UNLESS NOTED	DO NOT SCALE PRINT		TRCD	DATE: 4/22/2020 SCALE: 1:4 DTD1001

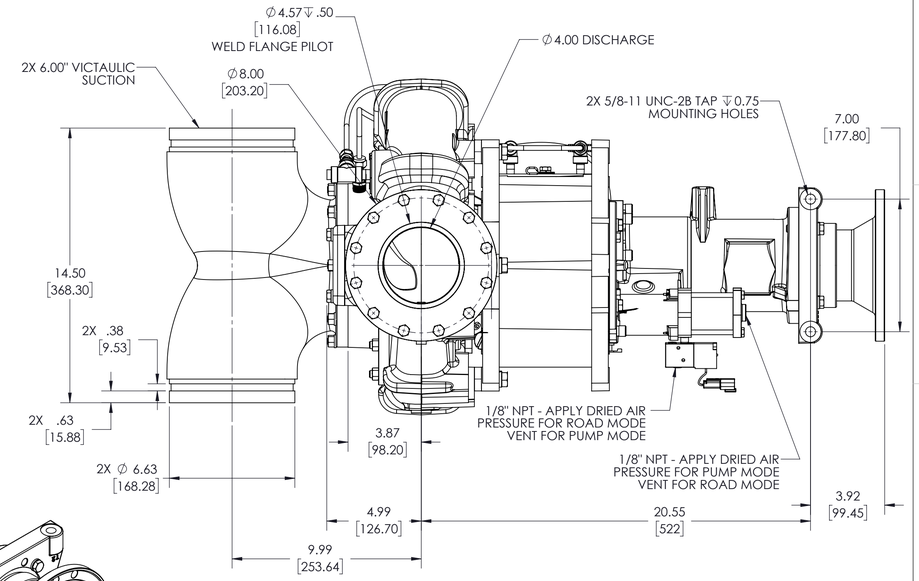
MODEL	SHEET
DTD1001	1/1 D

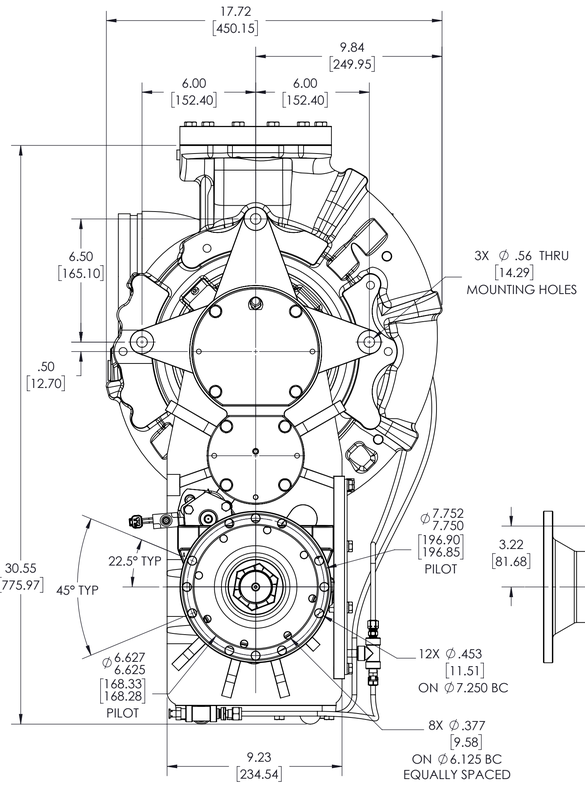
NOTES:
1) ONLY SHIFT PUMP WHEN DRIVELINE IS NOT SPINNING
2) APPROXIMATE WEIGHT: 557 LBS [253 KG]

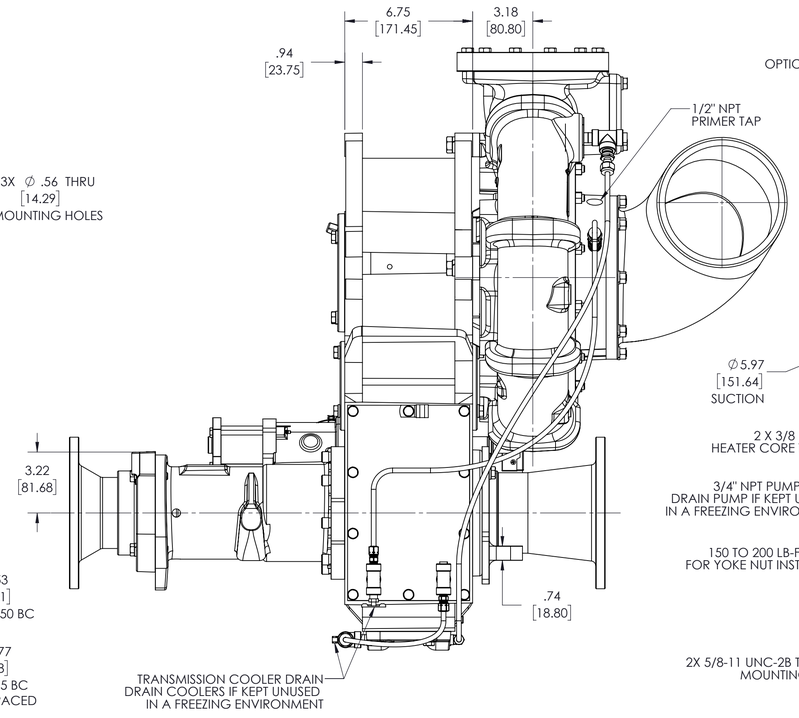
ASSEMBLIES SHOWN:
CAST IRON PUMP - PT01000
TRANSMISSION - TM00238
CAST IRON GEAR CASE - 1804204
INPUT FLANGE - 4816811
OUTPUT FLANGE - 4816810
TRANSMISSION COOLER - AM00401
TRANSMISSION COOLER - AM00403
GEAR RATIO 2.12:1 - KR07701
RV FLANGE - YF00601
PUMP SHIFT - AH00403
NO BRAKE - AB00403
SHIFT INTERLOCK - AH00600
SUCTION - KC02500
DISCHARGE FLANGE - YF00141

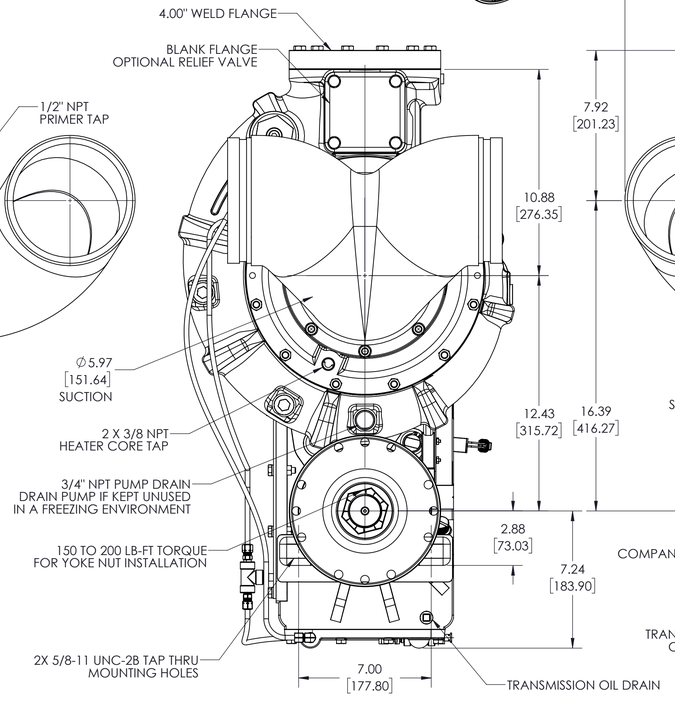


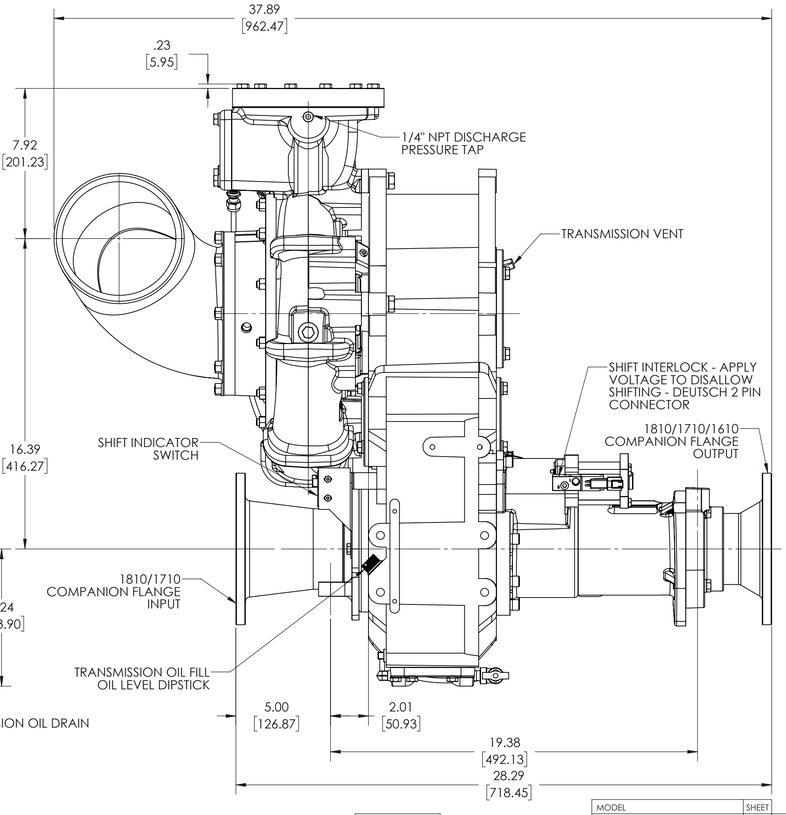








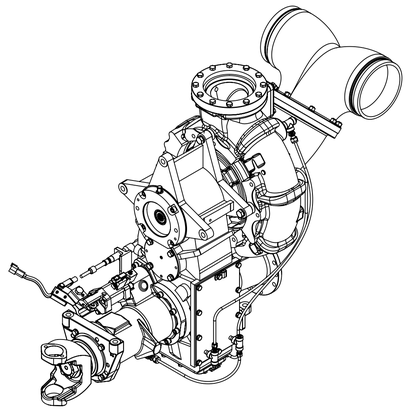


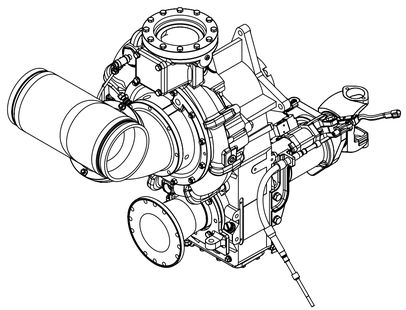


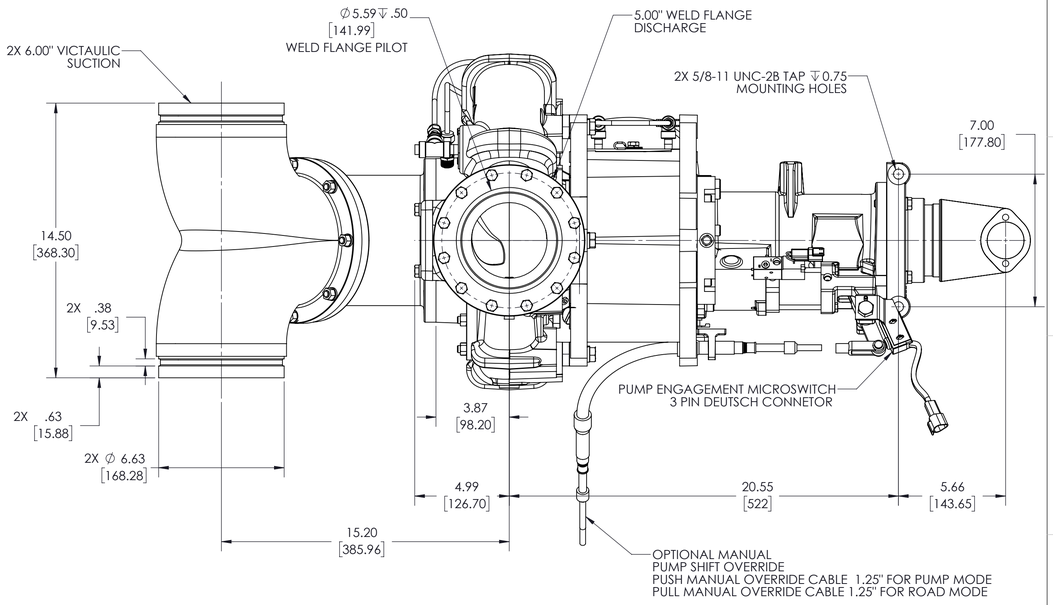
		THIRD ANGLE PROJECTION		MODEL	SHEET
				DTD1002	1/1 D
REMOVE SHARP EDGES	INCH [MILLIMETER]		OLD PART NO.	TOLERANCE EXCEPT AS NOTED .00 ±.03 .000 ±.010 ANGLES ±1	Darley® ITASCA, IL CHIPPEWA FALLS, WI
MATERIAL DESCRIPTION	MASS		MATERIAL NO.	PATTERN NO.	DWG - TSM, PUMP FORWARD COMP FLANGES, SWEPT TEE
	558.02 LBS			DRWN SMS	
THIS DESIGN IS THE PROPERTY OF WS. DARLEY CO. - UNAUTHORIZED REPRODUCTION IS PROHIBITED	ALL DIMENSIONS IN INCHES UNLESS NOTED	DO NOT SCALE PRINT		CKHD WAH	DATE: 4/22/2020 DTD1002
				TRCD	SCALE: 1:4

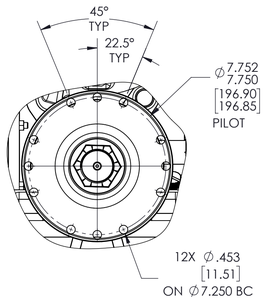
NOTES:
1) ONLY SHIFT PUMP WHEN DRIVELINE IS NOT SPINNING
2) APPROXIMATE WEIGHT: 585 LBS [265 KG]

ASSEMBLIES SHOWN:
CAST IRON PUMP - PT01002
TRANSMISSION - TM00237
CAST IRON GEAR CASE - 1804204
INPUT FLANGE - 4816811
OUTPUT FLANGE - 4813410
TRANSMISSION COOLER - AM00401
TRANSMISSION COOLER - AM00403
GEAR RATIO 2.12:1 - KR07701
RV FLANGE - YF00601
PUMP SHIFT - AH00117
PUMP SHIFT - AH00110
NO BRAKE - AB00403
SHIFT INTERLOCK - AH00600
SUCTION EXT - KC02600
SUCTION TEE - KC2501
DISCHARGE FLANGE - YF00142

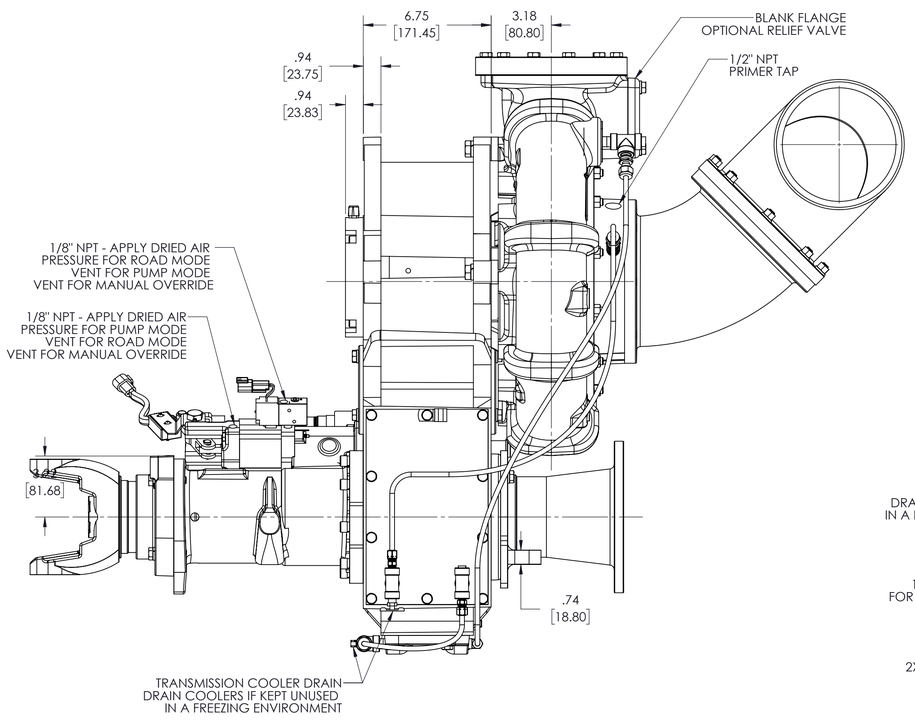


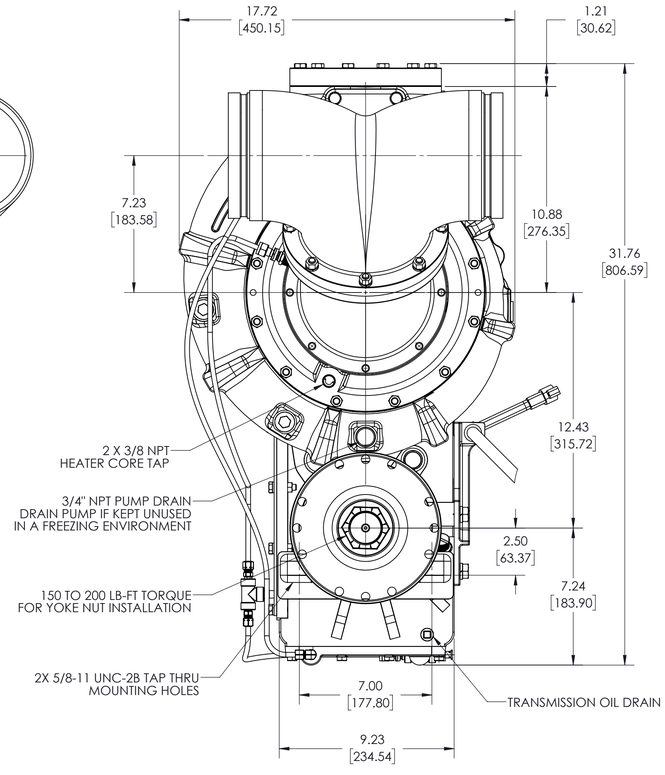


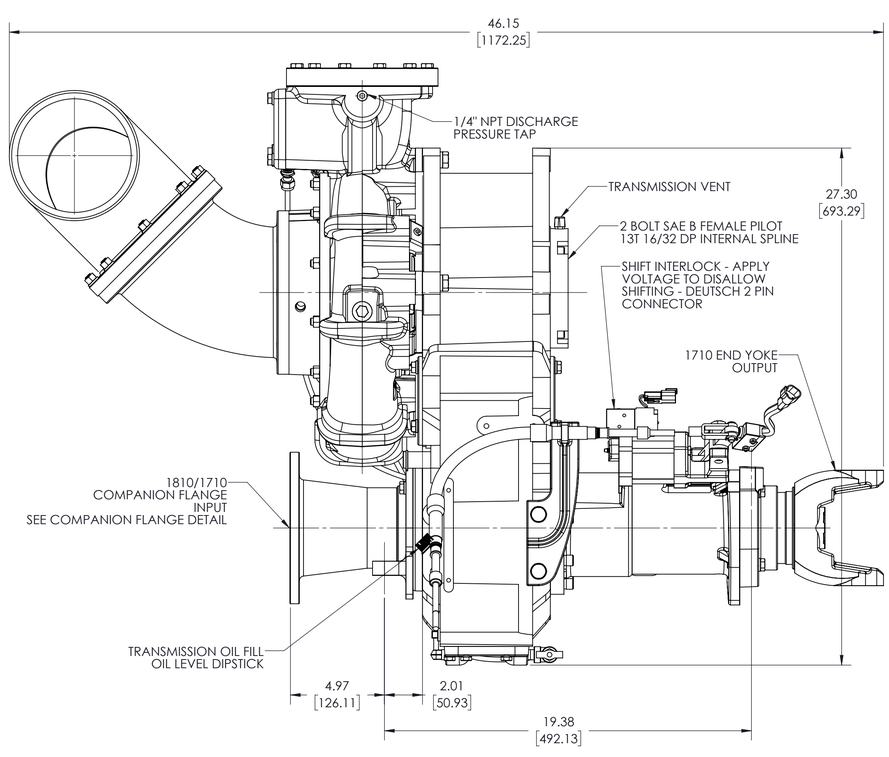




COMPANION FLANGE DETAIL







		THIRD ANGLE PROJECTION		MODEL	SHEET
				DTD1003	1/1 D
REMOVE SHARP EDGES	INCH [MILLIMETER]		OLD PART NO.	TOLERANCE EXCEPT AS NOTED .00 ±.03 .000 ±.010 ANGLES ±1	Darley ITASCA, IL CHIPPEWA FALLS, WI
MATERIAL DESCRIPTION	MASS		MATERIAL NO. / PATTERN NO.		DWG - TSM, PUMP FORWARD
	586.09 LBS			DRWN SMS	SAE B HYD ADAPT, MANIFOLDS
THIS DESIGN IS THE PROPERTY OF WS. DARLEY CO. - UNAUTHORIZED REPRODUCTION IS PROHIBITED	ALL DIMENSIONS IN INCHES UNLESS NOTED	DO NOT SCALE PRINT		CKHD WAH	DATE: 5/6/2020 DTD1003
				TRCD	SCALE: 1:4

MECHANICAL SEAL

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.

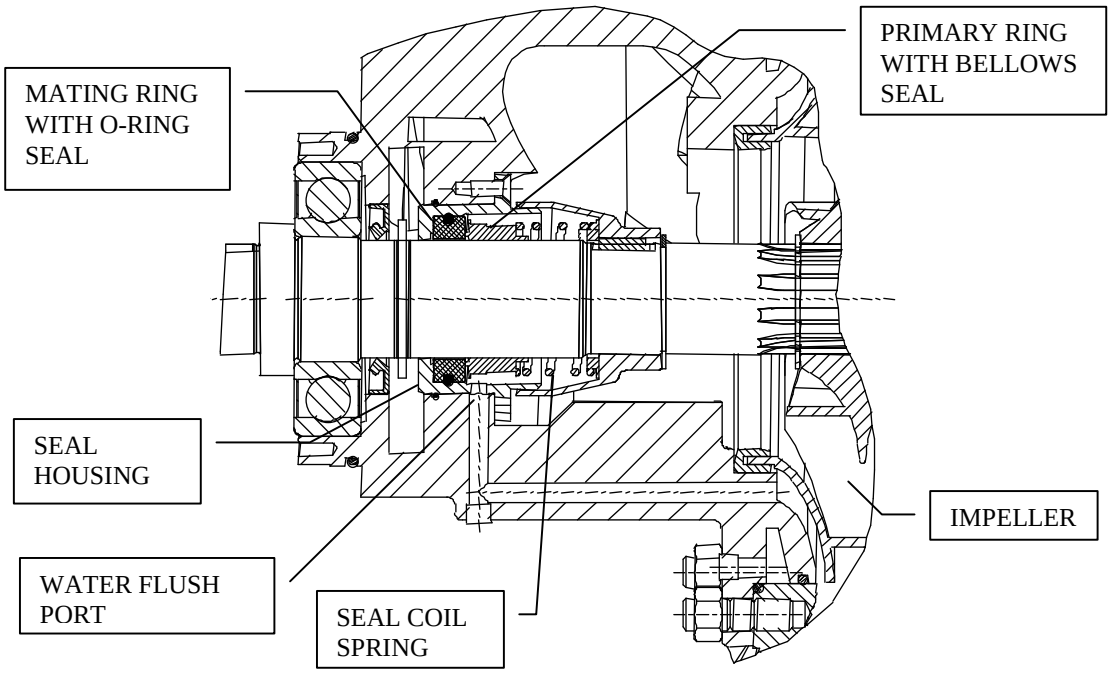
Mechanical Seal Basics

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

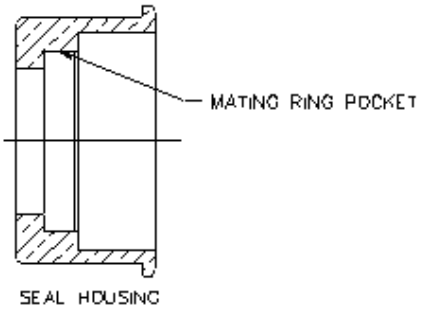
SPECIAL HANDLING

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.

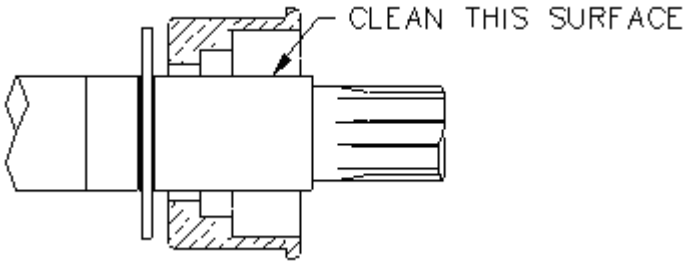
INSTRUCTION STEPS:

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.

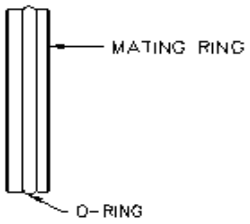


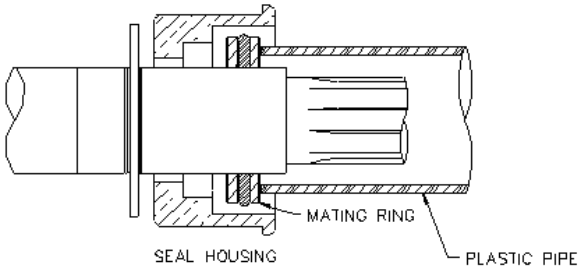
2. Inspect the pump shaft surface under the bellows, ensuring it is clean and nick free to provide a proper sealing surface. Isopropyl alcohol may be used to clean surface if required.



3. Lightly lubricate the entire o-ring on the mating ring with a single drop of P-80 water soluble rubber lubricant - evenly distributed (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. Be careful not to get the P80 on either face. If P-80 is on either face, remove it from the faces prior to installation.
   Note: The polished face of the mating ring must face out – away from the pump's gear case. Try to not touch the polished sealing face with your fingers; the oils from your fingerprint can cause the seal to leak. Remove any P-80 from the sealing face after installation.

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



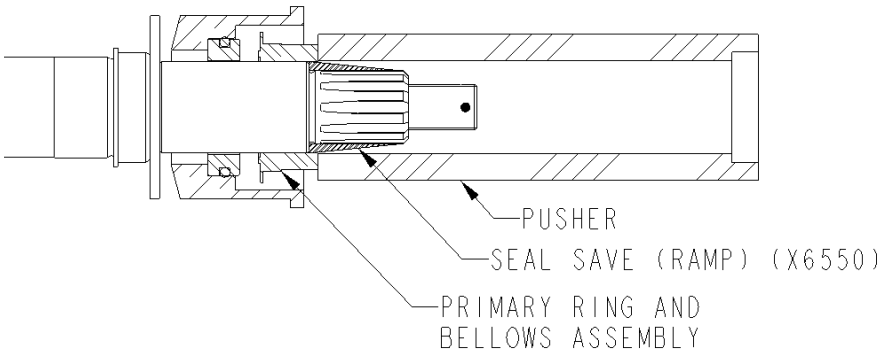


4. Clean the mating ring surface with isopropyl alcohol to remove any fingerprints and any other contaminants left on mating ring.

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

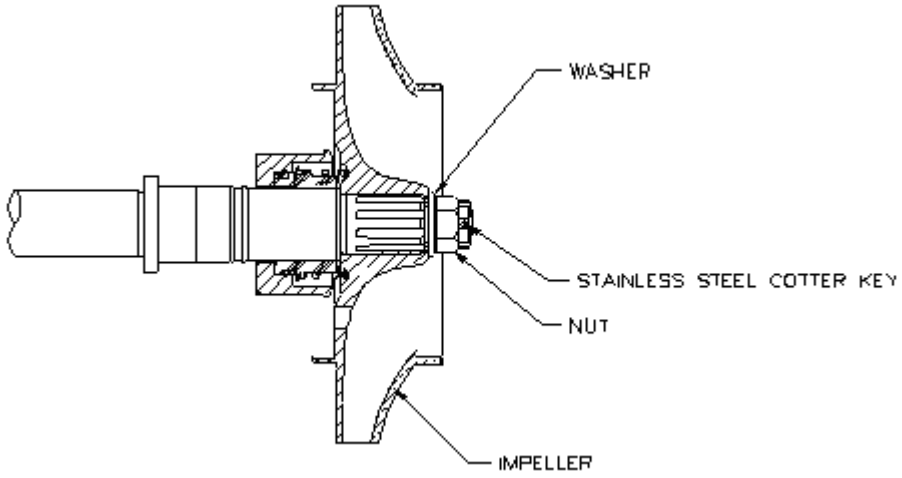
5. Apply a small drop of P-80 rubber lubricant or water-soluble lubricant (not soapy water) evenly distributed to the inside diameter of the bellows assembly allowing it to be pushed easily into position.
6. Clean the polished sealing face of the primary ring with a clean lint free rag with isopropyl alcohol to remove all fingerprints and other contaminants.

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



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.

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.

