TREAD CORPORATION

MOBILE TREADBED MANUAL

SN3194

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Prill Body Overhead Boom

Model Identification

The Tread Corporation TREADBED model number is used to define the configuration, capacity and material of manufacture. The first two numbers indicate the profile and boom location type.

10 - Overhead boom, standard profile
11 - Overhead boom, high profile
12 - Overhead boom, high/wide profile
15 - Side boom, standard profile
16 - Side boom, high profile
17 - Side boom, high/wide profile

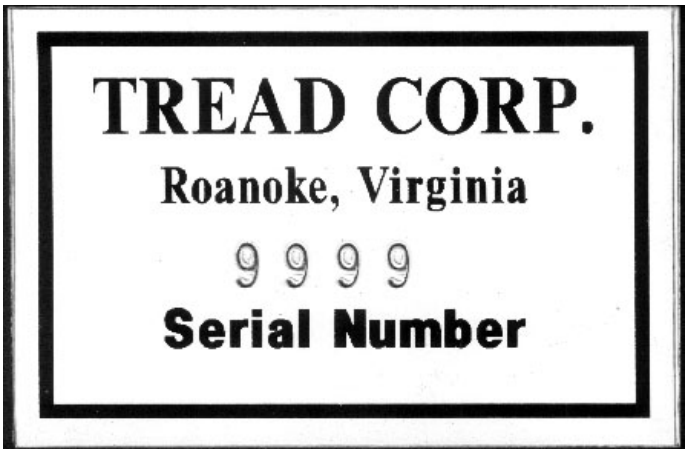
The first letter indicates the body material type and the second letter indicates the material composition of the augers.

MM - Mild steel body / mild steel augers and tubes
MS - Mild steel body / stainless steel augers and tubes
SS - Stainless steel body / stainless steel augers and tubes

The next two digits indicate the body length or length of the ammonium nitrate hopper. The lengths range from 5 feet to 20 feet. The most common lengths are:

8	-	8 foot prill body length
10	-	10 foot prill body length
12	-	12 foot prill body length
14	-	14 foot prill body length
15	-	15 foot prill body length
16	-	16 foot prill body length
18	-	18 foot prill body length

Serial Numbers



All Tread Corporation TREADBED bodies are numbered serially. It is important that you know your serial number when calling Tread Corporation with questions regarding your TREADBED. The serial number may be found on the body at the ladder location. This is done to give us a reference number that is unique to each specific body. This allows us to help you with trouble-shooting your unit in the field. When you call in for parts or help with your unit, it is very important to have this number in hand. If your tag has been lost or has become unreadable, we can help you find this information through a search of the truck files. Your company should have this data on file as it was on the original invoice. We cannot stress the importance of having this number available when calling for help. Your company unit number is not kept on file in our records as the unit may have changed hands a few times since it was originally built, and this would make keeping up with this information almost impossible.
The Treadbed serial number tag is mounted near the ladder. This is done to give you a reference as to where to look for the tag. The tag is white and about 2”x3”. This tag carries a four-digit number that is unique to your unit.

On older Treadbed units the tag was mounted at the point where the body met the frame rail of the chassis on the rear right on the unit. The easiest way to find this tag on older units is to walk up to the rear bumper. Using your right hand, point to where the frame of the Treadbed contacts the frame of the chassis. You should now be pointing at the tag. As the quad-type trucks became more popular, this area became more congested and required us to move the tag to the new location. The new location has proved much better as this area is almost always less cluttered.

Hatch covers



Hopper bodies are equipped with hatch covers that are used as closure for the AN/ANFO compartments. The hatches are on slides allowing them to be opened under the bin. These hatches are designed to keep rain and other foreign material out of the product. Their other purpose is to keep product from blowing out of the unit during travel. These covers should be open only during filling and when dislodging hung product.

WARNING * Your hopper is a confined space and should ONLY be entered following all rules that apply from your company as well as OSHA and MSHA.**

Hatch covers are equipped with a locking device that enables the operator to lock the openings for overnight storage when permitted. This device is a sliding rod on the top of the unit. When the lock is removed, the rod can slide away from the





locked position and be rotated, allowing the tabs on the rod to give clearance to the hatch covers. This allows the hatch cover to be raised over its locking shoulder, permitting the hatch cover to be slid open.
Many of your companies have BATF preloading variance that allows you to load your unit the night before the shot. When this is done, the variance has rules that must be followed. Each company has specific rules and we will not attempt to cover them now, however, almost all of them require the locking of the AN hopper and emulsion tank.

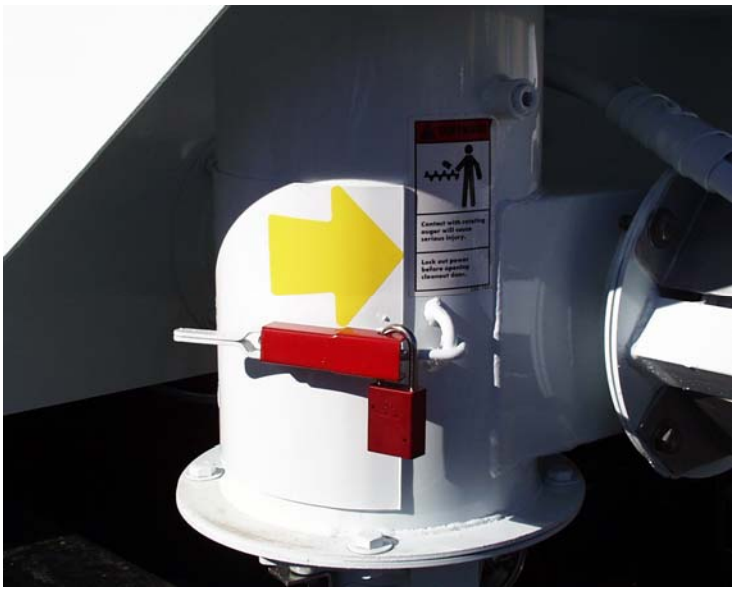
Hatch cover daily inspection and maintenance:

- Make sure that the hatch cover is free of foreign material and the unit slides freely on the guides.

• Inspect the locking device to make sure that the rod works freely and accepts the lock properly.
•If the hatches have become bent or do not fit properly, they should be repaired or replaced at once.

When the vehicle is moved over the highway or between the bench and the pattern, the hatches should be secured properly.

Augers



Treadbed augers are accessible through inspection doors that are locked during normal operation. These doors are strategically located at auger intersections to allow the cleaning and disassembly and reassembly of augers. These doors should only be unlocked for maintenance of the auger system or freeing jammed material from the augers.

Your auger inspection doors should be unlocked and opened ONLY in compliance with the stated tag out/lock out procedure following all rules that apply from your company as well as OSHA and MSHA.

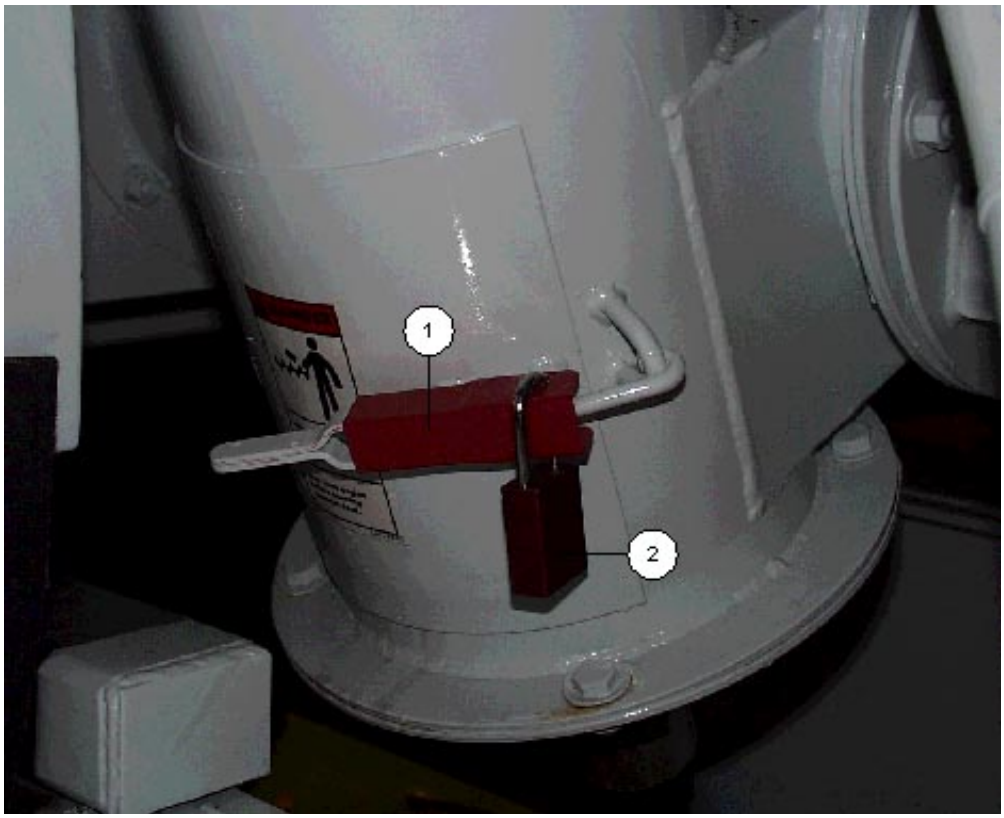
During these operations, the engine of the truck should be off and the ignition keys locked out.





Keys locked out!

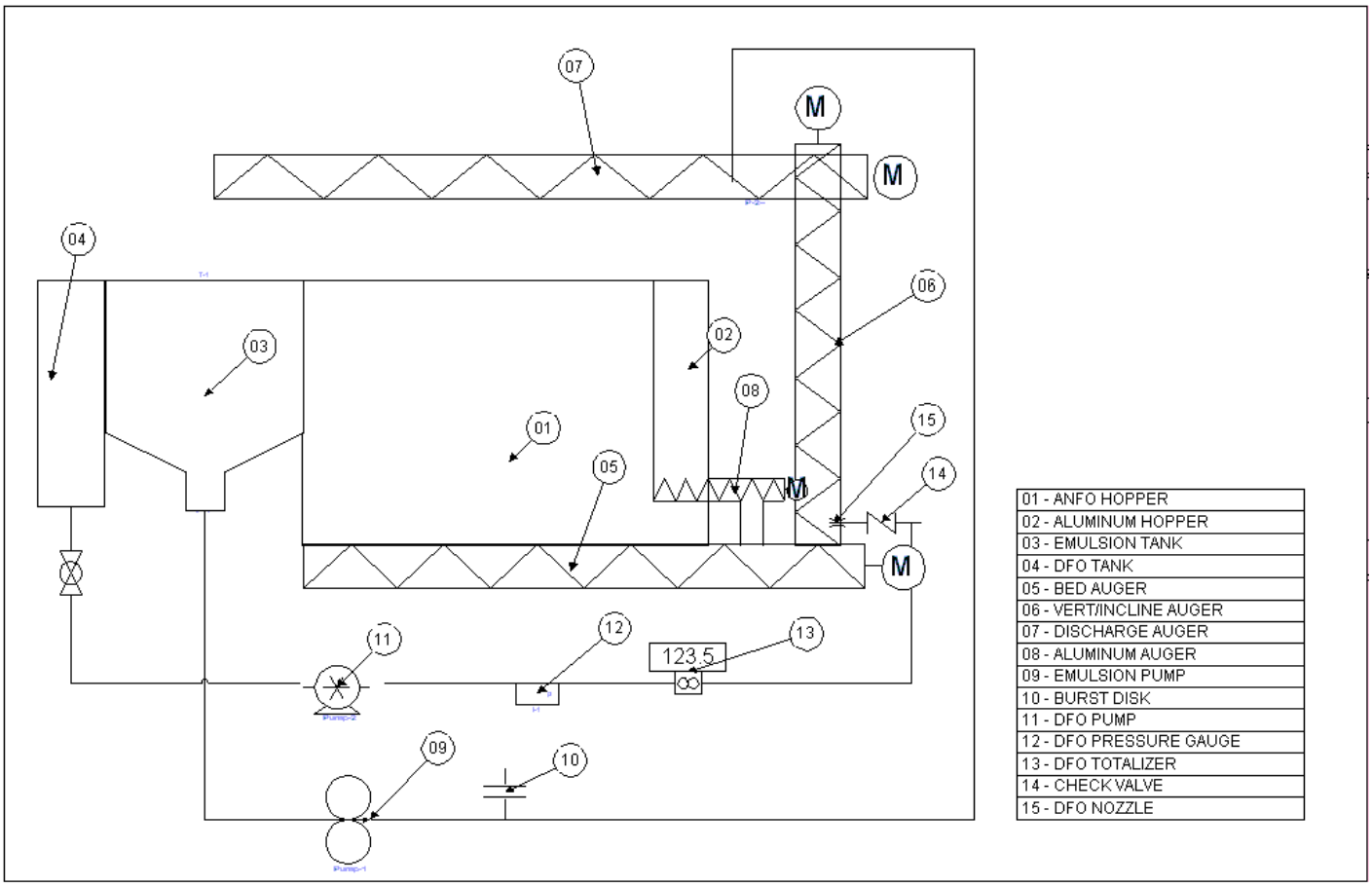
LOCKOUT DEVICE WITH LOCK



ITEM	QTY.	PART NO.	DESCRIPTION
1	1	285.9900	LOCKOUT DEVICE - RED
2	1	280.0017	LOCK AMERICAN #1106R PADLOCK

Auger inspection door daily inspection and maintenance:

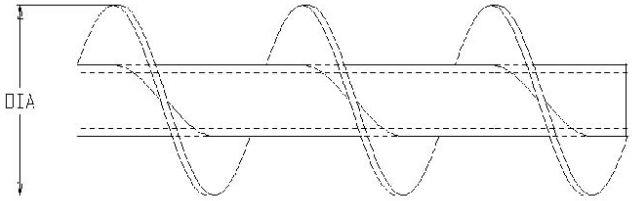
1 - Make sure that all doors are closed and secured before starting operation.
2 - Replace any locks that are missing or damaged.
3 - **With the truck empty and engine locked out**, inspect augers for missing drive bolts. Make sure there is no foreign material in the auger intersection area.



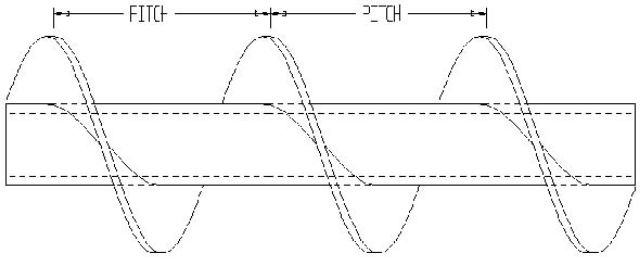
Auger Basics

Archimedes invented screw conveyor in 240 B.C.
It can be used for lifting water.
It consists of a conveyor screw rotating in a stationary trough.
It is a constant volume device.
Is used for accurate metering of materials.
It must be calibrated for material being conveyed.
Screw efficiency will change with age (usually better).

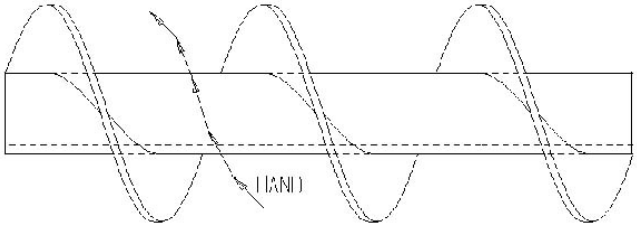
Diameter is the outside diameter of the flighting. It usually 1 inch less than housing diameter (7 inch diameter auger in an 8 inch housing).



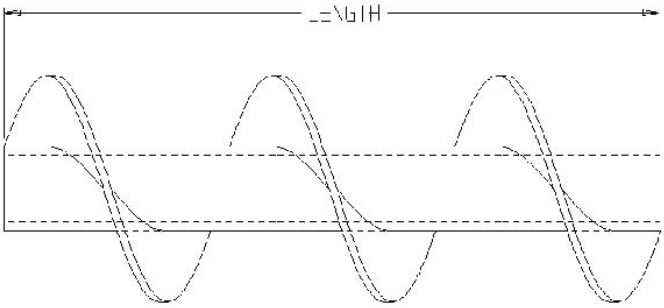
Pitch is the distance between flights and is specified as a fraction of the diameter.
Normally full, 2/3, ½.
7 inch full pitch has 7 inches between flights.
9 inch 2/3 pitch has 6 inches between flights.



Hand is the rotation direction relative to the material movement
Right hand - auger turns to the right (clockwise)
Left hand - auger turn to the left (counter clockwise)



Length is the total length of the auger
Usually the housing length less 2 inches



Auger percent fill

The auger can not convey material within a housing if it is loaded at 100%.
If you are going to add material (emulsion, aluminum) there must be somewhere for it to go.

Design techniques are used to keep the augers properly filled with material. This is referred to as PERCENT OF FILL.

The manner in which the augers convey material can adversely affect product quality

Augers that are overloaded can crush/grind the ANFO lowering its density

Augers that have reduced capacity from product buildup (less void space) can affect quality

Augers that are worn (reduced diameter) or damaged (bent flight) can affect quality.

Augers that are worn (reduced diameter) or damaged (bent flight) will affect the material delivery rate.

Augers that are overloaded are prone to jamming.

Reducing the percent of fill in the bed auger is accomplished by

1. Change in pitch at transition from hopper body to bed auger housing. (2/3 to full or 1/2 to 2/3)
2. Larger bed auger housing. 10 inch housing with a 7 inch auger (side boom trucks)

Reducing the percent of fill in auger to auger transitions is accomplished by

1. Change in relative speed of augers (faster motor or higher output pump section)
2. Change in relative size of auger (8 to 10)

Delivery rates

7 inch 1/2 pitch ~ 3.0 lbs/rev
7 inch 2/3 pitch ~ 4.5 lbs/rev
7 inch full pitch ~ 6.0 lbs/rev

Delivery rates will change over time. Augers that are worn smooth from use will have better delivery rates. Augers must be calibrated when new. Should follow-up in one month and then annually thereafter.

Safety

Moving parts of mixing system designed to prevent heat buildup.
Bearings are >1 in. from the product container.
Auger drive shaft has a bushing for easier removal.

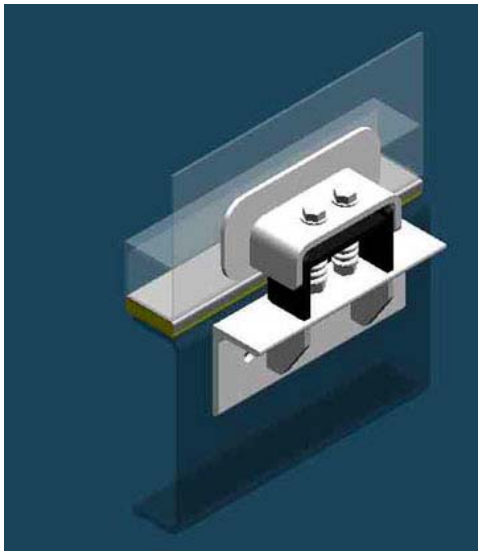
Clogged or jammed augers are a fact of auger systems
Must be dealt with in a safe manner
Never stick your hands in the auger
Know where everyone else is and what they are doing

Guards in place
Keep hands/clothing away from rotating parts
Before clearing the auger follow lockout/tagout procedures
remove primary power (PTO disengaged, engine off, keys in pocket)

Lockout/tagout always applies when doing maintenance
No welding or open flames shall be used on or around any part of the delivery equipment unless it has been completely washed down and all oxidizer material removed.
Before welding or making repairs to hollow shafts, the shaft shall be thoroughly cleaned inside and out and vented with a one-half-inch diameter opening.

Inspection and Maintenance

Visually inspect spyder gear for wear.
Grease bearings daily.
Grease seal daily.
Shaft keys tight with set screw.
No fluid leaks.



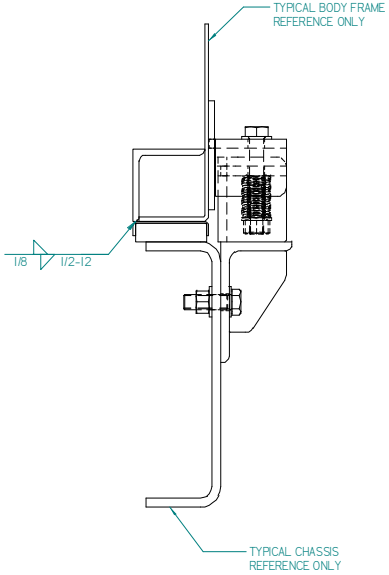
Flex Mount System

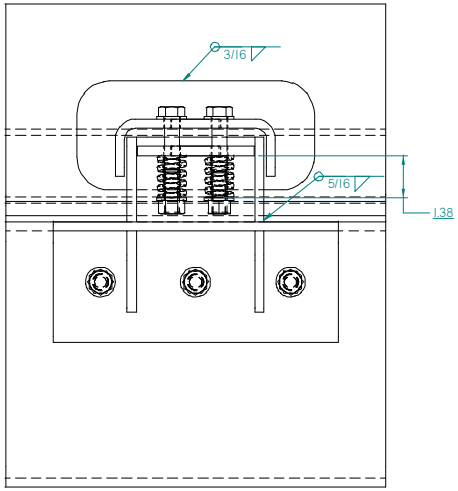
Tread Corporation has developed a new body mounting system for bulk trucks called ***Flex Mount***. The new mounting system supports the body along its entire length on UHMW polyethylene mounting sills and uses a spring-loaded tie-down system that allows for body

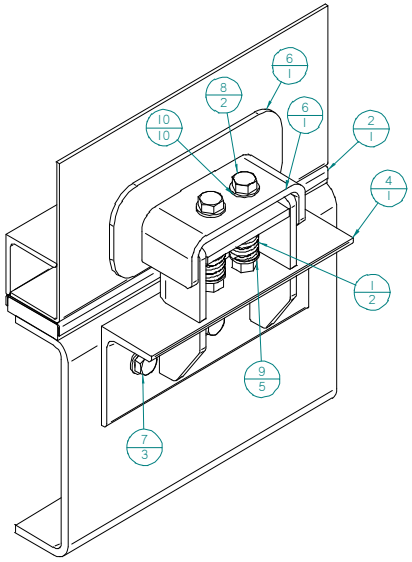
movement due to chassis flex. The spring-loaded attachment brackets permit vertical movement of the body which reduces stresses at the attachment points that might otherwise damage the chassis or the body. The continuous mounting sill transfers uniformly distributed loads to the truck frame for reduced flexural stresses, while the UHMW material protects the top surface of the frame flange from damage.

Daily inspection and maintenance:

1 - Check chassis bracket bolts for tightness.
2 - Check flex mount springs for any sign of cracking or breakage.
3 - Check flex mount bolts for properly adjusted spring height of 1.5 inches.







NOTES:
1. ALIGN TOP SURFACE OF CHASSIS MOUNTING ANGLE WITH TOP SURFACE OF CHASSIS RAIL AT REQUIRED LOCATION.
2. MATCH DRILL 11/16 DIA HOLES IN CHASSIS RAIL FOR BOLTING ANGLE TO CHASSIS.
3. TORQUE 5/8 GRADE 8 ANGLE MOUNTING BOLTS AND STOVER LOCK NUTS TO 100 FT-LB.
4. TIGHTEN 5/8 GRADE 8 SPRING MOUNTING BOLTS AND STOVER LOCK NUTS TO 1-3/8 INCH SPRING HEIGHT.

ITEM	QTY	DWG NO.	DESCRIPTION	PART ID
1	2	S10001P08	SPRING COMP 1.25 OD .625 X 1.75L	269.9019
2	1	S10001P05	FLEX MOUNT RUB RAIL RETAINER SS	287.6029
3*	1	S10001P04	FLEX MOUNT UHMW RUB RAIL 3.0 X .75	230.0018
4	1	S10001A04	FLEX MOUNT CHASSIS ANGLE WELDMENT CS	
5*	1	S10001A03	FLEX MOUNT CHASSIS BRACLET WELDMENT CS	287.6031
6	1	S10001A02	FLEX MOUNT FRAME BRACKETT WELDMENT SS	287.6032
7	3		SCREW CAP HEX HEAD .625-11 X 2.00 GR8	900.67308
8	2		SCREW CAP HEX HEAD .625-11 X 4.00 GR8	900.68108
9	5		NUT HEX STOVER LOCK .625-11	955.6610
10	10		WASHER FLAT HARD A325 .625	962.6610

PROPRIETARY STATEMENT

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UNLESS OTHERWISE SPECIFIED ALL DIMENSIONS ARE IN INCHES
1.0 INCH = 25.4 mm

THIRD ANGLE PROJECTION

TOLERANCE LIMITS
UNLESS OTHERWISE SPECIFIED
DECIMAL X = ± .100
DECIMAL .XX = ± .020
DECIMAL .XXX = ± .005
ANGULARITY = ± 0.5 DEG

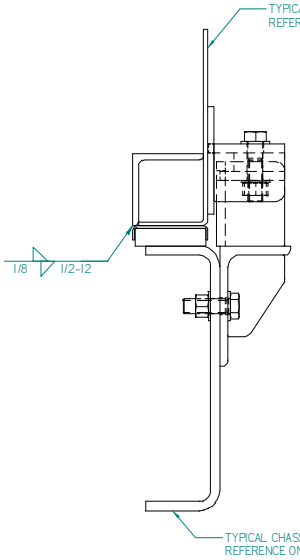
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DATE: 7/21/01
APPR.

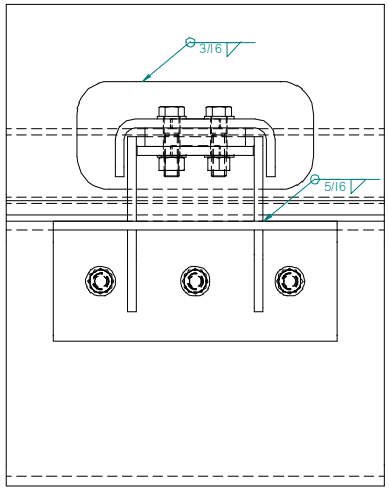
TREAD CORPORATION ROANOKE, VIRGINIA 24012 USA

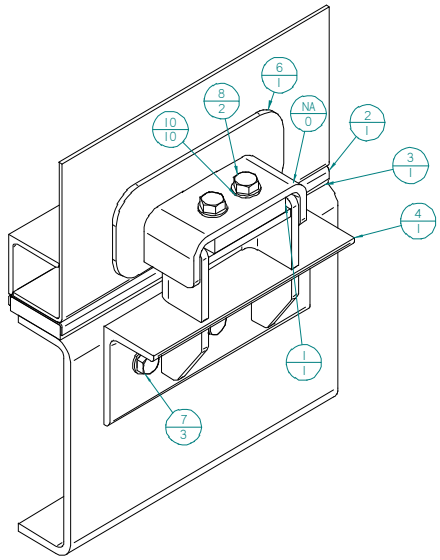
PROJECT: TREADBED BULK TRUCKS
TITLE: FLEX MOUNT SPRING MOUNT ASSEMBLY
FLEX MOUNT BODY MOUNTING SYSTEM
DWG NO: S10001A01 REV: 1 SIZE: C
WEIGHT: 34.9 lbm SHEET 1 OF 1

PART ID
287.6034

Last Changed: 12/28/01







NOTES:
1. ALIGN TOP SURFACE OF CHASSIS MOUNTING ANGLE WITH TOP SURFACE OF CHASSIS RAIL AT REQUIRED LOCATION.
2. MATCH DRILL 11/16 DIA HOLES IN CHASSIS RAIL FOR BOLTING ANGLE TO CHASSIS.
3. TORQUE 5/8 GRADE 8 BOLTS AND STOVER LOCK NUTS TO 100 FT-LB.

ITEM	QTY	DWG NO.	DESCRIPTION	PART ID
1	1	S10001P10	FLEX MOUNT UHMW BLOCK SPACER	230.0019
2	1	S10001P05	FLEX MOUNT RUB RAIL RETAINER SS	287.6029
3	1	S10001P04	FLEX MOUNT UHMW RUB RAIL 3.0 X .75	230.0018
4	1	S10001A04	FLEX MOUNT CHASSIS ANGLE WELDMENT CS	
5*	1	S10001A03	FLEX MOUNT CHASSIS BRACLET WELDMENT CS	287.6031
6	1	S10001A02	FLEX MOUNT FRAME BRACKETT WELDMENT SS	287.6032
7	3		SCREW CAP HEX HEAD .625-11 X 2.00 GR8	900.67308
8	2		SCREW CAP HEX HEAD .625-11 X 2.50 GR8	900.67508
9*	5		NUT HEX STOVER LOCK .625-11	955.6610
10	10		WASHER FLAT HARD A325 .625	962.6610

PART ID
287.6035

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1.0 INCH = 25.4 mm
THIRD ANGLE PROJECTION

TOLERANCE LIMITS
UNLESS OTHERWISE SPECIFIED
DECIMAL X = ± .100
DECIMAL .XX = ± .020
DECIMAL .XXX = ± .005
ANGULARITY = ± .05 DEG

DRAWN: D. COLE
DATE: 7/21/01
APPR:

TREAD CORPORATION ROANOKE, VIRGINIA 24012 USA

PROJECT: TREADBED BULK TRUCKS
TITLE: FLEX MOUNT RIGID MOUNT ASSEMBLY
FLEX MOUNT BODY MOUNTING SYSTEM

DWG NO: S10001A11 | REV: 1 | SIZE: C
WEIGHT: 34.5 lbm | SHEET: 1 OF 1

Last Changed 12/28/01

Rear Bumper

The DOT requires that the bumper be of a strength that will protect the tank and body in the event of a rear end collision with the force of 2 g's.

This bumper is designed to meet these standards and should not be altered in any



way.

ICC under-run protection at the rear of the unit is designed to prevent an automobile from running under the truck.

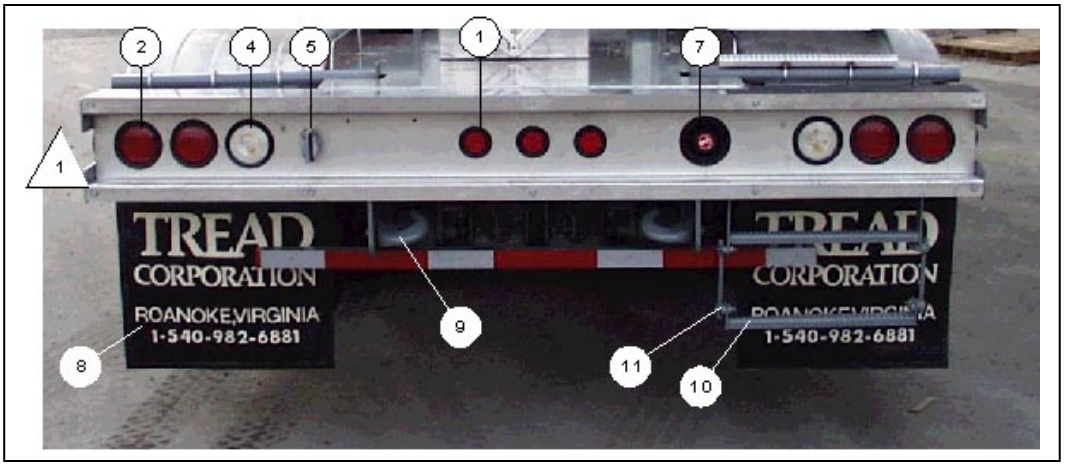
Daily inspection and maintenance:

1 - Inspect any damage to the rear bumper that would lessen its ability to withstand a rear end collision.

2 - Inspect any damage in the under-run protection that would lessen its ability to withstand a rear end collision.

3 - All lights should be in working order.

BUMPER ASSEMBLY



NOTES:
1 - LIGHTS ON EACH SIDE ARE THE SAME AS THE 3 IN THE MIDDLE. ITEM 1

ITEM	QTY.	PART NO.	DESCRIPTION
1	5	231.6002	LIGHT 12V MARKER RED GROTE GROMMET MT
2	4	231.6000	LIGHT 12V STP/TRN/TL HARNESS TYPE GROTE
4	2	231.6001	LIGHT 12V BACK-UP GROTE HARNESS TYPE
5	1	231.6003	LIGHT 12V LICENSE GROTE HARNESS TYPE
7	1	231.6025	BACK-UP ALARM GROTE GROMET TYPE 12/24V
8	2	243.5581	MUD FLAPS "TREADBED"
9	1 SET	239.2800	TOW HOOKS 90000 PSI
10	1	287.5007	SWING STEP WELDMENT
11	2	982.3697	WIRE ROPE CLIP .50" GALVANIZED

Ladders and Walkways

The function of the ladders and walkway is to give the operator a safe and easy way to ascend to the top of the unit and perform the necessary tasks that must be undertaken on a routine basis.

The ladder assembly starts close to the ground and gives three points of contact from the ground to the top of the vehicle.



The walkway runs the full length of the body and gives the operator a working surface to load the vehicle, as well as perform any necessary maintenance that is required.



Walkways are equipped with a 6-inch toe board for added safety and compliance to MSHA and OSHA.

Ladder and walkway daily inspection and maintenance:

Ladder and walkways should be cleaned on a regular basis to allow for an uncluttered workspace.

All welded joints should be inspected on a regular basis to assure a safe situation. Any damaged area should be repaired in as timely a fashion as possible.

Handrails

Handrails are provided to assure the maximum amount of safety while on top of the vehicle. The rails are engineered to meet all of the requirements of OSHA and MSHA. The full extension yields 42 inches of height with an intermediate rail as required.



The pre-shift inspection is a good time to inspect the condition of the hydraulic hose and fittings. Put the PTO in gear and look for leaking fittings and system components as you actuate each control function. Inspect the hose assemblies carefully for any sign of abrasion, wear of kinking. Replace any suspect hose as soon as possible.

Operation

This section shows a "typical" control assembly. Your control assembly may vary depending on your specifications. Please reference the engineering schematics, located in the rear of this manual, for the exact controls of your Treadbed.

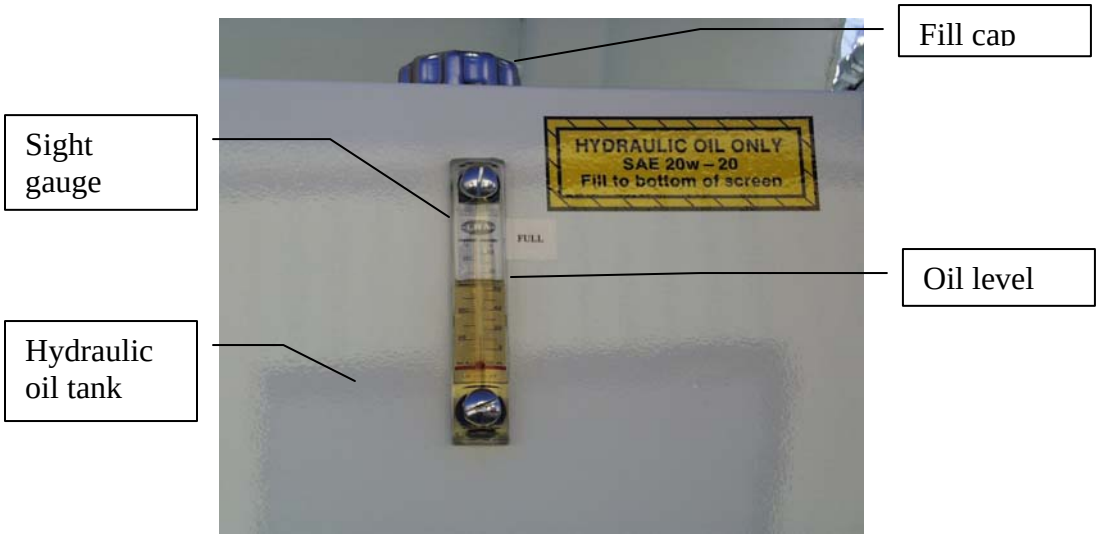
First and Last Checklist.

This checklist should be used BEFORE and AFTER each use.

1. Hydraulic controls in the off or neutral position.

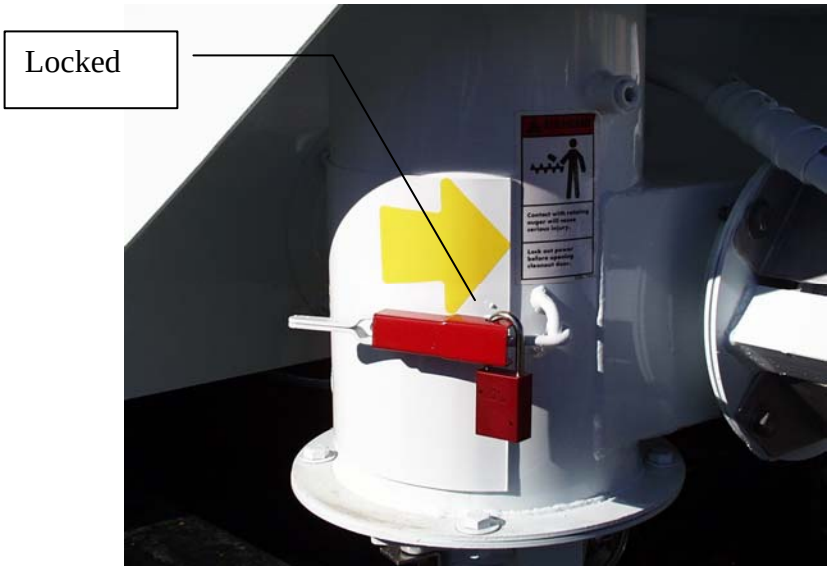


2. Hydraulic fluid level is visible in the sight gauge. (at least ½ the way up the gauge)



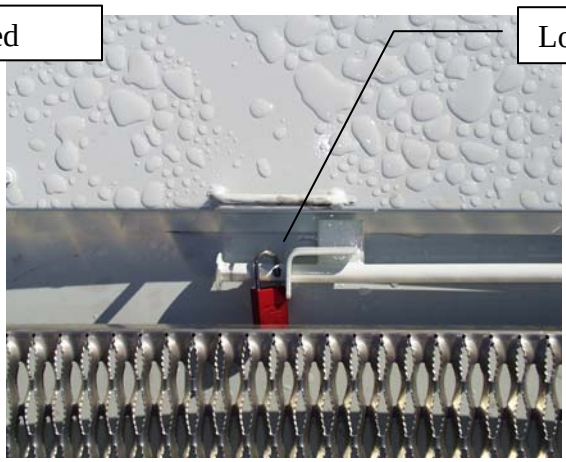
3. Slide gates closed (if so equipped)

4. Visually inspect the bottom and vertical augers through the clean out access doors for loose material. Lock the clean-out doors after the inspection.

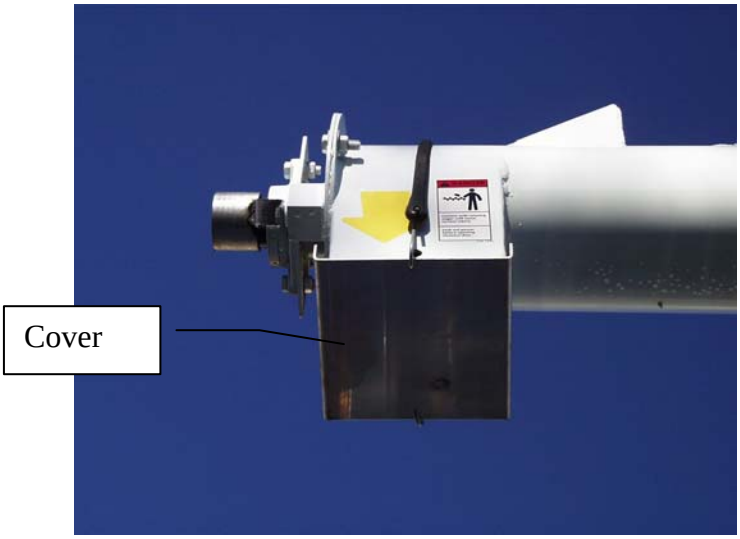


5. Inspect the compartment interiors for loose materials.
6. Make certain that the hatch covers are closed and locked properly.



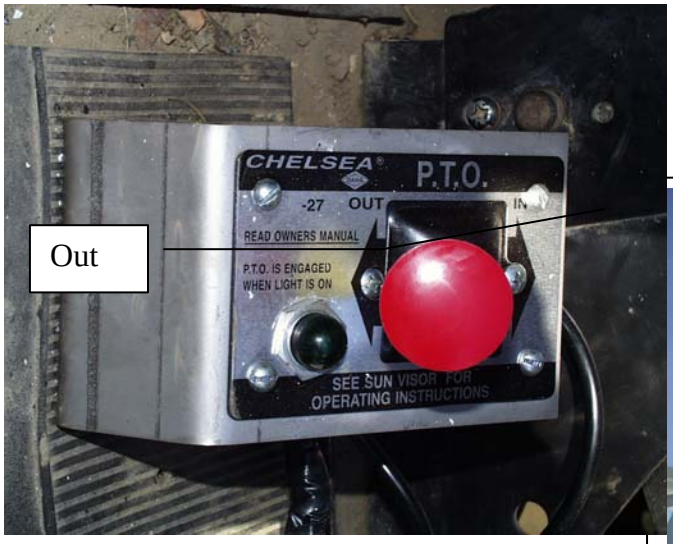


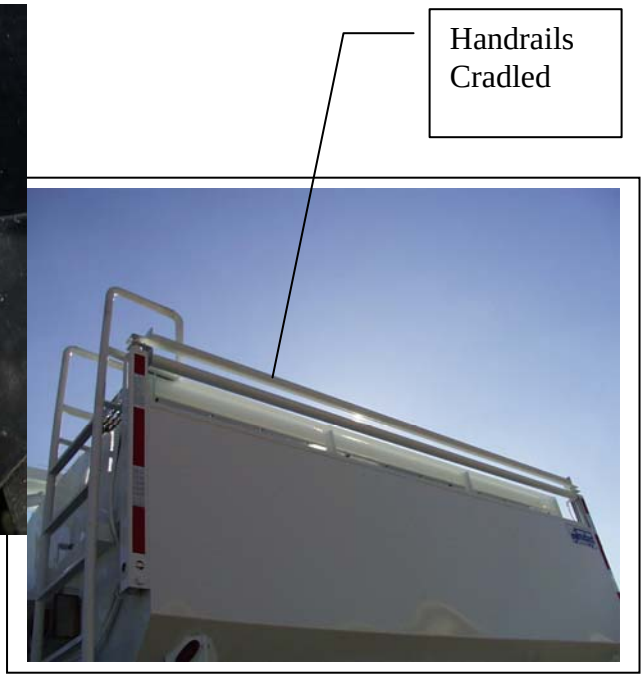
7. Check boom auger for cover installed and proper cradle position.





8. Disengage the power take-off. “Out” is the off position.





9. Check to make sure that no one is on top of the truck.
10. Lower the handrails to the cradled position.

IMPORTANT NOTICE: Before operating the truck on the highway or for travel at the job site, the following should be observed.

1. Make certain the hatch covers are closed and locked properly.
2. Check the overhead auger for proper cradle position.
3. Disengage the transmission power take-off.
4. Close gates (if so equipped).

Compartment Loading

1. Close all gates (if so equipped).
2. Raise handrails, before climbing the ladder.
3. Open the hatch cover.
4. Fill the compartment.
5. Close and lock the hatch cover.
6. Lower handrails when no one is on top of the truck, or on the ladder.

Product delivery

1. Engage the power take off by
   a. Depress the clutch.
   b. Pause for a moment.
   c. Move the switch to the “in” position.
   d. Release the clutch.
2. Set engine throttle for the desired engine RPM. The system is designed for a nominal engine RPM of 1100 RPM. Use caution when exceeding this speed since higher engine speeds lead to higher system operating pressures.
3. Actuate the valve marked “BOOM” to “RAISE” the boom to the desired position.
4. Activate the valve marked “ROTATE” to swing the boom to the desired location.
5. Install the boom cone and hose if required.
6. Open the slide gate for the compartment you wish to unload (if so equipped). Only unload one compartment at a time. Do not unload product through a full compartment. Instead, unload the compartment nearest the vertical auger first and then the next compartment away from the vertical auger.



7. Move the valves marked “ANFO” and “AUGERS” to the “FORWARD” position. Use caution when moving the valve to the “REVERSE” position. This position is only used when clearing the augers of jammed material.
8. Adjust the throttle control to achieve the desired delivery rate of material. Under no circumstances should the pressure reading, when delivering material, exceed 3000 PSI. Above this point, the relief valve will unseat, leading to a decrease in system performance. The nominal pressure reading for a properly operating system should be about 1800 PSI under maximum delivery conditions.



Maintenance Inspection

CAUTION ********** **CAUTION**
Before performing any maintenance on the equipment, the following must be observed!

Routine Maintenance

A pre-maintenance safety inspection and cleaning must be per-formed before any maintenance is done to the equipment. For routine maintenance, a thorough washing with a high pressure washer should be done to remove any contamination with Ammonium Nitrate, D.F.O. or Bulk Emulsion spillage. Steam clean those tight areas on the unit where high-pressure water may not be sufficient.

Repair Service

Repair service may include the use of oxy-acetylene or electrical welding equipment or the drilling or boring of holes near pumps, bins, product hose or product tanks. It is imperative that no product be present when repairing the equipment. Particular attention must be paid to those areas where voids can become filled with product that is not immediately visible to the eye. This includes, but is not limited to, all transfer pumps, product piping and transfer augers. For repair service, a partial disassembly of the equipment may be necessary in order to properly clean the unit. In particular, if any repair is to be performed on an auger or auger tube, the auger must be completely disassembled before performing repairs. This must include removal of the auger shafts.

Washing

Due to the highly corrosive environment caused by Ammonium Nitrate, it is very important that the truck be kept free of any and all loose material when being stored for overnight or other extended periods of time. Periodic washing is imperative if the expected lifetime of the body is to be realized.

In order to avoid mechanical failure of components on the truck, it is recommended that a periodic inspection and maintenance schedule be followed. Recommendations concerning the type and frequency of these inspections are presented in this section. Maintenance of any piece of equipment should include not only those things that will improve the long-term operation of the equipment but also those things that will provide for safe operation. The need for a periodic check of the body mounting, truck lights, mud flaps, boom pivot bolts, etc. cannot be stressed enough. For the sake of all concerned, KEEP YOUR EQUIPMENT IN SAFE OPERATING ORDER.

Periodic Operation

All systems on the truck should be operated on a routine basis. Do not allow the truck to sit idle for extended periods of time without operation. All the slide gates, augers, oiling systems, etc. should be cycled or operated regularly to avoid the seizure of the moving parts.

Fasteners

All bolts, nuts and washers are stainless steel to prevent servicing problems. It is imperative that all fasteners lost or damaged during truck maintenance be replaced with stainless steel fasteners.

Lubrication

Proper lubrication is one of the most important factors leading to the performance and reliability of any machine. Special care should be taken to keep lubricants from becoming contaminated with dirt, abrasives, or any foreign substance. All containers, grease guns or other means of storing or applying lubricants should be cleaned prior to and after application of the lubricant. Also, all grease fittings should be wiped clean before and after lubrication so as not to inject dirt into the bearing

CAUTION: The use of air pressure-operated grease guns is not recommended. Improper use may result in seal rupture.

Bearings

Grease all bearings with a high-grade anti-friction grease of medium to medium-soft consistency. The grease must be free from acid, alkali or any filler, which would act as a lapping agent. All bearings should be serviced every day and immediately after washing due to the highly corrosive environment. There are also lubrication points at the following locations

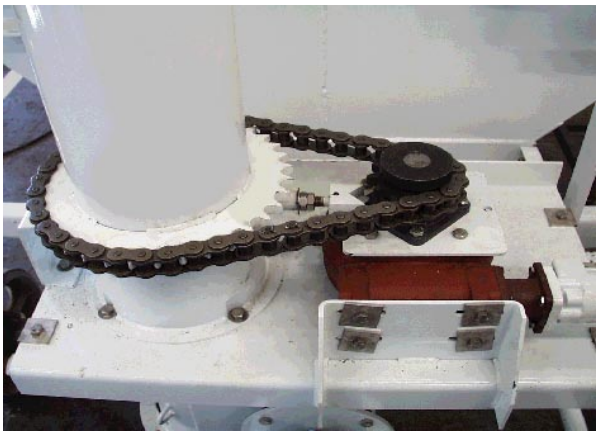
1. At both ends of all augers. Do not forget the bearing located on the top of the vertical auger.
2. Pump shafts
3. The split clamp ring on the boom auger pivot, and the top auger support.
4. The gear reducer on the boom swing drive located above the turntable or on the boom swing drive
5. The gear reducer located on top at the boom on hose reels,

Sprockets, chains, racks and pinions

Brush Never-Seez Nickel Compound over all exposed moving parts every two weeks or immediately after washing. This should include the swing drive chain and sprocket.

Vertical auger support and drive.

This support system contains two primary components. The turntable assembly supports vertical loads while the top support handles horizontal loads.



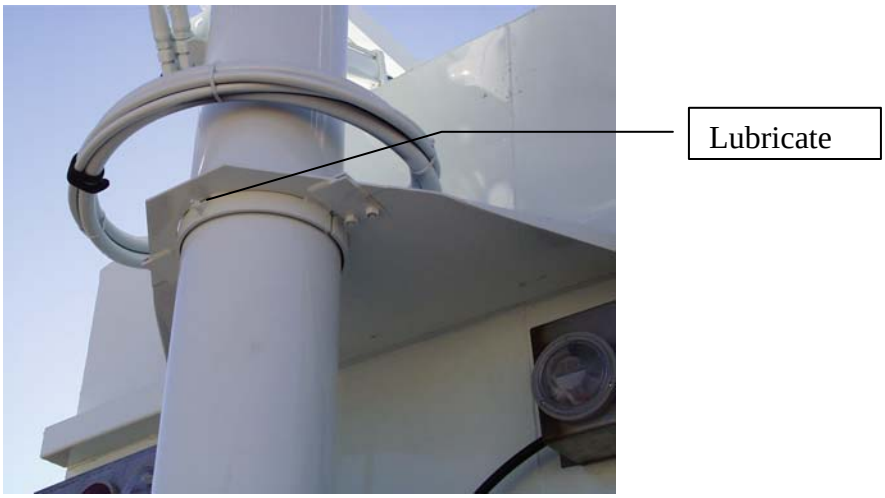
Turntable Assembly

The turntable assembly is composed of parts that are bolted in place and, therefore, may be easily replaced if necessary. When changing or adding oil to the gear reducer, use a gear lube of the following specification:

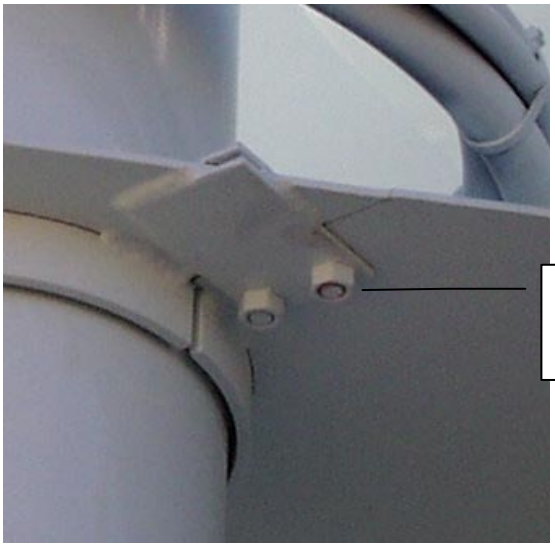
SAE 80W-85W-140
A.P.I. Service GL-5

Top Support

The top support is welded to the upper body. It is of fail-safe design to prevent the assembly from coming apart if the nuts loosen. If the nut works loose, the bolt will remain in place due to its' orientation.

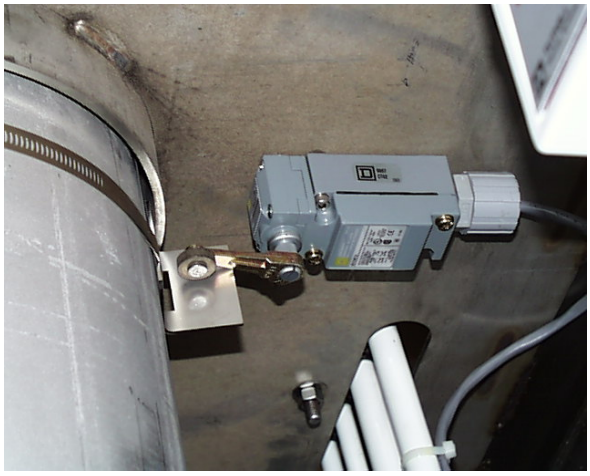


NOTE: When reinstalling the four (4) top support bolts, make certain they are installed with the bolt head on top.



Bolt heads on top/nuts on bottom

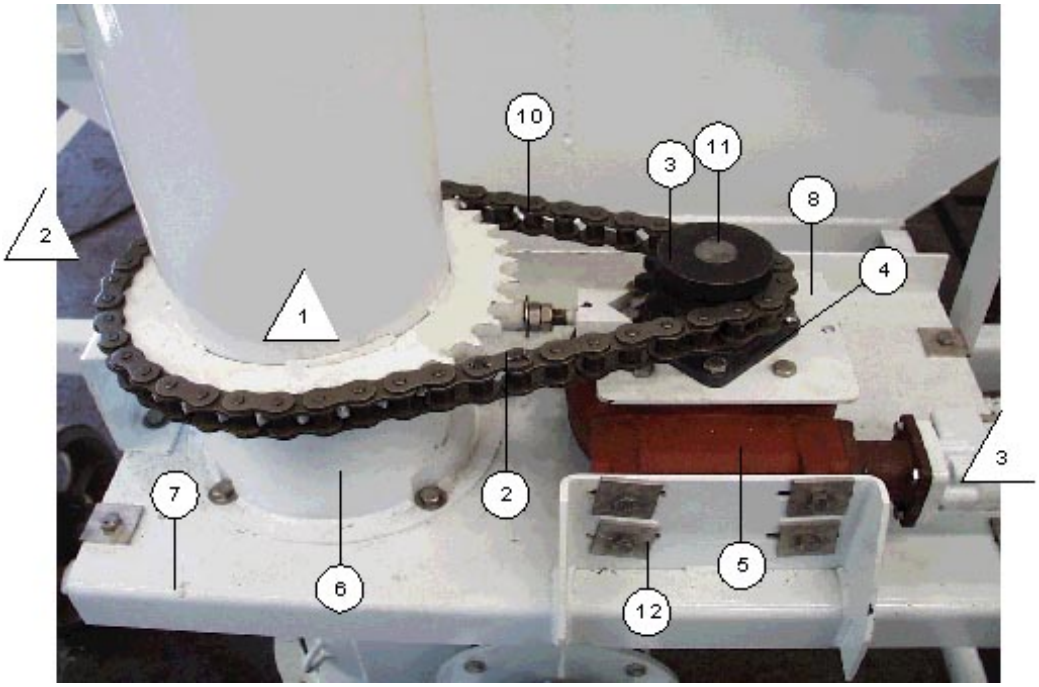
Boom Rotation Limit Switch



With electrical control systems, the rotation of the overhead boom auger is restricted by a limit switch that is mounted on the underside of the vertical auger top support. Two adjustable actuation tabs are attached to the vertical auger housing adjacent to the limit switch. When the vertical housing rotates, one of these tabs will come into contact with the limit switch arm and interrupt the electrical current going to the hydraulic valve solenoid. The second tab will limit rotation in the opposite direction. To adjust the tabs, loosen the worm gear hose clamp and slide the tabs to the desired position, then retighten the hose clamp.

The tabs should be adjusted to stop the boom auger immediately above the boom auger cradle in one direction, and to stop the boom auger before it hits the ladder or the handrail in the other direction (about 270 degrees of rotation). The limit switch must be properly adjusted at all times to ensure that the boom auger does not pass over the walkway when personnel are present.

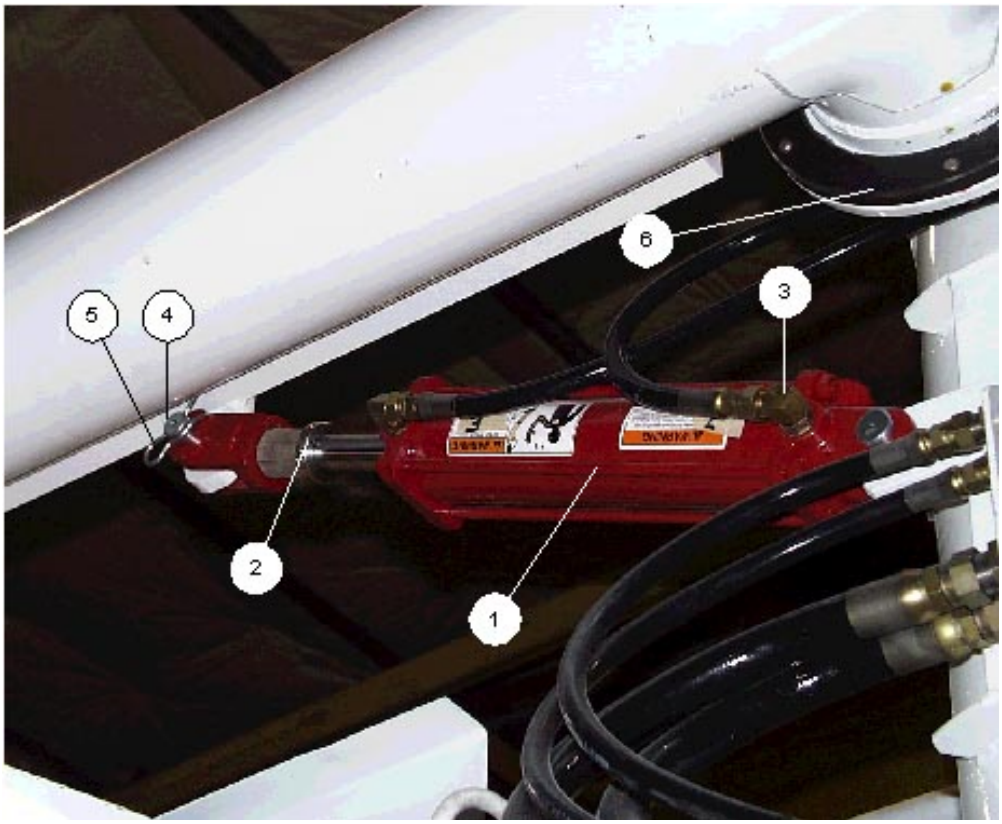
VERTICAL AUGER SUPPORT/DRIVE



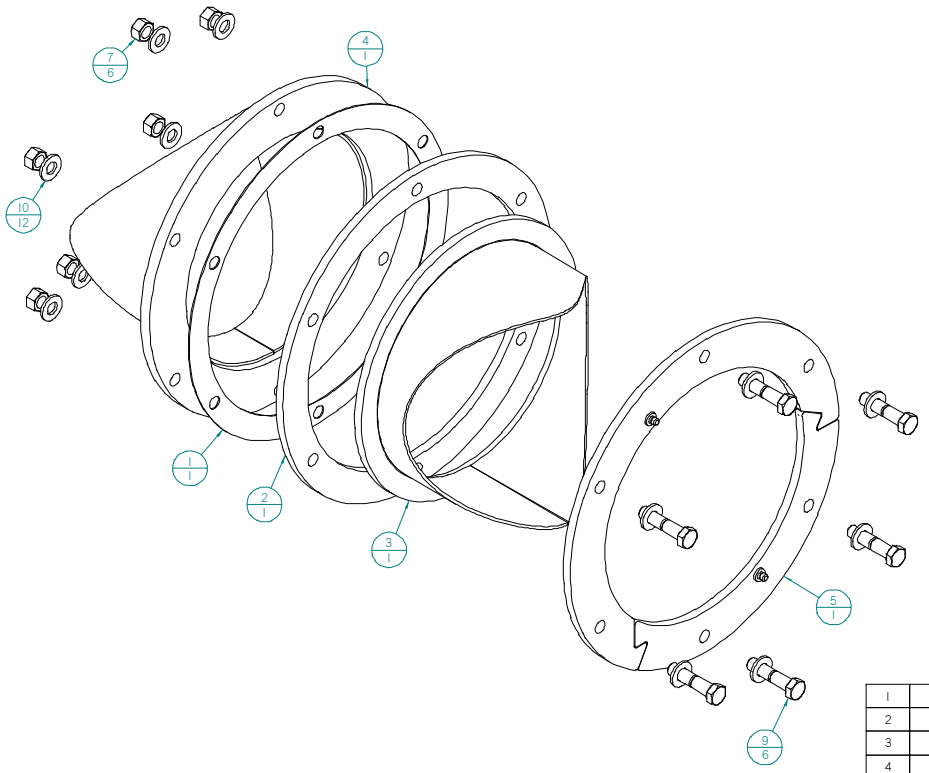
NOTES:
1 - ITEM 1 UHMW WEAR STRIP (NOT SHOWN) IS BETWEEN BASE WELDMENT AND VERTICAL AUGER HOUSING.
2 - ITEM 9 CHAIN GUARD (NOT SHOWN)
3 - FOR HYDRAULIC MOTOR SIZE AND TYPE REFERENCE HYDRAULIC SCHEMATIC.

ITEM	QTY.	PART NO.	DESCRIPTION
1	3'	221.0226	UHMW TAPE .125 X 2.0
2	1	247.1268	CHAIN LINK 100-1 ROLLER
3	1	247.7867	SPROCKET 100B12 X 1.50
4	1	247.0937	BEARING FLANGED 1.50" SF24
5	1	247.2990	GEAR REDUCER A-26 4766
6	1	285.8150	A26 PIVOT BASE WELDMENT
7	1	285.8140	TURNTABLE A26 MS
8	1	285.8145	A26 TAKEUP ASSEMBLY MS WITH STUD
9	1	285.8160	CHAIN GUARD A26 OVERHEAD MS
10	5'	247.1267	CHAIN 100-1 ROLLER RIVETED
11	1.75"	247.0955	KEYSTOCK .375 SQUARE
12	10	960.6010	WASHER 2 X 2 X .25 W/ .56 SS

BOOM CYLINDER OVERHEAD



ITEM	QTY.	PART NO.	DESCRIPTION
1	1	261.3012	CYLINDER BOOM 3 X 12 -08 SAE
2	1	248.9206	COLLAR 2 PIECE SHAFT 1.25 BORE SS
3	1	285.7278	BOOM JACK FITTING 3/64 JIC .50
4	2	981.4299	PIN CLEVIS 1 X 3.50
5	2	980.9710	PIN HAIRPIN COTTER .177 SHINY BRIGHT
6	1		BOOM PIVOT CLAMP RING



ITEM	QTY	DWG. NO.	DESCRIPTION	PART ID
1	1	SI0044P16	VERTICAL AUGER PIVOT RING SHIM SS	
2	1	SI0044P13	VERICAL AUGER PIVOT RING SS	
3	1	SI0044P12	BOOM AUGER PIVOT RING SS	
4	1	SI0044P11	VERTICAL AUGER PIVOT FLANGE SS	
5	1	SI0044A12	BOOM PIVOT CLAMP RING ASM SS	
7	6		NUT HEX .50-13 ULTRA GR8	950.54198
10	12		WASHER PLAIN FLAT .50 ULTRA GR8	960.54198
9	6		SCREW CAP HEX HEAD .50-13 X 2.25 ULTRA GR8	900.55498

PART ID

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DECIMAL XX= ±020
DECIMAL XXX = ± 005
ANGULARITY = ± 0.5 DEG

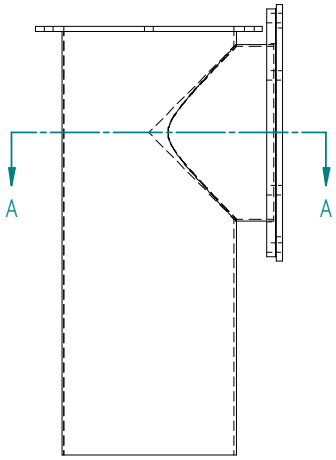
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10 INCH = 254 mm

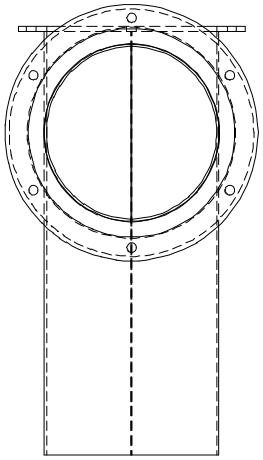
THIRD ANGLE PROJECTION

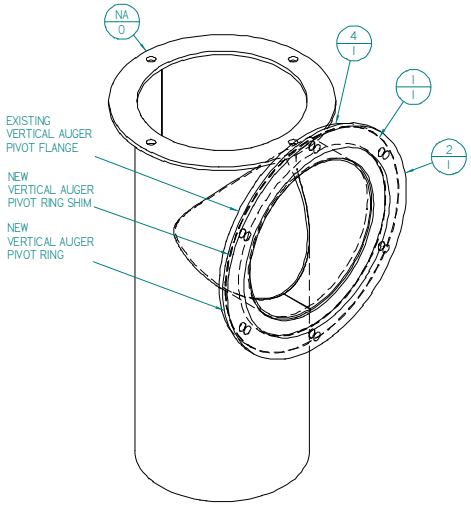
DRAWN D COLE
DATE 25-JUL-00
APPR D COLE

TREAD CORPORATION ROANOKE, VIRGINIA 24012 USA

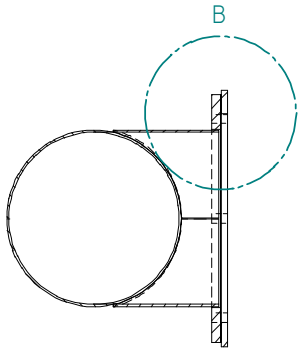
PROJECT AUGER BULK TRUCKS
TITLE BOOM AUGER PIVOT ASSEMBLY SS
OVERHEAD PRILL AUGER SYSTEM SS
DWG NO SI0044A11
REV 1
SIZE C
WEIGHT 28.9 lb
SHEET 1 OF 4



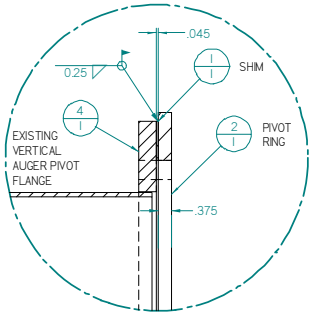




UPPER SECTION OF VERTICAL AUGER HOUSING



SECTION A-A



DETAIL B

WELD A NEW 3/8 INCH VERTICAL AUGER PIVOT RING TO THE EXISTING 1/2 INCH VERTICAL AUGER PIVOT FLANGE. ALIGN THE BOLT HOLES AND INSERT THE 0.045 INCH PIVOT RING SHIM BETWEEN THE FLANGE AND THE RING BEFORE WELDING.

WELD IS TO BE A 1/4 INCH FILLET WELD CONTINUOUS AROUND THE CIRCUMFERENCE OF THE JOINT.

WELD PROCEEDURE IS TO BE A QUALIFIED SHIELDED METAL ARC WELD PROCESS USING A MINIMUM 70,000 PSI FILLER METAL.

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DECIMAL .XX = ±.020
DECIMAL .XXX = ±.005
ANGULARITY = ± 0.5 DEG

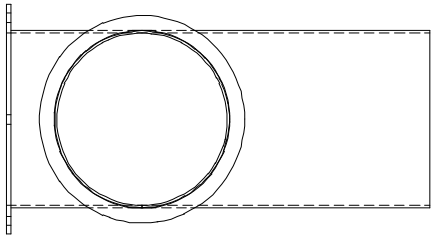
UNLESS OTHERWISE SPECIFIED
ALL DIMENSIONS ARE IN INCHES
1.0 INCH = 25.4 mm

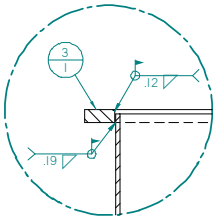
THIRD ANGLE PROJECTION

DRAWN D COLE
DATE 25-JUL-00
APPR D COLE

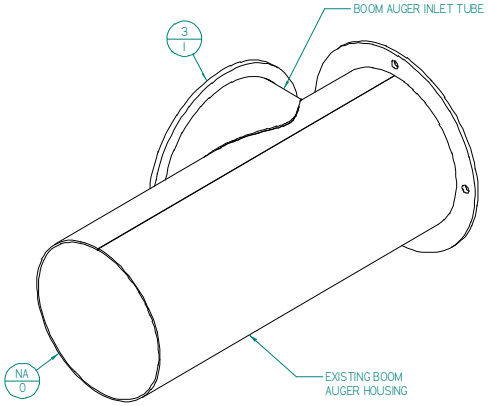
TREAD CORPORATION ROANOKE, VIRGINIA 24012 USA

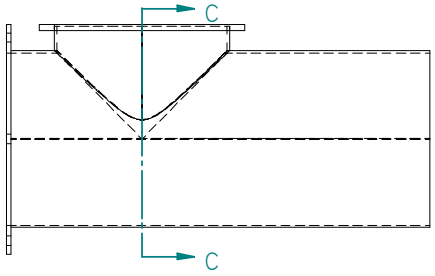
PROJECT AUGER BULK TRUCKS
TITLE BOOM AUGER PIVOT ASSEMBLY SS
OVERHEAD PRILL AUGER SYSTEM SS
DWG NO S10044A11
REV 1
SIZE C
WEIGHT 28.9 lb
SHEET 2 OF 4

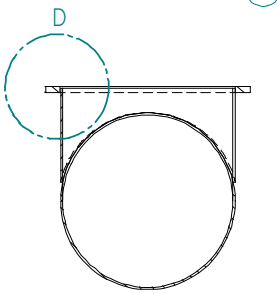




DETAIL D







SECTION C-C

BOOM AUGER HOUSING

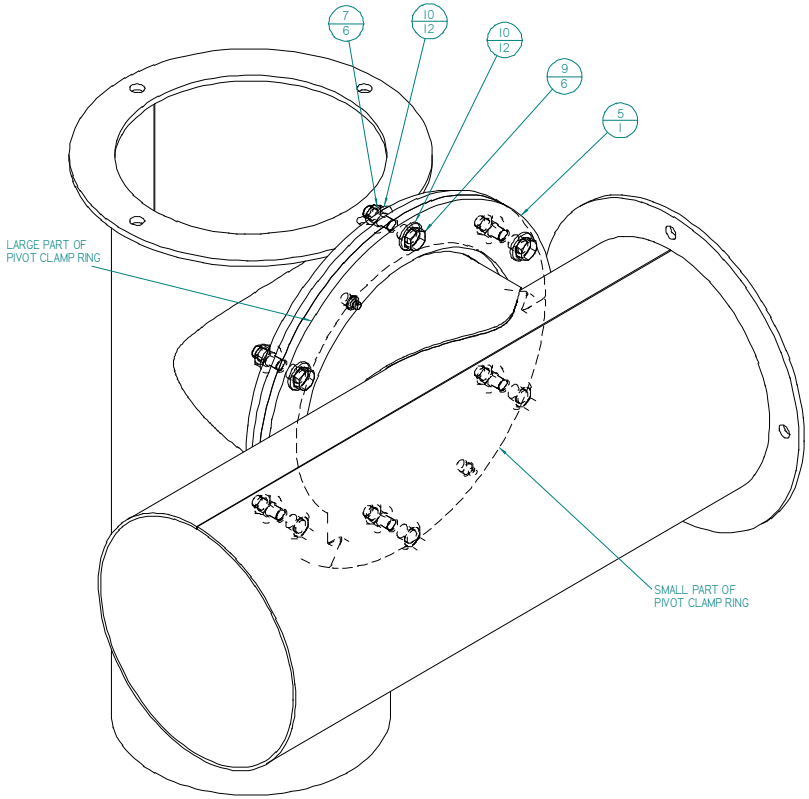
REMOVE THE EXISTING ANGLE RING FROM THE BOOM AUGER INLET TUBE.

WELD A NEW 3/8 INCH PLATE PIVOT RING TO THE BOOM AUGER INLET TUBE.

WELD IS TO BE A 3/16 INCH FILLET WELD CONTINUOUS AROUND THE CIRCUMFERENCE OF THE OUTSIDE OF THE JOINT AND A 1/8 INCH FILLET WELD CONTINUOUS AROUND THE CIRCUMFERENCE OF THE INSIDE OF THE JOINT.

WELD PROCEDURE IS TO BE A QUALIFIED SHIELDED METAL ARC WELD PROCESS USING A MINIMUM 70,000 PSI FILLER METAL.

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TOLERANCE LIMITS UNLESS OTHERWISE SPECIFIED DECIMAL X = ± .100 DECIMAL .XX = ± .020 DECIMAL .XXX = ± .005 ANGULARITY = ± 0.5 DEG	DRAWN D COLE DATE 25-JUL-00 APPR D COLE	PROJECT AUGER BULK TRUCKS TITLE BOOM AUGER PIVOT ASSEMBLY SS OVERHEAD PRILL AUGER SYSTEM SS DWG NO S10044A11 REV 1 SIZE C WEIGHT 28.9 lb SHEET 3 OF 4



PIVOT ASSEMBLY

INSTALL THE BOOM PIVOT CLAMP RING WITH THE LARGE PART OF THE RING ON THE UPPER SIDE OF THE PIVOT ASSEMBLY TOWARD THE DISCHARGE END OF THE AUGER HOUSING.

BOLT THE CLAMP RING IN PLACE WITH SIX (6) 1/2 X 2-1/4 GRADE 8 HIGH STRENTEH HEX HEAD CAP SCREWS AND HIGH STRENGTH HEX NUTS.

USE A HIGH STRENGTH FLAT WASHER UNDER THE HEAD OF EACH BOLT AND UNDER EACH NUT.

USE LOCKTITE 262 PERMANENET THREADLOCKER OR EQUAL ON THE THREADS OF EACH BOLT.

TORQUE EACH BOLT TO 100 FOOT POUNDS.

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DECIMAL XXX = ± .005
ANGULARITY = ± 0.5 DEG

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ALL DIMENSIONS ARE IN INCHES
[ ] INCH = 25.4 mm

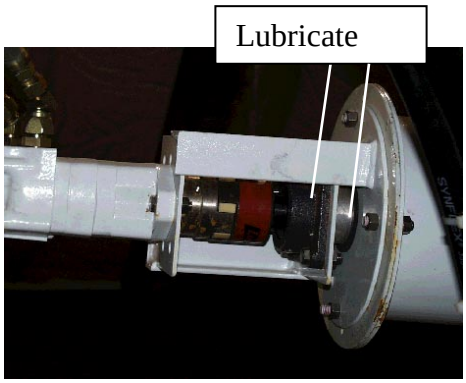
THIRD ANGLE PROJECTION

DRAWN D COLE
DATE 25-JUL-00
APPR D COLE

TREAD CORPORATION ROANOKE, VIRGINIA 24012 USA

PROJECT AUGER BULK TRUCKS
TITLE BOOM AUGER PIVOT ASSEMBLY SS
OVERHEAD PRILL AUGER SYSTEM SS
DWG NO S10044A11 REV 1 SIZE C
WEIGHT 28.9 lb SHEET 4 OF 4

Hydraulic Drive Assembly with Jaw Coupling Drive



This unit is designed for quick efficient maintenance and minimum stocking of replacement parts. The primary components of this assembly are: Motor, Bearing, Coupling, Shaft, Bushing, Seal housing, Seal and Mount. When ordering or replacing motors, be aware of the fact that not all drive assemblies will use the same motor.

Drive coupling

This coupling is used to protect the hydraulic motor seals and Bearings from damage due to misalignment of the unit. The hytrel spyder is essential for this reason and should be replaced when worn out. The coupling is made up of two pieces, the motor coupling with a 1-inch diameter bore and the shaft coupling with a 1-1/2 inch diameter bore.

Bearing

A self-aligning spherical bearing is used for auger support. If lubricated daily, this bearing will give long service.

Seal

The seal is intended to keep ammonium nitrate prills from leaving the auger housing and corroding the bearings and other drive components. Periodic inspection of the seal and grease packing is very important.
When replacing the seal housing, pack the housing full of grease so it completely fills the housing area. When the drive unit is reassembled, the seal tube should be held tightly between the drive end plate and the bearing so as not to rotate when the auger is in motion. The rubber shaft seal helps to pre-load the seal housing to assume a tight fit.

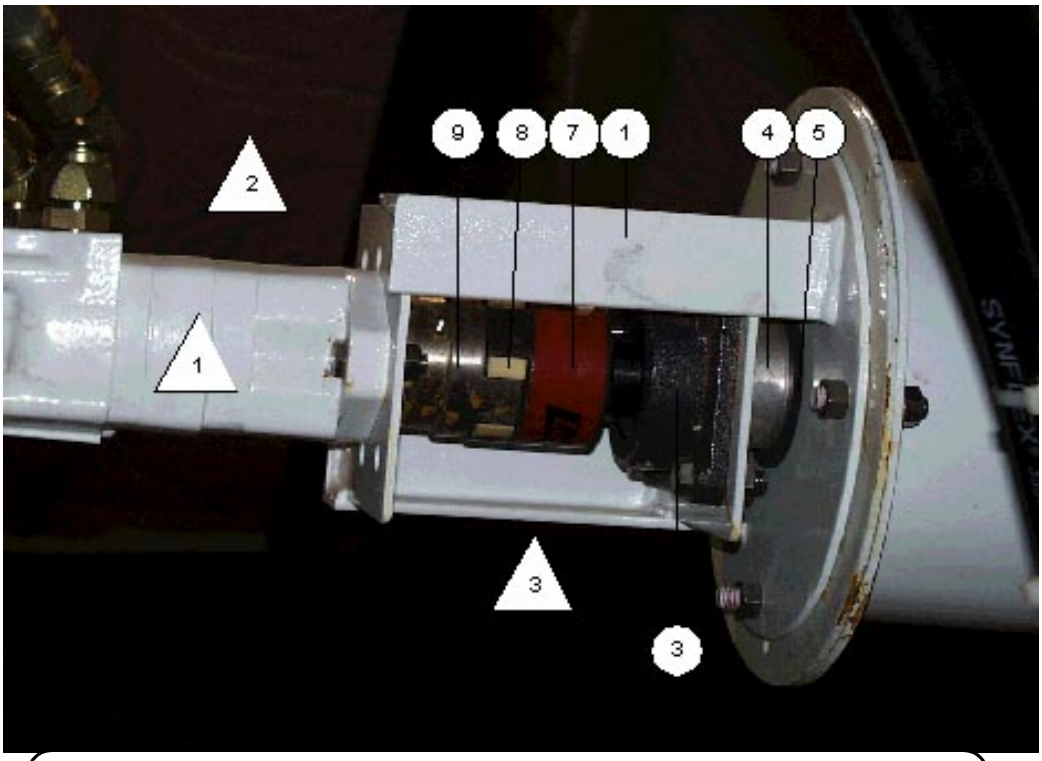
Shaft

The 1-1/2 inch aluminum shaft is keyed with a 3/8 square key to the drive coupling. Retaining rings are installed on the shaft on both sides of the bearing to hold the auger shaft in position and to keep the auger from having axial movement that may cause the coupling to disengage. When assembling the drive unit. DO NOT leave the retaining rings off.

Bushing

A urethane bushing is pressed onto the drive shaft and fits inside the auger shaft. Two stainless steel bolts with locknuts secure these shafts together. The urethane bushing will not corrode when in contact with the Ammonium Nitrate, thereby, insuring the ability to remove the shafts for service. When installing the shaft to the auger, be careful about over-tightening of the nut and possible distortion of the auger pipe.

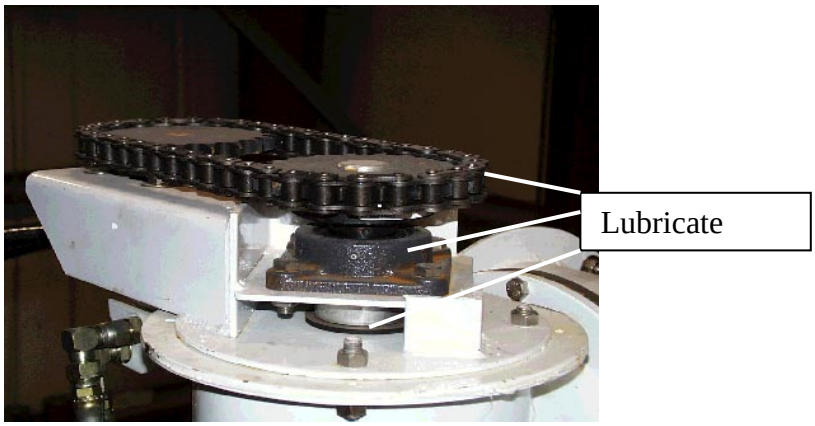
HYDRAULIC DRIVE ASSEMBLY
COUPLING DRIVE



NOTES:
1 - FOR HYDRAULIC MOTOR SIZE AND TYPE REFERENCE THE HYDRAULIC SCHEMATIC.
2 - ITEM 2 NOT VISIBLE
3 - ITEM 6 & 11 NOT VISIBLE

ITEM	QTY.	PART NO.	DESCRIPTION
1	1	285.9014	HYDRAULIC MOTOR MOUNT L110 DRIVEN MS
2	1	285.9010	DRIVE SHAFT TREADBED AUGERS
3	1	247.0937	BEARING FLANGED 1.50" SF24
4	1	285.6141	SHAFT SEAL HOUSING
5	1	285.6143	GASKET SHAFT SEAL
6	2	980.9610	RING EXTERNAL RETAINING 1.50"
7	1	247.1384	COUPLING L110 X 1.50
8	1	247.1380	SPYDER L110 HYTREL
9	1	285.9012	DRIVE COUPLING L110 X 1 MACHINED
10	1.5"	247.0955	KEYSTOCK .375 SQUARE

Hydraulic Drive Assembly with Chain Drive



This unit is designed for quick efficient maintenance and minimum stocking of replacement parts. The primary components of this assembly are: Motor, Bearing, Sprockets, Chain, Chain Link, Shaft, Bushing, Seal housing, Seal and Mount. When ordering or replacing motors, be aware of the fact that not all drive assemblies will use the same motor.

Sprockets

The sprockets allow the length of the drive to be reduced to maintain better clearances both overhead and underneath the truck body. Using a chain driven assembly on the vertical auger also extends the life of the components, as the ammonium nitrate prills which discharge from the vertical auger housing contacts fewer components.

Bearing

A self-aligning spherical bearing is used for auger support. If lubricated daily, this bearing will give long service.

Seal

The seal is intended to keep ammonium nitrate prills from leaving the auger housing and corroding the bearings and other drive components. Periodic inspection of the seal and grease packing is very important.
When replacing the seal housing, pack the housing full of grease so it completely fills the housing area. When the drive unit is reassembled, the seal tube should be held tightly between the drive end plate and the bearing so as not to rotate when the auger is in motion. The rubber shaft seal helps to pre-load the seal housing to assume a tight fit.

Shaft

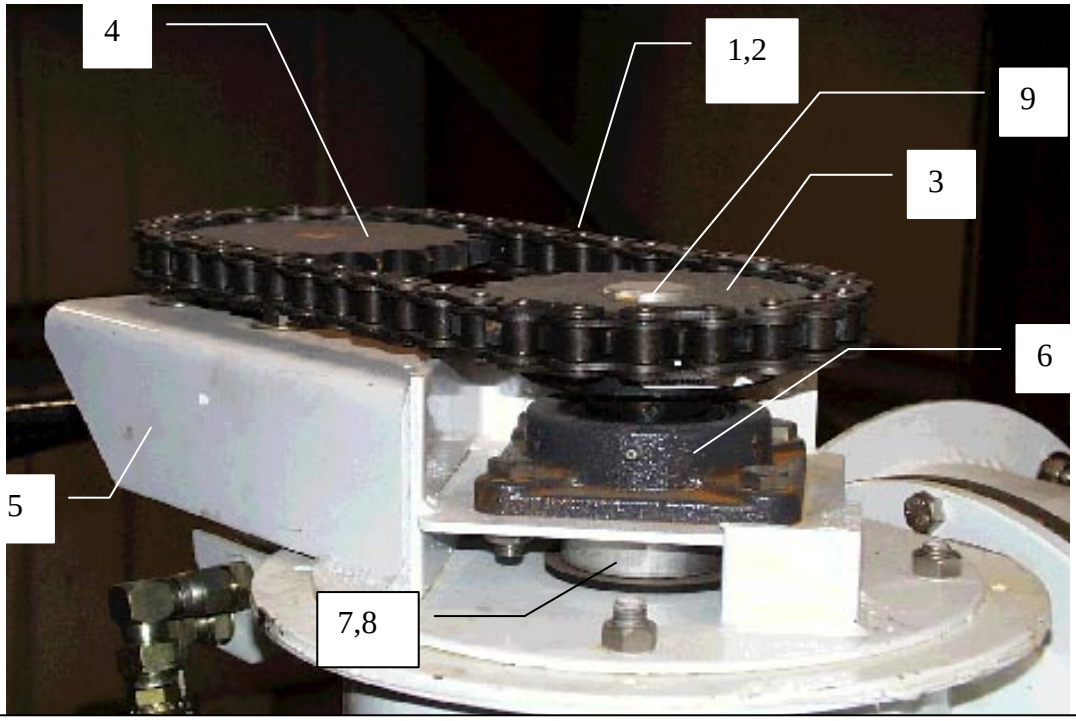
The 1-1/2 inch aluminum shaft is keyed with a 3/8 square key to the drive coupling. Retaining rings are installed on the shaft on both sides of the bearing to hold the auger shaft in position and to keep the auger from having axial movement that may cause the coupling

to disengage. When assembling the drive unit DO NOT leave the retaining rings off.

Bushing

A urethane bushing is pressed onto the drive shaft and fits inside the auger shaft. Two stainless steel bolts with locknuts secure these shafts together. The urethane bushing will not corrode when in contact with the Ammonium Nitrate, thereby, insuring the ability to remove the shafts for service. When installing the shaft to the auger, be careful about over-tightening of the nut and possible distortion of the auger pipe.

HYDRAULIC DRIVE ASSEMBLY
CHAIN DRIVE



NOTES:
FOR HYDRAULIC MOTOR SIZE AND TYPE, REFERENCE THE HYDRAULIC SCHEMATIC.
ITEM 10,11 AND 12 ARE NOT VISIBLE.

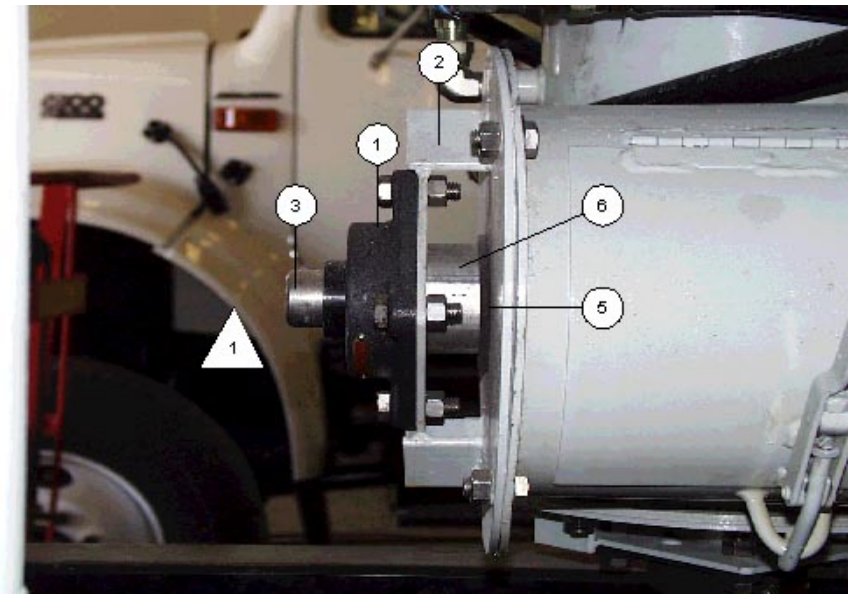
ITEM	QTY	PART NO.	DESCRIPTION
1	1	247.1264	CHAIN LINK 80-1 ROLLER
2	5’	247.1263	CHAIN 80 ROLLER RIVITED
3	1	247.7870	SPROCKET 80B20 X 1
4	1	247.7869	SPROCKET 80B20 X 1.50
5	1	285.9023	HYDRAULIC MOTOR MOUNT CHAIN DRIVEN M
6	1	247.0937	BEARING FLANGED 1.50” SF24
7	1	285.6141	SHAFT SEAL HOUSING
8	1	285.6143	GASKET SHAFT SEAL
9	1	285.9010	DRIVE SHAFT TREADBED AUGERS
10	2	980.9610	RING EXTERNAL RETAINING
11	1.5”	247.0955	KEYSTOCK .375 SQUARE
12	1	285.8181	GUARD HYDRAULIC CHAIN DRIVE

Bearing Assembly

The bearing assembly is patterned after the bearing mount on the hydraulic drive assembly. Please refer to paragraphs on the bearing, seal, shaft and bushing in the section on hydraulic drive assemblies. The only difference is that the bearing shaft does not have retaining rings.