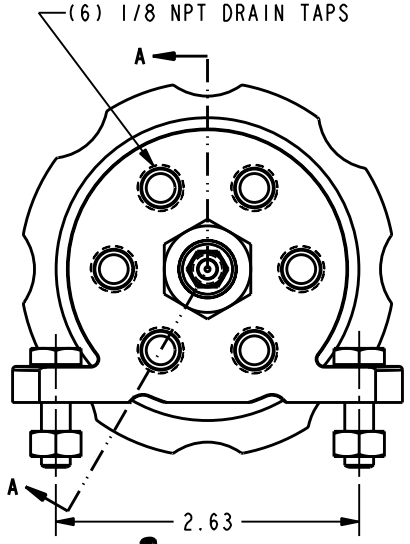
Section 5

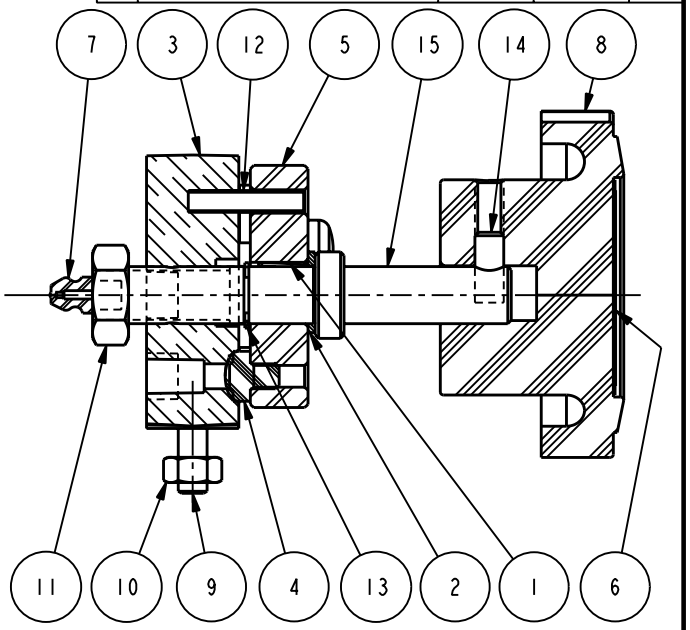
Optional Equipment

MULTIPLE DRAIN VALVE

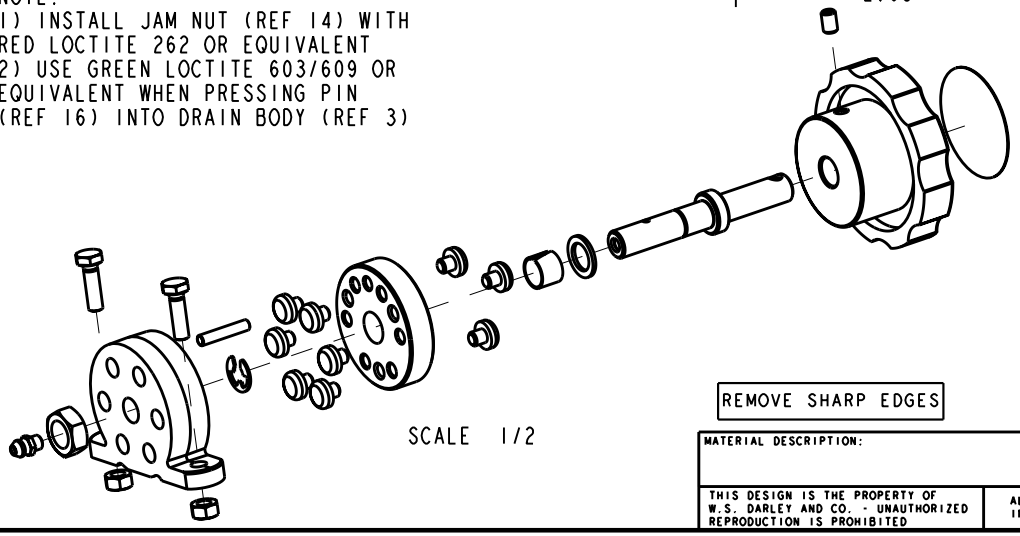
NO.	DESCRIPTION	PART NO.	QTY.
1	BEARING - NYLINER, 0.50 ID	1760102	1
2	BEARING - OILITE, 0.500 ID	1760024	1
3	BODY - MULTIPLE DRAIN VALVE	5320602	1
4	BUMPER - DRAIN VALVE	4401727	9
5	CAP - MULTIPLE DRAIN VALVE	5323803	1
6	DECAL - DRAIN VALVE	1963200	1
7	GREASE ZERK - .25-28	4403200	1
8	HANDWHEEL	3001800	1
9	HHCS - .250-20 x 0.88, 18-8	5400658	2
10	NUT - HEX, .250-20, 18-8 SST	5403027	2
11	NUT - JAM, .500-20, 18-8 SST	5403219	1
12	PIN - SPRING, 0.19 X 1.00, SST	3605029	1
13	RING - RETAINER, 68011	3600435	1
14	SSS - 1/4-20 x 0.38, SST	5402603	1
15	STEM - MULTIPLE DRAIN VALVE	5241303	1

NOTE:
1) INSTALL JAM NUT (REF 14) WITH RED LOCTITE 262 OR EQUIVALENT
2) USE GREEN LOCTITE 603/609 OR EQUIVALENT WHEN PRESSING PIN (REF 16) INTO DRAIN BODY (REF 3)

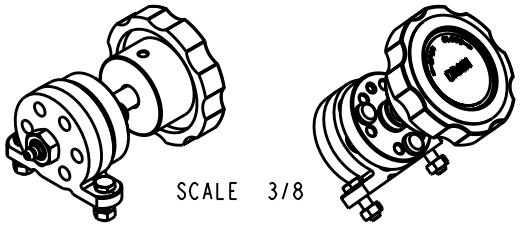




SECTION A-A



SCALE 1/2



SCALE 3/8

REVISIONS				
LTR	DESCRIPTION	DATE	CHG NO.	APPR'D

MODEL NAME	MDL CREATED	SHEET	
VD00600	12JUN2009	1/1	B

REMOVE SHARP EDGES

INCH [MILLIMETER]

THIRD ANGLE PROJECTION

OLD PART NO.

MATERIAL DESCRIPTION:

MATERIAL NO.

PATTERN NO.

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

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

DWG - MULTIPLE DRAIN VALVE BUMPER

DR'N SMS

CHKD MCR

TRCD

DATE 16-Jul-09

SCALE 1/1

DGC0904

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ALL DIMENSIONS IN INCHES UNLESS NOTED

DO NOT SCALE PRINT

NAME:SMS OBJECT:DGC0904 DATE:13-May-10 13:22:00

BALL VALVE

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.

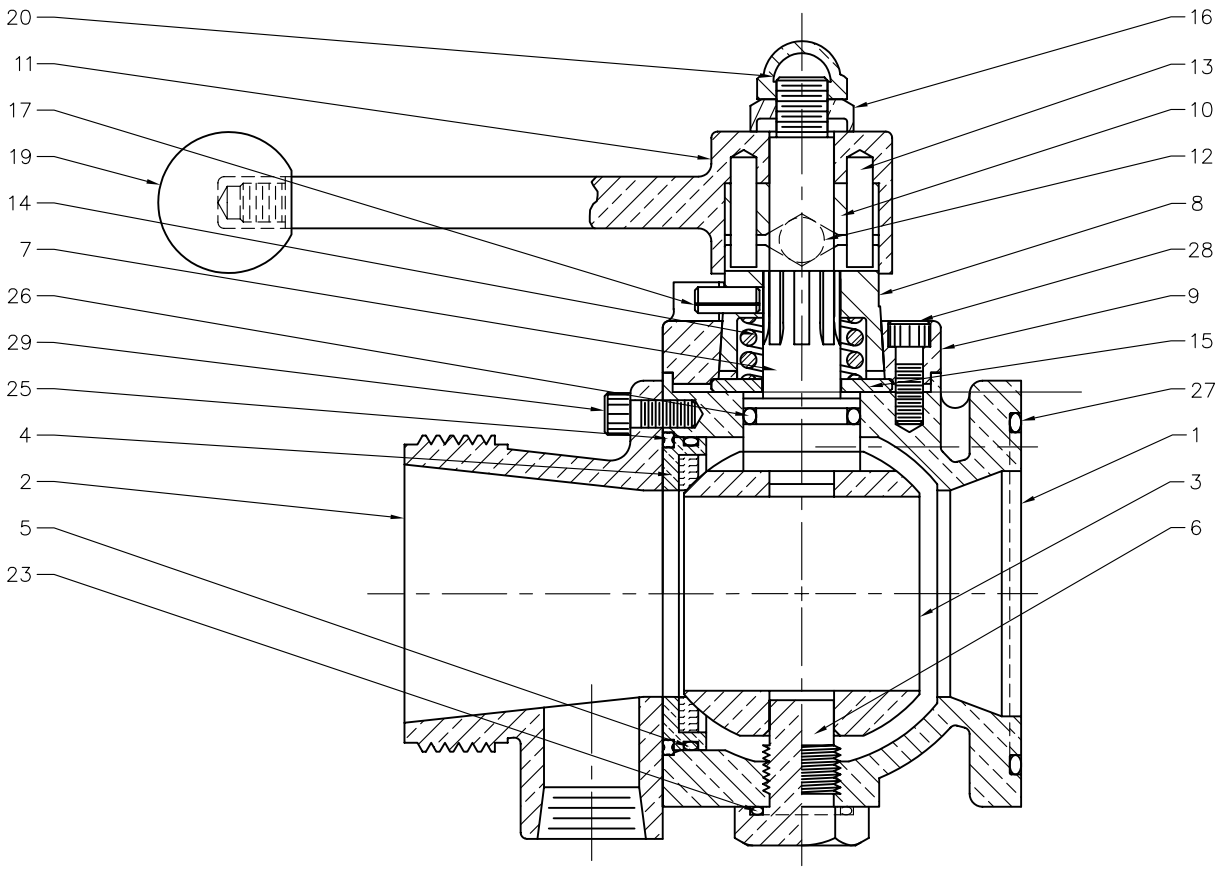
5. Place seat assembly (4), seat o-ring (5), and quad ring (25) into position.

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]

THIRD ANGLE PROJECTION

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

ALL DIMENSIONS IN INCHES UNLESS NOTED

DO NOT SCALE PRINT

PRESSURE RELIEF VALVE

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 case when initially inserting screen into body to avoid damaging quad ring (64) or valve seat.

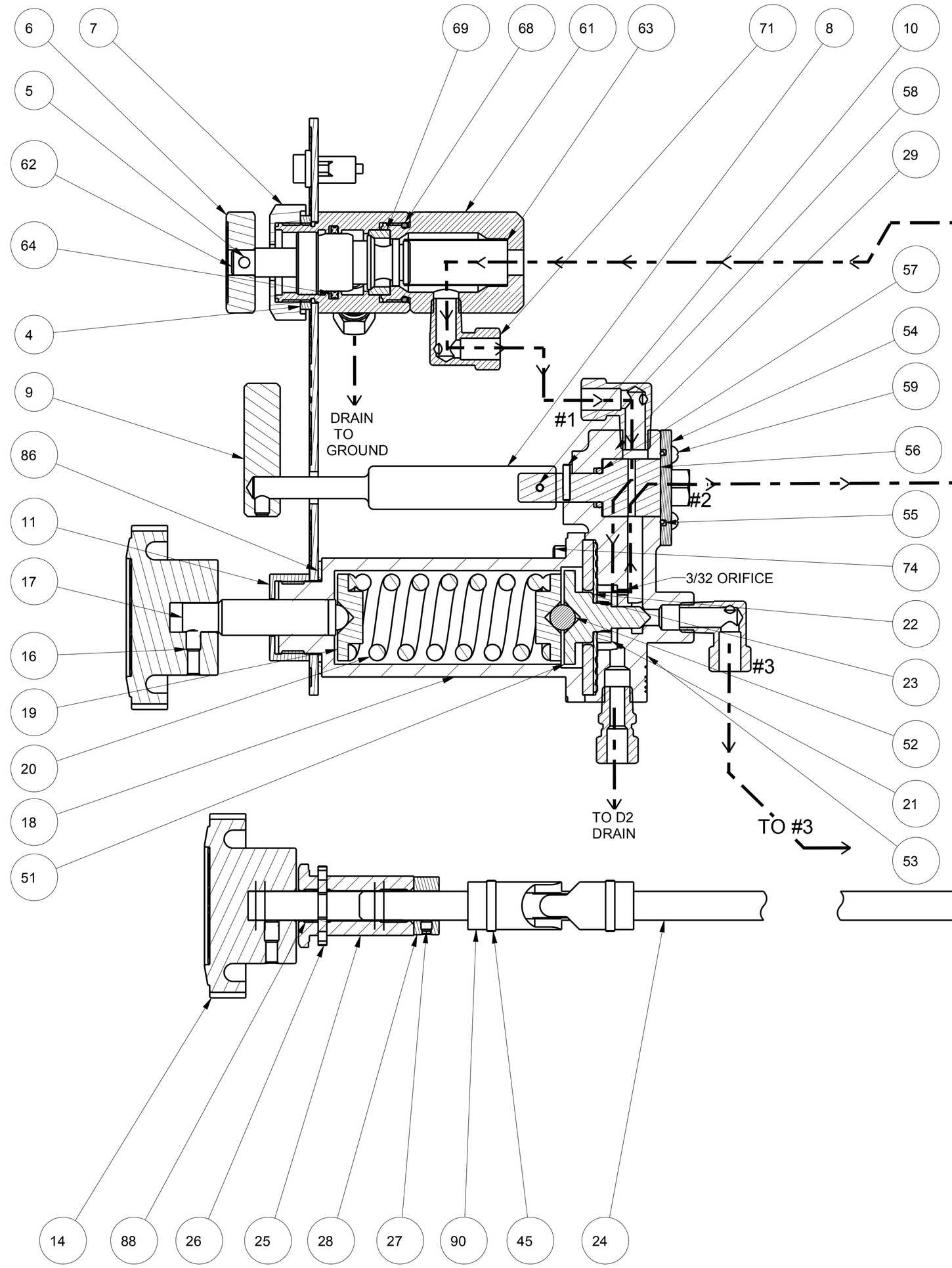
To replace flush valve seat (69), remove stem/screen assembly, disconnect tubing lines attached to (61) body half and unscrew (61) body half from (70) body half. Replace (69) valve seat. Reverse procedure to reassemble valve.

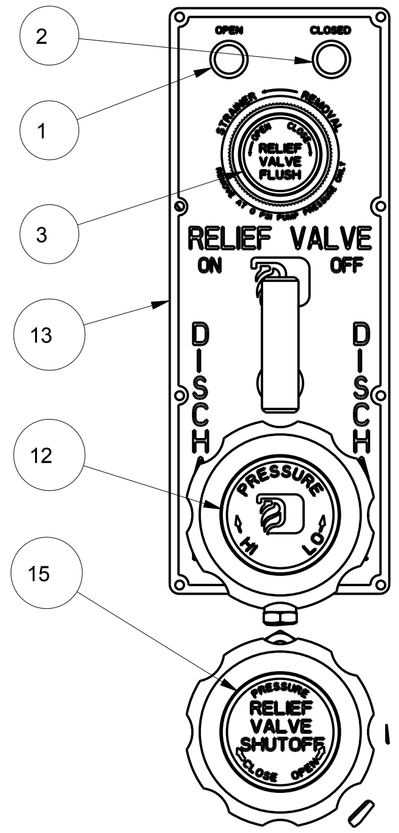
All Darley relief valves can be provided with a micro switch and either one or two pilot lights to indicate when the valve is open or closed.

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

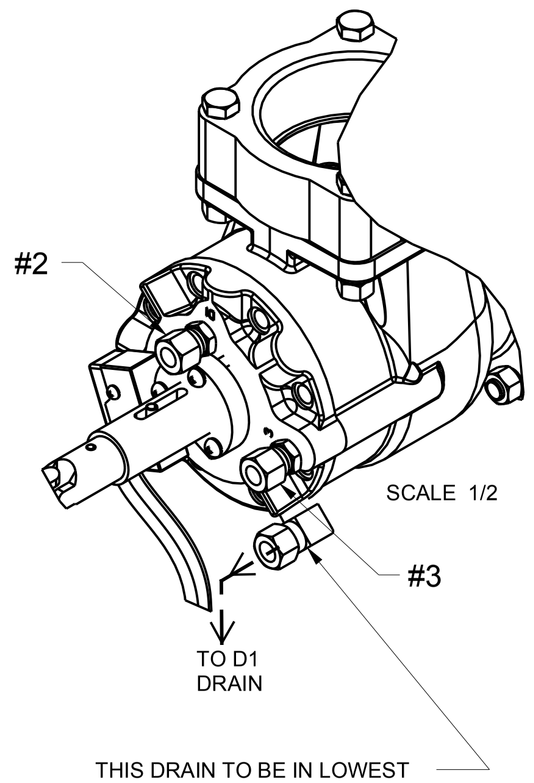
NO.	DESCRIPTION	PART NO.	QTY.
1	LIGHT - AMBER	-	1
2	LIGHT - GREEN	-	1
3	DECAL - FLUSH SCREEN	-	1
4	NUT - PANEL, FLUSH VALVE	-	1
5	SSS - NO.10-32 x 0.38, GR5	-	1
6	KNOB - FLUSH VALVE	-	1
7	NUT - PANEL, 1.38-12	-	1
8	COUPLING - RELEIF VALVE STEM	-	1
9	LEVER - R.V. ON/OFF	-	1
10	PIN - DRIVE LOK, 0.125 X 0.750	-	1
11	NUT - PANEL VALVE, 1.250-12	-	1
12	DECAL - PRESSURE, HI/LO	-	1
13	PLATE - TRIM, REMOTE HEAD	-	1
14	HANDWHEEL	-	2
15	DECAL - PRESSURE RELIEF VALVE	-	1
16	SSS - 1/4-20 x 0.38, SST	-	3
17	SCREW - SPRING TENSION	-	1
18	HOUSING - PILOT VALVE	-	1
19	RETAINER - SPRING	-	2
20	SPRING - PRESSURE REGULATOR	-	1
21	NUT - PILOT VALVE	-	1
22	RING - HOUSING PILOT	-	1
23	DIAPHRAM - PIOLET HEAD	-	1
24	SHAFT - R.V. EXTENSION, 24"	-	1
25	BUSHING - RETAINER, PANEL	-	1
26	NUT - .750, CONDUIT	-	1
27	SSS - NO.10-24 x 0.19, GR5	-	1
28	COLLAR - SHAFT. 1/2" BORE	-	1
29	SSS - .313 x 0.31, GR5	-	1
30	COUPLING - RELIEF VALVE STEM	-	1
31	MICROSWITCH - OMRON	-	1
32	PIN - SPRING, 0.19 X 1.12	-	1
33	O-RING - 0.38 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 0.94 x 0.09	-	1
36	PLATE - SEAL, VALVE STEM	-	1
37	O-RING - 3.25 x 3.38 x 0.06	-	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 3.69 x 0.09	-	2
43	CENTER PLUG - PISTON SPRING	-	1
44	SPRING - PISTON	-	1
45	PIN - SPRING, 0.16 X 0.88	-	4
46	QUAD RING - 2.88 x 3.25 x 0.19	-	1
47	WASHER - 0.39 x 0.61 x .06 BR	-	1
48	STEM - RELIEF VALVE SWITCH	-	1
49	SHIM - SWITCH SPACER, 0.0125	-	1
50	PLUG - PIPE, 0.125, SST SOC HD	-	1
51	PIN - PILOT VALVE	-	1
52	BALL - CAM, 0.44"	-	1
53	HEAD - PILOT CONTROL	-	1
54	COVER - ON/OFF 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, SST	-	1
59	RHMS - NO.8-32 X 0.50, BR	-	4
61	BODY - FLUSH VALVE, COMPLETE	-	1
62	STEM - FLUSH VALVE	-	1
63	STRAINER - SCREEN	-	1
64	QUAD RING - 1.00 x 1.25 x 0.12	-	1
68	O-RING - 1.19 x 1.38 x 0.09	-	1
69	SEAT - FLUSH VALVE	-	1
71	TUBE FITTING - EL, .38 x .25	-	5
72	TUBE FITTING - STR, .38 cf x .25 NPTM	-	3
73	TUBE FITTING - STR, .38 cf x .12 NPTM	-	1
74	SHCS - .250-20 X 0.88, SST	-	4
75	SHCS - .313-18 x 0.75, GR8	-	8
76	WASHER - LOCK, NO.6 ID, SST	-	2
77	RHMS - NO.6-32 X1.00, BR	-	2
79	NUT - HEX, .375-16, GR2	-	8
81	HHCS - .375-16 x 2.25, GR5	-	8
82	FLANGE - ADAPTER, 3 NPT	-	2
83	RHMS - NO.10-24 X 0.75, GR5	-	3
86	WASHER - INT. TOOTH, 1.250 ID	-	1
88	BEARING - NYLINER, 0.50 ID	-	2
90	JOINT - UNIVERSAL, .500"	-	2
91	SHIM - SWITCH SPACER, 0.025	-	1
93	WASHER - LOCK, NO.10 ID, SST	-	3
95	CONNECTOR - DUETCH DT 06-3S	-	1

REVISIONS				
LTR	DESCRIPTION	DATE	CHG NO.	APPR'D
A	REVERSED LIGHT POSITIONS	12JUL07	2007-285	RJG
B	ADDED FLOW PATH VIEW	21NOV2007	2007-451	SMS



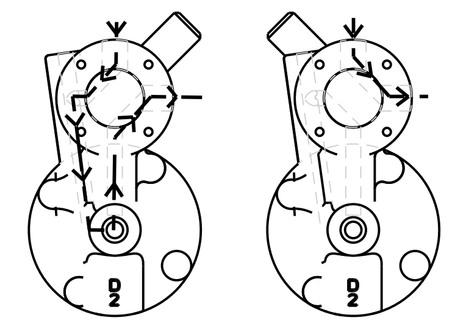


SCALE 1/2



SCALE 1/2

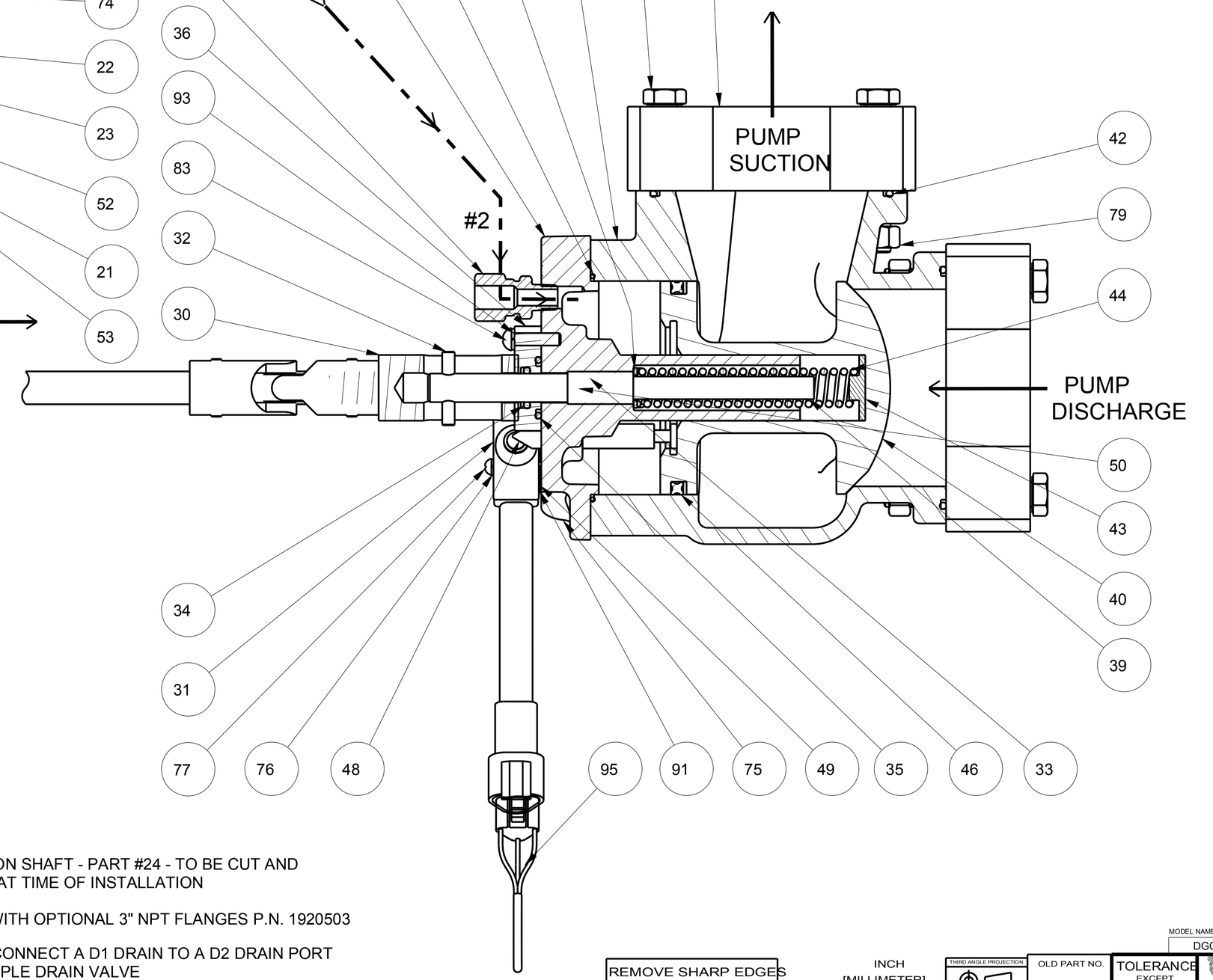
THIS DRAIN TO BE IN LOWEST PORT BY ORIENTATION AT TIME OF INSTALLATION

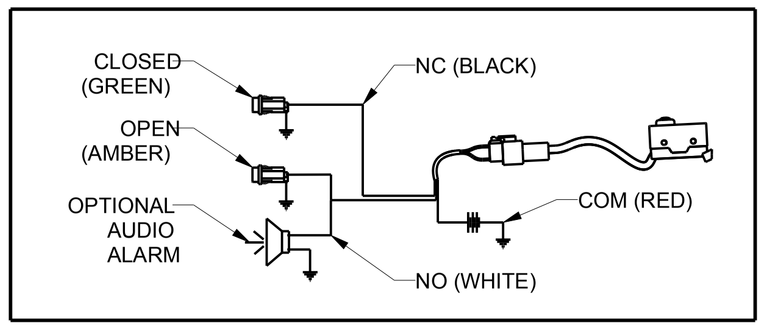


SCALE 1/2

VALVE ON VALVE OFF

(B) FLOW PATH THRU PILOT CONTROL VALVE





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

MODEL NAME	MDL CREATED	SHEET	
DGC0141	08JUN05	1/2	D

REMOVE SHARP EDGES | INCH [MILLIMETER] | THIRD ANGLE PROJECTION | OLD PART NO.

MATERIAL DESCRIPTION: | MATERIAL NO. | PATTERN NO.