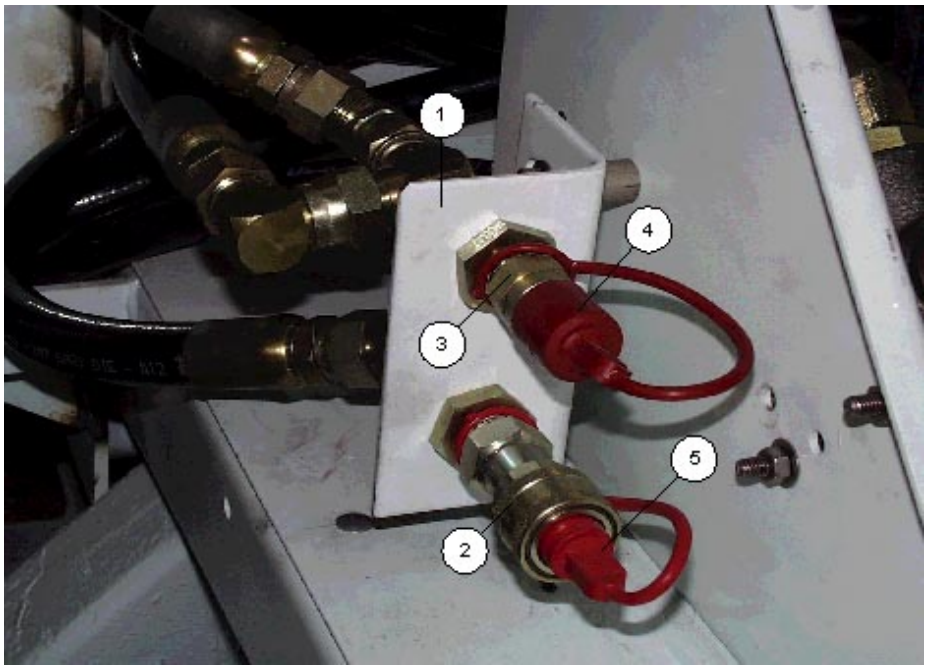
BEARING ASSEMBLY



NOTES:
ITEM 2A = 8 INCH BEARING PLATE IS FOR 8" O.D. AUGER HOUSINGS.
ITEM 2B = 10 INCH BEARING PLATE IS FOR 10" O.D. AUGER HOUSINGS.
1 - ITEM 4 GUARD IS NOT SHOWN

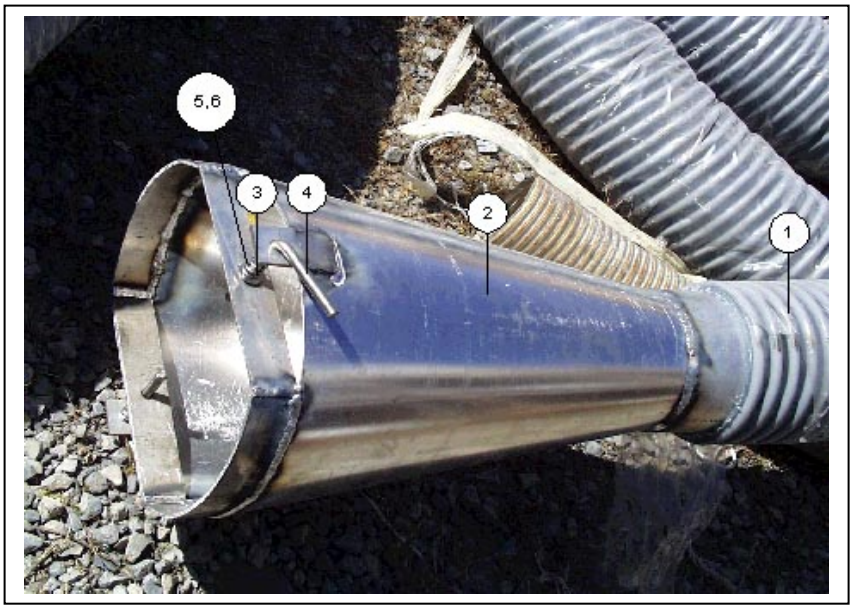
ITEM	QTY.	PART NO.	DESCRIPTION
1	1	247.0937	BEARING FLANGED 1.50" SF24
2A	1	285.5002	BEARING MOUNT 8" MS
2B	1	285.5026	BEARING MOUNT 10" MS
3	1	285.5003	BEARING SHAFT TREADBED AUGERS
4	1	287.5715	GUARD SF24 BEARING ASSEMBLY
5	1	285.6143	GASKET SHAFT SEAL
6	1	285.6141	SHAFT SEAL HOUSING

Error! Not a valid filename.AUXILARY HYDRAULICS ASSEMBLY



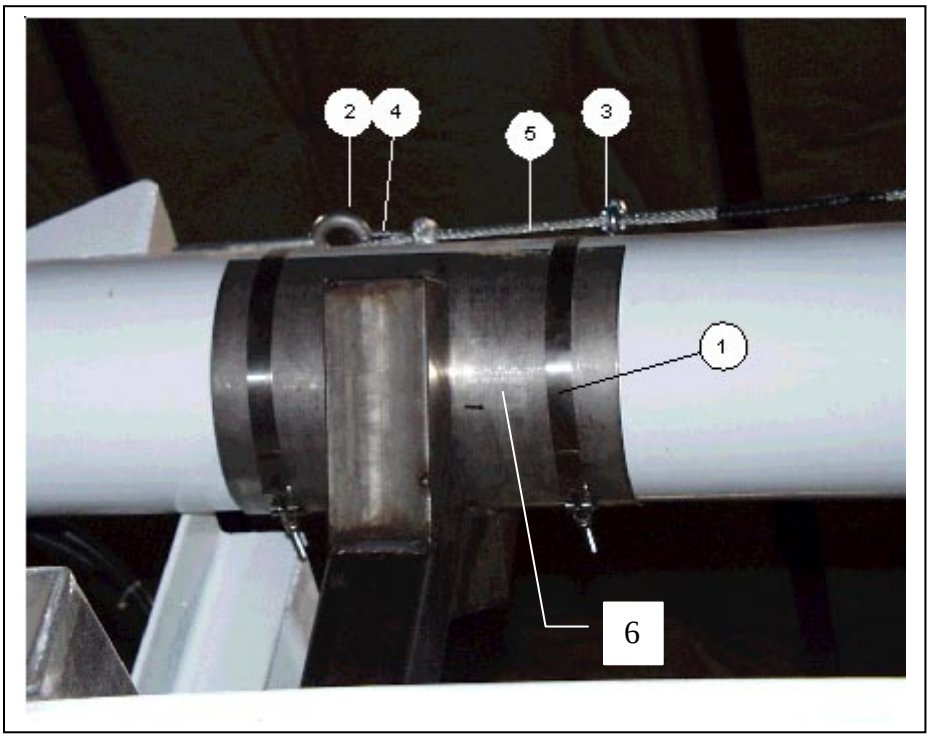
ITEM	QTY.	PART NO.	DESCRIPTION
1	1	286.7005	AUXILLARY HYDRAULICS BRACKET JIC SS
2	1	85601.0810	QUICK DISCONNECT FEMALE
3	1	85602.0810	QUICK DISCONECT MALE
4	1	85657.10	DUST CAP
5	1	85659.10	DUST PLUG

BOOM CONE ASSEMBLY WITH HOSE



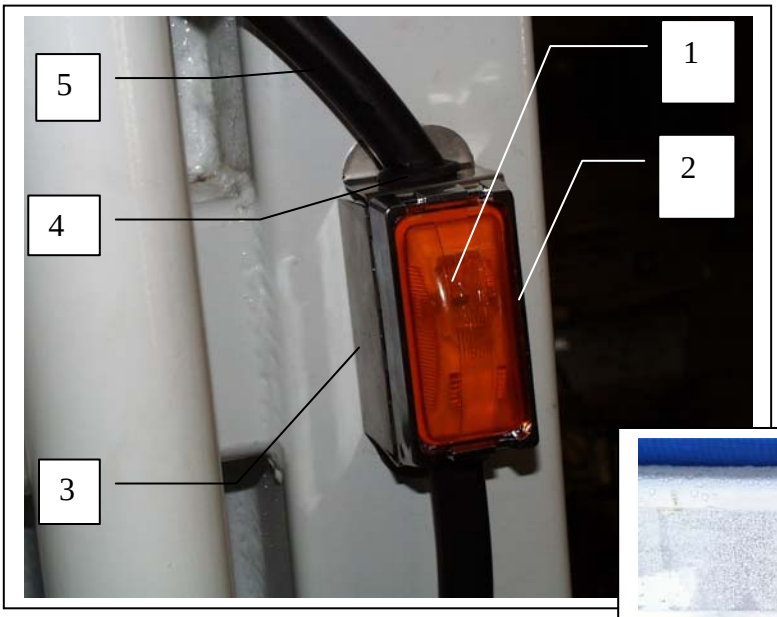
ITEM	QTY	PART NO.	DESCRIPTION
1A	10’	240.3402	HOSE VINYL 5”
1B	10’	240.3403	HOSE VINYL 6”
1C	10’	240.3404	HOSE VINYL 8”
2A	1	287.5100	BOOM DISCHARGE CONE 5”
2B	1	287.5110	BOOM DISCHARGE CONE 6”
2C	1	287.5113	BOOM DISCHARGE CONE 8”/8”
2D	1	287.5112	BOOM DISCHARGE CONE 10”/8”
3	2	269.7849	SPRING DISCHARGE CONE HANDLE
4	2	287.5119	HANDLE SS CONE
5	2	960.4214	WASHER PLAIN FLAT .375 SS
6	2	986.0994	PIN SLOT SPRING .125 X 1.00 SS

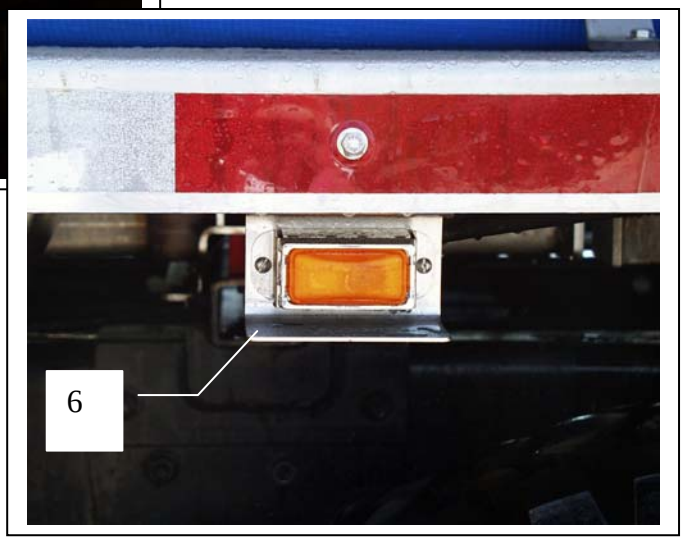
BOOM CRADLE STIFFENER



ITEM	QTY	PART NO.	DESCRIPTION
1A	2	240.0909	CLAMP T BOLT 8” DIXON STB888
1B	2	240.1010	CLAMP T BOLT 10” DIXON STBC1088 MODIFIED
2	1	978.0100	BOLT EYE .50-13X6.00 GALVANIZED
3	4	269.9001	WIRE ROPE CLIP .25” GALVANIZED
4	2	269.9003	WIRE ROPE THIMBLE .25
5	25’	269.9010	WIRE ROPE .25”
6A	1	285.8015	BOOM AUGER SHIELD 8”
6B	1	285.8016	BOOM AUGER SHIELD 10”

CLEARANCE/MARKER LIGHT

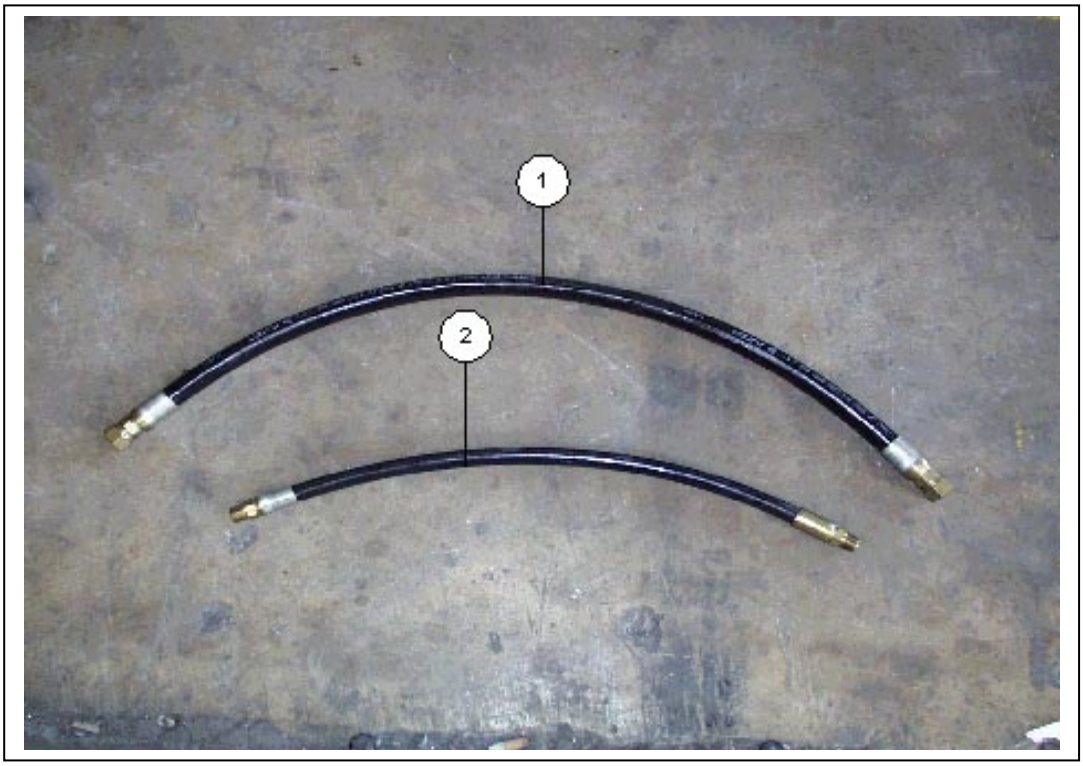




ITEM	QTY	PART NO.	DESCRIPTION
1A	2	231.6045	LIGHT MARKER RED 12V NARROW GROTE
1B	2	231.6046	LIGHT MARKER RED 24V NARROW GROTE
1C	4	231.6048	LIGHT MARKER YELLOW 12V NARROW GROTE
1D	4	231.6044	LIGHT MARKER YELLOW 24V NARROW GROTE
2	6	231.6047	BRACKET FOR NARROW MARKER LIGHT GROTE
3	6	286.2401	BRACKET MARKER LIGHT MOUNTING GROTE
4	12	231.6006	GROMMET RUBBER GROTE LIGHT SYSTEM LICENS
5	50’	231.7001	TUBING PLASTIC .50ID X .625OD
6	2	286.2402	BRACKET UNDER FENDER LIGHT MOUNT
7	12	231.6049	RETAINING CLIP FOR BETTS TUBING

Note – Item 7 is not visible in the photo.

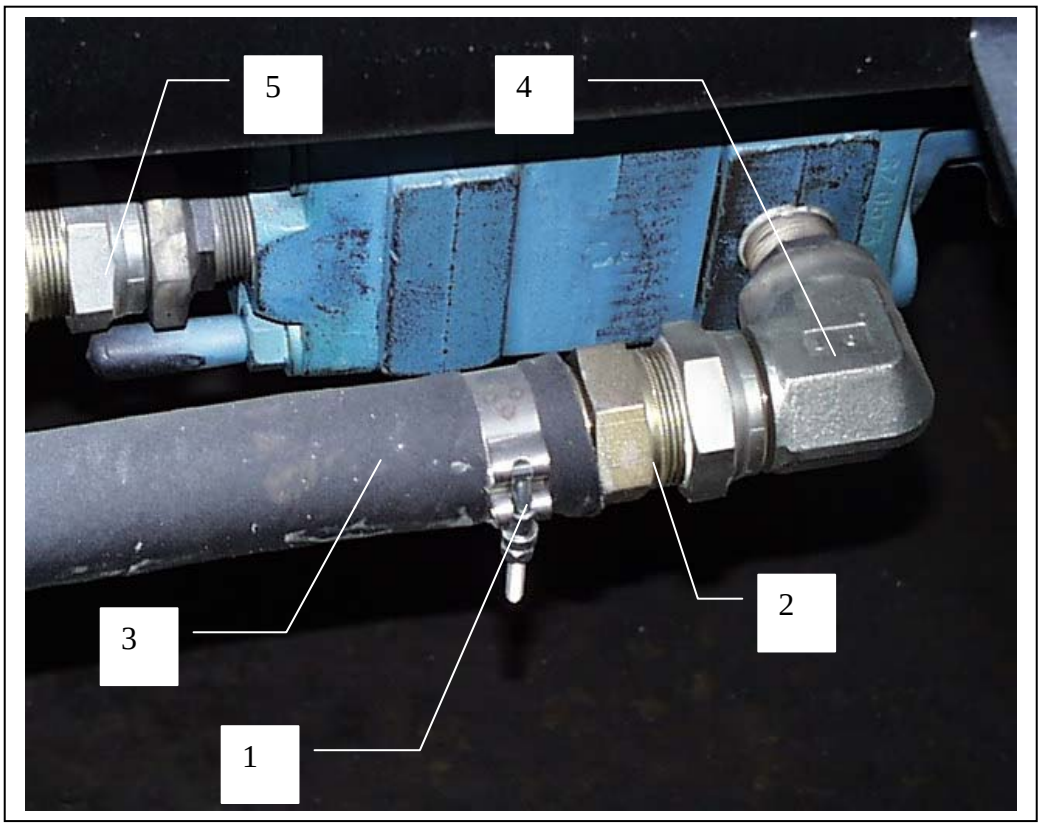
HYDRAULIC PRESSURE HOSE ASSEMBLY



We can make custom pressure assemblies upon request.
MNPT assemblies are all Male National Pipe Thread sizes.
FJIC are all Female Swivel 37° JIC sizes.
PART NO. Legend _ _ = length in feet.

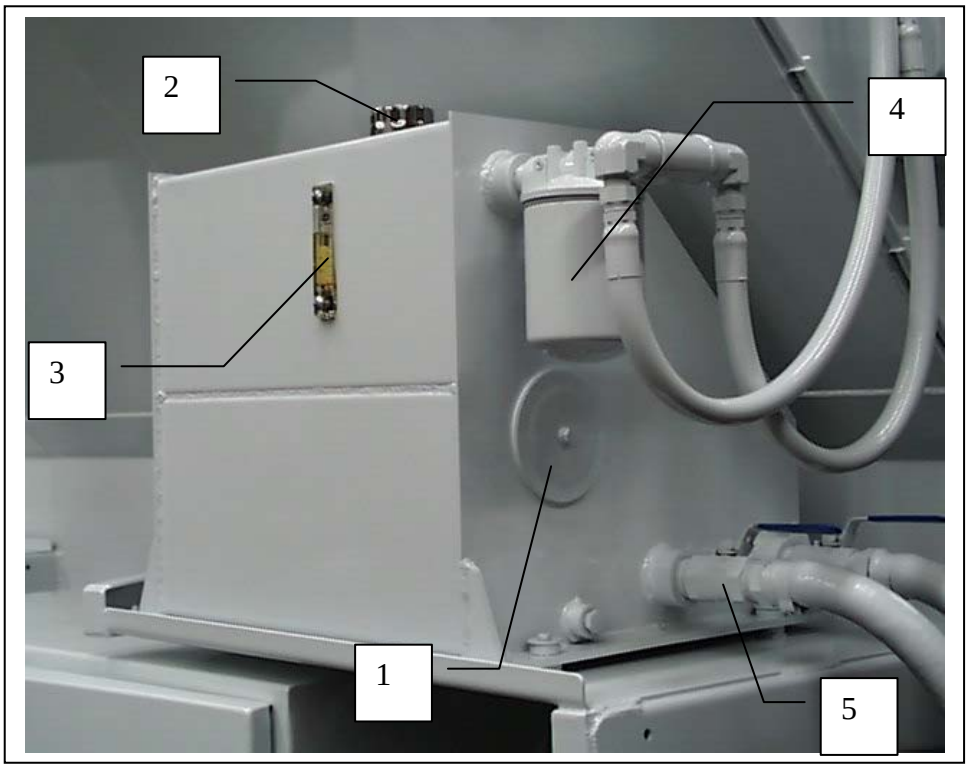
ITEM	QTY	PART NO.	DESCRIPTION
1A	1	262.06_ _	HOSE ASSEMBLY .375 X _ _’ FJIC
1B	1	262.08_ _	HOSE ASSEMBLY .50 X _ _’ FJIC
1C	1	262.12_ _	HOSE ASSEMBLY .75 X _ _’ FJIC
2A	1	262.0304	HOSE ASSEMBLY .125 X 4’ 02 MNPT
2B	1	262.06_ _X	HOSE ASSEMBLY .375 X_ _’MNPT
2C	1	262.08_ _X	HOSE ASSEMBLY .50 X _ _’ MNPT
2D	1	262.12_ _X	HOSE ASSEMBLY .75 X _ _’ MNPT

HYDRAULIC SUCTION HOSE



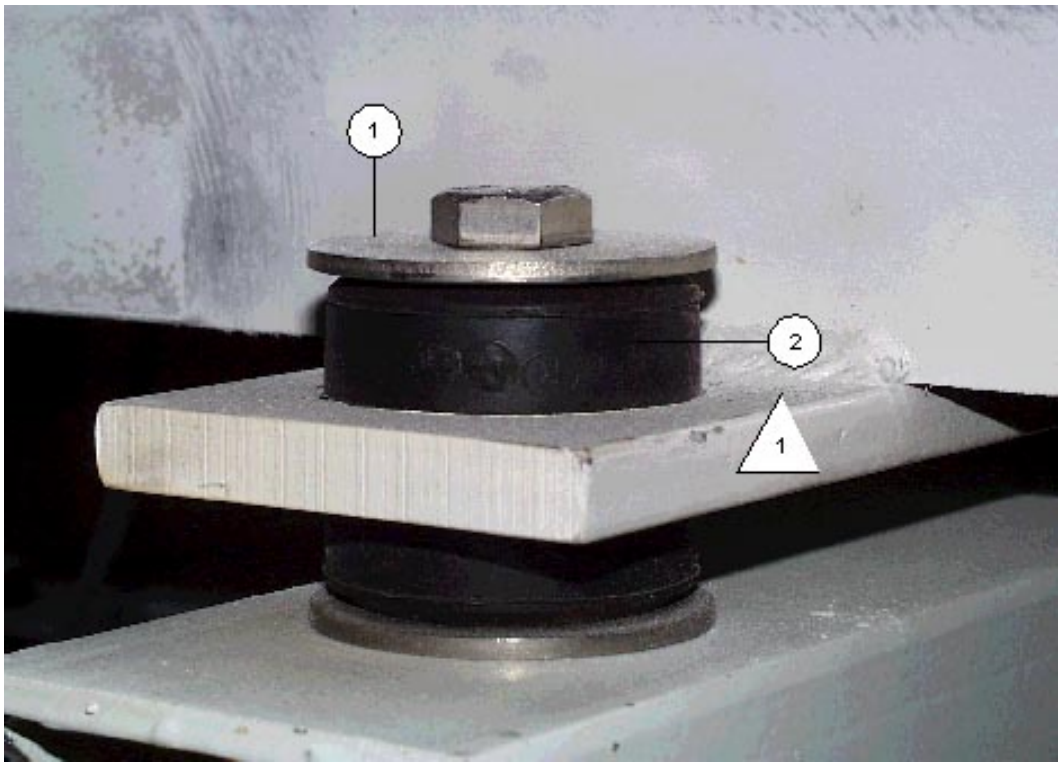
ITEM	QTY	PART NO.	DESCRIPTION
1	2	240.0915	CLAMP T BOLT SS 1.50 HOSE 2.00 DIA
2	2	247.5737	NIPPLE COMBINATION MNPT/HOSE 1.5" MS
3	10’	262.3825	HOSE HYDRAULIC SUCTION 1.5 PIRELLI
4	2	286.8002	FITTING HYRAULIC PUMP 90 1-1.5"
5	2	286.8001	FITTING HYRAULIC PUMP STRAIGHT 1-1.5"

HYDRAULIC TANK ASSEMBLY



ITEM	QTY	PART NO.	DESCRIPTION
1	1	239.2237	TANK END COVER 6" SS WITH 3/8" BOLT
2	1	260.2773	FILLER CAP PRESSURE PBB40-5-N
3	1	260.2774	GAUGE SIGHT/TEMP 0-200F
4	1	260.2781	FILTER RETURN FPS212-1JDNH
5	?	264.3212	VALVE BALL SS 1.50

ISOLATION MOUNTS



NOTES:
1 - ITEM 2 HAS TWO PIECES FOR ONE MOUNT (TOP & BOTTOM).

ITEM	QTY.	PART NO.	DESCRIPTION
1A	2	247.2212	WASHER REBOUND .50 ISOLATOR
1B	1	247.2211	WASHER REBOUND .375 ISOLATOR
2A	1	247.2202	MOUNT ISOLATION .50" X 380 LB PUR/WHT
2B	1	247.2201	MOUNT ISOLATION .375" X 140 LB GRN/WHT

Maintenance Schedule-General Auger System

Action	Daily	Weekly	Monthly	Annually
Check hydraulic oil level	X			
Lubricate bearings	X			
Check pivot bolts	X			
Check for hydraulic leaks	X			
Check coupling spiders	X			
Check auger cross bolts	X			
Check hatch cover retainers	X			
Check all hydraulic valve operation	X			
Check condition of tube and hose	X			
Check mud flaps	X			
Check drive/bearing seals		X		
Lubricate swing chain		X		
Lubricate thrust ring		X		
Lubricate boom pivot		X		
Check tightness of flex ride mounts		X		
Check lights		X		
Check PTO mounting bolts		X		
Lubricate gate rack and pinion		X		
Lubricate all hydraulic selector valves		X		
Lubricate all hydraulic flow valves		X		
Check swing chain tension		X		
Lubricate all spool valves		X		
Check bumper bolts		X		
Lubricate swing reducer			X	
Change hydraulic filters			X	
Re-torque flex ride bolts			X	
Lubricate gate guides			X	
Check all bolts and fasteners			X	

CALIBRATION PROCEDURES

OVERVIEW:

The objective of this procedure is to introduce a standard for Field personnel to refer back to when calibrations are performing on Bulk truck units. This will not only ensure uniformity during calibrations but will also have a benefit to our customers.

DEFINITIONS:

Calibrate:
The checking of a measuring instrument against an accurate standard to determine any deviation and correct for errors.

Target:
A target is a device to activate a sensor.

Meter:
Is a measuring device

Sensor:
A device capable of detecting and responding to physical stimulation such as movement, light, or heat

Totalizer:
A device that records pluses from a sensor and calculates totals

Component:
Any one of the substances necessary to describe each phase of a formula. I.e. Emulsion, Prill Gassing, Water and Diesel Fuel Oil.

Formula:
The combination of components at a specific rate or quantity.

Equipment:
The tools, clothing, or other items needed for a particular purpose or activity.

Scale value:
Coverts incoming pulse to a value. (EX LBS, KG, AND FEET ECT.)

Density.
A measure of a quantity such as mass per unit volume.

DESCRIPTION AND PURPOSE OF DEVICES ON A BULK TRUCK:

Digital Meters:

Rate meter:
The purpose of the rate meter is to indicate the rate of the component, formula auger or pump in a specific unit of measure. The rate meter can be configured to display the component measured in pound/minute, kilograms/min and revolutions/minute.

Totalize meter:
The purpose of the totalizer is to accumulate the different inputs from the sensors then display the accumulative inputs as a measure of units in pound/minute, kilogram/min, or revolutions

Analog flow meters:
The flow meter is calibrated to a specific min and maximum range output indicated on the flow meter in percentage of flow delivered. Meters will be also calibrated in gallons and liters. Gassing, water and Diesel fuel oil form part of these Analog flow meters.

Target:
The purpose of the target device is to stimulate the sensor. The target can be configured to stimulate a sensor in several different means and time periods. The target installed on the Bulk trucks manufactured by Tread Corporation use two methods.
For example
Target wheel with ten slots (10X) or holes drill through a round metal plate.
Target cylinder with thirty slots (30X) diagonal cut on the cylinder.
When the target device is turned as refer to one revolution of the device it will stimulate the sensor X times.

Pumps:
All shapes and sizes of pumps are being used to transfer products on a Bulk Truck. For the purpose of this document we will discuss positive displacement pumps. The following information is important when dealing with positive displacement pumps.
Positive displacement pumps produce a consistent volume per revolution.
Product density will change the weight per revolution not the volume.
Backpressure will change the volume per revolution

Augers:
Different size augers are being used to transfer products on a Bulk Truck. The following information is important when dealing with augers.
Auger size and speed have a direct impact on quantity deliver.
Auger speed effects friction.
Friction effects product output (the output will increase as friction decreases.)
Product density affects the weight per revolution.

VARIABLES AND THEIR EFFECTS

When working with equipment on a bulk truck it is important to now that the equipment is design to perform specific outputs. The output will vary depending on the application and condition of such equipment.

For example

System Back-pressure:
All pumps should be calibrated at the backpressure they would be under during normal operation. This can be accomplished by using the full length of hose or a device to simulate the backpressure under normal operation.
Speed:
Pump speed- Emulsion and product pumps run at various speeds. By calibrating the pumps at mid speed operation with normal backpressure we can determine their efficiency.
(Compare to output chart and if not in range calibrate pump with no backpressure and compare results. If the output increased by 15% the pump could be worn out.)

Speed:
Auger speed- Prill augers become more efficient during high speeds, due to the drop in friction. It is advised to always operate the auger at mid range of the low and high scale, therefore calibration of Prill auger should be done at normal operating speeds. (A Quad unit auger runs at approx. 30 RPM low speed and 125 Rpm high speed. The calibration should be taken at mid speed.

DENSITY

Density is the mass weight of a volumetric unit and is measured in specific gravity. Pumps and augers produce a volume of product every revolution, density has no effect on the volume displaced, only the weight of the volume.
For example:
A five gallon bucket of AN weights 32.9 lbs at 0.79 S.G
A five gallon bucket of granular aluminum weights 50 lbs at 1.20 S.G
The result is that five gallon of volume of different products is the same but a different weight at a specific gravity.

PRODUCT DENSITY CHECK

Equipment requirements:
Postal scale that is calibrated
Sample cup
Spatchula

Note book.
The following procedure is a quick guide to determine a product density.

Turn power on scale and set to grams. (Be sure scale surface is clean and scale is level.)
Fill the sample cup with water to the top (The same level the product would be when you scrape the excess off the top of the cup.)
Weight the cup with water and document. (Ex. 1000 grams)
Fill cup with product (Be careful when filling cup not to trap air for this will not produce a accurate sample)
Tap the cup on a rubber surface to eliminate any air pockets.
Scrape the top of the cup level and clean the outside of the cup free from product.
Weight cup (Ex. 1274 grams)
Take the weight of the cup with product and divide by the cup water weight
$\frac{1274}{1000}$ = 1.274 S.G.
The specific gravity of the sample is 1.274 S.G.

CALIBRATION OF EMULSION

The following procedure will explain the calibration process that needs to be followed

Perform a density check on emulsion:
Assure the meters and sensors are operating properly.
Document the scale values (EX. 332) in the totalizers and rate meters (not all units have rate meters).
Check the emulsion tank to ensure there is enough product to obtain sample.
Set the A/P flow control to straight emulsion and check that selector valve is set to blend.
Pre-fill the emulsion path (Obtain a sample where the hose connects to the injection port weldment to ensure proper back pressure.)
Tare scale and reset meters
Run sample
Document the actual scale weight and the totalizer display.
Apply the scale factor correction formula
NSV=(AW/TV) x OSV
NSV= new scale value
AW= actual weight
TV=totalizer value
OSV= old scale value (the scale value in the rate and totalizer)
Example: Actual weight 1000 divided by totalizer value 921 x old scale value 332
NSV= (1000/921) x 332 =362
Enter the correct scale value to adjust the meter.
Repeat steps 5 to 8 to confirm that the calibrations are correct. (If the calibration is correct the actual weight should match the totalizer.)
If the sample did not match totalizer repeat steps 3 to 11 and confirm totalizer value.
If the samples did not match add all three correct scale values and divided by three to obtain an average. (EX. (360+355+357)/3 = 357 average) Enter correct scale value to correct the meter.
Document correct scale value.

The notes below refer to pump delivery rates under different densities. This can be taken only as a reference and not as a definite delivery rate of a pump

NOTES:

Bowie 2” pump should produce 3.1 to 3.7 lbs per/rev with a product density of 1.20sg to 1.25sg.
Bowie 2” pump should produce 3.7 to 4.2 lbs per/rev with a product density of 1.30sg to 1.36sg.
Bowie 3” pump should produce 5lbs to 5.5 lbs per/rev with a product density of 1.20sg to 1.25sg.
Bowie 3” pump should produce 5.5lbs to 6.5 lbs per/rev with a product density of 1.30sg to 1.36sg.
If pump output is low, with no backpressure there may be a problem at the suction side of the pump. (Suction plumbing or valves)
The max pressure for a Bowie pump is 100 psi.

CALIBRATION FOR AMMONIUM NITRATE

Perform density check on AN:
Assure sensors and meters are working properly.
Document the scale value in totalizers and rate meters.
Check the AN compartment for proper amount of product for calibrations.
Set the engine RPM’s at the speed the customer operates unit.
Pre fill auger path till steady stream of product is flowing.
Tare scale and reset totalizer.
Run sample
Document actual scale weight and totalizer display.
Apply the scale factor correction formula
NSV=(AW/TV) x OSV
NSV= new scale value
AW= actual weight
TV=totalizer value
OSV= old scale value (the scale value in the rate and totalizer)
Enter the correct scale value in totalizer.
Repeat steps 5 to 10 to confirm the calibration is correct (If the calibrations are correct the scale reading should match the totalizer)
If the sample did not match totalizer repeat steps 3 to 11 and confirm. If the samples did not match add all three correct scale values and divided by three to obtain an average.
Enter correct scale value to correct the totalizer.
Document the correct scale value.

Refer to notes below that the auger output is within proper range.
NOTES:

THE 1//2 PITCH AUGER (QUAD UNIT) PRODUCE 3.4 TO 3.7 LBS PER/REV (WITHOUT FUEL)
THE 2/3 PTCH AUGER (OVERHEAD AUGER) PRODUCES 4.7 TO 4.9 LBS PER/REV (WITHOUT FUEL)
THE FULL PITCH AUGER (SIDE AUGER) PRODUCES 6.8 TO 7.2 LBS/REV. (WITHOUT FUEL)
ALWAYS HAVE THE BIN CLOSEST TO THE TRANSITION FULL WHEN CALIBRATING.

To ADD 6% FUEL OIL TO SAMPLE (DIVIDE THE SAMPLE BY .94 = ACTAUL WEIGHT WITH 6% FUEL (EX. 650 LBS AMMONIUM NITRATE / .94 = 691.48 LBS ANFO. (ALL THE TOTALIZERS USED STATE ANFO TOTAL)

CALIBRATION AMMONIUM NITRATE WITH FUEL

Perform density check on AN:
Assure sensors and meters are working properly.
Document the scale value in totalizers and rate meters.
Check the AN compartment for proper amount of product for calibrations and fuel oil tank.
Set the engine RPM's at the speed the customer operates unit.
Test fuel system for proper operation. (make sure the A/P flow control is a the 6% setting.)
Remove fuel oil line from injectors and install testing injector kit.
Pre fill auger path till steady stream of product and fuel oil is flowing
Tare scale, reset meters and tare fuel oil scale.
Run sample (make sure the fuel oil container is large enough)
Document the actual scale weight of the AN, fuel oil and the meters.
Add the fuel oil and the AN totals = Actual ANFO weight
Apply the scale factor correction formula
NSV=(AW/TV) x OSV
NSV= new scale value
AW= actual weight
TV=totalizer value
OSV= old scale value(the scale value in the rate and totalizer
Enter the correct scale value in meter.
Repeat steps 5 to 14 to confirm that the calibrations are correct. (If the calibration is correct the scale reading should match the totalizer)
If the sample did not match meter repeat steps 5 to 13 and confirm. If the samples did not match add all three correct scale values and divided by three to obtain an average. Enter correct scale value to correct the totalizer.
Document correct scale value.
Refer to notes below that the auger and fuel oil output is within proper range.

NOTES:

THE 1//2 PITCH AUGER (QUAD UNIT) PRODUCE 3.4 TO 3.7 LBS PER/REV (WITHOUT FUEL)
THE 2/3 PTCH AUGER (OVERHEAD AUGER) PRODUCES 4.7 TO 4.9 LBS PER/REV (WITHOUT FUEL)
THE FULL PITCH AUGER (SIDE AUGER) PRODUCES 6.8 TO 7.2 LBS/REV. (WITHOUT FUEL)
ALWAYS HAVE THE BIN CLOSEST TO THE TRANSITION FULL WHEN CALIBRATING.
TO FIGURE THE FUEL PERCENTAGE (fuel weight /ANFO weight (AN and fuel oil) = fuel oil percentage. (EX 600 lbs AN + 37 lbs fuel oil = 637 lbs ANFO
37 lbs fuel / 637= .058 or 5.8% fuel

CALIBRATE FUEL OIL METER

Must bypass AN auger.
Use a 5-gallon container.
Install test injector kit
Maintain normal operating speed on DFO pump.
Reset meter and run sample in container.
Compare container to meter. (Ex. Meter-4.6gal container 5.0-gal.)
Adjust meter to match container. (1 turn clockwise increases the meter 0.1gallon per gallon and 1 turn counterclockwise decreases the meter 0.1 gallon per gallon.)
Repeat steps 5 to 7 till sample and meter matches.
NOTES:

Five-gallon oil pails usually have 5-gallon mark inside the bucket.
Must maintain operating backpressure.

CALIBRATION WATER AND GASSING METER

Set water at 1 gpm at operating pressure.
Using a 1 gallon container run water for 1 minute at 1 gpm
The result should be 1 gallon or very close.

NOTES
THIS TEST CAN BE USED TO COMFIRM THE METER IS READING PROPERLY. A PULSATING WATER METER CAN GIVE A FALSE READING.
FORMULA USED TO FIGURE WATER PERCENTAGE. (PRODUCT RATE + WATER WEIGHT(GALLONS PER MINUTE X 8.33(LBS PER GALLON = WATER WEIGHT) WATER WEIGHT DIVIDED BY THE TOTAL WEIGHT(PRODUCT AND WATER)= WATER PERCENTAGE.
EXAMPLE (250 LBS/MIN OF PRODUCT WITH 1 GALLON OF WATER.)
8.33DIVIDED BY 258 = .0332 (3.3 %)
WHEN CALCULATING THE PERCENTAGE OF A GASSING CHEMICAL, THE WEIGHT PER GALLON MUST BE DETERMINED.

PROGRAMMING RATE METERS

Each rate meter has a left-arrow and up-arrow key. Pressing both at the same time will advance through the three screens. Pressing the up-arrow key changes the currently selected digit (0-1-2 … 9-0-1…). The left-arrow key moves the "cursor" to the next digit. Using these two keys you enter new numbers digit-by-digit.
PROGRAMMING TACHOMETERS

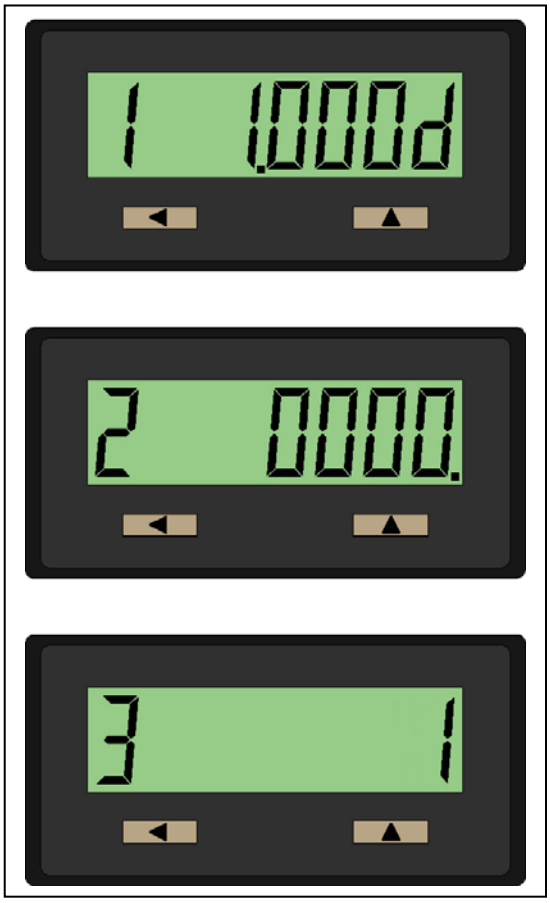
In order to enter a new scale value, you will first have to remove the clear front-cover of the Tach/Totalizer enclosure. Since even a tiny amount of Ammonium Nitrate can cause corrosion, make sure you have clean hands before opening the case. Use a screwdriver to remove the screws. Flip the central toggle switch to the program (PGM) position (up).

At this point, the meters will all be in program mode.

Screen 1 is the Rate Scale value. This is the value that will be determined during the calibration process. This should be the only value that needs to be changed.

Screen 2 is the rate-meter decimal point. This value should be left as shown here with the decimal to the far right.

Screen 3 sets a rate multiplier at (1x) or (10x). Leave the value at (1x).



ALL RATE METERS ARE SET TO REVOLUTIONS AT PLANT.

TO COVERT METER TO WEIGHT
Multiply the correct scale value in totalizer X 60 and enter value in rate meter screen 1
The rate meter will display the rate per minute of the totalizer.

PROGRAMMIMG TOTALIZERS

Leaving the programming switch in the PGM position, you can use the two arrow keys to change values in the totalizer in the same way as in the rate meters.

The totalizers have 4 screens instead of 3 however:

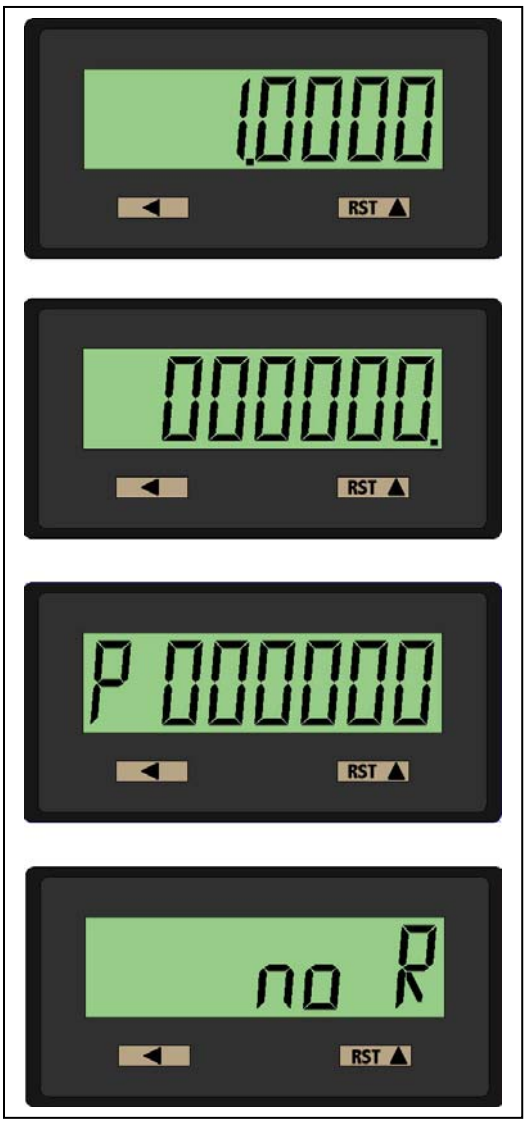
Screen 1 is the Count Scale value. This is the value that will be determined during the calibration process. This should be the only value that needs to be changed.

Screen 2 is the count decimal point. Leave this value as shown with the decimal to the far right.

Screen 3 is the display offset value. This number should be left as zero.

Screen 4 determines whether pressing the up-arrow key will reset the total. Leave this a “no Reset”. This way, only the button on the side of the Tach/Totalizer can reset the display.

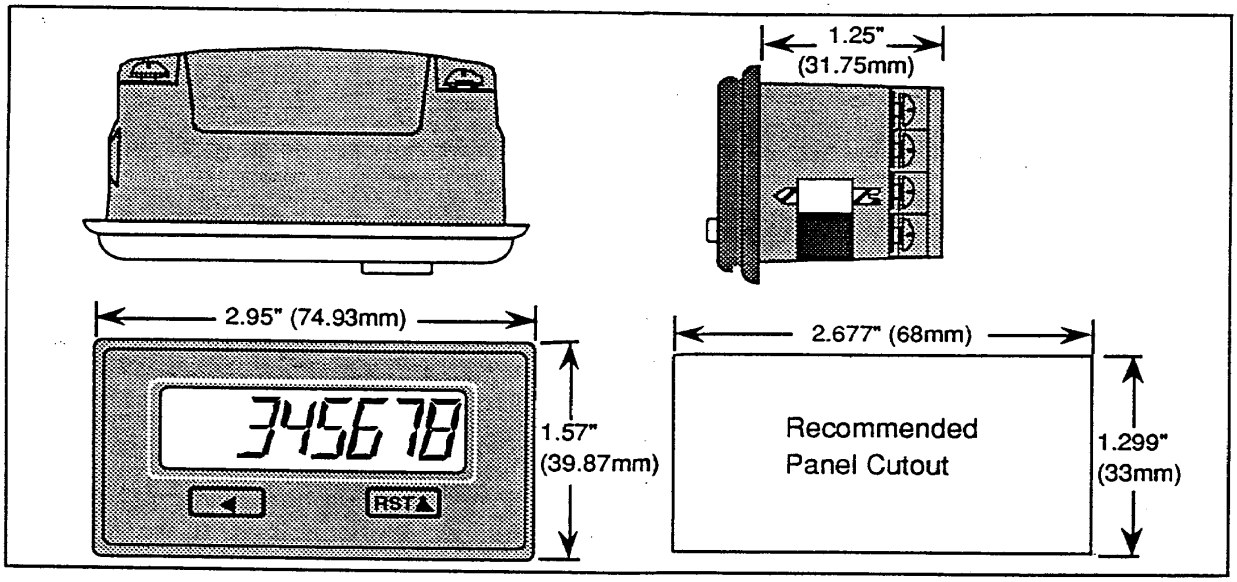
After you are done setting both the totalizers and the rate meters, make SURE to switch the programming switch back to the RUN (down) position before putting the front cover back on.



Durant®

INSTALLATION AND OPERATION
MANUAL NUMBER 53300-901-01

Courier Model: 53300-401 Add/Subtract Totalizer (Solid State Inputs)
53300-402 Add/Subtract Totalizer (Contact Inputs)



POWER
Internal battery: 3V, lithium.
Life expectancy: 5 years +.
Replacement Part: 36367-202.

PHYSICAL
Operation Temperature: 0° to 55°C.
Storage Temperature: -20°C to 70°C
Operating Humidity: 90% Non-condensing.
Weight: 2.2 oz. net.
Display Size: .43" high.
Front Panel Rating: NEMA 4X when mounted with gasket provided.
Case Material: Cycolac X-17.

TOTALIZER
Type: Up/Down Counting.
Digits: 8 digits positive/minus sign and 7 digits negative.
Scaler: 0.0001 - 100.0000
(0.0000 scales by 100 in the Courier Series).
Decimal Point: 5 positions, programmable.

DC COMMON (Terminal 1)

RESET INPUT (Terminal 4)
Resets totalizer when connected to DC common.
Min. Low Time: 0.25 to 1.0 sec. (maintained).
The required pulse width varies with count speed, scale factor and number of digits displayed.
Voltage Thresholds: Low 0 to 0.4 VDC.
High 2.0 to 28 VDC.

COUNT INPUT A (SUBTRACT); COUNT INPUT B (ADD) (TERMINALS 2 & 3)

Model -401
Inputs A & B require a voltage source, such as a current sourcing sensor or a current sinking sensor used with the provided pull up resistors.
Speed: 0 to 10 kHz.
Min Low Time: 80 microseconds.
Min High Time: 20 microseconds.
(These times are with a 0.0V to 5.0V swing).
Input Impedance: 2KΩ above 5 VDC.
Voltage Thresholds: Low 0 to 1.2 VDC
High 2.0 to 28 VDC
Max High 28 VDC.

Model - 402
Inputs A & B are designed for contact closures to DC common.
Speed; 0 to 20 Hz.
Min Low Time: 10 milliseconds.
Min High Time: 40 milliseconds.
Input Impedance: 101KΩ.
Voltage Thresholds: Low 0 to 0.4 VDC
High 2.0 to 28 VDC
Max High 28 VDC.

PROGRAM ENABLE INPUT (Terminal 5)
Operation: Level sensitive (maintained).

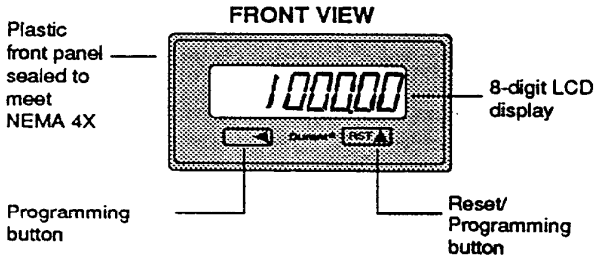
COUNT ACCURACY
100% when operated within specifications.

EATON

Eaton Corporation
901 South 12th Street
Watertown, WI 53094
414-261-4070 • TWX 910-260-3713 • FAX 414-261-9097

INTRODUCTION

Your 53300-401/402 is a counter with an eight digit LCD display. A programmable scaler and decimal point allow for display in any engineering unit.

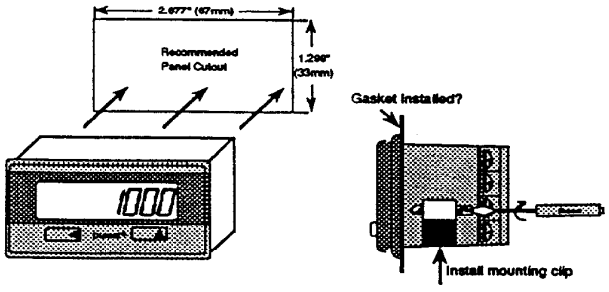


APPLICATION

Certain programming and wiring choices must be made to accomplish your application. We recommend the following sequence:

1. Answer the following questions:
   - What type of sensor will be used?
   - What engineering units should the counter be scaled to?
   - How many pulses per item is the sensor providing?
   - Is a decimal point needed on the display?
2. Calculate the scale factor.

MOUNTING



PROGRAM MODE

To enter the program mode, a connection must be made between terminals 1 and 5. (See page 4)

Screens

There are four program-mode screens in the 53300-401/402. Upon entering the setup mode, the counter will display screen 1. Press and hold the [◀] key while repeatedly pressing the [▲] key to advance to successive screens.

Programming Screens	
Screen	**Function**
1	Count Scale Factor
2	Count Decimal Point
3	Reset to Offset Value
4	Reset Key Enable / Disable

OPERATION

Add/Subtract Counting

There are two count input terminals on the rear of the totalizer. Count pulses entering Input A (terminal 3) cause the total to decrement (count down). Count pulses entering Input B (terminal 2) cause the total to increment (count up). The totalizer may start counting from zero, when reset, or may start from a user-programmed offset value. The offset value is a positive number and may be up to six digits.

If only one of the count inputs is used, the totalizer becomes an up counter with a range of zero to 99,999,999, or a down counter with a range of zero to -9,999,999. If both inputs are used, the totalizer displays the difference count between the two inputs - counts at Input B are added, counts at Input A are subtracted. In this mode of operation, the totalizer's range is -9,999,999 to 99,999,999. Positive numbers are not indicated with a plus sign(+). Both inputs may occur simultaneously, in which case the displayed total does not change.

Count Inputs

Model 53300-401 has hi-speed inputs and can accept pulses from solid state, current sourcing sensors at up to 10 kHz per input. The sensor must supply at least +2.0 VDC, but not more than +24VDC to the input. Counts are entered on the positive-going edge of the pulse.

Model 53300-402 has low speed inputs and can accept pulses from solid state, current sinking sensors or contact closures to ground at up to 20 Hz per input. These inputs are internally pulled up to +3 VDC. The sensor must be capable of sinking current from the input to bring the input voltage down to +0.4 VDC or less. Counts are entered on the negative-going edge of the pulse.

COUNT SCALER

Calculating the Count Scale Factor

The count scale factor is used to convert the incoming count pulses to the desired unit of measure to be displayed (feet, gallons, etc.) or to correct for a known amount of error (wheel wear, viscosity, etc.). This scaler has six digits available with a fixed decimal point.

Count Scaler Range: 0.0001 to 99.9999

(Setting the count scale factor to 0.0000 will allow scaling by 100 in the Courier Series)

Count Scaler (CS) Formula:

$$CS = \frac{DPF}{PPI}$$

where:

DPF is the decimal point factor corresponding to the desired decimal point location.

DISPLAY	DPF	DISPLAY	DPF
XXXXXX =	1	XXX.XXX =	1,000
XXXXX.X =	10	XX.XXXX =	10,000
XXXX.XX =	100		

PPI is the number of pulses per item from the sensor.

Example 1: A sensor produces 20 pulses per inch of material travel. Calculate the count scaler required to indicate material used in whole inches(XXXXXX).

$$CS = \frac{1}{20} = 0.05000$$

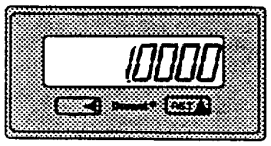
Example 2: An encoder produces 120 pulses per foot. Calculate the count scaler required to indicate material usage in 1/100's of feet (XXXX.XX).

$$CS = \frac{100}{120} = 0.8333$$

(Select the XXXX.XX position on the totalizer decimal point menu).

Programming Count Scale Factor

The first screen in the program mode is used to enter the count scale factor.



The far right digit will be flashing. Press the [RST▲] key until reaching the desired digit value.

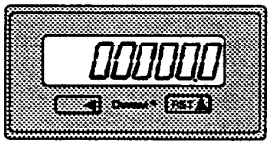
Note: Pressing and holding the [RST▲] key will cause the numbers to autoscroll.

Next press the [◀] key to move the flashing digit one place to the left. Change this digit to the desired value with the [RST▲] key.

Repeat this process until all digits are set correctly.

Programming Decimal Point

The second screen is used to enter the decimal point display on the totalizer screen. Press and hold the [◀] key and then press the [RST▲] key to move from screen one to screen two.



Press the [RST▲] key to move the decimal point to the desired position.

Programming Offset Value

Programming an offset value allows the counter to reset to a value other than zero. The offset may be up to six digits. The offset cannot be a negative number.

The third screen in the program mode is used to enter the offset value.



The far right digit will be flashing. Press the [RST▲] key until reaching the desired digit value.

Note: Pressing and holding the [RST▲] key will cause the numbers to autoscroll.

Next press the [◀] key to move the flashing digit one place to the left. Change this digit to the desired value with the [RST▲] key. Repeat this process until all digits are set correctly.

Enabling the Front Panel Reset Key

The fourth screen in the program mode allows the user to enable or disable the front panel reset key.



Press the [RST▲] key to choose the option you want.

Note: The reset terminal on the rear panel is still active when the front reset button is disabled.

To exit the program mode, break the connection between terminals 1 and 5.

WIRING RECOMMENDATIONS

Following these suggestions will increase noise immunity and lengthen unit life.

Cable: The connection between the count source and the totalizer should be made with a two-conductor shielded cable. The shield should be connected to earth ground at one end only.

Relay Coil Suppression: If a relay contact is used as a count source, the relay coil should be suppressed. This can be accomplished with an RC network for AC coils or a diode for DC coils. The Durant RC suppressor (38091-400) may be used.

Mounting: The totalizer should not be mounted near a solenoid or other inductive devices. Enough ventilation should be supplied to keep the totalizer operating within the temperature specifications. Do not mount this unit in a heavy vibration area.

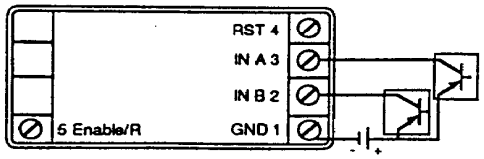
BATTERY SAFETY

The lithium battery that powers your device contains inflammable materials such as lithium organic solvent, and other chemical ingredients. Explosion or fire may result if the battery is not handled correctly. To avoid an accident follow these guidelines:

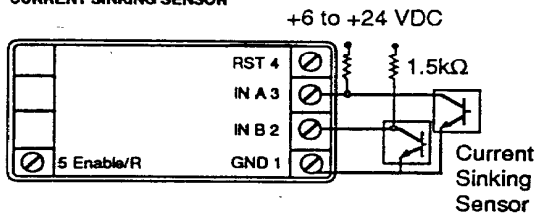
*Do not heat batteries above 95°C
*Do not recharge lithium batteries
*Do not dispose of batteries in fire
*Insert battery with correct polarity

WIRING DIAGRAMS

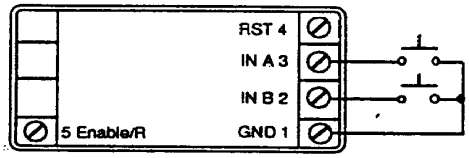
SOLID STATE ADD/SUBTRACT INPUT (53300-401)
CURRENT SOURCING SENSOR



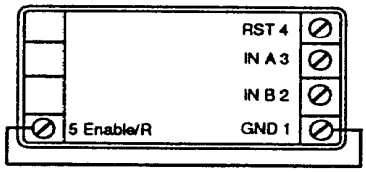
SOLID STATE ADD/SUBTRACT INPUT (53300-401)
CURRENT SINKING SENSOR



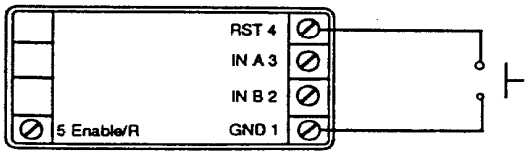
CONTACT CLOSURE COUNT INPUT (Model 53300-402)



PROGRAM MODE ENABLE (All Models)



REMOTE RESET (All Models)

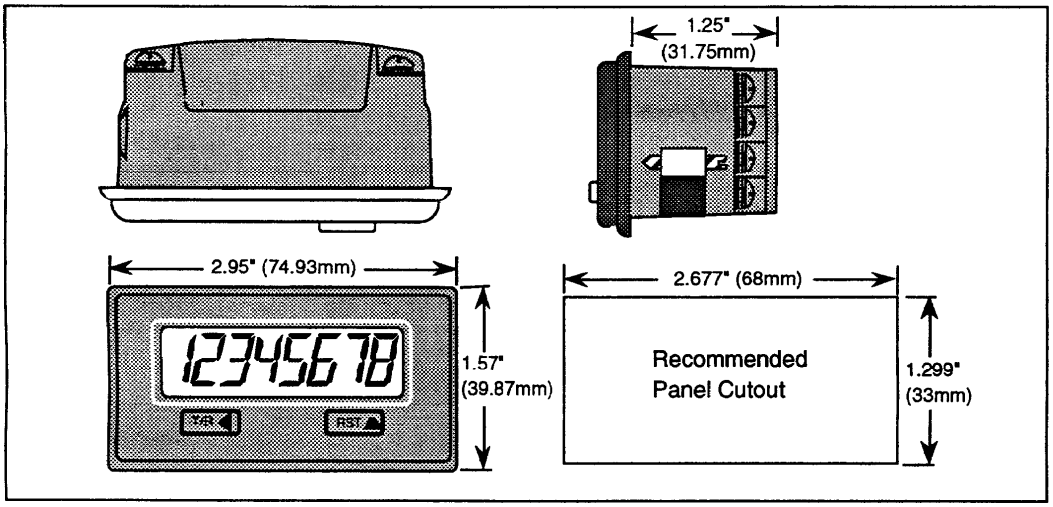


Terminal	Function	Operation
1	Ground	
2	Input B Count Input	Current Source Input (401) Current Sink Input (402)
3	Input A Count Input	Current Source Input (401) Current Sink Input (402)
4	Reset	Connect through Contact Closure to Ground
5	Program Enable	Connect to Ground to Enter Program Mode

Durant®

INSTALLATION AND OPERATION
MANUAL NUMBER 53300-905-05

Courier Model: 53300-405 Totalizer/Ratemeter
53301-405 Totalizer/Ratemeter - Extended Temperature Range
53302-405 Totalizer/Ratemeter with Backlight



POWER
- Internal Battery: 3V, Lithium.
- Life expectancy: 5 years +.
- Replacement Part: 36367-202.

BACKLIGHT
- 10-30 VDC @ 30 mA max.
- (Derate operating temperature 1°C/Volt above 17VDC.)
- Reverse polarity protected.

PHYSICAL
- Operating Temperatures:
  - Model 53300-405: 0° to 55°C.
  - Model 53301-405: -20° to 70°C.
  - Model 53302-405: 0° to 55°C.
- Storage Temperature: -20° to 70°C.
- Operating Humidity: 60% Non-condensing.
- Weight: 2.2 oz. net.
- Display Size: .43" high.
- Front Panel Rating: NEMA 4X when mounted with gasket provided.
- Case Material: Cycolac X-17.

TOTALIZER
- Type: UP counting.
- Digits: 8.
- Scaler: 0.0001 - 100.0000.
- (0.0000 scales by 100 in the Courier Series.)
- Decimal Point: 5 positions, programmable.

RATE INDICATOR
- Type: 1/Tau.
- Digits: 4/5, (4 calculated, 5 displayed with fixed 0 in LSD).
- Scaler Range: .001 to 9999.
- Decimal Point: 5 positions, programmable.
- Accuracy: ±0.2%.
- Update Time: .7 seconds.
- Zero Time: 10 seconds.

DC COMMON (Terminal 1)

COUNT / RATE INPUTS

Input B (Terminal 2) Low speed input designed for contact closures to DC common.
- Speed: 0 to 20 Hz.
- Min Low Time: 10 milliseconds.
- Min High Time: 40 milliseconds.
- Impedance: 101K ohm.
- Voltage Thresholds: Low 0 to 0.4 VDC.
  High 2.0 to 28 VDC.
  Max High: 28 VDC.

Input A (Terminal 3) High speed input requiring a voltage source such as a current sourcing sensor or a current sinking sensor used with the provided pull up resistors.
- Speed: 0 to 10 kHz.
- Min Low Time: 80 microseconds.
- Min High Time: 20 microseconds.
- (The above times are with a 0 to 5.0 V swing.)
- Input Impedance: 2kΩ above 5 VDC.
- Voltage Thresholds: Low 0 to 1.2 VDC.
  High 2.0 to 28 VDC.
  Max High 28 VDC.

RESET INPUT (Terminal 4)
- Resets totalizer to zero when connected to DC common.
- Min. Low Time: 0.25 to 1.0 sec. (maintained).
- The required pulse width varies with count speed, scale factor and number of digits displayed.
- Voltage Thresholds: Low 0 to 0.4 VDC.
  High:2.0 to 28 VDC.

PROGRAM ENABLE INPUT (Terminal 5)
- Operation: Level sensitive (maintained).

COUNT ACCURACY
- 100% when operated within specifications.

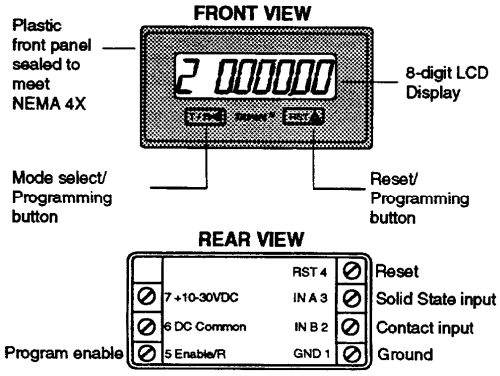
Cutler-Hammer

EATON

INTRODUCTION

The 5330X-405 is a combination UP counting totalizer and ratemeter. The totalizer has an eight digit display. The front-panel reset key can be disabled. A remote-reset terminal is provided. The count scaler and decimal point can be programmed.

The ratemeter has a 4/5 digit LCD display. A programmable rate scaler and decimal point allow for display of rate in any engineering terms.

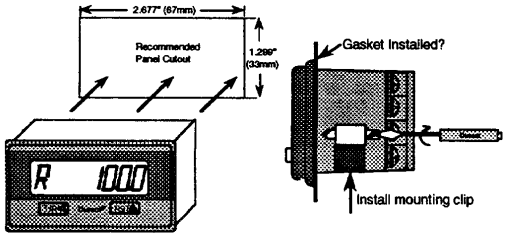


APPLICATIONS

The 5330X-405 is designed to show both total and process rate. Certain programming and wiring decisions must be made to complete your application. We recommend the following sequence:

1. Answer the following questions:
   - What type of sensor will be used?
   - What engineering units should the ratemeter be scaled to?
   - How many pulses per item is the sensor providing?
   - Is a decimal point needed on the count and/or rate display?
   - Should the front-panel reset key be active or inactive?
2. Calculate the count scale factor and the rate scale factor.

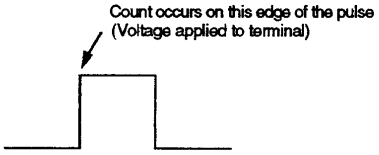
MOUNTING



OPERATION

Count Inputs

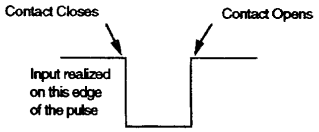
Separate contact and solid state count inputs are provided. The solid state input (terminal 3) requires a current-sourcing sensor and can count up to 10 kHz. Inputs into this terminal are counted on the positive-going edge.



Terminal 3 is pulled down to common. When a sensor output supplies voltage to this terminal, one count is registered on the display. The sourcing signal must supply at least +2.0VDC but no more than +28VDC.

Note: When a sourcing signal is applied to terminal 3, a power assist feature of the Courier extends the life of the battery.

Terminal 2 is the low-speed, current sinking count input designed to be used with a contact closure to ground. It has a maximum count speed of 20 Hz. Inputs into this terminal are counted on the negative-going edge.



Terminal 2 is pulled up to +3VDC. When a contact closes, pulling the voltage down to .4 VDC or less, one count is registered.

RUN MODE

Screens

Two screens are available on the 5330X-405.

Totalizer: This 8-digit screen shows you the accumulated scaled count inputs. The totalizer has lead-zero blanking.

Ratemeter: This 4/5 digit screen shows current process rate.

Front Panel Keys

Press the T/R key on the front panel to toggle between the totalizer and ratemeter screens.

Press the RST key to reset the totalizer display to zero. This button has no effect on the ratemeter screen.

The front panel reset key provides an edge-sensitive (momentary) reset.

Note: The RST key may be disabled. See program mode.

PROGRAM MODE

To enter the program mode, a connection must be made between terminals 1 and 5.

Screens

There are six program-mode screens in the 5330X-405. Press and hold the T/R key while repeatedly pressing the RST key to advance to successive screens.

Programming Screens	
Screen	**Function**
1	Count Scale Factor
2	Totalizer Decimal Point
3	Rate Scale Factor
4	Ratemeter Decimal Point
5	Rate x1/x10
6	Reset Key Enable/Disable

COUNT SCALER

Calculating the Count Scale Factor

The count scale factor is used to convert the incoming count pulses to the desired unit of measure to be displayed (feet, gallons, etc.) or to correct for a known amount of error (wheel wear, viscosity, etc.). This scaler has six digits available with a fixed decimal point.

Count Scaler Range: 0.0001 to 99.9999

Count Scaler (CS) Formula:

$$CS = \frac{DPF}{PPI}$$

where:

DPF is the decimal point factor corresponding to the desired decimal point location.

DISPLAY	DPF	DISPLAY	DPF
XXXXXX =	1	XXX.XXX =	1,000
XXXXX.X =	10	XX.XXXX =	10,000
XXXX.XX =	100		

PPI is the number of pulses per item from the sensor (times 2 if doubled count mode).

Example 1: A sensor produces 20 pulses per inch of material travel. Calculate the count scaler required to indicate material used in whole inches(XXXXXX).

$$CS = \frac{1}{20} = 0.05000$$

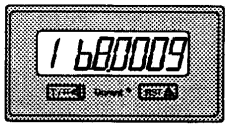
Example 2: An encoder produces 120 pulses per foot. Calculate the count scaler required to indicate material usage in 1/100's of feet (XXXX.XX).

$$CS = \frac{100}{120} = 0.8333$$

(Select the XXXX.XX position on the totalizer decimal point menu).

Programming Count Scale Factor

The first screen in the program mode is used to enter the count scale factor.



The far right digit will be flashing. Press the RST key until reaching the desired digit value.

Note: Pressing and holding the RST key will cause the numbers to autoscroll.

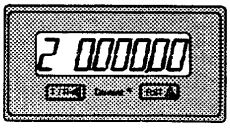
Next press the T/R key to move the flashing digit one place to the left. Change this digit to the desired value with the RST key.

Repeat this process until all digits are set correctly.

(Setting the count scale factor to 0.0000 will allow scaling by 100 in the Courier Series)

Programming Totalizer Decimal Point

The second screen is used to enter the decimal point display on the totalizer screen. Press and hold the T/R key and then press the RST key to move from screen one to screen two.



Press the RST key to move the decimal point to the desired position.

DURANT RATE SCALE PROGRAMMING

This is the most important example to refer back to if the sensor is 10,20,30pulses per revolution.

RATE SCALER

Calculating the Rate Scale Factor

This 1/Tau ratemeter calculates rate by measuring the time interval between input pulses, converting to a frequency (F = 1/Tau), and multiplying the product by the rate scaler. The rate scaler is user programmed to convert the count input frequency into the desired rate units for display (feet/minute, inches/second, gallons/hour, etc.)

Rate Scaler Range: 0.001 to 9999

Rate Scaler (RS) formula:

$$RS = \frac{Sec \times DPF}{PPI \times 10} \quad \text{for R x 10}$$

where:

SEC is the number of seconds in the rate time unit (items/second = 1, items/minute = 60, items/hour = 3600, etc.)

DPF is the decimal point factor corresponding to the desired decimal point location on the run mode screen:

Display	DPF
XXXX	1
XXX.X	10
XX.XX	100
X.XXX	1000

PPI is the number of pulses per item from the sensor.

Example 1: A sensor produces 10 pulses per foot of material travel. Display rate in whole feet per minute (XXXX).

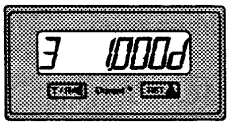
$$RS = \frac{60 \times 1}{10} = 6.000$$

Example 2: A flow sensor produces 400 pulses per gallon. Display flow rate in tenths of gallons per hour.

$$RS = \frac{3600 \times 10}{400} = 90.00$$

Programming Rate Scale Factor

The third program mode screen allows you to enter the rate scale factor.



The lower case "d" appears on the right of the display when it is time to enter the decimal point position for the rate scaler.

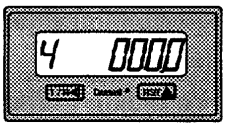
Note: This decimal point is used for the rate scaler only and will not appear on the ratemeter screen.

Press the RST▲ key to change the first digit to the correct value. Press the T/R◀ key to select the next digit to be changed. Repeat this process until all the digits are correct. When the "d" appears, press the RST▲ key until the decimal point is in the desired location.

Ratemeter Decimal Point

The fourth program mode screen is used to enter the decimal point position for the ratemeter run-mode display.

The display will show the screen number (4) and four zero's.

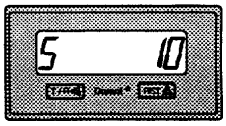


Press the RST▲ key until the decimal point is in the correct position.

Rate x1 or x10

The fifth screen is used to select the rate display multiplier of one or ten. Selecting rate x10 will add a zero to the far right of the display. This zero will not change value and does not affect the decimal point position.

The display will show the screen number (5) and a 1 at the right.



Press the RST▲ key to select 1 or 10.

Front Reset Key Enable/Disable

The last screen in the program mode is used to determine whether the front panel reset key will function. The screen will show a number 6 on the left and an R on the right.



Press the RST▲ key to choose the option you want.

Note: The reset terminal on the rear panel is still active when the front reset button is disabled.

To exit the program mode, break the connection between terminals 1 and 5.

WIRING RECOMMENDATIONS

Following these suggestions will increase noise immunity and lengthen unit life.

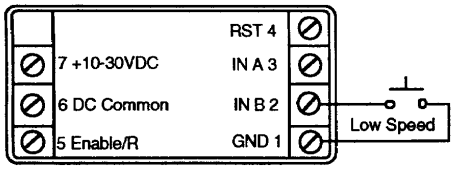
Cable: The connection between the count source and the totalizer / ratemeter should be made with a two-conductor shielded cable. The shield should be connected to earth ground at one end only. The connecting cable should not be run in conduits with cables switching high inductive loads.

Relay Coil Suppression: If a relay contact is used as a count source, the relay coil should be suppressed. This can be accomplished with an RC network for AC coils or a diode for DC coils. The Durant RC suppressor (38091-400) may be used.

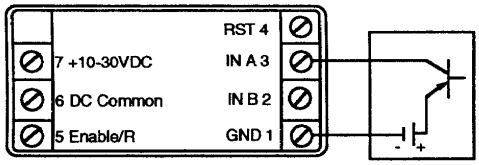
Mounting: This totalizer / ratemeter should not be mounted near a solenoid or other inductive devices. Enough ventilation should be supplied to keep the totalizer operating within the temperature specifications. Do not mount this unit in a heavy vibration area.

WIRING DIAGRAMS

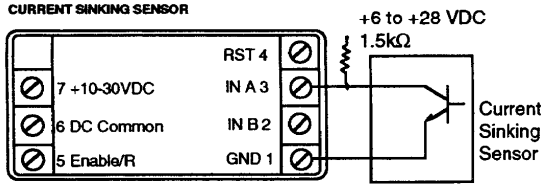
CONTACT CLOSURE COUNT INPUT



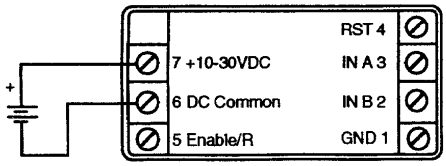
SOLID STATE COUNT / RATE INPUT
CURRENT SOURCING SENSOR



SOLID STATE COUNT / RATE INPUT
CURRENT SINKING SENSOR



BACKLIGHT WIRING



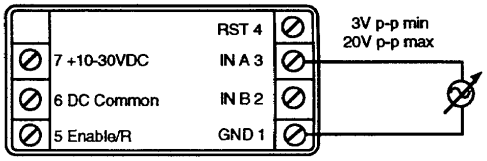
BATTERY SAFETY

The lithium battery that powers your device contains inflammable materials such as lithium organic solvent, and other chemical ingredients. Explosion or fire may result if the battery is not handled correctly. To avoid an accident follow these guidelines:

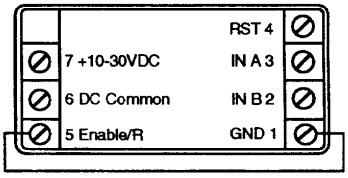
*Do not stack or jumble up batteries
*Do not heat batteries above 95°C
*Do not disassemble batteries
*Do not recharge lithium batteries
*Do not apply pressure to, or deform batteries
*Do not solder to batteries
*Do not dispose of batteries in fire
*Insert battery with correct polarity

Terminal	Function	Operation
1	Ground	
2	Input B Count Input	Use with Contact Closure to Ground up to 20 Hz Count Speed
3	Input A Count Input	Use with Current Sourcing up to 10 kHz Count Speed
4	Reset	Connect to Ground to Reset Totalizer. This is a maintained or Level Sensitive Reset.
5	Program Enable	Connect to Ground to Enter Program Mode
6	Backlight Common	
7	Backlight Power	Connect to Power to Light Display

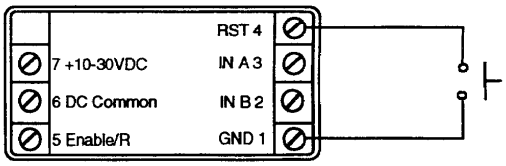
SOLID STATE COUNT / RATE INPUT
MAGNETIC PICKUP



PROGRAM MODE ENABLE



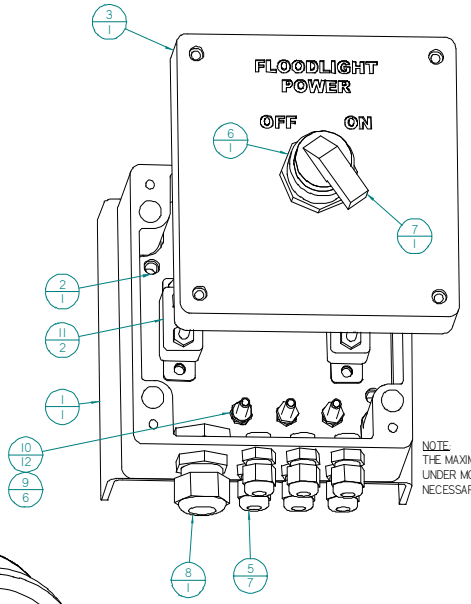
REMOTE RESET

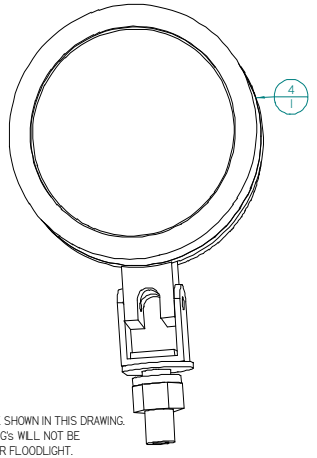


FloodLight System

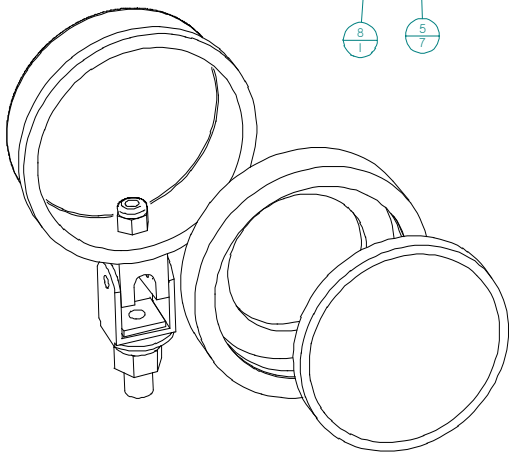
The Sealed Floodlighting System consists of four (4) floodlights. They are mounted one (1) on each corner of the body. The closed system protects the wires from abrasion, salt, capillary action and physical damage. All wiring is protected by 1/16” wall instrument grade tubing, nylon pipe to barb fittings, plus no external splices.







NOTE
THE MAXIMUM OF 8 PG7 STRAIN RELIEFS ARE SHOWN IN THIS DRAWING. UNDER MOST CIRCUMSTANCES, ALL THESE PG's WILL NOT BE NECESSARY. ONLY ONE PG7 IS REQUIRED PER FLOODLIGHT.



INSIDE VIEW OF FLOODLAMP ASSY

ITEM	QTY	DWG. NO.	DESCRIPTION	PART ID
1	1	S10027P04	MOUNTING BRACKET	
2	1	S10027P03	SWITCH BOX BACK PLATE	
3	1	S10027P02	SWITCH BOX	
6	1		SWITCH OPERATOR 2-POS SKS11B	234.8010
4	1		LIGHT FLOOD PEDASTAL MT	231.5301
12*	4		SWITCH CONTACT BLOCK TYPE KA1	234.8000
5	7		STRAIN RELIEF LIQUID-TIGHT PG7 .114-.250	231.0044
9	6		SCREW MACHINE SL ROUND HD #10-24X1.00 SS	915.1894
10	12		NUT HEX #10-24 SS	950.1814
8	1		STRAIN RELIEF LIQUID-TIGHT .5NPT .39-.56	231.0196
7	1		KNOB GLOVED HAND B25 FOR SKS SWITCH	234.8001
11	2		CIRCUIT BREAKER 12VDC 15A STUD-MT	231.0184

PROPRIETARY STATEMENT
THIS DOCUMENT AND ALL INFORMATION CONTAINED HEREIN ARE THE PROPERTY OF TREAD CORP. AND ARE NOT TO BE USED, DISCLOSED, OR COPIED EXCEPT AS EXPRESSELY AUTHORIZED.

UNLESS OTHERWISE SPECIFIED ALL DIMENSIONS ARE IN INCHES
1.0 INCH = 25.4 mm
THIRD ANGLE PROJECTION

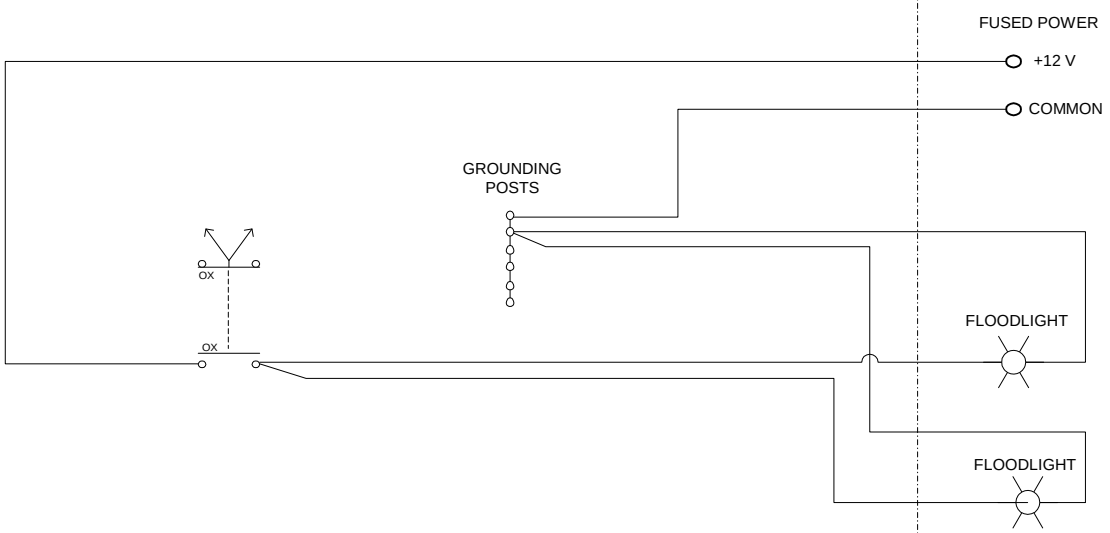
TOLERANCE LIMITS UNLESS OTHERWISE SPECIFIED
DECIMAL X = ± .100
DECIMAL .XX = ± .020
DECIMAL .XXX = ± .005
ANGULARITY = ± 0.5 DEG

DRAWN: T. BARHAM
DATE: 11-APR-00
APPR:

TREAD CORPORATION ROANOKE, VIRGINIA 24012 USA

PROJECT:
TITLE: FLOODLIGHT SYSTEM
FLOODLIGHT SYSTEM

DWG NO: S10027A01 | REV: 1 | SIZE: C
WEIGHT: 7.5 lb | SHEET: 1 OF 2



NOTES

1) THIS ELECTRICAL SCHEMATIC SHOWS THE CONNECTION OF TWO FLOODLIGHTS.

2) ONE SWITCH CONTACT-BLOCK IS USED FOR EVERY PAIR OF LIGHTS.

3) ONE #16 WIRE PAIR WILL BE USED TO SOURCE POWER FOR EACH PAIR OF FLOODLIGHTS.

	FLOODLIGHT SYSTEM FLOODLIGHT SYSTEM	
T BARHAM 11-APR-00	S10027A01	I
	7.5 lb	2 OF 2

Fuel Oiling System

There are three control points in the ANFO oiling system

1. Ball valves on the oil tank.
2. Fuel oil select valve.
3. Adjustable proportional flow control.

Valve Open



The ball valves are located at the bottom of the fuel oil tank. The ball valves MUST be open any time the oiling system is activated. The open position is when the handle of the ball valve is “in-line” with the valve. The closed position is when the handle of the ball valve is perpendicular to the valve. Also, make certain that there is oil in the fuel oil tank before operating the oiling system. Replace the fuel oil tank sight gauge if you cannot clearly see the oil level. Running the oil pump for even brief periods with no oil may result in pump damage.

Fuel oil select valve

The fuel oil select valve is located on either side of the hydraulic controls. The fuel oil select valve is to allow for product delivery without the addition of fuel oil. If you do not desire oil, put the valve labeled “FUEL OIL” in the “IN_OFF” position.



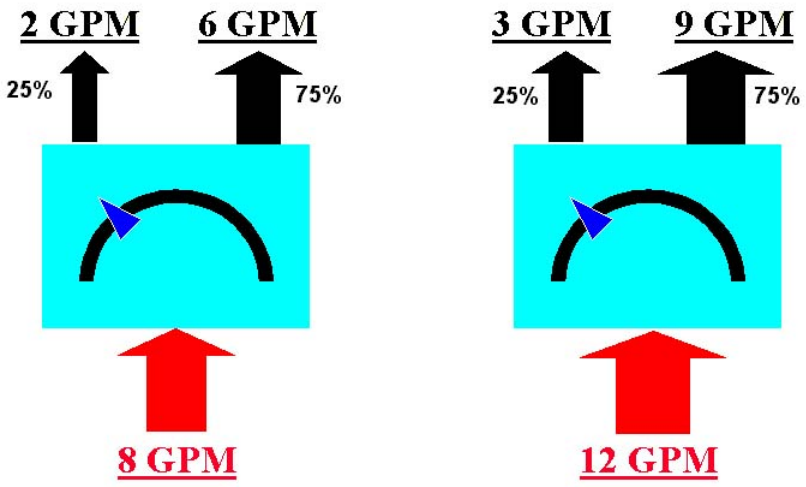


Adjustable proportional flow control



The adjustable proportional flow control is located on the fender in close proximity to the hydraulic controls. The adjustable proportional flow control is provided to insure flexibility of the oiling system. This valve actually adjusts the amount of oil going to the ammonium nitrate. The adjustable proportional flow control operates in an arch from left to right. The handle can be locked in place by turning the flow control knob in the clockwise direction. Full left allows little or no DFO into the AN stream and full right allows 10 to 12% DFO into the AN stream.

The AP flow divider splits the flow into two adjustable portions.



The set portions (percentage) remain constant when input flow changes.

The adjustable proportional flow control is used to calibrate the oiling system and to “trim” the system for specific conditions. It should be checked frequently to make sure that it slides freely. When sliding the adjustment, make certain the locking knob is in the unlocked position and that it is returned to the locked position when adjustment is completed.

Under cold conditions it is possible for the diesel fuel oil to gel, which may appear to be a malfunctioning oiling system or miscalibration of the system. Under these conditions it is recommended that the fuel oil distributor be consulted concerning different fuel blends or additives.

Oil Calibration

Standard Delivery

Due to the variations in the bulk densities of ammonium nitrate (45 lbs/cuft to 55 lbs/cuft), the amount of oil to be added to the prill will vary. Consequently, the calibration data presented here represents nominal values. After calibration, the system will require adjustment to match your conditions, It is important that detailed records of prill and D.F.O. usage be maintained in order that a history of use may be established. This will aid in the fine-tuning of the oiling system to match your needs.