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

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

RELIEF VALVE

DRN HAL
CHKD SJL
TRCD

DATE 13-Jun-05
SCALE 3/4

DGC0141

ALL DIMENSIONS IN INCHES UNLESS NOTED

DO NOT SCALE PRINT

NO.	DESCRIPTION	PART NO.	QTY.
1	LIGHT - AMBER	-	1
2	LIGHT - GREEN	-	1
3	DECAL - FLUSH SCREEN	-	1
4	NUT - PANEL, FLUSH VALVE	-	1
5	SSS - NO.10-32 x 0.38, GR5	-	1
6	KNOB - FLUSH VALVE	-	1
7	NUT - PANEL, 1.38-12	-	1
8	COUPLING - RELEIF VALVE STEM	-	1
9	LEVER - R.V. ON/OFF	-	1
10	PIN - DRIVE LOK, 0.125 X 0.750	-	1
11	NUT - PANEL VALVE, 1.250-12	-	1
12	DECAL - PRESSURE, HI/LO	-	1
13	PLATE - TRIM, REMOTE HEAD	-	1
14	HANDWHEEL	-	2
15	DECAL - PRESSURE RELIEF VALVE	-	1
16	SSS - 1/4-20 x 0.38, SST	-	3
17	SCREW - SPRING TENSION	-	1
18	HOUSING - PILOT VALVE	-	1
19	RETAINER - SPRING	-	2
20	SPRING - PRESSURE REGULATOR	-	1
21	NUT - PILOT VALVE	-	1
22	RING - HOUSING PILOT	-	1
23	DIAPHRAM - PIOLET HEAD	-	1
24	SHAFT - R.V. EXTENSION, 24"	-	1
25	BUSHING - RETAINER, PANEL	-	1
26	NUT - .750, CONDUIT	-	1
27	SSS - NO.10-24 x 0.19, GR5	-	1
28	COLLAR - SHAFT. 1/2" BORE	-	1
29	SSS - .313 x 0.31, GR5	-	1
30	COUPLING - RELIEF VALVE STEM	-	1
31	MICROSWITCH - OMRON	-	1
32	PIN - SPRING, 0.19 X 1.12	-	1
33	O-RING - 0.38 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 0.94 x 0.09	-	1
36	PLATE - SEAL, VALVE STEM	-	1
37	O-RING - 3.25 x 3.38 x 0.06	-	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 3.69 x 0.09	-	2
43	CENTER PLUG - PISTON SPRING	-	1
44	SPRING - PISTON	-	1
45	PIN - SPRING, 0.16 X 0.88	-	4
46	QUAD RING - 2.88 x 3.25 x 0.19	-	1
47	WASHER - 0.39 x 0.61 x .06 BR	-	1
48	STEM - RELIEF VALVE SWITCH	-	1
49	SHIM - SWITCH SPACER, 0.0125	-	1
50	PLUG - PIPE, 0.125, SST SOC HD	-	1
51	PIN - PILOT VALVE	-	1
52	BALL - CAM, 0.44"	-	1
53	HEAD - PILOT CONTROL	-	1
54	COVER - ON/OFF 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, SST	-	1
59	RHMS - NO.8-32 X 0.50, BR	-	4
61	BODY - FLUSH VALVE, COMPLETE	-	1
62	STEM - FLUSH VALVE	-	1
63	STRAINER - SCREEN	-	1
64	QUAD RING - 1.00 x 1.25 x 0.12	-	1
68	O-RING - 1.19 x 1.38 x 0.09	-	1
69	SEAT - FLUSH VALVE	-	1
71	TUBE FITTING - EL, .38 x .25	-	5
72	TUBE FITTING - STR, .38 cf x .25 NPTM	-	3
73	TUBE FITTING - STR, .38 cf x .12 NPTM	-	1
74	SHCS - .250-20 X 0.88, SST	-	4
75	SHCS - .313-18 x 0.75, GR8	-	8
76	WASHER - LOCK, NO.6 ID, SST	-	2
77	RHMS - NO.6-32 X1.00, BR	-	2
79	NUT - HEX, .375-16, GR2	-	8
81	HHCS - .375-16 x 2.25, GR5	-	8
82	FLANGE - ADAPTER, 3 NPT	-	2
83	RHMS - NO.10-24 X 0.75, GR5	-	3
86	WASHER - INT. TOOTH, 1.250 ID	-	1
88	BEARING - NYLINER, 0.50 ID	-	2
90	JOINT - UNIVERSAL, .500"	-	2
91	SHIM - SWITCH SPACER, 0.025	-	1
93	WASHER - LOCK, NO.10 ID, SST	-	3
95	CONNECTOR - DUETCH DT 06-3S	-	1

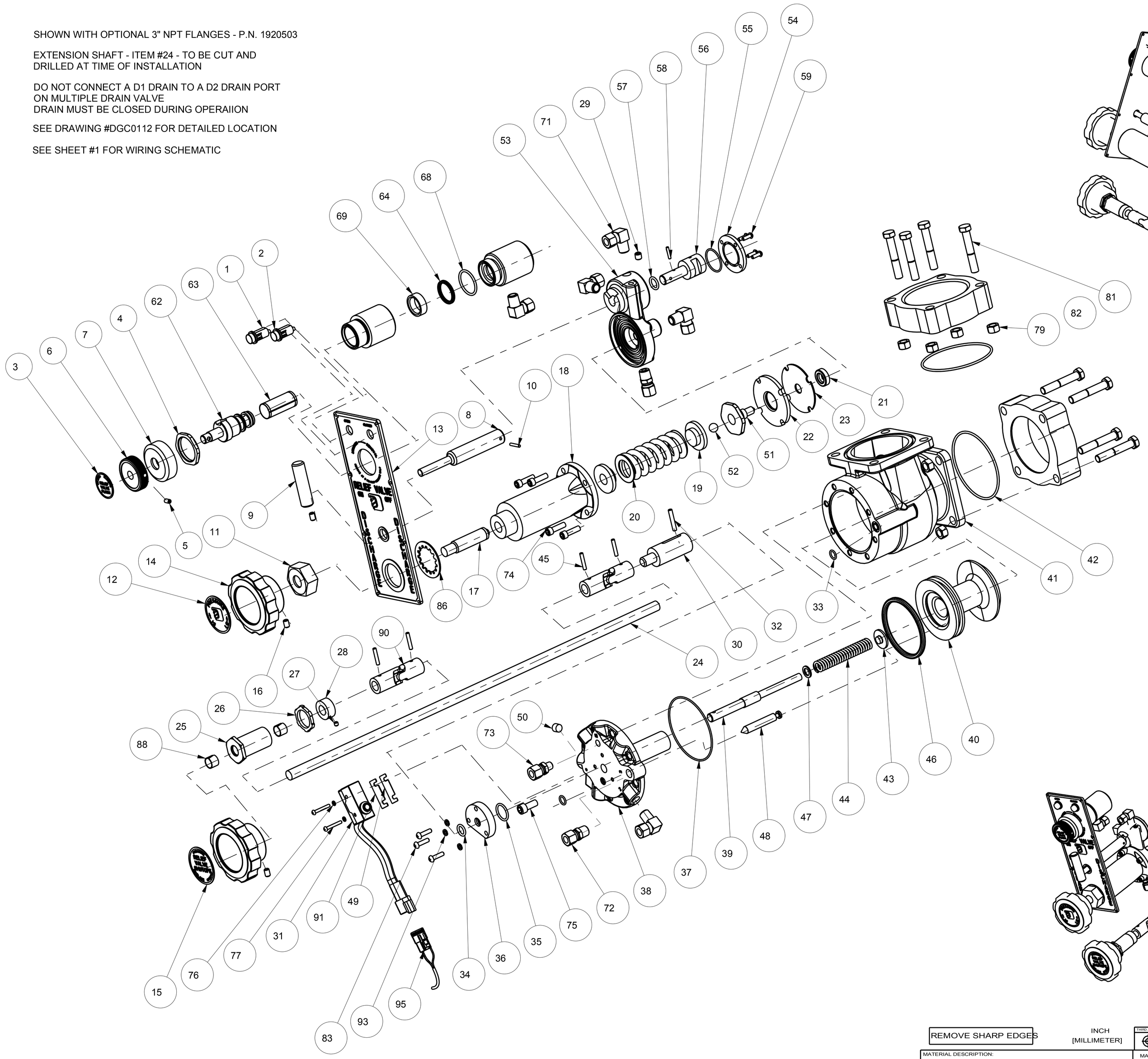
SHOWN WITH OPTIONAL 3" NPT FLANGES - P.N. 1920503

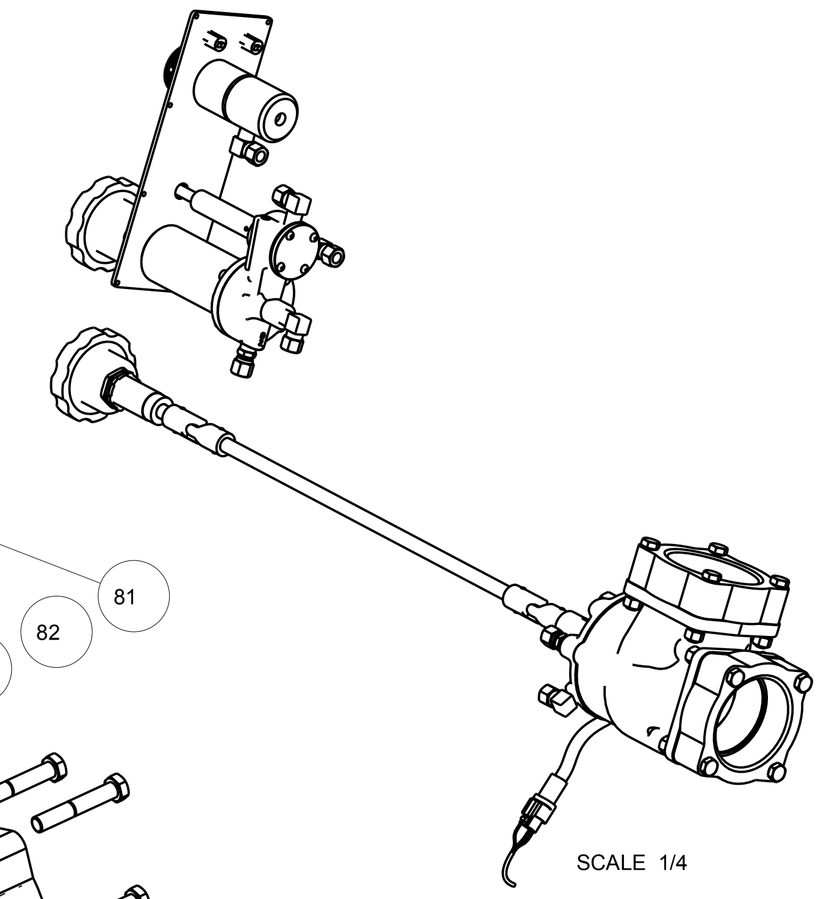
EXTENSION SHAFT - ITEM #24 - TO BE CUT AND DRILLED AT TIME OF INSTALLATION

DO NOT CONNECT A D1 DRAIN TO A D2 DRAIN PORT ON MULTIPLE DRAIN VALVE
DRAIN MUST BE CLOSED DURING OPERAIION

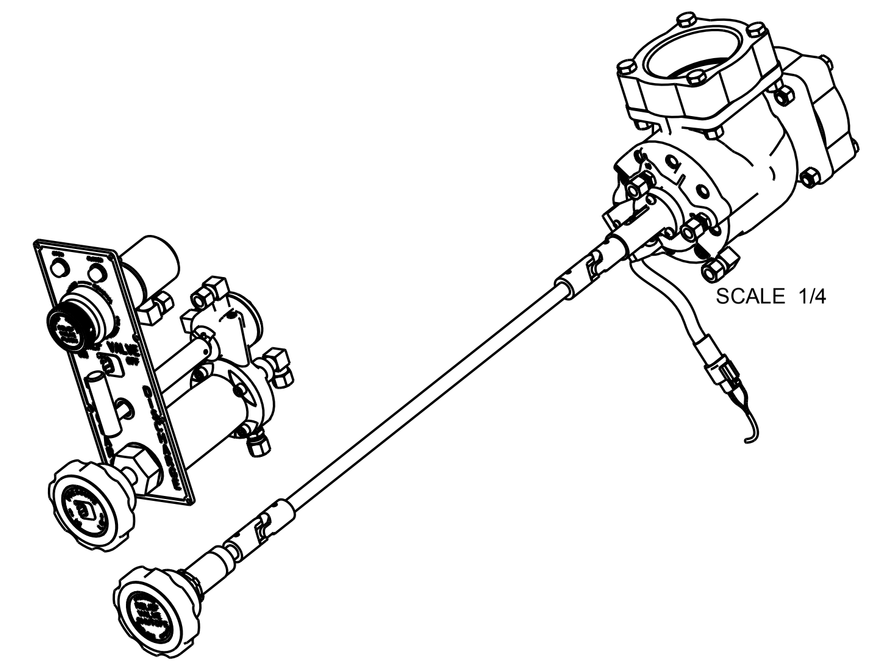
SEE DRAWING #DGC0112 FOR DETAILED LOCATION

SEE SHEET #1 FOR WIRING SCHEMATIC





SCALE 1/4



SCALE 1/4

REVISIONS				
LTR	DESCRIPTION	DATE	CHG NO.	APPR'D

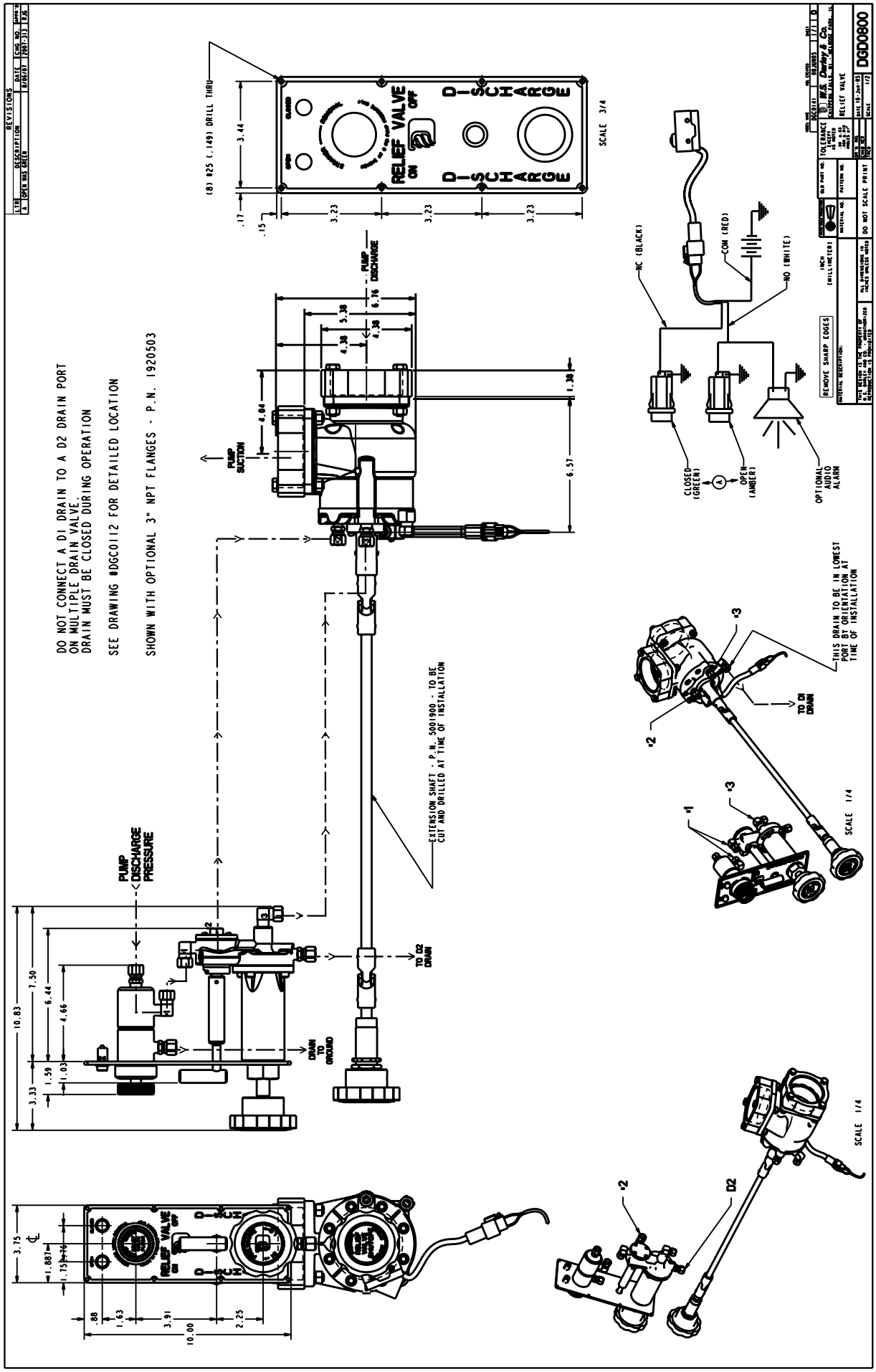
MODEL NAME	MDL CREATED	SHEET	
DGC0141	08JUN05	2 / 2	D

REMOVE SHARP EDGES	INCH [MILLIMETER]	THIRD ANGLE PROJECTION	OLD PART NO.	TOLERANCE EXCEPT AS NOTED .00 ±.03 .000 ±.010 ANGLES ±1°
MATERIAL DESCRIPTION:			MATERIAL NO. / PATTERN NO.	
THIS DESIGN IS THE PROPERTY OF W.S. DARLEY AND CO. - UNAUTHORIZED REPRODUCTION IS PROHIBITED	ALL DIMENSIONS IN INCHES UNLESS NOTED	DO NOT SCALE PRINT	DRN HAL / CHKD SJL / TRCD	DATE 15-Jun-05 / SCALE 3/4

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

RELIEF VALVE

DGC0141


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
(8) Ø25 (.149) DRILL THRU
SCALE 3/4
RELIEF VALVE
ON
OFF
D-SCHARGE
PUMP DISCHARGE
PUMP SUCTION
EXTENSION SHAFT - P.N. 5001900 - TO BE CUT AND DRILLED AT TIME OF INSTALLATION
PUMP DISCHARGE PRESSURE
TO D2 DRAIN
DRAIN TO GROUND
NC (BLACK)
COM (RED)
NO (WHITE)
CLOSED (GREEN)
OPEN (AMBER)
OPTIONAL AUDIO ALARM
THIS DRAIN TO BE IN LOWEST PORT BY ORIENTATION AT TIME OF INSTALLATION
TO D1 DRAIN
SCALE 1/4
SCALE 1/4
D2
REMOVE SHARP EDGES
DO NOT SCALE PRINT
RELIEF VALVE
DGD0800

W.S. DARLEY & CO.

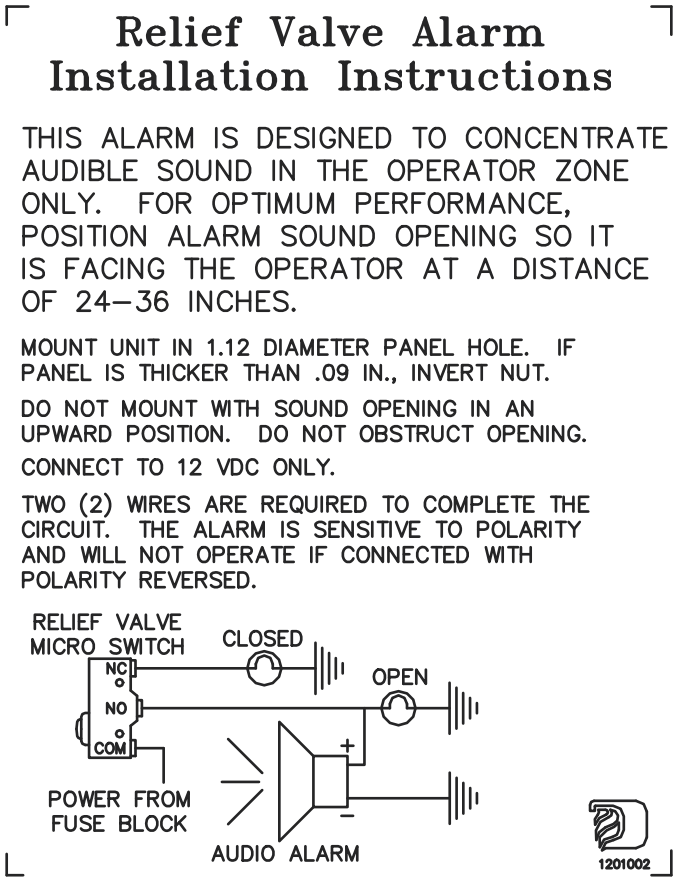
Relief Valve Alarm
Installation Instruction

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.

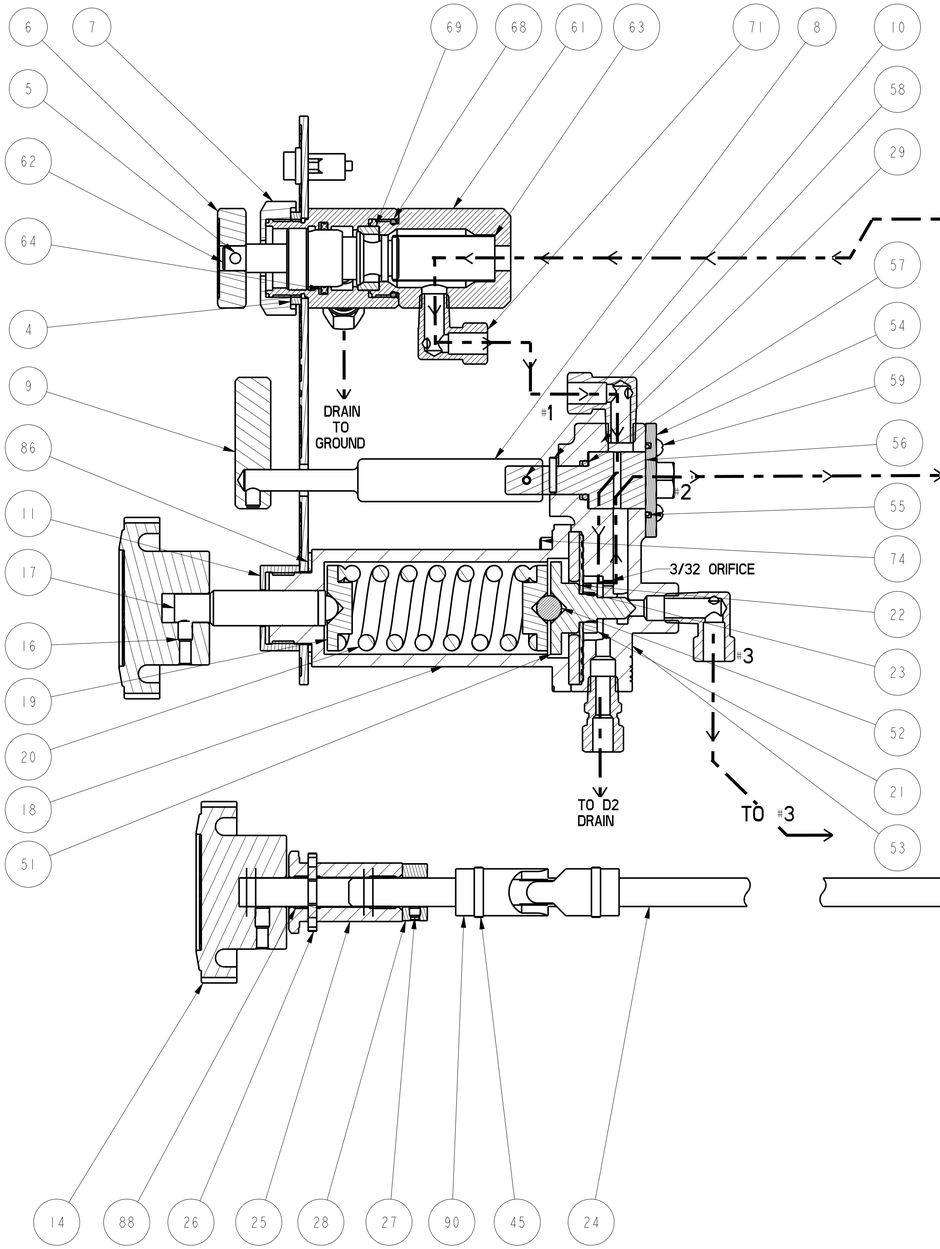
Connect to 12 VDC only.
Two (2) wires are required to complete the circuit. The alarm is sensitive to polarity and will not operate if connected with polarity reversed.

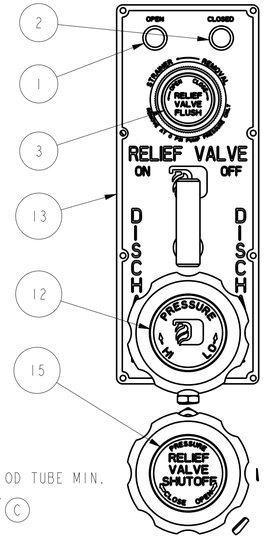


IF FURTHER INFORMATION IS NEEDED, CALL W.S. DARLEY & CO. AT CHIPPEWA FALLS, WI. AT 800-634-7812 or 715-726-2650

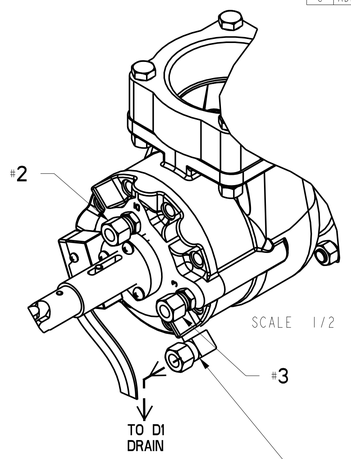
NO.	DESCRIPTION	PART NO.	QTY.
1	LIGHT - AMBER	-	1
2	LIGHT - GREEN	-	1
3	DECAL - FLUSH SCREEN	-	1
4	NUT - PANEL, FLUSH VALVE	-	1
5	SSS - NO.10-32 x 0.38, GR5	-	1
6	KNOB - FLUSH VALVE	-	1
7	NUT - PANEL, 1.38-12	-	1
8	COUPLING - RELEIF VALVE STEM	-	1
9	LEVER - R.V. ON/OFF	-	1
10	PIN - DRIVE LOK, 0.125 X 0.750	-	1
11	NUT - PANEL VALVE, 1.250-12	-	1
12	DECAL - PRESSURE, HI/LO	-	1
13	PLATE - TRIM, REMOTE HEAD	-	1
14	HANDWHEEL	-	2
15	DECAL - PRESSURE RELIEF VALVE	-	1
16	SSS - 1/4-20 x 0.38, SST	-	3
17	SCREW - SPRING TENSION	-	1
18	HOUSING - PILOT VALVE	-	1
19	RETAINER - SPRING	-	2
20	SPRING - PRESSURE REGULATOR	-	1
21	NUT - PILOT VALVE	-	1
22	RING - HOUSING PILOT	-	1
23	DIAPHRAM - PIOLET HEAD	-	1
24	SHAFT - R.V. EXTENSION, 24"	-	1
25	BUSHING - RETAINER, PANEL	-	1
26	NUT - .750, CONDUIT	-	1
27	SSS - NO.10-24 x 0.19, GR5	-	1
28	COLLAR - SHAFT, 1/2" BORE	-	1
29	SSS - .313 x 0.31, GR5	-	1
30	COUPLING - RELIEF VALVE STEM	-	1
31	MICROSWITCH - OMRON	-	1
32	PIN - SPRING, 0.19 X 1.12	-	1
33	O-RING - 0.38 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 0.94 x 0.09	-	1
36	PLATE - SEAL, VALVE STEM	-	1
37	O-RING - 3.25 x 3.38 x 0.06	-	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 3.69 x 0.09	-	2
43	CENTER PLUG - PISTON SPRING	-	1
44	SPRING - PISTON	-	1
45	PIN - SPRING, 0.16 X 0.88	-	4
46	QUAD RING - 2.88 x 3.25 x 0.19	-	1
47	WASHER - 0.39 x 0.61 x .06 BR	-	1
48	STEM - RELIEF VALVE SWITCH	-	1
49	SHIM - SWITCH SPACER, 0.0125	-	1
50	PLUG - PIPE, 0.125, SST SOC HD	-	1
51	PIN - PILOT VALVE	-	1
52	BALL - CAM, 0.44"	-	1
53	HEAD - PILOT CONTROL	-	1
54	COVER - ON/OFF 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, SST	-	1
59	RHMS - NO.8-32 X 0.50, BR	-	4
61	BODY - FLUSH VALVE, COMPLETE	-	1
62	STEM - FLUSH VALVE	-	1
63	STRAINER - SCREEN	-	1
64	QUAD RING - 1.00 x 1.25 x 0.12	-	1
68	O-RING - 1.19 x 1.38 x 0.09	-	1
69	SEAT - FLUSH VALVE	-	1
71	TUBE FITTING - EL, .38 x .25	-	5
72	TUBE FITTING - STR, .38 cf x .25 NPTM	-	3
73	TUBE FITTING - STR, .38 cf x .12 NPTM	-	1
74	SHCS - .250-20 X 0.88, SST	-	4
75	SHCS - .313-18 x 0.75, GR8	-	8
76	WASHER - LOCK, NO.6 ID, SST	-	2
77	RHMS - NO.6-32 X1.00, BR	-	2
79	NUT - HEX, .375-16, GR2	-	8
81	HHCS - .375-16 x 2.25, GR5	-	8
82	FLANGE - ADAPTER, 3 NPT	-	2
83	RHMS - NO.10-24 X 0.75, GR5	-	3
86	WASHER - INT. TOOTH, 1.250 ID	-	1
88	BEARING - NYLINER, 0.50 ID	-	2
90	JOINT - UNIVERSAL, .500"	-	2
91	SHIM - SWITCH SPACER, 0.025	-	1
93	WASHER - LOCK, NO.10 ID, SST	-	3
95	CONNECTOR - DUETCH DT 06-3S	-	1

REVISIONS				
LTR	DESCRIPTION	DATE	CHG NO.	APPR'D
A	REVERSED LIGHT POSITIONS	12JUL07	2007-285	RJG
B	ADDED FLOW PATH VIEW	21NOV2007	2007-451	SMS
C	ADDED NOTE: 3/8 OD TUBE SIZE	9-18-2015	ED-11153	TED



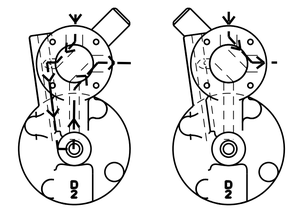


SCALE 1/2



SCALE 1/2

THIS DRAIN TO BE IN LOWEST PORT BY ORIENTATION AT TIME OF INSTALLATION



SCALE 1/2

VALVE ON VALVE OFF

(B) FLOW PATH THRU PILOT CONTROL VALVE

3/8 OD TUBE MIN. TYP. (C)

(A)

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

REMOVE SHARP EDGES

INCH [MILLIMETER]

THIRD ANGLE PROJECTION

OLD PART NO.

MATERIAL DESCRIPTION:

MATERIAL NO.

PATTERN NO.

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

ALL DIMENSIONS IN INCHES UNLESS NOTED

DO NOT SCALE PRINT

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

DR'N HAL

CHK'D SJL

TRC'D

MODEL NAME DGC0141 | MDL CREATED 08JUN05 | SHEET 1/2 | D

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

RELIEF VALVE

DATE 13-Jun-05

SCALE 3/4

DGC0141

NO.	DESCRIPTION	PART NO.	QTY.
1	LIGHT - AMBER	-	1
2	LIGHT - GREEN	-	1
3	DECAL - FLUSH SCREEN	-	1
4	NUT - PANEL, FLUSH VALVE	-	1
5	SSS - NO.10-32 x 0.38, GR5	-	1
6	KNOB - FLUSH VALVE	-	1
7	NUT - PANEL, 1.38-12	-	1
8	COUPLING - RELEIF VALVE STEM	-	1
9	LEVER - R.V. ON/OFF	-	1
10	PIN - DRIVE LOK, 0.125 X 0.750	-	1
11	NUT - PANEL VALVE, 1.250-12	-	1
12	DECAL - PRESSURE, HI/LO	-	1
13	PLATE - TRIM, REMOTE HEAD	-	1
14	HANDWHEEL	-	2
15	DECAL - PRESSURE RELIEF VALVE	-	1
16	SSS - 1/4-20 x 0.38, SST	-	3
17	SCREW - SPRING TENSION	-	1
18	HOUSING - PILOT VALVE	-	1
19	RETAINER - SPRING	-	2
20	SPRING - PRESSURE REGULATOR	-	1
21	NUT - PILOT VALVE	-	1
22	RING - HOUSING PILOT	-	1
23	DIAPHRAM - PIOLET HEAD	-	1
24	SHAFT - R.V. EXTENSION, 24"	-	1
25	BUSHING - RETAINER, PANEL	-	1
26	NUT - .750, CONDUIT	-	1
27	SSS - NO.10-24 x 0.19, GR5	-	1
28	COLLAR - SHAFT, 1/2" BORE	-	1
29	SSS - .313 x 0.31, GR5	-	1
30	COUPLING - RELIEF VALVE STEM	-	1
31	MICROSWITCH - OMRON	-	1
32	PIN - SPRING, 0.19 X 1.12	-	1
33	O-RING - 0.38 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 0.94 x 0.09	-	1
36	PLATE - SEAL, VALVE STEM	-	1
37	O-RING - 3.25 x 3.38 x 0.06	-	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 3.69 x 0.09	-	2
43	CENTER PLUG - PISTON SPRING	-	1
44	SPRING - PISTON	-	1
45	PIN - SPRING, 0.16 X 0.88	-	4
46	QUAD RING - 2.88 x 3.25 x 0.19	-	1
47	WASHER - 0.39 x 0.61 x .06 BR	-	1
48	STEM - RELIEF VALVE SWITCH	-	1
49	SHIM - SWITCH SPACER, 0.0125	-	1
50	PLUG - PIPE, 0.125, SST SOC HD	-	1
51	PIN - PILOT VALVE	-	1
52	BALL - CAM, 0.44"	-	1
53	HEAD - PILOT CONTROL	-	1
54	COVER - ON/OFF 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, SST	-	1
59	RHMS - NO.8-32 X 0.50, BR	-	4
61	BODY - FLUSH VALVE, COMPLETE	-	1
62	STEM - FLUSH VALVE	-	1
63	STRAINER - SCREEN	-	1
64	QUAD RING - 1.00 x 1.25 x 0.12	-	1
68	O-RING - 1.19 x 1.38 x 0.09	-	1
69	SEAT - FLUSH VALVE	-	1
71	TUBE FITTING - EL, .38 x .25	-	5
72	TUBE FITTING - STR, .38 cf x .25 NPTM	-	3
73	TUBE FITTING - STR, .38 cf x .12 NPTM	-	1
74	SHCS - .250-20 X 0.88, SST	-	4
75	SHCS - .313-18 x 0.75, GR8	-	8
76	WASHER - LOCK, NO.6 ID, SST	-	2
77	RHMS - NO.6-32 X1.00, BR	-	2
79	NUT - HEX, .375-16, GR2	-	8
81	HHCS - .375-16 x 2.25, GR5	-	8
82	FLANGE - ADAPTER, 3 NPT	-	2
83	RHMS - NO.10-24 X 0.75, GR5	-	3
86	WASHER - INT. TOOTH, 1.250 ID	-	1
88	BEARING - NYLINER, 0.50 ID	-	2
90	JOINT - UNIVERSAL, .500"	-	2
91	SHIM - SWITCH SPACER, 0.025	-	1
93	WASHER - LOCK, NO.10 ID, SST	-	3
95	CONNECTOR - DUETCH DT 06-3S	-	1

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

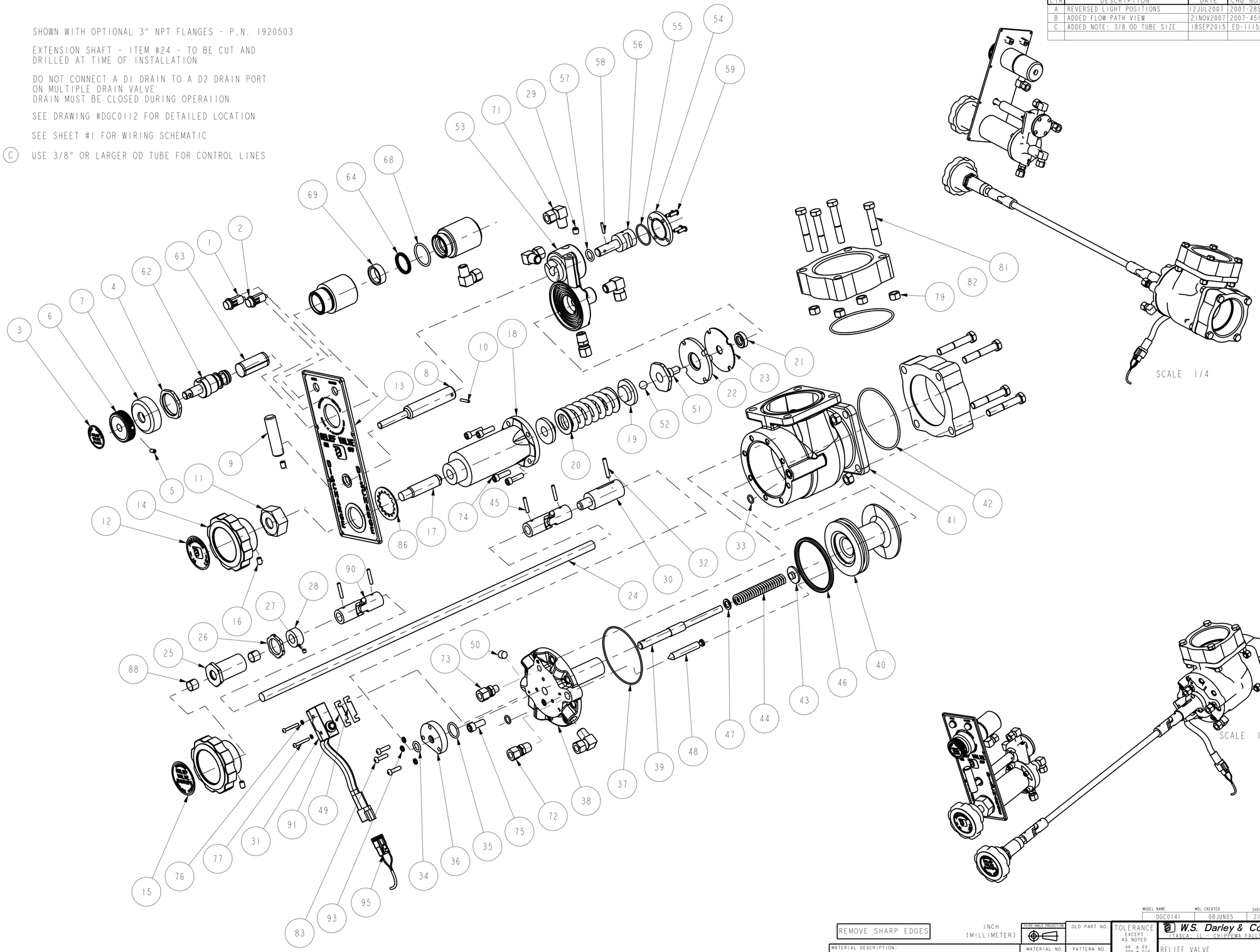
EXTENSION SHAFT - ITEM #24 - TO BE CUT AND DRILLED AT TIME OF INSTALLATION

DO NOT CONNECT A D1 DRAIN TO A D2 DRAIN PORT ON MULTIPLE DRAIN VALVE
DRAIN MUST BE CLOSED DURING OPERAIION

SEE DRAWING #DGC0112 FOR DETAILED LOCATION

SEE SHEET #1 FOR WIRING SCHEMATIC

(C) USE 3/8" OR LARGER OD TUBE FOR CONTROL LINES



SCALE 1/4

SCALE 1/4

REVISIONS				
LTR	DESCRIPTION	DATE	CHG NO.	APPR'D
A	REVERSED LIGHT POSITIONS	12JUL2007	2007-285	RJG
B	ADDED FLOW PATH VIEW	21NOV2007	2007-451	SMS
C	ADDED NOTE: 3/8 OD TUBE SIZE	18SEP2015	ED-11153	TED

MODEL NAME	MDL CREATED	SHEET	
DGC0141	08JUN05	2/2	D

REMOVE SHARP EDGES | INCH [MILLIMETER] | THIRD ANGLE PROJECTION | OLD PART NO.

MATERIAL DESCRIPTION: | MATERIAL NO. | PATTERN NO.

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

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

DR'N HAL | CHKD SJL | TRCD

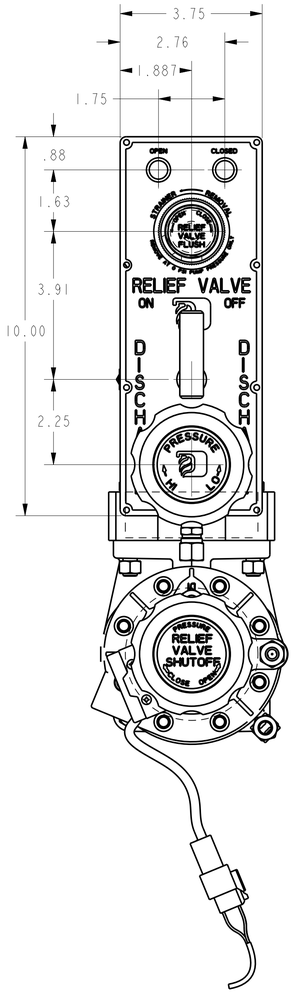
W.S. Darley & Co.
ITASCA, IL CHIPPEWA FALLS, WI

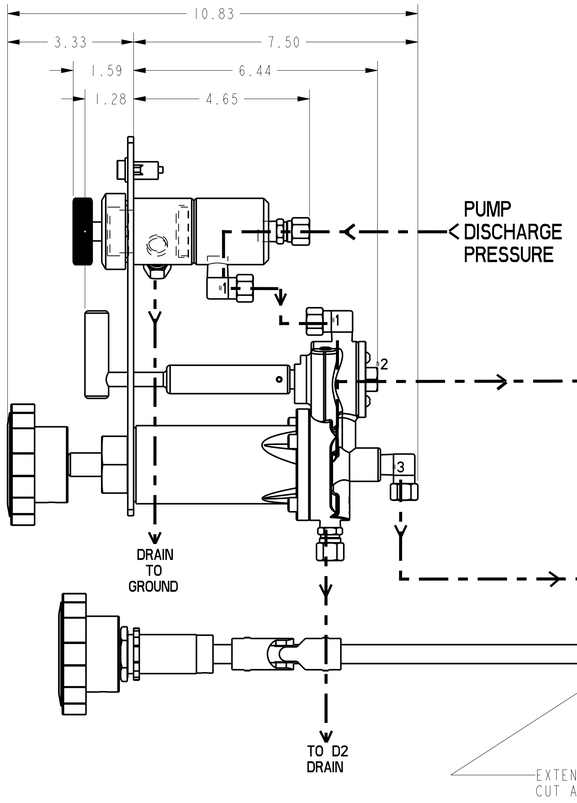
RELIEF VALVE

DATE 15-Jun-05 | SCALE 3/4

DGC0141

REVISIONS				
LTR	DESCRIPTION	DATE	CHG NO.	APPR'D
A	OPEN WAS GREEN	8/06/07	2007-313	RJG
B	ADDED NOTE: 3/8 OD TUBE SIZE	02OCT2015	ED-11153	TED

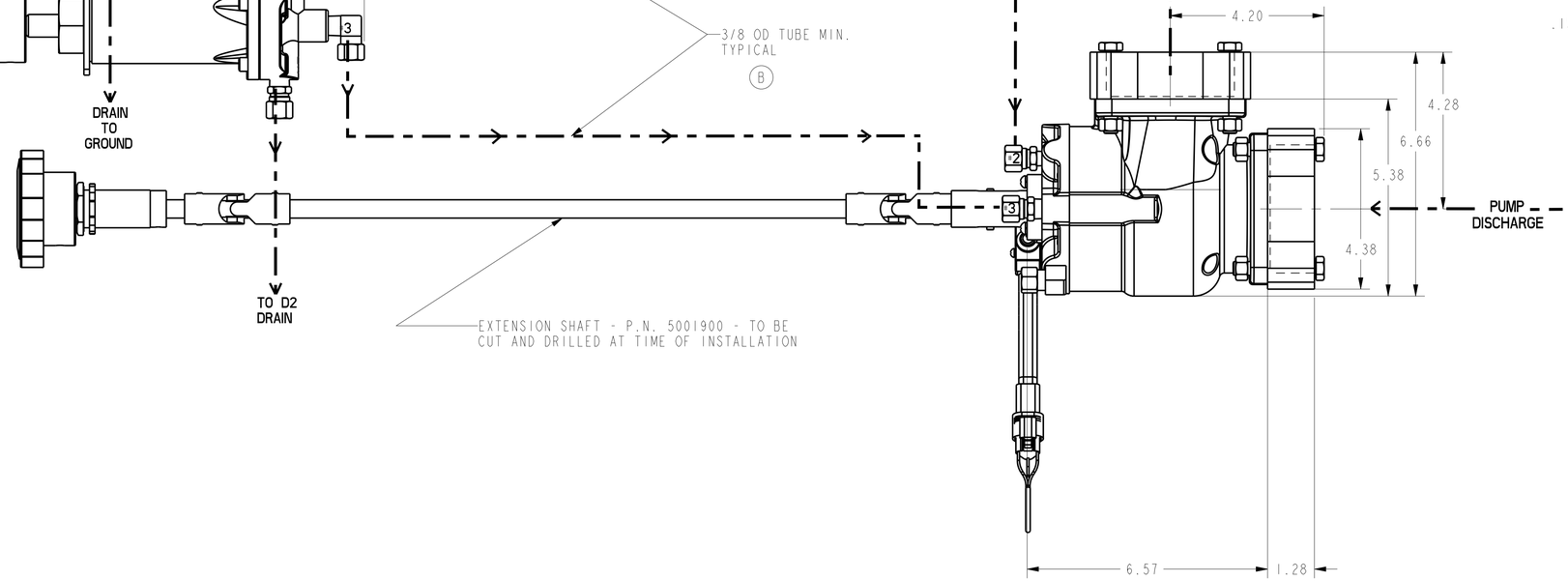


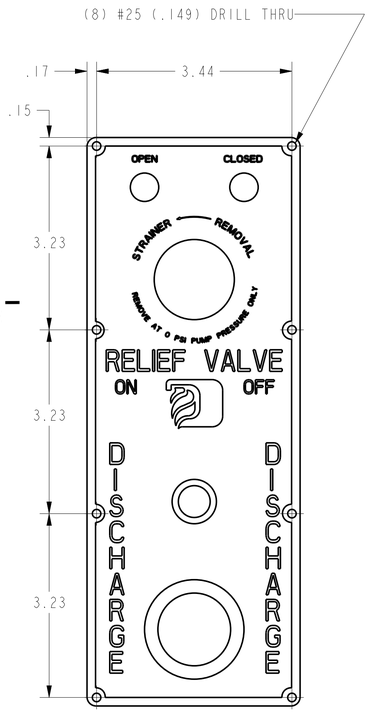


DO NOT CONNECT A DI DRAIN TO A D2 DRAIN PORT
ON MULTIPLE DRAIN VALVE.
DRAIN MUST BE CLOSED DURING OPERATION

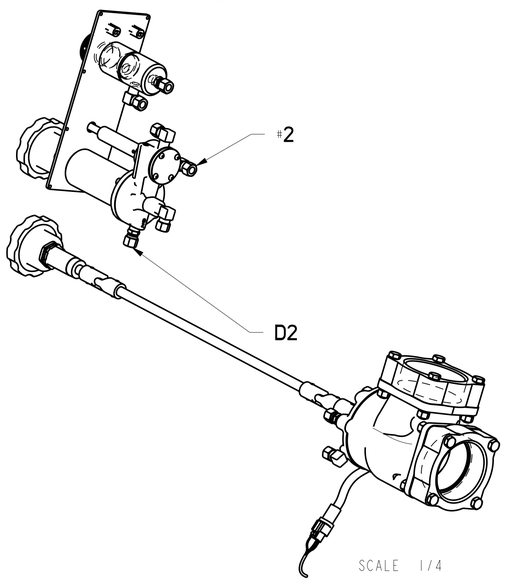
SEE DRAWING #DGC0112 FOR DETAILED LOCATION

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

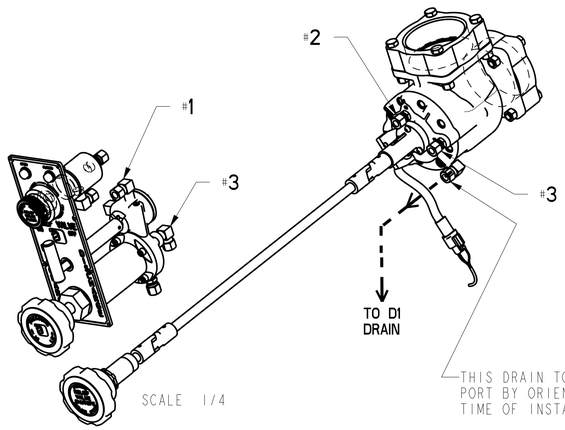




SCALE 3/4

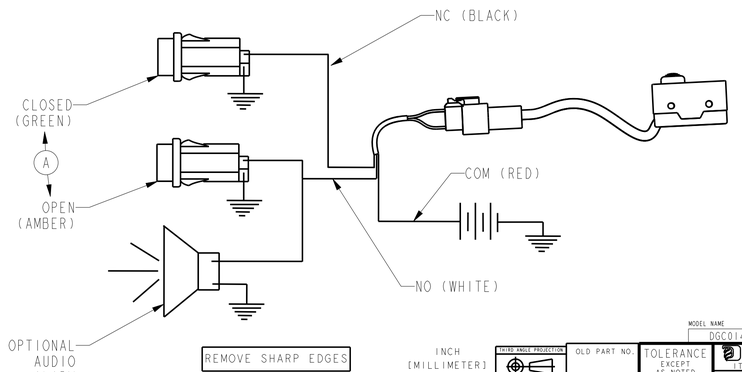


SCALE 1/4



SCALE 1/4

THIS DRAIN TO BE IN LOWEST PORT BY ORIENTATION AT TIME OF INSTALLATION



MODEL NAME	MDL CREATED	SHEET
DGC0141	08JUN05	1/1 D

REMOVE SHARP EDGES | INCH [MILLIMETER] | THIRD ANGLE PROJECTION | OLD PART NO.

MATERIAL DESCRIPTION: | MATERIAL NO. | PATTERN NO.

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

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

DR'N HAL
CHKD MCR
TRCD

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

RELIEF VALVE

DATE 16-Jun-05
SCALE 1/2

DGD0800

W.S. DARLEY & CO.

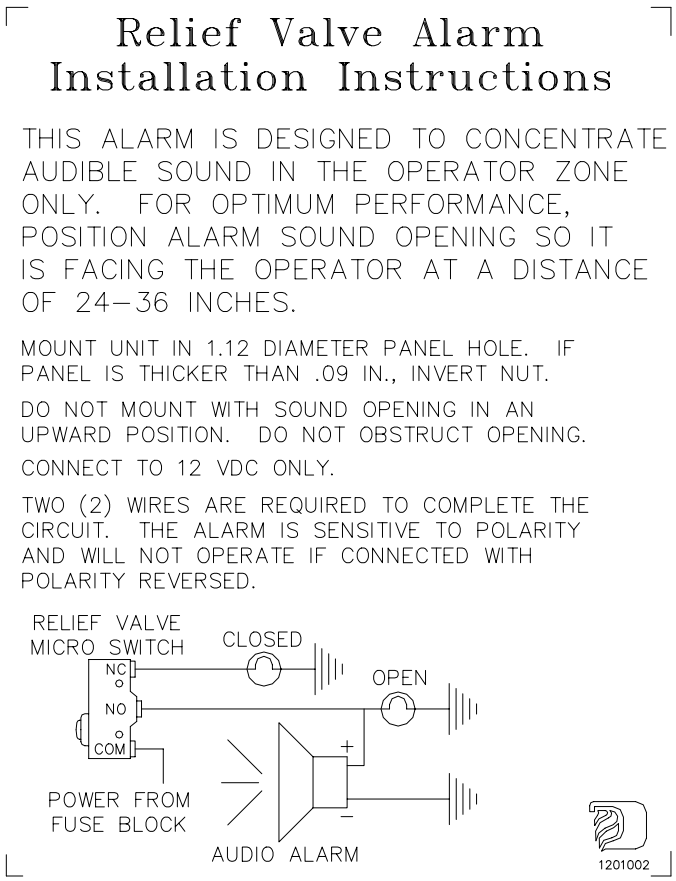
Relief Valve Alarm
Installation Instruction

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.

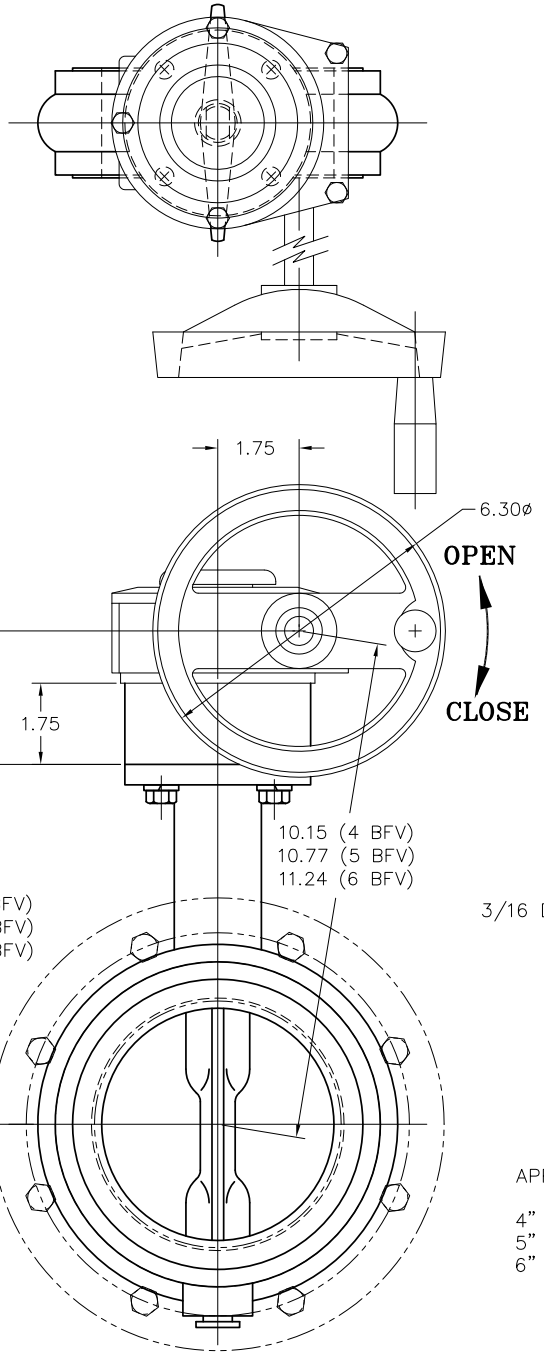
Do not mount with sound opening in an upward position. Do not obstruct opening.

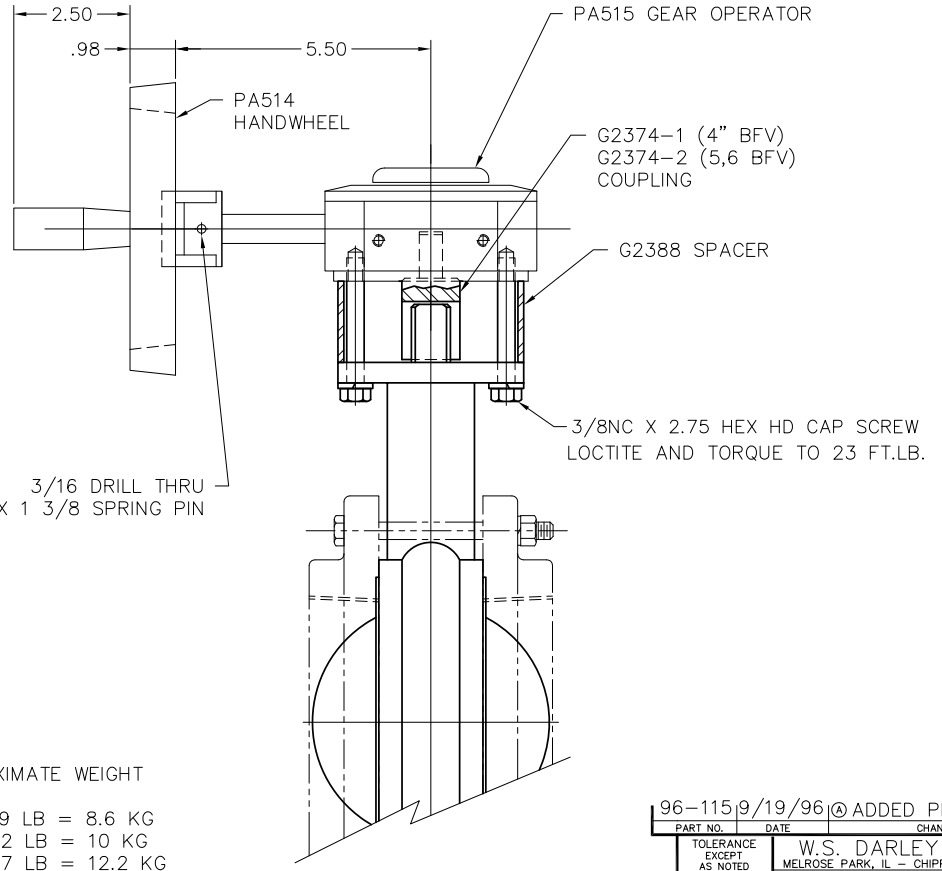
Connect to 12 VDC only.
Two (2) wires are required to complete the circuit. The alarm is sensitive to polarity and will not operate if connected with polarity reversed.



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

BUTTERFLY VALVE





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

APPROXIMATE WEIGHT

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

PART NO.	DATE	CHANGE
96-115	9/19/96	Ⓐ ADDED PLATE LMH

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

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

DWG - BTRFLY VALVE ASSY
MANUAL CONTROLLED

OLD PART NO. G2420

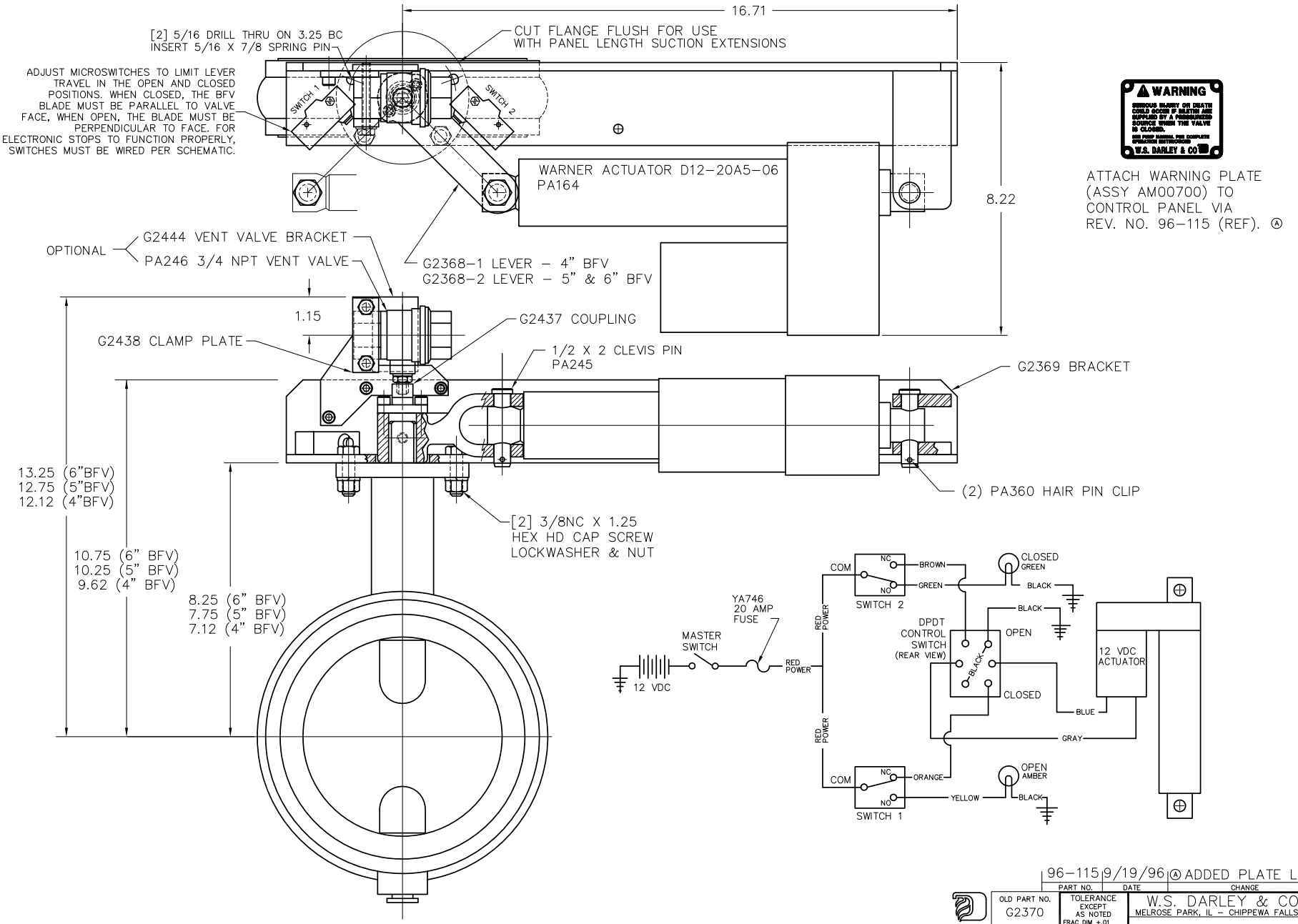
DR'N DWS
CHKD
TRCD

DATE SEP25,91
SCALE 1/2

DGD0104

ALL DIMENSIONS IN INCHES UNLESS NOTED

DO NOT SCALE PRINT



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

PART NO.	DATE	CHANGE
96-115	9/19/96	Ⓐ ADDED PLATE LMH

MATERIAL:	MATERIAL NO. –	PATTERN NO.	OLD PART NO. G2370	TOLERANCE EXCEPT AS NOTED FRAC DIM ±.01 .00 ±.01 .000 ±.005 ANGLES ±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	DR'N SEITZ CHKD TRCD	DATE NOV20,91 SCALE 1/2

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

DWG – BUTTERFLY VALVE ASSEMBLY
ELECTRIC ACTUATED

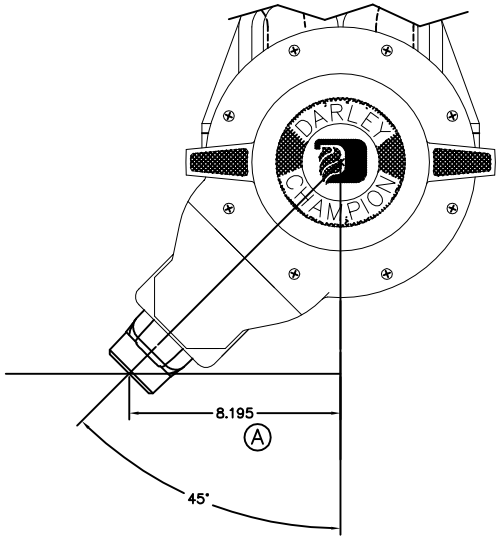
DGD0101

INLET RELIEF VALVE INFORMATION: Ⓐ

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

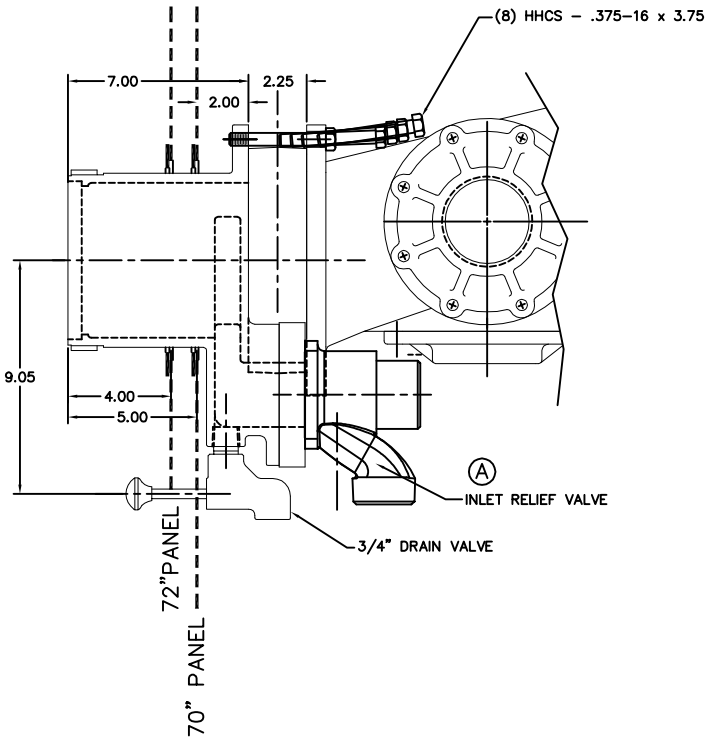
ADJUSTMENT INSTRUCTIONS (IF REQUIRED): Ⓐ

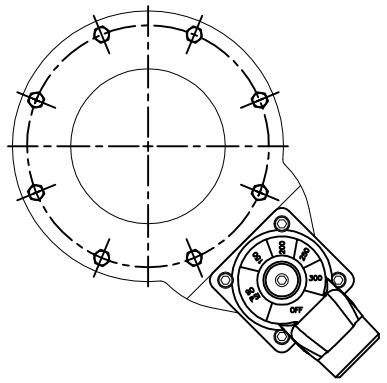
ADJUST CENTER HEX COUNTERSUNK HEX HEAD PRESSURE ADJUSTING BOLT WITH A 1/4" ALLEN WRENCH, 9/16" OR 14 MM SOCKET.
TO SET AT THE DESIRED RELIEF PRESSURE, ADJUST THE ADJUSTING BOLT HEAD SO THE TOP OF THE BOLT HEAD IS EVEN WITH THE DESIRED PRESSURE.