Your truck, when delivered, will have had the oiling system calibrated for you at a nominal setting of approximately 1 GAL of D.F.O. per 100 LBS of delivered material. However, there are times you may need to recalibrate the oiling system yourself. Follow these steps to achieve proper calibration.

Calibration Data

Note: These are nominal values that will establish a baseline of approximately 1 gal D.F.O. per 100 lbs of delivered Ammonium Nitrate.

Standard Delivery

Bottom Auger (RPM)	Oil Flow (GPM)
140	6.0
100	4.3
70	3.0

or

RPM ∗ .043 = GPM

Procedure

Unscrew the fittings from the oil injection ports on the bottom auger housing under the turntable. Make sure that the fitting's orifice is in place. Place the hose ends with fittings attached into a bucket of appropriate size. Start the bottom auger and adjust the engine speed for a given RPM. Run the oil (select FUEL OIL OUT-ON) for a specified length of time.

The flow rate of the oil is determined from the following equation.

where: GPM = oil flow rate
GAL = reading from oil totalizer
TIME = time in seconds

$$GPM = \frac{GAL * 60}{TIME}$$

The adjustable proportional flow control can then be adjusted to provide for more or less flow as is necessary. Repeat the procedure until the proper flow rate for the set RPM is achieved.

Example:

A TREADBED has 2/3 flighting for the bottom auger. This is a standard delivery model. The engine speed is set to give a bottom auger speed of 120 RPM. After removing the fittings from the injection ports and noting the condition of the orifices, the hose ends with fittings are placed into the bucket. After running the oiler for 30 seconds, the reading on the totalizer is noted (be sure that the totalizer is zeroed before each run). It reads 2.3 gallons. The GPM being delivered is, therefore,

$$GPM = \frac{2.3 \text{ gals} * 60}{30 \text{ sec.}}$$

$$GPM = 4.6$$

Comparing this with the requirements given by the calibration data formula for the standard ANLoader:

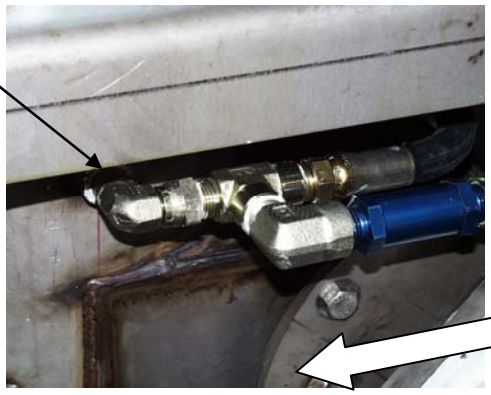
$$GPM = RPM * .043$$

$$GPM = 120 * .043$$

$$GPM = 5.2$$

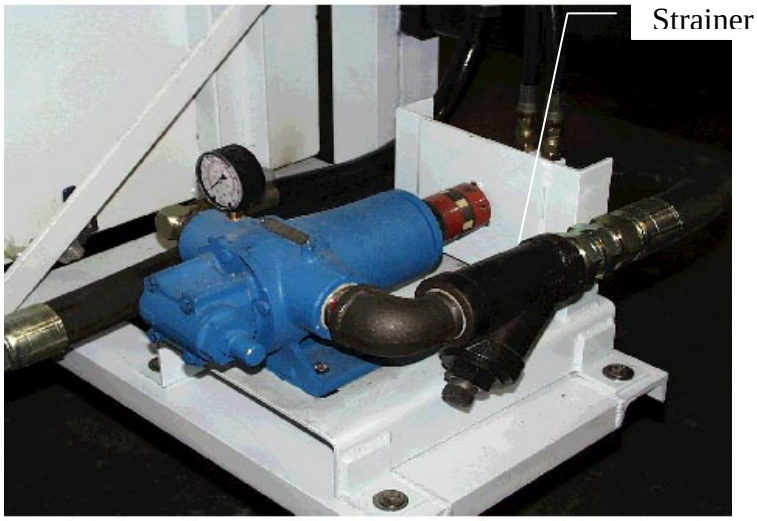
Therefore, the flow of oil to the injectors must be increased. This is done by sliding the adjustable proportional flow control to the right, thereby, increasing the flow of oil being sent to the injection nozzles. Repeat the procedure until satisfied with the oil flow rate.

Oil Injectors



The oil injectors are located in the bottom auger housing just below the connection with the vertical auger housing (under the turntable on series 10 and 11 models). The fittings should be unscrewed and the orifices checked for wear on an annual basis or when calibration of the system becomes difficult. The injectors should also be inspected for seepage of oil when the oiling system is off. An undue amount of seepage indicates that the check valve may have dirt on the valve seat that interferes with proper seating of the valve. Otherwise, the valve may be worn and in need of replacement. Be sure to install the 30 psi check valve with the flow direction toward the oil injectors. The check valve will prevent gravity feed from the tank.

Oil Strainer



The strainer is located on the oil pump assembly. The strainer should be cleaned out as often as necessary to insure an uninterrupted flow of oil to the oil injectors.

Pump and Motor

The Viking gear pump has an internal relief valve. The pump runs in proportion to the bed auger over the full operating range. The pump discharges approximately .017 gallons per minute, although pump wear will change this calibration. The pump is supplied with a thrust bearing, which allows for adjustment to compensate for pump wear.

Maintenance Schedule

	Daily	Weekly	Monthly	Annually
Check sight gauge	X			
Check operation of ball valves	X			
Check general condition of hose	X			
Check pressure gauge	X			
Check oil tank mounting bolts		X		
Ck adj proportional flow control		X		
Check injection ports for seepage		X		
Clean DFO strainer			X	
Check injection ports for wear				X

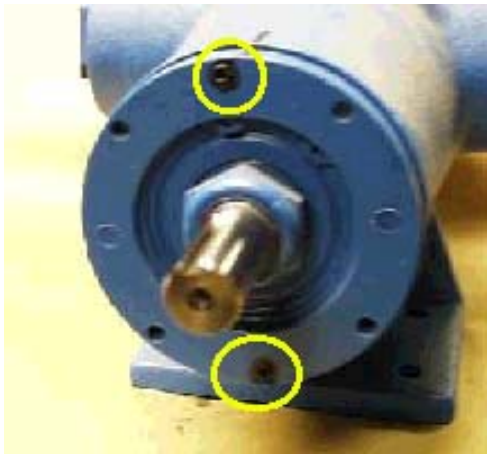
Pressure relief setting

1. Remove the valve cap covering the adjustment screw, and loosen the locknut.
2. Back off the adjusting screw by turning it CCW until it is almost all the way out.
3. Remove the discharge line and plug it.
4. Run the pump and observe the pressure gauge reading.
5. Turn the adjusting screw CW to increase the pressure to 100 psi.
6. Tighten the locknut and install the valve cap.



Thrust ring adjustment

Loosen the set screws in the face of the thrust bearing assembly using a 7/16 inch allen wrench.



While turning the rotor shaft, rotate the thrust bearing assembly until a noticeable drag occurs. This is zero clearance. Mark this position with the pump housing.



Rotate the thrust bearing assembly CCW 9/16 of an inch, as measured on the outside of the pump housing. Tighten the setscrews to secure the thrust bearing assembly in this position.



Oil Totalizer

The fuel oil totalizer indicates the amount of gallons of oil used since the last reset. It also indicates the total gallons used since its' installation. It has a calibration screw to calibrate the meter.



Calibration

Disconnect the oil pressure lines including the injectors. (The fuel injectors must be used when obtaining a sample due to backpressure).
Reset the totalizer.
Run the pump and fill the 5 gallon container full of fuel.
Compare to the totalizer reading.



Adjust the calibration set screw CW to increase the indicated amount. Turn CCW to decrease the indicated amount.
Repeat the test until the meter reads 5 gallons.

Calibration screw with screw cover



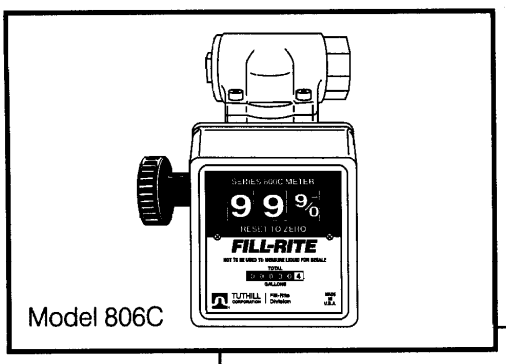
Pump System Technology

FILL-RITE

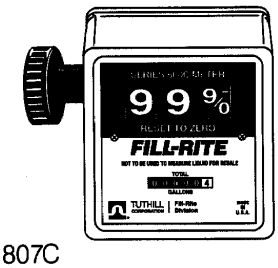
Parts and Technical Service Guide

SERIES 800C METER

For models 806C, 807C



Model 806C



Model 807C

OUTSTANDING FEATURES

- 5 to 20 GPM / 19 to 76 LPM flow rate
- Accurate to within ±1%
- 3/4" or 1" NPT flow ports
- Large, easy to read numbers
- Quick reset knob
- Totalizer
- UL Listed

TUTHILL CORPORATION | Fill-Rite Division
8825 Aviation Drive
Fort Wayne, Indiana USA 46809
Tel 219 747-7524 Fax 219 747-3159

Dear Fill-Rite Customer,

Thank you for buying a Fill-Rite product. We believe that you have bought the best. This piece of literature contains information about your new equipment and its operating and service requirements. Please take a few minutes to read it carefully.

Fill-Rite's products are distributed around the world and are the result of people at Fill-Rite working together to design, manufacture, sell, ship and service products which meet the needs of each and every customer.

If, for any reason, any of our products do not meet your performance expectations, we would like to hear from you. Our best sales force is you, our customer, and we want you to be satisfied. We appreciate your purchase of a Fill-Rite product and look forward to providing your future equipment needs.

Sincerely,

George P. Jenkins
President

SAFETY INSTRUCTIONS

To ensure safe and efficient operation, it is essential to read and follow each of these warnings and precautions.

1. **Improper use or installation of this product can cause serious bodily injury or death.**
2. Do NOT smoke near meter or use meter near an open flame when dispensing flammable fluids. Fire could result.
3. CAUTION: DO NOT INSTALL ADDITIONAL FOOT VALVE OR CHECK VALVE DURING INSTALLATION WITHOUT PRESSURE RELIEF VALVE. CRACKING MAY RESULT.

GENERAL DESCRIPTION

The Fill-Rite Series 800C meter is a nutating disc flow meter. The meter uses wheel counters for registering either U.S. gallons or liters. The U.S. gallon meter has two unit wheels and a tenth wheel which can be reset to zero. It's totalizer has five unit wheels and a tenth wheel. The liter counter has three unit wheels which can be reset to zero. It's totalizer has six unit wheels.

OPTIONS

- Liter registers
- 1" NPT Flow Ports
- Teflon or nickel coatings
- EPDM O-rings
- BSP threads

SAFETY

The safety of Fill-Rite Series 800 meters is proven by their listing with the following agencies.

Underwriters Laboratories Inc., a nationally recognized independent organization for testing of products to ensure public safety.

Canadian Standards Association, a Canadian organization for testing of products to ensure public safety.

TECHNICAL INFORMATION

Design Features

- 3/4" or 1" NPT female inlet and outlet ports
- Recommended for 5 to 20 GPM (19 to 76 LPM) output
- ± 1% accuracy
- 50 PSI maximum pressure
- Meters fluid at temperatures from -15°F (-26°C) to 150°F (66°C)
- Weatherproof, corrosion resistant
- Zero reset unit wheels have large 11/16" figures
- Easy to read totalizer registers to 99,999.9 gallons
- Compact design - 8" x 6" x 6"
- Convenient, large reset knob
- Not for resale use
- Maximum viscocity of fluid: Diesel Fuel

Fluid Compatibility

The 800C is compatible with the following fluids:

- Diesel Fuel, Gasoline, Kerosene, Mineral Spirits, Heptane, and Hexane

The 800C is NOT compatible with the following fluids:

- Bleach, Hydrochloric Acid, Ink, Motor Oil, and Salt Water

If in doubt about compatibility of a specific fluid, contact supplier of fluid to check for any adverse reactions to the following wetted materials.

All Series 800C Meters		
Ryton	**300S Stainless Steel**	**400S Stainless Steel**
Aluminum: 806C, 806CL, 806CI, 807C, 807CL, 807CI, 807C-1, 807CL-1, 807CI-1		
Aluminum, Nickel Plated: 807CN, 807CN-1, 807CNL		
Aluminum, Teflon Coated: 806CT, 806CTL, 807CT, 807CT-1, 807CTL-1		
Viton: 806C, 806CT, 806CL, 806CTL, 806CI, 807C, 807CN, 807CT, 807CL, 807C-1, 807CN-1, 807CT-1, 807CL-1, 807CNL-1, 807CTL-1, 807CI-1		
Buna N: 806C, 806CL, 806CI, 807C, 807CL, 807C-1, 807CL-1, 807CI-1		
EPDM: 806CQ, 807CQ		
Cast Iron: 806C, 806CT, 806CL, 806CLT, 806CI		

INSTALLATION

Meters are furnished for horizontal piping, left to right flow, unless otherwise specified. Use oil and gasoline resistant pipe compound on all threaded joints. Flow ports can be located in any of four positions for horizontal or vertical piping.

1. Determine direction of fluid flow.
2. Rotate meter so that counter points slightly down. This prevents parts from falling out when casting is separated.
3. Remove four screws (item 20) and meter housing (item 19).
4. Lift and rotate chamber assembly (item 26) so that chamber inlet points toward where the meter housing inlet will be.
5. Rotate meter housing (item 19) to desired position. Make sure chamber inlet is also pointing in the same direction.
6. Replace four screws (item 20).

ASSEMBLY/DISASSEMBLY

Meter consists of a chamber housing, measuring chamber, gear train, counter assembly and cover. Meter can be completely disassembled without disturbing piping, or meter can be partially disassembled as required.

Counter Assembly

For access to counter assembly, remove reset knob (item 3) by grasping edges and pulling firmly. Knob is held in place by a spring clip. Loosen two screws (item 29) and lift counterface (item 2) and cover (item 1) off. Remove two screws (item 13) to extract counter (item 4). Reassemble by reversing procedure.

Meter Chamber Assembly

To expose meter chamber assembly, tilt the meter at least slightly face down, so that no parts fall out when removing meter housing. Remove the four screws (item 20), then remove meter housing (item 19). Meter chamber assembly consists of upper and lower chambers, a nutating disc and seal gasket. Reassemble by reversing procedure.

If replacement of any components of the meter chamber assembly is required, the complete assembly must be replaced due to the precise method of its construction. This assures a proper fit and a correctly operating chamber.

Gear Train and Seal

To disassemble gear train and seal, remove gear frame (item 12) by prying slightly. Remove cluster gear (item 10) and washer (item 11) from shaft (item 9). Remove drive gear (item 8) and washers (item 7) by rotating and pulling drive gear. Remove O-ring seal (item 6).

When reassembling seal, lubricate O-ring liberally with oil or petroleum jelly and replace in cover. Place washer on drive gear shaft. Rotate and push shaft through O-ring and cover carefully to prevent damage to O-ring. Shaft must then be guided into pinion bevel (item 28) if counter has not been removed. Replace remaining parts to complete assembly by reversing disassembly procedure.

CALIBRATION

The Fill-Rite Series 800C meters can be calibrated for either U.S. gallons or liters. Calibration is required after disassembly, when metering a different fluid, or after significant wear. Depending on the model, Series 800C meters are calibrated at the factory, metering Stoddard solvent in either U.S. gallons or liters.

Meter calibration can be easily changed by following the calibration procedure listed below. A proving container or a container of KNOWN volume will be needed for the calibration procedure. It is recommended that the container's volume be at least five times larger than the unit of calibration. For example, a five gallon container should be used when calibrating for gallons.

Procedure for Calibration

1. Fill container to a known volume.
2. If indicated amount does not match known volume, insure pump is off and pressure relieved, then remove seal screw (item 23) and turn calibration screw (item 21) counterclockwise to reduce indicated amount or clockwise to increase the amount. A full turn will change the indicated amount by approximately 0.1 Gal. (0.4L). Reinstall seal screw
3. Repeat step 2 until calibration is acceptable.

OPERATING INSTRUCTIONS

For accurate measurement, meter and piping must always be filled with liquid and free of air. Meter should be calibrated per instructions in this manual prior to its use.

1. Reset meter to "0".
2. Meter is ready for use. Do not exceed 50PSI line pressure.

MAINTENANCE

Meter should operate maintenance free. However, certain liquids can dry out while in the meter housing, causing meter to stop. If this happens, meter should be thoroughly cleaned (see instructions below).

Cleaning Instructions

Run a flushing fluid through meter. For a more thorough cleaning, disassemble meter per "ASSEMBLY/ DISASSEMBLY" section, "Meter Chamber Assembly" subsection. Rinse all meter components. Recalibrate meter following calibration instructions above.

Storage

If meter is to be stored for a period of time, clean thoroughly. This will help protect meter from damage.

REPAIR

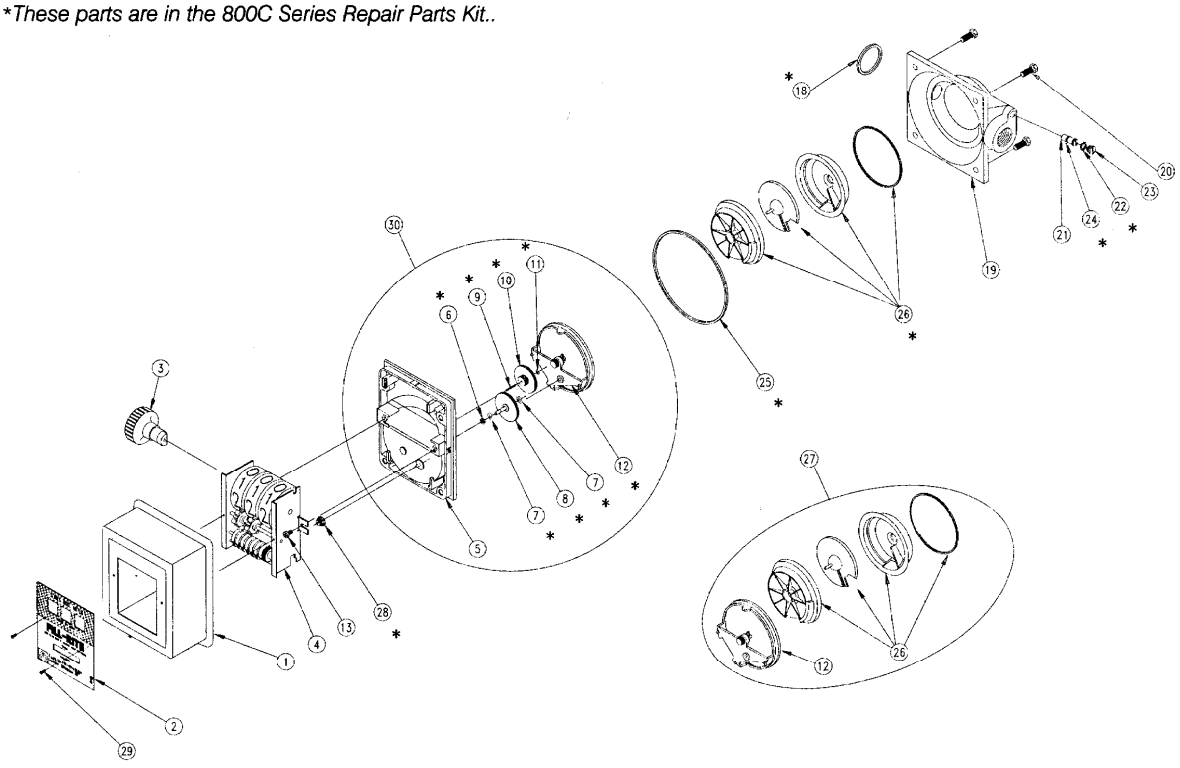
Meters needing repair should be taken to an authorized repair shop or returned to factory for service. Meters must be thoroughly triple-rinsed before being taken in for repair.

800C METER PARTS LIST

ITM. NO.	PART NO.	PROC. NO.	DESCRIPTION	QTY.
1	F4132	F4132	Counter Cover	1
2	800G0208	G0208	Counter Face, U.S.	1
	800G0241	G0241	Counter Face, Liter	
3	800-105A	F4261	Knob Assembly	1
4	800-85	F4080	Counter, U.S. Gallon	1
	800-85L	F4081	Counter, Liter	Opt.
5	800G2246	G2246	Meter Cover	1
	800G2247	G2247	Meter Cover, Nickel Plated	Opt.
	800G2248	G2248	Meter Cover, Teflon Coated	Opt.
*6	800-97V	F4191	O-ring (5-106), Viton	1
	800-191	F4033	O-ring (5-106), EPDM	Opt.
*7	800-55	F3980	Washer	2
*8	800-160A	F3845	Drive Gear (70T), U.S. Gallon	1
	800-162A	F3846	Drive Gear (84T), Liter	Opt.
	800-95	F4185	Drive Gear (73T), Imperial Gallon	Opt.
*9	800-16	F3820	Shaft, Cluster Gear	1
*10	800-159	F3841	Cluster Gear (22T/67T), U.S. Gallon	1
	800-161	F3843	Cluster Gear (10T/67T), Liter	Opt.
	800-23	F3541	Cluster Gear (19T/67T), Imperial Gallon	Opt.
*11	800-18	F3830	Washer	1
*12	800G2250	G2250	Gear Frame Assembly	1
13	F4007	F4007	#8-32 x 5/16 PHMS ACR II	2
*18	700-15	F2800	O-ring (-218), Buna-N (For 800A , 700A/B)	Opt.
	700-15V	F2801	O-ring (-218), Viton (For 800A, 700A/B)	Opt.
	700-15Q	G2601	O-ring (-218), EPDM (For 800A, 700A/B)	Opt.
19	800G2236	G2236	3/4 Inlet - 3/4 Outlet Housing	1
	800G2237	G2237	3/4 Inlet - 3/4 Outlet Hsg., Nickel Plated	Opt.
	800G2238	G2238	3/4 Inlet - 3/4 Outlet Hsg., Teflon Coated	Opt.
	800G2242	G2242	1 Inlet - 1 Outlet U.S. Housing	Opt.
	800G2243	G2243	1 Inlet - 1 Outlet U.S. Hsg., Nickel Plated	Opt.
	800G2244	G2244	1 Inlet - 1 Outlet U.S. Hsg., Teflon Coated	Opt.

ITM. NO.	PART NO.	PROC. NO.	DESCRIPTION	QTY.
	800G2255	G2255	1 Inlet - 1 Outlet BSP Housing	Opt.
	800G2256	G2256	1 Inlet - 1 Outlet BSP Hsg., Nickel Plated	Opt.
	800G2257	G2257	1 Inlet - 1 Outlet BSP Hsg., Teflon Coated	Opt.
20	700-16	F2810	5/16-18 x 7/8 HHCS	4
21	800-146A	F4463	Calibration Screw (Includes item 24)	1
*22	800-125V	F4449	O-ring (-012), Viton	1
	800-193	F3389	O-ring (-012), EPDM	Opt.
23	800-124	F4440	Seal Screw	1
*24	800-68V	F4036	O-ring (-008), Viton	1
	800-192	F4034	O-ring (-008), EPDM	Opt.
*25	800-65	F4010	O-ring (-156), Buna-N	1
	800-65V	F4011	O-ring (-156), Viton	Opt.
	800-194	F4032	O-ring (-156), EPDM	Opt.
*26	800G2262	G2262	Meter Chamber Assembly, Buna-N	1
	800G2599	G2599	Meter Chamber Assembly, Viton	Opt.
	800G2600	G2600	Meter Chamber Assembly, EPDM	Opt.
27	800G2531	G2531	Meter Chamber Assembly, Buna-N (Includes items 12 & 26)	1
*28	800-172	F3959	Pinion Bevel	1
29	800F2221	F2221	#4-40 x 3/8 Phillips Pan Head, Type F, SS	2
30	800G2532	G2532	Cover Assy., U.S. Gallon	1
	800G2533	G2533	Cover Assy., U.S. Gallon, Nickel Plated	Opt.
	800G2534	G2534	Cover Assy., U.S. Gallon, Teflon Coated	Opt.
	800G2535	G2535	Cover Assy., Liter	Opt
	800G2536	G2536	Cover Assy., Liter, Nickel Plated	Opt.
	800G2537	G2537	Cover Assy., Liter, Teflon Coated	Opt.
	800G2544	G2544	Cover Assy., Imperial Gallon	Opt.
	800G2765	G2765	Cover Assy., U.S. with EPDM Seal	Opt.
	800G2778	G2778	Cover Assy., U.S., Nickel with EPDM Seal	Opt.
	800G2900	G2900	Cover Assy., Liter with EPDM Seal	Opt.

**These parts are in the 800C Series Repair Parts Kit..*



800B/800C SERIES REPAIR PARTS KITS

PART NO.	PROC. NO.	DESCRIPTION
800-RKU	G2540	Repair Kit, U.S. Gallon (Standard Seals) (Includes items 6-12, 18, 22, 24-26, 28)
800-RKUV	G2541	Repair Kit, U.S. Gallon (Viton Seals) (Includes items 6-12, 18, 22, 24-26, 28)
800-RKL	G2542	Repair Kit, Liter (Standard Seals) (Includes items 6-12, 18, 22, 24-26, 28)
800-RKLV	G2543	Repair Kit, Liter (Viton Seals) (Includes items 6-12, 18, 22, 24-26, 28)
800-RKIV	G2572	Repair Kit, Imperial Gallon (Viton Seals) (Includes items 6-12, 18, 22, 24-26, 28)
800-RKUQ	G2579	Repair Kit, U.S. Gallon, (EPDM Seals) (Includes items 6-12, 18, 22, 24-26, 28)

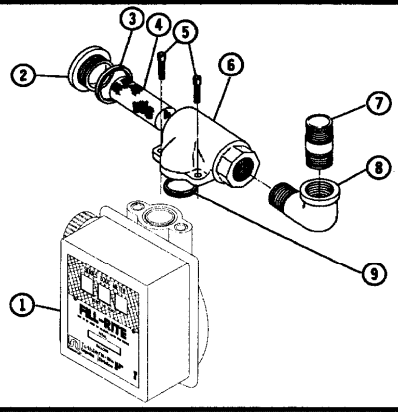
WHEN ORDERING REPAIR PARTS, BE SURE TO GIVE REPLACEMENT PART NUMBER, DATE OF MANUFACTURE AND METER SERIES NUMBER. THIS WILL ENSURE THAT THE CORRECT REPLACEMENT PART IS SUPPLIED.

800B TO 800C CONVERSION KIT

PART NO.	PROC. NO.	DESCRIPTION
800F4134	F4134	Conversion Kit Includes items 1, 2, & 29

NOTE: OTHER REPAIR AND STRAINER KITS AVAILABLE UPON REQUEST.

800C SERIES STRAINER KIT



ITM. NO.	PART NO.	PROC. NO.	DESCRIPTION	QTY.
1	800G1325	G1325	806C, 1", U.S. Gallon	1
	800G2727	G2727	806C, 1", U.S. Gallon, Nickel Plated	Opt.
	800G1387	G1387	806C, 1", U.S. Gallon, Teflon Coated	Opt.
	800G1998	G1998	806C, 1" BSP, Liters	Opt.
	800G2705	G2705	806C, 1" BSP, Liters, Nickel Plated	Opt.
	800G1440	G1440	806C, 1" BSP, Liters, Teflon Coated	Opt.
2	800-114	F4360	Cover	1
	800-114N	F4362	Cover, Nickel Plated	Opt.
	800-114T	F4361	Cover, Teflon Coated	Opt.
3	800-115	F4380	O-Ring (-131), Buna-N	1
	800-115V	F4381	O-Ring (-131), Viton	Opt.
4	800-113	F4350	Screen	1
5	800-110	F4320	5/16-18 x 7/8 SHCS	2
6	800-112	F4340	Strainer Housing	1
	800-112N	F4343	Strainer Housing, Nickel Plated	Opt.
	800-112T	F4342	Strainer Housing, Teflon Coated	Opt.
	800-112 BSP	F4337	Strainer Housing, BSP Threads	Opt.
	800-112T BSP	F4339	Strainer Housing, BSP Threads, Teflon	Opt.
	800-112N BSP	F4338	Strainer Housing, BSP Threads, Nickel	Opt.
7	800-118	F4390	1 x 2 Pipe Nipple	1
8	800-119	F4400	1" Street Elbow	1
9	700-15	F2800	O-Ring (-218)	1
	700-15V	F2801	O-Ring (-218), Viton	Opt.
	TH-18	F7105	Strainer Kit, 1", U.S. (Includes items 2-6, 9)	
	TH-18T	F7104	Strainer Kit, 1", U.S., Teflon Ctd. (items 2-9)	
	TH-18-X418	F7107	Strainer Kit, 1" BSP (Includes items 2-6, 9)	
	TH-18T-X418	F7111	Strainer Kit, 1" BSP, Teflon Ctd. (items 2-6, 9)	

TROUBLESHOOTING GUIDE

PROBLEM	POSSIBLE CAUSE	SOLUTION
Counter reading high or low	•Calibration off •Air in product •Measuring chamber or gears sticking	•Recalibrate meter. •Find and repair air leaks in system. •Clean or replace internal metering components.
Shaft seal leakage	•Dirty seal •Bad seal	•Clean O-ring seal and seat area. •Replace seal.
Gasket leakage	•Loose joints •Dirty gasket •Bad gasket	•Tighten joints. •Clean gasket and seat area. •Replace gasket.
Low capacity	•Clogged meter chamber •Clogged screen (806C)	•Clean meter chamber. •Clean screen.
Meter body cracks	•High pressure	•Install pressure relief valve to allow bleed back to tank.
Nutating disc breaks	•Flow surge	•Put shut-off valve on outlet of meter •Place meter as close as possible to pump

Fill-Rite: A Worldwide Reputation for Reliability.

For over 40 years, people all over the world who have needed tough, dependable pumps have insisted on Fill-Rite products. For them, Fill-Rite has been "the reliable red pump" that keeps on working even under the toughest of conditions. We're proud of the reputation our hand pumps, DC and AC pumps and meters have earned. Today they're only a part of the rapidly expanding Fill-Rite line.

Applying the Science of Fluid Transfer.

An active research and development program is the centerpiece of our ongoing commitment to respond to new fluid transfer opportunities. This has led to new products and to new technologies and new facilities to produce these products.

To bring this advanced technology to market, we have invested in precision engineering and testing equipment. This improves our ability to produce fluid handling equipment that meets market demands for quality, performance and price.

A Hard Working Support Network.

Just as important as these capabilities are the people behind them - our design and production personnel. They give you the ability to specify systems that meet the most challenging of applications. With them, you can be assured of prompt, intelligent answers to your fluid transfer questions.

To service customers in the field, we've put together a select, well-monitored team of distributors. Throughout the world, they are ready to help you with technical advice, ordering and delivery.

Fill-Rite will always stand for reliable red pumps and fluid handling equipment. We'll continue to develop new products and production techniques to keep pace with ever changing technologies. Each of our products will always be made with the same care and quality that made our pumps famous.

PRODUCT WARRANTY

Fill-Rite Division of Tuthill Corporation (Manufacturer) warrants to each buyer of its products (the Buyer) for a period of 12 months from date of installation **but in no event more than 18 months from date of manufacture** that goods **of its manufacture** (Goods) will be free from defects of material and workmanship. Manufacturer's sole obligation under the foregoing warranties will be limited to either, at Manufacturer's option, replacing or repairing defective Goods (subject to limitations hereinafter provided) or refunding the purchase price for such Goods theretofore paid by the Buyer, and Buyer's exclusive remedy for breach of any such warranties will be enforcement of such obligations of Manufacturer. If Manufacturer so requests the return of the Goods, the Goods will be redelivered to Manufacturer in accordance with Manufacturer's instructions F.O.B. Factory. If Manufacturer elects to repair defective Goods and written notice of defects is given to Manufacturer during the warranty period specified above **and within 90 days from date of installation,** then Manufacturer will provide at its cost the services of an authorized representative for on-site repair of defective Goods. If such notice shall be given **after such 90 days** all service costs incurred in the repair or replacement of defective Goods shall be the responsibility of the Buyer. The remedies contained herein shall constitute the sole recourse of the Buyer against Manufacturer for breach of warranty. IN NO EVENT SHALL MANUFACTURER BE LIABLE FOR CONSEQUENTIAL DAMAGES NOR SHALL MANUFACTURER'S LIABILITY ON ANY CLAIM FOR DAMAGES ARISING OUT OF THE MANUFACTURE, SALE, DELIVERY OR USE OF THE GOODS EXCEED THE PURCHASE PRICE OF THE GOODS.

The foregoing warranties will not extend to Goods subjected to misuse, neglect, accident or improper installation or maintenance or which have been altered or repaired by anyone other than Manufacturer or its authorized representative.

THE FOREGOING WARRANTIES ARE EXCLUSIVE AND IN LIEU OF ALL OTHER WARRANTIES OF MERCHANTABILITY, FITNESS FOR PURPOSE AND OF ANY OTHER TYPE, WHETHER EXPRESS OR IMPLIED.

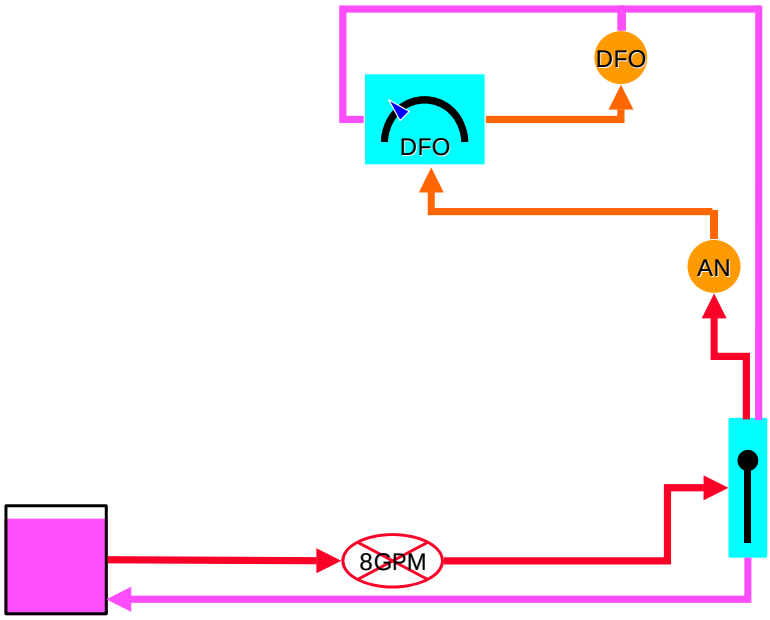
No person may vary the foregoing warranties and remedies except in writing signed by a duly authorized officer of Manufacturer. Warranties or remedies that differ from the foregoing shall not otherwise be binding on Manufacturer. The Buyer's acceptance of delivery of the Goods constitutes acceptance of the foregoing warranties and remedies, and all conditions and limitations thereof.

FILL-RITE

TUTHILL CORPORATION | Fill-Rite Division
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Fort Wayne, Indiana USA 46809
Tel 219 747-7524 Fax 219 747-3159

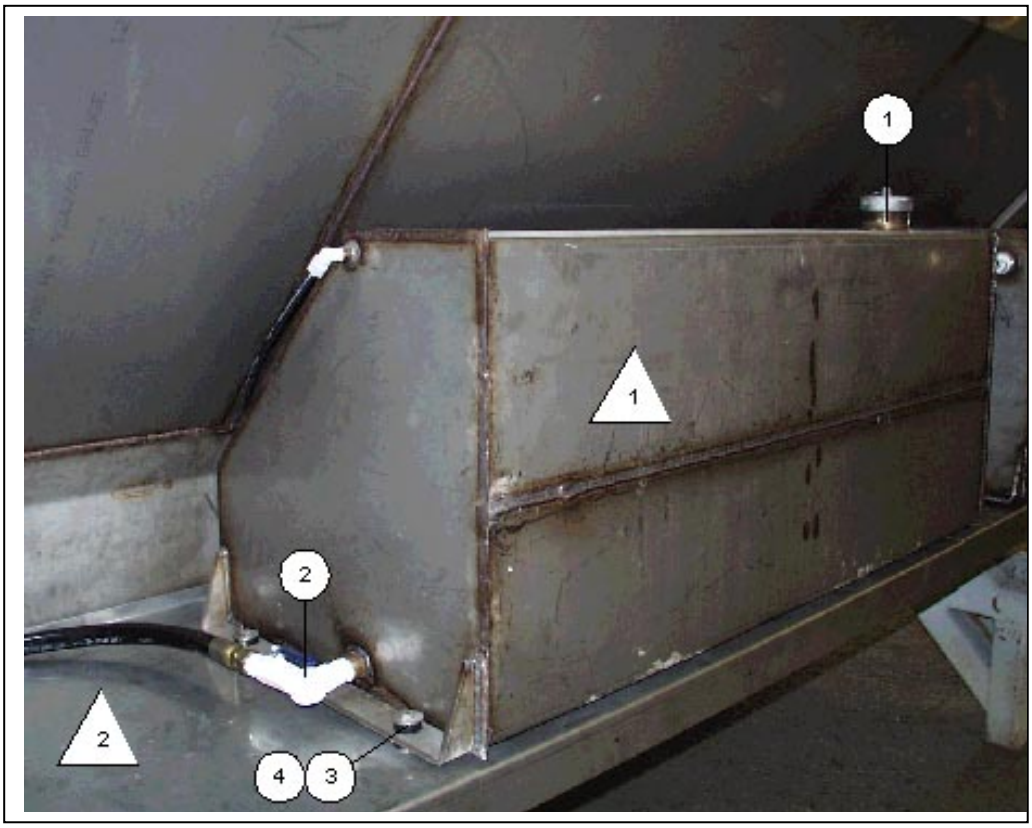
F9146 REV. 5

Fuel Oiling System Circuit



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TANK-FENDER



TANK SIZES AND TYPE MAY VARY, DEPENDING ON YOUR CONFIGURATION.

ITEM	QTY	PART NO.	DESCRIPTION
1	1	240.0901	CAP PIPE AL FUSIBLE 3” FNPT
2	1	264.3106	VALVE BALL ST .75
3	4	247.2202	MOUNT ISOLATION .50” X 380 LB PUR/WHT
4	8	247.2212	WASHER REBOUND .50 ISOLATOR

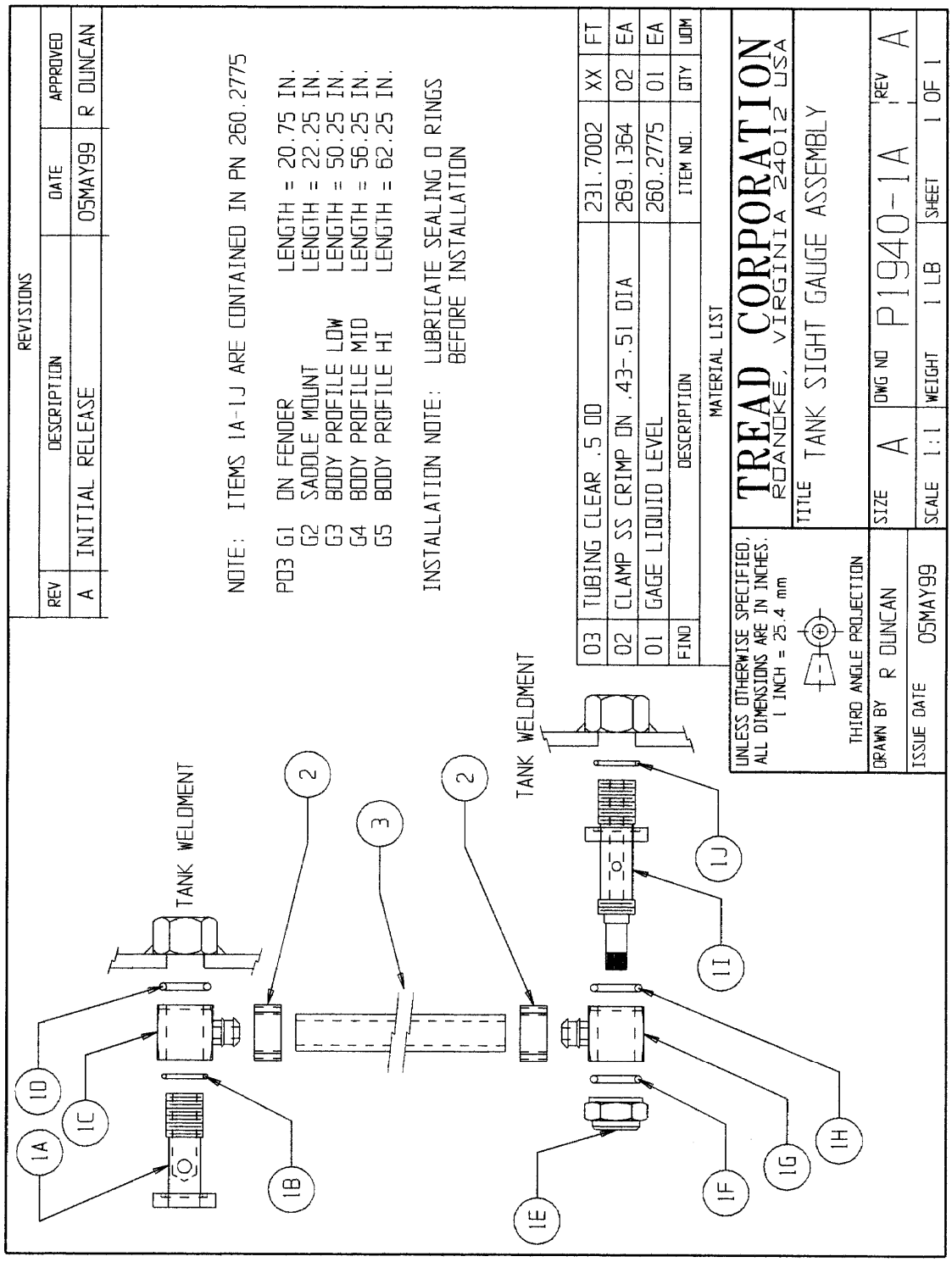
TANK-BODY PROFILE



TANK SIZES AND TYPE MAY VARY, DEPENDING ON YOUR CONFIGURATION.
THE FOLLOWING PARTS ARE NOT VISIBLE

ITEM	QTY	PART NO.	DESCRIPTION
1	1	240.0901	CAP PIPE AL FUSIBLE 3” FNPT (NOT SHOWN)
2	1	239.2237	TANK END COVER 6" SS WITH 3/8" BOLT

TANK SIGHT GAUGE ASSEMBLY



8/30/00

TC-6-SS INSTALLATION INSTRUCTIONS

1. Check opening to make sure both sides of hole are clean and in good condition.

2. Loosen bolt until it is flush with the back cover.

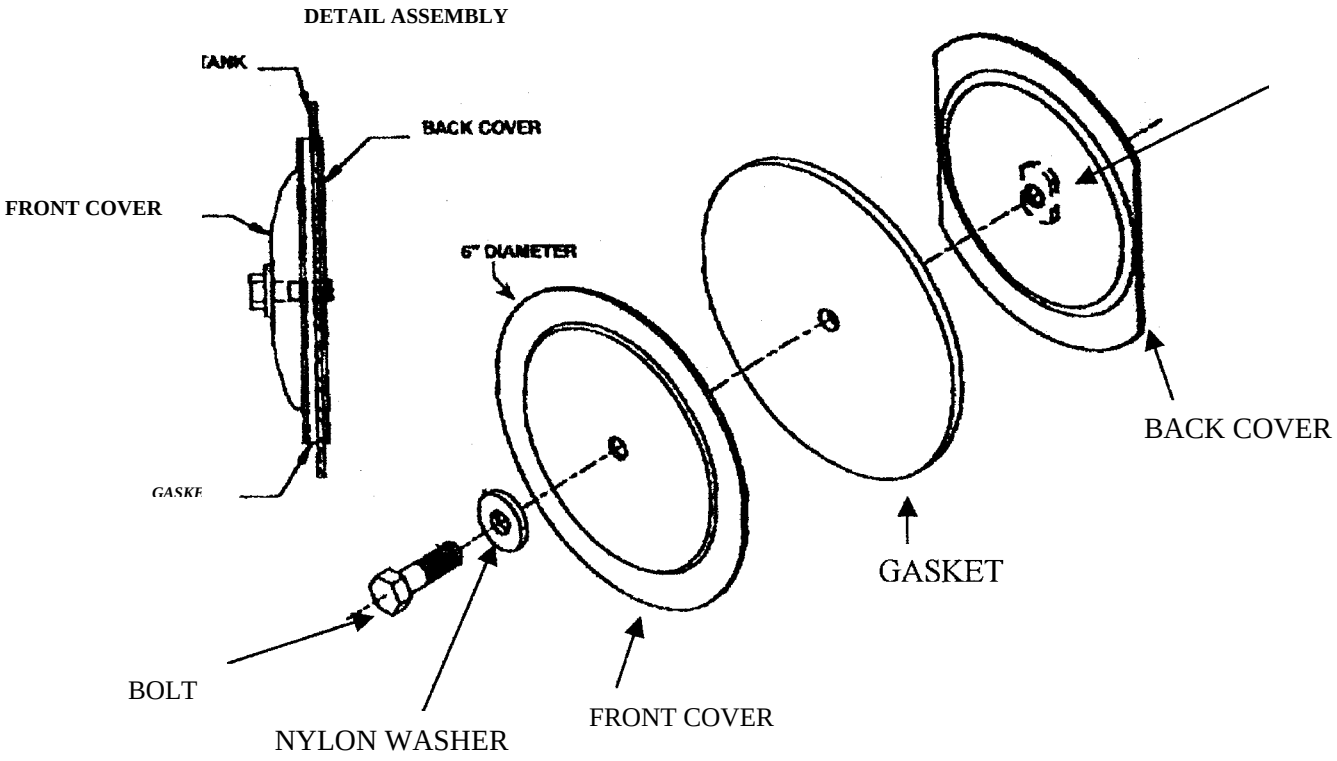
3. Slide back cover in the opening making sure the gasket is on the outside of the tank and is visible all the way around the cover plate.

4. Check to make sure the tank cover is centered in the hole.

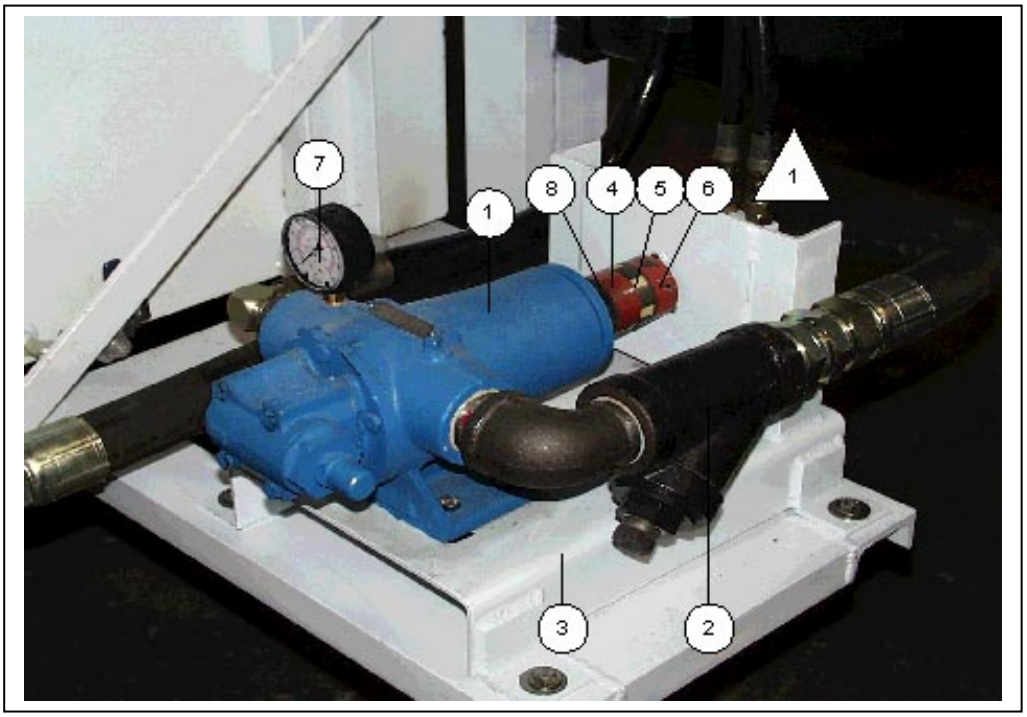
5. Using a torque wrench begin to tighten the bolt to about 5 ft/lbs you should see the cover plate start to pull in at the bolt this should happen between 5-7ft/lbs. 6.

6. This completes the installation.

Note: See diagram below for detail assembly. Threaded tab faces inside of tank



VIKING PUMP ASSEMBLY
STANDARD DELIVERY



1-FOR HYDRAULIC MOTOR SIZE AND TYPE REFERENCE HYDRAULIC SCHEMATIC.
286.0504 COUPLING GUARD IS NOT SHOWN.
STANDARD DELIVERY USES ¾" PIPING.
ORAFICE SIZE IS 11/64" INJECTORS.

ITEM	QTY	PART NO.	DESCRIPTION
1	1	241.0002	PUMP VIKING HL4195
2	1	271.0081	STRAINER Y .75" FNPT
3	1	287.0175	PUMP MOUNT VIKING FENDER MS
4	1	247.1370	COUPLING L095 X .75
5	1	247.1369	SPYDER L095 HYTREL
6	1	247.1371	COUPLING L095 X 1
7	1	260.7021	GAUGE 2" 160 PSI .25 MNPT BOTTOM CONN
8	1"	247.0953	KEYSTOCK .1875 SQUARE

Maintenance Schedule-Fuel Oil System

Action	Daily	Weekly	Monthly	Annually
Check sight gauge	X			
Check operation of all ball valves	X			
Check general condition of hose	X			
Check pressure gauge	X			
Check oil tank mounting bolts		X		
Check injection ports for seepage		X		
Replace fuel oil filter			X	
Check injection ports for wear				X

Viking Rotary Pump HD 4195

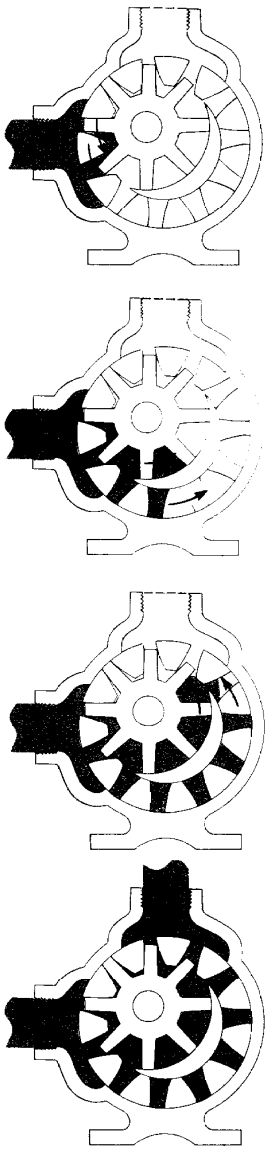
THE VIKING PRINCIPLE

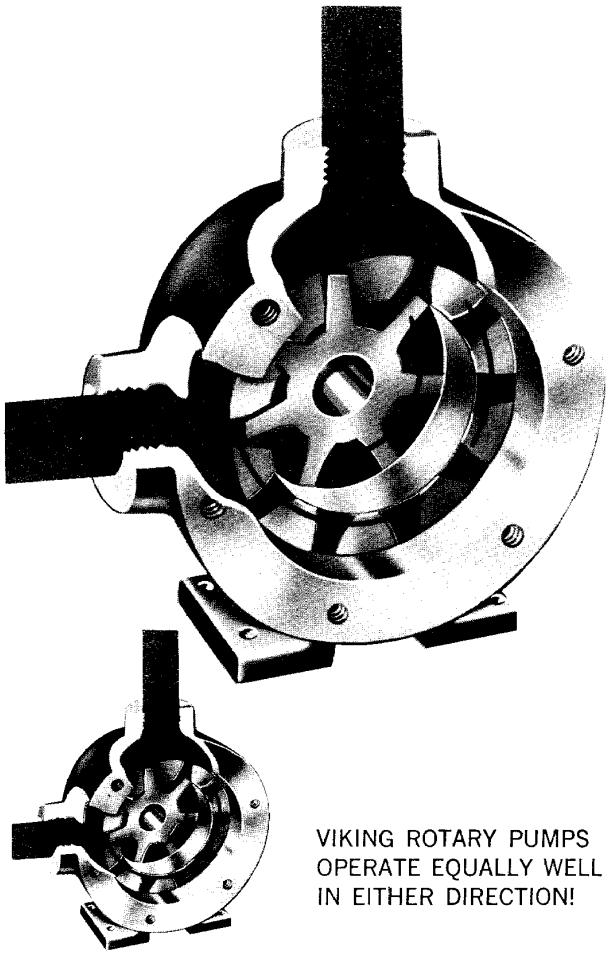
1 The colored portion at right indicates the liquid as it enters the suction port area of the casing and the area between the rotor teeth and corresponding concave area between the idler teeth. The two black arrows indicate the pump rotation and progress of the liquid.

2 Notice the progress of the liquid through the pump and between the teeth of the "gear-within-a-gear" principle. Also note how the crescent shape on the head divides the liquid and acts as a seal between the suction and discharge ports.

3 This illustration shows the pump in a nearly flooded condition just previous to the liquid being forced into the discharge port area. Notice how the gear design of the idler and rotor form locked pockets for the liquid so as to guarantee absolute volume control.

4 This view shows the pump in a completely flooded condition and in the process of discharging the liquid through the discharge port. The rotor and idler teeth mesh, forming a seal equi-distant between the discharge and suction ports, forcing liquid out the discharge port.





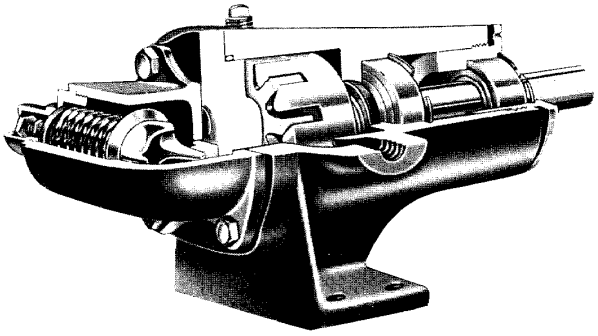
VIKING ROTARY PUMPS OPERATE EQUALLY WELL IN EITHER DIRECTION!

Viking's famous "gear-within-a-gear" principle has only two moving parts. It is the secret of dependable efficient operation of all positive displacement Viking rotary pumps. Positive displacement of liquid is accomplished by the meshing of rotor and idler gear teeth and the use of close running clearances.

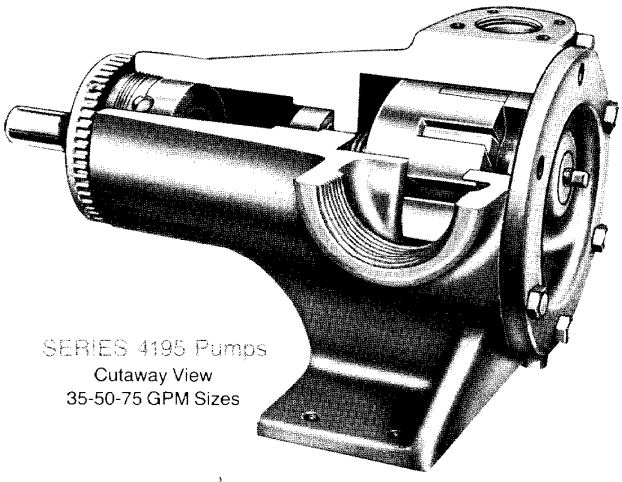
With every revolution of the pump shaft a definite amount of liquid is drawn into the pump through the suction port. This liquid fills the spaces between the teeth of the rotor and the idler. The crescent shape on the pump head splits the flow of liquid as it is moved smoothly toward the discharge port.

The rotor, supported and driven by the pump shaft, carries liquid between its teeth, the casing and the outside surface of the crescent. The idler, supported on the idler pin projecting from the pump head, carries liquid between its teeth and the inside surface of the crescent. The four schematic drawings at left show a graphic illustration of flow through the pump.

FEATURES

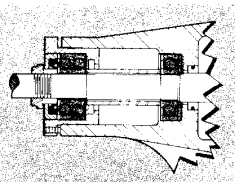


SERIES 4195 Pumps
Cutaway View
10-20-30 GPM Sizes

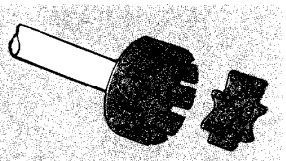


SERIES 4195 Pumps
Cutaway View
35-50-75 GPM Sizes

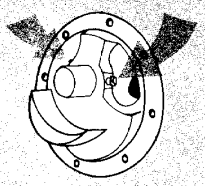
①Pressure Range	250 PSI for 100 SSU and above 150 PSI for 38 to 100 SSU 100 PSI for below 38 SSU
①Temperature Range	– 40° F. to + 350° F.
①Viscosity Range	0.1 cP to 15,000 SSU



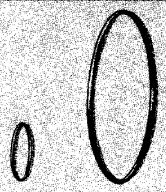
BALL BEARINGS
(Standard Equipment)
Pumps are equipped with inner casing ball bearing installed outside of mechanical seal and a radial thrust ball bearing permitting heavy-duty service up to 250 PSI.



DUCTILE IRON PARTS
(Standard Equipment)
("AS", "AK", "AL" Sizes)
Internal pumping gears (rotor and idler) are constructed of ductile iron for added strength in handling all types of liquids up to 15,000 SSU. "HL" size rotor also furnished in ductile iron.



PRESSURE LUBRICATION
(Standard Equipment)
("AS", "AK", "AL" Sizes)
A patented pressure lubrication system automatically lubricates the idler bushing. This system provides a constant film of liquid between the idler bushing and idler pin at a pressure equal to the pump discharge pressure regardless of pump rotation.



O-RING GASKETS
(Standard Equipment)
O-Ring gaskets are used between casing and head plate and between casing and relief valve or valve plates. Flat asbestos valve gaskets furnished on "GG", "HJ" and "HL" size pumps. These gaskets provide a positive seal eliminating a chance for leakage at these points.

GPM 10-20-30-35-50-75

②(Nominal Rating)

Viking's high-speed, heavy-duty Series 4195 pumps are available in capacities of 10, 20, 30, 35, 50 and 75 GPM. The three smaller size pumps can be furnished directly connected to either 1800 or 1200 RPM motors. The three larger sizes directly connected to 1200 RPM motors. (See Series 4195D units shown on page 144.5.) All six sizes of Viking Series 4195 pumps are furnished with Roto-Ring mechanical seals. This seal is a simple self-adjusting, non-leak method of shaft sealing located ahead of the casing ball bearing. The Series 4195 pumps are built for continuous or intermittent duty for such applications as filtering, circulating, transferring, or booster service in general industrial, petroleum and marine uses. NOTE: "UL" listed pumps for handling flammable liquids require special construction. (Ductile Iron Casing on "AS", "AK" and "AL" sizes). See Catalog Section 440 for details and pricing information. Model numbers for these pumps must be designated by a suffix -F, eg. GG4195-F or when used with a "D" drive, GG4195D-F. "UL" listed models **must** be equipped with either an internal or return-to-tank safety relief valve. Maximum discharge pressure for "UL" listed models is 125 PSIG.

① Values shown represent minimums or maximums. Some special construction or consideration may be required before a catalogued pump can be applied to an application involving maximum pressure or minimum or maximum temperature and/or viscosity. Certain models have restrictions in pressures and/or viscosities. See specifications, page 144.4, and performance curves.

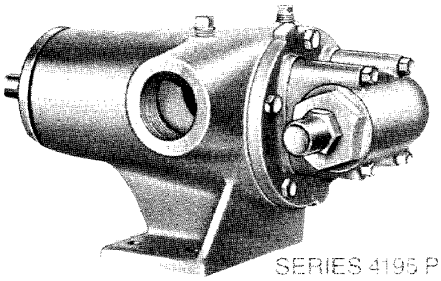
② Nominal capacities based on handling thin liquids at 1800 RPM on three small sizes, 1200 RPM on three large sizes.

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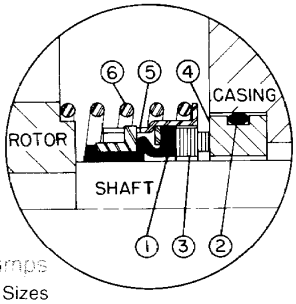
SERIES 4195

STANDARD CONSTRUCTION

UNMOUNTED PUMPS

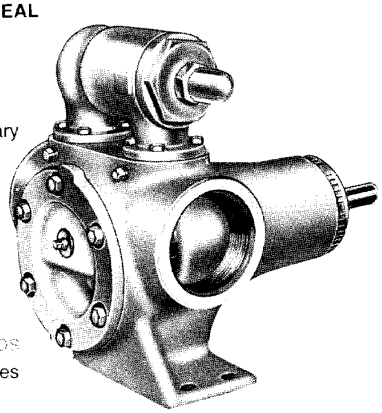


SERIES 4195 Pumps
"GG", "HJ" and "HL" Sizes



MECHANICAL SEAL

① Buna-N bellows.
② Buna-N O-ring.
③ Carbon rotating face (washer)
④ Ni-Resist stationary seat.
⑤ Steel metal parts.
⑥ Stainless steel spring.



SERIES 4195 Pumps
"AS", "AK" and "AL" Sizes

In addition to the famous features listed on the previous page, Series 4195 heavy-duty pumps are furnished with an integral relief valve as shown in the pump photos above. Return-to-tank valves are also available on all models on request. Note: On the "GG", "HJ" and "HL" sizes, the valve mounts on the pump head. The "AS", "AK" and "AL" size value mounts on top of the pump casing. All sizes equipped with Buna-N mechanical seal with carbon rotating and Ni-Resist stationary faces.

For Optional Seal Construction—See Section 630.
Dimensions for Unmounted Pumps—See Page 144.8.
Performance Data for Unmounted Pumps—See Pages 144.13 through 144.26.

CONSTRUCTION—SERIES ①4195 ("GG" THROUGH "AL" SIZES)

Standard Construction Models	Casing	Head	Rotor	Idler	Rotor Shaft and Idler Pin	Idler Bushing	Internal Safety Relief Valve
GG4195 HJ4195	Iron	Iron	②Iron	③Iron	Steel	Carbon Graphite	Iron
HL4195	Iron	Iron	Ductile Iron	Iron	Steel	Carbon Graphite	Iron
AS4195 AK4195 AL4195	Iron	Iron	Ductile Iron	Ductile Iron	Steel	Carbon Graphite	Iron

SPECIFICATIONS—UNMOUNTED PUMPS

Model Numbers	Port Size	④ Nominal Pump Rating		Motor Horsepower Required At Rated Speed Pumping 100 SSU Liquid		Maximum Hydro-static Pressure	⑦ Maximum Pump Discharge Pressure	① Maximum Temperature	⑤ Steel Fitted Construction Recommended Above This Viscosity	Approximate Shipping Weight With Valve (Less Power)
Unmounted Pump	Inches	GPM	RPM	50 PSI	100 PSI	PSIG	PSIG	Degrees F.	SSU	Pounds
GG4195	1	10 7	1800 1200	¾ ½	1 ¾	400	100—below 38 SSU 150—38 to 100 SSU 250—above 100 SSU	225	7500	20
HJ4195	1½	20 13	1800 1200	1½ 1	2 1½	400	100—below 38 SSU 150—38 to 100 SSU 250—above 100 SSU	225	7500	44
HL4195	1½	30 20	1800 1200	2 1½	3 2	400	100—below 38 SSU 150—38 to 100 SSU 250—above 100 SSU	225	⑥	44
AS4195	2½	35	1200	2	3	400	100—below 38 SSU 150—38 to 100 SSU 250—above 100 SSU	225	⑥	85
AK4195	2½	50	1200	3	5	400	100—below 38 SSU 150—38 to 100 SSU 250—above 100 SSU	225	⑥	85
AL4195	3	75	1200	5	7½	400	100—below 38 SSU 150—38 to 100 SSU 250—above 100 SSU	225	⑥	86

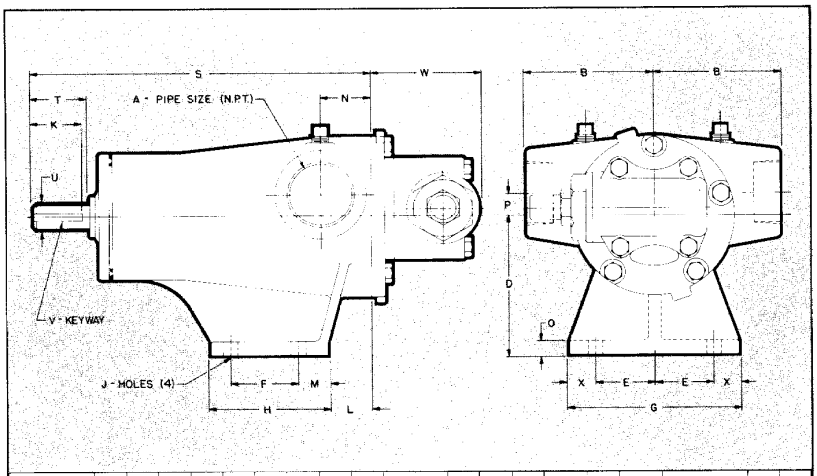
① Standard Buna-N seal from—20°F. to +225°F. With special construction, temperatures from −40°F. to +350°F. can be handled with this series.
② When steel fitted construction is required, "GG" will have steel rotor, "HJ" will have ductile iron rotor.
③ "GG" size has steel idler.
④ Nominal capacities based on handling thin liquids at 1800 RPM on three small sizes, 1200 RPM on three large sizes.
⑤ For viscosities above 15,000 SSU, provide details for recommendations.
⑥ These models have ductile iron rotors; steel fitted rotors not necessary.
⑦ If suction pressure exceeds 100 PSIG, consult factory.

DIMENSIONS

These dimensions are average and not for construction purposes. Certified prints on request.

For specifications, see page 144.4.

DIMENSIONS— SERIES 4195 UNMOUNTED PUMPS "GG"—"HJ"—"HL" SIZES

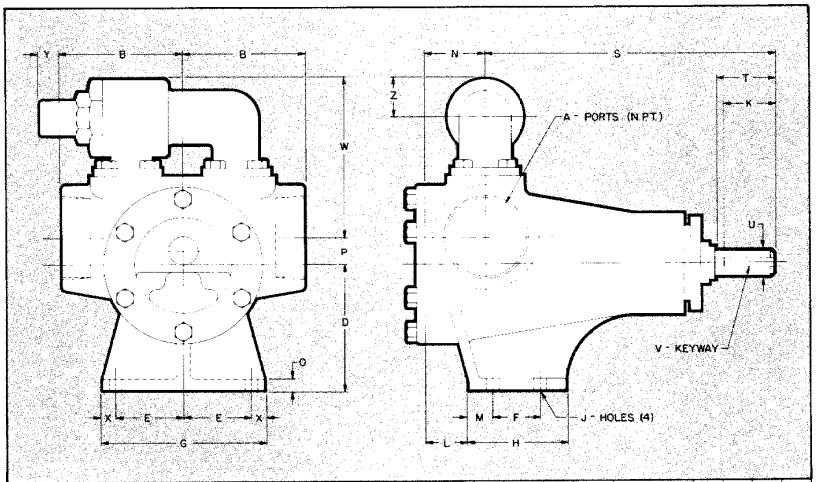


MODEL NO.	A	B	D	E	F	G	H	J	K	L	M	N	O	P	S	T	U	V	W	X
GG4195	1	2.75	2.75	1.62	1.31	4.00	2.44	.34	.94	.03	.66	1.12	.31	.62	7.31	1.12	.500	FLAT	2.66	.38
		70	70	41	33	102	62	9	24	1	17	29	8	16	186	29	12.70		67	10
HJ4195	1½	3.75	4.12	1.75	2.00	5.00	3.50	.41	1.50	1.25	.88	1.50	.44	.62	10.00	1.62	.750	.19 X .09	3.28	.75
		95	105	44	51	127	89	10	38	32	22	38	11	16	254	41	19.05	4.76 X 2.38	83	19
HL4195	1½	3.75	4.12	1.75	2.00	5.00	3.50	.41	1.50	1.25	.88	1.50	.44	.62	10.00	1.62	.750	.19 X .09	3.28	.75
		95	105	44	51	127	89	10	38	32	22	38	11	16	254	41	19.05	4.76 X 2.38	83	19

NOTE: Dimensions shown in grey area are millimeters, others are inches.

For specifications, see page 144.4.

DIMENSIONS— SERIES 4195 UNMOUNTED PUMPS "AS"—"AK"—"AL" SIZES



MODEL NO.	A	B	D	E	F	G	H	J	K	L	M	N	O	P	S	T	U	V	W	X	Y	Z
AS4195	2½	5.00	5.25	2.88	2.00	6.75	4.00	.41	2.25	1.25	1.00	2.00	.44	1.12	12.12	2.38	1.000	.25 X .12	7.00	.50	1.00	1.56
		127	133	73	51	171	102	10	57	32	25	51	11	29	308	60	25.40	6.35 X 3.18	178	13	25	40
AK4195	2½	5.00	5.25	2.88	2.00	6.75	4.00	.41	2.25	1.25	.00	2.00	.44	1.12	12.12	2.38	1.000	.25 X .12	7.00	.50	1.00	1.56
		127	133	73	51	171	102	10	57	32	25	51	11	29	308	60	25.40	6.35 X 3.18	178	13	25	40
AL4195	3	5.00	5.25	2.88	2.00	6.75	4.00	.41	2.25	1.75	1.00	2.50	.44	1.12	12.12	2.38	1.000	.25 X .12	7.00	.50	1.00	1.56
		127	133	73	51	171	102	10	57	44	25	64	11	29	308	60	25.40	6.35 X 3.18	178	13	25	40

NOTE: Dimensions shown in grey area are millimeters, others are inches.

NOTE: AS, AK & AL 4195 Series Pumps can be operated at speeds up to 1,750 RPM at viscosities less than 1,000 SSU. The NPSH required at 1,750 RPM is 23.3 ft. and noise levels will be elevated.

PERFORMANCE CURVE NOTES

INLET CONDITIONS: The performance curves show "Based on 10 (or 15) In.-Hg." which is Viking's standard test condition. This is not the maximum vacuum capability of the pump.

NPSH (Net Positive Suction Head): The $NPSH_R$ (Net Positive Suction Head—Required by the pump) is given in the table below and applies for viscosities through 750 SSU. $NPSH_A$ (Net Positive Suction Head—Available in the system) must be greater than $NPSH_R$.

$NPSH_R$—FEET OF LIQUID (SP. GR. 1.0), Viscosities to 750 SSU

Pump Size	PUMP SPEED, RPM					
	540	760	950	1150	1450	1750
GG	2.2	2.6	3.1	3.9	5.6	7.6
HJ, HL	2.8	3.4	4.5	6.2	9.5	13.5
AS, AK, AL	3.9	5.5	7.7	11.2	—	—

For a complete explanation of NPSH, see Viking Application Data Sheet, AD-19.

METRIC CONVERSION: The following table has been compiled for conversion to metric values.

FOR VISCOSITIES ABOVE 750 SSU ($NPSH_R$ data not available): The performance curves are based on 15 In.-Hg. While vacuums up to 20 In.-Hg. will not generally result in any loss of capacity, it is recommended that the suction line size and possibly the pump port size be increased to hold the expected vacuum to 15 In.-Hg. or less. Vacuum above 20 In.-Hg. should be avoided. (Refer to Viking's General Catalog, Engineering Section 510, and Engineering Service Bulletin ESB-56 for information helpful in determining suction line size.)

THIN LIQUIDS: The 28 SSU curves should be used when applying the Series 4195 and 495 pumps to such liquids as alcohols, solvents, etc.

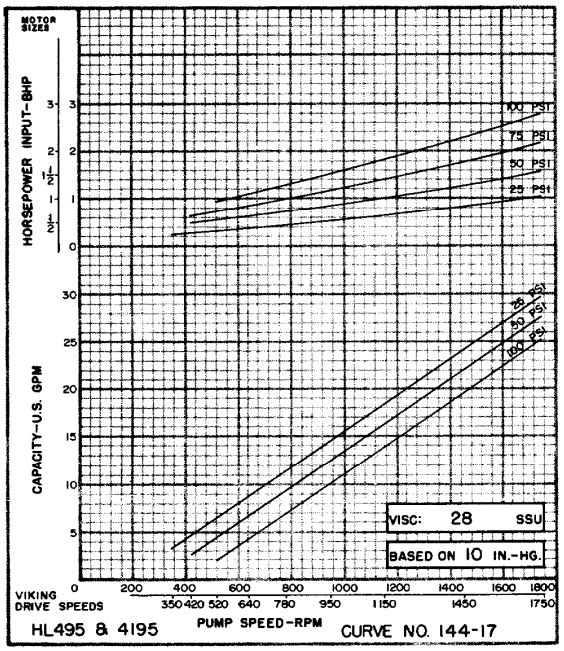
***VISCOUS LIQUIDS:** Pump should not operate longer than 15 minutes of each operating cycle at 25,000 SSU and above. If continuous duty is desired, the mechanical seal should be changed to a positive-drive type seal. This recommendation applies to the "GG", "HJ" and "HL" sizes only.

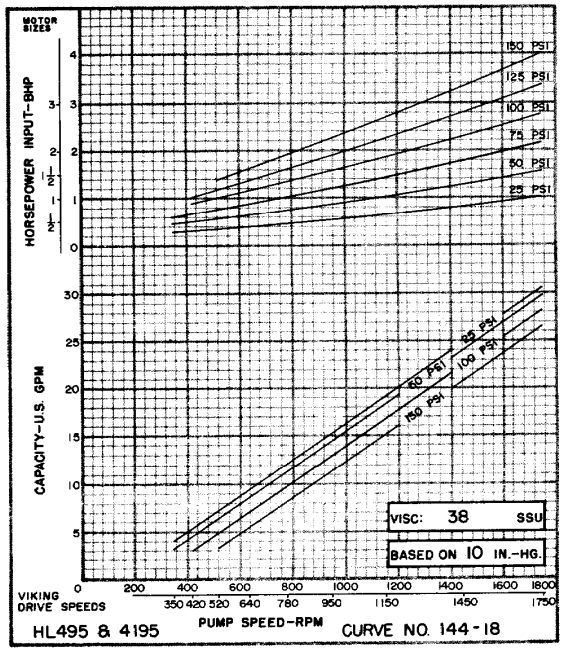
MECHANICAL EFFICIENCY: The Mechanical Efficiency (expressed in per cent) can be calculated using the following formula:

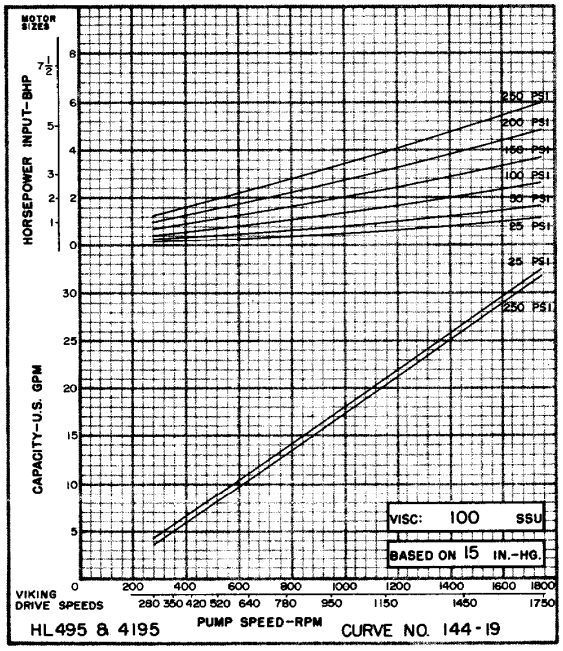
$$\text{Mechanical Efficiency} = \frac{(\text{Differential Pressure, PSI})\,(\text{Capacity, GPM})\,(100)}{(\text{Horsepower, BHP})\,(1715)}$$

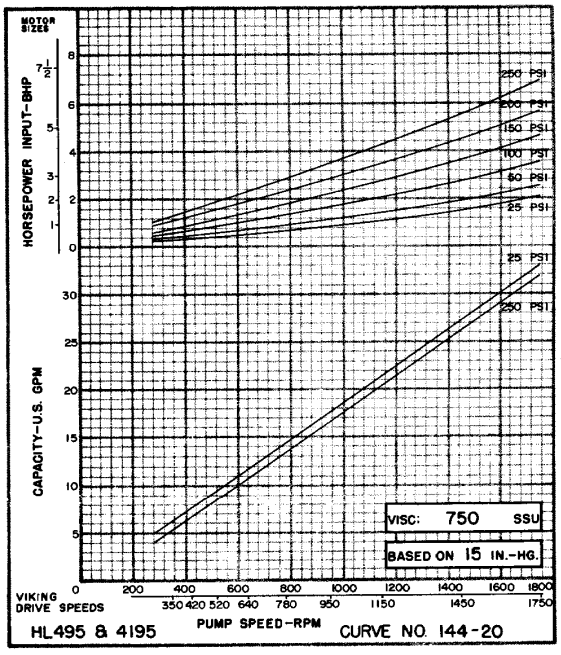
Vacuum		Pressure		Capacity	
In.-Hg. (Inches-Mercury)	kPa* (Kilopascal)	PSI ($lbf/in.^2$)	kPa* (Kilopascal)	GPM (Gal./min.)	L/min (Litre/min.)
1	3.4	1	6.9	1	3.8
5	17	25	172	0.26	1
10	34	50	345		
15	51	100	690		
20	68	150	1034		
25	85	200	1379		
		250	1724		

*100 kPa = 1 bar


MOTOR SIZES
HORSEPOWER INPUT-BHP
CAPACITY-U.S. GPM
100 PSI
75 PSI
50 PSI
25 PSI
VISC: 28 SSU
BASED ON 10 IN.-HG.
VIKING DRIVE SPEEDS
PUMP SPEED-RPM
HL495 & 4195 CURVE NO. 144-17


MOTOR SIZES
HORSEPOWER INPUT-BHP
CAPACITY-U.S. GPM
150 PSI
125 PSI
100 PSI
75 PSI
50 PSI
25 PSI
VISC: 38 SSU
BASED ON 10 IN.-HG.
VIKING DRIVE SPEEDS
PUMP SPEED-RPM
HL495 & 4195 CURVE NO. 144-18


MOTOR SIZES
HORSEPOWER INPUT-BHP
CAPACITY-U.S. GPM
250 PSI
200 PSI
150 PSI
100 PSI
50 PSI
25 PSI
VISC: 100 SSU
BASED ON 15 IN.-HG.
VIKING DRIVE SPEEDS
PUMP SPEED-RPM
HL495 & 4195 CURVE NO. 144-19


MOTOR SIZES
HORSEPOWER INPUT-BHP
CAPACITY-U.S. GPM
250 PSI
200 PSI
150 PSI
100 PSI
50 PSI
25 PSI
VISC: 750 SSU
BASED ON 15 IN.-HG.
VIKING DRIVE SPEEDS
PUMP SPEED-RPM
HL495 & 4195 CURVE NO. 144-20

SPECIAL INFORMATION

DANGER

BEFORE OPENING ANY VIKING PUMP LIQUID CHAMBER (PUMPING CHAMBER, RESERVOIR, JACKET, ETC.) BE SURE:

1. THAT ANY PRESSURE IN CHAMBER HAS BEEN COMPLETELY VENTED THROUGH SUCTION OR DISCHARGE LINES OR OTHER APPROPRIATE OPENINGS OR CONNECTIONS.
2. THAT THE DRIVING MEANS (MOTOR, TURBINE, ENGINE, ETC.) HAS BEEN "LOCKED OUT" OR MADE NON-OPERATIONAL SO THAT IT CANNOT BE STARTED WHILE WORK IS BEING DONE ON PUMP.

FAILURE TO FOLLOW ABOVE LISTED PRE-CAUTIONARY MEASURES MAY RESULT IN SERIOUS INJURY OR DEATH.

SPECIAL INFORMATION

ROTATION: Viking pumps operate equally well in a clockwise or counterclockwise rotation. Shaft rotation determines which port is suction and which is discharge. Suction port is where pumping elements (gear teeth) come out of mesh.

PRESSURE RELIEF VALVES:

1. Relief valves are mounted on the head of GG, HJ, and HL and on the casing of AS, AK and AL pumps. Relief valves are not available on jacketed heads.
2. Pumps not furnished with a relief valve must be provided with some means of pressure protection (inline pressure relief valve, torque limiting device, etc.).
3. If pump rotation is to be reversed during normal operation, using same pump to load and unload, then pressure protection must be provided on *both* sides of pump.
4. Relief valve adjusting screw cap must *always* point towards suction side of pump. If pump rotation is reversed, remove pressure relief valve and turn end for end. Refer to Figure 5.
5. Pressure relief valves should not be used to control pump flow or regulate discharge pressure.

For additional information on pressure relief valves, refer to Technical Service Manual TSM000 and Engineering Service Bulletin ESB-31.

SPECIAL MECHANICAL SEALS

This bulletin illustrates the mechanical seal which is standard in the catalog pump. A Seal Installation Drawing will be furnished with a pump fitted with a non-standard mechanical seal. Consult this Seal Installation Drawing before disassembling pump.

Modifications are required to install Teflon seals in these pumps. Contact factory for specific information.

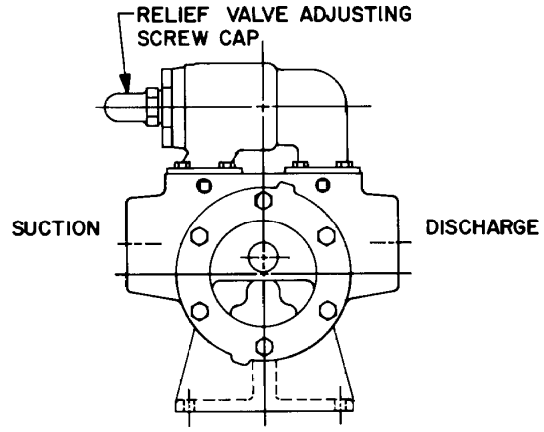


FIGURE 5

MAINTENANCE

Series 4195 and 495 pumps are designed for long, trouble-free service life under a wide variety of application conditions with a minimum of maintenance. The points listed below will help provide long service life.

CLEANING PUMP: Keep pump as clean as possible. This will facilitate inspection, adjustment and repair work and help prevent overlooking a dirt covered grease fitting.

STORAGE: If pump is to be stored, or not used for six months or more, pump must be drained and a light coat of non-detergent SAE 30 weight oil must be applied to all internal pump parts. Lubricate fittings and apply grease to pump shaft extension. Viking suggests rotating pump shaft by hand one complete revolution every 30 days to circulate the oil.

SUGGESTED REPAIR TOOLS: The following tools must be available to properly repair Series 4195 and 495 pumps. These tools are in addition to standard mechanics' tools such as open end wrenches, pliers, screw drivers, etc. Most of the items can be obtained from an industrial supply house.

1. Lead hammer
2. Allen wrenches (set screws & special mechanical seals)
3. Snap ring pliers
   INTERNAL - 2-810-047-999 GG-HJ-HL 4195-495
   EXTERNAL - 2-810-029-375 GG-HJ-HL 4195-495
4. Mechanical seal installation sleeve
   2-751-001-900 for ¾ inch seal; GG 4195-495
   2-751-004-900 for 1¼ inch seal; AS-AL 4195-495
5. Bearing locknut spanner wrench
   (Source: #471 J. H. Williams & Co. or equal)
6. Spanner wrench, adjustable pin type for use on bearing housing end cap.
   (Source: #482 J. H. Williams & Co. or equal)
7. Brass bar
8. Arbor press

DISASSEMBLY

DANGER

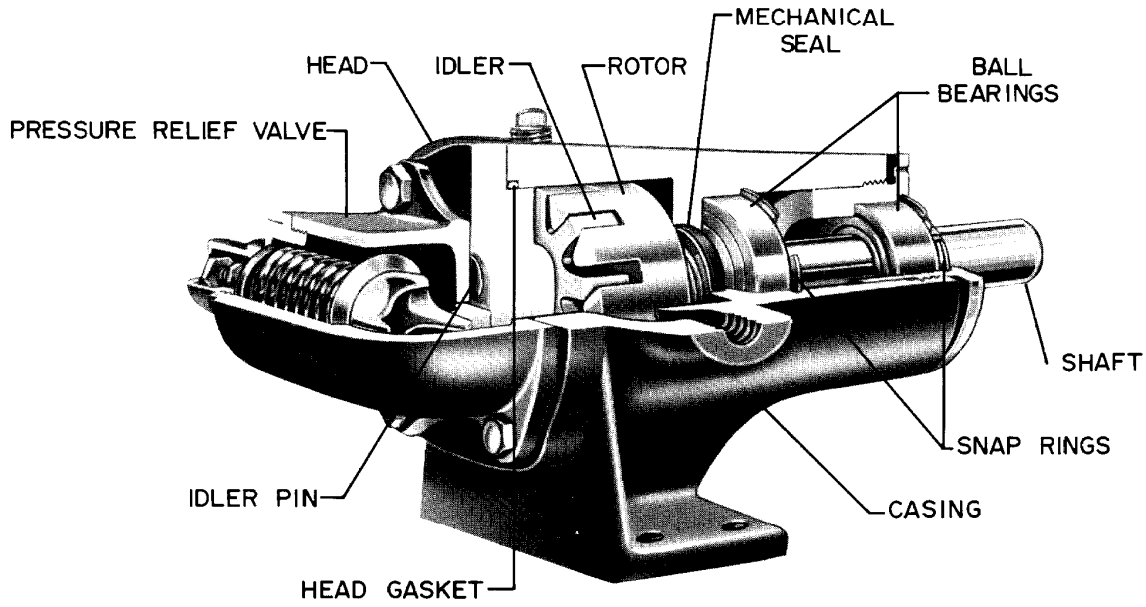
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1. THAT ANY PRESSURE IN CHAMBER HAS BEEN COMPLETELY VENTED THROUGH SUCTION OR DISCHARGE LINES OR OTHER APPROPRIATE OPENINGS OR CONNECTIONS.
2. THAT THE DRIVING MEANS (MOTOR, TURBINE, ENGINE, ETC.) HAS BEEN "LOCKED OUT" OR MADE NON-OPERATIONAL SO THAT IT CANNOT BE STARTED WHILE WORK IS BEING DONE ON PUMP.

FAILURE TO FOLLOW ABOVE LISTED PRE-CAUTIONARY MEASURES MAY RESULT IN SERIOUS INJURY OR DEATH.

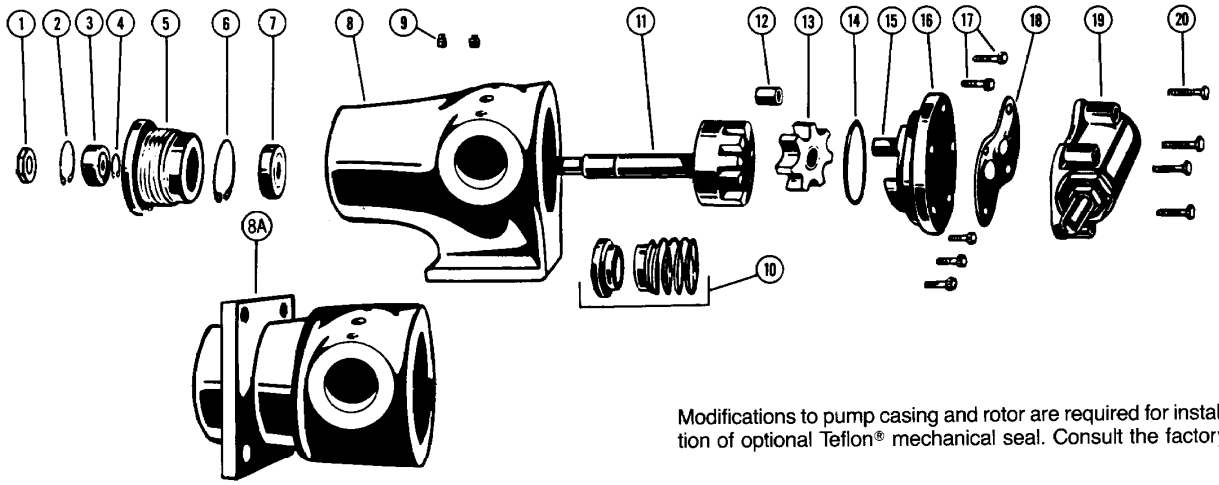
1. Refer to figures 7 & 8 page 4 for model to be disassembled and name of parts. Models 4195 & 495 are disassembled and assembled the same. The difference between these models is the casings.
2. Mark head and casing before disassembly to insure proper reassembly. The idler pin, which is offset in pump head, must be positioned up and equal distance between port connections to allow for proper flow of liquid through pump.
3. Remove the head capscrews.