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

Ⓐ





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

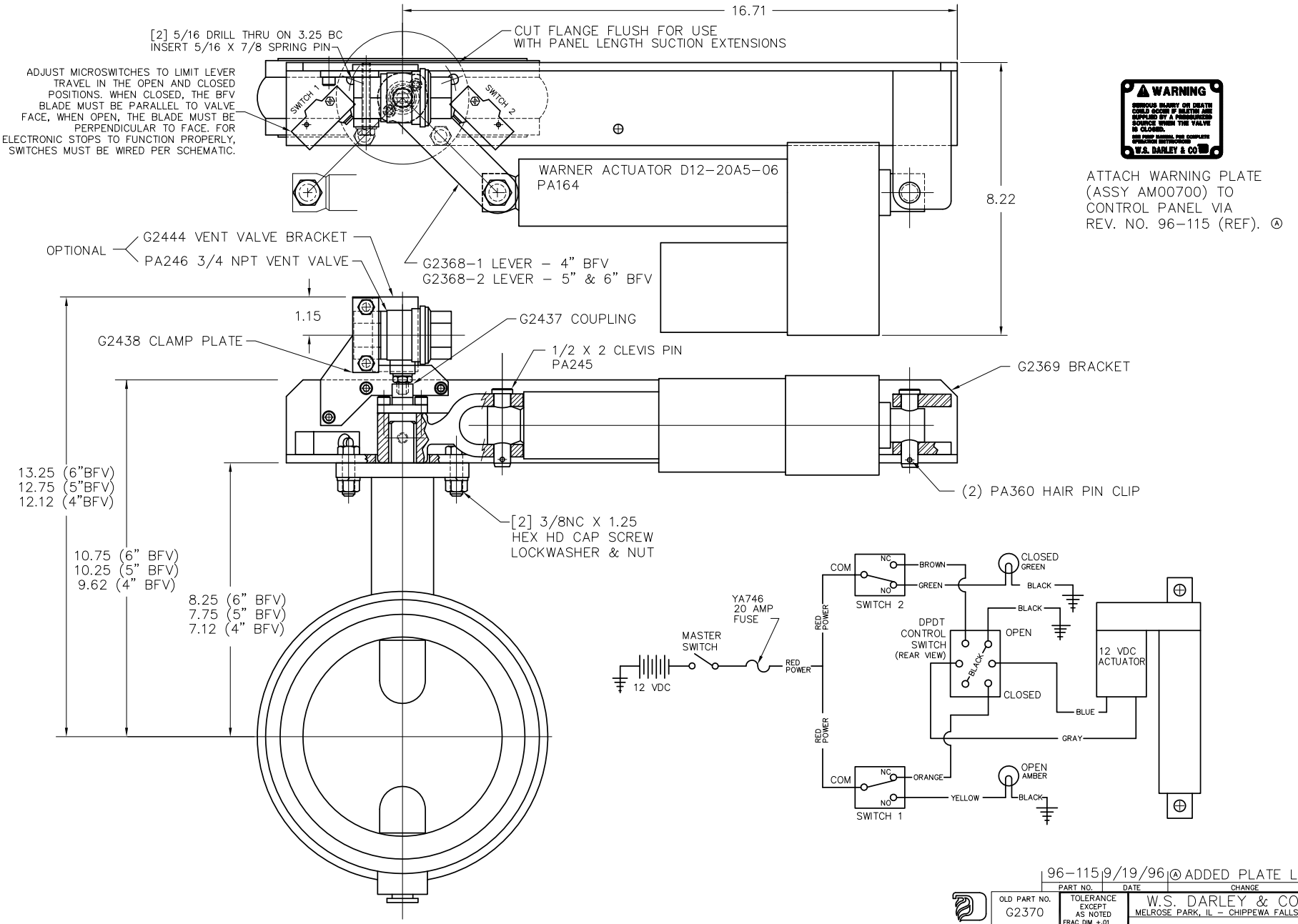
EXTENSION AND NIPPLE ARE THE SAME FOR 70 & 72" ASSEMBLIES WITH AND WITHOUT BUTTERFLY VALVES.
IF BFV IS NOT REQUIRED, THEN KC00300 ASSY W/2.25 THICK SPACER IS USED.
USE 1962503 STAINLESS STEEL PANEL TRIM RING

PART NO.	DATE	CHANGE
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

TOLERANCE EXCEPT AS NOTED FRAC DIM ±.01 .00 ±.01 .000 ±.005 ANGLES ±1°	W.S. DARLEY & CO. MELROSE PARK, IL – CHIPPEWA FALLS, WI
MATERIAL:	INSTR – INLET RV ADJUSTMENT –
PATTERN NO.	
DR'N CKE	DATE 03FEB,00
CHKD SJL	SCALE 1/4
TRCD	I200572

ALL DIMENSIONS IN INCHES UNLESS NOTED

DO NOT SCALE PRINT



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

PART NO.	DATE	CHANGE
96-115	9/19/96	Ⓐ ADDED PLATE LMH

MATERIAL:	MATERIAL NO. –	PATTERN NO.	OLD PART NO. G2370	TOLERANCE EXCEPT AS NOTED FRAC DIM ±.01 .00 ±.01 .000 ±.005 ANGLES ±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	DR'N SEITZ CHKD TRCD	DATE NOV20,91 SCALE 1/2

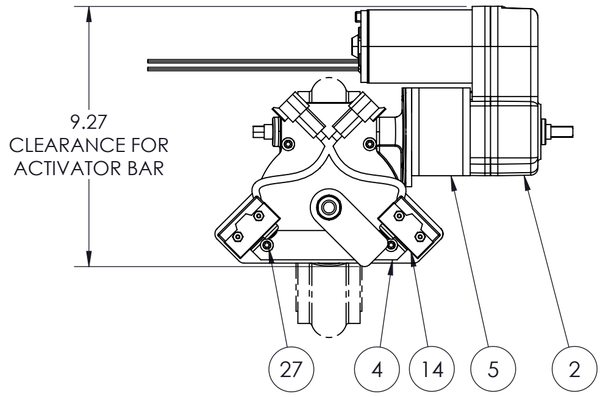
W.S. DARLEY & CO.
MELROSE PARK, IL – CHIPPEWA FALLS, WI

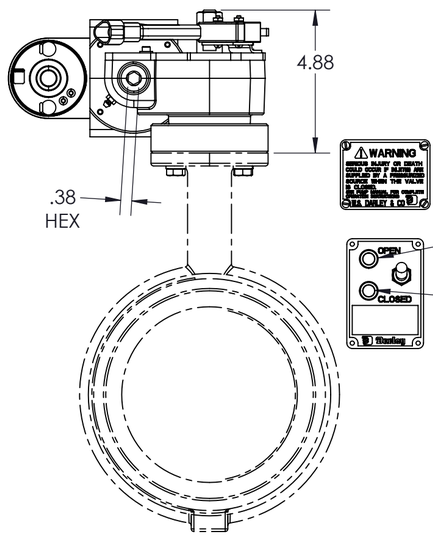
DWG – BUTTERFLY VALVE ASSEMBLY
ELECTRIC ACTUATED

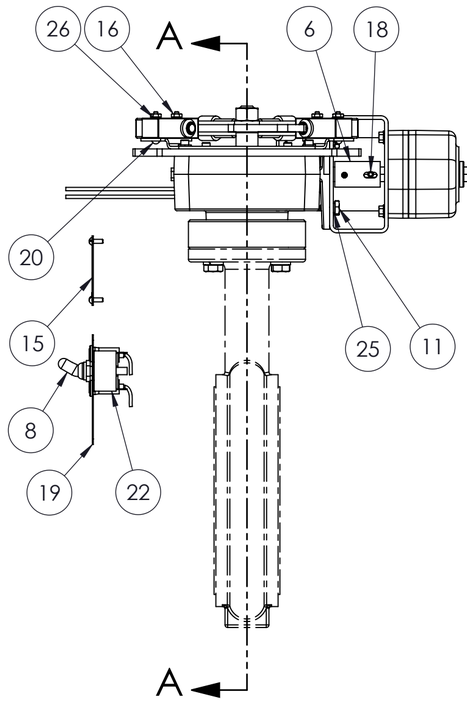
DGD0101

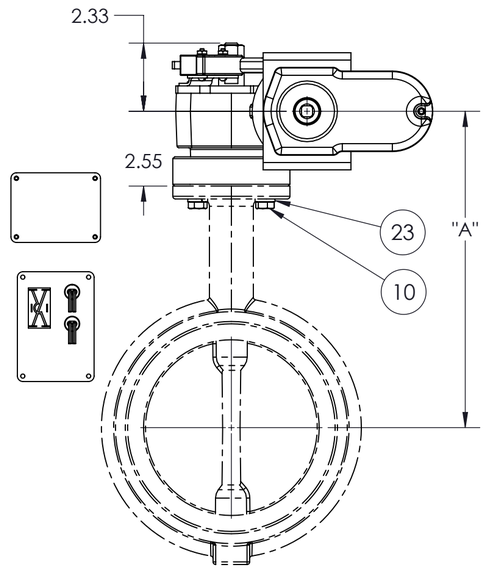
ITEM NO.	File Name	Darley Item Description (Line 1)	QTY.
1	2603181	ACTUATOR- MAN, ELKHART	1
2	2603203	ACTUATOR - THOMSON, ROTARY	1
3	5329901	BAR - ACTIVATOR	1
4	4010521	BRACKET-MOUNTING MICRO SW	1
5	4034121	BRACKET-THOMSON ACTUATOR	1
6	5323904	COUPLING-BTRFLY VALVE	1
7	5330100	COVER - ACTUATOR	1
8	2605001	COVER - TOGGLE SWITCH	1
9	5403005	NUT - HEX, .500-13, GR2	1
10	5400037	HHCS - .375-16 x 1.25, GR5	4
11	5400123	HHCS - 10-24 X .50, GR5	4
12	2602302	LIGHT - INDICATOR, AMBER 12V	1
13	2602301	LIGHT - INDICATOR, GREEN, 12V	1
14	2600056	MICROSWITCH - OMRON, POTTED	2
15	AM00700	MISC - VALVE WARNING PLATE	1
16	5403008	NUT - HEX, .750-16, GR2	4
17	3601111	O-RING - 0.69 x 0.88 x 0.09	1
18	3605029	PIN - SPRING, 0.19 x 1.00, SST	2
19	1960201	PLATE - SWITCH	1
20	5402011	RHMS - NO.6-32 x 1.00, GR5	4
21	5023800	SHAFT - DRIVE, ACTUATOR	1
22	2600005	SWITCH - TOGGLE, MOMENTARY	1
23	3603503	WASHER - LOCK, 0.375 ID	4
24	3603505	WASHER - LOCK, 0.500 ID	1
25	3603509	WASHER - LOCK, NO.10 ID	4
26	3603508	WASHER - LOCK, NO.6 ID	4
27	5401430	SHCS - NO.8-32 x .75" SST	4

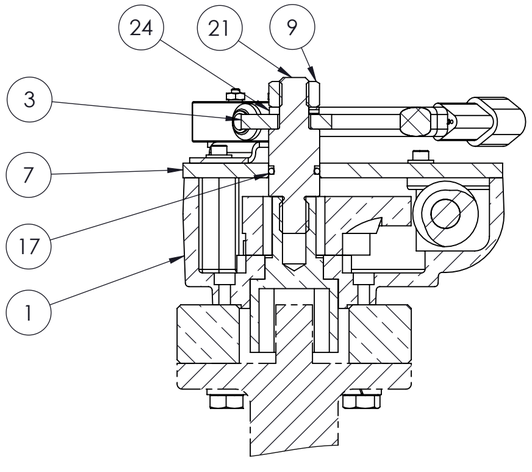
REVISIONS					
ZONE	REV.	DESCRIPTION	DATE	CHG NO.	APPROVED
F6	B	2603181 WAS 2603182	6/10/2019	12368	SMS









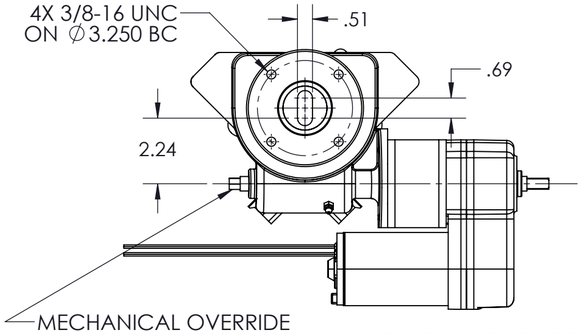


SECTION A-A

SCALE 1 : 2

SIZE	PART #	"A"
5"	5206000	9.68
6"	5206100	10.80
6"	5206110	9.43

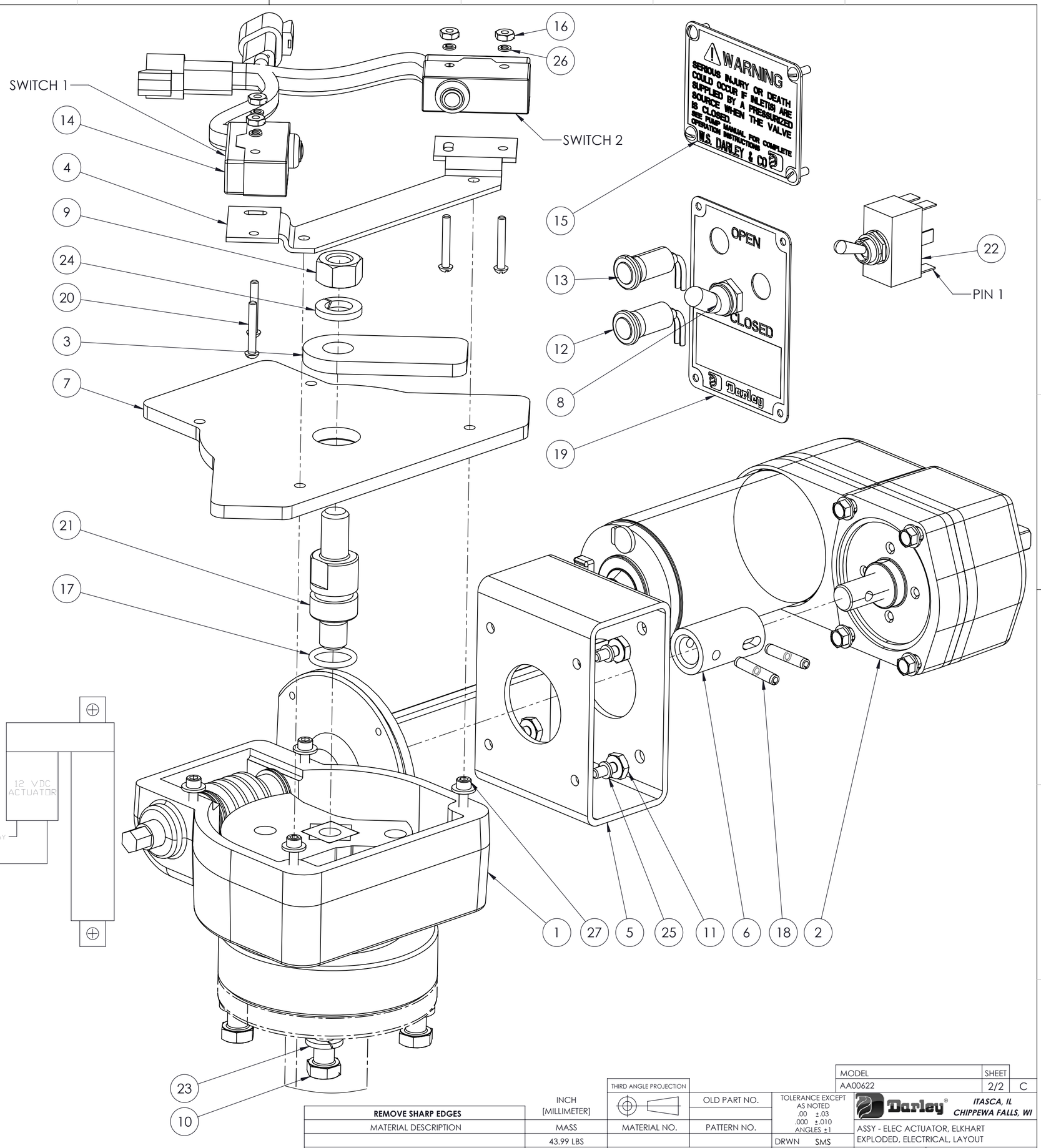
SHOWN

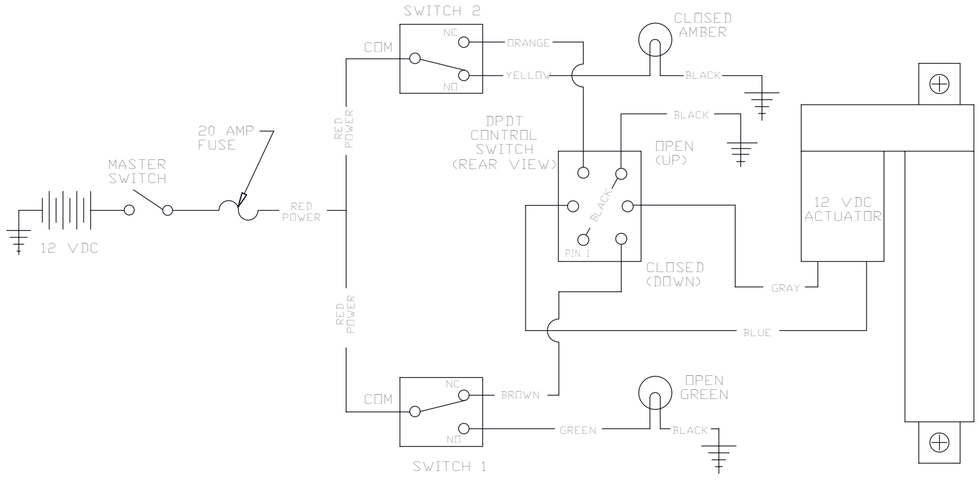


MECHANICAL OVERRIDE
TURN CLOCKWISE 12-13 TURNS FROM FULLY OPEN TO FULLY CLOSED
TURN COUNTERCLOCKWISE 12-13 TURNS FROM FULLY CLOSED TO FULLY OPEN

		THIRD ANGLE PROJECTION		MODEL	SHEET
				AA00622	1/2 C
REMOVE SHARP EDGES	INCH [MILLIMETER]		OLD PART NO.	TOLERANCE EXCEPT AS NOTED .00 ±.03 .000 ±.010 ANGLES ±1	Darley ITASCA, IL CHIPPEWA FALLS, WI
MATERIAL DESCRIPTION	MASS	MATERIAL NO.	PATTERN NO.	ASSY - ELEC ACTUATOR, ELKHART EXPLODED, ELECTRICAL, LAYOUT	
	43.99 LBS			DRWN SMS	
THIS DESIGN IS THE PROPERTY OF WS. DARLEY CO. - UNAUTHORIZED REPRODUCTION IS PROHIBITED	ALL DIMENSIONS IN INCHES UNLESS NOTED	DO NOT SCALE PRINT		CKHD CLH	DATE: 11/1/2016 DGD0903
				TRCD	SCALE: 1:4

ITEM NO.	File Name	Darley Item Description (Line 1)	QTY.
1	2603181	ACTUATOR- MAN, ELKHART	1
2	2603203	ACTUATOR - THOMSON, ROTARY	1
3	5329901	BAR - ACTIVATOR	1
4	4010521	BRACKET-MOUNTING MICRO SW	1
5	4034121	BRACKET-THOMSON ACTUATOR	1
6	5323904	COUPLING-BTRFLY VALVE	1
7	5330100	COVER - ACTUATOR	1
8	2605001	COVER - TOGGLE SWITCH	1
9	5403005	NUT - HEX, .500-13, GR2	1
10	5400037	HHCS - .375-16 x 1.25, GR5	4
11	5400123	HHCS - 10-24 X .50, GR5	4
12	2602302	LIGHT - INDICATOR, AMBER 12V	1
13	2602301	LIGHT - INDICATOR, GREEN, 12V	1
14	2600056	MICROSWITCH - OMRON, POTTED	2
15	AM00700	MISC - VALVE WARNING PLATE	1
16	5403008	NUT - HEX, .750-16, GR2	4
17	3601111	O-RING - 0.69 x 0.88 x 0.09	1
18	3605029	PIN - SPRING, 0.19 x 1.00, SST	2
19	1960201	PLATE - SWITCH	1
20	5402011	RHMS - NO.6-32 x 1.00, GR5	4
21	5023800	SHAFT - DRIVE, ACTUATOR	1
22	2600005	SWITCH - TOGGLE, MOMENTARY	1
23	3603503	WASHER - LOCK, 0.375 ID	4
24	3603505	WASHER - LOCK, 0.500 ID	1
25	3603509	WASHER - LOCK, NO.10 ID	4
26	3603508	WASHER - LOCK, NO.6 ID	4
27	5401430	SHCS - NO.8-32 x .75" SST	4





REMOVE SHARP EDGES	INCH [MILLIMETER]	THIRD ANGLE PROJECTION	OLD PART NO.	TOLERANCE EXCEPT AS NOTED .00 ±.03 .000 ±.010 ANGLES ±1	Darley® ITASCA, IL CHIPPEWA FALLS, WI
MATERIAL DESCRIPTION	MASS	MATERIAL NO.	PATTERN NO.		ASSY - ELEC ACTUATOR, ELKHART EXPLODED, ELECTRICAL, LAYOUT
	43.99 LBS			DRWN SMS	
THIS DESIGN IS THE PROPERTY OF WS. DARLEY CO. - UNAUTHORIZED REPRODUCTION IS PROHIBITED	ALL DIMENSIONS IN INCHES UNLESS NOTED	**DO NOT SCALE PRINT**		CKHD CLH	DATE: 11/1/2016
				TRCD	SCALE: 3:4

MODEL	SHEET	
AA00622	2/2	C

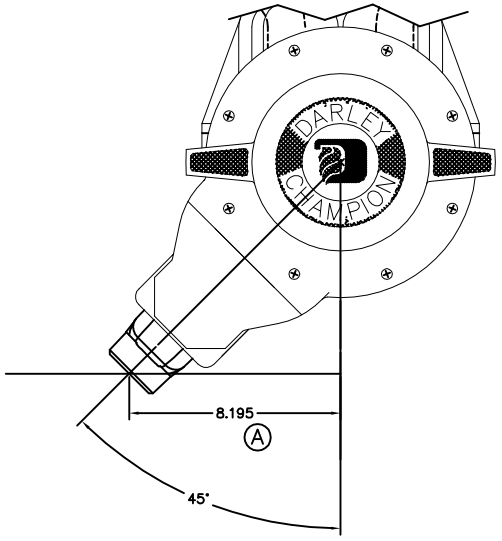
DGD0903

INLET RELIEF VALVE INFORMATION: Ⓐ

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

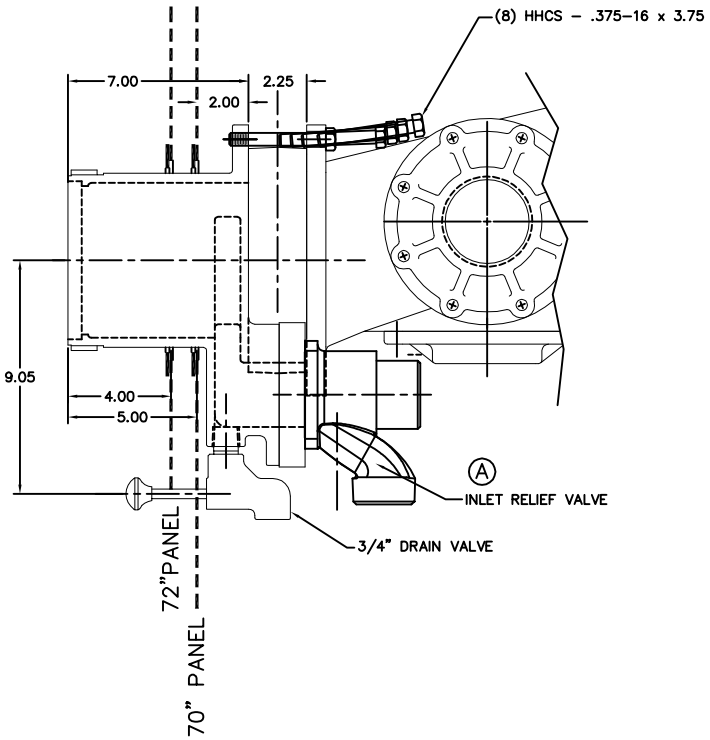
ADJUSTMENT INSTRUCTIONS (IF REQUIRED): Ⓐ

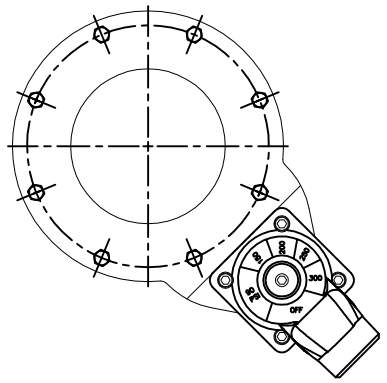
ADJUST CENTER HEX COUNTERSUNK HEX HEAD PRESSURE ADJUSTING BOLT WITH A 1/4" ALLEN WRENCH, 9/16" OR 14 MM SOCKET.
TO SET AT THE DESIRED RELIEF PRESSURE, ADJUST THE ADJUSTING BOLT HEAD SO THE TOP OF THE BOLT HEAD IS EVEN WITH THE DESIRED PRESSURE.