   NOTE: The four valve capscrews, valve and gasket must be removed from the GG 4195-495 model before the six head capscrews are removed.
4. Tilt top of head back when removing to prevent idler from falling off idler pin.
5. Remove idler and bushing assembly. If idler bushing needs replacing, see "Installation of Carbon Graphite Bushings" page 7.
6. Insert a brass bar or piece of hardwood in the port opening and between rotor teeth to keep shaft from turning. Turn the locknut counterclockwise and remove locknut. See Figure 9 or 10.
7. Loosen two setscrews in face of bearing housing and turn thrust bearing assembly counterclockwise and remove from casing. See Figure 9 or 10.
8. **GG, HJ, HL:** Remove snap ring from shaft. See Figure 9.
   AS, AK, AL: Remove bearing spacer from shaft. See Figure 10.
9. Remove brass bar or piece of hardwood from port opening.



CUTAWAY OF MODELS GG, HJ or HL 4195

FIGURE 6

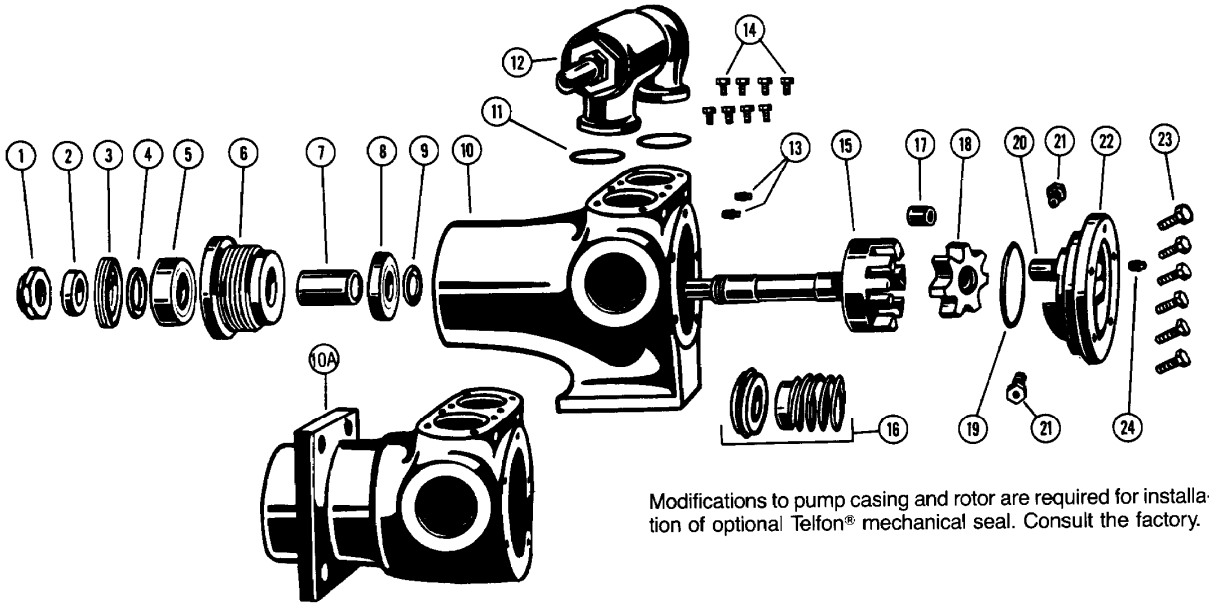


Modifications to pump casing and rotor are required for installation of optional Teflon® mechanical seal. Consult the factory.

EXPLODED VIEW MODELS GG, HJ and HL 4195 and 495
FIGURE 7

ITEM	NAME OF PART	ITEM	NAME OF PART	ITEM	NAME OF PART	ITEM	NAME OF PART
1	Locknut	7	Ball Bearing, Inner	12	Idler Bushing	18	Gasket for Relief Valve
2	Snap Ring, Outer	8	Casing (4195)	13	Idler and Bushing	19	Relief Valve
3	Ball Bearing, Outer	8A	Casing (495)	14	Head Gasket	20	Capscrew for Valve
4	Snap Ring for Shaft*	9	Pipe Plug	15	Idler Pin		
5	Bearing Housing	10	Mechanical Seal	16	Head and Idler Pin		
6	Snap Ring, Inner	11	Rotor and Shaft	17	Capscrew for Head		

*Not used on "GG" size pumps.

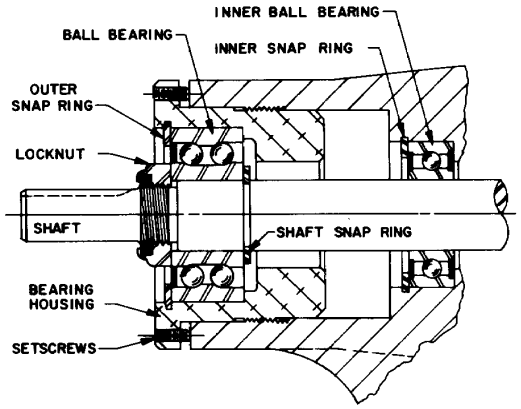


Modifications to pump casing and rotor are required for installation of optional Telfon® mechanical seal. Consult the factory.

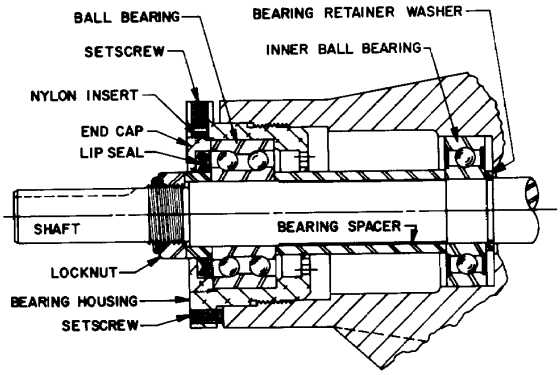
EXPLODED VIEW MODELS AS, AK and AL 4195 and 495
FIGURE 8

ITEM	NAME OF PART	ITEM	NAME OF PART	ITEM	NAME OF PART	ITEM	NAME OF PART
1	Locknut	7	Bearing Spacer	12	Relief Valve	18	Idler and Bushing
2	Bearing Spacer Collar	8	Ball Bearing, Inner	13	Pipe Plug	19	Head Gasket
3	End Cap for Bearing Housing	9	Bearing Retainer Washer	14	Capscrew for Valve	20	Idler Pin
4	Lip Seal for Bearing Housing	10	Casing (4195)	15	Rotor and Shaft	21	Head and Idler Pin
5	Ball Bearing, Outer	10A	Casing (495)	16	Mechancial Seal	22	Capscrew for Head
6	Bearing Housing	11	Gasket for Relief Valve	17	Idler Bushing	23	Capscrew for Valve

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THRUST BEARING ASSEMBLY GG, HJ, HL SIZES
FIGURE 9



THRUST BEARING ASSEMBLY AS, AK, AL SIZES
FIGURE 10

10. The rotor and shaft can now be removed by tapping on end of shaft with a lead hammer or, if using a regular hammer, use a piece of hardwood between shaft and hammer. The rotary member of the seal will come out with rotor and shaft.

11. **AS, AK, AL:** Remove bearing retainer washer. The washer may have stayed with Rotor and Shaft when removed or is against ball bearing. See Figure 10.

12. Remove the mechanical seal rotary member and spring from rotor and shaft assembly.

13. **GG, HJ, HL:** Remove inner snap ring and single row ball bearing from casing.
    AS, AK, AL: Remove single row ball bearing from casting.

14. Remove seal seat or stationary part of seal from casing.

15. Disassemble thrust bearing assembly.
    GG, HJ, HL: Remove outer snap ring from bearing housing and remove ball bearing. See Figure 9.
    AS, AK, AL: Loosen two set screws in flange outside diameter. Rotate end cap and lip seal counterclockwise and remove. Remove ball bearing. See Figure 10.

The casing should be examined for wear, particularly in the area between ports. All parts should be checked for wear before pump is put together.

When making major repairs, such as replacing a rotor and shaft; it is advisable to also install a new mechanical seal, head and idler pin, idler and bushing. See "Installation of Carbon Graphite Bushings" page 7.

Clean all parts thoroughly and examine for wear or damage. Check lip seals, ball bearings, bushing and idler pin and replace if necessary. Check all other parts for nicks, burrs, excessive wear and replace if necessary.

Wash bearings in clean solvent. Blow out bearings with compressed air. Do not allow bearings to spin; turn them slowly by hand. Spinning bearings will damage race and balls. Make sure bearings are clean, then lubricate with non-detergent SAE 30 weight oil and check for roughness. Roughness can be determined by turning outer race by hand. Replace bearings if bearings have roughness.

Be sure shaft is free from nicks, burrs and foreign particles that might damage mechanical seal. Scratches on shaft in seal area will provide leakage paths under mechanical seal. Use fine emery cloth to remove scratches or sharp edges.

ASSEMBLY

Assembly Notes On Standard Mechanical Seal (Synthetic Rubber Bellows Type)

READ CAREFULLY BEFORE REASSEMBLING PUMP

The seal used in this pump is simple to install and good performance will result if care is taken during installation.

The principle of mechanical seal is contact between the rotary and stationary members. These parts are lapped to a high finish and their sealing effectiveness depends on complete contact.

Prior to installing rotary portion of mechanical seal, prepare and organize rotor shaft, head and idler assemblies and appropriate gaskets for quick assembly.

Once rotary portion of mechanical seal is installed on rotor shaft, it is necessary to assemble parts as quickly as possible to insure the seal does not stick to shaft in wrong axial position. The seal will stick to the shaft after several minutes setting time.

Never touch sealing faces with anything except clean hands or clean cloth. Minute particles can scratch the seal faces and cause leakage.

1. Coat idler pin with non-detergent SAE 30 weight oil and place idler and bushing on idler pin in head. If replacing a carbon graphite bushing, refer to Installation of Carbon Graphite Bushings, page 7.

2. Clean rotor hub and casing seal housing bore. Make sure both are free from dirt and grit. Coat outer diameter of seal seat and inner diameter of seal housing bore with nondetergent SAE 30 weight oil.

3. Start seal seat in seal housing bore. If force is necessary protect seal face with a clean cardboard disc and gently tap it in place with a piece of wood. Be sure seal seat is completely seated in the bore.

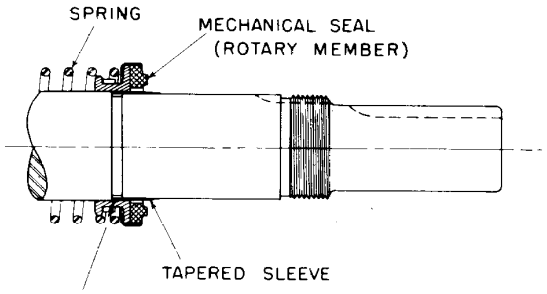


FIGURE 11

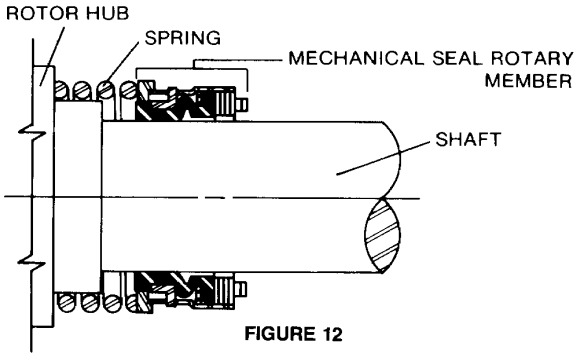


FIGURE 12

4. Place tapered installation sleeve on shaft, refer to Figure 11. Sleeve is furnished with GG, AS, AK and AL replacement mechanical seals. Coat rotor shaft, tapered installation sleeve and inner diameter of mechanical seal rotary member with a generous amount of non-detergent SAE 30 weight oil. Petrolatum may be used but grease is not recommended.

5. Place seal spring on shaft against rotor hub. Refer to Figure 12.

6. Slide rotary member, lapped contact surface facing away from spring, over installation sleeve on shaft until just contacting the spring. Do not compress spring. Remove installation sleeve.

7. Coat rotor shaft with non-detergent SAE 30 weight oil. Install shaft slowly pushing until the ends of rotor teeth are just below the face of the casing.

8. Leave the rotor in this position. Withdrawal of rotor and shaft may displace the carbon seal rotating face and result in damage to the seal.

9. Place O-ring gasket on head and install head and idler assembly on pump. Pump head and casing were marked before disassembly to insure proper reassembly. If not, be sure idler pin, which is offset in pump head, is positioned up and equal distance between port connections to allow for proper flow of liquid through pump.

10. Tighten head capscrews evenly.

11. If pump was equipped with a relief valve and was removed during disassembly, install on head with new gaskets. Relief valve adjusting screw cap must always point towards suction port. Refer to Figure 5 page 2. For relief valve repair or adjustments, see PRESSURE RELIEF VALVE INSTRUCTIONS, Page 7.

12. Pack inner ball bearing with multi-purpose grease, NLGI #2.

    GG, HJ, HL: Install bearing in casing with sealed side towards head end of pump. Drive the bearing into the bore. Tap the inner race with a brass bar and lead hammer to position bearing. Install inner snap ring.

    AS, AK, AL: Install bearing retainer washer over the shaft before installing ball bearing. Install ball bearing in casing with sealed side towards head end of pump. Drive the bearing into the bore. Tap the inner race with a brass bar and lead hammer to position bearing.

13. **GG, HJ, HL:** Install shaft snap ring in groove in the shaft. See Figure 9.

    AS, AK, AL: Install bearing spacer over shaft and against single row ball bearing. See Figure 10.

14. Pack lubrication chamber between inner ball bearing and double row ball bearing in the thrust bearing assembly approximately one-half full of multi-purpose grease, NLGI #2. The thrust bearing assembly will take the remaining space. See Figure 9 and 10.

15. Pack double row ball bearing with multi-purpose grease, NLGI #2.

    GG, HJ, HL: Install ball bearing into bearing housing with shield side toward coupling end of shaft. See Figure 9. Install snap ring into bearing housing to retain ball bearing. This snap ring has a tapered edge to fit tapered groove in bearing housing. The tapered edge is located away from ball bearing.

    AS, AK, AL: Install ball bearing into bearing housing. Install lip seal in bearing housing end cap. The lip should face towards end of shaft. Put bearing spacer collar in lip seal and install in bearing housing and tighten set screws securely. See Figure 10.

16. Insert brass bar or hardwood through port opening between rotor teeth to keep shaft from turning.

17. Start thrust bearing assembly into casing. Turn by hand until tight. This forces rotor against head. Replace and tighten locknut or shaft.

18. Remove brass bar or hardwood from port opening.

19. Adjust pump end clearance, refer to page 7.

DANGER

BEFORE STARTING PUMP, BE SURE ALL DRIVE EQUIPMENT GUARDS ARE IN PLACE.

FAILURE TO PROPERLY MOUNT GUARDS MAY RESULT IN SERIOUS INJURY OR DEATH.

THRUST BEARING ADJUSTMENT

See Figures 9 and 10.

Loosen two screws in face of thrust bearing assembly.

If shaft cannot be rotated freely, turn thrust bearing assembly counterclockwise until shaft can be turned easily.

To set end clearance:

1. While turning rotor shaft, rotate thrust bearing assembly clockwise until noticeable drag occurs. This is zero end clearance.
2. Mark position of bearing housing with respect to the casing.
3. Rotate thrust bearing assembly counterclockwise the distance listed below as measured on outside of bearing housing.
4. Tighten two setscrews in face of bearing housing after adjustment is made to secure thrust bearing assembly position.

   For viscosities above 2500 SSU, add additional end clearance (0.004" for GG, HJ and HL size pumps and 0.005" for AS, AK and AL size pumps).

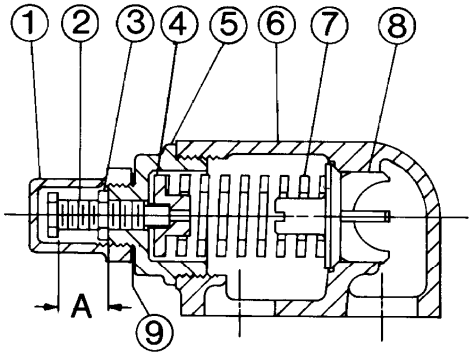
Pump Size	Distance in Inches on O.D. of Bearing Housing	End Clearance
GG	7/16"	.003
HJ, HL	9/16"	.003
AS, AK, AL	1/2"	.003

INSTALLATION OF CARBON GRAPHITE BUSHINGS

When installing carbon graphite bushings, extreme care must be taken to prevent breaking. Carbon graphite is a brittle material and easily cracked. If cracked, the bushing will quickly disintegrate. Using a lubricant and adding a chamfer on the bushing and the mating part will help in installation. The additional precautions listed below must be followed for proper installation:

1. A press must be used for installation.
2. Be certain bushing is started straight.
3. Do not stop pressing operation until bushing is in proper position, starting and stopping will result in a cracked bushing.
4. Check bushing for cracks after installation.

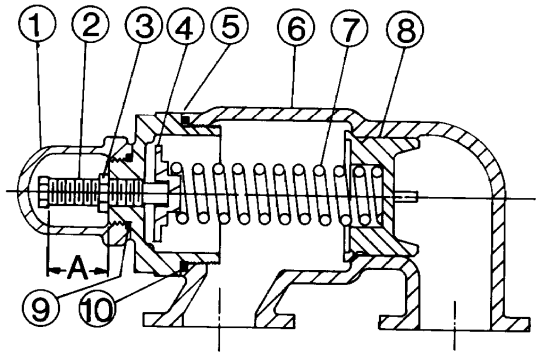
PRESSURE RELIEF VALVE INSTRUCTIONS



VALVE — GG, HJ AND HL SIZES

LIST OF PARTS	
1. Valve Cap	6. Valve Body
2. Adjusting Screw	7. Valve Spring
3. Lock Nut	8. Poppet
4. Spring Guide	9. Cap Gasket
5. Bonnet	

FIGURE 13



VALVE — AS, AK and AL SIZES

LIST OF PARTS	
1. Valve Cap	6. Valve Body
2. Adjusting Screw	7. Valve Spring
3. Lock Nut	8. Poppet
4. Spring Guide	9. Cap Gasket
5. Bonnet	10. Bonnet Gasket

FIGURE 14

Suggested Reference: Hydraulic Institute Handbook, 14th Edition.

INSTALLATION

General

Before installation is started a few items of a general nature should be considered.

1. *Location* — always locate the pump as close as possible to the supply of liquid to be pumped. Locate it below the liquid supply if at all practical. Viking pumps are self priming but the better the suction conditions the better the performance.

2. *Accessibility* — the pump should be located where it is accessible for inspection, maintenance, and repair. For large pumps, allow room to remove the rotor and shaft without removing the pump from the base.

3. *Port Arrangement* — since the pumps have different port arrangements depending on the model, port location should be checked before starting the installation. The ports may be upright, opposite or at right angles to each other, see Figure 1. The right angle ports are normally right-hand, see Figure 2; some models are available with left-hand arrangements; still other models are available with the right angle ports located in any one of eight positions including right-hand and left-hand.

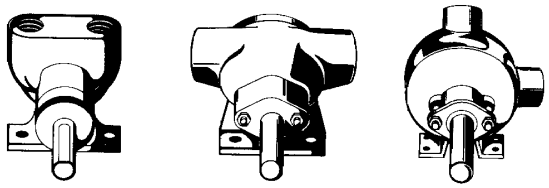


FIGURE 1

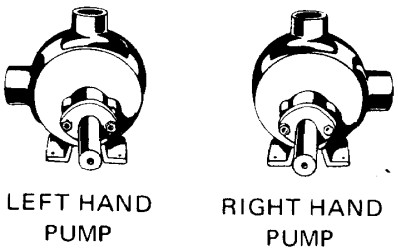


FIGURE 2

4. *Suction/Discharge* — shaft rotation will determine which port is suction and which discharge. A look at Figure 3 will show how rotation determines which port is which; as the pumping elements (gears) come out of mesh, point "A" on Figure 3, liquid is drawn into the suction port; as the gears come into mesh, point "B", the liquid is forced out the discharge port. Reversing the rotation reverses the flow through the pump. When determining shaft rotation, always look from the shaft end of the pump. Unless otherwise specified, rotation is assumed to be clockwise (CW), which makes the suction port on the right side of the pump. The idler pin, which is offset in the pump head, should be properly positioned toward and an equal distance between the port connections.

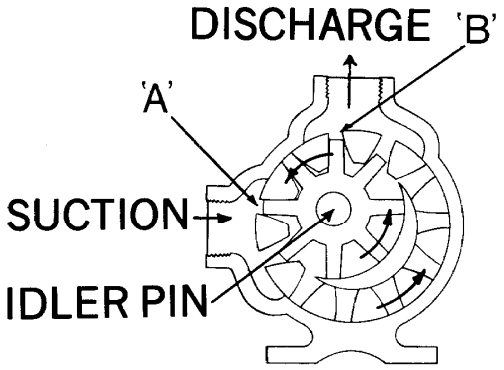
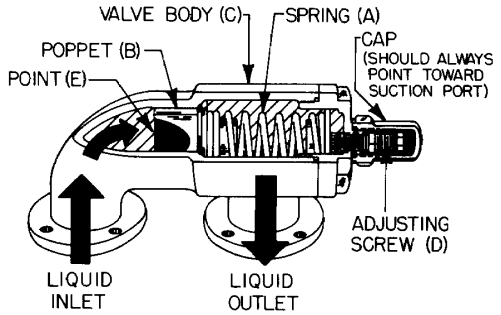


FIGURE 3

5. *Pressure Relief Valve* — the Viking pump is a positive displacement pump. This means that when the pump is rotated, liquid will be delivered to the discharge side of the pump. If there is no place for this liquid to go — discharge line is blocked or closed — the pressure will build up until the motor stalls, the drive equipment fails, a pump part breaks or ruptures, or the piping bursts. To prevent the possibility of any one or more of these things happening in case of unintentional closing of the discharge line, the use of a pressure relief valve is recommended. A pressure relief valve will relieve the pressure at a predetermined value, thus protecting the entire system.



CUT-AWAY OF VIKING INTERNAL PRESSURE RELIEF VALVE
FIGURE 4

The pressure relief valve mounted on Viking pumps and most in-line valves are of the spring loaded poppet design. See Figure 4. The spring (A) holds poppet (B) against the seat in the valve body (C) with a given force determined by the spring size and by how tightly it is compressed by the

adjusting screw (D). The pump discharge pressure pushes against the under side of the poppet at point (E). When the force exerted by the liquid under the poppet exceeds that exerted by the spring, the poppet lifts and liquid starts to flow through the valve. As the discharge pressure builds up, more and more of the liquid flows through until a pressure is reached at which all of the liquid being pumped is going through the valve. This pressure is the relief valve setting.

CAUTION:

THE INTERNAL TYPE PRESSURE RELIEF VALVE MOUNTED ON THE VIKING PUMP SHOULD ALWAYS HAVE THE CAP OR BONNET POINTED TOWARD THE SUCTION SIDE OF THE PUMP. THE RETURN-TO-TANK TYPE PRESSURE RELIEF VALVE SHOULD ALWAYS BE MOUNTED ON THE DISCHARGE SIDE OF THE PUMP. IF PUMP ROTATION IS PERMANENTLY REVERSED CHANGE THE RELIEF VALVE. TURN THE INTERNAL TYPE END FOR END; MOVE THE RETURN-TO-TANK TYPE TO THE OTHER PORT. IF, ON A PARTICULAR INSTALLATION IT IS THE INTENT TO REVERSE THE PUMP ROTATION FREQUENTLY, *e.g., USING ONE PUMP TO FILL A TANK AND THEN BY USE OF A REVERSING SWITCH OR OTHER MEANS CHANGING ROTATION TO PERMIT THE SAME PUMP TO CIRCULATE THE LIQUID THROUGH A HEATER OR TO LOAD OUT)* THEN OVER PRESSURE PROTECTION MUST BE PROVIDED FOR *BOTH* SIDES OF THE PUMP OR FOR BOTH ROTATIONS. USE AN INTERNAL PRESSURE RELIEF VALVE TO PROTECT ONE SIDE AND AN IN-LINE PRESSURE RELIEF VALVE TO PROTECT THE OTHER; USE AN IN-LINE PRESSURE RELIEF VALVE ON EACH SIDE OF THE PUMP OR USE SOME MEANS OF LIMITING TORQUE THAT IS FUNCTIONAL IN BOTH DIRECTIONS OF ROTATION.

PUMPS OR SYSTEMS WITHOUT PRESSURE RELIEF VALVES SHOULD HAVE SOME FORM OF OVER PRESSURE PROTECTION, e.g., TORQUE LIMITING DEVICES, RUPTURE DISCS, ETC.

Viking pumps can be furnished with either an internal pressure relief valve — one which directs the flow from the valve back to the suction side of the pump — or a return-to-tank valve which directs the flow through piping back to the supply tank. See Figure 5. An inline pressure relief valve mounted in the discharge piping also directs the flow back to the supply tank. This type of valve should be mounted close to the pump so that the pressure drop through the piping between the pump and the valve is at a minimum. Be sure there are no shutoff valves between the pump and relief valve. Piping from a return-to-tank or an in-line valve to the supply tank should also be as short and large as possible.

The spring loaded poppet-type valve is strictly a differential valve, sensing only those pressures on each side of the poppet. It should **not** be used as a pressure or flow control device. **It is intended strictly as a pressure relief valve.**

The pressure at which either the return-to-tank or internal pressure relief valve bypasses can be changed by turning the adjusting screw. Do not back the adjusting screw all the way out.

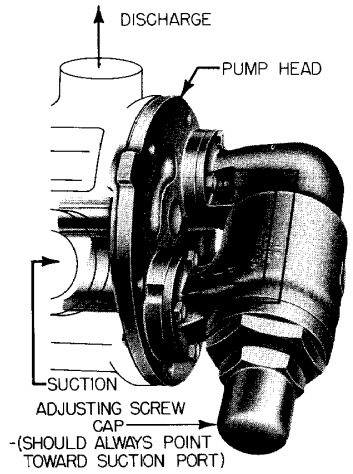


FIGURE 5A
INTERNAL PRESSURE RELIEF VALVE

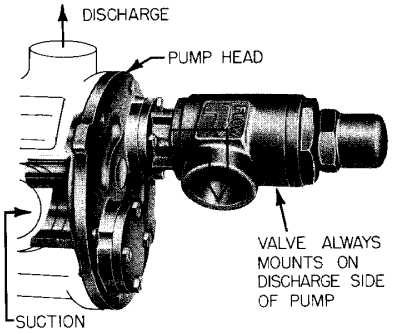


FIGURE 5B
RETURN-TO-TANK PRESSURE RELIEF VALVE

NOTE: on some models the pressure relief valve is mounted on the pump casing instead of the pump head.

Stop when spring tension is off the screw (the screw starts to turn easily).

For details on maintenance of the relief valve see Technical Service Manual covering your model series.

6. *Motor* — follow local electrical codes when hooking up motors.

Foundation

Every pump should have a good foundation. It may be any structure sufficiently strong to hold the pump rigid and to absorb any strain or shock that may be encountered.

A certified print of the pumping unit should be used in preparing the foundation. As for one. If a separate foundation is provided, make it at least four inches wider and longer than the base of the unit.

When the unit is placed on the foundation it should be leveled and checked for position against the piping layout and then fastened down.

Alignment

CHECK ALIGNMENT AFTER MOUNTING

For detailed coupling alignment procedures see Viking service bulletin ESB-61.

The pump, drive, and motor were properly aligned at the time they were assembled. During shipping and mounting the alignment is often disturbed. **CHECK IT!**

1. Check pump ports to be sure they are square and in proper position; shim or move pump as required.
2. If the pump is driven by a flexible coupling(s) either direct connected to the motor or through a reducer, remove any coupling guards or covers and check alignment of the coupling halves. A straightedge (a piece of key stock works nicely) across the coupling must rest evenly on both rims at the top, bottom, and sides. See Figure 6.
3. If the pump is driven by V-belts, check the alignment by using a long straightedge or tightly drawn string across the face of the sheaves. See Figure 6A.
4. Make a final check on alignment after piping is hooked up.

   See item 13 under "Installation — Piping".
   Figures 7, 8, and 9 show typical units — direct, gear reducer and V-belt drive.
5. For high temperature applications (those above 300°F) allow pump to reach operating temperature, then recheck alignment.

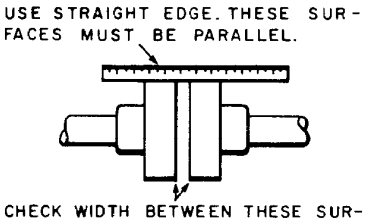
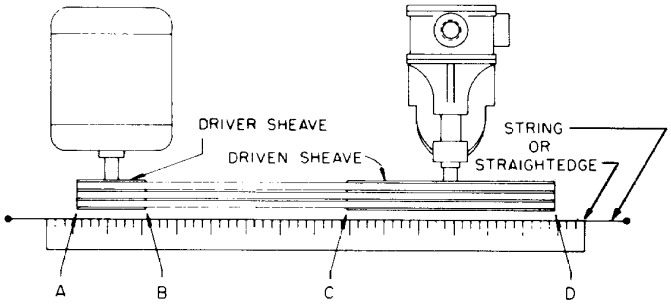


FIGURE 6



WHEN SHEAVES PROPERLY ALIGNED ALL POINTS A, B, C, D WILL TOUCH STRING OR STRAIGHTEDGE

FIGURE 6A

Piping

The cause of many pumping problems can be traced to suction piping. It should always be as large and short as practical. For help in selecting the proper size piping, both suction and discharge, refer to Viking General Catalog Section 510.

Before starting layout and installation of your piping system, consider the following points:

1. Never use piping smaller than the pump port connections.
2. Be sure the inside of the pipe is clean before hooking it up.
3. *Foot valve* — When pumping a light liquid with a suction lift, a foot valve at the end of the suction piping or a check valve in the first horizontal run will hold the liquid in the line and make it easier for the pump to prime. Be sure the foot or check valve is big enough so that it doesn't cause excessive line loss.

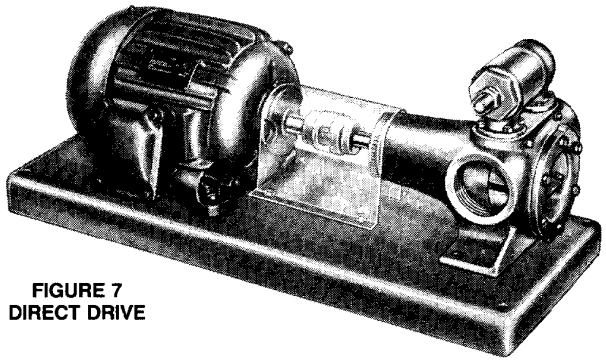


FIGURE 7
DIRECT DRIVE

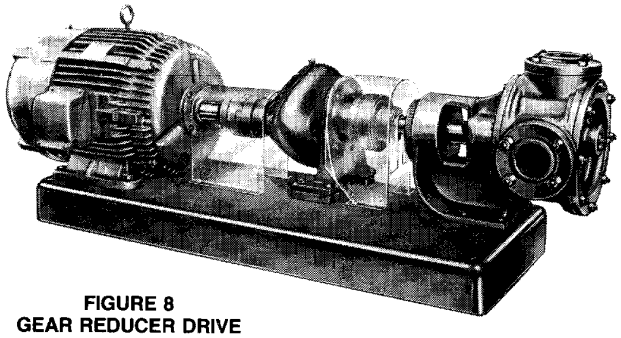


FIGURE 8
GEAR REDUCER DRIVE

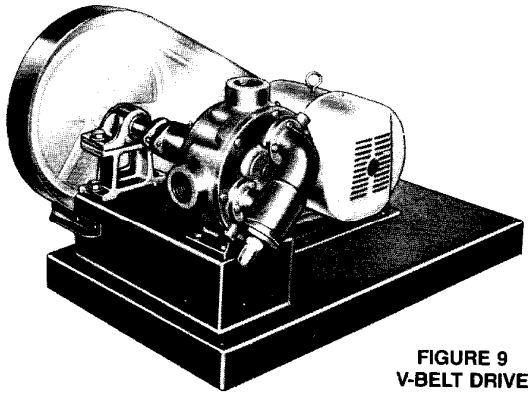


FIGURE 9
V-BELT DRIVE

4. When approaching an obstacle in the suction or discharge line, go around the obstacle instead of over it. Going over it creates an air pocket. See Figure 10.

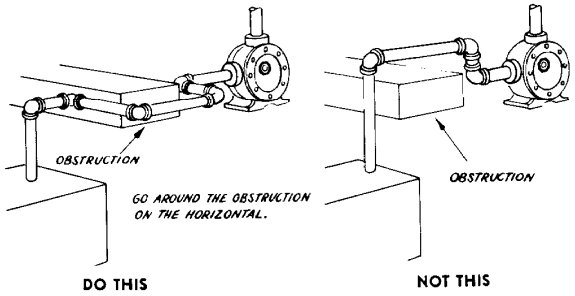


FIGURE 10

5. Where practical, slope the piping so no air or liquid pockets will be formed. Air pockets in the suction line make it hard for the pump to prime.

6. For a suction line with a long horizontal run keep the horizontal portion below the liquid level if possible. This keeps the pipe full so the pump does not have to remove so much air when starting; this is most helpful when there is no foot valve. See Figure 11.

7. When piping a hot or cold system (liquid being handled is at a temperature different from the air surrounding the pump), be sure allowance is made for expansion and contraction of the piping. Loops, expansion joints, or unsecured (this does not mean unsupported) runs should be used so the pump casing is not distorted or put into a bind.

8. **STRAINER** — It is always good practice to consider a strainer on the suction side of a positive displacement pump. The strainer will keep foreign objects from going into the pump; without a strainer some would go through; others would cause a jammed pump, a broken part, or a torn up drive. The strainer basket mesh or perforation size should be big enough so that it does not cause excessive pressure drop, but it should be find enough to protect the pump. When in doubt as to the proper size, check with the manufacturer, giving him pipe size, flow rate, and viscosity involved. Provision should be made for cleaning the strainer. If the pump operates continuously, a bypass should be built around the strainer or two strainers should be put in parallel with proper valving so they can be isolated for cleaning. Use of a strainer is particularly important at start up to help clean the system of weld beads, pipe scale, and other foreign objects. For additional information, refer to TSM640.

9. If the pump is not equipped with a pressure relief valve, consideration should be given to mounting one in the discharge line. See discussion on pressure relief valves under START UP.

10. The pump should not be used to support the piping. The weight of the pipe should be carried by hangers, supports, stands, etc.

11. When fastening the piping to the pump it should not be necessary to impose any strain on the pump casing. "Springing" or "drawing" the piping up to the pump will cause distortion, possible misalignment, and probable rapid wear of the pump. Do not use the pump to correct errors in piping layout or assembly.

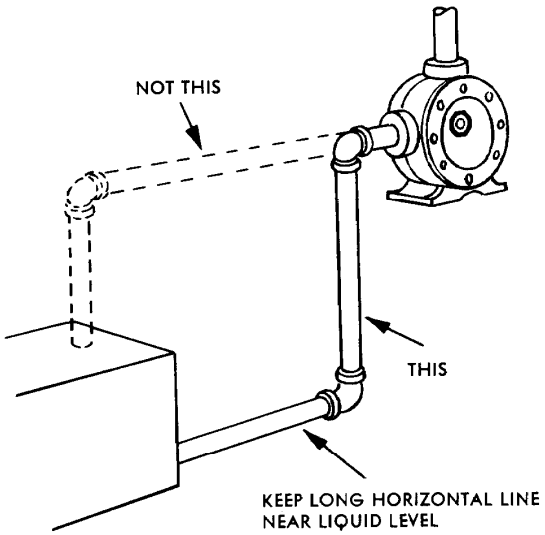


FIGURE 11

12. All joints of the piping system should be tight; pipe sealer or teflon tape will help assure leak-free threaded joints. Leaks in the suction line permitting air to be drawn in may cause a noisy pump, or a reduction in capacity.

13. **ALIGNMENT** — Check the alignment of the drive after the piping is hooked up. As a final check on pump alignment remove the head of the pump and with a feeler gauge determine if there is clearance all the way around between the rotor and casing. Because of manufacturing tolerances, bushing clearances, etc., the rotor may not be centered in the casing, but it should not drag; dragging would indicate unit misalignment or casing distortion from piping strain. Making this check is most desirable on installations involving Q, M and N size standard duty pumps.

14. The auxiliary piping hooked to jackets, glands, etc. for heating, cooling, quenching, or for other purposes should receive the same attention as the piping handling the liquid pumped.

15. Provide a pressure relief device in any part of a pump and piping system that can be valved off and, thus, completely isolated. This is particularly important:
    1. When handling a cold liquid such as refrigeration ammonia that can warm up to ambient temperatures when the pump is shut off or
    2. When handling a liquid such as asphalt or molasses that has to be heated before it can be pumped.
    The rise in temperature causes the liquid to expand; if there is no provision for pressure relief in the closed off section, there is a chance that the pump or piping will rupture.

START UP

Before pushing the "start" button, check the following:

1. Are there vacuum and pressure gauges on or near the pump? These gauges are the quickest and most accurate way of finding out what is happening in the pump.

2. Check alignment — See suggestions under "Installation — Alignment" in this manual.
3. Check piping to be sure there is no strain on the pump casing.
4. Rotate the pump shaft by hand to be sure it turns freely.
5. Jog motor to be sure it is turning in the right direction; see discussion on pump rotation under "Installation — General" item 4 in this manual.
6. Check any pressure relief valve to be sure it is installed correctly. See discussion on pressure relief valve under "Installation — General".
7. Check suction piping to be sure (a) it is all connected and tight, (b) valves are open, and (c) end of pipe is below liquid level.
8. Check discharge piping to be sure (a) it is connected and tight, (b) valves are open, and (c) there is a place for the liquid to go.
9. Lubricate any grease fitting on the pump using a good, general purpose #2 ball bearing grease. Check any gear reducer, motor, coupling, etc. for instructions and lubricate as recommended. See Engineering Service Bulletin ESB-515.
10. For packed pumps, loosen packing gland nuts so gland can be moved slightly by hand. Adjust gland to reduce leakage only after pump has run long enough to reach constant temperature. Packing should weep a little to keep it cool and lubricated.
11. Do **not** use the Viking pump to flush, pressure test or prove the system with water. Either remove the pump or run piping around it while flushing or testing. Pumping water, dirty or otherwise, can do more damage in a few minutes than months of normal service.
12. Check to be sure all guards are in place.
13. Now you are ready to push the "start" button — gently.

If the pump begins to deliver liquid within 60 seconds, you're in business. If it does not, push the "stop" button. Do **not** run the pump longer than one minute without liquid in it; you will ruin it. Review the steps just outlined, consider what the suction and discharge gauges indicate, see page 6; if everything appears to be in order, put some liquid in the pump, a lubricating liquid is best. This will help it prime.

Push the "start" button again. If nothing is flowing within two minutes, stop the pump. The pump is not a compressor, it will not build up much air pressure; it may be necessary to vent the discharge line until liquid begins to flow.

If the pump still does not deliver, the cause may be one or more of the following:

1. Suction line air leaks; vacuum gauge reading should help determine if this is the problem.
2. End of suction pipe not submerged deep enough in liquid.
3. Suction lift is too great or the suction piping is too small.
4. Liquid is vaporizing in the suction line before it gets to the pump.

If after consideration of these points it still does not pump, suggest you review again all points given under START UP; read through Troubleshooting in this manual and try again. If it still does not pump, contact your Viking representative.

TROUBLESHOOTING

A Viking pump which is properly installed and maintained will give long and satisfactory performance.
NOTE: Before making any pump adjustment or opening the pump liquid chamber in any manner, make sure that:

1) any pressure in the pumping chamber has been vented through the suction or discharge lines or other openings provided for this purpose, 2) the driver has been "locked out" so that it cannot inadvertently be started while work is being done on the pump and 3) the pump has been allowed to cool down to the point where there is no chance of anyone being burned.

If trouble does develop, one of the first steps toward finding the difficulty is to *install a vacuum gauge in the suction port and a pressure gauge in the discharge port.* Readings on these gauges often will give a clue as to where to start looking for the trouble.

Vacuum Gauge — Suction Port

1. High reading would indicate —
   a. Suction line blocked — foot valve stuck, gate valve closed, strainer plugged.
   b. Liquid too viscous to flow through the piping.
   c. Lift too high.
   d. Line too small.
2. Low reading would indicate —
   a. Air leak in suction line.
   b. End of pipe not in liquid.
   c. Pump is worn.
   d. Pump is dry — should be primed.
3. Fluttering, jumping, or erratic reading —
   a. Liquid vaporizing.
   b. Liquid coming to pump in slugs, possibly an air leak or insufficient liquid above the end of the suction pipe.
   c. Vibrating from cavitation, misalignment, or damaged parts.

Pressure Gauge — Discharge Port

1. High reading would indicate —
   a. High viscosity and small and/or long discharge line.
   b. Gate valve partially closed.
   c. Filter plugged.
   d. Vertical head did not consider a high specific gravity liquid.
   e. Line partially plugged from build up on inside of pipe.
   f. Liquid in pipe not up to temperature.
   g. Liquid in pipe has undergone a chemical reaction and has solidified.
   h. Relief valve set too high.
2. Low reading would indicate —
   a. Relief valve set too low.

b. Relief valve poppet not seating properly.
c. Bypass around the pump partially open.
d. Too much extra clearance.
e. Pump worn.

3. Fluttering, jumping, or erratic reading —
   a. Cavitation.
   b. Liquid coming to pump in slugs.
   c. Air leak in suction line.
   d. Vibrating from misalignment or mechanical problems.

Some of the following may also help pinpoint the problem:

A. Pump does not pump.
   1. Lost its prime — air leak, low level in tank, foot valve stuck.
   2. Suction lift too high.
   3. Rotating in wrong direction.
   4. Motor does not come up to speed.
   5. Suction and discharge valves not open.
   6. Strainer clogged.
   7. Bypass valve open, relief valve set too low, relief valve poppet stuck open.
   8. Pump worn out.
   9. Any changes in the liquid system, or operation that would help explain the trouble, e.g. new source of supply, added more lines, inexperienced operators, etc.
   10. Tighten end clearance.
   11. Head position incorrect. See Fig. 3.

B. Pump starts, then loses its prime.
   1. Supply tank empty.
   2. Liquid vaporizing in the suction line.
   3. Air leaks or air pockets in the suction line; leaking air through packing or mechanical seal.
   4. Worn out.

C. Pump is noisy.
   1. Pump is being starved (heavy liquid cannot get to pump fast enough). Increase suction pipe size or reduce length.
   2. Pump is cavitating (liquid vaporizing in the suction line). Increase suction pipe size or reduce length; if pump is above the liquid, raise the liquid level closer to the pump; if the liquid is above the pump, increase the head of liquid.
   3. Check alignment.
   4. May have a bent shaft or rotor tooth. Straighten or replace.
   5. Relief valve chatter; increase pressure setting.
   6. May have to anchor base or piping to eliminate or reduce vibration.
   7. May be a foreign object trying to get into the pump through the suction port.

D. Pump not up to capacity.
   1. Starving or cavitating — increase suction pipe size or reduce length.
   2. Strainer partially clogged.
   3. Air leak in suction piping or along pump shaft.
   4. Running too slowly; is motor the correct speed and is it wired up correctly.
   5. Bypass line around pump partially open.
   6. Relief valve set too low or stuck open.
   7. Pump worn out.
   8. Tighten end clearance.
   9. Head position incorrect. See Fig. 3.

E. Pump takes too much power.
   1. Running too fast — Is correct motor speed, reducer ratio, sheave size, etc. being used.
   2. Is liquid more viscous than unit sized to handle; heat the liquid, increase the pipe size, slow the pump down, or get a bigger motor.
   3. Discharge pressure higher than calculated, check with pressure gauge. Increase size or reduce length of pipe, reduce speed (capacity), or get bigger motor.
   4. Packing gland drawn down too tight.
   5. Pump misaligned.
   6. Extra clearance on pumping elements may not be sufficient for operating conditions. Check parts for evidence of drag or contact in pump and increase clearance where necessary.

F. Rapid Wear.
   On most applications the pump will operate for many months or years before it gradually loses its ability to deliver capacity or pressure. Examination of such a pump would show a smooth wear pattern on all parts. Rapid wear, occurring in a few minutes, hours or days, shows up as heavy grooving, galling, twisting, breaking or similar severe signs of trouble.
   SEE CHART PAGE 7.

PREVENTATIVE MAINTENANCE

Performing a few preventative maintenance procedures will extend the life of your pump and reduce the cost per gallon pumped.

A. Lubrication — Grease all zerks after every 500 hours of operation or after 60 days, whichever occurs first. If service is severe, grease more often. Do it gently with a hand gun. Use a #2 ball bearing grease for normal applications. For hot or cold applications use appropriate grease. See Engineering Service Bulletin ESB-515.

B. Packing Adjustment — Occasional packing adjustment may be required to keep leakage to a slight weep; if impossible to reduce leakage by gentle tightening, replace packing or use different type. See Technical Service Manual on particular model series for details on repacking.

C. End Clearance Adjustment — After long service the running clearance between the end of the rotor teeth and the head may have increased through wear to the point where the pump is losing capacity or pressure. Resetting end clearance will normally improve pump performance. See TSM on particular model series for procedure on adjusting end clearance for pump involved.

D. Examine Internal Parts — Periodically remove the head, examine idler and bushing and head and pin for wear. Replacing a relatively inexpensive idler bushing and idler pin after only moderate wear will eliminate the need to replace more expensive parts at a later date. See TSM on particular model series for procedure in removing head of the pump. Be sure idler does not slide off idler pin as head is removed and drop and hurt someone or damage the part.

E. Cleaning the Pump — A clean pump is easier to inspect, lubricate, adjust, and runs cooler; plus, it looks better.

F. Storage — If a pump is to be out of service or stored for a long time, drain it and protect it from rusting inside and out.

RAPID WEAR

CAUSE	EVIDENCE	POSSIBLE SOLUTION
1. Abrasives	Gouges or marks made by large, hard particles; a rapid wearing away of bushings from very small abrasives similar to pumice; or anything in between.	Flush the system with the pump removed. Install strainer in suction line. Oftentimes after a system has run for a few cycles or a few days the dirt is pretty well cleaned out and if the pump is rebuilt into good condition it will then last for a long time.
2. Corrosion	Rust, general overall aggressive attack or sloughing off a metal.	Check the Viking General Catalog Liquid List for materials of construction recommendation. Consider whether all of the materials used in pump construction were attacked; consider other materials used in the system to determine how they resisted the liquid. Check to see whether or not the liquid has been contaminated to make it more corrosive than anticipated.
3. Exceeding operating limits	Noisy operation, broken bushings, twisted shaft, parts show evidence of high heat.	Review General Catalog for operating limits on particular model involved.
4. Insufficient extra clearance	Pump may stall. Evidence of heavy contact between end of rotor teeth and head or other parts.	Increase end clearance and/or contact your distributor or the factory with details of the application so that information regarding proper extra clearance may be provided.
5. Lack of lubrication	Noisy bearings, localized heating at bearings or lip seal, smoke, rapid bushing wear.	Be sure all zerks are greased before starting and instructions for lubrication of drive equipment are followed; consider use of auxiliary lubricating equipment.
6. Misalignment	Wear on only one part of a surface, e.g., one side of the casing, one side of the packing gland, only a portion of the face of the head.	Double check alignment of drive equipment and piping. Check the alignment under conditions as close to operating conditions as possible.
7. Run dry	Pump stalls because parts have uneven expansion caused by frictional heat; galling between surfaces having relative motion; seal seats and idler pins changing color because of high heat.	Be sure there is liquid in the system at the time of start up. Provide some kind of automatic alarm or shut-off if supply tank runs dry.

DO'S AND DON'TS

Do's and Don'ts for installation, operation, and maintenance of Viking pumps to assure safe, long, trouble-free operation.

Installation —

1. Do install pump as close to supply tank as possible.
2. Do leave working space around the pumping unit.
3. Do use large, short, and straight suction piping.
4. Do install a strainer in the suction line.
5. Do double check alignment after the unit is mounted and piping is hooked up.
6. Do provide a pressure relief valve for the discharge side of the pump.
7. Do cut out the center of gaskets used as port covers on flanged port pumps.
8. Do record pump model number and serial number and file for future reference.

Operation —

1. Don't run pump at speeds faster than shown in the catalog for your model.
2. Don't require pump to develop pressures higher than those shown in the catalog for your model.
3. Don't operate pumps at temperatures above or below limits shown in the catalog for your pump.
4. Don't operate pumps without all guards being in place.
5. Don't operate pump without a pressure relief valve on the pump or in the discharge piping; be sure valve is mounted and set correctly.
6. Don't exceed catalog limits for temperature and pressures of fluids in jacketed areas of pump.

TECHNICAL SERVICE MANUAL

INSTALLATION, START UP, TROUBLESHOOTING, PREVENTATIVE MAINTENANCE, DO'S & DON'TS

7. Don't use the pump in a system which includes a steam blow or an air or vapor blow or purge **without** provision for overspeed shutdown in case the pump starts to act as a turbine and overspeeds the drive.
8. Don't operate the pump with all of the liquid bypassing through a pump mounted internal type pressure relief valve or without any flow of liquid going through the pump for more than a couple of minutes. Operation under either of these conditions may result in a heat buildup in the pump which could cause hazardous conditions or happenings.
9. Do have spare parts, pumps or standby units available, particularly if the pump is an essential part of a key operation or process.

Maintenance —

1. Do make sure any pump that has residual system pressure in it or that has handled high vapor pressure liquids, e.g., LP-gas, ammonia, Freons, etc. has been vented through the suction or discharge lines or other openings provided for this purpose.
2. Do make sure that if the pump is still hooked to the driver while maintenance is being performed that the driver has been "locked out" so that it cannot be inadvertently started while work is being done on the pump.
3. Do make sure any pump that has handled a corrosive, flammable, hot, or toxic liquid has been drained, flushed, vented and/or cooled before it is disassembled.
4. Don't drop parts during disassembly, e.g., idler can slip from the pin as the head is removed from the pump; it may drop on your foot, plus, it may get nicked or gouged.
5. Don't stick fingers in the ports of a pump! The close running parts may trim more than your fingernails if the pump is rotated.
6. Don't spin the idler on the idler pin! Fingers may be jammed between teeth and crescent.
7. Do remember that a few simple preventative maintenance procedures such as periodic lubrication, adjustment of end clearance, examination of internal parts, etc., will extend the service life of your pump.
8. Do **obtain,** read and keep maintenance instructions furnished with your pump.

VIKING PUMP IDEX

WARRANTY

Viking warrants all products manufactured by it to be free from defects in workmanship or material for a period of one (1) year from date of startup, provided that in no event shall this warranty extend more than eighteen (18) months from the date of shipment from Viking. If, during said warranty period, any products sold by Viking prove to be defective in workmanship or material under normal use and service, and if such products are returned to Viking's factory at Cedar Falls, Iowa, transportation charges prepaid, and if the products are found by Viking to be defective in workmanship or material, they will be replaced or repaired free of charge, F.O.B. Cedar Falls, Iowa.

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Equipment and accessories purchased by Viking from outside sources which are incorporated into any Viking product are warranted only to the extent of and by the original manufacturer's warranty or guarantee, if any.

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DISASSEMBLY

DANGER

BEFORE OPENING ANY VIKING PUMP LIQUID CHAMBER (PUMPING CHAMBER, RESERVOIR, JACKET, ETC.) BE SURE:

1. THAT ANY PRESSURE IN CHAMBER HAS BEEN COMPLETELY VENTED THROUGH SUCTION OR DISCHARGE LINES OR OTHER APPROPRIATE OPENINGS OR CONNECTIONS.
2. THAT THE DRIVING MEANS (MOTOR, TURBINE, ENGINE, ETC.) HAS BEEN "LOCKED OUT" OR MADE NON-OPERATIONAL SO THAT IT CANNOT BE STARTED WHILE WORK IS BEING DONE ON PUMP.

FAILURE TO FOLLOW ABOVE LISTED PRECAUTIONARY MEASURES MAY RESULT IN SERIOUS INJURY OR DEATH.

Mark valve and head before disassembly to insure proper reassembly.

1. Remove valve cap.
2. Measure and record length of extension of adjusting screw. Refer to "A" on Figures 13 and 14.
3. Loosen locknut and back out adjusting screw until spring pressure is released.
4. Remove bonnet, spring guide, spring and poppet from valve body. Clean and inspect all parts for wear or damage and replace as necessary.

ASSEMBLY

Reverse procedures outlined under Disassembly. If valve is removed for repairs, be sure to replace in same position. Relief valve adjusting screw cap must *always* point towards suction side of pump. If pump rotation is reversed, remove relief valve and turn end for end. Refer to Figure 5, page 2.

DANGER

BEFORE STARTING PUMP, BE SURE ALL DRIVE EQUIPMENT GUARDS ARE IN PLACE.

FAILURE TO PROPERLY MOUNT GUARDS MAY RESULT IN SERIOUS INJURY OR DEATH.

PRESSURE ADJUSTMENT

If a new spring is installed or if pressure setting of pressure relief valve is to be changed from that which the factory has set, the following instructions must be carefully followed.

1. Carefully remove valve cap which covers adjusting screw.

   Loosen locknut which locks adjusting screw so pressure setting will not change during operation of pump.
2. Install a pressure gauge in discharge line for actual adjustment operation.
3. Turn adjusting screw in to increase pressure and out to decrease pressure.
4. With discharge line closed at a point beyond pressure gauge, gauge will show maximum pressure valve will allow while pump is in operation.

IMPORTANT

In ordering parts for pressure relief valve, always give model number and serial number of pump as it appears on nameplate and name of part wanted. When ordering springs, be sure to give pressure setting desired.

VIKING PUMP HOUDAILLE™

WARRANTY

Viking warrants all products manufactured by it to be free from defects in workmanship or material for a period of one (1) year from date of startup, provided that in no event shall this warranty extend more than eighteen (18) months from the date of shipment from Viking. If, during said warranty period, any products sold by Viking prove to be defective in workmanship or material under normal use and service, and if such products are returned to Viking's factory at Cedar Falls, Iowa, transportation charges prepaid, and if the products are found by Viking to be defective in workmanship or material, they will be replaced or repaired free of charge, F.O.B. Cedar Falls, Iowa.

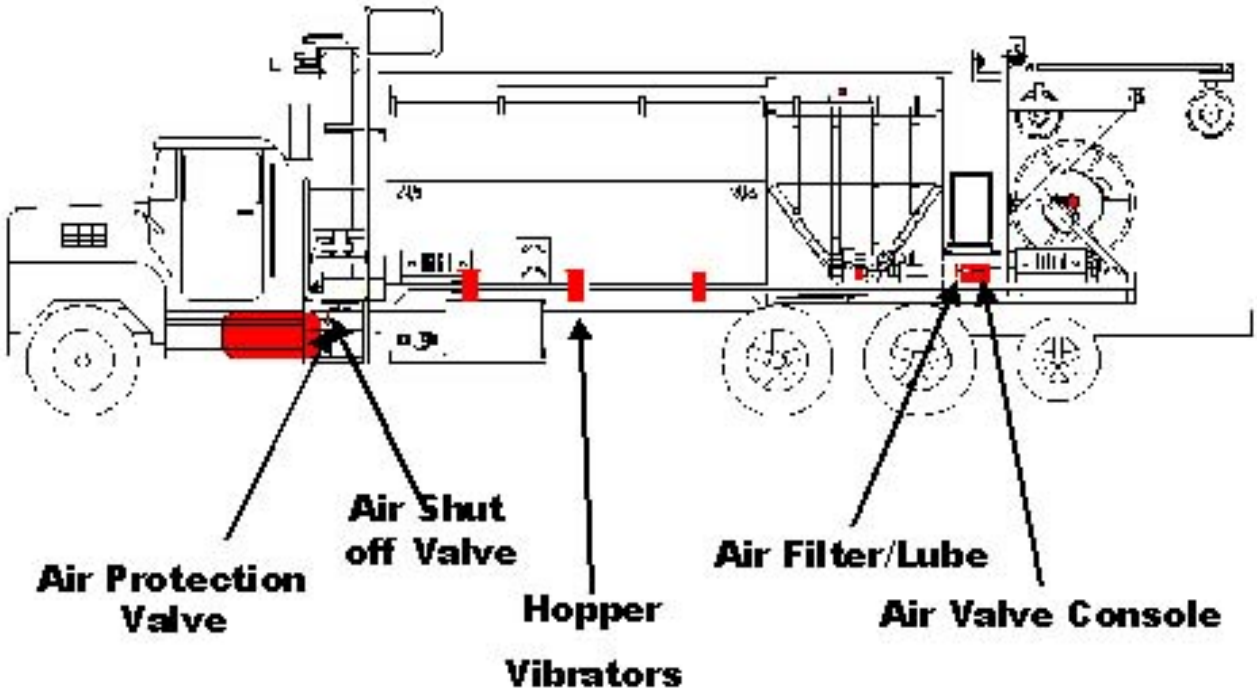
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Equipment and accessories purchased by Viking from outside sources which are incorporated into any Viking product are warranted only to the extent of and by the original manufacturer's warranty or guarantee, if any.

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Hopper Vibrator System

Component Location

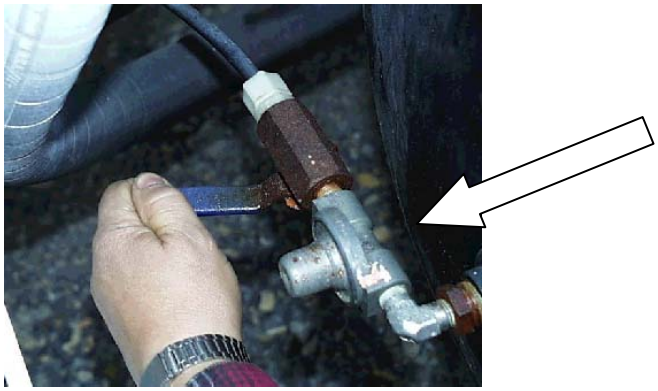


Treadbed trucks vary in individual configuration so component locations may vary from truck to truck.

Operation

1. Open the air shut off valve, located near the air tank. The valve is in the open position when the handle of the valve is in line with the body of the valve
2. Press and hold the air valve on the air control console marked vibrators. There is a valve for each AN hopper compartment. Release the valve, and it will spring return to the neutral position.
3. Close the air shut off valve after using the hopper vibrators.

Air Protection Valve



The air protection valve is located near the truck cab and is just adjacent to the air reservoir. Its purpose is to protect the truck chassis's air system. Should the Treadbed body develop an air leak, it will not draw down air pressure below 70 psi. Maintaining air pressure is important for proper brake operation. The Air protection Valve requires little maintenance. The operator should periodically check for and visual damage to the unit and its plumbing. Check for air leaks on each side of the valve.

Air Filter and Lubricator



The Air filter and lubricator is located adjacent to the air valve console. The location of the air valve console varies, but is always fender mounted.
The Air filter removes dirt particles from the incoming air stream. These irt particles could damage the air-operated components. Therefore it is important to keep the air filter cartridge clean. The Lubricator adds special oil into the air stream after it has been filtered. This oil will lubricate the moving parts of all air-operated parts. Specifically, the Air Filter has two-stage filtration. The larger dirt particles are caught in the filter bowl. These collect in the filter bowl. The smaller particles are caught in the filter element. To maintain peak filter efficiency, keep the filter element clean. A dirty air filter will reduce air pressure. If the filter element has a light coating of dirt, clean or replace it.

An Important Safety Note.

Compressed air is very dangerous. Never remove an air-operated component without first shutting off the air supply first. This is done by moving the handle of the shut off ball valve perpendicular to the valve body. This isolates the Treadbed Air system. To inspect or replace the air filter element, the filter bowl must first be removed. The bowl is removed by unscrewing it from the body. Once the bowl is loose, pull it straight off the cartridge. The filter element also screws off. Pull

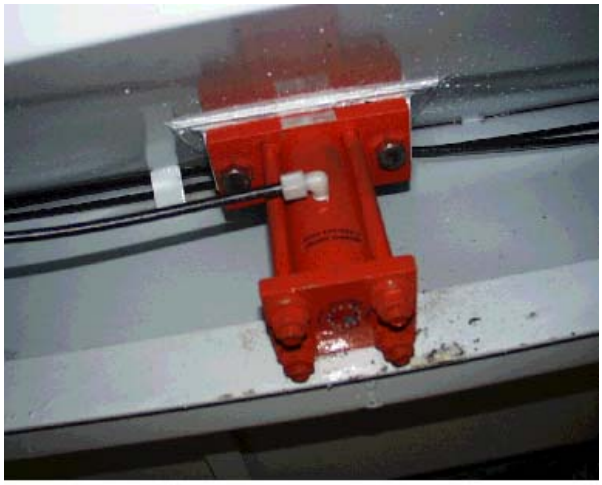
down while turning. The filter element fits very tight. Once the element is free, study its condition. Discoloration indicates that the pores of the element are dirty. The element can be cleaned in a mild detergent solution. Very dirty elements should be replaced. The large particles that are collected in the filter bowl can be drained without removing the filter bowl. The valve screw on the bottom of the bowl turns clockwise to open. Allow the fluid to drain out. Close the valve back before returning it to operation. Drain the filter bowl before the liquid reaches the lower baffle inside the filter bowl.

Air Control Console



The air control console is fender mounted. Air console locations will vary from truck to truck. The Air Valve console is the mounting location for the individual air valves. These valves each have a knob to actuate the function on the truck. The console also contains an air pressure gauge to measure the incoming air pressure from the truck. Individual Air valves are used to actuate certain truck functions. The Air Valve has a body with a "spool" connected to a red knob. The spool moves through the valve body closing and opening passageways for the air supply. This way the air can be directed to the right side of the air actuator used on the vehicle. There are basic types of air valves used on the trucks. "Spring Return" types are used for momentary air supply (while the handle is depressed). The spool will return to the original position after pressure to the handle is removed. "Detent" types are for air functions that need to remain open or closed for longer periods of time. The valve spool will remain in position. The Air Valve can be disassembled for inspection and cleaning should it begin to stick or leak. This procedure can be done without the valve removed from its stack or individually. Unscrew jam nut and pull knob and spool out of the body. Look closely at the o-ring. Dirt or a cut O-ring may cause the air to escape by. Clean dirt from the o-ring and lubricate the o-ring again with grease. Replace a cut o-ring. Reassemble valve.

Vibrator

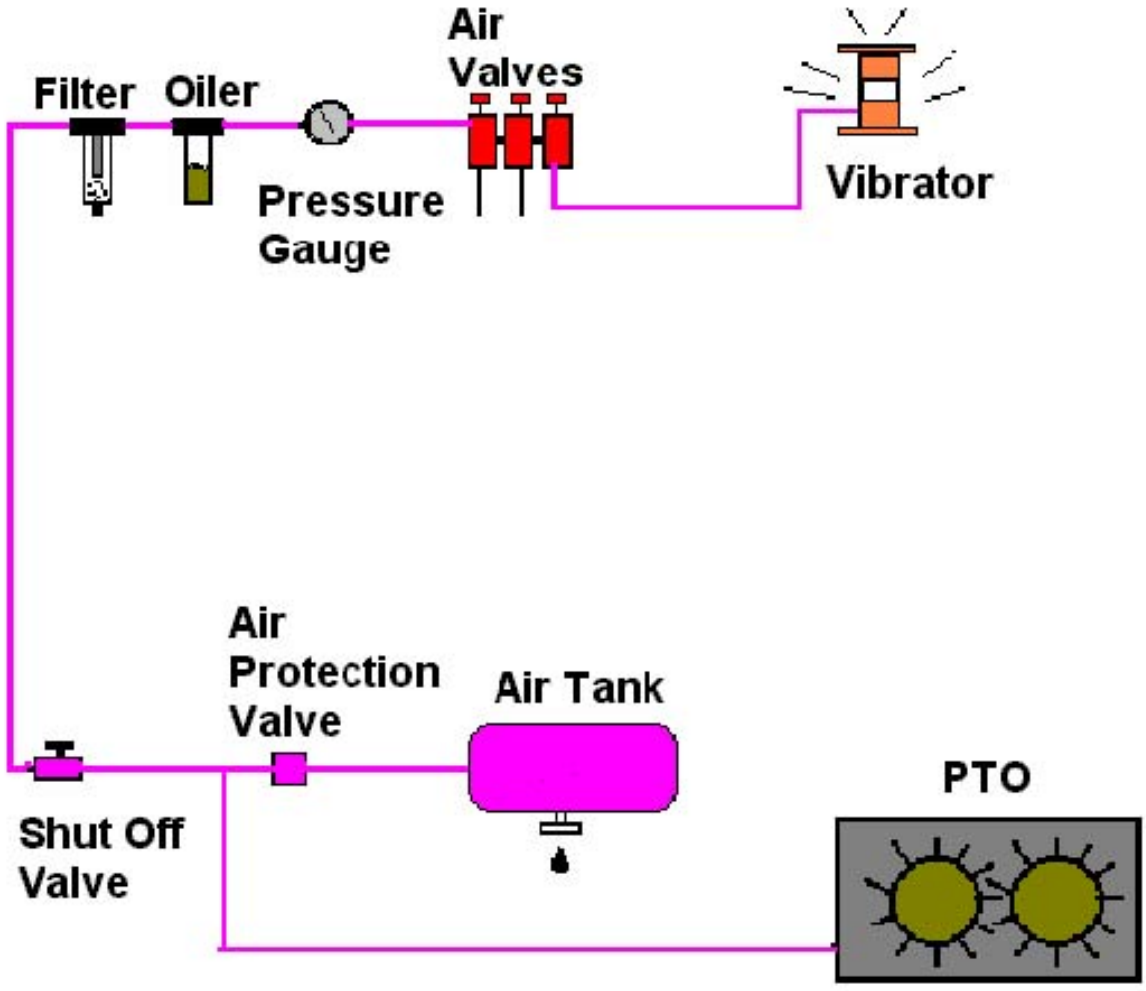


View from under truck

The vibrator has a mounting pad on the bottom slope of the Anfo bin. The mounting bolts must be regularly tightened since the vibrations can loosen them. The air connection should also be checked to tightness and air tube cracking. Unclean air will diminish the

life considerably and clog the 3-4/1000 clearance between cylinder and piston. Water in the line will diminish the protection of the oily air necessary to make the unit operate properly. Water, dirt and airline rust at air pressures over 80 psi will create a smear similar to grinding compound and will wear down the cylinder and piston very fast. No oil in the air will wear down the piston and cylinder very quickly, often in as little as 8 hours.

Vibrator circuit



PNEUMATIC PISTON TYPE

Uniquely designed FLANGE-MOUNTED vibrators develop greater output energy per cubic foot of air consumed at all pressures than any previous or competitive models.

CONSTRUCTION & OPERATION: Series 50 vibrators are constructed of fatigue-resistant steel alloys which are heat treated to guarantee long service under high stress conditions. The flat base plate provides an efficient means of transmitting the shock energy to the system which is developed by the reciprocating piston. The repetitive hammer action of the vibrator on the apparatus to which it is attached is controllable by regulating the applied air pressure.

Series 50 vibrators are available in the High Impact (Standard), High Amplitude (L), Silent Operating (S), and High Temperature (H) models, all of which can be equipped with Dustproofers. Models are available in the following bore sizes: 1", 1-1/4", 1-1/2", 2", 3", and 4". Other models are: Model 10, 20, 30, 40, 42, 43, 44--all following these service instructions.

HIGH IMPACT VIBRATORS: This standard model provides much higher impact than competitive and end-mounting vibrators and yet it is lighter in weight. Through the use of a new shock isolation assembly design, bolt fatigue problems are eliminated in these flange-mounted vibrators. Close tolerance construction results in reduced air consumption and increased efficiency.

HIGH AMPLITUDE (L) VIBRATORS: Certain applications require a low impact but a high reciprocating momentum action. These requirements can be satisfied through the use of high amplitude models. This type of action is usually necessary for the movement of dry materials of low density and high surface area.

"SILENT" OPERATING (S) VIBRATORS: This model is utilized in areas where noise is objectionable and may affect production. Its high thrust action permits operation at low air pressures. When used in place of an impacting model, the next larger size should be employed.

HIGH TEMPERATURE (H) VIBRATORS: This model is available upon special request for use on high temperature applications up to 600°F. It is also designed to function under conditions of marginal lubrication.

IMPORTANT CONSIDERATIONS FOR LONG OPERATING LIFE.

1. Always blow out the airline before attaching it to the vibrator.
   - A. UNCLEAN AIR will diminish the life considerably and clog the 3-4/1000 clearance between cylinder and piston.
   - B. UNCLEAN AIR will increase the wear of the piston which will increase the air consumption and diminish vibrator efficiency.
   - C. WATER IN THE LINE will diminish the protection of the oily air necessary to make the unit operate properly.

D. WATER, DIRT & AIR LINE RUST at air pressures over 80 PSI will create a smear similar to grinding compound and will wear down the cylinder and piston very fast.

2. Piston vibrators must be lubricated. Use SAE-10, or lighter.

   A. NO OIL in the air will wear down the piston and cylinder walls very quickly, even perhaps in less than 8 hours.

   B. IN VERY COLD OPERATION, mix antifreeze or kerosene with the oil.

   C. INJECT a small quantity of kerosene directly into the vibrator ocassionally to clean out accumulated sludge.

3. Make sure air pressure is not higher than 80 PSI.

   A. AIR PRESSURE in excess of 80 PSI will increase the velocity of the piston, diminishing the protective oil film and increasing the unit wear.

PISTON REPAIRS

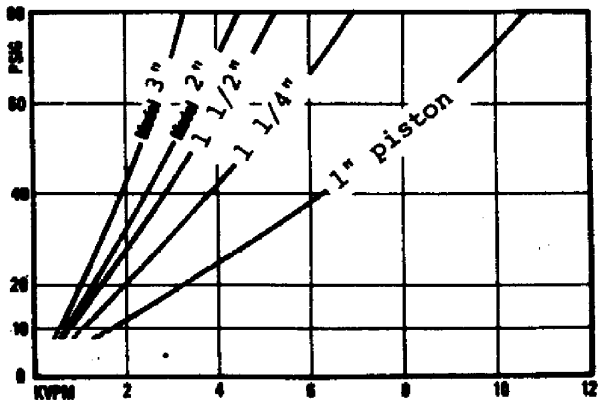
Field repairs of piston vibrators are limited to replacing bolts, nuts, washers, and rubber shocks. Any other repairs should be done at the factory. Once the piston and cylinder have worn down, the cylinder can be rebored and the piston replaced with an oversized one.

A. BOLT BREAKAGE is caused by:

   (1) Air pressure in excess of 80 PSI.
   (2) Loose mounting bolts.
   (3) Excessive movement of vibrator on hopper or bin caused by:
      (a) Too flexible hopper or bin that cannot absorb vibration created.
      (b) Operation on empty hopper.
   (4) Dried up rubber buffers. Buffers are used to absorb shock energy and prolong bolt life. Through aging the buffers will take a "set" and deteriorate. It is advisable to replace all buffers and bolts at this time.

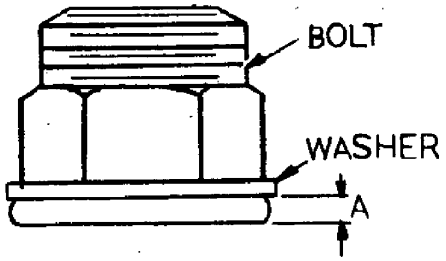
B. REPLACE BUFFERS following these instructions. The bolts are not torqued but tightened to compress the buffers to dimension "A" below:

Vibrator Frequency vs. Applied Air Pressure



The above data is for standard models only. Technical data concerning amplitude, frequency, force and air consumption for High Amplitude (L) Vibrators is available

MODEL	DIMENSION "A"
50-1"	3/16
50-1-1/4"	7/32
50-1-1/2"	9/32
50-2"	1/4
50-2L"	1/4
50-3"	5/16
50-3L"	5/16
50-4"	3/4



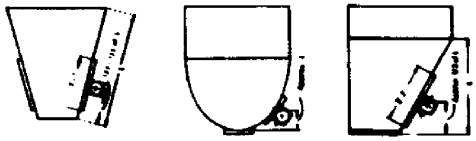
VIBCO INC.

MOUNTING AND SERVICE INSTRUCITONS FOR PNEUMATIC, TURBINE & BALL & ROTARY VIBRATORS

A. MOUNTING

1. PLACEMENT

a) for coarse materials, mount vibrator 1/3 up the bin side from the discharge.
b) for fine materials 1/4 up



2. MOUNTING CHANNEL

Never place the vibrator directly on the skin of the bin. It is either mounted to a plate or a channel iron, welded to the bin. The plate should be 1/3 to 1/4" thick and extend 3 - 4" outside the vibrator, for the smaller vibrators with impacts up to 100 lbs. For vibrators up to 500 lbs. force, use a 3/8 to 1/2" thick plate and 6 - 8" larger than the vibrator. For vibrators with a force over 500 lbs., use a 1/2' - 5/8" thick plate 8 - 12" larger than the vibrator. The preferable mounting is to use a 3 or 4" channel iron, which will not only help to stiffen up the structure to be vibrated but also spread the vibration over a larger surface, increasing the overall efficiency and diminishing the possibilities of fatigue cracks in the bin material. THE LENGTH OF THE CHANNEL IRON is determined by the thickness of the bin plate. for 3/16" - 3/8" plate, the channel iron should be 1 - 2' long under 3/16", 1-1/2 - 3' long, over 3/8" it need only be 8 - 12". The above for vibrators with a force up to 500 lbs. For vibrators with forces from 500 - 1000 lbs., add 1 - 1-1/2' to the channel iron.

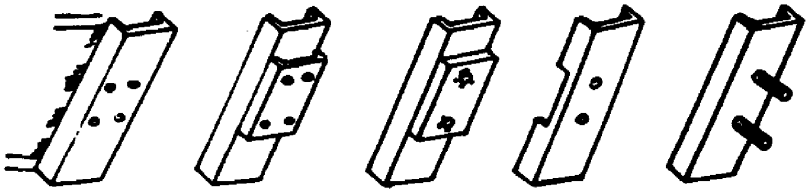
3. WELDING MOUNTING PLATE TO CHANNEL IRON

Weld the mounting plate to the middle of the channel iron. If bin plate is 3/16" or less, weld the mounting plate to the back of the channel iron, if bin plate is over 3/16" weld mounting bracket to the legs of the channel iron. Make sure bracket does not warp. If it did straighten it out or replace it.

4. DIFFERENT SUGGESTIONS FOR MOUNTING CHANNEL

NOTE Always stop welds 1" from ends, to prevent a heat concentration and bin cracks, skip weld channel weld 2 - 3" ship 1 - 2".

a) 3 or 4" channel with holes or nuts welded on back side
b) Add mounting plate and tap 2 holes
c) Notch the channel for access to mounting bolts
d) Weld studs to back of channel



5. WELDING CHANNEL IRON TO BIN

Where possible the mounting plate on the channel iron should be placed 1/3 to 1/4 of the distance L. on the bin. Tack weld channel iron in place, then weld intermittent welds 3 - 6" long with 3" between them. NOTE STOP WELDS AT LEAST 1" FROM THE ENDS OF THE CHANNEL IRON – DO NOT WELD THE ENDS. The heat concentration when welding the ends could cause crystallization of the metal and the start of fatigue cracks.

6. INSTALLATION OF VIBRATOR

THE VIBCO vibrator is now put in place. Make sure it is secured tightly. Retighten the bolts after the first 10 - 15 minutes of running, then check them periodically for tightness. NOTE: A loose vibrator can cause damage to the bin and itself. It is also advisable to install a safety chain or wire in case the vibrator works itself loose.

7. TO OBTAIN MAXIMUM PERFORMANCE

It is not necessary to operate the vibrators at their maximum capability to obtain maximum performance, as well as you do not drive your car at maximum speed because it has that capability. Air regulators, timers, etc. should be used to tune the vibration for optimum performance and to save operating dollars and the equipment for longer life.

8. CONTINUOUS VERSUS INTERMITTENT OPERATION

For bulk material handling applications the vibrator should be used to reduce the material friction not as a feeder.

Once the friction of the particles have been reduced, gravity flow occurs and the vibrator has performed the function it should then be shut off for several reasons:

a) ECONOMY. Power is a cost of production and is increasing every year.

Most vibrators run up to 60 - 80% of the time longer than they should. They run for the full time the bin is being activated. If the vibrator has performed its function, why leave it on? A great amount of energy is wasted.

Rotary vibrators produce enough force that short bursts of vibration are usually more effective than operating continuously. Experience has shown that for most applications short bursts of only 10 to 30 seconds for each 1 to 5 minutes of discharge are more effective and efficient.

b) LIFE OF THE UNIT. The life of the vibrator will be extended to the same degree that the power is conserved.

c) GUARANTEE SUCCESS OF THE APPLICATION. The vibrator can only furnish material to the discharge area. If more material is furnished than conveyed, the remaining material will pack in the bin.

We suggest the vibrators only run when the gates or doors are open on the bin, or when material flow is desired.

9. AIR LINE TO VIBRATOR

The hose to the vibrator should have the same or larger hose ID as the inlet ID (pipe size) of the vibrator, so that the pressure loss from the compressor to the vibrator is minimized.,

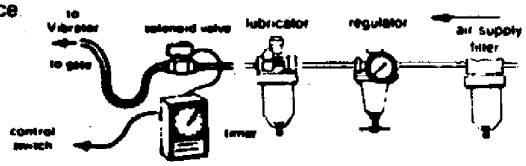
10. FLOW VALVE

A simple Flow Control Valve is recommended to allow "tuning" the vibrator to the desired force necessary for solving your material flow problem. The flow volume determines the force and frequency of the vibrator. By throttling the flow, you can "find" the desired material discharge rate and avoid the natural frequency of the bin or hopper. You should watch for and avoid speeds (frequency) at which the bin wall and vibrator shake violently. A simple increase or decrease of the speed will (assuming the amount is rigid) usually cause them to smooth out and run with a minimum of movement.

11. QUICK OPENING VALVES

These are recommended between the air regulator and the vibrator so that the air enters the vibrator with full starting force even at low regulator valve settings. The only requirement is that you install the air regulator at some distance from the quick-opening valve so that the air pressure between the two valves will build up enough to yield the necessary starting force.

Solenoid (quick opening) valves are recommended for automatic operations. Automatic Timed Cycling is diagrammed below with the timer usually directly connected to the bin or hopper gate switch. When the gate is opened, the timed cycling system is activated.



12. AIR LUBRICATOR

Lubrication is only to be used for Rotary and ball vibrators, not for turbines (they have prelubricated bearings). Adjust lubricator to 5 drops of oil per minute.

13. AIR FILTER

Use an air cleaner in the line. Clean air will prolong the life of any pneumatic vibrator. Dirty or moist air will harm the unit and impair it from operating at maximum efficiency and lowest energy consumption.

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Hydraulics

 ***WARNING *** the surface of the hydraulic components can become very hot. The hydraulic oil tank has a "hot surface".***

The objective of this section is to provide you with a working knowledge of our STANDARD bulk truck hydraulic system. By STANDARD, we mean the traditional gear pump hydraulic systems found on the majority of Tread bulk trucks. *We include this section with the Proportional pumps also (for informational purposes).*

In order to understand the hydraulic system, we will discuss the function of the individual components that make up the system.

As we discuss each of the hydraulic system components, our focus will include the following points:

1. The operation of all controls

2. Safety considerations

3. Daily inspection and maintenance requirements

On-the-bench troubleshooting and repair

Two of the most frequently used words in the vocabulary of hydraulics are the terms PRESSURE and FLOW. It helps to understand just what these terms mean.

1. Pressure is a measure of the force that the hydraulic oil pushes with. Pressure is defined as force of hydraulic fluid per unit area and is usually measured in pounds per square inch, or PSI. This means the force in pounds that pushes on a one square inch area.

2. Flow is a measure of the volume of hydraulic fluid passing a point in a given amount of time.

Flow is defined as volume per unit time and is typically measured in gallons per minute, or GPM.

It is pressure that produces force, while it is flow that produces movement.

One of the first indications of an improperly functioning system will be the pressure reading of the console pressure gauges. For a normally operating system delivering material at the design rate (1000 lbs/min for overhead boom trucks and 1500 lbs/min for side boom trucks), the pressure reading should be about 1500 PSI for the bottom auger and 1700 PSI for the vertical or incline augers. Under the no-load condition (i.e. no material being conveyed but the augers engaged), the pressure readings should be about 1/2 of that when conveying material.

Flow information can only be determined with a flow meter installed in the hydraulic line. Standard TREADBEDS have a two-section pump that delivers 12 GPM and 8 GPM at approximately 1000 engine RPM.

The only way to adequately test a hydraulic system is from information about both the flow and pressure. Therefore, in order to obtain the data for a proper evaluation of the hydraulic system, it is necessary that a flow meter/pressure gauge test kit be used. The flow meter should be of the in-line variety and should read from about 1 GPM to 15 GPM. The pressure gauge should read 0 to 4000 PSI.

Hydraulic Fluid Components

Our review of the hydraulic system will begin with the components that produce and convey power.

1. The power take-off draws power from the engine.

2. The hydraulic pump converts engine power into hydraulic fluid pressure and flow.

3. The hydraulic tubing conveys hydraulic fluid through the system.

The hydraulic reservoir and filters store and condition the hydraulic fluid.

In order to understand how to operate the hydraulic system, we will need to pay particular attention to the components that control the hydraulic fluid.

1. Pressure control valves are used to limit the pressure of hydraulic fluid.

2. Flow control valves are used to control the flow of hydraulic fluid.

Directional control valves are used to start, stop, and control the direction of fluid flow.

Reservoir and Filters



Make certain that the replacement filter is equivalent to the original equipment. On all return line filters, the filter element is 30-micron size. These filters are found on the main hydraulic return lines at the hydraulic fluid reservoir.

Components

Tank of 40 to 60 gallon capacities, with suction strainer.
Return line filter.
Suction line valves.
Filler and breather cap.
Level and temperature gauge.



Function and Operation

Filters the oil.
Helps cool the oil.
Allows air bubbles to escape from the oil.
Supplies oil to make up for leaks.

Safety

Tank surfaces may be hot.

Inspection

Check fluid level daily.
Check fill cap secure daily.
Check valves open daily.

Maintenance

Replace filter when engine is serviced.
Replace fluid every two years.

Troubleshooting and Repair

Hydraulic oil temperature exceeds 150 °F.
Look for a problem in the hydraulic system.
Hydraulic oil temperature exceeds 180 °F.

Stop operation until repaired.

Hydraulic fluid

Hydraulic fluids serve three main functions:

1. Fluid under pressure provides the linear force to push, pull or rotate mechanical components. It is often referred to as the “working fluid”.

2. It lubricates the components of the hydraulic system, especially the bearings in pumps and motors.

3. It acts as a sealant by helping to prevent dirt from reaching mechanical components.

CAUTION: HYDRAULIC OIL CAN REACH TEMPERATURES OF 180°F IN LESS THAN 30 MINUTES OF OPERATION. AT THIS TEMPERATURE, CONTACT WITH THE SKIN WILL EASILY CAUSE SECOND DEGREE BURNS. EXERCISE CAUTION WHEN WORKING AROUND HOT HYDRAULIC FLUID.

Hydraulic Fluid Selection

The efficiency of the system, the cost of maintenance and the service life of the components depend upon the selection of the proper hydraulic fluid. Hydraulic fluids are formulated to protect the hydraulic system against rust, wear, oxidation and foam.

Industrial grade anti-wear hydraulic oil is installed in the hydraulic reservoir at the factory. This oil is formulated to protect the hydraulic system against rust, wear, oxidation and foam. The hydraulic oil level should be checked daily at the pre-shift inspection and should be visible through the sight glass on the hydraulic reservoir.

Oil operating temperature is the main factor in determining the weight, or Viscosity Grade, of oil to use. The following chart shows ISO-VG to use for different oil temperatures. SAE grades are listed for reference.

Oil Temperature Range, °F	ISO VG	SAE Grade
35° - 120°	32	5
55° - 140°	46	10
75° - 160°	68	20
95° - 180°	100	30

Our standard hydraulic oil is VG-68 which is acceptable for the majority of conditions and oil temperatures experienced after normal system warm-up. For operation in extreme cold, it may be desirable to drain the reservoir and refill with the thinner VG-32 oil. However, it will likely be necessary to change back to VG-68 for summertime operation.

Although not recommended, multi-grade automotive engine oils can be used in the hydraulic system if hydraulic oil is not available. SAE 10W/40, API classification SE or SG, may be used with the expectation of more frequent filter changes. Also, multi-grade oils will tend to loose viscosity with use and will need to be changed more frequently.

Hose &Tubing



Conveys hydraulic oil through the system.
Contains hydraulic fluid under pressure.
Helps cool the oil.

Safety

WARNING! Hot hydraulic oil at 3000 PSI can cause serious injury.
DO NOT OPERATE with visible defects.
DO NOT OPERATE with loose fittings.

Inspection and Maintenance

Check for visible defects.
Check for tight fittings.

CAUTION: A DOUBLE WIRE BRAID HOSE SHOULD NEVER BE USED FOR A VACUUM (SUCTION) LINE. IN A VACUUM, THE INNER LINER OF A DOUBLE BRAID HOSE MAY PULL AWAY FROM THE OUTER LINER AND COLLAPSE. THIS WILL CLOG THE INLET TO THE PUMP AND CAUSE SEVERE DAMAGE. USE ONLY HOSE THAT IS DESIGNED FOR SUCTION LINE APPLICATIONS.

Eaton®
Hydraulic Fluid Recommendations

No. 3-401
November, 1996

EATON

Technical Data

Introduction
The ability of Eaton hydraulic components to provide the desired performance and life expectancy depends largely on the fluid used. The purpose of this document is to provide readers with the knowledge required to select the appropriate fluids for use in systems that employ Eaton hydraulic components.

One of the most important characteristic to consider when choosing a fluid to be used in a hydraulic system is **viscosity.** Viscosity choice is always a compromise; the fluid must be thin enough to flow easily but thick enough to seal and maintain a lubricating film between bearing and sealing surfaces. Viscosity requirements for each of Eaton's product lines are given on the back of this document.

Viscosity and Temperature
Fluid temperature affects viscosity. In general, as the fluid warms it gets thinner and its viscosity decreases. The opposite is true when fluid cools. When choosing a fluid, it is important to consider the start-up and operating temperatures of the hydraulic system. Generally, the fluid is thick when the hydraulic system is started. With movement, the fluid warms to a point where a cooling system begins to operate. From then on, the fluid is maintained at the temperature for which the hydraulic system was designed. In actual applications this sequence varies; hydraulic systems are used in many environments from very cold to very hot. Cooling systems also vary from very elaborate to very simple, so ambient temperature may affect operating temperature. Equipment manufacturers who use Eaton hydraulic components in their products should anticipate temperature in their designs and make the appropriate fluid recommendations to their customers.

Cleanliness
Cleanliness of the fluid in a hydraulic system is extremely important. Eaton recommends that the fluid used in its hydraulic components be maintained at ISO Cleanliness Code 18/13 per SAE J1165. This code allows a maximum of 2500 particles per milliliter greater than 5 µm and a maximum of 80 particles per milliliter greater than 15 µm. When components with different cleanliness requirements are used in the same system, the cleanliest standard should be applied. OEM's and distributors who use Eaton hydraulic components in their products should provide for these requirements in their designs. A reputable filter supplier can supply filter information.

Fluid Maintenance
Maintaining correct fluid viscosity and cleanliness level is essential for all hydraulic systems. Since Eaton hydraulic components are used in a wide variety of applications it is impossible for Eaton to publish a fluid maintenance schedule that would cover every situation. Field testing and monitoring are the only ways to get accurate measurements of system cleanliness. OEM's and distributors who use Eaton hydraulic components should test and establish fluid maintenance schedules for their products. These maintenance schedules should be designed to meet the viscosity and cleanliness requirements laid out in this document.

Fluid Selection
Premium grade petroleum based hydraulic fluids will provide the best performance in Eaton hydraulic components. These fluids typically contain additives that are beneficial to hydraulic systems. Eaton recommends fluids that contain anti-wear agents, rust inhibitors, anti-foaming agents, and oxidation inhibitors. Premium grade petroleum based hydraulic fluids carry an ISO VG rating.

SAE grade crankcase oils may be used in systems that employ Eaton hydraulic components, but it should be noted that these oils may not contain all of the recommended additives. This means using crankcase oils may increase fluid maintenance requirements.

Hydraulic fluids that contain V.I. (viscosity index) improvers, sometimes called multi-viscosity oils, may be used in systems that employ Eaton hydraulic components. These V.I. improved fluids are known to "shear-down" with use. This means that their actual viscosity drops below the rated value. Fluid maintenance must be increased if V.I. improved fluids are used. Automotive automatic transmission fluids contain V.I. improvers.

Synthetic fluids may be used in Eaton hydraulic components. A reputable fluid supplier can provide information on synthetic fluids. Review applications that require the use of synthetic fluids with your Eaton representative.

Viscosity Requirements

Product Line	* Minimum	Optimum Range	Maximum	ISO Cleanliness Requirements	Comments
Heavy Duty Piston Pumps and Motors	45 SUS [6 cSt]	60 - 180 SUS [10 - 39 cSt]	10,000 SUS [2158 cSt]	18/13	
Medium Duty Piston Pumps and Motors Charged Systems	45 SUS [6 cSt]	60 - 180 SUS [10 - 39 cSt]	10,000 SUS [2158 cSt]	18/13	
Medium Duty Piston Pumps and Motors Non-charged Systems	60 SUS [10 cSt]	60 - 180 SUS [10 - 39 cSt]	2,000 SUS [432 cSt]	18/13	
Light Duty Transaxles, Transmissions, Pumps and Series 1150 Transaxles	60 SUS [10 cSt]	80 - 180 SUS [16 - 39 cSt]	10,000 SUS [2158 cSt]	18/13	Automotive multi-viscosity oils and ATF are not recommended
Series 2030 Motor Axles	70 SUS [13 cSt]	100 - 200 SUS [20 - 43 cSt]	10,000 SUS [2158 cSt]	18/13	Automotive multi-viscosity oils and ATF are not recommended
Char-Lynn J, R, and S Series Motors, and Disc Valve Motors	70 SUS [13 cSt]	100 - 200 SUS [20 - 43 cSt]	10,000 SUS [2158 cSt]	18/13	
Char-Lynn A Series and H Series Motors	100 SUS [20 cSt]	100 - 200 SUS [20 - 43 cSt]	10,000 SUS [2158 cSt]	18/13	
Char-Lynn Steering Control Units, Priority and Control Valves	55 SUS [9 cSt]	100 - 200 SUS [20 - 43 cSt]	10,000 SUS [2158 cSt]	18/13	When emergency manual steering is required, maximum viscosity is 2,000 SUS [450 cSt]
Gear Pumps and Motors, and Cylinders	45 SUS [6 cSt]	60 - 200 SUS [10 - 43 cSt]	10,000 SUS [2158 cSt]	18/13	

*** MINIMUM VISCOSITY APPLIES AT INTERMITTENT CONDITION OF 10% OF EVERY MINUTE.**

Additional Notes:

- Fluids too thick to flow in cold weather start-ups will cause pump cavitation and possible damage. Motor cavitation is not a problem during cold start-ups, except for two speed motors. Thick oil can cause high case pressures which in turn can blow motor shaft seals.
- When choosing a hydraulic fluid, all the components in the system must be considered and the optimum viscosity range adjusted accordingly. For example, when a medium duty piston pump is combined with a Geroler motor the optimum viscosity range becomes 100 - 150 SUS [20 - 32 cSt] and viscosity should never fall below 70 SUS [13 cSt].
- If the natural color of the fluid has become black it is possible that an overheating problem exists.
- If the fluid becomes milky, water contamination may be a problem.
- Take fluid level reading when the system is cold.
- Contact your Eaton representative if you have specific questions about the fluid requirements of Eaton hydraulic components.

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EATON

Eaton®

Biodegradable Oil (Vegetable) Guidelines

No. 3-405
October, 1994

EATON

Technical Data

Product Line	Rating With Biodegradable Oil	Comments
Heavy Duty Piston Pumps and Motors	80% of normal pressure rating listed for mineral oils in Eaton Publications No. 5-410.	80° C (176° F) max fluid temp (unit) 70° C (158° F) max fluid temp (reservoir)
Medium Duty Piston Pumps and Motors	80% of normal pressure rating.	80° C (176°F) max fluid temp (unit) 70° C (158°F) max fluid temp (reservoir)
Light Duty Transmissions, Pumps, and Model 1150 Transaxle	90% of normal pressure or torque rating listed for mineral oils in Eaton Publications Nos. 11-880 and 11-873.	60° C (140° F) max fluid temp (unit)
Models 751, 851, 771, and 781 Transaxles	90% of 16:1 drive ratio torque rating, 75% of 19:1 drive ratio torque rating, and 60% of 23:1 drive ratio torque rating listed for mineral oils in Eaton Publication No. 11-888	60° C (140° F) max fluid temp (unit)
Series 2030 Motor Axles	60% of normal pressure rating listed for mineral oils in Eaton Publication No. 11-878 for 2000 Series Disc Valve Motors	60° C (140° F) max fluid temp (unit)
Disc and Spool Valve Motors	60% of normal pressure rating listed for mineral oils in Eaton Publication Nos. 11-878 and 11-885	60° C (140° F) max fluid temp (unit)
Steering Valves, Control Valves, and Cylinders	100% of standard Eaton catalog or product pressure rating.	Maintain unit fluid temperature between -18° C (0° F) and 80°C (176° F)
Gear Pumps and Motors	80% of normal pressure rating.	80° C (176° F) max fluid temp (unit) 70° C (158° F) max fluid temp (reservoir)

ADDITIONAL NOTES:

- Viscosity and ISO cleanliness requirements must be maintained as outlined on the next page..
- Based on limited product testing to date, no reduction in unit life is expected when operating at the pressure ratings indicated above.
- Vegetable oil is miscible with mineral oil. However, only the vegetable oil content is biodegradable. Systems being converted from mineral oil to vegetable oil should be repeatedly flushed with vegetable oil to ensure 100% biodegradability.
- Specific vegetable oil products may provide normal unit life when operating at pressure ratings higher than those indicated above.

Viscosity Requirements

Product Line	Minimum	Optimum Range	Maximum	ISO Cleanliness Requirements	Comments
Heavy Duty Piston Pumps and Motors	60 SUS [10 cSt]	80 - 180 SUS [16 - 39 cSt]	10,000 SUS [2158 cSt]	18/13	
Medium Duty Piston Pumps and Motors Charged Systems	45 SUS [6 cSt]	60 - 180 SUS [10 - 39 cSt]	10,000 SUS [2158 cSt]	18/13	
Medium Duty Piston Pumps and Motors Non-charged Systems	45 SUS [6 cSt]	60 - 180 SUS [10 - 39 cSt]	2,000 SUS [432 cSt]	18/13	
Light Duty Transaxles, Transmissions, Pumps and Series 1150 Transaxles	60 SUS [10 cSt]	80 - 180 SUS [16 - 39 cSt]	10,000 SUS [2158 cSt]	18/13	Automotive multi-viscosity oils and ATF are not recommended
Series 2030 Motor Axles	70 SUS [13 cSt]	100 - 200 SUS [20 - 43 cSt]	10,000 SUS [2158 cSt]	18/13	Automotive multi-viscosity oils and ATF are not recommended
Char-Lynn J, R, and S Series Motors, and Disc Valve Motors	70 SUS [13 cSt]	100 - 200 SUS [20 - 43 cSt]	10,000 SUS [2158 cSt]	18/13	
Char-Lynn A Series and H Series Motors	100 SUS [20 cSt]	100 - 200 SUS [20 - 43 cSt]	10,000 SUS [2158 cSt]	18/13	
Char-Lynn Steering Control Units, Priority and Control Valves	55 SUS [9 cSt]	100 - 200 SUS [20 - 43 cSt]	8,000 SUS [1900 cSt]	18/13	When emergency manual steering is required, maximum viscosity is 2,000 SUS [450 cSt]
Gear Pumps and Motors, and Cylinders	45 SUS [6 cSt]	60 - 200 SUS [10 - 43 cSt]	10,000 SUS [2158 cSt]	18/13	

Additional Notes:

- Products using fluids exceeding the maximum viscosity limits in cold weather start-ups will cause pump cavitation and possible damage. Motor cavitation is typically not a problem during cold start-ups, but can cause high case pressures which may exceed motor shaft seal rating.
- When choosing a hydraulic fluid, all the components in the system must be considered and the optimum viscosity range adjusted accordingly. For example, when a medium duty piston pump is combined with a disc valve motor the optimum viscosity range becomes 100 - 180 SUS [20 - 39 cSt] and viscosity should never fall below 70 SUS [13 cSt].
- If the natural color of the fluid has become black it is possible that an overheating problem exists.
- If the fluid becomes milky, water contamination may be a problem.
- Take fluid level reading when the system is cold.
- Contact your Eaton representative if you have specific questions about the fluid requirements of Eaton hydraulic components.

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Technical Data

Recommended Practices for Handling and Storage of Hydraulic Components

The life of every hydraulic system is directly related to system cleanliness. Typically, the cleaner a system is, the longer it will last. Particle or chemical contamination, therefore, is the enemy of any hydraulic system and extra effort should be taken to avoid contamination whenever and wherever possible. The following is a list of good practices to reduce or eliminate potential contamination while storing, handling, assembling and using hydraulic system components.

Ports & Fittings

- Port plugs should remain in components and hoses until ready to use.
- Use care in removing port plugs so that plastic does not shear off in threads.
- Use caution to ensure excess paint near the port face does not chip off or fall into the unit.
- The area around the port face is a sealing surface and should be protected from dents or contamination.
- Fittings being screwed into the port should be kept clean and lubricated.

Assembly & Storage

- Hose and tube assemblies should be flushed and capped until used.
- Reservoirs should be pickled treated with rust protection and sealed until used. At the time of use the rust protection must be flushed out.
- Never use shop air to blow out a tube, hose or reservoir as the air supply may not be "clean" air.
- Filler caps should be kept clean.
- Hydraulic assembly areas should be free of airborne contaminants.
- If components are stored in a cold environment, be sure to remove any condensation that may occur as the components warm up.
- If storage is prolonged, components may need to be rust proofed.

Fluids

- Hydraulic fluid should be filtered to ISO 18/13 or better for initial fill.
- Water and hydraulic fluid do not mix; water is considered a foreign chemical contaminant.
- Any surface in contact with hydraulic fluid must be clean and dry.
- Random sampling should be taken from hydraulic systems on vehicles ready to ship to ensure cleanliness level meets ISO 18/13 or better.

Exposed Surfaces

- Exposed cylinder rods should be handled with care to avoid scratches and dents.
- Motor and pump shafts should be kept clean and free of physical damage. Splines should be coated with anti-seize compound or grease before assembly. Tapered shafts should also be protected from physical damage to the shaft and coupling ID.

Returns

If there is a suspected problem with a new start-up component, remove the component and protect it for later analysis. In the event a component must be returned to Eaton, do NOT disassemble the unit and use only lint-free rags to wipe components. ***NOTE:*** Units returned to Eaton require a returned goods authorization (RGA) assigned BEFORE shipping.

Technical Data

1. BETA: Counting particles less than 40μ (40 **microns**) in size and using AC Fine Test Dust (ACFTD) as test contaminant.

2. RATIO:

$$\frac{\text{Particle Count* in Upstream Oil (one pass through filter)}}{\text{Particle Count* in Downstream Oil (one pass through filter)}}$$

* The number of particles of a given size or greater per unit of volume.

3. Example:

$$\frac{\text{1,000 Particles 10μ or greater in Upstream Oil Sample}}{\text{500 Particles 10μ or greater in Downstream Oil Sample}} = 2 \text{ (NOTE: } \mu = \text{micron)}$$

$$\frac{1{,}000}{500} = 2 \text{ (filter removed 50\% of particles 10μ or greater in one pass through filter)}$$

4. TERMINOLOGY: $B_{10} = 2$ (Beta ten ratio equals two)

5. Other ratio numbers and equivalent efficiencies:

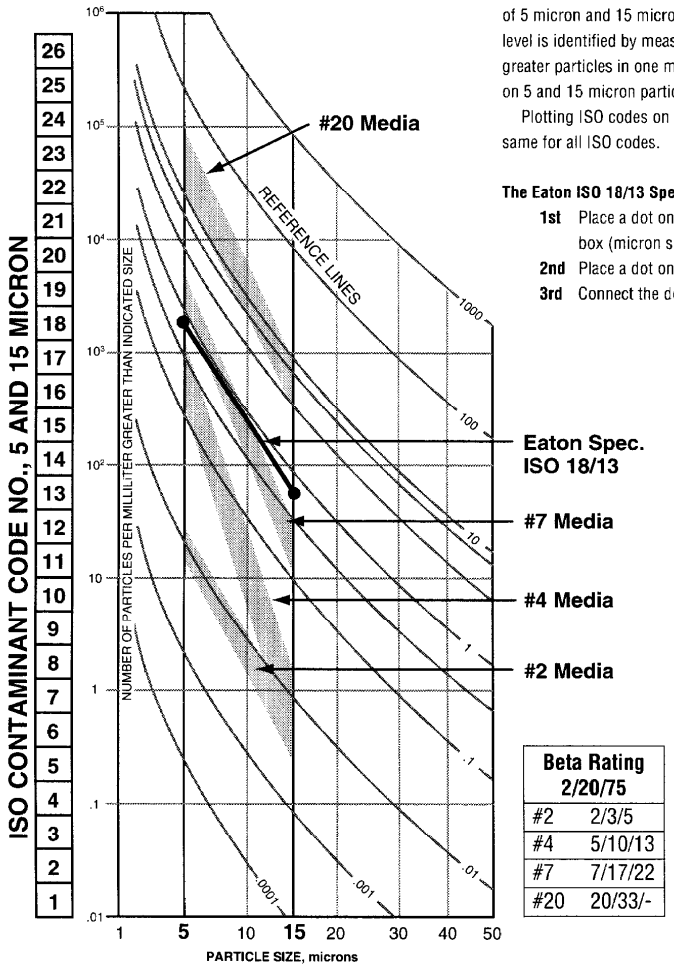
$Beta_{(x)}$	= 1.0	represents	.0%	efficiency in one pass	
$Beta_{(x)}$	= 1.14	represents	12.28%	efficiency in one pass	
$Beta_{(x)}$	= 1.5	represents	33.33%	efficiency in one pass	
• **$Beta_{(x)}$**	**= 2.0**	**represents**	**50.00%**	**efficiency in one pass**	**= Nominal Rating**
$Beta_{(x)}$	= 3.0	represents	66.67%	efficiency in one pass	
$Beta_{(x)}$	= 4.0	represents	75.00%	efficiency in one pass	
$Beta_{(x)}$	= 10.0	represents	90.00%	efficiency in one pass	
$Beta_{(x)}$	= 16.0	represents	93.75%	efficiency in one pass	
• **$Beta_{(x)}$**	**= 20.0**	**represents**	**95.00%**	**efficiency in one pass**	
$Beta_{(x)}$	= 50.0	represents	98.00%	efficiency in one pass	
• **$Beta_{(x)}$**	**= 75.0**	**represents**	**98.67%**	**efficiency in one pass**	**= Absolute Rating** (see below)

IMPORTANT! DON'T LET BETA RATINGS MISLEAD YOU. There is only one Industry Standard: ISO 4572.
The ISO (International Standards Organization) 4572 standard was developed to create a common testing format for filter manufacturers to rate filter media efficiencies. This standardization gives the end user the ability to reliably compare published filter ratings between manufacturers. Part of that standard says the maximum reliable filtration ratio is $Beta_{(X)} = 75$ (commonly known as the "absolute" rating). Anything above $Beta_{(X)} = 75$ cannot be statistically verified. Therefore, filters with ratings higher than $Beta_{(X)} = 75$ are immediately suspect in terms of reliable, consistent performance data.

6. A "2/20/75" rating for filter media is the most common way of describing media efficiency on three particle sizes. A "2/20/75" of 5/10/15 means 50% efficiency on 5μ or greater 95% efficiency on 10μ or greater and 98.67% efficiency on 13μ or greater particles in one pass.

Technical Data

Contamination Control Chart



Beta Rating 2/20/75	
#2	2/3/5
#4	5/10/13
#7	7/17/22
#20	20/33/-

Manufacture's ISO contamination levels are based on controlling the particle counts of 5 micron and 15 micron and 15 micron particles in hydraulic system's fluid. This level is identified by measuring the amount of 5 micron and greater and 15 micron and greater particles in one milliliter of the system's hydraulic oil. All ISO codes are based on 5 and 15 micron particles.

Plotting ISO codes on the contamination chart is simple and the procedure is the same for all ISO codes.

The Eaton ISO 18/13 Specification:

1st Place a dot on the 5 micron line horizontally centered on the chart's #18 box (micron sized located along bottom of chart).

2nd Place a dot on the 15 micron line horizontally centered on the #13 box.

3rd Connect the dots to get the ISO 18/13 contamination level specification.

Note: The ISO 18/13 in numerical terms.
2500 5 micron particles/ml
80 15 micron particles/ml
(all numbers shown on chart are logarithmic)

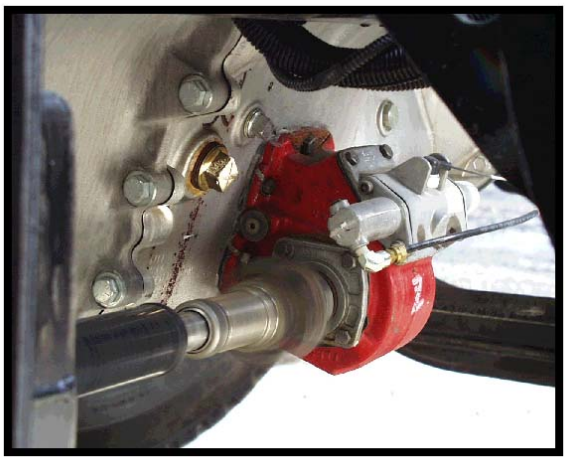
All particles falling on and above the line are potentially damaging to the component and exceed the ISO 18/13 contamination specifications. All particles below the line are considered tolerable to the components because of their small size.

Filter manufacturers publish Beta 2/20/75 ratings for filters to describe efficiency performance levels. However, a direct connection between the Beta rating scale and the ISO rating scale cannot be made.

The solution is to monitor a filter media's performance at removing 5 and 15 micron particle. Lab testing and infield monitoring are the only ways to get these measurements. Data from several tests should be combined to form a range of performance. Remember, actual filter performance may vary between applications.

Plot any media performance range on the ISO chart. If it falls below the ISO line (or the bottom line of the range does not intersect the ISO line) the component should be protected.

Power Take Off (P.T.O.)



The P.T.O. bolts directly to the truck transmission. The hydraulic pump can be direct mounted to the P.T.O. or driveshaft driven. The P.T.O. Provides engine power to the hydraulic pump. It can be engaged and disengaged from transmission.

Operation

Engage
Bring the truck to a full stop.
Depress clutch.
Pause a moment.
Lift and shift P.T.O. operator to the “IN” position.
Observe green light.
Release clutch smoothly.
Disengage
Depress clutch.
P.T.O. is held in under load.
Lift and shift P.T.O. operator to the “OUT” position.
Release the clutch.

Safety

Avoid over speeding P.T.O.
Disengage P.T.O. before leaving bench

Stay clear of rotating driveshaft (if applicable).
Observe tag-out, lockout procedures for maintenance

Inspection and Maintenance

Check P.T.O. mounting flange bolts
Check airline and fittings

If drive shaft installation:
Check & lube driveshaft u-joints
Check & lube driveshaft slip-joint

Troubleshooting and Repair

The P.T.O. does not engage.
Check air pressure for 80-psi minimum
Check for frozen air line . . . blow out line

Power Takeoff Manual:

CONTENTS

GENERAL INFORMATION
- Safety Information
- P.T.O. Ratings

INSTALLATION INSTRUCTIONS
- Application Questions
- Mounting P.T.O. to Transmission
- Checking Backlash
- Adapter Plates, Filler Blocks, Adapter Assembly
- Mounting Adapter Assembly
- Lubricant in Transmission/Inspect Installation
- P.T.O. Installation Tips for Automatic Transmissions

WIRE SHIFT P.T.O.'s
- Continuity Check, 378969 Indicator Switch
- Cable Control Installation Instructions

AIR SHIFT INSTALLATION
- Continuity Check, 378969 Indicator Switch
  100, 220, 260, 812, 381, 410, 420 and 431 Series

AUTOMATIC TRANSMISSIONS
- Pressure Lube Hose Connection
- P.T.O. Openings for Automatic Transmissions

INDICATOR LIGHT INSTALLATION TEMPLATE
- Lever and Wire Control
  220, 260, 812, 100, 321, 322, 340, 350,
  381, 410, 420, 431, 450 and 445 Series
- Indicator Light Installation
- Indicator Light Dash Drilling Template
- P.T.O. Shifting Procedure & Precautions

AIR SHIFT INSTALLATION
- New Air Shift Valves
- Dash Drilling Templates
- New Electric Over Air Shift
- Transmission Tag Locations

WARRANTY

SAFETY INFORMATION

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

GENERAL SAFETY INFORMATION

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

- Read carefully all 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.

PROPER MATCHING OF P.T.O.

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

To avoid personal injury and / or equipment damage:

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

This symbol warns of possible personal injury.

SAFETY INFORMATION (CONT.)

COLD WEATHER OPERATION OF POWER SHIFT P.T.O.'s

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

The power take-off output shaft rotation could cause unexpected movement of the driven equipment resulting in serious personal injury, death, or equipment damage.

To avoid personal injury or equipment damage:

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

ROTATING AUXILIARY DRIVESHAFTS

WARNING: 

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

GUARDING AUXILIARY DRIVESHAFTS

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

This symbol warns of possible personal injury.

SAFETY INFORMATION (CONT.)

USING SET SCREWS

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

IMPORTANT: SAFETY INFORMATION AND OWNER'S MANUAL

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

WARNING: OPERATING THE P.T.O. WITH THE VEHICLE IN MOTION

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

If in doubt about the P.T.O.'s specifications and capabilities, avoid operating the P.T.O. when the vehicle is in motion. Improper application and/or operation can cause serious personal injury or premature failure of the vehicle, the driven equipment, and/or the P.T.O.

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

PUMP INSTALLATION PRECAUTIONS

Use a bracket to support the pump to the transmission if:

- The pump weighs 40 pounds or more.
- The combined length of the P.T.O. and pump is 18 inches or more from the P.T.O. centerline to the end of the pump.

Also remember to pack the female pilot of the P.T.O. pump flange with grease before installing the pump on the P.T.O.

This symbol warns of possible personal injury.

P.T.O. RATINGS

Basic P.T.O. Models			Horsepower At		Intermittent	Weight
New Model No.	Old Model No.	SAE Aperture	500 rpm	1000 rpm	Torque Rating *	Approximate Pounds
100	A1, 2, 3N	6-Bolt	11.9	23.5	125 lbs. ft.	10 lbs.
220L & P	A22C & D	6-Bolt	19	38	200 lbs. ft.	30 lbs.
220- E & C	A22L & LL	6-Bolt	23.5	47	250 lbs. ft.	30 lbs.
260	26	6-Bolt	23.5	47	250 lbs. ft.	28 lbs.
321 Hel.	320	6-Bolt	13.2	26.5	140 lbs. ft.	39 lbs.
322 Spur.	S320	6-Bolt	13.2	26.5	140 lbs. ft.	39 lbs.
340	34L	6-Bolt	19	38	200 lbs. ft.	32 lbs.
350	S35, 36, & 37	6-Bolt	13.2	26.5	140 lbs. ft.	37 lbs.
381	S380	6-Bolt	13.2	26.5	140 lbs. ft.	23 lbs.
410__U	41D	6-Bolt	11.9	23.5	125 lbs. ft.	26 lbs.
410__W	41K	6-Bolt	10	20	110 lbs. ft.	26 lbs.
410__X	41X	6-Bolt	8	16	85 lbs. ft.	26 lbs.
420—S		6-Bolt	19	38	200 lbs. ft.	26 lbs.
420—Q	42	6-Bolt	21.4	42.8	225 lbs. ft.	26 lbs.
	430D	6-Bolt	17	32	180 lbs. ft.	30 lbs.
431__U		6-Bolt	18.6	37.1	195 lbs. ft.	30 lbs.
	430K	6-Bolt	15	30	160 lbs. ft.	30 lbs.
431__W		6-Bolt	16.7	33.3	175 lbs. ft.	30 lbs.
450	S45, 46 & 47	6-Bolt	13.2	26.5	140 lbs. ft.	37 lbs.
445-Q		6-Bolt	19	38	225 lbs. ft.	30 lbs.
445-S		6-Bolt	21.4	42.8	200 lbs. ft.	30 lbs.
445-U		6-Bolt	18.6	37.1	195 lbs. ft.	30 lbs.
445-W		6-Bolt	16.7	33.3	175 lbs. ft.	30 lbs.
700	A2625	Gear Box	11.9	23.5	125 lbs. ft.	39 lbs.
710	A2627	Gear Box				
Single Speed Shaft			10	20	110 lbs. ft.	
Two Speed & Input Shaft			11.9	23.5	125 lbs. ft.	39 lbs.
720	2615	Gear Box	13.2	26.5	140 lbs. ft.	49 lbs.
730	2536	Gear Box	13.2	26.5	140 lbs. ft.	49 lbs.
740	2538	Gear Box	13.2	26.5	140 lbs. ft.	49 lbs.
800	810	8-Bolt	33	66	350 lbs. ft.	38 lbs.
812	811	8-Bolt	38	76	400 lbs. ft.	50 lbs.
822	821	8-Bolt	47	94	500 lbs. ft.	76 lbs.
832	831	8-Bolt	28.5	57	300 lbs. ft.	76 lbs.
852	851	8-Bolt	47	94	500 lbs. ft.	88 lbs.
862	861	8-Bolt	47	94	500 lbs. ft.	96 lbs.
901	4600	Split Shaft P.T.O.			4300 lbs. ft.	185 lbs.
911	4700	Split Shaft P.T.O.			4500 lbs. ft.	126 lbs.
931	5551	Split Shaft P.T.O.			250 lbs. ft.	102 lbs.
Front Mounted						
2230U		Gear Box	21.4	42.8	225 lbs. ft.	88 lbs.
2381	2740	Gear Box	13.2	26.5	140 lbs. ft.	69 lbs.
2420*S		Gear Box	19	38	200 lbs. ft.	69 lbs.
2420*Q	2642	Gear Box	21.4	42.8	225 lbs. ft.	69 lbs.

This chart provides a guide to the many different models of P.T.O.'s which may be used in a given application.

From this group, a model can be selected to meet the exact horsepower, speed and rotation requirements of the accessory to be driven.

* At 1200 R.P.M. Output, a minimum of 100 Hours of Total P.T.O. Life is available. For a continuous Duty Rating use 70% of the Intermittent Rating.

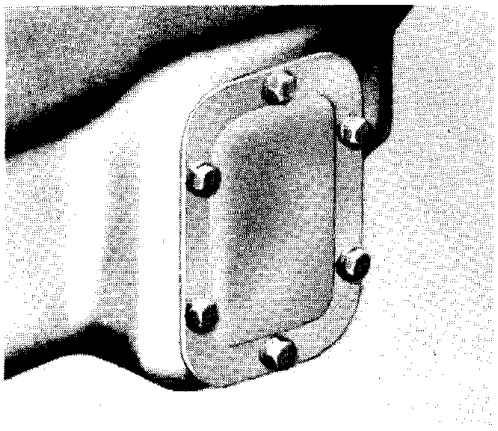
APPLICATION QUESTIONS

Here are some of the questions that are relevant to the Proper Selection of a Transmission Mounted Power Take-Off

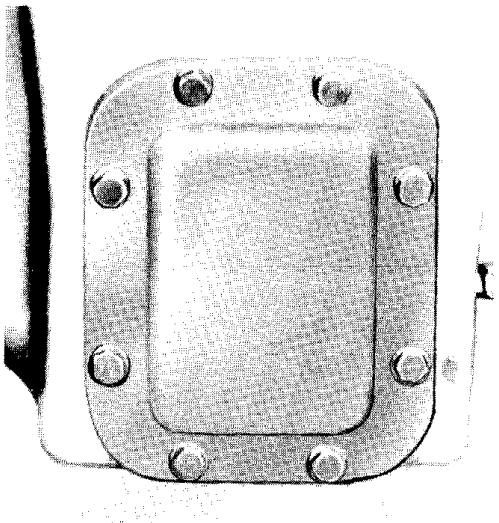
1. What is the make and model of your transmission?
2. Which P.T.O. opening will be used?
3. What accessory is to be driven?
4. How much horsepower is required to drive the accessory?
5. What is the required rotation of the P.T.O.?
6. What is required P.T.O. output shaft speed as a percent of engine speed?
7. What is the required method of shifting the P.T.O., cable, lever of air?

Once all of the answers to these questions have been determined, a transmission mounted P.T.O. can be selected to meet the horsepower, speed and rotation that you require.

Having made the selection of a P.T.O., you are ready to start the installation.

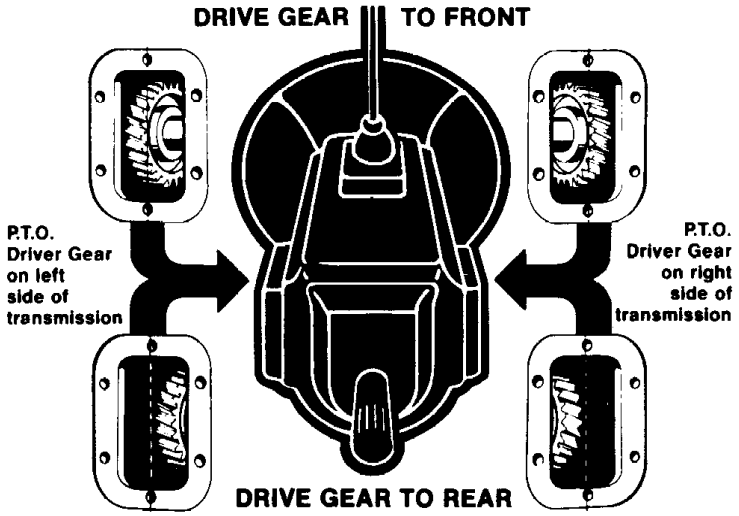


SAE 6 Bolt



SAE 8 Bolt
Standard SAE Power Take-Off Apertures

P.T.O. Drive Gear Location
The standard location for the P.T.O. drive gear in the transmission is ½" to the front or ½"to the rear of vertical center line.



MOUNTING P.T.O. TO TRANSMISSION
For 6 or 8 Bolt Applications

1. Drain the oil from the transmission and remove the P.T.O. aperture cover plate. (See Fig. 1.)
2. Discard the cover plate and cover plate gasket then clean the aperture pad using a putty knife or wire brush. (See Fig. 2.)

   NOTE: Stuff a rag in the aperture opening to prevent dirt from entering the transmission while you are cleaning it.
3. Using your hand, rock the P.T.O. driver gear in the transmission (see Fig. 3) and the driven gear in the P.T.O. assembly (see Fig. 4). Rocking the gears provides two important factors.
   (a) It shows you the amount of backlash that has been designed into each unit.
   (b) It is helpful in establishing the proper backlash when installing the P.T.O.
4. Install the proper studs (furnished with P.T.O.) in the P.T.O. aperture pad using a stud driver. Studs may have either interference fit threads (plain) or preapplied locking/sealing compound. (See Fig. 5 for installation method).
5. Where holes are tapped through the transmission case, use studs with preapplied locking/sealing compound Permatex or equivalent to prevent leaks.

   NOTE: Avoid contact of Permatex with automatic transmission fluid in automatics. Always check to be sure that the studs do not interfere with transmission gears.

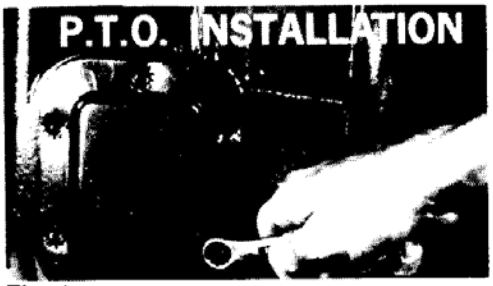


Fig. 1


Fig. 2



Fig. 3



Fig. 4


Fig. 5

MOUNTING P.T.O. TO TRANSMISSION (continued)

6. Tighten studs securely and torque to 17-19 lbs. ft. (2.35-2.63 kg meters) for 6 bolt and 19-21 lbs. ft. (2.63-2.90 kg meters) for 8 bolt. Caution - overtightening of studs may damage stud and/or transmission threads. (See Fig. 6)
7. Place the correct number of gaskets over studs. (See Fig. 7.) Do not use Permatex between gaskets because you may want to add or subtract gaskets to obtain proper backlash.
   - When mounting a P.T.O. use gaskets between all mounting surfaces.
   - Do not stack more than **3** gaskets together.
   - Usually one thick gasket .020 (.50mm) will be required.
   - Remember the lubricant in the transmission also lubricates the P.T.O. Therefore, at least one gasket must always be used on either side of filler blocks, adapter assemblies or adapter plates. More gaskets may be required when establishing proper backlasn.
8. Secure P.T.O. to the transmission.
   - Copper gaskets are used as a guard against leaks under cap screw head. (See Fig. 8.)

   NOTE: If holes in the P.T.O. aperture are not drilled through, discard the copper gaskets and replace them with lock washers.

   The 220 Series must always have a copper washer under its one cap screw head that goes through inside of housing.
9. Fasten the P.T.O. to the transmission torquing 6 bolt to 30-35 lbs. ft. (4.14-4.84 kg meters) and 8 bolt to 45-50 lbs. ft. (6.22-6.91 kg meters.) (See Fig. 9.)

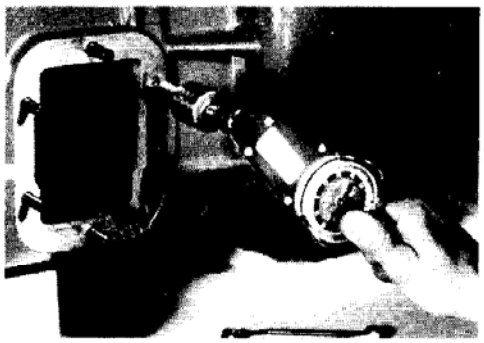


Fig. 6



Fig. 7

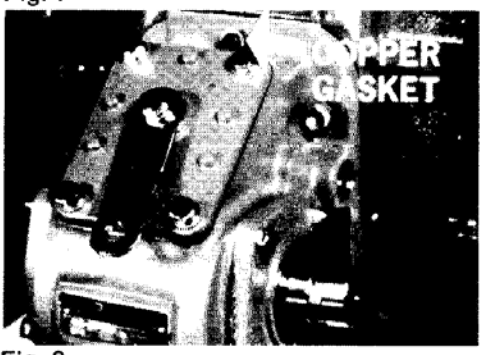


Fig. 8

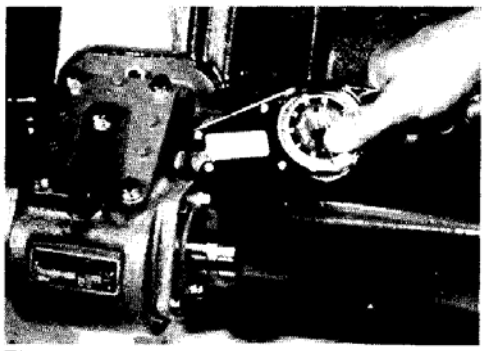


Fig. 9

CHECKING BACKLASH

To check for proper backlash on P.T.O.'s with shift cover

1. Remove the P.T.O. shift housing and/or inspection plate.
2. Mount the dial indicator so that it registers movement of the input gear (driven gear) of the P.T.O. (See Fig. 10.)

NOTE: See Figure 11 for proper location of dial indicator contact point. (Two common type dial indicators shown.)

3. Hold the P.T.O. driver gear in transmission with a screwdriver or bar and rock the P.T.O. input gear (driven gear) back and forth with your hand. Note the total movement on the dial indicator.
4. Establish backlash at .006"-.012" (.15mm-.30mm) by adding or subtracting gaskets.

General rule—A Chelsea .010" gasket will change backlash approx. .006". A .020" gasket changes backlash approx. .012".

5. Replace the shift housing and/or inspection plate and retorque (4) four capscrews to 16-20 lbs. ft. (2.21-2.76 kg meters).

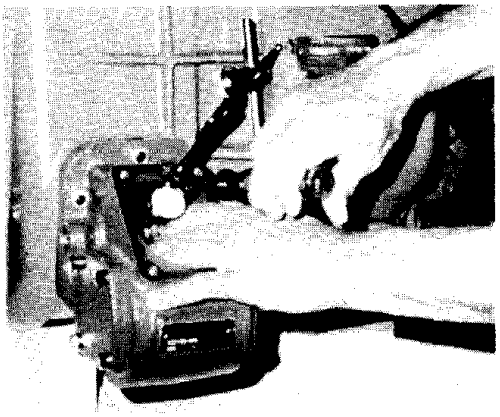


Fig. 10

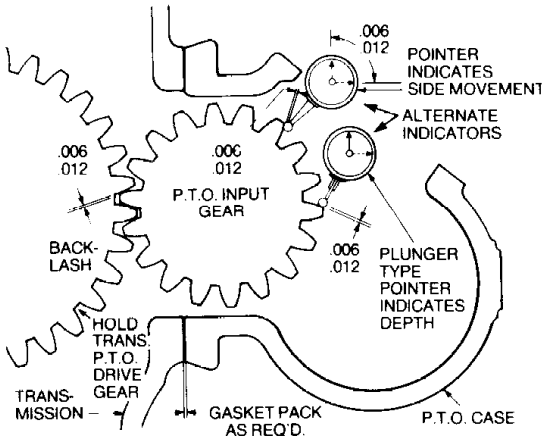


Fig. 11

NOTE: *When using a 220, 260 or 270 Series P.T.O. with the New AJ gear designation on an Allison Automatic transmission with a six bolt opening, a special gasket (35-P-41) is supplied. When installed with the P.T.O. this gasket reduces the need for backlash adjustment.*

2 GEAR—8—BOLTS—822, 832 & 862

An inspection hole is provided in the P.T.O. housing for feeling the mounted backlash.

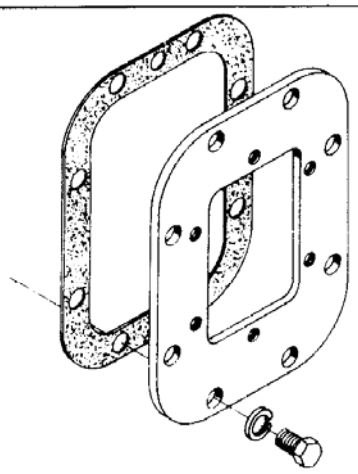
Rock the P.T.O. Input Gear with your hand and correlate this backlash to the unmounted backlash found in Step 3 on page 7. Use Gaskets to get backlash feel as close to unmounted condition as possible.



ADAPTER PLATES

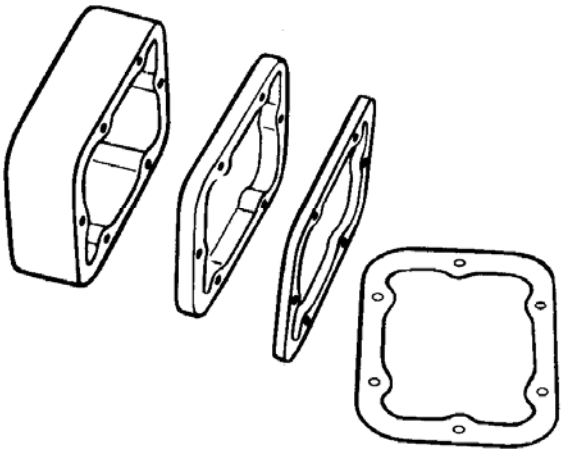
Adapter plates are used to permit mounting a 6 bolt P.T.O. on a transmission that has an 8 bolt aperture.

NOTE: A wire locking stud kit is recommended when mounting a 6 Bolt P.T.O. to an adapter plate on a bottom opening.



FILLER BLOCKS

Filler blocks may be required where it is necessary to use a spacer to mount the power take-off to a particular transmission.



P.T.O. APPLICATION AND ADAPTER ASSEMBLY

Figure 13 illustrates typical adapter assembly configurations. Some P.T.O. applications require adapter assemblies because it is impossible to reach the P.T.O. driver gear in the transmission without this assembly.

An adapter assembly will change the rotation of the P.T.O. and this may be necessary for driving pumps or other accessory equipment. Obstructions, such as a bulge in the transmission, exhaust pipes or motor

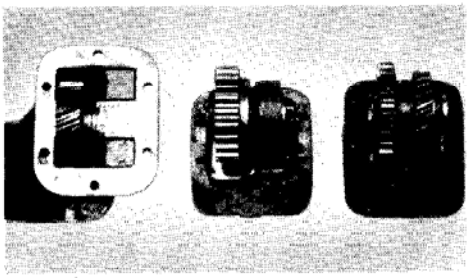


Fig. 13

mounts can sometimes be compensated for through the use of an adapter.

MOUNTING ADAPTER ASSEMBLY

How to mount an adapter assembly to the transmission and P.T.O.

1. Use same procedure for mounting the adapter and checking backlash as was used when mounting the P.T.O. to transmission. (See Fig. 14.)
2. After checking for proper backlash remove the adapter, gaskets and filler block (if required) from the transmission. Keep the gaskets and filler block as a "package." (See Fig. 15.)
3. Bench mount the adapter to the P.T.O. using appropriate length studs. (See Fig. 16.)
4. Proper backlash will determine the number of gaskets to be used between the adapter and the P.T.O. (See Fig. 17.)
5. Remount the adapter assembly, all gaskets and the P.T.O. to the transmission in their respective sequence. (See Fig. 18.)
6. Secure all nuts and cap screws to proper torque.

Now . . . run the P.T.O. momentarily and check for noise!

CAUTION: The transmission and P.T.O. have no lubrication at this time so running time should be as short as possible.

- If the P.T.O. whines it may be mounted too tight, too little backlash. This indicates that gaskets should be added.
- If the P.T.O. clatters it may be mounted too loose, too much backlash. This indicates that gaskets should be removed.

General Rule: A Chelsea .010 (.25mm) gasket will change backlash approximately .006 (.15mm) and a .020 (.50mm) gasket changes backlash approximately .012 (.30mm).

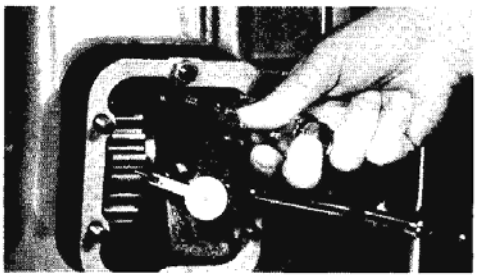


Fig. 14

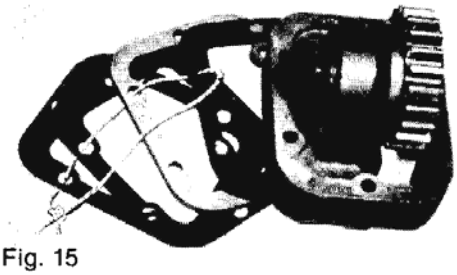


Fig. 15

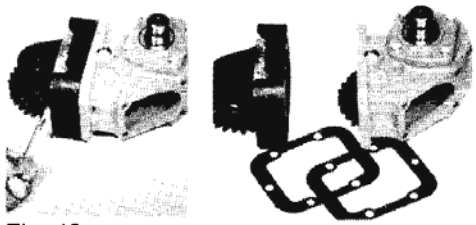


Fig. 16

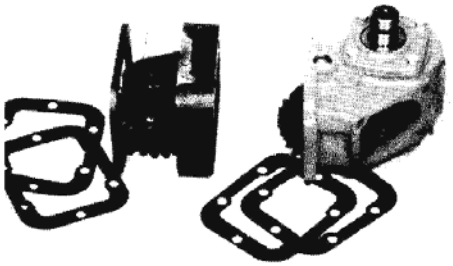


Fig. 18



Figure 19 illustrates a typical input gear (driven gear) in a P.T.O. that was mounted too deep—insufficient backlash. Extreme heat turned the gear blue and resulted in gear and bearing failure.

LUBRICANT IN TRANSMISSION/INSPECT INSTALLATION

1. Remove the filler plug from the transmission and add recommended transmission lubricant to the level prescribed by the transmission or truck manufacturer. (See Fig. 20.)

   NOTE: If the P.T.O. is mounted below oil level, additional lubricant will be required.

2. Run the P.T.O. for 5-10 minutes and check for oil leaks and noise.
3. Should a quiet P.T.O. become noisy after the universal joint connection is made, check the P.T.O. driveline components for an out of phase condition, excessive or unequal joint angles or possibly worn parts in the driven accessory.
4. Re-torque all mounting bolts, nuts, cap screws and set up inspection routine of the P.T.O. driveline components and the driven auxiliary equipment.

   NOTE: Anticipate slight increase in P.T.O. noise level as oil thins out at operating temperatures.



Fig. 20

P.T.O. Installation Tips For Automatic Transmissions

The procedure for installing a P.T.O. on an automatic is basically the same as for a mechanical transmission. Power take-offs for automatic transmissions are assembled with a special drilled input shaft which allows the input gear to be pressure lubricated during operation. (see page 21).

After installing a P.T.O. on an automatic transmission, connect pressure lubrication hose to the P.T.O. and the transmission per installation instructions shown on page 22 of this booklet.

WARNING: Adapter assemblies are never used on an automatic transmission because they do not have pressure lubricated design features.

WARNING: Use only wire control with P.T.O. made for wire cable control. If lever is desired, order P.T.O. for lever control. The internal shifting mechanism for wire is not designed for heavy forces usually encountered with lever control linkage.

CONTINUITY CHECK
378969 and 379110 INDICATOR SWITCHES

In order to insure that the switch is functioning properly, the following procedure can be used with the unit on a bench, or installed.

▲ 1. Use a continuity checker, battery type, either meter or light. Attach one (1) probe to the screw on the 378969 or 379110 Indicator Switch.

2. With the other probe, make contact with the shifter cover or housing (see Figs. #1 & 2).

3. Actuate shifting device and the meter or light* should be actuated when P.T.O. gear is engaged (see Figs. #3 & 4).

4. Shift unit out of gear and the meter or light* should return to normal as shown (see Figs. #1 and 2).

This test procedure can be used to check Chelsea wire, lever, and air shifter covers, although an air source would be necessary for the latter.

*If a meter is not available the light in the 328751X can be used (see Figs. #2 & 4). A six volt battery is all that is necessary for a power source.

▲ **Make sure 378969 and 379110 Indicator Switches, in the P.T.O. shifter or housing, are torqued to 10-15 lbs. ft. (1.38-2.07 kg meters).**

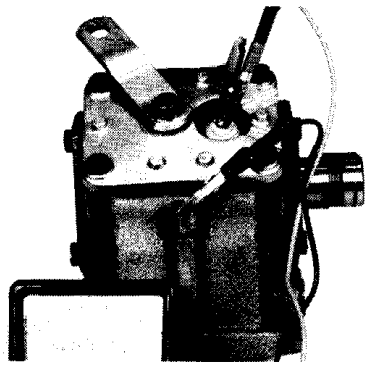


Fig. 1

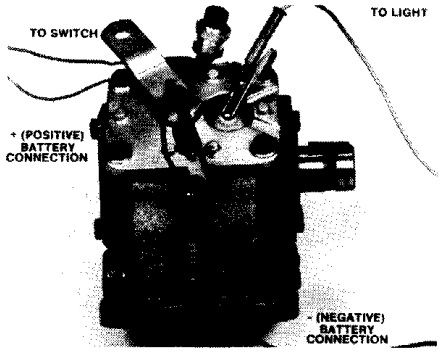


Fig. 2

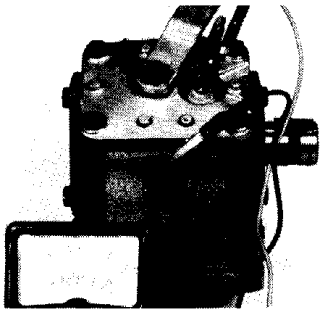


Fig. 3

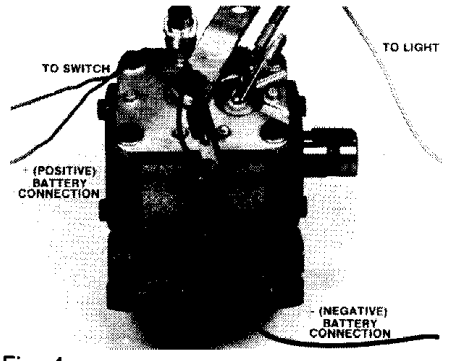


Fig. 4

WIRE SHIFT P.T.O.'s*
Cable Control Installation Instructions

1. Find a suitable area on the dash to install the cable control and the control plate - indicator light.

   NOTE: The location of the cable control and the control plate should be as close to each other as possible and easily accessible by the driver or operator, but should not be an obstacle to driver movement nor interfere with other controls, instruments, or equipment.

2. Drill a ½" (.5") diameter hole for the control cable.

3. Install the control cable on the dash using the hex nuts supplied with the cable. The knob can then be screwed into place. The length of cable can then run through the firewall and back to the P.T.O. — making sure it is kept away from the exhaust, moving parts, etc. (Fig. #1, 2)

   NOTE: Do not kink the cable. In order for the cable to operate properly, there can be no bends smaller than 6 inch radius. Total bends in the cable should not exceed 360° (example - four 90° bends in cable).

4. Using the template found on page 30 drill the necessary holes for the control plate-indicator light (Fig. #3 & 4).

* All six bolt wire shifts with the exception of the reversibles, dual shift units, and some gear boxes.

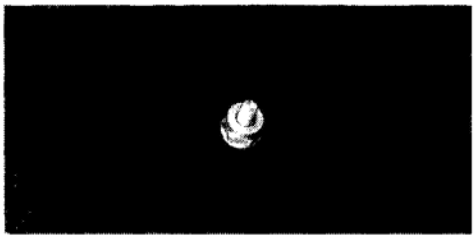


Fig. 1

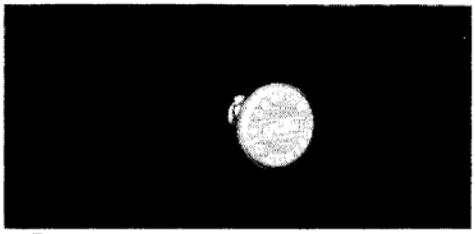


Fig. 2

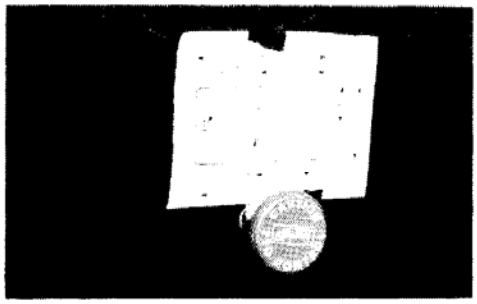


Fig. 3



Fig. 4



Fig. 5

WIRE SHIFT P.T.O.'s (continued)

5. Install the control plate - indicator light on the dash using the hardware supplied in the 328751X parts bag. (Fig. #5)

6. Determine from which direction the cable must come in order for the unit to be disengaged when the knob is all the way in.

   NOTE: The shifter must always be installed in the following manner:
   ▲CABLE IN: P.T.O. DISENGAGED (Fig. #6)
   CABLE OUT: P.T.O. ENGAGED (Fig. #7)

7. Install the wire control bracket found in either the 328380X or 328380-1X wire control parts bag. (Fig. #8)

8. Line the cable up with the wire control bracket and shifter lever (disengaged position) on the P.T.O. cover assembly (Fig. #9)

   NOTE: It may be necessary to change the position of the shifter lever on the P.T.O. To do this, remove the shifter cover from the unit. This will prevent the possible loss of the poppet and/or spring into the transmission if the shifter post assembly should be pushed through the cover when reinstalling the lever.

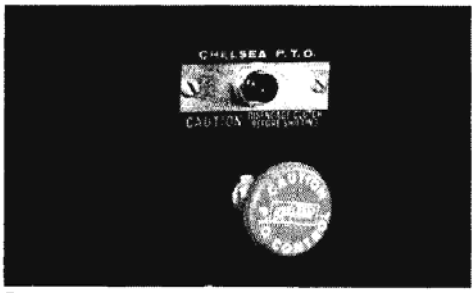


Fig. 6 ▲

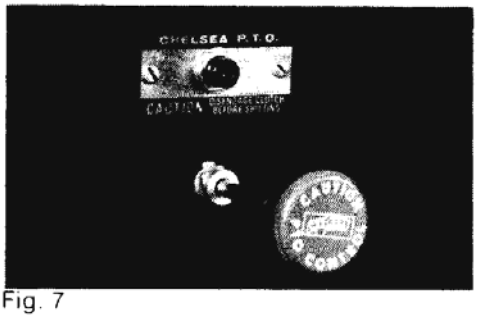
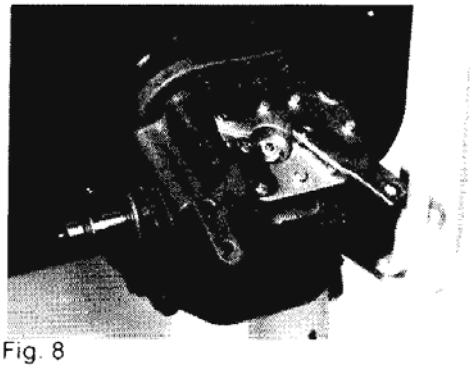
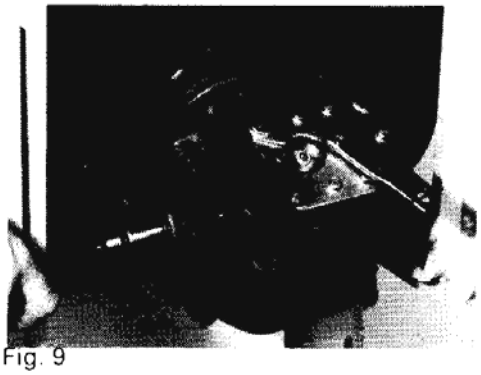


Fig. 7


Fig. 8


Fig. 9

▲ The wire shift cable should be installed so that when the cable (knob) is pushed all the way in, the PTO has also moved the full travel of the PTO shifter, to the disengaged mode.

9. Shift the P.T.O. to the engaged position to see how much of the cable casing must be cut to allow the lever enough travel to shift in and out completely. The casing need only go just beyond the bracket, whereas, the wire must be long enough to go through the swivel pin in the shifter lever. (Fig. #10)

   NOTE: In some instances the cable control may not be long enough. Chelsea has available four longer lengths than the standard ten-foot cable. These come in five foot increments (i.e., 328346-15X = 15-foot cable).

10. When the length of the casing has been determined, pull the wire back through until the case can be cut without cutting the wire. Use a hacksaw or heavy pair of sidecutters to cut the casing. (Fig. #11)

    NOTE: The cable can be held by a bench vise as long as the jaws are not tightened to the point where the case mushrooms. If a vise is not accessible, a pair of vise grips will do the job.

11. Push the wire back through and install the cable using the hardware from the previously mentioned wire control parts bag (Step #7), (Fig. #12). See exploded drawing.

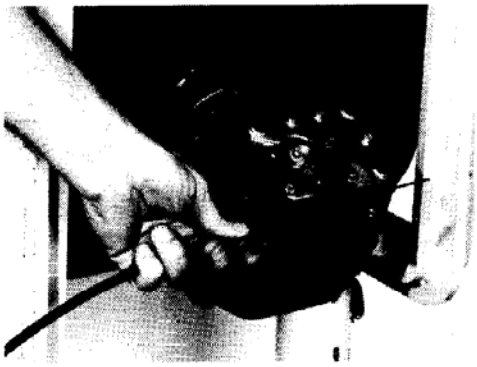


Fig. 10



Fig. 11

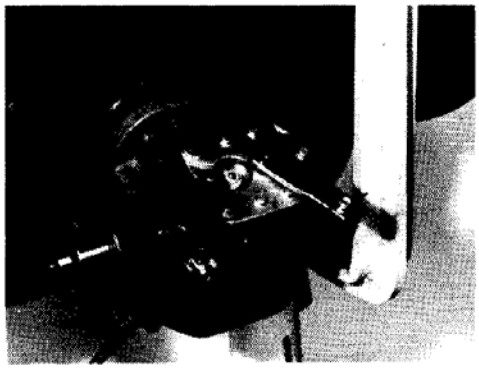


Fig. 12

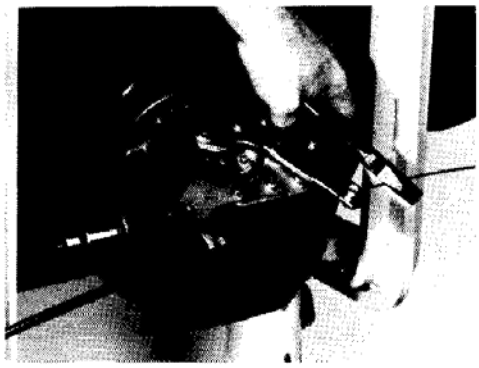


Fig. 13

WIRE SHIFT P.T.O.'s (continued)

12. Cut the excess wire after the cable casing and wire have been installed and tightened. (Fig. #13)
13. Shift the P.T.O. to insure enough casing has been removed to allow full gear engagement.
14. Install the wiring for the indicator light using the schematic from page 30 ■ (Fig. #14).

    NOTE: Check both the cable and indicator light wires to be certain that they are not near the exhaust system or any moving parts. Carefully fasten to stationary parts of the vehicle if necessary.
15. Shift the P.T.O. The following should be adhered to:
    CABLE IN: P.T.O. DISENGAGED: LIGHT OUT (Fig. #14 & 15)
    CABLE OUT: P.T.O. ENGAGED: LIGHT ON (Fig. #16 & 17)

    NOTE: The P.T.O. should be checked for continuity as per the instructions in this manual.

    NOTE: Cable must be rigidly mounted-possibly to the transmission within 12-24" of the PTO.

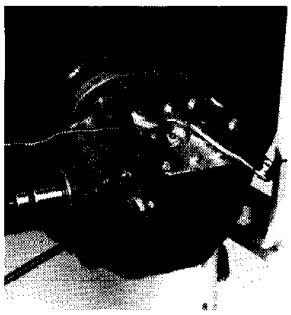


Fig. 14

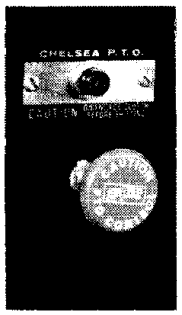


Fig. 15

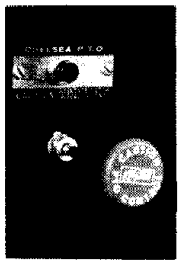


Fig. 16

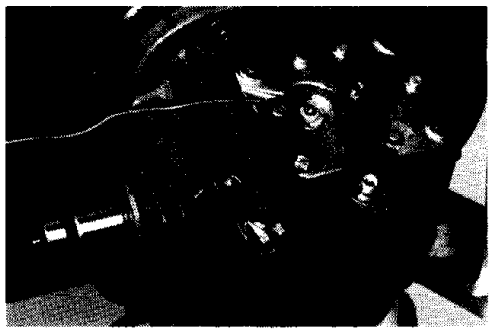


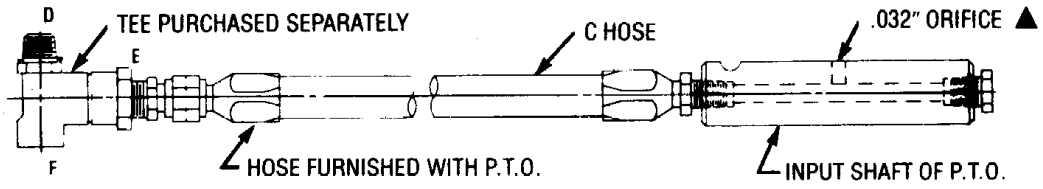
Fig. 17

WIRE SHIFT INSTALLATION INSTRUCTIONS
(Reversibles, dual shift units, and some gear boxes)

1. Use step #1 - #5 from previous instructions.
2. In step #6 the cable can come from either direction since the P.T.O. will always be engaged when all the way in or out.
3. Follow step #7 and #8.
4. In step #9 shift the P.T.O. from forward to reverse or vice versa to determine the amount of travel needed and the length of casing to be cut.
5. Follow step #10 - #14.
6. Step #15 will show the following:

   CABLE IN: P.T.O.
   ENGAGED: LIGHT ON
   CABLE OUT (1st position):
   P.T.O. DISENGAGED:
   LIGHT OUT
   CABLE OUT (2nd position):
   P.T.O. ENGAGED: LIGHT ON

AUTOMATIC TRANSMISSIONS
Pressure Lube Hose Connection



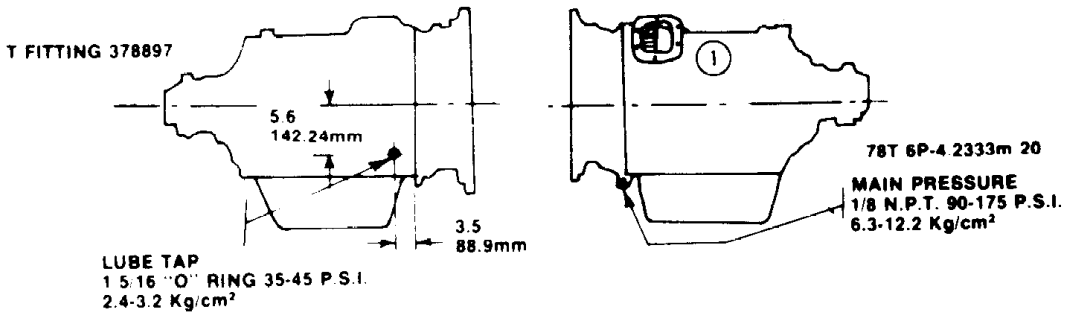
TEE FITTING	378840	378880	378970	378897
D	.750-16 U.N.F. 2A	.875-14 U.N.F. 2A	1.062-12 U.N.F. 2A	1.312-12 U.N. 2A
E	.250-18 N.P.T.F.	.250-18 N.P.T.F.	.250-18 N.P.T.F.	.250-18 N.P.T.F.
F	.750-16 U.N.F. 2B	.875-14 U.N.F. 2B	1.062-12 U.N.F. 2B	1.312-12 U.N. 2B

The specific "T" Fitting for each Automatic Transmission is called out at the bottom of each transmission's application sheet. If a "T" fitting is not called out, then a standard pipe tee will adapt.

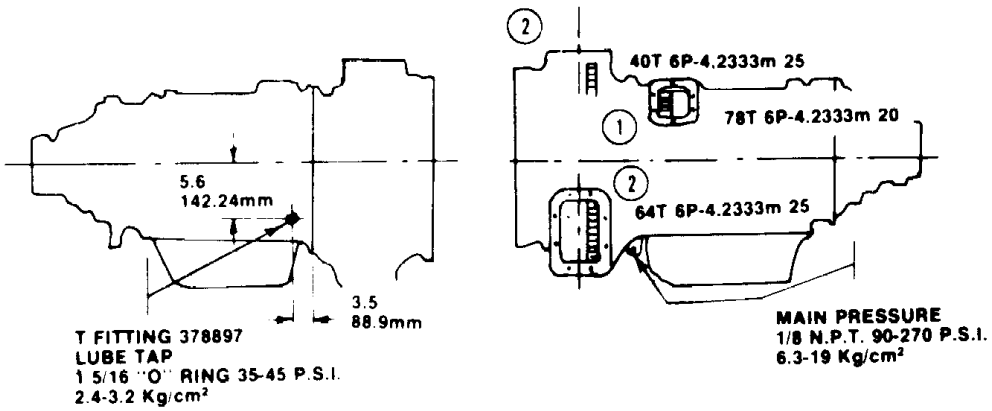
▲NOTE: *The .032" orifice is built into all pressure lubed idler shafts. No additional orifices are required when using these pressure lubed shafts.*

P.T.O. OPENINGS
For Automatic Transmissions Allison Models

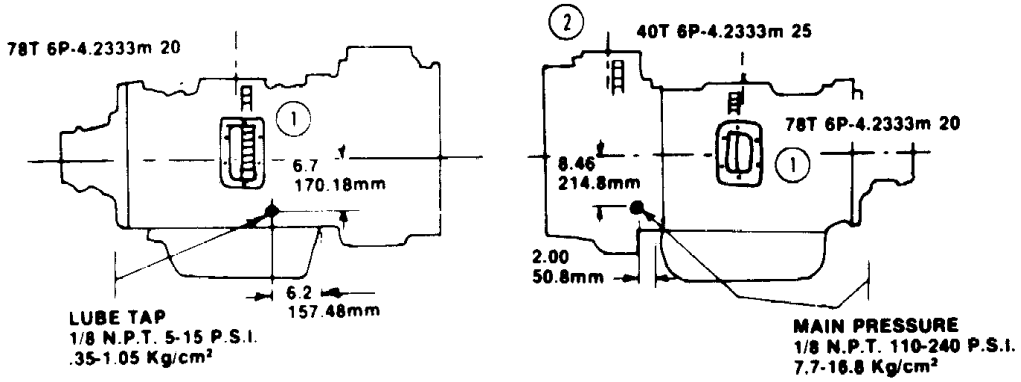
HT-740
HT-750D



CLT-750

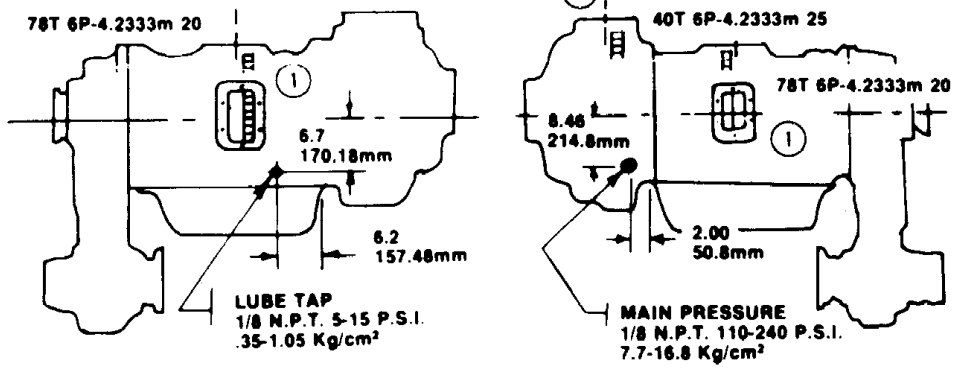


HT-70

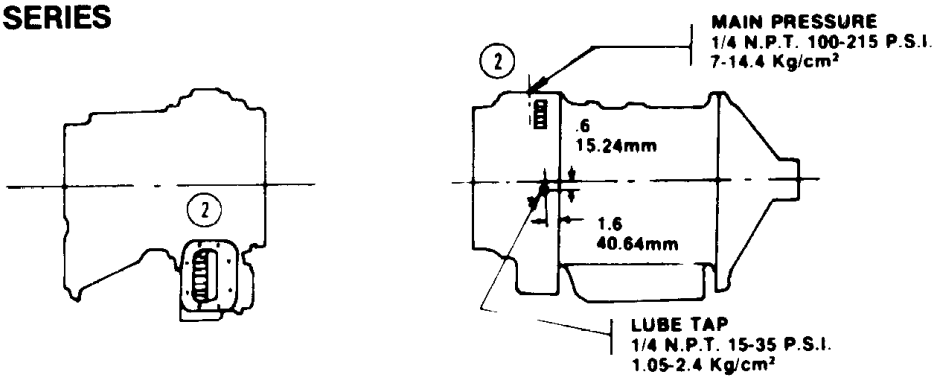


P.T.O. OPENINGS (Continued)

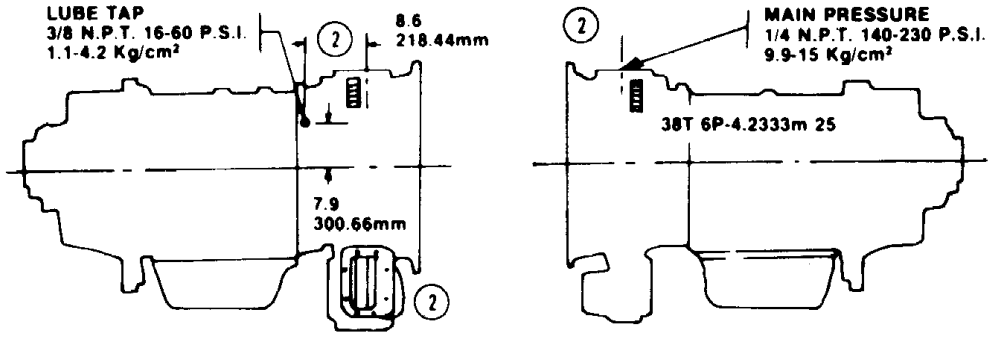
4460



5000 SERIES



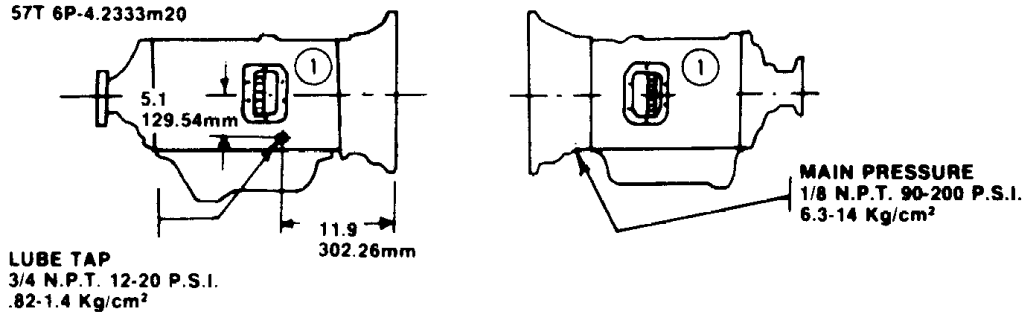
8000 SERIES



1. *Converter driven P.T.O. Drive Gear*
2. *Engine driven P.T.O. Drive Gear*

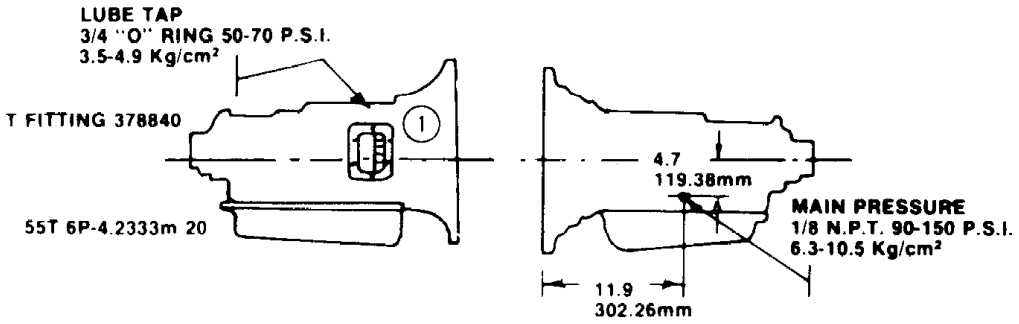
P.T.O. OPENINGS (continued)

MT-30-42
6 SPEED
3341-3441

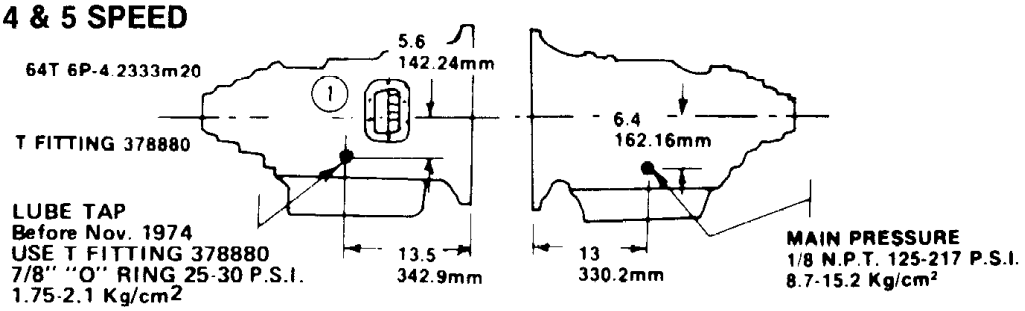


LUBE TAP
3/4 N.P.T. 12-20 P.S.I.
.82-1.4 Kg/cm²

AT-540
4 SPEED



MT-640
MT-650
4 & 5 SPEED



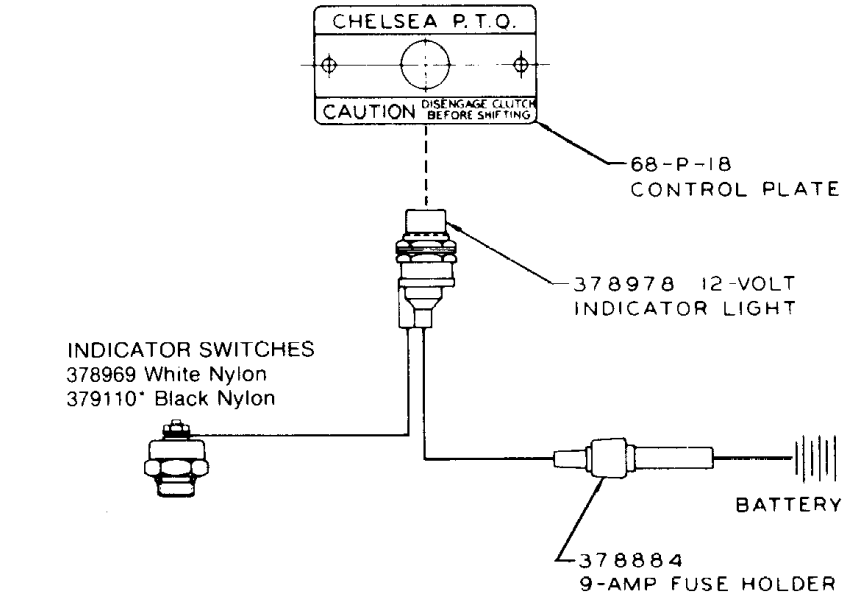
LUBE TAP
Before Nov. 1974
USE T FITTING 378880
7/8" "O" RING 25-30 P.S.I.
1.75-2.1 Kg/cm2

After Nov. 1974
USE T FITTING 378970
1-1/16" "O" RING 25-30 P.S.I.
1.75-2.1 Kg/cm2

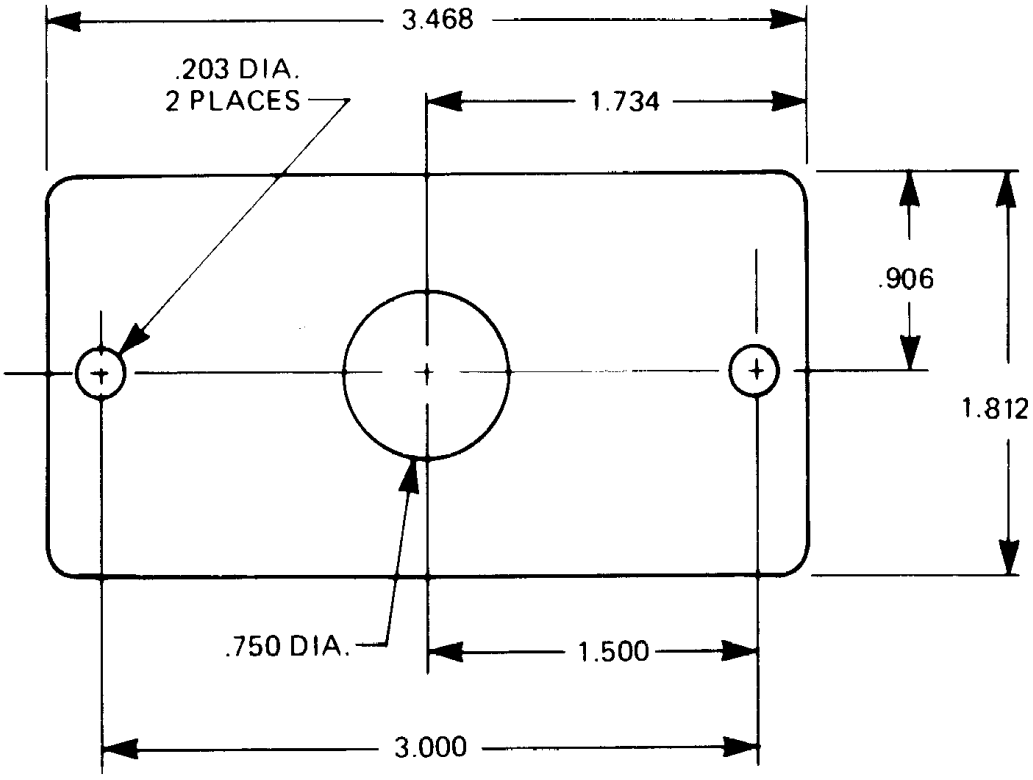
1. Converter driven P.T.O. Drive Gear

INDICATOR LIGHT INSTALLATION/ DASH DRILLING TEMPLATE

For Indicator Light Installation of 220, 260, 812, 100, 321, 322, 340, 350*, 381, 410, 420, 431, 445* and 450* Series Wire and Lever Control



*Special Indicator Switch for these models.



P.T.O. SHIFTING PROCEDURE & PRECAUTIONS

CAUTION

This vehicle is equipped with a POWER TAKE-OFF
Shut Engine Off Before Working On POWER TAKE-OFF Or Getting Below Vehicle.
Consult Operating Instructions Before Using. (See Sun Visor)

POWER TAKE-OFF OPERATION —VEHICLE STATIONARY

I. Mechanical Transmission

1. A power take-off is, and should be, operated as an integral part of the main transmission.
2. Before shifting the power take-off into or out of gear disengage the clutch and wait for transmission or P.T.O. gears to stop rotating.

II. Automatic Transmission with Manual Shift P.T.O.'s (Includes Air Shift)

On automatic transmissions, the gears in the transmission turn when the transmission is in neutral, therefore, gear clashing will occur if the power take-off is shifted into gear at this time.

A. With Converter Driven Gear:

1. Shift transmission lever into any of the drive positions (This will stop transmission gear from turning.)
2. Shift power take-off into gear.
3. Shift transmission into neutral. (This will start transmission gears turning).

B. With Engine Driven Gear:

1. Shift P.T.O. into gear before starting engine.

This procedure should eliminate gear clash.

III. Automatic Transmission with Power Shift P.T.O.'s

Engage P.T.O. with engine at idle speed.

Power Shift P.T.O.'s: Engine must be at idle when P.T.O. is engaged. See transmission manufacturer's instructions for special procedures.

IMPORTANT: Failure to follow proper shifting or operating sequences will result in premature P.T.O. failure with possible damage to other equipment.

WARNING

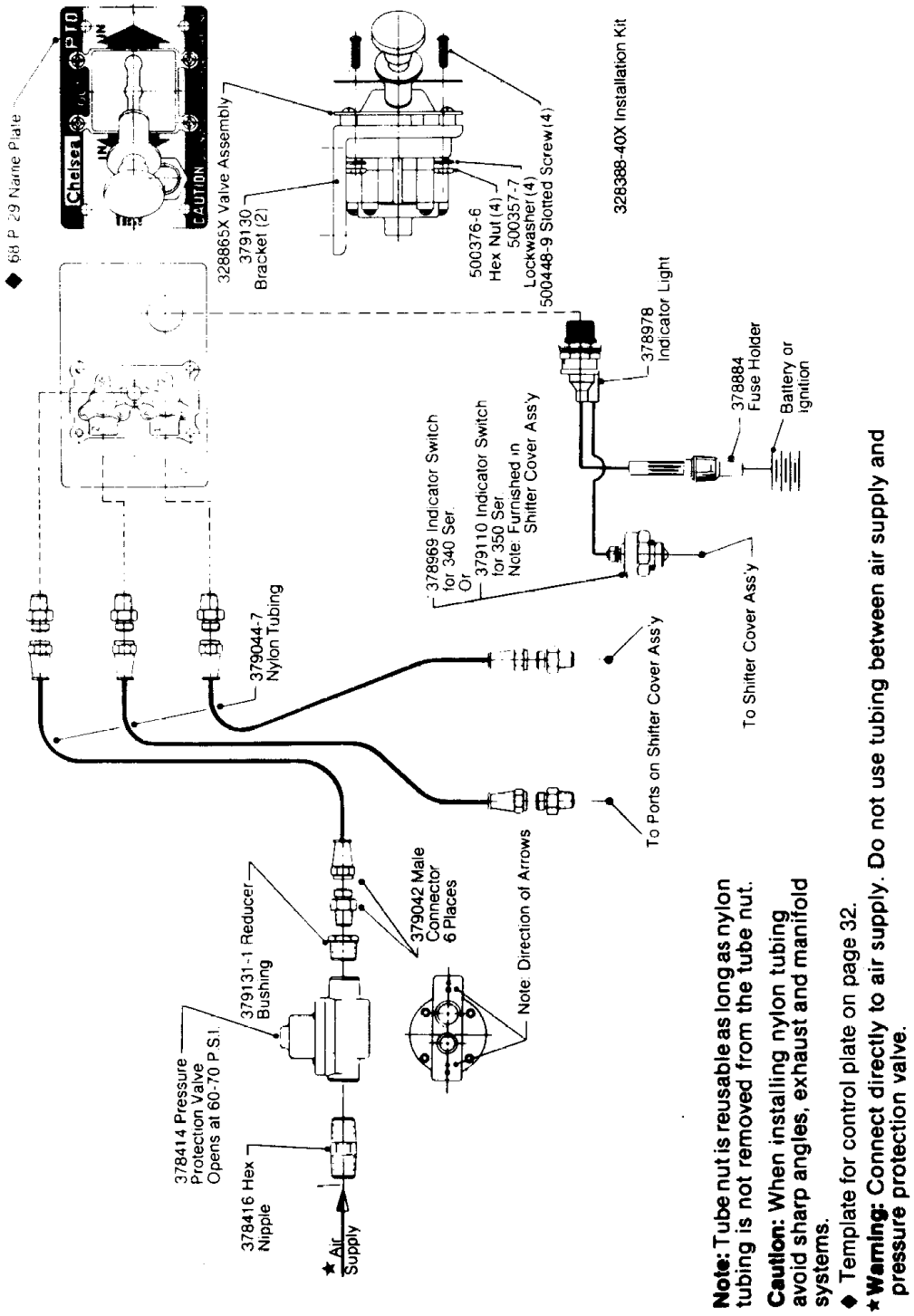
Use only wire control with P.T.O. made for wire cable control. If lever control is desired, order P.T.O. for lever control. The internal shifting mechanism for wire is not designed for heavy forces usually encountered with lever control linkage.

Do not attempt to work on an installed power take off with the engine running.

Make sure to block any moving or raised device that may injure a person working on or under the truck. A lever or its linkage may be accidentally moved causing movement of the device which could cause injury to a person near the device.

AIR SHIFT

Installation Sketch for 340 and 350 Series Using:
New Williams Valve



Note: Tube nut is reusable as long as nylon tubing is not removed from the tube nut.

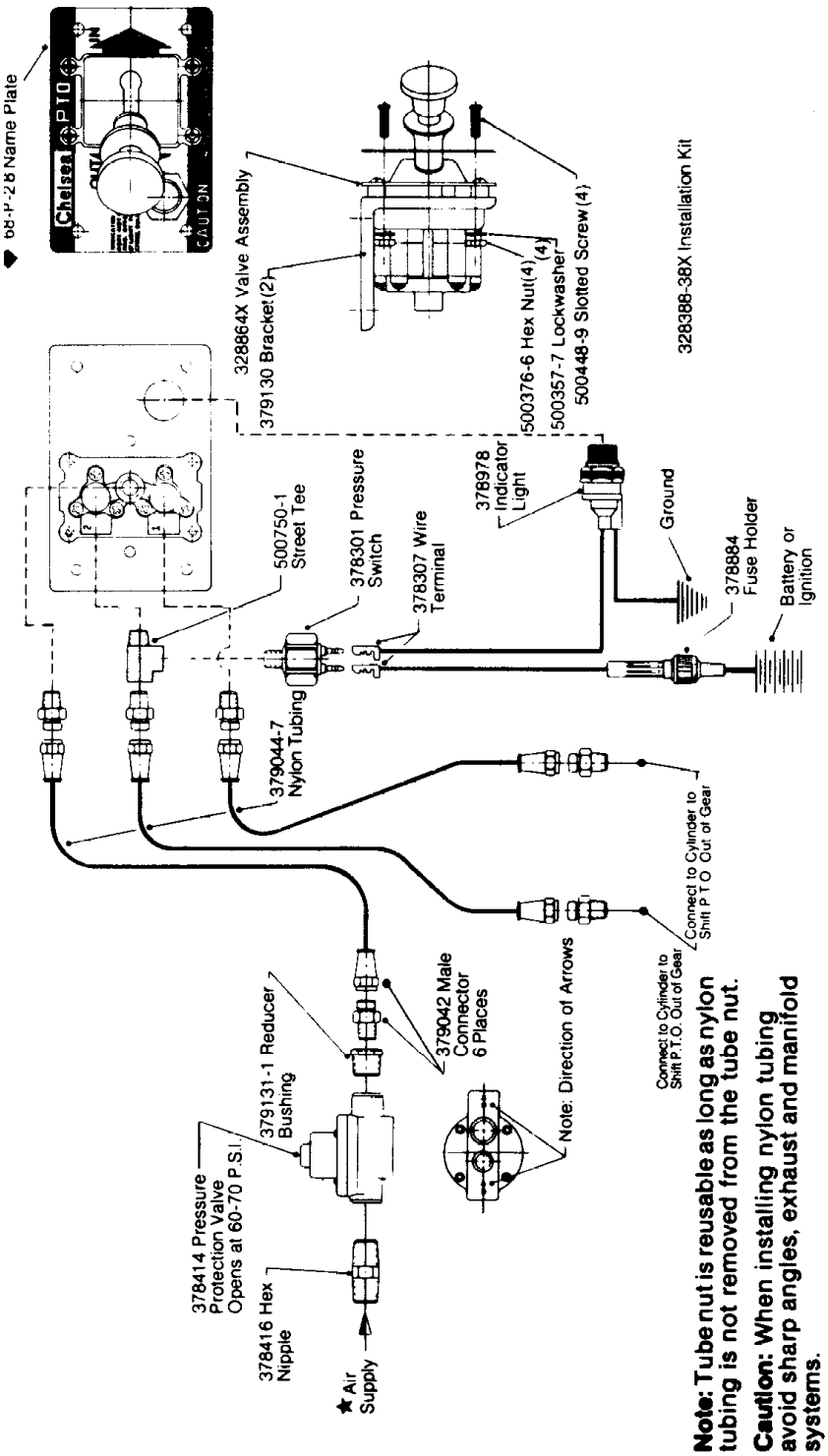
Caution: When installing nylon tubing avoid sharp angles, exhaust and manifold systems.