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

PART NO.	DATE	CHANGE
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

TOLERANCE EXCEPT AS NOTED FRAC DIM ±.01 .00 ±.01 .000 ±.005 ANGLES ±1°	W.S. DARLEY & CO. MELROSE PARK, IL – CHIPPEWA FALLS, WI
MATERIAL:	INSTR – INLET RV ADJUSTMENT
PATTERN NO.	–
DR'N CKE	DATE 03FEB,00
CHKD SJL	SCALE 1/4
TRCD	I200572

ALL DIMENSIONS IN INCHES UNLESS NOTED

DO NOT SCALE PRINT

PUMP OVERHEAT PROTECTION

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

INSTALLATION INSTRUCTIONS:

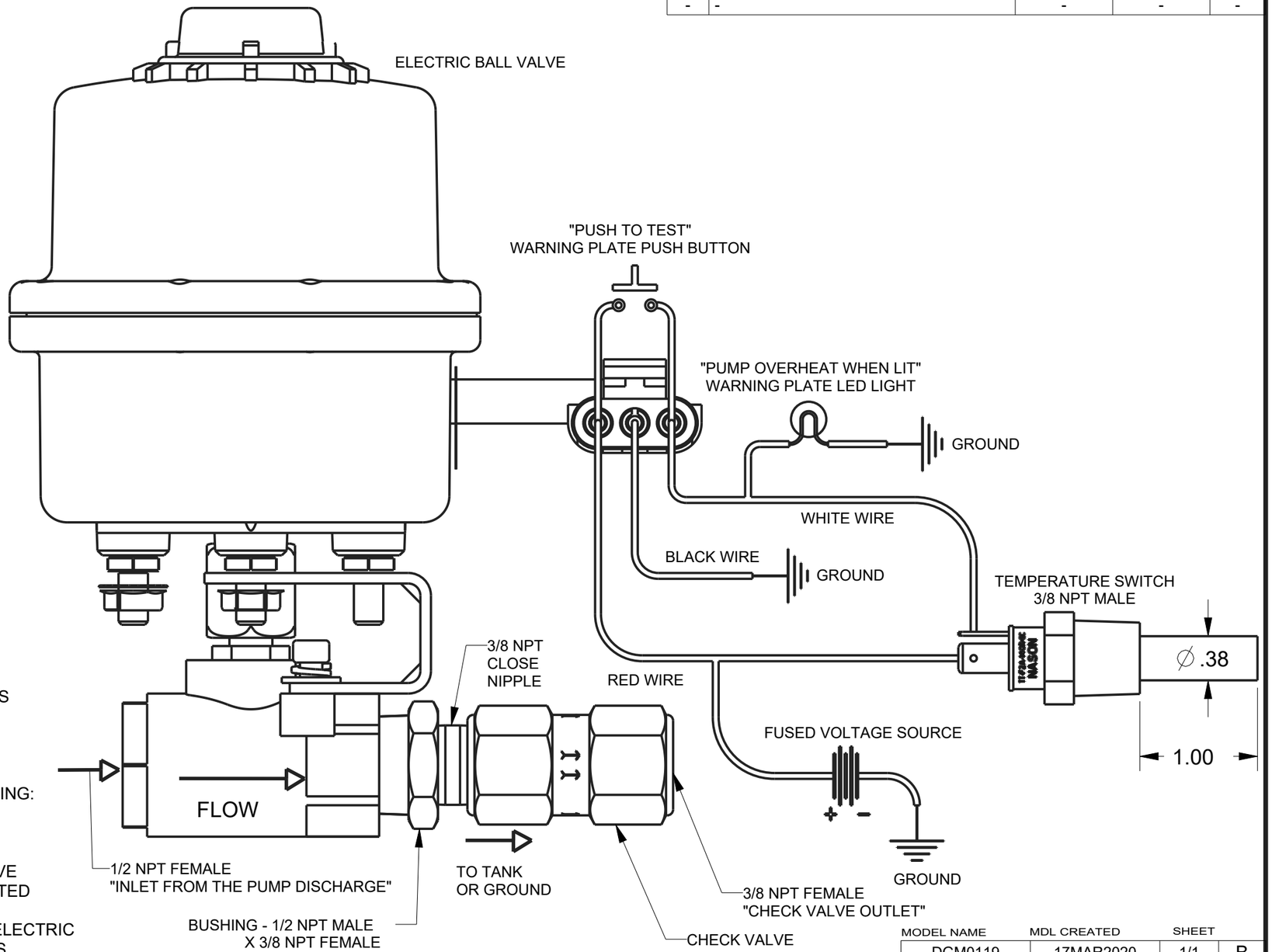
1) INSTALL THE TEMPERATURE SWITCH ON THE SUCTION SIDE OF THE PUMP, AS NEAR TO THE IMPELLER AS POSSIBLE, PREFERABLY BETWEEN THE IMPELLER AND THE SUCTION RELIEF VALVE.
2) PLUMB THE "INLET FROM THE PUMP DISCHARGE" TO THE DISCHARGE SIDE OF THE PUMP. ITS LOCATION IS NOT CRITICAL BUT IT MUST BE MOUNTED SUCH THAT IT CAN DRAIN IF NEEDED. IT CAN BE MOUNTED DIRECTLY TO THE PUMP OR POSITIONED REMOTELY AND THEN CONNECTED WITH A 3/8 OD MINIMUM LINE.
3) THE ELECTRIC BALL VALVE DOES NOT NEED TO BE MOUNTED HORIZONTALLY AS SHOWN.
4) *PLUMB THE "CHECK VALVE OUTLET" TO THE TANK, IF DESIRED, USING A 3/8 OD MINIMUM LINE. KEEP ALL LINES AS SHORT AS POSSIBLE.

* CONNECTION OF THE "CHECK VALVE OUTLET" TO THE TANK MAY CAUSE THE TANK TO OVERHEAT, REDUCING THE EFFECTIVENESS OF THIS ASSEMBLY. PLUMBING THE "CHECK VALVE OUTLET" TO GROUND WILL ENSURE THE PUMP NEVER OVERHEATS BUT IT IS POSSIBLE TO DRAIN THE TANK IN THIS MANNER.

5) ATTACH THE WHITE WIRE OF THE ELECTRIC BALL VALVE TO A SPADE ON THE TEMPERATURE SWITCH AND TO THE WHITE WIRE FROM THE "PUSH TO TEST" BUTTON. ATTACH THE RED WIRE FROM THE ELECTRICAL BALL VALVE TO A FUSED VOLTAGE SOURCE AND TO THE OTHER SPADE ON THE TEMPERATURE SWITCH AS WELL AS TO THE RED WIRE FROM THE "PUSH TO TEST" BUTTON. ATTACH THE BLACK WIRE FROM THE ELECTRIC BALL VALVE AND THE BLACK WIRE FROM THE "PUMP OVERHEAT WHEN LIT" LED LIGHT TO GROUND.
6) THE TEMPERATURE SWITCH ALSO CONTROLS A "PUMP OVERHEAT WHEN LIT" LED LIGHT ON THE WARNING PLATE NOTIFYING THE OPERATOR THAT THE PUMP IS OVERHEATING AND THE ELECTRIC BALL VALVE HAS BEEN OPENED.
7) TO TEST THIS ASSEMBLY: WITH THE PUMP RUNNING, PRESS THE "PUSH TO TEST BUTTON". IF THIS ASSEMBLY DOES NOT DISCHARGE WATER OR THE "PUMP OVERHEAT WHEN LIT" LED LIGHT DOES NOT LIGHT UP, THE CHECK VALVE MAY HAVE BEEN INSTALLED BACKWARDS OR THE WIRING CONNECTIONS WERE INCORRECT.

REFERENCE NOTES:

A) THIS ASSEMBLY IS INTENDED TO FLOW WATER FROM A PUMP ONCE THE TEMPERATURE SWITCH GOES TO A CLOSED CIRCUIT FROM SENSING:
140° F+/-5° F (60.0C+/-2.8C) OR
120° F+/-5° F (48.9C+/-2.8C)
DEPENDING UPON THE ASSEMBLY USED.
B) TO PREVENT FREEZING DAMAGE, WHEN PLUMBING THE "CHECK VALVE OUTLET" TO THE TANK, THE ELECTRIC BALL VALVE SHOULD BE MOUNTED HORIZONTALLY TO THE TANK AND VERTICALLY ABOVE THE PUMP.
C) IF THE "CHECK VALVE OUTLET" DISCHARGES TO THE GROUND, THE ELECTRIC BALL VALVE SHOULD BE MOUNTED ON, OR AS CLOSE TO THE PUMP AS POSSIBLE.
D) THE PURPOSE OF THE CHECK VALVE IS TO ALLOW THE PUMP TO PRIME IF THE PUMP IS IN AN ENVIROMENT WHERE IT ALREADY EXCEEDS THE TEMPERATURE THRESHOLD OF THE TEMPERATURE SWITCH.
E) THE ELECTRIC BALL VALVE IS MADE FROM BRASS, RATED FOR 600 PSIG PRESSURES, 29.9 IN/HG VACUUMS, OPENS AND CLOSES IN ABOUT A SECOND.
F) WE RECOMMEND THE ELECTRIC BALL VALVE HAVE AT LEAST A 5 AMP FUSE FOR THE FUSED VOLTAGE SOURCE (THE RED WIRE).



MODEL NAME	MDL CREATED	SHEET	
DGM0119	17MAR2020	1/1	B

REMOVE SHARP EDGES

INCH [MILLIMETER]

THIRD ANGLE PROJECTION

OLD PART NO.

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

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

MATERIAL DESCRIPTION: -

MATERIAL NO. -

PATTERN NO. -

DWG - THERMAL RELIEF SYSTEM
KZCO VALVE, WITH TEST SWITCH

DR'N WAH
CHKD SMS
TRCD

DATE 17MAR2020

SCALE 1/1

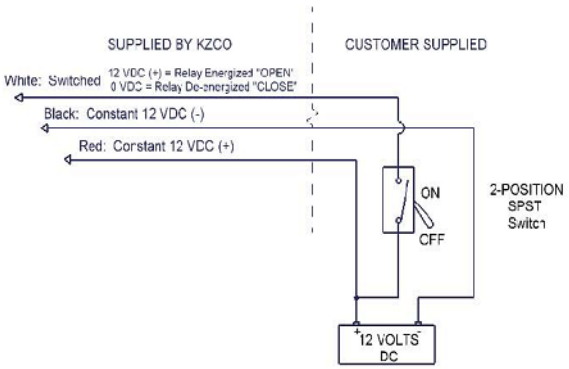
DGM0119

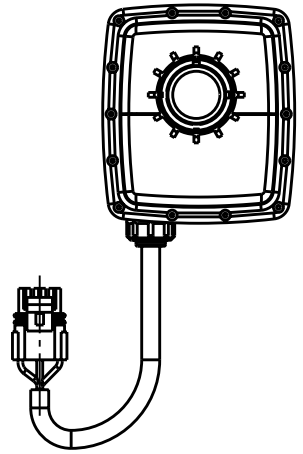
ALL DIMENSIONS IN INCHES UNLESS NOTED

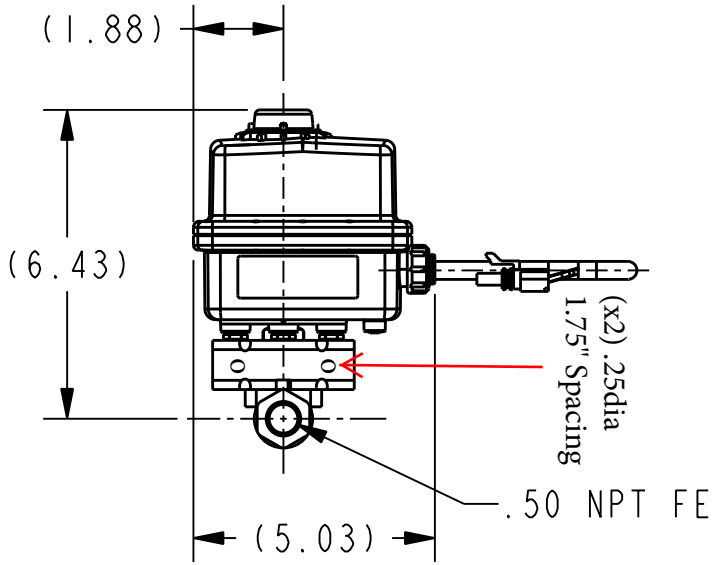
DO NOT SCALE PRINT

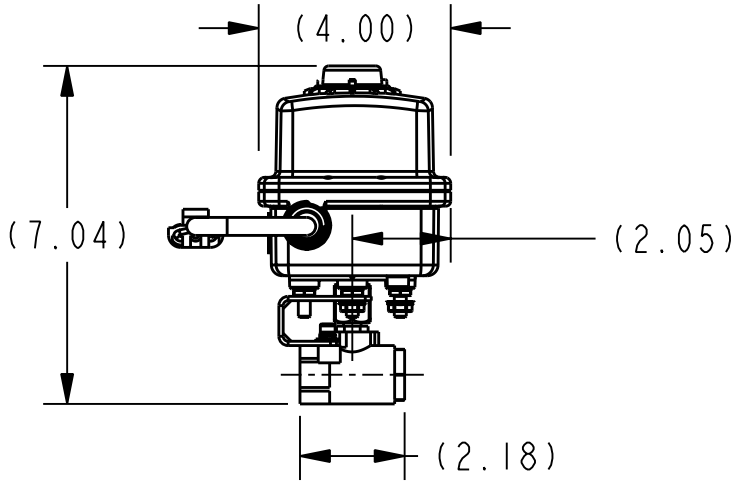
NAME:RJG OBJECT:5209401_1 DATE:17-Nov-08 11:49:17

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]

THIRD ANGLE PROJECTION

OLD PART NO.

MATERIAL DESCRIPTION: KZCO 84D23-10D20-P01

MATERIAL NO. -

PATTERN NO. -

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

DR'N RJG
CHKD DWS
TRCD

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

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

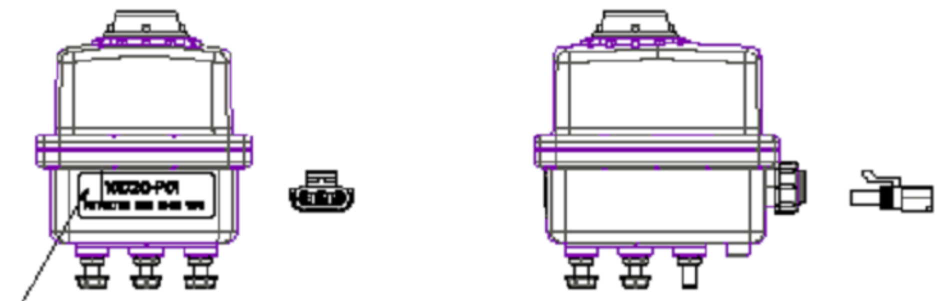
DATE 13-Nov-08
SCALE 1/4

5209401

ALL DIMENSIONS IN INCHES UNLESS NOTED

DO NOT SCALE PRINT

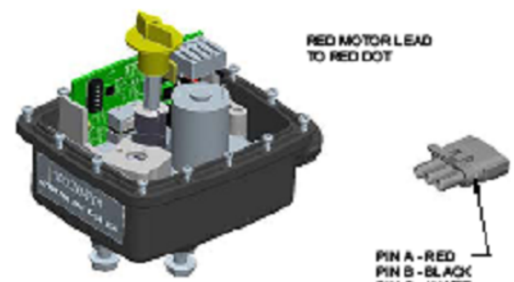
REV	REVISED BY	REVISION DATE	REVISED/APPROVED BY
-2+		7/15/2008 9:41:57 AM	bgotschall



ACTUATOR LABEL
MAS90 / LABEL DESCRIPTION
"ACTUATOR, EH3 12 / 24 VDC"

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

DIP SX 4 'ON'



RED MOTOR LEAD
TO RED DOT

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

SCALE .500

PROGRAM NOTE:

MAS90 SET DATA
CONTROL INPUT = 1
FEEDBACK = 0
OPERATION = 0
MOTOR = M2
SPEED CT = 0.8
ZEROSET = 135
RANGE TOLERANCE = 1
ROTATION = CC092
ACTUATOR RANGE = 0.00-0.00
DESIGN VOLTAGE = E
DIP SX = 3
LABEL = KZCO
OPTIONS = 0
PLUG TYPE = P
TEST PLUG =

DET	QTY	PART NUMBER	DESCRIPTION	MATERIAL
21	1	EH-502	LABEL, EH ACTUATOR, 2.5" X 1", THERMAL TRANSFER, WHITE	NO_MATERIAL
20	1	800018	HARNESS, 80A,3ST, WP3T,22.5"	
19	1	EH3-115-Y	FLAG, YELLOW	POLYPROPYLENE_TALC_20
18	1	399-0029	PCB ASSY, EH3 L1 SOLID STATE 12 VDC	
17	1	100401	GEAR MOTOR, M2 18 RPM/MOLON	NO_MATERIAL
16	3	QX-222	NUT, HEX HEAD, SERRATED FLANGE, .250-20 UNC-2B	STAINLESS_STEEL,TYPE_303
15	4	EH3-135	STUD, 1/4-20 X 1/2 MTG	STAINLESS_STEEL,TYPE_303
14	1	EH-104	RETAINER, PUSH-ON 5/16" SHAFT	STAINLESS_STEEL_TYPE_18-8
13	1	499-0100	CAM ASSY, EXTD LOBE FOR EH2/5 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,55_DUROMETER
10	1	EH3-114	DOME, CLEAR	POLYCARBONATE,
9	14	EHPT-1103	SCREW, PAN, PHILLIPS, HIGH-LOW, 6-20 X .562	STAINLESS_STEEL_TYPE_410
8	1	EH3-1001-N	LID, CASE, EH3, DOME	NYLON_DPC_6N33-L_BLACK
7	4	EH3-139	SCREW, 8-32 X 1.25 PPHMS SS	STAINLESS_STEEL,TYPE_18-8
6	1	EH-157	SCREW, 8-18 x 3/8" TSB PPH SS	STAINLESS_STEEL,TYPE_18-8
5	1	EH3-1030	O-RING, EH3, CASE LID, #120	SILICONE,RED,55_DUROMETER
4	1	EH-139	O-RING, #006, PRESSURE TEST PORT	FLUOROCARBON,BLACK,75_DUROMETER
3	1	EHPT-140	O-RING, #112, MOTOR SHAFT, VITON	FLUOROCARBON,BLACK,75_DUROMETER
2	1	EH3-1003-N	LOWER CASE - EH3 INTERNAL MTG	NYLON,DPC_6N33-L,BLACK
1	1	498-0002	CASE KIT, EH3 IM DOME NYLON M2 MTR	

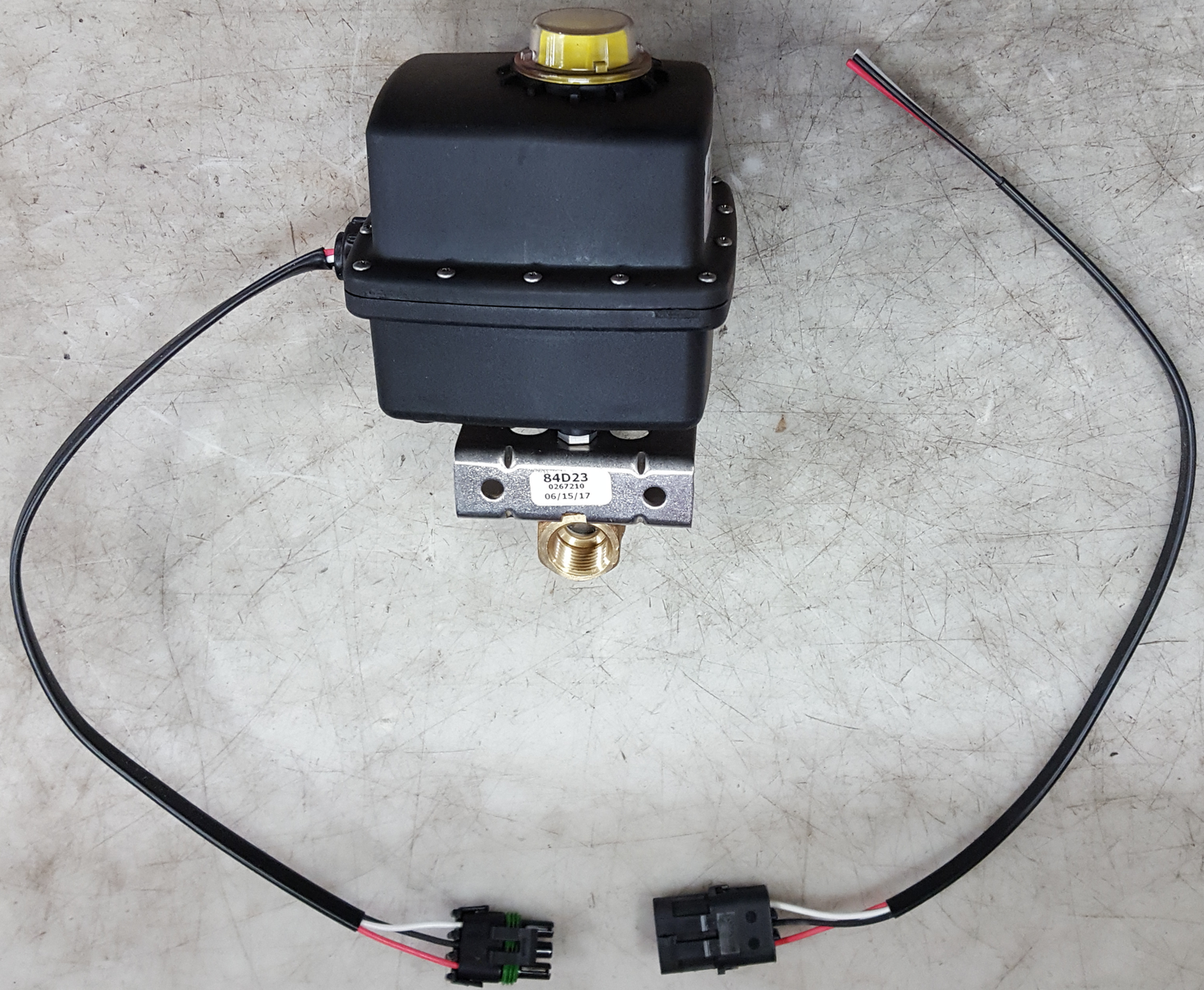
STANDARD TOLERANCES
ALL DIMENSIONS IN INCHES [mm]

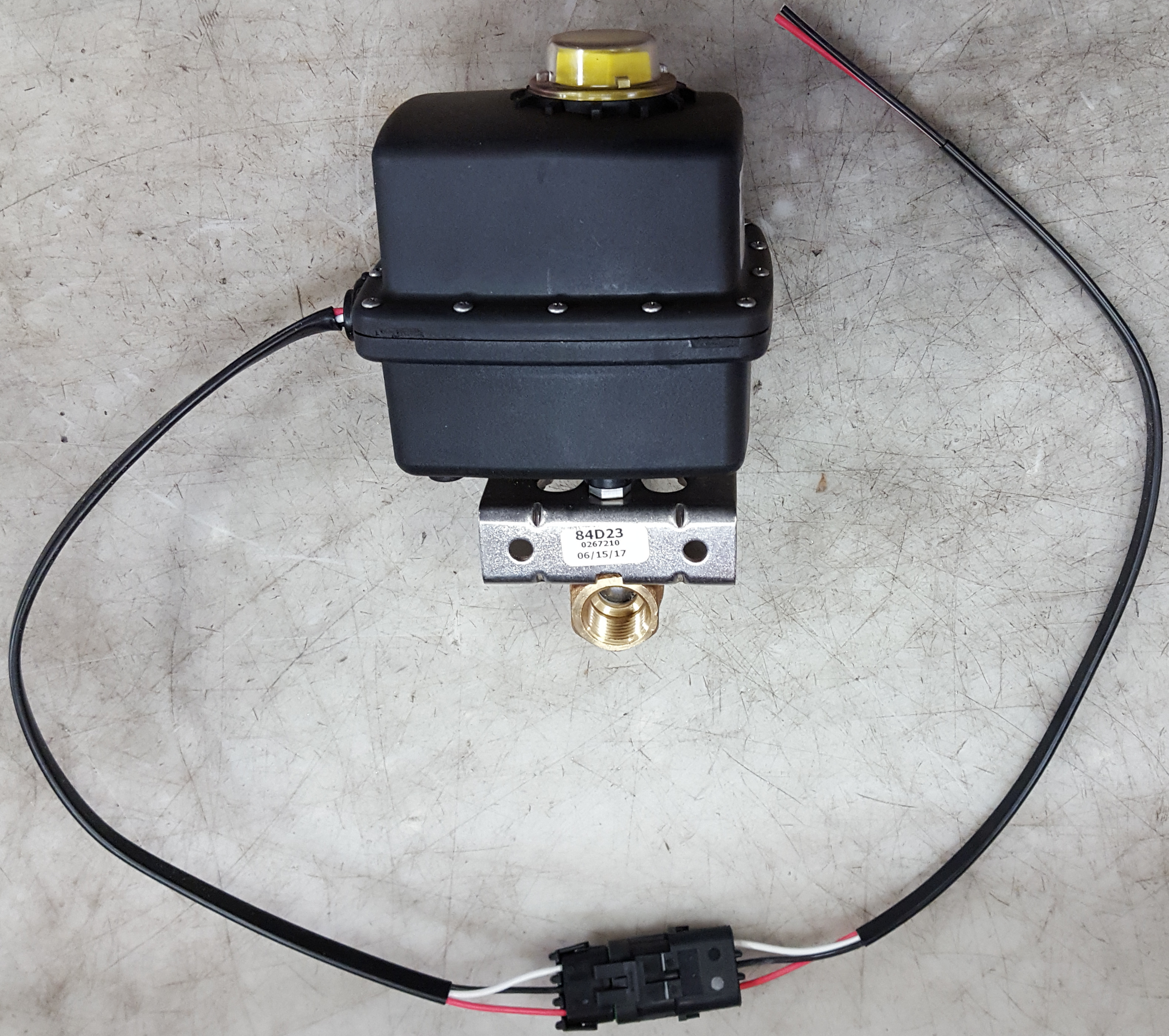
DATE: 2008-05-29
DESIGNED: L. ERDKAMP
DRAWN: W. FEDDE
APPROVED: A. KOTTAS
SCALE: .500 SIZE: B
MATERIAL:

KZCO Inc.

TITLE: ACTUATOR, EH3, SOLID STATE
REF:
PART NO: 10020-P01 REVISION: -2+
DRAWING NO: 10020-P01 SHEET: 1 OF 1

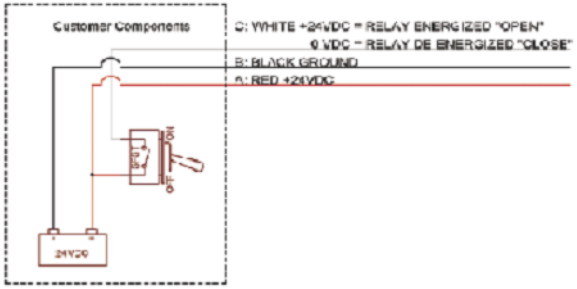
NAME:RJG OBJECT:5209401_2 DATE:17-Nov-08 11:49:19

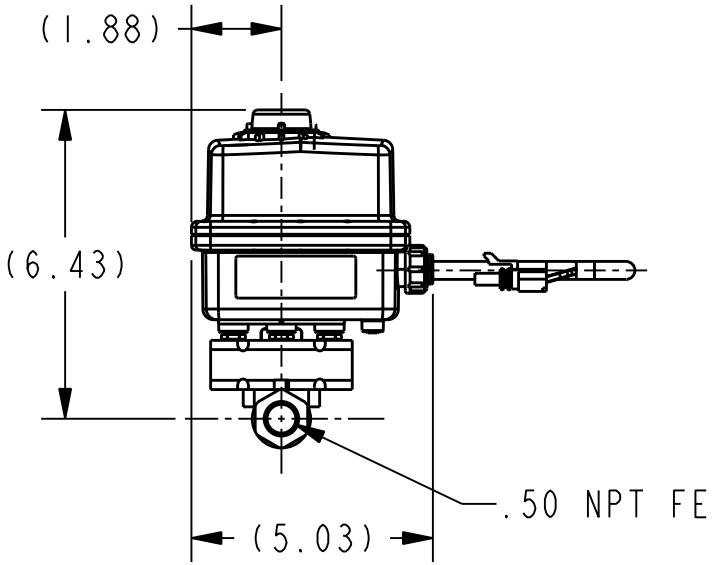

84D23
0267210
06/15/17

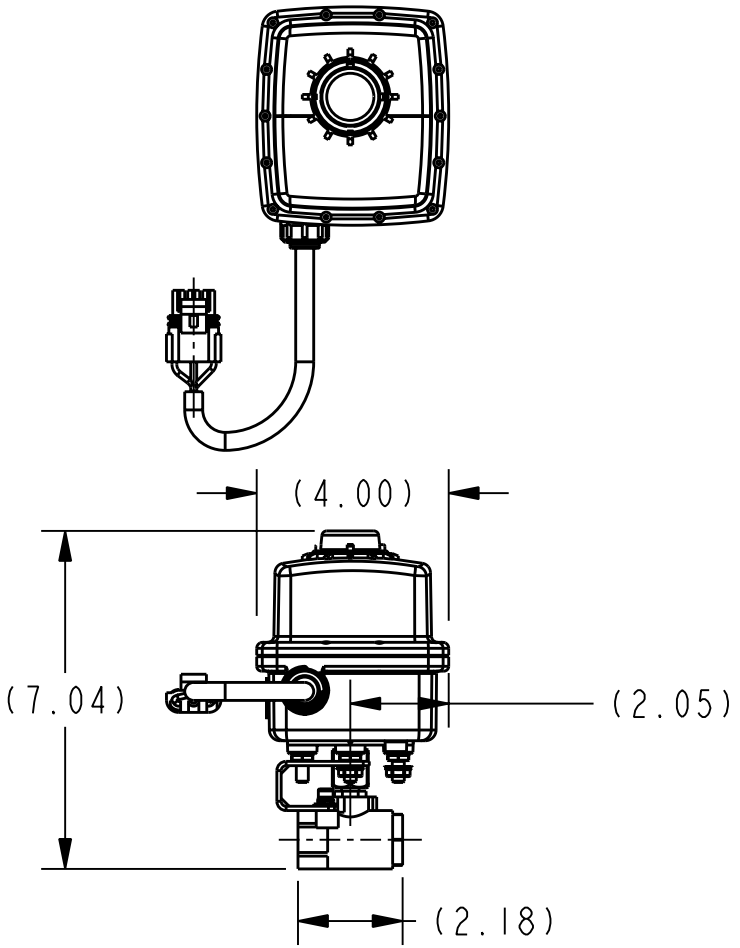

84D23
0267210
06/15/17

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	A

REMOVE SHARP EDGES

INCH [MILLIMETER]

THIRD ANGLE PROJECTION

OLD PART NO.