◆ Template for control plate on page 32.

★**Warning:** Connect directly to air supply. Do not use tubing between air supply and pressure protection valve.

AIR SHIFT

Installation Sketch for 822, 832, 900, 910, and 920 Series Using:
New Williams Valve



Note: Tube nut is reusable as long as nylon tubing is not removed from the tube nut.

Caution: When installing nylon tubing avoid sharp angles, exhaust and manifold systems.

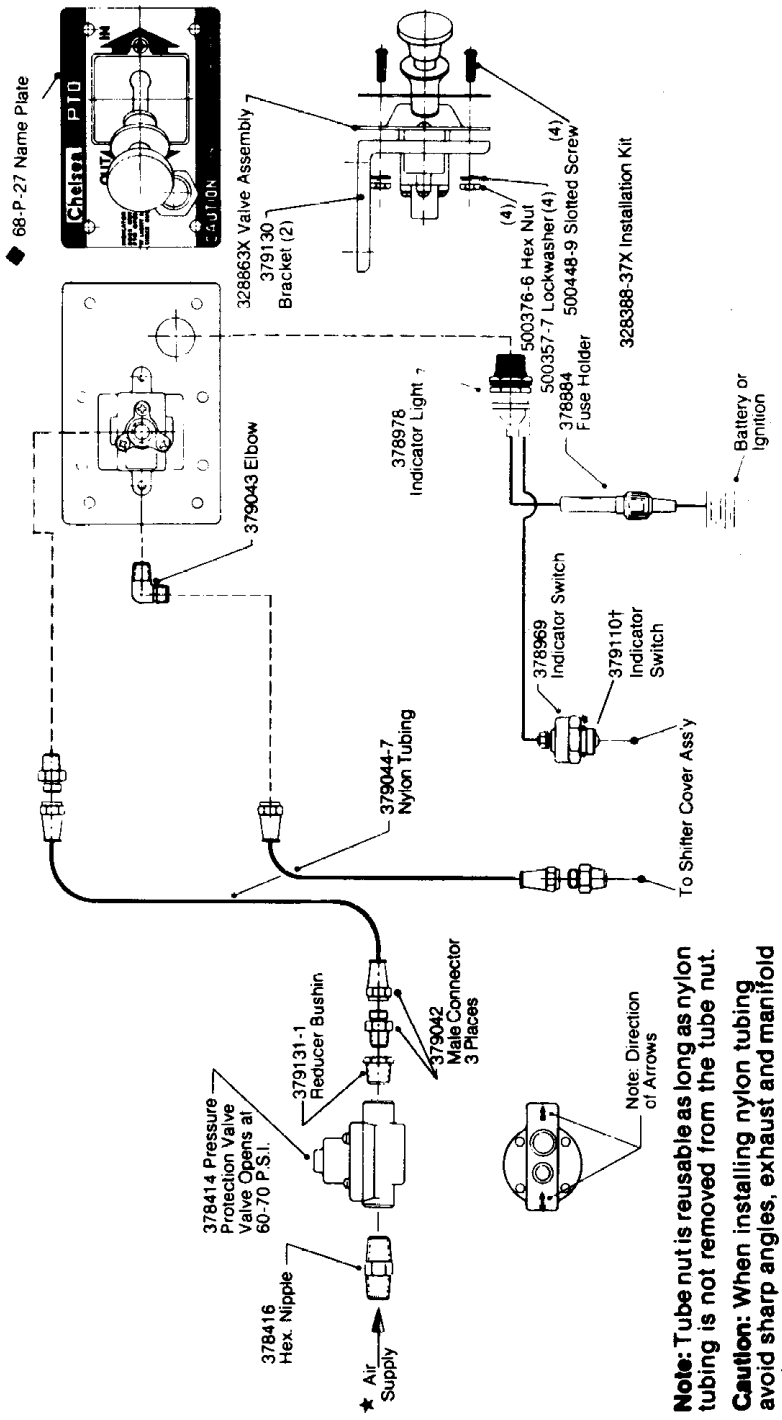
Important: When this installation is used on vehicles with automatic transmissions, the P.T.O. drive gear must be stopped before shifting.

◆ Template for control plate on page 32.

★ **Warning:** Connect directly to air supply. Do not use tubing between air supply and pressure protection valve.

AIR SHIFT

Installation Sketch for 100, 220, 260, 381, 410, 420, 431, 445 and 812 Series
Using: New Williams Valve



Note: Tube nut is reusable as long as nylon tubing is not removed from the tube nut.

Caution: When installing nylon tubing avoid sharp angles, exhaust and manifold systems.

Important: When this installation is used on vehicles with automatic transmissions, the P.T.O. drive gear must be stopped before shifting.

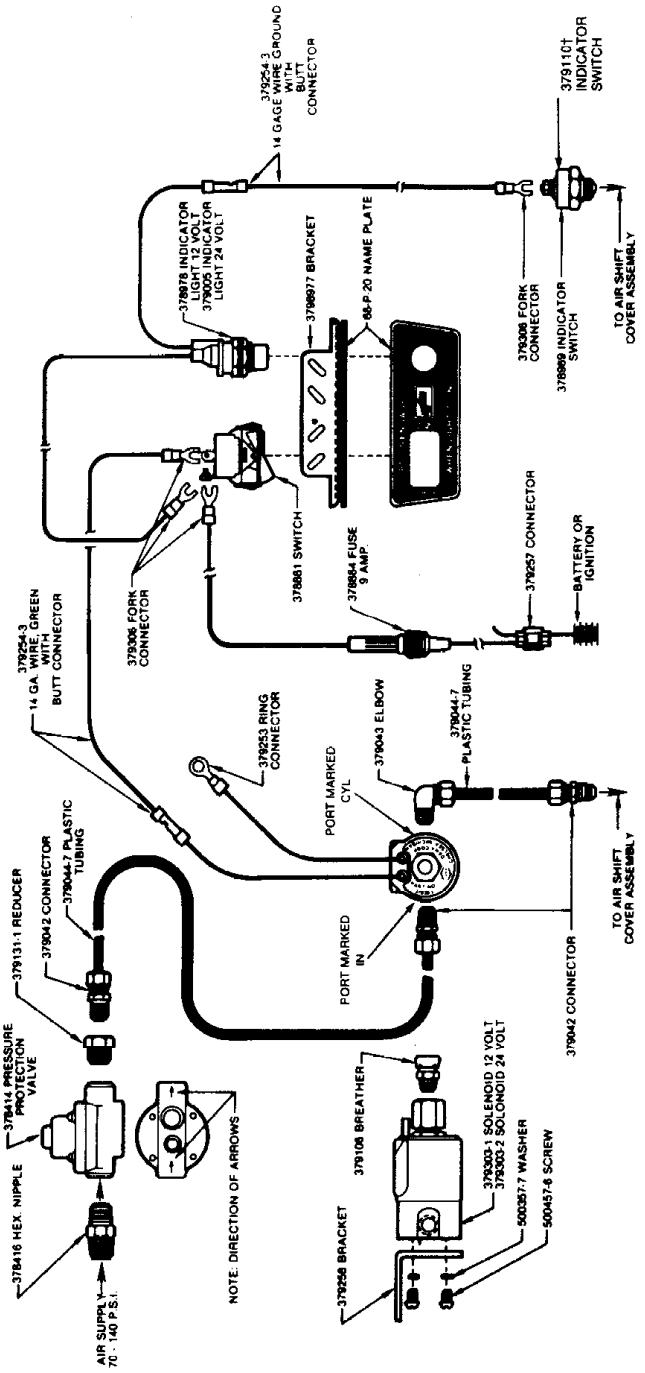
◆ Template for control plate on page 30.

★ **Warning:** Connect directly to air supply. Do not use tubing between air supply and pressure protection valve.

† 379110 Indicator Switch with Black Nylon used on the 445 Series.

ELECTRIC OVER AIR SHIFT

Installation Sketch for 100, 220, 260, 381, 410, 420, 431, 445 and 812 Series



Note: Tube nut is reusable as long as nylon tubing is not removed from the tube nut.

Caution: When installing nylon tubing, avoid sharp angles, exhaust and manifold systems.

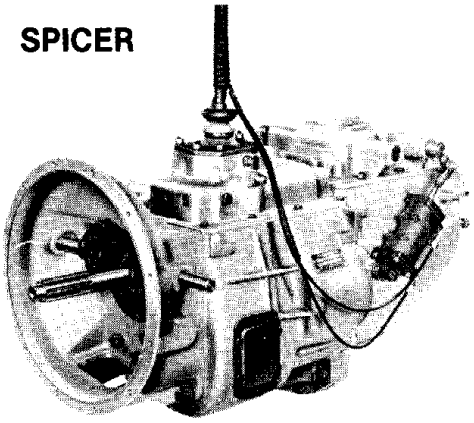
Important: When this installation is used on vehicles with automatic transmissions the P.T.O. drive gear must be stopped before shifting.

***Warning:** Connect directly to air supply. Do not use tubing between air supply and pressure protection valve.

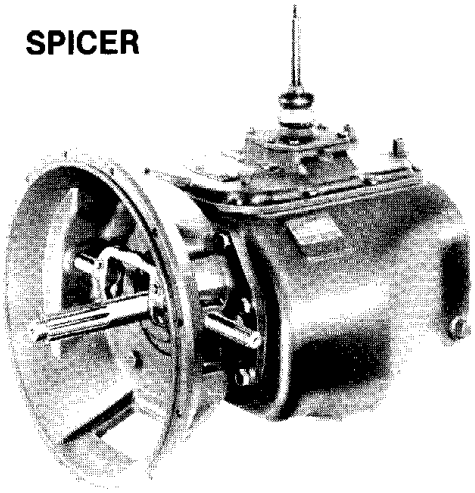
† 379110 Indicator Switch with Black Nylon used on the 445 Series.

TRANSMISSION TAG LOCATIONS

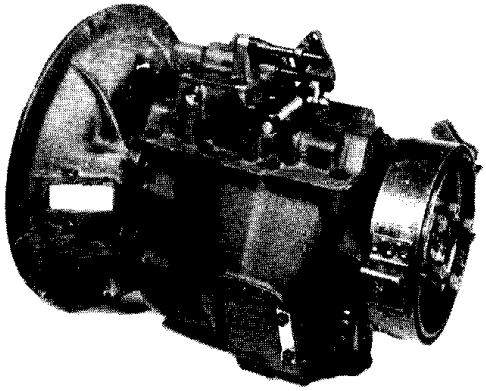
SPICER



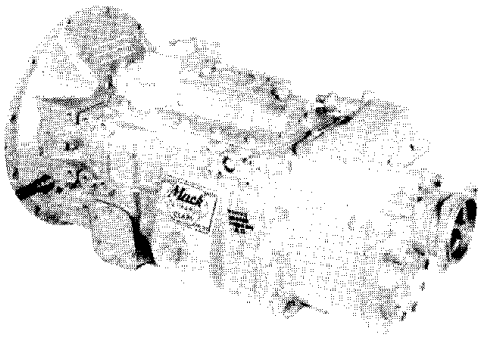
SPICER



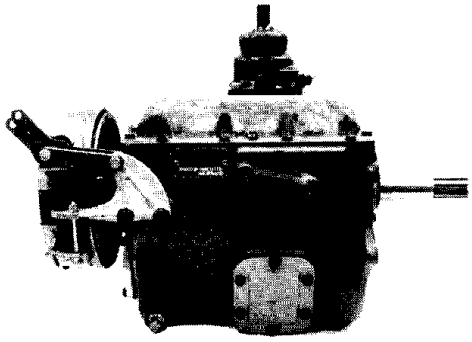
NEW PROCESS



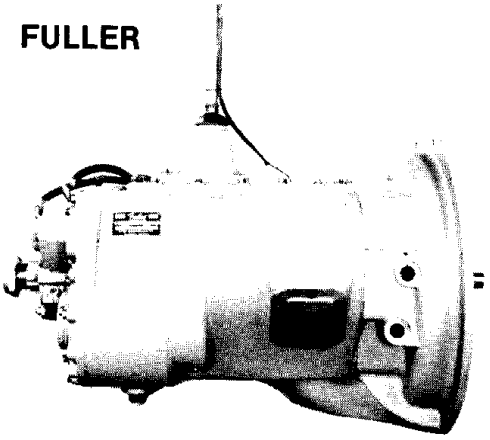
MACK

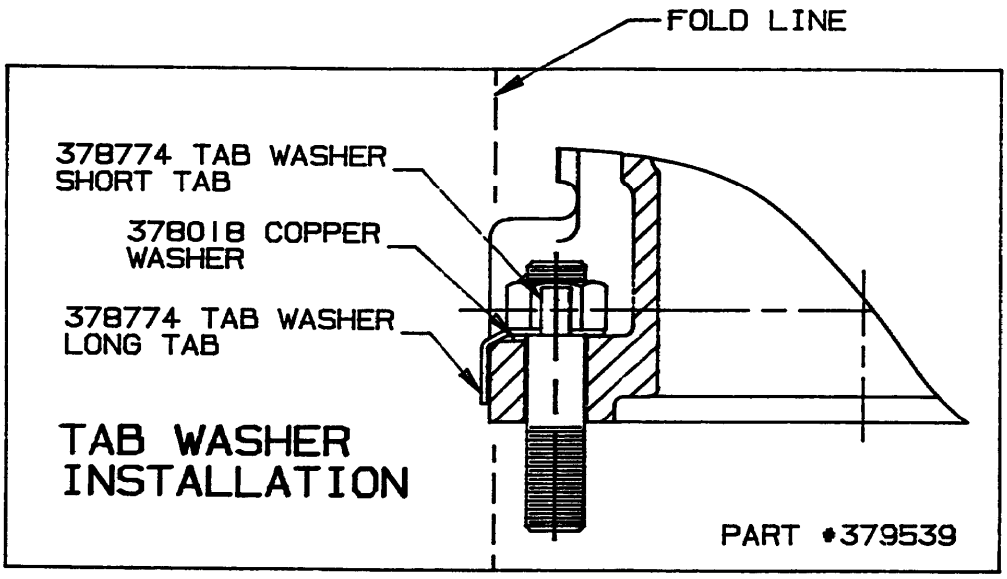


CLARK



FULLER



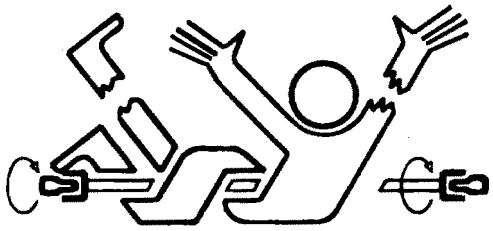

FOLD LINE
378774 TAB WASHER
SHORT TAB
378018 COPPER
WASHER
378774 TAB WASHER
LONG TAB
TAB WASHER
INSTALLATION
PART #379539

WARNING

ROTATING SHAFTS ARE DANGEROUS

YOU CAN SNAG CLOTHES, SKIN, HAIR, HANDS, ETC
THIS CAN CAUSE SERIOUS INJURY OR DEATH.

- EXPOSED ROTATING SHAFTS MUST BE GUARDED.
- 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.



READ P.T.O. OWNERS MANUAL
FOR MORE SAFETY INFORMATION

379276 6/93

WARNING

LOCATE NEAR P.T.O. CONTROL

PLACE THIS PART OF DECAL ON SUN VISOR

379085-1

IMPORTANT

This vehicle is equipped with a POWER TAKE - OFF

-READ OWNERS MANUAL LOCATED IN THE GLOVE BOX.

-SEE SUN VISOR FOR OPERATING INSTRUCTIONS.

CHELSEA®

DANA

6-94

POWER TAKE OFF OPERATION MECHANICALLY SHIFTED P.T.O.'S

I. MANUALLY SHIFTED TRANS.

1) STOP THE VEHICLE, ENGAGE THE VEHICLE BRAKES.
(DO NOT ENGAGE THE PARKING BRAKE AT THIS TIME).
2) DISENGAGE CLUTCH AND SHIFT TRANSMISSION TO NEUTRAL.
WAIT FOR THE TRANSMISSION OR P.T.O. GEARS TO STOP ROTATING.
3) SHIFT THE POWER TAKE OFF.
4) FOR A STATIONARY OPERATION LEAVE THE TRANSMISSION IN NEUTRAL.
APPLY THE PARKING BRAKE, ENGAGE CLUTCH.
5) RELEASE VEHICLE BRAKES.

II. AUTOMATIC TRANSMISSION

1) STOP THE VEHICLE AND ENGAGE THE VEHICLE BRAKES.
(DO NOT ENGAGE THE PARKING BRAKE AT THIS TIME).
2) SHIFT TRANSMISSION LEVER INTO ANY OF THE DRIVE POSITIONS. (THIS WILL STOP THE TRANSMISSION GEARS FROM TURNING).
3) SHIFT THE POWER TAKE OFF.
4) SHIFT THE TRANSMISSION INTO NEUTRAL. (THIS WILL START THE TRANSMISSION GEARS ROTATING AGAIN).
5) FOR A STATIONARY OPERATION, APPLY THE PARKING BRAKE.
6) RELEASE VEHICLE BRAKES.

6-94

Pump



The hydraulic pump draws fluid from the reservoir. It pushes fluid through the system. Oil pumped under pressure provides power to hydraulic motors. Gears draw oil from suction port and push it out pressure port. The same quantity of oil is moved on every revolution. The pump pressure rises to meet any resistance to flow.

Operation

Engage the P.T.O. to run pump.
Run the pump at idle to warm the oil.
Set engine throttle for 1100 RPM.
Disengage PTO before leaving the bench.

Safety

Avoid over speeding the hydraulic pump.
Do not operate the pump with an inadequate oil supply.
Do not operate the pump deadheaded (maximum pressure) for extended periods.

Inspection and Maintenance

Check mounting bolts for tightness.
Check fittings for tightness.
Check hoses for wear.

Troubleshooting

The first place to start troubleshooting a hydraulic system is at the pump. A combination flow meter and pressure gauge test kit should be installed between the pump pressure port and the valve assembly. This will enable you to adequately evaluate the condition of the pump when in operation.

With the engine set for a constant engine speed of 1000 RPM and no-load on the pump (none of the spools on the valve are actuated), the pump should be delivering 12 GPM and 8 GPM.

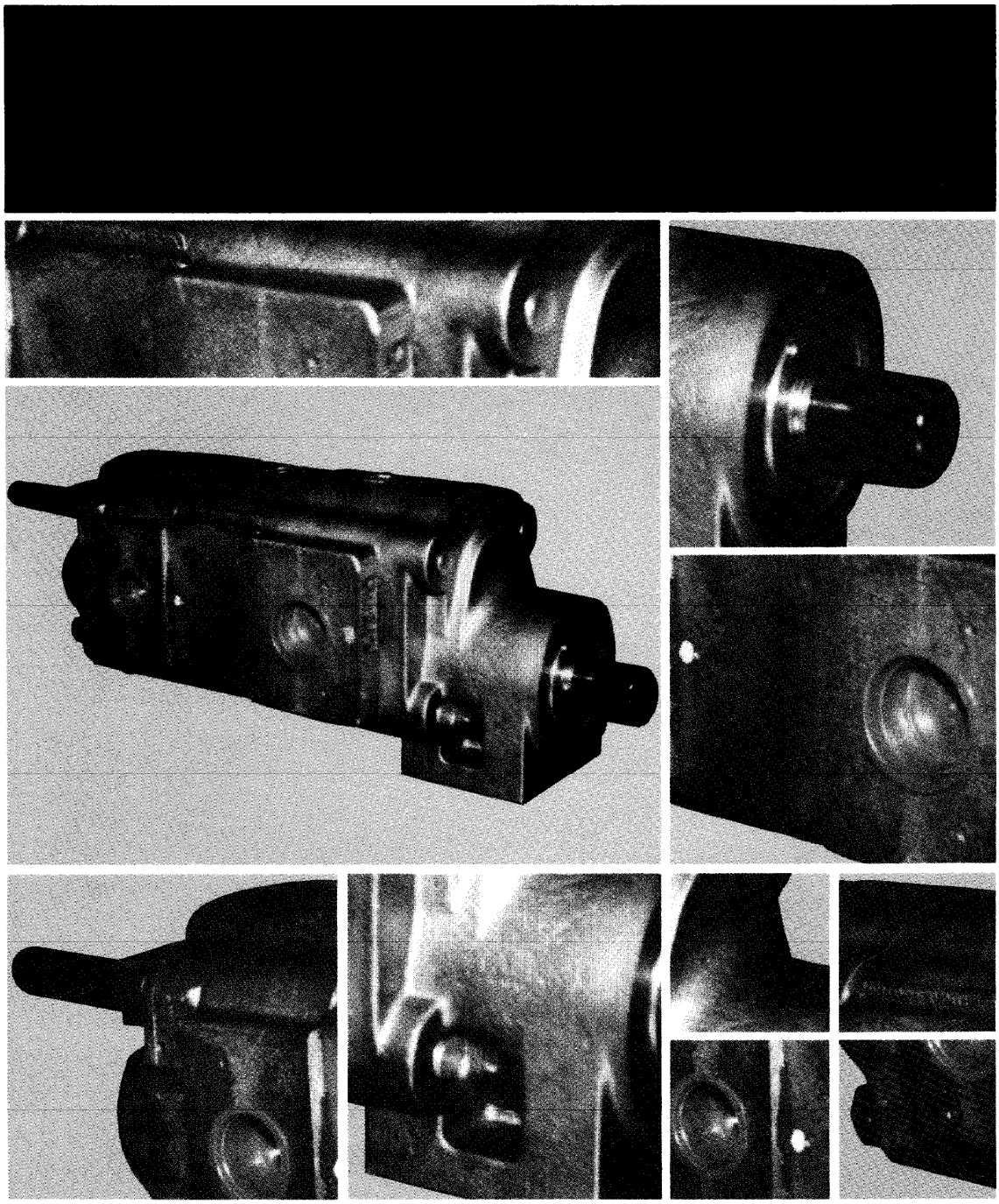
Load Testing the 12 GPM Pump Or the 8 GPM Pump Section

1. Actuate the boom raise circuit until the boom cylinder reaches maximum extension. This provides a restriction and imposes a load on the pump. At this point the pressure gauge should indicate approximately

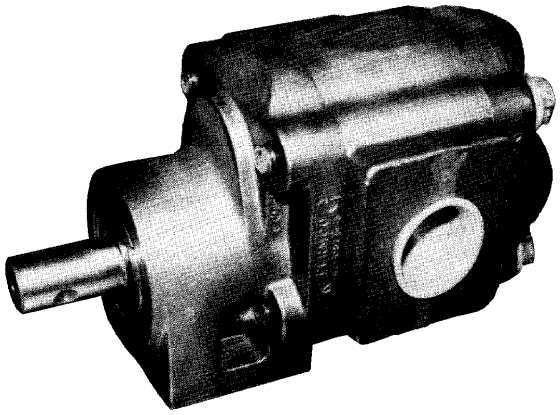
3000 PSI. (If the gauge does not show 3000 PSI, see the section on relief valve evaluation before proceeding.)

2. As the pump is loaded, the flow rate will fall slightly due to internal leakage in the pump. If, during this load test, the pump flow rate falls below 10 GPM for the 12 GPM section or 6.5 GPM for the 8 GPM section, the pump should be replaced. Increase the engine speed to achieve the flow rate observed under the no-load condition (i.e. 12 GPM and 8 GPM). The engine should now be running approximately 1200 RPM.

SERIES P2500, P3700
GEAR PUMPS



Read this manual carefully before you start to assemble, disassemble, or rebuild your Permco pump: and also before you use Permco's patented diverter plates.



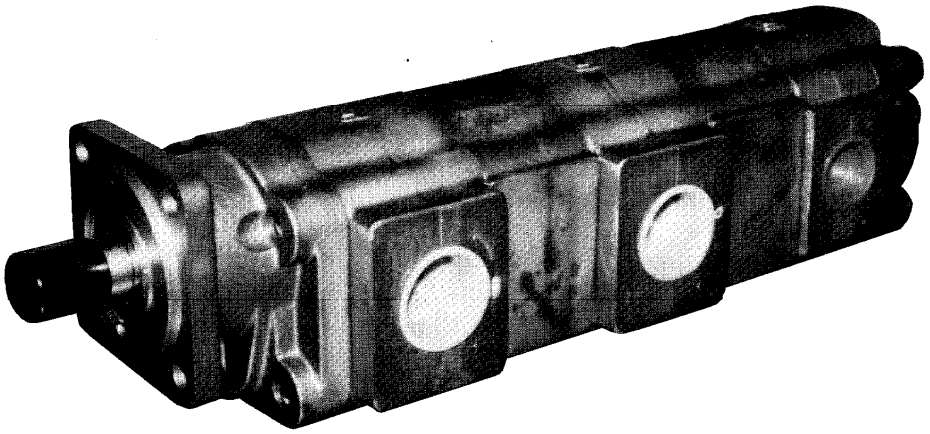
PERMCO PUMP MAINTENANCE. . .

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PERMCO

© PERMCO, INC. 1981



If you intend to rebuild a pump that has thrust plates and you wish to replace the thrust plates with Permco diverter plates, inspect the original port end cover, shaft end cover, gear housing and bearing carriers very carefully. To obtain the maximum performance from diverter plates, all of the above components must be in good condition with minimal amount of wear. The following areas of wear are the most critical...and often overlooked:

1. Shaft end covers, port end covers, and bearing carriers . . . Check bearing bores for out-of-roundness or elliptical shape. If more than 0.003" out-of-round, do not use.

2. Gear housings. . .If the wear pattern on the inlet side is in excess of 0.003" depth, do not use.

3. Gears . . . Inspect very carefully. If you have scored, scuffed or pitted journals, scratched or scuffed tooth faces, deep nicks on tooth edges, do **not** use; install new drive and driven gear.

4. Bearings . . . A loose fit between gear hub and bearing ID may not mean a bad bearing. The misalignment it can cause is detrimental to good pump performance. We recommend installing a complete set of new bearings at each rebuild.

5. Seals . . . It is recommended that all seals be replaced on any rebuild job.

Putting Permco diverter plates into a pump and re-using the old worn parts will not necessarily restore the pump to the high efficiency and performance of a new Permco pump. Merely installing new Permco diverter plates cannot restore the pump to its original performance. Permco's high efficiency, performance, and life expectancy are based on using all new Permco parts.

If you are rebuilding a Permco gear pump, you must not install thrust plates of another make. Tolerances and finishes on Permco parts are held closer than those of other manufacturers of pump parts. For warranty repairs under any circumstances, you must not substitute other makes of parts in a Permco pump. USE ONLY GENUINE PERMCO PARTS.

You can successfully use Permco diverter plates to rebuild other makes of pumps to obtain increased operating pressures and pump life. However, read the above paragraphs carefully.

If you have any questions about rebuilding Permco pumps or about using Permco parts to upgrade other makes of pumps, call your local Permco pump and parts distributor.

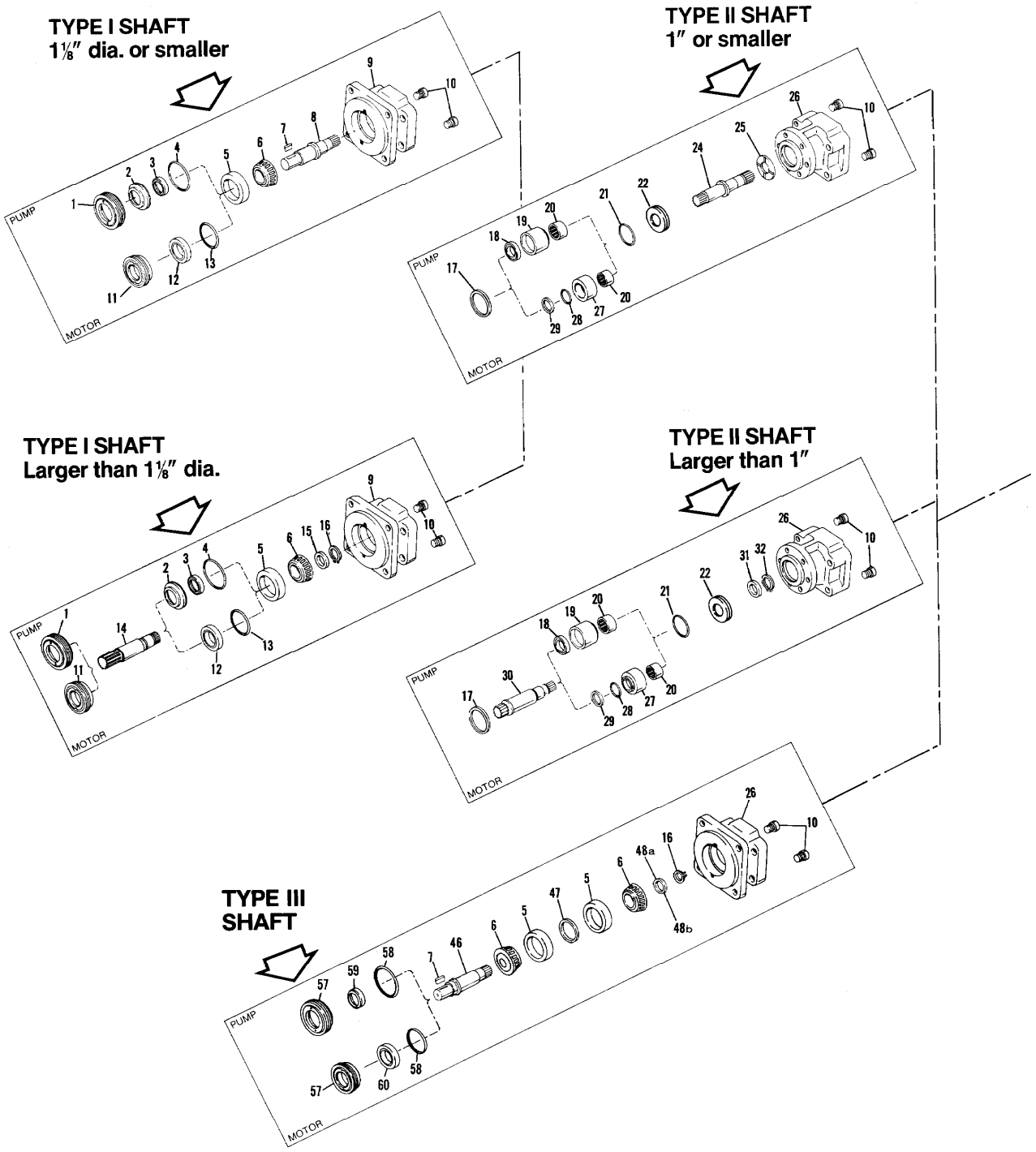
THREE TYPES OF PUMPS

There are three types of Permco pumps, as determined by the configuration of the shaft end covers . . . Type I, Type II, and Type III. There are slight differences in disassembly and re-assembly procedures, according to each shaft end cover. Also, Type II and Type III are normally longer from front to back than Type I. Be sure you know which type you are working on.

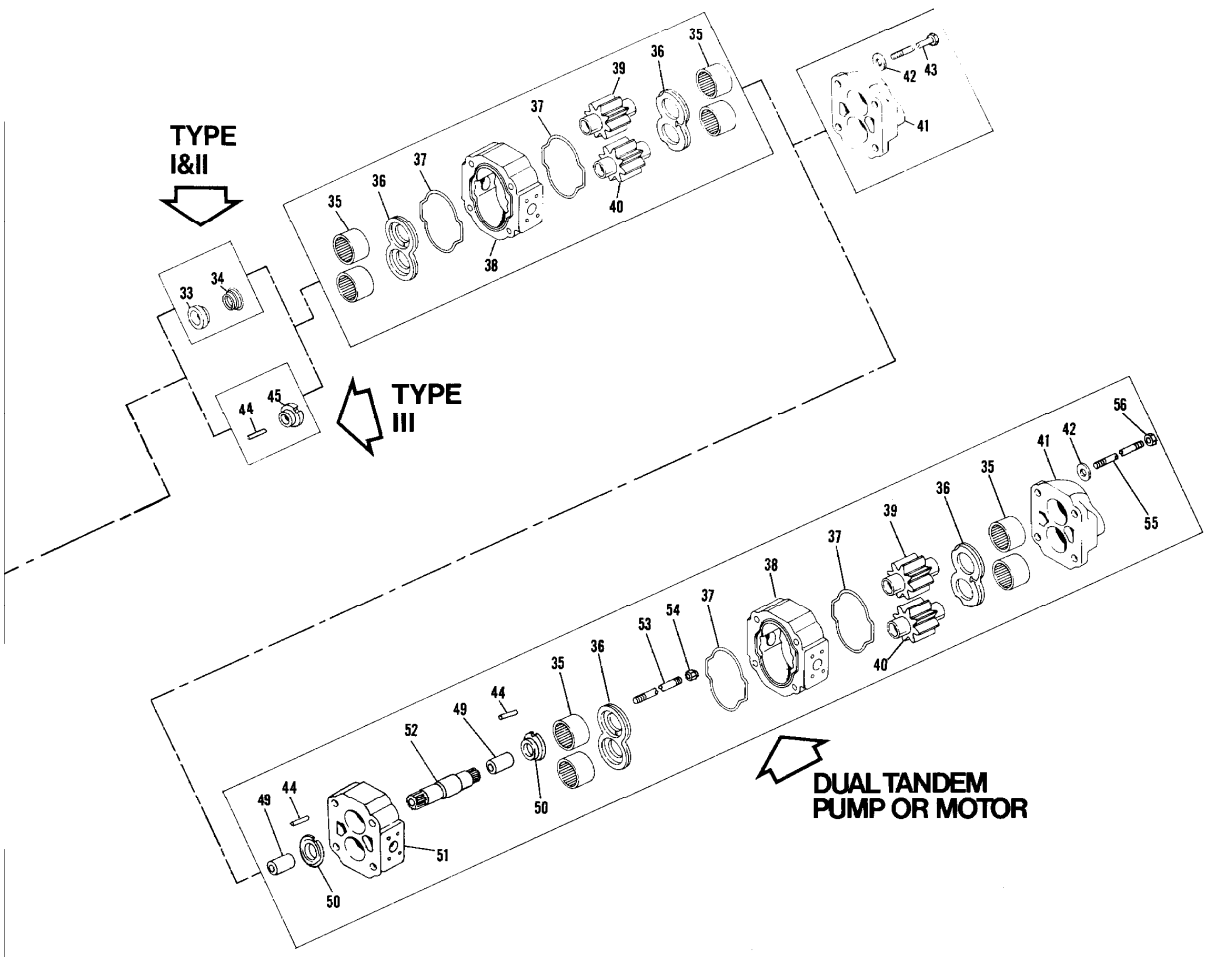
CLEANLINESS IS HIGHLY IMPORTANT

WARNING. Before you start disassembling the pump, clean up your work bench. This will avoid the headaches and danger of getting dirt, metal fragments, and foreign objects into the fine-finished cavities and threads of the pump and components, and eventually into the entire hydraulic system. In pump maintenance, extreme cleanliness is most important.

2500 SERIES



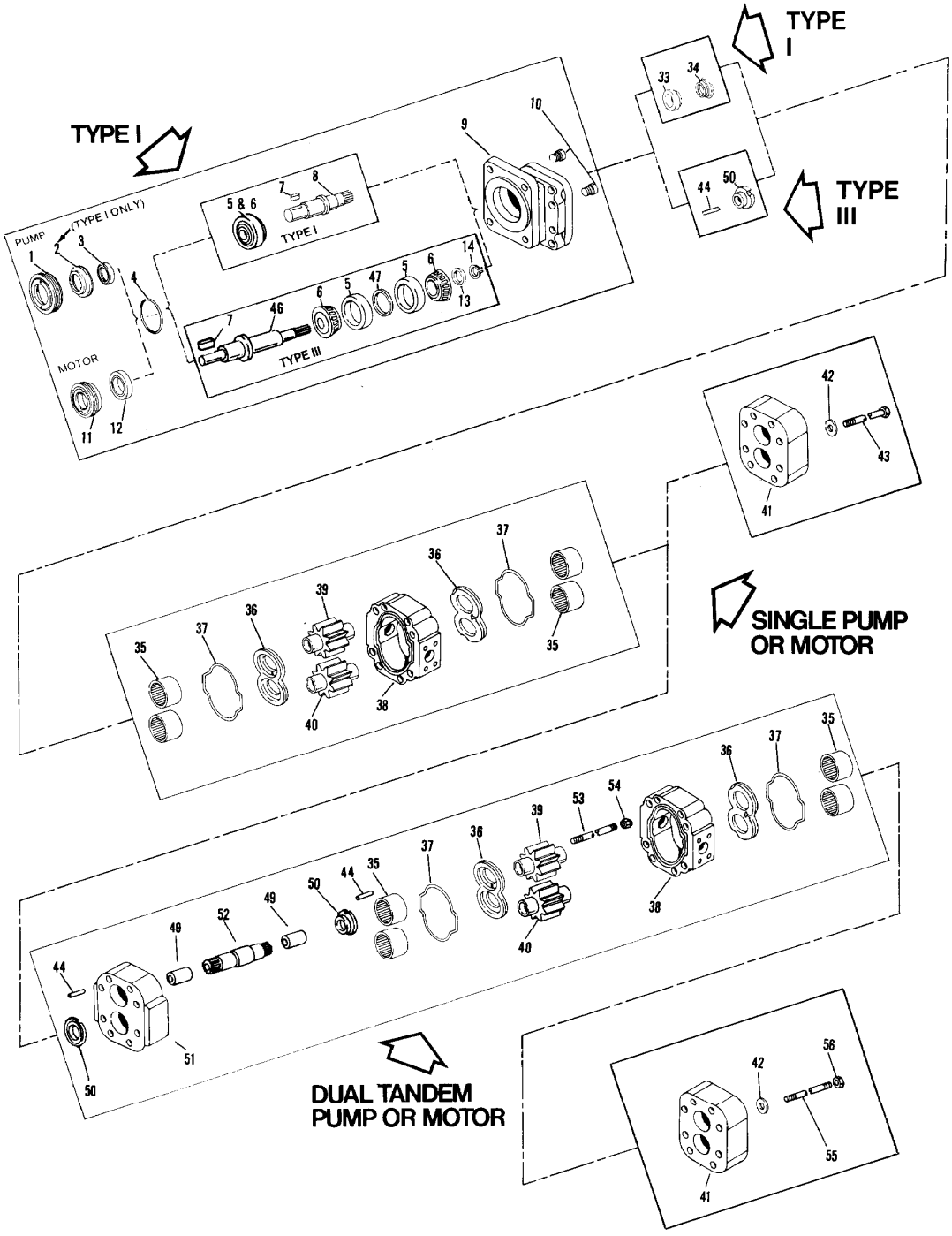
PERMCO



Exploded View of Pump or Motor

PERMCO

3700 SERIES



PERMCO

PARTS ORDERING NUMBERS

2500 SERIES PUMPS

Item Number On Exploded View	Order This Part Number	Quantity To Order	Item Number On Exploded View	Order This Part Number	Quantity To Order
1	V-0961	1	32	W093-02	1
2	RZ-0558	1	33	ZG-1909	1
3	W62-26-13		34	Z-0216-182	1
4 & 13	K-2995-26	1	35	R-0921	4 per section
5 & 6	W015-7	1	36	X-0947	2 per section
7	(Replace original key with identical key).	1		X-0947-TC	2 per section
				X-0947-DS	2 per section
				X-0947-BRD	2 per section
8, 14, 24, 30, 46	See Engineering Catalog		37	TA-2995-244	2 per section
			38	LZ-0577- * - *	1 per section
9 & 26	* -057 * - *	1	39 & 40	JZ-0996L- *	1 set/section
10	S-0280/L-0280-K	2	41	QZ-0592- *	1
11	KZ-0961	1	42	W033-2	4
12	W62-49-3	1	43 & 55	5/8-11 Grade 8	4
15	XZ-0558-1	1	44	W004-19	1
16	W86-100	1	45	ZQ-1909	1
17	W023-206	1	47	FA-0558	1
18	W62-26-15	1	48	XZ-0558-1	1
19	FZ-0961	1	49	SZ-0408- *	1
20	W0921	1	50	ZQ-1909	2
21	K-2995-109	1	51	J*-0576- * - *	1
22	W051-D9	1	52	SZ-0022	1
25	DA-0558	1	53	3/8-16 Rod	1
27	ZU-1909	1	54	W78-05	1
28	Q-2995-8	1	56	W3-65	4
29	J-2909-19	1	57	GZ-0961	1
31	CA-0558	1	58	K-2995-47	1
32	W093-02	1	59	W62-26-10	1
			60	W62-49-1	1

3700 SERIES PUMPS

Item Number On Exploded View	Order This Part Number	Quantity To Order	Item Number On Exploded View	Order This Part Number	Quantity To Order
1	U-0961 Type I	1	14	W-86-112	1
	IZ-0961 Type III	1	36	W-0947	2 per section
2	QZ-0558 Type I only	1		W-0947-TC	2 per section
3	W62-26-10	1		W-0947-DS	2 per section
4	K-2995-33 Type I	1		W-0947-BRD	2 per section
	K-2995-4 Type III	1	37	TA-2995-249	2 per section
5 & 6	W015-5	1	38	KZ-0577- * - *	1 per section
7	(Replace original key with identical key).	1	39 & 40	IZ-0996L- *	1 set/section
			41	MZ-0592- *	1
			42	W033-1	8
8 & 46	* -0023	1	43 & 55	1/2-13 Grade 8	8
9	* -0575- *	1	44	W004-19	2
10	S-0280/L-0280-K	2	49	LZ-0408- *	1
11	LZ-0961 Type I	1	50	ZV-1909	1
	IZ-0961 Type III	1	51	*Z-0576- * - *	1
12	W62-49-1	1	52	RZ-0022	1
33	ZF-1909	1	53	3/8-16 Rod	1
34	Z-0216-177	2	54	W78-05	1
35	Q-0921	4 per section	56	W3-40	8
13	ZA-0558- *	1	47	GA-0558	1

NOTE:
*THIS PORTION OF PART NUMBER SHOULD BE IDENTICAL TO ORIGINAL PART NUMBER.
OBTAIN BY REFERRING TO UNIT CODE NUMBER. CONTACT DISTRIBUTOR OR PERMCO SALES DEPT.

DISASSEMBLING

TYPE I PUMP:

1. With a sharp metal scribing tool, grease pencil, Magic Marker, or paint, make an indexing mark that runs straight across a surface of the port end cover (41), gear housing (38), and shaft end cover (9). This will enable you to reassemble these parts into the same position when you put the pump back together.

2. With a face spanner wrench, loosen and unscrew the threaded retainer ring (1) on the shaft end of the pump a couple of turns to relieve the preload on the tapered roller bearing (6). DO NOT REMOVE the retainer ring (1) entirely.

3. Install the unit in a vise, shaft end down.

4. Remove the cap screws (43) and washers (42) at the rear of the pump that hold the port end cover (41) and the gear housing (38) together. Remove the port end cover (41) and diverter plate (36), or the thrust plate. The roller bearings (35) will remain intact with the port end cover (41). (In pumps with thrust plates, the pocket seals will come out easily; Permco pumps with diverter plates do not require pocket seals.)

5. Remove the pump drive gear (39), the driven gear (40), and the gear housing (38) from the shaft end cover (9). BE CAREFUL to keep the drive gear and driven gear together; you must reassemble them as the original pair later, since they have worked-in together.

DISASSEMBLY: SHAFT END COVER (9)

1. Set the partially disassembled pump (shaft end cover(9)) from which the gear housing was separated in the vise with the pilot up. The drive end of the shaft will be pointing straight up.

2. Now finish unscrewing threaded retainer ring (1), loosened at the start, and remove from shaft (8 or 14).

3. Pull entire drive shaft assembly (2 thru 8) out of shaft end cover (9). Carefully note direction of bearing taper, so bearing can be reassembled correctly.

4. Turn the shaft end cover (9) pilot-down; the end of which the drive shaft assembly (2 thru 8) was removed. Diverter plate (36) will now be accessible.

5. With a knife blade or thin-blade screwdriver, VERY gently pry the diverter plate (36) off the bearings of the shaft end cover (9). If working on another make of pump to be refitted with PERMCO diverter plates, remove and throw away the pocket seals; PERMCO pumps require no pocket seals.

6. With a bearing puller, pull the shaft bearings (35) out of the shaft end cover (9) if you plan to replace the bearings. If you pull the bearings, check bores for out-of-roundness and elliptical shape. If more than 0.003" out-of-round, **DO NOT USE.** If you need to remove only the conical spring (34) and shaft bushing (33), pull ONLY the shaft-end **drive** bearing; **do not pull** the shaft-end **driven** bearing.

NOTE: Skip Step 7 IF the pump drive shaft is 1-1/8" or smaller in diameter; go directly to Step 8. If the shaft is larger than 1-1/8" in diameter——

7. Remove snap ring (16) and spacer (15) from gear end of shaft.

8. If the drive shaft is 1-1/8" or smaller in diameter, press the tapered bearing (6), the cup (5), seal retainer (2), and lip seal (3) off the DRIVE end of the shaft. If the shaft is larger than 1-1/8" in diameter, press these four parts off the GEAR end of the shaft.

9. Remove and discard the "O" ring from bore in shaft end cover (9). Have an identical new replacement "O" ring ready for reassembly. Remove and discard lip seal (3) from seal retainer (2); have replacement lip seal on hand for reassembly.

GEAR HOUSING

1. Remove square gasket seals (37) from gear housing (38) and discard. Have identical replacements on hand for reassembly. Do **Not** use "O" rings. Check for depth of wear at this time, using a telescoping gage and a micrometer with the depth tolerance as described on Page 3, Paragraph 2.

PORT END COVER

1. With a knife blade or thin-blade screwdriver, gently pry the diverter plate (36) or thrust plate off the bearings of the port end cover (41).

2. On makes of pumps other than PERMCO, remove and discard the pocket seals. You do not need pocket seals when installing PERMCO diverter plates; these patented diverter plates do not use pocket seals.

3. Only if you are replacing the two shaft roller bearings (35) with new ones, pull the bearings out of the port end cover (41) with a bearing puller.

TYPE II PUMP:

1. With a sharp metal scribe, grease pencil, magic marker or paint, make an indexing mark that runs straight across a surface of the port end cover (41), gear housing (38), and shaft end cover (26). This will enable you to reassemble these parts into the same position when you put the pump back together.

2. Remove the cap screws (43) and washers (42) from the port end cover (41).

3. Separate the port end cover (41) from the gear housing (38) and the diverter plate (36), or thrust plate from the bearings of the port end cover. The roller bearings (35) will remain intact with the port end cover. (In pumps with thrust plates, the pocket seals will be easily removable; Permco pumps with diverter plates do not require pocket seals.)

4. The drive gear (39) and the driven gear (40) will still be in the gear housing (38). Remove them. BE CAREFUL to keep the drive gear (39) and driven gear (40) together; it's recommended that you reassemble them as the original pair later, since they have worked-in together. Now separate the gear housing (38) from the shaft end cover (26).

DISASSEMBLY: SHAFT END COVER

1. Turn the shaft end cover (26) on end so that the drive end of the shaft (24) is pointing upward. With a pointed tool or thin screwdriver blade, snap out the retaining ring (17) **WARNING USE EYE PROTECTION.**

2. Pull the entire drive shaft assembly out of the shaft end cover (26). If the drive shaft is smaller than 1" diameter, you will have to remove the thrust washer (25) from the base of the bearing bore separately after pulling out the drive shaft assembly. (18 thru 25 for a pump with a 1" diameter drive shaft and smaller; 18-32 for a pump with a drive shaft larger than 1" diameter).

3. Upend the shaft end cover (26) to expose the diverter plate (36) or thrust plate. Gently pry the diverter plate (36) or thrust plate away from the shaft end cover (26), using a knife blade or thin-blade screwdriver. On pumps other than Permco's, remove and discard the pocket seals; Permco pumps require no pocket seals.

4. To remove roller bearings (35), pull them out of the shaft end cover (26), using a bearing puller. After bearings have been removed check bores for out-of-roundness and elliptical shape. If more than 0.003" out-of-round **do not use.**

5. (a) For drive shafts 1" in diameter and smaller: Slip the needle bearing assembly (18 thru 20) off the drive end of the shaft (24). The two thrust bearings races (22) and thrust bearing roller (23) can now be slipped off the drive end of the drive shaft (24).

5. (b) For drive shafts larger than 1" in diameter:

(1) Hold the needle bearing assembly (18 thru 23, 31, and 32) forward towards the drive end of the drive shaft (30). Remove snap ring (32) with snap ring pliers.

(2) Slip the snap ring retainer (31), two thrust bearing races (22), thrust bearing roller (23), "O" ring (21), needle bearing (20), bearing and seal retainer (19), and double-lip seal (18) off the gear end of the drive shaft (30).

6. On both diameters of shafts, remove seal (18) and "O" ring (21) from seal and bearing retainer (19). Be sure you have new replacement seal and "O" ring available for replacement.

7. When installing needle bearing (20), press the old bearing out of the seal and bearing retainer (19). Have a new bearing on hand for reassembly.

GEAR HOUSING

Remove square gasket seals (37) from grooves in gear housing (38) and discard. Have replacement seals at hand for re-assembly. Check for depth of wear at this time, using telescoping gage and micrometer with the depth tolerance as described on Page 3, Paragraph 2.

PORT END COVER

1. Gently pry off the diverter plate (36) or thrust plate with a knife blade or thin-blade screwdriver. (On other makes, the pocket seals should be removed and discarded----PERMCO diverter plates require no pocket seals.)

2. To install new roller bearings (35), pull these bearings from the port end cover (41) bearing bores with a bearing puller. After bearings have been removed check bores for out-of-roundness and elliptical shape. If more than 0.003" out-of-round, **do not use.**

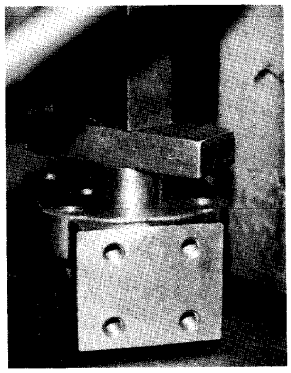
END OF DISASSEMBLY OF TYPES I AND II PUMPS

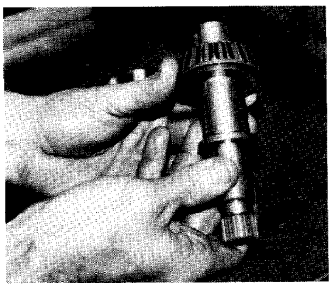
TYPE III PUMP:

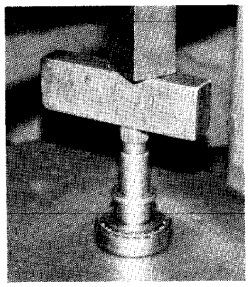
For Type III, disassembly is the same as Type I larger than 1-1/8" diameter. However, there are two tapered roller bearings (5 and 6) on shaft (46).

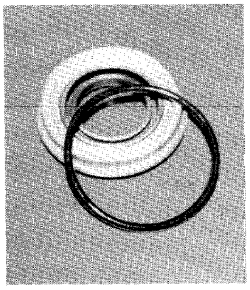
REASSEMBLING TYPE I PUMP:

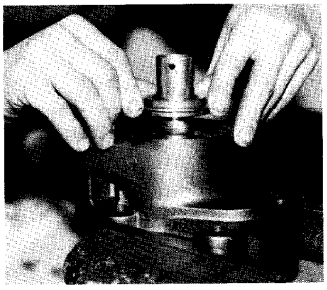














REASSEMBLING THE TYPE I PUMP

1. Grip shaft end cover (9), gear end up. Place bronze shaft bushing (33) in the bearing bore of the shaft end cover (9) with bushing flange down.

2. Place conical spring (34) against bronze shaft bushing (33) with smaller end of spring over pilot shoulder of bushing.

3. Replace the two roller bearings (35) in the bores of the shaft end cover (9). Take care that the top of the conical spring (34) does not cock and wedge between bearing (35) and bottom of bearing counterbore.

4. Place shaft end cover in a soft jaw vise. Turn cover end-for-end and clamp with flange end up.

FOR PUMP WITH DRIVE SHAFT SMALLER THAN 1-1/8" DIAMETER

5. Repack tapered roller bearing (6) with good lithium-base high-temperature bearing grease, No. 2 consistency.

6. Carefully press the bearing (6) on the drive shaft (8). Be sure the larger diameter of the bearing (6) is seated against the shoulder of the drive shaft (8).

7. Insert the assembled drive shaft (8) into shaft end cover (9). Be sure shaft bushing (33) is centered in the shaft cover bore (9).

8. Place bearing cup (5) over tapered roller bearing (6). Carefully press or tap cup down to seat firmly against bottom of bearing bore.

9. Press lip seal (3) into recess in seal retainer (2) with lip of seal facing up. Put "O" ring into bearing bore on top of bearing cup (5).

10. Install this seal retainer subassembly (1,2,3,4) over drive shaft, being careful to seat it firmly against top side of bearing cup (5).

NOTE: if you are reassembling a unit used as a MOTOR, with either diameter shaft, press a motor shaft seal (12) into the seal retainer (11), using proper shaft seal tool.

FOR PUMP WITH DRIVE SHAFT 1-1/8" DIAMETER AND LARGER

5. Carefully press lip seal (3) into seal retainer (2) with lip of seal facing outward.

6. Next, press this seal retainer subassembly (2-3) onto drive shaft (14). Small end of subassembly should face outer or drive end of shaft (14).

7. Put "O" ring (4) into groove in seal retainer (2).

8. Repack tapered bearing (6) with good lithium-base high-temperature bearing grease, No. 2 consistency.

9. Carefully press bearing (6) on drive shaft (14). Be sure smaller diameter of bearing (6) is facing towards the seal retainer (2). Place bearing cup (5) over bearing (6).

10. Push the spacer (15) over gear end of shaft (14). Put snap ring (16) in correct groove on shaft (14).

11. Press seal retainer assembly (2, 3, 4), bearing (5, 6), and spacer (15) tightly against snap ring (16).

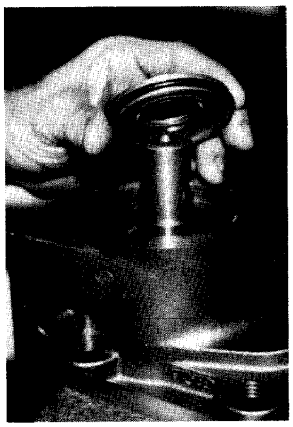
12. Insert assembled drive shaft (14 etc.) in shaft end cover (9).

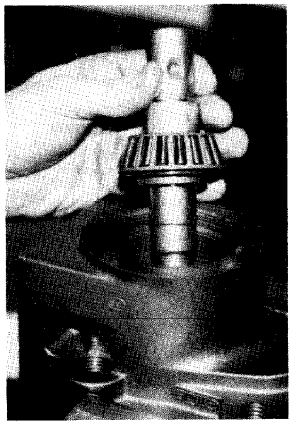
13. Thread the retainer ring (1) **loosely** into shaft end cover (9), but DO NOT tighten retainer ring (1) enough to preload bearing (5, 6); this will be done later.

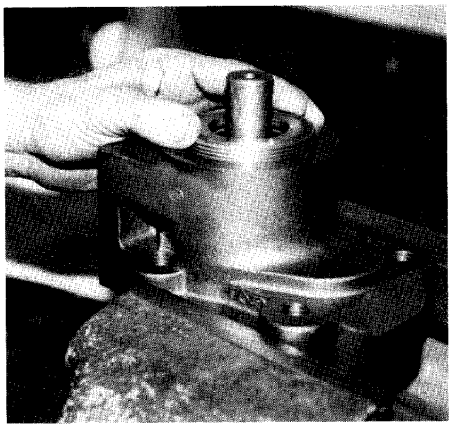
14. Release shaft end cover (9) from vise, turn cover end-for-end, and clamp with flange end down.

15. If you are reassembling a single-rotation pump, and IF you removed the plug (10) installed on the high-pressure side of the pump, replace it; leave the low-pressure opening unplugged. If your pump is a double rotation unit, and IF you removed the two check assemblies (10), replace with new valves.

TO COMPLETE THE ASSEMBLY OF TYPE I PUMP, skip to Page 13: Port End Cover Assembly.







TYPE II PUMP:

REASSEMBLING THE TYPE II PUMP:

SHAFT END COVER

1. With the shaft end cover (26), gear end up, install bronze shaft bushing (33), with flange down.

2. Place conical spring (34) against bronze shaft bushing (33) with smaller end of spring over pilot shoulder of bushing.

3. IF you removed them, replace the two roller bearings (35) in the bores of the shaft end cover (26). Take care that the top of the conical spring (34) does not cock or wedge between bearings (35) and bottom of bearing counterbore.

4. Place shaft end cover (26) in a soft jaw vise flange end up.

5. With lip of seal (18) facing up, press seal into

recess in bearing- and-seal retainer (19). IF you removed needle bearing (20) during disassembly, press it into bearing-and-seal retainer (19). Put "O" ring (21) over small diameter of bearing-and-seal retainer (19).

6. For double bearing units, see Page 12.

NOTE: If you are reassembling a unit used as a MOTOR, with either diameter shaft (smaller or larger than 1" diameter), install the special motor seal retainer (27) which combines an "O" ring (28) and a back-up ring (29) in the I.D. of the seal retainer (27). (Place "O" ring in retainer first and then install back-up ring).

A. FOR PUMP WITH DRIVE SHAFT 1" IN DIAMETER AND SMALLER

6a. Put thrust washer (25) in bottom of bearing bore of shaft end cover (26), with grooves facing up.

7a. Put one of the two thrust bearing races (22) over drive end of drive shaft (24) so race rests against shaft shoulder. Put thrust bearing roller (23) on drive shaft (24), followed by second thrust bearing race (22). Slide needle bearing (20) and "O" ring (21) on drive shaft (24) with "O" ring against outer thrust bearing race (22).

(NOW SKIP TO STEP 10)

B. FOR PUMP WITH DRIVE SHAFT LARGER THAN 1" IN DIAMETER

6b. Install the complete seal retainer subassembly (18-21) (Step 5, above) over the drive shaft (30); seal should bear on shoulder of drive end of drive shaft (30).

7b. Put one of the two thrust bearing races (22) on the drive shaft (30) next to the "O" ring (21). Next, slip thrust bearing roller (23) on drive shaft (30). Slide the second thrust bearing race (22) on, follow with snap ring retainer (31).

8b. Push this entire bearing assembly (18-23, 31) together on drive shaft (30); hold firmly against shaft shoulder on drive end of shaft (30).

9b. Install the snap ring (32) to hold the bearing assembly (18-23,31) in place.

(NOW RESUME ASSEMBLY OF PUMPS WITH EITHER DIAMETER DRIVE SHAFT)

10. Insert complete drive shaft assembly (18-23, or 18-23, 31, 32) into shaft end cover (26).

11. Install retaining ring, either spiralox or snap ring (17) into groove in shaft end cover.

12. Release shaft end cover (26) from vise; turn cover end-for-end; reclamp with gear end up. At this point, check to be sure plugs or check assemblies are firmly in place. NOTE: Double-rotation pumps require TWO check assemblies (10); single-rotation pumps DO NOT require check assemblies, but DO require a plug in the high pressure side of the pump, and NO plug in the low-pressure opening.

TYPE III PUMP:

REASSEMBLING THE TYPE III PUMP:

1. Put the PERMCO diverter plate (36) in position over the two bearings (35). Counter-bored side of the diverter plate should be placed over the bearings; high-pressure crescent recesses should be on the pump inlet side; gear relief recess should be on the high-pressure side. Double-check this for correct position.

REASSEMBLING THE TYPE III DOUBLE-BEARING SHAFT END COVER.

Where double outboard bearing assemblies are to be installed:

Pack both tapered roller bearings (6) with a No. 2 consistency lithium base high temperature bearing grease. Press the bearings with a spacer (47) between them onto the shaft (46). Be sure that the larger diameter end of the bearing (6) is seated against shaft shoulder. Next, install spacer (48) to insure proper running clearance. Try using the 0.133" thick spacer (48a) and snap ring (16) first. If spacer does not fit, use the 0.128" thick spacer (48b).

Double tapered roller bearing units **do not** have a conical spring (34) behind the bronze shaft bushing.

Double bearing units have a roll pin (44) pressed into the drive bearing bore of the shaft end cover (as shown). Next the bronze bushing (45) is installed with the slot placed over the roll pin and this flange portion up.

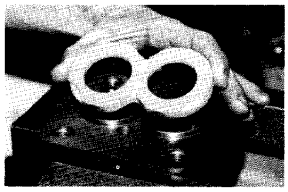
Before inserting the assembled shaft into the shaft end cover, make sure that the shaft bushing (45) is centered around the shaft. Take care not to nick or damage bronze shaft bushing when inserting the shaft assembly.

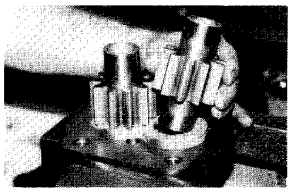
Continue assembly procedure.

In the final assembly procedure, the threaded retainer ring (1) should be tightened securely and

staked. DO NOT BACK OFF RETAINING RING BEFORE STAKING.

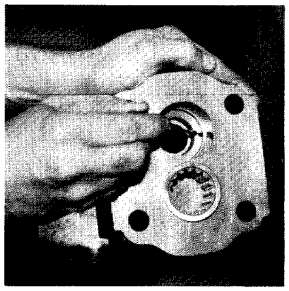
It is not necessary to back off the retainer ring, since the use of the spacer (48) of the proper thickness assures correct running clearance. (With single bearing assemblies, as before, the retaining ring must be backed off 1/2" before staking.)

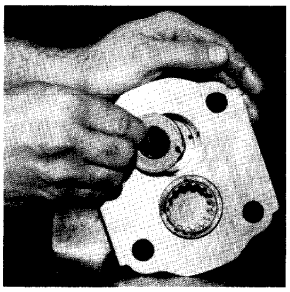




PORT END COVER ASSEMBLY

1. If you removed the two roller bearings (35) during disassembly, install new bearings in the two bores in the port end cover (41). Fit should be at least a light press fit.

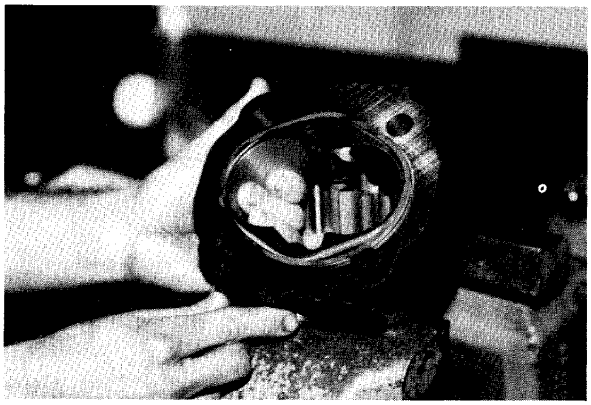




2. Put the diverter plate (36) over the two roller bearings (35). Counter-bored side of the diverter plate should be placed over the bearings with the high pressure crescent recesses on the inlet side and the gear relief recess on the high pressure side of the pump. Double check this.

FINAL ASSEMBLY

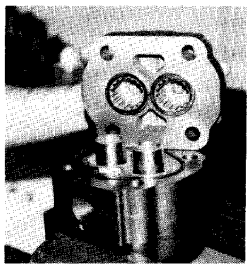
1. Clamp the shaft end cover assembly (26, etc.) in a soft jaw vise, gear end up.



2. Pour a little hydraulic or "STP" oil over face of diverter plate (36) to lubricate gears on startup. Gently stone the sides of each gear (39 and 40) to remove any burrs. Dip whole gear into cleaning solvent to remove dirt and metallic dust particles. Install the drive gear (39) in bore over spline of the shaft. Next install the driven gear (40). Be sure both gears firmly contact plate.

3. Lightly grease square gasket seals (37); carefully install them in the grooves in the two faces of the gear housing (38). Be sure they are properly seated.

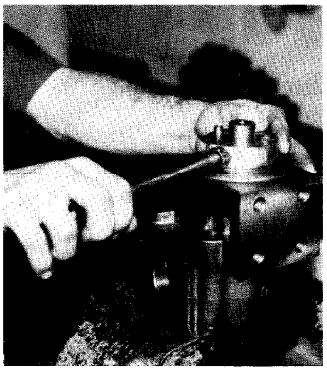




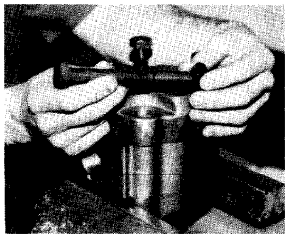
4. Carefully place the gear housing subassembly (38 etc.) over the gears, on top of the shaft end cover (26). Making sure that the square gasket (37) is not being pinched or cocked, gently tap the gear housing (38) down on the shaft end cover (26) with a plastic or rawhide mallet. Pour a little hydraulic oil or "STP" over the gears while rotating the drive shaft for startup lubrication.

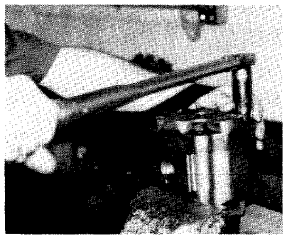
5. Place the Permco diverter plate (36) over the gear hubs – and into the gear housing, face down – counter bores up. The plate should rest slightly below the housing surface. Next, place the port end cover assembly (41) on top of the gear housing guiding the hubs of the gears (39 and 40) into the I.D. of the roller bearings. Gently tap the port end cover (41) down onto the housing with a rubber or rawhide mallet. Be sure the square gasket is not cocked or pinched.

RECOMMENDED TORQUE FOR PUMPS ASS'Y AND MOTORS			
SERIES	SIZE	REQUIRED	TORQUE
2500	5/8-11 UNC-2A THREAD	4	200 Ft. - lbs.
3700	1/2-13 UNC-2A THREAD	8	120 Ft. - lbs.
NOTE: ALL BOLTS OR TIE RODS MUST BE SAE CLASS 8 (TENSILE STRENGTH 150,000 PSI MIN.)			









6. Put flat washers (42) on the cap screws (43) and drop them into the port end cover (41) holes. Alternately tighten the cap screws (43) evenly to required torque with a torque wrench. **(See chart)**

7. Test the assembled pump for free rotation by turning the drive shaft. CAUTION: Wrap several layers of cloth around the shaft ends before applying the wrench. The shaft should rotate with very little effort, and NO hard spots and no rubbing noises.

A. YOUR TYPE II OR TYPE III PUMP IS NOW READY TO GO BACK INTO SERVICE

B. YOUR TYPE I PUMP STILL NEEDS THE FOLLOWING:

8. Release the Type I Pump from the vise; turn it end-for-end so drive shaft (8 and 14) is facing up; reclamp in vise.

9. Use a face spanner wrench to tighten the retainer ring (1) snugly.

10. Provide required preload on the pump bearings and correct running clearance for the pump as follows:

a. With the threaded retainer ring (1) snugged up, scribe a match mark across the face of the retainer ring (1) and the face of the flange of the shaft end cover (9).

b. Using the face spanner wrench, unscrew the retainer ring (1) so that the two ends of the match mark are 1/2" apart, measuring from the outer end of the mark on the outside diameter of the retainer ring (1). This amount of relief will provide the desired 0.005" clearance to produce the required bearing preload and adjustment.

c. After you have checked the distance between the two halves of the match mark to be 1/2", stake the outer edge of the retainer ring (1) into the groove or slot provided in the I.D. of the pilot of the shaft end cover (9). Use a blunt tool and hammer to force the metal of the retainer ring (1) into the pilot groove or slot of the shaft end cover. Check to be sure the ring is firmly locked in place.

C. YOUR TYPE I PUMP IS NOW READY TO GO BACK INTO SERVICE

START-UP INSTRUCTIONS FOR PERMCO PUMPS

FOLLOW THESE INSTRUCTIONS CAREFULLY. If you don't, you can instantly ruin your pump if the relief pressure setting is too high.

1. Before you operate the pump, unscrew the main relief valve adjusting screw on the main hydraulic system. OR remove adjusting shims or spacers.
2. Run the pump about five minutes under ZERO PRESSURE, with all control valves in neutral position. If the test system has a throttling valve, set it at 100 psi. above user's expected operating pressure.
3. If everything seems to function properly and no unusual noises are heard, back-off the throttling valve to zero. Shut down the system.
4. Adjust the relief valve pressure to the setting your hydraulic system requires.

LUBRICATION OF PERMCO PUMPS

1. The hydraulic oil used in the entire circuit provides the lubrication for all parts of the pump. KEEP THIS OIL CLEAN AND FREE OF DIRT. PERMCO recommends a 25-micron return filter and a 149-micron (100-mesh screen) suction filter to fully protect the pump and system from excessive wear and damage from dirt.
2. If the pump fails and you think metal particles have gotten in the circuit:
   a. Drain ALL oil from the whole system,
   b. Flush the system with kerosene,
   c. Refill the system with fresh oil of correct grade,
   (These are correct oils:
   Viscosity index at 100° F (37° C): 90 or higher;
   Viscosity SUS at 100° F (37° C): 150 to 300 (32-65 CST);
   Aniline point: 165 or higher;
   Anti-foam and anti-oxidant additives.)
3. Temperature of oil should never exceed 185° F (85° C.)
4. NEVER use low-viscosity naphtha-base oils, aircraft hydraulic fluids, or automotive brake fluids without consulting PERMCO, INC. or a Permco distrubutor.
5. For extended operation at temperatures below 20° F (-7° C) always use a low-pour-point oil of top quality.

TROUBLE SHOOTING

PROBLEM	REMEDY
EXCESSIVE NOISE IN PUMP:	
Insufficient Fluid	Replenish fluid to proper level, with proper grade
Fluid is too heavy	Drain system and refill with specified grade of fluid
Oil filter is dirty	Clean or replace filter element
Suction line too small	Install larger suction line
Clogged suction line	Clean line thoroughly
Pump overspeeding	Check pump maximum speed; Slow down pump driver; Or install larger pump
Air vent on fluid reservoir clogged	Clean or replace breather on reservoir
Air bubbles in fluid	Drain system and refill with non-foaming hydraulic fluid
Filter too small	Replace with larger filter
Coupling misalignment	Realign flexible coupling between pump and driver
Air leaks at pump intake or pump shaft packing or inlet pipe	Drip oil over suspected joint; listen for change in sound of pump; tighten joints
Worn or broken pump parts	Replace parts as necessary
FOAMING FLUID	
Improper fluid	Drain system and refill to correct level with proper grade of anti-foaming fluid
Low fluid level	Top up with proper grade of anti-foaming fluid
Inadequate baffling in tank	Install correct baffling
Air leaking into suction line between reservoir and pump	Tighten all connections
OIL LEVEL IN TANK CONTINUES TO DROP	
Oil level in tank continues to drop	Indicates a broken pipe line or a pipe left out between a bulkhead coupling and the bottom of the tank after cleaning tank. Replace pipe.

PROBLEM	REMEDY
Pump rotating in wrong direction	IMMEDIATELY STOP PUMP DRIVER to prevent damaging pump. Then reverse direction of pump rotation
Pump fails to prime itself a. Air leak into suction line b. Oil is too heavy	Tighten up joints. Drain system and replace fluid with proper grade of anti-foaming fluid
c. System not in Neutral	Open valve on pressure side of pump, or install air bleed valve
SYSTEM LACKS ANY PRESSURE WITH PUMP RUNNING	
Relief valve not set correctly.	Use pressure gauge and reset valve to specified pressure
Relief valve leaking	Check relief valve seat for score marks. Reseat by grinding. Or replace.
Broken relief valve spring	Replace spring; reset relief valve
Flow of fluid to tank is unrestricted	Check for control valve in "Neutral" or for open return line
Internal leakage in control valve or power cylinder	Repair or replace leaking valve or cylinder
EXCESSIVE WEAR IN PUMP:	
Abrasive contaminants in fluid	Drain and flush entire system. Install new filter. Fill system with fresh oil of proper grade or filter contaminated oil through a 10-micron filter before refilling. Operate pump an hour. Drain system again. Install new filter element and fluid.
Fluid too light for pump service	Drain and replace with anti-foaming fluid of proper grade.
Sustained pressure above pump maximum rating	Check and reset relief valve pressure, using pressure gauge.

PROBLEM	REMEDY
Sustained excessive speed at pressure above pump maximum rating	Recheck pump rated speed. Slow down driver to produce this speed.
Drive misalignment; Tight belt; weight of pump supported by its drive shaft	Check pump/driver coupling or belt alignment. Install adequate support for pump.
Entrapped air in hydraulic system	Bleed air from hydraulic system

OVERHEATED FLUID

Fluid too heavy	Drain system and refill with lighter grade of anti-foaming fluid.
Fluid too light for high-temperature pump location	Drain system and refill with heavier weight anti-foaming fluid.
Dirty fluid	Drain and flush system; refill with proper grade of anti-foaming fluid; replace filter element.
Dirt or chip caught between plunger and seat of relief valve	Disassemble relief valve and remove contaminant. Check condition of filter to prevent recurrence.
Incorrect setting on relief valve	Use gauge and adjust relief valve setting to correct pressure
Worn pump permits oil to bypass internally	Repair worn pump parts or replace pump.
Relief valve leaks or not operating	Repair or replace relief valve
Excessive friction caused by pump components overtorqued	Disassemble pump and back off overtorqued components to tighteness specified in this maintenance manual.
Undersize hoses and valves in system	Replace with proper size hose and valves
Restrictions and excessive bends in lines	Replumb system to eliminate restrictions
Inadequate reservoir prevents adequate cooling of fluid	Install larger reservoir or add fluid radiator
Internal leaks not in pump	Locate and repair leaks

PUMP NOT EFFICIENT

Worn pump parts reduce pump efficieny	Repair or replace pump
Air in system	Bleed air from system; check line connections for air leaks

PROBLEM	REMEDY
Internal leak in control valve or cylinder	Repair or replace control valve. Replace cylinder packing. Check cylinder walls for scoring and replace if necessary.
Erratic pump performance: a. If pump runs slow on startup, and speeds up after fluid is warm, fluid fluid grade is too heavy.	a. Drain system and refill with lighter grade anti-foaming fluid
b. If pump slows down after fluid has heated up, fluid is too light.	b. Drain system and refill with heavier grade anti-foaming fluid.

MOTOR DOESN'T DEVELOP PROPER TORQUE OR SPEED (when pump is used as a motor)

Relief valve incorrectly adjusted	Use a pressure gauge and increase relief valve pressure setting to proper level.
Relief valve sticking open	Disassemble relief valve and remove dirt from under ball or piston. Check condition of filter to prevent recurrence.
Flow of fluid to tank is unrestricted	Check for control valve in "Neutral" or for open return line
Insufficient pump pressure or volume	Use pressure and flow gauges to check pump output and pressure
Misalignment of pump/driver	Realign belt drive or coupling, recheck torque requirements of pump for maximum input.

MOTOR SUBJECTED TO OVERPRESSURE. (when pump is used as hydraulic motor)

If you have used a standard control valve to control a hydraulic motor, serious and catastrophic harm can result. When the standard control valve is returned to "Neutral", to start or stop the motor sudden excessive pressure develops. This pressure can burst seals, fracture drive shafts, burst housings, and rupture hoses.

HOW TO ORDER PARTS

ALWAYS GIVE US THE SERIES NUMBER, please. It instantly tells us what PERMCO Pump or Motor you want parts for. You will find this Series Number on the nameplate.

IF YOU CANNOT SUPPLY THE SERIES NUMBER, please answer these questions:

1. Is the unit a pump or a hydraulic motor?
2. If a pump, which way does it rotate when you look at it from the shaft end? Clockwise? Or counter-clockwise?
3. How many gear housing sections does the unit have?
4. Check "Series Identification Table" below to determine series.

STEPS IN IDENTIFICATION:

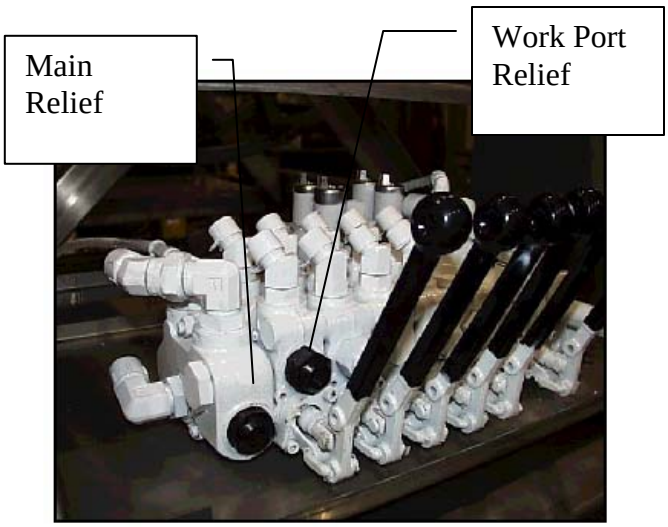
1. Shaft end cover:
   Mounting flange: Is it pad mounting or foot mounting? How many bolts, 2, 4, 6, 8? If round flange, measure pilot diameter, center diameter, and bolt-hole diameters.
2. Bearing arrangement:
   With or without outboard bearings? Double outboard bearings? Bearing measurements? Any drains or grease fittings?
3. Drive shaft:
   Diameter of shaft end? Keyed or not? Length of spline? Number of spline teeth? Spline O.D.? Total length of shaft?
4. Housing:
   Width of housing? Inside diameter of ports?
5. Port end cover:
   Inside diameter of ports?
6. Bearing carrier:
   Inside diameter of ports? Direction of flow thru internal passage or coring?
7. Gears:
   Gear tooth width? Gear O.D. measured over teeth? If gears are integral, describe drive end of drive gear, as in Paragraph 3 above.

SERIES IDENTIFICATION

SERIES	STUD HOLES No. and Dia.	STUD DIA.	DRIVE SHAFTS		HOUSING HEIGHT	HOUSING WIDTH GEAR WIDTH, PLUS:
			CONTINENTAL (Separate Drive Shaft)	INTEGRAL (One-Piece Drive Shaft and Gear Set)		
1200	10 — 9/16"	1/2"	X		7"	1/2"
1500	4 — 9/16"	1/2"	X		5-1/4"	3/4"
2500	4 — 11/16"	5/8"	X		6"	3/4"
3700	8 — 9/16"	1/2"	X		7-5/16"	1"
3000 3100 (Doweled)	4 — 11/16"	5/8"	†	X	5-3/8"	3/4"
5000 5100 (Doweled)	4 — 11/16"	5/8"	†	X	6"	3/4"
7500 7600 (Doweled)	8 — 11/16"	5/8"	†	X	7-7/8"	1"

† Continental (separate) drive shafts available on Series 3000, 5000 and 7500 as specials; consult factory.

Relief Valve



The relief valve is normally closed. It is connected between the pressure and the tank. Pressure acts against a spring. At a set pressure valve the valve diverts oil to tank.

Main System Relief Valve

The Main System Relief valve limits system pressure. The Main System Relief is located in spool valve inlet section. The Main System Relief pressure is 3,000 PSI

Work Port Relief Valve

A Work Port Relief valve is used to limit the pressure at one work port. A Work Port Relief is located in a spool valve work section.
Work Port Relief pressures may be 600 PSI or 1200 PSI.

Safety

Oil forced through a relief valve generates HEAT.
Heat can seriously damage hydraulic components .
DO NOT OPERATE with Main System Relief valve open continuously.

Troubleshooting and Repair

Main Relief

The bulk of the valve assembly problems are related to the relief valve. The following procedure may be used when evaluating the condition of the main circuit relief valve.

1. Install the flow meter/pressure gauge test kit in the pressure line between the pump and valve assembly. Valve assemblies used with the two-section pump have two main relief valves, one for each pump section.

2. Test the pump using the pump test procedure.

3. Raise the boom to its' highest point or actuate the plugged valve section as applicable. Compare the pressure gauge readings for the panel-mounted gauge and the test gauge.

4. If the panel gauge indicates 3000 PSI to 3100 PSI, the relief valve is okay and should need no adjustment. If the gauge reads less than 3000 PSI, the cartridge may need replacement, however, it is recommended that an attempt at adjustment be made first.

Cross Port Relief

Some of the components in the system require that a lower relief setting than the main system relief be available in order to protect the components from damage. On standard TREADBEDS with the V-20 valve assembly, a work port relief cartridge is used for the protection of such components as the boom swing gearbox, hydraulic gate assemblies and hose reels. The following procedure may be used when determining the relief setting.

1. Remove the lines from the valve in question and plug the fittings. Actuate the spool and observe the system pressure. Adjust or replace the work port relief as is necessary.

Hydraulic Spool Valve



A spool valve controls the direction of flow. A sectional spool valve combines several spool section into one assembly. A 3-Position spool valve provides RUN-OFF-REV

Operation

Manual spool operation.
Electric spool operation.
Push handle to RUN.

Safety

Clear any hazard zone before engaging the valve.
Observe expected result after engaging valve.

Inspection and Maintenance

Check for proper spool action.
Check for debris around handle linkage.
Lubricate the valve handle.

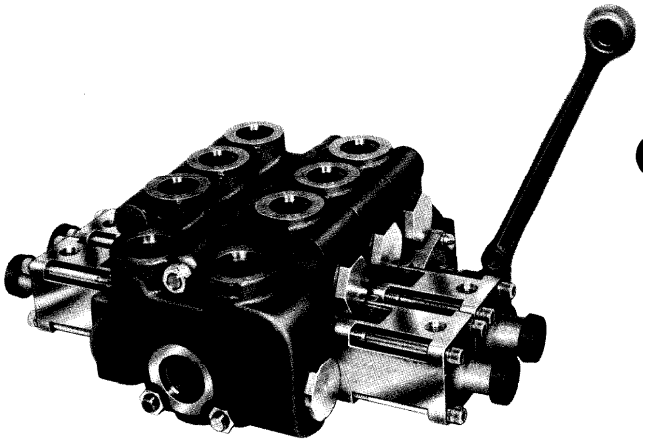
Troubleshooting

Sticking spools are usually the result of foreign material in the spool. Disassemble, clean and reassemble the spool making certain that the spool is replaced in the same bore from which it was taken.

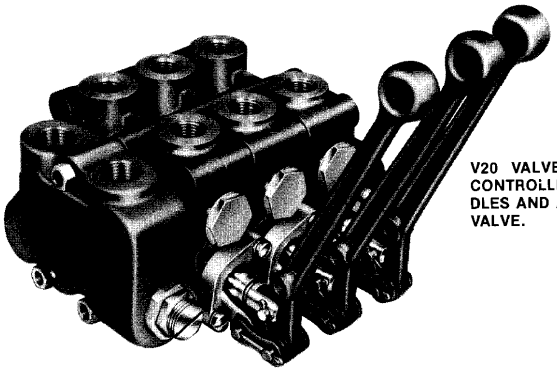
Another cause of sticking spools may be from galling or varnishing of the spool. Varnish on the spool may be removed with a spray carburetor cleaner or lacquer thinner. If inspection of the spool reveals galling to be the problem, complete replacement of the valve section is required.

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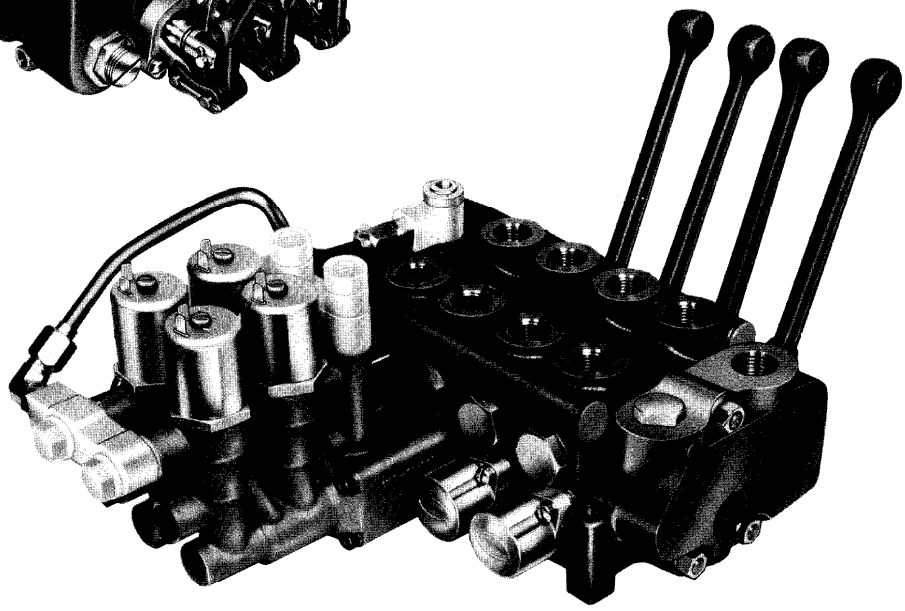
DANA



V20 VALVE ASSEMBLY WITH TWO HYDRAULIC REMOTE SPOOL ACTUATORS AND ONE MANUALLY CONTROLLED SECTION.



V20 VALVE ASSEMBLY, MANUALLY CONTROLLED WITH VERTICAL HANDLES AND ADJUSTABLE MAIN RELIEF VALVE.



V20 VALVE ASSEMBLY WITH TWO SOLENOID CONTROLLED SECTIONS AND TWO MANUALLY CONTROLLED SECTIONS.

INTRODUCTION

Directional Control Valves . . . start, stop and direct fluid flow. They control extension and retraction of cylinders, rotation of fluid motors and actuators, and sequence other circuit operations.

Gresen offers two basic types of body designs . . . the Monoblock which has all component parts in one single casting . . . and the Sectional Body design.

Sectional Body Valves . . . consist of one or more complete work sections with end covers. The entire assembly is bolted together to form a complete Sectional Body Directional Control Valve. A variety of work sections, spools, and spool actions, end covers and relief combinations are available to provide the exact type of valve assembly required for any given application whether mobile, industrial or agricultural.

Gresen's Model V20 Directional Control Valve is available for parallel, tandem, combined parallel/tandem and series hydraulic circuit applications, up to 3500 PSI [242 bar] continuous operating pressure. Its new spool design has resulted in lighter spool actuating effort making its finger-tip touch and extra-fine metering characteristics ideal for back hoe, front end loader and personnel lift applications. This sensitivity also gives the design engineer a wider latitude of mechanical linkage possibilities.

Service or conversion is simple since individual sections can be added, removed or replaced in the field. Individual service or field conversion sections, rather than complete valve assemblies, can be stocked thus reducing inventories.

FEATURES

Exact Work Port Control . . . is achieved with smooth, positive metering valve spools. Spools are precisely hone-fitted to a matching work section for excellent spool-hold characteristics giving minimum load "leak down."

Built-In Safety . . . Hydraulic system and equipment protection incorporated at each work port eliminates need for any additional external plumbing. Main relief valves, work port relief valves, anti-cavitation checks and work port restrictors are available for safety, equipment protection and positive control.

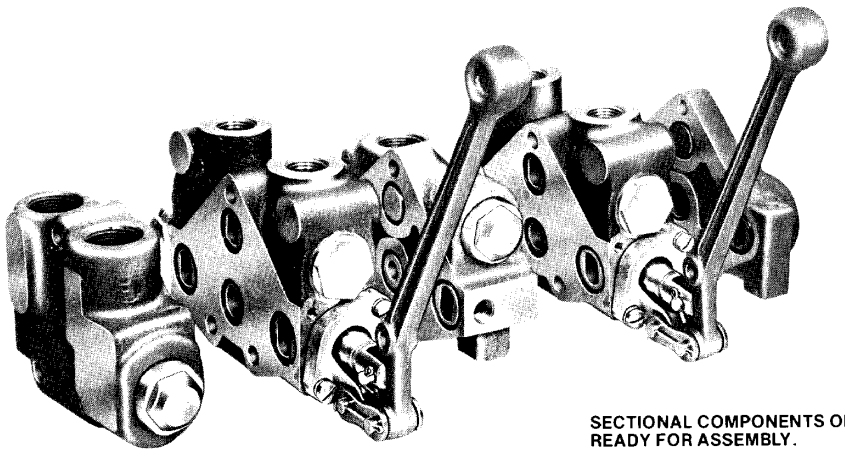
Construction . . . All valve housings are made of ductile cast iron for durability and resistance to shock loads.

Spools are hard, chrome-plated for long life and resistance to corrosion. All spools are select hone-fitted for minimum internal leakage and maximum load-holding ability.

Seal Compatibility . . . All standard Gresen products utilize BUNA-N seals which are compatible with petroleum base, water-in-oil emulsions, and water-glycol fluids. Phosphate ester type fire-resistant fluids will cause BUNA-N seals to swell. This swelling is not normally detrimental to static seals, but will be a problem for dynamic seals such as valve spool seals. Swelling of these seals can result in binding spools. The temperature range of BUNA-N seals is −40°F [−40°C] to +200°F [+93°C] for continuous operation.

VITON seals are recommended for most applications that use phosphate-ester type fluids. VITON seals are also recommended for applications that have a continuous operating temperature of +200°F [+93°C] or more. VITON seals are available for Model V20 valves.

Due to the large number of hydraulic oil manufacturers, and the increasing availability of oil under various brand names, we recommend the customer consult his fluid manufacturer regarding compatibility . . . or test to his own satisfaction.



SECTIONAL COMPONENTS OF A MODEL V20 VALVE READY FOR ASSEMBLY.

GRESEN®

DANA

SELECTING A V20 VALVE

Gresen's V20 Directional Control Valves are offered in six different models and are grouped into two basic systems. . . **open center** and **closed center.** This catalog has grouped these two systems, each into its own section. Full description and specifications for these Valves will be found in their respective sections. To order your V20 Valves, you must first determine which system will be best for your application.

OPEN CENTER SYSTEM • Refer to Page 23

Model V20P Parallel Circuit • **Model V20T** Tandem Circuit • **Model V20PT** Parallel/Tandem Circuit • **Model V20S** Series Circuit

Hydraulic oil is directed from the inlet port, thru the open center core to the outlet port of the Directional Control Valve when all spools are in the neutral position. Shifting the valve spool directs oil flow to the desired work port.

Maximum circuit pressure is limited by the main relief valve, which relieves into the exhaust core.

In a neutral position, open center systems operate at full flow and at low pressure.

ADVANTAGES

- **Requires simpler, fixed displacement pumps**
- **Lower initial cost**
- **Components more readily available**

DISADVANTAGES

- **Limited metering capability**
- **Lower overall efficiency**
- **Limited simultaneous operation of different functions**

CLOSED CENTER SYSTEM • Refer to Page 49

Model V20C Constant Pressure-Parallel Circuit

The Model V20C work section has no open center core. Pump flow is blocked by the valve when the valve spool is in neutral position. Shifting the valve spool directs the oil flow to the desired work port.

A pump that varies the output flow and maintains a predetermined output pressure is required for this type of circuit. Closed center systems typically operate at minimum flow and at high pressure standby when the valve spool is in the neutral position. The only flow required is that which will compensate for internal losses or for other system requirements.

- **Delivers only the flow required by the function**
- **Improved metering**
- **Faster operation**
- **Remains at high pressure when on standby**
- **Requires a more complex, variable displacement, pressure compensated pump**

LOAD SENSING SYSTEM • Refer to Page 49

Model V20LS Load Sensing, flow and pressure compensated, parallel circuit

The Model V20LS load sensing work section is identical to the Model V20C closed center section except that internal porting has been added to allow a signal from the selected work port to be sent to the pump compensator through an external line. A flow and pressure compensated load sensing circuit permits the pump output pressure to drop to a relatively low standby pressure (150 to 250 PSI [10 to 17 bar]) when the valve spool is in the neutral position.

This system varies both pump flow and pressure with work load demand.

- **Improved pump life**
- **Increased overall efficiency**
- **Increased metering capability**
- **More complex pump control required**
- **External pilot line between valve and pump compensator required.**

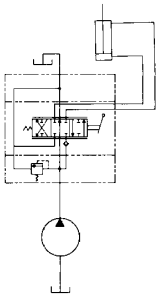
APPLICATION EXAMPLE

Consider an application requiring a maximum flow of 20 GPM [76 litres/min] at a maximum pressure of 2500 PSI [172 bar]. To meet the requirements of the application, the pump must be able to supply maximum flow at maximum pressure when required. However, during most of its operation, it is required to deliver less than its maximum flow at less than its maximum pressure. The way in which the system responds to the reduced-load conditions and the percentage of the total operating time the system will be used under reduced-load conditions should be considered.

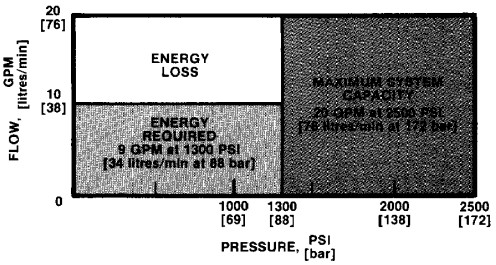
Functions requiring maximum system flow at maximum system pressure will all require approximately the same amount of power, assuming that system components are equivalent in size.

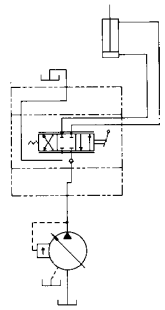
Functions requiring less than maximum flow and pressure best illustrate the advantages of the load sensing system. Consider a function in which a cylinder is to be extended. 1300 PSI [88 bar] is required at a metered flow rate of 9 GPM [34 litres/min].

EFFICIENCY

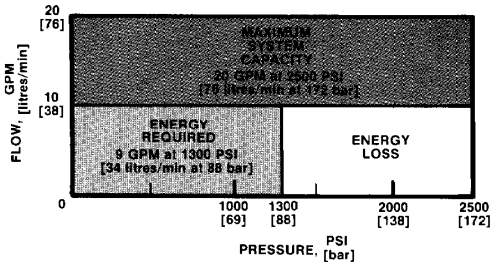


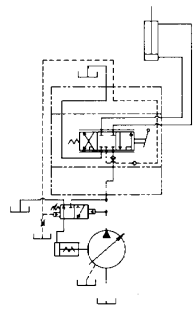
The open center system requires a fixed displacement pump capable of 20 GPM [76 litres/min] and a relief valve set at 2500 PSI [172 bar]. System pressure is determined by load resistance. Therefore, the pump delivers a full 20 GPM [76 litres/min] at 1300 PSI [88 bar] to the control valve. The control valve allows 9 GPM [34 litres/min] to be directed to the cylinder, the remaining 11 GPM [42 litres/min] is directed to the reservoir and its energy lost in the form of heat.



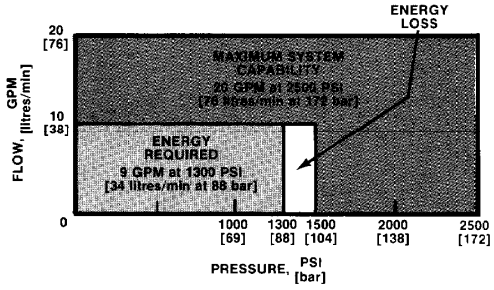


The closed center system requires a variable displacement, pressure compensated pump capable of 20 GPM [76 litres/min] with the compensator set to "destroke" the pump at 2500 PSI [172 bar]. The pump delivers only the required 9 GPM [34 litres/min] to the control valve, but at a pressure of 2500 PSI [172 bar]. Because the cylinder only requires 1300 PSI [88 bar], there is a 1200 PSI [83 bar] pressure drop through the control valve at the 9 GPM [34 litres/min] flow rate. Energy is again lost in the form of heat.





The closed center system with load sensing requires a variable-displacement, pressure compensated pump capable of 20 GPM [76 litres/min] with the compensator set to "destroke" the pump at 200 PSI [14 bar]. As the control valve is shifted to the working position, the pressure within the work port is sensed at the pump compensator. The work port pressure, 1300 PSI [88 bar], is additive to the "destroke" pressure of 200 PSI [14 bar]. Therefore, the pump delivers 9 GPM [34 litres/min] at 1500 PSI [104 bar] to the control valve. There is a 200 PSI [14 bar] pressure drop through the control valve which is lost as heat.

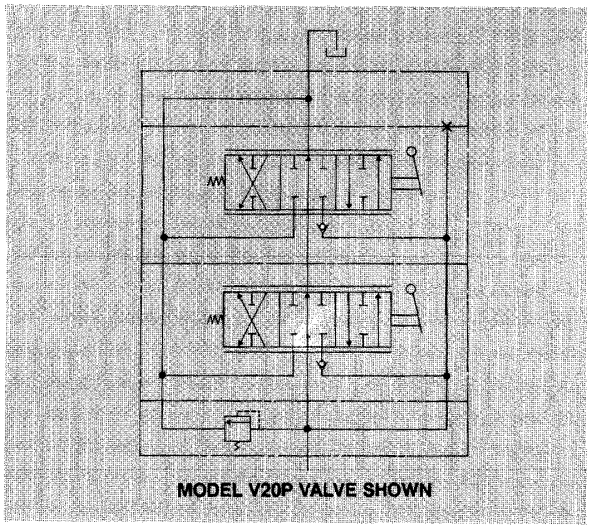


HYDRAULIC CIRCUITS

PARALLEL CIRCUITS

In a parallel circuit valve, two or more spools may be actuated at the same time and the oil will follow the path of least resistance. If a 2-spool valve is used to control two hydraulic cylinders, each with a different load, the cylinder with the lightest load will operate first if both spools are fully actuated at the same time. If the spool controlling the cylinder with the light load is metered (spool not fully actuated), then both cylinders can be operated at the same time.

When a spool is fully actuated, the open center core is blocked and oil is directed into the power core. Oil is then available to the work ports of all sections in the valve assembly.


MODEL V20P VALVE SHOWN

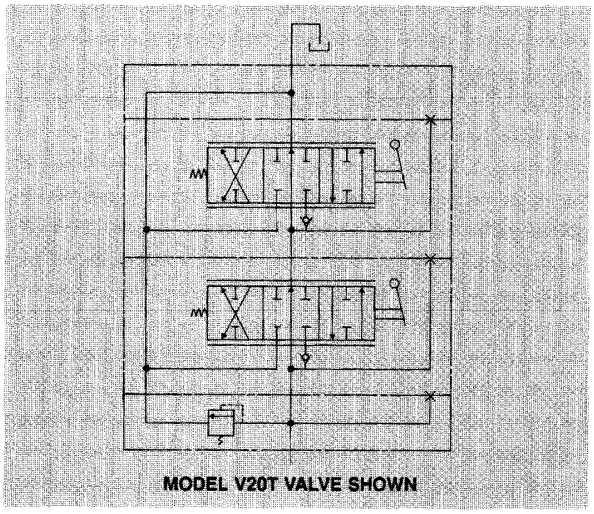
TANDEM CIRCUITS

A valve assembly made up of tandem work sections may be referred to as a priority valve or series parallel valve.

In the neutral position, oil is available to all valve sections through the open center core. When two or more valve spools are fully actuated at the same time, oil will only be available to the work ports of the upstream work section (section closest to the inlet). In a tandem valve, an upstream work section will always has priority over a downstream work section when its spool is fully actuated.

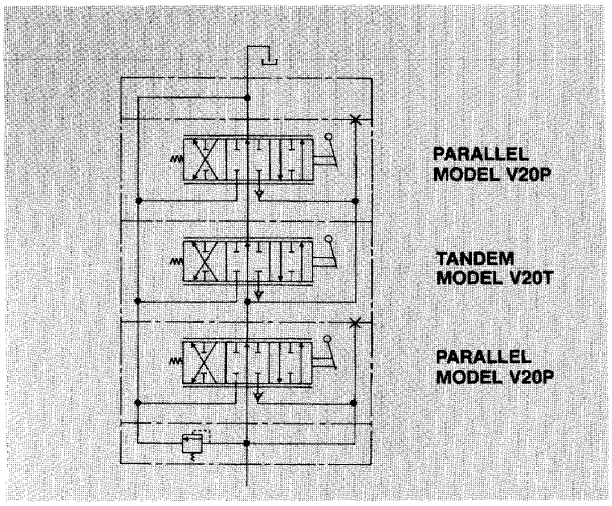
The tandem work section is very similar to the parallel work section with the following exceptions:

1. A passage within the tandem work section connects the open center core with the power core.
2. The power core is blocked on the upstream side of the tandem work section.


MODEL V20T VALVE SHOWN

COMBINED PARALLEL/TANDEM CIRCUITS

A valve assembly may be made up of any combination of parallel and tandem sections to fit a particular application. In this type of valve assembly, the section upstream from the tandem work section has priority (the tandem section itself does not have priority). The adjacent hydraulic schematic shows a three-work-section valve: the first work section is a parallel valve; the second, a tandem valve; and the third, a parallel valve. Note that in the tandem valve work section the open center core is connected to the power core and the power core from section No. 1 is blocked at the upstream side of the tandem work section. If the spool in section No. 2 is actuated, oil will be available to its work ports. But, if the spool in section No 1 is fully actuated at the same time, all the oil will go to the work ports of section No. 1. No oil will be available to the second or third work sections.

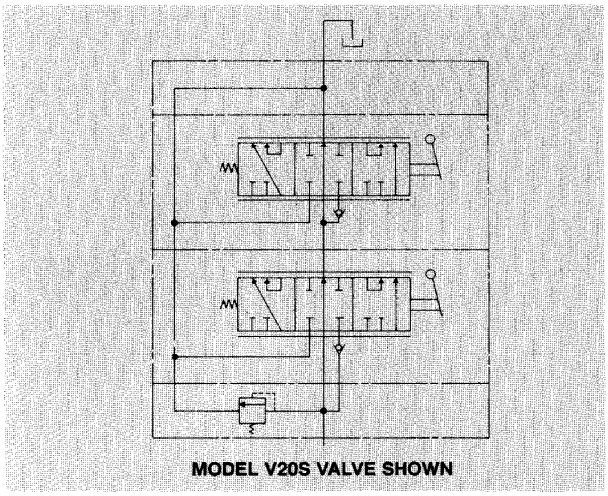


SERIES CIRCUITS

In a series circuit valve, two or more spools may be actuated at the same time. The entire flow of oil is available to each work section in sequence from inlet to outlet port through the open center core. In a 2-spool valve (both spools actuated), oil is directed from the inlet port to a work port of section No. 1. The return oil to work section No. 1 is directed back to the open center core (and not to the tank port as in a parallel valve circuit). The returning oil is then available to section No. 2.

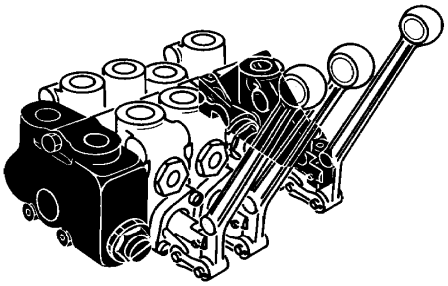
In a series circuit, pressure is additive. That is, the sum of all pressures required by all sections cannot exceed the main relief valve setting or pump pressure capability.

With certain restrictions, Model V20S sections may be intermixed with parallel or tandem work sections in the same valve assembly. Refer to page 38 for V20S stacking sequence restrictions.


MODEL V20S VALVE SHOWN

GRESEN®

DANA



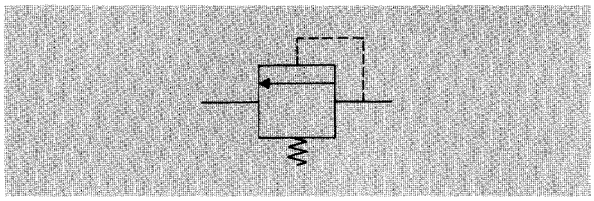
INLET COVERS and OUTLET COVERS

INLET COVERS

Inlet covers are designed to provide a variety of port sizes and locations. This permits valve assemblies to be "customized" using a minimum of external plumbing.

The outlet port may be located in either the inlet (left) cover or the outlet (right) cover. Location must be specified. If the addition of a secondary hydraulic pump is necessary, a mid-inlet conversion section for Model V20P and V20T Valves can be installed between any two work sections, providing an inlet port for the secondary pump (see page 32). Valve inlet covers are machined to accept Model WH or Model RP51 main system relief valve cartridges.

MAIN SYSTEM RELIEF VALVES

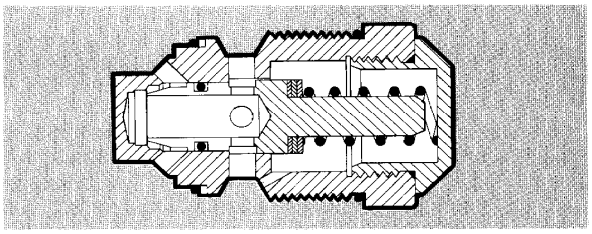


The primary function of a main system relief valve is to prevent excessive system pressures. Normally, this relief valve is installed in the inlet cover.

Relief valves for the V20 Valve Assembly are designed and fabricated in cartridge form to permit easier servicing and allow minimum interchangeability time. They feature quiet operation and are virtually trouble free and highly tolerant of foreign material in the hydraulic system.

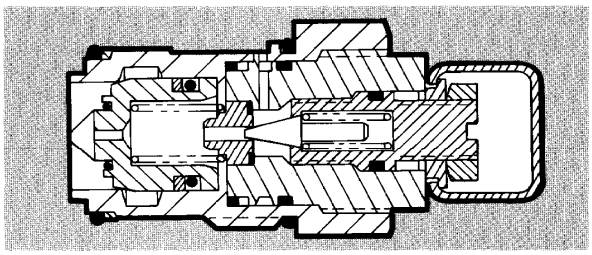
Relief valves are available in adjustable or tamperproof/non-adjustable configurations.

Model WH-Standard



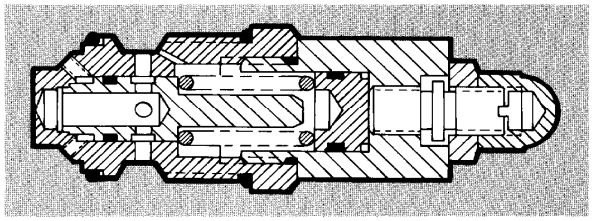
This unit is shim adjustable with shims within the spring range.

Model RP51 Optional

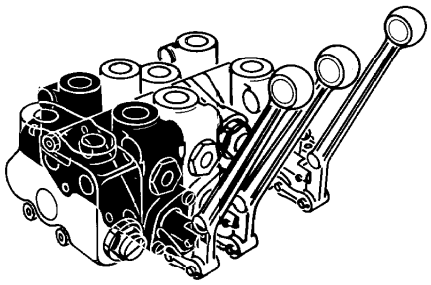


This relief valve cartridge is a pilot-operated type.
- Model RP51A — externally adjustable
- Model RP51N — tamperproof

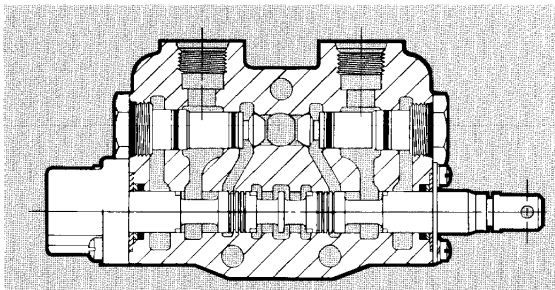
Model WHA-Optional



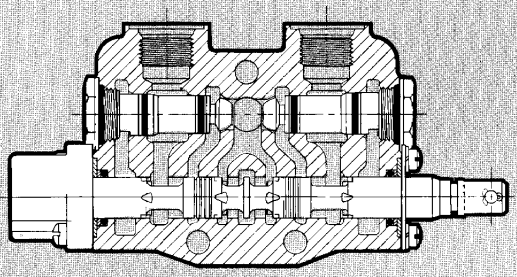
This model is easily adjustable within the spring range.



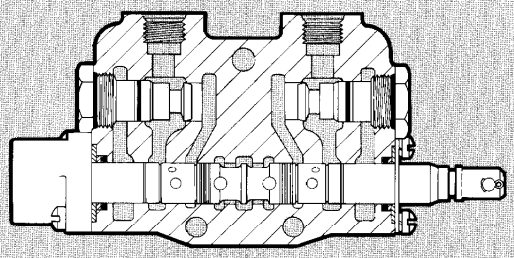
WORK SECTIONS



MODEL V20P WORK SECTION
(8072 HOUSING)



MODEL V20T WORK SECTION
(8112 HOUSING)



MODEL V20S WORK SECTION
(11483 HOUSING)

Work sections in Gresen's Sectional Body Directional Control Valves are precisely machined from high tensile cast iron housings.

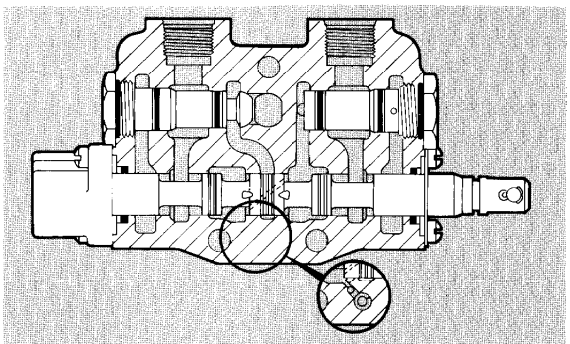
Valve spools may be manually, hydraulically, pneumatically, mechanically or electrically operated. All valve spools are select hone-fitted at the factory for minimum internal leakage and are not field replaceable.

Five types of basic work sections are available:

- Model V20P for open center, parallel circuit applications*
- Model V20T for open center, tandem circuit applications*
- Model V20S for open center, series circuit applications
- Model V20C for closed center, parallel circuit applications
- Model 20LS load sensing, for closed center, parallel circuit applications.

A variety of spools, spool action options and work port options are available for the work sections, depending on the particular application.

*Optional 4-way work sections with reduced open center pressure drop are available for parallel (V20RP) and tandem (V20RT) circuits. These reduced pressure drop sections are interchanged with a standard V20 open center sections and use standard V20 covers. All V20 spools and options are available with these sections. A heavier spool centering spring is required with V20RP and V20RT sections.



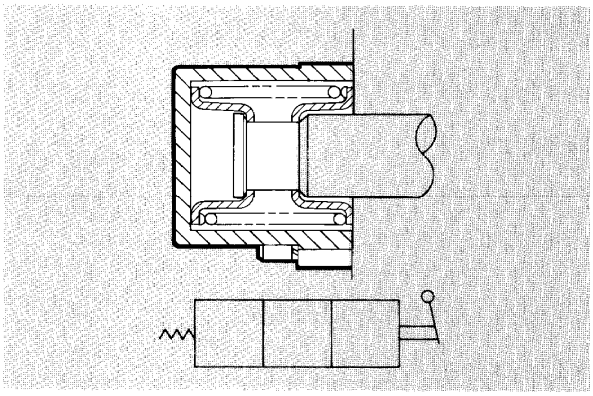
MODEL V20C WORK SECTION
WITH V20LS MODIFICATION
(8364 HOUSING)

SPOOL ACTION OPTIONS

Spring Return to Neutral

(Furnished as standard, unless otherwise specified)

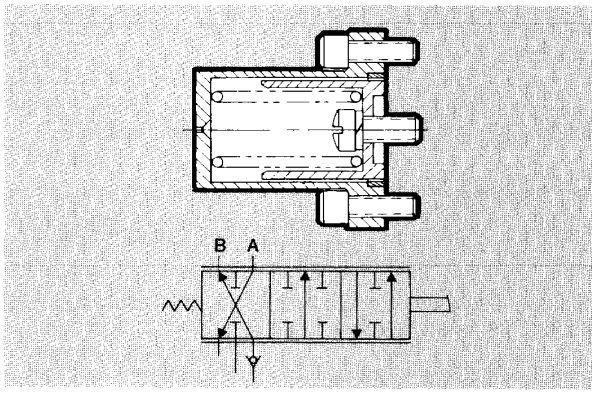
Spool action has three positions with spring return to neutral from "A" and "B" power positions.



Spring Extended Spool

Code Symbol A

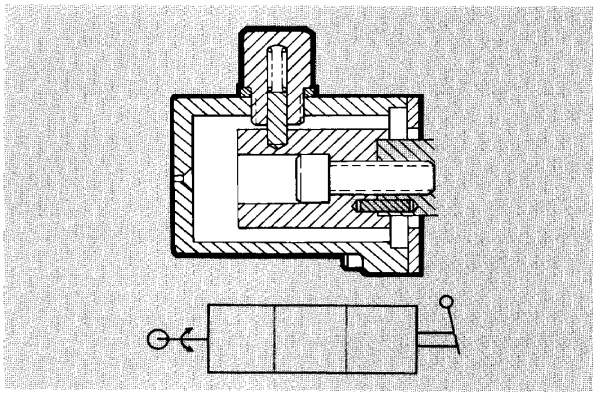
This feature eliminates spring-return to neutral, and spring loads the spool to the "OUT" position only (port "B" power position). Usually used for "Cam-Operation" of spool. Customer must supply cam-follower mechanism. When this option is ordered, a handle assembly is not furnished.



Rotary Spool Actuator

Code Symbol W

With this option, the movement of the spool is controlled by a rotary movement of the handle. Allows for 90° rotation of the spool each direction from center, making 180° total handle rotation with detent position in neutral. There is no spring-centering, therefore the spool will stay in any position placed. Handle assembly option not available with rotary actuator. (Customer must furnish his own handle mechanism.)



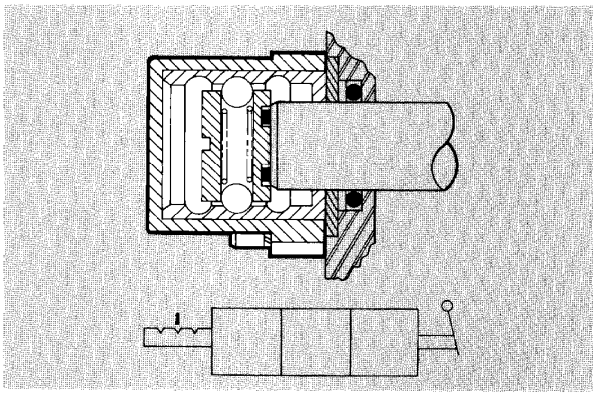
3-Position Detent

Code Symbol D

With this option the valve spool will remain in any of the three detented positions in which it is manually placed. No spring return to neutral.

Detent stop, 1889-001, is available to limit spool travel to two positions—neutral and spool "IN" or neutral and spool "OUT."

NOTE: The detent option is designed to provide operator "FEEL." It is NOT intended for use as a positive spool locking device against excessive external forces or machine vibration.

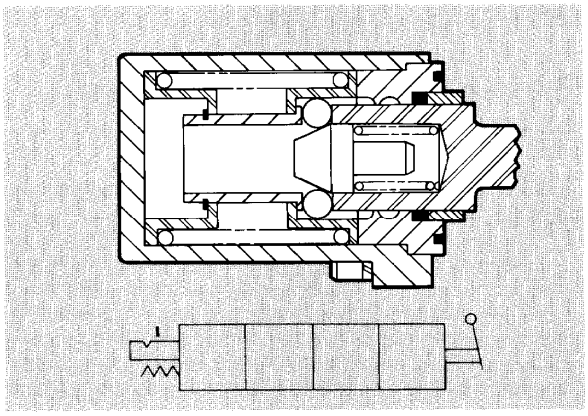


4-Position Float Assembly

Code Symbol K4

This option is spring-centered to neutral from the "A" or "B" work port power position. The fourth position is the detented "Float" position, which allows a cylinder to "Float" or a motor to "Free Wheel."

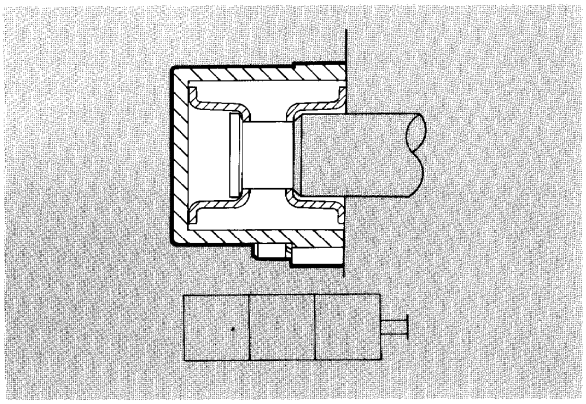
NOTE: Float spool positioners for Series type sections are different from those used in Parallel and Tandem sections.



Manual Actuator

Code Symbol M

The manual spool permits full spool travel without spring centering or detent assemblies.

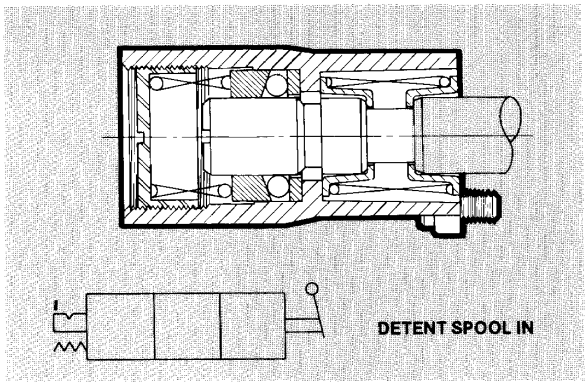


Optional Spool Detent Positions

1-POSITION SPOOL "IN" DETENT WITH SPRING RETURN to NEUTRAL

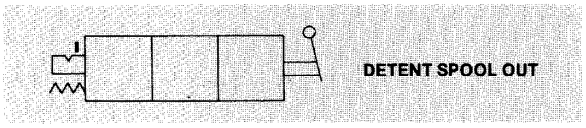
Code Symbol R

Work port "B" remains open to tank in detent position. Allows a single-acting cylinder to "Float."



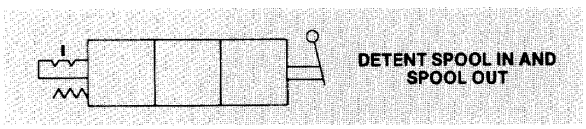
1-POSITION SPOOL "OUT" DETENT WITH SPRING RETURN to NEUTRAL

Code Symbol RO



2-POSITION SPOOL "IN" and "OUT" DETENT WITH SPRING RETURN to NEUTRAL

Code Symbol RIO



Internal Hydraulic Detent Release

Code Symbol KO

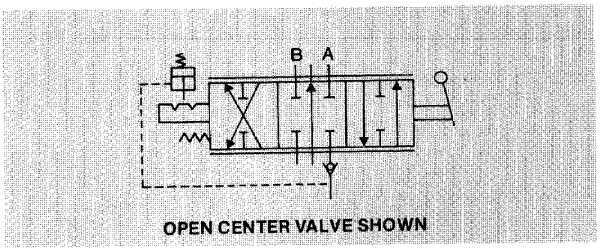
Automatically returns the spool to a neutral position as soon as the work cycle is completed.

The standard 4-way 3-position section has a 2-position detent with the spool spring loaded to the neutral position. The spool is held in either power position by the detent assembly. When pressure in the power circuit reaches a predetermined setting, the detent assembly releases and the centering spring returns the spool to neutral. Pressure detent release is field adjustable. Release pressure must be a minimum of 200 PSI [13,80 bar] below main relief setting.

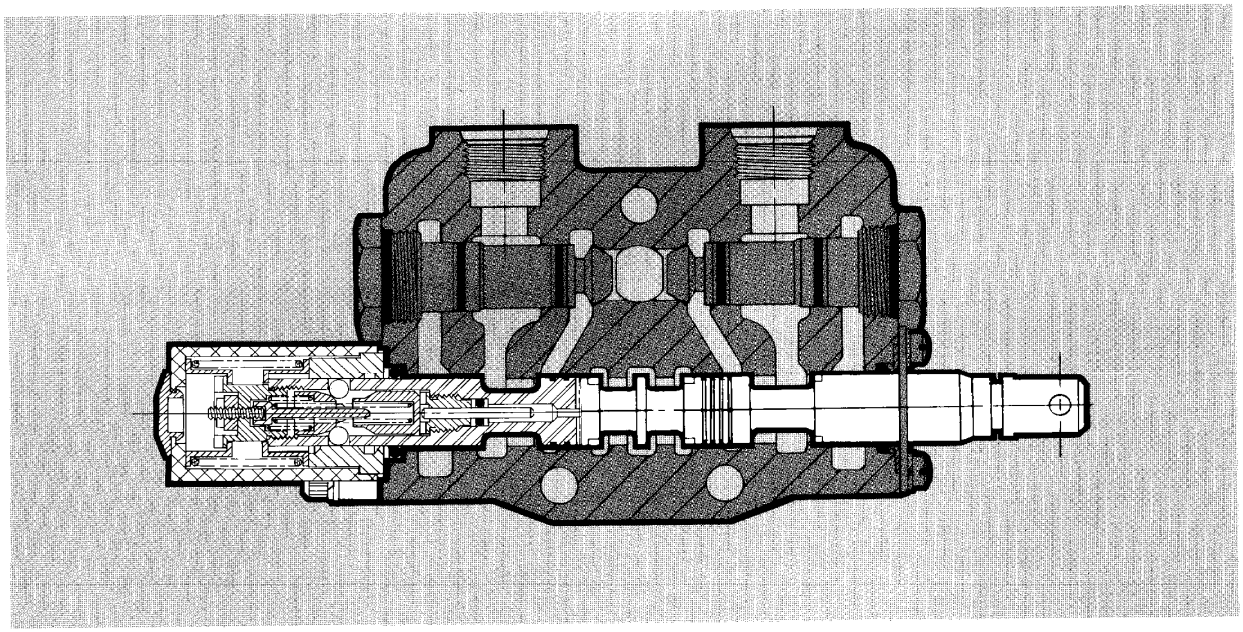
As many valve sections with hydraulic detent release as required may be assembled into one valve assembly. This option is also available for float sections.

SPECIFICATIONS

Operating Range . . . . . 500-3500 PSI [35-242 bar]
Normal Setting Tolerance. . . . . ±100 PSI [±7 bar]
Handles . . . . . "A" or "B" Port End



OPEN CENTER VALVE SHOWN



PRESSURE RELEASE FROM "A" POWER POSITION

Detent release pressure is sensed through the power core of the valve when the spool is in the "A" power position. In a valve assembly containing two or more KO sections, the section having the lowest detent pressure release setting will release its spool first when the spool is in the "A" power position. Each spool will release to neutral from the "A" power position as the pressure increases. The detent having the highest pressure setting will be the last to release to neutral.

PRESSURE RELEASE FROM "B" POWER POSITION

Detent release pressure is sensed only through the open center core of the valve when the spool is in the "B" power position. When an upstream spool is shifted to either power position, the open center core is blocked off preventing any downstream KO sections from sensing pressure in the open center core. Therefore, a downstream KO section will not release to neutral when an upstream spool is shifted to the "A" or "B" power position. A KO spool will only release to neutral from the "B" power position when all upstream sections are in the neutral or float position.

Electro-Magnetic Spool Release

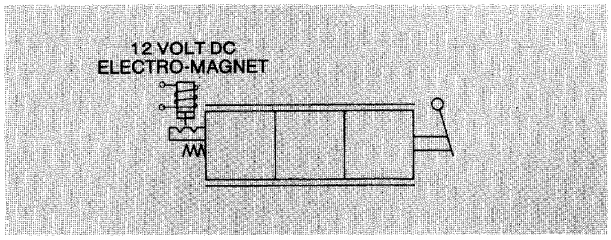
Code Symbol E

This option incorporates two electro-magnets in the bonnet assembly. The magnets may be energized continuously with a 12 volt DC power supply. When the operator manually shifts the spool to either power position, the spool will be held in position by magnetic force. A return spring will center the spool to neutral when the magnet is de-energized, or the spool may be returned to neutral manually.

The male connector on the bonnet contains three pins marked A, B, and C. Both magnets are connected to a common ground (pin C), pin A is connected to the magnet which will hold the spool in the "A" power position (spool "IN"), and pin B is connected to the magnet which will hold the spool in the "B" power position (spool "OUT").

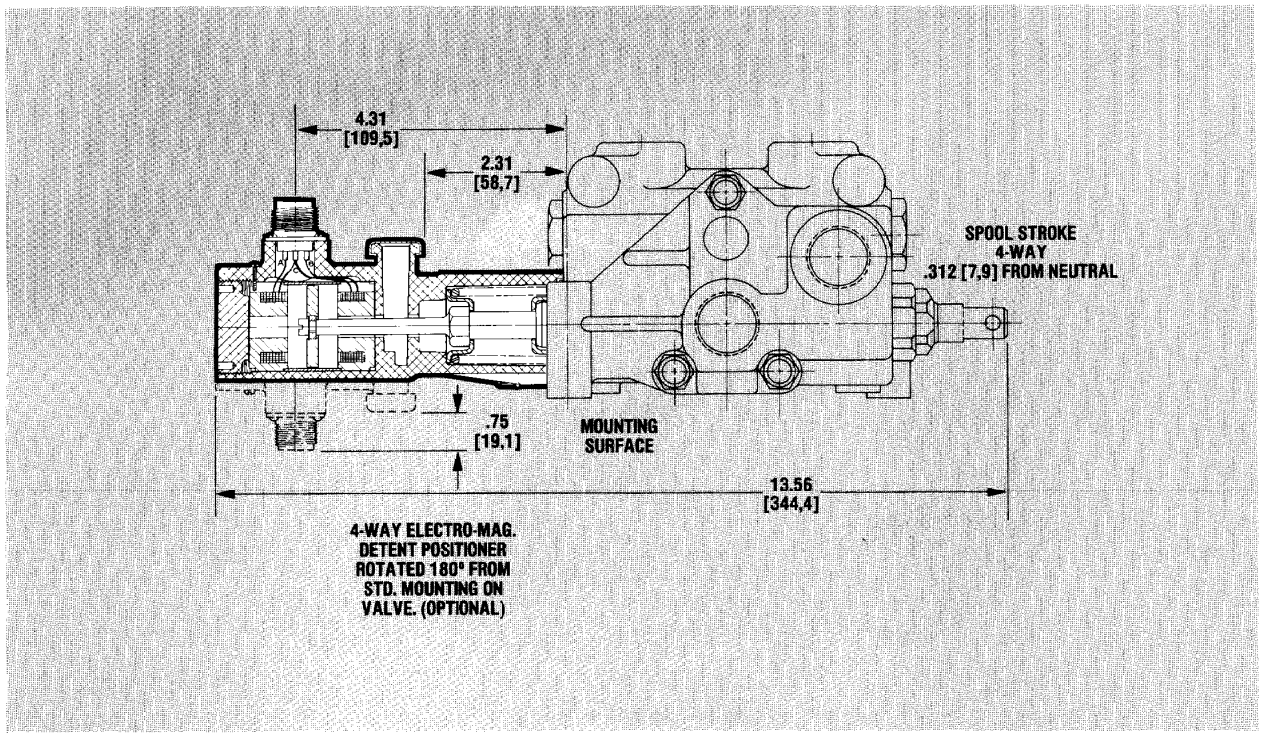
If a one position electric detent is required, only one magnet will be connected to the male connector. Pins A and C will be wired for spool "IN" detent, or pins B and C will be wired for spool "OUT" detent.

The electro-magnetic spool release assembly may be used with an external limit switch (furnished by the customer) to limit the stroke of a cylinder. This results in a more efficient operation, quicker cycle times, and saves time by automatically repositioning the cylinder while the operator is performing other operations. Another advantage is hydraulic system pressure does not build up to main relief valve pressure, which eliminates pressure surges and reduces heat build-up.



SPECIFICATIONS

Spools	Standard 3- or 4-way (not 4-way float)
Supply Voltage	12 volt DC
Male Bonnet Connector	MS 3102A-10SL-3P
Female Connector	MS 3106A-10SL-3S (Furnished by customer)



Hydraulic Remote Spool Actuator

Code Symbol HR, HRO and HRH

Hydraulic Remote Spool Actuators, Option Code HR, provide for remote operation of the Model V20 Directional Control Valve with two or three-position spools.

An external adjustment screw override, Option Code HRO, is available as an option. The screw provides for emergency manual operation in case of pilot pressure failure or permits lowering a load with the pump shut down.

A handle override feature is also available. Option Code HRH. This option allows full manual control at the valve with remote hydraulic control at a remote location. This option is ideal for applications where two control stations are required.

A customer-supplied, remotely located hydraulic controller will provide infinite spool positioning for metering flow to the work ports of the V20 Valve. The only limitation for metering capability is the pressure regulating performance of the hydraulic controller or the Valve.

Although valve work sections with Actuator control are normally assembled at the factory, field assembly on existing valve work sections is possible. Manually-operated valve work sections may be combined with Actuator-operated valve work sections in any arrangement.

For more information, refer to Gresen Catalog No. PC-1103.

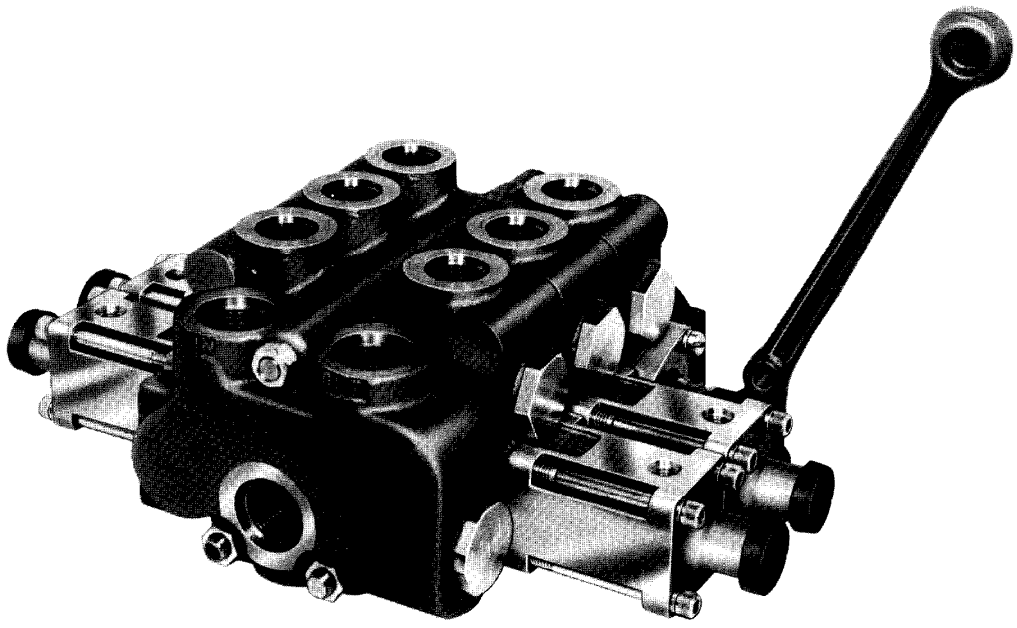
SPECIFICATIONS

DIRECTIONAL CONTROL VALVE

Capacity (nominal) . . . . . 20 GPM [75 litres/min]
Maximum Operating Pressure . . . . . 3500 PSI [242 bar]
Maximum Exhaust Core Pressure . . . . . 500 PSI [34 bar]

SPOOL ACTUATOR

For two, three, or four-position spool functions only
(Four-position for float operation)
Max. Pressure Rating . . . . . 500 PSI [34 bar]
Pilot Pressure to Initiate Spool Movement . . . . . 60 PSI [4 bar]
Pilot Pressure to Compensate for Spring Tension at Full Stroke . . . . . 300 PSI [20 bar]
Pilot Flow . . . . . 2 to 4 GPM [7.5 to 15 litres/min]



Option "HRO" Shown

Solenoid-Controlled Directional Control Valve

Gresen's on-off solenoid-controlled, pilot operated actuators are designed to provide remote operation of Model V20 Hydraulic Directional Control Valves.

Most Gresen Model V20 Sectional Body Directional Control Valves having a 3-position spool will accept a solenoid-controlled actuator. (Exceptions are the float spool and the standard Free Flow spool. A modified Free Flow spool is available for solenoid operation.)

Each Valve section may be solenoid-controlled, manually-controlled or both.

The sectional-body feature offers maximum flexibility and ease of maintenance. Although valve work sections with solenoid control are normally assembled at the factory, field assembly is possible in order to add additional work sections to an existing assembly.

The outlet tank port may be located in the outlet cover or in the left inlet cover of the control valve assembly.

A power beyond option is **not** available in the outlet cover of V20 solenoid operated valve assemblies. The power beyond option is available in the utility section. If a power beyond option is used in the utility section, the pressure build-up valve must be located in the downstream valve assembly.

For more information regarding electrical system requirements, optional accessories, and dimensions, refer to Gresen Catalog No. PC-1104.

SPECIFICATIONS

Pressure Rating . . . . . 3500 PSI [242 bar] max.
(Directional Control Valve)

Capacity (Nominal) . . . . . 20 GPM [75,5 litres/min]

Differential Pilot Pressure to Actuator . . . . . 200-300 PSI [14-21 bar]
(A minimum of 200 PSI [13,8 bar] is required to actuate the valve spool)

Maximum Allowable System Back Pressure . . . . . 300 PSI [21 bar]

Pilot Flow to Actuator . . . . . 2-4 GPM [7,6-15 litres/min]

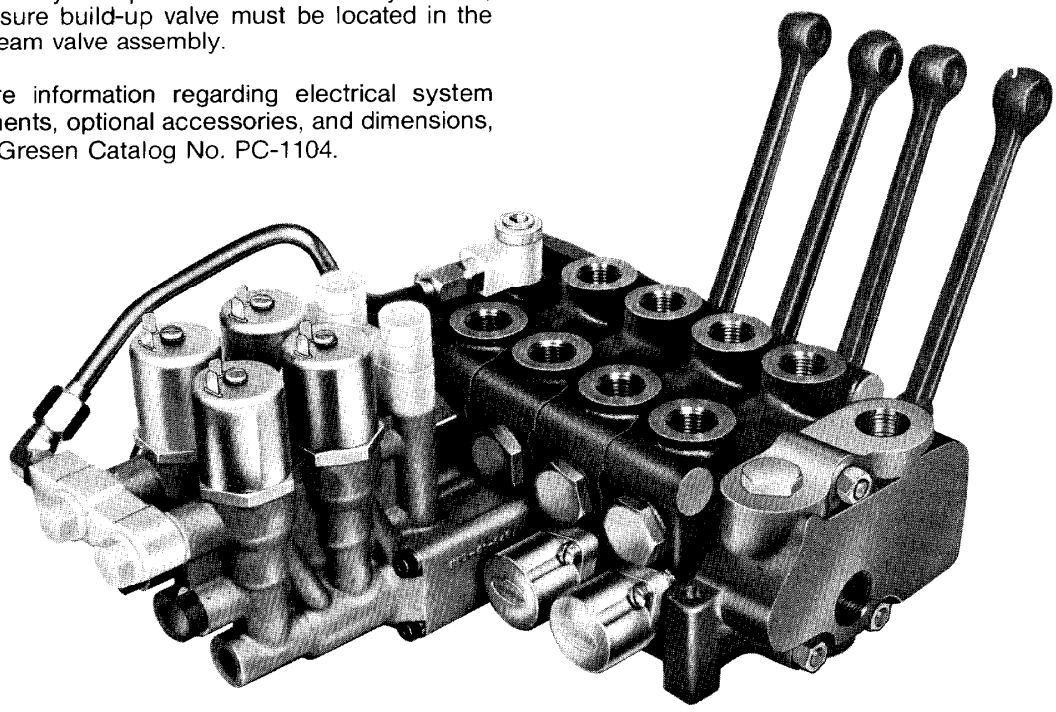
Operating Oil Temp . . . . . 180°F [82°C]
(Maximum)

Filtration Req. (Min.) . . . . . 33 micrometre

Solenoid Power Req. . . . . . 1.7-1.9 amps, 12 VDC
0.6-0.7 amps, 24 VDC

Weight:
Directional Control Valve Work Section with Solenoid-Controlled Actuator . . . . . Approx. 13 lbs. [5,9 kg]
Utility Section . . . . . Approx. 9 lbs. [4.1 kg]

Note: Double-throw switches are required when using internal pilot and must be provided by the customer.



GRESEN®

DANA

SPECIFYING GRESEN SECTIONAL BODY DIRECTIONAL CONTROL VALVES

Sectional Body Valves are custom assembled to meet specific application requirements.

When ordering a work section, valve component or a complete valve assembly, submit the information required in the Table of Options for Complete Valve Assemblies, page 54. Submit all of the information that applies to your application. Add any option information not specifically referred to in this catalog.

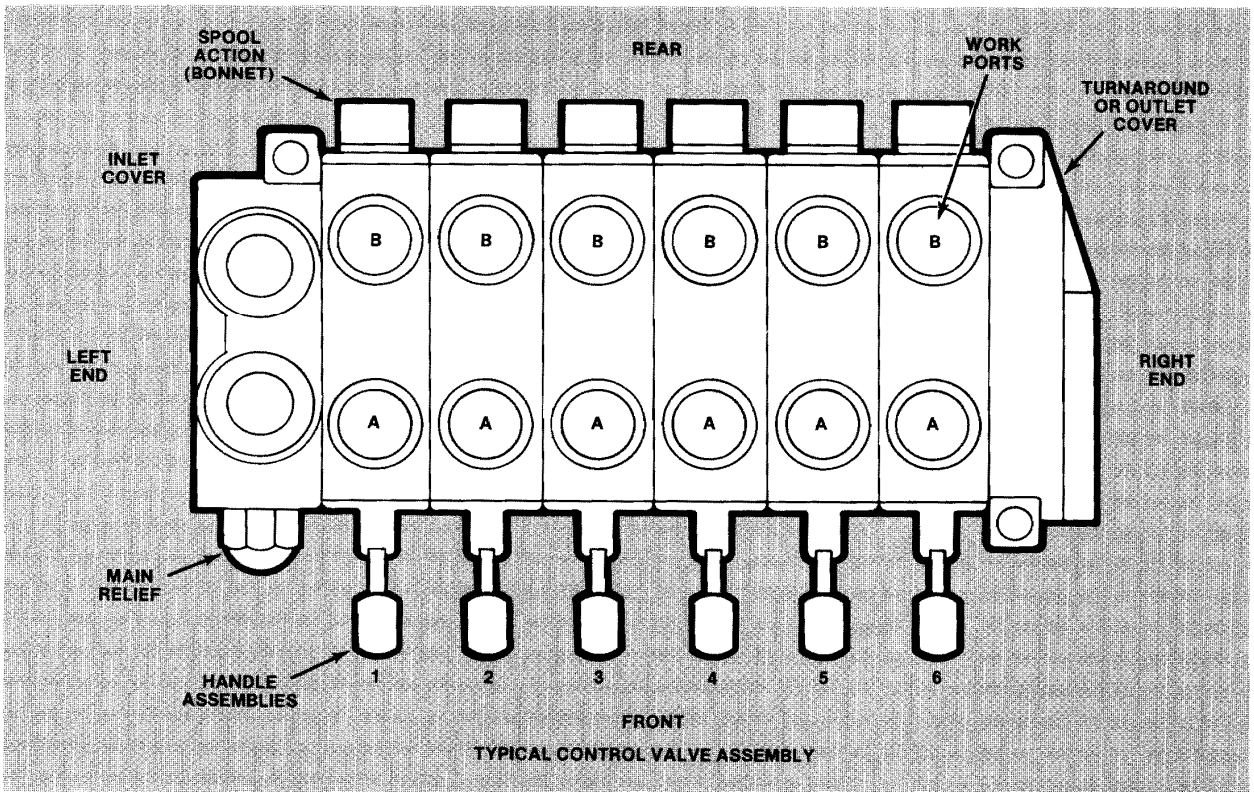
To properly specify the individual work sections, follow this procedure:

Using the diagram below, work ports should be on top with the "A" port nearest you. Inlet cover will be to your left and the outlet cover to your right.

The accompanying sketch of a typical control valve assembly has the handle assemblies in the standard location at the "A" port end of the valve.

Valve assembly specification forms are available to help simplify the ordering of various sections or complete valve assemblies. When ordering V20 Valves, use Form No. 9005. Specification forms have been included at the back of this Catalog. If additional forms are needed, contact any Gresen Distributor, Representative or the Sales Department, Minneapolis.

On receipt of the information, an order design number will be assigned to your valve assembly. Then, on future orders, the order design number or your part number need only be specified to identify the correct valve section, or assembly.



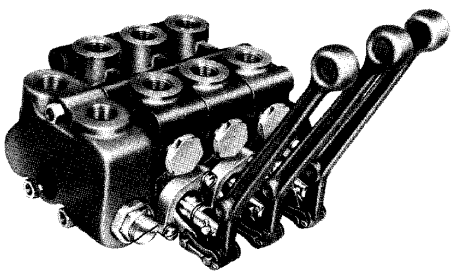
TYPICAL CONTROL VALVE ASSEMBLY

GRESEN®

DANA

OPEN CENTER VALVE ASSEMBLIES

Models V20P, V20T, V20PT and V20S



Models V20P, V20T, and V20S Valve Assemblies utilize the same inlet and outlet covers, and most of the same basic options.

Model V20P, V20T, and V20S sections may be combined into one valve assembly. See page 38 for V20S stacking sequence restrictions.

FEATURES

- **Minimal spool actuating effort—Maximum, 50 pounds [22,6 kg] at the spool**
- **Improved, extra-fine metering**
- **Minimum pressure drops through open center and through work ports**
- **Float section may be installed at any point within the Valve assembly**

SPECIFICATIONS

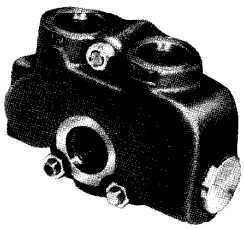
Pressure Rating:
Continuous Operating ..... 3500 PSI [242 bar] max.
Maximum Exhaust Core Pressure:
With Handle Bracket or Heavy Duty Spool Seal Retainer Installed
Continuous Operating ..... 500 PSI [34,5 bar]
Intermittent Peak ..... 1000 PSI [69,0 bar]
With Standard Spool Seal Retainer Installed ..... 200 PSI [13,8 bar]
Capacity ..... Refer to Pressure Drop Charts.
Flow rate is determined by the maximum pressure drop acceptable for the application.
Filtration Required (Min.) ..... 33 micrometre
Weight:
Inlet Cover ..... Approx. 6 lbs. [2,7 kg]
Outlet Cover ..... Approx. 3½ lbs. [1,6 kg]
Work Section, Each ..... Approx. 9 lbs. [4,1 kg]

INLET COVERS

All Model V20 valve inlet covers are machined for the Model WH main relief. If the relief is not required, a no relief (NR) plug will be installed. The following inlet covers are available:

Inlet Cover, No. 8398

No. 8398 inlet cover is available with top, end and bottom inlet ports. It is also available with top and end outlet ports. Top in and top out are the standard port locations for this cover.



NO. 8398 INLET COVER

PORTING OPTIONS AVAILABLE

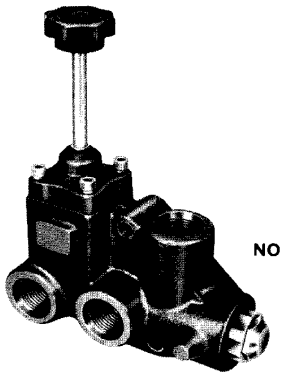
LOCATION	SAE STRAIGHT THREAD PORTS		NPT PIPE PORTS**	BSP PIPE PORTS	GAGE PORTS
	STANDARD	OPTIONAL	OPTIONAL	OPTIONAL	OPTIONAL
No. 8398 LEFT INLET COVER End, Top or Bottom* Inlet Ports. End or Top Outlet Ports.	SAE 12 (1-1/16" - 12 UN)	SAE 10 (7/8" - 14 UNF)	1/2" - 14 3/4" - 14	3/4" BSP	SAE 4 (7/16" - 14 UNF)

*Bottom inlet available only with SAE 10 or 3/4" NPT ports.
**NPT pipe ports are not recommended for pressure ports above 2000 PSI [138 bar].
NOTE: All ports in a casting must be the same type. SAE, BSP and NPT cannot be intermixed.
Top inlet and top outlet ports are cored. If not specified, they will be plugged.

Inlet Cover, No. 7736 With Flow Control

A No. 7736 Inlet Cover contains an adjustable flow control assembly which directs the controlled portion of the inlet flow to the work ports and any excess flow into the exhaust core. The adjusted flow is pressure compensated and is the maximum amount of flow available to any work section in the valve assembly.

This inlet cover is machined for the Model WH relief. A no relief (NR) plug may be installed if the main relief valve is not required.



NO. 7736 INLET COVER

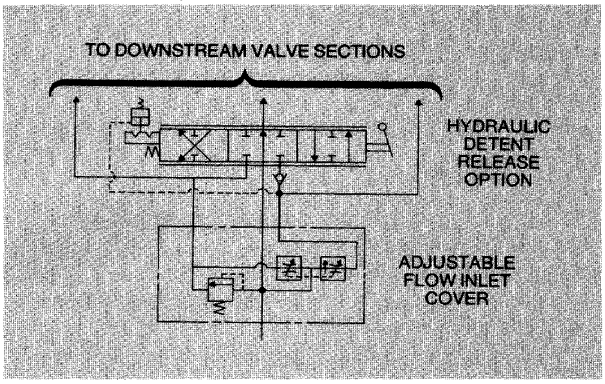
PORTING OPTIONS AVAILABLE

SAE and NPT ports cannot be intermixed in the same casting.

LOCATION	NPT PIPE PORTS		SAE STRAIGHT THREAD PORTS	
	STANDARD	OPTIONAL	STANDARD	OPTIONAL
END INLET	3/4"-14		SAE 12	SAE 10
TOP INLET	3/4"-14		SAE 12	SAE 10
END OUTLET	3/4"-14		SAE 12	

FLOW CONTROL RANGE TO 25 GPM [95 litres/min].

A control knob is furnished as standard. If it is to be omitted, please specify.



Excess Flow Option

This option utilizes the excess flow from the flow control by using the end outlet port as the excess flow port. An outlet port is not available in this cover when this option is specified. A typical application for this option is to direct the excess flow to a combined flow mid-inlet section installed downstream. When the upstream spools are in neutral, all flow is available downstream. When an upstream spool is activated, only excess flow oil is available to the downstream spools. This option also allows the flow from one pump to be split for two separate functions.

To order this option, specify "Plug B end exhaust core".

Main System Relief Valve

The main system relief valve is installed in the inlet cover. A detailed description of the main relief valve, its options and performance will be found on pages 10 and 11.

Relief setting at "crack pressure" or at "full flow" must be specified.

A main relief valve is available in the following configurations:

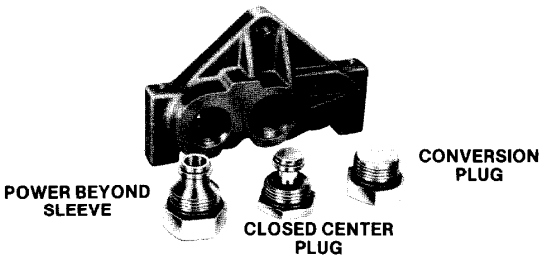
	ORDER CODE
Standard (adjustable with shims)	WH
Tamperproof (adjustable with shims)	WHNJ
Adjustable with screwdriver	WHA
Pilot operated relief	RP51
No Relief Plug (no relief valve installed)	NR

OPTIONS:

- Stainless steel relief springs
- VITON seals to replace standard BUNA-N seals

OUTLET COVERS

A variety of options and combinations of port sizes are offered. These options enable the user to customize valve assemblies while minimizing external plumbing. In addition, four application variations are available:



NO. 6770 OUTLET COVER WITH POWER BEYOND SLEEVE, CLOSED CENTER AND CONVERSION PLUG.

Outlet cover, No. 6770, is available for use with four application variations:

1. Open Center (standard)
2. Closed Center (conversion)
3. Power Beyond
4. Conversion Plug

Application variations are all accomplished by the machining and/or assembly of the outlet cover. Machining and assembly of the inlet cover and center sections do not affect these variations.

Outlet Port Option ...

If the outlet port is to be located in the outlet cover and closed center, power beyond or conversion plug options are specified, then the outlet port will be in the optional location.

Turnaround Cover Option ...

For plumbing convenience, the outlet port may be located in the inlet (left) cover. When it is, the turnaround (right) cover will direct the exhausting oil back to the inlet cover.

Application Variations ...

Application variations are all accomplished by the machining and/or assembly of the outlet cover. Machining and assembly of the inlet cover and center sections do not affect these variations.

OPEN CENTER

(Furnished as standard, unless otherwise specified)

Hydraulic oil is directed from the inlet port, thru the open center core to the outlet port of the Directional Control Valve when all spools are in the neutral position. Shifting the valve spool directs oil flow to the desired work port.

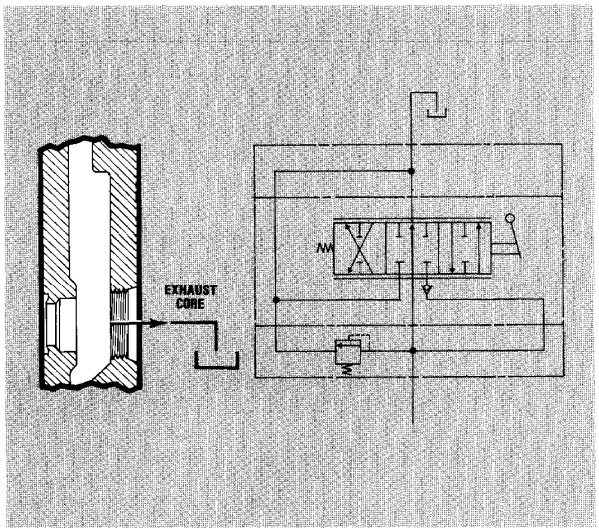
Maximum circuit pressure is limited by the main relief valve, which relieves into the exhaust core.

The standard Gresen valve is an open center control valve. The inlet port is open to the tank port, and both work ports are blocked when the control valve spool is in neutral position, thereby holding the cylinder or hydraulic motor in position.

The outlet port may be located in the right cover . . .

OR

Outlet port may be located in the left cover when a right turnaround cover is used.



Closed Center

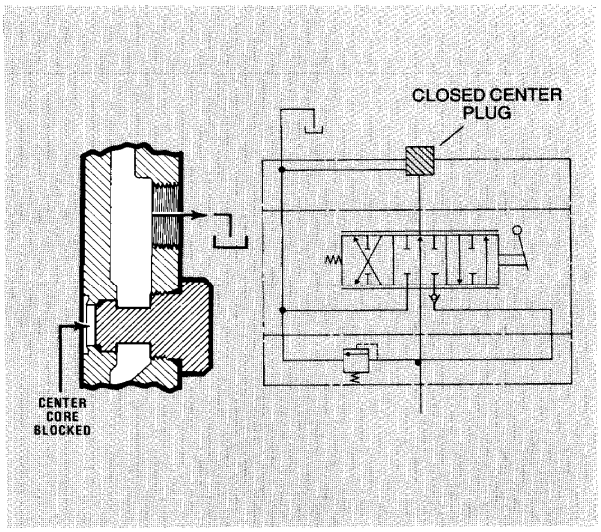
Code Symbol C

To convert an open center valve to a closed center valve.

By installing a special closed center plug in the outlet cover, hydraulic oil flow from the pump is blocked at the outlet port with valve spools in neutral position.

Pressure is normally maintained at the control valve inlet by use of a variable-displacement pump or an accumulator-type circuit with an unloading valve.

In a Gresen closed center control valve, the center passage is blocked and both work ports are also blocked when the control valve spool is in neutral position.



Power Beyond (High Pressure Carryover)

Code Symbol Y

This option allows the installation of another valve downstream from the first valve.

A power beyond sleeve is installed in the outlet cover of the upstream valve which separates the open center core from the exhaust core at the outlet port. This allows hydraulic oil under pressure to be carried thru the upstream valve, thus making it available for a downstream function. A separate tank line is required from each control valve in the circuit.

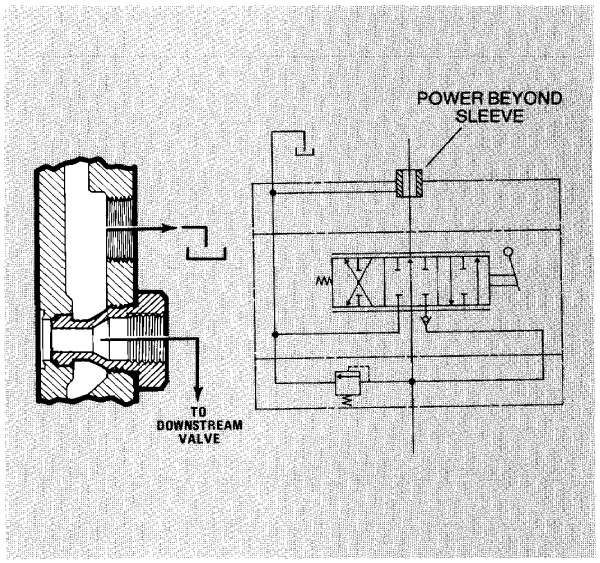
Hydraulic oil is available to the downstream valve only when all spools in the upstream valve are in the neutral position.

If pressure requirements for both valves are the same, only one relief valve is required. It must be installed in the upstream valve.

Each valve in the circuit may have a different relief setting, but the highest setting must be upstream.

The outlet cover can be machined to accept a power beyond sleeve which allows the open center oil to be used by a downstream valve. When a power beyond sleeve is specified, an outlet port is still required. Outlet port can be located in the left inlet cover or in the right outlet cover. The following power beyond sleeve port sizes are available for No. 6770 right outlet cover:

THREAD	1/2" - 14 NPT (Female) SAE 8 (3/4" - 16 UN) (Female) SAE 10 (7/8" - 14 UN) (Female) SAE 16 (1" tube fitting) (Male)



Conversion Plug Assembly

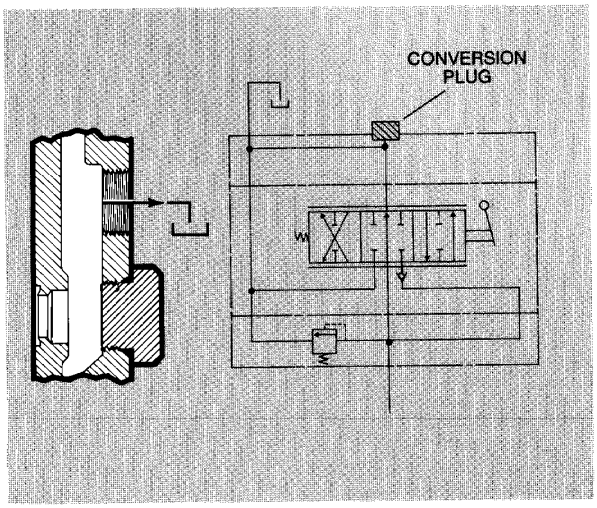
Code Symbol X

If additional hydraulic circuit options are to be added at a later date, or if the control valve is being ordered for stock, a conversion plug assembly should be considered. A conversion plug assembly gives a control valve great versatility and easily converts for different applications, reducing inventory requirements.

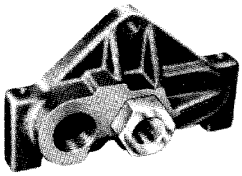
A control valve with a conversion plug remains an open center valve. The outlet cover, when machined for this option, will also accept power beyond sleeves and closed center plugs. When the need arises the proper plug or sleeve is inserted to convert the assembly into either a closed center or power beyond

valve. Service kits are available for these optional parts and must be ordered separately.

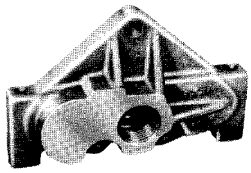
When a conversion plug is installed in the outlet cover the control valve remains an open center valve. When the outlet cover is machined for a conversion plug, it will also accept a power beyond sleeve or a closed center plug. If the need arises, the proper plug or sleeve can be inserted to convert the assembly to either a closed center or power beyond application.



Outlet Port Option



OUTLET COVER FOR MODEL V20P VALVE SHOWING OPTIONAL PORT LOCATION AND POWER BEYOND SLEEVE INSTALLED



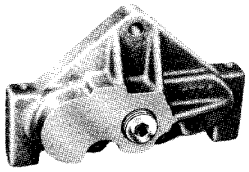
OUTLET COVER FOR MODEL V20P VALVE SHOWING STANDARD PORT LOCATION

If the outlet port is to be located in the outlet (right) cover and closed center, power beyond or conversion plug options are specified, then the outlet port will be in the optional location.

The following outlet port sizes are available for No. 6770 right outlet cover:

	THREAD	
	NPT	SAE
Outlet Ports	1/2" - 14 3/4" - 14	SAE 10 (7/8" - 14 UN) SAE 12 (1-1/16" - 12 UN)

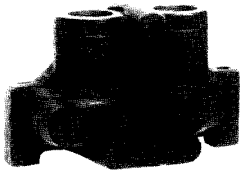
Turnaround Cover Option



OUTLET COVER FOR MODEL V20P VALVE SHOWING TURNAROUND

For plumbing convenience, the outlet port may be located in the inlet (left) cover. When it is, the turnaround cover is provided to direct the flow of exhausting oil back to the inlet cover.

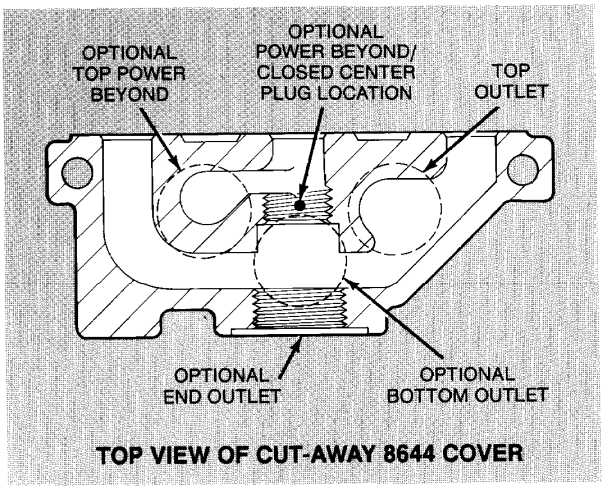
Optional Outlet Cover with Top Outlet and Power Beyond Ports No. 8644



OPTIONAL OUTLET COVER FOR MODEL V20P VALVE SHOWING TOP OUTLET AND POWER BEYOND PORTS.

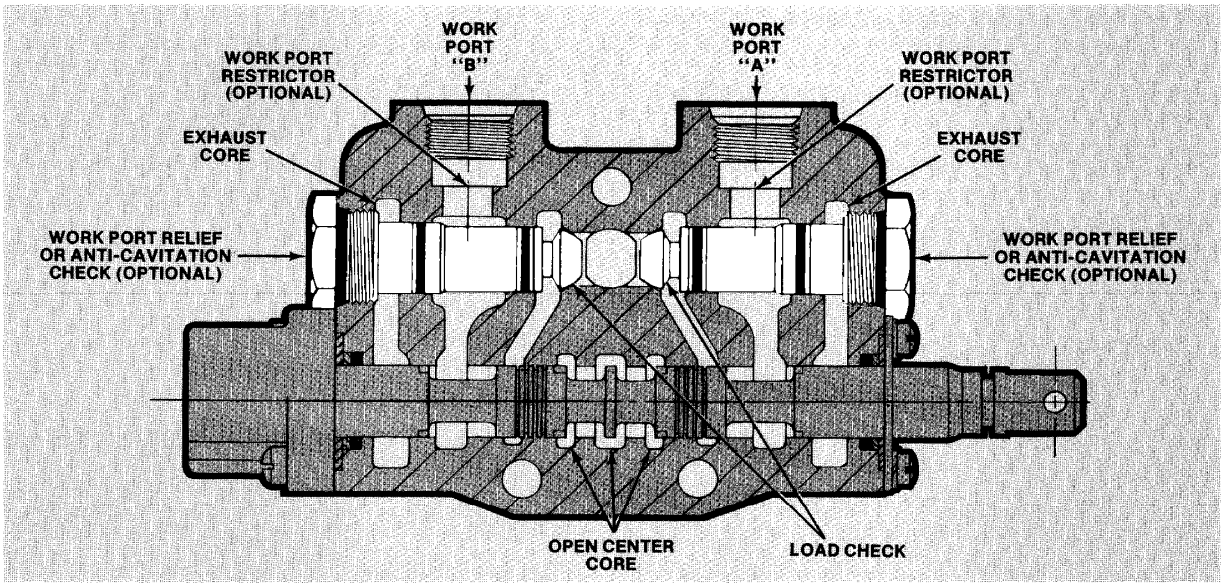
An optional outlet cover, No. 8644, is available. This option offers top porting options rather than end porting only. Port options are:

- Top, End or Bottom Outlet
- Top Power Beyond
- SAE12 or ¾" NPT Ports



TOP VIEW OF CUT-AWAY 8644 COVER

WORK PORT RELIEFS, CHECKS AND RESTRICTORS



In addition to load checks which are standard in the V20 Valves, Gresen offers a wide range of options to control oil flow. From these options you may select the exact accessories to customize your valves to your specific application.

The following are available:

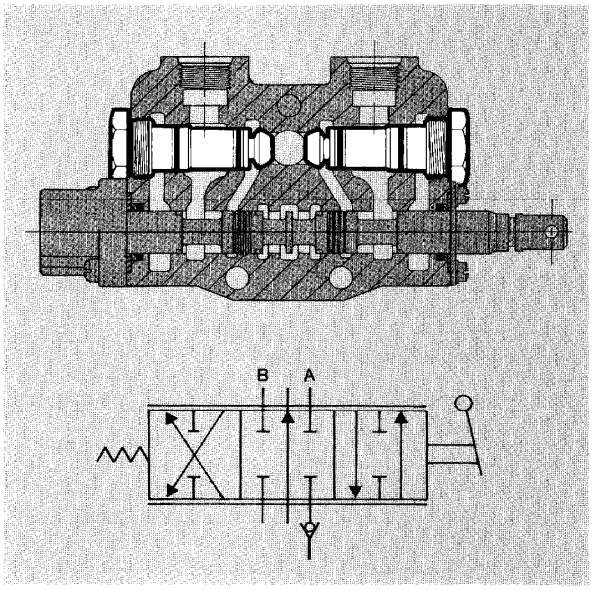
- Work Port Relief Valve
- Anti-Cavitation Check
- Combination Relief and Anti-Cavitation Check
- Pilot-Operated Check Valves
- Work Port Restrictors
  (not available with NPT pipe ports).

Standard Load Check Assembly

A standard load check assembly is provided with every work section except when a free-flow motor spool is installed. Then load checks are not required. The load check blocks against pressurized return flow from a work port back to the inlet port until overcome by pressure build-up from the pump.

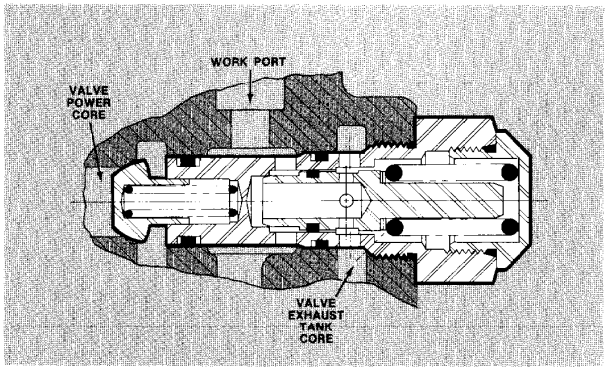
This feature will keep a load from dropping while the control valve spool is being shifted and until the inlet pressure is equal to or slightly greater than the pressure developed by the load. At this time the load check will open and movement of the load can then be controlled by the control valve spool.

NOTE: Load checks for Series type sections are different from those used in Parallel and Tandem sections.



Work Port Relief Valves

MODELS RC and RCS (Series)



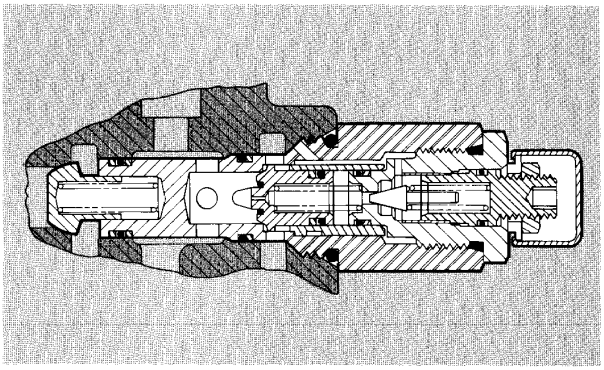
Models RC and RCS work port relief valves are differential poppet type.

Model RP20 recommended for pressures over 3000 PSI [207 bar].

NOTE: If the control valve is equipped with vertical handle, 1802-001, the adjustable relief valve, Model RCA which has an extended profile beyond valve body, will interfere with handle. It should NOT be installed on the valve-handle end.

These relief valves, installed in a work port, will limit the maximum pressure in that work port. They also prevent pressure build up in a work port when the valve spool is in neutral.

MODEL RP20



Model RP20 work port relief valves are pilot-operated type.

- Model RP20A — externally adjustable
- Model RP20N — tamperproof

2-STAGE RELIEF VALVE

A 2-stage relief option is available for Model RC work port relief valve cartridges. This option will provide a second (higher) pressure setting when a pilot pressure (750 PSI minimum) is applied to an SAE 6 pilot port in the cartridge. The "high" pressure setting (3000 PSI maximum) is shim adjustable. The "low" pressure setting (500 PSI c/p minimum) is externally screw adjustable and must be specified as a "crack" pressure (1 GPM flow).

Anti-Cavitation Check

The anti-cavitation check is used in the work section and prevents cylinder or motor cavitation. It allows cavitating work ports to refill from the exhaust core, supplementing pump flow. Anti-cavitation check is non-adjustable but is designed to operate whenever the work port pressure is lower than the exhaust core pressure.

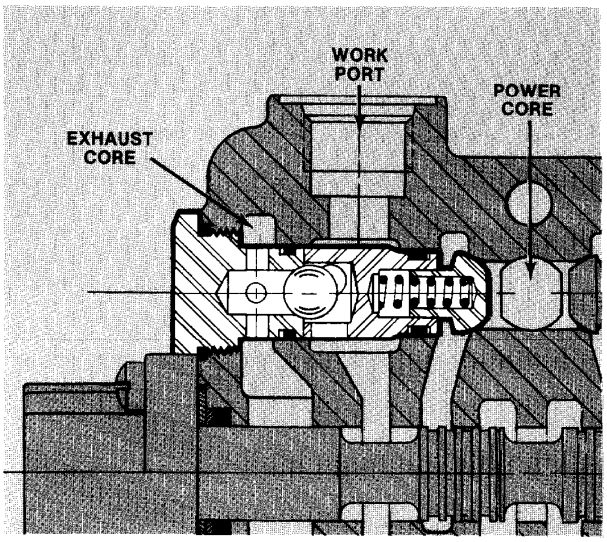
NOTE: Anti-cavitation checks for Series type sections are different from those used in Parallel and Tandem sections.

PERFORMANCE

Will pass 5 GPM [18,93 liters/min] at 8 PSI [,55 bar] Pressure Differential

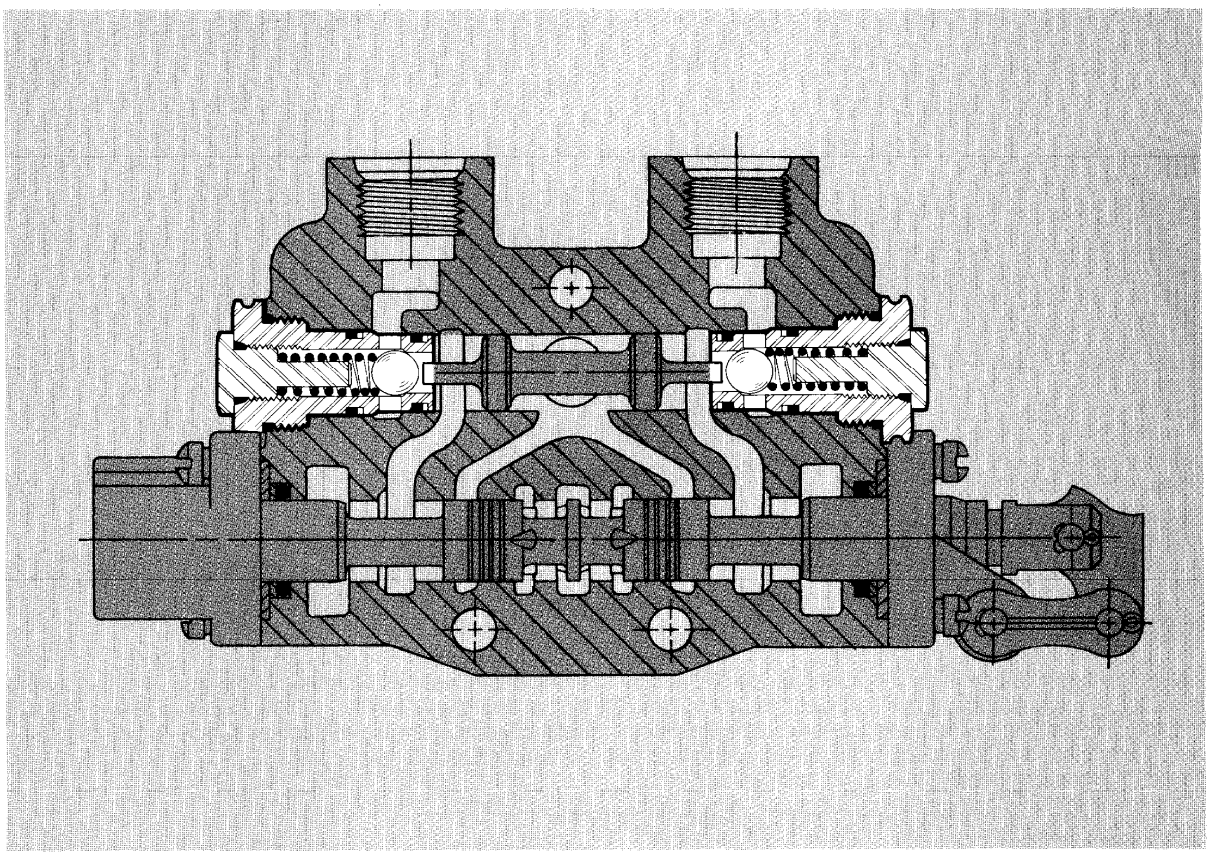
Will pass 10 GPM [37,85 liters/min] at 19.5 PSI [1,35 bar] Pressure Differential

Will pass 15 GPM [56,78 liters/min] at 39 PSI [2,69 bar] Pressure Differential



Pilot-Operated Check Valves

FOR MODEL V20-LO VALVE ONLY

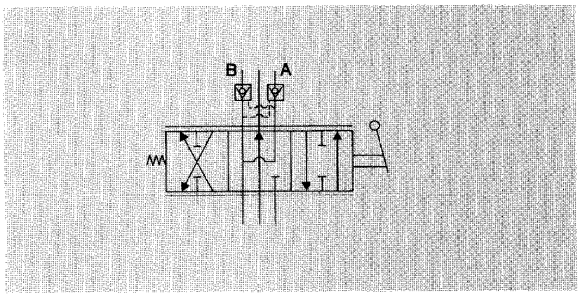


Model V20-LO work sections are designed with double pilot-operated check valves. These pilot operated checks will lock a cylinder or part of a circuit—without leakage—when the control valve spool is in the neutral position. When the spool is shifted to a power position, pressurized oil is directed to one work port. Return oil into the opposite work port is momentarily blocked until pilot pressure unseats the check. Metering characteristics of valve spools are slightly diminished when using these pilot-operated check valves.

These checks are used on applications such as clamps, outriggers, and elevated work platforms where internal fluid leakage could affect the operation of the system. The functions of a 4-Way Section and a pilot-operated check or lock-out in one valve housing are combined in one section.

The spool is a 4-way, 3-position modified free flow spool.

This spool is the same as F4, 4-way, 3-position free flow except the free flow feature is restricted. Free flow prevents any pressure build up between the pump and the pilot operated check when the valve spool is in neutral position.



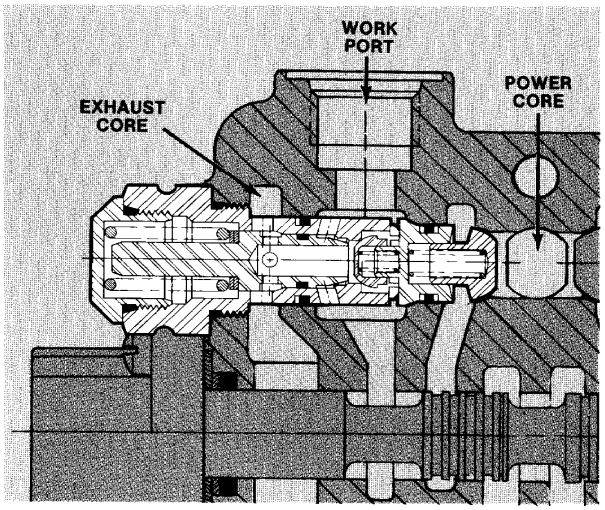
This work section and check valve are combined to perform the functions of a 4-way work section and a pilot-operated check or lockout valve in one single housing.

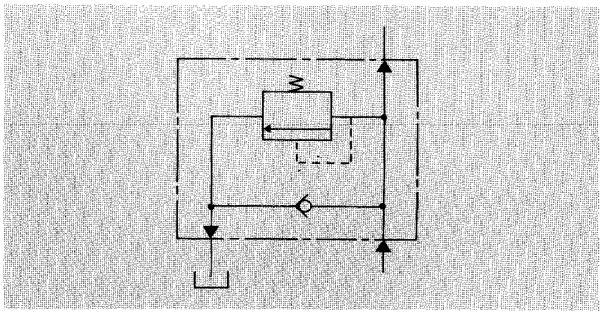
Combination Work Port Relief Valve and Anti-Cavitation Check

MODEL CRA

At times both a relief valve and an anti-cavitation check are required for the same work port. Both of those functions have been incorporated into one assembly.

Pressure range is: 500-3000 PSI [34-207 bar]





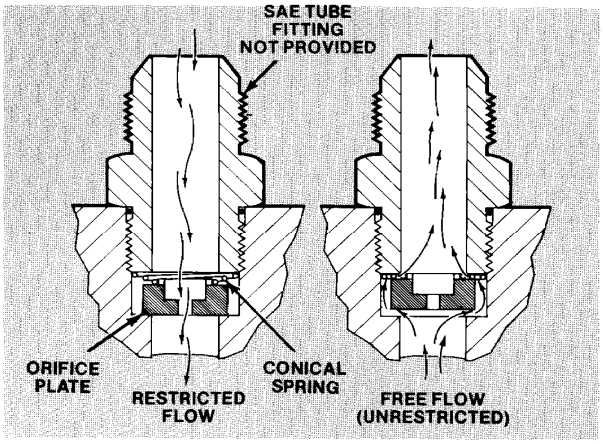
Restrictors

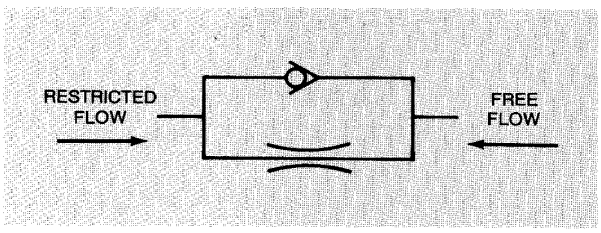
Restrictors may be inserted directly into a SAE work port and will limit oil flow in one direction while allowing free flow in the opposite direction. When restricting flow in the return port, restrictors will:

1. Prevent cylinder or motor cavitation having an inertia load.
2. Provide accurate control of double-acting cylinder by pressurizing both sides of cylinder piston.
3. Restrict oil flow from a hydraulic motor for smoother operation.

When restricting flow in pressure port, restrictors will meter oil flow to provide proper speed of operation.

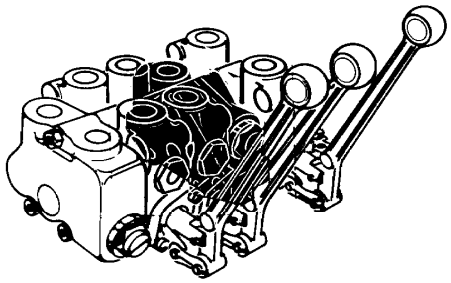
Work port restrictors are available for SAE 8 and SAE 10 work ports. Nominal orifice diameters are available from .015 to .220 inches [.38 to 5.6 mm]. Specify restrictor hole size desired. Specify whether restrictor should be installed to restrict flow out of the valve work port, or restrict flow into the valve work port.