MATERIAL DESCRIPTION: KZCO 84D23-60AD-M

MATERIAL NO. -

PATTERN NO. -

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

DR'N RJG
CHKD DWS
TRCD

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

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

DATE 13-Nov-08

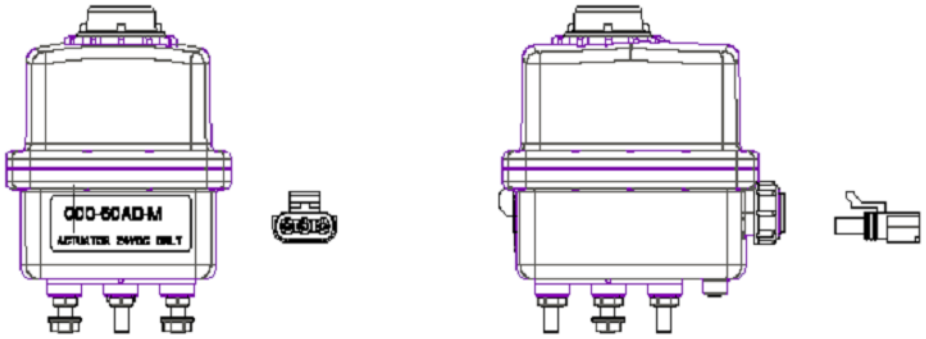
SCALE 1/4

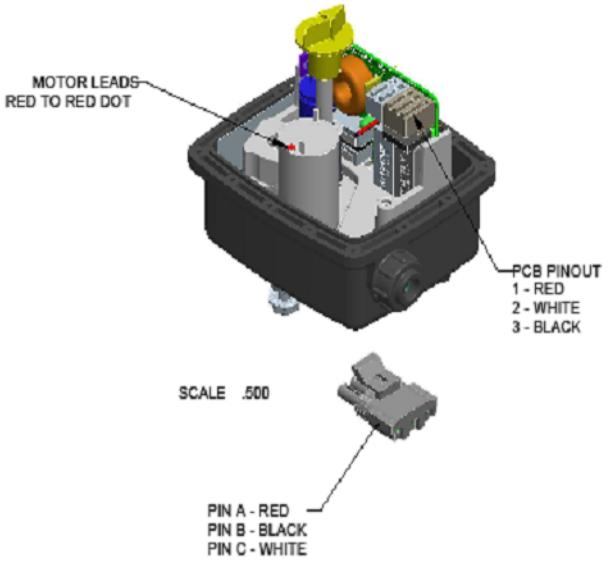
5209402

ALL DIMENSIONS IN INCHES UNLESS NOTED

DO NOT SCALE PRINT

REVMER	REVISION ECO	REVISION/VERSION DATE	REVISION/VERSION BY
*** .1		3/28/2008 1:49:38 PM	wfedde





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 = D
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 [mm]-
.Xa .1
.XXa .01
.XXXa .005
XX°a1°
TOTAL RUNOUT: .005 FIM
CORNER BREAK: .001/.010
SURFACE FINISH: 125µIN

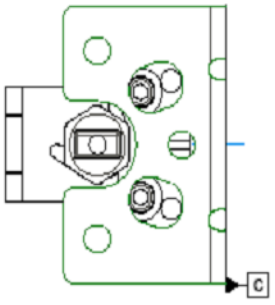
DENSITY: .047 LBM/CU IN
MASS: .592 LBM
SURF AREA: 163.793 SQ IN
VOLUME: 12.043 CU IN

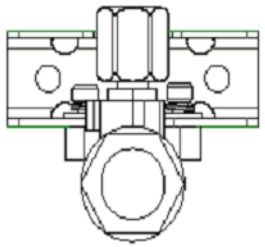
DATE: 2007-04-16
DESIGNED: L. ERDKAMP
DRAWN: W. FEDDE
APPROVED: A. KOTTAS
SCALE: .500
SIZE: B
MATERIAL:

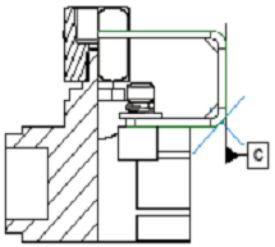
KZCO inc.
23660 KZ PARKWAY
GREENWOOD, NE 68366 USA
PHONE: +1.402.944.2767
FAX: +1.402.944.2402

TITLE: ACTUATOR, EH3, .8S @24VDC
REF:
PART NO: 000-60AD-M
REVMER: *** .1
DRAWING NO: 000-60AD-M
SHEET: 1 OF 1

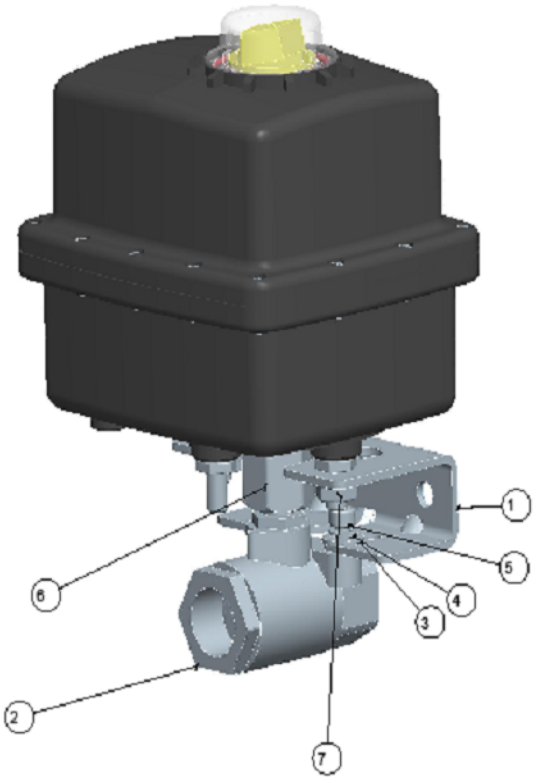
REVISER	REVISION ECO	REVISION/VERSION DATE	REVISION/VERSION BY
-.6+		8/12/2008 9:18:50 AM	bgotschall







SECTION A-A



ACTUATOR SHOWN IS REPRESENTITVE 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-109	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
.XX±.01
.XXX±.005
XX°±1°

TOTAL RUNOUT: .005 FIM
CORNER BREAK: .01/.010
SURFACE FINISH: 125µIN

DENSITY: .259 LBM/CU IN
MASS: 3.134 LBM
SURF AREA: 142.873 SQ IN
VOLUME: 12.142 CU IN

DATE: 2007-08-08
DESIGNED: L. ERDKAMP
DRAWN: C. HOWARD
APPROVED: L.ERDKAMP
SCALE: .750
SIZE: B
MATERIAL: AS NOTED

KZCO inc.
23593 KZ PARKWAY
GREENWOOD, NE 68366 USA
PHONE: +1.402.944.2767
FAX: +1.402.944.2402

TITLE: VALVE KIT, EH3 OFFSET MTG 1/2" 2-PC BRZ
REF:
PART NO: 84D23
REVISER: -.6+
DRAWING NO: 84D23
SHEET: 1 OF 1

Primer

W.S. DARLEY & CO.

OPERATING INSTRUCTIONS - ELECTRIC PRIMING PUMP

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

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

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

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

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

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

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

CAUTION: FOR PRIMING UP TO 10' OF LIFT:

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

CAUTION: FOR PRIMING 10' OF LIFT AND HIGHER:

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

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

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

Engage "Pump" shift to start pumping water.

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

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

LUBRICATING SYSTEM - ELECTRIC PRIMING PUMPS WITH FLUID RESERVOIR

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

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

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

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

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

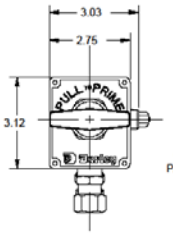
ELECTRIC PRIMING PUMPS WITHOUT FLUID RESERVOIR

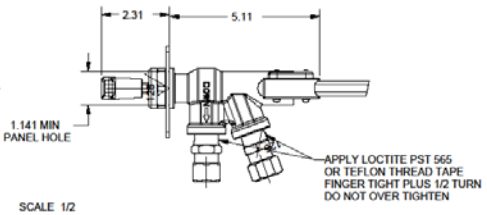
The fluidless electric-motor rotary-vane primer pump creates a high vacuum by using a special material for the vanes and an initial factory applied lubricant film. This film must be present in order for the primer to operate properly and to provide maximum life for the primer components.

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

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

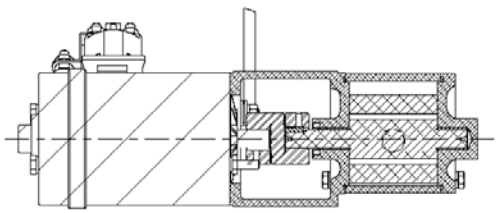
NO.	DESCRIPTION	PART NO.	QTY.
1	ASSEMBLY - PRIMER, ROTOR	4420105	1
2	BEARING - OILITE, 0.626 ID	1760023	2
3	COUPLING - #44093	2404500	1
4	CYLINDER - VACUUM PUMP	1020800	1
5	HEAD - CYLINDER INBOARD	2808904	1
6	HEAD - CYLINDER, OUTBOARD	2808800	1
7	HHCS - .313-18 x 1.00, SST	5400510	4
8	KEY - SQ., 0.19 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
14	MOTOR - PRIMER, 24V	4223500	1
15	PLUG - PIPE, 0.250, BR SQ HD	1080504	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



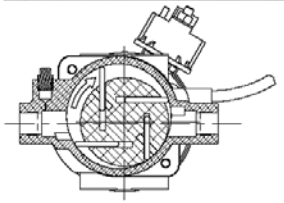


SCALE 1/2

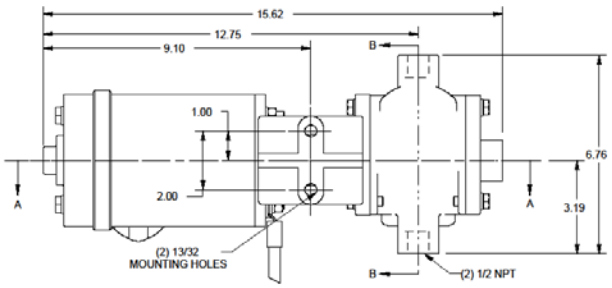
NOTE:
- FOR CROSS SECTION AND EXPLODED VIEW DRAWING SEE DVC0203, DVC0204 & DVC0205
- ALSO, WHEN REPLACING THE OLD VERSION OF THIS VALVE WITH THIS NEW VERSION; BUSHING 1762500 CAN BE USED TO RETROFIT IT TO THE EXISTING PANEL.

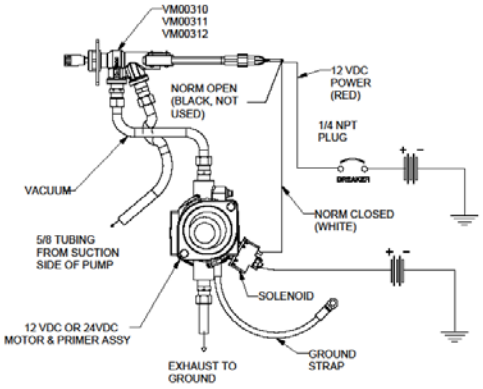


SECTION A-A
SCALE 1/2



SECTION B-B





NOTE: (B)

MOUNT HORIZONTALLY 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' ..... #0 (12V), #3 (24V) COPPER
0' TO 25' ..... #00 (12V), #2 (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)

REVISIONS

LTR	DESCRIPTION	DATE	CHG NO.	APPR'D
A	REMOVED FROST PLUG	4/15/09	5226	AAN
B	ADDED "HORIZONTALLY" TO NOTE	6/26/18	12092	TAK

REMOVE SHARP EDGES

INCH [MILLIMETER]

MATERIAL DESCRIPTION:

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

ALL DIMENSIONS IN INCHES UNLESS NOTED

OLD PART NO.

MATERIAL NO.

PATTERN NO.

DO NOT SCALE PRINT

TOLERANCE EXCEPT AS NOTED .XX ±.01 .XXX ±.010 ANGLES ± 1°

DRN'N RJG
CHK'D DWG
TRCD

MODEL NAME DVC0207 | MDL CREATED 04/16/08 | SHEET V1 | D

W.S. Darley & Co.
CHICAGO, IL - SOMERSET, PENNA. 15501

DWG - ELEC. PRIMER, VLV, 4 V, NO TANK, CR, SECTION, EXPLODED

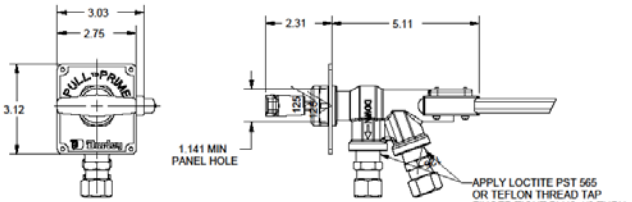
DATE 16-Apr-09

SCALE 1/2

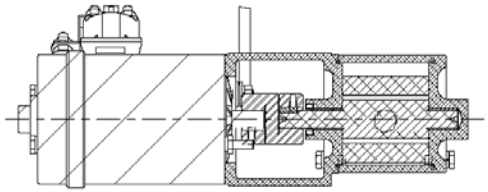
DVC0207

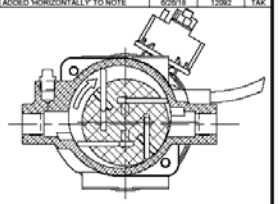
NO.	DESCRIPTION	PART NO.	QTY.
1	ASSEMBLY - PRIMER, ROTOR	4420105	1
2	BEARING - OILITE, 0.626 ID	1760023	2
3	COUPLING - #44093	2404500	1
4	CYLINDER - VACUUM PUMP	1020800	1
5	HEAD - CYLINDER INBOARD	2808904	1
6	HEAD - CYLINDER, OUTBOARD	2808800	1
7	HHCS - .313-18 x 1.00, SST	5400610	4
8	KEY - SQ., 0.19 X 0.62 GR2	3602425	1
9	KEY - WOODRUFF, 606	3602200	1
10	MOTOR - PRIMER, 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

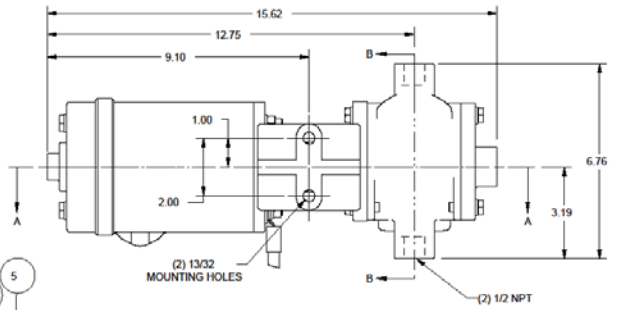
REVISIONS				
LTR	DESCRIPTION	DATE	CHG NO.	APPR'D
A	REMOVED FROST PLUG	4/15/09	5226	AAN
B	ADDED 'HORIZONTALLY' TO NOTE	5/29/18	12092	TAK

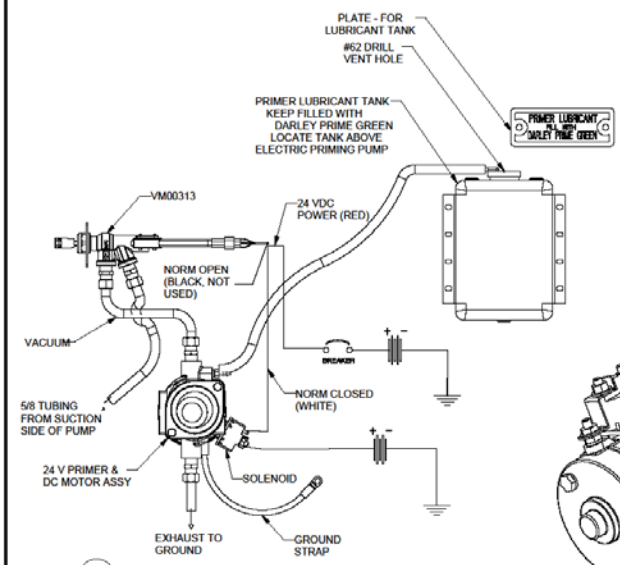


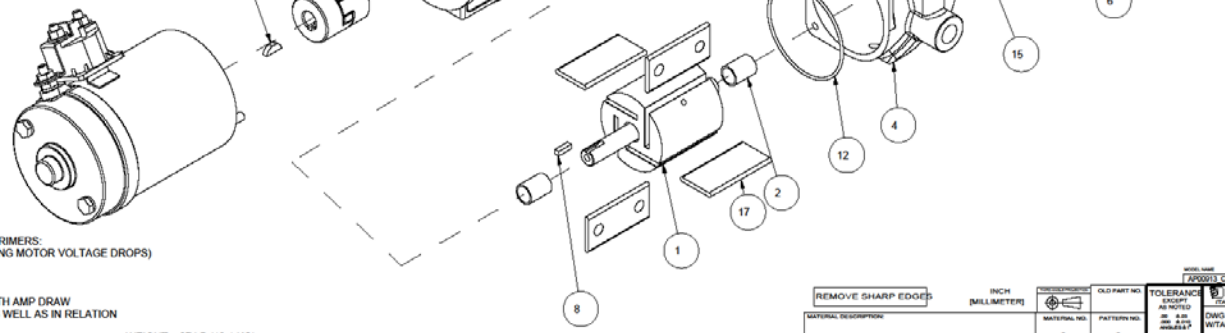
NOTE:
- FOR CROSS SECTION AND EXPLODED VIEW DRAWING SEE DRAWING DVC0203
- ALSO, WHEN REPLACING THE OLD VERSION OF THIS VALVE WITH THIS NEW VERSION; BUSHING 1762500 CAN BE USED TO RETROFIT IT TO THE EXISTING PANEL.











NOTE: (B)

MOUNT HORIZONTALLY 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 | INCH [MILLIMETER] | OLD PART NO. | MATERIAL DESCRIPTION | MATERIAL NO. | PATTERN NO.

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

TOLERANCE EXCEPT AS NOTED: .XX ±.03, .XXX ±.010, ANGLES ±1°

DRN RJG | CHKD DWG | TRCD

MODEL NAME: AP00913 CHINA | MDL CREATED: 24-SEP-2004 | SHEET: 1/1 | D

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

DWG - ELEC, PRIMER, VLV, 4 VANE
W/TANK, DARLEY, GR. SEC., EXPL

DATE 18-Apr-08 | SCALE 1/2

DVC0209

W.S. DARLEY & CO.

OPERATING INSTRUCTIONS - ELECTRIC PRIMING PUMP

PUSH BUTTON ELECTRIC ACTUATED VALVE

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

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

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

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

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

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

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

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

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

Engage “Pump” shift to start pumping water.

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

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

LUBRICATING SYSTEM - ELECTRIC PRIMING PUMPS WITH FLUID RESERVOIR

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

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

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

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

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

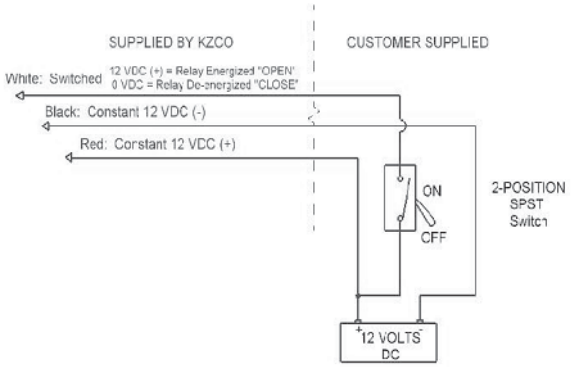
ELECTRIC PRIMING PUMPS WITHOUT FLUID RESERVOIR

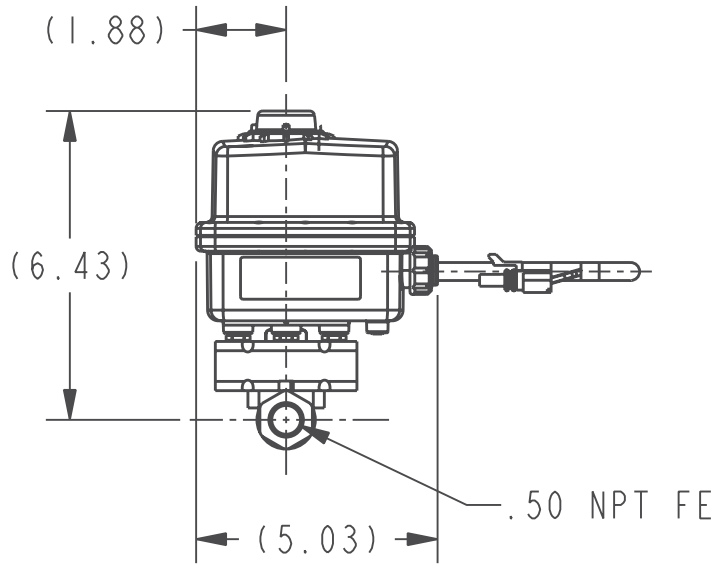
The fluidless electric-motor rotary-vane primer pump creates a high vacuum by using a special material for the vanes and an initial factory applied lubricant film. This film must be present in order for the primer to operate properly and to provide maximum life for the primer components.

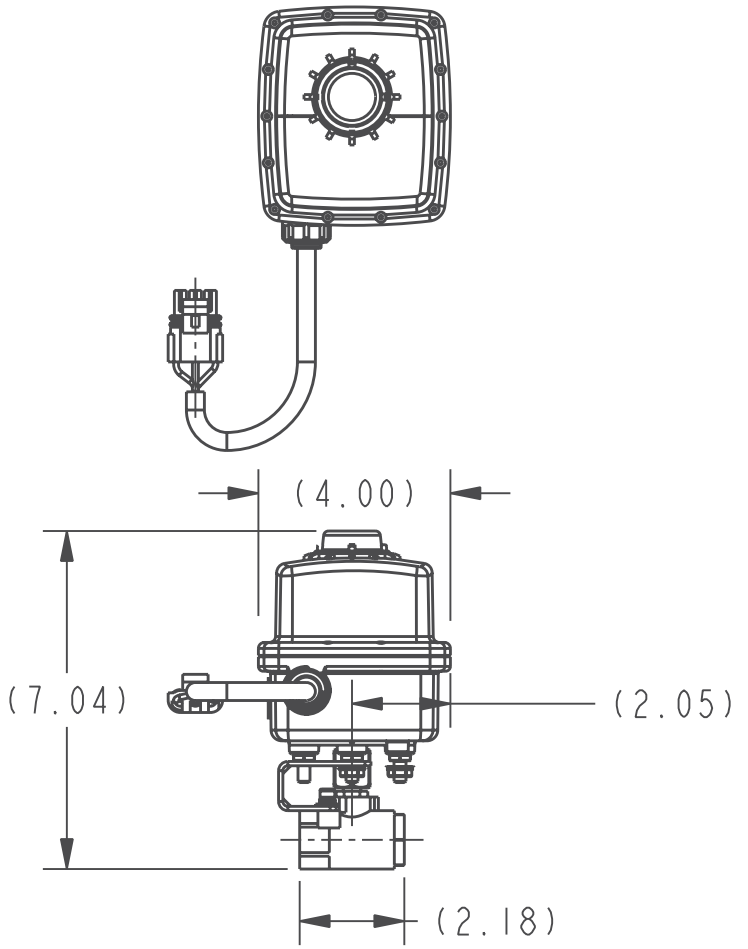
This film will not wash away completely if the pump is used to pump water. If the priming pump is disassembled for any reason, all internal surfaces of the housing and end caps must be coated completely with Dow Corning #111 Silicone valve lubricant prior to operating the primer. If after several years,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

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

REVISIONS				
LTR	DESCRIPTION	DATE	CHG NO.	APPR'D







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

REMOVE SHARP EDGES

INCH [MILLIMETER]

THIRD ANGLE PROJECTION

OLD PART NO.

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

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

MATERIAL DESCRIPTION:
KZCO 84D23-10D20-P01

MATERIAL NO. -

PATTERN NO. -

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

DR'N RJG
CHKD DWS
TRCD

DATE 13-Nov-08

SCALE 1/4

5209401

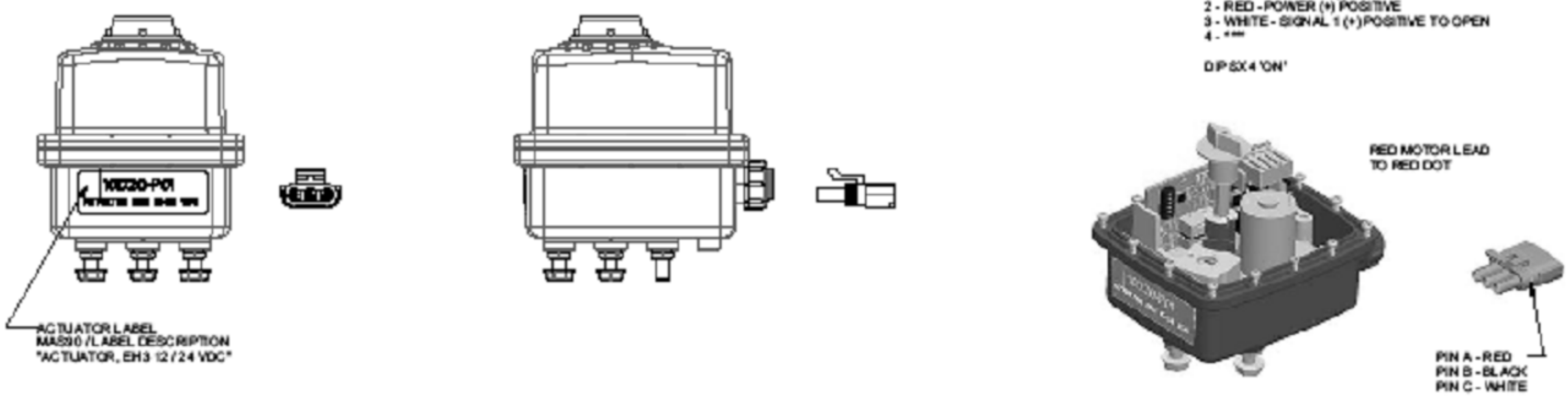
ALL DIMENSIONS IN INCHES UNLESS NOTED

DO NOT SCALE PRINT

REVISION	REVISED ECO	REVISION DATE	REVISED BY
-.2+		7/15/2008 9:41:57 AM	bgotschall

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

DIP SX 4 'ON'



SCALE .500

PROGRAM NOTE:

MAS90 SET DATA
CONTROL INPUT = 1
FEEDBACK = 0
OPERATION = 0
MOTOR = M2
SPEED CT = 0.8
ZEROSET = 135
RANGE TOLERANCE = 1
ROTATION = CC092
ACTUATOR RANGE = 0.00-0.00
DESIGN VOLTAGE = E
DIP SX = 3
LABEL = KZCO
OPTIONS = 0
PLUG TYPE = P
TEST PLUG =

ITEM	QTY	PART NUMBER	DESCRIPTION	MATERIAL
21	1	EH-502	LABEL, EH ACTUATOR, 2.5" X 1", THERMAL TRANSFER, WHITE	NO_MATERIAL
20	1	800018	HARNESS, 89A,3ST, WP3T,22.5"	
19	1	EH3-115-Y	FLAG, YELLOW	POLYPROPYLENE_TALC_20
18	1	399-0029	PCB ASSY, EH3 L1 SOLID STATE 12 VDC	
17	1	100401	GEAR MOTOR, M2 18 RPM/MOLON	NO_MATERIAL
16	3	QX-222	NUT, HEX HEAD, SERRATED FLANGE, .250-20 UNC-2B	STAINLESS_STEEL_TYPE_303
15	4	EH3-135	STUD, 1/4-20 X 1/2 MTG	STAINLESS_STEEL_TYPE_303
14	1	EH-104	RETAINER, PUSH-ON 5/16" SHAFT	STAINLESS_STEEL_TYPE_18-8
13	1	499-0100	CAM ASSY, EXTD LOBE FOR EH2/3 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_55_DUROMETER
10	1	EH3-114	DOME, CLEAR	POLYCARBONATE,
9	14	EHPT-1103	SCREW, PAN, PHILLIPS, HIGH-LOW, 5-20 X .562	STAINLESS_STEEL_TYPE_410
8	1	EH3-1001-N	LID, CASE, EH3, DOME	NYLON_DPC_6N33-L_BLACK
7	4	EH3-139	SCREW, 8-32 X 1.25 PPHMS SS	STAINLESS_STEEL_TYPE_18-8
6	1	EH-157	SCREW, 8-18 x 3/8" TSB PPH SS	STAINLESS_STEEL_TYPE_18-8
5	1	EH3-1030	O-RING, EH3, CASE LID, #120	SILICONE_RED_55_DUROMETER
4	1	EH-139	O-RING, #006, PRESSURE TEST PORT	FLUOROCARBON_BLACK_75_DUROMETER
3	1	EHPT-140	O-RING, #112, MOTOR SHAFT, VITON	FLUOROCARBON_BLACK_75_DUROMETER
2	1	EH3-1003-N	LOWER CASE - EH3 INTERNAL MTG	NYLON_DPC_6N33-L_BLACK
1	1	498-0002	CASE KIT, EH3 IM DOME NYLON M2 MTR	

STANDARD TOLERANCES
ALL DIMENSIONS IN INCHES [mm]

DATE	2008-05-29
DESIGNED	L. ERDKAMP
DRAWN	W. FEDDE
APPROVED	A. KOTTAS
SCALE	.500
SIZE	B
MATERIAL	

KZCO Inc.