MID-INLET CONVERSION SECTIONS

A mid-inlet conversion section provides an inlet port for a secondary pump downstream in the valve assembly. These sections can be installed between any two work sections thereby providing two different flow paths.



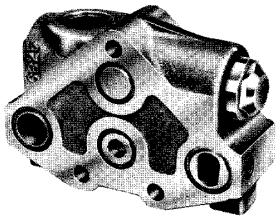
The addition of a mid-inlet section actually combines two separate valve assemblies into one giving them one common tank return line that provides the following advantages:

1. Simplifies installation, reducing plumbing and mounting costs.
2. All valve control handles can be mounted within easy reach.
3. Overall assembly costs are lower than two separate control valves.

Mid-inlet conversion sections are available in the following configurations:

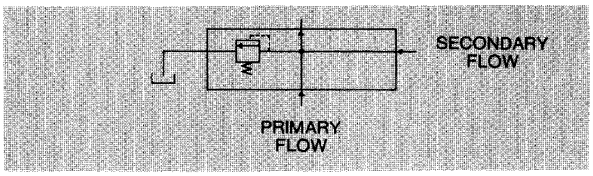
1. Combined Flow Section
2. Split Flow Section
3. Combination 3-Way Work Section and Mid-Inlet Section

Combined Flow Section



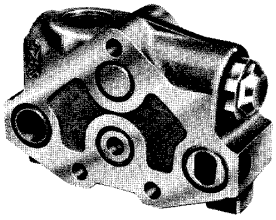
MID-INLET CONVERSION SECTION WITH COMBINED FLOW

When upstream work sections are in the neutral position, the combined flow from both pumps is available to the downstream sections. Combined flow of both pumps cannot exceed the flow capacity of the entire valve.



Split Flow Section

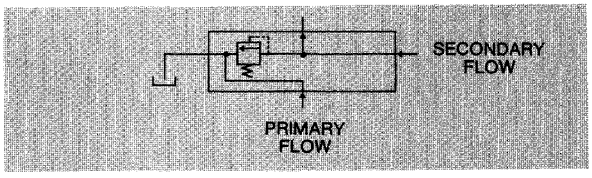
MID-INLET CONVERSION SECTION WITH SPLIT FLOW



Except for a common tank return passage, the split flow section completely separates upstream and downstream work sections. Upstream sections are fed by the primary pump, downstream work sections by the secondary pump.

When ordering a Combined Flow or Split Flow Mid-Inlet Conversion Section be sure to specify:

- Port Size
- Port Location
- Relief Valve Type
- Relief Valve Setting



PORTING OPTIONS AVAILABLE

(Combined Flow and Split Flow Sections)

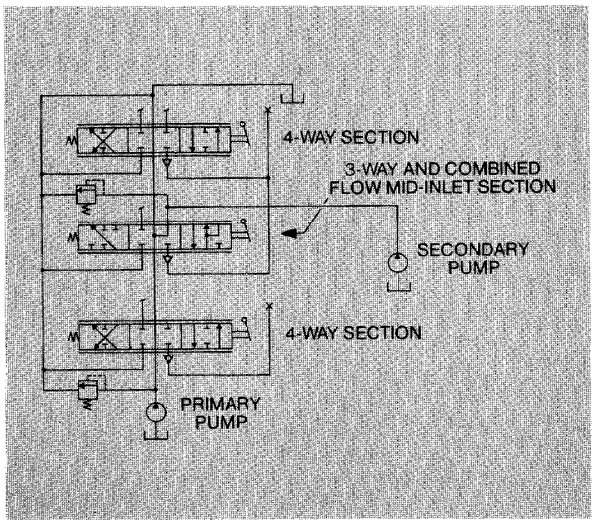
LOCATION	NPT PIPE PORTS		SAE STRAIGHT THREAD PORTS	
	STANDARD	OPTIONAL	STANDARD	OPTIONAL
TOP INLET	1/2"-14	3/4"-14	SAE 10 (7/8"-14 UN)	SAE 12 (1-1/16"-12 UN)
BACK INLET	1/2"-14	3/4"-14	SAE 10 (7/8"-14 UN)	SAE 12 (1-1/16"-12 UN)

Combination 3-Way Work Section and Mid-Inlet Section

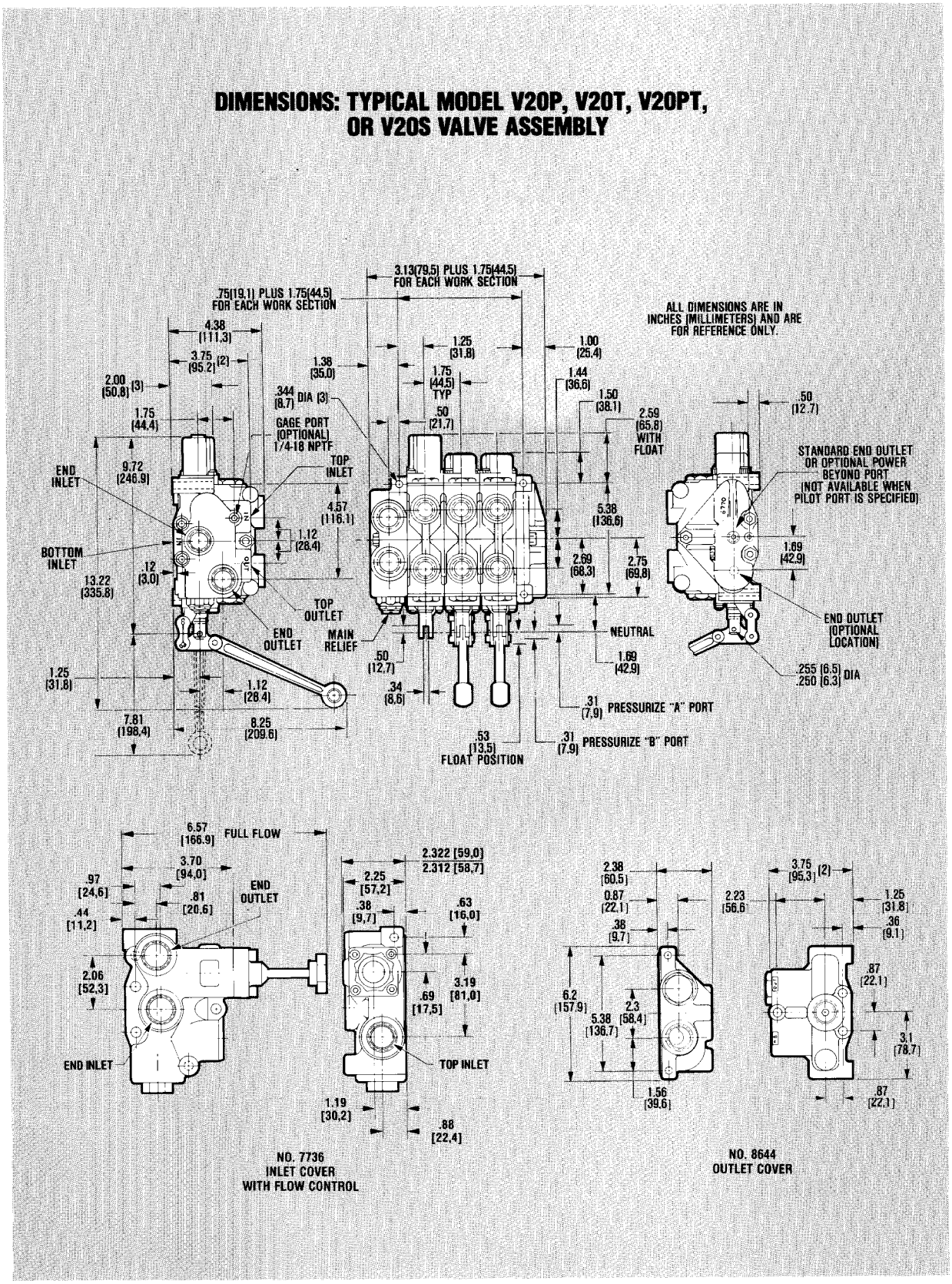
A special 3-way spool is used to convert a tandem work section to a combination 3-way work section and mid-inlet section. Port "A", which is normally plugged in a 3-way work section, is used as the mid-inlet port. A modified work port relief valve installed in port "A" serves as the main relief valve for the secondary pump.

This combination section eliminates the need for separate combined flow mid-inlet section, thus reducing the size and weight of the complete valve assembly. It can be used in any V20 open center application where a 3-way section requires a combined flow. Any number of 3-way or 4-way work sections which require a combined flow can be used downstream from this section.

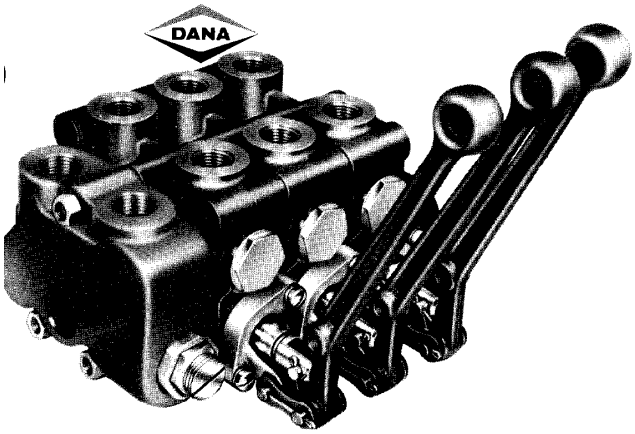
To order, specify Bill of Material No. 1522-8137. Also, specify port size, relief pressure setting and whether clevis is to be located on the "A" or "B" port end.



DIMENSIONS: TYPICAL MODEL V20P, V20T, V20PT, OR V20S VALVE ASSEMBLY



GRESEN®



CLOSED CENTER VALVE ASSEMBLIES

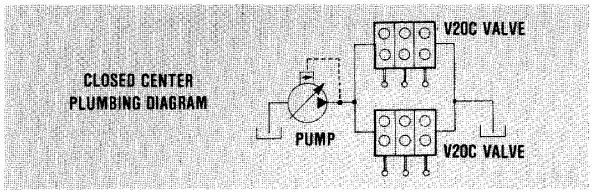
Models V20C and V20LS

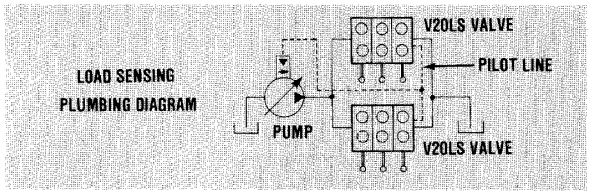
Gresen's Models V20C and V20LS Directional Control Valves are available for parallel, hydraulic circuit applications, up to 3500 PSI [242 bar] continuous operating pressure. New spool designs have resulted in lighter spool actuating effort making their finger-tip touch and extra-fine metering characteristics ideal for back hoe, front end loader and personnel lift applications. This sensitivity also gives the design engineer a wider latitude of mechanical linkage possibilities.

Service or conversion is simple since individual sections can be added, removed or replaced in the field. Individual service or field conversion sections, rather than complete valve assemblies, can be stocked thus reducing inventories.

The Model V20C Directional Control Valve is designed specifically for high standby pressure, closed center systems. The Model V20LS Directional Control Valve is designed specifically for low standby pressure, closed center systems with load sensing.

Normally, an open center valve may be converted to a closed center valve by plugging the open center core in the outlet cover. Under these conditions, the valve's power core is exposed to high pressure at all times. Leakage may then occur past the valve spool and on into the work port area and cause a cylinder to extend while the valve spool is in neutral position. High pressure build-up at the work port in the Models V20C and V20LS is prevented by installing an anti-drift cartridge. Refer to work port options on page 51.





APPLICATIONS

Two or more Directional Control Valve Assemblies may be supplied from a single, variable displacement pump in the hydraulic system by using a "tee" arrangement. The power beyond option normally available with open center valves is not required for Model V20C or V20LS work sections since neither work section has an open center core.

FEATURES

- **Minimal spool actuating effort — Maximum, 50 pounds [23 kg] at the spool**
- **Improved, extra-fine metering**
- **Valve housings made of high tensile cast iron for durability and resistance to shock loads.**
- **Spools are hard, chrome plated for long life and corrosion resistance.**

SPECIFICATIONS

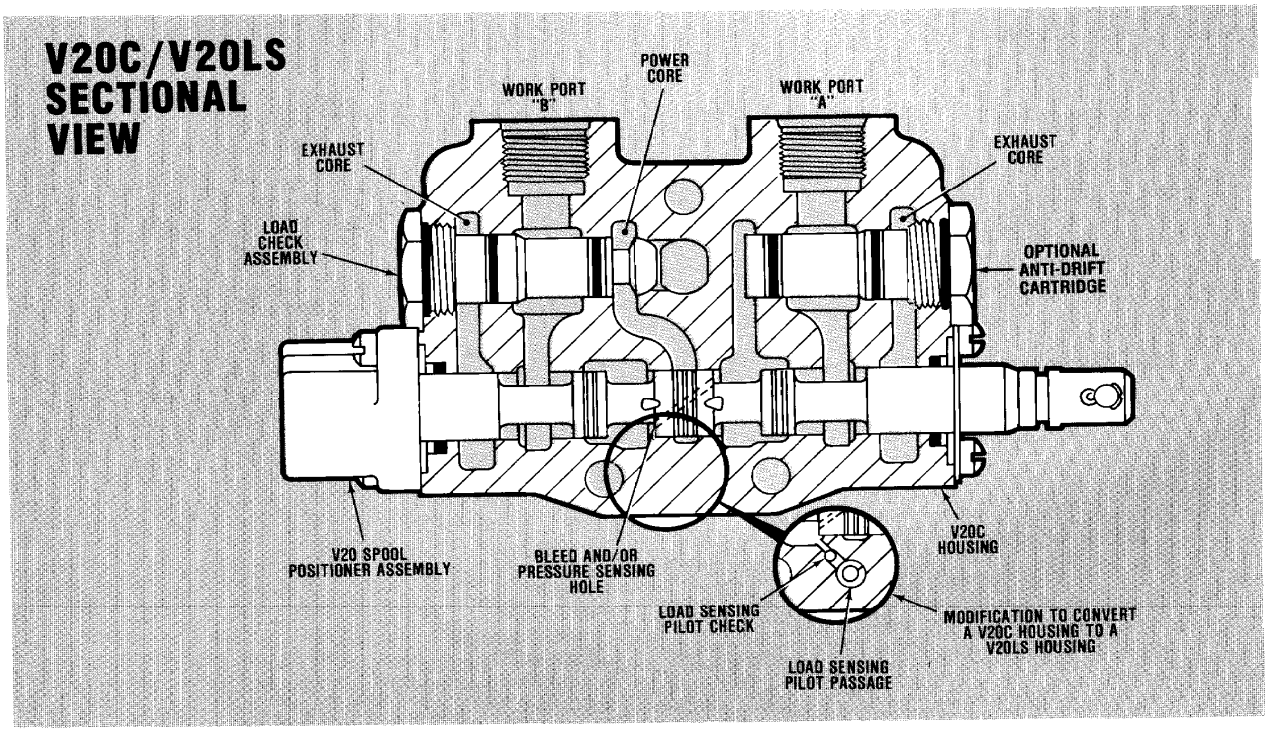
Pressure Rating:
Continuous Operating ..... 3500 PSI [242 bar] max.

Capacity:
Nominal Flow ..... 20 GPM [76 litres/min]
Maximum Flow ..... 30 GPM [114 litres/min]

Maximum Exhaust Core Pressure:
With Handle Bracket or Heavy Duty Spool Seal Retainer Installed
Continuous Operating ..... 500 PSI [34,5 bar]
Intermittent Peak ..... 1000 PSI [69,0 bar]
With Standard Spool Seal Retainer Installed ..... 200 PSI [13,8 bar]

Filtration Required (Min.) ..... 33 micrometre

Weight:
Inlet Cover ..... Approx. 6 lbs. [2,7 kg]
Outlet Cover ..... Approx. 3½ lbs. [1,6 kg]
Work Section, Each ..... Approx. 9 lbs. [4,1 kg]



VALVE METERING

Closed Center Systems

Valve spool metering is improved because the volume of oil is controlled by the metering notches at a constant pressure drop across the spool. The pump displacement will self-adjust to maintain full system pressure thus creating this constant pressure drop across the spool. Controlling flow across spool metering notches is improved when the pressure drop remains constant.

Closed Center Systems with Load Sensing

Valve spool metering is further improved since pump pressure is maintained at the slightly higher standby pressure (150 to 250 PSI [10 to 17 bar]) than is required by the function. This fixed pressure drop remains the same from minimum to maximum load requirements in contrast to the conventional closed center system.

INLET COVER

Part No. 8398-

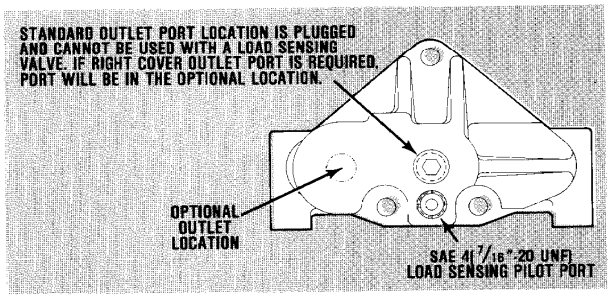
The inlet cover is designed to provide a variety of port sizes and locations. This permits valve assemblies to be "customized" using a minimum of external plumbing. For information regarding main system relief valves, refer to pages 10 and 11.

OUTLET COVER

Part No. 6770-

The outlet cover provides an end outlet port. It also provides for a pilot port in load sensing systems. If the outlet port and the pilot port are both required in the outlet cover, the outlet port will be furnished in the optional location. (Refer to illustration.)

A pilot drain option is available for the load sensing outlet cover. This option is required in a load sensing system when a pilot drain orifice is not provided in the pressure compensated pump. The pilot drain orifice relieves the load sensing pilot pressure in the pump compensator after the control valve spool is returned to neutral. It is necessary to relieve this pressure signal in order for the pump to return to its standby pressure setting.



For plumbing convenience, the outlet port may be located in the inlet (left) cover. When it is, a "turnaround" (right) cover will direct exhausting oil back to the inlet cover.

A power beyond option is not available since there is no open center core in V20C or V20LS work sections.

SPOOL ACTION OPTIONS and HANDLE END OPTIONS

The Models V20C and V20LS work sections are available with the same spool action options and handle end options as offered for the Model V20P except V20LS float option can not be reversed in the housing.

Spool Action Options

Refer to pages 14 through 19.

	CODE SYMBOL
Spring Return to Neutral (Standard)	—
3-Position Detent	D
No. 1889-001 Detent Stop	—
4-Position Float	K4
1-Position, Spool "IN" Detent	R
1-Position, Spool "OUT" Detent	RO
2-Position, Spool "IN" and "OUT" Detent	RIO
Spring Extended Spool	A
Manual	M
Internal Pressure Detent Release	KO
Electro-Mechanical Detent Release	E
Solenoid Control (Request Catalog No. PC-1104)	—
Hydraulic Remote Spool Actuator *	HR
Hydraulic Remote Spool Actuator (Manual Override)*	HRO
(Request Catalog No. PC-1103)	

* Pilot Pressure For Remote Actuators
300 PSI [21 bar] is required to actuate either Gresen's Solenoid or Hydraulic Remote Actuator Assemblies. This may be accomplished by installing a pressure reducing valve at the pump discharge and plumbing the lower pressure hydraulic fluid to the Remote Actuator Assemblies.

When the system has load sensing, standby pressure must be increased to 300 PSI [21 bar].

Handle and Handle End Options

Refer to pages 20 and 21.

	CODE SYMBOL
Complete Vertical Handle Assembly	CVHA
Complete Horizontal Handle Assembly	CHHA
Die Cast Handle Bracket, No. 1801-001	—
Cast Iron Handle Bracket, No. 7355-001	—
Standard Spool Seal Retainer Assembly, No. K-6033	—
Heavy Duty Spool Seal Retainer Assembly, No. K-6029	—
Spool Wiper, No. 1800-001	—
Spool Boot Assembly, No. K-6056	—
Less Handle Only	LHO
Less Complete Handle Assembly	LCHA

SPOOL VARIATIONS

Refer to page 13.

	CODE SYMBOL
3-Way, 3-Position	3
3-Way, 3-Position, Free Flow	F3
4-Way, 3-Position	4
4-Way, 3-Position, Free Flow	F4
4-Way, 4-Position, Float	K4

WORK PORT OPTIONS

The same work port options which are available for the Model V20P Directional Control Valve are also available for the Models V20C and V20LS in the "B" port location.

In the "A" port location, an optional anti-drift cartridge is also available. The anti-drift cartridge prevents any build-up of pressure at the work ports when the valve is in neutral position. Any leakage past the spool into the sensing cores is drained back to the tank through the anti-drift cartridge. When the work port is powered, pressure closes the anti-drift cartridge to eliminate any flow loss.

The anti-drift cartridge must be installed in the "A" port location only and one is required for each work section in which pressure build-up at the work port will be detrimental to the application.

The anti-drift cartridge replaces the standard load check plug. It is not available where a work port relief or anti-cavitation check is required in the "A" port location.

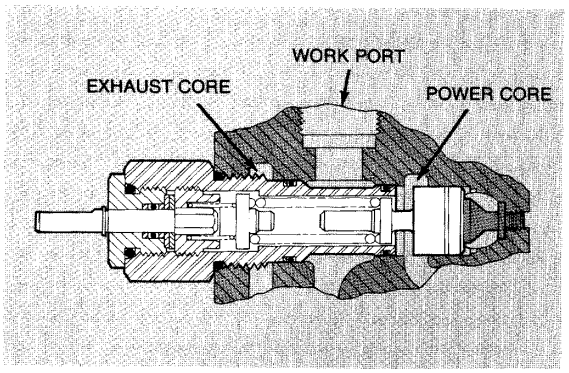
OPTION	ORDER CODE	AVAILABLE FOR "A" PORT	AVAILABLE FOR "B" PORT
Work Port Relief	RC,RP20	X	X
Combination Relief and Anti-Cavitation Check	CRA	X	X
Anti-Cavitation Check	AC	X	X
Load Check		—	X
Anti-Drift Cartridge	B	X	—

Pressure Compensated Flow Control

A pressure compensated flow control option is available for Models V20C and V20LS. This option is installed in the load check area of the valve section and is externally adjustable.

The flow control allows each valve section (both work ports) to operate at a predetermined maximum flow rate independent of pump discharge flow and pressure. Flow ranges of 1 to 5 GPM, 3 to 15 GPM, and 5 to 25 GPM are available.

This flow control option cannot be field installed. Special valve section machining is required.

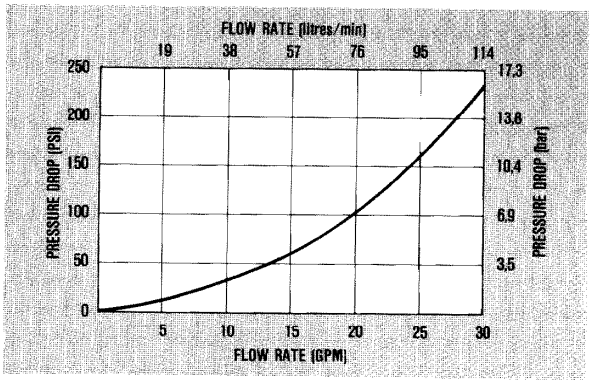


PRESSURE DROP

150 SUS oil at 100° F • Inlet port: SAE 12 • Work port: SAE 10

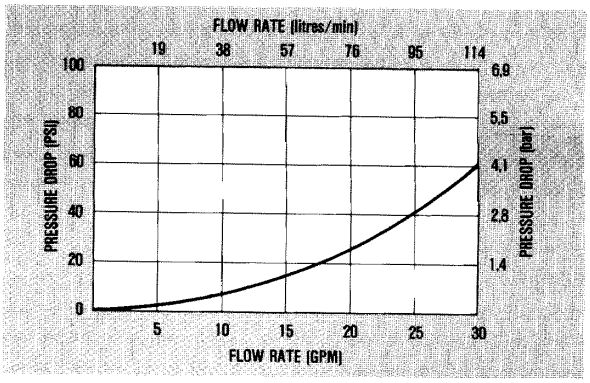
Inlet To Work Port

Typical pressure drop to any work port in a 4-spool valve



Work Port To Outlet

Typical pressure drop from any work port in a 4-spool valve



CLOSED CENTER VALVE ASSEMBLIES

ORDERING INSTRUCTIONS

To assure delivery of the proper Directional Control Valve, Form 9005 must be completed. Additional ordering information needed for manufacture and assembly of Models V20C and V20LS work sections are:

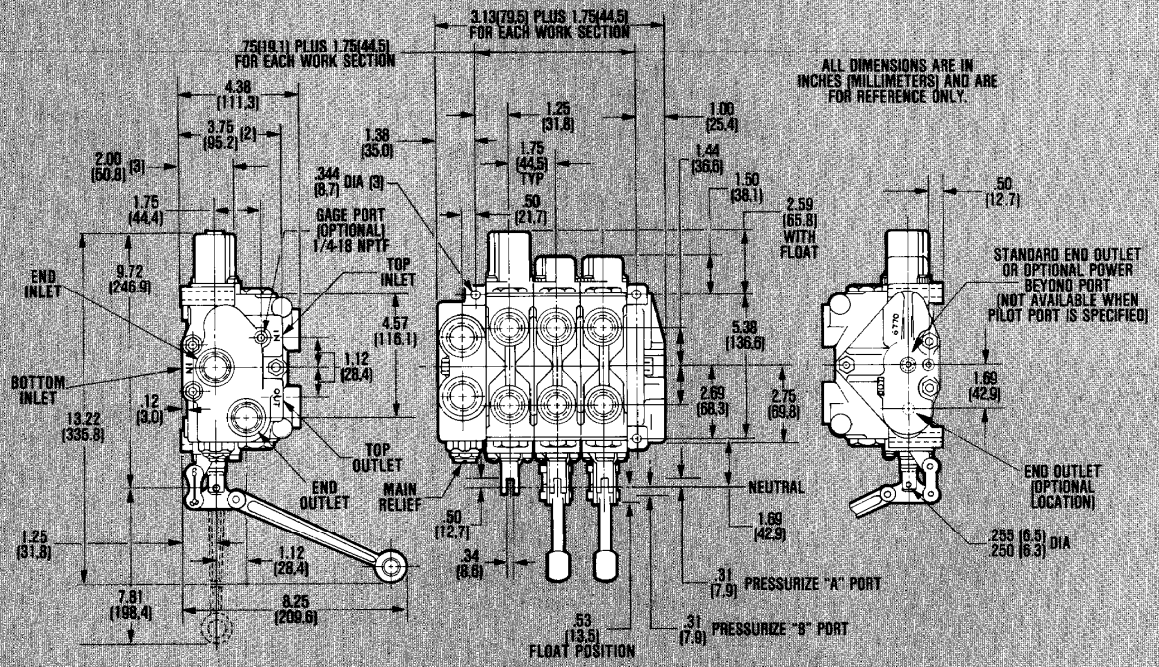
1. To specify a valve with V20C closed center work sections or V20LS load sensing work sections, write in No. 8364 in the "Center Section Housing No." box for each work section required. Do not check the "Closed Center" box in right cover block.
   - Under "Additional Features" write in V20C and check the box in each work section to specify a closed center valve.

   OR

   - Write in V20LS and check the box in each work section to specify a load sensing valve. Also specify Housing No. 6770-LS in right cover block in order to include the SAE 4 pilot port.
2. If an anti-drift cartridge is required, write in under Cylinder Port "A", order symbol Anti-Drift Cartridge and check the box for each work section requiring this option.

NOTE: A V20 closed center valve can also be made from standard V20P, No. 8072, open center section by using a closed center plug in the right cover. To specify this type of closed center valve, write in Housing No. 8072 for center sections and check the closed center box in the right cover. (Anti-drift cartridge cannot be used in this valve.)

DIMENSIONS: Typical V20C and V20LS Assembly



PORTING OPTIONS AVAILABLE

LOCATION	SAE STRAIGHT THREAD PORTS		BSP PIPE PORTS	GAGE PORT	PILOT PORT
	STANDARD	OPTIONAL	OPTIONAL	OPTIONAL	OPTIONAL
No. 8398 LEFT INLET COVER* End, Top or Bottom Inlet. Ports, End or Top Outlet Ports	SAE 12 (1-1/16" — 12 UN)	SAE 10 (⅞" —14 UNF)	¾" BSP	SAE 4 (7/16"–20 UNF)	—
WORK SECTION	SAE 10 (⅞"—14 UNF)	SAE 8 (¾"—16 UNF)	½" BSP	—	—
No. 6770 RIGHT OUTLET COVER Standard or Optional End Outlet Ports	SAE 12 (1-1/16"—12 UN)	SAE 10 (⅞" —14 UNF)	¾" BSP	—	SAE 4 (7/16"–20 UNF)

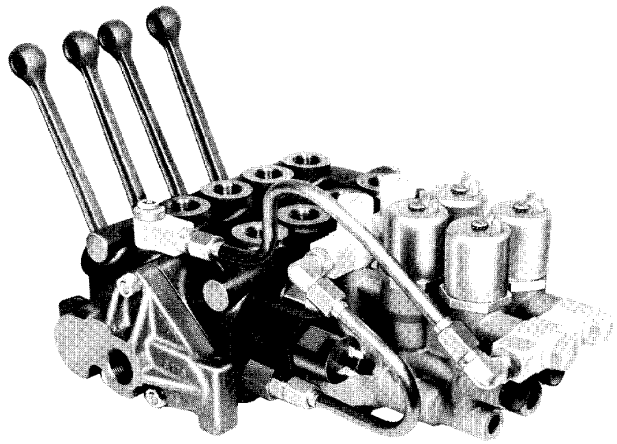
*Top inlet and top outlet ports are cored. If not specified, they will be plugged.

NOTE: All ports in a casting must be the same. SAE and BSP ports cannot be intermixed.

GRESEN®

DANA

Model V20
SOLENOID-CONTROLLED DIRECTIONAL CONTROL VALVE



Gresen's on-off solenoid-controlled, pilot operated actuators are designed to provide remote operation of Model V20 Hydraulic Directional Control Valves.

Most Gresen Model V20 Sectional Body Directional Control Valves, having a 3-position spool will accept a solenoid-controlled actuator. (Exceptions are the float spool and the standard free flow spool. A modified free flow spool is available for solenoid operation.)

Each Valve section may be solenoid-controlled, manually-controlled or both.

Gresen's sectional-body feature offers maximum flexibility and ease of maintenance. Although valve work sections with solenoid control are normally assembled at the factory, field assembly is possible in order to add additional work sections to an exisiting assembly.

The outlet tank port may be located in the outlet cover or in the left inlet cover of the control valve assembly.

SPECIFICATIONS

Pressure Rating ..... 3500 PSI [242 bar] max.
(Directional Control Valve)

Capacity (Nominal) ..... 20 GPM [75,5 litres/min]

Differential Pilot Pressure to Actuator ..... 200-300 PSI [14-21 bar]
(A minimum of 200 PSI [13,8 bar] is required to actuate the valve spool)

Maximum Allowable System Back Pressure ..... 300 PSI [21 bar]

Pilot Flow to Actuator ..... 2-4 GPM [7,6-15 litres/min]

Operating Oil Temp ..... 180°F [82°C] (Maximum)

Filtration Req. (Min.) ..... 33 micrometre

Solenoid Power Req. ..... 1.7-1.9 amps, 12 VDC
0.6-0.7 amps, 24 VDC

Weight:
Directional Control Valve Work Section with Solenoid-Controlled Actuator ..... Approx. 13 lbs. [5,9 kg]
Utility Section ..... Approx. 9 lbs. [4.1 kg]

Note: Double-throw switches are required when using internal pilot and must be provided by the customer.

FEATURES

- **Electrical or Manual Operation**
- **Either Open Center or Closed Center Hydraulic Circuit Applications**
- **May Be Field Installed**
- **All Gresen Model V20 Features Are Available (Request Catalog No. PC-1106)**
  - **Load check for every work port**
  - **Work port relief valves**
  - **Work port anti-cavitation checks**
  - **Work port restrictors**

DESCRIPTION

Solenoid-Controlled Actuator

The solenoid-controlled actuator assembly contains two, 3-way, normally closed solenoid-operated valves and a pilot-operated piston mounted directly to the control valve spool. When a solenoid is energized, the solenoid valve opens, pilot pressure at 300 PSI [21 bar] above tank line pressure is applied to one side of the piston causing the spool to shift from its neutral position. When both solenoids are de-energized, both sides of the piston are open to exhaust and the spool is spring-returned to neutral.

A needle valve, externally adjustable, meters the exhaust pilot flow to control the spool's rate of travel.

Solenoid coils are molded, impervious to moisture, continuous-duty rated, class H (180°C), and are supplied with two male, spade terminals. Customer must supply two female spade terminals, Packard Part No. 2965470 and one panel connector, Packard Part No. 2965490 or equivalent, for each solenoid.

Utility Section (Casting No. 7820)

A pilot source of 2 to 4 GPM [7,6 to 15 litres/min] at 300 PSI [21 bar] is required to operate each actuator and may be supplied by the customer from a source external to the control valve. Or, the pilot source may be supplied by a utility section which is assembled as an integral part of the control valve.

The utility section incorporates all components required to operate the actuators, eliminating the need to supply any external pilot lines. The entire control valve assembly is self-contained.

The utility section must be installed between the last work section in a directional control valve assembly and the right or outlet cover.

Both open center and closed center applications are available.

The tank port may be located in either the inlet or outlet cover of the control valve assembly.

The following component parts are included with the utility section:

Solenoid-Operated Pressure Build-Up Valve must be wired in parallel with each solenoid-controlled actuator. Because of the low open center pressure drop found in the Model V20 Direction Control Valve, the pressure build-up valve is necessary to increase the oil pressure required to shift the valve spools.

For closed center applications, the pressure build-up valve is not required. However, the system must have a stand-by pressure of 300 PSI [21 bar] available.

Pressure Reducing Valve reduces oil pressure to the solenoid-controlled actuator to 300 PSI [21 bar] at 2 to 4 GPM [7,6 to 15 litres/min].

Uni-Directional Check Valve installed in the soleniod-controlled actuator return or exhaust port to prevent system shock peaks from affecting the actuator.

Hydraulic Systems With A Customer-Supplied External Pilot Source

The utility section is not required if the hydraulic system has a 2 to 4 GPM [7,6 to 15 litres/min], 300 PSI [21 bar] pilot source available. Pilot tubing must be a minimum of 3/8-inch tubing with SAE No. 6 (9/16" — 18) fittings.

The pilot exhaust line should be plumbed directly back to the reservoir. If teed into the control valve return line, a one-way check valve must be installed in the pilot line to prevent shock peaks from affecting the actuators.

Manual Handle Assembly

Handles for manual operation of Gresen Directional Control Valves may be installed on the opposite end of the spool on which the solenoid-controlled actuator is mounted. This gives the operator a choice of either remote electrical control or manual control. Provision for manual operation also offers a standby alternative in case of electrical power failure.

APPLICATION CONSIDERATIONS

Some points to consider when desigining the solenoid valve into a hydraulic system are:

1. The standard free flow spool cannot be used with a solenoid actuator. The spool timing is such that as the spool begins to shift the pump is open to tank dropping pressure below 200 PSI [14 bar] and stopping the spool. A modified free flow spool is provided for solenoid operated valve sections.

2. The 4-way, 4-position float spool cannot be used with a solenoid actuator.

3. The solenoid actuator requires a differential pilot pressure of 200 PSI [14 bar] above the exhaust line back pressure. The pressure reducing valve senses back pressure and will provide a pilot pressure of 200 to 300 PSI [14 to 21 bar] above the back pressure.

   Back pressure should not exceed 300 PSI [21 bar]. This will eliminate the possibility of exceeding 600 PSI [41,4 bar] pilot pressure in the soleniod actuators.

4. For over center or light load applications: if the pressure requirement at the powered work port is less than 200 PSI [14 bar], the pressure at the actuator drops to that same requirement. When that happens, the centering spring begins to move the spool back to neutral. If the solenoid remains actuated, the spool will begin to "hunt".

   Use a restrictor in the work port to maintain pressure requirements above 200 PSI [14 bar] at all times.

5. A power beyond option is **not** available in the outlet cover of V20 solenoid operated valve assemblies. The power beyond option is available in the utility section. If a power beyond option is used in the utility section, the pressure build-up valve must be located in the downstream valve assembly.

ELECTRICAL SYSTEM REQUIREMENTS AND RECOMMENDATIONS

Switches:

The solenoid switch must meet the following requirements:

1. Must be D.C. rated.
2. Electrical rating should be at least 3 AMPS. However, 6 AMPS is suggested.
3. Use a double-pole, double-throw (DPDT) switch for most applications. **Exceptions** are:
   — Closed center
   — Separate pilot source is used (no internal pilot).
   Single-pole, double-throw switches (SPDT) are to be used for the exceptions, because a pressure build-up valve is not required in the circuit for these types of applications.

Types Of Switches:

Literally, dozens of types are available — rocker, rocker with detent, toggle, toggle with detent, push button, etc. It makes no difference which type is used as long as the switch which has been selected meets requirements outlined above.

Wiring:

It is recommended that stranded copper wire be used. The size of wire primarily depends on the length that is required. Keep in mind that the solenoid power requirements must be met. The longer the length, the more current drop there will be.

Generally, 16 gauge wire can be used for lengths up to approximately 80 feet and 14 gauge for lengths up to 100 feet.

Wire classification can be found in an SAE handbook under the heading of "SAE J558, (a Low Tension Cable)".

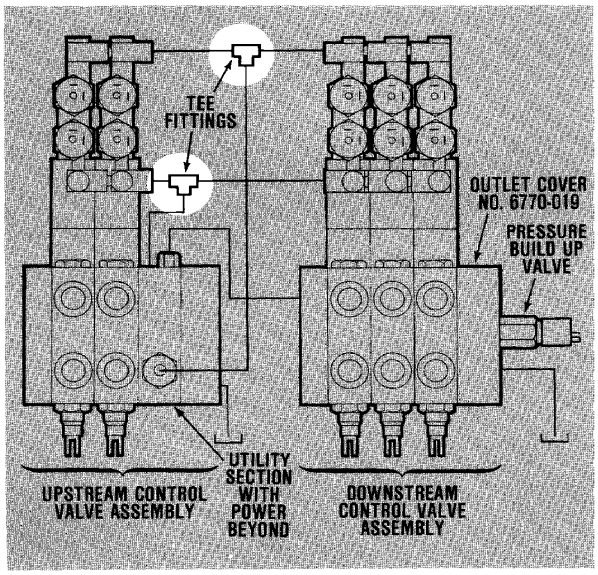
Terminals:

The customer must supply two female spade terminals, Packard Part No. 2965470 and one panel connector, Packard Part No. 2965490 or equivalent for each solenoid.

Note that special tools for crimping terminals are available from most electrical supply houses.

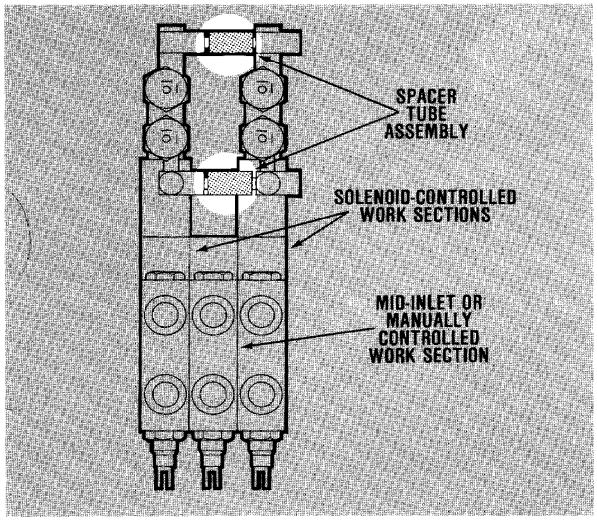
OPTIONAL ACCESSORIES

Optional Tee Fitting (Part No. K-6118) is available to connect an upstream control valve assembly and a downstream control valve assembly to one utility section. A power beyond sleeve must be used in the utility section in the upstream valve assembly and a pressure build-up valve must be used in the outlet cover. Two kits are required.

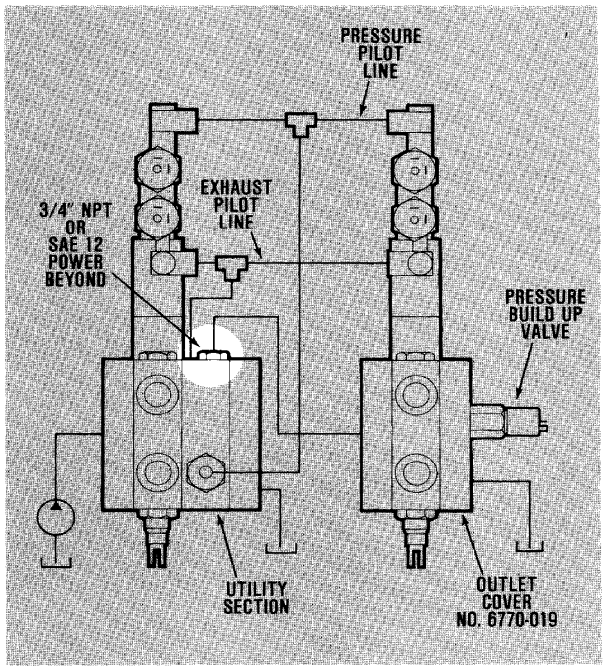


Optional Spacer Tube Assembly (Part No. K-6117). In some applications it is impossible to have adjacent solenoid-controlled work sections, such as valves with mid-inlets. For these applications, two one-section spacer tubes are requried to connect the pilot pressure and exhaust line to the actuators. See diagram for typical application of spacer tubes.

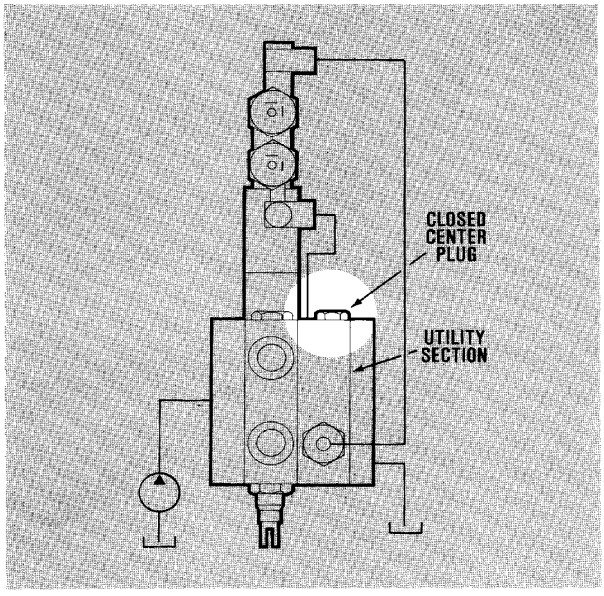
Note: Spacer tubes are designed for a one-section space only. No attempt should be made to stack these tubes in more than a one-section space.



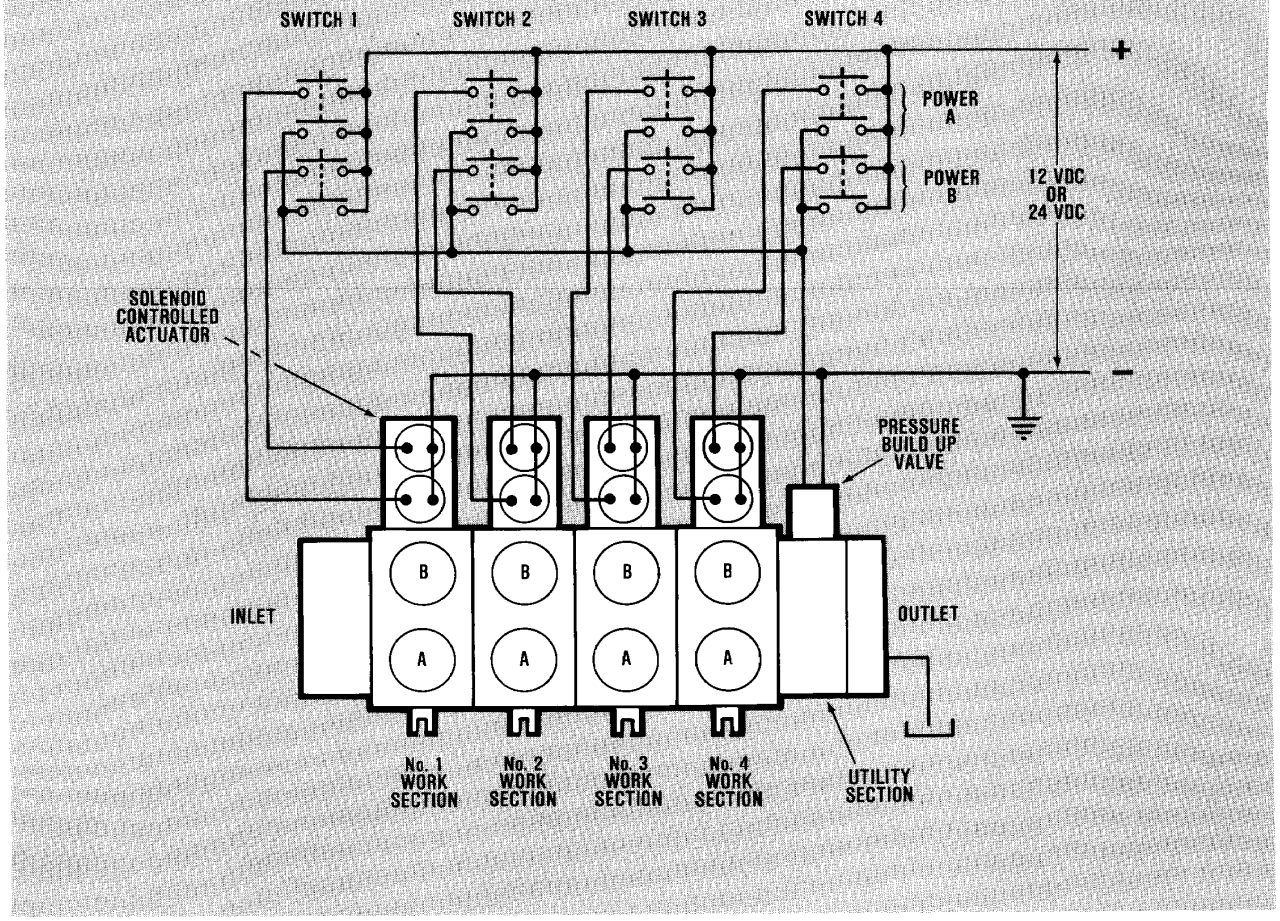
Optional Power Beyond Sleeve is available for use in the utility section in place of the pressure build-up valve. If a power beyond sleeve is used, the pressure build-up valve must be installed in the outlet cover of the downstream valve. Use outlet cover, Part No. 6770-019 in downstream valve. Outlet cover No. 6770-019 has SAE 12 outlet port.



Optional Closed Center Plug is available to replace the pressure build-up valve. System must have standby pressure of 300 PSI [21 bar] available.



WIRING DIAGRAM

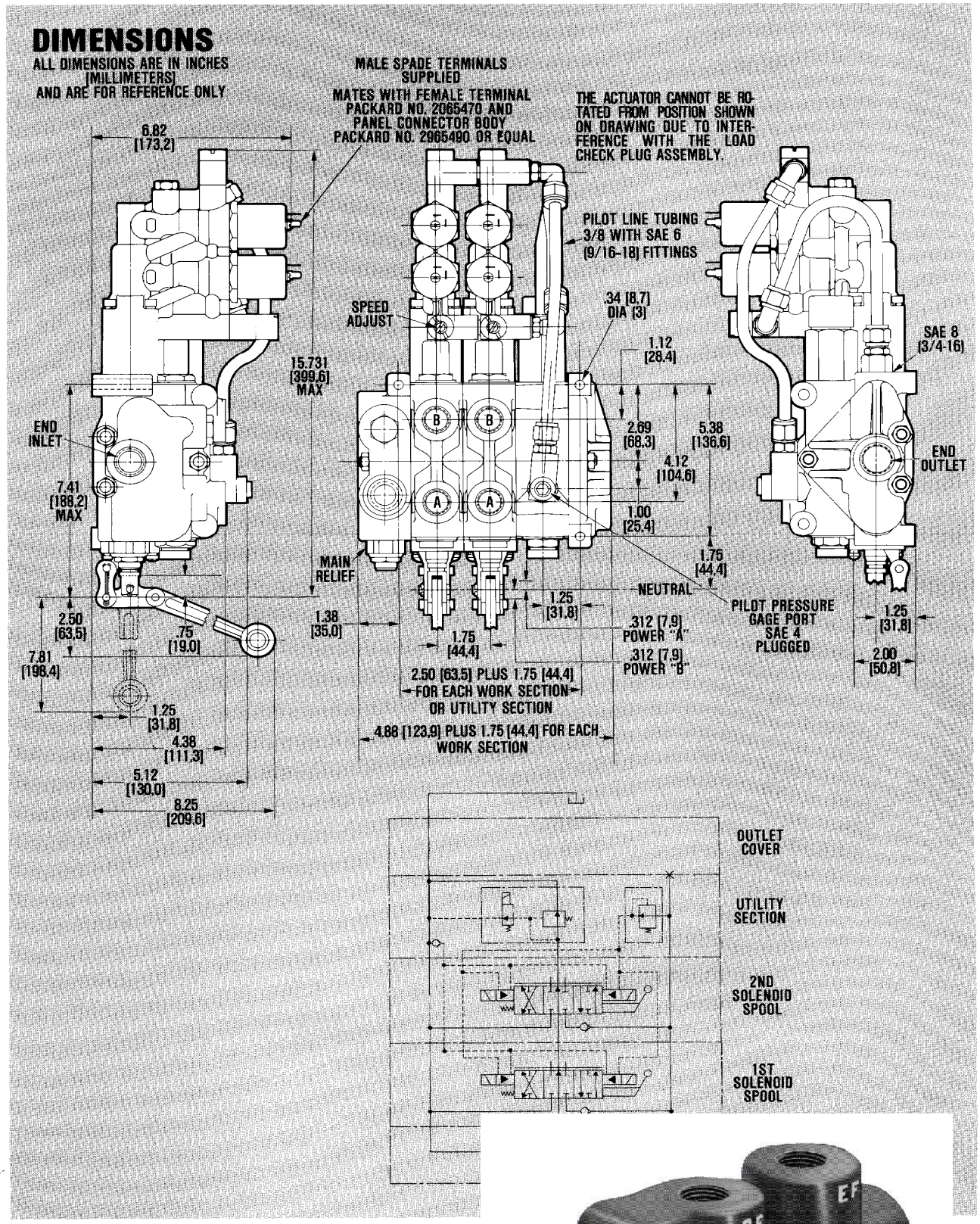


ORDERING INSTRUCTIONS

To assure delivery of the proper directional control valve with the proper options and configuration, Form No. 9005 should be fully completed. Additional ordering information needed for manufacture and assembly of Solenoid-Controlled Directional Valves are:

1. Under "ADDITIONAL FEATURES" write in "soleniod actuator" and check the box for each work section requiring this option. Specify 12 VDC or 24 VDC.

2. If a utility section (Part No. 7820) is not required to be furnished as part of the valve assembly, specify under "REMARKS", utility section not required.





By Pass Flow Divider

The By-pass flow divider controls flow to one circuit. It is used to control speed of a hydraulic motor. It is of a 3-port design, P, CF, EF. It operates like a faucet. Turn the knob clockwise to reduce the controlled flow, or turn the knob counter-clockwise to increase controlled flow

Safety

Be aware of the effect of changing settings.
Avoid large changes in setting with system off.

Inspection and Maintenance

Check for easy movement through full range.
Adjustment through full range will help avoid freeze up.

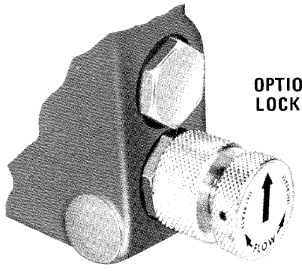
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DANA

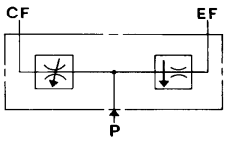
MODEL
CFDA

PRESSURE COMPENSATED-ADJUSTABLE
FLOW DIVIDER





OPTIONAL
LOCKNUT



The Model CFDA Adjustable Flow Divider offers an inexpensive, dependable means of obtaining flow adjustment up to 15 GPM [15,8 litres/min]. Provides easy manual control where frequent flow change is required. Pressure compensation provides a smooth, constant output flow regardless of pressure changes at the Controlled Flow Work Port.

Rotating the adjusting knob varies the flow from the Controlled Flow Work Port. After the controlled flow demand is satisfied, the balance of the inlet flow passes through the Excess Flow Port and returns to the tank. The Excess Flow Port is not a work port.

Flow through the Controlled Flow Work Port can be reversed but is not pressure compensated. The Model CFDA is not available with a built-in relief valve.

FEATURES

- **Adjustable Flow Rate**
- **Cross-Drilled, Shifting-Type Spool—provides extremely accurate metering**
- **Hardened Metering Spool**
- **High-Tensile Cast Iron Body**

SPECIFICATIONS

Capacity (nominal) Adjustable . . Up to 15 GPM [56 litres/min]
Maximum Operating Pressure . . . . . 2500 PSI [172 bar]
Flow Adjustment . . . . . Approx. 6 turns of knob from min. to max. flow
Shipping Weight . . . . . 8 Pounds [3,6 kg]

HOW TO USE THE PRESSURE DROP DATA

Example:
With a 15 GPM [56,8 litres/min] pump outlet, adjust Control Knob to deliver 3 GPM [11,4 litres/min] thru CF port. Pressure drop thru CF port is 4 PSI [0,3 bar], while remaining 12 GPM [45,4 litres/min] flow is directed thru EF port with 35 PSI [2,4 bar] pressure drop.

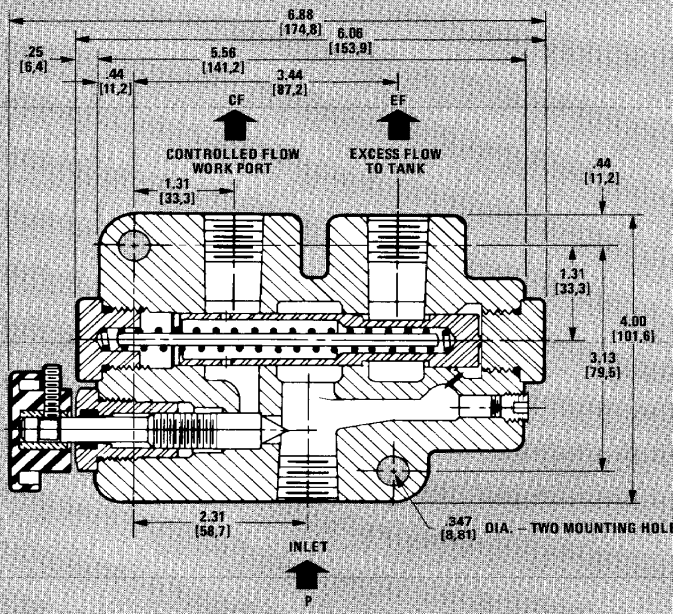
PRESSURE DROP
Typical Test Figures Using 150 SUS Oil at 100°F [37,8°C]

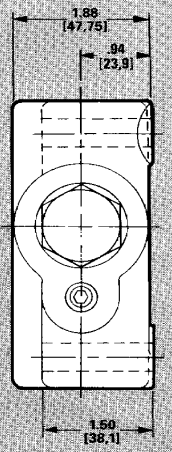
OUTPUT GPM [litres/min]	PRESSURE DROP THRU CF PORT PSI [bar]	PRESSURE DROP THRU EF PORT PSI [bar]
3 [11,3]	4 [0,2]	45 [3,1]
6 [22,7]	7 [0,4]	43 [2,9]
9 [34,0]	17 [1,1]	40 [2,7]
12 [45,4]	28 [1,9]	35 [2,4]
15 [56,7]	40 [2,7]	32 [2,2]

DIMENSIONS

ALL DIMENSIONS ARE IN INCHES [MILLIMETRES] AND ARE FOR REFERENCE ONLY

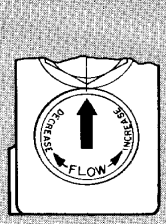
CFD-A

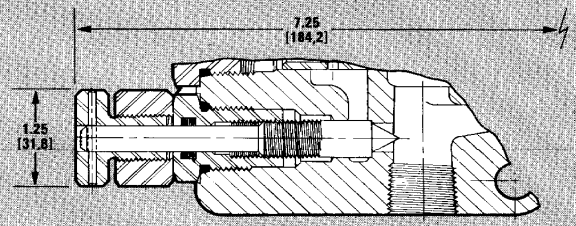




OPTIONAL LOCK NUT ASSEMBLY

An optional adjusting knob arrangement with a Locking Nut to lock the adjusting screw in a selected position is available. Extremely helpful in applications where vibration may cause flow adjustment to change.





ORDERING INSTRUCTIONS

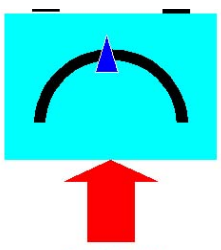
MODEL NO. CFDA - L - 10

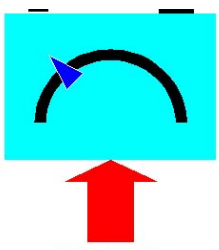
ADJUSTING KNOB	
–	Standard Knob
L	With Locking Nut

PORT SIZES (ALL PORTS)	
10	SAE 10 (7/8" – 14 UNF)
50	1/2" – 14 NPT
75	3/4" – 14 NPT
51	1/2" – 14 BSP
71	3/4" – 14 BSP

NOTE: NPT pipe ports are not recommended for pressures above 2000 PSI [138 bar].

Adjustable Proportional Flow Divider (AP)





The AP flow divider controls flow to two circuits. It divides oil in two portions. It is used to control the percentage of components, and is of a 3-port design, P, C1, C2

Operation

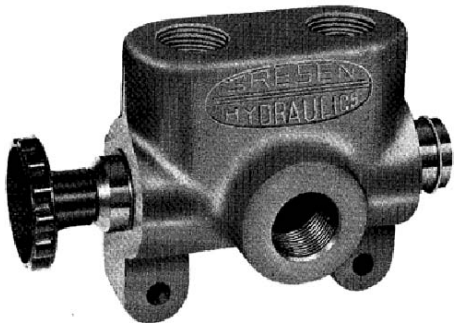


Loosen the handle knob and slide pointer as required.
Adjusts any ratio from 100:0 to 0:100.
Lock knob at desired position.
The AP Flow Divider splits input flow into two adjustable portions.
The set portions remain constant when input flow changes.

Inspection and Maintenance

Check for easy movement throughout full range.
Check for proper function of pointer and knob.
Check for debris around handle linkage.

Selector Valve



A selector valve directs the flow of oil to one of two separate hydraulic circuits
Used to select between two different functions
3-port design, P, A, B

Operation

Push-Pull the two position valve. It is usually set up for Push Off - Pull On. It is not designed to be switched under pressure.

Maintenance and Inspection

Check for easy movement in and out.
Regular operation helps avoid freeze-up.

Troubleshooting

Selector knob will not move in or out

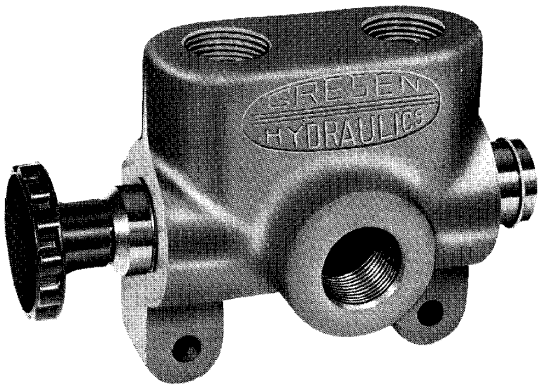
Spray both ends of valve spool with WD-40.
Clean rust and crud from valve spool ends.
Work valve in and out until free.

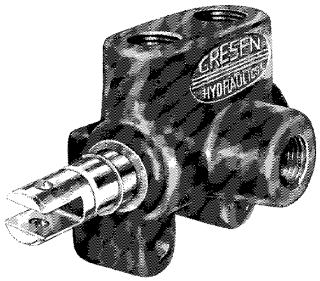
GRESEN®

DANA

MODEL **S**

TWO-POSITION THREE-WAY (SELECTOR) VALVES





WITH OPTIONAL CLEVIS ASSEMBLY

3 SIZES FROM WHICH TO CHOOSE

S-50 • S-75 • S-100

The Model S, Two-Position, Selector Valves offer a simple method of directing the flow of hydraulic oil to two separate hydraulic lines. The addition of these Selector Valves to the hydraulic circuit will permit operation of two single-acting cylinders with one three-way control valve. In some applications, two double-acting cylinders may be operated with one 4-way control valve.

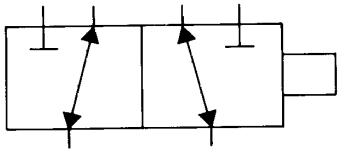
The hydraulic circuit which is to be operated should be selected before pressure is applied.

Valve Spool is of the open crossover type. As Spool is moved and one outlet port starts to close, the other outlet port starts to open.

Three sizes; 15 GPM [56 litres/min], 24 GPM [90 litres/min] and 40 GPM [151 litres/min] permit selection for any application.

FEATURES

- **Pressure balanced Spool**
- **Easy to Mount**
- **Chrome Plated Spool**
- **High-Tensile Cast Iron Body**

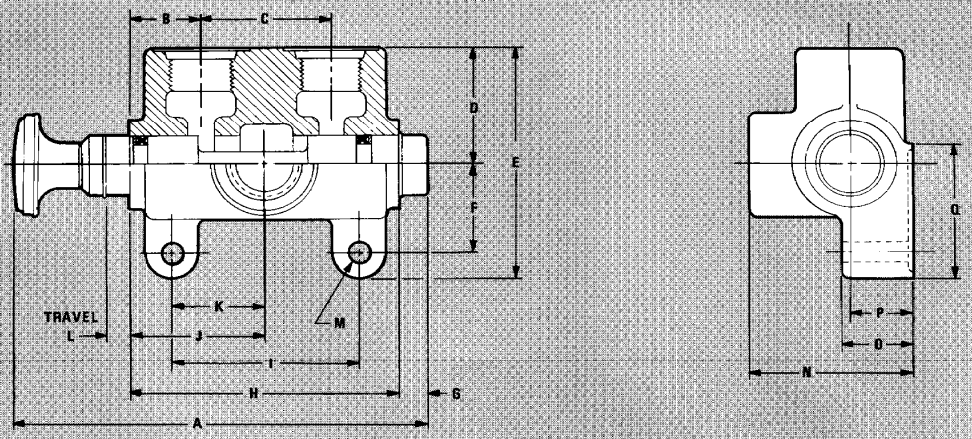


SPECIFICATIONS

	S-50	S-75	S-100
Capacity (nominal)	15 GPM [56 litres/min]	24 GPM [90 litres/min]	40 GPM [151 litres/min]
*Maximum Operating Pressure	3000 PSI [207 bar]	3000 PSI [207 bar]	3000 PSI [207 bar]
Shipping Weight	2-3/4 Pounds [1,3 kg]	5-1/2 Pounds [2,5 kg]	9-1/2 Pounds [4,3 kg]

DIMENSIONS

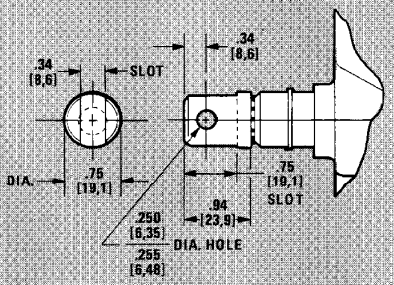
ALL DIMENSIONS ARE IN INCHES [MILLIMETRES] AND ARE FOR REFERENCE ONLY



MODEL	"A"	"B"	"C"	"D"	"E"	"F"	"G"	"H"	"I"	"J"	"K"	"L"	"M"	"N"	"O"	"P"	"Q"
S-50	5.69 [144,5]	.97 [24,6]	1.63 [41,4]	1,69 [42,9]	3.31 [84,1]	1.19 [30,2]	.25 [6,4]	3.56 [90,4]	2.13 [54,1]	1.78 [45,2]	1.06 [26,9]	.31 [7,9]	.31 [7,9]	2.63 [66,8]	1.13 [28,7]	1.00 [25,4]	2.00 [50,8]
S-75	6.56 [166,6]	1.13 [28,7]	2.13 [54,1]	2.00 [50,8]	3.94 [100,1]	1.50 [38,1]	.25 [6,4]	4.38 [111,3]	3.00 [76,2]	2.19 [55,6]	1.50 [38,1]	.38 [9,7]	.31 [7,9]	2.63 [66,8]	1.13 [28,7]	1.00 [25,4]	2.31 [58,7]
S-100	7.31 [185,7]	1.19 [30,2]	2.56 [65,0]	2.25 [57,2]	4.50 [114,3]	1.69 [42,9]	.25 [6,4]	4.94 [125,5]	3.44 [87,4]	2.47 [62,7]	1.72 [43,7]	.38 [9,7]	.38 [9,7]	3.50 [88,9]	1.38 [35,1]	1.25 [31,8]	2.88 [73,2]

OPTIONAL CLEVIS

An optional clevis assembly instead of a knob is available for Model S Selector Valves, specify part no. 1478-001.



ORDERING INSTRUCTIONS

MODEL NO. S - 50 - R

PORT SIZES (ALL PORTS)	
S-50 Model	
50	1/2" – 14 NPT
8	SAE 8 (3/4" – 16 UNF)
10	SAE 10 (7/8" – 14 UNF)
51	1/2" – 14 BSP
S-75 Model	
75	3/4" – 14 NPT
12	SAE 12 (1-1/16" – 12 UN)
71	3/4" – 14 BSP
S-100 Model	
100	1" – 11-1/2 NPT
16	SAE 16 (1-1/16" – 12 UN)
101	1" – 11 BSP

NOTE: NPT pipe ports are not recommended for pressures above 2000 PSI [138 bar].

–	Control Knob and Spool Assembly Standard as Shown.
R	Control Knob and Spool Assembly Reversed From That Shown.

Control Knob is standard
Clevis is optional. Specify: With Clevis, part no. 1478-001
If neither Control Knob nor Clevis is desired, Specify: Less Control Knob and Clevis.

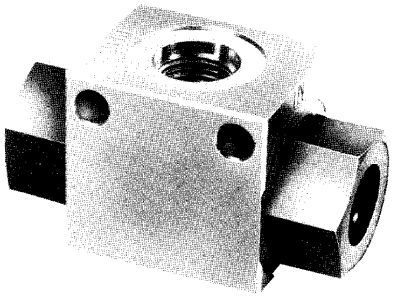
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DANA

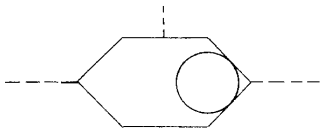
MODEL ASH

SHUTTLE VALVE

4 GPM (Nominal)
3000 PSI
For use in Pilot Systems



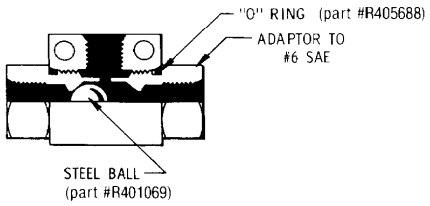
SYMBOL

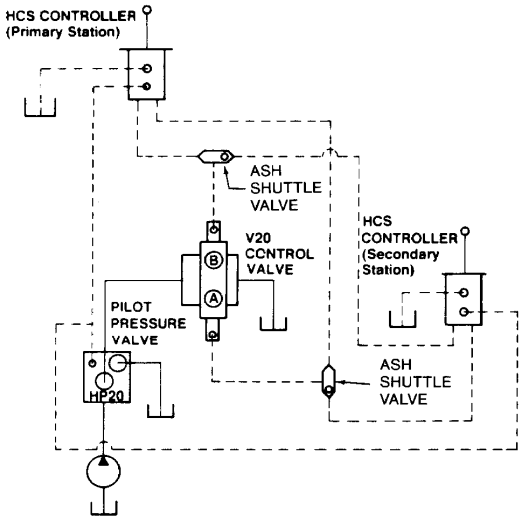


DESCRIPTION

Model ASH Shuttle Valve is designed to be used in a pilot system to select the higher of two pilot pressures.

In the typical application shown, the shuttle valve allows one control valve to be remotely controlled from two separate stations.





SPECIFICATIONS

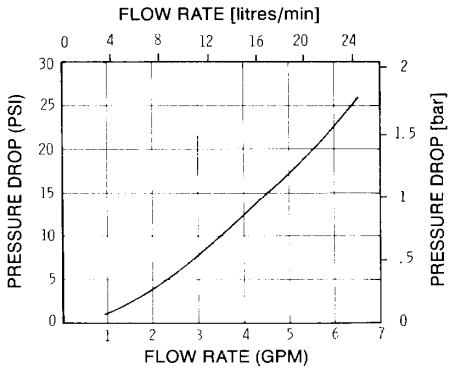
Flow Rating (nominal) . . . . . 4 GPM [15,2 litres/min]
Operating Pressure (maximum) . . . . . 3000 PSI [207 bar]
Mounting Position . . . . . Not restricted
Material . . . . . All steel
Weight (approx.) . . . . . 0.75 lbs. [0,34 kg]

Catalog No. GP-4005
Rel. 2/87
Printed in U.S.A.
Copyright ©1987 Gresen Manufacturing

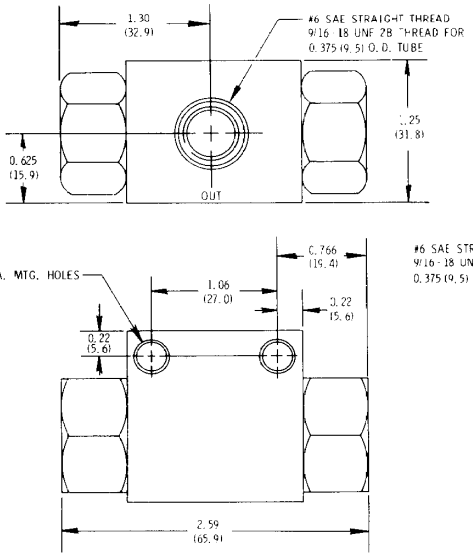
PRESSURE DROP DATA

Data taken with oil viscosity of 200 SUS [43cSt] @ 100°F [37.8°C]

MAXIMUM LEAKAGE .15 in³/min [2.5 cm³/min]



DIMENSIONS



ALL DIMENSIONS ARE IN INCHES [MILLIMETERS] AND ARE FOR REFERENCE ONLY

ORDER CODE

ASH - 06 - 2

MODEL

PORT SIZE	
25	1/4" NPTF
06	SAE 6

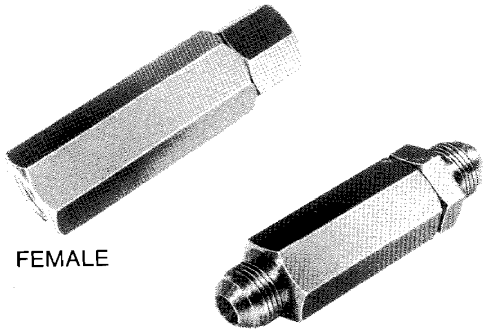
PORT TYPE	
1	NPTF
2	SAE

MOBILE FLUID PRODUCTS DIVISION • DANA CORPORATION

4675 CLARK RD., SARASOTA, FL 34233, PHONE: (813) 924-1284, TWX: 5106003403, TELEFAX: (813) 921-6218

GRESEN®

DANA



FEMALE

MALE

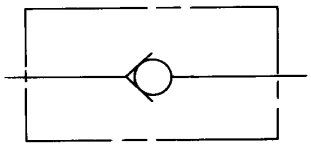
MODEL CLS

INLINE CHECK VALVE

3000 PSI

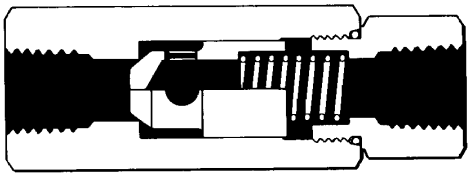
¼″ to 1½″

SYMBOL



DESCRIPTION

Model CLS inline check valves are designed to provide free flow in one direction and a positive check in the opposite direction. They are available with a variety of port types and sizes and may be mounted in any position.



SPECIFICATIONS

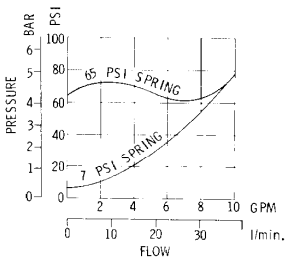
Flow Rating ..... Consult Pressure Drop Data
Operating Pressure (maximum) 3000 PSI [207 bar]
Temperature — Under normal conditions of continuous operation, fluid temperature should not exceed 180°F [82°C]. In no instance should the temperature exceed 200°F [93°C].
Fluid Recommendations — Premium grade hydraulic fluid with viscosity of 60 SUS [10 cSt] to 1000 SUS [216 cSt] at operating temperature.
Mounting Position ..... Not restricted
Material ..... All steel

Weight (approx.)

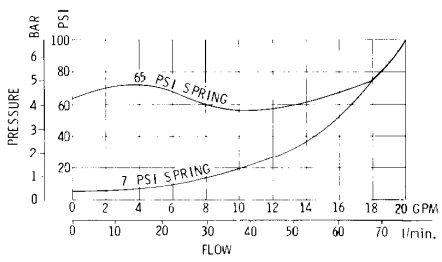
¼″	0.50 lbs. [0,23 kg]
⅜″	0.63 lbs. [0,28 kg]
½″	1.00 lbs. [0,45 kg]
¾″	2.88 lbs. [1,30 kg]
1″	2.88 lbs. [1,30 kg]
1¼″	5.88 lbs. [2,67 kg]
1½″	5.90 lbs. [2,68 kg]
SAE 6	0.80 lbs. [0,36 kg]
SAE 8	1.00 lbs. [0,45 kg]
SAE 10	1.50 lbs. [0,68 kg]
SAE 12	2.80 lbs. [1,27 kg]
SAE 16	3.00 lbs. [1,36 kg]
SAE 20	6.00 lbs. [2,72 kg]

PRESSURE DROP DATA (Typical)

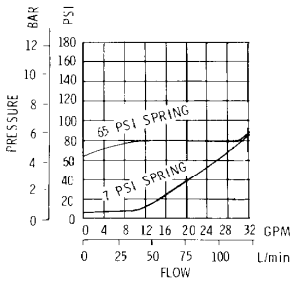
1/4″



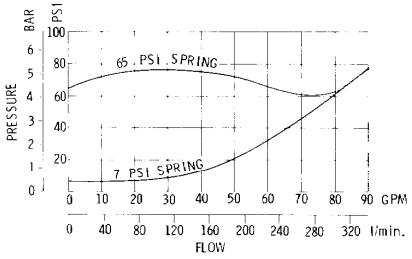
3/8″



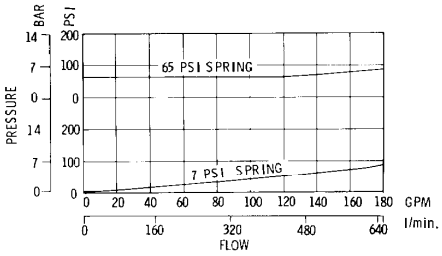
1/2″



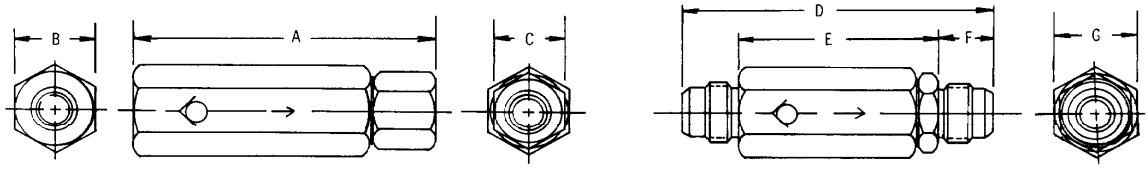
3/4″ & 1″



1-1/4″ & 1-1/2″



DIMENSIONS



VALVE SIZE NPT & FEMALE SAE	A	B	C
1/4″ & SAE 6	3.30 (83.8)	0.88 (22.3)	0.75 (19.1)
3/8″ & SAE 8	3.66 (92.9)	1.00 (25.4)	0.88 (22.3)
1/2″ & SAE 10	4.50 (114.3)	1.38 (35.0)	1.25 (31.7)
3/4″ & SAE 12	5.22 (132.6)	1.75 (44.4)	1.50 (38.1)
1″ & SAE 16	5.75 (146.1)	1.75 (44.4)	1.75 (44.4)
1-1/4″ & SAE 20	6.72 (170.7)	2.38 (60.4)	2.12 (53.8)
1-1/2″	7.00 (177.8)	2.38 (60.4)	2.12 (53.8)

VALVE SIZE MALE TUBE	D	E	F	G
SAE 6	3.27 (83.1)	2.15 (54.6)	0.56 (14.2)	0.88 (22.3)
SAE 8	3.78 (96.0)	2.48 (63.0)	0.65 (16.5)	1.00 (25.4)
SAE 10	4.61 (117.1)	3.11 (79.0)	0.75 (19.1)	1.38 (35.1)
SAE 12	5.30 (134.6)	3.58 (90.9)	0.86 (21.8)	1.75 (44.4)
SAE 16	5.36 (136.1)	3.54 (89.9)	0.91 (23.1)	1.75 (44.4)
SAE 20	6.30 (160.0)	4.40 (111.8)	0.95 (24.1)	2.38 (60.5)

INCHES (MILLIMETRES)

2

ORDER CODE

CLS - 125 - 17F

CLS — CHECK

CLS — MODEL

125 — PORT SIZE

PORT SIZE			
25	1/4" NPTF	**06**	SAE 6
38	3/8" NPT	**08**	SAE 8
50	1/2" NPT	**10**	SAE 10
75	3/4" NPT	**12**	SAE 12
100	1" NPT	**16**	SAE 16
125	1-1/4" NPT	**20**	SAE 20
150	1-1/2" NPT		

NOTE: NPT ports not available on Male type valves.

17F — PORT TYPE

PORT TYPE	
1	NPT
2	SAE

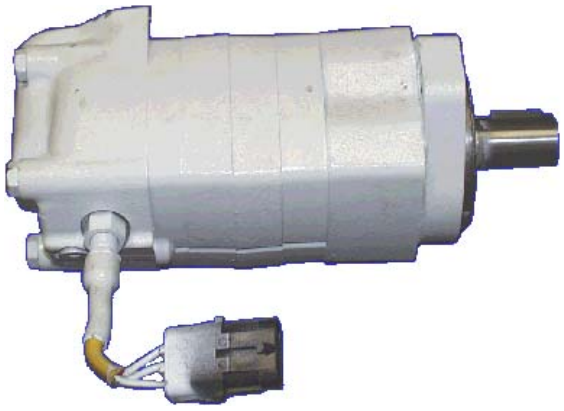
17F — SPRING RATE

SPRING RATE	
7	7 PSI
65	65 PSI

17F —

M	Male
F	Female

Motor



The hydraulic motor converts flow into rotary motion. Reverses rotation with reverse of flow. Used to drive augers and pumps. Two port design, A and B. It is used to drive augers and pumps. Hydraulic fluid causes motor shaft to rotate. Output speed is a function of flow. Output torque is a function of pressure.

Operation

Push spool valve handle to RUN motor.
Center spool valve handle for OFF.
Pull spool valve handle to REVERSE.
Adjust hydraulic flow to change speed

Safety

DANGER! Contact with rotating machinery will cause serious injury.
DO NOT OPERATE if personnel exposed.
Observe lockout, tag-out procedures.

Inspection and Maintenance

Check for tight mounting bolts.
Check for tight hydraulic fittings.
Check for leaking shaft seal.

Troubleshooting

If the hydraulic motor does not turn, or turns slowly when the valve is actuated, there may be a problem with the motor. It is imperative that the hydraulic pump and relief valves be checked BEFORE the motor, if any useful information is to be gained from this test. The following procedure may be used when testing for a leaking auger drive motor.

1. Remove the line from the return side of the motor and either cap the line or place the flow meter test kit in-line. Foul the auger by putting a piece of wood through the clean-out doors. Actuate the motor valve and observe the leakage rate of oil through the motor. The rate should be approximately one pint in 15 to 20 seconds (3/8 to 1/2 GPM). If the motor is defective, the leakage rate will be more on the order of one gallon in 15 to 20 seconds (3 to 4 GPM).

Cylinder



The cylinder moves a load to a position. It also holds a load in position. It is used for boom positioning.

Function

Flow in one port extends piston.
Flow in opposite port retracts piston.

Operation

Pull spool valve handle to extend cylinder.
Push spool valve handle to retrace cylinder.

Safety

WARNING! A failed cylinder can drop a load and cause serious injury.
DO NOT OPERATE a damaged cylinder.
DO NOT OPERATE with loose or damaged hose or fittings.

Inspection and Maintenance

Check for visible damage.
Check for secure clevis pins.
Check for tight hydraulic fittings.
Check for leaking rod seals.

Troubleshooting

The hydraulic cylinder on the TREADBED is the simplest component to test. If the boom will not rise when the valve is actuated and you have hydraulic pressure, the piston seal has failed and requires replacement.

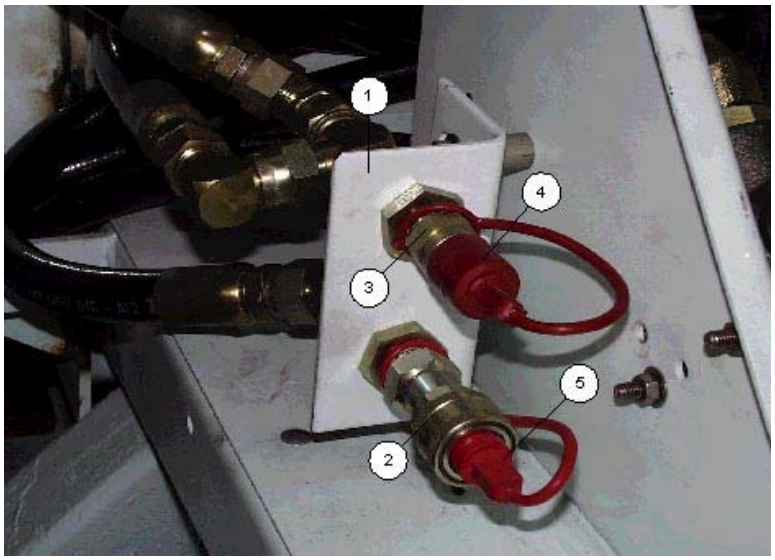
If the boom raises very slowly or will only rise when the engine speed is increased, the Boom Fitting orifice may be clogged or the seal is leaking. The seal may be checked by installing the flow meter on the exit port of the cylinder. After the cylinder is fully raised, continue to keep the valve engaged. If flow is noted from the exit port of the cylinder, the seal has failed.

If the cylinder seal is replaced, the cylinder bore will need to be honed. If any scratches are evident inside the cylinder, the unit should be replaced.

The fitting in the Boom Cylinder has an orifice installed to slow down the boom travel for safety reasons. Check this orifice for blockage and clean if necessary.

Auxiliary Hydraulics

The auxiliary hydraulics circuit takes oil being supplied to the vertical and boom augers and directs it to the quick disconnect fittings mounted on the side of the control console.



To activate the circuit, pull the valve marked “AUX HYD”, located on the hydraulic controls, to the “OUT-ON” position and push the handle labeled “AUGERS” to the “FORWARD-RUN” position.

To activate the circuit, pull the valve marked “AUX HYD”, located on the hydraulic controls, to the “OUT-ON” position and push the handle labeled “AUGERS” to the “FORWARD-RUN” position.



Troubleshooting Guide

NOTE; OIL OPERATING TEMPERATURE MUST BE ACHIEVED IN ORDER FOR THE SYSTEM TO FUNCTION PROPERLY.

Problem	Possible Cause	What To Do
1. Boom will not raise.	A. Power take-off is not engaged. B. Hydraulic oil level low. C. Inadequate hydraulic pressure. D. Hydraulic cylinder.	A. Check PTO shifter B. Fill to sight glass level. C. See relief valve test procedure. D. See cylinder test procedure.
2. Boom drifts down.	A. Cylinder damaged.	A. See cylinder test procedure.
3. Boom will not swing.	A. Power take-off is not engaged. B. Hydraulic oil level low. C. Hydraulic pressure below 450 PSI. D. Drive sprocket key sheared. E. Chain jumping.	A. Check PTO shifter. B. Fill to sight glass level. C. See boom swing circuit test procedure. D. Replace key. E. Adjust chain tension.
4. Augers will not run.	A. Power take-off is not engaged. B. Hydraulic oil level low. C. Inadequate hydraulic pressure. D. Inadequate hydraulic	A. Check PTO shifter. B. Fill to sight glass level. C. See relief valve test procedure. D. Test pump.
5. Bottom auger will not run. Vertical and overhead augers run.	A. Bottom auger valve not actuated. B. Hydraulic oil level low. C. Hydraulic pressure below 600 PSI. D. Foreign material lodged in auger. E. Bottom auger motor by-passing oil. F. A.P. Flow Control defective.	A. Push in handle. B. Fill to sight glass level. C. See relief valve test procedure. D. Reverse augers for 10 seconds then attempt forward. E. See motor test procedure. F. See A.P. Flow Control test procedure.
6. Vertical auger will not run when overhead auger runs.	A. Vertical auger motor by-passing oil.	A. See motor test procedure.
7. Overhead auger will not run when vertical auger runs.	A. Vertical auger motor by-passing oil.	A. See motor test procedure.

Problem	Possible Cause	What To Do
8. Bottom auger runs slow.	A. Hydraulic oil level low. B. Hydraulic pressure below	A. Fill to sight glass level. B. 1. Increase engine speed

	1500 PSI. C. Hydraulic pressure above 3000 PSI. D. Jammed material. E. Bottom auger motor by-passing oil.	and check gear selection. 2. See relief valve test procedure. C. Decrease engine speed to achieve 1950 PSI or less. D. Reverse augers for 5 secs. Close all gates and run augers for 1 minute. Open gates. E. Run truck with PTO engaged.
9. All augers run slow.	A. Hydraulic oil level low. B. Hydraulic pressure below 1500 PSI. C. Hydraulic pressure above 3000 PSI. D. Jammed material. E. System cold.	A. Fill to sight glass level. B. 1. Increase engine speed and check gear selection. 2. See relief valve test procedure. C. Decrease engine speed to achieve 1950 PSI or less. D. Reverse augers for 5 secs. Close all gates and run augers for 1 minute. Open gates. E. Run truck with PTO engaged.
10. Auger motors run. No material delivered.	A. Gates closed. B. Discharge hose has too much angle. C. Keys or bolts sheared on drive assembly.	A. Open gate. B. Let hose hang down. C. Repair or replace.
11. System runs hot.	A. Hydraulic level low. B. Relief valve set low. C. Suction or return line obstructed. D. Motors bypassing oil or valve spool leaking.	A.. Fill to sight glass level. B. See relief valve test procedure. C. Inspect and replace as necessary. D. See detailed test procedure.
12. Hydraulic gates do not operate.	A. Power take-off is not engaged. B. Hydraulic oil level low. C. Work port relief valve setting too low.	A. Check PTO shifter. B. Fill to sight glass level. C. See relief valve test procedure.
13. Oiling system does not inject oil.	A. Adjustable proportional flow control is in wrong position or bypass is in wrong position. B. Ball valves closed. C. Oil tank empty. D. Adjustable orifice is im-properly adjusted. E. Strainer clogged. F. Injectors clogged.	A. Adjust valve. B. Open ball valves. C. Fill tank. D. See oiling system calibration procedure. E. Clean. F. Clean or replace.