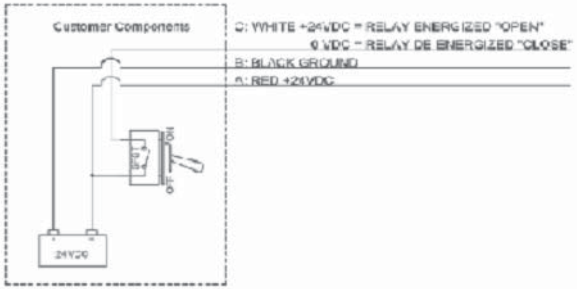
TITLE	ACTUATOR, EH3, SOLID STATE
REF.	
PART NO.	10020-P01
REVISION	-2+
DRAWING NO.	10020-P01
SHEET	1 of 1

Prepared By: RJG
Approved By: DWS

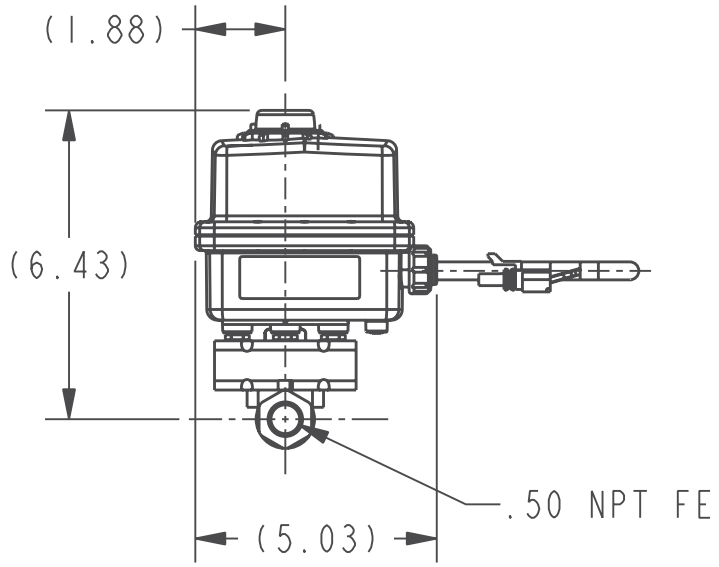
5

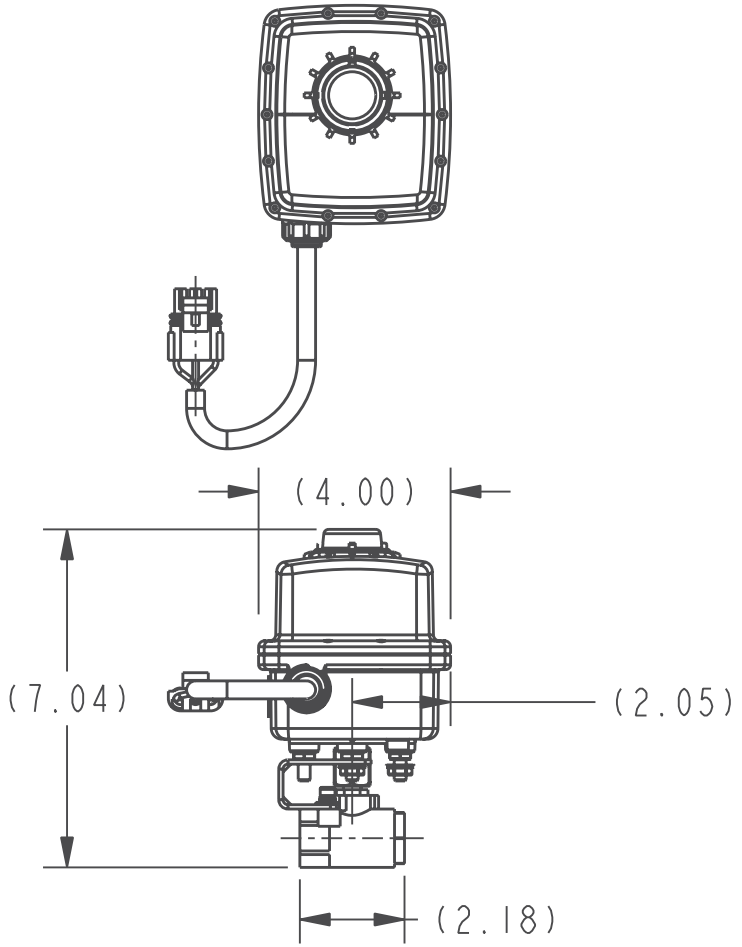
Rev. 0
Date: 12/02/08
1200617.doc

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	A

REMOVE SHARP EDGES

INCH [MILLIMETER]

THIRD ANGLE PROJECTION

OLD PART NO.

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

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

MATERIAL DESCRIPTION:
KZCO 84D23-60AD-M

MATERIAL NO.
-

PATTERN NO.
-

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

DR'N	RJG
CHKD	DWS
TRCD	

DATE 13-Nov-08

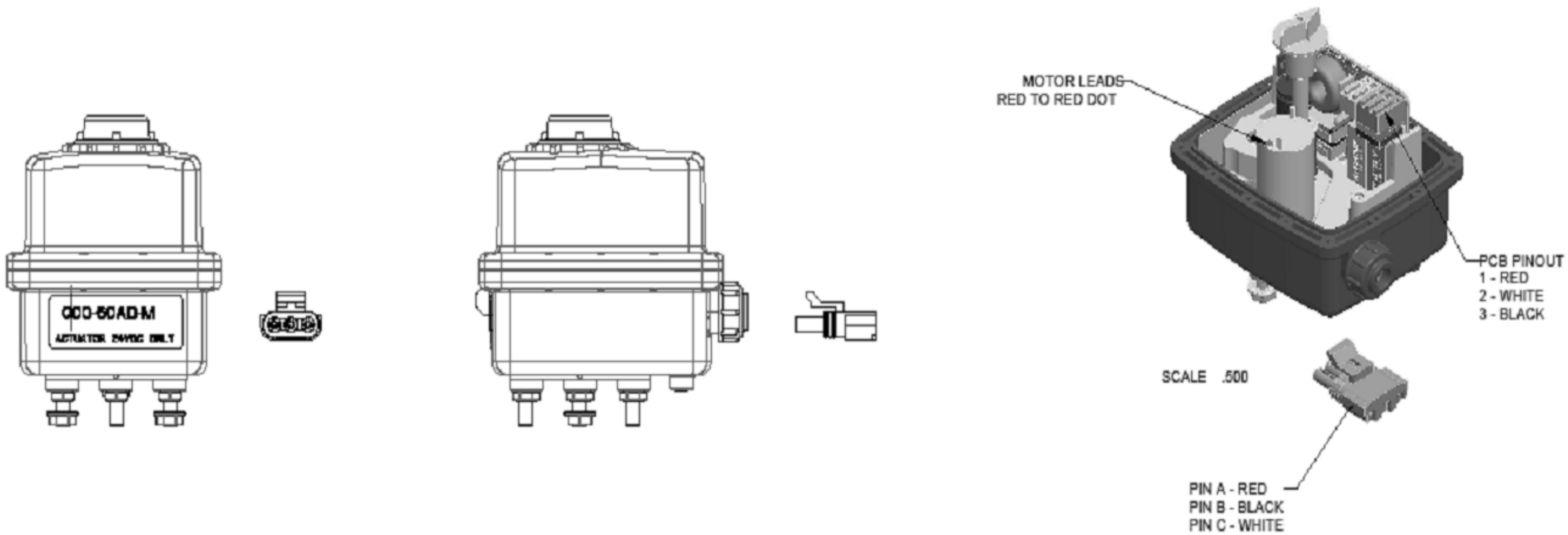
SCALE 1/4

5209402

ALL DIMENSIONS IN INCHES UNLESS NOTED

DO NOT SCALE PRINT

REV/VER	REVISION ECO	REVISION/VERSION DATE	REVISION/VERSION BY
*** .1		3/28/2008 1:49:38 PM	wfedde



MAS90 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 = D
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	

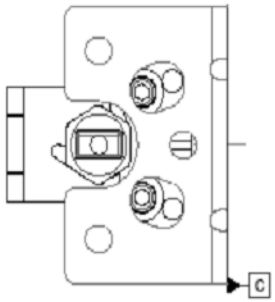
-STANDARD TOLERANCES-
-ALL DIMENSIONS IN INCHES [mm]-
.Xx ±.1 .XXx ±.01 .XXXx ±.005 XX°±1°
TOTAL RUNOUT: .005 FIM
CORNER BREAK: .001/.010
SURFACE FINISH: 125μIN
DENSITY: .047 LBM/CU IN
MASS: .562 LBM
SURF AREA: 163.793 SQ IN
VOLUME: 12.043 CU IN

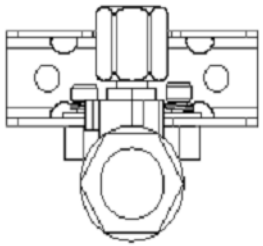
DATE: 2007-04-16
DESIGNED: L. ERDKAMP
DRAWN: W. FEDDE
APPROVED: A. KOTTAS
SCALE: .500 SIZE: B
MATERIAL:

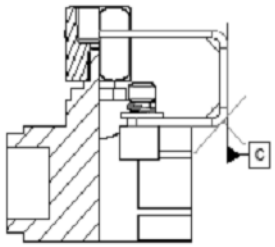
KZCO inc.
23860 KZ PARKWAY
GREENWOOD, NE 68366 USA
PHONE: +1.402.944.2767
FAX: +1.402.944.2402

TITLE: ACTUATOR, EH3, .8S @24VDC
REF:
PART NO: 000-60AD-M
REV/VER: *** .1
DRAWING NO: 000-60AD-M
SHEET: 1 OF 1

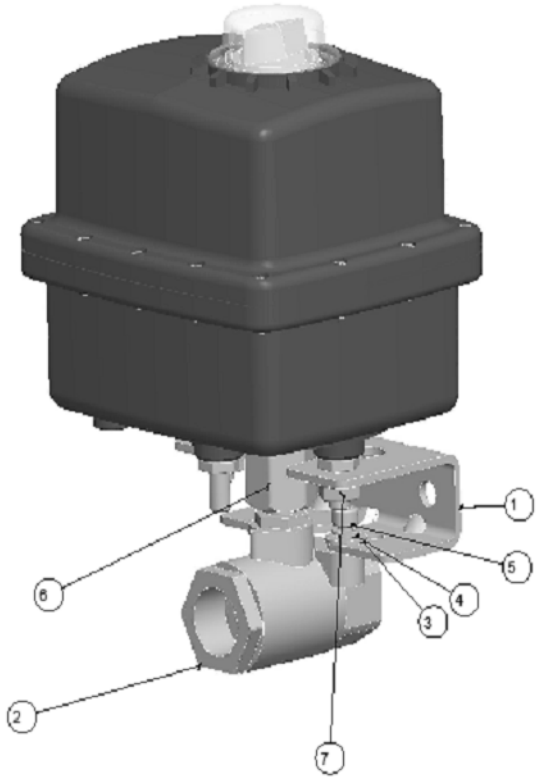
REVISER	REVISION ECO	REVISION/VERSION DATE	REVISION/VERSION BY
-.6+		8/12/2008 9:18:50 AM	bgotschall







SECTION A-A



ACTUATOR SHOWN IS REPRESENTITVE 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-146	COUPLER, 1/4" ~ 1/2" APOLLO	STAINLESS_STEEL_TYPE_316
5	2	EH-158	SCREW, #10-24 X 3/8" SS SOCKET HEAD	STAINLESS_STEEL,TYPE_303_OR_316
4	2	EHPT-109	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	EH3-64D	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
.XX±.01
.XXX±.005
XX°±1°
TOTAL RUNOUT: .005 FIM
CORNER BREAK: .001/.010
SURFACE FINISH: 125µIN
DENSITY: .259 LBM/CU IN
MASS: 3.134 LBM
SURF AREA: 142.873 SQ IN
VOLUME: 12.142 CU IN

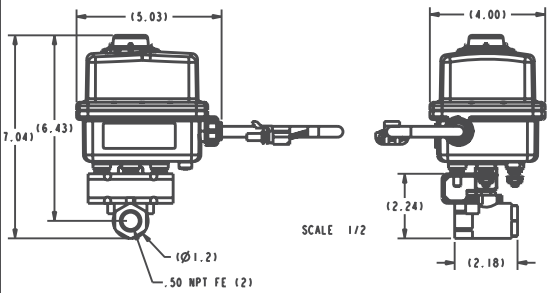
DATE: 2007-08-08
DESIGNED: L. ERDKAMP
DRAWN: C. HOWARD
APPROVED: L.ERDKAMP
SCALE: .750
SIZE: B
MATERIAL: AS NOTED

KZCO inc.
23880 KZ PARKWAY
GREENWOOD, NE 68366 USA
PHONE: +1.402.944.2767
FAX: +1.402.944.2402

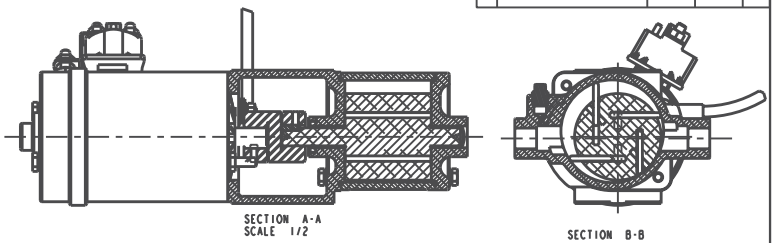
TITLE: VALVE KIT, EH3 OFFSET MTG 1/2" 2-PC BRZ
REF:
PART NO: 84D23
REVISER: -.6+
DRAWING NO: 84D23
SHEET: 1 OF 1

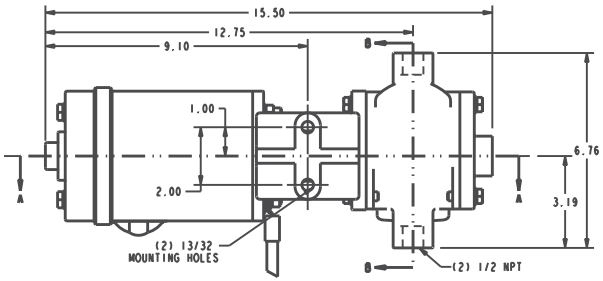
CREATED BY: bgotschall CREATED ON: 8/12/2008 9:18:50 AM REV: - VER: 6+ REL: Revision LOCATION: Root Folder\Engineering\Parts BRANCH: main

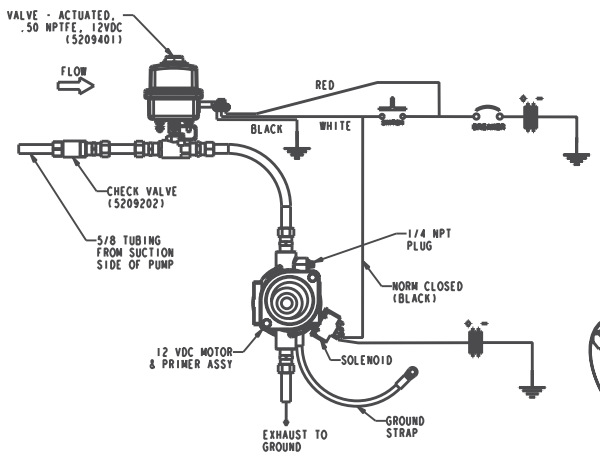
NO.	DESCRIPTION	PART NO.	QTY.
1	ASSEMBLY - PRIMER, ROTOR	4420105	1
2	BEARING - OILITE, 0.626 ID	1760023	2
3	COUPLING - #44093	2404500	1
4	CYLINDER - VACUUM PUMP	1020800	1
5	HEAD - CYLINDER INBOARD	2808904	1
6	HEAD - CYLINDER, OUTBOARD	2808800	1
7	HHCS - .313-18 x 1.00, SST	5400610	4
8	KEY - SQ., 0.19 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
14	PLUG - 0.75", FREEZE	4402500	1
15	PLUG - PIPE, 0.250, BR SO HD	1080504	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



5209401 - KZCO VALVE - ACTUATED,
12 VDC, .50NPT FE
KZCO MDL #84D23-10D20-P01







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' ..... #0 (12V)
0' TO 25' ..... #00 (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

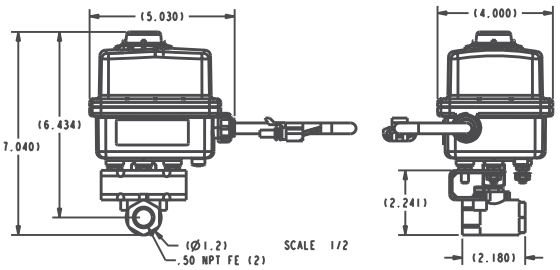
WEIGHT = 27 LB (12.1 KG)

REVISIONS

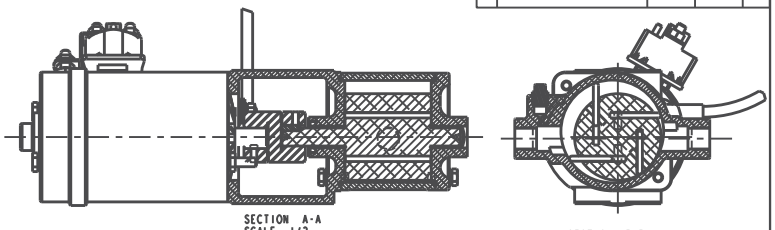
LTR	DESCRIPTION	DATE	CHG NO.	APPR'D

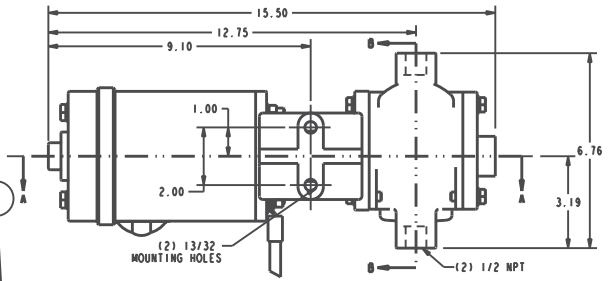
REMOVE SHARP EDGES | INCH (MILLIMETER)
MATERIAL DESCRIPTION: -
THIS DESIGN IS THE PROPERTY OF W.S. DARLEY AND CO. - UNAUTHORIZED REPRODUCTION IS PROHIBITED
ALL DIMENSIONS IN INCHES UNLESS NOTED
OLD PART NO. | MATERIAL NO. - | PATTERN NO. -
DO NOT SCALE PRINT
TOLERANCE EXCEPT AS NOTED .00 ±.03 .000 ±.010 ANGLES ±1°
DR TJS | CHKD DJS | TYCO
MODEL NAME DVC0210 | ADL CREATED 04/18/08 | SHEET 1/1 | REV B
W.S. Darley & Co. ITASCA, IL - CHIPPEWA FALLS, WI
DRG - ELEC. PRIMER, VLV, 4 V NO TANK, CR. SECTION, EXPLODED
DATE 18-Apr-08
SCALE 1/2
DVC0210

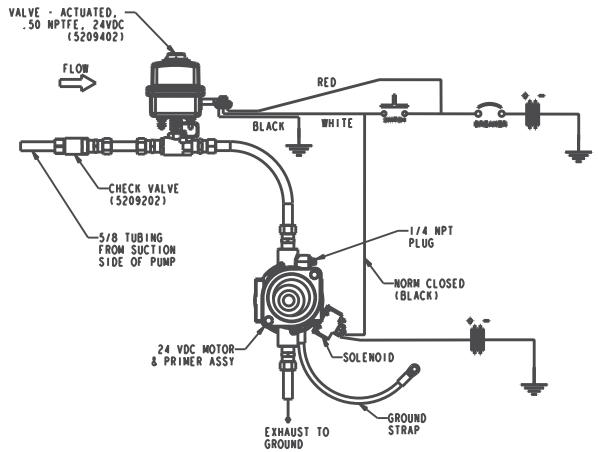
NO.	DESCRIPTION	PART NO.	QTY.
1	ASSEMBLY - PRIMER, ROTOR	4420105	1
2	BEARING - OILITE, 0.626 ID	1760023	2
3	COUPLING - #44093	2404500	1
4	CYLINDER - VACUUM PUMP	1020800	1
5	HEAD - CYLINDER INBOARD	2808904	1
6	HEAD - CYLINDER, OUTBOARD	2808800	1
7	HHCS - .313-18 x 1.00, SST	5400610	4
8	KEY - SQ., 0.19 X 0.62 GR2	3602425	1
9	KEY - WOODRUFF, 606	3602200	1
10	MOTOR - PRIMER, 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
14	PLUG - 0.75", FREEZE	4402500	1
15	PLUG - PIPE, 0.250, BR SQ HD	1080504	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



5209402 - KZCO VALVE - ACTUATED,
24 VDC, .50NPT FE
KZCO MDL #84D23-60AD-M







NOTE:

MOUNT WITH EXHAUST OUTLET DOWN

CONNECT 4 GA COPPER GROUND STRAP TO CLEAN, PAINT FREE GROUNDING SURFACE

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

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)

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)

REVISIONS

LTR	DESCRIPTION	DATE	CHG NO.	APPR'D

REMOVE SHARP EDGES

INCH (MILLIMETER)

DO NOT SCALE PRINT

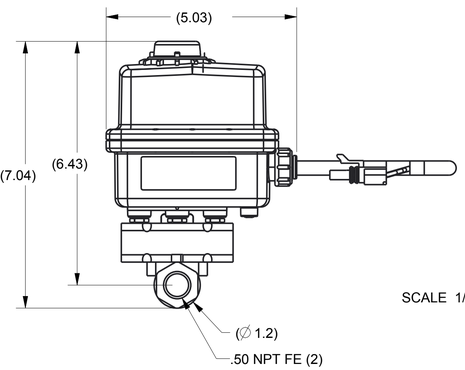
W.S. Darley & Co.

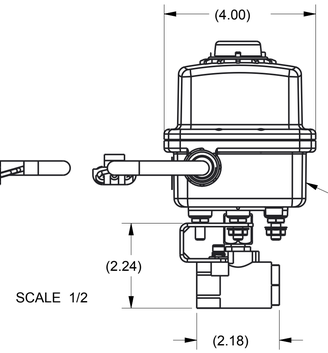
DWG - ELEC. PRIMER, VLV., 4 V NO TANK, CR. SEC., EXPL., 24VDC

DVC0211

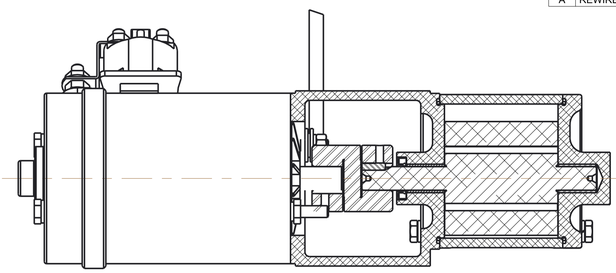
NO.	DESCRIPTION	PART NO.	QTY.
1	ASSEMBLY - PRIMER, ROTOR	4420105	1
2	BEARING - OILITE, 0.626 ID	1760023	2
3	COUPLING - #44093	2404500	1
4	CYLINDER - VACUUM PUMP	1020800	1
5	HEAD - CYLINDER INBOARD	2808904	1
6	HEAD - CYLINDER, OUTBOARD	2808800	1
7	HHCS - .313-18 x 1.00, SST	5400610	4
8	KEY - SQ., 0.19 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
14	MOTOR - PRIMER, 24V	4223500	1
15	PLUG - PIPE, 0.250, BR SQ HD	1080504	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				
LTR	DESCRIPTION	DATE	CHG NO.	APPR'D
A	REWIRED	30AUG2016	11482	WAH

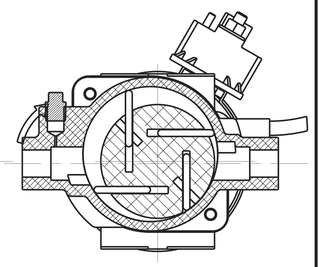




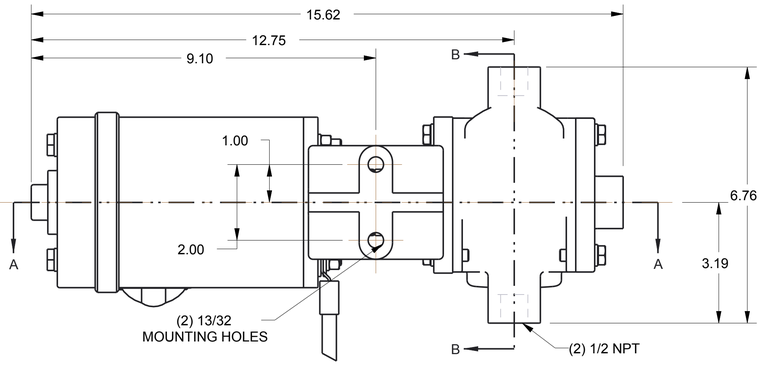
5209401 - KZCO VALVE - ACTUATED,
12 VDC, .50NPT FE
KZCO MDL #84D23-10D20-PO1

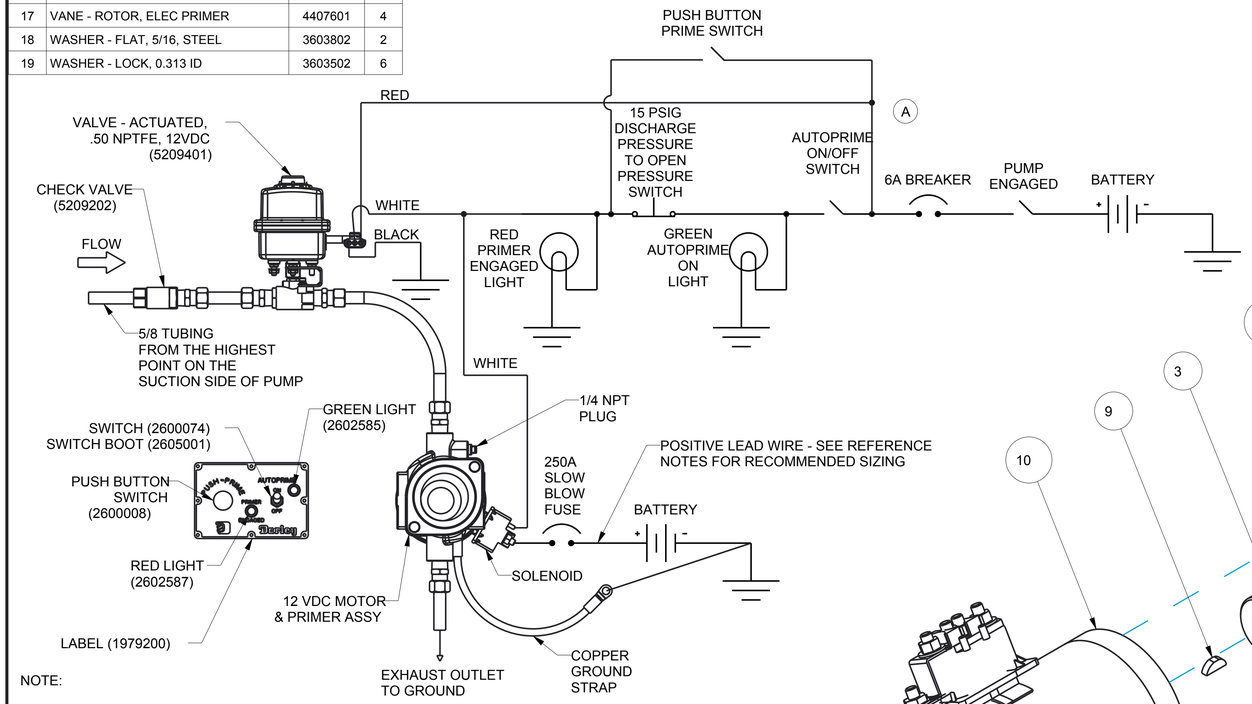


SECTION A-A
SCALE 1/2



SECTION B-B





NOTE:

1) MOUNT WITH EXHAUST OUTLET DOWN

2) CONNECT 4 GA COPPER GROUND STRAP
TO CLEAN, PAINT FREE GROUNDING SURFACE

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

4) AUTOPRIME ASSEMBLY CONSISTS OF THE ABOVE PRIMER AND KIT KA00214 WHICH INCLUDES:
1 - 2602585 GREEN 12V LIGHT
1 - 2602587 RED 12V LIGHT
1 - 2600074 25A CAPABLE SINGLE POLE SWITCH
1 - 2605001 SWITCH BOOT
1 - 2600114 15 PSIG DISCHARGE PRESSURE TO OPEN PRESSURE SWITCH WITH 1/8" NPT MALE
1 - 1979200 LABEL
1 - 5209202 1/2" NPT FEMALE CHECK VALVE
1 - 5209401 ELECTRIC VALVE
1 - 2600008 PUSH BUTTON SWITCH

5) PLUMB 2600114 15 PSIG DISCHARGE PRESSURE SWITCH ON THE DISCHARGE SIDE
OF THE PUMP. WIRE BETWEEN THE "C" AND "NC" SPADES. THE "NO" SPADE WILL
NOT BE USED.

6) ENGINE SHOULD REMAIN AT IDLE UNTIL PUMP IS PRIMED.

7) WHEN THE PUMP IS SHIFTED INTO PUMP MODE THE PUMP ENGAGED MICROSWITCH
WILL PROVIDE POWER TO THE AUTOPRIME CIRCUIT SHOWN ABOVE

REFERENCES NOTES:

POSITIVE LEAD WIRE SIZES FOR 12 V PRIMER:
UP TO 5' LENGTHS USE AWG #6
OVER 5' AND UP TO 8' LENGTHS USE AWG #4
OVER 8' AND UP TO 12' LENGTHS USE AWG #2
OVER 12' AND UP TO 16' LENGTHS USE AWG #1
OVER 16' AND UP TO 20' LENGTHS USE AWG #0
OVER 20' AND UP TO 25' LENGTHS USE A DOUBLE RUN OF AWG #00
OVER 25' AND UP TO 32' LENGTHS USE A DOUBLE RUN OF AWG #000

MASTER SWITCH CAN BE REFERENCED BY DARLEY 2600055 OR DARLEY 2600065
250A SLOW BLOW FUSE CAN BE REFERENCED BY DARLEY 2605058 AND 2605059
6A BREAKER CAN BE REFERENCED BY DARLEY 2600023

12V MOTORS DRAWS 240A

WEIGHT = 27 LB (12.1 KG)

SCALE 1/4
LABEL MOUNTING
DIMENSIONS

MODEL NAME	MDL CREATED	SHEET		
DVC0217	23SEP2015	1/1	D	

REMOVE SHARP EDGES | INCH [MILLIMETER] | THIRD ANGLE PROJECTION | OLD PART NO.

MATERIAL DESCRIPTION: - | MATERIAL NO. - | PATTERN NO. -

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ALL DIMENSIONS IN INCHES UNLESS NOTED

DO NOT SCALE PRINT

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

DRN SMS
CHKD WAH
TRCD

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

DWG - ELEC. PRIMER, AUTOPRIME
KZCO VALVE - 5209401, 1/4 TURN

DATE 23SEP2015
SCALE 1/2

DVC0217

Appendix

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